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Biostratigraphic distribution of orbitolinids in the ammonite biozones (Urgonian platform of southeastern France).

Part 2: Barremian *p.p.*

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Abstract: The biostratigraphic distribution of orbitolinids for the Barremian of SE France proposed hereafter is calibrated on the ammonite biozonation. This work is based on the study of eleven sections with orbitolinids associated to macrofossils (ammonites and/or echinids) significant in terms of biostratigraphy or overlain with levels bearing the above macrofossils.

Key-words:

- Barremian;
- Urgonian;
- orbitolinid foraminifers;
- ammonites;
- biostratigraphy;
- SE France

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Résumé : Répartition biostratigraphique des orbitolinidés dans la biozonation à ammonites (plate-forme urgonienne du Sud-Est de la France). 2e partie : Barrémien *p.p.*- La répartition biostratigraphique des orbitolinidés du Barrémien présentée ci-dessous est calibrée sur la biozonation des ammonites. Ce travail est basé sur l'étude de onze coupes de terrain qui ont livré des orbitolinidés de niveaux encadrés ou surmontés par des faciès à ammonites et/ou à échinides significatifs sur le plan biostratigraphique.

Mots-clefs :

- foraminifères ;
- Orbitolinidae ;
- taxinomie ;
- phylogénie ;
- biostratigraphie ;
- SE France

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1. Introduction

This publication focuses on Barremian orbitolinid species [and a lookalike, *Moulladella jourdanensis* (FOURY & MOULLADE, 1966), which will appear preceded by a spade sign ♠ in the rest of the text, figures, and plates. As a matter of fact, this species was recently excluded from the family Orbitolinidae and transferred to the family Pfenderinidae by BUCUR and SCHLAGINTWEIT (2018). According to M. SEPTFONTAINE (personal communication, 27/09/2021), it is possibly an isomorph of *Conicopfenderina* SEPTFONTAINE, 1988] from sections logged with diagnostic ammonites (and echinids, using CLAVEL's range chart, 1984). It is the second publication in a row because it follows a first one that dealt with slightly older orbitolinid assemblages, *i.e.*, late Hauterivian to earliest Barremian in age (CLAVEL *et al.*, 2010). The eleven sections studied (Fig. 1) span environments ranging from the shallower inner platform (Serre de Tourre, Pont d'Arc) to deeper basinal areas (*e.g.*, La Charce). These data supplement and corroborate the observations carried out from the debris flows and turbidites at L'Estellon, the "Rosetta Stone of the Urganian biostratigraphy" (BUSNARDO *et al.*, 2013; GRANIER *et al.*, 2013, 2014, 2017; CLAVEL *et al.*, 2014; BERT, 2017). They also contribute to demonstrating that, contrary to the misleading claims of ARNAUD-VANNEAU (1980 *et seq.*), most orbitolinid species previously reported from Urganian and coeval facies mostly ascribed late Barremian or Bedoulian (early Aptian *sensu lato*) ages were already extensively present from the dawn of the Barremian.

2. Material and method

The ammonites were initially studied by the late Robert BUSNARDO 1926-2018 whereas the micropaleontological analyses are mostly the work of the late Bernard CLAVEL 1938-2018 (CHAROLLAIS & GRANIER, 2020).

The **ammonites** (Ammonitina, Ancyloceratina, Lytoceratina and Phylloceratina) were identified by Robert BUSNARDO the material of whom, identified with a FSL numbering, is stored in the collections of Faculté des Sciences de Lyon, Université Claude BERNARD (Lyon). One may find in our publication some illustrations of material (ammonites and orbitolinids) with an ID numbering, which stands for Institut DOLOMIEU, Université Joseph FOURIER (Grenoble); this material is mostly reused from publications of ARNAUD-VANNEAU (1980) and ARNAUD *et al.* (1998). There could be some disagreements regarding the generic and/or specific identifications between our colleague's original views and other options following Didier BERT's quick review (the latter joined our working group just before the passing of Robert BUSNARDO). However, that should not affect significantly the stratigraphic ascription of the strata bearing the orbitolinids.

Regarding the **orbitolinids**, the large number

of plates and photomicrographs emphasizes the purpose of the project leader, the late Bernard CLAVEL, to include the various orbitolinid species because they usually occur in most samples studied and not only in a few sections particularly illustrative of specimens perfectly preserved but seldom found, hence of limited value for biostratigraphical purposes. These thin sections and the related material will be deposited at the "Muséum d'Histoire naturelle de Genève" (Switzerland).

Some species benefit from a larger number of photomicrographs than others. They correspond to:

1) forms previously described but never reported in the biostratigraphic range charts published by ARNAUD-VANNEAU (see ARNAUD *et al.*, 1998; ARNAUD-VANNEAU *et al.*, 2005), among which A) *Montseciella arabica* (HENSON, 1948) [Pls. 93, 113], clearly identified throughout the studied area and included in our list of species cited, as well as B) *Montseciella glanensis* (FOURY, 1968) and C) *Paracoskinolina querolensis* CANÉROT & PEYBERNÈS, 1981, and

2) forms (*e.g.*, *Orbitolinopsis briacensis* ARNAUD-VANNEAU, 1980, *O. buccifer* ARNAUD-VANNEAU & THIEULOUY, 1972, *O. cuvillieri* MOULLADE, 1960, and *O. kiliani* (PREVER, 1905)) the occurrences of which were supposedly restricted to various levels of the upper Barremian or the Bedoulian (lower Aptian *sensu lato*) as erroneously claimed by the same author (see ARNAUD *et al.*, 1998; ARNAUD-VANNEAU *et al.*, 2005).

Although the specific features of *Paleodictyoncus cuvillieri* are indifferently distributed in both *P. cuvillieri* and *P. actinostoma* starting from the upper Hauterivian strata and upwards, this question will not be addressed here but in a forthcoming paper. Finally, in our opinion, *Orbitolinopsis pygmaea* ARNAUD-VANNEAU, 1980, first recorded in lowermost Barremian strata, actually corresponds to the early growth stage in the ontogenetic development (= juvenile specimens) of several *Orbitolinopsis* species and should not be considered as an individual species.

The workflow and techniques developed by the late Bernard CLAVEL to study orbitolinids have already been discussed in several earlier publications (CLAVEL *et al.*, 2010, 2014; CLAVEL in GRANIER *et al.*, 2013, 2017). We assume that they provide a simple explanation of the huge discrepancies, eventually exceeding one full stage, in the biostratigraphic ranges published respectively by ARNAUD *et al.* (1998) and ARNAUD-VANNEAU (2005), on one side, and by CLAVEL *et al.* (2007, 2009a, 2009b, 2009c, 2010, 2014), CHAROLLAIS *et al.* (2008), and GRANIER *et al.* (2013, 2014, 2016, 2017), on the other side.

At the very beginning of any orbitolinid study, any geologist is urged to correctly sample rock material from the outcrops (Pl. 31, fig. A). To start with, a close examination with hand lenses on the field is required to undertaking the selection of rich and representative rock samples, commonly reaching half a kilogram in weight.

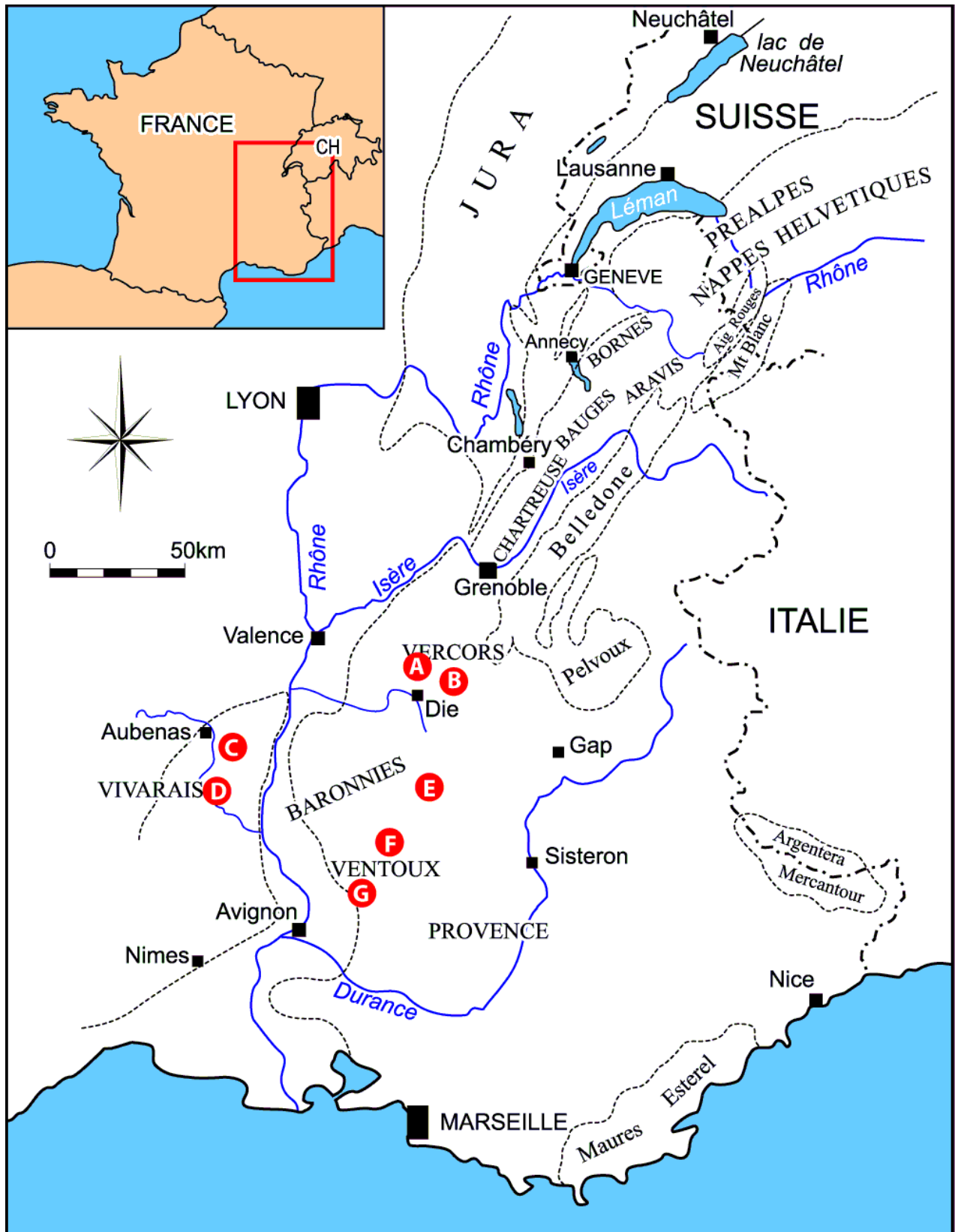


Figure 1: Location map of the sections studied. Section labels are a continuation of the numbering used in the first part of this study (CLAVEL *et al.*, 2010): A) La Béguère [12], Col de Rousset [16]; B) La Montagnette [10]; C) Rochecolombe [13]; D) Mas de Gras [9], Serre de Tourre [11], Pont d'Arc [18], Orgnac [19]; E) La Charce [17], L'Estellon; F) Mas Thibaud [14]; G) Gorges de la Nesque [15].



In the case of limestones, the samples are slabbed in the laboratory (Pl. 31, fig. C). Then each piece of slab is planed and polished (Pl. 31, fig. D) before careful examination under a binocular microscope to locate sections of various orbitolinid species with orientations suitable for their taxonomic identification (Pl. 31, figs. E-G). The most characteristic sections, *e.g.*, axial sections cutting through the embryo, are photographed. Later they are possibly used to prepare discrete petrographic thin sections (Pl. 31, figs. I-J). Unfortunately, during this last process, some specimens could be destroyed: In this case, the only material left will be a low-resolution photomicrograph. Photomicrographs of specimens only available from polished slabs are marked by the sample numbering followed of an asterisk *; in the case no photomicrograph record exists in the electronic archives of the late Bernard CLAVEL (CD, DVD, external hard drive), the sample numbering is preceded by a question mark ? and once again followed of an asterisk * plus a note [NF] standing for "not found" (which applies to 10 photomicrographs only). Most of the time the petrographic thin sections of the selected samples allow the taking of photomicrographs in transmitted light with a better resolution than those of the polished slabs taken in reflected light.

In the case of marls, a larger volume of rock is required. For instance, samplings of not less than ten kilograms in both hemipelagic layers underlying the bioclastic facies and marly layers occurring within the Urgonian Limestone Formation were necessary to obtain residues sufficiently rich in microfauna for analysis after washing, drying and sieving (Pl. 31, fig. K).

Experience has shown that this selection task, which requires several days of sample handling and examination, is the only way to obtain a significant diversity in the fossil assemblage, on the one hand, and characteristic sections of the various orbitolinid species that make up it, on the other hand. When studying the "Gorges du Nan" section, one of us (BC) computed that more than 85 kg of rocks were collected, out of which polished slabs and 350 thin sections were made representing respectively some 5.7 m² and less than 0.2 m² in surface. As a result, the surface covered when observing polished slabs is 36 times larger than that for thin sections, increasing significantly the number of orbitolinid specimens observed. Another extremely demonstrative example is given by comparison of the results of BERNAUS (1998) versus those of BECKER (1999). Both authors successively worked on the Organyà section (Catalan Pyrenees) but, on a 70 m thick interval of this section, BERNAUS (1998; BERNAUS *et al.*, 2000) identified only one species of orbitolinid with no real biostratigraphic value whereas BECKER (1999) identified 13 taxa (SCHROEDER *et al.*, 2000; CONRAD *et al.*, 2004: Fig. 2) and documented his finds with some fifteen photomicrographs of the most significant species.

3. Summary descriptions of the studied sections

In the first part of this study, CLAVEL *et al.* (2010) documented the fossil assemblages (ammonites, echinids, orbitolinids, *Moulladella jourdanensis*, and Dasycladales) from 8 sections:

1. the "Pic de l'Oeilette" section (38 Isère, Chartreuse) logged along RD (departmental road) 520B in the vicinity of the peak [GPS: 45°21'00.1"N 5°46'12.6"E] (ARNAUD-VANNEAU, 1980: p. 219-220),
2. the "Combe de Bella Cha" section (74 Haute-Savoie, Aravis) based on several spots of observation and fossil collection (CHAROLLAIS *et al.*, 2009),
3. the "Grands Goulets" section (26 Drôme, Vercors), starting at 675 m altitude, GPS coordinates: 45°00'37.5"N 5°24'33.1"E, and ending at 675 m altitude, GPS: 45°00'07.9"N 5°25'17.7"E (ARNAUD-VANNEAU, 1980: p. 238),
4. the "Pont de Laval" section (07 Ardèche, Vivarais), starting at the 353 m marked spot [GPS: 44°24'07.4"N 4°28'55.6"E] and ending at the 601 m marked spot [GPS: 44°24'27.2"N 4°29'00.5"E] (CHAROLLAIS *et al.*, 1998: p. 103, 105, 107),
5. the "Mont Aiguille" section (38 Isère, Vercors), A) lower part in the Aiguille mountain stream, starting at 1491 m, GPS coordinates: circa 44°50'43.9"N 5°33'04.2"E, and ending at 1750 m, GPS coordinates: circa 44°50'33.5"N 5°33'08.8"E, and B) upper part East of the Aupet mountain pass at 1750 m altitude, GPS coordinates: circa 44°50'23.9"N 5°32'44.4"E (BUSNARDO *et al.*, 1991),
6. the "Pas de l'Essaure" section (38 Isère, Vercors), in Combau valley below the pass at 1662 m altitude, GPS coordinates: 44°47'33.7"N 5°33'31.4"E (ARNAUD-VANNEAU, 1980: p. 267),
7. the Arredons section (07 Ardèche, Vivarais), West of Saint-Remèze, in the vicinity of the 382 m marked spot, GPS coordinates: 44°23'04.3"N 4°28'36.3"E (CHAROLLAIS *et al.*, 1998: p. 103, 105, 107).
8. the Chames section (07 Ardèche, Vivarais) in the "Gorges de l'Ardèche", starting at 98 m altitude, GPS coordinates: 44°22'36.5"N 4°25'28.9"E (CHAROLLAIS *et al.*, 1998: p. 104-105, 107).

9. La Vignasse, Mas de Gras (07 Ardèche, Vivarais)

(Fig. 2.9)

lower Barremian (Ba2 LST): Pulchella Zone (Pls. 32 - 45)

The "La Vignasse" section [beginning at UTM 31 (WGS84) X: 620804.545, Y: 4920393.199; GPS: 44°25'36.3"N 4°31'03.7"E ending at UTM 31 (WGS84) X: 623168.416, Y: 4921520.324; GPS: 44°26'11.4"N 4°32'51.5"E] is located ap-



proximately 5 km northeastward of the area of "Pont de Laval" (CLAVEL *et al.*, 2010: § 4. Pont de Laval, Fig. 2.4). It is a section of major interest for the biostratigraphic calibration of the orbitolinids on the lower Barremian ammonite zones. First studied by LAFARGE (1978), it was later revisited by CLAVEL *et al.* (2007, 2014). For a better understanding of the regional framework, one should refer to the 1:50 000 scale geological maps of "Bourg-Saint-Andéol" (PASCAL *et al.*, 1989) and "Aubenas" (ELMI *et al.*, 1996), as well to the Geological Guide no. 8 of the University of Geneva (CHAROLLAIS *et al.*, 1998).

At Mas de Gras, the first biocalcarenic levels with orbitolinids and dasycladalean algae are found interbedded with hemipelagic facies that yield numerous ammonites of the Ohmi, Hugii, Pulchella, Compressissima, and Moutonianum zones (Fig. 2.9). *Emericiceras emericici* (LÉVEILLÉ, 1837), cf. *Pseudothurmannia mortilleti* (PICTET & LORIOU, 1858) [Pl. 32, fig. B, FSL 89581], and *Taveraidiscus hugii* (OOSTER, 1860) [Pl. 32, fig. A, FSL 89641] are found at the base of the section whereas its upper part yields *Astieridiscus* sp., *Dissimilites dissimilis* (ORBIGNY, 1841) [Pl. 33, fig. A, FSL 89719], ? *Holcodiscus caillaudianus* (ORBIGNY, 1850) -RB- {or *Amohaldites* aff. *camelinus* (ORBIGNY, 1850) -DB-} [Pl. 33, fig. H, FSL 89677], *Holcodiscus perezianus* (ORBIGNY, 1850) [Pl. 32, figs. E-F, H, FSL 89613, FSL 89674, FSL 89707, respectively], ? *Kotetischvilia compressissima* (ORBIGNY, 1840) -RB- {or *Heinzia communis* (BÜRGL, 1956) -DB-} [Pl. 33, fig. E, FSL 89697], ? *Kotetischvilia compressissima* -RB- {or ? *Nicklesia didayana* (ORBIGNY, 1841) -DB-} [Pl. 32, fig. G, FSL 89704], *Kotetischvilia compressissima* [Pl. 33, fig. G, FSL 89703], *Nicklesia didayana* (ORBIGNY, 1841) [Pl. 33, figs. D, F, FSL 89705 & FSL 89703b, respectively], *Nicklesia pulchella* (ORBIGNY, 1841) [Pl. 32, figs. C-D, FSL 89615 & FSL 89616, respectively; Pl. 33, fig. B, FSL 89617], *Torcapella capillosa* BUSNARDO, 1970, and *Moutoniceras moutonianum* ORBIGNY, 1850 [Pl. 33, fig. C, FSL 89718].

The study of thin sections and polished slabs prepared from 8 rock samples (no. 375, 376, 377, 381, 409, 410, 6873, 6874) of the Ba2 LST interval led to the identification of the following list of species (each coming with its specific identification and the label of the corresponding thin section or polished slab *):

- ♠ *Moulladella jourdanensis* (Pl. 36), and the orbitolinids:
- *Cribellopsis elongata* (DIENI *et al.*, 1963) (Pl. 42),
- *Cribellopsis neoelongata* (CHERCHI & SCHROEDER, 1978) (Pl. 43),
- *Cribellopsis schroederi* ARNAUD-VANNEAU, 1980 (Pl. 43),
- *Cribellopsis thieuloyi* ARNAUD-VANNEAU, 1980 (Pl. 42),
- *Dictyorbitolina carthusiana* SCHROEDER *et al.*, 1990 (Pl. 34),

- *Eopalorbitolina charollaisi* SCHROEDER, 1968 (Pl. 34). Note that Pl. 34, fig. 410-1 is duplicated from CLAVEL *et al.* (2007, Pl. 4, fig. F);
- *Falsurgonina pileola* ARNAUD-VANNEAU & ARGOT, 1973 (Pl. 36),
- *Falsurgonina vanneauae* CLAVEL *et al.*, 2009 (Pl. 36),
- *Montseciella algerensis* CHERCHI & SCHROEDER, 1999 (Pl. 45),
- *Montseciella glanensis* (Pl. 37),
- *Orbitolinopsis briacensis* ARNAUD-VANNEAU, 1980 (Pl. 39),
- *Orbitolinopsis buccifer* (Pls. 38 - 39),
- *Orbitolinopsis cuvillieri* (Pl. 40),
- *Orbitolinopsis debelmasi* MOULLADE & THIEULOY, 1965 (Pl. 41),
- *Orbitolinopsis kiliani* (Pl. 39),
- *Paleodictyoconus actinostoma* ARNAUD-VANNEAU & SCHROEDER, 1976 (Pl. 44),
- *Paleodictyoconus cuvillieri* (FOURY, 1963) (Pls. 44 - 45),
- *Paracoskinolina hispanica* PEYBERNÈS, 1976 (Pl. 35),
- *Paracoskinolina maynci* (CHEVALIER, 1961) (Pl. 35),
- *Paracoskinolina ? praereicheli* CLAVEL *et al.*, 2009 (Pl. 43),
- *Paracoskinolina querolensis* (Pl. 35),
- *Paracoskinolina ? reicheli* (GUILLAUME, 1956) (Pl. 43). Note that Pl. 43, fig. 381-30a is duplicated from CLAVEL *et al.* (2007, Pl. 5, fig. L) and fig. 381-30b from CLAVEL *et al.* (2007, Pl. 5, fig. K) as "*Dictyoconus ? reicheli* GUILLAUME";
- *Paracoskinolina* aff. *sunnilandensis* (MAYNC, 1955) (Pl. 35),
- *Praedictyorbitolina claveli* SCHROEDER, 1994 (Pl. 34),
- *Urgonina alpillensis* (FOURY, 1963) (Pl. 37),
- *Valserina broennimanni* SCHROEDER & CONRAD, 1968 (Pl. 34),
- *Valserina turbinata* (FOURY, 1968) (Pl. 34),
- *Vanneauina vercorii* (ARNAUD-VANNEAU, 1980) (Pl. 45).

Out of 34 species (♠ *Moulladella jourdanensis* included) identified until now in Barremian sections, 29 are already present in the Pulchella Zone of the lower Barremian.

10. La Montagnette (26 Drôme, Vercors)

(Fig. 2.10)

lower Barremian (Ba2 LST): Pulchella Zone

(Pls. 46 - 52)

The "La Montagnette" section [beginning at UTM 31 (WGS84) X: 702029.191, Y: 4962746.656; GPS: 44°47'22.4"N 5°33'14.4"E ending at UTM 31 (WGS84) X: 701873.128, Y: 4960817.256; GPS: 44°46'20.1"N 5°33'04.5"E] corresponds to the middle part of the "Plateau de Glandasse" section the lower part of which has been published by CLAVEL *et al.* (CLAVEL *et al.*, 2010: § 6. Pas de l'Essaure, Fig. 2.6). This section also appears in several earlier publications of ARNAUD-VANNEAU and coauthors (ARNAUD-VANNEAU, 1980, p. 267; ARNAUD, 1981; ARNAUD *et al.*, 1998).

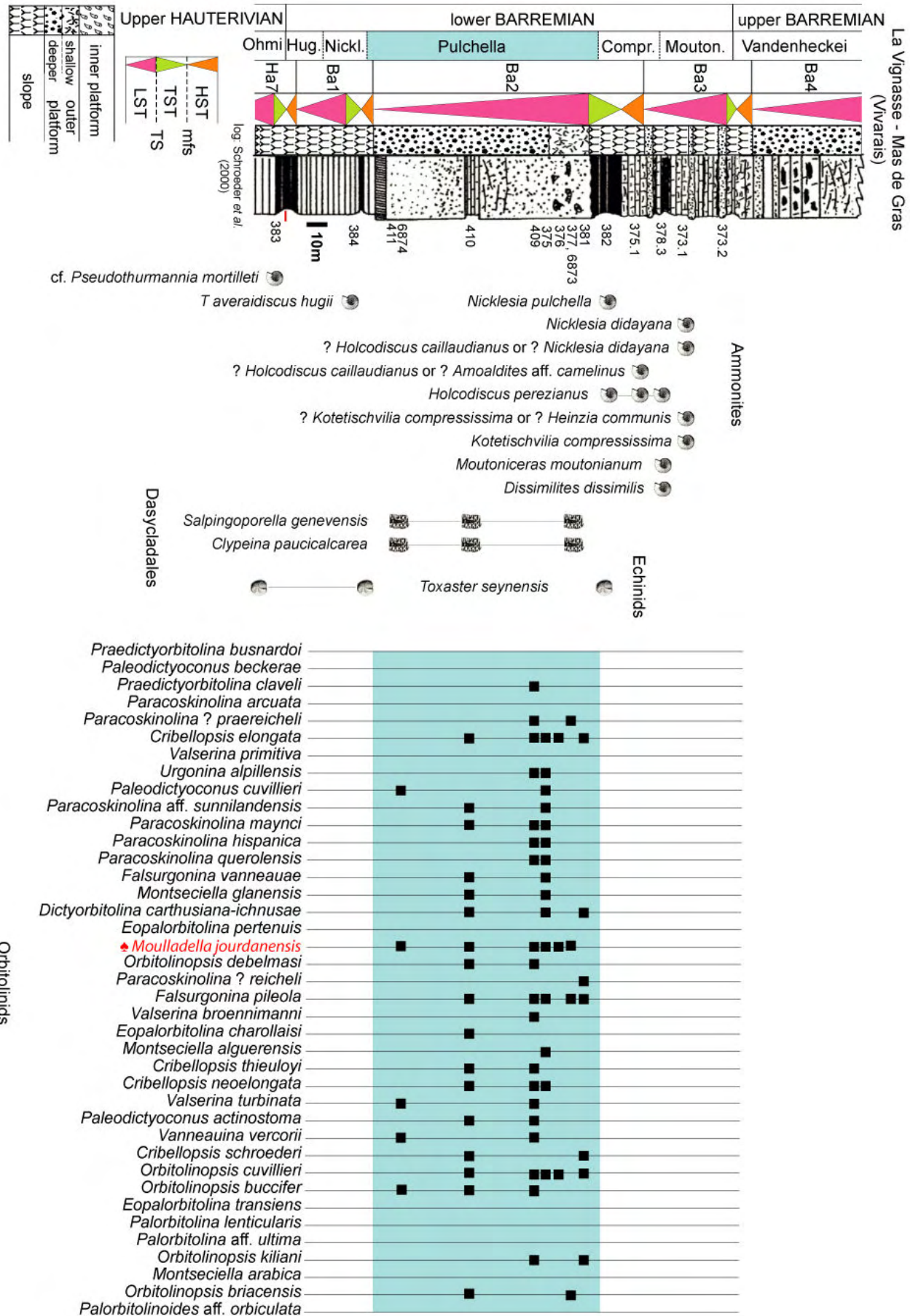


Figure 2.9: La Vignasse section.



The biocalcarenic levels with orbitolinids and dasycladalean algae are interspersed with hemipelagic facies in the lower part of the section and overlain by hemipelagic facies at the top of the section. These hemipelagic facies provided rare ammonites belonging to the Nicklesi, Pulchella, and Compressissima zones (Fig. 2.10).

The lower part of the section is characterized by *Paraspiticer* (*Paraspiticer*) *guerinianum* (ORBIGNY, 1850) [ARNAUD *et al.*, 1998: Pl. 2, fig. 4, UJF-ID 10569; herein Pl. 46, fig. E1, E2', E2''], *Torcapella fabrei* (TORCAPEL, 1884) [ARNAUD *et al.*, 1998: Pl. 2, fig. 1, UJF-ID 10566; herein Pl. 46, fig. D], *Torcapella* gr. *falcata* BUSNARDO, 1970, *Torcapella suessiformis* BUSNARDO, 1970, and *Moutoniceras* gr. *nodosum* (ORBIGNY, 1850) [ARNAUD *et al.*, 1998: Pl. 2, fig. 3, UJF-ID 10568; herein Pl. 46, fig. B], whereas the upper part provided *Cassidoiceras* sp., *Duyeina* cf. *boutini* (COQUAND in MATHERON, 1879), *Torcapella* cf. *suessiformis* BUSNARDO, 1970 [Pl. 46, fig. A, FSL 88731], and *Nikolovites* gr. *charrierianus* (ORBIGNY, 1842) [Pl. 46, fig. C, FSL 88827].

In a single sampling (no. 492) in the Ba2 LST interval at the top of Montagnette, we identified the following list of species (coming with their specific identification and the label of the corresponding thin section or polished slab *):

- ♠ *Moulladella jourdanensis* (Pl. 47), and the orbitolinids:
 - *Cribellopsis elongata* (Pl. 50),
 - *Cribellopsis neolongata* (Pl. 50),
 - *Cribellopsis schroederi* (Pl. 51),
 - *Cribellopsis thieuloyi* (Pl. 50). Note that Pl. 50, fig. ID 21179 is duplicated from ARNAUD-VANNEAU (1980, Pl. 96, fig. 15);
 - *Dictyorbitolina carthusiana* (Pl. 47),
 - *Eopalorbitolina charollaisi* (Pl. 47),
 - *Falsurgonina pileola* (Pl. 48),
 - *Montseciella algerensis* (Pl. 49). Note that Pl. 49, fig. ID 21244 is duplicated from ARNAUD-VANNEAU (1980, Pl. 106, fig. 5a);
 - *Montseciella glanensis* (Pl. 49),
 - *Orbitolinopsis buccifer* (Pl. 51),
 - *Orbitolinopsis cuvillieri* (Pl. 51). Note that Pl. 51, fig. ID 21118 is duplicated from ARNAUD-VANNEAU (1980, Pl. 93, fig. 1);
 - *Orbitolinopsis debelmasi* (Pl. 51),
 - *Paleodictyoconus actinostoma* (Pl. 52),
 - *Paleodictyoconus cuvillieri* (Pl. 52). Note that Pl. 52, fig. ID 21241 is duplicated from ARNAUD-VANNEAU (1980, Pl. 106, fig. 1a);
 - *Paracoskinolina hispanica* (Pl. 48),
 - *Paracoskinolina maynci* (Pl. 48),
 - *Paracoskinolina querolensis* (Pl. 48),
 - *Paracoskinolina ? reicheli* (Pl. 47). Note that the blurred photomicrograph 492bb2 from the polished plug, which was used to make the thin section 492-73b, looks very similar to a *Paracoskinolina ? praereicheli*;
 - *Paracoskinolina* aff. *sunnilandensis* (Pl. 47),
 - *Urgonina alpillensis* (Pl. 48),
 - *Valserina broennimanni* (Pl. 47),

- *Valserina turbinata* (Pl. 47).

Out of the 34 species (♠ *Moulladella jourdanensis* included) reported until now in Barremian sections, 23 were observed in the Pulchella Zone of this section.

11. Serre de Tourre (07 Ardèche, Vivarais)

(Fig. 2.11)

Barremian (Ba2 LST to Ba4 HST): Pulchella, Compressissima, Moutonianum, and Vandenheckei zones

(Pls. 53 - 72)

The "Serre de Tourre" section [beginning at UTM 31 (WGS84) X: 614493.842, Y: 4915104.504; GPS: 44°22'48.7"N 4°26'14.2"E ending at UTM 31 (WGS84) X: 617780.826, Y: 4911849.545; GPS: 44°21'01.3"N 4°28'40.0"E] constitutes the upper part of the "Gorges de l'Ardèche" cliff (East of the "Vallée du Tiourre", West of the "Plateau de Saint-Remèze") of which the lower part is the Arredons section (CLAVEL *et al.*, 2010: § 7. Arredons, Fig. 2.7).

The levels with rudists and orbitolinids are interspersed in their middle part by two episodes of external platform environments, which provided ammonites belonging to the Compressissima, Moutonianum, and Vandenheckei zones (Fig. 2.11): *Astieridiscus menglonensis* (SAYN, 1891) (Pl. 53, fig. M, FSL 88967), *Barremites* sp. (Pl. 53, fig. I, FSL 88971), *Holcodiscus diversecostatus* (COQUAND, 1880) -RB- {or *Holcodiscus* sp. -DB-} (Pl. 53, fig. H, FSL 89458), *Holcodiscus* sp. (Pl. 53, figs. K-L, FSL 88970, FSL 89454), *Puezalpella* cf. *uhligi* (Pl. 53, fig. A, FSL 89519), *Puezalpella* sp. (Pl. 53, figs. B, D-G, J, respectively FSL 89457, FSL 88969, FSL 88968a, FSL 88968c, FSL 88968d, FSL 88968b), and *Silesites* cf. *cirtense* (SAYN, 1890) -RB- {or *Silesites vulpes* (COQUAND, 1878) -DB-} Pl. 53, fig. C, FSL 89456), as well as few echinids of the circalittoral domain, *i.e.*, *Toxaster seynensis* (LAMBERT, 1920), and numerous echinids of the infralittoral domain, *i.e.*, *Heteraster couloni* (AGASSIZ, 1839).

This section was described by LAFARGE (1978), right above the viewpoint ("Belvédère") de "Serre de Tourre" [GPS: 44°22'26.2"N 4°26'21.4"E] (Fig. 2.11). Its upper part, starting, from the basal part of the "Vire du Serre de Tourre" - Ba2 - was supplemented along RD 290 - where strata crop out on several spots - up to its uppermost part - Ba5 -, which can be observed westward of RD 590.

This uppermost part is represented by a characteristic marly level with many rudists and *Heteraster oblongus*, of which it is the first occurrence. It also crops out on the opposite bank of the Ardèche river, near the "Combe de Sarran" at Orgnac-l'Aven (§ 19. Orgnac, Fig. 2.19). There one of us (B.C.) collected a specimen of *Heteroceras* cf. *baylei* REYNÈS, 1876 (Pl. 120, fig. B, FSL 89455), an ammonite that is still present in the Sarasini Zone. The last appearance of *H. couloni* (HST Ba4) and the appearance (FO) of *H. oblongus* (TST Ba5, "vire 4") occur respectively at the

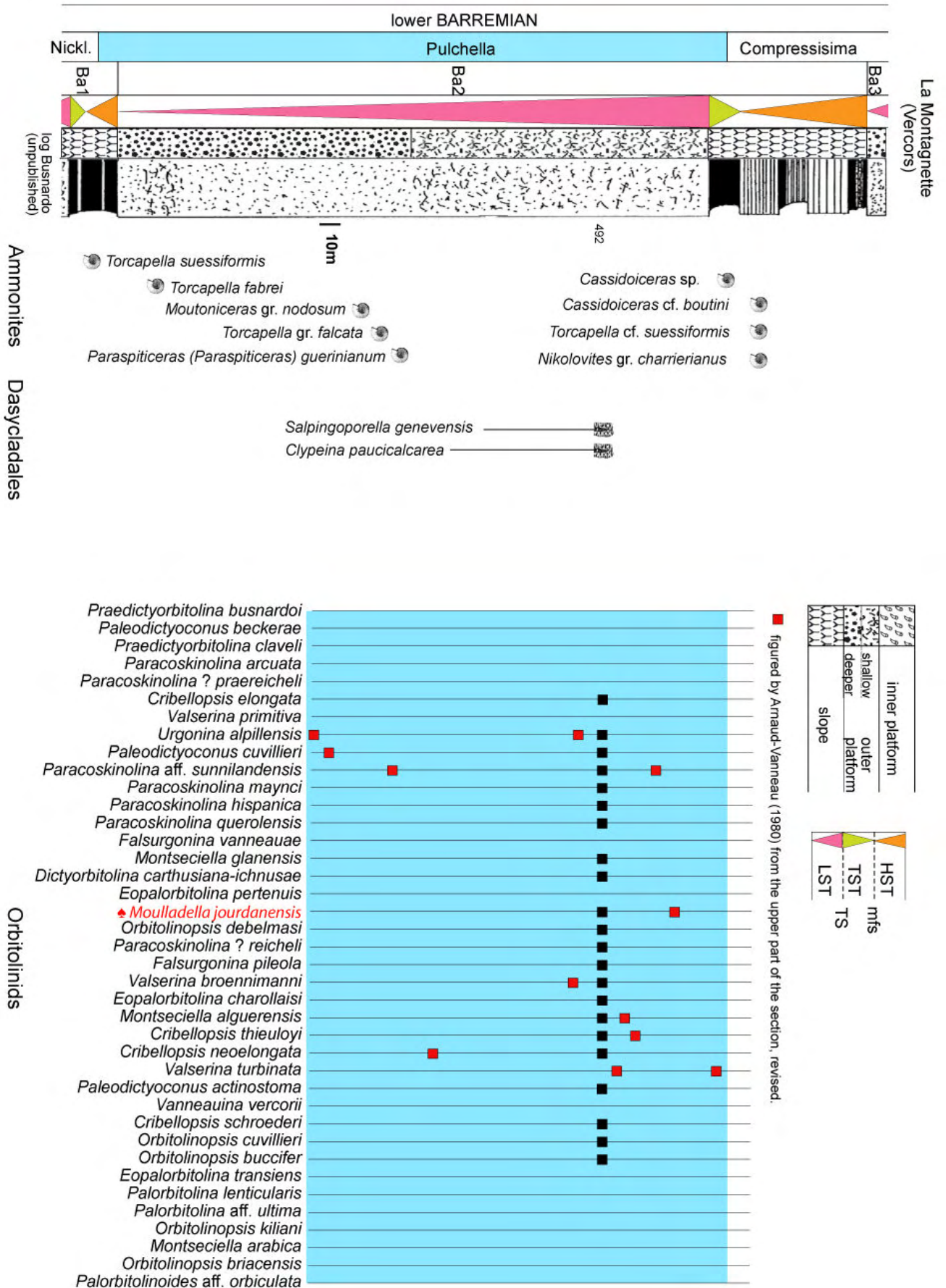


Figure 2.10: La Montagnette section.



base and at the top of the Sarasini Zone (CLAVEL *et al.*, 1995, 2007, 2014). Although the final sequence of the "Serre de Tourre" section is not formally identified by ammonites, it is marked by the first occurrence of *Heteraster oblongus*, less than 20 m above the last *Heteraster couloni*. Hence the orbitolinids from this interval are assigned to the Sarasini Zone.

Species identified in the discrete ammonite biozones are the following:

Pulchella Zone (Ba2 LST, samples no. 262.2 and 7400):

- ♠ *Moulladella jourdanensis* (Pls. 54, 57), and the orbitolinids:
- cf. *Eopalorbitolina transiens* (CHERCHI & SCHROEDER, 1999) (Pls. 55 - 56), first appearance in the area,
- *Cribellopsis elongata* (Pl. 58),
- *Cribellopsis neoelongata* (Pl. 57),
- *Cribellopsis schroederi* (Pl. 55),
- *Falsurgonina pileola* (Pl. 54),
- *Falsurgonina vanneauae* (Pl. 58),
- *Montseciella glanensis* (Pl. 54),
- Orbitolinidae gen. et sp. indet. (Pl. 56),
- *Orbitolinopsis buccifer* (Pl. 56),
- *Orbitolinopsis debelmasi* (Pls. 56, 58),
- *Paleodictyoconus actinostoma* (Pls. 55, 58),
- *Paleodictyoconus cuvillieri* (Pl. 58),
- *Paracoskinolina hispanica* (Pl. 54),
- *Paracoskinolina maynci* (Pls. 54, 57),
- *Paracoskinolina ? praereicheli* (Pl. 57),
- *Paracoskinolina querolensis* (Pl. 54),
- *Paracoskinolina ? reicheli* (Pl. 57),
- *Paracoskinolina aff. sunnilandensis* (Pl. 54),
- *Urgonina alpillensis* (Pl. 56),
- *Valserina gr. broennimanni-turbinata* (Pl. 57);

Compressissima Zone (Ba2 TST-HST, samples no. 217 and 263):

- *Cribellopsis neoelongata* (Pl. 61),
- *Cribellopsis schroederi* (Pl. 61),
- *Cribellopsis thieuloyi* (Pl. 61),
- *Montseciella glanensis* (Pl. 61),
- *Orbitolinopsis debelmasi* (Pls. 60 - 61),
- *Paleodictyoconus actinostoma* (Pls. 59 - 60),
- *Paleodictyoconus cuvillieri* (Pl. 59),
- *Paracoskinolina maynci* (Pl. 61),
- *Paracoskinolina ? praereicheli* (Pl. 60),
- *Paracoskinolina ? reicheli* (Pl. 60),
- *Paracoskinolina aff. sunnilandensis* (Pl. 60),
- *Urgonina alpillensis* (Pl. 61);

Moutonianum Zone (Ba3 TST, sample no. 219):

- ♠ *Moulladella jourdanensis* (Pl. 62, fig. A), and the orbitolinids:
- *Orbitolinopsis buccifer* (Pl. 62, fig. A),
- *Paleodictyoconus actinostoma* (Pl. 62, fig. A),
- *Paleodictyoconus cuvillieri* (Pl. 62, fig. A);

Vandenheckei Zone (Ba3 HST, samples no. 7401 and 7402):

- ♠ *Moulladella jourdanensis* (Pl. 65), and the orbitolinids:
- *Cribellopsis neoelongata* (Pl. 63),
- *Montseciella cf. alguerensis* (Pl. 64),

- *Montseciella glanensis* (Pls. 63 - 64),
- *Orbitolinopsis debelmasi* (Pls. 63 - 64),
- *Paleodictyoconus actinostoma* (Pl. 64),
- *Paracoskinolina maynci* (Pl. 65),
- *Paracoskinolina querolensis* (Pl. 64),
- *Paracoskinolina ? reicheli* (Pl. 65),
- *Paracoskinolina aff. sunnilandensis* (Pl. 65),
- *Urgonina alpillensis* (Pl. 63);

Giraudi and Sarasini zones (Ba4 HST, samples no. 336, 339, 340, and 348):

- *Cribellopsis neoelongata* (Pl. 69),
- *Cribellopsis schroederi* (Pls. 70 - 71),
- *Eopalorbitolina transiens* (Pl. 66),
- *Falsurgonina pileola* (Pl. 67),
- *Montseciella alguerensis* (Pl. 67),
- *Orbitolinopsis briacensis* (Pl. 69),
- *Orbitolinopsis buccifer* (Pls. 68 - 69),
- *Orbitolinopsis cuvillieri* (Pl. 69),
- *Paleodictyoconus actinostoma* (Pl. 72),
- *Paleodictyoconus cuvillieri* (Pls. 70, 72),
- *Palorbitolina lenticularis* (BLUMENBACH, 1805) (Pl. 66),
- *Palorbitolina ultima* CHERCHI & SCHROEDER in SCHROEDER *et al.*, 2010 (Pl. 66),
- *Paracoskinolina maynci* (Pl. 67),
- *Paracoskinolina ? reicheli* (Pl. 67),
- *Paracoskinolina aff. sunnilandensis* (Pl. 67).

Out of the 34 species (♠ *Moulladella jourdanensis* included) identified until now in Barremian sections, 21 are already present in the lower Barremian of this section.

12. La Béguère (26 Drôme, Vercors)

(Fig. 2.12)

Barremian (Ba3):

Moutonianum and Vandenheckei zones

(Pls. 73 - 82)

The "La Béguère" section [beginning at UTM 31 (WGS84) X: 691730.561, Y: 4970541.010; GPS: 44°51'45.0"N 5°25'36.7"E ending at UTM 31 (WGS84) X: 692631.917, Y: 4970500.379; GPS: 44°51'42.8"N 5°26'17.7"E] is located at the upper part of the first bioclastic levels marking in the southern Vercors the progradation of the Urgonian platform towards the Vocontian trough.

At its uppermost part two marly levels decametric in thickness, called "Marnes de Font Froide" and "Marnes de la Béguère" by ARNAUD (1981 *et seq.*), yield numerous Palorbitolinas as well as a sea urchin characteristic of the circalittoral domain, *i.e.*, *Toxaster seynensis*. Marls are separated by argillaceous limestones at the top of which VIRLOUVET (1997: Pl. 4, "photographie A", UJF-ID 10574; herein Pl. 73, fig. A-A') reported a "*Camereiceras limentinus* (juv.)". ARNAUD *et al.* (1998: Pl. 4, fig. 3) refer it to "? *Camereiceras* sp." whereas CLAVEL *et al.* (2014: p. 29) reassign it to "*Toxancyloceras gr. vandenheckei*" (ASTIER, 1851) -RB-, *i.e.*, to the ammonite species marker of the eponymous zone {or ? *Camereiceras limentinus* -DB-}. The first rudists appear in the last visible meters of the section, above the "Marnes de la Béguère".

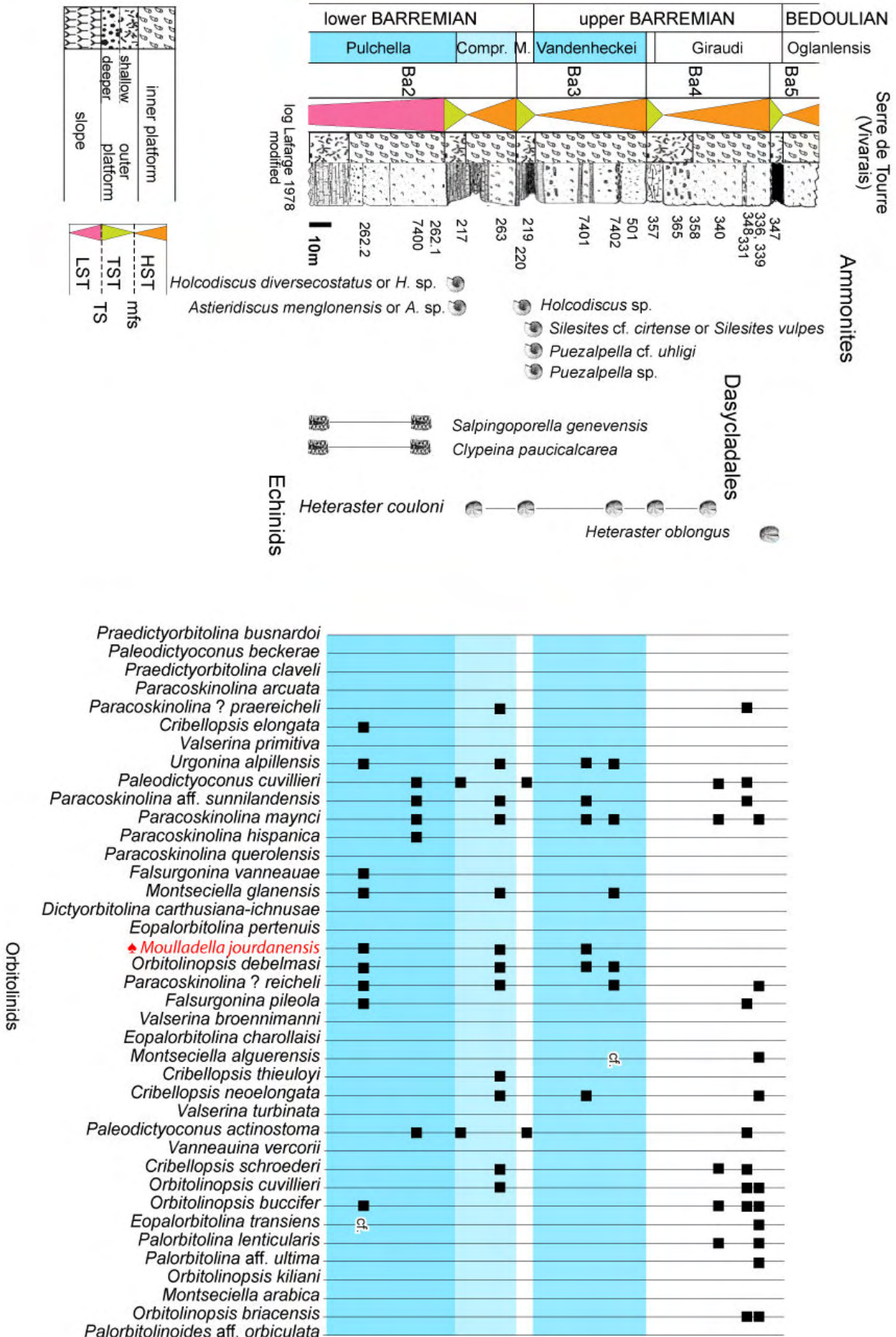


Figure 2.11: Serre de Tourre section.



The orbitolinids identified in the ammonite biozones are the following:

Moutonianum Zone (Ba3 LST, samples no. 398, 464, and 465; Ba3 TST, sample no. 395):

- *Cribellopsis elongata* (Pl. 78),
- *Cribellopsis neolongata* (Pl. 78),
- *Cribellopsis schroederi* (Pl. 78),
- *Cribellopsis thieuloyi* (Pl. 78),
- *Eopalorbitolina transiens* (Pl. 73, fig. B),
- *Falsurgonina pileola* (Pl. 79),
- *Falsurgonina vanneauae* (Pl. 79),
- *Montseciella glanensis* (Pl. 79),
- *Orbitolinopsis briacensis* (Pl. 77),
- *Orbitolinopsis buccifer* (Pl. 76),
- *Orbitolinopsis cuvillieri* (Pl. 77),
- *Orbitolinopsis kiliani* (Pl. 77),
- *Paleodictyoconus actinostoma* (Pl. 80),
- *Paleodictyoconus cuvillieri* (Pl. 80),
- ? *Paracoskinolina arcuata* (ARNAUD-VANNEAU, 1976) (Pl. 75),
- *Paracoskinolina hispanica* (Pl. 75),
- *Paracoskinolina maynci* (Pl. 75),
- *Paracoskinolina ? praereicheli* (Pl. 74),
- *Paracoskinolina querolensis* (Pl. 75),
- *Paracoskinolina ? reicheli* (Pl. 74),
- *Paracoskinolina aff. sunnilandensis* (Pl. 75).

