

1

2 *Tectonics*

3

Supporting Information for

4

5 **A reappraisal of the Poya Terrane (New Caledonia): Accreted Late Cretaceous-Paleocene**
6 **marginal basin upper crust, passive margin sediments and Early Eocene E-MORB sill**
 complex.

7

Dominique Cluzel¹, Matthew Whitten², Sébastien Meffre³, Jonathan C. Aitchison⁴,
and Pierre Maurizot⁵

9

¹University of New Caledonia, BP R4, 98850 Nouméa cedex, New Caledonia, dominique.cluzel@unc.nc

10

²University of Otago, 362 Leith St, North Dunedin, Dunedin 9016, New Zealand, geologistz55@gmail.com

11

³University of Tasmania, Sandy Bay campus Private Bag 51, Hobart Tasmania 7001 Australia, smeffre@utas.edu.au

12

⁴School of Earth and Environmental Sciences, Faculty of Science, The University of Queensland, Brisbane QLD 4072,
Australia, jona@uq.edu.au

14

⁵Geological Survey of New Caledonia, DIMENC B.P. 465, 98845 Nouméa, New Caledonia, pierre.maurizot@gouv.nc

15

16

Contents of this file

17

Figures S1 to S5

19

Text S1

20

Tables S1 to S4

21

22

Additional Supporting Information (Files uploaded separately)

23

24

Datasets S1 to S2

25

Introduction

26

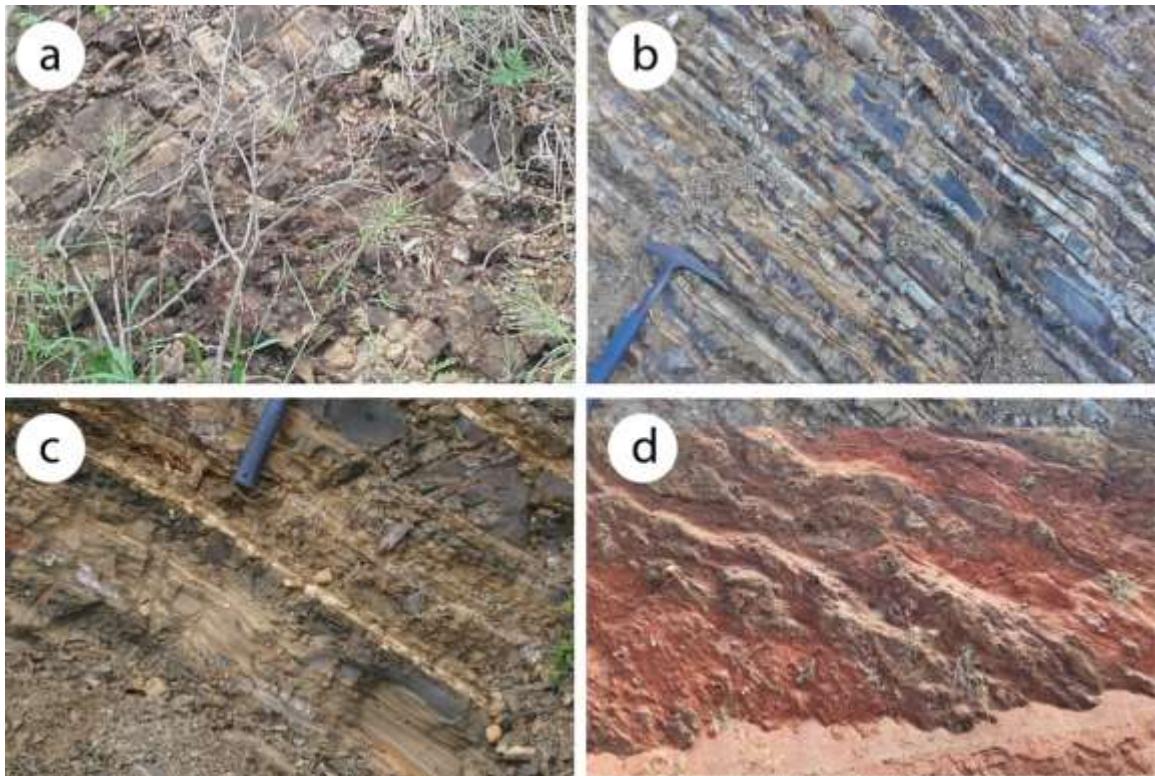
The additional supporting information presented here includes

27

- photo plates (outcrop pictures and thin sections)
- sample location (WGS 84)
- analytical procedures (sandstone petrography, U-Pb geochronology, whole rock geochemistry, isotope geochemistry)

- 31 • U-Pb detrital zircon data
32 • U-Pb micro-zircon data (dolerites)
33 • whole rock geochemical data (dolerites)
34 • Nd-Sr isotope data (dolerites)

