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METEORITICS & PLANETARY SCIENCE

The Meteoritical Bulletin, No. 107

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Manuscripts

The Meteoritical Bulletin, No. 107

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Abstract

Meteoritical Bulletin 107 contains 2714 meteorites including 16 falls (Aba Panu, Ablaketa, Andila, Guelat Zemmour, Hamburg, Karimati, Mahbas Arraid, Mangui, Mazichuan, Mukundpura, Ozerki, Parauapebas, Renchen, San Pedro de Urabá, Sokoto, Tintigny), with 2226 Ordinary chondrites, 168 HED achondrites, 132 Carbonaceous chondrites (including 41 CM, 34 CV, 26 CO, 21 CK, 4 CR, 5 ungrouped), 43 Ureilites, 30 Iron meteorites (including 2 ungrouped), 29 Lunar meteorites, 22 Martian meteorites, 16 Primitive achondrites (including 3 brachinites), 12 Rumuruti chondrites, 9 Enstatite chondrites, 7 Ungrouped achondrites, 6 Pallasites, 5 Mesosiderites, 3 Enstatite achondrites, 3 Ungrouped chondrites, and 2 Angrites. 1569 meteorites are from Antarctica, 835 from Africa, 206 from South America, 62 from Asia, 21 from North America, 11 from unknown locations, 8 from Europe (including one from Russia), and 1 from Oceania.

1. Trends and specificities

Meteoritical Bulletin 107 (MB107) contains the 2714 meteorites reported to and accepted by the Nomenclature Committee of the Meteoritical Society in 2018. This number is the second highest ever after a peak in MB102 with 3141 meteorites. The number of NWA meteorites reaches a new peak with 799 meteorites (Figure 1). Antarctic and NWA meteorites make up 58% and 29% of the total number of meteorites in MB107, respectively. As for the last few years, Chile, with 200 meteorites is now the main meteorite provider outside of NWA and Antarctica.

The 2714 meteorites in MB107 total over 2.3 tons of material, including 6 meteorites over 50 kg. Of particular significance for 2017 is the large number of Lunar meteorites, with 29 meteorites totaling over 68 kg, with 10 stones over 1 kg and 2 stones over 10 kg. (Figure 3). All these lunar meteorites are from NW Africa (Algeria, Mali, Mauritania, Morocco, Western Sahara) and coordinates are known for 2 of them (Aridal 017 and Errachidia). Many of these stones are likely paired.

A similar surge in Martian meteorites is observed with 22 meteorites totaling over 15 kg, including 3 meteorites over 2 kg (Figure 2). Again, most of these meteorites are from NW Africa (19 out of 22). 17 are shergottites, 1 is a nakhlite, and the remaining 4 (totaling 30g and including Rabt Sbayta 010 for which coordinates are available) are polymict breccias paired with NWA 7034.

The total numbers of Lunar and Martian meteorites published until and including MB107 are 383 and 239, respectively, and growing at an increasing rate (Figure 3).

2. Notable meteorites

Four non-ordinary chondrite falls are reported: Mazichuan (diogenite), Mukundpura (CM2), Sokoto (Iron, IIIAB), and Tintigny (polymict eucrite). Another notable fall is Aba Panu, a 160 kg L3 from Nigeria. Other notable meteorites include NWA 12322 (35 kg CV3), NWA 11610 (28 kg CO3), NWA 12320 (4 kg angrite).

3. Novelties in the Meteorite Bulletin Database

Strewnfield data can now be plotted into Google Earth from the Meteorite Database. Example for Sutter's Mill meteorite is shown in Figure 4. Data are available in the Meteorite Bulletin Database by following the strewnfield link. We encourage submission of location coordinates for past and future strewnfields.

4. Alphabetical text entries for non-Antarctic meteorites

See online version of this article

5. New Dense Collection Areas (DCA)

In 2018, 24 new DCA were created, including 13 in China. See online version of this article for a list of DCA approved in 2018. A full list of all approved DCAs can be found at <https://www.lpi.usra.edu/meteor/DenseAreas.php>.

6. Listing of institutes and collections

Eight new type specimen repositories were approved (see online version of this article for a complete list).

In accordance with §7.1 of the *Guidelines for Meteorite Nomenclature*, type specimens of all new meteorites "... must be deposited in institutions that have well-curated meteorite collections and long-standing commitments to such curation." The minimum mass of a type specimen should be 20% of the total mass or 20 g, whichever is the lesser amount. For larger meteorites, the Nomenclature Committee now strongly recommend the following: for 0.4 to 10 kg as at least 5% of total mass, and for meteorites > 10 kg as at least 500 g. However, these larger type specimens requirements are mandatory for meteorites declared to be in Special Pairing Groups (§4.2c).

7. Reclassifications

Sixteen meteorites have been reclassified in MB107. Eleven of these are Martian meteorites, likely paired with NWA 7034, that are now classified as "Martian (polymict breccia)". See online version of this article for a complete list of reclassifications.

8. Bibliography

See online version of this article.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

- Online supplement 1: Table of Data including Antarctic meteorites
- Online supplement 2: Table of Corrections
- Data S1. A complete copy of entire Meteoritical Society Bulletin can be found in the supplementary information of this article as well as on the Meteoritical Bulletin Archive

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3 page at http://meteoriticalsociety.org/?page_id=57. Information about the approved
4 meteorites can be obtained from the Meteoritical Bulletin Database (MBD) available
5 online at <https://www.lpi.usra.edu/meteor/>.
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8 **Figure captions**

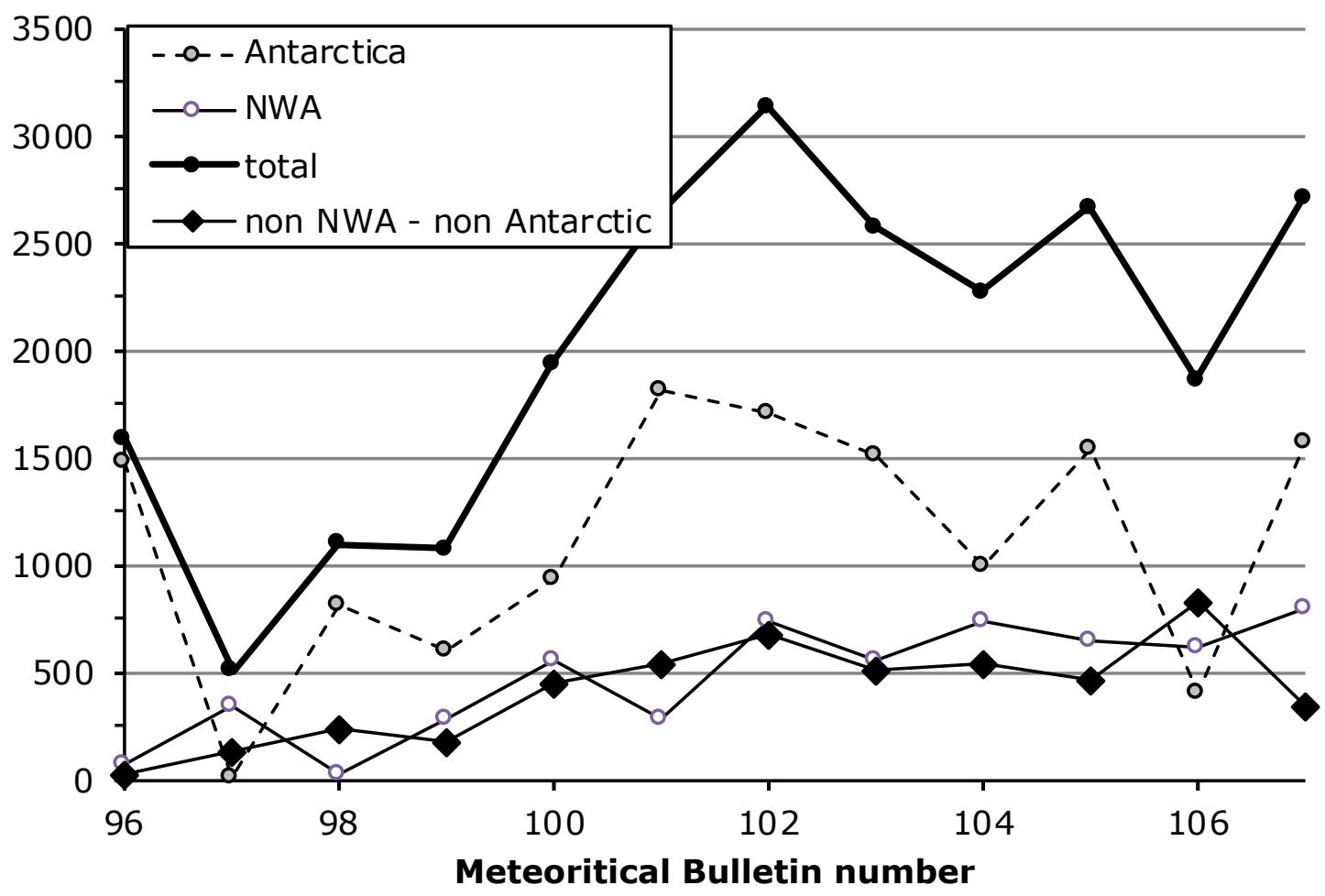
9 Figure 1: Number of meteorites from Antarctica, NWA, and other areas reported in the last
10 12 Meteoritical Bulletins.

11 Figure 2: Number of Lunar and Martian meteorites reported in the last 12 Meteoritical
12 Bulletins.

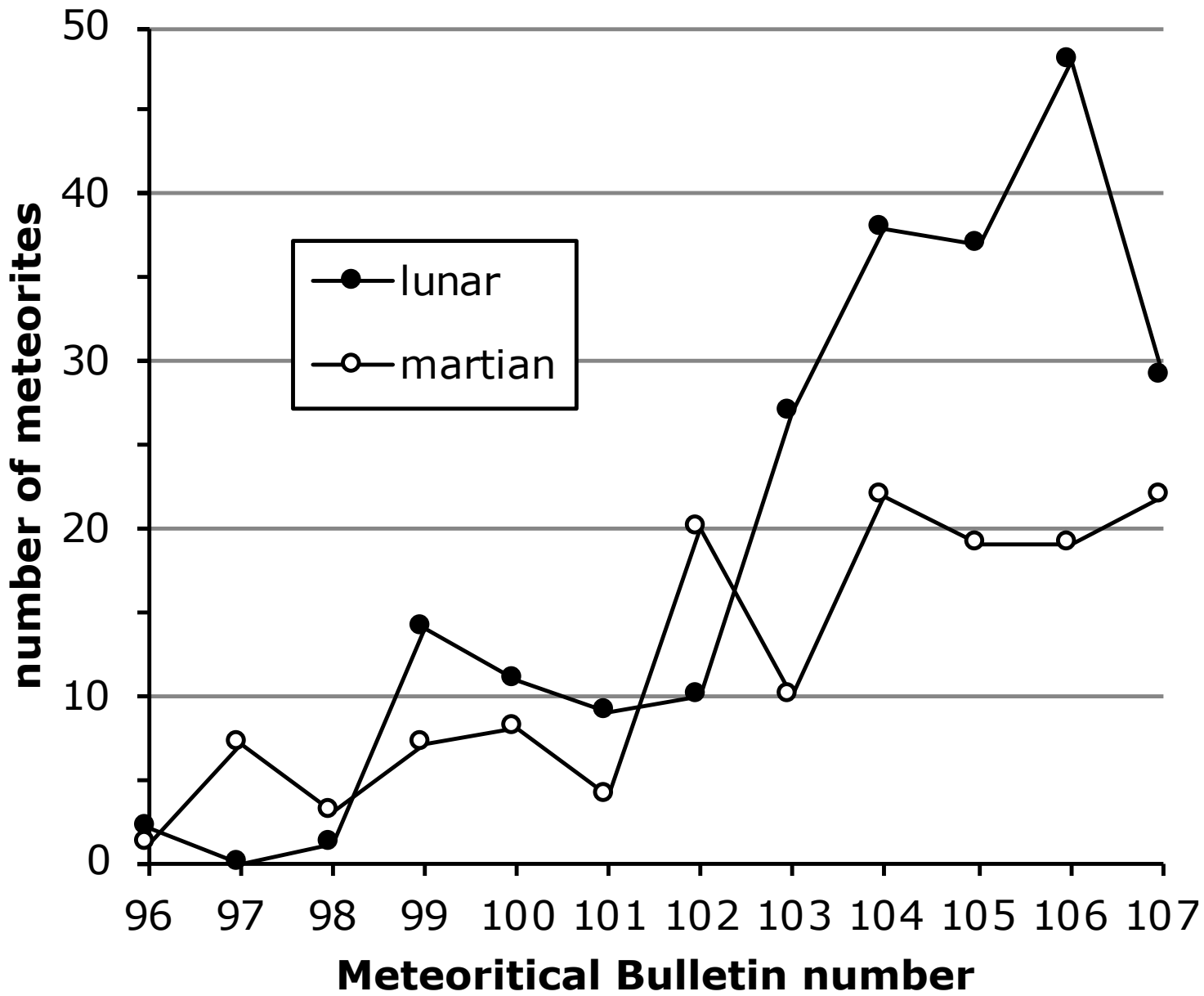
13 Figure 3: Cumulative number of Lunar and Martian meteorites with time.

14 Figure 4: Sutter's Mill strewnfield as extracted from the Meteoritical Bulletin Database.
15 Each stone is numbered with full details (mass and coordinates) available in the
16 database.
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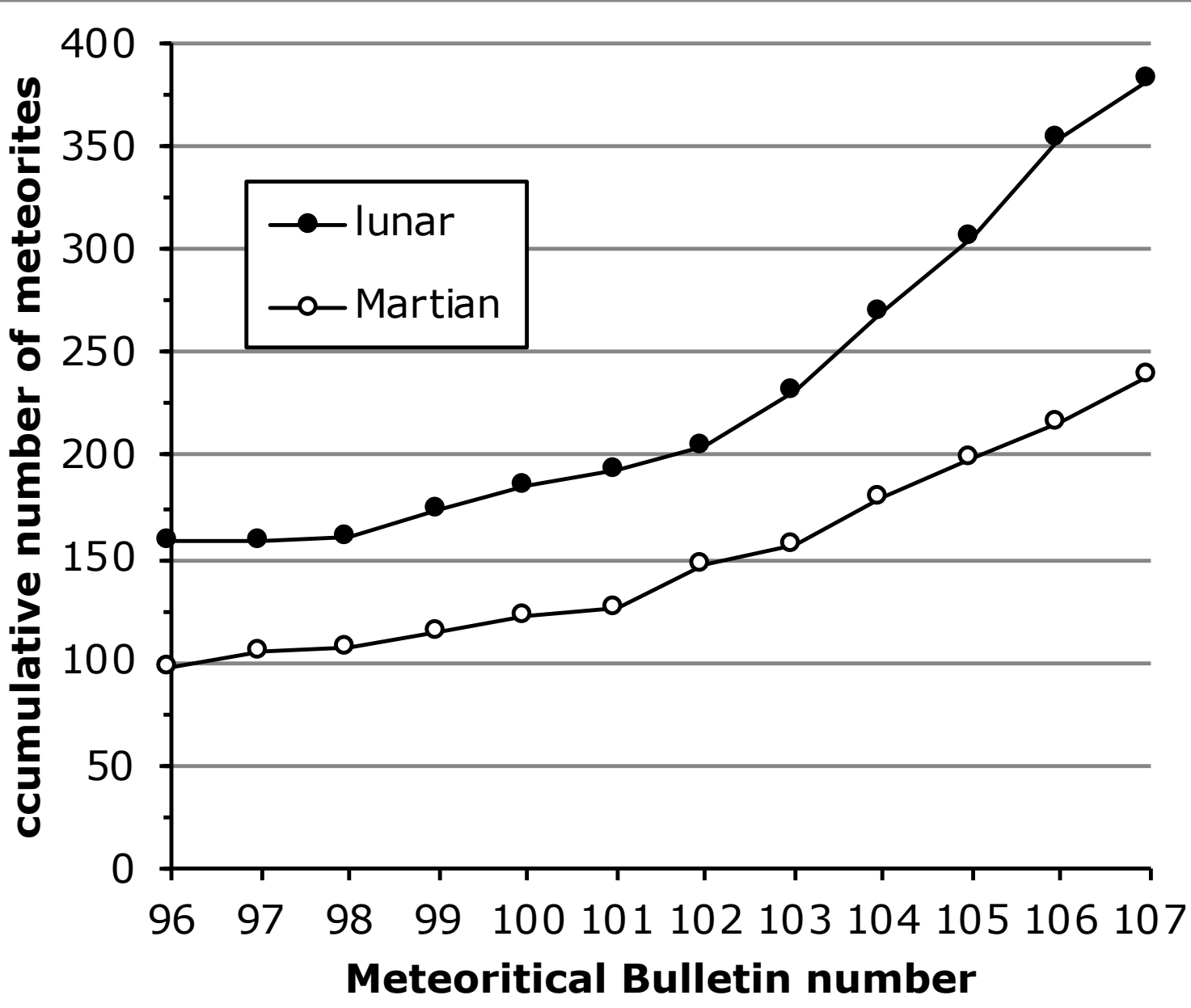
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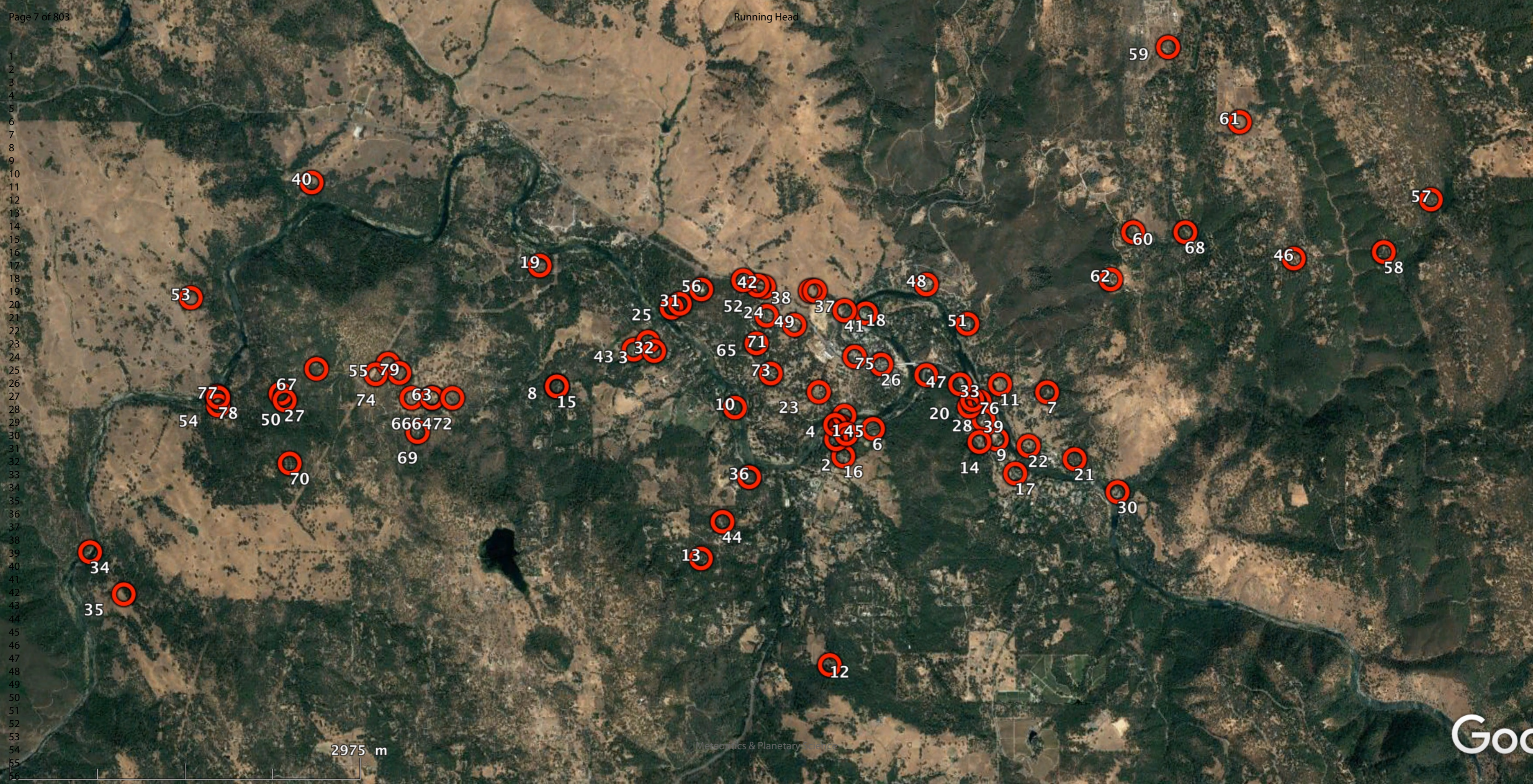
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db_id	db_name	db_class	db_country	tbl_mass	TKW (kg)
67412	Aydar	Acapulcoite	Morocco	533	0.533
68489	Northwest Africa 12199	Acapulcoite	Western Sahara	499	0.499
67569	Elephant Moraine 14074	Acapulcoite	Antarctica	14.4	0.0144
67401	Northwest Africa 11739	Achondrite-pr	(Northwest Africa)	20	0.02
67542	Northwest Africa 11562	Achondrite-ur	(Northwest Africa)	1361	1.361
68624	Northwest Africa 12338	Achondrite-ur	(Northwest Africa)	1126.5	1.1265
66411	Northwest Africa 11575	Achondrite-ur	Mali	598	0.598
66865	Northwest Africa 11112	Achondrite-ur	Morocco	528	0.528
68468	Northwest Africa 12217	Achondrite-ur	(Northwest Africa)	148	0.148
67852	Northwest Africa 11916	Achondrite-ur	(Northwest Africa)	10.4	0.0104
66390	Northwest Africa 11558	Achondrite-ur	(Northwest Africa)	3.92	0.00392
68635	Northwest Africa 12320	Angrite	Mauritania	4459	4.459
68323	Northwest Africa 12004	Angrite	Morocco	183	0.183
66406	Northwest Africa 11573	Aubrite	(Northwest Africa)	107	0.107
67546	Northwest Africa 11756	Brachinite	Morocco	840	0.84
52068	Northwest Africa 6308	Brachinite	(Northwest Africa)	600	0.6
51432	Northwest Africa 6023	Brachinite-an	(Northwest Africa)	72	0.072
67850	Northwest Africa 8781	C-ung	(Northwest Africa)	380	0.38
67058	Asuka 09535	C-ung	Antarctica	2.703	0.002703
67378	Asuka 09003	C-ung	Antarctica	1.696	0.001696
66389	Northwest Africa 11556	C2-ung	(Northwest Africa)	61	0.061
67405	Northwest Africa 11750	C3.00-ung	Morocco	8.49	0.00849
67057	Asuka 09505	CH3	Antarctica	0.85	0.00085
68609	Northwest Africa 12273	Chondrite-un	(Northwest Africa)	280	0.28
68620	Sierra Gorda 009	Chondrite-un	Chile	240	0.24
67875	Dominion Range 14080	Chondrite-un	Antarctica	10.34	0.01034
66830	Northwest Africa 11708	CK3	Morocco	1104	1.104
66464	Northwest Africa 11607	CK3-6	(Northwest Africa)	450	0.45
66864	Northwest Africa 11707	CK4	Morocco	453	0.453
67590	Northwest Africa 11808	CK4	(Northwest Africa)	412	0.412
66797	Northwest Africa 11670	CK4	(Northwest Africa)	154	0.154
68115	Grosvenor Mountains 17169	CK4	Antarctica	78.959	0.078959
54694	Northwest Africa 7055	CK4/5	(Northwest Africa)	26.93	0.02693
68613	Northwest Africa 12286	CK5	(Northwest Africa)	795	0.795
66863	Northwest Africa 11706	CK5	Morocco	116	0.116
67493	Northwest Africa 11764	CK5	(Northwest Africa)	113	0.113
68108	Grosvenor Mountains 17059	CK5	Antarctica	102.442	0.102442
67641	Northwest Africa 11836	CK5	(Northwest Africa)	70	0.07
68413	Northwest Africa 12192	CK5	Algeria	42.7	0.0427
67562	Elephant Moraine 14007	CK5	Antarctica	11.4	0.0114
67502	Northwest Africa 11773	CK6	(Northwest Africa)	890	0.89
66402	Northwest Africa 11565	CK6	(Northwest Africa)	399.8	0.3998
66475	Northwest Africa 11636	CK6	(Northwest Africa)	152.5	0.1525
68419	Northwest Africa 12200	CK6	Mauritania	76	0.076

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67584	San Juan 085	CK6	Chile	18	0.018
67218	Asuka 12267	CK6	Antarctica	17.219	0.017219
67494	Northwest Africa 11765	CK6	(Northwest Af	15	0.015
67187	Asuka 12236	CM	Antarctica	93.65	0.09365
67199	Asuka 12248	CM	Antarctica	52.912	0.052912
67350	Asuka 12408	CM	Antarctica	10.216	0.010216
36665	Yamato 980039	CM	Antarctica	7.683	0.007683
36663	Yamato 980037	CM	Antarctica	2.675	0.002675
36737	Yamato 980111	CM	Antarctica	2.579	0.002579
36664	Yamato 980038	CM	Antarctica	2.56	0.00256
36710	Yamato 980084	CM	Antarctica	2.538	0.002538
36709	Yamato 980083	CM	Antarctica	2.447	0.002447
36825	Yamato 980199	CM	Antarctica	2.313	0.002313
36988	Yamato 980363	CM	Antarctica	2.092	0.002092
36869	Yamato 980243	CM	Antarctica	1.733	0.001733
36715	Yamato 980089	CM	Antarctica	1.336	0.001336
36777	Yamato 980151	CM	Antarctica	1.002	0.001002
67123	Asuka 10139	CM	Antarctica	0.83	0.00083
66791	Northwest Africa 11254	CM-an	(Northwest Af	18	0.018
68631	Northwest Africa 12328	CM1	(Northwest Af	43.2	0.0432
66795	Mukundpura	CM2	India	2000	2
68329	Northwest Africa 12184	CM2	(Northwest Af	220	0.22
67568	Elephant Moraine 14068	CM2	Antarctica	185.6	0.1856
66806	Northwest Africa 11699	CM2	(Northwest Af	75.6	0.0756
67745	Northwest Africa 11889	CM2	(Northwest Af	75	0.075
68124	Northwest Africa 11965	CM2	(Northwest Af	57.3	0.0573
68103	Grosvenor Mountains 17004	CM2	Antarctica	52.933	0.052933
67561	Reckling Peak 14005	CM2	Antarctica	33.4	0.0334
68614	Northwest Africa 12287	CM2	(Northwest Af	33	0.033
67555	Northwest Africa 11791	CM2	(Northwest Af	17.1	0.0171
67705	Northwest Africa 11781	CM2	(Northwest Af	15.5	0.0155
68101	Amundsen Glacier 17290	CM2	Antarctica	14.393	0.014393
67816	Northwest Africa 11919	CM2	(Northwest Af	11	0.011
68040	Miller Range 15094	CM2	Antarctica	10.636	0.010636
66446	Northwest Africa 11588	CM2	(Northwest Af	10.3	0.0103
67557	Northwest Africa 11793	CM2	(Northwest Af	10.1	0.0101
67556	Northwest Africa 11792	CM2	(Northwest Af	6	0.006
67397	Northwest Africa 11733	CM2	(Northwest Af	3.3	0.0033
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67634	Northwest Africa 11840	CM2	(Northwest Af	1.8	0.0018
67563	Elephant Moraine 14013	CM2	Antarctica	0.3	0.0003
66794	Northwest Africa 11638	CM2.0	(Northwest Af	9.7	0.0097
67396	Northwest Africa 11732	CM2.0	(Northwest Af	3.8	0.0038
67321	Asuka 12376	CO	Antarctica	129.97	0.12997

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36666	Yamato 980040	CO	Antarctica	14.932	0.014932
67060	Asuka 09551	CO	Antarctica	2.306	0.002306
67048	Asuka 09471	CO	Antarctica	0.821	0.000821
66468	Northwest Africa 11610	CO3	(Northwest Af	28208	28.208
66394	Northwest Africa 11564	CO3	(Northwest Af	3130	3.13
53737	Northwest Africa 6827	CO3	(Northwest Af	1289	1.289
67746	El Médano 389	CO3	Chile	1186	1.186
68298	Northwest Africa 11996	CO3	(Northwest Af	960	0.96
66866	Northwest Africa 11113	CO3	Morocco	470	0.47
66412	Calama 005	CO3	Chile	380	0.38
67747	El Médano 390	CO3	Chile	132	0.132
68470	Northwest Africa 12219	CO3	(Northwest Af	129	0.129
68628	Northwest Africa 12367	CO3	(Northwest Af	92.8	0.0928
68627	Northwest Africa 12366	CO3	(Northwest Af	81.5	0.0815
57789	Dhofar 1762	CO3	Oman	81	0.081
68626	Northwest Africa 12365	CO3	(Northwest Af	56.1	0.0561
32164	Northwest Africa 1292	CO3	(Northwest Af	56	0.056
68519	Northwest Africa 11521	CO3	Morocco	50	0.05
67849	Northwest Africa 8676	CO3	(Northwest Af	45	0.045
67636	Northwest Africa 11844	CO3	(Northwest Af	35	0.035
66391	Northwest Africa 11559	CO3	Algeria	33.9	0.0339
68469	Northwest Africa 12218	CO3	(Northwest Af	27	0.027
67730	Northwest Africa 11790	CO3	(Northwest Af	7.2	0.0072
67788	Northwest Africa 11906	CO3.0	(Northwest Af	84.8	0.0848
67407	Northwest Africa 11751	CO3.05	(Northwest Af	168.7	0.1687
68417	Northwest Africa 12197	CR2	Western Saha	487	0.487
68109	Grosvenor Mountains 17063	CR2	Antarctica	388.3	0.3883
68110	Grosvenor Mountains 17064	CR2	Antarctica	226.4	0.2264
67631	Northwest Africa 11561	CR6	(Northwest Af	5746	5.746
68637	Northwest Africa 12322	CV3	Niger	35300	35.3
67787	Northwest Africa 11904	CV3	(Northwest Af	4000	4
67399	Northwest Africa 11737	CV3	(Northwest Af	2550	2.55
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60989	Northwest Africa 8406	CV3	(Northwest Af	944	0.944
68607	Northwest Africa 12268	CV3	(Northwest Af	743	0.743
68477	Northwest Africa 12229	CV3	(Northwest Af	675	0.675
68642	Northwest Africa 12343	CV3	(Northwest Af	526	0.526
68623	Catalina 300	CV3	Chile	380	0.38
45608	Northwest Africa 4669	CV3	(Northwest Af	369	0.369
68315	Northwest Africa 12013	CV3	(Northwest Af	332.1	0.3321
67830	Northwest Africa 11957	CV3	(Northwest Af	251	0.251
68416	Northwest Africa 12196	CV3	Western Saha	226	0.226
67497	Northwest Africa 11768	CV3	(Northwest Af	183	0.183
66447	Northwest Africa 11589	CV3	(Northwest Af	148.9	0.1489
67646	Northwest Africa 11850	CV3	(Northwest Af	147	0.147

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68327	Northwest Africa 12180	CV3	(Northwest Af	126	0.126
67402	Northwest Africa 11740	CV3	(Northwest Af	106.9	0.1069
68503	Northwest Africa 11977	CV3	(Northwest Af	72.9	0.0729
33145	Northwest Africa 2637	CV3	(Northwest Af	71.5	0.0715
67637	Northwest Africa 11845	CV3	(Northwest Af	69	0.069
68494	Northwest Africa 12247	CV3	Algeria	59.3	0.0593
67823	Northwest Africa 11946	CV3	(Northwest Af	59	0.059
68471	Northwest Africa 12221	CV3	(Northwest Af	55	0.055
67499	Northwest Africa 11770	CV3	(Northwest Af	49	0.049
67318	Asuka 12373	CV3	Antarctica	31.379	0.031379
67495	Northwest Africa 11766	CV3	(Northwest Af	30	0.03
45762	Northwest Africa 4838	CV3	(Northwest Af	28	0.028
67793	Northwest Africa 11937	CV3	(Northwest Af	25.1	0.0251
68049	Miller Range 15254	CV3	Antarctica	21.468	0.021468
68052	Miller Range 15257	CV3	Antarctica	11.258	0.011258
68050	Miller Range 15255	CV3	Antarctica	7.492	0.007492
67650	Northwest Africa 11854	CV3	(Northwest Af	6.87	0.00687
36803	Yamato 980177	CV3	Antarctica	1.959	0.001959
66392	Northwest Africa 11560	Diogenite	(Northwest Af	13060	13.06
66831	Mazichuan	Diogenite	China	3282	3.282
66803	Northwest Africa 11696	Diogenite	(Northwest Af	2706	2.706
66793	Erg Chech 001	Diogenite	Algeria	1266	1.266
67822	Northwest Africa 11945	Diogenite	(Northwest Af	1176	1.176
66839	Northwest Africa 11741	Diogenite	(Northwest Af	773	0.773
67798	Northwest Africa 11909	Diogenite	(Northwest Af	589.6	0.5896
67658	Northwest Africa 11857	Diogenite	(Northwest Af	580	0.58
67744	Northwest Africa 11888	Diogenite	(Northwest Af	307	0.307
67167	Asuka 12144	Diogenite	Antarctica	143.03	0.14303
41757	Yamato 000995	Diogenite	Antarctica	134.75	0.13475
68530	Los Vientos 250	Diogenite	Chile	98.8	0.0988
68116	Grosvenor Mountains 17175	Diogenite	Antarctica	94.864	0.094864
68606	Northwest Africa 12267	Diogenite	(Northwest Af	86	0.086
68493	Northwest Africa 12245	Diogenite	(Northwest Af	80.77	0.08077
43638	Yamato 002876	Diogenite	Antarctica	61.05	0.06105
67500	Northwest Africa 11771	Diogenite	(Northwest Af	50	0.05
28993	Yamato 794039	Diogenite	Antarctica	42.72	0.04272
43639	Yamato 002877	Diogenite	Antarctica	34.652	0.034652
67678	Northwest Africa 11833	Diogenite	(Northwest Af	29	0.029
67169	Asuka 12158	Diogenite	Antarctica	17.899	0.017899
27187	Yamato 791838	Diogenite	Antarctica	16	0.016
41070	Yamato 000305	Diogenite	Antarctica	12.414	0.012414
41594	Yamato 000832	Diogenite	Antarctica	11.689	0.011689
41022	Yamato 000257	Diogenite	Antarctica	3.136	0.003136
67588	Northwest Africa 11805	Diogenite-pm	(Northwest Af	109.4	0.1094
68544	Caleta el Cobre 025	EH3	Chile	777	0.777

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67196	Asuka 12245	EL4	Antarctica	14.084	0.014084
68529	Caleta el Cobre 024	EL6	Chile	15900	15.9
68528	El Médano 394	EL6	Chile	3079	3.079
66488	Northwest Africa 11667	EL6	(Northwest Af	682	0.682
67395	Northwest Africa 11731	EL6	(Northwest Af	500	0.5
67157	Asuka 12077	EL6	Antarctica	185.43	0.18543
66381	MacKay Glacier 14005	EL6	Antarctica	172.1	0.1721
66801	Northwest Africa 11679	EL6	Morocco	98	0.098
68132	Northwest Africa 11354	Enst achon-u	Morocco	15000	15
67869	Northwest Africa 11998	Eucrite	(Northwest Af	2241	2.241
66448	Northwest Africa 11591	Eucrite	Algeria	1549	1.549
67566	Elephant Moraine 14056	Eucrite	Antarctica	1220	1.22
67564	Elephant Moraine 14049	Eucrite	Antarctica	1121	1.121
33346	Northwest Africa 2887	Eucrite	(Northwest Af	887	0.887
68541	Dhofar 2093	Eucrite	Oman	764	0.764
67596	Northwest Africa 11777	Eucrite	(Northwest Af	705	0.705
66387	Dhofar 2092	Eucrite	Oman	440	0.44
66812	Northwest Africa 11710	Eucrite	(Northwest Af	394	0.394
68126	Northwest Africa 11999	Eucrite	(Northwest Af	294.42	0.29442
67825	Northwest Africa 11949	Eucrite	(Northwest Af	280	0.28
67821	Northwest Africa 11928	Eucrite	(Northwest Af	235	0.235
67642	Northwest Africa 11837	Eucrite	(Northwest Af	218	0.218
67558	Northwest Africa 11794	Eucrite	(Northwest Af	206.5	0.2065
42127	Yamato 001365	Eucrite	Antarctica	206.1	0.2061
66811	Northwest Africa 11709	Eucrite	Morocco	180	0.18
66382	Northwest Africa 11550	Eucrite	(Northwest Af	159.4	0.1594
68612	Northwest Africa 12283	Eucrite	(Northwest Af	145.5	0.1455
67657	Northwest Africa 11856	Eucrite	(Northwest Af	137	0.137
66384	Northwest Africa 11552	Eucrite	(Northwest Af	109.2	0.1092
66451	Northwest Africa 11594	Eucrite	Algeria	106.77	0.10677
66444	Northwest Africa 11586	Eucrite	Algeria	91.5	0.0915
67179	Asuka 12223	Eucrite	Antarctica	75.47	0.07547
66457	Northwest Africa 11600	Eucrite	Algeria	75.24	0.07524
66452	Northwest Africa 11595	Eucrite	Algeria	71.3	0.0713
67824	Northwest Africa 11947	Eucrite	(Northwest Af	70	0.07
67791	Northwest Africa 11933	Eucrite	(Northwest Af	65.7	0.0657
67632	Malotas (b)	Eucrite	Argentina	62.4	0.0624
68617	Northwest Africa 12290	Eucrite	(Northwest Af	60	0.06
41892	Yamato 001130	Eucrite	Antarctica	59.25	0.05925
4607	Asuka 881898	Eucrite	Antarctica	55.82	0.05582
66453	Northwest Africa 11596	Eucrite	Algeria	51.93	0.05193
67149	Asuka 12043	Eucrite	Antarctica	49.815	0.049815
66450	Northwest Africa 11593	Eucrite	Algeria	44.37	0.04437
67236	Asuka 12285	Eucrite	Antarctica	38.049	0.038049
68476	Northwest Africa 12226	Eucrite	(Northwest Af	38	0.038

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66454	Northwest Africa 11597	Eucrite	Algeria	34.74	0.03474
67403	Northwest Africa 11747	Eucrite	(Northwest Africa)	31.97	0.03197
4398	Asuka 881689	Eucrite	Antarctica	29.962	0.029962
67404	Northwest Africa 11748	Eucrite	(Northwest Africa)	27.5	0.0275
66456	Northwest Africa 11599	Eucrite	Algeria	22.07	0.02207
67233	Asuka 12282	Eucrite	Antarctica	21.33	0.02133
68618	Northwest Africa 12293	Eucrite	(Northwest Africa)	20	0.02
67319	Asuka 12374	Eucrite	Antarctica	18.323	0.018323
66449	Northwest Africa 11592	Eucrite	Algeria	17.88	0.01788
66459	Northwest Africa 11602	Eucrite	Algeria	17.86	0.01786
66458	Northwest Africa 11601	Eucrite	Algeria	16.85	0.01685
4196	Asuka 881487	Eucrite	Antarctica	12.921	0.012921
41994	Yamato 001232	Eucrite	Antarctica	10.557	0.010557
4587	Asuka 881878	Eucrite	Antarctica	10.53	0.01053
66460	Northwest Africa 11603	Eucrite	Algeria	10.1	0.0101
67349	Asuka 12407	Eucrite	Antarctica	6.919	0.006919
44116	Yamato 003354	Eucrite	Antarctica	2.369	0.002369
67131	Asuka 10228	Eucrite	Antarctica	1.936	0.001936
36941	Yamato 980315	Eucrite	Antarctica	1.298	0.001298
36815	Yamato 980189	Eucrite	Antarctica	1.219	0.001219
36962	Yamato 980337	Eucrite	Antarctica	0.425	0.000425
67567	Elephant Moraine 14066	Eucrite	Antarctica	0.4	0.0004
66837	Northwest Africa 11729	Eucrite-an	Mauritania	345	0.345
66413	Northwest Africa 8671	Eucrite-an	(Northwest Africa)	164.2	0.1642
66785	Northwest Africa 8681	Eucrite-br	(Northwest Africa)	590	0.59
67586	Northwest Africa 11803	Eucrite-br	Algeria	442	0.442
68408	Northwest Africa 12182	Eucrite-br	(Northwest Africa)	122.5	0.1225
67491	Northwest Africa 11762	Eucrite-br	(Northwest Africa)	42	0.042
50794	Northwest Africa 5908	Eucrite-br	(Northwest Africa)	20.3	0.0203
67492	Northwest Africa 11763	Eucrite-br	(Northwest Africa)	14	0.014
33043	Northwest Africa 2426	Eucrite-cm	(Northwest Africa)	630	0.63
66415	Northwest Africa 11576	Eucrite-melt t	(Northwest Africa)	18000	18
68605	Northwest Africa 12265	Eucrite-melt t	(Northwest Africa)	4433	4.433
67398	Northwest Africa 11734	Eucrite-melt t	(Northwest Africa)	1010	1.01
67550	Northwest Africa 11785	Eucrite-melt t	(Northwest Africa)	822	0.822
66840	Northwest Africa 11742	Eucrite-melt t	(Northwest Africa)	650	0.65
68641	Northwest Africa 12342	Eucrite-melt t	(Northwest Africa)	526	0.526
68473	Northwest Africa 12223	Eucrite-melt t	(Northwest Africa)	327	0.327
68326	Northwest Africa 12011	Eucrite-mmic	(Northwest Africa)	2835	2.835
33153	Northwest Africa 2650	Eucrite-mmic	Morocco	2224	2.224
67831	Northwest Africa 11958	Eucrite-mmic	(Northwest Africa)	2112	2.112
67826	Northwest Africa 11953	Eucrite-mmic	(Northwest Africa)	1160	1.16
66805	Northwest Africa 11698	Eucrite-mmic	(Northwest Africa)	832.4	0.8324
67551	Northwest Africa 11786	Eucrite-mmic	(Northwest Africa)	417	0.417
67790	Calama 014	Eucrite-mmic	Chile	251	0.251

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67409	Los Vientos 212	Eucrite-pmict Chile	1430	1.43
66809	Northwest Africa 11704	Eucrite-pmict Mauritania	1127	1.127
68478	Northwest Africa 12230	Eucrite-pmict(Northwest Africa)	1024	1.024
66807	Northwest Africa 11701	Eucrite-pmict(Northwest Africa)	1015.8	1.0158
68625	Northwest Africa 12339	Eucrite-pmict(Northwest Africa)	634	0.634
67679	Northwest Africa 11861	Eucrite-pmict(Northwest Africa)	538	0.538
66800	Northwest Africa 11677	Eucrite-pmict(Northwest Africa)	499.2	0.4992
68643	Northwest Africa 12344	Eucrite-pmict(Northwest Africa)	456	0.456
68414	Northwest Africa 12193	Eucrite-pmictWestern Sahara	241	0.241
67868	Tintigny	Eucrite-pmict Belgium	210	0.21
68475	Northwest Africa 12225	Eucrite-pmict(Northwest Africa)	169	0.169
68492	Northwest Africa 12243	Eucrite-pmict Mauritania	164	0.164
67543	Northwest Africa 11753	Eucrite-pmict Morocco	159	0.159
67792	Northwest Africa 11934	Eucrite-pmict(Northwest Africa)	151.9	0.1519
68532	Northwest Africa 12282	Eucrite-pmict(Northwest Africa)	141.5	0.1415
68114	Grosvenor Mountains 17168	Eucrite-pmict Antarctica	133.858	0.133858
68117	Grosvenor Mountains 17176	Eucrite-pmict Antarctica	131.112	0.131112
68490	Northwest Africa 12202	Eucrite-pmictWestern Sahara	110	0.11
68621	Northwest Africa 12326	Eucrite-pmict(Northwest Africa)	76.1	0.0761
68639	Northwest Africa 12340	Eucrite-pmict(Northwest Africa)	74	0.074
68107	Grosvenor Mountains 17049	Eucrite-pmict Antarctica	61.353	0.061353
68415	Northwest Africa 12195	Eucrite-pmict Algeria	61	0.061
68121	Grosvenor Mountains 17211	Eucrite-pmict Antarctica	47.3	0.0473
68104	Grosvenor Mountains 17006	Eucrite-pmict Antarctica	40.372	0.040372
66484	Northwest Africa 11647	Eucrite-pmict(Northwest Africa)	39	0.039
68113	Grosvenor Mountains 17099	Eucrite-pmict Antarctica	26.701	0.026701
68118	Grosvenor Mountains 17189	Eucrite-pmict Antarctica	25.324	0.025324
68106	Grosvenor Mountains 17048	Eucrite-pmict Antarctica	23.531	0.023531
68622	Northwest Africa 12327	Eucrite-pmict(Northwest Africa)	21.6	0.0216
67789	Errachidia 002	Eucrite-pmict Morocco	21.26	0.02126
68105	Grosvenor Mountains 17039	Eucrite-pmict Antarctica	8.269	0.008269
67859	Northwest Africa 11969	Eucrite-unbr (Northwest Africa)	942	0.942
67643	Northwest Africa 11846	Eucrite-unbr (Northwest Africa)	754	0.754
67406	Northwest Africa 11749	Eucrite-unbr Morocco	460	0.46
68120	Grosvenor Mountains 17210	Eucrite-unbr Antarctica	184.233	0.184233
68603	Northwest Africa 12246	Eucrite-unbr Morocco	101.4	0.1014
68420	Northwest Africa 12201	Eucrite-unbr Western Sahara	81	0.081
68111	Grosvenor Mountains 17070	Eucrite-unbr Antarctica	64.631	0.064631
68119	Grosvenor Mountains 17200	Eucrite-unbr Antarctica	46.365	0.046365
67795	Northwest Africa 11897	Eucrite-unbr (Northwest Africa)	43.9	0.0439
68112	Grosvenor Mountains 17098	Eucrite-unbr Antarctica	38.752	0.038752
67144	Asuka 12036	H Antarctica	70.24	0.07024
66901	Asuka 09242	H Antarctica	2.524	0.002524
66403	Northwest Africa 11570	H/L4 (Northwest Africa)	75.04	0.07504
66397	Northwest Africa 11579	H~4 (Northwest Africa)	1247.7	1.2477

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67801	Northwest Africa 11972	H~5	Morocco	2880	2.88
66396	Rabt Sbayta 009	H~5	Western Sahara	2112.6	2.1126
68129	Alatage Mountain 044	H~5	China	709	0.709
67802	Northwest Africa 11973	H~5	(Northwest Africa)	334.8	0.3348
68437	Northwest Africa 12300	H~5	(Northwest Africa)	273	0.273
68659	Northwest Africa 12383	H~5	(Northwest Africa)	209.65	0.20965
67800	Northwest Africa 11971	H~5	(Northwest Africa)	105	0.105
67803	Northwest Africa 11974	H~5	(Northwest Africa)	73.7	0.0737
68431	Loulan Yizhi 008	H~5	China	29.3	0.0293
68658	Northwest Africa 12382	H~5	(Northwest Africa)	29.02	0.02902
68438	Lop Nur 003	H~5	China	27.2	0.0272
68651	Qira 001	H~5	China	8.03	0.00803
68436	Northwest Africa 12299	H~6	Morocco	4500	4.5
66398	Northwest Africa 11580	H~6	(Northwest Africa)	1518.9	1.5189
68648	Jinchang 001	H~6	China	813	0.813
68502	Mount Yirtkuq Bulak 001	H~6	China	540	0.54
67805	Northwest Africa 11979	H~6	(Northwest Africa)	78.1	0.0781
66401	Northwest Africa 11583	H~6	Morocco	24	0.024
31833	Ouargla 001	H3	Algeria	2705	2.705
67692	Al Khuwaymat 001	H3	Libya	1870.3	1.8703
67758	Northwest Africa 11936	H3	(Northwest Africa)	1429.5	1.4295
67592	Taltal 001	H3	Chile	1186	1.186
31625	Northwest Africa 432	H3	(Northwest Africa)	839	0.839
66825	El Médano 377	H3	Chile	405	0.405
67749	Northwest Africa 11923	H3	(Northwest Africa)	252	0.252
67416	Reckling Peak 14003	H3	Antarctica	231	0.231
67710	Stewart Valley 024	H3	United States	158.2	0.1582
67274	Asuka 12327	H3	Antarctica	156.7	0.1567
67750	Northwest Africa 11924	H3	(Northwest Africa)	125	0.125
67807	Sahara 98063	H3	(Sahara)	84	0.084
67272	Asuka 12323	H3	Antarctica	60.59	0.06059
67383	Scarham Creek	H3	United States	52.1	0.0521
67276	Asuka 12330	H3	Antarctica	42.665	0.042665
67418	Reckling Peak 14006	H3	Antarctica	22.6	0.0226
67510	Northwest Africa 11810	H3	(Northwest Africa)	21	0.021
67509	Northwest Africa 11806	H3	(Northwest Africa)	12	0.012
67213	Asuka 12262	H3	Antarctica	5.182	0.005182
67471	Elephant Moraine 14058	H3	Antarctica	0.7	0.0007
67704	Northwest Africa 11895	H3-5	(Sahara)	148	0.148
66854	Yucca 050	H3-5	United States	34.3	0.0343
67748	Yucca 052	H3-5	United States	23.3	0.0233
66853	Yucca 049	H3-5	United States	20.8	0.0208
66850	Yucca 046	H3-5	United States	11.1	0.0111
67391	Catalina 257	H3-6	Chile	42	0.042
66849	Yucca 045	H3-6	United States	39.7	0.0397

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66852	Yucca 048	H3-6	United States	20.9	0.0209
66851	Yucca 047	H3-6	United States	11.9	0.0119
67983	Dominion Range 14429	H3.5	Antarctica	40.145	0.040145
68006	Dominion Range 14491	H3.5	Antarctica	18.83	0.01883
66834	Northwest Africa 11700	H4	(Northwest Africa)	102300	102.3
67840	Chug Chug 003	H4	Chile	8918	8.918
68515	Northwest Africa 12350	H4	Morocco	6629.8	6.6298
66848	Qatar 013	H4	Qatar	5090	5.09
67702	Sahara 98001	H4	(Sahara)	4450	4.45
67385	El Médano 380	H4	Chile	2670	2.67
66846	Qatar 011	H4	Qatar	2590	2.59
68322	Northwest Africa 12240	H4	Mauritania	1808.4	1.8084
68319	Northwest Africa 12235	H4	Morocco	1740	1.74
68381	Paposo 043	H4	Chile	1614	1.614
67172	Asuka 12211	H4	Antarctica	1371.7	1.3717
68263	Northwest Africa 12152	H4	Algeria	1091.74	1.09174
66772	Hamburg	H4	United States	1000	1
68547	Los Vientos 259	H4	Chile	981	0.981
68261	Northwest Africa 12150	H4	Algeria	976.43	0.97643
31782	Northwest Africa 660	H4	(Northwest Africa)	668	0.668
67757	Northwest Africa 11935	H4	(Northwest Africa)	662.1	0.6621
67259	Asuka 12309	H4	Antarctica	587.77	0.58777
68266	Northwest Africa 12155	H4	Algeria	553.74	0.55374
31646	Northwest Africa 453	H4	(Northwest Africa)	539	0.539
68514	Northwest Africa 12349	H4	Morocco	522.1	0.5221
67696	Jabal Zaltan 003	H4	Libya	504.9	0.5049
43244	Yamato 002482	H4	Antarctica	503.35	0.50335
68422	Lenghu 003	H4	China	446	0.446
68363	Los Vientos 239	H4	Chile	445	0.445
31628	Northwest Africa 435	H4	(Northwest Africa)	428	0.428
68134	Northwest Africa 12023	H4	Algeria	408.46	0.40846
67328	Asuka 12383	H4	Antarctica	406.04	0.40604
31645	Northwest Africa 452	H4	(Northwest Africa)	373	0.373
68138	Northwest Africa 12027	H4	Algeria	358.74	0.35874
66669	Dominion Range 14461	H4	Antarctica	345.91	0.34591
67698	Jabal Zaltan 005	H4	Libya	336	0.336
67575	Northwest Africa 11819	H4	(Northwest Africa)	330	0.33
67727	Calama 016	H4	Chile	291	0.291
67147	Asuka 12040	H4	Antarctica	280.89	0.28089
68143	Northwest Africa 12032	H4	Algeria	276.91	0.27691
68226	Northwest Africa 12115	H4	Algeria	273.2	0.2732
67762	Northwest Africa 11941	H4	(Northwest Africa)	266.8	0.2668
67164	Asuka 12136	H4	Antarctica	266.69	0.26669
68223	Northwest Africa 12112	H4	Algeria	250.67	0.25067
68139	Northwest Africa 12028	H4	Algeria	241.17	0.24117

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68140	Northwest Africa 12029	H4	Algeria	221.83	0.22183
68376	Los Vientos 253	H4	Chile	220	0.22
67638	Northwest Africa 11830	H4	(Northwest Africa)	218	0.218
68150	Northwest Africa 12039	H4	Algeria	199.18	0.19918
31515	Northwest Africa 317	H4	Algeria	197.74	0.19774
68399	Northwest Africa 12251	H4	(Northwest Africa)	182	0.182
68135	Northwest Africa 12024	H4	Algeria	181.04	0.18104
68228	Northwest Africa 12117	H4	Algeria	176.82	0.17682
68336	Catalina 281	H4	Chile	171	0.171
68189	Northwest Africa 12078	H4	Algeria	167.26	0.16726
67184	Asuka 12233	H4	Antarctica	149.07	0.14907
67700	Jabal Zaltan 007	H4	Libya	147.5	0.1475
67690	Los Vientos 230	H4	Chile	147	0.147
68142	Northwest Africa 12031	H4	Algeria	138.44	0.13844
67265	Asuka 12316	H4	Antarctica	135.64	0.13564
68279	Northwest Africa 12168	H4	Algeria	131.65	0.13165
68535	Coipuno 003	H4	Chile	130	0.13
31516	Northwest Africa 318	H4	Algeria	127.73	0.12773
68153	Northwest Africa 12042	H4	Algeria	125.53	0.12553
68404	Northwest Africa 12257	H4	(Northwest Africa)	122	0.122
67278	Asuka 12332	H4	Antarctica	119.55	0.11955
68196	Northwest Africa 12085	H4	Algeria	119.31	0.11931
68167	Northwest Africa 12056	H4	Algeria	118	0.118
67315	Asuka 12370	H4	Antarctica	112.42	0.11242
67703	Sahara 98050	H4	(Sahara)	106	0.106
66548	Dominion Range 14129	H4	Antarctica	105.84	0.10584
68227	Northwest Africa 12116	H4	Algeria	105.71	0.10571
67180	Asuka 12226	H4	Antarctica	103.96	0.10396
68209	Northwest Africa 12098	H4	Algeria	96.96	0.09696
67153	Asuka 12053	H4	Antarctica	96.67	0.09667
66496	Northwest Africa 11680	H4	(Northwest Africa)	96	0.096
68148	Northwest Africa 12037	H4	Algeria	94.22	0.09422
67159	Asuka 12092	H4	Antarctica	91.49	0.09149
66508	Northwest Africa 11692	H4	(Northwest Africa)	88	0.088
68146	Northwest Africa 12035	H4	Algeria	87.3	0.0873
67966	Dominion Range 14412	H4	Antarctica	82.589	0.082589
68182	Northwest Africa 12071	H4	Algeria	80.38	0.08038
67695	Jabal Zaltan 002	H4	Libya	78.7	0.0787
68270	Northwest Africa 12159	H4	Algeria	78.44	0.07844
67361	Asuka 12419	H4	Antarctica	77.77	0.07777
68252	Northwest Africa 12141	H4	Algeria	76.87	0.07687
68168	Northwest Africa 12057	H4	Algeria	75.87	0.07587
67181	Asuka 12227	H4	Antarctica	71.75	0.07175
67191	Asuka 12240	H4	Antarctica	62.75	0.06275
67139	Asuka 12026	H4	Antarctica	62.58	0.06258

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67182	Asuka 12230	H4	Antarctica	62.42	0.06242
31514	Northwest Africa 316	H4	Algeria	60.25	0.06025
67193	Asuka 12242	H4	Antarctica	56.58	0.05658
67195	Asuka 12244	H4	Antarctica	56.162	0.056162
68272	Northwest Africa 12161	H4	Algeria	55.04	0.05504
67377	Asuka 12436	H4	Antarctica	51.125	0.051125
42361	Yamato 001599	H4	Antarctica	49.567	0.049567
67342	Asuka 12399	H4	Antarctica	48.987	0.048987
67867	Northwest Africa 12019	H4	(Northwest Africa)	48.89	0.04889
67185	Asuka 12234	H4	Antarctica	46.912	0.046912
67203	Asuka 12252	H4	Antarctica	46.292	0.046292
66760	Northwest Africa 11662	H4	(Northwest Africa)	45.32	0.04532
68208	Northwest Africa 12097	H4	Algeria	45.06	0.04506
68224	Northwest Africa 12113	H4	Algeria	42.75	0.04275
67333	Asuka 12388	H4	Antarctica	41.447	0.041447
68275	Northwest Africa 12164	H4	Algeria	39.28	0.03928
67202	Asuka 12251	H4	Antarctica	39.052	0.039052
68247	Northwest Africa 12136	H4	Algeria	38.45	0.03845
67292	Asuka 12346	H4	Antarctica	38.235	0.038235
67275	Asuka 12329	H4	Antarctica	38.202	0.038202
66573	Dominion Range 14185	H4	Antarctica	36.72	0.03672
67876	Dominion Range 14188	H4	Antarctica	35.45	0.03545
24804	Yamato 74426	H4	Antarctica	29.8	0.0298
66645	Dominion Range 14377	H4	Antarctica	28.96	0.02896
67989	Dominion Range 14435	H4	Antarctica	27.631	0.027631
67261	Asuka 12311	H4	Antarctica	26.803	0.026803
67249	Asuka 12299	H4	Antarctica	21.635	0.021635
67324	Asuka 12379	H4	Antarctica	19.583	0.019583
68278	Northwest Africa 12167	H4	Algeria	17.77	0.01777
42059	Yamato 001297	H4	Antarctica	17.747	0.017747
67269	Asuka 12320	H4	Antarctica	17.355	0.017355
67208	Asuka 12257	H4	Antarctica	16.946	0.016946
42191	Yamato 001429	H4	Antarctica	15.737	0.015737
67277	Asuka 12331	H4	Antarctica	14.944	0.014944
66518	Dominion Range 14037	H4	Antarctica	14.5	0.0145
43242	Yamato 002480	H4	Antarctica	14.491	0.014491
67189	Asuka 12238	H4	Antarctica	14.185	0.014185
68302	Calama 019	H4	Chile	12.5	0.0125
67305	Asuka 12360	H4	Antarctica	10.903	0.010903
67284	Asuka 12338	H4	Antarctica	10.667	0.010667
67183	Asuka 12232	H4	Antarctica	10.578	0.010578
27088	Yamato 791739	H4	Antarctica	8.42	0.00842
66661	Dominion Range 14453	H4	Antarctica	7.08	0.00708
40813	Yamato 000046	H4	Antarctica	6.248	0.006248
67078	Asuka 09625	H4	Antarctica	5.958	0.005958

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67005	Asuka 09390	H4	Antarctica	5.827	0.005827
67097	Asuka 09653	H4	Antarctica	5.766	0.005766
67081	Asuka 09629	H4	Antarctica	5.727	0.005727
66984	Asuka 09353	H4	Antarctica	5.687	0.005687
66976	Asuka 09339	H4	Antarctica	5.64	0.00564
67071	Asuka 09611	H4	Antarctica	5.529	0.005529
66921	Asuka 09275	H4	Antarctica	5.486	0.005486
67032	Asuka 09437	H4	Antarctica	5.394	0.005394
66924	Asuka 09278	H4	Antarctica	5.37	0.00537
67085	Asuka 09633	H4	Antarctica	5.337	0.005337
67098	Asuka 09654	H4	Antarctica	5.259	0.005259
67052	Asuka 09485	H4	Antarctica	5.21	0.00521
67049	Asuka 09472	H4	Antarctica	5.095	0.005095
66922	Asuka 09276	H4	Antarctica	5.012	0.005012
66783	Northwest Africa 11743	H4	Morocco	5	0.005
41256	Yamato 000491	H4	Antarctica	4.993	0.004993
41068	Yamato 000303	H4	Antarctica	4.981	0.004981
41066	Yamato 000301	H4	Antarctica	4.888	0.004888
41246	Yamato 000481	H4	Antarctica	4.884	0.004884
41134	Yamato 000369	H4	Antarctica	4.788	0.004788
40999	Yamato 000234	H4	Antarctica	4.758	0.004758
67101	Asuka 09657	H4	Antarctica	4.676	0.004676
41347	Yamato 000582	H4	Antarctica	4.606	0.004606
67103	Asuka 09659	H4	Antarctica	4.53	0.00453
43985	Yamato 003223	H4	Antarctica	4.438	0.004438
41376	Yamato 000612	H4	Antarctica	4.433	0.004433
40952	Yamato 000187	H4	Antarctica	4.425	0.004425
66926	Asuka 09280	H4	Antarctica	4.386	0.004386
67197	Asuka 12246	H4	Antarctica	4.36	0.00436
67084	Asuka 09632	H4	Antarctica	4.353	0.004353
41037	Yamato 000272	H4	Antarctica	4.297	0.004297
66898	Asuka 09233	H4	Antarctica	4.257	0.004257
41379	Yamato 000615	H4	Antarctica	4.25	0.00425
40943	Yamato 000178	H4	Antarctica	4.245	0.004245
40945	Yamato 000180	H4	Antarctica	4.243	0.004243
40968	Yamato 000203	H4	Antarctica	4.096	0.004096
66929	Asuka 09283	H4	Antarctica	4.057	0.004057
43853	Yamato 003091	H4	Antarctica	3.983	0.003983
67107	Asuka 09663	H4	Antarctica	3.938	0.003938
41532	Yamato 000769	H4	Antarctica	3.844	0.003844
41104	Yamato 000339	H4	Antarctica	3.74	0.00374
66904	Asuka 09248	H4	Antarctica	3.739	0.003739
41140	Yamato 000375	H4	Antarctica	3.721	0.003721
67109	Asuka 09665	H4	Antarctica	3.706	0.003706
41572	Yamato 000810	H4	Antarctica	3.688	0.003688

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43884	Yamato 003122	H4	Antarctica	3.646	0.003646
67079	Asuka 09626	H4	Antarctica	3.642	0.003642
67022	Asuka 09411	H4	Antarctica	3.641	0.003641
41505	Yamato 000741	H4	Antarctica	3.615	0.003615
40981	Yamato 000216	H4	Antarctica	3.606	0.003606
66972	Asuka 09333	H4	Antarctica	3.602	0.003602
41163	Yamato 000398	H4	Antarctica	3.543	0.003543
67030	Asuka 09429	H4	Antarctica	3.514	0.003514
66903	Asuka 09247	H4	Antarctica	3.499	0.003499
67035	Asuka 09444	H4	Antarctica	3.465	0.003465
41338	Yamato 000573	H4	Antarctica	3.46	0.00346
43784	Yamato 003022	H4	Antarctica	3.455	0.003455
66934	Asuka 09288	H4	Antarctica	3.454	0.003454
41311	Yamato 000546	H4	Antarctica	3.401	0.003401
66928	Asuka 09282	H4	Antarctica	3.4	0.0034
66925	Asuka 09279	H4	Antarctica	3.394	0.003394
41212	Yamato 000447	H4	Antarctica	3.309	0.003309
67104	Asuka 09660	H4	Antarctica	3.283	0.003283
67113	Asuka 09669	H4	Antarctica	3.245	0.003245
67105	Asuka 09661	H4	Antarctica	3.205	0.003205
67108	Asuka 09664	H4	Antarctica	3.204	0.003204
41554	Yamato 000791	H4	Antarctica	3.203	0.003203
66931	Asuka 09285	H4	Antarctica	3.189	0.003189
67020	Asuka 09407	H4	Antarctica	3.188	0.003188
67110	Asuka 09666	H4	Antarctica	3.181	0.003181
40976	Yamato 000211	H4	Antarctica	3.176	0.003176
41535	Yamato 000772	H4	Antarctica	3.146	0.003146
41136	Yamato 000371	H4	Antarctica	3.136	0.003136
66977	Asuka 09340	H4	Antarctica	3.123	0.003123
67086	Asuka 09634	H4	Antarctica	3.121	0.003121
66930	Asuka 09284	H4	Antarctica	3.091	0.003091
41526	Yamato 000763	H4	Antarctica	3.088	0.003088
41348	Yamato 000583	H4	Antarctica	3.083	0.003083
41346	Yamato 000581	H4	Antarctica	3.051	0.003051
43980	Yamato 003218	H4	Antarctica	3.033	0.003033
67100	Asuka 09656	H4	Antarctica	3.009	0.003009
66907	Asuka 09252	H4	Antarctica	2.921	0.002921
66927	Asuka 09281	H4	Antarctica	2.916	0.002916
42891	Yamato 002129	H4	Antarctica	2.906	0.002906
67111	Asuka 09667	H4	Antarctica	2.856	0.002856
67106	Asuka 09662	H4	Antarctica	2.832	0.002832
67034	Asuka 09440	H4	Antarctica	2.799	0.002799
66935	Asuka 09289	H4	Antarctica	2.797	0.002797
67112	Asuka 09668	H4	Antarctica	2.759	0.002759
66895	Asuka 09230	H4	Antarctica	2.748	0.002748

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66968	Asuka 09325	H4	Antarctica	2.731	0.002731
67117	Asuka 09673	H4	Antarctica	2.634	0.002634
40776	Yamato 000008	H4	Antarctica	2.594	0.002594
67120	Asuka 09678	H4	Antarctica	2.558	0.002558
66896	Asuka 09231	H4	Antarctica	2.506	0.002506
66932	Asuka 09286	H4	Antarctica	2.496	0.002496
66933	Asuka 09287	H4	Antarctica	2.481	0.002481
67115	Asuka 09671	H4	Antarctica	2.445	0.002445
66894	Asuka 09228	H4	Antarctica	2.432	0.002432
67083	Asuka 09631	H4	Antarctica	2.253	0.002253
67114	Asuka 09670	H4	Antarctica	2.163	0.002163
66936	Asuka 09290	H4	Antarctica	2.085	0.002085
66916	Asuka 09263	H4	Antarctica	2.063	0.002063
67118	Asuka 09674	H4	Antarctica	1.946	0.001946
66939	Asuka 09293	H4	Antarctica	1.94	0.00194
67080	Asuka 09628	H4	Antarctica	1.932	0.001932
66937	Asuka 09291	H4	Antarctica	1.927	0.001927
66940	Asuka 09294	H4	Antarctica	1.891	0.001891
66941	Asuka 09295	H4	Antarctica	1.794	0.001794
67072	Asuka 09612	H4	Antarctica	1.702	0.001702
66945	Asuka 09299	H4	Antarctica	1.692	0.001692
66944	Asuka 09298	H4	Antarctica	1.672	0.001672
67010	Asuka 09395	H4	Antarctica	1.652	0.001652
66950	Asuka 09304	H4	Antarctica	1.632	0.001632
67073	Asuka 09613	H4	Antarctica	1.616	0.001616
66965	Asuka 09321	H4	Antarctica	1.559	0.001559
66946	Asuka 09300	H4	Antarctica	1.507	0.001507
67119	Asuka 09677	H4	Antarctica	1.497	0.001497
66899	Asuka 09234	H4	Antarctica	1.494	0.001494
67013	Asuka 09398	H4	Antarctica	1.436	0.001436
66942	Asuka 09296	H4	Antarctica	1.374	0.001374
67088	Asuka 09636	H4	Antarctica	1.366	0.001366
66943	Asuka 09297	H4	Antarctica	1.317	0.001317
67087	Asuka 09635	H4	Antarctica	1.263	0.001263
42884	Yamato 002122	H4	Antarctica	1.167	0.001167
67050	Asuka 09477	H4	Antarctica	1.165	0.001165
67074	Asuka 09614	H4	Antarctica	1.09	0.00109
66961	Asuka 09315	H4	Antarctica	1.075	0.001075
66964	Asuka 09320	H4	Antarctica	1.044	0.001044
67016	Asuka 09401	H4	Antarctica	1.02	0.00102
67127	Asuka 10206	H4	Antarctica	0.88	0.00088
67077	Asuka 09623	H4	Antarctica	0.857	0.000857
66717	Miller Range 15105	H4	Antarctica	0.85	0.00085
66955	Asuka 09309	H4	Antarctica	0.847	0.000847
67129	Asuka 10216	H4	Antarctica	0.813	0.000813

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67082	Asuka 09630	H4	Antarctica	0.705	0.000705
43371	Yamato 002609	H4	Antarctica	0.681	0.000681
43891	Yamato 003129	H4	Antarctica	0.656	0.000656
66957	Asuka 09311	H4	Antarctica	0.605	0.000605
66956	Asuka 09310	H4	Antarctica	0.525	0.000525
43553	Yamato 002791	H4	Antarctica	0.516	0.000516
43369	Yamato 002607	H4	Antarctica	0.511	0.000511
42639	Yamato 001877	H4	Antarctica	0.461	0.000461
43334	Yamato 002572	H4	Antarctica	0.438	0.000438
42640	Yamato 001878	H4	Antarctica	0.422	0.000422
42693	Yamato 001931	H4	Antarctica	0.417	0.000417
43288	Yamato 002526	H4	Antarctica	0.399	0.000399
42739	Yamato 001977	H4	Antarctica	0.386	0.000386
66959	Asuka 09313	H4	Antarctica	0.375	0.000375
66960	Asuka 09314	H4	Antarctica	0.338	0.000338
42638	Yamato 001876	H4	Antarctica	0.308	0.000308
43382	Yamato 002620	H4	Antarctica	0.306	0.000306
43240	Yamato 002478	H4	Antarctica	0.225	0.000225
68520	Parauapebas	H4-5	Brazil	272.3	0.2723
67190	Asuka 12239	H4-6	Antarctica	52.553	0.052553
66405	Northwest Africa 11572	H4-melt brecc	(Northwest Africa)	897.52	0.89752
66810	Northwest Africa 11705	H4/5	(Northwest Africa)	11036	11.036
66845	Qatar 010	H4/5	Qatar	9264	9.264
66847	Qatar 012	H4/5	Qatar	2431	2.431
68395	San Juan 099	H4/5	Chile	1224	1.224
68386	Paposo 048	H4/5	Chile	1089	1.089
67660	Paposo 041	H4/5	Chile	860	0.86
68347	Catalina 292	H4/5	Chile	325	0.325
68352	Catalina 297	H4/5	Chile	180	0.18
68390	San Juan 094	H4/5	Chile	115	0.115
68504	Northwest Africa 12354	H4/5	(Northwest Africa)	94.1	0.0941
67613	Northwest Africa 11862	H4/5	(Northwest Africa)	30.38	0.03038
68338	Catalina 283	H5	Chile	47000	47
67459	Elephant Moraine 14043	H5	Antarctica	36700	36.7
67384	El Médano 379	H5	Chile	21300	21.3
68619	Maryborough	H5	Australia	17000	17
67448	Elephant Moraine 14032	H5	Antarctica	11200	11.2
67524	El Médano 384	H5	Chile	10440	10.44
67874	Dominion Range 14001	H5	Antarctica	8205	8.205
68629	Ablakетка	H5	Kazakhstan	5500	5.5
67846	Northwest Africa 12001	H5	Morocco	5230	5.23
66756	Northwest Africa 11658	H5	(Northwest Africa)	5000	5
68534	Northwest Africa 12369	H5	(Northwest Africa)	4685	4.685
68311	Northwest Africa 12215	H5	(Northwest Africa)	4235	4.235
66748	Dar al Gani 1069	H5	Libya	3958	3.958

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3	68660	Northwest Africa 12385	H5	Morocco	3463	3.463
4	68550	Los Vientos 261	H5	Chile	3189	3.189
5	68310	Northwest Africa 12211	H5	(Northwest Af	2729	2.729
6	67514	Northwest Africa 11814	H5	(Northwest Af	2510	2.51
7	68317	Hami 007	H5	China	2500	2.5
8	68518	Northwest Africa 12353	H5	Morocco	1423	1.423
9	67844	Chug Chug 005	H5	Chile	1295	1.295
10	66438	Northwest Africa 11642	H5	(Northwest Af	1259	1.259
11	68512	Northwest Africa 12347	H5	Morocco	1242.9	1.2429
12	32062	Northwest Africa 1089	H5	(Northwest Af	1136	1.136
13	67753	Northwest Africa 11929	H5	(Northwest Af	964	0.964
14	42158	Yamato 001396	H5	Antarctica	922.7	0.9227
15	67517	Los Vientos 221	H5	Chile	825	0.825
16	67711	Northwest Africa 11778	H5	(Northwest Af	767.5	0.7675
17	66510	Northwest Africa 11694	H5	(Northwest Af	751	0.751
18	68264	Northwest Africa 12153	H5	Algeria	677.79	0.67779
19	67728	Calama 017	H5	Chile	668	0.668
20	68283	Northwest Africa 12172	H5	Algeria	649.57	0.64957
21	67659	Los Vientos 227	H5	Chile	646	0.646
22	68549	Los Vientos 260	H5	Chile	646	0.646
23	31644	Northwest Africa 451	H5	(Northwest Af	620	0.62
24	67156	Asuka 12060	H5	Antarctica	612.5	0.6125
25	68321	Northwest Africa 12239	H5	(Northwest Af	586	0.586
26	68066	Miller Range 15383	H5	Antarctica	557.7	0.5577
27	68265	Northwest Africa 12154	H5	Algeria	510.99	0.51099
28	68304	Sierra Gorda 007	H5	Chile	502	0.502
29	68516	Northwest Africa 12351	H5	Morocco	498.3	0.4983
30	68508	Northwest Africa 12359	H5	(Northwest Af	486.2	0.4862
31	66814	Stewart Valley 023	H5	United States	485	0.485
32	67468	Elephant Moraine 14054	H5	Antarctica	463	0.463
33	68358	Los Vientos 234	H5	Chile	461.9	0.4619
34	68400	Northwest Africa 12253	H5	(Northwest Af	454	0.454
35	68133	Northwest Africa 12022	H5	Algeria	439.34	0.43934
36	66822	El Médano 374	H5	Chile	436	0.436
37	67140	Asuka 12027	H5	Antarctica	427.83	0.42783
38	68359	Los Vientos 235	H5	Chile	422.9	0.4229
39	68236	Northwest Africa 12125	H5	Algeria	422.78	0.42278
40	68194	Northwest Africa 12083	H5	Algeria	399.41	0.39941
41	67697	Jabal Zaltan 004	H5	Libya	397.9	0.3979
42	67176	Asuka 12219	H5	Antarctica	393.4	0.3934
43	67716	Chug Chug 002	H5	Chile	388	0.388
44	67706	Qatar 014	H5	Qatar	378	0.378
45	68355	El Médano 393	H5	Chile	332	0.332
46	67537	El Médano 385	H5	Chile	301	0.301
47	67580	Northwest Africa 11824	H5	(Northwest Af	301	0.301

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67610	Hermenegildo	H5	Brazil	300	0.3
67574	Northwest Africa 11818	H5	(Northwest Africa)	278	0.278
67530	Catalina 267	H5	Chile	267	0.267
67521	Catalina 262	H5	Chile	255	0.255
67538	El Médano 386	H5	Chile	253	0.253
66499	Northwest Africa 11683	H5	(Northwest Africa)	243	0.243
67313	Asuka 12368	H5	Antarctica	231.36	0.23136
67724	Calama 012	H5	Chile	227	0.227
68237	Northwest Africa 12126	H5	Algeria	226.76	0.22676
68191	Northwest Africa 12080	H5	Algeria	226.45	0.22645
66823	El Médano 375	H5	Chile	223	0.223
67581	Northwest Africa 11825	H5	(Northwest Africa)	218.4	0.2184
68517	Northwest Africa 12352	H5	Morocco	204.5	0.2045
67178	Asuka 12221	H5	Antarctica	196.29	0.19629
67891	Dominion Range 14234	H5	Antarctica	193.87	0.19387
67534	Catalina 270	H5	Chile	193	0.193
68357	Los Vientos 233	H5	Chile	192	0.192
68260	Northwest Africa 12149	H5	Algeria	191.04	0.19104
68239	Northwest Africa 12128	H5	Algeria	186.91	0.18691
67665	El Médano 388	H5	Chile	185	0.185
68144	Northwest Africa 12033	H5	Algeria	182.13	0.18213
68505	Northwest Africa 12356	H5	(Northwest Africa)	181.6	0.1816
67701	Jabal Zaltan 008	H5	Libya	176.9	0.1769
68185	Northwest Africa 12074	H5	Algeria	175.43	0.17543
68301	Calate 015	H5	Chile	175	0.175
68155	Northwest Africa 12044	H5	Algeria	173.59	0.17359
68187	Northwest Africa 12076	H5	Algeria	173.54	0.17354
68234	Northwest Africa 12123	H5	Algeria	171.34	0.17134
68218	Northwest Africa 12107	H5	Algeria	166.55	0.16655
68286	Northwest Africa 12175	H5	Algeria	164.82	0.16482
67173	Asuka 12212	H5	Antarctica	164.57	0.16457
68141	Northwest Africa 12030	H5	Algeria	161.01	0.16101
66821	Paposo 039	H5	Chile	160.3	0.1603
66816	Ravar 003	H5	Iran	154	0.154
66815	Gandom Beryan 010	H5	Iran	150	0.15
68366	Los Vientos 242	H5	Chile	147	0.147
67535	Catalina 271	H5	Chile	142	0.142
67577	Northwest Africa 11821	H5	(Northwest Africa)	142	0.142
67812	Northwest Africa 11912	H5	(Northwest Africa)	142	0.142
68303	Sierra Gorda 006	H5	Chile	142	0.142
68385	Paposo 047	H5	Chile	140	0.14
68356	Los Vientos 232	H5	Chile	139	0.139
67578	Northwest Africa 11822	H5	(Northwest Africa)	138.2	0.1382
66501	Northwest Africa 11685	H5	(Northwest Africa)	138	0.138
66862	Sayh al Uhaymir 606	H5	Oman	136.502	0.136502

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67672	Northwest Africa 11885	H5	(Northwest Africa)	135	0.135
67673	Northwest Africa 8282	H5	(Northwest Africa)	134	0.134
68149	Northwest Africa 12038	H5	Algeria	131.94	0.13194
68235	Northwest Africa 12124	H5	Algeria	130.3	0.1303
67219	Asuka 12268	H5	Antarctica	128.51	0.12851
67162	Asuka 12117	H5	Antarctica	127.91	0.12791
67683	Catalina 272	H5	Chile	123	0.123
68245	Northwest Africa 12134	H5	Algeria	122.71	0.12271
66671	Dominion Range 14463	H5	Antarctica	122.65	0.12265
67523	Los Vientos 223	H5	Chile	120	0.12
68244	Northwest Africa 12133	H5	Algeria	119.15	0.11915
67380	Wood River	H5	Canada	118	0.118
68274	Northwest Africa 12163	H5	Algeria	117.44	0.11744
68340	Catalina 285	H5	Chile	117	0.117
68147	Northwest Africa 12036	H5	Algeria	116.48	0.11648
67452	Elephant Moraine 14036	H5	Antarctica	115.4	0.1154
67325	Asuka 12380	H5	Antarctica	114.53	0.11453
66829	Catalina 255	H5	Chile	112.1	0.1121
68269	Northwest Africa 12158	H5	Algeria	111.79	0.11179
68284	Northwest Africa 12173	H5	Algeria	109.91	0.10991
68277	Northwest Africa 12166	H5	Algeria	109.38	0.10938
67331	Asuka 12386	H5	Antarctica	100.73	0.10073
67993	Dominion Range 14439	H5	Antarctica	100.154	0.100154
68157	Northwest Africa 12046	H5	Algeria	99.9	0.0999
68190	Northwest Africa 12079	H5	Algeria	97.72	0.09772
67271	Asuka 12322	H5	Antarctica	97.43	0.09743
66673	Dominion Range 14465	H5	Antarctica	96.57	0.09657
67571	Northwest Africa 11816	H5	(Northwest Africa)	93	0.093
67666	Catalina 277	H5	Chile	92.3	0.0923
67467	Elephant Moraine 14052	H5	Antarctica	92.2	0.0922
67267	Asuka 12318	H5	Antarctica	91.71	0.09171
68151	Northwest Africa 12040	H5	Algeria	91.58	0.09158
66505	Northwest Africa 11689	H5	(Northwest Africa)	90	0.09
67177	Asuka 12220	H5	Antarctica	88.41	0.08841
68163	Northwest Africa 12052	H5	Algeria	85	0.085
67961	Dominion Range 14407	H5	Antarctica	84.25	0.08425
67460	Elephant Moraine 14044	H5	Antarctica	83	0.083
66574	Dominion Range 14186	H5	Antarctica	82.56	0.08256
67582	Northwest Africa 11826	H5	(Northwest Africa)	82.4	0.0824
66674	Dominion Range 14466	H5	Antarctica	82.15	0.08215
67138	Asuka 12024	H5	Antarctica	80.1	0.0801
67813	San Juan 089	H5	Chile	78	0.078
67137	Asuka 12021	H5	Antarctica	77.03	0.07703
67752	Northwest Africa 11926	H5	(Northwest Africa)	76	0.076
66819	El-Shaikh Fadl 010	H5	Egypt	75.7	0.0757

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66843	Dueodde	H5	Denmark	75	0.075
68175	Northwest Africa 12064	H5	Algeria	71.18	0.07118
68271	Northwest Africa 12160	H5	Algeria	70.68	0.07068
67158	Asuka 12091	H5	Antarctica	68.8	0.0688
68396	San Juan 101	H5	Chile	68.8	0.0688
67572	Kerman 204	H5	Iran	68.2	0.0682
68096	Elephant Moraine 16016	H5	Antarctica	67.903	0.067903
68174	Northwest Africa 12063	H5	Algeria	67.77	0.06777
67533	Catalina 269	H5	Chile	67	0.067
67686	San Juan 088	H5	Chile	66.6	0.0666
66817	El-Shaikh Fadl 008	H5	Egypt	66.5	0.0665
68305	Sierra Gorda 008	H5	Chile	66	0.066
67962	Dominion Range 14408	H5	Antarctica	63.981	0.063981
67755	Northwest Africa 11931	H5	(Northwest Africa)	63	0.063
68178	Northwest Africa 12067	H5	Algeria	62.14	0.06214
67217	Asuka 12266	H5	Antarctica	61.04	0.06104
68246	Northwest Africa 12135	H5	Algeria	61.04	0.06104
68373	Los Vientos 249	H5	Chile	61	0.061
67160	Asuka 12100	H5	Antarctica	60.88	0.06088
67392	Catalina 258	H5	Chile	60.4	0.0604
67722	Northwest Africa 11914	H5	(Northwest Africa)	60.4	0.0604
67455	Elephant Moraine 14039	H5	Antarctica	59.9	0.0599
66757	Northwest Africa 11659	H5	(Northwest Africa)	58.2	0.0582
24430	Yamato 74052	H5	Antarctica	58.18	0.05818
67222	Asuka 12271	H5	Antarctica	57.919	0.057919
66818	El-Shaikh Fadl 009	H5	Egypt	56.3	0.0563
68173	Northwest Africa 12062	H5	Algeria	56.26	0.05626
67293	Asuka 12347	H5	Antarctica	55.996	0.055996
67221	Asuka 12270	H5	Antarctica	55.421	0.055421
67721	Northwest Africa 11913	H5	(Northwest Africa)	54.7	0.0547
68342	Catalina 287	H5	Chile	54	0.054
67964	Dominion Range 14410	H5	Antarctica	53.889	0.053889
66503	Northwest Africa 11687	H5	(Northwest Africa)	52	0.052
67393	Catalina 259	H5	Chile	51	0.051
66516	Dominion Range 14035	H5	Antarctica	50.55	0.05055
67893	Dominion Range 14250	H5	Antarctica	49.702	0.049702
67583	Northwest Africa 11827	H5	(Northwest Africa)	49	0.049
68276	Northwest Africa 12165	H5	Algeria	48.16	0.04816
68213	Northwest Africa 12102	H5	Algeria	46.28	0.04628
68287	Northwest Africa 12176	H5	Algeria	46.03	0.04603
67427	Elephant Moraine 14010	H5	Antarctica	44.2	0.0442
67515	Los Vientos 219	H5	Chile	44	0.044
68166	Northwest Africa 12055	H5	Algeria	43.82	0.04382
68217	Northwest Africa 12106	H5	Algeria	43.74	0.04374
67998	Dominion Range 14473	H5	Antarctica	43.6	0.0436

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67669	Northwest Africa 11883	H5	(Northwest Af	43.3	0.0433
67262	Asuka 12312	H5	Antarctica	42.963	0.042963
67239	Asuka 12289	H5	Antarctica	42.112	0.042112
67327	Asuka 12382	H5	Antarctica	41.812	0.041812
68172	Northwest Africa 12061	H5	Algeria	41.5	0.0415
66520	Dominion Range 14039	H5	Antarctica	40.34	0.04034
67214	Asuka 12263	H5	Antarctica	40.074	0.040074
67457	Elephant Moraine 14041	H5	Antarctica	39	0.039
67311	Asuka 12366	H5	Antarctica	38.66	0.03866
66423	Northwest Africa 11623	H5	(Northwest Af	37.59	0.03759
68161	Northwest Africa 12050	H5	Algeria	36.93	0.03693
67528	Catalina 265	H5	Chile	36.9	0.0369
67229	Asuka 12278	H5	Antarctica	36.676	0.036676
68285	Northwest Africa 12174	H5	Algeria	36.34	0.03634
68067	Miller Range 15390	H5	Antarctica	36.15	0.03615
68029	Miller Range 15082	H5	Antarctica	35.858	0.035858
68423	Red Dry Lake 062	H5	United States	35.85	0.03585
67238	Asuka 12288	H5	Antarctica	35.503	0.035503
68211	Northwest Africa 12100	H5	Algeria	33	0.033
67897	Dominion Range 14254	H5	Antarctica	32.339	0.032339
68004	Dominion Range 14479	H5	Antarctica	31.43	0.03143
67250	Asuka 12300	H5	Antarctica	31.131	0.031131
68159	Northwest Africa 12048	H5	Algeria	30.78	0.03078
68254	Northwest Africa 12143	H5	Algeria	30.37	0.03037
68200	Northwest Africa 12089	H5	Algeria	30.1	0.0301
68065	Miller Range 15379	H5	Antarctica	29.798	0.029798
68219	Northwest Africa 12108	H5	Algeria	28.58	0.02858
68056	Miller Range 15370	H5	Antarctica	28.343	0.028343
68102	Grosvenor Mountains 17001	H5	Antarctica	28.215	0.028215
68202	Northwest Africa 12091	H5	Algeria	27.91	0.02791
67425	Elephant Moraine 14008	H5	Antarctica	27.3	0.0273
67527	Catalina 264	H5	Chile	27	0.027
68169	Northwest Africa 12058	H5	Algeria	27	0.027
67280	Asuka 12334	H5	Antarctica	26.762	0.026762
67895	Dominion Range 14252	H5	Antarctica	26.192	0.026192
66593	Dominion Range 14207	H5	Antarctica	26.03	0.02603
67426	Elephant Moraine 14009	H5	Antarctica	26	0.026
68165	Northwest Africa 12054	H5	Algeria	25.76	0.02576
68248	Northwest Africa 12137	H5	Algeria	25.32	0.02532
68374	Los Vientos 251	H5	Chile	25	0.025
67281	Asuka 12335	H5	Antarctica	23.504	0.023504
68063	Miller Range 15377	H5	Antarctica	23.306	0.023306
68012	Dominion Range 14497	H5	Antarctica	22.5	0.0225
68256	Northwest Africa 12145	H5	Algeria	22.3	0.0223
68171	Northwest Africa 12060	H5	Algeria	22.07	0.02207

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25607	Yamato 790258	H5	Antarctica	21.56	0.02156
67341	Asuka 12398	H5	Antarctica	21.206	0.021206
67975	Dominion Range 14421	H5	Antarctica	20.346	0.020346
67215	Asuka 12264	H5	Antarctica	20.238	0.020238
41340	Yamato 000575	H5	Antarctica	20.016	0.020016
67294	Asuka 12348	H5	Antarctica	19.819	0.019819
67911	Dominion Range 14268	H5	Antarctica	19.439	0.019439
67909	Dominion Range 14266	H5	Antarctica	19.055	0.019055
67987	Dominion Range 14433	H5	Antarctica	18.928	0.018928
67248	Asuka 12298	H5	Antarctica	18.887	0.018887
68389	San Juan 093	H5	Chile	18.1	0.0181
67898	Dominion Range 14255	H5	Antarctica	17.966	0.017966
67428	Elephant Moraine 14011	H5	Antarctica	17.2	0.0172
24438	Yamato 74060	H5	Antarctica	17.1	0.0171
68280	Northwest Africa 12169	H5	Algeria	16.94	0.01694
41620	Yamato 000858	H5	Antarctica	16.784	0.016784
68042	Miller Range 15096	H5	Antarctica	16.58	0.01658
68064	Miller Range 15378	H5	Antarctica	16.525	0.016525
68075	Miller Range 15398	H5	Antarctica	16.5	0.0165
67478	Elephant Moraine 14065	H5	Antarctica	16.3	0.0163
67516	Los Vientos 220	H5	Chile	16.2	0.0162
67242	Asuka 12292	H5	Antarctica	16.046	0.016046
67227	Asuka 12276	H5	Antarctica	15.868	0.015868
66860	Calate 013	H5	Chile	15.6	0.0156
68348	Catalina 293	H5	Chile	14	0.014
68059	Miller Range 15373	H5	Antarctica	13.786	0.013786
67917	Dominion Range 14294	H5	Antarctica	13.738	0.013738
41561	Yamato 000798	H5	Antarctica	12.943	0.012943
67279	Asuka 12333	H5	Antarctica	12.699	0.012699
67310	Asuka 12365	H5	Antarctica	12.362	0.012362
25541	Yamato 790192	H5	Antarctica	12.17	0.01217
66660	Dominion Range 14452	H5	Antarctica	11.99	0.01199
67906	Dominion Range 14263	H5	Antarctica	11.922	0.011922
68037	Miller Range 15091	H5	Antarctica	11.888	0.011888
66575	Dominion Range 14187	H5	Antarctica	11.78	0.01178
67904	Dominion Range 14261	H5	Antarctica	11.599	0.011599
68215	Northwest Africa 12104	H5	Algeria	11.58	0.01158
67330	Asuka 12385	H5	Antarctica	11.533	0.011533
68152	Northwest Africa 12041	H5	Algeria	11.35	0.01135
68206	Northwest Africa 12095	H5	Algeria	11.03	0.01103
68255	Northwest Africa 12144	H5	Algeria	10.93	0.01093
67470	Elephant Moraine 14057	H5	Antarctica	10.9	0.0109
68221	Northwest Africa 12110	H5	Algeria	10.88	0.01088
66662	Dominion Range 14454	H5	Antarctica	10.76	0.01076
41748	Yamato 000986	H5	Antarctica	10.62	0.01062

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67479	Elephant Moraine 14067	H5	Antarctica	10.5	0.0105
42770	Yamato 002008	H5	Antarctica	10.415	0.010415
66495	Calama 007	H5	Chile	10	0.01
67420	Elephant Moraine 14002	H5	Antarctica	10	0.01
68380	Los Vientos 257	H5	Chile	10	0.01
41008	Yamato 000243	H5	Antarctica	9.887	0.009887
41044	Yamato 000279	H5	Antarctica	9.852	0.009852
68205	Northwest Africa 12094	H5	Algeria	9.27	0.00927
67223	Asuka 12272	H5	Antarctica	9.268	0.009268
2422	Asuka 87065	H5	Antarctica	9.147	0.009147
41977	Yamato 001215	H5	Antarctica	9.063	0.009063
2438	Asuka 87081	H5	Antarctica	9.03	0.00903
68210	Northwest Africa 12099	H5	Algeria	8.84	0.00884
66614	Dominion Range 14248	H5	Antarctica	8.56	0.00856
67244	Asuka 12294	H5	Antarctica	8.519	0.008519
2430	Asuka 87073	H5	Antarctica	8.372	0.008372
66529	Dominion Range 14089	H5	Antarctica	8.3	0.0083
27919	Yamato 792570	H5	Antarctica	7.63	0.00763
41017	Yamato 000252	H5	Antarctica	7.63	0.00763
67320	Asuka 12375	H5	Antarctica	7.34	0.00734
40890	Yamato 000125	H5	Antarctica	6.878	0.006878
67525	Los Vientos 224	H5	Chile	6.4	0.0064
68536	Calama 021	H5	Chile	6.3	0.0063
42451	Yamato 001689	H5	Antarctica	6.218	0.006218
27921	Yamato 792572	H5	Antarctica	6.1	0.0061
27915	Yamato 792566	H5	Antarctica	6.08	0.00608
43558	Yamato 002796	H5	Antarctica	5.971	0.005971
27920	Yamato 792571	H5	Antarctica	5.14	0.00514
66982	Asuka 09347	H5	Antarctica	4.988	0.004988
42550	Yamato 001788	H5	Antarctica	4.769	0.004769
43837	Yamato 003075	H5	Antarctica	4.76	0.00476
41573	Yamato 000811	H5	Antarctica	4.758	0.004758
66979	Asuka 09344	H5	Antarctica	4.748	0.004748
42165	Yamato 001403	H5	Antarctica	4.554	0.004554
66908	Asuka 09253	H5	Antarctica	4.507	0.004507
66962	Asuka 09316	H5	Antarctica	4.475	0.004475
43782	Yamato 003020	H5	Antarctica	4.403	0.004403
66868	Asuka 09201	H5	Antarctica	4.394	0.004394
66923	Asuka 09277	H5	Antarctica	4.376	0.004376
41422	Yamato 000658	H5	Antarctica	4.289	0.004289
41507	Yamato 000743	H5	Antarctica	4.277	0.004277
67102	Asuka 09658	H5	Antarctica	4.244	0.004244
66871	Asuka 09204	H5	Antarctica	4.22	0.00422
43987	Yamato 003225	H5	Antarctica	4.189	0.004189
41400	Yamato 000636	H5	Antarctica	4.115	0.004115

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66869	Asuka 09202	H5	Antarctica	4.106	0.004106
41183	Yamato 000418	H5	Antarctica	4.041	0.004041
67099	Asuka 09655	H5	Antarctica	3.942	0.003942
66980	Asuka 09345	H5	Antarctica	3.931	0.003931
41131	Yamato 000366	H5	Antarctica	3.931	0.003931
66985	Asuka 09354	H5	Antarctica	3.922	0.003922
41531	Yamato 000768	H5	Antarctica	3.852	0.003852
43989	Yamato 003227	H5	Antarctica	3.833	0.003833
43850	Yamato 003088	H5	Antarctica	3.784	0.003784
44008	Yamato 003246	H5	Antarctica	3.756	0.003756
66667	Dominion Range 14459	H5	Antarctica	3.74	0.00374
67006	Asuka 09391	H5	Antarctica	3.725	0.003725
42733	Yamato 001971	H5	Antarctica	3.431	0.003431
66995	Asuka 09366	H5	Antarctica	3.411	0.003411
43874	Yamato 003112	H5	Antarctica	3.355	0.003355
66988	Asuka 09357	H5	Antarctica	3.315	0.003315
66999	Asuka 09378	H5	Antarctica	3.308	0.003308
67000	Asuka 09381	H5	Antarctica	3.235	0.003235
43498	Yamato 002736	H5	Antarctica	3.149	0.003149
67076	Asuka 09622	H5	Antarctica	3.148	0.003148
67440	Elephant Moraine 14024	H5	Antarctica	3.1	0.0031
36656	Yamato 980030	H5	Antarctica	2.898	0.002898
36839	Yamato 980213	H5	Antarctica	2.826	0.002826
66915	Asuka 09262	H5	Antarctica	2.754	0.002754
42062	Yamato 001300	H5	Antarctica	2.738	0.002738
66983	Asuka 09348	H5	Antarctica	2.712	0.002712
43793	Yamato 003031	H5	Antarctica	2.667	0.002667
66997	Asuka 09369	H5	Antarctica	2.619	0.002619
67008	Asuka 09393	H5	Antarctica	2.617	0.002617
67017	Asuka 09404	H5	Antarctica	2.617	0.002617
66938	Asuka 09292	H5	Antarctica	2.502	0.002502
66909	Asuka 09254	H5	Antarctica	2.494	0.002494
66910	Asuka 09256	H5	Antarctica	2.432	0.002432
66912	Asuka 09258	H5	Antarctica	2.335	0.002335
66969	Asuka 09326	H5	Antarctica	2.333	0.002333
67225	Asuka 12274	H5	Antarctica	2.267	0.002267
36932	Yamato 980306	H5	Antarctica	2.253	0.002253
66878	Asuka 09211	H5	Antarctica	2.223	0.002223
36695	Yamato 980069	H5	Antarctica	2.213	0.002213
66978	Asuka 09341	H5	Antarctica	2.13	0.00213
66981	Asuka 09346	H5	Antarctica	1.978	0.001978
67116	Asuka 09672	H5	Antarctica	1.912	0.001912
66885	Asuka 09218	H5	Antarctica	1.824	0.001824
67095	Asuka 09645	H5	Antarctica	1.793	0.001793
67053	Asuka 09487	H5	Antarctica	1.755	0.001755

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66948	Asuka 09302	H5	Antarctica	1.734	0.001734
67018	Asuka 09405	H5	Antarctica	1.722	0.001722
67009	Asuka 09394	H5	Antarctica	1.643	0.001643
67011	Asuka 09396	H5	Antarctica	1.623	0.001623
66966	Asuka 09322	H5	Antarctica	1.606	0.001606
66949	Asuka 09303	H5	Antarctica	1.6	0.0016
42890	Yamato 002128	H5	Antarctica	1.575	0.001575
67014	Asuka 09399	H5	Antarctica	1.532	0.001532
66887	Asuka 09220	H5	Antarctica	1.518	0.001518
66902	Asuka 09246	H5	Antarctica	1.443	0.001443
36906	Yamato 980280	H5	Antarctica	1.424	0.001424
41416	Yamato 000652	H5	Antarctica	1.424	0.001424
67015	Asuka 09400	H5	Antarctica	1.423	0.001423
66967	Asuka 09324	H5	Antarctica	1.42	0.00142
68092	Miller Range 15536	H5	Antarctica	1.41	0.00141
66947	Asuka 09301	H5	Antarctica	1.373	0.001373
66722	Miller Range 15277	H5	Antarctica	1.37	0.00137
68087	Miller Range 15531	H5	Antarctica	1.37	0.00137
67012	Asuka 09397	H5	Antarctica	1.367	0.001367
67033	Asuka 09438	H5	Antarctica	1.355	0.001355
67096	Asuka 09646	H5	Antarctica	1.335	0.001335
68089	Miller Range 15533	H5	Antarctica	1.31	0.00131
66883	Asuka 09216	H5	Antarctica	1.278	0.001278
66911	Asuka 09257	H5	Antarctica	1.278	0.001278
36669	Yamato 980043	H5	Antarctica	1.267	0.001267
66951	Asuka 09305	H5	Antarctica	1.194	0.001194
36660	Yamato 980034	H5	Antarctica	1.169	0.001169
67091	Asuka 09641	H5	Antarctica	1.157	0.001157
67264	Asuka 12314	H5	Antarctica	1.137	0.001137
42889	Yamato 002127	H5	Antarctica	1.108	0.001108
67417	Reckling Peak 14004	H5	Antarctica	1.1	0.0011
67090	Asuka 09640	H5	Antarctica	1.087	0.001087
67094	Asuka 09644	H5	Antarctica	1.086	0.001086
66886	Asuka 09219	H5	Antarctica	1.056	0.001056
67093	Asuka 09643	H5	Antarctica	1.04	0.00104
66888	Asuka 09221	H5	Antarctica	1.03	0.00103
66889	Asuka 09222	H5	Antarctica	1.02	0.00102
66954	Asuka 09308	H5	Antarctica	1.008	0.001008
36706	Yamato 980080	H5	Antarctica	0.994	0.000994
36784	Yamato 980158	H5	Antarctica	0.969	0.000969
67126	Asuka 10152	H5	Antarctica	0.957	0.000957
67036	Asuka 09449	H5	Antarctica	0.826	0.000826
67023	Asuka 09415	H5	Antarctica	0.82	0.00082
66953	Asuka 09307	H5	Antarctica	0.801	0.000801
68093	Miller Range 15538	H5	Antarctica	0.79	0.00079

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66952	Asuka 09306	H5	Antarctica	0.751	0.000751
42886	Yamato 002124	H5	Antarctica	0.694	0.000694
66737	Elephant Moraine 16211	H5	Antarctica	0.651	0.000651
42892	Yamato 002130	H5	Antarctica	0.644	0.000644
66891	Asuka 09224	H5	Antarctica	0.581	0.000581
42623	Yamato 001861	H5	Antarctica	0.578	0.000578
67092	Asuka 09642	H5	Antarctica	0.52	0.00052
67125	Asuka 10148	H5	Antarctica	0.507	0.000507
66958	Asuka 09312	H5	Antarctica	0.393	0.000393
42586	Yamato 001824	H5	Antarctica	0.385	0.000385
66890	Asuka 09223	H5	Antarctica	0.37	0.00037
43164	Yamato 002402	H5	Antarctica	0.35	0.00035
42740	Yamato 001978	H5	Antarctica	0.349	0.000349
67466	Elephant Moraine 14051	H5	Antarctica	0.3	0.0003
43621	Yamato 002859	H5	Antarctica	0.298	0.000298
67489	Beryozovka	H5-6	Kazakhstan	35650	35.65
67839	Metameur 012	H5-6	Tunisia	74.2	0.0742
67738	Paposo 040	H5-melt brecc	Chile	23300	23.3
67817	Northwest Africa 11920	H5-melt brecc	(Northwest Africa)	4	0.004
68345	Catalina 290	H5/6	Chile	544	0.544
67685	Los Vientos 229	H5/6	Chile	69.3	0.0693
68634	Gumu	H6	China	39000	39
32061	Northwest Africa 1088	H6	(Northwest Africa)	21000	21
67718	Northwest Africa 11903	H6	(Northwest Africa)	8000	8
66750	Northwest Africa 11652	H6	(Northwest Africa)	7674	7.674
67838	Northwest Africa 11995	H6	(Northwest Africa)	7210	7.21
45606	Northwest Africa 4667	H6	(Northwest Africa)	5000	5
68335	Catalina 280	H6	Chile	4370	4.37
67662	San Juan 087	H6	Chile	4210	4.21
68316	Coyote Dry Lake 349	H6	United States	4000	4
66437	Catalina 254	H6	Chile	2243	2.243
43816	Yamato 003054	H6	Antarctica	1712.9	1.7129
66504	Northwest Africa 11688	H6	(Northwest Africa)	1375	1.375
67505	Calama 010	H6	Chile	1248.18	1.24818
66751	Northwest Africa 11653	H6	(Northwest Africa)	1130	1.13
68369	Los Vientos 245	H6	Chile	1118	1.118
67175	Asuka 12216	H6	Antarctica	1043.3	1.0433
67606	Northwest Africa 11855	H6	(Northwest Africa)	980	0.98
68361	Los Vientos 237	H6	Chile	920	0.92
68548	Northwest Africa 12330	H6	(Northwest Africa)	915	0.915
68343	Catalina 288	H6	Chile	880	0.88
43106	Yamato 002344	H6	Antarctica	676.8	0.6768
68351	Catalina 296	H6	Chile	642	0.642
67488	Northwest Africa 11798	H6	(Northwest Africa)	510	0.51
67351	Asuka 12409	H6	Antarctica	496.69	0.49669

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31624	Northwest Africa 431	H6	(Northwest Af	492	0.492
68367	Los Vientos 243	H6	Chile	489	0.489
67861	Northwest Africa 12010	H6	(Northwest Af	483	0.483
67593	Diego de Almagro 001	H6	Chile	430	0.43
68364	Los Vientos 240	H6	Chile	310	0.31
67170	Asuka 12201	H6	Antarctica	286.05	0.28605
68645	Calama 023	H6	Chile	284.04	0.28404
68273	Northwest Africa 12162	H6	Algeria	281.64	0.28164
68216	Northwest Africa 12105	H6	Algeria	270.13	0.27013
68353	Catalina 298	H6	Chile	260	0.26
68498	Northwest Africa 12336	H6	(Northwest Af	258	0.258
68646	Calama 024	H6	Chile	252.95	0.25295
67297	Asuka 12351	H6	Antarctica	242.87	0.24287
66627	Dominion Range 14301	H6	Antarctica	211.53	0.21153
67866	Northwest Africa 12018	H6	(Northwest Af	192.43	0.19243
67536	Los Vientos 226	H6	Chile	182	0.182
68229	Northwest Africa 12118	H6	Algeria	178.49	0.17849
68282	Northwest Africa 12171	H6	Algeria	175.59	0.17559
68160	Northwest Africa 12049	H6	Algeria	172.94	0.17294
68199	Northwest Africa 12088	H6	Algeria	171.97	0.17197
68241	Northwest Africa 12130	H6	Algeria	169.77	0.16977
68195	Northwest Africa 12084	H6	Algeria	164.95	0.16495
67889	Dominion Range 14232	H6	Antarctica	161.46	0.16146
67308	Asuka 12363	H6	Antarctica	159.19	0.15919
68230	Northwest Africa 12119	H6	Algeria	147.97	0.14797
68362	Los Vientos 238	H6	Chile	140	0.14
67972	Dominion Range 14418	H6	Antarctica	134.868	0.134868
68250	Northwest Africa 12139	H6	Algeria	134.72	0.13472
68183	Northwest Africa 12072	H6	Algeria	128.72	0.12872
67371	Asuka 12429	H6	Antarctica	128.2	0.1282
68201	Northwest Africa 12090	H6	Algeria	118.4	0.1184
67970	Dominion Range 14416	H6	Antarctica	104.266	0.104266
67579	Northwest Africa 11823	H6	(Northwest Af	103.4	0.1034
68186	Northwest Africa 12075	H6	Algeria	101.97	0.10197
66563	Dominion Range 14175	H6	Antarctica	96.42	0.09642
68188	Northwest Africa 12077	H6	Algeria	89.17	0.08917
68290	Northwest Africa 12179	H6	Algeria	88.71	0.08871
67168	Asuka 12154	H6	Antarctica	87.71	0.08771
68158	Northwest Africa 12047	H6	Algeria	85.94	0.08594
66567	Dominion Range 14179	H6	Antarctica	83.13	0.08313
67295	Asuka 12349	H6	Antarctica	79.45	0.07945
68242	Northwest Africa 12131	H6	Algeria	77.52	0.07752
66600	Dominion Range 14224	H6	Antarctica	77.064	0.077064
67230	Asuka 12279	H6	Antarctica	72.98	0.07298
68240	Northwest Africa 12129	H6	Algeria	68.15	0.06815

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67220	Asuka 12269	H6	Antarctica	66.81	0.06681
67204	Asuka 12253	H6	Antarctica	66.05	0.06605
67959	Dominion Range 14405	H6	Antarctica	66.002	0.066002
67881	Dominion Range 14213	H6	Antarctica	63.269	0.063269
68156	Northwest Africa 12045	H6	Algeria	62.69	0.06269
68154	Northwest Africa 12043	H6	Algeria	61.61	0.06161
66546	Dominion Range 14126	H6	Antarctica	59.06	0.05906
68232	Northwest Africa 12121	H6	Algeria	58.55	0.05855
66747	Istifane 005	H6	Morocco	58	0.058
67207	Asuka 12256	H6	Antarctica	57.54	0.05754
68179	Northwest Africa 12068	H6	Algeria	56.63	0.05663
66568	Dominion Range 14180	H6	Antarctica	55.91	0.05591
68251	Northwest Africa 12140	H6	Algeria	55.7	0.0557
67253	Asuka 12303	H6	Antarctica	55.653	0.055653
67296	Asuka 12350	H6	Antarctica	54.004	0.054004
67240	Asuka 12290	H6	Antarctica	52.105	0.052105
68249	Northwest Africa 12138	H6	Algeria	51.66	0.05166
67150	Asuka 12044	H6	Antarctica	51.424	0.051424
66706	Dominion Range 14539	H6	Antarctica	49.54	0.04954
66507	Northwest Africa 11691	H6	Mali	49	0.049
68055	Miller Range 15357	H6	Antarctica	48.785	0.048785
66569	Dominion Range 14181	H6	Antarctica	44.96	0.04496
66597	Dominion Range 14221	H6	Antarctica	44.183	0.044183
68198	Northwest Africa 12087	H6	Algeria	44.15	0.04415
67862	Northwest Africa 12014	H6	(Northwest Africa)	43	0.043
66533	Dominion Range 14103	H6	Antarctica	42.312	0.042312
67759	Northwest Africa 11938	H6	(Northwest Africa)	41.9	0.0419
66540	Dominion Range 14120	H6	Antarctica	41.44	0.04144
67992	Dominion Range 14438	H6	Antarctica	41.315	0.041315
67520	Catalina 261	H6	Chile	41	0.041
68214	Northwest Africa 12103	H6	Algeria	40.22	0.04022
68197	Northwest Africa 12086	H6	Algeria	39.77	0.03977
68164	Northwest Africa 12053	H6	Algeria	37.84	0.03784
68053	Miller Range 15258	H6	Antarctica	36.636	0.036636
66425	Northwest Africa 11625	H6	(Northwest Africa)	36.41	0.03641
67205	Asuka 12254	H6	Antarctica	35.441	0.035441
68076	Miller Range 15399	H6	Antarctica	34.51	0.03451
67485	Mount DeWitt 14001	H6	Antarctica	33.7	0.0337
68071	Miller Range 15394	H6	Antarctica	32.9	0.0329
30183	Yamato 86677	H6	Antarctica	31.81	0.03181
66580	Dominion Range 14194	H6	Antarctica	31.703	0.031703
66654	Dominion Range 14396	H6	Antarctica	31.64	0.03164
68035	Miller Range 15089	H6	Antarctica	30.965	0.030965
68034	Miller Range 15088	H6	Antarctica	30.538	0.030538
66541	Dominion Range 14121	H6	Antarctica	30.48	0.03048

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67715	Northwest Africa 11879	H6	(Northwest Africa)	28.95	0.02895
67031	Asuka 09430	H6	Antarctica	28.836	0.028836
67252	Asuka 12302	H6	Antarctica	28.816	0.028816
66514	Dominion Range 14033	H6	Antarctica	28.24	0.02824
66855	Yucca 051	H6	United States	27.8	0.0278
68068	Miller Range 15391	H6	Antarctica	27.79	0.02779
67257	Asuka 12307	H6	Antarctica	27.789	0.027789
67210	Asuka 12259	H6	Antarctica	27.728	0.027728
67322	Asuka 12377	H6	Antarctica	27.619	0.027619
68030	Miller Range 15083	H6	Antarctica	27.598	0.027598
67234	Asuka 12283	H6	Antarctica	26.259	0.026259
27209	Yamato 791860	H6	Antarctica	25.16	0.02516
67290	Asuka 12344	H6	Antarctica	24.638	0.024638
66519	Dominion Range 14038	H6	Antarctica	24.49	0.02449
67976	Dominion Range 14422	H6	Antarctica	24.271	0.024271
68176	Northwest Africa 12065	H6	Algeria	23.78	0.02378
67901	Dominion Range 14258	H6	Antarctica	23.193	0.023193
67287	Asuka 12341	H6	Antarctica	22.842	0.022842
66653	Dominion Range 14395	H6	Antarctica	22.53	0.02253
68069	Miller Range 15392	H6	Antarctica	22.48	0.02248
66610	Dominion Range 14244	H6	Antarctica	22.43	0.02243
67899	Dominion Range 14256	H6	Antarctica	21.926	0.021926
67251	Asuka 12301	H6	Antarctica	21.476	0.021476
68072	Miller Range 15395	H6	Antarctica	21.45	0.02145
68204	Northwest Africa 12093	H6	Algeria	21.21	0.02121
68039	Miller Range 15093	H6	Antarctica	21.073	0.021073
67283	Asuka 12337	H6	Antarctica	20.892	0.020892
67483	Elephant Moraine 14072	H6	Antarctica	20.2	0.0202
66647	Dominion Range 14379	H6	Antarctica	19.894	0.019894
67198	Asuka 12247	H6	Antarctica	19.25	0.01925
67984	Dominion Range 14430	H6	Antarctica	18.95	0.01895
66609	Dominion Range 14243	H6	Antarctica	18.58	0.01858
66590	Dominion Range 14204	H6	Antarctica	18.46	0.01846
68225	Northwest Africa 12114	H6	Algeria	17.97	0.01797
68074	Miller Range 15397	H6	Antarctica	17.9	0.0179
68047	Miller Range 15252	H6	Antarctica	17.858	0.017858
66716	Dominion Range 14559	H6	Antarctica	17.54	0.01754
68043	Miller Range 15097	H6	Antarctica	16.096	0.016096
67908	Dominion Range 14265	H6	Antarctica	15.701	0.015701
67211	Asuka 12260	H6	Antarctica	15.69	0.01569
66603	Dominion Range 14227	H6	Antarctica	15.45	0.01545
67228	Asuka 12277	H6	Antarctica	14.953	0.014953
66578	Dominion Range 14191	H6	Antarctica	14.95	0.01495
68073	Miller Range 15396	H6	Antarctica	14.63	0.01463
67231	Asuka 12280	H6	Antarctica	14.619	0.014619

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68193	Northwest Africa 12082	H6	Algeria	14.56	0.01456
68346	Catalina 291	H6	Chile	14	0.014
67950	Dominion Range 14357	H6	Antarctica	13.987	0.013987
68220	Northwest Africa 12109	H6	Algeria	13.96	0.01396
66710	Dominion Range 14553	H6	Antarctica	13.47	0.01347
66639	Dominion Range 14364	H6	Antarctica	13.367	0.013367
68058	Miller Range 15372	H6	Antarctica	12.891	0.012891
68041	Miller Range 15095	H6	Antarctica	12.489	0.012489
68048	Miller Range 15253	H6	Antarctica	11.99	0.01199
67949	Dominion Range 14356	H6	Antarctica	11.982	0.011982
68051	Miller Range 15256	H6	Antarctica	11.18	0.01118
68045	Miller Range 15250	H6	Antarctica	11.156	0.011156
67268	Asuka 12319	H6	Antarctica	10.865	0.010865
68243	Northwest Africa 12132	H6	Algeria	10.82	0.01082
43110	Yamato 002348	H6	Antarctica	10.288	0.010288
66613	Dominion Range 14247	H6	Antarctica	10.02	0.01002
27904	Yamato 792555	H6	Antarctica	9.97	0.00997
2420	Asuka 87063	H6	Antarctica	9.636	0.009636
67288	Asuka 12342	H6	Antarctica	9.597	0.009597
2417	Asuka 87060	H6	Antarctica	9.078	0.009078
2658	Asuka 87301	H6	Antarctica	9.055	0.009055
66659	Dominion Range 14451	H6	Antarctica	9.03	0.00903
2459	Asuka 87102	H6	Antarctica	8.995	0.008995
67285	Asuka 12339	H6	Antarctica	8.963	0.008963
66605	Dominion Range 14229	H6	Antarctica	8.777	0.008777
2381	Asuka 87024	H6	Antarctica	8.651	0.008651
68238	Northwest Africa 12127	H6	Algeria	7.89	0.00789
66582	Dominion Range 14196	H6	Antarctica	7.539	0.007539
67161	Asuka 12108	H6	Antarctica	7.233	0.007233
68350	Catalina 295	H6	Chile	7	0.007
36686	Yamato 980060	H6	Antarctica	6.974	0.006974
43435	Yamato 002673	H6	Antarctica	6.818	0.006818
67241	Asuka 12291	H6	Antarctica	6.694	0.006694
67258	Asuka 12308	H6	Antarctica	6.345	0.006345
43787	Yamato 003025	H6	Antarctica	6.215	0.006215
66615	Dominion Range 14249	H6	Antarctica	5.61	0.00561
68258	Northwest Africa 12147	H6	Algeria	5.36	0.00536
67444	Elephant Moraine 14028	H6	Antarctica	5	0.005
40962	Yamato 000197	H6	Antarctica	4.957	0.004957
43916	Yamato 003154	H6	Antarctica	4.913	0.004913
66986	Asuka 09355	H6	Antarctica	4.902	0.004902
43105	Yamato 002343	H6	Antarctica	4.726	0.004726
43942	Yamato 003180	H6	Antarctica	4.704	0.004704
43890	Yamato 003128	H6	Antarctica	4.665	0.004665
66867	Asuka 09200	H6	Antarctica	4.629	0.004629

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42405	Yamato 001643	H6	Antarctica	4.533	0.004533
43845	Yamato 003083	H6	Antarctica	4.532	0.004532
66987	Asuka 09356	H6	Antarctica	4.524	0.004524
66991	Asuka 09361	H6	Antarctica	4.492	0.004492
68044	Miller Range 15098	H6	Antarctica	4.436	0.004436
66998	Asuka 09376	H6	Antarctica	4.272	0.004272
43780	Yamato 003018	H6	Antarctica	4.25	0.00425
66897	Asuka 09232	H6	Antarctica	4.217	0.004217
67462	Elephant Moraine 14046	H6	Antarctica	4.2	0.0042
68257	Northwest Africa 12146	H6	Algeria	4.16	0.00416
66989	Asuka 09358	H6	Antarctica	4.153	0.004153
67235	Asuka 12284	H6	Antarctica	4.077	0.004077
43915	Yamato 003153	H6	Antarctica	4.057	0.004057
67038	Asuka 09451	H6	Antarctica	4.056	0.004056
43939	Yamato 003177	H6	Antarctica	3.942	0.003942
41286	Yamato 000521	H6	Antarctica	3.926	0.003926
43798	Yamato 003036	H6	Antarctica	3.897	0.003897
41059	Yamato 000294	H6	Antarctica	3.895	0.003895
67051	Asuka 09483	H6	Antarctica	3.854	0.003854
43896	Yamato 003134	H6	Antarctica	3.83	0.00383
40950	Yamato 000185	H6	Antarctica	3.787	0.003787
66870	Asuka 09203	H6	Antarctica	3.565	0.003565
43007	Yamato 002245	H6	Antarctica	3.56	0.00356
43926	Yamato 003164	H6	Antarctica	3.504	0.003504
67237	Asuka 12286	H6	Antarctica	3.327	0.003327
67286	Asuka 12340	H6	Antarctica	3.316	0.003316
36882	Yamato 980256	H6	Antarctica	3.288	0.003288
43906	Yamato 003144	H6	Antarctica	3.166	0.003166
43947	Yamato 003185	H6	Antarctica	3.152	0.003152
66990	Asuka 09360	H6	Antarctica	3.084	0.003084
43935	Yamato 003173	H6	Antarctica	3.037	0.003037
36850	Yamato 980224	H6	Antarctica	2.999	0.002999
36752	Yamato 980126	H6	Antarctica	2.982	0.002982
41284	Yamato 000519	H6	Antarctica	2.935	0.002935
66872	Asuka 09205	H6	Antarctica	2.854	0.002854
67007	Asuka 09392	H6	Antarctica	2.791	0.002791
41332	Yamato 000567	H6	Antarctica	2.755	0.002755
43747	Yamato 002985	H6	Antarctica	2.699	0.002699
66993	Asuka 09363	H6	Antarctica	2.642	0.002642
68259	Northwest Africa 12148	H6	Algeria	2.62	0.00262
67003	Asuka 09385	H6	Antarctica	2.603	0.002603
67474	Elephant Moraine 14061	H6	Antarctica	2.6	0.0026
66875	Asuka 09208	H6	Antarctica	2.588	0.002588
66873	Asuka 09206	H6	Antarctica	2.522	0.002522
66992	Asuka 09362	H6	Antarctica	2.462	0.002462

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36844	Yamato 980218	H6	Antarctica	2.453	0.002453
66879	Asuka 09212	H6	Antarctica	2.379	0.002379
66880	Asuka 09213	H6	Antarctica	2.286	0.002286
66874	Asuka 09207	H6	Antarctica	2.179	0.002179
43898	Yamato 003136	H6	Antarctica	2.137	0.002137
66994	Asuka 09364	H6	Antarctica	2.136	0.002136
67456	Elephant Moraine 14040	H6	Antarctica	2.1	0.0021
67039	Asuka 09454	H6	Antarctica	2.047	0.002047
66973	Asuka 09335	H6	Antarctica	2.041	0.002041
66877	Asuka 09210	H6	Antarctica	1.928	0.001928
66876	Asuka 09209	H6	Antarctica	1.799	0.001799
66884	Asuka 09217	H6	Antarctica	1.753	0.001753
67475	Elephant Moraine 14062	H6	Antarctica	1.7	0.0017
67037	Asuka 09450	H6	Antarctica	1.65	0.00165
36764	Yamato 980138	H6	Antarctica	1.616	0.001616
66881	Asuka 09214	H6	Antarctica	1.59	0.00159
36627	Yamato 980001	H6	Antarctica	1.551	0.001551
66882	Asuka 09215	H6	Antarctica	1.521	0.001521
36811	Yamato 980185	H6	Antarctica	1.503	0.001503
66974	Asuka 09336	H6	Antarctica	1.46	0.00146
68088	Miller Range 15532	H6	Antarctica	1.45	0.00145
67025	Asuka 09418	H6	Antarctica	1.386	0.001386
66723	Miller Range 15292	H6	Antarctica	1.37	0.00137
66721	Miller Range 15272	H6	Antarctica	1.36	0.00136
67301	Asuka 12356	H6	Antarctica	1.33	0.00133
66893	Asuka 09227	H6	Antarctica	1.32	0.00132
67464	Elephant Moraine 14048	H6	Antarctica	1.3	0.0013
67476	Elephant Moraine 14063	H6	Antarctica	1.3	0.0013
68078	Miller Range 15417	H6	Antarctica	1.2	0.0012
36937	Yamato 980311	H6	Antarctica	1.188	0.001188
66718	Miller Range 15153	H6	Antarctica	1.16	0.00116
67458	Elephant Moraine 14042	H6	Antarctica	1.1	0.0011
66743	Elephant Moraine 16218	H6	Antarctica	1.071	0.001071
66732	Elephant Moraine 16206	H6	Antarctica	1.06	0.00106
36821	Yamato 980195	H6	Antarctica	1.044	0.001044
66739	Elephant Moraine 16214	H6	Antarctica	1.037	0.001037
67124	Asuka 10144	H6	Antarctica	0.983	0.000983
66905	Asuka 09250	H6	Antarctica	0.92	0.00092
67026	Asuka 09419	H6	Antarctica	0.919	0.000919
66744	Elephant Moraine 16219	H6	Antarctica	0.889	0.000889
36957	Yamato 980332	H6	Antarctica	0.832	0.000832
66742	Elephant Moraine 16217	H6	Antarctica	0.813	0.000813
67482	Elephant Moraine 14071	H6	Antarctica	0.8	0.0008
66970	Asuka 09330	H6	Antarctica	0.775	0.000775
43860	Yamato 003098	H6	Antarctica	0.774	0.000774

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68085	Miller Range 15477	H6	Antarctica	0.76	0.00076
36971	Yamato 980346	H6	Antarctica	0.674	0.000674
66741	Elephant Moraine 16216	H6	Antarctica	0.672	0.000672
43929	Yamato 003167	H6	Antarctica	0.658	0.000658
66735	Elephant Moraine 16209	H6	Antarctica	0.628	0.000628
66975	Asuka 09337	H6	Antarctica	0.624	0.000624
67024	Asuka 09417	H6	Antarctica	0.555	0.000555
43932	Yamato 003170	H6	Antarctica	0.542	0.000542
68086	Miller Range 15478	H6	Antarctica	0.54	0.00054
68082	Miller Range 15432	H6	Antarctica	0.53	0.00053
66740	Elephant Moraine 16215	H6	Antarctica	0.522	0.000522
66731	Elephant Moraine 16205	H6	Antarctica	0.456	0.000456
43899	Yamato 003137	H6	Antarctica	0.437	0.000437
43104	Yamato 002342	H6	Antarctica	0.405	0.000405
68090	Miller Range 15534	H6	Antarctica	0.39	0.00039
43341	Yamato 002579	H6	Antarctica	0.323	0.000323
43613	Yamato 002851	H6	Antarctica	0.311	0.000311
43913	Yamato 003151	H6	Antarctica	0.271	0.000271
66892	Asuka 09225	H6	Antarctica	0.244	0.000244
68080	Miller Range 15430	H6	Antarctica	0.17	0.00017
66471	Northwest Africa 11613	H7	(Northwest Africa)	354	0.354
68481	Northwest Africa 12236	H7	Morocco	21.03	0.02103
67785	Northwest Africa 11899	Howardite	Mali	16000	16
68600	Northwest Africa 12227	Howardite	Algeria	1780	1.78
68291	Northwest Africa 11964	Howardite	(Northwest Africa)	1250	1.25
68412	Northwest Africa 12190	Howardite	Western Sahara	1146.5	1.1465
68632	Twayla 001	Howardite	Western Sahara	500	0.5
66813	Northwest Africa 11712	Howardite	(Northwest Africa)	500	0.5
67656	Northwest Africa 11858	Howardite	Morocco	453.5	0.4535
66383	Northwest Africa 11551	Howardite	Mauritania	446.9	0.4469
68421	Northwest Africa 12203	Howardite	Algeria	293	0.293
66470	Northwest Africa 11612	Howardite	(Northwest Africa)	274	0.274
68474	Northwest Africa 12224	Howardite	(Northwest Africa)	230	0.23
68488	Northwest Africa 12194	Howardite	Algeria	85.1	0.0851
68496	Northwest Africa 12250	Howardite	(Northwest Africa)	42.7	0.0427
67870	Northwest Africa 11997	Howardite	Morocco	30.2	0.0302
67640	Northwest Africa 11834	Howardite	(Northwest Africa)	15	0.015
68601	Northwest Africa 12231	Howardite	(Northwest Africa)	13	0.013
66455	Northwest Africa 11598	Howardite	Algeria	3.9	0.0039
66462	Northwest Africa 11605	Howardite	Algeria	2.13	0.00213
66461	Northwest Africa 11604	Howardite	Algeria	2.04	0.00204
66463	Northwest Africa 11606	Howardite	Algeria	1.71	0.00171
67872	Grosvenor Mountains 17102	Iron, IAB com	Antarctica	4959.5	4.9595
67871	Grosvenor Mountains 17051	Iron, IAB com	Antarctica	2805.95	2.80595
67625	Nova 027	Iron, IAB-MG (unknown)		120000	120

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67621	Northwest Africa 11859	Iron, IAB-MG(Northwest Africa)	78000	78
67628	Nova 021	Iron, IAB-MG (unknown)	62000	62
67855	Sauceda de la Borda	Iron, IAB-MG Mexico	41000	41
67627	Nova 026	Iron, IAB-MG (unknown)	18200	18.2
66486	Northwest Africa 11649	Iron, IAB-MG Morocco	17400	17.4
67608	Entrèves	Iron, IAB-MG Italy	17300	17.3
66476	Nagara	Iron, IAB-MG Japan	16243	16.243
67837	Yuli	Iron, IAB-MG China	10000	10
67676	Nova 025	Iron, IAB-MG (unknown)	9370	9.37
67731	Nova 028	Iron, IAB-MG (unknown)	3530	3.53
67622	Nova 022	Iron, IAB-MG (unknown)	2150	2.15
67626	Elmore County	Iron, IAB-MG United States	578	0.578
67620	Nova 020	Iron, IAB-MG (unknown)	538	0.538
67623	Nova 023	Iron, IAB-MG (unknown)	537	0.537
67624	Nova 024	Iron, IAB-MG (unknown)	110	0.11
66428	Northwest Africa 11577	Iron, IAB-sHL Morocco	86	0.086
66478	Northwest Africa 11637	Iron, IIAB Morocco	4368	4.368
68314	Northwest Africa 12000	Iron, IIAB Morocco	225	0.225
67806	Caçapava do Sul	Iron, IID Brazil	27000	27
67601	Sokoto	Iron, IIIAB Nigeria	30000	30
67381	Dahongliuxia	Iron, IIIAB China	15600	15.6
67851	Ilafeqh 018	Iron, IIIAB Algeria	11100	11.1
68465	Bañobárez	Iron, IIIAB Spain	132	0.132
66724	Elephant Moraine 16045	Iron, IIIAB Antarctica	105.047	0.105047
67382	Alatage Mountain 043	Iron, IVB China	9800	9.8
66792	Jeminay	Iron, ungroup China	6427	6.427
67873	Grosvenor Mountains 17195	Iron, ungroup Antarctica	75.77	0.07577
66545	Dominion Range 14125	L-imp melt Antarctica	71.31	0.07131
67712	Northwest Africa 11832	L-melt rock (Northwest Africa)	290	0.29
68501	Nanbaxian 001	L~4 China	3784	3.784
68533	Ganq 003	L~5 China	2200	2.2
68434	Northwest Africa 12297	L~5 (Northwest Africa)	110.5	0.1105
68500	Da Qaidam 001	L~6 China	17500	17.5
68523	Ganq 002	L~6 China	5340	5.34
68522	Ganq 001	L~6 China	3907	3.907
66399	Northwest Africa 11581	L~6 (Northwest Africa)	2076	2.076
68650	Hoboksar 001	L~6 China	1500	1.5
68652	Turpan 001	L~6 China	1500	1.5
68649	Dunhuang 001	L~6 China	1427	1.427
66395	Northwest Africa 11578	L~6 (Northwest Africa)	983.6	0.9836
68430	Hami 008	L~6 China	589.4	0.5894
66400	Northwest Africa 11582	L~6 Mauritania	564.5	0.5645
68499	Weiya 001	L~6 China	201	0.201
68439	Xinjiang 011	L~6 China	89.5	0.0895
68432	Xinjiang 009	L~6 China	60.3	0.0603

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3	68657	Northwest Africa 12381	L~6	(Northwest Af	21.7	0.0217
4	67799	Aba Panu	L3	Nigeria	160000	160
5	67486	Northwest Africa 11782	L3	Mali	25700	25.7
6	66774	Northwest Africa 11722	L3	(Northwest Af	7210	7.21
7	68424	Northwest Africa 12285	L3	(Northwest Af	4710	4.71
8	68297	Northwest Africa 11994	L3	(Northwest Af	2160	2.16
9	68482	Northwest Africa 12324	L3	(Northwest Af	1840	1.84
10	68551	Northwest Africa 12331	L3	(Northwest Af	753	0.753
11	68640	Northwest Africa 12341	L3	(Northwest Af	719	0.719
12	67667	Northwest Africa 11881	L3	(Northwest Af	590	0.59
13	66435	Northwest Africa 11634	L3	(Northwest Af	527	0.527
14	66436	Northwest Africa 11635	L3	(Northwest Af	505	0.505
15	67585	Northwest Africa 11802	L3	(Northwest Af	446.5	0.4465
16	67171	Asuka 12205	L3	Antarctica	400.95	0.40095
17	51835	Northwest Africa 6263	L3	(Northwest Af	347	0.347
18	66490	Northwest Africa 11672	L3	(Northwest Af	282	0.282
19	67560	Northwest Africa 11796	L3	(Northwest Af	233	0.233
20	66409	San Juan de Allende	L3	Mexico	200	0.2
21	67761	Northwest Africa 11940	L3	(Northwest Af	180	0.18
22	66781	Northwest Africa 11735	L3	(Northwest Af	163	0.163
23	67135	Asuka 12018	L3	Antarctica	157.98	0.15798
24	66765	Northwest Africa 11713	L3	(Northwest Af	80	0.08
25	66766	Northwest Africa 11714	L3	(Northwest Af	75	0.075
26	66782	Northwest Africa 11736	L3	(Northwest Af	71.3	0.0713
27	67751	Northwest Africa 11925	L3	(Northwest Af	67	0.067
28	67611	Northwest Africa 11829	L3	(Northwest Af	52	0.052
29	67612	Northwest Africa 11835	L3	(Northwest Af	42.5	0.0425
30	32398	Northwest Africa 1723	L3	Morocco	28	0.028
31	66431	Northwest Africa 11630	L3	(Northwest Af	18	0.018
32	67434	Elephant Moraine 14018	L3	Antarctica	5.7	0.0057
33	67001	Asuka 09383	L3	Antarctica	5.694	0.005694
34	67027	Asuka 09420	L3	Antarctica	4.489	0.004489
35	66963	Asuka 09319	L3	Antarctica	3.979	0.003979
36	41494	Yamato 000730	L3	Antarctica	3.714	0.003714
37	43805	Yamato 003043	L3	Antarctica	3.434	0.003434
38	43990	Yamato 003228	L3	Antarctica	3.302	0.003302
39	67075	Asuka 09621	L3	Antarctica	3.033	0.003033
40	67028	Asuka 09422	L3	Antarctica	2.927	0.002927
41	66920	Asuka 09271	L3	Antarctica	2.156	0.002156
42	67128	Asuka 10214	L3	Antarctica	2.003	0.002003
43	66913	Asuka 09259	L3	Antarctica	1.689	0.001689
44	67061	Asuka 09555	L3	Antarctica	1.611	0.001611
45	66918	Asuka 09266	L3	Antarctica	1.475	0.001475
46	66914	Asuka 09260	L3	Antarctica	1.47	0.00147
47	67029	Asuka 09423	L3	Antarctica	1.458	0.001458

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66906	Asuka 09251	L3	Antarctica	1.044	0.001044
31849	Northwest Africa 787	L3-6	(Northwest Africa)	30000	30
68293	Northwest Africa 11978	L3-6	(Northwest Africa)	1159	1.159
67819	Northwest Africa 11922	L3-6	(Northwest Africa)	138	0.138
66410	Northwest Africa 11574	L3.10	(Northwest Africa)	750	0.75
66544	Dominion Range 14124	L3.5	Antarctica	58.55	0.05855
66587	Dominion Range 14201	L3.6	Antarctica	16.8	0.0168
66522	Dominion Range 14082	L3.6	Antarctica	9.29	0.00929
66601	Dominion Range 14225	L3.8	Antarctica	71.004	0.071004
67670	Northwest Africa 11884	L4	Morocco	8015	8.015
68655	Gueltat Zemmour	L4	Morocco	8000	8
67629	Northwest Africa 11872	L4	(Northwest Africa)	6220	6.22
66777	Northwest Africa 11725	L4	(Northwest Africa)	2703	2.703
68513	Northwest Africa 12348	L4	Morocco	2347.5	2.3475
66780	Northwest Africa 11728	L4	(Northwest Africa)	2157	2.157
66491	Northwest Africa 11674	L4	(Northwest Africa)	1536	1.536
66493	Northwest Africa 11678	L4	(Northwest Africa)	1110	1.11
32064	Northwest Africa 1091	L4	(Northwest Africa)	850	0.85
68337	Catalina 282	L4	Chile	556	0.556
67767	Northwest Africa 11959	L4	(Northwest Africa)	519.3	0.5193
68136	Northwest Africa 12025	L4	Algeria	362.15	0.36215
67469	Elephant Moraine 14055	L4	Antarctica	361	0.361
68231	Northwest Africa 12120	L4	Algeria	355.04	0.35504
66509	Northwest Africa 11693	L4	(Northwest Africa)	330	0.33
67316	Asuka 12371	L4	Antarctica	189.62	0.18962
67573	Northwest Africa 11817	L4	(Northwest Africa)	188.1	0.1881
66498	Northwest Africa 11682	L4	(Northwest Africa)	163	0.163
67323	Asuka 12378	L4	Antarctica	160.6	0.1606
66758	Northwest Africa 11660	L4	(Northwest Africa)	158	0.158
32072	Northwest Africa 1099	L4	(Northwest Africa)	140	0.14
66672	Dominion Range 14464	L4	Antarctica	123.57	0.12357
67836	Northwest Africa 11986	L4	(Northwest Africa)	105.4	0.1054
67145	Asuka 12037	L4	Antarctica	77.45	0.07745
67655	Northwest Africa 11878	L4	(Northwest Africa)	75.52	0.07552
67148	Asuka 12042	L4	Antarctica	74.44	0.07444
66675	Dominion Range 14467	L4	Antarctica	68.81	0.06881
67615	Northwest Africa 11864	L4	(Northwest Africa)	65.31	0.06531
67996	Dominion Range 14471	L4	Antarctica	44.84	0.04484
66512	Dominion Range 14031	L4	Antarctica	41.66	0.04166
66677	Dominion Range 14469	L4	Antarctica	37.31	0.03731
66828	Sayh al Uhaymir 605	L4	Oman	26.24	0.02624
66513	Dominion Range 14032	L4	Antarctica	25.37	0.02537
66786	MacKay Glacier 14006	L4	Antarctica	15.7	0.0157
67618	Northwest Africa 11869	L4	(Northwest Africa)	15.66	0.01566
67317	Asuka 12372	L4	Antarctica	14.872	0.014872

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66691	Dominion Range 14523	L4	Antarctica	14.49	0.01449
67256	Asuka 12306	L4	Antarctica	12.826	0.012826
67291	Asuka 12345	L4	Antarctica	8.93	0.00893
67200	Asuka 12249	L4	Antarctica	6.787	0.006787
44107	Yamato 003345	L4	Antarctica	4.566	0.004566
41092	Yamato 000327	L4	Antarctica	4.466	0.004466
66971	Asuka 09332	L4	Antarctica	4.382	0.004382
42126	Yamato 001364	L4	Antarctica	4.17	0.00417
44131	Yamato 003369	L4	Antarctica	3.905	0.003905
41139	Yamato 000374	L4	Antarctica	3.751	0.003751
41159	Yamato 000394	L4	Antarctica	3.715	0.003715
44133	Yamato 003371	L4	Antarctica	2.716	0.002716
44112	Yamato 003350	L4	Antarctica	2.173	0.002173
67059	Asuka 09544	L4	Antarctica	1.335	0.001335
36659	Yamato 980033	L4	Antarctica	1.272	0.001272
66789	MacKay Glacier 14018	L4	Antarctica	0.5	0.0005
66726	Elephant Moraine 16197	L4	Antarctica	0.498	0.000498
68122	Nova 054	L4-6	(Unknown)		
68328	Northwest Africa 12181	L4-melt brecc	(Northwest Africa)	930	0.93
66778	Northwest Africa 11726	L4/5	(Northwest Africa)	4470	4.47
67663	Caleta el Cobre 023	L4/5	Chile	1500	1.5
66416	Northwest Africa 11609	L4/5	(Northwest Africa)	253	0.253
66427	Northwest Africa 11627	L4/5	(Northwest Africa)	68.82	0.06882
66407	Northwest Africa 11584	L5	(Northwest Africa)	56970	56.97
68383	Paposo 045	L5	Chile	13245	13.245
68511	Northwest Africa 12346	L5	Morocco	12600	12.6
66442	Realicó	L5	Argentina	12000	12
66827	Los Vientos 213	L5	Chile	7935	7.935
68480	Northwest Africa 12301	L5	(Northwest Africa)	7500	7.5
68633	Wuerhe	L5	China	6000	6
68382	Paposo 044	L5	Chile	5458	5.458
66779	Northwest Africa 11727	L5	(Northwest Africa)	3620	3.62
67386	El Médano 381	L5	Chile	3485	3.485
68320	Northwest Africa 12238	L5	(Northwest Africa)	2491.2	2.4912
68540	Sayh al Uhaymir 607	L5	Oman	2452	2.452
67713	Ngare Sero	L5	Tanzania	2233	2.233
66826	El Médano 378	L5	Chile	2201	2.201
67605	Northwest Africa 11847	L5	(Northwest Africa)	2098	2.098
68426	Northwest Africa 12292	L5	(Northwest Africa)	1957	1.957
32068	Northwest Africa 1095	L5	(Northwest Africa)	1800	1.8
66841	Northwest Africa 11744	L5	(Northwest Africa)	1566.1	1.5661
66775	Northwest Africa 11723	L5	(Northwest Africa)	1522	1.522
68521	Northwest Africa 11980	L5	(Northwest Africa)	1370	1.37
67841	Chug Chug 004	L5	Chile	1080	1.08
67506	Sierra Gorda 001	L5	Chile	1013	1.013

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68598	Karimati	L5	India	930	0.93
67484	Elephant Moraine 14073	L5	Antarctica	796	0.796
68384	Paposo 046	L5	Chile	678	0.678
67699	Jabal Zaltan 006	L5	Libya	659.4	0.6594
68267	Northwest Africa 12156	L5	Algeria	606.82	0.60682
68538	Chug Chug 006	L5	Chile	594	0.594
68268	Northwest Africa 12157	L5	Algeria	571.94	0.57194
66842	Northwest Africa 11745	L5	(Northwest At	554.16	0.55416
68177	Northwest Africa 12066	L5	Algeria	518.83	0.51883
67508	Chug Chug 001	L5	Chile	514	0.514
67299	Asuka 12354	L5	Antarctica	482.17	0.48217
31796	Northwest Africa 674	L5	(Northwest At	430	0.43
67576	Northwest Africa 11820	L5	(Northwest At	401	0.401
66668	Dominion Range 14460	L5	Antarctica	380.76	0.38076
68137	Northwest Africa 12026	L5	Algeria	347.67	0.34767
68145	Northwest Africa 12034	L5	Algeria	342.12	0.34212
68405	Northwest Africa 12258	L5	(Northwest At	328	0.328
67764	Northwest Africa 11943	L5	(Northwest At	321	0.321
67165	Asuka 12138	L5	Antarctica	298.6	0.2986
67887	Dominion Range 14230	L5	Antarctica	288.53	0.28853
68181	Northwest Africa 12070	L5	Algeria	277.86	0.27786
68095	Elephant Moraine 16002	L5	Antarctica	259.4	0.2594
68406	Northwest Africa 12259	L5	(Northwest At	223	0.223
68427	Northwest Africa 12294	L5	(Northwest At	206	0.206
67834	Northwest Africa 11982	L5	(Northwest At	194	0.194
67691	Catalina 276	L5	Chile	186	0.186
66440	Northwest Africa 11646	L5	(Northwest At	184.2	0.1842
68407	Northwest Africa 12260	L5	(Northwest At	179	0.179
67842	Sierra Gorda 003	L5	Chile	154	0.154
67694	Jabal Zaltan 001	L5	Libya	151.3	0.1513
66858	Northwest Africa 11760	L5	(Northwest At	126	0.126
66856	Northwest Africa 11758	L5	(Northwest At	124.4	0.1244
68184	Northwest Africa 12073	L5	Algeria	120.07	0.12007
67845	Sierra Gorda 005	L5	Chile	112	0.112
67671	Catalina 279	L5	Chile	105	0.105
66466	Northwest Africa 11666	L5	(Northwest At	101	0.101
67967	Dominion Range 14413	L5	Antarctica	99.891	0.099891
66560	Dominion Range 14172	L5	Antarctica	99.03	0.09903
66759	Northwest Africa 11661	L5	(Northwest At	84.9	0.0849
66572	Dominion Range 14184	L5	Antarctica	83.03	0.08303
66632	Dominion Range 14307	L5	Antarctica	74.832	0.074832
67963	Dominion Range 14409	L5	Antarctica	73.13	0.07313
66562	Dominion Range 14174	L5	Antarctica	72.32	0.07232
66421	Northwest Africa 11621	L5	(Northwest At	65.65	0.06565
67955	Dominion Range 14401	L5	Antarctica	64.509	0.064509

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66755	Northwest Africa 11657	L5	(Northwest Af	63.8	0.0638
66565	Dominion Range 14177	L5	Antarctica	61.89	0.06189
66676	Dominion Range 14468	L5	Antarctica	61.08	0.06108
66754	Northwest Africa 11656	L5	(Northwest Af	59	0.059
66598	Dominion Range 14222	L5	Antarctica	57.549	0.057549
68300	Calate 014	L5	Chile	55	0.055
66559	Dominion Range 14171	L5	Antarctica	52.14	0.05214
68552	Machuca 003	L5	Chile	52	0.052
67979	Dominion Range 14425	L5	Antarctica	49.982	0.049982
66764	Northwest Africa 11711	L5	(Northwest Af	48.8	0.0488
67936	Dominion Range 14343	L5	Antarctica	48.451	0.048451
66679	Dominion Range 14511	L5	Antarctica	47.32	0.04732
67883	Dominion Range 14215	L5	Antarctica	46.992	0.046992
66820	El Médano 373	L5	Chile	46	0.046
68388	San Juan 092	L5	Chile	44.7	0.0447
68032	Miller Range 15085	L5	Antarctica	42.171	0.042171
67886	Dominion Range 14218	L5	Antarctica	41.805	0.041805
66561	Dominion Range 14173	L5	Antarctica	40.32	0.04032
67603	Sweihan	L5	United Arab E	40	0.04
66564	Dominion Range 14176	L5	Antarctica	39.1	0.0391
66680	Dominion Range 14512	L5	Antarctica	38.668	0.038668
67958	Dominion Range 14404	L5	Antarctica	36.534	0.036534
68024	Dominion Range 14509	L5	Antarctica	33.466	0.033466
66646	Dominion Range 14378	L5	Antarctica	33.377	0.033377
67991	Dominion Range 14437	L5	Antarctica	32.904	0.032904
66539	Dominion Range 14109	L5	Antarctica	32.753	0.032753
66526	Dominion Range 14086	L5	Antarctica	32.19	0.03219
67619	Northwest Africa 11870	L5	(Northwest Af	30.91	0.03091
67988	Dominion Range 14434	L5	Antarctica	30.193	0.030193
68212	Northwest Africa 12101	L5	Algeria	30.16	0.03016
66591	Dominion Range 14205	L5	Antarctica	29.48	0.02948
66702	Dominion Range 14535	L5	Antarctica	27.91	0.02791
67990	Dominion Range 14436	L5	Antarctica	27.561	0.027561
67982	Dominion Range 14428	L5	Antarctica	27.068	0.027068
67944	Dominion Range 14351	L5	Antarctica	26.878	0.026878
68288	Northwest Africa 12177	L5	Algeria	26.49	0.02649
66570	Dominion Range 14182	L5	Antarctica	25.89	0.02589
66685	Dominion Range 14517	L5	Antarctica	24.937	0.024937
66555	Dominion Range 14136	L5	Antarctica	24.86	0.02486
67879	Dominion Range 14211	L5	Antarctica	24.675	0.024675
66644	Dominion Range 14376	L5	Antarctica	23.992	0.023992
67981	Dominion Range 14427	L5	Antarctica	22.324	0.022324
68013	Dominion Range 14498	L5	Antarctica	21.65	0.02165
68061	Miller Range 15375	L5	Antarctica	20.581	0.020581
66703	Dominion Range 14536	L5	Antarctica	20.55	0.02055

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68070	Miller Range 15393	L5	Antarctica	20.54	0.02054
66524	Dominion Range 14084	L5	Antarctica	20.08	0.02008
66695	Dominion Range 14528	L5	Antarctica	19.34	0.01934
68038	Miller Range 15092	L5	Antarctica	18.727	0.018727
68057	Miller Range 15371	L5	Antarctica	18.278	0.018278
66699	Dominion Range 14532	L5	Antarctica	16.96	0.01696
66701	Dominion Range 14534	L5	Antarctica	16.1	0.0161
66586	Dominion Range 14200	L5	Antarctica	15.88	0.01588
66606	Dominion Range 14240	L5	Antarctica	15.87	0.01587
66707	Dominion Range 14550	L5	Antarctica	15.72	0.01572
66637	Dominion Range 14362	L5	Antarctica	15.354	0.015354
68054	Miller Range 15299	L5	Antarctica	15.297	0.015297
67953	Dominion Range 14375	L5	Antarctica	14.466	0.014466
41021	Yamato 000256	L5	Antarctica	14.461	0.014461
67915	Dominion Range 14292	L5	Antarctica	14.307	0.014307
68025	Dominion Range 14527	L5	Antarctica	14.11	0.01411
67928	Dominion Range 14315	L5	Antarctica	13.15	0.01315
67920	Dominion Range 14297	L5	Antarctica	11.052	0.011052
41750	Yamato 000988	L5	Antarctica	10.295	0.010295
66585	Dominion Range 14199	L5	Antarctica	9.759	0.009759
67877	Dominion Range 14192	L5	Antarctica	9.445	0.009445
27103	Yamato 791754	L5	Antarctica	9.25	0.00925
67243	Asuka 12293	L5	Antarctica	8.849	0.008849
67289	Asuka 12343	L5	Antarctica	8.27	0.00827
27104	Yamato 791755	L5	Antarctica	7.7	0.0077
66665	Dominion Range 14457	L5	Antarctica	7.11	0.00711
66581	Dominion Range 14195	L5	Antarctica	6.196	0.006196
66861	San Juan 084	L5	Chile	5	0.005
44222	Yamato 003460	L5	Antarctica	4.761	0.004761
44115	Yamato 003353	L5	Antarctica	4.655	0.004655
44209	Yamato 003447	L5	Antarctica	4.534	0.004534
44218	Yamato 003456	L5	Antarctica	4.511	0.004511
44117	Yamato 003355	L5	Antarctica	4.484	0.004484
67002	Asuka 09384	L5	Antarctica	4.322	0.004322
44300	Yamato 003538	L5	Antarctica	4.112	0.004112
44211	Yamato 003449	L5	Antarctica	4.096	0.004096
44215	Yamato 003453	L5	Antarctica	4.057	0.004057
44095	Yamato 003333	L5	Antarctica	3.943	0.003943
44227	Yamato 003465	L5	Antarctica	3.864	0.003864
44212	Yamato 003450	L5	Antarctica	3.566	0.003566
44279	Yamato 003517	L5	Antarctica	3.388	0.003388
44128	Yamato 003366	L5	Antarctica	3.374	0.003374
41253	Yamato 000488	L5	Antarctica	3.363	0.003363
41052	Yamato 000287	L5	Antarctica	3.279	0.003279
44207	Yamato 003445	L5	Antarctica	3.273	0.003273

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41392	Yamato 000628	L5	Antarctica	3.269	0.003269
44024	Yamato 003262	L5	Antarctica	3.231	0.003231
44223	Yamato 003461	L5	Antarctica	3.112	0.003112
41434	Yamato 000670	L5	Antarctica	3.046	0.003046
44186	Yamato 003424	L5	Antarctica	3.031	0.003031
44063	Yamato 003301	L5	Antarctica	2.915	0.002915
44228	Yamato 003466	L5	Antarctica	2.858	0.002858
44122	Yamato 003360	L5	Antarctica	2.742	0.002742
44261	Yamato 003499	L5	Antarctica	2.611	0.002611
44130	Yamato 003368	L5	Antarctica	2.515	0.002515
44104	Yamato 003342	L5	Antarctica	2.503	0.002503
36810	Yamato 980184	L5	Antarctica	2.486	0.002486
44189	Yamato 003427	L5	Antarctica	2.351	0.002351
44020	Yamato 003258	L5	Antarctica	2.348	0.002348
44202	Yamato 003440	L5	Antarctica	2.147	0.002147
44028	Yamato 003266	L5	Antarctica	2.052	0.002052
36986	Yamato 980361	L5	Antarctica	1.996	0.001996
44221	Yamato 003459	L5	Antarctica	1.875	0.001875
44114	Yamato 003352	L5	Antarctica	1.818	0.001818
44311	Yamato 003549	L5	Antarctica	1.814	0.001814
44120	Yamato 003358	L5	Antarctica	1.752	0.001752
44307	Yamato 003545	L5	Antarctica	1.644	0.001644
66788	Mackay Glacier 14011	L5	Antarctica	1.6	0.0016
44226	Yamato 003464	L5	Antarctica	1.426	0.001426
44225	Yamato 003463	L5	Antarctica	1.402	0.001402
68091	Miller Range 15535	L5	Antarctica	1.4	0.0014
44206	Yamato 003444	L5	Antarctica	1.385	0.001385
36638	Yamato 980012	L5	Antarctica	1.321	0.001321
66719	Miller Range 15222	L5	Antarctica	1.26	0.00126
44065	Yamato 003303	L5	Antarctica	1.212	0.001212
44179	Yamato 003417	L5	Antarctica	1.191	0.001191
44066	Yamato 003304	L5	Antarctica	1.176	0.001176
36911	Yamato 980285	L5	Antarctica	1.174	0.001174
66730	Elephant Moraine 16204	L5	Antarctica	1.08	0.00108
44201	Yamato 003439	L5	Antarctica	1.045	0.001045
43475	Yamato 002713	L5	Antarctica	0.935	0.000935
66727	Elephant Moraine 16198	L5	Antarctica	0.857	0.000857
68079	Miller Range 15418	L5	Antarctica	0.85	0.00085
44310	Yamato 003548	L5	Antarctica	0.836	0.000836
44064	Yamato 003302	L5	Antarctica	0.789	0.000789
36958	Yamato 980333	L5	Antarctica	0.721	0.000721
44074	Yamato 003312	L5	Antarctica	0.721	0.000721
44070	Yamato 003308	L5	Antarctica	0.699	0.000699
44219	Yamato 003457	L5	Antarctica	0.677	0.000677
66725	Elephant Moraine 16173	L5	Antarctica	0.663	0.000663

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44187	Yamato 003425	L5	Antarctica	0.629	0.000629
66738	Elephant Moraine 16213	L5	Antarctica	0.62	0.00062
44075	Yamato 003313	L5	Antarctica	0.601	0.000601
44068	Yamato 003306	L5	Antarctica	0.596	0.000596
44224	Yamato 003462	L5	Antarctica	0.575	0.000575
41374	Yamato 000610	L5	Antarctica	0.554	0.000554
44213	Yamato 003451	L5	Antarctica	0.541	0.000541
44183	Yamato 003421	L5	Antarctica	0.527	0.000527
44191	Yamato 003429	L5	Antarctica	0.521	0.000521
44312	Yamato 003550	L5	Antarctica	0.508	0.000508
66787	MacKay Glacier 14007	L5	Antarctica	0.5	0.0005
44073	Yamato 003311	L5	Antarctica	0.475	0.000475
44178	Yamato 003416	L5	Antarctica	0.451	0.000451
44321	Yamato 003559	L5	Antarctica	0.353	0.000353
66728	Elephant Moraine 16200	L5	Antarctica	0.338	0.000338
44086	Yamato 003324	L5	Antarctica	0.263	0.000263
68081	Miller Range 15431	L5	Antarctica	0.26	0.00026
68123	Nova 055	L5	(Unknown)		
68656	Renchen	L5-6	Germany	999	0.999
67707	Qatar 015	L5-6	Qatar	195	0.195
68616	Northwest Africa 12289	L5-melt brecc	(Northwest Africa)	145	0.145
68341	Catalina 286	L5/6	Chile	1200	1.2
68398	Las Bombas 002	L5/6	Chile	170	0.17
67708	Qatar 016	L5/6	Qatar	119	0.119
67794	Mangui	L6	China	50000	50
68644	Calama 022	L6	Chile	32000	32
67661	Vaquillas 005	L6	Chile	14350	14.35
67504	Calama 009	L6	Chile	13500	13.5
67604	Northwest Africa 11842	L6	(Northwest Africa)	13400	13.4
67725	Calama 013	L6	Chile	8435	8.435
67709	Ozerki	L6	Russia	6500	6.5
67847	Paposo 042	L6	Chile	5650	5.65
67664	El Médano 387	L6	Chile	5427	5.427
67461	Elephant Moraine 14045	L6	Antarctica	4556	4.556
66776	Northwest Africa 11724	L6	(Northwest Africa)	4150	4.15
67598	San Pedro de Urabá	L6	Colombia	3768	3.768
68479	Los Vientos 258	L6	Chile	3150	3.15
32081	Northwest Africa 1108	L6	(Northwest Africa)	2800	2.8
3320	Asuka 880611	L6	Antarctica	1846.4	1.8464
68097	Elephant Moraine 16020	L6	Antarctica	1707.2	1.7072
66492	Northwest Africa 11676	L6	(Northwest Africa)	1664	1.664
68262	Northwest Africa 12151	L6	Algeria	1412.46	1.41246
67594	Diego de Almagro 002	L6	Chile	1314	1.314
44098	Yamato 003336	L6	Antarctica	1043.2	1.0432
67472	Elephant Moraine 14059	L6	Antarctica	1031	1.031

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67595	Las Bombas 001	L6	Chile	1005	1.005
41929	Yamato 001167	L6	Antarctica	1002.2	1.0022
67848	El Médano 391	L6	Chile	984	0.984
31791	Northwest Africa 669	L6	(Northwest Af	908	0.908
31793	Northwest Africa 671	L6	(Northwest Af	876	0.876
67754	Northwest Africa 11930	L6	(Northwest Af	864	0.864
67473	Elephant Moraine 14060	L6	Antarctica	849	0.849
31629	Northwest Africa 436	L6	(Northwest Af	841	0.841
43185	Yamato 002423	L6	Antarctica	758.1	0.7581
67411	Northwest Africa 11779	L6	(Northwest Af	668.9	0.6689
68334	Altamira 002	L6	Chile	566	0.566
66502	Northwest Africa 11686	L6	(Northwest Af	559	0.559
68344	Catalina 289	L6	Chile	545	0.545
68654	Andila	L6	Chad	500	0.5
68371	Los Vientos 247	L6	Chile	424	0.424
67174	Asuka 12214	L6	Antarctica	413.64	0.41364
67726	Calama 015	L6	Chile	373	0.373
66497	Northwest Africa 11681	L6	(Northwest Af	368	0.368
66422	Northwest Africa 11622	L6	(Northwest Af	361.47	0.36147
66485	Mürtschenstock	L6	Switzerland	354.5	0.3545
67329	Asuka 12384	L6	Antarctica	348.16	0.34816
67511	Los Vientos 218	L6	Chile	326	0.326
68393	San Juan 097	L6	Chile	313	0.313
67414	Reckling Peak 14001	L6	Antarctica	304	0.304
68207	Northwest Africa 12096	L6	Algeria	283.91	0.28391
66670	Dominion Range 14462	L6	Antarctica	280.69	0.28069
67373	Asuka 12432	L6	Antarctica	273.14	0.27314
67487	Northwest Africa 11797	L6	(Northwest Af	267	0.267
68192	Northwest Africa 12081	L6	Algeria	265	0.265
67134	Asuka 12014	L6	Antarctica	259.37	0.25937
66434	Northwest Africa 11633	L6	(Northwest Af	255	0.255
67888	Dominion Range 14231	L6	Antarctica	244.62	0.24462
68180	Northwest Africa 12069	L6	Algeria	243.15	0.24315
67652	Northwest Africa 11875	L6	(Northwest Af	235.19	0.23519
68483	Northwest Africa 12325	L6	(Northwest Af	228	0.228
66626	Dominion Range 14300	L6	Antarctica	218.71	0.21871
67518	Los Vientos 222	L6	Chile	206	0.206
68377	Los Vientos 254	L6	Chile	199	0.199
66494	Calama 006	L6	Chile	191	0.191
68098	Elephant Moraine 16021	L6	Antarctica	183.169	0.183169
67763	Northwest Africa 11942	L6	(Northwest Af	182.9	0.1829
67394	Catalina 260	L6	Chile	181	0.181
67166	Asuka 12142	L6	Antarctica	171.68	0.17168
67843	Sierra Gorda 004	L6	Chile	170	0.17
31647	Northwest Africa 454	L6	(Northwest Af	168	0.168

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67890	Dominion Range 14233	L6	Antarctica	164.1	0.1641
67136	Asuka 12020	L6	Antarctica	163.04	0.16304
66506	Northwest Africa 11690	L6	(Northwest Africa)	163	0.163
67132	Asuka 12012	L6	Antarctica	162.5	0.1625
67531	Los Vientos 225	L6	Chile	161	0.161
67151	Asuka 12046	L6	Antarctica	160.87	0.16087
67760	Northwest Africa 11939	L6	(Northwest Africa)	152.4	0.1524
67465	Elephant Moraine 14050	L6	Antarctica	146.3	0.1463
67232	Asuka 12281	L6	Antarctica	135.4	0.1354
67835	Northwest Africa 11984	L6	(Northwest Africa)	134.6	0.1346
67206	Asuka 12255	L6	Antarctica	130.41	0.13041
68391	San Juan 095	L6	Chile	129.4	0.1294
67969	Dominion Range 14415	L6	Antarctica	128.801	0.128801
67224	Asuka 12273	L6	Antarctica	126.11	0.12611
68370	Los Vientos 246	L6	Chile	123	0.123
67263	Asuka 12313	L6	Antarctica	119.83	0.11983
68365	Los Vientos 241	L6	Chile	117	0.117
67526	Catalina 263	L6	Chile	116	0.116
68368	Los Vientos 244	L6	Chile	110	0.11
67968	Dominion Range 14414	L6	Antarctica	100.68	0.10068
33223	Northwest Africa 2730	L6	(Northwest Africa)	100	0.1
67971	Dominion Range 14417	L6	Antarctica	96.903	0.096903
66542	Dominion Range 14122	L6	Antarctica	95.83	0.09583
67453	Elephant Moraine 14037	L6	Antarctica	93.8	0.0938
36780	Yamato 980154	L6	Antarctica	93.31	0.09331
67387	Los Vientos 214	L6	Chile	93.1	0.0931
66543	Dominion Range 14123	L6	Antarctica	92.66	0.09266
67432	Elephant Moraine 14016	L6	Antarctica	90.6	0.0906
66596	Dominion Range 14220	L6	Antarctica	87.186	0.087186
67687	Catalina 273	L6	Chile	86	0.086
68537	Sierra Gorda 011	L6	Chile	84	0.084
67212	Asuka 12261	L6	Antarctica	83.12	0.08312
67973	Dominion Range 14419	L6	Antarctica	81.815	0.081815
67617	Northwest Africa 11868	L6	(Northwest Africa)	80.15	0.08015
67390	Los Vientos 217	L6	Chile	79	0.079
66633	Dominion Range 14308	L6	Antarctica	76.049	0.076049
67447	Elephant Moraine 14031	L6	Antarctica	75.6	0.0756
66566	Dominion Range 14178	L6	Antarctica	74.96	0.07496
67999	Dominion Range 14474	L6	Antarctica	72.51	0.07251
67960	Dominion Range 14406	L6	Antarctica	71.72	0.07172
67312	Asuka 12367	L6	Antarctica	71.5	0.0715
67654	Northwest Africa 11877	L6	(Northwest Africa)	71.38	0.07138
67529	Catalina 266	L6	Chile	69.9	0.0699
67346	Asuka 12404	L6	Antarctica	69.75	0.06975
67954	Dominion Range 14400	L6	Antarctica	65.518	0.065518

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67435	Elephant Moraine 14019	L6	Antarctica	64.7	0.0647
67892	Dominion Range 14235	L6	Antarctica	63.72	0.06372
66657	Dominion Range 14399	L6	Antarctica	60.93	0.06093
68000	Dominion Range 14475	L6	Antarctica	60.43	0.06043
68001	Dominion Range 14476	L6	Antarctica	60.16	0.06016
67729	Calama 018	L6	Chile	60	0.06
68170	Northwest Africa 12059	L6	Algeria	59.52	0.05952
68003	Dominion Range 14478	L6	Antarctica	58.71	0.05871
26079	Yamato 790730	L6	Antarctica	58.32	0.05832
67532	Catalina 268	L6	Chile	58	0.058
67956	Dominion Range 14402	L6	Antarctica	57.619	0.057619
66532	Dominion Range 14102	L6	Antarctica	55.38	0.05538
67965	Dominion Range 14411	L6	Antarctica	53.791	0.053791
66857	Northwest Africa 11759	L6	(Northwest Africa)	52.2	0.0522
67937	Dominion Range 14344	L6	Antarctica	50.959	0.050959
67141	Asuka 12029	L6	Antarctica	50.53	0.05053
66687	Dominion Range 14519	L6	Antarctica	50.173	0.050173
67878	Dominion Range 14210	L6	Antarctica	48.399	0.048399
67674	Northwest Africa 8285	L6	(Northwest Africa)	48	0.048
66558	Dominion Range 14139	L6	Antarctica	47.05	0.04705
68100	Elephant Moraine 16043	L6	Antarctica	47.04	0.04704
68394	San Juan 098	L6	Chile	45	0.045
67938	Dominion Range 14345	L6	Antarctica	44.888	0.044888
66652	Dominion Range 14394	L6	Antarctica	44.72	0.04472
66634	Dominion Range 14309	L6	Antarctica	44.139	0.044139
68002	Dominion Range 14477	L6	Antarctica	43.11	0.04311
66547	Dominion Range 14128	L6	Antarctica	42.99	0.04299
67957	Dominion Range 14403	L6	Antarctica	41.377	0.041377
68125	Willcox Playa 011	L6	United States	41	0.041
67941	Dominion Range 14348	L6	Antarctica	40.59	0.04059
67326	Asuka 12381	L6	Antarctica	40.343	0.040343
67332	Asuka 12387	L6	Antarctica	40.291	0.040291
68349	Catalina 294	L6	Chile	40.1	0.0401
67282	Asuka 12336	L6	Antarctica	39.521	0.039521
66684	Dominion Range 14516	L6	Antarctica	39.384	0.039384
67934	Dominion Range 14341	L6	Antarctica	39.217	0.039217
67246	Asuka 12296	L6	Antarctica	39.179	0.039179
67522	El Médano 383	L6	Chile	39	0.039
68253	Northwest Africa 12142	L6	Algeria	38.47	0.03847
66537	Dominion Range 14107	L6	Antarctica	37.319	0.037319
68062	Miller Range 15376	L6	Antarctica	36.611	0.036611
67340	Asuka 12397	L6	Antarctica	36.144	0.036144
66649	Dominion Range 14391	L6	Antarctica	36.12	0.03612
66577	Dominion Range 14190	L6	Antarctica	36.032	0.036032
67480	Elephant Moraine 14069	L6	Antarctica	36	0.036

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66683	Dominion Range 14515	L6	Antarctica	35.984	0.035984
67943	Dominion Range 14350	L6	Antarctica	35.852	0.035852
66531	Dominion Range 14101	L6	Antarctica	35.31	0.03531
67339	Asuka 12396	L6	Antarctica	35.225	0.035225
67995	Dominion Range 14470	L6	Antarctica	35.16	0.03516
67980	Dominion Range 14426	L6	Antarctica	35.112	0.035112
67689	Catalina 275	L6	Chile	34.8	0.0348
66557	Dominion Range 14138	L6	Antarctica	34.63	0.03463
67675	Northwest Africa 8286	L6	(Northwest Africa)	34	0.034
67985	Dominion Range 14431	L6	Antarctica	33.987	0.033987
67940	Dominion Range 14347	L6	Antarctica	33.898	0.033898
66538	Dominion Range 14108	L6	Antarctica	33.249	0.033249
67896	Dominion Range 14253	L6	Antarctica	33.229	0.033229
67933	Dominion Range 14340	L6	Antarctica	33.113	0.033113
66686	Dominion Range 14518	L6	Antarctica	32.429	0.032429
67978	Dominion Range 14424	L6	Antarctica	32.146	0.032146
67304	Asuka 12359	L6	Antarctica	32.074	0.032074
68397	San Juan 102	L6	Chile	32	0.032
67914	Dominion Range 14291	L6	Antarctica	31.977	0.031977
66511	Dominion Range 14030	L6	Antarctica	31.88	0.03188
66530	Dominion Range 14100	L6	Antarctica	31.461	0.031461
66698	Dominion Range 14531	L6	Antarctica	31.36	0.03136
66656	Dominion Range 14398	L6	Antarctica	31.11	0.03111
67986	Dominion Range 14432	L6	Antarctica	31.067	0.031067
67902	Dominion Range 14259	L6	Antarctica	31.06	0.03106
66534	Dominion Range 14104	L6	Antarctica	30.852	0.030852
68233	Northwest Africa 12122	L6	Algeria	30.81	0.03081
68007	Dominion Range 14492	L6	Antarctica	30.71	0.03071
66525	Dominion Range 14085	L6	Antarctica	30.7	0.0307
67454	Elephant Moraine 14038	L6	Antarctica	30.5	0.0305
66521	Dominion Range 14081	L6	Antarctica	30.45	0.03045
67894	Dominion Range 14251	L6	Antarctica	30.263	0.030263
66553	Dominion Range 14134	L6	Antarctica	30.11	0.03011
66550	Dominion Range 14131	L6	Antarctica	30.01	0.03001
66441	Northwest Africa 11648	L6	(Northwest Africa)	30	0.03
66535	Dominion Range 14105	L6	Antarctica	29.744	0.029744
67882	Dominion Range 14214	L6	Antarctica	29.675	0.029675
68060	Miller Range 15374	L6	Antarctica	29.383	0.029383
67348	Asuka 12406	L6	Antarctica	28.726	0.028726
66681	Dominion Range 14513	L6	Antarctica	28.481	0.028481
67947	Dominion Range 14354	L6	Antarctica	28.381	0.028381
66678	Dominion Range 14510	L6	Antarctica	28.124	0.028124
67314	Asuka 12369	L6	Antarctica	28.007	0.028007
68162	Northwest Africa 12051	L6	Algeria	27.77	0.02777
67913	Dominion Range 14290	L6	Antarctica	27.251	0.027251

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67884	Dominion Range 14216	L6	Antarctica	27.106	0.027106
67885	Dominion Range 14217	L6	Antarctica	27.096	0.027096
66651	Dominion Range 14393	L6	Antarctica	27.09	0.02709
66536	Dominion Range 14106	L6	Antarctica	26.979	0.026979
66648	Dominion Range 14390	L6	Antarctica	26.66	0.02666
66650	Dominion Range 14392	L6	Antarctica	26.52	0.02652
66655	Dominion Range 14397	L6	Antarctica	26.48	0.02648
68021	Dominion Range 14506	L6	Antarctica	26.455	0.026455
67463	Elephant Moraine 14047	L6	Antarctica	26.4	0.0264
67942	Dominion Range 14349	L6	Antarctica	26.291	0.026291
67997	Dominion Range 14472	L6	Antarctica	26.11	0.02611
66704	Dominion Range 14537	L6	Antarctica	26.09	0.02609
68354	El Médano 392	L6	Chile	26	0.026
67921	Dominion Range 14298	L6	Antarctica	25.743	0.025743
67923	Dominion Range 14310	L6	Antarctica	25.278	0.025278
66579	Dominion Range 14193	L6	Antarctica	25.186	0.025186
66705	Dominion Range 14538	L6	Antarctica	25.12	0.02512
67614	Northwest Africa 11863	L6	(Northwest Africa)	24.92	0.02492
68031	Miller Range 15084	L6	Antarctica	24.85	0.02485
67977	Dominion Range 14423	L6	Antarctica	24.475	0.024475
66527	Dominion Range 14087	L6	Antarctica	24.46	0.02446
67952	Dominion Range 14368	L6	Antarctica	23.887	0.023887
67880	Dominion Range 14212	L6	Antarctica	23.509	0.023509
67616	Northwest Africa 11865	L6	(Northwest Africa)	23.48	0.02348
66608	Dominion Range 14242	L6	Antarctica	23.19	0.02319
66611	Dominion Range 14245	L6	Antarctica	23.12	0.02312
67939	Dominion Range 14346	L6	Antarctica	23.062	0.023062
67924	Dominion Range 14311	L6	Antarctica	23.055	0.023055
67912	Dominion Range 14269	L6	Antarctica	22.804	0.022804
66426	Northwest Africa 11626	L6	(Northwest Africa)	22.73	0.02273
68222	Northwest Africa 12111	L6	Algeria	22.49	0.02249
67270	Asuka 12321	L6	Antarctica	22.367	0.022367
68015	Dominion Range 14500	L6	Antarctica	21.98	0.02198
67450	Elephant Moraine 14034	L6	Antarctica	21.8	0.0218
66658	Dominion Range 14450	L6	Antarctica	21.44	0.02144
67910	Dominion Range 14267	L6	Antarctica	21.307	0.021307
67925	Dominion Range 14312	L6	Antarctica	20.873	0.020873
67926	Dominion Range 14313	L6	Antarctica	20.598	0.020598
66700	Dominion Range 14533	L6	Antarctica	20.58	0.02058
66607	Dominion Range 14241	L6	Antarctica	20.47	0.02047
66551	Dominion Range 14132	L6	Antarctica	20.31	0.02031
67974	Dominion Range 14420	L6	Antarctica	20.093	0.020093
67688	Catalina 274	L6	Chile	20	0.02
67946	Dominion Range 14353	L6	Antarctica	19.662	0.019662
68033	Miller Range 15087	L6	Antarctica	19.597	0.019597

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67309	Asuka 12364	L6	Antarctica	19.428	0.019428
66549	Dominion Range 14130	L6	Antarctica	19.33	0.01933
68022	Dominion Range 14507	L6	Antarctica	19.293	0.019293
67424	Elephant Moraine 14006	L6	Antarctica	19	0.019
66697	Dominion Range 14530	L6	Antarctica	18.87	0.01887
66682	Dominion Range 14514	L6	Antarctica	18.548	0.018548
68018	Dominion Range 14503	L6	Antarctica	18.51	0.01851
66688	Dominion Range 14520	L6	Antarctica	18.27	0.01827
66713	Dominion Range 14556	L6	Antarctica	18.13	0.01813
68387	San Juan 091	L6	Chile	18.1	0.0181
67916	Dominion Range 14293	L6	Antarctica	18.076	0.018076
68016	Dominion Range 14501	L6	Antarctica	18.055	0.018055
66554	Dominion Range 14135	L6	Antarctica	18.04	0.01804
67922	Dominion Range 14299	L6	Antarctica	17.966	0.017966
68020	Dominion Range 14505	L6	Antarctica	17.842	0.017842
67918	Dominion Range 14295	L6	Antarctica	17.726	0.017726
67927	Dominion Range 14314	L6	Antarctica	17.513	0.017513
67370	Asuka 12428	L6	Antarctica	17.255	0.017255
66583	Dominion Range 14197	L6	Antarctica	17.157	0.017157
68028	Dominion Range 14562	L6	Antarctica	17.133	0.017133
68378	Los Vientos 255	L6	Chile	17	0.017
67306	Asuka 12361	L6	Antarctica	16.926	0.016926
67930	Dominion Range 14317	L6	Antarctica	16.705	0.016705
67443	Elephant Moraine 14027	L6	Antarctica	16.7	0.0167
67507	Sierra Gorda 002	L6	Chile	16.4	0.0164
68313	Troy Dry Lake	L6	United States	16.3	0.0163
68005	Dominion Range 14490	L6	Antarctica	16.29	0.01629
67951	Dominion Range 14358	L6	Antarctica	16.209	0.016209
68019	Dominion Range 14504	L6	Antarctica	16.092	0.016092
67684	Los Vientos 228	L6	Chile	15.8	0.0158
66696	Dominion Range 14529	L6	Antarctica	15.63	0.01563
67945	Dominion Range 14352	L6	Antarctica	15.329	0.015329
68017	Dominion Range 14502	L6	Antarctica	15.128	0.015128
68036	Miller Range 15090	L6	Antarctica	15.084	0.015084
67931	Dominion Range 14318	L6	Antarctica	14.912	0.014912
68011	Dominion Range 14496	L6	Antarctica	14.86	0.01486
66711	Dominion Range 14554	L6	Antarctica	14.75	0.01475
68281	Northwest Africa 12170	L6	Algeria	14.71	0.01471
67900	Dominion Range 14257	L6	Antarctica	14.357	0.014357
66589	Dominion Range 14203	L6	Antarctica	14.34	0.01434
66640	Dominion Range 14365	L6	Antarctica	14.304	0.014304
66592	Dominion Range 14206	L6	Antarctica	14.2	0.0142
67451	Elephant Moraine 14035	L6	Antarctica	14.1	0.0141
67919	Dominion Range 14296	L6	Antarctica	14.015	0.014015
66556	Dominion Range 14137	L6	Antarctica	13.87	0.01387

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67369	Asuka 12427	L6	Antarctica	13.821	0.013821
67907	Dominion Range 14264	L6	Antarctica	13.742	0.013742
66576	Dominion Range 14189	L6	Antarctica	13.63	0.01363
66693	Dominion Range 14525	L6	Antarctica	13.52	0.01352
66643	Dominion Range 14369	L6	Antarctica	13.469	0.013469
66595	Dominion Range 14209	L6	Antarctica	13.42	0.01342
68009	Dominion Range 14494	L6	Antarctica	13.28	0.01328
68010	Dominion Range 14495	L6	Antarctica	13.27	0.01327
68026	Dominion Range 14560	L6	Antarctica	13.268	0.013268
68379	Los Vientos 256	L6	Chile	13.2	0.0132
66689	Dominion Range 14521	L6	Antarctica	13.08	0.01308
66694	Dominion Range 14526	L6	Antarctica	12.92	0.01292
68023	Dominion Range 14508	L6	Antarctica	12.874	0.012874
67932	Dominion Range 14319	L6	Antarctica	12.388	0.012388
66690	Dominion Range 14522	L6	Antarctica	12.08	0.01208
68372	Los Vientos 248	L6	Chile	12	0.012
67298	Asuka 12353	L6	Antarctica	11.973	0.011973
66623	Dominion Range 14278	L6	Antarctica	11.936	0.011936
66636	Dominion Range 14361	L6	Antarctica	11.825	0.011825
66515	Dominion Range 14034	L6	Antarctica	11.65	0.01165
66588	Dominion Range 14202	L6	Antarctica	11.54	0.01154
66708	Dominion Range 14551	L6	Antarctica	11.29	0.01129
67413	Calama 008	L6	Chile	11.23	0.01123
68008	Dominion Range 14493	L6	Antarctica	11.19	0.01119
67929	Dominion Range 14316	L6	Antarctica	11.129	0.011129
66638	Dominion Range 14363	L6	Antarctica	10.956	0.010956
68014	Dominion Range 14499	L6	Antarctica	10.83	0.01083
66612	Dominion Range 14246	L6	Antarctica	10.68	0.01068
66692	Dominion Range 14524	L6	Antarctica	10.55	0.01055
66715	Dominion Range 14558	L6	Antarctica	10.24	0.01024
67446	Elephant Moraine 14030	L6	Antarctica	10.2	0.0102
66635	Dominion Range 14360	L6	Antarctica	10.154	0.010154
67903	Dominion Range 14260	L6	Antarctica	9.975	0.009975
66552	Dominion Range 14133	L6	Antarctica	9.92	0.00992
66663	Dominion Range 14455	L6	Antarctica	9.92	0.00992
67388	Los Vientos 215	L6	Chile	9.9	0.0099
67226	Asuka 12275	L6	Antarctica	9.839	0.009839
3897	Asuka 881188	L6	Antarctica	9.688	0.009688
66528	Dominion Range 14088	L6	Antarctica	9.6	0.0096
66664	Dominion Range 14456	L6	Antarctica	9.19	0.00919
66594	Dominion Range 14208	L6	Antarctica	9.14	0.00914
40934	Yamato 000169	L6	Antarctica	9.08	0.00908
67430	Elephant Moraine 14014	L6	Antarctica	9	0.009
66641	Dominion Range 14366	L6	Antarctica	8.923	0.008923
67245	Asuka 12295	L6	Antarctica	8.372	0.008372

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2440	Asuka 87083	L6	Antarctica	8.355	0.008355
67437	Elephant Moraine 14021	L6	Antarctica	8.1	0.0081
67255	Asuka 12305	L6	Antarctica	8.041	0.008041
66642	Dominion Range 14367	L6	Antarctica	8	0.008
66709	Dominion Range 14552	L6	Antarctica	7.8	0.0078
67247	Asuka 12297	L6	Antarctica	7.527	0.007527
66616	Dominion Range 14271	L6	Antarctica	7.451	0.007451
66584	Dominion Range 14198	L6	Antarctica	7.386	0.007386
68027	Dominion Range 14561	L6	Antarctica	7.176	0.007176
67905	Dominion Range 14262	L6	Antarctica	7.146	0.007146
67445	Elephant Moraine 14029	L6	Antarctica	6.7	0.0067
67948	Dominion Range 14355	L6	Antarctica	6.607	0.006607
66714	Dominion Range 14557	L6	Antarctica	6.44	0.00644
67300	Asuka 12355	L6	Antarctica	6.361	0.006361
67422	Elephant Moraine 14004	L6	Antarctica	6	0.006
68375	Los Vientos 252	L6	Chile	6	0.006
66712	Dominion Range 14555	L6	Antarctica	5.99	0.00599
66996	Asuka 09367	L6	Antarctica	5.572	0.005572
67438	Elephant Moraine 14022	L6	Antarctica	5.3	0.0053
42930	Yamato 002168	L6	Antarctica	5.187	0.005187
67064	Asuka 09564	L6	Antarctica	5.165	0.005165
27021	Yamato 791672	L6	Antarctica	5.13	0.00513
67519	El Médano 382	L6	Chile	5.1	0.0051
44301	Yamato 003539	L6	Antarctica	4.989	0.004989
44121	Yamato 003359	L6	Antarctica	4.93	0.00493
44127	Yamato 003365	L6	Antarctica	4.875	0.004875
41250	Yamato 000485	L6	Antarctica	4.812	0.004812
25111	Yamato 75070	L6	Antarctica	4.75	0.00475
41606	Yamato 000844	L6	Antarctica	4.733	0.004733
44056	Yamato 003294	L6	Antarctica	4.69	0.00469
44265	Yamato 003503	L6	Antarctica	4.596	0.004596
44136	Yamato 003374	L6	Antarctica	4.529	0.004529
44242	Yamato 003480	L6	Antarctica	4.438	0.004438
41859	Yamato 001097	L6	Antarctica	4.41	0.00441
44253	Yamato 003491	L6	Antarctica	4.376	0.004376
44292	Yamato 003530	L6	Antarctica	4.375	0.004375
43848	Yamato 003086	L6	Antarctica	4.359	0.004359
44054	Yamato 003292	L6	Antarctica	4.276	0.004276
67021	Asuka 09410	L6	Antarctica	4.228	0.004228
43781	Yamato 003019	L6	Antarctica	4.185	0.004185
44216	Yamato 003454	L6	Antarctica	4.176	0.004176
44091	Yamato 003329	L6	Antarctica	4.162	0.004162
44126	Yamato 003364	L6	Antarctica	4.135	0.004135
44026	Yamato 003264	L6	Antarctica	4.099	0.004099
44278	Yamato 003516	L6	Antarctica	4.086	0.004086

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43856	Yamato 003094	L6	Antarctica	3.998	0.003998
67439	Elephant Moraine 14023	L6	Antarctica	3.9	0.0039
36891	Yamato 980265	L6	Antarctica	3.9	0.0039
66919	Asuka 09270	L6	Antarctica	3.841	0.003841
66523	Dominion Range 14083	L6	Antarctica	3.83	0.00383
43801	Yamato 003039	L6	Antarctica	3.811	0.003811
44025	Yamato 003263	L6	Antarctica	3.756	0.003756
44125	Yamato 003363	L6	Antarctica	3.731	0.003731
44055	Yamato 003293	L6	Antarctica	3.718	0.003718
67431	Elephant Moraine 14015	L6	Antarctica	3.6	0.0036
44236	Yamato 003474	L6	Antarctica	3.565	0.003565
44245	Yamato 003483	L6	Antarctica	3.549	0.003549
67054	Asuka 09490	L6	Antarctica	3.523	0.003523
44241	Yamato 003479	L6	Antarctica	3.491	0.003491
67436	Elephant Moraine 14020	L6	Antarctica	3.4	0.0034
44052	Yamato 003290	L6	Antarctica	3.375	0.003375
44271	Yamato 003509	L6	Antarctica	3.319	0.003319
41387	Yamato 000623	L6	Antarctica	3.296	0.003296
44027	Yamato 003265	L6	Antarctica	3.261	0.003261
44232	Yamato 003470	L6	Antarctica	3.257	0.003257
43844	Yamato 003082	L6	Antarctica	3.251	0.003251
44129	Yamato 003367	L6	Antarctica	3.238	0.003238
67442	Elephant Moraine 14026	L6	Antarctica	3.2	0.0032
44264	Yamato 003502	L6	Antarctica	3.173	0.003173
44283	Yamato 003521	L6	Antarctica	3.161	0.003161
44199	Yamato 003437	L6	Antarctica	3.143	0.003143
67055	Asuka 09492	L6	Antarctica	3.131	0.003131
44240	Yamato 003478	L6	Antarctica	3.086	0.003086
43914	Yamato 003152	L6	Antarctica	3.075	0.003075
44250	Yamato 003488	L6	Antarctica	3.019	0.003019
68339	Catalina 284	L6	Chile	3	0.003
67004	Asuka 09386	L6	Antarctica	2.974	0.002974
44123	Yamato 003361	L6	Antarctica	2.932	0.002932
44119	Yamato 003357	L6	Antarctica	2.922	0.002922
67423	Elephant Moraine 14005	L6	Antarctica	2.9	0.0029
67449	Elephant Moraine 14033	L6	Antarctica	2.9	0.0029
36855	Yamato 980229	L6	Antarctica	2.9	0.0029
41666	Yamato 000904	L6	Antarctica	2.892	0.002892
44246	Yamato 003484	L6	Antarctica	2.882	0.002882
67066	Asuka 09601	L6	Antarctica	2.814	0.002814
36960	Yamato 980335	L6	Antarctica	2.81	0.00281
44288	Yamato 003526	L6	Antarctica	2.747	0.002747
44139	Yamato 003377	L6	Antarctica	2.676	0.002676
36926	Yamato 980300	L6	Antarctica	2.654	0.002654
67056	Asuka 09493	L6	Antarctica	2.627	0.002627

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44204	Yamato 003442	L6	Antarctica	2.609	0.002609
67062	Asuka 09557	L6	Antarctica	2.603	0.002603
67429	Elephant Moraine 14012	L6	Antarctica	2.6	0.0026
36970	Yamato 980345	L6	Antarctica	2.585	0.002585
36729	Yamato 980103	L6	Antarctica	2.569	0.002569
36645	Yamato 980019	L6	Antarctica	2.565	0.002565
36935	Yamato 980309	L6	Antarctica	2.564	0.002564
67441	Elephant Moraine 14025	L6	Antarctica	2.5	0.0025
67065	Asuka 09600	L6	Antarctica	2.482	0.002482
36914	Yamato 980288	L6	Antarctica	2.474	0.002474
36912	Yamato 980286	L6	Antarctica	2.39	0.00239
44092	Yamato 003330	L6	Antarctica	2.377	0.002377
44269	Yamato 003507	L6	Antarctica	2.339	0.002339
44263	Yamato 003501	L6	Antarctica	2.323	0.002323
44134	Yamato 003372	L6	Antarctica	2.303	0.002303
44247	Yamato 003485	L6	Antarctica	2.287	0.002287
44326	Yamato 003564	L6	Antarctica	2.287	0.002287
44230	Yamato 003468	L6	Antarctica	2.232	0.002232
36897	Yamato 980271	L6	Antarctica	2.221	0.002221
44291	Yamato 003529	L6	Antarctica	2.221	0.002221
67481	Elephant Moraine 14070	L6	Antarctica	2.2	0.0022
36940	Yamato 980314	L6	Antarctica	2.18	0.00218
36862	Yamato 980236	L6	Antarctica	2.174	0.002174
44285	Yamato 003523	L6	Antarctica	2.171	0.002171
36921	Yamato 980295	L6	Antarctica	2.147	0.002147
44284	Yamato 003522	L6	Antarctica	2.133	0.002133
44272	Yamato 003510	L6	Antarctica	2.121	0.002121
67040	Asuka 09458	L6	Antarctica	2.106	0.002106
36794	Yamato 980168	L6	Antarctica	2.104	0.002104
67419	Elephant Moraine 14001	L6	Antarctica	2.1	0.0021
44231	Yamato 003469	L6	Antarctica	2.082	0.002082
67089	Asuka 09637	L6	Antarctica	2.073	0.002073
36888	Yamato 980262	L6	Antarctica	2.052	0.002052
36842	Yamato 980216	L6	Antarctica	2.009	0.002009
44124	Yamato 003362	L6	Antarctica	2	0.002
36903	Yamato 980277	L6	Antarctica	1.975	0.001975
67067	Asuka 09602	L6	Antarctica	1.961	0.001961
44244	Yamato 003482	L6	Antarctica	1.956	0.001956
36826	Yamato 980200	L6	Antarctica	1.952	0.001952
44195	Yamato 003433	L6	Antarctica	1.895	0.001895
44267	Yamato 003505	L6	Antarctica	1.889	0.001889
36875	Yamato 980249	L6	Antarctica	1.867	0.001867
42885	Yamato 002123	L6	Antarctica	1.851	0.001851
44308	Yamato 003546	L6	Antarctica	1.849	0.001849
44293	Yamato 003531	L6	Antarctica	1.837	0.001837

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44184	Yamato 003422	L6	Antarctica	1.835	0.001835
67019	Asuka 09406	L6	Antarctica	1.832	0.001832
36657	Yamato 980031	L6	Antarctica	1.816	0.001816
44257	Yamato 003495	L6	Antarctica	1.806	0.001806
36671	Yamato 980045	L6	Antarctica	1.741	0.001741
36847	Yamato 980221	L6	Antarctica	1.731	0.001731
36860	Yamato 980234	L6	Antarctica	1.723	0.001723
44268	Yamato 003506	L6	Antarctica	1.709	0.001709
44273	Yamato 003511	L6	Antarctica	1.709	0.001709
66917	Asuka 09264	L6	Antarctica	1.678	0.001678
44274	Yamato 003512	L6	Antarctica	1.665	0.001665
67042	Asuka 09460	L6	Antarctica	1.596	0.001596
44314	Yamato 003552	L6	Antarctica	1.487	0.001487
44252	Yamato 003490	L6	Antarctica	1.47	0.00147
44256	Yamato 003494	L6	Antarctica	1.449	0.001449
36892	Yamato 980266	L6	Antarctica	1.421	0.001421
67260	Asuka 12310	L6	Antarctica	1.397	0.001397
44297	Yamato 003535	L6	Antarctica	1.392	0.001392
44313	Yamato 003551	L6	Antarctica	1.367	0.001367
36854	Yamato 980228	L6	Antarctica	1.322	0.001322
44138	Yamato 003376	L6	Antarctica	1.29	0.00129
44205	Yamato 003443	L6	Antarctica	1.282	0.001282
44254	Yamato 003492	L6	Antarctica	1.273	0.001273
44111	Yamato 003349	L6	Antarctica	1.255	0.001255
44260	Yamato 003498	L6	Antarctica	1.251	0.001251
44316	Yamato 003554	L6	Antarctica	1.251	0.001251
68077	Miller Range 15416	L6	Antarctica	1.25	0.00125
44229	Yamato 003467	L6	Antarctica	1.25	0.00125
44286	Yamato 003524	L6	Antarctica	1.236	0.001236
44243	Yamato 003481	L6	Antarctica	1.204	0.001204
44315	Yamato 003553	L6	Antarctica	1.186	0.001186
67041	Asuka 09459	L6	Antarctica	1.168	0.001168
67043	Asuka 09461	L6	Antarctica	1.147	0.001147
44290	Yamato 003528	L6	Antarctica	1.143	0.001143
67130	Asuka 10221	L6	Antarctica	1.111	0.001111
67063	Asuka 09558	L6	Antarctica	1.089	0.001089
36628	Yamato 980002	L6	Antarctica	1.076	0.001076
68094	Miller Range 15567	L6	Antarctica	1.07	0.00107
36829	Yamato 980203	L6	Antarctica	1.041	0.001041
44328	Yamato 003566	L6	Antarctica	1.036	0.001036
67068	Asuka 09604	L6	Antarctica	1.02	0.00102
68084	Miller Range 15436	L6	Antarctica	1.01	0.00101
42913	Yamato 002151	L6	Antarctica	0.999	0.000999
36974	Yamato 980349	L6	Antarctica	0.969	0.000969
44248	Yamato 003486	L6	Antarctica	0.967	0.000967

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67121	Asuka 10062	L6	Antarctica	0.888	0.000888
44097	Yamato 003335	L6	Antarctica	0.873	0.000873
44197	Yamato 003435	L6	Antarctica	0.857	0.000857
67045	Asuka 09463	L6	Antarctica	0.854	0.000854
44289	Yamato 003527	L6	Antarctica	0.837	0.000837
66733	Elephant Moraine 16207	L6	Antarctica	0.835	0.000835
44317	Yamato 003555	L6	Antarctica	0.826	0.000826
44259	Yamato 003497	L6	Antarctica	0.821	0.000821
36915	Yamato 980289	L6	Antarctica	0.815	0.000815
67046	Asuka 09464	L6	Antarctica	0.795	0.000795
44319	Yamato 003557	L6	Antarctica	0.783	0.000783
44281	Yamato 003519	L6	Antarctica	0.775	0.000775
44135	Yamato 003373	L6	Antarctica	0.77	0.00077
44084	Yamato 003322	L6	Antarctica	0.768	0.000768
44069	Yamato 003307	L6	Antarctica	0.752	0.000752
44275	Yamato 003513	L6	Antarctica	0.748	0.000748
67069	Asuka 09605	L6	Antarctica	0.744	0.000744
67044	Asuka 09462	L6	Antarctica	0.728	0.000728
44203	Yamato 003441	L6	Antarctica	0.701	0.000701
67421	Elephant Moraine 14003	L6	Antarctica	0.7	0.0007
43858	Yamato 003096	L6	Antarctica	0.674	0.000674
44071	Yamato 003309	L6	Antarctica	0.657	0.000657
44188	Yamato 003426	L6	Antarctica	0.648	0.000648
44266	Yamato 003504	L6	Antarctica	0.585	0.000585
44276	Yamato 003514	L6	Antarctica	0.585	0.000585
44277	Yamato 003515	L6	Antarctica	0.58	0.00058
44329	Yamato 003567	L6	Antarctica	0.521	0.000521
66720	Miller Range 15225	L6	Antarctica	0.52	0.00052
44255	Yamato 003493	L6	Antarctica	0.493	0.000493
67070	Asuka 09606	L6	Antarctica	0.48	0.00048
67047	Asuka 09470	L6	Antarctica	0.459	0.000459
36630	Yamato 980004	L6	Antarctica	0.445	0.000445
66729	Elephant Moraine 16202	L6	Antarctica	0.444	0.000444
44113	Yamato 003351	L6	Antarctica	0.444	0.000444
36894	Yamato 980268	L6	Antarctica	0.43	0.00043
36816	Yamato 980190	L6	Antarctica	0.427	0.000427
66736	Elephant Moraine 16210	L6	Antarctica	0.425	0.000425
66734	Elephant Moraine 16208	L6	Antarctica	0.419	0.000419
36959	Yamato 980334	L6	Antarctica	0.416	0.000416
44078	Yamato 003316	L6	Antarctica	0.406	0.000406
44320	Yamato 003558	L6	Antarctica	0.406	0.000406
66900	Asuka 09237	L6	Antarctica	0.404	0.000404
44172	Yamato 003410	L6	Antarctica	0.401	0.000401
43232	Yamato 002470	L6	Antarctica	0.384	0.000384
44193	Yamato 003431	L6	Antarctica	0.362	0.000362

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43814	Yamato 003052	L6	Antarctica	0.353	0.000353
44152	Yamato 003390	L6	Antarctica	0.351	0.000351
44185	Yamato 003423	L6	Antarctica	0.348	0.000348
44162	Yamato 003400	L6	Antarctica	0.345	0.000345
44169	Yamato 003407	L6	Antarctica	0.341	0.000341
44044	Yamato 003282	L6	Antarctica	0.336	0.000336
40937	Yamato 000172	L6	Antarctica	0.329	0.000329
44174	Yamato 003412	L6	Antarctica	0.314	0.000314
44046	Yamato 003284	L6	Antarctica	0.309	0.000309
43686	Yamato 002924	L6	Antarctica	0.304	0.000304
44077	Yamato 003315	L6	Antarctica	0.247	0.000247
44233	Yamato 003471	L6	Antarctica	0.204	0.000204
44082	Yamato 003320	L6	Antarctica	0.175	0.000175
44087	Yamato 003325	L6	Antarctica	0.165	0.000165
67645	Northwest Africa 11849	L6-an	(Northwest Af	335.4	0.3354
67739	Vaquillas 006	L6-melt brecc	Chile	4400	4.4
67677	San Juan 086	L6-melt brecc	Chile	490	0.49
67389	Los Vientos 216	L6-melt brecc	Chile	24	0.024
66474	Northwest Africa 11617	LL(L)3	(Northwest Af	1200	1.2
66469	Northwest Africa 11611	LL(L)3	(Northwest Af	232	0.232
68128	Kumtag 040	LL~4	China	560	0.56
68292	Northwest Africa 11975	LL~5	(Northwest Af	95.8	0.0958
68429	Alaer 003	LL~6	China	85.4	0.0854
68433	Xinjiang 010	LL~6	China	71.5	0.0715
68653	Yangguanzhen 001	LL~6	China	8.66	0.00866
66489	Northwest Africa 11669	LL3	(Northwest Af	23000	23
67720	Northwest Africa 11908	LL3	(Northwest Af	12338	12.338
68599	Northwest Africa 12009	LL3	(Northwest Af	5751	5.751
66417	Northwest Africa 11615	LL3	(Northwest Af	3114	3.114
67857	Northwest Africa 11967	LL3	(Northwest Af	2347.3	2.3473
67570	Gandom Beryan 011	LL3	Iran	2067	2.067
67719	Northwest Africa 11907	LL3	(Northwest Af	1326.7	1.3267
68294	Northwest Africa 11991	LL3	(Northwest Af	1020	1.02
68497	Northwest Africa 12284	LL3	(Northwest Af	832.5	0.8325
68295	Northwest Africa 11992	LL3	(Northwest Af	337	0.337
67827	Northwest Africa 11954	LL3	(Northwest Af	270	0.27
68425	Northwest Africa 12291	LL3	(Northwest Af	259	0.259
68318	Northwest Africa 12234	LL3	Algeria	257	0.257
67599	Scottsdale	LL3	United States	210.8	0.2108
67152	Asuka 12050	LL3	Antarctica	183.05	0.18305
68331	Northwest Africa 12244	LL3	Morocco	174.8	0.1748
67512	Northwest Africa 11812	LL3	(Northwest Af	144.6	0.1446
32069	Northwest Africa 1096	LL3	(Northwest Af	120	0.12
66408	Northwest Africa 11590	LL3	(Northwest Af	105.5	0.1055
67804	Northwest Africa 11976	LL3	(Northwest Af	78.6	0.0786

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68299	Northwest Africa 12185	LL3	(Northwest At	45	0.045
68539	Coya Sur 004	LL3	Chile	40	0.04
67347	Asuka 12405	LL3	Antarctica	32.443	0.032443
68485	Northwest Africa 12281	LL3	(Northwest At	30.6	0.0306
67513	Northwest Africa 11813	LL3	(Northwest At	25.3	0.0253
67477	Elephant Moraine 14064	LL3	Antarctica	23	0.023
67433	Elephant Moraine 14017	LL3	Antarctica	11.8	0.0118
67630	Northwest Africa 11873	LL3-6	(Northwest At	7630	7.63
67639	Northwest Africa 11831	LL3-6	(Northwest At	65	0.065
67408	Northwest Africa 11752	LL3.05	(Northwest At	39.5	0.0395
67797	Northwest Africa 11905	LL3.10-5	(Northwest At	6974	6.974
67740	Catalina 278	LL3.4	Chile	10720	10.72
66571	Dominion Range 14183	LL3.7	Antarctica	20.26	0.02026
66666	Dominion Range 14458	LL3.7	Antarctica	9.51	0.00951
66749	Northwest Africa 11651	LL4	(Northwest At	7250	7.25
67668	Northwest Africa 11882	LL4	(Northwest At	1200	1.2
68360	Los Vientos 236	LL4	Chile	1073	1.073
68401	Northwest Africa 12254	LL4	(Northwest At	427	0.427
67765	Northwest Africa 11944	LL4	(Northwest At	397.2	0.3972
67693	Al Khuwaymat 002	LL4	Libya	274	0.274
67865	Northwest Africa 12017	LL4	(Northwest At	130.78	0.13078
66465	Northwest Africa 11665	LL4	(Northwest At	108.4	0.1084
67146	Asuka 12038	LL4	Antarctica	81.98	0.08198
36611	Belgica 9819	LL4	Antarctica	80.76	0.08076
67335	Asuka 12392	LL4	Antarctica	67.72	0.06772
67360	Asuka 12418	LL4	Antarctica	53.29	0.05329
67935	Dominion Range 14342	LL4	Antarctica	42.705	0.042705
67336	Asuka 12393	LL4	Antarctica	38.633	0.038633
67337	Asuka 12394	LL4	Antarctica	28.981	0.028981
67358	Asuka 12416	LL4	Antarctica	28.652	0.028652
67357	Asuka 12415	LL4	Antarctica	27.419	0.027419
67359	Asuka 12417	LL4	Antarctica	24.169	0.024169
67651	Northwest Africa 11874	LL4	(Northwest At	19.75	0.01975
66517	Dominion Range 14036	LL4	Antarctica	17.89	0.01789
66790	MacKay Glacier 14020	LL4	Antarctica	2.9	0.0029
68083	Miller Range 15433	LL4	Antarctica	1.04	0.00104
67723	Northwest Africa 11915	LL4-6	(Northwest At	718	0.718
68509	Northwest Africa 12361	LL4-6	(Northwest At	583	0.583
67766	Northwest Africa 11948	LL4-6	(Northwest At	260	0.26
67133	Asuka 12013	LL4-6	Antarctica	164.61	0.16461
66439	Northwest Africa 11645	LL4-6	(Northwest At	154.5	0.1545
67307	Asuka 12362	LL4-6	Antarctica	80.52	0.08052
66430	Northwest Africa 11629	LL4-6	(Northwest At	61	0.061
67338	Asuka 12395	LL4-6	Antarctica	37.259	0.037259
31631	Northwest Africa 438	LL5	(Northwest At	3000	3

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66482	Northwest Africa 11643	LL5	(Northwest Africa)	2428	2.428
68510	Northwest Africa 12337	LL5	(Northwest Africa)	1269	1.269
67155	Asuka 12059	LL5	Antarctica	381.62	0.38162
67302	Asuka 12357	LL5	Antarctica	348.31	0.34831
66762	Northwest Africa 11664	LL5	(Northwest Africa)	262	0.262
68099	Elephant Moraine 16040	LL5	Antarctica	218.38	0.21838
67717	Calama 011	LL5	Chile	181	0.181
66630	Dominion Range 14304	LL5	Antarctica	160.89	0.16089
66424	Northwest Africa 11624	LL5	(Northwest Africa)	147.1	0.1471
68306	Calama 020	LL5	Chile	144	0.144
68203	Northwest Africa 12092	LL5	Algeria	136.64	0.13664
67303	Asuka 12358	LL5	Antarctica	126.26	0.12626
67365	Asuka 12423	LL5	Antarctica	99.17	0.09917
66631	Dominion Range 14306	LL5	Antarctica	74.465	0.074465
68403	Northwest Africa 12256	LL5	(Northwest Africa)	72.4	0.0724
67356	Asuka 12414	LL5	Antarctica	46.888	0.046888
66602	Dominion Range 14226	LL5	Antarctica	43.339	0.043339
66824	El Médano 376	LL5	Chile	38	0.038
67364	Asuka 12422	LL5	Antarctica	26.639	0.026639
66418	Northwest Africa 11618	LL5	(Northwest Africa)	26.13	0.02613
67372	Asuka 12431	LL5	Antarctica	19.572	0.019572
66624	Dominion Range 14279	LL5	Antarctica	13.818	0.013818
67334	Asuka 12391	LL5	Antarctica	11.376	0.011376
67366	Asuka 12424	LL5	Antarctica	8.065	0.008065
66618	Dominion Range 14273	LL5	Antarctica	7.001	0.007001
66859	Catalina 256	LL5	Chile	5.1	0.0051
67344	Asuka 12402	LL5	Antarctica	4.67	0.00467
36605	Belgica 9813	LL5	Antarctica	3.587	0.003587
68441	Northwest Africa 11811	LL5-an	(Northwest Africa)	182.4	0.1824
68507	Northwest Africa 12358	LL5/6	(Northwest Africa)	69.6	0.0696
68506	Northwest Africa 12357	LL5/6	(Northwest Africa)	62	0.062
68602	Mahbas Arraid	LL6	Western Sahara	5500	5.5
67600	Northwest Africa 11838	LL6	(Northwest Africa)	2489	2.489
67864	Northwest Africa 12016	LL6	(Northwest Africa)	1035.47	1.03547
67863	Northwest Africa 12015	LL6	(Northwest Africa)	1025.11	1.02511
66420	Northwest Africa 11620	LL6	(Northwest Africa)	724.22	0.72422
68127	Northwest Africa 12020	LL6	(Northwest Africa)	576	0.576
66752	Northwest Africa 11654	LL6	(Northwest Africa)	570	0.57
67163	Asuka 12129	LL6	Antarctica	468.39	0.46839
67142	Asuka 12030	LL6	Antarctica	337.58	0.33758
66500	Northwest Africa 11684	LL6	(Northwest Africa)	304	0.304
67368	Asuka 12426	LL6	Antarctica	281.4	0.2814
67756	Northwest Africa 11932	LL6	(Northwest Africa)	250	0.25
66419	Northwest Africa 11619	LL6	(Northwest Africa)	216.93	0.21693
67653	Northwest Africa 11876	LL6	(Northwest Africa)	203.44	0.20344

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67353	Asuka 12411	LL6	Antarctica	186.87	0.18687
67154	Asuka 12058	LL6	Antarctica	161.31	0.16131
68392	San Juan 096	LL6	Chile	157	0.157
68324	Northwest Africa 12007	LL6	(Northwest Af	155.6	0.1556
66628	Dominion Range 14302	LL6	Antarctica	150.64	0.15064
66753	Northwest Africa 11655	LL6	(Northwest Af	149	0.149
66432	Northwest Africa 11631	LL6	(Northwest Af	145	0.145
66767	Northwest Africa 11715	LL6	(Northwest Af	136	0.136
66629	Dominion Range 14303	LL6	Antarctica	133.43	0.13343
67143	Asuka 12032	LL6	Antarctica	121.02	0.12102
67355	Asuka 12413	LL6	Antarctica	119.5	0.1195
66761	Northwest Africa 11663	LL6	(Northwest Af	104	0.104
68402	Northwest Africa 12255	LL6	(Northwest Af	102.1	0.1021
68428	Northwest Africa 12295	LL6	(Northwest Af	99	0.099
67186	Asuka 12235	LL6	Antarctica	93.89	0.09389
67354	Asuka 12412	LL6	Antarctica	88.02	0.08802
68435	Northwest Africa 12298	LL6	(Northwest Af	87.6	0.0876
66768	Northwest Africa 11716	LL6	(Northwest Af	78.7	0.0787
67833	Northwest Africa 11963	LL6	(Northwest Af	73	0.073
67362	Asuka 12420	LL6	Antarctica	71.46	0.07146
66599	Dominion Range 14223	LL6	Antarctica	64.981	0.064981
66433	Northwest Africa 11632	LL6	(Northwest Af	61	0.061
67363	Asuka 12421	LL6	Antarctica	57.966	0.057966
67352	Asuka 12410	LL6	Antarctica	51.003	0.051003
67376	Asuka 12435	LL6	Antarctica	50.285	0.050285
67201	Asuka 12250	LL6	Antarctica	45.093	0.045093
67343	Asuka 12401	LL6	Antarctica	39.869	0.039869
67375	Asuka 12434	LL6	Antarctica	35.703	0.035703
67194	Asuka 12243	LL6	Antarctica	34.533	0.034533
67345	Asuka 12403	LL6	Antarctica	34.092	0.034092
66429	Northwest Africa 11628	LL6	(Northwest Af	33	0.033
66763	Northwest Africa 11702	LL6	Mauritania	33	0.033
67266	Asuka 12317	LL6	Antarctica	30.565	0.030565
68289	Northwest Africa 12178	LL6	Algeria	27.51	0.02751
67254	Asuka 12304	LL6	Antarctica	23.685	0.023685
66771	Northwest Africa 11719	LL6	(Northwest Af	23.5	0.0235
67209	Asuka 12258	LL6	Antarctica	21.831	0.021831
66769	Northwest Africa 11717	LL6	(Northwest Af	21.5	0.0215
43960	Yamato 003198	LL6	Antarctica	21.03	0.02103
67216	Asuka 12265	LL6	Antarctica	18.957	0.018957
67192	Asuka 12241	LL6	Antarctica	15.067	0.015067
67188	Asuka 12237	LL6	Antarctica	14.465	0.014465
66621	Dominion Range 14276	LL6	Antarctica	13.744	0.013744
66622	Dominion Range 14277	LL6	Antarctica	13.683	0.013683
66770	Northwest Africa 11718	LL6	(Northwest Af	12.3	0.0123

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66617	Dominion Range 14272	LL6	Antarctica	10.907	0.010907
66620	Dominion Range 14275	LL6	Antarctica	10.253	0.010253
26889	Yamato 791540	LL6	Antarctica	9.95	0.00995
2671	Asuka 87314	LL6	Antarctica	8.446	0.008446
68046	Miller Range 15251	LL6	Antarctica	8.337	0.008337
67367	Asuka 12425	LL6	Antarctica	6.593	0.006593
66619	Dominion Range 14274	LL6	Antarctica	6.39	0.00639
66604	Dominion Range 14228	LL6	Antarctica	5.52	0.00552
67374	Asuka 12433	LL6	Antarctica	5.397	0.005397
67994	Dominion Range 14445	LL6	Antarctica	5.091	0.005091
36964	Yamato 980339	LL6	Antarctica	4.626	0.004626
43961	Yamato 003199	LL6	Antarctica	4.151	0.004151
36917	Yamato 980291	LL6	Antarctica	1.803	0.001803
36672	Yamato 980046	LL6	Antarctica	1.419	0.001419
43614	Yamato 002852	LL6	Antarctica	0.32	0.00032
67415	Reckling Peak 14002	LL6	Antarctica	0.2	0.0002
67808	Northwest Africa 11776	LL6-an	(Northwest Africa)	100.7	0.1007
66838	Northwest Africa 11730	LL6-melt breccia	(Northwest Africa)	315.4	0.3154
68525	Northwest Africa 12272	LL7	(Northwest Africa)	153	0.153
67741	Los Vientos 231	LL7	Chile	127	0.127
67648	Northwest Africa 11852	LL7	(Northwest Africa)	45	0.045
67644	Northwest Africa 11848	Lodranite	(Northwest Africa)	2064	2.064
67559	Northwest Africa 11795	Lodranite	(Northwest Africa)	1270	1.27
67832	Northwest Africa 11960	Lodranite	(Northwest Africa)	1265	1.265
67786	Northwest Africa 11901	Lodranite	Western Sahara	662	0.662
67860	Northwest Africa 11970	Lodranite	(Northwest Africa)	180.9	0.1809
42382	Yamato 001620	Lodranite	Antarctica	9.533	0.009533
42084	Yamato 001322	Lodranite	Antarctica	5.232	0.005232
66625	Dominion Range 14289	Lodranite	Antarctica	3.42	0.00342
66473	Northwest Africa 11616	Lunar	(Northwest Africa)	2550.8	2.5508
67854	Northwest Africa 11962	Lunar	(Northwest Africa)	85.8	0.0858
67597	Northwest Africa 11801	Lunar	Algeria	67.05	0.06705
67742	Northwest Africa 11886	Lunar	(Northwest Africa)	36	0.036
67496	Northwest Africa 11767	Lunar	(Northwest Africa)	15	0.015
68325	Northwest Africa 12008	Lunar (basalt)	Morocco	577	0.577
67552	Northwest Africa 11787	Lunar (feldsp)	Mauritania	23500	23.5
67553	Northwest Africa 11788	Lunar (feldsp)	Mali	10441	10.441
66745	Northwest Africa 11303	Lunar (feldsp)	(Northwest Africa)	6000	6
67554	Northwest Africa 11789	Lunar (feldsp)	Mauritania	5492	5.492
67609	Northwest Africa 11828	Lunar (feldsp)	(Northwest Africa)	5340	5.34
68546	Northwest Africa 12368	Lunar (feldsp)	(Northwest Africa)	1868	1.868
68610	Northwest Africa 12279	Lunar (feldsp)	Algeria	1830	1.83
68526	Northwest Africa 12270	Lunar (feldsp)	Mauritania	1300	1.3
33042	Northwest Africa 2425	lunar (feldsp)	(Northwest Africa)	810	0.81
67784	Northwest Africa 11898	Lunar (feldsp)	Mali	767.8	0.7678

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66487	Aridal 017	Lunar (feldsp Western Sahara)	590	0.59
67858	Northwest Africa 11968	Lunar (Feldsp(Northwest Africa))	427.8	0.4278
66802	Northwest Africa 11695	Lunar (feldsp Algeria)	350	0.35
67647	Northwest Africa 11851	Lunar (feldsp Mali)	227	0.227
67856	Northwest Africa 11966	Lunar (Feldsp(Northwest Africa))	157.13	0.15713
66414	Errachidia	Lunar (feldsp Morocco)	156	0.156
66746	Northwest Africa 11517	Lunar (feldsp (Northwest Africa))	88	0.088
67591	Northwest Africa 11809	Lunar (feldsp (Northwest Africa))	67	0.067
67548	Northwest Africa 11783	Lunar (Feldsp(Northwest Africa))	65	0.065
66393	Northwest Africa 11563	Lunar (feldsp (Northwest Africa))	54.5	0.0545
68495	Northwest Africa 12248	Lunar (feldsp Mauritania)	37.3	0.0373
67681	Northwest Africa 11871	Lunar (feldsp Algeria)	21.9	0.0219
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67379	Caleta el Cobre 022	Martian (nakl Chile)	474	0.474
67783	Northwest Africa 11896	Martian (poly(Northwest Africa))	14	0.014
67818	Northwest Africa 11921	Martian (poly(Northwest Africa))	7.7	0.0077
67853	Rabt Sbayta 010	Martian (poly)Western Sahara	6.1	0.0061
68472	Northwest Africa 12222	Martian (poly(Northwest Africa))	1.9	0.0019
68545	Northwest Africa 12335	Martian (sher(Northwest Africa))	3970.7	3.9707
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68604	Northwest Africa 12262	Martian (sher(Northwest Africa))	3294	3.294
68608	Northwest Africa 12269	Martian (sher(Northwest Africa))	1679	1.679
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67814	Jiddat al Harasis 846	OC3 Oman	260.1	0.2601
68410	Northwest Africa 12186	Pallasite (Northwest Africa)	682	0.682
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68615	Northwest Africa 12288	Pallasite (Northwest Africa)	29	0.029
67809	Chasseron	Pallasite, PM Switzerland	4.867	0.004867

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67732	La'gad 002	Pallasite, PMWestern Saha	16.63	0.01663
66836	Northwest Africa 11721	R3 (Northwest Af	5345	5.345
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67796	Northwest Africa 11900	Ureilite Western Saha	457	0.457
68411	Northwest Africa 12189	Ureilite Algeria	435	0.435
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67734	Northwest Africa 11891	Ureilite (Northwest Af	289.7	0.2897
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67565	Elephant Moraine 14053	Ureilite Antarctica	252.3	0.2523
68296	Northwest Africa 11993	Ureilite (Northwest Af	245	0.245
67549	Northwest Africa 11784	Ureilite (Northwest Af	234.6	0.2346
66477	Jiddat al Harasis 1103	Ureilite Oman	225.8	0.2258
68486	Northwest Africa 12188	Ureilite Mauritania	209	0.209
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68636	Northwest Africa 12321	Ureilite (Northwest Af	194	0.194
68409	Northwest Africa 12183	Ureilite (Northwest Af	167	0.167
68531	San Juan 100	Ureilite Chile	160.7	0.1607
67733	Northwest Africa 11890	Ureilite (Northwest Af	150.2	0.1502

66388	Jiddat al Harasis 1102	Ureilite	Oman	95	0.095
67545	Northwest Africa 11755	Ureilite	Morocco	83	0.083
67737	Northwest Africa 11894	Ureilite	(Northwest Africa)	72.3	0.0723
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67503	Northwest Africa 11775	Ureilite	Morocco	63	0.063
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66467	Northwest Africa 11608	Ureilite	(Northwest Africa)	53	0.053
66483	Northwest Africa 11644	Ureilite	(Northwest Africa)	41.2	0.0412
66773	Ramlat as Sahmah 530	Ureilite	Oman	30	0.03
41378	Yamato 000614	Ureilite	Antarctica	4.684	0.004684
67122	Asuka 10104	Ureilite	Antarctica	0.766	0.000766
67539	Northwest Africa 11511	Ureilite-an	Algeria	527	0.527
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44	Eucrite		A 12043	J26	JB	2018-04-18
45	Eucrite		NWA 11593			2018-02-09
46	Eucrite		A 12285	J26	JB	2018-04-18
47	Eucrite		NWA 12226			2018-11-13