Vandenheckei Zone (Ba3 HST, samples no. 243 and 394):

- *Cribellopsis neolongata* (Pl. 82),
- *Eopalorbitolina transiens* (Pl. 82),
- *Paleodictyoconus cuvillieri* (Pl. 82),
- *Palorbitolina gr. lenticularis* (Pl. 81),
- *Palorbitolina ultima* (Pl. 81),
- *Paracoskinolina maynci* (Pl. 82),
- *Paracoskinolina aff. sunnilandensis* (Pl. 82).

13. Rochecolombe (09 Ardèche, Vivarais)

(Fig. 2.13)

upper Barremian (Ba4 LST): Vandenheckei Zone

(Pls. 83 - 87)

The Rochecolombe section [beginning at UTM 31 (WGS84) X: 615028.010, Y: 4931900.036; GPS: 44°31'52.5"N 4°26'51.7"E ending at UTM 31 (WGS84) X: 614787.911, Y: 4931734.317; GPS: 44°31'47.3"N 4°26'40.1"E] is located at the northern edge of the "Plateau de Saint-Remèze" (ELMI *et al.*, 1996) and more precisely in the "Serre Palas". It corresponds to the southwestward progradation of the bioclastic facies over the hemipelagic domain of the "faisceau de l'Ibie" (ELMI *et al.*, 1996: p. 87).

This section spans the top of the hemipelagic marl-limestone alternations and the bottom of coarse calcarenitic intervals cropping out locally in the area. Numerous ammonites, *e.g.*, *Holcodiscus fallax* (MATHERON, 1880) (Pl. 84, fig. B, FSL 141538) and *Nicklesia* sp. -RB- {or *Kotetishvilia compressissima* -DB-} (Pl. 84, fig. A, FSL 141546) - Compressissima Zone -, *Moutoniceras*

moutonianum - Moutonianum Zone -, and *Toxancyloceras vandenheckei* -RB- {or *Gassendiceras quelquejeui* BERT *et al.*, 2006 (Pl. 83, fig. A, FSL 89187) and ? *Pseudoshasticrioceras* sp. (Pl. 83, fig. B, FSL 47195) -DB-} - Vandenheckei Zone -, were collected from this section.

Orbitolinids identified in the rock samples no. 361 and 362 are the following:

- *Cribellopsis neolongata* (Pl. 85),
- *Cribellopsis schroederi* (Pl. 85),
- *Montseciella glanensis* (Pl. 85),
- *Orbitolinopsis buccifer* (Pls. 85 - 86),
- *Paleodictyoconus actinostoma* (Pl. 87),
- *Paleodictyoconus cuvillieri* (Pl. 87),
- *Paracoskinolina maynci* (Pl. 84, fig. C),
- *Paracoskinolina ? praereicheli* (Pl. 85),
- *Paracoskinolina querolensis* (Pl. 84, fig. C),
- *Paracoskinolina aff. sunnilandensis* (Pl. 84, fig. C),
- *Urgonina alpillensis* (Pl. 84, fig. C).

14. Mas Thibaud

(84 Vaucluse, Montagne de Bluye)

(Fig. 2.14)

upper Barremian (Ba4 LST): Vandenheckei Zone

(Pls. 88 - 89)

Initially studied by FOURY (1972), the "Mas Thibaud" section [beginning at UTM 31 (WGS84) X: 685828.906, Y: 4896160.496; GPS 44°11'42.0"N 5°19'28.3"E ending at UTM 31 (WGS84) X: 685364.129, Y: 4896360.906; GPS: 44°11'48.9"N 5°19'10.9"E] is located in the hemipelagic domain N of "Mont Ventoux". Its lower part was partly logged along RD 40, W of Brantes. It consists of Vocontian-type limestone-marl alternations with slumps and thin bioclastic flows, overlain by an orbitolinid grainstone layer, followed by cherty mud-/wacke-stones with sponge spicules upward into the Bedoulian (lower Aptian). The Moutonianum Zone is characterized here by the occurrence of *Moutoniceras nodosum* (Pl. 88, fig. A, FSL 88791), *Holcodiscus fallax* (Pl. 88, fig. C, FSL 88972), and *Nikolovites gr. charrierianus* (Pl. 88, fig. B, FSL 88794).

We only consider here the orbitolinids from sample no. 7335 that was collected in bioclastic flows within the marls with *Heinzia sayni* HYATT, 1903, an ammonite characteristic of the Vandenheckei Zone:

- *Cribellopsis neolongata* (Pl. 89),
- *Cribellopsis schroederi* (Pl. 89),
- *Montseciella glanensis* (Pl. 89),
- *Orbitolinopsis buccifer* (Pl. 88, fig. D),
- *Orbitolinopsis cuvillieri* (Pl. 88, fig. D),
- *Paleodictyoconus cuvillieri* (Pl. 89),
- *Palorbitolina lenticularis* (Pl. 89),
- *Paracoskinolina maynci* (Pl. 89),
- *Vanneauina vercorii* (Pl. 89).

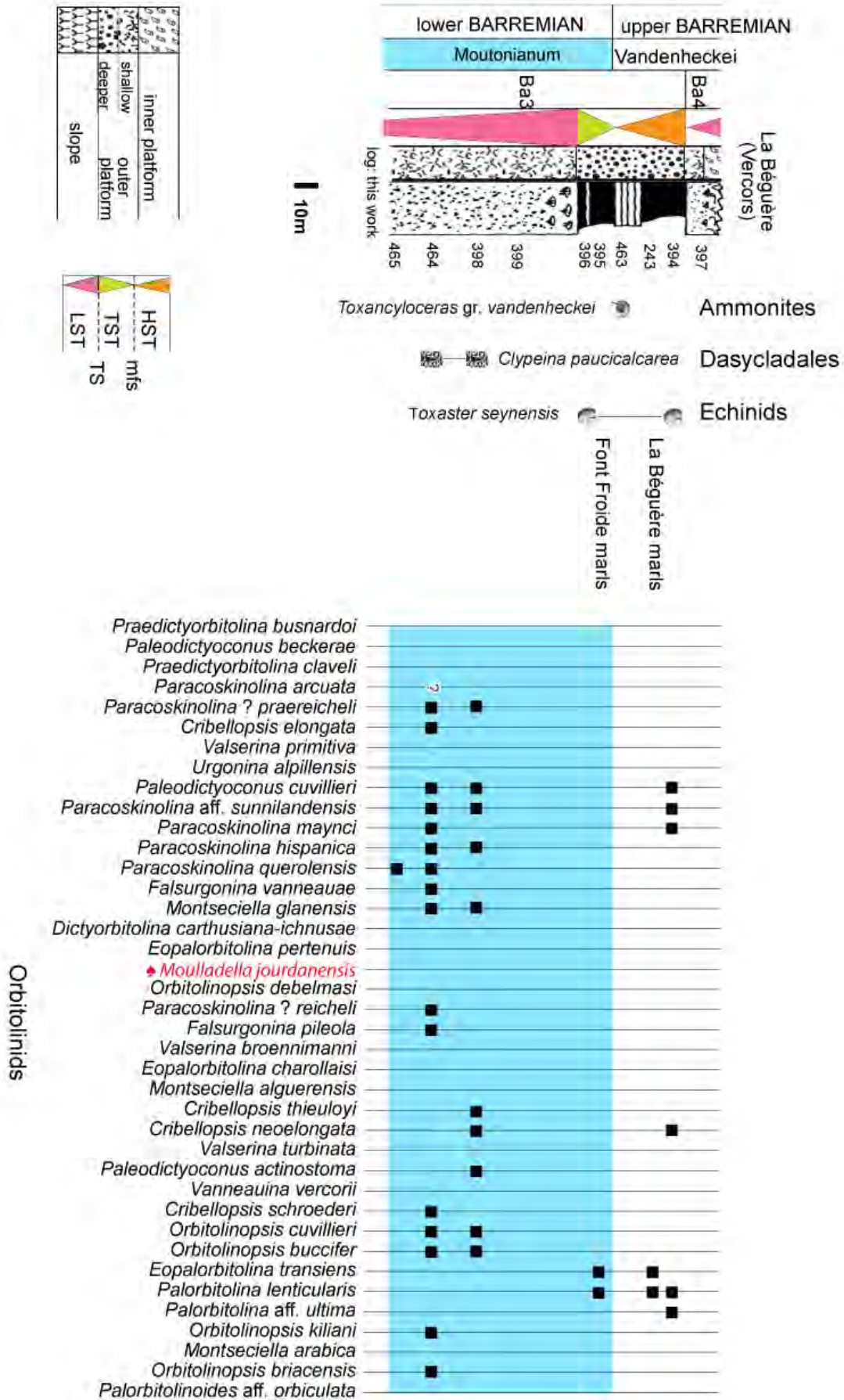


Figure 2.12: La Bégère section.

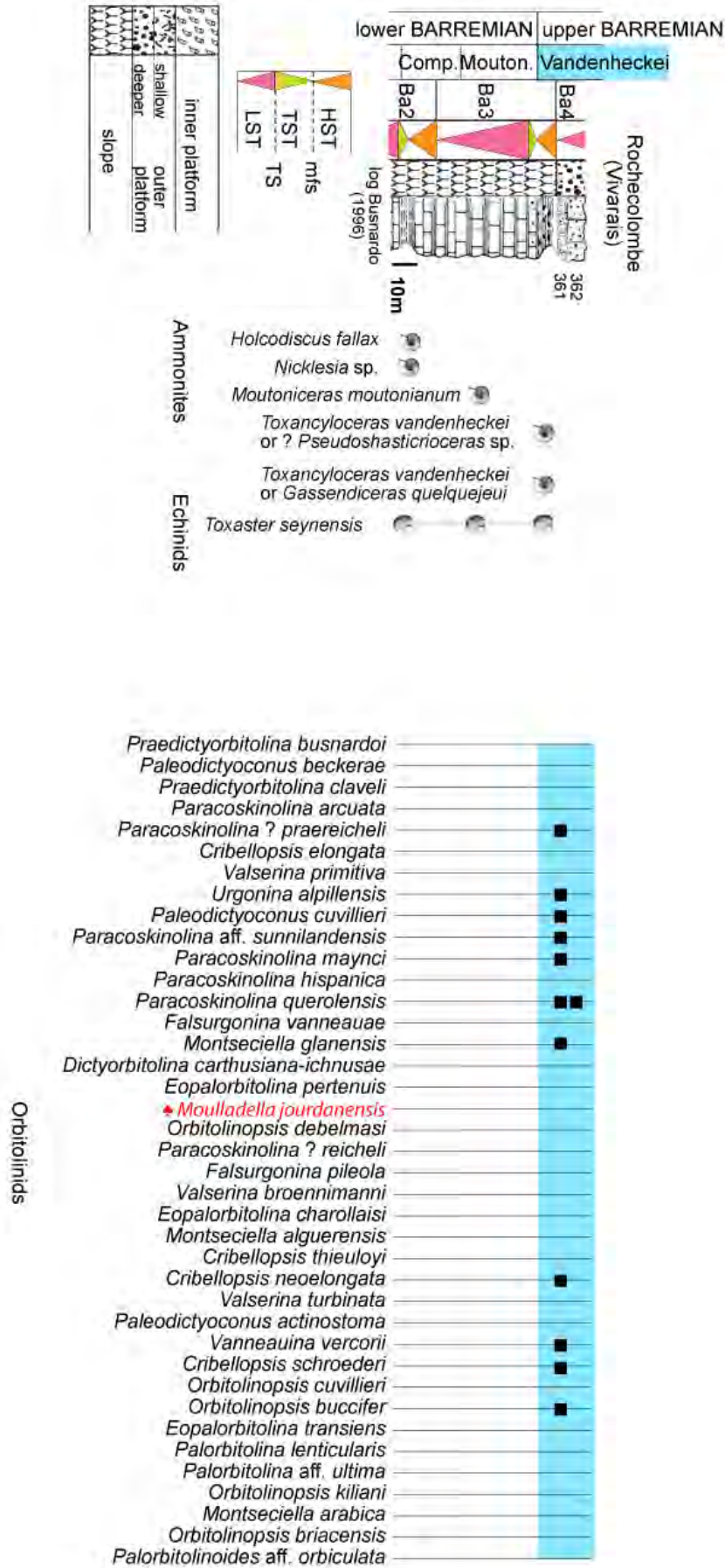


Figure 2.13: Rochecolombe section.

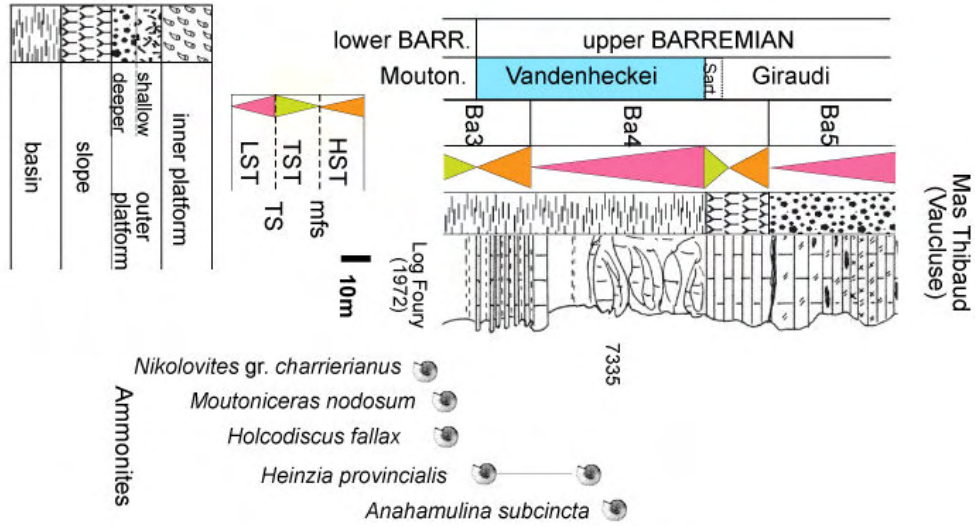


Figure 2.14: Mas Thibaud section.

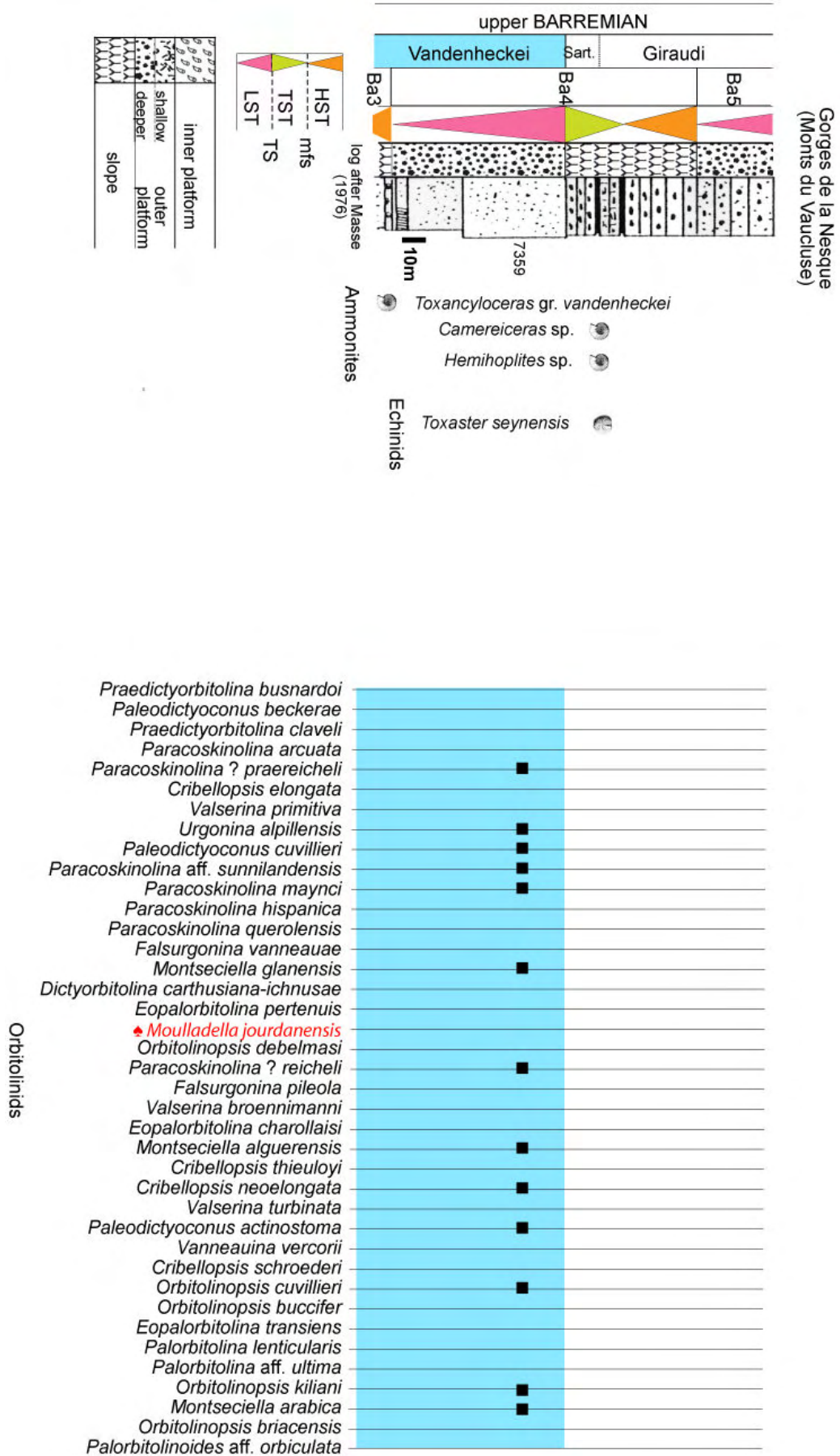


Figure 2.15: Gorges de la Nesque section.



**15. Gorges de la Nesque
(84 Vaucluse, Monts du Vaucluse)**

(Fig. 2.15)

**upper Barremian (Ba4 LST):
Vandenheckei Zone**

(Pls. 90 - 93)

The Gorges de la Nesque section [beginning at UTM 31 (WGS84) X: 684764.332, Y: 4882018.225; GPS: 44°04'05.0"N 5°18'25.8"E ending at UTM 31 (WGS84) X: 684954.533, Y: 4881859.029; GPS: 44°03'59.6"N 5°18'34.1"E] was measured along RD 942, upstream of the "maison cantonnière". It marks a SW-NE progradation of the Urgonian platform towards the Vocontian trough, depositing external platform facies in an hemipelagic domain in the early late Barremian times.

The sampled level no. 3759 corresponds to the "biocalcarénites des Caranques" (level 4 of the section published by MASSE, 1976), overlain by argillaceous limestones and marls where several *Hemihoplites* sp. and many *Toxaster seynensis* were collected. The *Camereiceras* aff. *limentinus* (THIEULOUY, 1979) -RB- {or ? *Hemihoplites feraudianus* -DB-} collected at Rocher du Cire (LÉONIDE *et al.*, 2012: Fig. 6.G; herein Pl. 90, fig. A-A') indicates the bottom of the Sartousiana Zone -RB- {or ? the top of the Sartousiana Zone -DB-}.

The orbitolinids identified from this sampling are the following:

- *Cribellopsis neolongata* (Pl. 91),
- *Montseciella algerensis* (Pl. 91),
- *Montseciella arabica* (Pl. 93),
- *Montseciella glanensis* (Pl. 90, fig. B; Pl. 91),
- *Orbitolinopsis cuvillieri* (Pl. 90, fig. B),
- *Orbitolinopsis kiliani* (Pl. 90, fig. B),
- *Paleodictyoconus actinostoma* (Pl. 93),
- *Paleodictyoconus cuvillieri* (Pl. 93),
- *Paracoskinolina maynci* (Pl. 91),
- *Paracoskinolina ? praereicheli* (Pl. 92),
- *Paracoskinolina ? reicheli* (Pl. 92),
- *Paracoskinolina* aff. *sunnilandensis* (Pl. 91),
- *Urgonina alpillensis* (Pl. 91).

16. Col de Rousset (26 Drôme, Vercors)

(Fig. 2.16)

**upper Barremian (Ba4 LST):
Vandenheckei Zone**

(Pls. 94 - 103)

The "Col de Rousset" section, of which only the lower part [beginning at UTM 31 (WGS84) X: 689739.581, Y: 4967466.041; GPS: 44°50'07.3"N 5°24'01.9"E ending at UTM 31 (WGS84) X: 689859.947, Y: 4967528.812; GPS: 44°50'09.3"N 5°24'07.5"E] is studied here, illustrates the ultimate observable step of the Urgonian platform progradation from the Vercors region towards the Vocontian trough.

Above the hemipelagic lower Hauterivian-Barremian strata, the "Urgonian" carbonate platform is represented by two bioclastic units separated by a very thick (~60 m) hemipelagic interval consisting of argillaceous limestones and marls. This

unit yields ammonites characteristic of the Sartousiana Zone (ARNAUD *et al.*, 1998): *Camereiceras limentinus* (Pl. 94, fig. A1, UJF-ID 10580 - A2, UJF-ID 10579 - A.3, UJF-ID 10549, not ID 10289 as stated in the caption of Pl. 5, fig. 8 in ARNAUD *et al.*, 1998), *C. sp.* -RB- {or *Hemihoplites feraudianus* -DB-} (Pl. 94, fig. A4-A4', FSL 108225), *Gerhardtia sartousiana*, *Hemihoplites cf. heberti* {*nomen dubium* -DB-}, *H. cf. feraudianus*, *H. cf. soulieri* {*H. soulieri* is a junior synonym of *H. feraudianus* -DB-}, *etc.*, as well as some cirralittoral echinids (*Toxaster seynensis*).

This section was already described by ARNAUD (1981); it was illustrated again by ARNAUD *et al.* (1998: Fig. 13) and dated as late Barremian (including both the "lower" Feraudianus and the "upper" Sartousiana subzones of the Sartousiana Zone). The uppermost marly level of the thick calcareo-argillaceous series above the first bioclastic deposits was correlated by these authors to the type-level of the "Marnes de La Béguère", the type-locality of which is some 4 km north-eastward. This correlation is erroneous because, in the eponymous section, the marls lie on strata that provided an ammonite pointing to the lower part of the Alpinum Subzone of the Vandenheckei Zone (cf. § 12. La Béguère, Pl. 73, fig. A-A'). The assemblage of orbitolinids at "Col de Rousset" (Ba4 LST) are also different from that at "La Béguère" (Ba3 HST).

Orbitolinids identified in samples no. 462, 7864, and 7865 are the following:

- *Cribellopsis neolongata* (Pl. 102),
- *Cribellopsis schroederi* (Pl. 102),
- *Falsurgonina pileola* (Pl. 94),
- *Falsurgonina vanneauae* (Pl. 94),
- *Montseciella algerensis* (Pl. 101),
- *Montseciella glanensis* (Pls. ? 95, 101),
- *Orbitolinopsis briacensis* (Pl. 100),
- *Orbitolinopsis buccifer* (Pls. 97 - 98, 100),
- *Orbitolinopsis cuvillieri* (Pl. 99),
- *Orbitolinopsis kiliani* (Pl. 100),
- *Paleodictyoconus actinostoma* (Pl. 103),
- *Paleodictyoconus cuvillieri* (Pl. 103),
- *Paracoskinolina maynci* (Pl. 96),
- *Paracoskinolina ? praereicheli* (Pl. 95),
- *Paracoskinolina querolensis* (Pl. 96),
- *Paracoskinolina ? reicheli* (Pl. 95),
- *Paracoskinolina* aff. *sunnilandensis* (Pl. 96),
- *Urgonina alpillensis* (Pl. 102).

17. La Charce (26 Drôme, Baronnies)

(Fig. 2.17)

**upper Barremian (Ba4):
Vandenheckei, Sartousiana,
and Giraudi zones**

(Pls. 104 - 109)

The "La Charce" section [beginning at UTM 31 (WGS84) X: 695113.430, Y: 4927406.766; GPS: 44°28'25.1"N 5°27'11.5"E ending at UTM 31 (WGS84) X: 695211.232, Y: 4927562.911; GPS: 44°28'30.0"N 5°27'16.2"E] is located in the western border of the Vocontian trough. It

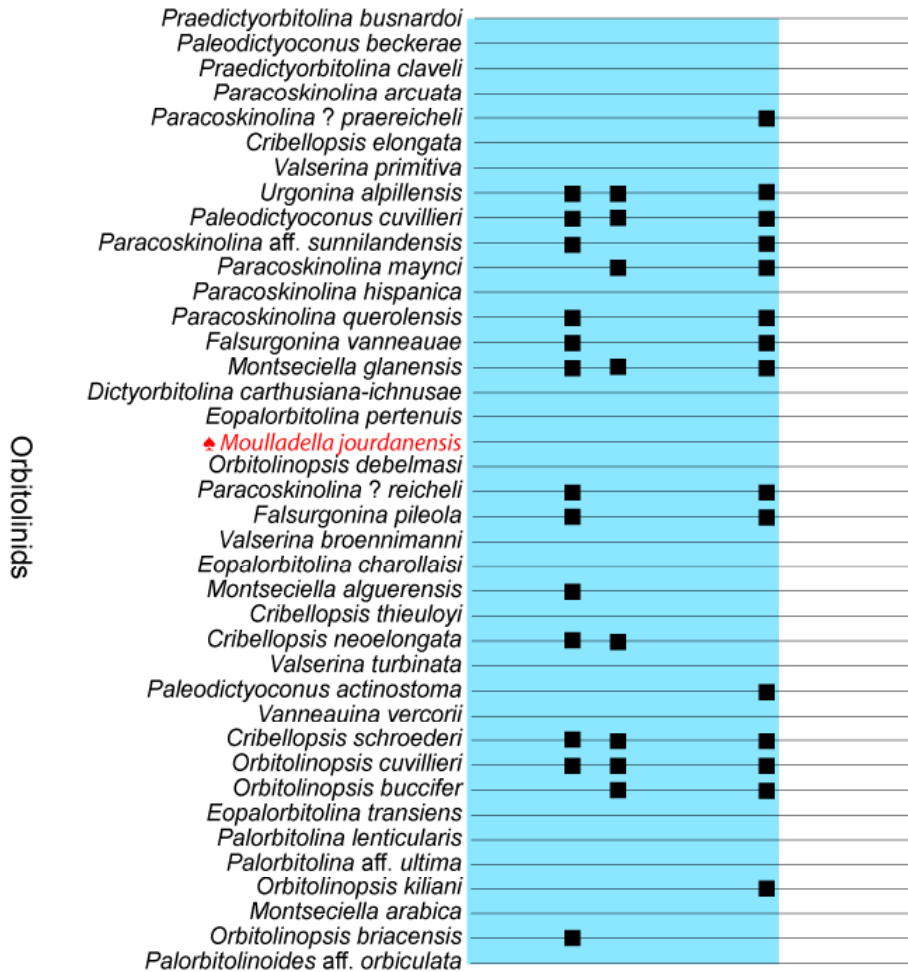
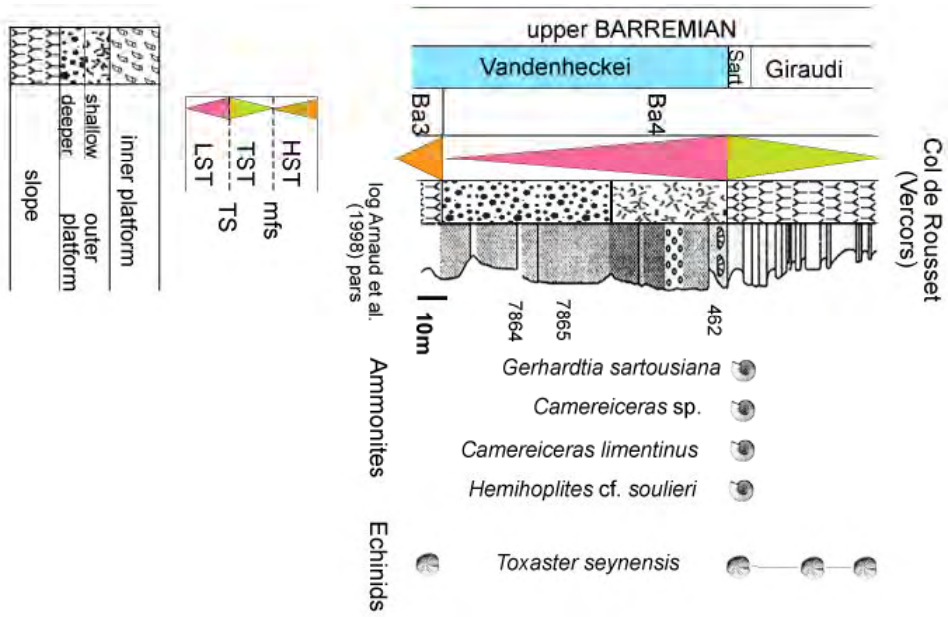


Figure 2.16: Col de Rousset section.

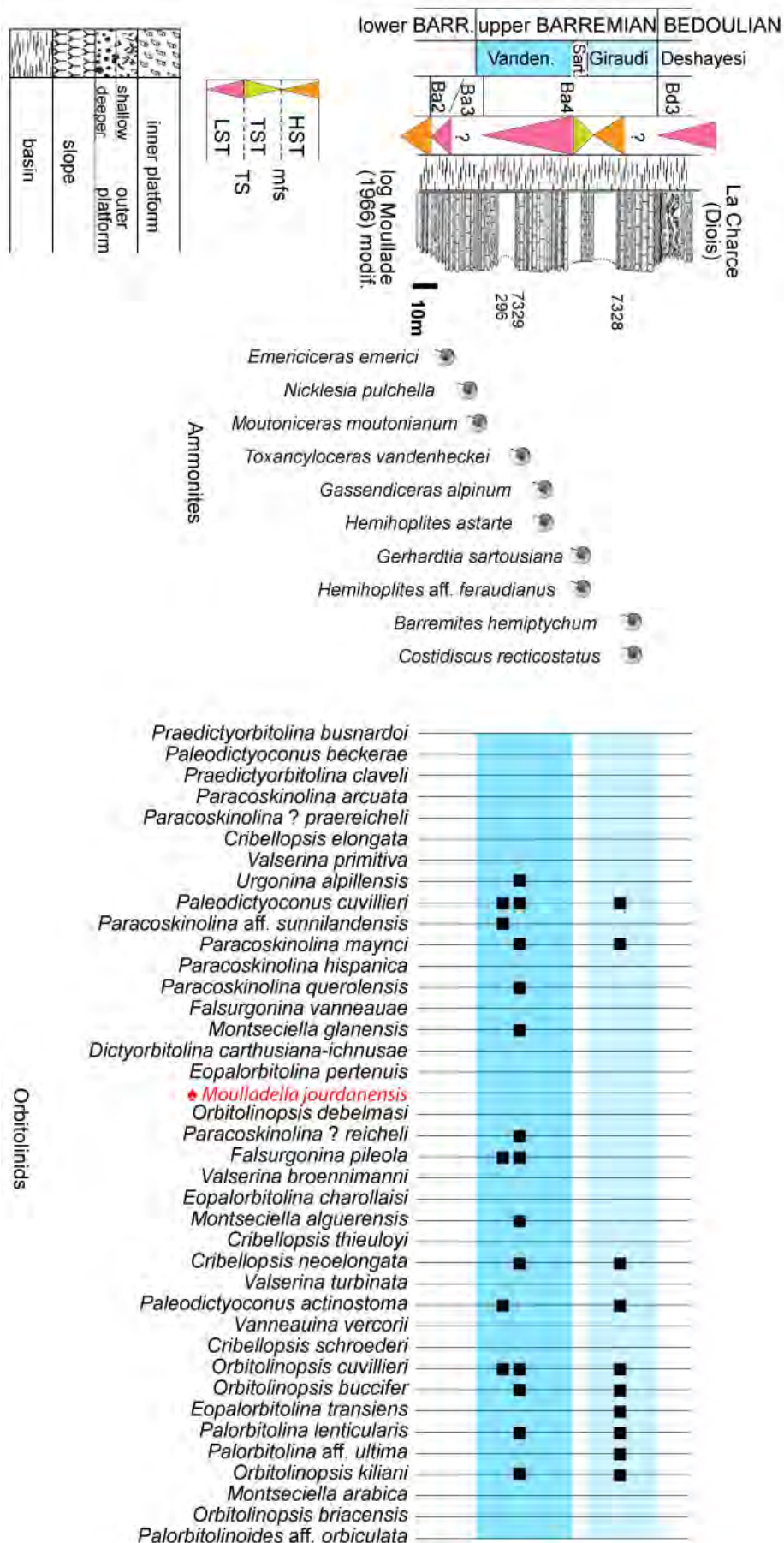


Figure 2.17: La Charce section.



displays several bioclastic debris flows (and slumps) intercalated in the condensed and disturbed interval with the rather rich ammonite contents of the logged section (MOULLADE, 1966; FERRY, 1976).

Whereas faunas of lower Barremian do not allow a precise biozonation, those of the upper Barremian clearly identify the Vandennecke (*Toxancyloceras vandenheckei*, *Gassendiceras alpinum*, *Hemihoplites astarte*, with samples no. 296 and 7329), Sartousiana (*Gerhardtia sartousiana*, *Hemihoplites* aff. *feraudianus*) and Giraudi (sample no. 7328) zones.

This section supplements the inventory of orbitolinids collected in the neighbouring "L'Estelton" section (GRANIER *et al.*, 2013, 2014, 2017) for the upper Barremian strata.

The lists of orbitolinids identified in the different biozones are as follows:

Vandennecke Zone:

- *Cribellopsis neoelongata* (Pl. 106),
- *Cribellopsis schroederi* (Pl. 106),
- *Falsurgonina pileola* (Pl. 106),
- *Montseciella algerensis* (Pl. 105),
- *Montseciella glanensis* (Pl. 105),
- *Orbitolinopsis buccifer* (Pl. 107),
- *Orbitolinopsis cuvillieri* (Pl. 106),
- *Orbitolinopsis kiliani* (Pl. 107),
- *Paleodictyoconus actinostoma* (Pl. 107),
- *Paleodictyoconus cuvillieri* (Pl. 107),
- *Palorbitolina lenticularis* (Pl. 105),
- *Paracoskinolina maynci* (Pl. 106),
- *Paracoskinolina querolensis* (Pl. 107),
- *Paracoskinolina ? reicheli* (Pl. 106),
- *Paracoskinolina* aff. *sunnilandensis* (Pl. 106),
- *Urgonina alpiliensis* (Pl. 106).

Giraudi Zone:

- *Cribellopsis neoelongata* (Pl. 109),
- *Eopalorbitolina transiens* (Pls. 108 - 109),
- *Orbitolinopsis buccifer* (Pl. 108),
- *Orbitolinopsis cuvillieri* (Pl. 108),
- *Orbitolinopsis kiliani* (Pl. 108),
- *Paleodictyoconus actinostoma* (Pl. 109),
- *Paleodictyoconus cuvillieri* (Pl. 109),
- *Palorbitolina lenticularis* (Pl. 108),
- *Palorbitolina ultima* (Pl. 108),
- *Paracoskinolina maynci* (Pl. 108).

18. Pont d'Arc (07 Ardèche, Vivarais)

(Fig. 2.18)

upper Barremian (Ba4 LST - Ba5 TST):

Giraudi/Sarasini zones

(Pls. 110 - 119)

The "Pont d'Arc" section [beginning at UTM 31 (WGS84) X: 612221.750, Y: 4915395.368; GPS: 44°22'59.4"N 4°24'31.8"E ending at UTM 31 (WGS84) X: 612234.055, Y: 4915862.653; GPS: 44°23'14.5"N 4°24'32.7"E] constitutes the upper part of the "Gorges de l'Ardèche" cliff (westward of the Tiourre valley, westward of the "Plateau de Saint-Remèze"). A description of its lowermost part - the Chames section - was already published by CLAVEL *et al.* (2010: § 8. Chames, Fig. 2.8).

The equivalent of the "vire" of the "Serre de Tourre", *i.e.*, v3 on the geological map of Bourg-Saint-Andéol (PASCAL *et al.*, 1989), is found at the top of cliff, in line with the Cirque d'Estre and the famous Chauvet Cave. However, it is hardly visible nowadays due to the development of the vegetation cover on the "Plaine des Gras" that was a long time ago deserted by the flocks of sheep and goats whose grazing kept the rocks exposed. Only its most external upper part, very rich in *Heteraster couloni*, remains visible at the tennis courts of the Blachas campsite (Salavas), on the opposite side of the Ardèche river [at UTM 31 (WGS84) X: 611981.150, Y: 4915547.060; GPS: 44°23'04.4"N 4°24'21.0"E]. Although the dolomitized level observed in the "Serre de Tourre" (cf. § 11. Serre de Tourre) is still present at the base of the rudist limestones in the "Cirque d'Estre", some visibility gaps along departmental road D290 do not allow us to precisely correlate both sections.

Nonetheless, as in the very close "Serre de Tourre" section, the Ba4 sequence of the "Pont d'Arc" section is marked by the increasing rarity and then disappearance of *H. couloni*, which is replaced by *Heteraster oblongus* starting from the thin marly beds preceding the "Grotte des Huguenot". This level also provided a fragment of ammonite that one of us (R.B.) ascribed to a *Pseudocrioceras* sp. (Pl. 110, fig. B), typical of the upper part of the Sarasini Zone (uppermost Barremian).

Orbitolinids identified in the Giraudi/Sarasini zones comprise the following species:

- *Cribellopsis neoelongata* (Pls. 112, 115),
- *Cribellopsis schroederi* (Pl. 115),
- *Falsurgonina pileola* (Pl. 112),
- *Montseciella algerensis* (Pl. 112),
- *Montseciella arabica* (Pl. 113),
- *Orbitolinopsis briacensis* (Pl. 117),
- *Orbitolinopsis buccifer* (Pl. 110, fig. A; Pl. 116),
- *Orbitolinopsis cuvillieri* (Pl. 110, fig. A; Pl. 116),
- *Orbitolinopsis kiliani* (Pl. 117),
- *Paleodictyoconus actinostoma* (Pls. 113, 118),
- *Paleodictyoconus cuvillieri* (Pls. 113, 118),
- *Palorbitolina lenticularis* (Pls. 114 - 115),
- *Paracoskinolina maynci* (Pls. 112, 115),
- *Paracoskinolina ? praereicheli* (Pl. 110, fig. A),
- *Paracoskinolina ? reicheli* (Pl. 111),
- *Paracoskinolina* aff. *sunnilandensis* (Pls. 112, 115),
- *Vanneauina vercorii* (Pl. 119).

19. Orgnac (07 Ardèche, Vivarais)

(Fig. 2.19)

Barremian: Sarasini Zone

(Pls. 120 - 125)

The Orgnac section [sited at UTM 31 (WGS84) X: 613252.000, Y: 4908211.990; GPS: 44°19'6.028"N 4°25'12.675"E] is located westward of the "Combe de Sarran". It comprises a marly interval occurring within Urgonian limestones with rudists, *i.e.*, v4 on the geological map of Bourg-Saint-Andéol (PASCAL *et al.*, 1989), that crops out

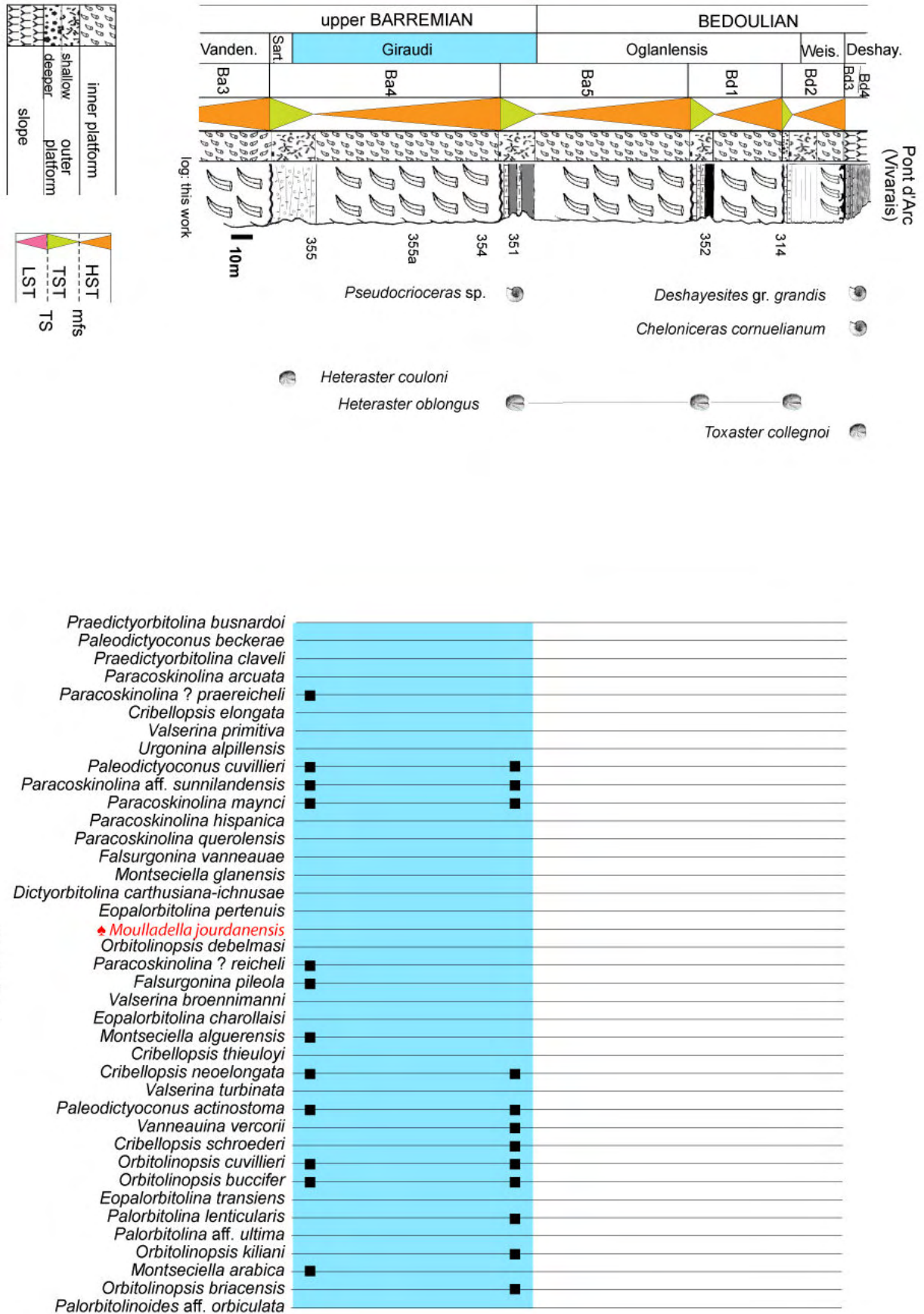


Figure 2.18: Pont d'Arc section.

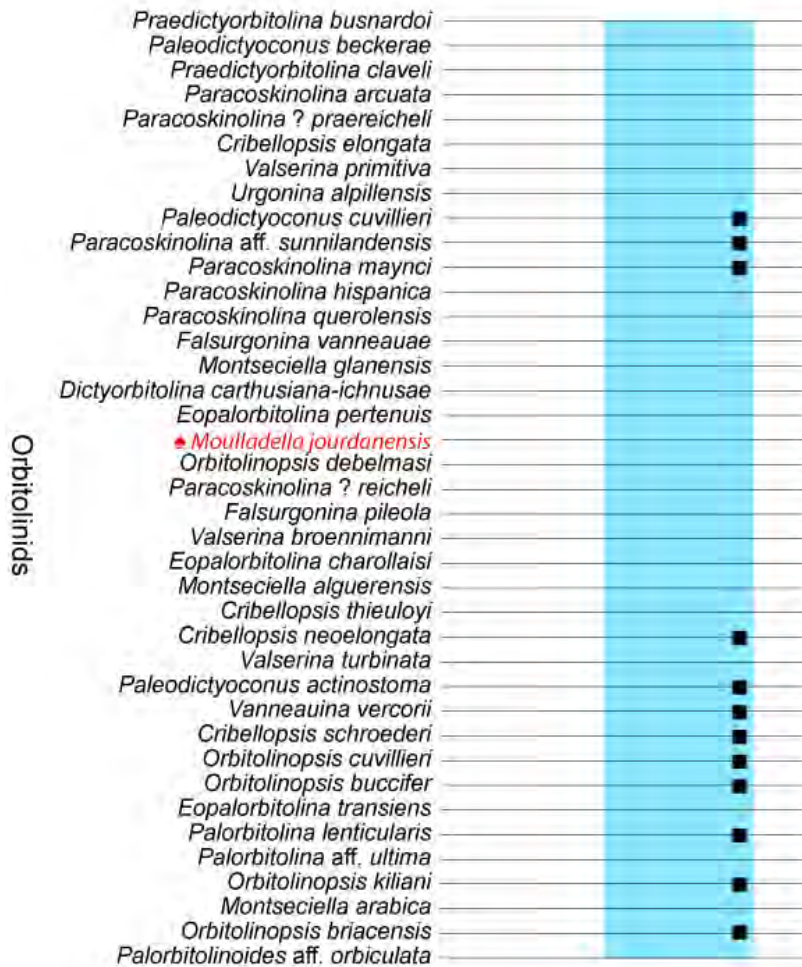
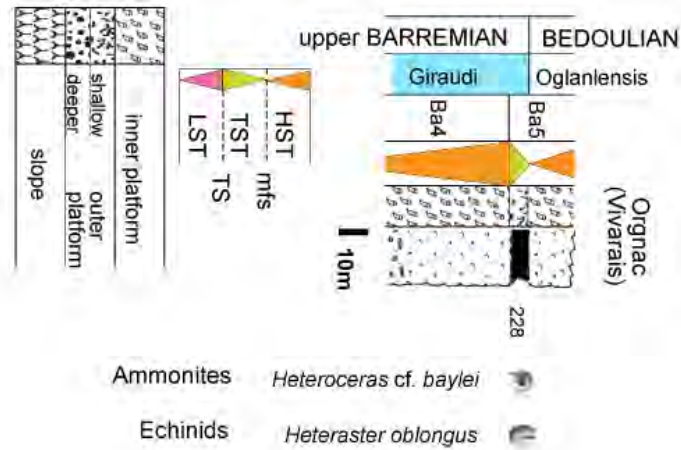


Figure 2.19: Orgnac section.



along an agricultural road connecting RD 317 (to the SW) and RD 217 (to the NE). Besides the numerous rudists unearthed on the structural surface, this level also provided a fragment of ammonite ascribed to *Heteroceras* cf. *baylei* (fide R.B., Pl. 120, fig. B, FSL 89455). The occurrence of numerous *Heteraster oblongus* argues for its ascription to the uppermost part of the Sarasini Zone.

Orbitolinids identified in rock sample no. 228 are the following:

- *Cribellopsis neoelongata* (Pl. 124),
- *Cribellopsis schroederi* (Pl. 124),
- *Orbitolinopsis briacensis* (Pl. 121),
- *Orbitolinopsis buccifer* (Pl. 122),
- *Orbitolinopsis cuvillieri* (Pl. 121),
- *Orbitolinopsis kiliani* (Pl. 121),
- *Paleodictyoconus actinostoma* (Pl. 125),
- *Paleodictyoconus cuvillieri* (Pl. 125),
- *Palorbitolina* gr. *lenticularis* (Pl. 120, fig. A),
- *Paracoskinolina* aff. *sunnilandensis* (Pl. 123),
- *Paracoskinolina maynci* (Pl. 123),
- *Vanneauina vercorii* (Pl. 123).

4. Conclusions

To summarize, the study of the orbitolinid records from 20 sections of SE France (8 in 2010, 1 in 2013, 11 today), all calibrated on ammonite biozones and ascribed ages ranging from the late Hauterivian to the late Barremian, marginally improves or consolidates our knowledge of the stratigraphic ranges of these foraminifers.

Figure 3 is the latest version of the biostratigraphic range chart of 38 orbitolinid species occurring in the Upper Hauterivian to Bedoulian (i.e., lower Aptian) interval of SE France and W Switzerland by CLAVEL *et al.* (2007), which was regularly updated since its first publication. This new version includes the latest information regarding the upper Berriasian first occurrences of 9 orbitolinid species (SCHLAGINTWEIT & BUCUR, 2021) plus ♠ *Moulladella jourdanensis*, a species which was recently assigned to the family Pfenderinidae, hence which should not anymore be considered as part of the family Orbitolinidae (BUCUR & SCHLAGINTWEIT, 2018).

On a biostratigraphic point of view:

- Upper Hauterivian interval: Three species (namely *Paleodictyoconus beckeriae*, *Praedictyorbitolina busnardoii*, and *Valserina primitiva*) are not found in strata higher than the Upper Hauterivian in the composite stratigraphic column (Fig. 3). Based on current knowledge, the first two species (i.e., *Paleodictyoconus beckeriae* and *Praedictyorbitolina busnardoii*) are apparently restricted to the Upper Hauterivian strata in SE France whereas a striking first occurrence of *Valserina primitiva* was recently documented from upper Berriasian limestones of E Serbia (SCHLAGINTWEIT & BUCUR, 2021). Besides *Valserina primitiva*, SCHLAGINTWEIT and BUCUR

(2021) also reported from Kamenica ♠ *Moulladella jourdanensis* and 9 more orbitolinid species (namely *Cribellopsis elongata*, *Cr. neoelongata*, *Cr. thieuloyi*, *Montseciella algerensis*, *M. glanensis*, *Orbitolinopsis buccifer*, *Orb. debelmasi*, *Urgonina alpillensis*, and *Vanneauina vercorii*), which have not been found yet in strata lower than the Upper Hauterivian [or even lower than the lower Barremian (namely *Orbitolinopsis buccifer* and *Vanneauina vercorii*)] in SE France or in W Switzerland. Although 10 out of the 38 orbitolinid species (26%) from the Urgonian facies of SE France already existed in late Berriasian times in the Kamenica area (SCHLAGINTWEIT & BUCUR, 2021), there are 15 (39%), including 8 Berriasian orbitolinid species, that are first reported from Upper Hauterivian strata in SE France;

- Barremian interval: Barremian studied sections yield up to 33 orbitolinid species (plus ♠ *Moulladella jourdanensis*), out of which 28 (85%) were already present in the Pulchella Zone of the lower Barremian. 9 Barremian orbitolinid species [namely *Cribellopsis elongata*, *Cr. thieuloyi*, *Dictyorbitolina carthusiana-ichnusa*, *Eopalorbitolina charollaisi*, *Eop. pertenuis*, *Paracoskinolina hispanica*, *Pradictyorbitolina claveli*, *Valserina broennimanni*, and *V. turbinata* (which is restricted to the sole lower Barremian)] do not reach upper Barremian strata. In contrast, 14 Barremian or older orbitolinid species (38%) reach Bedoulian strata;

- *Montseciella arabica* [Pls. 93, 113] is the sole species to appear in upper Barremian strata. This species rare in SE France but rather common in the Middle East was found in the sequence Ba4 of two studied sections (§ 15. Gorges de la Nesque; §18. Pont d'Arc), which is correlated to the Moutonianum to Vandennecke zones. Its last record could be in the regressive tract (Ba5) following the Barremian/Bedoulian boundary (GRANIER & BUSNARDO, 2013);

- The lowest occurrence of *Palorbitolina lenticularis* is first documented herein from the Vandennecke Zone of the upper Barremian at la Béguère (Ba3 HST, § 12.), Mas Thibaud (Ba4 LST, § 14.), and La Charce (Ba4 LST, § 17.) whereas it occurs in the Pulchella Zone of the lower Barremian at L'Estellon (GRANIER *et al.*, 2013: Ba2 LST), which contributes to justify calling it the "Rosetta Stone of the Urgonian biostratigraphy".