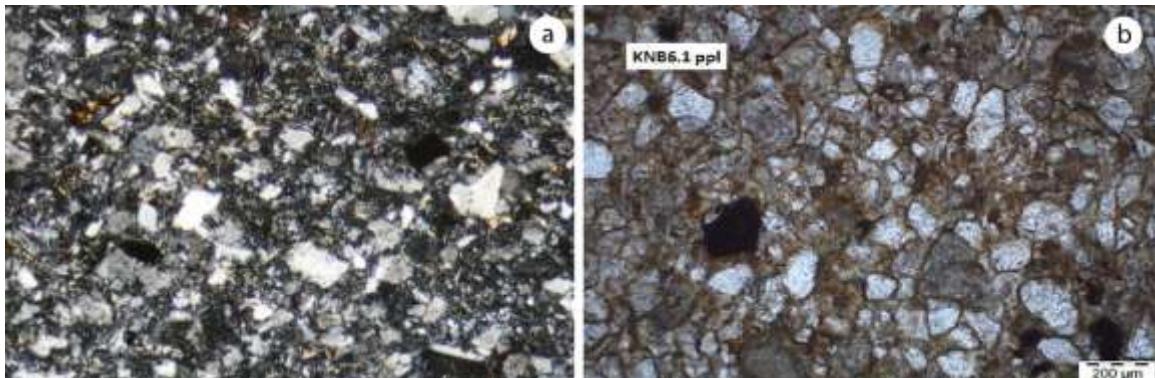
35
36
37
38



39

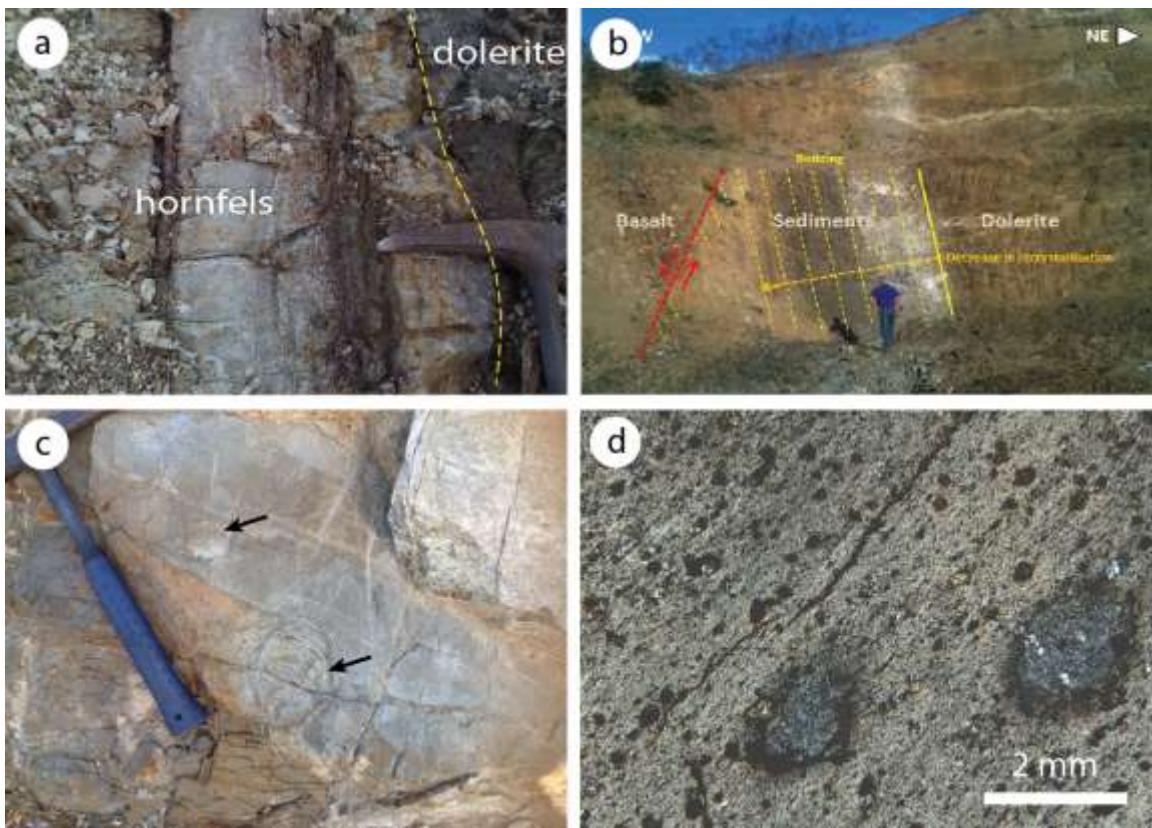
40 **Figure S1.** Pictures of field exposures of Kone Facies and Poya sediments; 1a: medium-grain
 41 sandstone, Kone-Tiwaka main road near Baco; 1b: cm-bedded turbidite, Petit Baco quarry;
 42 1c: laminated silty turbidite, Petit Baco quarry; 1d: sheared mélange-like mixture of red argillite
 43 and chert (CR 35 track from Col des Citrons southward).

44

45
46

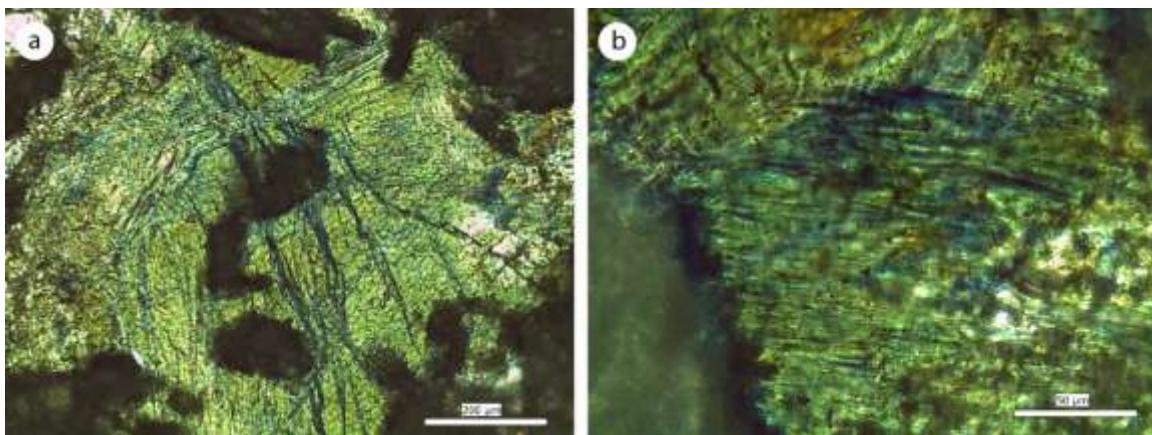
47 **Figure S2.** Microphotographs of representative sandstones of Kone Facies. 2a: fine-grain,
 48 poorly rounded sandstone with some volcanogenic components (clinopyroxene); 2b: fine-
 49 grain, slightly smoothed polymictic sandstone.

50



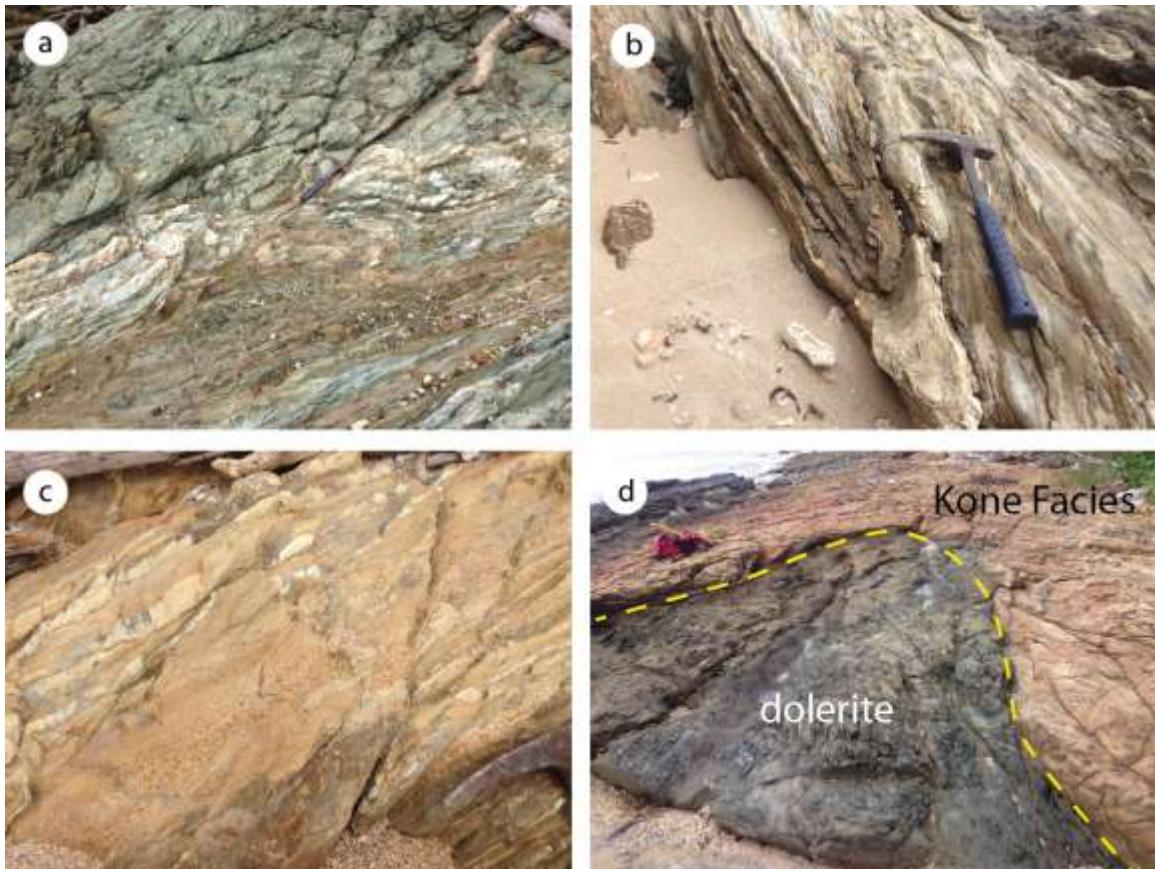
51
52
53
54
55
56
57
58

Figure S3. 3a: close view of nodular hornfels at the boundary of a dolerite sill (north end of Pouembout); 3b: outcrop view of contact metamorphism at the boundary of a dolerite sill (Voh communal quarry); 3c: siltstone recrystallized into nodular hornfels near a thick (~100m) dolerite sill (note inoceramid fossils on bed's surface) (Baco quarry near Kone); 3d: hydrochlorite-albite recrystallization nodules in a siltstone (polarized light, crossed nicols).