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Euclite	NWA 11748				2018-04-19
Euclite	NWA 11599				2018-02-09
Euclite	A 12282	J26		JB	2018-04-18
Euclite	NWA 12293				2018-12-11
Euclite	A 12374	J26		JB	2018-04-18
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Euclite	NWA 11602				2018-02-09
Euclite	NWA 11601				2018-02-09
Euclite	A-881487	J26		J	2018-04-18
Euclite	Y-001232	J26		J	2018-04-18
Euclite	A-881878	J26		J	2018-04-18
Euclite	NWA 11603				2018-02-09
Euclite	A 12407	J26		JB	2018-04-18
Euclite	Y-003354	J26		J	2018-04-18
Euclite	A 10228	J26		JB	2018-04-18
Euclite	Y-980315	J26		J	2018-04-18
Euclite	Y-980189	J26		J	2018-04-18
Euclite	Y-980337	J26		J	2018-04-18
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Euclite-br	NWA 8681				2018-03-13
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Euclite-br	NWA 12182				2018-11-09
Euclite-br	NWA 11762				2018-05-11
Euclite-br	NWA 5908				2018-03-27
Euclite-br	NWA 11763				2018-05-11
Euclite-cm	NWA 2426				2018-05-11
Euclite-melt breccia	NWA 11576				2018-01-22
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Euclite-melt breccia	NWA 11742				2018-04-07
Euclite-melt breccia	NWA 12342				2018-12-14
Euclite-melt breccia	NWA 12223				2018-11-13
Euclite-mmict	NWA 12011				2018-10-27
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Euclite-mmict	NWA 11958				2018-09-15
Euclite-mmict	NWA 11953				2018-09-15
Euclite-mmict	NWA 11698				2018-03-27
Euclite-mmict	NWA 11786				2018-05-26
Euclite-mmict				Antofagasta	2018-08-31

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6	Eucrite-pmict	NWA 11701			2018-03-27
7	Eucrite-pmict	NWA 12339			2018-12-11
8	Eucrite-pmict	NWA 11861			2018-07-17
9	Eucrite-pmict	NWA 11677			2018-03-27
10	Eucrite-pmict	NWA 12344			2018-12-14
11	Eucrite-pmict	NWA 12193			2018-11-09
12	Eucrite-pmict			Luxembourg	2018-09-27
13	Eucrite-pmict	NWA 12225			2018-11-13
14	Eucrite-pmict	NWA 12243			2018-11-24
15	Eucrite-pmict	NWA 11753			2018-05-26
16	Eucrite-pmict	NWA 11934			2018-08-31
17	Eucrite-pmict	NWA 12282			2018-12-02
18	Eucrite-pmict	GRO 17168	41(2)	A	2018-09-28
19	Eucrite-pmict	GRO 17176	41(2)	A	2018-09-28
20	Eucrite-pmict	NWA 12202			2018-11-18
21	Eucrite-pmict	NWA 12326			2018-12-11
22	Eucrite-pmict	NWA 12340			2018-12-14
23	Eucrite-pmict	GRO 17049	41(2)	A	2018-09-28
24	Eucrite-pmict	NWA 12195			2018-11-09
25	Eucrite-pmict	GRO 17211	41(2)	A	2018-09-28
26	Eucrite-pmict	GRO 17006	41(2)	A	2018-09-28
27	Eucrite-pmict	NWA 11647			2018-02-20
28	Eucrite-pmict	GRO 17099	41(2)	A	2018-09-28
29	Eucrite-pmict	GRO 17189	41(2)	A	2018-09-28
30	Eucrite-pmict	GRO 17048	41(2)	A	2018-09-28
31	Eucrite-pmict	NWA 12327			2018-12-11
32	Eucrite-pmict			Draâ-Tafilalet	2018-08-31
33	Eucrite-pmict	GRO 17039	41(2)	A	2018-09-28
34	Eucrite-unbr	NWA 11969			2018-09-23
35	Eucrite-unbr	NWA 11846			2018-07-04
36	Eucrite-unbr	NWA 11749			2018-04-19
37	Eucrite-unbr	GRO 17210	41(2)	A	2018-09-28
38	Eucrite-unbr	NWA 12246			2018-12-11
39	Eucrite-unbr	NWA 12201			2018-11-09
40	Eucrite-unbr	GRO 17070	41(2)	A	2018-09-28
41	Eucrite-unbr	GRO 17200	41(2)	A	2018-09-28
42	Eucrite-unbr	NWA 11897			2018-09-02
43	Eucrite-unbr	GRO 17098	41(2)	A	2018-09-28
44	H	A 12036	J26	JB	2018-04-18
45	H	A 09242	J26	JB	2018-04-18
46	H/L4	NWA 11570			2018-01-16
47	H~4	NWA 11579			2018-01-15

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H~5				Xinjiang	2018-12-16
H~6	NWA 12299				2018-11-09
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H~6				Gansu	2018-12-16
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H~6	NWA 11979				2018-09-02
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H3				Ouargla	2018-06-10
H3				Ajdabiya	2018-07-17
H3	NWA 11936				2018-08-03
H3				Antofagasta	2018-05-28
H3	NWA 432				2018-10-20
H3	EM 377			Antofagasta	2018-03-27
H3	NWA 11923				2018-08-03
H3	RKP 14003	-	K		2018-04-23
H3	StV 024			Nevada	2018-07-20
H3	A 12327	J26	JB		2018-04-18
H3	NWA 11924				2018-08-03
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H3	A 12323	J26	JB		2018-04-18
H3				Alabama	2018-04-19
H3	A 12330	J26	JB		2018-04-18
H3	RKP 14006	-	K		2018-04-23
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H3-6				Antofagasta	2018-04-19
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6	H3.5	DOM 14429	41(2)	A		2018-09-28
7	H3.5	DOM 14491	41(2)	A		2018-09-28
8	H4	NWA 11700				2018-04-07
9	H4					
10	H4				Antofagasta	2018-09-15
11	H4	NWA 12350				2018-11-27
12	H4				Jarayan al Ba	2018-04-07
13	H4					
14	H4					2018-07-20
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16	H4				Ash Shamal	2018-04-07
17	H4	NWA 12240				2018-10-20
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22	H4	NWA 12152				2018-10-08
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24	H4				Michigan	2018-03-02
25	H4	LoV 259			Antofagasta	2018-12-06
26	H4	NWA 12150				2018-10-08
27	H4	NWA 660				2018-10-20
28	H4	NWA 11935				2018-08-03
29	H4	A 12309	J26	JB		2018-04-18
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31	H4	NWA 453				2018-10-20
32	H4	NWA 12349				2018-11-27
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34	H4				Ajdabiya	2018-07-17
35	H4	Y-002482	J26	J		2018-04-18
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37	H4				QingHai	2018-11-09
38	H4	LoV 239			Antofagasta	2018-11-08
39	H4	NWA 435				2018-10-20
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41	H4	A 12383	J26	JB		2018-04-18
42	H4	NWA 452				2018-10-20
43	H4	NWA 12027				2018-10-08
44	H4	DOM 14461	41(1)	A		2018-02-23
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46	H4				Ajdabiya	2018-07-17
47	H4	NWA 11819				2018-05-26
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52	H4	NWA 12115				2018-10-08
53	H4	NWA 11941				2018-08-03
54	H4	A 12136	J26	JB		2018-04-18
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56	H4	NWA 12028				2018-10-08
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H4	NWA 317				2018-10-20
H4	NWA 12251			Morocco, Lae	2018-11-08
H4	NWA 12024				2018-10-08
H4	NWA 12117				2018-10-08
H4				Antofagasta	2018-11-08
H4	NWA 12078				2018-10-08
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H4				Ajdabiya	2018-07-17
H4	LoV 230			Antofagasta	2018-07-17
H4	NWA 12031				2018-10-08
H4	A 12316	J26		JB	2018-04-18
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H4	A 12226	J26		JB	2018-04-18
H4	NWA 12098				2018-10-08
H4	A 12053	J26		JB	2018-04-18
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H4	NWA 12159				2018-10-08
H4	A 12419	J26		JB	2018-04-18
H4	NWA 12141				2018-10-08
H4	NWA 12057				2018-10-08
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H4	A 12026	J26		JB	2018-04-18

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13	H4		A 12252	J26	JB	2018-04-18
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19	H4		A 12251	J26	JB	2018-04-18
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21	H4		A 12346	J26	JB	2018-04-18
22	H4		A 12329	J26	JB	2018-04-18
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24	H4		DOM 14188	41(2)	A	2018-09-28
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29	H4		A 12299	J26	JB	2018-04-18
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15	H4		Y-001977	J26	J	2018-04-18
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21	H4-5				Para	2018-12-02
22	H4-6		A 12239	J26	JB	2018-04-18
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24	H4/5		NWA 11705			2018-03-27
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29	H4/5				Antofagasta	2018-07-08
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35	H5				Antofagasta	2018-11-08
36	H5		EET 14043	-	K	2018-04-23
37	H5		EM 379		Antofagasta	2018-04-19
38	H5				Victoria	2018-12-11
39	H5		EET 14032	-	K	2018-04-23
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41	H5		DOM 14001	41(2)	A	2018-09-28
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46	H5		NWA 12215			2018-10-16
47	H5		DaG 1069		Al Jufrah	2018-02-24

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H5	NWA 12359				2018-11-27
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H5	NWA 12022				2018-10-08
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H5	A 12027	J26		JB	2018-04-18
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H5	NWA 12125				2018-10-08
H5	NWA 12083				2018-10-08
H5				Ajdabiya	2018-07-17
H5	A 12219	J26		JB	2018-04-18
H5				Antofagasta	2018-07-24
H5				Jarayan al B	2018-07-20
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46	H5				Kerman	2018-03-27
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48	H5	LoV 242			Antofagasta	2018-11-08
49	H5				Antofagasta	2018-05-11
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56	H5	LoV 232			Antofagasta	2018-11-08
57	H5	NWA 11822				2018-05-26
58	H5	NWA 11685				2018-02-20
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H5		DOM 14186	41(1)		A	2018-02-23
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21	H5		MIL 15398	41(2)	A	2018-09-28
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35	H5		DOM 14263	41(2)	A	2018-09-28
36	H5		MIL 15091	41(2)	A	2018-09-28
37	H5		DOM 14187	41(1)	A	2018-02-23
38	H5		DOM 14261	41(2)	A	2018-09-28
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15	H5	A-87081	J26	J		2018-04-18
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18	H5	A 12294	J26	JB		2018-04-18
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28	H5	Y-792572	J26	J		2018-04-18
29	H5	Y-792566	J26	J		2018-04-18
30	H5	Y-002796	J26	J		2018-04-18
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35	H5	Y-000811	J26	J		2018-04-18
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37	H5	Y-001403	J26	J		2018-04-18
38	H5	A 09253	J26	JB		2018-04-18
39	H5	A 09316	J26	JB		2018-04-18
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41	H5	A 09201	J26	JB		2018-04-18
42	H5	A 09277	J26	JB		2018-04-18
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44	H5	Y-000743	J26	J		2018-04-18
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37	H5		A 09326	J26	JB	2018-04-18
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38	H6		LoV 245		Antofagasta	2018-11-08
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7	H6		LoV 240		Antofagasta	2018-11-08
8	H6		A 12201	J26	JB	2018-04-18
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12	H6		NWA 12105			2018-10-08
13	H6				Antofagasta	2018-11-08
14	H6		NWA 12336			2018-11-24
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19	H6		LoV 226		Antofagasta	2018-05-11
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21	H6		NWA 12171			2018-10-08
22	H6		NWA 12049			2018-10-08
23	H6		NWA 12088			2018-10-08
24	H6		NWA 12130			2018-10-08
25	H6		NWA 12084			2018-10-08
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27	H6		A 12363	J26	JB	2018-04-18
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31	H6		NWA 12139			2018-10-08
32	H6		NWA 12072			2018-10-08
33	H6		A 12429	J26	JB	2018-04-18
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35	H6		DOM 14416	41(2)	A	2018-09-28
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37	H6		NWA 12075			2018-10-08
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8	H6		NWA 12043			2018-10-08
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23	H6		A 12044	J26	JB	2018-04-18
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25	H6		NWA 11691			2018-02-20
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27	H6		DOM 14181	41(1)	A	2018-02-23
28	H6		DOM 14221	41(1)	A	2018-02-23
29	H6		NWA 12087			2018-10-08
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31	H6		DOM 14103	41(1)	A	2018-02-23
32	H6		NWA 11938			2018-08-03
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48	H6		DOM 14396	41(1)	A	2018-02-23
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27	H6		A 12301	J26	JB	2018-04-18
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37	H6		DOM 14204	41(1)	A	2018-02-23
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7	H6		DOM 14553 41(1)	A	2018-02-23
8	H6		DOM 14364 41(1)	A	2018-02-23
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11	H6		MIL 15253 41(2)	A	2018-09-28
12	H6		DOM 14356 41(2)	A	2018-09-28
13	H6		MIL 15256 41(2)	A	2018-09-28
14	H6		MIL 15250 41(2)	A	2018-09-28
15	H6		A 12319 J26	JB	2018-04-18
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18	H6		DOM 14247 41(1)	A	2018-02-23
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21	H6		A 12342 J26	JB	2018-04-18
22	H6		A-87060 J26	J	2018-04-18
23	H6		A-87301 J26	J	2018-04-18
24	H6		DOM 14451 41(1)	A	2018-02-23
25	H6		A-87102 J26	J	2018-04-18
26	H6		A 12339 J26	JB	2018-04-18
27	H6		DOM 14229 41(1)	A	2018-02-23
28	H6		A-87024 J26	J	2018-04-18
29	H6		NWA 12127		2018-10-08
30	H6		DOM 14196 41(1)	A	2018-02-23
31	H6		A 12108 J26	JB	2018-04-18
32	H6			Antofagasta	2018-11-08
33	H6		Y-980060 J26	J	2018-04-18
34	H6		Y-002673 J26	J	2018-04-18
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36	H6		A 12308 J26	JB	2018-04-18
37	H6		Y-003025 J26	J	2018-04-18
38	H6		DOM 14249 41(1)	A	2018-02-23
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H6	A 09203	J26	JB	2018-04-18
H6	Y-002245	J26	J	2018-04-18
H6	Y-003164	J26	J	2018-04-18
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H6	Y-003185	J26	J	2018-04-18
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H6	A 09362	J26	JB	2018-04-18

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7	H6		Y-003136	J26	J	2018-04-18
8	H6		A 09364	J26	JB	2018-04-18
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13	H6		A 09209	J26	JB	2018-04-18
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26	H6		MIL 15272	41(1)	A	2018-02-23
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28	H6		A 09227	J26	JB	2018-04-18
29	H6		EET 14048	-	K	2018-04-23
30	H6		EET 14063	-	K	2018-04-23
31	H6		MIL 15417	41(2)	A	2018-09-28
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33	H6		MIL 15153	41(1)	A	2018-02-23
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36	H6		EET 16206	41(1)	A	2018-02-23
37	H6		Y-980195	J26	J	2018-04-18
38	H6		EET 16214	41(1)	A	2018-02-23
39	H6		A 10144	J26	JB	2018-04-18
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41	H6		A 09419	J26	JB	2018-04-18
42	H6		EET 16219	41(1)	A	2018-02-23
43	H6		Y-980332	J26	J	2018-04-18
44	H6		EET 16217	41(1)	A	2018-02-23
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5	H6	EET 16216	41(1)	A	2018-02-23
6	H6	Y-003167	J26	J	2018-04-18
7	H6	EET 16209	41(1)	A	2018-02-23
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9	H6	A 09417	J26	JB	2018-04-18
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11	H6	MIL 15478	41(2)	A	2018-09-28
12	H6	MIL 15432	41(2)	A	2018-09-28
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14	H6	EET 16205	41(1)	A	2018-02-23
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16	H6	Y-002342	J26	J	2018-04-18
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18	H6	Y-002579	J26	J	2018-04-18
19	H6	Y-002851	J26	J	2018-04-18
20	H6	Y-003151	J26	J	2018-04-18
21	H6	A 09225	J26	JB	2018-04-18
22	H6	MIL 15430	41(2)	A	2018-09-28
23	H7	NWA 11613			2018-02-20
24	H7	NWA 12236			2018-11-14
25	Howardite	NWA 11899			2018-08-31
26	Howardite	NWA 12227			2018-12-11
27	Howardite	NWA 11964			2018-10-09
28	Howardite	NWA 12190			2018-11-09
29	Howardite			Sagua el Hai	2018-12-14
30	Howardite	NWA 11712			2018-03-27
31	Howardite	NWA 11858			2018-07-08
32	Howardite	NWA 11551			2018-01-05
33	Howardite	NWA 12203			2018-11-09
34	Howardite	NWA 11612			2018-02-20
35	Howardite	NWA 12224			2018-11-13
36	Howardite	NWA 12194			2018-11-18
37	Howardite	NWA 12250			2018-11-24
38	Howardite	NWA 11997			2018-09-27
39	Howardite	NWA 11834			2018-07-04
40	Howardite	NWA 12231			2018-12-11
41	Howardite	NWA 11598			2018-02-09
42	Howardite	NWA 11605			2018-02-09
43	Howardite	NWA 11604			2018-02-09
44	Howardite	NWA 11606			2018-02-09
45	Iron, IAB complex	GRO 17102	41(2)	A	2018-09-28
46	Iron, IAB complex	GRO 17051	41(2)	A	2018-09-28
47	Iron, IAB-MG				2018-06-30

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3	Iron, IAB-MG	NWA 11859				2018-06-30
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5	Iron, IAB-MG				Zacatecas	2018-09-23
6	Iron, IAB-MG					2018-06-30
7	Iron, IAB-MG	NWA 11649				2018-02-20
8	Iron, IAB-MG				Valle d'Aosta	2018-06-22
9	Iron, IAB-MG				Chubu	2018-02-20
10	Iron, IAB-MG				Xinjiang	2018-09-15
11	Iron, IAB-MG					2018-07-17
12	Iron, IAB-MG					2018-08-03
13	Iron, IAB-MG					2018-06-30
14	Iron, IAB-MG					2018-06-30
15	Iron, IAB-MG					2018-06-30
16	Iron, IAB-MG					2018-06-30
17	Iron, IAB-MG					2018-06-30
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21	Iron, IAB-MG					2018-06-30
22	Iron, IAB-sHL	NWA 11577				2018-01-24
23	Iron, IIAB	NWA 11637				2018-02-20
24	Iron, IIAB	NWA 12000				2018-10-20
25	Iron, IID				Rio Grande d	2018-09-02
26	Iron, IIIAB				Sokoto	2018-06-16
27	Iron, IIIAB				Xinjiang	2018-04-19
28	Iron, IIIAB				Adrar	2018-09-23
29	Iron, IIIAB				Castilla y Leo	2018-11-12
30	Iron, IIIAB	EET 16045	41(1)	A		2018-02-23
31	Iron, IVB	AM 043			Xinjiang	2018-04-19
32	Iron, ungrouped				Xinjiang	2018-03-27
33	Iron, ungrouped	GRO 17195	41(2)	A		2018-09-28
34	L-imp melt	DOM 14125	41(1)	A		2018-02-23
35	L-melt rock	NWA 11832				2018-07-24
36	L~4				Qinghai	2018-11-24
37	L~5				Qinghai	2018-12-02
38	L~5	NWA 12297				2018-11-09
39	L~6				Qinghai	2018-11-24
40	L~6				Qinghai	2018-12-02
41	L~6				Qinghai	2018-12-02
42	L~6	NWA 11581				2018-01-15
43	L~6				Xinjiang	2018-12-16
44	L~6				Xinjiang	2018-12-16
45	L~6				Gansu	2018-12-16
46	L~6	NWA 11578				2018-01-15
47	L~6				Xinjiang	2018-11-09
48	L~6	NWA 11582				2018-01-15
49	L~6				XinJiang	2018-11-24
50	L~6				Xinjiang	2018-11-09
51	L~6				Xinjiang	2018-11-09

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L3		NWA 12324			2018-11-14
L3		NWA 12331			2018-12-06
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L3		NWA 11835			2018-06-22
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9	L3.5	DOM 14124	41(1)	A	2018-02-23
10	L3.6	DOM 14201	41(1)	A	2018-02-23
11	L3.6	DOM 14082	41(1)	A	2018-02-23
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25	L4	NWA 1091			2018-10-20
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36	L4	NWA 11817			2018-05-26
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47	L4	A 12042	J26	JB	2018-04-18
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53	L4	DOM 14469	41(1)	A	2018-02-23
54	L4	DOM 14469	41(1)	A	2018-02-23
55	L4	SaU 605		Al Wusta	2018-03-27
56	L4	DOM 14032	41(1)	A	2018-02-23
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58	L4	MCY 14006	-	P	2018-03-13
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L5			Antofagasta	2018-05-11

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27	L5	NWA 11982			2018-09-15
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43	L5	DOM 14307	41(1)	A	2018-02-23
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17	L5		DOM 14215 41(2)	A	2018-09-28
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44	L5		DOM 14211 41(2)	A	2018-09-28
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7	L5		MIL 15371	41(2)	A	2018-09-28
8	L5		DOM 14532	41(1)	A	2018-02-23
9	L5		DOM 14534	41(1)	A	2018-02-23
10	L5		DOM 14200	41(1)	A	2018-02-23
11	L5		DOM 14240	41(1)	A	2018-02-23
12	L5		DOM 14550	41(1)	A	2018-02-23
13	L5		DOM 14362	41(1)	A	2018-02-23
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15	L5		Y-003416	J26	J	2018-04-18	
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47	L6		EET 14059	-	K		2018-04-23

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29	L6		EET 14016 -	K	2018-04-23
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45	L6	NWA 12142			2018-10-08
46	L6	DOM 14107	41(1)	A	2018-02-23
47	L6	MIL 15376	41(2)	A	2018-09-28
48	L6	A 12397	J26	JB	2018-04-18
49	L6	DOM 14391	41(1)	A	2018-02-23
50	L6	DOM 14190	41(1)	A	2018-02-23
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31	L6		NWA 12122		2018-10-08
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34	L6		EET 14038 -	K	2018-04-23
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38	L6		DOM 14131 41(1)	A	2018-02-23
39	L6		NWA 11648		2018-01-29
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42	L6		MIL 15374 41(2)	A	2018-09-28
43	L6		A 12406 J26	JB	2018-04-18
44	L6		DOM 14513 41(1)	A	2018-02-23
45	L6		DOM 14354 41(2)	A	2018-09-28
46	L6		DOM 14510 41(1)	A	2018-02-23
47	L6		A 12369 J26	JB	2018-04-18
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19	L6		DOM 14314	41(2)	A	2018-09-28
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26	L6		EET 14027	-	K	2018-04-23
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28	L6					California 2018-10-20
29	L6		DOM 14490	41(2)	A	2018-09-28
30	L6		DOM 14358	41(2)	A	2018-09-28
31	L6		DOM 14504	41(2)	A	2018-09-28
32	L6		LoV 228			Antofagasta 2018-07-17
33	L6		DOM 14529	41(1)	A	2018-02-23
34	L6		DOM 14352	41(2)	A	2018-09-28
35	L6		DOM 14502	41(2)	A	2018-09-28
36	L6		MIL 15090	41(2)	A	2018-09-28
37	L6		DOM 14318	41(2)	A	2018-09-28
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44	L6		DOM 14206	41(1)	A	2018-02-23
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8	L6		DOM 14209	41(1)	A	2018-02-23
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10	L6		DOM 14495	41(2)	A	2018-09-28
11	L6		DOM 14560	41(2)	A	2018-09-28
12	L6		LoV 256			Antofagasta 2018-11-08
13	L6		DOM 14521	41(1)	A	2018-02-23
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15	L6		DOM 14508	41(2)	A	2018-09-28
16	L6		DOM 14319	41(2)	A	2018-09-28
17	L6		DOM 14522	41(1)	A	2018-02-23
18	L6		LoV 248			Antofagasta 2018-11-08
19	L6		A 12353	J26	JB	2018-04-18
20	L6		DOM 14278	41(1)	A	2018-02-23
21	L6		DOM 14361	41(1)	A	2018-02-23
22	L6		DOM 14034	41(1)	A	2018-02-23
23	L6		DOM 14202	41(1)	A	2018-02-23
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25	L6					Antofagasta 2018-04-19
26	L6		DOM 14493	41(2)	A	2018-09-28
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33	L6		EET 14030	-	K	2018-04-23
34	L6		DOM 14360	41(1)	A	2018-02-23
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37	L6		DOM 14455	41(1)	A	2018-02-23
38	L6		LoV 215			Antofagasta 2018-04-19
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52	L6		Y-980200	J26	J	2018-04-18
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54	L6		Y-003433	J26	J	2018-04-18
55	L6		Y-003505	J26	J	2018-04-18
56	L6		Y-980249	J26	J	2018-04-18
57	L6		Y-980249	J26	J	2018-04-18
58	L6		Y-002123	J26	J	2018-04-18
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7	L6		Y-980045	J26	J	2018-04-18
8	L6		Y-980221	J26	J	2018-04-18
9	L6		Y-980234	J26	J	2018-04-18
10	L6		Y-003506	J26	J	2018-04-18
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14	L6		A 09460	J26	JB	2018-04-18
15	L6		Y-003552	J26	J	2018-04-18
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23	L6		Y-003376	J26	J	2018-04-18
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25	L6		Y-003492	J26	J	2018-04-18
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27	L6		Y-003498	J26	J	2018-04-18
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29	L6		MIL 15416	41(2)	A	2018-09-28
30	L6		Y-003467	J26	J	2018-04-18
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35	L6		A 09461	J26	JB	2018-04-18
36	L6		Y-003528	J26	J	2018-04-18
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38	L6		A 09558	J26	JB	2018-04-18
39	L6		Y-980002	J26	J	2018-04-18
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41	L6		Y-980203	J26	J	2018-04-18
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20	L6		A 09462	J26	JB	2018-04-18
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22	L6		EET 14003	-	K	2018-04-23
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29	L6		Y-003567	J26	J	2018-04-18
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9	L6	Y-000172	J26	J	2018-04-18
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18	L6-melt breccia			Antofagasta	2018-08-03
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20	L6-melt breccia	LoV 216		Antofagasta	2018-04-19
21	LL(L)3	NWA 11617			2018-02-20
22	LL(L)3	NWA 11611			2018-02-20
23	LL~4			Xinjiang	2018-10-06
24	LL~5	NWA 11975			2018-10-09
25	LL~6			Xinjiang	2018-11-09
26	LL~6			Xinjiang	2018-11-09
27	LL~6			Gansu	2018-12-16
28	LL3	NWA 11669			2018-02-20
29	LL3	NWA 11908			2018-07-24
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31	LL3	NWA 11615			2018-01-22
32	LL3	NWA 11967			2018-09-23
33	LL3			Kerman	2018-05-26
34	LL3	NWA 11907			2018-07-24
35	LL3	NWA 11991			2018-10-09
36	LL3	NWA 12284			2018-11-24
37	LL3	NWA 11992			2018-10-09
38	LL3	NWA 11954			2018-09-15
39	LL3	NWA 12291			2018-11-09
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41	LL3			Arizona	2018-06-07
42	LL3	A 12050	J26	JB	2018-04-18
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44	LL3	NWA 11812			2018-05-11
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6	LL3		NWA 12281			2018-11-17
7	LL3		NWA 11813			2018-05-11
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9	LL3		EET 14017	-	K	2018-04-23
10	LL3-6		NWA 11873			2018-06-30
11	LL3-6		NWA 11831			2018-07-04
12	LL3.05		NWA 11752			2018-04-19
13	LL3.10-5		NWA 11905			2018-09-02
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15	LL3.7		DOM 14183	41(1)	A	2018-02-23
16	LL3.7		DOM 14458	41(1)	A	2018-02-23
17	LL4		NWA 11651			2018-02-24
18	LL4		NWA 11882			2018-07-08
19	LL4		LoV 236		Antofagasta	2018-11-08
20	LL4		NWA 12254		Morocco, Dal	2018-11-08
21	LL4		NWA 11944			2018-08-03
22	LL4				Ajdabiya	2018-07-17
23	LL4		NWA 12017			2018-09-23
24	LL4		NWA 11665			2018-02-09
25	LL4		A 12038	J26	JB	2018-04-18
26	LL4		B-9819	J26	J	2018-04-18
27	LL4		A 12392	J26	JB	2018-04-18
28	LL4		A 12418	J26	JB	2018-04-18
29	LL4		DOM 14342	41(2)	A	2018-09-28
30	LL4		A 12393	J26	JB	2018-04-18
31	LL4		A 12394	J26	JB	2018-04-18
32	LL4		A 12416	J26	JB	2018-04-18
33	LL4		A 12415	J26	JB	2018-04-18
34	LL4		A 12417	J26	JB	2018-04-18
35	LL4		NWA 11874			2018-07-04
36	LL4		DOM 14036	41(1)	A	2018-02-23
37	LL4		MCY 14020	-	P	2018-03-13
38	LL4		MIL 15433	41(2)	A	2018-09-28
39	LL4-6		NWA 11915			2018-07-24
40	LL4-6		NWA 12361			2018-11-27
41	LL4-6		NWA 11948			2018-08-03
42	LL4-6		A 12013	J26	JB	2018-04-18
43	LL4-6		NWA 11645			2018-01-27
44	LL4-6		A 12362	J26	JB	2018-04-18
45	LL4-6		NWA 11629			2018-01-24
46	LL4-6		A 12395	J26	JB	2018-04-18
47	LL5		NWA 438			2018-10-20

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LL5					Antofagasta	2018-07-24
LL5		DOM 14304	41(1)	A		2018-02-23
LL5		NWA 11624				2018-01-24
LL5					Antofagasta	2018-10-09
LL5		NWA 12092				2018-10-08
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LL5		A 12423	J26	JB		2018-04-18
LL5		DOM 14306	41(1)	A		2018-02-23
LL5		NWA 12256				2018-11-08
LL5		A 12414	J26	JB		2018-04-18
LL5		DOM 14226	41(1)	A		2018-02-23
LL5		EM 376			Antofagasta	2018-03-27
LL5		A 12422	J26	JB		2018-04-18
LL5		NWA 11618				2018-01-24
LL5		A 12431	J26	JB		2018-04-18
LL5		DOM 14279	41(1)	A		2018-02-23
LL5		A 12391	J26	JB		2018-04-18
LL5		A 12424	J26	JB		2018-04-18
LL5		DOM 14273	41(1)	A		2018-02-23
LL5					Antofagasta	2018-04-07
LL5		A 12402	J26	JB		2018-04-18
LL5		B-9813	J26	J		2018-04-18
LL5-an		NWA 11811				2018-11-09
LL5/6		NWA 12358				2018-11-27
LL5/6		NWA 12357				2018-11-27
LL6					Guelmim Sm:	2018-12-11
LL6		NWA 11838				2018-06-07
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LL6		NWA 12015				2018-09-23
LL6		NWA 11620				2018-01-24
LL6		NWA 12020				2018-10-06
LL6		NWA 11654				2018-02-24
LL6		A 12129	J26	JB		2018-04-18
LL6		A 12030	J26	JB		2018-04-18
LL6		NWA 11684				2018-02-20
LL6		A 12426	J26	JB		2018-04-18
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LL6		NWA 11876				2018-07-04

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3	LL6		A 12411	J26	JB 2018-04-18
4	LL6		A 12058	J26	JB 2018-04-18
5	LL6		SJ 096		Antofagasta 2018-11-08
6	LL6		NWA 12007		2018-10-27
7	LL6		DOM 14302	41(1)	A 2018-02-23
8	LL6		NWA 11655		2018-02-24
9	LL6		NWA 11631		2018-01-24
10	LL6		NWA 11715		2018-02-24
11	LL6		DOM 14303	41(1)	A 2018-02-23
12	LL6		A 12032	J26	JB 2018-04-18
13	LL6		A 12413	J26	JB 2018-04-18
14	LL6		NWA 11663		2018-02-24
15	LL6		NWA 12255		2018-11-08
16	LL6		NWA 12295		2018-11-09
17	LL6		A 12235	J26	JB 2018-04-18
18	LL6		A 12412	J26	JB 2018-04-18
19	LL6		NWA 12298		2018-11-09
20	LL6		NWA 11716		2018-02-24
21	LL6		NWA 11963		2018-09-15
22	LL6		A 12420	J26	JB 2018-04-18
23	LL6		DOM 14223	41(1)	A 2018-02-23
24	LL6		NWA 11632		2018-01-24
25	LL6		A 12421	J26	JB 2018-04-18
26	LL6		A 12410	J26	JB 2018-04-18
27	LL6		A 12435	J26	JB 2018-04-18
28	LL6		A 12250	J26	JB 2018-04-18
29	LL6		A 12401	J26	JB 2018-04-18
30	LL6		A 12434	J26	JB 2018-04-18
31	LL6		A 12243	J26	JB 2018-04-18
32	LL6		A 12403	J26	JB 2018-04-18
33	LL6		NWA 11628		2018-01-24
34	LL6		NWA 11702		2018-02-24
35	LL6		A 12317	J26	JB 2018-04-18
36	LL6		NWA 12178		2018-10-08
37	LL6		A 12304	J26	JB 2018-04-18
38	LL6		NWA 11719		2018-02-24
39	LL6		A 12258	J26	JB 2018-04-18
40	LL6		NWA 11717		2018-02-24
41	LL6		Y-003198	J26	J 2018-04-18
42	LL6		A 12265	J26	JB 2018-04-18
43	LL6		A 12241	J26	JB 2018-04-18
44	LL6		A 12237	J26	JB 2018-04-18
45	LL6		DOM 14276	41(1)	A 2018-02-23
46	LL6		DOM 14277	41(1)	A 2018-02-23
47	LL6		NWA 11718		2018-02-24
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LL6		MIL 15251	41(2)	A		2018-09-28
LL6		A 12425	J26	JB		2018-04-18
LL6		DOM 14274	41(1)	A		2018-02-23
LL6		DOM 14228	41(1)	A		2018-02-23
LL6		A 12433	J26	JB		2018-04-18
LL6		DOM 14445	41(2)	A		2018-09-28
LL6		Y-980339	J26	J		2018-04-18
LL6		Y-003199	J26	J		2018-04-18
LL6		Y-980291	J26	J		2018-04-18
LL6		Y-980046	J26	J		2018-04-18
LL6		Y-002852	J26	J		2018-04-18
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LL6-melt breccia		NWA 11730				2018-04-07
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LL7		LoV 231			Antofagasta	2018-08-03
LL7		NWA 11852				2018-07-04
Lodranite		NWA 11848				2018-07-04
Lodranite		NWA 11795				2018-05-26
Lodranite		NWA 11960				2018-09-15
Lodranite		NWA 11901				2018-08-31
Lodranite		NWA 11970				2018-09-23
Lodranite		Y-001620	J26	J		2018-04-18
Lodranite		Y-001322	J26	J		2018-04-18
Lodranite		DOM 14289	41(1)	A		2018-02-23
Lunar		NWA 11616				2018-02-20
Lunar		NWA 11962				2018-09-23
Lunar		NWA 11801				2018-06-07
Lunar		NWA 11886				2018-08-03
Lunar		NWA 11767				2018-05-11
Lunar (basalt)		NWA 12008				2018-10-27
Lunar (feldsp. breccia)		NWA 11787				2018-05-26
Lunar (feldsp. breccia)		NWA 11788				2018-05-26
Lunar (feldsp. breccia)		NWA 11303				2018-02-24
Lunar (feldsp. breccia)		NWA 11789				2018-05-26
Lunar (feldsp. breccia)		NWA 11828				2018-06-22
Lunar (feldsp. breccia)		NWA 12368				2018-12-06
Lunar (feldsp. breccia)		NWA 12279			Tindouf	2018-12-11
Lunar (feldsp. breccia)		NWA 12270				2018-12-02
lunar (feldsp. breccia)		NWA 2425				2018-05-11
Lunar (feldsp. breccia)		NWA 11898				2018-08-31

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3	Lunar (feldsp. breccia)			Rio de Oro	2018-02-20
4	Lunar (Feldsp. Breccia)	NWA 11968			2018-09-23
5	Lunar (feldsp. breccia)	NWA 11695			2018-03-27
6	Lunar (feldsp. breccia)	NWA 11851			2018-07-04
7	Lunar (Feldsp. Breccia)	NWA 11966			2018-09-23
8	Lunar (feldsp. breccia)				2018-01-22
9	Lunar (feldsp. breccia)	NWA 11517			2018-02-24
10	Lunar (feldsp. breccia)	NWA 11809			2018-05-28
11	Lunar (Feldsp. Breccia)	NWA 11783			2018-05-26
12	Lunar (feldsp. breccia)	NWA 11563			2018-01-12
13	Lunar (feldsp. breccia)	NWA 12248			2018-11-24
14	Lunar (feldsp. breccia)	NWA 11871			2018-07-17
15	Lunar (gabbro)	NWA 11703			2018-03-27
16	Martian (nakhlite)	CeC 022		Antofagasta	2018-04-10
17	Martian	NWA 11896			2018-08-31
18	Martian	NWA 11921			2018-09-15
19	Martian (basaltic breccia)			Rio de Oro	2018-09-23
20	Martian (basaltic breccia)	NWA 12222			2018-11-12
21	Martian (shergottite)	NWA 12335			2018-12-06
22	Martian (shergottite)			Rio de Oro	2018-04-07
23	Martian (shergottite)	NWA 12262			2018-12-11
24	Martian (shergottite)	NWA 12269			2018-12-11
25	Martian (shergottite)	NWA 12241			2018-11-24
26	Martian (shergottite)	NWA 12323			2018-12-14
27	Martian (shergottite)	NWA 11955			2018-09-15
28	Martian (shergottite)	NWA 12210			2018-11-12
29	Martian (shergottite)	NWA 12280		Tindouf	2018-12-11
30	Martian (shergottite)	NWA 2424			2018-05-11
31	Martian (shergottite)	NWA 11804			2018-05-28
32	Martian (shergottite)	A 12325	J26	JB	2018-04-18
33	Martian (shergottite)	NWA 11866			2018-07-17
34	Martian (shergottite)	NWA 11668			2018-03-27
35	Martian (shergottite)			Zufar	2018-04-19
36	Martian (shergottite)	NWA 11746			2018-04-07
37	Martian (shergottite)	NWA 12002			2018-10-16
38	Mesosiderite	NWA 11761			2018-05-11
39	Mesosiderite	NWA 11774			2018-05-12
40	Mesosiderite	NWA 11853			2018-07-04
41	Mesosiderite	NWA 11887			2018-08-03
42	Mesosiderite	NWA 12212			2018-11-12
43	OC3	JaH 846		Al Wusta	2018-09-15
44	Pallasite	NWA 12186			2018-11-09
45	Pallasite	NWA 5693			2018-08-31
46	Pallasite	NWA 12288			2018-12-11
47	Pallasite, PMG			Vaud	2018-09-15

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Pallasite, PMG-an	NWA 11720		2018-04-07
Pallasite, PMG-an		Sagua el Har	2018-08-03
R3	NWA 11721		2018-04-07
R3	NWA 11927		2018-09-15
R3	NWA 11769		2018-05-11
R3-5	NWA 11587		2018-02-03
R3-5	NWA 11860		2018-07-24
R3-5	NWA 11614		2018-02-20
R3-5	NWA 8791		2018-06-22
R3-6	NWA 11697		2018-03-27
R3.5-4	NWA 11880		2018-07-17
R4	NWA 11304		2018-04-07
R4	NWA 11571		2018-01-16
R5	NWA 11772		2018-05-11
Ureilite	NWA 11892		2018-08-03
Ureilite	NWA 11950		2018-09-15
Ureilite	NWA 11757		2018-05-26
Ureilite	NWA 12271		2018-12-02
Ureilite	NWA 11956		2018-09-15
Ureilite	NWA 11641		2018-02-20
Ureilite	NWA 11639		2018-02-20
Ureilite	NWA 12191		2018-11-18
Ureilite	NWA 11893		2018-08-03
Ureilite	NWA 12198		2018-11-09
Ureilite	NWA 11640		2018-02-20
Ureilite	NWA 12237		2018-12-02
Ureilite	JaH 1101	Al Wusta	2018-01-08
Ureilite	NWA 11900		2018-09-02
Ureilite	NWA 12189		2018-11-09
Ureilite	NWA 11671		2018-03-27
Ureilite	NWA 11675		2018-03-27
Ureilite	JaH 1100	Al Wusta	2018-01-08
Ureilite	NWA 11754		2018-05-26
Ureilite	NWA 11891		2018-08-03
Ureilite	NWA 11815		2018-06-16
Ureilite	EET 14053 -	K	2018-05-26
Ureilite	NWA 11993		2018-10-09
Ureilite	NWA 11784		2018-05-26
Ureilite	JaH 1103	Al Wusta	2018-02-20
Ureilite	NWA 12188		2018-11-18
Ureilite	NWA 11951		2018-09-15
Ureilite	NWA 12321		2018-12-14
Ureilite	NWA 12183		2018-11-09
Ureilite	SJ 100	Antofagasta	2018-12-02
Ureilite	NWA 11890		2018-08-03

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Ureilite		JaH 1102			Al Wusta	2018-01-08
Ureilite		NWA 11755				2018-05-26
Ureilite		NWA 11894				2018-08-03
Ureilite		NWA 11585				2018-02-03
Ureilite		NWA 11775				2018-05-11
Ureilite		NWA 11738				2018-04-19
Ureilite		NWA 11608				2018-02-20
Ureilite		NWA 11644				2018-02-20
Ureilite		RaS 530			Al Wusta	2018-03-02
Ureilite		Y-000614	J26	J		2018-04-18
Ureilite		A 10104	J26	JB		2018-04-18
Ureilite-an		NWA 11511				2018-05-12
Winonaite		NWA 11917				2018-09-15
Winonaite		NWA 11807				2018-05-28

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7	0000-00-00			Elephant Moroc		2014 Dec 12	76°15.525'S
8	0000-00-00				Erfoud, Moroc	P 2017	
9	0000-00-00				Temara	P 2017 Oct	
10	0000-00-00				Erfoud, Moroc	P 2016 Nov	
11	0000-00-00				Mauritania	P 2016 Sept	
12	0000-00-00				Beijing	2016	
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15	0000-00-00				Morocco	P 2017 Sep	
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18	0000-00-00				Tucson Gem	P 2017	
19	0000-00-00				Guelmim, Mor	P 2017 Sep	
20	0000-00-00				Erfoud, Moroc	P 2009	
21	0000-00-00				Erfoud, Moroc	P 2009	
22	0000-00-00				Zagora	P 2014 Jul	
23	0000-00-00					2009	
24	0000-00-00					1990	
25	0000-00-00				Agadir	P 2017 Mar	
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27	0000-00-00					2009	
28	0000-00-00				Morocco	P 2018	
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35	0000-00-00			Antofagasta	desert	2017 Oct 21	22°30.10'S
36	0000-00-00					2014	
37	0000-00-00			Morocco			
38	0000-00-00				Erfoud	P Feb 2016	
39	0000-00-00				Morocco	P 2017	
40	0000-00-00				Erfoud	P Feb 2016	
41	0000-00-00				Morocco	P 2017 Nov	
42	0000-00-00				Zagora	P 2017 Mar	
43	0000-00-00					2017	
44	0000-00-00				Tucson	P 2007 Jan	
45	0000-00-00				Morocco	P 2018	
46	0000-00-00				Erfoud	P Sept 2016	
47	0000-00-00				Zagora, Moroc	P 2014	
48	0000-00-00					2017	
49	0000-00-00				Morocco	P 2018	
50	0000-00-00				Mauritania	P May 2018	
51	0000-00-00						
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4	0000-00-00			2012	
5	0000-00-00				
6	0000-00-00		Erfoud, Moroc	P 2014	
7	0000-00-00			2012	
8	0000-00-00			2012	
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23	0000-00-00			1998	
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25	0000-00-00			2010	
26	0000-00-00		Laayoune	P 2016 Oct	
27	0000-00-00		Denver	P 2017	
28	0000-00-00				
29	0000-00-00	Rajasthan	agricultural fie	June 6, 2017	26°52'52.5"N
30	0000-00-00				
31	0000-00-00		Algeria	P 2018	
32	0000-00-00		Elephant Morc	2014 Dec 12	76°14.940'S
33	0000-00-00		Mauritania	P 2017 Oct	
34	0000-00-00		Morocco/Wesi	P 2018	
35	0000-00-00		Morocco	P 2018	
36	0000-00-00			2017	
37	0000-00-00				
38	0000-00-00		Reckling Peak	2014 Nov 16	76°15.954'S
39	0000-00-00				
40	0000-00-00		Morocco	P 2018	
41	0000-00-00		Morocco	P 2017	
42	0000-00-00		Moscow (Rus	P 2017 Aug 0	
43	0000-00-00			2017	
44	0000-00-00				
45	0000-00-00		Morocco	P 2018	
46	0000-00-00			2015	
47	0000-00-00		Erfoud	P 2017	
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49	0000-00-00		Morocco	P 2017	
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53	0000-00-00		Morocco	P 2017	
54	0000-00-00		Morocco	P 2017	
55	0000-00-00		Morocco	P 2018	
56	0000-00-00				
57	0000-00-00		Elephant Morc	2014 Nov 21	76°17.195'S
58	0000-00-00				
59	0000-00-00		Morocco	P 2017	
60	0000-00-00			2012	

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3	0000-00-00			1998	
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7	0000-00-00		Morocco	P 2017 Jun	
8	0000-00-00		Mauritania	P 2017 Sep	
9	0000-00-00		Erfoud, Moroc	P 2008	
10	0000-00-00				
11	0000-00-00	Antofagasta	deflation surfa	2016 Nov 04	~24°51'S
12	0000-00-00			Tinduf, Algeria	P 2017 Apr
13	0000-00-00			Beijing	2016
14	0000-00-00				
15	0000-00-00	Antofagasta	Desert	25 March 201	22°23.56'S
16	0000-00-00	Antofagasta	deflation surfa	2017 May 17	~24°51'S
17	0000-00-00			Ensisheim, Fr	P 2007 Jun
18	0000-00-00			Zagora (Moroc	P April 2018
19	0000-00-00			Zagora, Moroc	P April 2018
20	0000-00-00				
21	0000-00-00	Zufar		Poland	P 2018 Feb 18.888°N
22	0000-00-00			Laayoune, Mo	P April 2018
23	0000-00-00			Erfoud	P Aug 2001
24	0000-00-00				
25	0000-00-00		Desert	Ensisheim, Fr	P 2017
26	0000-00-00			Laayoune	P 2014 May
27	0000-00-00			Morocco	P 2018
28	0000-00-00			Mauritania	P 2017 Jun
29	0000-00-00			Ensisheim, Fr	P 2007 Jun
30	0000-00-00			Morocco	P 2018
31	0000-00-00			Algeria	P 2018
32	0000-00-00			Erfoud	P 2017
33	0000-00-00			Mauritania	P May 2018
34	0000-00-00				2017
35	0000-00-00				2017
36	0000-00-00			France	P 2016 Dec
37	0000-00-00			Temara	P 2018 Aug
38	0000-00-00			Morocco	P 2018
39	0000-00-00			Erfoud, Moroc	P 2017
40	0000-00-00			Morocco	P 2018
41	0000-00-00			Rissani	P 2013 Feb
42	0000-00-00			Morocco	P 2018 Jun
43	0000-00-00			Tucson Gem	z P 2017
44	0000-00-00			Ouarzate, MP	P 2018 Mar
45	0000-00-00	Antofagasta	deflation surfa	2018 March	25°14'S
46	0000-00-00			Erfoud	P 2006
47	0000-00-00			Morocco	P 2018
48	0000-00-00			Zagora	P 2018 Mar
49	0000-00-00			Mauritania	P May 2018
50	0000-00-00			Erfoud, Moroc	P 2013
51	0000-00-00			Erfoud	P 2017
52	0000-00-00			Erfoud	P 2017 Sep
53	0000-00-00				
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3	0000-00-00		Morocco	P 2018	
4	0000-00-00		Zagora, Moroc	P 2014	
5	0000-00-00		Tucson	P Feb 2017	
6	0000-00-00		Erfoud	P 2004	
7	0000-00-00		Morocco	P 2018	
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21	0000-00-00		Temara	P 2017 Oct	
22	0000-00-00	Shaanxi	Mountains	2016 Sept 16	36.693°N
23	0000-00-00		Mauritania	P 2017 Sep	
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29	0000-00-00		Morocco/Wesl	P 2018	
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33	0000-00-00			2017	
34	0000-00-00		Morocco	P 2018 Jun	
35	0000-00-00		Zagora	P 2018 Apr	
36	0000-00-00			2000	
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41	0000-00-00		Morocco	P 2018	
42	0000-00-00			2012	
43	0000-00-00			1979	
44	0000-00-00			2000	
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49	0000-00-00		Arizona	P 2018 Jan	
50	0000-00-00	Antofagasta		2018 Apr	~24°20'S

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4	0000-00-00	Antofagasta	2018 Apr	~24°20'S
5	0000-00-00	Antofagasta	2018 Apr	24°51'S
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8	0000-00-00			2012
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10	0000-00-00	Morocco, Laay	Genova	P May 2014
11	0000-00-00		Beijing China	P Feb. 2017
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18	0000-00-00		Tucson Gem	ε P 2017
19	0000-00-00	Zufar	15 Feb 2015	18°45.30'N
20	0000-00-00		Munich, Germ	P 2017
21	0000-00-00		Tucson Gem	ε P 2011 Feb
22	0000-00-00		Laayoune, We	P 2018
23	0000-00-00		Erfoud, Moroc	P 2018
24	0000-00-00		Morocco	P 2018
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26	0000-00-00			2000
27	0000-00-00		Erfoud	P June 2016
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29	0000-00-00		Agadir, Moroc	P 2018
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37	0000-00-00		Erfoud, Moroc	P 2018
38	0000-00-00		Ensisheim, Fr	P 2018
39	0000-00-00	Santiago del E	Department of	22 Jun 1931 28°56'S
40	0000-00-00		Layaoune, Mo	P 2018
41	0000-00-00			2000
42	0000-00-00			1988
43	0000-00-00		Morocco	P 2016 May 1
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48	0000-00-00			2012
49	0000-00-00			2012
50	0000-00-00		Hamburg, Ger	P 2007 Dec
51	0000-00-00			
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3	0000-00-00		Morocco	P 2016 May 1
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5	0000-00-00			1988
6	0000-00-00		Tucson	P 2011
7	0000-00-00		Morocco	P 2016 May 1
8	0000-00-00			2012
9	0000-00-00		Layaoune, Mo	P 2018
10	0000-00-00			2012
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13	0000-00-00		Morocco	P 2016 May 1
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15	0000-00-00			2000
16	0000-00-00			1988
17	0000-00-00		Morocco	P 2016 May 1
18	0000-00-00			2012
19	0000-00-00			2000
20	0000-00-00			2010
21	0000-00-00			1998
22	0000-00-00			1998
23	0000-00-00			1998
24	0000-00-00		Elephant Mora	2014 Dec 12 76°15.492'S
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26	2018-06-08	Reclassified	Morocco	P 2014 May
27	0000-00-00		Ensisheim	P 2014 Jun
28	0000-00-00		Morocco	P 2017 Aug
29	0000-00-00		Tagant, Mauri	P 2017
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31	0000-00-00		Munich, Germ	P 2007
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36	0000-00-00		Erfoud, Moroc	P 2017
37	0000-00-00		Morocco	P 22 May 201
38	0000-00-00		Quarzazate, M	P 2016
39	0000-00-00		Guelmim, Mor	P 2018 Aug
40	0000-00-00		Sainte-Marie- z	P 2005 Jun
41	0000-00-00		Tucson	P 2018 Jan
42	0000-00-00		Erfoud	2004
43	0000-00-00		Tucson	P 2018 Feb
44	0000-00-00		Morocco	P 2018 Feb
45	0000-00-00		Tucson	P 2017 Feb
46	0000-00-00		Morocco	P 30 Aug 201!
47	0000-00-00	Antofagasta		11 Feb 2018 22°26.27'S

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3	0000-00-00	Antofagasta	Gravel pedime	2017 Feb 21	24°38.765'S
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5	0000-00-00		Tucson Gem	ε P 2017	
6	0000-00-00		Denver	P 2017 Sep	
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8	0000-00-00		Tucson Gem	ε P 2018	
9	0000-00-00		Mauritania	P 2017 Nov	
10	0000-00-00		Talsint, Moroc	P 2018 Jan	
11	0000-00-00		Mauritania	P May 2018	
12	0000-00-00	Luxembourg	Tintigny	Feb. 1971	49.683786°N
13	0000-00-00		Sainte-Marie-ε	P 2007 Jun	
14	0000-00-00		Mauritania	P 2018 May	
15	0000-00-00		Guelmim, Mor	P 2017 Jul	
16	0000-00-00		Ensisheim, Fr	P 2018	
17	0000-00-00		Tucson, Arizoi	2016	
18	0000-00-00			2017	
19	0000-00-00			2017	
20	0000-00-00		Mauritania	P May 2018	
21	0000-00-00		Morocco	P 2016	
22	0000-00-00		Ensisheim, Fr	P 2006 Jun	
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25	0000-00-00			2017	
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27	0000-00-00		St Marie-aux M	P 2016	
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30	0000-00-00			2017	
31	0000-00-00		Morocco	P 2016	
32	0000-00-00	Draâ-Tafilalet	Flat desert are	2017	31°52'03.4"N
33	0000-00-00			2017	
34	0000-00-00		Morocco	P 2015	
35	0000-00-00		New York City	P 2018 Jan	
36	0000-00-00		Munich	P 2016 Oct	
37	0000-00-00			2017	
38	0000-00-00		Mauritania	P 2018 May	
39	0000-00-00		Mauritania	P May 2018	
40	0000-00-00			2017	
41	0000-00-00			2017	
42	0000-00-00		Morocco	P 2018	
43	0000-00-00			2017	
44	0000-00-00			2012	
45	0000-00-00			2009	
46	0000-00-00		Erfoud, Moroc	P March 2017	
47	0000-00-00		Ouarzazate	P 2017 Augus	
48	0000-00-00				
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3	0000-00-00			France	2017	
4	0000-00-00	Rio de Oro	stony desert (I	Ouarzazate	2015 Apr	~24°10'N
5	0000-00-00	Xinjiang	desert		22 Jan 2015	41°04'44.73"N
6	0000-00-00			Beijing	P Nov 2015	
7	0000-00-00		desert	Chenzhou, Hu	P 2018	
8	0000-00-00			Hamburg	P 2018	
9	0000-00-00			Munich	P 2011 Oct	
10	0000-00-00			Tucson	P Feb 2018	
11	0000-00-00	Xinjiang	desert	Bayingol, Xinji	2013	~40°30'N
12	0000-00-00			Hamburg	P 2018	
13	0000-00-00	Xinjiang	desert	Shanshan, Xir	2017	40°5'N
14	0000-00-00	Xinjiang	desert		2012	37°34'22.01"N
15	0000-00-00		desert	Chenzhou, Hu	P 2018	
16	0000-00-00			Ouarzazate	P 2017 August	
17	0000-00-00	Gansu	desert		22 Aug 2015	38°24'45.56"N
18	0000-00-00	XinJiang	desert		01 May 2015	41°26'20.91"N
19	0000-00-00			Beijing	P Nov 2015	
20	0000-00-00			Ouazazate	P 2017	
21	0000-00-00	Ouargla		Alnif	P before 2001	31°06'
22	0000-00-00	Ajdabiya	Sandy Desert		2006	27.46099°N
23	0000-00-00			Ensisheim, Fr	P 2018	
24	0000-00-00	Antofagasta			2016 Jan 14	25°29'19"S
25	0000-00-00			Morocco	P 2003	
26	0000-00-00	Antofagasta			17 Mar 2017	24°50.17'S
27	0000-00-00			Erfoud, Moroc	P 2018	
28	0000-00-00		Reckling Peak		2014 Nov 10	76°12.744'S
29	0000-00-00	Nevada	Dry Lake Bed		2017 Jan 07	36°14.991'N
30	0000-00-00				2012	
31	0000-00-00			Erfoud, Moroc	P 2018	
32	0000-00-00		Desert		1998	
33	0000-00-00				2012	
34	0000-00-00	Alabama			2015	34.319
35	0000-00-00				2012	
36	0000-00-00		Reckling Peak		2014 Nov 16	76°16.344'S
37	0000-00-00			Munich	P 2005	
38	0000-00-00			Munich	P 2005	
39	0000-00-00				2012	
40	0000-00-00		Elephant Mora		2014 Dec 12	76°15.921'S
41	0000-00-00		Desert		1998	
42	0000-00-00	Arizona			25 Nov 2011	34°48.036'N
43	0000-00-00	Arizona			27 Mar 2011	34°45.800'N
44	0000-00-00	Arizona			01 May 2014	34°49.033'N
45	0000-00-00	Arizona			12 Oct 2011	34°46.009'N
46	0000-00-00	Antofagasta	deflation surfa		2010 Apr 14	~25°14'S
47	0000-00-00	Arizona			27 Mar 2011	34°45.894'N

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3	0000-00-00	Arizona		23 Sep 2012	34°49.402'N
4	0000-00-00	Arizona		24 Nov 2011	34°49.281'N
5	0000-00-00			2014	
6	0000-00-00			2014	
7	0000-00-00				
8	0000-00-00		Temara	P 2017 Nov	
9	0000-00-00	Antofagasta	plain	2018 Apr 5	22°29.931'S
10	0000-00-00			Quartzite, Ariz	P 2006
11	0000-00-00	Jarayan al Bai	Desert	13 Feb 2018	24°52.27'N
12	0000-00-00		Desert	1998	
13	0000-00-00	Antofagasta	deflation surfa	2017 Mar	24°43'37.02"S
14	0000-00-00	Ash Shamal	Desert	6 Feb 2018	25°58.36'N
15	2018-11-06	Corrections to		CFMS show ir	2017
16	0000-00-00			Ebay; S. Tutor	P Jan. 2017
17	0000-00-00	Antofagasta		26 Feb 2016	25°00.560'S
18	0000-00-00			2012	
19	0000-00-00		Morocco	P 2016 May 0	
20	0000-00-00	Michigan		2018 Jan 16	42°26.82'N
21	0000-00-00	Antofagasta	granodiorite pi	2017 Feb 21	24°38'57.2"S
22	0000-00-00		Morocco	P 2016 May 0	
23	0000-00-00			Erfoud, Moroc	P 2001
24	0000-00-00			Ensisheim, Fr	P 2018
25	0000-00-00			2012	
26	0000-00-00		Morocco	P 2016 May 0	
27	0000-00-00		Morocco	P 2003	
28	0000-00-00			Erfoud, Moroc	P 2017 Feb
29	0000-00-00	Ajdabiya	Arid Plateau	2006	28.17254°N
30	0000-00-00			2000	
31	0000-00-00	QingHai	Qaidam Basin	20 Aug 2017	38.0713°N
32	0000-00-00	Antofagasta		21 Feb 2017	24°42.610'S
33	0000-00-00		Morocco	P 2003	
34	0000-00-00		Morocco	P 2016 May 0	
35	0000-00-00			2012	
36	0000-00-00		Morocco	P 2003	
37	0000-00-00		Morocco	P 2016 May 0	
38	0000-00-00			2014	
39	0000-00-00	Ajdabiya	Arid Plateau	2006	28.25716°N
40	0000-00-00		Bologna	P March 2016	
41	0000-00-00	Antofagasta		17 March 201	22°26.38'S
42	0000-00-00			2012	
43	0000-00-00		Morocco	P 2016 May 0	
44	0000-00-00		Morocco	P 2016 May 0	
45	0000-00-00			Sainte Marie ε	P 2018
46	0000-00-00			2012	
47	0000-00-00		Morocco	P 2016 May 0	
48	0000-00-00		Morocco	P 2016 May 0	
49	0000-00-00			2014	
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3	0000-00-00		Morocco	P 2016 May 0	
4	0000-00-00	Antofagasta		09 Feb 2018	24°39.202'S
5	0000-00-00		Morocco	P 2018	
6	0000-00-00		Morocco	P 2016 May 0	
7	0000-00-00		Erfoud	P 2002	
8	0000-00-00	Morocco, Laa	Genova	P May 2017	
9	0000-00-00		Morocco	P 2016 May 0	
10	0000-00-00		Morocco	P 2016 May 0	
11	0000-00-00	Antofagasta		24 Feb 2016	25°16.190'S
12	0000-00-00		Morocco	P 2016 May 0	
13	0000-00-00			2012	
14	0000-00-00	Ajdabiya	Arid Plateau	2006	28.44534°N
15	0000-00-00	Antofagasta	deflation surfa	2010 Mar 07	24°48'3.33"S
16	0000-00-00		Morocco	P 2016 May 0	
17	0000-00-00			2012	
18	0000-00-00		Morocco	P 2016 May 0	
19	0000-00-00	Antofagasta		22 Oct 2017	21°30.00'S
20	0000-00-00		Erfoud	P 2002	
21	0000-00-00		Morocco	P 2016 May 0	
22	0000-00-00		Erfoud	P March 2018	
23	0000-00-00			2012	
24	0000-00-00		Morocco	P 2016 May 0	
25	0000-00-00		Morocco	P 2016 May 0	
26	0000-00-00			2012	
27	0000-00-00		Desert	1998	
28	0000-00-00			2014	
29	0000-00-00		Morocco	P 2016 May 0	
30	0000-00-00			2012	
31	0000-00-00		Morocco	P 2016 May 0	
32	0000-00-00			2012	
33	0000-00-00	Morocco, Laa	Genova	P May 2014	
34	0000-00-00		Morocco	P 2016 May 0	
35	0000-00-00			2012	
36	0000-00-00	Morocco, Dah	Torino	P October 201	
37	0000-00-00		Morocco	P 2016 May 0	
38	0000-00-00			2014	
39	0000-00-00		Morocco	P 2016 May 0	
40	0000-00-00			2012	
41	0000-00-00	Ajdabiya	Arid Plateau	2006	28.21140°N
42	0000-00-00		Morocco	P 2016 May 0	
43	0000-00-00			2012	
44	0000-00-00		Morocco	P 2016 May 0	
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46	0000-00-00		Morocco	P 2016 May 0	
47	0000-00-00		Morocco	P 2016 May 0	
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4	0000-00-00	Erfoud	P 2002
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8	0000-00-00	Morocco	P 2016 May 0
9	0000-00-00		2012
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12	0000-00-00	Bessey	P 2012
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16	0000-00-00	Verona	P 2016
17	0000-00-00	Morocco	P 2016 May 0
18	0000-00-00	Morocco	P 2016 May 0
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49	0000-00-00		2012
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51	0000-00-00	Antofagasta	21 Mar 2017 22°21.63'S
52	0000-00-00		2012
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56	0000-00-00		2014
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22	0000-00-00	Marrakech P May 2014
23	0000-00-00	2000
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26	0000-00-00					
27	0000-00-00	Para	City	Parauapebas	2013 Dec 09	6°3.373'S
28	0000-00-00				2012	
29	0000-00-00			Erfoud, Moroc	P March 2017	
30	0000-00-00			Zagora	P 2017 Mar	
31	0000-00-00					
32	0000-00-00	Jarayan al Bai	Desert		15 Feb 2018	24° 52.29'N
33	0000-00-00	Jarayan al Bai	Desert		15 Feb 2018	24°52.57'N
34	0000-00-00	Antofagasta			13 Feb 2018	25°34.800'S
35	0000-00-00	Antofagasta			10 Feb 2018	24°59.059'S
36	0000-00-00	Antofagasta				
37	0000-00-00	Antofagasta	deflation surfa		2017 Nov	24°59'03.3"S
38	0000-00-00	Antofagasta			21 Feb 2017	25°04.985'S
39	0000-00-00	Antofagasta			15 Feb 2018	25°14.270'S
40	0000-00-00	Antofagasta				
41	0000-00-00	Antofagasta			17 Feb 2016	25°33.946'S
42	0000-00-00			Laayoune (Mc	P April 2018	
43	0000-00-00			Munich	P 2005	
44	0000-00-00					
45	0000-00-00	Antofagasta			27 Feb 2016	24°59.722'S
46	0000-00-00		Elephant Mora		2014 Dec 12	76°16.028'S
47	0000-00-00	Antofagasta	deflation surfa		2017 Mar	~24°51'S
48	0000-00-00	Victoria		Maryborough	2015 May	37°05'21"S
49	0000-00-00					
50	0000-00-00		Elephant Mora		2014 Dec 03	76°15.448'S
51	0000-00-00	Antofagasta	deflation surfa		2017 Mar	~24°51'S
52	0000-00-00				2014	
53	0000-00-00					
54	0000-00-00	East Kazakhsi			16 Feb 2018	49°51.27'N
55	0000-00-00			Tucson	P 2018 Feb	
56	0000-00-00			Erfoud	P 2016	
57	0000-00-00			Morocco	P 2018	
58	0000-00-00					
59	0000-00-00			Florida	P 2018 May	
60	2018-03-05	Corrected na			14 Nov 2003	

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3	0000-00-00		Changsha, Ch	unknown	
4	0000-00-00	Antofagasta	granodiorite p		2017 Feb 21 24°40'05.3"S
5	0000-00-00		Morocco	P	2018 Apr
6	0000-00-00		Zagora	P	2016
7	0000-00-00	Xinjiang	a sigle piece v	Beijing	2013 Oct 12 42°08'4.55"N
8	0000-00-00		Erfoud, Moroc	P	2017 Feb
9	0000-00-00	Antofagasta			10 Apr 2018 22°29.79'S
10	0000-00-00		Morocco	P	2017
11	0000-00-00		Erfoud, Moroc	P	2017 Feb
12	0000-00-00		Erfoud, Moroc	P	2003
13	0000-00-00		Erfoud, Moroc	P	2018
14	0000-00-00				2000
15	0000-00-00	Antofagasta	deflation surfa		2012 July 7 ~24°41'S
16	0000-00-00		Morocco, Zag	P	June 2013
17	0000-00-00	Morocco, Dah	Torino	P	October 201
18	0000-00-00		Morocco	P	2016 May 0
19	0000-00-00	Antofagasta			21 March 201: 22°26.44'S
20	0000-00-00		Morocco	P	2016 May 0
21	0000-00-00	Antofagasta	deflation surfa		2017 Nov 24°34'00.6"S
22	0000-00-00	Antofagasta			2017 Nov 24°41'S
23	0000-00-00		Morocco	P	2003
24	0000-00-00				2012
25	0000-00-00		Tucson	P	2017
26	0000-00-00				2015
27	0000-00-00		Morocco	P	2016 May 0
28	0000-00-00	Antofagasta			31 Mar 2018 22°30.59'S
29	0000-00-00		Erfoud, Moroc	P	2017 Feb
30	0000-00-00		Zagora (Moroc	P	April 2018
31	0000-00-00	Nevada	Dry Lake Bed		2017 Jan 6 36°14.06'N
32	0000-00-00		Elephant Morc		2014 Dec 12 76°13.852'S
33	0000-00-00	Antofagasta			27 Feb 2016 24°37.727'S
34	0000-00-00	Morocco, Dah	Genova	P	May 2017
35	0000-00-00		Morocco	P	2016 May 0
36	0000-00-00	Antofagasta			16 Mar 2017 24°43.64'S
37	0000-00-00				2012
38	0000-00-00	Antofagasta			28 Feb 2016 24°38.689'S
39	0000-00-00		Morocco	P	2016 May 0
40	0000-00-00		Morocco	P	2016 May 0
41	0000-00-00	Ajdabiya	Arid Plateau		2006 28.28916°N
42	0000-00-00				2012
43	0000-00-00	Antofagasta			6 Apr 2018 22°29.47'S
44	0000-00-00	Jarayan al Bai	Desert		06 March 201: 24° 53.30'N
45	0000-00-00	Antofagasta			10 Feb 2018 24°46.928'S
46	0000-00-00	Antofagasta	deflation surfa		2015 Jan 03 ~24°51'S
47	0000-00-00		Bologna	P	March 2016

1					
2					
3	0000-00-00	Rio Grande de		2004	33°39.07'S
4	0000-00-00		Bologna	P March 2016	
5	0000-00-00	Antofagasta	deflation surfa	2010 Jul 05	~25°14'S
6	0000-00-00	Antofagasta	deflation surfa	2017 Nov 13	~25°14'S
7	0000-00-00	Antofagasta	deflation surfa	2011 Nov 12	~24°51'S
8	0000-00-00	Morocco, Dah	Bologna	P March 2016	
9	0000-00-00			2012	
10	0000-00-00	Antofagasta		19 Nov 2017	22°26.02'S
11	0000-00-00		Morocco	P 2016 May 0	
12	0000-00-00		Morocco	P 2016 May 0	
13	0000-00-00	Antofagasta		16 Mar 2017	24°42.15'S
14	0000-00-00		Bologna	P March 2016	
15	0000-00-00		Erfoud, Moroc	P 2017 Feb	
16	0000-00-00			2012	
17	0000-00-00			2014	
18	0000-00-00	Antofagasta	deflation surfa	2011 Nov 12	~25°14'S
19	0000-00-00	Antofagasta		27 Feb 2016	24°41.635'S
20	0000-00-00		Morocco	P 2016 May 0	
21	0000-00-00		Morocco	P 2016 May 0	
22	0000-00-00	Antofagasta	deflation surfa	2017 Jun 19	24°49'02.1"N
23	0000-00-00		Morocco	P 2016 May 0	
24	0000-00-00		Laayoune (Mc	P April 2018	
25	0000-00-00	Ajdabiya	Arid Plateau	2006	28.30210°N
26	0000-00-00		Morocco	P 2016 May 0	
27	0000-00-00	Antofagasta		21 Oct 2016	21°35.80'S
28	0000-00-00		Morocco	P 2016 May 0	
29	0000-00-00		Morocco	P 2016 May 0	
30	0000-00-00		Morocco	P 2016 May 0	
31	0000-00-00		Morocco	P 2016 May 0	
32	0000-00-00		Morocco	P 2016 May 0	
33	0000-00-00		Morocco	P 2016 May 0	
34	0000-00-00		Morocco	P 2016 May 0	
35	0000-00-00		Morocco	P 2016 May 0	
36	0000-00-00		Morocco	P 2016 May 0	
37	0000-00-00		Morocco	P 2016 May 0	
38	0000-00-00		Morocco	P 2016 May 0	
39	0000-00-00		Morocco	P 2016 May 0	
40	0000-00-00		Morocco	P 2016 May 0	
41	0000-00-00			2012	
42	0000-00-00		Morocco	P 2016 May 0	
43	0000-00-00	Antofagasta		16 Mar 2017	24°55.18'S
44	0000-00-00	Kerman		02 April 2016	31°58.18'N
45	0000-00-00	Kerman		01 April 2016	31°52.29'N
46	0000-00-00	Antofagasta		22 Feb 2017	24°41.570'S
47	0000-00-00	Antofagasta	deflation surfa	2014 Dec 19	~25°14'S
48	0000-00-00		Bologna	P March 2016	
49	0000-00-00		Tucson, Arizo	P February 20	
50	0000-00-00	Antofagasta		31 Mar 2018	22°30.66'S
51	0000-00-00	Antofagasta		17 Feb 2017	24°56.893'S
52	0000-00-00	Antofagasta		27 Feb 2016	24°40.200'S
53	0000-00-00		Bologna	P March 2016	
54	0000-00-00	Morocco, Laa	Bologna	P March 2016	
55	0000-00-00	Al Wusta	Desert plain	12.02.17	20°20.555'N
56	0000-00-00				
57	0000-00-00				
58	0000-00-00				
59	0000-00-00				
60	0000-00-00				

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3	0000-00-00		Morocco/Wesl	P 2017
4	0000-00-00		Torino	P 2011
5	0000-00-00		Morocco	P 2016 May 0
6	0000-00-00		Morocco	P 2016 May 0
7	0000-00-00			2012
8	0000-00-00			2012
9	0000-00-00			
10	0000-00-00			
11	0000-00-00	Antofagasta	deflation surfa	2009 Dec 13 ~25°14'S
12	0000-00-00		Morocco	P 2016 May 0
13	0000-00-00			2014
14	0000-00-00			
15	0000-00-00	Antofagasta	deflation surfa	2017 Nov 19 ~24°41'S
16	0000-00-00		Morocco	P 2016 May 0
17	0000-00-00	Saskatchewan		Unknown 50°08'N
18	0000-00-00		Morocco	P 2016 May 0
19	0000-00-00			
20	0000-00-00	Antofagasta		17 Feb 2017 24°55.874'S
21	0000-00-00		Morocco	P 2016 May 0
22	0000-00-00			
23	0000-00-00		Elephant Moræ	2014 Dec 03 76°16.053'S
24	0000-00-00			2012
25	0000-00-00	Antofagasta	deflation surfa	2009 Dec 10 ~25°14'S
26	0000-00-00		Morocco	P 2016 May 0
27	0000-00-00		Morocco	P 2016 May 0
28	0000-00-00		Morocco	P 2016 May 0
29	0000-00-00			
30	0000-00-00			2012
31	0000-00-00			2014
32	0000-00-00			
33	0000-00-00		Morocco	P 2016 May 0
34	0000-00-00		Morocco	P 2016 May 0
35	0000-00-00			2012
36	0000-00-00			2014
37	0000-00-00			
38	0000-00-00	Morocco, Dah	Genova	P May 2016
39	0000-00-00	Antofagasta	deflation surfa	2010 Jul 05 ~25°14'S
40	0000-00-00			
41	0000-00-00		Elephant Moræ	2014 Dec 12 76°02.689'S
42	0000-00-00			2012
43	0000-00-00		Morocco	P 2016 May 0
44	0000-00-00			
45	0000-00-00	Morocco, Dah	Genova	P May 2016
46	0000-00-00			2012
47	0000-00-00		Morocco	P 2016 May 0
48	0000-00-00			2014
49	0000-00-00			
50	0000-00-00		Elephant Moræ	2014 Dec 12 76°15.689'S
51	0000-00-00			2014
52	0000-00-00		Bologna	P March 2016
53	0000-00-00			2014
54	0000-00-00			2012
55	0000-00-00			
56	0000-00-00	Antofagasta		18 Jan 2017 25°26.488'S
57	0000-00-00			2012
58	0000-00-00			
59	0000-00-00		Erfoud, Moroc	P 2018
60	0000-00-00	Al Bahr al Ahn		29 Mar 2010 28°11.94'N

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2				
3	0000-00-00			2017 July 17 54°59'24"N
4	0000-00-00			
5	0000-00-00		Morocco	P 2016 May 0
6	0000-00-00		Morocco	P 2016 May 0
7	0000-00-00			2012
8	0000-00-00	Antofagasta		14 Feb 2018 25°29.963'S
9	0000-00-00	Kerman	Bologna	P March 2016 30°23.99'N
10	0000-00-00			2016
11	0000-00-00			
12	0000-00-00		Morocco	P 2016 May 0
13	0000-00-00	Antofagasta	deflation surfa	2009 Dec 18 ~25°14'S
14	0000-00-00	Antofagasta	deflation surfa	2010 Feb 16 25°18'43.31"S
15	0000-00-00	Al Bahr al Ahn		27 Mar 2010 28°13.23'N
16	0000-00-00	Antofagasta		10 Apr 2018 22°30.15'S
17	0000-00-00			2014
18	0000-00-00			
19	0000-00-00		Erfoud, Moroc	P 2018
20	0000-00-00		Morocco	P 2016 May 0
21	0000-00-00			2012
22	0000-00-00		Morocco	P 2016 May 0
23	0000-00-00			2012
24	0000-00-00	Antofagasta		09 Feb 2018 24°40.875'S
25	0000-00-00			2012
26	0000-00-00	Antofagasta	deflation surfa	2010 Jul 04 ~25°14'S
27	0000-00-00		E-bay	P 2013
28	0000-00-00		Elephant Mora	2014 Dec 12 76°15.759'S
29	0000-00-00		Bologna	P 3/2015
30	0000-00-00			1974
31	0000-00-00			2012
32	0000-00-00	Al Bahr al Ahn		26 Feb 2010 28°12.94'N
33	0000-00-00		Morocco	P 2016 May 0
34	0000-00-00			2012
35	0000-00-00			2012
36	0000-00-00		E-bay	P 2013
37	0000-00-00	Antofagasta		17 Feb 2017 24°57.191'S
38	0000-00-00			2014
39	0000-00-00	Morocco, Smæ	Bologna	P March 2016
40	0000-00-00	Antofagasta	deflation surfa	2014 Dec 20 ~25°14'S
41	0000-00-00			2014
42	0000-00-00			2014
43	0000-00-00		Bologna	P March 2016
44	0000-00-00		Morocco	P 2016 May 0
45	0000-00-00		Morocco	P 2016 May 0
46	0000-00-00		Morocco	P 2016 May 0
47	0000-00-00			2014
48	0000-00-00		Elephant Mora	2014 Nov 16 76°17.133'S
49	0000-00-00	Antofagasta	deflation surfa	2014 ~24°41'S
50	0000-00-00		Morocco	P 2016 May 0
51	0000-00-00		Morocco	P 2016 May 0
52	0000-00-00		Morocco	P 2016 May 0
53	0000-00-00			2014
54	0000-00-00			
55	0000-00-00			
56	0000-00-00			
57	0000-00-00		Morocco	P 2016 May 0
58	0000-00-00		Morocco	P 2016 May 0
59	0000-00-00			2014
60	0000-00-00			

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2			
3	0000-00-00	Zagora	P 2018
4	0000-00-00		2012
5	0000-00-00		2012
6	0000-00-00		2012
7	0000-00-00		2012
8	0000-00-00	Morocco	P 2016 May 0
9	0000-00-00		2014
10	0000-00-00		2012
11	0000-00-00		2012
12	0000-00-00	Elephant Mora	2014 Dec 12 76°15.654'S
13	0000-00-00		2012
14	0000-00-00		2012
15	0000-00-00	Tucson (Said	P Jan 2010
16	0000-00-00	Morocco	P 2016 May 0
17	0000-00-00	Antofagasta deflation surfa	2010 Jul 04 ~25°14'S
18	0000-00-00		2012
19	0000-00-00		2012
20	0000-00-00	Morocco	P 2016 May 0
21	0000-00-00		2015
22	0000-00-00		2015
23	0000-00-00		2015
24	0000-00-00	Arizona dry lake	2005 Sep 03 35°39.05'N
25	0000-00-00		2012
26	0000-00-00		2012
27	0000-00-00	Morocco	P 2016 May 0
28	0000-00-00		2014
29	0000-00-00		2014
30	0000-00-00		2012
31	0000-00-00		2012
32	0000-00-00	Morocco	P 2016 May 0
33	0000-00-00	Morocco	P 2016 May 0
34	0000-00-00	Morocco	P 2016 May 0
35	0000-00-00		2015
36	0000-00-00		2015
37	0000-00-00	Morocco	P 2016 May 0
38	0000-00-00		2015
39	0000-00-00		2017
40	0000-00-00		2017
41	0000-00-00	Morocco	P 2016 May 0
42	0000-00-00	Elephant Mora	2014 Nov 16 76°16.407'S
43	0000-00-00	Antofagasta deflation surfa	2009 Dec 18 ~25°14'S
44	0000-00-00		2012
45	0000-00-00	Morocco	P 2016 May 0
46	0000-00-00		2012
47	0000-00-00		2014
48	0000-00-00		2014
49	0000-00-00		2014
50	0000-00-00	Elephant Mora	2014 Nov 16 76°17.133'S
51	0000-00-00	Morocco	P 2016 May 0
52	0000-00-00	Morocco	P 2016 May 0
53	0000-00-00		2012
54	0000-00-00	Antofagasta	09 Feb 2018 24°40.892'S
55	0000-00-00		2012
56	0000-00-00		2015
57	0000-00-00		2014
58	0000-00-00		2014
59	0000-00-00	Morocco	P 2016 May 0
60	0000-00-00	Morocco	P 2016 May 0

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3	0000-00-00		1979
4	0000-00-00		2012
5	0000-00-00		2014
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12	0000-00-00		2014
13	0000-00-00		2014
14	0000-00-00		2012
15	0000-00-00		2012
16	0000-00-00	Antofagasta	03 Feb 2015 25°34.691'S
17	0000-00-00		2014
18	0000-00-00	Elephant Moræ	2014 Nov 16 76°17.644'S
19	0000-00-00		1974
20	0000-00-00		2014
21	0000-00-00	Morocco	P 2016 May 0
22	0000-00-00		2000
23	0000-00-00		2015
24	0000-00-00		2015
25	0000-00-00		2015
26	0000-00-00		2015
27	0000-00-00		2015
28	0000-00-00	Elephant Moræ	2014 Dec 12 76°15.332'S
29	0000-00-00	Antofagasta deflation surfa	2014 ~24°41'S
30	0000-00-00		2012
31	0000-00-00		2012
32	0000-00-00		2012
33	0000-00-00	Antofagasta	25 Oct 2016 21°34.33'S
34	0000-00-00	Antofagasta	14 Feb 2018 25°17.895'S
35	0000-00-00		2015
36	0000-00-00		2014
37	0000-00-00		2014
38	0000-00-00		2000
39	0000-00-00		2012
40	0000-00-00		2012
41	0000-00-00		2012
42	0000-00-00		1979
43	0000-00-00		2014
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46	0000-00-00		2015
47	0000-00-00		2014
48	0000-00-00		2014
49	0000-00-00		2014
50	0000-00-00	Morocco	P 2016 May 0
51	0000-00-00		2012
52	0000-00-00	Morocco	P 2016 May 0
53	0000-00-00	Morocco	P 2016 May 0
54	0000-00-00	Morocco	P 2016 May 0
55	0000-00-00	Morocco	P 2016 May 0
56	0000-00-00	Elephant Moræ	2014 Dec 12 76°15.899'S
57	0000-00-00		2014
58	0000-00-00	Morocco	P 2016 May 0
59	0000-00-00		2014
60	0000-00-00		2000

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3	0000-00-00	Elephant Mora	2014 Dec 12	76°15.177'S
4	0000-00-00		2000	
5	0000-00-00	Antofagasta	17 Mar 2017	22°19.26'S
6	0000-00-00	Elephant Mora	2014 Nov 16	76°17.625'S
7	0000-00-00	Antofagasta	18 Feb 2018	24°41.972'S
8	0000-00-00		2000	
9	0000-00-00		2000	
10	0000-00-00			
11	0000-00-00			
12	0000-00-00	Morocco	P 2016 May 0	
13	0000-00-00		2012	
14	0000-00-00		1987	
15	0000-00-00		2000	
16	0000-00-00		1987	
17	0000-00-00			
18	0000-00-00	Morocco	P 2016 May 0	
19	0000-00-00		2014	
20	0000-00-00		2012	
21	0000-00-00		1987	
22	0000-00-00		2014	
23	0000-00-00		1979	
24	0000-00-00		2000	
25	0000-00-00		2012	
26	0000-00-00		2000	
27	0000-00-00		2012	
28	0000-00-00		2000	
29	0000-00-00	Antofagasta deflation surfa	2010 Jan 22	~24°41'S
30	0000-00-00	Antofagasta	21 Mar 2017	22°21.37'S
31	0000-00-00		2000	
32	0000-00-00		1979	
33	0000-00-00		1979	
34	0000-00-00		2000	
35	0000-00-00		1979	
36	0000-00-00		2000	
37	0000-00-00		1979	
38	0000-00-00		2009	
39	0000-00-00		2000	
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16	0000-00-00	2014
17	0000-00-00	2009
18	0000-00-00	2000
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25	0000-00-00	2009
26	0000-00-00	2000
27	0000-00-00	2000
28	0000-00-00	2009
29	0000-00-00	2014 Nov 21 76°17.163'S
30	0000-00-00	1998
31	0000-00-00	1998
32	0000-00-00	1998
33	0000-00-00	2009
34	0000-00-00	2000
35	0000-00-00	2009
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16	0000-00-00	1998
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35	0000-00-00	2009
36	0000-00-00	1998
37	0000-00-00	2009
38	0000-00-00	2012
39	0000-00-00	2000
40	0000-00-00	2014 Nov 10 76°12.376'S
41	0000-00-00	2009
42	0000-00-00	2009
43	0000-00-00	2009
44	0000-00-00	2009
45	0000-00-00	2009
46	0000-00-00	2009
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59	0000-00-00	2015
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3	0000-00-00			2009
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5	0000-00-00			2016
6	0000-00-00			2000
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16	0000-00-00			2009
17	0000-00-00			2000
18	0000-00-00			2000
19	0000-00-00			2000
20	0000-00-00	Elephant Mora		2014 Dec 12 76°14.962'S
21	0000-00-00			2000
22	0000-00-00	Pavlodar		August 2013 52°39.86'N
23	0000-00-00	Madaniyin Desert		2018 Mar 33°19'50.07"N
24	0000-00-00	Antofagasta deflation surfa		2017 Nov 24°56'32.9"S
25	0000-00-00		Zagora, Moroc	P 2018
26	0000-00-00	Antofagasta		20 Feb 2017 25°12.962'S
27	0000-00-00	Antofagasta deflation surfa		2010 Jan 19 ~24°41'S
28	0000-00-00	Tibet	Beijing	June 25, 2018 33°10.17'N
29	0000-00-00		Erfoud, Moroc	P 2003
30	0000-00-00		Morocco	P 2016
31	0000-00-00		Erfoud	P 2017
32	0000-00-00		Alicante, Spai	P 2012
33	0000-00-00		Rissani	P 2004
34	0000-00-00	Antofagasta		31 Jan 2015 25°12.068'S
35	0000-00-00	Antofagasta deflation surfa		2017 Nov 25°24'09.0"S
36	0000-00-00	California	buried under a	2015 Dec 12 35°3.396'N
37	0000-00-00	Antofagasta		24 Mar 2016 25°13'40"S
38	0000-00-00			2000
39	0000-00-00	Morocco, Our	Genova	P May 2016
40	0000-00-00	Antofagasta limestone defl.		2017 Oct 15 22°24.643' S
41	0000-00-00		Erfoud	P 2017
42	0000-00-00	Antofagasta		22 Feb 2017 24°41.170'S
43	0000-00-00			2012
44	0000-00-00		Munich	P 2017 Oct
45	0000-00-00	Antofagasta		21 Feb 2017 24°45.942'S
46	0000-00-00		Western Saha	P 2018
47	0000-00-00	Antofagasta		20 Feb 2017 25°13.711'S
48	0000-00-00			2000
49	0000-00-00	Antofagasta		15 Feb 2018 25°14.262'S
50	0000-00-00		near Dakhla Morocco	P 2018
51	0000-00-00			2012
52	0000-00-00			
53	0000-00-00			
54	0000-00-00			
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3	0000-00-00		Morocco	P 2003
4	0000-00-00	Antofagasta		22 Feb 2017 24°41.386'S
5	0000-00-00			
6	0000-00-00		Morocco	P 2018 Apr
7	0000-00-00	Atacama		2017 Nov 10 26°17'55"S
8	0000-00-00	Antofagasta		22 Feb 2017 24°39.042'S
9	0000-00-00			
10	0000-00-00			2012
11	0000-00-00	Antofagasta	limestone defl.	19 Oct 2017 22°28.050'S
12	0000-00-00		Morocco	P 2016 May 0
13	0000-00-00		Morocco	P 2016 May 0
14	0000-00-00			
15	0000-00-00	Antofagasta		15 Feb 2018 25°13.153'S
16	0000-00-00			P 2017
17	0000-00-00	Antofagasta	limestone defl.	19 Oct 2017 22°27.549'S
18	0000-00-00			
19	0000-00-00			2012
20	0000-00-00			2014
21	0000-00-00		Tucson Gem	P 2012 Feb
22	0000-00-00	Antofagasta	deflation surfa	2014 Dec 21 ~24°41'S
23	0000-00-00			
24	0000-00-00		Morocco	P 2016 May 0
25	0000-00-00		Morocco	P 2016 May 0
26	0000-00-00		Morocco	P 2016 May 0
27	0000-00-00		Morocco	P 2016 May 0
28	0000-00-00		Morocco	P 2016 May 0
29	0000-00-00		Morocco	P 2016 May 0
30	0000-00-00		Morocco	P 2016 May 0
31	0000-00-00			
32	0000-00-00			2014
33	0000-00-00			2012
34	0000-00-00		Morocco	P 2016 May 0
35	0000-00-00	Antofagasta		21 Feb 2017 24°44.527'S
36	0000-00-00			
37	0000-00-00			2014
38	0000-00-00		Morocco	P 2016 May 0
39	0000-00-00		Morocco	P 2016 May 0
40	0000-00-00			
41	0000-00-00			2012
42	0000-00-00		Morocco	P 2016 May 0
43	0000-00-00			
44	0000-00-00			2014
45	0000-00-00		Bologna	P March 2016
46	0000-00-00		Morocco	P 2016 May 0
47	0000-00-00			
48	0000-00-00			2014
49	0000-00-00		Morocco	P 2016 May 0
50	0000-00-00		Morocco	P 2016 May 0
51	0000-00-00			
52	0000-00-00			2012
53	0000-00-00		Morocco	P 2016 May 0
54	0000-00-00			
55	0000-00-00			2014
56	0000-00-00			2012
57	0000-00-00		Morocco	P 2016 May 0
58	0000-00-00			
59	0000-00-00			2014
60	0000-00-00			2012
			Morocco	P 2016 May 0

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3	0000-00-00			2012	
4	0000-00-00			2012	
5	0000-00-00			2014	
6	0000-00-00			2014	
7	0000-00-00			2014	
8	0000-00-00			Morocco	P 2016 May 0
9	0000-00-00			Morocco	P 2016 May 0
10	0000-00-00			Morocco	P 2016 May 0
11	0000-00-00				2014
12	0000-00-00			Morocco	P 2016 May 0
13	0000-00-00	South	Gravel		2017 Mar 31°01.55'N
14	0000-00-00				2012
15	0000-00-00			Morocco	P 2016 May 0
16	0000-00-00				2014
17	0000-00-00			Morocco	P 2016 May 0
18	0000-00-00				2012
19	0000-00-00			Morocco	P 2016 May 0
20	0000-00-00				2012
21	0000-00-00				2012
22	0000-00-00				2012
23	0000-00-00			Morocco	P 2016 May 0
24	0000-00-00				2012
25	0000-00-00				2014
26	0000-00-00			Mali	Torino
27	0000-00-00				P October 201
28	0000-00-00				2015
29	0000-00-00				2014
30	0000-00-00				2014
31	0000-00-00			Morocco	P 2016 May 0
32	0000-00-00				P 2017
33	0000-00-00				2014
34	0000-00-00			Sainte Marie	P 2018
35	0000-00-00				2014
36	0000-00-00				2014
37	0000-00-00			Antofagasta	deflation surfa
38	0000-00-00				2017 Nov 12 ~25°14'S
39	0000-00-00			Morocco	P 2016 May 0
40	0000-00-00			Morocco	P 2016 May 0
41	0000-00-00			Morocco	P 2016 May 0
42	0000-00-00				2015
43	0000-00-00			Tucson (Said	P Jan 2012
44	0000-00-00				2012
45	0000-00-00				2015
46	0000-00-00			Mt. DeWitt	2014 Dec 11 77°12.239'S
47	0000-00-00				2015
48	0000-00-00				1986
49	0000-00-00				2014
50	0000-00-00				2014
51	0000-00-00				2015
52	0000-00-00				2015
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54	0000-00-00				2014
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56	0000-00-00				2015
57	0000-00-00				2014
58	0000-00-00				2015
59	0000-00-00				2015
60	0000-00-00				2014

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3	0000-00-00		Said Hadnany P 2011 Feb
4	0000-00-00		2009
5	0000-00-00		2012
6	0000-00-00		2014
7	0000-00-00		2014
8	0000-00-00	Arizona	11 Nov 2011 34°48.990'N
9	0000-00-00		2015
10	0000-00-00		2012
11	0000-00-00		2012
12	0000-00-00		2012
13	0000-00-00		2012
14	0000-00-00		2012
15	0000-00-00		2015
16	0000-00-00		2012
17	0000-00-00		1979
18	0000-00-00		2012
19	0000-00-00		2014
20	0000-00-00		2014
21	0000-00-00		2014
22	0000-00-00		2014
23	0000-00-00	Morocco	P 2016 May 0
24	0000-00-00		2014
25	0000-00-00		2012
26	0000-00-00		2014
27	0000-00-00		2014
28	0000-00-00		2015
29	0000-00-00		2014
30	0000-00-00		2014
31	0000-00-00		2012
32	0000-00-00		2012
33	0000-00-00		2015
34	0000-00-00	Morocco	P 2016 May 0
35	0000-00-00		2015
36	0000-00-00		2012
37	0000-00-00		2012
38	0000-00-00	Elephant Morc	2014 Dec 12 76°15.270'S
39	0000-00-00		2014
40	0000-00-00		2012
41	0000-00-00		2014
42	0000-00-00		2014
43	0000-00-00		2014
44	0000-00-00		2014
45	0000-00-00		2014
46	0000-00-00	Morocco	P 2016 May 0
47	0000-00-00		2015
48	0000-00-00		2015
49	0000-00-00		2014
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51	0000-00-00		2015
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56	0000-00-00		2012
57	0000-00-00		2014
58	0000-00-00		2014
59	0000-00-00		2015
60	0000-00-00		2012

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3	0000-00-00		Morocco P 2016 May 0
4	0000-00-00	Antofagasta	21 Feb 2017 25°04.950'S
5	0000-00-00		2014
6	0000-00-00		2014
7	0000-00-00		Morocco P 2016 May 0
8	0000-00-00		2014
9	0000-00-00		2014
10	0000-00-00		2014
11	0000-00-00		2015
12	0000-00-00		2015
13	0000-00-00		2015
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16	0000-00-00		2015
17	0000-00-00		2015
18	0000-00-00		2015
19	0000-00-00		2012
20	0000-00-00		Morocco P 2016 May 0
21	0000-00-00		2000
22	0000-00-00		2014
23	0000-00-00		1979
24	0000-00-00		1987
25	0000-00-00		1987
26	0000-00-00		2012
27	0000-00-00		1987
28	0000-00-00		1987
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31	0000-00-00		1987
32	0000-00-00		2012
33	0000-00-00		2014
34	0000-00-00		2014
35	0000-00-00		1987
36	0000-00-00		2014
37	0000-00-00		Morocco P 2016 May 0
38	0000-00-00		2014
39	0000-00-00		2012
40	0000-00-00	Antofagasta	15 Feb 2018 25°14.789'S
41	0000-00-00		1998
42	0000-00-00		2000
43	0000-00-00		2012
44	0000-00-00		2012
45	0000-00-00		2000
46	0000-00-00		2014
47	0000-00-00		2014
48	0000-00-00		2014
49	0000-00-00		2014
50	0000-00-00		Morocco P 2016 May 0
51	0000-00-00	Elephant Morc	2014 Nov 21 76°17.270'S
52	0000-00-00		2000
53	0000-00-00		2000
54	0000-00-00		2009
55	0000-00-00		2009
56	0000-00-00		2000
57	0000-00-00		2000
58	0000-00-00		2000
59	0000-00-00		2000
60	0000-00-00		2009

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4	0000-00-00		2000
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6	0000-00-00		2009
7	0000-00-00		2009
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11	0000-00-00		2000
12	0000-00-00		2009
13	0000-00-00		2009
14	0000-00-00	Elephant Morc	2014 Dec 12 76°15.507'S
15	0000-00-00	Morocco	P 2016 May 0
16	0000-00-00		2009
17	0000-00-00		2012
18	0000-00-00		2000
19	0000-00-00		2000
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37	0000-00-00		1998
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43	0000-00-00		1998
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50	0000-00-00		2000
51	0000-00-00		2000
52	0000-00-00		2009
53	0000-00-00		2009
54	0000-00-00	Morocco	P 2016 May 0
55	0000-00-00		2009
56	0000-00-00	Elephant Morc	2014 Dec 12 76°15.602'S
57	0000-00-00		2009
58	0000-00-00		2009
59	0000-00-00		2009
60	0000-00-00		2009

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3	0000-00-00	1998
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9	0000-00-00	2009
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11	0000-00-00	Elephant Moræ 2014 Dec 12 76°15.663'S
12	0000-00-00	2009
13	0000-00-00	2009
14	0000-00-00	2009
15	0000-00-00	2009
16	0000-00-00	2009
17	0000-00-00	2009
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19	0000-00-00	Elephant Moræ 2014 Dec 12 76°15.553'S
20	0000-00-00	2009
21	0000-00-00	1998
22	0000-00-00	2009
23	0000-00-00	2009
24	0000-00-00	1998
25	0000-00-00	2009
26	0000-00-00	1998
27	0000-00-00	2009
28	0000-00-00	2009
29	0000-00-00	2015
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31	0000-00-00	2015
32	0000-00-00	2015
33	0000-00-00	2015
34	0000-00-00	2012
35	0000-00-00	2009
36	0000-00-00	2009
37	0000-00-00	Elephant Moræ 2014 Dec 12 76°15.349'S
38	0000-00-00	Elephant Moræ 2014 Dec 12 76°15.280'S
39	0000-00-00	2015
40	0000-00-00	1998
41	0000-00-00	2015
42	0000-00-00	2015
43	0000-00-00	Elephant Moræ 2014 Dec 12 76°15.573'S
44	0000-00-00	2016
45	0000-00-00	2016
46	0000-00-00	2016
47	0000-00-00	1998
48	0000-00-00	2016
49	0000-00-00	2016
50	0000-00-00	2010
51	0000-00-00	2009
52	0000-00-00	2009
53	0000-00-00	2016
54	0000-00-00	2016
55	0000-00-00	1998
56	0000-00-00	2016
57	0000-00-00	2016
58	0000-00-00	Elephant Moræ 2014 Dec 12 76°15.554'S
59	0000-00-00	2009
60	0000-00-00	2000

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3	0000-00-00		2015
4	0000-00-00		1998
5	0000-00-00		2016
6	0000-00-00		2000
7	0000-00-00		2016
8	0000-00-00		2009
9	0000-00-00		2009
10	0000-00-00		2000
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13	0000-00-00		2016
14	0000-00-00		2016
15	0000-00-00		2000
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22	0000-00-00		2000
23	0000-00-00		2000
24	0000-00-00		2000
25	0000-00-00		2009
26	0000-00-00		2015
27	0000-00-00	Temara	P 2017 Aug
28	0000-00-00	Tucson Gem	P 2018 Jan
29	0000-00-00	Mali	P 2017
30	0000-00-00		April 2018
31	0000-00-00	Morocco	P 2017
32	0000-00-00	Mauritania	P May 2018
33	0000-00-00	Sagua el Handry river (wadi Ouarzazate	2014 Dec ~26°50.2'N
34	0000-00-00	Morocco	P 2017
35	0000-00-00	Munich	P 2008
36	0000-00-00	Tucson	P 2017 Jan 30
37	0000-00-00	Mauritania	P May 2018
38	0000-00-00	Temara	P 2017 Aug
39	0000-00-00	Sainte-Marie	P 2006 Jun
40	0000-00-00	Mauritania	P May 2018
41	0000-00-00	Mauritania	P 2018 May
42	0000-00-00	online	P July 2018
43	0000-00-00	Morocco	P 2018
44	0000-00-00		P 2018
45	0000-00-00	Morocco	P 2016 May 1
46	0000-00-00	Morocco	P 2016 May 1
47	0000-00-00	Morocco	P 2016 May 1
48	0000-00-00	Morocco	P 2016 May 1
49	0000-00-00		2017
50	0000-00-00		2017
51	0000-00-00		P 2005
52	0000-00-00		
53	0000-00-00		
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58	0000-00-00		
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3	0000-00-00			P 2017		
4	0000-00-00			P 2016		
5	0000-00-00					
6	0000-00-00	Zacatecas		October, 2016	22°49'15.73"N	
7	0000-00-00			P 2005		
8	0000-00-00					
9	0000-00-00		Munich	P 2005		
10	0000-00-00	Valle d'Aosta		May 1987	45°49.14'N	
11	0000-00-00	Chubu		2012 Oct	35°26'33.9"N	
12	0000-00-00	Xinjiang		2015 Dec	41.3°N	
13	0000-00-00					
14	0000-00-00			P 2004		
15	0000-00-00			P 2004		
16	0000-00-00			P 2013		
17	0000-00-00			1940		
18	0000-00-00					
19	0000-00-00			P 2014		
20	0000-00-00			P 2014		
21	0000-00-00			P 2010		
22	0000-00-00					
23	0000-00-00		Ouarzazate	P 2017 Jan		
24	0000-00-00		Chenzhou	P May 2017		
25	0000-00-00		Chenzhou City	P May 2017		
26	0000-00-00					
27	0000-00-00	Rio Grande de	Countryside	about 1908	30°41'34.9"S	
28	0000-00-00	Sokoto		10 Jan 2008	13°0.3'N	
29	0000-00-00	Xinjiang		Hami	1999	44°10'20"
30	0000-00-00	Adrar	Limestone per		2001 Dec	21°20'31.93"N
31	0000-00-00	Salamanca			1981	40°51.04'N
32	0000-00-00					
33	0000-00-00				2016	
34	0000-00-00	Xinjiang		Urumqi	2013	41°03'22"N
35	0000-00-00	Xinjiang	desert		6 June 2017	47°52'59"N
36	0000-00-00					
37	0000-00-00				2017	
38	0000-00-00				2014	
39	0000-00-00					
40	0000-00-00			Morocco	P 2018	
41	0000-00-00	Qinghai	desert		07 June 2016	37°59'2.07"N
42	0000-00-00	Qinghai	desert		16 Sept 2015	37°39'35.17"N
43	0000-00-00					
44	0000-00-00			Beijing	P 2015	
45	0000-00-00	Qinghai	desert		13 July 2015	37°49'2.34"N
46	0000-00-00	Qinghai	desert		10 Mar 2014	37°34'54.59"N
47	0000-00-00	Qinghai	desert		03 Nov 2013	37°29'12.31"N
48	0000-00-00					
49	0000-00-00			Ouarzazate	P 2017 August	
50	2019-01-15	Updated coor	Xinjiang	desert	2018 Jun	46°49'51.07"N
51	0000-00-00		Xinjiang	desert	26 Nov 2013	42°33'43.03"N
52	0000-00-00		Gansu	desert	16 Sept 2018	40°13'12.56"N
53	0000-00-00					
54	0000-00-00			Ouarzazate	P 2017 March	
55	0000-00-00	Xinjiang	desert		16 Nov 2016	42°27'51.71"N
56	0000-00-00			ebay	2017	
57	0000-00-00	Xinjiang	desert		20 Aug 2012	41°43'1.04"N
58	0000-00-00	Xinjiang	desert			
59	0000-00-00	Xinjiang	desert	Urumqi, Xinjia	2014	
60	0000-00-00	Xinjiang	desert	Hami, Xinjiang	P 2013	

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2					
3	0000-00-00		Hamburg	P 2018	
4	0000-00-00	Oyo		19 April 2018	8°16'55.83"N
5	0000-00-00		Mali	P 2018	
6	0000-00-00		Munich	P 2005	
7	0000-00-00		Morocco	P 2018	
8	0000-00-00		Tinduf, Algeria	P 2017 Jan	
9	0000-00-00		Morocco	P 2017	
10	0000-00-00		Zagora	P March 2018	
11	0000-00-00		Guelmim, Mor	P 2018 Aug	
12	0000-00-00		Zagora	P 2018	
13	0000-00-00		Hamburg, Ger	P 2017	
14	0000-00-00		Hamburg, Ger	P 2017	
15	0000-00-00		Morocco	P 2017 Jun	
16	0000-00-00			2012	
17	0000-00-00	Northwest Afri	Erfoud	P 2010	
18	0000-00-00		Morocco	P 2017 Jun	
19	0000-00-00		Tindouf, Alger	P 2018	
20	0000-00-00	Chihuahua	Allende strew	1995 Aug	26.94°N
21	0000-00-00		Sainte Marie	P 2018	
22	0000-00-00		Munich, Germ	P 2017	
23	0000-00-00			2012	
24	0000-00-00		Morocco	P 2017	
25	0000-00-00		Morocco	P 2017	
26	0000-00-00		Algeria	P 2017	
27	0000-00-00		Erfoud, Moroc	P 2018	
28	0000-00-00		Morocco	P 2018	
29	0000-00-00		Morocco	P 2018	
30	0000-00-00		Tucson, AZ	unknown	
31	0000-00-00		Hamburg, Ger	P 2017	
32	0000-00-00	Elephant Morc		2014 Nov 21	76°17.125'S
33	0000-00-00			2009	
34	0000-00-00			2009	
35	0000-00-00			2009	
36	0000-00-00			2000	
37	0000-00-00			2000	
38	0000-00-00			2000	
39	0000-00-00			2000	
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42	0000-00-00			2009	
43	0000-00-00			2010	
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47	0000-00-00			2009	
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3	0000-00-00			2009	
4	0000-00-00		Casablanca	P 2001 Mar	
5	0000-00-00		Beijing	P Nov. 2015	
6	0000-00-00		Erfoud, Moroc	P 2018	
7	0000-00-00		Morocco	P 2017	
8	0000-00-00			2014	
9	0000-00-00			2014	
10	0000-00-00			2014	
11	0000-00-00			2014	
12	0000-00-00			2014	
13	0000-00-00			2014	
14	0000-00-00			2014	
15	0000-00-00		Sainte-Marie	ε Jun 2017	
16	2018-02-24	changed to α	Boujdour	Gueltat Zemm	21 Aug 2018 25°05'32.0"N
17	0000-00-00			Ensisheim, Fr	P 2007 June
18	0000-00-00			Munich	P 2005
19	0000-00-00			Erfoud, Moroc	P 2017 Feb
20	0000-00-00			Munich	P 2005
21	0000-00-00			Temara	P 2017 Nov
22	0000-00-00			Temara	P 2017 Nov
23	0000-00-00			Erfoud, Moroc	P 2003
24	0000-00-00		Antofagasta		25 Feb 2016 25°08.980'S
25	0000-00-00			Morocco	P 2018 May
26	0000-00-00			Morocco	P 2016 May 0
27	0000-00-00		Elephant Mora		2014 Dec 12 76°16.246'S
28	0000-00-00			Morocco	P 2016 May 0
29	0000-00-00		Morocco, Dah	Torino	P October 201
30	0000-00-00				2012
31	0000-00-00			Bologna	P March 2016
32	0000-00-00		Morocco, Laa	Bologna	P March 2016
33	0000-00-00				2012
34	0000-00-00			Bologna	P 3/2015
35	0000-00-00			Erfoud, Moroc	P 2003
36	0000-00-00				2014
37	0000-00-00			Munich	P 2005
38	0000-00-00				2012
39	0000-00-00			Said Hadnany	P 2011 Feb
40	0000-00-00				2012
41	0000-00-00				2014
42	0000-00-00			Munich	P 2005
43	0000-00-00				2012
44	0000-00-00			Said Hadnany	P 2011 Feb
45	0000-00-00				2012
46	0000-00-00				2014
47	0000-00-00			Munich	P 2005
48	0000-00-00				2014
49	0000-00-00				2014
50	0000-00-00				2014
51	0000-00-00		Al Wusta		2014 Nov 5 20°32'37.51"N
52	0000-00-00				2014
53	0000-00-00				2015 Jan 17 77°13.645'S
54	0000-00-00				2012
55	0000-00-00			Munich	P 2005
56	0000-00-00				2012
57	0000-00-00				2012
58	0000-00-00				2012
59	0000-00-00				2012
60	0000-00-00				2012

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3	0000-00-00			2014	
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20	0000-00-00			2009	
21	0000-00-00			1998	
22	0000-00-00				
23	0000-00-00			2015 Jan 20	77°14.453'S
24	0000-00-00			2016	
25	0000-00-00				
26	0000-00-00				
27	0000-00-00		Morocco	P 2018	
28	0000-00-00		Munich	P 2005	
29	0000-00-00	Antofagasta	deflation surfa	2018 Apr	24°18.195'S
30	0000-00-00				
31	0000-00-00		Marrakech	P 2017 Oct	
32	0000-00-00		Tucson (Said	P Jan 2014	
33	0000-00-00		Tucson	P 2017	
34	0000-00-00	Antofagasta		26 Feb 2016	24°59.145'S
35	0000-00-00				
36	0000-00-00		Erfoud, Moroc	P 2017 Feb	
37	0000-00-00	La Pampa	Realico	1970	35°1'S
38	0000-00-00	Antofagasta		25 Mar 2017	24°37.73'S
39	0000-00-00				
40	0000-00-00		Erfoud	P 2017 Apr	
41	0000-00-00	Xinjiang		2018 July 25	46°01'01.1"N
42	0000-00-00	Antofagasta		26 Feb 2016	24°58.209'S
43	0000-00-00				
44	0000-00-00		Munich	P 2005	
45	0000-00-00	Antofagasta	deflation surfa	2017 Nov	24°41'34.9"S
46	0000-00-00		Morocco	P 2011	
47	0000-00-00	Al Wusta		3 Mar 2011	20°4.80'
48	0000-00-00	Arusha	plain	9 Sept 2017	2°37.845'S
49	0000-00-00	Antofagasta		17 Mar 2017	24°50.20'S
50	0000-00-00				
51	0000-00-00		New York City	P 2018 Jan	
52	0000-00-00		Layaoune, Mc	P 2018	
53	0000-00-00		Erfoud, Moroc	P 2003	
54	0000-00-00				
55	0000-00-00		Morocco	P 2004	
56	0000-00-00		Munich	P 2005	
57	0000-00-00				
58	0000-00-00		Ouarzazate	P 2017 March	
59	0000-00-00	Antofagasta		29 Mar 2018	22°28.75'S
60	0000-00-00	Antofagasta		21 Oct 2017	22°30.15'S

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3	0000-00-00	Uttar Pradesh	Karimati villag	28 May 2009	25°54'N
4	0000-00-00		Elephant Mora	2014 Dec 12	76°15.853'S
5	0000-00-00	Antofagasta		16 Feb 2017	24°56.977'S
6	0000-00-00	Ajdabiya	Arid Plateau	2006	28.25710°N
7	0000-00-00				
8	0000-00-00			Morocco	P 2016 May 0
9	0000-00-00	Antofagasta		29 Mar 2018	22°29.50'S
10	0000-00-00			Morocco	P 2016 May 0
11	0000-00-00			Morocco	P 2004
12	0000-00-00			Morocco	P 2016 May 0
13	0000-00-00	Antofagasta		24 Mar 2017	22°29.25'S
14	0000-00-00				2012
15	0000-00-00			Erfoud, Moroc	P 2001
16	0000-00-00			Bologna	P March 2016
17	0000-00-00				2014
18	0000-00-00			Morocco	P 2016 May 0
19	0000-00-00			Morocco	P 2016 May 0
20	0000-00-00			Erfoud	P March 2018
21	0000-00-00			Sainte Marie	P 2018
22	0000-00-00				2012
23	0000-00-00				2014
24	0000-00-00			Morocco	P 2016 May 0
25	0000-00-00				2016
26	0000-00-00			Erfoud	P March 2018
27	0000-00-00			Layaoune, Mc	P 2018
28	0000-00-00			Munich	P 2005
29	0000-00-00	Antofagasta	deflation surfa	2010 Mar 21	~25°14'S
30	0000-00-00			Munich, Germ	P 2015
31	0000-00-00			Erfoud	P March 2018
32	0000-00-00	Antofagasta		06 Apr 2018	22°30.32'S
33	0000-00-00	Ajdabiya	Arid Plateau	2006	28.28583°N
34	0000-00-00			Alexander's Ki	P 31 Mar 2014
35	0000-00-00			St. Marie-aux-	P 2011
36	0000-00-00			Morocco	P 2016 May 0
37	0000-00-00	Antofagasta		06 Apr 2018	22°30.32'S
38	0000-00-00	Antofagasta	Gravel pedime	2017 Feb 17	24°54'21.2"S
39	0000-00-00			Munich, Germ	P 2015
40	0000-00-00				2014
41	0000-00-00				2014
42	0000-00-00			Verona	P 2015
43	0000-00-00				2014
44	0000-00-00				2014
45	0000-00-00				2014
46	0000-00-00				2014
47	0000-00-00				2014
48	0000-00-00			Tucson (Said	P Jan 2012
49	0000-00-00				2014
50	0000-00-00				
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3	0000-00-00		Bologna	P 2017
4	0000-00-00			2014
5	0000-00-00			2014
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7	0000-00-00		Bologna	P 2017
8	0000-00-00			2014
9	0000-00-00			2014
10	0000-00-00	Antofagasta		20 Oct 2016 21°32.79'S
11	0000-00-00			2014
12	0000-00-00	Antofagasta		2017 Apr 28 22°44'59.9"S
13	0000-00-00			2014
14	0000-00-00			2014
15	0000-00-00		Morocco	P 2017
16	0000-00-00			2014
17	0000-00-00			2014
18	0000-00-00			2014
19	0000-00-00			2014
20	0000-00-00	Antofagasta		15 Mar 2017 24°47.73'S
21	0000-00-00	Antofagasta		02 Feb 2015 25°34.466'S
22	0000-00-00			2015
23	0000-00-00			2014
24	0000-00-00			2014
25	0000-00-00			2014
26	2018-06-17	corrected ma: Abu Zaby		2017 Feb 24°25.42'N
27	0000-00-00			2014
28	0000-00-00			2014
29	0000-00-00			2014
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38	0000-00-00		Munich	P 2005
39	0000-00-00			2014
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41	0000-00-00		Morocco	P 2016 May 0
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49	0000-00-00		Morocco	P 2016 May 0
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26	0000-00-00	2000
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28	0000-00-00	2014
29	0000-00-00	2014
30	0000-00-00	1979
31	0000-00-00	2012
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33	0000-00-00	1979
34	0000-00-00	2014
35	0000-00-00	2014
36	0000-00-00	2014
37	0000-00-00	2014
38	0000-00-00	Antofagasta 25 Oct 2016 25°34.11'S
39	0000-00-00	2000
40	0000-00-00	2000
41	0000-00-00	2000
42	0000-00-00	2000
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44	0000-00-00	2000
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28	0000-00-00	2000
29	0000-00-00	2000
30	0000-00-00	2000
31	0000-00-00	2000
32	0000-00-00	2015 Jan 18 77°14.442'S
33	0000-00-00	2000
34	0000-00-00	2000
35	0000-00-00	2015
36	0000-00-00	2000
37	0000-00-00	2000
38	0000-00-00	1998
39	0000-00-00	2015
40	0000-00-00	2000
41	0000-00-00	2000
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43	0000-00-00	2000
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45	0000-00-00	1998
46	0000-00-00	2016
47	0000-00-00	2000
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51	0000-00-00	2015
52	0000-00-00	2000
53	0000-00-00	2000
54	0000-00-00	2000
55	0000-00-00	1998
56	0000-00-00	2000
57	0000-00-00	2000
58	0000-00-00	2000
59	0000-00-00	2000
60	0000-00-00	2016

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3	0000-00-00		2000
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13	0000-00-00		2000
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15	0000-00-00		2000
16	0000-00-00		2015 Jan 17 77°13.641'S
17	0000-00-00		2000
18	0000-00-00		2000
19	0000-00-00		2000
20	0000-00-00		2000
21	0000-00-00		2016
22	0000-00-00		2000
23	0000-00-00		2000
24	0000-00-00		2015
25			
26	0000-00-00	Baden-Wurtte Field	10 July 2018 48°35'17.998E
27	0000-00-00	Al Jumayliyah Desert	03 March 2011 25° 30.44'N
28	0000-00-00		
29	0000-00-00	Errachidia, Mc P	2018
30	0000-00-00	Antofagasta	17 Feb 2017 24°56.256'S
31	0000-00-00	Antofagasta	31 Jan 12 25°51.490'S
32	0000-00-00	Jarayan al Bai Desert	20 April 2018 24° 55.17'N
33	0000-00-00	Yunnan farming field	1 June 2018 22°2'6"N
34	0000-00-00	Antofagasta plain	2017 Oct 15 22°18.192'S
35	0000-00-00	Antofagasta deflation surfa	2017 Nov 25°21'58.1"S
36	0000-00-00	Antofagasta limestone defl.	2017 Oct 13 22°24.200' S
37	0000-00-00		
38	0000-00-00	Mauritania	P 2018
39	0000-00-00	Antofagasta	28 Jan 2018 22°26.15'S
40	0000-00-00	Lipetskaya ob plain, plowed l	21 June 2018 52°48.084'N
41	0000-00-00	Antofagasta	2017 Nov 11 25°4.155'S
42	0000-00-00	Antofagasta deflation surfa	2017 May 17 24°49'54.1"S
43	0000-00-00	Elephant Mora	2014 Dec 12 76°15.683'S
44	0000-00-00		
45	0000-00-00	Munich	P 2005
46	0000-00-00	Antioquia	16 Feb 2017 8°16'44.39"N
47	0000-00-00	Antofagasta	2017 Nov 24°41'S
48	0000-00-00		
49	0000-00-00	Erfoud, Moroc	P 2003
50	0000-00-00		1988
51	0000-00-00		2016
52	0000-00-00		
53	0000-00-00	Munich	P 2005
54	0000-00-00	Morocco	P 2016 May 0
55	0000-00-00	Atacama	2016 Jan 17 26°20'52"S
56	0000-00-00		2000
57	0000-00-00	Elephant Mora	2014 Dec 12 76°15.878'S
58	0000-00-00		
59	0000-00-00		
60	0000-00-00		

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3	0000-00-00	Antofagasta		2017 Nov 8	25°46'27"S
4	0000-00-00			2000	
5	0000-00-00				
6	0000-00-00	Antofagasta		2017 Nov 13	24°45.242'S
7	0000-00-00		Erfoud, Moroc	P 2001	
8	0000-00-00		Erfoud, Moroc	P 2001	
9	0000-00-00		Erfoud, Moroc	P 2018	
10	0000-00-00				
11	0000-00-00	Elephant Moræ		2014 Dec 12	76°15.784'S
12	0000-00-00		Morocco	P 2003	
13	0000-00-00			2000	
14	0000-00-00				
15	0000-00-00		Morocco	P 2012	
16	0000-00-00	Antofagasta		02 Feb 2015	25°47.689'S
17	0000-00-00	Morocco, Smæ	Bologna	P March 2016	
18	0000-00-00	Antofagasta		20 Feb 2017	25°13.012'S
19	0000-00-00	Ouaddai	fields	2014 Aug 21	12.79°N
20	0000-00-00	Antofagasta		08 Feb 2018	24°37.402'S
21	0000-00-00				
22	0000-00-00			2012	
23	0000-00-00				
24	0000-00-00	Antofagasta		11 Feb 2018	22°26.29'S
25	0000-00-00	Morocco, Laa!	Bologna	P March 2016	
26	0000-00-00		Tucson (Said	P Jan 2015	
27	0000-00-00				
28	0000-00-00	Glarus	Rocky mounta	2017 Jul 17	47°4.285'N
29	0000-00-00			2012	
30	0000-00-00	Antofagasta	deflation surfa	2015 Oct 30	~24°41'S
31	0000-00-00	Antofagasta		18 Feb 2016	25°32.674'S
32	0000-00-00		Reckling Peak	2014 Nov 10	76°12.782'S
33	0000-00-00				
34	0000-00-00		Morocco	P 2016 May 0	
35	0000-00-00			2014	
36	0000-00-00			2012	
37	0000-00-00				
38	0000-00-00		Tindouf, Alger	P 2018	
39	0000-00-00				
40	0000-00-00		Morocco	P 2016 May 0	
41	0000-00-00			2012	
42	0000-00-00		Hamburg, Ger	P 2017	
43	0000-00-00			2014	
44	0000-00-00				
45	0000-00-00		Morocco	P 2016 May 0	
46	0000-00-00		Said Hadnany	P 2011 Feb	
47	0000-00-00				
48	0000-00-00		Morocco	P 2018	
49	0000-00-00			2014	
50	0000-00-00	Antofagasta	deflation surfa	2012	~24°41'S
51	0000-00-00	Antofagasta		09 Feb 2018	24°39.578'S
52	0000-00-00	Antofagasta		15 Mar 2017	22°22.87'S
53	0000-00-00			2016	
54	0000-00-00				
55	0000-00-00		Sainte Marie ε	P 2018	
56	0000-00-00	Antofagasta	deflation surfa	2014 Dec 20	~25°14'S
57	0000-00-00			2012	
58	0000-00-00				
59	0000-00-00	Antofagasta		06 Apr 2018	22°30.18'S
60	0000-00-00		Morocco	P 2003	

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3	0000-00-00			2014
4	0000-00-00			2012
5	0000-00-00			2012
6	0000-00-00	Morocco, Dah	Genova	P May 2016
7	0000-00-00			2012
8	0000-00-00	Antofagasta	deflation surfa	2010 Sep 30 ~24°41'S
9	0000-00-00			2012
10	0000-00-00			2012
11	0000-00-00		Sainte Marie ε	P 2018
12	0000-00-00	Elephant Mora		2014 Dec 12 76°15.040'S
13	0000-00-00			2012
14	0000-00-00			2012
15	0000-00-00		Munich	P 2005
16	0000-00-00			2012
17	0000-00-00	Antofagasta		17 Feb 2016 25°32.700'S
18	0000-00-00			2014
19	0000-00-00			2012
20	0000-00-00			2012
21	0000-00-00	Antofagasta		22 Feb 2017 24°42.402'S
22	0000-00-00			2012
23	0000-00-00			2012
24	0000-00-00	Antofagasta		22 Feb 2017 24°40.457'S
25	0000-00-00	Antofagasta	deflation surfa	2010 Mar 06 ~25°14'S
26	0000-00-00	Antofagasta		22 Feb 2017 24°41.412'S
27	0000-00-00			2014
28	0000-00-00			2014
29	0000-00-00		Erfoud	P 2004
30	0000-00-00			2014
31	0000-00-00			2014
32	0000-00-00			2014
33	0000-00-00	Elephant Mora		2014 Dec 12 76°16.015'S
34	0000-00-00			1998
35	0000-00-00	Antofagasta	deflation surfa	2009 Dec 28 ~24°41'S
36	0000-00-00			2014
37	0000-00-00			2014
38	0000-00-00	Elephant Mora		2014 Nov 21 76°16.800'S
39	0000-00-00			2014
40	0000-00-00	Antofagasta	deflation surfa	2010 Mar 06 ~25°14'S
41	0000-00-00	Antofagasta		1 Apr 2018 22°30.58'S
42	0000-00-00			2012
43	0000-00-00			2012
44	0000-00-00			2014
45	0000-00-00			2014
46	0000-00-00		Munich	P 2005
47	0000-00-00	Antofagasta	deflation surfa	2015 Jan 03 ~24°41'S
48	0000-00-00			2014
49	0000-00-00			2014
50	0000-00-00	Elephant Mora		2014 Nov 21 76°16.968'S
51	0000-00-00			2014
52	0000-00-00			2014
53	0000-00-00			2014
54	0000-00-00			2014
55	0000-00-00			2012
56	0000-00-00		Said Hadnany P	2008 Feb
57	0000-00-00	Antofagasta	deflation surfa	2010 Jul 05 ~25°14'S
58	0000-00-00			2012
59	0000-00-00			2012
60	0000-00-00			2014

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3	0000-00-00	Elephant Mora	2014 Nov 21 76°17.319'S
4	0000-00-00		2014
5	0000-00-00		2014
6	0000-00-00		2014
7	0000-00-00		2014
8	0000-00-00		2014
9	0000-00-00		2014
10	0000-00-00	Antofagasta	29 April 2018 22°26.11'S
11	0000-00-00		P 2016 May 0
12	0000-00-00	Morocco	2014
13	0000-00-00		1979
14	0000-00-00		2014
15	0000-00-00	Antofagasta deflation surfa	2010 Jul 05 ~25°14'S
16	0000-00-00		2014
17	0000-00-00		2014
18	0000-00-00		2014
19	0000-00-00		2014
20	0000-00-00		Alexander's KIP 31 Mar 2014
21	0000-00-00		2014
22	0000-00-00		2012
23	0000-00-00		2014
24	0000-00-00		2014
25	0000-00-00		2014
26	0000-00-00		2014
27	0000-00-00	Torino	P 2011
28	0000-00-00		2014
29	0000-00-00		2016
30	0000-00-00		2014
31	0000-00-00	Antofagasta	24 Feb 2016 25°21.102'S
32	0000-00-00		2014
33	0000-00-00		2014
34	0000-00-00		2014
35	0000-00-00		2014
36	0000-00-00		2014
37	0000-00-00		2014
38	0000-00-00		2014
39	0000-00-00	Arizona	Willcox Playa 2018 Jan 22 32°7.0'N
40	0000-00-00		2014
41	0000-00-00		2012
42	0000-00-00		2012
43	0000-00-00		2012
44	0000-00-00		2012
45	0000-00-00	Antofagasta	14 Feb 2018 25°14.820'S
46	0000-00-00		2012
47	0000-00-00		2014
48	0000-00-00		2014
49	0000-00-00		2014
50	0000-00-00		2012
51	0000-00-00	Antofagasta deflation surfa	2017 Nov 13 24°43.293'S
52	0000-00-00		P 2016 May 0
53	0000-00-00	Morocco	2014
54	0000-00-00		2014
55	0000-00-00		2015
56	0000-00-00		2012
57	0000-00-00		2014
58	0000-00-00		2014
59	0000-00-00		2014
60	0000-00-00	Elephant Mora	2014 Dec 12 76°15.244'S

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3	0000-00-00		2014
4	0000-00-00		2014
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6	0000-00-00		2014
7	0000-00-00		2012
8	0000-00-00		2014
9	0000-00-00		2014
10	0000-00-00		2014
11	0000-00-00	Antofagasta deflation surfa	2010 Mar 07 ~25°14'S
12	0000-00-00		2014
13	0000-00-00		
14	0000-00-00	Torino	P 2011
15	0000-00-00		2014
16	0000-00-00		2014
17	0000-00-00		2014
18	0000-00-00		2014
19	0000-00-00		2014
20	0000-00-00		2014
21	0000-00-00		2014
22	0000-00-00		2014
23	0000-00-00		2014
24	0000-00-00		2012
25	0000-00-00	Antofagasta	14 Feb 2018 25°30.812'S
26	0000-00-00		2014
27	0000-00-00		2014
28	0000-00-00		2014
29	0000-00-00		2014
30	0000-00-00		2014
31	0000-00-00		2014
32	0000-00-00		2014
33	0000-00-00		2014
34	0000-00-00		2014
35	0000-00-00		2014
36	0000-00-00		2014
37	0000-00-00	Morocco	P 2016 May 0
38	0000-00-00		2014
39	0000-00-00		2014
40	0000-00-00		2014
41	0000-00-00	Elephant Morc	2014 Dec 12 76°15.934'S
42	0000-00-00		2014
43	0000-00-00		2014
44	0000-00-00		2014
45	0000-00-00		2014
46	0000-00-00		2014
47	0000-00-00		2014
48	0000-00-00	Tucson	P 2002 Feb
49	0000-00-00		2014
50	0000-00-00		2014
51	0000-00-00		2015
52	0000-00-00		2012
53	0000-00-00		2014
54	0000-00-00		2014
55	0000-00-00		2014
56	0000-00-00		2014
57	0000-00-00		2014
58	0000-00-00		2012
59	0000-00-00	Morocco	P 2016 May 0
60	0000-00-00		2014

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12	0000-00-00		2014
13	0000-00-00		2014
14	0000-00-00	Elephant Moræ	2014 Dec 12 76°15.350'S
15	0000-00-00		2014
16	0000-00-00		2014
17	0000-00-00		2014
18	0000-00-00		2014
19	0000-00-00	Antofagasta	10 Feb 2018 24°47.015'S
20	0000-00-00		2014
21	0000-00-00		2014
22	0000-00-00		2014
23	0000-00-00		2014
24	0000-00-00		2014
25	0000-00-00	Munich	P 2005
26	0000-00-00		2015
27	0000-00-00		2014
28	0000-00-00		2014
29	0000-00-00		2014
30	0000-00-00		2014
31	0000-00-00		2014
32	0000-00-00		2014
33	0000-00-00	Munich	P 2005
34	0000-00-00		2014
35	0000-00-00		2014
36	0000-00-00		2014
37	0000-00-00		2014
38	0000-00-00		2014
39	0000-00-00		2014
40	0000-00-00		2014
41	0000-00-00	Tucson (Said	P Jan 2013
42	0000-00-00	Morocco	P 2016 May 0
43	0000-00-00		2012
44	0000-00-00		2014
45	0000-00-00		2014
46	0000-00-00	Elephant Moræ	2014 Dec 03 76°16.510'S
47	0000-00-00		2014
48	0000-00-00		2014
49	0000-00-00		2014
50	0000-00-00		2014
51	0000-00-00		2014
52	0000-00-00		2014
53	0000-00-00		2014
54	0000-00-00		2014
55	0000-00-00		2014
56	0000-00-00		2014
57	0000-00-00	Antofagasta deflation surfa	2010 Mar 06 ~25°14'S
58	0000-00-00		2014
59	0000-00-00		2014
60	0000-00-00		2015

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3	0000-00-00		2012
4	0000-00-00		2014
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7	0000-00-00	Elephant Mora	2014 Nov 16 76°17.332'S
8	0000-00-00		2014
9	0000-00-00		2014
10	0000-00-00		2014
11	0000-00-00		2014
12	0000-00-00		2014
13	0000-00-00		2014
14	0000-00-00		2014
15	0000-00-00	Antofagasta	03 Feb 2015 25°34.478'S
16	0000-00-00		2014
17	0000-00-00		2014
18	0000-00-00		2014
19	0000-00-00		2014
20	0000-00-00		2014
21	0000-00-00		2014
22	0000-00-00		2014
23	0000-00-00		2014
24	0000-00-00		2014
25	0000-00-00		2012
26	0000-00-00		2014
27	0000-00-00		2014
28	0000-00-00		2014
29	0000-00-00	Antofagasta	09 Feb 2018 24°41.581'S
30	0000-00-00		2012
31	0000-00-00		2014
32	0000-00-00		2014
33	0000-00-00	Elephant Mora	2014 Nov 21 76°16.804'S
34	0000-00-00	Antofagasta	24 Mar 2017 22°30.27'S
35	0000-00-00	California	On the margin 2017 Apr 7 34°48.53'N
36	0000-00-00		2014
37	0000-00-00		2014
38	0000-00-00		2014
39	0000-00-00		2014
40	0000-00-00		2014
41	0000-00-00	Antofagasta deflation surfa	2009 Dec 28 ~24°41'S
42	0000-00-00		2014
43	0000-00-00		2014
44	0000-00-00		2014
45	0000-00-00		2014
46	0000-00-00		2015
47	0000-00-00		2014
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49	0000-00-00		2014
50	0000-00-00		2014
51	0000-00-00	Morocco	P 2016 May 0
52	0000-00-00		2014
53	0000-00-00		2014
54	0000-00-00		2014
55	0000-00-00		2014
56	0000-00-00		2014
57	0000-00-00		2014
58	0000-00-00	Elephant Mora	2014 Dec 03 76°16.035'S
59	0000-00-00		2014
60	0000-00-00		2014

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3	0000-00-00		2012
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12	0000-00-00		2014
13	0000-00-00		2014
14	0000-00-00		2014
15	0000-00-00	Antofagasta	10 Feb 2018 24°41.115'S
16	0000-00-00		2014
17	0000-00-00		2014
18	0000-00-00		2014
19	0000-00-00		2014
20	0000-00-00		2014
21	0000-00-00		2014
22	0000-00-00		2014
23	0000-00-00	Antofagasta	08 Feb 2018 24°39.330'S
24	0000-00-00		2012
25	0000-00-00		2014
26	0000-00-00		2014
27	0000-00-00		2014
28	0000-00-00		2014
29	0000-00-00		2014
30	0000-00-00		2014
31	0000-00-00		2014
32	0000-00-00	Antofagasta limestone defl.	2017 Oct 19 22°27'32.7" S
33	0000-00-00		2014
34	0000-00-00		2014
35	0000-00-00		2014
36	0000-00-00		2014
37	0000-00-00		2014
38	0000-00-00		2014
39	0000-00-00		2014
40	0000-00-00		2014
41	0000-00-00		2014
42	0000-00-00	Elephant Moræ	2014 Nov 21 76°16.980'S
43	0000-00-00		2014
44	0000-00-00		2014
45	0000-00-00		2014
46	0000-00-00		2014
47	0000-00-00		2014
48	0000-00-00	Antofagasta deflation surfa	2009 Dec 28 ~24°41'S
49	0000-00-00		2012
50	0000-00-00		2012
51	0000-00-00		1988
52	0000-00-00		2014
53	0000-00-00		2014
54	0000-00-00		2014
55	0000-00-00		2014
56	0000-00-00		2000
57	0000-00-00		2000
58	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.006'S
59	0000-00-00		2014
60	0000-00-00		2012

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3	0000-00-00		1987
4	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.222'S
5	0000-00-00		2012
6	0000-00-00		2014
7	0000-00-00		2014
8	0000-00-00		2014
9	0000-00-00		2012
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13	0000-00-00		2014
14	0000-00-00		2014
15	0000-00-00		2014
16	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.187'S
17	0000-00-00		2014
18	0000-00-00		2014
19	0000-00-00		2012
20	0000-00-00		2014 Nov 16 76°17.132'S
21	0000-00-00	Elephant Moræ	
22	0000-00-00	Antofagasta	09 Feb 2018 24°39.621'S
23	0000-00-00		2014
24	0000-00-00		2009
25	0000-00-00		2014 Nov 21 76°17.176'S
26	0000-00-00	Elephant Moræ	2000
27	0000-00-00		2009
28	0000-00-00		1979
29	0000-00-00	Antofagasta deflation surfa	2017 Nov 14 24°46.125'S
30	0000-00-00		2000
31	0000-00-00		2000
32	0000-00-00		2000
33	0000-00-00		2000
34	0000-00-00		2000
35	0000-00-00		2000
36	0000-00-00		2000
37	0000-00-00		2000
38	0000-00-00		1975
39	0000-00-00		2000
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51	0000-00-00		2000
52	0000-00-00		2009
53	0000-00-00		2000
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3	0000-00-00		2000
4	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.166'S
5	0000-00-00		1998
6	0000-00-00		2009
7	0000-00-00		2014
8	0000-00-00		2000
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13	0000-00-00		2000
14	0000-00-00		2000
15	0000-00-00	Elephant Moræ	2014 Nov 21 76°16.805'S
16	0000-00-00		2000
17	0000-00-00		2000
18	0000-00-00		2009
19	0000-00-00		2000
20	0000-00-00		2000
21	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.092'S
22	0000-00-00		2000
23	0000-00-00		2000
24	0000-00-00		2000
25	0000-00-00		2000
26	0000-00-00		2000
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29	0000-00-00		2000
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31	0000-00-00		2000
32	0000-00-00	Elephant Moræ	2014 Nov 21 76°16.865'S
33	0000-00-00		2000
34	0000-00-00		2000
35	0000-00-00		2000
36	0000-00-00		2009
37	0000-00-00		2000
38	0000-00-00		2000
39	0000-00-00		2000
40	0000-00-00		2000
41	0000-00-00		2000
42	0000-00-00	Antofagasta	17 Feb 2017 24°55.315'S
43	0000-00-00		2009
44	0000-00-00		2000
45	0000-00-00		2000
46	0000-00-00		2000
47	0000-00-00	Elephant Moræ	2014 Nov 16 76°17.370'S
48	0000-00-00	Elephant Moræ	2014 Dec 03 76°16.563'S
49	0000-00-00		1998
50	0000-00-00		2000
51	0000-00-00		2000
52	0000-00-00		2000
53	0000-00-00		2009
54	0000-00-00		1998
55	0000-00-00		2000
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58	0000-00-00		1998
59	0000-00-00		2009
60	0000-00-00		2009

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3	0000-00-00		2000
4	0000-00-00		2009
5	0000-00-00		2009
6	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.284'S
7	0000-00-00		1998
8	0000-00-00		1998
9	0000-00-00		1998
10	0000-00-00		1998
11	0000-00-00		1998
12	0000-00-00	Elephant Moræ	2014 Nov 21 76°17.125'S
13	0000-00-00		2009
14	0000-00-00		1998
15	0000-00-00		1998
16	0000-00-00		1998
17	0000-00-00		2000
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26	0000-00-00		1998
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28	0000-00-00		2000
29	0000-00-00	Elephant Moræ	2014 Dec 12 76°15.320'S
30	0000-00-00		1998
31	0000-00-00		1998
32	0000-00-00		1998
33	0000-00-00		2000
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38	0000-00-00		2009
39	0000-00-00		1998
40	0000-00-00		1998
41	0000-00-00	Elephant Moræ	2014 Nov 16 76°17.758'S
42	0000-00-00		2000
43	0000-00-00		2009
44	0000-00-00		1998
45	0000-00-00		1998
46	0000-00-00		1998
47	0000-00-00		2000
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49	0000-00-00		1998
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22	0000-00-00	1998
23	0000-00-00	2012
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26	0000-00-00	2000
27	0000-00-00	1998
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36	0000-00-00	2015
37	0000-00-00	2000
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43	0000-00-00	2009
44	0000-00-00	2009
45	0000-00-00	2000
46	0000-00-00	2010
47	0000-00-00	2009
48	0000-00-00	1998
49	0000-00-00	2015
50	0000-00-00	1998
51	0000-00-00	2000
52	0000-00-00	2009
53	0000-00-00	2000
54	0000-00-00	2009
55	0000-00-00	2015
56	0000-00-00	2000
57	0000-00-00	1998
58	0000-00-00	2000
59	0000-00-00	2000
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7	0000-00-00	2009
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9	0000-00-00	2000
10	0000-00-00	2016
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12	0000-00-00	2000
13	0000-00-00	2000
14	0000-00-00	1998
15	0000-00-00	2009
16	0000-00-00	2000
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21	0000-00-00	2000
22	0000-00-00	2000
23	0000-00-00	2000
24	0000-00-00	2009
25	0000-00-00	2009
26	0000-00-00	2000
27	0000-00-00	2000
28	0000-00-00	Elephant Morz 2014 Nov 16 76°17.517'S
29	0000-00-00	2000
30	0000-00-00	2000
31	0000-00-00	2000
32	0000-00-00	2000
33	0000-00-00	2000
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38	0000-00-00	2015
39	0000-00-00	2000
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41	0000-00-00	2009
42	0000-00-00	2009
43	0000-00-00	2009
44	0000-00-00	1998
45	0000-00-00	2016
46	0000-00-00	2000
47	0000-00-00	1998
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49	0000-00-00	1998
50	0000-00-00	2016
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18	0000-00-00			2000
19	0000-00-00			2000
20	0000-00-00			2000
21	0000-00-00		Tucson	P 2018 Jan
22	0000-00-00			
23	0000-00-00	Antofagasta	deflation surfa	2018 Apr 25°21.882'W
24	0000-00-00	Antofagasta		November 9, 25°37'55"S
25	0000-00-00	Antofagasta	deflation surfa	2009 Dec 28 ~24°41'S
26	0000-00-00			
27	0000-00-00		Temara	P 2017 Nov
28	0000-00-00		Temara	P 2017 Aug
29	0000-00-00	Xinjiang	desert	18 Aug 2012 41°53'15.67"N
30	0000-00-00			
31	0000-00-00		Tucson	P Feb. 2017
32	0000-00-00	Xinjiang	desert	Aksu, Xinjiang 2007 ~40°20'N
33	0000-00-00	Xinjiang	desert	Hami, Xinjiang P 2013
34	0000-00-00	Gansu	desert	2015 39°48'04"N
35	0000-00-00			
36	0000-00-00		Rissani	P 2013 Dec
37	0000-00-00		Tucson	P 2018
38	0000-00-00		Ensisheim	P 2017 Jun
39	0000-00-00			
40	0000-00-00		Temara	P 2017 Aug
41	0000-00-00		Morocco	P 2015
42	0000-00-00	Kerman	Northern sand	4 January 2013 31°52.659' N
43	0000-00-00			
44	0000-00-00		Tucson	P 2018
45	0000-00-00		Tucson	P 2018 Jan
46	0000-00-00		Erfoud, Moroc	P 2018
47	0000-00-00			
48	0000-00-00		Denver	P 2007, Sept
49	0000-00-00		Zagora	P 2017 Nov
50	0000-00-00		Layaoune, Mo	P 2018
51	0000-00-00			2016 March
52	0000-00-00	Arizona		1 April 2017 33°42.358'N
53	0000-00-00			
54	0000-00-00			2012
55	0000-00-00		Mauritania	P 2018 May
56	0000-00-00		Ensisheim	P 2017
57	0000-00-00			
58	0000-00-00		Erfoud, Moroc	P 2003
59	0000-00-00		Ensisheim	P 2017
60	0000-00-00		Beijing	P Nov 2017

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3	0000-00-00		Morocco	P 2009	
4	0000-00-00	Antofagasta		13 Oct 2017	22°26.07'S
5	0000-00-00			2012	
6	0000-00-00				
7	0000-00-00		Tucson, Arizona	P 2013	
8	0000-00-00		Ensisheim	P 2017	
9	0000-00-00				
10	0000-00-00	Elephant Moræ		2014 Dec 12	76°15.224'S
11	0000-00-00	Elephant Moræ		2014 Nov 21	76°18.424'S
12	0000-00-00		Sainte-Marie-ε	P 2008 June	
13	0000-00-00		Morocco	P 2018	
14	0000-00-00		Erfoud	P 2017	
15	0000-00-00		Tucson	P 2017	
16	0000-00-00	Antofagasta	deflation surfa	2017 Nov 08	24°55'54.2"S
17	0000-00-00			2014	
18	0000-00-00			2014	
19	0000-00-00		Erfoud	P 2017	
20	0000-00-00		Zagora	P 2018	
21	0000-00-00	Antofagasta		28 Feb 2016	24°39.838'S
22	0000-00-00	Morocco, Dah	Genova	P May 2017	
23	0000-00-00		Sainte Marie ε	P 2018	
24	0000-00-00	Ajdabiya	Sandy desert	2006	27.47354°N
25	0000-00-00		Tucson Gem ε	P 2008 Feb	
26	0000-00-00		Munich, Germ	P 2015	
27	0000-00-00			2012	
28	0000-00-00			1998	
29	0000-00-00			2012	
30	0000-00-00			2012	
31	0000-00-00			2012	
32	0000-00-00			2014	
33	0000-00-00			2012	
34	0000-00-00			2012	
35	0000-00-00			2012	
36	0000-00-00			2012	
37	0000-00-00		Said Hadnany	P 2011 Feb	
38	0000-00-00			2014	
39	0000-00-00			2015 Jan 20	77°14.084'S
40	0000-00-00			2015	
41	0000-00-00		E-bay	P 2013	
42	0000-00-00		Zagora (Moroc	P April 2018	
43	0000-00-00		Erfoud, Moroc	P 2018	
44	0000-00-00			2012	
45	0000-00-00		Munich, Germ	P 2015	
46	0000-00-00			2012	
47	0000-00-00		Hamburg, Ger	P 2017	
48	0000-00-00			2012	
49	0000-00-00		Morocco	P 2003	
50	0000-00-00				
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3	0000-00-00		Tinghir , Moro P 2017
4	0000-00-00		Morocco P 2015 Apr
5	0000-00-00		2012
6	0000-00-00		2012
7	0000-00-00		2012
8	0000-00-00		Erfoud P 2016
9	0000-00-00		2016
10	0000-00-00		2016
11	0000-00-00	Antofagasta	16 Oct 2017 22°18.65'S
12	0000-00-00		2014
13	0000-00-00		Tucson (Said P Jan 2009
14	0000-00-00		2012
15	0000-00-00	Antofagasta	15 Oct 2017 22°18.21'S
16	0000-00-00		Morocco P 2016 May 0
17	0000-00-00		2012
18	0000-00-00		2012
19	0000-00-00		2014
20	0000-00-00		Erfoud P March 2016
21	0000-00-00		2012
22	0000-00-00		2012
23	0000-00-00		2014
24	0000-00-00		2014
25	0000-00-00	Antofagasta	17 Mar 2017 24°52.25'S
26	0000-00-00		2012
27	0000-00-00		Tucson (Said P Jan 2012
28	0000-00-00		2012
29	0000-00-00		2014
30	0000-00-00		2012
31	0000-00-00		2012
32	0000-00-00		2012
33	0000-00-00		2014
34	0000-00-00		2014
35	0000-00-00	Antofagasta	24 Oct 2016 25°3.75'S
36	0000-00-00		2012
37	0000-00-00		1998
38	0000-00-00		Erfoud P 2017
39	0000-00-00		Zagora (Moroc P April 2018
40	0000-00-00		Zagora (Moroc P April 2018
41	0000-00-00		2013 Dec 9 27°38.333'N
42	0000-00-00	Guelmim Sma	2017
43	0000-00-00		Tucson Gem : P 2005 Feb
44	0000-00-00		Tucson Gem : P 2007 Feb
45	0000-00-00		Tucson (Said P Jan 2011
46	0000-00-00		Tinduf, Algeria P 2017 Dec
47	0000-00-00		Erfoud P 2017
48	0000-00-00		2012
49	0000-00-00		2012
50	0000-00-00	Morocco, Sma	Bologna P March 2016
51	0000-00-00		2012
52	0000-00-00		Erfoud, Moroc P 2018
53	0000-00-00		Tucson (Said P Jan 2008
54	0000-00-00		Said Hadnany P 2011 Feb
55	0000-00-00		
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3	0000-00-00		2012
4	0000-00-00		2012
5	0000-00-00		2012
6	0000-00-00	Antofagasta	17 Feb 2016 25°32.669'S
7	0000-00-00		Tucson P 2018 Feb
8	0000-00-00		2014
9	0000-00-00		Erfoud P 2017
10	0000-00-00		Hamburg, Ger P 2017
11	0000-00-00		Morocco P 2017
12	0000-00-00		2014
13	0000-00-00		2012
14	0000-00-00		2012
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16	0000-00-00		2012
17	0000-00-00		Erfoud P 2016
18	0000-00-00		Erfoud P March 2016
19	0000-00-00		Layaoune, Mo P 2018
20	0000-00-00		2012
21	0000-00-00		2012
22	0000-00-00		2012
23	0000-00-00		2012
24	0000-00-00	desert	Beijing P 2015
25	0000-00-00		Morocco P 2017
26	0000-00-00		2012
27	0000-00-00	Sahara	Tucson, AZ P 02/12/2015
28	0000-00-00		2012
29	0000-00-00		2014
30	0000-00-00		Hamburg, Ger P 2017
31	0000-00-00		2012
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42	0000-00-00		Hamburg, Ger P 2017
43	0000-00-00		Mauritania P 2017 Sep
44	0000-00-00		2012
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46	0000-00-00		Morocco P 2016 May 0
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60	0000-00-00		Morocco P 2017

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3	0000-00-00			2014
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16	0000-00-00			1998
17	0000-00-00			1998
18	0000-00-00			2000
19	0000-00-00			2014 Nov 10
20	0000-00-00	Reckling Peak		76°12.608'S
21	0000-00-00		Tucson Gem	2017
22	0000-00-00		Morocco	P 2017
23	0000-00-00		Guelmim, Mor	P 2017 Oct
24	0000-00-00	Antofagasta	Gravel pedime	2017 Feb 21
25	0000-00-00		Tucson	P 2018 Feb
26	0000-00-00		Nouadhibou, M	P 2018 Jan
27	0000-00-00		Tindouf, Alger	P 2018
28	0000-00-00		Morocco	P 2018 Apr
29	0000-00-00		Western Saha	P 2017
30	0000-00-00		Tucson	2015
31	0000-00-00			2000
32	0000-00-00			2000
33	0000-00-00			2014
34	0000-00-00		Mauritania	P 2017 Mar
35	0000-00-00		Vienna	P 2013
36	0000-00-00		Morocco	P 2016 May 1
37	0000-00-00		Erfoud	P 2018 March
38	0000-00-00		Erfoud, Moroc	P 2012
39	0000-00-00		Zagora	P 2018 Aug
40	0000-00-00		Mauritania	P 2017
41	0000-00-00		Mali	P 2017
42	0000-00-00		Mauritania	P 2017 Mar
43	0000-00-00		Mauritania	P 2017
44	0000-00-00		Morroco	2017
45	0000-00-00		Morocco	P 2018
46	0000-00-00	Tindouf	Tindouf Hama	Denver, USA
47	0000-00-00			2016 Oct 10
48	0000-00-00		Mauritania	P 2018
49	0000-00-00		Tucson	P 2016
50	0000-00-00		Mali	P 2018
51	0000-00-00			
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3	0000-00-00	Rio de Oro	Denver	P 2016 Sep	25.634°N
4	0000-00-00		Morocco	P 2015	
5	0000-00-00		Morocco	P 2017	
6	0000-00-00		Mali	P 2018 Mar	
7	0000-00-00		Morocco	P 2015	
8	0000-00-00				
9	0000-00-00				
10	0000-00-00	Desert		April 2016	31°41.28102'N
11	0000-00-00		St. Marie aux	P 2017	
12	0000-00-00		Erfoud	P 2017 Sep	
13	0000-00-00		Morocco	P 20 Sep 2014	
14	0000-00-00		Morocco	P 2016 Jun	
15	0000-00-00		Mauritania	P 2018 May	
16	0000-00-00		Gladstone, Or	P 2018 May	
17	0000-00-00		Erfoud	P 2015 Apr	
18	0000-00-00				
19	0000-00-00				
20	0000-00-00	Antofagasta	deflation surfa	2016 Nov	~24°20'S
21	2018-11-16	Updated clas:	Ensisheim	P 2017	
22	2018-11-16	Updated clas:	Zagora, Moroc	P 2018	
23	2018-11-16	Updated clas:	Rio de Oro	Zagora	2017 Dec 8 24.135944
24	2018-11-16	Updated clas:	Guelmim, Mor	P 2018 Mar	
25	2018-11-16	Updated clas:			
26	0000-00-00		Morocco	P 2018	
27	0000-00-00				
28	0000-00-00	Rio de Oro	Jrifiya	2014 May 25	24.732°N
29	0000-00-00		Ouarzazate	P 2018 Jul	
30	0000-00-00		Ouarzazate	P 2018 Jul	
31	0000-00-00		Bordj Badji Mc	P 2018 Aug	
32	0000-00-00		Agadir	P 2018 Aug	
33	0000-00-00		Zagora	P 2018 May	
34	0000-00-00		Zagora	P 2018 Jun	
35	0000-00-00				
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37	0000-00-00	Tindouf	Tindouf Hama	Denver, USA	2016 Oct 10
38	0000-00-00		Tucson	P 2016	
39	0000-00-00		Mauritania	P 2018 Jan	
40	0000-00-00				
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42	0000-00-00		Zagora	P 2018 May	
43	0000-00-00		Tindouf, Alger	P 2018	
44	0000-00-00				
45	0000-00-00	Zufar	Desert plain	31.01.16	19°0.580'N
46	0000-00-00		Morocco	P 2015	
47	0000-00-00		France	P 2017	
48	0000-00-00		St. Marie-aux-	P June 2016	
49	0000-00-00		Zagora	P 2018 Jan	
50	0000-00-00		Agadir	P 2011 Apr	
51	0000-00-00		Erfoud	P 2015	
52	0000-00-00		Munich	P 2005	
53	0000-00-00				
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55	0000-00-00	Al Wusta		2011	19.839°N
56	0000-00-00		Algeria	P 2018	
57	0000-00-00		Erfoud, Moroc	P 2007	
58	0000-00-00		Morocco	P 2017	
59	0000-00-00				
60	0000-00-00	Vaud	Pasturage	1959	46°51.07'N

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3	0000-00-00		Tucson	P 2017 Jan	
4	0000-00-00	Saguia el Han		2004	27°14'25.7"N
5	0000-00-00		Mauritania	P 2017 Dec	
6	0000-00-00		Erfoud, Moroc	P 2018	
7	0000-00-00		Zagora, Moroc	P 2014	
8	0000-00-00		Tucson Gem	ε P 2017	
9	0000-00-00		Tucson Gem	ε P 2017	
10	0000-00-00		Morocco	P 2017 Sep	
11	0000-00-00		Ensisheim	P 2011 Jun	
12	0000-00-00		Zagora	P 2017 Nov	
13	0000-00-00		Tucson Gem	ε P 2018 Jan	
14	0000-00-00		Morocco	P 2017 April	
15	0000-00-00		Erfoud, Moroc	P March 2017	
16	0000-00-00		Zagora, Moroc	P 2014	
17	0000-00-00		Erfoud, Moroc	P Nov 2016	
18	0000-00-00		Tucson	P 2007 Jan	
19	0000-00-00		Guelmim, Mor	P 2017 Sep	
20	0000-00-00		Morocco	P 2018	
21	0000-00-00		Munich	P 2015 Oct	
22	0000-00-00		Mali	P 2017	
23	0000-00-00		Morocco	P 2017	
24	0000-00-00		Mauritania	P May 2018	
25	0000-00-00		Erfoud, Moroc	P Feb 2017	
26	0000-00-00		Mauritania	P May 2018	
27	0000-00-00		Morocco	P 2017	
28	0000-00-00		Tucson	P 2017	
29	0000-00-00	Al Wusta		15 Feb 2015	19°44.58'N
30	0000-00-00		Western Saha	P 2017	
31	0000-00-00		Mauritania	P May 2018	
32	0000-00-00		Temara	P 2017 Aug	
33	0000-00-00		Zagora	P 2017 Mar	
34	0000-00-00	Al Wusta		15 Feb 2015	19°42.31'N
35	0000-00-00		Guelmim, Mor	P 2017 Jul	
36	0000-00-00		Erfoud, Moroc	P Nov 2016	
37	0000-00-00		Tindouf, Alger	P 2017 Dec	
38	0000-00-00		Elephant Morc	2014 Dec 12	76°17.138'S
39	0000-00-00		Denver	P 2006 Sept	
40	0000-00-00		Morocco	P 27 Jul 2015	
41	0000-00-00	Al Wusta	MC 154	2014 May 7	19°46.660'N
42	0000-00-00		Mauritania	P May 2018	
43	0000-00-00		Tucson	P 2014 Jan	
44	0000-00-00		Erfoud	P 2004 Oct	
45	0000-00-00		Morocco	P 2018	
46	0000-00-00	Antofagasta		14 Feb 2018	25°29.875'S
47	0000-00-00		Erfoud, Moroc	P Nov 2016	
48	0000-00-00				
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0000-00-00	Al Wusta	15 Feb 2015	19°25.34'N
0000-00-00		Missour, Moro P	2017 Sep
0000-00-00		Morocco	P 2016
0000-00-00	North West Af	Ouarzazate	P October 201
0000-00-00		Malaga, Spair P	2018 Jan
0000-00-00		Zagora, Moroc P	2012
0000-00-00		Temara	P 2017 Aug
0000-00-00		Morocco	P 2017
0000-00-00	Al Wusta	20 Apr 2014	20°34.104'N
0000-00-00		2000	
0000-00-00		2010	
2018-08-03	reclassified u:	Mauritania	P 2017 Jun
0000-00-00		Tucson, Arizona	P 2012
2018-08-13	reclassified b:	Tucson	P 2018 Jan

For Peer Review Only

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tbl_long	tbl_pieces	tbl_shock	tbl_weath	tbl_fa	tbl_fs	tbl_wo
10°31'0.40"W	21		high	10.9±0.0 (N=2)	9.8±0.0 (N=2)	1.5±0.3
	2	low	moderate	12.0±0.1	10.4±0.1	4.5±0.1
156°34.277'E	1			10.4±0.5	10.4±0.3	2.1±0.2
	1	low	low	31.2±0.1 (n=1)	11.2±0.5 (n=1)	43.4±0.6 (n=1)
	1	high	low	1.0-1.1	0.9-1.0	1.0-2.3
	1	moderate	low	70.0±0.2 (N=140.5±3.3)	210.6±4.1 (N=2)	
	1	moderate	low		28.3±3.3, 24.47.3±1.6, 30.0±	
	2	low	weak	37.3±0.6 (n=1)	29.3±0.2 (n=1)	3.1±0.1 (n=13)
	1	high	low	9.6±2.5	19.3±0.8	2.6±0.4
	1		moderate		38.7±3.8 (N=8)	6.9±2.0
	2	low	low		5.1-78.7	38.8-15.4
	several	low	low	39.6-79.7	20.5-45.9	51.6-52.8
	1	low	low	36.6-84.1	20.9-46.7	52.0-52.9
	3	low	moderate		0.2±0.2	0.4±0.1
	1	low	high	26.8	22.1; 9.1	2.1; 43.6
	1	low	moderate	28.5	25.4	2.2
	1	low	moderate	32.3	11.4	43.3
	several	S2	low	1.1-70.7	1.0-7.0	1.2-0.4
	1		B	11.4 (0.6-49.9)	1.6 (0.8-3.2)	
	1		B	19.3 (0.5-31.5)	17.1 (0.9-9.5)	
	1	S1	low	1.2-51.0	0.9-1.0	1.0-3.6
	1		minimal	11.9±17.1 (N=3)	3.2±2.2 (N=3)	3.8±1.1
	1		B	13.5 (1.1-45.3)	3.7 (2.0-5.5)	
	1	low	low	26.2±3.3	15.3±1.8	0.7±0.2
69°08.20'W	3	S1	moderate	0.47±0.10 (N=1)	1.42±0.39 (N=0)	0.88±0.63 (N=)
	1		C	15	5-14	
	1	S3	W1	1.7±0.2 (n=6);	2.5±0.2 (n=15)	2.1±0.1; 39.0±
	1	S1	low	22.4; 29.6	16.3; 26.9	0.9; 1.1
	1	S3	W1	28.0±1.2 (n=1)	23.7±1.0 (n=4)	1.7±0.2
	1	S2	low	34.2-34.3	9.3-9.8	46.5-46.0
	1	S2	low	32.1-32.4	26.7-29.7	0.8-1.8
	1		A/B		11-15	
	1	S2	low	30.9-31.1	25.4-26.3	0.5-0.9
	1	S1	W2	29.9	25.7; 7.0	0.8; 47.5
	1	S3	W1	34.0±1.3 (n=7)	13.5±0.4 (n=6)	49.3±1.3
	1	S2	low	33.4±0.3 (n=1)	26.8±0.2 (n=9)	0.8±0.1 (n=9)
	1		B	31	23	
	1	S2	W3	31.1	25.8; 11.3	1.0; 48.2
	1	low	moderate	29.9±1.0	25.4±1.0	0.7±0.0
156°26.081'E	1			29.8±0.2	25.5±0.7	0.6±0.04
	1	S2	W1	33.2±0.2 (n=1)		
	1	S2	W4	30.1±0.5 (n=1)	2.5 (n=1)	0.6 (n=1)
	16	S1	W2	29.5±0.2 (n=1)	25.3±0.5 (n=3)	1.6±0.6 (n=3)
	1	moderate	moderate	27.2±0.9		

1								
2								
3	69°48'55.3"W	1		minimal	33.2±0.4 (N=4			
4				B	31.5 (29.7-34.			
5		1						
6		1	S2	W1	31.3±0.3 (n=1	26.4±0.3 (n=1	1.6±1.4 (n=10	
7		1		A	2.3 (0.2-19.1)	1.8 (0.8-6.0)		
8		1						
9		1						
10		1		A	6.1 (0.3-38.2)	8.1 (1.0-36.7)		
11		1		A	7.6 (0.5-51.3)	3.3 (0.8-8.6)		
12		1		A	8.7 (0.3-62.1)	1.3 (0.9-2.5)		
13		1		A	7.7 (0.3-48.1)	3.8 (1.1-7.0)		
14		1			5.4 (0.3-54.3)	2.8 (0.9-7.1)		
15		1						
16		1		A	8.6 (0.3-44.5)	3.0 (0.8-13.6)		
17		1		A	5.8 (0.5-44.7)	4.7 (0.9-8.8)		
18		1		A	9.4 (0.5-47.4)	4.7 (1.7-8.4)		
19		1			10.4 (0.5-40.9)	11.2 (1.0-38.7		
20		1			11.6 (0.3-41.8)	4.7 (3.2-5.7)		
21		1			6.7 (0.3-52.4)	1.2 (0.9-1.6)		
22		1						
23		1						
24		1		A	10.5 (0.4-50.7)	1.2 (1.1-1.4)		
25		1		A	8.0 (0.3-36.3)	6.0 (1.1-36.9)		
26		1	S2	low	0.8-58.6	1.8-3.1	1.1-0.4	
27		8		low				
28		1	low	W0	0.9-32.7	1.6 (Ca-poor)	1.1 (Ca-poor)	
29	75°39'53.7"E	1	S1	low	13.6±16.6 (0.2	1.2±0.1 (1.1-1	1.2±0.1 (1.0-1	
30		1			8.4±13.5	1.7±1.7	1.3±0.9	
31	156°36.855'E	1	S1	low	0.4-58.8	0.6-0.7	1.3-0.8	
32		1			6.7±13.4 (N=1	1.3 (N=1)	0.9	
33		1	low	low	12.5±17.6	3.5±3.3	3.4±0.5	
34		1		Be	0-39			
35	158°07.073'E	1			10.5±19.3	2.2±1.4	2.4±1.3	
36		1	S1	low	19.4±15.6 (0.4	3.1±3.4 (0.6-8	1.2±0.6 (0.8-2	
37		6	S1	moderate	22.0±21.9 (0.8	1.7±1.0 (1.1-4	1.0±0.7 (1.3-0	
38		1		low				
39		1		Be	1-33	9		
40		many	S1	low	8.2±8.1 (0.6-2			
41		1		Be	1-46	1		
42		1		moderate	16.6±13.1 (N=0.8;	7.2 (N=2)	0.8; 3.8	
43		12	S2	low	19.6±20.4 (0.7	1.6±0.7 (0.9-2	1.1±0.1 (0.8-1	
44		many	S2	moderate	17.5±15.3 (0.9	3.6±0.4 (3.1-4	1.1±0.3 (0.8-1	
45		1	S1	low	17.0±16.4 (0.7	1.7±0.2 (1.5-2	2.6±1.4 (0.8-4	
46		1	S1	low	2.2±2.2 (0.4-5			
47		1	S1	low	17.6±14.6 (1.0	2.0±0.5 (1.3-2	0.9±0.4 (0.4-1	
48		1	S1	moderate	16.5±17.3 (0.6			
49	156°27.181'E	1			26.5±27.2	2.0±1.7	2.4±1.7	
50		many	S1	moderate				
51		1	S2	low				
52		1		A	7.2 (0.6-39.5)	2.4 (0.8-7.1)		

1							
2							
3		1	A		15.4 (0.3-60.4	3.2 (0.9-11.2)	
4		1	A		13.9 (0.2-54.4	11.0 (0.7-29.4)	
5		1					
6		1	B		3.4 (0.4-8.4)	1.6 (0.7-4.0)	
7		1	S2	low	0.2-41.0	2.3-23.2	0.8-0.9
8		1	S2	low	1.2-64.7	0.6-27.5	0.8-3.0
9							
10		25	S1	W1	16.7±15.0 (1.0-2.7±0.8	(2.0-4.1)0±0.1	(0.7-1.1)
11	~70°32'W	1		minimal	16.8±18.2 (N=		
12		Many	S1	W2	36.0±8.0	5.7±3.1	2.8±1.4
13		1	low	weak	5.0±2.6 (n=16	1.9±0.9 (n=15)	1.9±1.4 (n=15)
14							
15	68°38.61'W	1			22.2±18.4 (N=11.6±10.8	(N=1.8±1.4	(N=20)
16	~70°32'W	1		moderate	18.0±15.6 (N=1.0	(N=1)	4.0
17		1	S1	Low	21.5±14.3	3.6±3.0	1.9±1.1
18		1	S2	moderate	10.3±14.5 (n=6.2±12.0	(n=1)	1.5±1.0
19		1	S1	moderate	11.9±14.0 (n=2.3±1.3	(n=12)	1.7±1.5
20							
21	54.467°E	1	S2	low	1.7-60.7	0.6-36.6	0.9-2.8
22		1	S2	strong	8.9±9.8 (n=21	7.2±13.3 (n=1)	1.3±1.1
23		1	S2		0.5-39.9	1.4; 6.5	2.9; 5.7
24		1	S2	low	18.7±14.6 (n=4.8±3.4	(n=24)	2.7±2.2 (n=24)
25		1	S2	W2	0.7-43.4	0.9-6.3	0.9-4.4
26		1	S2	moderate	20.2±16.8 (2.0-1.5±2.9	(1.3-2.1)6±0.9	(0.8-3.0)
27		1	S2	low	0.9-41.5	12.6-23.8	2.1-0.6
28		1	S1	Low	12.3±16.7	2.7±2.4	1.7±0.9
29		2	S2	moderate	15.0±17.6 (0.9-1.5±0.4	(0.9-2.1)6±1.2	(0.8-4.0)
30		1	low	low	14.0±14.6	2.3±1.2	1.7±1.4
31		1		moderate	10.4±10.0 (N=3.6±1.4	(N=4)	3.8±2.0
32		1	low	moderate	3.3±3.3	1.3±0.4	1.9±1.3
33		1		B	9-38	12-17	
34		1		B	1-36	9-19	
35		1	low	low	29.0-29.8	23.3-23.6; 10.3	3.8-3.6; 41.8-3.0
36		2	S2	moderate	0.2-45.3	0.7-0.9; 2.5	1.1; 36.0
37		1	low	moderate	2.8±2.7	4.5±7.7	1.2±0.5
38		16	S2	moderate	6.8±4.7 (1.4-1.6±0.5	(0.8-20.7±0.2	(0.4-1.1)
39		1	S2	strong	16.6±18.2 (0.5-2.2±0.4	(1.8-3.1)1±0.1	(0.9-1.1)
40		1	S2	low	0.4-16.8	0.8-13.8	0.9-3.5
41		3	low	low	0.8-53.0	0.7-2.4	1.0-1.2
42		1	low	moderate	11.3±15.6	1.4±0.4	1.1±0.8
43		many	S3	moderate	7.4	1.8	1.6
44	69°43'W	1		moderate	4.73±6.1 (n=6	10.0 (n=1)	0.6 (n=1)
45		1	S1	moderate	6.7 (chondrule		
46		1	S2	high	3.2±2.5; 11.14	1.1±0.3	1.8±1.8
47		several	S2	moderate	1.2-58.9	1.1-1.2	0.7-4.2
48		1	low	moderate	4.4±4.1	1.1±0.3	0.9±0.2
49		5	S2	high	5.5±4.9 (0.6-1.2±0.2	(1.0-1.1)0±0.1	(0.9-1.1)
50		1		low	10.0±10.5 (N=1.2±0.4	(N=2)	0.9±0.1
51		1	S2	low	0.6-58.7	1.7-4.1	1.2-1.3

1									
2									
3		1	S1	low	12.2±15.6	(0.81.4±0.2	(1.0-12.5±1.5	(0.9-4	
4		1	S2	W2	15.4±16.7	(0.71.7±0.7	(1.0-30.9±0.1	(0.7-1	
5		1	S2		14.7±5.0	(n=19.4±5.6	(n=14	0.8±0.7	
6		1	S2	moderate	0.6-57.3	0.7-51.2	0.5-2.5		
7		1	S1	moderate	14.1±17.6	(0.31.1±0.4	(0.6-10.9±0.2	(0.5-1	
8		1	S2	low	0.3-37.3	0.7-1.2	0.8-0.7		
9		1	S2	moderate	4.9±3.6	(1.4-11.6±0.2	(1.1-21.0±0.2	(0.7-1	
10		1	S2	moderate	5.7	1.6	1.3		
11		1	S2	high	7.9±6.1	(1.3-21.6±0.7	(1.1-41.0±0.1	(0.8-1	
12		1	A		13.1	(0.6-31.6	10.5	(1.5-22.3	
13		1	S2	moderate	10.0±14.4	(0.41.1±0.2	(0.9-11.2±0.2	(0.9-1	
14		1	S2	low	0.1-37.9	0.4-0.5; 1.0; 0	1.0-0.9; 28.0; :		
15		17	S1	moderate	14.4±16.2	(1.61.3±0.4	(0.9-21.3±0.7	(0.8-2	
16		1	B		1-44	1			
17		1	B		1-14	1-5			
18		1	B		1-52	1-15			
19		1	S2	moderate	0.2-41.0	0.9-1.2	3.8-0.7		
20		1	B		1.2	(0.4-3.7)	1.4	(0.6-3.7)	
21		1	low	low	26.2-26.3	22.7-23.5	1.5-2.0		
22	108.30°E	3				21.5±0.4	(n=3	1.7±0.2	(n=32
23		1	low	low		24.5-25.6	1.9-2.2		
24	2.0797°W	3	low	low		23.1-23.2	1.7-1.8		
25		1	low	moderate		25.5	2.7		
26		1	low	moderate		27.5	4.0		
27		1	low	moderate		23.2±0.3	1.8±0.1		
28		1	low	low		26.2±0.6; 10.6	2.8±0.7; 44.0±		
29		1		minor		25.9±3	(N=4)	2.5±0.4	
30		1				30.9	(28.8-32.		
31		1		A		33.1	(30.8-44.		
32	69°50.533'W	1	High	low					
33		1		A		12-30			
34		1	low	low to m	22.6	22.8-28.5	2.9-1.3		
35		1	moderate	low		34.0-34.1	2.3-2.8		
36		1				23.2	(21.9-24.		
37		1	low	low	37.7	29.2	4.2		
38		1				24.4	(22.7-25.		
39		1				23.9	(22.7-25.		
40		1	moderate	low		28.8	4.1		
41		1				25.4	(22.9-27.		
42		1				24.7	(22.2-26.		
43		1		A		32.8	(30.7-40.		
44		1		A		33.0	(29.2-35.		
45		1				33.7	(30.8-51.		
46		1	low	low	28.9; 52.0	23.4-24.5	2.3-2.0		
47	~70°15'W	1		minimal		2.7±2.1	(N=7)	0.8±0.9	

1								
2								
3		1		B		1.0 (0.0-5.0)		
4		1		minimal		0.4±0.1 (N=3)	1.4±0.0	
5	~70°15'W	1		minimal		0.3±0.0 (N=3)	1.6±0.0	
6	70°32'W	2						
7		1	S2	W2		0.4±0.1 (n=17)	1.4±0.2 (n=17)	
8		1	S1	W4		0.4±0.1 (n=17)	1.6±0.1 (n=17)	
9		1		A		0.4 (0.1-0.9)		
10		1						
11	158°13.450'	1						
12		1				0.3	1.6	
13		1						
14		1	low	W1	0.1±0.2 (n=18)	0.1±0.2 (n=19)	1.4±0.3 (n=19)	
15		1	moderate	low		43.9±2.2; 61.7	71.7±0.6; 44.6±	
16		1						
17	156°41.497'E	1				45.9±0.6	1.7±0.6	
18	156°38.370'E	1				37.3±14.8	3.1±1.7	
19		3	moderate	moderate		49±13 (N=10)	17±16	
20	54°8.889'E	4		low		56.8±3.3 (n=1)	7.2±4.4	
21		1	moderate	low		61.2±0.5; 26.4	2.5±0.4; 44.2±	
22	54°31.15'E	3				50.2±14.9 (N=15)	2.2±18.0 (N	
23		1	low	low		58.3; 29.6	3.9; 39.4	
24		1	low	low				
25		1	low	low		57.7; 23.7	1.9; 44.6	
26		1	moderate	low		35.6; 45.0	6.3; 31.5	
27		1	low	moderate		62.6; 34.4	6.6; 39.6	
28		11	moderate	moderate		61.6; 26.8	2.4; 43.3	
29		1		A		62.7 (60.8-64.		
30		1	medium	medium		36.6±1.1 (n=6)	3.3±0.2; 44.4±	
31		1		minor		60.0±1.7	2.1±0.8	
32		4	low	low		60.3; 26.7	2.4; 43.4	
33		1	low	low		59.4±0.6; 25.8	2.0±0.2; 43.4±	
34		1		moderate		66.1±1.7	4.9±0.3	
35		1						
36		1						
37		1		A		47.4 (46.2-48.		
38		1						
39		1	low	low		34.2; 60.7	9.3; 24.5	
40		1	low	low		58.5; 29.1	2.8; 40.5	
41	63°14'W	1	minimal					
42		1	strong	moderate		60.3; 26.3	2.6; 42.9	
43		1		A		46.9 (32.8-65.		
44		1				61.1 (58.4-63.		
45		1						
46		1				40.3 (39.1-41.		
47		1						
48		1				40.3 (39.4-41.		
49		1	low	low		58.3; 35.3	6.7; 34.4	
50		1						
51		1						
52		1						
53		1						
54		1						
55		1						
56		1						
57		1						
58		1						
59		1						
60		1	low	low		58.3; 35.3	6.7; 34.4	

1						
2						
3						
4						
5						46.5±8.3 (N=48.4± 0.9
6						39.8 (38.6-41.
7						58.1±1.3 (N=36.6± 1.7
8						
9						
10						66.6 (64.0-68.
11			moderate	moderate		60.3; 26.4 2.1; 42.8
12						61.6 (60.6-63.
13						
14						
15						
16						
17						
18						64.1 (62.0-65.
19				A		62.9 (40.3-65.
20						61.5 (58.4-66.
21						
22						
23						68.2
24					25.3 (23.6-29.	21.7 (20.5-24.
25						58.5 (56.4-60.
26						47.9 (46.2-48.
27						38.1 (29.1-42.
28						48.9 (46.4-49.
29						
30						
31	156°36.556'E					35.3±13.7 2.5±1.3
32		low	moderate	73.9-74.1	69.5-69.6	1.9-1.7
33		high	low		47.9-49.1; 36.5-5-4.4; 10.8-7	
34		high	moderate		61.0-62.2; 26.4-4-2.1; 43.6-4	
35		high	low		61.1; 27.3	2.1; 42.4
36		low	low		42.3; 29.6	4.1; 37.5
37		low	low		42.3; 25.2	3.9; 39.6
38		moderate	low		42.1; 27.1	2.1; 40.8
39		moderate	low		60.9; 26.7	2.4; 42.6
40		strong	moderate		31±9 (N=45)	18±17
41		high	moderate		62.1±1.1, 28.32.7±0.8, 42.2±	
42		high	low	80.4-80.8	31.2-58.7	12.0-19.6
43		high	moderate		60.8; 27.6	2.8; 42.9
44		high	moderate		53.1, 22.6	1.9, 44.1
45		moderate	moderate		59.9; 27.8	4.0; 42.1
46		moderate	low		59.8; 26.7	3.5; 43.2
47		strong	moderate		63.3; 27.8	2.4; 43.2
48		low	low		59.0-59.4; 24.1.8-1.5; 43.3-4	
49						
50						
51		high	low		58.3-61.4; 26.6-5-3.0; 44.1-4	
52		high	low		57.9-60.6; 26.4-0-2.1; 41.8-4	
53		low	low		60.8-62.5	3.6-1.8
54		high	moderate		59.0±2.1, 27.65.2±2.5, 42.4±	
55			minimal			
56	68°51.27'W					
57						
58						
59						
60						

1							
2							
3	69°53.048'W	2		minimal			
4		many	moderate	low		58.5; 28.1	4.6; 41.0
5		34	moderate	low	43.5±6.5	51.4±9.8; 26.25.8±2.3; 40.5±	
6		2	high	low	84.5-85.6	61.4-61.5	2.8-2.0
7		1	moderate	low		33.0±3.9 (N=138.1±5.3 (N=1	
8		1	moderate	low		49.7±7.6; 42.02.5±0.7; 12.2±	
9		1	low	low		61.2; 26.0	1.5; 42.9
10		many	strong	moderate	75.0	64.5; 30.8	2.4; 42.5
11		1	high	moderate		48.1±14.0	10.7±7.3
12	5.532957°E	1					
13		1	moderate	moderate		26.7; 56.0	43.0; 5.2
14		1	low	low	42.3-51.0	27.9-29.0; 43.2.1-3.6; 2.6-5.	
15		1	moderate	low		47.8; 20.2; 29.2.1; 42.2; 3.7	
16		3	low	low		37.6; 34.4; 29.5.3; 36.3; 3.3	
17		1	low	low			
18		1		A/B		28-64	
19		1		A/B		27-63	
20		1	high	low		48.3±11.6	9.3±9.2
21		2	low	low		55.1; 31.6	3.4; 34.9
22		2	high	moderate		45.6; 27.3	4.7; 40.1
23		1		A/B		27-65	
24		1	high	low		42.6±11.4	9.8±9.1
25		1		A/B		28-65	
26		1		A/B		28-64	
27		1	low	low		26.7; 43.4; 21.2.9; 2.9; 40.0	
28		1		A		20-52	
29		1		A		26-60	
30		1		A/B		29-66	
31		2	moderate	low		41.1; 21.0	2.6; 41.9
32	4°09'55.2"W	2		low		49.6±12.9 (27.16.64±13.8 (2	
33		1		A/B		27-62	
34		1	moderate	low		59.4±1.0, 33.73.5±1.6, 35.2±	
35		1	low	low			
36		3		minimal		63.0±0.3 (N=6.2.2±0.4	
37		1		A/B		25-60	
38		1	low	low	80.5-82.6	30.2-30.7; 57.5.8-6.1; 3.9-2.	
39		1	low	moderate		57.1±1.4, 26.53.8±2.4, 41.5±	
40		1		A		29-60	
41		1		A/B		25-61	
42		1	moderate	low		45.5±8.4	5.2±2.0
43		1		A/B		24-60	
44		1		B	20.8 (19.2-22.17.6 (15.6-18.		
45		1		B	20.2 (17.4-21.18.5 (15.0-20.		
46		1	S4	W5	21.7±1.0 (n=1 17.6±6.6 (n=6 1.2±0.8 (n=6)		
47		1		W4			

1					
2					
3					
4				W0/1	
5	~14°24'W	23		W2	
6	92°01'24.76"E	1		W3	
7		1		W2	
8		1		W1	
9		1		W2	
10		1		W2	
11		1		W1 to W4	
12		1		W3	
13		1		W4	
14	~89°54'E	1		W4	
15		1		W4	
16	90°12'E	1		W1	
17	80°23'33.46"E	1		W5	
18		1		W0	
19		1		W3	
20		1		W3	
21	102° 2'48.71"E	1		W2	
22	90°42'25.67"E	1		W3	
23		1		W2	
24		1		W1	
25		1		W1	
26	5°11'	5	S1	W2	19.4±1.5 (n=1 16.4±0.5 (n=3 1.2±0.2
27	22.36440°E	1	S3	W1	18.2±7.2 (n=1 18.0±9.1 (n=4 2.4±1.6 (n=4)
28		5	S2	W1	17.3±7.5 (0.3- 13.1±4.7 (2.0-0.9±0.7 (0.3-1
29	70°02'28"W	1	S2	W1	14.5±8.0 (4.0- 10.9±7.1 (2.8-0.8±0.3 (0.3-1
30		1	S1	W5	18.1
31	70°23.02'W	1	S2	W2	18.5±2.4 (N=120.8±2.7 (N=12.1±1.6 (N=15
32		1	S2	W3	14.6±9.5 (0.8- 11.4±7.2 1.4-11.5±1.2 (0.4-4
33	158°32.205'E	1	S4	W1	11.3±10.9 19.2±7.4 2.1±1.8
34	116°10.319'W	1	S1	W5	18.0±0.2 (n=1 16.1±0.2 (n=1 1.5±0.1
35		1		B	19.0 (17.4-24. 16.6 (15.4-18.
36		1	S1	W3	11.8±8.3 (0.2- 10.9±7.0 (1.0- 1.4±1.5 (0.3-4
37		1	S2	W2	19.6±4.3 (n=2 12.3±5.7 (n=2 1.3±1.2 (n=20
38		1		B	15.5 (3.7-28.9 9.0 (1.9-27.5)
39	-85.979	1	S2	W3	14.7±4.0 10.8±8.8 0.9±0.5
40		1		C	15.2 (14.8-15. 13.7 (10.4-17.
41	158°08.727'E	1	S2	W1	20.6±7.9 17.5±7.1 1.1±1.1
42		1	S2	W1	2.0-37.0 2.1-31.3 0.6-1.7
43		1	S2	W2	0.8-23.1 1.4-28.6 0.7-1.8
44		1		B	20.2 (0.6-29.0 11.4 (2.1-25.6
45	156°34.723'E	1	S2	W2	14.9±5.3 12.2±5.2 1.3±1.3
46		1	S2	W2	17.6±2.5 (n=9 15.7±3.4 (n=1 1.4±0.5 (n=11
47	114°15.346'W	1	S3	W1	18.7±2.2 15.2±3.6 1.6±0.8
48	114°14.349'W	1	S3	W2	17.0±6.1; 18.315.4±5.0; 11.51.4±0.9; 1.1±1
49	114°16.238'W	1	S4	W2	19.5±5.1 15.6±6.4 1.2±1.1
50	114°14.415'W	1	S3	W1	20.1± 6.0 15.6± 5.3 1.2± 1.0
51	~69°43'W	1		W1	18.2±1.9 (N=616.9±0.5 (N=3 1.0±0.2
52	114°14.101'W	1	S3	W2	17.7±9.2; 19.615.4±6.5; 17.61.2±1.0; 1.3±0

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3	114°16.573'W	1	S3	W1	17.6±9.6	13.9±4.8 1.4±0.7
4	114°16.655'W	1	S3	W1	19.2± 7.0	13.1± 5.4 0.9± 0.8
5		1		B	5-44	8-25
6		1		A	9-41	2-22
7		many	S2	W2	18.8-18.9	15.5-17.0 0.5-1.2
8	69°8.683'W	6	S1	W1	19.86±1.57 (N14.1±3.5 (N=31.42±1.26 (N=	
9		1	S2	W1	19.1±0.5 (N=116.2±0.1 (N=11.0±0.3 (N=10	
10	51°05.25'E	25	S3	W4	17.7±0.3 (n=9 15.8±0.4 (n=1 2.0±1.1	
11		1	S2	W3	17.0±0.4 (n=1 15.2±0.2 (n=1 1.1±0.2 (n=19	
12	70°08'42.18"V	1		W1	17.6±0.2 (N=815.8±0.4 (N=9 1.1±0.6	
13	51°03.56'E	1	S2	W3-4	17.5±0.4 (n=1 15.6±0.3 (n=9 1.1±0.2	
14		8	S2	W1	19.0±2.9 (n=2 17.6±3.0 (n=1 1.1±0.5 (n=18	
15		1		W4	18.1±1.1 (N=116.4±0.9 (N=1 1.5±0.4	
16	70°08.670'W	3	S3	W2	17.8±0.5 (N=115.7±0.5 (N=11.0±0.5 (N=16	
17		1		B	19.2 (18.1-22. 17.3 (16.3-21.	
18		1	S2	W2	17.79±0.23 (n=16.02±0.12 (n=0.94±0.14 (n=	
19	83°50.5'W	20	S2	W0	18.7±0.7 (1SD 16.3±0.4 (1SD 1.3±0.1 (1SD;	
20	069°52'45.5"V	1		W1	19.0±0.5 (n=3 16.8±0.4 (n=2 3.0±2.28	
21		1	S2	W2	18.84±0.54 (n=16.91±0.24 (n=1.11±0.35 (n=	
22		1	S4	W1	18.2	
23		1	S2	W2	17.3±0.3 (n=1 14.3±2.3 (9.7-0.7±0.7 (0.2-3	
24		1		B	18.9 (16.9-22. 16.7 (14.9-22.	
25		1	S2	W3	20.99±3.61 (n=16.78±0.39 (n=0.94±0.27 (n=	
26		1	S2	W5	17.4	
27		92	S2	W4	19.5±0.1 (N=116.3±1.4 (N=11.4±1.1 (N=10	
28	20.36420°E	1	S1	W3	17.6±0.2 (n=4 15.8±0.4 (n=4 1.3±0.2 (n=4)	
29		1		B	18.3 (17.4-19. 16.1 (14.0-19.	
30	93.0853°E	1	S2	W3	19.3±1.02 (n= 17.4±1.09 (n= 1.84±0.97 (n=	
31	69°50.650'W	2	S3	W1	19.9±0.5 (N=117.2±0.5 (N=11.2±0.5 (N=17	
32		1	S1	W5	17.3	
33		1	S2	W1	18.19±0.31 (n=16.05±0.59 (n=0.95±1.02 (n=	
34		1		B	18.7 (18.1-19. 16.4 (15.9-17.	
35		1	S1	W3	17.8	
36		1	S1	W2	18.56±0.4 (n= 16.42±0.5 (n= 1.24±0.16 (n=	
37		1		Ce	17 15	
38	20.29086°E	1	S1	W3/4	17.9±0.2 (n=5 17.1±1.7 (n=5 0.7±0.6 (n=5)	
39		1	S1	W4	19.4±0.3 (n=7 17.5±0.3 (n=6 1.2±0.1	
40	68°50.32'W	3	S2	W2	18.3±0.4 (N=216.4±0.5 (N=21.4±0.4 (N=22	
41		1		C	19.0 (18.1-20. 17.1 (14.6-19.	
42		1	S3	W3	18.88±0.63 (n=17.02±1 (n=1 1.34±0.96 (n=	
43		1	S2	W3	18.22±0.44 (n=16.48±0.88 (n=0.77±0.34 (n=	
44		1	S1	W3	17.4±0.4 (n=1 15.2±3.9 (8.2-0.7±0.2 (0.4-1	
45		1		A	19.1 (17.5-22. 16.5 (15.5-17.	
46		1	S1	W2	18.15±0.71 (n=15.46±0.28 (n=0.61±0.49 (n=	
47		1	S2	W2	18.51±0.18 (n=16.28±0.28 (n=0.84±0.2 (n=1	

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4		1	S2	W2	18.51±0.79 (n=16.23±0.19 (n=1.44±0.13 (n=
5	69°52.244'W	1	S1	W4	19.0±0.5 (N=117.4±0.5 (N=21.2±0.5 (N=20
6		1	S1	W3	17.0±0.2 (n=1.13.8±3.1 (n=2.0.5±0.4 (n=29
7		1	S2	W1	19.29±1.37 (n=16.73±0.62 (n=0.97±0.27 (n=
8		1	S2	W5	17.6 ± 0.4
9					
10		2	S3	W2	19.2±0.3 (n=7 16.6±0.5 (n=6 1.3±0.1
11		1	S2	W1	18.09±0.56 (n=15.88±0.26 (n=1.35±0.78 (n=
12					
13		1	S2	W2	18.75±1.08 (n=16.86±0.56 (n=1.06±0.4 (n=7
14	69°50.234'W	1	S1	W2	20.0±0.5 (N=116.8±0.5 (N=11.1±0.5 (N=15
15		1	S2	W1	18.7±0.03 (n=16.74±1.02 (n=0.91±0.45 (n=
16		1		B	19.3 (18.3-23. 17.1 (15.6-19.
17	20.25766°E	1	S2	W3/4	17.4±0.3 (n=3 15±0.2 (n=3) 0.4±0.7 (n=3)
18	69°43'16.02"V	1		W1	
19			S2	W2	17.98±0.17 (n=16.21±0.31 (n=1.58±0.17 (n=
20		1		B	18.4 (17.1-20. 16.3 (15.6-17.
21		1			
22		1	S2	W2	19.12±0.45 (n=17.3±0.5 (n=4 0.89±0.18 (n=
23	69°2.02'W	1	S1	W1	18.6±1.5 (N=115.3±1.7 (N=11.4±0.3 (N=15
24		1	S2	W5	17.6±0.1
25		1	S1	W2	17.34±2.26 (n=16.07±1.1 (n=0.57±0.21 (n=
26		1	S1	W2	19.1±0.3 (n=7 16.7±0.2 (n=6 1.3±0.1
27		1		B	18.7 (17.2-21. 16.7 (15.8-18.
28		1	S2	W3	18.58±0.28 (n=16.98±0.74 (n=1.43±0.28 (n=
29		1	S1	W2	17.83±0.64 (n=15.74±1 (n=1.0.96±0.49 (n=
30		1		B	19.4 (17.9-22. 16.8 (15.7-19.
31		1	S2	W2	19.1±0.2 (n=2 16.6±1.0 (n=1 0.8±0.3 (n=19
32		1		Be	18 15
33		1	S2	W2	16.94±0.24 (n=15.13±0.86 (n=0.43±0.13 (n=
34		1		B	19.3 (17.9-22. 16.8 (14.8-17.
35		1	S2	W2	16.16±0.37 (n=15.36±1.2 (n=0.96±0.56 (n=
36		1		B	19.0 (15.1-20. 16.5 (13.1-18.
37		1	S1	W4	19.7±0.2 (n=1.17.9±0.2 (n=5 1.5±0.1
38		1	S2	W3	18.4±0.19 (n=16.42±0.4 (n=0.72±0.29 (n=
39		1		B	19.4 (18.0-22. 17.3 (15.3-21.
40		1	S4	W2	20.7±0.2 (n=7 18.0±0.2 (n=1 1.2±0.2
41		1	S3	W2	18.44±0.36 (n=16.57±0.57 (n=0.98±0.32 (n=
42		1		B	19 17
43		1	S3	W3	18.58±0.31 (n=16.25±0.66 (n=0.92±1.15 (n=
44	20.36367°E	1	S2	W3	17.7±0.3 (n=5 15.8±0.4 (n=3 1.4±0.3 (n=3)
45		1	S1	W3	17.35±0.23 (n=18.01±0.87 (n=1.23±1.37 (n=
46		1		B	16.4 (15.5-17. 14.9 (13.8-16.
47		1	S3	W2	18.88±0.5 (n=16.63±0.74 (n=1.9±1.02 (n=6
48		1	S1	W2	18.53±0.2 (n=16.76±0.43 (n=1.16±0.26 (n=
49		1		B	19.4 (18.5-22. 16.8 (15.3-20.
50		1		B	18.9 (17.7-20. 17.2 (16.1-19.
51		1		B	18.5 (16.1-21. 16.0 (14.8-17.
52		1			
53		1			
54		1			
55		1			
56		1			
57		1			
58		1			
59		1			
60		1			

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3				
4	1		B	19.3 (18.0-23. 16.8 (13.4-19.
5	1	S1	W5	18.9±0.2
6	1		B	19.1 (18.2-20. 16.6 (15.5-18.
7	1		B	19.5 (18.1-24. 16.8 (15.2-19.
8	1	S2	W2	18.25±0.24 (n=16.66±0.77 (n=1.51±0.98 (n=
9	1		B	19.5 (18.4-21. 17.4 (15.4-24.
10	1		B	18.9 (17.0-20. 17.1 (16.2-18.
11	1		B	18.5 (18.0-19. 16.5 (14.6-21.
12	1	S3	W2	18.7±1
13	1		B	19.6 (17.5-23. 17.5 (16.3-21.
14	1		B	19.7 (17.9-23. 16.6 (14.3-17.
15	1	S1	W4	18.1±0.1 (n=8 18.2±0.1 (n=7 2.4
16	1	S2	W2	18.51±0.29 (n=16.51±0.78 (n=1.24±0.72 (n=
17	1	S2	W2	17.1±0.26 (n=15.33±0.43 (n=0.7±0.39 (n=6
18	1		B	20.1 (18.6-22. 17.9 (15.9-22.
19	1	S1	W1	17.55±0.59 (n=15.27±0.25 (n=0.8±0.64 (n=7
20	1		B	19.2 (17.8-21. 17.1 (16.0-19.
21	1	S2	W3	18.88±0.35 (n=16.27±0.89 (n=1.38±1.56 (n=
22	1		A	19.7 (18.6-24. 17.2 (16.1-20.
23	1		B	18.6 (17.3-19. 16.6 (14.4-19.
24	1		Ce	17 15
25	1		Ce	18 7-29
26	1		B	19.7 (18.0-24. 17.4 (16.2-21.
27	1		B/C	17 15
28	1		B/C	19 17
29	1		B	19.1 (18.1-22. 16.7 (15.5-17.
30	1		B	19.7 (17.9-23. 17.3 (15.2-20.
31	1		B	19.4 (17.9-23. 16.9 (15.6-20.
32	1	S4	W2	19.41±0.36 (n=17.26±0.55 (n=1.66±0.9 (n=6
33	1		C	19.3 (17.8-21. 17.1 (16.0-19.
34	1		B	18.4 (17.4-22. 16.3 (14.5-21.
35	1		B	19.7 (17.1-21. 16.8 (13.0-18.
36	1		B	17.6 (15.7-21. 15.4 (12.1-18.
37	1		B	18.1 (16.8-20. 16.9 (13.6-29.
38	1		B/C	17 7-26
39	1		B	20.5 (18.3-23. 16.9 (15.5-18.
40	1		B	20.0 (18.6-22. 17.8 (15.8-19.
41	68°36.42'W	1		17.7±0.6 (N=114.9±0.7 (N=11.0±0.5 (N=14
42		1	B	18.3 (14.7-19. 15.9 (12.2-17.
43		1	B	19.4 (17.5-21. 17.1 (15.5-18.
44		1	B	18.6 (16.5-20. 16.0 (15.2-17.
45		1	B	18.9 (17.6-20. 17.0 (16.3-20.
46		1	C	19 16
47		1	B	19.7 (17.6-25. 17.7 (14.6-23.
48		1	B	19.8 (18.4-25. 17.6 (15.9-20.

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3	1	B	19.1 (18.0-20. 16.4 (13.1-18.
4	1	B	17.6 (16.9-18. 16.3 (15.2-19.
5	1	B	19.2 (18.4-20. 17.0 (12.5-19.
6	1	B	18.9 (17.8-20. 17.0 (15.1-20.
7	1	B	17.8 (16.9-20. 16.0 (14.8-19.
8	1	B	19.1 (18.5-19. 16.8 (15.8-19.
9	1	B	17.9 (16.5-21. 15.7 (14.1-18.
10	1	B	17.6 (15.7-20. 15.8 (9.4-18.5
11	1	B	18.0 (17.0-20. 16.1 (15.3-17.
12	1	B	19.2 (17.7-21. 16.7 (14.1-21.
13	1	C	19.2 (17.7-21. 16.7 (14.1-21.
14	1	B	18.0 (17.0-20. 15.8 (15.2-16.
15	1	B	19.3 (17.9-20. 17.0 (15.7-19.
16	1	B	19.7 (18.3-21. 17.1 (15.0-21.
17	1	B	18.3 (17.1-20. 16.2 (14.7-18.
18	1	B	18.9±0.3 (N=217.8±0.3 (n=20.8±0.1 (n=24
19	1	S2	W2
20	1	B	19.3 (18.1-22. 17.2 (14.9-19.
21	1	B	20.5 (17.8-24. 17.3 (16.8-18.
22	1	B	19.0 (17.6-20. 16.8 (16.1-18.
23	1	B	19.3 (18.5-21. 17.3 (16.0-18.
24	1	B	19.3 (18.5-21. 17.3 (16.0-18.
25	1	B	19.2 (18.0-21. 17.2 (15.5-21.
26	1	B	19.8 (18.0-24. 17.9 (16.6-19.
27	1	B	18.5 (17.0-20. 16.7 (16.0-20.
28	1	B	19.2 (18.1-21. 16.6 (15.6-17.
29	1	B	18.2 (17.0-21. 16.5 (14.8-22.
30	1	B	18.8 (17.7-21. 16.5 (14.9-17.
31	1	B	19.8 (19.0-21. 18.0 (17.0-19.
32	1	B	19.4 (18.2-21. 17.2 (15.8-19.
33	1	B	18.1 (16.2-21. 15.9 (14.5-17.
34	1	B	19.0 (18.3-22. 16.4 (14.9-18.
35	1	C	19.4 (18.1-22. 16.7 (15.3-17.
36	1	B	19.3 (18.3-21. 17.0 (15.8-20.
37	1	C	18.8 (18.1-19. 17.0 (15.9-20.
38	1	B	19.7 (18.2-22. 17.1 (15.9-19.
39	1	B	18.7 (17.2-21. 17.0 (15.7-19.
40	1	B	19.6 (18.3-23. 16.8 (15.4-18.
41	1	B	19.0 (17.9-20. 16.8 (15.9-18.
42	1	B	17.9 (16.3-19. 16.1 (14.4-19.
43	1	B	19.2 (18.5-20. 16.9 (15.8-19.
44	1	B	18.1 (16.3-20. 16.1 (14.5-17.
45	1	B	19.3 (17.7-21. 16.9 (15.2-20.
46	1	B	19.3 (18.2-22. 17.0 (15.0-20.
47	1	C	19.4 (18.4-22. 16.8 (15.0-18.
48	1	B	19.4 (18.1-21. 17.0 (15.4-19.
49	1	B	18.2 (17.1-21. 17.1 (14.7-23.
50	1	B	19.4 (18.7-20. 17.0 (15.8-17.

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2			
3	1	C	20.0 (18.6-22. 17.1 (16.2-19.
4	1	B	20.5 (18.7-25. 17.6 (15.2-21.
5	1	B	18.8 (17.2-20. 16.9 (16.0-19.
6	1	B	19.5 (18.1-24. 17.4 (16.2-20.
7	1	B	19.5 (17.5-21. 17.2 (16.0-19.
8	1	B	18.7 (16.6-22. 16.5 (14.8-18.
9	1	B	17.8 (16.3-20. 15.6 (14.4-16.
10	1	B	19.2 (17.4-23. 17.2 (16.1-22.
11	1	C	19.3 (18.2-21. 17.1 (16.2-19.
12	1	B	19.5 (18.7-21. 17.2 (16.0-23.
13	1	C	18.8 (17.7-19. 16.6 (14.7-17.
14	1	B	19.8 (18.4-24. 17.9 (16.3-21.
15	1	B	17.9 (16.3-19. 16.6 (15.5-19.
16	1	B	20.2 (17.7-26. 18.0 (16.3-21.
17	1	B	17.7 (16.7-18. 16.0 (14.9-17.
18	1	B	17.6 (15.3-19. 16.0 (14.3-18.
19	1	C	20.0 (19.0-20. 17.3 (16.3-18.
20	1	A	17.9 (17.0-20. 16.6 (14.8-19.
21	1	B	18.2 (16.0-22. 16.3 (14.9-19.
22	1	B	17.9 (16.1-22. 16.5 (14.8-19.
23	1	B	17.8 (17.0-19. 16.3 (15.4-17.
24	1	B	18.9 (18.1-19. 16.9 (15.9-18.
25	1	B	17.8 (16.4-22. 16.3 (15.0-19.
26	1	A	19.3 (16.9-22. 17.6 (16.5-21.
27	1	B	18.1 (17.2-19. 16.3 (14.7-20.
28	1	B	19.1 (17.4-21. 16.8 (15.8-17.
29	1	B	19.2 (17.3-21. 16.8 (15.2-18.
30	1	B	19.3 (17.6-20. 16.9 (15.7-18.
31	1	B	18.2 (17.2-22. 16.2 (14.8-20.
32	1	C	19.0 (17.6-20. 16.6 (15.6-17.
33	1	B	18.0 (17.1-20. 16.1 (15.2-18.
34	1	B	18.4 (17.7-18. 16.5 (15.0-18.
35	1	B	18.0 (17.2-19. 15.7 (14.2-17.
36	1	B	19.6 (19.0-20. 17.5 (16.2-21.
37	1	B	18.8 (18.2-19. 16.7 (15.2-18.
38	1	A	18.3 (17.0-21. 17.0 (15.4-19.
39	1	B	17.8 (16.3-19. 16.0 (14.4-18.
40	1	B	17.8 (17.2-20. 16.2 (14.9-18.
41	1	B	19.1 (17.0-23. 16.8 (14.9-20.
42	1	B	17.7 (16.8-18. 16.1 (14.8-18.
43	1	B	17.9 (16.8-20. 16.4 (15.3-20.
44	1	B	18.8 (17.8-19. 16.6 (15.7-17.
45	1	B	17.6 (17.0-19. 15.8 (14.7-17.
46	1	B	18.5 (17.1-23. 17.0 (15.0-19.
47	1	B	19.1 (18.1-20. 16.6 (15.4-17.
48	1		
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59	1		
60	1	B	19.1 (18.1-20. 16.6 (15.4-17.

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3	1	B	19.2 (17.6-23. 16.4 (15.0-17.
4	1	B	18.3 (17.1-20. 16.8 (15.7-21.
5	1	B	17.8 (17.4-18. 16.0 (14.5-17.
6	1	B	18.0 (16.9-20. 16.4 (15.0-20.
7	1	B	19.3 (18.7-22. 17.0 (15.9-19.
8	1	B	18.0 (16.7-20. 16.5 (14.5-18.
9	1	B	18.1 (17.1-20. 16.5 (15.4-19.
10	1	B	17.8 (16.3-21. 16.1 (15.3-17.
11	1	B	18.9 (17.9-19. 16.8 (15.9-18.
12	1	B	18.0 (16.9-19. 15.9 (15.2-17.
13	1	B	18.2 (16.4-20. 16.7 (14.9-21.
14	1	B	18.0 (16.5-20. 16.7 (15.4-20.
15	1	B	17.8 (16.6-19. 16.1 (14.9-18.
16	1	B	18.8 (17.0-22. 16.0 (13.5-17.
17	1	B	18.4 (16.8-21. 16.4 (13.2-19.
18	1	B	19.2 (18.0-25. 17.0 (16.2-18.
19	1	B	18.3 (16.9-20. 16.1 (15.1-19.
20	1	B	18.0 (16.9-20. 16.9 (15.7-20.
21	1	B	18.0 (17.0-20. 16.9 (15.4-21.
22	1	B	19.4 (18.2-25. 17.1 (15.8-20.
23	1	B	17.8 (16.9-20. 16.4 (14.6-21.
24	1	B	18.4 (16.4-21. 15.8 (14.7-17.
25	1	B	20.0 (18.5-22. 17.3 (13.5-25.
26	1	B	18.3 (16.8-22. 16.7 (14.5-22.
27	1	B	19.5 (18.3-21. 17.1 (14.6-19.
28	1	B	17.9 (17.0-21. 16.1 (15.0-17.
29	1	C	18.4 (17.2-21. 16.8 (15.0-21.
30	1	B	17.7 (16.5-20. 16.1 (14.6-18.
31	1	C	18.9 (17.6-19. 17.4 (15.9-20.
32	1	A	19.6 (17.7-25. 17.3 (15.3-19.
33	1	B	17.8 (16.7-18. 15.7 (9.0-16.8
34	1	B	17.9 (16.4-19. 15.7 (14.8-16.
35	1	B	18.0 (16.9-22. 16.2 (15.3-18.
36	1	B	17.9 (17.1-19. 15.8 (14.8-16.
37	1	B	19.7 (18.2-25. 16.8 (16.0-18.
38	1	B	18.1 (16.6-19. 16.3 (15.1-18.
39	1	B	19.1 (18.2-22. 16.7 (15.4-18.
40	1	B	19.1 (17.8-21. 16.7 (15.6-18.
41	1	B	18.6 (16.7-22. 17.1 (15.3-20.
42	1	A/B	18.8 (13.7-20. 16.7 (12.1-20.
43	1	B	18.7 (17.1-21. 16.8 (14.8-19.
44	1	B	19.8 (18.6-22. 17.0 (15.8-19.
45	1	B	20 8-20
46	1	B	18.1 (16.5-23. 16.4 (15.4-20.
47	1	B	18.7 (17.1-20. 16.4 (15.4-17.

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27	49°53.347'W	2	S4	W0	17.8-21.2 (n=5 5.6-19.3 (n=6 7.00-47.5 (n=6
28		1		B	19.3 (17.6-20. 15.8 (2.8-19.8
29		1	S5	W1	17.5±0.8 (n=8 16.0±0.6 (n=5 0.7±0.2 (n=5)
30		1	S2	W0/1	15.6-15.7 14.0-14.1 0.6-0.7
31		1			
32	51° 05.30'E	1	S2	W4	17.7±0.2 (n=1 15.6±0.3 (n=1 0.8±0.3
33	51°04.24'E	10	S2	W4	17.7±0.2 (n=1 15.4±1.0 (n=1 1.7±0.8
34	69°44.571'W	1	S4	W1	17.9±0.5 (N=2 15.2±0.5 (N=2 1.4±0.5 (N=2 1
35	70°07.710'W	1	S4	W1	18.2±0.5 (N=2 15.4±0.5 (N=2 1.3±0.5 (N=2 3
36	70°10'52.7"W	1		W1	
37					
38	69°45.031'W	1	S1	W2	18.7±0.5 (N=1 15.4±0.5 (N=1 1.0±0.5 (N=1 9
39	69°48.414'W	1	S3	W2	19.6±0.5 (N=1 17.7±0.5 (N=1 1.2±0.5 (N=1 8
40					
41	69°43.036'W	1	S3	W2	19.7±0.5 (N=1 16.5±0.5 (N=1 1.0±0.5 (N=1 7
42		1	S2	W3	18.6±0.3 (n=5 16.3±0.3 (n=5 1.1±0.1 (n=5)
43		1	S2	W2	18.9-19.1 16.3-17.2 1.0-0.7
44					
45	69°59.310'W	many	S1	W3	17.3±0.5 (N=2 16.8±0.5 (N=2 1.0±0.5 (N=2 2
46	156°36.238'E	1	S1	W1	18.2±0.1 16.0±0.3 1.4±0.2
47	~70°32'W	7		W1	18.5 (N=1) 16.7 (N=1) 0.8
48	143°44'32"E	1	S1	W1	19.3 17.1 1.4
49					
50	156°38.987'E	1	S1	W1	17.9±0.2 15.7±0.2 1.5±0.2
51	~70°32'W	2		W1	19.1 (N=1) 16.2 (N=1) 0.6
52		1		B	18 17
53					
54	82°48.89'E	10	S3	W0	19.1±0.4 (N=2 17.1±0.6 (N=2 1.4±0.2 (N=2 3
55		6	S2	W1.0	18.3±0.3 (n=4 16.0±0.2 (n=3 1.2±0.2 (n=3 9
56		1	S1	W3	20.8±0.2 (n=7 17.2±0.1 (n=7 1.6
57		1	S3	W2	18.2±0.2 16.0±0.1 1.5±0.1
58		1	S2	W1/2	19.5-19.9 16.8-16.9 1.1-1.0
59		1	S1	W3	20.5±0.2 (n=7 17.1±0.1 (n=6 2.0
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4		1	moderate	W1	18.3±0.1 (n=4	16.4±0.3 (n=2	1.6±0.2 (n=27	
5	069°52'49.3"V	2		W1		16.7±0.1 (n=2	1.3±0.3	
6		1	S2	W2/3	18.3-18.4	15.4-15.9	1.0-1.7	
7		1		W1	18.5±0.1 (N=216.4±0.0	(N=21	1.4±0.3	
8	93°25'31.72"E	1	S3	W1	18.6	16.1	1.0	
9		1	S3	W2	18.7±0.2 (N=116.4±0.1	(N=11.5±0.2	(N=13	
10	69°07.51'W	2	S1	W1	18.3±0.3 (N=115.6±0.3	(N=11.0±0.1	(N=15	
11		8	S1	W3	18.1±0.2 (n=1	15.8±0.1 (n=1	0.8±0.1 (n=13	
12		1	S2	W3	16.7±0.2 (N=114.6±0.2	(N=11.7±0.0	(N=11	
13		1	S4	W3	18.0			
14		1	S1	W2	17.6±0.2 (n=1	15.2±0.6 (n=1	0.5±0.3 (n=16	
15		1		B	17.8 (16.0-18.	15.7 (15.0-17.		
16	~69°46'W	1		W1				
17		1	S2	W1	18.0±0.0 (N=616.2±0.0	(N=11.1		
18		1	S3	W3	20.4±0.2 (n=7	16.7±0.1 (n=7	0.9±0.1	
19		1	S3	W1	18.83±0.29 (n	16.52±0.08 (n	1.02±0.2 (n=6	
20	68°50.25'W	13	S1	W2	18.6±0.4 (N=116.1±0.5	(N=21.0±0.5	(N=20	
21		1	S2	W2	19.53±0.52 (n	17.55±1.02 (n	0.96±0.12 (n=	
22	69°44'12.9"W	1		W3				
23	69°46'W	1		W3	18.5 (n=1)	17.1 (n=1)	1.0	
24		1	S2	W5	18.8			
25		1		B	18.8 (18.2-19.	16.8 (15.5-18.		
26		Many	S3	W2	18.7±0.3	15.4±0.1	1.4±1.2	
27		1		B/C	20	18		
28		1	S3	W3	19.3±0.34 (n=	17.76±1.1 (n=	1.66±0.09 (n=	
29	69°7.40'W	7			18±0.4 (N=15)	15.9±0.8 (N=11.2±0.2	(N=10	
30		1	S3	W1	18.8±0.5 (N=115.9±1.7	(N=10.5±0.3	(N=10	
31		1	S4	W1	16.6±0.1 (n=5	15.1±0.6 (n=6	2.8±0.3 (n=6)	
32	116°9.837'W	Hundreds	S2	W3	18.4±0.4 (n=1	16.3±0.4 (n=8	1.1±0.2	
33	156°34.015'E	1	S3	W1	18.2±0.1	16.3±0.3	1.3±0.5	
34	69°52.078'W	6	S2	W2	17.4±0.5 (N=216.8±0.5	(N=11.0±0.5	(N=19	
35		2	S4	W3	18.7±0.4 (n=6	16.2±0.4 (n=6	1.0±0.1	
36		1	S3	W2	19.25±0.13 (n	17.13±0.83 (n	1.28±0.28 (n=	
37	70°5.62'W	1	S2	W2	17.7±0.5 (N=115.6±0.4	(N=11.2±0.1	(N=12	
38		1		B	20.1 (19.1-21.	16.8 (9.9-18.6		
39	69°52.113'W	2	S1	W2	19.7±0.5 (N=117.8±0.5	(N=11.0±0.5	(N=18	
40		1	S2	W3	19.04±0.77 (n	16.27±0.1 (n=	1.08±0.28 (n=	
41		1	S2	W3	18.41±0.38 (n	16.72±1.09 (n	2.27±3.96 (n=	
42	20.30314°E	1	S3	W4	18.3±0.3 (n=6	16.9±0.8 (n=5	0.3±0.7 (n=5)	
43		1		C	19.9 (18.7-21.	17.7 (16.1-21.		
44	69°12.74'W	1	S2	W1	17.7±0.3 (N=215.8±0.4	(N=11.1±0.1	(N=12	
45	51° 04.25'E	1	S3	W4	17.3 ± 0.4 (n=	15.6 ± 0.6 (n	1.4 ± 0.6 (n=1	
46	70°04.489'W	1	S3	W3	19.8±0.5 (N=217.3±0.5	(N=21.0±0.5	(N=22	
47	~70°32'W	1		W2				
48		1	S1	W3	19.4±0.4 (n=6	17.3±0.4 (n=6	1.5±0.1	

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3	53°14.90'W	1	S4	W2	19.3±0.6 (N=17.3±0.9 (N=91.14±0.15 (n=
4		1	S1	W2	20.2±0.3 (n=6 17.6±0.2 (n=7 1.8±0.1
5					
6	~69°43'W	1		W1	
7	~69°43'W	1		W1	
8	~70°32'W	1		W1	
9					
10		1	S2	W3	20.5±0.2 (n=6 17.4±0.2 (n=6 1.6±0.1
11		1		B	18.6 (17.7-19. 16.8 (16.2-18.
12	68°50.59'W	1	S3	W1	18.2±0.4 (N=215.5±0.4 (N=21.2±0.4 (N=21
13		1	S4	W2	19.58±0.52 (n=17.05±0.68 (n=1.26±0.4 (n=7
14		1	S4	W2	19.38±0.78 (n=16.69±0.54 (n=1.47±0.67 (n=
15		1			
16	70°7.74'W	1	S3	W1	18.6±0.6 (N=116.3±0.3 (N=11.1±0.3 (N=12
17		1	S1	W4	20.3±0.2 (n=7 15.0±0.2 (n=8 0.5±0.1
18		1	S2	W1	17.7±0.2 (N=115.5±0.2 (N=11.4±0.1 (N=10
19		1		B	19.8 (18.7-21. 17.3 (16.3-19.
20		1		C	18 21
21		1			
22		1			
23	~69°43'W	1		W2	
24	69°54.795'W	1	S1	W3	19.9±0.5 (N=117.2±0.5 (N=10.9±0.5 (N=19
25		1	S3	W1	17.53±0.11 (n=15.77±0.52 (n=1.62±0.83 (n=
26		1	S2	W2	18.47±0.88 (n=16.4±0.5 (n=6 0.88±0.31 (n=
27		1			
28	70°05'08.8"W	1		W1	
29		1	S2	W1	18.65±0.36 (n=16.64±0.72 (n=1.23±0.96 (n=
30		1	S2	W4	18.5±0.3 (n=5 16.4±0.2 (n=4 1.5±0.2 (n=4)
31		1			
32	20.35023°E	1	S2	W3	17.2±0.4 (n=3 15.1±0.3 (n=4 0.3±0.6 (n=4)
33		1	S2	W2	18.18±0.47 (n=16.09±0.71 (n=0.71±0.5 (n=7
34	69°37.40'W	15			17.2±0.3 (N=115.1±0.2 (N=10.8±0.3 (N=13
35		1	S2	W2	20.55±0.24 (n=16.88±1.26 (n=0.61±0.34 (n=
36		1	S3	W2	17.48±0.28 (n=15.75±0.85 (n=1.18±0.65 (n=
37		1	S1	W2	17.19±2.28 (n=16.05±0.2 (n=0.88±0.19 (n=
38		1	S3	W3	18.8±0.32 (n=16.65±0.33 (n=1.11±0.31 (n=
39		1	S1	W2	18.9±0.36 (n=16.81±0.22 (n=0.83±0.23 (n=
40		1		B	20.2 (18.6-23. 17.8 (16.1-19.
41		1	S2	W3	18.26±0.5 (n=16.06±0.35 (n=1.62±0.63 (n=
42		1			
43	70°13.92'W	1	S3	W1	19.3±1.5 (N=117.0±1.3 (N=11.3±0.6 (N=12
44	56°59.80'N	1	S2	W3	17.8±0.9 (N=515.1±1.1 (N=5 1.2±0.5 (N=5)
45	57°3.80	1	S1	W3	18.9±0.8 (N=116.6±0.9 (N=11.1±0.4 (N=10
46	69°55.317'W	1	S1	W2	18.7±0.5 (N=117.0±0.5 (N=21.0±0.5 (N=20
47	~69°43'W	1		W1	
48		1	S3	W2	19.1±0.3 (n=7 16.6±0.3 (n=7 1.3±0.2
49		1	S2	W1	18.4±0.3 (N=519.5±0.3 (N=6 1.7±0.1
50		1			
51	69°7.43'W	5			17.6±0.2 (N=115.4±0.1 (N=11.1±0.2 (N=13
52	70°00.557'W	1	S1	W1	17.8±0.5 (N=116.9±0.5 (N=21.0±0.5 (N=20
53	69°55.222'W	1	S2	W2	18.9±0.5 (N=117.7±0.5 (N=11.0±0.5 (N=16
54		1	S2	W3	20.8±0.2 (n=7 18.8±0.1 (n=7 1.3±0.1
55		1	S3	W3	20.5±0.1 (n=8 17.4±0.2 (n=5 1.2±0.1
56	56°49.427'E	1	S2	W0	18.1±0.3 (N=16.3±0.4 (N=0.9±0.2 (N=2

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4		1		W1			
5		1	S1	W2	16.2	14.3	1.3
6		1	S1	W2	17.88±0.52 (n=15.89±0.5	(n=1.49±1.19 (n=	
7		1	S3	W2	19.43±0.47 (n=16.17±1.09	(n=1.66±1.13 (n=	
8		1		B	18.5 (17.8-19.16.3	(15.2-17.	
9		1		C	19.9 (18.3-22.17.6	(16.1-20.	
10		1		C	19.9 (18.3-22.17.6	(16.1-20.	
11	~69°43'W	2		W3	19.1 (N=1)	18.5 (N=1)	0.9
12		1	S3	W3	17.17±0.46 (n=15.97±0.75	(n=0.8±0.68 (n=5	
13		1		C	17	15	
14		1		C	17	15	
15	~69°46'W	1		W1			
16		1	S3	W2	19.12±0.5 (n=16.7±0.58	(n=1.15±0.24 (n=	
17		1	S3	W2	19.12±0.5 (n=16.7±0.58	(n=1.15±0.24 (n=	
18	106°13'W	5	S2	W2	20.0 ± 1.2 (n=16.6 ± 0.9	(n=1.1±0.1	
19		1	S4	W2	19.73±0.4 (n=17.45±0.28	(n=1.19±0.28 (n=	
20	69°58.263'W	1	S2	W2	19.8±0.5 (N=117.2±0.5	(N=11.0±0.5 (N=18	
21		1	S3	W3	18.13±0.3 (n=16.56±0.58	(n=1.35±0.11 (n=	
22		1	S3	W3	18.13±0.3 (n=16.56±0.58	(n=1.35±0.11 (n=	
23	156°30.735'E	1	S1	W1	20.1±0.4	17.7±0.6	1.4±0.2
24		1		B	19.6 (17.7-22.17.9	(15.5-25.	
25	~69°43'W	2		W2	19.2 (N=1)	17.1 (N=1)	1.3
26		1	S2	W2	19.81±0.36 (n=17.02±0.56	(n=1.07±0.36 (n=	
27		1	S2	W2	19.81±0.36 (n=17.02±0.56	(n=1.07±0.36 (n=	
28		1	S1	W2	19.46±0.23 (n=17.74±0.56	(n=1.16±0.07 (n=	
29		1	S2	W3	18.05±0.25 (n=16.94±1.28	(n=1.02±0.09 (n=	
30		1		B	17.3 (16.0-20.15.5	(12.9-19.	
31		1		B	17.3 (16.0-20.15.5	(12.9-19.	
32		1		B/C	19	17	
33		1	S2	W3	18.8±0.42 (n=16.81±0.77	(n=1.31±0.14 (n=	
34		1	S2	W2	17.79±0.03 (n=15.7±0.18	(n=1.32±0.12 (n=	
35		1		B	19.4 (18.4-21.16.9	(16.1-17.	
36		1		B	19.4 (18.4-21.16.9	(16.1-17.	
37		1		C	17	15	
38		1	S2	W3	17.8±0.3 (n=8 14.1±0.5	(n=7 0.9±0.2	
39	~69°43'W	1		W3			
40		1		W3			
41	156°07.593'E	1	S3	W1	18.0±0.3	15.9±0.1	1.1±0.4
42		1		B	18.6 (17.7-20.16.9	(15.8-20.	
43		1	S2	W3	20.18±1.41 (n=16.63±0.81	(n=1.18±0.19 (n=	
44		1	S1	W3	20.6±0.2 (n=1 17.7±0.2	(n=8 0.7±0.1	
45		1	S1	W3	20.6±0.2 (n=1 17.7±0.2	(n=8 0.7±0.1	
46		1		B	19.4 (18.1-22.17.2	(15.4-19.	
47		1	S3	W2	19.19±0.18 (n=17.41±0.6	(n=1.38±0.27 (n=	
48		1		B/C	19	17	
49		1		B/C	19	17	
50	156°36.561'E	1	S2	W1	18.1±0.2	16.0±1.0	1.1±0.2
51		1		B/C	19	17	
52		1	S2	W3	20.0±0.3 (n=6 17.7±0.3	(n=8 1.4±0.2	
53		1		C	17	15	
54		1		C	17	15	
55		1		B	18.4 (17.0-21.16.1	(15.2-17.	
56	69°53.232'W	1	S4	W1	19.9± 0.5	17.8± 0.7	1.3± 0.2
57		1		B	18.2 (17.0-19.16.2	(14.8-18.	
58		1		B	18.2 (17.0-19.16.2	(14.8-18.	
59		1	S1	W1	17.7±0.1 (n=1 15.5±0.3	(n=1 1.1±0.2 (n=10	
60	31°16.66'E	1	S3	W3	18.5±0.1 (N=5 16.6±0.5	(N=5 1.1±0.2 (N=5)	

1								
2								
3	15°04'12"E	1		W1	19.4±0.4	17.2±0.5		
4								
5		1	S2	W2	16.35±0.3 (n=14.29±1.44 (n=1.78±0.31 (n=			
6		1	S2	W3	20.83±2.09 (n=19.92±1.25 (n=1.55±1.94 (n=			
7		1		B/C	20.1 (18.5-22.17.1 (15.4-19.			
8	69°44.648"W	1	S2	W3	17.6±0.5 (N=116.5±0.5 (N=11.1±0.5 (N=16			
9								
10	57°54.92'E	1	S3	W3	20.4±0.2 (n=6 19.0±0.3 (n=6 1.5±0.1			
11		1		B/C	19	17		
12		1	S2	W3	19.24±0.94 (n=17.35±2.89 (n=1.40±0.59 (n=			
13								
14	~69°43'W	1		W1				
15	69°48'58.51"V	2		W3/4	19.7 (N=1)	16.8 (N=1)	1.5	
16	31°15.12'E	1	S1	W2	18.3±0.6 (N=516.3±0.3 (N=5 1.3±0.3 (N=5)			
17								
18	69°7.97'W	1			18.1±0.4 (N=115.8±0.3 (N=11.3±0.6 (N=10			
19		1		A/B	19	17		
20		1	S2	W1	16.7±0.2 (n=1 14.6±0.1 (n=1 0.6±0.1 (n=16			
21		1	S2	W2	20.24±1.58 (n=17.3±0.42 (n=1.06±0.25 (n=			
22								
23		1		B	19.0 (17.9-20.17.6 (15.8-20.			
24		1	S4	W2	19.06±0.18 (n=16.89±0.21 (n=0.21±0.21 (n=			
25	69°50.901'W	1	S1	W4	20.6±0.5 (N=118.0±0.5 (N=10.9±0.5 (N=15			
26								
27		1		B	19.7 (18.8-21.17.6 (15.5-19.			
28	~69°43'W	11		W3	19.6 (N=1)	17.2±0.2 (N=2 1.1±0.0		
29		1	S2	W2	19.2±0.6	17.1±0.8	1.2±0.3	
30								
31	156°34.601'E	1	S2	W1	20.1±0.3	17.6±0.3	1.5±0.1	
32		1	S1	W3	19.1±0.1 (n=6 17.0±0.1 (n=7 1.3			
33		1		C	19.1 (17.8-21.17.0 (16.0-18.			
34		1		B	19.4 (18.2-22.16.8 (15.8-19.			
35								
36	31°14.66'E	1	S3	W3	18.3±0.2 (N=516.2±0.3 (N=5 1.3±0.2 (N=5)			
37		1	S2	W2	18.66±0.25 (n=16.33±0.66 (n=1.74±1.76 (n=			
38		1		B	19.7 (18.5-21.17.6 (16.0-20.			
39		1		B	19.4 (17.9-21.16.8 (15.4-18.			
40								
41		1	S2	W4	19.8 ± 0.2	17.4 ± 0.2	1.5 ± 0.1	
42	69°58.940'W	2	S2	W2	20.2±0.5 (N=118.1±0.5 (N=11.1±0.5 (N=17			
43		1		B	20	18		
44								
45		1	S2	W2	20.5±0.1 (n=8 17.8±0.2 (n=7 1.3±0.2			
46	~69°43'W	1		W1	18.5 (N=1)	16.1 (N=1)	1.1	
47		1		B	18	16		
48								
49		1		B	19	18		
50		1	S1	W2	19.2±0.4 (n=7 17.5±0.7 (n=7 1.5±0.1			
51		1	S3	W2	19.56±0.49 (n=17.91±0.49 (n=1.39±0.07 (n=			
52		1	S2	W3	18.92±0.51 (n=16.56±0.66 (n=1.09±0.25 (n=			
53		1	S2	W2	19.45±0.44 (n=17.88±0.83 (n=1.03±0.45 (n=			
54								
55	156°27.409'E	1	S1	W1	18.3±0.5	16.2±0.3	1.4±0.2	
56	~69°46'W	1		W1				
57		1	S3	W3	18.45±0.34 (n=16.22±0.3 (n=1.16±0.57 (n=			
58		1	S2	W2	18.75±0.46 (n=17.02±0.56 (n=1.5±0.21 (n=6			
59								
60		1		B/C	19	17		

1							
2							
3		6	W3	18.7 (N=1)	16.4 (N=1)	1.4 (N=1)	
4		1	B	19.8 (18.3-22.	17.5 (16.2-22.		
5		1	B	19.2 (18.2-20.	16.9 (14.6-18.		
6		1	B	19.3 (18.4-21.	16.9 (15.6-21.		
7		1					
8		1	S3	W2	18.62±1.11 (n=	17.93±1.85 (n=	0.75±0.40 (n=
9		1		B/C	18	16	
10		1		B	18.6 (17.3-21.	16.5 (15.1-19.	
11		1					
12	156°34.675'E	1	S2	W1	18.0±0.2	16.0±0.2	1.0±0.3
13		1		A	18.0 (17.3-19.	16.3 (14.4-19.	
14		1	S2	W2	16		
15		1	S3	W2	18.24±0.78 (n=	16.9±2.52 (n=	0.77±0.34 (n=
16		1					
17	~69°43'W	1		W1			
18		1		C	18.9 (17.8-20.	17.2 (16.6-19.	
19		1	S3	W1	19.15±0.4 (n=	16.92±0.28 (n=	0.88±0.19 (n=
20		1		C	20	17	
21		1		B/C	19	17	
22		1					
23		1	S2	W5	18.40±0.3 (N=	16.6±0.2 (N=	11.5±0.2 (N=
24	114°1.66'W	1		C	19.1 (18.1-21.	16.9 (15.2-18.	
25		1	S2	W3	19.9±0.65 (n=	15.6±1.47 (n=	0.67±0.59 (n=
26		1		B	19		
27		1		B/C	19	17	
28		1		B	19.7 (18.3-25.	17.0 (13.8-20.	
29		1	S3	W3	18.77±0.4 (n=	16.09±3.17 (n=	1.57±0.86 (n=
30		1	S2	W1	18.57±0.24 (n=	16.67±0.41 (n=	1.46±0.15 (n=
31		1	S2	W3	19.34±0.57 (n=	16.92±0.37 (n=	1.29±0.09 (n=
32		1		B/C	19	17	
33		1	S2	W3	18.9±0.26 (n=	16.73±0.1 (n=	1.44±0.11 (n=
34		1		B/Ce	19	17	
35		1		B/C	19	17	
36		1	S5	W3	18.87±0.52 (n=	17.14±0.66 (n=	1.53±1.07 (n=
37	156°27.376'E	1	S1	W1	18.2±0.2	16.2±0.4	1.3±0.3
38	~69°43'W	1		W1			
39		1	S1	W2	18.42±0.39 (n=	16.38±0.67 (n=	1.04±0.72 (n=
40		1		C	18.1 (15.9-19.	15.9 (15.5-16.	
41		1		B/C	20	17	
42		1		Be	17	15	
43	156°27.409'E	1	S2	W1	18.2±0.2	16.1±0.3	1.2±0.2
44		1	S2	W2	18.61±0.55 (n=	16.38±0.48 (n=	1±0.53 (n=
45		1	S1	W3	18.78±0.21 (n=	16.37±0.46 (n=	1.17±0.17 (n=
46	69°51.070'W	1	S3	W3	19.7±0.5 (N=	117.1±0.5 (N=	11.0±0.5 (N=
47		1		B	18.0 (16.0-22.	15.9 (14.6-19.	
48		1		B/Ce	19	17	
49		1		C	19	18	
50		1	S1	W2	18.56±0.15 (n=	17.19±0.78 (n=	1.26±0.29 (n=
51		1	S3	W2	17.4±2.9 (n=	16.15±0.56 (n=	1.05±0.24 (n=
52		1					
53		1					
54		1					
55		1					
56		1					
57		1					
58		1					
59		1					
60		1					

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3			B	19.3 (17.9-20. 17.3 (16.3-17.	
4			B	19.8 (18.3-21. 17.5 (16.5-19.	
5			B	19.8 (18.3-21. 17.5 (16.5-19.	
6			B/C	19 17	
7			B	19.8 (17.9-21. 17.8 (15.8-20.	
8			B	19.0 (17.9-20. 16.9 (16.3-17.	
9			B	19.9 (15.6-22. 19.8 (15.3-28.	
10			B	19.9 (15.6-22. 19.8 (15.3-28.	
11			B/C	19 17	
12			B/C	19 18	
13			B/C	19 17	
14			B/C	19 17	
15			B	18.9 (17.9-19. 16.4 (15.6-17.	
16	69°44.129'W	1	S1	W2	17.1±0.5 (N=115.4±0.5 (N=10.9±0.5 (N=17
17				B/C	18 18
18				B/C	18 18
19	156°24.290'E	1	S2	W1	19.1±1.1 16.9±4.0 0.8±0.6
20				B	19.1 (17.3-21. 16.8 (15.5-18.
21				B	19.1 (17.3-21. 16.8 (15.5-18.
22			S1	W3	19.51±0.68 (n=14.84±1.63 (n=0.61±0.46 (n=
23				B	19.0 (17.9-19. 16.9 (15.4-18.
24				B/C	19 17
25				B/Ce	19 17
26				B/Ce	18 16
27				B/Ce	18 16
28	156°35.220'E	1	S1	W1	18.3±0.4 16.1±0.4 1.3±0.2
29	~69°46'W	1		W4	18.7 (N=1) 16.7 (N=1) 0.9
30				B	19.2 (17.9-23. 16.9 (15.6-18.
31				B	18.7 (17.4-19. 17.1 (15.8-22.
32				B	18.7 (17.4-19. 17.1 (15.8-22.
33	69°37.81'W	1	S2	W4	18.7±0.4 (N=116.1±0.2 (N=11.0±0.1 (N=10
34	69°49.215'W	1	S3	W1	19.1±0.5 (N=117.0±0.5 (N=11.0±0.5 (N=12
35				B/Ce	21 17
36				B/Ce	21 17
37				A/B	18 17
38				B	19.2 (18.1-20. 16.9 (14.8-19.
39				C	19.0 (18.4-20. 17.0 (15.7-20.
40				C	19.0 (18.4-20. 17.0 (15.7-20.
41				B	19.2 (18.0-20. 17.3 (16.2-19.
42				B	19.3 (18.1-21. 16.8 (15.6-17.
43				B	19.3 (18.1-21. 16.8 (15.6-17.
44				B/C	17 15
45				B/C	18 16
46				B/C	19 17
47				Ce	17 15
48				Ce	17 15
49				A/B	19 18
50			S3	W3	17.75±0.31 (n=15.45±0.26 (n=1.42±1.01 (n=
51				B	19.4 (17.9-21. 17.5 (15.8-20.
52				B	19.4 (17.9-21. 17.5 (15.8-20.
53			S2	W2	18.82±0.27 (n=16.64±1.67 (n=1.07±0.36 (n=
54			S3	W3	18.91±0.53 (n=16.95±0.5 (n=1.23±0.16 (n=
55			S3	W3	18.84±0.31 (n=16.9±0.52 (n=1.18±0.1 (n=6
56	156°34.877'E	1	S2	W1	19.7±0.2 17.5±0.3 1.4±0.3
57				W1	19.7±0.2 17.5±0.3 1.4±0.3
58			S3	W3	20.82±3.51 (n=17.04±1.47 (n=1.26±0.16 (n=
59				C	17 15
60				B	19.8 (18.7-22. 17.2 (16.3-19.