After testing the validity of two extant distribution charts of orbitolinids (1. ARNAUD-VANNEAU *et al.*, 2005, versus 2. CLAVEL *et al.*, 2007 *et seq.*), it turns out that the highest discrepancies appear with ARNAUD-VANNEAU's (ARNAUD-VANNEAU *et al.*, 2005) and that by far the best match is obtained with CLAVEL's (CLAVEL *et al.*, 2007 *et seq.*, not to mention GRANIER *et al.*, 2013, with the L'Estellon section). As for previous publications (e.g., CONRAD *et al.*, 2012; CHAROLLAIS *et al.*, 2013), these

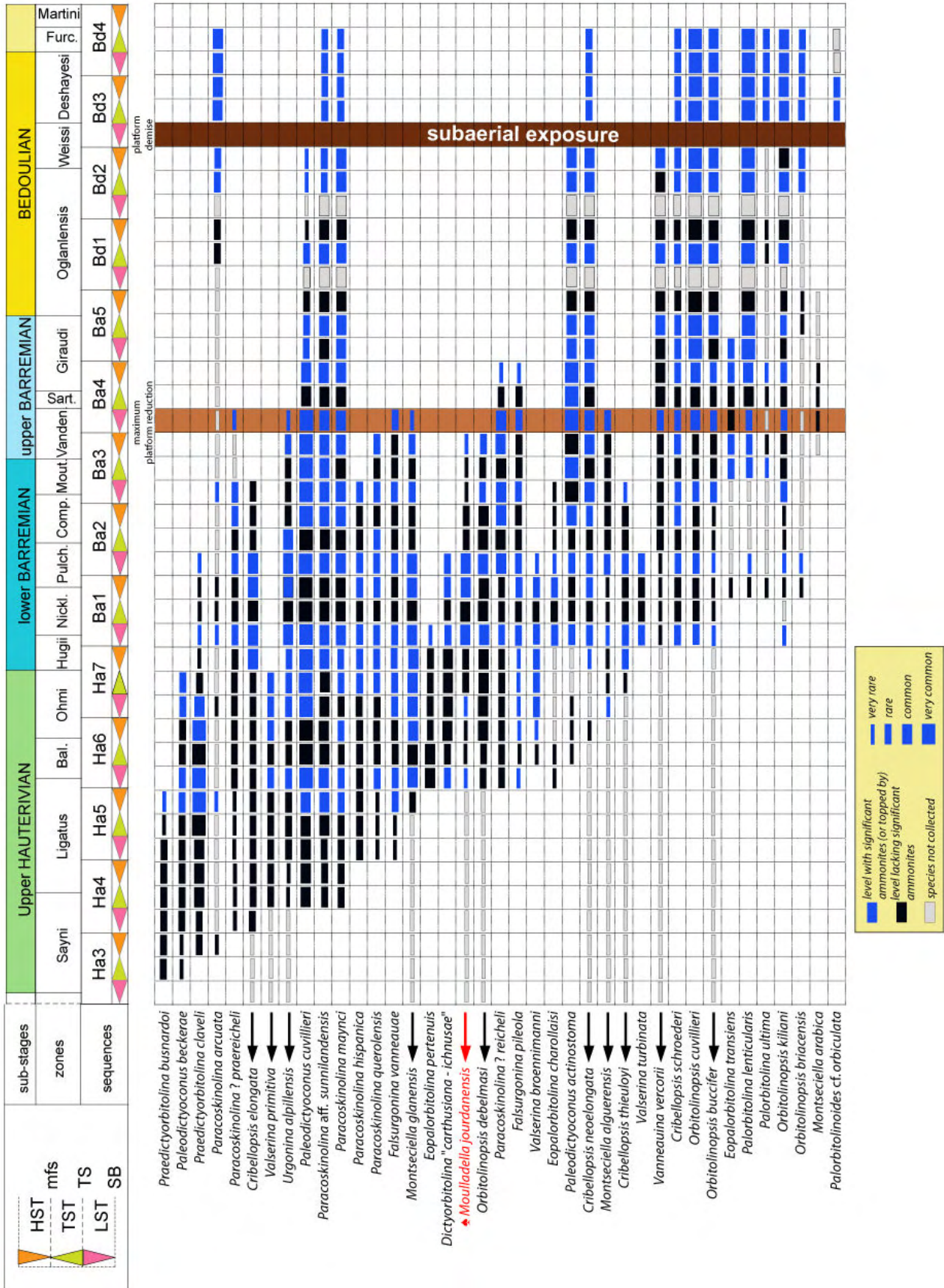


Figure 3: New biostratigraphic distribution of the orbitolinids from Upper Hauterivian to Bedoulian (lowermost Aptian) strata of southeastern France.



observations question the relevance of the conclusions and hypotheses of any published work based on the biased stratigraphic distribution ranges for the orbitolinids, *e.g.*, any work based on ARNAUD-VANNEAU's range chart (*i.e.*, ARNAUD-VANNEAU *et al.*, 2005, and earlier versions).

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Appendix

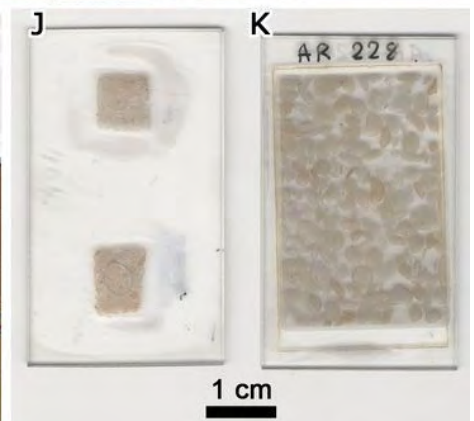
Sections	Easting, X (km)	Northing, Y (km)	Latitude, Longitude
1. Pic de l'Oeillette	868850 ***	3344000	45°20'43.6"N, 5°46'03.3"E
ARNAUD, 1980, p. 219	868850 ***	334500 [sic]	45°21'16.0"N, 5°46'05.2"E
peak	869031 ***	3344516	45°21'00.1"N, 5°46'12.6"E
2. Bella Cha	922620 **	2108750	45°54'07.9"N, 6°29'45.4"E
Adroit des Aravis	920500 **	2105620	45°52'30.2"N, 6°27'59.6"E
"Trou de la Mouche"	923978 ***	410031	45°54'57.2"N, 6°30'45.8"E
3. Grands Goulets	start: 689800 *	4987000	45°00'39.8"N, 5°24'31.1"E
	end: 690170 *	4986650	45°00'28.1"N, 5°24'47.5"E
ARNAUD, 1980, p. 238	842900 ***	305100	45°00'17.9"N, 5°25'05.4"E
4. Pont de Laval	617930 *	4917770	44°24'13.0"N, 4°28'51.6"E
start (353m)			44°24'07.4"N, 4°28'55.6"E
end (601 m)			44°24'27.2"N, 4°29'00.5"E
5. Mont Aiguille (stream)	854100 ***	3287750	44°50'42.3"N, 5°33'05.5"E
(Aupet pass)	853600	3287250	44°50'26.8"N, 5°32'41.9"E
6. Pas de l'Essaure	854900 ***	3281950	44°47'33.6"N, 5°33'31.6"E
7. Arredons	770750 ***	3241100	44°26'59.6"N, 4°28'55.9"E
8. Chames	767100 ***	3233400	44°22'53.3"N, 4°26'01.9"E
9. Mas de Gras	620804 *	4920393	44°25'36.3"N, 4°31'03.7"E
	623168 *	4921520	44°26'11.4"N, 4°32'51.5"E
10. La Montagnette	702029 *	4962746	44°47'22.4"N, 5°33'14.3"E
	701873 *	4960817	44°46'20.1"N, 5°33'04.5"E
ARNAUD, 1980, p. 267	854200 ***	280900	44°47'00.5"N, 5°32'57.9"E
11. Serre de Tourre	614493 *	4915104	44°22'48.6"N, 4°26'14.1"E
	617780 *	4911849	44°21'01.3"N, 4°28'40.0"E
12. La Béguère	691731 *	4970541	44°51'45.0"N, 5°25'36.7"E
	692632 *	4970500	44°51'42.8"N, 5°26'17.7"E
13. Rochecolombe	615028 *	4931900	44°31'52.5"N, 4°26'51.7"E
	614787 *	4931734	44°31'47.3"N, 4°26'40.7"E
14. Mas Thibaud (Mt. Bluye)	685364 *	4896360	44°11'48.9"N, 5°19'10.9"E
	685339 *	4896567	44°11'55.6"N, 5°19'10.0"E
15. Gorges de la Nesque	684764 *	4882018.	44°04'05.0"N, 5°18'25.8"E
	684954 *	4881859	44°03'59.6"N, 5°18'34.1"E
16. Col de Rousset	689739 *	4967466	44°50'07.3"N, 5°24'01.9"E
	689859 *	4967528	44°50'09.2"N, 5°24'07.4"E
17. La Charce	695113 *	4927406	44°28'25.0"N, 5°27'11.5"E
	695211 *	4927562	44°28'03.0"N, 5°27'16.2"E
18. Pont d'Arc	612221 *	4915395	44°22'59.3"N, 4°24'31.7"E
	612234 *	4915862	44°23'14.5"N, 4°24'32.7"E
19. Orgnac	613252 *	4908212	44°19'06.0"N, 4°25'12.7"E

Caption: * UTM 30 (WGS84); ** Lambert II étendu; *** Lambert III Carto (France Sud)



Plates

► **Plate 31: A)** Bernard CLAVEL sampling the "Pont d'Arc" section (§ 18. Pont d'Arc) on the side of RD (departmental road) 290 on 21/06/2012 [GPS: 44°23'01.9"N 4°24'28.8"E]; **B-C)** masonry saw (C) and lapidary saw (B), used to cut respectively rock slabs and the "sugar pieces" for thin sectioning. **D-F)** on 24/08/2014, Bernard CLAVEL at work, polishing the slabs (D), looking for diagnostic sections of foraminifer under the binocular microscope (E), and marking them of a slab (F); **G)** marks on slabs; **H)** sugar pieces cut from a limestone slab and plugs with one or several loose specimens obtained after sorting of the residue of marl sieving; **I)** on 15/07/2014, mounting of the sugar pieces and plugs with epoxy resin on a glass slide by Pierre DESJACQUES; **J-K)** examples of petrographic thin sections after the polishing to 25 µm in thickness of the mounted pieces of rocks (J) or specimens (K).



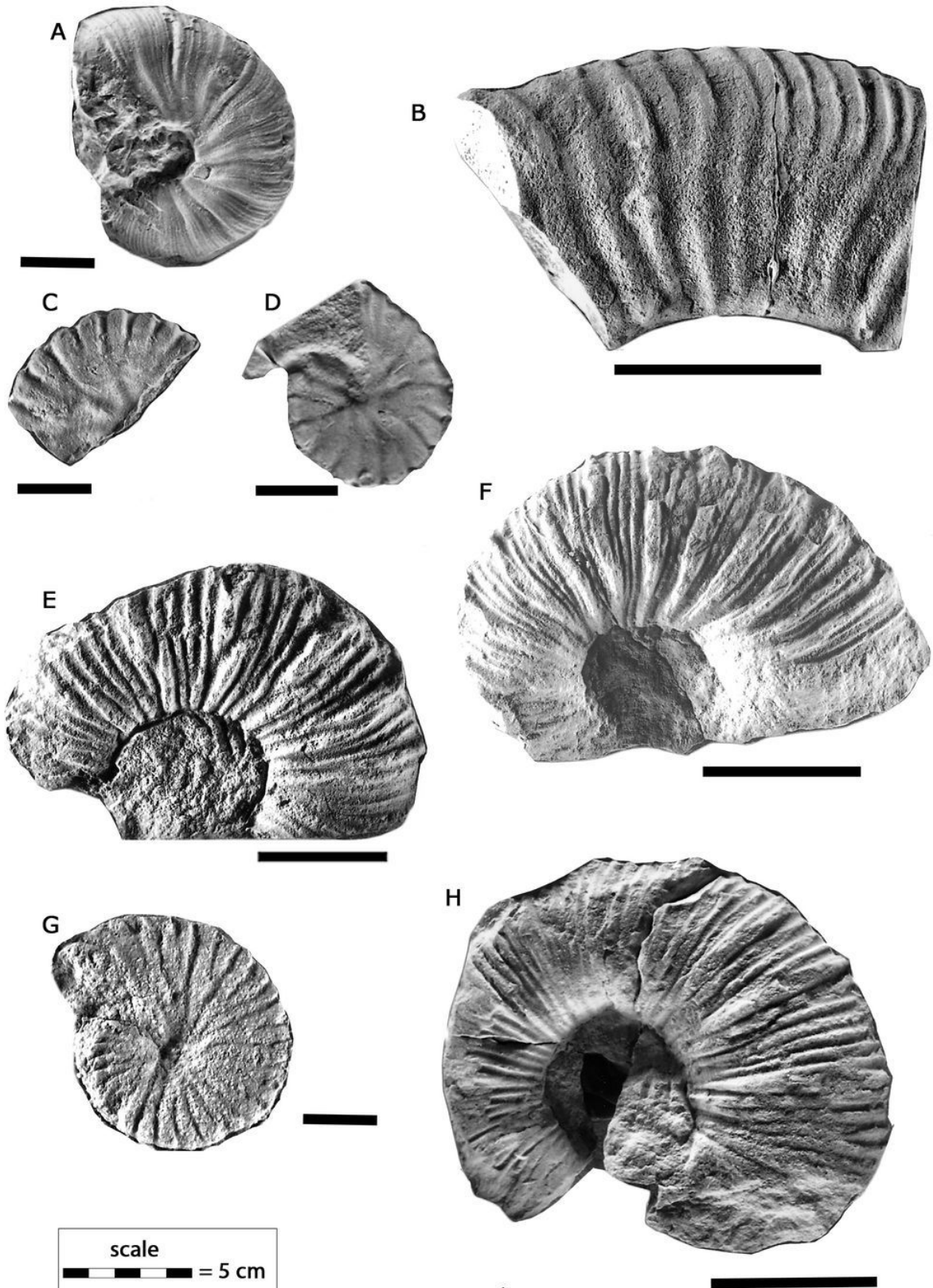


Plate 32: Ammonites of the Ohmi, Hugii, Nicklesi, Pulchella, Compressissima and Moutonianum zones at Mas de Gras. A) *Taveraidiscus hugii*, FSL 89641, bed 384; B) cf. *Pseudothurmannia mortilleti*, FSL 89581, bed 383; C) *Nicklesia pulchella*, FSL 89615, bed 382; D) *Nicklesia pulchella*, FSL 89616, bed 382; E) *Holcodiscus perezianus* (formerly identified a *Holcodiscus caillaudianus*), FSL 89613, bed 382; F) *Holcodiscus perezianus*, formerly identified as *Holcodiscus caillaudianus* (CLAVEL *et al.*, 2007, Pl. 1, fig. H), FSL 89674, bed 375-1; G) ? *Kotetischvilia compressissima* (CLAVEL *et al.*, 2007, Pl. 1, fig. K) {or *Nicklesia didayana* -DB-}, FSL 89704, bed 373-1; H) *Holcodiscus perezianus*, formerly identified as *Holcodiscus caillaudianus* (CLAVEL *et al.*, 2007, Pl. 1, fig. I), FSL 89707, bed 378. All scale bars = 5 cm.

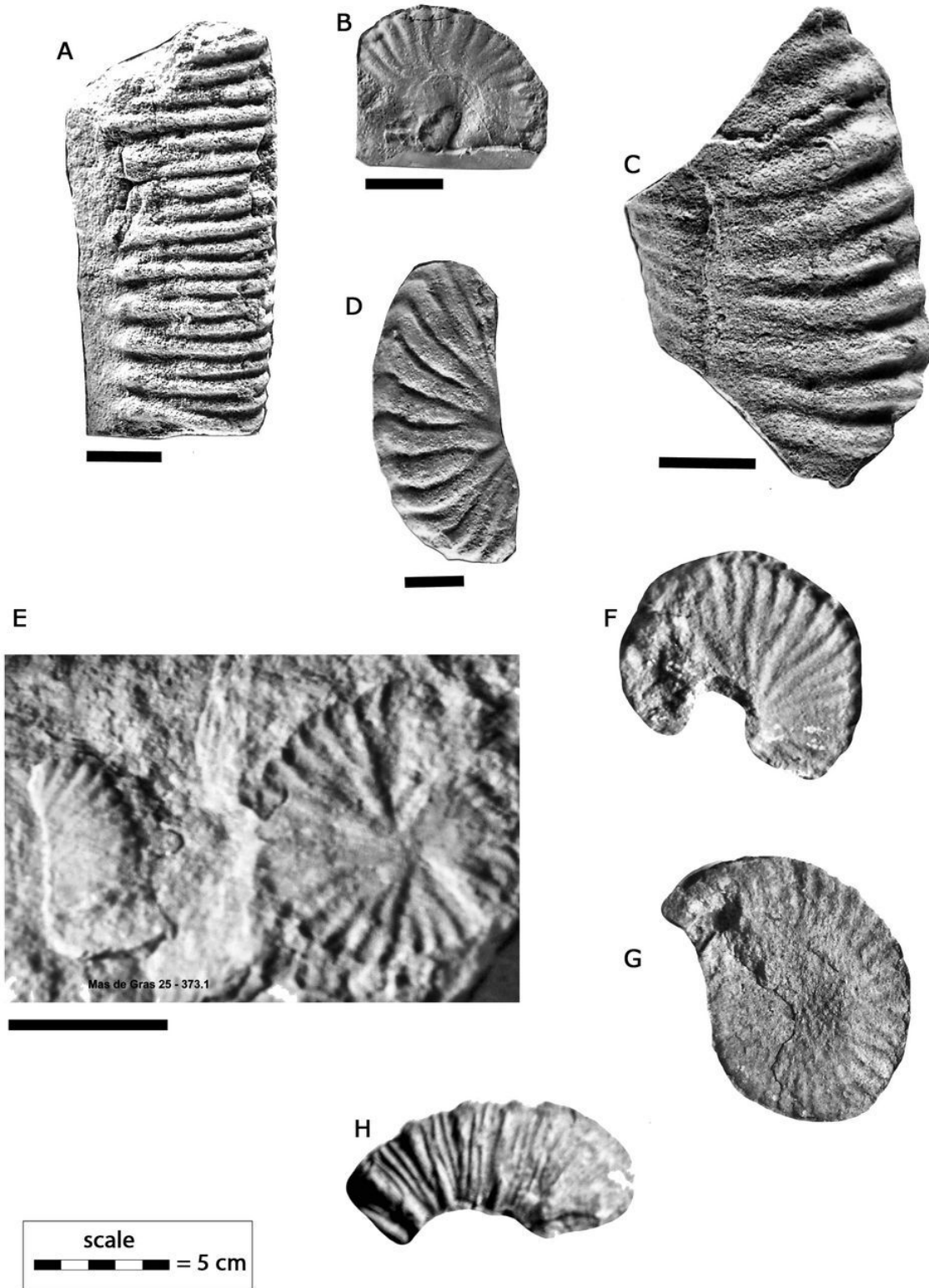


Plate 33: Ammonites of the Compressissima and Moutonianum zones at Mas de Gras. A) *Dissimilites dissimilis* (CLAVEL *et al.*, 2007, Pl. 1, fig. J), FSL 89719, bed 378; B) *Nicklesia pulchella*, FSL 89617, bed 382; C) *Moutoniceras moutonianum* (CLAVEL *et al.*, 2007, Pl. 1, fig. N), FSL 89718, bed 378; D) *Nicklesia didayana* (CLAVEL *et al.*, 2007, Pl. 1, fig. L), FSL 89705, bed 373; E) ? *Kotetischvilia compressissima* -RB- {or *Heinzia communis* -DB-}, FSL 89697, bed 373; F) *Nicklesia didayana*, FSL 89703b, bed 373; G) *Kotetischvilia compressissima*, FSL 89703, bed 373; H) ? *Holcodiscus caillaudianus* -RB- {or *Amohaldites aff. camelinus* (ORBIGNY, 1849) -DB-}, FSL 89677, bed 375. All scale bars = 5 cm.

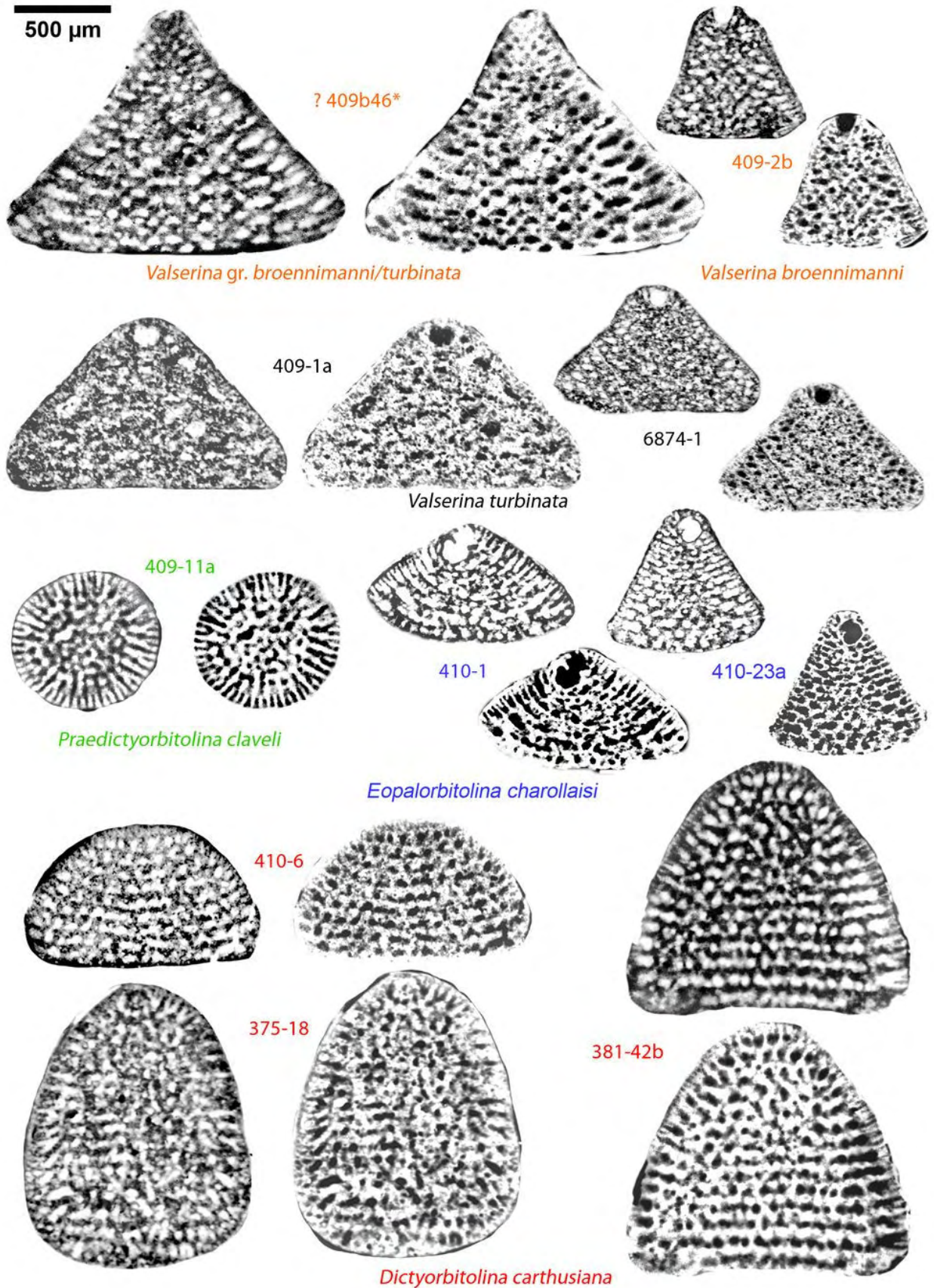


Plate 34: Orbitolinids of the Pulchella Zone at Mas de Gras. *Dictyorbitolina carthusiana*: 375-18, 381-42b, 410-6; *Eopalorbitolina charollaisi*: 410-1 (CLAVEL et al., 2007, Pl. 4, fig. F), 410-23a; *Praedictyorbitolina claveli*: 409-11a; *Valserina broennimanni*: 409-2b; *Valserina gr. broennimanni/turbinata*: ? 409b46* [NF]; *Valserina turbinata*: 409-1a, 6874-1. Scale bar = 500 µm.

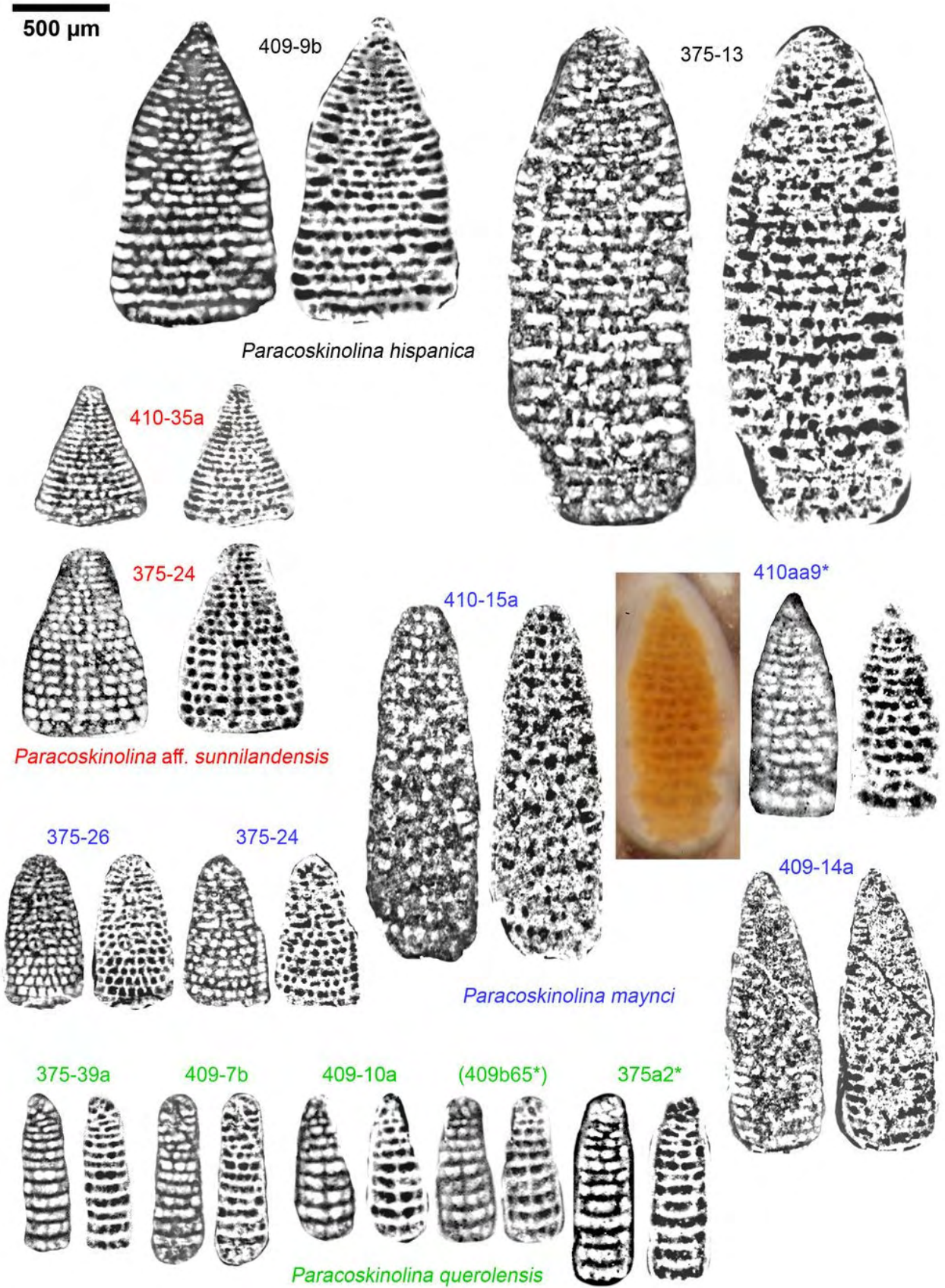


Plate 35: Orbitolinids of the Pulchella Zone at Mas de Gras. *Paracoskinolina hispanica*: 375-13, 409-9b; *Paracoskinolina maynci*: 375-24, 375-26, 409-14a, 410aa9*, 410-15a; *Paracoskinolina querolensis*: 375-39a, 375a2*, 409-7b, 409-10a (409b65*); *Paracoskinolina aff. sunnilandensis*: 375-24, 410-35a. Scale bar = 500 µm.

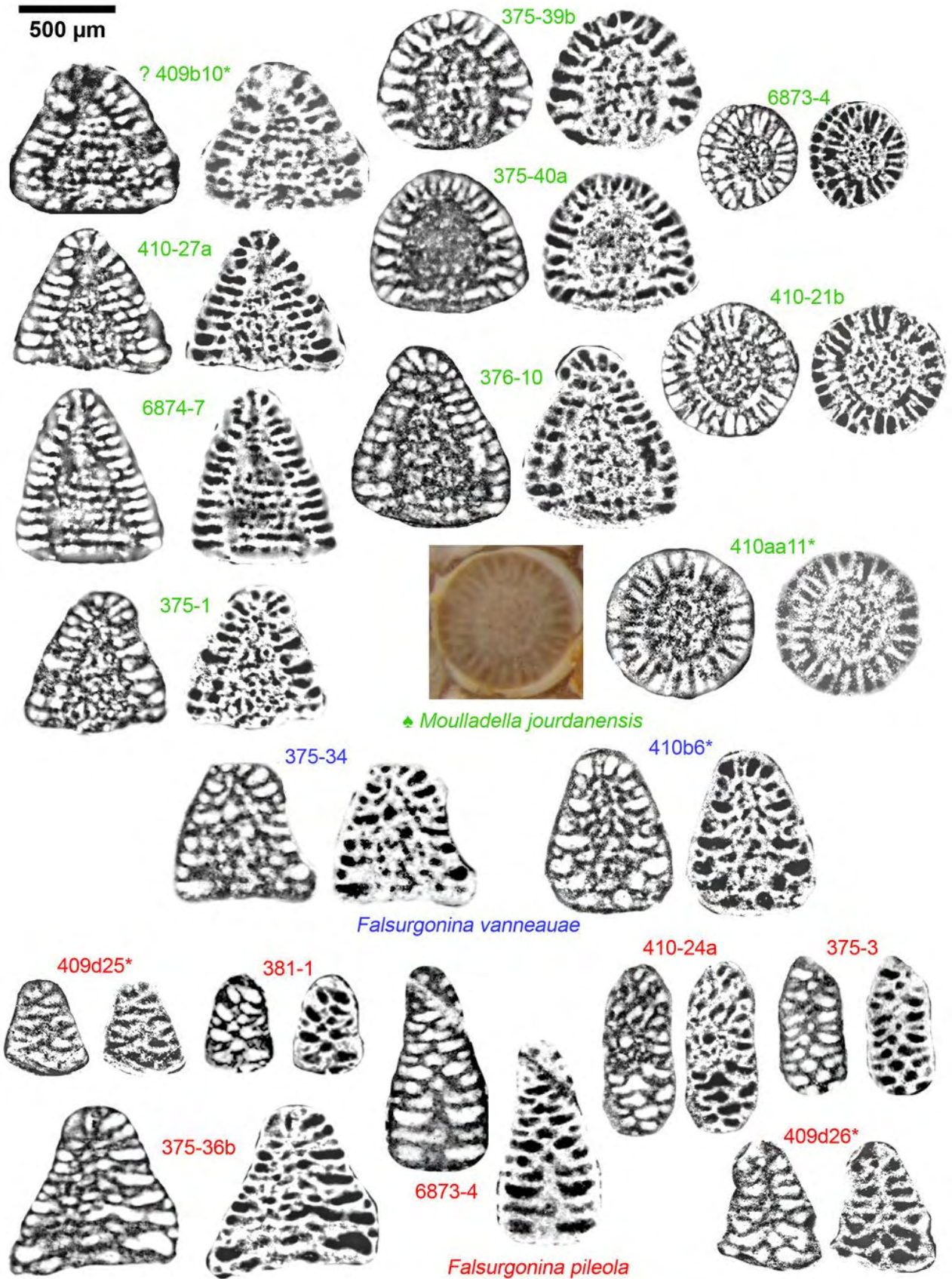


Plate 36: *Moulladella* and orbitolinids of the Pulchella Zone at Mas de Gras. ◆ *Moulladella jourdanensis*: 375-1, 375-39b, 375-40a, 376-10, ? 409b10* [NF], 410-21b, 410-27a, 410aa11*, 6873-4, 6874-7; *Falsurgonina pileola*: 375-3, 375-36b, 381-1, 409d25*, 409d26*, 410-24a, 6873-4; *Falsurgonina vanneauae*: 375-34, 410b6*. Scale bar = 500 μm.

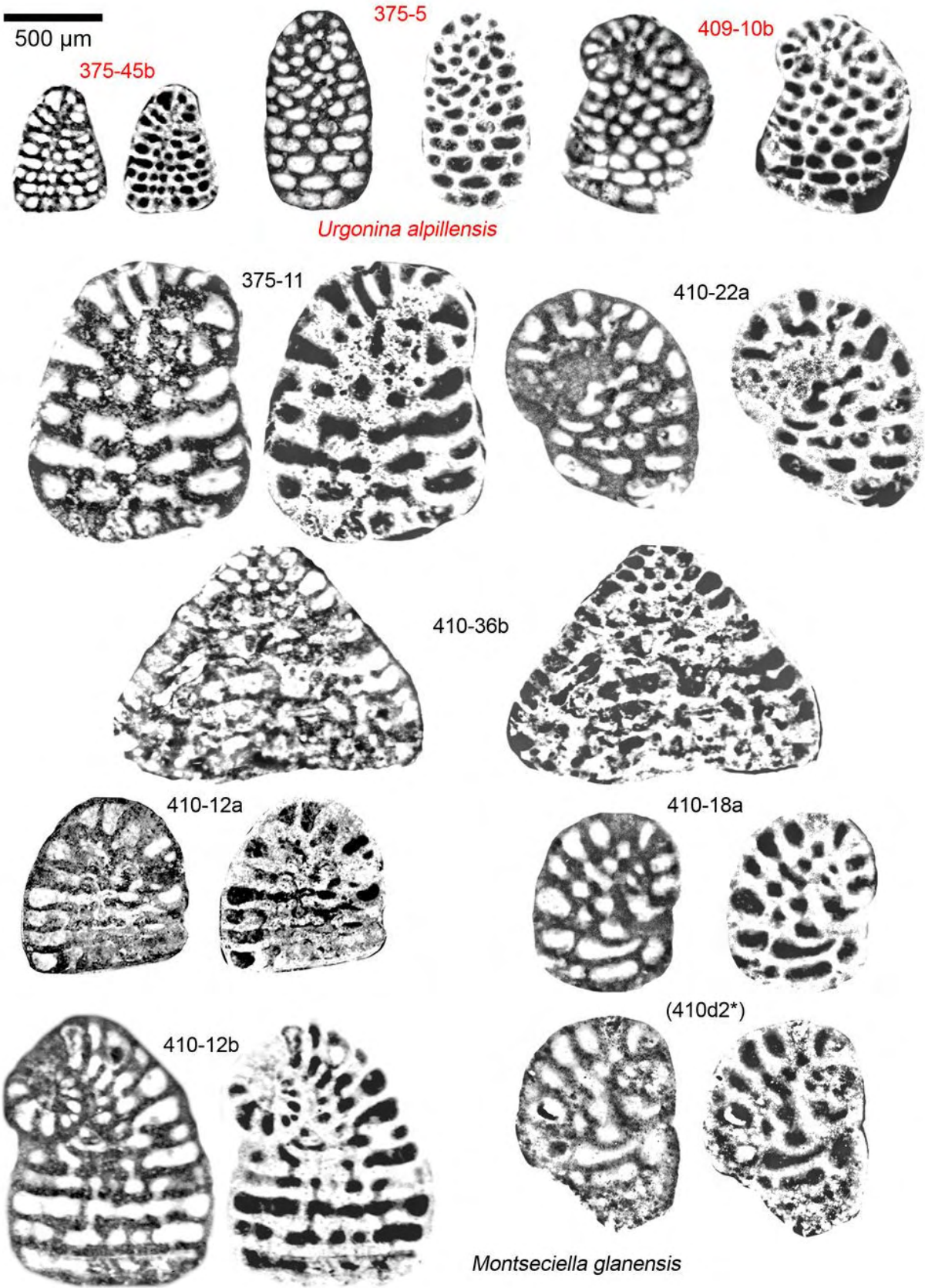


Plate 37: Orbitolinids of the Pulchella Zone at Mas de Gras. *Montseciella glanensis*: 375-11, 410-12a, 410-12b, 410-18a, 410-22a, 410-36b (410d2*); *Urgonina alpillensis*: 375-5, 375-45b, 409-10b. Scale bar = 500 μ m.

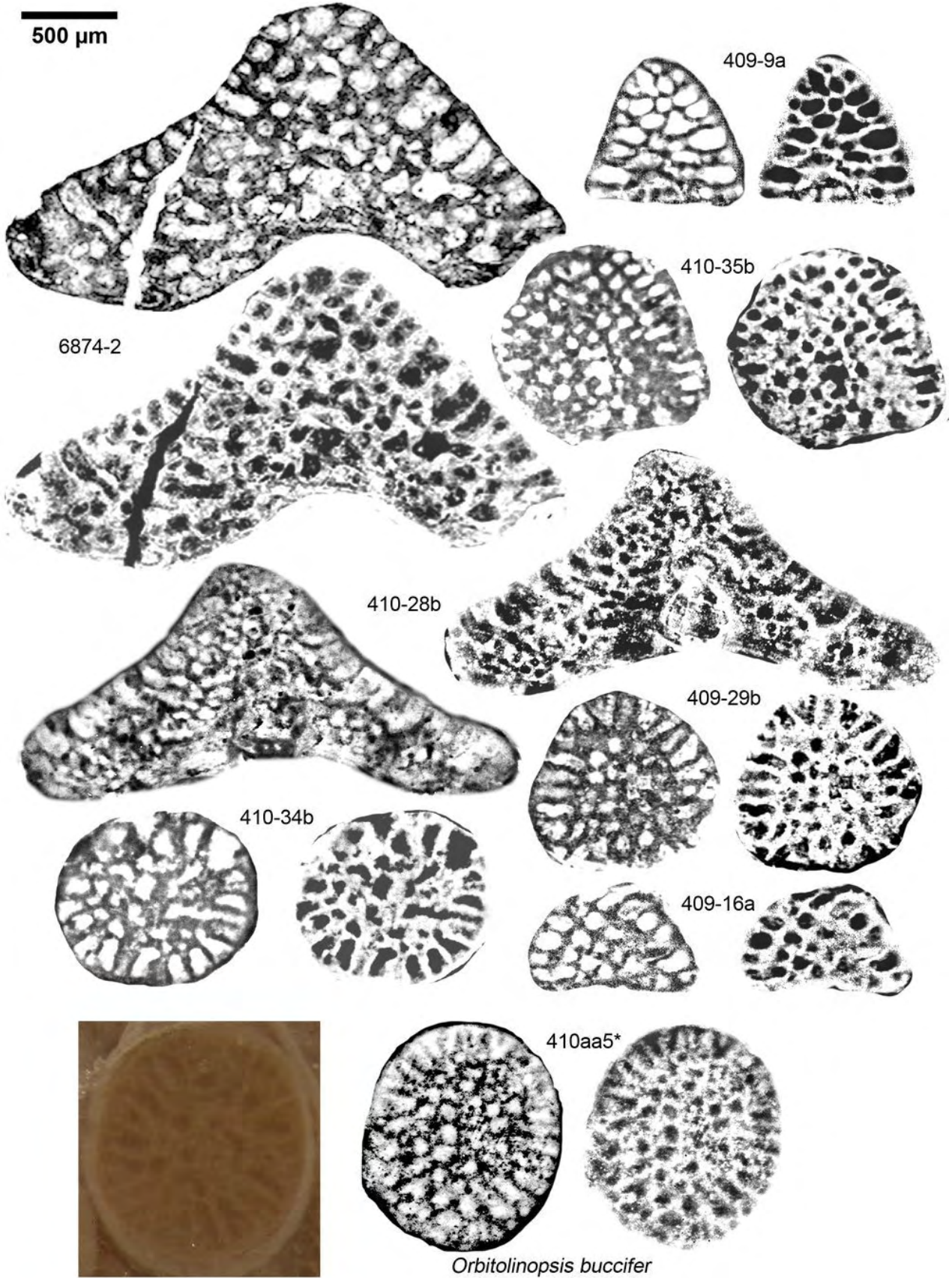


Plate 38: Orbitolinids of the Pulchella Zone at Mas de Gras. *Orbitolinopsis buccifer* : 409-9a, 409-16a, 409-29b, 410-28b, 410-34b, 410-35b, 410aa5*, 6874-2. Scale bar = 500 μm.



500 µm

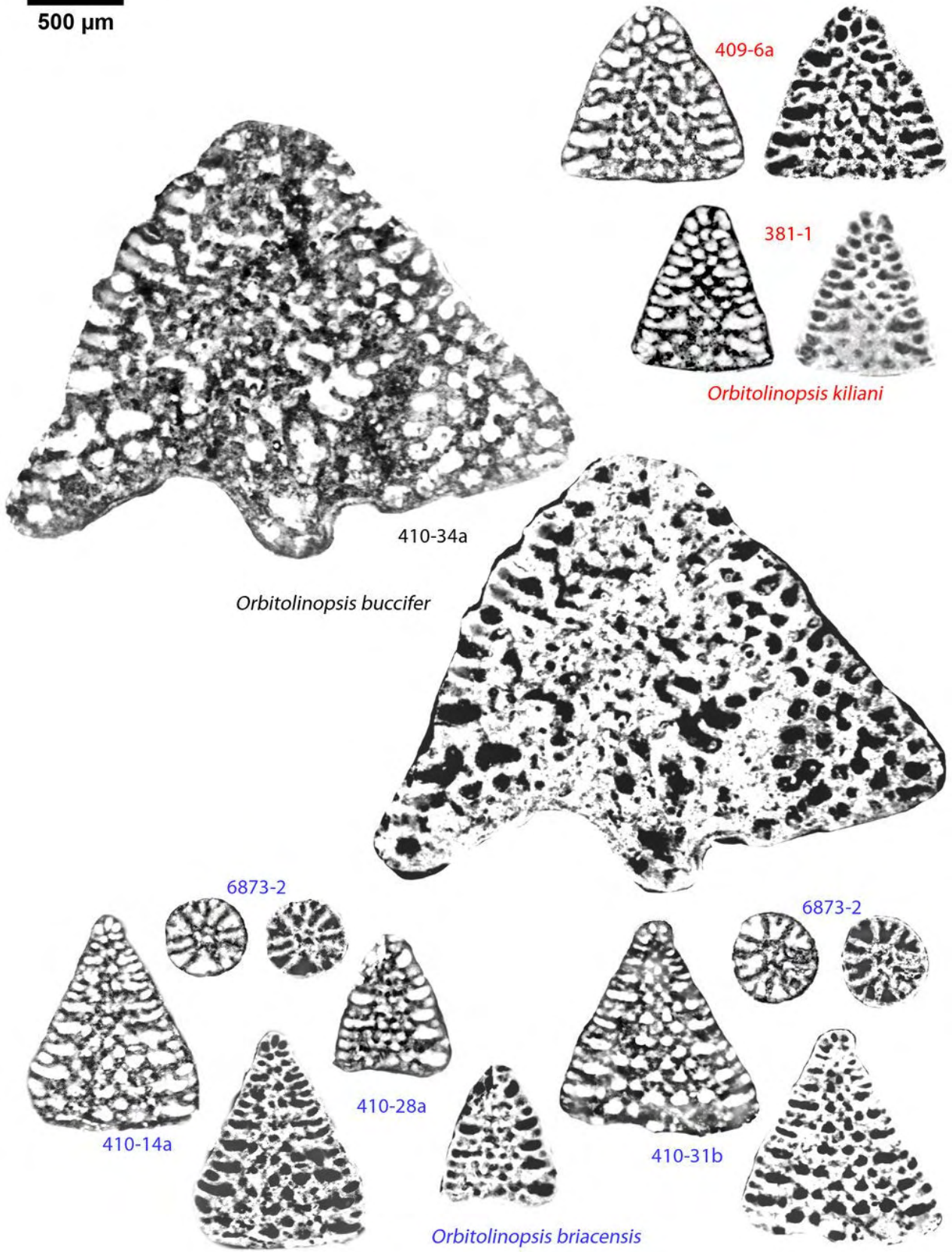


Plate 39: Orbitolinids of the Pulchella Zone at Mas de Gras. *Orbitolinopsis briacensis*: 410-14a, 410-28a, 410-31b, 6873-2; *Orbitolinopsis buccifer*: 410-34a; *Orbitolinopsis kiliani*: 381-1, 409-6a. Scale bar = 500 µm.

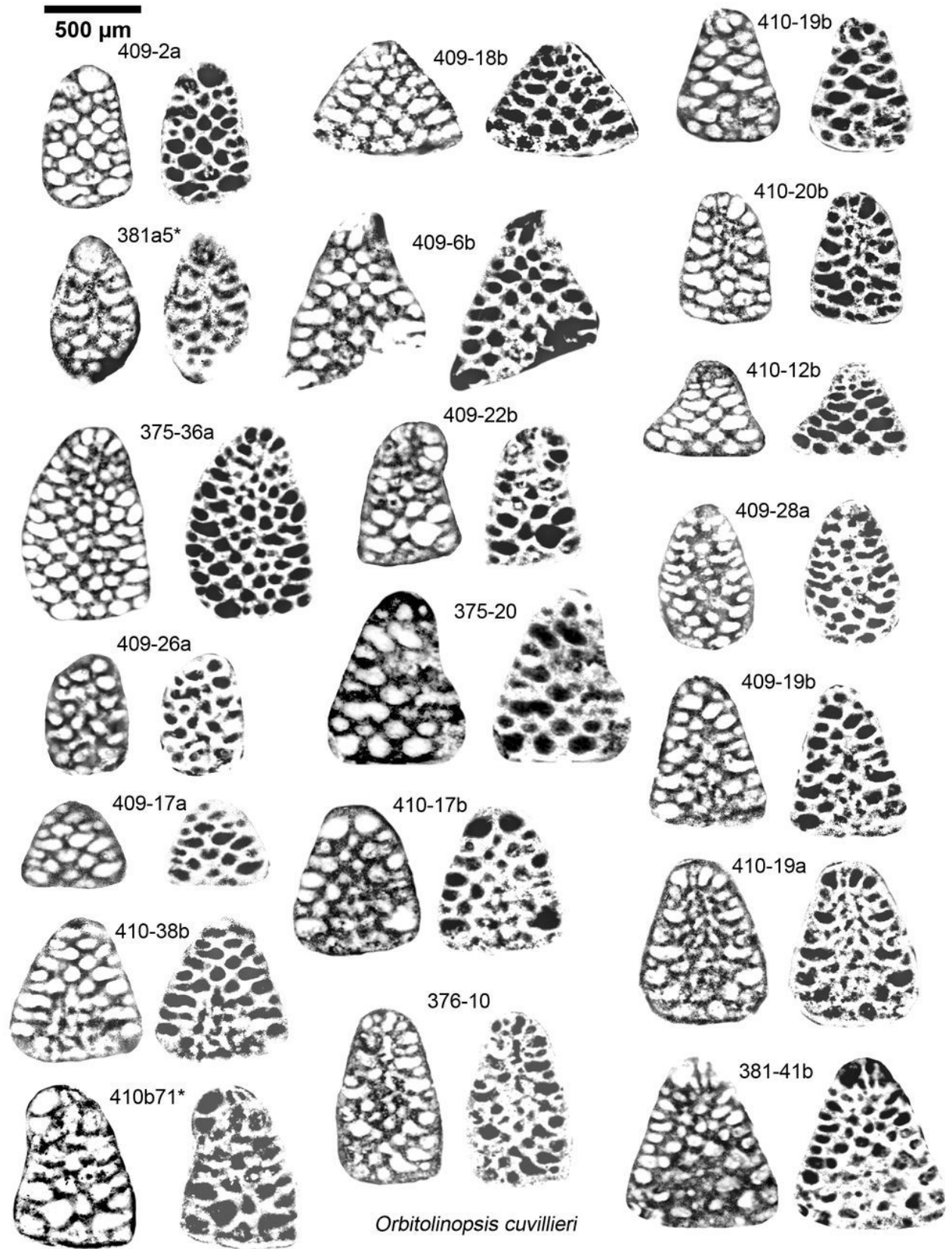


Plate 40: Orbitolinids of the Pulchella Zone at Mas de Gras. *Orbitolinopsis cuvillieri* : 375-20, 375-36a, 376-10, 381a5*, 381-41b, 409-2a, 409-6b, 409-17a, 409-18b, 409-19b, 409-22b, 409-26a, 409-28a, 410-12b, 410-17b, 410-19a, 410-19b, 410-20b, 410-38b, 410b71*. Scale bar = 500 μ m.