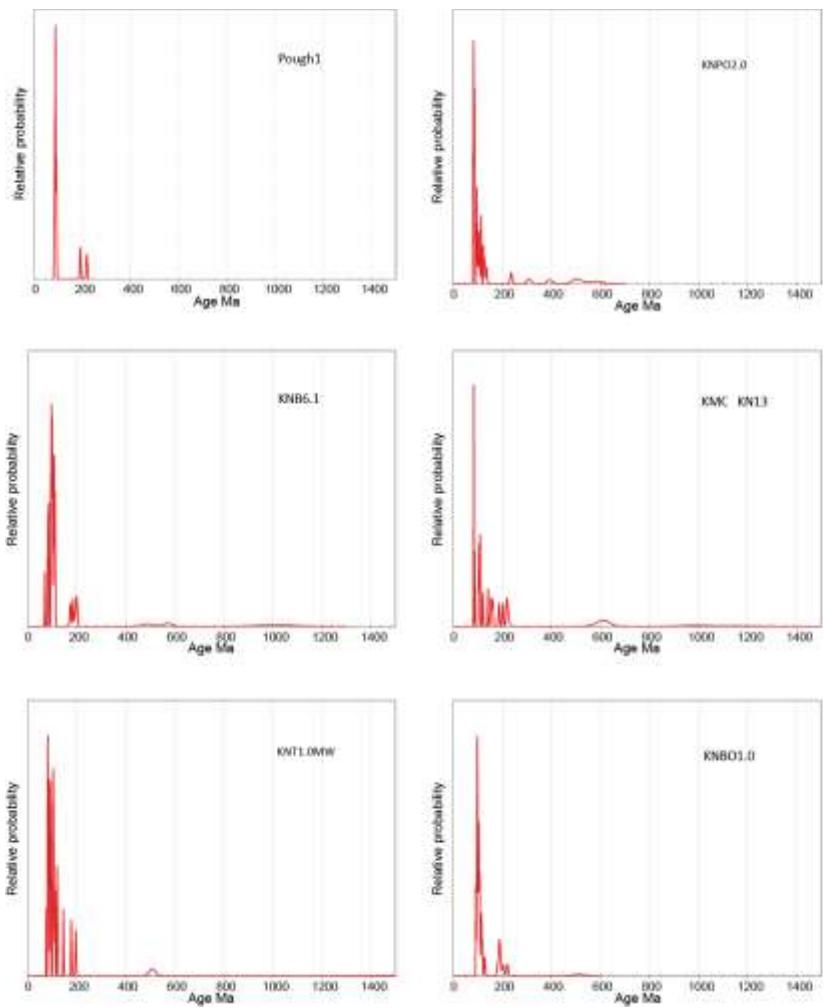
59
60
61
62
63
64

Figure S4. Microphotographs of thin sections of metadolerites. 4a: glaucophane crack seals in clinopyroxene; 4b: glaucophane needles interspersed in retrograde hornblende-actinolite (Thiem bridge, east coast)



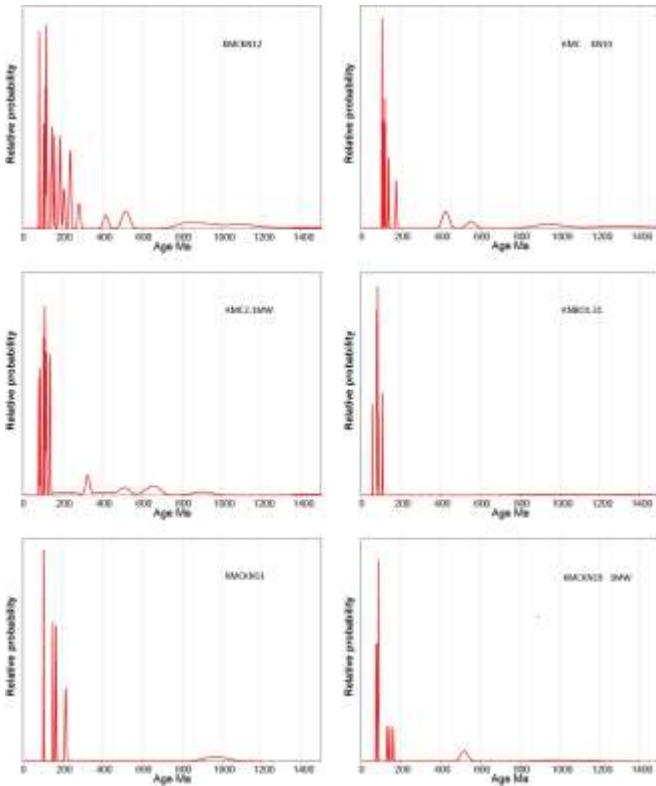
65
66
67
68
69
70
71
72

Figure S5. Pictures of east coast outcrops. 5a: sheared fine-grained turbidites of the Kone Facies (hammer in the center of the picture for scale); 5b: tightly folded Kone Facies sediments; 5c: sheared spotted schists near a dolerite sill; 5d: gently folded dolerite sill, red backpack and sledge hammer in the upper left corner for scale (5a: Teganpaik Beach, 5b,c,d: Balepaik Beach; about 13 km to the SE of Hienghène).



73
74

75 **Figure S6a.** Individual age-probability plots of detrital zircon population from sandstones of
76 the Kone Facies using Isoplot 3.75 software (Ludwig, 2014)
77



78

79

80 **Figure S6b.** Individual age-probability plots of detrital zircon population from sandstones of
81 the Kone Facies using Isoplot 3.75 software (Ludwig, 2014)

82

83 **Data Set S1.** U-Pb detrital zircon data (xlsx file uploaded separately)

84

85 **Data Set S2.** U-Pb micro-zircon from dolerite data (xlsx file uploaded separately)

86

87

88 **Text S1. Analytical procedures**

89

90 **Whole-rock geochemistry**

91 The new 15 dolerite samples have been analyzed at the SARM (CRPG Nancy, France) by ICP-
92 AES for major elements and ICP-MS for trace elements and rare earth elements (REE). For
93 details about analytical procedures, see Carignan et al. (2001), accuracy and detection limits
94 are provided at: <http://helium.crgn.cnrs-nancy.fr/SARM/pages/roches.html>.

95

96 **Nd-Sr analytical procedure**

97 Nd-Sr analyses have been performed at SARM (CRPG Nancy, France)

98 For details about analytical procedures, accuracy and detection limits see:

99 <http://helium.crgn.cnrs-nancy.fr/SARM/pages/roches.html>.

100

101 **U-Pb zircon geochronology.**

102

103 For dating dolerites, the FEI MLA 650 ESEM was used for micro zircon imaging. The
104 following information describes the features and functions of this device: (from
105 <http://www.utas.edu.au/research/central-science-laboratory/facilities/electron-microscopy-and-x-ray-microanalysis>) tungsten source 3 vacuum modes: high vacuum, low vacuum (large
106 field of view, up to 1 torr), environmental (up to 20 torr) FEI detectors: Everhardt-Thornley SE,
107 CBS solid state BSE, Large Field SE (for low vacuum), Gaseous SE (for ESEM) Gatan PanaCLF
108 panchromatic CL detector with RGB filters Bruker Quantax Esprit 1.9 EDS system with two
109 XFlash 5030 SDD detectors, MnKa 133 eV resolution, combined throughput up to 800kcps 5-
110 axis motorised stage, XYZ range 150x150x65mm Peltier cooling stage Mineral Liberation
111 Analysis (MLA) software package v3.1: Programmed mainly for the mining industry, this
112 software independently controls the instrument for quantitative phase/mineralogical and
113 textural analysis, but can be used for many other purposes such as rare phase search.
114

115 Sandstone samples for detrital zircon data were analyzed using mineral separates. These
116 samples were processed using the standard mineral separation techniques used at the
117 University of Tasmania. Approximately 200 -400 g of rock was crushed in a Cr-steel ring mill to
118 a grain size <400 micron. Non-magnetic heavy minerals were then separated using a gold pan
119 and a Fe-B-Nd hand magnet. The zircons were hand-picked from the heavy mineral
120 concentrate under the microscope in cross-polarised transmitted light. The selected crystals
121 were placed on double sided sticky tape and epoxy glue was then poured into a 2.5 cm
122 diameter mould on top of the zircons. The mount was dried for 12 hours and polished using
123 clean sandpaper and a clean polishing lap. The samples were then washed in distilled water in
124 an ultrasonic bath. One sample RRG2 was analysed without separation directly on a polished
125 rock mount after the zircons were located using automated scanning electron microscopy (see
126 Sack et al. 2011).