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2						
3	156°36.723'E	1	S2	W1	18.5±0.1	16.4±0.2 1.0±0.3
4		1		B	18.6	(17.3-22. 16.9 (15.7-21.
5		1		B	18.6	(17.3-22. 16.9 (15.7-21.
6	68°40.52'W	1	S1	W3	19.0±0.2	(N=114.9±0.2 (N=11.1±0.2 (N=13
7	156°25.443'E	1	S1	W1	18.5±0.2	16.3±0.2 1.5±0.2
8	69°50.770'W	1	S2	W4	17.4±0.5	(N=116.2±0.5 (N=11.1±0.5 (N=13
9		1		B	19.1	(18.4-20. 16.8 (15.6-17.
10		1		B	19.2	(18.2-21. 17.2 (16.6-18.
11		1		B	19.2	(18.2-21. 17.2 (16.6-18.
12		1	S2	W3	18.55±0.72	(n=16.31±0.51 (n=1.34±0.28 (n=
13		1		B	18.9	(17.2-21. 16.0 (14.7-17.
14		1		B	18.9	(17.2-21. 16.0 (14.7-17.
15		1		C	18.8	(17.7-19. 16.7 (14.6-18.
16		1		B	18.9	(17.8-20. 16.7 (15.6-20.
17		1		B	17.2	(15.8-21. 15.7 (13.8-19.
18		1		B	17.2	(15.8-21. 15.7 (13.8-19.
19		1	S3	W3	18.38±0.32	(n=16.4±0.45 (n=1.77±0.63 (n=
20		1		B/C	17	15
21		1		B	19.0	(17.9-19. 16.5 (15.7-17.
22		1		B	19.0	(17.9-19. 16.5 (15.7-17.
23		1		B	19.9	(18.7-24. 17.7 (16.0-22.
24		1		C	17	15
25		1		B	19.5	(18.8-20. 17.0 (16.2-17.
26		1		B	19.4	(17.4-22. 17.1 (16.1-20.
27		1		B	19.4	(17.4-22. 17.1 (16.1-20.
28		1		A	19.9	(18.3-23. 17.0 (12.2-21.
29		1		B	19.3	(18.3-21. 17.1 (15.7-22.
30	~69°46'W	1		W2		
31		1		W2	18.5±0.2	(N=116.2±0.1 (N=11.2±0.2 (N=13
32	68°36.42'W	1	S1	W2	18.5±0.2	(N=116.2±0.1 (N=11.2±0.2 (N=13
33		1		B	19.2	(18.0-21. 16.6 (15.5-17.
34		1		B	19.4	(18.8-21. 17.1 (16.4-18.
35		1		B	19.5	(18.1-23. 17.3 (15.9-20.
36		1		B	19.5	(18.1-23. 17.3 (15.9-20.
37		1		B	19.7	(18.6-23. 17.0 (15.9-20.
38		1		B	19.7	(18.6-23. 17.0 (15.9-20.
39		1		B	19.3	(18.4-19. 17.2 (16.4-19.
40		1		B	18.7	(17.7-21. 16.5 (14.7-19.
41		1		B	19.0	(18.1-20. 16.8 (16.1-18.
42		1		B	18.9	(17.2-21. 16.7 (14.7-17.
43		1		B	18.9	(17.2-21. 16.7 (14.7-17.
44		1		B	19.7	(18.6-25. 16.9 (15.6-17.
45		1		B	19.7	(18.3-23. 17.2 (14.5-20.
46		1		A	17.2	(15.8-17. 15.4 (14.0-16.
47		1		B	19.3	(17.8-22. 17.1 (15.5-22.
48		1		B	19.3	(17.8-22. 17.1 (15.5-22.
49		1		C	18.9	(17.5-20. 16.8 (15.4-17.
50		1		B	19.6	(18.1-23. 17.1 (16.3-18.
51		1		B	18.3	(17.4-19. 16.4 (15.3-16.
52		1		B	17.6	(15.9-21. 15.9 (14.7-17.
53		1		B	17.6	(15.9-21. 15.9 (14.7-17.
54		1		B	20.1	(18.5-22. 17.5 (16.5-20.
55		1		B	18.9	(17.7-20. 16.5 (13.9-17.
56		1		B	17.8	(16.2-20. 15.9 (14.4-18.
57		1		B	17.8	(16.2-20. 15.9 (14.4-18.
58		1		B	19.4	(18.8-20. 17.2 (16.2-19.
59		1		B/C	18.6	(17.2-20. 16.3 (14.4-18.
60		1		B	19.8	(18.7-22. 17.4 (16.8-19.

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29	156°26.805'E	1	S1	W2	18.2±0.2	16.4±0.4	1.5±0.3
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3		1	B	17.9 (16.6-21. 16.4 (14.7-18.				
4		1	B	19.0 (17.7-22. 16.8 (14.8-19.				
5		1	B	19.8 (18.7-22. 17.1 (11.2-18.				
6		1	B	19.7 (18.4-21. 17.1 (12.3-19.				
7		1	C	19.3 (18.2-23. 16.8 (15.7-18.				
8		1	B	17.6 (16.5-20. 16.0 (15.0-16.				
9		1	B	19.2 (17.9-23. 17.7 (15.6-21.				
10		1	A	19.3 (15.1-23. 17.8 (15.2-26.				
11		1	B	19.2 (18.4-20. 17.2 (15.9-21.				
12		1	C	19.3 (18.0-22. 17.1 (16.1-21.				
13		1	B	18.6 (17.8-21. 16.5 (15.5-17.				
14		1	B	20.1 (18.7-22. 17.5 (16.1-18.				
15		1	B	19.5 (17.4-24. 16.6 (5.5-25.3				
16		1	B	19.4 (17.8-20. 17.5 (16.5-19.				
17		1	B	20	17			
18		1	B	18.1 (16.9-21. 16.5 (14.3-22.				
19		1	B	16	15			
20		1	C	19	17			
21		1	A/B	19.5 (18.4-20. 17.1 (15.7-20.				
22		1	B	17.0 (12.2-20. 16.2 (14.4-18.				
23		1	C	18.0 (16.6-20. 16.0 (14.6-17.				
24		1	B	19	17			
25		1	B	18.7 (16.9-19. 17.1 (15.3-20.				
26		1	C	19.2 (17.9-21. 16.9 (14.9-19.				
27		1	B	19.1 (18.3-20. 16.8 (15.3-18.				
28		1	B	18.2 (16.8-22. 16.4 (14.4-20.				
29		1	B	19.4 (17.9-23. 16.8 (15.4-19.				
30		1	B	19.4 (18.6-21. 16.8 (14.3-19.				
31		1	B	18.6 (17.5-20. 16.5 (15.6-19.				
32		1	B	18.3 (17.5-21. 16.2 (14.3-19.				
33	158°29.109'E	1	S2	W1	18.9±0.4	16.6±0.3	1.3±0.2	
34		1	B	19.3 (18.5-20. 16.8 (16.0-17.				
35		1	B	17.9 (16.1-19. 16.0 (15.1-18.				
36		1	B	19.1 (18.0-20. 16.6 (15.8-17.				
37		1	B	18.1 (16.5-20. 16.3 (15.0-17.				
38		1	B	18.8 (17.8-20. 16.5 (15.5-17.				
39		1	B	18.7 (17.6-19. 16.7 (14.7-19.				
40		1	B	17.9 (16.8-20. 16.0 (14.5-18.				
41		1	C	19.8 (18.7-23. 17.1 (15.3-18.				
42		1	B	19.1 (17.2-21. 16.8 (15.8-18.				
43		1	B	17.9 (17.1-21. 16.6 (15.0-21.				
44		1	C	18.8 (17.8-22. 16.4 (15.5-18.				
45		1	B	19.7 (18.3-23. 17.5 (16.3-20.				
46		1	B	18.1 (16.4-22. 16.5 (15.4-18.				
47		1	Ce	20	18			

1							
2							
3			B	18.0 (16.6-20. 16.6 (14.9-19.			
4			B	19.4 (18.2-20. 17.1 (15.7-19.			
5							
6				17 15			
7			B	19.5 (18.0-24. 17.2 (14.6-21.			
8			B	18.7 (17.9-19. 16.5 (14.8-18.			
9							
10			B	19.6 (18.6-23. 16.8 (15.9-18.			
11			B	19.2 (18.3-22. 16.9 (15.0-19.			
12			C	19.0 (17.6-22. 16.5 (15.2-17.			
13							
14			B	17.5 (15.6-18. 16.4 (14.9-19.			
15			B	19.5 (18.1-23. 17.5 (15.6-19.			
16			B	19.8 (18.5-23. 17.0 (15.6-18.			
17							
18			B	18.4 (17.3-20. 17.0 (15.3-19.			
19			C	19.4 (18.3-22. 17.3 (16.2-21.			
20	156°40.593'E	1	S2	W1	19.6±0.4	17.2±0.3	1.3±0.4
21							
22				B	19.4 (17.6-21. 17.2 (16.4-19.		
23	76°55.26'E	1	S3	W2	19.1±0.5 (N=116.7±0.3 (N=11.4±0.2 (N=16		
24	10°25'10.17"E	4	S3	W3	19.0±0.6 (n=4 16.6±0.3 (n=6 1.1± 0.1 (n=6)		
25	70°11'40.9"W	3		W1			
26							
27		2	S4	W2	20.9±0.3 (n=1.		
28	69°47.183'W	2	S4	W3	18.6±0.3 (N=116.5±0.4 (N=11.3±0.4 (N=18		
29	~69°46'W	1		W4	19.2 (N=1)	16.4(N=1)	1.7
30	85°41.86'E	20	S2	W1	19.1	16.3	1.4
31							
32		1	S2	W3	19.3		
33		1	S3	W2	19.2±0.1	17.0±0.2	1.3±0.3
34		1	S2	W4	20.8±0.1 (n=7 17.1±0.1 (n=8 3.3		
35		1	S1	W0/1	19.5±0.4	17.0±0.3	1.3±0.2
36		1	S1	W1	19.9	17.7	1.5
37		1	S1	W1	19.9	17.7	1.5
38	69°43.577'W	1	S2	W3	19.8±0.3 (N=218.1±0.4 (N=21.2±0.4 (N=22		
39	69°39'05.5"W	1		W2			
40							
41	116°46.096'W	many	S4	W3	20.1±0.11 (N=19.25±0.23 (N2.29±0.07 (N=		
42	69°49'14"W	1	S1	W1	18.8±0.2 (n=1 16.6±0.2 (n=1 1.3±0.1 (n=11		
43		1		C	18.9 (18.3-19. 16.5 (15.7-17.		
44		1					
45		1	S3	W4	19.5±0.1 (n=8 16.8±0.1 (n=8 1.1±0.1		
46	68°34.622' W	19	S3	W2	19.3±0.4 (N=217.0±0.3 (N=21.5±0.2 (N=25		
47		1	S3	W5	19.4±0.1 (n=8 17.4±0.1 (n=7 1.2		
48	69°55.177'W	3	S1	W1	18.8±0.3 (N=116.7±0.4 (N=11.0±0.4 (N=19		
49							
50		1		B	18.6 (17.5-21. 16.4 (15.5-20.		
51		1	S4	W2	19.9-20.0	16.9-17.6	1.2-1.1
52	69°50.947'W	1	S3	W1	19.2±0.3 (N=216.8±0.4 (N=21.0±0.4 (N=20		
53							
54		1		W1	18.6±0.9 (n=6 17.0±0.7 (n=5 0.9±0.7		
55	69°47.325'W	1	S2	W2	18.6±0.3 (N=216.5±0.4 (N=21.1±0.4 (N=21		
56		1		C	18.6 (17.8-19. 16.4 (15.0-17.		
57	69°48.309'W	1	S1	W2	18.5±0.3 (N=217.1±0.4 (N=20.9±0.4 (N=21		
58							
59		1	S1	W3	18.3±0.3 (n=1 16.3±0.1 (n=1 1.4±0.2 (n=12		
60		1		B/C	19.5 (17.7-20. 17.1 (16.0-19.		

1					
2					
3					
4		1	S2	W2	18.2
5	69°54.539'W	1	S1	W2	18.0±0.3 (N=216.6±0.4 (N=21.1±0.4 (N=22
6		1	S2	W1	19.5-19.8 16.9-17.4 1.5-1.3
7	70°08'43"W	1	S2	W2	19.4±0.2 (n=1.17.1±0.1 (n=1.14±0.2 (n=13
8	69°56.696'W	1	S3	W1	18.3±0.3 (N=216.3±0.4 (N=20.9±0.4 (N=22
9					
10		1		A	20.0 (19.2-21. 17.5 (16.3-18.
11	68°38.786'W	2	S2	W2	19.44±0.18 (N17.28±0.35 (N1.45±0.14 (N=
12		1	S2	W3	18.9±0.26 (n= 16.84±0.22 (n 1.41±0.09 (n=
13		1	S2	W2	19.15±0.25 (n 16.93±0.24 (n 1.54±0.14 (n=
14		1	S2	W2	19.1±0.3 (N=116.8±0.4 (N=10.9±0.4 (N=16
15	69°47.512'W	1	S2	W2	19.1±0.3 (N=116.8±0.4 (N=10.9±0.4 (N=16
16		1	S3	W4	20.1±0.9 18.9±0.8 1.8±0.5
17	68°39.227'W	2	S2	W2	19.73±0.36 (N17.24±0.26 (N1.22±0.25 (N=
18					
19		1		B	19.5 (18.8-19. 17.3 (15.7-20.
20		1		B	18 17
21		1			
22		1	S4	W2	19.8±1
23	~69°46'W	1		W3	
24		1	S2	W2	18.81±0.14 (n 16.66±0.4 (n= 1.33±0.12 (n=
25		1	S3	W2	20.06±0.32 (n 17.87±0.47 (n 1.24±0.27 (n=
26		1	S2	W2	19.57±0.86 (n 17.32±0.32 (n 1.52±0.43 (n=
27		1	S3	W3	19.22±0.2 (n= 17.6±1.55 (n= 1.45±0.19 (n=
28		1	S1	W2	18.98±0.37 (n 16.78±0.18 (n 1.38±0.18 (n=
29		1	S2	W2	18.78±0.68 (n 16.79±1.67 (n 1.14±0.41 (n=
30		1			
31		1		C	19 17
32		1		C	20.3 (18.9-22. 17.4 (16.3-21.
33		1	S2	W3	19.55±1.07 (n 17.04±0.41 (n 1.72±1.46 (n=
34	69°51.649'W	1	S3	W1	19.1±0.3 (N=216.5±0.4 (N=11.0±0.4 (N=18
35		1		B	19 18
36		1	S2	W2	19.19±0.28 (n 16.67±0.25 (n 1.17±0.22 (n=
37		1	S2	W3	19.08±0.22 (n 17.05±0.18 (n 1.5±0.25 (n=1
38		1		C	18.7 (17.6-20. 16.3 (14.8-16.
39		1	S3	W2	18.67±0.42 (n 16.46±0.51 (n 1.11±0.23 (n=
40		1		B/C	18 17
41		1	S1	W4	20.8±0.3 (n=8 18.0±0.3 (n=8 1.6±0.1
42		1	S3	W3	19.11±0.66 (n 16.86±0.86 (n 1.15±0.3 (n=7
43		1		C	17 15
44		1	S2	W2	18.38±0.42 (n 16.46±0.36 (n 1.23±0.14 (n=
45		1	S3	W3	20.03±0.56 (n 17.96±0.76 (n 1.37±0.11 (n=
46		1		B	19.3 (18.2-20. 17.0 (15.8-17.
47		1	S3	W2	19.41±1.78 (n 15.6±2.05 (n= 1.83±0.67 (n=
48		1		C	17 15
49		1		C	18.5 (18.0-19. 16.2 (14.5-17.
50		1	S1	W2	18.75±0.38 (n 16.47±0.22 (n 1.3±0.18 (n=6
51		1		B/Ce	21 18
52		1		B	19.4 (18.1-22. 17.6 (15.8-20.
53		1	S2	W3	19.81±2.75 (n 16.47±1.12 (n 1.16±0.17 (n=

1							
2							
3							
4		1	B	20.3 (19.2-22.17.6 (15.9-20.			
5		1	B	19.7 (18.5-21.17.6 (16.5-19.			
6		1	B/C	19	17		
7		1	B/C	19	17		
8							
9		1	S2	W2	18.49±0.25 (n=16.63±0.77 (n=0.95±0.26 (n=		
10		1	S3	W1	17.8±0.78 (n=17.08±2.24 (n=0.93±0.07 (n=		
11		1		Ce	17	15	
12		1	S2	W3	19.15±0.23 (n=16.77±0.32 (n=1.89±0.63 (n=		
13							
14	5°38.01'W	1	S2	W2	20.1±0.1 (n=9 17.9±0.1 (n=6 1.7		
15		1		C	19.7 (18.5-21.17.3 (15.9-19.		
16		1	S3	W2	18.83±0.21 (n=16.7±0.28 (n=1.20±0.26 (n=		
17		1		Ce	17	15	
18							
19		1	S2	W3	19.09±0.33 (n=16.66±0.33 (n=1.32±0.21 (n=		
20		1		B	19.9 (18.7-22.17.9 (16.5-21.		
21		1		C	19.3 (18.4-20.17.1 (16.4-17.		
22		1		C	19.3 (18.2-21.16.9 (15.4-19.		
23		1		C	19.3 (18.2-21.16.9 (15.4-19.		
24		1	S3	W3	19.65±0.28 (n=17.48±0.31 (n=1.45±0.28 (n=		
25		1		C	18.3 (17.5-18.16.5 (15.7-17.		
26		1		C	17	15	
27		1		C	17	15	
28		1	S1	W1	17.7±0.1 (n=1 16.3±0.2 (n=1 1.1±0.1		
29		1		B/C	19	17	
30		1		Ce	17	15	
31		1		B	20	19	
32		1		B	20	19	
33		1	S3	W3	18.61±0.36 (n=16.8±0.44 (n=1.18±0.51 (n=		
34		1	S5	W2	19.6±1.0 (17.8 18.8±1.4 (16.8 1.9±0.7 (1.2-3		
35		1		B/C	17	15	
36		1		B/C	17	15	
37		1	S1	W2	19.1±0.2 (n=1 16.5±0.2 (n=1 1.7±0.1 (n=15		
38		1		C	17	15	
39		1		B/C	19	17	
40							
41	~69°43'W	1		W1			
42		1	S2	W2	18.74±0.18 (n=16.75±0.81 (n=1.29±0.88 (n=		
43		1	S2	W2	18.91±0.3 (n=17.03±0.32 (n=1.67±0.1 (n=9		
44		1					
45		1	S1	W2	17.97±0.78 (n=17.44±1.73 (n=1.48±0.86 (n=		
46		1		B/C	20	18	
47		1	S5	W1	18		
48		1		B	18.3 (16.9-20.16.7 (14.7-19.		
49		1		Ce	19	17	
50		1		Ce	19	17	
51	159°45.123'E	1	S3	W1	19.7±0.6	17.3±0.4	1.4±0.1
52		1		Ce	19	17	
53		1		B	19.6 (17.3-21.17.2 (16.2-17.		
54		1		B	19.6 (17.3-21.17.2 (16.2-17.		
55		1		B/C	19	16	
56		1		Ce	17	15	
57		1		C	20	18	
58		1		B/C	19	17	
59		1		B/C	19	17	
60		1		Ce	17	15	

1						
2						
3						
4		1	S5	W2	20.0±1	
5		1		B	20.2 (19.6-22.17.8 (16.8-20.	
6		1		C	18.4 (17.7-21.16.3 (14.5-17.	
7		1		C	18	16
8		1				
9	114°16.151'W	1	S3	W1	19.9±0.5	17.3±0.5 1.4±0.4
10		1		Ce	19	18
11		1		B	19.6 (18.6-21.17.5 (15.8-19.	
12		1		B	20.3 (18.6-23.18.2 (16.2-22.	
13		1		B	20.0 (18.8-22.17.6 (16.3-23.	
14		1		B/C	18	16
15		1		B	20.2 (18.7-24.17.5 (16.1-18.	
16		1		B	19.3 (18.2-20.16.7 (15.4-17.	
17		1		B	19.7 (18.6-22.17.2 (16.3-18.	
18		1		B/C	18	16
19		1		B/C	19	18
20		1	S1	W1	19.01±0.29 (n=16.8±0.32 (n=1.22±0.20 (n=	
21		1		B/C	20	17
22		1		B	19.5 (17.8-26.17.6 (16.0-20.	
23		1		Ce	18	16
24		1		Ce	19	
25		1		C	18	16
26		1		B/C	20	19
27		1		B	19.5 (18.5-21.17.2 (14.8-19.	
28		1		C	19	17
29		1	S4	W2	18.95±0.35 (n=17.03±0.38 (n=1.31±0.11 (n=	
30		1		B/C	19	17
31		1		B	19.0 (17.4-21.17.1 (15.5-20.	
32		1	S1	W1	20.0±0.5	17.2±0.4 1.3±0.3
33		1		B/C	17	15
34		1		B	19.7 (19.0-20.17.3 (16.3-18.	
35		1		B/C	19	18
36		1		C	19	16
37		1		Ce	18	16
38	156°39.601'E	1	S3	W2	19.97±0.26 (n=17.42±0.17 (n=1.49±0.18 (n=	
39		1		C	18	
40		1		B/C	18	16
41		1		C	18	16
42		1		B/C	19	18
43		1		B	21.4 (18.5-25.17.7 (15.0-20.	
44		1		B/Ce	19	16
45		1		B	19.7 (18.5-22.17.3 (15.5-21.	
46		1		B/Ce	17	15
47		1		Ce	19	17
48		1		B	20.3 (18.4-25.17.9 (16.2-21.	
49		1				
50		1				
51		1				
52		1				
53		1				
54		1				
55		1				
56		1				
57		1				
58		1				
59		1				
60		1				

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3					
4		1	S3	W3	17.51±0.35 (n=16.23±1.09 (n=1.69±1.96 (n=
5	69°44.807'W	1	S3	W2	19.4±0.3 (N=117.3±0.4 (N=11.2±0.4 (N=14
6		1		B/C	19 17
7		1	S3	W3	18.55±0.37 (n=16.94±1.12 (n=2.12±1.13 (n=
8		1		C	17 15
9		1		B/C	18 16
10		1		B/C	18 16
11		1		Ce	21 18
12		1		B/C	19 17
13		1		B/C	20 17
14		1		B/C	19 17
15		1		B/C	19 17
16		1		B/C	20 16
17		1		B/C	19 17
18		1		B	19.6 (17.5-22. 16.8 (16.2-18.
19		1		B	19.6 (17.5-22. 16.8 (16.2-18.
20		1	S2	W3	18.79±0.23 (n=16.64±0.28 (n=1.34±0.08 (n=
21		1		C	19.3 (18.4-21. 17.0 (15.4-19.
22		1		C	17 15
23		1		C	17 15
24		1		C	19.3 (18.3-23. 16.8 (15.7-17.
25		1		C	20.1 (19.1-21. 17.4 (16.6-17.
26		1		C	21.2 (19.7-23. 18.2 (15.3-25.
27		1		C	21.2 (19.7-23. 18.2 (15.3-25.
28		1		C	19.9 (18.6-20. 17.4 (16.5-18.
29		1		B	19.6 (18.1-21. 17.6 (16.3-20.
30		1		B/Ce	19 16
31		1		C	19.0 (18.2-19. 17.1 (16.1-18.
32		1		C	19.5 (18.0-20. 17.4 (16.2-22.
33		1		C	19.5 (18.0-20. 17.4 (16.2-22.
34		1		B/C	21 20
35		1		B	18.8 (17.8-19. 17.1 (15.9-20.
36		1		B	18.8 (17.8-19. 17.1 (15.9-20.
37		1	S2	W3	18.74±0.29 (n=16.78±1.04 (n=1.17±0.26 (n=
38		1		B/C	17 15
39		1		C	16.1 (15.4-20.
40		1		C	16.1 (15.4-20.
41	69°48.986'W	1	S2	W2	18.8±0.3 (N=117.2±0.4 (N=10.9±0.4 (N=16
42		1		B	19.5 (18.3-20. 17.2 (16.5-17.
43		1		B	19.5 (18.7-20. 17.3 (16.2-20.
44		1		B	20.9 (18.9-23. 17.3 (16.2-18.
45		1		B	20.9 (18.9-23. 17.3 (16.2-18.
46		1		B	19.1 (18.3-20. 16.6 (14.8-18.
47		1		C	19.2 (18.5-20. 16.9 (15.6-19.
48		1		C	19.2 (18.5-20. 16.9 (15.6-19.
49		1		C	18 15
50		1	S2	W3	18.74±0.3 (n=16.73±0.82 (n=1.3±0.26 (n=5
51	156°27.504'E	1	S3	W1	18.8±0.8 16.2±0.7 1.0±0.1
52		1		B	19.7 (18.3-20. 17.6 (16.7-21.
53		1		C	19.5 (18.1-21. 16.9 (15.2-18.
54		1		C	19.5 (18.1-21. 16.9 (15.2-18.
55		1		B	19.1 (17.0-21. 17.0 (14.7-20.
56		1		B	19.1 (17.0-21. 17.0 (14.7-20.
57		1		C	19.6 (18.2-22. 17.5 (16.2-20.
58		1		C	20.5 (19.7-22. 18.0 (16.6-20.
59		1		B	20.3 (18.5-22. 17.8 (16.0-20.
60		1		B	19.6 (18.0-21. 16.8 (16.1-18.

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3						
4		1	B	19.9	(18.3-22.17.7	(16.1-19.
5		1	C	19.7	(18.4-20.17.4	(16.0-18.
6		1	B	19.3	(18.2-22.17.4	(15.8-20.
7		1	B	19.7	(18.4-23.17.0	(15.8-18.
8		1	B/C	20		17
9						
10		1	B	19.4	(18.1-25.17.1	(15.8-20.
11		1	B	19.4	(18.6-20.17.1	(16.1-17.
12		1	B	19.4	(18.3-20.17.4	(16.5-20.
13		1	B	19.4	(18.3-20.17.4	(16.5-20.
14	156°36.642'E	1	S1	W1	19.3±0.1	16.6±0.6 1.4±0.1
15		1	S2	W3	19.28±0.59	(n=16.68±0.29 (n=1.43±0.62 (n=
16		1	B	19.0	(17.9-21.17.0	(15.7-21.
17		1	B	19.6	(18.1-22.16.9	(15.9-17.
18		1	B	19.4	(18.4-20.16.9	(15.1-20.
19		1	B	19.4	(18.4-20.16.9	(15.1-20.
20		1	C	18.7	(17.2-20.16.7	(15.1-20.
21		1	C	20.1	(19.4-21.17.9	(16.2-20.
22		1	B	18.9	(17.3-20.17.0	(16.0-18.
23		1	B	19.1	(18.0-19.17.1	(16.6-17.
24		1	B	19.3	(18.3-19.17.4	(16.6-19.
25		1	B	19.3	(18.3-19.17.4	(16.6-19.
26		1	B	19.6	(18.2-22.17.5	(15.4-21.
27		1	B	19.6	(18.2-22.17.5	(15.4-21.
28		1	B	17.3	(16.3-17.15.4	(14.1-19.
29		1	B	19.7	(19.0-22.17.2	(15.3-18.
30		1	B	19.3	(18.3-20.16.9	(15.7-19.
31		1	B	19.6	(18.2-23.17.7	(15.8-23.
32		1	B	19.6	(18.2-23.17.7	(15.8-23.
33		1	B	20.3	(18.9-23.17.2	(15.4-19.
34		1	C	19.4	(18.8-20.17.2	(16.3-17.
35		1	C	19.3	(18.1-21.17.3	(15.7-21.
36		1	C	19.3	(18.1-21.17.3	(15.7-21.
37		1	B	19.4	(17.8-21.17.3	(16.6-18.
38		1	B	18.9	(17.3-20.16.8	(15.3-19.
39		1	C	19.8	(18.5-21.16.8	(15.5-18.
40		1	B	19.5	(17.7-23.17.2	(15.6-23.
41		1	B	20.3	(18.7-24.17.8	(16.7-19.
42		1	B	20.3	(18.7-24.17.8	(16.7-19.
43		1	B	19.9	(18.6-22.17.1	(16.2-18.
44		1	B	19.3	(18.4-22.16.7	(15.0-19.
45		1	B	19.3	(18.4-22.16.7	(15.0-19.
46		1	B	20.1	(18.9-21.17.8	(16.9-19.
47		1	B	19.5	(18.1-24.17.5	(16.2-20.
48		1	B	19.7	(18.3-24.16.8	(14.6-19.
49		1	B	19.7	(18.3-24.16.8	(14.6-19.
50		1	B	20.0	(19.1-21.17.6	(16.3-18.
51		1	B	18.9	(17.4-20.16.6	(14.6-18.
52		1	B	19.2	(18.1-21.16.6	(15.3-18.
53		1	B	19.2	(18.1-21.16.6	(15.3-18.
54		1	S2	W3	19.09±0.23	(n=17.12±0.38 (n=1.4±0.15 (n=5
55		1	B/C	19.4	(18.3-22.17.3	(14.5-20.
56	156°35.553'E	1	S1	W1	19.1±0.2	16.7±0.1 1.2±0.4
57		1	B	19.5	(18.9-22.17.0	(12.7-20.
58		1	B	18.9	(17.7-20.17.1	(14.9-20.
59		1	B	18.9	(17.7-20.17.1	(14.9-20.
60		1	B	19.2	(18.1-22.17.4	(15.2-21.

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3							
4		1		C	18.5 (17.8-19.16.4 (16.0-16.		
5		1		B	19.5 (17.8-22.17.1 (15.7-18.		
6		1		B	19.5 (18.3-21.17.3 (15.6-20.		
7		1		B	19.3 (18.6-21.17.2 (16.0-19.		
8		1		B	18.9 (17.5-19.16.9 (16.2-18.		
9		1		B	19.1 (17.5-20.17.2 (15.5-22.		
10		1		B	19.1 (17.5-20.17.2 (15.5-22.		
11	156°34.660'E	1	S1	W1	19.0±0.04	17.0±0.2	1.5±0.3
12		1		B	19.2 (18.1-21.17.0 (15.8-19.		
13		1		B	20.2 (19.1-22.17.8 (16.3-21.		
14		1		B	19.2 (17.6-21.17.1 (15.1-21.		
15		1		B	19.0 (18.2-19.16.8 (16.1-17.		
16		1		B	19.0 (17.6-21.16.5 (14.6-18.		
17		1		B	19.0 (17.6-21.16.5 (14.6-18.		
18		1		B	19.0 (17.6-21.16.5 (14.6-18.		
19	156°35.571'E	1	S1	W1	19.2±0.2	16.8±0.2	1.4±0.2
20		1		C	18.6 (17.2-23.16.5 (15.8-17.		
21		1		B	19.9 (18.4-21.17.6 (15.7-21.		
22		1		B	19.4 (18.4-21.17.3 (15.8-19.		
23		1		B	19.4 (18.4-21.17.3 (15.8-19.		
24		1		C	19.0 (17.5-22.16.8 (15.9-19.		
25		1		B	19.4 (17.5-21.16.9 (15.7-20.		
26		1		B	19.9 (19.1-23.17.4 (16.5-17.		
27		1		B	19.9 (19.1-23.17.4 (16.5-17.		
28		1		B	20.6 (19.2-27.17.2 (16.2-17.		
29		1		Ce	19	18	
30		1		C	19.4 (18.1-22.16.9 (15.4-19.		
31		1		C	19.4 (18.1-22.16.9 (15.4-19.		
32		1		Ce	17	15	
33		1		C	16	15	
34		1		B	19.8 (18.6-21.17.0 (15.9-18.		
35		1		B	19.5 (18.4-20.16.7 (16.0-17.		
36		1		B	19.5 (18.4-20.16.7 (16.0-17.		
37	156°36.976'E	1	S1	W1	19.3±0.2	16.9±0.2	1.4±0.2
38	156°35.709'E	1	S1	W1	19.2±0.3	17.0±0.1	1.3±0.2
39		1		C	18	17	
40		1		C	18	17	
41		1		C	19.1 (17.9-22.16.9 (16.4-17.		
42		1		C	17	15	
43	156°34.702'E	1	S1	W1	19.1±0.2	16.9±0.4	1.2±0.2
44		1			17	15	
45		1			17	15	
46		1			17	15	
47		1		C	19.2 (18.5-20.17.1 (16.3-17.		
48		1			17	15	
49		1			17	15	
50		1		B	20.2 (18.9-22.17.5 (16.8-18.		
51		1		C	19.5 (18.7-21.17.0 (16.1-17.		
52		1		C	19.1 (18.1-20.16.6 (15.6-17.		
53		1		C	19.1 (18.1-20.16.6 (15.6-17.		
54		1			17	15	
55		1		B	20.3 (19.0-23.17.8 (16.4-19.		
56		1			17	15	
57	156°37.010'E	1	S1	W1	19.0±0.3	16.7±0.2	1.2±0.2
58		1		B	19.6 (18.5-20.17.2 (15.2-19.		
59		1		B	19.6 (18.5-20.17.2 (15.2-19.		
60		1		C	18.8 (17.0-19.16.6 (15.5-17.		

1							
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4							
5	1		B	19	17		
6	1		B	19.6 (18.3-23.	17.2 (15.7-18.		
7	1			17	15		
8	1		B	20.0 (18.9-21.	17.4 (16.4-19.		
9	1			17	15		
10	1		B	20.3 (18.4-23.	17.5 (14.3-21.		
11	1		C	18.9 (17.8-20.	16.8 (15.8-17.		
12	1		B	19.9 (18.7-21.	17.5 (16.6-21.		
13	1		B/C	18	16		
14	1		C	19	17		
15	1			17	15		
16	1			17	15		
17	1			17	15		
18	1		B	18.9 (17.3-21.	16.7 (15.7-19.		
19	1		C	19.3 (18.4-20.	17.3 (15.4-21.		
20	1		B	21	18		
21	1		B	19.5 (17.9-23.	18.0 (16.3-20.		
22	1		B	19.6 (18.2-23.	17.1 (15.8-20.		
23	1		B	19.2 (17.9-21.	17.1 (16.3-20.		
24	1		C	18.8 (17.5-20.	16.9 (15.0-18.		
25	1		C	19	17		
26	1	S2	W2	18.2-18.3	16.0-16.1	3.5-4.3	
27	1	S1	W1	17.9±1.4 (n=2	15.0±0.7 (n=2	2.1±1.1 (n=24	
28	Many	high	low		25.1±2.5, 49.7	3.6±2.2, 4.8±2	
29	1	Moderate	Low				
30	1	high	moderate		25.3±3.0; 42.3	32.3±0.6; 5.8±3	
31	1	high	moderate	45.7	25.4±3.3, 47.8	2.6±1.0, 8.7±9	
32	~9°11.6'W			2	43.7±10.0 (n=	35.4±1.4 (n=3	4.4±1.1
33	1	high	moderate		33.6; 58.6; 28.	2.3; 4.4; 40.4	
34	1	moderate	low				
35	1		minor		27.1±3.8, 41.6	2.4±1.0, 3.1±1	
36	1	high	moderate		28.1±2.5, 47.5	2.6±1.0, 6.7±3	
37	1	low	low		34.8-39.6	2.5-1.7	
38	1	strong	moderate	77.7	24.1; 35.1; 49.	1.9; 5.4; 16.8	
39	1	high	moderate		38.6±13.9	7.5±9.6	
40	1	low	low	52.0-57.1	16.0-18.3; 54.	1.3-1.5; 1.1	
41	4	Moderate	Low				
42	1	low	low		59.2; 15.8; 32.	3.9; 43.4; 2.2	
43	One	None	Low				
44	1						
45	1						
46	1						
47	1						
48	1						
49	1		A/B				
50	1		A/B				
51	1						
52	1						
53	1						
54	1						
55	1						
56	1						
57	1						
58	1						
59	1						
60	1						

1					
2					
3		1			
4		1			
5		1			
6	102°31'28.99"	1	medium	low	
7		1			
8		1	moderate	low	
9		1			
10	06°54.82'E	1		medium	
11	136°46'51.5"E	2			
12	86.25°E	1			
13		1			
14		1			
15		1			
16		1			
17		1			
18		1			
19		1			
20		1			
21		1			
22		1			
23		2	low	low	
24		3	low	low	
25		1	moderate	low	
26		1			
27	53°39'05.1"W	1			
28	5°14.85'E	1	low	low	
29	91°42'30"	1			
30	0°49'26.02"E	1		minimal	
31		1			
32	6°36.46'W	1		moderate	
33		1			
34	92°06'00"E	4			
35		1			
36	85°54'22"E	1	high	low	
37		1		A/B	
38		1		C	13-42 12-25
39		1	S4	W1	21.7±0.2 (n=1 18.6±0.2 (n=1 1.7±0.7 (n=12
40		1		W3	
41	94°18'6.72"E	1		W3	
42	92°15'36.22"E	1		W3/4	
43		1		W0	
44		1		W3	
45	95°23'25.53"E	2		W3	
46	92°14'45.81"E	1		W1	
47	92°18'37.84"E	1		W3	
48		1		W4	
49		1		W4	
50	85°42'4.33"E	many		W1	
51	89°00'36.02"E	1		W3	
52	94°23'55.97"E	9		W3	
53		1		W4	
54		1		W4	
55	93°13'68.47"E	3		W3	
56		1		W1	
57		1		W4	
58	94°14'30.94"E	1		W4	
59		1		W4	
60		1		W4	

1							
2							
3							
4				W2			
5	3°34'1.72"E	Many	S4	W0	24.3±5.7	17.0±11.6	2.0±1.9
6		1	S2	W2	24.7±5.5	19.8±5.6	1.2±0.7
7		1	S2	W1/2	6.3-43.5	2.1-19.5	0.3-0.4
8		1	S1	W3	14.0±9.6 (0.6-12.3±7.8	(3.3-1.1±1.3	(0.1-3
9		1	S4	W2	22.1±3.1	11.6±5.2	1.0±1.1
10		1	S2	W2	14.9±9.1 (5.2-12.3±8.1	(3.1-0.8±0.5	(0.4-2
11		1		W2	25.4±2.5 (n=5 14.4±4.7	(n=4 0.6±3.32	
12		5	S1	W4	18.4±12.3 (n=7.3±6.4	(n=22 0.7±0.5	
13		many		W2	22.7±8.2 (N=714.8±10.3	(N=0.5±0.2	
14		4	S1	W2	23.4±2.8 (15.5±14.4±6.5	(2.4-1.0±0.7	(0.3-3
15		5	S1	W2	23.2±4.4 (10.5±15.0±6.9	(5.9-0.7±0.7	(0.2-4
16		2	S2	W1	0.6-81.6	1.5-23.3	0.2-3.4
17		1		B	24.5 (13.3-27.21.0	(12.5-23.	
18		3	S2	W2	4.7-26.5	9.2-12.9	0.9-1.1
19		1	S2	W0/1	1.8-64.0	3.3-18.8	0.2-2.0
20		1	S1	W2	14.5±9.4 (0.8-12.6±8.0	(1.4-1.3±0.9	(0.5-4
21	105.30°W	1	S3	W1	22.1±7.5	11.6±8.2	0.9±0.8
22		1	S1	W2	14.8±9.6 (0.8-13.1±7.3	(3.8-0.7±0.4	(0.3-1
23		1	S2	W2	13.7±8.2 (2.4-11.2±8.2	(2.1-0.7±0.3	(0.1-1
24		1		B	24.1 (0.8-30.2 13.7	(5.0-21.4	
25		1	S4	W2	22.7±8.1 (1.5-15.6±6.4	(5.6-0.8±0.6	(0.3-1
26		1	S1	W2	15.6±10.1 (0.5±11.1±7.7	(1.4-0.6±0.3	(0.2-1
27		1	S2	W2	15.3±8.8 (3.5-12.5±7.4	(2.8-0.9±0.6	(0.2-1
28		1	S4	W2	13.0±8.3 (0.5-11.3±7.5	(2.5-0.8±0.4	(0.4-1
29		1	S2	W1	11.9±11.3 (0.5±12.1±7.8	(2.1-0.6±0.3	(0.3-1
30		1	S2	W1	13.4±10.9 (0.4±11.8±7.8	(1.5-0.9±0.8	(0.2-2
31		1	S2	W2	22.9 (N=17)	19.4 (N=15)	2
32		1	S1	W2	16.1±10.7 (0.7±13.1±7.5	(5.3-1.1±1.2	(0.2-4
33	156°29.040'E	1	S2	W1	17.3±9.2	14.9±7.1	1.1±1.1
34		1		B	21.4 (0.9-30.2 16.9	(3.2-36.4	
35		1		B	11.4 (1.3-24.8 11.6	(1.5-29.8	
36		1		B	21.8 (1.6-44.0 9.7	(2.3-41.0)	
37		1		B	26.3 (25.2-28.20.3	(4.8-24.8	
38		1		B	25.2 (23.1-39.17.0	(6.9-25.4	
39		1		B/C	16.5 (0.7-28.9 11.2	(1.1-24.1	
40		1		A	24.1 (15.7-26.18.8	(6.4-24.4	
41		1		B	24.6 (19.6-26.18.2	(6.3-27.3	
42		1		A	24.1 (14.2-27.19.1	(10.3-35.	
43		1		A	28.9 (2.3-84.0 12.5	(2.8-37.4	
44		1		B	25.5 (24.1-30.19.7	(7.7-32.7	
45		1		A	24.4 (12.0-27.15.9	(7.6-19.9	
46		1		A	23.5 (16.0-25.15.4	(2.8-25.8	
47		1		B	24.9 (23.3-26.18.0	(9.2-31.2	
48		1		A	24.0 (10.1-27.17.8	(9.0-23.0	

1						
2						
3		1	B	24.6 (20.1-27.19.6 (8.9-26.5		
4		many	S2	W1	24.3-27.3 (N=20.4 (N=2)	1.1
5		1	S3	W4	23.2±2.0 (n=2 17.0±5.6 (n=1	1.5±1.4
6		1	S3	W4	23.2±2.0 (n=2 17.0±5.6 (n=1	1.5±1.4
7		2	S4	W1	14.9; 25.2	12.5; 20.0 0.5; 1.9
8		1	S2	W2	16.4±12.5	13.0±10.6 1.8±1.9
9		1		B/C	0-48	16-24
10		1		Be	1-30	2-24
11		1		B/C	0-34	5-19
12		1		B/Ce	18-27	6-28
13		1		W1	25.2 (N=1)	21.1 (N=1) 2.42
14		1		W1	25.2 (N=1)	21.1 (N=1) 2.42
15		1		W1	25.2 (N=1)	21.1 (N=1) 2.42
16	12°37'23.9"W	3	S2	W0	26.0±0.7 (n=1 20.7±0.8 (n=7	1.1±0.5 (N=7)
17		1	S4	W1	24.5±0.5 (23.8±24.0±3.1 (14.20.5±0.3 (0.2-1	
18		1	S2	W1	24.9-25.0	20.5-20.6 1.6-4.0
19		1	S4	W3	25.0±2.0 (N=120.5±0.6 (N=11.5±0.2 (N=10	
20		1	S2	W1	24.5-24.9	19.4-20.5 0.5-1.2
21		1	S2	W1	24.9-25.3	20.6-20.8 0.9-0.7
22		1	S2	W2	25.5-25.6	20.9-21.0 1.4-1.5
23		1	S2	W2	25.5-25.6	20.9-21.0 1.4-1.5
24		4	S4	W2	23.9	
25		4	S4	W2	23.9	
26	69°41.730"W	1	S1	W3	24.6±0.7 (N=121.4±0.6 (N=11.5±0.5 (N=15	
27		1	S2	W2	23.5-23.8	19.8-20.5 1.3-1.0
28		1	S2	W1	23.96±1.16 (n=20.26±0.71 (n=1.57±1.55 (n=	
29		1	S2	W1	23.96±1.16 (n=20.26±0.71 (n=1.57±1.55 (n=	
30	157°12.207'E	1	S2	W1	25.3±0.4	21.2±0.3 1.4±0.3
31		1	S1	W2	24.79±0.24 (n=16.4±0.5 (n=6 1.47±1.07 (n=	
32		1	S4	W2	22.2±2.8 (n=7 21.7±3.3 (n=7 0.8±0.1	
33		1		B	25.0 (23.5-27.21.1 (19.9-22.	
34		1		B	25.0 (23.5-27.21.1 (19.9-22.	
35		1	S2	W1	26.0±0.3 (n=7 22.3±0.2 (n=6 1.5±0.1	
36		1	S4	W2	26.3±0.3 (n=6 21.6±0.3 (n=5 0.8±0.1	
37		1	S4	W2	26.3±0.3 (n=6 21.6±0.3 (n=5 0.8±0.1	
38		1		A	25.5 (24.1-29.21.4 (19.5-23.	
39		1	S1	W3	26.1±0.2 (n=8 21.9±0.2 (n=8 1.6	
40		1	S4	W1	24.0	
41		1		Be	23	19
42		1		Be	23	19
43		1	S2	W2	24.5-24.7	19.6-20.9 1.0-1.6
44		1		B	24.3 (20.0-25.19.3 (12.6-21.	
45		1		B	24.3 (20.0-25.19.3 (12.6-21.	
46		1	S2	W2	26.2±1	
47		1		B	24.9 (24.1-27.21.4 (20.2-24.	
48		1		Be	23	19
49		1		Be	23	19
50		1	S2	W1/2	24.8-25.1	18.9-20.6 1.1-0.5
51		1		B/C	25	21
52		1		B	25	21
53		1		B/Ce	23	19
54		1		B/Ce	23	19
55	56°40'35.98"E	1		W1	24.2±1.1 (N=816.2±6.5 (N=1 1.0±0.8	
56		1		A/B	22	19
57		1		A/B	22	19
58	158°09.197'E	1	S3	W1	21.6±1.0 (N=818.4±1.2 (N=8 1.4	
59		1	S4	W1/2	23.5-23.7	20.0-20.2 3.4-1.5
60		1		B	25.8 (24.4-27.21.8 (20.2-23.	

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3			B/Ce	23	11-21
4			B	25.8 (24.7-28.2)	1.8 (20.0-25.0)
5			A	24.7 (23.3-26.2)	2.0 (14.7-25.0)
6			B	25.3 (23.9-27.2)	1.5 (20.2-24.0)
7			B	25.4 (23.9-26.2)	2.1 (20.6-24.0)
8			B	25.0 (23.9-26.2)	1.3 (19.1-24.0)
9			A	25.2 (22.0-26.1)	1.8 (10.0-24.0)
10			A	23.9 (22.5-28.2)	0.1 (11.7-22.0)
11			B	25.4 (23.1-27.2)	1.3 (19.5-22.0)
12			B	25.6 (23.9-27.2)	1.3 (19.5-22.0)
13			B	25.8 (24.7-28.2)	1.6 (20.6-23.0)
14			B	25.6 (24.3-27.2)	1.6 (20.4-23.0)
15			B	25.7 (24.6-27.2)	2.0 (21.0-24.0)
16			B	24.8 (21.2-27.1)	1.8 (8.0-27.4)
17			A	23.9 (17.6-27.1)	1.9 (9.4-33.7)
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23	158°05.322'E	1	S3	W3	22.5±0.9 (N=8) 19.8±1.3 (N=8) 1.9
24		1			22 19
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27		1	S4	W1	24.3±0.2 (n=1) 18.0±3.2 (10.1) 0.7±0.3 (0.3-1)
28		1	S2	W1	24.5-24.7 20.5-21.8 1.6-1.5
29	70°06.826'W	1		W1	
30		1	S2	W1	25.5-25.6 20.9-21.0 1.4-1.5
31		1	S3	W1	24.9
32		1	S3	W2	24.8±1.2 21.5±0.5 1.8±0.2
33		1	S1	W3	25.2±0.5 (N=12) 1.8±0.5 (N=21) 1.1±0.4 (N=20)
34	70°09.031'W	1	S3	W4	24.4±0.3 (N=20) 0.6±0.4 (N=1) 1.1±0.1 (N=1)
35		1	S3	W3	25.4±0.5 (n=5) 21.1±0.5 (n=2) 1.2±0.2 (n=28)
36	64°19'W	1	S3	W3	24.3±0.2 (N=120) 0.3±0.5 (N=11) 1.9±0.6 (N=12)
37	69°52.46'W	1	S3	W3	24.3±0.2 (N=120) 0.3±0.5 (N=11) 1.9±0.6 (N=12)
38		1	S3/4	W3	24.3±0.9 (n=3) 20.4±1.2 (n=1) 1.5±0.2
39		1	S6	W1	24.6 (N=12) 20.7 (N=11) 1.6
40	86°16'34.4"E	26	S1	W5	23.3±0.5 (N=119) 0.6±0.5 (N=11) 1.8±0.4 (N=17)
41	70°10.875'W	2	S2	W1/2	24.7-25.1 20.9-21.0 1.3-1.6
42		1		W0	
43	70°07'18.9"W	1			
44		3	S3	W2	25.5±0.3 20.3±3.3 1.8±1.3
45		1	S5	W3	23.3±0.3 (N=52) 0.4±0.6 (N=5) 0.9±0.1 (N=5)
46	56°50.39'	1	S1	W1	25.24±0.6 (N=22) 0.8±0.53 (N=1) 1.66±0.35 (N=)
47	35°53.353'E	1	S2	W3	24.8±0.7 (N=120) 0.6±0.4 (N=11) 1.4±0.1 (N=12)
48	70°23.03'W	1	S5	W1	24.4-25.2 20.5-20.6 2.1-2.0
49		2	S1	W2	25.9±0.4 (n=1) 21.3±0.2 (n=1) 1.3±0.1 (n=11)
50		20	S4	W1	25.0
51		1	S4/5	W1	24.7±0.5 (N=52) 1.7±1.1 (N=2) 2.4±2.5
52		1	S2	W1/2	25.5-25.9 20.9-21.2 1.8-1.5
53		2	S3	W1	22.1±0.6 (n=1) 19.2±1.1 (n=9) 0.8±0.6
54		2	S2	W2	24.1±0.2 (N=120) 0.4 (N=14) 1.4±0.2 (N=14)
55	69°06.28'W	1	S2	W2	24.1±0.2 (N=120) 0.4 (N=14) 1.4±0.2 (N=14)
56	69°4.87'W	1	S2	W2	25.1±0.4 (N=221) 0.2 (N=21) 1.4±0.3 (N=24)

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3	80°10'31"E	1	S2/3	W0	25.3±0.6 (n=1)	22.2±1.0 (n=1)	1.0	
4	156°34.258'E	1	S2	W1	24.9±0.3	21.0±0.5	1.5±0.2	
5	70°02.304'W	1	S1	W3	25.5±0.4 (N=222.2±0.4)	21.7±0.3 (N=20)		
6	20.29093°E	1	S4	W4	24.0±1 (n=3)	20.3±0.1 (n=3)	0.8±0.7 (n=3)	
7		1	S2	W2	24.53±0.4 (n=20.97±0.72)	1.56±0.34 (n=)		
8		1	S2	W2	23.5±0.4 (N=119.8±0.3)	11.5±0.2 (N=13)		
9	69°5.23'W	1	S1	W2	24.42±0.25 (n=21.76±1.5)	1.28±0.4 (n=8)		
10		1	S4/5	W1	25.5±0.8 (N=122.2±0.7)	1.7±0.2		
11		1	S2	W2	23.79±0.44 (n=20.4±0.12)	20.4±0.12 (n=)		
12	69°6.34'W	1	S2	W2	24.7±0.3 (N=120.4±0.4)	11.7±0.3 (N=12)		
13		1		B	25.4 (24.2-27.2)	21.8 (20.0-24.)		
14		1	S2	W4	25.6			
15		1	S1	W2	26.6±0.2 (n=8)	21.6±0.4 (n=8)	1.4±0.2	
16		1		B/Ce	23	19		
17		1	S3	W2	25.24±0.82 (n=20.6±0.24)	1.43±0.26 (n=)		
18		1	S3	W1	25.09±0.23 (n=21.23±0.31)	1.67±0.33 (n=)		
19		1	S3	W3	24.7±0.5 (n=6)	20.5±0.3 (n=7)	1.6±0.1	
20		1	S2	W1	23.3±0.2 (n=1)	19.4±0.2 (n=1)	1.4±0.1 (n=13)	
21		1		C	25.2 (24.0-26.2)	21.3 (20.1-23.)		
22		1		B/C	25			
23		1	S2	W1	24.94±0.31 (n=22.06±0.69)	1.4±0.31 (n=9)		
24		1		B/C	26	21		
25		1	S2	W2	25.4±0.3 (n=5)	21.2±0.3 (n=6)	1.9±0.2	
26		1	S2	W2	25.5±0.4 (n=1)	21.0±0.2 (n=1)	1.0±0.4 (n=12)	
27		1	S2	W2	24.6-25.5	20.4-20.7	1.5-1.0	
28	~69°43'W	1		W1	25.2 (N=1)	21.3±0.2 (N=4)	1.8±0.2	
29		2	S2	W1	24.0±0.2 (n=1)	20.5±0.2 (n=1)	1.7±0.1 (n=14)	
30		1	S2	W1	25.3±0.4 (n=5)	19.5±0.5 (n=7)	1.8±0.1	
31	69°08.94'W	1	S2	W4	24.2±0.4 (N=119.9±0.3)	11.6±0.2 (N=15)		
32	20.31391°E	1		W2/3	24.7±1.4 (n=1)	22.1±2.6 (n=5)	0.3±0.7 (n=5)	
33		1	S2	W3	24.2±0.2 (N=120.7±0.4)	11.5±0.2 (N=10)		
34		4	S3	W1	24.6±0.3 (N=5)	20.6±0.5 (N=5)	1.6±0.1 (N=5)	
35		1	S2	W2	24.94±1.1 (n=20.86±1.11)	1.31±0.21 (n=)		
36	69°08.98'W	1	S2	W4	24.4±0.2 (N=120.2±0.2)	11.5±0.2 (N=15)		
37	069°59'35.6"V	1		W2	24.7±0.2 (N=2)	21.2 (N=1)	1.4	
38		1	S2	W2	25.2±0.1 (n=1)	21.1±0.2 (n=1)	1.7±0.4 (n=18)	
39		1		B/C	25	21		
40		1		A/B	22	19		
41		1	S3	W4	26.0±0.2 (n=6)	21.7±0.2 (n=5)	1.3	
42		1		Be	22	19		
43		1		B/C	21	19		
44		1		B	24	21		
45		1		A/B	22	19		
46		1	S1	W2	23			
47		1		B/C	25	21		

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10	69°39.91'W	5		24±0.3 (N=12)	20±0.3 (N=13)
11		1	A/B	22	19
12	68°29'58.7"W	1		25.2±0.4 (n=5)	21.2 (n=1) 1.8
13		1	B/C	25	21
14		1		24.9±0.3 (n=1)	21.4±0.6 (n=1)
15		1	S2	W1	1.9±0.3 (n=11)
16		1	A/B	25	22
17		1	A/B	22	19
18		1	A/B	22	19
19		1	B/C	24	21
20	70°2.59'W	1	S4	W1	25.2±0.5 (N=12)
21	69°43.995'W	1	S1	W3	24.3±0.5 (N=12)
22		1		24.3±0.5 (N=12)	20.5±0.5 (N=16)
23		1	B	25	21
24		1	B/C	25	21
25		1	A/B	22	19
26		1		22.8±0.3 (n=6)	0.8±0.1
27	55°32.27'E	1	S2	W3	
28		1	A/B	22	19
29		1	B/C	22	19
30		1	B/C	26	22
31		1	B/C	26	22
32		1	A/B	24	21
33		1	B	22	20
34		1	A/B	25	20
35		1	A/B	22	19
36		1	A/B	22	19
37		1	B/C	23	19
38		1	S2	W1	24.7-24.8 21.4-21.5 1.3-1.2
39		1	B/C	25	21
40		1		24.6±0.18 (n=20)	0.76±0.27 (n=1)
41		1	S2	W3	1.78±0.11 (n=)
42		1	C	23	20
43		1	C	23	19
44		1	B/C	25	
45		1	B/C	25	
46		1	A/B	25	21
47		1	B	24	21
48		1		25.87±0.5 (n=21)	1.74±0.57 (n=1)
49		1	S2	W2	1.72±0.48 (n=)
50		1	B	23	18
51		1	B/C	22	19
52		1	Ce	23	19
53		1	B	25	21
54		1	B	25	21
55		1	A/B	23	19
56		1	B/C	25	22
57		1	B/C	22	
58		1	B/C	22	
59		1	A/Be	25	21
60		1	Be	23	20

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38	69°55.64'W		S3	W4	24.9±0.3 (N=120.6±0.3 (N=11.3±0.2 (N=10
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4	1		B	25.7 (23.9-28.21.8 (20.8-24.
5	1		B	25.4 (24.2-28.21.0 (19.7-23.
6	1		B	25.6 (24.5-27.21.9 (20.5-24.
7	1		B	25.8 (25.0-28.21.7 (21.0-23.
8	1		A	25.2 (18.4-27.21.1 (19.0-23.
9	1			
10	1		B	25.2 (23.4-26.21.8 (20.6-24.
11	1		B	26.0 (24.0-29.21.5 (19.6-22.
12	1		C	25.1 (23.1-27.22.1 (20.9-24.
13	1		A	26.0 (25.0-31.21.4 (20.5-23.
14	1		B	25.4 (24.2-28.21.6 (20.2-25.
15	1		B	25.4 (24.2-26.21.4 (20.1-22.
16	1		B	25.4 (24.2-26.21.4 (20.1-22.
17	1		B	24.7 (23.9-25.20.5 (19.6-21.
18	1		B	25.6 (24.0-28.21.6 (20.1-24.
19	1		B	25.4 (23.7-29.21.5 (20.1-23.
20	1		B	25.3 (24.0-27.22.3 (20.9-23.
21	1		B	25.8 (24.5-28.21.3 (20.1-23.
22	1		B	26.3 (25.2-28.22.2 (20.7-24.
23	1		B	25.7 (23.7-28.22.0 (20.2-24.
24	1		B	25.8 (24.0-29.21.8 (20.2-23.
25	1		B	25.5 (24.8-27.21.6 (20.0-23.
26	1		B	25.4 (24.6-27.22.0 (20.0-25.
27	1		B	25.8 (24.5-28.21.6 (20.2-25.
28	1		B	22.0±0.7 (N=818.6±0.8 (N=82.1
29	1		B	25.4 (23.0-27.21.9 (20.5-24.
30	1		B	25.5 (24.2-27.21.8 (20.6-23.
31	1		B	25
32	158°05.308'E	S5	W2	25.6 (24.5-27.21.6 (20.1-23.
33	1		B	25.3 (23.7-29.21.2 (20.4-22.
34	1		B	22 19
35	1		B	25.8 (24.4-29.21.4 (20.5-23.
36	1		B	26.0 (25.2-27.22.3 (21.1-24.
37	1		B	25.1 (23.8-29.21.6 (20.2-25.
38	1		B	23.8 (22.5-26.20.4 (18.9-22.
39	1		B	22 19
40	1		B	25.3 (22.2-26.21.7 (19.9-24.
41	1		B	25.2 (23.5-28.21.3 (20.3-24.
42	1		B	23 19
43	1		A/B	24 19
44	1		B	25.7 (24.2-28.22.0 (19.0-25.
45	1		B	25.2 (23.9-26.21.8 (20.9-23.
46	1		B	25.2 (23.9-26.21.8 (20.2-24.
47	1		B	26.1 (23.6-29.21.7 (20.2-25.
48	1		C	25.9 (24.3-29.22.3 (20.8-26.
49	1		B	25.9 (24.2-29.22.1 (19.0-24.
50	1		B/C	23 19
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3		1		A	25.2 (24.2-27.2)	21.6 (20.2-24.		
4		1			23	20		
5		1		B	25.4 (24.4-26.2)	21.0 (19.1-23.		
6		1		B	25.1 (22.6-27.2)	21.2 (20.4-21.		
7		1		B	25.2 (24.3-28.2)	21.3 (19.1-23.		
8		1		A	26.2 (24.3-28.2)	22.3 (20.1-23.		
9		1		B	25.5 (23.9-29.2)	21.8 (20.5-24.		
10		1		B	25.9 (24.8-28.2)	22.3 (21.2-25.		
11		1		A	25.0 (22.3-27.2)	21.6 (19.8-24.		
12		1		B	26.3 (24.6-29.2)	22.5 (20.8-26.		
13		1		B	25.1 (23.9-27.2)	21.2 (20.2-21.		
14		1		A	26.1 (24.8-28.2)	22.7 (21.1-25.		
15		1		B	25.5 (24.4-28.2)	21.7 (20.8-25.		
16	158°09.196'E	1	S4	W1	22.0±0.7 (N=8)	18.6±0.8 (N=8)	2	
17		1		B	25.1 (23.9-27.2)	21.2 (20.2-21.		
18		1		A	26.1 (24.8-28.2)	22.7 (21.1-25.		
19		1		B	25.5 (24.4-28.2)	21.7 (20.8-25.		
20		1			23	19		
21		1		B	25.6 (24.1-27.2)	22.2 (20.8-24.		
22		1		B/C	25	20		
23		1						
24		1						
25								
26	8°0'00.00"E	5	S4	W0	26.0±0.5 (n=2)	21.9±0.4 (n=2)	1.4±0.3 (n=2)	
27	50°55.33'E	1	S4	W4	24.1±0.7 (n=2)	20.2±0.4 (n=2)	2.1±0.9 (n=2)	
28		1	S2, melt	W3	24.1±0.4 (n=2)	20.3±0.2 (n=1)	1.4±0.2 (n=1)	16
29	69°58.341'W	5	S3	W3	24.7±0.4 (N=2)	20.1±0.4 (N=1)	11.0±0.3 (N=1)	18
30	70°21.911'W	1	S1	W2	24.2±0.5 (N=1)	20.8±0.5 (N=1)	11.2±0.4 (N=1)	19
31	51°07.54'E	1	S4	W3-4	25.0±0.4 (n=2)	21.5±0.9 (n=1)	1.3±0.1 (n=1)	
32	100°10'29"E	hundreds	S5	W0	25.0±0.6 (N=1)	21.1±0.3 (N=6)	1.8±0.3	
33	68°33.0557'W	many	S1	W1	25.4±0.6 (N=2)	20.7±0.7 (N=2)	21.5±0.3 (N=2)	21
34	69°29'19.8"W	many		W1				
35	68°37.632' W	1	S3/4	W1/2	25.7±0.4 (N=4)	21.5±0.3 (N=3)	31.4±0.3 (N=3)	32
36		1	S2	W2	25.0±0.4 (n=1)	21.1±0.2 (n=1)	1.6±0.2 (n=1)	11
37	68°51.25'W	964	S2	W2	25.4±0.5 (N=2)	21.2±0.5 (N=1)	11.6±0.3 (N=1)	18
38	38°10.268'E	>91	S4/5	W0	25.6±0.3 (N=5)	21.4±0.2 (N=4)	11.6±0.26 (N=4)	
39	70°11.315'W	1	S3	W2	24.3±0.2 (n=1)	20.7±0.3 (n=1)	1.5±0.2 (n=1)	11
40	70°03'15.2"W	1		W0				
41	156°36.560'E	1	S1	W1	25.3±0.2	21.5±0.1	1.5±0.2	
42		1	S2	W2/3	25.2-25.3	21.6-21.8	1.7-1.1	
43	76°22'41.67"V	1	S3	W0	25.1±0.3	21.4±1.2	1.5±0.2	
44	69°46'W	9		W2				
45		25	S3	W2	23.7			
46		1		A	25.5 (24.3-27.2)	21.7 (19.7-24.		
47		1		A	24	21		
48		1	S2	W2	26.1-26.2	20.9-21.2	1.3-1.5	
49		1	S3	W3	25.16±0.41 (n=2)	21.1±0.13 (n=1)	1.63±0.19 (n=1)	
50	70°08'55"W	1	S2	W2	25.1±0.2 (n=1)	20.9±0.1 (n=1)	1.6±0.2 (n=1)	16
51		1		B	25.6 (24.0-27.2)	22.0 (20.8-25.		
52	156°34.859'E	1	S1	W1	25.5±0.1	21.3±0.1	1.8±0.3	

1					
2					
3	70°19'32"W	1	S2	W2	24.6±0.2 (n=1) 21.1±0.6 (n=1) 1.6±0.2 (n=14)
4		1		A	25.0 (24.7-25.2) 1.4 (20.5-23.
5		1			
6	70°21.871'W	1	S3	W2	24.1±0.6 (n=1) 20.6±0.4 (n=1) 1.7±0.1 (n=13)
7		1	S2	W3	25.4
8		1	S4	W2	25.3
9		1			
10		1	S2	W3	24.7±0.3 (n=1) 20.6±0.1 (n=1) 1.8±0.1 (n=10)
11	156°35.092'E	1	S1	W1	25.3±0.2 21.1±0.1 1.7±0.2
12		1	S3	W5	24.4 21.1
13		1			
14		1		B	24.9 (23.7-27.2) 0.7 (19.4-22.
15		1	S1	W1	24.9 19.4 1.3
16	69°49.774'W	5	S1	W2	23.9±0.5 (N=120.8±0.5) (N=11.8±0.4) (N=16)
17		1	S1	W4	26.4±0.2 (n=8) 22.4±0.3 (n=1) 1.4±0.2
18					
19	69°47.012'W	2	S1	W3	24.6±0.4 (N=121.6±0.4) (N=11.6±0.3) (N=19)
20	21.20° E	several	S1	W0	25.5±0.2 (N=321.8±0.1) (N=3) 1.8±0.3
21	69°48.772'W	3	S2	W2	25.4±0.4 (N=122.3±0.4) (N=12.2±0.3) (N=19)
22		1			
23		1		B	24.8 (19.9-28.2) 0.9 (19.1-23.
24	68°51.27'W	5	S3	W1	25.8±0.5 (N=221.5±0.5) (N=21.5±0.3) (N=21)
25		1	S3	W2	25.8±0.3 (n=7) 21.7±0.3 (n=1) 1.6±0.2
26		1	S2	W2	27
27		1			
28	9°9.023'E	1	S4	W1	24.4±0.4 (24.0) 20.6±0.4 (20.2) 1.5±0.3 (0.9-2
29		1		B	25.9 (24.4-28.2) 1.3 (19.9-23.
30	~69°46'W	1		W3	25.7 (N=1) 21.1 (N=1) 1.8
31					
32	69°42.679'W	1	S4	W2	23.5±0.5 (N=121.0±0.5) (N=11.1±0.4) (N=19)
33	158°28.320'E	1	S4	W1	24.9±0.3 21.2±0.4 1.5±0.2
34		1	S3	W2	23.52±0.98 (n=20) 20.75±1.82 (n=1) 1.5±0.3 (n=7)
35		1		A/B	23 19
36		1			
37		1		B	25.4 (24.4-26.2) 1.9 (20.2-28.
38		1	S3	W2	24.6±0.1 (n=1) 20.9±0.2 (n=1) 1.6±0.2 (n=13)
39		1	S3	W3	25.1±0.63 (n=21) 21.57±0.92 (n=1) 1.84±0.11 (n=
40		1			
41		1		B	25.7 (24.1-29.2) 2.1 (20.7-24.
42		1	S3	W2	24.2±0.2 (n=1) 20.6±0.2 (n=1) 1.6±0.1 (n=13)
43		1		A/B	24 21
44		1			
45		1	S2	W2	25.16±0.01 (n=21) 21.31±0.35 (n=1) 1.58±0.25 (n=
46		1	S2	W2	25.0±1
47		1	S2	W2	23.7±0.4 (n=1) 20.0±0.5 (n=1) 1.4±0.2 (n=13)
48		1		B	23 19
49		1			
50	~69°46'W	1		W2	25.1±0.3 (N=321.6±0.2) (N=2) 1.2±0.0
51	69°58.006'W	2	S2	W2	24.4±0.4 (N=120.8±0.4) (N=11.4±0.3) (N=16)
52	68°38.36'W	2	S3	W2	24.8±0.5 (N=220.8±0.7) (N=21.4±0.3) (N=21)
53		1		A/B	25 21
54		1			
55		1	S2	W2	23.8±0.4 (n=1) 20.5±0.8 (n=1) 1.6±0.4 (n=14)
56	~69°43'W	7		W2	25.0 (N=1) 21.1 (N=1) 1.4
57		1		B	25.2 (24.2-26.2) 1.7 (20.1-24.
58		1			
59	69°08.81'W	1	S2	W2	23.9±0.2 (N=119.7±0.2) (N=11.6±0.2) (N=15)
60		1	S4	W1	24.2

1								
2								
3				A	26	21		
4				A	25.5	(23.4-29.2)	1.4	(18.9-24.
5								
6			S4	W2	25.6±0.3	(n=1 22.5±0.3	(n=6 1.1±0.1	
7				B	25.5	(23.6-27.2)	1.7	(19.8-23.
8								
9	~69°46'W	1		W2				
10				B	25.0	(23.8-25.2)	1.1	(20.3-21.
11			S2	W1	23.7±0.1	(n=1 19.8±0.2	(n=1 1.7±0.2	(n=11
12	156°40.126'E	1	S2	W1	25.2±0.3	21.2±0.2	1.5±0.1	
13				B	25.4	(23.6-26.2)	2.2	(20.3-24.
14								
15			S2	W2	25.0-25.5	21.0-21.2	2.1-1.9	
16				B	25.3	(23.3-28.2)	2.0	(20.2-24.
17								
18	69°42.886'W	2	S1	W3	24.6±0.5	(N=121.8±0.5	(N=11.7±0.4	(N=17
19				B/C	25	21		
20				B	25.1	(24.0-28.2)	1.5	(20.2-23.
21	69°52.279'W	3	S1	W3	24.3±0.4	(N=121.9±0.4	(N=11.5±0.3	(N=19
22								
23				B	24.9	(23.2-28.2)	1.2	(20.2-25.
24	69°58.551'W	1	S2	W2	23.3±0.5	(N=120.4±0.5	(N=11.3±0.4	(N=14
25	~69°43'W	1		W1				
26	69°54.506'W	3	S2	W2	23.1±0.5	(N=120.8±0.5	(N=11.5±0.4	(N=16
27								
28				B/C	23	21		
29			S2	W1/2	24.8-24.9	20.6-20.9	1.5-1.4	
30								
31				B/C	24	21		
32				B	23	19		
33	156°34.262'E	1	S2	W1	25.2±0.3	21.1±0.3	1.6±0.2	
34				A	25.6	(24.4-27.2)	2.1	(20.5-26.
35	~69°46'W	1		W2	25.1	(N=1)	20.9	(N=1) 1.4
36				A/B	22	19		
37								
38	156°31.487'E	1	S4	W1	25.2±0.4	21.1±0.3	1.5±0.3	
39								
40				B/C	22	19		
41	~69°43'W	1		W3	25.7	(N=1)	20.5	(N=1) 3.4
42	69°7.75'W	5	S2	W2	23.7±0.2	(N=119.9±0.2	(N=11.6±0.1	(N=12
43				B	26.0	(24.9-27.2)	2.3	(20.8-24.
44								
45				A/B	24	21		
46			S2	W1	24.8-24.9	20.8-21.8	1.0-0.9	
47	~69°46'W	1		W2	25.4±0.0	(N=221.8±0.3	(N=2 1.3±0.2	
48								
49				B	23	20		
50	156°30.985'E	1	S4	W1	25.0±0.2	21.0±0.1	1.7±0.3	
51				A/B	22	20		
52				A/Be	24	20		
53								
54				A/B	25			
55				A	24.8	(23.9-26.2)	2.1	(20.3-22.
56			S2	W1	24.8±1			
57	~69°43'W	1		W1				
58								
59				B	26.0	(24.6-28.2)	2.4	(20.4-25.
60				A/B	25	21		

1						
2						
3	156°28.475'E	1	S4	W1	25.0±0.4	21.1±0.2 1.6±0.2
4				B	24	21
5		1		A/B	22	19
6		1		A/B	24	21
7		1		B	25	
8		1				
9		1				
10	68°50.31'W	1	S2	W2	25.1±0.6 (N=121.2±0.5 (N=11.4±0.3 (N=17	
11		1	S3	W2	24.57±0.41 (n=21.08±0.8 (n= 1.31±0.21 (n=	
12		1		B/C	25	21
13		1		B	26.0 (24.4-33.21.5 (20.5-23.	
14		1				
15	~69°43'W	1		W3		
16		1		B/C	24	22
17		1		A/B	23	19
18		1		A/B	25	21
19		1		A/B	25	21
20		1	S2	W1	25.7±0.8 (N=121.4±0.3 (N=11.4±0.3 (N=12	
21		1		B/C	24	21
22		1		B	26.0 (23.8-29.21.5 (20.2-23.	
23		1		A/Be	22	
24		1		A/B	25	21
25		1				
26		1	S1	W1	22.5	19.5 1.5
27		1		B	23	19
28		1		A/B	25	
29		1				
30	69°47.217'W	1	S1	W3	24.3±0.5 (N=121.5±0.5 (N=11.5±0.4 (N=18	
31		1		B/C	24	21
32		1		B/C	22	19
33		1		B	23	19
34		1		B/C	24	21
35		1		C	23	19
36		1		A/B	25	21
37		1				
38		1				
39	109°53.3'W	1	S4	W2	25.1±0.2 (N=422.4±0.2 (N=53.0±0.1	
40		1		A/Be	24	20
41		1		B	25.6 (24.4-27.21.8 (19.6-24.	
42		1		A	25.4 (24.7-25.21.3 (20.5-22.	
43		1				
44	69°49.008'W	1	S3	W3	25.5±0.4 (N=122.3±0.4 (N=11.5±0.3 (N=13	
45		1		B	25.1 (24.0-28.21.2 (19.9-23.	
46		1		B/C	23	19
47		1		B/C	25	21
48		1		B	25.3 (24.1-27.21.7 (20.5-25.	
49		1				
50		1				
51	70°11.445'W	1		W1	24.9 (N=1)	21.4 (N=1) 1.1
52		1	S2	W2	25.32±0.35 (n=21.34±0.36 (n=1.93±0.18 (n=	
53		1		A/B	22	19
54		1		Be	24	
55		1		B	26.1 (24.5-29.21.7 (20.8-22.	
56		1		B/C	23	19
57		1		A/B	22	19
58		1				
59		1				
60	156°39.795'E	1	S4	W1	25.0±0.9	20.7±0.6 1.2±0.1

1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11	~69°43'W					
12						
13						
14		S2				
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25	69°43.808'W	S3				
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37		S4				
38						
39						
40						
41	156°34.471'E	S4				
42						
43						
44						
45						
46						
47		S5				
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59		S2				
60						

1						
2						
3			B	24	21	
4			B	25	20	
5			C	23	19	
6			B/C	22	19	
7			B	22	19	
8			C	23	19	
9			B	22	19	
10			C	23	19	
11			B	22	19	
12			A/B	25	22	
13						
14	156°36.976'E	1	S4	W1	24.8±0.4	21.1±0.2 1.4±0.2
15		1		B	24	21
16		1		B/C	25	21
17		1		B/C	22	19
18						
19	70°04.500'W	1	S5	W2	23.9±0.5 (N=120.9±0.5 (N=11.3±0.4 (N=14	
20		1		A/B	25	21
21		1		A/B	25	21
22		1		B/C	23	19
23		1		C	23	19
24		1		W1	25.0-25.8	20.6-21.1 2.0-2.5
25		1	S2	A/B	25	22
26		1		B	24	22
27		1		B/C	22	19
28		1		B/C	23	19
29		1		B	25	21
30		1		W2	24.5-25.0	21.6-21.7 1.6-1.9
31		1	S2	B/Ce	23	19
32		1		C	23	19
33		1		B/C	25	21
34		1		B	25	21
35		1		B/C	25	21
36		1		W2	26	
37		1	S4	W2	25.1±0.27 (n= 21.4±0.29 (n= 1.62±0.35 (n=	
38		1	S3	B	24.5 (22.9-26.20.9 (20.2-21.	
39		1		A/B	25	22
40		1		W1	25.1±0.4	21.4±0.2 1.6±0.2
41	156°30.635'E	1	S4	B	22	20
42		1		B	25	21
43		1		B	25	
44		1		A/B	25	20
45		1		C	22	19
46		1		C	23	19
47		1		Be	22	19
48		1		B/C	23	20
49		1				
50		1		W3		
51	~69°43'W	1		A/B	24	21
52		1		A/B	25	22
53		1				
54		1				
55		1				
56		1				
57		1				
58		1				
59		1				
60		1				

1							
2							
3							
4				B	25.4 (24.3-27.2)	21.3 (20.7-22.1)	
5				B	23	19	
6				B/C	25		
7	156°25.913'E	1	S4	W1	25.2±0.3	21.6±0.3	1.3±0.3
8				A/B	22	19	
9				A/B	23	19	
10				B	25	22	
11				B	23	19	
12				B	23		
13				B	23		
14				B	23		
15	69°43.993'W	1	S3	W2	24.9±0.5 (N=121.7±0.5)	21.4±0.4 (N=11.4±0.4)	(N=11)
16				A/B	25	21	
17				B	24	21	
18				B/Ce	23	19	
19				A/B		20	
20				B/C	24		
21				B/C	25		
22				B/C	25	21	
23				C	25.2 (23.8-26.2)	21.2 (20.3-21.1)	
24				B/C	22	19	
25				A/B	25	21	
26	69°56.768'W	1	S2	W2	24.5±0.4 (N=120.7±0.4)	21.4±0.3 (N=11.4±0.3)	(N=15)
27				B	25.7 (24.7-28.2)	21.7 (20.4-25.1)	
28				B	24	21	
29				B	24	21	
30				B	24	21	
31	156°28.048'E	1	S3	W1	25.8±0.5	21.4±0.1	1.5±0.1
32	69°1.85'W	1	S3	W2	25.2±0.9 (N=120.9±0.9)	21.6±0.3 (N=11.6±0.3)	(N=12)
33	116°33.05'W	1	S4	W2	24.7±0.2 (N=222.3±0.2)	22.7±0.2	
34				B	25	21	
35				B/C	24	21	
36				B	25		
37				B	25		
38				B	25		
39				B	25		
40	~69°46'W	1		W2	25.7 (N=1)	20.9 (N=1)	1.2
41				B	22	19	
42				B/C	24	20	
43				B	25		
44				B/C	22	18	
45				B/C	24	21	
46				B/C	25	21	
47				B	23	19	
48				B	23	19	
49				B	23	19	
50				B	23	19	
51				B	23	19	
52				B	23	19	
53				B	23	19	
54				B	23	19	
55				B	23	19	
56				B	23	19	
57	156°31.227'E	1	S4	W1	25.0±0.3	21.5±0.2	1.4±0.2
58				B/C	25	21	
59				C	23	19	
60				C	23	19	

1								
2								
3								
4				C	25.6 (24.5-27.22.0 (21.1-23.			
5			1	B	25	21		
6			1	A/B	22	19		
7			1	Ce	23	19		
8			1	A/B	23	19		
9								
10			1	C	22	19		
11			1	B/C	24	21		
12			1	B/C	25	21		
13			1	B/C	25	21		
14			1	B/C	25	21		
15	69°55.044'W	1	S1	W2	23.3±0.5 (N=119.8±0.5 (N=11.6±0.4 (N=16			
16		1		B	23	19		
17		1		B	22	19		
18		1		B	25	21		
19		1		Be	25	21		
20		1		C	23	19		
21		1		C	23	19		
22		1		C	23	19		
23	69°49.813'W	1	S2	W2	23.8±0.5 (N=119.0±0.5 (N=11.7±0.4 (N=15			
24		1		B	25.3 (24.3-27.21.4 (20.2-22.			
25		1		B/C	22	19		
26		1		B/C	23	19		
27		1		C	22	19		
28		1		C	22	19		
29		1		B	23	19		
30		1		B	23	19		
31		1		B	23	19		
32	68°39'12" W	1	S2	W2	25.59±0.50 (N21.72±0.28 (N1.61±0.21 (N=			
33		1		B/C	25	21		
34		1		A/B	24	21		
35		1		B/C	22	19		
36		1		Ce	25	21		
37		1		C	25	21		
38		1		A/B	22	19		
39		1		B/C	22	20		
40		1		B/C	22	20		
41		1		B/C	22	20		
42	156°30.790'E	1	S4	W1	25.2±0.8	20.6±0.9	2.8±2.4	
43		1		Be	25	21		
44		1		B	24	21		
45		1		Ce	22	19		
46		1		C	23	19		
47		1		C	23	19		
48	~69°46'W	1		W2	25.7 (N=1)	20.8 (N=1)	1.9	
49		1		B	25.3 (24.4-26.21.4 (20.3-22.			
50		1		B	25.0 (24.2-26.21.3 (20.6-22.			
51		1		B	25.0 (24.2-26.21.3 (20.6-22.			
52		1		B/C	22	19		
53		1		A/B	23	19		
54		1		Ce	25	21		
55		1		B	25.3 (23.7-27.21.7 (20.4-24.			
56		1		B	25.3 (23.7-27.21.7 (20.4-24.			
57	156°27.828'E	1	S4	W1	24.7±0.2	20.5±0.1	1.5±0.2	
58		1		B/C	25	21		
59		1		B/C	25	21		
60		1		B	25.2 (22.4-27.21.7 (20.5-23.			

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3				B	25.5 (24.5-28.21.9 (20.7-25.		
4				W1	24.8±0.4	21.6±0.7	1.4±0.2
5	156°26.695'E	1	S4	A	24.5 (23.0-25.20.6 (19.1-21.		
6		1		B/C	22	20	
7		1		B	23	19	
8		1		B	25.2 (23.8-26.21.5 (20.4-23.		
9		1		B/C	21	19	
10		1		B/C	22	19	
11		1		B/C	25	22	
12		1		B	24	21	
13		1		W1	25.1±0.8	21.1±0.3	1.5±0.3
14	156°27.893'E	1	S4	B/C	25	21	
15		1		B	23	19	
16		1		A	25.4 (24.6-26.21.5 (20.6-22.		
17		1		W1	25.6±0.6	21.2±0.2	1.6±0.1
18	156°26.552'E	1	S4	W3	23.4±0.4 (N=120.9±0.4 (N=11.9±0.3 (N=15		
19	69°51.844'W	1	S5	B	23	19	
20		1		B	25.5 (23.9-29.22.3 (20.2-24.		
21		1		W1	25.4±0.7	21.1±0.3	1.6±0.1
22	156°26.757'E	1	S4	A	23.0 (21.7-25.20.2 (18.4-23.		
23		1		A	25.2 (24.3-27.21.8 (20.1-24.		
24		1		B	24.9 (23.9-26.21.7 (19.6-25.		
25		1		W2	26.2 (24.7-30.23.1 (19.5-29.		
26	70° 21.673'W	1		B	24.7 (23.4-27.20.9 (20.3-22.		
27		1		B	25.6 (23.8-27.21.7 (20.7-23.		
28		1		B	26.1 (23.9-27.22.0 (19.9-26.		
29		1		B	25.6 (24.5-27.21.7 (20.5-23.		
30		1		B	25.4 (24.0-26.21.2 (19.9-22.		
31		1		A	25.1 (23.6-26.21.0 (19.6-22.		
32		1		B	25.3 (22.0-27.21.8 (20.3-24.		
33		1		B	25.3 (22.2-27.21.8 (21.0-24.		
34		1		B	25.1 (21.6-27.21.5 (20.1-22.		
35		1		A	26.6 (25.5-28.22.8 (21.1-24.		
36		1		A	25.9 (24.4-27.21.9 (20.2-23.		
37		1		B	25.7 (24.3-27.22.2 (20.7-24.		
38		1		B	25.2 (23.8-28.21.1 (20.3-22.		
39		1		A	25.2 (24.3-26.21.5 (20.4-24.		
40		1		B	25.4 (24.1-27.21.8 (20.9-23.		
41		1		B	26.6 (25.8-27.21.8 (20.4-23.		
42		1		B	25.7 (24.5-29.21.7 (20.7-25.		
43		1		A	25.4 (24.1-26.21.9 (20.8-23.		
44		1		B	25.8 (24.3-27.21.8 (19.8-25.		
45		1		B	25.1 (24.2-27.21.2 (19.7-23.		
46		1		A	25.6 (22.9-29.21.6 (20.1-23.		
47		1					
48		1					
49		1					
50		1					
51		1					
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55		1					
56		1					
57		1					
58		1					
59		1					
60		1					

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3				B	25.2 (24.2-27.2)	21.5 (21.1-22.1)	
4				W1	24.8±0.1	20.8±0.3	1.4±0.1
5	156°26.801'E	1	S4				
6		1		B	25.4 (24.3-27.2)	21.5 (20.6-22.1)	
7		1		B	25.6 (24.1-29.2)	21.4 (20.4-23.1)	
8		1		C	25	21	
9							
10		1		B	25.5 (24.4-28.2)	21.5 (20.0-24.1)	
11		1		B	25.3 (22.3-28.2)	21.6 (20.9-25.1)	
12		1		B	25.4 (23.5-27.2)	21.8 (20.5-23.1)	
13		1		B	25.3 (24.1-26.2)	21.2 (19.6-23.1)	
14							
15	156°31.060'E	1	S4	W1	25.0±0.2	21.0±0.3	1.6±0.3
16		1		B	25.2 (23.4-27.2)	21.6 (19.9-25.1)	
17		1		B	25.6 (23.6-28.2)	20.9 (19.6-22.1)	
18		1		B	26.4 (24.1-31.2)	22.1 (20.4-24.1)	
19		1		B	25.5 (24.3-27.2)	21.6 (19.5-25.1)	
20							
21	156°29.957'E	1	S4	W1	24.6±0.1	20.8±0.7	1.4±0.1
22		1		B	25.8 (24.4-27.2)	21.5 (19.7-25.1)	
23		1		A/B	25.3 (23.5-28.2)	21.6 (20.0-24.1)	
24		1		B	25.4 (24.2-27.2)	21.3 (19.4-22.1)	
25		1		B	25.4 (24.2-30.2)	21.4 (20.6-23.1)	
26		1		B	25.4 (23.9-27.2)	22.0 (20.6-23.1)	
27		1		B	25.5 (24.7-29.2)	21.7 (20.1-24.1)	
28		1		B	25.5 (23.8-28.2)	21.4 (19.9-24.1)	
29							
30		1		W1	24.9±0.6	20.8±0.1	1.4±0.3
31	156°27.564'E	1	S4	A/B	25.5 (24.2-28.2)	22.0 (19.6-26.1)	
32		1		B	25.7 (24.2-28.2)	21.7 (20.5-25.1)	
33		1		B	25.4 (23.4-28.2)	21.9 (20.6-25.1)	
34		1		B	26.3 (24.3-30.2)	21.9 (20.0-27.1)	
35		1		B	25.6 (23.9-30.2)	21.9 (19.5-26.1)	
36		1		A	25.3 (24.0-29.2)	21.2 (20.0-22.1)	
37		1		A	25.3 (23.8-26.2)	22.0 (20.5-24.1)	
38							
39	69°58.022'W	1	S1	W2	23.5±0.5 (N=121.4±0.5)	21.5±0.4 (N=11)	14
40		1		A	24.6 (22.8-25.2)	21.0 (20.1-23.1)	
41		1		B	25.7 (24.0-28.2)	21.6 (20.7-23.1)	
42		1		A	25.8 (24.4-28.2)	21.7 (20.1-25.1)	
43	156°25.744'E	1	S4	W1	24.9±0.7	20.8±0.3	1.3±0.3
44	156°30.605'E	1	S4	W1	25.0±0.4	21.3±0.3	2.5±2.3
45		1		B	25.7 (24.9-27.2)	21.9 (21.0-23.1)	
46		1		B	25.8 (24.5-30.2)	22.1 (20.4-26.1)	
47		1		B	25.5 (23.8-28.2)	21.1 (19.9-24.1)	
48		1		B	25.1 (22.1-30.2)	21.8 (20.8-24.1)	
49		1		B	25.9 (25.1-27.2)	21.9 (21.3-22.1)	
50		1		B	25.9 (24.4-27.2)	21.9 (20.2-24.1)	
51		1		B	25.8 (24.5-29.2)	22.2 (21.0-25.1)	
52		1		B	25.9 (24.7-28.2)	21.6 (20.0-24.1)	
53		1		B	25.5 (24.5-27.2)	21.1 (20.0-22.1)	
54							
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3		1		B	25.9 (23.9-29.22.0 (20.4-24.		
4		1		A	25.7 (24.8-27.22.2 (21.5-23.		
5		1					
6	156°27.039'E	1	S3	W1	24.6±0.2	20.4±0.4	1.6±0.2
7		1		B	25.1 (23.5-28.21.2 (20.2-22.		
8		1		B	25.8 (23.8-29.21.7 (20.9-23.		
9		1					
10		1		B	25.3 (24.0-26.21.3 (19.9-24.		
11		1		B	25.7 (24.7-27.21.5 (21.0-22.		
12	156°26.951'E	1	S4	W1	25.3±1.2	21.0±0.2	1.4±0.1
13		1		B	25.3 (23.0-32.22.4 (20.9-26.		
14		1		B	25.7 (24.6-27.21.9 (21.0-22.		
15		1		B	25.9 (24.8-29.22.3 (21.1-24.		
16		1		B	25.5 (23.3-27.22.1 (20.4-24.		
17		1		A	25.4 (23.8-27.21.5 (20.3-24.		
18		1		A	25.4 (23.0-26.21.7 (20.3-24.		
19		1		A	25.5 (24.3-28.21.8 (19.5-23.		
20		1		B	25.5 (24.4-28.21.5 (19.9-23.		
21		1		B	25.8 (23.9-28.21.7 (20.5-23.		
22		1		B	25.3 (23.9-27.22.0 (20.6-24.		
23		1		B	25.8 (24.5-28.22.0 (20.5-24.		
24		1		B	25.7 (24.9-26.21.9 (21.1-23.		
25		1					
26		1					
27		1					
28		1					
29	156°34.040'E	1	S4	W1	24.7±0.2	20.4±0.5	1.6±0.2
30		1		B	25.9 (24.2-28.22.0 (21.1-23.		
31		1		B	25.7 (24.5-27.21.5 (20.5-23.		
32		1		B	25.8 (24.3-28.22.1 (20.6-24.		
33		1		B	26.0 (24.9-29.21.8 (20.1-24.		
34		1		B	26.0 (24.9-29.21.9 (20.4-24.		
35		1		A	25.9 (24.2-29.21.7 (20.8-23.		
36		1		B	25.2 (23.8-27.21.7 (20.5-26.		
37		1		B	25.6 (24.4-26.21.5 (20.1-24.		
38		1					
39		1					
40		1					
41	156°24.970'E	1	S2	W1	24.4±1.0	20.4±0.3	1.4±0.2
42		1		B	25.3 (23.3-26.21.7 (19.9-23.		
43		1		B	25.6 (24.4-27.21.8 (20.6-23.		
44		1		A	25.9 (25.0-26.21.5 (20.2-23.		
45		1		B	25.5 (24.8-26.21.4 (19.0-24.		
46		1		B	25.3 (23.2-28.22.0 (20.6-24.		
47		1		B	25.6 (24.6-26.22.3 (21.1-25.		
48		1		B	25.0 (23.3-27.21.7 (20.5-25.		
49		1		B	25.8 (24.4-28.21.7 (20.4-23.		
50		1		A	25.8 (24.4-27.21.4 (20.9-22.		
51		1		B	25.6 (24.5-27.21.3 (19.2-23.		
52		1		A	25.7 (24.6-26.21.9 (19.2-24.		
53		1		B	25.6 (24.6-28.21.5 (20.9-21.		
54		1		A	25.1 (23.8-28.21.9 (20.5-24.		
55		1		B	26.0 (24.5-30.22.8 (20.9-27.		
56		1		B	25.4 (24.2-27.21.6 (20.9-23.		
57		1					
58		1					
59		1					
60		1					

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3	1	B	25.5 (24.4-27.2) 21.6 (20.8-24.
4	1	B	24.8 (23.0-25.2) 20.8 (18.8-23.
5	1	B	24.8 (23.4-26.2) 21.4 (20.1-24.
6	1	B	24.8 (23.4-26.2) 21.4 (20.1-24.
7	1	A	25.6 (24.2-28.0) 21.4 (19.7-23.
8	1	A	25.3 (24.4-26.2) 21.7 (20.2-25.
9	1	B	26.0 (24.4-29.6) 21.7 (20.5-23.
10	1	B	26.0 (24.4-29.6) 21.7 (20.5-23.
11	1	A	26.0 (24.9-28.1) 22.0 (20.4-25.
12	1	A	25.4 (22.9-27.9) 22.2 (21.0-25.
13	1	A	25.5 (24.2-27.8) 21.5 (20.6-22.
14	1	A	25.5 (24.2-27.8) 21.5 (20.6-22.
15	1	B	25.8 (23.9-29.7) 22.4 (21.1-25.
16	1	A	25.4 (22.3-28.5) 21.8 (20.6-24.
17	1	B	26.3 (25.4-30.2) 22.1 (21.3-24.
18	1	B	25.8 (24.5-28.1) 21.7 (20.9-23.
19	1	B	25.8 (24.5-28.1) 21.7 (20.9-23.
20	1	A	25.7 (22.4-28.0) 22.0 (20.5-23.
21	1	A	25.7 (24.5-27.9) 21.9 (20.0-24.
22	1	A	25.7 (24.5-27.9) 21.9 (20.0-24.
23	1	B	25.7 (24.5-28.1) 21.6 (21.0-22.
24	1	B	25.4 (24.7-27.1) 21.6 (20.9-23.
25	1	B	25.7 (24.5-27.9) 22.2 (21.0-25.
26	1	A	25.4 (23.7-27.1) 21.3 (20.3-22.
27	1	A	25.4 (23.7-27.1) 21.3 (20.3-22.
28	1	B	25.6 (24.5-26.7) 21.7 (20.1-24.
29	1	B	25.2 (23.6-27.0) 21.4 (20.3-22.
30	1	B	25.3 (24.4-26.2) 22.1 (19.6-26.
31	1	B	25.3 (24.4-26.2) 22.1 (19.6-26.
32	1	A	25.8 (24.4-27.2) 21.9 (20.8-24.
33	1	B	25.9 (24.3-28.5) 22.0 (19.4-24.
34	1	A	25.9 (24.6-28.2) 22.0 (20.7-24.
35	1	B	26.0 (24.7-29.3) 22.5 (20.8-25.
36	1	B	26.0 (24.7-29.3) 22.5 (20.8-25.
37	1	A/B	25 22
38	1	A	25.3 (23.8-26.8) 21.7 (20.2-24.
39	1	B	25.5 (24.4-27.2) 21.8 (20.4-25.
40	1	B	25.5 (24.4-27.2) 21.8 (20.4-25.
41	1	B	25.3 (23.5-27.1) 21.5 (19.6-24.
42	1	B	26.2 (24.9-31.1) 22.4 (21.2-24.
43	1	B	25.9 (24.4-31.4) 21.1 (19.8-22.
44	1	B	25.9 (24.4-31.4) 21.1 (19.8-22.
45	1	B	25.7 (23.8-28.6) 21.4 (20.2-23.
46	1	A	25.9 (24.3-27.5) 21.7 (21.0-22.
47	1	B	25.5 (24.2-27.8) 21.8 (18.7-24.
48	1	A	26.0 (24.2-27.8) 21.8 (20.6-23.
49	1	A	26.0 (24.2-27.8) 21.8 (20.6-23.
50	1	B	25.3 (24.1-28.5) 21.3 (20.5-23.
51	1	C	26 22
52	1	A	25.6 (24.5-28.1) 21.8 (20.9-24.
53	1	B	26.2 (25.1-28.3) 21.6 (20.0-23.
54	1	B	26.2 (25.1-28.3) 21.6 (20.0-23.
55	1	B	25.6 (24.2-30.0) 21.5 (20.2-23.
56	1	Be	25 22
57	1	B	25.5 (23.4-28.6) 21.3 (20.2-22.
58	1	B	25.5 (23.4-28.6) 21.3 (20.2-22.
59	1	B	25.2 (23.7-27.7) 21.8 (20.0-25.
60	1	A	25.8 (24.4-28.2) 21.8 (20.2-23.

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28	156°25.937'E	1	S4	W1	24.8±0.6	21.2±0.8 1.4±0.1
29		1		B	25.7 (24.6-27.2)	21.8 (20.6-23.2)
30		1		B	26.0 (24.2-28.2)	22.2 (20.5-25.1)
31		1		A	25.4 (24.4-27.2)	21.4 (20.2-22.6)
32		1		A	25.3 (23.3-27.2)	22.1 (20.1-24.1)
33		1		A	25.4 (24.1-29.2)	21.4 (20.8-22.0)
34		1		A	25.8 (24.2-28.2)	22.1 (20.6-25.1)
35		1		A	25.4 (23.9-27.2)	21.5 (20.3-24.1)
36		1		B/C	23	20
37		1		B	25.5 (24.4-29.2)	22.1 (20.2-24.1)
38		1		B	25.1 (24.3-27.2)	21.6 (20.0-23.2)
39		1		B	25.1 (21.9-27.2)	21.1 (19.5-22.7)
40		1		A	25.2 (23.7-26.2)	21.2 (20.3-22.1)
41		1			23	19
42		1		A	25.5 (24.1-28.2)	21.8 (19.9-23.5)
43		1		B	25.0 (24.0-26.2)	21.1 (19.9-23.2)
44		1		B	26.0 (25.1-27.2)	22.0 (20.5-24.1)
45		1			22	19
46		1			25	21
47		1		B	25.6 (24.5-26.2)	21.9 (20.8-23.0)
48		1		B	25.6 (24.3-27.2)	21.9 (20.4-26.1)
49		1		B	25.7 (23.9-30.2)	22.0 (20.4-25.1)
50		1		B	25.3 (24.2-27.2)	21.8 (20.5-23.1)
51		1		A	25.9 (24.7-30.2)	21.7 (19.0-23.4)
52		1		A	25.5 (24.4-26.2)	21.3 (20.4-22.2)
53		1		A	25.7 (24.5-28.2)	21.6 (20.8-23.0)

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4		1	S2	W1	15.7±10.2 (0.6±11.0±8.1 (1.4-0.7±0.8 (0.2-3
5	69°39.16'W	4	S1	W4	26.1±14.9 (N=15.6±7 (N=35) 1.6±1.6 (N=35
6		1		A	28.8 (26.8-30.2) 1.6 (9.7-25.0
7		1	S1	W2	20.0±6.2 15.7±7.8 1.4±1.2
8		1		W3	18.2±8.1 (N=18.0±4.1 (N=4) 2.3±1.8
9					
10	156°35.422'E	1	S2	W1	18.8±9.2 13.0±6.4 1.4±1.6
11	156°31.991'E	1	S1	W1	13.8±10.9 14.7±9.8 9.2±12.9
12		1	S3	W3	28.2; 29.3 17.2; 23.6 0.8; 1.5
13		1	S2	W1	14.9; 30.7 11.9; 25.0 0.8; 2.1
14		1		W3	16.8±5.4 (N=6) 10.4±8.4 (N=4) 1.6±1.3
15		1		W2	14.0±11.0 11.1±10.0 1.1±0.8
16		1	S3	W2	14.0±11.0 11.1±10.0 1.1±0.8
17	69°44'15.9"W	365		W2	13.9±9.6 (N=1
18		1		A	15-31 5-26
19		1		A/B	4-44 5-20
20		1	S2	W3	29.2±0.3 (n=6) 24.2±0.2 (n=7) 1.5
21		many		W2	29.1±0.2 (N=223.7±0.3 (N=2) 0.9±0.1
22					
23	69°51.574'W	5	S1	W4	28.7±0.5 (N=222.6±0.5 (N=2) 1.8±0.5 (N=22
24		2	S4	W1	27.8±0.4 (n=8) 23.5±2.2 (n=5) 0.6±0.1
25		1	S2	W2	27.6±0.4 (n=1) 20.3±3.2 (9.6-0.4±0.1 (0.2-0
26	22.38276°E	1	S3	W2	27.2±0.8 (n=1) 23.4±0.1 (n=2) n.d. (n=2)
27		1	S3	W3	28.1±1
28		1	S2	W2	28.5±0.2 (n=1) 21.0±2.7 (n=2) 1.8±0.8 (n=23
29		1		B	26.8 (25.2-30.2) 0.3 (15.2-23.
30		1		B	28.3 (27.5-28.2) 0.3 (22.7-25.
31		1		A	29.1 (27.4-29.2) 0.3 (22.6-26.
32		1		A	29.1 (27.1-30.2) 0.4 (22.0-25.
33		1		B	28 24
34		1		A	29.3 (28.3-31.2) 0.4 (19.9-25.
35		1		A	29.4 (28.8-30.2) 0.9 (14.6-26.
36		1		A	29.5 (28.2-30.2) 0.4 (19.5-25.
37		1		A	29.6 (28.4-30.2) 0.3 (22.5-25.
38		1		A	29.7 (28.9-31.2) 0.3 (17.3-26.
39		1	S1	W2	28.2±1
40		1		B/C	30 24
41	158°07.606'E	1	S3	W2	27.6±1.4 (N=8) 23.0±0.6 (N=8) 1.9
42		1		A/B	29 23
43		1	S2	W3	30.2±0.4, 30.3±19.9±4.9, 25.6±1.0±0.8, 2.0±0
44		1	S4	W1	26.7±0.7 (n=1) 23.7±6.5 (n=1) 1.9±2.6 (n=14
45		1	S2	W2	27.3; 27.2 20.6; 22.6 1.2; 3.5
46		1		B	30.3 (27.0-32.2) 0.2 (20.6-28.
47		1	S2	W1	29.7; 30.0 23.4; 25.2 2.3; 2.8
48		1		B	30.3 (19.9-34.2) 0.5 (15.6-28.
49		1	S2	W1	29.2; 30.0 20.6; 24.2 2.4; 3.5
50		1		A	29.6 (28.5-32.2) 0.5 (20.8-25.
51		1	S2	W1	26.6

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4		72	S4	W1	26.7±0.2 (n=1) 21.8±0.1 (n=1) 1.0±0.5 (n=16)
5		1	S2	low	28.2±0.4 (N=123) 1.0±0.4 (N=11) 1.3±0.1
6		1		A	29.7 (26.9-33) 23.6 (21.0-27)
7		1		B	29.0 (23.7-32) 23.0 (13.3-26)
8		1	S1	W1	33.0±0.3 (n=6) 27.0±0.3 (n=7) 1.7
9		1		A/B	28 24
10		1			
11	68°33.00'W	1	S2	W2	29.0±1.0 (N=123) 9±0.7 (N=11) 6±0.3 (N=13)
12		1		B	27 23
13		1			
14		1	S2	W2	28
15	68°33.02'W	1			30.8±1.5 (N=124) 3±0.4 (N=12) 0.2 (N=10)
16		1	S2	W3	27.63±0.57 (n=23) 5±1.71 (n=2) 0.8±0.14 (n=)
17		1		A	28.4 (24.9-31) 22.5 (19.6-25)
18		1		B	29.2 (27.4-30) 24.4 (21.7-25)
19		1		A/Be	27 23
20		1			
21		1	S3	W1	33.0±0.5 (n=6) 27.0±0.5 (n=7) 1.6±0.1
22		1		B	29.4 (28.7-30) 23.7 (17.8-26)
23		1		B/C	28 24
24		1			
25	70°22.67'W	1	S1	W2	27.4±0.3 (N=122) 5±0.4 (N=11) 5±0.5 (N=12)
26		1		A	30.0 (29.1-31) 25.0 (22.3-26)
27		1			
28		2	S2	W2	28
29		1		A	28.8 (27.9-32) 23.5 (20.7-26)
30		1		B/C	28 23
31		1		A	29.8 (28.7-34) 24.7 (23.4-26)
32		1		B	29.7 (28.7-30) 22.7 (14.8-25)
33		1		B/C	27 23
34		1			
35	69°55.64'W	1	S3	W2	27.6±0.9 (N=121) 7±0.3 (N=11) 9±0.2 (N=12)
36		1		A	29.6 (28.6-30) 23.7 (22.2-25)
37		1		B	28.1 (26.7-29) 22.9 (21.7-23)
38		1		moderate	33.5±0.9 (N=8) 26.4±0.2 (N=5) 1.6±0.1
39		1			
40		1	S2	W1-2	32.8±0.4 (n=5) 26.3±0.5 (n=5) 2.2±0.9 (n=5)
41		1	S3	W3-4	32.7±0.3 (n=4) 26.6±0.3 (n=5) 1.8±0.3 (n=5)
42		1			
43	9°28.124'W	Many	S4	W0	26±0.4 (n=15) 25±0.2 (n=11) 2±0.3
44		1	S3	W4	31.1±0.7 (N=5) 27.7±0.6 (N=5) 3.2±0.8 (N=51)
45		1	S3	W1	30.5±1
46		1	S4	W1	28.8±1
47		1			
48		1	S3	W3	27
49		1			
50		2	S3	W3	31.3±0.4 24.9±0.4 1.6±0.1
51		1	S1	W1	33.0±0.3 (n=7) 27.0±0.2 (n=8) 1.9
52		1		A/B	28.9 (26.1-32) 22.8 (19.3-26)
53		1		B	30.5 (26.7-33) 24.4 (19.5-26)
54		1			
55		1	S3	W2	26.4±0.2 (n=5) 23.6±0.3 (n=6) 1.6±0.1
56		1		B	31.1 (29.9-32) 25.4 (24.8-25)
57		1			
58		1	S2	W3	28.4±0.1 (n=1) 23.6±0.1 (n=1) 1.7±0.2 (n=10)
59		2	S3	W1	29
60		1	S3	W4	27.9±1

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4		1	A	29.4 (28.2-30.24.2 (22.3-25.	
5		1	B	30.5 (27.9-32.24.5 (19.6-26.	
6	69°42.890'W	1	S2	W4	30.8±0.3 (N=224.6±0.4 (N=21.8±0.4 (N=22
7		1	S2	W1	33.0-33.1 26.4-26.6 1.9-1.8
8		1		Ce	27 23
9					
10		1	S1	W1	32.6±0.2 (n=7 27.0±0.2 (n=7 1.7
11		1	S2	W1	29.5±0.1 (n=1 24.9±0.2 (n=1 2.7±0.1 (n=13
12		1	S2	W1	32.9±0.2 (n=1 26.6±0.2 (n=6 1.6±0.1 (n=6)
13					
14		1		C	27 23
15		1		A	30.7 (27.2-33.25.2 (23.8-27.
16		1		B	29.2 (27.9-30.24.4 (21.2-25.
17		1	S3	W3	27.8±0.3 (n=7 22.1±0.2 (n=6 1.6
18		1	S3	W3	33.0±0.3 (n=7 26.4±0.3 (n=7 1.6±0.1
19		1			
20		2	S1	W3	29.8±0.2 (n=1 24.4±0.2 (n=1 1.8±0.2 (n=11
21		1		B	32.2 (30.6-33.26.4 (25.6-27.
22					
23		1		A	28.8 (27.7-29.22.2 (13.7-25.
24		1		W0	
25		1	S2	W1	32.6±0.2 (n=1 26.2±0.2 (n=1 1.8±0.1 (n=13
26		1	S5	W1	28.4±0.3 (n=1 23.3±0.2 (n=4 1.9±0.1 (n=4)
27					
28		1		B	30.4 (28.6-31.25.0 (24.3-25.
29		1		B/C	27 24
30		1	S2	W1	31.4±0.2 (n=1 25.5±0.2 (n=1 1.7±0.1 (n=13
31					
32		1		A	29.6 (28.8-30.24.4 (23.4-25.
33		1		A	29.4 (28.4-30.24.2 (22.3-25.
34		1		A	29.3 (28.3-31.24.5 (22.5-26.
35		1		B	31.3 (30.3-34.25.6 (23.4-26.
36		1		B	30.0 (29.2-31.24.9 (23.3-26.
37		1		B	30.1 (29.3-30.24.3 (21.4-26.
38		1		B	31.0 (26.9-32.25.0 (22.0-26.
39		1		A	29.5 (29.1-30.24.0 (18.9-25.
40					
41		1	S2	W1	32.1±0.2 (n=1 26.0±0.2 (n=1 2.1±0.1 (n=12
42		1	S2	W0/1	29.7-30.0 22.9-23.6 2.7-3.9
43					
44		1		B	31.6 (30.5-35.25.6 (24.5-26.
45		1	S4	W1	25.74±0.53 (n=23.66±1.09 (n=1.53±0.27 (n=
46		1		A	29.7 (26.4-33.23.6 (13.1-29.
47		1	S3	W2	32.4±0.2 (n=1 26.1±0.2 (n=1 1.8±0.1 (n=12
48		1		B	29.1 (25.0-33.23.1 (12.9-27.
49		1	S3	W1	32.2±0.2 (n=1 26.0±0.2 (n=1 2.2±0.2 (n=14
50					
51		1		B	28.6 (26.7-32.23.1 (22.4-23.
52		1		A	31.6 (30.5-33.26.4 (24.6-28.
53		1		B	31.3 (28.8-33.24.3 (20.0-26.
54		1		B	31.2 (29.0-35.25.4 (24.5-26.
55		1		A/B	27 23
56		1		B/C	27 23
57		1			
58		1	S4	W2	33.0±0.4 (n=1 26.5±0.4 (n=1 2.3±0.3 (n=15
59					
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4			B/C	27	23			
5			A/B	27	23			
6			A	29.8 (28.1-34.2)	24.0 (23.1-24.6)			
7			A	31.0 (29.5-34.6)	24.6 (22.3-25.1)			
8			B	29	23			
9			A	29.6 (28.1-30.2)	24.2 (19.1-26.1)			
10			B/C	27	23			
11			A/B	29	24			
12			A	30.0 (29.0-30.2)	24.3 (19.8-26.1)			
13			B	28				
14			A	30.6 (28.9-32.2)	25.3 (23.0-26.1)			
15			B	28.5 (27.0-30.2)	23.3 (21.7-25.1)			
16			B	31.9 (30.6-33.2)	25.7 (24.8-26.1)			
17			A	32.6 (30.7-33.2)	26.6 (25.7-28.1)			
18			A	30.3 (29.3-31.2)	25.0 (24.3-25.1)			
19			A	30.3 (29.3-31.2)	25.0 (24.3-25.1)			
20			A	30.3 (29.3-31.2)	25.0 (24.3-25.1)			
21			A	30.3 (29.3-31.2)	25.0 (24.3-25.1)			
22			A	30.3 (29.3-31.2)	25.0 (24.3-25.1)			
23	158°28.086'E	1	S2	W1	31.4±0.8	25.8±0.7	1.4±0.2	
24		1	S6	W3	35.7±0.3	26.6±0.4	1.9±0.3	
25		1	S4	W2	32.7±0.2	26.3±0.2	1.8±0.3	
26		1	S2	W2	29.9±0.3	23.9±0.4; 12.8	4.1±0.3; 38.5±	
27		1	S2	W2	29.9±0.3	23.9±0.4; 12.8	4.1±0.3; 38.5±	
28	69°53.708'W	1		high	31.1 (N=1)	25.7±0.0 (N=3)	2.0±0.3	
29		1	S2	W0/1	29.6-29.8	23.7-23.8	1.7-2.0	
30		1	low	moderate	10.7-10.8	9.9-10.5	1.5-2.7	
31		1	moderate	strong	10.7	10.3; 4.6	2.2; 43.6	
32		1	low	low	10.4-10.6	4.2-4.4	45.1-45.5	
33		1	low	low	10.4-10.6	4.2-4.4	45.1-45.5	
34		Many	low	moderate	11.0±0.1	5.0±0.6	41.4±2.9	
35		4	low	low	11.5-11.9	10.5-12.5; 4.3	0.1-4.0; 39.7-4	
36		1		A	12.4 (9.2-13.2)	11.2 (10.4-12.1)		
37		1		A	12.1 (11.5-12.1)	10.7 (9.5-12.5)		
38		1		Ce	12-13	5-12		
39		1	high	low	34.6-59.8	26.4-39.4	9.7-11.7	
40		1		Moderate	12.0-61.1	10.7-69.9	0.9-44.9	
41		1						
42		1		minimal		44.4±6.0 (N=5)	22.9±9.0	
43		1	many	high	low	31.6	25.6; 16.1	10.7; 35.7
44		1	high	low	39.0-90.0	25.9-71.4	28.6-23.1	
45		Many	high	moderate	25.6±8.9	26.2±8.8, 35.9	6.2±2.5, 26.9±	
46		Many	high	moderate	31.2±9.4	36.0±10.0	22.2±8.8	
47		several	low	low	26.7-47.2	24.1; 52.4; 8.0	3.6; 18.8; 44.3	
48		9	high	moderate	31.7±6.3	32.2±10.8	12.9±8.2	
49		several						
50		1	high	moderate	53.3±11.8, 91.2	6.0±1.3, 38.3	6.4±1.3, 24.2±	
51		1						
52		6	high	moderate	42.7±7.3	37.0±8.0	17.9±6.9	
53		1	moderate	moderate	28±5 (N=13)	29±11 (N=24)	16±16	
54		Several	high	low	25.0±6.4	31.0±3.6; 22.3	8.1±3.6; 35.0±	

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3	13.193°W	1	low	low	10.1-27.0	20.9-21.7	4.5-7.0	
4		1	high	low	37.4±9.5	36.1±3.5, 19.95.4±1.3, 33.3±		
5		Many	high	moderate	35.7±10.2	30.0±6.8, 26.710.1±7.6, 37.0		
6		1	moderate	low	17.8-23.5	25.4-37.2	8.1-13.0	
7		1	high	low	35.8±5.0	33.6±5.3, 29.012.6±6.8, 34.8		
8	4°11.16582'W	1	moderate	low	32.6 (9.8-90.1	29.5 (15.6-507.9 (1.7-24.8,		
9		4	moderate	low	18.6-53.0	16.4-42.5; 40.2.9-5.8; 5.9-26		
10		1	low	low	30.0-41.3	25.2-35.7	7.9-4.2	
11		Several	high	moderate	28.1±4.8	19.0±4.4	23.1±17.6	
12		1	low	low	23.0-37.4	29.5;29.6; 22.4.5; 7.4; 25.1;		
13		1	low	low	13.1; 44.5	32.0-38.2	14.6-4.5	
14		1	low	low	19.7-51.6	45.7-47.9	3.6	
15		1	high	low	32.1-32.4	26.0-27.8	9.7-5.7	
16	~70°15'W	1	low	minimal	70.2±3.4 (N=728.4±2.9 (N=240.0±0.6			
17		1						
18		6		low		25.1; 39.9; 25.3.6; 8.0; 36.7		
19	-14.763139	3	high	low		36.0±10.0, 23.5.0±2.3, 40.3±		
20		9	moderate	low		37.6, 33.5	35.7, 4.0	
21		6	high	moderate		48.0±10.7, 29.16.8±6.0, 34.7		
22	14.319°W	several	high	moderate	19.1-48.7	16.5-21.7; 32.2.2-3.5; 11.0-1		
23		1	high	low		28.5-30.6	28.2-23.7	
24		1	high	low		24.8-41.8	31.4-24.3	
25		many	low	low	32.7-34.3	25.0-30.4; 17.5.5-10.0; 32.7		
26		1	high	low		22.1; 29.9; 31.3.1; 7.3; 13.7-		
27		1	high	low	49.3-49.4	29.2-45.7	10.4-8.1	
28		1	high	low	38.1-40.7	24.7; 26.4-30.4.1; 11.0-7.5; ;		
29		1						
30		1	high	moderate	32±±8 (N=82)	31±6 (N=168)	15±9	
31		several	high	low	76.3	26.1-45.0; 47.28.6-30.8; 12.1		
32		1		A	37.1 (33.9-38.25.4 (24.4-26.			
33		several	high	low		41.8-58.8; 24.11.1-14.4; 33.1		
34		4	strong	low		53.7; 26.2	14.3; 32.2	
35	53°20.587'E	1	strong	low	40.8±3.5 (N = 29.8±3.1 (N = 12.1±8.1 (N =			
36		1	High	Low		50.5±14.8, 29.16.9±6.8, 31.7		
37		1	moderate	low				
38		1						
39		1	low	low		30.3-33.5	3.6-5.3	
40		many	low	moderate		15.8; 24.7; 46.1.1; 2.7; 2.8		
41		1		minimal		15.9 (N=1)	0.60	
42		1	low	low		32.7-32.9	4.2-5.1	
43	55.870°E	1	S2	W2	0.6-38.1	1.9-35.2	0.5-4.4	
44		1	low	moderate	12.9±0.1 (n=1			
45		1	low	high	13.1			
46		many	S1	strong	12.9±0.2 (n=1.			
47	6°32.32E	1		W1	14.9±1.1 (N =			

1							
2							
3		several	low	low	13.3-13.7		
4	8°50'49.5"W	1		low	13.8±0.1 (N=8		
5		several	S2	low	7.0-57.4	8.1-32.7	0.1-6.6
6		1	S3	W2	26.3	18.7; 10.3	1.5; 42.1
7		1	S2	W3	36.0±4.8 (26.6	19.8±4.2 (13.6	0.7±0.3 (0.2-1
8		1	S3	W2	38.9±0.3 (n=6	11.1±0.9 (n=6	45.9±1.0; 1.6±
9		1	S2	W2	25.0±14.7; 41.1	3.8±9.2; 36.0	1.1±1.0; 2.2±0
10		many	S2	W1	2.9-42.4	1.1-31.0	0.3-2.2
11		1	S2	W2	39.2-39.9	2.2-30.3	0.2-3.2
12		3	S2	low	1.5-48.4	1.9-14.5	0.3-2.9
13		1	S2	W0	8.3-43.1	10.5-33.8	1.1-46.3
14		2	S2	low	1.0; 39.1-41.6	4.5; 16.3; 11.0	0.4; 2.7; 45.5-
15		1	S1	W2	37.2±1.7 (n=1	22.1±1.4 (n=2	41.6±1.6 (n=2
16		38	S4	W1	38.2	30.1; 12.0	1.3; 44.3
17		1	low	low	21.6±0.1 (N=111.5	±2.4 (N=17.9	±1.6 (N=10
18		1		moderate	21.1±0.2 (N=117.9	±0.1 (N=17.5	±0.1 (N=15
19		1	moderate	moderate	21.0; 1.4	18.0	7.2
20		1	low	moderate	20.8±0.1	17.4±0.2, 10.9	4.3±0.2, 34.5±
21		1	low	low	10.8-11.0	11.0-11.1	4.6-4.7
22		1	low	moderate	20.0±0.1 (n=1	17.0±0.1 (n=1	9.1±0.1 (n=12
23		1	low	moderate	25.5±0.1 (n=1	21.0±0.3 (n=1	4.3±0.1 (n=12
24		1	low	moderate	15.4±0.1	9.8±2.1	7.0±1.8
25		1	low	low	16.0±0.1 (core	13.7±0.1 (13.4	7.4±0.1 (7.3-7
26		1	low	moderate	21.6±0.3	12.4±1.5	9.8±3.0
27		1	low	moderate	20.9±0.1 (n=1	13.4±1.4 (10.8	7.6±3.4 (3.4-1
28		1	low	moderate	22.0±0.2	18.8±0.1	6.0±0.2
29	56°41.22'E	3	S5	W3	23.8±3.0 (N=415.8	±2.0 (N=67.5	±1.7
30		1	low	moderate	22.2±0.1	18.6±0.3, 11.7	4.2±0.1, 34.9±
31		1	low	moderate	21.5±0.1	17.8±0.1	4.8±0.8
32		1	low	low	20.6-20.8		
33		1	low	moderate	19.6-19.9	13.0-15.5	6.6-11.7
34	56°35.64'E	2			21.8±2.0 (N=215.5	±2.8 (N=28.0	±2.9
35		1	moderate	moderate	11.4; 6.6	10.7; 6.6	4.9; 36.2
36		4	low	low	19.7±0.1 (N=116.7	±0.2 (N=17.6	±0.1 (N=10
37		1	moderate	high	18.3±0.2; 3.6±	15.3±0.3	8.1±0.3.
38	156°35.726'E	1	low	W1	14.9±0.3	12.8±0.2	4.3±0.2
39		1	U-S4	minor	22.6, 15.6		
40		1	low	moderate	12.0±3.5	12.7±0.3, 8.1	±4.9±0.0, 35.4±
41	56°32.840'E	1	moderate	moderate	23.8±0.2 (n=1	14.3±1.4 (11.9	9.0±3.9 (3.6-1
42		1	low	moderate	12.1±0.1	11.1±1.6, 6.0	±4.5±0.1, 36.5±
43		1		moderate	19.6±0.2 (N=117.1	±0.1 (N=15.4	±0.1 (N=17
44		1	low	low	21.9-22.2	18.4-18.5	9.3-9.2
45		1	low	moderate	21.3±0.1 (n=1	18.1±0.1 (n=1	8.9±0.1 (n=13
46	69°44.639'W	1	medium	low			
47		1	low	low	21.7±0.1 (N=112.6	±2.5 (N=19.3	±1.7 (N=10

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55°53.44'E	2			23.9±1.5 (N=416.6±1.7 (N=36.8±1.9		
	1	low	moderate	21.3; 9.0	11.8	6.1
	1	moderate	medium	19.2±0.0 (n=1	15.9±0.2 (N=110.7±0.3 (N=1	
	1		low	10.8±0.6 (N=310.1±0.8 (N=18.3±0.6 (N=11		
	2	moderate	moderate	20.1; 7.7	17.3	3.6
	1	moderate	moderate	20.8±0.3 (n=1	17.9±0.1 (n=1	8.0±0.1 (n=16
	1	low	low	17.3-17.5		
	2	low	moderate	14.1±0.1 (n=1	12.5±0.1 (n=1	7.8±0.1 (n=13
55°43.342'E	1	low	high	21.2±0.5 (n=1	11.3±0.1 (n=1	36.6±0.2 (n=1
	1				32.6 (27.7-34.	
	1			19.6 (1.4-23.2		
	1	low	low	12.6-12.7	10.4-10.5	4.5-4.4
	1	S2	W1	0.72±0.44 (n=	0.53±0.21 (n=	1.3±0.3
	1	low	low	2.9-3.0	2.7-3.0	1.1-1.0

For Peer Review Only

	tbl_magsus	tbl_typespec	tbl_typespec	tbl_mainmas	tbl_classifier	tbl_finder
4	4.44	20.2	CEREGE	Jean Redelsperger	J. Gattacceca	Mohamed Ma
5		21.1	UNM	DPitt	C. Agee, UNM	
6		14.4	KOPRI	KOPRI	C. Park, S. Y. J. H. Kim	
7		4.2	MNB	Stefan Ralew	A. Greshake, I	
8		20.5	UWB	Ke Zuokai	A. Irving and F	
9		24.0	UWO	S. Tutorow	Z.G. Guo, UW	
10		22.1	UNM	DPitt	C. Agee, UNM	
11		20	PMO	Ke Zuokai	Li Y., PMO	
12		20.7	UNM	Jay Piatek	C. Agee, UNM	
13	3.91	2.2	CEREGE	Labenne Luc	J. Gattacceca	Labenne Luc
14		2.56	UWB	B. Hoefnagels	A. Irving and S	
15		20.6	UWB	D. Pitt	A. Irving and S	
16		22.3	UWB	B. Hoefnagels	A. Irving and S	
17		20.6	App	PARI	A. Love, App	Anonymous
18		20	IfP, Münster	Nourddine Azar	K. Metzler, IfP	
19		27.2	MNB	Marcin Cimala	A. Greshake, I	
20		14.4	MNB	Stefan Ralew	A. Greshake, I	
21		20.1	UWB	S. Ralew/D. P.A.	Irving and S	
22		2.703	NIPR	NIPR	A. Yamaguchi	
23		1.696	NIPR	NIPR	A. Yamaguchi	
24		12.3	UWB	A. Habibi	A. Irving and S	
25	4.03	1.69	CEREGE	CEREGE	J. Gattacceca	
26		0.85	NIPR	NIPR	A. Yamaguchi	
27		23.2	UNM	Jay Piatek	C. Agee, UNM	
28		30	Vernad.	Anonymous o	M.A. Ivanova, Mr. M.E. Nepe	
29	5.07	10.340	JSC	JSC	SI	ANSMET
30		24.0	MSN-FI	Mimaghador	V. Moggi Cecc	
31		25.2	MNB	Martin Goff	A. Greshake, I	
32		20.1	MSN-FI	Mimaghador	V. Moggi Cecc	
33		20.2	UWB	M. Arjdal	A. Irving and S	
34		21	UWB	A. Aaronson	A. Irving and S	
35	4.58	78.959	JSC	JSC	SI	ANSMET
36		26	ROM	D. Gregory	A. Irving and S	
37		20	MNB	Philippe Schm	A. Greshake, I	
38		20	MSN-FI	Mimaghador	V. Moggi Cecc	
39		20.1	MNB	Stefan Ralew	A. Greshake, I	
40	4.54	102.442	JSC	JSC	SI	ANSMET
41		14	MNB	Philippe Schm	A. Greshake, I	
42		9	UNM	Darryl Pitt	C. Agee, UNM	
43		11.4	KOPRI	KOPRI	C. Park, S. Y. H. Yoo	
44		20	MNB	Stefan Ralew	A. Greshake, I	
45		20.31	UCLA	with owner (St)	A. Rubin, UCL	
46		20	MNB	Vincent Gira	A. Greshake, I	
47		15.9	UNM	Darryl Pitt	C. Agee, UNM	

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3	4.45	3.7	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
4		17.219	NIPR	NIPR	A. Yamaguchi
5		3.3	MNB	Stefan Ralew	A. Greshake, I
6		93.65	NIPR	NIPR	A. Yamaguchi
7		52.912	NIPR	NIPR	A. Yamaguchi
8		10.216	NIPR	NIPR	A. Yamaguchi
9		7.683	NIPR	NIPR	A. Yamaguchi
10		2.675	NIPR	NIPR	A. Yamaguchi
11		2.579	NIPR	NIPR	A. Yamaguchi
12		2.56	NIPR	NIPR	A. Yamaguchi
13		2.538	NIPR	NIPR	A. Yamaguchi
14		2.447	NIPR	NIPR	A. Yamaguchi
15		2.313	NIPR	NIPR	A. Yamaguchi
16		2.092	NIPR	NIPR	A. Yamaguchi
17		1.733	NIPR	NIPR	A. Yamaguchi
18		1.336	NIPR	NIPR	A. Yamaguchi
19		1.002	NIPR	NIPR	A. Yamaguchi
20		0.83	NIPR	NIPR	A. Yamaguchi
21		3.6	UWB	D. Dickens	A. Irving and S
22		8.7	ASU	Ruben Garcia	L. Garvie
23		30.5	PRL	GSI	A.D. Shukla and A.D. Shukla
24		20	MNB	Marcin Cimala	A. Greshake, I
25		185.6	KOPRI	KOPRI	C. Park, S. Y. S. Park
26		15.2	UWB	B. Hoefnagels	A. Irving and S
27	4.97	23.5	CEREGE	R. Lenssen	J. Gattacceca,
28		11.5	UNM	Aziz Habibi	C. Agee, UNM
29	3.54	52.933	JSC	JSC	SI ANSMET
30		33.4	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
31		7	MNB	Vincent Gira	A. Greshake, I
32		3.5	MNB	Vincent Gira	A. Greshake, I
33		3.9	UrFU	A.N. Zavaritsk	S. V. Berzin and
34	3.13	14.393	JSC	JSC	SI ANSMET
35		2.3	MNB	Philippe Schm	A. Greshake, I
36		10.636	JSC	JSC	SI ANSMET
37	4.23	2.25	CEREGE	Kuntz	J. Gattacceca,
38		2.2	MNB	Vincent Gira	A. Greshake, I
39		1.2	MNB	Vincent Gira	A. Greshake, I
40		0.7	MNB	Philippe Schm	A. Greshake, I
41		0.44	MNB	Vincent Gira	A. Greshake, I
42		0.38	MNB	Vincent Gira	A. Greshake, I
43		0.36	MNB	Vincent Gira	A. Greshake, I
44		0.3	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
45		2	MNB	Vincent Gira	A. Greshake, I
46		0.8	MNB	Philippe Schm	A. Greshake, I
47		129.97	NIPR	NIPR	A. Yamaguchi

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3		14.932	NIPR	NIPR	A. Yamaguchi
4		2.306	NIPR	NIPR	A. Yamaguchi
5		0.821	NIPR	NIPR	A. Yamaguchi
6		40.1	UWB	K. Zuokai	A. Irving and S
7		24.05	UWB	H. Naji	A. Irving and S
8		20.4	MNB	Stefan Ralew	A. Greshake, I
9		20.4	MNB	Stefan Ralew	A. Greshake, I
10		20.4	MNB	Stefan Ralew	A. Greshake, I
11	4.42	53	CEREGE	MMC	J. Gattacceca, Rodrigo Martir
12		20	IfP	Manuel Nieto	K. Metzler, IfP
13		27	PMO	Ke Zuokai	Li Y., PMO
14		27	PMO	Ke Zuokai	Li Y., PMO
15		76	Vernad	Mr. Timur Kryz	M. A. Ivanova, Mr. Timur Kryz
16	4.63	20.2	CEREGE	MMC	J. Gattacceca, Rodrigo Martir
17		20	IfP	Anonymous	K. Metzler, IfP
18		19.0	IfP	Marc Jost and	K. Klemm, Add
19		17.1	IfP	Marc Jost and	K. Klemm, Add
20		17.1	IfP	Marc Jost and	K. Klemm, Add
21		16.3	UWB	M. Goff	A. Irving and S
22		11.3	IfP	Marc Jost and	K. Klemm, Add
23		11.3	IfP	Marc Jost and	K. Klemm, Add
24		21.7	UCLA, PSF	G. and A. Hup	A. Irving and S
25		10.1	IfP	Sergey Vassili	Kerstin Klemm unknown
26		9	UWB	J. Higgins	A. Irving and S
27		9	UWB	J. Higgins	A. Irving and S
28		7	MNB	Philippe Schm	A. Greshake, I
29		9.5	UWB	DPitt	A. Irving and S
30		5.5	IfP	Anonymous	K. Metzler, IfP
31		1.5	MNB	Vincent Gira	A. Greshake, I
32		1.5	MNB	Vincent Gira	A. Greshake, I
33		17.3	UNM	Matthew Stre	C. Agee, UNM
34	4.69	21.10	CEREGE	Kuntz	J. Gattacceca,
35		22.3	UNM	Darryl Pitt	C. Agee, UNM
36		22.3	UNM	Darryl Pitt	C. Agee, UNM
37	4	388.300	JSC	JSC	SI ANSMET
38	3.87	226.400	JSC	JSC	SI ANSMET
39		53.0	UWB	B. Hoefnagels	A. Irving and S
40		53.0	UWB	B. Hoefnagels	A. Irving and S
41		42	UWB	A. Aaronson	A. Irving & P. (
42		20.66	UNM	Abdelhadi Ait	C. Agee, UNM
43		20.1	MNB	Stefan Ralew	A. Greshake, I
44		20.1	MNB	Stefan Ralew	A. Greshake, I
45		22.4	MNB	Philippe Schm	A. Greshake, I
46		24	UWB	M. Jost	A. Irving and S
47		24.5	UWB	C. Zlimen	A. Irving and S
48		24.5	UWB	C. Zlimen	A. Irving and S
49	3.91	28	App	PARI	A. Love, App Unknown
50		20	IfP, Münster	Nourddine Az	K. Metzler, IfP
51	4.39	23.00	CEREGE	Labenne Luc	L. Krämer Ruç
52		21.7	NHNV	A. Pani	F. Brandstätte
53		21.7	NHNV	A. Pani	F. Brandstätte
54	4.35	42.38	App	Blaine Reed	A. Love, App Anonymous
55		21.82	UWB	FKuntz	A. Irving and S
56		21.2	UNM	Darryl Pitt	C. Agee, UNM
57		21.2	UNM	Darryl Pitt	C. Agee, UNM
58		20.2	MNB	Stefan Ralew	A. Greshake, I
59	3.91	22.64	CEREGE	Kuntz	J. Gattacceca,
60		21.62	UWB	F. Kuntz	A. Irving and S

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3		20.4	MNB	Martin Goff	A. Greshake, I	
4		20	MNB	Stefan Ralew	A. Greshake, I	
5						
6	3.89	14.6	Kiel	Li Bofang, Bei	R. Bartoschew	anonymous
7		14.4	PSF	A. Hupé	A. Irving and S	
8		13.8	MNB	Philippe Schm	A. Greshake, I	
9		15.8	UWB	DPitt	A. Irving and S	
10		11.9	MNB	Harald Stehlik	A. Greshake, I	
11		11	IfP	Anonymous	K. Metzler, IfP	
12		9.8	MNB	Stefan Ralew	A. Greshake, I	
13		31.379	NIPR	NIPR	A. Yamaguchi	
14		6.2	MNB	Stefan Ralew	A. Greshake, I	
15		28	ROM	ROM	A. Irving and S	
16		5.8	MNB	Hanno Strufe	A. Greshake, I	
17	3.90	21.468	JSC	JSC	SI	ANSMET
18	3.87	11.258	JSC	JSC	SI	ANSMET
19	3.96	7.492	JSC	JSC	SI	ANSMET
20		6.87	PSF	PSF	A. Irving and S	
21		1.959	NIPR	NIPR	A. Yamaguchi	
22		20.2	UWB	Aaronson	A. Irving & P. I	
23		36	PMO	Liu Yukun	Wu Y., PMO	
24		24.8	UWB	T. Boudreaux	A. Irving and F	
25		21.6	UWB	J. Higgins	A. Irving and S	
26		24	MNB	Hanno Strufe	A. Greshake, I	
27		20.6	MNB	Marcin Cimala	A. Greshake, I	
28		20.1	UNM	MMGM	C. Agee, UNM	
29		20	App	Steve Arnold	A. Love, App	Unknown
30	3.32	30.9	CEREGE	R. Lenssen	J. Gattacceca,	
31		143.03	NIPR	NIPR	A. Yamaguchi	
32		134.75	NIPR	NIPR	A. Yamaguchi	
33		21	UPC	David Allepuz	J. Llorca, UPC	David Allepuz-
34	2.52	94.864	JSC	JSC	SI	ANSMET
35		18.1	UWB	C. Zlimen	A. Irving and F	
36		16.32	UWB	F. Olsen/D. B.	A. Irving and S	
37		61.05	NIPR	NIPR	A. Yamaguchi	
38		10	MNB	Stefan Ralew	A. Greshake, I	
39		42.72	NIPR	NIPR	A. Yamaguchi	
40		34.652	NIPR	NIPR	A. Yamaguchi	
41		5.9	MNB	Philippe Schm	A. Greshake, I	
42		17.899	NIPR	NIPR	A. Yamaguchi	
43		16	NIPR	NIPR	A. Yamaguchi	
44		12.414	NIPR	NIPR	A. Yamaguchi	
45		11.689	NIPR	NIPR	A. Yamaguchi	
46		3.136	NIPR	NIPR	A. Yamaguchi	
47		21.1	UWB	C. Colvin	A. Irving and S	
48	5.24	67	CEREGE	ArtMet collecti	J. Gattacceca,	anonymous

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2					
3		14.084	NIPR	NIPR	A. Yamaguchi
4					
5	5.36	32	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
6	5.51	44	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
7		20.3	MNB	Said Yousfi	A. Greshake, I
8		20	MNB	Philippe Schm	A. Greshake, I
9					
10		185.43	NIPR	NIPR	A. Yamaguchi
11	5.51	54.8	MNA-SI	MNA-SI	M. Salvini, M. (Jacopo Nava
12		19.6	MSN-FI	Castellano	V. Moggi Cecc
13					
14		24	PMO	Ke Zuokai	Wu Y., PMO
15		35.6	App	PARI	A. Love, App Unknown
16		35.1	GUT	GUT	B. Miao, L. Hu
17					
18		1220	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
19		1121	KOPRI	KOPRI	C. Park, S. Y. S. Han
20		26.7	UCLA	N. Gessler	P. Warren, UC
21	2.88	20.0	Kiel	Anonymous	R. Bartoschew Anonymous
22					
23		20	App	PARI	A. Love, App Unknown
24		440	SQU	SQU	P. Hill, N. Ban
25		20.7	MNB	Philippe Schm	A. Greshake, I
26					
27		22.11	ROM	Gregory	V. Di Cecco, F
28		21.9	MNB	Abdeltif Mech	A. Greshake, I
29		20	MNB	Hichame Mim	A. Greshake, I
30					
31		29.3	MNB	Philippe Schm	A. Greshake, I
32		20.3	MNB	Vincent Gira	A. Greshake, I
33		206.1	NIPR	NIPR	A. Yamaguchi
34		20.2	MSN-FI	Cavaglià	V. Moggi Cecc
35					
36		157.8	Cascadia	Cascadia	M. Hutson, A.
37		22	MNB	Hanno Strufe	A. Greshake, I
38		20.0	App	PARI	A. Love, App Unknown
39					
40		21.5	Cascadia	Bastian Baeck	M. Hutson, A.
41		34.6	GUT	GUT	B. Miao, L. Hu
42		21.8	GUT	GUT	B. Miao, C. Zh
43					
44		75.47	NIPR	NIPR	A. Yamaguchi
45		16.2	GUT	GUT	B. Miao, L. Hu
46		25.3	GUT	GUT	B. Miao, L. Hu
47		14.2	MNB	Harald Stehlik	A. Greshake, I
48		14.3	MNB	Hanno Strufe	A. Greshake, I
49					
50		20	MLP	MMG-Cordob	J. Roszjar, N-Prof. Juan Ols
51		12.1	MNB	Hichame Mim	A. Greshake, I
52					
53		59.25	NIPR	NIPR	A. Yamaguchi
54		55.82	NIPR	NIPR	A. Yamaguchi
55		16.9	GUT	GUT	B. Miao, L. Hu
56		49.815	NIPR	NIPR	A. Yamaguchi
57					
58		12.1	GUT	GUT	B. Miao, L. Hu
59		38.049	NIPR	NIPR	A. Yamaguchi
60		8	IfP, MÄ¼nster	Anonymous	K. Metzler, IfP

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3	11.1	GUT	GUT	B. Miao, L. Hu
4	6.7	ROM	D. Gregory	L. F. White an
5	29.962	NIPR	NIPR	A. Yamaguchi
6	6.1	ROM	D. Gregory	L. F. White an
7	8.9	GUT	GUT	B. Miao, L. Hu
8	21.33	NIPR	NIPR	A. Yamaguchi
9	4.6	MNB	Hichame Mim	A. Greshake, I
10	18.323	NIPR	NIPR	A. Yamaguchi
11	4.2	GUT	GUT	B. Miao, L. Hu
12	10.8	GUT	GUT	B. Miao, L. Hu
13	8.4	GUT	GUT	B. Miao, L. Hu
14	12.921	NIPR	NIPR	A. Yamaguchi
15	10.557	NIPR	NIPR	A. Yamaguchi
16	10.53	NIPR	NIPR	A. Yamaguchi
17	4.6	GUT	GUT	B. Miao, L. Hu
18	6.919	NIPR	NIPR	A. Yamaguchi
19	2.369	NIPR	NIPR	A. Yamaguchi
20	1.936	NIPR	NIPR	A. Yamaguchi
21	1.298	NIPR	NIPR	A. Yamaguchi
22	1.219	NIPR	NIPR	A. Yamaguchi
23	0.425	NIPR	NIPR	A. Yamaguchi
24	0.4	KOPRI	KOPRI	C. Park, S. Y. T. Kim
25	22.5	UWB	R. Falls	A. Irving and S
26	20.1	UWB	Hmani Inc.	A. Irving and S
27	24.8	UWB	S. Vasiliev	A. Irving and S
28	22	UWB	G. Fujihara	A. Irving and S
29	20.3	MNB	Marcin Cimala	A. Greshake, I
30	8.4	MNB	Stefan Ralew	A. Greshake, I
31	4.2	MNB	Jürgen Naube	A. Greshake, I
32	2.8	MNB	Stefan Ralew	A. Greshake, I
33	20	UCLA	N. Gessler	P. Warren, UC
34	24.5	UNM	Mohamed Aid	C. Agee, UNM
35	20.6	UWB	A. Aaronson	A. Irving and S
36	20	MNB	Harald Stehlik	A. Greshake, I
37	20	UNM	Jay Piatek	C. Agee, UNM
38	24.4	MNB	Marcin Cimala	A. Greshake, I
39	20	IfP, Münster	Nourddine Az	K. Metzler, IfP
40	20	IfP, Münster	Anonymous	K. Metzler, IfP
41	20.2	UWB	MMGM	A. Irving and S
42	23.1	ROM	D. Schultz	T. Bunch and
43	25.5	UWB	R. Falls	A. Irving and S
44	46.5	UWB	J. Phillips	A. Irving and S
45	25.5	UWB	R. Falls	A. Irving and S
46	22	UNM	Jay Piatek	C. Agee, UNM
47	20	UPC	Alfonso Viera	J. Llorca, UPC Alfonso Viera

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2						
3	3.69	21	CEREGE	Sergey Vasilie	J. Gattacceca,	Sergey Vasilie
4		26.6	UWB	J. Higgins	A. Irving and	€
5		41.5	App	J. Sinclair	A. Love, App	Unknown
6	3.44	25.8	UWB	R. Falls	A. Irving and	€
7		20.8	UWO	R. Watts	Z.G. Guo, UW	
8		20	App	Steve Arnold	A. Love, App	Unknown
9		21.1	UWB	D. Pitt	A. Irving and	€
10		20	IfP, Münster	Nourddine Az	K. Metzler, IfP	
11		21.9	UNM	Darryl Pitt	C. Agee, UNM	
12		210	RBINS	RBINS	H. Pourkhors	€Eudore Schmi
13		20	IfP	Anonymous	K. Metzler, IfP	
14		20.1	UWB	DPitt	A. Irving and	€
15		20	IfP, Münster	Nourddine Az	K. Metzler, IfP	
16		21.2	MNB	Hanno Strufe	A. Greshake, I	
17		21.99	ASU	Michael Farm	S. Dillon, E. D	Anonymous
18	2.69	133.858	JSC	JSC	SI	ANSMET
19	2.65	131.112	JSC	JSC	SI	ANSMET
20		20.4	UNM	DPitt	C. Agee, UNM	
21		19	MNB	Franco Vignat	A. Greshake, I	
22		15	IfP, Münster	anonymous	K. Metzler, IfP	
23	2.72	61.353	JSC	JSC	SI	ANSMET
24		12.5	UNM	Darryl Pitt	C. Agee, UNM	
25	2.81	47.300	JSC	JSC	SI	ANSMET
26	2.67	40.372	JSC	JSC	SI	ANSMET
27		8.6	MNB	Jürgen Naube	A. Greshake, I	
28	2.02	26.701	JSC	JSC	SI	ANSMET
29	2.71	25.324	JSC	JSC	SI	ANSMET
30	3.62	23.531	JSC	JSC	SI	ANSMET
31		6.7	MNB	Franco Vignat	A. Greshake, I	
32	3.56	4.4	FSAC	Private collect	H. Chennaoui	Tarik Hezzi (E
33	2.89	8.269	JSC	JSC	SI	ANSMET
34		21	UNM	Jay Piatek	C. Agee, UNM	
35		20.6	UWB	D. Pitt	A. Irving and	€
36	2.64	23.9	CEREGE	Andreas Gren	J. Gattacceca,	
37	2.61	184.233	JSC	JSC	SI	ANSMET
38		21.1	UWB	DPitt	A. Irving and	€
39		17.1	UNM	Darryl Pitt	C. Agee, UNM	
40	2.72	64.631	JSC	JSC	SI	ANSMET
41	2.64	46.365	JSC	JSC	SI	ANSMET
42		8.9	UNM	Craig Zlimen	€C. Agee, UNM	
43	2.59	38.752	JSC	JSC	SI	ANSMET
44		70.24	NIPR	NIPR	A. Yamaguchi	
45		2.524	NIPR	NIPR	A. Yamaguchi	
46		16.79	UCLA	Sean Tutorow	A. Rubin, UCL	
47	4.74	24.3	Kiel	Dieter Janek, I	Bart	anonymous

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3	5.45	20.5	Kiel	F. Vignato, Ve Bart	anonymous
4	4.77	20.5	Kiel	Dieter Janek, Bart	nomad group
5	4.89	26.9	Kiel	Xu Jianjiang aR. Bartoschew Xu Jianjiang	
6	5.01	25.3	Kiel	Li Bofang, BeiR. Bartoschew	anonymous
7	5.12	21.2	Kiel	Wang Ziyao R. Bartoschew	anonymous
8	5.13	22.0	Kiel	W. Kalisch (B€R. Bartoschew	anonymous
9	5.12	21.8	Kiel	anonymous Bart	anonymous
10	4.69	15.2	Kiel	Li Bofang, BeiR. Bartoschew	anonymous
11	4.77	5.9	Kiel	Wang Ziyao R. Bartoschew	Bi Chunlin (Ta
12	4.70	5.9	Kiel	Joseph KaiserR. Bartoschew	anonymous
13	5.17	5.8	Kiel	Wang Ziyao R. Bartoschew	Zhao Tailu (St
14	4.59	1.70	Kiel	BartoschewitzR. Bartoschew	Bi Chunlin (Ta
15	5.39	20.8	Kiel	Wang Ziyao R. Bartoschew	anonymous
16	5.13	20.6	Kiel	Dieter Janek, Bart	anonymous
17	5.27	24.5	Kiel	Wang Ziyao R. Bartoschew	Wang Ziyao
18	5.30	24.1	Kiel	Xu Jianjiang R. Bartoschew	Xu Jianjiang
19	5.11	16.8	Kiel	Qu Pan, BeijinR. Bartoschew	anonymous
20	5.44	5.2	Kiel	A. Mazur Bart	anonymous
21		23.84	UCLA	David GregoryA. Rubin, UCL	
22		22.5	OU	Joe Bazyk R. Greenwooc	Joe Bazyk
23	5.27	30	MNB	Hanno Strufe A. Greshake,	
24		25.6	MNB	Dario Ruiz Ansgar Gresh	Dario Ruiz
25		39.42	UCLA	Nick Gessler A. Rubin, UCL	
26		60.8	Vernad	DMUH C. A. Lorenz, '	
27	4.86	31	MNB	Hichame Mim:A. Greshake,	
28		231	KOPRI	KOPRI C. Park, S. Y. J. I. Lee	
29		20	UCLA	Ken Eltrich A. Rubin, UCL	Ken Eltrich
30		156.7	NIPR	NIPR A. Yamaguchi	
31	4.58	20	MNB	Hichame Mim:A. Greshake,	
32		8.3	IfP	Labenne K. Klemm, A.	
33		60.59	NIPR	NIPR A. Yamaguchi	
34		10.5	UNM	KD MeteoritesC. Agee, UNM	Chris Whitten
35		42.665	NIPR	NIPR A. Yamaguchi	
36		22.6	KOPRI	KOPRI C. Park, S. Y. J. I. Lee	
37	5.14	21	PSF	PSF A. Irving and €	
38	4.86	12	PSF	PSF A. Irving and €	
39		5.182	NIPR	NIPR A. Yamaguchi	
40		0.7	KOPRI	KOPRI C. Park, S. Y. T. Kim	
41		18.9	IfP	unknown K. Klemm, A.	
42		23.4	Cascadia	Cascadia M. Hutson anc	Wendy Woodc
43		19.8	Cascadia	Cascadia M. Hutson anc	Jim Wooddell
44		18.4	Cascadia	Cascadia M. Hutson anc	Troy Ball
45		9.0	Cascadia	Cascadia M. Hutson anc	Jim Wooddell
46	5.16	11	CEREGE	Eric ChristensJ. Gattacceca,	Eric Christens
47		38.0	Cascadia	Cascadia M. Hutson anc	Jim Wooddell

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3		19.3	Cascadia	Cascadia	M. Hutson and Troy Ball	
4		11.3	Cascadia	Cascadia	M. Hutson and Jim Wooddell	
5						
6	3.79	40.145	JSC	JSC	SI	ANSMET
7	3.97	18.830	JSC	JSC	SI	ANSMET
8						
9		29.2	UWB	A. Aaronson	A. Irving and S	
10		20	FMMR	Mikhail Nepon	Pavel Yu. Plek	Mikhail Nepon
11		206	UWO	S. Tutorow	M. Spencer, U	
12		28.3	lfp	Finder	K. Klemm and	Nasser Albuai
13						
14		27.8	lfp	Labenne	K. Klemm, A.	
15	5.10	30.3	CEREGE	ArtMet collecti	J. Gattacceca,	anonymous
16		20.1	lfp	Finder	K. Klemm and	Nasser Albuai
17		53.3	UCLA	Michael Santo	A. Rubin, UCL	
18		21.88	YPMNH	WES	K. Abe and J.	
19		33	UPC	Ion Ander Lan	J. Llorca, UPC	Ion Ander Lan
20		1371.7	NIPR	NIPR	A. Yamaguchi	
21						
22		1091.74	GUT	GUT	B. Miao, Z. Xia	
23						
24		22.7	FMNH	Robert Ward	P. Heck, Jenn	Robert Ward
25	5.44	23.78	CEREGE	Andreas Kopp	L. Krämer Ruç	Andreas Kopp
26		976.43	GUT	GUT	B. Miao, Z. Xia	
27						
28		136.65	UCLA	Michael Cottin	A. Rubin, UCL	
29	5.42	26.4	MNB	Hanno Strufe	A. Greshake, I	
30		587.77	NIPR	NIPR	A. Yamaguchi	
31						
32		553.74	GUT	GUT	B. Miao, Z. Xia	
33		28.4	UCLA	Nick Gessler	A. Rubin, UCL	
34		23.2	UWO	S. Tutorow	T.V. Kizovski,	
35		87.2	OU	Joe Bazyk	R. Greenwood	Joe Bazyk
36		503.35	NIPR	NIPR	A. Yamaguchi	
37		223	GUT	GUT	H. Chen, J. Zhi	Y.Li, HY.Chen
38		22	UPC	José Vicente (J.	Llorca, UPC	José Vicente (
39		26.4	UCLA	Nick Gessler	A. Rubin, UCL	
40		408.46	GUT	GUT	B. Miao, Z. Xia	
41		406.04	NIPR	NIPR	A. Yamaguchi	
42		21.94	UCLA	Nick Gessler	A. Rubin, UCL	
43		358.74	GUT	GUT	B. Miao, Z. Xia	
44						
45						
46						
47	5.2	345.91	JSC	JSC	SI	ANSMET
48		23.3	OU	Joe Bazyk	R. Greenwood	Joe Bazyk
49		29.8	MSN-FI	Di Martino	V. Moggi Cecc	Anonymous
50		24	UPC	Alfonso Viera	J. Llorca, UPC	Alfonso Viera
51		280.89	NIPR	NIPR	A. Yamaguchi	
52		276.91	GUT	GUT	B. Miao, Z. Xia	
53		273.2	GUT	GUT	B. Miao, Z. Xia	
54						
55						
56	4.95	32.8	MNB	Hanno Strufe	A. Greshake, I	
57		266.69	NIPR	NIPR	A. Yamaguchi	
58		250.67	GUT	GUT	B. Miao, Z. Xia	
59		241.17	GUT	GUT	B. Miao, Z. Xia	
60						

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3		221.83	GUT	GUT	B. Miao, Z. Xia
4		22	UPC		José Vicente (J. Llorca, UPCJosé Vicente (
5		23.8	MNB		Philippe SchmA. Greshake, I
6		199.18	GUT	GUT	B. Miao, Z. Xia
7		42.53	UCLA		Dean Bessey A. Rubin, UCL
8		32.0	MSN-FI	Castellano	Vanni Moggi C
9		181.04	GUT	GUT	B. Miao, Z. Xia
10		176.82	GUT	GUT	B. Miao, Z. Xia
11		30	UPC	Ion Ander LanJ. Llorca, UPC	Ion Ander Lan
12		167.26	GUT	GUT	B. Miao, Z. Xia
13		149.07	NIPR	NIPR	A. Yamaguchi
14		21.7	OU	Joe Bazyk	R. Greenwood Joe Bazyk
15	5.04	28	CEREGE	Eric ChristensJ. Gattacceca	Eric Christens
16		138.44	GUT	GUT	B. Miao, Z. Xia
17		135.64	NIPR	NIPR	A. Yamaguchi
18		131.65	GUT	GUT	B. Miao, Z. Xia
19		32.4	Vernad	Mr. M. NepomLorenz C. A., 'Mr. M. Nepom	
20		21.64	UCLA	Dean Bessey A. Rubin, UCL	
21		125.53	GUT	GUT	B. Miao, Z. Xia
22		20.1	MSN-FI	Mimaghador	Vanni Moggi C
23		119.55	NIPR	NIPR	A. Yamaguchi
24		119.31	GUT	GUT	B. Miao, Z. Xia
25		118	GUT	GUT	B. Miao, Z. Xia
26		112.42	NIPR	NIPR	A. Yamaguchi
27		9.7	IfP	Labenne	K. Klemm, A.
28	5.16	105.84	JSC	JSC	SI ANSMET
29		105.71	GUT	GUT	B. Miao, Z. Xia
30		103.96	NIPR	NIPR	A. Yamaguchi
31		96.96	GUT	GUT	B. Miao, Z. Xia
32		96.67	NIPR	NIPR	A. Yamaguchi
33		19.2	MSN-FI	Castellano	V. Moggi Cecc
34		94.22	GUT	GUT	B. Miao, Z. Xia
35		91.49	NIPR	NIPR	A. Yamaguchi
36		17.7	MSN-FI	Castellano	V. Moggi Cecc
37		87.3	GUT	GUT	B. Miao, Z. Xia
38	5.00	82.589	JSC	JSC	SI ANSMET
39		80.38	GUT	GUT	B. Miao, Z. Xia
40		16	OU	Joe Bazyk	R. Greenwood Joe Bazyk
41		78.44	GUT	GUT	B. Miao, Z. Xia
42		77.77	NIPR	NIPR	A. Yamaguchi
43		76.87	GUT	GUT	B. Miao, Z. Xia
44		75.87	GUT	GUT	B. Miao, Z. Xia
45		71.75	NIPR	NIPR	A. Yamaguchi
46		62.75	NIPR	NIPR	A. Yamaguchi
47		62.58	NIPR	NIPR	A. Yamaguchi

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3		62.42	NIPR	NIPR	A. Yamaguchi
4		20	UCLA	Dean Bessey	A. Rubin, UCL
5		56.58	NIPR	NIPR	A. Yamaguchi
6		56.162	NIPR	NIPR	A. Yamaguchi
7		55.04	GUT	GUT	B. Miao, Z. Xia
8		51.125	NIPR	NIPR	A. Yamaguchi
9		49.567	NIPR	NIPR	A. Yamaguchi
10		48.987	NIPR	NIPR	A. Yamaguchi
11		10.2	ROM	Gregory	S. Yokoyama,
12		46.912	NIPR	NIPR	A. Yamaguchi
13		46.292	NIPR	NIPR	A. Yamaguchi
14		12.4	MSN-FI	Cojocar	V. Moggi Cecchi
15		45.06	GUT	GUT	B. Miao, Z. Xia
16		42.75	GUT	GUT	B. Miao, Z. Xia
17		41.447	NIPR	NIPR	A. Yamaguchi
18		39.28	GUT	GUT	B. Miao, Z. Xia
19		39.052	NIPR	NIPR	A. Yamaguchi
20		38.45	GUT	GUT	B. Miao, Z. Xia
21		38.235	NIPR	NIPR	A. Yamaguchi
22		38.202	NIPR	NIPR	A. Yamaguchi
23	5.03	36.72	JSC	JSC	SI ANSMET
24	5.01	35.450	JSC	JSC	SI ANSMET
25		29.8	NIPR	NIPR	A. Yamaguchi
26	5.03	28.96	JSC	JSC	SI ANSMET
27	4.99	27.631	JSC	JSC	SI ANSMET
28		26.803	NIPR	NIPR	A. Yamaguchi
29		21.635	NIPR	NIPR	A. Yamaguchi
30		19.583	NIPR	NIPR	A. Yamaguchi
31		17.77	GUT	GUT	B. Miao, Z. Xia
32		17.747	NIPR	NIPR	A. Yamaguchi
33		17.355	NIPR	NIPR	A. Yamaguchi
34		16.946	NIPR	NIPR	A. Yamaguchi
35		15.737	NIPR	NIPR	A. Yamaguchi
36		14.944	NIPR	NIPR	A. Yamaguchi
37	4.96	14.5	JSC	JSC	SI ANSMET
38		14.491	NIPR	NIPR	A. Yamaguchi
39		14.185	NIPR	NIPR	A. Yamaguchi
40		2.55	Vernad.	Mr. E. Zakhar	Lorenz C. A., 'Mr. E. Zachar
41		10.903	NIPR	NIPR	A. Yamaguchi
42		10.667	NIPR	NIPR	A. Yamaguchi
43		10.578	NIPR	NIPR	A. Yamaguchi
44		8.42	NIPR	NIPR	A. Yamaguchi
45	5.18	7.08	JSC	JSC	SI ANSMET
46		6.248	NIPR	NIPR	A. Yamaguchi
47		5.958	NIPR	NIPR	A. Yamaguchi

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3	5.827	NIPR	NIPR	A. Yamaguchi
4	5.766	NIPR	NIPR	A. Yamaguchi
5	5.727	NIPR	NIPR	A. Yamaguchi
6	5.727	NIPR	NIPR	A. Yamaguchi
7	5.687	NIPR	NIPR	A. Yamaguchi
8	5.64	NIPR	NIPR	A. Yamaguchi
9	5.529	NIPR	NIPR	A. Yamaguchi
10	5.529	NIPR	NIPR	A. Yamaguchi
11	5.486	NIPR	NIPR	A. Yamaguchi
12	5.394	NIPR	NIPR	A. Yamaguchi
13	5.37	NIPR	NIPR	A. Yamaguchi
14	5.37	NIPR	NIPR	A. Yamaguchi
15	5.337	NIPR	NIPR	A. Yamaguchi
16	5.259	NIPR	NIPR	A. Yamaguchi
17	5.21	NIPR	NIPR	A. Yamaguchi
18	5.21	NIPR	NIPR	A. Yamaguchi
19	5.095	NIPR	NIPR	A. Yamaguchi
20	5.012	NIPR	NIPR	A. Yamaguchi
21	4.94 g	NHMV	AUA	Ioannis Baziot
22	4.993	NIPR	NIPR	A. Yamaguchi
23	4.993	NIPR	NIPR	A. Yamaguchi
24	4.981	NIPR	NIPR	A. Yamaguchi
25	4.888	NIPR	NIPR	A. Yamaguchi
26	4.884	NIPR	NIPR	A. Yamaguchi
27	4.884	NIPR	NIPR	A. Yamaguchi
28	4.788	NIPR	NIPR	A. Yamaguchi
29	4.758	NIPR	NIPR	A. Yamaguchi
30	4.676	NIPR	NIPR	A. Yamaguchi
31	4.676	NIPR	NIPR	A. Yamaguchi
32	4.606	NIPR	NIPR	A. Yamaguchi
33	4.53	NIPR	NIPR	A. Yamaguchi
34	4.438	NIPR	NIPR	A. Yamaguchi
35	4.433	NIPR	NIPR	A. Yamaguchi
36	4.433	NIPR	NIPR	A. Yamaguchi
37	4.425	NIPR	NIPR	A. Yamaguchi
38	4.386	NIPR	NIPR	A. Yamaguchi
39	4.36	NIPR	NIPR	A. Yamaguchi
40	4.36	NIPR	NIPR	A. Yamaguchi
41	4.353	NIPR	NIPR	A. Yamaguchi
42	4.297	NIPR	NIPR	A. Yamaguchi
43	4.257	NIPR	NIPR	A. Yamaguchi
44	4.257	NIPR	NIPR	A. Yamaguchi
45	4.25	NIPR	NIPR	A. Yamaguchi
46	4.245	NIPR	NIPR	A. Yamaguchi
47	4.243	NIPR	NIPR	A. Yamaguchi
48	4.096	NIPR	NIPR	A. Yamaguchi
49	4.096	NIPR	NIPR	A. Yamaguchi
50	4.057	NIPR	NIPR	A. Yamaguchi
51	3.983	NIPR	NIPR	A. Yamaguchi
52	3.938	NIPR	NIPR	A. Yamaguchi
53	3.938	NIPR	NIPR	A. Yamaguchi
54	3.844	NIPR	NIPR	A. Yamaguchi
55	3.74	NIPR	NIPR	A. Yamaguchi
56	3.739	NIPR	NIPR	A. Yamaguchi
57	3.739	NIPR	NIPR	A. Yamaguchi
58	3.721	NIPR	NIPR	A. Yamaguchi
59	3.706	NIPR	NIPR	A. Yamaguchi
60	3.688	NIPR	NIPR	A. Yamaguchi

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3	3.646	NIPR	NIPR	A. Yamaguchi
4	3.642	NIPR	NIPR	A. Yamaguchi
5	3.641	NIPR	NIPR	A. Yamaguchi
6	3.641	NIPR	NIPR	A. Yamaguchi
7	3.615	NIPR	NIPR	A. Yamaguchi
8	3.606	NIPR	NIPR	A. Yamaguchi
9	3.602	NIPR	NIPR	A. Yamaguchi
10	3.602	NIPR	NIPR	A. Yamaguchi
11	3.543	NIPR	NIPR	A. Yamaguchi
12	3.514	NIPR	NIPR	A. Yamaguchi
13	3.499	NIPR	NIPR	A. Yamaguchi
14	3.499	NIPR	NIPR	A. Yamaguchi
15	3.465	NIPR	NIPR	A. Yamaguchi
16	3.46	NIPR	NIPR	A. Yamaguchi
17	3.455	NIPR	NIPR	A. Yamaguchi
18	3.455	NIPR	NIPR	A. Yamaguchi
19	3.454	NIPR	NIPR	A. Yamaguchi
20	3.401	NIPR	NIPR	A. Yamaguchi
21	3.4	NIPR	NIPR	A. Yamaguchi
22	3.4	NIPR	NIPR	A. Yamaguchi
23	3.394	NIPR	NIPR	A. Yamaguchi
24	3.309	NIPR	NIPR	A. Yamaguchi
25	3.283	NIPR	NIPR	A. Yamaguchi
26	3.283	NIPR	NIPR	A. Yamaguchi
27	3.245	NIPR	NIPR	A. Yamaguchi
28	3.205	NIPR	NIPR	A. Yamaguchi
29	3.204	NIPR	NIPR	A. Yamaguchi
30	3.203	NIPR	NIPR	A. Yamaguchi
31	3.203	NIPR	NIPR	A. Yamaguchi
32	3.189	NIPR	NIPR	A. Yamaguchi
33	3.188	NIPR	NIPR	A. Yamaguchi
34	3.181	NIPR	NIPR	A. Yamaguchi
35	3.176	NIPR	NIPR	A. Yamaguchi
36	3.176	NIPR	NIPR	A. Yamaguchi
37	3.146	NIPR	NIPR	A. Yamaguchi
38	3.136	NIPR	NIPR	A. Yamaguchi
39	3.123	NIPR	NIPR	A. Yamaguchi
40	3.123	NIPR	NIPR	A. Yamaguchi
41	3.121	NIPR	NIPR	A. Yamaguchi
42	3.091	NIPR	NIPR	A. Yamaguchi
43	3.088	NIPR	NIPR	A. Yamaguchi
44	3.088	NIPR	NIPR	A. Yamaguchi
45	3.083	NIPR	NIPR	A. Yamaguchi
46	3.051	NIPR	NIPR	A. Yamaguchi
47	3.033	NIPR	NIPR	A. Yamaguchi
48	3.009	NIPR	NIPR	A. Yamaguchi
49	3.009	NIPR	NIPR	A. Yamaguchi
50	2.921	NIPR	NIPR	A. Yamaguchi
51	2.916	NIPR	NIPR	A. Yamaguchi
52	2.906	NIPR	NIPR	A. Yamaguchi
53	2.906	NIPR	NIPR	A. Yamaguchi
54	2.856	NIPR	NIPR	A. Yamaguchi
55	2.832	NIPR	NIPR	A. Yamaguchi
56	2.799	NIPR	NIPR	A. Yamaguchi
57	2.799	NIPR	NIPR	A. Yamaguchi
58	2.797	NIPR	NIPR	A. Yamaguchi
59	2.759	NIPR	NIPR	A. Yamaguchi
60	2.748	NIPR	NIPR	A. Yamaguchi

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2				
3	2.731	NIPR	NIPR	A. Yamaguchi
4	2.634	NIPR	NIPR	A. Yamaguchi
5	2.594	NIPR	NIPR	A. Yamaguchi
6	2.558	NIPR	NIPR	A. Yamaguchi
7	2.506	NIPR	NIPR	A. Yamaguchi
8	2.496	NIPR	NIPR	A. Yamaguchi
9	2.481	NIPR	NIPR	A. Yamaguchi
10	2.445	NIPR	NIPR	A. Yamaguchi
11	2.432	NIPR	NIPR	A. Yamaguchi
12	2.253	NIPR	NIPR	A. Yamaguchi
13	2.163	NIPR	NIPR	A. Yamaguchi
14	2.085	NIPR	NIPR	A. Yamaguchi
15	2.063	NIPR	NIPR	A. Yamaguchi
16	1.946	NIPR	NIPR	A. Yamaguchi
17	1.94	NIPR	NIPR	A. Yamaguchi
18	1.932	NIPR	NIPR	A. Yamaguchi
19	1.927	NIPR	NIPR	A. Yamaguchi
20	1.891	NIPR	NIPR	A. Yamaguchi
21	1.794	NIPR	NIPR	A. Yamaguchi
22	1.702	NIPR	NIPR	A. Yamaguchi
23	1.692	NIPR	NIPR	A. Yamaguchi
24	1.672	NIPR	NIPR	A. Yamaguchi
25	1.652	NIPR	NIPR	A. Yamaguchi
26	1.632	NIPR	NIPR	A. Yamaguchi
27	1.616	NIPR	NIPR	A. Yamaguchi
28	1.559	NIPR	NIPR	A. Yamaguchi
29	1.507	NIPR	NIPR	A. Yamaguchi
30	1.497	NIPR	NIPR	A. Yamaguchi
31	1.494	NIPR	NIPR	A. Yamaguchi
32	1.436	NIPR	NIPR	A. Yamaguchi
33	1.374	NIPR	NIPR	A. Yamaguchi
34	1.366	NIPR	NIPR	A. Yamaguchi
35	1.317	NIPR	NIPR	A. Yamaguchi
36	1.263	NIPR	NIPR	A. Yamaguchi
37	1.167	NIPR	NIPR	A. Yamaguchi
38	1.165	NIPR	NIPR	A. Yamaguchi
39	1.09	NIPR	NIPR	A. Yamaguchi
40	1.075	NIPR	NIPR	A. Yamaguchi
41	1.044	NIPR	NIPR	A. Yamaguchi
42	1.02	NIPR	NIPR	A. Yamaguchi
43	0.88	NIPR	NIPR	A. Yamaguchi
44	0.857	NIPR	NIPR	A. Yamaguchi
45	0.85	JSC	JSC	SI ANSMET
46	0.847	NIPR	NIPR	A. Yamaguchi
47	0.813	NIPR	NIPR	A. Yamaguchi

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2					
3		0.705	NIPR	NIPR	A. Yamaguchi
4		0.681	NIPR	NIPR	A. Yamaguchi
5		0.656	NIPR	NIPR	A. Yamaguchi
6		0.605	NIPR	NIPR	A. Yamaguchi
7		0.525	NIPR	NIPR	A. Yamaguchi
8		0.516	NIPR	NIPR	A. Yamaguchi
9		0.511	NIPR	NIPR	A. Yamaguchi
10		0.461	NIPR	NIPR	A. Yamaguchi
11		0.438	NIPR	NIPR	A. Yamaguchi
12		0.422	NIPR	NIPR	A. Yamaguchi
13		0.417	NIPR	NIPR	A. Yamaguchi
14		0.399	NIPR	NIPR	A. Yamaguchi
15		0.386	NIPR	NIPR	A. Yamaguchi
16		0.375	NIPR	NIPR	A. Yamaguchi
17		0.338	NIPR	NIPR	A. Yamaguchi
18		0.308	NIPR	NIPR	A. Yamaguchi
19		0.306	NIPR	NIPR	A. Yamaguchi
20		0.225	NIPR	NIPR	A. Yamaguchi
21		34.8	IGc/USP	Andre L. R. M.M.E. Zucolotti	S. Lima and
22		52.553	NIPR	NIPR	A. Yamaguchi
23		28.89	UCLA	Sean Tutorow	A. Rubin, UCL
24		26.7	UWB	R. Falls	A. Irving and S
25		24.8	lfp	Finder	K. Klemm and Nasser Albuai
26		36.2	lfp	Finder	K. Klemm and Nasser Albuai
27		39	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
28		23	UPC	David Allepuz (J. Llorca, UPC)	David Allepuz-
29	5.31	24.8	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
30		27	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
31		25	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
32		25	UPC	Ion Ander Lan (J. Llorca, UPC)	Ion Ander Lan
33		25.6	lfp	Marc Jost and	K. Klemm and
34		30.38	PSF	PSF	A. Irving and S
35		50	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
36		36700	KOPRI	KOPRI	C. Park, S. Y. T. Kim
37	5.14	83.8	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
38		15900	Vic	Vic	W. Birch, Vic; David Cole
39		11200	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
40	4.97	44.4	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
41		8205.000	JSC	JSC	SI ANSMET
42		165.9	Vernad	anonymous	Lorenz C. A., 'Mr. Alexander
43		71.8	UAb	M. Ouzillou	C. Herd and L
44		21.1	MSN-FI	Gal Hassin	V. Moggi Cecr
45		25	UNM	Aaronson	C. Agee, UNM
46		122.1	UWB	S. Lee	A. Irving and S
47		57.2	MSN-FI	Tomelleri	V. Moggi Cecr (Giorgio Tomel

1					
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3		3463	HMG	HMG	G. Wang, GIG Unknown
4					
5	5.41	36.8	CEREGE	A.Koppelt and L. Krämer	UçA. Koppelt and
6		20.6	UWB	T. Simard	A. Irving and S
7	5.47	25	CEREGE	Labenne Luc	J. Gattacceca, Labenne Luc
8		90	IGGCAS	Qiang Xu	Y. Xu, N. Wan anonymous
9		20.5	UWO	S. Tutorow	Z. Jiang, UWC
10		191.7	Vernad.	Ilya Chaplygin	Lorenz C. A., 'Ilya Chaplygin
11		23.6	MNB	anonymous	A. Greshake, I
12		54.0	UWO	S. Tutorow	J. Laughton, U
13		32.90	UCLA	Michael Cottin	A. Rubin, UCL
14					
15		62.6	MNB	Hichame Mim	A. Greshake, I
16	5.06	922.7	NIPR	NIPR	A. Yamaguchi
17					
18	5.40	54	CEREGE	Labenne Luc	J. Gattacceca, Labenne Luc
19		120	USil	USil	T.A. Przylibski
20		21.0	MSN-FI	Castellano	V. Moggi Cec
21		677.79	GUT	GUT	B. Miao, Z. Xi
22		21	UPC	Alfonso Viera	J. Llorca, UPC Alfonso Viera
23		649.57	GUT	GUT	B. Miao, Z. Xi
24					
25	4.98	36	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
26					
27	4.90	34	CEREGE	ArtMet collecti	L. Krämer Uç
28		38.6	UCLA	Nick Gessler	A. Rubin, UCL
29		612.5	NIPR	NIPR	A. Yamaguchi
30		20	UNM	Suzanne Morr	C. Agee, UNM
31					
32	5.21	557.700	JSC	JSC	SI ANSMET
33		510.99	GUT	GUT	B. Miao, Z. Xi
34		103.17	Vernad.	Mr. T. Kryach	Lorenz C. A., 'Mr. T. Kryach
35		32.2	UWO	S. Tutorow	C. Zhu, UWO
36		26.7	IfP	Marc Jost and	K. Klemm and
37		20	UCLA	Ken Eltrich	A. Rubin, UCL Ken Eltrich
38		463	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
39		37	UPC	David Allepuz	J. Llorca, UPC David Allepuz
40		24.0	MSN-FI	Castellano	Vanni Moggi C
41		439.34	GUT	GUT	B. Miao, Z. Xi
42		60.6	Vernad	DMUH	C.A. Lorenz, V
43		427.83	NIPR	NIPR	A. Yamaguchi
44		30	UPC	David Allepuz	J. Llorca, UPC David Allepuz
45		422.78	GUT	GUT	B. Miao, Z. Xi
46		399.41	GUT	GUT	B. Miao, Z. Xi
47		45.9	OU	Joe Bazyk	R. Greenwood Joe Bazyk
48		393.4	NIPR	NIPR	A. Yamaguchi
49		91	Vernad	Mr. T. Kryach	C. A. Lorenz, 'Mr. T. Kryach
50		23.2	IfP	Finder	K. Klemm and Nasser Albuai
51		65	UPC	José Vicente (J. Llorca, UPC	José Vicente (
52					
53	5.04	22	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
54		20.1	MSN-FI	Di Martino	V. Moggi Cecr Anonymous

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2					
3		23	MNRJ	Museu Tancre	M.E. Zucolotto
4		28.4	MSN-FI	Di Martino	V. Moggi Cecchi
5					Anonymous
6	5.19	24	CEREGE	Eric Christens	J. Gattacceca
7	5.19	250	CEREGE	CEREGE	H. Pourkhorsai
8					Romain Tartese
9	5.15	23	CEREGE	Eric Christens	J. Gattacceca
10		20.3	MSN-FI	Castellano	V. Moggi Cecchi
11		231.36	NIPR	NIPR	A. Yamaguchi
12		24	UPC	Alfonso Viera	J. Llorca, UPC
13					Alfonso Viera
14		226.76	GUT	GUT	B. Miao, Z. Xie
15		226.45	GUT	GUT	B. Miao, Z. Xie
16		21.0	Vernad	DMUH	C.A. Lorenz, V
17		20.6	MSN-FI	Di Martino	V. Moggi Cecchi
18					Anonymous
19		30.2	UWO	S. Tutorow	B. Borba de C
20		196.29	NIPR	NIPR	A. Yamaguchi
21	5.42	193.87	JSC	JSC	SI ANSMET
22	5.09	23	CEREGE	Eric Christens	J. Gattacceca
23					Eric Christens
24		27	UPC	Ion Ander Lan	J. Llorca, UPC
25					Ion Ander Lan
26		191.04	GUT	GUT	B. Miao, Z. Xie
27		186.91	GUT	GUT	B. Miao, Z. Xie
28	5.21	24	CEREGE	Museo del me	J. Gattacceca
29					Rodrigo Martir
30		182.13	GUT	GUT	B. Miao, Z. Xie
31		29.6	lfp	Marc Jost and	K. Klemm and
32		24.1	OU	Joe Bazyk	R. Greenwood
33					Joe Bazyk
34		175.43	GUT	GUT	B. Miao, Z. Xie
35		40.7	Vernad.	Mr. T. Kryachk	Lorenz C. A., 'Mr. T. Kryachk
36		173.59	GUT	GUT	B. Miao, Z. Xie
37		173.54	GUT	GUT	B. Miao, Z. Xie
38		171.34	GUT	GUT	B. Miao, Z. Xie
39		166.55	GUT	GUT	B. Miao, Z. Xie
40		164.82	GUT	GUT	B. Miao, Z. Xie
41		164.57	NIPR	NIPR	A. Yamaguchi
42		161.01	GUT	GUT	B. Miao, Z. Xie
43		28.7	Vernad	DMUH	C.A. Lorenz, V
44		29.3	Vernad	Mr. T. V. Kryachk	Lorenz C. A., 'Mr. T. V. Kryachk
45		40.3	Vernad	Mr. T. V. Kryachk	Lorenz C. A., 'Mr. T. V. Kryachk
46		23	UPC	José Vicente (J.	Llorca, UPC
47					José Vicente (
48	5.19	21	CEREGE	Eric Christens	J. Gattacceca
49					Eric Christens
50		20.1	MSN-FI	Di Martino	V. Moggi Cecchi
51					Anonymous
52		24.30	UCLA	Fred Olsen	D. Sheikh, FS
53		28.42	Vernad.	Mr. T. Kryachk	Lorenz C. A., 'Mr. T. Kryachk
54		33	UPC	José Vicente (J.	Llorca, UPC
55					José Vicente (
56		30	UPC	Josep Maria B.	J. Llorca, UPC
57					Josep Maria B
58		21.1	MSN-FI	Di Martino	V. Moggi Cecchi
59		21.5	MSN-FI	Castellano	V. Moggi Cecchi
60		136.502	NMBE	NMBE	À. Rosén, E.G
					Edwin Gnos, F

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2					
3	5.39	20.1	CEREGE	R. Lenssen	J. Gattacceca,
4		20.84	MSP	Castellano	V. Moggi Cecc
5		131.94	GUT	GUT	B. Miao, Z. Xia
6		130.3	GUT	GUT	B. Miao, Z. Xia
7		128.51	NIPR	NIPR	A. Yamaguchi
8		127.91	NIPR	NIPR	A. Yamaguchi
9					
10					
11	5.03	23	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
12		122.71	GUT	GUT	B. Miao, Z. Xia
13					
14	5.14	122.65	JSC	JSC	SI ANSMET
15	5.16	110	CEREGE	CEREGE	H. Pourkhorsae Lydie Bonal
16		119.15	GUT	GUT	B. Miao, Z. Xia
17		21	ROM	owner	V. Di Cecco, I.
18		117.44	GUT	GUT	B. Miao, Z. Xia
19		20	UPC	José Vicente	(J. Llorca, UPC, José Vicente)
20		116.48	GUT	GUT	B. Miao, Z. Xia
21		115.4	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
22		114.53	NIPR	NIPR	A. Yamaguchi
23					
24					
25	4.82	22	CEREGE	Eric Christens	H. Pourkhorsae Eric Christens
26		111.79	GUT	GUT	B. Miao, Z. Xia
27		109.91	GUT	GUT	B. Miao, Z. Xia
28		109.38	GUT	GUT	B. Miao, Z. Xia
29		100.73	NIPR	NIPR	A. Yamaguchi
30		100.154	JSC	JSC	SI ANSMET
31	5.20	99.9	GUT	GUT	B. Miao, Z. Xia
32		97.72	GUT	GUT	B. Miao, Z. Xia
33		97.43	NIPR	NIPR	A. Yamaguchi
34					
35					
36					
37	5.05	96.57	JSC	JSC	SI ANSMET
38		18.6	MSN-FI	Castellano	V. Moggi Cecc, Anonymous
39	5.09	19	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
40		92.2	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
41		91.71	NIPR	NIPR	A. Yamaguchi
42		91.58	GUT	GUT	B. Miao, Z. Xia
43		18.1	MSN-FI	Castellano	V. Moggi Cecc
44		88.41	NIPR	NIPR	A. Yamaguchi
45		85	GUT	GUT	B. Miao, Z. Xia
46					
47					
48	4.99	84.250	JSC	JSC	SI ANSMET
49		83	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
50					
51	5.07	82.56	JSC	JSC	SI ANSMET
52		21.3	MSN-FI	Di Martino	V. Moggi Cecc, Anonymous
53					
54	5.12	82.15	JSC	JSC	SI ANSMET
55		80.1	NIPR	NIPR	A. Yamaguchi
56		17.3	Cascadia	Charles Lucas	M. Hutson anc Charles and N
57		77.03	NIPR	NIPR	A. Yamaguchi
58					
59	5.17	21	MNB	Hichame Mim	:A. Greshake, I
60		16.3	Vernad	anonymous	Lorenz C. A., 'anonymous

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2					
3		75	NHMD	NHMD	A.N. Krot, D. V
4		71.18	GUT	GUT	B. Miao, Z. Xia
5		70.68	GUT	GUT	B. Miao, Z. Xia
6		68.8	NIPR	NIPR	A. Yamaguchi
7		14	UPC	David Allepuz	J. Llorca, UPCDavid Allepuz
8		18.7	MSN-FI	Di Martino	V. Moggi Cecchi
9		18.7	MSN-FI	Di Martino	V. Moggi Cecchi
10		18.7	MSN-FI	Di Martino	V. Moggi Cecchi
11	5.09	67.903	JSC	JSC	SI ANSMET
12		67.77	GUT	GUT	B. Miao, Z. Xia
13	5.13	18	CEREGE	Eric Christens	J. GattaccecaEric Christens
14	4.71	14	CEREGE	Eric Christens	J. GattaccecaEric Christens
15		16.3	Vernad	anonymous	Lorenz C. A., 'anonymous
16		13.23	Vernad.	Mr. T. Kryachuk	Lorenz C. A., 'Mr. T. Kryachuk
17		13.23	Vernad.	Mr. T. Kryachuk	Lorenz C. A., 'Mr. T. Kryachuk
18		13.23	Vernad.	Mr. T. Kryachuk	Lorenz C. A., 'Mr. T. Kryachuk
19	4.82	63.981	JSC	JSC	SI ANSMET
20	5.15	24.4	MNB	Hichame Mimouni	A. Greshake, I
21		62.14	GUT	GUT	B. Miao, Z. Xia
22		61.04	NIPR	NIPR	A. Yamaguchi
23		61.04	GUT	GUT	B. Miao, Z. Xia
24		61.04	GUT	GUT	B. Miao, Z. Xia
25		18	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
26		60.88	NIPR	NIPR	A. Yamaguchi
27		60.88	NIPR	NIPR	A. Yamaguchi
28	4.61	13	CEREGE	Eric Christens	J. GattaccecaEric Christens
29		17.1	Cascadia	John A. Shea,	M. Hutson, A.
30		59.9	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
31		16.9	MSN-FI	Petriccione	V. Moggi Cecchi
32		16.9	MSN-FI	Petriccione	V. Moggi Cecchi
33		58.18	NIPR	NIPR	A. Yamaguchi
34		57.919	NIPR	NIPR	A. Yamaguchi
35		11.3	Vernad	anonymous	Lorenz C. A., 'anonymous
36		56.26	GUT	GUT	B. Miao, Z. Xia
37		55.996	NIPR	NIPR	A. Yamaguchi
38		55.996	NIPR	NIPR	A. Yamaguchi
39		55.421	NIPR	NIPR	A. Yamaguchi
40		11.4	Cascadia	John A. Shea,	M. Hutson and
41		11.4	Cascadia	John A. Shea,	M. Hutson and
42		18	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
43	5.10	53.889	JSC	JSC	SI ANSMET
44		12.1	MSN-FI	Castellano	V. Moggi Cecchi
45		12.1	MSN-FI	Castellano	V. Moggi Cecchi
46	4.92	12	CEREGE	Eric Christens	J. GattaccecaEric Christens
47	5.03	50.55	JSC	JSC	SI ANSMET
48	5.10	49.702	JSC	JSC	SI ANSMET
49		49.702	JSC	JSC	SI ANSMET
50		13	MSN-FI	Di Martino	V. Moggi Cecchi
51		13	MSN-FI	Di Martino	V. Moggi Cecchi
52		48.16	GUT	GUT	B. Miao, Z. Xia
53		46.28	GUT	GUT	B. Miao, Z. Xia
54		46.03	GUT	GUT	B. Miao, Z. Xia
55		44.2	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
56	5.31	11	CEREGE	Labenne Luc	J. GattaccecaLabenne Luc
57		43.82	GUT	GUT	B. Miao, Z. Xia
58		43.74	GUT	GUT	B. Miao, Z. Xia
59		43.74	GUT	GUT	B. Miao, Z. Xia
60	5.03	43.600	JSC	JSC	SI ANSMET

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2					
3	4.80	9.1	CEREGE	Jean Redelsp	J. Gattacceca,
4		42.963	NIPR	NIPR	A. Yamaguchi
5		42.112	NIPR	NIPR	A. Yamaguchi
6		41.812	NIPR	NIPR	A. Yamaguchi
7		41.5	GUT	GUT	B. Miao, Z. Xia
8					
9	4.88	40.34	JSC	JSC	SI ANSMET
10		40.074	NIPR	NIPR	A. Yamaguchi
11		39	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
12		38.66	NIPR	NIPR	A. Yamaguchi
13		7.7	ROM	Gregory	S. Yokoyama,
14		36.93	GUT	GUT	B. Miao, Z. Xia
15					
16	5.02	10	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
17		36.676	NIPR	NIPR	A. Yamaguchi
18		36.34	GUT	GUT	B. Miao, Z. Xia
19					
20	5.13	36.150	JSC	JSC	SI ANSMET
21		35.858	JSC	JSC	SI ANSMET
22		8.62	UCLA	Verish	A. Rubin, UCL John P. Wolfe
23		35.503	NIPR	NIPR	A. Yamaguchi
24		33	GUT	GUT	B. Miao, Z. Xia
25					
26	4.91	32.339	JSC	JSC	SI ANSMET
27	4.90	31.430	JSC	JSC	SI ANSMET
28		31.131	NIPR	NIPR	A. Yamaguchi
29		30.78	GUT	GUT	B. Miao, Z. Xia
30		30.37	GUT	GUT	B. Miao, Z. Xia
31		30.1	GUT	GUT	B. Miao, Z. Xia
32					
33	5.03	29.798	JSC	JSC	SI ANSMET
34		28.58	GUT	GUT	B. Miao, Z. Xia
35					
36	5.16	28.343	JSC	JSC	SI ANSMET
37	4.94	28.215	JSC	JSC	SI ANSMET
38		27.91	GUT	GUT	B. Miao, Z. Xia
39		27.3	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
40					
41	5.16	8	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
42		27	GUT	GUT	B. Miao, Z. Xia
43		26.762	NIPR	NIPR	A. Yamaguchi
44					
45	5.16	26.192	JSC	JSC	SI ANSMET
46	5.03	26.03	JSC	JSC	SI ANSMET
47		26	KOPRI	KOPRI	C. Park, S. Y. S. Park
48		25.76	GUT	GUT	B. Miao, Z. Xia
49		25.32	GUT	GUT	B. Miao, Z. Xia
50		9	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
51		23.504	NIPR	NIPR	A. Yamaguchi
52	5.14	23.306	JSC	JSC	SI ANSMET
53	5.08	22.500	JSC	JSC	SI ANSMET
54		22.3	GUT	GUT	B. Miao, Z. Xia
55		22.07	GUT	GUT	B. Miao, Z. Xia

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3		21.56	NIPR	NIPR	A. Yamaguchi
4		21.206	NIPR	NIPR	A. Yamaguchi
5					
6	4.81	20.346	JSC	JSC	SI ANSMET
7		20.238	NIPR	NIPR	A. Yamaguchi
8		20.016	NIPR	NIPR	A. Yamaguchi
9					
10		19.819	NIPR	NIPR	A. Yamaguchi
11	5.11	19.439	JSC	JSC	SI ANSMET
12	5.17	19.055	JSC	JSC	SI ANSMET
13					
14	5.21	18.928	JSC	JSC	SI ANSMET
15		18.887	NIPR	NIPR	A. Yamaguchi
16		17	UPC	Jordi Llorca	J. Llorca, UPC Jordi Llorca
17					
18	5.11	17.966	JSC	JSC	SI ANSMET
19		17.2	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
20		17.1	NIPR	NIPR	A. Yamaguchi
21		16.94	GUT	GUT	B. Miao, Z. Xia
22					
23		16.784	NIPR	NIPR	A. Yamaguchi
24	5.04	16.58	JSC	JSC	SI ANSMET
25	4.79	16.525	JSC	JSC	SI ANSMET
26					
27	5.02	16.500	JSC	JSC	SI ANSMET
28		16.3	KOPRI	KOPRI	C. Park, S. Y. Justin
29	4.51	4.3	CEREGE	Labenne Luc	J. Gattacceca, Labenne Luc
30		16.046	NIPR	NIPR	A. Yamaguchi
31					
32		15.868	NIPR	NIPR	A. Yamaguchi
33		10.1	Vernad	Vernad	C. A. Lorenz, 'Mr. S. E. Boris
34		3	UPC	José Vicente	(J. Llorca, UPC José Vicente (
35					
36	5.15	13.786	JSC	JSC	SI ANSMET
37	5.01	13.738	JSC	JSC	SI ANSMET
38		12.943	NIPR	NIPR	A. Yamaguchi
39		12.699	NIPR	NIPR	A. Yamaguchi
40					
41		12.362	NIPR	NIPR	A. Yamaguchi
42		12.17	NIPR	NIPR	A. Yamaguchi
43					
44	5.15	11.99	JSC	JSC	SI ANSMET
45	5.06	11.922	JSC	JSC	SI ANSMET
46		11.888	JSC	JSC	SI ANSMET
47	4.99	11.78	JSC	JSC	SI ANSMET
48					
49	5.18	11.599	JSC	JSC	SI ANSMET
50		11.58	GUT	GUT	B. Miao, Z. Xia
51		11.533	NIPR	NIPR	A. Yamaguchi
52		11.35	GUT	GUT	B. Miao, Z. Xia
53					
54		11.03	GUT	GUT	B. Miao, Z. Xia
55		10.93	GUT	GUT	B. Miao, Z. Xia
56		10.9	KOPRI	KOPRI	C. Park, S. Y. S. Park
57		10.88	GUT	GUT	B. Miao, Z. Xia
58					
59	5.24	10.76	JSC	JSC	SI ANSMET
60		10.62	NIPR	NIPR	A. Yamaguchi

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2					
3		10.5	KOPRI	KOPRI	C. Park, S. Y. S. Park
4		10.415	NIPR	NIPR	A. Yamaguchi
5		3.6	Vernad.	T. Kryachko, tLorenz C. A., 'T. Kryachko, E	
6		10	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
7		8	UPC	José Vicente (J. Llorca, UPCJosé Vicente (
8		9.887	NIPR	NIPR	A. Yamaguchi
9		9.852	NIPR	NIPR	A. Yamaguchi
10		9.27	GUT	GUT	B. Miao, Z. Xia
11		9.268	NIPR	NIPR	A. Yamaguchi
12		9.147	NIPR	NIPR	A. Yamaguchi
13		9.063	NIPR	NIPR	A. Yamaguchi
14		9.03	NIPR	NIPR	A. Yamaguchi
15		8.84	GUT	GUT	B. Miao, Z. Xia
16	5.21	8.56	JSC	JSC	SI ANSMET
17		8.519	NIPR	NIPR	A. Yamaguchi
18		8.372	NIPR	NIPR	A. Yamaguchi
19	4.59	8.3	JSC	JSC	SI ANSMET
20		7.63	NIPR	NIPR	A. Yamaguchi
21		7.63	NIPR	NIPR	A. Yamaguchi
22		7.34	NIPR	NIPR	A. Yamaguchi
23		6.878	NIPR	NIPR	A. Yamaguchi
24	5.02	2	CEREGE	Eric ChristensJ. Gattacceca, Eric Christens	
25		4.36	Vernad	Mr. T. Kryachko, Lorenz C. A., 'Mr. T. Kryachko	
26		6.218	NIPR	NIPR	A. Yamaguchi
27		6.1	NIPR	NIPR	A. Yamaguchi
28		6.08	NIPR	NIPR	A. Yamaguchi
29		5.971	NIPR	NIPR	A. Yamaguchi
30		5.14	NIPR	NIPR	A. Yamaguchi
31		4.988	NIPR	NIPR	A. Yamaguchi
32		4.769	NIPR	NIPR	A. Yamaguchi
33		4.76	NIPR	NIPR	A. Yamaguchi
34		4.758	NIPR	NIPR	A. Yamaguchi
35		4.748	NIPR	NIPR	A. Yamaguchi
36		4.554	NIPR	NIPR	A. Yamaguchi
37		4.507	NIPR	NIPR	A. Yamaguchi
38		4.475	NIPR	NIPR	A. Yamaguchi
39		4.403	NIPR	NIPR	A. Yamaguchi
40		4.394	NIPR	NIPR	A. Yamaguchi
41		4.376	NIPR	NIPR	A. Yamaguchi
42		4.289	NIPR	NIPR	A. Yamaguchi
43		4.277	NIPR	NIPR	A. Yamaguchi
44		4.244	NIPR	NIPR	A. Yamaguchi
45		4.22	NIPR	NIPR	A. Yamaguchi
46		4.189	NIPR	NIPR	A. Yamaguchi
47		4.115	NIPR	NIPR	A. Yamaguchi
48					
49					
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3		4.106	NIPR	NIPR	A. Yamaguchi
4		4.041	NIPR	NIPR	A. Yamaguchi
5		3.942	NIPR	NIPR	A. Yamaguchi
6		3.931	NIPR	NIPR	A. Yamaguchi
7		3.931	NIPR	NIPR	A. Yamaguchi
8		3.922	NIPR	NIPR	A. Yamaguchi
9		3.852	NIPR	NIPR	A. Yamaguchi
10		3.833	NIPR	NIPR	A. Yamaguchi
11		3.784	NIPR	NIPR	A. Yamaguchi
12		3.756	NIPR	NIPR	A. Yamaguchi
13		3.74	JSC	JSC	SI ANSMET
14	4.61	3.725	NIPR	NIPR	A. Yamaguchi
15		3.431	NIPR	NIPR	A. Yamaguchi
16		3.411	NIPR	NIPR	A. Yamaguchi
17		3.355	NIPR	NIPR	A. Yamaguchi
18		3.315	NIPR	NIPR	A. Yamaguchi
19		3.308	NIPR	NIPR	A. Yamaguchi
20		3.235	NIPR	NIPR	A. Yamaguchi
21		3.149	NIPR	NIPR	A. Yamaguchi
22		3.148	NIPR	NIPR	A. Yamaguchi
23		3.1	KOPRI	KOPRI	C. Park, S. Y. B. W. Son
24		2.898	NIPR	NIPR	A. Yamaguchi
25		2.826	NIPR	NIPR	A. Yamaguchi
26		2.754	NIPR	NIPR	A. Yamaguchi
27		2.738	NIPR	NIPR	A. Yamaguchi
28		2.712	NIPR	NIPR	A. Yamaguchi
29		2.667	NIPR	NIPR	A. Yamaguchi
30		2.619	NIPR	NIPR	A. Yamaguchi
31		2.617	NIPR	NIPR	A. Yamaguchi
32		2.617	NIPR	NIPR	A. Yamaguchi
33		2.502	NIPR	NIPR	A. Yamaguchi
34		2.494	NIPR	NIPR	A. Yamaguchi
35		2.432	NIPR	NIPR	A. Yamaguchi
36		2.335	NIPR	NIPR	A. Yamaguchi
37		2.333	NIPR	NIPR	A. Yamaguchi
38		2.267	NIPR	NIPR	A. Yamaguchi
39		2.253	NIPR	NIPR	A. Yamaguchi
40		2.223	NIPR	NIPR	A. Yamaguchi
41		2.213	NIPR	NIPR	A. Yamaguchi
42		2.13	NIPR	NIPR	A. Yamaguchi
43		1.978	NIPR	NIPR	A. Yamaguchi
44		1.912	NIPR	NIPR	A. Yamaguchi
45		1.824	NIPR	NIPR	A. Yamaguchi
46		1.793	NIPR	NIPR	A. Yamaguchi
47		1.755	NIPR	NIPR	A. Yamaguchi
48					
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3	1.734	NIPR	NIPR	A. Yamaguchi	
4	1.722	NIPR	NIPR	A. Yamaguchi	
5	1.643	NIPR	NIPR	A. Yamaguchi	
6	1.623	NIPR	NIPR	A. Yamaguchi	
7	1.623	NIPR	NIPR	A. Yamaguchi	
8	1.606	NIPR	NIPR	A. Yamaguchi	
9	1.6	NIPR	NIPR	A. Yamaguchi	
10	1.6	NIPR	NIPR	A. Yamaguchi	
11	1.575	NIPR	NIPR	A. Yamaguchi	
12	1.532	NIPR	NIPR	A. Yamaguchi	
13	1.518	NIPR	NIPR	A. Yamaguchi	
14	1.518	NIPR	NIPR	A. Yamaguchi	
15	1.443	NIPR	NIPR	A. Yamaguchi	
16	1.424	NIPR	NIPR	A. Yamaguchi	
17	1.424	NIPR	NIPR	A. Yamaguchi	
18	1.424	NIPR	NIPR	A. Yamaguchi	
19	1.423	NIPR	NIPR	A. Yamaguchi	
20	1.42	NIPR	NIPR	A. Yamaguchi	
21	1.410	JSC	JSC	SI	ANSMET
22	1.373	NIPR	NIPR	A. Yamaguchi	
23	1.373	NIPR	NIPR	A. Yamaguchi	
24	1.37	JSC	JSC	SI	ANSMET
25	1.370	JSC	JSC	SI	ANSMET
26	1.367	NIPR	NIPR	A. Yamaguchi	
27	1.367	NIPR	NIPR	A. Yamaguchi	
28	1.355	NIPR	NIPR	A. Yamaguchi	
29	1.335	NIPR	NIPR	A. Yamaguchi	
30	1.310	JSC	JSC	SI	ANSMET
31	1.310	JSC	JSC	SI	ANSMET
32	1.278	NIPR	NIPR	A. Yamaguchi	
33	1.278	NIPR	NIPR	A. Yamaguchi	
34	1.267	NIPR	NIPR	A. Yamaguchi	
35	1.194	NIPR	NIPR	A. Yamaguchi	
36	1.194	NIPR	NIPR	A. Yamaguchi	
37	1.169	NIPR	NIPR	A. Yamaguchi	
38	1.157	NIPR	NIPR	A. Yamaguchi	
39	1.137	NIPR	NIPR	A. Yamaguchi	
40	1.137	NIPR	NIPR	A. Yamaguchi	
41	1.108	NIPR	NIPR	A. Yamaguchi	
42	1.1	KOPRI	KOPRI	C. Park, S. Y. S. Park	
43	1.087	NIPR	NIPR	A. Yamaguchi	
44	1.086	NIPR	NIPR	A. Yamaguchi	
45	1.086	NIPR	NIPR	A. Yamaguchi	
46	1.056	NIPR	NIPR	A. Yamaguchi	
47	1.04	NIPR	NIPR	A. Yamaguchi	
48	1.03	NIPR	NIPR	A. Yamaguchi	
49	1.03	NIPR	NIPR	A. Yamaguchi	
50	1.02	NIPR	NIPR	A. Yamaguchi	
51	1.008	NIPR	NIPR	A. Yamaguchi	
52	1.008	NIPR	NIPR	A. Yamaguchi	
53	0.994	NIPR	NIPR	A. Yamaguchi	
54	0.969	NIPR	NIPR	A. Yamaguchi	
55	0.957	NIPR	NIPR	A. Yamaguchi	
56	0.826	NIPR	NIPR	A. Yamaguchi	
57	0.82	NIPR	NIPR	A. Yamaguchi	
58	0.82	NIPR	NIPR	A. Yamaguchi	
59	0.801	NIPR	NIPR	A. Yamaguchi	
60	0.790	JSC	JSC	SI	ANSMET

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3		0.751	NIPR	NIPR	A. Yamaguchi
4		0.694	NIPR	NIPR	A. Yamaguchi
5		0.651	JSC	JSC	SI ANSMET
6		0.644	NIPR	NIPR	A. Yamaguchi
7		0.581	NIPR	NIPR	A. Yamaguchi
8		0.578	NIPR	NIPR	A. Yamaguchi
9		0.52	NIPR	NIPR	A. Yamaguchi
10		0.507	NIPR	NIPR	A. Yamaguchi
11		0.393	NIPR	NIPR	A. Yamaguchi
12		0.385	NIPR	NIPR	A. Yamaguchi
13		0.37	NIPR	NIPR	A. Yamaguchi
14		0.35	NIPR	NIPR	A. Yamaguchi
15		0.349	NIPR	NIPR	A. Yamaguchi
16		0.3	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
17		0.298	NIPR	NIPR	A. Yamaguchi
18		1468	Vernad	DMUH	C. A. Lorenz, '
19		16.0	IfP	Finder	K. Klemm, A. lanonymous
20	5.22	77.4	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
21	4.92	0.82	MNB	Said Yousfi	A. Greshake, I
22		37	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
23	4.66	21	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
24		290	IGGCAS	Pengli Chen	N. Wang, Y. XCa Rongpubu
25		593.36	UCLA	Michael Cottin	A. Rubin, UCL
26		25	UNM	Dustin Dicken	C. Agee, UNM
27		52.4	MSN-FI	Tomelleri	V. Moggi Cecc
28		20	IfP	Manuel Nieto	K. Metzler, IfP
29		141	NHMV	A. Pani	F. Brandstaett
30		47	UPC	Ion Ander Lan	J. Llorca, UPC Ion Ander Lan
31	5.04	54	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
32		36	UCLA	Verish	D. Sheikh, FS Mark Bittmanr
33		25.5	MNB	Dario Ruiz	Ansgar Gresh, Dario Ruiz
34		1712.9	NIPR	NIPR	A. Yamaguchi
35		20.2	MSN-FI	Castellano	V. Moggi Cecc
36		1189.29	UrFU	UrFU	V. V. Sharygir UrFU meteorit
37		30.2	MSN-FI	Tomelleri	V. Moggi Cecc
38		21	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
39		1043.3	NIPR	NIPR	A. Yamaguchi
40		20.8	UWB	S. Ralew	A. Irving and S
41		28	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
42	5.05	23.3	CEREGE	R. Lenssen	L. Krämer Ruç
43		78	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
44		676.8	NIPR	NIPR	A. Yamaguchi
45		41	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
46		29.2	MNB	Ahmed Taleb	A. Greshake, I Ahmed Taleb
47		496.69	NIPR	NIPR	A. Yamaguchi

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2					
3		20.51	UCLA	Nick Gessler	A. Rubin, UCL
4		31	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
5		20.1	UWB	M. Goff	A. Irving and S
6		24.9	MNB	Dario Ruiz	Ansgar Gresh; Dario Ruiz
7		58	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
8		286.05	NIPR	NIPR	A. Yamaguchi
9		249.36	UrFU	UrFU	Victor V. Shar; UrFU meteorit
10		281.64	GUT	GUT	B. Miao, Z. Xia
11		270.13	GUT	GUT	B. Miao, Z. Xia
12		33	UPC	David Allepuz	J. Llorca, UPC; David Allepuz
13		258	OAM	OAM	L. Folco, UPis
14		213.8	UrFU	UrFU	Victor V. Shar; UrFU meteorit
15		242.87	NIPR	NIPR	A. Yamaguchi
16	5.21	211.53	JSC	JSC	SI ANSMET
17		25.1	ROM	Gregory	S. Yokoyama,
18	4.95	21	CEREGE	Eric Christens	J. Gattacceca; Eric Christens
19		178.49	GUT	GUT	B. Miao, Z. Xia
20		175.59	GUT	GUT	B. Miao, Z. Xia
21		172.94	GUT	GUT	B. Miao, Z. Xia
22		171.97	GUT	GUT	B. Miao, Z. Xia
23		169.77	GUT	GUT	B. Miao, Z. Xia
24		164.95	GUT	GUT	B. Miao, Z. Xia
25	4.88	161.460	JSC	JSC	SI ANSMET
26		159.19	NIPR	NIPR	A. Yamaguchi
27		147.97	GUT	GUT	B. Miao, Z. Xia
28		20	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
29	5.12	134.868	JSC	JSC	SI ANSMET
30		134.72	GUT	GUT	B. Miao, Z. Xia
31		128.72	GUT	GUT	B. Miao, Z. Xia
32		128.2	NIPR	NIPR	A. Yamaguchi
33		118.4	GUT	GUT	B. Miao, Z. Xia
34	5.23	104.266	JSC	JSC	SI ANSMET
35		20.5	MSN-FI	Di Martino	V. Moggi Cecchi; Anonymous
36		101.97	GUT	GUT	B. Miao, Z. Xia
37	5.19	96.42	JSC	JSC	SI ANSMET
38		89.17	GUT	GUT	B. Miao, Z. Xia
39		88.71	GUT	GUT	B. Miao, Z. Xia
40		87.71	NIPR	NIPR	A. Yamaguchi
41		85.94	GUT	GUT	B. Miao, Z. Xia
42	5.03	83.13	JSC	JSC	SI ANSMET
43		79.45	NIPR	NIPR	A. Yamaguchi
44		77.52	GUT	GUT	B. Miao, Z. Xia
45	5.38	77.064	JSC	JSC	SI ANSMET
46		72.98	NIPR	NIPR	A. Yamaguchi
47		68.15	GUT	GUT	B. Miao, Z. Xia