500 μ m

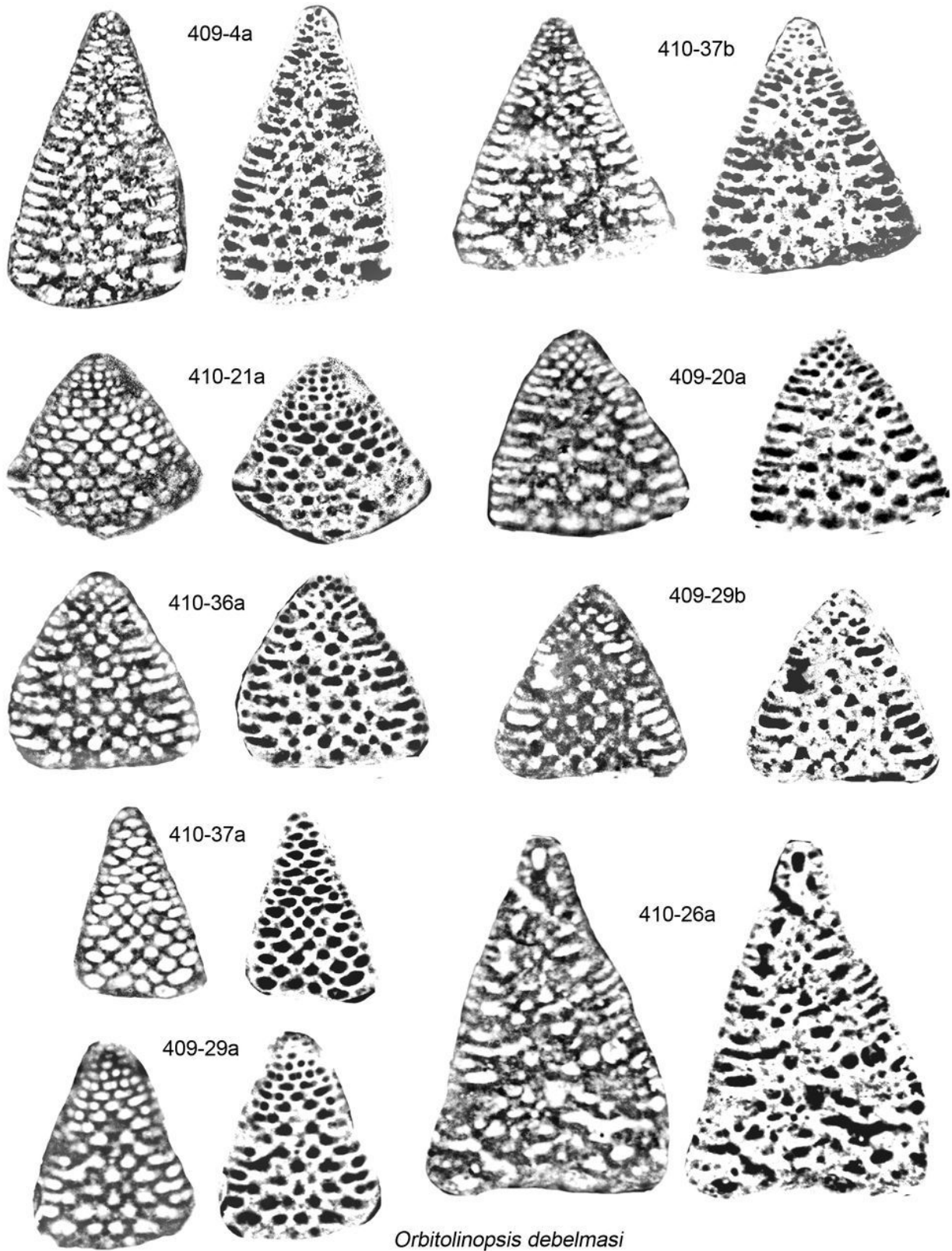


Plate 41: Orbitolinids of the Pulchella Zone at Mas de Gras. *Orbitolinopsis debelmasi* : 409-4a, 409-20a, 409-29a, 409-29b, 410-21a, 410-26a, 410-36a, 410-37a, 410-37b. Scale bar = 500 μ m.

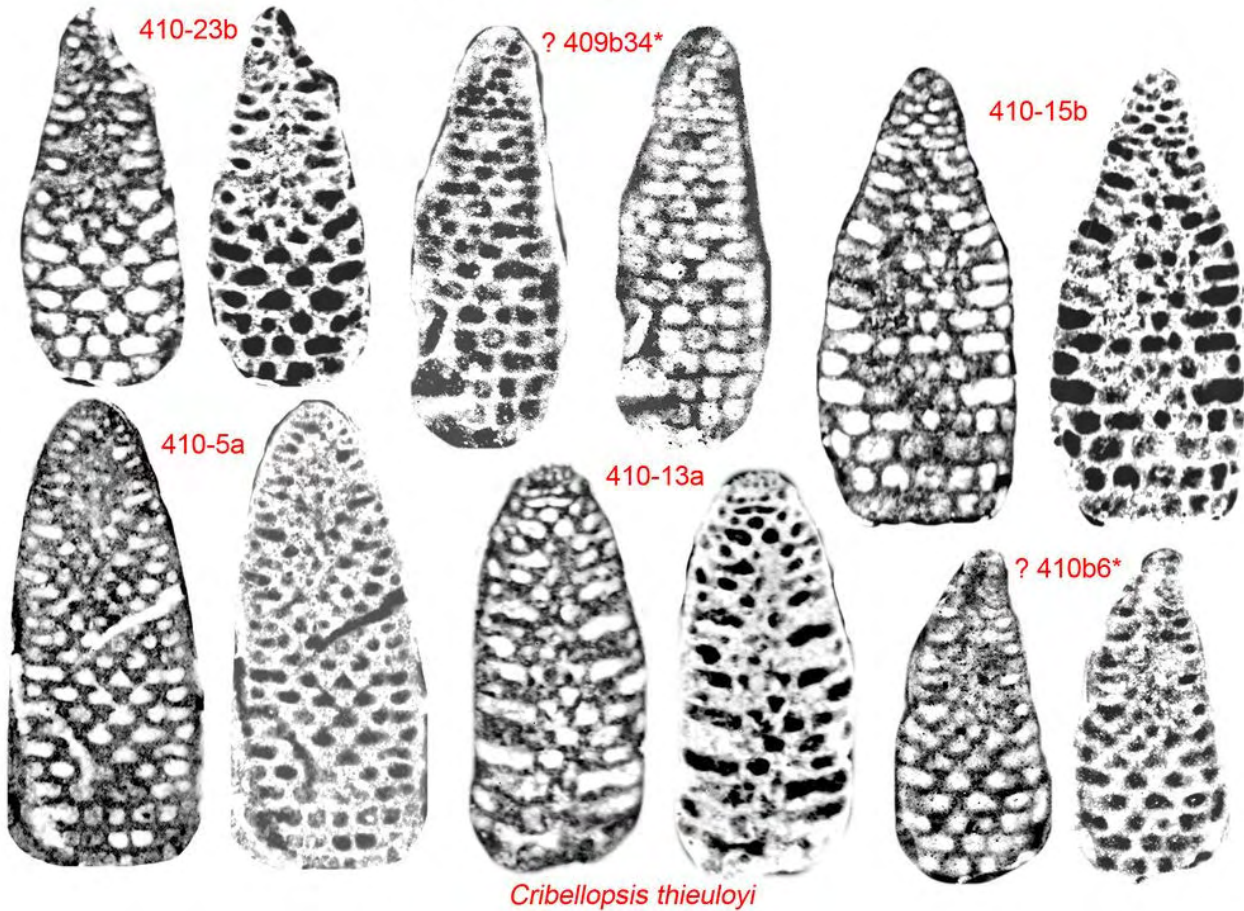
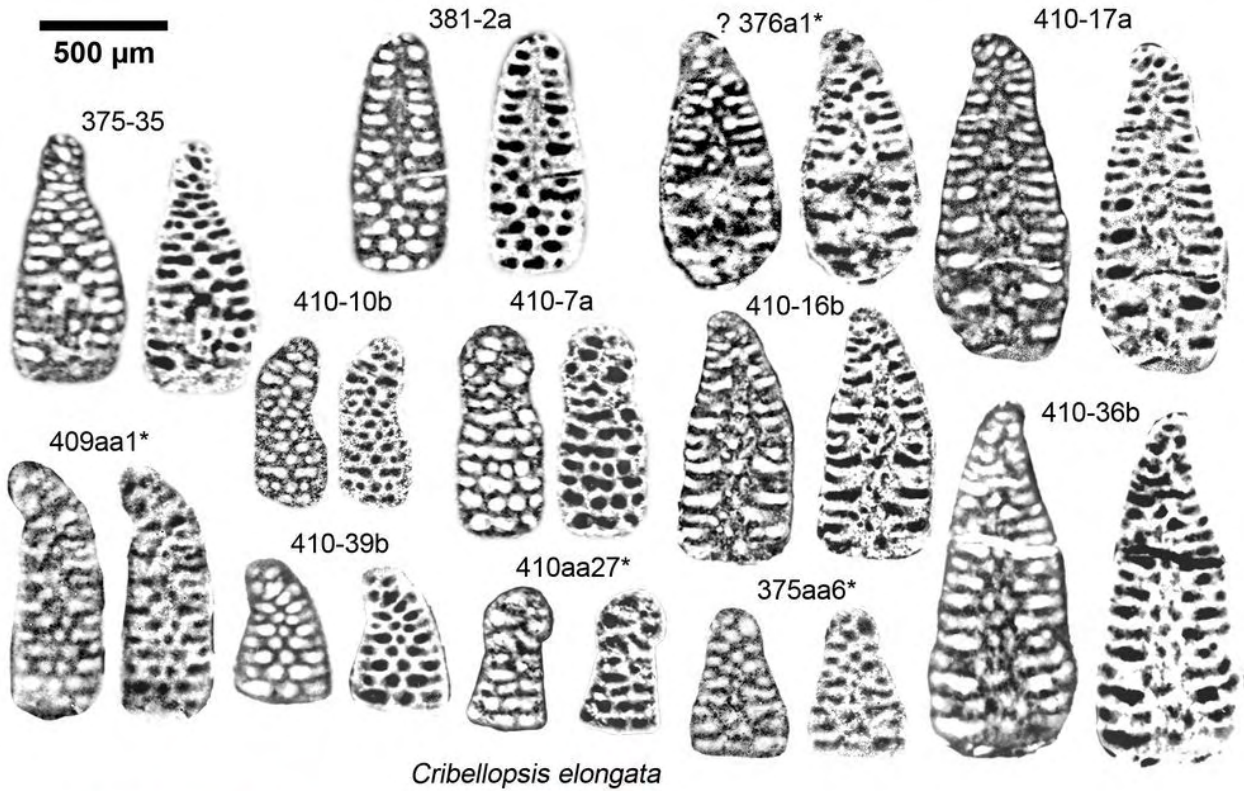


Plate 42: Orbitolinids of the Pulchella Zone at Mas de Gras. *Cribellopsis elongata*: 375aa6*, 375-35, ? 376a1 * [NF], 381-2, 409aa1*, 410-7a, 410-10b, 410-16b, 410-17a, 410-36b, 410-39b, 410aa27*; *Cribellopsis thieuloyi*: ? 409b34* [NF], 410-5a, 410-13a, 410-15b, 410-23b, ? 410b6* [NF]. Scale bar = 500 μm.

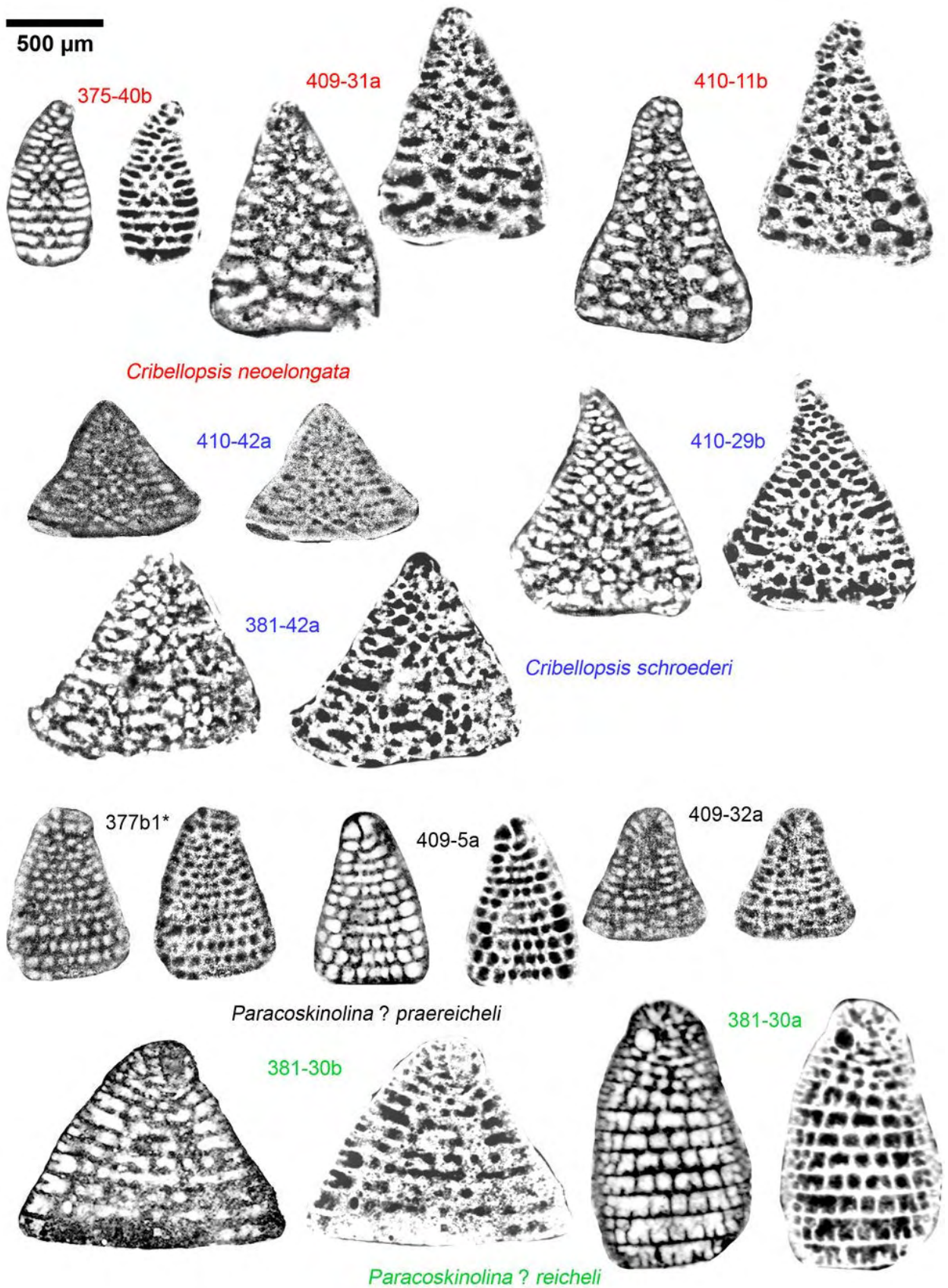


Plate 43: Orbitolinids of the Pulchella Zone at Mas de Gras. *Cribellopsis neoelongata*: 375-40b, 409-31a, 410-11b; *Cribellopsis schroederi*: 381-42a, 410-29b, 410-42a; *Paracoskinolina ? praereicheli*: 377b1*, 409-5a, 409-32a; *Paracoskinolina ? reicheli*: 381-30a, 381-30b. Note that Pl. 43, fig. 381-30a is duplicated from CLAVEL *et al.* (2007, Pl. 5, fig. L) and fig. 381-30b from CLAVEL *et al.* (2007, Pl. 5, fig. K) as "*Dictyoconus ? reicheli* GUILLAUME". Scale bar = 500 µm.

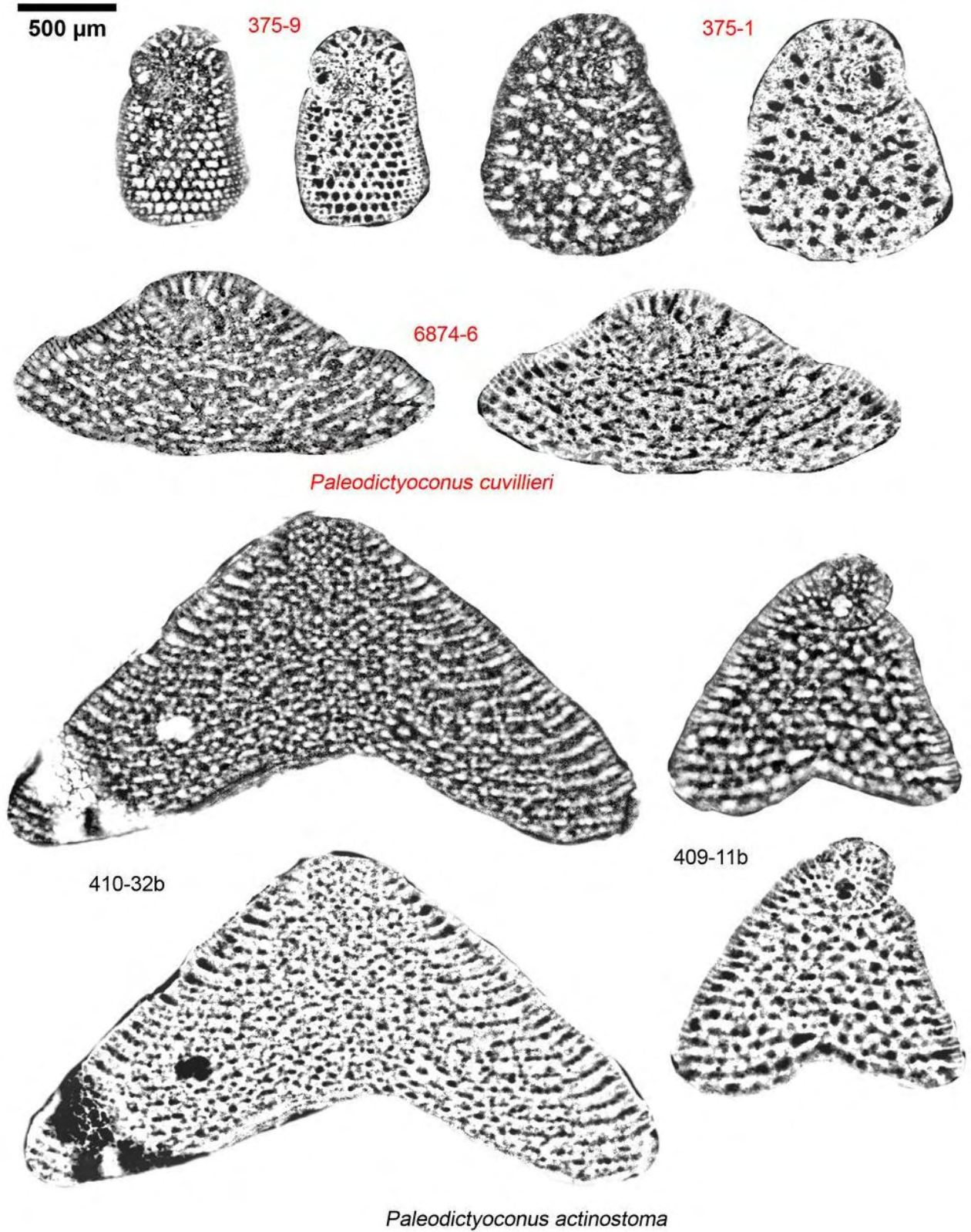
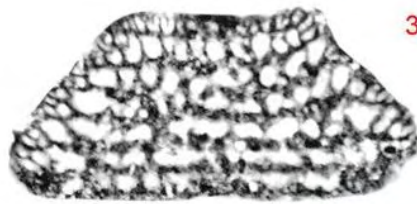


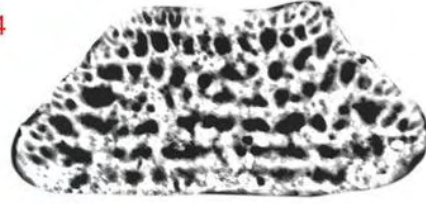
Plate 44: Orbitolinids of the Pulchella Zone at Mas de Gras. *Paleodictyoconus actinostoma*: 409-11b, 410-32b; *Paleodictyoconus cuvillieri* : 375-1, 375-9, 6874-6. Scale bar = 500 μm .



500 µm



375-4



Montseciella algerensis

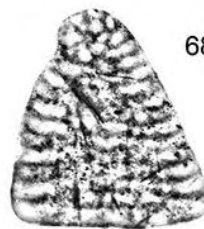
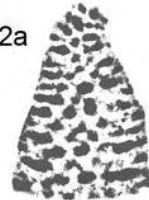


376-12

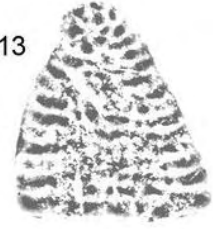
Paleodictyoconus cuvillieri



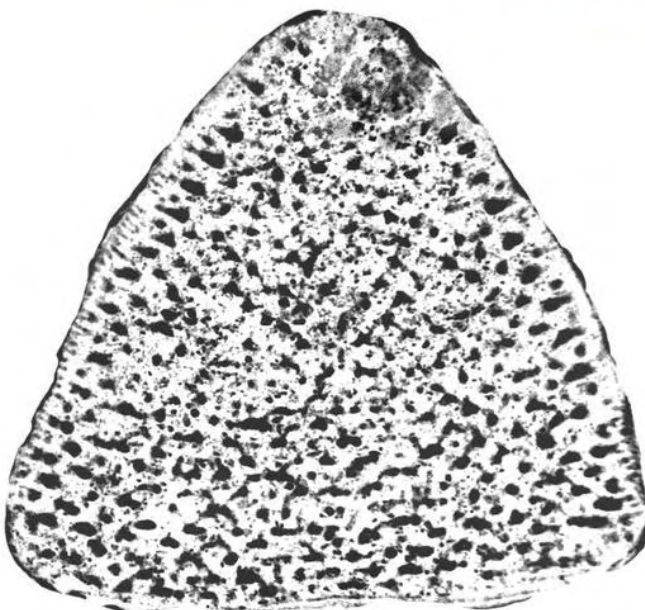
409-12a



6874-13



Vanneauina vercorii



6874-10

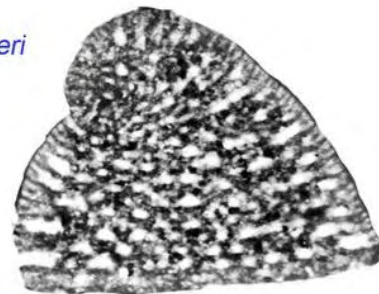


Plate 45: Orbitolinids of the Pulchella Zone at Mas de Gras. *Montseciella algerensis* : 375-4; *Paleodictyoconus cuvillieri*: 376-12, 6874-10; *Vanneauina vercorii*: 409-12a, 6874-13. Scale bar = 500 µm.

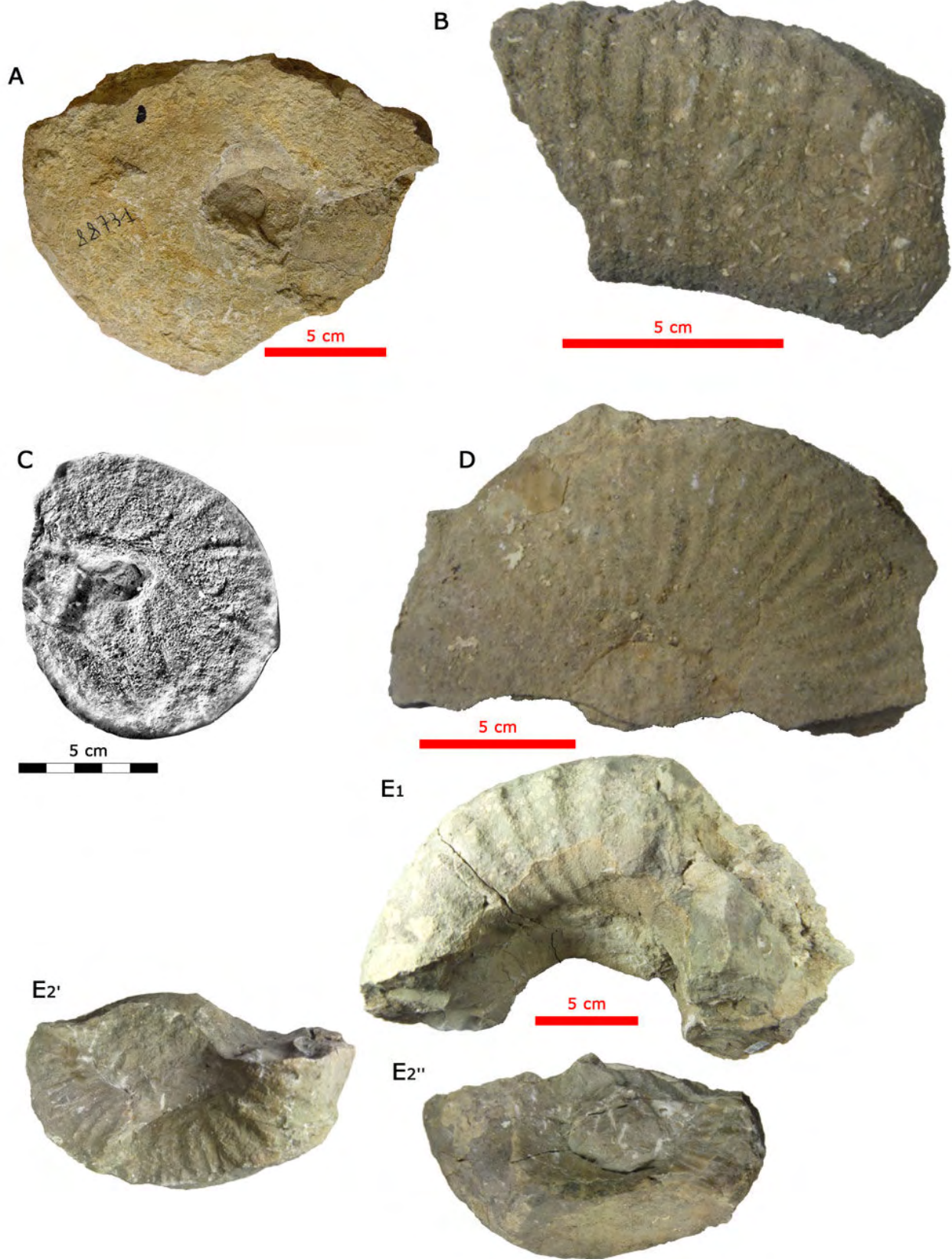


Plate 46: Ammonites of the Pulchella and Compressissima zones at La Montagnette. A) *Torcapella* cf. *suessiformis*, FSL 88731; B) *Moutoniceras* gr. *nodosum*, UJF-ID 10568 © OSUG (ARNAUD *et al.*, 1998: Pl. 2, fig. 3); C) *Nikolovites* gr. *charrierianus*, FSL 88827; D) *Torcapella fabrei*, UJF-ID 10566 © OSUG (ARNAUD *et al.*, 1998: Pl. 2, fig. 1); E1, E2', E2'') *Paraspiticer* (*Paraspiticer*) *guerinianum*, UJF-ID 10569 © OSUG (ARNAUD *et al.*, 1998: Pl. 2, fig. 4). All scale bars = 5 cm.

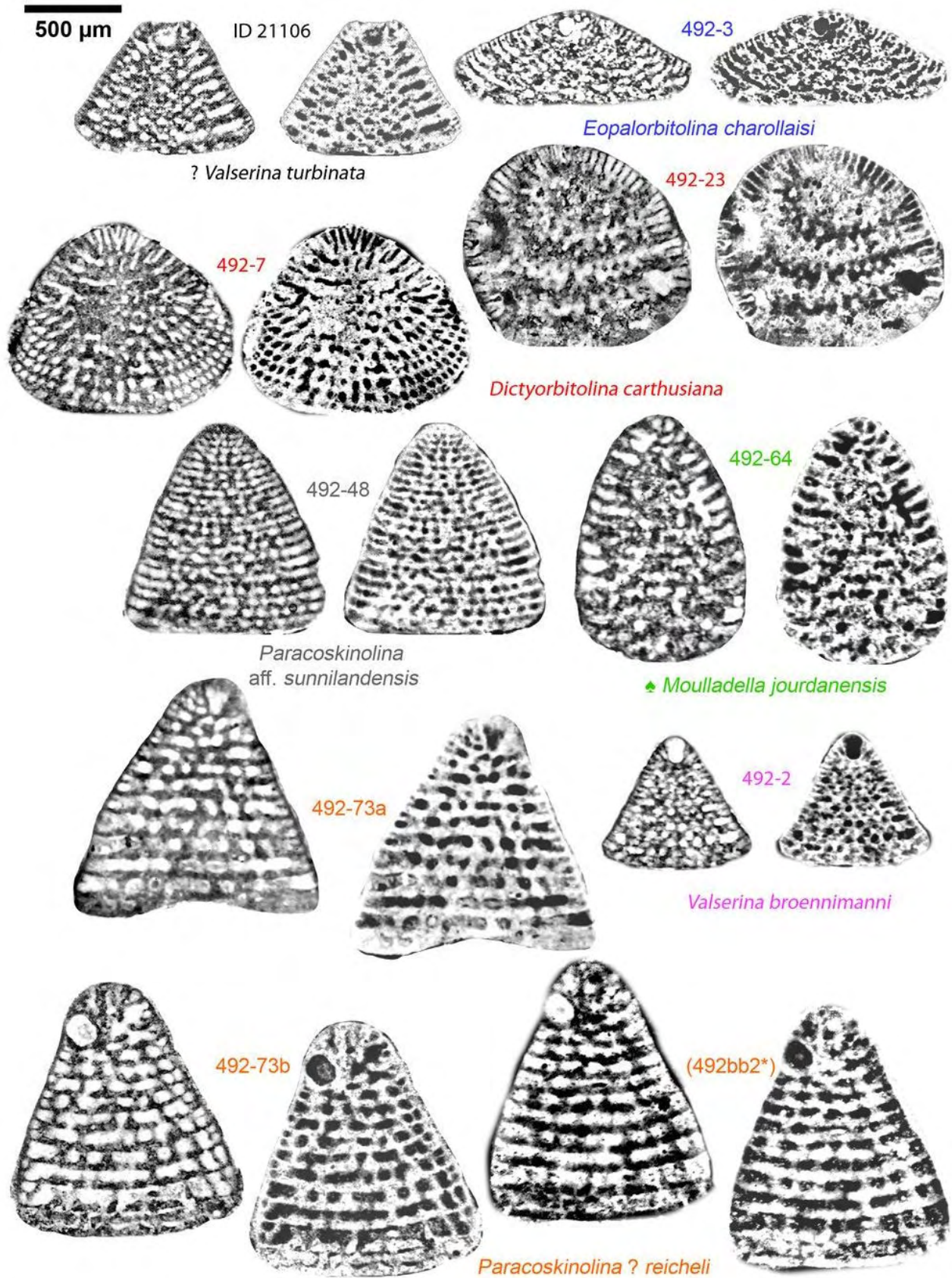


Plate 47: *Moulladella* and orbitolinids of the Pulchella Zone at La Montagnette. ♠ *Moulladella jourdanensis* : 492-64; *Dictyorbitolina carthusiana*: 492-7, 492-23; *Eopalorbitolina charollaisi*: 492-3; *Paracoskinolina ? reicheli*: 492-73a, 492-73b (492bb2*); *Paracoskinolina* aff. *sunnilandensis*: 492-48; *Valserina broennimanni*: 492-2; *Valserina turbinata*: ID 21106. Note that Pl. 46, fig. ID 21106 is duplicated from ARNAUD-VANNEAU (1980, Pl. 105, fig. 5) as "*Alpillina antiqua*". Note that the blurred photomicrograph 492bb2 from the polished plug, which was used to make the thin section 492-73b, looks very similar to a *Paracoskinolina ? praereicheli*. Scale bar = 500 μm.

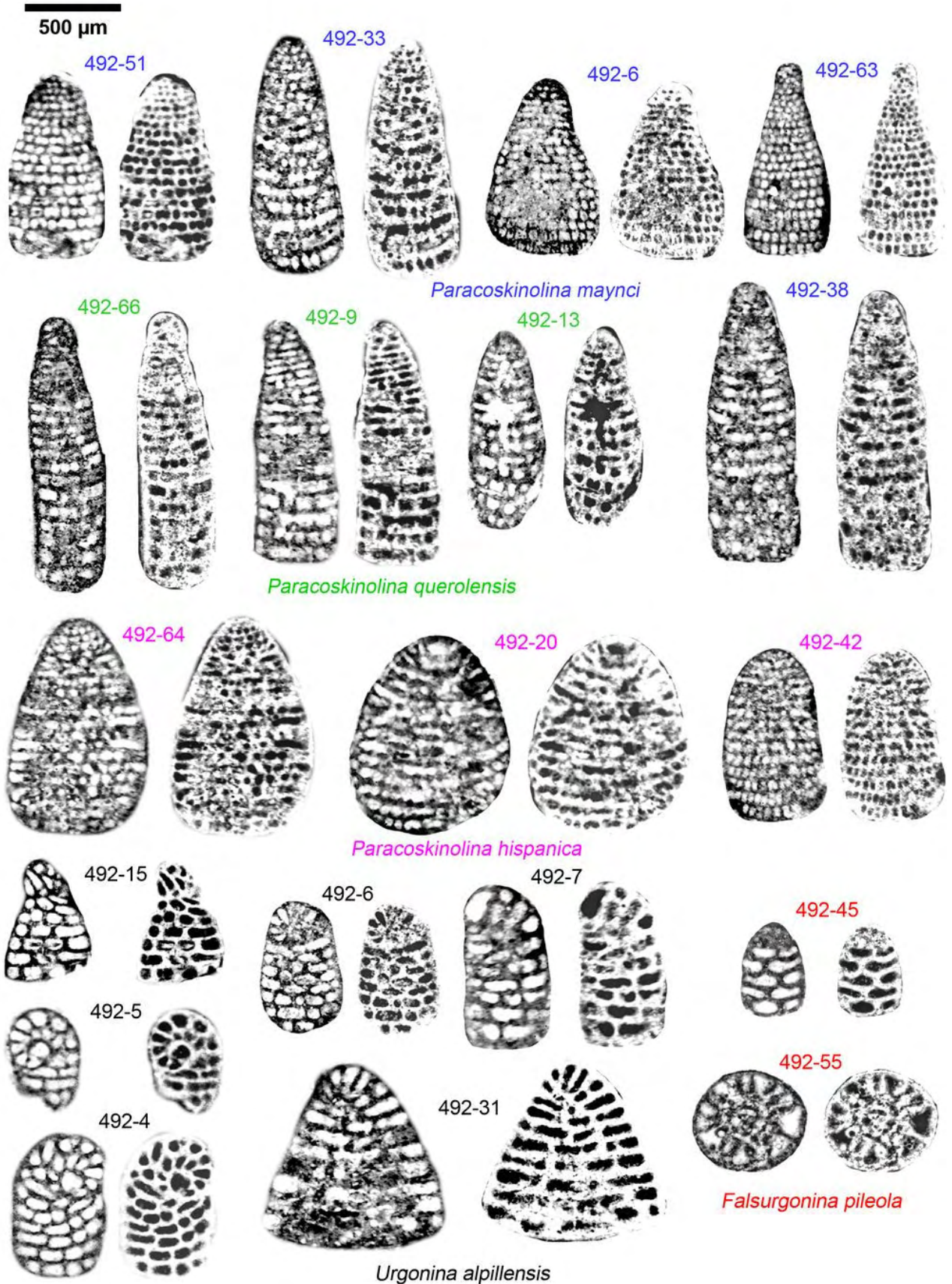


Plate 48: Orbitolinids of the Pulchella Zone at La Montagnette. *Falsurgonina pileola* : 492-45, 492-55; *Paracoskinolina hispanica* : 492-20, 492-42, 492-64; *Paracoskinolina maynci* : 492-6, 492-33, 492-38, 492-51, 492-63; *Paracoskinolina querolensis* : 492-9, 492-13, 492-66; *Urgonina alpillensis* : 492-4, 492-5, 492-6, 492-7, 492-15, 492-31. Scale bar = 500 µm.



500 µm

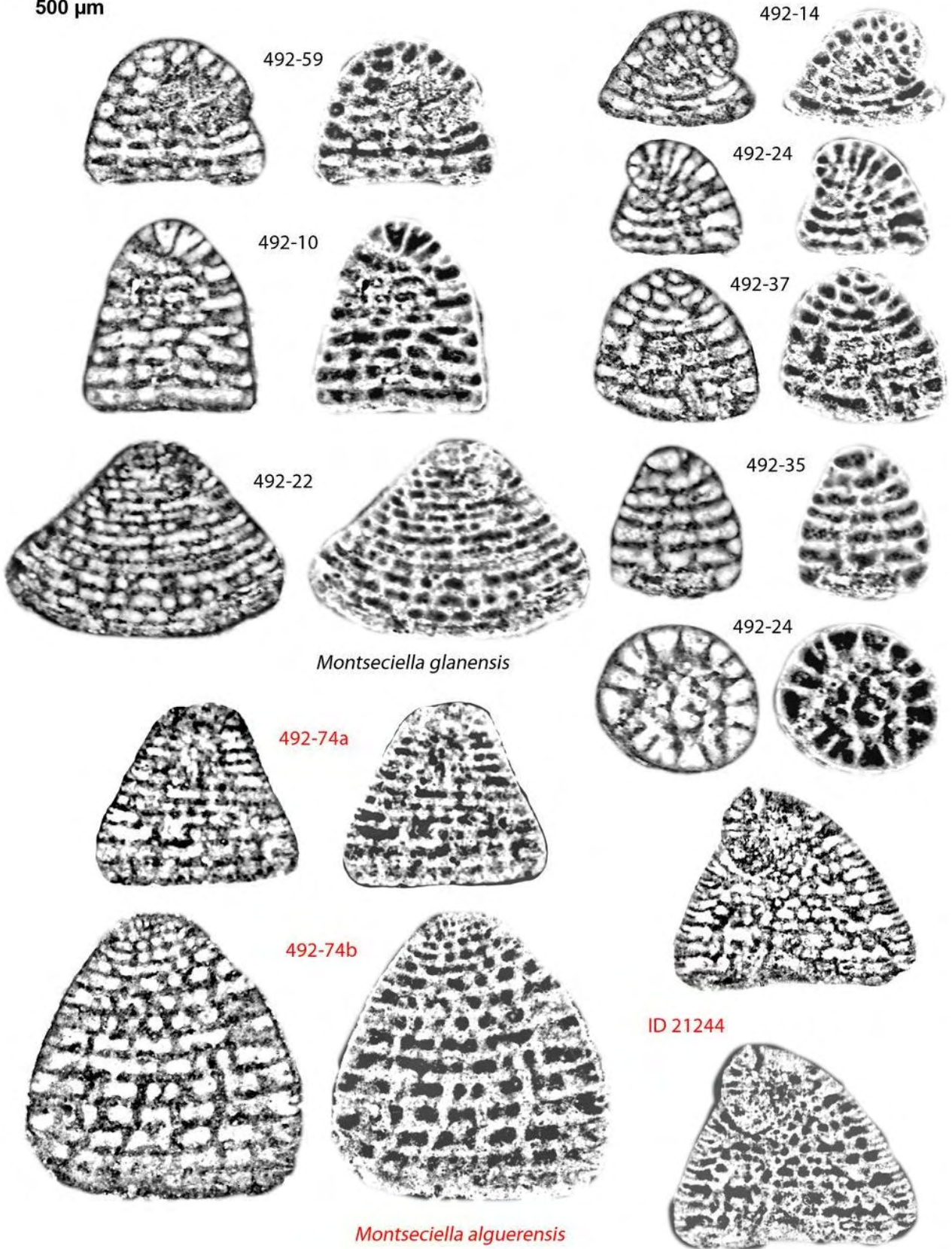


Plate 49: Orbitolinids of the Pulchella Zone at La Montagnette. *Montseciella algerensis*: 492-74a, 492-74b, ID 21244; *Montseciella glanensis*: 492-10, 492-14, 492-22, 492-24, 492-35, 492-37, 492-59. Note that Pl. 48, fig. ID 21244 is duplicated from ARNAUD-VANNEAU (1980, Pl. 106, fig. 5a) as "*Paleodictyoconus* n. sp. 2". Scale bar = 500 µm.

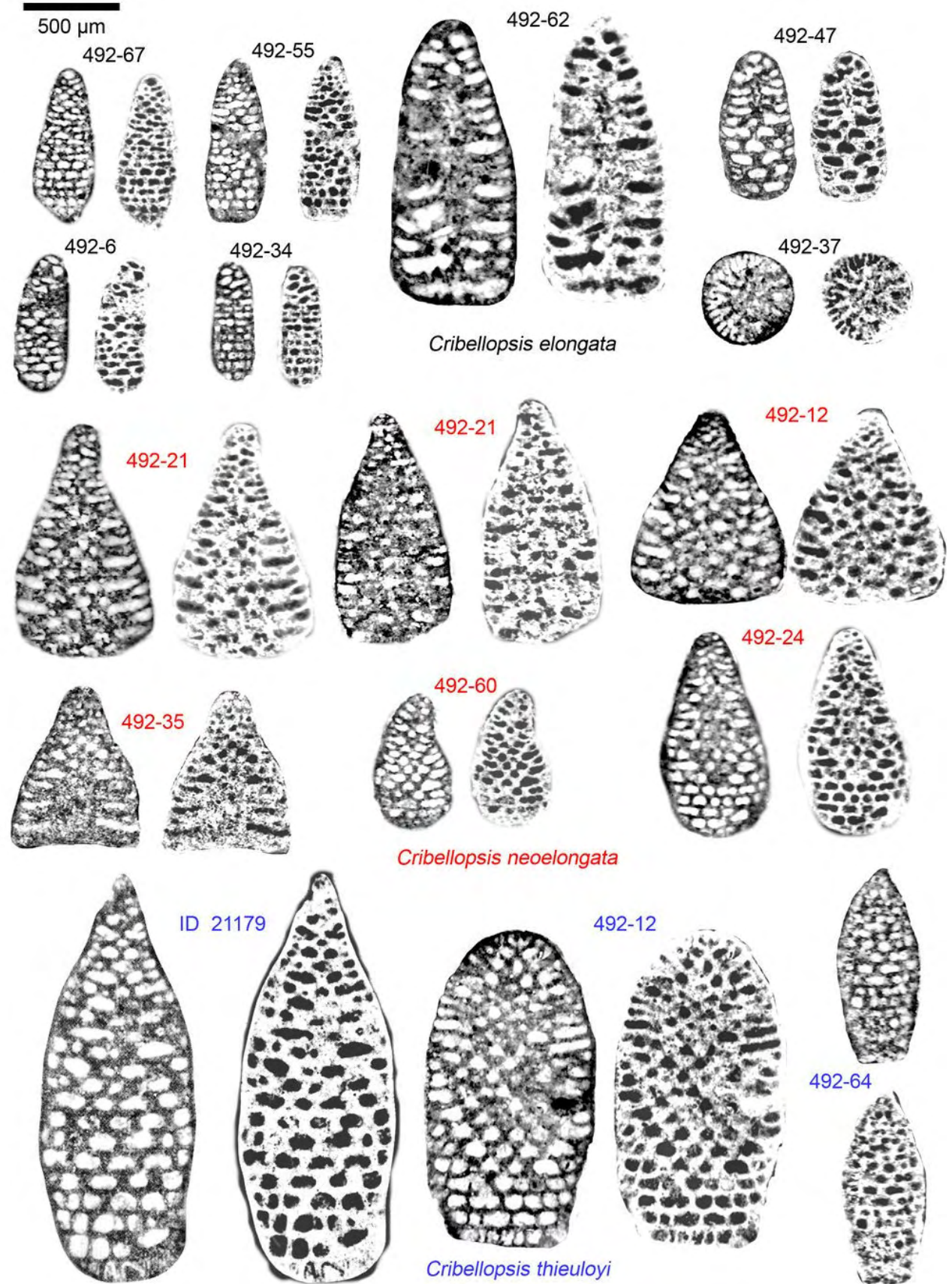


Plate 50: Orbitolinids of the Pulchella Zone at La Montagnette. *Cribellopsis elongata* : 492-6, 492-34, 492-37, 492-47, 492-55, 492-62, 492-67; *Cribellopsis neoelongata*: 492-12, 492-21, 492-24, 492-35, 492-60; *Cribellopsis thieuloyi*: 492-12, 492-64, ID 21179. Note that Pl. 49, fig. ID 21179 is duplicated from ARNAUD-VANNEAU (1980, Pl. 96, fig. 15). Scale bar = 500 µm.

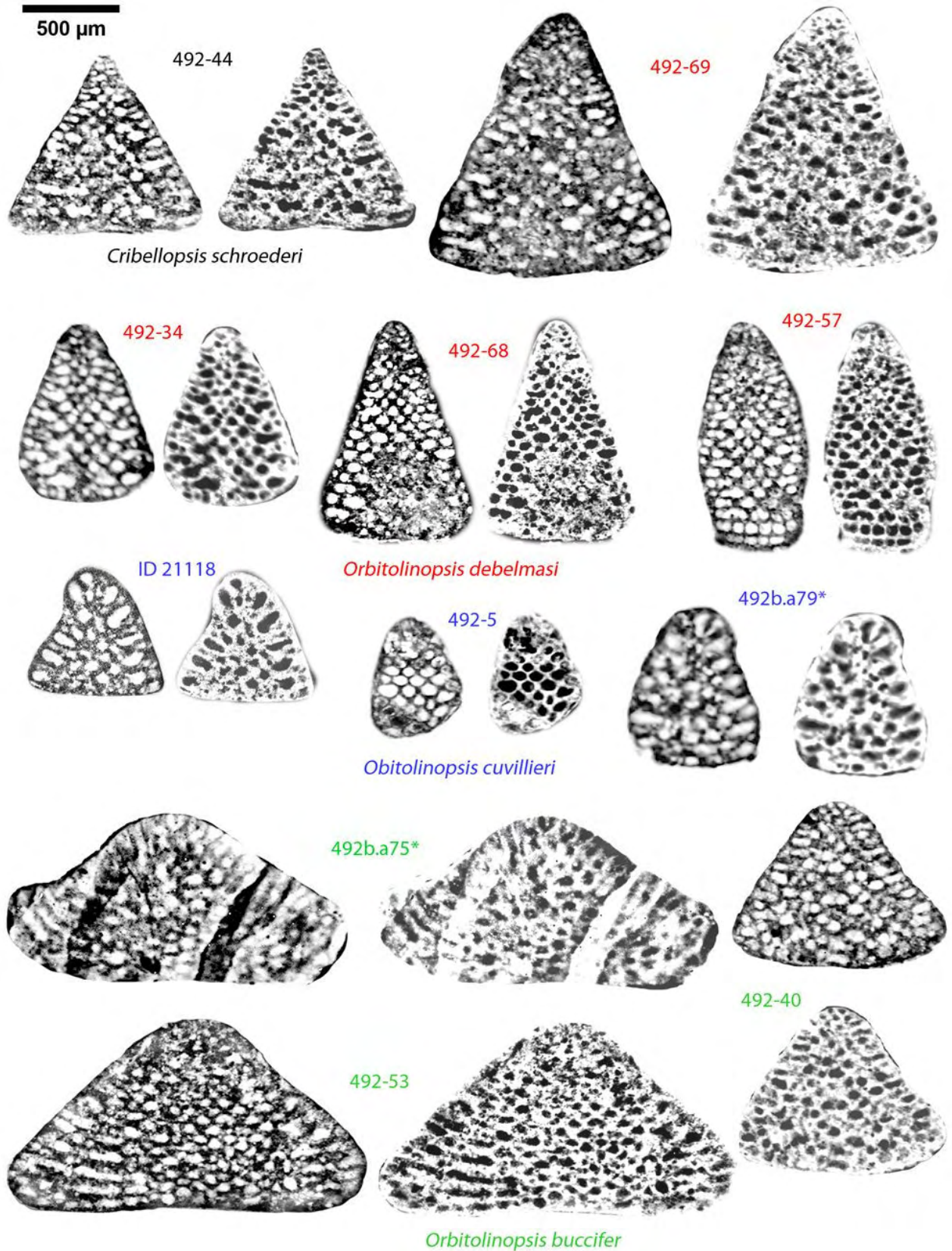


Plate 51: Orbitolinids of the Pulchella Zone at La Montagnette. *Cribellopsis schroederi* : 492-44; *Orbitolinopsis buccifer*: 492-53, 492-40, 492b.a75*; *Orbitolinopsis cuvillieri*: 492-5, 492b.a79*, ID21118; *Orbitolinopsis debelmasi*: 492-34a, 492-44, 492-57, 492-68, 492-69. Note that Pl. 50, fig. ID 21118 is duplicated from ARNAUD-VANNEAU (1980, Pl. 93, fig. 1). Scale bar = 500 µm.