127 U-Pb zircon analyses were performed on an Agilent 7500cs quadrupole ICPMS with a 193
128 nm Coherent Ar-F gas laser and the Resonetics S155 ablation cell at the School of Earth
129 Sciences, University of Tasmania. Each analysis was pre-ablated with 5 laser pulses to remove
130 the surface contamination then the blank gas was analysed for 30 s followed by 30 s of zircon
131 ablation at 5 Hz and ~2 J/cm² using a spot size of 13 µm; keeping U and Th in the pulse
132 counting mode of detection on the electron multiplier. A flow of He carrier gas at a rate of 0.35
133 l/min carried particles ablated by the laser out of the sample chamber to be mixed with Ar gas
134 before transfer to the plasma. Elements measured include ⁴⁹Ti, ⁵⁶Fe, ⁹⁰Zr, ¹⁷⁸Hf, ²⁰²Hg, ²⁰⁴Pb,
135 ²⁰⁶Pb, ²⁰⁷Pb, ²⁰⁸Pb, ²³²Th and ²³⁸U with each element being measured sequentially every 0.16 s
136 with longer counting time on the Pb isotopes compared to the other elements. The down hole
137 fractionation, instrument drift and mass bias correction factors for Pb/U and Pb/Th ratios on
138 zircons were two analyses on the primary standard (91500 of Wiedenbeck et al., 1995) and one
139 analysis on each of the secondary standard zircons (TEMORA 1 of Black et al., 2003; GJ-1 of
140 Jackson et al., 2004) analysed at the beginning of the session and every 16 unknowns using
141 the same spot size and conditions as used on the samples to provide an independent control
142 to assess accuracy and precision. Additional secondary zircon standards (Mud Tank of Black
143 and Gulson, 1978; Plšovice of Sláma et al., 2008) were also analysed. The correction factor for
144 the ²⁰⁷Pb/²⁰⁶Pb ratio was calculated using six analyses of the international glass standard
145 NIST610 analysed throughout analytical session and corrected using the values recommended
146 by Baker et al. (2004) to provide an independent control to assess accuracy and precision.
147

148 **Sandstone petrography and provenance analysis**

149 Staining Methods to identify Plagioclase Feldspar and Potassium Feldspar

150 Thin sections and hand specimens may be stained according to the procedures presented
151 below however, rock slabs were the principal focus of this study. Using a variety of chemical
152 stains, potassium feldspar and plagioclase feldspar may be distinguished on the basis of color
153 resulting from the reaction of an etched residue formed on the feldspars following exposure
154 to hydrofluoric acid (HF). The feldspars themselves are not permanently stained. The colour
155 results from the reaction of the reagents with the residue from the particular feldspar. As a
156 general rule, potassium feldspar will stain yellow and plagioclase pink to brick red, dependent
157 upon composition. The staining method described below, uses sodium cobaltinitrite to stain
158 for potassium feldspar and potassium rhodizonate solution and amaranth solution is used to
159 stain for plagioclase feldspar.

160

161 **Reagents:**

162 Concentrated hydrofluoric acid (52% HF)
163 Barium chloride solution (5% BaCl₂)
164 Sodium cobaltinitrite solution (Na₃Co(NO₂)₆)
165 Amaranth solution (C₂₀H₁₁₂Na₃O₁₀S₃)

166

167 **Procedure:**

168 1. Etch rock slab using HF vapour or thin coating of HF applied to rock surface for 10 – 15
169 secs. Etching using HF creates an etched film surface where the strong acid has attacked the
170 Si-O bonds in the feldspars exposing K⁺ and Ca²⁺ ions in potassium feldspar and plagioclase
171 respectively.

172 2. Rinse in tap water to remove excess HF, do not rub as this may remove or transpose the
173 etched film.

174 3. Immerse or brush the slab with concentrated sodium cobaltinitrite solution for 10-15
175 secs. The etched residue formed on kspars hieratite (K₂SiF₆) reacts with sodium cobaltinitrite
176 to form K₂Na[Co(NO₂)₆] an insoluble yellow precipitate.

177 4. Rinse in running water to remove excess cobaltinitrite and dry thoroughly (compressed
178 air/hot air drier).

179 5. Dip or brush the slab with barium chloride solution for 5-10 secs, wash excess under
180 running water and dry with compressed/hot air. Ca ions in the etched residue of plagioclase
181 are replaced by Ba ions from the BaCl₂ solution. Na ions are not replaced by the Ba ions,
182 possibly due to the ionic charge and size.

183 6. Dip the slab in amaranth solution for 1-2 secs, wash off excess and allow to dry.

184 Reaction between the Ba in the etch residue after plagioclase with the amaranth results in
185 the development of a pink to brick red coloured precipitate with increasing Ca content of the
186 original plagioclase. Plagioclase with An<3 will not be stained by the amaranth due to the low
187 initial Ca content of the mineral and therefore the etch. Pure albite is not stained by this
188 process and is discussed in the following methodology:

189

Mineral	Treatment	Result
Potassium feldspar	1) HF (49%) 2) Sodium Cobaltinitrite Na ₃ Co(NO ₂) ₆	Potassium Feldspar: yellow – orange Plagioclase feldspar: no stain Quartz – no stain
Plagioclase feldspar	1) HF (49%) 2) Amaranth solution or potassium rhodizonate solution	Plagioclase – pink to red
Calcite and dolomite	1) HCl (1.5%) 2) Alizarin red solution	Calcite – rose to red Dolomite – colourless

	3) Potassium ferrocyanide K ₄ Fe(CN) ₆ .3H ₂ O	
--	--	--

190

191 **The Gazzi-Dickinson method**

192 26 samples of sandstone were collected from Koné Facies and examined using a hand lens
 193 to infer differences in source rocks from sedimentary to metamorphic or mafic / felsic volcanic
 194 sources between the samples. From these, 10 representative samples were made into thin
 195 section for further analysis. Parameters counted, and criteria for their identification, are
 196 described by Dickinson (1970), Graham et al. (1976), Ingersoll (1978), and Ingersoll and Suczek
 197 (1979). The parameters counted are described in Table 1. For each thin section 300 points
 198 were counted using the maximum grid spacing to ensure coverage of the whole slide. Matrix
 199 and cement were not counted.

200

201 **Additional references**

202 Baker, J., Peate, D., Waight, T. and Meyzen, C., Pb isotopic analysis of standards and samples
 203 using a Pb-207-Pb-204 double spike and thallium to correct for mass bias with a double-
 204 focusing MC-ICP-MS. Chemical Geology 2004, 211, 275-303.

205 Bizimis M., Salters V.J.M., Bonatti E., Trace and REE content of clinopyroxenes from supra-
 206 subduction zone peridotites. Implications for melting and enrichment processes in island arcs.
 207 Chemical Geology 2000, 165, 67-85.

208 Carignan J., Hild P., Mevelle G., Morel J. and Yeghicheyan D., Routine analyses of trace
 209 elements in geological samples using flow injection and low pressure on-line liquid
 210 chromatography coupled to ICP-MS: a study of geochemical reference materials BR, DR-N, UB-
 211 N, AN-G and GH. Geostandards Newsletter 2001, 25, 2-3, 187-198, DOI: 10.1111/j.1751-
 212 908X.2001.tb00595.x

213 Halpin, J.A., Jensen, T., McGoldrick, P., Meffre, S., Berry, R.F., Everard, J.L., Calver, C.R.,
 214 Thompson, J., Goemann, K., Whittaker, J.M., Authigenic monazite and detrital zircon dating
 215 from the Proterozoic Rocky Cape Group, Tasmania: Links to the Bel-Purcell Supergroup, North
 216 America. Precambrian Research. 2014, 250, 50-67.