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2					
3		66.81	NIPR	NIPR	A. Yamaguchi
4		66.05	NIPR	NIPR	A. Yamaguchi
5					
6	5.51	66.002	JSC	JSC	SI ANSMET
7	5.14	63.269	JSC	JSC	SI ANSMET
8		62.69	GUT	GUT	B. Miao, Z. Xia
9		61.61	GUT	GUT	B. Miao, Z. Xia
10					
11	5.2	59.06	JSC	JSC	SI ANSMET
12		58.55	GUT	GUT	B. Miao, Z. Xia
13		11.7	MSN-FI	Jacques de la V. Moggi Cec	
14		57.54	NIPR	NIPR	A. Yamaguchi
15		56.63	GUT	GUT	B. Miao, Z. Xia
16					
17	5.15	55.91	JSC	JSC	SI ANSMET
18		55.7	GUT	GUT	B. Miao, Z. Xia
19		55.653	NIPR	NIPR	A. Yamaguchi
20		54.004	NIPR	NIPR	A. Yamaguchi
21		52.105	NIPR	NIPR	A. Yamaguchi
22		51.66	GUT	GUT	B. Miao, Z. Xia
23		51.424	NIPR	NIPR	A. Yamaguchi
24					
25	5.24	49.54	JSC	JSC	SI ANSMET
26		12.0	MSN-FI	Castellano	V. Moggi Cec
27	4.90	48.785	JSC	JSC	SI ANSMET
28	5.07	44.96	JSC	JSC	SI ANSMET
29	5.09	44.183	JSC	JSC	SI ANSMET
30		44.15	GUT	GUT	B. Miao, Z. Xia
31		26.9	UCLA	UCLA	C. Anderkin, L
32	5.16	42.312	JSC	JSC	SI ANSMET
33	5.30	9.6	MNB	Hanno Strufe	A. Greshake, I
34	5.1	41.44	JSC	JSC	SI ANSMET
35	5.05	41.315	JSC	JSC	SI ANSMET
36	5.10	40	CEREGE	CEREGE	H. Pourkhorsaj. Gattacceca
37		40.22	GUT	GUT	B. Miao, Z. Xia
38		39.77	GUT	GUT	B. Miao, Z. Xia
39		37.84	GUT	GUT	B. Miao, Z. Xia
40	5.10	36.636	JSC	JSC	SI ANSMET
41		8.2	ROM	Gregory	S. Yokoyama,
42		35.441	NIPR	NIPR	A. Yamaguchi
43	5.05	34.510	JSC	JSC	SI ANSMET
44		33.7	KOPRI	KOPRI	C. Park, S. Y. T. Kim
45	4.88	32.900	JSC	JSC	SI ANSMET
46		31.81	NIPR	NIPR	A. Yamaguchi
47	5.04	31.703	JSC	JSC	SI ANSMET
48	5.07	31.64	JSC	JSC	SI ANSMET
49		30.965	JSC	JSC	SI ANSMET
50		30.538	JSC	JSC	SI ANSMET
51	5.21	30.48	JSC	JSC	SI ANSMET
52					
53					
54					
55					
56					
57					
58					
59					
60					

1					
2					
3		5.8	ROM	Gregory	J. Poitras and
4		28.836	NIPR	NIPR	A. Yamaguchi
5		28.816	NIPR	NIPR	A. Yamaguchi
6		28.816	NIPR	NIPR	A. Yamaguchi
7	5.21	28.24	JSC	JSC	SI ANSMET
8		21.7	Cascadia	Cascadia	M. Hutson and Jim Wooddell
9		27.790	JSC	JSC	SI ANSMET
10	4.83	27.790	JSC	JSC	SI ANSMET
11		27.789	NIPR	NIPR	A. Yamaguchi
12		27.728	NIPR	NIPR	A. Yamaguchi
13		27.619	NIPR	NIPR	A. Yamaguchi
14		27.598	JSC	JSC	SI ANSMET
15		27.598	JSC	JSC	SI ANSMET
16		26.259	NIPR	NIPR	A. Yamaguchi
17		25.16	NIPR	NIPR	A. Yamaguchi
18		24.638	NIPR	NIPR	A. Yamaguchi
19		24.638	NIPR	NIPR	A. Yamaguchi
20	4.75	24.49	JSC	JSC	SI ANSMET
21	5.11	24.271	JSC	JSC	SI ANSMET
22		23.78	GUT	GUT	B. Miao, Z. Xia
23		23.78	GUT	GUT	B. Miao, Z. Xia
24	5.07	23.193	JSC	JSC	SI ANSMET
25		22.842	NIPR	NIPR	A. Yamaguchi
26		22.53	JSC	JSC	SI ANSMET
27	5.01	22.53	JSC	JSC	SI ANSMET
28	4.87	22.480	JSC	JSC	SI ANSMET
29	4.98	22.43	JSC	JSC	SI ANSMET
30	4.99	21.926	JSC	JSC	SI ANSMET
31		21.926	JSC	JSC	SI ANSMET
32		21.476	NIPR	NIPR	A. Yamaguchi
33	5.09	21.450	JSC	JSC	SI ANSMET
34		21.21	GUT	GUT	B. Miao, Z. Xia
35		21.073	JSC	JSC	SI ANSMET
36		21.073	JSC	JSC	SI ANSMET
37		20.892	NIPR	NIPR	A. Yamaguchi
38		20.2	KOPRI	KOPRI	C. Park, S. Y. T. Kim
39		19.894	JSC	JSC	SI ANSMET
40	4.97	19.894	JSC	JSC	SI ANSMET
41		19.25	NIPR	NIPR	A. Yamaguchi
42	5.09	18.950	JSC	JSC	SI ANSMET
43	4.74	18.58	JSC	JSC	SI ANSMET
44		18.58	JSC	JSC	SI ANSMET
45	4.86	18.46	JSC	JSC	SI ANSMET
46		17.97	GUT	GUT	B. Miao, Z. Xia
47	5.11	17.900	JSC	JSC	SI ANSMET
48		17.858	JSC	JSC	SI ANSMET
49	5.01	17.858	JSC	JSC	SI ANSMET
50	4.9	17.54	JSC	JSC	SI ANSMET
51	4.77	16.096	JSC	JSC	SI ANSMET
52	5.02	15.701	JSC	JSC	SI ANSMET
53		15.69	NIPR	NIPR	A. Yamaguchi
54		15.69	NIPR	NIPR	A. Yamaguchi
55	5.18	15.45	JSC	JSC	SI ANSMET
56		14.953	NIPR	NIPR	A. Yamaguchi
57		14.953	NIPR	NIPR	A. Yamaguchi
58	5.01	14.95	JSC	JSC	SI ANSMET
59	5.08	14.630	JSC	JSC	SI ANSMET
60		14.619	NIPR	NIPR	A. Yamaguchi

1					
2					
3		14.56	GUT	GUT	B. Miao, Z. Xia
4		3	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
5					
6	4.98	13.987	JSC	JSC	SI ANSMET
7		13.96	GUT	GUT	B. Miao, Z. Xia
8	5.17	13.47	JSC	JSC	SI ANSMET
9					
10	4.81	13.367	JSC	JSC	SI ANSMET
11	4.71	12.891	JSC	JSC	SI ANSMET
12		12.489	JSC	JSC	SI ANSMET
13					
14	4.92	11.990	JSC	JSC	SI ANSMET
15	4.75	11.982	JSC	JSC	SI ANSMET
16	5.06	11.180	JSC	JSC	SI ANSMET
17	4.87	11.156	JSC	JSC	SI ANSMET
18					
19		10.865	NIPR	NIPR	A. Yamaguchi
20		10.82	GUT	GUT	B. Miao, Z. Xia
21					
22		10.288	NIPR	NIPR	A. Yamaguchi
23	5.14	10.02	JSC	JSC	SI ANSMET
24		9.97	NIPR	NIPR	A. Yamaguchi
25		9.636	NIPR	NIPR	A. Yamaguchi
26					
27		9.597	NIPR	NIPR	A. Yamaguchi
28		9.078	NIPR	NIPR	A. Yamaguchi
29		9.055	NIPR	NIPR	A. Yamaguchi
30	5.09	9.03	JSC	JSC	SI ANSMET
31					
32		8.995	NIPR	NIPR	A. Yamaguchi
33		8.963	NIPR	NIPR	A. Yamaguchi
34	5.07	8.777	JSC	JSC	SI ANSMET
35					
36		8.651	NIPR	NIPR	A. Yamaguchi
37		7.89	GUT	GUT	B. Miao, Z. Xia
38	4.95	7.539	JSC	JSC	SI ANSMET
39					
40		7.233	NIPR	NIPR	A. Yamaguchi
41		5	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
42		6.974	NIPR	NIPR	A. Yamaguchi
43		6.818	NIPR	NIPR	A. Yamaguchi
44					
45		6.694	NIPR	NIPR	A. Yamaguchi
46		6.345	NIPR	NIPR	A. Yamaguchi
47		6.215	NIPR	NIPR	A. Yamaguchi
48	4.92	5.61	JSC	JSC	SI ANSMET
49					
50		5.36	GUT	GUT	B. Miao, Z. Xia
51		5	KOPRI	KOPRI	C. Park, S. Y. J. Woo
52		4.957	NIPR	NIPR	A. Yamaguchi
53					
54		4.913	NIPR	NIPR	A. Yamaguchi
55		4.902	NIPR	NIPR	A. Yamaguchi
56		4.726	NIPR	NIPR	A. Yamaguchi
57					
58		4.704	NIPR	NIPR	A. Yamaguchi
59		4.665	NIPR	NIPR	A. Yamaguchi
60		4.629	NIPR	NIPR	A. Yamaguchi

1				
2				
3	4.533	NIPR	NIPR	A. Yamaguchi
4	4.532	NIPR	NIPR	A. Yamaguchi
5	4.524	NIPR	NIPR	A. Yamaguchi
6	4.492	NIPR	NIPR	A. Yamaguchi
7	4.436	JSC	JSC	SI ANSMET
8	4.272	NIPR	NIPR	A. Yamaguchi
9	4.25	NIPR	NIPR	A. Yamaguchi
10	4.217	NIPR	NIPR	A. Yamaguchi
11	4.2	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
12	4.16	GUT	GUT	B. Miao, Z. Xia
13	4.153	NIPR	NIPR	A. Yamaguchi
14	4.077	NIPR	NIPR	A. Yamaguchi
15	4.057	NIPR	NIPR	A. Yamaguchi
16	4.056	NIPR	NIPR	A. Yamaguchi
17	3.942	NIPR	NIPR	A. Yamaguchi
18	3.926	NIPR	NIPR	A. Yamaguchi
19	3.897	NIPR	NIPR	A. Yamaguchi
20	3.895	NIPR	NIPR	A. Yamaguchi
21	3.854	NIPR	NIPR	A. Yamaguchi
22	3.83	NIPR	NIPR	A. Yamaguchi
23	3.787	NIPR	NIPR	A. Yamaguchi
24	3.565	NIPR	NIPR	A. Yamaguchi
25	3.56	NIPR	NIPR	A. Yamaguchi
26	3.504	NIPR	NIPR	A. Yamaguchi
27	3.327	NIPR	NIPR	A. Yamaguchi
28	3.316	NIPR	NIPR	A. Yamaguchi
29	3.288	NIPR	NIPR	A. Yamaguchi
30	3.166	NIPR	NIPR	A. Yamaguchi
31	3.152	NIPR	NIPR	A. Yamaguchi
32	3.084	NIPR	NIPR	A. Yamaguchi
33	3.037	NIPR	NIPR	A. Yamaguchi
34	2.999	NIPR	NIPR	A. Yamaguchi
35	2.982	NIPR	NIPR	A. Yamaguchi
36	2.935	NIPR	NIPR	A. Yamaguchi
37	2.854	NIPR	NIPR	A. Yamaguchi
38	2.791	NIPR	NIPR	A. Yamaguchi
39	2.755	NIPR	NIPR	A. Yamaguchi
40	2.699	NIPR	NIPR	A. Yamaguchi
41	2.642	NIPR	NIPR	A. Yamaguchi
42	2.62	GUT	GUT	B. Miao, Z. Xia
43	2.603	NIPR	NIPR	A. Yamaguchi
44	2.6	KOPRI	KOPRI	C. Park, S. Y. S. Park
45	2.588	NIPR	NIPR	A. Yamaguchi
46	2.522	NIPR	NIPR	A. Yamaguchi
47	2.462	NIPR	NIPR	A. Yamaguchi

1				
2				
3	2.453	NIPR	NIPR	A. Yamaguchi
4	2.379	NIPR	NIPR	A. Yamaguchi
5	2.286	NIPR	NIPR	A. Yamaguchi
6	2.179	NIPR	NIPR	A. Yamaguchi
7	2.137	NIPR	NIPR	A. Yamaguchi
8	2.136	NIPR	NIPR	A. Yamaguchi
9	2.1	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
10	2.047	NIPR	NIPR	A. Yamaguchi
11	2.041	NIPR	NIPR	A. Yamaguchi
12	1.928	NIPR	NIPR	A. Yamaguchi
13	1.799	NIPR	NIPR	A. Yamaguchi
14	1.753	NIPR	NIPR	A. Yamaguchi
15	1.7	KOPRI	KOPRI	C. Park, S. Y. S. Park
16	1.65	NIPR	NIPR	A. Yamaguchi
17	1.616	NIPR	NIPR	A. Yamaguchi
18	1.59	NIPR	NIPR	A. Yamaguchi
19	1.551	NIPR	NIPR	A. Yamaguchi
20	1.521	NIPR	NIPR	A. Yamaguchi
21	1.503	NIPR	NIPR	A. Yamaguchi
22	1.46	NIPR	NIPR	A. Yamaguchi
23	1.450	JSC	JSC	SI ANSMET
24	1.386	NIPR	NIPR	A. Yamaguchi
25	1.37	JSC	JSC	SI ANSMET
26	1.36	JSC	JSC	SI ANSMET
27	1.33	NIPR	NIPR	A. Yamaguchi
28	1.32	NIPR	NIPR	A. Yamaguchi
29	1.3	KOPRI	KOPRI	C. Park, S. Y. Z. Beach
30	1.3	KOPRI	KOPRI	C. Park, S. Y. S. Park
31	1.200	JSC	JSC	SI ANSMET
32	1.188	NIPR	NIPR	A. Yamaguchi
33	1.16	JSC	JSC	SI ANSMET
34	1.1	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
35	1.071	JSC	JSC	SI ANSMET
36	1.06	JSC	JSC	SI ANSMET
37	1.044	NIPR	NIPR	A. Yamaguchi
38	1.037	JSC	JSC	SI ANSMET
39	0.983	NIPR	NIPR	A. Yamaguchi
40	0.92	NIPR	NIPR	A. Yamaguchi
41	0.919	NIPR	NIPR	A. Yamaguchi
42	0.889	JSC	JSC	SI ANSMET
43	0.832	NIPR	NIPR	A. Yamaguchi
44	0.813	JSC	JSC	SI ANSMET
45	0.8	KOPRI	KOPRI	C. Park, S. Y. S. Han
46	0.775	NIPR	NIPR	A. Yamaguchi
47	0.774	NIPR	NIPR	A. Yamaguchi

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2					
3	0.760	JSC	JSC	SI	ANSMET
4	0.674	NIPR	NIPR	A. Yamaguchi	
5	0.672	JSC	JSC	SI	ANSMET
6	0.658	NIPR	NIPR	A. Yamaguchi	
7	0.628	JSC	JSC	SI	ANSMET
8	0.624	NIPR	NIPR	A. Yamaguchi	
9	0.555	NIPR	NIPR	A. Yamaguchi	
10	0.542	NIPR	NIPR	A. Yamaguchi	
11	0.540	JSC	JSC	SI	ANSMET
12	0.530	JSC	JSC	SI	ANSMET
13	0.522	JSC	JSC	SI	ANSMET
14	0.456	JSC	JSC	SI	ANSMET
15	0.437	NIPR	NIPR	A. Yamaguchi	
16	0.405	NIPR	NIPR	A. Yamaguchi	
17	0.390	JSC	JSC	SI	ANSMET
18	0.323	NIPR	NIPR	A. Yamaguchi	
19	0.311	NIPR	NIPR	A. Yamaguchi	
20	0.271	NIPR	NIPR	A. Yamaguchi	
21	0.244	NIPR	NIPR	A. Yamaguchi	
22	0.170	JSC	JSC	SI	ANSMET
23	21.5	UWB	A. Aaronson	A. Irving and S	
24	5.02	ROM	GREGORY	V. Di Cecco, F	
25	22.8	UNM	Dustin Dicken	C. Agee, UNM	
26	25.65	UCLA	Matthew Stre	D. Sheikh, FS	
27	20.0	UNM	Kai Ke	C. Agee, UNM	
28	25.3	UNM	Darryl Pitt	C. Agee, UNM	
29	3.34	20.03	Kiel	Dieter Janek, Bart	Lahsen Duine
30	20	MNB	Philippe Schm	A. Greshake, I	
31	21.3	UAb	Joshua Tree M	C. Herd and J	
32	20.0	Cascadia	HMANI Inc	M. Hutson, A.	
33	23.3	UNM	Darryl Pitt	C. Agee, UNM	
34	24	UWB	A. Aaronson	A. Irving and S	
35	20	IfP, Münster	Anonymous	K. Metzler, IfP	
36	22.8	UNM	DPitt	C. Agee, UNM	
37	12.2	UWB	DPitt	A. Irving and S	
38	8.98	UCLA	D. Sheikh	D. Sheikh, FS	
39	3	MNB	Philippe Schm	A. Greshake, I	
40	3	UCLA	Main mass wit	C. Anderkin	
41	1.5	GUT	GUT	B. Miao, L. Hu	
42	0.6	GUT	GUT	B. Miao, L. Hu	
43	1.2	GUT	GUT	B. Miao, L. Hu	
44	1.3	GUT	GUT	B. Miao, L. Hu	
45	4959.500	SI	SI	SI	ANSMET
46	2805.950	SI	SI	SI	ANSMET
47	1680	UCLA	unknown	J.T. Wasson, I	

1					
2					
3		125	UCLA	unknown	J.T. Wasson, I
4		132	UCLA	unknown	J.T. Wasson, I
5		1200	ASU	MFarmer	L. Garvie, ASU
6		45	UCLA	Adam Hupé	J.T. Wasson, I
7		22.8	UAb	Hollis Meteorit	C. Herd, UAb
8		28	MSN-FI	Tomelleri	V. Moggi Cecc
9		55.8	UTok and NIP	Finder	T. Mikouchi, UK. Mitsumura
10		100	PMO	SSTM	J.T. Wasson, I
11		2682	ASU	unknown	J.T. Wasson, I
12		59	ASU	unknown	J.T. Wasson, I
13		42	UCLA	J. Utas	J.T. Wasson, I
14		40	UCLA	Fred B	J.T. Wasson, I
15		538	UCLA	UCLA	J.T. Wasson, I
16		22	NMBE	NMBE	J.T. Wasson, I
17		37	UCLA	110	J.T. Wasson, I
18		18.7	UAb	J. Shea	C. Herd, UAb
19		25.2	UAb	Wang Chen	C. Herd, UAb
20		24.3	UAb	Zhang Qingya	C. Herd and L
21		94.8	MNRJ/UFRJ	UNIPAMPA	J.T. Wasson, I
22		21.9	UAb	Unnamed ovr	C. Herd, UAb
23		300	IGCAS	Peng Wang	Hao Peng, IG(a local herder
24		22.18	CEREGE	Frankie Yu	M. D'Orazio, J
25		21	UPC	MNCN	Jordi Llorca (L
26		105.047	JSC	JSC	SI ANSMET
27		90	IGCAS	Xinping Wen	Hao Peng, IG(a stone hunter
28		26.3	UAb	Wang Ziyao	C. Herd, UAb
29		75.770	SI	SI	SI ANSMET
30	4.58	71.31	JSC	JSC	SI ANSMET
31	4.92	24.6	MNB	Philippe Schm	A. Greshake, I
32	4.83	22.2	Kiel	Wang Ziyao	R. Bartoschew Xu Zhong
33	4.82	20.7	Kiel	Liu Bingham	R. Bartoschew Chen Wie (Ha
34	5.06	20.1	Kiel	Wang Ziyao	R. Bartoschew anonymous
35	4.55	22.7	Kiel	Wang Ziyao	R. Bartoschew Ma Yonglu
36	4.95	20.3	Kiel	Liu Bingham a	R. Bartoschew Zhang Qun
37	4.62	21.3	Kiel	Liu Bingham a	R. Bartoschew Liu Bingham
38	4.36	20.8	Kiel	Dieter Janek, Bart	anonymous
39	4.95	22.9	Kiel	Wang Ziyao a	R. Bartoschew Zijian Wang (
40	4.81	21.9	Kiel	Wang Ziyao a	R. Bartoschew Zijian Wang (L
41	4.84	22.3	Kiel	Wang Ziyao a	R. Bartoschew Liu Bingham (f
42	4.45	24.0	Kiel	Dieter Janek, Bart	anonymous
43	4.79	21.7	Kiel	Wang Ziyao	R. Bartoschew Zijian Wang (L
44	4.77	22.7	Kiel	A. Mazur	Bart anonymous
45	4.83	22.6	Kiel	Wang Ziyao	R. Bartoschew Wang Ziyao
46	4.70	18.5	Kiel	Wang Ziyao	R. Bartoschew anonymous
47	4.32	12.3	Kiel	Wang Ziyao	R. Bartoschew anonymous

1				
2				
3	4.85	4.4	Kiel	Ben Levi KarsR. Bartoschew anonymous
4		242	ASU	Michael FarmL. Garvie anonymous
5		39.4	UNM	Abdelhadi AitC. Agee, UNM
6		7210	PSF	PSF A. Irving and S
7				
8	4.36	20	MNB	Philippe SchmA. Greshake, I
9		20	IfP	Manuel Nieto K. Metzler, IfP
10				
11	4.63	26.5	MNB	Franco VignatA. Greshake, I
12	4.45	23.13	CEREGE	Fabien Kuntz L. Krämer Ruç
13				
14		20	IfP, Münster	Nourddine AzK. Metzler, IfP
15	4.53	25	CEREGE	Jean RedelspiJ. Gattacceca,
16		20.6	MNB	Hanno Strufe A. Greshake, I
17		27.8	MNB	Hanno Strufe A. Greshake, I
18				
19	4.76	20.5	UWB	G. Fujihara A. Irving and S
20		400.95	NIPR	NIPR A. Yamaguchi
21	4.46	23	UWB	C. Giessler A. Irving and S
22				
23	4.73	21.8	UWB	G. Fujihara A. Irving and S
24		20	MNB	Salamu HamaA. Greshake, I
25		20.2	Cascadia	Anonymous hK. Farley, M. F
26	4.59	22.5	MNB	Hanno Strufe A. Greshake, I
27		26.8	MNB	Hanno Strufe A. Greshake, I
28				
29		157.98	NIPR	NIPR A. Yamaguchi
30		16.5	MNB	Philippe SchmA. Greshake, I
31		16.5	MNB	Philippe SchmA. Greshake, I
32		15	MNB	Alan Mazur A. Greshake, I
33				
34	4.61	17.7	MNB	Hichame MimA. Greshake, I
35		10.4	MNB	Philippe SchmA. Greshake, I
36		9.2	MNB	Philippe SchmA. Greshake, I
37		6.5	SI	M. CottingharM. Takahashi, unknown
38		4	MNB	Hanno Strufe A. Greshake, I
39				
40		5.7	KOPRI	KOPRI C. Park, S. Y. H. Yoo
41		5.694	NIPR	NIPR A. Yamaguchi
42		4.489	NIPR	NIPR A. Yamaguchi
43		3.979	NIPR	NIPR A. Yamaguchi
44		3.714	NIPR	NIPR A. Yamaguchi
45		3.434	NIPR	NIPR A. Yamaguchi
46		3.302	NIPR	NIPR A. Yamaguchi
47		3.033	NIPR	NIPR A. Yamaguchi
48		2.927	NIPR	NIPR A. Yamaguchi
49		2.156	NIPR	NIPR A. Yamaguchi
50		2.003	NIPR	NIPR A. Yamaguchi
51		1.689	NIPR	NIPR A. Yamaguchi
52		1.611	NIPR	NIPR A. Yamaguchi
53		1.475	NIPR	NIPR A. Yamaguchi
54		1.47	NIPR	NIPR A. Yamaguchi
55		1.458	NIPR	NIPR A. Yamaguchi
56				
57				
58				
59				
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3		1.044	NIPR	NIPR	A. Yamaguchi	
4		90	UCLA	M. Farmer	A. Irving and S	
5						
6	4.48	20.1	Kiel	Li Bofang, Bei	R. Bartoschew	anonymous
7	4.45	24.6	MNB	Hichame Mim	A. Greshake, I	
8						
9		29	UNM	Marcin Cimala	C. Agee, UNM	
10	4.61	58.55	JSC	JSC	SI	ANSMET
11	4.19	16.8	JSC	JSC	SI	ANSMET
12						
13	3.9	9.29	JSC	JSC	SI	ANSMET
14	5.08	71.004	JSC	JSC	SI	ANSMET
15		25	CEREGE	Andreas Gren	J. Gattacceca,	
16	4.95	50.1	FSAC	Aaronson, Mo	H. Chennaoui	Mohamed Oui
17		20	IfP	Anonymous	K. Metzler, IfP	
18						
19		2703	PSF	PSF	A. Irving and S	
20		51.3	UWO	S. Tutorow	G. Ibe, UWO	
21						
22		2157	PSF	PSF	A. Irving and S	
23		21	UWB	Aaronson	A. Irving and S	
24		35.4	UWB	A. Aaronson	A. Irving and S	
25		61.10	UCLA	Michael Cottin	A. Rubin, UCL	
26						
27		44	UPC	David Allepuz	J. Llorca, UPC	David Allepuz
28		26.2	UWB	B. Hoefnagels	A. Irving and S	
29		362.15	GUT	GUT	B. Miao, Z. Xia	
30						
31		361	KOPRI	KOPRI	C. Park, S. Y. H. Yoo	
32		355.04	GUT	GUT	B. Miao, Z. Xia	
33		20.1	MSN-FI	Castellano	V. Moggi Cec	
34		189.62	NIPR	NIPR	A. Yamaguchi	
35		20.1	MSN-FI	Di Martino	V. Moggi Cec	Anonymous
36		25.8	MSN-FI	Castellano	V. Moggi Cec	
37						
38		160.6	NIPR	NIPR	A. Yamaguchi	
39		20.5	MSN-FI	Petriccione	V. Moggi Cec	
40						
41		25	UCLA	Michael Cottin	A. Rubin, UCL	
42	4.65	123.57	JSC	JSC	SI	ANSMET
43		105.4	PSF	PSF	A. Irving and S	
44						
45		77.45	NIPR	NIPR	A. Yamaguchi	
46		16.27	ROM	Gregory	J. Poitras and	
47		74.44	NIPR	NIPR	A. Yamaguchi	
48	4.64	68.81	JSC	JSC	SI	ANSMET
49		65.31	PSF	PSF	A. Irving and S	
50						
51	4.37	44.840	JSC	JSC	SI	ANSMET
52	4.42	41.66	JSC	JSC	SI	ANSMET
53						
54	4.58	37.31	JSC	JSC	SI	ANSMET
55	4.71	6.38	CEREGE	anonymous	J. Gattacceca,	anonymous
56	4.86	25.37	JSC	JSC	SI	ANSMET
57						
58		15.7	MNA-SI	MNA-SI	F. Focacci, M. Maurizio Gem	
59		15.66	PSF	PSF	A. Irving and S	
60		14.872	NIPR	NIPR	A. Yamaguchi	

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3	4.5	14.49	JSC	JSC	SI	ANSMET
4						
5		12.826	NIPR	NIPR	A. Yamaguchi	
6		8.93	NIPR	NIPR	A. Yamaguchi	
7		6.787	NIPR	NIPR	A. Yamaguchi	
8		4.566	NIPR	NIPR	A. Yamaguchi	
9		4.466	NIPR	NIPR	A. Yamaguchi	
10		4.382	NIPR	NIPR	A. Yamaguchi	
11		4.17	NIPR	NIPR	A. Yamaguchi	
12		3.905	NIPR	NIPR	A. Yamaguchi	
13		3.751	NIPR	NIPR	A. Yamaguchi	
14		3.715	NIPR	NIPR	A. Yamaguchi	
15		2.716	NIPR	NIPR	A. Yamaguchi	
16		2.173	NIPR	NIPR	A. Yamaguchi	
17		1.335	NIPR	NIPR	A. Yamaguchi	
18		1.272	NIPR	NIPR	A. Yamaguchi	
19		0.5	MNA-SI	MNA-SI	F. Focacci, M. Jacopo Nava	
20		0.498	JSC	JSC	SI	ANSMET
21						
22						
23						
24						
25						
26	4.87	35	MNB	Marcin Cimala	A. Greshake, I	
27		4470	PSF	PSF	A. Irving and S	
28						
29	4.53	24	CEREGE	ArtMet collecti	J. Gattacceca, anonymous	
30		21.2	UWB	B. Hoefnagels	A. Irving and S	
31		16	ROM	Gregory	S. Yokoyama,	
32		20.5	UNM	DPitt	C. Agee, UNM	
33		161	UPC	José Vicente (J. Llorca, UPC	José Vicente (
34		89.6	UWO	S. Tutorow	P. Reger, UW	
35		47.5	MLP	Private	M. E. Varela, I unknown	
36		43.8	Vernad	DMUH	C.A. Lorenz, \	
37						
38	4.04	20.2	Kiel	Fabien Kuntz	R. Bartoschew	Anonymous
39		136	IGGCAS	Pengli Chen a	Y. Xu, N. Wan	Pengli Chen, \
40		43	UPC	Ion Ander Lan	J. Llorca, UPC	Ion Ander Lan
41		3620	PSF	PSF	A. Irving and S	
42						
43						
44	4.98	23.5	CEREGE	ArtMet collecti	J. Gattacceca, anonymous	
45		30.6	UNM	Brad Kern	C. Agee, UNM	
46		663.5	Vernad	Mr. E. Zakhar	C. A. Lorenz, 'Mr. E. Zachar	
47		106	FMMR	2127 g – Kirill P. Yu. Plecho	Kirill Vlasov ar	
48		115.5	Vernad	DMUH	C.A. Lorenz, \	
49		20.1	UWB	DPitt	A. Irving and S	
50		42.9	MNB	Hichame Mim	A. Greshake, I	
51		114.80	UCLA	Michael Cottin	A. Rubin, UCL	
52		1566.1	OU	OU	Craig Walton,	
53		1522	PSF	PSF	A. Irving and S	
54						
55	4.94	20.1	Kiel	Dieter Janek, Bart		anonymous
56		152.6	Vernad.	Ilya Chaplygin	Lorenz C. A., 'Ilya Chaplygin	
57		130.3	Vernad	Mr. T. Kryach	C. A. Lorenz, 'Mr. T. Kryach	
58						
59						
60						

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2					
3		930	GSI	GSI	A. Dutta and E
4		796	KOPRI	KOPRI	C. Park, S. Y. J. H. Kim
5		79	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
6		22.8	OU	Joe Bazyk	R. Greenwood Joe Bazyk
7		606.82	GUT	GUT	B. Miao, Z. Xia
8		68.7	Vernad	Mr. M. Nepom	Lorenz C. A., 'Mr. M. Nepom
9		571.94	GUT	GUT	B. Miao, Z. Xia
10		554.16	OU	OU	C. Walton, US
11		518.83	GUT	GUT	B. Miao, Z. Xia
12		24.2	Vernad	DMUH	C. A. Lorenz, '
13		482.17	NIPR	NIPR	A. Yamaguchi
14		27.6	UCLA	Michael Cottin	A. Rubin, UCL
15		20.2	MSN-FI	Di Martino	V. Moggi Cecchi
16	4.86	380.76	JSC	JSC	SI ANSMET
17		347.67	GUT	GUT	B. Miao, Z. Xia
18		342.12	GUT	GUT	B. Miao, Z. Xia
19		20.2	MSN-FI	Mimaghador	Vanni Moggi Cecchi
20	4.92	35.6	MNB	Hanno Strufe	A. Greshake, I
21		298.6	NIPR	NIPR	A. Yamaguchi
22	4.83	288.530	JSC	JSC	SI ANSMET
23		277.86	GUT	GUT	B. Miao, Z. Xia
24	4.75	259.400	JSC	JSC	SI ANSMET
25		20	MSN-FI	Mimaghador	Vanni Moggi Cecchi
26		20.1	MNB	Hichame Mimouni	A. Greshake, I
27		194	PSF	PSF	A. Irving and S
28	4.63	20	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
29		25.4	MNB	Juergen Naube	A. Greshake, I
30		27	MSN-FI	Mimaghador	Vanni Moggi Cecchi
31		49.5	Vernad	Ilya Chaplygin	Lorenz C. A., 'Ilya Chaplygin
32		103	OU	Joe Bazyk	R. Greenwood Joe Bazyk
33		26	Vernad	DMUH	M. A. Ivanova,
34		24.9	Vernad	anonymous	C. A. Lorenz, 'anonymous
35		120.07	GUT	GUT	B. Miao, Z. Xia
36		30.9	Vernad	Ilya Chaplygin	Lorenz C. A., 'Ilya Chaplygin
37		22.1	CEREGE	Peter Buhl	J. Gattacceca, Peter Buhl
38		23.9	MNB	Jörgen Naube	A. Greshake, I
39	4.60	99.891	JSC	JSC	SI ANSMET
40	4.77	99.03	JSC	JSC	SI ANSMET
41		17.85	MSN-FI	Cojocarú	V. Moggi Cecchi
42	4.74	83.03	JSC	JSC	SI ANSMET
43	4.16	74.832	JSC	JSC	SI ANSMET
44	4.63	73.130	JSC	JSC	SI ANSMET
45	4.63	72.32	JSC	JSC	SI ANSMET
46		13.5	ROM	Gregory	J. Poitras, UT
47	4.61	64.509	JSC	JSC	SI ANSMET

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3		12.9	MSN-FI	CavagliÀ	V. Moggi Cecc	
4	4.81	61.89	JSC	JSC	SI	ANSMET
5	4.61	61.08	JSC	JSC	SI	ANSMET
6		23	MSN-FI	CavagliÀ	V. Moggi Cecc	
7						
8	5.08	57.549	JSC	JSC	SI	ANSMET
9		12.5	Vernad.	Mr. T. Kryach	Lorenz C. A., 'Mr. T. Kryach	
10						
11	4.67	52.14	JSC	JSC	SI	ANSMET
12	4.66	11	CEREGE	MMC	L. Krämer Ruç	
13						
14	4.41	49.982	JSC	JSC	SI	ANSMET
15		12.1	MNB	Philippe Schm	A. Greshake, I	
16	4.85	48.451	JSC	JSC	SI	ANSMET
17	4.56	47.32	JSC	JSC	SI	ANSMET
18						
19	4.66	46.992	JSC	JSC	SI	ANSMET
20		9.5	Vernad	DMUH	C.A. Lorenz, V	
21		40	UPC	Jordi Llorca	J. Llorca, UPC	Jordi Llorca
22						
23		42.171	JSC	JSC	SI	ANSMET
24	4.66	41.805	JSC	JSC	SI	ANSMET
25	4.75	40.32	JSC	JSC	SI	ANSMET
26						
27		8	MSN-FI	OAM	V. Moggi Cecc	Anonymous
28	4.53	39.1	JSC	JSC	SI	ANSMET
29	4.59	38.668	JSC	JSC	SI	ANSMET
30						
31	4.42	36.534	JSC	JSC	SI	ANSMET
32	4.53	33.466	JSC	JSC	SI	ANSMET
33	4.62	33.377	JSC	JSC	SI	ANSMET
34	4.70	32.904	JSC	JSC	SI	ANSMET
35						
36	4.7	32.753	JSC	JSC	SI	ANSMET
37	4.72	32.19	JSC	JSC	SI	ANSMET
38		30.91	PSF	PSF	A. Irving and S	
39						
40	4.53	30.193	JSC	JSC	SI	ANSMET
41		30.16	GUT	GUT	B. Miao, Z. Xiè	
42	4.42	29.48	JSC	JSC	SI	ANSMET
43	4.52	27.91	JSC	JSC	SI	ANSMET
44						
45	4.63	27.561	JSC	JSC	SI	ANSMET
46	4.56	27.068	JSC	JSC	SI	ANSMET
47	4.81	26.878	JSC	JSC	SI	ANSMET
48						
49		26.49	GUT	GUT	B. Miao, Z. Xiè	
50	4.66	25.89	JSC	JSC	SI	ANSMET
51	4.45	24.937	JSC	JSC	SI	ANSMET
52	4.44	24.86	JSC	JSC	SI	ANSMET
53						
54	4.54	24.675	JSC	JSC	SI	ANSMET
55	4.49	23.992	JSC	JSC	SI	ANSMET
56	4.65	22.324	JSC	JSC	SI	ANSMET
57						
58	4.42	21.650	JSC	JSC	SI	ANSMET
59	4.73	20.581	JSC	JSC	SI	ANSMET
60	4.56	20.55	JSC	JSC	SI	ANSMET

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2						
3	4.51	20.540	JSC	JSC	SI	ANSMET
4	4.57	20.08	JSC	JSC	SI	ANSMET
5	4.51	19.34	JSC	JSC	SI	ANSMET
6		18.727	JSC	JSC	SI	ANSMET
7	4.49	18.278	JSC	JSC	SI	ANSMET
8	4.58	16.96	JSC	JSC	SI	ANSMET
9	4.57	16.1	JSC	JSC	SI	ANSMET
10	4.59	15.88	JSC	JSC	SI	ANSMET
11	4.52	15.87	JSC	JSC	SI	ANSMET
12	4.57	15.72	JSC	JSC	SI	ANSMET
13	4.5	15.354	JSC	JSC	SI	ANSMET
14	4.24	15.297	JSC	JSC	SI	ANSMET
15	4.52	14.466	JSC	JSC	SI	ANSMET
16		14.461	NIPR	NIPR	A. Yamaguchi	
17	4.55	14.307	JSC	JSC	SI	ANSMET
18	4.56	14.110	JSC	JSC	SI	ANSMET
19	4.49	13.150	JSC	JSC	SI	ANSMET
20	4.54	11.052	JSC	JSC	SI	ANSMET
21		10.295	NIPR	NIPR	A. Yamaguchi	
22	4.55	9.759	JSC	JSC	SI	ANSMET
23	4.65	9.445	JSC	JSC	SI	ANSMET
24		9.25	NIPR	NIPR	A. Yamaguchi	
25		8.849	NIPR	NIPR	A. Yamaguchi	
26		8.27	NIPR	NIPR	A. Yamaguchi	
27		7.7	NIPR	NIPR	A. Yamaguchi	
28	4.64	7.11	JSC	JSC	SI	ANSMET
29	4.55	6.196	JSC	JSC	SI	ANSMET
30		3.4	Vernad	Vernad	C. A. Lorenz, 'Mr. S. E. Boris	
31		4.761	NIPR	NIPR	A. Yamaguchi	
32		4.655	NIPR	NIPR	A. Yamaguchi	
33		4.534	NIPR	NIPR	A. Yamaguchi	
34		4.511	NIPR	NIPR	A. Yamaguchi	
35		4.484	NIPR	NIPR	A. Yamaguchi	
36		4.322	NIPR	NIPR	A. Yamaguchi	
37		4.112	NIPR	NIPR	A. Yamaguchi	
38		4.096	NIPR	NIPR	A. Yamaguchi	
39		4.057	NIPR	NIPR	A. Yamaguchi	
40		3.943	NIPR	NIPR	A. Yamaguchi	
41		3.864	NIPR	NIPR	A. Yamaguchi	
42		3.566	NIPR	NIPR	A. Yamaguchi	
43		3.388	NIPR	NIPR	A. Yamaguchi	
44		3.374	NIPR	NIPR	A. Yamaguchi	
45		3.363	NIPR	NIPR	A. Yamaguchi	
46		3.279	NIPR	NIPR	A. Yamaguchi	
47		3.273	NIPR	NIPR	A. Yamaguchi	
48						
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3	3.269	NIPR	NIPR	A. Yamaguchi		
4	3.231	NIPR	NIPR	A. Yamaguchi		
5	3.112	NIPR	NIPR	A. Yamaguchi		
6	3.046	NIPR	NIPR	A. Yamaguchi		
7	3.031	NIPR	NIPR	A. Yamaguchi		
8	3.031	NIPR	NIPR	A. Yamaguchi		
9	2.915	NIPR	NIPR	A. Yamaguchi		
10	2.858	NIPR	NIPR	A. Yamaguchi		
11	2.858	NIPR	NIPR	A. Yamaguchi		
12	2.742	NIPR	NIPR	A. Yamaguchi		
13	2.611	NIPR	NIPR	A. Yamaguchi		
14	2.611	NIPR	NIPR	A. Yamaguchi		
15	2.515	NIPR	NIPR	A. Yamaguchi		
16	2.503	NIPR	NIPR	A. Yamaguchi		
17	2.486	NIPR	NIPR	A. Yamaguchi		
18	2.486	NIPR	NIPR	A. Yamaguchi		
19	2.351	NIPR	NIPR	A. Yamaguchi		
20	2.348	NIPR	NIPR	A. Yamaguchi		
21	2.147	NIPR	NIPR	A. Yamaguchi		
22	2.147	NIPR	NIPR	A. Yamaguchi		
23	2.052	NIPR	NIPR	A. Yamaguchi		
24	1.996	NIPR	NIPR	A. Yamaguchi		
25	1.875	NIPR	NIPR	A. Yamaguchi		
26	1.875	NIPR	NIPR	A. Yamaguchi		
27	1.818	NIPR	NIPR	A. Yamaguchi		
28	1.814	NIPR	NIPR	A. Yamaguchi		
29	1.814	NIPR	NIPR	A. Yamaguchi		
30	1.752	NIPR	NIPR	A. Yamaguchi		
31	1.644	NIPR	NIPR	A. Yamaguchi		
32	1.6	MNA-SI	MNA-SI	F. Focacci, M. Maurizio Gem		
33	1.426	NIPR	NIPR	A. Yamaguchi		
34	1.402	NIPR	NIPR	A. Yamaguchi		
35	1.402	NIPR	NIPR	A. Yamaguchi		
36	1.400	JSC	JSC	SI	ANSMET	
37	1.385	NIPR	NIPR	A. Yamaguchi		
38	1.321	NIPR	NIPR	A. Yamaguchi		
39	1.321	NIPR	NIPR	A. Yamaguchi		
40	1.26	JSC	JSC	SI	ANSMET	
41	1.212	NIPR	NIPR	A. Yamaguchi		
42	1.191	NIPR	NIPR	A. Yamaguchi		
43	1.176	NIPR	NIPR	A. Yamaguchi		
44	1.176	NIPR	NIPR	A. Yamaguchi		
45	1.174	NIPR	NIPR	A. Yamaguchi		
46	1.08	JSC	JSC	SI	ANSMET	
47	1.045	NIPR	NIPR	A. Yamaguchi		
48	1.045	NIPR	NIPR	A. Yamaguchi		
49	0.935	NIPR	NIPR	A. Yamaguchi		
50	0.857	JSC	JSC	SI	ANSMET	
51	0.850	JSC	JSC	SI	ANSMET	
52	0.850	JSC	JSC	SI	ANSMET	
53	0.836	NIPR	NIPR	A. Yamaguchi		
54	0.789	NIPR	NIPR	A. Yamaguchi		
55	0.721	NIPR	NIPR	A. Yamaguchi		
56	0.721	NIPR	NIPR	A. Yamaguchi		
57	0.721	NIPR	NIPR	A. Yamaguchi		
58	0.699	NIPR	NIPR	A. Yamaguchi		
59	0.677	NIPR	NIPR	A. Yamaguchi		
60	0.347	0.663	JSC	JSC	SI	ANSMET

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3		0.629	NIPR	NIPR	A. Yamaguchi
4		0.62	JSC	JSC	SI ANSMET
5		0.601	NIPR	NIPR	A. Yamaguchi
6		0.596	NIPR	NIPR	A. Yamaguchi
7		0.575	NIPR	NIPR	A. Yamaguchi
8		0.554	NIPR	NIPR	A. Yamaguchi
9		0.541	NIPR	NIPR	A. Yamaguchi
10		0.527	NIPR	NIPR	A. Yamaguchi
11		0.521	NIPR	NIPR	A. Yamaguchi
12		0.508	NIPR	NIPR	A. Yamaguchi
13		0.5	MNA-SI	MNA-SI	F. Focacci, M. Jacopo Nava
14		0.475	NIPR	NIPR	A. Yamaguchi
15		0.451	NIPR	NIPR	A. Yamaguchi
16		0.353	NIPR	NIPR	A. Yamaguchi
17		0.338	JSC	JSC	SI ANSMET
18		0.263	NIPR	NIPR	A. Yamaguchi
19		0.260	JSC	JSC	SI ANSMET
20		20.9	lfp	Finder	M. Patzek, A. anonymous
21		20.1	lfp	Finder	K. Klemm and Nasser Albuai
22		20	MNB	Said Yousfi	A. Greshake, I
23		114	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
24		32	UPC	Ion Ander Lan	J. Llorca, UPC Ion Ander Lan
25		20.2	lfp	Finder	K. Klemm and Nasser Albuai
26		80	IGGCAS, PM	(several Chinese)	S. Hu, Y. Lin et
27		60	FMMR	Timur Kryachk	Pavel Yu. Plek Timur Kryachk
28	4.65	80	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
29		12512	UrFU	UrFU	V. V. Sharygir UrFU meteorit
30		244.4	MNB	Martin Goff	A. Greshake, I
31		26	UPC	Alfonso Viera	J. Llorca, UPC Alfonso Viera
32	4.80	798.6	UrFU	798.6 g (3 san	V. V. Sharygir UrFU meteorit
33	4.37	48.1	MNB	Tomasz Jakut	Ansgar Gresh Tomasz Jakut
34	4.87	49	CEREGE	Museo del me	J. Gattacceca, Rodrigo Martir
35		4556	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
36		4150	PSF	PSF	A. Irving and S
37		32	ASU	Michael Farm	(L. Garvie, ASU Orlando Cuev.
38	4.47	25.7	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
39		98.3	UCLA	Michael Cottin	A. Rubin, UCL
40		1846.4	NIPR	NIPR	A. Yamaguchi
41	4.63	1707.200	JSC	JSC	SI ANSMET
42		39.1	PSF	Kenosha Publ	A. Irving and S
43		1412.46	GUT	GUT	B. Miao, Z. Xi
44		27.2	MNB	Dario Ruiz	Ansgar Gresh Dario Ruiz
45		1043.2	NIPR	NIPR	A. Yamaguchi
46		1031	KOPRI	KOPRI	C. Park, S. Y. S. Park

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2					
3		28.2	MNB	Dario Ruiz	Ansgar Gresh: Dario Ruiz
4		1002.2	NIPR	NIPR	A. Yamaguchi
5					
6	4.62	21	MNB	Tomasz Jakut	Ansgar Gresh: Tomasz Jakut
7		120.88	UCLA	Michael Cottin	A. Rubin, UCL
8					
9		32.19	UCLA	Michael Cottin	A. Rubin, UCL
10	4.55	28.5	MNB	Hichame Mim:	A. Greshake, I
11		849	KOPRI	KOPRI	C. Park, S. Y. S. Park
12		50.9	UCLA	Nick Gessler	A. Rubin, UCL
13					
14		758.1	NIPR	NIPR	A. Yamaguchi
15		40	USil	Tomasz Jakut	R. Kryza, T.A.
16		25	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
17		20.1	MSN-FI	Castellano	V. Moggi Cecc
18					
19		29	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
20	4.84	42	CEREGE	with governor JC Doumnang	villagers and I
21		49	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
22					
23		413.64	NIPR	NIPR	A. Yamaguchi
24		26	UPC	Alfonso Viera	J. Llorca, UPC Alfonso Viera
25		20.1	MSN-FI	Castellano	V. Moggi Cecc
26					
27		23.8	ROM	Gregory	S. Yokoyama,
28	4.70	70	ETH	Naturwissensc	E. Gnos, B. H. Andreas Stue
29		348.16	NIPR	NIPR	A. Yamaguchi
30					
31		35	CEREGE	CEREGE	J. Gattacceca, Bertrand Dev
32		56	UPC	Francisco Gal	J. Llorca, UPC Francisco Gal
33		304	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
34		283.91	GUT	GUT	B. Miao, Z. Xi
35	4.63	280.69	JSC	JSC	SI ANSMET
36					
37		273.14	NIPR	NIPR	A. Yamaguchi
38					
39		20	MNB	Salamu Hama	A. Greshake, I
40		265	GUT	GUT	B. Miao, Z. Xi
41		259.37	NIPR	NIPR	A. Yamaguchi
42		32.1	MNB	Hanno Strufe	A. Greshake, I
43	4.81	244.620	JSC	JSC	SI ANSMET
44					
45		243.15	GUT	GUT	B. Miao, Z. Xi
46		21.08	ROM	Gregory	J. Poitras and
47	4.66	33.7	MNB	Franco Vignat	A. Greshake, I
48	4.67	218.71	JSC	JSC	SI ANSMET
49					
50	4.71	26	CEREGE	Labenne Luc	J. Gattacceca, Labenne Luc
51		32	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
52		39.2	Vernad	T. Kryachko, t	Lorenz C. A., 'T. Kryachko, E
53	4.46	183.169	JSC	JSC	SI ANSMET
54	4.77	25.8	MNB	Hanno Strufe	A. Greshake, I
55					
56	4.29	26	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
57		171.68	NIPR	NIPR	A. Yamaguchi
58					
59		38.0	Vernad.	Ilya Chaplygin	Lorenz C. A., 'Ilya Chaplygin
60		22.45	UCLA	Nick Gessler	A. Rubin, UCL

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2						
3	4.63	164.100	JSC	JSC	SI	ANSMET
4		163.04	NIPR	NIPR	A. Yamaguchi	
5		20.1	MSN-FI	Castellano	V. Moggi Cecc	
6		162.5	NIPR	NIPR	A. Yamaguchi	
7						
8	4.48	26	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
9		160.87	NIPR	NIPR	A. Yamaguchi	
10						
11	4.78	22.3	MNB	Hanno Strufe	A. Greshake, I	
12		146.3	KOPRI	KOPRI	C. Park, S. Y. H. Yoo	
13		135.4	NIPR	NIPR	A. Yamaguchi	
14		134.6	PSF	PSF	A. Irving and S	
15		130.41	NIPR	NIPR	A. Yamaguchi	
16		33	UPC	Josep Maria B.J.	Llorca, UPC	Josep Maria E
17						
18						
19	4.18	128.801	JSC	JSC	SI	ANSMET
20		126.11	NIPR	NIPR	A. Yamaguchi	
21		24	UPC	José Vicente (J.	Llorca, UPC	José Vicente (
22		119.83	NIPR	NIPR	A. Yamaguchi	
23		22	UPC	José Vicente (J.	Llorca, UPC	José Vicente (
24						
25	4.58	23	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
26		20	UPC	José Vicente (J.	Llorca, UPC	José Vicente (
27						
28	4.65	100.68	JSC	JSC	SI	ANSMET
29		24.5	PSF	PSF	A. Irving and S	
30	4.81	96.903	JSC	JSC	SI	ANSMET
31						
32	4.47	95.83	JSC	JSC	SI	ANSMET
33		93.8	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee	
34		93.31	NIPR	NIPR	A. Yamaguchi	
35						
36	4.70	21	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
37	4.55	92.66	JSC	JSC	SI	ANSMET
38		90.6	KOPRI	KOPRI	C. Park, S. Y. Z. Beach	
39	5.21	87.186	JSC	JSC	SI	ANSMET
40						
41	4.45	20	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
42		16.9	Vernad	Mr. T. Kryachk	Lorenz C. A., 'Mr. T. Kryachk	
43		83.12	NIPR	NIPR	A. Yamaguchi	
44						
45	4.77	81.815	JSC	JSC	SI	ANSMET
46		80.15	PSF	PSF	A. Irving and S	
47	4.20	19	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
48						
49	4.77	76.049	JSC	JSC	SI	ANSMET
50		75.6	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee	
51	4.63	74.96	JSC	JSC	SI	ANSMET
52	4.68	72.510	JSC	JSC	SI	ANSMET
53						
54	4.62	71.720	JSC	JSC	SI	ANSMET
55		71.5	NIPR	NIPR	A. Yamaguchi	
56		14.52	ROM	Gregory	J. Poitras and	
57	4.64	16	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
58		69.75	NIPR	NIPR	A. Yamaguchi	
59						
60	4.70	65.518	JSC	JSC	SI	ANSMET

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2						
3		64.7	KOPRI	KOPRI	C. Park, S. Y.	S. Park
4	4.68	63.720	JSC	JSC	SI	ANSMET
5	4.72	60.93	JSC	JSC	SI	ANSMET
6	4.67	60.430	JSC	JSC	SI	ANSMET
7	4.63	60.160	JSC	JSC	SI	ANSMET
8		21	UPC	Alfonso Viera	J. Llorca, UPC	Alfonso Viera
9		59.52	GUT	GUT	B. Miao, Z. Xi	
10	4.60	58.710	JSC	JSC	SI	ANSMET
11		58.32	NIPR	NIPR	A. Yamaguchi	
12	4.41	13	CEREGE	Eric Christens	J. Gattacceca,	Eric Christens
13	4.55	57.619	JSC	JSC	SI	ANSMET
14	4.6	55.38	JSC	JSC	SI	ANSMET
15	4.77	53.791	JSC	JSC	SI	ANSMET
16		12.9	Vernad	DMUH	M. A. Ivanova,	
17	4.83	50.959	JSC	JSC	SI	ANSMET
18		50.53	NIPR	NIPR	A. Yamaguchi	
19	4.57	50.173	JSC	JSC	SI	ANSMET
20	4.59	48.399	JSC	JSC	SI	ANSMET
21		9.61	MSP	Castellano	V. Moggi Cecchi	
22	4.69	47.05	JSC	JSC	SI	ANSMET
23	4.87	47.040	JSC	JSC	SI	ANSMET
24		22	UPC	Ion Ander Lan	J. Llorca, UPC	Ion Ander Lan
25	4.55	44.888	JSC	JSC	SI	ANSMET
26	4.58	44.72	JSC	JSC	SI	ANSMET
27	4.67	44.139	JSC	JSC	SI	ANSMET
28	4.49	43.110	JSC	JSC	SI	ANSMET
29	4.52	42.99	JSC	JSC	SI	ANSMET
30	4.66	41.377	JSC	JSC	SI	ANSMET
31		8.2	UCLA	Robert Verish	D. Sheikh, FS	
32	4.60	40.590	JSC	JSC	SI	ANSMET
33		40.343	NIPR	NIPR	A. Yamaguchi	
34		40.291	NIPR	NIPR	A. Yamaguchi	
35		11	UPC	David Allepuz	J. Llorca, UPC	David Allepuz
36		39.521	NIPR	NIPR	A. Yamaguchi	
37	4.31	39.384	JSC	JSC	SI	ANSMET
38	4.55	39.217	JSC	JSC	SI	ANSMET
39		39.179	NIPR	NIPR	A. Yamaguchi	
40	4.93	38	CEREGE	CEREGE	H. Pourkhorsaz	J. Gattacceca
41		38.47	GUT	GUT	B. Miao, Z. Xi	
42	4.67	37.319	JSC	JSC	SI	ANSMET
43	4.51	36.611	JSC	JSC	SI	ANSMET
44		36.144	NIPR	NIPR	A. Yamaguchi	
45	4.5	36.12	JSC	JSC	SI	ANSMET
46	4.54	36.032	JSC	JSC	SI	ANSMET
47		36	KOPRI	KOPRI	C. Park, S. Y.	S. Park

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2						
3	4.84	35.984	JSC	JSC	SI	ANSMET
4	4.56	35.852	JSC	JSC	SI	ANSMET
5	4.66	35.31	JSC	JSC	SI	ANSMET
6	4.66	35.31	JSC	JSC	SI	ANSMET
7		35.225	NIPR	NIPR	A. Yamaguchi	
8	4.58	35.160	JSC	JSC	SI	ANSMET
9	4.51	35.112	JSC	JSC	SI	ANSMET
10	4.51	35.112	JSC	JSC	SI	ANSMET
11	4.45	9	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
12	4.55	34.63	JSC	JSC	SI	ANSMET
13		6.83	MSP	Castellano	V. Moggi Cecchi	
14		6.83	MSP	Castellano	V. Moggi Cecchi	
15	4.91	33.987	JSC	JSC	SI	ANSMET
16	4.53	33.898	JSC	JSC	SI	ANSMET
17	4.74	33.249	JSC	JSC	SI	ANSMET
18	4.74	33.249	JSC	JSC	SI	ANSMET
19	4.76	33.229	JSC	JSC	SI	ANSMET
20	4.50	33.113	JSC	JSC	SI	ANSMET
21	4.64	32.429	JSC	JSC	SI	ANSMET
22	4.64	32.429	JSC	JSC	SI	ANSMET
23	4.77	32.146	JSC	JSC	SI	ANSMET
24		32.074	NIPR	NIPR	A. Yamaguchi	
25		7	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
26		7	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
27	4.46	31.977	JSC	JSC	SI	ANSMET
28	4.52	31.88	JSC	JSC	SI	ANSMET
29	4.66	31.461	JSC	JSC	SI	ANSMET
30	4.46	31.36	JSC	JSC	SI	ANSMET
31	4.46	31.36	JSC	JSC	SI	ANSMET
32	4.53	31.11	JSC	JSC	SI	ANSMET
33	4.53	31.067	JSC	JSC	SI	ANSMET
34	4.73	31.060	JSC	JSC	SI	ANSMET
35	4.52	30.852	JSC	JSC	SI	ANSMET
36	4.52	30.852	JSC	JSC	SI	ANSMET
37		30.81	GUT	GUT	B. Miao, Z. Xiao	
38	4.41	30.710	JSC	JSC	SI	ANSMET
39	4.57	30.7	JSC	JSC	SI	ANSMET
40	4.57	30.7	JSC	JSC	SI	ANSMET
41		30.5	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee	
42	4.75	30.45	JSC	JSC	SI	ANSMET
43	4.72	30.263	JSC	JSC	SI	ANSMET
44	4.72	30.263	JSC	JSC	SI	ANSMET
45	4.45	30.11	JSC	JSC	SI	ANSMET
46	4.61	30.01	JSC	JSC	SI	ANSMET
47		28.7	Cascadia	Cascadia	A. Ruzicka, K.	
48		28.7	Cascadia	Cascadia	A. Ruzicka, K.	
49	4.62	29.744	JSC	JSC	SI	ANSMET
50	4.53	29.675	JSC	JSC	SI	ANSMET
51	4.86	29.383	JSC	JSC	SI	ANSMET
52		28.726	NIPR	NIPR	A. Yamaguchi	
53		28.726	NIPR	NIPR	A. Yamaguchi	
54	4.5	28.481	JSC	JSC	SI	ANSMET
55	4.59	28.381	JSC	JSC	SI	ANSMET
56	4.54	28.124	JSC	JSC	SI	ANSMET
57		28.007	NIPR	NIPR	A. Yamaguchi	
58		28.007	NIPR	NIPR	A. Yamaguchi	
59		27.77	GUT	GUT	B. Miao, Z. Xiao	
60	4.44	27.251	JSC	JSC	SI	ANSMET

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2						
3	4.57	27.106	JSC	JSC	SI	ANSMET
4	4.66	27.096	JSC	JSC	SI	ANSMET
5	4.53	27.09	JSC	JSC	SI	ANSMET
6	4.72	26.979	JSC	JSC	SI	ANSMET
7	4.51	26.66	JSC	JSC	SI	ANSMET
8	4.69	26.52	JSC	JSC	SI	ANSMET
9	4.56	26.48	JSC	JSC	SI	ANSMET
10	4.59	26.455	JSC	JSC	SI	ANSMET
11		26.4	KOPRI	KOPRI	C. Park, S. Y.	Z. Beach
12	4.49	26.291	JSC	JSC	SI	ANSMET
13	4.58	26.110	JSC	JSC	SI	ANSMET
14	4.51	26.09	JSC	JSC	SI	ANSMET
15		6	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
16	4.59	25.743	JSC	JSC	SI	ANSMET
17	4.51	25.278	JSC	JSC	SI	ANSMET
18	4.43	25.186	JSC	JSC	SI	ANSMET
19	4.57	25.12	JSC	JSC	SI	ANSMET
20		24.92	PSF	PSF	A. Irving and S	
21		24.850	JSC	JSC	SI	ANSMET
22	4.74	24.475	JSC	JSC	SI	ANSMET
23	4.63	24.46	JSC	JSC	SI	ANSMET
24	4.52	23.887	JSC	JSC	SI	ANSMET
25	4.54	23.509	JSC	JSC	SI	ANSMET
26		23.48	PSF	PSF	A. Irving and S	
27	4.54	23.19	JSC	JSC	SI	ANSMET
28	4.53	23.12	JSC	JSC	SI	ANSMET
29	4.54	23.062	JSC	JSC	SI	ANSMET
30	4.54	23.055	JSC	JSC	SI	ANSMET
31	4.65	22.804	JSC	JSC	SI	ANSMET
32		4.5	ROM	Gregory	S. Yokoyama,	
33		22.49	GUT	GUT	B. Miao, Z. Xi	
34		22.367	NIPR	NIPR	A. Yamaguchi	
35	4.41	21.980	JSC	JSC	SI	ANSMET
36		21.8	KOPRI	KOPRI	C. Park, S. Y.	S. Park
37	4.72	21.44	JSC	JSC	SI	ANSMET
38	4.55	21.307	JSC	JSC	SI	ANSMET
39	4.48	20.873	JSC	JSC	SI	ANSMET
40	4.47	20.598	JSC	JSC	SI	ANSMET
41	4.49	20.58	JSC	JSC	SI	ANSMET
42	4.61	20.47	JSC	JSC	SI	ANSMET
43	4.46	20.31	JSC	JSC	SI	ANSMET
44	5.20	20.093	JSC	JSC	SI	ANSMET
45	4.33	5	CEREGE	Eric Christens	J. Gattacceca	Eric Christens
46	4.64	19.662	JSC	JSC	SI	ANSMET
47		19.597	JSC	JSC	SI	ANSMET

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2						
3		19.428	NIPR	NIPR	A. Yamaguchi	
4	4.63	19.33	JSC	JSC	SI	ANSMET
5	4.60	19.293	JSC	JSC	SI	ANSMET
6		19	KOPRI	KOPRI	C. Park, S. Y. H. Yoo	
7	4.63	18.87	JSC	JSC	SI	ANSMET
8	4.58	18.548	JSC	JSC	SI	ANSMET
9	4.53	18.510	JSC	JSC	SI	ANSMET
10	4.67	18.27	JSC	JSC	SI	ANSMET
11	4.5	18.13	JSC	JSC	SI	ANSMET
12		7	UPC	David Allepuz	J. Llorca, UPC	David Allepuz
13	4.54	18.076	JSC	JSC	SI	ANSMET
14	4.56	18.055	JSC	JSC	SI	ANSMET
15	4.59	18.04	JSC	JSC	SI	ANSMET
16	4.58	17.966	JSC	JSC	SI	ANSMET
17	4.54	17.842	JSC	JSC	SI	ANSMET
18	4.41	17.726	JSC	JSC	SI	ANSMET
19	4.46	17.513	JSC	JSC	SI	ANSMET
20		17.255	NIPR	NIPR	A. Yamaguchi	
21	4.78	17.157	JSC	JSC	SI	ANSMET
22	4.56	17.133	JSC	JSC	SI	ANSMET
23		16	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
24		16.926	NIPR	NIPR	A. Yamaguchi	
25	4.56	16.705	JSC	JSC	SI	ANSMET
26		16.7	KOPRI	KOPRI	C. Park, S. Y. J. Woo	
27		4.0	Vernad	DMUH	C. A. Lorenz, '	
28		3.5	UCLA	Verish	D. Sheikh, FS	Mark Bittmanr
29	4.59	16.290	JSC	JSC	SI	ANSMET
30	4.61	16.209	JSC	JSC	SI	ANSMET
31	4.60	16.092	JSC	JSC	SI	ANSMET
32	4.74	4.2	CEREGE	Eric Christens	J. Gattacceca,	Eric Christens
33	4.58	15.63	JSC	JSC	SI	ANSMET
34	4.42	15.329	JSC	JSC	SI	ANSMET
35	4.58	15.128	JSC	JSC	SI	ANSMET
36		15.084	JSC	JSC	SI	ANSMET
37	4.67	14.912	JSC	JSC	SI	ANSMET
38	4.53	14.860	JSC	JSC	SI	ANSMET
39	4.55	14.75	JSC	JSC	SI	ANSMET
40		14.71	GUT	GUT	B. Miao, Z. Xi	
41	4.68	14.357	JSC	JSC	SI	ANSMET
42	4.85	14.34	JSC	JSC	SI	ANSMET
43	4.79	14.304	JSC	JSC	SI	ANSMET
44	4.63	14.2	JSC	JSC	SI	ANSMET
45		14.1	KOPRI	KOPRI	C. Park, S. Y. J. H. Kim	
46	4.52	14.015	JSC	JSC	SI	ANSMET
47	4.55	13.87	JSC	JSC	SI	ANSMET

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2						
3		13.821	NIPR	NIPR	A. Yamaguchi	
4						
5	4.57	13.742	JSC	JSC	SI	ANSMET
6	4.67	13.63	JSC	JSC	SI	ANSMET
7	4.58	13.52	JSC	JSC	SI	ANSMET
8	4.62	13.469	JSC	JSC	SI	ANSMET
9						
10	4.61	13.42	JSC	JSC	SI	ANSMET
11	4.56	13.280	JSC	JSC	SI	ANSMET
12	4.54	13.270	JSC	JSC	SI	ANSMET
13						
14	4.55	13.268	JSC	JSC	SI	ANSMET
15		7	UPC	David Allepuz	J. Llorca, UPC	David Allepuz
16	4.59	13.08	JSC	JSC	SI	ANSMET
17	4.53	12.92	JSC	JSC	SI	ANSMET
18						
19	4.55	12.874	JSC	JSC	SI	ANSMET
20	4.47	12.388	JSC	JSC	SI	ANSMET
21	4.57	12.08	JSC	JSC	SI	ANSMET
22						
23		11	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
24		11.973	NIPR	NIPR	A. Yamaguchi	
25	5.08	11.936	JSC	JSC	SI	ANSMET
26	4.57	11.825	JSC	JSC	SI	ANSMET
27	4.51	11.65	JSC	JSC	SI	ANSMET
28	4.52	11.54	JSC	JSC	SI	ANSMET
29	4.56	11.29	JSC	JSC	SI	ANSMET
30						
31						
32		8.4	UrFU	8.4 g cut-off – V.V. Sharygin	UrFU meteorit	
33	4.66	11.190	JSC	JSC	SI	ANSMET
34	4.62	11.129	JSC	JSC	SI	ANSMET
35	4.54	10.956	JSC	JSC	SI	ANSMET
36	4.56	10.830	JSC	JSC	SI	ANSMET
37	4.31	10.68	JSC	JSC	SI	ANSMET
38	4.59	10.55	JSC	JSC	SI	ANSMET
39	4.55	10.24	JSC	JSC	SI	ANSMET
40						
41						
42		10.2	KOPRI	KOPRI	C. Park, S. Y.	H. Yoo
43	4.67	10.154	JSC	JSC	SI	ANSMET
44	4.52	9.975	JSC	JSC	SI	ANSMET
45	4.57	9.92	JSC	JSC	SI	ANSMET
46	4.81	9.92	JSC	JSC	SI	ANSMET
47	4.85	3	CEREGE	Eric Christens	H. Pourkhorsā	Eric Christens
48						
49		9.839	NIPR	NIPR	A. Yamaguchi	
50		9.688	NIPR	NIPR	A. Yamaguchi	
51	4.67	9.6	JSC	JSC	SI	ANSMET
52	4.74	9.19	JSC	JSC	SI	ANSMET
53	4.77	9.14	JSC	JSC	SI	ANSMET
54						
55		9.08	NIPR	NIPR	A. Yamaguchi	
56		9	KOPRI	KOPRI	C. Park, S. Y.	J. I. Lee
57	4.37	8.923	JSC	JSC	SI	ANSMET
58						
59		8.372	NIPR	NIPR	A. Yamaguchi	
60						

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2					
3		8.355	NIPR	NIPR	A. Yamaguchi
4		8.1	KOPRI	KOPRI	C. Park, S. Y. S. Park
5		8.041	NIPR	NIPR	A. Yamaguchi
6					
7	4.56	8	JSC	JSC	SI ANSMET
8	4.66	7.8	JSC	JSC	SI ANSMET
9					
10		7.527	NIPR	NIPR	A. Yamaguchi
11	4.96	7.451	JSC	JSC	SI ANSMET
12	4.27	7.386	JSC	JSC	SI ANSMET
13	4.54	7.176	JSC	JSC	SI ANSMET
14	4.68	7.146	JSC	JSC	SI ANSMET
15					
16		6.7	KOPRI	KOPRI	C. Park, S. Y. J. Woo
17	4.70	6.607	JSC	JSC	SI ANSMET
18					
19	4.5	6.44	JSC	JSC	SI ANSMET
20		6.361	NIPR	NIPR	A. Yamaguchi
21		6	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
22					
23		6	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
24	4.57	5.99	JSC	JSC	SI ANSMET
25		5.572	NIPR	NIPR	A. Yamaguchi
26					
27		5.3	KOPRI	KOPRI	C. Park, S. Y. S. Park
28		5.187	NIPR	NIPR	A. Yamaguchi
29		5.165	NIPR	NIPR	A. Yamaguchi
30					
31		5.13	NIPR	NIPR	A. Yamaguchi
32	4.60	5	CEREGE	CEREGE	H. Pourkhorsæ Lydie Bonal
33		4.989	NIPR	NIPR	A. Yamaguchi
34		4.93	NIPR	NIPR	A. Yamaguchi
35					
36		4.875	NIPR	NIPR	A. Yamaguchi
37		4.812	NIPR	NIPR	A. Yamaguchi
38		4.75	NIPR	NIPR	A. Yamaguchi
39		4.733	NIPR	NIPR	A. Yamaguchi
40					
41		4.69	NIPR	NIPR	A. Yamaguchi
42		4.596	NIPR	NIPR	A. Yamaguchi
43		4.529	NIPR	NIPR	A. Yamaguchi
44					
45		4.438	NIPR	NIPR	A. Yamaguchi
46		4.41	NIPR	NIPR	A. Yamaguchi
47		4.376	NIPR	NIPR	A. Yamaguchi
48		4.375	NIPR	NIPR	A. Yamaguchi
49					
50		4.359	NIPR	NIPR	A. Yamaguchi
51		4.276	NIPR	NIPR	A. Yamaguchi
52		4.228	NIPR	NIPR	A. Yamaguchi
53					
54		4.185	NIPR	NIPR	A. Yamaguchi
55		4.176	NIPR	NIPR	A. Yamaguchi
56		4.162	NIPR	NIPR	A. Yamaguchi
57					
58		4.135	NIPR	NIPR	A. Yamaguchi
59		4.099	NIPR	NIPR	A. Yamaguchi
60		4.086	NIPR	NIPR	A. Yamaguchi

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2					
3		3.998	NIPR	NIPR	A. Yamaguchi
4		3.9	KOPRI	KOPRI	C. Park, S. Y. S. Park
5		3.9	NIPR	NIPR	A. Yamaguchi
6		3.841	NIPR	NIPR	A. Yamaguchi
7		3.841	NIPR	NIPR	A. Yamaguchi
8	4.41	3.83	JSC	JSC	SI ANSMET
9		3.811	NIPR	NIPR	A. Yamaguchi
10		3.756	NIPR	NIPR	A. Yamaguchi
11		3.731	NIPR	NIPR	A. Yamaguchi
12		3.731	NIPR	NIPR	A. Yamaguchi
13		3.718	NIPR	NIPR	A. Yamaguchi
14		3.718	NIPR	NIPR	A. Yamaguchi
15		3.6	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
16		3.565	NIPR	NIPR	A. Yamaguchi
17		3.549	NIPR	NIPR	A. Yamaguchi
18		3.549	NIPR	NIPR	A. Yamaguchi
19		3.523	NIPR	NIPR	A. Yamaguchi
20		3.491	NIPR	NIPR	A. Yamaguchi
21		3.4	KOPRI	KOPRI	C. Park, S. Y. B. W. Son
22		3.375	NIPR	NIPR	A. Yamaguchi
23		3.375	NIPR	NIPR	A. Yamaguchi
24		3.319	NIPR	NIPR	A. Yamaguchi
25		3.296	NIPR	NIPR	A. Yamaguchi
26		3.296	NIPR	NIPR	A. Yamaguchi
27		3.261	NIPR	NIPR	A. Yamaguchi
28		3.257	NIPR	NIPR	A. Yamaguchi
29		3.251	NIPR	NIPR	A. Yamaguchi
30		3.238	NIPR	NIPR	A. Yamaguchi
31		3.238	NIPR	NIPR	A. Yamaguchi
32		3.2	KOPRI	KOPRI	C. Park, S. Y. J. Woo
33		3.173	NIPR	NIPR	A. Yamaguchi
34		3.161	NIPR	NIPR	A. Yamaguchi
35		3.161	NIPR	NIPR	A. Yamaguchi
36		3.143	NIPR	NIPR	A. Yamaguchi
37		3.131	NIPR	NIPR	A. Yamaguchi
38		3.086	NIPR	NIPR	A. Yamaguchi
39		3.075	NIPR	NIPR	A. Yamaguchi
40		3.075	NIPR	NIPR	A. Yamaguchi
41		3.019	NIPR	NIPR	A. Yamaguchi
42		2	UPC	José Vicente (J. Llorca, UPC)	José Vicente (
43		2.974	NIPR	NIPR	A. Yamaguchi
44		2.974	NIPR	NIPR	A. Yamaguchi
45		2.932	NIPR	NIPR	A. Yamaguchi
46		2.922	NIPR	NIPR	A. Yamaguchi
47		2.922	NIPR	NIPR	A. Yamaguchi
48		2.9	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
49		2.9	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
50		2.9	NIPR	NIPR	A. Yamaguchi
51		2.892	NIPR	NIPR	A. Yamaguchi
52		2.882	NIPR	NIPR	A. Yamaguchi
53		2.882	NIPR	NIPR	A. Yamaguchi
54		2.814	NIPR	NIPR	A. Yamaguchi
55		2.81	NIPR	NIPR	A. Yamaguchi
56		2.81	NIPR	NIPR	A. Yamaguchi
57		2.747	NIPR	NIPR	A. Yamaguchi
58		2.676	NIPR	NIPR	A. Yamaguchi
59		2.676	NIPR	NIPR	A. Yamaguchi
60		2.654	NIPR	NIPR	A. Yamaguchi
61		2.627	NIPR	NIPR	A. Yamaguchi

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2				
3	2.609	NIPR	NIPR	A. Yamaguchi
4	2.603	NIPR	NIPR	A. Yamaguchi
5	2.6	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
6	2.585	NIPR	NIPR	A. Yamaguchi
7	2.569	NIPR	NIPR	A. Yamaguchi
8	2.565	NIPR	NIPR	A. Yamaguchi
9	2.564	NIPR	NIPR	A. Yamaguchi
10	2.564	NIPR	NIPR	A. Yamaguchi
11	2.564	NIPR	NIPR	A. Yamaguchi
12	2.5	KOPRI	KOPRI	C. Park, S. Y. B. W. Son
13	2.482	NIPR	NIPR	A. Yamaguchi
14	2.474	NIPR	NIPR	A. Yamaguchi
15	2.474	NIPR	NIPR	A. Yamaguchi
16	2.39	NIPR	NIPR	A. Yamaguchi
17	2.377	NIPR	NIPR	A. Yamaguchi
18	2.377	NIPR	NIPR	A. Yamaguchi
19	2.339	NIPR	NIPR	A. Yamaguchi
20	2.323	NIPR	NIPR	A. Yamaguchi
21	2.303	NIPR	NIPR	A. Yamaguchi
22	2.303	NIPR	NIPR	A. Yamaguchi
23	2.287	NIPR	NIPR	A. Yamaguchi
24	2.287	NIPR	NIPR	A. Yamaguchi
25	2.232	NIPR	NIPR	A. Yamaguchi
26	2.221	NIPR	NIPR	A. Yamaguchi
27	2.221	NIPR	NIPR	A. Yamaguchi
28	2.221	NIPR	NIPR	A. Yamaguchi
29	2.2	KOPRI	KOPRI	C. Park, S. Y. S. Han
30	2.18	NIPR	NIPR	A. Yamaguchi
31	2.18	NIPR	NIPR	A. Yamaguchi
32	2.174	NIPR	NIPR	A. Yamaguchi
33	2.171	NIPR	NIPR	A. Yamaguchi
34	2.147	NIPR	NIPR	A. Yamaguchi
35	2.147	NIPR	NIPR	A. Yamaguchi
36	2.133	NIPR	NIPR	A. Yamaguchi
37	2.121	NIPR	NIPR	A. Yamaguchi
38	2.106	NIPR	NIPR	A. Yamaguchi
39	2.104	NIPR	NIPR	A. Yamaguchi
40	2.104	NIPR	NIPR	A. Yamaguchi
41	2.1	KOPRI	KOPRI	C. Park, S. Y. J. I. Lee
42	2.082	NIPR	NIPR	A. Yamaguchi
43	2.073	NIPR	NIPR	A. Yamaguchi
44	2.073	NIPR	NIPR	A. Yamaguchi
45	2.052	NIPR	NIPR	A. Yamaguchi
46	2.009	NIPR	NIPR	A. Yamaguchi
47	2	NIPR	NIPR	A. Yamaguchi
48	1.975	NIPR	NIPR	A. Yamaguchi
49	1.975	NIPR	NIPR	A. Yamaguchi
50	1.961	NIPR	NIPR	A. Yamaguchi
51	1.956	NIPR	NIPR	A. Yamaguchi
52	1.952	NIPR	NIPR	A. Yamaguchi
53	1.952	NIPR	NIPR	A. Yamaguchi
54	1.895	NIPR	NIPR	A. Yamaguchi
55	1.889	NIPR	NIPR	A. Yamaguchi
56	1.867	NIPR	NIPR	A. Yamaguchi
57	1.867	NIPR	NIPR	A. Yamaguchi
58	1.851	NIPR	NIPR	A. Yamaguchi
59	1.849	NIPR	NIPR	A. Yamaguchi
60	1.837	NIPR	NIPR	A. Yamaguchi

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2					
3	1.835	NIPR	NIPR	A. Yamaguchi	
4	1.832	NIPR	NIPR	A. Yamaguchi	
5	1.816	NIPR	NIPR	A. Yamaguchi	
6	1.806	NIPR	NIPR	A. Yamaguchi	
7	1.806	NIPR	NIPR	A. Yamaguchi	
8	1.741	NIPR	NIPR	A. Yamaguchi	
9	1.731	NIPR	NIPR	A. Yamaguchi	
10	1.723	NIPR	NIPR	A. Yamaguchi	
11	1.723	NIPR	NIPR	A. Yamaguchi	
12	1.709	NIPR	NIPR	A. Yamaguchi	
13	1.709	NIPR	NIPR	A. Yamaguchi	
14	1.709	NIPR	NIPR	A. Yamaguchi	
15	1.678	NIPR	NIPR	A. Yamaguchi	
16	1.665	NIPR	NIPR	A. Yamaguchi	
17	1.596	NIPR	NIPR	A. Yamaguchi	
18	1.596	NIPR	NIPR	A. Yamaguchi	
19	1.487	NIPR	NIPR	A. Yamaguchi	
20	1.47	NIPR	NIPR	A. Yamaguchi	
21	1.449	NIPR	NIPR	A. Yamaguchi	
22	1.449	NIPR	NIPR	A. Yamaguchi	
23	1.421	NIPR	NIPR	A. Yamaguchi	
24	1.397	NIPR	NIPR	A. Yamaguchi	
25	1.392	NIPR	NIPR	A. Yamaguchi	
26	1.392	NIPR	NIPR	A. Yamaguchi	
27	1.367	NIPR	NIPR	A. Yamaguchi	
28	1.322	NIPR	NIPR	A. Yamaguchi	
29	1.29	NIPR	NIPR	A. Yamaguchi	
30	1.282	NIPR	NIPR	A. Yamaguchi	
31	1.282	NIPR	NIPR	A. Yamaguchi	
32	1.273	NIPR	NIPR	A. Yamaguchi	
33	1.255	NIPR	NIPR	A. Yamaguchi	
34	1.251	NIPR	NIPR	A. Yamaguchi	
35	1.251	NIPR	NIPR	A. Yamaguchi	
36	1.251	NIPR	NIPR	A. Yamaguchi	
37	1.250	JSC	JSC	SI	ANSMET
38	1.25	NIPR	NIPR	A. Yamaguchi	
39	1.236	NIPR	NIPR	A. Yamaguchi	
40	1.236	NIPR	NIPR	A. Yamaguchi	
41	1.204	NIPR	NIPR	A. Yamaguchi	
42	1.186	NIPR	NIPR	A. Yamaguchi	
43	1.168	NIPR	NIPR	A. Yamaguchi	
44	1.168	NIPR	NIPR	A. Yamaguchi	
45	1.147	NIPR	NIPR	A. Yamaguchi	
46	1.143	NIPR	NIPR	A. Yamaguchi	
47	1.111	NIPR	NIPR	A. Yamaguchi	
48	1.089	NIPR	NIPR	A. Yamaguchi	
49	1.089	NIPR	NIPR	A. Yamaguchi	
50	1.076	NIPR	NIPR	A. Yamaguchi	
51	1.070	JSC	JSC	SI	ANSMET
52	1.041	NIPR	NIPR	A. Yamaguchi	
53	1.041	NIPR	NIPR	A. Yamaguchi	
54	1.036	NIPR	NIPR	A. Yamaguchi	
55	1.02	NIPR	NIPR	A. Yamaguchi	
56	1.010	JSC	JSC	SI	ANSMET
57	0.999	NIPR	NIPR	A. Yamaguchi	
58	0.999	NIPR	NIPR	A. Yamaguchi	
59	0.969	NIPR	NIPR	A. Yamaguchi	
60	0.967	NIPR	NIPR	A. Yamaguchi	

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2					
3	0.888	NIPR	NIPR	A. Yamaguchi	
4	0.873	NIPR	NIPR	A. Yamaguchi	
5	0.857	NIPR	NIPR	A. Yamaguchi	
6	0.854	NIPR	NIPR	A. Yamaguchi	
7	0.837	NIPR	NIPR	A. Yamaguchi	
8	0.835	JSC	JSC	SI	ANSMET
9	0.826	NIPR	NIPR	A. Yamaguchi	
10	0.821	NIPR	NIPR	A. Yamaguchi	
11	0.815	NIPR	NIPR	A. Yamaguchi	
12	0.795	NIPR	NIPR	A. Yamaguchi	
13	0.783	NIPR	NIPR	A. Yamaguchi	
14	0.775	NIPR	NIPR	A. Yamaguchi	
15	0.77	NIPR	NIPR	A. Yamaguchi	
16	0.768	NIPR	NIPR	A. Yamaguchi	
17	0.752	NIPR	NIPR	A. Yamaguchi	
18	0.748	NIPR	NIPR	A. Yamaguchi	
19	0.744	NIPR	NIPR	A. Yamaguchi	
20	0.728	NIPR	NIPR	A. Yamaguchi	
21	0.701	NIPR	NIPR	A. Yamaguchi	
22	0.7	KOPRI	KOPRI	C. Park, S. Y. H. Yoo	
23	0.674	NIPR	NIPR	A. Yamaguchi	
24	0.657	NIPR	NIPR	A. Yamaguchi	
25	0.648	NIPR	NIPR	A. Yamaguchi	
26	0.585	NIPR	NIPR	A. Yamaguchi	
27	0.585	NIPR	NIPR	A. Yamaguchi	
28	0.58	NIPR	NIPR	A. Yamaguchi	
29	0.521	NIPR	NIPR	A. Yamaguchi	
30	0.52	JSC	JSC	SI	ANSMET
31	0.493	NIPR	NIPR	A. Yamaguchi	
32	0.48	NIPR	NIPR	A. Yamaguchi	
33	0.459	NIPR	NIPR	A. Yamaguchi	
34	0.445	NIPR	NIPR	A. Yamaguchi	
35	0.444	JSC	JSC	SI	ANSMET
36	0.444	NIPR	NIPR	A. Yamaguchi	
37	0.43	NIPR	NIPR	A. Yamaguchi	
38	0.427	NIPR	NIPR	A. Yamaguchi	
39	0.425	JSC	JSC	SI	ANSMET
40	0.419	JSC	JSC	SI	ANSMET
41	0.416	NIPR	NIPR	A. Yamaguchi	
42	0.406	NIPR	NIPR	A. Yamaguchi	
43	0.406	NIPR	NIPR	A. Yamaguchi	
44	0.404	NIPR	NIPR	A. Yamaguchi	
45	0.401	NIPR	NIPR	A. Yamaguchi	
46	0.384	NIPR	NIPR	A. Yamaguchi	
47	0.362	NIPR	NIPR	A. Yamaguchi	
48					
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59					
60					

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2					
3		0.353	NIPR	NIPR	A. Yamaguchi
4		0.351	NIPR	NIPR	A. Yamaguchi
5		0.348	NIPR	NIPR	A. Yamaguchi
6		0.345	NIPR	NIPR	A. Yamaguchi
7		0.341	NIPR	NIPR	A. Yamaguchi
8		0.336	NIPR	NIPR	A. Yamaguchi
9		0.329	NIPR	NIPR	A. Yamaguchi
10		0.314	NIPR	NIPR	A. Yamaguchi
11		0.309	NIPR	NIPR	A. Yamaguchi
12		0.304	NIPR	NIPR	A. Yamaguchi
13		0.247	NIPR	NIPR	A. Yamaguchi
14		0.204	NIPR	NIPR	A. Yamaguchi
15		0.175	NIPR	NIPR	A. Yamaguchi
16		0.165	NIPR	NIPR	A. Yamaguchi
17		20.4	UWB	G. Hupe	A. Irving and S
18	4.97	37	CEREGE	ArtMet collecti	J. Gattacceca, anonymous
19		20	MNB	Dario Ruiz	A. Greshake, I Dario Ruiz
20	4.79	5.5	CEREGE	Eric Christens	J. Gattacceca, Eric Christens
21		21.2	UWB	A. Aaronson	A. Irving and S
22		22	UWB	A. Aaronson	A. Irving and S
23	4.44	22.7	Kiel	Wang Ziyao	R. Bartoschew Wang Ziyao
24	4.41	19.1	Kiel	Li Bofang, Bei	R. Bartoschew anonymous
25	4.44	18.1	Kiel	Wang Ziyao	R. Bartoschew Fan Xingang (
26	4.37	15.6	Kiel	Wang Ziyao	R. Bartoschew anonymous
27	4.08	1.77	Kiel	Bartoschewitz	R. Bartoschew Liu Binghan (f
28	3.22	26.4	UWB	A. Aaronson	A. Irving and S
29		24.4	UNM	MMGM	C. Agee, UNM
30	3.61	22.7	UWB	M. Jost	A. Irving and S
31		32.8	UWB	Aaronson	A. Irving and S
32		22.4	UNM	Jay Piatek	C. Agee, UNM
33		2056.6	URFU	UrFU	V.V. Sharygin, UrFU meteorit
34		22.7	UNM	MMGM	C. Agee, UNM
35		48.4	Cascadia	Tobin	M. Hutson, S.
36	4.08	21.3	MNB	Hanno Strufe	A. Greshake, I
37		22.7	Cascadia	Mr. Ronnie Mc	M. Hutson, S.
38	3.80	22.41	UWB	FKuntz	A. Irving and S
39	4.18	21.3	MNB	Hichame Mim	A. Greshake, I
40		22.13	UCLA	Matthew Stre	D. Sheikh, FS
41		23.5	ASU	with finder	L. Garvie, ASI Mr. Todd Dziu
42		183.05	NIPR	NIPR	A. Yamaguchi
43		25.6	UWB	D. Pitt	A. Irving and S
44	3.94	20.53	CEREGE	Kuntz	J. Gattacceca,
45		20	UCLA	Michael Cottin	A. Rubin, UCL
46		20.49	CEREGE	Kuntz	J. Gattacceca,
47	3.95	15.8	Kiel	Li Bofang, Bei	R. Bartoschew anonymous

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2					
3	3.85	9	MNB	Tomasz Jaku	A. Greshake, I
4		8.0	Vernad	Mr. T. Kryach	Lorenz C. A., 'Mr. T. Kryach
5		32.443	NIPR	NIPR	A. Yamaguchi
6		30.6	ASU	ASU	Bercovici, H., anonymous
7		5.15	CEREGE	Kuntz	J. Gattacceca,
8	3.51	23	KOPRI	KOPRI	C. Park, S. Y. S. Park
9		11.8	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
10		20	IfP	Anonymous	K. Metzler, IfP
11		13	MNB	Philippe Schm	A. Greshake, I
12	4.00	8.14	CEREGE	Kuntz	J. Gattacceca,
13		48.5	UNM	Matthew Marti	C. Agee, UNM
14	3.93	182	CEREGE	MMC	J. Gattacceca, Rodrigo Martir
15	3.94	20.26	JSC	JSC	SI ANSMET
16	4.65	9.51	JSC	JSC	SI ANSMET
17		32.4	MSN-FI	Tomelleri	V. Moggi Cecc
18	4.09	22	CEREGE	Jean Redelsp	J. Gattacceca,
19		46	UPC	Ion Ander Lan	J. Llorca, UPC Ion Ander Lan
20		25.0	MSN-FI	Castellano	Vanni Moggi C
21	4.06	53.2	MNB	Hanno Strufe	A. Greshake, I
22		21.7	OU	Joe Bazyk	R. Greenwooc Joe Bazyk
23		21.0	ROM	Gregory	S. Yokoyama,
24		24.5	MNB	Jörgen Naube	A. Greshake, I
25		81.98	NIPR	NIPR	A. Yamaguchi
26		80.76	NIPR	NIPR	A. Yamaguchi
27		67.72	NIPR	NIPR	A. Yamaguchi
28		53.29	NIPR	NIPR	A. Yamaguchi
29	4.23	42.705	JSC	JSC	SI ANSMET
30		38.633	NIPR	NIPR	A. Yamaguchi
31		28.981	NIPR	NIPR	A. Yamaguchi
32		28.652	NIPR	NIPR	A. Yamaguchi
33		27.419	NIPR	NIPR	A. Yamaguchi
34		24.169	NIPR	NIPR	A. Yamaguchi
35		5.81	ROM	Gregory	J. Poitras and
36	3.46	17.89	JSC	JSC	SI ANSMET
37		2.9	MNA-SI	MNA-SI	F. Focacci, M. Gabriele Giuli
38		1.040	JSC	JSC	SI ANSMET
39		83.5	Cascadia	John A. Shea,	M. Hutson anc
40		33.3	IfP	Marc Jost and	K. Klemm and
41	3.71	29.1	MNB	Harald Stehlik	A. Greshake, I
42		164.61	NIPR	NIPR	A. Yamaguchi
43		23.3	MNB	Juergen Naub	A. Greshake, I
44		80.52	NIPR	NIPR	A. Yamaguchi
45		13.8	MNB	Hanno Strufe	A. Greshake, I
46		37.259	NIPR	NIPR	A. Yamaguchi
47		20	UCLA	Nick Gessler	A. Rubin, UCL

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3		20	MNB	anonymous	A. Greshake, I	
4		42.7	UWO	S. Tutorow	Z.G. Guo, UW	
5		381.62	NIPR	NIPR	A. Yamaguchi	
6		348.31	NIPR	NIPR	A. Yamaguchi	
7		20.2	MSN-FI	Mimaghador	V. Moggi Cecc	
8						
9						
10	4.43	218.380	JSC	JSC	SI	ANSMET
11		40.7	Vernad	Mr. T. Kryach	C. A. Lorenz, 'Mr. T. Kryach	
12	4.71	160.89	JSC	JSC	SI	ANSMET
13		22.2	ROM	Gregory	S. Yokoyama,	
14		27	Vernad.	Mr. T. Kryach	Lorenz C. A., 'Mr. T. Kryach	
15		136.64	GUT	GUT	B. Miao, Z. Xi	
16		126.26	NIPR	NIPR	A. Yamaguchi	
17		99.17	NIPR	NIPR	A. Yamaguchi	
18						
19						
20	4.6	74.465	JSC	JSC	SI	ANSMET
21		20.5	MSN-FI	Vignato	Vanni Moggi C	
22		46.888	NIPR	NIPR	A. Yamaguchi	
23						
24	4.63	43.339	JSC	JSC	SI	ANSMET
25		7.98	Vernad	DMUH	C.A. Lorenz, V	
26		26.639	NIPR	NIPR	A. Yamaguchi	
27		5.7	ROM	Gregory	J. Poitras, UT	
28		19.572	NIPR	NIPR	A. Yamaguchi	
29						
30	4.75	13.818	JSC	JSC	SI	ANSMET
31		11.376	NIPR	NIPR	A. Yamaguchi	
32		8.065	NIPR	NIPR	A. Yamaguchi	
33						
34	4.75	7.001	JSC	JSC	SI	ANSMET
35		3.7	Vernad	Vernad	C. A. Lorenz, 'Mr. S. E. Boris	
36		4.67	NIPR	NIPR	A. Yamaguchi	
37		3.587	NIPR	NIPR	A. Yamaguchi	
38						
39	3.42	20.07	CEREGE	Kuntz	J. Gattacceca,	
40		14.8	IfP	Marc Jost and	K. Klemm and	
41		12.7	IfP	Marc Jost and	K. Klemm and	
42						
43	3.7	51	FSAC	Aaras Jonikas	H. Chennaoui A nomad girl r	
44		455.88	UCLA	Daniel Sheikh	D. Sheikh, UF	
45		23.5	ROM	Gregory	S. Yokoyama,	
46		21.2	ROM	Gregory	S. Yokoyama,	
47		22.1	ROM	Gregory	J. Poitras, UT	
48		20	IfP	Manuel Nieto	K. Metzler, IfP	
49		23.7	MSN-FI	Tomelleri	V. Moggi Cecc	
50		468.39	NIPR	NIPR	A. Yamaguchi	
51		337.58	NIPR	NIPR	A. Yamaguchi	
52		20.1	MSN-FI	Castellano	V. Moggi Cecc	
53		281.4	NIPR	NIPR	A. Yamaguchi	
54						
55	3.33	48.6	MNB	Hichame Mim	A. Greshake, I	
56		21.3	ROM	Gregory	J. Poitras, UT	
57		22.34	ROM	Gregory	J. Poitras and	
58						
59						
60						

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3		186.87	NIPR	NIPR	A. Yamaguchi
4		161.31	NIPR	NIPR	A. Yamaguchi
5		21	UPC	Francisco Gal	J. Llorca, UPCFrancisco Gal
6		21.2	UWB	B. Reed	A. Irving and S
7		21.2	UWB	B. Reed	A. Irving and S
8		150.64	JSC	JSC	SI ANSMET
9	4.62	150.64	JSC	JSC	SI ANSMET
10		22	MSN-FI	Tomelleri	V. Moggi Cecc
11		20.6	MNB	Hanno Strufe	A. Greshake, I
12		22.2	MNB	Philippe Schm	A. Greshake, I
13		22.2	MNB	Philippe Schm	A. Greshake, I
14	5	133.43	JSC	JSC	SI ANSMET
15		121.02	NIPR	NIPR	A. Yamaguchi
16		119.5	NIPR	NIPR	A. Yamaguchi
17		104.4	MSN-FI	Mimaghador	V. Moggi Cecc
18		104.4	MSN-FI	Mimaghador	V. Moggi Cecc
19		24.7	MSN-FI	Vignato	Vanni Moggi C
20		19.9	MNB	Hichame Mim	A. Greshake, I
21		19.9	MNB	Hichame Mim	A. Greshake, I
22		93.89	NIPR	NIPR	A. Yamaguchi
23		88.02	NIPR	NIPR	A. Yamaguchi
24	3.49	18.2	Kiel	Wang Ziyao	R. Bartoschewanonymous
25		16	MNB	Philippe Schm	A. Greshake, I
26		16	MNB	Philippe Schm	A. Greshake, I
27		17	UCLA	Verish	A. Rubin, UCL
28		71.46	NIPR	NIPR	A. Yamaguchi
29	4.59	64.981	JSC	JSC	SI ANSMET
30		64.981	JSC	JSC	SI ANSMET
31		15.1	MNB	Hanno Strufe	A. Greshake, I
32		57.966	NIPR	NIPR	A. Yamaguchi
33		51.003	NIPR	NIPR	A. Yamaguchi
34		50.285	NIPR	NIPR	A. Yamaguchi
35		45.093	NIPR	NIPR	A. Yamaguchi
36		45.093	NIPR	NIPR	A. Yamaguchi
37		39.869	NIPR	NIPR	A. Yamaguchi
38		35.703	NIPR	NIPR	A. Yamaguchi
39		34.533	NIPR	NIPR	A. Yamaguchi
40		34.533	NIPR	NIPR	A. Yamaguchi
41		34.092	NIPR	NIPR	A. Yamaguchi
42		8.8	MNB	Hanno Strufe	A. Greshake, I
43		8.8	MNB	Hanno Strufe	A. Greshake, I
44		8.4	UWB	J. Bliss	A. Irving and S
45		30.565	NIPR	NIPR	A. Yamaguchi
46		27.51	GUT	GUT	B. Miao, Z. Xia
47		23.685	NIPR	NIPR	A. Yamaguchi
48		23.685	NIPR	NIPR	A. Yamaguchi
49		4.7	MNB	Philippe Schm	A. Greshake, I
50		21.831	NIPR	NIPR	A. Yamaguchi
51		4.4	MNB	Philippe Schm	A. Greshake, I
52		4.4	MNB	Philippe Schm	A. Greshake, I
53		21.03	NIPR	NIPR	A. Yamaguchi
54		18.957	NIPR	NIPR	A. Yamaguchi
55		15.067	NIPR	NIPR	A. Yamaguchi
56		14.465	NIPR	NIPR	A. Yamaguchi
57		14.465	NIPR	NIPR	A. Yamaguchi
58	4.83	13.744	JSC	JSC	SI ANSMET
59	4.59	13.683	JSC	JSC	SI ANSMET
60		2.5	MNB	Philippe Schm	A. Greshake, I

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2						
3	4.69	10.907	JSC	JSC	SI	ANSMET
4	4.78	10.253	JSC	JSC	SI	ANSMET
5		9.95	NIPR	NIPR	A. Yamaguchi	
6		8.446	NIPR	NIPR	A. Yamaguchi	
7	3.64	8.337	JSC	JSC	SI	ANSMET
8		6.593	NIPR	NIPR	A. Yamaguchi	
9	4.64	6.39	JSC	JSC	SI	ANSMET
10	4.6	5.52	JSC	JSC	SI	ANSMET
11		5.397	NIPR	NIPR	A. Yamaguchi	
12	3.87	5.091	JSC	JSC	SI	ANSMET
13		4.626	NIPR	NIPR	A. Yamaguchi	
14		4.151	NIPR	NIPR	A. Yamaguchi	
15		1.803	NIPR	NIPR	A. Yamaguchi	
16		1.419	NIPR	NIPR	A. Yamaguchi	
17		0.32	NIPR	NIPR	A. Yamaguchi	
18		0.2	KOPRI	KOPRI	C. Park, S. Y. C. H. Oh	
19	3.88	20.0	App	PARI	A. Love, App	Unknown
20		34.8	UNM	Larry Atkins	C. Agee, UNM	
21		20	IfP	Nourddine Azi	K. Metzler, IfP	
22	3.16	20	CEREGE	Sergey Vasilie	J. Gattacceca, Thomas Kurtz	
23		9.2	UWB	F. Olsen	A. Irving and S	
24		28.8	UWB	R. Chaoui	A. Irving and S	
25		35	MNB	Salamu Hama	A. Greshake, I	
26		24.1	UWB	B. Hoefnagels	A. Irving and S	
27		22.9	UNM	Dustin Dicken	C. Agee, UNM	
28		180.9	ASU	ASU	E.T. Dunham,	
29		9.533	NIPR	NIPR	A. Yamaguchi	
30		5.232	NIPR	NIPR	A. Yamaguchi	
31	5.46	3.42	JSC	JSC	SI	ANSMET
32		20.9	UWB	D. Pitt	A. Irving, S. Ki	
33		80.8	NHMOV	NHMOV	F. Brandstätte	
34		67.05	GUT	GUT	B. Miao, H.Liu	
35	3.60	7.5	CEREGE	Labenne Luc	J. Gattacceca,	
36		3	MNB	Stefan Ralew	A. Greshake, I	
37		25.2	UWB	B. Hoefnagels	A. Irving and S	
38		21.25	UNM	Dustin Dicken	C. Agee, UNM	
39		28.9	UNM	Dustin Dicken	C. Agee, UNM	
40		20.0	UWB	D. Dickens	A. Irving and S	
41		43.15	UNM	Dustin Dicken	C. Agee, UNM	
42		663	Vernad	anonymous	F. Badyukov, '	
43		20.6	UNM	Aaronson	C. Agee, UNM	
44		37.9	GUT	Guobing Zhon	H. Chen, J. Zh	
45		29.2	UNM	Terry Boudrea	C. Agee, UNM	
46		21.2	UCLA	N. Gessler	P. Warren, UC	
47		21.6	UNM	Dustin Dicken	C. Agee, UNM	

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3		20.2	ROM/UWB	D. Gregory A. Irving and S
4		20	UNM	Jay Piatek C. Agee, UNM
5		20.85	CSFK	Z. Kereszty C. Agee, UNM
6		22	UWB	H. Naji A. Irving & P. C
7		20.1	UNM	Jay Piatek C. Agee, UNM
8		23.5	IfP	Finder A.-K. Kraemer anonymous
9		17.6	App	J. Sinclair A. Love, App Anonymous
10		14.11	UWB	F. Kuntz A. Irving and S
11		13	UNM	Jay Piatek C. Agee, UNM
12		11.8	UWB	B. Hoefnagels A. Irving and S
13		9.5	UWB	DPitt A. Irving and S
14		4.73	UWB	J. Hum A. Irving and S
15		20.1	UWB	D. Pitt A. Irving and S
16	3.93	21	CEREGE	with anonymo J. Gattacceca, anonymous
17		2.90	SI	Ahmed El Gor N. G. Lunning
18	4.42	1.55	MNB	Said Yousfi A. Greshake, I
19		1.3	UNM	Jean Redelsp C. Agee, UNM
20		0.38	IfP	Nourddine Az K. Metzler, IfP
21		20.7	UNM	John Higgins C. Agee, UNM
22		41	21 g UWB, 20	D. Pitt; S. Arn A. Irving and S Zaid Balli and
23		26.3	UWB	A. Aaronson A. Irving, P. C
24		20.5	UWB	Aaronson A. Irving, P. C
25		22.4	UWB	N. Faraji and I A. Irving and S
26		22.1	UWB	B. Hoefnagels A. Irving and S
27		23.4	UWB	B. Hoefnagels A. Irving and S
28		20.5	UWB	B. Hoefnagels A. Irving and S
29		18.5	GUT	Guobing Zhon H. Chen, J. Zh
30		14.2	UCLA	N. Gessler P. Warren, UC
31		6.88	UWB	J. Higgins A. Irving and S
32		28.022	NIPR	NIPR A. Yamaguchi
33		4.8	UWB	B. Hoefnagels A. Irving and S
34		4.2	MNB	Salamu Hama A. Greshake, I
35		13.049	NMBE	NMBE F. Mechelke, f Edwin Gnos, f
36		1.9	UNM	Jay Piatek C. Agee, UNM
37		3.2	UAb	M. Ouzillou C. Herd and L
38		103	Vernad	anonymous C. A. Lorenz, '
39		24.1	UWB	R. Falls A. Irving & S. I
40		21	PSF	A. Debienne A. Irving and S
41		16	CEREGE	Labenne Luc J. Gattacceca,
42		7.5	PSF	PSF A. Irving and S
43	4.91	24.19	PSF	Anonymous A. Irving and S
44		22.5	MNB	Philippe Schm A. Greshake, I
45		14.4	MNB	Fabien Kuntz A. Greshake, I
46		5.8	MNB	Vincent Gira A. Greshake, I
47		4.8446 g	UNIL	UNIL B. Hofmann, M Mr Reto Merlo

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3		20.2	UWB	M. Bandli	A. Irving and S
4		16.63	ASU	ASU	L. Garvie Michael Farme
5		25.3	UWB	J. Phillips	A. Irving and S
6		31.2	MNB	Hichame Mim	A. Greshake, I
7	2.91	20.3	MNB	Stefan Ralew	A. Greshake, I
8		20.2	App	PARI	A. Love, App Anonymous
9		20.0	App	PARI	A. Love, App Unknown
10		25.7	UWB	G. Fujihara	A. Irving and S
11		21.2	PSF	F. Kuntz	A. Irving and S
12		20.5	UWB	R. Falls	A. Irving and S
13		32.87	ROM	ROM	V. Di Cecco, F
14		21.2	UWB	D. Dickens	A. Irving and S
15		33.97	UCLA	Sean Tutorow	A. Rubin, UCL
16		7.6	MNB	Stefan Ralew	A. Greshake, I
17		37.8	UWO	S. Tutorow	M. Spencer, U
18		40	ROM	Gregory	B. C. Hyde, R
19		20	IfP, Münster	Nourddine Azi	K. Metzler, IfP
20		20.2	UNM	Zouhair Fetto	C. Agee, UNM
21		27.8	UWB	M. Jost	A. Irving and S
22		20.4	MNB	Marcin Cimala	A. Greshake, I
23		24.1	MNB	Marcin Cimala	A. Greshake, I
24		20.1	UNM	DPitt	C. Agee, UNM
25		21.0	UWO	S. Tutorow	M. Spencer, C
26		20	UNM	Darryl Pitt	C. Agee, UNM
27		20	MNB	Marcin Cimala	A. Greshake, I
28		20.2	UNM	Suzanne Morr	C. Agee, UNM
29		460	SQU	SQU	P. Hill, N. Ban
30		20.7	UNM	Dustin Dicken	C. Agee, UNM
31		21.1	UNM	Darryl Pitt	C. Agee, UNM
32		20.6	UWB	A. Aaronson	A. Irving and S
33		22.4	UWB	R. Falls	A. Irving and S
34		365	SQU	SQU	P. Hill, N. Ban
35		20	IfP, Münster	Nourddine Azi	K. Metzler, IfP
36		20.1	UWO	S. Tutorow	M. Spencer, U
37		20	IfP	Manuel Nieto	K. Metzler, IfP
38		252.3	KOPRI	KOPRI	C. Park, S. Y. H. Yoo
39		20.6	Cascadia	Mr. Ronnie Mc	A. Ruzicka, S.
40		20.2	UNM	Jay Piatek	C. Agee, UNM
41		20	MNB	Marcin Cimala	A. Greshake, I
42		22.2	UNM	DPitt	C. Agee, UNM
43		20	ROM	Gregory	B. C. Hyde, R
44		20.1	UWB	A. Aaronson	A. Irving and S
45		20	MNB	Marcin Cimala	A. Greshake, I
46		21	UPC	David Allepuz	J. Llorca, UPCDavid Allepuz
47		20.0	UWO	S. Tutorow	M. Spencer, U

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2				
3	95	SQU	SQU	P. Hill, N. Ban
4	20	IfP, Münster	Nourddine AzıK. Metzler, IfP	
5	15.3	UWO	S. DeBoer	M. Spencer, F
6	14.2	NHM	Morten Bilet	N. Rai, N. V. A
7	13	IfP, Münster	José Antonio K. Metzler, IfP	
8	11.4	MNB	Stefan Ralew	A. Greshake, I
9	10.7	UWB	A. Aaronson	A. Irving and S
10	8.3	MNB	anonymous	A. Greshake, I
11	6.6	MNB	Marcin Cimala	A. Greshake, I Marcin Cimala
12	4.684	NIPR	NIPR	A. Yamaguchi
13	0.766	NIPR	NIPR	A. Yamaguchi
14	20.3	UWB	DPitt	A. Irving and S
15	20.73	UCLA	Brad Kern	A. Rubin, UCL
16	20.2	UWB	D. Pitt	A. Irving and S
17				
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22				
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tblcomment

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3
4 work name JR049; submitted by Jerome Gattaceca
5 Field name MVCH-360; submitted by C. Agee, UNM
6 Submitted by C. Park, KOPRI
7 Submitted by Ansgar Greshake
8 Work name M2049; submitted by A. Irving
9 G688; submitted by A. Bouvier
10 Submitted by C. Agee
11 Submitted by Hsu W.
12 Field name JP-94; submitted by C. Agee
13 work name LL2015-9; submitted by J. Gattacceca
14 Work name BH127; submitted by A. Irving
15 Work name MVCH 338; submitted by A. Irving
16 Work name BH140; submitted by A. Irving
17 Submitted by Anthony Love
18 Submitted by K. Metzler, IfP
19 Submitted by Ansgar Greshake
20 Submitted by Ansgar Greshake
21 RC60.2; submitted by A. Irving
22 Y-82094 like; submitted by A. Yamaguchi
23 Y-82094 like; submitted by A. Yamaguchi
24 Work name AH17-30; submitted by A. Irving
25 work name CC1701; submitted by Jerome Gattacceca
26 Submitted by A. Yamaguchi
27 Field name ZF-1; submitted by C. Agee
28 Field names Calama 3-51, Misha 3-37 and KIR10; submitted by Marina Ivanova
29 Submitted by AMN
30 Submitted by Vanni Moggi Cecchi
31 Submitted by Ansgar Greshake
32 Submitted by Vanni Moggi Cecchi
33 Arj18-1; submitted by A. Irving
34 Work name M2014; submitted by A. Irving
35 Submitted by AMN
36 LM52939; submitted by A. Irving
37 Submitted by Ansgar Greshake
38 Submitted by Vanni Moggi Cecchi
39 Submitted by Ansgar Greshake
40 Submitted by AMN
41 Submitted by Ansgar Greshake
42 Field name MVCH-353; submitted by C. Agee, UNM
43 Submitted by C. Park, KOPRI
44 Submitted by Ansgar Greshake
45 Submitted by Alan Rubin
46 Submitted by Ansgar Greshake
47 Field name MVCH-361; submitted by C. Agee, UNM

1
2
3 work name LM68 / D55; submitted by Jérôme Gattacceca

4 Submitted by A. Yamaguchi

5 Submitted by Ansgar Greshake

6 Submitted by A. Yamaguchi

7 Heavily altered; submitted by A. Yamaguchi

8 Submitted by A. Yamaguchi

9 Submitted by A. Yamaguchi

10 Submitted by A. Yamaguchi

11 Submitted by A. Yamaguchi

12 Submitted by A. Yamaguchi

13 Submitted by A. Yamaguchi

14 Submitted by A. Yamaguchi

15 Submitted by A. Yamaguchi

16 Submitted by A. Yamaguchi

17 Submitted by A. Yamaguchi

18 Submitted by A. Yamaguchi

19 Submitted by A. Yamaguchi

20 Submitted by A. Yamaguchi

21 Work name DD17-6; submitted by A. Irving

22 Submitted by L. Garvie

23 Submitted by A.D. Shukla, PRL

24 Algeria; submitted by Ansgar Greshake

25 Submitted by C. Park, KOPRI

26 Work name BH129; submitted by A. Irving

27 work name RL04; submitted by Jérôme Gattacceca

28 Submitted by C. Agee

29 Submitted by AMN

30 Submitted by C. Park, KOPRI

31 Submitted by Ansgar Greshake

32 Submitted by Ansgar Greshake

33 Submitted by Stepan Vasilevich Berzin

34 Submitted by AMN

35 Submitted by Ansgar Greshake

36 Submitted by AMN

37 work name K326; submitted by Jérôme Gattacceca

38 Submitted by Ansgar Greshake

39 Submitted by Ansgar Greshake

40 Submitted by Ansgar Greshake

41 Submitted by Ansgar Greshake

42 Submitted by Ansgar Greshake

43 Submitted by Ansgar Greshake

44 Submitted by C. Park, KOPRI

45 Submitted by Ansgar Greshake

46 Submitted by Ansgar Greshake

47 Submitted by A. Yamaguchi

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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Work name 507-A; submitted by A. Irving
8 Work name 400-A; submitted by A. Irving
9 Submitted by Ansgar Greshake
10 work name RM567; submitted by Jérôme Gattacceca
11 Submitted by K. Metzler, IfP
12 Submitted by Hsu W.
13 Submitted by M. A. Ivanova
14 work name RM598; submitted by Jérôme Gattacceca
15 Submitted by K. Metzler, IfP
16 Working No.: SM 1804-10; submitted by K. Klemm, IfP; submitted by Klemm K.
17 Working No.: SM 1804-9; submitted by K. Klemm, IfP; submitted by Klemm K.
18 Submitted by A. Irving
19 Working No.: SM 1804-6; submitted by K. Klemm, IfP; submitted by Klemm K.
20 Work name H128; submitted by A. Irving
21 Field name: SV2017-01; submitted by Samuel Ebert; submitted by Ebert S.
22 JH14-14; submitted by A. Irving
23 Submitted by Ansgar Greshake
24 Work name MVCH 303; submitted by A. Irving
25 Submitted by K. Metzler, IfP
26 Submitted by Ansgar Greshake
27 Field name MAS-2; submitted by C. Agee, UNM
28 work name K338; submitted by Jerome Gattacceca
29 Field name MVCH-358; submitted by C. Agee, UNM
30 Submitted by AMN
31 Submitted by AMN
32 Work name BH116; submitted by A. Irving
33 Work name M2169; submitted by A. Irving
34 Field name AB-73; submitted by C. Agee, UNM
35 Submitted by Ansgar Greshake
36 Morocco; submitted by Ansgar Greshake
37 SJS 13001; submitted by A. Irving
38 Work name ZLI03; submitted by A. Irving
39 Submitted by Anthony Love
40 Submitted by K. Metzler, IfP
41 Work name LL75; submitted by Lisa Krämer Ruggiu
42 Submitted by F. Brandstätter
43 Submitted by Anthony Love
44 Work name K386; submitted by A. Irving
45 Field name MVCH-357; submitted by C. Agee, UNM
46 Submitted by Ansgar Greshake
47 work name K352; submitted by Jérôme Gattacceca
48 Work name K373; submitted by A. Irving

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3 Morocco; submitted by Ansgar Greshake
4 Submitted by Ansgar Greshake
5 NWA-LB005; submitted by R. Bartoschewitz
6 Submitted by A. Irving
7 Submitted by Ansgar Greshake
8 Work name MVCH 369; submitted by A. Irving
9 Submitted by Ansgar Greshake
10 Submitted by K. Metzler, IfP
11 Submitted by Ansgar Greshake
12 Submitted by A. Yamaguchi
13 Submitted by Ansgar Greshake
14 Work name MC030; submitted by A. Irving
15 Submitted by Ansgar Greshake
16 Submitted by AMN
17 Submitted by AMN
18 Submitted by AMN
19 Work name CHC18018; submitted by A. Irving
20 Submitted by A. Yamaguchi
21 Work name M2036; submitted by A. Irving
22 Submitted by Hsu W.
23 Work name 349-A; submitted by A. Irving
24 Work name JH17-6; submitted by A. Irving
25 Submitted by Ansgar Greshake
26 Submitted by Ansgar Greshake
27 MVCH-336; submitted by C. Agee, UNM
28 Submitted by Anthony Love
29 work name RL02; submitted by Jérôme Gattacceca
30 Unbrecciated; submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Field name: Met-2018-007; submitted by David Allepuz
33 Submitted by AMN
34 Work name ZLI02; submitted by A. Irving
35 Work name FO18-1; submitted by A. Irving
36 Submitted by A. Yamaguchi
37 Submitted by Ansgar Greshake
38 Submitted by A. Yamaguchi
39 Submitted by A. Yamaguchi
40 Submitted by Ansgar Greshake
41 Breccia; submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 An79.5-87.3; submitted by A. Yamaguchi
44 An90.6; submitted by A. Yamaguchi
45 Heavily shocked; submitted by A. Yamaguchi
46 CC18-1; submitted by A. Irving
47 work name LM79/E44; submitted by Jérôme Gattacceca
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3 Si = 0.51 wt%; submitted by A. Yamaguchi
4 work name LM77/E37; submitted by Jérôme Gattacceca
5 work name LM67/E1; submitted by Jérôme Gattacceca
6 Submitted by Ansgar Greshake
7 Submitted by Ansgar Greshake
8 Si = 0.83 wt%; submitted by A. Yamaguchi
9 Submitted by M.Salvini, M. Gemelli DST-PI
10 Submitted by Vanni Moggi Cecchi
11 Submitted by Hsu W.
12 Submitted by Anthony Love
13 Submitted by Bingkui Miao
14 Submitted by C. Park, KOPRI
15 Submitted by C. Park, KOPRI
16 Gessler's address: 2010 Calgary Ln, Los Angeles, CA 90077, USA; submitted by Paul Warren
17 Submitted by R. Bartoschewitz
18 Submitted by Anthony Love
19 Submitted by P. Hill
20 Submitted by Ansgar Greshake
21 Submitted by V. Di Cecco, ROM
22 Submitted by Ansgar Greshake
23 Submitted by Ansgar Greshake
24 Submitted by Ansgar Greshake
25 Submitted by Ansgar Greshake
26 Submitted by Ansgar Greshake
27 Submitted by Ansgar Greshake
28 An85.3-91.4; submitted by A. Yamaguchi
29 Submitted by Vanni Moggi Cecchi
30 Lab number CML0920; submitted by A. Ruzicka
31 Submitted by Ansgar Greshake
32 Submitted by Anthony Love
33 Lab number CML0943; submitted by A. Ruzicka
34 Submitted by Bingkui Miao
35 Submitted by Bing-kui Miao
36 An89.7-92.6; submitted by A. Yamaguchi
37 Submitted by Bingkui Miao
38 Submitted by Bingkui Miao
39 Submitted by Ansgar Greshake
40 Submitted by Ansgar Greshake
41 Submitted by Maria Eugenia Varela
42 Submitted by Ansgar Greshake
43 An84.5-91.9; submitted by A. Yamaguchi
44 An67.3-92.8; submitted by A. Yamaguchi
45 Submitted by Bingkui Miao
46 An92.3-94.2; submitted by A. Yamaguchi
47 Submitted by Bingkui Miao
48 An92.3-94.2; submitted by A. Yamaguchi
49 Submitted by K. Metzler, IfP
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3 Submitted by Bingkui Miao
4 Sample number LM58206 in the Royal Ontario Museum collection. Formerly named DGRO 33-16.; subr
5 An92.4-94.1; submitted by A. Yamaguchi
6 Sample number LM58207 in the Royal Ontario Museum collection. Formerly named ROM060.; submitte
7 Submitted by Bingkui Miao
8 An81.1-89.7; submitted by A. Yamaguchi
9 Submitted by Ansgar Greshake
10 An72.8-93.7; submitted by A. Yamaguchi
11 Submitted by Bingkui Miao
12 Submitted by Bingkui Miao
13 Submitted by Bingkui Miao
14 An85.4-89.3; submitted by A. Yamaguchi
15 An86.1-88.8; submitted by A. Yamaguchi
16 An82.3-91.6; submitted by A. Yamaguchi
17 Submitted by Bingkui Miao
18 Wo4.2-37.1En20.7-55.3, An78.4-86.6; submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 An75.3-86.6; submitted by A. Yamaguchi
21 An87.2-90.2; submitted by A. Yamaguchi
22 An79.3-94.9; submitted by A. Yamaguchi
23 An86.8-90.4; submitted by A. Yamaguchi
24 Submitted by C. Park, KOPRI
25 Work name RC97.1; submitted by A. Irving
26 OT15; submitted by A. Irving
27 SVMJ14-1; submitted by A. Irving
28 GF18-2; submitted by A. Irving
29 Submitted by Ansgar Greshake
30 Submitted by Ansgar Greshake
31 Submitted by Ansgar Greshake
32 Submitted by Ansgar Greshake
33 Gessler's address: 2010 Calgary Ln, Los Angeles, CA 90077, USA; submitted by Paul Warren
34 Field name AID 125; submitted by C. Agee, UNM
35 Work name M1796; submitted by A. Irving
36 Submitted by Ansgar Greshake
37 Field name JP-75; submitted by C. Agee, UNM
38 Submitted by Ansgar Greshake
39 Submitted by K. Metzler, IfP
40 Submitted by K. Metzler, IfP
41 Work name MVCH 340; submitted by A. Irving
42 Submitted by Aicheng Zhang
43 Work name BF18-24; submitted by A. Irving
44 Work name JP18-2; submitted by A. Irving
45 Work name BF17-15; submitted by A. Irving
46 Field name JP-76; submitted by C. Agee, UNM
47 Submitted by Jordi Llorca (UPC)
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3 work name ST15; submitted by Jerome Gattacceca
4 Work name JH18-1; submitted by A. Irving
5 Submitted by Anthony Love
6 Work name BF17-20; submitted by A. Irving
7 UWO-244; submitted by A. Bouvier
8 Submitted by Anthony Love
9 Work name MVCH 324; submitted by A. Irving
10 Submitted by K. Metzler, IfP
11 Field name MVCH-354; submitted by C. Agee, UNM
12 Submitted by Vinciane Debaille
13 Submitted by K. Metzler, IfP
14 Work name MVCH 365; submitted by A. Irving
15 Submitted by K. Metzler, IfP
16 Submitted by Ansgar Greshake
17 Submitted by L. Garvie
18 Submitted by AMN
19 Submitted by AMN
20 Field name MVCH-363; submitted by C. Agee, UNM
21 Submitted by Ansgar Greshake
22 Submitted by K. Metzler, IfP
23 Submitted by AMN
24 Field name MVCH-356; submitted by C. Agee, UNM
25 Submitted by AMN
26 Submitted by AMN
27 Submitted by Ansgar Greshake
28 Submitted by AMN
29 Submitted by AMN
30 Submitted by Ansgar Greshake
31 Submitted by T. Shisseh
32 Submitted by AMN
33 Field name JP-401; submitted by C. Agee, UNM
34 Work name MVCH 330; submitted by A. Irving
35 work name AG001; submitted by Jerome Gattacceca
36 Submitted by AMN
37 Work name MVCH 367; submitted by A. Irving
38 Field name MVCH-362; submitted by C. Agee, UNM
39 Submitted by AMN
40 Submitted by AMN
41 Field name DD-24; submitted by C. Agee, UNM
42 Submitted by AMN
43 Melt breccia; submitted by A. Yamaguchi
44 Breccia; submitted by A. Yamaguchi
45 Submitted by Alan Rubin
46 working name DJ2018/02; submitted by R. Bartoschewitz
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3 Working name NWA-FV01; submitted by R. Bartoschewitz
4 working name DJ2017/17; submitted by R. Bartoschewitz
5 working name WZ10; submitted by R. Bartoschewitz
6 NWA-LB001; submitted by R. Bartoschewitz
7 working name WZ38; submitted by R. Bartoschewitz
8 NWA-WK01; submitted by R. Bartoschewitz
9 Submitted by R. Bartoschewitz
10 NWA-LB002; submitted by R. Bartoschewitz
11 working name WZ18; submitted by R. Bartoschewitz
12 NWA-JK01; submitted by R. Bartoschewitz
13 working name WZ16; submitted by R. Bartoschewitz
14 Submitted by R. Bartoschewitz
15 working name WZ30; submitted by R. Bartoschewitz
16 working name DJ2018/03; submitted by R. Bartoschewitz
17 working name WZ05; submitted by R. Bartoschewitz
18 working name WZ11; submitted by R. Bartoschewitz
19 NWA-LB007; submitted by R. Bartoschewitz
20 NWA AM4; submitted by R. Bartoschewitz
21 synonym Northwest Africa 736; submitted by Simone de Leuw
22 work name B1; submitted by Richard Greenwood, H el ene Greenwood
23 Submitted by Ansgar Greshake
24 Submitted by Ansgar Greshake
25 Submitted by Simone de Leuw
26 Field name is 2-5; analyst S. E. Borisovsky (IGEM); Estimated subtype 3.9; submitted by C. A. Lorenz (\n
27 Submitted by Ansgar Greshake
28 Submitted by C. Park, KOPRI
29 Submitted by Ken Eltrich
30 Submitted by A. Yamaguchi
31 Submitted by Ansgar Greshake
32 Submitted by Ebert S.
33 Submitted by A. Yamaguchi
34 Submitted by C. Agee
35 Submitted by A. Yamaguchi
36 Submitted by C. Park, KOPRI
37 CHC18020; submitted by A. Irving
38 CHC18019; submitted by A. Irving
39 Submitted by A. Yamaguchi
40 Submitted by C. Park, KOPRI
41 work name Sahara 98050A; submitted by Ebert S.
42 Lab number CML0788; field number W232.; submitted by A. Ruzicka
43 Lab number CML0775; field number J25.; submitted by A. Ruzicka
44 Lab number CML0780; field number TB673.; submitted by A. Ruzicka
45 Lab number CML0777; field number J141.; submitted by A. Ruzicka
46 work name EJ492; submitted by J er me Gattacceca
47 Lab number CML0776; field number J32; submitted by A. Ruzicka
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3 Lab number CML0779; field number TB519.; submitted by A. Ruzicka
4 Lab number CML0778; field number J223.; submitted by A. Ruzicka
5 Submitted by AMN
6 Submitted by AMN
7 Work name M2081; submitted by A. Irving
8 Submitted by Pavel Yu. Plechov, pplechov@gmail.com
9 G709; submitted by A. Bouvier, UWO
10 Submitted by Ebert S.
11 Submitted by Ebert S.
12 work name LM47 / C12; Packed chondrules rimmed with opaques.; submitted by Jérôme Gattacceca
13 Submitted by Ebert S.
14 Submitted by Simone de Leuw
15 Submitted by James P. Greenwood
16 Field name: Met-2016-029; submitted by David Allepuz
17 Submitted by A. Yamaguchi
18 In Chinese publications, its former name was M16214; submitted by Bingkui Miao
19 P.R. Heck acknowledges Robert Ward for donating his first meteorite to FMNH, Terry Boudreaux for sup
20 Work name AK26; submitted by Lisa Krämer Ruggiu
21 In Chinese publications, its former name was M16212; submitted by Bingkui Miao
22 Submitted by Simone de Leuw
23 Submitted by Ansgar Greshake
24 Submitted by A. Yamaguchi
25 In Chinese publications, its former name was M16218; submitted by Bingkui Miao
26 Submitted by Simone de Leuw
27 G706; submitted by A. Bouvier, UWO
28 work name E2; submitted by Richard Greenwood, Hélène Greenwood
29 Submitted by A. Yamaguchi
30 Submitted by Bingkui Miao
31 Field name: Met-2017-026; submitted by David Allepuz
32 Submitted by Simone de Leuw
33 In Chinese publications, its former name was M16031; submitted by Bingkui Miao
34 Submitted by A. Yamaguchi
35 Submitted by Simone de Leuw
36 In Chinese publications, its former name was M16035; submitted by Bingkui Miao
37 SEM; submitted by AMN
38 work name E4; submitted by Richard Greenwood, Hélène Greenwood
39 Submitted by Vanni Moggi Cecchi
40 Submitted by Jordi Llorca (UPC)
41 Submitted by A. Yamaguchi
42 In Chinese publications, its former name was M16046; submitted by Bingkui Miao
43 In Chinese publications, its former name was M16155; submitted by Bingkui Miao
44 Submitted by Ansgar Greshake
45 Submitted by A. Yamaguchi
46 In Chinese publications, its former name was M16152; submitted by Bingkui Miao
47 In Chinese publications, its former name was M16036; submitted by Bingkui Miao

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3 In Chinese publications, its former name was M16037; submitted by Bingkui Miao

4 Field name: Met-2018-012; submitted by David Allepuz

5 Submitted by Ansgar Greshake

6 In Chinese publications, its former name was M16061; submitted by Bingkui Miao

7 Chondrules well defined. Olivine: undulose extinction, lacks planar fractures. A few low-Ca pyroxene phe

8 Submitted by Vanni Moggi Cecchi

9
10 In Chinese publications, its former name was M16032; submitted by Bingkui Miao

11 In Chinese publications, its former name was M16157; submitted by Bingkui Miao

12 Field name: Met-2016-026; submitted by David Allepuz

13 In Chinese publications, its former name was M16117; submitted by Bingkui Miao

14 Submitted by A. Yamaguchi

15 work name E6; submitted by Richard Greenwood, Hélène Greenwood

16 work name EJ426; submitted by Jérôme Gattacceca

17 In Chinese publications, its former name was M16039; submitted by Bingkui Miao

18 Submitted by A. Yamaguchi

19 In Chinese publications, its former name was M16250; submitted by Bingkui Miao

20 The meteorite is brecciated. Field name is Calama 2-66; analyst T. Kryachko (Technograd, Moscow); su

21 Chondrules are well defined. Olivine exhibits undulose extinction, but lacks planar fractures. Small chron

22 In Chinese publications, its former name was M16064; submitted by Bingkui Miao

23 Submitted by Vanni Moggi Cecchi

24 Submitted by A. Yamaguchi

25 In Chinese publications, its former name was M16124; submitted by Bingkui Miao

26 In Chinese publications, its former name was M16078; submitted by Bingkui Miao

27 Submitted by A. Yamaguchi

28 work name Sahara 98050B; submitted by Ebert S.

29 Submitted by AMN

30 In Chinese publications, its former name was M16156; submitted by Bingkui Miao

31 Breccia; submitted by A. Yamaguchi

32 In Chinese publications, its former name was M16137; submitted by Bingkui Miao

33 Submitted by A. Yamaguchi

34 Submitted by Vanni Moggi Cecchi

35 In Chinese publications, its former name was M16053; submitted by Bingkui Miao

36 Submitted by A. Yamaguchi

37 Submitted by Vanni Moggi Cecchi

38 In Chinese publications, its former name was M16049; submitted by Bingkui Miao

39 SEM; submitted by AMN

40 In Chinese publications, its former name was M16110; submitted by Bingkui Miao

41 work name E1; submitted by Richard Greenwood, Hélène Greenwood

42 In Chinese publications, its former name was M16230; submitted by Bingkui Miao

43 Submitted by A. Yamaguchi

44 In Chinese publications, its former name was M16183; submitted by Bingkui Miao

45 In Chinese publications, its former name was M16079; submitted by Bingkui Miao

46 Submitted by A. Yamaguchi

47 Submitted by A. Yamaguchi

48 Submitted by A. Yamaguchi

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3 Submitted by A. Yamaguchi
4 Chondrules are well defined. Olivine exhibits sharp optical extinction. Very few low-Ca pyroxene grains ε
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 In Chinese publications, its former name was M16236; submitted by Bingkui Miao
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Catalogued at the Royal Ontario Museum as LM58150; submitted by V. Di Cecco, ROM
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by Vanni Moggi Cecchi
15 In Chinese publications, its former name was M16136; submitted by Bingkui Miao
16 In Chinese publications, its former name was M16153; submitted by Bingkui Miao
17 Submitted by A. Yamaguchi
18 In Chinese publications, its former name was M16244; submitted by Bingkui Miao
19 Submitted by A. Yamaguchi
20 In Chinese publications, its former name was M16177; submitted by Bingkui Miao
21 Submitted by A. Yamaguchi
22 SEM; submitted by AMN
23 SEM; submitted by AMN
24 Submitted by A. Yamaguchi
25 SEM; submitted by AMN
26 SEM; submitted by AMN
27 Darkened; submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 In Chinese publications, its former name was M16249; submitted by Bingkui Miao
31 Submitted by A. Yamaguchi
32 Darkened; submitted by A. Yamaguchi
33 Slightly brecciated; submitted by A. Yamaguchi
34 Darkened; submitted by A. Yamaguchi
35 Partly melted; submitted by A. Yamaguchi
36 Submitted by AMN
37 Submitted by A. Yamaguchi
38 Submitted by A. Yamaguchi
39 Field name is Calama 2-34; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Verr
40 Submitted by A. Yamaguchi
41 Submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 Submitted by AMN
46 Submitted by A. Yamaguchi
47 Submitted by A. Yamaguchi
48 Submitted by A. Yamaguchi

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3 Slightly brecciated; submitted by A. Yamaguchi

4 Submitted by A. Yamaguchi

5 Breccia; submitted by A. Yamaguchi

6 Submitted by A. Yamaguchi

7 Submitted by A. Yamaguchi

8 Submitted by A. Yamaguchi

9 Submitted by A. Yamaguchi

10 Submitted by A. Yamaguchi

11 Submitted by A. Yamaguchi

12 Submitted by A. Yamaguchi

13 Submitted by A. Yamaguchi

14 Darkened; submitted by A. Yamaguchi

15 Darkened; submitted by A. Yamaguchi

16 Submitted by A. Yamaguchi

17 Submitted by Ioannis Baziotis

18 Submitted by A. Yamaguchi

19 Breccia; submitted by A. Yamaguchi

20 Submitted by A. Yamaguchi

21 Submitted by A. Yamaguchi

22 Submitted by A. Yamaguchi

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36 Submitted by A. Yamaguchi

37 Submitted by A. Yamaguchi

38 Submitted by A. Yamaguchi

39 Submitted by A. Yamaguchi

40 Shock vein; submitted by A. Yamaguchi

41 Submitted by A. Yamaguchi

42 Submitted by A. Yamaguchi

43 Submitted by A. Yamaguchi

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51 Submitted by A. Yamaguchi

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3 Submitted by A. Yamaguchi
4 Breccia; submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
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9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
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12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Darkened; submitted by A. Yamaguchi
17 Darkened; submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Breccia; submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 Submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
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29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Slightly brecciated; submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Darkened; submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
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11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
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28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Slightly brecciated; submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
37 Submitted by A. Yamaguchi
38 Submitted by A. Yamaguchi
39 Submitted by A. Yamaguchi
40 Submitted by A. Yamaguchi
41 Slightly brecciated; submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
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53 Submitted by A. Yamaguchi
54 Submitted by A. Yamaguchi
55 Submitted by A. Yamaguchi
56 Breccia; submitted by A. Yamaguchi
57 SEM; submitted by AMN
58 Submitted by A. Yamaguchi
59 Submitted by A. Yamaguchi
60 Submitted by A. Yamaguchi

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3 Breccia; submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Darkened; submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
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21 Submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by Daniel Atencio, Dorelia Cunha and Andre L. R. Moutinho
27 Genomict breccia; submitted by A. Yamaguchi
28 Submitted by Alan Rubin
29 Work name BF17-21; submitted by A. Irving
30 Submitted by Ebert S.
31 Submitted by Ebert S.
32 Field name: Met-2018-026; submitted by David Allepuz
33 Breccia Field name: Met-2018-024; submitted by David Allepuz
34 work name LM60/D26; submitted by Jérôme Gattacceca
35 Field name: Met-2017-023; submitted by David Allepuz
36 Field name: Met-2018-049; submitted by David Allepuz
37 Field name: Met-2016-013; submitted by David Allepuz
38 Working No.: SM 1804-4; submitted by K. Klemm, IfP; submitted by Klemm K.
39 Work name CHC18009; submitted by A. Irving
40 Field name: Met-2016-041; submitted by David Allepuz
41 Submitted by C. Park, KOPRI
42 work name LM33 / C10; Brecciated chondrite with type 3 and type 5 material.; submitted by Jérôme Gat
43 Submitted by W. Birch
44 Submitted by C. Park, KOPRI
45 work name LM45 / C08; submitted by J. Gattacceca
46 SEM; submitted by AMN
47 Submitted by C. A. Lorenz
48 Field number MMO-2018-3A; submitted by C. Herd
49 Submitted by Vanni Moggi Cecchi
50 M2159; submitted by C. Agee
51 Work name SLee18-1; submitted by A. Irving
52 Submitted by Vanni Moggi Cecchi
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3 Submitted by Guiqin Wang Nengyong Hu
4 Work name MA002; submitted by Lisa Krämer Ruggiu
5 Work name TS18-1; submitted by A. Irving
6 work name LL21 (LAB060417a); submitted by J. Gattacceca
7 Submitted by Y. Xu, IGGCAS
8 G713; submitted by A. Bouvier, UWO
9 Field name is Calama032-Ch; analyst S. E. Borisovsky (IGEM); submitted by Lorenz C.A., Vernad
10 plagioclase grain size about 15 μm ; submitted by Ansgar Greshake
11 G704; submitted by A. Bouvier, UWO
12 Submitted by Simone de Leuw
13 Brownish individual without fusion crust. plagioclase grain size about 25 μm ; submitted by Ansgar Gresh
14 Submitted by A. Yamaguchi
15 work name LL2-3; submitted by J. Gattacceca
16 Submitted by Katarzyna Luszczek
17 Submitted by Vanni Moggi Cecchi
18 In Chinese publications, its former name was M16215; submitted by Bingkui Miao
19 Submitted by Jordi Llorca (UPC)
20 In Chinese publications, its former name was M16262; submitted by Bingkui Miao
21 work name LM53/D5; This ordinary chondrite is rather unusual with high porosity (15%, determined by p
22 work name LM53/D5; has high porosity (15%, determined by point counting, N=169); well-preserved chc
23 Submitted by Simone de Leuw
24 Submitted by A. Yamaguchi
25 Field name SM-3; submitted by C. Agee, UNM
26 SEM; submitted by AMN
27 In Chinese publications, its former name was M16216; submitted by Bingkui Miao
28 Field name is Calama 4-16; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Verr
29 G710; submitted by A. Bouvier, UWO
30 Working No.: SM 1804-16; submitted by K. Klemm, IfP; submitted by Klemm K.
31 Submitted by Ken Eltrich
32 Submitted by C. Park, KOPRI
33 Field name: Met-2016-045; submitted by David Allepuz
34 Submitted by Vanni Moggi Cecchi
35 In Chinese publications, its former name was M16030; submitted by Bingkui Miao
36 Field name is 2-1; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
37 Darkened; submitted by A. Yamaguchi
38 Field name: Met-2016-047; submitted by David Allepuz
39 In Chinese publications, its former name was M16165; submitted by Bingkui Miao
40 In Chinese publications, its former name was M16122; submitted by Bingkui Miao
41 work name E3; submitted by Richard Greenwood, Hélène Greenwood
42 Submitted by A. Yamaguchi
43 Field name is Calama 3-57; analyst V. V. Kozlov (Oxford Instruments, Moscow); submitted by Lorenz C.
44 Submitted by Eber S.
45 Field name: Met-2018-020; submitted by David Allepuz
46 work name EJ1125; submitted by J. Gattacceca
47 Submitted by Vanni Moggi Cecchi
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3 Submitted by Maria Elizabeth Zucolotto
4 Submitted by Vanni Moggi Cecchi
5 work name EJ615; submitted by J. Gattacceca
6 work name JG061; submitted by J. Gattacceca
7 work name EJ971; submitted by J. Gattacceca
8 Submitted by Vanni Moggi Cecchi
9 Submitted by A. Yamaguchi
10 Submitted by Jordi Llorca (UPC)
11 In Chinese publications, its former name was M16166; submitted by Bingkui Miao
12 In Chinese publications, its former name was M16119; submitted by Bingkui Miao
13 Field name is 2-3b; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
14 Submitted by Vanni Moggi Cecchi
15 G711; submitted by A. Bouvier, UWO
16 Submitted by A. Yamaguchi
17 Submitted by AMN
18 work name EJ972; submitted by J. Gattacceca
19 Field name: Met-2016-040; submitted by David Allepuz
20 In Chinese publications, its former name was M16209; submitted by Bingkui Miao
21 In Chinese publications, its former name was M16168; submitted by Bingkui Miao
22 work name RM615; submitted by Jérôme Gattacceca
23 In Chinese publications, its former name was M16047; submitted by Bingkui Miao
24 Working No.: SM 1804-8; submitted by K. Klemm, IfP; submitted by Klemm K.
25 work name E7; submitted by Richard Greenwood, Hélène Greenwood
26 In Chinese publications, its former name was M16113; submitted by Bingkui Miao
27 Field name is Calate Q10; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Vernad
28 In Chinese publications, its former name was M16066; submitted by Bingkui Miao
29 In Chinese publications, its former name was M16115; submitted by Bingkui Miao
30 In Chinese publications, its former name was M16163; submitted by Bingkui Miao
31 In Chinese publications, its former name was M16146; submitted by Bingkui Miao
32 In Chinese publications, its former name was M16271; submitted by Bingkui Miao
33 Submitted by A. Yamaguchi
34 In Chinese publications, its former name was M16038; submitted by Bingkui Miao
35 Field name is 1-8; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
36 Field name is Irantown7; analyst N. N. Kononkova (Vernad); submitted by Lorenz C. A., Vernad
37 Field name is Irantown6; analyst N. N. Kononkova (Vernad); submitted by Lorenz C. A., Vernad
38 Field name: Met-2017-031; submitted by David Allepuz
39 work name EJ1092. Shock veins. Chromite-plagioclase assemblages.; submitted by J. Gattacceca
40 Submitted by Vanni Moggi Cecchi
41 Submitted by Daniel Sheikh
42 Field name is Calama 4-19; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Vernad
43 Field name: Met-2017-016; submitted by David Allepuz
44 Field name: Met-2016-038; submitted by David Allepuz
45 Submitted by Vanni Moggi Cecchi
46 Submitted by Vanni Moggi Cecchi
47 Field number 1702_0369; submitted by Beda Hofmann

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3 work name RL06. Crusted stone. Cut surface reveals grey interior with abundant fresh metal.; submitted
4 Submitted by Vanni Moggi Cecchi
5
6 In Chinese publications, its former name was M16060; submitted by Bingkui Miao
7 In Chinese publications, its former name was M16164; submitted by Bingkui Miao
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10
11 work name EJ116; submitted by Jérôme Gattacceca
12 In Chinese publications, its former name was M16175; submitted by Bingkui Miao
13 SEM; submitted by AMN
14
15 work name JG142. Shock veins. Average plagioclase size below 50 μm .; submitted by J. Gattacceca
16 In Chinese publications, its former name was M16173; submitted by Bingkui Miao
17 Submitted by V. Di Cecco
18
19 In Chinese publications, its former name was M16241; submitted by Bingkui Miao
20 Field name: Met-2017-009; submitted by David Allepuz
21 In Chinese publications, its former name was M16052; submitted by Bingkui Miao
22 Submitted by C. Park, KOPRI
23 Submitted by A. Yamaguchi
24
25 work name EJ057; Chondritic texture with average plagioclase size below 50 μm .; submitted by Jerome
26 In Chinese publications, its former name was M16229; submitted by Bingkui Miao
27 In Chinese publications, its former name was M16268; submitted by Bingkui Miao
28 In Chinese publications, its former name was M16247; submitted by Bingkui Miao
29 Submitted by A. Yamaguchi
30 SEM; submitted by AMN
31
32 In Chinese publications, its former name was M16068; submitted by Bingkui Miao
33 In Chinese publications, its former name was M16118; submitted by Bingkui Miao
34 Submitted by A. Yamaguchi
35 SEM; submitted by AMN
36 Submitted by Vanni Moggi Cecchi
37
38 work name EJ611; submitted by Gattacceca
39 Submitted by C. Park, KOPRI
40 Submitted by A. Yamaguchi
41
42 In Chinese publications, its former name was M16062; submitted by Bingkui Miao
43 Submitted by Vanni Moggi Cecchi
44 Submitted by A. Yamaguchi
45
46 In Chinese publications, its former name was M16074; submitted by Bingkui Miao
47 SEM; submitted by AMN
48 Submitted by C. Park, KOPRI
49 SEM; submitted by AMN
50 Submitted by Vanni Moggi Cecchi
51 SEM; submitted by AMN
52 Submitted by A. Yamaguchi
53
54 Lab number CML0948; submitted by A. Ruzicka
55 Submitted by A. Yamaguchi
56
57 Brownish individual partly covered with fusion crust. plagioclase grain size about 30 μm ; submitted by Ar
58 Field name is CH70ESF; analyst N. N. Kononkova (Vernad); submitted by Lorenz C. A., Vernad
59
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3 Submitted by M. Bizzarro, A.N. Krot, D. Wielandt

4 In Chinese publications, its former name was M16087; submitted by Bingkui Miao

5 In Chinese publications, its former name was M16232; submitted by Bingkui Miao

6 Submitted by A. Yamaguchi

7 Field name: Met-2018-030; submitted by David Allepuz

8 Submitted by Vanni Moggi Cecchi

9 SEM; submitted by AMN

10 In Chinese publications, its former name was M16085; submitted by Bingkui Miao

11 work name EJ166; submitted by J. Gattacceca

12 work name EJ322; submitted by Jérôme Gattacceca

13 Field name is CH40AT5ESF; analyst N. N. Kononkova (Vernad); submitted by Lorenz C. A., Vernad

14 Field name is Calama 4-70; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Verr

15 SEM; submitted by AMN

16 Brownish individual without fusion crust. plagioclase grain size about 20 μm ; submitted by Ansgar Gresh

17 In Chinese publications, its former name was M16096; submitted by Bingkui Miao

18 Submitted by A. Yamaguchi

19 In Chinese publications, its former name was M16176; submitted by Bingkui Miao

20 Field name: Met-2018-008; submitted by David Allepuz

21 Submitted by A. Yamaguchi

22 work name EJ589. Average plagioclase size below 50 μm . Chromite-plagioclase assemblages.; submitte

23 Lab number CML0813; submitted by A. Ruzicka

24 Submitted by C. Park, KOPRI

25 Submitted by Vanni Moggi Cecchi

26 Submitted by A. Yamaguchi

27 Submitted by A. Yamaguchi

28 Field name is CH20G8ESF; analyst N. N. Kononkova (Vernad); submitted by Lorenz C. A., Vernad

29 In Chinese publications, its former name was M16084; submitted by Bingkui Miao

30 Submitted by A. Yamaguchi

31 Submitted by A. Yamaguchi

32 Lab number CML0812; submitted by A. Ruzicka

33 Field name: Met-2017-013; submitted by David Allepuz

34 SEM; submitted by AMN

35 Submitted by Vanni Moggi Cecchi

36 work name EJ1094; submitted by Jérôme Gattacceca

37 SEM; submitted by AMN

38 SEM; submitted by AMN

39 Submitted by Vanni Moggi Cecchi

40 In Chinese publications, its former name was M16245; submitted by Bingkui Miao

41 In Chinese publications, its former name was M16141; submitted by Bingkui Miao

42 In Chinese publications, its former name was M16283; submitted by Bingkui Miao

43 Submitted by C. Park, KOPRI

44 work name LL1-3a; submitted by J. Gattacceca

45 In Chinese publications, its former name was M16077; submitted by Bingkui Miao

46 In Chinese publications, its former name was M16145; submitted by Bingkui Miao

47 SEM; submitted by AMN

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3 work name JR052; Bought from Mohamed Elguirah in Zagora in 2018. Six identical looking fragments wi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7
8 In Chinese publications, its former name was M16083; submitted by Bingkui Miao
9 SEM; submitted by AMN
10 Submitted by A. Yamaguchi
11 Submitted by C. Park, KOPRI
12 Submitted by A. Yamaguchi
13 ROM Number M57519; No mosaicism, some oxidation with veining; submitted by V. Di Cecco, ROM
14
15 In Chinese publications, its former name was M16072; submitted by Bingkui Miao
16 work name EJ588. shock veins.; submitted by J. Gattacceca
17 Submitted by A. Yamaguchi
18
19 In Chinese publications, its former name was M16270; submitted by Bingkui Miao
20 SEM; submitted by AMN
21 Submitted by AMN
22
23 Fieldname = ReDL062; thin-section ID# = RSV062; submitted by Daniel Sheikh
24 Submitted by A. Yamaguchi
25
26 In Chinese publications, its former name was M16139; submitted by Bingkui Miao
27 SEM; submitted by AMN
28 SEM; submitted by AMN
29 Submitted by A. Yamaguchi
30
31 In Chinese publications, its former name was M16070; submitted by Bingkui Miao
32 In Chinese publications, its former name was M16185; submitted by Bingkui Miao
33 In Chinese publications, its former name was M16128; submitted by Bingkui Miao
34 SEM; submitted by AMN
35
36 In Chinese publications, its former name was M16147; submitted by Bingkui Miao
37 SEM; submitted by AMN
38 Submitted by AMN
39
40 In Chinese publications, its former name was M16130; submitted by Bingkui Miao
41 Submitted by C. Park, KOPRI
42 work name EJ150; submitted by J. Gattacceca
43
44 In Chinese publications, its former name was M16080; submitted by Bingkui Miao
45 Submitted by A. Yamaguchi
46 SEM; submitted by AMN
47 SEM; submitted by AMN
48 Submitted by C. Park, KOPRI
49
50 In Chinese publications, its former name was M16076; submitted by Bingkui Miao
51 In Chinese publications, its former name was M16178; submitted by Bingkui Miao
52 Field name: Met-2018-009; submitted by David Allepuz
53 Submitted by A. Yamaguchi
54 SEM; submitted by AMN
55 SEM; submitted by AMN
56
57 In Chinese publications, its former name was M16187; submitted by Bingkui Miao
58 In Chinese publications, its former name was M16082; submitted by Bingkui Miao
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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 SEM; submitted by AMN
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 Submitted by A. Yamaguchi
15 Field name: Met-2015-033; submitted by David Allepuz
16 SEM; submitted by AMN
17 Submitted by C. Park, KOPRI
18 Breccia; submitted by A. Yamaguchi
19 In Chinese publications, its former name was M16254; submitted by Bingkui Miao
20 Submitted by A. Yamaguchi
21 SEM; submitted by AMN
22 SEM; submitted by AMN
23 SEM; submitted by AMN
24 Submitted by C. Park, KOPRI
25 work name LL1-6; submitted by J. Gattacceca
26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Field name is 7-1; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
29 Field name: Met-2018-034; submitted by David Allepuz
30 SEM; submitted by AMN
31 SEM; submitted by AMN
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 SEM; submitted by AMN
37 SEM; submitted by AMN
38 SEM; submitted by AMN
39 SEM; submitted by AMN
40 SEM; submitted by AMN
41 SEM; submitted by AMN
42 SEM; submitted by AMN
43 In Chinese publications, its former name was M16143; submitted by Bingkui Miao
44 Submitted by A. Yamaguchi
45 In Chinese publications, its former name was M16063; submitted by Bingkui Miao
46 In Chinese publications, its former name was M16134; submitted by Bingkui Miao
47 In Chinese publications, its former name was M16186; submitted by Bingkui Miao
48 Submitted by C. Park, KOPRI
49 In Chinese publications, its former name was M16150; submitted by Bingkui Miao
50 SEM; submitted by AMN
51 Submitted by A. Yamaguchi
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3 Submitted by C. Park, KOPRI

4 Submitted by A. Yamaguchi

5 Field name is Calama18. Analyst V. V. Kozlov (Tescan Demo Centre, Moscow, Russia); submitted by Lc

6 Submitted by C. Park, KOPRI

7 Field name: Met-2018-066; submitted by David Allepuz

8 Submitted by A. Yamaguchi

9 Submitted by A. Yamaguchi

10 In Chinese publications, its former name was M16133; submitted by Bingkui Miao

11 Submitted by A. Yamaguchi

12 Submitted by A. Yamaguchi

13 Submitted by A. Yamaguchi

14 Submitted by A. Yamaguchi

15 In Chinese publications, its former name was M16138; submitted by Bingkui Miao

16 SEM; submitted by AMN

17 Submitted by A. Yamaguchi

18 Slightly brecciated; submitted by A. Yamaguchi

19 SEM; submitted by AMN

20 Submitted by A. Yamaguchi

21 Submitted by A. Yamaguchi

22 Submitted by A. Yamaguchi

23 Submitted by A. Yamaguchi

24 work name EJ310; submitted by J. Gattacceca

25 Field name is Calama 1-36; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Verr

26 Submitted by A. Yamaguchi

27 Submitted by A. Yamaguchi

28 Submitted by A. Yamaguchi

29 Submitted by A. Yamaguchi

30 Submitted by A. Yamaguchi

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15 Submitted by A. Yamaguchi
16 SEM; submitted by AMN
17 Slightly brecciated; submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 Darkened; submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 Submitted by C. Park, KOPRI
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Slightly brecciated; submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
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12 Slightly brecciated; submitted by A. Yamaguchi
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18 Slightly brecciated; submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 SEM; submitted by AMN
21 Submitted by A. Yamaguchi
22 SEM; submitted by AMN
23 SEM; submitted by AMN
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 SEM; submitted by AMN
28 Submitted by A. Yamaguchi
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42 Submitted by C. Park, KOPRI
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58 Submitted by A. Yamaguchi
59 Submitted by A. Yamaguchi
60 SEM; submitted by AMN

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3 Submitted by A. Yamaguchi
4 Large metal nodule; submitted by A. Yamaguchi
5 SEM; submitted by AMN
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Slightly brecciated; submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Submitted by C. Park, KOPRI
20 Submitted by A. Yamaguchi
21 analyst N.N. Kononkova, Vernad; submitted by C. A. Lorenz (Vernad)
22 breccia; submitted by Ebert S.
23 work name LM58/D24; Breccia with chondritic clasts in a melt rock matrix. The chondritic clasts have av
24 Submitted by Ansgar Greshake
25 Field name: Met-2017-021; submitted by David Allepuz
26 work name EJ242. High interchondrules porosity; submitted by Jérôme Gattacceca
27 Submitted by Y. Xu, IGGCAS
28 Submitted by Simone de Leuw
29 Field name DD-32; submitted by C. Agee, UNM
30 Submitted by Vanni Moggi Cecchi
31 Submitted by K. Metzler, IfP
32 Submitted by F. Brandstätter
33 Field name: Met-2015-020; submitted by David Allepuz
34 work name LM66/D49; submitted by Jérôme Gattacceca
35 Fieldname = UU151212V; thin-section ID = V-C1; submitted by Daniel Sheikh
36 plagioclase grain size about 60 um; submitted by Ansgar Greshake
37 Submitted by A. Yamaguchi
38 Submitted by Vanni Moggi Cecchi
39 Field name Kol-2; analyst V.V. Sharygin (SIGM and UrFU); submitted by Victor V. Sharygin, sharygin@i
40 Submitted by Vanni Moggi Cecchi
41 Field name: Met-2017-034; submitted by David Allepuz
42 Submitted by A. Yamaguchi
43 Submitted by A. Irving
44 Field name: Met-2017-024; submitted by David Allepuz
45 Work name RL01; Highly recrystallized with relict chondrules. Plagioclase to 100 um, average 80um.; su
46 Field name: Met-2017-019; submitted by David Allepuz
47 Submitted by A. Yamaguchi
48 Field name: Met-2018-048; submitted by David Allepuz
49 Plagioclase grain size about 60 µm; submitted by Ansgar Greshake
50 Submitted by A. Yamaguchi

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2
3 Submitted by Simone de Leuw
4 Field name: Met-2017-032; submitted by David Allepuz
5 Work name MG18-1; submitted by A. Irving
6 plagioclase grain size about 70 um; submitted by Ansgar Greshake
7 Field name: Met-2017-028; submitted by David Allepuz
8 Submitted by A. Yamaguchi
9 Field name LAR-4; submitted by V.V. Sharygin (SIGM and UrFU)
10 In Chinese publications, its former name was M16239; submitted by Bingkui Miao
11 In Chinese publications, its former name was M16144; submitted by Bingkui Miao
12 Field name: Met-2018-051; submitted by David Allepuz
13 Submitted by Romano Serra (OAM)
14 Field name LAR-3; submitted by Victor V. Sharygin, SIGM and UrFU
15 Submitted by A. Yamaguchi
16 Submitted by AMN
17 Catalogued at the Royal Ontario Museum as LM58145; submitted by V. Di Cecco, ROM
18 work name EJ1108; submitted by J. Gattacceca
19 In Chinese publications, its former name was M16158; submitted by Bingkui Miao
20 In Chinese publications, its former name was M16260; submitted by Bingkui Miao
21 In Chinese publications, its former name was M16071; submitted by Bingkui Miao
22 In Chinese publications, its former name was M16127; submitted by Bingkui Miao
23 In Chinese publications, its former name was M16170; submitted by Bingkui Miao
24 In Chinese publications, its former name was M16123; submitted by Bingkui Miao
25 SEM; submitted by AMN
26 Darkened; submitted by A. Yamaguchi
27 In Chinese publications, its former name was M16159; submitted by Bingkui Miao
28 Field name: Met-2017-025; submitted by David Allepuz
29 SEM; submitted by AMN
30 In Chinese publications, its former name was M16181; submitted by Bingkui Miao
31 In Chinese publications, its former name was M16111; submitted by Bingkui Miao
32 Submitted by A. Yamaguchi
33 In Chinese publications, its former name was M16129; submitted by Bingkui Miao
34 SEM; submitted by AMN
35 Submitted by Vanni Moggi Cecchi
36 In Chinese publications, its former name was M16114; submitted by Bingkui Miao
37 SEM; submitted by AMN
38 In Chinese publications, its former name was M16116; submitted by Bingkui Miao
39 In Chinese publications, its former name was M16310; submitted by Bingkui Miao
40 Submitted by A. Yamaguchi
41 In Chinese publications, its former name was M16069; submitted by Bingkui Miao
42 SEM; submitted by AMN
43 Submitted by A. Yamaguchi
44 In Chinese publications, its former name was M16171; submitted by Bingkui Miao
45 SEM; submitted by AMN
46 Submitted by A. Yamaguchi
47 In Chinese publications, its former name was M16169; submitted by Bingkui Miao
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3 Submitted by A. Yamaguchi

4 Submitted by A. Yamaguchi

5 SEM; submitted by AMN

6 SEM; submitted by AMN

7 In Chinese publications, its former name was M16067; submitted by Bingkui Miao

8 In Chinese publications, its former name was M16065; submitted by Bingkui Miao

9 SEM; submitted by AMN

10 In Chinese publications, its former name was M16161; submitted by Bingkui Miao

11 Submitted by Vanni Moggi Cecchi

12 Submitted by A. Yamaguchi

13 In Chinese publications, its former name was M16097; submitted by Bingkui Miao

14 SEM; submitted by AMN

15 In Chinese publications, its former name was M16182; submitted by Bingkui Miao

16 Submitted by A. Yamaguchi

17 Submitted by A. Yamaguchi

18 Submitted by A. Yamaguchi

19 In Chinese publications, its former name was M16180; submitted by Bingkui Miao

20 Submitted by A. Yamaguchi

21 SEM; submitted by AMN

22 Submitted by Vanni Moggi Cecchi

23 SEM; submitted by AMN

24 SEM; submitted by AMN

25 SEM; submitted by AMN

26 In Chinese publications, its former name was M16126; submitted by Bingkui Miao

27 Submitted by Christian Anderkin

28 SEM; submitted by AMN

29 Dark brownish individual lacking any fusion crust. plagioclase grain size about 60 μm ; submitted by Ansg

30 SEM; submitted by AMN

31 SEM; submitted by AMN

32 work name JG058. Shock veins. Average plagioclase size above 50 μm .; submitted by J. Gattacceca

33 In Chinese publications, its former name was M16142; submitted by Bingkui Miao

34 In Chinese publications, its former name was M16125; submitted by Bingkui Miao

35 In Chinese publications, its former name was M16075; submitted by Bingkui Miao

36 SEM; submitted by AMN

37 ROM Number LM58184; Poorly defined chondrules, major mosaicism, minor oxidation; submitted by V. I

38 Submitted by A. Yamaguchi

39 SEM; submitted by AMN

40 Submitted by C. Park, KOPRI

41 SEM; submitted by AMN

42 Submitted by A. Yamaguchi

43 SEM; submitted by AMN

44 SEM; submitted by AMN

45 SEM; submitted by AMN

46 SEM; submitted by AMN

47 SEM; submitted by AMN

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3 ROM Number LM57102; Chrondrules barely discernable and broken up. Many olivine grains show mosaic

4 Submitted by A. Yamaguchi

5 Submitted by A. Yamaguchi

6 SEM; submitted by AMN

7 Lab number CML0796; field number JW193.; submitted by A. Ruzicka

8 SEM; submitted by AMN

9 Submitted by A. Yamaguchi

10 Submitted by A. Yamaguchi

11 Submitted by A. Yamaguchi

12 SEM; submitted by AMN

13 Submitted by A. Yamaguchi

14 Submitted by A. Yamaguchi

15 Shock vein; submitted by A. Yamaguchi

16 SEM; submitted by AMN

17 SEM; submitted by AMN

18 In Chinese publications, its former name was M16089; submitted by Bingkui Miao

19 SEM; submitted by AMN

20 Submitted by A. Yamaguchi

21 SEM; submitted by AMN

22 SEM; submitted by AMN

23 SEM; submitted by AMN

24 SEM; submitted by AMN

25 Submitted by A. Yamaguchi

26 SEM; submitted by AMN

27 In Chinese publications, its former name was M16132; submitted by Bingkui Miao

28 SEM; submitted by AMN

29 Submitted by A. Yamaguchi

30 Submitted by C. Park, KOPRI

31 SEM; submitted by AMN

32 Submitted by A. Yamaguchi

33 SEM; submitted by AMN

34 SEM; submitted by AMN

35 SEM; submitted by AMN

36 In Chinese publications, its former name was M16154; submitted by Bingkui Miao

37 SEM; submitted by AMN

38 SEM; submitted by AMN

39 SEM; submitted by AMN

40 SEM; submitted by AMN

41 SEM; submitted by AMN

42 Submitted by A. Yamaguchi

43 Submitted by AMN

44 Submitted by A. Yamaguchi

45 SEM; submitted by AMN

46 SEM; submitted by AMN

47 Submitted by A. Yamaguchi

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3 In Chinese publications, its former name was M16121; submitted by Bingkui Miao
4 Field name: Met-2017-022; submitted by David Allepuz
5 SEM; submitted by AMN
6
7 In Chinese publications, its former name was M16148; submitted by Bingkui Miao
8 SEM; submitted by AMN
9 SEM; submitted by AMN
10 SEM; submitted by AMN
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 SEM; submitted by AMN
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 SEM; submitted by AMN
18 Submitted by A. Yamaguchi
19
20 In Chinese publications, its former name was M16172; submitted by Bingkui Miao
21 Submitted by A. Yamaguchi
22 SEM; submitted by AMN
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 SEM; submitted by AMN
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 SEM; submitted by AMN
34 Submitted by A. Yamaguchi
35
36 In Chinese publications, its former name was M16167; submitted by Bingkui Miao
37 SEM; submitted by AMN
38 Large metal nodule; submitted by A. Yamaguchi
39 Field name: Met-2018-045; submitted by David Allepuz
40 Submitted by A. Yamaguchi
41 Submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 Submitted by A. Yamaguchi
46 SEM; submitted by AMN
47
48 In Chinese publications, its former name was M16189; submitted by Bingkui Miao
49 Submitted by C. Park, KOPRI
50 Submitted by A. Yamaguchi
51 Shock vein; submitted by A. Yamaguchi
52 Submitted by A. Yamaguchi
53 Submitted by A. Yamaguchi
54 Shock vein; submitted by A. Yamaguchi
55 Large metal nodule; submitted by A. Yamaguchi
56 Submitted by A. Yamaguchi
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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 SEM; submitted by AMN
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
13 Submitted by C. Park, KOPRI
14 In Chinese publications, its former name was M16188; submitted by Bingkui Miao
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 Submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Darkened; submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
37 Submitted by A. Yamaguchi
38 Submitted by A. Yamaguchi
39 Submitted by A. Yamaguchi
40 Submitted by A. Yamaguchi
41 Shock vein; submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 Submitted by A. Yamaguchi
46 Submitted by A. Yamaguchi
47 Submitted by A. Yamaguchi
48 Submitted by A. Yamaguchi
49 Submitted by A. Yamaguchi
50 Submitted by A. Yamaguchi
51 Submitted by A. Yamaguchi
52 Submitted by A. Yamaguchi
53 In Chinese publications, its former name was M16191; submitted by Bingkui Miao
54 Submitted by A. Yamaguchi
55 Submitted by C. Park, KOPRI
56 Submitted by A. Yamaguchi
57 Submitted by A. Yamaguchi
58 Submitted by A. Yamaguchi
59 Submitted by A. Yamaguchi
60 Submitted by A. Yamaguchi

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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Submitted by C. Park, KOPRI
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Submitted by C. Park, KOPRI
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 Submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 SEM; submitted by AMN
30 Submitted by A. Yamaguchi
31 SEM; submitted by AMN
32 SEM; submitted by AMN
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by C. Park, KOPRI
36 Submitted by C. Park, KOPRI
37 SEM; submitted by AMN
38 Submitted by A. Yamaguchi
39 SEM; submitted by AMN
40 Submitted by C. Park, KOPRI
41 SEM; submitted by AMN
42 SEM; submitted by AMN
43 Submitted by A. Yamaguchi
44 SEM; submitted by AMN
45 Submitted by A. Yamaguchi
46 SEM; submitted by AMN
47 Submitted by A. Yamaguchi
48 SEM; submitted by AMN
49 Submitted by A. Yamaguchi
50 Submitted by A. Yamaguchi
51 Submitted by A. Yamaguchi
52 SEM; submitted by AMN
53 Submitted by A. Yamaguchi
54 SEM; submitted by AMN
55 Submitted by C. Park, KOPRI
56 Submitted by A. Yamaguchi
57 Submitted by A. Yamaguchi
58 Submitted by A. Yamaguchi
59 Submitted by A. Yamaguchi
60 Submitted by A. Yamaguchi

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3 SEM; submitted by AMN
4 Submitted by A. Yamaguchi
5 SEM; submitted by AMN
6 Submitted by A. Yamaguchi
7 SEM; submitted by AMN
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Shock vein; submitted by A. Yamaguchi
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 SEM; submitted by AMN
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 SEM; submitted by AMN
18 Submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 SEM; submitted by AMN
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 SEM; submitted by AMN
28 Work name M2047; submitted by A. Irving
29 Submitted by V. Di Cecco, ROM
30 Field name DD-26; submitted by C. Agee, UNM
31 Submitted by D. Sheikh
32 Submitted by C. Agee
33 Field name MVCH-351; submitted by C. Agee, UNM
34 working name DJ2017/12; submitted by R. Bartoschewitz
35 Submitted by Ansgar Greshake
36 Submitted by C. Herd
37 Lab number CML0928; submitted by A. Ruzicka
38 Field name MVCH-364; submitted by C. Agee, UNM
39 Work name M2046; submitted by A. Irving
40 Submitted by K. Metzler, IfP
41 Field name MVCH-355; submitted by C. Agee, UNM
42 Work name MVCH 375; submitted by A. Irving
43 Submitted by D. Sheikh
44 Submitted by Ansgar Greshake
45 Submitted by Christian Anderkin
46 Submitted by Bingkui Miao
47 Submitted by Bingkui Miao
48 Submitted by Bingkui Miao
49 Submitted by Bingkui Miao
50 Submitted by AMN
51 Submitted by AMN
52 Submitted by J.T. Wasson
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3 Submitted by J.T. Wasson
4 Submitted by J.T. Wasson
5 Submitted by L. Garvie
6 Submitted by J.T. Wasson
7 Submitted by C. Herd
8 Submitted by Vanni Moggi Cecchi
9 Submitted by T. Mikouchi, UTok
10 Submitted by J. T. Wasson and W. B. Xu
11 Submitted by J.T. Wasson
12 Submitted by J.T. Wasson
13 Submitted by J.T. Wasson
14 Submitted by J.T. Wasson
15 Submitted by J.T. Wasson
16 Submitted by J.T. Wasson
17 Submitted by J.T. Wasson
18 Submitted by J.T. Wasson
19 Submitted by J.T. Wasson
20 Submitted by J.T. Wasson
21 Submitted by J.T. Wasson
22 Submitted by C. Herd
23 Submitted by C. Herd
24 Field number MMO-2018-3B; submitted by C. Herd
25 Submitted by M. Zucolotto
26 Submitted by C. Herd
27 Submitted by Shijie Li
28 Submitted by J. Gattacceca
29 Submitted by Jordi Llorca (UPC)
30 Submitted by AMN
31 Submitted by Shijie Li
32 Submitted by C. Herd
33 Submitted by AMN
34 Submitted by AMN
35 Submitted by Ansgar Greshake
36 working name WZ09; submitted by R. Bartoschewitz
37 working name WZ12; submitted by R. Bartoschewitz
38 working name WZ24; submitted by R. Bartoschewitz
39 working name WZ08; submitted by R. Bartoschewitz
40 working name WZ02; submitted by R. Bartoschewitz
41 working name WZ01; submitted by R. Bartoschewitz
42 working name DJ2018/04; submitted by R. Bartoschewitz
43 working name WZ13; submitted by R. Bartoschewitz
44 working name WZ14; submitted by R. Bartoschewitz
45 working name WZ23; submitted by R. Bartoschewitz
46 working name DJ2017/16; submitted by R. Bartoschewitz
47 working name WZ15; submitted by R. Bartoschewitz
48 NWA AM3; submitted by R. Bartoschewitz
49 working name WZ07; submitted by R. Bartoschewitz
50 working name WZ19; submitted by R. Bartoschewitz
51 working name WZ20; submitted by R. Bartoschewitz
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3 NWA-BLK01; submitted by R. Bartoschewitz

4 Submitted by L. Garvie

5 Field name AB-220; submitted by C. Agee, UNM

6 Work name CHC18001; submitted by A. Irving

7 Submitted by Ansgar Greshake

8 Submitted by K. Metzler, IfP

9 Submitted by Ansgar Greshake

10 Work name K382; submitted by Lisa Krämer Ruggiu

11 Submitted by K. Metzler, IfP

12 work name JR050; submitted by Gattacceca

13 mean chondrule diameter is about 0.6 mm; submitted by Ansgar Greshake

14 mean chondrule diameter is about 0.7 mm; submitted by Ansgar Greshake

15 GF18-1; submitted by A. Irving

16 Submitted by A. Yamaguchi

17 work name CG10-3; submitted by A. Irving

18 Work name GF17-3; submitted by A. Irving

19 Submitted by Ansgar Greshake

20 Lab number CML0115. Coordinates are 26.94 ± 0.03 deg N and 105.30 ± 0.04 deg W. The errors are ± 3

21 Submitted by Ansgar Greshake

22 Submitted by Ansgar Greshake

23 Submitted by A. Yamaguchi

24 Chondritic texture of partly deformed, closely packed chondrules (mean diam ~ 0.7 mm) in finer grained r

25 Chondritic texture of sharply defined chondrules of various types ~ 0.6 in diameter set in a fine-grained r

26 Submitted by Ansgar Greshake

27 Submitted by Ansgar Greshake

28 Submitted by Ansgar Greshake

29 Submitted by Ansgar Greshake

30 Submitted by M. Zolensky and M. Takahashi

31 mean chondrule diameter is about 0.6 mm; submitted by Ansgar Greshake

32 Submitted by C. Park, KOPRI

33 Submitted by A. Yamaguchi

34 Submitted by A. Yamaguchi

35 Submitted by A. Yamaguchi

36 Submitted by A. Yamaguchi

37 Submitted by A. Yamaguchi

38 Submitted by A. Yamaguchi

39 Submitted by A. Yamaguchi

40 Submitted by A. Yamaguchi

41 Submitted by A. Yamaguchi

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49 Submitted by A. Yamaguchi

50 Submitted by A. Yamaguchi

51 Submitted by A. Yamaguchi

52 Submitted by A. Yamaguchi

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3 Submitted by A. Yamaguchi
4 UCLA specimen #1108; submitted by A. Irving
5 NWA-LB006; submitted by R. Bartoschewitz
6 Submitted by Ansgar Greshake
7 Field name MC 150; submitted by C. Agee, UNM
8 Submitted by AMN
9 Submitted by AMN
10 Submitted by AMN
11 Submitted by AMN
12 work name AG003. Fragments with reddish-brown fracture surfaces and dark brown fusion crust. Well d
13 Submitted by H. Chennaoui Aoudjehane
14 Submitted by K. Metzler, IfP
15 Work name CHC18004; submitted by A. Irving
16 G705; submitted by A. Bouvier, UWO
17 Work name CHC18007; submitted by A. Irving
18 Work name M2076; submitted by A. Irving
19 Work name M2077; submitted by A. Irving
20 Submitted by Simone de Leuw
21 Field name: Met-2016-028; submitted by David Allepuz
22 Work name BH147; submitted by A. Irving
23 In Chinese publications, its former name was M16033; submitted by Bingkui Miao
24 Submitted by C. Park, KOPRI
25 In Chinese publications, its former name was M16160; submitted by Bingkui Miao
26 Submitted by Vanni Moggi Cecchi
27 Submitted by A. Yamaguchi
28 Submitted by Vanni Moggi Cecchi
29 Submitted by Vanni Moggi Cecchi
30 Submitted by A. Yamaguchi
31 Submitted by Vanni Moggi Cecchi
32 Submitted by Simone de Leuw
33 SEM; submitted by AMN
34 CHC18026; submitted by A. Irving
35 Submitted by A. Yamaguchi
36 ROM Number LM57442; Chondrules readily defined and have irregular fractures and grains showing un
37 Submitted by A. Yamaguchi
38 SEM; submitted by AMN
39 Work name CHC 18011; submitted by A. Irving
40 SEM; submitted by AMN
41 Submitted by AMN
42 SEM; submitted by AMN
43 work name F01-2014; submitted by Jerome Gattacceca
44 SEM; submitted by AMN
45 3 x 2 x 1.5 cm irregular shape stone, 60% crusted with bleached haloes, brown oxidised interior; submi
46 Work name CHC18016; submitted by A. Irving
47 Shock vein; submitted by A. Yamaguchi
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3 SEM; submitted by AMN
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 Submitted by A. Yamaguchi
22 millimeter sized, crusted fragment; submitted by F.Focacci M. Gemelli, (DST-PI)
23 SEM; submitted by AMN
24
25
26 Morocco; submitted by Ansgar Greshake
27 Work name CHC18005; submitted by A. Irving
28 work name LM75/E28; submitted by Jérôme Gattacceca
29 Work name BH128; submitted by A. Irving
30 ROM Number LM57455, formerly DGR01114; Readily delineated chondrules, some undulatory extinctions
31 Field name MVCH314; submitted by C. Agee, UNM
32 Field name: Met-2016-032; submitted by David Allepuz
33 G701; submitted by A. Bouvier, UWO
34 Submitted by M. E. Varela
35 Field name is 2-24a; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
36 working name K369; submitted by R. Bartoschewitz
37 Submitted by Y. Xu, IGGCAS
38 Field name: Met-2016-031; submitted by David Allepuz
39 Work name CHC18006; submitted by A. Irving
40 work name LM67 / D53; submitted by Jérôme Gattacceca
41 Field name SM-2; submitted by C. Agee, UNM
42 Field name is Om2011; analyst N. N. Kononkova (Vernad.); submitted by C. A. Lorenz (Vernad)
43 Field name Engare Sero; submitted by Pavel Yu.Plechov (FMRR)
44 Field name is 2-6; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
45 Work name MVCH 331; submitted by A. Irving
46 plagioclase grain size about 15 μm ; Two brownish individuals without fusion crust.; submitted by Ansgar
47 Submitted by Simone de Leuw
48 Work name M13; submitted by Craig Walton
49 Work name CHC18002; submitted by A. Irving
50 working name DJ2017/13; submitted by R. Bartoschewitz
51 Field name is Calama002-Ch; analyst S. E. Borisovsky (IGEM); submitted by Lorenz C.A., Vernad
52 Field name is Calama50; analyst V. V. Kozlov (Oxford Instruments, Moscow). A stone of irregular shape
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3 Submitted by Director General (DG), GSI.

4 Submitted by C. Park, KOPRI

5 Field name: Met-2017-006; submitted by David Allepuz

6 work name E5; submitted by Richard Greenwood, Hélène Greenwood

7 In Chinese publications, its former name was M16220; submitted by Bingkui Miao

8 Field name is Calama 3-Misha; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Vernad

9 In Chinese publications, its former name was M16224; submitted by Bingkui Miao

10 work name M15.; submitted by Craig Walton

11 In Chinese publications, its former name was M16091; submitted by Bingkui Miao

12 Field name is 2-23; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)

13 Submitted by A. Yamaguchi

14 Submitted by Simone de Leuw

15 Submitted by Vanni Moggi Cecchi

16 SEM; submitted by AMN

17 In Chinese publications, its former name was M16034; submitted by Bingkui Miao

18 In Chinese publications, its former name was M16048; submitted by Bingkui Miao

19 Submitted by Vanni Moggi Cecchi

20 Dark grayish individual with some fusion crust. plagioclase grain size about 30 μm ; submitted by Ansgar

21 Shock vein; submitted by A. Yamaguchi

22 SEM; submitted by AMN

23 In Chinese publications, its former name was M16109; submitted by Bingkui Miao

24 SEM; submitted by AMN

25 Submitted by Vanni Moggi Cecchi

26 plagioclase grain size about 20 μm ; Brownish individual with some fusion crust.; submitted by Ansgar

27 CHC18022; submitted by A. Irving

28 work name EJ448; submitted by Jérôme Gattacceca

29 breccia; plagioclase grain size about 30 μm ; submitted by Ansgar Greshake

30 Submitted by Vanni Moggi Cecchi

31 Field name is Calama025-Ch; analyst S. E. Borisovsky (IGEM); submitted by Lorenz C.A., Vernad

32 work name D; submitted by Richard Greenwood, Hélène Greenwood

33 Field name is PET-2; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)

34 Field name is ?H2FM; analyst N. N. Kononkova (Vernad); submitted by C. A. Lorenz (Vernad)

35 In Chinese publications, its former name was M16112; submitted by Bingkui Miao

36 Field name is Calama027-Ch; analyst S. E. Borisovsky (IGEM); submitted by Lorenz C.A., Vernad

37 work name PB01. Found on grano-diorite pediment surface while meteorite prospecting with six-person

38 Purchased from a Moroccan meteorite dealer at the mineral fair in Munich, Germany. Plagioclase grain size

39 SEM; submitted by AMN

40 SEM; submitted by AMN

41 Submitted by Vanni Moggi Cecchi

42 SEM; submitted by AMN

43 SEM; submitted by AMN

44 SEM; submitted by AMN

45 SEM; submitted by AMN

46 ROM Number LM57439; submitted by V. Di Cecco, ROM

47 SEM; submitted by AMN

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3 Submitted by Vanni Moggi Cecchi

4 SEM; submitted by AMN

5 SEM; submitted by AMN

6 Submitted by Vanni Moggi Cecchi

7 SEM; submitted by AMN

8 Field name is Calate Q5; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Vernac

9 SEM; submitted by AMN

10 Work name RM586; submitted by Lisa Krämer Ruggiu

11 SEM; submitted by AMN

12 plagioclase grain size about 30 um; submitted by Ansgar Greshake

13 SEM; submitted by AMN

14 SEM; submitted by AMN

15 SEM; submitted by AMN

16 Field name is 1-1; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)

17 Field name: Met-2015-024; submitted by David Allepuz

18 SEM; submitted by AMN

19 SEM; submitted by AMN

20 SEM; submitted by AMN

21 Submitted by Vanni Moggi Cecchi

22 SEM; submitted by AMN

23 SEM; submitted by AMN

24 SEM; submitted by AMN

25 SEM; submitted by AMN

26 SEM; submitted by AMN

27 SEM; submitted by AMN

28 SEM; submitted by AMN

29 SEM; submitted by AMN

30 Work name CHC18017; submitted by A. Irving

31 SEM; submitted by AMN

32 In Chinese publications, its former name was M16140; submitted by Bingkui Miao

33 SEM; submitted by AMN

34 SEM; submitted by AMN

35 SEM; submitted by AMN

36 SEM; submitted by AMN

37 SEM; submitted by AMN

38 In Chinese publications, its former name was M16291; submitted by Bingkui Miao

39 SEM; submitted by AMN

40 SEM; submitted by AMN

41 SEM; submitted by AMN

42 SEM; submitted by AMN

43 SEM; submitted by AMN

44 SEM; submitted by AMN

45 SEM; submitted by AMN

46 SEM; submitted by AMN

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48 SEM; submitted by AMN

49 SEM; submitted by AMN

50 SEM; submitted by AMN

51 SEM; submitted by AMN

52 SEM; submitted by AMN

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3 SEM; submitted by AMN
4 SEM; submitted by AMN
5 SEM; submitted by AMN
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10 SEM; submitted by AMN
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 SEM; submitted by AMN
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 SEM; submitted by AMN
18 SEM; submitted by AMN
19 SEM; submitted by AMN
20 Submitted by A. Yamaguchi
21 SEM; submitted by AMN
22 Submitted by AMN
23 SEM; submitted by AMN
24 SEM; submitted by AMN
25 SEM; submitted by AMN
26 Submitted by A. Yamaguchi
27 SEM; submitted by AMN
28 SEM; submitted by AMN
29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 SEM; submitted by AMN
35 SEM; submitted by AMN
36 Field name is 4-II; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
37 Submitted by A. Yamaguchi
38 Submitted by A. Yamaguchi
39 Submitted by A. Yamaguchi
40 Submitted by A. Yamaguchi
41 Submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 Submitted by A. Yamaguchi
46 Submitted by A. Yamaguchi
47 Shock vein; submitted by A. Yamaguchi
48 Shock vein; submitted by A. Yamaguchi
49 Shock vein; submitted by A. Yamaguchi
50 Shock vein; submitted by A. Yamaguchi
51 Submitted by A. Yamaguchi
52 Submitted by A. Yamaguchi
53 Shock vein; submitted by A. Yamaguchi
54 Shock vein; submitted by A. Yamaguchi
55 Shock vein; submitted by A. Yamaguchi
56 Shock vein; submitted by A. Yamaguchi
57 Submitted by A. Yamaguchi
58 Submitted by A. Yamaguchi
59 Shock vein; submitted by A. Yamaguchi
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3 Submitted by A. Yamaguchi
4 Shock vein; submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Shock vein; submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Shock vein; submitted by A. Yamaguchi
20 Shock vein; submitted by A. Yamaguchi
21 Submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 1 x 1 x 1 cm rounded brownish stone with cracks, fully crusted; submitted by F.Focacci M. Gemelli, (DS1
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 SEM; submitted by AMN
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
37 SEM; submitted by AMN
38 Submitted by A. Yamaguchi
39 SEM; submitted by AMN
40 Submitted by A. Yamaguchi
41 Submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 SEM; submitted by AMN
46 Submitted by A. Yamaguchi
47 Submitted by A. Yamaguchi
48 SEM; submitted by AMN
49 SEM; submitted by AMN
50 Submitted by A. Yamaguchi
51 Submitted by A. Yamaguchi
52 Submitted by A. Yamaguchi
53 Submitted by A. Yamaguchi
54 Submitted by A. Yamaguchi
55 Submitted by A. Yamaguchi
56 Submitted by A. Yamaguchi
57 Submitted by A. Yamaguchi
58 Submitted by A. Yamaguchi
59 SEM; submitted by AMN
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3 Submitted by A. Yamaguchi
4 SEM; submitted by AMN
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 Submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 1 x 0.5 x 0.5 cm fully crusted rounded brownish stone; submitted by F.Focacci M. Gemelli, (DST-PI)
17 Submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 SEM; submitted by AMN
22 Submitted by A. Yamaguchi
23 SEM; submitted by AMN
24
25
26 Submitted by Samuel Ebert; submitted by Ebert S.
27 shock veins, breccia; submitted by Eber S.
28 Submitted by Ansgar Greshake
29 Field name: Met-2017-010; submitted by David Allepuz
30 Field name: CL-12-1 (meado); submitted by David Allepuz
31 Submitted by Eber S.
32 Submitted by S. Hu, Y. Lin and J. Ji, IGGCAS ; Weibiao Hsu, PMO
33 Submitted by Pavel Yu. Plechov, pplechov@gmail.com
34 work name LM61/D35; Contains mm thick shock veins.; submitted by Jérôme Gattacceca
35 Field name KRUG-1; analyst V.V. Sharygin (SIGM and UrFU).; submitted by Victor V. Sharygin, sharygi
36 plagioclase grain size about 80 µm; Big brownish individual lacking any fusion crust.; submitted by Ansg
37 Submitted by Jordi Llorca (UPC)
38 Submitted by Victor V. Sharygin
39 plagioclase grain size about 80 µm; submitted by Ansgar Greshake
40 work name RM596; Shock veins containing metal and troilite droplets. Troilite polycrystalline. Plagioclase
41 Submitted by C. Park, KOPRI
42 Work name CHC18003; submitted by A. Irving
43 Submitted by L. Garvie
44 work name LM57/D19; submitted by Jérôme Gattacceca
45 Submitted by Simone de Leuw
46 Shock vein; submitted by A. Yamaguchi
47 SEM; submitted by AMN
48 Work name CHC18008; submitted by A. Irving
49 In Chinese publications, its former name was M16213; submitted by Bingkui Miao
50 plagioclase grain size about 60 µm; submitted by Ansgar Greshake
51 Submitted by A. Yamaguchi
52 Submitted by C. Park, KOPRI

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3 plagioclase grain size about 70 μm ; submitted by Ansgar Greshake
4 Submitted by A. Yamaguchi
5
6 plagioclase grain size about 90 μm ; Single stone with fusion crust.; submitted by Ansgar Greshake
7 Submitted by Simone de Leuw
8 Submitted by Simone de Leuw
9
10 Brownish individual without fusion crust. plagioclase grain size about 60 μm ; submitted by Ansgar Greshake
11 Submitted by C. Park, KOPRI
12 Submitted by Simone de Leuw
13 Shock vein; submitted by A. Yamaguchi
14 Submitted by Katarzyna Luszczek
15
16 Field name: Met-2015-021; submitted by David Allepuz
17 Submitted by Vanni Moggi Cecchi
18
19 Field name: Met-2017-020; submitted by David Allepuz
20 Submitted by Pierre Rochette
21
22 Field name: Met-2018-003; submitted by David Allepuz
23 Submitted by A. Yamaguchi
24 Submitted by Jordi Llorca (UPC)
25 Submitted by Vanni Moggi Cecchi
26
27 ROM Number LM57453; No mosaicism, minor oxidation; submitted by V. Di Cecco, ROM
28 Submitted by Maria Schönbächler
29 Submitted by A. Yamaguchi
30
31 work name M640; Recrystallized chondritic texture with average plagioclase size above 50 μm .; submitted by Ansgar Greshake
32 Field name: Met-2016-017; submitted by David Allepuz
33 Submitted by C. Park, KOPRI
34
35 In Chinese publications, its former name was M16135; submitted by Bingkui Miao
36 SEM; submitted by AMN
37 Submitted by A. Yamaguchi
38 Submitted by Ansgar Greshake
39
40 In Chinese publications, its former name was M16120; submitted by Bingkui Miao
41 Shock vein; submitted by A. Yamaguchi
42 plagioclase grain size about 70 μm ; submitted by Ansgar Greshake
43 SEM; submitted by AMN
44
45 In Chinese publications, its former name was M16108; submitted by Bingkui Miao
46 ROM Number LM57439A; Chondrules very poorly defined. Minor undulatory extinction and very few shock veins; submitted by Ansgar Greshake
47 plagioclase grain size about 60 μm ; Brownish individual with some fusion crust.; submitted by Ansgar Greshake
48 SEM; submitted by AMN
49
50 work name LL14; submitted by J. Gattacceca
51 Field name: Met-2018-014; submitted by David Allepuz
52
53 Field name is Calama11. Analyst V. V. Kozlov (Tescan Demo Centre, Moscow, Russia); submitted by Lorenz C.A., Vernad
54 SEM; submitted by AMN
55
56 Dark brownish individual without fusion crust. plagioclase grain size about 70 μm ; submitted by Ansgar Greshake
57 work name EJ1098; submitted by Jérôme Gattacceca
58 Submitted by A. Yamaguchi
59
60 Field name is Calama023-Ch; analyst S. E. Borisovsky (IGEM); submitted by Lorenz C.A., Vernad
Submitted by Simone de Leuw

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3 SEM; submitted by AMN
4 Submitted by A. Yamaguchi
5 Submitted by Vanni Moggi Cecchi
6 Submitted by A. Yamaguchi
7 work name EJ696; submitted by J. Gattacceca
8 Submitted by A. Yamaguchi
9 Dark grayish individual with some fusion crust. plagioclase grain size about 60 μm ; submitted by Ansgar
10 Submitted by C. Park, KOPRI
11 Submitted by A. Yamaguchi
12 CHC18024; submitted by A. Irving
13 Submitted by A. Yamaguchi
14 Field name: Met-2016-015; submitted by David Allepuz
15 SEM; submitted by AMN
16 Submitted by A. Yamaguchi
17 Field name: Met-2017-036; submitted by David Allepuz
18 Submitted by A. Yamaguchi
19 Field name: Met-2017-030; submitted by David Allepuz
20 work name EJ397; submitted by J. Gattacceca
21 Field name: Met-2017-033; submitted by David Allepuz
22 SEM; submitted by AMN
23 Submitted by A. Irving
24 SEM; submitted by AMN
25 SEM; submitted by AMN
26 Submitted by C. Park, KOPRI
27 Breccia; submitted by A. Yamaguchi
28 work name EJ206; chondritic texture with average plagioclase size above 50 μm . Shock veins. Troilite is
29 SEM; submitted by AMN
30 Submitted by C. Park, KOPRI
31 SEM; submitted by AMN
32 work name EJ398; submitted by Jerome Gattacceca
33 Field name is Calama 3-30; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Verr
34 Shock vein; submitted by A. Yamaguchi
35 SEM; submitted by AMN
36 Work name CHC18015; submitted by A. Irving
37 work name EJ1116; submitted by Jérôme Gattacceca
38 SEM; submitted by AMN
39 Submitted by C. Park, KOPRI
40 SEM; submitted by AMN
41 SEM; submitted by AMN
42 SEM; submitted by AMN
43 Submitted by A. Yamaguchi
44 ROM Number LM52582; Chondrules very poorly defined. Majority of matrix recrystallized. Undulatory ex
45 work name EJ606. Average plagioclase size above 50 μm . Shock veins.; submitted by J. Gattacceca
46 Shock vein; submitted by A. Yamaguchi
47 SEM; submitted by AMN

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3 Submitted by C. Park, KOPRI
4 SEM; submitted by AMN
5 SEM; submitted by AMN
6 SEM; submitted by AMN
7 SEM; submitted by AMN
8 SEM; submitted by AMN
9 Submitted by Jordi Llorca (UPC)
10 In Chinese publications, its former name was M16081; submitted by Bingkui Miao
11 SEM; submitted by AMN
12 Submitted by A. Yamaguchi
13 work name EJ607; submitted by J. Gattacceca
14 SEM; submitted by AMN
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 Field name is 52.2; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
18 SEM; submitted by AMN
19 Shock vein; submitted by A. Yamaguchi
20 SEM; submitted by AMN
21 SEM; submitted by AMN
22 Submitted by Vanni Moggi Cecchi
23 SEM; submitted by AMN
24 SEM; submitted by AMN
25 Field name: Met-2016-021; submitted by David Allepuz
26 SEM; submitted by AMN
27 SEM; submitted by AMN
28 SEM; submitted by AMN
29 SEM; submitted by AMN
30 SEM; submitted by AMN
31 SEM; submitted by AMN
32 SEM; submitted by AMN
33 SEM; submitted by AMN
34 SEM; submitted by AMN
35 SEM; submitted by AMN
36 SEM; submitted by AMN
37 SEM; submitted by AMN
38 Submitted by Daniel Sheikh
39 SEM; submitted by AMN
40 Submitted by A. Yamaguchi
41 Shock vein; submitted by A. Yamaguchi
42 Field name: Met-2018-044; submitted by David Allepuz
43 Submitted by A. Yamaguchi
44 SEM; submitted by AMN
45 SEM; submitted by AMN
46 Submitted by A. Yamaguchi
47 work name JG065. Shock veins. Average plagioclase size above 50 μm .; submitted by J. Gattacceca
48 In Chinese publications, its former name was M16184; submitted by Bingkui Miao
49 SEM; submitted by AMN
50 SEM; submitted by AMN
51 Submitted by A. Yamaguchi
52 SEM; submitted by AMN
53 SEM; submitted by AMN
54 Submitted by C. Park, KOPRI

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3 SEM; submitted by AMN
4 SEM; submitted by AMN
5 SEM; submitted by AMN
6 Submitted by A. Yamaguchi
7 SEM; submitted by AMN
8 SEM; submitted by AMN
9 work name EJ419. Shock veins; submitted by Jérôme Gattacceca
10 SEM; submitted by AMN
11 Submitted by Vanni Moggi Cecchi
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 SEM; submitted by AMN
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 SEM; submitted by AMN
18 SEM; submitted by AMN
19 SEM; submitted by AMN
20 SEM; submitted by AMN
21 SEM; submitted by AMN
22 SEM; submitted by AMN
23 Submitted by A. Yamaguchi
24 Field name: Met-2018-029; submitted by David Allepuz
25 SEM; submitted by AMN
26 SEM; submitted by AMN
27 SEM; submitted by AMN
28 SEM; submitted by AMN
29 SEM; submitted by AMN
30 SEM; submitted by AMN
31 SEM; submitted by AMN
32 SEM; submitted by AMN
33 SEM; submitted by AMN
34 SEM; submitted by AMN
35 SEM; submitted by AMN
36 In Chinese publications, its former name was M16162; submitted by Bingkui Miao
37 SEM; submitted by AMN
38 SEM; submitted by AMN
39 Submitted by C. Park, KOPRI
40 SEM; submitted by AMN
41 SEM; submitted by AMN
42 SEM; submitted by AMN
43 SEM; submitted by AMN
44 Lab number CML0015; submitted by Alex Ruzicka
45 SEM; submitted by AMN
46 SEM; submitted by AMN
47 SEM; submitted by AMN
48 Submitted by A. Yamaguchi
49 SEM; submitted by AMN
50 SEM; submitted by AMN
51 SEM; submitted by AMN
52 Submitted by A. Yamaguchi
53 SEM; submitted by AMN
54 SEM; submitted by AMN
55 SEM; submitted by AMN
56 Submitted by A. Yamaguchi
57 In Chinese publications, its former name was M16073; submitted by Bingkui Miao
58 SEM; submitted by AMN
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3 SEM; submitted by AMN
4 SEM; submitted by AMN
5 SEM; submitted by AMN
6 SEM; submitted by AMN
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10 SEM; submitted by AMN
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 Submitted by C. Park, KOPRI
14 SEM; submitted by AMN
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 SEM; submitted by AMN
18 Field name: Met-2018-019; submitted by David Allepuz
19 SEM; submitted by AMN
20 SEM; submitted by AMN
21 SEM; submitted by AMN
22 SEM; submitted by AMN
23 SEM; submitted by AMN
24 Work name CHC18010; submitted by A. Irving
25 SEM; submitted by AMN
26 SEM; submitted by AMN
27 SEM; submitted by AMN
28 SEM; submitted by AMN
29 SEM; submitted by AMN
30 SEM; submitted by AMN
31 SEM; submitted by AMN
32 Work name CHC18012; submitted by A. Irving
33 SEM; submitted by AMN
34 SEM; submitted by AMN
35 SEM; submitted by AMN
36 SEM; submitted by AMN
37 SEM; submitted by AMN
38 SEM; submitted by AMN
39 SEM; submitted by AMN
40 ROM Number LM57440, formerly DGR 00314; Poorly defined chondrules, some mosaicism, some oxide
41 In Chinese publications, its former name was M16151; submitted by Bingkui Miao
42 Large igneous clast; submitted by A. Yamaguchi
43 SEM; submitted by AMN
44 Submitted by C. Park, KOPRI
45 SEM; submitted by AMN
46 SEM; submitted by AMN
47 SEM; submitted by AMN
48 SEM; submitted by AMN
49 SEM; submitted by AMN
50 SEM; submitted by AMN
51 SEM; submitted by AMN
52 SEM; submitted by AMN
53 SEM; submitted by AMN
54 SEM; submitted by AMN
55 SEM; submitted by AMN
56 SEM; submitted by AMN
57 work name EJ401; submitted by Jérôme Gattacceca
58 SEM; submitted by AMN
59 SEM; submitted by AMN
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3 Submitted by A. Yamaguchi
4 SEM; submitted by AMN
5 SEM; submitted by AMN
6 Submitted by C. Park, KOPRI
7 SEM; submitted by AMN
8 SEM; submitted by AMN
9 SEM; submitted by AMN
10 SEM; submitted by AMN
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 Field name: Met-2015-027; submitted by David Allepuz
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 SEM; submitted by AMN
18 SEM; submitted by AMN
19 SEM; submitted by AMN
20 SEM; submitted by AMN
21 SEM; submitted by AMN
22 SEM; submitted by AMN
23 SEM; submitted by AMN
24 Submitted by A. Yamaguchi
25 SEM; submitted by AMN
26 SEM; submitted by AMN
27 Field name: Met-2018-015; submitted by David Allepuz
28 Submitted by A. Yamaguchi
29 SEM; submitted by AMN
30 Submitted by C. Park, KOPRI
31 Field name is 1-21c; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
32 Submitted by Daniel Sheikh
33 SEM; submitted by AMN
34 SEM; submitted by AMN
35 SEM; submitted by AMN
36 work name EJ212; Shock veins; submitted by Jérôme Gattacceca
37 SEM; submitted by AMN
38 SEM; submitted by AMN
39 SEM; submitted by AMN
40 SEM; submitted by AMN
41 SEM; submitted by AMN
42 SEM; submitted by AMN
43 SEM; submitted by AMN
44 SEM; submitted by AMN
45 SEM; submitted by AMN
46 SEM; submitted by AMN
47 SEM; submitted by AMN
48 SEM; submitted by AMN
49 SEM; submitted by AMN
50 In Chinese publications, its former name was M16259; submitted by Bingkui Miao
51 SEM; submitted by AMN
52 Submitted by AMN
53 SEM; submitted by AMN
54 SEM; submitted by AMN
55 Submitted by C. Park, KOPRI
56 SEM; submitted by AMN
57 SEM; submitted by AMN
58 Submitted by C. Park, KOPRI
59 SEM; submitted by AMN
60 SEM; submitted by AMN

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3 Submitted by A. Yamaguchi

4 SEM; submitted by AMN

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11 SEM; submitted by AMN

12 SEM; submitted by AMN

13 SEM; submitted by AMN

14 SEM; submitted by AMN

15 Field name: Met-2018-018; submitted by David Allepuz

16 SEM; submitted by AMN

17 SEM; submitted by AMN

18 SEM; submitted by AMN

19 SEM; submitted by AMN

20 SEM; submitted by AMN

21 SEM; submitted by AMN

22 SEM; submitted by AMN

23 Field name: Met-2018-004; submitted by David Allepuz

24 Submitted by A. Yamaguchi

25 SEM; submitted by AMN

26 SEM; submitted by AMN

27 SEM; submitted by AMN

28 SEM; submitted by AMN

29 SEM; submitted by AMN

30 SEM; submitted by AMN

31 SEM; submitted by AMN

32 Submitted by Victor V. Sharygin

33 SEM; submitted by AMN

34 SEM; submitted by AMN

35 SEM; submitted by AMN

36 SEM; submitted by AMN

37 SEM; submitted by AMN

38 Submitted by AMN

39 SEM; submitted by AMN

40 SEM; submitted by AMN

41 Submitted by C. Park, KOPRI

42 Submitted by AMN

43 SEM; submitted by AMN

44 SEM; submitted by AMN

45 SEM; submitted by AMN

46 work name EJ214. Abundant shock veins. Polycrystalline troilite.; submitted by Jérôme Gattacceca

47 Submitted by A. Yamaguchi

48 Submitted by A. Yamaguchi

49 SEM; submitted by AMN

50 SEM; submitted by AMN

51 Submitted by AMN

52 Submitted by A. Yamaguchi

53 Submitted by C. Park, KOPRI

54 Submitted by AMN

55 Shock vein; submitted by A. Yamaguchi

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3 Submitted by A. Yamaguchi
4 Submitted by C. Park, KOPRI
5 Submitted by A. Yamaguchi
6 SEM; submitted by AMN
7 SEM; submitted by AMN
8 Submitted by A. Yamaguchi
9 SEM; submitted by AMN
10 SEM; submitted by AMN
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 SEM; submitted by AMN
14 Submitted by C. Park, KOPRI
15 SEM; submitted by AMN
16 SEM; submitted by AMN
17 Submitted by A. Yamaguchi
18 Submitted by C. Park, KOPRI
19 Field name: Met-2018-011; submitted by David Allepuz
20 SEM; submitted by AMN
21 Breccia; submitted by A. Yamaguchi
22 Submitted by C. Park, KOPRI
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 work name DM047; Average plagioclase size above 50 um.; submitted by J. Gattacceca
27 Submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 Shock vein; submitted by A. Yamaguchi
31 Shock vein; submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Shock vein; submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Shock vein; submitted by A. Yamaguchi
37 Submitted by A. Yamaguchi
38 Submitted by A. Yamaguchi
39 Shock vein; submitted by A. Yamaguchi
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41 Shock vein; submitted by A. Yamaguchi
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43 Shock vein; submitted by A. Yamaguchi
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45 Shock vein; submitted by A. Yamaguchi
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48 Submitted by A. Yamaguchi
49 Shock vein; submitted by A. Yamaguchi
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59 Submitted by A. Yamaguchi
60 Submitted by A. Yamaguchi

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3 Shock vein; submitted by A. Yamaguchi
4 Submitted by C. Park, KOPRI
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by AMN
8 Shock vein; submitted by A. Yamaguchi
9 Shock vein; submitted by A. Yamaguchi
10 Submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by C. Park, KOPRI
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by C. Park, KOPRI
21 Submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Darkened; submitted by A. Yamaguchi
24 Shock vein; submitted by A. Yamaguchi
25 Shock vein; submitted by A. Yamaguchi
26 Shock vein; submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by C. Park, KOPRI
29 Submitted by A. Yamaguchi
30 Shock vein; submitted by A. Yamaguchi
31 Shock vein; submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
37 Submitted by A. Yamaguchi
38 Submitted by A. Yamaguchi
39 Submitted by A. Yamaguchi
40 Submitted by A. Yamaguchi
41 Field name: Met-2017-007; submitted by David Allepuz
42 Shock vein; submitted by A. Yamaguchi
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 Submitted by C. Park, KOPRI
46 Submitted by C. Park, KOPRI
47 Submitted by A. Yamaguchi
48 Submitted by A. Yamaguchi
49 Submitted by A. Yamaguchi
50 Shock vein; submitted by A. Yamaguchi
51 Submitted by A. Yamaguchi
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54 Shock vein; submitted by A. Yamaguchi
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3 Submitted by A. Yamaguchi
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5 Submitted by C. Park, KOPRI
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11 Submitted by A. Yamaguchi
12 Submitted by C. Park, KOPRI
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Shock vein; submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
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26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by C. Park, KOPRI
29 Shock vein; submitted by A. Yamaguchi
30 Shock vein; submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
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35 Submitted by A. Yamaguchi
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38 Submitted by A. Yamaguchi
39 Submitted by A. Yamaguchi
40 Submitted by C. Park, KOPRI
41 Submitted by A. Yamaguchi
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55 Shock vein; submitted by A. Yamaguchi
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3 Submitted by A. Yamaguchi
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5 Submitted by A. Yamaguchi
6 Shock vein; submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
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15 Shock vein; submitted by A. Yamaguchi
16 Shock vein; submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Shock vein; submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
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36 Submitted by A. Yamaguchi
37 SEM; submitted by AMN
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51 SEM; submitted by AMN
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4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
8 Submitted by A. Yamaguchi
9 SEM; submitted by AMN
10 Submitted by A. Yamaguchi
11 Submitted by A. Yamaguchi
12 Submitted by A. Yamaguchi
13 Submitted by A. Yamaguchi
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Shock vein; submitted by A. Yamaguchi
18 Shock vein; submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by A. Yamaguchi
21 Shock vein; submitted by A. Yamaguchi
22 Submitted by A. Yamaguchi
23 Submitted by A. Yamaguchi
24 Submitted by A. Yamaguchi
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Submitted by C. Park, KOPRI
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
37 SEM; submitted by AMN
38 Shock vein; submitted by A. Yamaguchi
39 Darkened; submitted by A. Yamaguchi
40 Submitted by A. Yamaguchi
41 Shock vein; submitted by A. Yamaguchi
42 SEM; submitted by AMN
43 Submitted by A. Yamaguchi
44 Submitted by A. Yamaguchi
45 Submitted by A. Yamaguchi
46 SEM; submitted by AMN
47 SEM; submitted by AMN
48 Submitted by A. Yamaguchi
49 Submitted by A. Yamaguchi
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51 Submitted by A. Yamaguchi
52 Submitted by A. Yamaguchi
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54 Shock vein; submitted by A. Yamaguchi
55 Submitted by A. Yamaguchi
56 Shock vein; submitted by A. Yamaguchi
57 Submitted by A. Yamaguchi
58 Shock vein; submitted by A. Yamaguchi
59 Submitted by A. Yamaguchi
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3 Shock vein; submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by A. Yamaguchi
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14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Shock vein; submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Work name GH-469; submitted by A. Irving
21 work name LM72/E09; Breccia with chondritic clasts in a melt rock matrix. Chondritic clasts have plagioclase
22 Submitted by Ansgar Greshake
23 work name EJ218. Type 6 chondritic clasts set in a melt rock matrix.; submitted by Jérôme Gattacceca
24 Work name M2061; submitted by A. Irving
25 Work name M2040; submitted by A. Irving
26 working name WZ06; submitted by R. Bartoschewitz
27 NWA-LB003; submitted by R. Bartoschewitz
28 working name WZ22; submitted by R. Bartoschewitz
29 working name WZ21; submitted by R. Bartoschewitz
30 Submitted by R. Bartoschewitz
31 Work name M1630; submitted by A. Irving
32 MVCH-333; submitted by C. Agee, UNM
33 Work name SJS18004; submitted by A. Irving
34 Work name M2056; submitted by A. Irving
35 Field name JP-90; submitted by C. Agee, UNM
36 Field name Past-4; analyst V.V. Sharygin (SIGM and UrFU); submitted by Victor Sharygin
37 MVCH-332; submitted by C. Agee, UNM
38 Specimen number CML0091.; submitted by Alex Ruzicka
39 Submitted by Ansgar Greshake
40 Specimen numbers RM-4 and CML0677.; submitted by Alex Ruzicka
41 Work name K372; submitted by A. Irving
42 Submitted by Ansgar Greshake
43 Submitted by Daniel Sheikh
44 Submitted by L. Garvie
45 Submitted by A. Yamaguchi
46 Work name MVCH 372; submitted by A. Irving
47 work name K360; submitted by J. Gattacceca
48 Submitted by Simone de Leuw
49 work name K366; submitted by Jérôme Gattacceca
50 NWA-LB004; submitted by R. Bartoschewitz
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3 Morocco; submitted by Ansgar Greshake
4 Field name is Calama 2-2; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Verná
5 Submitted by A. Yamaguchi
6 Submitted by L. Garvie
7 work name K368; submitted by J. Gattacceca
8 Submitted by C. Park, KOPRI
9 Submitted by C. Park, KOPRI
10 Submitted by K. Metzler, IfP
11 Submitted by Ansgar Greshake
12 work name K340; submitted by Jerome Gattacceca
13 Submitted by C. Agee
14 work name RM647; submitted by Gattacceca
15 Submitted by AMN
16 Submitted by AMN
17 Submitted by Vanni Moggi Cecchi
18 work name JR051; Bought from Mohamed Elguirah in Zagora in 2018. Gray stones, some with fusion cr
19 Field name: Met-2016-048; submitted by David Allepuz
20 Submitted by Vanni Moggi Cecchi
21 Submitted by Ansgar Greshake
22 work name B2; submitted by Richard Greenwood, H el ene Greenwood
23 Catalogued at the Royal Ontario Museum as LM58174. Formerly DGR-031-16; submitted by V. Di Cecc
24 Purchased from a Moroccan meteorite dealer at the mineral fair in Munich, Germany. Mean chondrule di
25 Darkened; submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 Submitted by A. Yamaguchi
28 Submitted by A. Yamaguchi
29 SEM; submitted by AMN
30 Submitted by A. Yamaguchi
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 ROM Number LM57441; Chondrules not sharply but readily delineated. Undulatory extinction, but few st
37 Submitted by AMN
38 1 x 1 x 1 cm rounded stone, 90% brown fusion crust, fresh interior; submitted by F.Focacci M. Gemelli, (
39 SEM; submitted by AMN
40 Lab number CML0817; submitted by A. Ruzicka
41 Breccia, shock veins; Working No.: SM 1804-18; submitted by K. Klemm, IfP; submitted by Klemm K.
42 Submitted by Ansgar Greshake
43 Genomict breccia; submitted by A. Yamaguchi
44 Submitted by Ansgar Greshake
45 Genomict breccia; submitted by A. Yamaguchi
46 Submitted by Ansgar Greshake
47 Genomict breccia; submitted by A. Yamaguchi
48 Submitted by Simone de Leuw

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3 Submitted by Ansgar Greshake
4 G671; submitted by A. Bouvier
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 Submitted by Vanni Moggi Cecchi
8 SEM; submitted by AMN
9 Field name is Calama 2-24; analyst V. V. Kozlov (Oxford Instruments, Moscow); submitted by Lorenz C.
10 SEM; submitted by AMN
11 ROM Number LM57445; Readily delineated chondrules, some undulatory extinction but no opaque shoc
12 The meteorite is metamorphosed clastic breccia. Field name is Calama 3-20; analyst T. Kryachko (Tech
13 In Chinese publications, its former name was M16131; submitted by Bingkui Miao
14 Submitted by A. Yamaguchi
15 Submitted by A. Yamaguchi
16 SEM; submitted by AMN
17 Submitted by Vanni Moggi Cecchi
18 Submitted by A. Yamaguchi
19 SEM; submitted by AMN
20 Field name is 2-4; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
21 Submitted by A. Yamaguchi
22 ROM Number LM58185; Many chondrules defined, more "readily delineated." Some undulatory extincti
23 Submitted by A. Yamaguchi
24 SEM; submitted by AMN
25 Submitted by A. Yamaguchi
26 Submitted by A. Yamaguchi
27 SEM; submitted by AMN
28 Field name is 5-1; analyst S. E. Borisovsky (IGEM); submitted by C. A. Lorenz (Vernad)
29 Submitted by A. Yamaguchi
30 Breccia; submitted by A. Yamaguchi
31 work name K331; submitted by J. Gattacceca
32 Working No.: SM 1804-15; submitted by K. Klemm, IfP; submitted by Klemm K.
33 Working No.: SM 1804-14; submitted by K. Klemm, IfP; submitted by Klemm K.
34 Submitted by H. Chennaoui Aoudjehane
35 Submitted by Daniel Sheikh
36 Catalogued at the Royal Ontario Museum as LM58148; submitted by V. Di Cecco, ROM
37 Catalogued at the Royal Ontario Museum as LM58147; submitted by V. Di Cecco, ROM
38 ROM Number LM57444; submitted by V. Di Cecco, ROM
39 Submitted by K. Metzler, IfP
40 Submitted by Vanni Moggi Cecchi
41 Submitted by A. Yamaguchi
42 Submitted by A. Yamaguchi
43 Submitted by Vanni Moggi Cecchi
44 Submitted by A. Yamaguchi
45 Brownish individual without fusion crust. plagioclase grain size about 60 μm ; submitted by Ansgar Gresh
46 ROM Number LM58183; Some chondrules visible. Olivines bear undulatory extinction and planar fractur
47 ROM Number LM57446; Chondrules barely defined and matrix recrystallized. Largest grains show no si

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3 Submitted by A. Yamaguchi
4 Submitted by A. Yamaguchi
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6 Field name: Met-2016-016; submitted by David Allepuz
7 Work name BR 106; submitted by A. Irving
8 SEM; submitted by AMN
9
10 Submitted by Vanni Moggi Cecchi
11 breccia; plagioclase grain size about 80 μm ; submitted by Ansgar Greshake
12 plagioclase grain size about 60 μm ; submitted by Ansgar Greshake
13
14 SEM; submitted by AMN
15 Submitted by A. Yamaguchi
16 Submitted by A. Yamaguchi
17 Submitted by Vanni Moggi Cecchi
18 Submitted by Vanni Moggi Cecchi
19 plagioclase grain size about 60 μm ; Two brownish individuals with some fusion crust.; submitted by Ansgar Greshake
20 Breccia; submitted by A. Yamaguchi
21 Breccia; submitted by A. Yamaguchi
22 working name WZ27; submitted by R. Bartoschewitz
23 plagioclase grain size about 80 μm ; submitted by Ansgar Greshake
24 Submitted by Simone de Leuw
25 Submitted by A. Yamaguchi
26 SEM; submitted by AMN
27 plagioclase grain size about 60 μm ; submitted by Ansgar Greshake
28 Submitted by A. Yamaguchi
29 Submitted by A. Yamaguchi
30 Submitted by A. Yamaguchi
31 Breccia; submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by A. Yamaguchi
34 Breccia; submitted by A. Yamaguchi
35 Submitted by A. Yamaguchi
36 Submitted by A. Yamaguchi
37 Breccia; submitted by A. Yamaguchi
38 Breccia; submitted by A. Yamaguchi
39 breccia; plagioclase grain size about 60 μm ; submitted by Ansgar Greshake
40 Work name JB17-1; submitted by A. Irving
41 Breccia; submitted by A. Yamaguchi
42 In Chinese publications, its former name was M16303; submitted by Bingkui Miao
43 Submitted by A. Yamaguchi
44 plagioclase grain size about 80 μm ; submitted by Ansgar Greshake
45 Submitted by A. Yamaguchi
46 plagioclase grain size about 60 μm ; contains shock veins; submitted by Ansgar Greshake
47 Shock vein; submitted by A. Yamaguchi
48 Submitted by A. Yamaguchi
49 Breccia; submitted by A. Yamaguchi
50 Breccia; submitted by A. Yamaguchi
51 SEM; submitted by AMN
52 SEM; submitted by AMN
53 plagioclase grain size about 60 μm ; submitted by Ansgar Greshake

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3 SEM; submitted by AMN
4 SEM; submitted by AMN
5 Submitted by A. Yamaguchi
6 Submitted by A. Yamaguchi
7 SEM; submitted by AMN
8 Submitted by A. Yamaguchi
9 SEM; submitted by AMN
10 Submitted by A. Yamaguchi
11 SEM; submitted by AMN
12 SEM; submitted by AMN
13 Submitted by A. Yamaguchi
14 Submitted by AMN
15 Submitted by A. Yamaguchi
16 Shock vein; submitted by A. Yamaguchi
17 Submitted by A. Yamaguchi
18 Breccia; submitted by A. Yamaguchi
19 Submitted by A. Yamaguchi
20 Submitted by C. Park, KOPRI
21 Submitted by Anthony Love
22 Field name LA-4; submitted by C. Agee, UNM
23 Submitted by K. Metzler, IfP
24 work name ST11; submitted by Gattacceca
25 Work name FO18-1; submitted by A. Irving
26 Work name RC99.2; submitted by A. Irving
27 Submitted by Ansgar Greshake
28 Work name BH146; submitted by A. Irving
29 Field name DD-28; submitted by C. Agee, UNM
30 Submitted by L. Garvie
31 Submitted by A. Yamaguchi
32 Submitted by A. Yamaguchi
33 Submitted by AMN
34 Work name MVCH 258; submitted by A. Irving
35 Submitted by F. Brandstätter
36 Submitted by Bingkui Miao
37 work name LL76; submitted by Jérôme Gattacceca
38 Submitted by Ansgar Greshake
39 Work name BH155; submitted by A. Irving
40 Field name DD-20; submitted by C. Agee, UNM
41 Field name DD-21; submitted by C. Agee, UNM
42 Work name DD17-10; submitted by A. Irving
43 Field name DD-22; submitted by C. Agee, UNM
44 Submitted by Dmitry Badyukov
45 M2157; submitted by C. Agee
46 Submitted by Bingkui Miao
47 Field name MF-6; submitted by C. Agee, UNM
48 Gessler's address: 2010 Calgary Ln, Los Angeles, CA 90077, USA; submitted by Paul Warren
49 Field name DD-25; submitted by C. Agee, UNM
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3 Work name DG18-1; submitted by A. Irving
4 Field name M1820; submitted by C. Agee, UNM
5 Field name ZK-13; submitted by C. Agee, UNM
6 Work name HN-713; submitted by A. Irving
7 Field name JP-84; submitted by C. Agee, UNM
8 Work name: "Aoufous"; submitted by Ebert Samuel
9 Submitted by Anthony Love
10 K371; submitted by A. Irving
11 Field name JP-29; submitted by C. Agee, UNM
12 Work name BH003; submitted by A. Irving
13 Work name MVCH 371; submitted by A. Irving
14 Work name Hum18-1; submitted by A. Irving
15 Work name MAC 133; submitted by A. Irving
16 work name RM573; submitted by Jérôme Gattacceca
17 Submitted by Nicole G. Lunning
18 Submitted by Ansgar Greshake
19 Submitted by C. Agee
20 Submitted by K. Metzler, IfP
21 Field name Z-2; submitted by C. Agee
22 Submitted by A. Irving
23 Work name MA18-200; submitted by A. Irving
24 Work name MA18-201; submitted by A. Irving
25 Work name ML18-1; submitted by A. Irving
26 Work name BH145; submitted by A. Irving
27 Work name BH141; submitted by A. Irving
28 Work name BH142; submitted by A. Irving
29 Submitted by Bingkui Miao
30 Gessler's address: 2010 Calgary Ln, Los Angeles, CA 90077, USA; submitted by Paul Warren
31 JH18-2; submitted by A. Irving
32 Shock vein, An52.5-55.4; submitted by A. Yamaguchi
33 Work name BH144; submitted by A. Irving
34 Submitted by Ansgar Greshake
35 Field number 1601_0094; submitted by Beda Hofmann
36 Fieldname JP-24; submitted by C. Agee
37 Field number MMO-2018-3C; submitted by C. Herd
38 Submitted by C. A. Lorenz (Vernad)
39 Work name BF18-22; submitted by A. Irving
40 Submitted by A. Irving
41 work name LL82; submitted by Jérôme Gattacceca
42 Work name E511; submitted by A. Irving
43 Work name MCZ1; submitted by A. Irving
44 Algeria; submitted by Ansgar Greshake
45 Submitted by Ansgar Greshake
46 Submitted by Ansgar Greshake
47 Submitted by Nicolas Meisser
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3 Work name B386; submitted by A. Irving
4 Provisional name was NWA 2683; submitted by L. Garvie
5 Work name JP18-1; submitted by A. Irving
6 Submitted by Ansgar Greshake
7 Submitted by Ansgar Greshake
8 Submitted by Anthony Love
9 Submitted by Anthony Love
10 Work name GF17-4; submitted by A. Irving
11 work name K189; submitted by A. Irving
12 Work name BF17-19; submitted by A. Irving
13 Sample registered at ROM as M58493; submitted by V. Di Cecco, ROM
14 Work name DD17-9; submitted by A. Irving
15 Submitted by Alan Rubin
16 Submitted by Ansgar Greshake
17 G692 as a field name.; submitted by A. Bouvier
18 Submitted by B. C. Hyde
19 Submitted by K. Metzler, IfP
20 Field name Z-3; submitted by C. Agee, UNM
21 Work name SJS18005; submitted by A. Irving
22 Submitted by Ansgar Greshake
23 Submitted by Ansgar Greshake
24 Field name MVCH-352; submitted by C. Agee, UNM
25 G703 as a field name.; submitted by A. Bouvier
26 Field name MVCH-359; submitted by C. Agee, UNM
27 Submitted by Ansgar Greshake
28 Field name SM-1; submitted by C. Agee, UNM
29 Submitted by P. Hill
30 Field name DD-27; submitted by C. Agee, UNM
31 Field name MVCH-350; submitted by C. Agee, UNM
32 Work name M2027; submitted by A. Irving
33 Work name BF17-16; submitted by A. Irving
34 Submitted by P. Hill
35 Submitted by K. Metzler, IfP
36 G691 as a field name.; submitted by A. Bouvier
37 Submitted by K. Metzler, IfP
38 Submitted by C. Park, KOPRI
39 Specimen numbers RM-8 and CML0681.; submitted by Alex Ruzicka
40 Field name JP-62; submitted by C. Agee, UNM
41 Submitted by Ansgar Greshake
42 Field name MVCH-349; submitted by C. Agee, UNM
43 Submitted by B. C. Hyde
44 Work name M365; submitted by A. Irving
45 Morocco; submitted by Ansgar Greshake
46 Field name: Met-2018-032; submitted by David Allepuz
47 G690 as a field name.; submitted by A. Bouvier
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Submitted by P. Hill

Submitted by K. Metzler, IfP

Submitted by A. Bouvier

Submitted by N. V. Almeida

Submitted by K. Metzler, IfP

Submitted by Ansgar Greshake

Work name M2019; submitted by A. Irving

Submitted by Ansgar Greshake

Submitted by Ansgar Greshake

Submitted by A. Yamaguchi

Submitted by A. Yamaguchi

Work name MVCH 296; submitted by A. Irving

Submitted by Alan Rubin

MVCH 335; submitted by A. Irving

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support, the Tawani Foundation for funding, Jim Holstein and Drew Carhart for help with sample prepar:

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enocrysts exhibit polysynthetic twinning. Weathering veins rim chondrules and traverse the sample.; s

Submitted by Lorenz C.A., Vernad

nite veinlets occur. Weathering veins rim the chondrules and traverse the sample.; submitted by Simo

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4 exhibit polysynthetic twinning. Weathering veins rim the chondrules and traverse the sample.; submit
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.tacceca

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joint counting, N=169) between well-preserved chondrules.; submitted by Jérôme Gattacceca
chondrules.; submitted by Lisa Krämer Ruggiu

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.A., Vernad

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l by Gattacceca

Gattacceca

nsgar Greshake

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ed by Jérôme Gattacceca

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with shiny fusion crust.; submitted by Gattacceca

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orenz C. A. (Vernad.)