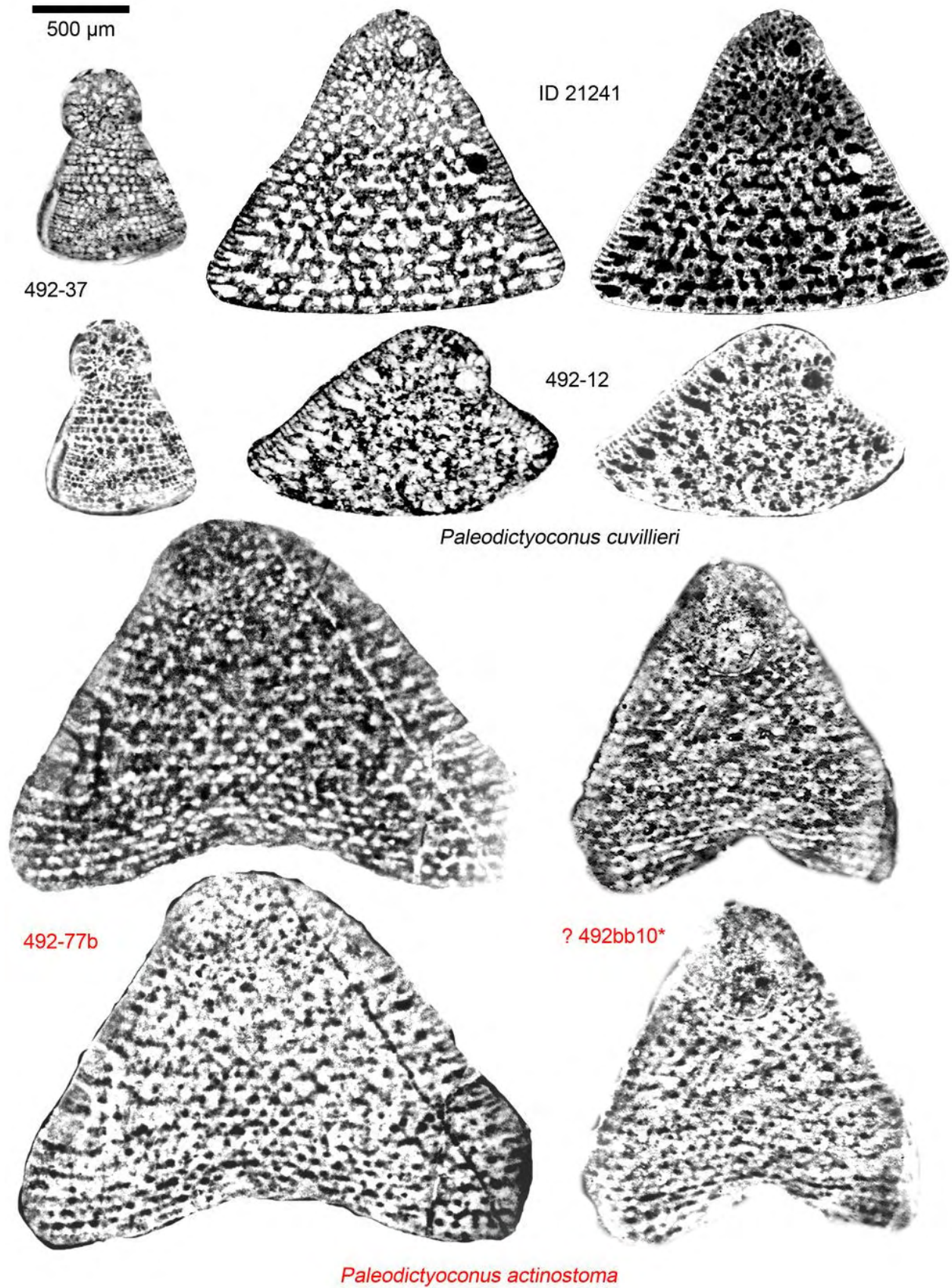


Plate 52: Orbitolinids of the Pulchella Zone at La Montagnette. *Paleodictyoconus actinostoma* : 492-77b, ? 492bb10* [NF]; *Paleodictyoconus cuvillieri*: 492-12, 492-37, ID21241. Note that Pl. 51, fig. ID 21241 is duplicated from ARNAUD-VANNEAU (1980, Pl. 106, fig. 1a). Scale bar = 500 μm.

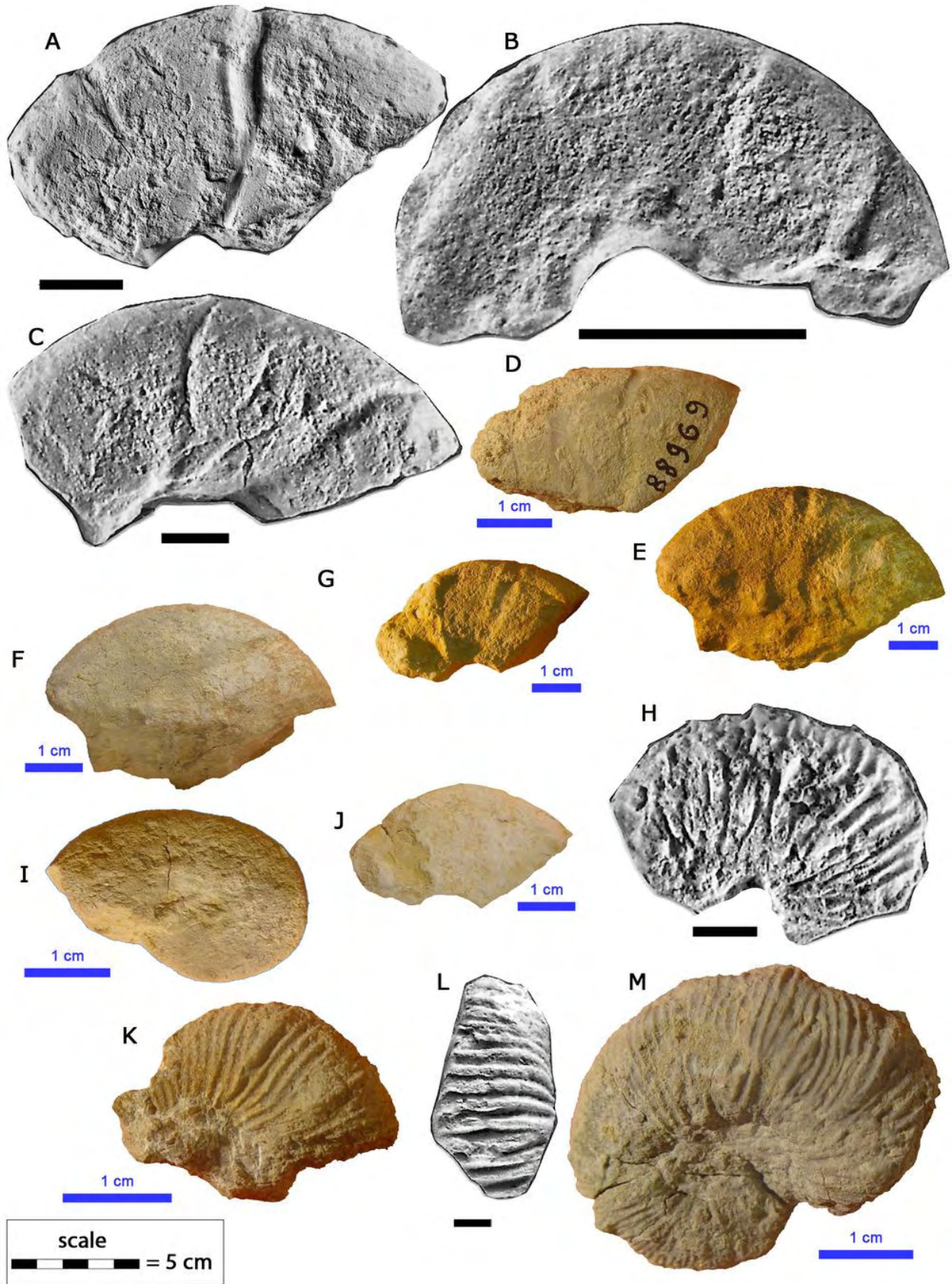


Plate 53: Ammonites of the *Compressissima*, *Moutonianum*, and *Vandenheckei* zones in the Serre de Tourre section. A) *Puezalpella* cf. *uhlgi*, FSL 89519; B) *Puezalpella* sp., FSL 89457; C) *Silesites* cf. *cirtense* -RB- {or *Silesites vulpes* -DB-}, FSL 89456; D) *Puezalpella* sp., FSL 88969; E) *Puezalpella* sp., FSL 88968a; F) *Puezalpella* sp., FSL 88968c; G) *Puezalpella* sp., FSL 88968d; H) *Holcodiscus diversecostatus* -RB- {or *Holcodiscus* sp. -DB-}, FSL 89458; I) *Barremites* sp., FSL 88971; J) *Puezalpella* sp., FSL 88968b; K) *Holcodiscus* sp., FSL 88970; L) *Holcodiscus* sp., FSL 89454; M) *Astieridiscus menglonensis*, FSL 88967. All scale bars = 1 cm.

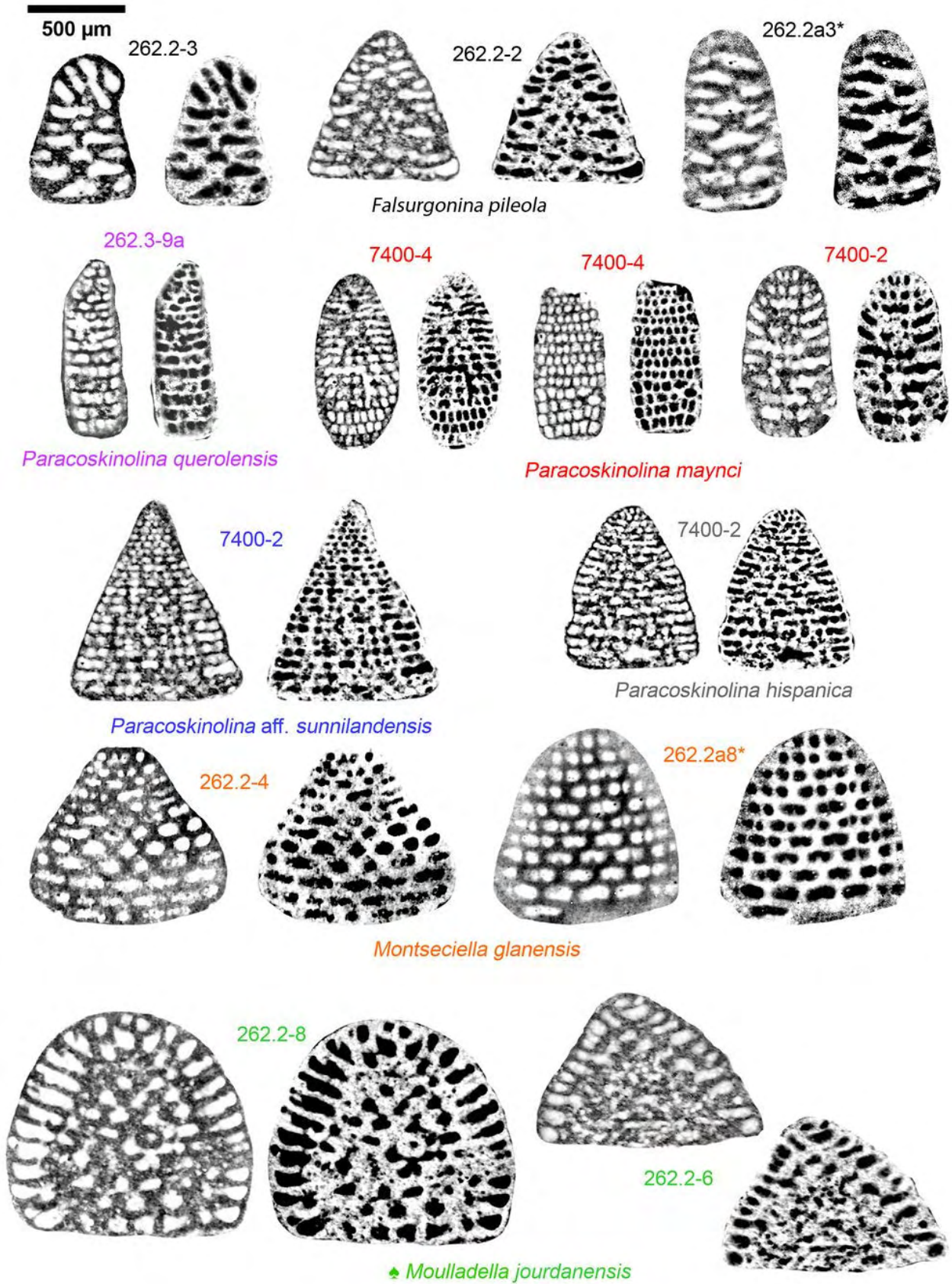
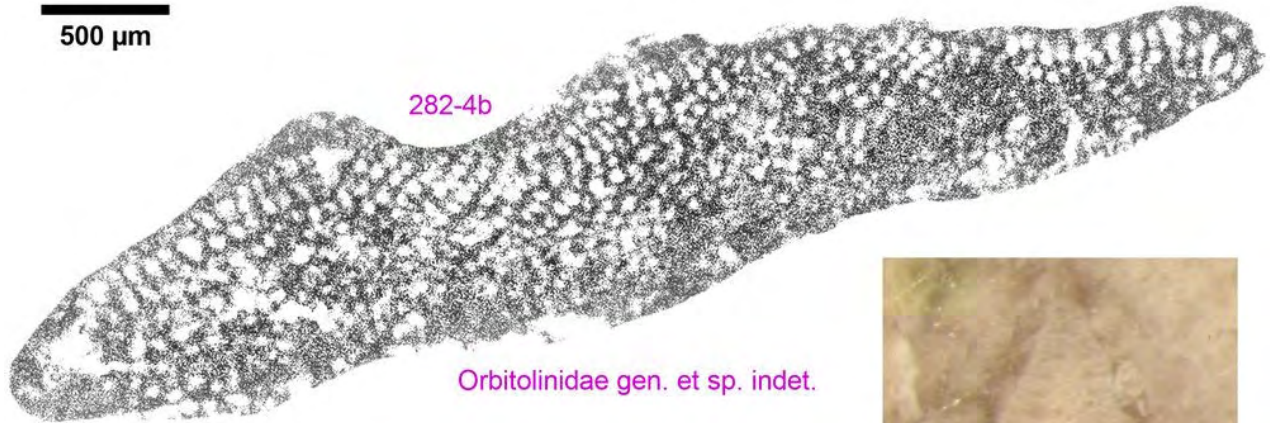


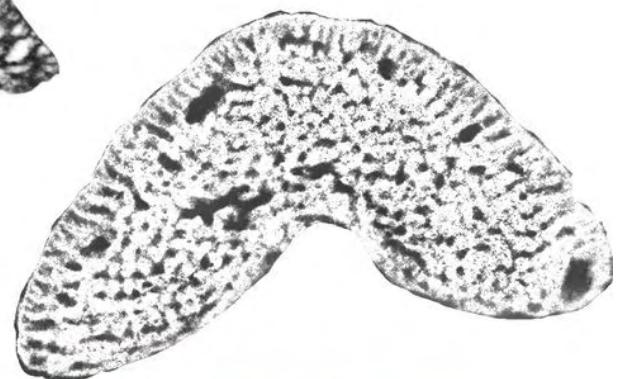
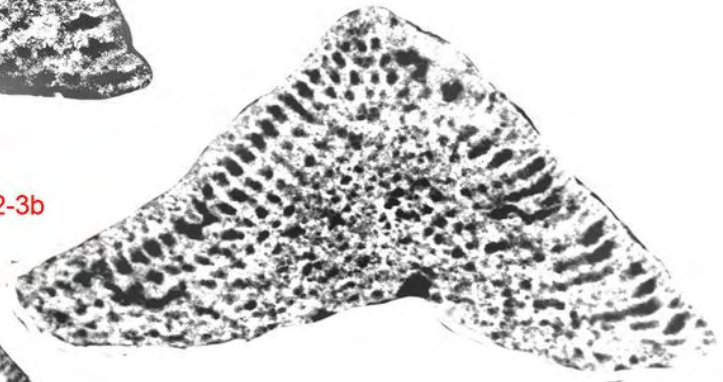
Plate 54: *Moulladella* and orbitolinids of the Pulchella zone in the Serre de Tourre section. ♣ *Moulladella jourdanensis*: 262.2-6, 262.2-8; *Falsurgonina pileola*: 262.2-2, 262.2-3, 262.2a3*; *Montseciella glanensis*: 262.2-4, 262.2a8*; *Paracoskinolina hispanica*: 7400-2; *Paracoskinolina maynci*: 7400-2, 7400-4; *Paracoskinolina querolensis*: 262.3-9a; *Paracoskinolina aff. sunnilandensis*: 7400-2. Scale bar = 500 µm.



500 µm



Cribellopsis schroederi

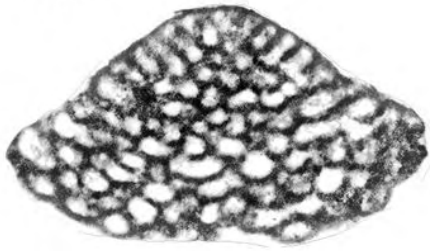


Paleodictyoconus actinostoma

Plate 55: Orbitolinids of the Pulchella zone in the Serre de Tourre section. Orbitolinidae gen. et sp. indet.: 282-4b; *Cribellopsis schroederi*: 282a13*; *Paleodictyoconus actinostoma*: 282-3b, 282-5b. Scale bar = 500 µm.



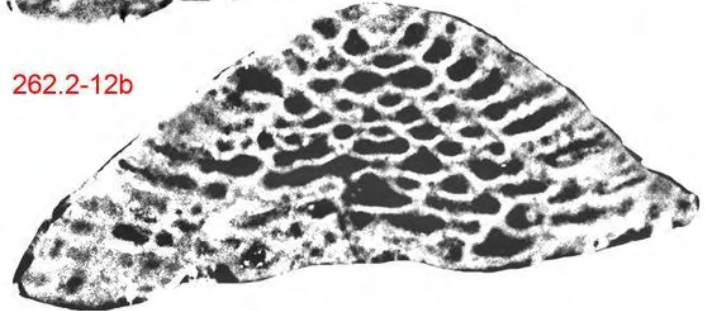
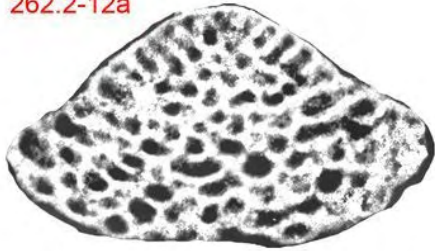
500 µm



262.2-12a



262.2-12b

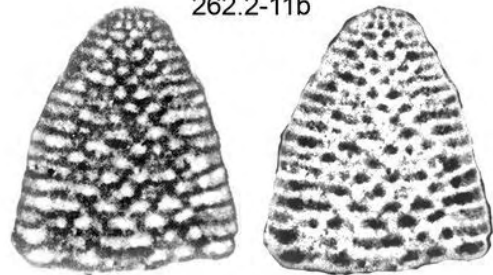


Orbitolinopsis buccifer



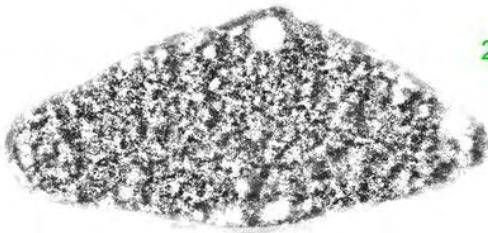
262.2a2*

Urgonina alpillensis

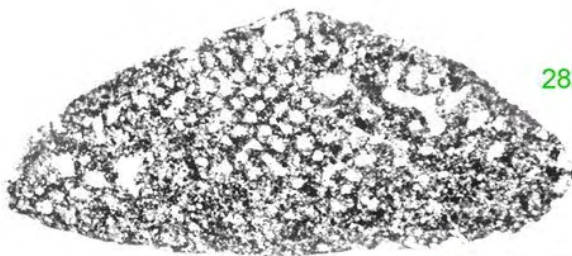
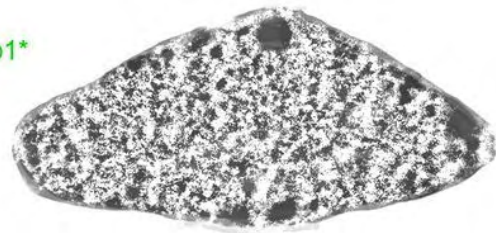


262.2-11b

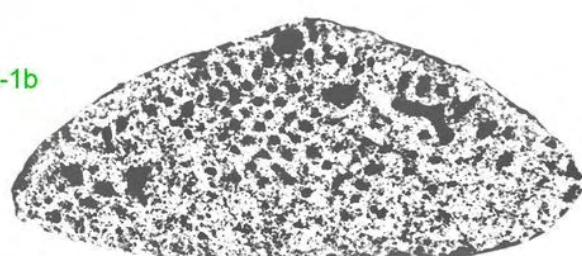
Orbitolinopsis debelmasi



262.2b1*



282-1b



cf. *Eopalorbitolina transiens*

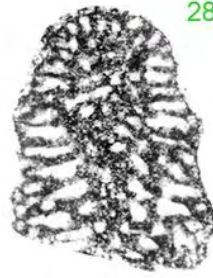
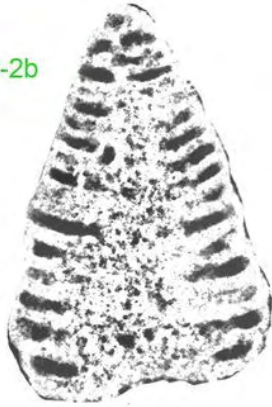
Plate 56: Orbitolinids of the Pulchella zone in the Serre de Tourre section. cf. *Eopalorbitolina transiens*: 282-1b, 262.2b1*; *Orbitolinopsis buccifer*: 262.2-12a, 262.2-12b; *Orbitolinopsis debelmasi*: 262.2-11b; *Urgonina alpillensis*: 262.2a2*. Scale bar = 500 µm.



500 µm



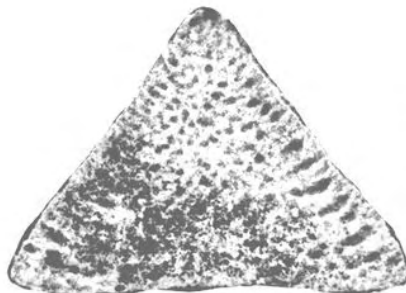
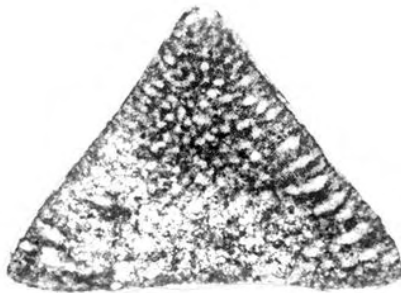
282-2b



282-1b



♣ *Moulladella jourdanensis*



Valserina gr. *broennimanni-turbinata* 282-2a



282-1a



Paracoskinolina maynci



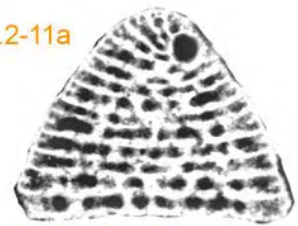
282-3a



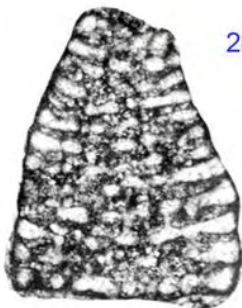
Paracoskinolina ? *praereicheli*



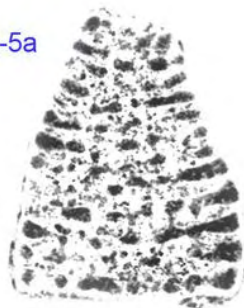
262.2-11a



Paracoskinolina ? *reicheli*



282-5a



282-4a



Cribellopsis neolongata

Plate 57: *Moulladella* and orbitolinids of the Pulchella zone in the Serre de Tourre section. ♣ *Moulladella jourdanensis*: 282-1b, 282-2b; *Cribellopsis neolongata*: 282-4a, 282-5a; *Paracoskinolina maynci*: 282-1a; *Paracoskinolina* ? *praereicheli*: 282-3a; *Paracoskinolina* ? *reicheli*: 262.2-11a; *Valserina* gr. *broennimanni-turbinata*: 282-2a. Scale bar = 500 µm.

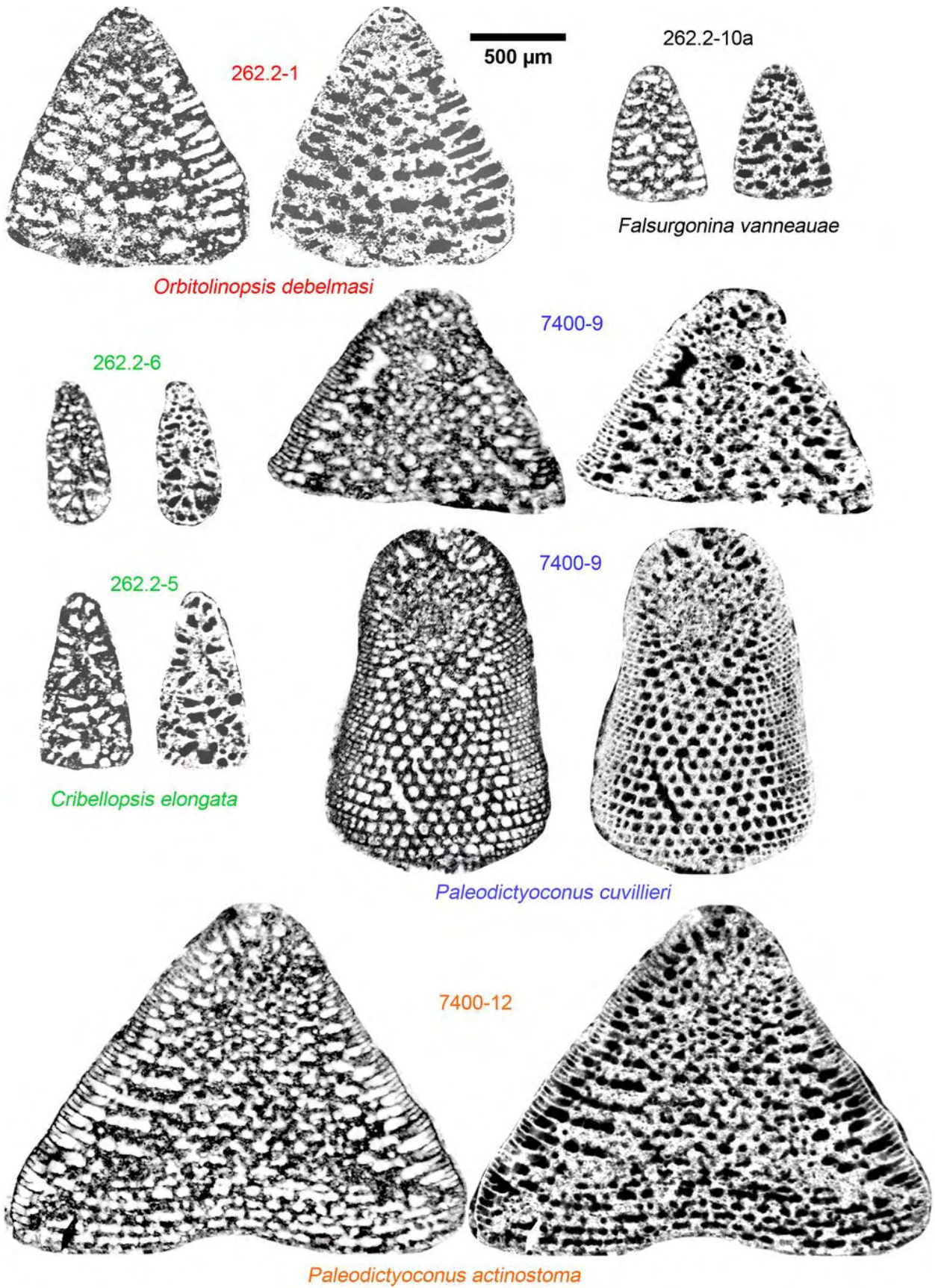
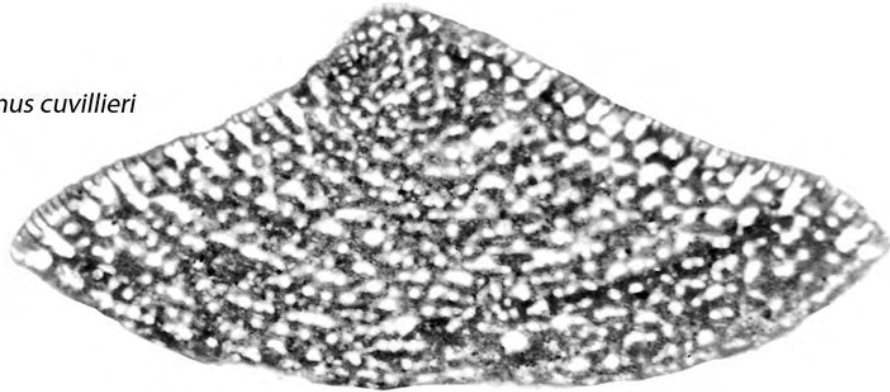


Plate 58: Orbitolinids of the Pulchella zone in the Serre de Tourre section. *Cribellopsis elongata*: 262.2-5, 262.2-6; *Falsurgonina vanneauae*: 262.2-10a; *Orbitolinopsis debelmasi*: 262.2-1; *Paleodictyoconus actinostoma*: 7400-12; *Paleodictyoconus cuvillieri*: 7400-9. Scale bar = 500 μ m.

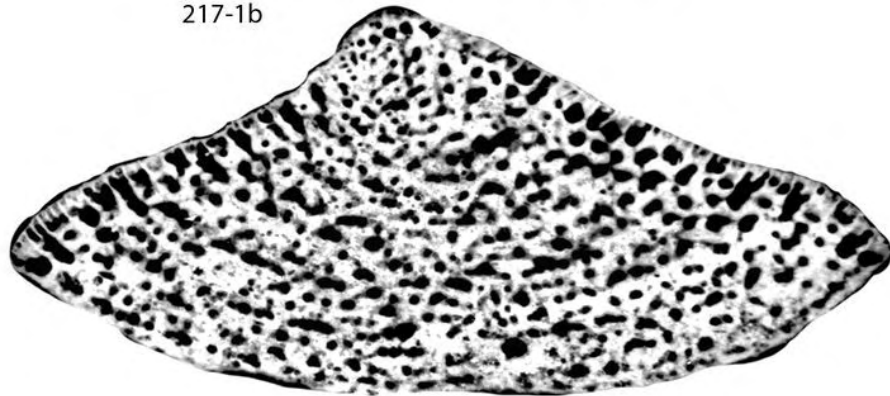


500 μ m

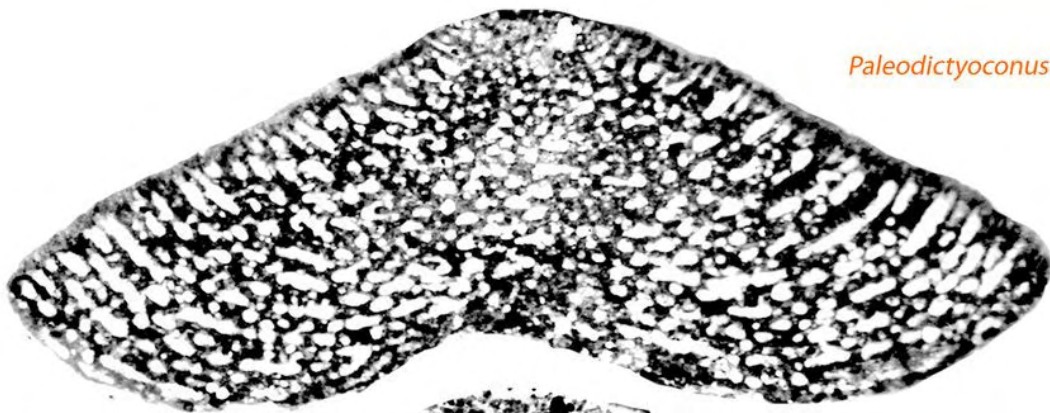
Paleodictyoconus cuvillieri



217-1b



Paleodictyoconus actinosoma



217-1c

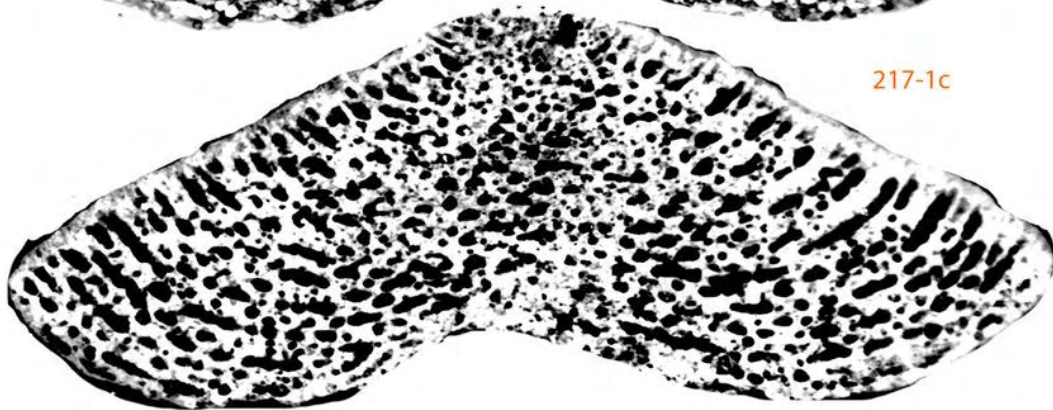


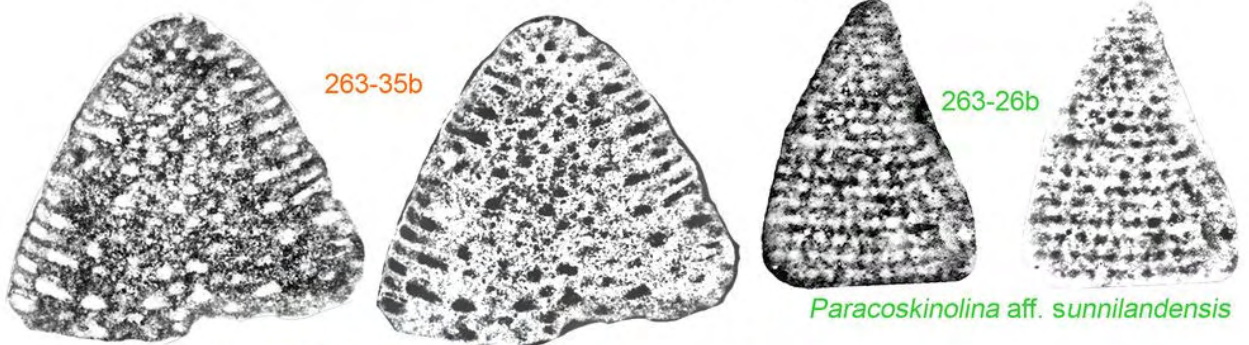
Plate 59: Orbitolinids of the Compressissima zone in the Serre de Tourre section. *Paleodictyoconus actinosoma*: 217-1c; *Paleodictyoconus cuvillieri*: 217-1b. Scale bar = 500 μ m.



500 µm

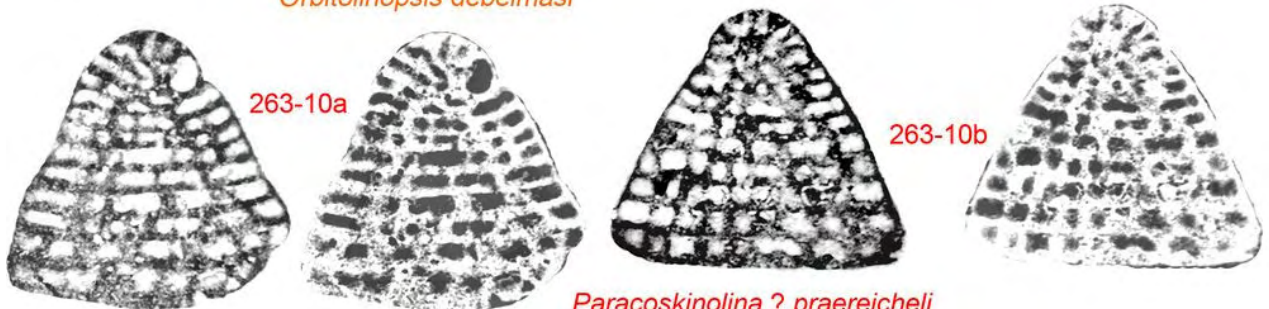


Paleodictyoconus actinostoma

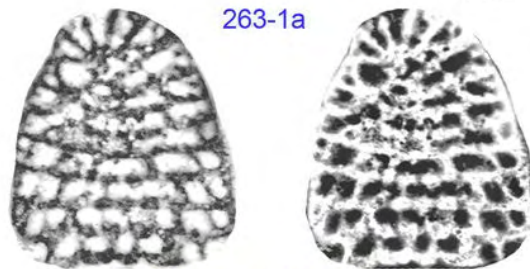
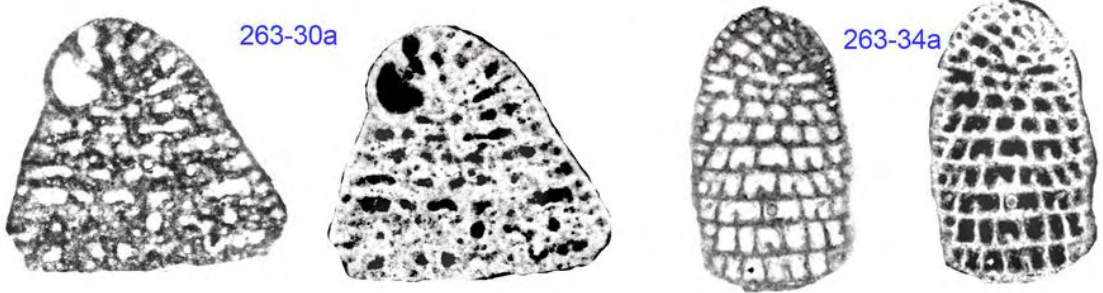


Orbitolinopsis debelmasi

Paracoskinolina aff. sunnilandensis



Paracoskinolina ? praereicheli



Paracoskinolina ? reicheli

Plate 60: Orbitolinids of the Compressissima zone in the Serre de Tourre section. *Orbitolinopsis debelmasi*: 263-35b; *Paleodictyoconus actinostoma*: 217-1a; *Paracoskinolina ? praereicheli*: 263-10a, 263-10b; *Paracoskinolina ? reicheli*: 263-1a, 263-30a, 263-34a; *Paracoskinolina aff. sunnilandensis*: 263-26b. Scale bar = 500 µm.

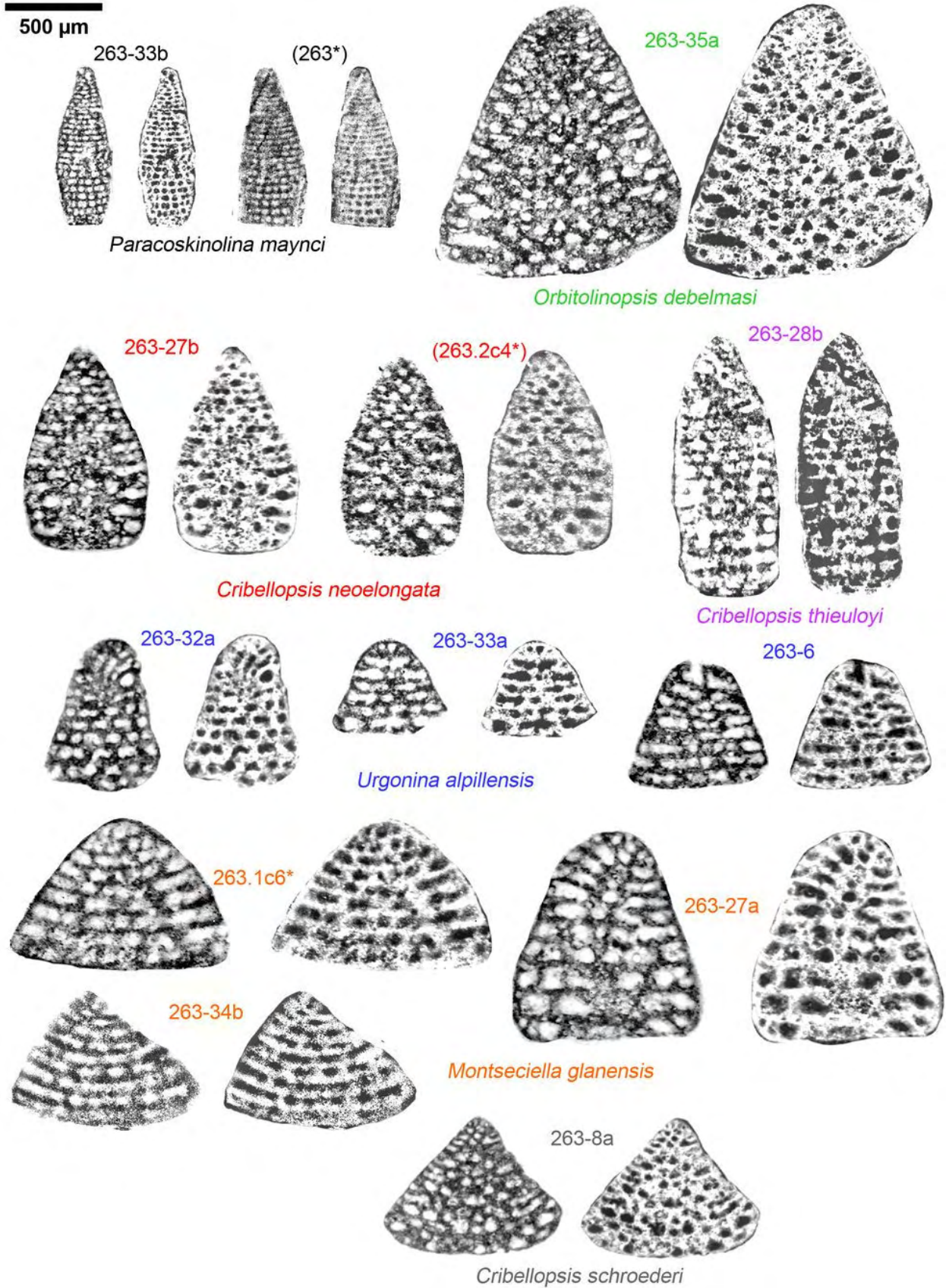


Plate 61: Orbitolinids of the Compressissima zone in the Serre de Tourre section. *Cribellopsis neoelongata*: 263-27b (263.2c4*); *Cribellopsis schroederi*: 263-8a; *Cribellopsis thieuloyi*: 263-28b; *Montseciella glanensis*: 263.1c6*, 263-27a, 263-34b; *Orbitolinopsis debelmasi*: 263-35a; *Paracoskinolina maynci*: 263-33b (263*); *Urganina alpillensis*: 263-6, 263-32a, 263-33a. Scale bar = 500 µm.

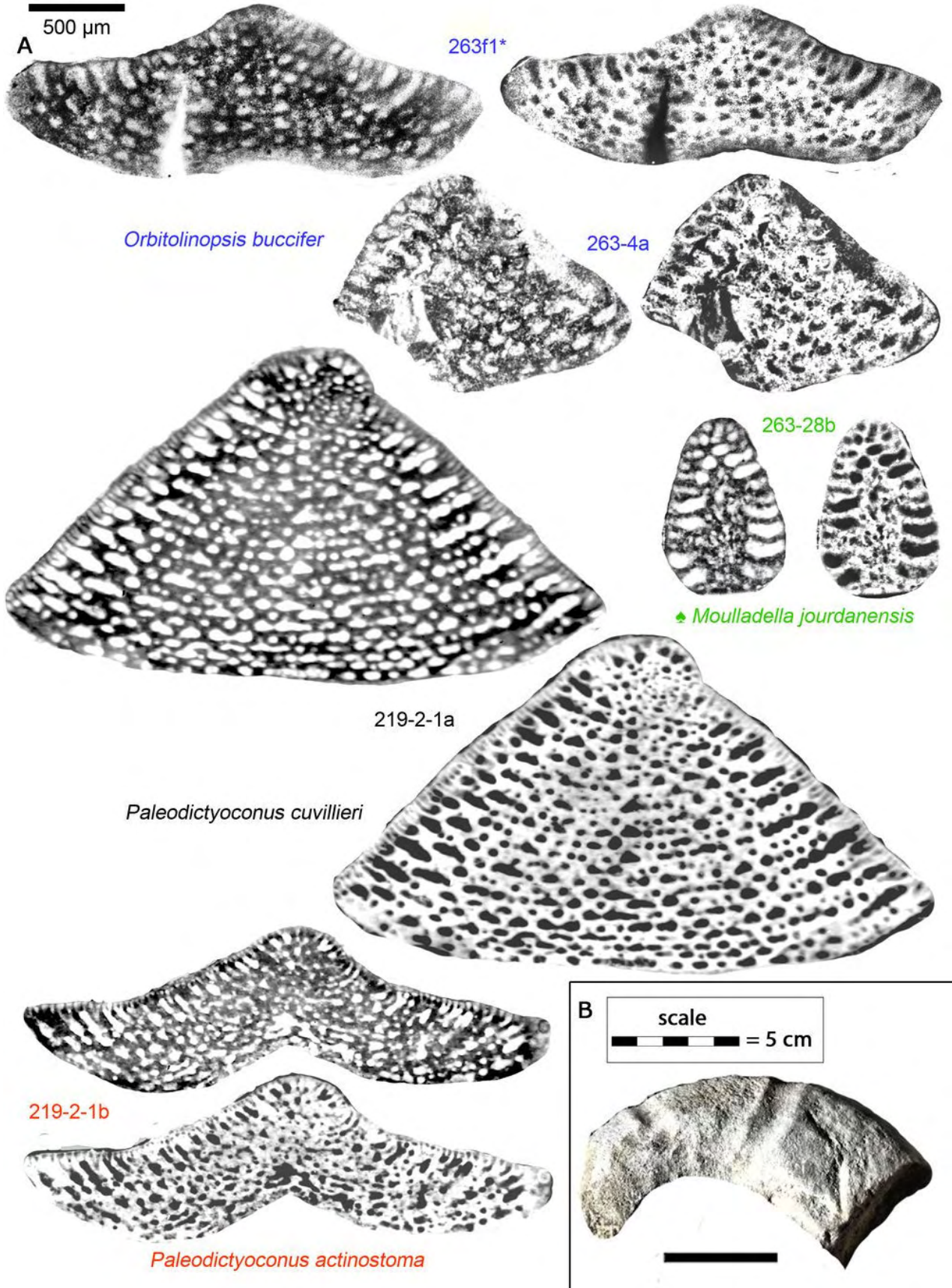


Plate 62: A) *Moulladella* and orbitolinids of the Moutonianum zone in the Serre de Tourre section. ♣ *Moulladella jourdanensis*: 263-28b; *Orbitolinopsis buccifer*: 263f1*, 263-4a; *Paleodictyoconus actinostoma*: 219-2-1b; *Paleodictyoconus cuvillieri*: 219-2-1a. B) *Puezalpella* cf. *uhligi*, FSL 88968e. Scale bar (A) = 500 μ m, and ammonite scale bar (B) = 5 cm.

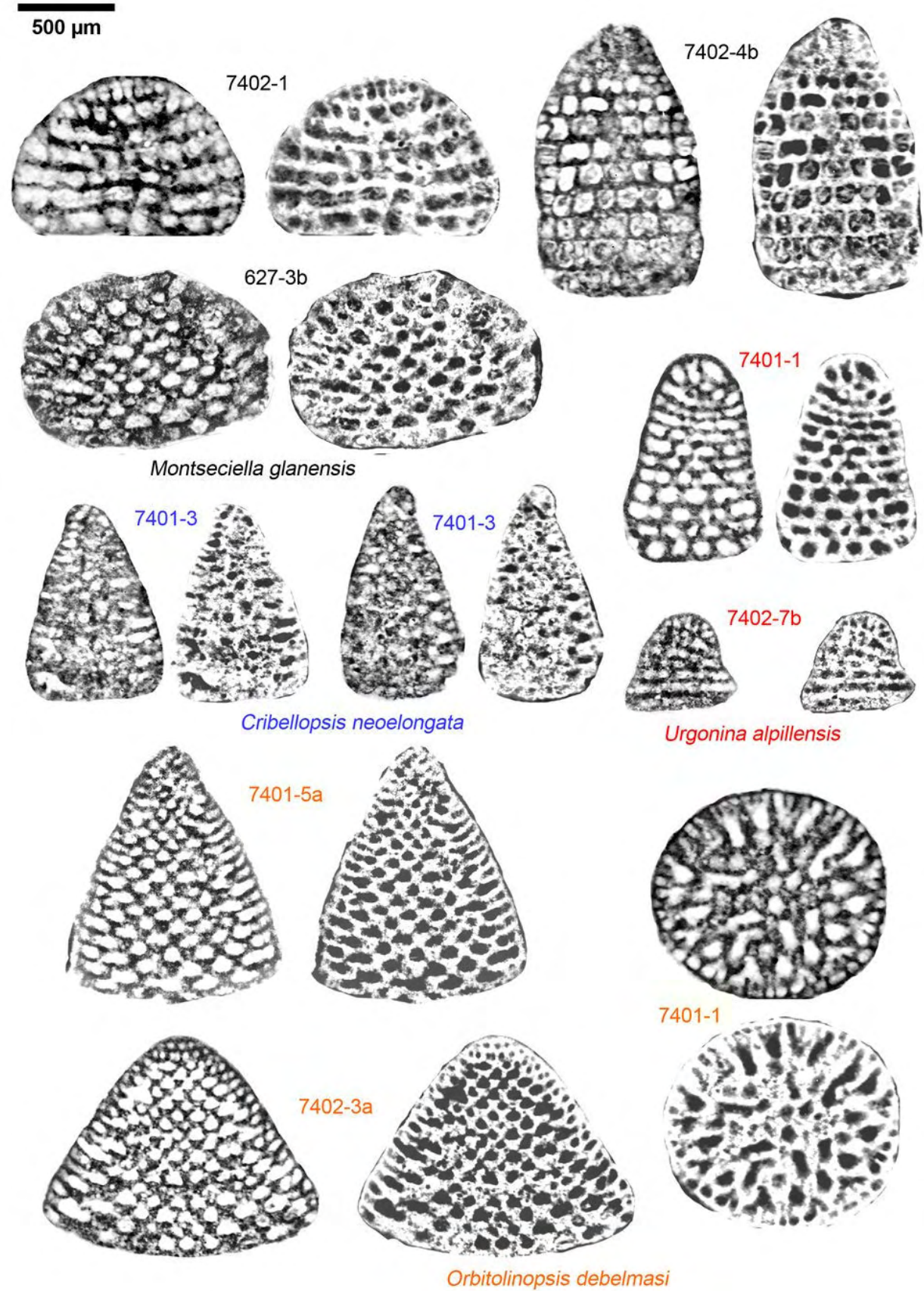


Plate 63: Orbitolinids of the Vandenheckei zone in the Serre de Tourre section. *Cribellopsis neoelongata*: 7401-3; *Montseciella glanensis*: 627-3b, 7402-1, 7402-4b; *Orbitolinopsis debelmasi*: 7401-1, 7401-5a, 7402-3a; *Urgonina alpillensis*: 7401-1, 7402-7b. Scale bar = 500 µm.