217 Jackson, S.E., Pearson, N.J., Griffin, W.L., Belousova, E.A., 2004, The application of laser
 218 ablation-inductively coupled plasma-mass spectrometry to in situ U-Pb zircon geochronology.
 219 Chemical Geology 211, 47-69.

220 Jacobsen, S.B., Wasserburg, J.G., 1980. Sm-Nd isotopic evolution of chondrites. Earth &
 221 Planetary Science Letters 50, 139-155.

222 Kosler, J., 2001. Laser-ablation ICPMS study of metamorphic minerals and processes. In:
 223 Sylvester P. J. ed. Laser-ablation-ICPMS in the earth sciences; principles and applications
 224 Mineralogical Association of Canada Short Course Handbook 2001, 29, 185-202.

225 Pin, C. and Santos Zalduegui, J.F., Sequential separation of light rare-earth elements,
 226 thorium and uranium by miniaturized extraction chromatography ; application to isotopic
 227 analyses of silicate rocks. Analytica Chimica Acta 1997, 339, 79-89.

228 Sack, P.J., Berry, R.F., Meffre, S., Falloon, T.J., Gemmell, J.B., Friedman, R.M., In situ location
 229 and U-Pb dating of small zircon grains in igneous rocks using laser ablation-inductively
 230 coupled plasma-quadrupole mass spectrometry. Geochemistry, Geophysics, Geosystems 2011,
 231 12.

232 Slama, J., Kosler, J., Condon, D.J., Crowley, J.L., Gerdes, A., Hanchar, J.M., Horstwood, M.S.A.,
 233 Morris, G.A., Nasdala, L., Norberg, N., Schaltegger, U., Schoene, B., Tubrett, M.N., Whitehouse,
 234 M.J., Plesovice zircon - A new natural reference material for U-Pb and Hf isotopic microanalysis.
 235 Chemical Geology 2008, 249, 1-35.

236 Wiedenbeck, M., Alle, P., Corfu, F., Griffin W.L., Meier, M., Oberli, F., Vonquadt A., Roddick,
 237 J.C., Speigel W., 3 Natural Zircon Standards for U-Th-Pb, Lu-Hf, Trace-Element and REE
 238 Analyses. Geostandards Newsletter 1995, 19, 1-23.

239
240
241

sample	Age Ma	Rock type	Locality	WGS 84 Long.	Lat. (south)
PO 50	54.4±1.6	Sill Kone Facies	RT1 NW of Nandaï	165.4552	21.5077
PO 57	55.7±1.4	Sill Kone Facies	Barraoua quarry	165.3943	21.4674
PO 58	50.6±3.3	Dike Poya basalts	Dolbeau Station	165.3306	21.4898
PO 60	54.7±1.9	Sill Kone Facies	Koné quarry	164.8892	21.0517
KNBO2.1	47.6±4.0	Dike Poya basalts	Le Cap Station	165.3390	21.5040
KNBO3.0	49.2±4.4	Sill Kone Facies	Haute Pouéo (Bourail)	165.5070	21.4860
KNK5.0	50.0±7.1	Sill Kone Facies	Temala	164.6669	20.8716
KNK8.2	58±15	Sill Kone Facies	Pouembout	164.8909	21.1013
KNK10.0	50.0±4.4	Sill Kone Facies	Koné	164.8680	21.0701
KNK19.3	58.4±1.5	Sill Kone Facies	Pouembout	164.8891	21.0884
THIEM 2	55.9±1.2	Sill Kone Facies	Thiem bridge	165.1134	21.7620
THIEM 3	reset	Sill Kone Facies	Thiem bridge	165.1134	21.7620

242

243 **Table S1.** Location of dolerite samples for micro-zircon U-Pb geochronology

244
245

sample	Rock Type	Locality	WGS 84 Long.	Lat. (south)
KNBO1.0	Sandstone	Bouloupari	166.06940	21.88834
KNBO1.31	Sandstone	Bouloupari	166.07302	21.88244
KNBO1.41	Sandstone	Bouloupari	166.07303	21.88245
KNBO1.5	Greywacke	Bouloupari	166.07260	21.88350
KNB1.1	Sandstone	Bourail	165.53900	21.57200
KNB4.2	Sandstone	Bourail	165.50500	21.48500
KNB4.3	Sandstone	Bourail	165.50501	21.48501
KNB6.1	Sandstone	Bourail	165.43500	21.49200
KNPO2.0	Sandstone	Koné	165.22010	21.28533
KNK14.0	Sandstone	Koné	164.85975	21.05262
KNK19.2	Sandstone	Koné	164.88912	21.08838
KNK27.0	Sandstone	Koné	164.90057	21.07003
KNT4.0	Sandstone	Temala	164.68860	20.88450
KMC3.0	Sandstone	Kaala-Gomen	164.41824	20.63868

246

247 **Table S2.** Location of sandstone samples of the Kone Facies for point counting and detrital
 248 zircon U-Pb geochronology

249
250

251 **Table S3.** Whole rock geochemical data

sample	25125	25085	25172	25148	25150	3566	3567	3568	3569
Name	dolerite	dolerite	dolerite	dolerite	dolerite	Gabbro	Gabbro	Gabbro	Gabbro
Unit	Poya W	Koné	Koné	Koné	Koné				
Location	Nekliai	Bonhom me	Pouanlotc h	Ouanamb ou	Ouanamb ou	Temala	Temala	Témala	Témala
sampler	P.Black	P.Black	P.Black	P.Black	P.Black	Audet	Audet	Audet	Audet
SiO ₂	47.37	49.91	48.06	47.89	49.15	48.29	48.01	48.97	48.13
TiO ₂	1.23	1.11	1.37	0.86	1.00	1.24	1.38	1.66	1.28
Al ₂ O ₃	14.60	13.65	14.40	14.33	13.86	18.66	14.1	11.86	14
Fe ₂ O ₃	11.17	11.93	12.69	10.18	10.04	10.54	12.71	14.66	12.31
MnO	0.18	0.25	0.21	0.21	0.28	0.16	0.21	0.28	0.2
MgO	8.31	7.23	7.11	8.75	8.66	4.7	7.9	7.12	8.08
CaO	9.57	10.01	11.27	13.12	12.43	11.28	10.95	9.73	11.34
Na ₂ O	3.17	3.01	2.32	1.86	2.12	3.1	2.61	3.08	2.47
K ₂ O	0.32	0.70	0.13	0.15	0.26	0.37	0.22	0.33	0.3
P ₂ O ₅	0.12	0.10	0.12	0.08	0.07	0.09	0.13	0.13	0.09
LOI	3.51	1.80	1.76	1.83	2.16	2.03	2.5	2	2.29
H ₂ O-	0.19	0.17	0.18	0.35	0.12				
Total	99.74	99.87	99.62	99.61	100.15	100.47	100.71	99.82	100.5
Ba	27.52	211.40	56.5	45.41	73.40	46.88	319.6	124.7	167.4
Be									
Ce	8.73	9.79	10.9	7.88	8.50	9.168	13.2	11.34	9.815
Co	49.4	51.9	50	54.9	48.0			48.47	49.5
Cr	306	115	87	340	261			15.07	178.2
Cs	0.05	0.98	0.09	0.17	0.35	0.332	0.189	0.191	0.277
Cu	117	153	132	139	33			109.3	193.3
Dy	1.82	3.97	4.13	2.75	3.35	3.273	4.495	4.69	3.563
Er	1.01	2.42	2.64	1.66	2.10	1.978	2.732	2.878	2.173
Eu	0.54	0.97	1.01	0.73	0.79	0.94	1.113	1.142	0.97
Ga									
Gd	1.74	3.28	3.47	2.28	2.81	2.741	3.874	4.036	3.013
Ge									
Hf	1.41	1.15	1.66	1.16	1.30	1.583	2.063	1.798	1.613
Ho	0.37	0.87	0.93	0.61	0.75	0.683	0.93	0.985	0.747
In									
La	2.55	3.76	4.12	3.16	3.06	3.604	5.177	4.321	3.806
Lu	0.13	0.37	0.41	0.26	0.32	0.32	0.421	0.436	0.348
Mo									
Nb	3.67	3.67	4.29	3.19	3.61			4.101	4.06
Nd	5.66	7.63	8.34	5.76	6.73	3.681	5.092	8.861	7.128
Ni	129	80	75	129	100	6.816	9.356	8.861	7.128
Pb	0.61	0.92	1.32	0.81	6.18			54.65	100.3
Pr	1.2	1.60	1.72	1.25	1.36				
Rb	2.83	14.66	1.36	2.39	5.22	1.361	1.923	1.729	1.424