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average plagioclase size <50 μm . They contain veinlets of metal and sulfides.; submitted by Jérôme Ga

igm.nsc.ru

submitted by Lisa Krämer Ruggiu

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GUT: Guilin University of Technology. PRIC: Polar Research Institute of China

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gar Greshake

Di Cecco, ROM

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cism. Thin section has iron staining. More than 20% of the metal and sulfides affected by oxidation.; s

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3.8 km (about 1.8 minutes) latitude and ± 5.2 km west (about 2.4 minutes) longitude.; submitted by Al

matrix that contains weakly altered FeNi metal.; submitted by Ansgar Greshake

matrix of chondrule and mineral fragments and FeNi metal.; submitted by Ansgar Greshake

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refined chondrules. Rare plagioclase to 5 um. Zoned pyroxenes.; submitted by Gattacceca

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regulatory extinction. More than 20% of metal oxidized.; submitted by V. Di Cecco, ROM

submitted by F.Focacci M. Gemelli, (DST-PI)

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on, very minor mosaicism and very little oxidation; submitted by V. Di Cecco, ROM

Greshake

has a smooth surface that is covered by dark-brown fusion crust.; submitted by C. A. Lorenz (Vernad

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Vernad

Greshake

reshake

team. Shock veins.; submitted by Gattacceca
size about 15 um.; submitted by Ansgar Greshake

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n@igm.nsc.ru
jar Greshake

ε-chromite assemblages. A 3.5 metal nugget is visible in the studied polished section.; submitted by J

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ed by J. Gattacceca

ock veins are present. Some fractures affected by weathering.; submitted by V. Di Cecco, ROM
reshake

orenz C. A. (Vernad.)

Greshake

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Greshake

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is polycrystalline.; submitted by Jérôme Gattacceca

nad

inction and mosaicism are present. Metal mostly unaltered with minor oxidation on rims.; submitted |

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ation and veining; submitted by V. Di Cecco, ROM

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plagioclase average size >50 μm . They contain veinlets of metal and sulfides, chromite-plagioclase assemblage

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ust. Millimeter-sized chondrules are visible on broken surfaces.; submitted by Gattacceca

co, ROM

diameter is about 0.8 mm; submitted by Ansgar Greshake

hock veins. Metal lightly oxidized.; submitted by V. Di Cecco, ROM

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.A., Vernad

ck veins; submitted by V. Di Cecco, ROM
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on and irregular fractures.; submitted by V. Di Cecco, ROM

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gns of undulatory extinction, and sample fairly weathered through its orange coloration and <5% pres

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gar Greshake

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ation.; submitted by Philipp R. Heck, Jennika Greer

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submitted by Simone de Leuw

one de Leuw

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ted by Simone de Leuw

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Ilex Ruzicka

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Jérôme Gattacceca

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by V. Di Cecco, ROM

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blages, and eutectic metal/sulfide grains.; submitted by Jérôme Gattacceca

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sence of unoxidized metal.; submitted by V. Di Cecco, ROM

db_id	db_name	db_abbrev	db_amn	db_anttype	db_class	db_country
33298	Northwest Africa 2824	NWA 2824			Eucrite-an	(Northwest Afr
33682	Northwest Africa 3358	NWA 3358			H3.10	(Northwest Afr
52951	Northwest Africa 6567	NWA 6567			L3	(Northwest Afr
54831	Northwest Africa 7034	NWA 7034			Martian (polyn	Morocco
56132	Northwest Africa 7475	NWA 7475			Martian (polyn	(Northwest Afr
56550	Northwest Africa 7533	NWA 7533			Martian (polyn	(Northwest Afr
57538	Northwest Africa 7906	NWA 7906			Martian (polyn	(Northwest Afr
57539	Northwest Africa 7907	NWA 7907			Martian (polyn	(Northwest Afr
58459	Northwest Africa 8114	NWA 8114			Martian (polyn	Western Saha
58684	Northwest Africa 8171	NWA 8171			Martian (polyn	(Northwest Afr
61234	Northwest Africa 8674	NWA 8674			Martian (polyn	(Northwest Afr
64405	Northwest Africa 10922	NWA 10922			Martian (polyn	(Northwest Afr
65309	Northwest Africa 11220	NWA 11220			Martian (polyn	(Northwest Afr
65632	Northwest Africa 11289	NWA 11289			Iron, IIIAB	Morocco
66188	Northwest Africa 11522	NWA 11522			Martian (polyn	(Northwest Afr
64990	Rabt Sbayta 003				Martian (polyn	Western Saha

db_state	db_approved	db_modified	db_reason	tbl_stateco
	2008-12-23	2018-06-08	Reclassified	
	2005-02-03	2018-06-08	Reclassified	
	2013-09-06	2018-05-28	Reclassified from CV3 to L3	
	2012-01-24	2018-11-16	Updated class	
	2013-05-06	2018-11-16	Updated class; see NWA 7034)	
	2012-12-11	2018-11-16	Updated class; see NWA 7034)	
	2013-06-19	2018-11-16	Updated class; see NWA 7034)	
	2013-06-19	2018-11-16	Updated class; see NWA 7034)	
Rio de Oro	2013-12-10	2018-11-16	Updated class; see NWA 7034)	Rio de Oro
	2014-01-23	2018-11-16	Updated class; see NWA 7034)	
	2014-12-12	2018-11-16	Updated class; see NWA 7034)	
	2016-12-03	2018-11-16	Updated class; see NWA 7034)	
	2017-08-06	2018-11-16	Updated class; see NWA 7034)	
	2017-06-28	2018-06-16	Reclassified by Wasson	
	2017-11-21	2018-11-16	Updated class; see NWA 7034)	
Rio de Oro	2017-03-03	2018-11-16	Updated class; see NWA 7034)	Rio de Oro

tbl_origin	tbl_purchplace	tbl_date	tbl_lat	tbl_long	tbl_mass	tbl_pieces
	Morocco	2005			485	1
	Sainte Marie	May 2001			1162	1
	Temara	P 2010 Nov			6000	1
	Morocco	P 2011			319.8	1
	Morocco	P 2012 Sep			80.2	1
	Agadir	P June 2012			84	1
	Morocco	P Jan 2013			47.68	1
	Morocco	P Jan 2013			29.94	1
		Feb 2013	24°04'45.8"N	14°47'12.4"W	1.9	1
	Ensisheim, France	P June 2013			81.88	1
	Morocco	P 2012			12	1
	Morocco	P 2013			182	1
	Zagora, Morocco	P Jan 2017			36.62	1
50 km east of	Temara	P 2012 Oct			4.6 kg	1
	Morocco	P 2013 Nov			3.2	1
	Taliouine	2016 Nov	24.122°N	14.772°W	20.57	1

tbl_class	tbl_shock	tbl_weath	tbl_fa	tbl_fs	tbl_wo	tbl_magsus
Diogenite				31.2-33.8	3.1-3.8	
H(L)3		W2	13.5 ± 7	11 ± 10		
CV3	S2	W1/2	0.4-24.8			
Achondrite-un				31.6±6.7, 35.53.1±0.8, 8.0±3		
Martian (basal medium		low		19-48; 25-44; 1-5; 5-19; 29-		
Achondrite-un				29.4±7.7, 21.43.2±1.5, 41.1±		
Martian (basal S2				22-43	2-4	
Martian (basal S2				21-55	2-5	
Martian (basal low		medium		19-44	1.5-38	
Martian (basal				21-46	2-4	
Martian (basal low		low				
Martian (basal low		low	34.3±0.5	31.2±7.7, 24.13.7±2.1, 38.6±		
Martian (basal						
Iron, IIIE		Medium				
Martian (basal		Low	57.1	32.3±6.4 (N=37.0±4.4 (N=35		
Martian	low	low		19.6-46.7; 27.3.1-4.6; 40.4-4.48		

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	tbl_type	spec	tbl_type	spec	tbl_main	mas	tbl_classifier	tbl_finder	tblcomment
	32	PSF	anonymous	T. Bunch and					Highly shocked and brecciated c
	23	Mun		Niemeier, Jorc					
	23	UWB	Aaronson	A. Irving and S					Submitted by A. Irving
	30	UNM	Jay Piatek	C. Agee					Submitted by C. Agee
	16.1	UWB	L. Labenne	A. Wittmann, \					Submitted by A. Irving
	17.1	MNHNP	Labenne Mété	R. Hewins, B.					Submitted by B. Zanda
	10.50	NMBE	Marc Jost	B. Hofmann N					Submitted by Beda Hofmann
	8.20	NMBE	Marc Jost	B. Hofmann N					Submitted by Beda Hofmann
	1.9	ULei	ULei	J. Bridges, UL					Submitted by John Bridges
	16.50	NMBE	Marc Jost, Be	B. Hofmann, N					Submitted by Beda Hofmann
	2.5	UNM	Jay Piatek	C. Agee, UNM					Submitted by C. Agee
	22	UNM	Jay Piatek	C. Agee, UNM					Field name BB-182; submitted b
	7.46	NHM London	Martin Goff	A. M. Krzesins					Submitted by N. V. Almeida
	93.0	UWO	A. Aaronson	A. Bouvier, Uv	Unknown				Submitted by A. Bouvier, UWO
	0.948	NHM	NHM	C. Smith, NHM					The specimen is texturally and n
	4.2	UWB	B. Hoefnagels	A. Irving and S					BH040; submitted by A. Irving

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4 diogenite that is plagioclase rich
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15 by C. Agee
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19 mineralogically very similar to NWA 7034 and its numerous pairs, including NWA 11220, which was a
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Also classified at the NHM.; submitted by Caroline Smith

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3 **The Meteoritical Bulletin, No. 107**
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6 **TABLE OF CONTENTS**
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1. Alphabetical text entries for non-Antarctic meteorites
 2. New Dense Collection Areas
 3. Listing of institutes and collections
 4. Bibliography

1. Alphabetical text entries for non-Antarctic meteorites

Aba Panu 8°16'55.83"N, 3°34'1.72"E

Oyo, Nigeria

Confirmed fall: 19 April 2018

Classification: Ordinary chondrite (L3)

History: On the afternoon of 19 April 2018, a large fireball detonated over the Nigerian state of Oyo. This fireball was recorded by NASA's Center for Near Earth Object Studies ([CNEOS](#)) as event 2018-04-19 14:02:27. The meteoroid entered at 20.9 km/s and detonated at an altitude of 30 km at 7.5°N, 3.6°E releasing a calculated total impact energy of 0.23 kt. Many stones fell between the villages of Ipapo (8°7'50.84"N, 3°30'34.58"E) and Tede to the north (8°33'21.49"N, 3°26'46.31"E). Stone were collected at [multiple locations](#). The meteorite is named for the village of Aba Panu near the center of the strewn-field: multiple kg-sized stones were found in and around this village. Current total known weight is near 160 kg.

Physical characteristics: The stones are hard, range from 30 g to near 40 kg, rounded with broad poorly developed regmaglypts, and largely lacking fusion crust. Fusion crust is occasionally preserved within the shallow regmaglypts. Most stones are greyish green and show areas of rounded to angular light-colored clasts. Largest clast (5 × 2 cm) is angular, fine-grained, and achondritic. Observations from multiple slices show that clasts constitute roughly <10 areal%.

Petrography: Visually the cut surfaces are dominated by a gray matrix, studded with well-developed chondrules and chondrule fragments. Some chondrules to 4 mm but the majority are 0.1 to 1 mm across. Observations on an 8 × 7 cm slab shows the following clasts: L6 (3 × 1 cm); L5 (1.5 × 1 cm); and sub-rounded 1-cm dark clast with sparse 200 micron chondrules. Shock veins are rare. Metal and sulfide occurs as: fine-grained spheres in the matrix; armoring chondrules; and, occasional lumps to 5 mm. Petrographic observations show a range of chondrule types dominated by PO, POP, RP, PP, and BO. Particularly evident in thin section are BO and PO chondrules with reddish purple (in plain polarized light) glass that is isotropic under crossed polars. The silicates are extensively shocked with olivine showing mosaicism and PDFs. SEM observations show that much of the metal/sulfide in the matrix occurs as fine-droplets, veins, and melt pods. Large Fe-Ni grains are polycrystalline with each crystal showing a kamacite core, dark-

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3 etched martensitic inner rim, and outer Ni-rich rim. Troilite is dominantly single
4 crystal, and occasionally polycrystalline. Sparse chromite grains.

5 **Geochemistry:** (L. Garvie, *ASU*) Olivine $Fa_{24.3\pm 5.7}$, $n=18$, range $Fa_{7.5-32.8}$. Mean
6 $Cr_2O_3 = 0.08$, $\sigma-Cr_2O_3 = 0.07$, range 0.02 to 0.3. $FeO/MnO=55.8\pm 12.6$. Low
7 Ca, pyroxene $Fs_{17.0\pm 11.6}Wo_{2.0\pm 1.9}$ range $Fs_{2.4-49.2}Wo_{0.3-6.0}$, $n=17$. High Ca pyroxene
8 $Fs_{8.7}Wo_{49.2}$, $n=1$. Reddish purple, isotropic glass within BO and PO chondrules
9 $Or_{1.4\pm 0.8}Ab_{87.6\pm 4.8}$, $n=6$, TiO_2 to 1 wt%. Oxygen isotopes (K. Ziegler, *UNM*):
10 analyses of three subsamples by laser fluorination gave, respectively, $\delta^{17}O = 3.724$,
11 3.625, 3.684; $\delta^{18}O = 5.160$, 4.980, 5.089; $\Delta^{17}O = 1.000$, 0.996, 0.997 per mil.

12 **Classification:** Geochemistry and oxygen isotopic data consistent with L chondrite.
13 Estimated petrologic type 3.6 based on Fa and Fs spread, and Cr_2O_3 content in
14 olivine. L3, S4, W0.

15 **Specimens:** Michael Farmer and Moritz Karl - 50 kg, Eric *Twelker* 7.74 kg,
16 and *ASU* 242 g. Based on photographic evidence, it is estimated that the Nigerian
17 government collected on the order of 100 kg of stones, though this mass is
18 uncertain. Given the size of the fall and area of the fall, the total mass is
19 conservatively given as 160 kg.

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27 **Ablakotka** 49°51.27'N, 82°48.89'E

28 East Kazakhstan, Kazakhstan

29 Fall: 16 Feb 2018

30 Classification: Ordinary chondrite (H5)

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32 **History:** The fall occurred on the 16 Feb 2018 at 14:43:37 UTS. Residents of
33 Ablakotka, a suburb of Ust-Kamenogorsk, Kazakhstan, watched a bright bolide
34 moving approximately north and accompanied by an explosion. The bolide was
35 recorded by video camera mounted on a locomotive moving NE from Charsk. The
36 first sample was discovered by Mr. Alexander Baranov on February 18, near the
37 Irtysh river, on a field covered by snow ~10-20 cm deep. The fall left two scratchy
38 traces: the first was ~0.5 m in length, excavating snow and some soil; the second
39 scratch, 8 m away, was terminated by a channel in the snow where the stone was
40 found. On Feb. 22, two other pieces were recovered by anonymous finders. Later,
41 about 10 pieces were collected by anonymous persons from Feb to Apr 2018, in a
42 strewn field of 1×5 km, on an azimuth of 20°, with central coordinates of
43 49°51.27'N, 82°48.89'E.

44
45 **Physical characteristics:** The stone discovered first is 763 g and covered by black
46 fusion crust, with only a few small broken parts, displaying light-gray interior. Two
47 smaller individuals are 63.5 and 266.6 g. Later, several individual samples with
48 dark-grey- to black interior were recovered. The masses of individuals are in a
49 range 0.1-1.2 kg. A total collected mass of the meteorite shower is approximately
50 5.5 kg.

51
52 **Petrography:** The meteorite has brecciated, chondritic texture. Macroscopically, a
53 light-gray chondritic host contains cm-sized clasts of dark-gray chondritic lithology
54 (~20 vol%). The clasts have sharp contacts with the host. The host is composed of
55 chondrules and chondrule fragments, mineral clasts and fine-grained, recrystallized,
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3 silicate matrix. The main phases are olivine, pyroxene, FeNi metal; minor phases
4 are devitrified glass, feldspar, troilite; spinel is accessory. Olivine has weak
5 undulatory extinction and planar fractures. Impact melt veinlets and melt pockets
6 are present in the host chondrite. The dark lithology has the same texture and
7 composition of the silicates, but is intensive darkened. It has high abundance of tiny
8 inclusions and narrow veinlets of troilite, occurring in the fractures and along the
9 grain boundaries. Several objects in the dark lithology are fine-grained, silicate
10 breccias with troilite matrix. The olivine demonstrates strong undulatory extinction
11 and planar fractures decorated by opaque inclusions.

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15 **Geochemistry:** Mineral compositions and geochemistry: (N. N. Kononkova,
16 EMP, *Vernad*): Olivine $\text{Fa}_{19.1 \pm 0.4}$ (N=24), Pyroxene $\text{Fs}_{17.1 \pm 0.6} \text{Wo}_{1.4 \pm 0.2}$ (N=23).

17
18 **Classification:** (C. A. Lorenz, *Vernad*) ordinary chondrite (H5, monomict breccia)
19 Shock stage is S3; weathering grade is W0.

20
21 **Specimens:** Two thin sections and two samples of 108.7 and 57.2 g are on deposit
22 in *Vernad*; anonymous collectors hold the main mass.

23
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25 **Alaer 003** ~40°20'N, ~81°15'E

26 Xinjiang, China

27 Find: 2007

28
29 Classification: Ordinary chondrite (LL~6)

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31 **History:** (Ziyao Wang) Purchased by Wang Ziyao from Fan Xingang in Aksu,
32 Xinjiang in 2010. This meteorite was discovered in the Taklimakan region, close to
33 Alaer in 2007.

34 **Physical characteristics:** (Wang Ziyao) Dark brown stone of 85.4 g

35
36 **Petrography:** (R. Bartoschewitz, *Bart*) Brown stained recrystallized matrix with
37 nearly complete recrystallized chondrules (0.9-1.8 mm, av. 1.1 mm) and few metal
38 specks.

39
40 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.44$

41
42 **Classification:** Ordinary chondrite (LL~6, W3)

43
44 **Specimens:** 18.1 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 22 g
45 with *Bart*.

46
47
48 **Alatage Mountain 043 (AM 043)** 41°03'22"N, 92°06'00"E

49 Xinjiang, China

50 Find: 2013

51
52 Classification: Iron meteorite (IVB)

53
54 **History:** The meteorite was found in 2013 by a stone hunter in the eastern of Lop
55 Nur, Xinjiang Province.

56
57 **Physical characteristics:** The total mass of the four meteorites is 9.8 kg. The
58 largest one is 7.68 kg. The largest meteorite has an irregular shield shape, the back
59 side with regmalyps and the front side with melting streamlines.

Petrography: Polished section of the sample observed under the SEM shows extremely fine (~5µm) taenite and kamacite forming an ataxite pattern. No inclusions can be observed in the section

Geochemistry: (ELAN DRC-e Q-ICP-MS) Ni=16.7, Co=0.73 (in wt%), Ga=0.22, Ge=2.27, As=1.35, W=3.36, Ir= 36.80, Au=0.06 (in ppm)

Classification: Iron Meteorite (ataxite), IVB

Specimens: Main mass with Xinping Wen. One polished section and a 100 g slice was deposited in *IGCAS*

Alatage Mountain 044 (AM 044) 41°04'44.73"N, 92°01'24.76"E

Xinjiang, China

Find: 22 Jan 2015

Classification: Ordinary chondrite (H~5)

History: (Ziyao Wang) The meteorite was discovered by Xu Jianjiang (Hami/Xinjiang) in the Gobi Desert about 120 km NE of Lop Nur, colose to the Dawadi pass, near Ruoqiang county, Korla city, Bayingol Mongolian Autonomous Prefecture, Xinjiang province on Jan. 22, 2015. Wang Ziyao purchased part of it.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Reddish-brown, heavily fractured, irregular rock of 709 g without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, recrystallized matrix, with well developed chondrules (0.3-0.6 mm) and irregular metallic specks.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.89$

Classification: Ordinary chondrite (H~5, W3)

Specimens: 23.3 g on deposit at *Kiel*, Xu Jianjiang (Hami/Xinjiang) and Wang Ziyao hold the main mass, and 79.2 g with *Bart*.

Andila 12.79°N, 21.20° E

Ouaddai, Chad

Confirmed fall: 2014 Aug 21

Classification: Ordinary chondrite (L6)

History: According to written report from the prefect of Abdi (Mr. Levy Dappina), on August 21, 2014, around 10 am, a series of strong detonations were heard over a distance of 70 km. Later the prefect got a phone call from the village of Andila (12 km W of Abdi) signaling that rocks fell from the sky. A police patrol went to the place and collected, the same day, a series of stones, said to have made a 10 cm hole in the soil and which produced smoke on impact. It is not clear if several individuals were collected or if the stones mentioned were fragments from a single individual. Based on the 171 g piece received by J.C. Doumnang from N'Djamena University, and a discussion with Mr. Dappina, the whole individual mass is estimated to about half a kg. The prefect later handed the stones (except the one that was brought to J.C. Doumnang for identification in 2018) to the governor of

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3 Ouaddaï, together with a report. J.C. Doumnang later brought the stone
4 to *CEREGE* where it was classified.

5
6 **Physical characteristics:** The 171 g fragment is one-third covered with black
7 fusion crust. Fractures reveal a homogeneous, light gray, chondrule-bearing stone
8 with a few faint rust stains. Some troilite aggregates. The material is quite fragile
9 due to intense fracturing.

10
11 **Petrography:** Recrystallized chondritic texture with average plagioclase size >50
12 μm , but relatively well-preserved chondrules. Main minerals are olivine, pyroxene,
13 plagioclase, kamacite, troilite. Olivine shows sharp optical extinction. No oxidation
14 products visible in section.

15
16 **Geochemistry:** Olivine $\text{Fa}_{25.5\pm 0.2}$ (N=3), orthopyroxene $\text{Fs}_{21.8\pm 0.1}\text{Wo}_{1.8\pm 0.3}$ (N=3).

17
18 **Classification:** Ordinary chondrite, L6

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20 **Specimens:** 124 g fragment in N'Djamena University, type specimen (42 g) a
21 polished section and a thin section at *CEREGE*.

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24 **Aridal 017** 25.634°N, 13.193°W

25 Rio de Oro, Western Sahara

26 Purchased: 2016 Sep

27 Classification: Lunar meteorite (feldspathic breccia)

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29 **History:** Found in Morocco in sandy soil, several meters from the find site
30 for [Northwest Africa 10608](#) (which was found earlier by desert truffle hunters). The
31 stone was purchased by Dr. David *Gregory* in September 2016 from a Moroccan
32 dealer at the Denver Show.

33
34 **Physical characteristics:** A single grayish stone (590 g) lacking fusion crust but
35 with a glossy external patina. The fresh interior consists of small whitish clasts in a
36 dark-gray matrix.

37
38 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular
39 mineral clasts of anorthite, olivine, orthopyroxene, pigeonite, ferropigeonite,
40 augite, silica polymorph, Ti-chromite and ilmenite (with rare inclusions of
41 baddeleyite) in a fine grained matrix of the same minerals plus minor kamacite,
42 troilite and K-bearing glass.

43
44 **Geochemistry:** Olivine ($\text{Fa}_{10.1-27.0}$, $\text{FeO/MnO} = 74-106$, N = 3), orthopyroxene
45 ($\text{Fs}_{20.9}\text{Wo}_{4.5}$, $\text{FeO/MnO} = 51$), pigeonite ($\text{Fs}_{21.7}\text{Wo}_{7.0}$, $\text{FeO/MnO} = 54$),
46 ferropigeonite ($\text{Fs}_{63.1}\text{Wo}_{18.5}$, $\text{FeO/MnO} = 72$), augite ($\text{Fs}_{17.3}\text{Wo}_{40.5}$, $\text{FeO/MnO} = 46$),
47 anorthite ($\text{An}_{95.2-95.4}\text{Or}_{0.5}$, N = 2).

48
49 **Classification:** Lunar (feldspathic regolith breccia). This stone was found at the
50 same place as Northwest Africa 10608 and probably is paired with it.

51
52 **Specimens:** 10.1 g including one polished endcut at *UWB*; 10.1 g at *ROM*; main
53 mass with *Gregory*.

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57 **Aydar** 27°49'33.10"N, 10°31'0.40"W

58 Morocco

59 Find: 2008
60

Classification: Primitive achondrite (Acapulcoite)

History: The stones were found by Mohamed Maskour. They were bought in TanTan in 2017 from Mohamed Elguirah.

Physical characteristics: Dark brown irregular stones. The largest stone weighs 267 g. Cut surface reveals a dark interior.

Petrography: Recrystallized texture with triple junctions. Typical silicate grain size 200 μm . Main minerals are olivine, orthopyroxene, Ca-pyroxene. No plagioclase was observed. FeNi metal and troilite are found as small blebs in silicates and as euhedral grains to 500 μm . Chromite to 100 μm . Abundant μm wide veins filled with opaques and associated weathering products.

Geochemistry: Olivine $\text{Fa}_{10.9\pm 0.0}$, $\text{FeO/MnO}=18.9$ (N=2). Orthopyroxene $\text{Fs}_{9.8\pm 0.0}\text{Wo}_{1.5\pm 0.3}$, $\text{FeO/MnO}=12.6$ (N=2). Ca-pyroxene $\text{Fs}_{4.2\pm 0.0}\text{Wo}_{44.0\pm 1.7}$, Cr_2O_3 1.07 wt%, $\text{FeO/MnO}=12.6$ (N=2). Kamacite Ni=5.87 wt%, Co = 0.27 wt% (N=2)

Classification: Achondrite (acapulcoite)

Specimens: 20.3 g at *CEREGE*. Main mass with Jean Redelsperger.

Bañobárez 40°51.04'N, 6°36.46'W

Salamanca, Spain

Find: 1981

Classification: Iron meteorite (IIIAB)

History: Eduardo Martín González, retired teacher and founder of the Archeological Museum of Lumbrales (Salamanca), got the sample from a farmer, who found it in 1981. He gave it to Angel Rolland (researcher at IAA-CSIC), who gave it in 2008 to Alberto Castro-Tirado (also researcher at IAA-CSIC), who in turn sent it to Jordi Llorca (*UPC*) for study.

Petrography: (J. Llorca, *UPC*) The meteorite is a medium octahedrite containing kamacite, taenite and few plessite fields. Kamacite bandwidth is 1.0 ± 0.2 mm.

Geochemistry: (J. Llorca, *UPC*) ICP-OES data: Ni=80.8, Co=5.6, P=1.4, S=0.1 (all mg/g); ICP-MS data: Cu=167, Cr=48, Ge=42, Ga=21, Pt=11, Os=5.0, Ru=9.7, Ir=3.6, Au=1.0 (all $\mu\text{g/g}$)

Beryozovka 52°39.86'N, 76°55.26'E

Pavlodar, Kazakhstan

Find: August 2013

Classification: Ordinary chondrite (H5-6)

History: A single stone was found in August 2013 by Mr. K. M. Tulendiev ~18 km north of the village Berezovka (synonym Zhambyl, Pavlodar region, Kazakhstan) on the steppe during hay making. The stone was in a pit of 2 m in diameter and ~0.7 m in depth. The sample was moved to Berezovka and remained there in a shed. In 2015, Mr. Aron Kadyrov learned about the stone's location from Mr. Tulendiev and searched for it. He find that the shed was demolished, but eventually found the stone among junk. Several pieces of ~100 g were separated from the

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3 main mass. The stone was identified as a meteorite by Dr. V. L. Levin (K. I.
4 Satpaev Institute of Geological Sciences, Almaty, Kazakhstan). In 2016 Mr.
5 Kadyrov presented the sample of the meteorite to *DMUH*.

6
7 **Physical characteristics:** The stone is a pie-shaped oriented meteorite with a flat
8 frontal surface and well-developed regmaglypts on the sides. The color is grayish-
9 brown. Rear side appears faceted. Fusion crust is mostly preserved. Total recovered
10 weight is 35.65 kg.

11
12 **Petrography:** (C. A. Lorenz, *Vernad*) The slices show a fractured and brecciated
13 interior. In section, the meteorite has a recrystallized chondritic texture
14 corresponding to type 5 and comprises mineral grains, chondrule fragments and
15 uncommon complete chondrules, cm-sized completely recrystallized fragments of
16 type 6 chondrite, and rare carbonaceous chondrite fragments up to 1.5 mm in size
17 containing fine-grained phyllosilicate matrix and different objects. The type-5
18 lithology contains shock melt pockets and veinlets. Main phases are olivine,
19 pyroxene, feldspar, Fe,Ni metal, troilite; chromite and phosphate are accessory. The
20 type-6 clasts are up to 1.5 cm in size and have sharp borders with the H5 host.
21 Carbonaceous chondrite clasts, up to 1.5 mm in size, have a fine-grained
22 phyllosilicate-rich matrix enclosing inclusions of serpentine, olivine, pyroxene,
23 sulfides, minor magnetite, and FeNi metal enclosed within the olivine grains. Two
24 olivine chondrules of 25 and 100 μm in diameter were found in the carbonaceous
25 clasts.

26
27 **Geochemistry:** Mineral compositions and geochemistry: (N. N.
28 Kononkova, *Vernad*.) Olivine $\text{Fa}_{19.1\pm 0.5}$ (N=18); Pyroxene $\text{Fs}_{16.7\pm 0.3}\text{Wo}_{1.4\pm 0.2}$ (N=16)
29 . Carbonaceous chondrite clasts matrix (defocused beam, N=17), wt%: Na_2O
30 0.18 ± 0.15 ; MgO 15.5 ± 2.6 ; Al_2O_3 2.44 ± 0.18 ; SiO_2 31.2 ± 2.2 ; K_2O 0.46 ± 0.45 ; CaO
31 0.58 ± 0.36 ; TiO_2 0.11 ± 0.3 ; Cr_2O_3 0.39 ± 0.8 ; MnO 0.18 ± 0.11 ; FeO 29.9 ± 3.2 ; NiO
32 2.02 ± 0.82 .

33
34 **Classification:** H5-6 breccia with CM-chondrite clasts. The meteorite is
35 moderately weathered (W2) and shocked (S3).

36
37 **Specimens:** A sample of 1468 g and two sections are deposited
38 in *Vernad*; *DMUH* holds a sample of 31.7 kg.

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41 **Caçapava do Sul** 30°41'34.9"S, 53°39'05.1"W

42 Rio Grande do Sul, Brazil

43 Find: about 1908

44 Classification: Iron meteorite (IID)

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46 **History:** The meteorite was found around 1908 among the remains of an
47 abandoned country seat. The stone drew attention due to its weight and the farmer
48 decided to use it to amuse visitors. Prof. Elver Ubirajara had heard about the
49 mysterious rock since he was a boy. Recently, thinking it to be a meteorite, he
50 spent many years in finding the current owner of the stone, Mr. João A. R. Lopes.
51 When the meteoritic nature was confirmed by the *MNRJ/UFRJ*, it was donated to
52 the local university (UNIPAMPA).
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Physical characteristics: A rough pear-shaped mass of 27 kg, with average dimensions of $27 \times 21 \times 12$ cm and weathered surface.

Petrography: (Zucolotto, M.E., *MNRJ, IGEO-UFRJ*) The etched sections display a medium Widmanstätten structure, consisting of kamacite lamellae bordered by taenite and plessite fields. The kamacite lamellae are straight, swollen and have an average bandwidth of 0.65 ± 0.15 mm and microhardness HV 325 ± 30 . The kamacite has an indistinct ϵ -structure. Taenite and plessite cover 30-40% per area, mainly as comb and net plessite fields and some with martensitic varieties. The broad taenite lamellae have a mean microhardness HV 500 ± 30 . Schreibersite occurs as small blocks or skeletal crystals, mainly enveloped by swathing kamacite broad lamellae. Troilite is very rare as scattered nodules.

Geochemistry: Bulk composition (INAA - J.T. Wasson, *UCLA*) in wt%: Ni = 9.43, Co = 0.66; and in ppm: Cr=90, Cu=307, Ga=70.8, As=4.3, W=2.8, Ir=21.6 and Au=0.56. Presents the highest Ir among IID irons and one of the lowest Au and As values. (EPMA - A. Tosi, *LABSONDA/IGEO-UFRJ*) kamacite 7.32 ± 0.15 wt.% Ni and 0.65 ± 0.06 % Co content and taenite lamellae 21.5 ± 0.5 wt.% Ni and 0.35 ± 0.05 wt.% Co.

Classification: (J.T. Wasson, *UCLA*) Iron (IID), medium octahedrite

Specimens: 94.8 g *MNRJ, IGEO-UFRJ*, main mass UNIPAMPA.

Calama 005 $22^{\circ}23.56'S$, $68^{\circ}38.61'W$

Antofagasta, Chile

Find: 25 March 2017

Classification: Carbonaceous chondrite (CO3)

Physical characteristics: 1 individual sample, 380 g, broken in several pieces, brown-black and covered with brown fusion crust.

Petrography (M. A. Ivanova, *Vernad*): meteorite consists of fine-grained matrix material, chondrules of Type I and II, and refractory inclusions. Average diameter of chondrules is 0.2 mm. Chondrules consist of olivine, pyroxene and plagioclase mesostasis. The minor phases are spinel, melilite, chromite, sulfides, kamacite, taenite, and tetrataenite.

Geochemistry: Mineral compositions and geochemistry (M. A. Ivanova, *Vernad*): Olivine (EMPA) is $Fa_{22.2 \pm 18.4}$ (N=98) mol%, CaO 0.24 ± 0.16 ; MnO 0.23 ± 0.13 (both wt. %), pyroxene is presented by orthopyroxene ($Fs_{11.6 \pm 10.8}Wo_{1.8 \pm 1.4}$ (N=20)), augite ($Fs_{4.5}Wo_{41.9}En_{53.5}$), diopside ($Fs_{1.4}Wo_{50.7}$), and Al-diopside ($Fs_{4.3}Wo_{51.7}$), Al_2O_3 16.3 wt%, TiO_2 2.9 wt%. Mesostasis in chondrules is (wt%): SiO_2 50.4; TiO_2 0.42; Al_2O_3 22.8; Cr_2O_3 0.19; FeO 3.6; MnO 0.14; MgO 2.80; CaO 14.6; Na_2O 2.95; K_2O 0.19.

Classification (M. A. Ivanova, *Vernad*): Based on the texture, average chondrules size, mineralogy, and mineral chemistry the meteorite is a carbonaceous chondrite of CO3 type. The meteorite shows only minor weathering features.

Specimens: 1 piece (70 g) and a thin section are deposited in *Vernad*. The main mass with Mr. Timur Kryachko and Mt. Eugeni Zakharchuk.

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5 **Calama 008** 22°27'32.7" S, 68°39'12" W

6 Antofagasta, Chile

7 Find: 2017 Oct 19

8 Classification: Ordinary chondrite (L6)

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10 **History:** Meteorite (11.23 g) was found 19 October 2017 by the *UrFU* meteorite
11 expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A.,
12 Kolunin R.N.) near Chiu-Chiu, Calama region.

13
14 **Physical characteristics:** Total mass is 11.23 g. The meteorite has roughly
15 rounded shape. Exterior of the stone is desert polished. The surface and interior of
16 the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust
17 was observed.

18
19 **Petrography:** Classification (V.V. Sharygin, *SIGM* and *UrFU*). Petrographic
20 observation of a polished thin section shows very rare chondrules in a coarse-
21 middle recrystallized matrix. Such chondrules are very poorly delineated and their
22 sizes vary from 500 μm to 3 mm. They have porphyritic texture and mainly consist
23 of olivine, low-Ca-pyroxene and plagioclase, and \pm diopside, chromite and blebs of
24 troilite and FeNi-metal. Chromite-plagioclase segregation (300 μm , chondrule ?)
25 was also observed in the matrix. Olivine, low-Ca-pyroxene and plagioclase are
26 main minerals in matrix. Plagioclase grains are larger than 50-100 μm . This
27 indicates petrologic type 6. Undulatory extinction and irregular fractures in olivine,
28 as well as the absence of opaque shock veins and melt pockets, indicate a shock
29 stage of S2. Majority of grains of FeNi metal (kamacite, taenite, rarely tetrataenite,
30 up to 500 μm) and troilite (200-500 μm) are fresh. Weathering products (goethite
31 and other Fe-Ni-hydroxides) occur as in situ partial alteration of FeNi-metals and
32 troilite and fill microfractures in minerals from matrix and chondrules (weathering
33 grade – W2). Clinopyroxene, chromite, chlorapatite and merrillite (200-400 μm)
34 occur locally in the matrix. Single inclusion (5 μm) of molybdenite was found in
35 troilite grain.

36
37 **Geochemistry:** EDS-WDS analyses (V. V. Sharygin, *SIGM* and *UrFU*). The
38 primary chondrite paragenesis includes olivine $\text{Fa}_{25.59\pm 0.50}$ (N=27), orthopyroxene
39 $\text{Fs}_{21.72\pm 0.28}\text{Wo}_{1.61\pm 0.21}$ (N=22), plagioclase $\text{Ab}_{83.5}\text{An}_{10.8}\text{Or}_{5.7}$ (N=23), Cr-bearing
40 clinopyroxene $\text{En}_{45.3}\text{Fs}_{8.6}\text{Wo}_{46.1}$ (N=6), chromite $\text{Cr}_{82.3}\text{Spl}_{12.4}$ (N=16),
41 chlorapatite, merrillite and FeNi-metals. Chlorapatite contains F (up to 0.5 wt.%);
42 Cl – 5.30 wt.% (N=3). Merrillite is poor in FeO (0.6-0.7 wt.%). Composition of
43 metals (in wt.%): kamacite (N=9) – Fe 93.71 ± 1.55 , Ni – 5.39 ± 1.01 , Co –
44 0.97 ± 0.17 ; taenite (N=17) – Fe 68.28 ± 4.53 , Ni 31.24 ± 4.67 , Co 0.50 ± 0.09 ;
45 tetrataenite (N=3) – Fe 49.22, Ni 50.29, Co 0.33. Fe-Ni-hydroxides sometimes
46 contain 22.6-38.3 wt.% NiO.

47
48 **Classification:** Ordinary chondrite. L6, S2, W2. In chemical composition of olivine
49 and low-Ca pyroxene this meteorite seems to be similar to Calama 006.

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51 **Specimens:** 8.4 g cut-off – *UrFU*; 1.25 g cut-off and thin section – *SIGM*.
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3 **Calama 009** 22°24.200' S, 68°37.632' W

4 Antofagasta, Chile

5 Find: 2017 Oct 13

6 Classification: Ordinary chondrite (L6)

7
8 **History:** The 13.5 kg meteorite was found 13 October 2017 by the *UrFU* meteorite
9 expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A.,
10 Kolunin R.N.) near Chiu-Chiu, Calama region.

11 **Physical characteristics:** The meteorite has angular shape. Exterior of the stone is
12 desert polished. The interior of the meteorite is light gray in color with red-brown
13 spots due to Fe-hydroxides around metal and troilite. Fusion crust is present.

14 **Petrography:** Classification (V. V. Sharygin, *SIGM* and *UrFU*). Petrographic
15 observation of a polished thin section shows very rare chondrules in a coarse
16 recrystallized matrix. Chondrules are very poorly delineated with apparent size to 1
17 mm. The porphyritic and olivine- or orthopyroxene-banded chondrules are common
18 and mainly consist of olivine, low-Ca-pyroxene and plagioclase, diopside, and
19 \pm chromite and blebs of troilite and FeNi-metal. Olivine, low-Ca-pyroxene and
20 plagioclase are main minerals in matrix. Plagioclase grains are larger than 50-100
21 μ m. This indicates a petrological type of 6 for the meteorite. Undulatory extinction,
22 irregular and planar fractures in olivine, as well as the presence of opaque melt
23 pockets and twinning in low-Ca-pyroxene, troilite and ilmenite, indicate a shock
24 stage of S3/4. Majority of grains of FeNi metal (kamacite, taenite, tetrataenite, up
25 to 1.5 mm) and troilite (100-500 μ m) are fresh. Weathering products (goethite and
26 other Fe-Ni-hydroxides) occur as in situ partial alteration of FeNi-metals and
27 troilite and fill microfractures in minerals from matrix and chondrules (weathering
28 grade W1/2). Grains of copper (up to 50 μ m) are occasionally found in kamacite-
29 taenite-tetrataenite aggregate. Pentlandite (\pm Ni-rich pyrrhotite, 4.4-6.1 wt.% Ni, up
30 to 10 μ m) is rarely observed in troilite. Ni-free pyrrhotite sometimes fills fissures in
31 troilite and seems to be an intermediate phase of troilite alteration to goethite and
32 other Fe-hydroxides. Clinopyroxene, chromite, ilmenite, chlorapatite and merrillite
33 (100-300 μ m) occur locally in the matrix. Opaque melt pockets (up to 100 μ m) are
34 rarely located near large FeNi-metal grains and contain abundant metal blebs in
35 fine-grained olivine-pyroxene aggregate.

36 **Geochemistry:** EDS-WDS analyses (V. V. Sharygin, *SIGM* and *UrFU*). The
37 primary chondrite paragenesis includes olivine $\text{Fa}_{25.68\pm 0.43}$ (N=40), orthopyroxene
38 $\text{Fs}_{21.46\pm 0.32}\text{Wo}_{1.43\pm 0.31}$ (N=32), plagioclase $\text{Ab}_{83.9}\text{An}_{10.5}\text{Or}_{5.6}$ (N=25), Cr-bearing
39 clinopyroxene $\text{En}_{45.8}\text{Fs}_{8.6}\text{Wo}_{45.8}$ (N=2), chromite $\text{Crt}_{81.2}\text{Spl}_{13.3}$ (N=11), ilmenite
40 $\text{Ilm}_{84.9}\text{Gkl}_{12.9}$ (N=16), chlorapatite, merrillite, FeNi-metals and copper. Chlorapatite
41 contains F (up to 0.9 wt.%); Cl – 5.33 wt.% (N=11). Merrillite is poor in FeO (0.5-
42 0.7 wt.%, N=11). Composition of metals (in wt.%): kamacite (N=22) – Fe
43 94.38 ± 1.59 , Ni – 4.77 ± 1.52 , Co – 0.84 ± 0.24 ; taenite (N=40) – Fe 66.78 ± 3.53 , Ni
44 32.75 ± 3.49 , Co 0.42 ± 0.08 ; tetrataenite (N=16) – Fe 44.65 ± 1.24 , Ni 55.07 ± 1.26 , Co
45 0.22 ± 0.05 ; copper (N=10) – Cu 93.13 ± 0.69 , Fe 4.46 ± 0.66 , Ni 2.37 ± 0.18 .

46 **Classification:** Ordinary chondrite. L6, S3/4, W1/2.

47 **Specimens:** 12.512 kg at *UrFU*; 960 g at The Catholic University of the North,
48 Antofagasta, Chile; 19 g and thin section – *SIGM*.
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5 **Calama 010** 22°24.643' S, 68°34.622' W

6 Antofagasta, Chile

7 Find: 2017 Oct 15

8 Classification: Ordinary chondrite (H6)

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10 **History:** The meteorite was found 15 October 2017 by the *UrFU* meteorite
11 expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A.,
12 Kolunin R.N.) near Chiu-Chiu, Calama region.

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14 **Physical characteristics:** The meteorite has roughly rounded shape. Exterior of the
15 stone is desert polished. The surface and interior of the meteorite is light to dark
16 brown in color due to Fe-hydroxides. No fusion crust was observed.

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18 **Petrography:** Classification (V. V. Sharygin, *SIGM* and *UrFU*). Petrographic
19 observation of a polished thin section shows very rare chondrules in a coarse
20 recrystallized matrix. Chondrules are very poorly delineated with apparent size to 2
21 mm. The POP chondrules are common and mainly consist of olivine, low-Ca-
22 pyroxene and plagioclase, diopside, and \pm chromite and blebs of troilite and FeNi-
23 metal. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix.
24 Plagioclase grains are larger than 50-100 μ m. This indicates a petrological type of 6
25 for the meteorite. Undulatory extinction and irregular fractures in olivine, as well as
26 the presence of opaque shock veins, indicate a shock stage of S3. Majority of grains
27 of FeNi-metal (100-800 μ m) are mainly represented by kamacite; taenite and
28 tetrataenite are rare. Sizes of troilite grains are 50-300 μ m. Weathering products
29 (goethite, Fe-Ni-Cl-hydroxide and other Fe-Ni-hydroxides, gypsum) occur as in
30 situ partial alteration of FeNi-metals and troilite and fill microfractures in minerals
31 from matrix and chondrules (weathering grade – W2). Nickel (1-3 μ m) was found
32 in abundant Fe-Ni-Cl-hydroxide-goethite aggregate around tetrataenite. Pentlandite
33 (up to 10 μ m) is rarely observed in troilite. Clinopyroxene, chromite, chlorapatite
34 and merrillite (50-300 μ m) occur locally in the matrix. Opaque shock veins are
35 locally abundant and contain troilite (\pm Fe-Ni-metal) blebs in fine-grained olivine-
36 orthopyroxene \pm clinopyroxene aggregate.

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38 **Geochemistry:** EDS-WDS analyses (V. V. Sharygin, *SIGM* and *UrFU*). The
39 primary chondrite paragenesis includes olivine $\text{Fa}_{19.33\pm 0.35}$ (N=29), orthopyroxene
40 $\text{Fs}_{16.96\pm 0.28}\text{Wo}_{1.46\pm 0.20}$ (N=25), plagioclase $\text{Ab}_{83.9}\text{An}_{10.5}\text{Or}_{5.6}$ (N=25), Cr-bearing
41 clinopyroxene $\text{En}_{45.9}\text{Fs}_{7.6}\text{Wo}_{46.5}$ (N=3), chromite $\text{Cr}_{80.4}\text{Spl}_{14.9}$ (N=15), chlorapatite,
42 merrillite, and FeNi-metals. Chlorapatite contains F (up to 1.1 wt.%); Cl – 4.87
43 wt.% (N=11). Merrillite is poor in FeO (0.5-0.9 wt.%, N=12). Composition of
44 metals (in wt.%): kamacite (N=23) – Fe 92.85 \pm 0.41, Ni – 6.60 \pm 0.42, Co –
45 0.84 \pm 0.09; taenite (N=43) – Fe 60.31, Ni 39.38, Co 0.28; tetrataenite (N=1) – Fe
46 50.55, Ni 49.17, Co 0.14. Fe-Ni-Cl-hydroxide (N=5, in wt.%): FeO - 59.37, NiO –
47 11.91, CoO – 0.75, Cl – 16.83.

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49 **Classification:** Ordinary chondrite. H6, S3, W2.

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51 **Specimens:** 1189.29 g (18 pieces) at *UrFU*; 53.8 g sample and thin section
52 at *SIGM*.
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Calama 014 22°26.27'S, 68°51.27'W

Antofagasta, Chile

Find: 11 Feb 2018

Classification: HED achondrite (Eucrite, monomict)

Petrography: Monomict breccia composed of mostly rounded basaltic eucrite clasts in a sparse matrix of related crystalline debris. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, chromite and troilite.

Geochemistry: Host orthopyroxene ($\text{Fs}_{58.6-60.0}\text{Wo}_{2.8-4.1}$, $\text{FeO/MnO} = 31 \pm 0.6$, $N=24$). Clinopyroxene exsolution lamellae ($\text{Fs}_{29.5-30.6}\text{Wo}_{40.1-40.4}$; $\text{FeO/MnO} = 32 \pm 0.8$, $N=16$). Plagioclase ($\text{An}_{88.2-89.0}\text{Or}_{0.9-1.0}$, $N=10$)

Calama 022 22°18.192'S, 68°33.0557'W

Antofagasta, Chile

Find: 2017 Oct 15

Classification: Ordinary chondrite (L6)

History: The meteorite (1 piece 12 kg and many smaller fragments) was found October 15, 2017 by Timur Kryachko.

Physical characteristics: Total mass is about 32 kg. Many similar meteorite fragments were collected in area about 40 square meters. Largest stone (about 12 kg) ~12% covered by fusion crust. Fragments all have different shapes plus very rare fragments of fusion crust. The interior of the meteorite is light brown, whereas the surface is dark brown. Some cracks (up to 0.3 mm in thickness) are filled by alunite.

Petrography: (Pavel Yu. Plechov, *FMMR*). The main part of the meteorite contains many chondrules without clear borders. Chondrule sizes vary from 400 to 800 μm . Some chondrules (about 5%) have clear barred olivine textures, with plagioclase between the bars. Most of the chondrules consist of Ol+Opx with Cpx+Pl interstitial. Matrix consists of olivine and low-Ca pyroxene grains (70-200 μm) with aggregates of Ca-pyroxene and plagioclase. Plagioclase grains ($\text{An}_{10.4-10.8}$) are about 40-70 μm . These features indicate a petrologic type of 6 for the meteorite. Rare Fe-Ni metal blebs (up to 300 μm) and very rare troilite (up to 30 μm) occur in matrix. Metal consists of kamacite and taenite (with 35-53 wt.% of Ni). Olivine has no undulatory extinction; this plus the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi-metals. Troilite, olivine, pyroxene, chromite, metal are fresh and not weathered (weathering grade W1).

Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $\text{Fa}_{25.35 \pm 0.56}$ ($N=25$), orthopyroxene $\text{Fs}_{20.7 \pm 0.7}\text{Wo}_{1.47 \pm 0.29}$ ($N=21$), plagioclase $\text{Ab}_{82.0}\text{An}_{10.6}\text{Or}_{6.7}$ ($N=4$), Cr-bearing clinopyroxene $\text{En}_{46.6}\text{Fs}_{9.1}\text{Wo}_{44.1}$ ($N=2$), chromite $\text{Cr}_{75.6}\text{Spl}_{9.1}$ ($N=2$) and Cl-apatite. No merrillite occurred in the meteorite.

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3 Composition of kamacite (in wt.%, N=1): Fe 93.78, Ni 5.25, Co 0.75. Taenite
4 (N=4) contains 33.85 and 0.46 wt.% of Ni and Co, respectively. Troilite is close to
5 ideal FeS.
6

7 **Classification:** (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. L6, S1, W1.

8 **Specimens:** Timur Kryachko, Ilya Kryachko, Mikhail Nepomiluev holds main
9 mass about 32 kg. 60 g (7 small fragments) and thin section, *FMMR*.
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13 **Calama 023** 22°28.050'S, 68°38.786'W

14 Antofagasta, Chile

15 Find: 19 Oct 2017

16 Classification: Ordinary chondrite (H6)

17 **History:** Meteorite (284.04 g) was found 19 October 2017 by the *UrFU* meteorite
18 expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A.,
19 Kolumin R.N.) near Chiu-Chiu, Calama region.
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21 **Physical characteristics:** Total mass is 284.04 g. The meteorite has roughly
22 rounded shape. Exterior of the stone is desert polished. The surface and interior of
23 the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust
24 was observed.
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26 **Petrography:** Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Very rare
27 chondrules in a coarse recrystallized matrix. Chondrules are poorly delineated and
28 their sizes vary from 200 μm to 2 mm. The largest chondrules (1-2 mm) are visible
29 macroscopically and represented by PO, POP and RP textural types. They mainly
30 consist of olivine, low-Ca-pyroxene and plagioclase, diopside, and \pm chromite and
31 blebs of troilite and FeNi-metal. Olivine, low-Ca-pyroxene and plagioclase are
32 main minerals in matrix. Clinopyroxene, chromite, ilmenite and merrillite (50-300
33 μm) occur locally in the matrix, chlorapatite was not observed. Large olivine grains
34 from matrix and POP chondrules may contains partially crystallized (silicate-melt?)
35 inclusions (low-Ca-pyroxene + diopside + plagioclase/glass + troilite). Plagioclase
36 grains in the matrix are larger than 50 μm , indicating a petrologic type of 6 for the
37 meteorite. The absence of opaque shock veins and weak undulatory extinction and
38 irregular fractures in olivine indicate a shock stage of S2. Majority of grains of
39 FeNi metal (kamacite, taenite, tetrataenite, up to 1.5 mm) and troilite (100-500 μm)
40 are fresh. Pentlandite (\pm Ni-rich pyrrhotite, up to 50 μm) is rare in troilite on the
41 contact with kamacite. In addition, alabandite + Ni-rich pyrrhotite (?) association
42 (3x10 μm) was found in a kamacite-hosted troilite bleb (70 μm). Grains of copper
43 (up to 5 μm) were observed in a kamacite-taenite-tetrataenite-troilite aggregate.
44 Weathering products (goethite, Fe-Ni-Cl-hydroxide and other Fe-Ni-hydroxides,
45 Fe-S-hydroxide) occur as in situ partial alteration of FeNi-metals and troilite and
46 fill microfractures in minerals from matrix and chondrules (weathering grade –
47 W2). The association of trevorite + akaganeite is common as an alteration product
48 of Ni-rich metal grains (taenite or kamacite + taenite + tetrataenite). Rare Fe-Ni-
49 hydroxides veins are crosscut the meteorite sample.
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51 **Geochemistry:** EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The
52 primary chondrite paragenesis includes olivine $\text{Fa}_{19.44\pm 0.18}$ (N=36), orthopyroxene
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3 $\text{Fs}_{17.28 \pm 0.35} \text{Wo}_{1.45 \pm 0.14}$ (N=36), plagioclase $\text{Ab}_{82.5} \text{An}_{11.8} \text{Or}_{5.7}$ (n=10), Cr-bearing
4 clinopyroxene $\text{En}_{47.4} \text{Fs}_{7.0} \text{Wo}_{45.6}$ (N=8, Cr_2O_3 – 0.83 wt.%), chromite
5 $\text{Cr}_{81.5} \text{Spl}_{13.9}$ (N=16), ilmenite $\text{Ilm}_{79.4} \text{Gk}_{10.9}$ (N=10), merrillite, and FeNi-metals.
6 Merrillite is poor in FeO (0.4-0.8 wt.%, N=14). Composition of metals and sulfides
7 (in wt.%): kamacite (N=27) – Fe 92.83 ± 0.31 , Ni – 6.73 ± 0.13 , Co – 0.44 ± 0.05 ;
8 taenite (N=12) – Fe 75.44, Ni 24.26, Co 0.28; tetrataenite (N=14) – Fe 47.24, Ni
9 52.59, Co 0.14; pentlandite (N=5) – Fe 45.99, Ni 20.67, Co 0.27, S 33.05;
10 alabandite (N=2) – Mn 53.45; Fe 9.12, Ni 1.09, Co 0.14, S – 36.28.

11 **Classification:** Ordinary chondrite. H6, S2, W2.

12 **Specimens:** 249.36 g sample – *UrFU*; 27.25 g sample and thin section – *SIGM*.

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18 **Calama 024** 22°27.549'S, 68°39.227'W

19 Antofagasta, Chile

20 Find: 19 Oct 2017

21 Classification: Ordinary chondrite (H6)

22 **History:** Meteorite (252.95 g) was found 19 October 2017 by the *UrFU* meteorite
23 expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A.,
24 Kolumin R.N.) near Chiu-Chiu, Calama region.

25 **Physical characteristics:** Total mass is 252.95 g. The meteorite has roughly
26 rounded shape. Exterior of the stone is desert polished. The surface and interior of
27 the meteorite is light to dark brown in color due to Fe-hydroxides. Fusion crust is
28 locally preserved (up to 1 mm).

29 **Petrography:** Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Petrographic
30 observation of a polished thin section shows chondrules in a coarse recrystallized
31 matrix. Chondrules are poorly delineated and their sizes vary from 200 μm to 2
32 mm. The largest chondrules (1-2 mm) are visible macroscopically and represented
33 by PO, POP and RP textural types. The PO and POP chondrules mainly consist of
34 olivine, low-Ca-pyroxene and plagioclase, diopside, and \pm chromite and metal-
35 sulfide blebs. Some RP chondrules may contains SiO_2 polymorph (10x100 μm) In
36 addition to chondrules, a "refractory forsterite-rich object" (size - 300 μm , RFR0)
37 was found. It consists of high-Mg forsterite and low-Ca pyroxene phenocrysts, and
38 interstitial augitic clinopyroxene and An-rich plagioclase. Olivine, low-Ca-
39 pyroxene and plagioclase are main minerals in the chondrite matrix.

40 Clinopyroxene, chromite, chlorapatite and merrillite (50-300 μm) occur locally in
41 the matrix. Plagioclase grains in the matrix are larger than 50 μm , indicating a
42 petrologic type of 6 for the meteorite. The absence of opaque shock veins and weak
43 undulatory extinction and irregular fractures in olivine indicate a shock stage of S2.
44 Majority of grains of FeNi metal (kamacite, taenite, tetrataenite, up to 1 mm) and
45 troilite (100-500 μm) are fresh. Pyrrhotite (Ni – 0.4 wt.%, up to 10 μm) occurs in
46 outer parts of troilite. Grains of copper (up to 10 μm) were observed in kamacite-
47 taenite-tetrataenite-troilite aggregates. Weathering products (goethite, Fe-Ni-Cl-
48 hydroxides, Fe-chloride-hydrate and gypsum) occur as in situ partial alteration of
49 FeNi-metals and troilite and fill microfractures in minerals from matrix and
50 chondrules (weathering grade – W2). Rare Fe-Ni-hydroxides veins are crosscut the
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meteorite sample. Fusion crust consists of dendritic/skeletal magnetite and olivine and Fe-rich glass. Plagioclase near fusion crust is transformed into maskelynite. Fe-rich glass contains rare metal-sulfide blebs (5-10 μm).

Geochemistry: EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine $\text{Fa}_{19.73\pm 0.36}$ (N=48), low-Ca pyroxene $\text{Fs}_{17.24\pm 0.26}\text{Wo}_{1.22\pm 0.25}$ (N=26), plagioclase $\text{Ab}_{82.8}\text{An}_{11.7}\text{Or}_{5.5}$ (n=17), Cr-bearing clinopyroxene $\text{En}_{47.3}\text{Fs}_{7.2}\text{Wo}_{45.5}$ (N=8, $\text{Cr}_2\text{O}_3 - 0.87$ wt.%), chromite $\text{Crt}_{81.7}\text{Spl}_{13.6}$ (N=12), merrillite, chlorapatite and FeNi-metals. Chemical variations in RFRO: olivine $\text{Fa}_{4.9-20.3}$ (N=10), low-Ca pyroxene $\text{Fs}_{3.1-3.6}\text{Wo}_{0.3-0.4}$ (N=5), clinopyroxene $\text{En}_{59.6-62.5}\text{Fs}_{3.2-5.9}\text{Wo}_{30.9-35.1}$ ($\text{Cr}_2\text{O}_3 - 1.8-2.5$ wt.%, $\text{Al}_2\text{O}_3 - 3.3-5.0$ wt.%, N=8), plagioclase $\text{An}_{47.3}\text{Ab}_{51.9}\text{Or}_{0.8}$ (N=1). Merrillite in matrix is poor in FeO (0.6-0.9 wt.%, N=11). Chlorapatite contains F (up to 0.5 wt.%); Cl – 5.32 wt.%, $\text{Na}_2\text{O} - 0.5$ wt.% (N=8). Composition of metals (in wt.%): kamacite (N=30) - Fe 93.46 ± 1.78 , Ni 6.10 ± 1.78 , Co 0.46 ± 0.06 ; taenite (N=9) – Fe 67.25, Ni 32.55, Co 0.26; tetrataenite (N=6) – Fe 49.21, Ni 51.60, Co 0.15; copper (N=4) – Cu 92.66, Fe 5.05, Ni 2.33. Fe-chloride-hydrate (in wt.%): FeO 62.6, NiO 2.8, CoO 0.5, SO_3 0.5, Cl 30.1.

Classification: Ordinary chondrite. H6, S2, W2.

Specimens: 213.8 g sample – *UrFU*; 32.51 g sample and thin section – *SIGM*

Caleta el Cobre 022 $\sim 24^\circ 20' \text{S}$, $\sim 70^\circ 15' \text{W}$

Antofagasta, Chile

Find: 2016 Nov

Classification: Martian meteorite (Nakhlite)

History: A single stone was found casually by a tourist family next to their night camp in the Atacama desert. The stone was presented to Rodrigo Martinez from *MMC*, and identified as a meteorite. A sample was then sent by the finder to *CEREGE* for classification.

Physical characteristics: A single stone entirely covered by shiny fusion crust. Cut surface reveals a dark greenish coarse-grained interior with a few mm-sized orangish crystals. Magnetic susceptibility measured on several pieces is very homogeneous with $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.93\pm 0.01$ (N=5, including measurement of the main mass remaining after cutting)

Petrography: Cumulate texture with euhedral elongated augite crystals (typical size 1 mm by 300 μm) with interstitial plagioclase (typical size 250 μm , birefringent) and rare fine grained mesostasis. Olivine crystals (up to 2.5 mm) are crosscut and surrounded by aqueous alteration products ("iddingsite") and contain melt inclusions (to 100 μm). Thin sulfide veins (pyrrhotite) penetrate the olivine crystals. Other notable minerals: finely exsolved Fe-Ti oxides to 1 mm in size, with TiO_2 16.8 wt% , Cr_2O_3 2.23 wt%, Al_2O_3 1.56 wt%, MgO 0.50 wt%, MnO 0.42 wt% (mean of 4 analyses with electron beam defocused to 10 μm). Modal abundances (from image analyses of a 2 cm^2 polished section): pyroxene 69.0 vol%, plagioclase and mesostasis 27.1 vol%, olivine 2.2 vol%, opaque minerals 1.8 vol%. Magnetic measurements (hysteresis properties of a 360 mg piece) indicate a

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3 titanomagnetite content of at least 4.3 wt%. None of the silicates show petrological
4 sign of shock.

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6 **Geochemistry:** Augite $\text{Fs}_{28.4\pm 2.9}\text{Wo}_{40.0\pm 0.6}$ (N=20), with Fe-rich ~10 μm thick rims
7 (cores down to $\text{Fs}_{24.5}$, rims up to $\text{Fs}_{33.3}$), $\text{FeO/MnO}=37.4\pm 3.6$. Plagioclase
8 $\text{An}_{30.4\pm 1.0}\text{Ab}_{66.9\pm 0.8}\text{Or}_{2.8\pm 0.4}$ (N=7). Olivine $\text{Fa}_{70.2\pm 3.4}$ (range $\text{Fa}_{67.2-76.4}$),
9 $\text{FeO/MnO}=47.6\pm 1.6$ (N=7). Olivine alteration products (iddingsite) SiO_2 53.2 wt%,
10 FeO 26.1 wt%, MgO 2.5 wt%, Al_2O_3 0.56 wt%, MnO 0.32 wt%, CaO 0.21 wt%,
11 K_2O 0.18 wt%, Na_2O 0.16 wt%, total 83.3 wt% (average of 5 analyses with
12 electron beam defocused at 10 μm). The bulk chondrite-normalized REE pattern
13 (V. Debaille, ULB) is similar to that of nakhlites.

14
15 **Classification:** Martian (nakhlite). Minimal weathering. This nakhlite is unusually
16 rich in plagioclase and in titanomagnetite.

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18 **Specimens:** 21 g, 3 polished sections, 1 thin polished section at *CEREGE*. Main
19 mass with anonymous finder
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24 **Caleta el Cobre 024** ~24°20'S, ~70°15'W

25 Antofagasta, Chile

26 Find: 2018 Apr

27 Classification: Enstatite chondrite (EL6)

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29 **History:** The stone was found lying at the surface in the Atacama desert in April
30 2018.

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32 **Physical characteristics:** A single dark brown stone. Cut face reveals a dark
33 interior with abundant metal.

34
35 **Petrography:** (J. Gattacceca, Bertrand Devouard, *CEREGE*) Highly recrystallized
36 chondritic texture. One relict chondrule observed in the 2 cm^2 studied section. Main
37 minerals are enstatite, plagioclase (typical size 100 μm , to 200 μm), kamacite
38 (typical size 100 μm), sulfides (typical size 100 μm , also present as abundant 5-10
39 μm mixed sulfides/kamacite grains in the silicates). No olivine. Sulfides include
40 alabandite and troilite.

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42 **Geochemistry:** Enstatite $\text{Fs}_{0.4\pm 0.1}\text{Wo}_{1.4\pm 0.0}$ (N=3). Plagioclase
43 $\text{An}_{14.4\pm 0.5}\text{Ab}_{81.2\pm 0.5}\text{Or}_{3.8\pm 0.0}$ (N=2). Si in kamacite 1.5 ± 0.1 wt% (N=5). Magnetic
44 susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.36$.

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46 **Classification:** Enstatite chondrite (EL6). EL classification from the Si content of
47 kamacite and the presence of alabandite. Minimal weathering. This meteorite was
48 found 2 km away from the [Caleta el Cobre 025](#) EH3 meteorite.

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50 **Specimens:** Type specimen 32 g at *CEREGE*. Main mass with *ARTMET*.
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54 **Caleta el Cobre 025** ~24°20'S, ~70°15'W

55 Antofagasta, Chile

56 Find: 2018 Apr

57 Classification: Enstatite chondrite (EH3)

58
59 **History:** The stone was found lying at the surface in the Atacama desert in April
60 2018.

Physical characteristics: A single dark-brown stone. Cut face reveals a dark interior with abundant metal and small chondrules.

Petrography: (J. Gattacceca, Bertrand Devouard, *CEREGE*) Chondrite with well-defined chondrule (average apparent diameter $270 \pm 150 \mu\text{m}$, $N=33$) with clear mesostasis. Main mineral is enstatite. Abundant kamacite and sulfide in the form of rounded composite grains with typical size $100 \mu\text{m}$. Sulfides display a wide compositional range and include troilite, alabandite, and niningerite.

Geochemistry: Enstatite $\text{Fs}_{2.7 \pm 2.1} \text{Wo}_{0.8 \pm 0.9}$, $\text{Fs PMD}=58\%$ ($N=7$). Si in kamacite $2.8 \pm 0.2 \text{ wt}\%$ ($N=5$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.24$.

Classification: Enstatite chondrite (EH3). EH classification from the Si content of kamacite. Minimal weathering. This meteorite was found 2 km away from the [Caleta el Cobre 024](#) EL6 meteorite.

Specimens: Type specimen 67 g at *CEREGE*. Main mass with *ARTMET*.

Catalina 257 $\sim 25^{\circ}14'S, \sim 69^{\circ}43'W$

Antofagasta, Chile

Find: 2010 Apr 14

Classification: Ordinary chondrite (H3-6)

Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-defined, packed chondrules. One 3 mm type 6 clast.

Geochemistry: Type 3 host lithology: olivine $\text{Fa}_{18.2 \pm 1.9}$, $\text{PMD} = 9\%$, ($N=6$), low-Ca pyroxene $\text{Fs}_{16.9 \pm 0.5}$ ($N=3$). Type 6 clast: olivine $\text{Fa}_{19.7}$ ($N=1$), orthopyroxene $\text{Fs}_{17.7} \text{Wo}_{1.4}$.

Catalina 278 $24^{\circ}55'54.2''S, 69^{\circ}44'15.9''W$

Antofagasta, Chile

Find: 2017 Nov 08

Classification: Ordinary chondrite (LL3.4)

Petrography: (J. Gattacceca, *CEREGE*) Tightly packed chondrules. Clasts with cluster chondrite texture as defined by [Metzler \(2012\)](#). Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite appears to be as metamorphosed as Chainpur (LL3.4). The Raman spectroscopy parameters of interest are $\text{FWHM-D (cm}^{-1}\text{)}=155.8 \pm 7.6$, $\text{ID/IG}=1.02 \pm 0.04$ (see [Bonal et al., 2016](#), figure 7).

Geochemistry: Olivine $\text{Fa}_{13.9 \pm 9.6}$, $\text{Fa PMD}=65\%$, range $\text{Fa}_{1.1-29.7}$ ($N=16$), Cr_2O_3 in ferroan olivine $0.14 \pm 0.11 \text{ wt}\%$ ($N=15$). Low-Ca pyroxene $\text{Fs}_{15.1 \pm 6.9} \text{Wo}_{2.1 \pm 1.9}$, range $\text{Fs}_{1.1-22.2}$ ($N=10$).

Classification: LL3.4. Subtype from Raman spectroscopy.

Specimens: 182 g and a polished section at *CEREGE*. Main mass at MMC.

Catalina 300 $25^{\circ}14'S, 69^{\circ}43'W$

Antofagasta, Chile

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2
3 Find: 2018 March

4 Classification: Carbonaceous chondrite (CV3)

5 **Physical characteristics:** Dark stone. Cut surface reveals chondrules and CAIs set
6 in a dark matrix.

7 **Petrography:** Chondrules with average size 1350 μm (n=10) and CAIs set in fine
8 grained matrix (45vol%, from point counting n=207). Abundant sulfides and
9 magnetite, rare metal.

10 **Geochemistry:** Olivine $\text{Fa}_{4.7\pm 6.1}$, PMD=11%, range $\text{Fa}_{0.2-14.9}$ (n=7), Cr_2O_3 in ferroan
11 olivine is $0.58\pm 0.78\text{wt}\%$ (n=5). Low-ca pyroxene $\text{Fs}_{1.0}\text{Wo}_{0.6}$ (n=1)

12 **Classification:** Carbonaceous chondrite (CV3, oxidized subgroup)

13 **Specimens:** 23 g and a polished section at *CEREGE*. Main mass with Luc Labenne

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20 **Chasseron** 46°51.07'N, 6°32.32E

21 Vaud, Switzerland

22 Find: 1959

23 Classification: Pallasite (Main group)

24 **History:** Found by Mr. Reto Merlo, Grüningen, Switzerland, during a school
25 excursion in summer 1959 while he was searching for firewood. The finder
26 remembers having found the sample between the hotel and the summit of
27 Chasseron (distance ~160 m). The finder glued the sample on a piece of wood and
28 kept it until 2017. After reading about meteorites, he sent the sample to
29 the *NMBE* (received May 9, 2017) from where it was transferred to *UNIL*.

30 **Physical characteristics:** Metallic sponge shape, only slightly rusted, fragment
31 with embedded yellow-green forsterite (olivine) grains. Locally fresh-looking,
32 shiny fusion crust on metal and olivine. $23.5 \times 13 \times 11$ mm.

33 **Petrography:** Typical pallasitic texture. Forsterite (olivine) grains size is 8-2 mm.
34 Droplet-like troilite grains up to 0.6 mm embedded in forsterite (olivine).
35 Schreibersite rounded inclusions in Ni-rich iron up to 1.8 mm. Ni-rich iron
36 weathering is relatively low in an outermost zone just 0.1 mm thick, consistent with
37 weathering grade W1. Bulk density by immersion in isopropanol is 6.17 g/cm³.
38 From density calculation, volume fraction of forsterite is 57% and volume fraction
39 of Ni-rich iron is 43%.

40 **Geochemistry:** Forsterite (olivine): microprobed $\text{Fa}_{14.9\pm 1.1}$ (range $\text{Fa}_{13.6-15.9}$), Fe/Mn
41 (at.) $34\pm n=5$. Two analyses of Ni-rich iron (variety kamacite) yielded: Ni
42 7.15 ± 0.21 wt. % and Co 1.20 ± 0.20 wt. %. One analysis of schreibersite (XRD
43 checked) yielded the following formula (based on 4 apfu):

44 $(\text{Fe}_{1.92}\text{Ni}_{0.97}\text{Co}_{0.03})_{2.92}\text{P}_{1.08}$. Stoichiometric troilite crystals checked by XRD. One
45 analysis of chromite (XRD checked) yielded the following formula (based on 4
46 oxygen atoms): $(\text{Fe}_{0.62}\text{Mg}_{0.35}\text{Mn}_{0.03})_{1.00}(\text{Cr}_{1.65}\text{Al}_{0.31}\text{Fe}_{0.02}\text{V}_{0.02})_{2.00}\text{O}_4$. Forsterite
47 (olivine) oxygen isotopes (R. Greenwood, *OU*): $\delta^{17}\text{O}$ 1.514 ± 0.051 , $\delta^{18}\text{O}$

48 3.239 ± 0.094 , $\Delta^{17}\text{O}$ -0.170 (n=2). Cosmogenic radionuclides: (Å. Rosén, *GeMSE*):
49 Gamma-spectrometry performed in May 2017 showed significant activities of ²⁶Al
50 ($10.8\pm 2.5/-1.7$ dpm/kg) and ⁴⁰K ($17.6\pm 9.3/-4.9$ dpm/kg, probably a contamination).
51 No short-lived cosmogenic isotopes were detected. A significant activity

(17.0±2.1/-1.2 dpm/kg) of ^{137}Cs is present as terrestrial contamination, consistent with a first peak of nuclear bomb-produced ^{137}Cs in the years 1957-1959.

Classification: This is a main-group pallasite based on texture, mineralogy and mineral composition including oxygen isotopes. Low degree of weathering.

Specimens: 4.8446 g and one epoxy resin polished section with isolated olivine grains at *UNIL*; sample number 093320.

Chug Chug 003 22°29.931'S, 69°8.683'W

Antofagasta, Chile

Find: 2018 Apr 5

Classification: Ordinary chondrite (H4)

History: Meteorite (1 piece 8700 g and 5 small fragments) was found April 5, 2018, by Mikhail Nepomiluev during a meteorite search organized by Timur Kryachko.

Physical characteristics: Total mass is 8918 g. Meteorite has roughly rounded and slightly elongated shape. The surface and interior of the meteorite is light, with dark brown fusion crust up to 2 mm. No fresh glass in fusion crust was observed. Outermost slightly fractured zone is up to 5 mm width. Cracks (up to 0.1 mm in thickness) form a network in this zone.

Petrography: (Pavel Yu. Plechov, *FMMR*). Petrographic observation of a polished section shows that main part of the meteorite contains well-formed chondrules in the matrix. Chondrules sizes vary from 200 to 600 μm . They have quenched or porphyritic texture, rarely cryptocrystalline, and consist of Ol, Ol+Opx, Ol+Opx+Cpx+Pl. Matrix consists of olivine grains (50-150 μm) and less low-Ca-pyroxene, which is surrounded by cryptocrystalline matrix with a significant amount of tiny (about 1 μm) round drops of metal (kamacite and taenite), chromite and plagioclase. Plagioclase grains ($\text{An}_{18.5-41}$) are less than 5 μm . These features indicate a petrological type of 4. Fresh Fe-Ni metal blebs (up to 300 μm) and troilite (up to 20 μm) occurs in matrix. Metal consists of kamacite surrounded by relatively small grains of taenite and troilite on the boundary with matrix. One elongated area (4 × 7 mm) in the thin section have sharp boundaries with main part of the meteorite. It also consists of chondrules (about 500 μm) and coarse-grained (200-400 μm) Ol-Px matrix. Less metal is in the matrix of the area of a large (2 × 2 mm) metal blob. Olivine has no undulatory extinction, and opaque shock veins and melt pockets are absent, indicating a shock stage of S1. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi-metals and troilite near meteorite surface. Olivine, pyroxene, chromite, metal and troilite are fresh and not weathered (weathering grade W1). Clinopyroxene, chromite and merrillite (up to 200 μm) occur locally in the matrix.

Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $\text{Fa}_{19.9\pm 1.6}$ (N=34), orthopyroxene $\text{Fs}_{14.1\pm 3.5}\text{Wo}_{1.42\pm 1.26}$ (N=34), plagioclase $\text{Ab}_{62.6}\text{An}_{28.8}\text{Or}_{6.7}$ (N=3), Cr-bearing clinopyroxene $\text{En}_{48.1}\text{Fs}_{6.4}\text{Wo}_{45.4}$ (N=1), chromite $\text{Crt}_{77.8\pm 5.93}\text{Spl}_{13.2\pm 0.78}$ (N=3) and merrillite. No Cl-apatite occurred in the

1
2
3 meteorite. Merrillite contain (in wt.%, N=6) FeO - 0.28-1.71 wt.%, MgO - 3.52-
4 3.83 and Cl - 0.01-0.02. Composition of kamacite (in wt.%, N=2): Fe 93.3-94.0, Ni
5 6.2-6.7, Co 0.88. Taenite contain 39.8 wt.% of Ni. Troilite is close to ideal FeS.
6 Rare goethite contains 1.9 wt.% NiO and 0.4 wt.% CoO.

7
8 **Classification:** (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. H4, S1, W1.

9
10 **Specimens:** 8700 g, Mikhail Nepomiluev; 198 g (4 pieces), Timur Kryachko, type
11 specimen at *FMMR*.

12
13
14 **Coya Sur 004** (CS 004) 22°26.07'S, 69°39.16'W

15 Antofagasta, Chile

16 Find: 13 Oct 2017

17 Classification: Ordinary chondrite (LL3)

18
19 **Petrography:** Average chondrule diameter 870 μm

20
21
22
23 **Coyote Dry Lake 349** (CyDL 349) 35°3.396'N, 116°46.096'W

24 California, USA

25 Find: 2015 Dec 12

26 Classification: Ordinary chondrite (H6)

27
28 **History:** While hunting for meteorites on a dry-lake, Mark Bittmann, spotted a
29 rusty rock protruding out of the corner of a hummock that was just beginning to be
30 eroded by a small gully. Glancing at the gully he noticed many more fragments
31 protruding out of the surface. Digging deeper into both the small dune and gully, he
32 recovered 20 more equally weathered chondritic fragments. Later, returning with a
33 recovery crew and a metal-detector, another 130 g, sand-encrusted fragment was
34 unearthed.

35
36 **Physical characteristics:** All 22 fragments are very weathered, but have a range of
37 grades and color from yellowish-brown to brownish-black. Some fragments are
38 coated in silt and sand-grains cemented with orange rust. Cut surfaces show fine-
39 grained metal/sulfide set in a uniformly brown matrix, faint chondrules barely
40 detectable.

41
42 **Petrography:** (D. Sheikh, *FSU*) Chondrule boundaries blurred (250-600 μm , N=6).
43 Recrystallized coarse-grained matrix with plagioclase (>60 μm). Numerous
44 interconnected iron-oxide veins.

45
46 **Geochemistry:** Olivine, $\text{Fa}_{20.1\pm 0.1}$ (N=26); orthopyroxene, $\text{Fs}_{19.3\pm 0.2}\text{Wo}_{2.3\pm 0.1}$ (N=25).
47 It is noted that the measured Fs and Wo values are slightly higher than the main
48 amounts present in most H chondrites.

49
50 **Classification:** Ordinary Chondrite (H6)

51
52 **Specimens:** 36 grams at *UCLA*; main mass with *Verish*.

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54
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56 **Da Qaidam 001** 37°49'2.34"N, 95°23'25.53"E

57 Qinghai, China

58 Find: 13 July 2015

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) Ma Yonglu (Lenghu/Qinghai) discovered two stones of about 17.5 kg while they were doing road maintenance work 4 km SE of Chaidan Town, Qinghai province, on July 13, 2015. Both stones were purchased by Wang Ziyao.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Two black-brown stones, one of 16.5 kg and a second one of about 1 kg, both without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) internally brown-stained (in some rim areas, less oxidized) recrystallized matrix with poorly developed chondrules and irregular metal specks up to 1 mm and much smaller irregular sulfide specks.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.55$

Classification: Ordinary chondrite (L~6, W3)

Specimens: 22.7 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 168.4 g with *Bart*.

Dahongliuxia 44°10'20", 91°42'30"

Xinjiang, China

Find: 1999

Classification: Iron meteorite (IIIAB)

History: The meteorite was found in 1999 by a local herder in Balikun County, Xinjiang Province.

Physical characteristics: The total mass of the meteorite is 15.6 kg. It is an ovoid shaped iron meteorite covered with a brown to black layer. One side is smooth and the other side shows regmaglypts.

Petrography: Polished section of the sample observed under the SEM reveals bands of kamacite and taenite interleaved with bandwidth of 1.2 mm (medium Widmanstätten pattern). No silicate inclusions and other minerals can be found in the section.

Geochemistry: (ELAN DRC-e Q-ICP-MS) Ni=9.4, Co=0.65 (in wt%). Ga=18.15, Ge=34.53, Ir=9.35, W=1.71, Au=0.53 (in ppm).

Classification: Iron Meteorite (Om), IIIAB

Specimens: Main mass with Peng Wang. One polished section and a 300 g slice was deposited in *IGCAS*

This meteorite was mistakenly released on 24 Feb 2018 as NWA 11650. That name will henceforth be a synonym for **Dar al Gani 1069**.

Dhofar 1762 (Dho 1762) 18.888°N, 54.467°E

Zufar, Oman

Purchased: 2018 Feb

Classification: Carbonaceous chondrite (CO3)

History: Found in Oman in 2010 by an anonymous prospector and subsequently purchased by Martin Goff in February 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely packed, well-formed, small chondrules (apparent diameter $220 \pm 130 \mu\text{m}$, $N = 20$), mineral grains and very fine grained CAI are set in a finer grained matrix (orange-brown in thin section).

Geochemistry: Olivine ($\text{Fa}_{1.7-60.7}$, Cr_2O_3 in ferroan examples 0.10-0.45 wt.%, mean 0.19 ± 0.13 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{0.6-36.6}\text{Wo}_{0.9-2.8}$, $N = 3$), clinopyroxene ($\text{Fs}_{1.3-1.5}\text{Wo}_{38.3-46.0}$, $N = 2$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 16.3 g including one polished thin section at *UWB*; remainder with Mr. M. Goff.

Dhofar 2092 (Dho 2092) $18^\circ 45.30' \text{N}$, $54^\circ 31.15' \text{E}$

Zufar, Oman

Find: 15 Feb 2015

Classification: HED achondrite (Eucrite)

Physical characteristics: A 440 g sample supplied by the Sultan Qaboos University, which has a millimeter thick, dark brown fusion crust present on all faces except one cut face. This fusion crust lacks remaglypts instead has a mainly rough surface and angular. There are no contraction cracks present on this sample. This rock has already been cut and there is a clean face already present. Beige colour clasts can be identified on cut face and they are surrounded by a light grey ground mass. The sample is not magnetic.

Petrography (P. Hill, *UWO*) The sample is breccia containing numerous clasts of coarse-grained plagioclase and pyroxene. The clasts are poorly sorted and are sub-rounded with one clast reaching up to 2 cm on the cut face. Pyroxene (low and high Ca) and plagioclase make up most of the clasts and the groundmass; however, and free silica was observed in significant quantities. The free silica mainly located at grain boundaries within the fine-grained groundmass. Distinct exsolution lamellae are present within the grains of pyroxene. Troilite and oxides are present within the sample and through EDS analysis the oxides were determined to be ilmenite. No weathering products were observed within the samples suggest a low degree of terrestrial weathering. The sample does show undulose extinction in some of the grains of plagioclase and irregular fractures were observed, but not in high abundance suggesting that the sample is very weakly shocked.

Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Plagioclase ($\text{An}_{88.4 \pm 0.9}$), Low-Ca Pyroxene ($\text{Fs}_{59.8 \pm 2.5}\text{Wo}_{3.0 \pm 2.4}$), High-Ca Pyroxene ($\text{Fs}_{27.36 \pm 2.1}\text{Wo}_{42.5 \pm 2.3}$) and Free Silica (SiO_2 99.3 ± 1.3 wt%)

Classification: Classification: Eucrite S2, W1.

Specimens: 440 g type specimen, including polished thin section, are on deposit at *SQU*.

Dhofar 2093 (Dho 2093) 18°34.398'N, 54°8.889'E

Zufar, Oman

Find: 2014

Classification: HED achondrite (Eucrite)

History: Discovered by an anonymous finder on a desert trip 12 km SE of Dauka in 2014.

Physical characteristics: Four gray fragments, partly covered by black-brownish crust ranging from 301.3 to 30.5 g. Cut face shows light-gray matrix with white, black, and light-brown inclusions.

Petrography: (R. Bartoschewitz, *Bart*) Microscopic examination of a thin section shows holocrystalline hypidiomorphic texture and weak shock effect: undulatory extinction in plagioclase. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 2.88$.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene (pigeonite) $\text{Fs}_{56.8\pm 3.3}\text{Wo}_{7.2\pm 4.4}$, Fe/Mn 29.5 (n=13); Plagioclase $\text{An}_{89.4\pm 4.9}\text{Ab}_{10.2\pm 4.5}$ (n=20); SiO_2 ; chromite CRAL 80, FFM 98 (n=1); ilmenite; kamacite Ni <0.1, Co 0.5 wt.% (n=2).

Classification: Achondrite (basaltic eucrite, monomict breccia)

Specimens: 20.0 g on deposit at *Kiel*, main mass anonymous

Dueodde 54°59'24''N, 15°04'12"E

Denmark

Find: 2017 July 17

Classification: Ordinary chondrite (H5)

History: While cleaning the roof of the annex of their summerhouse in the area of Dueodde, in the southern part of the island of Bornholm, Denmark, the finder noticed a circular hole of approximately 5 cm in diameter in the roof. Further inspection of the area under the roof revealed the presence of single dark stone with apparent fusion crust. The finder estimates that the meteorite fall must have occurred within the last 2-3 years. Following recovery of the specimen, staff at the *NHMD* were contacted and the stone delivered.

Physical characteristics: Single 75 g spherical stone covered by irregular black fusion crust.

Petrography: The petrography was investigated from a polished thick section using backscattered electron imaging and X-ray scans. The meteorite displays an unbrecciated and recrystallized chondritic texture. Plagioclase grains are present and are typically less than 50 μm in size. The chondrules typically display obscured outlines. Porphyritic olivine and radial pyroxene chondrules are observed, ranging in sizes from 0.2 to 1 mm in diameter.

Geochemistry: The mean composition of olivine is $\text{Fa}_{19.4\pm 0.4}$ with a compositional range of $\text{Fa}_{19.1-19.8}$ (n=14). The low-Ca pyroxenes have a mean composition of $\text{Fs}_{17.2\pm 0.5}$ (n=15), defining a compositional range of $\text{Fs}_{16.4-17.2}$. The mean plagioclase composition is $\text{An}_{12.0\pm 0.3}\text{Or}_{5.4\pm 2.0}$ (n= 15; range $\text{An}_{11.6-12.2}$).

Classification: H5

Specimens: Main mass and one thick polished section at *NHMD*.

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6 **Dunhuang 001** 40°13'12.56"N, 94°23'55.97"E

7 Gansu, China

8 Find: 16 Sept 2018

9 Classification: Ordinary chondrite (L~6)

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11 **History:** (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) in the desert,
12 25 km WNW of Dunhuang City, Gansu Province, on 16 Sept 2018

13 **Physical characteristics:** (Wang Ziyao) Nine dark brown flat eroded stones of
14 totally 1427 g (main mass 1283 g).

15
16 **Petrography:** (R. Bartoschewitz, *Bart*) Brown stained recrystallized matrix with
17 well recognizable chondrules (0.6-1.6 mm, av. 0.7 mm) and few metal specks.

18 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.84$

19
20
21 **Classification:** Ordinary chondrite (L~6, W3)

22 **Specimens:** 22.3 g on deposit at *Kiel*, Wang Ziyao and Liu Binghan holds the main
23 mass, and 109 g with *Bart*.
24
25

26
27 **El Médano 381** (EM 381) 24°41'34.9"S, 70°07'18.9"W

28 Antofagasta, Chile

29 Find: 2017 Nov

30
31 Classification: Ordinary chondrite (L5)

32 **Physical characteristics:** Dark stone. Cut surface reveals a dark interior with
33 chondrules and abundant and fresh FeNi metal.

34
35 **Petrography:** (J. Gattacceca, *CEREGE*) Recrystallized chondrite with packed
36 chondrules. The meteorite displays pervasive shock darkening, with abundant
37 troilite and metal veinlets and droplets. Metal and sulfides are often associated and
38 form grains to several mm. Plagioclase-chromite assemblages to several hundreds
39 μm are found. Plagioclase average size is $<50 \mu\text{m}$.

40
41 **Classification:** Ordinary chondrite (L5). Shock darkened.

42 **Specimens:** Type specimen at *CEREGE*. Main mass with *ARTMET*.
43
44
45

46 **El Médano 389** (EM 389) ~24°51'S, ~70°32'W

47 Antofagasta, Chile

48 Find: 2016 Nov 04

49
50 Classification: Carbonaceous chondrite (CO3)

51 **History:** The meteorite was found in January 2016 in the Atacama desert by
52 Rodrigo Martinez while he was looking for meteorites

53
54 **Petrography:** (J. Gattacceca, *CEREGE*) Chondrules (predominantly of type I) and
55 small CAIs set in a fine-grained Fe-rich matrix. Average chondrule apparent size
56 300 μm (N=26). Opaques are metal and troilite.
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Geochemistry: Olivine in the range $Fa_{0.5-69.1}$ (mean $Fa_{16.8\pm 18.2}$, $PMD=89\%$, $N=25$). Cr_2O_3 in ferroan olivine 0.11 ± 0.09 wt.% ($N=22$). Low-Ca pyroxene $Fs_{5.5}Wo_{1.0}$ and $Fs_{4.8}Wo_{0.9}$ ($N=2$). Magnetic susceptibility $\log \chi (\times 10^{-9} m^3/kg) = 4.42$.

Classification: Carbonaceous chondrite (CO3). Minimal weathering

Specimens: 53 g and a polished section at *CEREGE*. Main mass at *MMC*.

El Médano 390 (EM 390) $\sim 24^\circ 51'S, \sim 70^\circ 32'W$

Antofagasta, Chile

Find: 2017 May 17

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was found in May 2017 in the Atacama desert by Rodrigo Martinez while he was looking for meteorites

Petrography: (J. Gattacceca, *CEREGE*) Chondrules (predominantly of type I) and small CAIs set in a fine-grained Fe-rich matrix. Average chondrule apparent size about 250 μm . Opaques are metal and troilite.

Geochemistry: Olivine in the range $Fa_{0.5-34.4}$ mean $Fa_{18.0\pm 15.6}$, $N=4$). Cr_2O_3 in ferroan olivine 0.07 ± 0.01 wt.% ($N=3$). Low-Ca pyroxene $Fs_{1.01}Wo_{4.0}$ ($N=1$). Magnetic susceptibility $\log \chi (\times 10^{-9} m^3/kg) = 4.63$.

Classification: Carbonaceous chondrite (CO3). Moderate weathering

Specimens: 20 g and a polished section at *CEREGE*. Main mass at *MMC*.

El Médano 394 (EM 394) $24^\circ 51'S, 70^\circ 32'W$

Antofagasta, Chile

Find: 2018 Apr

Classification: Enstatite chondrite (EL6)

History: The stone was found lying at the surface in the Atacama desert in April 2018.

Physical characteristics: A single dark brown stone. Cut face reveals a dark interior with abundant metal.

Petrography: (J. Gattacceca, Bertrand Devouard, *CEREGE*) Highly recrystallized chondritic texture. No visible chondrule in the 1.5 cm² observed section. Main minerals are enstatite, plagioclase (typical size 100 μm , to 400 μm), kamacite (typical size 300 μm , to mm), sulfides (typical size 150 μm , to 400 μm). No olivine. Sulfides include alabandite, oldhamite, troilite.

Geochemistry: Enstatite $Fs_{0.3\pm 0.0}Wo_{1.6\pm 0.0}$ ($N=3$). Plagioclase $An_{15.2\pm 0.2}Ab_{80.6\pm 0.7}Or_{4.3\pm 0.5}$ ($N=2$). Si in kamacite 1.4 ± 0.0 wt% ($N=5$). Magnetic susceptibility $\log \chi (\times 10^{-9} m^3/kg) = 5.51$.

Classification: Enstatite chondrite (EL6). EL classification from the Si content of kamacite and the presence of alabandite. Minimal weathering.

Specimens: Type specimen 41 g at *CEREGE*. Main mass with *ARTMET*.

Elephant Moraine 14007 (EET 14007) $76^\circ 17.213'S, 156^\circ 26.081'E$

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3 Antarctica

4 Find: 2014 Nov 16

5 Classification: Carbonaceous chondrite (CK5)

6 **Petrography:** The section consists of high abundance of recrystallized matrix.
7 Complete absence of FeNi-metal. Cr-bearing magnetite is dominant.

8 **Geochemistry:** Olivine is $Fa_{29.5-30.0}$; low-Ca pyroxene is $Fs_{25.1-26.3}Wo_{0.6}$;
9 plagioclase is An_{42-71} .

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14 **Elephant Moraine 14013** (EET 14013) 76°17.195'S, 156°27.181'E

15 Antarctica

16 Find: 2014 Nov 21

17 Classification: Carbonaceous chondrite (CM2)

18 **Petrography:** The section consists of a few small chondrules (~22 vol %, <~100
19 μm to ~2 mm in diameter), CAIs (~2 vol%), and matrix (~76 vol%) with carbonate,
20 sulfides, and phyllosilicates. Fe-Ni metal is very rare (<0.1 vol%). The chondrules
21 have experience varying ° of aqueous alteration. The matrix occurs as fine-grained
22 rims surrounding chondrules.

23 **Geochemistry:** Olivine is $Fa_{0.3-65.7}$; low-Ca pyroxene is $Fs_{1.1-4.5}Wo_{0.7-4.4}$.

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30 **Elephant Moraine 14017** (EET 14017) 76°18.424'S, 156°31.991'E

31 Antarctica

32 Find: 2014 Nov 21

33 Classification: Ordinary chondrite (LL3)

34 **Petrography:** Sharply defined chondrules (~80 vol %, average size of ~0.9mm)
35 with glassy mesostasis are observed. Metal is less than 1 vol%. Aluminum-rich
36 chondrules are present.

37 **Geochemistry:** Olivine is $Fa_{0.4-53.5}$; low-Ca pyroxene is $Fs_{1.1-37.1.5}Wo_{0-6.2}$.

38
39
40
41
42 **Elephant Moraine 14018** (EET 14018) 76°17.125'S, 156°29.040'E

43 Antarctica

44 Find: 2014 Nov 21

45 Classification: Ordinary chondrite (L3)

46 **Petrography:** The section has sharply defined chondrules (average size of ~0.6
47 mm) with some glassy mesostasis. Metal abundance is ~4 vol%.

48 **Geochemistry:** Olivine is $Fa_{0.5-27.1}$; low-Ca pyroxene is $Fs_{4.9-29.4}Wo_{0.2-4.0}$.

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54 **Elephant Moraine 14049** (EET 14049) 76°15.926'S, 156°38.370'E

55 Antarctica

56 Find: 2014 Dec 12

57 Classification: HED achondrite (Eucrite)

Petrography: The section consists of pyroxene and calcic plagioclase ($>An_{80}$) with minor amount of silica and metal. The section is brecciated and contains mineral and lithic fragments.

Geochemistry: Low-Ca pyroxene is $Fs_{19.4-60.9}Wo_{1.5-7.9}$; Plagioclase is $An_{80.2-97.2}$.

Elephant Moraine 14053 (EET 14053) $76^{\circ}17.138'S, 156^{\circ}35.726'E$

Antarctica

Find: 2014 Dec 12

Classification: Ureilite

Petrography: The section consists of large olivine (up to ~ 2 mm) and low-Ca pyroxene (up to ~ 2 mm), and dark interstitial materials including carbon, metal, and sulfides. The high CaO contents (0.24 \sim 0.32 wt%) in olivine are observed.

Geochemistry: Olivine is $Fa_{4.2-15.3}$; low-Ca pyroxene is $Fs_{12.5-13.2}Wo_{4.1-4.6}$.

Elephant Moraine 14056 (EET 14056) $76^{\circ}12.637'S, 156^{\circ}41.497'E$

Antarctica

Find: 2014 Dec 12

Classification: HED achondrite (Eucrite)

Petrography: The section mainly consists of low-Ca pyroxene and plagioclase ($>An_{90}$). This meteorite is unbrecciated and equigranular with grain sizes of 0.3-2 mm in diameter.

Geochemistry: Low-Ca pyroxene is $Fs_{44.8-46.8}Wo_{1.1-3.3}$; Plagioclase is $An_{93.1-94.8}$

Elephant Moraine 14064 (EET 14064) $76^{\circ}15.224'S, 156^{\circ}35.422'E$

Antarctica

Find: 2014 Dec 12

Classification: Ordinary chondrite (LL3)

Petrography: The section shows sharply defined chondrules (~ 70 vol %, average chondrule size of ~ 0.9 mm) with glassy mesostasis. Metal abundance is $\sim < 2$ vol%.

Geochemistry: Olivine is $Fa_{0.6-28.9}$; low-Ca pyroxene is $Fs_{3.6-23.6}Wo_{0.2-7.2}$.

Elephant Moraine 14066 (EET 14066) $76^{\circ}15.492'S, 156^{\circ}36.556'E$

Antarctica

Find: 2014 Dec 12

Classification: HED achondrite (Eucrite)

Petrography: The section mainly consists of pyroxene and plagioclase ($>An_{86}$) with a minor amount of silica and metal. The section is brecciated with mineral and lithic fragments.

Geochemistry: Low-Ca pyroxene is $Fs_{21.1-56.5}Wo_{1.3-7.1}$; Plagioclase is $An_{86.0-97.2}$. One olivine was analyzed ($Fa_{26.6}$).

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3 **Elephant Moraine 14068** (EET 14068) 76°14.940'S, 156°36.855'E

4 Antarctica

5 Find: 2014 Dec 12

6 Classification: Carbonaceous chondrite (CM2)

7 **Petrography:** The section consists of a few small chondrules (~30 vol %, up to 1.5
8 mm in diameter, the average size of chondrule is ~300 μm), and matrix (~70 vol%).
9 Fe-Ni metal is very rare (<0.1 vol%). The section has abundant hydrated materials,
10 mainly serpentine.
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12 **Geochemistry:** Olivine is $Fa_{0.5-35.9}$; low-Ca pyroxene is $Fs_{0.8-5.5}Wo_{0.6-2.7}$.
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17 **Elephant Moraine 14074** (EET 14074) 76°15.525'S, 156°34.277'E

18 Antarctica

19 Find: 2014 Dec 12

20 Classification: Primitive achondrite (Acapulcoite)

21 **Petrography:** The section mainly consists of fine- to medium grained equigranular
22 (~220 μm) orthopyroxene and olivine, abundant FeNi metal (~14 vol%), and minor
23 amount of chromite and apatite.
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25 **Geochemistry:** Olivine is $Fa_{9.6-11.0}$; low-Ca pyroxene is $Fs_{10.0-10.6}Wo_{2.0-2.3}$.
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30 **Elmore County**

31 United States

32 Find: 1940

33 Classification: Iron meteorite (IAB-MG)

34 **History:** Purportedly found in Alabama, USA. Presented to *UCLA* by L. Garvie in
35 2014. The find account provided by Fred Bart is the following: "Many years after
36 leaving medicine, I learned that I practiced in near proximity to the Wetumpka
37 Impact Crater. Not knowing that any fragments of the impact meteorite would have
38 long ago rusted, I asked Greg Dubay to ask his patients if any of them had found
39 fragments of the meteorite and if they would allow me to hunt their property.
40 Michael Mulgrew politely pointed out that this was an exercise in futility--a fact I
41 failed to convey to Greg Dubay. One of his patients (Mr. Greathouse) relayed that
42 they had a "space rock" in their house that had been found by his father and/or
43 uncle in the 1940s. This farmer family was working the land for most of their lives.
44 One day, they encountered a rock unlike anything they had seen before and brought
45 it home. Sometime in the next decade or so, it was transported to Auburn
46 University, where it was confirmed to be a meteorite and painted with a sealant.
47 Mr. Greathouse gave the piece to Dr Dubay who, in turn, gave it to me. After I
48 received it, I carefully removed the sealant with pure acetone. While he was alive, I
49 asked Dr. Dubay to inquire if he knew the origin of the find or even the name of the
50 farm from where it came. Regrettably, such specifics were forgotten years ago, if
51 they were ever known. All I know is that it was unearthed in Elmore County,
52 Alabama."
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Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 66.4, Co = 4.48 (both mg/g), Ga = 89.6, As = 11, W = 1.25, Ir = 4.1, Au = 1.457 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group. Chemical composition is similar to [Campo del Cielo](#) with which it may be paired.

Specimens: Type specimens at *UCLA* and *ASU* (both >20 g).

Entrèves 45°49.14'N, 06°54.82'E

Valle d'Aosta, Italy

Find: May 1987

Classification: Iron meteorite (IAB-MG)

History: A single 20 × 17 × 18 cm mass was found in 1987 by an anonymous bomb-slayers hunter near a moraine at the border of the Brenva glacier, on the Italian side of Mont Blanc, near Entrèves. The sample was subsequently sold to Claude Scavone, a French mineral collector who sold it to Giorgio Tomelleri, an Italian meteorite collector

Physical characteristics: The main mass, weighing 17.3 kg, displays several small fusion pits and is apparently well preserved from rust. A distinct coarse grained Widmanstaetten pattern is visible on sawn and etched surfaces.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*). The 2 × 2 cm cut and etched chip examined contains no silicates. Coarse-grained (~5 mm width) equigranular kamacite grains with 120° grain boundaries can be distinguished, with rare taenite. No Neumann lines are visible. Schreibersite is present as rare laths, up to 150 μm in width and to 1 mm in length, within some kamacite grains and at grain boundaries. Schreibersite is frequently surrounded by iron oxides.

Geochemistry: SEM-EDX spot analyses, all in wt% (V. Moggi Cecchi, G. Pratesi, S. Caporali, *Uni-Fi*): schreibersite $\text{P}19.9 \pm 0.2\text{Fe}44.6 \pm 0.6\text{Ni}35.6 \pm 0.8$ (N=6); taenite $\text{Fe}70.5 \pm 0.5\text{Ni}29.5 \pm 0.2$ (N=6); kamacite $\text{Fe}92.6 \pm 0.6\text{Ni}7.4 \pm 0.2$ (N=5). Bulk composition (C. Herd and G. Chen, *UAb*) Ni=69.0, Co=4.5 (both mg/g); Cu=124, Ga=91, As=11.2, W=1.8, Ir=3.9, Pt=9.9, Pd=3.4, Ru=7.4, Re=0.4, Os=5.2, (all $\mu\text{g/g}$). Obtained by ICP-MS using [North Chile](#) as standard.

Classification: IAB-MG, coarse octahedrite. Composition is consistent with IAB Complex, Main Group (MG). The composition of this meteorites is extremely similar to that of [Campo del Cielo](#). However Neumann bands are absent whereas they are abundant in Campo del Cielo.

Specimens: A polished chip weighing 28 g is on deposit at *MSN-FI*. Main mass with Giorgio Tomelleri.

Erg Chech 001 (EC 001) 26.0555°N, 2.0797°W

Algeria

Find: 2016 Dec

Classification: HED achondrite (Diogenite)

History: Three similar looking stones (weighing 998, 138, and 130 g) were found in December 2016 and January 2017 in the Erg Chech Desert, 235 km WSW of the village of Tawrirt in the Adrar region of Algeria. The 138 g stone was subsequently acquired by John Higgins.

Physical characteristics: The 138 g stone lacks fusion crust and the fresh interior is mostly yellowish-green with sparse opaque grains.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate of predominantly orthopyroxene (mean grain size 0.9 mm) plus minor chromite (containing blebs of troilite) and rare taenite (containing minor Cu).

Geochemistry: Orthopyroxene ($Fe_{23.1-23.2}Wo_{1.7-1.8}$, FeO/MnO = 28-33, N = 3).

Classification: Diogenite.

Specimens: 21.6 g including one polished endcut at *UWB*; remainder of the 138 g stone with Mr. J. Higgins; other stones with the anonymous finders.

Errachidia 31°41.28102'N, 4°11.16582'W

Morocco

Find: April 2016

Classification: Lunar meteorite (feldspathic breccia)

History: One piece of 156 g was found April 2016 about 0.5 km west of Aoufous in Morocco.

Petrography: (A.-K. Kraemer and A. Bischoff, *IffP*) Breccia composed of angular anorthite-rich lithic and mineral fragments embedded in a fine-grained clastic matrix. The sample also contains melt spherules and some glassy areas. Observed minerals include anorthite, olivine, low-Ca pyroxene, Ca-rich pyroxene, Al-Ti-chromite, kamacite, taenite, ilmenite and troilite.

Geochemistry: Mineral composition and geochemistry: Olivine (mean: $Fe_{32.6}$, Fe/Mn = 96; N = 43), low-Ca pyroxene (mean $Fe_{29.5}Wo_{7.9}$, Fe/Mn = 59, N = 40), Ca-rich pyroxene (mean: $Fe_{15.8}Wo_{41.4}$; Fe/Mn = 49; N = 11), anorthite (mean $An_{95.9}Or_{0.1}$, N = 56).

Errachidia 002 31°52'03.4"N, 4°09'55.2"W

Draâ-Tafilalet, Morocco

Find: 2017

Classification: HED achondrite (Eucrite, polymict)

History: (H. Chennaoui Aoudjehane, *FSAC*) Found in a flat area SE of Errachidia called An-Nebch around 8 km NE of a Jramena village. A single piece of 4.02 g was collected on 11 Oct 2017 in the field during a systematic prospecting mission by a team of PhD students (*FSAC*) with H. Chennaoui. This area was selected because of the report of the first sample 17.24 g that was found there by a hunter on January 2017.

Physical characteristics: (H. Chennaoui Aoudjehane) One stone partially covered by a shiny fusion crust. Fresh pieces showing a low weathering grade. Clear grains of a small size (up to 1 mm) are visible through the fusion crust. The fractured face

shows brecciation with dark and clear areas. Up to 1 mm sized grains of fresh unoxidized metal are present in the cut portion.

Petrography: (T. Shisseh, *FSAC*; R. Hewins, S. Pont, *MNHNP*) Breccia with rock fragments up to 0.7 mm and lithic clasts up to 1 mm embedded in a fine grained clastic matrix. Grains of exsolved low-Ca pyroxene with up to 16 μm exsolution lamellae, fractured with a 6 μm displacement and distorted, are present in the lithic clasts and the matrix. Contains shock veins up to 0.2 mm with entrained rounded grains of pyroxene, plagioclase and silica. A faulting surface was also observed extending over 1.5 mm. The main minerals are Ca-poor pyroxene, augite and plagioclase, with minor silica, ilmenite, chromite and pure Fe-metal.

Geochemistry: Mineral compositions and geochemistry: (T. Shisseh, H. Chennaoui Aoudjehane, *FSAC*) Orthopyroxene compositions are $\text{En}_{37.9}\text{Fs}_{59.5}\text{Wo}_{2.6}$, low-Ca pyroxenes $\text{En}_{32.7}\text{Fs}_{61.8}\text{Wo}_{5.6}$ to $\text{En}_{31.2}\text{Fs}_{59.3}\text{Wo}_{18.3}$ (N=7), augite $\text{En}_{51.9}\text{Fs}_{27.2}\text{Wo}_{20.9}$ to $\text{En}_{26.9}\text{Fs}_{29.8}\text{Wo}_{43.4}$ (N=4) Fe/Mn=30 in average. Plagioclase is $\text{An}_{95.2-87.9}\text{Ab}_{4.64-11.7}\text{Or}_{0.12-0.5}$ (N=6).

Classification: (H. Chennaoui Aoudjehane, T. Shisseh, *FSAC*) Polymict eucrite breccia. The meteorite contains anorthite, and pyroxene with Fe/Mn ratios matching eucrite, plus typical eucrite textures.

Specimens: The main mass 17.24 g is held by a private collector. The type specimen consists of 4.4 g and one polished section in *FSAC*.

Gandom Beryan 011 31°52.659' N, 57°02.920' E

Kerman, Iran

Find: 4 January 2017

Classification: Ordinary chondrite (LL3)

History: The meteorite was found on 4 January 2017 by the *UrFU* meteorite expedition-2017 in Iran (Pastukhovich A. Yu., Larionov M. Yu., Kruglikov N.A., Zamyatin D.A.) 5 km north-east from the middle part of the road Ravar – Dige-e-Rostam hot springs, Tabas (northern sandy part of the Lut desert).

Physical characteristics: The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. Fusion crust is present.

Petrography: Classification (V. V. Sharygin, *SIGM* and *UrFU*). The meteorite shows a chondritic texture. The amount of chondrules and their fragments is up to 90 vol.%. Their sizes vary from 30-50 μm to 2 mm and they are well delineated. They have barred, porphyritic or cryptocrystalline texture and mainly consist of olivine, low-Ca-pyroxene and glassy matrix, diopside, and \pm chromite and blebs of troilite and FeNi-metal. In all chondrules the matrix does not contain fresh glass, now it is fine-devitrified aggregate. Olivine and sometimes low-Ca-pyroxene form skeletal/dendritic crystals and contain silicate-melt inclusions in some chondrules. In addition the crystals of these minerals sometimes show evident zonation. All these indicate the high rate of quenching. The exotic porphyritic chondrules containing olivine, spinel, plagioclase and cryptocrystalline Pl-Cpx matrix (former glass) are very rare. Olivine and low-Ca-pyroxene are main minerals in fine-

grained matrix; plagioclase was not observed. All petrographic features indicate a petrological type of 3 for the meteorite. Undulatory extinction and irregular fractures in olivine reveal a shock stage of S2. Majority of grains of FeNi-metal (100-500 μm) are mainly represented by kamacite, taenite and tetrataenite; but individual grains of kamacite also occur. The Neumann lines were locally observed in kamacite. Rare copper grains (up to 10 μm) were found in tetrataenite-taenite-troilite association. Sizes of troilite grains are 50-200 μm . Weathering products (goethite and other Fe-Ni-hydroxides, calcite, Fe-Ni-carbonate) are not very abundant and occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in all minerals (weathering grade – W2). Pentlandite+Ni-rich pyrrhotite (up to 10 μm) is rarely observed in troilite. Clinopyroxene, chromite and chlorapatite (50-100 μm) occur locally in the matrix. Merrillite was found only as rounded inclusions (up to 5 μm) in FeNi-metal and troilite. The fine-grained fusion crust (occasionally vesicular) is up to 100 μm and contains zoned olivine, Fe-rich or Fe-poor glass, magnetite and sulfides, rare low-Ca pyroxene. In the chondrules, which were in fusion crust zone, the matrix turned into glass and individual metal-sulfide blebs appeared. The blebs consist of troilite, Ni-rich metal and Ni-rich sulfides.

Geochemistry: EDS-WDS analyses (ViV. ctor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine, low-Ca-pyroxene, Cr-bearing clinopyroxene, plagioclase, spinel-supergrain minerals, chlorapatite, merrillite, FeNi-metals and copper. The main minerals vary widely in composition. The averaged olivine is $\text{Fa}_{23.94\pm 7.36}$ (N=141). However its zoned crystals in chondrules show more contrast compositions: core (min) – $\text{Fa}_{0.80}$, rim (max) – $\text{Fa}_{31.53}$; grains from matrix indicate more homogeneous composition - $\text{Fa}_{29.4\pm 0.61}$ (N=31), outlining the LL group. The same situation is with low-Ca-pyroxene: average - $\text{Fs}_{14.91\pm 8.12}\text{Wo}_{1.96\pm 1.85}$ (N=70); chondrules: core (min) – $\text{Fs}_{1.97}$, rim (max) – $\text{Fs}_{36.93}$; matrix – $\text{Fs}_{19.10\pm 6.07}\text{Wo}_{1.35\pm 0.32}$ (N=8). Plagioclase is rare: anorthite $\text{An}_{72.9}\text{Ab}_{24.3}\text{Or}_{2.8}$ (N=6) occurs in spinel-containing chondrules, whereas albite $\text{Ab}_{93.2}\text{An}_{3.7}\text{Or}_{3.1}$ (n=1) – in matrix of some POP chondrules. Spinel-supergrain minerals are represented by chromite $\text{Crt}_{87.1}\text{Spl}_{6.5}$ (N=15, common in matrix), spinel $\text{Spl}_{98.8}\text{Crt}_{0.3}$ (N=6, in some chondrules) and intermediate chromite-spinel $\text{Crt}_{49.9}\text{Spl}_{47.5}$ (n=5, in some chondrules). Composition of metals (in wt.%): kamacite (N=35) – Fe 93.16 \pm 0.59, Ni – 5.88 \pm 0.58, Co – 1.00 \pm 0.17; taenite (N=22) – Fe 65.55, Ni 34.02, Co 0.48; tetrataenite (N=19) – Fe 48.43, Ni 51.25, Co 0.34; copper (N=5) – Fe 5.42, Ni 3.02, Cu 91.61. Pentlandite (in wt.%, N=5): Fe 46.42, Ni 19.83, Co 0.42, S – 33.49. Former glasses in chondrules also show contrast compositions: with moderate alkalis (Na_2O 5.3-9.7, K_2O 2.2-4.1, SiO_2 60.1-77.4, Al_2O_3 10.6-16.3 wt.%) and nepheline-normative (Na_2O 10.2-15.2, K_2O 0.2-3.5, SiO_2 47.5-60.7, Al_2O_3 18.0-27.4 wt.%).

Classification: Ordinary chondrite. LL3, S2, W2. Estimated subtype 3.4/3.9 based on variations of Fa in olivine and Fs in low-Ca pyroxene.

Specimens: 2056.6 g sample – *UrFU*; 6.53 g cut-off and thin section – *SIGM*.

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3 **Ganq 001** 37°29'12.31"N, 92°18'37.84"E

4 Qinghai, China

5 Find: 03 Nov 2013

6 Classification: Ordinary chondrite (L~6)

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8 **History:** (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) in the Gobi
9 desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan
10 Autonomous Prefecture, Qinghai province, on Nov. 3, 2013.

11 **Physical characteristics:** (Ziyao Wang and R. Bartoschewitz, *Bart*) One black-
12 brown almost complete rounded stone of 3907 g with about 90% of weathered and
13 eolic eroded fusion crust.

14 **Petrography:** (R. Bartoschewitz, *Bart*) heavy brown stained recrystallized matrix
15 with poor defined chondrules (0.4 - 3 mm) and irregular metal and sulphide
16 inclusions up to 2 mm

17 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.62$

18 **Classification:** Ordinary chondrite (L~6, W3)

19 **Specimens:** 20.5 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) and Wang
20 Ziyao hold the main mass, and 108.5 g with *Bart*.

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23 **Ganq 002** 37°34'54.59"N, 92°14'45.81"E

24 Qinghai, China

25 Find: 10 Mar 2014

26 Classification: Ordinary chondrite (L~6)

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28 **History:** (Ziyao Wang) Discovered by Zhang Qun (Haixi/Qinghai) and Liu
29 Binghan (Haixi/Qinghai) in the Gobi desert about 150 km SE of Huangtouzhen,
30 Haixi Mongolian and Tibetan Autonomous Prefecture, Qinghai province, on March
31 10, 2014.

32 **Physical characteristics:** (Ziyao Wang and R. Bartoschewitz, *Bart*) Shield shaped
33 oriented individual of 5340 g. Black, eroded fusion crust presents well-developed
34 flow lines.

35 **Petrography:** (R. Bartoschewitz, *Bart*) weak brown-stained, recrystallized matrix
36 with poorly defined chondrules and irregular metal and sulfide inclusions up to 1
37 mm

38 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.95$

39 **Classification:** Ordinary chondrite (L~6, W1)

40 **Specimens:** 20.3 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) and Zhang Qun
41 (Haixi/Qinghai) hold the main mass, 150 g with Wang Ziyao, and 129.6 g
42 with *Bart*.

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45 **Ganq 003** 37°39'35.17"N, 92°15'36.22"E

46 Qinghai, China

47 Find: 16 Sept 2015

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3 Classification: Ordinary chondrite (L~5)

4 **History:** (Ziyao Wang) Discovered by Chen Wie (Haixi/Qinghai) in the desert
5 close to Mangai county, Haixi, Mongolian and Tibetan Autonomous Prefecture on
6 16 Sept 2015. Liu Binghan (Haixi/Qinghai) purchased the complete stone in 2018.

7 **Physical characteristics:** (Ziyao Wang) Black-brown stone of 2200 g without
8 fusion crust
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10 **Petrography:** (R. Bartoschewitz, *Bart*) brown stained recrystallized matrix with
11 well-defined chondrules (0.4-2 mm, av. 0.7 mm).
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13 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.82$
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16 **Classification:** Ordinary chondrite (L~5, W3/4)

17 **Specimens:** 20.7 g on deposit at *Kiel*, Liu Binghan holds the main mass, 138 g with
18 Wang Ziyao, and 106 g with *Bart*.
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22 **Gueltat Zemmour** 25°05'32.0''N, 12°37'23.9''W

23 Boujdour, Morocco

24 Fall: 21 Aug 2018

25 Classification: Ordinary chondrite (L4)

26 **History:** (H. Chennaoui Aoudjehane *FSAC*, UH2C, Ahmed Bouferra, Mohamed
27 Aid, "Moroccan association of meteorites"). On 21 Aug 21 2018 around 14:20,
28 many people from the south of Morocco saw a bright fireball. In Smara, Seddiki
29 Mbarek reported the passing of a fireball similar to a yellow-white shining star,
30 moving from the northeast to southwest, in the direction of Gueltat Zemmour. His
31 son Aboubakr also saw the fireball, saying that his sighting only lasted a few
32 seconds before a building blocked the view. Abderrahmane Latifi and his son Adil,
33 also from Smara, both saw a fireball shining red, then yellow, brighter than the
34 Sun, lasting about 3 s. In the fall area, Mahjoub Boutabâa, a nomad, was inside his
35 tent; he heard a sound similar to the explosion of a mine, followed by a few sonic
36 booms that resonated in the entire Oued Labiyad valley, similar to thunder. Abba
37 Essahed, another nomad, and his wife Basaddouk Aicha were out of their tent when
38 they heard a whistling sound almost identical to ocean waves, then five sonic
39 booms akin to the explosion of a mine, making them feel like the mountains would
40 crumble. They saw a very bright fireball comparable to a burning 4x4 vehicle in
41 terms of size, first red then yellow, more dazzling than the Sun, with a flashing
42 light moving from north to south for a few seconds. There was smoke in the sky
43 directly above them. Aicha was so scared that she went to hide between the water
44 barrels. All testimonies are concordant on the date and the time of August 21
45 around 14:20. Due to the period of the fall (one day before "Aid El Adha"), hunters
46 could not search immediately. Searching began ten days after the fall and the first
47 pieces were found in mid-September, about three weeks after the fall, a few km to
48 the west of Gueltat Zemmour. A group of hunters: Mohamed Ouicha, Brahim
49 Ouhra, Mbarek Amediaz, Aissa Ouicha and Brahim Ouadjou found many pieces
50 (5.1, 5.0, 6.3, 7.2, and 15 g) in a valley between Wad Awzireft and Wad Labiyad
51 (N25°05'32.0''; W12°37'23.9'') and north of Koudiat Rjilya. Bigger pieces were
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found SW of this site (N24°53'29.52"; W12°42'10.5'' ; around 700 g)
(N24°56'37.06"; W12°40'52.12''; around 200 g). The direction of the fall was
NNE-SSW and the strewnfield is about 12 km.

Physical characteristics: A few small pieces totalling around 500 g and 3 bigger ones (5448 g, 1374 g and 426 g) not weathered, totally covered by a black matte fusion crust, showing fine grains, very friable material, and easily discernable chondrules. Large pieces are broken and show a gray-colored interior; they are partially covered by fusion crust.

Petrography: (H. Chennaoui Aoudjehane UH2C, L. Folco UniPi) Numerous well-defined chondrules (POP, PO, GPO, PP, RP and glassy chondrules) up to 3 mm. Plagioclase is very small (2 μm maximum). Mesostasis is microcrystalline. Most metal and sulfides are automorphous grains, μm sized, to large grains up to 500 μm ; they occur inside chondrules as small grains, in the mesostasis as small and large grains, and surrounding some chondrules.

Geochemistry: (V. Moggi Cecchi, *UniFi*, H. Chennaoui Aoudjehane UH2C) Olivine $\text{Fa}_{26.0\pm 0.7}$ Fe/Mn=51.23 (N=10), low-Ca pyroxene $\text{Fs}_{20.7\pm 0.8}$ $\text{Wo}_{1.1\pm 0.5}$ Fe/Mn=28.51 (N=7), plagioclase $\text{An}_{8.2\pm 2.4}$ $\text{Or}_{4.8\pm 0.8}$ (N=3), Taenite Ni 50.3 ± 2.7 (N=3) Whole-rock trace-element concentrations by ICP-MS (M. D'Orazio, UniPi): V 59, Cr 2799, Ni 10115, Co 399, La 0.329, Ce 0.879, Pr 0.138, Nd 0.645, Sm 0.211, Eu 0.088, Gd 0.284, Tb 0.054, Dy 0.364, Ho 0.081, Er 0.242, Tm 0.035, Yb 0.236, Lu 0.038 (units = $\mu\text{g/g}$). Cosmogenic radionuclides: (Å. Rosén, B. Hofmann, NMBE, GeMSE): Gamma-spectroscopy performed in October 2018 on a 21.74 g sample showed the presence of several short-lived cosmogenic radionuclides (^{57}Co , ^{46}Sc , ^{56}Co , ^{58}Co , ^7Be ($t_{1/2}=53$ d; $84.6\pm 10/-7$ dpm/kg) and ^{48}V ($t_{1/2}=16$ d; $17.8\pm 4.6/-5.4$ dpm/kg). Recalculated to August 21, 2018 the $^{22}\text{Na}/^{26}\text{Al}$ activity ratio is 1.69 ± 0.1 . These data confirm that it is a fresh fall. The ^{26}Al activity of $55.5\pm 3.6/-3.1$ dpm/kg and absence of detected ^{60}Co (<0.8 dpm/kg) indicates only a few cm of shielding.

Classification: L4

Specimens: A sample of 20.1 g provided by the "Moroccan association of meteorites", small pieces totaling 30 g provided by *Aaronson, FSAC*. Aaronson: 1374 + 426 g; Mohamed Aid: 5448 g; Private collector, Casablanca: 21 + 7.2 + 6.3 + 5.1 + 5 g.

Gumu 33°10.17'N, 85°41.86'E

Tibet, China

Find, possible fall: June 25, 2018

Classification: Ordinary chondrite (H6)

History: There was a rumor that a meteorite fall had happened in the Qiangtang region of Tibet. A local farmer first found a 0.5 kg meteorite on June 25, 2018. After that, 14 kg and 24.5 kg were collected in the same location on July 1 and Aug 5, 2018.

Physical characteristics: About 20 pieces were found, with a total weight of ~39 kg. A few of them are covered with black fusion crust, and some show rusty spots.

Petrography: (N. Wang, Y. Xu and Y. Lin, *IGGCAS*) It is an equilibrated ordinary chondrite, with homogeneous compositions of olivine and pyroxene. Most of the feldspars are $>50\ \mu\text{m}$ in size. The chondrules are very poorly delineated. Fe-Ni metal and troilite, with minor phosphate make up about 20% of the volume.

Geochemistry: The chemical compositions of olivine and pyroxene are homogeneous across the thin section. Olivine: $\text{Fa}_{19.1\pm 1.2}$ ($n=28$), orthopyroxene: $\text{Fs}_{16.3\pm 0.9}\text{Wo}_{1.4\pm 0.4}$ ($n=34$)

Classification: H6 (N. Wang, Y. Xu and Y. Lin, *IGGCAS*)

Specimens: Main mass with P. Chen.

Hamburg $42^{\circ}26.82'\text{N}$, $83^{\circ}50.5'\text{W}$

Michigan, United States

Confirmed fall: 2018 Jan 16

Classification: Ordinary chondrite (H4)

History: On 16 January 2018 around 20:10 EST, a fireball was observed and reported by hundreds of people from seven states. The fireball was recorded by multiple security cameras and registered as a 2.0 magnitude earthquake. Mike Hankey (*AmMS*) calculated the trajectory within one hour. A strewnfield map was produced by Marc Fries (*JSC*) using weather radar data from radar reflections of falling meteorites. The first fragment was found on 18 January 2018 at 7:50 EST by Robert Ward on Strawberry Lake near Hamburg, Michigan. Five other masses, ranging from 17 to 102.6 g, were found later the same day by Ward, Larry Atkins, and Darryl Landry on Strawberry and Bass Lakes. Thirteen additional pieces were found within two weeks of the fall.

Physical characteristics: Most stones are fully covered by fusion crust.

Petrography: Metal-rich texture typical of H chondrites is apparent on cut surfaces. The metal volume estimate is 9% based on an Fe EDS map. Chondrules are visible in polished section. The average chondrule diameter is $0.4\pm 0.2\ \text{mm}$ ($N=26$). Several chondrules are well-defined and have sharp boundaries. Pyroxenes are mostly orthopyroxene and less abundant clinopyroxene as determined with Raman spectroscopy. Feldspar grains vary in size and measure $3.4\pm 2.2\ \mu\text{m}$ ($n=64$) in a representative field of view. Chromites are impact fractured. No chromite veinlets nor opaque veins are observed within the meteorite. Phosphates account for about 0.5% of the meteorite and occur mainly as merrillite (0.4%) and apatite (0.1%). In a representative field of view, grain sizes for merrillite average around $100\ \mu\text{m}$ and range from $<1\ \mu\text{m}$ up to $430\ \mu\text{m}$ ($n=37$); apatite ranges from $70\ \mu\text{m}$ to $310\ \mu\text{m}$ with an average of $150\ \mu\text{m}$ ($n=8$). The meteorite appears very weakly shocked. Melt veins (Fe-sulfide) occur only in close proximity to the fusion crust.

Geochemistry: Mineral Compositions and geochemistry: Olivine $\text{Fa}_{18.7\pm 0.7}$ ($N=34$).

The average composition of Ca-poor px is $\text{Fs}_{16.3\pm 0.4}\text{Wo}_{1.3\pm 0.1}$ ($n=80$). Feldspar is present with an average composition of $\text{An}_{14.0\pm 4.0}\text{Ab}_{81.1\pm 3.0}\text{Or}_{4.8\pm 1.3}$ ($n=13$).

Chromite: $\text{TiO}_2=2.0\pm 0.4\ \text{wt}\%$ $\text{V}_2\text{O}_3=0.8\pm 0.2\ \text{wt}\%$ ($N=25$). Apatite contains about 5 wt% Cl and $<1\ \text{wt}\%$ F.

Classification: The petrology, mineral chemistry and compositional heterogeneity of the minerals listed is consistent with H4 chondrites. The meteorite is classified as H4, S2, W0.

Specimens: Type specimen 22.8 g and polished section at *FMNH*; 102.6 g specimen with Robert *Ward*; 44.5 g specimen with Terry *Boudreaux*.

Hami 007 42°08'4.55''N, 93°25'31.72''E

Xinjiang, China

Find: 2013 Oct 12

Classification: Ordinary chondrite (H5)

History: The meteorite was found during searching for meteorites near Yamasu ore mine on Oct. 12, 2013. Subsequently, it was purchased by Qiang Xu.

Physical characteristics: complete black fusion crust. The bottom on the desert shows rusty spots.

Petrography: (Y. Xu, N. Wang and Y. Lin, *IGGCAS*) The meteorite consists mainly of olivine, pyroxene, plagioclase, Fe-Ni metal, and troilite, with minor chromite, chlorapatite and whitlockite.

Geochemistry: Mineral compositions and geochemistry: The olivine, pyroxene and plagioclase have homogeneous chemical compositions. Olivine: $\text{Fa}_{18.6\pm 0.6}$ (n=22), orthopyroxene: $\text{Fs}_{16.1\pm 0.6}\text{Wo}_{1.0\pm 0.7}$ (n=27). Plagioclase: An_{12} (n=25)

Classification: H5 (Y Xu, N. Wang and Y. Lin, *IGGCAS*), probably paired with [Hami 001](#), [Hami 003](#), and [Hami 005](#)

Specimens: the main mass was hold by Q. Xu

Hami 008 42°27'51.71"N, 93°13'68.47"E

Xinjiang, China

Find: 16 Nov 2016

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) The meteorite was discovered by Zijian Wang 45 km SW of Hami city, Xinjiang province on 16 Nov 2016. Three fragments were discovered within a distance of 1.2 m.

Physical characteristics: (Ziyao Wang) Three brown heavy fractured irregular fragments of 475 g, 75.4 g, and 39 g, in total 589.4 g.

Petrography: (R. Bartoschewitz, *Bart*) brown stained recrystallized matrix with poor defined chondrules (0.6-1.2 mm, av. 0.8 mm)

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.79$

Classification: Ordinary chondrite (L~6, W3)

Specimens: 21.7 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 64 g with *Bart*.

Hermenegildo 33°39.07'S, 53°14.90'W

Rio Grande do Sul , Brazil

Find: 2004

Classification: Ordinary chondrite (H5)

History: After a large fireball was seen at 1997, several masses of meteorites were found near Santa Vitória do Palmar (RS, Brazil). This mass was found in the sand area of the swamp near the beach after light and thunder had been observed by the finder, who reported the phenomena as UFOs. Despite the great enthusiasm of the finder, he probably witnessed an ignis fatuus due to the marsh or ore deposits, with no relation to the meteorite.

Physical characteristics: A single small weathered irregular mass with about 300 g and lacking fusion crust.

Petrography: (M. E. Zucolotto, *MNRJ, IGEO-UFRJ* and C. Villaça, *IGEO-UFRJ*) Polished thin and microprobe sections show a chondritic texture. A variety of textural types of chondrules and chondrules fragments were observed, embedded in a fine to microcrystalline matrix. Plagioclase grains do not exceed 50 μm in size. Metal grains include kamacite, zoned taenite and zoneless plessite. Mono crystalline chromite is present. The presence of sets of planar fractures in olivine and undulatory extinction and mosaicism of olivine with no maskelynite indicate a S4 shock stage. Moderately weathered with the entire sample percolated by hydrated ferric oxide veins; the iron metal nickel is partly transformed into oxides indicatives of weathering grade W2

Geochemistry: A. Tosi, *LABSONDA/IGEO-UFRJ*) Olivine $\text{Fa}_{19.3\pm 0.6}$ (n=29), pyroxene $\text{Fs}_{17.3\pm 0.9}$ $\text{Wo}_{1.14\pm 0.15}$ (n=9)

Classification: Ordinary chondrite (H5), shock stage S4, weathering (W2).

Specimens: Two samples (12 g and 15g) at *MNRJ*, 10 g Pulo Martini INPE. Main mass at Museu Tancredo Mello

Hoboksar 001 46°49'51.07"N, 85°42'4.33"E

Xinjiang, China

Find: 2018 Jun

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) A 544 g meteorite fragment was discovered by Zijian Wang in Hoboksar Mongol Autonomous County, Tarbagatay Prefecture, Ili Kazak Autonomous Prefecture, Xinjiang province in Jun 2018. In October he searched for missing fragments and discovered some within a distance of 20 m. In November, the main mass of 6.9 kg was discovered 500 m away.

Physical characteristics: (Wang Ziyao) Black brown 6 kg broken individual with fresh black fusion crust and some smaller fragments of 2 kg that fit to a nearly complete stone. The main mass of 6.9 kg is a part individual with fresh fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (0.6-1.2 mm, av. 0.7 mm) and irregular metal and sulphide inclusions.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.95$

Classification: Ordinary chondrite (L~6, W1)

Specimens: 22.9 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 58 g with *Bart*.

Ilafegh 018 21°20'31.93"N, 0°49'26.02"E

Adrar, Algeria

Find: 2001 Dec

Classification: Iron meteorite (IIIAB)

History: Compact, heavily sculpted mass with well-preserved fusion crust on large parts of the surface and only a thin layer of surface oxidation. The mass shows distinct regmaglypts and heavy ablation of edges. The iron was found by nomadic Berbers in 2001, "probed" for possible gold or silver content with negative results, and left in place, remembered only as a curiosity. Only in 2015, when the finders made contact with Moroccan meteorite dealers, was the iron recovered from its find location and recognized as an iron Meteorite, and subsequently purchased by S. Buhl.

Physical characteristics: Single mass with regmaglypts and remnants of fusion crust on large parts of the surface. Minor surface oxidation.

Petrography: (J. Gattacceca, *CEREGE*): The etched section shows octahedrite texture with a 1-2 mm heat alteration zone. Only three kamacite bands are visible in the section, with average width 1.4 mm. Kamacite is polycrystalline and in the epsilon form. Comb, black and net plessite are present. No accessory minerals were observed.

Geochemistry: (M. D'Orazio, *DST-PI*): Composition of the metal is Co=0.44, Ni=7.7 (both in wt%), Cu=184, Ga=20.3, Ge=41, As=4.9, Mo=6.5, Ru=10.8, Rh=1.85, Pd=3.10, Re=0.48, Ir=5.5, Pt=11.5, Au=0.67 (all in ppm). Ni and Co have been measured by hand-held XRF following Gemelli et al. 2015; all other elements by ICP-MS following [D'Orazio and Folco \(2003\)](#).

Classification: Iron, IIIAB.

Jeminay 47°52'59"N, 85°54'22"E

Xinjiang, China

Find: 6 June 2017

Classification: Iron meteorite (ungrouped)

History: Found by Ye Erbo Lati and his companions Wang Ziyao and Yang Guang on June 6, 2017, while they were using metal detectors to search for meteorites in the Gobi Desert. The location is near the small town of Qiake'er in the Xinjiang Uyghur Autonomous Region, Altay, Jeminay County, China.

Physical characteristics: The main mass is discoid in shape, approximately 3 cm thick, with a glossy brown to red-brown exterior.

Petrography: (C. Herd, *UAb*) Optical and SEM investigation of a ~1 × 2.5 cm polished and etched surface reveals a well-developed Widmanstätten pattern consistent with a finest octahedrite (0.06±0.02 mm; n=66), but having a matte

appearance typical of hatched γ -structure. In detail, shock-hatching predominates, grain boundaries are irregular, and low-Ni areas consist of irregular, wavy grains. Inclusions on cut surfaces of other samples were noted, but not available for study.

Geochemistry: ICP-MS data, using sample of [North Chile](#) (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 16.7, Co = 0.93 (both wt%); Cu = 341, Ga = 8, As = 12, W = 0.7, Ir = 13.4, Pt = 20.0, Au = 0.99 (all $\mu\text{g/g}$).

Classification: (C. Herd, *UAb*): Ungrouped, finest octahedrite. Although high Ni and Ir are suggestive of the IVB group, other element concentrations fall outside of known ranges for IVB irons.

Specimens: Type specimen consisting of two representative slices (13.5 g and 12.8 g) at *UAb*. Wang Ziyao 3 kg, Ye Erbo Lati 1.5 kg, Yang Guang 1.5 kg, Mendy Ouzillou 300 g.

Jiddat al Harasis 846 (JaH 846) 19.839°N, 55.870°E

Al Wusta, Oman

Find: 2011

Classification: Ordinary chondrite (type 3)

History: Found by an anonymous prospector in Oman in 2011.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed, medium-sized chondrules (apparent diameter $560\pm 380\ \mu\text{m}$, $N = 40$; some up to 2.2 mm) in a finer grained matrix. Minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, silica polymorph, chromite, troilite and altered kamacite. Some chondrules are devoid of olivine and are composed predominantly of orthopyroxene + a silica polymorph.

Geochemistry: Olivine ($\text{Fa}_{0.6-38.1}$; Cr_2O_3 in ferroan olivine 0.04-0.22 wt.%, mean 0.08 wt.%, sd 0.06 wt.%, $N = 9$), orthopyroxene ($\text{Fs}_{1.9-35.2}\text{Wo}_{0.5-4.4}$, $N = 3$), clinopyroxene ($\text{Fs}_{6.0-6.1}\text{Wo}_{43.6-44.8}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of 7 acid-washed subsamples by laser fluorination gave $\delta^{17}\text{O}$ 4.988, 3.882, 4.098, 4.396, 4.262, 4.762, 4.838; $\delta^{18}\text{O}$ 8.668, 6.724, 6.533, 7.237, 6.999, 8.155, 8.124; $\Delta^{17}\text{O}$ 0.411, 0.332, 0.649, 0.575, 0.567, 0.456, 0.549 per mil. Magnetic susceptibility $\log \chi (\times 10^{-9}\ \text{m}^3/\text{kg}) = 4.91$.

Classification: Ordinary chondrite (OC3). Unusual features of this specimen include chondrules dominated by orthopyroxene + a silica polymorph, oxygen isotopic compositions closer to the TFL than for typical ordinary chondrites with similar degree of desert weathering and extending to very high $\delta^{18}\text{O}$ values.

Specimens: Type specimen plus one polished thin section are at *PSF*; main mass with the anonymous finder.

Jiddat al Harasis 1100 (JaH 1100) 19°42.31'N, 56°35.64'E

Al Wusta, Oman

Find: 15 Feb 2015

Classification: Ureilite

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3 **Physical characteristics:** A 365 g sample supplied by the Sultan Qaboos
4 University, which has a millimeter thick, dark brown-grey fusion crust present on
5 all faces except one cut face. This fusion crust lacks remaglypts instead has a
6 mainly rough surface. There are no contraction cracks present on this sample. This
7 rock has already been cut and there is a clean face already present. Elongated grey
8 laths can be identified on the cut face, with most less than 0.5 cm wide. The sample
9 is also magnetic.

10
11
12 **Petrography** (P. Hill, *UWO*) The sample is composed of elongated, round grains
13 of olivine and pyroxene that are ~1-2 mm wide and occasionally meet at
14 120° angles. Olivine (~60 vol%) is more modally abundant than pyroxene (30 vol
15 %). The sample is fairly porous with large gaps between pyroxene and olivine
16 grains; however, there is a lack of porosity between grains of the same mineralogy.
17 Instead, iron oxides are present and have filled in most of the fractures. Within
18 some of the larger pores, graphite is observed. The graphite is associated with the
19 olivine grains, with only a few occurrences near the pyroxene. Pyroxene is often
20 associated with small porous inclusions throughout the grains, often running
21 perpendicular to the elongated nature of the grain and a plane of cleavage. These
22 inclusions are often filled with iron oxides. The reduction rims observed in olivine
23 grains are <50 µm thick fitting within the R2 grade put forward by Wittke et al.
24 (2007). Very little kamacite or taenite are present, most are occurring as small
25 inclusions. Most of the metal has oxidized, (>95%). Overall there is little evidence
26 of the silicate phases weathering and no weathering phase was identified in
27 abundance. Overall, this meteorite has experienced moderate terrestrial weathering
28 with most of the Fe-Ni metal being oxides but no evidence of alteration in the
29 silicates phases. The olivine within these samples does show undulose extinction
30 and the mosaic texture of the olivines suggesting this sample has been highly
31 shocked.

32
33 **Geochemistry:** Mineral composition and geochemistry (M. Beauchamp, P.
34 Hill, *UWO*) Olivine ($\text{Fa}_{23.9\pm 1.5}$), low-Ca pyroxene ($\text{Fs}_{15.5\pm 2.8}\text{Wo}_{7.9\pm 2.9}$)

35 **Classification:** Classification: Ureilite, S5, W3.

36 **Specimens:** 365 g type specimen, including polished thin section, are on deposit
37 at *SQU*.

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42 **Jiddat al Harasis 1101** (JaH 1101) 19°44.58'N, 56°41.22'E

43 Al Wusta, Oman

44 Find: 15 Feb 2015

45 Classification: Ureilite

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48 **Physical characteristics:** A 460 g sample supplied by the Sultan Qaboos
49 University, which has a millimeter thick, dark brown-gray fusion crust present on
50 all faces except one cut face. This fusion crust lacks remaglypts instead has a
51 mainly rough surface. There are no contraction cracks present on this sample. This
52 rock has already been cut and there is a clean face already present. Rounded grey
53 laths can be identified on the cut face, with most less than 0.5 cm wide. The sample
54 is also magnetic.

Petrography (P. Hill, *UWO*) The sample is composed of elongated grains of olivine and pyroxene that are ~1-2 mm wide. Olivine is much more prevalent than pyroxene (60 vol % vs. 30 vol %). The olivine grains show mosaiced texture with some grains of olivine exhibiting undulatory extinction suggesting high levels of shock. Pyroxene grains are fractured but still have clear and distinct extinction. The grain boundaries are defined by oxides and graphite. Pyroxene is often associated with small porous inclusions throughout the grains. Though distinct exsolution lamellae are not present, small blebs of a more Ca-rich pyroxene are present throughout the pyroxene grains. In particular, a single grain of pyroxene (100 μm wide) is surrounded by olivine and completely rimmed by iron oxide that in some places is 50 μm thick. The olivine contains reduction rims ~50 μm thick with significant amounts of graphite remaining. Based on the classification put forward by Wittke et al. (2007), this sample fits in the R2 grade. Though the grain boundaries are defined by iron oxides, kamacite and taenite are present as inclusions within grains where fractures have not exposed the metal to terrestrial weathering. In one occurrence an iron oxide rim surrounds a Fe-Ni core. Overall there is little evidence of the silicate phases weathering; however, several sulfate veins were observed. This sample has been moderately weathered based on the presence of sulfates, oxidization of most Fe-Ni metal, but the absence of any silicate weathering phase. The olivine within these samples does show undulatory extinction and the mosaic texture of the olivines suggest higher levels of shock metamorphism.

Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Olivine ($\text{Fa}_{23.8\pm 3.0}$), low-Ca pyroxene ($\text{Fs}_{15.8\pm 2.0}\text{Wo}_{7.5\pm 1.7}$)

Classification: Classification: Ureilite, S5, W3.

Specimens: 460 g type specimen, including polished thin section, are on deposit at *SQU*.

Jiddat al Harasis 1102 (JaH 1102) 19°25.34'N, 55°53.44'E

Al Wusta, Oman

Find: 15 Feb 2015

Classification: Ureilite

Physical characteristics: A 95 g sample supplied by the Sultan Qaboos University, which has a millimeter thick, dark brown-gray fusion crust present on all faces except one cut face. This fusion crust lacks remaglypts on 3 of faces, however a smooth face with small remaglypts is present. There are no contraction cracks present on this sample. This rock has already been cut and there is a clean face already present. Rounded grey laths can be identified on the cut face, with most less than 0.5 cm wide. The sample is also magnetic.

Petrography (P. Hill, *UWO*) The sample is composed of elongated grains of olivine and pyroxene that are ~1-2 mm wide, often meeting at 120° angles. The olivine grains show mosaiced texture suggesting a high level of shock. Pyroxene grains are fractured but still have sharp, distinct extinction. The grain boundaries are defined by oxides, and there is little porosity between grain boundaries.

Pyroxene is often associated with small porous inclusions throughout the grains. Though the grain boundaries are defined by iron oxides, kamacite and taenite are present as inclusions within grains where fractures have not exposed the metal to terrestrial weathering. In one occurrence and iron oxide rim surrounds a Fe-Ni core; however, most of the iron oxide occurs as veins running along grain boundaries. Troilite was also observed as a large (200 μm) inclusion within a pyroxene grain. Though diamonds and carbide were not observed within these thin sections, graphite is observed. The reduction rims of olivine grains are ~ 50 μm thick. According to the classification system put forward by Wittke et al. (2007), this sample fits with the R2 grade. Overall there is little evidence of the silicate phases weathering except for the occurrence of several sulphate veins. The olivine within these samples does show undulose extinction and the mosaic texture of the olivines suggest high levels of shock metamorphism.

Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Olivine ($\text{Fa}_{21.8\pm 2.0}$), low-Ca pyroxene ($\text{Fs}_{16.6\pm 1.6}\text{Wo}_{6.8\pm 1.9}$)

Classification: Classification: Ureilite, S5, W3.

Specimens: 95 g type specimen, including polished thin section, are on deposit at *SQU*.

Jiddat al Harasis 1103 (JaH 1103) 19°46.660'N, 56°32.840'E

Al Wusta, Oman

Find: 2014 May 7

Classification: Ureilite

History: The meteorite was found in 2014 during a field trip in the Oman desert.

Physical characteristics: Brownish individual lacking any fusion crust.

Petrography: The meteorite shows a cumulate texture of up to 1.8 mm sized olivine and pigeonite grains. Olivine appears to be recrystallized to small up to 15 μm sized crystallites and pigeonite grains display patchy compositional zoning. Olivine shows characteristic reduced rims. The meteorite also contains flaky graphite.

Geochemistry: Reduced rims in olivine: $\text{Fa}_{6.4-14.0}$; olivine contains 0.43 ± 0.08 wt% Cr_2O_3 and 0.29 ± 0.05 wt% CaO

Jinchang 001 38°24'45.56"N, 102° 2'48.71"E

Gansu, China

Find: 22 Aug 2015

Classification: Ordinary chondrite (H~6)

History: (Ziyao Wang) Discovered by Wang Ziyao in a Gobi desert area of Yongchang county, 15 km SW of Jinchang city, Gansu province, on Aug. 22, 2015.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Black-brown stone of 813 g with rusty fusion crust with adhering sand grains.

Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, recrystallized matrix with poorly defined chondrules and irregular metal and sulfide specks up to 0.6 mm

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.27$

Classification: Ordinary chondrite (H~6, W2)

Specimens: 20.5g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 114.8 g with *Bart*.

Karimati 25°54'N, 80°10'31"E

Uttar Pradesh, India

Confirmed fall: 28 May 2009

Classification: Ordinary chondrite (L5)

History: Around noon on 28 May 2009, an eyewitness in the village of Karimati heard a roaring sound and a blackish stone fell near a wall in his house, 1.5 m away from him. The fall created an 18 × 15 cm oval-shaped pit in the ground. Out of fear, villagers put the stone in a water tank for about 72 hrs. When the local authorities came to know about it, they took the material in their possession. Dr. H.C. Verma (*IIT*) visited the place on June 2, following a newspaper report and took possession of the sample. Dr. Verma sent the meteorite to *PRL*, and it was then transferred to *GSI*.

Physical characteristics: The stone is covered with a black crust, except on one face, where a piece has been broken off by the villagers. The sample has rounded to sub-rounded edges. Regmaglypts are also observed. A few chondrules are visible by naked eye.

Petrography: The meteorite is composed of olivine + orthopyroxene + feldspathic glass (plagioclase composition) + Fe-Ni metals (kamacite and taenite) + troilite ± apatite ± merrillite. Clinopyroxene is rare. The chondrules are composed of olivine and orthopyroxene, whereas the interstitial spaces (mesostasis) are occupied by feldspathic glass. Chondrule range up to 1000 μm in diameter. The shape of chondrules varies from near circular to elliptical to sub-elliptical. Barred olivine (BO), granular pyroxene (GP), porphyritic olivine (PO), porphyritic olivine pyroxene (POP) and granular olivine (GO) chondrules are present. Matrix is relatively fine grained and thoroughly recrystallized in which a feldspathic melt mosaic is disseminated. The feldspathic melt (plagioclase composition) is fine grained (<50 μm), patchy and interconnected in the matrix. At places it forms melt veins. The matrix is also brecciated. Troilite forms rim around kamacite grains.

Classification: Ordinary chondrite (L5)

Specimens: Main mass at *GSI*.

Kumtag 040 41°53'15.67"N, 93°55'44.80"E

Xinjiang, China

Find: 18 Aug 2012

Classification: Ordinary chondrite (LL~4)

History: (Ziyao Wang) Discovered by Wang Ziyao in the Gobi Desert, 4 km E of Yamansu Town, near Hami city in Xinjiang province on Aug. 18, 2012.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) One dark-brown, stone broken into two pieces that fit together, totaling 560 g. No fusion crust recognizable.

Petrography: (R. Bartoschewitz, *Bart*) Gray, brecciated texture of microcrystalline matrix with well-defined deformed chondrules up to 2 mm and irregular metal and sulfide specks up to 0.5 mm.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.44$

Classification: Ordinary chondrite (LL~4, W1)

Specimens: 22.7 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 54.4 g with *Bart*.

La'gad 002 27°14'25.7"N, 8°50'49.5"W

Saguia el Hamra, Western Sahara

Find: 2004

Classification: Pallasite (Main group, anomalous)

History: Near the end of 2004, Michael Farmer visited a site at the northeastern corner of Western Sahara in search of a newly discovered pallasite - www.meteoriteguy.com/catalog/almahbas.htm. This site yielded several large masses of a deeply weathered pallasite. In addition, Mr. Farmer collected and acquired several small fresh looking pallasite stones from the same site. The relationship between the large weathered masses and fresh stones is unknown. This pallasite is sold and traded under the name "Al Mahbas". The total mass of the weathered material is in the many kg range, whereas only a few grams, probably <100 g of the fresh stones was collected. *ASU* acquired one of the fresh stones upon which this classification is based.

Physical characteristics: Dark rounded stone with olivine grains visible at the surface.

Petrography: Cut, polished, and etched surface shows the following minerals (areal%) 70% metal, 20% olivine, and 5% troilite and schreibersite. Olivine grains are small (<5 mm) and well-rounded. They are light green and glassy clear. One grain contains oriented linear inclusions. Metal composed of approximately 50:50 kamacite:plessite. Kamacite mostly swathing the olivine. Troilite highly shocked and fine grained. Where troilite and olivine are in contact, the olivine appears brecciated and fragments are distributed throughout the troilite. Interior of the plessite composed of ~75% kamacite and 25% tetrataenite. Within the plessite, the kamacite is dominated by anhedral grains typically 5 to 15 microns across.

Geochemistry: (J. Wasson, *UCLA*) Metal composition by INAA (mean of two analyses) Ni=76.8 mg/g, Co=5.64 mg/g, Cr=11 µg/g, Cu=164 µg/g, Ga=20.6 µg/g, As=22.8 µg/g, Ru=0.8 µg/g, W=0.2 µg/g, Re=121 ng/g, and Ir=1.42 µg/g. The Ni concentration is the lowest PMG ever measured by *UCLA*; however, in pallasites Ni is strongly affected by random variations in the kamacite/taenite ratios. Our Ni replicates scattered (90.5 and 63.0 mg/g). The Ir content is the fifth highest in a PMG. No other PMG is closely similar to La'gad 002; the closest is Marjalahti,

which also has high Ir (2.1 $\mu\text{g/g}$) and relatively low Ni (88 mg/g, the eighth lowest). (K. Ziegler, *UNM*): Analyses of 2 acid-washed olivine subsamples by laser fluorination dual inlet mass spectrometry gave, respectively $\delta^{17}\text{O}$ 1.68, 1.777; $\delta^{18}\text{O}$ 3.623, 3.861; $\Delta^{17}\text{O}$ -0.295, -0.262 per mil (reference TFL slope = 0.528, values are linearized). (L. Garvie, *ASU*) EPMA analyses of eight olivine grains $\text{Fa}_{13.8\pm 0.1}$, $\text{FeO/MnO}=42.0\pm 1.8$, Cr_2O_3 to 0.05 wt%.

Classification: Main-group pallasite-anomalous. This stone is likely paired with [NWA 10015](#), [NWA 10023](#), [NWA 10252](#) and [NWA 11720](#) based on the similar Fa and oxygen isotopic values and the high proportion of plessite. The anomalous designation is based on the high proportion of plessitic metal, similar to that in NWA 10023, 10252 and 11720.

Lop Nur 003 40°5'N, 90°12'E

Xinjiang, China

Find: 2017

Classification: Ordinary chondrite (H~5)

History: (Ziyao Wang) Purchased by Wang Ziyao from Zhao Tailu (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2017. This meteorite was discovered in the Lop Nur dense collection area in 2017. The reported coordinates were read from a map provided by the finder.

Physical characteristics: (Ziyao Wang) Black-brown stone of 27.2 g with fusion crust and adhering sand grains

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (0.2-0.9 mm, av. 0.4 mm)

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.55$

Classification: Ordinary chondrite (H~5, W1)

Specimens: 5.8 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 5.0 g with *Bart*.

Los Vientos 212 (LoV 212) 24°38.765'S, 69°53.048'W

Antofagasta, Chile

Find: 2017 Feb 21

Classification: HED achondrite (Eucrite, polymict)

History: Found by driving on small hills while meteorite prospecting.

Physical characteristics: Crusted stone. Cut surface reveals light grey interior with darker clasts to 5 mm.

Petrography: (Jérôme Gattacceca, *CEREGE*) Brecciated igneous rocks with clasts of varied textures (variolitic, subophitic, granulitic) set in a clastic matrix of plagioclase and pyroxene with typical grain size 20 μm . Some pyroxene in the matrix are zoned, others not, others are exsolved. Other minerals: FeNi metal, troilite, chromite, ilmenite, silica polymorph.

Geochemistry: Clastic matrix: low-Ca pyroxene $Fs_{31.2\pm 8.5}Wo_{1.2-8.2}$, $Fe/Mn=34.2$ (N=7), plagioclase $An_{90.5}Ab_{8.8}Or_{0.7}$ (N=1). Granulitic clasts: low-Ca pyroxene $Fs_{56.0\pm 0.6}Wo_{4.3\pm 0.3}$, $FeO/MnO=31.5$, plagioclase $An_{80.0}Ab_{18.8}Or_{1.3}$ (N=2). Variolitic clasts: low-Ca pyroxene $Fs_{56.9}Wo_{5.0\pm 1.1}$, $FeO/MnO=35.6$ (N=3), plagioclase $An_{89.0}Ab_{10.1}Or_{0.9}$ (N=2).

Classification: eucrite-pmict

Specimens: Type specimen at *CEREGE*. Main mass with Sergey Vasiliev.

Los Vientos 231 (LoV 231) $24^{\circ}39.116'S, 69^{\circ}53.708'W$

Antofagasta, Chile

Find: 2017 Feb 21

Classification: Ordinary chondrite (LL7)

History: Found by a six-person team who were driving on small hills while meteorite prospecting.

Petrography: (J. Gatacceca, *CEREGE*) Highly recrystallized texture. Main minerals are olivine, pyroxene (to 200 μm), plagioclase (to 100 μm). No discernible chondrules. FeNi metal is rare. Troilite is almost entirely replaced by terrestrial weathering products.

Geochemistry: Olivine $Fa_{31.1}$ (N=1). Low-Ca pyroxene $Fs_{25.7\pm 0.0}Wo_{2.0\pm 0.3}$ (N=3)

Classification: LL7. Type 7 designation from texture, absence of chondrules and low-Ca pyroxene Wo content.

Specimens: Type specimen and polished section at *CEREGE*. Main mass with Sergey Vasiliev.

Los Vientos 250 (LoV 250) $24^{\circ}41.093'S, 69^{\circ}50.533'W$

Antofagasta, Chile

Find: 8 Feb 2018

Classification: HED achondrite (Diogenite)

Physical characteristics: Single stone partially covered by fusion crust with flow lines. Sawn surface shows a yellowish-orange interior with abundant opaque grains and metal.

Petrography: Thin section shows pyroxene (95 vol%) grains up to 6 mm in the long dimension with abundant shock veins. Chromite spinel grains (3 vol%) are well scattered through the sample and measure up to 3 mm and are usually associated to iron oxide. Metal grains (2 vol%) are in the range 1-3 mm. Olivine occurrence is rare. Additional minerals are Si polymorphs, FeS and Ti-spinel.

Geochemistry: Low-Ca pyroxene composition in the range $Fs_{23.2-23.5}Wo_{0.9-1.2}$ (mean $Fs_{23.4\pm 0.2}Wo_{1.0\pm 0.2}$, N=8), with $FeO/MnO=26.0\pm 1.2$. Mean olivine composition is $Fa_{35.3\pm 0.2}$ (N=2). Chromite exhibits $Cr/(Cr+Al)$ values of 0.82 ± 0.05 (N=8). Metal is Ni-free. No plagioclase has been found in the section studied.

Los Vientos 258 (LoV 258) $24^{\circ}41'S, 69^{\circ}46'W$

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2
3 Antofagasta, Chile

4 Find: 2017 Nov

5 Classification: Ordinary chondrite (L6)

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7 **Petrography:** (J. Gattacceca, *CEREGE*) Brecciated chondrite with abundant shock
8 veins and cm size melt pockets. The melt pockets contain abundant μm sized
9 FeS/FeNi eutectic droplets. Plagioclase size $>50 \mu\text{m}$.

10
11 **Classification:** L6. Likely paired with [Los Vientos 014](#).

12 **Specimens:** Type specimen at *CEREGE*. Main mass with *ARTMET*.
13
14

15
16 **Loulan Yizhi 008** ~40°30'N, ~89°54'E

17 Xinjiang, China

18 Find: 2013

19 Classification: Ordinary chondrite (H~5)

20
21 **History:** (Ziyao Wang) Purchased by Wang Ziyao from Bi Chunlin (Tangshan
22 City, Hebei) in Bayingol/Xinjiang in 2013. This meteorite was discovered in the
23 Lop Nur area, close to the ruins of Loulan Yizhi in 2013.

24
25 **Physical characteristics:** (Wang Ziyao) Black-brown stone of 29.3 g

26
27 **Petrography:** (R. Bartoschewitz, *Bart*) Brown stained recrystallized matrix with
28 poor defined chondrules (0.2-1.1 mm, av. 0.4 mm). Metal and sulphide are nearly
29 complete oxidized and vugs are filled with gypsum.

30
31 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.77$

32
33 **Classification:** Ordinary chondrite (H~5, W4)

34
35 **Specimens:** 5.9 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 5.9 g
36 with *Bart*.
37
38

39 **Mackay Glacier 14005** (MCY 14005) 77°13.981'S, 158°13.450'

40 Antarctica

41 Find: 2015 Jan 15

42 Classification: Enstatite chondrite (EL6)

43
44 **History:** A $6 \times 5 \times 5$ cm stone was found during the XXX PNRA Italian
45 expedition, 2014-2015

46
47 **Physical characteristics:** Rounded shape, 80% crusted stone with a broken tip ($6 \times$
48 5×5 mm)

49
50 **Petrography:** (M. Salvini, M. Gemelli, T. Di Rocco, *DST-PI*) The meteorite
51 consists largely of prismatic (mainly subhedral) or granular enstatite (grain size
52 0.2-0.4 mm) and Fe-Ni metal, with minor amount of sulfides and plagioclase and a
53 silica phase. Only vague traces of chondritic structure are discernable in thin
54 section: in fact, only two poorly-defined relict chondrules (diameter of 0.8 and 1.5
55 mm) are visible. The sulfide phases are troilite, alabandite, daubreelite and
56 oldhamite. Schreibersite and osbornite (TiN) have also been identified. No olivine
57 has been found. Plotting our average mineral compositions on the diagrams of
58 Zhang et al. (1995), we conclude that the meteorite is an EL6 chondrite.
59
60

Geochemistry: (M. Salvini, M. Gemelli, T. Di Rocco EMP at *IGG-CNR Padua*) Enstatite ($\text{Fs}_{0.2-0.8}\text{En}_{98-98.3}\text{Wo}_{1.4-1.5}$), plagioclase ($\text{Ab}_{80.5}\text{An}_{15.0}\text{Or}_{4.15}$), metal (Fe 93.5, Ni 6.6, Si 0.9). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.51$.

Classification: Enstatite chondrite (EL6)

Specimens: Main mass (172.1g), type specimen and one thin section (*MNA-SI*).

Mahbas Arraid 27°38.333'N, 9°28.124'W

Guelmim Smara, Western Sahara

Probable fall: 2013 Dec 9

Classification: Ordinary chondrite (LL6)

History: (H. Chennaoui Aoudjehane *FSAC*, H. Lharbi) A fireball fall was reported in the southern part of Morocco by many eyewitnesses from Assa, Zag and Al Mahbes area on 9 December 2013 around 6:30 pm GMT. Ali Houmida, Cheggef, Jdi and many other Moroccan hunters, as well as people from the area, saw the fireball lasting several ". Collection of the testimonies of the fireball and their conciliation indicate a bolide moving from the northeast to southwest. The meteor terminated above the area south of Mahbas Aaraid. Three sonic booms were reported. Meteorite hunters traveled to the expected fall site as indicated by meteor termination. No meteorites were found, and hunting was stopped after a few days. In the beginning of September 2014 (nine months latter after the fireball), Fatma, a young nomad girl found two black stones, totally different from all the other rocks in the area. After news of the find spread, several meteorite hunters returned to the area and collected more pieces. Samples of this meteorite were sent to the Hassan II University of Casablanca Morocco by H. Lharbi on 30 December 2014 for classification. To date, the total known mass is about 5500 g. The meteorite is known under the name of "Al Mahbes" by Moroccan hunters.

Physical characteristics: Many fresh full stones with fusion crust. The interior is brecciated with clear and dark-gray clasts surrounded by lighter-colored regions. Neither troilite nor metal grains are clearly visible.

Petrography: Polished mount shows recrystallized matrix with a few poorly defined barred chondrules. Olivine and opx are fractured (mm-sized clasts). Plagioclase occurs as irregular grains to 0.1 mm. Troilite and taenite are evenly distributed in grains to 0.1 mm. Accessory chromite and ilmenite.

Geochemistry: Olivine $\text{Fa}_{26\pm 0.4}$ (N=15); Opx $\text{Fs}_{25\pm 0.2}\text{Wo}_{2\pm 0.3}$ (N=11); Cpx $\text{Fs}_{10\pm 1}\text{Wo}_{44\pm 1}$ (N=5); plagioclase $\text{An}_{10\pm 0.2}\text{Or}_{5\pm 1}$ (N=7); taenite Ni52. Short-lived cosmogenic isotopes were measured by P. Weber at La Chaux de Fonds (La Vuedes-Alpes underground laboratory, Switzerland; Gonin et al 2003). Measurement was on a sample of 27.23 g during 6 days in April 2015, 478 days after the fireball. Long- and short-lived cosmogenic radionuclides were measured. The presence and amount of short-lived isotopes support a fall around the time of the witnesses fireball. ^{26}Al 43.6 ± 2.2 , ^{22}Na 79.4 ± 4.5 ; ^{54}Mn 47.1 ± 3.2 , all calculated at 9 December 2013; the other short lived isotopes: ^{57}Co < 1.5 ; ^{46}Sc < 1.0 ; ^{56}Co < 3.0 ; ^{58}Co < 0.8 ; ^{51}Cr < 6.2 ; ^{48}V < 1.3 . The $^{22}\text{Na}/^{26}\text{Al}$ ratio calculated at the time of the fireball 1.82 (compared to [Mreira](#) 2.4 or [Tissint](#) 2.3) is compatible with the estimated time

1
2
3 of fall. The activity of the cosmogenic isotopes was calculated according to the
4 method described in [Weber et al. \(2017\)](#), with 3-sigma statistical errors. A 10%
5 additional systematic uncertainty is estimated.
6

7 **Classification:** LL6, brecciated

8 **Specimens:** 26 g (21.4+3.9+1.6) provided by Hamza Lharbi and 24.1 g provided
9 by Aaras Jonikas to *FSAC*.
10
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12

13 **Malotas (b)** 28°56'S, 63°14'W

14 Santiago del Estero, Argentina

15 Find, doubtful fall: 22 Jun 1931

16 Classification: HED achondrite (Eucrite)

17 **History:** On the morning of 22 June 1931, a meteorite fall was reported in the
18 province of Santiago del Estero, Argentina. Samples were given to Professor Juan
19 Olsacher (Cordoba University) who decided to travel to the place of the fall and
20 collect some pieces. Many of the studied pieces were H5 ordinary chondrites,
21 named [Malotas](#). However, during a visit to the small meteorite collection at *MMG-*
22 *Cordoba* in 2015, Maria Eugenia Varela discovered two very different looking
23 stones labeled as "Malotas, 1931" in the showcase. Recognizing that one of the
24 stones was not an ordinary chondrite, Varela, in agreement with the director of the
25 museum, made a detailed study of these stones. One of the samples was a piece of
26 the ordinary chondrite, Malotas; the second one turned out to be a eucrite. The
27 director of *MMG-Cordoba* provided Varela with a copy of Prof. Olsacher's paper,
28 entitled: The meteorite of Salavina, 1931, in which he clearly indicates that the fall
29 consisted of two different types of rocks (translated Spanish text, see [attached pdf](#)):
30 "This meteorite, which represents a case of 'stone rain' is made up of fragments
31 that correspond to two different types based on their composition and structure: one
32 is chondritic, composed by olivine and pyroxene with abundant metallic minerals;
33 the second one is feldspar-rich with scarce presence of the previous components
34 and with an ophitic texture (1). (1) This feldspar-rich meteorite is mainly composed
35 of anorthite with few olivine and troilite grains. As we do not have enough
36 bibliography concerning feldspar-rich meteorites I have left the description for a
37 complementary publication, to the one presented now in which only the chondrite
38 is studied."
39

40 **Physical characteristics:** Single 62.4 g stone covered by fresh shiny fusion crust.

41 **Petrography:** The meteorite is a monomict breccia, mainly composed of pyroxene
42 (pigeonite, often with augite lamellae) and plagioclase with coarse- and fine-
43 grained domains. Accessory phases include: troilite, silica-polymorphs, ilmenite,
44 chromite, F-apatite, merrillite, and zircon. There are only few shock features, with
45 some minerals showing faint undulatory extinction. One of the thin sections
46 (sample belonging to the *NHMV*) show a small melt vein. The state of shock is
47 minimal. The rock is unaltered.

48 **Geochemistry:** Mineral composition and geochemistry: (J. Roszjar; *NHMV*)

49 Electron Microprobe examination of two polished mounts show very similar
50 plagioclase and pyroxene composition for the coarse- and fine-grained areas. Low-
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Ca pyroxene $\text{Fs}_{62.5\pm 0.8}\text{Wo}_{2.23\pm 0.9}$, $n=96$; Ca-rich Pyroxenes $\text{Fs}_{26.9\pm 0.9}\text{Wo}_{43.9\pm 1}$, $n=96$. The composition of the rock-forming plagioclase is $\text{An}_{82.1\pm 3.4}$, $n=110$ with minor, secondary anorthitic plagioclase with $\text{An}_{95.7\pm 2.7}$, $n=50$. Spinel composition is chromite ($\text{Chr}_{0.74}\text{Her}_{0.18}$), $n=124$. Oxygen Isotopes (R. Tanaka, *OkaU*): A cleaned sample was analyzed by laser fluorination. Replicate analyses are, respectively, $\delta^{17}\text{O}$ of 1.785 and 1.775 permil; $\delta^{18}\text{O}$ of 3.779 and 3.787 permil; $\Delta^{17}\text{O}$ of -0.208 and -0.222 permil.

Classification: Basaltic eucrite, type 4 (based on the chemical composition of spinels and characteristic of pyroxenes that are also diagnostic for this thermal metamorphic classification). Because this meteorite is fresh and the ordinary chondrite Malotas is weathered, this eucrite may actually be the meteorite that fell on June 22, 1931, and the ordinary chondrite may be an unrelated find. This hypothesis remains untested. Henceforth, Malotas (a) will be a synonym for the Malotas H5 chondrite.

Specimens: Type specimen of 20 g in deposit at the *MLP* and three thin sections are on deposit at *ICATE*. One thin section and another sample mount are in deposit at *NHMV*. The main mass is at the *MMG-Cordoba*.

Mangui 22°2'6"N, 100°10'29"E

Yunnan, China

Confirmed fall: 1 June 2018

Classification: Ordinary chondrite (L6)

History: A fireball was witness seen around 9 pm in Xishuangbanna region of Yunnan province on June 1, 2018. A piece of meteorite with black fusion crust broke through a farmer's silt-roofed house. A number of pieces of the meteorite varying from 1 to 100s of g have been found by several farmers from Manlun, Manyan, Manlang villages from June 2 to 9. The largest mass (for which coordinates are provided) weighs 1.28 kg and was found near the village of Mangui.

Physical characteristics: Most fragments are partially or fully covered with black fusion. Thin black shock-induced melt veins can be seen in the exposed areas of most samples.

Petrography: (S. Hu, Y. Lin and J. Ji, *IGGCAS*; Q. Zhou, *NAOC*; Li Ye, *PMO*) Equilibrated ordinary chondrite texture with poorly defined chondrules and strongly recrystallized matrix. Main minerals are olivine, pyroxene, plagioclase (maskelized), Fe-Ni metal, and troilite, with minor chromite, chlorapatite and whitlockite. Secondary feldspar grains are 50-100 μm in size. Shock veins and melt pockets are observed.

Geochemistry: Mineral compositions and geochemistry: (S. Hu, Y. Lin and J. Ji, *IGGCAS*; Q. Zhou, *NAOC*) The olivine and pyroxene have homogeneous chemical compositions. Olivine $\text{Fa}_{25.0\pm 0.6}$ ($n=109$), orthopyroxene $\text{Fs}_{21.1\pm 0.3}\text{Wo}_{1.6\pm 0.3}$ ($n=66$).

Classification: Ordinary chondrite, L6 S5

Specimens: Type specimens at *PMO* (45 g) and *IGGCAS* (35 g). Main mass with various Chinese meteorite collectors.

Maryborough 37°05'21"S, 143°44'32"E

Victoria, Australia

Find: 2015 May

Classification: Ordinary chondrite (H5)

History: Found 2 km south of Maryborough.

Petrography: (A. Tomkins, *Monash*) Chondrule edges are indistinct, matrix and chondrule mesostases are strongly recrystallised, and plagioclase grains are up to 50 μm across, but mostly less than 20 μm . Discernible chondrule varieties include RP, BO, PO, PP, POP. Olivine has sharp optical extinction, there are irregular fractures and no melt pockets. About 20% of the metal has been destroyed by rusting, whereas most troilite remains.

Geochemistry: (W. Birch, *Vic*) Microprobe analyses: olivine $\text{Fa}_{19.3\pm 0.5}$ (n=24); Low-Ca pyroxene $\text{Fs}_{17.1\pm 0.5}\text{Wo}_{1.4}$ (n=27).

Classification: Ordinary Chondrite (H5, S1, W1)

Mazichuan 36.693°N, 108.30°E

Shaanxi, China

Confirmed fall: 2016 Sept 16

Classification: HED achondrite (Diogenite)

History: On 16 September 2016, at about 15:00 local time, many residents from several villages heard an airplane-like noise followed by three loud sonic booms. A woman in Mazichuan witnessed dusty smoke rising from a hillside 100 m away from her home. She went to the hillside and picked up a black stone in a hole. She then knocked off a corner of the stone and found greenish crystals inside. The stone was abandoned outside her yard and later picked up by her neighbor. Photos of the stone with black fusion crust and greenish crystals appeared on an amateur meteorite website in November 2016. A Chinese meteorite collector (Wang Ziyao) contacted the holders. He went to the fall site three times (April, June, and September 2017) and did a thorough investigation. Mr. Wang confirmed the fall account. A total of three stones (1302, 1100, and 880 g) were recovered by residents. The largest was bought from a local villager by a meteorite hobbyist (Liu Yukun) on December 1, 2017.

Physical characteristics: The hand specimen is covered with a fresh black fusion crust. Numerous mm-sized greenish crystals can be seen on the exposed section.

Petrography: A monomict breccia mainly consisting of coarse-grained orthopyroxene (a few mm) set in a fine-grained matrix of orthopyroxene. Accessory minerals are chromite, sulfide, FeNi metal and silica. Anorthite was not found.

Geochemistry: Orthopyroxene grains have very homogeneous compositions regardless their grain size. Orthopyroxene ($\text{Fs}_{20.9-22.5}\text{Wo}_{1.3-2.2}$), Fe/Mn (cation ratio) range from 25.2 to 33.6 with an average of 29.8 ± 2.1 ($n=32$).

Specimens: 36 g at *PMO*, a 1.3 kg mass with Mr. Liu Yukun, and two other masses are in the possession of local finders.

Mount Yirtkuq Bulak 001 (MYB 001) 41°26'20.91"N, 90°42'25.67"E

XinJiang, China

Find: 01 May 2015

Classification: Ordinary chondrite (H~6)

History: (Ziyao Wang) The meteorite was discovered by Xu Jianjiang (Hami/Xinjiang), one of four meteorite hunters, in the Gobi Desert about 100 km N of Lop Nur, near the Paergang pass in Shanshan county, Tulufan city, Xinjiang province on May 1, 2015.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Dark-brown stone of 540 g, partly covered with fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, recrystallized porous matrix with poorly developed chondrules (0.3-2 mm) and few irregular metal specks.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.30$

Classification: Ordinary chondrite (H~6, W3)

Specimens: 22.4 g on deposit at *Kiel*, Xu Jianjiang (Hami/Xinjiang) holds the main mass, 80 g with Wang Ziyao, and 63.4 g with *Bart*.

Mukundpura 26°52'52.5''N, 75°39'53.7''E

Rajasthan, India

Fall: June 6, 2017

Classification: Carbonaceous chondrite (CM2)

History: A meteorite weighing approximately 2 kg fell in Mukundpura village at 05:15 hrs on June 6, 2017, on sandy soil in the agricultural field of Mr. Banshi Ram. The impact formed a nearly circular crater of ~40 cm diameter with a depth of 15 cm. Upon impact, the stone shattered into several large pieces and multiple gram and subgram-sized fragments. Mr. Banshi Ram observed a bright red-yellow colored burning fragment fall with a thundering sound about 100 m away from his house. They informed the nearby Bhankrota police station, where the large pieces were deposited. The fall of meteorite in the Mukundpura Village was reported in the media. Dr. Anil D. Shukla and Dr. D. Ray visited the fall site two days after the fall and acquired some fragments from the local villagers, with the help of police.

Physical characteristics: The meteorite is covered in well-developed matte fusion crust with a few broad regmaglypts. The interior of the stone is dark black with an abundance of small white spots. There are various clasts (angular to rounded and up to 4 cm across) embedded in the dark colored matrix.

Petrography: The modal abundances averaged from three thick sections include chondrule (~15%), matrix (~70%), refractory inclusions (~2%), carbonates (~7%), Fe-Ni metal (~2%), and sulfides (~4%). Matrix is dominated by serpentine with lesser tochilinite.

Geochemistry: The Fa content of granular porphyritic olivine chondrule is uniform and highly forsteritic (Fa<1, SD=0.13, n=16). The Fa content of barred olivine chondrule is ferroan and composition ranges Fa₃₂₋₃₃(SD=0.06, n=11). The Cr₂O₃ of granular and barred olivine is almost indistinguishable and ranges 0.36 to 0.61 wt%. The Fe/Mn ratios of type IIA chondrule follow the similar trend to the CO chondrites. The bulk chemical composition of Mukundpura chondrite was analysed using XRF and Q-ICPMS. The major oxides of Mukundpura show a very good match with [Murchison](#) and [Paris](#) CM carbonaceous chondrite. Following XRF data in wt%: SiO₂ 29.5, TiO₂ 0.13, Al₂O₃ 1.3, Fe₂O₃ 32.4, MnO 0.22, MgO 17.4, CaO 1.7, Na₂O 0.59, K₂O 0.05, and P₂O₅ 0.21.

Classification: CM2 chondrite fall.

Specimens: Type specimen 30.5 g at *PRL*. Main mass ~2000 g with *GSI* (Based on the report on *GSI* web portal).

Mürtschenstock 47°4.285'N, 9°9.023'E

Glarus, Switzerland

Find: 2017 Jul 17

Classification: Ordinary chondrite (L6)

History: A black stone was found by Andreas Stucki on the return from a mountain hike during a chance meeting with another independently hiking person, Iris Landolt, who witnessed the discovery.

Physical characteristics: Single stone with dimensions 10.1 × 5.7 × 5.0 cm. The stone is nearly completely covered by black matte fusion crust. Small areas of approx. 1 cm square show exposed interior material, which is of yellowish brown color. The volume based on a shape model is 108.38 cm³, yielding a bulk density of 3.27 g/cm³.

Petrography: (B. Hofmann, E. Gnos): The rock shows a strongly recrystallized texture with poorly delineated large chondrules well recognizable. Typical size of plagioclase grains is 50-150 μm. Chromites are up to 0.6 mm in size, ilmenite is common, up to 0.1 mm. Shock stage is S4 based on partially mosaicized olivine and partially maskelynitized plagioclase. Some shock veins are present and show metal-troilite globules in silicate matrix. Weathering is low (W1), thickness of (hydr)oxide rims on metal ranges from a few μm to 100 μm.

Geochemistry: Electron microprobe analysis (E. Reusser, *ETH*) yielded: Olivine Fa_{24.4±0.4} (Fa_{24.0-26.7}; n=48); low-Ca pyroxene Fs_{20.6±0.4}Wo_{1.5±0.3} (Fs_{20.2-22.2}Wo_{0.9-2.1}; n=52); high-Ca pyroxene Fs_{7.2±0.8}Wo_{45.8±1.0} (Fs_{6.5-8.4}Wo_{44.3-46.8}, N=9). Cosmogenic radionuclides: (Å. Rosén, *Bern/GeMSE*): Gamma-spectroscopy performed in August-September 2017 showed no detectable short-lived radionuclides (²²Na <0.5 dpm/kg), the ²⁶Al activity was 52.2(+4.6,-4.8) dpm/kg. The fall must have occurred before the year 2000.

Classification: All available data are consistent with a classification as L ordinary chondrite, petrographic grade 6, shock stage S4, low weathering (W1).

Specimens: 70 g and one polished thin section at *ETH*.

Nagara 35°26'33.9"N, 136°46'51.5"E

Chubu, Japan

Find: 2012 Oct

Classification: Iron meteorite (IAB-MG)

History: A 6.5 kg piece of iron was discovered by Mr. K. Mitsumura in October, 2012, among stones plowed from his chestnut yard in Nagara, Gifu city, Gifu prefecture, Japan. Mr. Mitsumura took the specimen to his home and kept it till June, 2017. Eventually, he considered that it might be a meteorite and the specimen was brought by his friend Mr. H. Iwasa to S. Kawakami at Gifu Shotoku Gakuen Univ. Then, the specimen was sent to T. Mikouchi, *UTok* for identification. A second 9.7 kg mass was found later.

Physical characteristics: The 6.5 kg mass has an exterior with several rounded ridges and shows a brownish dark surface color coated by rust.

Petrography: Polished sections (all ca. 12 × 6 mm in sizes) show no Widmanstätten pattern and >95% of the sections consist of kamacite with veins of terrestrial weathering products (up to 0.5 mm wide). Rare schreibersite is present at the interior of such weathered veins. Taenite is present as small elongated grains (~0.1 mm wide and ~0.5 mm long) with less than 0.1% abundance.

Geochemistry: Electron microprobe analysis (T. Mikouchi, *UTok*): Fe=92.0-94.5, Ni=5.5-6.5 and Co=0.55-0.65 for kamacite (N=549), Fe=45-54, Ni=30-38 and P=15 for schreibersite (N=26), and Fe=61-65, Ni=34-39 and Co=0.1-0.2 for taenite (N=9). LA-ICP-MS data (A. Yamaguchi, *NIPR* and N. Shirai at Tokyo Met. U.): Ni=6.10, (in wt%); Ir=4.25, Ga=91.6, Ge=402, Au=1.58 (all µg/g, average of ~5 mm long 4 traverses on the section).

Classification: IAB-MG

Specimens: *UTok*: 52.7 g slice (after cutting of small chips for polished mounts) and *NIPR*: 3 polished mounts

Nanbaxian 001 37°59'2.07"N, 94°18'6.72"E

Qinghai, China

Find: 07 June 2016

Classification: Ordinary chondrite (L~4)

History: (Ziyao Wang) On June 7, 2016, the farmer Xu Zhong (Huzhu/Qinghai) and his colleges discovered a strange rock while they were on a desert walk about 0.5 km WNW of Nanbaxian village, Dachaidan Town, Qinghai province. Wang Ziyao purchased the complete stone in 2018.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Reddish-brown, heavily fractured, irregular rock of 3784 g without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, microcrystalline matrix with well developed chondrules (0.2-2 mm) and few metallic specks.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.83$

Classification: Ordinary chondrite (L~4, W3)

Specimens: 22.2 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 103.5 g with *Bart*.

Ngare Sero 2°37.845'S, 35°53.353'E

Arusha, Tanzania

Find: 9 Sept 2017

Classification: Ordinary chondrite (L5)

History: Meteorite (2233 g) was found 9 Sept 2017 by Kirill Vlasov and Artyom Akshintsev while returning to the field camp from Ngare Sero village. The date of fall is unknown.

Physical characteristics: Total mass is 2233 g. Meteorite has roughly rounded shape. The surface and interior is light with dark brown crust up to 2 mm due to desert weathering. Cracks (up to 0.1 mm in thickness) occur in external part of meteorite.

Petrography: Classified by P. Yu. Plechov, *FMMR*. Petrographic observation of a polished section shows clearly delineated chondrules in a coarse recrystallized matrix. Chondrules are relatively rare and their sizes vary from 500 to 1200 μm . They have quenched or porphyritic texture, rarely cryptocrystalline, and consist of Ol+Pl, Opx+Pl, Ol+Opx+Cpx+Pl or Opx+Cpx+Pl. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix. Plagioclase grains are larger than 50 μm . This indicates a petrological type of 5 for the meteorite. Olivine has no undulatory extinction, as well as the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Fresh FeNi metals and troilite (up to 200 μm) occurs in recrystallized matrix. Some taenite-kamacite aggregates have thin rims of Fe-hydroxide. Kamacite-taenite-troilite aggregates (up to 20 μm) are observed in some cryptocrystalline chondrules. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi-metals and troilite near meteorite surface. Olivine, pyroxene, chromite and troilite are fresh and not weathered (weathering grade – W1). Clinopyroxene, chromite, chlorapatite and merrillite (up to 200 μm) occur locally in the matrix.

Geochemistry: EDS-WDS analyses (P. Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $\text{Fa}_{25.24\pm 0.6}$ (N=28), orthopyroxene $\text{Fs}_{22.8\pm 0.53}\text{Wo}_{1.66\pm 0.35}$ (N=19), plagioclase $\text{Ab}_{80.2}\text{An}_{10.6}\text{Or}_{6.3}$ (N=11), Cr-bearing clinopyroxene $\text{En}_{47.8}\text{Fs}_{8.1}\text{Wo}_{43.9}$ (N=6), chromite $\text{Crt}_{76.6\pm 4.5}\text{Spl}_{10.5\pm 1.3}$ (N=14), chlorapatite and merrillite. Chlorapatite contains Cl – 5.26 wt.% (N=5). Merrillite has wide range in FeO content (0.54-2.92 wt.%, N=13). Composition of kamacite (in wt.%, N=8): Fe 92.3 ± 0.67 , Ni – 6.3 ± 0.7 , Co – 1.45 ± 0.17 . Troilite is close to ideal FeS. Rare goethite contains 4.2-6.8 wt.% NiO and up to 1.12 wt.% CoO.

Classification: Ordinary chondrite. L5, S1, W1

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3 **Specimens:** 2127 g – Kirill Vlasov; 106 g cut-offs and thin section – *FMMR*.
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7 **Northwest Africa 431** (NWA 431)

8 (Northwest Africa)

9 Purchased: 2003

10 Classification: Ordinary chondrite (H6)

11 **Petrography:** Chondrules are recrystallized and poorly defined. Olivine exhibits
12 undulose extinction, but lacks planar fractures. Plagioclase grains are ~50 µm
13 across. There are chromite-plagioclase assemblages and small chromite veinlets
14 present.
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19 **Northwest Africa 432** (NWA 432)

20 (Northwest Africa)

21 Purchased: 2003

22 Classification: Ordinary chondrite (H3)

23 **Petrography:** Chondrules are sharply defined, but none contain isotropic
24 mesostases. Low-Ca pyroxene phenocrysts exhibit prominent polysynthetic
25 twinning. Olivine grains have sharp optical extinction.
26
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28 **Classification:** H3 (estimated subtype 3.7/3.8).
29
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32 **Northwest Africa 435** (NWA 435)

33 (Northwest Africa)

34 Purchased: 2003

35 Classification: Ordinary chondrite (H4)

36 **Petrography:** Chondrules are well defined. Olivine exhibits sharp optical
37 extinction. Chondrules range in diameter from 0.25 to 2.7 mm.
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42 **Northwest Africa 436** (NWA 436)

43 (Northwest Africa)

44 Purchased: 2003

45 Classification: Ordinary chondrite (L6)

46 **Petrography:** Chondrules are recrystallized and poorly defined. Olivine exhibits
47 undulose extinction; some grains contain planar fractures. Plagioclase grains range
48 up to ~120 µm across. Weathering veins traverse the sample.
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53 **Northwest Africa 438** (NWA 438)

54 (Northwest Africa)

55 Purchased: 2003

56 Classification: Ordinary chondrite (LL5)

57 **Petrography:** Chondrules are recrystallized, but readily discernable. Olivine
58 exhibits undulose extinction, but lacks planar fractures. Chondrules range up to 1.6
59
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3 mm in diameter. Many metal and troilite grains are 200-800 μm across. Some
4 troilite grains are polycrystalline.
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8 **Northwest Africa 451** (NWA 451)

9 (Northwest Africa)

10 Purchased: 2003

11 Classification: Ordinary chondrite (H5)

12 **Petrography:** Numerous weathering veins transect the meteorite. A few patches of
13 clay are present. More than 99% of the metal and troilite grains have been
14 weathered to form oxide. Olivine exhibits undulose extinction. Chondrules are well
15 defined.
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21 **Northwest Africa 452** (NWA 452)

22 (Northwest Africa)

23 Purchased: 2003

24 Classification: Ordinary chondrite (H4)

25 **Petrography:** A few metal grains contain some small, irregular grains of troilite.
26 Chondrules are well defined. Olivine exhibits sharp optical extinction. A few
27 chondrules are surrounded by thin rings of troilite. About 75% of the metal grains
28 have been weathered to form oxides.
29
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33 **Northwest Africa 453** (NWA 453)

34 (Northwest Africa)

35 Purchased: 2003

36 Classification: Ordinary chondrite (H4)

37 **Petrography:** More than 99% of the metal and troilite grains have been weathered
38 to form oxide. Some clay is present. Numerous weathering veins transect the
39 meteorite. Chondrules are well defined. Olivine exhibits undulose extinction. Some
40 low-Ca pyroxene phenocrysts exhibit polysynthetic twinning.
41
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46 **Northwest Africa 454** (NWA 454)

47 (Northwest Africa)

48 Purchased: 2003

49 Classification: Ordinary chondrite (L6)

50 **Petrography:** Some metal grains are elongated. A few chondrules are surrounded
51 by troilite-rich rims. Some metal grains contain small, irregular grains of troilite.
52 The troilite is polycrystalline. Chondrules are recrystallized and poorly defined.
53 Some plagioclase grains are 50-80 μm in size. Some olivine grains exhibit weak
54 mosaic extinction.
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60 **Northwest Africa 660** (NWA 660)

1
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3 (Northwest Africa)

4 Purchased: 2001

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6 Classification: Ordinary chondrite (H4)

7 **Petrography:** The sample contains elongated metal grains; some metal grains
8 contain small, irregular grains of troilite. Some kamacite and troilite grains are
9 polycrystalline. Chondrules are well defined. Olivine exhibits weak mosaic
10 extinction.
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15 **Northwest Africa 669** (NWA 669)

16 (Northwest Africa)

17 Purchased: 2001

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19 Classification: Ordinary chondrite (L6)

20 **Petrography:** Chondrules are recrystallized and poorly defined. A few plagioclase
21 grains reach 100 μm in diameter. Olivine has undulose extinction. Silicate-rich
22 shock veins ($\sim 50 \mu\text{m} \times 6 \text{mm}$) including small metal blebs cut across the meteorite.
23 Also present are small metal and sulfide veins. Some coarse metal grains are
24 elongated. The sample was probably shocked and annealed.
25
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29 **Northwest Africa 671** (NWA 671)

30 (Northwest Africa)

31 Purchased: 2001

32
33 Classification: Ordinary chondrite (L6)

34 **Petrography:** Olivine exhibits weak-to-moderate mosaic extinction. Chondrules
35 are recrystallized and poorly defined. Plagioclase grains range up to 120 μm in size.
36 Maskelynite is absent. Metal grains are coarse, averaging $\sim 400 \mu\text{m}$. Some metal
37 grains contain a few small, irregular grains of troilite.
38
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41 **Northwest Africa 674** (NWA 674)

42 (Northwest Africa)

43 Purchased: 2001

44
45 Classification: Ordinary chondrite (L5)

46 **Petrography:** Chondrules are moderately recrystallized, but readily delineated.
47 Olivine exhibits undulose extinction, but lacks planar fractures. About 95% of the
48 metal grains have been oxidized.
49
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53 **Northwest Africa 787** (NWA 787)

54 (Northwest Africa)

55 Purchased: 2001 Mar

56
57 Classification: Ordinary chondrite (L3-6)

58 **History:** Purchased by Michael Farmer in March 2001 from a dealer in Casablanca,
59 Morocco.
60

Petrography: (A. Irving and S. Kuehner, *UWS*; A. Rubin, *UCLA*) Breccia composed predominantly of type-6 chondrite clasts exhibiting some remnant chondrules in a recrystallized matrix containing stained metal and merrillite. Sparse, isolated enstatite-rich chondrules are present in this breccia, but no forsterite-rich chondrules were observed in the studied thin section.

Geochemistry: Olivine ($\text{Fa}_{24.3-27.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.4}\text{Wo}_{1.1}$, $N=2$), enstatite in one unequilibrated chondrule ($\text{Fs}_{2.1}\text{Wo}_{0.7}$), clinopyroxene ($\text{Fs}_{1.4}\text{Wo}_{40.3}$).

Classification: Ordinary chondrite (L3-6, brecciated). Contains a few isolated enstatite-rich chondrules.

Specimens: 90 g including one polished thin section at *UCLA*; 5.89 g at *PSF*; remainder with Farmer.

Northwest Africa 1088 (NWA 1088)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (H6)

Petrography: Numerous weathering veins cut across the sample. Some chondrules are readily discernable; others are poorly defined. Some plagioclase grains are between 50 and 80 μm across. Olivine exhibits undulose extinction. Some troilite grains are elongated.

Northwest Africa 1089 (NWA 1089)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (H5)

Petrography: There are rapidly cooled, cellular, metal-troilite assemblages. Some metal and sulfide grains are elongated. Chondrules are recrystallized; some are readily discernable; others are poorly defined. Plagioclase grains average $\sim 20 \mu\text{m}$ in size. Olivine exhibits weak mosaic extinction. Some low-Ca pyroxene grains display shock-induced polysynthetic twinning.

Northwest Africa 1091 (NWA 1091)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (L4)

Petrography: Several chondrules are partly surrounded by troilite-rich rims. Some metal grains contain small, irregular grains of troilite. Troilite is polycrystalline. Some metal and sulfide grains are elongated. Most chondrules are well defined, but some appear recrystallized. Some olivine grains contain planar fractures; a few olivine and low-ca pyroxene grains exhibit weak mosaic extinction.

Northwest Africa 1095 (NWA 1095)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (L5)

Petrography: Some metal grains are elongated and form parts of discontinuous veins. Small grains of metallic Cu are present within some metal grains. Some metal grains contain small, irregular grains of troilite. Chondrules are recrystallized, but readily discernable. Plagioclase grains average ~20 μm in size. Olivine exhibits weak mosaic extinction. Some low-Ca pyroxene grains exhibit shock-induced polysynthetic twinning.

Northwest Africa 1096 (NWA 1096)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (LL3)

Petrography: Many chondrules are surrounded by thin rims of troilite±metal. A few metal grains contain small, irregular troilite grains. Thin metal and sulfide veins also occur. Thin weathering veins are also present. Chondrules are very sharply defined. Some chondrules contain patches of brown isotropic mesostases. Olivine exhibits weak mosaic extinction. Some low-Ca pyroxene phenocrysts exhibit polysynthetic twinning.

Classification: LL3 (estimated subtype 3.5).

Northwest Africa 1099 (NWA 1099)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (L4)

Petrography: Metal and sulfide grains are elongated; some metal grains contain small irregular grains of troilite. Chondrules are well defined. A few low-Ca pyroxene grains exhibit polysynthetic twinning. No glassy mesostases occur. Olivine grains exhibit weak mosaic extinction.

Northwest Africa 1108 (NWA 1108)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (L6)

Petrography: Some metal and sulfide grains are elongated. Metal and sulfide veins are present. Chondrules are poorly defined and very recrystallized. Some plagioclase grains are 50 μm in size. A few olivine grains contain planar fractures.

Northwest Africa 1292 (NWA 1292)

(Northwest Africa)

Purchased: Aug 2001

Classification: Carbonaceous chondrite (CO3)

History: Purchased by G. and A. Hupe in August 2001 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed small chondrules (apparent diameter $190 \pm 100 \mu\text{m}$) together with mineral fragments and fine grained CAI are set in a sparse matrix ($\sim 15 \text{ vol.}\%$) containing stained kamacite and minor pleonaste.

Geochemistry: Olivine ($\text{Fa}_{0.5-39.9}$, Cr_2O_3 in ferroan examples 0.06-0.76 wt.%, mean $0.19 \pm 0.28 \text{ wt.}\%$, $N = 7$), orthopyroxene ($\text{Fs}_{1.4}\text{Wo}_{2.9}$), pigeonite ($\text{Fs}_{6.5}\text{Wo}_{5.7}$), clinopyroxene ($\text{Fs}_{0.5-9.4}\text{Wo}_{49.3-49.0}$, $N = 2$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 21.7 g including one polished thin section at *PSF*; 11.3 g at *UCLA*; remainder with *GHupé*.

Northwest Africa 1723 (NWA 1723)

Morocco

Find: unknown

Classification: Ordinary chondrite (L3)

Petrography: Olivine $\text{Fa}_{22.9}$, range Fa_{10-24} , PMD 6% ($n=17$) with average 0.05 wt% CaO. Low-Ca pyroxene $\text{Fs}_{19.4}$, range Fs_{13-20} , PMD 15% ($n=15$). Plagioclase $\text{Ab}_{95}\text{Or}_2$ ($n=10$). Metal includes kamacite, taenite and possible tetrataenite. Troilite and chromite are abundant. Contains a 2-cm sized dark inclusion.

Northwest Africa 2424 (NWA 2424)

(Northwest Africa)

Purchased: 2016

Classification: Martian meteorite (Shergottite)

Physical characteristics: Fresh, unstained, 20% covered by dull, smooth fusion crust, remaining surfaces polished by ventifaction. Cut appearance: uniform gray, fine-grained.

Petrography: (P. Warren, *UCLA*) The rock consists of about 20% olivine phenocrysts, up to 1 mm (2 mm as glomerocrysts), in a much finer-grained pyroxene-dominated groundmass. The minor feldspathic phase is entirely maskelynite.

Geochemistry: Mineral compositions and geochemistry: Olivines are zoned from $\text{Fa}_{21.5}$ to Fa_{50} . Groundmass pyroxene compositions fan out from $\text{Fs}_{26}\text{Wo}_{3.7}$ toward $\text{Fs}_{25}\text{Wo}_{28}$ and $\text{Fs}_{44}\text{Wo}_{11}$. Pyroxenes in melt inclusions within olivine are systematically more magnesian, e.g., $\text{Fs}_{21}\text{Wo}_{28}$. Pyroxene FeO/MnO (wt.) averages 30.0 ± 2.4 . Maskelynite ($N=31$) is An_{44-54} , average $\text{An}_{51.5}$. Bulk composition results from INAA and fused-bead EPMA include Ga = 14.4 ppm, $\text{Al}_2\text{O}_3 = 5.1 \text{ wt}\%$; this Ga/Al ratio confirms shergottite affinity.

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3 **Classification:** Shergottite.
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7 **Northwest Africa 2425** (NWA 2425)

8 (Northwest Africa)

9 Purchased: 2016

10 Classification: Lunar meteorite (feldspathic breccia)

11 **Physical characteristics:** Weathered, red caliche stain, dull, no fusion crust, etched
12 by ventifaction. Cut appearance: near-black matrix with gray clasts.

13 **Petrography:** (P. Warren, *UCLA*) The rock is a thoroughly polymict lunar
14 highland breccia, mostly plagioclase, with clasts up to 10 mm but dominated by
15 extremely fine-grained chaotic impact debris. A search for regolithic glass
16 spheroids found only one, 0.2 mm, very round and undevitrified.

17 **Geochemistry:** Mineral compositions and geochemistry: Plagioclase: $An_{95.9\pm 1.3}$
18 (N=19). Low-Ca pyroxene: $Fs_{33\pm 8}Wo_{4.3\pm 0.9}$ (N=11), high-Ca pyroxene:
19 $Fs_{17\pm 4}Wo_{40\pm 2}$ (N=7). Pyroxene FeO/MnO (wt.) averages 55 ± 8 (N=24). Bulk
20 composition results from INAA and fused-bead EPMA include $Al_2O_3 = 27.1$ wt%,
21 $Mg\# = 73$ mol%, Th = 0.13 ppm. The glass spheroid is similarly anorthositic (26
22 wt% Al_2O_3).
23

24 **Classification:** The meteorite is a lunar highland polymict breccia.
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31 **Northwest Africa 2426** (NWA 2426)

32 (Northwest Africa)

33 Purchased: 2016

34 Classification: HED achondrite (Eucrite, cumulate)

35 **Physical characteristics:** Weathered, red caliche stain, 80% covered by glossy
36 fusion crust showing flow lines and scales. Cut appearance: mottled gray matrix
37 with both lighter and darker gray clasts; one large (~12 mm) clast with white
38 feldspar and deep brown mafic silicates.

39 **Petrography:** (P. Warren, *UCLA*) The rock is dominated by pyroxene and
40 plagioclase. Its texture is for the most part severely brecciated and fine-grained, but
41 scattered clasts preserve vestiges of a medium-grained (1-3 mm) equigranular
42 igneous texture.

43 **Geochemistry:** Mineral compositions and geochemistry: Low-Ca pyroxene: $Fs_{37\pm 3},$
44 $Wo_{3.5\pm 0.9}$ (N=35), high-Ca pyroxene: $Fs_{15.5\pm 2}Wo_{43\pm 1}$ (N=10). Pyroxene
45 FeO/MnO (wt.) averages 28 ± 3 . Plagioclase: $An_{92.5\pm 0.8}$ (N=11). Scattered tiny metals
46 have Ni at margin of EPMA detectability: very approximately 0.04 wt%, along
47 with 0.23 ± 0.16 wt% Co (N=10). Bulk composition results from INAA and fused-
48 bead EPMA include $Al_2O_3 = 12.5$ wt%, $Mg\# = 62$ mol%, Sm = 0.6 ppm. Despite
49 obscuration of texture by brecciation, high $Mg\#$ and low REE indicate cumulate
50 origin.
51

52 **Classification:** Brecciated cumulate eucrite.

53 **Specimens:** manifestly paired stones of 254, 232 and 144 g.
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Northwest Africa 2637 (NWA 2637)

(Northwest Africa)

Purchased: 2004

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Adam *Hupé* in 2004 from a dealer in Erfoud, Morocco.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter $710 \pm 510 \mu\text{m}$, $N = 18$) plus sparse, amoeboid very fine grained CAI are set in a fine grained matrix (orange-brown in thin section). Andradite garnet was observed in one CAI.**Geochemistry:** Olivine ($\text{Fa}_{0.6-57.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.7-51.2}\text{Wo}_{0.5-2.5}$, $N = 2$), clinopyroxene ($\text{Fs}_{0.8}\text{Wo}_{39.0}$).**Classification:** Carbonaceous chondrite (CV3).**Specimens:** 14.4 g including one polished thin section at *PSF*; remainder with *AHupé*.**Northwest Africa 2650** (NWA 2650)

Morocco

Find: 2004

Classification: HED achondrite (Eucrite, monomict)

History: A 2224 g complete stone that measures 189 mm \times 112 mm \times 82 mm at the widest points, with fresh crust was purchased in Erfoud, Morocco**Petrography:** The meteorite has a texture of brecciated meteorite, with coarse-grained gabbro eucrite fragments and coarse-grained mineral fragments embedded in relatively fine-grained matrix composed of pyroxene and plagioclase fragments. Both shock-induced melt veins and pockets are observed. Mineralogically, this meteorite consists mainly of coarse-grained plagioclase (up to 7 mm) and pyroxenes (up to 5 mm). Other minerals include silica phase, chromite, ilmenite, troilite, and zircon. Almost all of the pyroxene grains exhibit exsolution lamella. Extensive albite, Carlsbad, and complex igneous twinning occur in plagioclase.**Geochemistry:** The coarse-grained minerals in the coarse-grained gabbro eucrite fragments have compositions almost identical to those in the relatively fine-grained matrix. Orthopyroxene host ($\text{En}_{37.2 \pm 0.7}\text{Fs}_{60.1 \pm 1.5}\text{Wo}_{2.7 \pm 1.3}$, $\text{Fe}/\text{Mn} = 29.9 \pm 0.7$, $n = 14$), augite exsolution lamella ($\text{En}_{29.7 \pm 0.4}\text{Fs}_{26.4 \pm 0.5}\text{Wo}_{43.9 \pm 0.5}$, $\text{Fe}/\text{Mn} = 29.8 \pm 1.8$, $n = 14$), plagioclase ($\text{An}_{90.5 \pm 1.5}\text{Ab}_{9.2 \pm 1.4}$, $n = 17$), and chromite ($\text{Cr}/(\text{Cr} + \text{Al}) = 0.79 \pm 0.01$, $n = 8$).**Northwest Africa 2730** (NWA 2730)

(Northwest Africa)

Purchased: 2004

Classification: Ordinary chondrite (L6)

History: A stone of several hundred grams was purchased by Mike Farmer and Jim *Strope* in 2004 from a dealer in Erfoud, Morocco, and a 24.5 g specimen was

submitted to Dr. Ted Bunch for classification. The whereabouts and exact weight of the original main mass are unknown, but the 24.5 g specimen was acquired by the Planetary Studies Foundation and subsequently classified at the University of Washington.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules. Accessory merrillite and chlorapatite are present.

Geochemistry: Olivine ($\text{Fa}_{24.8-24.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.6-20.9}\text{Wo}_{1.5-1.4}$, $N = 2$), clinopyroxene ($\text{Fs}_{8.3-8.5}\text{Wo}_{45.1-44.3}$, $N = 2$).

Classification: Ordinary chondrite (L6).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 2887 (NWA 2887)

(Northwest Africa)

Purchased: 2016

Classification: HED achondrite (Eucrite)

Physical characteristics: Weathered, slight red caliche stain, 90% covered by dull black fusion crust.

Petrography: (P. Warren, *UCLA*) The rock is dominated by pyroxene and plagioclase. Its texture is unbrecciated and for the most part fine-grained, but uncommonly heterogeneous: locally coarse (laths up to 4 mm), and elsewhere locally equigranular with 120-degree triple junctions.

Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene: $\text{Fs}_{57.5\pm 0.3}\text{Wo}_{6.3\pm 0.2}$ ($N=7$), high-Ca pyroxene: $\text{Fs}_{28.8\pm 0.1}\text{Wo}_{41.5\pm 0.2}$ ($N=3$). Plagioclase: 5 analyses, range $\text{An}_{89.4-92.0}$. For trace metal component, a single analysis found 0.34 wt% Co, 0.04 wt% Ni. Bulk composition results from INAA and fused-bead EPMA include $\text{Al}_2\text{O}_3 = 12.5$ wt%, $\text{Mg}\# = 40$ mol%, $\text{Sm} = 1.9$ ppm.

Classification: The meteorite is a eucrite.

Specimens: manifestly paired stones of 570, 275 and 42 g.

Northwest Africa 4669 (NWA 4669)

(Northwest Africa)

Purchased: 2006

Classification: Carbonaceous chondrite (CV3)

History: In 2006, A. Pani purchased a single stone of 369 g in Erfoud, Morocco.

Physical characteristics: The stone is a compact rock with a wind-polished surface of grayish-black color. Fusion crust is not present.

Petrography: (F. Brandstätter, *NHMV*) The meteorite consists mainly of abundant chondrules (mean diameter 1.05 mm), minor AOAs and CAIs set in a fine-grained matrix. CAIs (fine-grained) are sparse and on average small (<2-3 mm). The matrix is dominated by Fe-rich olivine, magnetite, minor pentlandite, and very rare metal grains.

Geochemistry: Chondrule olivine ($\text{Fa}_{0.2-31.3}$, mean $\text{Fa}_{6.7}$, $N=68$), matrix olivine ($\text{Fa}_{8.9-63.8}$, mean $\text{Fa}_{47.3}$, mean $\text{NiO} = 0.09$ wt%, $N = 26$), magnetite ($\text{Al}_2\text{O}_3 = 1.18$ wt%, $\text{Cr}_2\text{O}_3 = 0.31$ wt%, $\text{TiO}_2 = 0.15$ wt%, $\text{NiO} = 0.05$ wt%, $N = 10$)

Classification: Carbonaceous chondrite (CV3)

Specimens: 21.7 g is on deposit at *NHMV*. *Pani* holds the main mass.

Northwest Africa 4838 (NWA 4838)

(Northwest Africa)

Purchased: 2006

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Marcin Cimala in 2006 from a dealer in Erfoud, Morocco, and subsequently acquired by *ROM*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter 500 ± 300 μm , $N = 15$) and fine-grained CAI are set in a very fine-grained matrix (~ 40 vol.%, black in thin section).

Geochemistry: Olivine ($\text{Fa}_{0.1-37.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.4-0.5}\text{Wo}_{1.0-0.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{1.0}\text{Wo}_{28.0}$), Al-Ti-diopside ($\text{Fs}_{0.8}\text{Wo}_{59.0}$, $\text{Al}_2\text{O}_3 = 19.9$ wt.%, $\text{TiO}_2 = 2.0$ wt.%).

Classification: Carbonaceous chondrite (CV3).

Specimens: All material from this stone including one polished thin section is at *ROM*.

Northwest Africa 5693 (NWA 5693)

(Northwest Africa)

Purchased: 2007

Classification: Pallasite

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Brownish, strongly altered individual lacking any fusion crust.

Petrography: The meteorite is composed of large up to 1 cm sized olivine crystals set into a matrix of iron oxides or hydroxides. Olivine is often crosscut by veins filled with brownish/reddish alteration products. No primary Fe-Ni metal was detected

Geochemistry: Olivine: $\text{Fa}_{13.1 \pm 0.1}$ ($\text{Fa}_{12.9-13.4}$, $\text{FeO/MnO} = 32-46$, $n=19$)

Classification: Pallasite

Northwest Africa 5908 (NWA 5908)

(Northwest Africa)

Purchased: 2007

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was purchased from a Moroccan meteorite dealer on the mineral fair in Munich, Germany.

Physical characteristics: Small dark-grayish individual partly covered with fusion crust.

Petrography: The meteorite is a fragmental breccia composed of basaltic clasts and up to 1 cm sized black impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and plagioclase grains about 20 to 300 μm in size. Few matrix pyroxenes display magmatic zoning. Minor phases include chromite, ilmenite, pyrrhotite, silica and metallic iron.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{42.1\pm 3.6}\text{Wo}_{2.1\pm 0.3}$ ($\text{Fs}_{34.7-45.8}\text{Wo}_{1.8-3.0}$, $n=12$, $\text{FeO/MnO}=36-42$); Ca-pyroxene: $\text{Fs}_{27.1\pm 1.0}\text{Wo}_{40.8\pm 1.3}$ ($\text{Fs}_{26.1-29.0}\text{Wo}_{37.9-42.1}$, $n=12$, $\text{FeO/MnO}=31-36$); calcic plagioclase: $\text{An}_{87.6\pm 1.8}$ ($\text{An}_{84.1-90.0}$, $n=14$)

Northwest Africa 6023 (NWA 6023)

(Northwest Africa)

Purchased: 2009

Classification: Brachinite-an

History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark brownish rock with patches of fusion crust.

Petrography: A polished surface of the meteorite shows sub-mm sized shiny crystals. It displays an equilibrium texture of 200-300 μm sized olivine (about 90 vol.%), some Ca-pyroxene and chromite typically showing triple junctions between adjoining crystals. Nearly all olivine crystals are surrounded by fine-grained intergrowths of low-Ca pyroxene and metallic Fe. Strikingly, olivine shows pronounced reduced rims and the meteorite contains flaky graphite. No plagioclase has been detected.

Geochemistry: olivine: $\text{Fa}_{32.3\pm 0.7}$ ($\text{Fa}_{30.4-32.9}$, $n=14$, $\text{CaO}=0.11\pm 0.02$, $\text{Cr}_2\text{O}_3=0.03\pm 0.01$, $\text{FeO/MnO}=70\pm 5$); reduced rims in olivine: $\text{Fa}_{12.6-16.2}$; Ca-pyroxene: $\text{Fs}_{11.4\pm 0.2}\text{Wo}_{43.3\pm 0.3}$ ($\text{Fs}_{11.1-11.8}\text{Wo}_{42.6-43.8}$, $n=13$, $\text{FeO/MnO}=35\pm 3$); Oxygen isotopes (K. Ziegler, UNM): material analyzed by laser fluorination gave: $\delta^{18}\text{O}=5.162, 5.226, 4.838, 5.110$; $\delta^{17}\text{O}=2.445, 2.491, 2.269, 2.402$; $\Delta^{17}\text{O}=-0.281, -0.268, -0.285, -0.296$ (all per mil)

Classification: Brachinite-anomalous. Mineral chemistry, high abundance of olivine, equilibrium texture and oxygen isotopes are consistent with classification as brachinite, but reduced rims and high graphite-content are typical of ureilites.

Northwest Africa 6263 (NWA 6263)

(Northwest Africa)

Purchased: 2010

Classification: Ordinary chondrite (L3)

History: Purchased by Carsten Giessler in 2010 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, fairly closely packed chondrules (apparent diameter $680\pm 350\ \mu\text{m}$, $N = 12$) are set in a finer matrix (dark brown in thin section).

Geochemistry: Olivine ($\text{Fa}_{4.7-26.5}$, Cr_2O_3 in ferroan examples 0.03-0.06 wt.%, mean 0.05 ± 0.01 wt.%, $N = 5$), orthopyroxene ($\text{Fs}_{9.2-12.9}\text{Wo}_{0.9-1.1}$, $N = 2$), subcalcic augite ($\text{Fs}_{9.0}\text{Wo}_{32.5}$). Magnetic susceptibility $\log \chi (\times 10^{-9}\ \text{m}^3/\text{kg}) = 4.46$.

Classification: Ordinary chondrite (L3).

Specimens: 23 g including one polished thin section at *UWB*; remainder with Mr. C. Giessler.

Northwest Africa 6308 (NWA 6308)

(Northwest Africa)

Purchased: 2009

Classification: Primitive achondrite (Brachinite)

History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark-brownish rock without fusion crust.

Petrography: A sawn surface of the meteorite shows up to 1 mm sized shiny crystals. It displays an equilibrium texture of equally sized olivine (about 80 vol.%) and orthopyroxene with abundant triple junctions between adjoining crystals. Along the grain boundaries symplectic exsolutions of orthopyroxene and Fe-sulfides are frequently observed. Minor phases are chromite and some phosphates.

Geochemistry: olivine: $\text{Fa}_{28.5\pm 0.4}$ ($\text{Fa}_{27.8-29.2}$, $n=20$, $\text{FeO}/\text{MnO}=63\pm 4$); low-Ca pyroxene: $\text{Fs}_{25.4\pm 0.1}\text{Wo}_{2.2\pm 0.1}$ ($\text{Fs}_{25.1-25.6}\text{Wo}_{2.0-2.3}$, $n=20$, $\text{FeO}/\text{MnO}=44\pm 3$)

Classification: Mineral chemistry, high abundance of olivine, equilibrium texture and grain size are consistent with classification as brachinite.

Northwest Africa 6827 (NWA 6827)

(Northwest Africa)

Purchased: 2008

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Twenty five brownish fragments lacking any fusion crust.

Petrography: The meteorite shows a dark brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are dominantly porphyritic type I and have an apparent mean diameter of about 0.2 mm. Some sulfides and FeNi metal are present in matrix and chondrules.

Northwest Africa 7055 (NWA 7055)

(Northwest Africa)

Purchased: 2007 Jan

Classification: Carbonaceous chondrite (CK4/5)

History: Purchased by Dr. David *Gregory* in January 2007 from a dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen consisting of separated chondrules (apparent diameter 0.2-2.0 mm) containing Cr-magnetite set within a relatively coarse grained matrix. The texture is transitional between type 4 and type 5.

Geochemistry: Olivine ($\text{Fa}_{30.9-31.1}$, $N = 2$), orthopyroxene ($\text{Fs}_{25.4-26.3}\text{Wo}_{0.5-0.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.4-11.2}\text{Wo}_{46.5-42.6}$, $N = 2$), one exotic ferroan olivine grain ($\text{Fa}_{62.7}$).

Classification: Carbonaceous chondrite (CK4/5).

Specimens: The entire specimen plus a polished thin section and polished thick section at *ROM*.

Northwest Africa 8406 (NWA 8406)

(Northwest Africa)

Purchased: 2013 Feb

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Marc Jost in February 2013 from a dealer in Rissani, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Medium sized, granular chondrules together with some amoeboid, fine to medium grained CAIs in a brown matrix.

Geochemistry: Olivine ($\text{Fa}_{0.4-16.8}$; Cr_2O_3 in ferroan olivine = 0.06-0.28 wt.%, mean 0.05 ± 0.02 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{0.8-13.8}\text{Wo}_{0.9-3.5}$, $N = 3$), diopside ($\text{Fs}_{0.8-0.9}\text{Wo}_{47.3-46.0}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 24 g including one polished thin section at *UWB*. The remaining material is held by *SJS*.

Northwest Africa 8671 (NWA 8671)

(Northwest Africa)

Purchased: 2014 May

Classification: HED achondrite (Eucrite)

History: Purchased in Morocco by Ali and Mohammed *Hmani* in May 2014 and said to have been found near Foug El Hisn, Morocco.

Physical characteristics: Single stone (164.2 g) lacking fusion crust. The fresh interior is relatively coarse grained and composed of subequal amounts of dark gray pyroxene and beige plagioclase.