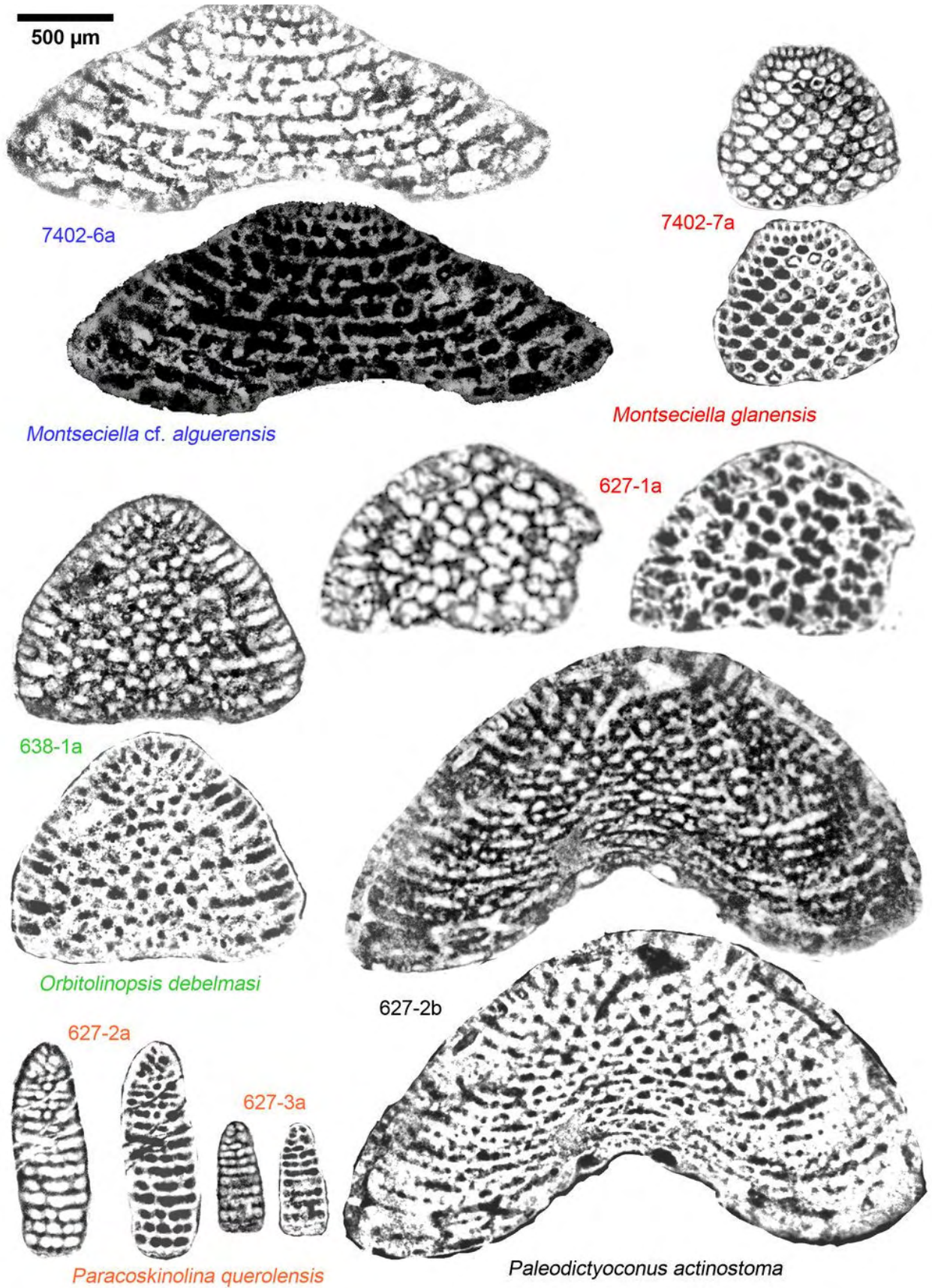


Plate 64: Orbitolinids of the Vandenheckei zone in the Serre de Tourre section. *Montseciella cf. alguerensis*: 7402-6a; *Montseciella glanensis*: 627-1a, 7402-7a; *Orbitolinopsis debelmasi*: 638-1a; *Paleodictyoconus actinostoma*: 627-2b; *Paracoskinolina querolensis*: 627-2a, 627-3a. Scale bar = 500 μ m.

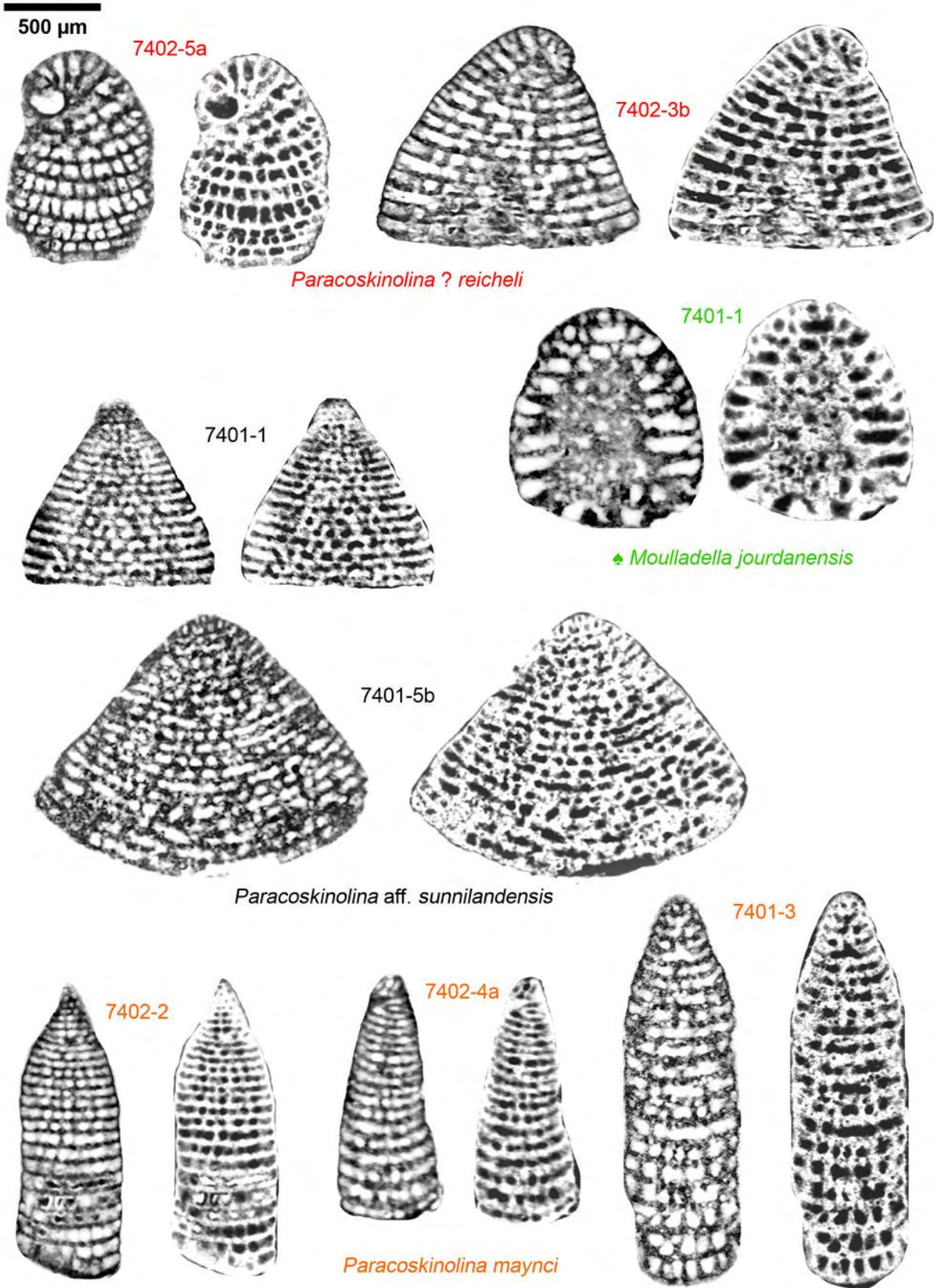
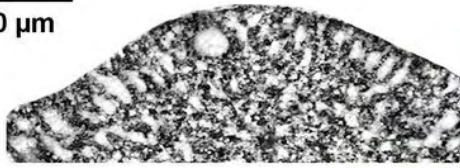


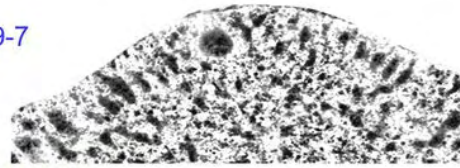
Plate 65: *Moulladella* and orbitolinids of the Vandenheckei zone in the Serre de Tourre section. ♣ *Moulladella jourdanensis*: 7401-1; *Paracoskinolina maynci*: 7401-3, 7402-2, 7402-4a; *Paracoskinolina ? reicheli*: 7402-3b, 7402-5a; *Paracoskinolina aff. sunnilandensis*: 7401-1, 7401-5b. Scale bar = 500 μm .



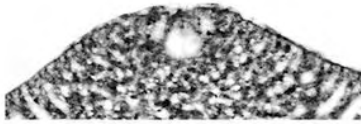
500 µm



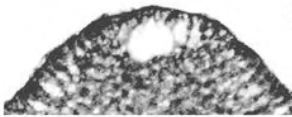
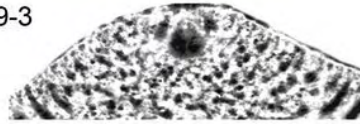
339-7



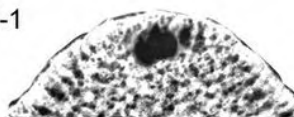
Eopalorbitolina transiens



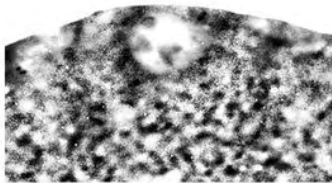
339-3



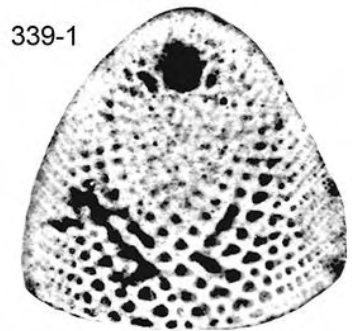
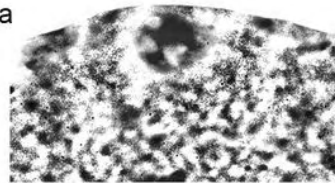
336-1



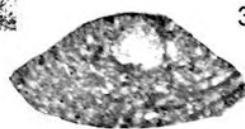
339-1



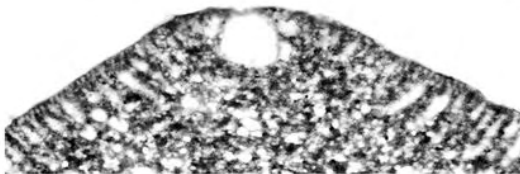
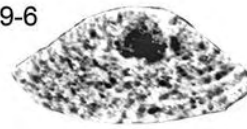
340-1a



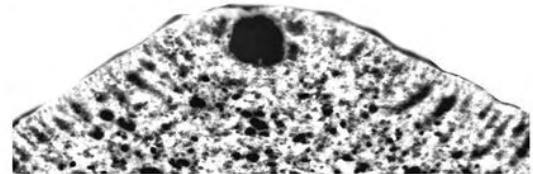
339-12a



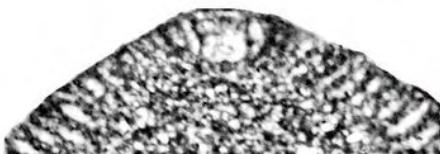
339-6



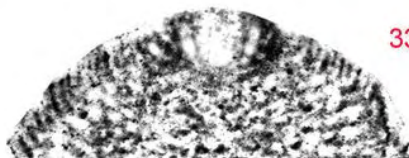
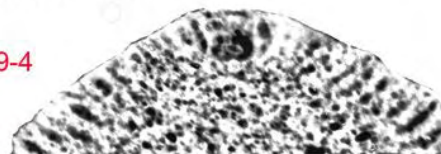
339-2



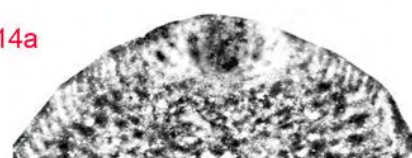
Palorbitolina lenticularis



339-4



339-14a



Palorbitolina ultima

Plate 66: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Eopalorbitolina transiens*: 339-7; *Palorbitolina lenticularis*: 336-1, 339-1, 339-2, 339-2, 339-3, 339-6, 339-12a, 340-1a; *Palorbitolina ultima*: 339-4, 339-14a. Scale bar = 500 µm.

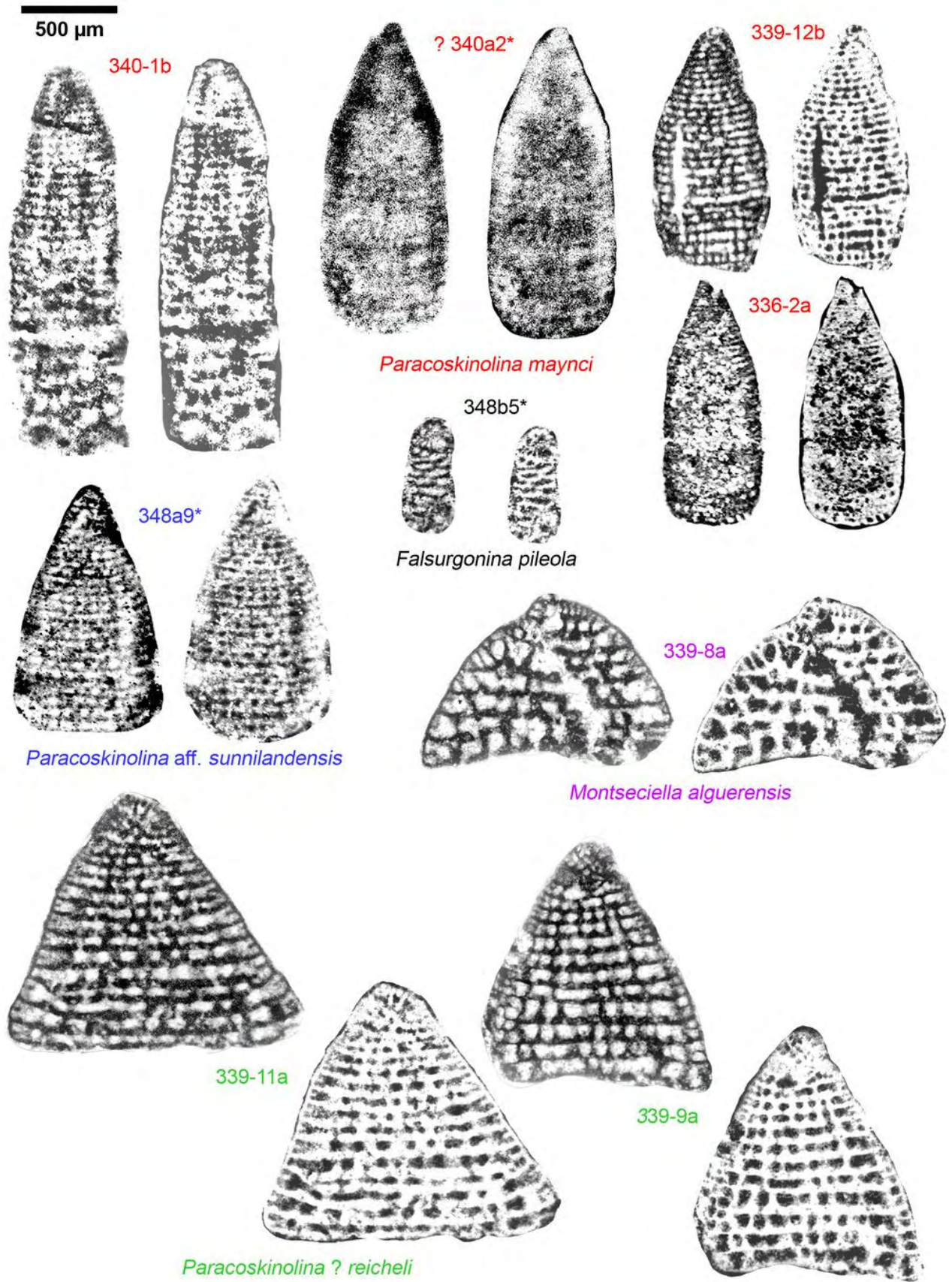
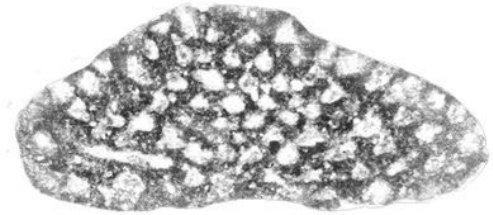
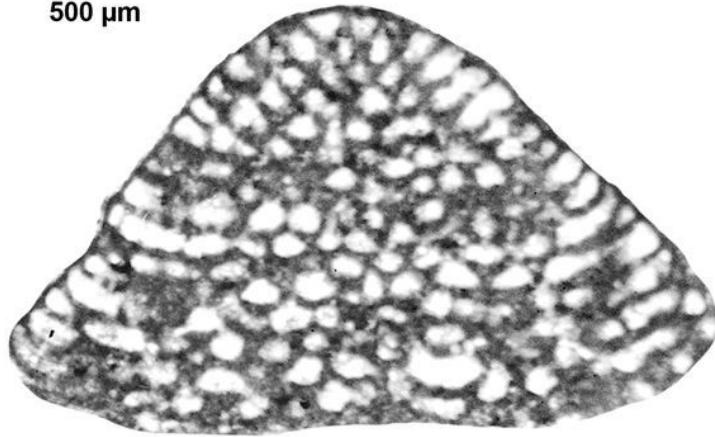


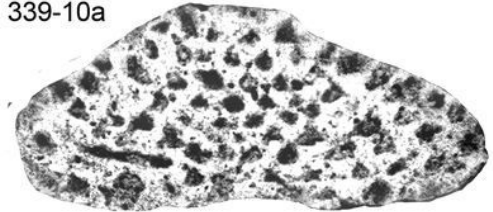
Plate 67: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Falsurgonina pileola*: 348b5*; *Montseciella alguerensis*: 339-8a; *Paracoskinolina maynci*: 336-2a, 339-12b, ? 340a2* [NF], 340-1b; *Paracoskinolina ? reicheli*: 339-9a, 339-11a.; *Paracoskinolina aff. sunnilandensis*: 348a9*. Scale bar = 500 µm.



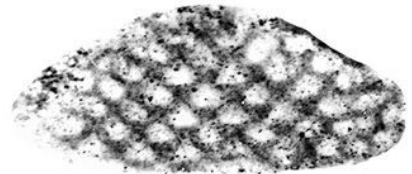
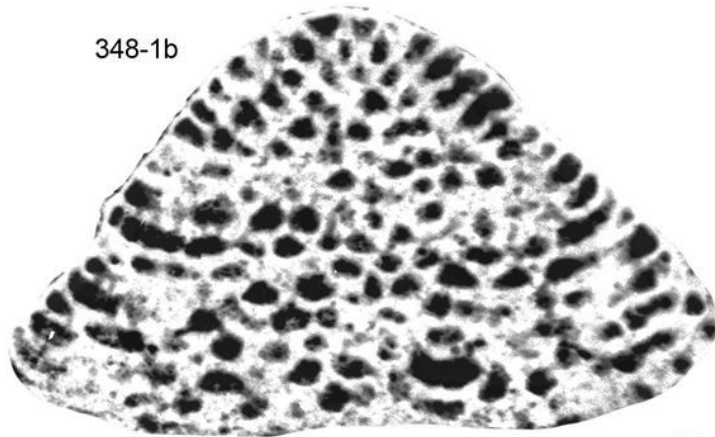
500 μ m



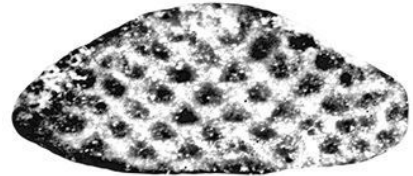
339-10a



348-1b



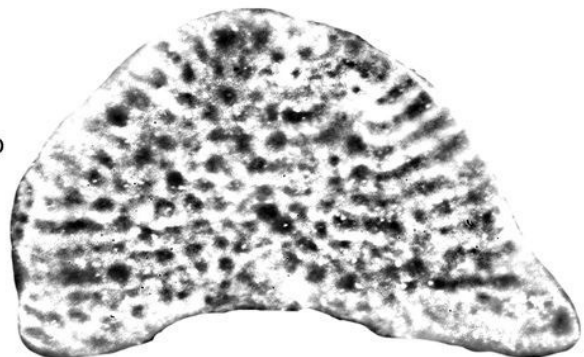
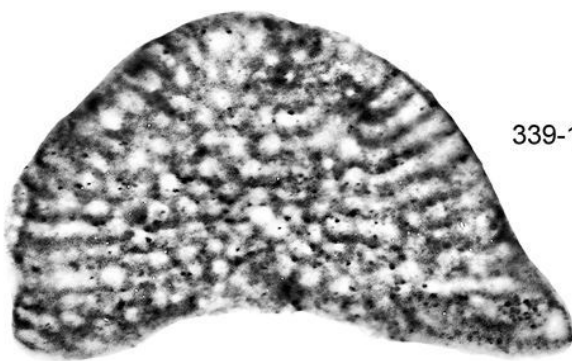
340-1b



348b10



339-14b



Orbitolinopsis buccifer

Plate 68: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Orbitolinopsis buccifer*: 339-10a, 339-14b, 340-1b, 348-1b, ? 348b10*[NF]. Scale bar = 500 μ m.

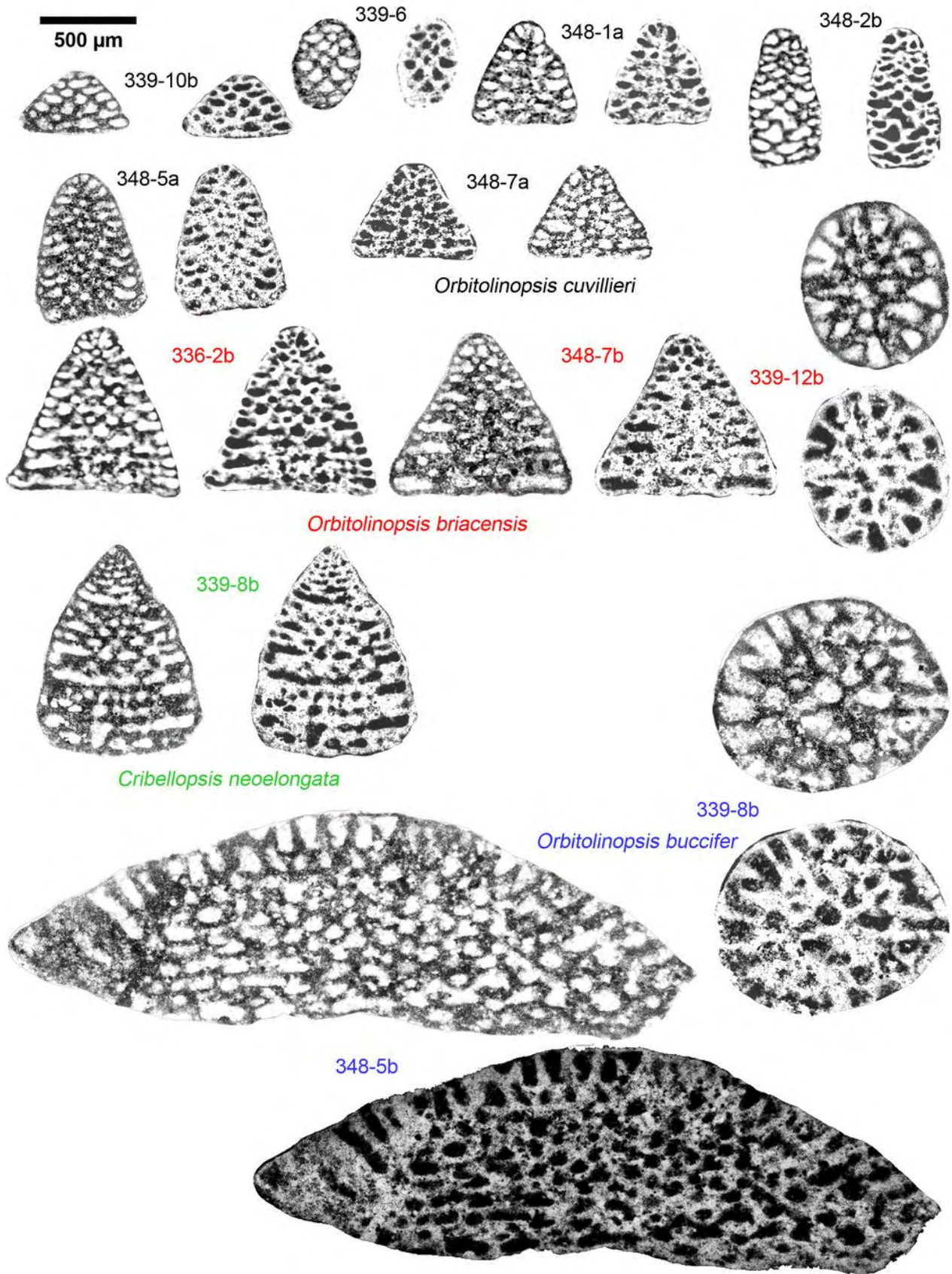
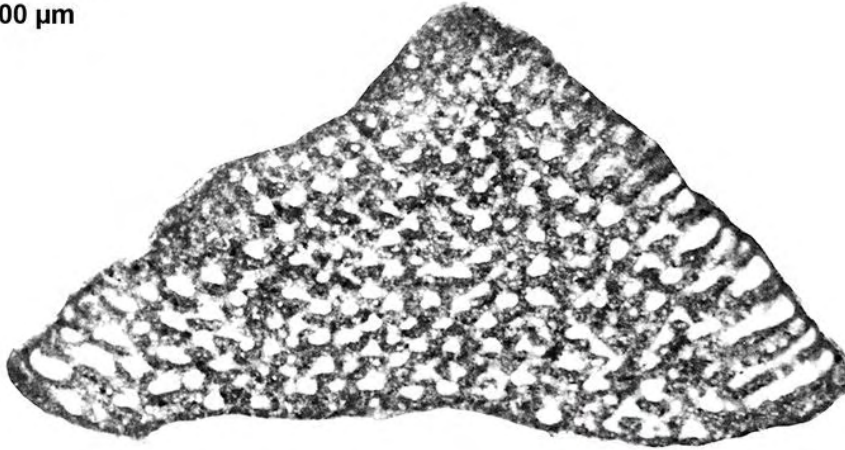


Plate 69: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Cribellopsis neolongata*: 339-8b; *Orbitolinopsis briacensis*: 336-2b, 339-12b, 348-7b; *Orbitolinopsis buccifer*: 339-8b, 348-5b; *Orbitolinopsis cuvillieri*: 339-6, 339-10b, 348-1a, 348-2b, 348-7a, 348-5a. Scale bar = 500 μm .

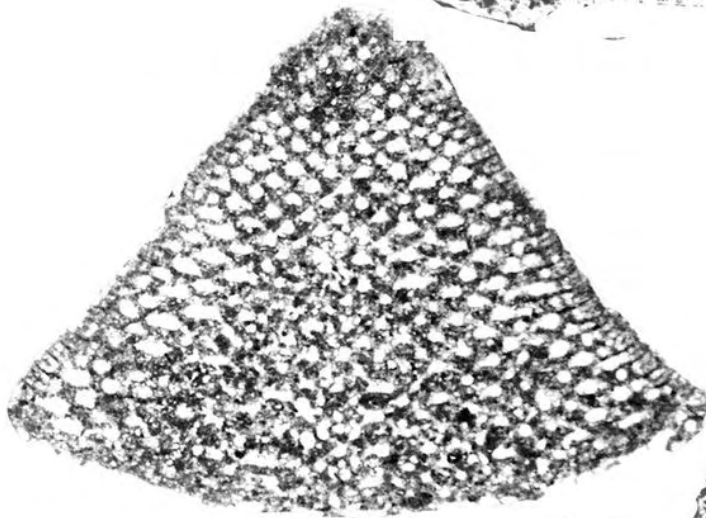
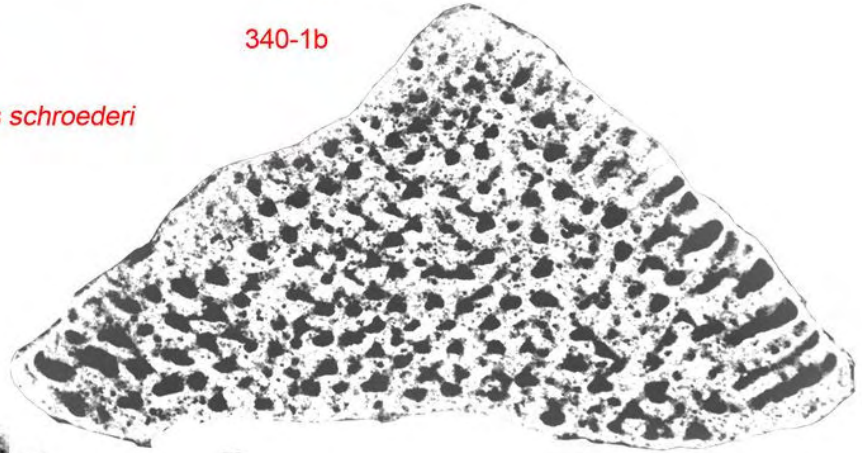


500 μ m



340-1b

Cribellopsis schroederi



340-1b

Paleodictyoconus cuvillieri

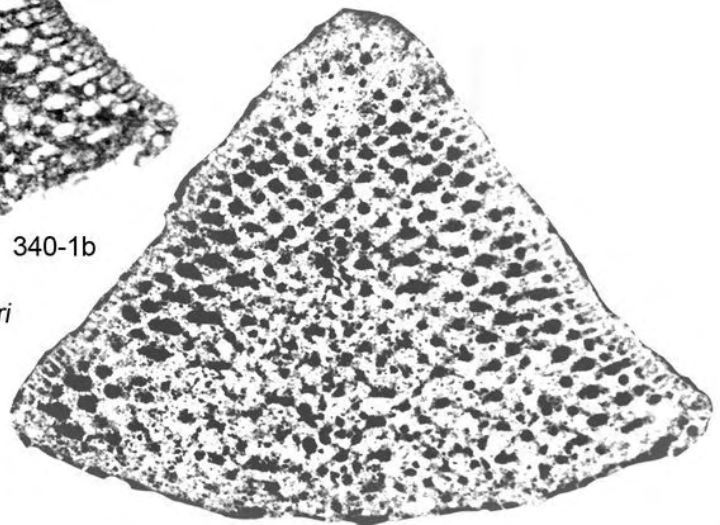
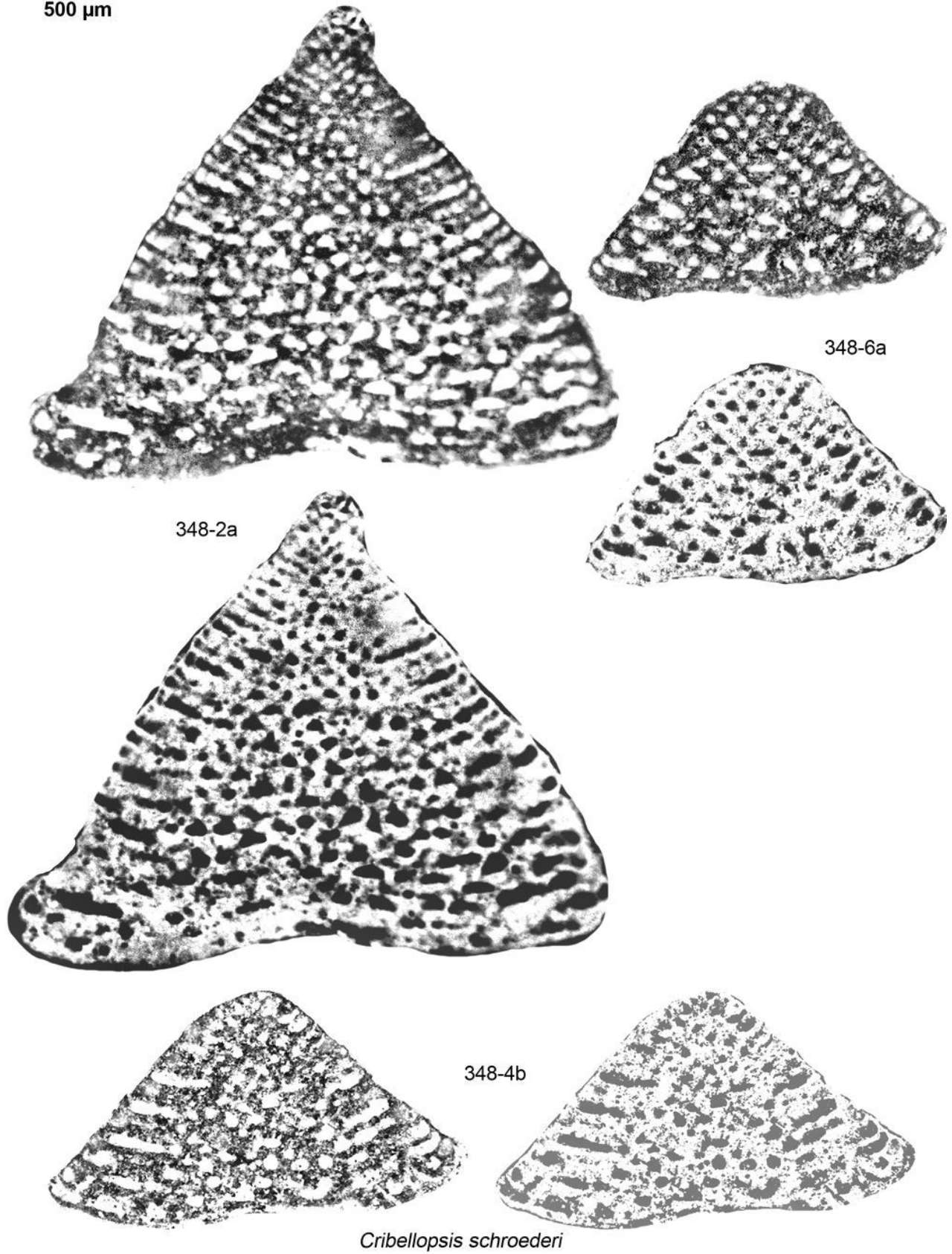


Plate 70: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Cribellopsis schroederi*: 340-1b; *Paleodictyoconus cuvillieri*: 340-1b. Scale bar = 500 μ m.



500 μ m



Cribellopsis schroederi

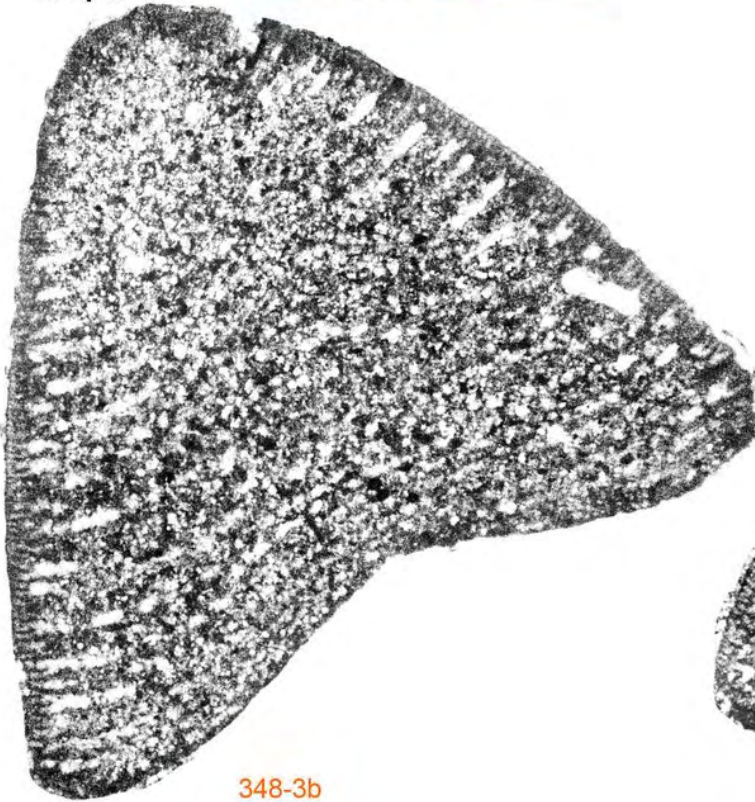
Plate 71: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Cribellopsis schroederi*: 348-2a, 348-4b, 348-6a. Scale bar = 500 μ m.



500 μ m

Paleodictyoconus actinostoma

Paleodictyoconus cuvillieri



348-3b



348-3a

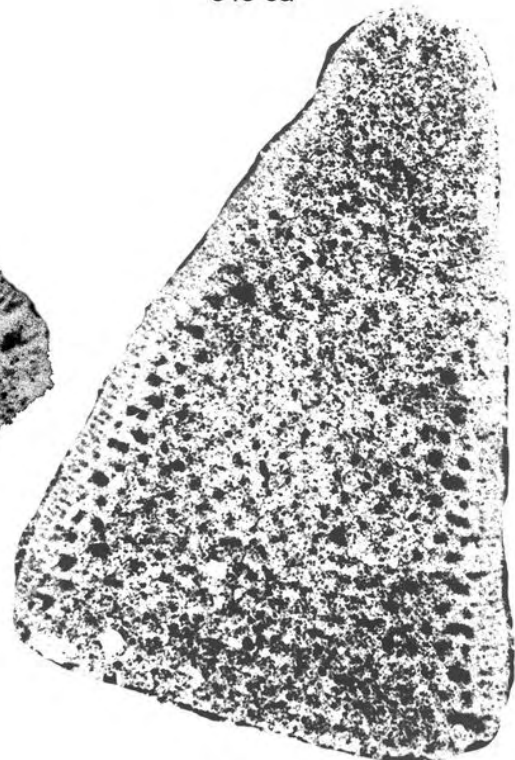
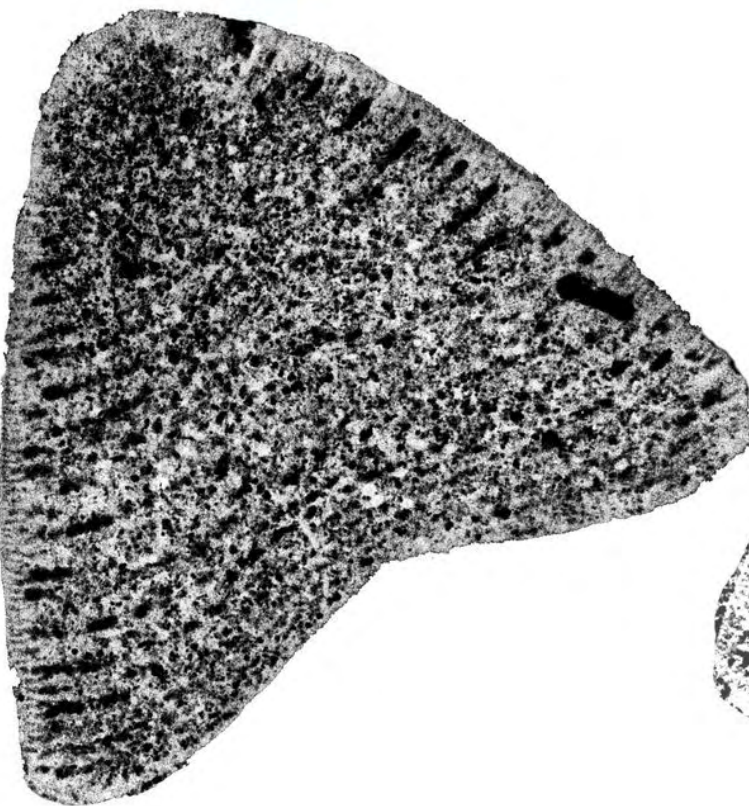


Plate 72: Orbitolinids of the Giraudi and Sarasini zones in the Serre de Tourre section. *Paleodictyoconus actinostoma*: 348-3b; *Paleodictyoconus cuvillieri*: 348-3a. Scale bar = 500 μ m.

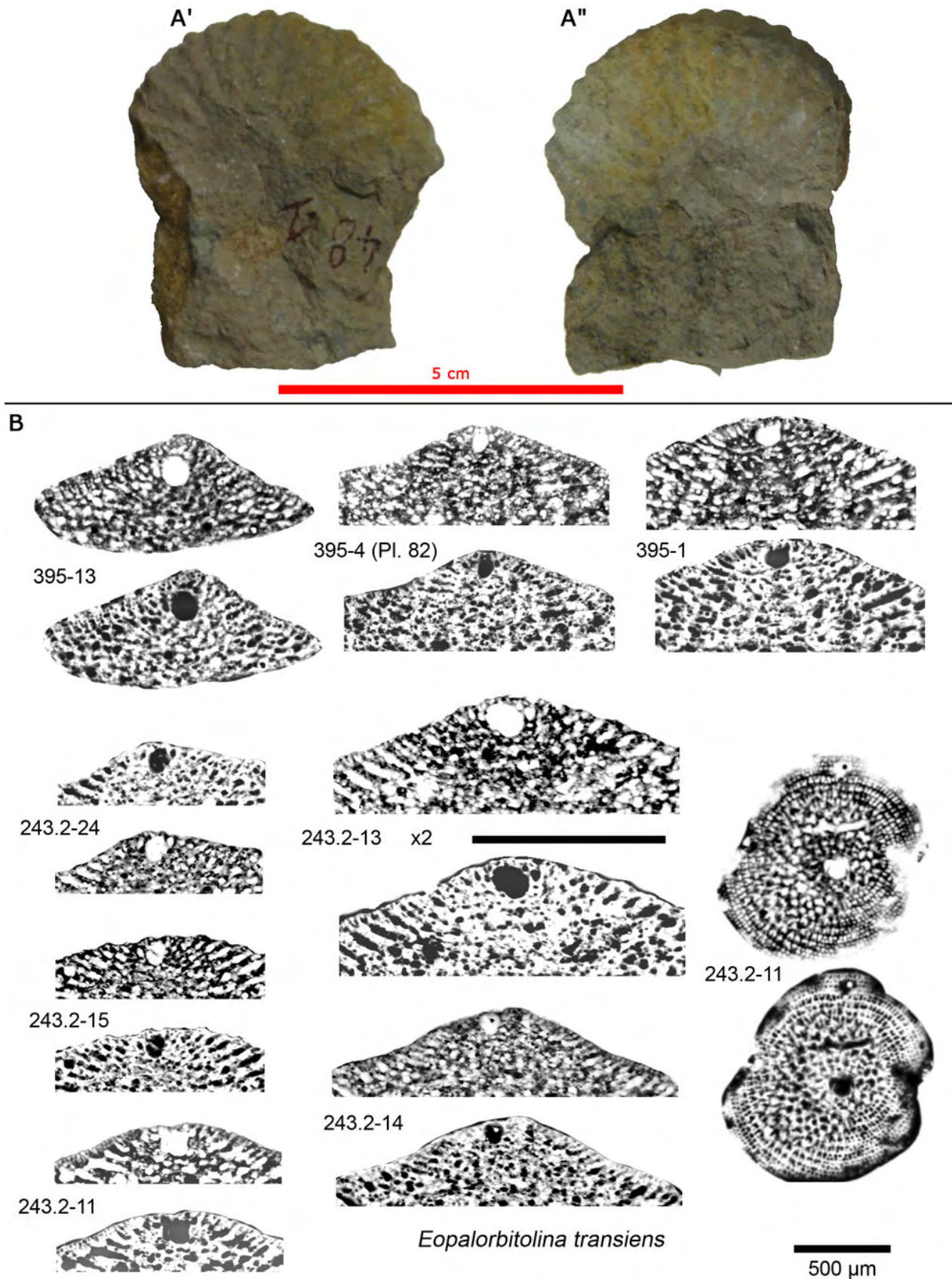


Plate 73: A, A') Ammonite of the Vandennecke zone below the Béguère marls at "Plateau du Veymont". *Toxancyloceras* gr. *vandennecke* -RB- {or ? *Camereiceras limentinus* -DB-} duplicated from ARNAUD *et al.* (1998, Pl. 4, fig. 3-4) as "? *Camereiceras* sp.", UJF-ID 10574, B. VIRLOUVET *legit* © OSUG (1997, Pl. 4, fig. 3). B) Orbitolinids of the Moutonianum and Vandennecke zones at La Béguère. *Eopalorbitolina transiens* : 243.2-11, 243.2-13, 243.2-14, 243.2-15, 243.2-24, 395-1, 395-4, 395-13. Ammonite scale bar (A) = 5 cm, and scale bar (B) = 500 µm.

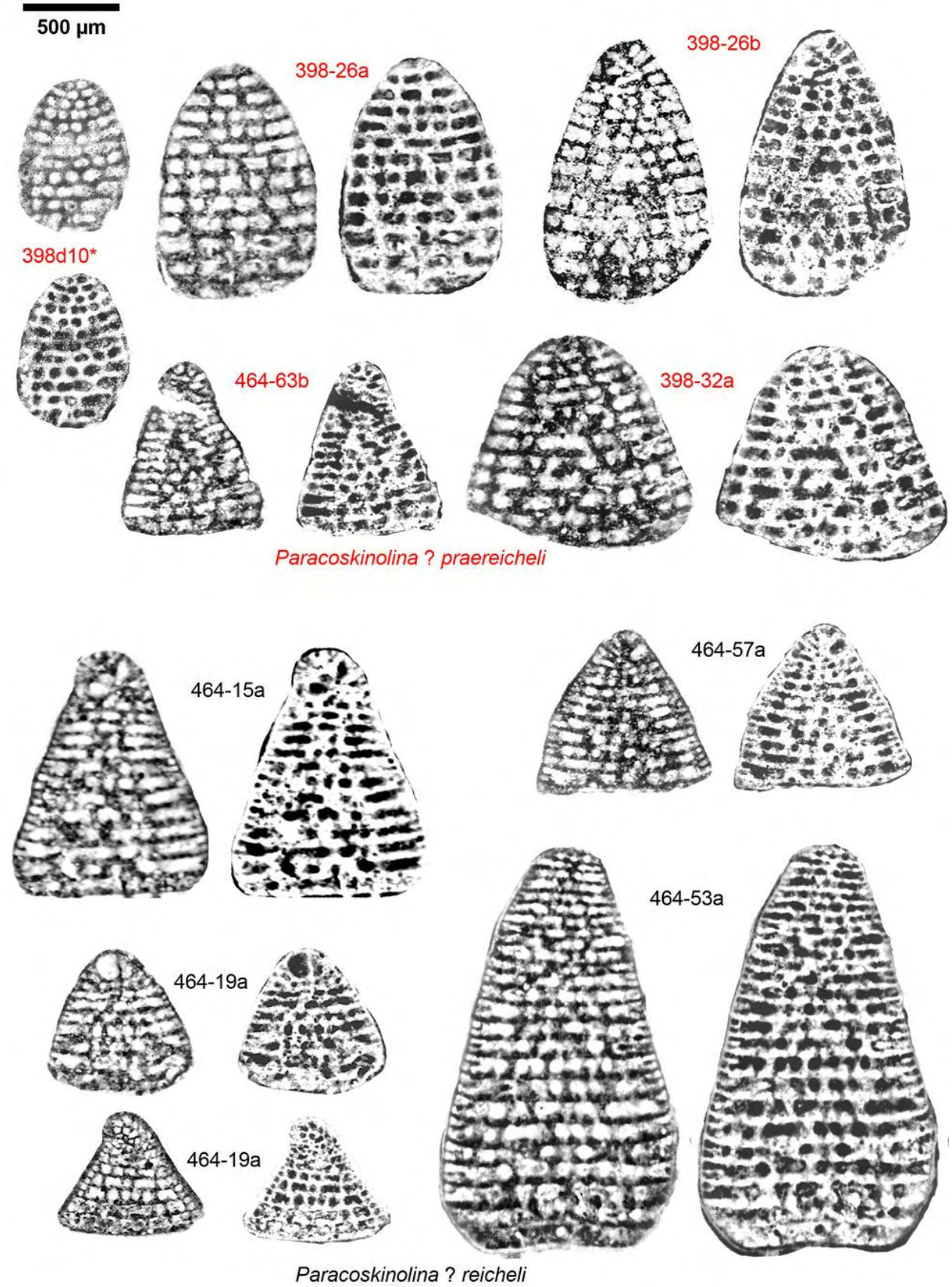


Plate 74: Orbitolinids of the Moutonianum Zone at La Béguère. *Paracoskinolina ? praereicheli*: 398-26a, 398-26b, 398-32a, 398d10*, 464-63b; *Paracoskinolina ? reicheli*: 464-15a, 464-19a, 464-53a, 464-57a. Scale bar = 500 μm .