Sc	-	-	-	-	-	6.617	3.114	4.528	4.726
Sm	1.66	2.47	2.75	1.85	2.23	2.144	2.985	2.998	2.292
Sr	161	167	128	109.02	126	166	145.2	150.7	186.2
Ta	0.56	0.49	0.75	0.35	0.72	0.301	0.421	0.332	0.321
Tb	0.3	0.60	0.64	0.42	0.52	0.495	0.692	0.71	0.547
Th	0.1	0.21	0.37	0.30	0.27	0.341	0.529	0.411	0.386
Tm	0.14	0.36	0.39	0.25	0.32			0.431	0.327
U	-	-	0.09	-	0.06	0.099	0.152	0.112	0.119
V	258	299	339	254	264			489.9	361.2
W									
Y	8.27	24.92	25.6	17.58	21.40	18.87	26.07	26.93	21.18
Yb	0.89	2.37	2.59	1.66	2.07	2.046	2.733	2.862	2.236
Zn	92	68	94	126	106			100.6	86.91
Zr	47.9	66.00	64	49	54.00	57.74	74.08	62.95	58.94

252
253

sample	3570	3572	3573	3574	PO15	PO28	PO16	PO17	PO39
Name	Gabbro	Gabbro	Gabbro	Gabbro	Dolérite	Dolérite	gabbro peg	gabbro	gabbro
Unit	Koné	Koné	Koné	Kone	Koné? NW Nandaï	Koné? Ouitcham bo	Poya W	Poya W	Poya W
Location	Témala	Témala	Témala	Témala			Daoui	Daoui	RT1 Tiéta
sampler	Audet	Audet	Audet	Audet	Cluzel	Cluzel	Cluzel	Cluzel	Cluzel
SiO ₂	48.38	48.58	48.75	48.79	48.45	45.97	48.47	47.69	48.59
TiO ₂	1.3	1.21	1.27	1.21	1.06	1.14	2.27	1.51	1.00
Al ₂ O ₃	14.13	17.2	13.95	14.13	14.37	14.76	13.29	14.58	13.35
Fe ₂ O ₃	13.02	10.1	12.02	11.83	11.95	11.88	16.05	11.94	11.82
MnO	0.2	0.15	0.2	0.19	0.23	0.21	0.24	0.18	0.20
MgO	7.12	5.5	7.92	8.09	7.76	8.61	5.78	7.92	7.88
CaO	11.65	11.2	11.99	12.57	10.29	11.61	8.66	10.36	9.95
Na ₂ O	2.26	3.16	2.3	2.14	2.88	2.81	2.96	2.73	2.97
K ₂ O	0.13	0.46	0.2	0.13	0.21	0.41	0.37	0.51	0.58
P ₂ O ₅	0.1	0.06	0.1	0.11	0.16	0.10	0.22	0.14	0.19
LOI	1.97	2.16	1.8	1.73	2.65	2.50	1.81	2.83	3.47
H ₂ O-							0.45	0.41	
Total	100.26	99.79	100.49	100.92	100.00	100.00	100.57	100.80	100.00
Ba	102.5	53.43	66.64	43.17	70.41	65.89	60.22	233.92	82.395
Be									
Ce	10.38	11.68	10.5	11.23	15.973	8.971	21.94	21.53	10.994
Co	48.8	39.73	49.23	50.86	48.20	49.40	51.10	88.10	48.660
Cr	103.7	38.21	286.3	315	182.16	362.98	9.40	299.60	155.24
Cs	< L.D.	0.823	0.157	< L.D.	0.039	0.276	0.08	0.32	0.172
Cu	218.3	142.9	150	153.5					
Dy	4.26	3.265	3.734	3.984	5.019	3.476	6.93	7.16	4.319
Er	2.618	2.053	2.269	2.416	3.107	2.091	4.24	4.25	2.588
Eu	1.065	0.97	0.984	1.035	1.192	0.967	1.79	1.98	1.082
Ga									
Gd	3.592	2.761	3.218	3.437	4.269	3.021	6.01	6.41	3.672
Ge									
Hf	1.77	2.303	1.72	1.774	2.553	1.677	3.20	2.49	1.812
Ho	0.905	0.694	0.789	0.846	1.096	0.749	1.56	1.52	0.937
In									
La	3.929	4.663	4.122	4.361	6.190	3.173	8.00	7.51	4.220
Lu	0.414	0.324	0.353	0.376	0.449	0.289	0.63	0.61	0.371
Mo					1.156	0.273			0.575
Nb	3.739	5.239	4.388	4.344	7.155	3.266	7.51	7.69	3.398
Nd	8.192	7.63	7.674	8.405	11.178	7.327	16.43	16.64	8.749
Ni	8.192	7.63	7.674	8.405	90.55	111.74	34.00	173.64	
Pb	84.76	57.13	105.6	112.6	1.111	0.485	0.73	1.46	1.082
Pr					2.347	1.429	3.42	3.35	1.760
Rb	1.586	1.642	1.543	1.664	0.935	4.634	4.06	10.87	5.400
Sc	1.371	10.87	3.573	1.767					
Sm	2.648	2.262	2.509	2.618	3.336	2.354	5.03	5.09	2.848

Sr	119.1	181.3	125.5	122.3	135.404	148.154	163.99	303.61	223
Ta	0.319	0.429	0.339	0.353	0.477	0.220	0.52	0.56	0.224
Tb	0.638	0.506	0.566	0.604	0.770	0.542	1.10	1.13	0.662
Th	0.389	0.61	0.424	0.436	0.566	0.212	0.59	0.37	0.302
Tm	0.401	0.307	0.345	0.364	2.138	1.876		4.21	
U	0.108	0.17	0.119	0.119	0.167	0.065	0.17	0.09	0.088
V	387.1	304.9	340.3	360.6	395.23	373.17			411.18
W					0.104	0.071			0.059
Y	25.18	20	21.62	23.33	31.298	21.400	41.21	41.96	26.990
Yb	2.672	2.153	2.287	2.431	2.930	1.941	4.05	4.03	2.431
Zn	94.21	77.2	106.3	94.38	73.86	64.59	34.00		72.393
Zr	64.16	87.7	61.85	63.77	94.0	61.4	141.8	84.0	65.2