Petrography: (A. Irving and S. Kuehner, *UWS*) This is a very unusual specimen consisting of dispersed, angular domains of coarse, polygranular, birefringent,

1
2
3 calcic plagioclase separated by regions of recrystallized clinopyroxene. The
4 plagioclase domains have irregular geometric shapes with re-entrant angles, and
5 exhibit marginal reaction zones against clinopyroxene composed of ferropigeonite
6 plus fayalitic olivine. The main regions of clinopyroxene contain numerous
7 irregularly distributed, small patches with two distinctly different compositions:
8 one low in Ca and the other higher in Ca. No high-Ca augite was found. Accessory
9 minerals are silica polymorph, Al-bearing chromite and troilite.

10
11 **Geochemistry:** Low-Ca pyroxene (Fs_{47.9-49.1}Wo_{5.5-4.4}, FeO/MnO = 28-29, N = 3),
12 pigeonite (Fs_{36.3-34.7}Wo_{10.8-7.6}, FeO/MnO = 26-28, N = 3), ferropigeonite rims
13 (Fs_{52.5-55.5}Wo_{21.6-16.5}, FeO/MnO = 30, N = 2), fayalite (Fa_{82.2-82.9}, FeO/MnO = 39),
14 plagioclase (An_{91.4-93.0}Or_{0.1}, N = 2). Oxygen isotopes (K. Ziegler, UNM): acid-
15 washed subsamples analyzed by laser fluorination gave $\delta^{17}\text{O} = 1.736, 1.642, 1.694$;
16 $\delta^{18}\text{O} = 3.847, 3.688, 3.776$; $\Delta^{17}\text{O} = -0.295, -0.305, -0.300$ per mil

17
18 **Classification:** Eucrite (unbrecciated, partially melted). The overall texture and
19 reaction zones on plagioclase aggregates are unique among eucrites, and indicate
20 that this specimen underwent a partial melting event subsequent to its igneous
21 crystallization.

22
23 **Specimens:** 20.1 g including one polished thin section at *UWB*. The remainder is
24 held by *Hmani Inc.*

25 26 27 28 29 30 **Reclassification of Northwest Africa 8671** (NWA 8671)

31 (Northwest Africa)

32 Find: 2014

33
34 **Classification:** Eucrite (anomalous). The disequilibrium textures in this specimen
35 are unique among eucrites and the absence of high Ca augite is very unusual.
36 Furthermore, the oxygen isotope composition plots to more negative $\Delta^{17}\text{O}$ values
37 than for all other analyzed eucrites.

38 39 40 41 **Northwest Africa 8676** (NWA 8676)

42 (Northwest Africa)

43 Purchased: 2014 May

44 Classification: Carbonaceous chondrite (CO3)

45
46 **History:** Purchased by John Higgins in May 2014 from a dealer in Laayoune,
47 Morocco.

48
49 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Small chondrules ($230 \pm 130 \mu\text{m}$,
50 $N=20$) and rare, very fine-grained CAI in a sparse, brown matrix (40 vol%) rich in
51 ferroan olivine and containing sparse altered kamacite, taenite and troilite.

52
53 **Geochemistry:** Olivine (Fa_{0.7-43.4}; Cr₂O₃ in ferroan olivine 0.07-0.19 wt.%, $N = 7$),
54 orthopyroxene (Fs_{0.9-6.3}Wo_{0.9-4.4}, $N = 3$), clinopyroxene (Fs_{2.0-4.0}Wo_{47.2-45.2}).

55
56 **Classification:** Carbonaceous chondrite (CO3).

57
58 **Specimens:** 9 g including one polished thin section at *UWB*. The remaining
59 material is held by Mr. J. Higgins.

Northwest Africa 8681 (NWA 8681)

(Northwest Africa)

Purchased: 2014 Jun

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Sergey Vasiliev from a Moroccan dealer at the Ensisheim Show in June 2014.**Physical characteristics:** Single stone (590 g) with a light reddish-brown weathered exterior. The interior is dark gray with whitish clasts visible.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia consisting of gabbroic eucrite clasts set in a very dark brown matrix containing related crystal debris plus minor unexsolved pigeonite. Gabbroic eucrite clasts are composed of exsolved pigeonite (commonly with wavy clinopyroxene exsolution lamellae), polycrystalline calcic plagioclase, silica polymorph, chromite, ilmenite and Ni-free metal. Secondary minerals from terrestrial weathering include, barite, calcite and iron hydroxides.**Geochemistry:** Orthopyroxene host crystals ($\text{Fs}_{61.0-62.2}\text{Wo}_{4.4-2.1}$, $\text{FeO/MnO} = 32-35$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{26.8-28.3}\text{Wo}_{43.6-42.5}$, $\text{FeO/MnO} = 30-33$, $N = 3$), pigeonite ($\text{Fs}_{36.2}\text{Wo}_{5.6}$, $\text{FeO/MnO} = 23$).**Classification:** Eucrite (brecciated). Likely paired with [NWA 7989](#), [NWA 8036](#), [NWA 8588](#) and related stones.**Specimens:** 24.8 g including one polished thin section at *UWB*; main mass with Mr. S. Vasiliev.**Northwest Africa 8781** (NWA 8781)

(Northwest Africa)

Purchased: 2014 Jul

Classification: Carbonaceous chondrite (Ungrouped)

History: Several black stones found together near Fom Zguid, Morocco, in July 2014 were purchased by Rachid Chaoui and were subsequently sold to Stefan *Ralew* and Darryl Pitt.**Petrography:** (A. Irving and S. Kuehner, *UWS*, L. Garvie, *ASU*) Composed of very small chondrules ($210 \pm 60 \mu\text{m}$, $N=20$) and small mineral fragments in a black, very fine-grained matrix ($\sim 50 \text{ vol.}\%$). No phyllosilicates were detected by powder-XRD in the matrix. No CAI were observed. Minerals are olivine, orthopyroxene, diopside, stained kamacite and troilite.**Geochemistry:** Olivine ($\text{Fa}_{1.1-70.7}$, Cr_2O_3 in ferroan examples = 0.21-0.40 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{1.0-7.0}\text{Wo}_{1.2-0.4}$, $N = 3$), diopside ($\text{Fs}_{2.1}\text{Wo}_{40.8}$; $\text{Fs}_{0.4}\text{Wo}_{48.2}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of five 1-2 mg acid-washed non homogenized subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -10.020, -9.832, -6.298, -5.897, -4.490; $\delta^{18}\text{O}$ -6.085, -5.472, -1.822, -0.895, 1.221; $\Delta^{17}\text{O}$ -6.807, -6.943, -5.336, -5.424, -5.135 (all per mil). These compositions plot on the CCAM trend, but distinctly below the trend for CO chondrites

Classification: Carbonaceous chondrite (ungrouped). This specimen is not a CV3 chondrite (chondrule size much too small, no CAI), not a CK chondrite (no magnetite), not a CO3 chondrite (oxygen isotopes are different, no CAI), and not a CM chondrite (matrix apparently anhydrous, oxygen isotopes displaced to more ^{16}O -rich compositions). Therefore it seems to be an ungrouped carbonaceous chondrite.

Specimens: 20.1 g including one polished thin section at *UWB*; 170 g with *Kuntz*; other samples with Mr. S. *Ralew* and *DPitt*.

Northwest Africa 8791 (NWA 8791)

(Northwest Africa)

Purchased: 2011 Jun

Classification: Rumuruti chondrite (R3-5)

History: Purchased by Fabien *Kuntz* in June 2011 from a Moroccan dealer at the Ensisheim Show.

Physical characteristics: Single stone (241 g) with an overall light-brown color and composed of small clasts in a finer-grained matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of equilibrated Type 5 clasts (containing sparse chondrules), separated well-formed, forsterite-bearing Type 3 chondrules ((apparent diameter $470\pm 210\ \mu\text{m}$)) and angular mineral fragments in a finer grained matrix (orange-brown in thin section). Accessory minerals include Ti-V-Al-bearing chromite, troilite, Ni-bearing pyrrhotite and minor altered kamacite.

Geochemistry: Olivine in Type 5 clasts ($\text{Fa}_{39.2-39.9}$, $N = 3$), magnesian olivine in Type 3 chondrules ($\text{Fa}_{3.2-4.5}$, $N = 2$), orthopyroxene ($\text{Fs}_{2.2-30.3}\text{Wo}_{0.2-3.2}$, $N = 3$), augite ($\text{Fs}_{27.7}\text{Wo}_{39.2}$; $\text{Fs}_{12.1}\text{Wo}_{44.0}$, $N = 2$), fayalite ($\text{Fa}_{71.4}$).

Classification: R3-5 chondrite.

Specimens: 21.2 g plus one polished thin section at *PSF*; 21.29 g at *MGC*; main mass with *Kuntz*.

Northwest Africa 11112 (NWA 11112)

Morocco

Find: 2016

Classification: Ungrouped achondrite

History: Purchased by Ke Zuokai in Dec. 2016 from a Moroccan dealer.

Physical characteristics: The meteorite has a black fusion crust and partially covered by weathering products.

Petrography: A polished mount shows a medium-grained rock (mostly 0.1-1 mm) with granular texture. It is composed of ~47% olivine and ~42% pyroxene with intersertally ~4% plagioclase and 7% opaque minerals (FeNi metal, sulfide and chromite). No relic chondrules. Not brecciated.

Geochemistry: The compositions of olivine, pyroxene and plagioclase are quite uniform. Olivine $\text{Fa}_{36.4-38.5}$, $\text{Fe/Mn}=80.2-108.1$; orthopyroxene $\text{Fs}_{29.1-30.0}\text{Wo}_{2.8-3.2}$,

1
2
3 Fe/Mn=51.2-63.6; plagioclase $An_{52.3-55.7}Ab_{43.0-46.5}Or_{1.1-1.3}$; chromite TiO_2 1.51-1.80,
4 Al_2O_3 13.71-14.05, MgO 3.01-3.72 (all in wt%); taenite Ni 16.09-21.16 wt%;
5 kamacite Ni 6.58-6.93 wt%.

6
7 **Classification:** Achondrite (ungrouped). No relic chondrules are found in this thin
8 section, and the compositions of plagioclase ($\sim An_{52.3}$) are significantly different
9 from those of chondrites. In this regard, we consider NWA 11112 is not an
10 equilibrated chondrite. The petrography and mineral compositions (olivine,
11 pyroxene, plagioclase, chromite and Fe-Ni metal) in this meteorite are very similar
12 to those of the ungrouped achondrite [NWA 3250](#).
13
14
15

16 17 **Northwest Africa 11113** (NWA 11113)

18 Morocco

19 Find: 2016

20 Classification: Carbonaceous chondrite (CO3)

21 **History:** Purchased by Ke Zuokai in Dec. 2016 from a Moroccan dealer.

22 **Physical characteristics:** The meteorite has a black fusion crust.

23 **Petrography:** Abundant small well-defined chondrules (50-300 μm) and a few
24 fine-grained CAIs set in fine-grained matrix. Most chondrules appear to be Type I
25 with or without pyroxene, and a small amount of Type II chondrules are present.
26 Metal and sulfide occur within and around the chondrules.
27
28

29 **Geochemistry:** Olivine $Fa_{0.6-49.7}$, Cr_2O_3 in ferroan olivine 0.01-0.15 wt.%, mean
30 0.0 ± 0.03 wt.%, $N = 25$; In detail, the cores of olivine in Type I chondrules are rich
31 in magnesium, and the Fa values are between 0.6-10.6. In comparison, the rims of
32 olivine in some Type I chondrules and the grains in Type II chondrules have higher
33 Fe contents ($Fa_{22.9-49.7}$). Cr_2O_3 in ferroan olivine 0.01-0.15 wt.%, mean 0.07 ± 0.03
34 wt.%, $N = 25$; orthopyroxene $Fs_{0.9-4.3}Wo_{0.7-5.3}$; clinopyroxene $Fs_{1.0-9.5}Wo_{30.1-40.0}$,
35 $Fs_{1.0-6.1}Wo_{43.1-49.5}$.
36
37

38 **Classification:** CO3
39
40
41

42 43 **Northwest Africa 11254** (NWA 11254)

44 (Northwest Africa)

45 Purchased: 2016 Oct

46 Classification: Carbonaceous chondrite (CM, anomalous)

47 **History:** Purchased by Dustin Dickens in October 2016 from a dealer in Laayoune,
48 Morocco.
49

50 **Petrography:** (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Very small
51 chondrules (apparent diameter 200 ± 100 μm), mineral fragments and some very
52 fine grained CAI are set in an extremely fine grained matrix (~ 30 vol.%, black in
53 thin section) containing pyrrhotite, kamacite, and taenite. No phyllosilicates were
54 detected by X-ray diffraction.
55

56 **Geochemistry:** Olivine ($Fa_{0.8-58.6}$, $N = 3$), orthopyroxene ($Fs_{1.8-3.1}Wo_{1.1-0.4}$, $N = 3$),
57 clinopyroxene ($Fs_{1.5-2.0}Wo_{45.3-42.6}$, $N = 2$). Oxygen isotopes (Karen Ziegler, *ASU*) of
58
59
60

1
2
3 acid-washed subsamples: $\delta^{17}\text{O}$ 0.241, -0.423; $\delta^{18}\text{O}$ 9.268, 8.823; $\Delta^{17}\text{O}$ -4.653, -
4 5.082 (all per mil).

5
6 **Classification:** Carbonaceous chondrite (CM-an). The anomalous character comes
7 from the absence of phyllosilicates, and the oxygen isotopes that plot below the
8 trend for CM chondrites.

9
10 **Specimens:** 3.6 g including one polished thin section at *UWB*; remainder with Mr.
11 D. Dickens.

12 13 14 **Northwest Africa 11303** (NWA 11303)

15 (Northwest Africa)

16 Purchased: 2017 Mar

17 Classification: Lunar meteorite (feldspathic breccia)

18
19 **History:** Material excavated from a site near Tindouf, Algeria, was purchased by
20 Dustin Dickens in March 2017 from a Mauritanian dealer. The coordinates of the
21 site are unknown.

22
23 **Physical characteristics:** Many small fragments coated by pale reddish-brown
24 terrestrial weathering products. The fresh interiors of the largest fragments exhibit
25 white to beige clasts in a dark gray, fine-grained matrix.

26
27 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular
28 mineral grains of anorthite, olivine, orthopyroxene, exsolved pigeonite, ferroan
29 pigeonite, augite, ilmenite, Ti-chromite and fayalite in a partly vesicular matrix
30 containing minor kamacite and barite.

31
32 **Geochemistry:** Olivine ($\text{Fa}_{26.7-47.2}$, $\text{FeO/MnO} = 75-81$, $N = 2$), orthopyroxene
33 ($\text{Fs}_{24.1}\text{Wo}_{3.6}$, $\text{FeO/MnO} = 67$), orthopyroxene host ($\text{Fs}_{47.1}\text{Wo}_{3.3}$, $\text{FeO/MnO} = 68$),
34 ferroan pigeonite ($\text{Fs}_{52.4}\text{Wo}_{18.8}$, $\text{FeO/MnO} = 67$), augite ($\text{Fs}_{8.0}\text{Wo}_{44.3}$, $\text{FeO/MnO} =$
35 35), plagioclase ($\text{An}_{96.7-97.4}\text{Or}_{0.2-0.1}$, $N = 2$).

36
37 **Classification:** Lunar (feldspathic regolith breccia).

38
39 **Specimens:** 20.0 g including one polished endcut at *UWB*; remainder with Mr. D.
40 Dickens.

41 42 43 **Northwest Africa 11304** (NWA 11304)

44 (Northwest Africa)

45 Purchased: 2017 April

46 Classification: Rumuruti chondrite (R4)

47
48 **History:** Purchased by Dustin Dickens in April 2017 from a Moroccan dealer.

49
50 **Petrography:** (A. Irving and S. Kuehner, *UWS*) The specimen is a breccia mostly
51 composed of well-formed, relatively small chondrules (apparent diameter 250 ± 150
52 μm , $N = 12$) in a finer grained matrix (~ 30 vol.%), but some petrologically-similar,
53 angular lithic clasts (including type 3 and type 4 clasts) are also present. Both
54 olivine and orthopyroxene have very magnesian cores, but the predominant mafic
55 minerals are much more ferroan. Other minerals are clinopyroxene, sodic
56 plagioclase, pentlandite, pyrrhotite and magnetite.

Geochemistry: Olivine (cores $Fa_{1.0-1.2}$; predominantly $Fa_{39.1-41.6}$; $N = 4$), orthopyroxene (core $Fs_{4.5}Wo_{0.4}$; mantle $Fs_{16.3}Wo_{2.7}$), clinopyroxene ($Fs_{11.0-12.4}Wo_{45.5-41.7}$, $N = 2$), plagioclase ($Ab_{85.7}An_{12.3}Or_{14.6}$).

Classification: R4. May contain R3 material.

Specimens: 21.2 g including one polished thin section at *UWB*; remainder with Mr. D. Dickens.

Northwest Africa 11354 (NWA 11354)

Morocco

Purchased: Feb. 2017

Classification: Enstatite achondrite (ungrouped)

History: Purchased by Ke Zuokai in Feb. 2017 from a Moroccan dealer.

Physical characteristics: The meteorite is covered by a dark brown fusion crust.

Petrography: The meteorite is composed of medium-grained (~0.1-0.5 mm) silicates, metal and sulfide. Enstatite is the dominant silicate phase. Other silicates are olivine, albitic plagioclase and fine-grained diopside (4-20 μm). No chondrules or clasts are observed. Some regions of the thin section exhibit triple junctions. Metal and sulfide include kamacite, taenite, troilite, alabandite, daubreelite and schreibersite. Daubreelite often presents as lamellae within troilite.

Geochemistry: Enstatite $Fs_{0.7-2.0}Wo_{0.7-1.7}$ ($n=19$), Fe/Mn (cation ratio)= 8.0 ± 3.9 ; minor fine-grained Ca-rich pyroxene $Fs_{43.1-47.2}Wo_{43.1-47.2}$ ($n=9$), Fe/Mn (cation ratio)= 16.6 ± 10.8 ; plagioclase $Ab_{71.5-83.6}Or_{0.01-3.4}$ ($n=9$); olivine grains are almost pure forsterite $Fo_{99.3-100}$ ($n=18$), Fe/Mn (cation ratio)= 3.1 ± 1.6 . This meteorite lacks Si content in metal. Kamacite (wt%) Fe 92.49, Ni 5.99, Co 0.51, P 0.05. Taenite (wt%) Fe 75.71, Ni 23.55, Co 0.31. Troilite (wt%) Fe 63.11, S 36.07, Co 0.13, Ti 0.18, Cr 0.29, V 0.06. Daubreelite (wt%) Fe 19.69, Cr 36.44, S 44.28, Ni 0.07, Ti 0.01, P 0.04, Co 0.05. Sulfide is low in Si (below 0.01 wt%).

Classification: Enstatite achondrite ungrouped. The meteorite is chemically similar to equilibrated EL chondrites. However, it is distinguished from EL6 chondrite by the lack of chondrules and presence of olivine. Moreover, this meteorite has low Si content in metal (below detection limit) and low Ti content in troilite (0.16 ± 0.02 wt%), similar to those in [NWA 10519](#) (Enst achon-ung).

Northwest Africa 11511 (NWA 11511)

Algeria

Purchased: 2017 Jun

Classification: Ureilite (anomalous)

History: Purportedly found near Adrar, Algeria, and purchased by Darryl Pitt in June 2017 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate composed predominantly of mafic silicates (orthopyroxene with subordinate olivine, grainsize 0.2-0.7 mm) with accessory sodic plagioclase, tabular graphite and rare

schreibersite. Both orthopyroxene and olivine have thin reduced, magnesian rims containing minor blebs of Fe metal.

Geochemistry: Orthopyroxene ($Fs_{10.4-10.5}Wo_{4.5-4.4}$, $FeO/MnO = 13$; rim $Fs_{1.1}Wo_{0.4}$, $FeO/MnO = 20$; $N = 3$), olivine ($Fa_{12.6-12.7}$, $FeO/MnO = 22-23$; rim $Fa_{6.8}$, $FeO/MnO = 10$; $N = 3$). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave, respectively, $d17O$ 2.018, 1.933, 1.622; $d18O$ 6.632, 6.506, 6.128; $D17O$ -1.484, -1.502, -1.614 per mil.

Classification: Ureilite (anomalous). Originally thought to be an orthopyroxene-rich lodranite. Oxygen isotopes show this graphite-rich achondrite is a ureilite, different from typical ureilites in being orthopyroxene-rich, containing unusually magnesian olivine and most significantly in containing sodic plagioclase.

Specimens: 20.3 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11517 (NWA 11517)

Northwest Africa

Purchased: 2017

Classification: Lunar meteorite (feldspathic breccia)

History: Four individuals weighing a total of 88 g were found near Tindouf, Algeria. John Sinclair purchased the stones from a Moroccan meteorite hunter at the Sainte Marie Aux Mines mineral show in France during June of 2017.

Physical characteristics: Sample is irregular-ovoid shaped and lacks fusion crust. The exterior surface is weathered and light orangish-gray in color. The stone shows brecciated texture composed of dominant light-colored clasts in a dark grey matrix. FeNi grains are present in several slices. Pits from weathering of clasts and vesicles contain orange caliche.

Petrography: Description and classification (A. Love, *App*) Sample is a polymict breccia composed of 0.5-3 mm irregularly shaped lithic and mineral clasts set within a micro-vesicular, melt matrix. Clasts are composed of poikilitic gabbro, vitrophyric, anorthosite, crystalline impact melt, and basaltic lithologies. Minerals clasts include olivine, exsolved Ca-rich and Ca-poor pyroxene, baddeleyite, ulvospinel, ilmenite, chromite, FeS, kamacite, taenite, Si-polymorph.

Geochemistry: (A. Love, *App*) Olivine ($Fa_{18.65-53.01}$, $FeO/MnO=83.29-109.49$, $N=12$), Opx ($Fs_{16.43-42.54}Wo_{2.92-4.47}$, $FeO/MnO=53.16-60.73$, $N=5$), pigeonite ($Fs_{40.64-67.00}Wo_{5.14-11.16}$, $FeO/MnO=54.93-67.00$, $N=8$); augite ($Fs_{17.44-36.61}Wo_{19.71-43.48}$, $N=8$); pyroxferroite $Fs_{70.28}Wo_{5.8}$, $FeO/MnO=60.5$, $N=1$); plagioclase $An_{95.55-98.72}Or_{0.00-0.27}$, $N=15$).

Classification: Lunar (feldspathic breccia). Textures and mineral compositions indicate this sample is a feldspathic breccia. FeO/MnO ratios from olivine and pyroxene and An-content of plagioclase suggest this sample is a lunar feldspathic breccia.

Specimens: J. Sinclair holds the main masses. An individual and a slice weighing 17.6 g and one polished thin section are on deposit at *App*.

Northwest Africa 11521 (NWA 11521)

Moroco

Purchased: 2017

Classification: Carbonaceous chondrite (CO3)

History: A single piece with a mass of 50 g was bought in 2017 from a Moroccan meteorite dealer in Ensisheim, France.

Physical characteristics: Fresh-looking individual with black (fusion) crust.

Petrography: The meteorite shows a chondritic texture of abundant small chondrules, metals, sulfides, CAIs, and mineral fragments embedded into a fine-grained greyish and porous matrix. Chondrules are dominantly porphyritic and typically 0.1-0.2 mm in diameter. Sulfides and FeNi metal are fresh and present in matrix and chondrules.

Geochemistry: Mineral compositions and geochemistry: Olivine (mean: $Fa_{18.7\pm 14.6}$, range: $Fa_{0.4-38.4}$, $n=33$), low-Ca pyroxene (mean $Fs_{4.8\pm 3.4}Wo_{2.7\pm 2.2}$, range: $Fs_{0.6-11.8}Wo_{0.4-7.4}$, $n=24$)

Classification: The textural observations suggest a CO3 classification of this rock. The olivines show undulatory extinction. Thus, the rock is of shock stage S2. The sample is only slightly weathered.

Northwest Africa 11550 (NWA 11550)

(Northwest Africa)

Purchased: 2017 Jan 29

Classification: HED achondrite (Eucrite)

History: Purchased NWA stone at the Tucson Gem show from Sidi Mohamad Ismaily

Physical characteristics: Exterior surfaces partly covered by black fusion crust; non-crusted surfaces are gray with portions covered by pinkish dust.

Petrography: In thin section dominated by many small mineral clasts, and some lithic clasts

Geochemistry: Low-Ca pyroxene $Fs_{60.0\pm 1.7}Wo_{2.1\pm 0.8}$ ($N=47$).

Classification: Monomict, largely equilibrated, brecciated eucrite based on texture and mineral composition.

Specimens: *Cascadia* holds the entire sample, consisting of 157.8 g, a polished thin section, and potted butt.

Northwest Africa 11551 (NWA 11551)

Mauritania

Purchased: 2017 Jan 30

Classification: HED achondrite (Howardite)

History: Type specimen donated to *Cascadia* by Mohammed *Hmani* at the Tucson Gem Show in 2017. Mr. *Hmani* stated that the meteorite was found in 2014 in Mauritania.

Physical characteristics: Exterior surfaces partly covered by black fusion crust; non-crust surfaces show obvious breccia texture with variegated clasts up to 1 cm across. Most surfaces appear relatively unweathered but rust spots are present.

Petrography: In thin section appears to be a roughly 50-50 mixture of diogenitic (coarse orthopyroxene) and eucritic (plagioclase, pyroxene-dominated) clasts. Some eucritic pyroxene shows zoning.

Geochemistry: Diogenitic orthopyroxene $\text{Fs}_{27.1\pm 3.8}\text{Wo}_{2.4\pm 1.0}$ (N=182), eucritic low-Ca pyroxene $\text{Fs}_{41.6\pm 6.0}\text{Wo}_{3.1\pm 1.0}$ (N=40), augite $\text{Fs}_{26.8\pm 7.8}\text{Wo}_{41.5\pm 2.5}$ (N=30), uninverted pigeonite $\text{Fs}_{48.8\pm 5.8}\text{Wo}_{8.0\pm 2.3}$ (N=36), bulk inverted pigeonite $\text{Fs}_{50.5\pm 5.4}\text{Wo}_{10.7\pm 3.0}$ (N=24).

Classification: Howardite based on textures and mineral proportions.

Specimens: *Cascadia* holds 20.0 g and two polished thin sections and a potted butt. The main mass is held by HMANI Inc. (13 Rue Joules Hardouin Mansart, 92600 Asnieres, France).

Northwest Africa 11552 (NWA 11552)

(Northwest Africa)

Purchased: 2016 Nov 16

Classification: HED achondrite (Eucrite)

History: Donated to *Cascadia* in February, 2017 by Dr. Baecker, who had purchased the sample as an unclassified NWA on eBay.

Physical characteristics: Single oriented cone mostly covered by black fusion crust. Interior cut faces show clastic texture ranging from small fragments to sub-cm subophitic-textured clasts. Brownish rust spots visible.

Petrography: Clastic texture in thin section, including mineral, lithic, and melt breccia clasts. Relatively abundant calcite veining

Geochemistry: Most pyroxene analyses are mixtures of low- and high-Ca pyroxene. Low-Ca pyroxene $\text{Fs}_{66.1\pm 1.7}\text{Wo}_{4.9\pm 0.3}$ (N=6); augite $\text{Fs}_{34.1\pm 2.0}\text{Wo}_{39.4\pm 2.4}$ (N=9).

Classification: Monomict, largely equilibrated, brecciated eucrite based on texture and mineral composition.

Specimens: *Cascadia* holds 21.5 g, two polished thin sections, and potted butt. Main mass is held Dr. Bastian Baecker (Huntsville, AL)

Northwest Africa 11556 (NWA 11556)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Carbonaceous chondrite (C2, ungrouped)

History: Purchased in Agadir, Morocco by Aziz Habibi in March 2017.

1
2
3 **Physical characteristics:** A single, very soft jet black stone (61 g) containing some
4 visible but tiny, clear crystalline objects. During preparation for powder X-ray
5 diffraction by immersing sample fines in methanol a strong organic odor was
6 emitted.
7

8 **Petrography:** (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Sparse very small,
9 subspherical polycrystalline objects (apparent diameter $180 \pm 150 \mu\text{m}$, $N = 18$) and
10 angular mafic silicate mineral grains are set in a very fine grained matrix. The
11 dominant matrix (~ 90 vol.%, jet black in thin section) contains prominent open
12 shrinkage cracks and is composed mainly of indeterminate mafic silicates plus
13 minor chromite, pentlandite and calcite. X-ray diffraction shows the specimen to be
14 dominated by tochilinite and well-crystallized serpentine. No CAI were observed
15 despite a careful search.
16

17 **Geochemistry:** Olivine ($\text{Fa}_{1.2-56.0}$, Cr_2O_3 in ferroan examples 0.10-0.40 wt.%, mean
18 0.25 ± 0.11 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{0.9-1.0}\text{Wo}_{1.0-3.6}$, $N = 3$), clinopyroxene
19 ($\text{Fs}_{1.1}\text{Wo}_{42.2}$; $\text{Fs}_{0.9}\text{Wo}_{48.0}$; $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of
20 untreated subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -2.789, -3.797;
21 $\delta^{18}\text{O}$ 1.421, -0.319; $\Delta^{17}\text{O}$ -3.539, -3.629 per mil.
22

23 **Classification:** Carbonaceous chondrite (type 2, ungrouped). The paucity of
24 chondrule-like objects, high abundance of matrix, and more 16O-rich bulk oxygen
25 isotope composition distinguish this specimen from CM chondrites.
26

27 **Specimens:** 12.3 g including one polished thin section at *UWB*; remainder with Mr.
28 A. Habibi.
29
30
31
32
33

34 **Northwest Africa 11558** (NWA 11558)

35 (Northwest Africa)

36 Purchased: 2017 Sep

37 Classification: Ungrouped achondrite

38 **History:** Two identical small samples of an unusual achondrite were sent by two
39 separate Moroccan dealers to Dr. Anthony Irving in January 2017. Later in
40 September 2017 the remainder of one of these specimens was purchased from one
41 of the original dealers by Ben Hoefnagels.
42

43 **Physical characteristics:** The friable specimens (total weight 3.92 g) are both
44 composed of abundant white and green grains.
45

46 **Petrography:** (A. Irving and S. Kuehner, *UWS*; I. Barker and D. Moser, *UWO*)
47 The specimens have a porphyritic plutonic igneous texture. The mineralogy is
48 dominated by larger grains (1.6-2.1 mm) of anorthite, strongly zoned clinopyroxene
49 and tridymite (identified by electron backscatter diffraction analysis). More sodic
50 (bytownitic) plagioclase and more ferroan clinopyroxenes occur in the groundmass
51 together with accessory orthopyroxene, ilmenite, ulvöspinel, troilite, cristobalite,
52 minor quartz, rare low-Ni kamacite and rare baddeleyite. Some silica occurs as
53 graphic intergrowths with clinopyroxene in the groundmass, or as very small
54 inclusions accompanied by clinopyroxene within plagioclase.
55

56 **Geochemistry:** Diopside cores ($\text{Fs}_{5.1-5.3}\text{Wo}_{38.8-39.0}$, $\text{FeO/MnO} = 6$, $N = 2$), subcalcic
57 augite ($\text{Fs}_{37.0}\text{Wo}_{30.9}$, $\text{FeO/MnO} = 8$), subcalcic ferroaugite ($\text{Fs}_{67.3}\text{Wo}_{25.8}$, FeO/MnO
58
59
60

= 10), ferropigeonite($\text{Fs}_{69.7-78.7}\text{Wo}_{22.3-15.4}$, $\text{FeO/MnO} = 7-10$, $N = 2$), plagioclase ($\text{An}_{69.2-91.9}\text{Or}_{1.2-0.2}$, $N = 3$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 2.716, 3.020, 3.525; $\delta^{18}\text{O}$ 6.990, 7.573, 8.530; $\Delta^{17}\text{O}$ -0.975, -0.979, -0.979 per mil.

Classification: Ungrouped achondrite. This material is paired with [NWA 11119](#) on the basis of closely similar mineralogy and identical oxygen isotopic composition. According to the IUGS nomenclature for igneous rocks (Le Maitre et al., 1989), this specimen would be a porphyritic quartz gabbro. However, given that the dominant silica polymorph is tridymite, a more appropriate designation would be tridymite gabbro.

Specimens: 2.56 g including one polished epoxy mount at *UWB*; 1.36 g with Mr. B. Hoefnagels.

Northwest Africa 11559 (NWA 11559)

Algeria

Purchased: 2017 Jun

Classification: Carbonaceous chondrite (CO3)

History: Purportedly found near the Algeria/Libya border and purchased by Darryl Pitt in June 2017 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small, well-formed chondrules (apparent diameter $420 \pm 190 \mu\text{m}$, $N = 20$) accompanied by sparse angular mineral grains are set in a finer grained matrix (~40 vol.%, brown in thin section) containing accessory chromite, altered kamacite and pyrrhotite. No CAI were observed.

Geochemistry: Olivine ($\text{Fa}_{0.9-41.4}$, Cr_2O_3 in ferroan examples <0.02 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{12.6-23.8}\text{Wo}_{2.1-0.6}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.1-10.9}\text{Wo}_{46.8-45.9}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.02$.

Classification: Carbonaceous chondrite (CO3). The below detection limit Cr_2O_3 contents in ferroan olivines indicate a petrologic subtype >3.6 .

Specimens: 9.5 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11560 (NWA 11560)

(Northwest Africa)

Purchased: 2017 Oct

Classification: HED achondrite (Diogenite)

History: Purchased in Temara, Morocco by Adam Aaronson in October 2017.

Physical characteristics: A single large stone (13060 g) composed predominantly of vitreous yellow-green pyroxene with sparse opaque grains.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grain size 0.9 mm) of predominantly orthopyroxene plus minor chromite and rare olivine. Minor calcite accompanied by iron hydroxide occurs along grain boundaries.

Geochemistry: Orthopyroxene ($\text{Fs}_{22.7-23.5}\text{Wo}_{1.5-2.0}$, $\text{FeO/MnO} = 28-30$, $N = 3$), olivine ($\text{Fa}_{26.2-26.3}$, $\text{FeO/MnO} = 44-46$, $N = 2$).

Classification: Diogenite.

Specimens: 20.2 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 11561 (NWA 11561)

(Northwest Africa)

Purchased: 2016 Dec

Classification: Carbonaceous chondrite (CR6)

History: Purchased in December 2016 by Ben Hoefnagels from a French dealer, who had obtained the stone from a source in Niger.

Petrography: (A. Irving and S. Kuehner, *UWS*) Metamorphic texture. Larger (up to 3.6 mm) pyroxene poikiloblasts containing numerous rounded olivine chadacrysts are present within a dominant finer-grained, recrystallized matrix exhibiting triple grain junctions. Pyroxene is mostly orthopyroxene, but blebby inclusions of clinopyroxene are present in places. Accessory phases are chromite, kamacite, Ni-poor taenite and troilite.

Geochemistry: Olivine ($\text{Fa}_{29.0-29.8}$, $\text{FeO/MnO} = 64-67$, $N = 3$), orthopyroxene host ($\text{Fs}_{23.0-23.6}\text{Wo}_{3.8-3.6}$, $\text{FeO/MnO} = 40-42$, $N = 2$), clinopyroxene exsolution lamellae ($\text{Fs}_{10.7-12.0}\text{Wo}_{41.8-39.8}$, $\text{FeO/MnO} = 28-31$, $N = 2$), plagioclase ($\text{An}_{42.0-50.3}\text{Or}_{1.6-1.8}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -0.259, -0.450, -0.344; $\delta^{18}\text{O}$ 2.659, 2.297, 2.506; $\Delta^{17}\text{O}$ -1.663, -1.663, -1.667 per mil.

Classification: Carbonaceous chondrite (CR6). In terms of textural, mineralogical and isotopic characteristics, this specimen is very similar to [Tafassasset](#) and [NWA 7531](#).

Specimens: 53.0 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11562 (NWA 11562)

(Northwest Africa)

Purchased: 2017 Oct

Classification: Ungrouped achondrite

History: Purchased in Temara, Morocco, by Adam *Aaronson* in October 2017.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen consists of coarser, protogranular regions (mean grainsize 0.25 mm) composed of forsterite and enstatite with some interstitial diopside, altered kamacite and blade-like cohenite, plus much finer-grained, quench-textured regions with the same mineralogy.

Geochemistry: Olivine ($\text{Fa}_{1.0-1.1}$, $\text{FeO/MnO} = 3-4$, $N = 3$), orthopyroxene ($\text{Fs}_{0.9-1.0}\text{Wo}_{1.0-2.3}$, $\text{FeO/MnO} = 2-3$, $N = 3$), diopside ($\text{Fs}_{0.2-0.9}\text{Wo}_{36.3-40.5}$, $\text{Al}_2\text{O}_3 = 2.0-3.6$ wt.%, $\text{TiO}_2 = 0.5-0.6$ wt.%, $N = 3$). Oxygen isotopes (K. Ziegler, *UNM*): analyses

of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}\text{O}$ 1.567, 1.396, 1.479; $\delta^{18}\text{O}$ 6.345, 6.084, 6.291; $\Delta^{17}\text{O}$ -1.783, -1.816, -1.843 per mil.

Classification: Achondrite (ungrouped). The oxygen isotope composition plots between the trends for CR and CV chondrites, and far from the trends for most achondrites (except for some ureilites); however, the highly magnesian silicates and evidence for partial melting would seem to preclude any affinity to ureilites.

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Ke Zuokai.

Northwest Africa 11563 (NWA 11563)

(Northwest Africa)

Purchased: 2016 Jun

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Ben Hoefnagels in June 2016 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of mineral clasts of anorthite, labradorite, olivine, orthopyroxene, pigeonite, subcalcic augite, exsolved pigeonite, ilmenite, fayalite and silica polymorph in a finer grained, partly vesicular matrix containing minor troilite and kamacite.

Geochemistry: Olivine ($\text{Fa}_{23.0-37.4}$, $\text{FeO/MnO} = 94$, $N = 2$), orthopyroxene ($\text{Fs}_{29.5}\text{Wo}_{4.5}$, $\text{FeO/MnO} = 45$), pigeonite ($\text{Fs}_{29.6}\text{Wo}_{7.4}$, $\text{FeO/MnO} = 83$), subcalcic augite ($\text{Fs}_{22.7}\text{Wo}_{25.1}$; $\text{Fs}_{34.2}\text{Wo}_{32.4}$, $\text{FeO/MnO} = 71-77$, $N = 2$), anorthite ($\text{An}_{95.0}\text{Or}_{0.2}$), labradorite ($\text{An}_{50.9-54.1}\text{Or}_{3.6-1.0}$, $N = 2$).

Classification: Lunar (feldspathic regolith breccia).

Specimens: 11.8 g in the form of a polished endcut at *UWB*; remainder of the stone with Mr. B. Hoefnagels.

Northwest Africa 11564 (NWA 11564)

(Northwest Africa)

Purchased: 2017 Sep

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Habib Naji in September 2017 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small, rounded to irregularly shaped chondrules (apparent diameter $165 \pm 80 \mu\text{m}$, $N = 20$) accompanied by sparse angular mineral grains and some very fine grained CAI are set in a finer grained matrix (~ 30 vol.%, brown in thin section).

Geochemistry: Olivine ($\text{Fa}_{1.2-64.7}$, Cr_2O_3 in ferroan examples < 0.02 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{0.8-27.5}\text{Wo}_{0.8-3.0}$, $N = 3$), clinopyroxene ($\text{Fs}_{1.5-4.4}\text{Wo}_{43.7-47.7}$, $N = 2$).

Classification: Carbonaceous chondrite (CO3). The below detection limit Cr_2O_3 contents in ferroan olivines indicate a petrologic subtype > 3.6 .

Specimens: 24.05 g including one polished thin section at *UWB*; remainder with H. Naji.

Northwest Africa 11565 (NWA 11565)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CK6)

Petrography: The stone is very recrystallized with a groundmass coarseness of 50-100 μm , typical of CK6 chondrites. It is rather weathered; $\sim 80\%$ of the silicates are stained brown. The rock contains ~ 15 vol.% discernable chondrules. Plagioclase grains are approximately 50 μm in size. The plagioclase is heterogeneous (typical of CKs): $\text{Ab}_{44.1\pm 19.4}\text{Or}_{1.5\pm 1.3}\text{An}_{54.4\pm 20.6}$ (n=9) with an overall range $\text{An}_{27.2-85.8}$. Also present are diopside ($\text{Fs}_{9.2\pm 0.6}\text{Wo}_{45.9\pm 0.9}$, n=4) and augite ($\text{Fs}_{14.8}\text{Wo}_{27.1}$, n=1). As in some other CK chondrites, there is more Ca pyroxene than low-Ca pyroxene. Olivine ($\text{Fa}_{30.1\pm 0.5}$, n=17) is also in the CK-chondrite range.

Northwest Africa 11570 (NWA 11570)

(Northwest Africa)

Purchased: March 2017

Classification: Ordinary chondrite (H/L4)

History: Purchased by Sean Tutorow and Brahim Tahiri from several different meteorite hunters in Morocco.

Petrography: The olivine in the rock is fairly homogeneous and is in between the Fa ranges for H ($\text{Fa}_{17.3-20.2}$) and L ($\text{Fa}_{23.0-25.8}$) chondrites, leading to a classification of H/L. Although the mean low-Ca pyroxene composition ($\text{Fs}_{17.6}$) is within the range of H chondrites, it is heterogeneous and is thus not definitive. Also present is rare Ca-pyroxene: $\text{Fs}_{8.7}\text{Wo}_{21.0}$ (n=1). The rock has well-defined chondrules. A few low-Ca pyroxene grains exhibit polysynthetic twinning. Chondrules have devitrified mesostases. There is minor recrystallization apparent in the rock; there is some integration of chondrules with the matrix. Some troilite grains are polycrystalline.

Northwest Africa 11571 (NWA 11571)

(Northwest Africa)

Purchased: March 2017

Classification: Rumuruti chondrite (R4)

History: Purchased by Sean Tutorow and Brahim Tahiri from several different meteorite hunters in Morocco.

Petrography: Pyroxene is rare, but some low-Ca pyroxene grains exhibit polysynthetic twinning. The only two grains that were analyzed are both Ca-pyroxene. Opaque phases consist of small grains of metal and both small and large grains of pyrrhotite. Chondrules are well defined; chondrule types include BO, PP, PO, POP, C, GOP and RP. Some

Northwest Africa 11572 (NWA 11572)

(Northwest Africa)

Purchased: March 2017

Classification: Ordinary chondrite (H4, melt breccia)

History: Purchased by Sean Tutorow and Brahim Tahiri from several different meteorite hunters in Morocco.

Petrography: The rock is an impact-melt breccia. Melted regions are very dark; they contain numerous metal-sulfide veins, polycrystalline troilite and rare cellular, rapidly cooled metal-sulfide assemblages. There are rare grains of coarse troilite. Most metal grains are not attached to sulfide grains. Some low-Ca pyroxene grains exhibit polysynthetic twinning, perhaps caused by post-shock quenching. There is strong mosaic extinction evident in the olivine grains.

Northwest Africa 11573 (NWA 11573)

(Northwest Africa)

Purchased: 2017

Classification: Enstatite achondrite (Aubrite)

History: Three uncrusted stones weighing a total of 107 g were found in Morocco prior to 2016. J. Donald Cline and John Sinclair acquired the samples from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Specimen is dark orange-brown-colored, has a pitted irregular-shape and lacks fusion crust. Interior shows a brecciated texture composed of light orange-brown crystals, lithic fragments and metallic grains are visible on the cut surface.

Petrography: Description and Classification (A. Love, *App*): Sample is a breccia composed of angular to subrounded crystals of enstatite (up to 5 mm) and cumulate-textured clasts. Clasts show poikilitic texture composed of subhedral to anhedral, polysynthetically twinned enstatite and anhedral plagioclase feldspar set within birefringent, nonstoichiometric albitic glass. Additional minerals are; daubréelite; Si-polymorph; schreibersite; Si-bearing (4.88 wt%) kamacite; perryite; graphite; niningerite; troilite and oldhamite.

Geochemistry: (A. Love, *App*) Enstatite ($\text{Fs}_{0.2\pm 0.2}\text{Wo}_{0.4\pm 0.1}$, N=18); plagioclase ($\text{An}_{2.4\pm 0.5}\text{Or}_{5.0\pm 0.4}$, N=11).

Classification: Achondrite (aubrite). Textures, mineralogy and mineral compositions suggest this is a aubrite.

Specimens: *PARI* holds the main mass. A whole individual and an endcut weighing 20.6 g, a polished mount and thin section are on deposit at *App*.

Northwest Africa 11574 (NWA 11574)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (L3.10)

History: Purchased by Marcin Cimala in Morocco, 2017.

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2
3 **Physical characteristics:** Single stone with weathered exterior, saw cuts shows
4 many densely packed chondrules set in a dark brown matrix.

5
6 **Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount
7 shows numerous porphyritic chondrules, most with mesostasis or glass. Abundant
8 opaque matrix. Apparent mean chondrule diameter $700 \pm 390 \mu\text{m}$, $n=31$, consistent
9 with L.

10
11 **Geochemistry:** (C. Agee, *UNM*) All olivine $\text{Fa}_{16.4 \pm 12.5}$, $\text{Fe/Mn} = 50 \pm 25$, $n=40$;
12 Ferroan chondrule olivine $\text{Fa}_{19.7 \pm 11.3}$, $\text{Fe/Mn} = 55 \pm 23$, $\text{Cr}_2\text{O}_3 = 0.21 \pm 0.21$ (wt%),
13 $n=33$; low-Ca pyroxene $\text{Fs}_{13.0 \pm 10.6}\text{Wo}_{1.8 \pm 1.9}$, $n=13$.

14
15 **Classification:** Ordinary chondrite (L3.10), type 3.10 based on mean value of
16 Cr_2O_3 in ferroan chondrule olivine and the 1-sigma standard deviation, near the
17 boundary between 3.10 and 3.15 in figure 13 ([Grossman and Brearley, 2005](#)),
18 however closest to values of [Adrar 003](#) (L/LL3.10) with $\text{Cr}_2\text{O}_3 = 0.23 \pm 0.21$ ($n=47$).

19
20 **Specimens:** 29 g including a probe mount on deposit at *UNM*, Marcin Cimala
21 holds the main mass.
22
23
24

25 Northwest Africa 11575 (NWA 11575)

26 Mali

27 Purchased: 2016 Sept

28 Classification: Ungrouped achondrite

29
30 **History:** Found in June 2016 at the border region of Mali and Algeria; purchased in
31 Mauritania in September 2016.

32
33 **Physical characteristics:** Single stone, 80% covered by fusion crust. Saw cut
34 reveals a surface of approximately 12 square cm with a light colored, felsic-
35 appearing, aphanitic texture. A single, ~1 mm wide, dark colored shock melt vein
36 crosscuts this surface. Also present are a few smaller xenoliths which are dark in
37 color, angular, mafic-appearing, and aphanitic; the largest of which is
38 approximately 1 cm across.

39
40 **Petrography:** (C. Agee, *UNM*) Microprobe and SEM examinations were
41 performed on a polished probe mount and on the saw-face of the deposit sample
42 respectively. An ophitic texture of pyroxene and plagioclase grains, making up
43 approximately 90-95% of the modal mineralogy, was observed. Pyroxenes were
44 typically 300-500 μm in size and showed significant igneous zoning. The pyroxene
45 grains had cores of magnesian pigeonite, outwardly transitioning to a zone of
46 augite, and rimmed by a zone of sub-calcic ferroaugite to ferropigeonite.
47 Plagioclase grains were oligoclase, mostly lath-like in shape, and typically 200x50
48 μm in size. We also observed ubiquitous potassium feldspar and silica, which were
49 commonly found in contact with each other, and together made up ~5% of the
50 modal mineralogy. Opaque phases made up ~1% of the modal mineralogy; these
51 included ilmenite, iron sulfide, iron metal (nickel not detected), chromite, and iron
52 oxide. The mafic xenolith clasts were basaltic in major mineralogy and lacked K-
53 feldspar. The shock melt vein composition within the host felsic lithology plots in
54 the andesite field of the TAS diagram, whereas the composition of the fusion crust
55 of the meteorite, plots in the basaltic andesite field.
56
57
58
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Geochemistry: (C. Agee, *UNM*) Magnesian pigeonite $\text{Fs}_{28.3\pm 3.3}\text{Wo}_{7.3\pm 1.6}$, $\text{Fe/Mn}=37\pm 4$, $n=5$; augite $\text{Fs}_{24.4\pm 4.2}\text{Wo}_{30.0\pm 3.8}$, $\text{Fe/Mn}=33\pm 4$, $n=21$; sub-calcic-ferroaugite/ferropigeonite $\text{Fs}_{57.3\pm 6.2}\text{Wo}_{14.7\pm 3.7}$, $\text{Fe/Mn}=48\pm 3$, $n=19$; plagioclase $\text{Ab}_{81.3\pm 1.9}\text{An}_{17.4\pm 2.0}\text{Or}_{1.3\pm 0.2}$, $n=20$; potassium feldspar $\text{Ab}_{4.0\pm 0.9}\text{An}_{0.4\pm 0.3}\text{Or}_{95.6\pm 1.1}$, $n=23$; shock melt vein (proxy for felsic lithology bulk composition) $\text{SiO}_2=59.1\pm 5.7$, $\text{Al}_2\text{O}_3=10.1\pm 1.5$, $\text{MgO}=4.5\pm 1.3$, $\text{FeO}=15.6\pm 5.9$, $\text{CaO}=6.5\pm 1.5$, $\text{Na}_2\text{O}=3.8\pm 1.2$ (all wt%), $n=11$.; fusion crust (proxy for meteorite bulk composition) $\text{SiO}_2=55.8\pm 3.7$, $\text{Al}_2\text{O}_3=8.2\pm 3.4$, $\text{MgO}=6.7\pm 1.0$, $\text{FeO}=16.2\pm 6.2$, $\text{CaO}=7.2\pm 0.7$, $\text{Na}_2\text{O}=2.6\pm 0.5$, $\text{K}_2\text{O}=0.5\pm 0.2$ (all wt%), $n=8$. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}\text{O}=4.875, 5.583, 5.349$; $\delta^{17}\text{O}=3.760, 4.137, 4.006$; $\Delta^{17}\text{O}=1.186, 1.189, 1.182$ (linearized, all per mil, TFL slope=0.528).

Classification: Ungrouped achondrite. Pyroxene compositional core-rim zoning trends are similar to that observed in Martian basalt [QUE 94201](#) (Papike et al. 2009) and Apollo 15 Mare basalts (Kushiro, 1973). Oxygen isotopes plot within the field defined by LL-chondrites, however the 3 measured data points, from different fragments of the meteorite, form a slope of 0.53, parallel to the mass dependent terrestrial fractionation line. The andesite to basaltic andesite compositions of the shock melt vein and fusion crust of this meteorite plot on the TAS diagram in a broadly similar location to the estimated bulk composition of ungrouped achondrites [GRA 06128/GRA 06129](#); and this meteorite and GRA 06128/06129 have similar oligoclase plagioclase. However, GRA 06128/06129 are not likely related to this meteorite since they are olivine-bearing, lack K-feldspar, and have oxygen isotopes that plot below the TFL.

Specimens: 22.1 g on deposit at *UNM*, Darryl Pitt holds the main mass.

Northwest Africa 11576 (NWA 11576)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Eucrite, melt breccia)

History: Reportedly found in Mali, September 2017, purchased in Morocco.

Physical characteristics: Single stone, no fusion crust, exterior shows numerous light colored clasts set in a dark matrix of shock melt.

Petrography: (C. Agee, *UNM*) Microprobe examination shows basaltic clasts with approximately 60% pyroxene and 35% plagioclase grains most in the range 100-200 μm . Many pyroxene grains have exsolution lamellae.

Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $\text{Fs}_{62.1\pm 1.1}\text{Wo}_{2.7\pm 0.8}$, $\text{Fe/Mn}=32\pm 1$, $n=7$; high-Ca pyroxene $\text{Fs}_{28.3\pm 1.6}\text{Wo}_{42.2\pm 1.8}$, $\text{Fe/Mn}=31\pm 1$, $n=6$; plagioclase $\text{An}_{88.9\pm 0.4}$, $n=3$.

Classification: Eucrite-melt breccia, eucrite clasts are consistent with type 6 ([Takeda and Graham, 1991](#)) showing clear compositional separation of low and high calcium pyroxenes.

Specimens: 24.5 g on deposit at *UNM*, Mohamed Aid holds the main mass.

Northwest Africa 11577 (NWA 11577)

Morocco

Purchased: 2017 Jan

Classification: Iron meteorite (IAB-sHL)

History: Reportedly found in Algeria by nomads in December 2016, subsequently sold to a Moroccan merchant in Ouarzazate, from whom it was purchased by J. Shea.

Physical characteristics: The main mass consists of two tabular specimens approximately 1 cm thick, both having dark brown exteriors.

Petrography: (C. Herd, *UAb*) SEM investigation of a $\sim 2 \times 3$ cm polished surface reveals a well-developed Widmanstätten pattern consistent with a finest octahedrite (0.025 ± 0.005 mm; $n=16$). Some areas of kamacite are coarser, and some kamacite has been replaced by terrestrial oxidation.

Geochemistry: ICP-MS data, using sample of [North Chile](#) (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 12.5, Co = 0.55 (both wt%); Ir = 0.12, Ga = 17, Ge = 38, As = 24, W = 0.38, Re = 0.01, Os = 0.22, Cu = 276, Au = 2.7 (all $\mu\text{g/g}$).

Classification: (C. Herd, *UAb*): IAB iron, sHL subgroup according to [Wasson and Kallemeyn \(2002\)](#).

Specimens: Type specimen consisting of two representative slices (16.6 and 2.1 g) at *UAb*. Main mass with Shea.

Northwest Africa 11584 (NWA 11584)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (L5)

History: Purchased from a Moroccan meteorite dealer in Tucson, 2017. Reportedly found in Morocco in 2016.

Physical characteristics: Single stone, broken surface shows numerous well defined chondrules, some oxidation present, desert caliche on exterior.

Petrography: (C. Agee, *UNM*) Microprobe examination shows distinct chondrules throughout, plagioclase grain size is ~ 20 μm , a significant portion of the matrix appears to be recrystallized. Kamacite, troilite, and oxidized iron are ubiquitous.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{24.8 \pm 1.2}$, Fe/Mn = 48 ± 7 , $n=11$; low-Ca pyroxene $\text{Fs}_{21.5 \pm 0.5} \text{Wo}_{1.8 \pm 0.2}$, Fe/Mn = 29 ± 1 , $n=6$.

Classification: Ordinary chondrite (L5)

Specimens: 20.5 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 11585 (NWA 11585)

North West Africa, Morocco

Purchased: October 2015

Classification: Ureilite

Petrography: (H. Downes, Birkbeck) Equigranular, anhedral, slightly poikilitic crystals of olivine and low-Ca pyroxene, with minor interstitial metal and very rare carbon. There is no evidence of zoning in minerals. This meteorite does not exhibit a typical ureilite texture, but is more similar to the Hughes Type.

Geochemistry: Mineral compositions and geochemistry: (N. Rai, N.V. Almeida, *NHM*). All analyses by EPMA. Olivine cores $\text{Fa}_{10.8\pm 0.6}$, 0.45 to 0.52 wt% MnO, 0.50 to 0.55 wt% Cr_2O_3 , 0.14 to 0.68 wt% CaO, < 0.01 wt% Ni, (N=32). Pyroxene $\text{Fs}_{10.1\pm 0.8}\text{Wo}_{8.3\pm 0.6}$, 0.38 to 0.52 wt% MnO, 0.89 to 0.92 wt% Cr_2O_3 , (N=11).

Classification: Ureilite

Specimens: 14.2 g on deposit at the *NHM*. M. Bilet holds the main mass.

Northwest Africa 11586 (NWA 11586)

Algeria

Purchased: 2016 May

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in May 2016 from Morocco.

Physical characteristics: Meteorite has residual visible black fusion crust and weak magnetic properties. Additionally, hand specimen is unbrecciated.

Petrography (B. Miao, C. Zhang, *GUT*): This meteorite, with weak magnetic properties and residual visible black fusion crust, whose rock structure is dense and section is full of small metal (Fe). Within polished thin section, mineral is slightly broken, rock structure is igneous but not brecciated. The mineral modal abundance is as follows: Low-Ca pyroxene (36.2 vol%), high-Ca pyroxene (10.6 vol%), plagioclase (44.3 vol%), SiO_2 (6.1 vol%), metal-Fe (0.3 vol%), chromite (0.6 vol%), other minerals such as ilmenite, troilite, apatite and zircon (1.9 vol%).

Geochemistry (B. Miao, C. Zhang, *GUT*, EPMA): Low-Ca pyroxene: Fe/Mn=27.5 Mg#=39.4; $\text{Fs}_{57.8}\text{Wo}_{4.7}\text{En}_{37.5}$ (n=50). High-Ca pyroxene: Fe/Mn=26.5 Mg#=51.8; $\text{Fs}_{28.2}\text{Wo}_{41.5}\text{En}_{30.3}$ (n=60). Plagioclase: $\text{An}_{90.9}\text{Or}_{0.5}\text{Ab}_{8.62}$ (n=29).

Classification: Basaltic unbrecciated eucrite

Specimens: 21.8 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 11587 (NWA 11587)

(Northwest Africa)

Purchased: 2017

Classification: Rumuruti chondrite (R3-5)

History: A single stone weighing 714 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Sample is dark brown and has a rounded shape with an irregular surface composed of pits and protrusions. The cut face shows the sample is a breccia composed of 3-4 distinct chondritic lithologies that are light orange to dark-brown in color.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of 0.5-4 cm unequilibrated equilibrated chondritic clasts (type 4-5) and a shock-darkened, unequilibrated lithology set within a host of unequilibrated chondrules, fragments and fragmental matrix. Chondrules in host and clasts have an average diameter of 340 μm (n=81). Additional minerals are: apatite, FeS, pentlandite and chromite.

Geochemistry: (A. Love, *App*) Type 5: Olivine ($\text{Fa}_{38.9\pm 0.3}$, Fe/Mn=76.1, N=6); high-Ca pyroxene ($\text{Fs}_{11.1\pm 0.9}\text{Wo}_{45.9\pm 1.0}$, N=6); low-Ca pyroxene ($\text{Fs}_{30.5\pm 0.6}\text{Wo}_{4.12/-2.8}$, n=2). Type 3: Olivine ($\text{Fa}_{13.7\pm 9.9}$, range $\text{Fa}_{0.4-33.8}$, CV=72%, Fe/Mn=2.3-85.6, N=36, Cr_2O_3 in ferroan olivine 0.2 ± 0.1 , N=22); low-Ca pyroxene $\text{Fs}_{12.2\pm 9.7}\text{Wo}_{1.6\pm 1.2}$ ($\text{Fs}_{0.7-31.7}\text{Wo}_{0.3-4.1}$, N=15).

Classification: Rumuruti chondrite (R3.2-5, S3, wi-2). Based on Fa and Fe/Mn compositions of olivines, chondrule diameter and texture this sample is a Rumuruti chondrite breccia. Based on the coefficient of variation of olivines within unequilibrated clast, the petrologic subtype is estimated at 3.2 ([Bischoff, 2000](#)).

Specimens: *PARI* holds the main mass. One 20.2g endcut and a polished thin section are on deposit at *App*.

Northwest Africa 11588 (NWA 11588)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CM2)

Physical characteristics: Dark-brown fragments. Cut surface reveals a dark interior with abundant matrix and small chondrules.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*; L. Bonal, *IPAG*) Chondrules (average apparent diameter about 200 μm) and chondrules fragments set in a fine-grained iron-rich matrix. Modal abundances: matrix 71 vol%, chondrules and chondrule fragments 29% (point counting, N=317). Infrared transmission spectra of matrix grains reveal the presence of phyllosilicates dominating the mineralogical assemblage and are comparable to those of CM chondrites ([Beck et al., 2010](#)). The 3- μm band, whose spectral characteristics are reflecting the chemistry of the phyllosilicate phases and are correlated with the alteration classification scheme of [Rubin et al. \(2007\)](#), shows that this meteorite experienced a relatively low extent of aqueous alteration, comparable to [Murray \(2.4/2.5\)](#).

Geochemistry: Olivine $\text{Fa}_{16.6\pm 13.1}$, PMD 66%, range $\text{Fa}_{0.9-37.9}$ (N=5). Orthopyroxene $\text{Fs}_{0.8}\text{Wo}_{0.8}$ and $\text{Fs}_{7.2}\text{Wo}_{3.8}$ (N=2). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.23$.

Classification: CM2

Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11589 (NWA 11589)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CV3)

Physical characteristics: Dark stone. Cut surface reveals a dark-gray interior with mm-sized chondrules and CAIs.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE* ; Lydie Bonal, *IPAG*) Chondrules (average apparent diameter 1.1 mm, N=18), mostly of type I, and CAIs set in a fine-grained iron-rich matrix. Main opaque minerals are troilite and metal. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite appears to be as metamorphosed as Axtell (3.6/3.7). The Raman spectroscopy parameters of interest are FWHM-D (cm⁻¹)=69.2±4.0, ID/IG=1.41±0.06 (see Bonal et al. 2006, GCA 70:1849-1863, figure 4).

Geochemistry: Olivine Fa_{10.0±10.5}, PMD 68% (N=11). Orthopyroxene Fs_{1.2±0.4}Wo_{0.9±0.1} (N=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m³/kg) = 3.91.

Classification: Carbonaceous chondrite (CV3, reduced subgroup). Estimated subtype 3.6/3.7.

Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11590 (NWA 11590)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL3)

Physical characteristics: Brownish stone. Cut surface reveals a brownish interior with packed, well-defined, mm-sized chondrules, and cm-sized darker clasts with smooth contours.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Packed chondrules with average size 850 μ m (N=24). Contains cm-sized clasts with very closely packed and indented chondrules, and abundant compound chondrules ("cluster chondrite" texture as defined by Metzler 2012, MAPS 47:2193-2217). These clasts are more weathered than the host lithology (W5 against W4).

Geochemistry: Olivine Fa_{14.2±8.8}, range Fa_{4.0-26.6}, PMD 57% (N=9), Cr₂O₃ in ferroan olivine 0.14±0.14 wt% (N=9). Orthopyroxene Fs_{13.4±8.4}Wo_{0.9±0.7}, Fs PMD 50% (N=10).

Classification: LL3. Contains cm-sized "cluster chondrite" LL3 clasts.

Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11591 (NWA 11591)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: The fusion crust has been largely weathered from the surface of the sample. In the area where it remains, it is thin (<0.5 mm) and shiny black. The interior of the stone is medium gray and contains inclusions that range from whitish-gray to black. There are several clasts and small fractures in the stone.

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2
3 A small amount of oxidation is present in the interior of the sample. The sample is
4 approximately $6.8 \times 8.6 \times 3.8$ cm.

5
6 **Petrography** (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is a pigeonite-
7 plagioclase rock with fine to medium grain size. Breccia composed of mineral and
8 lithic fragments set in a fine-grained, generally fragmental matrix. Lithic clasts are
9 generally ophitic with medium-grained pyroxenes and skeletal plagioclase grains
10 (width ~ 30 - $200 \mu\text{m}$) and a fine-grained recrystallized mesostasis. Pyroxene
11 generally contain pigeonite with augite lamellae (width $\sim 3 \mu\text{m}$). A silica phase is
12 commonly present. Accessories are ilmenite, chromite, troilite and rare phosphate
13 (apatite and merrillite).
14

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16 **Geochemistry** (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.2;
17 Low-Ca pyroxene: median compositions are Mg#=36.5; $\text{Fs}_{58.2}\text{Wo}_{8.4}$ (n=30). augite
18 lamellae: median compositions are Mg#=40.1, $\text{Fs}_{43.9}\text{Wo}_{26.7}$ (n=25). Plagioclase:
19 $\text{An}_{86.0}\text{Or}_{0.7}$ to $\text{An}_{92.4}\text{Or}_{0.4}$.

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21 **Classification**: Basaltic polymict brecciated eucrite

22 **Specimens**: 35.1 g and polished thin section are deposited in *GUT*
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26 Northwest Africa 11592 (NWA 11592)

27 Algeria

28 Purchased: 2016 May 1

29 Classification: HED achondrite (Eucrite)

30 **History**: Purchased by Miao Bing-an in 2016 in Morocco.

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32 **Physical characteristics**: This achondrite is covered on two surfaces with a shiny
33 black fusion crust (~ 2 mm thick). The interior appears massive and is a smokey
34 gray color. Many cracks penetrate the interior of this meteorite. A minute amount
35 of white deposit lines one crack. Dimensions: $2.5 \times 2.0 \times 4.5$ cm.
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38 **Petrography** (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is an
39 unbrecciated pigeonite-plagioclase rock with medium grain size. Textures are
40 ophitic with medium-grained (~ 0.3 - 0.8 mm) pyroxenes and granular to lath-shaped
41 plagioclase grains. Pyroxenes generally contain pigeonite with augite lamellae. It
42 also contains a shock vein (width ~ 4 mm) and a vein associated with formation of
43 medium-grained ferroan olivine (~ 50 - $250 \mu\text{m}$) and sometimes fine-grained
44 ilmenite, chromite and rare very fine-grained phosphate (apatite and merrillite).
45 Accessories are silica, ilmenite, chromite, troilite.
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48 **Geochemistry** (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=31.7;
49 low-Ca pyroxene: median compositions are Mg#=37.5; $\text{Fs}_{59.9}\text{Wo}_{4.2}$ (n=25). Augite
50 lamellae: median compositions are Mg#=50.1, $\text{Fs}_{29.9}\text{Wo}_{40.9}$ (n=12). Plagioclase:
51 $\text{An}_{87.2-90.0}\text{Or}_{0.5-0.9}$, median $\text{An}_{88.1}\text{Or}_{0.7}$ (n=8).
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53 **Classification**: Basaltic unbrecciated eucrite

54 **Specimens**: 4.2 g and polished thin section are deposited in *GUT*
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58 Northwest Africa 11593 (NWA 11593)

59 Algeria
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Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: A single stone of 44.37 g, partly covered by fusion crust. Many cracks penetrate the interior of this meteorite. Dimensions: $4.5 \times 4.0 \times 5.0$ cm.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies; also contains <10 vol% cumulate lithologies. Cumulate eucrite lithologies are coarse-grained (~0.5-1 mm) gabbros composed principally of low-Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies have fine to medium grain size, textures are subophitic to ophitic, and they contain very fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=34.9. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=51.9, $\text{Fs}_{46.3}\text{Wo}_{3.8}$ (n=20). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=41.5, $\text{Fs}_{55.3}\text{Wo}_{5.6}$ (n=36). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=43.4, $\text{Fs}_{47.6}\text{Wo}_{16.6}$ (n=45). Plagioclase: $\text{An}_{83.9-92.9}\text{Or}_{0.32-2.63}$, median $\text{An}_{90.1}\text{Or}_{0.9}$ (n=25).

Classification: Basaltic polymict brecciated eucrite

Specimens: 12.1 g and polished thin section are deposited in *GUT*

Northwest Africa 11594 (NWA 11594)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: On the unbroken surfaces, black fusion crust is partly preserved. The meteorite is a polymict breccia consisting of fragments of medium- to coarse-grained metamorphosed gabbroic rocks and fine-grained subophitic basaltic rocks. Dimensions: $5.5 \times 6.0 \times 7.2$ cm.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies, with <10 vol % cumulate lithologies. Cumulate eucrite lithologies are coarse grained (~0.6-1 mm) gabbros composed principally of low-Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine grained, have mostly subophitic textures, and contain very fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=35.2. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=51.7, $\text{Fs}_{46.6}\text{Wo}_{3.7}$ (n=20). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=45.2, $\text{Fs}_{52.6}\text{Wo}_{4.1}$ (n=43). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=47.7, $\text{Fs}_{38.5}\text{Wo}_{27.7}$ (n=45). Plagioclase: $\text{An}_{73.2-94.1}\text{Or}_{0.23-2.17}$, median $\text{An}_{88.2}\text{Or}_{0.76}$ (n=10).

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3 **Classification:** Basaltic polymict brecciated eucrite

4 **Specimens:** 34.6 g and polished thin section are deposited in *GUT*

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8 **Northwest Africa 11595** (NWA 11595)

9 Algeria

10 Purchased: 2016 May 1

11 Classification: HED achondrite (Eucrite)

12 **History:** Purchased by Miao Bing-an in 2016 in Morocco.

13 **Physical characteristics:** The fusion crust has been largely weathered from the
14 surface of the sample. The meteorite is a polymict breccia consisting of fragments
15 of medium- to coarse-grained metamorphosed gabbroic rocks and medium- to fine-
16 grained subophitic basaltic rocks. Dimensions: 4.5 × 6.0 × 6.4 cm.

17 **Petrography** (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of
18 basaltic lithologies, with <10 vol % cumulate lithologies. Cumulate eucrites
19 lithologies are coarse grained (~0.4-0.6 mm) gabbros composed principally of low-
20 Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine
21 grained, have mostly subophitic textures, and contain very fine-grained vitrophyric
22 textured basaltic lithologies. A silica phase is commonly present. Accessories are
23 ilmenite, chromite, troilite and rare iron metal.

24 **Geochemistry** (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=34.1.
25 Low-Ca pyroxene cumulate lithologies: median compositions are Mg#=50.9,
26 $\text{Fs}_{48.0}\text{Wo}_{2.2}$ (n=13). Low-Ca pyroxene of basaltic lithologies: median compositions
27 are Mg#=42.6, $\text{Fs}_{54.6}\text{Wo}_{4.9}$ (n=12). High-Ca pyroxene of basaltic lithologies:
28 median compositions are Mg#=44.4, $\text{Fs}_{45.3}\text{Wo}_{19.1}$ (n=28). Plagioclase: $\text{An}_{87.2-}$
29 $95.1\text{Or}_{0.41-1.56}$, median $\text{An}_{92.6}\text{Or}_{0.78}$ (n=12).

30 **Classification:** Basaltic polymict brecciated eucrite

31 **Specimens:** 25.3 g and polished thin section are deposited in *GUT*

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41 **Northwest Africa 11596** (NWA 11596)

42 Algeria

43 Purchased: 2016 May 1

44 Classification: HED achondrite (Eucrite)

45 **History:** Purchased by Miao Bing-an in 2016 in Morocco.

46 **Physical characteristics:** A black fusion crust covers the surface of the stone. The
47 meteorite is a polymict breccia consisting of fragments of medium- to coarse-
48 grained metamorphosed gabbroic rocks and medium- to fine-grained subophitic
49 basaltic rocks. Dimensions: 3.5 × 5.0 × 5.4 cm.

50 **Petrography** (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of
51 basaltic lithologies, with <10 vol% cumulate lithologies. Cumulate eucrite
52 lithologies are coarse grained (~0.3-1 mm) gabbros composed principally of low-
53 Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are
54 fine- to medium-grained, have textures that are mostly subophitic, and contain very
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3 fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly
4 present. Accessories are ilmenite, chromite, troilite and rare iron metal.

5 **Geochemistry** (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=36.6.
6 Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=51.3,
7 $\text{Fs}_{46.7}\text{Wo}_{4.2}$ (n=10). Low-Ca pyroxene of basaltic lithologies: median compositions
8 are Mg#=45.1, $\text{Fs}_{52.9}\text{Wo}_{3.8}$ (n=8). High-Ca pyroxene of basaltic lithologies: median
9 compositions are Mg#=43.8, $\text{Fs}_{47.5}\text{Wo}_{16.0}$ (n=18). Plagioclase: $\text{An}_{79.8-89.0}\text{Or}_{0.5-1.9}$,
10 median $\text{An}_{85.1}\text{Or}_{1.1}$ (n=11).

11 **Classification:** Basaltic polymict brecciated eucrite

12 **Specimens:** 16.9 g and polished thin section are deposited in *GUT*

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18 **Northwest Africa 11597** (NWA 11597)

19 Algeria

20 Purchased: 2016 May 1

21 Classification: HED achondrite (Eucrite)

22 **History:** Purchased by Miao Bing-an in 2016 in Morocco.

23 **Physical characteristics:** The interior of the meteorite is medium gray.

24 Dimensions: 2.5 × 3.0 × 3.4 cm.

25 **Petrography** (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of
26 basaltic lithologies, with <10 vol% cumulate lithologies. Cumulate eucrites
27 lithologies are coarse grained (~0.3-0.6 mm) gabbros composed principally of low-
28 Ca clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine
29 grained, and have textures that are mostly subophitic. A silica phase is commonly
30 present. Accessories are ilmenite, chromite and troilite.

31 **Geochemistry** (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=35.5.
32 Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=45.1,
33 $\text{Fs}_{52.3}\text{Wo}_{2.9}$ (n=10). Low-Ca pyroxene of basaltic lithologies: median compositions
34 are Mg#=40.8, $\text{Fs}_{57.2}\text{Wo}_{3.7}$ (n=8). High-Ca pyroxene of basaltic lithologies: median
35 compositions are Mg#=43.2, $\text{Fs}_{46.6}\text{Wo}_{18.6}$ (n=21). Plagioclase: $\text{An}_{90.0-91.9}\text{Or}_{0.5-0.7}$,
36 median $\text{An}_{91.9}\text{Or}_{0.7}$ (n=6).

37 **Classification:** Basaltic polymict brecciated eucrite

38 **Specimens:** 11.1 g and polished thin section are deposited in *GUT*

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43 **Northwest Africa 11598** (NWA 11598)

44 Algeria

45 Purchased: 2016 May 1

46 Classification: HED achondrite (Howardite)

47 **History:** Purchased by Miao Bing-an in 2016 in Morocco.

48 **Physical characteristics:** No fusion crust.

49 **Petrography** (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of
50 diogenite lithologies with ~40 vol% eucrite lithologies (mostly basaltic lithologies).
51 Basaltic eucrite detritus (composed of granular pyroxene and plagioclase) as veins
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invade the orthopyroxenitic diogenite lithologies (mainly composed of orthopyroxene). Accessories are silica, ilmenite, chromite, troilite.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.9; Orthopyroxene of diogenite lithologies: median compositions are Mg#=65.5, $\text{Fs}_{33.6}\text{Wo}_{2.6}$ (n=24). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=37.1, $\text{Fs}_{61.5}\text{Wo}_{2.2}$ (n=15). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=48.5, $\text{Fs}_{30.9}\text{Wo}_{40.0}$ (n=12). Plagioclase: median $\text{An}_{91.7}\text{Or}_{0.3}$ (n=11).

Classification: Polymict brecciated howardite

Specimens: 1.5 g and polished thin section are deposited in *GUT*. The remaining material is held by the anonymous finder.

Northwest Africa 11599 (NWA 11599)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: Single stone with black fusion crust. A saw cut reveals a mosaic of gray, coarse-grained, interlocking crystals.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Unbrecciated cumulate lithologies containing coarse-grained (~0.5-1.1 mm) gabbros composed principally of low-Ca clinopyroxene and calcic plagioclase (~20-40 vol%) with minor chromite (coarse-grained ~0.5-1.0 mm). Texture is equigranular with subequal amounts of pyroxene and plagioclase grains.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=28.6. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=63.1, $\text{Fs}_{36.0}\text{Wo}_{2.4}$ (n=29). High-Ca pyroxene of cumulate lithologies: median compositions are Mg#=73.2, $\text{Fs}_{14.5}\text{Wo}_{46.0}$ (n=23). Plagioclase: $\text{An}_{89.4-91.4}\text{Or}_{0.1-0.7}$, median $\text{An}_{90.2}\text{Or}_{0.5}$ (n=18).

Classification: Gabbroic cumulate eucrite

Specimens: 8.9 g and polished thin section are deposited in *GUT*

Northwest Africa 11600 (NWA 11600)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: Single stone with black fusion crust. A saw cut reveals a mosaic of gray, coarse-grained, interlocking crystals.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Unbrecciated cumulate lithologies containing coarse-grained (~0.8-1.5 mm) gabbros composed principally of low-Ca clinopyroxene and calcic plagioclase (~20-40 vol%) with minor

chromite (coarse-grained ~0.5-0.8 mm) and accessory phosphate. Texture is equigranular with subequal amounts of pyroxene and plagioclase grains.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=29.9. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=63.7, $\text{Fs}_{35.4}\text{Wo}_{2.7}$ (n=24). High-Ca pyroxene of cumulate lithologies: median compositions are Mg#=73.7, $\text{Fs}_{14.6}\text{Wo}_{44.4}$ (n=20). Plagioclase: $\text{An}_{87.8-91.1}\text{Or}_{0.2-0.7}$, median $\text{An}_{89.7}\text{Or}_{0.5}$ (n=26).

Classification: Gabbroic cumulate eucrite

Specimens: 16.2 g and polished thin section are deposited in *GUT*

Northwest Africa 11601 (NWA 11601)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: The meteorite has pitted irregular surfaces and is light to dark gray to pale brown in overall color. Most of the stones have partial coatings of greenish to whitish lichens.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is a pigeonite-plagioclase rock with fine to medium grain size. Breccia composed of mineral and lithic fragments set in a fine-grained, generally fragmental matrix. Lithic clasts are generally subophitic with fine to medium-grained (~0.1-0.4 mm) pyroxenes and skeletal plagioclase grains and a fine-grained mesostasis. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=32.1. Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=38.2, $\text{Fs}_{57.1}\text{Wo}_{5.6}$ (n=16). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=37.5, $\text{Fs}_{45.5}\text{Wo}_{27.5}$ (n=13). Plagioclase: $\text{An}_{85.2-87.7}\text{Or}_{0.5-1.3}$, median $\text{An}_{86.3}\text{Or}_{0.9}$ (n=14).

Classification: Basaltic unbrecciated eucrite

Specimens: 8.4 g and polished thin section are deposited in *GUT*

Northwest Africa 11602 (NWA 11602)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: Thin, shiny, black fusion crust covers 60% of the exterior of this sample. No fractures exist. Cleaving this achondrite revealed an interior with coarse-grained matrix containing an even distribution of white laths. The specimen is coherent and weathering is minimal.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is an unbrecciated pigeonite-plagioclase rock with medium grain size. With rhyolitic

structure, it contains fine to medium-grained (~0.05-0.5 mm) pyroxenes and granular plagioclase grains. Pyroxenes generally contain pigeonite with augite lamellae. Accessories are silica, ilmenite, troilite and rare iron metal.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=31.7. Low-Ca pyroxene: median compositions are Mg#=37.3, $Fs_{60.6}Wo_{3.5}$ (n=34). Augite lamellae : median compositions are Mg#=50.7, $Fs_{27.9}Wo_{43.4}$ (n=35). Plagioclase: $An_{88.4-90.2}Or_{0.1-0.4}$, median $An_{90.6}Or_{0.3}$ (n=22).

Classification: Basaltic unbrecciated eucrite

Specimens: 10.8 g and polished thin section are deposited in *GUT*

Northwest Africa 11603 (NWA 11603)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: Black fusion crust covers 40% of the exterior of this sample. No fractures exist. Cleaving this achondrite revealed an interior with coarse-grained matrix containing an even distribution of white laths.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is a unbrecciated pigeonite-plagioclase rock with medium grain size. Ophitic-gabbro texture with fine to medium-grained (~0.05-0.45 mm) pyroxenes and granular to lath-shaped plagioclase grains. Pyroxenes generally contain pigeonite with augite lamellae. Accessories are silica, ilmenite, troilite.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=32.7. Low-Ca pyroxene: median compositions are Mg#=36.5, $Fs_{60.5}Wo_{4.8}$ (n=26). Augite lamellae : median compositions are Mg#=51.2, $Fs_{27.4}Wo_{43.9}$ (n=14). Plagioclase: $An_{89.8-91.5}Or_{0.1-0.8}$, median $An_{90.6}Or_{0.3}$ (n=23).

Classification: Basaltic unbrecciated Eucrite

Specimens: 4.6 g and polished thin section are deposited in *GUT*

Northwest Africa 11604 (NWA 11604)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Howardite)

History: Purchased by Miao Bing-an in 2016 from Morocco.

Physical characteristics: The medium gray matrix contains a variety of clasts and the fusion crust is not found in this small sample.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic eucrite lithologies (~55 vol%) and cumulate eucrite lithologies (~30 vol%), with ~15 vol% diogenite lithologies. Basaltic eucrite lithologies mostly have a fine-grained recrystallized or subophitic texture. The texture of cumulate eucrite lithologies is equigranular with subequal amounts of pyroxene and plagioclase

grains. Diogenite lithologies mostly contain orthopyroxene. Accessories are silica, ilmenite, chromite, troilite.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.9; Orthopyroxene of diogenite lithologies: median compositions are Mg#=66.9, $\text{Fs}_{32.3}\text{Wo}_{2.3}$ (n=10). Low-Ca pyroxene of cumulate eucrite lithologies: median compositions are Mg#=54.3, $\text{Fs}_{44.8}\text{Wo}_{2.0}$ (n=12). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=38.8, $\text{Fs}_{59.5}\text{Wo}_{2.6}$ (n=10). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=51.6, $\text{Fs}_{28.1}\text{Wo}_{41.8}$ (n=8). Plagioclase: median $\text{An}_{92.5}\text{Or}_{0.3}$ (n=8).

Classification: Polymict brecciated howardite

Specimens: 1.2 g and polished thin section are deposited in *GUT*

Northwest Africa 11605 (NWA 11605)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Howardite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: The medium-gray matrix contains a variety of clasts and fusion crust is not found in this small sample.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of eucrite lithologies with ~10-15 vol% of diogenite lithologies. Basaltic eucrite lithologies mostly have a fine-grained recrystallized or subophitic texture and contain very fine-grained vitrophyric textured basaltic lithologies. Diogenites lithologies are mostly a orthopyroxene. The matrices are mostly basaltic detritus. Accessories are silica, ilmenite, chromite, troilite.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=32.5; Orthopyroxene of diogenite lithologies: median compositions are Mg#=67.1, $\text{Fs}_{31.9}\text{Wo}_{3.2}$ (n=16). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=37.4, $\text{Fs}_{60.4}\text{Wo}_{3.6}$ (n=14). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=54.1, $\text{Fs}_{26.3}\text{Wo}_{42.7}$ (n=8). Plagioclase: median $\text{An}_{91.3}\text{Or}_{0.4}$ (n=10).

Classification: Polymict brecciated howardite

Specimens: 0.6 g and polished thin section are deposited in *GUT*

Northwest Africa 11606 (NWA 11606)

Algeria

Purchased: 2016 May 1

Classification: HED achondrite (Howardite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: The medium-gray matrix contains a variety of clasts and fusion crust is not found in this small sample.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of eucrite lithologies with ~20%-40 vol% diogenite lithologies. Basaltic eucrite

lithologies mostly have subophitic texture. The texture of cumulate eucrite lithologies is equigranular with subequal amounts of pyroxene and plagioclase grains. Diogenite lithologies are mostly orthopyroxene. The matrices are mostly basaltic detritus. A higher C content chondritic clast (carbonaceous chondrite) was found in this section. Accessories are silica, ilmenite, chromite, troilite.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.1; Orthopyroxene of diogenite lithologies: median compositions are Mg#=65.0, $\text{Fs}_{34.2}\text{Wo}_{2.4}$ (n=12). Low-Ca pyroxene of cumulate eucrite lithologies: median compositions are Mg#=46.2, $\text{Fs}_{53.1}\text{Wo}_{1.3}$ (n=8). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=36.3, $\text{Fs}_{61.9}\text{Wo}_{2.9}$ (n=15). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=51.8, $\text{Fs}_{27.6}\text{Wo}_{42.7}$ (n=8). Plagioclase: median $\text{An}_{90.5}\text{Or}_{0.4}$ (n=10).

Classification: Polymict brecciated howardite

Specimens: 1.3 g and polished thin section are deposited in *GUT*

Northwest Africa 11607 (NWA 11607)

Northwest Africa

Purchased: 2017

Classification: Carbonaceous chondrite (CK3-6)

History: The meteorite was bought from a meteorite dealer in Morocco.

Physical characteristics: Dark grayish to black individual partly covered with fusion crust.

Petrography: The meteorite is a chondritic breccia composed of angular to subrounded type 3-6 clasts set into a more fine-grained clastic matrix. The different clasts are up to 2 cm in size and vary in color from light greenish to almost black. Matrix dominates over chondrules which are on average about 1.2 mm in diameter. Ferroan, Ni-rich olivine is the most abundant mineral in all lithologies. While highly unequilibrated in type 3 clasts and matrix it is equilibrated at $\text{Fa}_{29.6}$ in type 5 and 6 lithologies. One type 6 fragment with more Fe-rich olivine (Fa_{35}) has been encountered. Less abundant are Ca-pyroxene, low-Ca pyroxene, and intermediate feldspar. Feldspar is up to 200 μm in size in type 6 lithologies and often intergrown with Ca-pyroxene. The meteorite contains abundant Cr-bearing magnetite and some FeNi-sulfides.

Geochemistry: Type 3 lithology: olivine: $\text{Fa}_{22.4\pm 12.7}$ ($\text{Fa}_{1.7-34.0}$, NiO=0.3 \pm 0.2; FeO/MnO=103 \pm 31, n=32); low-Ca pyroxene: $\text{Fs}_{16.3\pm 8.0}\text{Wo}_{0.9\pm 0.9}$ ($\text{Fs}_{2.9-27.7}\text{Wo}_{0.5-4.1}$, n = 15), Ca-pyroxene: $\text{Fs}_{10.9\pm 4.8}\text{Wo}_{33.8\pm 6.5}$ ($\text{Fs}_{2.4-17.6}\text{Wo}_{23.1-45.1}$, n = 9); type 6 lithology: olivine: $\text{Fa}_{29.6\pm 0.6}$, NiO=0.4 \pm 0.1, FeO/MnO= 105 \pm 9, n=42; low-Ca pyroxene: $\text{Fs}_{26.9\pm 0.8}\text{Wo}_{1.1\pm 0.4}$, n=9, Ca-pyroxene: $\text{Fs}_{11.6\pm 2.6}\text{Wo}_{39.3\pm 6.6}$, n=13; Fe-rich fragment: olivine: $\text{Fa}_{35.0\pm 0.3}$, NiO=0.4 \pm 0.1, FeO/MnO= 143 \pm 13, n=38; Ca-pyroxene: $\text{Fs}_{12.6\pm 1.3}\text{Wo}_{46.5\pm 1.6}$, n=29; plagioclase: $\text{An}_{78.8}\text{Ab}_{20.9}\text{Or}_{0.3}$, n=3; andesitic feldspar: $\text{An}_{35.0}\text{Ab}_{64.3}\text{Or}_{0.7}$, n=3; Cr_2O_3 in magnetite is about 4.9 wt%.

Northwest Africa 11608 (NWA 11608)

(Northwest Africa)

Purchased: 2017 Aug

Classification: Ureilite

History: Purchased in Temara, Morocco by Adam *Aaronson* in August 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grainsize 1.7 mm) composed almost entirely of olivine (with dark, reduced magnesian rims) with minor accessory Fe metal and graphite. Multiple linear deformation boundaries are visible in some olivine grains viewed in cross-polarized light. A thorough search of the thin section revealed no pyroxene.

Geochemistry: Olivine (cores $\text{Fa}_{17.3-17.5}$, rims $\text{Fa}_{7.1-9.4}$, $N = 5$).

Classification: Ureilite (dunitic).

Specimens: 10.7 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11609 (NWA 11609)

Northwest Africa

Purchased: 2017 Oct

Classification: Ordinary chondrite (L4/5)

History: Purchased by Ben Hoefnagels in October 2017 from a dealer in Marrakech, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly well-formed chondrules are present within a recrystallized matrix containing stained metal.

Geochemistry: Olivine ($\text{Fa}_{25.5-25.6}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.9-21.0}\text{Wo}_{1.4-1.5}$, $N = 2$), clinopyroxene ($\text{Fs}_{6.7}\text{Wo}_{46.0}$).

Classification: Ordinary chondrite (L4/5).

Specimens: 21.2 g including one polished thin section at *UWB*; main mass with Mr. B. Hoefnagels.

Northwest Africa 11610 (NWA 11610)

(Northwest Africa)

Purchased: 2017 Jun

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Ke Zuokai in June 2017 from Moroccan dealer Habib Naji.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed small chondrules (apparent diameter $220 \pm 110 \mu\text{m}$, $N = 18$), angular mineral fragments and sparse very fine grained CAI are set in a finer grained matrix (brown in thin section).

Geochemistry: Olivine ($\text{Fa}_{0.2-41.0}$, Cr_2O_3 in ferroan examples 0.06-0.27 wt.%, mean 0.12 ± 0.08 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{2.3-23.2}\text{Wo}_{0.8-0.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{0.7-4.5}\text{Wo}_{42.2-41.0}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 4.07$.

Classification: Carbonaceous chondrite (CO3).

Specimens: 40.1 g including one polished thin section at *UWB*; main mass with Mr. K. Zuokai.

Northwest Africa 11611 (NWA 11611)

(Northwest Africa)

Purchased: 2017 Aug

Classification: Ordinary chondrite (LL(L)3)

History: Purchased in Temara, Morocco, by *Aaronson* in August 2017.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed chondrules (apparent diameter 580 ± 310 μm , $N = 18$) are set in a finer-grained matrix containing altered kamacite and chlorapatite.**Geochemistry:** Olivine ($\text{Fa}_{0.8-56.1}$, Cr_2O_3 in ferroan examples 0.05-0.10 wt.%, mean 0.08 ± 0.02 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{0.7-16.0}\text{Wo}_{0.7-0.1}$, $N = 3$), clinopyroxene ($\text{Fs}_{11.8}\text{Wo}_{37.3}$; $\text{Fs}_{8.7}\text{Wo}_{45.2}$; $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.20$.**Classification:** Ordinary chondrite (LL(L)3).**Specimens:** 22 g including one polished thin section at *UWB*; main mass with *Aaronson*.**Northwest Africa 11612** (NWA 11612)

(Northwest Africa)

Purchased: 2017 Aug

Classification: HED achondrite (Howardite)

History: Purchased in Temara, Morocco, by *Aaronson* in August 2017.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular grains of diogenitic orthopyroxene (~60 vol.%), exsolved pigeonite, bytownitic plagioclase and some polycrystalline diogenite clasts in a finer grained matrix containing silica polymorph, Ti-poor chromite, ilmenite, Ni-free metal, troilite, zircon and minor secondary calcite.**Geochemistry:** Orthopyroxene host ($\text{Fs}_{52.0}\text{Wo}_{1.3}$; $\text{Fs}_{36.8-39.6}\text{Wo}_{1.7-1.6}$; $\text{FeO}/\text{MnO} = 30-31$; $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{14.4-14.5}\text{Wo}_{45.1-43.1}$, $\text{FeO}/\text{MnO} = 23$, $N = 2$), diogenitic orthopyroxene ($\text{Fs}_{34.8}\text{Wo}_{2.5}$, $\text{FeO}/\text{MnO} = 30$), plagioclase ($\text{An}_{74.6-83.0}\text{Or}_{1.0-0.6}$, $N = 2$).**Classification:** Howardite.**Specimens:** 24 g including one polished thin section at *UWB*; main mass with *Aaronson*.**Northwest Africa 11613** (NWA 11613)

(Northwest Africa)

Purchased: 2017 Aug

Classification: Ordinary chondrite (H7)

History: Purchased in Temara, Morocco, by *Aaronson* in August 2017.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Recrystallized and equilibrated specimen lacking chondrule remnants, but containing some orthopyroxene

poikiloblasts enclosing smaller olivine grains. Primary metal is partly altered and some cross-cutting iron hydroxide veinlets are present.

Geochemistry: Olivine ($\text{Fa}_{18.2-18.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.0-16.1}\text{Wo}_{3.5-4.3}$, $N = 2$), clinopyroxene ($\text{Fs}_{6.9-7.2}\text{Wo}_{43.4-41.4}$, $N = 2$).

Classification: Ordinary chondrite (H7).

Specimens: 21.5 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11614 (NWA 11614)

(Northwest Africa)

Purchased: 2017 Sep

Classification: Rumuruti chondrite (R3-5)

History: Purchased by Gary Fujihara in September 2017 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of separated unequilibrated chondrules (apparent diameter $440 \pm 180 \mu\text{m}$, $N = 15$) together with equilibrated type 5 chondrite clasts in a finer grained matrix. Accessory minerals include sodic plagioclase, pentlandite, troilite and Ti-bearing chromite.

Geochemistry: Olivine in equilibrated clasts ($\text{Fa}_{40.2-42.4}$, $N = 3$), forsterite in type 3 chondrules ($\text{Fa}_{2.9-3.3}$, $N = 2$), orthopyroxene ($\text{Fs}_{1.1-31.0}\text{Wo}_{0.3-2.2}$, $N = 3$), clinopyroxene ($\text{Fs}_{0.8-10.0}\text{Wo}_{45.8-46.3}$, $N = 2$), plagioclase ($\text{An}_{9.4-12.0}\text{Or}_{6.4-3.5}$, $N = 2$).

Classification: R3-5 chondrite breccia.

Specimens: 25.7 g including one polished thin section at *UWB*; main mass with Mr. G. Fujihara.

Northwest Africa 11615 (NWA 11615)

Northwest Africa

Purchased: 2017 Aug

Classification: Ordinary chondrite (LL3)

History: Purchased in Temara, Morocco by Adam *Aaronson* in August 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter $710 \pm 420 \mu\text{m}$, $N = 18$) are set in a finer grained matrix containing altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{0.7-41.7}$, Cr_2O_3 in ferroan examples 0.06-0.10 wt.%, mean 0.08 ± 0.02 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{2.8-21.2}\text{Wo}_{0.2-3.0}$, $N = 3$), pigeonite ($\text{Fs}_{17.8-21.9}\text{Wo}_{20.9-16.2}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 3.73$.

Classification: Ordinary chondrite (LL3).

Specimens: 32.8 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11616 (NWA 11616)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Lunar meteorite

History: Purchased by *DPitt* in March 2017 from a Mauritanian dealer.

Physical characteristics: A single very fresh specimen (2550.8 g) containing separate olivine gabbro and olivine-free basaltic clasts in a fragmental matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*; S. Valencia and P.

Carpenter, *WUSL*) Polymict breccia with two different clast types. Olivine gabbro clasts (mean grain size 1.1 mm) consist of equant grains of olivine, zoned clinopyroxene (pigeonite, ferroan pigeonite, subcalcic augite) and maskelynite with accessory chromite, ilmenite, troilite, fayalite, taenite and baddeleyite. A basalt clast has porphyritic texture and is composed mainly of larger prismatic grains (up to 2.5 mm long) of zoned clinopyroxene and smaller lath-like grains of maskelynite with accessory ilmenite, chromite, troilite, silica polymorph, rare baddeleyite, rare K-feldspar and rare Ni-poor kamacite. The remainder of the breccia consists of related crystalline debris.

Geochemistry: Olivine gabbro clasts: olivine (Fa_{34.6-59.8}, FeO/MnO = 83-108, N = 9), pigeonite (Fs_{26.4-39.4}Wo_{9.7-11.7}, FeO/MnO = 51-70, N = 6), ferroan pigeonite (Fs_{43.4-71.4}Wo_{15.4-25.0}, FeO/MnO = 57-94, N = 3), subcalcic augite (Fs_{17.6-28.4}Wo_{27.2-35.6}, FeO/MnO = 51-59, N = 5), maskelynite (85.2-95.6Or_{2.2-0.1}, N = 10). Basalt clast: pigeonite (Fs_{26.2-26.3}Wo_{6.4-6.5}; Fs_{29.1}Wo_{11.7}; Fs_{49.8}Wo_{19.1}; FeO/MnO = 55-73; N = 4), augite (Fs_{21.9-25.6}Wo_{34.7-35.2}, FeO/MnO = 49-50, N = 2), ferropigeonite rims (Fs_{78.0-78.2}Wo_{18.9-20.3}, FeO/MnO = 83-86, N = 2), maskelynite (An_{84.4-86.2}Or_{3.6-2.0}, N = 2). Bulk composition (R. Korotev, *WUSL*) INAA of breccia subsamples gave (in wt.%) FeO 19.1, Na₂O 0.25 (in ppm) Sc 42.0, Cr 3230, La 13.6, Nd 22.9, Sm 6.73, Eu 0.578, Tb 1.37, Yb 1.37, Lu 0.66, Hf 5.1, Th 2.0.

Classification: Lunar meteorite (polymict breccia with olivine gabbro and basalt clasts). The olivine gabbro lithology is paired with other magnesian gabbro material present in breccia stones such as [NWA 773](#), [NWA 2727](#) and [NWA 3333](#) and also as discrete meteorites such as [NWA 2977](#), [NWA 6950](#) and [NWA 8127](#). The olivine-free basalt lithology differs from the olivine-phyric basalt lithology represented by [NWA 3160](#), and is a new member of the complex NWA 773 clan of lunar meteorites.

Specimens: 20.9 g including a polished thin section and polished endcut at *UWB*; remainder with *DPitt*.

Northwest Africa 11617 (NWA 11617)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Ordinary chondrite (LL(L)3)

History: Purchased in Temara, Morocco, by *Aaronson* in November 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter 680±420 μm, N = 18) are set in a finer grained matrix containing altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{0.8-48.0}$, Cr_2O_3 in ferroan examples 0.03-1.04 wt.%, mean 0.24 ± 0.40 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{0.2-21.4}\text{Wo}_{0.4-3.9}$, $N = 3$), subcalcic augite ($\text{Fs}_{6.9-12.4}\text{Wo}_{30.4-25.0}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.21$.

Classification: Ordinary chondrite (LL(L)3).

Specimens: 21.2 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11629 (NWA 11629)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL4-6)

Petrography: Chondritic breccia consisting of clastic LL4 type matrix and abundant LL6 clasts. Plagioclase grain size in LL6 clasts is about 80 μm .

Geochemistry: type 4 lithology: olivine: $\text{Fa}_{29.2 \pm 0.3}$, $n=12$; pyroxene: $\text{Fs}_{20.6 \pm 4.6}\text{Wo}_{2.4 \pm 0.8}$, ($\text{Fs}_{8.6-24.5}\text{Wo}_{0.5-3.5}$, $n = 17$); type 6 lithology: olivine: $\text{Fa}_{30.0 \pm 0.5}$, $n=12$; pyroxene: $\text{Fs}_{24.2 \pm 0.2}\text{Wo}_{3.5 \pm 0.4}$, $n=9$

Northwest Africa 11636 (NWA 11636)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CK6)

Physical characteristics: Sixteen small dark brownish individuals partly covered with fusion crust.

Petrography: The meteorite predominantly consists of fine-grained recrystallized matrix mainly composed of Ni-bearing ferrous olivine. Chondrules are only rarely encountered. Minor phases include intermediate plagioclase, low-Ca pyroxene, and troilite. Cr-rich magnetite is abundant; metal is virtually absent.

Geochemistry: Olivine: $\text{Fa}_{29.5 \pm 0.2}$, $\text{NiO}=0.4 \pm 0.1$, $\text{FeO/MnO}=100 \pm 11$, $n=12$; magnetite Cr_2O_3 is about 3.8 wt%.

Northwest Africa 11637 (NWA 11637)

Morocco

Purchased: May 2017

Classification: Iron meteorite (IIAB)

History: On May 21, 2017, during the China (Hunan) Mineral and Gem Show in Chenzhou, China, Wang Chen purchased 3 individual specimens (3096 g, 1100 g, 172.3 g) from a Moroccan dealer attending the show.

Physical characteristics: The three pieces have a dark brown exterior with minor rust-colored spots.

Petrography: (C. Herd, *UAb*) Optical investigation of a $\sim 4 \times 5$ cm polished and etched surface reveals a well-developed Widmanstätten pattern consistent with a

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2
3 coarsest octahedrite (3.6 ± 1 mm; $n=6$). No obvious inclusions were noted.
4 Terrestrial alteration has occurred along fractures connecting to the exterior.
5 **Geochemistry:** ICP-MS data, using sample of North Chile (Filomena) as standard
6 (C. Herd and G. Chen *UAb*): Ni = 5.7, Co = 0.47 (both wt%); Ir = 2.3, Ga = 54, Ge
7 = 137, As = 4.8, W = 2.5, Re = 0.15, Pt = 18.3, Cu = 139, Au = 0.5 (all $\mu\text{g/g}$).
8 **Classification:** (C. Herd, *UAb*): IIAB iron, through comparison of bulk
9 composition with data from Wasson et al. (2007).
10 **Specimens:** Type specimen consisting of two representative slices (13.5 and 11.8
11 g) at *UAb*. Wang Chen holds the main mass (2910 g), Wang Ziyao the 1100 g
12 individual, and Mendy Ouzillou holds the 172.3 g individual and a 117.5 g end cut
13 from the main mass.
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20 Northwest Africa 11638 (NWA 11638)

21 (Northwest Africa)

22 Purchased: 2017

23 Classification: CM2.0

24 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

25 **Physical characteristics:** Many small and dark-grayish fragments lacking any
26 fusion crust.

27 **Petrography:** The meteorite is a carbonaceous chondrite that is composed of
28 chondrule and CAI pseudomorphs set into a fine-grained Fe-rich matrix dominated
29 by phyllosilicates, carbonates and sulfides. It does not contain any anhydrous
30 silicates. Low totals of defocused matrix analyses attest to porosity and the
31 presence of hydrous phases, i.e., phyllosilicates. Abundant mineral phases are up to
32 50 μm sized Ca-carbonates, often fibrous phyllosilicates, and Ni-bearing pyrrhotite.

33 **Geochemistry:** Mean values of defocused (10 μm beam diameter) matrix analyses
34 (all wt%; $N=35$): SiO₂: 26.5, TiO₂: 0.12; Na₂O: 0.19; Cr₂O₃: 0.46, MgO: 20.5,
35 MnO: 0.25, CaO: 0.68, FeO: 29.5, Al₂O₃: 2.59, NiO: 0.69, P₂O₅: 0.14, S: 0.38,
36 Total: 82.0; Ca-carbonates contain about 1 wt% FeO.

37 **Classification:** CM2.0. Subtype following the classification scheme of [Rubin et al.](#)
38 (2007)).
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47 Northwest Africa 11639 (NWA 11639)

48 (Northwest Africa)

49 Purchased: 2017

50 Classification: Ureilite

51 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

52 **Physical characteristics:** Dark brownish fragment lacking any fusion crust.

53 **Petrography:** The meteorite displays a characteristic cumulate texture of up to 2
54 mm sized olivine and orthopyroxene crystals. Reduced rims in olivine are
55 abundant. The meteorite contains flaky graphite.
56

57 **Geochemistry:** reduced rims in olivine: Fa_{3.6-5.8}; olivine contains 0.32 ± 0.02 wt%
58 Cr₂O₃ and 0.25 ± 0.02 wt% CaO
59
60

Northwest Africa 11640 (NWA 11640)

(Northwest Africa)

Purchased: 2017

Classification: Ureilite

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Dark brownish fragment lacking any fusion crust.**Petrography:** The meteorite shows a cumulate texture of up to 2.5 mm sized olivine and pigeonite grains. Olivine crystals appear to consist of smaller subgrains and pigeonite shows patchy compositional zoning. Olivine displays characteristic reduced rims. The meteorite contains diamond and shows some foliation.**Geochemistry:** reduced rims in olivine: $Fa_{2.0-7.7}$; olivine contains 0.65 ± 0.04 wt% Cr_2O_3 and 0.35 ± 0.02 wt% CaO**Northwest Africa 11641** (NWA 11641)

(Northwest Africa)

Purchased: 2017

Classification: Ureilite

History: The meteorite was purchased from a local meteorite dealer in Mali.**Physical characteristics:** Dark brownish fragment lacking any fusion crust.**Petrography:** The meteorite shows a cumulate texture composed of up to 1 mm sized olivine and pigeonite grains. Olivine displays characteristic reduced rims and the meteorite contains abundant flaky graphite.**Geochemistry:** reduced rims in olivine: $Fa_{4.7-8.8}$; olivine contains 0.61 ± 0.02 wt% Cr_2O_3 and 0.34 ± 0.01 wt% CaO**Northwest Africa 11643** (NWA 11643)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL5)

Petrography: The meteorite is an ordinary chondrite predominantly composed of densely packed chondrules with a mean diameter of about 1 mm. Matrix and metal are rare; plagioclase grain size is about 20 μm . Olivine and pyroxene are completely equilibrated.**Northwest Africa 11644** (NWA 11644)

(Northwest Africa)

Purchased: 2017

Classification: Ureilite

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Two small dark brownish fragments lacking any fusion crust.

Petrography: The meteorite displays a coarse-grained cumulate texture of predominant up to 2 mm sized olivine grains and less abundant pigeonite. Contains some graphite flakes; olivine displays characteristic reduced rims.

Geochemistry: reduced rims in olivine: $Fa_{1.6-5.3}$; olivine contains 0.73 ± 0.02 wt% Cr_2O_3 and 0.33 ± 0.02 wt% CaO

Northwest Africa 11645 (NWA 11645)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL4-6)

Petrography: Chondritic breccia consisting of LL6 type fragments set into a clastic LL4 type matrix. Plagioclase grain size in LL6 clasts is about 70 μm .

Geochemistry: type 4 lithology: olivine: $Fa_{29.7 \pm 0.2}$, $n=12$; pyroxene: $Fs_{23.4 \pm 2.4} Wo_{2.3 \pm 0.9}$, ($Fs_{13.0-25.6} Wo_{0.5-3.5}$, $n = 21$); type 6 lithology: olivine: $Fa_{30.0 \pm 0.3}$, $n=13$; pyroxene: $Fs_{25.2 \pm 0.1} Wo_{2.8 \pm 0.2}$, $n=13$

Northwest Africa 11647 (NWA 11647)

(Northwest Africa)

Purchased: 2016

Classification: HED achondrite (Eucrite, polymict)

History: The meteorite was bought from a meteorite dealer at the mineral fair in St. Marie-aux Mines, France.

Physical characteristics: Grayish fragment partly covered with fusion crust.

Petrography: The meteorite is a polymict breccia with basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are magmatically zoned low-Ca pyroxenes, Fe-rich low-Ca pyroxenes with augite exsolution lamellae and calcic plagioclase. Minor phases include silica, chromite, FeS, and ilmenite. No metallic Fe has been found.

Geochemistry: zoned low-Ca pyroxene $Fs_{26.7 \pm 2.3} Wo_{2.9 \pm 0.8}$ ($Fs_{23.5-29.2} Wo_{2.0-5.1}$, $n=15$, $FeO/MnO=27-33$); low-Ca pyroxene host to augite exsolution lamellae: $Fs_{43.4 \pm 0.3} Wo_{2.9 \pm 0.3}$ ($Fs_{43.0-44.1} Wo_{2.6-3.5}$, $n=12$, $FeO/MnO=32-36$); Ca-pyroxene: $Fs_{21.0 \pm 0.3} Wo_{40.0 \pm 0.2}$ ($Fs_{20.3-21.5} Wo_{40.3-41.1}$, $n=13$, $FeO/MnO=26-32$); calcic plagioclase: $An_{90.7 \pm 1.1}$ ($An_{89.3-92.4}$, $n=14$)

Northwest Africa 11648 (NWA 11648)

(Northwest Africa)

Purchased: 2002 Feb

Classification: Ordinary chondrite (L6)

History: A single stone was purchased by Edwin *Thompson* at the Tucson Gem Show and donated to *Cascadia*.

Petrography: About a dozen readily identifiable chondrules are visible in thin section, but their edges grade into surrounding granular regions. Approximately 2% metal present. Minimal weathering. Shock stage (conventional) estimated from olivine deformation; plagioclase deformed.

Geochemistry: (A. Ruzicka and K. Farley, *Cascadia*) Olivine (Fa_{24.9±0.2}, N=13), low-Ca pyroxene (Wo_{1.5±0.3}Fs_{21.1±0.2}En_{77.4±0.2}, N=12), plagioclase (Ab_{85.1±0.6}Or_{3.2±0.4}An_{11.4±0.8}, N=13).

Classification: L6 chondrite based on texture and mineral chemistry.

Specimens: *Cascadia* holds the main mass and type specimen, consisting of 28.7 g in two pieces plus one thin section.

Northwest Africa 11649 (NWA 11649)

Morocco

Purchased: 2005

Classification: Iron meteorite (IAB-MG)

History: Purchased from a Moroccan dealer at the 2005 Munich show.

Physical characteristics: The meteorite is oblong, approximately 20 cm in longest dimension, and is characterized by a dark brown to black, regmaglypted exterior.

Petrography: (C. Herd, *UAb*) Optical investigation of a ~1.5 × 3 cm polished and etched surface reveals cm-scale, equant kamacite grains with Neumann lines.

Sulfide inclusions are present; no other inclusions are visible, although the surface area examined is relatively small. Terrestrial alteration has occurred along fractures connecting to the exterior.

Geochemistry: ICP-MS data, using sample of [North Chile](#) (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 6.7, Co = 0.46 (both wt%); Ir = 3.5, Ga = 88, As = 12.5, W = 1.4, Re = 0.31, Pt = 8.6, Cu = 134, Au = 1.3 (all µg/g).

Classification: (C. Herd, *UAb*): IAB iron, Main Group, through comparison of bulk composition with data from [Wasson and Kallemeyn \(2002\)](#).

Specimens: Type specimen consisting of one representative piece (22.8 g) at *UAb*. Main mass in the Hollis Meteorite Collection.

Northwest Africa 11667 (NWA 11667)

(Northwest Africa)

Purchased: 2017

Classification: Enstatite chondrite (EL6)

History: The meteorite was bought by the main mass holder from a local meteorite dealer in Morocco.

Physical characteristics: Dark brownish individual with some patches of fusion crust.

Petrography: The meteorite displays a fine-grained, recrystallized texture of predominantly enstatite, less abundant albitic feldspar, often intergrown daubreelite and troilite, and FeNi metal. No chondrules are visible.

Geochemistry: Feldspar: $An_{15.3}Ab_{80.2}$, $n=12$; FeNi metal contains about 1.2 wt% Si

Northwest Africa 11668 (NWA 11668)

(Northwest Africa)

Purchased: 2018

Classification: Martian meteorite (Shergottite)

History: The meteorite was purchased in Tindouf, Algeria, from a Sahrawi dealer.

Physical characteristics: Four dark-green pieces partly covered with fusion crust.

Petrography: The meteorite is a medium grained basalt predominantly composed of up to 1.5 mm sized pyroxene and plagioclase grains. Pyroxene is intensely fractured pigeonite and augite displaying mottled compositional zoning. Plagioclase is completely transformed into compositionally homogeneous maskelynite. Minor phases are ilmenite, ulvöspinel, pyrrhotite and some Si-rich mesostasis.

Geochemistry: pigeonite: $Fs_{53.7\pm 4.4}Wo_{14.3\pm 2.4}$ ($Fs_{35.5-59.6}Wo_{9.7-20.0}$, $n=38$, $FeO/MnO=33-43$); augite: $Fs_{26.2\pm 7.0}Wo_{32.2\pm 3.9}$ ($Fs_{21.1-48.9}Wo_{20.6-37.8}$, $n=32$, $FeO/MnO=27-40$); feldspar: $An_{56.8}Ab_{42.0}Or_{1.2}$, $n=15$

Classification: Martian (basaltic shergottite)

Northwest Africa 11669 (NWA 11669)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (LL3)

History: Purchased in Rissani, Morocco by Adam Aaronson in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, well-formed chondrules (apparent diameter 580 ± 340 μm , $N=18$) are set in a recrystallized matrix containing altered kamacite.

Geochemistry: Olivine ($Fa_{0.5-61.4}$, Cr_2O_3 in ferroan examples 0.07-0.18 wt.%, mean 0.12 ± 0.04 wt.%, $N=8$), orthopyroxene ($Fs_{3.0-14.9}Wo_{0.3-3.6}$, $N=3$), subcalcic augite ($Fs_{14.5}Wo_{33.0}$), diopside ($Fs_{1.0}Wo_{45.9}$). Magnetic susceptibility $\log \chi$ ($\times 10^{-9}$ m^3/kg) = 3.22.

Classification: Ordinary chondrite (LL3).

Specimens: 26.4 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11670 (NWA 11670)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Carbonaceous chondrite (CK4)

History: Purchased in Zagora, Morocco, by Adam Aaronson in March 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Equilibrated specimen composed of separated, medium-sized chondrules (containing rounded grains of stained Cr-magnetite) set in a finer grained matrix containing Cr-magnetite, chlorapatite and pentlandite.

Geochemistry: Olivine ($\text{Fa}_{32.1-32.4}$, $N = 3$), orthopyroxene ($\text{Fs}_{26.7-29.7}\text{Wo}_{0.8-1.8}$, $N = 3$), clinopyroxene ($\text{Fs}_{11.5-14.6}\text{Wo}_{47.6-48.3}$, $N = 2$).

Classification: CK4 chondrite.

Specimens: 21 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11671 (NWA 11671)

(Northwest Africa)

Purchased: 2017 Aug

Classification: Ureilite

History: Purchased in Temara, Morocco, by Adam *Aaronson* in August 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grain size 1.5 mm) composed entirely of olivine (with relatively thick dark, reduced magnesian rims). Multiple planar deformation lamellae are visible in some olivine grains viewed in cross-polarized light. A thorough search of the thin section revealed no pyroxene.

Geochemistry: Olivine (cores $\text{Fa}_{20.6-20.8}$, rim $\text{Fa}_{5.8}$, $N = 4$).

Classification: Ureilite (dunitic).

Specimens: 20.6 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11672 (NWA 11672)

(Northwest Africa)

Purchased: 2017 Jun

Classification: Ordinary chondrite (L3)

History: Purchased by Gary Fujihara in June 2017 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed, unequilibrated chondrules (apparent diameter $620 \pm 340 \mu\text{m}$, $N = 18$) are set in a recrystallized matrix containing slightly stained kamacite.

Geochemistry: Olivine ($\text{Fa}_{1.8-64.0}$, Cr_2O_3 in ferroan examples 0.02-0.84 wt.%, mean 0.19 ± 0.33 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{3.3-18.8}\text{Wo}_{0.2-2.0}$, $N = 3$), augite ($\text{Fs}_{8.7-11.8}\text{Wo}_{41.3-36.7}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 4.73$.

Classification: Ordinary chondrite (L3).

Specimens: 21.8 g including one polished thin section at *UWB*; main mass with Mr. G. Fujihara.

Northwest Africa 11674 (NWA 11674)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Ordinary chondrite (L4)

History: Purchased in Temara, Morocco by Adam *Aaronson* in November 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules are set in a recrystallized matrix containing stained kamacite and chlorapatite.

Geochemistry: Olivine ($\text{Fa}_{24.9-25.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.6-20.8}\text{Wo}_{0.9-0.7}$, $N = 3$), clinopyroxene ($\text{Fs}_{6.7-7.6}\text{Wo}_{45.6-44.3}$, $N = 2$).

Classification: Ordinary chondrite (L4).

Specimens: 21 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11675 (NWA 11675)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Ureilite

History: Purchased by Bob Falls in March 2017 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grainsize 1.9 mm) composed of olivine (~75 vol.%) and pigeonite (~25 vol.%).

Olivine grains have relatively thick, dark, reduced magnesian rims associated with Fe metal (extensively altered to hydroxides). Minor secondary gypsum is present.

Geochemistry: Olivine (cores $\text{Fa}_{19.6-19.9}$, rim $\text{Fa}_{6.3}$, $N = 3$), pigeonite ($\text{Fs}_{13.0}\text{Wo}_{5.5}$; $\text{Fs}_{15.5}\text{Wo}_{11.7}$; $N = 2$).

Classification: Ureilite.

Specimens: 22.4 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11676 (NWA 11676)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to *PSF*. In 2018 the specimen was acquired by the Kenosha Public Museum, Wisconsin.

Physical characteristics: A single broken stone (1664 g) partly coated with dark brown fusion crust. The fresher interior exhibits some partly weathered shiny metal and indistinct chondrules.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare chondrule remnants and altered metal.

Geochemistry: Olivine ($\text{Fa}_{26.1-26.2}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.9-21.2}\text{Wo}_{1.3-1.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.8-8.3}\text{Wo}_{44.2-44.7}$, $N = 2$).

Classification: Ordinary chondrite (L6).

Specimens: 39.1 g including one polished thin section at *PSF*; main mass housed at the Kenosha Public Museum, Wisconsin, USA.

Northwest Africa 11677 (NWA 11677)

(Northwest Africa)

Purchased: 2017 Nov

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Darryl Pitt in November 2017 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Polymict breccia consisting predominantly of eucrite clasts (exhibiting intersertal, subophitic, diabasic and gabbroic textures) and related crystalline debris, together with ~10 vol.% of diagenitic orthopyroxene (exhibiting more ferroan reaction rims against the matrix). Other minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti-chromite and troilite.

Geochemistry: Diagenitic orthopyroxene (cores $\text{Fs}_{31.3-33.5}\text{Wo}_{3.6-5.3}$, $\text{FeO/MnO} = 35-36$; rim $\text{Fs}_{53.8}\text{Wo}_{3.8}$, $\text{FeO/MnO} = 32$; $N = 3$), orthopyroxene host ($\text{Fs}_{61.2}\text{Wo}_{1.5}$, $\text{FeO/MnO} = 36$), clinopyroxene exsolution lamella ($\text{Fs}_{26.0}\text{Wo}_{42.9}$, $\text{FeO/MnO} = 34$), low-Ca pyroxene host ($\text{Fs}_{45.1}\text{Wo}_{7.1}$, $\text{FeO/MnO} = 31$), augite exsolution lamella ($\text{Fs}_{22.6}\text{Wo}_{39.1}$, $\text{FeO/MnO} = 30$), augite ($\text{Fs}_{30.1}\text{Wo}_{37.4}$, $\text{FeO/MnO} = 35$), plagioclase ($\text{An}_{88.7-89.1}\text{Or}_{0.3-0.6}$, $N = 2$).

Classification: Eucrite (polymict breccia).

Specimens: 21.1 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 11678 (NWA 11678)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Ordinary chondrite (L4)

History: Purchased in Temara, Morocco by Adam *Aaronson* in November 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules are set in a recrystallized matrix containing altered kamacite and merrillite.

Geochemistry: Olivine ($\text{Fa}_{25.5-25.6}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.9-21.0}\text{Wo}_{1.4-1.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.4-7.7}\text{Wo}_{45.1-45.4}$, $N = 2$).

Classification: Ordinary chondrite (L4).

Specimens: 35.4 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11679 (NWA 11679)

Morocco, Laayoun, (Northwest Africa)

Purchased: May 2014

Classification: Enstatite chondrite (EL6)

History: Collected by nomads in Western Sahara and purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 98 g with no fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); A fine-grained texture, with a pyroxene-dominant matrix and minor plagioclase is visible in thin section. No relic chondrules are visible. Kamacite and troilite are the main opaque phases, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite.

Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Orthopyroxene ($\text{Fs}_{0.3}\text{En}_{98.1}\text{Wo}_{1.6}$), plagioclase ($\text{An}_{17.9}\text{Or}_{4.8}$); Si in kamacite = 0.5 wt.%, Ti in troilite = 6.2 wt.%

Classification: Enstatite chondrite (EL6); strong weathering. EL classification is suggested by the presence of alabandite, An content of plagioclase and Si content of kamacite. Possibly paired with [NWA 11413](#), [NWA 11414](#), [NWA 11415](#), [NWA 11416](#).

Specimens: A total of 19.6 g specimen is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 11695 (NWA 11695)

Algeria

Purchased: 2017

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased from a Moroccan meteorite dealer in 2017. Reportedly found by nomads in Algeria, March 2017.

Physical characteristics: Many identical appearing pieces. Weathered exterior, no fusion crust, saw cut reveals a fragmental breccia with numerous white feldspathic clasts set in a dark-gray ground mass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows primarily feldspathic clasts and shock melt with lesser amounts of fragmental pyroxene and olivine. Z. Kerensky made 6 thin sections and also identified minor amounts of troilite and Fe-metal.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{35.7\pm 10.2}$, Mn/Fe=90±8, n=15; pigeonite $\text{Fs}_{30.0\pm 6.8}\text{Wo}_{10.1\pm 7.6}$, Mn/Fe=56±6, n=9; augite $\text{Fs}_{26.7\pm 15.3}\text{Wo}_{37.0\pm 7.7}$, Mn/Fe=54±11, n=7; plagioclase $\text{An}_{96.5\pm 0.5}$, n=7; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=43.5\pm 0.1$, $\text{TiO}_2=0.19\pm 0.01$, $\text{Al}_2\text{O}_3=28.9\pm 0.1$, $\text{Cr}_2\text{O}_3=0.11\pm 0.01$, $\text{MgO}=6.2\pm 0.0$, $\text{FeO}=4.1\pm 0.1$, $\text{MnO}=0.06\pm 0.00$, $\text{CaO}=16.0\pm 0.1$, $\text{Na}_2\text{O}=0.34\pm 0.01$, $\text{K}_2\text{O}=0.02\pm 0.00$, n=3 (all wt%).

Classification: Lunar, feldspathic breccia

Specimens: 20.85 g on deposit at *CSFK*, probe mount at *UNM*, Zsolt Kereszty holds the main mass.

Northwest Africa 11696 (NWA 11696)

(Northwest Africa)

Purchased: 2017 Sep

Classification: HED achondrite (Diogenite)

History: Portions of the same disaggregated stone were purchased separately by Habib Naji (540 g) and Rachid Chaoui (2166 g) from a Mauritanian dealer in September 2017. In February 2018 the material obtained by Rachid Chaoui was acquired by Terry *Boudreaux* and Bob Falls.

Physical characteristics: A disaggregated and quite brittle stone (2706 g); very fresh, mostly dark gray and in part exhibiting a vitreous luster.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) The fresh specimen is composed predominantly of orthopyroxene with accessory troilite, chromite and minor kamacite. Larger orthopyroxene grains are surrounded by regions of finer grained, crushed grains in a cataclastic texture.

Geochemistry: Orthopyroxene ($\text{Fs}_{24.5-25.6}\text{Wo}_{1.9-2.1}$, $\text{FeO/MnO} = 27-30$, $N = 5$).

Classification: Diogenite.

Specimens: 24.8 g including one polished thin section and one polished mount at *UWB*; remaining material with Mr. T. *Boudreaux*, Mr. H. Naji and Mr. R. Falls.

Northwest Africa 11697 (NWA 11697)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Rumuruti chondrite (R3-6)

History: Purchased by Bob Falls in November 2017 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of small unequilibrated Type 3 lithic clasts (containing separated chondrules with apparent diameter $560 \pm 350 \mu\text{m}$, $N = 10$) and related debris (including isolated chondrules), plus rare fine grained, recrystallized Type 5 and Type 6 chondrite clasts, in a finer grained matrix. Minerals in addition to olivine and pyroxenes include albitic plagioclase, pentlandite, troilite and minor ilmenite. Metal is absent. No CAI were observed in the studied thin section, but several chondrules were found to contain highly aluminous pyroxenes.

Geochemistry: Olivine in Type 3 clasts and isolated chondrules ($\text{Fa}_{1.5-48.4}$, $N = 4$), orthopyroxene ($\text{Fs}_{1.9-14.5}\text{Wo}_{0.3-2.9}$, $N = 3$), augite ($\text{Fs}_{10.7}\text{Wo}_{45.4}$), Al-rich subcalcic clinopyroxene in chondrule ($\text{Fs}_{3.5}\text{Wo}_{29.2}$, $\text{Al}_2\text{O}_3 = 7.7 \text{ wt.}\%$, $\text{TiO}_2 = 1.0 \text{ wt.}\%$), Al-rich diopside in chondrule ($\text{Fs}_{1.8}\text{Wo}_{41.9}$, $\text{Al}_2\text{O}_3 = 7.7 \text{ wt.}\%$, $\text{TiO}_2 = 0.9 \text{ wt.}\%$), Al-rich low-Ca pyroxene in chondrules ($\text{Fs}_{1.9-2.2}\text{Wo}_{2.9-3.2}$, $\text{Al}_2\text{O}_3 = 11.6-13.8 \text{ wt.}\%$, $\text{TiO}_2 = 0.5-0.7 \text{ wt.}\%$; $\text{Fs}_{16.6}\text{Wo}_{3.7}$, $\text{Al}_2\text{O}_3 = 16.0 \text{ wt.}\%$, $\text{TiO}_2 = 0.4 \text{ wt.}\%$; $N = 4$), plagioclase ($\text{An}_{6.5-10.0}\text{Or}_{2.0-2.9}$, $N = 2$).

Classification: R3-6 chondrite. The high content of Mg-Tschermak's component in low-Ca pyroxenes in some chondrules is an anomalous feature of this specimen.

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11698 (NWA 11698)

(Northwest Africa)

Purchased: 2017 Feb

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Bob Falls in February 2017 from a Moroccan dealer at the Tucson Gem and Mineral Show.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Monomict breccia consisting of closely packed, subophitic eucrite clasts in a sparse matrix of related debris.

Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite and troilite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{60.8-62.5}\text{Wo}_{3.6-1.8}$, $\text{FeO/MnO} = 33-35$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{26.3-26.8}\text{Wo}_{44.2-43.7}$, $\text{FeO/MnO} = 33-35$, $N = 2$), plagioclase ($\text{An}_{84.5-84.6}\text{Or}_{0.8-0.6}$, $N = 2$).**Classification:** Eucrite (monomict breccia).**Specimens:** 25.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.**Northwest Africa 11699** (NWA 11699)

(Northwest Africa)

Purchased: 2017 Oct

Classification: Carbonaceous chondrite (CM2)

History: Purchased by Ben Hoefnagels in October 2017 from a Mauritanian dealer.**Petrography:** (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Very small, well-formed granular chondrules (apparent diameter $200 \pm 70 \mu\text{m}$, $N = 14$), mineral fragments and sparse very fine grained CAI are set in a finer grained matrix (deep sepia brown in thin section) containing clay minerals and serpentine (both confirmed by powder X-ray diffraction) plus accessory phosphorian Fe-Ni sulfides.**Geochemistry:** Olivine ($\text{Fa}_{0.4-58.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.6-0.7}\text{Wo}_{1.3-0.8}$, $N = 2$), clinopyroxene ($\text{Fs}_{0.7-0.8}\text{Wo}_{44.6-40.1}$, $N = 2$). Oxygen isotopes (K. Ziegler, *ASU*) $\delta^{17}\text{O} - 0.850, -1.728$; $\delta^{18}\text{O} 6.238, 5.426$; $\Delta^{17}\text{O} -4.144, -4.593$ (all per mil).**Classification:** Carbonaceous chondrite (CM2). The presence of phosphorian Fe-Ni sulfides in this specimen is notable and represents only the second such confirmation among northwest African specimens. Phosphorian Fe-Ni sulfides were previously described in CM chondrites by [Nazarov et al. \(2009\)](#) and in CM-related clasts within polymict eucrite [NWA 5232](#) by Kuehner et al. (LPSC 40, #2314, 2009).**Specimens:** 15.2 g including one polished thin section at *UWB*; main mass with Mr. B. Hoefnagels.**Northwest Africa 11700** (NWA 11700)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Ordinary chondrite (H4)

History: Purchased in Temara, Morocco by Adam *Aaronson* in November 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed, relatively small chondrules are set in a recrystallized matrix containing altered kamacite and merrillite.

Geochemistry: Olivine ($\text{Fa}_{18.8-18.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{15.5-17.0}\text{Wo}_{0.5-1.2}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.5-9.4}\text{Wo}_{40.5-42.4}$, $N = 2$).

Classification: Ordinary chondrite (H4).

Specimens: 29.2 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11701 (NWA 11701)

(Northwest Africa)

Purchased: 2017 Sep

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Bob Falls in September 2017 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of intersertal to gabbroic eucrite clasts plus ~5 vol.% diagenetic orthopyroxene grains in a quench-textured melt matrix (partly vesicular with minor calcite infillings). Eucrite clasts consist of exsolved pigeonite and calcic plagioclase (polycrystalline) with accessory silica polymorph, ilmenite, fayalite, troilite, Ni-poor metal and zircon.

Geochemistry: Orthopyroxene host ($\text{Fs}_{61.4-61.5}\text{Wo}_{2.8-2.0}$, $\text{FeO/MnO} = 32$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{27.0-27.3}\text{Wo}_{43.4-41.4}$, $\text{FeO/MnO} = 32-33$, $N = 2$), diagenetic orthopyroxene ($\text{Fs}_{30.8-32.6}\text{Wo}_{5.4-3.1}$, $\text{FeO/MnO} = 31-34$, $N = 2$), fayalite ($\text{Fa}_{84.5-85.6}$, $\text{FeO/MnO} = 38$, $N = 2$), plagioclase ($\text{An}_{78.7-82.9}\text{Or}_{1.3-0.6}$, $N = 2$).

Classification: Eucrite (melt-matrix polymict breccia).

Specimens: 25.8 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11702 (NWA 11702)

Mauritania

Purchased: 2017 Sep

Classification: Ordinary chondrite (LL6)

History: Purchased by Jason Bliss in September 2017 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of closely packed clasts with rare remnant chondrules in a dominant recrystallized, poikiloblastic matrix containing stained metal and chlorapatite.

Geochemistry: Olivine ($\text{Fa}_{29.7-30.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{22.9-23.6}\text{Wo}_{2.7-3.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.6-11.4}\text{Wo}_{42.5-42.2}$, $N = 2$).

Classification: Ordinary chondrite (LL6 breccia).

Specimens: 8.4 g including one polished thin section at *UWB*; remainder with Mr. J. Bliss.

Northwest Africa 11703 (NWA 11703)

(Northwest Africa)

Purchased: 2015 Apr

Classification: Lunar meteorite (gabbro)

History: Purchased by Darryl Pitt in April 2015 from a dealer in Erfoud, Morocco.**Physical characteristics:** A single pale greenish stone (5309.1 g) with thin cross-cutting shock veinlets.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Medium grained (grainsize up to 1.4 mm) with cumulate texture. Major minerals are olivine, pigeonite, subcalcic augite and calcic plagioclase (predominantly converted to maskelynite with minor birefringent domains); accessory phases include ilmenite, taenite, troilite, Mg-merrillite and baddeleyite. Shock veinlets contain dark glass.**Geochemistry:** Olivine ($\text{Fa}_{32.1-32.4}$, $\text{FeO/MnO} = 91-97$, $N = 3$), pigeonite ($\text{Fs}_{26.0}\text{Wo}_{9.7}$; $\text{Fs}_{27.7}\text{Wo}_{5.7}$; $\text{FeO/MnO} = 47-60$; $N = 2$), subcalcic augite ($\text{Fs}_{16.4-17.5}\text{Wo}_{34.9-32.3}$, $\text{FeO/MnO} = 46-52$, $N = 2$), plagioclase ($\text{An}_{89.7-91.2}\text{Or}_{0.8-1.1}$, $N = 2$).**Classification:** Lunar (gabbro). This specimen is texturally and mineralogically identical to [NWA 2977](#), [NWA 6950](#), [NWA 8127](#), and to the olivine gabbro clasts in [NWA 773](#), [NWA 2700](#), [NWA 2727](#) and [NWA 3333](#), and evidently is paired with those lithologies.**Specimens:** 20.1 g including one polished thin section at *UWB*; remainder held by *DPitt*.**Northwest Africa 11704** (NWA 11704)

Mauritania

Purchased: 2018 Jan

Classification: HED achondrite (Eucrite, polymict)

History: A batch of about 50 stones with similar appearance found together in Mauritania was purchased by John Higgins in January 2018 from a Mauritanian dealer.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia consisting predominantly of gabbroic eucrite clasts, some ophitic eucrite clasts and sparse clasts of feldspathic diogenite in a finer grained matrix. Minerals include exsolved pigeonite, calcic plagioclase (exhibiting undulose to polycrystalline microstructure), silica polymorph, ilmenite, Ti-chromite, Ti-poor chromite, troilite and minor barite. Feldspathic diogenite clasts consist mainly of relatively ferroan orthopyroxene with subordinate anorthite and minor clinopyroxene.**Geochemistry:** Orthopyroxene host ($\text{Fs}_{58.5}\text{Wo}_{4.6}$, $\text{FeO/MnO} = 35$), clinopyroxene exsolution lamella ($\text{Fs}_{28.1}\text{Wo}_{41.0}$, $\text{FeO/MnO} = 34$), orthopyroxene host ($\text{Fs}_{44.5}\text{Wo}_{2.2}$, $\text{FeO/MnO} = 30$), clinopyroxene exsolution lamella ($\text{Fs}_{17.8}\text{Wo}_{43.8}$, $\text{FeO/MnO} = 25$), plagioclase ($\text{An}_{86.6}\text{Or}_{0.8}$). Minerals in feldspathic diogenite clast: orthopyroxene ($\text{Fs}_{33.2-33.8}\text{Wo}_{1.7-2.4}$, $\text{FeO/MnO} = 29-32$, $N = 2$), clinopyroxene ($\text{Fs}_{10.8}\text{Wo}_{45.8}$, $\text{FeO/MnO} = 21$), anorthite ($\text{An}_{95.4}\text{Or}_{0.2}$).

Classification: Eucrite (polymict breccia).

Specimens: 26.6 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

Northwest Africa 11705 (NWA 11705)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Ordinary chondrite (H4/5)

History: Purchased by Bob Falls in March 2017 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen containing some well-formed, relatively small chondrules in a recrystallized matrix containing merrillite, troilite, kamacite and taenite.

Geochemistry: Olivine ($\text{Fa}_{15.6-15.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{14.0-14.1}\text{Wo}_{0.6-0.7}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.9}\text{Wo}_{33.9}$; $\text{Fs}_{7.9}\text{Wo}_{47.2}$; $N = 2$).

Classification: Ordinary chondrite (H4/5). The mafic silicates in this specimen are unusually magnesian in comparison to those in most H chondrites.

Specimens: 26.7 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11706 (NWA 11706)

Morocco

Purchased: Sept 2016

Classification: Carbonaceous chondrite (CK5)

History: A single stone weighing 116 g was purchased by Hichame Mimaghador at the Erfoud market, Morocco, in 2016.

Physical characteristics: A single stone, almost completely covered by a fusion crust with several contraction cracks.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section displays a texture consisting of mm-sized granular olivine-rich chondrules containing magnetite blebs well integrated in a medium grained olivine-rich matrix. A fine grained olivine-augite-plagioclase aggregate $500 \times 250 \mu\text{m}$ wide is visible. Main minerals are olivine, augite, intermediate plagioclase. Opaques are mainly pentlandite and Cr-rich magnetite, with minor altered kamacite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Olivine ($\text{Fa}_{34.7 \pm 1.3}$, $\text{Fe/Mn} = 142.0 \pm 8.1$, $N = 7$), augite ($\text{Fs}_{13.5 \pm 0.4}\text{Wo}_{49.3 \pm 1.3}$, $\text{Al}_2\text{O}_3 = 1.28$ Wt.%, $N = 6$). Feldspar $\text{An}_{55.0}\text{Ab}_{43.9}\text{Or}_{1.1}$. Magnetite contains 1.7 ± 0.1 wt.% Cr_2O_3 , 0.26 wt.% Al_2O_3 , 0.23 wt.% NiO ($N=3$). Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}\text{O} = -5.76 \text{‰}$, $\delta^{18}\text{O} = -1.91 \text{‰}$, $\Delta^{17}\text{O} = -4.76 \text{‰}$.

Classification: Carbonaceous chondrite (CK5). Moderate weathering.

Specimens: A total of 19.6 g specimen, a block (0.4 g) and a thin section are on deposit at MSN-Fi. 96 g with Mimaghador.

Northwest Africa 11707 (NWA 11707)

Morocco

Purchased: Feb 2016

Classification: Carbonaceous chondrite (CK4)

History: A single stone weighing 470 g was purchased by Hichame Mimaghador at the Erfoud market, Morocco, in 2016.

Physical characteristics: A single stone covered by fusion crust with contraction cracks.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A texture consisting of well-formed, mm-sized granular chondrules containing magnetite can be observed. Chondrules are surrounded by a medium grained, recrystallized matrix with disseminated opaque phases. Main minerals are olivine, orthopyroxene, augite, albitic plagioclase. Opaque phases are mainly represented by troilite and Cr-rich magnetite, with minor kamacite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): Olivine ($\text{Fa}_{28.0\pm 1.2}$, $\text{Fe/Mn} = 93.6\pm 10.1$, $N = 8$), orthopyroxene ($\text{Fs}_{23.7\pm 1.0}\text{Wo}_{1.7\pm 0.2}$, $\text{Al}_2\text{O}_3 = 2.51$ Wt.%, $N = 4$); augite ($\text{Fs}_{8.8\pm 1.5}\text{Wo}_{44.1\pm 1.8}$, $\text{Al}_2\text{O}_3 = 0.51$ Wt.%, $N = 4$). Feldspar $\text{An}_{17.2}\text{Or}_{5.3}$. Magnetite contains 2.7 ± 0.1 wt.% Cr_2O_3 , 0.67 wt.% Al_2O_3 , 0.55 wt.% NiO ($N=3$); Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}\text{O} = -3.58$ ‰, $\delta^{18}\text{O} = 0.93$ ‰, $\Delta^{17}\text{O} = -4.06$ ‰

Classification: Carbonaceous chondrite (CK4). Moderate weathering.

Specimens: A total of 20.7 g specimen is on deposit at MSN-Fi. The main mass is with owner.

Northwest Africa 11708 (NWA 11708)

Morocco

Purchased: Feb 2016

Classification: Carbonaceous chondrite (CK3)

History: A stone weighing 1104 g was purchased by Hichame Mimaghador at the Erfoud market in 2016.

Physical characteristics: A single stone covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section displays separated, well-formed chondrules (ranging in diameter from 300 to 700 μm , mean value 350 μm) of different types, in a fine-grained matrix consisting of Fe-rich olivine and orthopyroxene, coarse grained Fe-rich olivine fragments and scattered opaque phases. Chondrule types are mainly PO, with minor POP and PP types. Main minerals are olivine, orthopyroxene, Ca-rich plagioclase and clinopyroxene. Opaques are mainly consisting of troilite and Cr-magnetite, with minor altered kamacite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Olivine in PO and POP chondrules ($\text{Fa}_{1.7\pm 0.2}$, $\text{Fe/Mn} = 11.4\pm 1.1$, $N = 6$); Olivine in mineral fragments ($\text{Fa}_{38.9\pm 5.3}$, $\text{Fe/Mn} = 101.7\pm 10.1$, $N = 10$), Orthopyroxene in POP chondrules ($\text{Fs}_{2.5\pm 0.2}\text{Wo}_{2.1\pm 0.1}$, $\text{Fe/Mn} = 11.5\pm 1.2$, $N = 15$); Matrix orthopyroxene ($\text{Fs}_{43.5\pm 3.5}\text{Wo}_{1.2\pm 0.2}$, $\text{Fe/Mn} = 105.1\pm 1.2$, $N = 5$); fassaite ($\text{Fs}_{4.4\pm 0.4}\text{En}_{56.6\pm 0.3}\text{Wo}_{39.0\pm 0.9}$,

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3 $\text{Al}_2\text{O}_3 = 6.0 \text{ Wt.}\%$, $N = 5$). Feldspar $\text{An}_{95.7}\text{Or}_{0.1}$. Oxygen isotopes: (I. Franchi, R.
4 Greenwood, *OU*) $\delta^{17}\text{O} = -4.75 \text{ ‰}$, $\delta^{18}\text{O} = -1.14 \text{ ‰}$, $\Delta^{17}\text{O} = -4.15 \text{ ‰}$.

5 **Classification:** Carbonaceous chondrite (CK3). Moderate weathering.

6 **Specimens:** A total of 24 g specimen is on deposit at *MSN-FI*. The main mass is
7 with owner.
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12 **Northwest Africa 11709** (NWA 11709)

13 Morocco

14 Purchased: June 2016

15 Classification: HED achondrite (Eucrite)

16 **History:** A fragmented stone consisting of many pieces totally weighing 180 g was
17 found by an anonymous person in Western Sahara and purchased 2016 by Enzo
18 Compagnucci.
19

20 **Physical characteristics:** Few fragments are partly covered by fusion crust.

21 **Petrography:** (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section
22 reveals a brecciated texture consisting of lithic clasts in a fine grained matrix.
23

24 Lithic clasts consists of exsolved orthopyroxene crystals with fine pigeonite
25 exsolution lamellae, 4-8 μm in width, augite, calcic plagioclase, ilmenite, chromite,
26 troilite and FeNi metal.
27

28 **Geochemistry:** (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Eucritic clasts:
29 orthopyroxene host ($\text{Fs}_{36.6\pm 1.1}\text{En}_{60.2\pm 1.3}\text{Wo}_{3.3\pm 0.2}$, $\text{FeO/MnO} = 29.5\pm 0.3$, $n=6$); augite
30 ($\text{Fs}_{22.6\pm 1.1}\text{En}_{33.0\pm 1.2}\text{Wo}_{44.4\pm 1.4}$; $n=6$; $\text{Fe/Mn} = 28.3\pm 0.3$); pigeonite exsolution lamellae
31 in orthopyroxene ($\text{Fs}_{52.6\pm 1.2}\text{En}_{44.4\pm 1.1}\text{Wo}_{3.0\pm 0.3}$; $n=5$; $\text{Fe/Mn} = 31.2\pm 0.3$); Plagioclase
32 $\text{An}_{91.7\pm 1.3}\text{Or}_{0.3\pm 0.1}$, $n=4$;
33

34 **Classification:** Eucrite with medium degree of shock and medium degree of
35 weathering.
36

37 **Specimens:** A total of 20.2 g specimen and one thin section is on deposit at MSN-
38 Fi. Cavaglià owns the main mass, now weighing 160 g.
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43 **Northwest Africa 11710** (NWA 11710)

44 (Northwest Africa)

45 Purchased: 2017

46 Classification: HED achondrite (Eucrite)

47 **History:** The meteorite was purchased from a Moroccan meteorite dealer at the
48 mineral fair in Munich, Germany.
49

50 **Physical characteristics:** Greyish individual partly covered with fusion crust.

51 **Petrography:** The meteorite is a medium-grained unbrecciated igneous rock
52 predominantly composed of 100-600 μm sized exsolved pyroxene and calcic
53 plagioclase. Minor phases include silica, ilmenite, troilite, and metallic iron.
54

55 **Geochemistry:** low-Ca pyroxene $\text{Fs}_{58.3\pm 1.3}\text{Wo}_{3.9\pm 1.6}$ ($\text{Fs}_{55.9-59.5}\text{Wo}_{2.1-6.2}$, $n=11$,
56 $\text{FeO/MnO} = 29-30$); Ca-pyroxene: $\text{Fs}_{29.6\pm 3.1}\text{Wo}_{39.4\pm 3.9}$ ($\text{Fs}_{27.1-38.8}\text{Wo}_{28.1-42.2}$, $n=11$,
57 $\text{FeO/MnO} = 27-32$); calcic plagioclase: $\text{An}_{89.8\pm 0.5}$ ($\text{An}_{88.6-90.5}$, $n=13$)
58
59
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Northwest Africa 11712 (NWA 11712)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Howardite)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Dark-grayish individual lacking any fusion crust.**Petrography:** The meteorite is a breccia composed of abundant up to 1.3 mm mineral and less abundant basaltic clasts set into a finer grained clastic matrix. Predominant minerals are exsolved pyroxene, diogenetic orthopyroxene (30-35%) and calcic plagioclase. Accessory phases include silica, chromite, and metallic Fe. The meteorite contains abundant shock melt veins and pockets.**Geochemistry:** diogenetic low-Ca pyroxene $\text{Fs}_{33.6\pm 0.5}\text{Wo}_{2.3\pm 0.2}$ ($\text{Fs}_{33.2-34.6}\text{Wo}_{2.0-2.8}$, $n=16$, $\text{FeO/MnO}=25-31$); low-Ca pyroxene host to augite exsolution lamellae: $\text{Fs}_{58.6\pm 0.7}\text{Wo}_{4.4\pm 0.7}$ ($\text{Fs}_{57.5-59.7}\text{Wo}_{3.2-5.7}$, $n=10$, $\text{FeO/MnO}=32-35$); Ca-pyroxene: $\text{Fs}_{28.6\pm 2.0}\text{Wo}_{40.4\pm 1.9}$ ($\text{Fs}_{25.8-31.9}\text{Wo}_{37.4-42.7}$, $n=6$, $\text{FeO/MnO}=31-38$); calcic plagioclase: $\text{An}_{89.4\pm 3.1}$ ($\text{An}_{82.6-92.9}$, $n=17$)**Northwest Africa 11720** (NWA 11720)

(Northwest Africa)

Purchased: 2017 Jan

Classification: Pallasite (Main group, anomalous)

History: A batch of small metal-bearing stones (230 g) purported to have been found at the same site as NWA 10023 and NWA 10252 was purchased by Mike Bandli in January 2017 from a Moroccan dealer at the Tucson Gem and Mineral Show.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Coarse grained aggregate of olivine and stained plessitic metal with rare accessory schreibersite.**Geochemistry:** Olivine ($\text{Fa}_{13.3-13.7}$, $\text{FeO/MnO} = 47-53$, $N = 3$).**Classification:** Pallasite PMG-an. Likely paired with [NWA 10023](#) and [NWA 10252](#). Anomalous designation based on the presence of the same plessitic metal observed in the larger specimens, plus the fact that these stones were found with the previous specimens and purchased from the same Moroccan dealer.**Specimens:** 20.2 g including one polished endcut at *UWB*; remainder with Mr. M. Bandli.**Northwest Africa 11721** (NWA 11721)

(Northwest Africa)

Purchased: 2017 Dec

Classification: Rumuruti chondrite (R3)

History: A batch of about 10 stones with similar appearance (total 5345 g, the largest stone 2670 g) was purchased by Jason Phillips in December 2017 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular clasts in a matrix of related debris. Clasts contain well-formed, separated unequilibrated chondrules (apparent diameter $310 \pm 200 \mu\text{m}$, $N = 15$) set in a finer grained metal-free matrix. Accessory minerals are sodic plagioclase, troilite, Ti-chromite and chlorapatite.

Geochemistry: Olivine ($\text{Fa}_{7.0-57.4}$, $N = 5$), orthopyroxene ($\text{Fs}_{0.7-8.1}\text{Wo}_{0.1}$, $N = 2$), pigeonite ($\text{Fs}_{32.7}\text{Wo}_{6.6}$), augite ($\text{Fs}_{11.7}\text{Wo}_{44.7}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.43$.

Classification: R3 chondrite (breccia).

Specimens: 25.3 g including one polished thin section at *UWB*; remainder with Mr. J. Phillips.

Northwest Africa 11722 (NWA 11722)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter $510 \pm 370 \mu\text{m}$, $N = 15$) are set in a finer grained matrix containing altered kamacite, merrillite and taenite.

Geochemistry: Olivine ($\text{Fa}_{6.3-43.5}$, Cr_2O_3 in ferroan examples 0.03-0.15 wt.%, mean 0.08 ± 0.05 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{2.1-19.5}\text{Wo}_{0.3-0.4}$, $N = 3$), pigeonite ($\text{Fs}_{3.6}\text{Wo}_{17.1}$), augite ($\text{Fs}_{7.9}\text{Wo}_{44.7}$).

Classification: Ordinary chondrite (L3).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11723 (NWA 11723)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules occur in a recrystallized matrix containing altered metal.

Geochemistry: Olivine ($\text{Fa}_{25.5-25.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.9-21.2}\text{Wo}_{1.8-1.5}$, $N = 2$), clinopyroxene ($\text{Fs}_{6.8-8.1}\text{Wo}_{46.2-44.3}$, $N = 2$).

Classification: Ordinary chondrite (L5).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11724 (NWA 11724)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules; accessory chlorapatite and merrillite are present. Silicates are extensively stained by weathering products of primary metal and there are cross-cutting Fe hydroxide veinlets.**Geochemistry:** Olivine ($\text{Fa}_{25.2-25.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{21.6-21.8}\text{Wo}_{1.7-1.1}$, $N = 2$), clinopyroxene ($\text{Fs}_{8.5-12.7}\text{Wo}_{43.8-41.8}$, $N = 2$).**Classification:** Ordinary chondrite (L6).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11725** (NWA 11725)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Well-formed, closely packed chondrules are set in a finer grained matrix containing stained metal.**Geochemistry:** Olivine ($\text{Fa}_{24.9-25.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.5-20.6}\text{Wo}_{1.6-4.0}$, $N = 2$), clinopyroxene ($\text{Fs}_{8.6-9.3}\text{Wo}_{44.2-42.7}$, $N = 2$).**Classification:** Ordinary chondrite (L4).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11726** (NWA 11726)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4/5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Some well-formed chondrules are present within a recrystallized matrix containing stained metal.**Geochemistry:** Olivine ($\text{Fa}_{24.5-24.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.5-21.8}\text{Wo}_{1.6-1.5}$, $N = 2$), clinopyroxene ($\text{Fs}_{7.9-8.1}\text{Wo}_{44.5-45.1}$, $N = 2$).**Classification:** Ordinary chondrite (L4/5).**Specimens:** The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11727 (NWA 11727)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Sparse chondrules occur in a recrystallized matrix containing altered metal.**Geochemistry:** Olivine ($\text{Fa}_{24.7-25.1}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.9-21.0}\text{Wo}_{1.3-1.6}$, $N = 2$), clinopyroxene ($\text{Fs}_{7.2-7.9}\text{Wo}_{45.2-44.7}$, $N = 2$).**Classification:** Ordinary chondrite (L5).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11728** (NWA 11728)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Well-formed, closely-packed chondrules are set in a finer grained matrix containing stained metal.**Geochemistry:** Olivine ($\text{Fa}_{24.5-24.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{19.4-20.5}\text{Wo}_{0.5-1.2}$, $N = 2$), subcalcic augite ($\text{Fs}_{21.6}\text{Wo}_{29.1}$), augite ($\text{Fs}_{9.6}\text{Wo}_{37.1}$).**Classification:** Ordinary chondrite (L4).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11729** (NWA 11729)

Mauritania

Purchased: 2017 Dec

Classification: HED achondrite (Eucrite, anomalous)

History: Purchased by Rachid Chaoui in December 2017 from a Mauritanian dealer and subsequently acquired by Bob Falls.**Physical characteristics:** A single brownish stone (345 g) mostly coated by black fusion crust. The interior exhibits a breccia texture with beige clasts stained light orange by terrestrial weathering.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed of closely packed microgabbroic clasts plus some genomict breccia clasts within a sparse matrix of related debris. Minerals are exsolved ferroan pigeonite, calcic plagioclase, silica polymorph, ilmenite Ti-chromite, fayalitic olivine and minor zircon. Terrestrial weathering has resulted in extensive alteration of primary troilite to Fe hydroxides and some cross-cutting hydroxide veinlets.

Geochemistry: Orthopyroxene host ($\text{Fs}_{69.6}\text{Wo}_{1.7}$, $\text{FeO/MnO} = 29$), clinopyroxene exsolution lamella ($\text{Fs}_{33.2}\text{Wo}_{42.1}$, $\text{FeO/MnO} = 30$), clinopyroxene host ($\text{Fs}_{30.9}\text{Wo}_{43.5}$, $\text{FeO/MnO} = 32$), orthopyroxene exsolution lamella ($\text{Fs}_{69.5}\text{Wo}_{1.9}$, $\text{FeO/MnO} = 36$), fayalite ($\text{Fa}_{73.9-74.1}$, $\text{FeO/MnO} = 47$, $N = 2$), plagioclase ($\text{An}_{82.3-84.3}\text{Or}_{0.7-0.5}$, $N = 2$). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 2.680, 3.062, 2.301; $\delta^{18}\text{O}$ 5.540, 6.312, 4.934; $\Delta^{17}\text{O}$ -0.245, -0.271, -0.304 per mil.

Classification: Eucrite (anomalous monomict breccia, microgabbroic, highly ferroan). The pyroxenes in this specimen are much more ferroan than in any other known eucrites: ferrosilite contents in orthopyroxene are almost 70 mol.%. The oxygen isotopic composition is also unusual with a higher $\delta^{18}\text{O}$ than other main group eucrites.

Specimens: 22.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11730 (NWA 11730)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL6, melt breccia)

History: Purchased by Larry Atkins from Morocco in 2017.

Physical characteristics: Single stone, no fusion crust. A saw cut reveals a gray-colored breccia with pervasive dark shock melt veins and pockets.

Petrography: (C. Agee, *UNM*) This meteorite is a breccia of LL6 chondrite clasts set in a network of shock melt veins. Faint chondrules were observed, most metal and sulfide is in the form of finely dispersed blebs.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{32.7\pm 0.2}$, $\text{Fe/Mn} = 66\pm 2$, $n=8$; low Ca pyroxene $\text{Fs}_{26.3\pm 0.2}\text{Wo}_{1.8\pm 0.3}$, $\text{Fe/Mn} = 39\pm 1$, $n=7$.

Classification: LL6-melt breccia

Specimens: 34.8 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

Northwest Africa 11731 (NWA 11731)

(Northwest Africa)

Purchased: 2017

Classification: Enstatite chondrite (EL6)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Brownish individual with some patches of black fusion crust.

Petrography: The meteorite displays a recrystallized texture dominated by up to 300 μm sized enstatite grains. Less abundant are albitic feldspar and typically intergrown daubreelite and troilite. No chondrules are visible. The meteorite is strongly altered, i.e., metal is completely converted into Fe-oxides and cracks are frequently filled with calcite and barite.

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3 **Geochemistry:** feldspar: $An_{15.8}Ab_{79.8}Or_{4.4}$, $n=5$

4 **Classification:** Although metal is completely oxidized and the Si content could not
5 be determined, the absence of niningerite and alkali sulfides points towards an EL6
6 classification.
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10 **Northwest Africa 11732** (NWA 11732)

11 (Northwest Africa)

12 Purchased: 2017

13 Classification: Carbonaceous chondrite (CM2.0)

14 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

15 **Physical characteristics:** Small black individual with some fusion crust.

16 **Petrography:** The meteorite is a brecciated carbonaceous chondrite composed of
17 chondrule, mineral and CAI polymorphs set into a fine-grained matrix of
18 phyllosilicates (as indicated by fibrous appearance), carbonates and sulfides
19 including up to 400 μm long needles of Ni-bearing pyrrhotite. Carbonates are
20 almost pure calcites and Mg-Mn-Fe-rich varieties. The hydrous and porous nature
21 of the matrix is also proven by low analytical totals of defocused (10 μm beam
22 diameter) electron microprobe analyses. Many components are surrounded by flaky
23 phyllosilicates apparently replacing former dust rims. No anhydrous silicates have
24 been found.
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26 **Geochemistry:** Mean values of defocused (10 μm beam diameter) matrix analyses
27 (all wt%; $N=27$): SiO_2 : 27.0, TiO_2 : 0.09; Na_2O : 0.11; Cr_2O_3 : 0.41, MgO : 19.8,
28 MnO : 0.18, CaO : 0.25, FeO : 21.7, Al_2O_3 : 2.29, NiO : 0.79, P_2O_5 : 0.03, S: 0.36,
29 Total: 73.01

30 **Classification:** CM2.0. Subtype based on the absence of anhydrous silicates.
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39 **Northwest Africa 11733** (NWA 11733)

40 (Northwest Africa)

41 Purchased: 2017

42 Classification: Carbonaceous chondrite (CM2)

43 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

44 **Physical characteristics:** Small black individual without fusion crust.

45 **Petrography:** The meteorite is a brecciated chondrite consisting of small
46 chondrules (mean apparent diameter about 0.3 mm), mineral fragments, and less
47 abundant CAIs set into a fine-grained matrix. Chondrules and CAIs are sometimes
48 surrounded by dust rims. Matrix minerals are phyllosilicates (as indicated by low
49 analytical totals), carbonates, and pyrrhotite.
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55 **Northwest Africa 11734** (NWA 11734)

56 (Northwest Africa)

57 Purchased: 2017

58 Classification: HED achondrite (Eucrite, melt breccia)
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3 **History:** The meteorite was purchased from a local meteorite dealer in Erfoud,
4 Morocco.

5 **Physical characteristics:** Brownish individual with some patches of black fusion
6 crust.

7 **Petrography:** The meteorite is a eucrite-melt breccia composed of up to 1 cm sized
8 light colored basaltic clasts set into dark recrystallized shock melt matrix.

9 Dominant minerals in the clasts are exolved pyroxene and calcic plagioclase. Minor
10 phases include silica, ilmenite, troilite, chromite, and barite. No metallic Fe has
11 been found.

12 **Geochemistry:** low-Ca pyroxene $\text{Fs}_{60.8\pm 1.0}\text{Wo}_{2.8\pm 0.5}$ ($\text{Fs}_{59.1-62.1}\text{Wo}_{2.1-3.3}$, $n=16$,
13 $\text{FeO/MnO}=30-35$); Ca-pyroxene: $\text{Fs}_{27.6\pm 1.5}\text{Wo}_{42.9\pm 1.5}$ ($\text{Fs}_{25.8-32.2}\text{Wo}_{37.9-44.2}$, $n=23$,
14 $\text{FeO/MnO}=29-37$); calcic plagioclase: $\text{An}_{88.2\pm 2.4}$ ($\text{An}_{83.3-91.0}$, $n=21$)

20 21 **Northwest Africa 11735** (NWA 11735)

22 (Northwest Africa)

23 Purchased: 2017

24 Classification: Ordinary chondrite (L3)

25 **History:** The meteorite was purchased from a Moroccan meteorite dealer on the
26 mineral fair in Munich, Germany.

27 **Physical characteristics:** Dark brownish individual with some fusion crust.

28 **Petrography:** The meteorite displays a chondritic texture with sometimes slightly
29 flattened and well packed chondrules (mean diameter about 0.6 mm) in a more
30 fine-grained matrix that contains sulfides and FeNi metal.

31 32 33 34 35 36 **Northwest Africa 11736** (NWA 11736)

37 (Northwest Africa)

38 Purchased: 2017

39 Classification: Ordinary chondrite (L3)

40 **History:** The meteorite was purchased from a local meteorite dealer in Algeria.

41 **Physical characteristics:** Light brownish individual without fusion crust.

42 **Petrography:** The meteorite shows a chondritic texture with clearly defined,
43 sometimes deformed packed chondrules (mean diameter about 0.7 mm) in a fine-
44 grained matrix of mineral and chondrule fragments, FeNi metal and sulfides.

45 46 47 48 49 50 **Northwest Africa 11737** (NWA 11737)

51 (Northwest Africa)

52 Purchased: 2017

53 Classification: Carbonaceous chondrite (CV3)

54 **History:** The meteorite was purchased from a local meteorite dealer in Erfoud,
55 Morocco.

56 **Physical characteristics:** Sixteen dark grayish individuals with some fusion crust.

Petrography: The meteorite displays a dark brownish interior and is composed of up to 1.5 mm sized chondrules (mean diameter about 0.9 mm), whitish CAIs, and olivine amoeboids set into a fine-grained almost opaque matrix. Chondrules frequently show brownish staining due to terrestrial weathering; type II chondrules are absent.

Northwest Africa 11738 (NWA 11738)

(Northwest Africa)

Purchased: 2012

Classification: Ureilite

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Dark brownish individual without fusion crust.

Petrography: The meteorite shows a cumulus texture of up to 1.5 mm sized Cr-rich olivine and pigeonite crystals. It is brecciated, contains some flaky graphite and olivine displays pronounced reduced rims.

Geochemistry: reduced rims in olivine: $Fa_{2.5-6.2}$; olivine contains 0.70 ± 0.03 wt% Cr_2O_3 and 0.43 ± 0.02 wt% CaO

Classification: Ureilite, brecciated

Northwest Africa 11739 (NWA 11739)

(Northwest Africa)

Purchased: 2017

Classification: Primitive achondrite

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Small light brownish individual without fusion crust. Sawn surface reveals mosaic of shiny, fine-grained crystals.

Petrography: The meteorite shows an equigranular equilibrium texture with abundant triple junctions between adjoining mineral grains. It is predominantly composed of 200-300 μm sized Fe-rich olivine (about 60 vol.%) with less abundant clinopyroxene (about 15 vol.%) and intermediate plagioclase (about 20 vol.%). Minor phases are FeNi metal and sulfides. No orthopyroxene has been detected.

Geochemistry: olivine: $Fa_{31.2 \pm 0.1}$, $CaO = 0.08 \pm 0.1$, $Cr_2O_3 = 0.01 \pm 0.1$, $FeO/MnO = 74-96$, $n=12$; Ca-pyroxene: $Fs_{11.2 \pm 0.5}Wo_{43.4 \pm 0.6}$, $FeO/MnO = 34-54$, $n=12$; feldspar: $An_{34.0}Ab_{63.0}Or_{3.0}$, $n=18$

Classification: Olivine-rich primitive achondrite with mineral chemistry close to brachinites. However, small grain sizes and high abundance of plagioclase are contrary to brachinites.

Northwest Africa 11740 (NWA 11740)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Greyish individual with some fusion crust.

Petrography: Carbonaceous chondrite composed of up to 3 mm sized chondrules (mean diameter about 1 mm), CAIs and olivine amoeboids all set into a fine-grained almost black matrix. One CAI about 7 mm in diameter has been observed. Type II chondrules are absent.

Northwest Africa 11741 (NWA 11741)

(Northwest Africa)

Purchased: 2016

Classification: HED achondrite (Diogenite)

History: The meteorite was bought from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Light brownish to orange individual with some patches of fusion crust.

Petrography: The meteorite is a fragmental breccia predominantly composed of blocky up to 4 mm sized orthopyroxene crystals. Minor phases include silica, chromite, troilite and metallic iron. Neither plagioclase nor olivine have been found in the section studied.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{27.5\pm 0.4}\text{Wo}_{4.0\pm 0.4}$ ($\text{Fs}_{26.7-28.0}\text{Wo}_{3.2-6.8}$, $n=22$, $\text{FeO/MnO}=27-32$)

Northwest Africa 11742 (NWA 11742)

(Northwest Africa)

Purchased: 2016

Classification: HED achondrite (Eucrite, melt breccia)

History: The meteorite was bought from a local meteorite dealer in Quarzazate, Morocco.

Physical characteristics: Brownish individual without fusion crust.

Petrography: The meteorite is a melt breccia composed of up to 5 mm sized basaltic clasts set into shock melted matrix. Basaltic clasts consist of exsolved pyroxenes and often lath shaped calcic plagioclase. The shock melt is mostly recrystallized to plagioclase and pyroxene; some regions show pronounced flow textures. Minor phases include silica, chromite, ilmenite and barite.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{59.9\pm 0.9}\text{Wo}_{4.0\pm 1.3}$ ($\text{Fs}_{57.4-61.1}\text{Wo}_{2.2-7.6}$, $n=14$, $\text{FeO/MnO}=33-37$); Ca-pyroxene: $\text{Fs}_{27.8\pm 1.2}\text{Wo}_{42.1\pm 1.2}$ ($\text{Fs}_{26.2-30.1}\text{Wo}_{39.7-43.8}$, $n=16$, $\text{FeO/MnO}=33-39$); calcic plagioclase: $\text{An}_{90.6\pm 0.8}$ ($\text{An}_{89.3-91.9}$, $n=16$)

Northwest Africa 11743 (NWA 11743)

1
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3 Morocco

4 Purchased: May 2014

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6 Classification: Ordinary chondrite (H4)

7 **History:** A small fragment of the studied meteorite weighting 5.0 g was purchased
8 by I. Baziotis from a dealer in Marrakech, Morocco (May 2014). The stone was a
9 broken fragment partly surrounded by fusion crust. A polished thin section was
10 carefully prepared from the fragment and subsequently examined using optical
11 microscopy to identify the texture and mineralogy.

12
13 **Physical characteristics:** 5.0 g. 1 piece. The color of the meteorite is pale brown.
14 Black fusion crust partly covers the sample. Red-brown oxidation is visible on the
15 exterior surface, around metal grains on cut surfaces and within the matrix.

16
17 **Petrography** (I. Baziotis, *AUA*; A. Bischoff, *IfP*): Textural observations of the thin
18 section in reflected light showed a chondritic structure. It contains porphyritic and
19 non-porphyritic chondrules, both Type I ($Mg/(Mg+Fe) < 90$). The porphyritic olivine
20 (PO) chondrules have a rounded to oval shape ranging from 300 to 350 μm , and
21 from 600 to 1200 μm in size. The groundmass consists of olivine (30 vol.%), low
22 Ca-pyroxene (20 vol.%), clinopyroxene (5 vol.%), plagioclase (5 vol.%) and rare
23 phosphates (apatite). Also, metal-rich material has filled the cracks of the fragment
24 (40 vol%). Shock veins were not observed. The rock matrix is brecciated.

25
26 **Geochemistry:** Mineral Composition and Geochemistry: Coarse grained rock with
27 euhedral to subhedral olivine with narrow compositional range ($Fa_{18.6-19.2}$),
28 embedded in a translucent feldspathic glassy mesostasis $Ab_{87.6-82.8}$. Olivine
29 $Fa_{18.9 \pm 0.3}$ (n=23); Low-Ca Pyroxene $Fs_{17.8 \pm 0.3}$ (n=24), $Wo_{0.8 \pm 0.1}$ (n=24).

30
31 **Classification** (I. Bazioti and A. Pantazidis, *AUA*): This meteorite is a H4 ordinary
32 chondrite. Weathering stage: Minor to slightly moderate oxidation W2, with the
33 major silicates being unaffected.

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35 **Specimens:** 4.94 g at *NHMV*.

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40 **Northwest Africa 11744** (NWA 11744)

41 (Northwest Africa)

42 Purchased: 2004

43
44 Classification: Ordinary chondrite (L5)

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46 **History:** sample was purchased from a meteorite collector by Dr Mahesh Anand
47 (*OU*). In July 2016, thin sections of the sample were passed to Craig Walton
48 (*UStA*) for classification work.

49
50 **Physical characteristics:** A single 1566 g stone. Sample mostly has a dark fusion
51 crust, but in places a light coloured interior is exposed. Sample contains abundant
52 complex shock features, mainly micro-fault shear textures, associated with melt
53 pools.

54
55 **Petrography:** (Craig Walton, *UStA*) Overall, sample has a chondritic brecciated
56 texture. Main phases are olivine and pyroxene with opaque metal + troilite.
57 Porphyritic olivine, radial pyroxene, barred olivine and porphyritic olivine
58 pyroxene chondrule types are all common, along with rare cryptocrystalline and
59 glassy chondrules. Chondrule average diameter is $370 \pm 220 \mu m$ (N=27), up to 1
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3 mm. Chondrules comprise ~70 % of the sample. Opaque phases are metal (Fe,Ni in
4 exsolution as kamacite and taenite) and sulfide (troilite). Modal abundances of
5 metal and sulfide are 5.8% and 4.4%, respectively. A recrystallized and shock-
6 darkened matrix of fine-grained lithic fragments comprises ~ 20% of the sample
7 area. Some isolated euhedral olivine grains (up to ~1 mm) occur embedded in this
8 matrix. Olivine contains planar deformation features and has undulose extinction.
9 Planes across which shear displacement has occurred (microfaults) crosscut
10 chondrule and brecciated matrix textures. Fine-grained silicate melt-pools bearing
11 globules of immiscible metal and sulfide are hosted within some sections of these
12 microfaults. Microfault textures crosscut chondrules, matrix and metal, with
13 individual faults running along the length of the slide. Offset on the faults is on the
14 order of 500 μm . ~50 μm -wide shock-melt pools/veins occur within the faults.

15
16 **Geochemistry:** Mineral compositions and geochemistry: (Craig Walton, *UStA*;
17 Mahesh Anand, Sam Hammond, Richard Greenwood, *OU*) Microprobe (Cameca
18 SX100 EMPA) (all values given in wt %). Olivine (n=5): MgO = 38.8, CaO = 0.1,
19 MnO = 0.5, FeO = 22.7, SiO = 38.1. TiO = 0.1 Pyroxene (n=2): Na₂O = 0.1, MgO
20 = 28.5, K₂O = 0.2, CaO = 1.3, MnO = 0.4, FeO = 14.2, Al₂O₃ = 0.8, Cr₂O₃ = 0.4,
21 SiO₂ = 55.1, TiO₂ = 0.1, P₂O₅ = 0.1. Oxygen Isotopes (Laser fluorination
22 CO₂ laser, Thermo Scientific MAT 253 gas source mass spectrometer) $\delta^{18}\text{O}$ =5.139,
23 $\delta^{17}\text{O}$ =3.778, $\Delta^{17}\text{O}$ =1.105 (all in ‰).

24
25 **Classification:** L5 chondrite. Shock stage is S4/5 as evidenced by shear microfault
26 textures, associated shock-melt veins, shock darkening of matrix and undulose
27 extinction and planar deformation features in olivine. Oxygen isotopes are
28 indiscernible between L and LL, however Fs (Px) and Fa (Ol) data along with
29 metal abundances indicate an L chondrite grouping. Potentially paired with [NWA](#)
30 [11745](#).

31
32 **Specimens:** Main mass at *OU*

33 Northwest Africa 11745 (NWA 11745)

34 (Northwest Africa)

35 Purchased: 2004

36 Classification: Ordinary chondrite (L5)

37
38 **History:** sample was purchased in Morocco from a meteorite collector by Dr
39 Mahesh Anand (*OU*) some years ago. In July 2016, thin sections of the sample
40 were passed to Craig Walton (*UStA*) for preliminary classification work.

41
42 **Physical characteristics:** One large piece is present in the collection (554.16).
43 Sample predominantly has a light color, but has a dark fusion crust on one side.
44 Sample contains abundant complex shock features - mainly micro-fault shear
45 textures, associated with melt pools.

46
47 **Petrography:** (Craig Walton, *UStA*) Overall, sample has a chondritic brecciated
48 texture. Main phases are olivine and pyroxene with opaque metal + troilite.
49 Porphyritic olivine, radial pyroxene, barred olivine and porphyritic olivine
50 pyroxene chondrule types are all common, along with rare cryptocrystalline and
51 glassy chondrules. Chondrule average diameter is 0.56 mm, ranging from 1.25 mm
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to 0.25 mm. Chondrules comprise ~ 70% of the sample. Opaque phases are metal (Fe, Ni in exsolution as kamacite and taenite) and sulfide (troilite). A recrystallized and shock-darkened matrix of fine-grained lithic fragments comprises ~ 20 % of the sample area. Some isolated euhedral olivine grains (up to ~ 1mm) occur embedded in this matrix. Olivine contains planar deformation features and has undulose extinction. Planes across which shear displacement has occurred (microfaults) crosscut chondrule and brecciated matrix textures. Fine-grained silicate melt-pools bearing globules of immiscible metal and sulfide are hosted within some sections of these microfaults. Microfault textures crosscut chondrules, matrix and metal, with individual faults running along the length of the slide. Offset on the faults is on the order of 500 μm . ~50 μm -wide shock-melt pools/veins occur within the faults.

Geochemistry: Mineral compositions and geochemistry: (Craig Walton, *UStA*; Mahesh Anand, Sam Hammond, Richard Greenwood, *OU*) Microprobe (Cameca SX100 EMPA) Olivine (n=15): MgO = 38.4, MnO = 0.5, FeO = 23.4, SiO = 38.3, P₂O₅ = 0.1 Pyroxene (n=7): MgO = 28.7, CaO = 0.9, MnO = 0.5, FeO = 14.5, Al₂O₃ = 0.2, Cr₂O₃ = 0.1, SiO₂ = 55.7, TiO₂ = 0.2. Plagioclase: Na₂O = 10.7, K₂O = 1.1, CaO = 2.3, FeO = 0.8, Al₂O₃ = 22.1, SiO₂ = 65.8 ; Plagioclase Ab_{76.1}Or_{7.71}An_{16.2} (N=11).. Oxygen Isotopes (Laser fluorination CO₂ laser, Thermo Scientific MAT 253 gas source mass spectrometer) $\delta^{18}\text{O} = 4.931$, $\delta^{17}\text{O} = 3.693$, $\Delta^{17}\text{O} = 1.129$, $\Delta^{17}\text{O}$ linear = 1.105 (all ‰).

Classification: L5. Shock stage is S4/5 as evidenced by shear microfault textures, associated shock-melt veins, shock darkening of matrix and undulose extinction and planar deformation features in olivine. Oxygen isotopes are indiscriminate between L and LL, however Fs (PX) and Fa (Ol) data indicate an L chondrite. Potentially paired with [NWA 11744](#).

Specimens: Main mass at *OU*

Northwest Africa 11746 (NWA 11746)

(Northwest Africa)

Purchased: 2015

Classification: Martian meteorite (Shergottite)

History: Purchased by Jay Piatek from Morocco, 2015.

Physical characteristics: Fusion crusted individual. A saw-cut surface reveals gray-green, fine-grained, basaltic texture.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows an ophitic texture with ~60% zoned pyroxene and ~30% maskelynite.

Accessory phases include titanomagnetite, ilmenite, Fe-sulfide, and silica.

Geochemistry: (C. Agee, *UNM*) Pigeonite Fs_{50.5±14.8}Wo_{16.9±6.8}, Fe/Mn=37±3, n=8; augite Fs_{29.3±10.4}Wo_{31.7±2.8}, Fe/Mn=32±4, n=12; maskelynite

Or_{2.8±1.1}Ab_{49.8±3.9}An_{47.4±4.9}, n=6.

Classification: Martian (shergottite), pyroxene-phyric. Possibly paired with [NWA 10016](#).

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3 **Specimens:** 1.9 g including a probe mount on deposit at *UNM*, Jay Piatek holds the
4 main mass.
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8 **Northwest Africa 11747** (NWA 11747)

9 (Northwest Africa)

10 Purchased: 2011

11 Classification: HED achondrite (Eucrite)

12 **Petrography:** Highly brecciated, fine-medium grained sample. Fine grained matrix
13 is composed of fragmented pyroxene and feldspar with three cohesive, coarse
14 grained subophitic/gabbroic clasts. Dark grey to black melt glass pockets, often
15 containing small fragmented clasts of pyroxene, are focused in a darker region of
16 the sample which constitutes approximately 40% of the thin section. Accessory
17 phases include apatite, merrillite, zircon, ilmenite and rare baddeleyite.
18

19 **Geochemistry:** Mineral compositions and geochemistry: Pyroxene yield bulk
20 Fe/Mn ratios of 29.42 (N=46). Pyroxene ($\text{En}_{45}\text{Fs}_{46}\text{Wo}_8$; N=43) with exsolved
21 augite lamella ($\text{En}_{35}\text{Fs}_{23}\text{Wo}_{42}$; N=3) occur throughout the sample. Feldspar
22 composition averages An_{88} (N=25). Mineral chemistry measured by EMP.
23

24 **Classification:** Eucrite (monomict breccia)
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30 **Northwest Africa 11748** (NWA 11748)

31 (Northwest Africa)

32 Purchased: 2011

33 Classification: HED achondrite (Eucrite)

34 **Petrography:** Sample is brecciated, containing subophitic gabbroic clasts of
35 pyroxene and plagioclase set in a finer grained matrix of the same assemblage.
36 Accessory phases include apatite, merrillite, zircon, ilmenite and rare baddeleyite.
37

38 **Geochemistry:** Mineral compositions and geochemistry: Pyroxene yield bulk
39 Fe/Mn ratios of 31.49 (N=34). Orthopyroxene ($\text{En}_{35}\text{Fs}_{58}\text{Wo}_7$; N=29) contain
40 abundant exsolution lamella of augite composition ($\text{En}_{30}\text{Fs}_{29}\text{Wo}_{41}$; N=5). Feldspar
41 yields highly anorthitic compositions averaging An_{91} (N=20). Mineral chemistry
42 measured by EMP.
43

44 **Classification:** Eucrite (monomict breccia)
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49 **Northwest Africa 11749** (NWA 11749)

50 Morocco

51 Purchased: 2016 Oct

52 Classification: HED achondrite (Eucrite, unbrecciated)

53 **History:** Bought in Munich from a dealer from NWA.

54 **Physical characteristics:** Crusted stone. Cut surface reveals a rather orase-grained
55 light grey rock.
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Petrography: Unbrecciated igneous rock with subophitic texture and typical grain size 500 μm . Main minerals are pyroxene and plagioclase. Troilite (to 40 μm), chromite, ilmenite, silica polymorph, FeNi metal are present.

Geochemistry: Low-Ca pyroxene $\text{Fs}_{63.0\pm 0.3}\text{Wo}_{2.2\pm 0.4}$ (N=6), augite exsolution $\text{Fs}_{26.4}\text{Wo}_{45.0}$ (N=2), FeO/MnO 31.1 ± 1.7 (N=8). Plagioclase $\text{An}_{88.6}\text{Ab}_{11.1}\text{Or}_{0.3}$ (N=3).

Classification: Eucrite-unbr

Specimens: Type specimen at *CEREGE*. Main mass with Andreas *Gren*.

Northwest Africa 11750 (NWA 11750)

Morocco

Purchased: 2016 May

Classification: C3.00-ung

History: The meteorite was reportedly found near Fom Zguid. It was bought by Pierre-Marie Pelé in Morocco in May 2016 and a subsample was sent to *CEREGE* for classification. In view of its scientific interest, the whole stone was eventually given to *CEREGE* by Pierre-Marie Pelé.

Physical characteristics: Black irregular stone. Cut surface reveals a dark homogeneous interior.

Petrography: (J. Gattacceca, B. Devouard, H. Pourkhorsandi, *CEREGE*; L. Bonal, *IPAG*) Chondrules and mineral fragments (26 vol%) set in a fine-grained iron-rich matrix (74 vol%, modal abundances by point counting N=204). Average chondrule apparent size 240 ± 170 μm (N=28). Opaque are mostly FeNi metal (both in matrix and chondrules) and sulfides with typical grain size about 10 μm . In the matrix, FeNi metal and sulfides are finely intermixed. Saturation magnetization is $M_s=2.39$ Am²/kg indicating a bulk metal content of at least 1.1 wt%. Hysteresis properties show the significant presence of tetrataenite in the form of cloudy zone (Gattacceca et al., 2014). XRD over a ~ 1 cm² area on a polished section (D. Borschnek, B. Devouard, *CEREGE*) does not reveal the presence of hydrous phases (serpentine, tochilinite) typically observed in type 2 chondrites using the same experimental setup. The absence of hydrous phases in the fine-grained matrix is confirmed by IR transmission spectra. Raman spectra of the fine-grained matrix reveal the presence of polyaromatic carbonaceous matter characterized by a structural order comparable to type 2 chondrites, thus reflecting a peak metamorphic temperature lower than in the least metamorphosed type 3 chondrites (e.g., Semarkona)

Geochemistry: Olivine $\text{Fa}_{11.9\pm 17.1}$, range $\text{Fa}_{0.8-45.1}$, PMD 126% (N=7). Ferroan olivine has Cr_2O_3 0.24 ± 0.16 wt% (N=3). Orthopyroxene $\text{Fs}_{3.2\pm 2.2}\text{Wo}_{3.8\pm 1.1}$ (N=3). Kamacite Fe 91.0, Ni 6.7, Co, 2.3 (N=1). Taenite Fe 67.2, Ni 29.6, Co 0.9 (atom%). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of a 1.5 mg aliquot of a powdered 40 mg bulk sample is $\delta^{17}\text{O}=3.47$, $\delta^{18}\text{O}=14.3$, $\Delta^{17}\text{O}=-4.0$, all per mil (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively). Magnetic susceptibility $\log \chi$ ($\times 10^{-9}$ m³/kg) = 4.03.

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3 **Classification:** C3.00-ung. The type 3 derives from the unequilibrated nature, the
4 absence of phyllosilicates and abundance of metal. The subtype 3.00 derives from
5 Raman spectroscopy. The ungrouped designation derives from the oxygen isotopes
6 and petrography.

7
8 **Specimens:** Main mass and type specimen at *CEREGE*.
9

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12 **Northwest Africa 11751** (NWA 11751)

13 (Northwest Africa)

14 Purchased: 2017

15 Classification: Carbonaceous chondrite (CO3.05)

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17 **Physical characteristics:** Dark brown stone. Cut surface reveals an almost
18 featurless dark brown interior.

19
20 **Petrography:** (J. Gattacceca, H. Pourkhorsandi, *CEREGE* ; Lydie Bonal, *IPAG*)
21 Small chondrules (average apparent diameter $230 \pm 100 \mu\text{m}$, $N=22$) set in a fine-
22 grained iron-rich matrix. Chondrules 65 vol%, matrix 35 vol% (point counting,
23 $N=213$). Small CAI are present. Based on the structural order of the polyaromatic
24 matter assessed by Raman spectroscopy, this meteorite appears to be less
25 metamorphosed than Colony (CO 3.1) and more metamorphosed than ALHA
26 77307 (CO 3.05). The Raman spectroscopy parameters of interest are FWHM-D
27 (cm^{-1})= 187.6 ± 6.0 , ID/IG= 1.00 ± 0.04 (see Bonal et al. 2016, GCA 189:312-337,
28 figure 6).
29

30
31 **Geochemistry:** Olivine $\text{Fa}_{10.4 \pm 10.0}$, range $\text{Fa}_{0.7-25.4}$, PMD 91% ($N=9$), Cr_2O_3 in
32 ferroan olivine $0.35 \pm 0.17 \text{ wt}\%$ ($N=7$). Orthopyroxene $\text{Fs}_{3.6 \pm 1.4}\text{Wo}_{3.8 \pm 2.0}$ ($N=4$).
33 Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg})=4.69$
34

35 **Classification:** Carbonaceous chondrite (CO3.05). Subtype from Raman
36 spectroscopy and Cr_2O_3 content in ferroan olivine.

37 **Specimens:** Type specimen at *CEREGE*. Main mass with Fabien *Kuntz*.
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41 **Northwest Africa 11752** (NWA 11752)

42 (Northwest Africa)

43 Purchased: 2017

44 Classification: Ordinary chondrite (LL3.05)

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46 **Physical characteristics:** Dark brown stone. Cut surface reveals packed well-
47 defined chondrules in a brown matrix.

48
49 **Petrography:** (J. Gattacceca, H. Pourkhorsandi, *CEREGE*; Lydie Bonal, *IPAG*)
50 Large and closely packed chondrules. Opaques are FeNi minerals and troilite.
51 Based on the structural order of the polyaromatic matter assessed by Raman
52 spectroscopy, this meteorite appears to be as metamorphosed as ALHA 77307
53 (CO3.05). The Raman spectroscopy parameters of interest are FWHM-D (cm^{-1})=
54 210.9 ± 14.8 , ID/IG= 0.95 ± 0.05 (see Bonal et al. 2016, GCA 189:312-337, figure
55 7).
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Geochemistry: Olivine $Fa_{16.8\pm 5.4}$, range $Fa_{8.6-24.9}$, PMD 27% (N=6), Cr_2O_3 in ferroan olivine 0.45 ± 0.05 wt% (N=6). Orthopyroxene $Fs_{10.4\pm 8.4}Wo_{1.6\pm 1.3}$ (N=4). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.00$.

Classification: LL3.05. Subtype from Raman spectroscopy and Cr_2O_3 content in ferroan olivine.

Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11753 (NWA 11753)

Morocco

Purchased: 2017 Jul

Classification: HED achondrite (Eucrite, polymict)

Petrography: (K. Metzler, *IfP*) Fine-grained polymict breccia consisting of mm-sized basalt clasts (subophitic and granulitic textures) and mineral fragments set in a fine-grained clastic matrix made of related debris. Breccia-in breccia textures occur. Most pyroxenes exhibit augite exsolution lamellae. Fragments of diagenitic low-Ca pyroxene are admixed (<10 vol%). Accessories are silica polymorph, ilmenite, chromite, troilite, and Cr-Al-spinel.

Geochemistry: Mineral compositions and geochemistry: Eucritic low-Ca pyroxene (host; n=9): $Fs_{47.8\pm 5.8}$ (39-58); $Wo_{2.1\pm 0.6}$ (1-3); mean Fe/Mn (at.): 33. Eucritic Ca-pyroxene (exsolution lamellae; n=3) $Fs_{20.2\pm 4.2}$ (18-25); $Wo_{42.2\pm 1.9}$ (40-44). Diagenitic pyroxene (n=4): $Fs_{29.5\pm 1.9}Wo_{3.7\pm 0.5}$ ($Fs_{28-31}Wo_{3-4}$); mean Fe/Mn (at.): 36. Plagioclase (n=10): $An_{90.6\pm 2.6}$ (85-94).

Northwest Africa 11754 (NWA 11754)

Morocco

Purchased: 2017 Jul

Classification: Ureilite

Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with metamorphic texture ($\sim 120^\circ$ triple junctions), consisting of olivine, low-Ca pyroxene, and Ca-pyroxene grains with sizes up to ~ 3 mm. Reverse zoning of olivine with Mg-rich zones at the margins and along cracks can be observed. Metal is concentrated along grain boundaries and cracks and mostly oxidized by terrestrial weathering.

Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=4): $Fa_{11.4\pm 0.7}$; Olivine rims (n=3): $Fa_{6.6\pm 0.3}$. Low-Ca pyroxene grains (n=9): $Fs_{10.7\pm 0.2}Wo_{4.9\pm 0.2}$. Ca-pyroxene grains (n=12): $Fs_{6.6\pm 0.2}Wo_{36.2\pm 0.2}$. The concentration of Cr_2O_3 in olivine and pyroxene is 0.5 wt% and 1.1 wt%, respectively.

Northwest Africa 11755 (NWA 11755)

Morocco

Purchased: 2017 Sep

Classification: Ureilite

Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with metamorphic texture ($\sim 120^\circ$ triple junctions), consisting of olivine and pyroxene grains up to ~ 5 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Graphite and partly oxidized metal are concentrated along grain boundaries.

Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=12): $Fa_{21.3\pm 0.3}$; Olivine rims (n=5): $Fa_{9.0\pm 2.0}$. Pyroxene grains (n=13): $Fs_{11.8\pm 1.5}Wo_{6.1\pm 1.8}$. The Cr_2O_3 concentration in olivine and pyroxene is 0.7 wt% and 1.0 wt%, respectively.

Northwest Africa 11756 (NWA 11756)

Morocco

Purchased: 2017 Sep

Classification: Primitive achondrite (Brachinite)

Petrography: (K. Metzler, *IfP*) Olivine-dominated ultramafic rock with metamorphic texture ($\sim 120^\circ$ triple junctions), consisting of olivine, low-Ca pyroxene, and Ca-pyroxene grains up to ~ 0.8 mm. Metal is replaced by weathering products which are also concentrated along grain boundaries. Accessories are Cr-Al-spinel (up to 700 μm) and weathered FeS. No plagioclase was found.

Geochemistry: Mineral compositions and geochemistry: Olivine grains (n=12):

$Fa_{26.8\pm 0.2}$, mean Fe/Mn (at.)= 58; Low-Ca pyroxene grains (n=12):

$Fs_{22.1\pm 0.4}Wo_{2.1\pm 0.1}$. Ca-pyroxene grains (n=5): $Fs_{9.1\pm 0.2}Wo_{43.6\pm 0.5}$. The concentration of Cr_2O_3 in olivine and pyroxene is <0.1 wt% and 0.3 wt%, respectively. Composition of Cr-spinel (n=2; at.): Cr/(Cr+Al)=0.78; TiO_2 1.4-1.5 wt%. SEM analyses of large thin section areas reveal that this sample is nearly devoid of aluminum.

Classification: Brachinite, based on metamorphic texture, grain size, modal composition, absence of plagioclase, and mineral chemistry.

Northwest Africa 11757 (NWA 11757)

Morocco

Purchased: 2017 Sep

Classification: Ureilite

Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with metamorphic texture ($\sim 120^\circ$ triple junctions), consisting of olivine and pyroxene grains up to ~ 2 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Metal is concentrated along grain boundaries and partly oxidized by terrestrial weathering.

Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=10):

$Fa_{21.0\pm 0.6}$; Olivine rims (n=5): $Fa_{1.4\pm 0.1}$. Pyroxene grains (n=10):

$Fs_{18.0\pm 0.3}Wo_{7.2\pm 0.2}$. The concentration of Cr_2O_3 in olivine and pyroxene is 0.5 wt% and 0.8 wt%, respectively.

Northwest Africa 11761 (NWA 11761)

(Northwest Africa)

Purchased: June 2016

Classification: Mesosiderite

History: The meteorite was purchased by an anonymous collector at St. Marie-aux-Mines, France, mineral show in June 2016 from an anonymous Moroccan dealer.

Physical characteristics: The stone of 2258 g total weight has irregular shape; the surface is reddish-brown; the fusion crust is not preserved.

Petrography: (C. A. Lorenz, *Vernad*) The meteorite has a brecciated texture; it is composed of lithic and mineral fragments (50 vol%) embedded into a troilite-metal-silicate melt matrix (13, 22, 15 vol% respectively). The mineral fragments are pyroxene, feldspar and silica; the rock fragments are fine-, medium- and coarse-grained pyroxene-feldspar rocks of equigranular, subophitic or gabbroic textures, fine-grained clastic and melt-matrix breccias and minor dunitic and peridotitic rocks. Coarse-grained pyroxenes contain the fine exsolution lamellae. The rock contains 11 vol% of fragments of >2 mm in size. The matrix has heterogeneous texture varying in troilite, metal and silicates composition. Matrix silicates forming intergrowths with troilite are fine-grained subhedral pyroxene, anhedral feldspar and glass. Metal-and sulfide-poor matrix surrounding large lithic fragments are fine-grained melt rock. Metal forms irregular and globular grains in the troilite matrix and is composed of kamacite with inclusions of taenite. Accessory minerals are silica and chromite.

Geochemistry: Mineral compositions and geochemistry: (Kononkova N. N., *Vernad*) Matrix pyroxene is $\text{En}_{21.5-56.2}\text{Wo}_{0.5-8.4}$ (Fe/Mn=16 - 30, at.), feldspar is $\text{An}_{84.7-90.2}\text{Ab}_{9.5-14.6}$; fragments pyroxene is $\text{En}_{20.4-31.0}\text{Wo}_{2.1-15.2}$ (Fe/Mn= 23 - 30, at.); feldspar is $\text{An}_{94.5}\text{Ab}_{5.5}$.

Classification: Mesosiderite of Type 4, anomalous; weathering is minimal. This mesosiderite is unusually troilite-rich and metal-poor.

Specimens: A piece and slices of 103 g total weight and thick section is on deposit in *Vernad*. Anonymous collector holds the main mass.

Northwest Africa 11762 (NWA 11762)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Small dark greyish individual with some fusion crust.

Petrography: The meteorite is a fragmental breccia composed of up to 5 mm sized basaltic clasts and dark impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and plagioclase grains of variable grain sizes ranging from about 20 to 600 μm . Several matrix pyroxenes display magmatic zoning. Minor phases include ilmenite, pyrrhotite, silica, apatite, and metallic iron.

Geochemistry: low-Ca pyroxene $\text{Fs}_{42.3\pm 10.3}\text{Wo}_{3.9\pm 1.2}$ ($\text{Fs}_{20.9-51.3}\text{Wo}_{2.0-5.7}$, $n=15$, $\text{FeO/MnO}=31-47$); Ca-pyroxene: $\text{Fs}_{25.2\pm 1.0}\text{Wo}_{39.6\pm 1.4}$ ($\text{Fs}_{23.2-27.6}\text{Wo}_{37.1-42.1}$, $n=14$, $\text{FeO/MnO}=30-35$); calcic plagioclase: $\text{An}_{90.2\pm 1.5}$ ($\text{An}_{87.5-92.5}$, $n=14$)

Northwest Africa 11763 (NWA 11763)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Small individual almost completely covered with fusion crust.

Petrography: The meteorite displays a light greyish to whitish interior and is composed of up to 4 mm sized angular to subrounded basaltic clasts set into a fine-grained recrystallized matrix. Dominant minerals in clasts and matrix are exsolved pyroxene and calcic plagioclase. Grain sizes in the matrix are 10 to 40 μm ; plagioclase laths in basaltic clasts are up to 300 μm in length. Minor phases are silica, chromite, ilmenite, and troilite. Metallic iron was not detected. Contains some thin shock melt veins.

Geochemistry: low-Ca pyroxene $\text{Fs}_{60.9\pm 0.5}\text{Wo}_{2.4\pm 0.3}$ ($\text{Fs}_{59.9-61.5}\text{Wo}_{1.9-3.0}$, $n=14$, $\text{FeO/MnO}=31-35$); Ca-pyroxene: $\text{Fs}_{26.7\pm 1.3}\text{Wo}_{42.6\pm 1.4}$ ($\text{Fs}_{25.6-31.0}\text{Wo}_{37.3-43.9}$, $n=18$, $\text{FeO/MnO}=30-38$); calcic plagioclase: $\text{An}_{89.4\pm 0.5}$ ($\text{An}_{88.6-90.2}$, $n=13$)

Northwest Africa 11764 (NWA 11764)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CK5)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Dark greyish to greenish individual with some fusion crust.

Petrography: The meteorite is composed of recrystallized matrix predominantly composed of Fe-rich olivine with several scattered and clearly defined chondrules (mean diameter about 0.8 mm). Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, and sulfides. Metal is virtually absent. Plagioclase grain size is about 100 μm .

Geochemistry: olivine: $\text{Fa}_{33.4\pm 0.3}$, $n=16$, $\text{FeO/MnO}=133\pm 9$; low-Ca pyroxene: $\text{Fs}_{26.8\pm 0.2}\text{Wo}_{0.8\pm 0.1}$, $n=9$; feldspar: $\text{An}_{54.9\pm 3.1}\text{Ab}_{42.9\pm 2.8}$, $n=3$

Northwest Africa 11765 (NWA 11765)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CK6)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Small individual almost completely covered with fusion crust.

Petrography: The meteorite is largely composed of fine-grained recrystallized matrix mainly consisting of ferrous olivine. Chondrules are only rarely encountered; one CAI was found. Minor phases include plagioclase, low-Ca pyroxene, Ca-pyroxene and sulfides. Cr-rich magnetite is abundant, metal is virtually absent.

Geochemistry: olivine: $\text{Fa}_{31.3\pm 0.3}$, $n=14$, $\text{FeO/MnO}=128\pm 13$; low-Ca pyroxene: $\text{Fs}_{26.4\pm 0.3}\text{Wo}_{1.6\pm 1.4}$, $n=10$; feldspar: $\text{An}_{79.8\pm 0.8}\text{Ab}_{19.9\pm 0.8}$, $n=5$

Northwest Africa 11766 (NWA 11766)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Almost black individual without fusion crust.

Petrography: Carbonaceous chondrite composed of separated and clearly defined chondrules (mean apparent diameter about 1.1 mm), CAIs (up to 7 mm), and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent.

Northwest Africa 11767 (NWA 11767)

(Northwest Africa)

Purchased: 2012

Classification: Lunar meteorite

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Many small light greenish fragments lacking any fusion crust.

Petrography: Monomict olivine-rich gabbroic breccia predominantly composed of up to 4 mm sized Fe-rich olivine, pigeonite, augite and calcic plagioclase. Minor phases include chromite, troilite and K-feldspar. The meteorite contains abundant shock melt veins along which some olivine has been transformed into ringwoodite.

Geochemistry: olivine: $\text{Fa}_{31.6\pm 0.2}$ ($\text{Fa}_{31.3-32.0}$, $n=13$, $\text{FeO/MnO}=85-105$); pigeonite: $\text{Fs}_{25.6\pm 1.1}\text{Wo}_{10.7\pm 2.8}$ ($\text{Fs}_{23.3-27.7}\text{Wo}_{5.9-16.4}$, $n=12$, $\text{FeO/MnO}=46-63$); augite: $\text{Fs}_{16.1\pm 1.0}\text{Wo}_{35.7\pm 2.1}$ ($\text{Fs}_{14.8-17.8}\text{Wo}_{32.1-39.0}$, $n=12$, $\text{FeO/MnO}=41-52$); calcic plagioclase: $\text{An}_{93.1\pm 0.8}$ ($\text{An}_{91.1-93.9}$, $n=10$)

Classification: Lunar Olivine-Gabbros. The meteorite might be paired with NWA 773 and paired stones.

Northwest Africa 11768 (NWA 11768)

(Northwest Africa)

Purchased: 2013

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Five dark greyish fragments without fusion crust.

Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 6 mm sized), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Most chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11769 (NWA 11769)

(Northwest Africa)

Purchased: 2014

Classification: Rumuruti chondrite (R3)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Brownish individual without fusion crust.

Petrography: The meteorite shows an orange interior and is composed of 200 to 800 μm sized chondrules (mean about 400 μm) in abundant matrix dominated by Fe-rich olivine. Olivine and low-Ca pyroxene in chondrules are mostly unequilibrated. Minor phases include pentlandite, sodic plagioclase, and Ti-bearing chromite; no metal has been detected.

Northwest Africa 11770 (NWA 11770)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Dark greyish individual without fusion crust.

Petrography: Carbonaceous chondrite composed of up separated and partly flattened chondrules (mean diameter about 1.2 mm; up to 5 mm), CAIs (up to 6 mm), and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Most chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11771 (NWA 11771)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Diogenite)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Greyish individual partly covered with fusion crust

Petrography: Monomict breccia predominantly composed of blocky up to 2 mm sized orthopyroxenes and more fine-grained cataclastic interstitial regions. Minor phases include feldspar, olivine, silica, chromite, and FeNi metal. No metallic iron has been detected.

Geochemistry: low-Ca pyroxene: $Fs_{29.2\pm 0.3}Wo_{4.2\pm 0.2}$ ($Fs_{28.7-29.5}Wo_{3.9-4.6}$, n=18, FeO/MnO=27-32); olivine: $Fa_{37.7}$, n=1, FeO/MnO=54; calcic plagioclase: $An_{92.7\pm 0.4}$ ($An_{92.2-93.4}$, n=5)

Northwest Africa 11772 (NWA 11772)

(Northwest Africa)

Purchased: 2014

Classification: Rumuruti chondrite (R5)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Thirty eight small dark greyish fragments partly covered with fusion crust. Sawn surface shows a fresh greyish interior.

Petrography: The meteorite is a R-type breccia composed of up to 8 mm sized angular to subrounded clasts set into a more fine-grained clastic matrix. Chondrules are 100 μ m to 1 mm with an average of about 350 μ m. Fe-rich olivine is the most abundant mineral phase in all lithologies. More minor phases include low-Ca pyroxene, augite, pentlandite, and sodic plagioclase (mean grain size about 40 μ m). No metal has been detected. All silicates are compositionally equilibrated.

Geochemistry: olivine: $Fa_{38.2\pm 0.3}$ (n=13, FeO/MnO=74-87); low-Ca pyroxene: $Fs_{30.1\pm 0.2}Wo_{1.3\pm 0.1}$ (n=11, FeO/MnO=47-58); augite: $Fs_{12.0\pm 0.3}Wo_{44.3\pm 0.4}$ (n=10, FeO/MnO=37-55)

Classification: R5 according to mineral chemistry and plagioclase grain size.

Northwest Africa 11773 (NWA 11773)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CK6)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Dark greyish individual without fusion crust.

Petrography: The meteorite displays a greyish to light greenish interior and is composed of abundant recrystallized matrix dominated by Fe-rich olivine with only few scattered and poorly defined chondrules (mean diameter about 0.7 mm).

Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, Ca-pyroxene, and sulfides. No metal has been detected.

Geochemistry: olivine: $Fa_{33.2\pm 0.2}$, $n=16$, $FeO/MnO=118\pm 9$; Ca-pyroxene: $Fs_{9.7\pm 1.2}Wo_{47.2\pm 3.1}$, $n=12$; feldspar: $An_{64.2}Ab_{35.0}Or_{0.8}$, $n=2$

Northwest Africa 11774 (NWA 11774)

Mauritania

Purchased: 2018 Jan

Classification: Mesosiderite

History: Found near Ain Ben Tili, Mauritania, in December 2017 and purchased by Bob Falls in January 2018 from a Moroccan dealer.

Physical characteristics: A single metal-rich mass (439.2 g) with a weathered exterior. The fresh interior consists mainly of metal with ~10 vol.% interstitial silicate-rich material.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed predominantly of granular kamacite (containing small, irregularly-shaped grains of taenite and rare schreibersite) together with interstitial regions containing calcic plagioclase, orthopyroxene, silica polymorph, chromite, merrillite, ilmenite and troilite.

Geochemistry: Orthopyroxene ($Fs_{30.3-31.7}Wo_{2.9-3.8}$, $FeO/MnO = 18-19$, $N = 3$), plagioclase ($An_{85.3-86.9}Or_{0.5-0.2}$, $N = 2$).

Classification: Mesosiderite. This specimen has close textural and mineralogical similarities to the metal-rich nodules in Bondoc, and is unusual because of its very high metal/silicate ratio relative to typical examples.

Specimens: 24.1 g in the form of a polished slice at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11775 (NWA 11775)

Morocco

Purchased: 2018 Jan

Classification: Ureilite

History: The sample was bought in Malaga, Spain, from a Saharawi meteorite dealer

Petrography: (K. Metzler, *IfP*) Ultramafic rock with metamorphic texture (~120° triple junctions), consisting of olivine and pyroxene grains up to ~1.5 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Metal is concentrated along grain boundaries and cracks and partly oxidized by terrestrial weathering.

Geochemistry: Mineral compositions and geochemistry: Olivine cores ($n=10$):

$Fa_{20.1\pm 0.3}$; Olivine rims ($n=5$): $Fa_{7.7\pm 2.3}$. Pyroxene grains ($n=10$):

$Fs_{17.3\pm 0.3}Wo_{3.6\pm 0.1}$. The mean concentration of Cr_2O_3 in olivine and pyroxene is 0.5 wt% and 0.7 wt%, respectively.

Northwest Africa 11776 (NWA 11776)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL6, anomalous)

History: 1 stone weighing 100.7 g was found near Laayoune, Morocco, prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Sample is dark-orange-brown in color, irregularly shaped. The sample lacks fusion crust. The interior of the cut face shows a brecciated texture.

Petrography: Description and Classification (A. Lov, *App*): Sample is a breccia composed of up to 1 cm angular recrystallized clasts of chondritic rock with barely discernible chondrules. All FeNi has been oxidized. Sulfides are partly altered. Average diameter of relict chondrules 1314 μm . Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.88$ (measured with a SM30 instrument).

Geochemistry: (A. Love, *App*) Olivine ($\text{Fa}_{35.7\pm 0.3}$, $N=8$, $\text{Fe}/\text{Mn}=69.6\pm 1.0$), low Ca pyroxene ($\text{Fs}_{26.6\pm 0.4}\text{Wo}_{1.9\pm 0.3}$, $N=8$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O} = 4.321, 4.476, 4.508$; $\delta^{18}\text{O} = 5.841, 6.144, 6.148$; $\Delta^{17}\text{O} = 1.237, 1.232, 1.262$ (all per mil).

Classification: Ordinary Chondrite (LL6-anomalous) S6 W3. The oxygen isotopes are in the LL range. Mean olivine and pyroxene compositions are outside the normal range for LL chondrites, hence the anomalous designation.

Specimens: *PARI* holds the main mass. One endcut weighing 20.02 g and a polished thin section are on deposit at *App*.

Northwest Africa 11777 (NWA 11777)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Eucrite)

History: One mostly crusted stone weighing 705 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Sample is rounded to irregularly shaped and contains many narrow and broad, shallow regmaglypts on 1/3 of its surface. Sample is ~85% covered by orange brown to dark brown patina, some of which may be original fusion crust. Fractures within the patina show a light-colored interior with fine-grained basaltic texture.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of up to 1 cm, rounded to irregularly shaped, ophitic, cumulate textured clasts and subophitic basaltic textured clasts. Clasts are set within a matrix of granular eucritic debris. Pyroxenes are exsolved. Minerals: orthopyroxene, Ca-pyroxene, ilmenite, phosphates, SiO_2 polymorph, FeS.

Geochemistry: (A. Love, *App*) Eucrite: low-Ca pyroxene $\text{Fs}_{61.2\pm 0.5}\text{Wo}_{2.5\pm 0.4}$ ($\text{Fs}_{60.2-62.1}\text{Wo}_{2.0-3.2}$, $\text{FeO}/\text{MnO}=29.4-31.1$, $N=14$); high-Ca pyroxene exsolution lamellae

1
2
3 $\text{Fs}_{26.4\pm 0.7}\text{Wo}_{44.2\pm 0.6}$ ($\text{Fs}_{25.1-27.8}\text{Wo}_{42.9-44.9}$, $\text{FeO/MnO}=29.6-32.0$, $N=14$); plagioclase
4 ($\text{An}_{88.0\pm 2.0}\text{Or}_{0.0}$ ($\text{An}_{85.2-91.9}\text{Or}_{0.0}$, $N=14$));

5 **Classification:** HED (equilibrated basaltic eucrite) Original igneous textures within
6 clasts are preserved while major element compositions of pyroxenes within sample
7 are equilibrated. Plagioclase compositions are poorly equilibrated.

8 **Specimens:** *PARI* holds the main mass. One 20 g endcut and a polished thin section
9 are on deposit at *App*.

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15 **Northwest Africa 11778** (NWA 11778)

16 (Northwest Africa)

17 Purchased: June 2013

18 Classification: Ordinary chondrite (H5)

19
20 **History:** Purchased by *WrocU*, Faculty of Geoengineering, Mining and Geology
21 from Moroccan dealer in Zagora; 120 g was cut off and analyzed in thin section;
22 16.5 g of sample was powdered and for bulk chemistry.

23 **Physical characteristics:** Single stone (767.5 g) covered by black (with slight
24 brown shade) fusion crust, 0.5 mm thick.

25
26 **Petrography:** (T.A. Przylibski, K. Luszczek, *UTWroc*) Chondrules (75 vol.%)
27 include BO, PO, GO, RP, POP, and C types. Chondrules are mostly well defined
28 and often have sharp edges. Chondrule diameters are from 0.2 to 1.2 mm, average
29 $600\pm 290\mu\text{m}$. One compound chondrule is 6.7 mm. Devitrified, partly crystallized
30 mesostasis. Opaque minerals (20 vol.%) include troilite, kamacite and taenite, and
31 rare chromite. Small feldspar grains discernible in electron images. Accessory
32 apatite crystals. Matrix (5 vol.%) is fine-grained, crystalline and transparent,
33 composed mostly of olivine crystals. Around 25% of low-Ca pyroxene crystals are
34 twinned, some of them showing inclined extinction. Some olivine and pyroxene
35 crystals show undulatory extinction. Irregular veins and cracks are filled with
36 opaque iron oxides and hydroxides. Some grains of kamacite are weathered on
37 edges.

38
39 **Geochemistry:** (R. Kryza, *WrocU*; T.A. Przylibski, K. Luszczek, *UTWroc*) Olivine
40 $\text{Fa}_{18.0\pm 0.0}$ ($n=6$); Pyroxene $\text{Fs}_{13.2\pm 0.0}\text{Wo}_{1.1}$ ($N=12$); Chromite ($\text{Mg}_{0.3}\text{Fe}_{2+0.38}$
41 $\text{Mn}_{0.03}\text{Zn}_{0.01}\text{Si}_{0.19}\text{Ti}_{0.02}\text{Ca}_{0.01}$)($\text{Al}_{0.27}\text{Fe}_{3+0.38}\text{Cr}_{1.27}$) O_4 ; kamacite
42 (5.85 wt%), taenite (from 40.4 to 52.7 wt%). Bulk chemistry (in wt%): Si 15.69, Al
43 0.99, Fe 29.74, Mg 12.42, Ca 1.19, Na 0.55, K 0.07, Ti 0.05, P 0.12, Mn 0.22, Cr
44 0.34, Ni 1.81, C 0.07, S 2.04; (in ppm) Ba 8, Co 961.2, Ga 4.8, Hf 6, Nb 0.3, Rb
45 1.5, Sr 15.2, V 64, Mo 1.3, Cu 93.5, Pb 0.1, Zn 10, As 0.7, Se 9.1, Zr 253.4, Au
46 207.3, Y 15.7, La 0.6, Ce 0.8, Pr 0.13, Nd 0.6, Sm 0.19, Eu 0.04, Gd 0.25, Tb 0.05,
47 Dy 0.26, Ho 0.07, Er 0.18, Tm 0.02, Yb 0.18, Lu 0.02

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49 **Classification:** Ordinary chondrite, H5, S2, W1.

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57 **Northwest Africa 11779** (NWA 11779)

58 (Northwest Africa)

59 Purchased: 2012

Classification: Ordinary chondrite (L6)

History: Purchased by Tomasz Jakubowski from Moroccan dealer in 2012; 40 g was cut off and analyzed as one thin section on petrographic microscope in polarized and reflected light, other one thin section was analyzed on microprobe; 16.5 g of sample was powdered and bulk chemistry was analyzed by ICP MS

Physical characteristics: Single specimen with partly preserved fusion crust.

Petrography: (T.A. Przylibski, K. Luszczek *UTWroc*) Rare chondrules, most with gradual transition to matrix. Only a few chondrules have sharp edges. Chondrules are identified as: BO, RP, PO, GO, PP. Some of them have rims up to 0.2 mm thick. Chondrule diameters are from 0.5 to 1.9 mm, average 1.2 mm. Some chondrules are up to 2.7 mm in diameter. Mesostasis is crystallized and matrix is coarse-grained with olivine crystals up to 0.5 mm in diameter. Also feldspar crystals are clearly visible and some of them are polysynthetically twinned. Feldspars are from 0.02 to 0.15 mm large. Opaque minerals (around 10 vol.%) include troilite, kamacite and taenite, and rare chromite.

Geochemistry: (R. Kryza *WrocU*; T.A. Przylibski, K. Luszczek, *UTWroc*) Olivine $\text{Fa}_{24.9}$; pyroxene $\text{Fs}_{19.4}\text{Wo}_{1.3}$; chromite ($\text{Mg}_{0.12}\text{Fe}^{2+}_{0.71}\text{Mn}_{0.03}\text{Zn}_{0.01}\text{Ti}_{0.07}$)($\text{Al}_{0.25}\text{Fe}^{3+}_{0.19}\text{Cr}_{1.56}$) O_4 ; kamacite (5.7-6.7 wt%), taenite (up to 29.6 wt%), troilite without traces of Ni. Bulk chemistry (in wt%): Si 19.65, Al 1.19, Fe 18.45, Mg 15.51, Ca 1.52, Na 0.70, K 0.09, Ti 0.07, P 0.10, Mn 0.28, Cr 0.39, Ni 1.20, C 0.07, S 1.61; (in ppm) Ba 66, Co 306.7, Ga 4.6, Hf 13.9, Nb 0.8, Rb 2.1, Sn 18, Sr 24.7, V 74, Mo 0.8, Cu 82.1, Pb 0.2, Zn 20, Se 6.9, Zr 581.3, Au 126.5, Hg 0.11, Y 34.5, La 0.7, Ce 1.4, Pr 0.19, Nd 0.9, Sm 0.28, Eu 0.09, Gd 0.37, Tb 0.06, Dy 0.38, Ho 0.08, Er 0.22, Tm 0.03, Yb 0.2, Lu 0.03

Classification: Ordinary chondrite, L6, S1, W1

Northwest Africa 11781 (NWA 11781)

(Northwest Africa)

Purchased: 2017 Aug 09

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was purchased from a meteorite dealer in Moscow, Russia.

Petrography: (S. V. Berzin and K. A. Dugushkina, *RAS-UB*) Chondrule ~20%, refractory inclusion (CAIs, AOAs, Forsterite rich objects) ~3-5% and fine-grained matrix. Most chondrules are porphyritic. Average chondrule size is 0.3 mm. Chondrule mesostasis is rare. The matrix contains phyllosilicates and calcite. CAIs are small (0.05-0.3 mm in size) and very fine grained. The dominant minerals of CAIs are spinel, Ca-pyroxene, hibonite, with accessory perovskite. Some CAIs have forsterite rims. AOAs mainly has spinel-diopside inclusion. Forsterite rich objects have low-Ca pyroxene rims. Refractory forsterite is zoned. Unshocked, low grade of terrestrial weathering (metal partially oxidized).

Geochemistry: Element composition by ICP-MS (ppm): Li 6.05, Sc 2.93, Ti 427, V 55.9, Cr 2307, Mn 1365, Co 236, Ni 2597, Cu 86.0, Zn 129, Ga 6.82, Ge 8.91, As 2.69, Se 4.82, Rb 0.952, Sr 190, Y 1.87, Zr 5.54, Nb 0.431, Mo 1.33, Ag 0.197, Cd 0.151, Sn 1.180, Sb 0.146, Te 0.949, Cs 0.038, Ba 283, La 0.545, Ce 1.33, Pr

0.194, Nd 0.963, Sm 0.281, Eu 0.104, Gd 0.458, Tb 0.061, Dy 0.409, Ho 0.088, Er 0.267, Tm 0.040, Yb 0.264, Lu 0.041, Hf 0.209, Ta 0.365, W 0.151, Tl 0.053, Pb 7.36, Bi 0.024, Th 0.100, U 0.481.

Classification: CM2 Carbonaceous chondrite

Northwest Africa 11782 (NWA 11782)

Mali

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: Purchased by Abdelhadi Aithiba in Mali.

Physical characteristics: Broken surface reveals numerous, distinct, closely packed chondrules. A single large sulfide grain ~5 mm was also observed.

Petrography: (C. Agee, *UNM*) microprobe examination of a polished mount of this lithology shows numerous porphyritic chondrules, most with mesostasis or glass. Cl-rich apatite detected.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{24.7\pm 5.5}$, $Cr_2O_3=0.10\pm 0.21$ (wt%), $n=21$; low-Ca pyroxene $Fs_{19.8\pm 5.6}Wo_{1.2\pm 0.7}$, $n=11$.

Classification: Ordinary chondrite (L3), subtype approximately L3.7 based on Fa and Fa s.d.

Specimens: 39.4g including a probe mount on deposit at *UNM*, Abdelhadi Aithiba holds the main mass.

Northwest Africa 11783 (NWA 11783)

(Northwest Africa)

Purchased: 20 Sep 2014

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Jay Piatek from a Moroccan meteorite dealer.

Physical characteristics: Several visually identical appearing pieces. No fusion crust. A saw cut reveals a fragmental breccia with white feldspathic clasts set in a dark gray ground mass.

Petrography: (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene, olivine, plagioclase grains. There are many domains that are fine-grained and cataclastic with shock melt and vesicles. Fe-metal, chromite, ilmenite, silica, and a phosphate mineral were detected.

Geochemistry: (C. Agee, *UNM*) olivine $Fa: 28.1\pm 4.8$, $Fe/Mn=100\pm 2$, $n=4$; clinopyroxene $Fs_{19.0\pm 4.4}Wo_{23.1\pm 17.6}$, $Fe/Mn=52\pm 8$, $n=3$; plagioclase $An_{94.6\pm 1.3}$, $n=3$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $SiO_2=46.0\pm 0.4$, $TiO_2=0.51\pm 0.02$, $Al_2O_3=28.0\pm 0.5$, $Cr_2O_3=0.11\pm 0.01$, $MgO=6.0\pm 0.2$, $FeO=4.7\pm 0.2$, $MnO=0.07\pm 0.00$, $CaO=15.3\pm 0.1$, $Na_2O=0.61\pm 0.03$, $K_2O=0.16\pm 0.01$ (all wt%), $n=7$.

Classification: Lunar feldspathic breccia

Specimens: 13 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11784 (NWA 11784)

(Northwest Africa)

Purchased: 27 Jul 2015

Classification: Ureilite

History: Purchased by Jay Piatek from a Moroccan meteorite dealer.**Physical characteristics:** Single stone. A saw cut reveals medium grained, gray, pyroxene crystals with a mildly aligned orientation. Very fine, scattered metal and graphite grains are visible throughout.**Petrography:** (C. Agee, *UNM*) Microprobe examination shows olivine, pigeonite, and augite grains, many in the size range ~1-2 mm. Graphite blades are present up to ~500 μm in length. Fine metal blebs and oxidized iron are observed along olivine grain boundaries. Olivines have oxidation-reduction rims.**Geochemistry:** (C. Agee, *UNM*) Olivine $\text{Fa}_{12.0\pm 3.5}$, $\text{Fe/Mn}=25\pm 8$, $\text{Cr}_2\text{O}_3=0.61\pm 0.02$, $\text{CaO}=0.29\pm 0.03$ (wt%), $n=6$; olivine cores $\text{Fa}_{14.2\pm 0.7}$, $n=4$; olivine rims $\text{Fa}_{7.7\pm 0.4}$, $n=2$; pigeonite $\text{Fs}_{12.7\pm 0.3}\text{Wo}_{4.9\pm 0.0}$, $\text{Fe/Mn}=20\pm 0$, $n=6$; augite $\text{Fs}_{8.1\pm 0.1}\text{Wo}_{35.4\pm 0.4}$, $\text{Fe/Mn}=16\pm 1$, $n=5$.**Classification:** Ureilite, augite-bearing.**Specimens:** 20.2 g on deposit at *UNM*, Jay Piatek holds the main mass.**Northwest Africa 11785** (NWA 11785)

(Northwest Africa)

Purchased: 22 May 2015

Classification: HED achondrite (Eucrite, melt breccia)

History: Purchased by Jay Piatek from a Moroccan meteorite dealer.**Physical characteristics:** Single stone, no fusion crust. Exterior shows numerous white clasts set in a dark matrix of shock melt.**Petrography:** (C. Agee, *UNM*) Microprobe examination shows a cataclastic mix of fragmental pyroxene and feldspar grains engulfed in abundant shock melt veins and pools. Accessory chromite and ilmenite were detected.**Geochemistry:** (C. Agee, *UNM*) Low-Ca pyroxene $\text{Fs}_{53.1}\text{Wo}_{1.9}$, $\text{Fe/Mn}=32$, $n=1$; high-Ca pyroxene $\text{Fs}_{22.6}\text{Wo}_{44.1}$, $\text{Fe/Mn}=28$, $n=1$; plagioclase $\text{An}_{90.5\pm 1.3}$, $n=2$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=46.1\pm 1.9$, $\text{TiO}_2=0.8\pm 0.02$, $\text{Al}_2\text{O}_3=25.1\pm 9.9$, $\text{Cr}_2\text{O}_3=0.13\pm 0.10$, $\text{MgO}=5.0\pm 3.5$, $\text{FeO}=9.2\pm 6.0$, $\text{MnO}=0.28\pm 0.19$, $\text{CaO}=14.4\pm 2.7$, $\text{Na}_2\text{O}=0.66\pm 0.27$, $\text{K}_2\text{O}=0.05\pm 0.01$ (all wt%), $n=5$.**Classification:** Eucrite-melt breccia, eucrite pyroxene compositions are consistent with cumulate eucrite.**Specimens:** 20 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.**Northwest Africa 11786** (NWA 11786)

(Northwest Africa)

Purchased: 30 Aug 2015

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Jay Piatek from a Moroccan meteorite dealer.