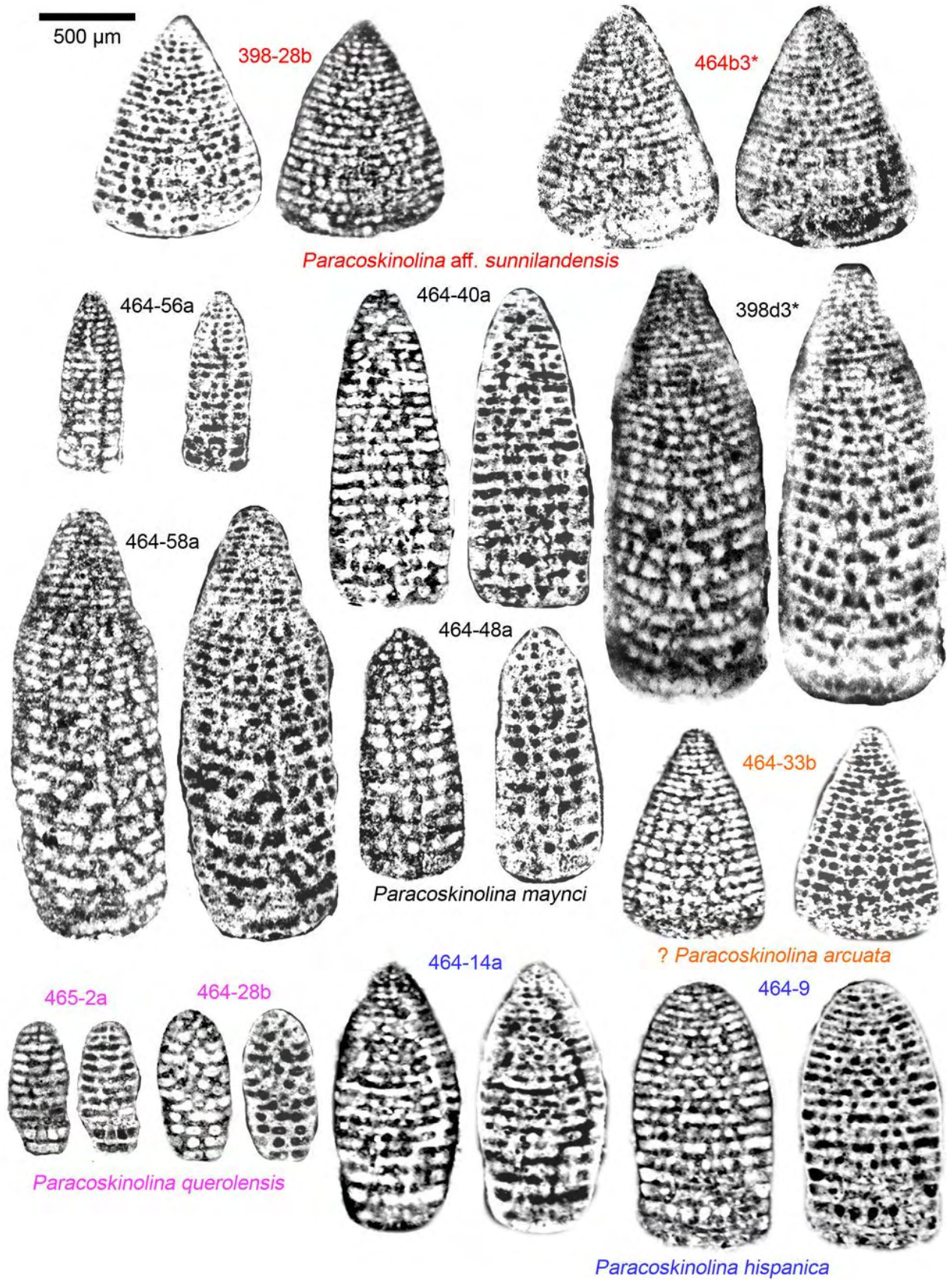


Plate 75: Orbitolinids of the Moutonianum Zone at La Bégùère. ? *Paracoskinolina arcuata*: 464-33b; *Paracoskinolina hispanica*: 464-9, 464-14a; *Paracoskinolina maynci*: 398d3*, 464-40a, 464-48a, 464-56a, 464-58a; *Paracoskinolina querolensis*: 464-28b, 465-2a; *Paracoskinolina aff. sunnilandensis*: 398-28b, 464b3*. Scale bar = 500 μm.



500 µm

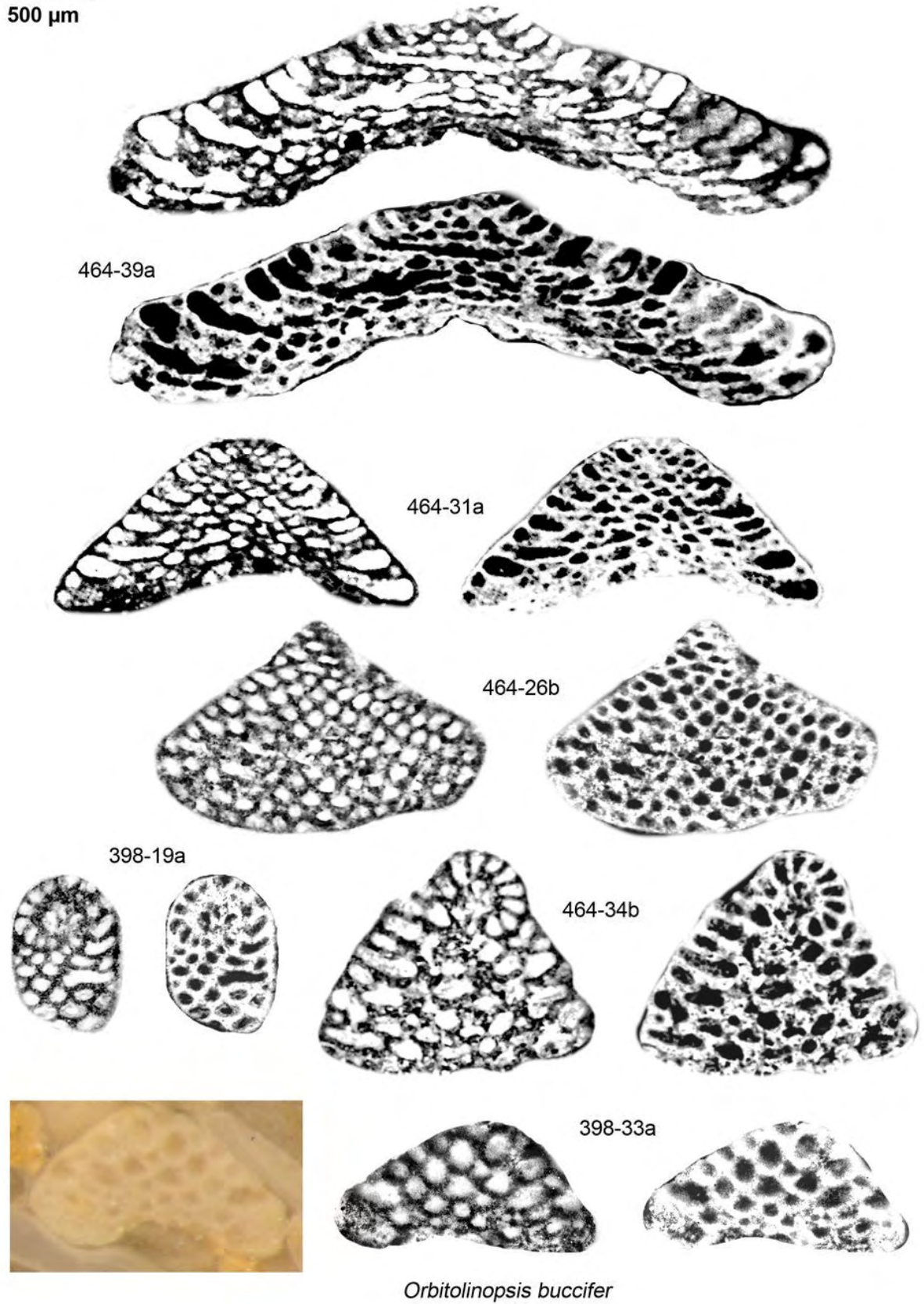


Plate 76: Orbitolinids of the Moutonianum Zone at La Béguère. *Orbitolinopsis buccifer*: 398-19a, 398-33a, 464-26b, 464-31a, 464-34b, 464-39a. Scale bar = 500 µm.

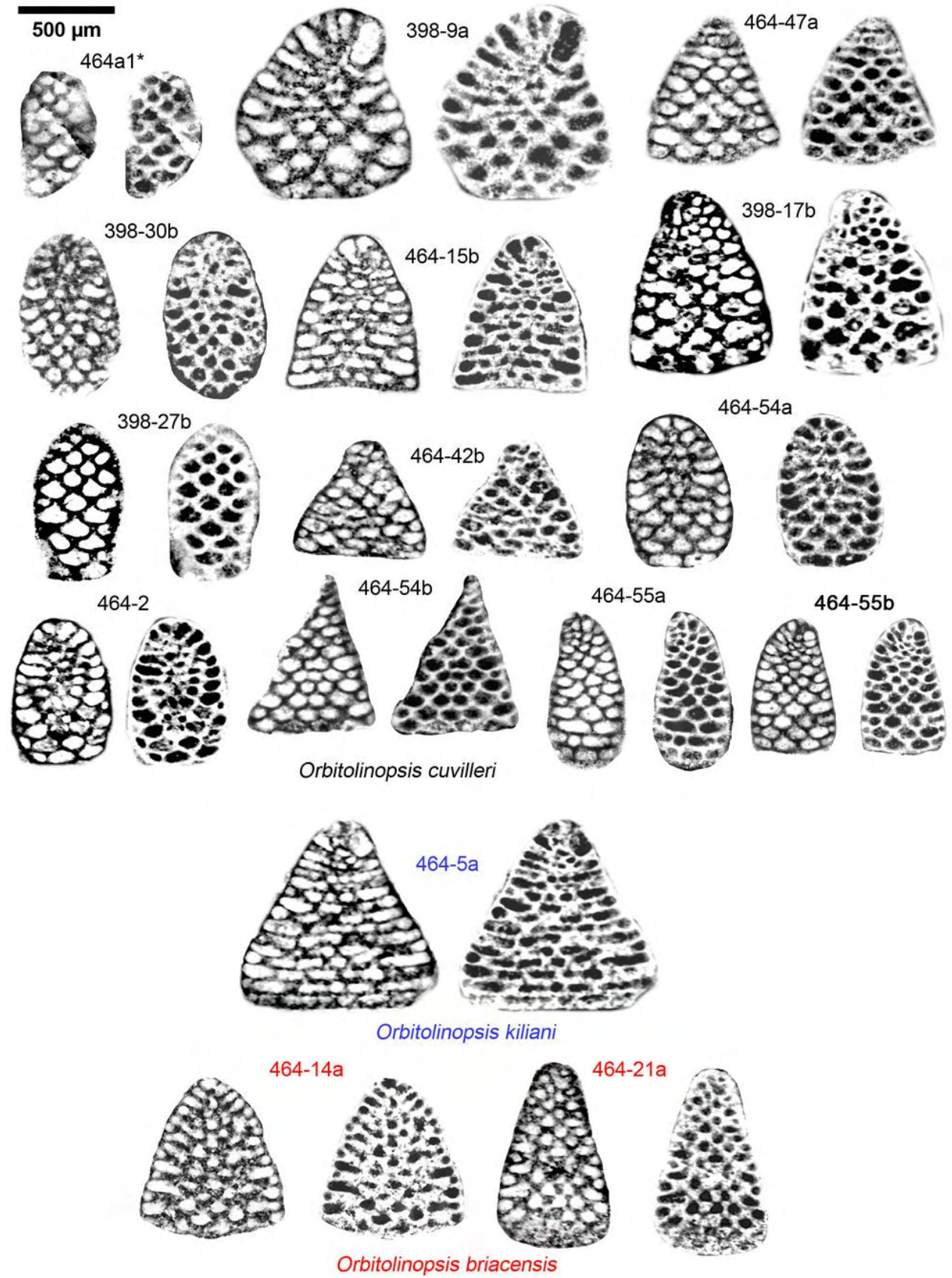


Plate 77: Orbitolinids of the Moutonianum Zone at La Bégùère. *Orbitolinopsis briacensis*: 464-14a, 464-21a; *Orbitolinopsis cuvillieri*: 398-9a, 398-17b, 398-27b, 398-30b, 464-2, 464-15b, 464-42b, 464-47a, 464-54a, 464-54b, 464-55a, 464-55b, 464a1*; *Orbitolinopsis kiliani*: 464-5a. Scale bar = 500 μm.

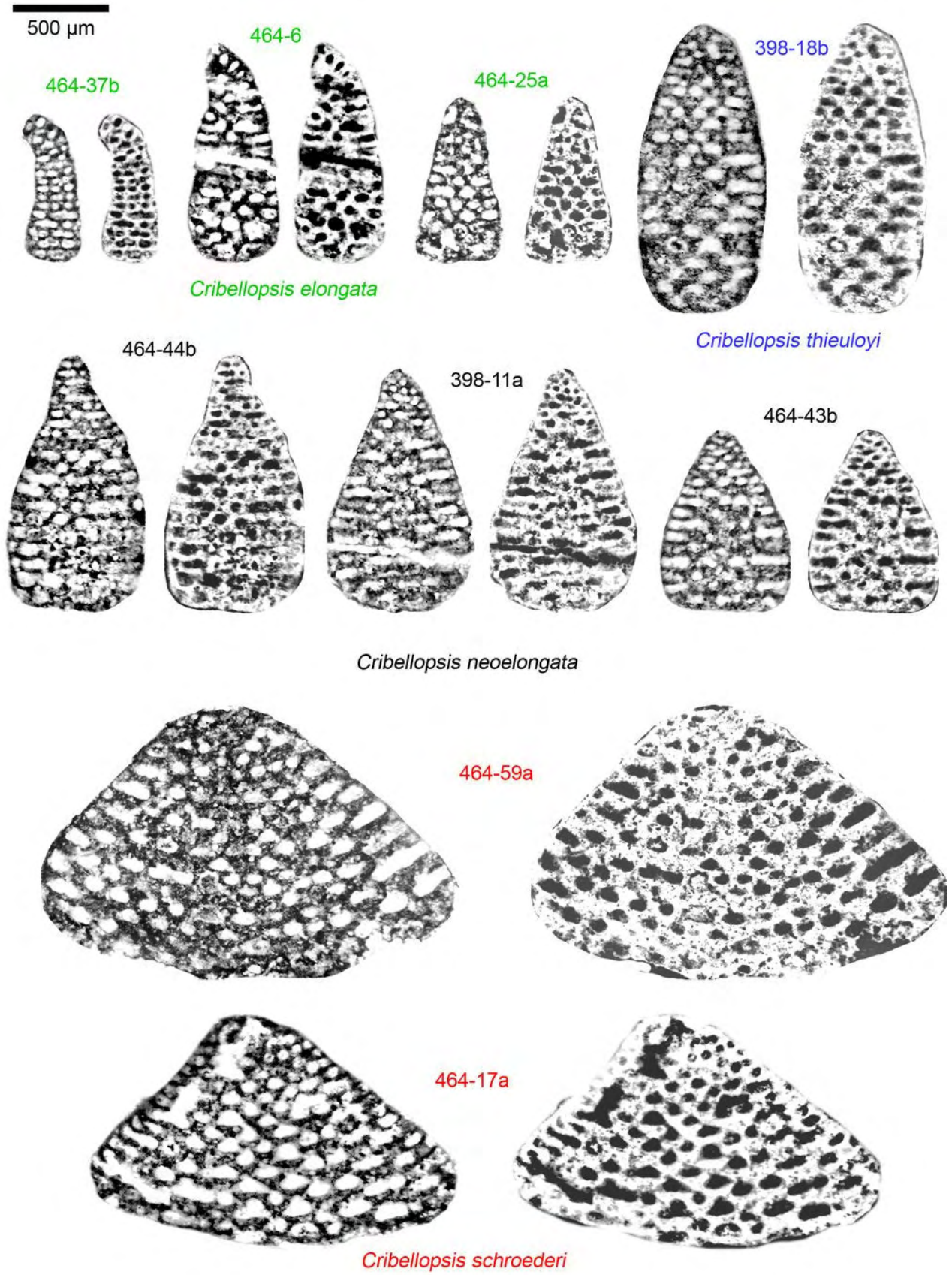


Plate 78: Orbitolinids of the Moutonianum Zone at La Bégùère. *Cribellopsis elongata*: 464-6, 464-25a, 464-37b; *Cribellopsis neoelongata*: 398-11a, 464-43b, 464-44b; *Cribellopsis schroederi*: 464-17a, 464-59a; *Cribellopsis thieuloyi*: 398-18b. Scale bar = 500 μ m.

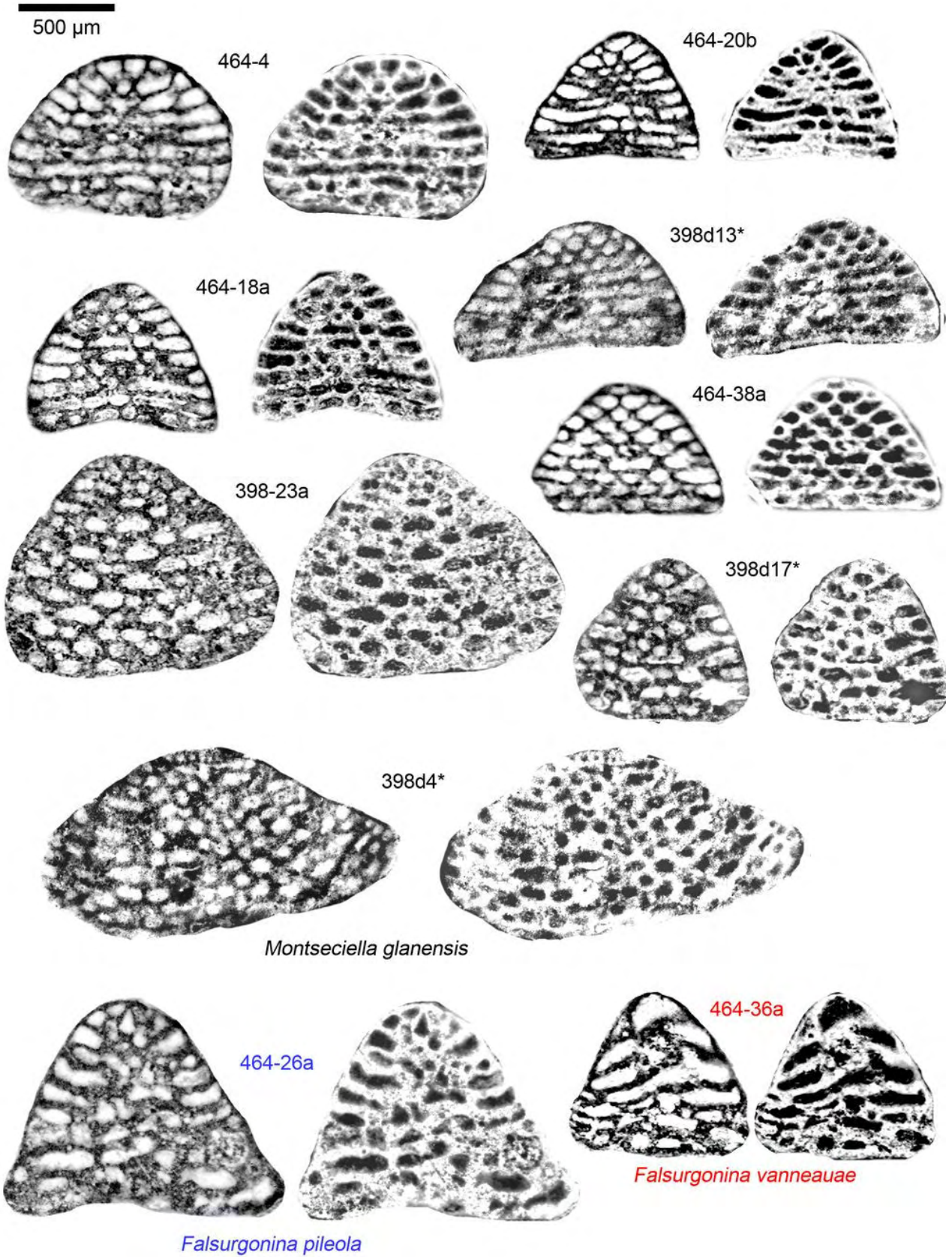
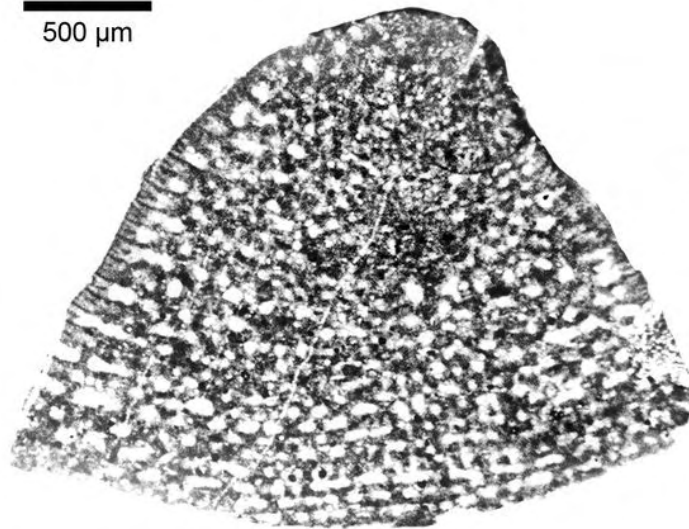


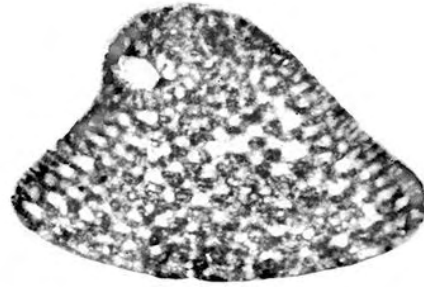
Plate 79: Orbitolinids of the Moutonianum Zone at La Béguère. *Falsurgonina pileola*: 464-26a; *Falsurgonina vanneauae*: 464-36a; *Montseciella glanensis*: 398-23a, 398d4*, 398d13, 398d17*, 464-4, 464-18a, 464-20b, 464-38a. Scale bar = 500 μ m.



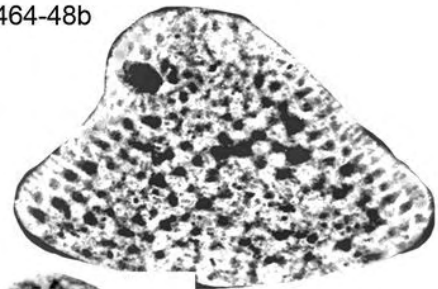
500 µm



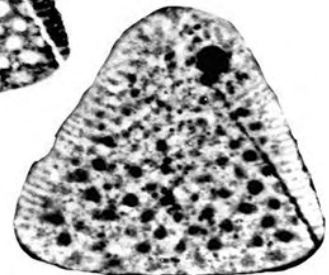
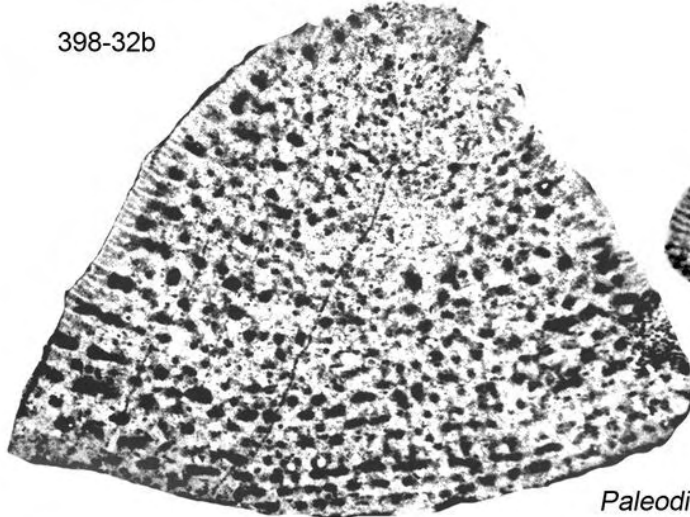
398-32b



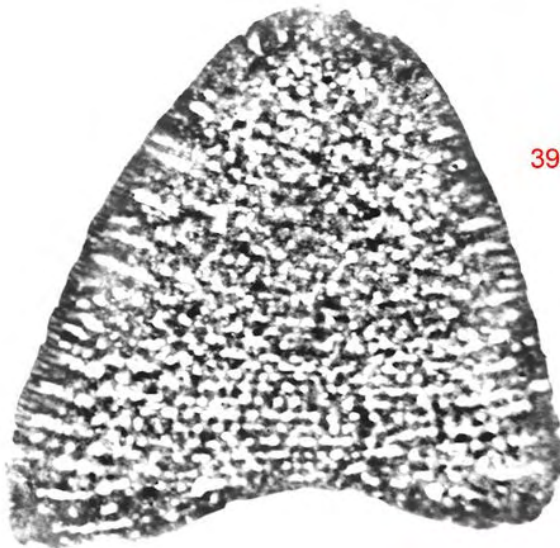
464-48b



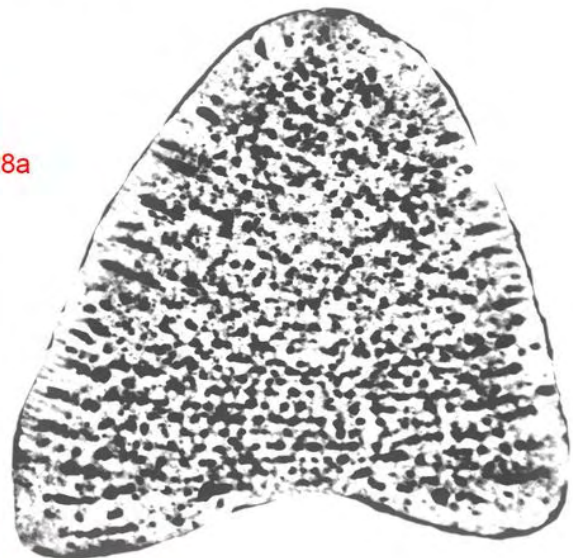
464-49a



Paleodictyoconus cuvillieri



398-28a



Paleodictyoconus actinostoma

Plate 80: Orbitolinids of the Moutonianum Zone at La Béguère. *Paleodictyoconus actinostoma*: 398-28a; *Paleodictyoconus cuvillieri*: 398-32b, 464-48b, 464-49a. Scale bar = 500 µm.

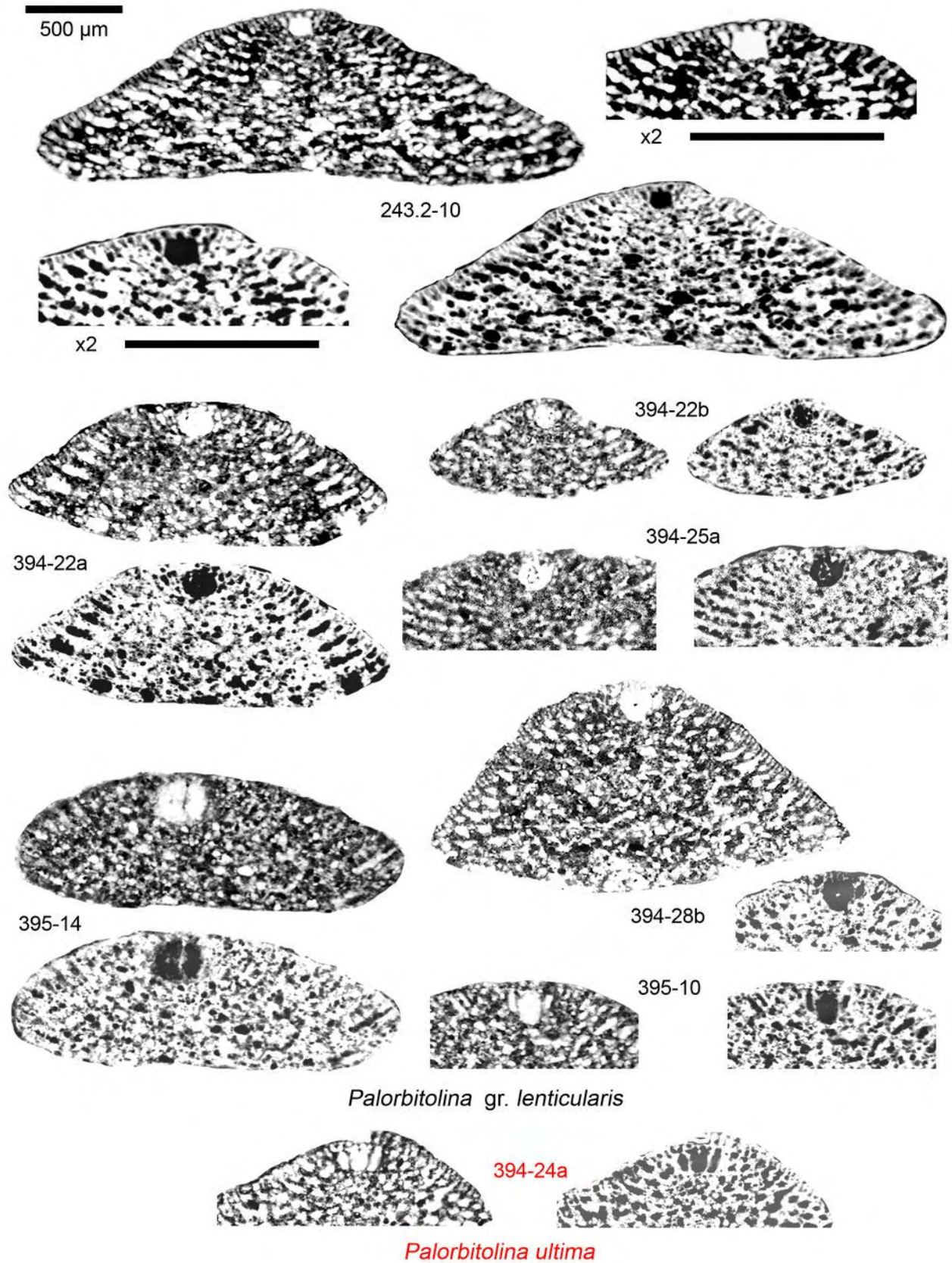


Plate 81: Orbitolinids of the Moutonianum and Vandenheckei (243, 394) zones at La Béguère. *Palorbitolina gr. lenticularis*: 243.2-10, 394-22a, 394-22b, 394-25a, 394-28b, 395-10, 395-14; *Palorbitolina ultima*: 394-24a. Scale bar = 500 µm.

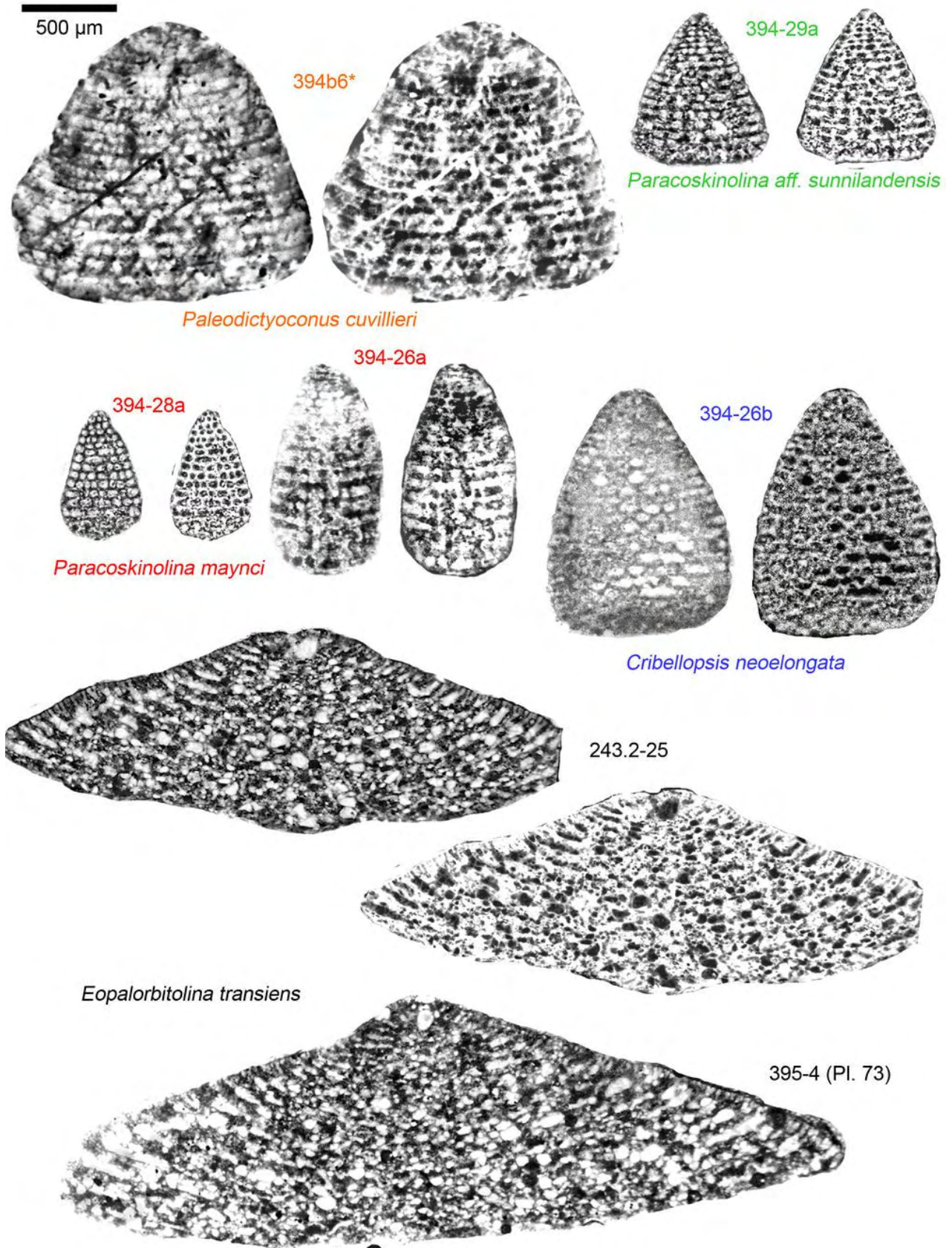


Plate 82: Orbitolinids of the Moutonianum and Vandenheckei zones at La Béguère. *Cribellopsis neolongata*: 394-26b; *Eopalorbitolina transiens*: 243.2-25, 395-4; *Paleodictyoconus cuvillieri*: 394b6*; *Paracoskinolina maynci*: 394-26a, 394-28a; *Paracoskinolina* aff. *sunnilandensis*: 394-29a. Scale bar = 500 μ m.

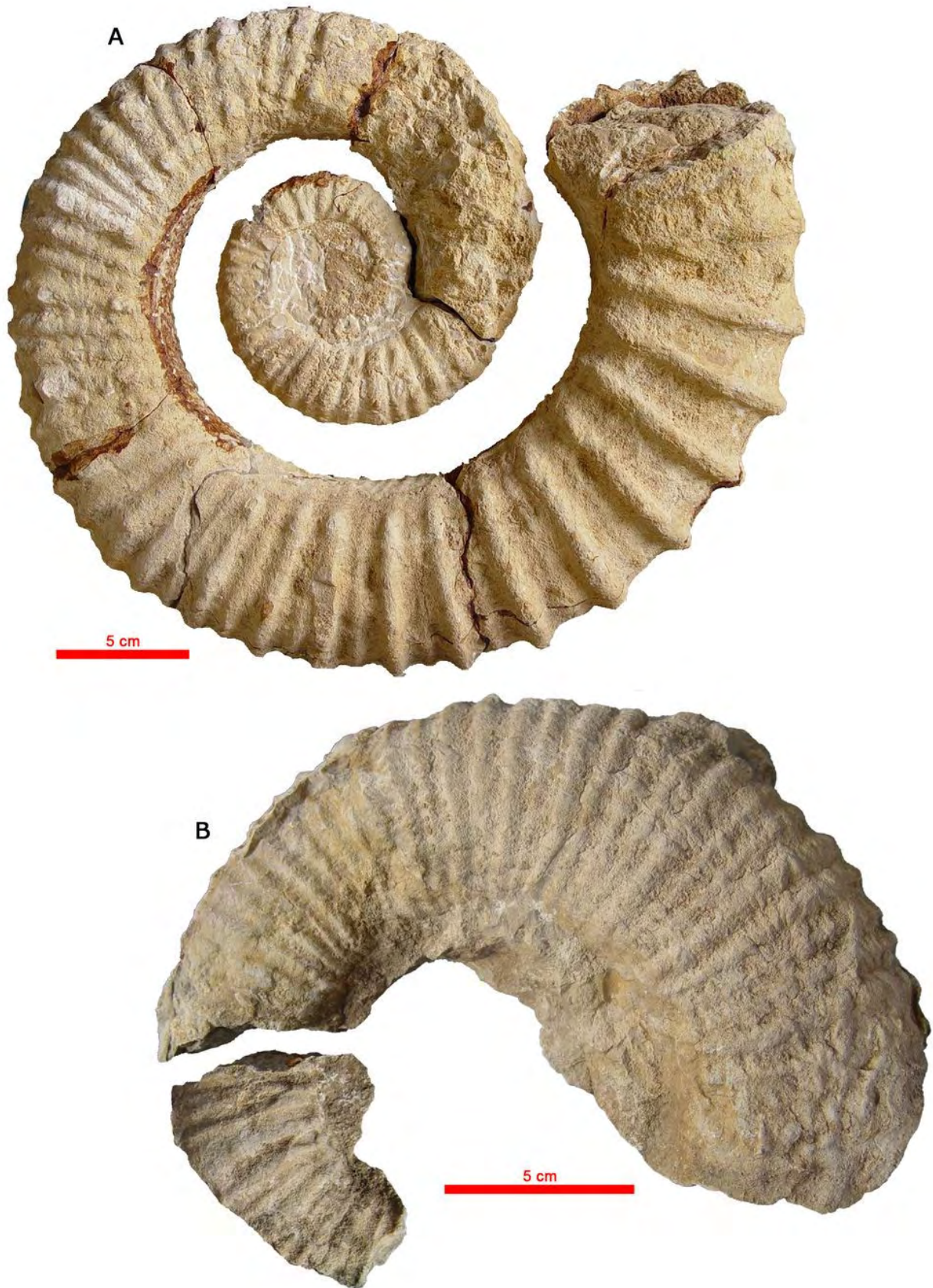


Plate 83: Ammonites of the Vandenheckei Zone at Rochecolombe. A) *Toxancyloceras vandenheckei* -RB- {or *Gasendicerias quelquejeui* -DB-}, FSL 89187; B) *Toxancyloceras vandenheckei* -RB- {or ? *Pseudoshastrioceras* sp. -DB-}, FSL 47195. All scale bars = 5 cm.

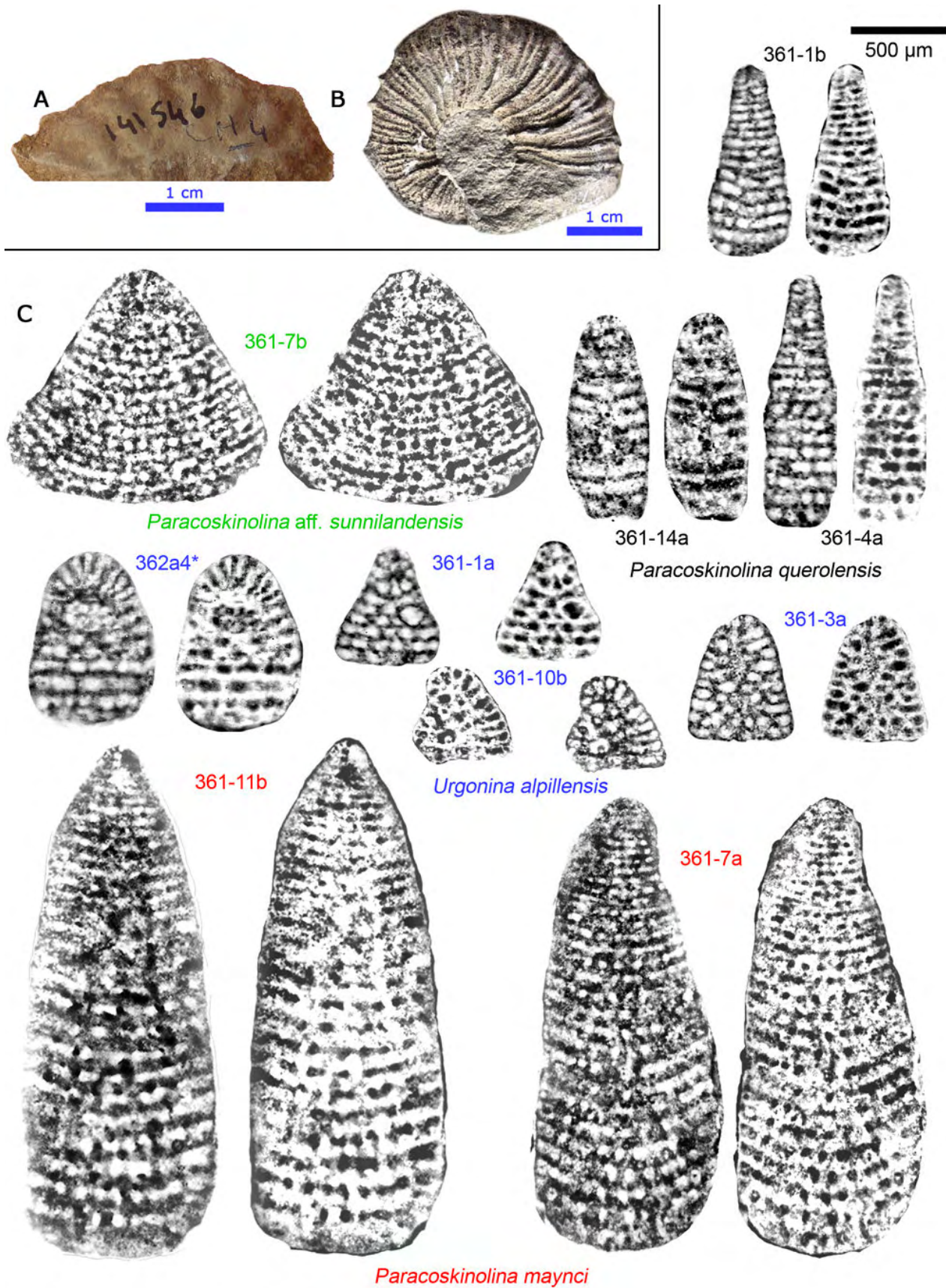


Plate 84: A-B) Ammonites of the Compressissima Zone at Rochecolombe. A) *Nicklesia* sp. -RB- {or *Kotetishvilia compressissima* -DB-}, FSL 141546; B) *Holcodiscus fallax*, FSL 141538. C) Orbitolinids of the Vandenheckei Zone at Rochecolombe. *Paracoskinolina maynci*: 361-7a, 361-11b; *Paracoskinolina querolensis*: 361-1b, 361-4a, 361-14a; *Paracoskinolina* aff. *sunnilandensis*: 361-7b; *Urganina alpillensis*: 361-1a, 361-3a, 361-10b, 361a4*. Ammonite scale bar (A-B) = 5 cm, and scale bar (C) = 500 µm.

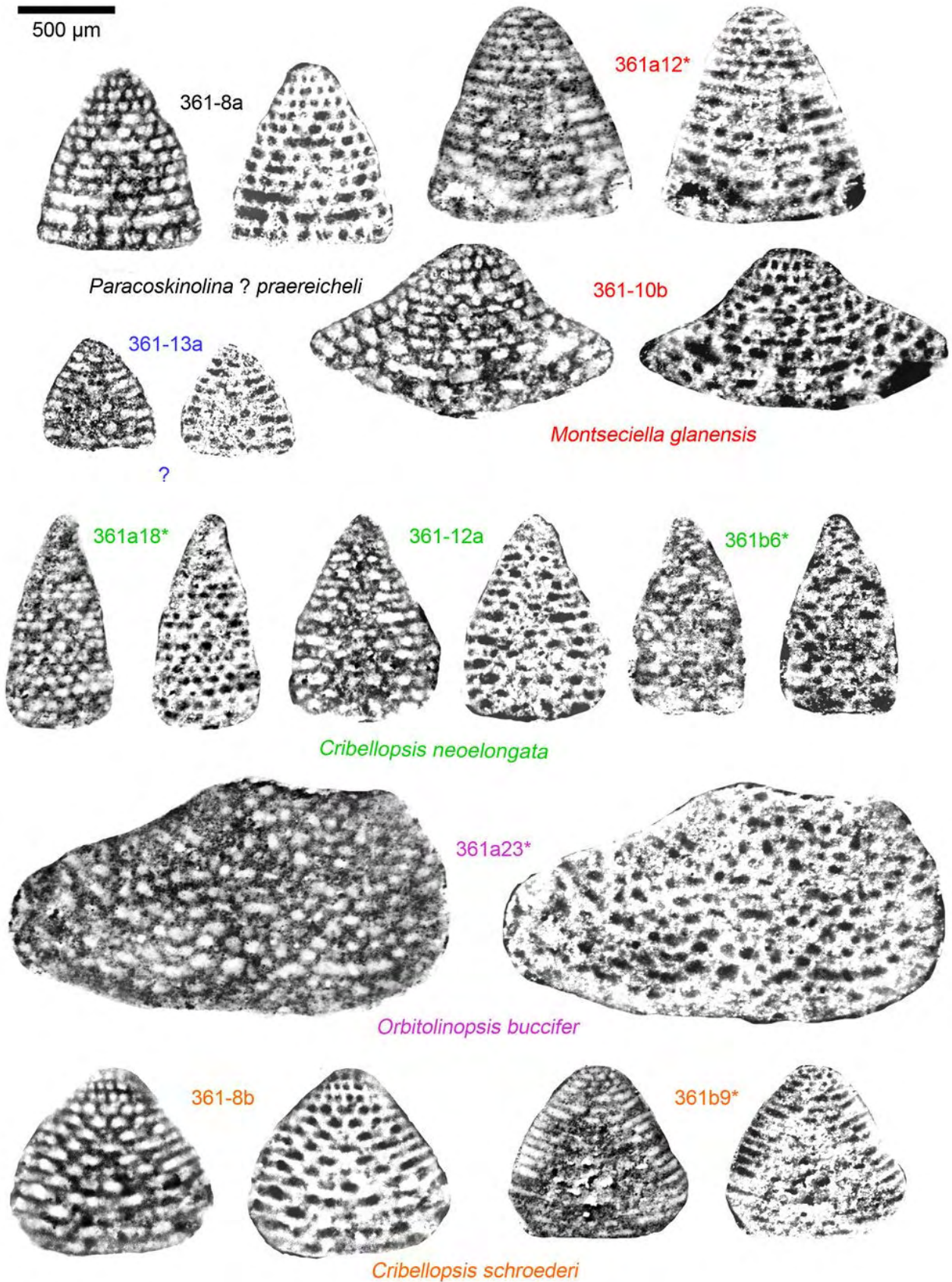
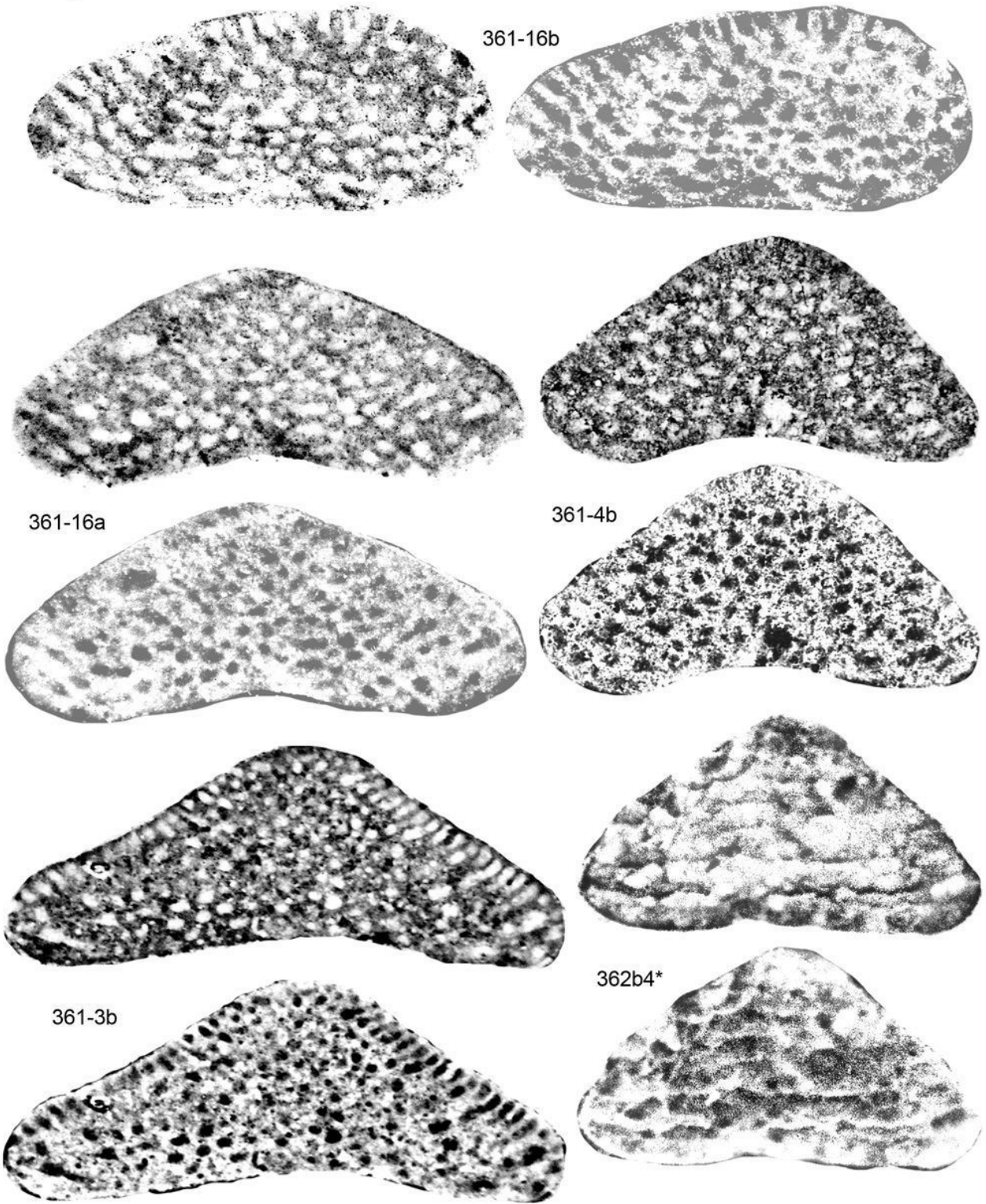


Plate 85: Orbitolinids of the Vandenheckei Zone at Rochecolombe. ?: 361-13a; *Cribellopsis neolongata*: 361-12a, 361a18*, 361b6*; *Cribellopsis schroederi*: 361-8b, 361b9*; *Montseciella glanensis*: 361-10b, 361a12*; *Orbitolinopsis buccifer*: 361a23*; *Paracoskinolina ? praereicheli*: 361-8a. Scale bar = 500 µm.