254

255

256

sample	25171	25064	25065	25182	25070	25197	25176	25185	25181
Name	Gabbro	Gabbro	Gabbro	Gabbro	Gabbro	Gabbro	Gabbro	Gabbro	dolerite
Unit	Poya W	Poya W	Poya W	Poya W	Poya W	Poya W	Poya W	Poya W	Poya W
Location	Voh Riv.	Moindou	Moindou	Voh Riv.	Moindou	Voh	Voh Riv.	Voh Riv.	Voh Riv.
	Pouanlotch h	Riv.Teme	Riv.Teme	Pouanlotch h	Poueo Riv	Temala	Pouanlotch h	Pouanlotch h	Pouanlotch h
sampler	P.Black	P.Black	P.Black	P.Black	P.Black	P.Black	P.Black	P.Black	P.Black
SiO ₂	51.84	47.42	47.80	48.44	47.66	48.91	48.88	48.69	48.26
TiO ₂	2.41	0.94	0.90	1.29	2.38	1.83	1.41	1.14	1.29
Al ₂ O ₃	12.21	13.24	12.21	14.06	12.05	12.91	13.99	17.89	14.03
Fe ₂ O ₃	17.42	10.74	11.42	12.61	18.88	15.07	12.73	10.43	12.18
MnO	0.31	0.21	0.22	0.23	0.32	0.24	0.19	0.14	0.21
MgO	2.68	9.34	10.25	6.80	5.65	6.11	6.28	4.72	7.58
CaO	6.60	12.54	12.99	10.19	8.33	10.32	9.67	11.55	11.87
Na ₂ O	3.77	2.24	1.81	3.44	2.43	2.46	3.66	3.13	1.92
K ₂ O	0.29	0.09	0.16	0.42	0.10	0.17	0.63	0.25	0.11
P ₂ O ₅	0.32	0.08	0.07	0.10	0.22	0.12	0.13	0.10	0.15
LOI	1.53	3.15	2.12	2.46	1.94	1.91	2.16	1.82	1.88
H ₂ O-	0.12	0.15	0.16	0.03	0.19	0.29	0.13	0.41	0.36
Total	99.50	100.14	100.11	100.07	100.15	100.34	99.86	100.27	99.84
Ba	71	68	45	61	106	40	122	34	37
Be	-	-	-	-	-	-	-	-	-
Ce	-	-	-	-	-	-	-	-	-
Co	-	-	-	-	-	-	-	-	-
Cr	-	336	365	84	-	-	16	14	169
Cs	-	-	-	-	-	-	-	-	-
Cu	42	113	110	183	278	243	337	187	163
Dy	-	-	-	-	-	-	-	-	-
Er	-	-	-	-	-	-	-	-	-
Eu	-	-	-	-	-	-	-	-	-
Ga	-	-	-	-	-	-	-	-	-
Gd	-	-	-	-	-	-	-	-	-
Ge	-	-	-	-	-	-	-	-	-
Hf	-	-	-	-	-	-	-	-	-
Ho	-	-	-	-	-	-	-	-	-
In	-	-	-	-	-	-	-	-	-
La	13.00	-	-	-	5.00	-	-	-	19.00
Lu	-	-	-	-	-	-	-	-	-
Mo	-	-	-	-	-	-	-	-	-
Nb	12	4	4	6	10	7	7	6	7
Nd	-	-	-	-	-	-	-	-	-
Ni	-	136	165	73	34	34	55	43	92
Pb	-	-	-	-	-	-	-	-	-
Pr	-	-	-	-	-	-	-	-	-
Rb	4	-	-	10	-	3	12	3	-

Sc	-	-	-	-	-	-	-	-	-
Sm	-	-	-	-	-	-	-	-	-
Sr	161	89	114	150	128	128	161	160	112
Ta	-	-	-	-	-	-	-	-	-
Tb	-	-	-	-	-	-	-	-	-
Th	-	-	-	-	-	-	-	-	-
Tm	-	-	-	-	-	-	-	-	-
U	-	-	-	-	-	-	-	-	-
V	106	317	333	340	574	557	378	273	329
W	-	-	-	-	-	-	-	-	-
Y	68	19	19	28	45	31	29	24	27
Yb	-	-	-	-	-	-	-	-	-
Zn	132	79	81	97	124	106	85	74	92
Zr	225.0	44.0	44.0	61.0	126.0	74.0	74.0	63.0	61.0

257
258

sample	25206	PO 50	PO 57	PO55	THIEM2	PAOLA	PO56	PO 58	THIEM3
Name	dolerite	dolerite	dolerite	dolerite	dolerite	dolerite	dolerite	dolerite	dolerite
Unit	Poya W	Kone	Poya	Kone	Kone	Koné	Kone ?	Kone	Kone
Location	Koumac Gamai	NW Nandai	Me Hera		Thiem	Thiem			Thiem
sampler	P.Black	D. Cluzel	D. Cluzel	D. Cluzel	Cluzel	D. Cluzel	D. Cluzel	D. Cluzel	D. Cluzel
SiO ₂	48.87	48.15	48.76	47.42	47.76	47.66	48.93	47.79	47.90
TiO ₂	1.54	1.34	1.48	1.36	1.26	1.25	1.67	1.30	1.56
Al ₂ O ₃	14.38	13.87	14.37	13.69	14.11	13.73	14.11	14.04	13.08
Fe ₂ O ₃	13.03	12.33	11.50	12.20	11.42	11.72	12.62	12.09	13.40
MnO	0.24	0.20	0.20	0.22	0.20	0.18	0.21	0.19	0.21
MgO	6.38	7.25	6.28	7.44	7.04	7.53	6.77	7.68	6.50
CaO	10.48	10.97	10.57	11.41	11.02	12.03	12.00	11.65	10.61
Na ₂ O	2.45	2.75	3.34	2.74	3.01	1.99	2.55	2.26	3.10
K ₂ O	0.12	0.28	0.64	0.08	0.69	0.18	0.12	< L.D.	0.22
P ₂ O ₅	0.15	< L.D.	< L.D.	< L.D.	< L.D.	0.1	< L.D.	< L.D.	< L.D.
LOI	2.07	2.13	2.13	2.38	2.83	3.35	1.49	1.73	2.84
H ₂ O-	0.13					0.15			
Total	99.84	99.26	99.26	98.95	99.34	99.87	100.46	98.72	99.42
Ba	93	49.4158	66.2017	40.3504	98.5973	78	32.2223	24.8478	58.5349
Be		0.354	0.4086	0.3456	0.3242		0.4581	0.363	0.4263
Ce	-	8.8615	12.1098	10.7141	8.4288	12	12.064	10.1174	13.0202
Co	-	46.575	40.1114	43.9335	39.3	46	42.4855	48.659	48.752
Cr	18	158.067	31.8027	200.57	54.4059	195.6	28.7796	214.469	25.2847
Cs		0.1308	0.6902	0.0316	0.7596	0.35	0.0405	0.0278	0.5493
Cu	205	111.326	227.763	162.166	158.472		102.215	352.104	233.648
Dy	-	3.5852	4.211	3.7619	3.4057	4.12	4.7901	3.5176	4.5386
Er	-	2.1884	2.4657	2.3262	2.0558	2.57	2.8255	2.1074	2.7629
Eu	-	0.9446	1.079	0.9704	0.8189	1.04	1.2427	0.9225	1.1385
Ga		16.6638	17.6451	16.318	15.8395		19.3175	17.3135	17.8472
Gd	-	2.8262	3.3565	3.035	2.6261	3.44	3.9186	2.8329	3.7483
Ge		1.3252	1.5302	1.3354	1.2574		1.4955	1.4347	1.5037
Hf	-	1.6042	1.9615	1.7062	1.4645	1.79	2.3211	1.4866	2.0577
Ho	-	0.8136	0.937	0.8406	0.7518	0.91	1.0499	0.7787	1.0052
In		0.0889	0.0849	0.0679	0.0562		0.0817	0.0696	0.0789
La	5.00	3.3377	5.012	4.2857	3.3117	4.71	4.3289	4.0265	5.0966
Lu	-	0.3377	0.3808	0.3465	0.3121	0.4	0.4033	0.3193	0.42
Mo		0.9363	1.0814	1.3249	0.8317		1.3887	1.3404	1.7699
Nb	9	3.5454	4.9119	4.4261	3.1433	4.64	3.892	4.2299	5.4413
Nd	-	6.8161	8.7328	7.7106	6.3835	9.04	9.9933	7.3373	9.4882
Ni	46	87.9124	52.6978	84.8916	64.903	70.4	51.256	95.6803	62.035
Pb		0.6215	0.7478	0.6984	0.5915	0.7	1.2116	0.7769	0.6456
Pr	-	1.3402	1.7841	1.5825	1.2551	1.89	1.9146	1.4906	1.9303
Rb	-	3.9356	9.7667	0.5273	10.7669	3.74	0.7691	0.4806	4.1001
Sc	-	49.22	49.79	48.52	50.68	47.1	54.14	49.09	48.18
Sm	-	2.3215	2.8051	2.5182	2.0916	2.86	3.3	2.3857	3.0943