Physical characteristics: Single stone, no fusion crust. Exterior shows, dark gray, fine grained texture.

Petrography: (C. Agee, *UNM*) (C. Agee, *UNM*) Microprobe examination shows approximately 60% pyroxene and 35% plagioclase. Shock melt veins and mild brecciation are present. Accessory troilite, chromite, silica, and ilmenite were detected.

Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $\text{Fs}_{59.0\pm 2.1}\text{Wo}_{5.2\pm 2.5}$, $\text{Fe/Mn}=31\pm 1$, $n=1$; high-Ca pyroxene $\text{Fs}_{27.6\pm 1.3}\text{Wo}_{42.4\pm 1.5}$, $\text{Fe/Mn}=31\pm 3$, $n=4$; plagioclase $\text{An}_{89.7\pm 0.7}$, $n=2$.

Classification: Eucrite, monomict

Specimens: 22 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11787 (NWA 11787)

Mauritania

Purchased: 2017

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in Mauritania by Dustin Dickens from anonymous meteorite hunter.

Physical characteristics: Many visually identical appearing pieces, ranging from several kilograms to sub-gram fragments. Some pieces show a light-gray, remnant fusion crust on one or more faces, with most having no fusion crust. Saw cut reveals a fragmental breccia with white feldspathic clasts set in a dark-gray ground mass.

Petrography: (C. Agee, *UNM*) This meteorite is a polymict breccia of fragmental feldspathic, troctolitic and mafic lithologies, as well as fragmental pyroxene, olivine, plagioclase grains, and shock melt with vesicles.

Geochemistry: (C. Agee, *UNM*) olivine Fa : 25.6 ± 8.9 , $\text{Fe/Mn}=95\pm 18$, $n=13$; low-Ca pyroxene $\text{Fs}_{26.2\pm 8.8}\text{Wo}_{6.2\pm 2.5}$, $\text{Fe/Mn}=52\pm 4$, $n=7$; subcalcic augite $\text{Fs}_{35.9\pm 5.8}\text{Wo}_{26.9\pm 7.9}$, $\text{Fe/Mn}=69\pm 5$, $n=2$; augite $\text{Fs}_{14.5\pm 7.1}\text{Wo}_{41.0\pm 2.0}$, $\text{Fe/Mn}=45\pm 15$, $n=3$; plagioclase $\text{An}_{96.2\pm 0.8}$, $n=6$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=42.9\pm 0.4$, $\text{TiO}_2=0.11\pm 0.05$, $\text{Al}_2\text{O}_3=31.1\pm 4.0$, $\text{Cr}_2\text{O}_3=0.10\pm 0.05$, $\text{MgO}=5.1\pm 3.3$, $\text{FeO}=3.3\pm 2.0$, $\text{MnO}=0.05\pm 0.05$, $\text{CaO}=16.6\pm 1.6$, $\text{Na}_2\text{O}=0.37\pm 0.06$, $\text{K}_2\text{O}=0.04\pm 0.00$ (all wt%), $n=3$.

Classification: Lunar feldspathic breccia

Specimens: 21.25 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11788 (NWA 11788)

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3 Mali

4 Purchased: 2017

5 Classification: Lunar meteorite (feldspathic breccia)

6 **History:** Purchased in Mali by Dustin Dickens from anonymous meteorite hunter.

7 **Physical characteristics:** Many dark visually identical appearing pieces, with
8 masses ranging from ~2 kg to many sub-g fragments, showing no fusion crust. Saw
9 cut reveals a finely fragmental breccia with white feldspathic clasts set in a dark
10 gray ground mass with metal flecks and minor vesiculation appearing throughout.

11 **Petrography:** (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene,
12 olivine, plagioclase grains. There are domains that are fine-grained and cataclastic
13 with shock melt and vesicles.

14 **Geochemistry:** (C. Agee, *UNM*) olivine Fa: 31.2 ± 9.4 , Fe/Mn=95±7, n=12;
15 clinopyroxene $Fs_{36.0 \pm 10.0} Wo_{22.2 \pm 8.8}$, Fe/Mn=60±5, n=12; plagioclase $An_{93.0 \pm 1.8}$, n=7;
16 Shock melt (20 μm defocused electron beam, proxy for bulk meteorite
17 composition): $SiO_2=43.2 \pm 1.7$, $TiO_2=0.46 \pm 0.20$, $Al_2O_3=24.2 \pm 3.6$,
18 $Cr_2O_3=0.23 \pm 0.08$, $MgO=7.8 \pm 1.4$, $FeO=8.0 \pm 3.2$, $MnO=0.10 \pm 0.05$, $CaO=14.2 \pm 1.4$,
19 $Na_2O=0.35 \pm 0.23$, $K_2O=0.08 \pm 0.05$ (all wt%), n=4.

20 **Classification:** Lunar feldspathic breccia

21 **Specimens:** 28.9 g including a probe mount on deposit at *UNM*, Dustin Dickens
22 holds the main mass.
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31 **Northwest Africa 11789** (NWA 11789)

32 Mauritania

33 Purchased: 2017

34 Classification: Lunar meteorite (feldspathic breccia)

35 **History:** Purchased in Mauritania by Dustin Dickens from anonymous meteorite
36 hunter.

37 **Physical characteristics:** Seven black visually identical appearing pieces that fit
38 back together to form a single mass with the largest piece weighing over 2 kg and
39 the smallest under 45 g. The larger pieces show a black-brown fusion crust and
40 thumb printing. Saw cut reveals a fragmented breccia with white feldspathic clasts
41 set in a black ground mass.

42 **Petrography:** (C. Agee, *UNM*) This meteorite is a polymict breccia of fragmental
43 feldspathic and mafic lithologies, as well as fragmental pyroxene, olivine,
44 plagioclase grains, and shock melt.

45 **Geochemistry:** (C. Agee, *UNM*) Olivine Fa: 31.7 ± 6.3 , Fe/Mn=92±9, n=10;
46 clinopyroxene $Fs_{32.2 \pm 10.8} Wo_{12.9 \pm 8.2}$, Fe/Mn=54±8, n=12; plagioclase $An_{96.7 \pm 0.8}$, n=7;
47 Shock melt (20 μm defocused electron beam, proxy for bulk meteorite
48 composition): $SiO_2=43.6 \pm 0.8$, $TiO_2=0.19 \pm 0.13$, $Al_2O_3=27.6 \pm 5.0$,
49 $Cr_2O_3=0.12 \pm 0.08$, $MgO=6.7 \pm 4.4$, $FeO=4.3 \pm 2.9$, $MnO=0.06 \pm 0.04$, $CaO=15.7 \pm 2.3$,
50 $Na_2O=0.34 \pm 0.13$, $K_2O=0.09 \pm 0.05$ (all wt%), n=6.

51 **Classification:** Lunar feldspathic breccia

52 **Specimens:** 43.15 g including a probe mount on deposit at *UNM*, Dustin Dickens
53 holds the main mass.
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Northwest Africa 11790 (NWA 11790)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Two black fragments partly covered with fusion crust.

Petrography: The meteorite displays a dark interior and is composed of small (mean diameter about 280 μm) chondrules, mineral fragments and CAIs set into an abundant fine-grained Fe-rich matrix. Opaques are mostly Fe,Ni metal. Several components are surrounded by fine-grained dust rims. Matrix constituents include phyllosilicates (low analytical totals), Ca-carbonates, and pyrrhotite.

Northwest Africa 11791 (NWA 11791)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Six black fragments partly covered with fusion crust.

Petrography: The meteorite is a breccia dominated by fine-grained almost opaque matrix composed of phyllosilicates, Fe-sulfides, Ca-carbonates and rare FeNi metal. Embedded in this matrix are chondrules (mean diameter about 300 μm), chondrule pseudomorphs, mineral fragments, and rare CAIs some of which are surrounded by fine-grained dust rims.

Northwest Africa 11792 (NWA 11792)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Many small dark-grayish to black fragments, some partly covered with fusion crust.

Petrography: Carbonaceous chondrite composed of small (about 0.1-0.6 mm in diameter, mean about 250 μm) chondrules, chondrule pseudomorphs, mineral fragments and rare CAIs many of which surrounded by fine-grained dust rims set into abundant matrix. Matrix is Fe-rich and contains abundant Fe-sulfides and less abundant phyllosilicates and Ca-carbonates. Most of the Fe-rich olivines are strongly corroded.

Northwest Africa 11793 (NWA 11793)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Twelve small almost black fragments lacking fusion crust.

Petrography: Brecciated matrix-dominated carbonaceous chondrite with chondrules (mean diameter about 350 μm), mineral fragments and few CAIs. Some of the components are dust-mantled. Matrix is highly porous and composed of abundant Ca-carbonates and less abundant phyllosilicates and Fe-sulfides. Some rare FeNi metal grains are present.

Northwest Africa 11794 (NWA 11794)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Eucrite)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Eleven greyish fragments partly covered with fusion crust.

Petrography: Unbrecciated fine-grained basaltic rock predominantly composed of exsolved pyroxene and often lath-shaped plagioclase with average grains sizes of about 150 μm . Minor phases include silica, ilmenite, chromite, and troilite; no metallic iron has been detected. The meteorite contains several shock melt veins.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{61.6\pm 0.6}\text{Wo}_{2.4\pm 0.5}$ ($\text{Fs}_{60.0-62.2}\text{Wo}_{1.8-3.7}$, $n=14$, $\text{FeO/MnO}=31-36$); Ca-pyroxene: $\text{Fs}_{26.8\pm 0.8}\text{Wo}_{43.3\pm 0.9}$ ($\text{Fs}_{26.0-29.5}\text{Wo}_{40.0-44.0}$, $n=16$, $\text{FeO/MnO}=29-36$); calcic plagioclase: $\text{An}_{89.4\pm 0.6}$ ($\text{An}_{88.7-90.4}$, $n=13$)

Northwest Africa 11795 (NWA 11795)

(Northwest Africa)

Purchased: 2018

Classification: Primitive achondrite (Lodranite)

History: The meteorite was purchased in Tindouf, Algeria, from a Sahrawi dealer.

Physical characteristics: Brownish individual lacking any fusion crust.

Petrography: The meteorite is a breccia predominantly composed of up to 3 mm sized olivine and orthopyroxene grains (mean diameter about 0.6 mm) with related fine-grained mineral debris. More minor phases include Ca-pyroxene, chromite, kamacite, troilite and Ni-bearing pyrrhotite. Ca-pyroxene often occurs as fine exsolution lamellae in low-Ca pyroxene and kamacite is mostly altered to Fe-oxides/hydroxides. No feldspar was found in the section studied.

Geochemistry: olivine: $\text{Fa}_{10.7\pm 0.1}$, ($\text{Fa}_{10.5-10.8}$, $n=13$, $\text{FeO/MnO}=25\pm 1$); low-Ca pyroxene: $\text{Fs}_{10.3\pm 0.1}\text{Wo}_{2.2\pm 0.2}$ ($\text{Fs}_{10.1-10.5}\text{Wo}_{1.9-2.5}$, $n=12$, $\text{FeO/MnO}=16\pm 1$); Ca-pyroxene: $\text{Fs}_{4.6\pm 0.2}\text{Wo}_{43.6\pm 0.5}$ ($\text{Fs}_{4.3-4.9}\text{Wo}_{42.8-44.9}$, $n=12$, $\text{FeO/MnO}=11\pm 1$); Cr_2O_3 in Ca-pyroxene: 1.06 ± 0.13 wt. %

Classification: Lodranite according to mineral chemistry, grain size, and absence of feldspar.

Northwest Africa 11796 (NWA 11796)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: The meteorite was purchased in Tindouf, Algeria, from a Sahrawi dealer.

Petrography: The meteorite displays a chondritic texture with slightly flattened and well-packed chondrules (mean diameter about 0.6 mm) in a more fine-grained matrix that contains sulfides and FeNi metal.

Northwest Africa 11797 (NWA 11797)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L6)

History: The meteorite was purchased in Tindouf, Algeria from a Sahrawi dealer.

Physical characteristics: Brownish individual lacking any fusion crust.

Petrography: Plagioclase grain size about 70 μm

Northwest Africa 11801 (NWA 11801)

Algeria

Purchased: 2016 May 1

Classification: Lunar meteorite

History: Purchased by Miao Bing-an in 2016 from Morocco.

Physical characteristics: This meteorite is in irregular and brecciated, partially covered with black fusion crust. A saw cut reveals an abundance of fragments set in dark-colored matrix.

Petrography: The section is composed of abundant mineral fragments and a few lithic clasts and glass set in a fine-grained matrix. The mineral fragments, lithic clasts, and glass areas show irregular shapes and variable textures with different sizes (from $\sim 10 \mu\text{m}$ to $\sim 4.1 \text{ mm}$ across). The matrix is made up of fine-grained minerals bound by glassy cement. Mineral fragments include plagioclase, pyroxene, olivine, and minor ilmenite, chromite, silica, Ni-Fe metal, troilite, armalcolite, k-feldspar. The section contains various types of lithic clasts (anorthosite, gabbro, troctolite, and crystalline impact melt breccia). Several glassy spheres and veins were found in the thin section. One anomalously large glassy vein (up to 2.7 mm thick) that crosscut the section was observed.

Geochemistry: Plagioclase $\text{An}_{91-96}\text{Or}_{<0.4}$; pyroxene $\text{Wo}_{4-36}\text{En}_{7-69}$; olivine Fo_{10-83} . The Fe/Mn ratios of pyroxene and olivine in this meteorite lie approximately along the lunar line, although the range of values is very large (44-79 for pyroxene and 72-127 for olivine).

Classification: Lunar (breccia)

Specimens: specimen and a polished thin section are deposited in *GUT*

Northwest Africa 11802 (NWA 11802)

(Northwest Africa)

Purchased: 2017 Jun

Classification: Ordinary chondrite (L3)

History: Purchased by Gary Fujihara in June 2017 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed unequilibrated chondrules (apparent diameter $620 \pm 410 \mu\text{m}$, $N = 18$) are set in a sparse fine grained matrix containing stained metal.

Geochemistry: Olivine ($\text{Fa}_{0.6-81.6}$, Cr_2O_3 in ferroan examples 0.06-0.28 wt.%, mean 0.12 ± 0.06 wt.%, $N = 9$), orthopyroxene ($\text{Fs}_{1.5-23.3}\text{Wo}_{0.2-3.4}$, $N = 3$), subcalcic augite ($\text{Fs}_{14.6}\text{Wo}_{26.6}$), augite ($\text{Fs}_{5.4}\text{Wo}_{45.4}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.76$.

Classification: Ordinary chondrite (L3). The ranges of Fa content in olivine and of Cr_2O_3 content in ferroan olivine indicate a relatively low petrologic subtype between 3.3 and 3.5.

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. G. Fujihara.

Northwest Africa 11803 (NWA 11803)

Algeria

Purchased: 2017 Aug

Classification: HED achondrite (Eucrite, brecciated)

History: Purportedly found in Algeria and purchased by Gary Fujihara in August 2017 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of large gabbroic eucrite clasts in a very fine grained, vesicular quenched melt matrix containing angular mineral debris. Eucrite clasts (grainsize up to 2 mm) consist of exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, troilite and Ni-free metal. Pyroxenes in the matrix include both pigeonite and ferropigeonite.

Geochemistry: Gabbroic eucrite clasts: orthopyroxene host ($\text{Fs}_{61.1}\text{Wo}_{2.1}$, $\text{FeO}/\text{MnO} = 33$), clinopyroxene exsolution lamella ($\text{Fs}_{27.3}\text{Wo}_{42.4}$, $\text{FeO}/\text{MnO} = 33$), orthopyroxene host ($\text{Fs}_{51.7}\text{Wo}_{2.0}$, $\text{FeO}/\text{MnO} = 35$), clinopyroxene exsolution lamella ($\text{Fs}_{20.3}\text{Wo}_{44.5}$, $\text{FeO}/\text{MnO} = 26$), plagioclase ($\text{An}_{91.3}\text{Or}_{0.2}$). Matrix: pigeonite ($\text{Fs}_{44.2}\text{Wo}_{11.6}$, $\text{FeO}/\text{MnO} = 32$), ferropigeonite ($\text{Fs}_{70.3}\text{Wo}_{23.1}$, $\text{FeO}/\text{MnO} = 38$), plagioclase ($\text{An}_{89.7}\text{Or}_{0.2}$).

Classification: Eucrite (gabbroic, melt matrix breccia).

Specimens: 22 g including one polished thin section at *UWB*; remainder with Mr. G. Fujihara.

Northwest Africa 11804 (NWA 11804)

(Northwest Africa)

Purchased: 2018 Jan

Classification: Martian meteorite (Shergottite)

History: Purportedly found in the Tanezrouft region of Algeria and purchased by John Higgins in January 2018 from a Mauritanian dealer.

Physical characteristics: A single disaggregated brownish stone (34 grams). Several of the desert-ablated fragments fit together and some retain partial black fusion crust.

Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic assemblage of mainly zoned clinopyroxene and maskelynite with accessory ilmenite, titanomagnetite, fayalite and pyrrhotite. Inclusions of K-rich glass and silica polymorph are present within pyroxenes.

Geochemistry: Subcalcic augite ($\text{Fs}_{26.1-45.0}\text{Wo}_{28.6-30.8}$, $\text{FeO/MnO} = 31-38$, $N = 3$), pigeonite ($\text{Fs}_{47.8-59.8}\text{Wo}_{12.7-15.4}$, $\text{FeO/MnO} = 35-37$, $N = 3$), fayalite ($\text{Fa}_{76.3}$, $\text{FeO/MnO} = 54$), maskelynite ($\text{An}_{53.1-53.3}\text{Or}_{0.9-1.0}$, $N = 2$).

Classification: Shergottite (diabasic). Paired with [NWA 2975](#) and many other stones found in the Tanezrouft area.

Specimens: 6.88 g including one polished thick section at *UWB*; remainder with Mr. J. Higgins.

Northwest Africa 11805 (NWA 11805)

(Northwest Africa)

Purchased: 2018 Jan

Classification: HED achondrite (Diogenite, polymict)

History: Purchased by Christopher Colvin in January 2018 from a dealer in Arizona, who had obtained the specimen from a Moroccan source.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of angular mineral debris plus sparse lithic clasts of diogenite and microgabbroic eucrite. The majority (>90 vol.%) of the mineral debris is diogenitic (orthopyroxene, olivine, chromite) with minor eucritic exsolved pigeonite, calcic plagioclase, silica polymorph, Ti-chromite and troilite.

Geochemistry: Diogenitic orthopyroxene ($\text{Fs}_{23.4-24.5}\text{Wo}_{2.3-2.0}$; $\text{Fs}_{17.1}\text{Wo}_{0.9}$; $\text{FeO/MnO} = 27-32$; $N = 3$), olivine ($\text{Fa}_{28.9}$; $\text{Fa}_{52.0}$; $\text{FeO/MnO} = 44-49$; $N = 2$), orthopyroxene host ($\text{Fs}_{44.7}\text{Wo}_{3.5}$, $\text{FeO/MnO} = 33$), clinopyroxene exsolution lamella ($\text{Fs}_{23.0}\text{Wo}_{39.4}$, $\text{FeO/MnO} = 26$), plagioclase ($\text{An}_{88.6-90.3}\text{Or}_{0.5-0.4}$, $N = 2$).

Classification: Diogenite (polymict breccia).

Specimens: 21.1 g including one polished thin section at *UWB*; remainder with Mr. C. Colvin.

Northwest Africa 11806 (NWA 11806)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H3)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to the Planetary Studies Foundation.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed chondrules (apparent diameter 350 ± 240 μm , $N = 24$) are set in a sparse fine grained matrix containing altered metal.

Geochemistry: Olivine ($\text{Fa}_{0.8-23.1}$, Cr_2O_3 in ferroan examples 0.02-0.28 wt.%, mean 0.07 ± 0.10 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{1.4-28.6}\text{Wo}_{0.7-1.8}$, $N = 3$), subcalcic augite ($\text{Fs}_{9.2-30.1}\text{Wo}_{30.9-32.7}$, $N = 2$), diopside ($\text{Fs}_{1.1}\text{Wo}_{41.7}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.86$.

Classification: Ordinary chondrite (H3).

Specimens: The entire specimen including a polished endcut is at *PSF*.

Northwest Africa 11807 (NWA 11807)

(Northwest Africa)

Purchased: 2018 Jan

Classification: Primitive achondrite (Winonaite)

History: Purchased by Darryl Pitt in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Metamorphic aggregate (mean grainsize 320 μm , with triple grain junctions) composed of forsterite, diopside and enstatite with accessory troilite and stained kamacite.

Geochemistry: Olivine ($\text{Fa}_{2.9-3.0}$, $\text{FeO}/\text{MnO} = 12-13$, $N = 3$), orthopyroxene ($\text{Fs}_{2.7-3.0}\text{Wo}_{1.1-1.0}$, $\text{FeO}/\text{MnO} = 8$, $N = 2$), clinopyroxene ($\text{Fs}_{1.1-1.2}\text{Wo}_{46.4-46.3}$, $\text{FeO}/\text{MnO} = 5$, $N = 2$). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 2.395, 2.477, 2.360; $\delta^{18}\text{O}$ 5.567, 5.758, 5.487; $\Delta^{17}\text{O}$ -0.544, -0.563, -0.537 per mil.

Classification: Winonaite.

Specimens: 20.2 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11808 (NWA 11808)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Carbonaceous chondrite (CK4)

History: Found by a camel herder in November 2017 near Tarfaya El Hagounia, Morocco and purchased by Mbark Arjdal.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed. magnetite-bearing granular chondrules (apparent diameter 770 ± 380 μm , $N = 20$) and sparse very fine grained CAI are set in a fine grained matrix containing orange-stained Cr-magnetite.

Geochemistry: Olivine ($\text{Fa}_{34.3-34.3}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.3-9.8}\text{Wo}_{46.5-46.0}$, $N = 2$), orthopyroxene ($\text{Fs}_{27.0}\text{Wo}_{3.9}$).

Classification: Carbonaceous chondrite (CK4).

Specimens: 20.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 11809 (NWA 11809)

(Northwest Africa)

Purchased: 2017 Sep

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Fabien *Kuntz* in September 2017 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral clasts of anorthite, olivine, orthopyroxene, pigeonite, subcalcic augite and Ti-chromite in a finer grained matrix containing minor barite.

Geochemistry: Olivine ($\text{Fa}_{30.0-41.3}$, $\text{FeO/MnO} = 87-97$, $N = 3$), orthopyroxene ($\text{Fs}_{35.7}\text{Wo}_{4.2}$, $\text{FeO/MnO} = 56$), pigeonite ($\text{Fs}_{25.2-29.8}\text{Wo}_{7.9-10.1}$, $\text{FeO/MnO} = 52-63$, $N = 2$), subcalcic augite ($\text{Fs}_{15.8}\text{Wo}_{30.1}$, $\text{FeO/MnO} = 56$), anorthite ($\text{An}_{92.0-95.0}\text{Or}_{0.2-0.1}$, $N = 2$).

Classification: Lunar (feldspathic breccia).

Specimens: 14.11 g including a polished slice at *UWB*; main mass with *Kuntz*.

Northwest Africa 11810 (NWA 11810)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H3)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to the Planetary Studies Foundation.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed chondrules (apparent diameter $400 \pm 160 \mu\text{m}$, $N = 20$) are set in a sparse fine grained matrix containing merrillite, chlorapatite and stained metal. A single crystal clast of forsterite was observed.

Geochemistry: Olivine in chondrules ($\text{Fa}_{2.0-37.0}\text{Cr}_2\text{O}_3$ in ferroan examples 0.03-0.21 wt.%, mean 0.08 ± 0.07 wt.%, $N = 7$), fosterite crystal ($\text{Fa}_{0.7}$), orthopyroxene ($\text{Fs}_{2.1-31.3}\text{Wo}_{0.6-1.7}$, $N = 3$), pigeonite ($\text{Fs}_{0.4}\text{Wo}_{6.3}$), augite ($\text{Fs}_{3.2}\text{Wo}_{35.0}$; $\text{Fs}_{6.2}\text{Wo}_{45.5}$; $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 5.14$.

Classification: Ordinary chondrite (H3).

Specimens: The entire specimen including a polished endcut is at *PSF*.

Northwest Africa 11811 (NWA 11811)

(Northwest Africa)

Purchased: 2017

Classification: LL5-an

Physical characteristics: Dark stone. Cut surface reveals a gray interior with chondritic texture.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Chondrite with recrystallized texture. Main minerals are olivine, pyroxene, and interstitial plagioclase with typical size about 25 μm . Presence of merrillite. Opaque minerals are sulfides (including pentlandite), chromite, and rare FeNi metal.

Geochemistry: Olivine $\text{Fa}_{33.5\pm 0.9}$, PMD=3%, NiO 0.17 wt% (N=8). Orthopyroxene $\text{Fs}_{26.4\pm 0.2}\text{Wo}_{1.6\pm 0.1}$ (N=5). Ca-pyroxene $\text{Fs}_{25.1}\text{Wo}_{17.4}$ (N=1). Plagioclase $\text{An}_{11.9}\text{Ab}_{80.2}\text{Or}_{7.9}$ (N=2). Chromite $\text{Cr}\# = 0.91$, TiO_2 3.6 wt% (N=1). FeNi metal $\text{Fe}_{32.3\pm 0.3}\text{Ni}_{66.2\pm 0.3}\text{Co}_{1.35\pm 0.06}$ (N=7). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.42$. Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 475 mg bulk sample is $\delta^{17}\text{O}=4.38\text{‰}$, $\delta^{18}\text{O}=5.85\text{‰}$, $\Delta^{17}\text{O}=1.31\text{‰}$ (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively).

Classification: LL5-anomalous. The anomalous designation comes from the high Fa content of olivine compared to other equilibrated LL chondrites, and the presence of metal in the form of FeNi2 exclusively.

Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11812 (NWA 11812)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL3)

Physical characteristics: Greyish stone. Cut surface reveals a dark-gray interior with closely packed well-defined chondrules.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Packed mm-sized chondrules.

Geochemistry: Olivine $\text{Fa}_{23.5\pm 6.7}$, range 11.9-30.6, PMD 23% (N=5). Orthopyroxene $\text{Fs}_{17.5\pm 5.3}\text{Wo}_{1.1\pm 1.0}$, Fs PMD 25% (N=5).

Classification: LL3. LL than L classification from magnetic susceptibility.

Specimens: Type specimen at *CEREGE*. Main mass with Fabien *Kuntz*.

Northwest Africa 11813 (NWA 11813)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (LL3)

Physical characteristics: Greyish stone. Cut surface reveals a dark grey interior with closely packed well-defined chondrules.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Packed chondrules with average apparent diameter 920 μm (N=36).

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3 **Geochemistry:** Olivine $\text{Fa}_{18.2\pm 8.1}$, range 1.1-33.8, PMD 33% (N=13), Cr_2O_3 in
4 ferroan olivine 0.17 ± 0.12 wt% (N=11). Orthopyroxene $\text{Fs}_{8.0\pm 4.1}\text{Wo}_{2.3\pm 1.8}$ (N=4).
5 **Classification:** LL3. LL than L classification from magnetic susceptibility.
6 **Specimens:** Type specimen at *CEREGE*. Main mass with Fabien *Kuntz*.
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10 **Northwest Africa 11814** (NWA 11814)

11 (Northwest Africa)

12 Purchased: 2016

13 Classification: Ordinary chondrite (H5)

14 **Petrography:** Chondrite with plagioclase to $40\ \mu\text{m}$ in the matrix. Porosity under
15 the form of pores of with typical size $150\ \mu\text{m}$ (maximum $300\ \mu\text{m}$) amounts to 9
16 vol% (point counting, N=185) is unusual for an equilibrated ordinary chondrite.
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22 **Northwest Africa 11815** (NWA 11815)

23 (Northwest Africa)

24 Purchased: 2017 Dec

25 Classification: Ureilite

26 **History:** Purchased from an Algerian mineral dealer.

27 **Petrography:** (K. Metzler, *IffP*) Coarse-grained ultramafic rock with aligned
28 texture, consisting of olivine and pyroxene grains with sizes up to ~ 2.5 mm.
29 Reverse zoning of olivine grains with Mg-rich zones at the margins and along
30 cracks. Metal is concentrated along grain boundaries and mostly oxidized by
31 terrestrial weathering.
32

33 **Geochemistry:** Mineral compositions and geochemistry: Olivine cores (n=9):
34 $\text{Fa}_{18.3\pm 0.2}$; Olivine rims (n=6): $\text{Fa}_{3.6\pm 1.1}$; Pyroxene grains (n=14):
35 $\text{Fs}_{15.3\pm 0.3}\text{Wo}_{8.1\pm 0.3}$. The mean concentration of Cr_2O_3 in olivine and pyroxene is 0.7
36 wt% and 1.2 wt%, respectively.
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42 **Northwest Africa 11828** (NWA 11828)

43 (Northwest Africa)

44 Find: 2017

45 Classification: Lunar meteorite (feldspathic breccia)

46 **History:** Stones were acquired from a Moroccan dealer in 2017.

47 **Physical characteristics:** A group of dark- and light-gray stones with no fusion
48 crust.
49

50 **Petrography:** (S. Demidova and D. Badyukov, *Vernad*): The meteorites are
51 polymict breccias containing numerous mineral fragments and large rounded lithic
52 clasts occurring within a brownish cryptocrystalline to glassy impact-melt matrix;
53 the lithic clast population comprises impact-melt breccias, as well as cataclastic
54 granulitic rocks of anorthositic, noritic, gabbro-noritic and troctolitic compositions;
55 clasts of impact-melt breccias typically show breccia-in-breccia textures; glass
56 fragments and rare spherules are present.
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Geochemistry: feldspar, An₉₂₋₉₈; orthopyroxene, Wo₂₋₅En₆₀₋₈₁; clinopyroxene; Wo₅₋₄₃En₃₃₋₆₉, olivine, Fo₂₂₋₉₃ (FeO/MnO = 85); accessory minerals include: ilmenite (2.6-6.2 wt % MgO), Cr-rich ulvöspinel, Ti,Al-rich chromite, silica, Ca-phosphate, armalcolite, baddeleyite, troilite, and abundant FeNi metal; the stones are moderately weathered; carbonate veins and Fe hydroxides are present.

Classification: Lunar, feldspathic regolith breccia

Specimens: 23 type specimens of 662.5 g, and a thin section, *Vernad*, the main mass with an anonymous keeper

Northwest Africa 11829 (NWA 11829)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Dark-grayish individual lacking any fusion crust.

Petrography: The meteorite displays a chondritic texture with slightly flattened and well packed chondrules (mean apparent diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 11830 (NWA 11830)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H4)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Dark brownish individual without fusion crust.

Petrography: The meteorite displays a chondritic texture with well defined chondrules (mean diameter about 0.3 mm) and fine-grained matrix containing sulfides and abundant FeNi metal. Low-Ca pyroxene is compositionally highly unequilibrated; olivine is equilibrated.

Northwest Africa 11831 (NWA 11831)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (LL3-6)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Dark greyish individual with some fusion crust.

Petrography: The meteorite is a chondritic breccia consisting of clastic LL3 type matrix with embedded up to 2 mm sized LL6 clasts. Plagioclase grain size in type 6 clasts is about 60 μ m. Chondrules have a mean diameter of about 0.8 mm.

Geochemistry: type 3 lithology: olivine: Fa_{14.9±8.5} (Fa_{5.0-31.9}, n = 11); pyroxene: Fs_{11.9±7.6}Wo_{0.8±0.9} (Fs_{2.0-24.7}Wo_{0.3-4.6}, n = 21); type 6 lithology: olivine: Fa_{30.7±0.1}, n=12; pyroxene: Fs_{25.0±0.2}Wo_{2.1±0.6}, n=13

Northwest Africa 11832 (NWA 11832)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L, melt rock)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Almost black individual partly covered with fusion crust.**Petrography:** The meteorite displays an almost black interior and consists of abundant and partly recrystallized shock melt regions with characteristic FeNi metal and sulfide spherules. Few relict chondrules and mineral fragments are present; no metal or sulfide veins are observed.**Northwest Africa 11833** (NWA 11833)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Diogenite)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Light-grayish individual with patches of fusion crust.**Petrography:** The meteorite is a breccia mainly composed of up to 2 mm sized blocky orthopyroxene grains (mean diameter about 0.8 mm) and related fine-grained mineral debris. Minor phases include calcic plagioclase, chromite, kamacite, and troilite; no nickel free metal has been detected.**Geochemistry:** low-Ca pyroxene: $\text{Fs}_{28.8\pm 0.3}\text{Wo}_{4.1\pm 0.1}$ ($\text{Fs}_{28.3-29.4}\text{Wo}_{3.9-4.3}$, $n=14$, $\text{FeO/MnO}=27-31$); calcic plagioclase: $\text{An}_{93.0\pm 0.7}$ ($\text{An}_{91.9-93.8}$, $n=9$)**Northwest Africa 11834** (NWA 11834)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Howardite)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Dark greyish individual without fusion crust.**Petrography:** The meteorite is a polymict breccia composed of mineral and lithic clasts (basaltic and impact melt clasts) set into a finer grained clastic matrix. Main minerals are exsolved pyroxene, up to 3 mm sized diogenitic orthopyroxene (about 15%) and calcic plagioclase. Minor phases include silica, chromite, ilmenite, barite, FeS, and metallic Fe. It contains abundant shock melt veins.**Geochemistry:** pyroxene host to augite lamellae: $\text{Fs}_{59.2\pm 0.9}\text{Wo}_{3.9\pm 1.2}$ ($\text{Fs}_{58.0-60.5}\text{Wo}_{2.1-6.6}$, $n=15$, $\text{FeO/MnO}=31-35$); Ca-pyroxene: $\text{Fs}_{15.8\pm 6.2}\text{Wo}_{43.4\pm 1.2}$ ($\text{Fs}_{11.7-29.0}\text{Wo}_{40.2-44.5}$, $n=14$, $\text{FeO/MnO}=21-38$); diogenitic pyroxene: $\text{Fs}_{32.4\pm 0.2}\text{Wo}_{2.2\pm 0.1}$ ($\text{Fs}_{31.8-32.6}\text{Wo}_{2.2-2.5}$, $n=12$, $\text{FeO/MnO}=29-34$); calcic plagioclase: $\text{An}_{87.4\pm 2.5}$ ($\text{An}_{82.7-90.2}$, $n=16$)

Northwest Africa 11835 (NWA 11835)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Brownish individual with some fusion crust.**Petrography:** The meteorite shows a chondritic texture with mostly rounded and well-packed chondrules (mean apparent diameter about 0.7 mm) in a fine-grained matrix, that contains sulfides and FeNi metal.**Northwest Africa 11836** (NWA 11836)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CK5)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Several greyish to light greenish fragments without fusion crust.**Petrography:** The meteorite displays a greyish interior and is predominantly composed of recrystallized olivine-rich matrix with scattered chondrules still being discernable. Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene and troilite; metal was not detected.**Geochemistry:** olivine: $\text{Fa}_{31.1\pm 0.2}$, $n=15$, $\text{FeO/MnO}=121.5\pm 7.2$; low-Ca pyroxene: $\text{Fs}_{25.8\pm 0.2}\text{Wo}_{1.0\pm 0.2}$, $n=13$; Ca-pyroxene: $\text{Fs}_{11.3\pm 0.7}\text{Wo}_{48.2\pm 0.3}$, $n=6$ **Northwest Africa 11837** (NWA 11837)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Brownish individual with some fusion crust.**Petrography:** Unbrecciated medium-grained basaltic rock predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with average grains sizes of about 600 μm . Minor phases include silica, ilmenite, chromite, troilite, and metallic iron.**Geochemistry:** low-Ca pyroxene: $\text{Fs}_{62.6\pm 0.6}\text{Wo}_{6.6\pm 0.7}$ ($\text{Fs}_{61.4-63.2}\text{Wo}_{5.5-8.0}$, $n=13$, $\text{FeO/MnO}=25-29$); Ca-pyroxene: $\text{Fs}_{34.4\pm 0.2}\text{Wo}_{39.6\pm 0.3}$ ($\text{Fs}_{34.1-34.8}\text{Wo}_{39.1-40.1}$, $n=14$, $\text{FeO/MnO}=26-30$); calcic plagioclase: $\text{An}_{88.1\pm 0.5}$ ($\text{An}_{87.2-88.9}$, $n=13$)**Northwest Africa 11838** (NWA 11838)

(Northwest Africa)

Find: 2017

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3 Classification: Ordinary chondrite (LL6)

4 **History:** Purchased by Daniel Sheikh in 2018

5 **Petrography:** (F. Sheikh, *UFla*) Chondrules almost absent ($800\pm 50\ \mu\text{m}$, $N=3$).
6 Fine-grained matrix containing low amounts of metal. Scattered shock melt veins
7 containing FeS and FeO.

8
9 **Geochemistry:** Olivine, $\text{Fa}_{25.2-47.6}$, mean $\text{Fa}_{31.1\pm 0.7}$, $N=54$; orthopyroxene, $\text{Fs}_{22.5-}$
10 $38.6\text{Wo}_{2.4-6.6}$, mean $\text{Fs}_{27.7\pm 0.6}\text{Wo}_{3.2\pm 0.8}$, $N=51$.

11 **Classification:** Ordinary Chondrite (LL6).

12 **Specimens:** 455.88 g at *UCLA*; main mass with Daniel Sheikh.
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17 Northwest Africa 11839 (NWA 11839)

18 (Northwest Africa)

19 Purchased: 2017

20 Classification: Carbonaceous chondrite (CM2)

21 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

22 **Physical characteristics:** Several small dark grayish to black fragments some of
23 which partly covered with fusion crust.

24 **Petrography:** The meteorite is a brecciated carbonaceous chondrite composed of
25 small chondrules (mean diameter about $250\ \mu\text{m}$), CAIs, and mineral fragments
26 often surrounded by fine-grained dust rims. The ferroan matrix contains abundant
27 sulfides, almost pure calcite and fibrous phyllosilicates.
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34 Northwest Africa 11840 (NWA 11840)

35 (Northwest Africa)

36 Purchased: 2018

37 Classification: Carbonaceous chondrite (CM2)

38 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

39 **Physical characteristics:** Many small almost black fragments partially covered
40 with fusion crust.

41 **Petrography:** Brecciated carbonaceous chondrite with abundant Fe-rich matrix,
42 chondrules (mean diameter $280\ \mu\text{m}$), chondrule pseudomorphs, CAIs, and mineral
43 fragments. Many components are surrounded by fine-grained dust rims. Matrix
44 consists of abundant carbonates, sulfides and phyllosilicates. No pyroxene has been
45 detected in the thin section studied. Absence of pyroxene and presence of Fe-Mg-
46 rich carbonates attest to a high degree of alteration.
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50 **Geochemistry:** Carbonates contain up to 1.3 wt% MgO and 1.0 wt% FeO
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54 Northwest Africa 11841 (NWA 11841)

55 (Northwest Africa)

56 Purchased: 2018

57 Classification: Carbonaceous chondrite (CM2)

58 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.
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3 **Physical characteristics:** Several small black fragments without fusion crust.
4 **Petrography:** Carbonaceous chondrite consisting of chondrule and CAI
5 pseudomorphs and mostly corroded mineral grains set into abundant fine-grained
6 matrix. Some components are surrounded by dust rims. Ferroan olivine and all
7 pyroxene have been aqueously altered; only few forsteric olivines are unaltered.
8 Matrix contains sulfides, phyllosilicates and some carbonates.
9 **Geochemistry:** Carbonates too small to be analyzed
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15 **Northwest Africa 11844** (NWA 11844)

16 (Northwest Africa)

17 Purchased: 2018

18 Classification: Carbonaceous chondrite (CO3)

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20 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

21 **Physical characteristics:** Small dark-brownish individual with some fusion crust.

22 **Petrography:** The meteorite shows a dark-brownish interior and is composed of
23 abundant small chondrules, CAIs, and mineral fragments some of which
24 surrounded by fine-grained dust rims set into a fine-grained matrix. Chondrules
25 have a mean diameter of about 0.2 mm; few regions show brownish staining due to
26 terrestrial weathering.
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31 **Northwest Africa 11845** (NWA 11845)

32 (Northwest Africa)

33 Purchased: 2018

34 Classification: Carbonaceous chondrite (CV3)

35
36 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

37 **Physical characteristics:** Dark greyish individual with patches of fusion crust.

38 **Petrography:** Carbonaceous chondrite composed of separated well-defined
39 chondrules (mean diameter about 1.0 mm), CAIs (up to 4 mm), and olivine
40 amoeboids all set into a fine-grained almost black matrix. Type II chondrules are
41 absent. Some chondrules show reddish staining due to terrestrial weathering.
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46 **Northwest Africa 11846** (NWA 11846)

47 (Northwest Africa)

48 Purchased: 2018 Jan

49 Classification: HED achondrite (Eucrite, unbrecciated)

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51 **History:** Purchased in New York City by Darryl Pitt in January 2018 from a
52 Moroccan dealer.
53

54 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Ophitic texture. Aggregate of
55 exsolved pigeonite and calcic plagioclase with accessory silica polymorph, Ti-
56 chromite, ilmenite and troilite.
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Geochemistry: Orthopyroxene host ($\text{Fs}_{62.2-62.3}\text{Wo}_{2.2-1.9}$, $\text{FeO/MnO} = 31-32$, $N = 2$), clinopyroxene exsolution lamellae ($\text{Fs}_{27.3-27.4}\text{Wo}_{43.5-43.3}$, $\text{FeO/MnO} = 28-31$, $N = 2$), plagioclase ($\text{An}_{88.4-89.7}\text{Or}_{0.5-0.6}$, $N = 2$).

Classification: Eucrite (unbrecciated).

Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11847 (NWA 11847)

(Northwest Africa)

Purchased: 2018 Jan

Classification: Ordinary chondrite (L5)

History: Purchased in New York City by Darryl Pitt in January 2018 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules occur in a dark, recrystallized matrix containing stained metal. The specimen is cross-cut by shock melt veins with very fine grained quench texture.

Geochemistry: Olivine ($\text{Fa}_{24.4-25.2}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.5-20.6}\text{Wo}_{2.1-2.0}$, $N = 3$), clinopyroxene ($\text{Fs}_{8.1-8.5}\text{Wo}_{44.8-43.8}$, $N = 2$).

Classification: Ordinary chondrite (L5, highly shocked).

Specimens: 20.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11848 (NWA 11848)

(Northwest Africa)

Purchased: 2018 Jan

Classification: Primitive achondrite (Lodranite)

History: Purchased by Rachid Chaoui in January 2018 from a dealer in Nouadhibou, Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Orthopyroxene-rich breccia composed of large grains (up to 6 mm) of low-Ca pyroxene (some exhibiting irregular exsolution lamellae) and orthopyroxenite lithic clasts in a relatively coarse grained matrix of orthopyroxene with accessory clinopyroxene, olivine, chromite, troilite and altered kamacite. Some secondary goethite veinlets are present.

Geochemistry: Orthopyroxene ($\text{Fs}_{9.9-10.5}\text{Wo}_{1.5-2.7}$, $\text{FeO/MnO} = 15-16$, $N = 3$), clinopyroxene ($\text{Fs}_{4.2-4.8}\text{Wo}_{44.4-41.4}$, $\text{FeO/MnO} = 10-12$, $N = 2$), olivine ($\text{Fa}_{10.7-10.8}$, $\text{FeO/MnO} = 25-26$, $N = 2$).

Classification: Lodranite (pyroxenitic breccia).

Specimens: 28.8 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.

Northwest Africa 11849 (NWA 11849)

(Northwest Africa)

Purchased: 2018 Jan

Classification: L6-an

History: Purchased by Greg *Hupe* in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Vesicular, metal-poor specimen consisting predominantly of finely recrystallized mafic silicates together with accessory sodic plagioclase, chromite, troilite and stained kamacite. Very sparse remnant chondrules are present, as well as poikiloblastic regions (presumably former chondrules). Small, spherical vesicles are present throughout.

Geochemistry: Olivine ($\text{Fa}_{24.4-25.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{18.9-20.5}\text{Wo}_{4.0-4.4}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.9-11.6}\text{Wo}_{38.6-35.9}$, $N = 2$).

Classification: Ordinary chondrite (L6, anomalous, metal-poor, vesicular). The presence of abundant vesicles and the paucity of metal are anomalous features in comparison with typical L6 chondrites. Although this specimen contains rare remnant chondrules, in most other respects it closely resembles [NWA 11253](#), and may be related to or even paired with that heterogeneous meteorite.

Specimens: 20.4 g including one polished thin section at *UWB*; remainder with *GHupé*.

Northwest Africa 11850 (NWA 11850)

(Northwest Africa)

Purchased: 2017 Sep

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien *Kuntz* in September 2017 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Irregularly shaped to rounded chondrules (mostly granular, some BO; apparent diameter $890 \pm 350 \mu\text{m}$, $N = 18$) and very fine grained, amoeboid CAI are set in a fine grained matrix (~40 vol.%, black in thin section).

Geochemistry: Olivine ($\text{Fa}_{0.6-58.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{2.5-15.1}\text{Wo}_{0.4-1.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.3-12.5}\text{Wo}_{39.6-37.4}$, $N = 2$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 21.62 g including one polished thin section at *UWB*; remainder with *Kuntz*.

Northwest Africa 11851 (NWA 11851)

Mali

Purchased: 2018 Mar

Classification: Lunar meteorite (feldspathic breccia)

History: Found in the Azawad region of northern Mali and purchased by Habib *Naji* in March 2018.

Physical characteristics: A fine grained, medium gray stone (227 g) with macroscopically indistinct clasts; partly coated by light brown weathering products.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Polymict breccia consisting of small mineral clasts (anorthite, olivine, pigeonite, augite, orthopyroxene, ilmenite, Ti-Cr-Mg-Al spinel, troilite, merrillite, kamacite) and small lithic clasts (including gabbroic lithologies and quench-textured melt rocks) in a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{17.8-23.5}$, $\text{FeO/MnO} = 90-127$, $N = 3$), orthopyroxene ($\text{Fs}_{16.1}\text{Wo}_{3.8}$, $\text{FeO/MnO} = 53$), pigeonite ($\text{Fs}_{25.4-37.2}\text{Wo}_{8.1-13.0}$, $\text{FeO/MnO} = 54-60$, $N = 3$), augite ($\text{Fs}_{44.1}\text{Wo}_{35.6}$, $\text{FeO/MnO} = 62$), plagioclase ($\text{An}_{95.5-95.7}\text{Or}_{0.5-0.3}$, $N = 2$).

Classification: Lunar (feldspathic breccia).

Specimens: 22 g including one polished thin section at *UWB*; remainder with Mr. H. Naji.

Northwest Africa 11852 (NWA 11852)

(Northwest Africa)

Purchased: 2018 Feb

Classification: Ordinary chondrite (LL7)

History: Purchased by Fred *Olsen* in February 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Triple grain junction texture with no chondrules or chondrule remnants. Relatively fine grained aggregate (mean grainsize $\sim 150 \mu\text{m}$) of olivine, orthopyroxene, clinopyroxene, sodic plagioclase, chromite, chlorapatite, taenite and troilite.

Geochemistry: Olivine ($\text{Fa}_{29.6-29.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{23.7-23.8}\text{Wo}_{1.7-2.0}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.0-10.4}\text{Wo}_{43.2-42.1}$, $N = 2$).

Classification: Ordinary chondrite (LL7).

Specimens: 9.2 g including one polished thin section at *UWB*; remainder with Mr. F. *Olsen*.

Northwest Africa 11853 (NWA 11853)

(Northwest Africa)

Purchased: 2011 Apr

Classification: Mesosiderite

History: Purchased by Alexandre Debiegne in April 2011 from a dealer in Agadir, Morocco.

Physical characteristics: A batch of identical brownish stones (total weight 270 g).

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively coarse-grained aggregate of compositionally zoned orthopyroxene, calcic plagioclase, troilite and abundant altered kamacite.

Geochemistry: Orthopyroxene ($\text{Fs}_{15.8}\text{Wo}_{1.1}$, $\text{FeO/MnO} = 33$; $\text{Fs}_{24.7}\text{Wo}_{2.7}$, $\text{FeO/MnO} = 27$; $\text{Fs}_{46.6}\text{Wo}_{2.8}$, $\text{FeO/MnO} = 31$, $N = 3$).

Classification: Mesosiderite.

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3 **Specimens:** A 21 g stone polished on one side is at *PSF*. The remaining material is
4 held by Mr. A. Debiegne.
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7

8 **Northwest Africa 11854** (NWA 11854)

9 (Northwest Africa)

10 Purchased: 2005

11 Classification: Carbonaceous chondrite (CV3)

12 **History:** Purchased by an anonymous collector from a dealer at the Munich Show
13 in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

14 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent
15 diameter $960 \pm 360 \mu\text{m}$, $N = 20$) and irregularly shaped, very fine grained CAI are
16 set in a fine grained matrix (40 vol.%, red-brown in thin section).
17

18 **Geochemistry:** Olivine ($\text{Fa}_{0.2-41.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.9-1.2}\text{Wo}_{3.8-0.7}$, $N = 3$),
19 clinopyroxene ($\text{Fs}_{0.9-1.2}\text{Wo}_{39.4-35.3}$; $\text{Fs}_{45.1}\text{Wo}_{50.3}$; $N = 3$).

20 **Classification:** Carbonaceous chondrite (CV3).

21 **Specimens:** The entire specimen including one polished thin section is at *PSF*.
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27 **Northwest Africa 11855** (NWA 11855)

28 (Northwest Africa)

29 Purchased: 2017 Oct

30 Classification: Ordinary chondrite (H6)

31 **History:** Purchased by Stefan *Ralew* in October 2017 from a Moroccan dealer at
32 the Munich Show.
33

34 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Shock-darkened breccia. Very
35 sparse remnant chondrules occur in a recrystallized matrix containing merrillite,
36 altered kamacite and taenite. Some secondary goethite veinlets are present.
37

38 **Geochemistry:** Olivine ($\text{Fa}_{19.9-20.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.9-17.6}\text{Wo}_{1.2-1.1}$, $N =$
39 3), clinopyroxene ($\text{Fs}_{6.4-9.3}\text{Wo}_{45.9-44.7}$, $N = 2$).

40 **Classification:** Ordinary chondrite (H6 breccia, shock-darkened).
41

42 **Specimens:** 20.8 g including one polished slice and one polished thin section
43 at *UWB*; remainder with Mr. S. *Ralew*.
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48 **Northwest Africa 11856** (NWA 11856)

49 (Northwest Africa)

50 Purchased: 2017

51 Classification: HED achondrite (Eucrite)

52 **History:** A single stone weighing 137 g was found in Morocco prior to 2017. J.
53 Donald Cline and John Sinclair purchased the sample from a meteorite dealer
54 during the 2017 Tucson Gem and Mineral Show.
55

56 **Physical characteristics:** Sample is coated with a patchy, glossy, black, flow-lined
57 fusion crust that covers ~75% of the irregularly shaped stone. Sample contains a
58
59
60

number of broad regmaglypts. Areas where fusion crust is absent show a light-colored, fine-grained granular texture.

Petrography: Description and Classification (A. Love, *App*): Sample is a matrix-supported breccia composed of dominantly of granular mineral fragments and sparse (~8 vol%) small (avg. dia. 1150 μm) angular-subrounded lithic clasts of intergranular to subophitic textured eucrite. Minerals are: birefringent clouded, plagioclase; exsolved pyroxenes; ilmenite; chromite; Fe metal; FeS.

Geochemistry: (A. Love, *App*) Low-Ca pyroxene host $\text{Fs}_{59.4\pm 0.6}\text{Wo}_{2.0\pm 0.2}$ ($\text{Fs}_{58.9-61.3}\text{Wo}_{1.7-2.3}$, $\text{FeO/MnO}=30.2-34.5$, $N=12$); high-Ca pyroxene exsolution lamellae $\text{Fs}_{25.8\pm 0.4}\text{Wo}_{43.4\pm 0.4}$ ($\text{Fs}_{25.1-26.5}\text{Wo}_{42.8-44.0}$, $N=12$); plagioclase $\text{An}_{82.3\pm 1.4}\text{Or}_{0.6\pm 0.2}$ ($\text{An}_{80.7-84.0}\text{Or}_{0.4-1.0}$ $N=8$).

Classification: HED (eucrite) FeO/MnO and Fs compositions of pyroxenes indicate this sample is a basaltic eucrite. Original igneous textures within clasts are preserved while major element compositions of pyroxenes within sample are equilibrated. Minor element compositions of pyroxenes (Al, Ti, Cr) are less equilibrated. Plagioclase compositions are unequilibrated.

Specimens: *PARI* holds the main mass. One endcut weighing 20 g and a polished thin section are on deposit at *App*.

Northwest Africa 11857 (NWA 11857)

Northwest Africa

Purchased: 2018

Classification: HED achondrite (Diogenite)

History: One stone weighing 580 g was found in Morocco prior to 2018. Steve Arnold purchased the sample from a meteorite dealer while at the 2018 Tucson Gem and Mineral Show.

Physical characteristics: The uncrusted sample has a weathered orangish-yellow exterior and yellowish-orange interior that is brecciated and friable. The cut face shows angular-subrounded clasts up to 5 mm in the long dimension.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of diogenitic lithic fragments (with average grainsize of 681 μm) and coarser grained (~1287 μm) cataclastic clasts mixed within a comminuted host of similar materials. Lithic clasts are composed of interlocking, orthopyroxenes, which share 120° grain boundaries. Orthopyroxenes contain CPX inclusions and exsolution lamellae (up to 0.5mm) within crystals. Additional minerals are Si polymorphs, chromite, FeS and rare Ni-free iron metal.

Geochemistry: (A. Love, *App*) Low-Ca pyroxene host $\text{Fs}_{26.2\pm 0.6}\text{Wo}_{2.8\pm 0.7}$ ($\text{Fs}_{26.2-28.0}\text{Wo}_{1.8-3.6}$, $\text{FeO/MnO}=26.3-27.6$, $N=12$); high-Ca pyroxene inclusions and exsolution lamellae $\text{Fs}_{10.6\pm 0.5}\text{Wo}_{44.0\pm 1.2}$ ($\text{Fs}_{9.9-11.6}\text{Wo}_{41.9-45.7}$, $\text{FeO/MnO}=20.1-21.2$ $N=6$)

Classification: HED (monomict diogenite breccia). Textures, FeO/MnO and Fs compositions of pyroxenes indicate this sample is a diogenite.

Specimens: Steve Arnold holds the main mass. One 20 g endcut, several fragments and a polished thin section are on deposit at *App*.

Northwest Africa 11858 (NWA 11858)

Morocco

Purchased: 2008

Classification: HED achondrite (Howardite)

History: The meteorite was purchased at the Munich show in 2008 from a Moroccan meteorite dealer from Rissani.

Physical characteristics: The main mass is approximately $4 \times 4 \times 10$ cm, and is almost completely covered in fusion crust, some of which is dark brown and glassy with flow lines. Minor evidence of terrestrial weathering is present as red-brown staining and adhered dust. Cut surfaces reveal numerous, mostly gray clasts set in a fine-grained, light-gray matrix.

Petrography: (C. Herd and J. Hamilton, *UAb*) Well-consolidated breccia of clasts up to 5 mm in longest dimension of diogenite (~25 vol%), unequilibrated eucrite (~10 vol%), equilibrated eucrite (~10 vol%), cumulate gabbroic eucrite (~10 vol%), and impact melt, as well as grains of anorthitic plagioclase, olivine, chromite, sulfide, and FeNi metal. All plagioclase has been transformed to maskelynite, and strong mosaicism is common. Fine-grained recrystallized areas of some gabbroic eucrite clasts indicate shock melting.

Geochemistry: (C. Herd, *UAb*) Diogenite orthopyroxene $\text{Fs}_{27\pm3}\text{Wo}_{2.6\pm0.8}$, Fe/Mn=32±2, n=23, eucrite pigeonite average $\text{Fs}_{48\pm10}\text{Wo}_{6\pm3}$, Fe/Mn=32±2, range Fs_{32-63} , n=32, eucrite augite $\text{Fs}_{40\pm10}\text{Wo}_{28\pm10}$, Fe/Mn=32±1, n=10; plagioclase $\text{An}_{88\pm3}\text{Ab}_{11\pm3}\text{Or}_{0.5\pm0.3}$, n=21; high-Ti (15 wt% TiO_2) and low-Ti (0.8 wt% TiO_2) chromite.

Classification: Achondrite (howardite)

Specimens: Type specimen of 21.3 g, including one thin section, is at *UAb*. Main mass at *JTESM*.

Northwest Africa 11859 (NWA 11859)

(Northwest Africa)

Purchased: 2017

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in the NWA area. Presented to *UCLA* by A. Aaronson in 2017.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 69.1, Co = 4.54 (both mg/g), Ga = 94.9, As = 11.8, W = 1.27, Ir = 3.75, Au = 1.485 (all µg/g).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen at *UCLA*.

Northwest Africa 11860 (NWA 11860)

(Northwest Africa)

Purchased: 2017

Classification: Rumuruti chondrite (R3-5)

History: A single stone weighing 520 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Sample is black in color, lacks fusion crust, has a rounded flattened shape with shallow broad regmaglypts. A small cut face shows brecciated texture composed of clasts set within abundant small chondrules, which, are visible through the patina. Sample is non-magnetic and only sulfides appear to reflect light on the surface of the cut face.

Petrography: Description and Classification (A. Love, *App*) Sample is a breccia composed of up to 3 cm irregularly shaped, light-orangish to brown-black unequilibrated and equilibrated clasts set within a recrystallized host containing chondrules (avg. dia. 432 μm), fragments and abundant Ni-bearing sulfides and pentlandite. Host contains 40 vol% well-defined, unequilibrated chondrules set within a recrystallized matrix. Unequilibrated clasts contain chemically-zoned, unequilibrated chondrules set within a fine-grained, opaque matrix. Equilibrated clasts contain olivine, low-Ca pyroxene within a recrystallized matrix containing isolated intergrowths of plagioclase with average size 30 μm (Berlin and Stoeffler, 2004).

Geochemistry: (A. Love, *App*) Host: Olivine $\text{Fa}_{25.0\pm 14.7}$ ($\text{Fa}_{2.1-48.5}$), Cr_2O_3 in ferroan olivine = 0.1 ± 0.1 , $\text{Fe}/\text{Mn} = 74.5$ $n=22$, Low Ca Pyroxene: $\text{Fs}_{13.8\pm 9.2}\text{Wo}_{1.1\pm 1.0}$ ($\text{Fs}_{2.1-28.1}\text{Wo}_{0.3-3.1}$), $N=9$. Clast: Olivine $\text{Fa}_{41.8\pm 0.3}$, $\text{Fe}/\text{Mn} = 94.5\pm 2.2$, $n=5$, low Ca Pyroxene: $\text{Fs}_{36.0\pm 0.2}\text{Wo}_{2.2\pm 0.3}$, $N=3$.

Classification: Rumuruti chondrite (R3-5, S2, wi-2). Based on Fa and Fe/Mn compositions of olivines, chondrule diameter and texture this sample is a Rumuruti chondrite breccia. Based on the coefficient of variation of olivine within unequilibrated clast, the petrologic subtype is estimated at 3.4 (Bischoff, 2000). Based on presence of low-Ca pyroxene and isolated plagioclase intergrowths within equilibrated clasts, these represent type 5 material.

Specimens: *PARI* holds the main mass. One endcut weighing 20.02 g and a polished thin section are on deposit at *App*.

Northwest Africa 11861 (NWA 11861)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite, polymict)

History: A single 538 g stone was found in Morocco prior to 2018. Steve Arnold purchased the stone from a meteorite dealer during the 2018 Tucson Gem and Mineral Show.

Physical characteristics: Stone is irregularly shaped and ~20% is covered by a weathered fusion crust. The weathered exterior is light orangish-gray in color and light gray on the cut face. Numerous mineral and rock clasts can be seen on the cut face.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of up to 5 mm angular basaltic and cumulate textured eucritic (~13 vol%) and diogenitic (~8 vol%) lithic clasts and related mineral fragments hosted within a fine-grained comminuted matrix. Eucrite clasts have ophitic to subophitic textures and exsolved pyroxenes. Minerals: Chromite, Ilmenite, FeS, Si Polymorph, phosphate.

Geochemistry: (A. Love, *App*) Eucrite: Low-Ca pyroxene host $\text{Fs}_{49.7\pm 7.6} \text{Wo}_{2.5\pm 0.7}$ ($\text{Fs}_{40.7-65.8} \text{Wo}_{1.7-4.5}$, $\text{FeO/MnO}=27.5-32.3$, $N=16$); pigeonite ($\text{Fs}_{42.0\pm 4.4} \text{Wo}_{12.2\pm 6.7}$ ($\text{Fs}_{35.9-48.4} \text{Wo}_{8.5-25.7}$, $\text{FeO/MnO}=29.0-31.2$, $N=5$); high-Ca pyroxene exsolution lamellae $\text{Fs}_{23.73\pm 6.1} \text{Wo}_{42.5\pm 1.8}$ ($\text{Fs}_{16.1-33.5} \text{Wo}_{39.5-44.2}$, $N=9$); plagioclase $\text{An}_{85.8\pm 7.4} \text{Or}_{0.6\pm 0.7}$ ($\text{An}_{71.5-94.7}$, $\text{Or}_{0.0-1.6}$, $N=10$). Diogenite: Low-Ca pyroxene $\text{Fs}_{26.4\pm 3.8} \text{Wo}_{2.4\pm 0.5}$ ($\text{Fs}_{21.1-31.8} \text{Wo}_{1.7-3.4}$, $\text{FeO/MnO}=27.8-34.7$, $N=10$)

Classification: HED (polymict eucrite breccia). FeO/MnO and Fs compositions of pyroxenes indicate this sample is a HED meteorite composed of a mixture of eucrite and diogenite components.

Specimens: Steve Arnold holds the main mass. Three slices and an endcut totaling 20g and a polished thin section are on deposit at *App*.

Northwest Africa 11862 (NWA 11862)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H4/5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Some well-formed chondrules are set in a recrystallized matrix containing relatively abundant altered metal.

Geochemistry: Olivine ($\text{Fa}_{18.9-19.1}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.3-17.2} \text{Wo}_{1.0-0.7}$, $N = 3$), clinopyroxene ($\text{Fs}_{6.0-6.2} \text{Wo}_{45.0-47.3}$, $N = 2$).

Classification: Ordinary chondrite (H4/5).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11863 (NWA 11863)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.

Geochemistry: Olivine ($\text{Fa}_{25.0-25.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.6-21.2} \text{Wo}_{2.0-2.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.4-9.9} \text{Wo}_{42.8-42.7}$, $N = 2$).

Classification: Ordinary chondrite (L6).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11864 (NWA 11864)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules are set in relatively coarse grained matrix.**Geochemistry:** Olivine ($\text{Fa}_{24.8-25.1}$, $N = 3$), orthopyroxene ($\text{Fs}_{18.9-20.6}\text{Wo}_{1.1-0.5}$, $N = 3$), subcalcic augite ($\text{Fs}_{18.1}\text{Wo}_{26.7}$), augite ($\text{Fs}_{10.6}\text{Wo}_{36.3}$).**Classification:** Ordinary chondrite (L4).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11865** (NWA 11865)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.**Geochemistry:** Olivine ($\text{Fa}_{24.5-25.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{21.6-21.7}\text{Wo}_{1.6-1.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{8.1-8.9}\text{Wo}_{44.4-43.7}$, $N = 2$).**Classification:** Ordinary chondrite (L6).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11866** (NWA 11866)

(Northwest Africa)

Purchased: 2018 May

Classification: Martian meteorite (Shergottite)

History: Purchased by Ben Hoefnagels in May 2018 from a dealer in Zagora, Morocco.**Physical characteristics:** A group of broken fragments with exterior coatings of black fusion crust (23.3 g) from an unknown larger stone. The pieces are very fresh and contain gray pyroxene and obvious glassy maskelynite.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Diabasic texture. Igneous assemblage of predominantly zoned clinopyroxene and maskelynite with accessory titanomagnetite, ilmenite, pyrrhotite and rare Fe-merrillite. Low-Ca pyroxene compositions do not extend to very magnesian compositions.

Geochemistry: Pigeonite ($\text{Fs}_{41.8-58.8}\text{Wo}_{11.1-14.4}$, $\text{FeO/MnO} = 33-36$, $N = 4$), subcalcic augite ($\text{Fs}_{24.5-47.2}\text{Wo}_{33.9-28.8}$, $\text{FeO/MnO} = 30-38$, $N = 3$), maskelynite ($\text{An}_{53.8-54.4}\text{Or}_{0.9}$, $N = 2$).

Classification: Martian (shergottite, diabasic). Although the pyroxene compositions are somewhat like those in Shergotty, the trend for low-Ca pyroxenes does not extend to as magnesian values.

Specimens: 4.8 g in the form of a polished endcut at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11868 (NWA 11868)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.

Geochemistry: Olivine ($\text{Fa}_{24.8-24.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.8-21.8}\text{Wo}_{1.0-0.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.2-12.2}\text{Wo}_{45.7-43.1}$, $N = 2$).

Classification: Ordinary chondrite (L6).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11869 (NWA 11869)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules are set in relatively coarse grained, shock-darkened matrix.

Geochemistry: Olivine ($\text{Fa}_{23.5-23.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.0-20.2}\text{Wo}_{3.4-1.5}$, $N = 3$), subcalcic augite ($\text{Fs}_{11.3}\text{Wo}_{27.4}$), augite ($\text{Fs}_{12.6}\text{Wo}_{35.6}$).

Classification: Ordinary chondrite (L4, shock-darkened).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11870 (NWA 11870)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with sparse remnant chondrules.

Geochemistry: Olivine ($\text{Fa}_{24.7-24.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{21.4-21.5}\text{Wo}_{1.3-1.2}$, $N = 3$), subcalcic augite ($\text{Fs}_{12.0}\text{Wo}_{29.1}$), augite ($\text{Fs}_{11.1}\text{Wo}_{43.8}$).

Classification: Ordinary chondrite (L5).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11871 (NWA 11871)

Algeria

Purchased: 2018 May

Classification: Lunar meteorite (feldspathic breccia)

History: Purportedly found near Tindouf, Algeria and purchased by Joseph Hum in May 2018 from a dealer in Gladstone, Oregon, who obtained it from a Mauritanian source.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of mineral clasts of anorthite, olivine, exsolved pigeonite, unexsolved pigeonite, orthopyroxene, aluminous subcalcic augite, chromite, ilmenite, troilite and kamacite in a fine grained, partly vesicular matrix.

Geochemistry: Olivine ($\text{Fa}_{19.7-51.6}$, $\text{FeO/MnO} = 92-105$, $N = 3$), orthopyroxene host ($\text{Fs}_{45.7}\text{Wo}_{3.6}$, $\text{FeO/MnO} = 55$), clinopyroxene exsolution lamella ($\text{Fs}_{24.2}\text{Wo}_{34.6}$, $\text{FeO/MnO} = 54$), orthopyroxene ($\text{Fs}_{47.9}\text{Wo}_{3.6}$, $\text{FeO/MnO} = 59$), pigeonite ($\text{Fs}_{24.8}\text{Wo}_{10.0}$, $\text{FeO/MnO} = 68$), aluminous subcalcic augite ($\text{Fs}_{18.5}\text{Wo}_{23.9}$, $\text{FeO/MnO} = 56$, $\text{Al}_2\text{O}_3 = 15.4$ wt.%, $\text{Na}_2\text{O} = 0.4$ wt.%), plagioclase ($\text{An}_{94.1-96.4}\text{Or}_{0.3-0.1}$).

Classification: Lunar (feldspathic regolithic breccia).

Specimens: 4.73 g including a polished endcut at *UWB*; remainder with Mr. J. Hum.

Northwest Africa 11872 (NWA 11872)

(Northwest Africa)

Purchased: 2007 June

Classification: Ordinary chondrite (L4)

History: Purchased from a moroccan mineral dealer at the meteorite show in Ensisheim, France.

Physical characteristics: Individual with about 50% fusion crust and deep, well-developed regmaglypts. The fusion crust and old fracture planes appear light brown, in contrast to the shock-darkened interior which is exposed on younger fracture planes.

Petrography: Brecciated shock-darkened ordinary chondrite with well-preserved chondrules. Silicates with tiny metal and sulfide veins along cracks and grain boundaries. Shock-deformed apatite with enclosed silicate clasts. One large sulfide grain (1.2 cm) was found.

Northwest Africa 11873 (NWA 11873)

(Northwest Africa)

Purchased: 2008 June

Classification: Ordinary chondrite (LL3-6)

History: Purchased from a Moroccan mineral dealer at the mineral show in Sainte-Marie-aux-Mines, France

Physical characteristics: Individual without fusion crust. Brecciation texture with differently colored clasts is visible. One fine-grained, gray, melt-rock clast of about 4 cm stands out.

Petrography: Genomict LL chondritic breccia, consisting of type 3 and type 6 clasts, embedded in a clastic matrix. The matrix also contains intact chondrules. One large melt rock clast occurs, consisting of euhedral igneously zoned olivine grains, embedded in a glassy mesostasis.

Geochemistry: Type 3 clast: Olivine $Fa_{28.2\pm 4.1}$ ($Fa_{12.9-32.7}$; $n=20$). Pyroxene $Fs_{17.2\pm 6.0}Wo_{0.8\pm 0.5}$ ($Fs_{8.0-24.4}Wo_{0.1-1.7}$; $n=15$). Type 6 clast: Olivine $Fa_{29.3\pm 0.4}$ ($Fa_{28.5-30.0}$; $n=12$). Pyroxene $Fs_{23.6\pm 0.4}Wo_{1.5\pm 0.2}$ ($Fs_{23.1-24.2}Wo_{1.3-1.9}$; $n=9$). Olivine in melt rock clast: $Fa_{11.6-42.2}$ ($n=2$).

Northwest Africa 11880 (NWA 11880)

Northwest Africa

Purchased: 2018 Jan

Classification: Rumuruti chondrite (R3.5-4)

Petrography: The sample is a breccia, consisting of light and dark clasts. The light clasts display well-defined chondrules surrounded by a fine-grained matrix. The dark clasts show very well-defined chondrules in a dark and glassy matrix. Mean apparent chondrule size is 550 ± 377 μm in the dark clasts, and 694 ± 316 μm in the light clasts. Maximum chondrule size is 2.65 mm. Undulatory extinction is visible in olivine grains. No oxidation rims are seen on sulphides or metal grains.

Geochemistry: As determined by EPMA, Dark Clast olivine compositions are: $Fa=31.3\pm 27.6$ ($n=35$), coefficient of variation $CV\%=43.7$, Cr_2O_3 (wt%) = 0.14.

Dark clast pyroxene compositions are: High Ca Pyroxene - $Fs_{18.2\pm 5.5}En_{52.5\pm 7.3}Wo_{29.2\pm 12}$ ($n=4$), Low Ca Pyroxene - $Fs_{29.6\pm 5.6}En_{66.2\pm 1.2}Wo_{4.2\pm 5.1}$, ($n=5$). Light Clast olivine compositions are: $Fa_{40.9\pm 0.6}$ ($n=10$), $CV\%=1.1$, Cr_2O_3 (wt%) = 0.08. Light clast pyroxene compositions are:

$Fs_{13.7\pm 3.4}En_{43.9\pm 0.7}Wo_{42.4\pm 4.0}$ ($n=6$) (V. Di Cecco, *ROM*)

Classification: Pyroxenes: Dark/Unequilibrated Clast - High and low Ca pyroxenes occur in roughly equal proportions. Light/Equilibrated Clast - Ca pyroxene is dominant. This follows the summary of [Bischoff et al. \(2011\)](#) for R chondrites. $Fa_{40.9\pm 0.6}$ is consistent with reported composition of equilibrated R chondrites. $CV\%$ of 43.7 suggests petrologic type 3.5.

Northwest Africa 11881 (NWA 11881)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: Bought from Mohamed Elguirah in Zagora in 2018.

Petrography: (J. Gattacceca, *CEREGE*) Packed chondrules with average size about 700 μm .

Geochemistry: Olivine $\text{Fa}_{7.3-29.1}$, $\text{Fa PMD}=32\%$. Cr_2O_3 in ferroan olivine 0.07 ± 0.07 wt% (n=7).

Classification: L3. L group based on magnetic susceptibility and chondrule size.

Northwest Africa 11886 (NWA 11886)

(Northwest Africa)

Purchased: 2018 March

Classification: Lunar meteorite

History: Bought in Erfoud, Morocco, in March 2018

Physical characteristics: Cut surface reveals a gray interior with light grey and white clasts.

Petrography: (J. Gattacceca, *CEREGE*) Igneous fragmental breccia. Main minerals are pyroxene and plagioclase with typical grain size of 300 μm . Other minerals include olivine, chromite, troilite, silica polymorph (to 200 μm), ilmenite, rare metal.

Geochemistry: Pyroxene $\text{Fs}_{44.4\pm 6.0}\text{Wo}_{22.9\pm 9.0}$, $\text{FeO/MnO}=67.3\pm 12.4$ (N=5). Plagioclase $\text{An}_{92.7}\text{Ab}_{7.2}\text{Or}_{0.1}$ (N=2). Olivine $\text{Fa}_{87.8}$, $\text{FeO/MnO}=109$ (N=1).

Classification: Lunar, fragmental breccia

Specimens: 7.5 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 11887 (NWA 11887)

(Northwest Africa)

Purchased: 2015

Classification: Mesosiderite

Physical characteristics: Cut surface reveals abundant metal, up to cm size.

Petrography: (J. Gattacceca, *CEREGE*) Main minerals are pyroxene (to 200 μm), interstitial plagioclase (to 150 μm), kamacite (to cm). Other minerals: troilite, silica polymorph, merrillite. Silicate show triple junctions.

Geochemistry: Orthopyroxene $\text{Fs}_{15.9}\text{Wo}_{0.6}$, $\text{FeO/MnO}=34.7$ (N=1). Plagioclase $\text{An}_{89.9}\text{Ab}_{9.6}\text{Or}_{0.5}$ (N=3).

Classification: Mesosiderite

Specimens: 16 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 11888 (NWA 11888)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Diogenite)

Physical characteristics: Dark stone. Cut surface reveals a dark gray interior with a variety of clasts up to cm.

Petrography: (J. Gattacceca, *CEREGE*) Brecciated igneous rock with fractured lithic and mineral clasts set in a clastic matrix. The dominant mineral is pyroxene (to 500 μm) and plagioclase (to 400 μm). Other minerals: troilite, chromite, silica polymorph, FeNi metal.

Geochemistry: Low-Ca pyroxene shows a wide range of composition from $\text{Fs}_{12.9}$ to $\text{Fs}_{47.4}$, and average $\text{Fa}_{26.6\pm 10.0}\text{Wo}_{2.8\pm 1.7}$, $\text{FeO/MnO}=30.0\pm 1.8$ ($n=15$). Augite exsolution $\text{Fs}_{25.2}\text{Wo}_{39.2}$ ($n=1$). Plagioclase $\text{An}_{86.6}\text{Ab}_{12.9}\text{Or}_{0.5}$ ($N=2$)

Classification: Diogenite

Specimens: 30.9 g and a polished section at *CEREGE*. Main mass with R. Lenssen.

Northwest Africa 11889 (NWA 11889)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CM2)

Physical characteristics: Dark stone. Cut surface reveals homogeneous dark interior.

Petrography: (J. Gattacceca, *CEREGE*) Chondrules, some with fine grained dust rim, with average size 180 ± 70 μm ($N=20$) set in a abundant fine grained iron rich matrix (61 vol% by point counting). Opaques are magnetite and troilite. No metal was observed. Low microprobe analyses totals in the matrix indicate the presence of phyllosilicates.

Geochemistry: Olivine $\text{Fa}_{1.0-46.6}$, Cr_2O_3 0.25 ± 0.14 wt% ($n=10$). Defocalized (10 μm) electron microprobe analyses in the matrix yield totals of 75 wt%.

Classification: CM2

Specimens: 23.5 g and a polished section at *CEREGE*. Main mass with R. Lenssen.

Northwest Africa 11890 (NWA 11890)

(Northwest Africa)

Purchased: Nov 2016

Classification: Ureilite

Petrography: coarse-grained olivine with reduced rims (90%), pyroxene (<5%), Fe-rich metal, and carbon phases. Graphite, metal, and sulfide occur in veins around the olivines and pyroxenes. Olivines are up to 2 mm. Si glass, graphite, and diamonds were also identified.

Geochemistry: Mineral Compositions and Geochemistry: Olivine cores, $\text{Fa}_{21.7\pm 0.1}$; rims $\text{Fa}_{8.2\pm 4.0}$. Pyroxenes contain a varied texture with lighter and darker spots, which display differing compositions: brighter $\text{Fs}_{9.3\pm 1.8}\text{Wo}_{30.4\pm 4.6}$; darker, $\text{Fs}_{12.6\pm 2.5}\text{Wo}_{9.3\pm 1.7}$.

Classification: Ureilite

Specimens: 20.0 g including a thin section and polished mount at *UWO*.

Northwest Africa 11891 (NWA 11891)

(Northwest Africa)

Purchased: Nov 2016

Classification: Ureilite

Petrography: olivine (90%) with reduced rims, pyroxene (5%), metals, and carbon phases. Olivine grains are up to 1.5 mm. Graphite and diamonds were found.**Geochemistry:** Mineral Compositions and Geochemistry: Olivine cores, $Fa_{19.7\pm 0.1}$; rims, $Fa_{10.2\pm 2.0}$. Pyroxene, $Fs_{16.7\pm 0.2}Wo_{7.6\pm 0.1}$.**Classification:** Ureilite**Specimens:** 20.1g including a thin section and polished mount at *UWO*.**Northwest Africa 11892** (NWA 11892)

(Northwest Africa)

Purchased: Nov 2016

Classification: Ureilite

Petrography: olivine (80%) with reduced rims, pyroxenes (15%), metal, sulfides, and carbon phases. Metal grains are present in veins and at the edges of olivine, pyroxene, and carbon grains. Olivines are up to 2.5 mm. Graphite and diamond were found.**Geochemistry:** Mineral Compositions and Geochemistry: Olivine cores, $Fa_{21.6\pm 0.1}$; rims $Fa_{8.9\pm 3.0}$. Pyroxenes contain a varied texture with lighter and darker spots, which display differing compositions: brighter $Fs_{8.0\pm 1.8}Wo_{31.9\pm 6.8}$; darker $Fs_{11.5\pm 2.4}Wo_{7.9\pm 1.6}$.**Classification:** Ureilite**Specimens:** 37.8g including a thin section and polished mount at *UWO*.**Northwest Africa 11893** (NWA 11893)

(Northwest Africa)

Purchased: Feb 2017

Classification: Ureilite

Petrography: The sample has a fine grained brecciated texture. It contains olivine (~65%) with reduced rims, pyroxene (pigeonite) (~25%), Metals in veins around grain boundaries, and graphite. Olivines are up to 3 mm. Graphite was found.**Geochemistry:** Mineral Compositions and Geochemistry: Olivine core and rim compositions vary, with reduced rims. Cores $Fa_{16.0\pm 0.1}$ ($Fa_{15.9-16.1}$, N=10); rims $Fa_{4.5\pm 2.3}$ ($Fa_{1.9-8.4}$, N=10). All pyroxenes are clinopyroxene, $Fs_{13.7\pm 0.1}Wo_{7.4\pm 0.1}$ ($Fs_{13.4-13.8}Wo_{7.3-7.5}$, N=10).**Classification:** Ureilite**Specimens:** 21.0 g including a thin section and polished mount at *UWO*.

Northwest Africa 11894 (NWA 11894)

(Northwest Africa)

Purchased: 2016

Classification: Ureilite

History: Specimen was purchased from a dealer in Dakhla, Western Moroccan Sahara.**Petrography:** olivine (~80%) with reduced rims, pyroxene (pigeonite) (~15%), metals, and carbon phases. Olivines are up to 1 mm in size. Graphite and diamonds were found.**Geochemistry:** Mineral Compositions and Geochemistry: Olivine cores, $Fa_{19.2\pm 0.0}$; rims $Fa_{12.6\pm 0.0}$). Pyroxenes, $Fs_{13.7\pm 0.1}Wo_{7.4\pm 0.1}$.**Classification:** Ureilite**Specimens:** 15.3 g including a thin section at *UWO*.**Northwest Africa 11895** (NWA 11895)

Sahara

Find: 1998

Classification: Ordinary chondrite (H3-5)

History: Sample was found 1998 by the *Labenne* group. The coordinates are unknown.**Petrography:** The sample is a breccia and contains fragments of different petrologic type, most fragments are recrystallized (type 5) and some are unequilibrated.**Geochemistry:** Olivine compositions are $Fa_{14.2-21.0}$ (mean $Fa_{17.6\pm 2.5}$, $n=9$), pyroxene compositions are $Fs_{8.2-20.4}Wo_{0.8-2.6}$ (mean $Fs_{15.7\pm 3.4}Wo_{1.4\pm 0.5}$, $n=11$). The equilibrated clasts have olivine compositions of $Fa_{19.2\pm 0.2}$ ($n=3$) and pyroxene compositions of $Fs_{16.9\pm 0.3}Wo_{1.3\pm 0.2}$ ($n=3$).**Classification:** Brecciated H chondrite (H3-5) based on mineral compositions and chondrule size. Very weakly shocked (S2), weathering degree: W2**Northwest Africa 11896** (NWA 11896)

(Northwest Africa)

Purchased: 2017

Classification: Martian meteorite

History: The Smithsonian specimen was purchased from Mendy Ouzillou, who had purchased it from Stefan *Ralew* in Ensisheim in 2017.**Physical characteristics:** The type specimen has black exterior except for its saw-cut face. The saw cut exposes a gray interior that includes black spherules with sharp boundaries along the contact with the matrix and white, gray, and black clasts.**Petrography:** Petrographic and microprobe examination of the polished sections show this breccia contains clasts, spherical inclusions, and mineral fragments with a wide range of textures and compositions. The fragmental minerals include

orthopyroxene, pigeonite, augite, plagioclase, albitic feldspar, potassium feldspar, phosphates, and opaque oxides. The clasts include basaltic (pyroxene-plagioclase) lithic clasts, with varying mineral compositions. This meteorite is texturally similar to Northwest Africa 7034 and 7475.

Geochemistry: Mineral compositions were determined by EPMA at *SI*. Low-Ca pyroxene are $\text{Fs}_{34\pm 8}\text{Wo}_{5\pm 4}$, $\text{Fe/Mn} = 35\pm 2$, $n = 144$. Augite are $\text{Fs}_{24\pm 7}\text{Wo}_{40\pm 4}$, $\text{Fe/Mn} = 32\pm 3$, $n = 53$. Collectively, the pyroxenes in Fe-Mn composition space have linear regression slope equal to 0.0289, using the method of Papike et al. (2003) *American Mineralogist* 88: 469. Plagioclase $\text{Ab}_{55\pm 10}\text{An}_{43\pm 10}\text{Or}_{2.4\pm 0.7}$, $n = 71$, albitic feldspar $\text{Ab}_{81\pm 11}\text{An}_{13\pm 11}\text{Or}_{5.4\pm 3.2}$, $n = 19$, and potassium feldspar $\text{Ab}_{20\pm 13}\text{An}_{2.0\pm 1.5}\text{Or}_{78\pm 14}$, $n = 18$ are all present.

Classification: Martian, basaltic breccia

Northwest Africa 11897 (NWA 11897)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite, unbrecciated)

History: Purchased in March 2018 by Craig Zlimen and Dustin Dickens from a Moroccan meteorite dealer.

Physical characteristics: Fusion crusted exterior; sawcut reveals a fine-grained, gray interior.

Petrography: (C. Agee, *UNM*) This meteorite is a porphyritic basalt with pigeonite phenocrysts set in a groundmass of fine-grained quench crystals of pyroxene, plagioclase, silica, chromite, and Fe-sulfide. Pigeonite phenocrysts show igneous zoning.

Geochemistry: (C. Agee, *UNM*) pigeonite $\text{Fs}_{45.5\pm 8.4}\text{Wo}_{5.2\pm 2.0}$, $\text{Fe/Mn}=36\pm 2$, $n=16$.

Classification: Unequilibrated, porphyritic eucrite; unbrecciated

Specimens: 8.9 g including a probe mount on deposit at *UNM*, Craig Zlimen and Dustin Dickens hold the main mass.

Northwest Africa 11898 (NWA 11898)

Mali

Purchased: 2018

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in March 2018 by Dustin Dickens from a meteorite dealer in Mali.

Physical characteristics: Several identical appearing dark stones covered partially with a milky-green fusion crust. Broken surface reveals a fragmental breccia with numerous white feldspathic clasts set in a dark colored ground mass.

Petrography: (C. Agee, *UNM*) This meteorite is a breccia of primarily feldspathic clasts, with lesser amounts of olivine and pyroxene fragments. The shock melt composition has a very high alumina content, vesicles occur throughout.

Geochemistry: (C. Agee, *UNM*) olivine $\text{Fa}_{25.0\pm 6.4}$, $\text{Fe/Mn}=90\pm 5$, $n=8$; pigeonite $\text{Fs}_{31.0\pm 3.6}\text{Wo}_{8.1\pm 3.6}$, $\text{Fe/Mn}=58\pm 4$, $n=6$; high-Ca pyroxene $\text{Fs}_{22.3\pm 3.7}\text{Wo}_{35.0\pm 4.7}$, $\text{Fe/Mn}=52\pm 5$, $n=4$; plagioclase $\text{An}_{96.3\pm 0.7}\text{Ab}_{3.5\pm 0.7}\text{Or}_{0.2\pm 0.0}$, $n=6$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=43.1\pm 0.6$, $\text{TiO}_2=0.12\pm 0.03$, $\text{Al}_2\text{O}_3=31.3\pm 1.2$, $\text{Cr}_2\text{O}_3=0.03\pm 0.01$, $\text{MgO}=2.0\pm 0.5$, $\text{FeO}=2.5\pm 0.5$, $\text{MnO}=0.03\pm 0.01$, $\text{CaO}=18.0\pm 0.4$, $\text{Na}_2\text{O}=0.36\pm 0.01$, $\text{K}_2\text{O}=0.04\pm 0.00$ (all wt%), $n=4$.

Classification: Lunar feldspathic breccia

Specimens: 21.6 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11899 (NWA 11899)

Mali

Purchased: 2017

Classification: HED achondrite (Howardite)

History: Purchased by Dustin Dickens from Nomad in Mali.

Physical characteristics: Many identically appearing pieces. Fusion crusted exterior. A saw cut reveals a breccia with light and dark clasts set in light-brown matrix.

Petrography: (C. Agee, *UNM*) This meteorite is a polymict breccia consisting of approximately 60% diogenite and 40% eucrite clasts. Accessory Fe-Ni metal, Fe-sulfide, and silica observed.

Geochemistry: (C. Agee, *UNM*) diogenite low-Ca pyroxene $\text{Fs}_{25.1\pm 2.5}\text{Wo}_{3.6\pm 2.2}$, $\text{Fe/Mn}=30\pm 2$, $n=10$; eucrite low-Ca pyroxene $\text{Fs}_{49.7\pm 5.2}\text{Wo}_{4.8\pm 2.8}$, $\text{Fe/Mn}=29\pm 2$, $n=7$; plagioclase $\text{AN}_{93.1\pm 1.2}$, $n=7$.

Classification: Howardite

Specimens: 22.8 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11900 (NWA 11900)

Western Sahara

Purchased: 2017

Classification: Ureilite

History: Purchased by Dustin Dickens from nomad near Dahkla in Western Sahara.

Physical characteristics: Weathered exterior; saw cut reveals an interior mosaic of green and brown crystals.

Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and augite. Ubiquitous fine-grained Fe-metal is present along grain boundaries. Elongate (100-200 μm) grains of graphite are scattered throughout.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{22.2\pm 0.1}$, $\text{Fe/Mn}=49\pm 1$, $\text{Cr}_2\text{O}_3=0.36\pm 0.02$ (wt%), $n=7$; pigeonite $\text{Fs}_{18.6\pm 0.3}\text{Wo}_{4.2\pm 0.1}$, $\text{Fe/Mn}=29\pm 1$, $n=4$; augite $\text{Fs}_{11.7\pm 0.1}\text{Wo}_{34.9\pm 0.1}$, $\text{Fe/Mn}=22\pm 1$, $n=3$.

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3 **Classification:** Augite-bearing ureilite

4 **Specimens:** 20.7 g including a probe mount on deposit at *UNM*, Dustin Dickens
5 holds the main mass.
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9 **Northwest Africa 11901** (NWA 11901)

10 Western Sahara

11 Purchased: 2017

12 Classification: Primitive achondrite (Lodranite)

13 **History:** Purchased by Dustin Dickens from nomad near Dahkla in Western
14 Sahara.
15

16 **Physical characteristics:** Many identically appearing pieces. Weathered exterior.
17 A saw cut reveals an interior of coarse green and brown crystals. Opaque grains are
18 scattered throughout.
19

20 **Petrography:** (C. Agee, *UNM*) This meteorite consists primarily of olivine and Cr-
21 diopside; low-Ca pyroxene and plagioclase are absent. Most grains are in the 1-3
22 mm size range.
23

24 **Geochemistry:** (C. Agee, *UNM*) Olivine $Fa_{11.0\pm 0.1}$, $Fe/Mn=38\pm 5$, $Cr_2O_3=0.03\pm 0.01$
25 (wt%), $n=4$; diopside $Fs_{5.0\pm 0.6}Wo_{41.4\pm 2.9}$, $Fe/Mn=14\pm 1$, $Cr_2O_3=1.09\pm 0.06$ (wt%) $n=7$.

26 **Classification:** Lodranite, opx-absent

27 **Specimens:** 22.9 g including a probe mount on deposit at *UNM*, Dustin Dickens
28 holds the main mass.
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33 **Northwest Africa 11903** (NWA 11903)

34 (Northwest Africa)

35 Purchased: 2016

36 Classification: Ordinary chondrite (H6)

37 **History:** Purchased by Dustin Dickens from Fyssal Mesgouri in Agadir, Morocco.
38

39 **Physical characteristics:** Weathered exterior. Saw cut reveals an interior with
40 many small opaque grains and a few faint chondrules set in a dark, reddish-brown
41 groundmass.
42

43 **Petrography:** (C. Agee, *UNM*) Faint, texturally equilibrated chondrules present,
44 abundant Fe-Ni metal and sulfide throughout, plagioclase up to 150 μm .
45

46 **Geochemistry:** (C. Agee, *UNM*) Olivine $Fa_{19.2\pm 0.1}$, $Fe/Mn=38\pm 1$, $n=7$; low-Ca
47 pyroxene $Fs_{17.0\pm 0.2}Wo_{1.3\pm 0.3}$, $Fe/Mn=22\pm 1$, $n=7$.
48

49 **Classification:** Ordinary chondrite, H6

50 **Specimens:** 25 g including a probe mount on deposit at *UNM*, Dustin Dickens
51 holds the main mass.
52
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55 **Northwest Africa 11904** (NWA 11904)

56 (Northwest Africa)

57 Purchased: 2018

58 Classification: Carbonaceous chondrite (CV3)
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History: Purchased by Abdelhadi Aithiba in Morocco in 2018.

Physical characteristics: Single stone, dark, weathered, irregular exterior, distinct chondrules up to ~3 mm and scattered CAIs are visible on the surface; the matrix is dark gray in color.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount many irregular shaped porphyritic chondrules, some AOAs observed, fine-grained matrix makes up about ~50% of this meteorite.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{2.8\pm 2.7}$, range $Fa_{0.5-11.9}$, $Cr_2O_3=0.25\pm 0.14$ (wt%), $CaO=0.27\pm 0.13$ (wt%), $n=22$; low-Ca pyroxene $Fs_{4.5\pm 7.7}Wo_{1.2\pm 0.5}$, $n=6$.

Oxygen isotopes (K. Ziegler, *UNM*): 3 analyses, with $\delta^{17}O = -2.359, -2.108, -0.349$ and $\delta^{18}O = 2.317, 2.000, 4.233$ (linearized values).

Classification: Carbonaceous chondrite (CV3)

Specimens: 20.66 g including a probe mount on deposit at *UNM*, Abdelhadi Aithiba holds the main mass.

Northwest Africa 11905 (NWA 11905)

(Northwest Africa)

Purchased: 2017

Classification: LL3.10-5

History: Purchased by Matthew Martin, February 2017, in Tucson from a Moroccan meteorite dealer.

Physical characteristics: Single stone. Saw cuts show a breccia of visually different chondrite clasts set in a host chondrite groundmass. Some of the clasts appear to be texturally equilibrated with less distinct chondrules, whereas others resemble type-3 lithologies with densely packed chondrules. The host groundmass contains numerous large, distinct, well-formed chondrules.

Petrography: (C. Agee, *UNM*) Microprobe examination of several polished mounts shows three group LL lithologies present: Lithology 1 is LL3.10; Lithology 2 is LL5; and Lithology 3 makes up the host groundmass and is LL3. Lithology 1 has numerous porphyritic chondrules, most with mesostasis or glass and abundant opaque matrix. The apparent mean chondrule diameter in Lithology 1 is 900 ± 400 μm , $n=31$. Lithology 2 has texturally equilibrated chondrules and plagioclase grains up to 25 μm . Lithology 3 (host) has numerous porphyritic chondrules, many with mesostasis, fine-grained plagioclase also detected.

Geochemistry: (C. Agee, *UNM*) Lithology 1: all olivine $Fa_{14.0\pm 11.0}$, $Fe/Mn=41\pm 15$, $n=44$; ferroan chondrule olivine $Fa_{17.3\pm 9.9}$, $Fe/Mn=45\pm 13$, $Cr_2O_3=0.32\pm 0.20$ (wt%), $n=35$; low-Ca pyroxene $Fs_{11.1\pm 10.0}Wo_{1.1\pm 0.8}$, $n=12$. Lithology 2: olivine $Fa_{30.7\pm 0.6}$, $Fe/Mn=60\pm 2$, $n=19$; low-Ca pyroxene $Fs_{24.9\pm 0.3}Wo_{1.3\pm 0.9}$, $n=12$. Lithology 3: olivine $Fa_{27.9\pm 3.0}$, $Fe/Mn=57\pm 15$, $n=8$; low-Ca pyroxene $Fs_{24.3\pm 1.8}Wo_{2.1\pm 3.5}$, $n=4$.

Classification: Ordinary chondrite (LL3.10-LL3-LL5), LL-group genomic breccia. Type 3.10 for Lithology 1 is based on the mean value of Cr_2O_3 in ferroan chondrule olivine and the 1-sigma standard deviation, ([Grossman and Brearley, 2005](#)), a similar petrologic type to [NWA 1756](#) (LL3.10), [NWA 3127](#) (LL3.10), [RC](#)

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3 [075](#) (H3.10), and [MET 96503](#) (L3.10). Estimated type for Lithology 3 is 3.8/3.9
4 based on the scatter in olivine composition.

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6 **Specimens:** 48.5 g on deposit at *UNM*, Matthew Martin holds the main mass.
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9 **Northwest Africa 11906** (NWA 11906)

10 (Northwest Africa)

11 Purchased: 2018

12 Classification: Carbonaceous chondrite (CO3.0)

13 **History:** Purchased by Matthew Stream from Tindouf, Algeria, April 2018.

14 **Physical characteristics:** Single stone, partially covered in dark fusion crust with
15 polygonal cracks. Broken surface reveals gray, fined-grained interior, with many
16 small chondrules visible, scattered small CAIs were observed.

17 **Petrography:** (C. Agee, *UNM*) This meteorite consists of numerous small
18 chondrules set in a fine-grained matrix. The matrix makes up approximately 40%
19 of this meteorite. Mean apparent chondrule size $200 \pm 175 \mu\text{m}$, $n=50$.

20 **Geochemistry:** (C. Agee, *UNM*) Olivine $\text{Fa}_{14.0 \pm 14.6}$, $\text{Cr}_2\text{O}_3 = 0.37 \pm 0.15$ (wt%), $n=18$;
21 low-Ca pyroxene $\text{Fs}_{2.3 \pm 1.2} \text{Wo}_{3.4 \pm 0.5}$, $n=4$.

22 **Classification:** Carbonaceous chondrite (CO3.0), 3.0 based on the Cr_2O_3 content
23 and 1-sigma in olivine (Grossman and Brearley, 2005).

24 **Specimens:** 17.3 g including a probe mount on deposit at *UNM*, Matthew Stream
25 holds the main mass.
26

27 **Northwest Africa 11907** (NWA 11907)

28 (Northwest Africa)

29 Purchased: 2018

30 Classification: Ordinary chondrite (LL3)

31 **History:** Darryl Pitt purchased from Said Haddany at the Tucson Gem and Mineral
32 Show in January 2018

33 **Physical characteristics:** Single stone with fusion crust. Saw cut reveals two
34 distinct lithologies, one lighter and one darker in color. Numerous well formed,
35 closely packed chondrules, some up to 2 mm in diameter. Average apparent
36 chondrule diameter is $750 \pm 450 \mu\text{m}$ ($n=16$). Scattered metal/sulfide grains observed.

37 **Petrography:** (C. Agee, *UNM*) Microprobe examination shows many porphyritic
38 chondrules in both lithologies, most with mesostasis and glass.

39 **Geochemistry:** (C. Agee, *UNM*) All olivine $\text{Fa}_{27.2 \pm 10.5}$, $n=42$; all low-Ca pyroxene
40 $\text{Fs}_{23.6 \pm 8.3} \text{Wo}_{0.9 \pm 0.5}$, $n=12$. Dark lithology: olivine $\text{Fa}_{22.1 \pm 11.4}$, $\text{Cr}_2\text{O}_3 = 0.11 \pm 0.16$,
41 $\text{Fe/Mn} = 51 \pm 17$, $n=21$; low-Ca pyroxene $\text{Fs}_{18.2 \pm 0.2} \text{Wo}_{1.1 \pm 0.8}$, $\text{Fe/Mn} = 21 \pm 1$, $n=6$. Light
42 lithology: olivine $\text{Fa}_{32.4 \pm 6.3}$, $\text{Cr}_2\text{O}_3 = 0.05 \pm 0.08$, $\text{Fe/Mn} = 66 \pm 13$, $n=21$; low-Ca
43 pyroxene $\text{Fs}_{29.2 \pm 3.2} \text{Wo}_{1.1 \pm 0.5}$, $\text{Fe/Mn} = 46 \pm 11$, $n=6$.

44 **Classification:** Ordinary chondrite (LL3), estimated sub-type LL3.2-3.3 based on
45 mean Fa content of olivine and the 1-sigma Fa content of olivine, and on mean
46 Cr_2O_3 content of ferroan olivine and the 1-sigma Cr_2O_3 content of ferroan
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3 olivine ([Grossman and Brearley, 2005](#)). Similar to [St. Marys County](#) (LL3.3), [GRO](#)
4 [95502](#) (L3.2) and [GRO 95544](#) (L3.2).

5
6 **Specimens:** 22.7 g on deposit at *UNM*, *MMGM* holds the main mass.
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10 **Northwest Africa 11908** (NWA 11908)

11 (Northwest Africa)

12 Purchased: 2018

13 Classification: Ordinary chondrite (LL3)

14 **History:** Darryl Pitt purchased from Said Haddany at the Tucson Gem and Mineral
15 Show in January 2018

16 **Physical characteristics:** Single stone. A saw cut reveals numerous distinct,
17 closely packed chondrules, a few up to 4mm in diameter, set in a dark brown
18 matrix.
19

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21 **Petrography:** (C. Agee, *UNM*) Microprobe examination reveals many porphyritic
22 chondrules with mesostasis and glass, abundant opaque matrix. Apparent mean
23 chondrule diameter $800 \pm 625 \mu\text{m}$, $n=47$.

24
25 **Geochemistry:** (C. Agee, *UNM*) Olivine $\text{Fa}_{16.8 \pm 8.3}$, $\text{Cr}_2\text{O}_3 = 0.09 \pm 0.05$,
26 $\text{Fe/Mn} = 52 \pm 21$, $n=31$; low-Ca pyroxene $\text{Fs}_{12.5 \pm 9.4} \text{Wo}_{1.2 \pm 1.1}$, $\text{Fe/Mn} = 24 \pm 15$, $n=10$.

27
28 **Classification:** Ordinary chondrite (LL3), estimated sub-type LL3.2-3.3 based on
29 mean Fa content of olivine and the 1-sigma Fa content of olivine, and on mean
30 Cr_2O_3 content of ferroan olivine and the 1-sigma Cr_2O_3 content of ferroan
31 olivine ([Grossman and Brearley, 2005](#)). Similar to [St. Mary's](#)
32 [County](#) (LL3.3), [GRO 95502](#) (L3.2) and [GRO 95544](#) (L3.2).
33

34 **Specimens:** 24.4 g on deposit at *UNM*, *MMGM* holds the main mass.
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38 **Northwest Africa 11909** (NWA 11909)

39 (Northwest Africa)

40 Purchased: 2018

41 Classification: HED achondrite (Diogenite)

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43 **History:** Darryl Pitt purchased from Said Haddany at the Tucson Gem and Mineral
44 Show in January 2018

45 **Physical characteristics:** Single stone, weathered exterior, coarse grained, green
46 crystals with some iron staining.
47

48 **Petrography:** (C. Agee, *UNM*) Microprobe examination reveals an
49 orthopyroxenite with minor amounts of chromite and sulfide; plagioclase and
50 olivine are absent. Highly equilibrated and relatively low shock.
51

52 **Geochemistry:** (C. Agee, *UNM*) low-Ca pyroxene, $\text{Fs}_{23.2 \pm 0.3} \text{Wo}_{1.8 \pm 0.1}$,
53 $\text{Fe/Mn} = 25 \pm 1$, $n=10$.

54 **Classification:** Diogenite

55 **Specimens:** 20.1 g on deposit at *UNM*, *MMGM* holds the main mass.
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59 **Northwest Africa 11912** (NWA 11912)
60

(Northwest Africa)

Purchased: February 2014

Classification: Ordinary chondrite (H5)

History: Purchased by Fred *Olsen* in 2014

Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred ($500\pm 80\ \mu\text{m}$, $N=12$). Recrystallized matrix with typical plagioclase size about $10\ \mu\text{m}$.

Geochemistry: Although the vast majority of olivine and orthopyroxene analyses are clustered, a few grains are unequilibrated. Olivine range $\text{Fa}_{14.1-24.0}$, mean $\text{Fa}_{18.4\pm 0.3}$ ($N=50$); orthopyroxene, range $\text{Fs}_{15.74-30.36}\text{Wo}_{0.95-3.34}$, mean $\text{Fs}_{19.5\pm 0.3}\text{Wo}_{1.7\pm 0.1}$ ($N=60$).

Classification: Ordinary Chondrite (H5)

Specimens: 24.30 g at *UCLA*; main mass with Fred *Olsen*.

Northwest Africa 11913 (NWA 11913)

(Northwest Africa)

Purchased: 2013

Classification: Ordinary chondrite (H5)

History: Purchased by John A. Shea in 2013 via E-bay from an IMCA member who acquired it in a lot of northwest African meteorites.

Physical characteristics: Dark brown weathering patina with patches of rust covers all exterior surfaces

Petrography: In thin section, chondrules and fragments are delineated by a complex veining of weathering products (oxides and carbonate). Individual grains within chondrules are readily distinguished from mesostasis. Chondrule mesostases are devitrified and generally fine-grained, with feldspar grains typically small (< 10 microns in diameter), but up to $\sim 40\ \mu\text{m}$ across.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{19.8\pm 0.2}$, $N=16$), low-Ca pyroxene ($\text{Fs}_{17.4\pm 0.2}\text{Wo}_{1.5\pm 0.1}$, $N=16$).

Classification: H5 chondrite based on chemistry and texture.

Specimens: *Cascadia* holds 11.4 g in two pieces, in addition to one polished thin section and a mounted butt.

Northwest Africa 11914 (NWA 11914)

(Northwest Africa)

Purchased: 2013

Classification: Ordinary chondrite (H5)

History: Purchased by John A. Shea in 2013 via E-bay from Steve Witt who acquired it in a lot of northwest African meteorites

Physical characteristics: Dark reddish brown weathering patina covers all exterior surfaces

Petrography: In thin section, chondrules are readily delineated; mesostases are devitrified.

Geochemistry: (M. Hutson, A. Cairns, A. Maroni, J. Longfellow, and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{19.2\pm 0.6}$, $N=33$), low-Ca pyroxene ($\text{Fs}_{17.1\pm 0.8}\text{Wo}_{1.2\pm 0.3}$, $N=17$).

Classification: H5 chondrite based on chemistry and texture

Specimens: *Cascadia* holds 17.1 g in three pieces, in addition to one polished thin section and a mounted butt.

Northwest Africa 11915 (NWA 11915)

(Northwest Africa)

Purchased: 2013

Classification: Ordinary chondrite (LL4-6)

History: Purchased by John A. Shea in 2013 via E-bay from Mirko Graul who acquired it in a lot of northwest African meteorites.

Physical characteristics: Exterior surface covered by reddish brown weathering patina and patches of black fusion crust. Cut faces show angular dark bluish-gray clasts amid a beige host lithology, along with a few metal and sulfide grains and patches of rust.

Petrography: Three lithologies are readily distinguished in thin section. A lighter colored coarse-grain clast (clast B), approximately $400 \times 600 \mu\text{m}$, with a highly integrated texture is encompassed within a larger clast (clast A) which has a well integrated texture with barely distinguishable chondrules. Clast A is truncated along the edge of the section, but is approximately 1.2 cm long. The two clasts are set in a host which has readily delineated chondrules, smaller clasts, and fragments. Approximately 85% of the opaque grains have been replaced by Fe-hydroxide weathering product. In BSE imaging, host olivine grains appear equilibrated, but many larger host pyroxene grains are zoned. The host is brecciated on a fine scale: a single large (150 micron long) plagioclase feldspar grain, is located adjacent to a chondrule fragment with strongly-zoned low-calcium pyroxene grains with a mesostasis of devitrified glass. A rectangular clast (approximately $1.1 \times 0.8 \text{ mm}$) consists of zoned low-calcium clinopyroxene enclosing a large patch of mostly replaced troilite containing silica polymorph rimmed by high-Ca pyroxene. Chondrules, clasts and larger mineral grains in the host are surrounded by a finer-grained (typically $5\text{-}20 \mu\text{m}$ across grains) of olivine, low-calcium pyroxene, and plagioclase feldspar grains.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Both host olivine ($\text{Fa}_{30.2\pm 0.4}$, $N=17$) and clast B olivine ($\text{Fa}_{30.3\pm 0.1}$) are equilibrated. Clast B low-Ca pyroxene ($\text{Fs}_{25.6\pm 0.3}\text{Wo}_{2.0\pm 0.2}$, $N=9$) is also equilibrated; however host low-Ca pyroxene ($\text{Fs}_{19.9\pm 4.0}\text{Wo}_{1.0\pm 0.8}$, $N=28$) is variable. Clast B plagioclase feldspar is albitic ($\text{Ab}_{84.5\pm 1.1}\text{An}_{11.3\pm 0.6}\text{Or}_{4.2\pm 0.5}$, $N=3$).

Classification: LL4-6 based on chemistry and texture.

Specimens: *Cascadia* holds 83.5 g in two pieces, in addition to one polished thin section and a mounted butt

Northwest Africa 11916 (NWA 11916)

(Northwest Africa)

Purchased: 2014

Classification: Ungrouped achondrite

History: Bought by Luc *Labenne* in Agadir in 2014**Physical characteristics:** A single brown weathered stone**Petrography:** J. Gattacecca, B. Devouard, P. Rochette, *CEREGE*) Main minerals are finely exsolved, blocky pigeonite crystals, to 1.5 mm, set in plagioclase. Low-Ca pyroxene is found as small inclusions in pigeonite. Pigeonite shows reduction at grain rims and along cracks. Accessory silica, merrillite, troilite, FeNi metal. Metal and sulfides are finely dispersed in the silicates and finely interspersed.**Geochemistry:** Pigeonite $\text{Fs}_{38.7\pm 3.8}\text{Wo}_{6.9\pm 2.0}$ ($\text{Fs}_{30.6-42.7}\text{Wo}_{5.0-10.2}$, N=8),

FeO/MnO=23.0±3.4 (range 17.0 - 28.5). Plagioclase

 $\text{An}_{95.9\pm 0.1}\text{Ab}_{4.0\pm 0.1}\text{Or}_{0.1\pm 0.1}$ (N=4). Oxygen isotopic composition (J. Gattacecca, C.Sonzogni, *CEREGE*) from analysis of two acid-washed 1.5 mg aliquots of apowdered 55 mg bulk sample is $\delta^{17}\text{O}=1.47\text{‰}$, $\delta^{18}\text{O}=3.68\text{‰}$, $\Delta^{17}\text{O}=-0.46\text{‰}$, and $\delta^{17}\text{O}=1.71\text{‰}$, $\delta^{18}\text{O}=4.09\text{‰}$, $\Delta^{17}\text{O}=-0.44\text{‰}$ (linearized, slope 0.5247, analyticaluncertainties 0.08‰, 0.12‰, 0.03‰ respectively). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.91$.**Classification:** Ungrouped achondrite. Oxygen isotopes and Ca-pyroxene

composition set this achondrite apart from HED achondrites.

Specimens: 2.2 g at *CEREGE*. Main mass with *Labenne***Northwest Africa 11917** (NWA 11917)

(Northwest Africa)

Purchased: 2012

Classification: Primitive achondrite (Winonaite)

Petrography: No chondrules are present, but there are irregularly shaped silicate clusters (50-700 μm in size) that may have been derived from recrystallized chondrule fragments. There is no clear igneous texture. Olivine exhibits mildy undulose extinction. Plagioclase also occurs. The rock contains ~20 vol.% metal plus sulfide. Opaque phases include kamacite, martensite, taenite, schreibersite, ferroan alabandite, and magnesiochromite. Metal and sulfide grains average ~100 μm in size. There are some grains of polycrystalline troilite and polycrystalline kamacite. There are rare 8x12- μm -size patches of daubreelite at the edge of some troilite grains. There are also rare ~40- μm -size metal grains with martensitic structure, rimmed by cloudy taenite. There is a single thick, elongated band of troilite at the edge of one thin section (~300 \times 3000 μm).**Geochemistry:** Also present are plagioclase ($\text{Ab}_{84.7\pm 0.2}\text{Or}_{2.7\pm 0.2}$; n=5); kamacite (in wt.%): 92.5 Fe, 0.48 Co, 0.06 P, 6.8 Ni, <0.03 Si; taenite: 73.5 Fe, 0.17 Co, <0.03 P, 23.5 Ni, <0.03 Si; troilite: 62.6 Fe, 37.0 S, 0.35 Cr; magnesiochromite: 67.3 Cr_2O_3 , 5.8 MnO, 12.0 MgO, 6.2 FeO. The O-isotopic composition of replicate samples was analyzed by R. Greenwood (*OU*): $\delta^{17}\text{O} = 1.876\pm 0.006$, $\delta^{18}\text{O} = 4.541\pm 0.011$, $\Delta^{17}\text{O} = -0.486\pm 0.012$ (per mil); this is in the winonaite range.

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3 **Classification:** This is one of the most reduced winonaites, with very little FeO in
4 the mafic silicates. The presence of some grains of polymict troilite and kamacite
5 indicates moderately high shock, but the mildly undulose extinction in the olivine
6 (characteristic of S2) suggests that the rock was shocked and then annealed, and
7 perhaps (mildly) shocked again.
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12 **Northwest Africa 11919** (NWA 11919)

13 (Northwest Africa)

14 Purchased: 2018

15 Classification: Carbonaceous chondrite (CM2)

16 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

17 **Physical characteristics:** Eleven dark fragments some of which partly covered
18 with fusion crust.

19 **Petrography:** The meteorite is a brecciated carbonaceous chondrite composed of
20 chondrules (mean diameter about 300 μm), chondrule pseudomorphs, CAIs, and
21 mineral fragments set into abundant Fe-rich matrix. Many of the components are
22 heavily corroded and often surrounded by fine-grained dust rims. Compositionally
23 zoned olivine is the only anhydrous silicate present; former pyroxenes are
24 completely altered. The meteorite matrix consists of abundant carbonates, sulfides
25 and phyllosilicates. Carbonates are particularly rich in Fe and Mg attesting to a
26 high degree of alteration.
27

28 **Geochemistry:** carbonates contain up to 16.5 wt% MgO and 15.6 wt% FeO
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35 **Northwest Africa 11920** (NWA 11920)

36 (Northwest Africa)

37 Purchased: 2018

38 Classification: Ordinary chondrite (H5, melt breccia)

39 **History:** The meteorite was purchased from a local meteorite dealer in Zagora,
40 Morocco.

41 **Physical characteristics:** Two small black individuals lacking any fusion crust.

42 **Petrography:** The meteorite is strongly brecciated and composed of recrystallized
43 shock melt regions, relict mineral fragments and some preserved clasts (type 5). No
44 pyroxene has been found in the thin section studied.
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50 **Northwest Africa 11921** (NWA 11921)

51 (Northwest Africa)

52 Purchased: 2018

53 Classification: Martian meteorite

54 **History:** Reportedly recovered in 2017 at the find site of [NWA 7034](#) and purchased
55 by Said Yousfi in 2018 from a local meteorite dealer in Zagora, Morocco.
56

57 **Physical characteristics:** Six black fragments with shiny crust.
58
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Petrography: The meteorite is a polymict breccia composed of lithic and mineral clasts set into a very fine-grained clastic matrix. Lithic clasts include basaltic and impact melt types; most abundant mineral phases in clasts and matrix are pyroxene and feldspar, both of highly variable composition. Minor phases are ilmenite, magnetite, Ti,Cr-magnetite, and Cl-apatite. The meteorite's high magnetic susceptibility reflects the high content of Fe-oxides and is in good agreement with data in [Gattacceca et al. 2014](#).

Geochemistry: low-Ca pyroxene: $\text{Fs}_{25.1\pm 5.5}\text{Wo}_{3.6\pm 1.1}$ ($\text{Fs}_{19.5-33.5}\text{Wo}_{2.0-5.0}$, $n=15$, $\text{FeO/MnO}=30-38$); pigeonite: $\text{Fs}_{39.9\pm 12.0}\text{Wo}_{8.0\pm 2.7}$ ($\text{Fs}_{25.6-52.3}\text{Wo}_{5.6-12.4}$, $n=10$, $\text{FeO/MnO}=30-40$); Ca-pyroxene: $\text{Fs}_{25.8\pm 10.2}\text{Wo}_{36.7\pm 6.5}$ ($\text{Fs}_{17.4-44.3}\text{Wo}_{26.1-43.3}$, $n=15$, $\text{FeO/MnO}=26-41$); feldspar: $\text{An}_{40.4\pm 9.2}\text{Ab}_{56.5\pm 8.2}\text{Or}_{3.1\pm 1.9}$ ($\text{An}_{29.0-49.3}\text{Ab}_{48.3-66.7}\text{Or}_{2.0-4.4}$, $n=13$)

Classification: Martian meteorite (basaltic breccia). Likely paired with NWA 7034 and respective clan members.

Northwest Africa 11922 (NWA 11922)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3-6)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Two dark-grayish individuals partly covered with fusion crust.

Petrography: The meteorite is a chondritic breccia consisting of angular to subrounded L3 and L6 clasts set into type 3 clastic matrix. Plagioclase grain size in L6 clasts is about 60 μm . Chondrules are mostly flattened and well packed and have a mean diameter of about 0.6 mm.

Geochemistry: type 3 lithology: olivine: $\text{Fa}_{14.9\pm 9.3}$ ($\text{Fa}_{2.5-26.9}$, $n=20$); pyroxene: $\text{Fs}_{12.5\pm 7.4}\text{Wo}_{0.5\pm 0.1}$ ($\text{Fs}_{4.5-21.7}\text{Wo}_{0.3-0.8}$, $n=17$); type 6 lithology: olivine: 25.2 ± 0.3 , $n=11$; pyroxene: $\text{Fs}_{20.0\pm 0.3}\text{Wo}_{1.9\pm 0.2}$, $n=12$

Northwest Africa 11923 (NWA 11923)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark brownish individual lacking any fusion crust.

Petrography: The meteorite displays a chondritic texture with well defined and slightly flattened chondrules (mean diameter about 0.4 mm) and fine-grained matrix containing sulfides and abundant FeNi metal.

Northwest Africa 11924 (NWA 11924)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark brownish individual lacking any fusion crust.

Petrography: The meteorite displays a chondritic texture with small and well separated chondrules (mean diameter about 0.3 mm) and fine-grained matrix containing sulfides and abundant FeNi metal.

Northwest Africa 11925 (NWA 11925)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark greyish individual with some fusion crust.

Petrography: The meteorite displays a chondritic texture with slightly flattened and well packed chondrules (mean diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 11927 (NWA 11927)

(Northwest Africa)

Purchased: 2018

Classification: Rumuruti chondrite (R3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Light brownish individual lacking any fusion crust.

Petrography: The meteorite displays a light brownish to orange interior and is composed of up to 5 mm sized angular type 3 clasts and matrix. Olivine and low-Ca pyroxene are compositionally unequilibrated in clasts and matrix; Fe-rich olivine is the most dominant mineral phase in the matrix. Chondrules have an average diameter of about 400 μm . More minor phases include low-Ca pyroxene, Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal has been detected.

Geochemistry: Olivine: $\text{Fa}_{26.3\pm 13.8}$ ($\text{Fa}_{1.6-44.9}$, $n=26$); low-Ca pyroxene:

$\text{Fs}_{18.7\pm 8.8}\text{Wo}_{1.5\pm 0.6}$ ($\text{Fs}_{8.1-30.5}\text{Wo}_{0.4-2.8}$, $n=17$); Ca-pyroxene: $\text{Fs}_{10.3\pm 3.0}\text{Wo}_{42.1\pm 5.4}$ ($\text{Fs}_{5.2-16.1}\text{Wo}_{31.7-47.3}$, $n=12$)

Northwest Africa 11928 (NWA 11928)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Grayish individual partly covered with fusion crust.

Petrography: The meteorite is a fine-grained polymict breccia with basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase with average grain sizes of about 200 μm . Minor phases include silica, chromite, FeS, fayalite, and ilmenite. No metallic Fe has been found.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{35.6\pm 2.1}\text{Wo}_{6.3\pm 0.8}$ ($\text{Fs}_{32.6-38.8}\text{Wo}_{5.5-8.6}$, $n=15$, $\text{FeO/MnO}=28-33$); Ca-pyroxene: $\text{Fs}_{45.0\pm 5.7}\text{Wo}_{31.5\pm 4.8}$ ($\text{Fs}_{43.7-46.1}\text{Wo}_{25.4-36.6}$, $n=11$, $\text{FeO/MnO}=29-35$); calcic plagioclase: $\text{An}_{93.1\pm 3.3}$ ($\text{An}_{86.4-96.4}$, $n=12$)

Northwest Africa 11933 (NWA 11933)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Greyish individual with some patches of fusion crust.

Petrography: The meteorite is an unbrecciated medium-grained basalt predominantly composed of exsolved pyroxene and calcic plagioclase with average grain sizes of about 500 μm . Pyroxene appears brownish in plane polarized light. Minor phases include silica, ilmenite, chromite, troilite, and metallic iron.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{58.5\pm 0.6}\text{Wo}_{2.8\pm 0.7}$ ($\text{Fs}_{56.9-59.2}\text{Wo}_{2.3-4.5}$, $n=11$, $\text{FeO/MnO}=28-31$); Ca-pyroxene: $\text{Fs}_{29.1\pm 1.7}\text{Wo}_{40.5\pm 1.9}$ ($\text{Fs}_{27.7-33.5}\text{Wo}_{36.0-41.9}$, $n=10$, $\text{FeO/MnO}=27-31$); calcic plagioclase: $\text{An}_{89.9\pm 0.8}$ ($\text{An}_{89.5-90.7}$, $n=13$)

Northwest Africa 11934 (NWA 11934)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite, polymict)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Three fragments lacking any fusion crust.

Petrography: The meteorite is a polymict breccia composed of mineral and lithic clasts (basaltic and dark impact melt clasts) set into a fine-grained clastic matrix. Main minerals in clasts and matrix are exsolved pyroxene and calcic plagioclase. Minor phases include up to 2 mm sized diagenetic orthopyroxene, silica, chromite, ilmenite, and FeS. No metallic Fe has been detected.

Geochemistry: pyroxene host to augite lamellae: $\text{Fs}_{37.6\pm 9.5}\text{Wo}_{5.3\pm 1.9}$ ($\text{Fs}_{23.0-55.4}\text{Wo}_{3.1-9.1}$, $n=21$, $\text{FeO/MnO}=27-37$); Ca-pyroxene: $\text{Fs}_{34.4\pm 10.8}\text{Wo}_{36.3\pm 3.2}$ ($\text{Fs}_{25.0-57.8}\text{Wo}_{29.3-41.8}$,

n=19, FeO/MnO=27-38); diogenitic pyroxene: $\text{Fs}_{29.1\pm 0.2}\text{Wo}_{3.3\pm 0.2}$ ($\text{Fs}_{28.8-29.4}\text{Wo}_{2.9-3.7}$, n=11, FeO/MnO=28-35); calcic plagioclase: $\text{An}_{91.2\pm 1.4}$ ($\text{An}_{88.6-94.3}$, n=13)

Northwest Africa 11935 (NWA 11935)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H4)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Brownish individual without fusion crust.

Petrography: The meteorite displays a chondritic texture with slightly flattened chondrules (mean diameter about 0.3 mm) in a more fine-grained brownish matrix that contains sulfides and FeNi metal.

Northwest Africa 11936 (NWA 11936)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H3)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Five dark brownish individuals with some fusion crust.

Petrography: The meteorite displays a chondritic texture with slightly flattened and well separated chondrules (mean diameter about 0.4 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 11937 (NWA 11937)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Seventeen small dark brownish individuals without fusion crust.

Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 0.8 mm; up to 4 mm sized), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Few chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11940 (NWA 11940)

(Northwest Africa)

Purchased: 2018

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3 Classification: Ordinary chondrite (L3)

4 **History:** The meteorite was bought from a Moroccan meteorite dealer at a mineral
5 fair in Sainte Marie aux Mines, France.

6 **Physical characteristics:** Dark brownish individual lacking any fusion crust.

7 **Petrography:** The meteorite shows a chondritic texture with well separated and
8 partly flattened chondrules (apparent mean diameter about 0.6 mm).
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13 **Northwest Africa 11941** (NWA 11941)

14 (Northwest Africa)

15 Purchased: 2018

16 Classification: Ordinary chondrite (H4)

17 **History:** The meteorite was bought from a Moroccan meteorite dealer at a mineral
18 fair in Sainte Marie aux Mines, France.

19 **Physical characteristics:** Dark brownish individual lacking any fusion crust.

20 **Petrography:** The meteorite shows a chondritic texture with small (apparent mean
21 diameter about 0.3 mm) well separated chondrules.
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27 **Northwest Africa 11944** (NWA 11944)

28 (Northwest Africa)

29 Purchased: 2018

30 Classification: Ordinary chondrite (LL4)

31 **History:** The meteorite was bought from a Moroccan meteorite dealer at a mineral
32 fair in Sainte Marie aux Mines, France.

33 **Physical characteristics:** Dark grayish individual lacking any fusion crust.

34 **Petrography:** The meteorite shows a chondritic texture with densely packed and
35 partly flattened chondrules (apparent mean diameter about 0.9 mm).
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41 **Northwest Africa 11945** (NWA 11945)

42 (Northwest Africa)

43 Purchased: 2018

44 Classification: HED achondrite (Diogenite)

45 **History:** The meteorite was bought from a Moroccan meteorite dealer at a mineral
46 fair in Sainte Marie aux Mines, France.

47 **Physical characteristics:** Light brownish individual lacking any fusion crust.

48 **Petrography:** The meteorite displays a light orange interior and is a monomict
49 breccia predominantly composed of blocky up to 1.5 mm sized orthopyroxenes
50 grains and more fine-grained cataclastic regions. Minor phases include silica,
51 chromite, and FeS. Neither plagioclase, olivine nor metallic iron have been found
52 in the section studied.
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56 **Geochemistry:** low-Ca pyroxene: $\text{Fs}_{25.5\pm 0.4}\text{Wo}_{2.7\pm 0.7}$ ($\text{Fs}_{25.0-26.3}\text{Wo}_{1.8-4.0}$, $n=15$,
57 $\text{FeO/MnO}=25-31$)
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Northwest Africa 11946 (NWA 11946)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Almost black individual without fusion crust.

Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 3 mm sized), CAIs, and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent. Several chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11947 (NWA 11947)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark greyish individual with some fusion crust.

Petrography: The meteorite is a coarse-grained breccia composed of up to 1 cm sized basaltic clasts set into a clastic matrix. Mineral phases are predominantly up to 1 mm sized pyroxene and lath shaped calcic plagioclase. Pyroxene is compositionally zoned with rims being more Fe- and Ca-rich than cores indicating a low degree of thermal metamorphism. Minor phases include silica, ilmenite, chromite, troilite, zircon and fayalite. No metallic iron has been detected.

Geochemistry: pyroxene cores: $\text{Fs}_{34.2\pm 4.4}\text{Wo}_{9.3\pm 3.1}$ ($\text{Fs}_{30.0-40.1}\text{Wo}_{6.7-14.3}$, $n=12$, $\text{FeO/MnO}=26-30$); pyroxene rims: $\text{Fs}_{60.7\pm 6.7}\text{Wo}_{24.5\pm 3.2}$ ($\text{Fs}_{42.0-66.2}\text{Wo}_{20.5-30.4}$, $n=12$, $\text{FeO/MnO}=29-41$); calcic plagioclase: $\text{An}_{85.5\pm 2.5}$ ($\text{An}_{81.0-88.7}$, $n=13$)

Northwest Africa 11948 (NWA 11948)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (LL4-6)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Brownish individual with some patches of fusion crust.

Petrography: The meteorite is a chondritic breccia consisting of clastic LL4 type matrix and embedded LL6 clasts. Plagioclase grain size in LL6 clasts is about 60 μm .

Geochemistry: type 4 lithology: olivine: $Fa_{27.3\pm 0.2}$, $n=12$; pyroxene: $Fs_{20.6\pm 3.8}Wo_{1.2\pm 0.7}$ ($Fs_{14.1-23.7}Wo_{0.5-2.0}$, $n=20$); type 6 lithology: olivine: $Fa_{27.2\pm 0.2}$, $n=11$; pyroxene: $Fs_{22.6\pm 0.3}Wo_{3.5\pm 0.7}$, $n=10$

Northwest Africa 11949 (NWA 11949)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Laâyoune, Western Sahara.

Physical characteristics: Greyish individual partly covered with fusion crust.

Petrography: The meteorite is an unbrecciated basalt predominantly composed of exsolved pyroxene and mostly lath-shaped calcic plagioclase with average grain sizes of about 300 μm . Several regions of the rock have a pronounced spherulitic appearance due to sprays of pyroxene and plagioclase. Minor phases include silica, ilmenite, chromite, and troilite. No metallic iron has been detected.

Geochemistry: low-Ca pyroxene: $Fs_{57.7\pm 0.3}Wo_{1.9\pm 0.3}$ ($Fs_{57.1-58.1}Wo_{1.6-2.9}$, $n=14$, $FeO/MnO=33-35$); Ca-pyroxene: $Fs_{23.7\pm 0.3}Wo_{44.6\pm 0.5}$ ($Fs_{23.3-24.6}Wo_{43.2-45.1}$, $n=14$, $FeO/MnO=29-35$); calcic plagioclase: $An_{81.8\pm 2.5}$ ($An_{76.9-84.7}$, $n=10$)

Northwest Africa 11950 (NWA 11950)

(Northwest Africa)

Purchased: 2007 Jan

Classification: Ureilite

History: Purchased by D. Gregory in Tucson, Arizona. Type specimen is under the museum number M53446

Petrography: (B. C. Hyde, *ROM*, *UWO*) The meteorite is predominantly olivine and pigeonite with grain size generally ranging from 0.5 to 3 mm. Olivine grains have reduced rims and minor reduction is seen along pigeonite rims. All olivine grains contain Ca,Cr-rich inclusions likely composed of multiple phases. Metal is abundant along grain boundaries and within reduction rims. Both graphite and diamond are present (as determined by Raman spectroscopy).

Geochemistry: Mineral Compositions and Geochemistry: SEM based quantitative EDS and WDS (B. C. Hyde, *UWO*, *ROM*): Olivine cores: $Fa_{21.1\pm 0.2}$ ($n=15$), 0.58 ± 0.04 wt% Cr_2O_3 , 0.28 ± 0.03 wt% CaO. Pyroxene cores: $Fs_{17.9\pm 0.1}Wo_{7.5\pm 0.1}$ ($n=15$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}O = 3.909, 3.733$; $\delta^{18}O = 9.183, 8.885$; $\Delta^{17}O = -0.940, -0.958$ per mil.

Classification: Ureilite

Specimens: Currently includes the main mass, type material, two thin sections and one thick section.

Northwest Africa 11951 (NWA 11951)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ureilite

History: Purchased by D. Gregory in Tucson, Arizona. Designated as DGR-001-14. Type specimen is under the museum number M58189

Petrography: (B. C. Hyde, ROM, UWO) The meteorite is predominantly olivine and pigeonite. Grains can be as large as 3 mm, but regions of small grains (10s to 100s of μm) are also common. Olivine grains have reduced rims. The smallest olivine grains often show reduction throughout the entire grain. Minor reduction is also seen along pigeonite rims. Metal is abundant along grain boundaries and within reduction rims. The meteorite has a high abundance of diamond. Graphite is also present (as determined by Raman spectroscopy). Minor phases include chromite (10s of microns).

Geochemistry: Mineral Compositions and Geochemistry: SEM based quantitative EDS and WDS (B. C. Hyde, UWO, ROM): Olivine cores: $\text{Fa}_{19.6\pm 0.2}$ (n=14), 0.72 ± 0.02 wt% Cr_2O_3 , 0.30 ± 0.01 wt% CaO. Pyroxene cores: $\text{Fs}_{17.1\pm 0.1}\text{Wo}_{5.4\pm 0.1}$ (n=17). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}\text{O} = 3.861, 3.832$; $\delta^{18}\text{O} = 8.834, 8.670$; $\Delta^{17}\text{O} = -0.803, -0.746$ per mil.

Classification: Ureilite**Specimens:** Currently includes the main mass, type material, one thin section and one thick section.**Northwest Africa 11953** (NWA 11953)

(Northwest Africa)

Purchased: 2018 Feb

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Jason Phillips in February 2018 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, UWS) Highly shocked and partially melted breccia. Gabbroic-textured clasts (some up to 3 cm across) and related disaggregated debris consist mainly of extremely fine scale polycrystalline aggregates after primary pigeonite (with some exsolution lamellae still preserved) and polycrystalline, microvesicular calcic plagioclase (exhibiting "swirly" microtexture indicative of being previously molten). Accessory minerals are silica polymorph, ilmenite, Ti-chromite, Ti-poor chromite, troilite and minor secondary barite and calcite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{57.9-60.6}\text{Wo}_{4.0-2.1}$, $\text{FeO/MnO} = 31-34$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{26.9-27.3}\text{Wo}_{41.8-42.6}$, $\text{FeO/MnO} = 30-31$, $N = 2$), plagioclase ($\text{An}_{89.2-90.4}\text{Or}_{0.9-0.4}$, $N = 2$).

Classification: Eucrite (monomict breccia, gabbroic, shock melted).**Specimens:** 46.5 g including one polished thin section at UWB; remainder with Mr. J. Phillips.

Northwest Africa 11954 (NWA 11954)

(Northwest Africa)

Purchased: 2017 Nov

Classification: Ordinary chondrite (LL3)

History: Purchased by Fabien Kuntz in November 2017 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter $690 \pm 450 \mu\text{m}$) are set in relatively fine grained matrix containing stained metal, merrillite and chlorapatite.**Geochemistry:** Olivine ($\text{Fa}_{1.3-44.0}$, Cr_2O_3 in ferroan examples 0.06-0.36 wt.%, mean 0.12 ± 0.12 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{2.5-15.1}\text{Wo}_{0.4-1.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.3-12.5}\text{Wo}_{39.6-37.4}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 3.80$.**Classification:** Ordinary chondrite (LL3). LL classification from magnetic susceptibility.**Specimens:** 22.41 g including one polished thin section at *UWB*; remainder with FKuntz.**Northwest Africa 11955** (NWA 11955)

(Northwest Africa)

Purchased: 2018 May

Classification: Martian meteorite (Shergottite)

History: Purchased by Ben Hoefnagels in May 2018 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Inequigranular gabbroic texture (pyroxene up to 3.1 mm, olivine up to 2.3 mm in length). Composed of homogeneous olivine, zoned pigeonite (prismatically twinned) and maskelynite with accessory Ti-chromite, ilmenite, merrillite, chlorapatite, pyrrhotite and minor baddeleyite.**Geochemistry:** Olivine ($\text{Fa}_{49.3-49.4}$, $\text{FeO}/\text{MnO} = 51-56$, $N = 3$), pigeonite ($\text{Fs}_{29.2-45.7}\text{Wo}_{10.4-8.1}$, $\text{FeO}/\text{MnO} = 30-33$, $N = 4$), maskelynite ($\text{An}_{50.9-55.0}\text{Or}_{2.0-1.9}$, $N = 2$).**Classification:** Shergottite (gabbroic).**Specimens:** 23.4 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.**Northwest Africa 11956** (NWA 11956)

(Northwest Africa)

Purchased: 2015 Oct

Classification: Ureilite

History: Purchased by Marc Jost in October 2015 from a Moroccan dealer at the Munich Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively coarse grained protogranular aggregate composed of subequal amounts of olivine (exhibiting reduced magnesian rims containing fine Fe metal) and polysynthetically twinned clinopyroxene (both pigeonite and augite). No evidence of microdiamond was found.

Geochemistry: Olivine (cores $\text{Fa}_{10.8-11.0}$; rims $\text{Fa}_{0.9-5.3}$; $N = 4$), low-Ca pyroxene ($\text{Fs}_{11.0-11.1}\text{Wo}_{4.6-4.7}$, $N = 2$), high-Ca pyroxene ($\text{Fs}_{5.8-6.8}\text{Wo}_{37.2-37.1}$, $N = 2$).

Classification: Ureilite.

Specimens: 27.8 g including one polished thin section at *UWB*; remainder with Space Jewels Switzerland.

Northwest Africa 11957 (NWA 11957)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien *Kuntz* in March 2018 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter $950 \pm 450 \mu\text{m}$) and irregularly-shaped, very fine grained CAI are set in a fine grained matrix ($\sim 40 \text{ vol.}\%$, deep sepia brown in thin section).

Geochemistry: Olivine ($\text{Fa}_{1.2-58.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{1.1-1.2}\text{Wo}_{0.7-4.2}$, $N = 3$), clinopyroxene ($\text{Fs}_{0.6}\text{Wo}_{46.7}$; $\text{Fs}_{0.8-1.0}\text{Wo}_{50.0-49.5}$, $N = 3$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 21.82 g including one polished thin section at *UWB*; remainder with *Kuntz*.

Northwest Africa 11958 (NWA 11958)

(Northwest Africa)

Purchased: 2018 Feb

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Bob Falls in February 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Physical characteristics: A single stone (2112 g) composed of greenish beige crystalline clasts (up to 5 cm across) in a patchy, very dark and fine grained matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of ophitic-textured eucrite clasts in a sparse, dark matrix composed of related crystalline debris within very fine grained quenched melt. Clasts are composed of exsolved pigeonite and calcic plagioclase (both microcrystalline) with accessory silica polymorph, ilmenite, Ti-chromite, troilite, Ni-free metal and minor secondary barite. Cross-cutting veinlets composed of vesicular glass, quenched crystals and entrained eucrite debris are also present.

Geochemistry: Orthopyroxene host ($\text{Fs}_{58.3-61.4}\text{Wo}_{6.5-3.0}$, $\text{FeO/MnO} = 30-31$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{26.4-29.1}\text{Wo}_{44.1-41.6}$, $\text{FeO/MnO} = 32-36$, $N = 2$), plagioclase ($\text{An}_{86.2-89.8}\text{Or}_{0.8-0.2}$, $N = 2$).

Classification: Euclite (monomict breccia, shock melted).

Specimens: 25.5 g in the form of a large polished slice at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11959 (NWA 11959)

(Northwest Africa)

Purchased: 2018 May

Classification: Ordinary chondrite (L4)

History: Purchased by Ben Hoefnagels in May 2018 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules are set in a relatively coarse grained matrix containing relatively abundant altered metal plus accessory merrillite and chlorapatite.

Geochemistry: Olivine ($\text{Fa}_{23.5-23.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{19.8-20.5}\text{Wo}_{1.3-1.0}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.3-10.6}\text{Wo}_{35.7-34.6}$, $N = 2$).

Classification: Ordinary chondrite (L4).

Specimens: 26.2 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11960 (NWA 11960)

(Northwest Africa)

Purchased: 2018 Apr

Classification: Primitive achondrite (Lodranite)

History: Purportedly found near Smara, Morocco. Purchased from a nomad by a Moroccan dealer in March 2018 and then sold to Ben Hoefnagels in April 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively coarse grained (1-2.5 mm) protogranular aggregate of olvine and clinopyroxene with accessory orthopyroxene, chromite, pyrrhotite, partly altered kamacite and taenite. Minor goethite from terrestrial alteration of metal is present as thin coatings on grain boundaries and in cracks.

Geochemistry: Olivine ($\text{Fa}_{10.4-10.6}$, $\text{FeO/MnO} = 22-23$, $N = 3$), clinopyroxene ($\text{Fs}_{4.2-4.4}\text{Wo}_{45.1-45.5}$, $\text{FeO/MnO} = 10-11$, $N = 2$), orthopyroxene ($\text{Fs}_{9.3-9.6}\text{Wo}_{1.5-2.0}$, $\text{FeO/MnO} = 13-15$, $N = 2$),

Classification: Lodranite (wehrlitic).

Specimens: 24.1 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11962 (NWA 11962)

(Northwest Africa)

Purchased: 2013

Classification: Lunar meteorite

History: In 2013, the *NHMV* acquired a single stone weighing 85.8 g from a Moroccan dealer.

Physical characteristics: The specimen is a flat and rounded individual with regmaglypts exhibiting a black shiny surface with in places dull brownish areas. A cut and polished face (3 cm²) reveals two different lithologies comprising a fine-grained, dark-gray matrix with mainly submillimeter-sized light clasts and a black compact area (1 × 0.5 cm) of impact melt.

Petrography: Clast-rich breccia containing fine-grained lithic and mineral clasts, brownish vesicular glass, and brownish to orange glass spherules. In places, the glass exhibits a flow-banded texture with dark-grey to black schlieren. Lithic clasts include basalts, gabbroic lithologies, breccia-within-breccia clasts and granophyric intergrowths of K-feldspar and silica. Mineral clasts include ortho- and clinopyroxenes (some showing exsolution lamellae), olivine, plagioclase (mostly anorthitic), silica, spinel (chromite, ulvöspinel), ilmenite, zircon, troilite and Fe,Ni metal.

Geochemistry: Olivine $Fa_{38.0\pm 13.5}$ (N = 40), plagioclase $An_{88.2\pm 11.2}Or_{0.6\pm 0.5}$ (N = 37), orthopyroxene $Fs_{14.3\pm 0.4}Wo_{1.3\pm 1.3}$ (N = 63), clinopyroxene $Fs_{30.8\pm 9.1}Wo_{23.4\pm 13.5}$ (N = 43), K-feldspar ($An_{4.5\pm 1.0}Or_{73.9\pm 6.4}$, (N = 11) BaO = 1.4-3.4 wt%), exsolved pyroxene: orthopyroxene host $Fs_{65.5\pm 4.8}Wo_{4.0\pm 1.3}$ (N = 19) with augite exsolution lamellae $Fs_{33.0\pm 2.3}Wo_{41.6\pm 2.3}$ (N = 20). The oxygen isotope composition (R. Greenwood, *OU*) is consistent with a lunar origin ($\delta^{17}O = 3.14$ per mil, $\delta^{18}O = 6.03$ per mil, $\Delta^{17}O = 0.01$ per mil).

Classification: Lunar, regolith breccia. Moderate weathering.

Specimens: A mass of 80.8 g and two thin sections are on deposit at *NHMV*.

Northwest Africa 11963 (NWA 11963)

(Northwest Africa)

Purchased: 02/12/2015

Classification: Ordinary chondrite (LL6)

Petrography: The rock is brecciated and highly recrystallized. Chondrules are poorly defined. Plagioclase grains average 60 μ m in size; many of them contain patches of maskelynite. There are black glassy shock veins in the rock. It contains chromite-plagioclase assemblages and polycrystalline troilite.

Northwest Africa 11964 (NWA 11964)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Howardite)

History: Purchased by Aziz Habibi in Morocco, 2017.

Physical characteristics: Saw cut reveals a fragmental breccia with dark and light clasts set in a gray groundmass.

Petrography: (C. Agee, *UNM*) This meteorite consists of approximately 50% diogenite and 50% eucrite clasts.

Geochemistry: (C. Agee, *UNM*) diogenite low-Ca pyroxene $\text{Fs}_{25.3\pm 3.0}\text{Wo}_{2.3\pm 0.6}$, $\text{Fe/Mn}=30\pm 1$, $n=10$; eucrite low Ca pyroxene $\text{Fs}_{42.3\pm 8.4}\text{Wo}_{5.8\pm 3.2}$, $\text{Fe/Mn}=31\pm 2$, $n=9$; eucrite high Ca pyroxene $\text{Fs}_{18.7}\text{Wo}_{42.4}$, $\text{Fe/Mn}=27$, $n=1$; plagioclase $\text{An}_{89.0\pm 6.7}$, $n=7$.

Classification: Howardite

Specimens: 20.0 g including a probe mount on deposit at *UNM*, Kyle Ke holds the main mass

Northwest Africa 11965 (NWA 11965)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CM2)

History: Purchased by Aziz Habibi in Morocco 2018.

Physical characteristics: Complete individual stone, partially covered with fusion crust. A broken surface reveals black, fine-grained interior; very friable; some CAIs are visible.

Petrography: (C. Agee, *UNM*) This meteorite consists of scattered porphyritic chondrules set in a fine grained matrix. The matrix makes up approximately 75% of this meteorite. Ubiquitous Fe-sulfide, Fe,Ni-sulfide, Fe, Ni-metal, phyllosilicates, and carbonates are present in the matrix.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{12.5\pm 17.6}$, range $\text{Fa}_{0.5-44.4}$, $\text{Cr}_2\text{O}_3=0.32\pm 0.16$, $n=11$; low-Ca pyroxene $\text{Fs}_{3.5\pm 3.3}\text{Wo}_{3.4\pm 0.5}$, $n=2$. Oxygen isotopes (K. Ziegler, *UNM*) done by laser fluorination $\delta^{17}\text{O}=1.681$, $\delta^{18}\text{O}=10.426$, $\Delta^{17}\text{O}=-3.825$, normalized, all permil.

Classification: Carbonaceous chondrite (CM2)

Specimens: 11.5 g including a probe mount on deposit at *UNM*, Aziz Habibi holds the main mass.

Northwest Africa 11966 (NWA 11966)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Jay Piatek on April 27, 2015 from a Moroccan meteorite dealer.

Physical characteristics: Single stone, fresh fusion-crust exterior. A saw cut reveals a fragmental breccia with many white feldspathic clasts and a large lithic clast set in a dark-gray groundmass.

Petrography: (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene, olivine, plagioclase grains. There are many domains that are fine-grained and cataclastic with shock melt and vesicles.

Geochemistry: (C. Agee, *UNM*) olivine $\text{Fa}_{35.8\pm 5.0}$, $\text{Fe/Mn}=98\pm 11$, $n=10$; pigeonite $\text{Fs}_{33.6\pm 5.3}\text{Wo}_{12.6\pm 6.8}$, $\text{Fe/Mn}=58\pm 3$, $n=8$; augite $\text{Fs}_{29.0\pm 2.9}\text{Wo}_{34.8\pm 4.3}$, $\text{Fe/Mn}=57\pm 1$, $n=2$;

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2
3 plagioclase $An_{96.4\pm 0.9}$, $n=7$; Shock melt (20 μm defocused electron beam, proxy for
4 bulk meteorite composition): $SiO_2=43.4\pm 0.4$, $TiO_2=0.18\pm 0.06$, $Al_2O_3=31.0\pm 1.2$,
5 $Cr_2O_3=0.06\pm 0.03$, $MgO=3.0\pm 0.6$, $FeO=3.6\pm 0.8$, $MnO=0.05\pm 0.03$, $CaO=17.5\pm 0.5$,
6 $Na_2O=0.35\pm 0.04$, $K_2O=0.07\pm 0.02$ (all wt%), $n=7$.

7
8 **Classification:** Lunar feldspathic breccia

9 **Specimens:** 20.1 g including a probe mount on deposit at *UNM*, Jay Piatek holds
10 the main mass.
11
12
13

14 **Northwest Africa 11967** (NWA 11967)

15 (Northwest Africa)

16 Purchased: 2015

17 Classification: Ordinary chondrite (LL3)

18 **History:** Purchased by Jay Piatek on June 26, 2015, from a Moroccan meteorite
19 dealer.
20

21 **Physical characteristics:** Single stone, weathered exterior. A saw cut reveals
22 numerous distinct, closely packed chondrules set in a brown groundmass. Mild
23 brecciation was observed.
24

25 **Petrography:** (C. Agee, *UNM*) This meteorite has many porphyritic chondrules,
26 most with mesostasis or glass, set in abundant opaque matrix. Apparent mean
27 chondrule size is 800 ± 500 μm , $n=19$.

28 **Geochemistry:** (C. Agee, *UNM*) Coarse-grained (non-matrix) ferroan olivine
29 $Fa_{23.3\pm 8.2}$, $Cr_2O_3=0.18\pm 0.22$ (wt%), $n=17$; low-Ca pyroxene $Fs_{15.5\pm 11.1}Wo_{0.8\pm 0.5}$,
30 $n=11$.

31 **Classification:** Ordinary chondrite LL3 breccia. Cr_2O_3 distribution in olivine is
32 similar to Ngawi (LL3.0-3.7) as described in [Grossman and Brearley \(2005\)](#) with
33 two populations, one resembling [Semarkona](#) $Cr_2O_3=0.50\pm 0.08$ and one
34 resembling [Bremervörde](#) $Cr_2O_3=0.04\pm 0.03$ (wt%).
35

36 **Specimens:** 22.4 g including a probe mount on deposit at *UNM*, Jay Piatek holds
37 the main mass.
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44 **Northwest Africa 11968** (NWA 11968)

45 (Northwest Africa)

46 Purchased: 2015

47 Classification: Lunar meteorite (feldspathic breccia)

48 **History:** Purchased by Jay Piatek from Adam *Aaronson* in Morocco, 2015.

49 **Physical characteristics:** Single stone. Fresh, light green-brown fusion crust
50 covers a significant part of the surface; the remainder of the exterior is a smooth,
51 lustrous black color. Saw cut reveals a fragmental breccia with many white
52 feldspathic clasts set in a dark gray ground mass.
53

54 **Petrography:** (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene,
55 olivine, plagioclase grains set in a fine-grained matrix. Fe-metal, chromite,
56 ilmenite, and troilite were detected.
57
58
59
60

Geochemistry: (C. Agee, *UNM*) Olivine Fa: 37.4 ± 9.5 , Fe/Mn=92±5, n=8; low-Ca pyroxene $\text{Fs}_{36.1 \pm 3.5} \text{Wo}_{5.4 \pm 1.3}$, Fe/Mn=54±0, n=2; high-Ca pyroxene $\text{Fs}_{19.9 \pm 2.3} \text{Wo}_{33.3 \pm 9.3}$, Fe/Mn=49±4, n=3; plagioclase $\text{An}_{95.7 \pm 1.4}$, n=4; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=43.7 \pm 1.0$, $\text{TiO}_2=0.20 \pm 0.11$, $\text{Al}_2\text{O}_3=30.7 \pm 3.6$, $\text{Cr}_2\text{O}_3=0.07 \pm 0.05$, $\text{MgO}=4.0 \pm 2.2$, $\text{FeO}=4.6 \pm 2.4$, $\text{MnO}=0.07 \pm 0.05$, $\text{CaO}=16.7 \pm 1.8$, $\text{Na}_2\text{O}=0.34 \pm 0.09$, $\text{K}_2\text{O}=0.05 \pm 0.02$ (all wt%), n=12.

Classification: Lunar feldspathic breccia

Specimens: 20.0 g including a probe mount on deposit at *UNM*, Jay Piatek holds 407.8 g.

Northwest Africa 11969 (NWA 11969)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite, unbrecciated)

History: Purchased by Jay Piatek on December 28, 2015 from a Moroccan meteorite dealer.

Physical characteristics: Single stone, saw cut show medium grained, equigranular, basaltic texture.

Petrography: (C. Agee, *UNM*) (C. Agee, *UNM*) Microprobe examination shows approximately 50% pyroxene and 50% plagioclase. Pyroxene grains show exsolution lamellae. Accessory troilite, chromite, silica, and ilmenite were detected.

Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $\text{Fs}_{59.4 \pm 1.0} \text{Wo}_{3.5 \pm 1.6}$, Fe/Mn=30±1, n=3; high-Ca pyroxene $\text{Fs}_{33.7 \pm 8.6} \text{Wo}_{35.2 \pm 11.4}$, Fe/Mn=31±4, n=3; plagioclase $\text{An}_{89.6 \pm 0.3}$, n=3.

Classification: Eucrite, unbrecciated

Specimens: 21 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11970 (NWA 11970)

(Northwest Africa)

Find: 2015

Classification: Primitive achondrite (Lodranite)

History: Acquired from a Moroccan meteorite dealer at the 2016 Tucson Gem and Mineral show.

Physical characteristics: Four similar looking stones, the largest being 87.1 g. The uncut stones are light gray with clumped protruding dark brown/red nodules and scattered visible bright green angular mm-scale minerals. The cut stones show a breccia of <1 cm-sized silicate grains.

Petrography: Observations from a thin section show a breccia dominated by angular to sub-rounded silicate grains the largest to 1 cm. Minerals dominated by olivine, orthopyroxene, and clinopyroxene; some of the pyroxene is polysynthetically twinned. Minor phases include chromite, troilite, stained

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2
3 kamacite and taenite, and some composite metal grains. The metal is dominated by
4 kamacite with minor tetrataenite. Metal grains (to 3 mm) are irregularly shaped
5 (holly leaf-like), with polycrystalline structure dominated by >100 μm polygonal
6 grains lacking Neumann bands. Troilite is dominantly single crystal.

7
8 **Geochemistry:** (E.T. Dunham, D. Kornau, T. Goodwyn, T. Fougner, N.
9 Delafuente, and E. Smith, *ASU*) Olivine ($\text{Fa}_{11.5-11.9}$ (avg=11.7), $\text{FeO/MnO}=24.0-$
10 26.8 (avg=25.9), $n=10$), orthopyroxene, $\text{Fs}_{11.3}\text{Wo}_{1.8}$ ($\text{Fs}_{10.4-12.4}\text{Wo}_{0.1-4.0}$),
11 $\text{FeO/MnO}=15.1-27.1$ (avg=19.6), $n=11$; clinopyroxene, $\text{Fs}_{5.1}\text{Wo}_{42.3}$ ($\text{Fs}_{4.3-6.1}\text{Wo}_{39.7-}$
12 44.5), $\text{FeO/MnO}=10.8-13.1$ (avg=11.5), $n=9$.

13
14 **Classification:** Lodranite breccia. This material is likely paired with [NWA](#)
15 [8118](#), [NWA 8216](#), and [NWA 8251](#)

16
17 **Specimens:** 180.9 g including 4 thin sections at *ASU*
18
19
20

21 Northwest Africa 11973 (NWA 11973)

22 (Northwest Africa)

23 Purchased: Nov 2015

24 Classification: Ordinary chondrite (H~5)

25
26 **History:** Purchased by Li Bofang from a Moroccan dealer at the mineral show
27 in *Beijing* in Nov. 2015.

28
29 **Physical characteristics:** 344.8 g stone, about 70% of the surface is covered with
30 yellowish oxidized crust; light-gray interior with many chondrules and metal
31 specks. Some cracks are partly filled yellow colored adherent soil-like material.

32
33 **Petrography:** (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows
34 recrystallized matrix with chondrules of 0.2-1.0 mm (av. 0.6 mm), about 30% of
35 chondrules are well defined.

36
37 **Geochemistry:** (R. Bartoschewitz, *Bart*) Magnetic susceptibility $\log \chi (\times 10^{-}$
38 $9 \text{ m}^3/\text{kg}) = 5.01$.

39 **Classification:** ordinary chondrite (H~5)

40
41 **Specimens:** 25.3 g on deposit at *Kiel*, B. Li holds the main mass and 40 g
42 with *Bart*.
43
44

45 Northwest Africa 11974 (NWA 11974)

46 (Northwest Africa)

47 Purchased: Feb 2018

48 Classification: Ordinary chondrite (H~5)

49
50 **History:** Purchased by Li Bofang from a Moroccan dealer in Tucson in Feb 2017.

51
52 **Physical characteristics:** Brown globular stone of 73.7 g. Cut face shows brown
53 matrix with many little chondrules and some tiny metal specks.

54
55 **Petrography:** (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows
56 recrystallized matrix with well-defined chondrules (0.1-0.6 mm, av. 0.3 mm) and
57 sparsely distributed metal specks.

58
59 **Geochemistry:** (R. Bartoschewitz, *Bart*) Magnetic susceptibility $\log \chi (\times 10^{-}$
60 $9 \text{ m}^3/\text{kg}) = 4.69$.

1
2
3 **Classification:** ordinary chondrite (H~5)

4 **Specimens:** 15.2 g on deposit at *Kiel*, B. Li holds the main mass and 10.2 g
5 with *Bart*.
6
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9 **Northwest Africa 11975** (NWA 11975)

10 (Northwest Africa)

11 Purchased: Feb. 2017

12 Classification: Ordinary chondrite (LL~5)

13 **History:** Purchased by Li Bofang from a Moroccan dealer in Tucson in Feb 2017.

14 **Physical characteristics:** Brown globular stone of 73.7 g. Cut face shows brown
15 matrix with chondrules and some tiny metal specks.

16 **Petrography:** (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows
17 recrystallized matrix with well-defined gray chondrules (0.6 - 2.0 mm) and metal
18 specks.

19 **Geochemistry:** (R. Bartoschewitz, *Bart*) Magnetic susceptibility $\log \chi (\times 10^{-9}$
20 $\text{m}^3/\text{kg}) = 4.41$.
21

22 **Classification:** ordinary chondrite (LL~5)

23 **Specimens:** 15.8 g on deposit at *Kiel*, B. Li holds the main mass and 9.6 g
24 with *Bart*.
25
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30 **Northwest Africa 11976** (NWA 11976)

31 (Northwest Africa)

32 Purchased: Nov 2017

33 Classification: Ordinary chondrite (LL3)

34 **History:** Purchased by Li Bofang from a Moroccan who got a language lecture
35 in *Beijing* in Nov. 2017.

36 **Physical characteristics:** 78.6 g stone covered by >80% dark, weak, shiny fusion
37 crust; non-crusted surface is strong eroded and presents well-defined chondrules.

38 **Petrography:** (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows poorly
39 recrystallized matrix with well-defined light- to dark-gray and olive-gray
40 chondrules of 0.4-2.0 mm and very few tiny metal specks.

41 **Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine
42 $\text{Fa}_{21.8\pm 10.5}$ (n=28); pyroxene $\text{Fs}_{11.4\pm 9.0}\text{Wo}_{0.9\pm 0.8}$ (n=15); Ca-pyroxene
43 $\text{Fs}_{26.9}\text{Wo}_{73.1}$ (n=1). Kamacite: Ni=5.0-6.3, Co=1.6-1.8 wt.% (n=6); tetrataenite,
44 troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9}$
45 $\text{m}^3/\text{kg}) = 3.95$.
46

47 **Classification:** ordinary chondrite (LL3)

48 **Specimens:** 15.8 g on deposit at *Kiel*, B. Li holds the main mass and 4.4 g
49 with *Bart*.
50
51

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55 **Northwest Africa 11977** (NWA 11977)

56 (Northwest Africa)
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Purchased: Feb 2017

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Li Bofang from a Moroccan dealer in Tucson in Feb 2017.

Physical characteristics: Dark brown 72.9 g stone, numerous chondrules are visible on the glossy, desert-varnished surface.

Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) thin section shows many chondrules <2.5 mm of various types (PO, PP, POP, RP), fine-grained, olivine-rich aggregates and CAIs are embedded in a fine-grained, dark brown matrix (roughly 40 vol%). Fe,Ni-rich metal and troilite are less abundant.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $Fa_{14.7\pm 5.0}$, $Cr_2O_3=0.37\pm 0.12$, $CaO=0.13\pm 0.07$ wt% (n=13); low-Ca pyroxene $Fs_{9.4\pm 5.6}Wo_{0.8\pm 0.7}$ (n=14); pigeonite $Fs_{17.3}Wo_{6.2}$ (n=1). Feldspar: $An_{14.2\pm 1.3}Or_{8.0\pm 0.6}$. Chromite: $CRAL=96.9.7\pm 5.3$, $FFM=96.4.7\pm 3.2$ (n=3). Kamacite: $Ni=4.8-6.6$, $Co=0.5-1.8$ (n=3); taenite: $Ni=44.1$, $Co=0.6$ (n=1) (wt.%); tetrataenite, troilite.

Classification: Carbonaceous chondrite (CV3).

Specimens: 14.6 g on deposit at *Kiel*, B. Li holds the main mass and 3.7 g with *Bart*.

Northwest Africa 11978 (NWA 11978)

(Northwest Africa)

Purchased: Nov. 2015

Classification: Ordinary chondrite (L3-6)

History: Purchased by Li Bofang from a Moroccan dealer at the mineral show in *Beijing* in Nov. 2015.

Physical characteristics: Brown 1159 g stone of about 10 cm in diameter.

Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows brown matrix with poor to well defined chondrules of 0.3 - 5 mm of various types (PO, PP, POP, RP), and dark xenolites. Metal is nearly complete oxidized.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{23.2\pm 2.0}$ (n=23); pyroxene $Fs_{17.0\pm 5.6}Wo_{1.5\pm 1.4}$ (n=13); Ca-pyroxene $Fs_{26.9}Wo_{73.1}$ (n=1). Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.48$.

Classification: ordinary chondrite (L3-6)

Specimens: 20.1 g on deposit at *Kiel*, B. Li holds the main mass and 67 g with *Bart*.

Northwest Africa 11979 (NWA 11979)

(Northwest Africa)

Purchased: Nov 2015

Classification: Ordinary chondrite (H~6)

History: Purchased by Li Bofang from a Moroccan dealer at the mineral show in *Beijing* in Nov. 2015. Later the main mass was donated to Qu Pan.

Physical characteristics: A 78.1 g dark brown elongated stone. Cut face shows fine distributed tiny metal specks all over the surface.

Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows light/dark phases with shock veins, strong recrystallized matrix and poor defined chondrules (0.2-0.5mm, av. 0.3 mm). The dark phase is finer grained than the lighter one.

Geochemistry: (R. Bartoschewitz, *Bart*) Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.11$.

Classification: ordinary chondrite (H~6)

Specimens: 16.8 g on deposit at *Kiel*, B. Li holds the main mass and 11.2 g with *Bart*.

Northwest Africa 11980 (NWA 11980)

(Northwest Africa)

Purchased: 2017 March

Classification: Ordinary chondrite (L5)

History: Purchased from a local dealer in Quarzazate in 2017.

Physical characteristics: Two stones of 1210 and 160 g. Cut face is gray with some lighter gray chondrules, light brown inclusions, and fresh metal.

Petrography: (R. Bartoschewitz, *Bart*) Microscopic examination of a thin section shows recrystallized and shocked matrix: mosaicism and planar fractures in olivine, undulatory extinction in plagioclase and maskelynite. Chondrules moderately developed (0.4-1.8 mm, average 0.9 mm).

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $\text{Fa}_{22.1 \pm 0.6}$ (n=19); pyroxene $\text{Fs}_{19.2 \pm 1.1} \text{Wo}_{0.8 \pm 0.6}$ (n=9); Ca-pyroxene $\text{Fs}_{21.4 \pm 3.2} \text{Wo}_{9.6 \pm 2.4}$ (n=2). Kamacite Ni=5.9-6.7, Co=0.6 wt.% (n=5); taenite Ni=34.7-36.6, Co=0.3 wt.% (n=2). Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.94$.

Classification: Ordinary chondrite (type L5, S3, W1)

Specimens: 20.1 g on deposit at *Kiel*, main mass Dieter Janek.

Northwest Africa 11982 (NWA 11982)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present in a recrystallized matrix containing chlorapatite and merrillite.

Geochemistry: Olivine ($\text{Fa}_{24.6-25.5}$, N = 3), orthopyroxene ($\text{Fs}_{20.4-20.7} \text{Wo}_{1.5-1.0}$, N = 3), clinopyroxene ($\text{Fs}_{7.3-7.8} \text{Wo}_{44.1-45.5}$, N = 2).

Classification: Ordinary chondrite (L5).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11984 (NWA 11984)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.**Geochemistry:** Olivine ($\text{Fa}_{25.0-25.5}$ N = 3), orthopyroxene ($\text{Fs}_{21.0-21.2}\text{Wo}_{2.1-1.9}$, N = 3), clinopyroxene ($\text{Fs}_{8.8}\text{Wo}_{44.3}$; $\text{Fs}_{13.6}\text{Wo}_{41.7}$; N = 2).**Classification:** Ordinary chondrite (L6).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11986** (NWA 11986)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Well-formed, equilibrated chondrules are set in a matrix containing altered metal, chlorapatite and merrillite.**Geochemistry:** Olivine ($\text{Fa}_{24.5-24.7}$, N = 3), orthopyroxene ($\text{Fs}_{19.6-20.9}\text{Wo}_{1.0-1.6}$, N = 3), clinopyroxene ($\text{Fs}_{8.3-9.5}\text{Wo}_{45.0-44.5}$, N = 2).**Classification:** Ordinary chondrite (L4).**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 11991** (NWA 11991)

(Northwest Africa)

Purchased: 2018 Jan

Classification: Ordinary chondrite (LL3)

History: Found in northwest Africa.**Physical characteristics:** In cut slices, interior is light gray to light brown with slight weathering staining, has well defined chondrules and metal contents typical of LL chondrites.**Petrography:** (A. Ruzicka, S. Goudy, *Cascadia*) Thin section shows well-defined chondrules, many with glassy mesostases, and good examples of cluster chondrite texture with little intervening matrix. Multiple bleached chondrules. Analysis in reflected light shows thin section contains roughly 2.3% metal with ~10% metal weathered, and roughly 4.2% troilite; largest slice contains $2.8 \pm 0.3\%$ metal and $5.4 \pm 0.6\%$ troilite (area% values). Based on olivine, shock stage is S5. Matrix is

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3 composed chiefly of <10 μm grains of ferroan olivine and albitic feldspar,
4 reminiscent of that found in Lut 005 and Lut 006.

5 **Geochemistry:** (M. Hutson, *Cascadia*) Olivine ($\text{Fa}_{21.6\pm 9.9}$, N = 156;
6 Cr_2O_3 0.07 \pm 0.05 wt%, N = 126).

7 **Classification:** LL3, estimated subtype 3.5. LL indicated by low metal content and
8 minor weathering. Type 3 indicated by texture, presence of chondrule glass, and
9 variable olivine composition. Subtype estimated as 3.5 based on olivine Fa
10 variability (subtype 3.4-3.6) and chrome content in olivine.

11 **Specimens:** A total of 48.4 g in two slices, a polished thin section, and potted butt
12 are available at *Cascadia*. Mr. James *Tobin* holds the main mass.
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18 Northwest Africa 11992 (NWA 11992)

19 (Northwest Africa)

20 Purchased: 2007, Sept

21 Classification: Ordinary chondrite (LL3)

22 **History:** Found in northwest Africa, donated to *Cascadia* July 2012.

23 **Physical characteristics:** In cut slices, exterior is dark gray and shiny, interior is
24 gray with well-defined chondrules and has less metal than typically observed in
25 fresh ordinary chondrites. Minimal weathering staining.

26 **Petrography:** (A. Ruzicka, S. Goudy, *Cascadia*) Thin section shows well-defined
27 chondrules with cluster chondrite texture and little intervening matrix. Glassy
28 chondrule mesostases present but not abundant. Roughly half of low-Ca pyroxene
29 grains show twinning suggestive of clinoenstatite polytype. Shock stage is S4.
30 Shock effects are heterogeneous with S1 and S4 olivine grains predominant. Some
31 bleached chondrules. Minimal weathering effects.

32 **Geochemistry:** (M. Hutson, *Cascadia*) Olivine ($\text{Fa}_{30.0\pm 4.0}$, N = 140;
33 Cr_2O_3 0.05 \pm 0.02 wt%, N = 56), low-Ca pyroxene ($\text{Fs}_{20.2\pm 6.8}\text{Wo}_{1.4\pm 1.1}$, N = 143).

34 **Classification:** LL3 chondrite, estimated subtype 3.7. Iron contents in olivine and
35 low-Ca pyroxene unusually high for LL3. LL indicated by low metal content and
36 low weathering grade and overlap with LL for olivine Fa and low-Ca pyroxene Fs.
37 Type 3 indicated by texture, presence of chondrule glass, abundance of
38 clinoenstatite, and variable olivine and pyroxene compositions. Subtype indicators
39 can be best reconciled with subtype of 3.7 to 3.8: Fa contents suggest 3.7-3.9, Fs
40 contents suggest 3.4-3.9, olivine chrome contents suggest 3.5.

41 **Specimens:** A total of 22.7 g in one slice, a polished thin section, and potted butt
42 are available at *Cascadia*. Mr. McKenzie holds the main mass.
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53 Northwest Africa 11993 (NWA 11993)

54 (Northwest Africa)

55 Purchased: 2006 Sept

56 Classification: Ureilite

57 **History:** Samples were donated to *Cascadia* by Mr. Fred *Olsen* in July 2012.
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Physical characteristics: Interior and slightly shiny exterior have a relatively uniform dark-gray color with occasional light reddish-brown patches.

Petrography: (A. Ruzicka, S. Goudy, *Cascadia*) Composed chiefly of olivine and pigeonite grains roughly 1 mm across, often separated by fine-grained materials, cracks, or Fe-hydroxide weathering product. No metal or sulfide minerals were found. Shock stage U-S4 ([Stöffler et al. 2018](#))

Geochemistry: (A. Ruzicka, M. Hutson, *Cascadia*) Cores of olivine grains have ferroan olivine ($\text{Fa}_{22.6\pm 0.7}$, $N = 38$) and rims are more magnesian ($\text{Fa}_{15.6\pm 3.6}$, $N = 9$). Pigeonite ($\text{Fs}_{17.1\pm 3.8}\text{Wo}_{11.1\pm 3.5}$, $N = 28$) shows less prominent magnesian rims.

Classification: Achondrite (ureilite). Silicate grain cores and rims were largely unaffected by weathering, but presence of hydroxide and reddish staining indicates some weathering occurred.

Specimens: A total of 20.6 g and 1 thin section are on deposit at *Cascadia*. Mr. McKenzie holds the main mass.

Northwest Africa 11994 (NWA 11994)

(Northwest Africa)

Purchased: 2017 Jan

Classification: Ordinary chondrite (L3)

Petrography: (K. Metzler, *IfP*) Ordinary chondrite of low petrologic type consisting of closely packed chondrules and metal grains with very low amounts of interchondrule matrix. Cluster chondrite texture. Chondrule shapes are mostly ellipsoidal with parallel alignment.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $\text{Fa}_{22.1\pm 3.1}$ ($\text{Fa}_{13.0-26.5}$; $n=32$); the mean low-Ca pyroxene composition is $\text{Fs}_{11.6\pm 5.2}\text{Wo}_{1.0\pm 1.1}$ ($\text{Fs}_{2.0-21.0}\text{Wo}_{0.0-5.0}$; $n=28$)

Classification: L chondrite based on olivine composition with a strong peak at $\sim\text{Fa}_{24}$. PMD of Fa values = 14, i.e. petrologic subtype estimated to be 3.8.

Northwest Africa 11995 (NWA 11995)

(Northwest Africa)

Purchased: 2012

Classification: Ordinary chondrite (H6)

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $\text{Fa}_{19.5\pm 0.4}$ ($\text{Fa}_{19.0-20.0}$); $n=15$; the mean low-Ca pyroxene composition is $\text{Fs}_{17.0\pm 0.3}\text{Wo}_{1.3\pm 0.2}$ ($\text{Fs}_{16.5-17.5}\text{Wo}_{1.0-1.5}$); $n=15$

Classification: H chondrite based on the mean compositions of olivine and pyroxene. Petrologic type 6 based on the size of secondary plagioclase ($>50\ \mu\text{m}$) and small Fa and Fs variations.

Northwest Africa 11996 (NWA 11996)

(Northwest Africa)

Purchased: 2017 Apr

Classification: Carbonaceous chondrite (CO3)

History: Bought from an African mineral dealer in Alicante, Spain

Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, and CAIs, embedded in a fine-grained brownish matrix (about 20 vol% matrix). The vast majority of chondrules belong to chemical type I. Mean apparent chondrule size: $180 \pm 120 \mu\text{m}$ (70-930 μm ; n=95).

Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $\text{Fa}_{36.0 \pm 8.0}$ ($\text{Fa}_{6.0-40.5}$); n=25. Random measurements of low-Ca pyroxene grains revealed $\text{Fs}_{5.7 \pm 3.1}$ $\text{Wo}_{2.8 \pm 1.4}$ ($\text{Fs}_{2.0-14.0}$ $\text{Wo}_{1.0-5.0}$); n=21.

Classification: CO chondrite based on CAI occurrence, small chondrule size, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3.7 estimated from chemical variation of olivine and pyroxene (PMD-Fa = 22.2).

Northwest Africa 11997 (NWA 11997)

Morocco

Purchased: July 2018

Classification: HED achondrite (Howardite)

History: Purchased online by D. Sheikh in July 2018.

Physical characteristics: Single 30.2 gram stone covered by black fusion crust with flow lines, cut surface reveals fine-grained, light-gray interior.

Petrography: (D. Sheikh, *FSU*) Fine-grained polymict breccia, <4 mm clast size for diogenite clasts, <2 mm for cumulate and basaltic eucrite clasts. Modal content of howardite (in vol.%): diogenites, 40%; cumulate eucrites, 25%; basaltic eucrites, 25%; anorthosite clasts, 7%; shock melt zones, 2%; opaques, 1%.

Geochemistry: Eucrite pyroxene: pigeonite ($\text{Fs}_{47.5}$ $\text{Wo}_{10.99}$), n=25; augite ($\text{Fs}_{35.45}$ $\text{Wo}_{30.2}$), n=5; FeO/MnO=23. Diogenite pyroxene: orthopyroxene ($\text{Fs}_{24.4}$ $\text{Wo}_{5.08}$), n=10; FeO/MnO=18. Calcic plagioclase (An_{87}), N=25. Ilmenite ($\text{Fe}/(\text{Fe}+\text{Mg})$) =87.83%, N=4. FeS and FeO scattered throughout matrix. SiO_2 -rich glass present.

Classification: Achondrite (Howardite)

Specimens: 8.98 g at *UCLA*, 2.67 g with C. Anderkin, main mass with D. Sheikh

Northwest Africa 11998 (NWA 11998)

Northwest Africa

Purchased: 2017

Classification: HED achondrite (Eucrite)

History: A 2241 g, partially fusion-crust stone was found near Laayoune, Western Sahara, in 2016. J. Donald Cline and John Sinclair Purchased the stone from Mohamed Ismaily at the Tucson Gem and Mineral show in 2017.

Physical characteristics: Sample is dark blackish brown in color, non-magnetic and has an irregular shape. Clasts are readily visible on the exterior of the sample.

Clasts range in size from 0.25-2 cm, are light colored, rounded to angular in shape and have very-fine to coarse grained igneous textures.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of clasts of basaltic-cumulate lithologies contained by a host of similar clastic debris set within a micro-vesicular melted matrix. Clasts are: fine-grained recrystallized basalt (25-50 μm phenocrysts); gabbroic clast with 423-512 μm pyroxenes and 348-506 μm plagioclase and rare (<1vol%) diogenite. All pyroxenes are exsolved. Some clasts show breccia in breccia structure. Additional minerals and phases are: ilmenite, chromite, FeS, apatite, rare olivine and rare FeNi metal.

Geochemistry: (A. Love, *App*) Basaltic eucrite: Low-Ca pyroxene host $\text{Fs}_{43.9\pm 2.2}\text{Wo}_{1.7\pm 0.1}$ ($\text{Fs}_{40.7-46.4}\text{Wo}_{1.5-1.8}$, $\text{FeO/MnO}=33.2-37.4$), $N=8$; high-Ca pyroxene exsolution lamellae $\text{Fs}_{17.5\pm 0.4}\text{Wo}_{44.6\pm 0.4}$ ($\text{Fs}_{17.0-17.8}\text{Wo}_{44.1-44.8}$), $N=3$. Cumulate eucrite: Low-Ca pyroxene host $\text{Fs}_{61.7\pm 2.7}\text{Wo}_{2.1\pm 0.3}$ ($\text{Fs}_{54.1-64.3}\text{Wo}_{1.7-2.6}$, $\text{FeO/MnO}=30.5-34.7$ $N=11$); high-Ca pyroxene exsolution lamellae $\text{Fs}_{27.3\pm 1.1}\text{Wo}_{43.0\pm 0.6}$ ($\text{Fs}_{26.1-29.0}\text{Wo}_{42.2-44.1}$, $N=6$); plagioclase $\text{An}_{87.2\pm 3.2}\text{Or}_{0.5\pm 0.6}$ ($\text{An}_{80.3-90.9}\text{Or}_{0.0-2.3}$ $N=10$). Diogenite: Low-Ca pyroxene $\text{Fs}_{23.5}\text{Wo}_{2.6}$ ($\text{FeO/MnO}=30.15$, $N=1$); Olivine $\text{Fa}_{54.3\pm 1.1}$, $N=2$.

Classification: HED (polymict eucrite breccia). FeO/MnO and Fs compositions of pyroxenes indicate this sample is a HED meteorite. Textural and compositional data indicate this is a polymict eucrite melt breccia.

Specimens: *PARI* holds the main mass. One slice totaling 35.6 g and a polished thin section are on deposit at *App*.

Northwest Africa 11999 (NWA 11999)

(Northwest Africa)

Purchased: 2011 Feb

Classification: HED achondrite (Eucrite)

History: Sample purchased by D. Gregory at the Tucson Gem and Mineral show in 2011. Sample originally named "ROM 057" and is listed in *ROM* catalogues as LM58492.

Physical characteristics: The meteorite is a flattened fist size sample with a dark-black patchy fusion crust, weathered to expose a light orange surface. The interior of the sample is pale gray with a fine-grained matrix and small crystalline clasts visible.

Petrography: Sample bears gabbroic clasts in a fine-grained fragmented matrix. Clasts range in size from 402-5500 μm and are composed of pyroxene and plagioclase. The fragmented matrix is of the same mineralogic composition and grains range in size from microcrystalline to 200 μm . Exsolution lamellae are visible in pyroxene grains.

Geochemistry: Mineral compositions and geochemistry: There is no difference in chemistry between the clasts and matrix. Low calcium pyroxenes have a composition of $\text{Fs}_{54.9\pm 3.1}\text{Wo}_{4.8\pm 3.9}$ FeO/MnO (wt%) = 29.6 ± 0.7 ($n=22$). Augite has a composition of $\text{Fs}_{24.3\pm 1.0}\text{Wo}_{42.8\pm 1.3}$ FeO/MnO (wt%) = 29.7 ± 1.1 ($n=19$). Plagioclase $\text{An}_{91.6\pm 0.8}$ ($\text{An}_{90.3-93.7}$, $n=39$)

Classification: (V. Di Cecco, *ROM*) Sample is an equilibrated monomict basaltic eucrite breccia. Lamellae and compositions suggest the sample has experienced thermal equilibration. Mineral chemistry suggests the sample is a basaltic eucrite.

Northwest Africa 12000 (NWA 12000)

Morocco

Purchased: May 2017

Classification: Iron meteorite (IIAB)

History: Purchased by Zhang Qingyan in May 2017 from a Moroccan dealer during the China (Hunan) Mineral & Gem Show in Chenzhou City

Physical characteristics: The main mass is approximately $2 \times 5 \times 10$ cm with a dark brown, regmaglypted exterior. Some rust-red spots and adhered caliche are visible.

Petrography: (C. Herd) A 1×2 cm polished and etched slice shows an equant texture of kamacite crystals at least as wide as the slice (1 cm) with interstitial schreibersite. The cm-scale kamacite is replaced by sub-500 μm equant crystals. Neumann lines are present.

Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 5.7, Co = 0.49 (both wt%); Cu = 123, Ga = 55, As = 9.5, Ru = 3.4, W = 0.7, Ir = 0.03, Pd = 2.5, Pt = 4.5, Au = 1.1 (all $\mu\text{g/g}$).

Classification: Iron, IIAB. Recrystallized texture.

Specimens: Type specimen of 24.3 g at *UAb*. Zhang Qingyan 103 g, Liang Chengguang 28 g, M. Ouzillou 69.3 g.

Northwest Africa 12001 (NWA 12001)

Morocco

Purchased: 2018 Feb

Classification: Ordinary chondrite (H5)

History: Purchased from Mohammed *Hmani* during the Tucson Gem and Mineral show February 2018.

Physical characteristics: Stones have a brownish exterior exposing many small chondrules and some specimens are partially covered with a brownish black crust. Some specimens also display prominent metal veining in positive relief.

Petrography: (C. Herd and L. Tunney, *UAb*) Optical and microprobe examination of a polished thin section shows well-delineated chondrules of a variety of textural types. No metal veins were observed in the specimen studied. Weathering grade according to Zurfluh et al. (2016).

Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $\text{Fa}_{18.3 \pm 0.3}$ (n=42); Low-Ca Pyroxene $\text{Fs}_{16.0 \pm 0.2} \text{Wo}_{1.2 \pm 0.2}$ (n=39).

Classification: Ordinary chondrite, H5

Specimens: Type specimen of 71.8 g, including one thin section, is at *UAb*. 3 stones totaling 2108 g with M. Ouzillou, 911 g stone with *GHupé*, and 2 stones totaling 2211 g with D. Dickens.

Northwest Africa 12002 (NWA 12002)

Morocco

Purchased: 2017

Classification: Martian meteorite (Shergottite)

History: Purchased from a France-based Moroccan dealer in 2017, via internet.

Physical characteristics: The main mass is a single, green-gray chip with adhering red-brown dust and fusion crust on one side.

Petrography: (C. Herd and L. Tunney, *UAb*; E. Walton and H. Jurak, MacEwan U) Optical and microprobe examination of a polished thin section shows low-Ca pyroxene oikocrysts up to 3.5 mm in longest dimension enclosing equant, rounded olivine and subhedral rounded to euhedral chromite chadacrysts. Assemblages of plagioclase, low- and high-Ca pyroxene, Ti-bearing chromite comprise the non-poikilitic areas. Shock deformation and transformation effects in host rock minerals include strong mosaicism of olivine and pyroxene, mechanical twinning in pyroxene and complete transformation of plagioclase to maskelynite. Small, isolated pockets of shock melt are heterogeneously distributed throughout the host rock, from which needles of stishovite have crystallized. Thin black veinlets of quenched shock melt cut across and displace igneous minerals.

Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{39.7\pm 1.5}$ (range $Fa_{34.1-41.2}$), $FeO/MnO = 51$ ($n=35$); low-Ca pyroxene $Fs_{29.4\pm 2.4}Wo_{10.6\pm 3.3}$ (range $Fs_{24.6-32.8}Wo_{2.8-16.6}$), $FeO/MnO = 30$ ($n=23$); high-Ca pyroxene $Fs_{18.4\pm 1.2}Wo_{33.8\pm 2.2}$ (range $Fs_{16.5-20.7}Wo_{31.2-38}$), $FeO/MnO = 25$ ($n=9$); plagioclase $An_{50.9\pm 4.8}Or_{2.8\pm 1.3}$ (range $An_{40.6-56.9}Or_{1.4-6.2}$) ($n=20$). Chromite range $TiO_2 = 0.9-17$ wt% ($n=16$).

Classification: Martian (shergottite, poikilitic)

Specimens: Type specimen of 3.2 g, including one thin section, at *UAb*. 1 g with M. Ouzillou.

Northwest Africa 12004 (NWA 12004)

Morocco

Purchased: 2018 Mar

Classification: Angrite

History: Found near Touignin in southern Morocco and purchased by Ben Hoefnagels in March 2018 from a Moroccan dealer.

Physical characteristics: A gray stone (183 g) lacking fusion crust and with visible sparse vesicles.

Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic texture (mean grain size 0.5 mm) with sparse vesicles. Major minerals are zoned calcic olivine (with

kirschsteinite rims), zoned Al-Ti-augite and anorthite, together with accessory titanomagnetite, troilite, silicoapatite and ferroan rhönite.

Geochemistry: Olivine ($\text{Fa}_{36.6-84.1}\text{Ln}_{1.4-15.4}$, $\text{FeO/MnO} = 70-95$, $N = 7$), clinopyroxene ($\text{Fs}_{20.9-46.7}\text{Wo}_{52.0-52.9}$, $\text{FeO/MnO} = 77-148$, $\text{TiO}_2 = 1.4-4.2$ wt.%, $\text{Al}_2\text{O}_3 = 7.3-11.6$ wt.%, $N = 5$), kirschsteinite ($\text{Fa}_{62.4}\text{Ln}_{33.8}$, $\text{FeO/MnO} = 69$), anorthite ($\text{An}_{99.5-99.6}\text{Ab}_{0.3}\text{Or}_{0.0}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}\text{O}$ 2.258, 2.197, 2.285; $\delta^{18}\text{O}$ 4.440, 4.284, 4.431; $\Delta^{17}\text{O}$ -0.086, -0.065, -0.055 per mil.

Classification: Angrite (diabasic).

Specimens: 22.3 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12007 (NWA 12007)

(Northwest Africa)

Purchased: 2018 Feb

Classification: Ordinary chondrite (LL6)

History: Purchased by Blaine *Reed* in February 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with regions of hollyleaf-shaped, stained metal grains and accessory chlorapatite. Some rare chondrule remnants were observed.

Geochemistry: Olivine ($\text{Fa}_{33.0-33.1}$, $N = 3$), orthopyroxene ($\text{Fs}_{26.4-26.6}\text{Wo}_{1.9-1.8}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.2-11.1}\text{Wo}_{44.9-44.2}$, $N = 2$).

Classification: Ordinary chondrite (LL6).

Specimens: 21.2 g including one polished thin section at *UWB*; remainder with Mr. B. *Reed*.

Northwest Africa 12008 (NWA 12008)

Morocco

Purchased: 2018 Aug

Classification: Lunar meteorite (basalt)

History: Purportedly found in Morocco and purchased by Ben Hoefnagels in August 2018 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small olivine phenocrysts (stained orange-brown) are set in an intersertal groundmass composed mainly of zoned clinopyroxene and elongate lath-like maskelynite with accessory skeletal ilmenite, Ti-chromite, Cr-Ti-Fe spinel, troilite and minor barite. Olivine contains inclusions of chromite and quenched melt inclusions (surrounded by radial cracks) composed of Al-Ti-bearing augite + K-bearing glass.

Geochemistry: Olivine (cores $\text{Fa}_{36.6-42.3}$, rim $\text{Fa}_{90.0}$, $\text{FeO/MnO} = 96-99$, $N = 3$), pigeonite ($\text{Fs}_{31.1}\text{Wo}_{14.0}$, $\text{FeO/MnO} = 50$), subcalcic augite ($\text{Fs}_{25.9-71.4}\text{Wo}_{28.6-23.1}$, $\text{FeO/MnO} = 50-75$, $N = 5$), augite ($\text{Fs}_{23.2}\text{Wo}_{39.7}$, $\text{FeO/MnO} = 49$), ferropigeonite

(Fs_{80.1}Wo_{19.5}, FeO/MnO = 79), augite in melt inclusion (Fs_{28.8}Wo_{50.1}, FeO/MnO = 71, Al₂O₃ = 10.5 wt.%, TiO₂ = 5.3 wt.%), plagioclase (An_{86.8-87.6}Or_{0.4-0.3}, N = 2).

Classification: Lunar (mare basalt).

Specimens: 25.2 g including two polished thin sections at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12009 (NWA 12009)

(Northwest Africa)

Purchased: 2017 Jun

Classification: Ordinary chondrite (LL3)

History: Purchased by Marc Jost in June 2017 from a Moroccan dealer at the Ensisheim Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, fairly closely packed chondrules (apparent diameter 950±610 μm, N = 24) are set in relatively fine grained matrix containing altered metal, merrillite and chlorapatite.

Geochemistry: Olivine (Fa_{1.2-98.0}, Cr₂O₃ in ferroan examples 0.09-0.18 wt.%, mean 0.1±0.04 wt.%, N = 7), orthopyroxene (Fs_{2.1-17.0}Wo_{0.4-2.4}, N = 3), subcalcic augite (Fs_{47.1}Wo_{31.2}), augite (Fs_{9.4}Wo_{42.5}). Magnetic susceptibility log χ (× 10⁻⁹ m³/kg) = 3.61.

Classification: Ordinary chondrite (LL3).

Specimens: 22.7 g including one polished thin section at *UWB*; remainder held by *SJS*.

Northwest Africa 12010 (NWA 12010)

(Northwest Africa)

Purchased: 2018 Apr

Classification: Ordinary chondrite (H6)

History: Purchased by Martin Goff in April 2018 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare chondrule remnants. Accessory minerals include sodic plagioclase, stained kamacite, chromite, merrillite, chlorapatite and troilite.

Geochemistry: Olivine (Fa_{19.5-19.8}, N = 3), orthopyroxene (Fs_{16.7-17.4}Wo_{1.5-1.3}, N = 3), clinopyroxene (Fs_{5.6-6.7}Wo_{46.4-45.2}, N = 2).

Classification: Ordinary chondrite (H6).

Specimens: 20.1 g including one polished thin section at *UWB*; remainder with Mr. M. Goff.

Northwest Africa 12011 (NWA 12011)

(Northwest Africa)

Purchased: 2018 Jan

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt on behalf of the Maine Mineral and Gem Museum in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh breccia composed of gabbroic eucrite clasts (grainsize up to 0.8 mm) and related mineral debris. Minerals are exsolved pigeonite and calcic plagioclase with accessory silica polymorph, ilmenite, Ti-chromite, troilite and baddeleyite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{59.0-59.4}\text{Wo}_{1.8-1.5}$, $\text{FeO/MnO} = 31-32$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{24.9-26.3}\text{Wo}_{43.3-42.0}$, $\text{FeO/MnO} = 28-29$, $N = 2$), plagioclase ($\text{An}_{91.8-92.0}\text{Or}_{0.4-0.3}$, $N = 2$).

Classification: Eucrite (monomict gabbroic breccia).

Specimens: 20.2 g including one polished thin section at *UWB*; remainder at *MMGM*.

Northwest Africa 12013 (NWA 12013)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CV3)

History: A single stone weighing 332.1 g was found in Morocco and subsequently purchased by Blaine *Reed* at the 2018 Tucson Gem and Mineral Show.

Physical characteristics: The stone is dark-orangish-brown in color, has a flattened ovoid shape, lacks fusion crust and has a weathered exterior with some chondrules protruding from the surface. The cut face showing the interior of the stone is dark greenish-brown and shows readily discernible dark-colored chondrules and irregular to circular dark-gray metallic grains.

Petrography: Description and classification (Anthony Love, *App*): Sample contains distinct chondrules (average diameter of 940 μm ($N=24$), fragments and refractory inclusions (CAIs up to 3 mm) all set within an opaque dark brown matrix. Matrix contains FeO-rich olivine, andradite, magnetite framboids and one prominent type B dark inclusion. Type I olivine chondrules are dominant (some of which contain isotropic glass). Sample has ~50% matrix.

Geochemistry: (A. Love-*App*) Type I chondrules $\text{Fa}_{3.2\pm 2.5}$ ($\text{Fa}_{0.4-8.2}$), $\text{Fe/Mn}=37.7\pm 27.3$ $n=17$; Type II chondrules $\text{Fa}_{11.14}$, $n=1$ low-Ca pyroxene $\text{Fs}_{1.1\pm 0.3}\text{Wo}_{1.8\pm 1.8}$ ($\text{Fs}_{0.7-1.5}\text{Wo}_{0.7-5.0}$), $n=4$; high Ca pyroxene $\text{Fs}_{1.4}\text{Wo}_{26.9}$, $n=1$.

Classification: Carbonaceous Chondrite (CV3, S2, high weathering)

Specimens: Blaine *Reed* holds the main mass. Two sliced fragments weighing 42.38 g and one polished thin section are on deposit at *App*.

Northwest Africa 12014 (NWA 12014)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (H6)

History: Purchased by Christian Anderkin in 2017.

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3 **Physical characteristics:** The sample is a single 43 g stone with visible weathered
4 fusion crust. There are several weak fractures that span the minor axis of the stone.

5 **Petrography:** Sample is highly shocked, with no discernable chondrules and many
6 dark shock melt veins. Matrix contains veins of sulfides and oxides amongst small
7 grains of pyroxene and olivine. Plagioclase grains are approximately 55 μm across
8 (N=2).
9

10 **Geochemistry:** Olivine, $\text{Fa}_{17.8-21.8}$, N = 15, mean $\text{Fa}_{19.6}$, N = 15; orthopyroxene,
11 $\text{Fs}_{16.8-22.4}$, mean 18.8, $\text{Wo}_{1.2-3.7}$, mean 1.9
12

13 **Classification:** H6
14

15 **Specimens:** 26.9 g at *UCLA*. Remainder of mass with C. Anderkin at UF.
16
17

18 **Northwest Africa 12015** (NWA 12015)
19

20 (Northwest Africa)

21 Purchased: 2007 Feb

22 Classification: Ordinary chondrite (LL6)
23

24 **Petrography:** Chondrules are relatively difficult to recognize. The matrix is mostly
25 recrystallized with fine secondary grains. Weak mosaicism is seen in parts with
26 undulatory extinction. Pervasive shock veins are seen with melt pockets. Minor
27 oxidation is taking place in the metals. (S. Yokoyama, *ROM*).
28
29

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31 **Northwest Africa 12016** (NWA 12016)
32

33 (Northwest Africa)

34 Purchased: 2005 Feb

35 Classification: Ordinary chondrite (LL6)
36

37 **Petrography:** Very few chondrules are visible. Minor opaque and mostly
38 recrystallized fine grained matrix surrounds chondrule fragments. A series of large
39 dark patches with fine grained crystals are seen. Minor mosaicism is seen in some
40 pyroxenes and undulatory extinction is present in olivines. Opaque shock veins are
41 also seen. <3% of oxidation has affected metal. (S. Yokoyama, *ROM*).
42
43
44

45 **Northwest Africa 12017** (NWA 12017)
46

47 (Northwest Africa)

48 Purchased: 2008 Feb

49 Classification: Ordinary chondrite (LL4)
50

51 **Petrography:** Well defined chondrules are seen in the slide surrounded by some
52 opaque and clastic matrix. Minor undulatory extinction is seen with some
53 mosaicism. Shock veins also seen in parts. >60% of metal has been affected by
54 oxidation from weathering. (S. Yokoyama, *ROM*).
55
56
57

58 **Northwest Africa 12018** (NWA 12018)
59

60 (Northwest Africa)

Purchased: 2012 Feb

Classification: Ordinary chondrite (H6)

Petrography: Sample is divided into darker and lighter clasts throughout the slide. Chondrules are difficult to detect as not many of them are intact. A fine grained matrix is observed. Although maskelynite is not observed, undulatory extinction and mosaicism are quite common. Interconnected shock veins are also seen. Not many metal grains are affected by oxidation. However, pervasive and interconnected oxide veins are seen throughout the slide. (S. Yokoyama, *ROM*).

Northwest Africa 12019 (NWA 12019)

(Northwest Africa)

Purchased: 2012

Classification: Ordinary chondrite (H4)

Petrography: Some patches of dark coexist with the brown. Chondrules are well defined in a mainly recrystallized matrix. Some opaque shock veins and undulatory extinctions are seen while sharp optical extinctions are still common in many olivine grains. Between 50 and 60% of Ni-Fe metal has been replaced by oxidation. Oxide rims are common as well as oxidation veins. (S. Yokoyama, *ROM*).

Northwest Africa 12020 (NWA 12020)

(Northwest Africa)

Purchased: 2017 Dec

Classification: Ordinary chondrite (LL6)

Petrography: (K. Metzler, *IfP*) Monomict breccia with recrystallized texture, showing some relict BO chondrules. Most secondary feldspar grains are $>50\ \mu\text{m}$. Melt pockets and melt veins are present.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $\text{Fa}_{31.3\pm 0.4}$ ($\text{Fa}_{30.7-32.0}$); $n=13$. The mean low-Ca pyroxene composition is $\text{Fs}_{24.9\pm 0.4}\text{Wo}_{1.6\pm 0.1}$ ($\text{Fs}_{24.2-25.6}\text{Wo}_{1.3-1.8}$), $n=13$.

Classification: LL chondrite based on mineral chemistry. Petrologic type 6 based on the equilibrated state of olivine and pyroxene and grain size of secondary plagioclase

Northwest Africa 12180 (NWA 12180)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Dark grayish-greenish individual lacking any fusion crust.

Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 2.5 mm sized), CAIs (up to 5 mm sized), and olivine amoeboids

all set into a fine-grained brownish to almost black matrix. Type II chondrules are absent.

Northwest Africa 12181 (NWA 12181)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L4, melt breccia)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Dark brownish individual lacking any fusion crust.

Petrography: The meteorite is a breccia composed of large regions of recrystallized shock melt containing characteristic FeNi metal and sulfide globules and regions displaying chondritic textures with well preserved chondrules. In chondritic portions olivine is compositionally equilibrated and pyroxene is unequilibrated.

Northwest Africa 12182 (NWA 12182)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was bought from a local meteorite dealer in Tagant, Mauritania.

Physical characteristics: Grayish individual partly covered with fusion crust.

Petrography: The meteorite is a fine-grained basaltic breccia composed of up to 2 mm sized basaltic clasts and up to 3.5 mm sized impact melt clasts set into a basaltic matrix. Mineral phases are predominantly up to 400 μm sized pyroxene and lath shaped calcic plagioclase. Pyroxene often shows magmatic zoning attesting to a low degree of thermal metamorphism. Minor phases include silica, ilmenite, chromite, and troilite. No metallic iron has been detected.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{42.3\pm 8.3}\text{Wo}_{4.1\pm 1.4}$ ($\text{Fs}_{30.5-54.4}\text{Wo}_{1.9-6.3}$, $n=11$, $\text{FeO/MnO}=28-39$); Ca-pyroxene: $\text{Fs}_{29.6\pm 2.2}\text{Wo}_{37.5\pm 5.9}$ ($\text{Fs}_{25.8-34.4}\text{Wo}_{23.1-41.6}$, $n=10$, $\text{FeO/MnO}=29-36$); calcic plagioclase: $\text{An}_{88.8\pm 4.0}$ ($\text{An}_{81.0-93.4}$, $n=15$)

Northwest Africa 12183 (NWA 12183)

(Northwest Africa)

Purchased: 2018

Classification: Ureilite

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Dark-brownish individual lacking any fusion crust.

Petrography: The meteorite shows a characteristic cumulate texture of up to 1 mm sized olivine and pigeonite grains. Olivine is enriched in Cr_2O_3 and displays typical reduced rims. The meteorite contains abundant flaky graphite.

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3 **Geochemistry:** reduced rims in olivine: $Fa_{5.1-11.0}$; olivine contains 0.67 ± 0.18 wt%
4 Cr_2O_3 and 0.31 ± 0.02 wt% CaO
5
6
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8 **Northwest Africa 12184** (NWA 12184)

9 (Northwest Africa)

10 Purchased: 2018

11 Classification: Carbonaceous chondrite (CM2)

12 **History:** The meteorite was bought from a local meteorite dealer in Algeria.

13 **Physical characteristics:** Almost black individual partly covered with fusion crust.

14 **Petrography:** Brecciated carbonaceous chondrite composed of chondrules (mean
15 diameter about 0.3 mm), chondrule pseudomorphs, CAIs, and mineral fragments
16 set into abundant Fe-rich matrix. Many of the components are surrounded by fine-
17 grained dust rims. The fine-grained almost black meteorite matrix consists of
18 abundant Ca-carbonates, sulfides and phyllosilicates.
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24 **Northwest Africa 12185** (NWA 12185)

25 (Northwest Africa)

26 Purchased: 2009

27 Classification: Ordinary chondrite (LL3)

28 **History:** The meteorite was bought from a local meteorite dealer in Morocco.

29 **Physical characteristics:** Brownish individual partly covered with fusion crust.

30 **Petrography:** The meteorite shows a chondritic texture of densely packed and
31 partly flattened chondrules, with an apparent mean diameter of about 0.9 mm; low
32 FeNi metal content and low magnetic susceptibility.
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39 **Northwest Africa 12186** (NWA 12186)

40 (Northwest Africa)

41 Purchased: 2018

42 Classification: Pallasite

43 **History:** The meteorite was bought from a local meteorite dealer in Algeria.

44 **Physical characteristics:** Brownish individual lacking any fusion crust.

45 **Petrography:** The meteorite is composed of typically 5 mm sized brownish olivine
46 set into abundant and well preserved FeNi metal matrix. Ni-poor regions contain
47 about 5 wt% and Ni-rich regions up to 31.6 wt% Ni.
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53 **Northwest Africa 12187** (NWA 12187)

54 (Northwest Africa)

55 Purchased: 2018

56 Classification: Carbonaceous chondrite (CV3)

57 **History:** The meteorite was bought from a local meteorite dealer in Morocco.

58 **Physical characteristics:** Dark brownish individual lacking any fusion crust.
59
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Petrography: Strongly weathered carbonaceous chondrite composed of chondrules (mean diameter about 0.8 mm; up to 2 mm sized), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Nearly all chondrules show reddish staining due to terrestrial alteration.

Northwest Africa 12188 (NWA 12188)

Mauritania

Purchased: May 2018

Classification: Ureilite

History: Found in the Adrar region of Mauritania, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone; sandblasted exterior; saw cut reveals an interior mosaic of light- and dark-gray crystals; minor amount iron-staining present.

Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and augite. Ubiquitous Fe-metal is present along grain boundaries, small (<100 μm) metal blebs are scattered throughout, and there are numerous Fe-metal/oxide veinlets crosscutting the silicate grains. Silicates are highly equilibrated both compositionally and texturally, no oxidation reduction rims observed on olivine grains. No graphite or diamond was observed.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{12.1\pm 0.1}$, Fe/Mn=21±1, $Cr_2O_3=0.50\pm 0.01$ (wt%), n=6; pigeonite $Fs_{11.1\pm 1.6}Wo_{4.5\pm 0.1}$, Fe/Mn=15±1, n=2; augite $Fs_{6.0\pm 0.2}Wo_{36.5\pm 0.5}$, Fe/Mn=10±0, n=2.

Classification: Augite-bearing ureilite

Specimens: 22.2 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12189 (NWA 12189)

Algeria

Purchased: May 2018

Classification: Ureilite

History: Found near Tindouf, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone; irregular, sandblasted exterior; saw cut reveals an interior mosaic of light and dark gray-brown crystals.

Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, graphite and Fe-metal. Ubiquitous, finely disseminated Fe-metal is occupies zones between silicate grain boundaries. Elongate graphite grains up to 1 mm are present throughout. Significant oxidation reduction rims observed on olivine grains with compositions of ~ Fa_{08} .

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{21.5\pm 0.1}$, Fe/Mn=47±4, $Cr_2O_3=0.54\pm 0.10$ (wt%), n=5; pigeonite $Fs_{17.8\pm 0.1}Wo_{4.8\pm 0.8}$, Fe/Mn=30±1, n=6.

Classification: Ureilite, graphite-bearing.

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3 **Specimens:** 21.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the
4 main mass.
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8 **Northwest Africa 12190** (NWA 12190)

9 Western Sahara

10 Purchased: May 2018

11 Classification: HED achondrite (Howardite)

12 **History:** Found in Gdeim Ashham, Western Sahara, February 2018. Purchased by
13 Darryl Pitt in Mauritania, May 2018.

14 **Physical characteristics:** Single stone; sandblasted exterior; saw cut reveals a
15 brecciated interior with numerous feldspar, pyroxene, and lithic clasts; significant
16 domains of recrystallized shock melt are present.

17 **Petrography:** (C. Agee, *UNM*) This meteorite is a polymict breccia consisting of
18 approximately 50% diogenite material and 50% cumulate eucrite material.

19 **Geochemistry:** (C. Agee, *UNM*) Diogenite mineralogy: olivine $Fa_{45.7}$, $Fe/Mn=49$,
20 $n=1$, low-Ca pyroxene $25.4\pm 3.3Wo_{2.6\pm 1.0}$, $Fe/Mn=30\pm 1$, $n=5$; eucrite mineralogy:
21 low-Ca pyroxene $47.8\pm 4.7Wo_{8.7\pm 9.0}$, $Fe/Mn=31\pm 1$, $n=5$; plagioclase $An_{92.9\pm 3.4}$.

22 **Classification:** Howardite

23 **Specimens:** 25.3 g including a probe mount on deposit at *UNM*, *DPitt* holds the
24 main mass.
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32 **Northwest Africa 12191** (NWA 12191)

33 Western Sahara

34 Purchased: May 2018

35 Classification: Ureilite

36 **History:** Found in Agmamin region, Western Sahara, February 2018. Purchased by
37 Darryl Pitt in Mauritania, May 2018.

38 **Physical characteristics:** Single stone; irregular, weathered exterior; saw cut
39 reveals an interior mosaic of light-brown and dark-gray crystals.

40 **Petrography:** (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and
41 Fe-metal. Ubiquitous, finely disseminated Fe-metal occupies zones between
42 silicate grain boundaries. A carbon polymorph (diamond or graphite) is present.

43 **Geochemistry:** (C. Agee, *UNM*) Olivine $Fa_{15.4\pm 0.1}$, $Fe/Mn=36\pm 1$, $Cr_2O_3=0.59\pm 0.01$
44 (wt%), $n=6$; pigeonite $Fs_{9.8\pm 2.1}Wo_{7.0\pm 1.8}$, $Fe/Mn=14\pm 4$, $n=6$.

45 **Classification:** Ureilite

46 **Specimens:** 20.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the
47 main mass.
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55 **Northwest Africa 12192** (NWA 12192)

56 Algeria

57 Purchased: May 2018

58 Classification: Carbonaceous chondrite (CK5)
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History: Found north of Tindouf, Algeria, January 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone with irregular weathered surface, saw cut reveals distinct chondrules up to 1mm in diameter set in a dark-gray groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination shows scattered, distinct, texturally equilibrated chondrules set in a fine-grained matrix. Plagioclase grain size up to 50 μm in diameter. Abundant chromium-rich magnetite observed throughout, some up to 300 μm in diameter.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{29.9\pm 1.0}$, $\text{Fe/Mn}=104\pm 8$, $\text{NiO}=0.30\pm 0.03$ (wt%), $n=13$; low-Ca pyroxene $\text{Fs}_{25.4\pm 1.0}\text{Wo}_{0.7\pm 0.0}$, $\text{Fe/Mn}=66\pm 6$, $n=6$; plagioclase $\text{Ab}_{69.2\pm 3.3}\text{An}_{22.1\pm 6.9}\text{Or}_{8.7\pm 8.8}$, $n=5$.

Classification: Carbonaceous chondrite (CK5) CK chondrite based Fe/Mn of olivine and pyroxenes, and on the presence of chromium-rich magnetite. Petrologic type 5 based on the equilibrated state of olivine and pyroxene, distinct chondrules, and secondary plagioclase size.

Specimens: 9 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12193 (NWA 12193)

Western Sahara

Purchased: May 2018

Classification: HED achondrite (Eucrite, polymict)

History: Found in Gdeim Asham, Western Sahara, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, with weathered exterior. A saw cut reveals a fragmental breccia of lithic clasts set in a light colored, fine-grained groundmass.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a mixture of unequilibrated, zoned pyroxenes and equilibrated pyroxenes with exsolution lamellae, leading to the conclusion that there are at least two distinct eucrite lithologies present.

Geochemistry: (C. Agee, *UNM*) Pyroxene $\text{Fs}_{48.1\pm 14.0}\text{Wo}_{10.7\pm 7.3}$, $\text{Fe/Mn}=31\pm 5$, $n=13$; plagioclase $\text{An}_{87.9\pm 4.7}$, $n=4$.

Classification: Polymict eucrite

Specimens: 21.9 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12194 (NWA 12194)

Algeria

Purchased: May 2018

Classification: HED achondrite (Howardite)

History: Found near Oum El Assel, Algeria, September 2017. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, with weathered exterior. A saw cut reveals a very dark-gray surface with faint appearing clasts and mineral fragments.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a fragmental breccia of pyroxene, plagioclase, and lithic clasts. The meteorite consists of approximately 33% diogenite, 33% cumulate eucrite, and 33% basaltic material.

Geochemistry: (C. Agee, *UNM*) Pyroxene $\text{Fs}_{38.6\pm 13.9}\text{Wo}_{7.5\pm 9.6}$, $\text{Fe/Mn}=30\pm 2$, $n=12$; plagioclase $\text{An}_{88.8\pm 1.3}$, $n=5$. Diogenite pyroxenes $\text{Fs}_{25.1\pm 4.8}\text{Wo}_{3.5\pm 1.5}$, $n=4$.

Classification: Howardite

Specimens: 22.8 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12195 (NWA 12195)

Algeria

Purchased: May 2018

Classification: HED achondrite (Eucrite, polymict)

History: Found north of Tindouf, Algeria, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, partial dark fusion-crust exterior. Saw cut reveals a light-gray fragmental breccia.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a mixture of unequilibrated, zoned pyroxenes with a population of equilibrated pyroxenes with exsolution lamellae and a clear compositional separation between low-Ca and high-Ca pyroxenes, leading to the conclusion that there are at least two distinct eucrite lithologies present.

Geochemistry: (C. Agee, *UNM*) Pyroxene $\text{Fs}_{42.6\pm 11.4}\text{Wo}_{9.8\pm 9.1}$, $\text{Fe/Mn}=30\pm 2$, $n=12$; plagioclase $\text{An}_{87.1\pm 3.5}$, $n=6$.

Classification: Polymict eucrite

Specimens: 12.5 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12196 (NWA 12196)

Western Sahara

Purchased: May 2018

Classification: Carbonaceous chondrite (CV3)

History: Found near the Algerian-Western Sahara border region, January 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, weathered exterior. A saw cut reveals numerous distinct chondrules up to 3 mm in diameter and some CAIs up to 5 mm in size. Gray colored groundmass makes up about 40% of this meteorite.

Petrography: (C. Agee, *UNM*) Microprobe examination showed many porphyritic chondrules most of which were type I. Abundant fine grained matrix throughout.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{4.4\pm 4.1}$, $n=16$; enstatite $\text{Fs}_{1.1\pm 0.3}\text{Wo}_{0.9\pm 0.2}$, $n=8$.

Classification: Carbonaceous chondrite (CV3)

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3 **Specimens:** 21.2 g on deposit at *UNM*, *DPitt* holds the main mass.
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7 **Northwest Africa 12197** (NWA 12197)

8 Western Sahara

9 Purchased: May 2018

10 Classification: Carbonaceous chondrite (CR2)

11 **History:** Found near the Algerian-Western Sahara border region, March 2018.

12 Purchased by Darryl Pitt in Mauritania, May 2018.

13 **Physical characteristics:** Single stone, weathered exterior. A saw cut reveals
14 numerous chondrules up to 1 mm in diameter many with irregular or decorated
15 rims, and sparse CAIs, but one observed was ~5 mm in size. Dark, gray-colored
16 groundmass makes up about 30% of this meteorite, ubiquitous opaques visible.

17 **Petrography:** (C. Agee, *UNM*) Microprobe examination showed many porphyritic
18 chondrules most of which were type I. Many chondrules are metal-rich. Abundant
19 fine grained, hydrous matrix throughout.

20 **Geochemistry:** (C. Agee, *UNM*) Olivine $\text{Fa}_{3.3\pm 3.3}$, $\text{Cr}_2\text{O}_3=0.20\pm 0.11$ (wt%), $n=21$;
21 pyroxene $\text{Fs}_{1.3\pm 0.4}\text{Wo}_{1.9\pm 1.3}$, $n=10$.

22 **Classification:** Carbonaceous chondrite (CR2)

23 **Specimens:** 22.3 g on deposit at *UNM*, *DPitt* holds the main mass.
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31 **Northwest Africa 12198** (NWA 12198)

32 Western Sahara

33 Purchased: May 2018

34 Classification: Ureilite

35 **History:** Found in Western Sahara, April 2018. Purchased by Darryl Pitt in
36 Mauritania, May 2018.

37 **Physical characteristics:** Single stone; irregular, weathered exterior; saw cut
38 reveals an interior mosaic of light brown and dark gray crystals.

39 **Petrography:** (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and
40 Fe-metal. Ubiquitous, finely disseminated Fe-metal is occupies zones between
41 silicate grain boundaries. Graphite observed.

42 **Geochemistry:** (C. Agee, *UNM*) Olivine $\text{Fa}_{21.6\pm 0.3}$, $\text{Fe}/\text{Mn}=50\pm 3$, $\text{Cr}_2\text{O}_3=0.49\pm 0.27$
43 (wt%), $n=6$; pigeonite $\text{Fs}_{9.8\pm 3.0}\text{Wo}_{9.8\pm 3.0}$, $\text{Fe}/\text{Mn}=18\pm 3$, $n=5$.

44 **Classification:** Ureilite

45 **Specimens:** 20 g including a probe mount on deposit at *UNM*, *DPitt* holds the main
46 mass.
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54 **Northwest Africa 12199** (NWA 12199)

55 Western Sahara

56 Purchased: May 2018

57 Classification: Primitive achondrite (Acapulcoite)
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History: Found near the Western Sahara-Mauritania border region, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Two identically looking stones with weathered exterior. Saw cut reveals an interior fine-grained mosaic of light-brown and dark-gray crystals.

Petrography: (C. Agee, *UNM*) Recrystallized texture with triple junctions. Grain size about 250 μm . This meteorite consists of olivine, low-Ca pyroxene, and Fe-metal. No plagioclase detected.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{12.0\pm 0.1}$, $\text{Fe/Mn}=22\pm 1$, $\text{Cr}_2\text{O}_3=0.50\pm 0.01$ (wt%), $n=6$; low-Ca pyroxene $\text{Fs}_{10.4\pm 0.1}\text{Wo}_{4.5\pm 0.1}$, $\text{Fe/Mn}=14\pm 0$, $n=7$.

Classification: Acapulcoite

Specimens: 21.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12200 (NWA 12200)

Mauritania

Purchased: May 2018

Classification: Carbonaceous chondrite (CK6)

History: Found in the Adrar Region, Mauritania, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone with irregular weathered surface. A saw cut reveals numerous faint chondrules up to 2mm in diameter set in a dark-gray groundmass. Orange-reddish oxidation staining is visible.

Petrography: (C. Agee, *UNM*) Microprobe examination shows recrystallized relict texturally equilibrated chondrules set in a recrystallized matrix. Plagioclase grain size up to 300 μm in length. Abundant chromium-rich magnetite observed throughout, some up to 200 μm in size. Only trace amounts of pyroxene are present. Melt pockets observed.

Geochemistry: (C. Agee, *UNM*) Olivine $\text{Fa}_{27.2\pm 0.9}$, $\text{Fe/Mn}=89\pm 7$, $\text{NiO}=0.49\pm 0.11$, $n=13$; melt $\text{SiO}_2=34.1\pm 1.9$, $\text{TiO}_2+0.15\pm 0.02$, $\text{Al}_2\text{O}_3=5.7\pm 1.9$, $\text{Cr}_2\text{O}_3=0.63\pm 0.11$, $\text{MgO}=21.5\pm 1.0$, $\text{FeO}=26.6\pm 3.3$, $\text{MnO}=0.21\pm 0.03$, $\text{CaO}=5.3\pm 0.3$, $\text{NiO}=0.34\pm 0.05$, $\text{Na}_2\text{O}=0.65\pm 0.23$, $\text{K}_2\text{O}=0.08\pm 0.00$, $\text{Fe/Mn}=128\pm 10$, $n=3$; plagioclase $\text{Ab}_{52.0\pm 4.3}\text{An}_{41.6\pm 7.8}\text{Or}_{6.4\pm 5.6}$, $n=6$.

Classification: Carbonaceous chondrite (CK6)

Specimens: 15.9 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12201 (NWA 12201)

Western Sahara

Purchased: May 2018

Classification: HED achondrite (Eucrite, unbrecciated)

History: Found in Western Sahara, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, weathered exterior. Saw cut reveals a dark gray surface with plagioclase and pyroxene crystals.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a mixture of approximately 50% pyroxene and 40% plagioclase. Pyroxenes show a clear compositional separation of low-Ca and high-Ca pyroxene typical of equilibrated basaltic eucrites. No brecciation observed.

Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $\text{Fs}_{57.1\pm 1.4}\text{Wo}_{3.8\pm 2.4}$, $\text{Fe}/\text{Mn}=33\pm 1$, $n=8$; high-Ca pyroxene $\text{Fs}_{26.5\pm 2.3}\text{Wo}_{41.5\pm 2.9}$, $\text{Fe}/\text{Mn}=31\pm 2$, $n=5$; plagioclase $\text{An}_{85.4\pm 0.8}$, $n=6$.

Classification: Unbrecciated basaltic eucrite

Specimens: 17.1 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12202 (NWA 12202)

Western Sahara

Purchased: May 2018

Classification: HED achondrite (Eucrite, polymict)

History: Found in Western Sahara, January 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, partial dark fusion-crust exterior. Saw cut reveals a light-gray fragmental breccia.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a fragmental breccia of predominately plagioclase and pyroxene. The pyroxene is mixture of cumulate eucrite compositions with a population of basaltic eucrite compositions leading to the conclusion that there are at least two distinct eucrite lithologies present.

Geochemistry: (C. Agee, *UNM*) Basaltic eucrite: low Ca pyroxene $\text{Fs}_{60.9\pm 1.3}\text{Wo}_{3.3\pm 2.2}$, $\text{Fe}/\text{Mn}=31\pm 1$, $n=4$; high Ca pyroxene $\text{Fs}_{47.9\pm 6.2}\text{Wo}_{23.2\pm 2.1}$, $\text{Fe}/\text{Mn}=31\pm 0$, $n=3$. Cumulate eucrite: low Ca pyroxene $\text{Fs}_{35.9\pm 1.9}\text{Wo}_{5.0\pm 2.8}$, $\text{Fe}/\text{Mn}=29\pm 2$, $n=4$.

Classification: Polymict eucrite

Specimens: 20.4 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12203 (NWA 12203)

Algeria

Purchased: May 2018

Classification: HED achondrite (Howardite)

History: Found near Oum El Assel, Algeria, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, with weathered exterior. A saw cut reveals a very dark gray surface with faint appearing clasts and mineral fragments.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a fragmental breccia of pyroxene, plagioclase, and lithic clasts. The meteorite consists of approximately 50% diogenite and 50% eucrite.

Geochemistry: (C. Agee, *UNM*) Diogenite pyroxene $\text{Fs}_{28.1\pm 2.5}\text{Wo}_{2.6\pm 1.0}$, $\text{Fe/Mn}=29\pm 2$, $n=7$; eucrite pigeonite $\text{Fs}_{47.5\pm 5.9}\text{Wo}_{6.7\pm 3.1}$, $\text{Fe/Mn}=30\pm 2$, $n=6$, eucrite high-Ca pyroxene $\text{Fs}_{29.3\pm 2.6}\text{Wo}_{39.1\pm 1.9}$, $\text{Fe/Mn}=30\pm 2$, $n=2$, plagioclase $\text{An}_{88.7\pm 5.6}$, $n=5$.

Classification: Howardite

Specimens: 23.3 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12210 (NWA 12210)

(Northwest Africa)

Purchased: 2018 Jun

Classification: Martian meteorite (Shergottite)

History: Purchased by Ben Hoefnagels in June 2018 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Poikilitic texture. Large pyroxene oikocrysts (up to 6 mm across) enclose olivine chadacrysts, and are set in a relatively coarse grained groundmass containing olivine, pyroxenes, lath-like maskelynite, abundant phosphates (both merrillite and chlorapatite), Ti-poor chromite and pyrrhotite. Mafic silicates exhibit very limited compositional zoning. Cores of pyroxene oikocrysts are stained orange.

Geochemistry: Olivine ($\text{Fa}_{38.1-40.7}$, $\text{FeO/MnO} = 49-51$, $N = 3$), low-Ca pyroxene core ($\text{Fs}_{24.7}\text{Wo}_{4.1}$, $\text{FeO/MnO} = 30$), pigeonite ($\text{Fs}_{26.4-30.8}\text{Wo}_{11.0-7.5}$; $\text{Fs}_{28.1}\text{Wo}_{16.3}$; $\text{FeO/MnO} = 25-29$; $N = 3$), subcalcic augite ($\text{Fs}_{16.8-18.5}\text{Wo}_{33.7-36.6}$, $\text{FeO/MnO} = 23-25$, $N = 2$), maskelynite ($\text{An}_{53.8-54.4}\text{Or}_{2.1-2.2}$, $N = 2$).

Classification: Martian (shergottite, poikilitic).

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12211 (NWA 12211)

(Northwest Africa)

Purchased: 2018 Apr

Classification: Ordinary chondrite (H5)

History: Purchased by Thierry Simard in April 2018 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present within a coarsely recrystallized assemblage containing abundant altered metal (some now replaced by red-brown iron hydroxides) and accessory merrillite.

Geochemistry: Olivine ($\text{Fa}_{18.3-18.4}$, $N = 3$), orthopyroxene ($\text{Fs}_{15.4-15.9}\text{Wo}_{1.0-1.7}$, $N = 4$), clinopyroxene ($\text{Fs}_{5.1-6.6}\text{Wo}_{46.3-45.3}$, $N = 2$).

Classification: Ordinary chondrite (H5).

Specimens: 20.6 g including one polished thin section at *UWB*; remainder with Monsieur T. Simard.

Northwest Africa 12212 (NWA 12212)

(Northwest Africa)

Purchased: 2005

Classification: Mesosiderite

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to the Planetary Studies Foundation.

Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of predominantly kamacite (containing wispy regions of taenite), low-Ca pyroxene and anorthite together with accessory Mg-merrillite, schreibersite and minor troilite.

Geochemistry: Low-Ca pyroxene ($\text{Fs}_{32.7-32.9}\text{Wo}_{4.2-5.1}$, $\text{FeO/MnO} = 21-28$, $N = 3$), anorthite ($\text{An}_{90.8-94.4}\text{Or}_{0.9-0.8}$, $N = 2$).

Classification: Mesosiderite.

Specimens: The entire specimen polished on one side is at *PSF*.

Northwest Africa 12215 (NWA 12215)

(Northwest Africa)

Purchased: 2018 May

Classification: Ordinary chondrite (H5)

History: Purchased by SunChul Lee from a dealer in Florida, who had obtained the specimen from a Moroccan source.

Petrography: (A. Irving and S. Kuehner, *UWS*) Extensively recrystallized with sparse chondrules, abundant altered metal and accessory merrillite.

Geochemistry: Olivine ($\text{Fa}_{19.5-19.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.8-16.9}\text{Wo}_{1.1-1.0}$, $N = 3$), clinopyroxene ($\text{Fs}_{5.7-5.9}\text{Wo}_{44.4-45.7}$, $N = 2$).

Classification: Ordinary chondrite (H5).

Specimens: 122.1 g including one polished thin section at *UWB*; remainder with Mr. S. Lee.

Northwest Africa 12217 (NWA 12217)

(Northwest Africa)

Purchased: 2015

Classification: Ungrouped achondrite

History: Purchased by Jay Piatek in 2015 from a Moroccan meteorite dealer.

Physical characteristics: Single stone, partially covered with black fusion crust. The surface also exposes a fragmental breccia interior with coarse cream-colored grains crosscut by fine dark veinlets. Saw-cut surface reveals light colored angular mineral fragments up to 1 cm in size bounded by darker gray, fine grained material. A prominent, partially oxidized metal grain was visible in the saw cut surface.

Petrography: (C. Agee, *UNM*) Backscatter electron mapping gives the approximate modal abundances: 93% olivine, 4% pyroxene, with minor chromite,

troilite, Fe-metal, alkali feldspar, plagioclase, silica, and fluorapatite, primarily occupying boundaries and pockets between the larger olivine grains.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{9.6\pm 2.5}$, $Fe/Mn=36\pm 3$, $n=19$; low-Ca pyroxene $Fs_{19.3\pm 0.8}Wo_{2.6\pm 0.4}$, $Fe/Mn=25\pm 1$, $n=8$; alkali feldspar $An_{2.9\pm 1.1}Or_{56.2\pm 10.3}Ab_{41.0\pm 10.1}$, $n=18$; plagioclase $An_{43.5\pm 3.7}Or_{1.6\pm 0.3}Ab_{54.9\pm 4.0}$, $n=4$; apatite $CaO=46.3\pm 0.4$, $MgO=3.6\pm 0.0$, $FeO=0.27\pm 0.01$, $Na_2O=2.5\pm 0.1$, $P_2O_5=45.3\pm 0.7$, $F=0.53\pm 0.04$, Cl (not detected) all wt%, $n=3$; metal $Fe=97.8\pm 0.6$, $Ni=2.1\pm 0.6$ (wt%), $n=5$; chromite $Al_2O_3=3.4\pm 0.1$, $Cr_2O_3=64.4\pm 0.8$, $MgO=7.9\pm 0.4$, $MnO=0.69\pm 0.05$, $FeO=19.4\pm 0.3$ (wt%), $n=3$. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O=3.723, 3.869, 3.660$; $\delta^{17}O=1.793, 1.884, 1.796$; $\Delta^{17}O=-0.173, -0.159, -0.136$ (linearized, all per mil, TFL slope=0.528).

Classification: Ungrouped achondrite, dunite breccia. The oxygen isotope values of this meteorite plot midway between the eucrite fractionation line (EFL) and the angrite fractionation line (AFL), however its mineralogy is unlike HEDs or angrites; in particular this meteorite possesses alkali feldspar and lacks Ca-rich plagioclase. Furthermore, the Fe/Mn of this meteorite is somewhat lower than for HEDs and much lower than angrites. Brachinites have similar oxygen isotope values, however this meteorite has olivine with much lower Fa and Fe/Mn values than brachinites.

Specimens: 20.7 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 12218 (NWA 12218)

(Northwest Africa)

Purchased: 2007 Jun

Classification: Carbonaceous chondrite (CO3)

History: Purchased from a moroccan dealer at the meteorite show in Ensisheim, France

Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained black matrix (about 20 vol% matrix). The vast majority of chondrules are type I chondrules. Apparent chondrule sizes mostly between 50 and 300 μm .

Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{12.3\pm 16.7}$ (2.7-77.5); $n=25$. Random measurements of low-Ca pyroxene grains revealed $Fs_{2.7\pm 2.4}Wo_{1.7\pm 0.9}$ ($Fs_{1.1-11.9}Wo_{0.8-4.6}$); $n=25$

Classification: CO chondrite based on CAI occurrence, small chondrule size, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene. Very low petrologic subtype (<3.5) based on the PMD of Fa values (136).

Northwest Africa 12219 (NWA 12219)

(Northwest Africa)

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3 Purchased: 2007 Jun

4 Classification: Carbonaceous chondrite (CO3)

5 **History:** Purchased from a Moroccan dealer at the meteorite show in Ensisheim,
6 France

7 **Petrography:** (K. Metzler, *IfP*) Chondrules, chondrule fragments, and CAIs are
8 embedded in a fine-grained brownish matrix (about 20 vol% matrix). The vast
9 majority of chondrules are type I chondrules. Apparent chondrule sizes mostly
10 between 50 and 300 μm .

11 **Geochemistry:** Mineral compositions and geochemistry: Random measurements of
12 olivine grains revealed $\text{Fa}_{21.5\pm 14.3}$ (2.5-48.3); $n=23$. Random measurements of low-
13 Ca pyroxene grains revealed $\text{Fs}_{3.6\pm 3.0}\text{Wo}_{1.9\pm 1.1}$ ($\text{Fs}_{1.0-13.9}\text{Wo}_{0.3-4.4}$); $n=24$

14 **Classification:** CO chondrite based on CAI occurrence, small chondrule size,
15 chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the
16 chemical variation of olivine and pyroxene. Low petrologic subtype (<3.5) based
17 on the PMD of Fa values (67).
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25 Northwest Africa 12221 (NWA 12221)

26 (Northwest Africa)

27 Purchased: 2006 June

28 Classification: Carbonaceous chondrite (CV3)

29 **History:** Purchased from a Moroccan dealer at the meteorite show in Ensisheim,
30 France

31 **Petrography:** (K. Metzler, *IfP*) Chondrules, CAIs and AOAs are embedded in a
32 fine-grained dark matrix (about 40 vol% matrix). Most chondrules have apparent
33 diameters between 0.2 and 1.0 mm, some up to 2.3 mm. Very few type II
34 chondrules. Many chondrules with distinctive fine-grained rims; some chondrules
35 with igneous rims. CAIs with sizes up to 2.3 mm have been observed.

36 **Geochemistry:** Mineral compositions and geochemistry: Random measurements of
37 olivine grains revealed $\text{Fa}_{5.7\pm 3.0}$ (0.7-9.6); $n=19$. Random measurements of low-Ca
38 pyroxene grains revealed $\text{Fs}_{1.6\pm 0.7}\text{Wo}_{1.3\pm 0.8}$ ($\text{Fs}_{0.7-3.2}\text{Wo}_{0.4-3.7}$); $n=21$.

39 **Classification:** CV chondrite based on CAI and AOA occurrence, size of
40 chondrules and CAIs, chondrule-matrix ratio, and mineral chemistry. Petrologic
41 type 3 based on the chemical variation of olivine and pyroxene.
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49 Northwest Africa 12222 (NWA 12222)

50 (Northwest Africa)

51 Purchased: 2018 Mar

52 Classification: Martian meteorite (basaltic breccia)

53 **Petrography:** (K. Metzler, *IfP*) Achondritic breccia, consisting of lithic and
54 mineral clasts, set in a fine-grained clastic matrix. The following minerals were
55 identified: Plagioclase, pyroxene (occasionally with exsolution lamellae), Cl-
56 bearing apatite, ilmenite, and pyrrhotite. Beside complex fine-grained lithologies
57 two different basalt clasts were found.
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Geochemistry: Mineral compositions and geochemistry: Basalt clast #1: Pyroxene (n=5) $\text{Fs}_{37.6\pm 0.2}\text{Wo}_{35.7\pm 0.4}$ ($\text{Fs}_{37.3-37.8}\text{Wo}_{35.2-36.1}$); mean Fe/Mn (at.)=36. Plagioclase (n=6): $\text{An}_{55.2\pm 3.5}\text{Or}_{1.9\pm 0.3}$ ($\text{An}_{50.2-59.3}\text{Or}_{1.3-2.2}$). Basalt clast #2: Pyroxene (n=7) $\text{Fs}_{33.5\pm 3.1}\text{Wo}_{4.0\pm 0.9}$ ($\text{Fs}_{25.6-34.6}\text{Wo}_{1.6-4.6}$); mean Fe/Mn (at.)=38. Plagioclase (n=7): $\text{An}_{53.5\pm 4.2}\text{Or}_{1.9\pm 0.4}$ ($\text{An}_{49.5-60.9}\text{Or}_{1.4-2.7}$).

Classification: Martian (basaltic breccia), based on texture and mineral composition. An values in Feldspar and Fe/Mn in pyroxene are typical of Martian basalts. This sample is most probably paired to [NWA 7034](#) and pairings.

Northwest Africa 12223 (NWA 12223)

(Northwest Africa)

Purchased: 2005 Jun

Classification: HED achondrite (Eucrite, melt breccia)

History: Purchased from a Moroccan dealer at the mineral show in Sainte-Marie-aux-Mines, France

Petrography: (K. Metzler, *IfP*) Melt breccia, consisting of eucritic basalt clasts (ophitic to subophitic textures) with sizes up to several cm and mineral fragments (pyroxene, plagioclase, silica polymorph), set in a dark matrix. This matrix represents a crystallized melt with subophitic texture consisting of pyroxene and skeletal plagioclase crystals. Melt pockets of partly devitrified glass also occur. Most pyroxene fragments show augite exsolution lamellae. Accessories are ilmenite, chromium spinel, and metal (mostly oxidized).

Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene (host; n=10): $\text{Fs}_{63.3\pm 0.5}\text{Wo}_{2.4\pm 0.3}$ ($\text{Fs}_{62.6-63.9}\text{Wo}_{0.9-2.8}$); mean Fe/Mn (at.): 33. Ca-rich pyroxene (exsolution lamellae; n=10) $\text{Fs}_{27.8\pm 0.9}\text{Wo}_{43.2\pm 0.7}$ ($\text{Fs}_{27.0-30.2}\text{Wo}_{41.7-44.0}$); Plagioclase (n=10): $\text{An}_{87.8\pm 1.7}$ ($\text{An}_{84.9-89.9}$).

Northwest Africa 12224 (NWA 12224)

(Northwest Africa)

Purchased: 2006 Jun

Classification: HED achondrite (Howardite)

History: Purchased from a Moroccan dealer at the mineral show in Sainte-Marie-aux-Mines, France

Petrography: (K. Metzler, *IfP*) Shock-compacted fine-grained breccia of dark gray appearance, criss-crossed by black shock melt veins up to several mm in width. It consists of gabbroic and basaltic (ophitic to subophitic) rock fragments and related debris. The majority of pyroxenes is free of exsolution lamellae, but exsolved pyroxenes also occur. Three grains of Fe-rich olivine have been found. This breccia contains devitrified melt droplets as well as clast-rich and clast-poor impact melt rocks. About 10-15% diagenetic components. Accessories are ilmenite, chromium spinel, troilite, silica polymorph, and Ni-poor metal (mostly oxidized).

Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene (n=19): $\text{Fs}_{35.1\pm 5.1}\text{Wo}_{5.4\pm 0.7}$ ($\text{Fs}_{29.3-49.7}\text{Wo}_{4.1-7.1}$); mean Fe/Mn (at.): 33. Ca-rich

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3 pyroxene (n=5) $\text{Fs}_{49.3\pm 2.8}\text{Wo}_{16.8\pm 3.6}$ ($\text{Fs}_{45.4-53.0}\text{Wo}_{13.1-20.5}$); mean Fe/Mn (at.): 31.
4 Diogenitic pyroxene (n=3) $\text{Fs}_{24.1}\text{Wo}_{1.9}$ ($\text{Fs}_{21.8-26.0}\text{Wo}_{1.6-2.1}$) mean Fe/Mn (at.): 32.
5 Olivine (n=3) $\text{Fa}_{77.7}$ ($\text{Fa}_{76.5-78.6}$); mean Fe/Mn (at.): 47. Plagioclase (n=9):
6 $\text{An}_{83.8\pm 3.9}$ ($\text{An}_{78.9-92.0}$).
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10 Northwest Africa 12225 (NWA 12225)

11 (Northwest Africa)

12 Purchased: 2007 Jun

13 Classification: HED achondrite (Eucrite, polymict)

14 **History:** Purchased from a Moroccan dealer at the mineral show in Sainte-Marie-
15 aux-Mines, France

16 **Petrography:** (K. Metzler, *IfP*) Polymict breccia consisting of gabbroic and
17 basaltic rock fragments and related debris. Partly brown appearance due to oxidized
18 Ni-free metal. This breccia contains clast-rich impact melt rocks. Accessories are
19 ilmenite, chromium spinel, silica polymorph, and traces of merrillite and zircon.

20 **Geochemistry:** Mineral compositions and geochemistry: Basalt clast #1: Pyroxene
21 (n=10): $\text{Fs}_{26.7\pm 0.9}\text{Wo}_{43.0\pm 0.6}$ ($\text{Fs}_{25.4-28.4}\text{Wo}_{42.0-43.9}$); mean Fe/Mn (at.): 29. Plagioclase
22 (n=10): $\text{An}_{74.5\pm 3.9}$ ($\text{An}_{71.2-82.4}$). Basalt clast #2: Pyroxene (n=10):
23 $\text{Fs}_{56.0\pm 0.5}\text{Wo}_{5.2\pm 1.1}$ ($\text{Fs}_{55.1-56.6}\text{Wo}_{3.7-8.0}$); mean Fe/Mn (at.): 26. Plagioclase (n=10):
24 $\text{An}_{87.3\pm 3.5}$ ($\text{An}_{82.6-92.4}$).
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32 Northwest Africa 12226 (NWA 12226)

33 (Northwest Africa)

34 Purchased: 2007 Dec

35 Classification: HED achondrite (Eucrite)

36 **History:** Purchased from a Moroccan dealer at the mineral show (CCH) in
37 Hamburg, Germany

38 **Petrography:** (K. Metzler, *IfP*) Unbrecciated ophitic basalt with exsolved
39 pyroxene. Accessories are ilmenite, chromium spinel, silica polymorph, Ni-free
40 iron metal, and troilite.

41 **Geochemistry:** Mineral compositions and geochemistry: Low-Ca pyroxene
42 (n=15): $\text{Fs}_{58.3\pm 1.2}\text{Wo}_{6.7\pm 1.2}$ ($\text{Fs}_{55.5-59.5}\text{Wo}_{5.7-9.1}$); mean Fe/Mn (at.): 32. Exsolved Ca-
43 rich pyroxene lamellae (n=9): $\text{Fs}_{35.3\pm 2.6}\text{Wo}_{34.4\pm 3.3}$ ($\text{Fs}_{32.3-39.0}\text{Wo}_{29.4-38.5}$); mean Fe/Mn
44 (at.): 34. Plagioclase (n=5): $\text{An}_{88.4\pm 1.8}$ ($\text{An}_{86.4-90.5}$).
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52 Northwest Africa 12227 (NWA 12227)

53 Algeria

54 Find: April 2018

55 Classification: HED achondrite (Howardite)

56 **Petrography:** (D. Sheikh, *FSU*) Fine-grained polymict breccia, <7 mm clast size
57 for basaltic eucrite clasts, <3 mm for diogenite clasts, <2mm for cumulate eucrite
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3 clasts. Modal content (in vol.%): diogenites, 46%; cumulate eucrites, 12%; basaltic
4 eucrites, 35%; anorthosite clasts, 5%; shock melt zones, 1%; opaques, 1%.

5
6 **Geochemistry:** Eucrite pyroxene: pigeonite ($\text{Fs}_{44.95}\text{Wo}_{18.29}$), $n=25$; augite
7 ($\text{Fs}_{39.9}\text{Wo}_{34.4}$), $n=6$; $\text{FeO/MnO}=28$. Diogenite pyroxene: orthopyroxene
8 ($\text{Fs}_{27.4}\text{Wo}_{6.84}$), $n=10$; $\text{FeO/MnO}=22$. Calcic plagioclase (An_{89}), $N=25$. Ilmenite
9 ($\text{Fe}/(\text{Fe}+\text{Mg}) = 88.42\%$, $N=2$. FeS and SiO_2 -rich glass present.

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11 **Classification:** Achondrite (howardite)

12 **Specimens:** 25.65 grams at *UCLA*, main mass with Matthew Stream.

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16 **Northwest Africa 12229** (NWA 12229)

17 (Northwest Africa)

18 Purchased: 2017

19 Classification: Carbonaceous chondrite (CV3)

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21 **History:** A single stone weighing 675 g was found in Morocco prior to 2016. J.
22 Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the
23 Tucson Gem and Mineral Show in February 2017.

24
25 **Physical characteristics:** Sample is dark brown in color, rounded to irregular in
26 shape and lacks fusion crust. Sample is coated on the bottom and sides with
27 caliche, some of which contains rounded sand grains. Chondrules and CAIs are
28 visible through the patina. The cut face shows abundant chondrules, CAIs and
29 AOAs.

30
31 **Petrography:** Description and classification (A. Love, *App*): Sample contains
32 distinct chondrules (average diameter of 743 μm ($N=29$), fragments and refractory
33 inclusions (CAIs up to 1 mm) all set within an opaque dark brown matrix. Matrix
34 contains FeO-rich olivine and has a weak fabric defined by slightly elongated
35 chondrules and oriented amoeboid olivine aggregates. Type I olivine chondrules
36 are dominant. Sample has 40% matrix.

37
38 **Geochemistry:** (A. Love, *App*) Olivine $\text{Fa}_{11.3\pm 15.6}$ (0.6-49.7), $N=16$; low Ca
39 pyroxene $\text{Fs}_{1.4\pm 0.4}\text{Wo}_{1.1\pm 0.8}$ ($\text{Fs}_{0.8-2.2}\text{Wo}_{0.5-3.6}$), $N=11$.

40
41 **Classification:** CV3. CV based on diameter of chondrules, matrix abundance and
42 ubiquitous CAIs. CV subgroup based on magnetic susceptibility. Type 3 based
43 upon unequilibrated compositions of chondrules.

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45 **Specimens:** *PARI* holds the main mass. One endcut weighing 28 g and a polished
46 thin section are on deposit at *App*.

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50 **Northwest Africa 12230** (NWA 12230)

51 (Northwest Africa)

52 Purchased: 2017

53 Classification: HED achondrite (Eucrite, polymict)

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55 **History:** 34 identical stones with a total weight 1024.7 g were found by a meteorite
56 prospector in Morocco. John Sinclair purchased the specimens at the 2017 Tucson
57 Gem and Mineral Show.

Physical characteristics: The stones have a dark-brownish-gray weathered exterior that has a granular texture and contains circular pits where clasts have been plucked out. The cut face of the interior is dark greenish-grey and shows a brecciated texture composed of lithic clasts and mineral fragments.

Petrography: Description and classification (A. Love, *App*): Sample is a polymict breccia composed of rounded to irregular-shaped mineral clasts and sparse lithic clasts (up to 2 cm) from cumulate and vitrophyric eucrites, and diogenites (~6 vol%). Pyroxenes are exsolved. Accessory minerals are FeNi grains, silica polymorph, ilmenite, chromite and olivine.

Geochemistry: (A. Love, *App*) Pigeonite host: $\text{Fs}_{51.4\pm 9.8}\text{Wo}_{5.8\pm 2.3}$ ($\text{Fs}_{34.8-65.6}\text{Wo}_{3.6-9.3}$, $\text{FeO/MnO}=27.4-34.2$), $N=8$; high-Ca pyroxene exsolution lamellae:

$\text{Fs}_{26.2\pm 5.8}\text{Wo}_{40.5\pm 0.9}$ ($\text{Fs}_{20.5-34.8}\text{Wo}_{39.2-41.4}$), $N=6$; diogenitic orthopyroxene:

$\text{Fs}_{23.5\pm 4.8}\text{Wo}_{2.7\pm 1.3}$ ($\text{Fs}_{14.2-28.2}\text{Wo}_{0.3-3.8}$, $\text{FeO/MnO}=24.4-32.4$), $N=6$; olivine ($\text{Fa}_{43.5\pm 6.5}$, $\text{FeO/MnO}=50.0-65.3$), $N=3$; plagioclase $\text{An}_{92.0\pm 2.1}$ ($\text{An}_{88.5-94.3}$), $N=10$.

Classification: Textural and compositional data (Fe/Mn of pyroxenes) indicate this is an HED achondrite. Sample contains 6% diogenite indicating this is a polymict eucrite breccia. The distinctive granular exterior and magnetic susceptibility suggest these stones are paired.

Specimens: John Sinclair holds the remainder of this material. A polished thin section, epoxy mount and 2 slices weighing 41.5 g are on deposit at *App*.

Northwest Africa 12231 (NWA 12231)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Howardite)

History: Purchased by V. Ouellet in Zagora in 2018.

Physical characteristics: The sample is a small stone with black fusion crust and a light grey, fine-grained interior.

Petrography: The sample is a fine-grained polymict breccia. Modal percentages of lithic fragments (in vol.%): cumulate eucrite clasts, 40%; basaltic eucrites, 30%; diogenitic clasts, 20%; anorthosite clasts, 5%; opaques, 3%; glass, 2%.

Geochemistry: Eucritic pyroxene: pigeonite ($\text{Fs}_{47.1\pm 4.3}\text{Wo}_{15.8\pm 4.3}$), $n=15$; augite ($\text{Fs}_{38.9\pm 3.8}\text{Wo}_{31.2\pm 3.6}$), $n=6$. Diogenitic pyroxene: orthopyroxene ($\text{Fs}_{18.05\pm 1.6}\text{Wo}_{4.54\pm 1.6}$), $n=9$. Calcic plagioclase ($\text{An}_{88.4\pm 4.2}$), $N=15$. Ilmenite ($\text{Fe}/(\text{Fe}+\text{Mg})=90.06\%$), $N=4$. Chromite, FeS and FeO Present. Silica-rich glass present.

Classification: howardite

Specimens: 3 g part slice at *UCLA*. 1 g powdered sample with C. Anderkin. Remainder of mass with V. Oullet.

Northwest Africa 12234 (NWA 12234)

Algeria

Find: 2016 March

Classification: Ordinary chondrite (LL3)

Petrography: (D. Sheikh, *FSU*) Composed of small to medium-sized chondrules (average ~0.7 mm) in a fine-grained matrix. Olivine and pyroxene are both heterogeneous in composition throughout. Low amount of metal present.

Geochemistry: Olivine, $\text{Fa}_{20.8\pm 9.6}$ ($\text{Fa}_{4.5-38.7}$, N=55); orthopyroxene $\text{Fs}_{16.2\pm 5.3}\text{Wo}_{3.2\pm 0.4}$ ($\text{Fs}_{8.2-31.5}\text{Wo}_{2.2-3.8}$, N=50).

Classification: Ordinary Chondrite (LL3)

Specimens: 22.13 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12235 (NWA 12235)

Morocco

Purchased: Jan. 2017

Classification: Ordinary chondrite (H4)

History: Purchased from S. Tutorow via Ebay. Place of origin is stated as Morocco.

Physical characteristics: Physical Characteristics: One mass of 1740 g. Completely fusion encrusted. Brown fusion crust. Sample cut once for preparing sections and a 21.88 g slice for Yale.

Petrography: Average chondrule diameter is 0.35 mm. No matrix, but sharp chondrule boundaries. Almost all Fe,Ni metal altered, but considerable volumes of troilite remain.

Classification: Ordinary Chondrite (H4).

Specimens: Main mass is at *WesU*, Joe Webb Peoples Museum. Several thick sections were prepared as well. *YPMNH*.

Northwest Africa 12236 (NWA 12236)

Morocco

Purchased: 2018 Jan

Classification: Ordinary chondrite (H7)

History: Specimen is cataloged at the Royal Ontario Museum as LM58922.

Petrography: Specimen is composed of olivine, pyroxene and minor plagioclase and is devoid of chondrules or relict chondrule rims. Texture is mainly poikilitic, with large olivine oikocrysts (averaging 2383 μm in diameter, n=12) enclosing small olivine phenocrysts (averaging 104 μm in diameter, n=26).

Geochemistry: Olivine: 17.9 ± 1.4 , $\text{Fe/Mn}=35.9\pm 5.5$ (n=27); Low Ca-pyroxene: $15.0\pm 0.7\text{Wo}_{2.1\pm 1.1}$, $\text{Fe/Mn}=23.3\pm 5.0$ (n=24); Augite $\text{Fs}_{6.6\pm 1.0}\text{Wo}_{42.0\pm 3.6}$, $\text{Fe/Mn}=15.9\pm 1.5$, $\text{Cr}_2\text{O}_3=1.22\pm 0.23$ wt% (n=7). Oxygen Isotopes: (Karen Ziegler, *UNM*) $\delta^{17}\text{O} = 2.937$ permil, $\delta^{18}\text{O} = 4.497$ permil, $\delta^{17}\text{O} = 0.562$ permil

Northwest Africa 12237 (NWA 12237)

(Northwest Africa)

Purchased: 2017

Classification: Ureilite

History: Purchased by Suzanne Morrison from a Moroccan meteorite dealer in Tucson, 2017.

Physical characteristics: Single stone with dark brown, weathered exterior.

Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and Fe-metal. Ubiquitous, finely disseminated Fe-metal occupies zones between silicate grain boundaries. Graphite is present.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{22.0\pm 0.2}$, $Fe/Mn=50\pm 3$, $Cr_2O_3=0.72\pm 0.18$ (wt%), $n=6$; pigeonite $Fs_{18.8\pm 0.1}Wo_{6.0\pm 0.2}$, $Fe/Mn=32\pm 2$, $n=6$.

Classification: Ureilite

Specimens: 20.2 g including a probe mount on deposit at *UNM*, Suzanne Morrison holds the main mass.

Northwest Africa 12238 (NWA 12238)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L5)

History: Purchased by Brad Kern in January 2011 from Morocco.

Physical characteristics: Three identical appearing stones.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows porphyritic chondrules and plagioclase grains up to 25 μm .

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{25.5\pm 0.3}$, $Fe/Mn=50\pm 1$, $n=6$; low-Ca pyroxene $Fs_{20.3\pm 0.6}Wo_{1.8\pm 1.3}$, $Fe/Mn=28\pm 1$, $n=5$.

Classification: Ordinary chondrite (L5)

Specimens: 30.6 g including a probe mount on deposit at *UNM*, Brad Kern holds the main mass of 1092.2 g.

Northwest Africa 12239 (NWA 12239)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (H5)

History: Purchased by Suzanne Morrison in Tucson, 2017.

Physical characteristics: Many identical appearing stones.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows porphyritic chondrules and plagioclase grains up to 25 μm .

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{18.7\pm 0.3}$, $Fe/Mn=38\pm 2$, $n=6$; low-Ca pyroxene $Fs_{15.4\pm 0.1}Wo_{1.4\pm 1.2}$, $Fe/Mn=22\pm 2$, $n=4$, plagioclase $Ab_{75.2\pm 11.1}$, $n=4$.

Classification: Ordinary chondrite (H5)

Specimens: 20 g including a probe mount on deposit at *UNM*, Suzanne Morrison holds the main mass.

Northwest Africa 12240 (NWA 12240)

Mauritania

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3 Find: 2017

4 Classification: Ordinary chondrite (H4)

5 **Petrography:** The rock contains well-defined RP, PP, PO, and BO chondrules
6 ranging from 80 to 1100 μm in diameter and averaging ~ 400 μm . Opaques include
7 metallic Fe-Ni, troilite and chromite. There are many shock features: (1) Most
8 troilite grains are polycrystalline. (2) Some kamacite grains contain small irregular
9 grains of troilite, some also containing metallic Cu (up to 8×30 μm in size) adjacent
10 to the troilite. (3) Also present are chromite-plagioclase assemblages and chromite
11 veinlets inside olivine grains. The typical plagioclase grain is 5-10 μm in size. All
12 of the low-Ca pyroxene grains are orthorhombic.
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18 **Northwest Africa 12241** (NWA 12241)

19 Algeria

20 Purchased: 2018 Aug

21 Classification: Martian meteorite (Shergottite)

22 **History:** Purportedly found in Algeria and purchased by Mohamed Brahim
23 Sueilem in August 2018 from a dealer in Bordj Badji Mokhtar, Algeria.

24 **Physical characteristics:** The material (total weight 1150 g) comprises multiple
25 broken fragments, some with adhering black fusion crust. The friable pieces are
26 pale green in color and contain white plagioclase but no evident maskelynite.

27 **Petrography:** (A. Irving and S. Kuehner, *UWS*) This fresh specimen has an
28 orthocumulate texture with ~ 15 vol.% lath-like, birefringent plagioclase occurring
29 interstitially to more abundant and coarser grained (0.2-1.6 mm, mean 0.7 mm)
30 mafic silicate grains (unzoned olivine and patchily zoned low-Ca and high-Ca
31 clinopyroxene with very limited compositional variation). Accessory phases
32 include Mg-merrillite, chlorapatite, ilmenite, Ti-rich chromite, Cr-rich chromite
33 and pyrrhotite (some associated with minor pentlandite). Levels of shock are
34 judged to be low, based on the absence of optical effects in plagioclase and the
35 complete lack of any conversion to maskelynite; the presence of widespread
36 microcracks in mafic silicates is the only clear evidence of shock.

37 **Geochemistry:** Olivine ($\text{Fa}_{32.7-34.3}$, $\text{FeO/MnO} = 47-48$, $N = 4$), pigeonite ($\text{Fs}_{25.0-}$
38 30.4 $\text{Wo}_{5.5-10.0}$, $\text{FeO/MnO} = 28-30$, $N = 4$), subcalcic augite ($\text{Fs}_{17.1-18.1}$ $\text{Wo}_{32.7-32.4}$,
39 $\text{FeO/MnO} = 23-25$, $N = 2$), aluminous augite inclusion in olivine ($\text{Fs}_{17.1}$ $\text{Wo}_{39.5}$,
40 $\text{FeO/MnO} = 28$, $\text{TiO}_2 = 1.1$ wt.%, $\text{Al}_2\text{O}_3 = 6.2$ wt.%), plagioclase ($\text{An}_{43.0-57.8}$ $\text{Or}_{2.4-}$
41 1.3 , $N = 3$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed
42 subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 2.907, 2.635, 2.808; $\delta^{18}\text{O}$
43 5.092, 4.620, 4.875; $\Delta^{17}\text{O}$ 0.218, 0.195, 0.234 per mil.

44 **Classification:** Martian (shergottite, olivine gabbroic, orthocumulate, low shock).

45 **Specimens:** 22.4 g including one polished thin section at *UWB*; remainder held
46 jointly by Naji Ben Faraji and Mohamed Brahim Sueilem.
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58 **Northwest Africa 12243** (NWA 12243)

59 Mauritania
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Purchased: 2018 May

Classification: HED achondrite (Eucrite, polymict)

History: Found in Mauritania and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh breccia specimen consisting of larger angular mineral clasts derived mostly from gabbroic eucrites in a finer matrix of the same phases. Minerals are exsolved pigeonite, anorthite, silica polymorph, unexsolved ferroan pigeonite, minor (<10 vol.%) diogenitic orthopyroxene, olivine, ilmenite, chromite and troilite.

Geochemistry: Diogenitic orthopyroxene ($\text{Fs}_{27.9-29.0}\text{Wo}_{2.1-3.6}$, $\text{FeO/MnO} = 27-28$, $N = 2$), olivine ($\text{Fa}_{42.3-51.0}$, $\text{FeO/MnO} = 50$, $N = 2$), low-Ca pyroxene host in exsolved pigeonite ($\text{Fs}_{43.5-45.9}\text{Wo}_{2.6-5.5}$, $\text{FeO/MnO} = 27-34$, $N = 2$), clinopyroxene exsolution lamella ($\text{Fs}_{17.7}\text{Wo}_{44.2}$, $\text{FeO/MnO} = 26$), subcalcic augite ($\text{Fs}_{62.5}\text{Wo}_{26.0}$, $\text{FeO/MnO} = 34$), anorthite ($\text{An}_{91.5-93.9}\text{Or}_{0.6-0.5}$, $N = 2$).

Classification: Eucrite (polymict breccia).

Specimens: 20.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12244 (NWA 12244)

Morocco

Purchased: 2018 May

Classification: Ordinary chondrite (LL3)

History: Found near Bir Lahlou, Western Sahara, and purchased by *DPitt* in May 2018 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed chondrules (apparent diameter $780 \pm 630 \mu\text{m}$, $N = 21$) are set in a sparse finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{0.3-49.1}$, Cr_2O_3 in ferroan examples 0.07-0.10 wt.%, mean 0.09 ± 0.01 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{2.3-25.2}\text{Wo}_{0.5-3.8}$, $N = 3$), pigeonite ($\text{Fs}_{18.0}\text{Wo}_{14.6}$), subcalcic augite ($\text{Fs}_{23.7}\text{Wo}_{22.4}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.80$.

Classification: Ordinary chondrite (LL3).

Specimens: 25.6 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12245 (NWA 12245)

(Northwest Africa)

Purchased: 2018 Apr

Classification: HED achondrite (Diogenite)

History: Purchased by Fred *Olsen* in April 2018 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of angular grains of orthopyroxene (exhibiting undulose extinction and containing sparse exsolution lamellae of clinopyroxene), anorthite (~15 vol.%,

polycrystalline), silica polymorph, chromite, troilite and Ni-free metal. Some composite clasts containing both orthopyroxene and anorthite are present, as well as pockets composed of radially-quenched shock melt.

Geochemistry: Orthopyroxene host (Fs_{34.0-34.1}Wo_{2.3-2.8}, FeO/MnO = 27-29, N = 3), clinopyroxene exsolution lamellae (Fs_{14.3-15.6}Wo_{44.4-42.8}, FeO/MnO = 24-25, N = 2), anorthite (An_{94.0-95.1}Or_{0.4-0.3}, N = 2).

Classification: Diogenite (noritic breccia, shocked).

Specimens: 16.32 g including one polished thin section at *UWB*; remainder with the estate of Mr. F. *Olsen* managed by D. Baldwin.

Northwest Africa 12246 (NWA 12246)

Morocco

Purchased: 2018 May

Classification: HED achondrite (Eucrite, unbrecciated)

History: Found near Bir Tighisit, southern Morocco and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh gabbroic eucrite composed mostly of zoned low-Ca and high-Ca pyroxene (grainsize up to 1.5 mm) and anorthite (as interstitial stubby laths) with accessory silica polymorph, fayalite, ilmenite, chromite and troilite.

Geochemistry: Low-Ca pyroxene cores (Fs_{30.2-30.7}Wo_{5.8-6.1}, FeO/MnO = 26-27, N = 2), orthopyroxene rims (Fs_{57.2-62.8}Wo_{3.9-2.1}, FeO/MnO = 33-34, N = 2), subcalcic augite (Fs_{39.2}Wo_{30.3}; Fs_{45.7}Wo_{23.4}; FeO/MnO = 31, N = 2), fayalite (Fa_{80.5-82.6}, FeO/MnO = 39-41), anorthite (An_{91.4-92.1}Or_{0.6-0.8}, N = 2).

Classification: Eucrite (unbrecciated, gabbroic).

Specimens: 21.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12247 (NWA 12247)

Algeria

Purchased: 2018 May

Classification: Carbonaceous chondrite (CV3)

History: Found in Algeria and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 900 ± 350 μm , N = 21; some rimmed) and fine grained CAI are set in a fine grained matrix (~30 vol.%, orange-brown in thin section) containing minor calcite and barite.

Geochemistry: Olivine (Fa_{0.3-37.3}, N = 3), orthopyroxene (Fs_{0.7-1.2}Wo_{0.8-0.7}, N = 3), augite (Fs_{5.0}Wo_{39.8}; Fs_{47.9}Wo_{50.1}; N = 2).

Classification: Carbonaceous chondrite (CV3).

Specimens: 15.8 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12248 (NWA 12248)

Mauritania

Purchased: 2018 May

Classification: Lunar meteorite (feldspathic breccia)

History: Found in Mauritania and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.**Physical characteristics:** A small (37.3 g) dark stone lacking fusion crust but coated by a shiny desert patina. The fresh interior contains small white and beige clasts set in a dark-gray matrix.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed of mineral clasts of anorthite, olivine, low-Ca pyroxenes, augite, ilmenite and troilite in a fine grained matrix containing Ni-poor metal and minor barite.**Geochemistry:** Olivine ($\text{Fa}_{44.5}$, $\text{FeO/MnO} = 105$; $\text{Fa}_{13.1}$, $\text{FeO/MnO} = 54$; $N = 2$), low-Ca pyroxene ($\text{Fs}_{38.2}\text{Wo}_{4.5}$, $\text{FeO/MnO} = 59$), pigeonite ($\text{Fs}_{32.0-32.5}\text{Wo}_{14.6-9.7}$, $\text{FeO/MnO} = 55-62$, $N = 2$), augite ($\text{Fs}_{22.4}\text{Wo}_{43.1}$, $\text{FeO/MnO} = 51$), anorthite ($\text{An}_{94.3-95.9}\text{Or}_{0.2}$, $N = 2$).**Classification:** Lunar (feldspathic breccia).**Specimens:** 9.5 g including one polished thin section at *UWB*; remainder with *DPitt*.**Northwest Africa 12250** (NWA 12250)

(Northwest Africa)

Purchased: 2018 May

Classification: HED achondrite (Howardite)

History: Found in Algeria and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed mainly of mineral clasts derived from gabbroic eucrites, rare lithic clasts of gabbroic eucrite, and ~15 vol.% diagenitic orthopyroxene (~15 vol.%) in a finer grained matrix of related debris. Other minerals are olivine, exsolved pigeonite, unexsolved pigeonite, subcalcic augite, calcic plagioclase, ilmenite and troilite.**Geochemistry:** Diagenitic orthopyroxene ($\text{Fs}_{16.0-18.3}\text{Wo}_{1.3-1.5}$, $\text{FeO/MnO} = 29-31$, $N = 2$), olivine ($\text{Fa}_{52.0-57.1}$, $\text{FeO/MnO} = 47-50$, $N = 2$), orthopyroxene host in exsolved pigeonite ($\text{Fs}_{54.3}\text{Wo}_{1.1}$; $\text{Fs}_{61.7}\text{Wo}_{1.4}$; $\text{FeO/MnO} = 28-29$; $N = 2$), pigeonite ($\text{Fs}_{58.0}\text{Wo}_{15.1}$, $\text{FeO/MnO} = 34$), subcalcic augite ($\text{Fs}_{55.6}\text{Wo}_{24.6}$, $\text{FeO/MnO} = 30$), plagioclase ($\text{An}_{82.0-89.4}\text{Or}_{0.9-0.3}$, $N = 2$).**Classification:** Howardite.**Specimens:** 12.2 g including one polished thin section at *UWB*; remainder with *DPitt*.**Northwest Africa 12262** (NWA 12262)

(Northwest Africa)

Purchased: 2018 Jul

Classification: Martian meteorite (Shergottite)

History: Purchased in Ouarzazate, Morocco by Mohamed Aid in July 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Medium-grained with diabasic texture and some small, dark glassy shock melt pockets. Composed predominantly of zoned clinopyroxene and maskelynite with accessory fine grained intergrowths of hedenbergite+fayalite+silica, Fe-Ti oxide (finely exsolved), merrillite and pyrrhotite.

Geochemistry: Subcalcic augite ($\text{Fs}_{28.5-30.6}\text{Wo}_{28.2-23.7}$, $\text{FeO/MnO} = 30$, $N = 2$), pigeonite ($\text{Fs}_{41.3}\text{Wo}_{15.5}$, $\text{FeO/MnO} = 31$), ferropigeonite ($\text{Fs}_{71.1-83.4}\text{Wo}_{17.1-11.3}$, $\text{FeO/MnO} = 38-45$, $N = 4$), maskelynite ($\text{An}_{50.9-52.1}\text{Or}_{2.1}$, $N = 2$).

Classification: Martian (shergottite, diabasic)

Specimens: 26.3 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12265 (NWA 12265)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Eucrite, melt breccia)

History: Purchased in Rissani, Morocco by Adam *Aaronson* in January 2015.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed predominantly of a vesicular quenched melt rock lithology enclosing sparse remnant clasts of shocked gabbroic eucrite. The fine grained melt rock lithology consists of aluminous pigeonite (with two distinct Fe/Mg ratios) and calcic plagioclase with accessory Ti-poor chromite, Cr-ulvöspinel and troilite. Gabbroic eucrite clasts contain recrystallized pigeonite and polycrystalline calcic plagioclase with minor fayalite, silica polymorph, Ti-poor chromite, Ti-chromite, troilite and minor barite.

Geochemistry: Pigeonite ($\text{Fs}_{31.2-38.4}\text{Wo}_{12.0-17.1}$, $\text{FeO/MnO} = 26-28$, $\text{Al}_2\text{O}_3 = 2.3-5.7$ wt.%, $N = 3$), ferroan pigeonite ($\text{Fs}_{56.6-58.7}\text{Wo}_{16.8-19.6}$, $\text{FeO/MnO} = 32-33$, $\text{Al}_2\text{O}_3 = 0.8-1.1$ wt.%), fayalite ($\text{Fa}_{80.4-80.8}$, $\text{FeO/MnO} = 45-47$, $N = 2$), plagioclase ($\text{An}_{88.0-89.9}\text{Or}_{0.4-0.8}$, $N = 2$).

Classification: Eucrite (vesicular, shock-melted breccia).

Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12267 (NWA 12267)

(Northwest Africa)

Purchased: 2018 Jun

Classification: HED achondrite (Diogenite)

History: Purchased by Craig Zlmen in June 2018 from a Moroccan dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed predominantly of larger and smaller angular clasts of orthopyroxene with accessory

chromite, Ti-chromite, calcic plagioclase, troilite and rare olivine (as inclusions in orthopyroxene). Some cross-cutting veinlets of goethite are present.

Geochemistry: Orthopyroxene ($\text{Fs}_{22.8-28.5}\text{Wo}_{2.9-1.3}$, $\text{FeO/MnO} = 27-31$, $N = 3$), plagioclase ($\text{An}_{83.4}\text{Or}_{1.1}$; $\text{An}_{96.3}\text{Or}_{0.1}$; $N = 2$), olivine ($\text{Fa}_{22.6}$, $\text{FeO/MnO} = 49$).

Classification: Diogenite (breccia).

Specimens: 18.1 g including one polished thin section at *UWB*; remainder with Mr. C. Zlmen.

Northwest Africa 12268 (NWA 12268)

(Northwest Africa)

Purchased: 2018 Jun

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Craig Zlmen in June 2018 from a Moroccan dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed granular chondrules (apparent diameter $950 \pm 450 \mu\text{m}$, $N = 22$) plus amoeboid to irregular, fine grained CAI are set in a very fine grained matrix ($\sim 30 \text{ vol.}\%$, black in thin section).

Geochemistry: Olivine ($\text{Fa}_{0.8-53.0}$, $N = 6$), orthopyroxene ($\text{Fs}_{0.7-2.4}\text{Wo}_{1.0-1.2}$, $N = 2$), clinopyroxene ($\text{Fs}_{1.0-1.7}\text{Wo}_{37.9-38.3}$, $N = 2$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 24.5 g including one polished thin section at *UWB*; remainder with Mr. C. Zlmen.

Northwest Africa 12269 (NWA 12269)

(Northwest Africa)

Purchased: 2018 Jul

Classification: Martian meteorite (Shergottite)

History: Purchased in Ouarzazate, Morocco by Mohamed Aid in July 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Relatively fine grained with intersertal texture. Composed predominantly of zoned clinopyroxene and maskelynite (some exhibiting a curved, narrow lath-like habit) with accessory fine grained intergrowths of hedenbergite+fayalite+silica, Fe-Ti oxides, merrillite and pyrrhotite.

Geochemistry: Subcalcic augite ($\text{Fs}_{24.8-41.8}\text{Wo}_{31.4-24.3}$, $\text{FeO/MnO} = 30-33$, $N = 3$), ferropigeonite ($\text{Fs}_{66.9-73.0}\text{Wo}_{16.6-16.5}$, $\text{FeO/MnO} = 41-43$, $N = 2$), maskelynite ($\text{An}_{51.9-53.1}\text{Or}_{1.3-1.2}$, $N = 2$).

Classification: Martian (shergottite, fine-intersertal)

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. Aaronson.

Northwest Africa 12270 (NWA 12270)

Mauritania

Purchased: 2018

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Terry *Boudreaux* from a meteorite dealer in Mauritania.

Physical characteristics: Six identically appearing pieces, no fusion crust, saw cut reveals a fragmental breccia with numerous white feldspathic clasts set in a dark gray ground mass.

Petrography: (C. Agee, *UNM*) This meteorite consists of primarily of fragmental pyroxene, olivine, feldspathic clasts and shock melt. Ubiquitous Ti-rich chromite and ilmenite present, rare Fe-Ni metal detected.

Geochemistry: (C. Agee, *UNM*) olivine $Fa_{42.7\pm 7.3}$, Fe/Mn=94±9, n=14; pigeonite $Fs_{37.0\pm 8.0}Wo_{17.9\pm 6.9}$, Fe/Mn=56±5, n=13; plagioclase $An_{96.6\pm 0.4}$, n=6; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition):

SiO₂=44.8±1.3, TiO₂=0.31±0.08, Al₂O₃=26.0±3.9, Cr₂O₃=0.15±0.09,

MgO=5.0±2.2, FeO=5.9±1.7, MnO=0.08±0.03, CaO=16.1±1.8, NiO=0.02±0.01,

Na₂O=0.44±0.07, K₂O=0.08±0.01 (all wt%), n=7.

Classification: Lunar feldspathic breccia

Specimens: 29.2 g including a probe mount on deposit at *UNM*, Terry *Boudreaux* holds the main mass.

Northwest Africa 12271 (NWA 12271)

(Northwest Africa)

Purchased: 2018

Classification: Ureilite

History: Purchased in Guelmim, Morocco, July 2018.

Physical characteristics: Single stone; sandblasted exterior; saw cut reveals an interior mosaic of brown crystals; minor amount iron-staining present.

Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and augite. Ubiquitous graphite throughout. Fine grained Fe-metal is present along grain boundaries.

Geochemistry: (C. Agee) olivine $Fa_{20.8\pm 0.1}$, Fe/Mn=44±1, n=7; pigeonite

$Fs_{17.4\pm 0.2}Wo_{4.3\pm 0.2}$, Fe/Mn=27±2, n=5; augite $Fs_{10.9\pm 0.1}Wo_{34.5\pm 0.1}$, Fe/Mn=19±0, n=2.

Classification: Augite and graphite-bearing ureilite

Specimens: 20.2 g including a probe mount on deposit at *UNM*, Zouhair Fettouh holds the main mass.

Northwest Africa 12272 (NWA 12272)

(Northwest Africa)

Purchased: 2017 Oct

Classification: Ordinary chondrite (LL7)

Petrography: (K. Metzler, *IfP*) Unbrecciated ordinary chondrite with distinct recrystallization texture. Large areas of secondary feldspar grains (many with sizes >100 μm) which poikilitically enclose olivine and pyroxene grains. Many plagioclase grains with rectangular outlines due to the alignment along boundaries

of recrystallized pyroxene crystals. Some metal veins up to 4 mm are observed. The outlines of a few large chondrules are still dimly visible.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{29.9\pm 0.3}$ (29.1-30.5); $n=14$. The mean low-Ca pyroxene composition is $Fs_{23.9\pm 0.4}Wo_{4.1\pm 0.3}$ ($Fs_{23.3-24.4}Wo_{3.6-4.5}$), $n=14$; Mean CaO concentration in low-Ca pyroxene: 2.1 ± 0.2 (1.9-2.3) wt%. The mean composition of Ca-rich pyroxene is $Fs_{12.8\pm 0.9}Wo_{38.5\pm 1.9}$ ($Fs_{10.8-13.9}Wo_{36.7-41.9}$), $n=16$.

Classification: LL chondrite based on mineral chemistry. Petrologic type 7 based on the equilibrated state of olivine and pyroxene, and large grain size of secondary plagioclase. According to [Tait et al. \(2014\)](#) the transition between types 6 and 7 is a CaO concentration in low-Ca pyroxene of 1.0 wt%; in this sample the respective value is 2.1 wt%. According to [Brearley and Jones \(1998\)](#) Ca-rich pyroxene in type 6 chondrites has a Wo value of 45 mol%, which decreases in type 7 chondrites to 45-36 mol%. In this sample the respective value is 38.5 mol%.

Northwest Africa 12273 (NWA 12273)

(Northwest Africa)

Purchased: 2018

Classification: Ungrouped chondrite

History: Purchased by Jay Piatek from a Moroccan meteorite dealer on October 25, 2018.

Physical characteristics: Dense, single individual. Fusion crust absent; abundant bright metal; scattered small chondrules are visible.

Petrography: (C. Agee, *UNM*) This meteorite consists of approximately 75% metal in the form of kamacite (~90%) and taenite (~10%) grains, diameters ranging from 50-500 μm . Minor troilite was observed throughout. Silicates occur primarily in the form of chondrules, most are porphyritic, diameters in the range 100-500 μm , making up approximately 20% of this meteorite.

Geochemistry: (C. Agee) Olivine $Fa_{26.2\pm 3.3}$, $Fe/Mn=55\pm 5$, $n=29$; low-Ca pyroxene $Fs_{15.3\pm 1.8}Wo_{0.7\pm 0.2}$, $Fe/Mn=23\pm 2$, $n=11$. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}\text{O}= 5.258, 5.613, 7.249$; $\delta^{17}\text{O}= 3.939, 3.971, 4.786$; $\Delta^{17}\text{O}= 1.163, 1.007, 0.959$ (linearized, all per mil, TFL slope=0.528).

Classification: Ungrouped chondrite. This is a metal-rich chondrite with oxygen isotopes that overlap with LL-chondrites. The olivine Fa content is consistent with L3, however the low-Ca pyroxene Fs is consistent with H4. The high metal content is inconsistent with ordinary chondrite. Texturally, this meteorite resembles a CB-b, however the oxygen isotopes and Fa and Fs are unlike CB chondrites.

Specimens: 23.2 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass of 240 g.

Northwest Africa 12279 (NWA 12279)

Tindouf, Algeria

Find: 2016 Oct 10

Classification: Lunar meteorite (feldspathic breccia)

History: The meteorite was purchased in Denver USA by Zhouping Guo and Guobing Zhong on September, 2017 from Adam Aaronson.

Physical characteristics: A single bulk specimen, with sepia fresh fusion crust and low weathering degree. A large impact molten mass was observed in the specimen.

Petrography: This lunar meteorite comprises two petrographic areas: impact melt breccia and anorthosite. The anorthosite includes forsterite, pigeonite, low-Ca pyroxene, plagioclase and minor minerals such as ilmenite, chromite, quartz and other opaque minerals. It has a subophitic structure. The impact-melt breccia contains various types of lithic clasts (anorthosite, olivine-gabbro, gabbro), mineral and glassy fragments. The matrix consists of very fine-grained, cryptocrystalline (~0.1mm) and vitric particles with sporadic small vesicles.

Geochemistry (JK. Zhou, HY. Chen, ZP. Xia *GUT*): Olivine, $Fa_{12.8-46.3}Fo_{53.8-87.3}$, $FeO/MnO=66.3-96.9$ (n=29); Orthopyroxene, $Fs_{15.5-32.2}Wo_{2.98-4.22}En_{64.9-80.3}$, $Fe/Mn(mol)=54.5-69.3$ (n=3); Pigeonite: $Fs_{23.2-53.1}Wo_{7.19-23.7}En_{39.8-57.4}$, $Fe/Mn(mol)=51.1-61.7$ (n=6); Augite, $Fs_{8.42-44.4}Wo_{31.4-44.1}En_{18.7-47.5}$, $Fe/Mn(mol)=37.1-53.9$ (n=14); Plagioclase: $An_{92.9-98.5}Or_{0.06-0.69}$ (n=15); Spinel: $MgO, 20.1\%-23.6\%$; $Al_2O_3, 59.5\%-69.2\%$; $Cr_2O_3, 3.91\%-6.00\%$; $FeO, 6.05\%-7.46\%$.

Classification: Lunar (anorthositic impact-melt breccia)

Specimens: 30.2 g including one polished thin section are deposited in *GUT*; Remaining material with Guobing Zhong and Zhouping Guo.

Northwest Africa 12280 (NWA 12280)

Tindouf, Algeria

Find: 2016 Oct 10

Classification: Martian meteorite (Shergottite)

History: The meteorite was purchased in Denver USA by Zhouping Guo and Guobing Zhong on September, 2017 from Adam Aaronson.

Physical characteristics: A single bulk specimen, no fusion crust. Coarse-grained absinthe-green minerals can be observed. Weathering is strong.

Petrography: This meteorite is composed of a moderate-grained (20-100 μm) assemblage of pyroxene (38 vol%), olivine (51 vol%), maskelynite (7 vol%) and minor opaque minerals such as ilmenite, chromite and spinel. Maskelynite appears to be injected between pyroxene and olivine crystals.

Geochemistry (JK. Zhou, HY. Chen, ZP. Xia *GUT*): olivine: $Fa_{35.2-37.3}$ (n=42), $Fe/Mn(mol)=48.3-53.3$ (n=42); pigeonite: $Fs_{18.8-28.2}Wo_{6.50-15.4}En_{56.8-68.6}$, $Fe/Mn(mol)=24.5-30.0$, $Mg\#=67.1-73.8$ (n=15); augite: $Fs_{13.9-20.4}Wo_{26.4-43.3}En_{42.8-53.3}$, $Fe/Mn(mol)=23.6-30.0$, $Mg\#=70.9-73.3$ (n=20); Maskelynite: $An_{49.5-59.9}Or_{2.29-3.62}Ab_{36.9-46.9}$ (n=17); Spinel: $MgO, 2.85\%-4.15\%$; $Al_2O_3, 4.08\%-7.17\%$; $TiO_2, 12.6\%-19.6\%$; $Cr_2O_3, 20.1\%-31.7\%$; $FeO, 44.3\%-52.8\%$.

Classification: Martian (shergottite)

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3 **Specimens:** 18.5 g including one polished thin section are deposited in *GUT*;
4 Remaining material 60.5 g with Guobing Zhong and Zhouping Guo.
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8 **Northwest Africa 12281** (NWA 12281)

9 (Northwest Africa)

10 Purchased: 2013

11 Classification: Ordinary chondrite (LL3)

12 **History:** Acquired from Ruben Garcia from 2013 Tucson Gem and Mineral Show.

13 **Physical characteristics:** Sub-rounded, 30.6 g meteorite partially covered in fusion
14 crust. Interior is dominantly light colored with well-developed chondrules and
15 mineral fragments supported by a sparse dark matrix. Metals and sulfides fine-
16 grained. Weathering is heterogeneous and is dominantly W1 with patches of W3.

17 **Petrography:** (Bercovici, H., Dolinschi, J., Dunham, E., Franco, G., Garani, J.,
18 Loescher, G., *ASU*): Visually, the meteorite is estimated to be 80% chondrules and
19 fragments, 16% matrix, and 3% opaques. Chondrules typically 0.2 to 1.5 mm in
20 diameter, with an estimated mean of 0.8 mm. Range of chondrules types present
21 including PP, PO, POP, BO, and RP. Some PO chondrules contain purple (plane
22 polarized light) glass. Several chondrules are mantled by sulfides with minor metal.
23 The largest chondrule (9 × 5 mm) is composed of a barred olivine core, PO mantle,
24 and porphyritic low-Ca pyroxene rim. Another chondrule (3 × 4 mm troilite-
25 mantled PO) contains euhedral olivine phenocrysts that have a comb-like
26 overgrowth of olivine (with different BSE brightness) protruding into the
27 devitrified mesostasis. Sulfide is more abundant than metal. Metal and troilite occur
28 in three settings: fine-grained and dispersed in the matrix; rounded grains to 100
29 microns; and rarely as nodules. The largest nodule (1.5 × 1 mm) consists of a
30 troilite with rounded grains of kamacite. This nodule contains a few grains (to 20
31 μm) of native copper. Troilite is polycrystalline with occasional shock twins. Shock
32 grade consistent with S2 and weathering with W2/3.

33 **Geochemistry:** Olivine $Fa_{20.0\pm 6.2}$, range $Fa_{12.0-29.9}$. Cr_2O_3 in olivine grain cores is
34 0.62 ± 0.07 , range 0.46-0.69, n=10. Low-Ca pyroxene $Fs_{15.7\pm 7.8}Wo_{1.4\pm 1.2}$, range $Fs_{1.9-}$
35 $33.7}Wo_{0.2-4.8}$, n=49. High-Ca pyroxene $Fs_{17.4\pm 8.6}Wo_{16.1\pm 9.5}$, range $Fs_{11.0-42.1}Wo_{5.1-41.2}$,
36 n = 18. Feldspar grains, found in only one chondrule, are $An_{97.9\pm 2.5}Ab_{2.1\pm 2.5}$, ranging
37 $An_{95.1-100.0}Ab_{0.0-4.8}$, n=3. Metal compositions in wt% are
38 $Fe_{78.46\pm 14.98}Ni_{21.14\pm 14.91}Co_{0.40\pm 0.14}$ n=5.

39 **Classification:** LL based on the low metal content. Estimated petrologic type of 3.4
40 based on Fa and Fs spread and Cr_2O_3 content in olivine grain cores.
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53 **Northwest Africa 12282** (NWA 12282)

54 (Northwest Africa)

55 Find: 2016

56 Classification: HED achondrite (Eucrite, polymict)

57 **History:** Purchased by Michael Farmer from a Moroccan meteorite dealer at the
58 2016 Tucson Gem and Mineral show.
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Physical characteristics: Sand-blasted, angular, orange-stained 141.5 g meteorite with patches of fusion crust. Light-colored clasts to 8 mm readily visible at the surface of the stone and supported by a gray matrix. Fresh stone with low weathering.

Petrography: (Dillon, S., Dunham, E., Fitch, R., Karageozian, M., Sedler, M., Teichert, Z., *ASU*): The meteorite is a breccia dominated by angular to sub-rounded grains and clasts to 8 mm. The petrography is based on two slices (4 × 3 cm and 4 × 4 cm), and a polished mount. The 4 × 3 cm slice is light colored with angular to sub-angular clasts to 4 mm in a poorly sorted clastic matrix dominated by pyroxene and plagioclase. The 4 × 4 cm slice is petrographically more varied with a range of clast textures (subophitic, diabasic, granulitic) supported by the eucritic debris. This slice has a prominent 6 × 5 mm subangular fine-grained dark clast containing a 3-mm spherical fine-grained clast with similar mineralogy as the bulk eucrite. Accessory minerals include silica, troilite, chromite, and ilmenite. The majority of the pyroxene grains exhibit exsolution lamellae. Plagioclase shows extensive twinning. Pyroxene grains are primarily Ca-poor pyroxene with Ca-rich pyroxene present in exsolution lamellae. Plagioclase grains are primarily anorthite rich end members. The sample has a low shock grade; one melt clast within a pyroxene clast is present and is potentially representative of a previous higher-stage shock event.

Geochemistry: Pyroxene without exsolution lamellae is pigeonite

$\text{Fs}_{52.6\pm 4.4}\text{Wo}_{10.4\pm 5.6}$, range $\text{Fs}_{43.7-55.8}\text{Wo}_{6.5-22.0}$, $\text{FeO/MnO}=33.2\pm 2.2$, $n=8$. Pyroxene with exsolution lamellae is predominantly clinopyroxene $\text{Fs}_{57.2\pm 0.7}\text{Wo}_{4.4\pm 0.9}$, range $\text{Fs}_{55.8-58.2}\text{Wo}_{2.7-5.4}$, $\text{FeO/MnO}=33.0\pm 2.1$, $n=12$, the lamellae are orthopyroxene $\text{Fs}_{27.3\pm 0.9}\text{Wo}_{41.9\pm 0.7}$, range $\text{Fs}_{26.3-28.8}\text{Wo}_{40.7-42.8}$, $\text{FeO/MnO}=34.1\pm 1.7$, $n=8$. Plagioclase has composition $\text{An}_{88.5\pm 6.0}$, $n = 18$.

Specimens: An original mass of 141.5 g was acquired by *MFarmer*; 21.99 g and one thin section is held by *ASU*. The main mass is held by Michael Farmer.

Northwest Africa 12283 (NWA 12283)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Agadir, Morocco.

Physical characteristics: Grayish fragments without fusion crust.

Petrography: The meteorite is a brecciated medium-grained basalt predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with average grains sizes of about 500 μm . Minor phases include silica, ilmenite, chromite, and troilite. No metallic iron has been detected.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{60.3\pm 0.5}\text{Wo}_{2.4\pm 0.7}$ ($\text{Fs}_{59.3-60.9}\text{Wo}_{1.8-4.0}$, $n=12$, $\text{FeO/MnO}=31-34$); Ca-pyroxene: $\text{Fs}_{26.7\pm 0.4}\text{Wo}_{43.4\pm 0.7}$ ($\text{Fs}_{25.7-27.4}\text{Wo}_{41.7-44.0}$, $n=12$, $\text{FeO/MnO}=29-33$); calcic plagioclase: $\text{An}_{89.9\pm 2.1}$ ($\text{An}_{86.4-92.5}$, $n=12$)

Northwest Africa 12284 (NWA 12284)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (LL3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.**Physical characteristics:** Brownish fragments without fusion crust.**Petrography:** The meteorite displays a chondritic texture with mostly rounded chondrules (mean diameter about 0.7 mm) in a fine-grained brownish and strongly altered matrix that contains sulfides and rare FeNi metal.**Classification:** LL based on magnetic susceptibility.**Northwest Africa 12285** (NWA 12285)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (L3)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Dark brownish individual without fusion crust.**Petrography:** The meteorite displays a chondritic texture with mostly rounded and well packed chondrules (mean diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.**Northwest Africa 12286** (NWA 12286)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CK5)

History: The meteorite was purchased from a local meteorite dealer in Morocco.**Physical characteristics:** Grayish to slightly greenish individual lacking any fusion crust.**Petrography:** The meteorite displays a greyish to greenish interior and is predominantly composed of recrystallized Fe-rich olivine dominated matrix with scattered well defined chondrules. Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene and troilite; metal was not detected.**Geochemistry:** olivine: $Fa_{29.9\pm 0.5}$, $n=14$, $FeO/MnO=110.5\pm 8.4$; low-Ca pyroxene: $Fs_{25.7\pm 0.3}Wo_{0.8\pm 0.1}$, $n=3$; Ca-pyroxene: $Fs_{7.0\pm 0.4}Wo_{47.5\pm 0.3}$, $n=3$ **Northwest Africa 12287** (NWA 12287)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

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3 **Physical characteristics:** Dark grayish individual without fusion crust.

4 **Petrography:** Brecciated carbonaceous chondrite composed of small chondrules
5 (mean diameter about 230 μm), CAIs, and mineral fragments most of which are
6 surrounded by fine-grained dust rims. The matrix is Fe-rich and contains abundant
7 sulfides, calcite and phyllosilicates.
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12 **Northwest Africa 12288** (NWA 12288)

13 (Northwest Africa)

14 Purchased: 2017

15 Classification: Pallasite

16 **History:** The meteorite was purchased from a local meteorite dealer in Morocco.

17 **Physical characteristics:** Many up to 1 cm sized brownish fragments without
18 fusion crust.

19 **Petrography:** The meteorite is composed of about 5 mm sized subrounded olivine
20 grains surrounded by a matrix of partly layered brownish iron oxides or hydroxides.
21 No pristine FeNi-metal has been found in the two fragments studied.

22 **Geochemistry:** olivine: $\text{Fa}_{12.6-13.2}$, FeO/MnO: 38-48
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28 **Northwest Africa 12289** (NWA 12289)

29 (Northwest Africa)

30 Purchased: 2018

31 Classification: Ordinary chondrite (L5, melt breccia)

32 **History:** The meteorite was purchased from a local meteorite dealer in Errachidia,
33 Morocco.

34 **Physical characteristics:** Brownish individual without fusion crust.

35 **Petrography:** The meteorite is a melt breccia composed of abundant recrystallized
36 shock melt regions with characteristic FeNi metal and sulfide globules and
37 embedded relict mineral fragments and some preserved chondrules. In chondritic
38 portions olivine and low-Ca pyroxene are compositionally equilibrated and the
39 plagioclase grain size is about 30 μm .
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46 **Northwest Africa 12290** (NWA 12290)

47 (Northwest Africa)

48 Purchased: 2018

49 Classification: HED achondrite (Eucrite)

50 **History:** The meteorite was purchased from a local meteorite dealer in Layaoune,
51 Morocco.

52 **Physical characteristics:** Brownish individual without fusion crust.

53 **Petrography:** The meteorite is an unbrecciated medium-grained basalt
54 predominantly composed of exsolved pyroxene and mostly lath-shaped calcic
55 plagioclase with average grains sizes of about 400 μm . Minor phases include silica,
56 ilmenite, chromite, troilite, barite, and zircon. No metallic iron has been detected.
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The meteorite is strongly shock metamorphosed and crosscut by several shock melt veins. All plagioclase has been transformed into maskelynite.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{60.3\pm 0.7}\text{Wo}_{2.6\pm 0.8}$ ($\text{Fs}_{58.2-61.1}\text{Wo}_{2.1-5.3}$, $n=16$, $\text{FeO/MnO}=31-35$); Ca-pyroxene: $\text{Fs}_{26.3\pm 1.0}\text{Wo}_{42.9\pm 1.3}$ ($\text{Fs}_{25.2-29.4}\text{Wo}_{39.1-44.1}$, $n=14$, $\text{FeO/MnO}=28-37$); calcic plagioclase: $\text{An}_{89.3\pm 1.0}$ ($\text{An}_{88.1-90.7}$, $n=14$)

Northwest Africa 12291 (NWA 12291)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (LL3)

History: The meteorite was purchased from a local meteorite dealer in Layaoune, Morocco.

Physical characteristics: Two brownish fragments with some fusion crust.

Petrography: The meteorite shows a chondritic texture with sharply defined, mostly flattened and well packed chondrules (mean diameter about 0.9 mm) in a fine-grained matrix, that contains sulfides and FeNi metal.

Northwest Africa 12293 (NWA 12293)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Layaoune, Morocco.

Physical characteristics: Grayish individual with some fusion crust.

Petrography: Unbrecciated coarse-grained basalt predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with average grains sizes of about 1 mm. Minor phases include silica, ilmenite, chromite, and barite. No metallic iron has been detected. The meteorite contains abundant shock melt veins and pockets.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{60.3\pm 0.7}\text{Wo}_{2.1\pm 0.2}$ ($\text{Fs}_{59.1-61.3}\text{Wo}_{1.7-2.6}$, $n=14$, $\text{FeO/MnO}=29-33$); Ca-pyroxene: $\text{Fs}_{26.4\pm 0.3}\text{Wo}_{42.8\pm 0.5}$ ($\text{Fs}_{25.8-26.8}\text{Wo}_{41.9-43.6}$, $n=15$, $\text{FeO/MnO}=28-32$); calcic plagioclase: $\text{An}_{90.5\pm 0.4}$ ($\text{An}_{89.8-91.4}$, $n=15$)

Northwest Africa 12297 (NWA 12297)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (L~5)

History: (Ziyao Wang) Purchased by Wang Ziyao from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2015

Physical characteristics: (Wang Ziyao) Black 110.5 g stone with dark black-brown fusion crust

Petrography: (R. Bartoschewitz, *Bart*) Light-gray recrystallized matrix with well recognizable lighter chondrules (0.5-1.6 mm, av. 0.8 mm) and irregular metal and sulphide.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.06$

Classification: Ordinary chondrite (L~5, W0)

Specimens: 20.1 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 4.5 g with *Bart*.

Northwest Africa 12298 (NWA 12298)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL6)

History: (Ziyao Wang) Purchased by Wang Ziyao from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2015

Physical characteristics: (Wang Ziyao) 87.6 g Partly with fresh black fusion crust covered gray-blue elongated stone.

Petrography: (R. Bartoschewitz, *Bart*) brecciated texture of light gray recrystallized matrix with poor developed chondrules up to 1.2 mm, mineral fragments, tiny sulphide grains that sometimes build larger assemblages, and few metal specks up to 0.5 mm.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.49$

Classification: Ordinary chondrite (LL~6, W0)

Specimens: 18.2 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 19 g with *Bart*.

Northwest Africa 12299 (NWA 12299)

Morocco

Purchased: 2018

Classification: Ordinary chondrite (H~6)

History: (Ziyao Wang) Purchased by Wang Ziyao from Fayssal Mezgouri during the China (Hubei) Mineral & Gem Show in Huangshi City in Sept 2018.

Physical characteristics: (Wang Ziyao) A red-purple stone of 4500 grams with some fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) Gray recrystallized matrix with poor developed chondrules (0.2-0.8 mm, av. 0.4 mm), and much homogenous distributed irregular metal and sulphide.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.39$

Classification: Ordinary chondrite (H~6, W0)

Specimens: 20.8 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 131 g with *Bart*.

Northwest Africa 12300 (NWA 12300)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H~5)

History: (Ziyao Wang) Purchased by Wang Ziyao from Sadam Sbai during the China (Hunan) Mineral & Gem Show in Chenzhou City in May 2018.**Physical characteristics:** (Wang Ziyao) Gray-black stone of 273 g, metal bumps are recognizable on the surface.**Petrography:** (R. Bartoschewitz, *Bart*) Gray-black recrystallized matrix with poor developed chondrules (0.2-1.4 mm, av. 0.5 mm), irregular shaped metal and sulphide grains (<0.1-1.5 mm).**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.12$ **Classification:** Ordinary chondrite (H~5, W1)**Specimens:** 21.2 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 38 g with *Bart*.**Northwest Africa 12301** (NWA 12301)

(Northwest Africa)

Purchased: 2017 Apr

Classification: Ordinary chondrite (L5)

History: Discovered by an anonymous person and purchased in Erfoud in April 2017**Physical characteristics:** One brown stone with regmaglypts. Cut face shows tiny metal specks.**Petrography:** (R. Bartoschewitz, *Bart*) Microscopic examination of a thin section shows recrystallized and shocked matrix: mosaicism and planar fractures in olivine, undulatory extinction in plagioclase. Chondrules poor developed. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.04$.**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $\text{Fa}_{24.3\pm 0.9}$ (n=32); pyroxene $\text{Fs}_{20.4\pm 1.2} \text{Wo}_{1.5\pm 0.2}$ (n=19); Ca-pyroxene $\text{Fs}_{48.8} \text{Wo}_{43.1}$ (n=1); feldspar $\text{An}_{10.1\pm 0.3} \text{Or}_{5.9\pm 1.2}$ (n=9). Kamacite Ni=2.9-5.3, Co=1.0 wt.-% (n=2). Sulfides: troilite, pyrrhotite, and pyrite.**Classification:** Ordinary chondrite (type L5)**Specimens:** 20.2 g on deposit at *Kiel*, main mass *Kuntz*.**Northwest Africa 12320** (NWA 12320)

Mauritania

Purchased: 2018 Apr

Classification: Angrite

History: Two large, dark gray stones (2379 g and 1946 g) plus several smaller stones were found together at an unspecified site in Mauritania, and subsequently purchased by Darryl Pitt in April-July 2018 from a dealer in Nouakchott, Mauritania. An additional 14.2 g of the same material (confirmed by electron microprobe analyses) was purchased by Ben Hoefnagels in October 2018 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic texture (grainsize 0.3-0.5 mm) with sparse vesicles containing partial interior coatings of secondary calcite and barite. Major minerals are zoned calcic olivine (with kirschsteinite rims), zoned Al-Ti-augite and anorthite (with slightly more sodic rims), together with accessory titanomagnetite, troilite and silicoapatite. Sparse xenocrysts of magnesian olivine with more ferroan reaction rims are present.

Geochemistry: Olivine ($\text{Fa}_{39.6-79.7}\text{Ln}_{1.7-14.8}$, $\text{FeO/MnO} = 72-96$, $N = 5$), clinopyroxene ($\text{Fs}_{20.5-45.9}\text{Wo}_{51.6-52.8}$, $\text{FeO/MnO} = 68-143$, $\text{TiO}_2 = 1.5-4.3$ wt.%, $\text{Al}_2\text{O}_3 = 6.9-7.8$ wt.%, $N = 4$), kirschsteinite ($\text{Fa}_{57.9-63.3}\text{Ln}_{36.7-34.3}$, $\text{FeO/MnO} = 68-75$, $N = 2$), olivine xenocryst (core $\text{Fa}_{13.8}\text{Ln}_{0.6}$; rim $\text{Fa}_{35.2}\text{Ln}_{1.3}$; $\text{FeO/MnO} = 85-103$; $N = 2$), anorthite (core $\text{An}_{99.7}\text{Ab}_{0.2}\text{Or}_{0.0}$; rim $\text{An}_{96.6}\text{Ab}_{3.3}\text{Or}_{0.1}$; $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}\text{O}$ 2.268, 2.281, 2.339; $\delta^{18}\text{O}$ 4.416, 4.407, 4.545; $\Delta^{17}\text{O}$ -0.063, -0.046, -0.060 per mil.

Classification: Angrite (diabasic).

Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *DPitt*, except for 14.2 g with Mr. B. Hoefnagels.

Northwest Africa 12321 (NWA 12321)

(Northwest Africa)

Purchased: 2004 Oct

Classification: Ureilite

History: Purchased in Erfoud, Morocco by Adam *Aaronson* in October 2004.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate of olivine (~80 vol.%) and pigeonite (~20 vol.%). Olivine exhibits dark reduced, magnesian rims. Minor grain boundary graphite was observed.

Geochemistry: Olivine (cores $\text{Fa}_{21.9-22.2}$; rim $\text{Fa}_{7.4}$; $N = 3$), pigeonite ($\text{Fs}_{18.4-18.5}\text{Wo}_{9.3-9.2}$, $N = 2$).

Classification: Ureilite.

Specimens: 20.1 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12322 (NWA 12322)

Niger

Purchased: 2018 Aug

Classification: Carbonaceous chondrite (CV3)

History: Found in Niger and purchased in Morocco by Adam *Aaronson* in August 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed granular and BO chondrules (some composite; apparent diameter $1250 \pm 690 \mu\text{m}$) and fine grained CAI (some up to 4.5 mm across) are set in a fine grained matrix ($\sim 30 \text{ vol.}\%$, orange-brown in thin section).

Geochemistry: Olivine ($\text{Fa}_{0.2-45.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.7-0.9}\text{Wo}_{1.1}$, $N = 2$), clinopyroxene ($\text{Fs}_{2.5}\text{Wo}_{36.0}$; $\text{Fs}_{21.4}\text{Wo}_{44.1}$; $N = 2$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 42 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12323 (NWA 12323)

(Northwest Africa)

Purchased: 2018 Aug

Classification: Martian meteorite (Shergottite)

History: Purchased by Ben Hoefnagels in August 2018 from a dealer in Agadir, Morocco.

Physical characteristics: Single stone (447 g) exhibiting a brown weathered exterior and a fresh interior with obvious glassy maskelynite. The specimen is crosscut by several thin, dark shock melt veinlets.

Petrography: (A. Irving and S. Kuehner, *UWS*) Gabbroic assemblage of predominantly prismatic, zoned and twinned grains of clinopyroxene (up to 3.6 mm long) and maskelynite (some as thin, curved laths in sheaf-like groups) with accessory merrillite, ilmenite, ulvöspinel and pyrrhotite, plus minor secondary barite and calcite.

Geochemistry: Orthopyroxene core ($\text{Fs}_{22.1}\text{Wo}_{3.1}$, $\text{FeO/MnO} = 32$), pigeonite ($\text{Fs}_{29.9}\text{Wo}_{7.3}$; $\text{Fs}_{31.9-76.8}\text{Wo}_{13.7-15.7}$; $\text{FeO/MnO} = 31-46$; $N = 5$), subcalcic augite ($\text{Fs}_{28.9-39.3}\text{Wo}_{31.7-27.1}$, $\text{FeO/MnO} = 33-37$, $N = 2$), maskelynite ($\text{An}_{54.6-54.7}\text{Or}_{0.6-0.5}$, $N = 2$).

Classification: Martian (shergottite, gabbroic).

Specimens: 22.1 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12324 (NWA 12324)

(Northwest Africa)

Purchased: 2017

Classification: Ordinary chondrite (L3)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Dark brownish individual with some fusion crust.

Petrography: The meteorite displays a chondritic texture with slightly flattened and slightly packed chondrules (mean diameter about 0.6 mm) in a more fine-

grained dark matrix that contains sulfides and FeNi metal. The meteorite contains shock melt veins.

Northwest Africa 12326 (NWA 12326)

(Northwest Africa)

Purchased: 2016

Classification: HED achondrite (Eucrite, polymict)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Two grayish individuals with fusion crust.

Petrography: The meteorite is a polymict breccia composed of mineral and lithic clasts set into a fine-grained clastic matrix. Lithic clasts are fine- and coarse-grained about 0.2 to 1.5 mm sized basaltic clasts and dark about 0.1 to 4 mm sized impact melt clasts. Main minerals in basaltic clasts and matrix are exsolved pyroxene and calcic plagioclase. Minor phases include silica, chromite, ilmenite, and zircon. No metallic Fe has been detected.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{55.1\pm 0.3}\text{Wo}_{3.4\pm 0.4}$ ($\text{Fs}_{54.5-55.6}\text{Wo}_{2.7-4.2}$, $n=14$, $\text{FeO/MnO}=31-36$); Ca-pyroxene: $\text{Fs}_{31.6\pm 5.0}\text{Wo}_{34.9\pm 5.8}$ ($\text{Fs}_{25.2-39.3}\text{Wo}_{26.1-42.2}$, $n=16$, $\text{FeO/MnO}=29-34$); calcic plagioclase: $\text{An}_{80.0\pm 1.7}$ ($\text{An}_{77.2-82.3}$, $n=13$)

Northwest Africa 12327 (NWA 12327)

(Northwest Africa)

Purchased: 2016

Classification: HED achondrite (Eucrite, polymict)

History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Two dark grayish individuals with fusion crust.

Petrography: The meteorite is a coarse-grained basaltic breccia composed of up to 6 mm sized basaltic and up to 5 mm sized dark impact melt clasts set into a clastic matrix. Mineral phases are predominantly up to 1.5 mm sized exsolved pyroxene and lath shaped calcic plagioclase. Several low-Ca pyroxene grains are magmatically zoned indicating a low degree of thermal metamorphism. Minor phases include silica, chromite, and FeNi metal.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{41.1\pm 4.2}\text{Wo}_{2.6\pm 0.9}$ ($\text{Fs}_{33.3-45.8}\text{Wo}_{1.2-3.8}$, $n=21$, $\text{FeO/MnO}=28-37$); Ca-pyroxene: $\text{Fs}_{21.0\pm 0.3}\text{Wo}_{41.9\pm 0.6}$ ($\text{Fs}_{20.4-21.7}\text{Wo}_{40.8-42.5}$, $n=15$, $\text{FeO/MnO}=23-27$); calcic plagioclase: $\text{An}_{91.0\pm 1.6}$ ($\text{An}_{88.5-93.2}$, $n=15$)

Northwest Africa 12328 (NWA 12328)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CM1)

History: Ruben Garcia and Bob Cucchiara purchased eight similar-looking, partially fusion-crusted meteorite fragments weighting 43.2 g from Adam Aaronson at the 2017 Denver Gem show.

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3 **Physical characteristics:** The largest fragments 20.2 g and 10.6 g have one surface
4 with well-developed, ropy fusion crust. Pieces without fusion crust are gray and
5 show slight wind abrasion. Fresh broken surfaces exhibit an earthy fracture, are
6 black and studded with tiny crystalline white flecks and sparse protruding
7 chondrules and nodules. Stones are very soft and can be easily crushed by hand to a
8 fine powder.
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11 **Petrography:** (L. Garvie, *ASU*) Powder x-ray diffraction of the bulk meteorite
12 shows a pattern dominated by serpentine, with low-intensity reflections for sulfides
13 (mackinawite, pentlandite), magnetite, bassanite, carbonates (ankerite, calcite), and
14 very weak reflections possibly from olivine. The 001 serpentine is a well-resolved
15 doublet with maxima at 0.735 and 0.724 nm. Powder XRD from each of the
16 fragments comprising the 43.2 g shows the double-peaked 001 serpentine
17 reflection. Powder XRD patterns from several nodules and chondrules shows
18 patterns dominated by the 0.735 nm clay. One chondrule also shows a three-
19 component 0.7 nm reflection and weak 1.4 nm peak, suggesting the presence of
20 minor chlorite. A polished mount of a 2 × 1.5 cm fragment shows two well-defined
21 chondrules (1 mm and 0.9 mm diameter), smaller (<0.5 mm) chondrules and dark
22 nodules, and sparse sulfide grains (<100 μm) set in a dark matrix with abundant
23 fine-grained sulfide. Analysis of a 2 × 2 mm region of the section shows that
24 chondrules, relict chondrules, and clay-rich nodules comprise 41 areal% of the
25 section. Chondrules and relict chondrules have a mean diameter of 331 μm (n=25).
26 An Mg x-ray map shows magnesium "hot-spots" in a few chondrules
27 corresponding to relict olivine grains. BSE images show that the olivine is deeply
28 corroded and partially replaced by clays. Olivine represents ~1 areal% of the
29 section, consistent with the weak peaks in the powder XRD profile. No CAIs were
30 found. Some of the fine-grained sulfide may be partially replaced by terrestrial
31 oxides.
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33 **Geochemistry:** (L. Garvie, *ASU*) WDX of a few relict olivine grains. BO
34 chondrule with olivine bars largely replaced by clay. One bar has Fa_{1.1}. A 200 μm
35 grain in matrix, Fa_{18.3}. The 1 mm chondrule contains a 0.5 mm olivine grain,
36 Fa_{0.5}. A 100 μm olivine grain in 300 μm-sized chondrule, Fa_{1.4}.
37

38 **Classification:** Carbonaceous chondrite (CM1). The chondrules to matrix ratio and
39 average diameter of the chondrules are consistent with a CM chondrite. The
40 predominance of serpentine and only minor amounts of olivine (~1 areal%), which
41 show extensive alteration to clays, argue for a petrologic grade 1 carbonaceous
42 chondrite.
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44 **Specimens:** 8.7 g and one polished mount at *ASU*.
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53 **Northwest Africa 12331** (NWA 12331)

54 (Northwest Africa)

55 Purchased: March 2018

56 Classification: Ordinary chondrite (L3)
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Geochemistry: Olivine $Fa_{25.4\pm 2.5}$, $PMD=8\%$, range $Fa_{23.5-29.9}$, $Cr_2O_3=0.02\pm 0.03wt\%$, $n=5$. Low-ca pyroxene $Fs_{14.4\pm 4.7}Wo_{0.6\pm 0.3}$, range $Fs_{8.9-21.7}Wo_{0.3-1.1}$ ($n=4$).

Specimens: 23.13 g and a polished section at *CEREGE*. Main mass with Fabien *Kuntz*

Northwest Africa 12335 (NWA 12335)

(Northwest Africa)

Purchased: 2018

Classification: Martian meteorite (Shergottite)

History: Purchased in Guelmim, Morocco by Ali Fettouh in July 2018

Physical characteristics: Six identically appearing pieces with the following weights: 2290 g, 1486 g, 170 g, 20.7 g, and 2 smaller fragments of 4 g. No fusion crust. Broken surface reveals a mix of brown pyroxene grains and black maskelynite domains and shock melt.

Petrography: (C. Agee, *UNM*) The two major phases in this meteorite are clinopyroxene and maskelynite. The pyroxene compositions range from pigeonite to sub-calcic augite to ferro-pigeonite with a modal abundance of approximately 60%, and significant core to rim zoning in backscatter electron images. Maskelynite has modal abundance of approximately 35%.

Geochemistry: (C. Agee, *UNM*) Pigeonite $Fs_{48.0\pm 10.7}Wo_{16.8\pm 6.0}$, $Fe/Mn=35\pm 3$, $n=8$; sub-calcic augite $Fs_{29.4\pm 3.9}Wo_{34.7\pm 2.1}$, $Fe/Mn=32\pm 2$, $n=4$; ferro-pigeonite $Fs_{81.8\pm 1.9}Wo_{13.7\pm 1.4}$, $Fe/Mn=36\pm 3$, $n=8$; maskelynite $An_{48.2\pm 6.0}Ab_{49.6\pm 4.5}Or_{2.2\pm 1.7}$, $n=10$; alkali feldspar $An_{3.8}Ab_{24.1}Or_{72.1}$, $n=1$.

Classification: Evolved Martian basalt, pyroxene trends are similar to [QUE 94201](#).

Specimens: 20.7 g including a probe mount on deposit at *UNM*. John Higgins holds the 2290 g stone; remainder with Ali Fettouh.

Northwest Africa 12337 (NWA 12337)

(Northwest Africa)

Purchased: 2015 Apr

Classification: Ordinary chondrite (LL5)

Petrography: (Z.G. Guo, *UWO*) This meteorite comprises 60-70% chondrules with mean diameter of 800 μm . Undulatory extinction is present in olivine. There is ~10% metal found within thin section.

Geochemistry: (EMPA, Z.G. Guo and M. Beauchamp, *UWO*) Olivine $Fa_{28.2\pm 0.4}$, $Fe/Mn=53.9\pm 2.5$ ($N=15$), high-Ca pyroxene $Fs_{8.5\pm 0.8}Wo_{43.6\pm 3.0}$; $Fe/Mn=22.5\pm 2.9$ ($N=3$); low-Ca pyroxene $Fs_{23.1\pm 0.4}Wo_{1.3\pm 0.1}$, $Fe/Mn=31.0\pm 0.9$ ($N=15$); plagioclase $An_{12.6\pm 0.5}$ ($N=12$).

Classification: Ordinary chondrite (LL5, S2)

Specimens: 42.7 g at *UWO* including a probe mount

Northwest Africa 12338 (NWA 12338)

(Northwest Africa)

Purchased: 2016 Nov

Classification: Ungrouped achondrite

Physical characteristics: The repository specimen has a brown fusion crust surface and a light-gray, fresh interior.

Petrography: (Z.G. Guo, *UWO*) This is an unbrecciated basaltic meteorite with fine-grained ophitic texture including ~100 μm -sized clinopyroxene (~55%), and 100-500 μm -sized plagioclase (~35%). Plagioclase is not acicular, as usually found in eucrites, but instead is interstitial between clinopyroxene crystals. Olivine (~5%) is found as ~100 μm individual crystals. It has a low content (<1%) of metal (partially weathered), chromite and troilite. Undulatory (up to mosaic) extinction is observed in plagioclase, with silica veinlets, which indicate a moderate shock stage.

Geochemistry: (EMPA, Z.G. Guo and M. Beauchamp, *UWO*) Olivine $\text{Fe}_{70.0\pm 0.2}$, $\text{Fe}/\text{Mn}=44\pm 1$ (n=10); pigeonite $\text{Fs}_{40.5\pm 3.3}\text{Wo}_{10.6\pm 4.1}$, $\text{Fe}/\text{Mn}=30\pm 1$ (n=20); plagioclase $\text{An}_{89.1\pm 1.4}$ (n=10); Bulk chemistry (INAA, R. Korotev, *WashU*) Na_2O 0.495%, CaO 10.2%, FeO 15.3%, and (all in ppm) Cr 3043, Co 16, Sr 92, Ba 19, La 1.05, Sm 0.74, Hf 0.52, Th 0.10, and U 0.16. (laser fluorination oxygen isotope analyses, A. Alexandre; L. Webb, *UWO*) acid-washed bulk rock powder $\Delta^{17}\text{O}=-0.18\pm 0.01$, $\delta^{17}\text{O}=1.980\pm 0.203$, $\delta^{18}\text{O}=4.16\pm 0.37$ (n=2).

Classification: Achondrite, ungrouped. This meteorite is an anomalous eucrite-like basaltic meteorite similar to other specimens which have been found to diverge from the HED oxygen mass fractionation line (similarly to [PCA 91007](#) and [Pasamonte](#), and significantly above the HED line). It has geochemical characteristics of eucrites for major element mineral compositions, and of cumulate eucrites for bulk trace element chemistry. But its mineral assemblage with the presence of igneous olivines, texture, and its oxygen isotopic composition indicate a different parent body from HED, thus an ungrouped achondrite classification.

Specimens: 24.0g at *UWO* including a probe mount.

Northwest Africa 12339 (NWA 12339)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Eucrite, polymict)

Physical characteristics: Stone is partially crusted with black glassy fusion crust. The interior is light gray with brown staining.

Petrography: (Z.G. Guo, *UWO*) This is a brecciated meteorite, in which the size of clasts varies from 300 μm to 8 mm. The metal content is low (<1%). A silica polymorph was observed. Other shock features like shock melt veins and sheared pyroxene exsolution lamellae were observed in thin section.

Geochemistry: (EMPA, Z.G. Guo and M. Beauchamp, *UWO*) The compositions of two pyroxenes vary among clasts and host matrix. Host: low-Ca pyroxene $\text{Fs}_{63.9\pm 2.0}\text{Wo}_{2.3\pm 2.0}$, $\text{Fe}/\text{Mn}=28.6\pm 0.7$ (N=5), high-Ca pyroxene $\text{Fs}_{31.7\pm 3.7}\text{Wo}_{39.9\pm 4.2}$, $\text{Fe}/\text{Mn}=29.0\pm 1.3$ (N=5) and plagioclase $\text{An}_{90.1\pm 2.7}$ (N=13); Clasts:

low-Ca pyroxene $\text{Fs}_{55.4\pm 3.9}\text{Wo}_{13.3\pm 4.8}$, $\text{Fe/Mn}=28.6\pm 0.2$ (N=3); high-Ca pyroxene $\text{Fs}_{36.5\pm 3.8}\text{Wo}_{32.6\pm 4.5}$, $\text{Fe/Mn}=27.8\pm 0.5$ (N=3), and plagioclase (2) $\text{An}_{72.0\pm 4.2}$, N=6.

Classification: Polymict eucrite

Specimens: 20.8g at *UWO* including a probe mount.

Northwest Africa 12340 (NWA 12340)

(Northwest Africa)

Purchased: 2006 Jun

Classification: HED achondrite (Eucrite, polymict)

History: Purchased from a Moroccan mineral dealer at the meteorite show in Ensisheim, France

Petrography: (K. Metzler, *IfP*) Polymict breccia consisting of eucritic lithic clasts with ophitic, subophitic and granulitic textures, and mineral fragments (eucritic and diagenitic pyroxene, plagioclase). Breccia-in breccia clasts and impact melt rock clasts are also present. These components are set in a fine-grained matrix of related debris, cemented by thin films of intergranular shock-melt. Most eucritic pyroxenes exhibit exsolution lamellae. Percentage of diagenitic components in the investigated sample is below 10 vol%. Accessories are silica polymorph, ilmenite, Cr-spinel, troilite, and metal. Secondary calcite occurs.

Geochemistry: Mineral compositions and geochemistry: Eucritic low-Ca pyroxene: $\text{Fs}_{45.6\pm 10.1}\text{Wo}_{4.7\pm 1.6}$ ($\text{Fs}_{32-61}\text{Wo}_{3-8}$); mean Fe/Mn (at.): 32; n=15. Eucritic Ca-rich pyroxene: $\text{Fs}_{27.3\pm 6.3}\text{Wo}_{40.1\pm 2.8}$ ($\text{Fs}_{15-35}\text{Wo}_{36-44}$; n=8). Diagenitic pyroxene: $\text{Fs}_{26.1\pm 1.8}\text{Wo}_{3.3\pm 0.5}$ ($\text{Fs}_{23-29}\text{Wo}_{2-4}$); mean Fe/Mn (at.): 33; n=8. Plagioclase $\text{An}_{91.1\pm 0.7}\text{Or}_{0.2\pm 0.2}$ ($\text{An}_{90-92}\text{Or}_{0-0.5}$); n=13.

Northwest Africa 12341 (NWA 12341)

(Northwest Africa)

Purchased: 2018 Aug

Classification: Ordinary chondrite (L3)

Petrography: (K. Metzler, *IfP*) Unshocked ordinary chondrite of low petrologic type, consisting of chondrules (types I and II) of all major textural types (PO, POP, PP, BO, C) with small amounts of interchondrule matrix. The apparent mean chondrule size is 470 μm (n=49). Nearly all metal has been oxidized by terrestrial weathering.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $\text{Fa}_{18.4\pm 12.3}$ ($\text{Fa}_{2.3-39.9}$; n=21); the mean low-Ca pyroxene composition is $\text{Fs}_{7.3\pm 6.4}\text{Wo}_{0.7\pm 0.5}$ ($\text{Fs}_{1.3-23.8}\text{Wo}_{0.2-2.4}$); n=22.

Classification: L chondrite based on mean apparent chondrule size. Petrologic type based on the chemical variation of olivine and pyroxene. The PMD of Fa values is 67%, indicating that the petrologic subtype is <3.5.

Northwest Africa 12342 (NWA 12342)

(Northwest Africa)

Purchased: 2018 Aug

Classification: HED achondrite (Eucrite, melt breccia)

Petrography: (K. Metzler, *IfP*) Subrounded eucritic lithic clasts (up to 2 cm) with ophitic to subophitic textures and mineral fragments (pyroxene, plagioclase, silica polymorph) embedded in a vesicular crystallized melt. The modal amount of melt is 30-50 vol%. The latter shows a fan-spherulitic texture consisting of skeletal pyroxene and plagioclase crystals with sizes up to 100 μm . Vesicles can reach sizes of ~ 400 μm . Many lithic clasts are surrounded by a thin dark layer of a more fine-grained crystallized melt. Most pyroxene fragments show shock-deformed exsolution lamellae. Accessories are silica polymorph, ilmenite, Cr-spinel, and troilite.

Geochemistry: Mineral compositions and geochemistry: Lithic clasts: Low-Ca pyroxene $\text{Fs}_{59.8\pm 2.0}\text{Wo}_{3.5\pm 1.4}$ ($\text{Fs}_{56.1-62.8}\text{Wo}_{1.8-6.2}$); mean Fe/Mn (at.): 33; n=14. Ca-pyroxene $\text{Fs}_{26.7\pm 0.4}\text{Wo}_{43.2\pm 0.4}$ ($\text{Fs}_{25.9-27.3}\text{Wo}_{42.7-44.1}$; n=12). Plagioclase $\text{An}_{88.9\pm 1.1}\text{Or}_{0.4\pm 0.3}$ ($\text{An}_{87.9-90.6}\text{Or}_{0-0.8}$); n=8.

Northwest Africa 12343 (NWA 12343)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Carbonaceous chondrite (CV3)

Petrography: (K. Metzler, *IfP*) Chondrules, CAIs and AOAs are embedded in a fine-grained dark matrix (about 30 vol% matrix). Most chondrules have apparent diameters between 0.3 and 1.5 mm, some up to 2.2 mm. Several chondrules show reddish staining due to terrestrial weathering. A slight alignment of chondrules is visible. CAIs with sizes of a few mm are observed.

Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $\text{Fa}_{7.4\pm 2.7}$ ($\text{Fa}_{1.3-12.7}$; n=26); n=23. Random measurements of low-Ca pyroxene grains revealed $\text{Fs}_{1.8\pm 0.8}\text{Wo}_{1.6\pm 1.2}$ ($\text{Fs}_{0.8-3.6}\text{Wo}_{0.8-4.4}$; n=13).

Classification: CV chondrite based on CAI and AOA occurrence, size of chondrules, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene.

Northwest Africa 12344 (NWA 12344)

(Northwest Africa)

Purchased: 2018 Jan

Classification: HED achondrite (Eucrite, polymict)

Petrography: (K. Metzler, *IfP*) Polymict breccia consisting of eucritic lithic clasts with ophitic textures and mineral fragments (pyroxene, plagioclase, silica polymorph) set in a fine-grained matrix of related debris. The matrix is clastic, bound by intergranular shock-melt, and intermingled with vesicular melt pockets (up to 5 mm). The latter show quench textures, consisting of parallel aligned pyroxene and plagioclase skeletal crystals. Both pyroxenes with and without

exsolution lamellae occur. Iron-rich olivine was found as isolated fragments and in the shape of veins in lithic clasts. Accessories are silica polymorph, ilmenite, Cr-spinel, troilite, and Ni-poor metal.

Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene: $\text{Fs}_{64.5\pm 4.4}\text{Wo}_{2.4\pm 0.7}$ ($\text{Fs}_{55.8-68.4}\text{Wo}_{1.9-4.7}$); mean Fe/Mn (at.): 29.8; n=13. Ca-rich pyroxene: $\text{Fs}_{30.8\pm 1.0}\text{Wo}_{42.5\pm 0.6}$ ($\text{Fs}_{28.4-32.2}\text{Wo}_{41.6-43.4}$) n=12. Olivine: $\text{Fa}_{75.0}$ ($\text{Fa}_{74.6-75.7}$); mean Fe/Mn (at.): 44.1; n=3. Plagioclase $\text{An}_{90.6\pm 2.5}\text{Or}_{0.3\pm 0.3}$ ($\text{An}_{86.9-94.0}\text{Or}_{0.0-0.8}$); n=8.

Northwest Africa 12346 (NWA 12346)

Morocco

Purchased: 2017 Feb

Classification: Ordinary chondrite (L5)

Physical characteristics: Small stone with visible oxidation of the matrix.

Petrography: (P. Reger, *UWO*) Mostly olivine and pyroxene, recrystallized matrix, with few secondary plagioclase grains (generally smaller than 50 μm), metal abundance ~ 5%, large chondrules generally easily discernible, smaller ones have fewer sharp boundaries. Mostly PP, RP chondrules, some POP and BO chondrules; mean diameter ~0.5 mm, larger (>0.5 mm) round, but fractured, smaller ones (<0.5 mm) can be less rounded; chondrule glass absent. Undulatory extinction in olivine and pyroxene, in addition to planar fractures in olivine (S3). All metal oxidized, but no alteration in silicates visible (W4).

Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($\text{Fa}_{24.4\pm 0.3}$; Fe/Mn = 45.7 ± 1.6 ; n=10), Orthopyroxene ($\text{Fs}_{20.6\pm 0.4}\text{Wo}_{1.1\pm 0.1}$, n=10), Plagioclase $\text{An}_{9.7\pm 0.7}$ (n=6). Maximum Ni content in metal phases is > 20%. Bulk rock ICP-MS analysis shows enrichment of incompatible rare earth elements compared to CI chondrites in G701

Classification: Ordinary chondrite L5 (W4, S3)

Specimens: 89.6 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12347 (NWA 12347)

Morocco

Purchased: 2017 Feb

Classification: Ordinary chondrite (H5)

Physical characteristics: A dark-brown fusion crust covers the outer edges of the hand sample. The sample appears to be at least moderately weathered due to an overall dark brown appearance and the absence of abundant visible metal grains. The largest chondrule visible in the type specimen has a diameter of 3.5 mm.

Petrography: (J. Laughton, *UWO*) Modal abundances were determined using a combination of optical microscopy and ImageJ software: 74% chondrules, 12% matrix, 6% oxide, 5% metal, and 3% sulphide [+ trace amount of calcium phosphate]. The silicates present include: olivine, orthopyroxene, minor clinopyroxene and plagioclase, and metal (~5%). The sulfide present was in the

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3 form of troilite with <0.5 wt.% Ni content. Chondrule diameters ranged in size
4 from 3.5 to 0.1 mm, with an average diameter of 0.4 mm (n = 50). Majority of the
5 chondrules could be discerned, but not all had sharp boundaries. Very minor
6 undulatory extinction patterns were observed in olivine and pyroxene crystals, as
7 well as some minor irregular fractures within the crystals. In thin section ~70% of
8 the metal and troilite has been replaced by a dark red iron oxide (hematite).

9
10 Oxidation of silicates has also started along the cracks of some crystals.

11 **Geochemistry:** (EMPA, M. Beauchamp, *UWO*) Olivine (Fa_{16.7±0.2}; Fe/Mn =
12 29.2±1.0; n=10), Orthopyroxene (Fs_{14.6±0.2}Wo_{1.7±0.0}; Fe/Mn = 17.8±0.6; n=11) and
13 Plagioclase An_{8.8±0.4} (n=10).

14 **Classification:** Ordinary chondrite H5, S2, W3.

15 **Specimens:** 54.0 g including a thin section at *UWO*. S. Tutorow holds the main
16 mass.
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22 Northwest Africa 12348 (NWA 12348)

23 Morocco

24 Purchased: 2017 Feb

25 Classification: Ordinary chondrite (L4)

26 **Physical characteristics:** The meteorite has a reddish-brown colored matrix
27 containing chondrules and chondrule fragments.

28 **Petrography:** (G. Ibe, *UWO*) Chondrules constitute about 75 vol% of this
29 meteorite and have well-defined rims, up to 2.2 mm in the thin section. Opaque
30 minerals in the meteorite include Fe-Ni metal, troilite, chromite. The amounts of
31 Fe-Ni metal and troilite are ~1% and ~3%, respectively. Plagioclase is present as a
32 minor phase. Undulatory optical extinction could be observed in olivine. About 60
33 ? 70% of the metal and sulfides were oxidized, but no similar features were
34 observed in the silicates.

35 **Geochemistry:** (EMPA, M. Beauchamp, *UWO*) Olivine Fa_{25.0±2.0} (n=10), low-Ca
36 pyroxenes (Fs_{20.5±0.6}Wo_{1.5±0.2}, n=10), and plagioclase An_{12.1±0.02}.

37 **Classification:** Ordinary Chondrite (L4, S4, W3).

38 **Specimens:** 51.3 g including a thin section at *UWO*. S. Tutorow holds the main
39 mass.
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48 Northwest Africa 12349 (NWA 12349)

49 Morocco

50 Purchased: 2017 Feb

51 Classification: Ordinary chondrite (H4)

52 **Physical characteristics:** A dark-brown to black fusion crust with regmaglypts is
53 observed over approximately 80% of the exterior. Faint chondrules set in a brown-
54 orange matrix are observed on the saw-cut face.

55 **Petrography:** (T.V. Kizovski, *ROM*) In thin section and in backscattered electron
56 view, chondrules are discernible with opaque boundaries set in a semi-
57 recrystallized matrix. The chondrules vary in size with an average diameter of 0.4
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60

mm (n = 41). The majority of the chondrules are porphyritic and are mainly comprised of pyroxene with varying amounts of olivine and devitrified glass. Barred olivine and cryptocrystalline chondrules are also observed. The matrix is mainly composed of iron oxide with some devitrified glass, pyroxene, terrestrial barite, and rare metal. The stone shows multiple signs of significant desert weathering. Several cracks, approximately 0.03 mm in width, cross-cut the sample and appear to be filled with terrestrial weathering products. The metals and sulfides in the matrix have been completely oxidized, although there has been no alteration of silicates. Subtle undulatory extinction is observed in the olivine and pyroxene grains. Plagioclase is rare, and only observed in the porphyritic chondrules.

Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{19.5\pm 0.1}$; $Fe/Mn = 37.6\pm 1.6$; $n=10$), low-Ca pyroxene ($Fs_{16.3\pm 1.4}Wo_{1.4\pm 1.1}$; $Fe/Mn = 25.7\pm 7.1$; $n=10$), plagioclase ($An_{8.8\pm 4.7}Ab_{78.1\pm 12.7}Or_{13.1\pm 16.5}$; $n=6$).

Classification: Ordinary Chondrite (H4, S2, W4)

Specimens: 23.2 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12350 (NWA 12350)

Morocco

Purchased: 2006

Classification: Ordinary chondrite (H4)

History: Purchased in 2006 by Sean Tutorow in Quartzsite, Arizona.

Physical characteristics: Typing specimen has a fusion crust and displays minor weathering.

Petrography: (M. Spencer, *UWO*) Olivine has irregular fractures. One large barred olivine crystal (>1 mm) is present in the thin section. Plagioclase displays twinning and undulatory extinction (S2). Pyroxene displays pleochroism in plain polarized light, undulatory extinction. Metal Abundance: Fe-Ni metals (mostly taenite, some kamacite present), Fe-Ni oxides, Fe-sulfides are still present (W1). Most chondrules display sharp boundaries, with an average diameter of 0.27 mm ($n=13$).

Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine: $Fa_{19.1\pm 0.5}$; $Fe/Mn=36.8\pm 1.5$ ($n=10$), Pyroxene: $Fs_{16.2\pm 0.1}Wo_{1.0\pm 0.3}$; $Fe/Mn=21.8\pm 1.1$ ($n=10$), Plagioclase: $An_{10.7\pm 3.3}$ ($n=10$).

Classification: Ordinary Chondrite (H4), Weathering W1, Shock S2

Specimens: 206 g including a thin section at *UWO*. Main mass with S. Tutorow.

Northwest Africa 12351 (NWA 12351)

Morocco

Purchased: 2017 Feb

Classification: Ordinary chondrite (H5)

Physical characteristics: Repository specimen has a fresh surface.

Petrography: (C. Zhu, *UWO*) Mostly granular pyroxene chondrule (200-500 μ m) and porphyritic pyroxene chondrules (200-600 μ m) Mostly barred olivine, radial

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3 olivine (200-400 μm) and porphyritic olivine (200-300 μm). Plagioclase grains
4 range from 10 to 40 μm in diameter with tabular shape. Olivine and pyroxene
5 grains show undulatory extinction, and some display planar fractures. Fe-Ni metal
6 (~10-15 vol%) is slightly oxidized. Other phases found include Fe-Ni-sulfides, and
7 minor chromite and chlorapatite.
8

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10 **Geochemistry:** (EMPA, M. Beauchamp, *UWO*) Olivine ($\text{Fa}_{18.8\pm 0.5}$; 18.2-19.6;
11 $\text{Fe/Mn} = 36.7\pm 2.0$; $n=15$), low-Ca pyroxene ($\text{Fs}_{15.9\pm 1.7}\text{Wo}_{0.5\pm 0.3}$; $\text{Fs}_{13.3-19.2}\text{Wo}_{0.1-1.1}$;
12 $\text{Fe/Mn} = 28.5\pm 8.8$; $n=10$), and plagioclase $\text{An}_{12.2\pm 2.9}$ ($\text{An}_{5.6-17.8}$; $n=10$).
13

14 **Classification:** Ordinary chondrite (H5, S3, W1)

15 **Specimens:** 32.2 g including a polished thin section are on deposit at *UWO*. S.
16 Tutorow holds the main mass.
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20 Northwest Africa 12352 (NWA 12352)

21 Morocco

22 Purchased: 2017 Feb

23 Classification: Ordinary chondrite (H5)

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25 **Physical characteristics:** This sample has a dark-brown fusion crust. The inside
26 shows a dark-gray matrix with a significant number of chondrules and metals.
27

28 **Petrography:** (B. Borba de Carvalho, *UWO*) The thin section exhibits numerous
29 chondrules (up to 1.6 mm) in a dark matrix of medium-grained silicates, metals,
30 minor oxides and sulfides. Most of the chondrules lack well-delineated edges.
31 Major mineral phases are olivine and low-Ca pyroxene. Minor plagioclase and
32 clinopyroxene were observed. No alteration and strong shock features were
33 observed, except for irregular fractures and undulatory extinction in olivine and
34 pyroxene. Fe-Ni metal phases have minor oxide rims.
35

36 **Geochemistry:** (EMPA, M. Beauchamp, *UWO*) Olivine ($\text{Fa}_{17.7\pm 0.2}$; $\text{Fe/Mn} =$
37 35.6 ± 1.2 ; $n=10$), Pyroxene ($\text{Fs}_{15.5\pm 0.2}\text{Wo}_{1.4\pm 0.1}$; $\text{Fe/Mn} = 20.7\pm 1$; $n=10$), Plagioclase
38 ($\text{An}_{13.1\pm 0.5}$; $n=10$).
39

40 **Classification:** Ordinary chondrite (H5, S2, W1).

41 **Specimens:** 30.2 g including a thin section at *UWO*. Main mass with S. Tutorow.
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45 Northwest Africa 12353 (NWA 12353)

46 Morocco

47 Purchased: 2017 Feb

48 Classification: Ordinary chondrite (H5)

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50 **Physical characteristics:** The repository specimen has a very dark interior and
51 contains visible chondrules.
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53 **Petrography:** (Z. Jiang, *UWO*) Porphyritic and radial pyroxene chondrules are
54 found with an average size of ~0.3 mm. There are planar and irregular fractures in
55 olivine and orthopyroxene. Minor plagioclase was found.
56

57 **Geochemistry:** (EMPA, M. Beauchamp, *UWO*) Olivine ($\text{Fa}_{18.7\pm 0.2}$; $\text{Fe/Mn} =$
58 36.8 ± 1.5 ; $n=15$), orthopyroxene ($\text{Fs}_{16.4\pm 0.1}\text{Wo}_{1.5\pm 0.2}$, $n=13$), and plagioclase
59 ($\text{An}_{12.4\pm 0.3}$; $n=10$).
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3 **Classification:** Ordinary chondrite (H5, S3, W2)

4 **Specimens:** 22.7 g including a thin section at *UWO*. S. Tutorow holds the main
5 mass.
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9 **Northwest Africa 12365** (NWA 12365)

10 (Northwest Africa)

11 Purchased: April 2018

12 Classification: Carbonaceous chondrite (CO3)

13 **History:** Bought in April 2018 from a mineral dealer in Laayoune, Morocco.

14 **Petrography:** (A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are
15 embedded in a fine-grained brownish matrix, which has an abundance of about 20-
16 30 vol%. The majority of chondrules belong to chemical type I and the mean
17 apparent chondrule size is about 200 μm . The sample is strongly weathered.

18 **Geochemistry:** (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and
19 geochemistry: Random measurements of olivine grains revealed $\text{Fa}_{8.9\pm 9.8}$ ($\text{Fa}_{0.7-28.6}$);
20 $n=21$. Random measurements of low-Ca pyroxene grains revealed
21 $\text{Fs}_{7.2\pm 13.3}\text{Wo}_{1.3\pm 1.1}$ ($\text{Fs}_{0.7-39.9}\text{Wo}_{0.5-4.2}$); $n=15$.

22 **Classification:** CO3 chondrite based on small chondrule size, chondrule-matrix
23 ratio, texture, and mineral chemistry.
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31 **Northwest Africa 12366** (NWA 12366)

32 (Northwest Africa)

33 Purchased: April 2018

34 Classification: Carbonaceous chondrite (CO3)

35 **History:** Bought in April 2018 from a dealer in Zagora, Morocco.

36 **Petrography:** (A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are
37 embedded in a fine-grained brownish matrix, which has an abundance of about 20-
38 30 vol%. The majority of chondrules contain Fe-poor olivine and low-Ca pyroxene
39 and the mean apparent chondrule size is about 200 μm .

40 **Geochemistry:** (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and
41 geochemistry: Random measurements of olivine grains revealed $\text{Fa}_{11.9\pm 14.0}$ ($\text{Fa}_{0.4-}$
42 49.4); $n=14$. Random measurements of low-Ca pyroxene grains revealed
43 $\text{Fs}_{2.3\pm 1.3}\text{Wo}_{1.7\pm 1.5}$ ($\text{Fs}_{1.1-5.7}\text{Wo}_{0.3-5.1}$); $n=12$.

44 **Classification:** CO3 chondrite based on small chondrule size, chondrule-matrix
45 ratio, texture, and mineral chemistry.
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53 **Northwest Africa 12367** (NWA 12367)

54 (Northwest Africa)

55 Purchased: April 2018

56 Classification: Carbonaceous chondrite (CO3)

57 **History:** Bought in April 2018 from a dealer in Zagora, Morocco.
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Petrography: (A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix, which has an abundance of about 20-30 vol%. The majority of chondrules belong to chemical type I and the mean apparent chondrule size is about 200 μm .

Geochemistry: (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and geochemistry: Random measurements of olivine grains revealed $\text{Fa}_{10.3\pm 14.5}$ ($\text{Fa}_{0.7-43.3}$); $n=29$. Random measurements of low-Ca pyroxene grains revealed $\text{Fs}_{6.2\pm 12.0}\text{Wo}_{1.5\pm 1.0}$ ($\text{Fs}_{0.6-35.9}\text{Wo}_{0.5-4.3}$); $n=15$.

Classification: CO3 chondrite based on small chondrule size, chondrule-matrix ratio, texture, and mineral chemistry.

Northwest Africa 12368 (NWA 12368)

(Northwest Africa)

Purchased: 2018

Classification: Lunar meteorite (feldspathic breccia)

History: Found in the spring of 2017 in the Moroccan Sahara and purchased in Temara by A. *Aaronson* on July 23, 2018.

Physical characteristics: Single complete stone, no fusion crust; saw cut reveals a fragmental breccia with scattered white feldspathic and mafic clasts set in a dark-gray groundmass.

Petrography: (C. Agee, *UNM*) This meteorite consists primarily of fragmental pyroxene, olivine, feldspathic and mafic clasts, and shock melt. Ubiquitous Fe-Ti-Cr-Al oxides are present, rare kamacite was detected. There appears to be 2 or 3 distinct populations of pyroxenes and olivines, suggesting that this is a polymict breccia.

Geochemistry: (C. Agee, *UNM*) olivine $\text{Fa}_{53.3\pm 11.8}$, $\text{Fe/Mn}=96\pm 7$, $n=7$; fayalite $\text{Fa}_{91.8\pm 2.9}$, $\text{Fe/Mn}=91\pm 8$, $n=3$; pigeonite $\text{Fs}_{26.0\pm 1.3}\text{Wo}_{6.4\pm 1.3}$, $\text{Fe/Mn}=51\pm 3$, $n=7$; subcalcic augite $\text{Fs}_{38.3\pm 3.2}\text{Wo}_{24.2\pm 4.3}$, $\text{Fe/Mn}=57\pm 3$, $n=2$; ferro-augite $\text{Fs}_{63.9\pm 4.3}\text{Wo}_{30.4\pm 7.6}$, $\text{Fe/Mn}=92\pm 21$, $n=2$; plagioclase $\text{An}_{95.5\pm 1.4}$, $n=6$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=44.6\pm 1.5$, $\text{TiO}_2=0.18\pm 0.13$, $\text{Al}_2\text{O}_3=28.8\pm 4.2$, $\text{Cr}_2\text{O}_3=0.11\pm 0.14$, $\text{MgO}=4.1\pm 1.8$, $\text{FeO}=4.2\pm 2.1$, $\text{MnO}=0.07\pm 0.03$, $\text{CaO}=16.8\pm 1.9$, $\text{NiO}=0.02\pm 0.02$, $\text{Na}_2\text{O}=0.54\pm 0.14$, $\text{K}_2\text{O}=0.06\pm 0.04$ (all wt%), $n=3$.

Classification: Lunar feldspathic breccia

Specimens: 20.6 g including a probe mount on deposit at *UNM*, Adam *Aaronson* holds the main mass.

Northwest Africa 12369 (NWA 12369)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H5)

History: Found in the Moroccan western Sahara in May 2018, purchased in Temara by A. *Aaronson* on August 14, 2018.

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3 **Physical characteristics:** Single stone, no fusion crust, saw cut reveals numerous
4 closely packed chondrules in a brown matrix.

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6 **Petrography:** (C. Agee, *UNM*) This meteorite has many porphyritic chondrules,
7 abundant Fe-metal, and plagioclase up to 25 μm in size.

8 **Geochemistry:** (C. Agee, *UNM*) olivine $\text{Fa}_{18.2\pm 0.2}$, $\text{Fe/Mn}=37\pm 2$, $n=30$; low-Ca
9 pyroxene $\text{Fs}_{16.0\pm 0.1}\text{Wo}_{1.5\pm 0.1}$, $\text{Fe/Mn}=21\pm 1$, $n=11$.

10 **Classification:** Ordinary chondrite H5

11 **Specimens:** 25 g including a probe mount on deposit at *UNM*,
12 Adam *Aaronson* holds the main mass.
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17 Northwest Africa 12381 (NWA 12381)

18 (Northwest Africa)

19 Purchased: 2018

20 Classification: Ordinary chondrite (L~6)

21 **History:** Purchased at Hamburg Mineral Show Dec. 2018.

22 **Physical characteristics:** 21.7 g dark-brown fragment

23 **Petrography:** (R. Bartoschewitz, *Bart*) recrystallized matrix with poorly defined,
24 but partly metal-rimmed chondrules (0.5-2 mm) and metal specks

25 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.85$

26 **Classification:** Ordinary chondrite (L~6, W2)

27 **Specimens:** 4.4 g on deposit at *Kiel*, Ben Levi Karsten (Hamburg) holds the main
28 mass, and 3.1 g with *Bart*.
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36 Northwest Africa 12382 (NWA 12382)

37 (Northwest Africa)

38 Purchased: 2018

39 Classification: Ordinary chondrite (H~5)

40 **History:** Purchased at Hamburg Mineral Show Dec. 2018.

41 **Physical characteristics:** 29.0 g brown fragment

42 **Petrography:** (R. Bartoschewitz, *Bart*) Brown stained, recrystallized matrix with
43 well-defined chondrules (av. 0.5 mm)

44 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.70$

45 **Classification:** Ordinary chondrite (H~5, W4)

46 **Specimens:** 5.9 g on deposit at *Kiel*, Joseph Kaiser (Hamburg) holds the main
47 mass, and 3.9 g with *Bart*.
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55 Northwest Africa 12383 (NWA 12383)

56 (Northwest Africa)

57 Purchased: 2018

58 Classification: Ordinary chondrite (H~5)
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History: Purchased at Hamburg Mineral Show Dec. 2018.

Physical characteristics: 209.65 g dark brown fragment

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with recognizable chondrules (av. 0.5 mm) and metal specks

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.13$

Classification: Ordinary chondrite (H~5, W2)

Specimens: 22.0 g on deposit at *Kiel*, W. Kalisch (Berlin) holds the main mass, and 17 g with *Bart*.

Northwest Africa 12385 (NWA 12385)

Morocco

Find: unknown

Classification: Ordinary chondrite (H5)

History: Found in Morocco and purchased by *HMG* from a dealer (Ke Zuokai) in Changsha, China.

Physical characteristics: About 75% of the angular stone is covered by a dull, dark fusion crust. The broken surface shows round chondrules.

Petrography: The thin section shows moderately abundant chondrules set in a fine-grained matrix. The chondrules have no clear boundaries and are cracked. The diameter of chondrules are 0.1 to 2.0 mm. Some chondrules are surrounded by opaque minerals. A few fragments of BO chondrules are visible. The opaque phases include metal, troilite and Fe-oxides are about 20 vol%. Oxidation of metal and troilite distributed as minor rims or fine veins. The weathering grade is W1.

Geochemistry: Silicates are equilibrated. Olivine $\text{Fa}_{18.3 \pm 0.1}$ (PMD= 0.5%); low-Ca pyroxene $\text{Fs}_{16.4 \pm 0.3} \text{Wo}_{1.6 \pm 0.2} \text{En}_{82.0 \pm 0.3}$ (PMD-Fs=2.0%); .

Classification: Ordinary chondrite. H5

Specimens: 3463 g is at *HMG*.

The name Nova 054 replaces the discredited name [Mercantour](#). A description of the meteorite may be found under the former name.

The name Nova 055 replaces the discredited name [Castenaso](#). Information originally submitted for this meteorite may be found under the former name.

Nova 020

(unknown)

Purchased: 2014

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Licking River, KY, USA. Presented to *UCLA* by P. Allen in 2014.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 65.2, Co = 4.58 (both mg/g), Ga = 89.5, As = 11.5, W = 1.27, Ir = 3.93, Au = 1.444 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Main mass at *UCLA*.

Nova 021

(unknown)

Purchased: 2016

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Copiapo, Chile. Presented to *UCLA* by D. Ruiz in 2016.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 64.8, Co = 4.56 (both mg/g), Ga = 86.4, As = 10.5, W = 1.22, Ir = 3.39, Au = 1.43 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen at *UCLA*.

Nova 022

(unknown)

Purchased: 2013

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Redding, CA, USA. Presented to *UCLA* by J. Utas in 2013.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 63, Co = 4.58 (both mg/g), Ga = 91.2, As = 11.4, W = 1.26, Ir = 3.55, Au = 1.531 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen at *UCLA*.

Nova 023

(unknown)

Purchased: 2014

Classification: Iron meteorite (IAB-MG)

History: Purportedly found on a beach, 7 km NNE of Sorso, Sardinia, Italy. Reported to *NMBE* by the finder on 22 Nov 2012. Sample presented to *UCLA* by B. Hofmann in 2014.

Physical characteristics: The surface of the specimen is mostly metal with little rust, with remnants of an earlier rust, so likely the specimen has been cleaned. However the finder reported that he did not clean the sample.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 64.7, Co = 4.64 (both mg/g), Ga = 89.1, As = 10.9, W = 1.29, Ir = 3.47, Au = 1.419 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen (22 g) and main mass at *NMBE*. INAA sample (2g) at *UCLA*.

Nova 024

(unknown)

Purchased: 2010

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Tucson, AZ, USA. Presented to *UCLA* by L. Labenne in 2010.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 68.1, Co = 4.52 (both mg/g), Ga = 91.2, As = 11.2, W = 1.25, Ir = 3.8, Au = 1.463 (all µg/g).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen at *UCLA*.

Nova 025

(unknown)

Purchased: 2004

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Blanco, NM, USA. Presented to *UCLA* by R. Jones in 2004.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 67.1, Co = 4.55 (both mg/g), Ga = 92.1, As = 11.1, W = 1.45, Ir = 3.75, Au = 1.482 (all µg/g).

Classification: Iron, IAB main group. Likely paired with [Campo del Cielo](#).

Specimens: 2682 g at *ASU*. INAA sample (1 g) at *UCLA*.

Nova 026

(unknown)

Purchased: 2005

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Randsburg, CA, USA. Presented to *UCLA* by G. Hupe and T. Irving in 2005.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 69.9, Co = 4.54 (both mg/g), Ga = 87.8, As = 10.8, W = 1.19, Ir = 3.65, Au = 1.462 (all µg/g).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen at *UCLA*.

Nova 027

(unknown)

Purchased: 2005

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Arispe, Baja California, Mexico. Presented to *UCLA* by P. Utas in 2005.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 65.6, Co = 4.54 (both mg/g), Ga = 90.9, As = 11.3, W = 1.37, Ir = 3.54, Au = 1.465 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group. Probably paired with [Campo del Cielo](#).

Specimens: Type specimen at *UCLA*.

Nova 028

(unknown)

Purchased: 2004

Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Utah, USA.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 67.9, Co = 4.5 (both mg/g), Ga = 91.6, As = 11.1, W = 1.26, Ir = 3.92, Au = 1.492 (all $\mu\text{g/g}$).

Classification: Iron, IAB main group

Specimens: Type specimen at *ASU*.

Ouargla 001 31°06', 5°11'

Ouargla, Algeria

Purchased: before 2001

Classification: Ordinary chondrite (H3)

Petrography: Low-Ca pyroxene exhibits polysynthetic twinning. Chondrules are sharply defined but lack glassy mesostases. Many metal grains are elongated and ragged; some contain small silicate grain fragments. Some metal grains contain small, irregular troilite grains. The rock appears to have been shocked and annealed.

Classification: H3 (estimated subtype 3.7).

Note: this name replaces provisional name NWA 736

Ozerki 52°48.084'N, 38°10.268'E

Lipetskaya oblast', Russia

Confirmed fall: 21 June 2018

Classification: Ordinary chondrite (L6)

History: The first meteorite fragments were recovered based on analysis of the fireball observed over the Lipetskaya oblast' in Russia on June 21, 2018, at 01:16:20 UT. The fireball was widely observed from many places in Russia, including Moscow. The scientists from *UrFU*, *UHelsinki*, and the Finnish Fireball Network formed a consortium enabling quick prediction and the actual discovery of the meteorite. Collection of the observational data and trajectory analysis were done by Esko Lyytinen, Maria Gritsevich, Nikolai Kruglikov, and Mikhail Larionov. The derived parameters, characterizing the trajectory were clearly

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3 indicative of a number of meteorite fragments landing on the ground. Using these
4 results, a comprehensive model of the strewn field providing the expected locations
5 of fragments was done by Jarmo Moilanen. The area of the meteorite shower was
6 predicted to be on the line Ozerki – Zlobino - Druzhba, Stanovlyansky district,
7 northwest of Yelets town, Lipetskaya oblast'. The modeling assumed about 100
8 meteorites (excepting the main body) with total mass ~7 kg. With the support of
9 these data, a meteorite recovery campaign was initiated by Victor I. Grokhovsky.
10 Five samples of the meteorite (1176 g) were recovered during the *UrFU* meteorite
11 expedition-2018 (23-27 June 2018; Pastukhovich A.Yu., Yakovlev G.A., Petrova
12 E.V. and volunteer Usenkov A.V.) in the Lipetskaya oblast'. The first sample was
13 found 25 June 2018 by G.A. Yakovlev (59.85 g). The *UrFU* finds were near Ozerki
14 village. During the next few weeks, more meteorite samples (>5500 g) were
15 recovered by institutional groups (*Vernad* - GEOKHI RAS, IA RAS, IDG RAS)
16 and private collectors in the area Ozerki – Zlobino. The total mass and number of
17 stones may increase due to additional finds.

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23 **Physical characteristics:** The meteorites have roughly rounded shapes, covered by
24 dark fusion crust; the interior is light colored and contains visible opaque shock
25 veins. The samples are fresh, but halos of Fe-hydroxides were already present
26 around metal grains. Some samples contain impact melt.

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28 **Petrography:** (V.V. Sharygin, *SIGM* and *UrFU*, and D.A. Zamyatin, *RAS-*
29 *UB* and *UrFU*): Petrographic observation of a polished section shows very rare
30 chondrules in a coarse recrystallized matrix. Most chondrules are very poorly
31 defined and their apparent sizes vary from 200 μm to 1 mm. Only the largest
32 chondrules (up to 4 mm) are clearly delineated. The PO, POP and BO chondrules
33 are most common and mainly consist of olivine, plagioclase, low-Ca pyroxene \pm
34 chromite and blebs of troilite and FeNi-metal. Other textural types of chondrules
35 were not observed. Olivine, low-Ca-pyroxene, plagioclase, FeNi-metal and troilite
36 are the main minerals in the matrix. Clinopyroxene, chromite, chlorapatite and
37 merrillite (100-300 μm) occur locally in the matrix. Plagioclase grains are larger
38 than 50-100 μm . Shock features include undulatory extinction, irregular and planar
39 fractures (three directions) in olivine and the presence of opaque shock veins. The
40 presence of impact melt suggests shock stage S5. Grains of FeNi metal (up to 1
41 mm) are represented by both individual phases (kamacite, taenite or plessite) and
42 their intergrowths (kamacite + taenite, kamacite + plessite + tetrataenite, kamacite
43 + tetrataenite + pentlandite) \pm troilite. Grains of troilite (100-500 μm) are spongy,
44 fine-grained aggregates of micrometer-sized individuals (<5 μm). Some pentlandite
45 grains occur in such aggregates, especially on contacts with FeNi-metal. Opaque
46 shock veins (up to 100 μm in thick) are not very abundant and contain metal-
47 sulfide intergrowths in fine-grained low-Ca pyroxene matrix. The thickness of
48 fusion crust is up to 600 μm . It is highly vesicular and zoned in texture: the outmost
49 zone is a cryptocrystalline aggregate of skeletal crystals of zoned olivine and
50 magnetite (up to 5 μm) and glass (44-47 wt.% SiO_2); the inner zone is represented
51 by larger skeletal crystals of newly formed olivine + glass + minor magnetite. Both
52 zones contain rounded relics of initial olivine and chromite and newly formed Ni-
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rich metal-sulfide globules (10-20 μm). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.8$ (analyst Yakovlev G.A.).

Geochemistry: SEM-EDS-WDS (V. V. Sharygin, *SIGM* and *UrFU*) and EMPA-WDS (D.A. Zamyatin, *RAS-UB* and *UrFU*). Olivine $\text{Fa}_{25.6\pm 0.3}$ (N=51), low-Ca pyroxene $\text{Fs}_{21.4\pm 0.2}\text{Wo}_{1.6\pm 0.3}$ (N=44), plagioclase $\text{Ab}_{83.5}\text{An}_{10.5}\text{Or}_{6.0}$ (N=35), Cr-bearing clinopyroxene $\text{En}_{45.8}\text{Fs}_{9.0}\text{Wo}_{45.2}$ ($\text{Cr}_2\text{O}_3 - 0.8\text{-}1.0 \text{ wt.}\%$, N=6), chromite $\text{Cr}_{82.8}\text{Spl}_{12.1}$ (N=17), chlorapatite, merrillite, FeNi-metals, troilite and pentlandite. Chlorapatite contains F (up to 0.5 wt.%); Cl – 5.5, $\text{Na}_2\text{O} - 0.5 \text{ wt.}\%$ (N=11). Merrillite is poor in FeO (0.3-0.7 wt.%, N=8). Composition of metal (in wt.%): kamacite (N=32) – Fe 93.2 ± 1.4 , Ni – 5.89 ± 1.44 , Co – 0.92 ± 0.13 ; taenite (N=20) – Fe 68.6 ± 5.1 , Ni 31.0 ± 5.1 , Co 0.36 ± 0.09 ; tetrataenite (N=3) – Fe 48.5, Ni 51.2, Co 0.16. Composition of sulfides (in wt.%): pentlandite (N=10, in association with troilite) – Fe 50.6 ± 0.8 , Ni 15.4 ± 1.0 , Co 0.15 ± 0.02 , Cu 0.61 ± 0.26 , S 33.6 ± 0.3 ; heazlewoodite (N=10, from fusion crust) – Fe 2.62 ± 0.46 , Ni 71.4 ± 0.8 , Co 0.11 ± 0.01 , Cu 0.37 ± 0.09 , S 25.6 ± 0.5 .

Classification: Ordinary chondrite. L6, S5, W0.

Specimens: *UrFU* - 798.6 g (3 samples: 550.4, 188.3, 59.9 g); *Vernad* - 603 g (3 samples); *SIGM* - 31.7 g fragment; *RAS-UB* - 15 g fragment; *UHelsinki* - 15 g fragment.

Parauapebas $6^{\circ}3.373'S, 49^{\circ}53.347'W$

Para, Brazil

Probable fall: 2013 Dec 09

Classification: Ordinary chondrite (H4-5)

History: (D. Cunha, D. Atencio, A.L.R. Moutinho) On 9 December 2013, about 7:00 p.m. local time, a meteorite fell in the city of Parauapebas, located in the eastern part of Pará State, Brazil. A witness reported seeing the bolide traveling from NE to SW direction. A stone hit the roof of a house with a loud noise that was heard by the resident Mrs. Maria. She claims that a meteorite fragment hit and injured her right shoulder but her son says that she was hit only by roof debris. Her son, I. S. Lima, collected the stone on the roof. The stone broke in two pieces during the impact. One piece is lost but the other remaining 62 g piece was kept by Mrs. Maria for some years and then donated to the Institute of Geosciences, *USP*. Another 210.3 g oriented mass was observed to fall by other city residents while they were in front of their house. Meire C. Rosa, her husband Paulo T. Nunes, her mother Rosa C. Santos and neighbors heard loud thunder and a noise when the stone penetrated the wooden beam of their house, embedding itself in the ground. Meire immediately collected the stone and noticed it was still warm. In early 2018, she contacted Andre L.R. Moutinho, who was already part of the classification team of the 62 g fragment. The 210.3 g stone was purchased by Andre L. R. Moutinho.

Physical characteristics: The 210.3 g mass is almost fully crusted, and measures $5.7 \times 5.3 \times 4.2 \text{ cm}$, and shows orientation features such as nose-cone shape and roll-over lips. A small portion of secondary crust is also present. The 62 g fragment

measuring $4.8 \times 3.5 \times 2.6$ cm shows the gray interior with two distinct lithologies: type-4 clast with an abundance of chondrules showing sharply defined edges; and type-5 clast, in which the edges of the chondrules are beginning to merge with the surrounding groundmass. Shock melt veins indicate it is a breccia.

Petrography: (C.V.N. Villaça and M.E. Zucolotto, *MNRJ/UFRJ*; D. Cunha, D. Atencio, *IGc/USP*). Polished thin sections were examined by MEV/EDS and electron microprobe. There are some black shock-induced melt veins, one broader crossing the entire thin section. Olivine, ortho and clinopyroxene were observed with abundant Fe-Ni-metal and sulfide. Mineralogy dominated by forsterite, enstatite, iron, troilite, and tetrataenite. Albite, chromite, diopside, augite, pigeonite, taenite, and merrillite are minor components. Texturally there are at least two lithologies. One exhibits an abundance of chondrules with well-defined margins and no visible plagioclase, consistent with petrologic type 4 chondrites. The other lithology displays chondrules with outlines blurring into the groundmass as evidence of an increasing recrystallization. In at least one clast some small plagioclase of about $20 \mu\text{m}$ confirmed a type-5 lithology. The presence of shock veins and large olivine with undulatory extinction, fractures and some weakly mosaicism infer a shock state S4

Geochemistry: (A.A. Tosi, Labsonda/UFRJ, A.L.R. Moutinho) Microprobe analysis yields: Type 4 - olivines ($\text{Fa}_{19.3 \pm 0.4}$, $\text{PMD} = 2.22$, $n = 30$); low-Ca pyroxenes ($\text{Fs}_{17.3 \pm 0.9} \text{Wo}_{0.9 \pm 0.3}$, $\text{PMD} = 9.16$, $n = 23$); high-Ca pyroxene $\text{Fs}_{10.4 \pm 2.6} \text{Wo}_{28.3 \pm 11.5}$, $\text{PMD} 29.2$, $n = 12$. Type 5 - olivines ($\text{Fa}_{18.9 \pm 0.4}$, $\text{PMD} = 1.96$, $n = 45$); low-Ca pyroxenes ($\text{Fs}_{16.9 \pm 0.6} \text{Wo}_{1.6 \pm 0.9}$, $\text{PMD} = 5.44$, $n = 19$); high-Ca pyroxene $\text{Fs}_{15.1 \pm 2.5} \text{Wo}_{16.0 \pm 2.5}$, $\text{PMD} 22.7$, $n = 7$). Metal: iron ($\text{Ni} = 6.15 \pm 0.32$ wt.%, $\text{Co} = 0.42 \pm 0.02$ wt.%, $n = 9$), tetrataenite ($\text{Ni} = 52.9 \pm 2.3$ wt.%, $\text{Co} = 0.09 \pm 0.08$ wt.%, $n = 3$), taenite ($\text{Ni} = 37.1$ wt.%, $\text{Co} = 0.12$ wt.%, $n = 1$), troilite ($\text{Ni} = 0.11 \pm 0.11$ wt.%, $n = 9$) and chromite ($\text{Cr}/(\text{Cr}+\text{Al}) = 0.928 \pm 0.003$, $n = 3$).

Cathodoluminescence also gives results comparable to breccia H4-5. (D. Atencio, D. Cunha, A. L. R. Moutinho, Laboratório de Microscopia Eletrônica/IGc/USP) SEM/EDS analysis yields: olivines ($\text{Fa}_{19.6 \pm 1.1}$, $\text{PMD} = 9.9$, $n = 6$); low-Ca pyroxenes ($\text{Fs}_{16.6 \pm 0.7} \text{Wo}_{0.0 \pm 0.0}$, $\text{PMD} = 3.43$, $n = 15$). plagioclase ($\text{Ab}_{83.0 \pm 2.0} \text{An}_{12.2 \pm 1.3} \text{Or}_{4.8 \pm 0.8}$, $n = 5$). Metal: tetrataenite ($\text{Ni} = 49.16 \pm 2.75$ wt.%, $n = 3$), troilite ($\text{Fe} = 61.49 \pm 1.66$ wt.%, $\text{S} = 37.46 \pm 1.02$ wt.%, $n = 10$) and chromite ($\text{Cr}/(\text{Cr}+\text{Al}) = 0.85$, $n = 2$)

Classification: It is a genomic breccia with the clasts and matrix from the same compositional group but different petrologic types, H4-5, S4, W0

Specimens: *IGc/USP*: 34.8 g, *MNRJ*: 4 g; Andre L. R. Moutinho: 210.3 g main mass and 13.08 g slice.

Qira 001 $37^{\circ}34'22.01''\text{N}$, $80^{\circ}23'33.46''\text{E}$

Xinjiang, China

Find: 2012

Classification: Ordinary chondrite (H~5)

History: (R. Bartoschewitz, *Bart*) Discovered by Bi Chunlin in the desert in Hotan county/Xinjiang in 2012 and was purchased by Wang Ziyao, who donated it to R. Bartoschewitz.

Physical characteristics: (R. Bartoschewitz, *Bart*) Red-brown 8.03 g stone with adhering desert sand.

Petrography: (R. Bartoschewitz, *Bart*) Red-brown stained recrystallized matrix with nearly complete recrystallized chondrules (av. ~1.0 mm). Metal and sulfide completely oxidized, vugs partly filled with gypsum.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.59$

Classification: Ordinary chondrite (H~5, W5)

Specimens: 1.70 g on deposit at *Kiel*, main mass of 5.8 g with *Bart*.

Rabt Sbayta 010 24.135944, -14.763139

Rio de Oro, Western Sahara

Find: 2017 Dec 8

Classification: Martian meteorite (basaltic breccia)

History: Found on 12/08/2017 by Zaid Oualguirah in the same area as [NWA 7034](#). Purchased by Jean Redelsperger from Mohamed Elguirah in Zagora, Morocco, in 2018.

Physical characteristics: Three identical appearing pieces 4.8 g, 0.7 g, and 0.6 g, two pieces preserve patches of original glassy fusion crust, the remaining exterior surfaces have a shiny black luster. Saw cut reveals a breccia with numerous dark and light colored fragmental crystals and polycrystalline lithologies, scattered spherules and spherical objects, set in a dark gray, fine-grained groundmass, some opaques visible.

Petrography: (C. Agee, *UNM*) Microprobe examination of the polished deposit sample shows a polymict breccia with fragmental feldspar and pyroxene grains, set in a very fine-grained groundmass composed of feldspar, pyroxene, oxides, and phosphates.

Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $\text{Fs}_{36.0 \pm 10.0} \text{Wo}_{5.0 \pm 2.3}$, $\text{Fe}/\text{Mn} = 36 \pm 4$, $n = 10$; high-Ca pyroxene $\text{Fs}_{23.5 \pm 2.9} \text{Wo}_{40.3 \pm 6.5}$, $\text{Fe}/\text{Mn} = 32 \pm 1$, $n = 2$; plagioclase $\text{Ab}_{58.4 \pm 6.5} \text{An}_{38.5 \pm 8.0} \text{Or}_{3.2 \pm 1.6}$, $n = 12$.

Classification: Martian (basaltic breccia). Paired with NWA 7034 pairing group

Specimens: 1.3 g including a probe mount on deposit at *UNM* Jean Redelsperger holds the main mass.

Ramlat as Sahmah 530 (RaS 530) 20°34.104'N, 55°43.342'E

Al Wusta, Oman

Find: 20 Apr 2014

Classification: Ureilite

History: The meteorite was found on 20 April 2014 during a field trip in the Oman desert.

Physical characteristics: Brownish individual lacking any fusion crust.

Petrography: The meteorite is dominantly composed of <1 mm sized olivine grains, sometimes poikilitically enclosing augite crystals. Olivine shows abundant reduced rims; the meteorite contains flaky graphite and Cr-bearing sulfides. Cracks are often found to be filled with barite likely due to intense terrestrial weathering.

Geochemistry: Reduced rims in olivine: $Fa_{1.4-4.5}$; olivine contains 0.28 ± 0.03 wt% Cr_2O_3 and 0.22 ± 0.02 wt% CaO; augite contains 1.58 ± 0.03 wt% Cr_2O_3 and 3.37 ± 0.03 wt% Al_2O_3

Classification: Ureilite, augite-bearing

Ramlat Fasad 057 19°0.580'N, 53°20.587'E

Zufar, Oman

Find: 31.01.16

Classification: Martian meteorite (Shergottite)

History: A single fragment was found during a search for meteorites.

Physical characteristics: Pale/greyish brown to greenish brown, platy fragment, 3x4x0.7 cm, without fusion crust. Wind-ablation on small sides.

Petrography: (Felix Mechelke, *Bern*, B. Hofmann, *NMBE*) The meteorite consists of pigeonite and augite (together 48 vol%, typical length 0.5-1 mm), olivine (35 vol.%, typical size 0.6 mm) and plagioclase completely transformed to maskelynite (11 vol.%, typical size 0.3x0.7 mm). Accessories (6 vol%) comprise pyrrhotite and spinel. Weathering effects: Minor replacement of silicates by terrestrial calcite along fractures, staining of silicates with iron hydroxides near surface.

Geochemistry: (Felix Mechelke, *Bern*, B. Hofmann, *NMBE*) Olivine rim compositions are $Fa_{40.8 \pm 3.5}$ (N = 43). Dark brown, partially altered cores are $Fa_{35.1 \pm 1.9}$ (N = 21). Pigeonite compositions are $Fs_{29.8 \pm 3.1}$ (N = 44, range 27.3-43.4), $Wo_{8.8 \pm 1.7}$ (range 6.3-13.6), mean $FeO/MnO = 28.0 \pm 1.4$; augite compositions are $Fs_{23.1 \pm 2.8}$ (range 20.1-29.2, N = 8) $Wo_{31.0 \pm 5.3}$ (range 20.3-36.4). Maskelynite has $An_{53.0 \pm 1.5}$ (range 48.5-55.7) $Or_{1.7 \pm 0.4}$ (range 1.2-2.8, N = 29). Bulk Fe/Mn (XRF) is 35.5 ± 2.7 (N = 5). Oxygen isotopes (R. Greenwood, *OU*): $\delta^{17}O$ 3.031, $\delta^{18}O$ 5.257, $\Delta^{17}O$ 0.297.

Classification: Based on petrography, mineral compositions, bulk Fe/Mn and oxygen isotopes this is a strongly shocked shergottite.

Specimens: All at *NMBE*

Realicó 35°1'S, 64°19'W

La Pampa, Argentina

Find: 1970

Classification: Ordinary chondrite (L5)

History: The meteorite was found around 1970 by a farmer while plowing a rock-free field in the Realicó area, La Pampa Province, Argentina. The only mass, with a weight of 12 kg approximately, was kept at the farm. This find was little known until 2015, when an amateur astronomer (J.C. Spagnotto, Observatorio El Catalejo

de Santa Rosa, La Pampa, Argentina) learned about the meteorite. Spagnotto sent a sample to ICATE and the stone was identified as a chondrite.

Petrography: The stone is highly altered. Different types of chondrules are visible: BO, RP and POP with apparent diameter ranging from 600 microns to 1.5 mm. The shock features record by crystals such as: undulatory extinction, planar fractures, melt pockets and the presence of polycrystalline troilite indicate a state of shock S3 or S4. A strong degree of oxidation of metal suggest an alteration stage W3.

Geochemistry: Mineral composition: EMP analyses, Olivine, $Fa_{25.4\pm 0.5}$ (n=51); pyroxene, $Fs_{21.1\pm 0.5}Wo_{1.2\pm 0.2}$ (n=28).

Classification: Ordinary chondrite (L5).

Specimens: Type specimen of 47.5 g is on deposit at the *MLP* and three thin sections are on deposit at ICATE, Argentina. The main mass remains at the farm.

Reckling Peak 14003 (RKP 14003) 76°12.744'S, 158°32.205'E

Antarctica

Find: 2014 Nov 10

Classification: Ordinary chondrite (H3)

Petrography: The section shows sharply defined chondrules (~0.4 mm in average) with some glassy mesostasis. Metal abundance is ~13 vol%. The section appears to be brecciated.

Geochemistry: Olivine composition is $Fa_{0.4-36.4}$; low-Ca pyroxene is $Fs_{15.5-40.6}Wo_{0.3-2.7}$.

Reckling Peak 14005 (RKP 14005) 76°15.954'S, 158°07.073'E

Antarctica

Find: 2014 Nov 16

Classification: Carbonaceous chondrite (CM2)

Petrography: The section consists of relatively small chondrules (~16 vol %, ~<100 μ m to ~1.6 mm in diameter, the average size of chondrule is ~300 μ m) and matrix (~84 vol%). Single hibonite crystal is observed in matrix. Fe-Ni metal is very rare (<0.1 vol%). The section has abundant hydrated materials, mainly serpentine. The matrix occurs as fine-grained rims surrounding chondrules.

Geochemistry: Olivine is $Fa_{0.4-57.5}$; low-Ca pyroxene is $Fs_{1.0-3.7}Wo_{0.9-3.4}$.

Reckling Peak 14006 (RKP 14006) 76°16.344'S, 158°08.727'E

Antarctica

Find: 2014 Nov 16

Classification: Ordinary chondrite (H3)

Petrography: The section shows sharply defined chondrules (~70 vol%, average size of ~0.3 mm) with glassy mesostasis. Metal abundance is ~10 vol%.

Geochemistry: Olivine is $Fa_{0.5-39.9}$; low-Ca pyroxene is $Fs_{4.1-42.7}Wo_{0.1-5.3}$.

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5 **Renchen** 48°35'17.9988''N, 8°0'00.00''E

6 Baden-Wurttemberg, Germany

7 Confirmed fall: 10 July 2018

8 Classification: Ordinary chondrite (L5-6)

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10 **History:** (Pavel Spurný, *CzAS*). A -13.4 maximum absolute magnitude bolide was
11 observed by many of eyewitnesses, mainly over western Germany, eastern France,
12 Belgium, Netherlands, Luxembourg, and Switzerland, and recorded
13 photographically and photoelectrically by instruments of the Czech and German
14 parts of the European Fireball Network on July 10, 2018, at 21:29:49-53 UT. Based
15 on these instrumental data, precise results on atmospheric trajectory, heliocentric
16 orbit and fragmentation history were quickly determined. From this analysis (done
17 at *CzAS*), it was evident that this event terminated with a multiple meteorite fall in
18 Baden-Württemberg, close to the Rhine river. The impact area for a possible range
19 of meteorite masses was thus modeled and sent to a German colleague
20 (Dieter *Heinlein*) shortly after the fall. As a result, all of the meteorites were found
21 in the predicted location for a given mass during dedicated searches.

22 **Physical characteristics:** (D. *Heinlein*). A total mass of 999 g was recovered
23 within the predicted fall site. The first meteorite (12 g) was discovered two weeks
24 after the fall. The largest meteorite fragment had a mass of 955 g and was found in
25 a field, close to a small impact pit. Two of the meteorites (5 and 6 g) were caught
26 by a hail net covering a fruit plantation.

27 **Petrography:** (M. Patzek and A. Bischoff, *IfP*): Based on the study of the thin
28 sections, Renchen is brecciated. Highly recrystallized fragments (type 6) coexist
29 with areas showing a chondritic texture (type 5) and fragments of impact melt.
30 Olivine shows weak mosaicism indicating shock stage S4. Opaque phases include
31 metals (kamacite, taenite), troilite, and chromite. Other accessory phases include
32 Cl-apatite and merrillite. Several shock veins cross the meteorite.

33 **Geochemistry:** (M. Patzek and A. Bischoff, *IfP*): The mean composition of olivine
34 is $\text{Fa}_{26.0\pm 0.5}$ with a compositional range of $\text{Fa}_{24.6-27.1}$ (n=59). The low-Ca pyroxene
35 has a mean composition of $\text{Fs}_{21.9\pm 0.4}\text{Wo}_{1.4\pm 0.3}$ (n= 21), varying between $\text{Fs}_{21.1-}$
36 22.6 . Mean plagioclase is $\text{An}_{9.8\pm 0.6}\text{Or}_{3.9\pm 2.6}$ (n= 10; range $\text{An}_{8.6-10.7}$). O-isotopes (A.
37 Pack; *UGött*): The mean oxygen isotope composition of two analyzed fragments is:
38 $\delta^{17}\text{O} = 3.63\text{‰}$, $\delta^{18}\text{O} = 4.74\text{‰}$, $\Delta^{17}\text{O} = 1.12\text{‰}$ (relative to a reference line with a
39 slope of 0.5305). The data are consistent with those of other L chondrites.

40 **Classification:** L chondrite breccia (L5-6, S4, W0)

41 **Specimens:** Type Specimens: 20.9 g, *IfP*; the main masses are with the finders.

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50 **Sahara 98063**

51 Sahara

52 Find: 1998

53 Classification: Ordinary chondrite (H3)

History: Sample was found 1998 by the *Labenne*-group. The coordinates are unknown.

Petrography: The sample is an unequilibrated chondrite, with chondrules of about 500 μm . Metal abundance is about 10 vol%.

Geochemistry: Olivine compositions are $\text{Fa}_{6.7-0-26.3}$ (mean $\text{Fa}_{19.6\pm 4.3}$, $n=21$), pyroxene compositions are $\text{Fs}_{2.1-17.5}\text{Wo}_{0.2-5.4}$ (mean $\text{Fs}_{12.3\pm 5.7}\text{Wo}_{1.3\pm 1.2}$, $n=20$).

Classification: H3 chondrite based on the high metal abundance and many silicate analyses in the H-group field.

San Juan de Allende 26.94°N, 105.30°W

Chihuahua, Mexico

Find: 1995 Aug

Classification: Ordinary chondrite (L3)

History: An approximately 200 g single individual was found by Ruben Jurado, sold to Edwin *Thompson*, with portions donated to *Cascadia* in 2004 and 2008.

Petrography: Well-defined chondrules, some glass-bearing, with an average diameter of 0.77 ± 0.34 mm ($N=59$), are present in a chondrite with an estimated metal content of 3.5 area%.

Geochemistry: Chondrules contain unequilibrated olivine ($\text{Fa}_{22.1\pm 7.5}$, $N=99$) and low-Ca pyroxene ($\text{Wo}_{0.9\pm 0.8}\text{Fs}_{11.6\pm 8.2}$, $N=52$). A subset of olivine point analyses, obtained with longer count times for better minor element data, gives a Cr_2O_3 content of 0.08 ± 0.08 wt% ($N=13$).

Classification: L3 chondrite based on mean chondrule size, metal abundance, olivine and pyroxene compositions. Subtype estimated as 3.4-3.6, based on olivine Fa content and Cr_2O_3 content (latter suggests ~ 3.2).

Specimens: Type sample at *Cascadia* consists of four pieces totaling to 20.2 g as well as a polished thin section. A 113 g main mass specimen is held by a person wishing to remain anonymous.

San Juan 085 (SJ 085) 25°22'29.4"S, 69°48'55.3"W

Antofagasta, Chile

Find: 2017 Nov

Classification: Carbonaceous chondrite (CK6)

Physical characteristics: Dark stone. Cut surface reveals an homogeneous dark-gray interior.

Petrography: (J. Gattacceca, *CEREGE*) Recrystallized chondrite with poorly defined large chondrules. Silicates are olivine, Ca-pyroxene, and plagioclase (average size >50 μm). No orthopyroxene was observed. Abundant sulfides (including pentlandite) and magnetite. No metal was observed.

Geochemistry: Olivine $\text{Fa}_{33.2\pm 0.4}$, NiO 0.48 ± 0.06 wt% ($N=4$). Ca-pyroxene $\text{Fs}_{12.7\pm 0.0}\text{Wo}_{47\pm 0.2}$ ($N=2$). Plagioclase $\text{An}_{31.9}\text{Ab}_{64.1}\text{Or}_{4.0}$ ($N=1$). Magnetite contains 3.7 wt% Cr_2O_3 .

Classification: Carbonaceous chondrite (CK6)

Specimens: Type specimen at *CEREGE*. Main mass with *ARTMET*.

San Juan 086 (SJ 086) 25°37'55''S, 69°46'16''W

Antofagasta, Chile

Find: November 9, 2017

Classification: Ordinary chondrite (L6, melt breccia)

History: The meteorite was found in 2017 during a field trip in the Atacama desert.

Physical characteristics: Dark brownish individual without fusion crust.

Petrography: The meteorite is composed of regions displaying chondritic textures with relict chondrules and mean plagioclase size about 60 μm , and large melt regions characterized by recrystallized shock melt containing characteristic FeNi metal and sulfide globules. Chondritic portions are crosscut by shock melt veins.

San Juan 089 (SJ 089) 25°26.488'S, 69°53.232'W

Antofagasta, Chile

Find: 18 Jan 2017

Classification: Ordinary chondrite (H5)

History: Charles and Nick Lucas used low-grade magnets attached to poles, while walking north-south lines about 5 m apart in the area where the meteorite was found, which is a relatively flat area with a 2 to 3 degree down slope to the north.

Physical characteristics: Dark-brown weathering patina covers entire exterior. Patches of beige caliche occur on top of the patina on one side of the samples

Petrography: The overall texture is fairly well integrated in thin section, although chondrules are readily identifiable. Chondrule mesostases are fine grained and include devitrified glass. Numerous chromite-plagioclase regions and several grains of metallic copper are present. BSE imaging shows that olivine and low-calcium pyroxene grains are coarse and equilibrated. Both chondrule mesostases and chromite-plagioclase objects extend into feldspathic veins which invade surrounding ferromagnesian. Feldspathic mesostases experienced segregation of sodic, potassic, and calcic components and display different gray levels in BSE images. Tiny chromite grains are concentrated in albitic patches in mesostases. One barred olivine chondrule was examined in detail. It contained a potassium feldspar grain adjacent to a grain with a perthitic intergrowth of albite and orthoclase. In the same chondrule were regions of chromite-albitic plagioclase intergrowths and small patches of calcic feldspathic glass.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{19.9\pm 0.5}$, N=34) and low-Ca pyroxene ($\text{Fs}_{17.8\pm 0.7}\text{Wo}_{1.3\pm 0.2}$, N=27) grains are equilibrated. Feldspathic material occurs in three roughly defined compositions (sodic $\text{Ab}_{79.8}\text{An}_{15.0}\text{Or}_{5.2}$, N=13; calcic $\text{Ab}_{26.4}\text{An}_{73.2}\text{Or}_{0.4}$, N=4; potassic $\text{Ab}_{10.6}\text{An}_{4.2}\text{Or}_{85.2}$, N=5).

Classification: H5 based on chemistry and texture.

Specimens: *Cascadia* holds 17.3 g in three pieces, in addition to one polished thin section and a mounted butt.

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6 **San Juan 100** (SJ 100) 25°29.875'S, 69°44.639'W

7 Antofagasta, Chile

8 Find: 14 Feb 2018

9 Classification: Ureilite

10 **Physical characteristics:** Sawn surface shows a dark interior with scattered
11 graphite flakes. Stone low weathered.

12 **Petrography:** Thin section shows typical ureilitic texture with interlocked olivine
13 (40 vol%) and pyroxene (60 vol%) grains of 0.8-3 mm in size. Common graphite
14 aggregates up to 1 mm are observed.

15 **Geochemistry:** Olivine cores in the range $Fa_{11.4-13.1}$ (mean $Fa_{11.9\pm 0.5}$, $N=18$), with
16 $FeO/MnO=21.6\pm 3.2$ and $Cr_2O_3=0.68\pm 0.07$. Pyroxene in the range $Fs_{10.0-11.6}$ (mean
17 $Fs_{10.6\pm 0.5}$ $Wo_{4.4\pm 0.3}$, $N=20$).

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23 **San Pedro de Urabá** 8°16'44.39"N, 76°22'41.67"W

24 Antioquia, Colombia

25 Confirmed fall: 16 Feb 2017

26 Classification: Ordinary chondrite (L6)

27 **History:** At 5:30 pm local time on 16 February 2017, a large fireball with sonic
28 booms was observed in northern Colombia. A meteorite subsequently impacted
29 near Mr. Orlando Cuevas on the edge of a soccer field in San Pedro de Urabá,
30 Turbo district, Antioquia State, Colombia. The event was widely reported in the
31 local media, e.g., [www.minuto30.com/fotos-en-zona-rural-de-turbo-aseguran-que-](http://www.minuto30.com/fotos-en-zona-rural-de-turbo-aseguran-que-cayo-un-meteorito/340813/)
32 [cayo-un-meteorito/340813/](http://www.minuto30.com/fotos-en-zona-rural-de-turbo-aseguran-que-cayo-un-meteorito/340813/), which shows a picture of the 3768 g stone from the
33 soccer field. Two other stones are known to have fallen, one much larger than the
34 one that was collected in the soccer field, but their whereabouts are unknown.
35 Michael Farmer acquired the 3768 g stone from Mr. Cuevas.

36 **Physical characteristics:** Single regmaglypted stone covered with matte black
37 fusion crust. Interior is a light greenish-gray and friable. Cut surface shows poorly
38 defined chondrules and even distribution of small metal/troilite grains. Only a
39 single thin shock vein is visible.

40 **Petrography:** (L. Garvie, ASU) SEM observation of a polished mount shows scattered
41 poorly defined chondrules (BO, RP, and PO) largely integrated with the matrix. All
42 silicates heavily fractured. Feldspar grains typically $>50\ \mu\text{m}$, with many around 100
43 to $200\ \mu\text{m}$. Troilite anhedral and dominantly single crystal to $400\ \mu\text{m}$. Rare
44 anhedral Ca-Na-Mg phosphates to $60\ \mu\text{m}$. Chromite to $600\ \mu\text{m}$ is anhedral to
45 subhedral and heavily fractured. Three Fe-Ni metal types present: kamacite,
46 dominantly single crystal (to 0.5 mm) with a frosty etch and weakly defined
47 Neumann bands; tetrataenite, rare, commonly contiguous to kamacite; and, equant
48 Ni-zoned grains with Ni-rich rims and dark-etched cores, some showing kamacite
49 spindles. Native Cu is rare and occurs as <10 micron grains at kamacite/troilite
50 boundary. Scattered and rare melt pockets to $60\ \mu\text{m}$.

Geochemistry: Olivine $\text{Fa}_{25.1\pm 0.3}$, $\text{FeO/MnO}=47.6\pm 1.8$, $n=9$; low Ca pyroxene $\text{Fs}_{21.4\pm 1.2}\text{Wo}_{1.5\pm 0.2}$, $\text{FeO/MnO}=28.4\pm 1.3$, $n=10$; Feldspars $\text{Or}_{13.4\pm 0.3}\text{Ab}_{67.3\pm 67.3\pm 0.5}$, $n=3$ and $\text{Or}_{5.4\pm 0.1}\text{Ab}_{84.4\pm 0.02}$, $n=2$.

Classification: Ordinary chondrite L6, S3, W0

Specimens: 32 g at *ASU*. Main mass with *MFarmer*.

Sauceda de la Borda 22°49'15.73"N, 102°31'28.99"W

Zacatecas, Mexico

Find: October, 2016

Classification: Iron meteorite (IAB-MG)

History: Found October, 2016, by Mr. Alejandro Cortes while he was clearing brush along a dirt road about 2 km southwest of Saucedá de la Borda. About 1/4 of the stone was sticking out of the ground. Purchased by Michael Farmer from the finder in December 2016.

Physical characteristics: A relatively unweathered and beautifully regmaglypted 41 kg stone, measuring approximately $37 \times 19 \times 18$ cm. A 17×12 cm cut and etched slice shows a well-developed Widmanstätten pattern and an abundance of graphite/troilite nodules, one 8×2 cm. A well-developed heat-affected zone is present around the whole of the slice. Layered fusion crust and beads of ablated material are present within some of the regmaglypts.

Petrography: (L. Garvie, *ASU*) A 13×10 cm slice demonstrates a variable structure typical of many group IAB octahedrites, with half of the section rich in decomposed cohenite and the other half showing a well-developed coarse octahedral structure with few inclusions - the two structural types are separated by an elongated graphite/troilite nodule. Etched sections display a coarse Widmanstätten pattern with short but bulky kamacite lamellae, typically 2 mm wide. Kamacite shows two generations of Neumann bands: the first are strongly developed, whereas the second are partially annealed and decorated with sub- μm sized precipitates. Taenite/plessite occupies ~ 4 areal%, most commonly as ribbons and wedge-shaped blocks separating kamacite lamellae. Plessite shows dominantly pearlitic, comb, and net structures. Decomposed cohenite is present in abundance as smoothly rounded elongated grains (to 4 cm), within and following kamacite lamellae, enveloping schreibersite grains, and around graphite/troilite nodules. In a polished mount, all of the cohenite is decomposed to graphite and ferrite.

Schreibersite occurs in three forms: as large grains (to 8 mm) with enveloping decomposed cohenite and surrounded by swathing kamacite; as grain boundary veinlets; and as rhabdites and sub-micron precipitates. The troilite/graphite nodules are entirely mantled by a structurally complex rim (<5 mm thick) of troilite, graphite, schreibersite, and decomposed cohenite. Deep emerald green crystals, possibly krinovite or kosmochlor, occur in several of the graphite nodules.

Geochemistry: (J.T. Wasson, *UCLA*), INAA, Ni = 69.9 and Co = 4.76 (both mg/g), Ga = 77.4, As = 15.3, Ir = 2.14, and Au = 1.59 (all $\mu\text{g/g}$).

Classification: Found only a few km from the iron [Zacatecas \(1792\)](#), though Saucedá de la Borda is structurally and chemically distinct. It is a member of the IAB main group and there are no other Mexican irons that are chemically similar.
Specimens: 1.2 kg at *ASU*. The rest with *MFarmer*.

Sayh al Uhaymir 605 (SaU 605) 20°32'37.51"N, 56°40'35.98"E

Al Wusta, Oman

Find: 2014 Nov 5

Classification: Ordinary chondrite (L4)

Physical characteristics: Single crusted stone

Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed and well-defined chondrules. Opaque are FeNi metal and troilite.

Geochemistry: Olivine $\text{Fa}_{24.2\pm 1.1}$, PMD 3.9% (N=8), range $\text{Fa}_{22.8-}$

26.1 . Orthopyroxene $\text{Fs}_{16.2\pm 6.5}\text{Wo}_{1.0\pm 0.8}$, Fs PMD 34%, range $\text{Fs}_{4.8-24.0}$ (N=10).

Classification: L4. Olivine is not completely equilibrated but the Fa PMD is below 5%, indicating a type 4.

Specimens: Type specimen at *CEREGE*. Main mass with anonymous finder.

Sayh al Uhaymir 606 (SaU 606) 20°20.555'N, 56°49.427'E

Al Wusta, Oman

Find: 12.02.17

Classification: Ordinary chondrite (H5)

History: A complete, fresh-looking individual was found during a search for meteorites on February 12, 2017. The area (to a distance of 1-2 km) was searched again in February 2018 but no paired meteorites were found.

Physical characteristics: Complete individual fully covered with black, slightly crackled fusion crust. Bulk density based on a shape model is 3.43 g/cm³.

Petrography: (Å. Rosén, *Bern*, E. Gnos, *MHNGE*, B. Hofmann, *NMBE*) The meteorite shows a brecciated chondritic texture with well-preserved chondrules. Minor and accessory minerals include chromite, ilmenite and native copper.

Typical grain size of plagioclase is 10-20 µm. Mean chondrule size is 0.47 ± 0.21 mm (n=128). Minor rust staining in silicates close to metal grains. Iron hydroxide rims around metal reach up to 20 µm.

Geochemistry: (Å. Rosén, *Bern* and B. Hofmann, *NMBE*) Olivine compositions are $\text{Fa}_{18.1\pm 0.3}$ (n=48), pyroxene compositions are $\text{Fs}_{16.3\pm 0.4}$, $\text{Wo}_{0.9\pm 0.2}$ (n=29).

Cosmogenic radionuclides: (Å. Rosén, *GeMSE*): Gamma-spectroscopy performed in April 2017 showed detectable activities of short-lived radionuclides indicating decay during ~5 years. At end of measurement, ²⁶Al was 39.1(+4.2,-3.8), ²²Na was 17.9(+2.7,-1.3) and ⁵⁴Mn was 1.1(+0.3,-0.2) dpm/kg.

Classification: Based on mineral compositions and mean chondrule size this is an equilibrated H5 chondrite. Cosmogenic isotope data indicate a fall around the year 2012.

Specimens: All at *NMBE*

Scarham Creek 34.319, -85.979

Alabama, United States

Find: 2015

Classification: Ordinary chondrite (H3)

History: Chris Whitten found this meteorite on his family's five-acre property near the Scarham Creek, Alabama, in May 2015. He had often searched the property for meteorites for over a decade with no results, however in 2015 a fire burned and cleared some of the wooded area on the property, after which, a new search produced the meteorite find. The sample, when spotted, stood out as different from local rocks and was slightly magnetic. The sample was sent to his aunt, Dana Jenkerson, for identification. KD Meteorites purchased the main mass.

Physical characteristics: Single stone, no fusion crust, weathered exterior.

Petrography: (C. Agee, *UNM*) Microprobe examination shows numerous porphyritic chondrules, most with mesostasis or glass. Much of the metal has been oxidized by terrestrial weathering.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{14.7\pm 4.0}$, $Fe/Mn=43\pm 14$, $n=33$; low-Ca pyroxene $Fs_{10.8\pm 8.8}Wo_{0.9\pm 0.5}$, $Fe/Mn=26\pm 18$, $n=8$.

Classification: Ordinary chondrite (H3), estimated subtype 3.7-3.9 based on mean Fa content of olivine and the 1-sigma Fa content of olivine.

Specimens: 10.5 g on deposit at *UNM*, Chris Whitten holds 3 grams, KD Meteorites holds the main mass.

Scottsdale 33°42.358'N, 111°56.006'W

Arizona, United States

Find: 1 April 2017

Classification: Ordinary chondrite (LL3)

History: Mr. Todd Dziuk found an unusual looking rock at the edge of a dry wash on 1 April 2017 in a desert area of Scottsdale, Arizona. He noticed that the underside had a rusty appearance and the stone felt slightly heavier than the average rock: power sanding of a corner of the stone revealed numerous bright shiny metallic spots. Extensive searching has not revealed further meteorites.

Physical characteristics: Single 210.8 g stone with broad, shallow regmaglypts. Fusion crust well preserved - light orange stained on the surface in contact with the soil and covered with matte grey fusion crust above the ground. Interior shows tightly packed, well-defined chondrules separated by a dark matrix and scattered metal/troilite grains.

Petrography: SEM observation of a polished mount shows a wide range of chondrule types including PO, PP, BO, RP, POP, and RPT (interleaved radial pyroxene and troilite), with many olivines and pyroxenes zoned. Many chondrules show rims of troilite and more rarely by Fe-Ni metal/troilite. Large range of chondrule sizes with the largest (PO) to 6×4 mm, though the majority are <1 mm diameter. Opaques dominated by troilite, with sparse kamacite and high-Ni metal.

Kamacite, to 500 μm , is single crystal. Many grains have well-developed curved Neumann bands. Troilite as polycrystalline grains to 500 μm , some grains with twin lamellae. The troilite rimming chondrules often has a "fizzy" texture. Native copper occurs in structurally complex grains of troilite/kamacite/tetrataenite. Scattered melt pockets to 100 microns. Weathering W1 based on minor oxidation of the metal.

Geochemistry: (L. Garvie, *ASU*) Olivine $\text{Fa}_{27.9\pm 7.8}$, $\text{Fa}_{0.7-31.3}$, $\text{Cr}_2\text{O}_3=0.06\pm 0.05$, range 0.01-0.3 wt%, $\text{FeO/MnO}=58.3\pm 8.6$, $\text{CaO}=0.12\pm 0.11$ wt%, $n=29$. Low Ca pyroxene $\text{Fs}_{15.9\pm 10.2}\text{Wo}_{1.7\pm 2.0}$, $\text{FeO/MnO}=21.6\pm 6.8$. High Ca pyroxene has a wide range of compositions, e.g., $\text{Fs}_{9.5}\text{Wo}_{30.8}$, $\text{Fs}_{15.6}\text{Wo}_{41.7}$, $\text{Fs}_{20.0}\text{Wo}_{44.0}$, and $\text{Fs}_{22.6}\text{Wo}_{23.9}$.

Classification: LL3 ordinary chondrite, with estimated 3.6 subtype based on Fa range and Cr_2O_3 content.

Sierra Gorda 009 22°30.10'S, 69°08.20'W

Antofagasta, Chile

Find: 2017 Oct 21

Classification: Ungrouped chondrite

History: Three pieces (30 g, 70 g, and 140 g) of one meteorite were found in the the desert by Mr. T. V. Kryachko, Mr. M. E. Nepomiluev, and an anonymous finder.

Physical characteristics: All samples of the meteorite have a brown fusion crust

Petrography: M. A. Ivanova (*Vernad*) Meteorite has chondritic texture and consists of FeNi-metal (22 -25 vol%), chondrules, and their fragments; matrix is absent. Chondrules, up to 2 mm, are PP, BO, POP, SiO_2 -bearing and Al-rich with clear boundaries; PP chondrules are dominant; the main minerals are pyroxene, Fe,Ni-metal, olivine and sulfides (troilite and daubreelite), schreibersite; accessory minerals are silica, Mg-chromite, anorthite, spinel, graphite and PGE-metal nuggets.

Geochemistry: Mineral compositions and geochemistry: M. A. Ivanova (*Vernad*), V. V. Kozlov (Oxford Instruments OM & Gatan Inc., Moscow Office) Olivine: $\text{Fa}_{0.47\pm 0.10}$ (N=74), orthopyroxene: $\text{Fs}_{1.42\pm 0.39}\text{Wo}_{0.88\pm 0.63}$ (N=42), (N=42), FeO-rich Opx: $\text{Fs}_{9.33-32.48}\text{Wo}_{0.23-4.74}$; diopside: $\text{Fs}_{1.34\pm 0.57}\text{Wo}_{47.32\pm 2.31}$; plagioclase varies in composition: $\text{An}_{32.28-95.04}\text{Ab}_{4.96-65.99}$; mesostasis in chondrules is enriched in K_2O (up to 9.18 wt%) and TiO_2 (up to 6.53 wt%); kamacite contains 5.07 wt% Ni, 0.43 wt% Co, Co/Ni - 0.09, Si and Cr are below detection (<0.03 wt%); taenite: Ni -32.3 wt%, Co - 0.25 wt% ; troilite is enriched in Cr (up to 2.4 wt%); MgO-chromite is almost pure MgO-end member. Oxygen isotopic compositions: (OU) $\delta^{17}\text{O}$ 3.763, 3.736; $\delta^{18}\text{O}$ 6.263, 6.169; $\Delta^{17}\text{O}$ 0.506, 0.528 permil.

Classification: ungrouped Fe,Ni-metal-rich chondrite with affinities to "G-chondrites" ([GRO 95551](#) and [NWA 5492](#), [Weisberg et al., 2015](#)) in texture and mineral chemistry. Oxygen isotopic compositions are between those of ordinary and enstatite chondrites.

Specimens: 3 pieces of the meteorite (6.3, 16.2, and 18 g), polished and thin sections are deposited in *Vernad*. Anonymous finder, Mt. M. E. Nepomiluev

(ramatahatta2@mail.ru), and Mt. T. V. Kryachko (bredfild@mail.ru) hold the main mass of the meteorite.

Sokoto 13°0.3'N, 5°14.85'E

Sokoto, Nigeria

Confirmed fall: 10 Jan 2008

Classification: Iron meteorite (IIIAB)

History: According to a newspaper report (THISDAY, January 11, 2008), a meteorite fell after a loud explosion and fireball at approximately 10:00 pm local time (2100h UTC) on 10 Jan 2008. The meteorite reportedly destroyed the roof of the house of Malam Bello Mohammed, in Mana Village, South Sokoto Local Government Council (on the outskirts of the city of Sokoto), and was found almost 2 m deep in the ground. The main mass reportedly weighs approximately 30 kg, and was broken into pieces with a hammer. A 240 g specimen was secured by Nigerian resident Eugene Egbe, who provided it to *Twelker*. Other pieces are reportedly with the Geological Survey Laboratory in Kaduna.

Physical characteristics: The meteorite is irregularly shaped, with deep regmaglypts, and a red-brown exterior.

Petrography: (C. Herd, *UAb*) Optical investigation of a $\sim 2 \times 3$ cm polished and etched surface reveals a well-developed Widmanstätten pattern consistent with a medium octahedrite (0.9 ± 0.2 mm; $n=22$). No obvious inclusions were noted. Terrestrial alteration has occurred along fractures connecting to the exterior.

Geochemistry: ICP-MS data, using sample of [North Chile](#) (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 8.6, Co = 0.51 (both wt%); Ir = 1.7, Ge = 41, As = 16.8, W = 1.1, Re = 0.16, Pt = 6.8, Cu = 158, Au = 1.6 (all $\mu\text{g/g}$).

Classification: (C. Herd, *UAb*): IIIAB iron, through comparison of bulk composition with data from [Wasson and Richardson \(2001\)](#).

Specimens: Type specimen consisting of one representative slice (21.9 g) at *UAb*. A 240 g mass with *Twelker*.

Stewart Valley 024 (StV 024) 36°14.991'N, 116°10.319'W

Nevada, USA

Find: 2017 Jan 07

Classification: Ordinary chondrite (H3)

Petrography: Chondrules are very sharply defined, but none appear to contain isotropic glassy mesostases, suggesting a high type-3 classification. Chondrule types include, PO, PP, POP, BO, RP and C. Olivine grains exhibit sharp optical extinction, indicative of shock stage S1. However, some of the troilite grains are polycrystalline, suggesting the rock was shocked and then annealed. Consistent with this is the occurrence of small irregular troilite grains within some grains of metallic Fe-Ni, probably a feature formed by localized shock melting. There are no observable crystalline plagioclase grains. More than 95% of the metal and troilite grains have been transformed into limonite and goethite by terrestrial weathering.

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5 **Sueilila 002** 24.732°N, 14.319°W

6 Rio de Oro, Western Sahara

7 Find: 2014 May 25

8 Classification: Martian meteorite (Shergottite)

9
10 **History:** (H. Chennaoui-Aoudjehane, *FSAC*) A party of four experienced meteorite
11 hunters (A. Bouferra, Z. Balli, A. Oubedda and M. Ouicha) had camped at a place
12 on their way back from Sbayta to Boujdour in southern Morocco on May 24, 2014,
13 and the next day searched there for meteorites. Mr. Zaid Balli found a 1467 g,
14 mostly buried rock which appeared different from the background desert soil, but
15 without fusion crust and somewhat weathered. Although following its excavation
16 this specimen did not seem promising, they decided to search for more material
17 anyway, and found several identical pieces within a few meters of the first stone. A
18 sample sent to *UWS* was soon confirmed to be a shergottite. On October 17, 2014
19 Dr. H. Chennaoui-Aoudjehane (accompanied by M. Aoudjehane, A. Bouragaa and
20 A. Bouferra) traveled to the find site to collect information on the coordinates.
21 Independently, other meteorite hunters visited the site during June and July, and
22 found additional pieces. One 560 g stone was purchased by Darryl Pitt in August
23 2014 and a 124 g stone was purchased by Steve Arnold in October 2014.

24
25 **Physical characteristics:** (A. Irving, *UWS* and A. Bouragaa) The buried portion of
26 the largest (1467 g) stone was coated by pale brown clay, but the small area that
27 was exposed is brown with dark phenocrysts visible. The cut interiors of both the
28 560 g and 124 g stones have a mottled brown appearance with larger, deep brown
29 phenocrysts. All stones have a weathering rind up to several millimeters thick.

30
31 **Petrography:** (A. Irving and S. Kuehner, *UWS*) Porphyritic texture. Euhedral to
32 subhedral, zoned olivine phenocrysts (up to 2.2 mm) are set in a finer grained
33 groundmass composed predominantly of zoned, prismatic-twinning pyroxene
34 and maskelynite with accessory olivine, chromite, ilmenite, Mg-bearing merrillite
35 and pyrrhotite. Olivine phenocrysts contain numerous tiny inclusions of chromite,
36 as well as sparse melt inclusions (now composed of low-Ca pyroxene, silica
37 polymorph, plagioclase, merrillite, pentlandite and glass) surrounded by radial
38 cracks. Cores of olivine grains are orange in thin section, whereas olivine rims,
39 groundmass olivine and groundmass pyroxene are all pale tan in color. Terrestrial
40 weathering effects include orange staining of groundmass opaque minerals and
41 minor thin calcite veinlets.

42
43 **Geochemistry:** Olivine phenocrysts (cores $\text{Fa}_{19.1-20.4}$, $N = 3$, rims $\text{Fa}_{36.9-39.5}$, $N = 2$,
44 $\text{FeO/MnO} = 48-55$), groundmass olivine ($\text{Fa}_{47.2-48.7}$, $\text{FeO/MnO} = 53-57$, $N = 2$),
45 orthopyroxene cores ($\text{Fs}_{16.5-21.7}\text{Wo}_{2.2-3.5}$, $\text{FeO/MnO} = 25-27$, $N = 2$), pigeonite
46 ($\text{Fs}_{32.2-34.1}\text{Wo}_{11.0-11.5}$, $\text{FeO/MnO} = 36$, $N = 3$), plagioclase ($\text{An}_{60.9-62.1}\text{Or}_{1.4-1.9}$, $N = 3$).

47
48 **Classification:** Martian (shergottite, olivine-phyric).

49
50 **Specimens:** 21 g including one polished thin section and one polished slice
51 at *UWB*; 20 g at *FSAC*. The remaining material is held by *DPitt*, Mr. S. Arnold, Mr.
52 A. Bouragaa and Mr. A. Bouferra.
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6 **Taltal 001** 25°29'19''S, 70°02'28''W

7 Antofagasta, Chile

8 Find: 2016 Jan 14

9 Classification: Ordinary chondrite (H3)

10 **History:** The meteorite was found in 2016 during a field trip in the Atacama desert.

11 **Physical characteristics:** Dark brownish individual without fusion crust.

12 **Petrography:** The meteorite shows a chondritic texture with often slightly
13 flattened and loosely packed chondrules (mean diameter about 0.4 mm) in a more
14 fine-grained matrix that contains sulfides and abundant FeNi metal.
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19 **Tintigny** 49.683786°N, 5.532957°E

20 Luxembourg, Belgium

21 Probable fall: Feb. 1971

22 Classification: HED achondrite (Eucrite, polymict)

23 **History:** (S. de Foestraets, S. Liégeois and V. Debaille): In February 1971, Mr.
24 Eudore Schmitz was working in his barn in the village of Tintigny late in the
25 afternoon, when he heard a noise from the roof of the building. Going upstairs, he
26 found a hole in a tile and a black stone on the floor. The school teacher of the
27 children, Albert Rossignon, confirmed it was a meteorite and kept the stone, hoping
28 for further investigation. The teacher later started religious seminary and became a
29 priest. While he kept the meteorite, and showed it from time to time to visitors and
30 children, the story never spread. Schmitz died in 2006. In 2017, after reading a
31 popular article about Belgian expeditions in Antarctica to find meteorites, Priest
32 Rossignon contacted Vinciane Debaille at *ULB*. After several contacts, the
33 Schmitz's 3 children, Jean-Paul, Joseph and Rita Schmitz, and his widow, Madam
34 Germaine Mathu, donated the meteorite to *RBINS*. Some parts of the meteorite are
35 now missing due to the handling of the stone by various people over the years, but
36 Priest Rossignon confirms that the fusion crust was initially complete with even a
37 piece of the tile stuck on it. Cracks were already visible at that time. The fusion
38 crust is still fresh and shiny with preserved flow lines. The punched tile was
39 recovered from the roof in 2018, as the hole was simply covered by another
40 transparent tile.
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48 **Physical characteristics:** A single stone partly covered with fresh glassy fusion
49 crust. Light-gray brecciated interior hosts darker (dark-gray to black) clasts.

50 **Petrography:** Brecciated ophitic to sub-ophitic texture. Contains low-Ca and high-
51 Ca pyroxene (both with exsolution lamellae), plagioclase, silica polymorph,
52 chromite, troilite, metal. Clasts with melted and variolitic (1 mm) textures are
53 present.
54

55 **Geochemistry:** Low-Ca pyroxenes $\text{Fs}_{33.4-56.5}\text{Wo}_{2.6-9.4}$, average

56 $\text{Fs}_{41.5\pm 8.5}\text{Wo}_{6.3\pm 2.8}$ $\text{FeO/MnO} = 30.6\pm 4.4$ (n=6). Ca-pyroxene $\text{Fs}_{30.1-70.0}\text{Wo}_{10.9-38.4}$,
57 average $\text{Fs}_{51.4\pm 12.3}\text{Wo}_{22.2\pm 9.3}$ $\text{FeO/MnO} = 34.7\pm 3.7$ (n=8). Average plagioclase
58
59
60

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3 An_{84.1}Or_{0.5} (n=4). Oxygen isotopes (R. Greenwood, *OU*, UK): $\Delta^{17}\text{O}$: -0.246 ± 0.003
4 per mil; $\delta^{18}\text{O}$ = 3.756 ± 0.041 per mil (n=2).

5 **Classification:** Achondrite (eucrite, polymict).

6 **Specimens:** Main mass and type specimen at *RBINS*. One polished section at
7 Laboratoire G-TIME (*ULB*).
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12 **Troy Dry Lake** 34°48.53'N, 116°33.05'W

13 California, United States

14 Find: 2017 Apr 7

15 Classification: Ordinary chondrite (L6)

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17 **History:** A single 16.3 g stone was found by Mark Bittmann on April 7, 2017,
18 while he was searching for meteorites on a dry lake. Subsequent searches resulted
19 in no additional fragments or other meteorites.

20
21 **Physical characteristics:** Dark-brown, flat shield-shaped fragment with
22 moderately rounded edges, and patches of relict fusion-crust that have developed a
23 desert-polished patina.

24
25 **Petrography:** (D. Sheikh, *FSU*) Chondrule boundaries blurred. Recrystallized
26 coarse-grained matrix with plagioclase (60 μ m). Interconnected shock melt veins.

27 **Geochemistry:** Olivine, Fa_{24.7 \pm 0.2} (N=26); orthopyroxene, Fs_{22.3 \pm 0.2}Wo_{2.7 \pm 0.2} (N=25).

28 **Classification:** Ordinary Chondrite (L6)

29 **Specimens:** 3.5 grams at *UCLA*; main mass with *Verish*.
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34 **Turpan 001** 42°33'43.03"N, 89°00'36.02"E

35 Xinjiang, China

36 Find: 26 Nov 2013

37 Classification: Ordinary chondrite (L~6)

38
39 **History:** (Ziyao Wang) The meteorite was discovered by Zijian Wang 45 km SSW
40 of Turpan City in Gaochang District on 26 Nov 2013.

41 **Physical characteristics:** (Ziyao Wang) Reddish brown heavy fractured wind
42 eroded irregular rock of 1500 g without fusion crust.

43
44 **Petrography:** (R. Bartoschewitz, *Bart*) brown stained recrystallized matrix with
45 poor defined chondrules (0.6-1.8 mm, av. 0.7 mm).

46
47 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.81$

48
49 **Classification:** Ordinary chondrite (L~6, W3)

50 **Specimens:** 21.9 g on deposit at *Kiel*, Wang Ziyao and Zijian Wang holds the main
51 mass, and 108 g with *Bart*.
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56 **Twayla 001** ~26°50.2'N, ~9°11.6'W

57 Saguia el Hamra, Western Sahara

58 Find, doubtful fall: 2014 Dec

59 Classification: HED achondrite (Howardite)
60

History: The family of nomad Lahsen Duine spent the winter of 2014/2015 in the Wad La'waj Talli area, nearly 70 km NE of Bir Lahlou. Short before the end of the year, they were awakened by lightning, followed by a curious whistling noise. In March 2015, the children discovered two black stones on the ground, in the grassy scrub, while they were catching their goats. The stones were discovered within several hundred m of each other. The bigger stone was purchased in Ouarzazate in March 2017.

Physical characteristics: Two nearly complete individuals of 318 and approximately 150 g with glossy black fusion crust. Cut face shows a breccia with fragmental light and darker clasts set in a light-gray groundmass. Some fractures show penetrating fusion crust; no traces of terrestrial fillings are recognizable.

Petrography: (R. Bartoschewitz, *Bart*) Polymict breccia with at least three distinct lithologies: diogenite, eucrite and anorthosite. Ubiquitous iron-nickel metal, Fe-sulfide and chromite present.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Diogenite pyroxene $\text{Fs}_{35.0\pm 0.7}\text{Wo}_{5.2\pm 1.4}$, Fe/Mn=27, n=8; chromite CRAL 78.3±1.2, FFM 88.6±3.6. Eucrite pyroxene $\text{Fs}_{40.0\pm 1.8}\text{Wo}_{9.4\pm 2.5}$, Fe/Mn=30, n=15; plagioclase $\text{An}_{89.7\pm 1.5}\text{Or}_{0.3\pm 0.1}$, n=14; olivine $\text{Fa}_{38.5}$, Fe/Mn=34, n=1. Anorthositic clast $\text{An}_{93.0\pm 0.8}\text{Or}_{0.3\pm 0.1}$, n=5. Matrix pyroxene $\text{Fs}_{35.0\pm 3.2}\text{Wo}_{5.6\pm 0.9}$, Fe/Mn=28, n=9; plagioclase $\text{An}_{91.9\pm 2.1}\text{Or}_{0.3\pm 0.1}$, n=2; olivine $\text{Fa}_{46.3\pm 12.7}$, Fe/Mn=51, n=2; chromite CRAL 79.4±2.0, FFM 90.4±0.4; kamazite Ni 0.0-2.0, Co 0.2-0.7 wt-%, n=15, troilite.

Classification: HED achondrite (howardite)

Specimens: 20.0 g on deposit at *Kiel*, main mass with Dieter Janek, 21.5 g *Bart*.

Weiya 001 41°43'1.04"N, 94°14'30.94"E

XinJiang, China

Find: 20 Aug 2012

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) Discovered by Wang Ziyao in the Gobi Desert, 12 km SW Weiya and 36 km SE of Yamansu, near Hami city in Xinjiang province on Aug. 20, 2012.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Dark, gray-brown, flat stone of 201 g without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) Gray, porous, strongly recrystallized matrix with poorly defined chondrules and irregular metal and sulfide specks up to 0.5 mm.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.83$

Classification: Ordinary chondrite (L~6, W4)

Specimens: 21.1 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 23.2 g with *Bart*.

Willcox Playa 011 32°7.0'N, 109°53.3'W

Arizona, United States

Find: 2018 Jan 22

Classification: Ordinary chondrite (L6)

History: A single stone was recovered by Mr. Chris McDoniel while he was searching for an old aircraft crash site. Field ID#: UU180122A

Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred ($900\pm 100\ \mu\text{m}$, $N=4$). Recrystallized coarse-grained matrix with plagioclase ($60\ \mu\text{m}$).

Interconnected shock melt veins.

Geochemistry: Olivine, $\text{Fa}_{25.1\pm 0.2}$, $N=49$; orthopyroxene, $\text{Fs}_{22.4\pm 0.2}\text{Wo}_{3.0\pm 0.1}$, $N=51$.

Classification: Ordinary Chondrite (L6)

Specimens: 8.2 grams at *UCLA*; main mass with Robert *Verish*.**Wood River** 50°08'N, 106°13'W

Saskatchewan, Canada

Find: Unknown

Classification: Ordinary chondrite (H5)

History: Found many years ago by the owners father along the banks of the Wood River in southern Saskatchewan. The find area is bounded by provincial highways #58 to the west; #363 to the north, #718 to the south and on the east by the Old Wives Lake bird sanctuary. The nearest villages are Coderre and Courval.

Petrography: Chondrules are readily delineated with much recrystallization. Chondrule glass is absent. Weak undulatory extinction visible in the olivine grains.

Geochemistry: Olivine composition determined by two methods: $\text{Fa}_{19.3\pm 1}$ (by X-ray diffraction, *ROM*) and $\text{Fa}_{20.0\pm 1.2}\%$ (EMPA, $n=28$); $\text{Fs}_{16.6\pm 0.9}\text{Wo}_{1.1\pm 0.1}$ (EMPA, $n=9$). No zoning was visible in olivine or pyroxene grains.

Wuerhe 46°01'01.1''N, 86°16'34.4''E

Xinjiang, China

Find: 2018 July 25

Classification: Ordinary chondrite (L5)

History: Three small meteorites were first found by three anonymous people who were looking for wind-eroded stones of quartz in the desert. These meteorites were confirmed by Pengli Chen. On return back to this area, 10 more pieces were found within 3 days. On September 17-19, 2018, the meteorite hunting team organized by P. Chen searched this area again, and they found 10 other pieces. Counting an additional 3 pieces recovered by anonymous finders, a total of 26 meteorites were collected in this new meteorite strewn field. The total mass is about 6 kg, and the largest piece is 1.3 kg. All of these pieces were completely covered by fusion crust.

Physical characteristics: Two of the meteorites were studied. Black melt veins and pockets can be seen in the exposed surfaces of samples.

Petrography: (Y. Xu, N. Wang and Y. Lin, *IGGCAS*) Microscopic observations of a polished mount reveal a chondritic texture with recrystallized matrix. Chondrules

are readily delineated. It consists mainly of olivine, pyroxene, plagioclase, Fe-Ni metal, and troilite. Plagioclase size is less than 50 μm . Ringwoodite and wadsleyite were found within and close to shock veins and pockets.

Geochemistry: Olivine and pyroxene have homogeneous chemical compositions. Olivine $\text{Fa}_{24.6\pm 0.9}$ (n=12), orthopyroxene $\text{Fs}_{20.7\pm 0.8}\text{Wo}_{1.6\pm 0.2}$ (n=11), plagioclase: An_{11} (n=5)

Classification: L5 (Y Xu, N. Wang and Y. Lin, *IGGCAS*)

Specimens: 2 slices with a total mass of 136 g in *IGGCAS*, 3 pieces with a total mass of ~400 g by P. Chen. Others with anonymous owners.

Xinjiang 009

Xinjiang, China

Purchased: 2013

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) Purchased by Wang Ziyao from an ornamental stone dealer in Hami/Xinjiang in 2013. He reportet that he got this stone from another ornamental stone dealer, and that it was found in the desert of Xinjiang.

Physical characteristics: (Wang Ziyao) Black-brown stone of 60.3 g with adhering sand grains.

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (1.0-1.6 mm, av. 1.0 mm)

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.32$

Classification: Ordinary chondrite (LL~6, W4)

Specimens: 12.3 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 11 g with *Bart*.

Xinjiang 010

Xinjiang, China

Purchased: 2013

Classification: Ordinary chondrite (LL~6)

History: (Ziyao Wang) Purchased by Wang Ziyao from an ornamental stone dealer in Hami/Xinjiang in 2013. He reportet that he got this stone from another ornamental stone dealer, and that it was found in the desert of Xinjiang.

Physical characteristics: (Wang Ziyao) Black stone of 71.5 g with fusion crust

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (1.0-1.6 mm, av. 1.0 mm) and irregular metal and sulphide specks.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.37$

Classification: Ordinary chondrite (LL~6, W3)

Specimens: 15.6 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 15 g with *Bart*.

Xinjiang 011

Xinjiang, China

Find: 2014

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) Purchased by Wang Ziyao from Han Yongfeng Urumqi/Xinjiang in 2015. The anonymous finder reported to Han Yongfeng that this meteorite was discovered in the Lop Nur area in 2015.

Physical characteristics: (Wang Ziyao) Brown stone of 89.5 g without fusion crust

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (0.4-1.5 mm, av. 0.6 mm)

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.70$

Classification: Ordinary chondrite (L~6, W4)

Specimens: 18.5 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 14.2 g with *Bart*.

Yangguanzen 001 39°48'04"N, 94°18'56"E

Gansu, China

Find: 2015

Classification: Ordinary chondrite (LL~6)

History: (R. Bartoschewitz, *Bart*) Discovered by Liu Binghan in the desert near near Aksay/Gansu in 2015 and was purchased by Wang Ziyao, who donated it to R. Bartoschewitz.

Physical characteristics: (R. Bartoschewitz, *Bart*) Brown 8.66 g stone.

Petrography: (R. Bartoschewitz, *Bart*) Brown stained recrystallized matrix with nearly complete recrystallized chondrules (0.6-1.0 mm) and few metal and sulphide specks, vugs partly filled with gypsum.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.08$

Classification: Ordinary chondrite (LL~6, W3)

Specimens: 1.77 g on deposit at *Kiel*, main mass of 6.5 g with *Bart*.

Yucca 045 34°45.894'N, 114°14.101'W

Arizona, United States

Find: 27 Mar 2011

Classification: Ordinary chondrite (H3-6)

History: Found with metal detector 6 inches below the surface in the Yucca DCA by Jim Wooddell March 27, 2011. Entire stone donated to *Cascadia*.

Physical characteristics: Exterior is covered with weathered fusion crust, with large patches of reddish-brown rust.

Petrography: In thin section, two distinct lithologies that appear lighter and darker in plane-polarized light are visible and have irregular and gradational boundaries. The light lithology is coarser grained and contains chondrules with boundaries integrated into their surroundings. Feldspar is variable in size, most slightly below 50 μm in diameter, but with a few larger grains. The dark lithology is dominated by fragmental material containing numerous small cryptocrystalline chondrules; BSE imaging shows that this lithology contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both magnesian and iron-rich olivine and pyroxene grains). This lithology also contains occasional coarse feldspar grains (most below 50 μm in diameter), coarse phosphate grains, and numerous chromite-plagioclase assemblages. FeNi carbide with some accompanying magnetite, aluminous low-calcium and high-calcium pyroxenes, and silica polymorph are present in the dark lithology. Along two edges of the section abutting the dark lithology is a small patch of shock melt (opaque in plane-polarized light) containing metal and troilite blebs, and a coarse-grained clast lacking chondrules.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Light lithology olivine ($\text{Fa}_{19.6\pm 0.6}$, $N=7$) and low-Ca pyroxene ($\text{Fs}_{17.6\pm 0.9}\text{Wo}_{1.3\pm 0.2}$, $N=5$) are consistent with a type 5 or 6 designation. Dark lithology olivine ($\text{Fa}_{17.7\pm 9.2}$, $N=35$) and low-Ca pyroxene ($\text{Fs}_{15.4\pm 6.5}\text{Wo}_{1.2\pm 1.0}$, $N=33$) compositions reflect the large admixture of type 3 material. Fragments in this lithology include a partial chondrule containing dusty forsteritic olivine grains ($\text{Fa}_{0.7\pm 4.0}$) and aluminum-rich diopside (6 wt% Al_2O_3) set in anorthitic glass ($\text{An}_{92}\text{Or}_0$), as well as a fragment of a ferroan chondrule with olivine (Fa_{34-51}) and low-Ca pyroxene ($\text{Fs}_{24}\text{Wo}_5$) set in a Na-K-rich glass. The coarse-grained clast at the edge of the section consists of equilibrated olivine ($\text{Fa}_{19.3\pm 0.3}$, $N=10$), low-Ca pyroxene ($\text{Fs}_{16.9\pm 0.2}\text{Wo}_{1.5\pm 0.4}$, $N=9$), and feldspar ($\text{Ab}_{78.2\pm 1.4}\text{An}_{14.4\pm 0.7}\text{Or}_{7.4\pm 0.8}$, $N=2$).

Classification: H3-6 finely intermixed genomic breccia. Light lithology is type 5-6 material as implied by medium to coarse feldspar grain sizes and equilibrated olivine and pyroxene; dark lithology contains type 3 material as implied by common presence of magnesian and zoned olivine. Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.

Specimens: *Cascadia* holds 38.0 g in two pieces, in addition to one polished thin section and a mounted butt.

Yucca 046 34°46.009'N, 114°14.415'W

Arizona, United States

Find: 12 Oct 2011

Classification: Ordinary chondrite (H3-5)

History: Found by Jim Wooddell on October 23, 2011 while searching with a metal detector. Mr. Wooddell donated the entire stone to *Cascadia* in September, 2013.

Physical characteristics: Brownish weathering patina occurs on exterior surfaces.

Petrography: In thin section, the sample appears to be relatively integrated, with many chondrule fragments and only a few complete chondrules present; distinct lithic clasts typical of a breccia are absent. The material between chondrule fragments is comprised of individual grains and smaller fragments. BSE imaging shows that most of meteorite consists of fragmental material, with an abundance of magnesian and iron-rich olivine and pyroxene grains, many of which show zoning, and which abut equilibrated fragments with typical H-chondrite compositions. Laths of a silica polymorph were observed, as well as several small chromite-plagioclase objects and merrillite grains up to 250 μ m across. Feldspathic material consists of glass of variable compositions and crystalline plagioclase feldspar grains typically 20-40 μ m across; no grains larger than 50 μ m across were observed. A single fragment 70 μ m across appears to be a typical type 3 matrix lump, found adjacent to a crystalline feldspar grain. Both high- and low-Ca aluminous pyroxenes (up to 6.7 wt% Al) were observed in three chondrule fragments and as single grains, sometimes with anorthitic glass, and sometimes with forsteritic olivine (Fa<5), and spinel. In addition to these small spinel grains, an isolated zoned spinel grain (100 μ m across) was observed. Fe-Ni carbide was found, along with magnetite; in one clast magnetite appears to be replacing troilite.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Sample contains a wide range of compositions of olivine (Fs_{20.1±6.0}, N=51), low-Ca pyroxene (Fs_{15.6±5.3}Wo_{1.2±1.0}, N= 61).

Classification: Metal abundance (9 area%) is consistent with an H chondrite. Although the chemistry and abundance of zoned grains suggests a type 3 designation, the presence of medium-sized crystalline feldspar, coarse phosphate, and chromite-plagioclase objects suggests a higher petrographic type. The thin section studied strongly resembles the "main" lithology found in the Buck Mountain Wash chondrite, suggesting that this is an H3-5 finely intermixed genomict breccia. Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.

Specimens: *Cascadia* holds 9.0 g in two pieces, in addition to a polished thin section and a mounted butt.

Yucca 047 34°49.281'N, 114°16.655'W

Arizona, United States

Find: 24 Nov 2011

Classification: Ordinary chondrite (H3-6)

History: Found with metal detector in the Yucca DCA by Jim Wooddell November 24, 2011. Entire stone donated to *Cascadia*.

Physical characteristics: Exterior is covered with a brownish weathering patina.

Petrography: In thin section, the sample appears to be a relatively integrated mixture of chondrules, chondrule fragments, and indistinct fragments of chondritic clasts. The section appears dark due to the size of small fragments and individual grains that make up material interstitial to chondrules and larger fragments. One discrete lighter colored clast is visible, which lacks discernable chondrules, and

contains coarse grains of feldspar (most slightly below 50 μm in diameter, but a few larger grains). BSE imaging shows that the meteorite contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both magnesian and iron-rich olivine and pyroxene grains). Free copper, an FeNi carbide, and magnetite are present, as well three grains of low-Ca pyroxene with relatively high (3.6-5.8 wt% Al_2O_3) alumina content, similar to those reported for Buck Mountain Wash. Small chromite-plagioclase objects are present. Opaques show minor weathering (~5-10% replacement by Fe-hydroxides). Shock effects in olivine are variable from sharp optical extinction to a recrystallized clast, but most olivine grains in the section show undulose extinction with one set of planar fractures, indicating a shock stage of S3.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Host lithology olivine ($\text{Fa}_{19.2\pm 7.0}$, N=50) and low-Ca pyroxene ($\text{Fs}_{13.1\pm 5.4}\text{Wo}_{0.9\pm 0.8}$, N= 47) compositions reflect the large admixture of type 3 material. A clast of higher type material has equilibrated olivine ($\text{Fa}_{19.1\pm 1.2}$, N=8) and low-Ca pyroxene ($\text{Fs}_{17.0\pm 0.7}\text{Wo}_{1.8\pm 1.0}$, N=10) compositions.

Classification: H3-6 finely intermixed genomic breccia. Type 5-6 lithology implied by medium to coarse feldspar grain sizes and equilibrated olivine and pyroxene; type 3 lithology implied by common presence of magnesian and zoned olivine. Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.

Specimens: *Cascadia* holds 11.3 g in a single piece, in addition to one polished thin section and a mounted butt.

Yucca 048 34°49.402'N, 114°16.573'W

Arizona, United States

Find: 23 Sep 2012

Classification: Ordinary chondrite (H3-6)

History: Found with metal detector in the Yucca DCA by Troy Ball September 12, 2012. Entire stone donated to *Cascadia*.

Physical characteristics: Exterior is covered with weathered fusion crust, with large patches of reddish-brown rust.

Petrography: In thin section two distinct lithologies that appear lighter and darker in plane-polarized light are visible and have irregular and gradational boundaries. The light lithology is coarser grained and contains chondrules with boundaries integrated into their surroundings. Feldspar is variable in size, most slightly below 50 μm in diameter, but with a few larger grains. The dark lithology is dominated by fragmental material with only 8 complete chondrules visible; BSE imaging shows that this lithology contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both magnesian and iron-rich olivine and pyroxene grains). This lithology also contains a large coarse-grained clast with anhedral olivine grains up to 1mm across, a shock melt clast with zoned olivine grains set in a ferromagnesian glass, and a small (~70 μm across) chondrule that contains numerous spinel grains [$(\text{Mg}_{0.7}\text{Fe}_{0.3})\text{Al}_2\text{O}_4$] and ilmenite set in a Ca,

Mg, Al-rich glass and surrounded by a shell of Al-rich low-Ca pyroxene. Abundant FeNi carbide with some accompanying magnetite is found only in the dark lithology.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Light lithology olivine ($\text{Fa}_{19.3\pm 0.8}$, N=8) and low-Ca pyroxene ($\text{Fs}_{16.8\pm 0.7}\text{Wo}_{1.7\pm 0.8}$) are consistent with a type 5 or 6 designation. Dark lithology olivine ($\text{Fa}_{17.6\pm 9.6}$, N=22) and low-Ca pyroxene ($\text{Fs}_{13.9\pm 4.8}\text{Wo}_{1.4\pm 0.7}$, N= 30) compositions reflect the large admixture of type 3 material. The coarse-grained clast in the dark lithology consists of highly equilibrated olivine ($\text{Fa}_{19.0\pm 0.1}$, N=8), low-Ca pyroxene ($\text{Fs}_{16.7\pm 0.1}\text{Wo}_{1.4\pm 0.1}$, N=5), diopside ($\text{Fs}_{5.4\pm 0.3}\text{Wo}_{47.3\pm 0.2}$, N=5), and feldspar ($\text{Ab}_{70.7\pm 3.5}\text{An}_{24.2\pm 4.5}\text{Or}_{5.1\pm 1.4}$, N=8).

Classification: H3-6 finely intermixed genomict breccia. Light lithology is type 5-6 material as implied by medium to coarse feldspar grain sizes and equilibrated olivine and pyroxene; dark lithology contains type 3 material as implied by common presence of magnesian and zoned olivine (dark lithology). Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.

Specimens: *Cascadia* holds 19.3 g in multiple pieces, in addition to one polished thin section and a mounted butt.

Yucca 049 34°49.033'N, 114°16.238'W

Arizona, United States

Find: 01 May 2014

Classification: Ordinary chondrite (H3-5)

History: Found by Troy Ball on May 1, 2013. The entire stone was donated to *Cascadia* in September, 2013.

Physical characteristics: Stone entirely coated with weathered fusion crust, which varies in color from dark brown to reddish brown. Two small (<1 cm across) patches of crust are missing, revealing a lighter colored reddish-stained interior.

Petrography: In thin section, the sample appears to be relatively integrated, with many chondrule fragments and only a few complete chondrules present; distinct lithic clasts typical of a breccia are absent. The material between chondrule fragments is comprised of individual grains and smaller fragments. BSE imaging shows that most of meteorite consists of fragmental material, with an abundance of magnesian and iron-rich olivine and pyroxene grains, many of which show zoning, and which abut equilibrated fragments with typical H-chondrite compositions.

Notable petrographic features include a fragment with zoned Fe-rich low-Ca pyroxene and coarse (up to 80 μm across) equant silica polymorph with veins and a partial rim of olivine; a large (~750 μm across) chromite-plagioclase region that encloses olivine; and an irregular fragment (~200 μm across) that contains elongate chromite-plagioclase pseudomorphs and Ca-pyroxene set in plagioclase. Coarse merrillite (up to 200 μm across) and Fe-Ni carbide was observed

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Sample contains a wide range of compositions of olivine ($\text{Fa}_{19.5\pm 5.1}$, N=71), low-Ca pyroxene ($\text{Fs}_{15.6\pm 6.4}\text{Wo}_{1.2\pm 1.1}$, N= 44). The pyroxene-silica fragment has zoned Fe-rich low-Ca

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3 pyroxene ($\text{Fs}_{33.5\pm 6.3}\text{Wo}_{1.8\pm 0.3}$, $N=7$); the surrounding shell and vein olivine are
4 somewhat higher in iron ($\text{Fs}_{26.9\pm 5.3}$, $N=19$) than the host olivine.

5 **Classification:** Although the chemistry and abundance of zoned grains suggests a
6 type 3 designation, the presence of medium-sized crystalline feldspar, coarse
7 phosphate, and chromite-plagioclase objects suggests a higher petrographic type.
8 The thin section studied strongly resembles the "main" lithology found in the Buck
9 Mountain Wash chondrite, suggesting that this is an H3-5 finely intermixed
10 genomict breccia. Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002)
11 on the basis of mineralogy, mineral chemistry, and texture.

12 **Specimens:** *Cascadia* holds the entire type specimen and main mass, which
13 consists of 18.4 g in two pieces, in addition to a polished thin section and a
14 mounted butt
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21 **Yucca 050** 34°48.036'N, 114°15.346'W

22 Arizona, United States

23 Find: 25 Nov 2011

24 Classification: Ordinary chondrite (H3-5)

25 **History:** Found by Wendy Wooddell on November 25, 2011

26 **Physical characteristics:** Sample has weathered fusion crust on one side. All other
27 exterior faces are broken surfaces which are medium-brown from weathering,
28 showing numerous small protruding dark bumps, which appear to represent
29 weathered metal grains

30 **Petrography:** In thin section, the sample appears to be relatively integrated, with
31 many chondrule fragments and only a few complete chondrules present; distinct
32 lithic clasts typical of a breccia are absent. The material between chondrule
33 fragments is comprised of individual grains and smaller fragments. BSE imaging
34 shows that most of meteorite consists of fragmental material, with about a 10%
35 admixture of magnesian and iron-rich olivine and pyroxene grains, many of which
36 show zoning, and which abut equilibrated fragments with typical H-chondrite
37 compositions. Numerous chromite-plagioclase objects were observed, including a
38 fragment containing chromite-plagioclase pseudomorphs after a lath-shaped phase
39 set in a feldspathic matrix. Throughout the section, feldspathic material consists of
40 glass of variable compositions and crystalline plagioclase feldspar grains typically
41 20-40 μm across; a few grains up to 70 μm across were observed. Also present are
42 merrillite grains, some up to 250 μm across. Fe-Ni carbide was found, along with
43 ilmenite and magnetite.

44 **Geochemistry:** (M. Hutson and A. Ruzicka, *Cascadia*) Sample contains a range of
45 compositions of olivine ($\text{Fa}_{18.7\pm 2.2}$, $N=31$) and low-Ca pyroxene ($\text{Fs}_{15.2\pm 3.6}\text{Wo}_{1.6\pm 0.8}$,
46 $N=44$).

47 **Classification:** Meteorite is an H-chondrite, based on chemistry. Although the
48 chemistry and abundance of zoned grains suggests a type 3 designation, the
49 presence of medium-sized crystalline feldspar, coarse phosphate, and chromite-
50 plagioclase objects suggests a higher petrographic type. The thin section studied
51 strongly resembles the "main" lithology found in the Buck Mountain Wash
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chondrite, which is an H3-5 finely intermixed genomict breccia. Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.

Specimens: *Cascadia* holds 23.4 g in one piece, in addition to three polished thin sections. Wendy Wooddell retained a 3.8 g end piece.

Yucca 051 34°48.990'N, 114°16.151'W

Arizona, United States

Find: 11 Nov 2011

Classification: Ordinary chondrite (H6)

History: Found 5 cm below the surface by Jim Wooddell on November 11, 2011 while searching with a metal detector. Mr. Wooddell donated the main mass to *Cascadia*.

Physical characteristics: Sample is almost entirely covered with weathered fusion crust. A rusted light-colored interior is visible in two small patches where crust is missing.

Petrography: In thin section, the sample appears to be well integrated and relatively coarse-grained, containing chondrules with boundaries that blend into their surroundings. Crystalline plagioclase feldspar grains are typically 30-40 μm across, although a few grains > 100 μm across were observed. Metallic copper and several chromite-plagioclase objects are present.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) The major silicate phases are equilibrated, including olivine ($\text{Fa}_{19.9\pm 0.5}$, N=20), low-Ca pyroxene ($\text{Fs}_{17.3\pm 0.5}\text{Wo}_{1.4\pm 0.4}$, N= 16), diopside ($\text{Fs}_{6.4\pm 2.0}\text{Wo}_{46.4\pm 1.4}$, N= 5), and plagioclase feldspar ($\text{Ab}_{77.7\pm 1.7}\text{An}_{15.1\pm 1.4}\text{Or}_{7.2\pm 1.1}$, N=8)

Classification: Mineral chemistry indicates an equilibrated H chondrite. A petrographic grade of 6 (near the 5/6 border) is suggested by the sample's well-integrated texture and the sizes of the plagioclase feldspar grains.

Specimens: *Cascadia* holds 21.7 g in one piece, in addition to a polished thin section. Jim Wooddell holds a 3.8 g end cut and a polished thin section.

Yucca 052 34°45.800'N, 114°14.349'W

Arizona, United States

Find: 27 Mar 2011

Classification: Ordinary chondrite (H3-5)

History: Found with metal detector by Jim Wooddell, March 27, 2011. Cut in 3 pieces. Jim Wooddell retained 1.2 gram slice, with remainder donated to *Cascadia*.

Physical characteristics: Exterior is covered with weathered brown fusion crust.

Petrography: In plane-polarized light, the thin section consists of a main lithology composed mainly of chondrule fragments, two light and two dark clasts, and a clast with a well-defined boundary that contains delineated chondrules in a dark matrix. BSE imaging of the main lithology shows that it contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both

magnesian and iron-rich olivine and pyroxene grains). Feldspathic material is mainly glass, although small (less than 20 μm in diameter) feldspar grains are present. This lithology includes grains of silica polymorph, FeNi carbide, aluminous high-Ca pyroxene, chlor-apatite and merrillite. One large chondrule fragment shows signs of aqueous alteration before it was incorporated into the main lithology. This fragment consists of olivine grains that have irregular Fe-rich rims set in a pyroxene-normative glass that has rims and cross-cutting veins of Fe-rich glass. One of the two dark clasts is along the edge of the section and is dark due to the presence of an extensive web of weathering veins. The other dark clast is shock-blackened and contains numerous parallel veins of partially weathered metal and troilite. BSE imaging of the two light clasts shows that they consist of equilibrated silicates. Minerals present include phosphate grains, including a single large ($> 300 \mu\text{m}$ across) grain of merrillite, plagioclase feldspar (less than 20 μm in diameter), and chromite-plagioclase assemblages. BSE imaging of the clast with well-defined chondrules shows that it consists of unequilibrated chondrules (rather than fragments) set in an Fe-rich, fine-grained matrix typical of a type 3 chondrite (hereafter referred to as the type 3 clast).

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Light clast olivine ($\text{Fa}_{18.9\pm 1.6}$, $N=14$) and low-Ca pyroxene ($\text{Fs}_{17.4\pm 1.0}\text{Wo}_{1.1\pm 0.7}$, $N=10$) are consistent with an H chondrite of petrographic type 5. The dark clasts were not analyzed. The main lithology has olivine ($\text{Fa}_{17.0\pm 6.1}$, $N=47$) and low-Ca pyroxene ($\text{Fs}_{15.4\pm 5.0}\text{Wo}_{1.4\pm 0.9}$, $N=56$) compositions suggestive of petrographic type 3, but petrographically resembles the "main lithology" of Buck Mountain Wash, which is a fragmental mixture of equilibrated and type 3 material. The type 3 clast has olivine ($\text{Fa}_{18.3\pm 8.1}$, $N=44$) and low-Ca pyroxene ($\text{Fs}_{11.5\pm 8.1}\text{Wo}_{1.1\pm 1.1}$, $N=35$) compositions consistent with a type 3 designation. The large chondrule fragment which appears to have been aqueously altered has olivine grains with cores of $\text{Fa}_{16.3\pm 2.3}$, $N=10$, consistent with an H-group precursor. The irregular rims on these grains are $\text{Fa}_{43.4\pm 3.4}$, $N=7$.

Classification: H3-5 genomict breccia. Paired with [Buck Mountain Wash](#) (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.

Specimens: *Cascadia* holds 19.8 g in two pieces, in addition to one polished thin section and a mounted butt. Jim Wooddell holds a 1.2 g slice.

Yuli 41.3°N, 86.25°E

Xinjiang, China

Find: 2015 Dec

Classification: Iron meteorite (IAB-MG)

History: The anonymous finders stated that the object was found in the neighborhood of Yuli County. The finders are unwilling to release the exact coordinates. The original informal name given to this meteorite was Mulei; this was based on a misunderstanding between the finders and the buyer. This is the name it is cataloged under in several collections.

Petrography: The meteorite is a coarsest octahedrite.

Geochemistry: Composition (based on duplicate INAA): Co, 4.67 mg/g; Ni, 60.9 mg/g; Ga, 92.1 µg/g; Ge, 444 µg/g; As, 11.7 µg/g; W, 1.33 µg/g; Ir 3.78 µg/g; Au, 1.396 µg/g . The meteorite is assigned to IAB-MG.

Classification: The meteorite is assigned to the IAB-MG. The Au and Ni are below and Co somewhat above the IAB-MG range. It could be designated IAB-MG-An, but this feature might also be produced by large sampling errors resulting in an anomalously high kamacite/taenite ratio. Most of the data for Yuli fall in the Campo del Cielo range, but the exceptionally low Ni and Au and somewhat elevated Co differ by too much for this assignment and there is good evidence that it was discovered in China.

Specimens: Type specimen at *PMO*. Main mass at *SSTM*. Only one mass is known.

2. New Dense Collection Areas (DCA)

24 Dense Collection Areas have been approved in 2018. A list of all DCAs can be found at <https://www.lpi.usra.edu/meteor/DenseAreas.php>.

3. Listing of institutes and collections

An up-to-date index of collections and approved repositories (next to a green check mark) cited in the Meteorite Bulletin can be found here:

<https://www.lpi.usra.edu/meteor/MetBullAddresses.php?grp=country>

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