Sr	159	158.227	144.024	123.084	95.4862	282	164.703	122.472	74.0055
Ta	-	0.2849	0.3869	0.3536	0.2775	0.47	0.3185	0.3029	0.4272
Tb	-	0.5325	0.615	0.5588	0.496	0.65	0.7111	0.5241	0.6677
Th	-	0.3363	0.4898	0.4167	0.3244	0.43	0.3418	0.3554	0.4562
Tm	-	0.3196	0.3586	0.3352	0.3001	0.39	0.4053	0.3048	0.4015
U	-	0.092	0.1365	0.115	0.0887	0.12	0.0999	0.1053	0.1315
V	344	361.288	390.287	339.131	338.22	384	354.357	343.047	374.773
W		< L.D.	< L.D.	< L.D.	5.4047		< L.D.	< L.D.	< L.D.
Y	32	21.358	24.6797	21.378	20.0133	23	26.0717	22.2513	26.0224
Yb	-	2.1753	2.4395	2.3178	2.0211	2.5	2.7513	2.0507	2.7018
Zn	94	91.103	87.2648	96.1862	80.63		96.012	98.098	106.244
Zr	95.0	55.9194	69.6339	61.6573	53.3987	68.2	81.9837	61.373	73.9673

259

260

sample	KNB8.0	KNBO2.1	KNBO3.0	KNK10.0	KNK7.0	KNK5.0	PO 60
Name	dolerite	dolerite	dolerite	dolerite	dolerite	dolerite	dolerite
Unit	Kone	Kone	Kone	Kone	Kone	Kone	Kone
Location							Kone qrry
sampler	Whitten	Whitten	Whitten	Whitten	Whitten	Whitten	Cluzel
SiO ₂	47.00	48.78	48.24	48.19	47.83	48.73	64.24
TiO ₂	1.29	1.24	1.33	1.21	1.21	1.22	0.57
Al ₂ O ₃	13.69	13.69	14.00	13.89	13.84	14.40	12.82
Fe ₂ O ₃	12.36	12.14	12.53	11.87	11.56	11.56	5.66
MnO	0.20	0.19	0.20	0.19	0.19	0.18	0.13
MgO	7.47	7.46	7.64	7.58	7.63	7.81	1.10
CaO	10.19	10.71	11.08	11.16	11.53	11.53	8.07
Na ₂ O	3.22	3.34	2.91	3.02	2.49	2.78	4.09
K ₂ O	0.26	0.29	0.39	0.25	0.34	0.24	< L.D.
P ₂ O ₅	< L.D.	< L.D.	< L.D.	< L.D.	< L.D.	< L.D.	< L.D.
LOI	3.31	2.33	2.42	3.28	2.79	2.60	2.01
H ₂ O-							
Total	99.00	100.15	100.72	100.64	99.41	101.06	98.69
Ba	104.297	58.2092	26.0057	92.1432	49.1567	75.6245	10.8848
Be	0.3629	0.3908	0.3282	0.3672	0.3498	0.3157	1.9614
Ce	11.6993	13.3666	9.8692	9.3606	10.9403	9.7504	49.6631
Co	67.0502	60.544	57.6443	58.0871	62.8638	57.9205	7.9904
Cr	176.263	184.114	169.277	292.277	244.461	302.626	20.8476
Cs	0.1977	0.1888	0.1712	0.1296	0.3696	0.3735	0.041
Cu	215.637	182.533	176.121	146.607	145.818	125.627	< L.D.
Dy	4.1832	4.6912	3.6455	3.7508	3.8138	3.774	13.4404
Er	2.5837	2.8689	2.2227	2.3078	2.2969	2.2467	9.6664
Eu	1.0417	1.1322	0.9027	0.9192	0.9452	0.9933	2.6607
Ga	17.4619	17.3213	15.9677	16.1663	16.3201	17.1194	23.5171
Gd	3.3765	3.7805	2.9254	2.944	3.0798	3.0563	9.6275
Ge	1.3731	1.5743	1.3864	1.3834	1.4576	1.3764	1.6105
Hf	1.8102	2.2092	1.5037	1.6145	1.7227	1.7355	12.5291
Ho	0.9274	1.0463	0.8109	0.835	0.8441	0.8146	3.277
In	0.0708	0.0753	0.0761	0.067	0.0652	0.0666	0.1001
La	4.6271	5.252	3.9388	3.6606	4.3837	3.6461	21.2145
Lu	0.3828	0.4364	0.3342	0.3518	0.3529	0.3286	1.7043
Mo	< L.D.	< L.D.	< L.D.	< L.D.	< L.D.	< L.D.	7.5582
Nb	4.5052	5.0975	3.8465	3.5153	4.2773	2.8495	23.7558
Nd	8.5846	9.7125	7.2866	7.0595	7.9122	7.7986	29.9718
Ni	83.8281	86.0564	85.8989	93.7015	104.826	76.5621	20.7401
Pb	1.0296	0.5245	0.7231	0.737	1.7143	0.7171	0.5947
Pr	1.735	1.9699	1.4613	1.418	1.6146	1.5166	6.6698
Rb	3.4848	4.9989	5.8192	3.621	6.8412	3.4971	0.4858
Sc	49.02	50.18	51.5	50.39	48.25	48.15	13.55
Sm	2.741	3.083	2.3509	2.4137	2.5561	2.5754	8.4321
Sr	222.419	202.111	135.681	234.907	124.485	237.907	19.7699

Ta	0.4568	0.495	0.3648	0.3504	0.4211	0.2844	2.0236
Tb	0.6105	0.6929	0.5333	0.5459	0.5623	0.5558	1.8428
Th	0.4162	0.5	0.3356	0.3267	0.3976	0.2773	3.4717
Tm	0.3658	0.4166	0.3234	0.3412	0.3335	0.3189	1.4959
U	0.1164	0.1403	0.1541	0.0914	0.1105	0.0778	0.972
V	338.594	325.201	347.419	325.883	321.499	285.323	17.499
W	138.351	93.4781	75.0966	99.208	133.58	75.2519	< L.D.
Y	23.3209	26.3469	20.9377	21.5061	21.9648	21.3386	91.406
Yb	2.5197	2.8215	2.1954	2.2949	2.2567	2.1581	10.5969
Zn	95.1536	100.889	93.8799	97.9892	100.739	93.1739	29.7383
Zr	66.5121	78.9437	55.9687	58.0998	62.7395	64.154	467.71

261

262

263
264

Sample	PO 58	THIEM 3	KNK5.0
	dolerite	dolerite	dolerite
Age (Ma)	50.6	49.2	54
Sm	2.3857	3.0943	2.5754
Nd	7.3373	9.4882	7.7986
Rb	0.4806	4.1001	3.4971
Sr	122.5	74.00	237.9
Sm/Nd	0.3251	0.3261	0.3302
$(^{143}\text{Nd}/^{144}\text{Nd})_{\text{meas.}}$	0.20073	0.20133	0.20387
$(^{87}\text{Sr}/^{86}\text{Sr})_{\text{meas.}}$	0.01094	0.15452	0.04100
$^{147}\text{Sm}/^{144}\text{Nd}$	0.20073	0.20133	0.20388
$(^{143}\text{Nd}/^{144}\text{Nd})_{\text{i}}$	0.51279	0.51281	0.51270
$(^{143}\text{Nd}/^{144}\text{Nd})_{\text{CHUR}}$	0.51257	0.51257	0.51257
ϵ_{Nd}	4.3	4.7	2.5
$^{87}\text{Rb}/^{86}\text{Sr}$	0.01094	0.15452	0.04100
$(^{87}\text{Sr}/^{86}\text{Sr})_{\text{i}}$	0.70378	0.70414	0.70468
$(^{87}\text{Sr}/^{86}\text{Sr})_{\text{CHUR}}$	0.70379	0.70425	0.70471

265
266 **Table S4.** New Nd-Sr isotopic data from dolerites of the Kone Facies
267
268
269