500 μ m



Orbitolinopsis buccifer

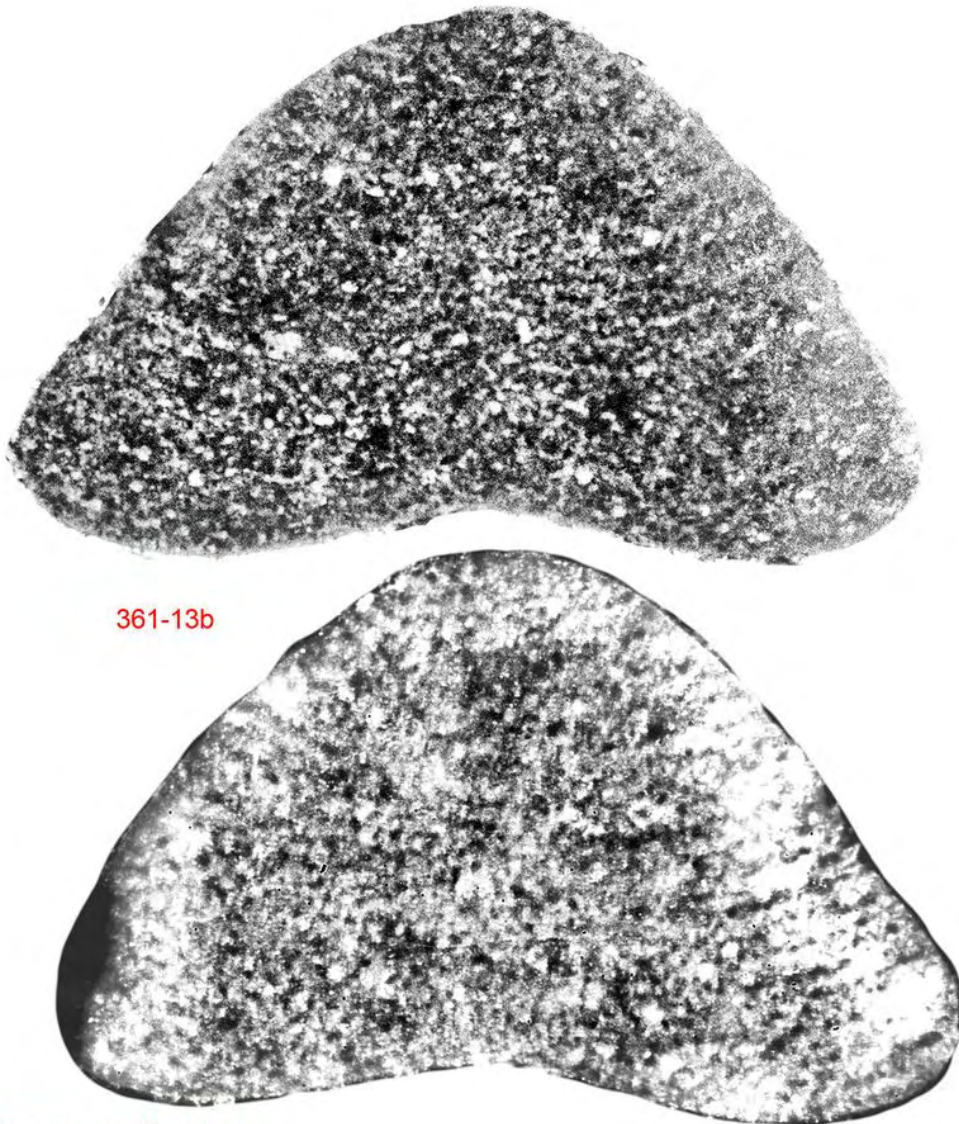
Plate 86: Orbitolinids of the Vandenneckeï Zone at Rochecolombe. *Orbitolinopsis buccifer*: 361-3b, 361-4b, 361-16a, 361-16b, 361b4*. Scale bar = 500 μ m.



500 μ m

361-11a

Paleodictyoconus cuvillieri



361-13b

Paleodictyoconus actinostoma

Plate 87: Orbitolinids of the Vandenheckei Zone at Rochecolombe. *Paleodictyoconus actinostoma*: 361-13b; *Paleodictyoconus cuvillieri*: 361-11a. Scale bar = 500 μ m.

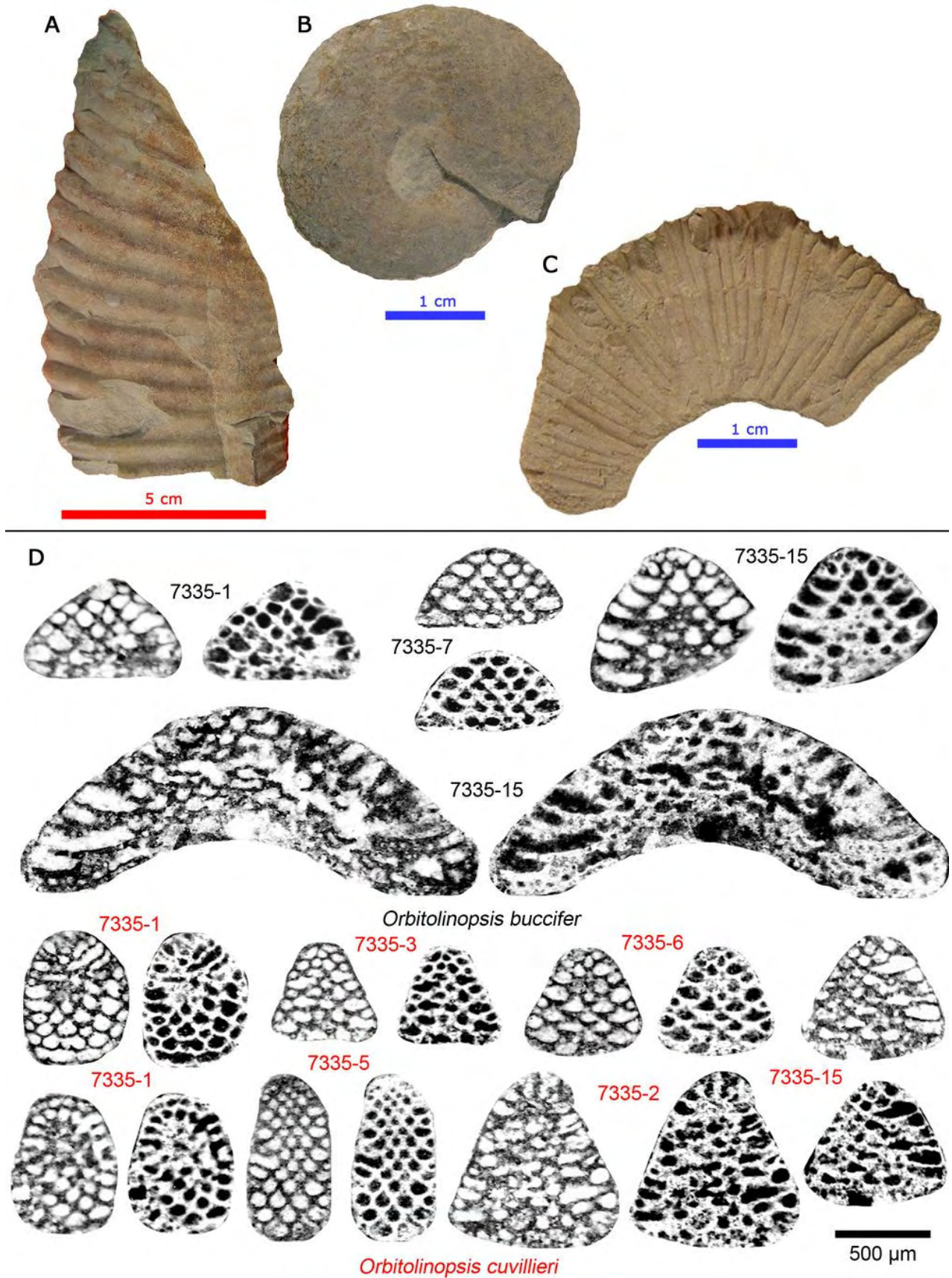


Plate 88: A-C) Ammonites of Moutonianum Zone at Mas Thibaud (Bluye). A) *Moutoniceras nodosum*, FSL 88791; B) *Nikolovites* gr. *charrierianus*, FSL 88794; C) *Holcodiscus fallax* -RB- {or *Holcodiscus* sp. -DB-}, FSL 88792; D) Orbitolinids of the Vandennecke Zone at Mas Thibaud (Bluye). *Orbitolinopsis buccifer*: 7335-1, 7335-7, 7335-15; *Orbitolinopsis cuvillieri*: 7335-1, 7335-2, 7335-3, 7335-5, 7335-6, 7335-15. Ammonite scale bars (A) = 5 cm, (B-C) = 1 cm, and orbitolinid scale bar (D) = 500 µm.

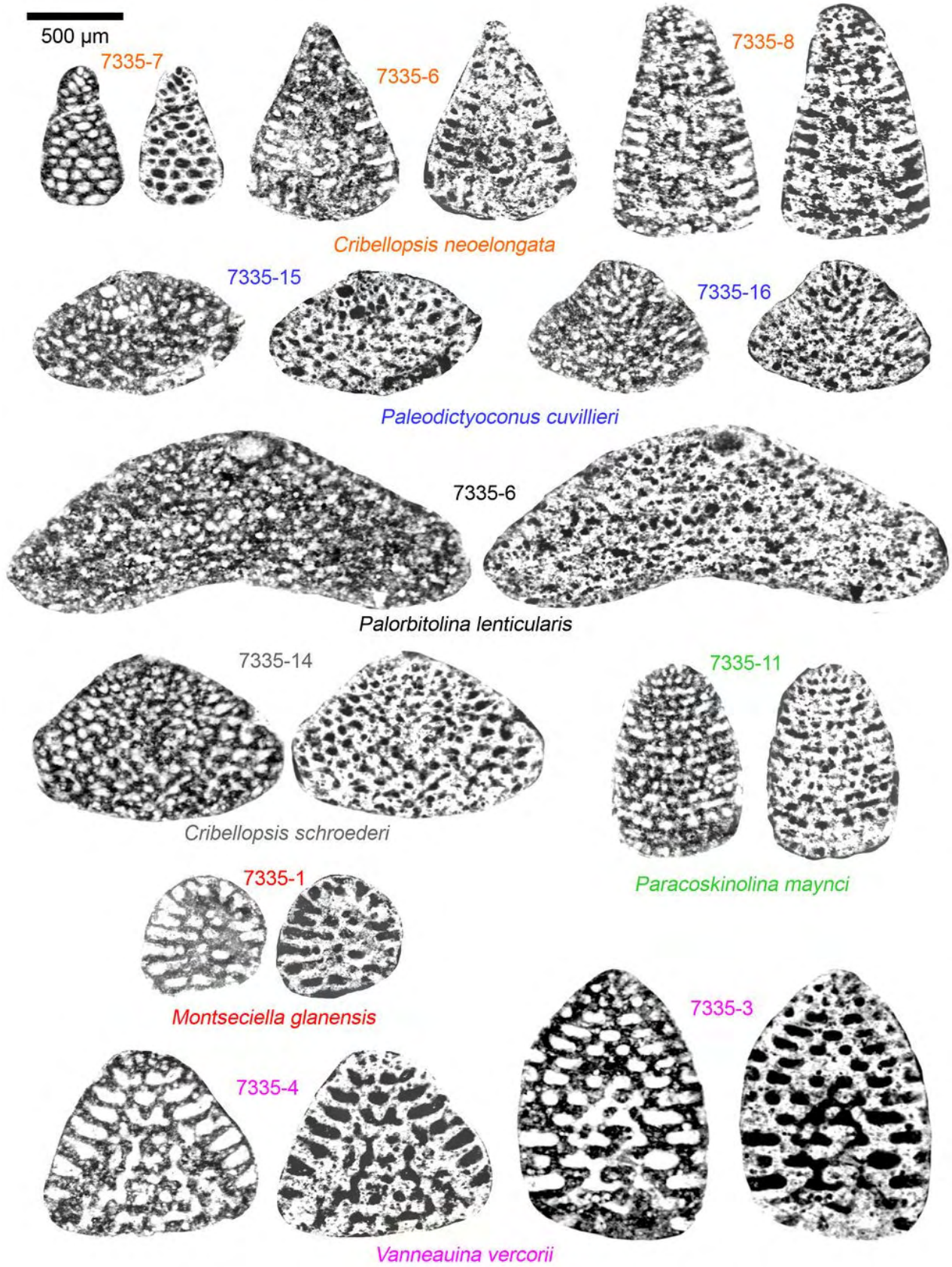


Plate 89: Orbitolinids of the Vandennecke Zone at Mas Thibaud (Bluye). *Cribellopsis neoelongata*: 7335-6, 7335-7, 7335-8; *Cribellopsis schroederi*: 7335-14; *Montseciella glanensis*: 7335-1; *Paleodictyoconus cuvillieri*: 7335-15, 7335-16; *Palorbitolina lenticularis*: 7335-6; *Paracoskinolina maynci*: 7335-11; *Vanneauina vercorii*: 7335-3, 7335-4. Scale bar = 500 μ m.

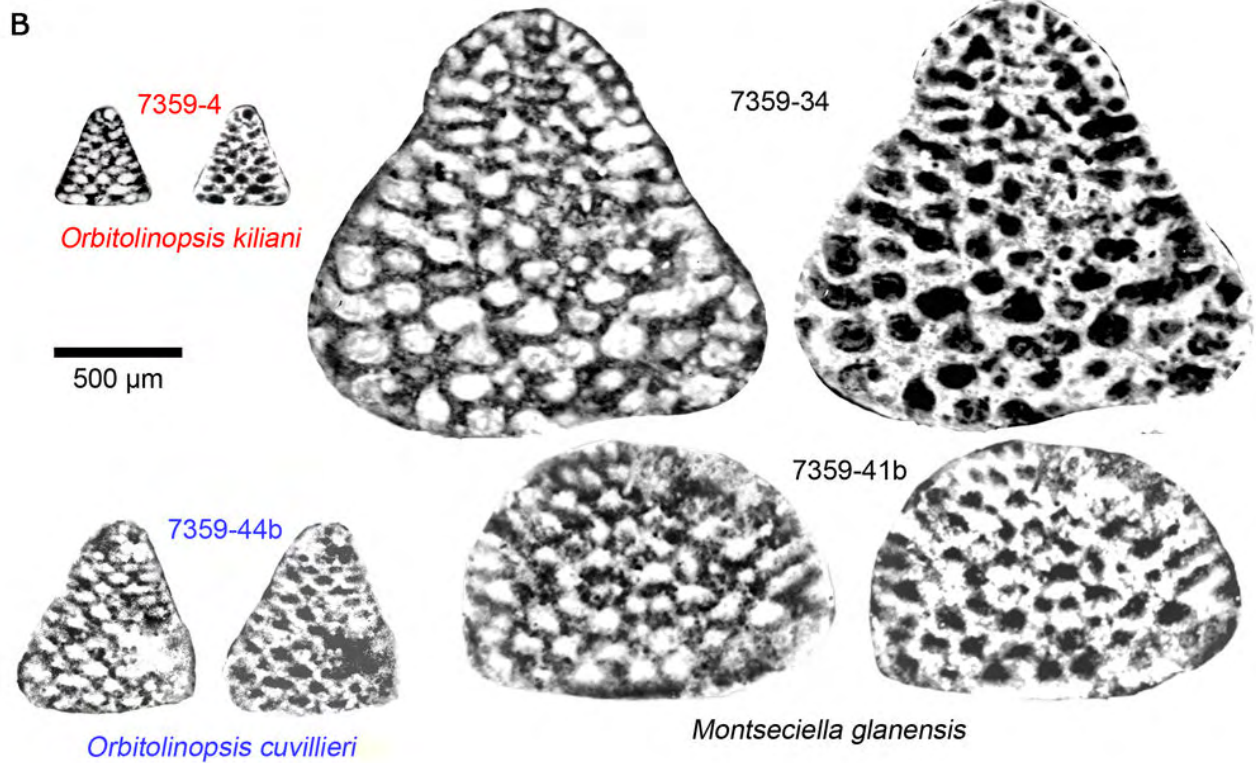
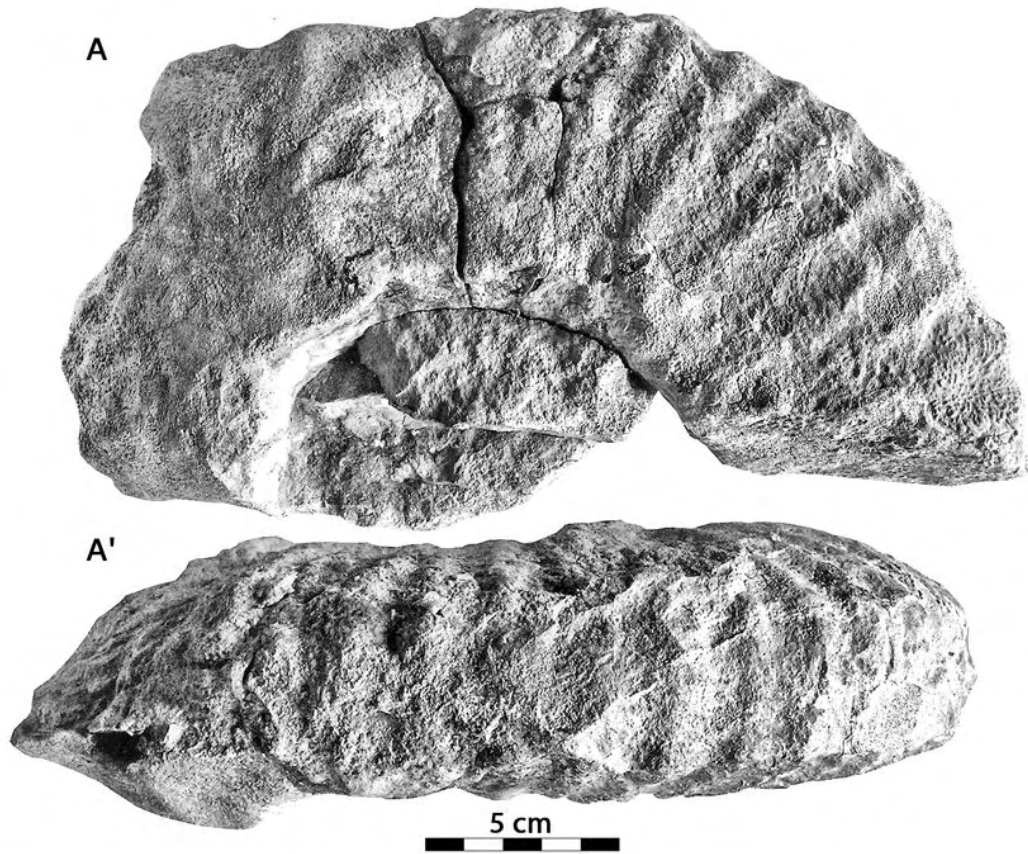


Plate 90: A-A') Ammonite of the Sartousiana Zone in the Gorges de la Nesque section. *Camereiceras* aff. *limentinus* -RB- {or ? *Hemihoplites feraudianus* -DB-}, Rocher du Cire, Ph. LÉONIDE *legit* (LÉONIDE *et al.*, 2012: Fig. 6.G, photo by courtesy of J.-P. MASSE); B) Orbitolinids of the Vandenheckei Zone in the Gorges de la Nesque section. *Montseciella glanensis*: 7359-34b, 7359-41b; *Orbitolinopsis cuvillieri*: 7359-44b; *Orbitolinopsis kiliani*: 7359-4. Ammonite scale bar (A) = 5 cm, and scale bar (B) = 500 µm.

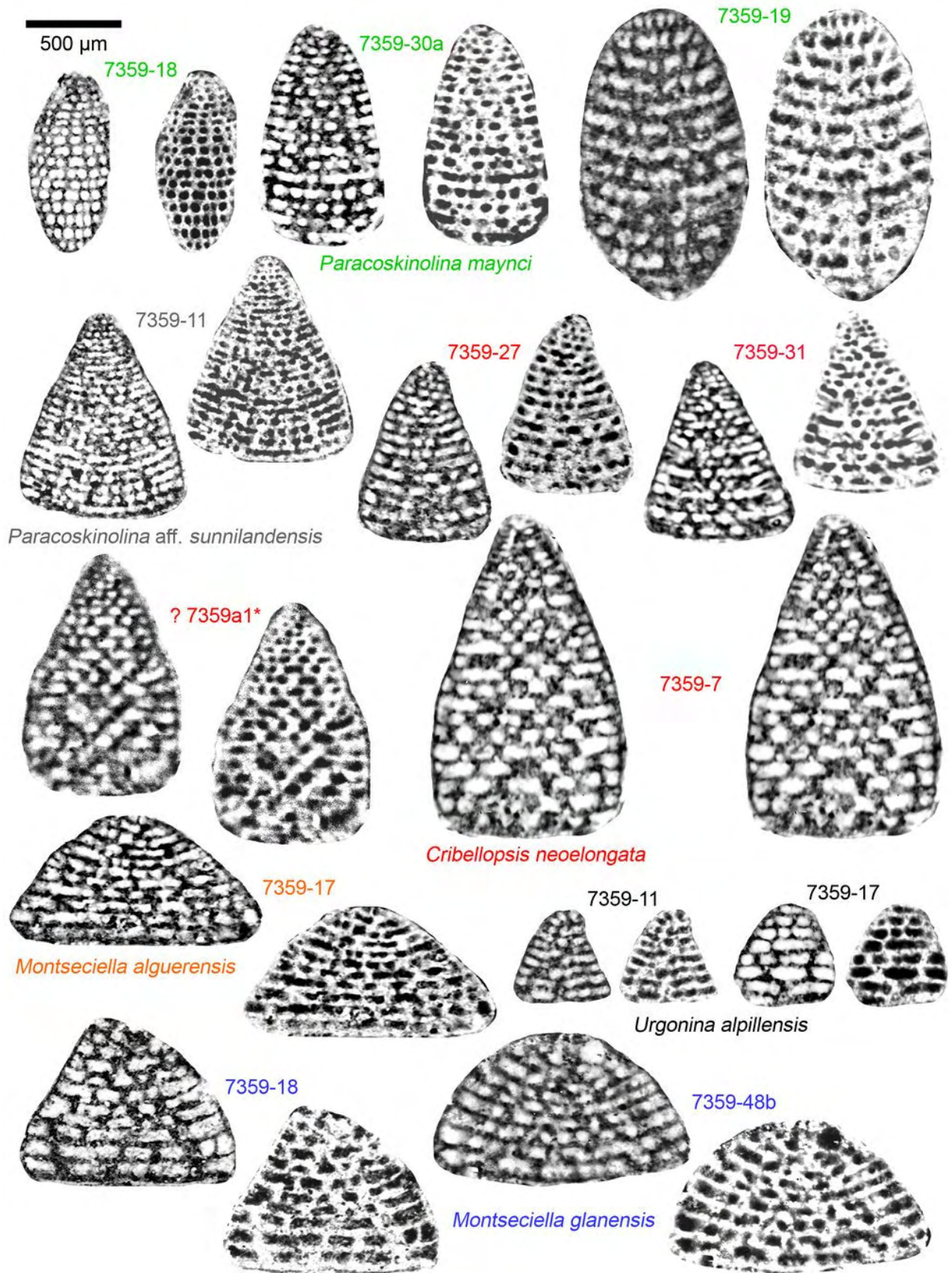


Plate 91: Orbitolinids of the Vandenheckei Zone in the Gorges de la Nesque section. *Cribellopsis neolongata*: 7359-27, 7359-31, 7359a1*; *Montseciella alguerensis*: 7359-17; *Montseciella glanensis*: 7359-18, 7359-48b; *Paracoskinolina maynci*: 7359-18, 7359-19, 7359-30a; *Paracoskinolina aff. sunnilandensis*: 7359-11; *Urganina alpillensis*: 7359-11, 7359-17. Scale bar = 500 μm.

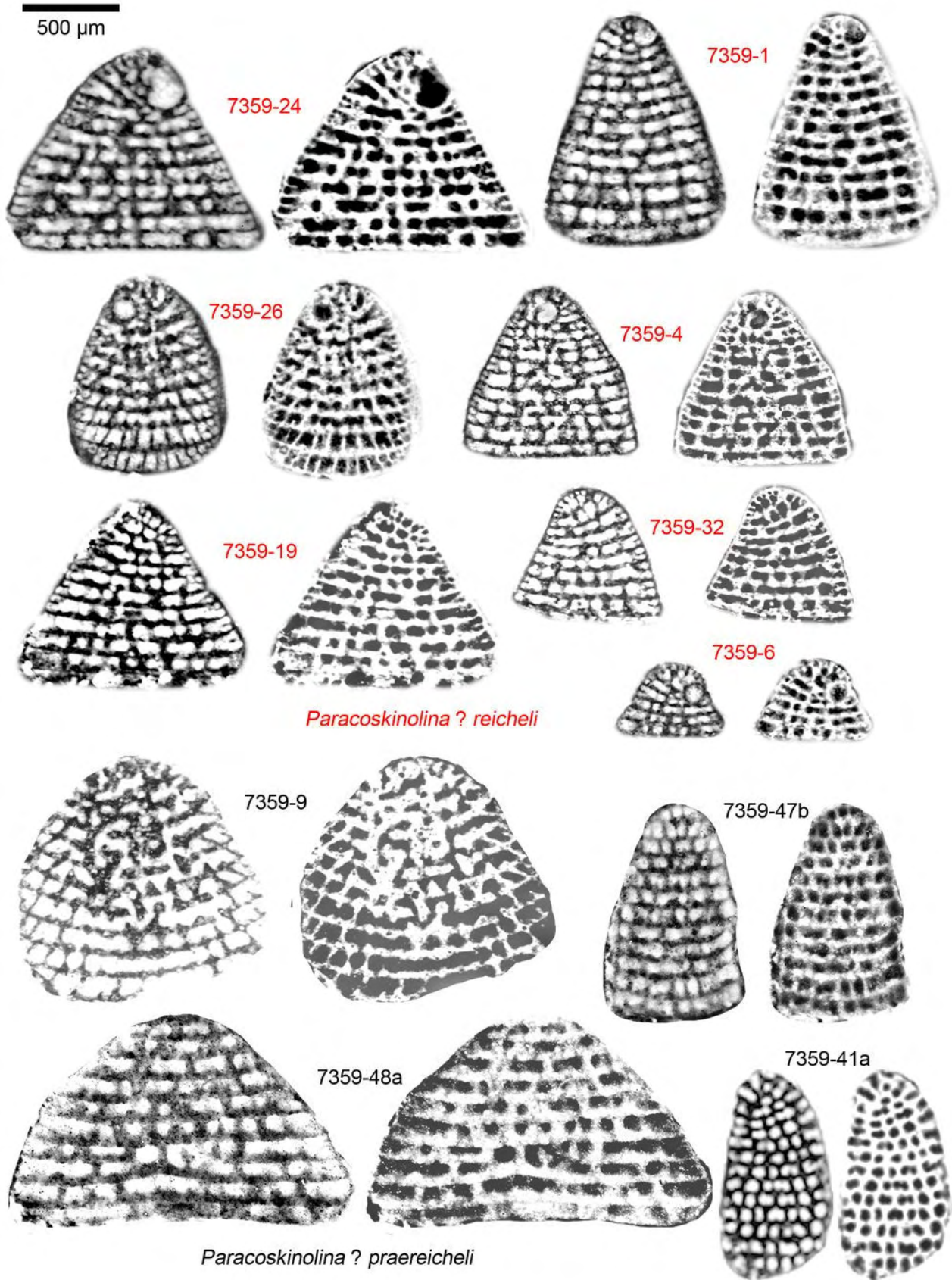
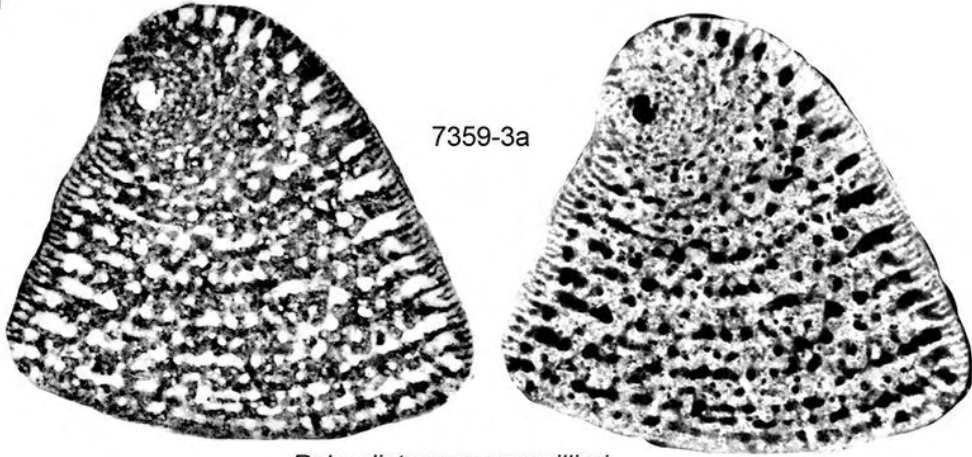


Plate 92: Orbitolinids of the Vandenheckei Zone in the Gorges de la Nesque section. *Paracoskinolina ? praereicheli*: 7359-1, 7359-4, 7359-6, 7359-19, 7359-24, 7359-26, 7359-32; *Paracoskinolina ? reicheli*: 7359-9, 7359-41a, 7359-47b, 7359-48a. Scale bar = 500 µm.

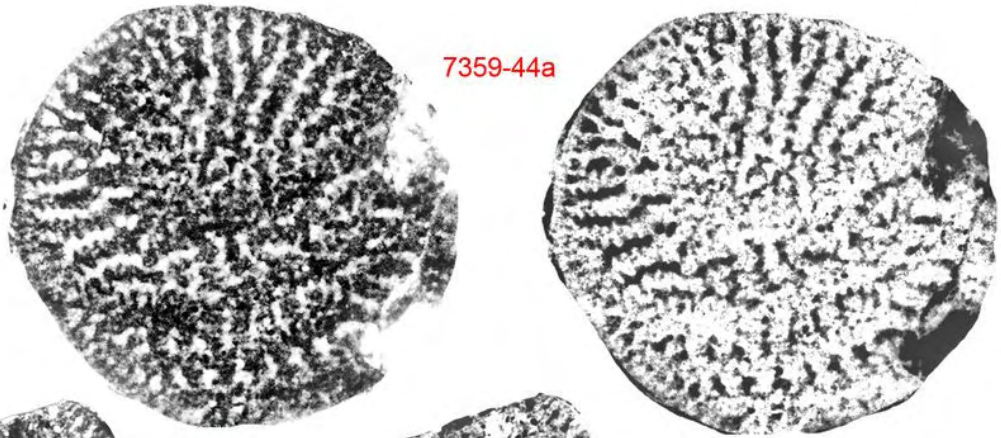


500 µm



7359-3a

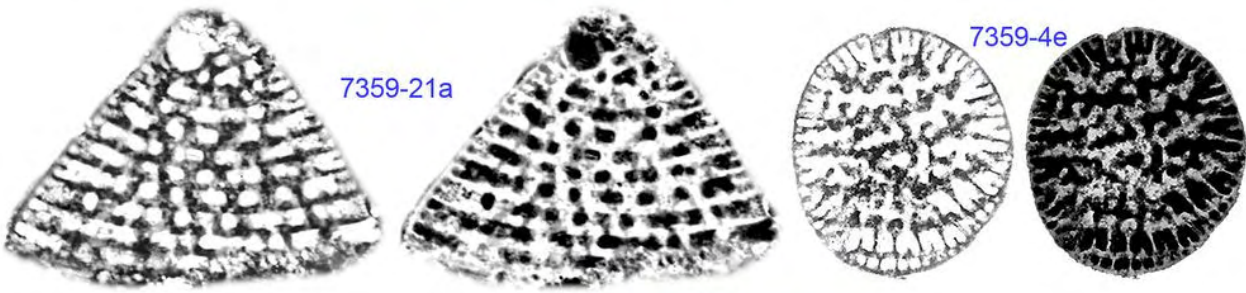
Paleodictyoconus cuvillieri



7359-44a

7359-43a

Paleodictyoconus actinostoma



7359-21a

7359-4e

Montseciella arabica

Plate 93: Orbitolinids of the Vandenheckei Zone in the Gorges de la Nesque section. *Montseciella arabica*: 7359-4, 7359-21; *Paleodictyoconus actinostoma*: 7359-43a, 7359-44a; *Paleodictyoconus cuvillieri*: 7359-3. Scale bar = 500 µm.

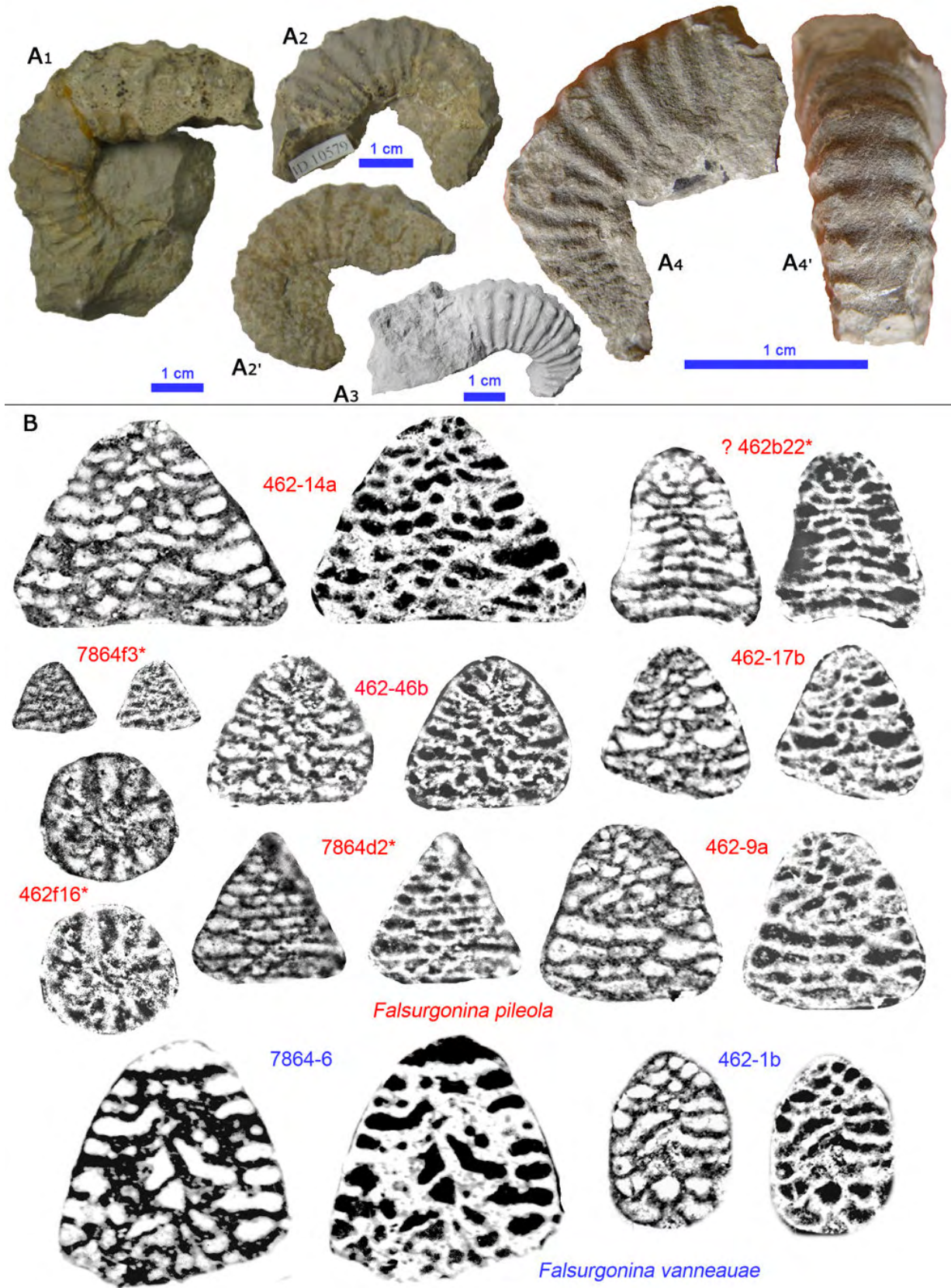


Plate 94: A) Ammonites of Sartousiana Zone at Col de Rousset: A1) *Camereiceras limentinus*, UJF-ID 10580 © OSUG; A2-A2') *Camereiceras limentinus*, UJF-ID 10579 © OSUG; A3) *Camereiceras limentinus*, UJF-ID 10549 © OSUG; A4-A4') *Camereiceras* sp. -RB- {or *Hemihoplites feraudianus* -DB-}, FSL 108225. B) Orbitolinids of the Vandenheckei Zone at Col de Rousset. *Falsurgonina pileola*: 462-9a, 462-14a, 462-17b, 462-46b, ? 462b22* [NF], 462f16*, 7864d2*, 7864f3*; *Falsurgonina vanneauae*: 462-1b, 7864-6. Ammonite scale bar (A-C) = 5 cm, and scale bar (D) = 500 µm. Note that Pl. 94, A3 ID 10289 [sic, actually UJF-ID 10589] is duplicated from ARNAUD *et al.* (1998) Pl. 5, fig 8.

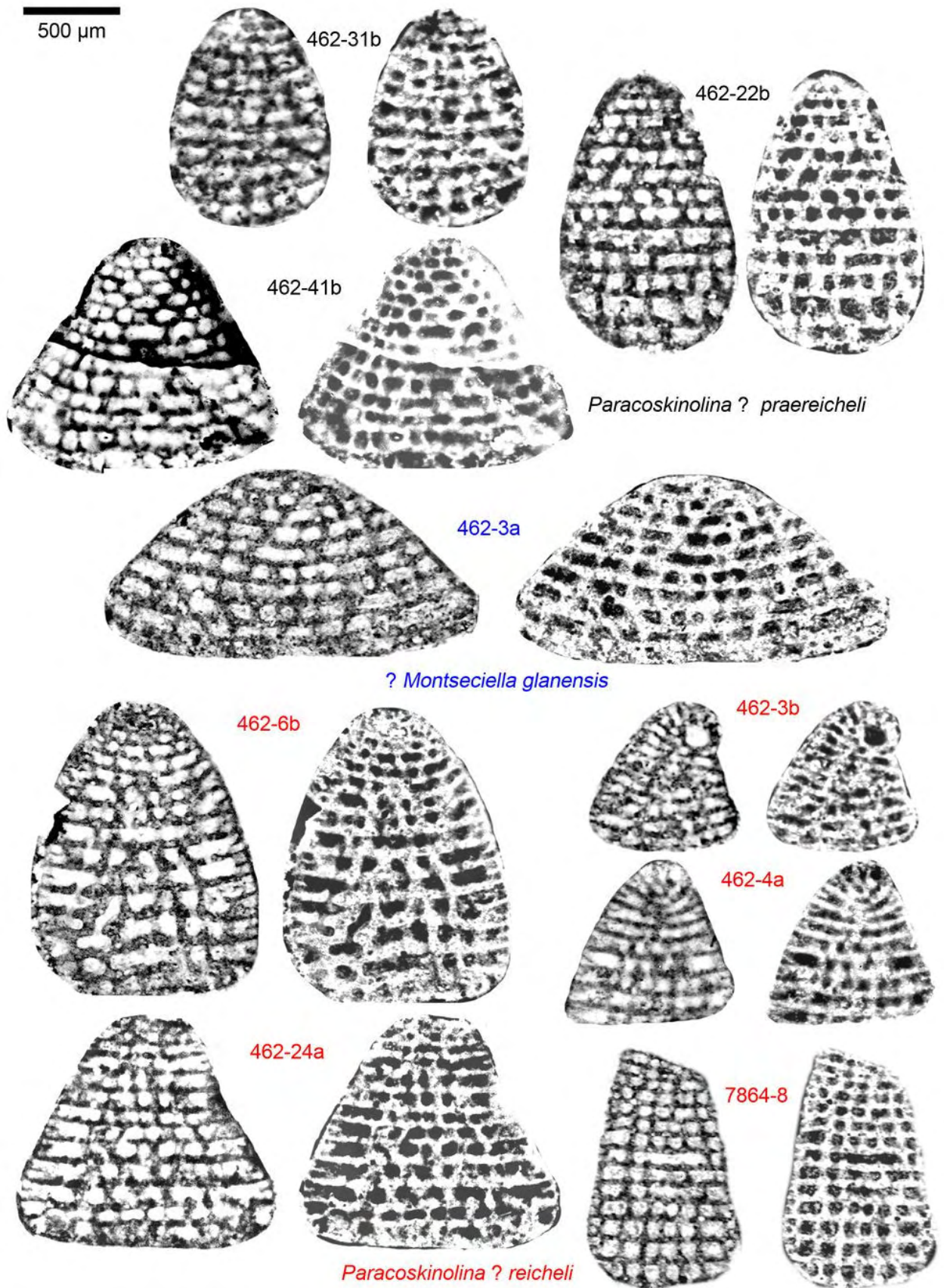


Plate 95: Orbitolinids of the Vandennecke Zone at Col de Rousset. ? *Montseciella glanensis*: 462-3a; *Paracoskinolina ? praereicheli*: 462-22b, 462-31b, 462-41b; *Paracoskinolina ? reicheli*: 462-3b, 462-4a, 462-6b, 462-24a, 7864-8. Scale bar = 500 μm .



500 µm

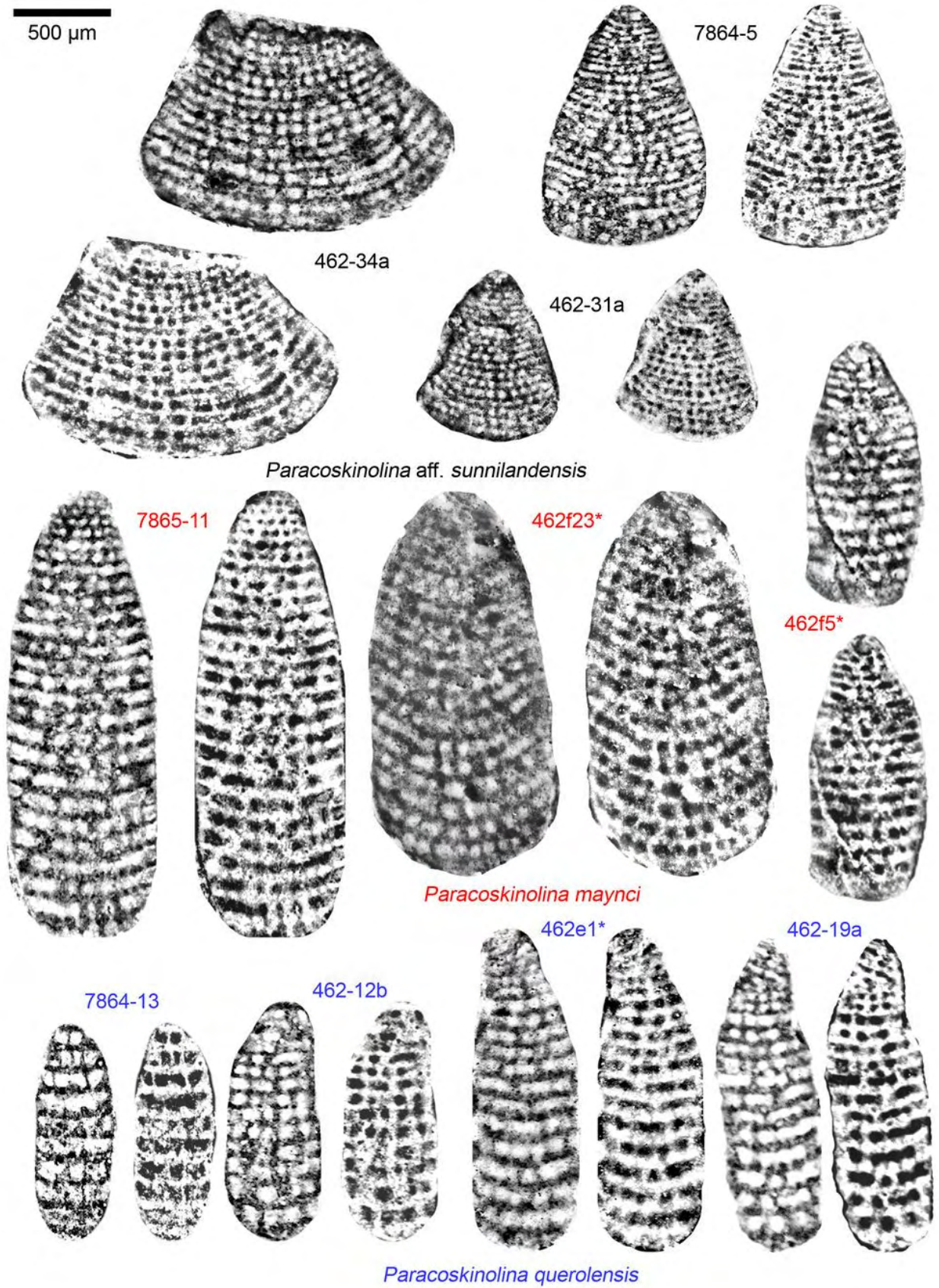


Plate 96: Orbitolinids of the Vandennecke Zone at Col de Rousset. *Paracoskinolina maynci*: 462f5*, 462f23*, 7865-11; *Paracoskinolina querolensis*: 462-12b, 462-19a, 462e1*, 7864-13; *Paracoskinolina aff. sunnilandensis*: 462-31a, 462-34a, 7864-5. Scale bar = 500 µm.

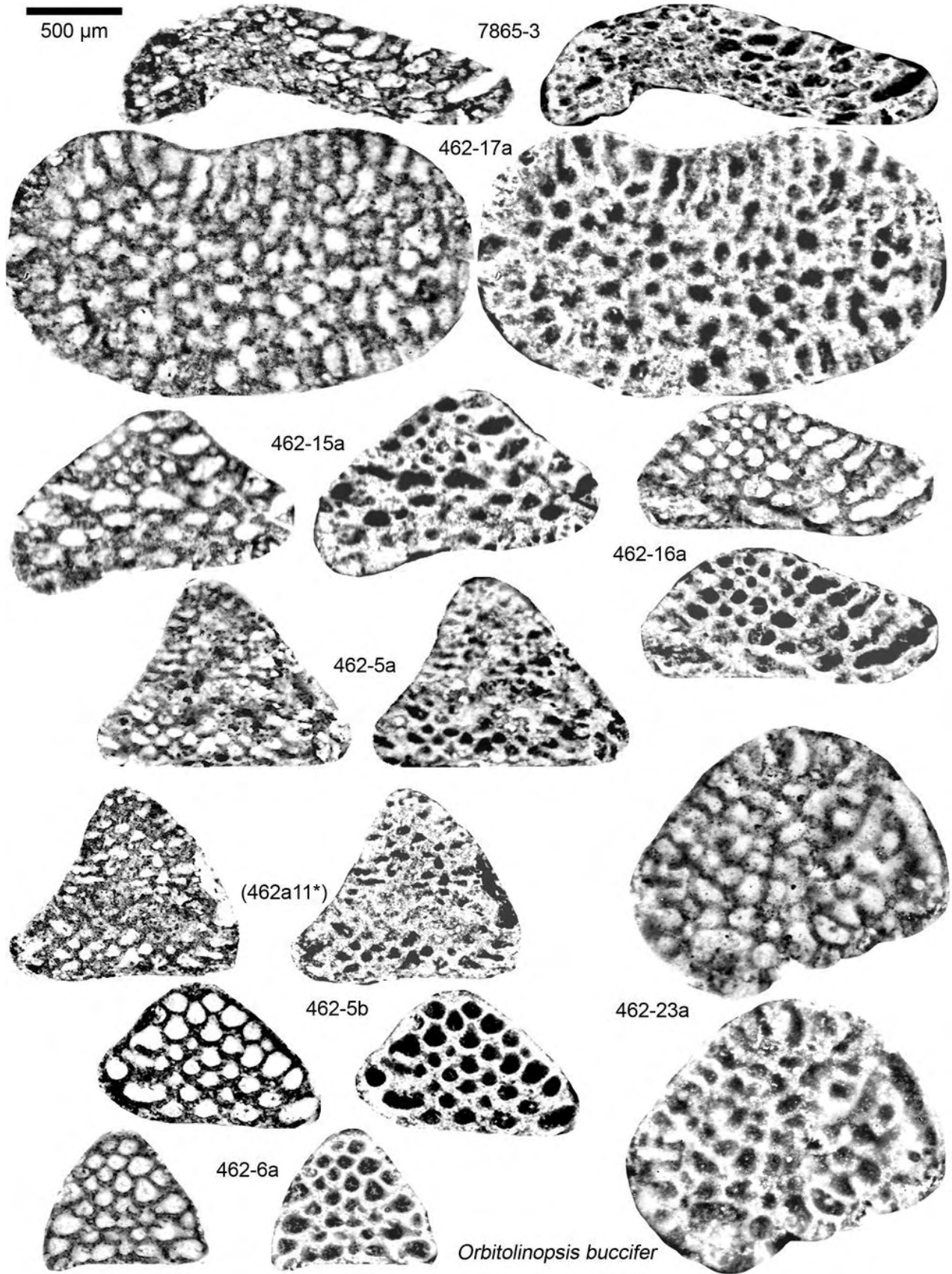


Plate 97: Orbitolinids of the Vandenheckei Zone at Col de Rousset. *Orbitolinopsis buccifer*: 462-5a (462a11*), 462-5b, 462-6a, 462-15a, 462-16a, 462-17a, 462-23a, 7865-3. Scale bar = 500 µm.

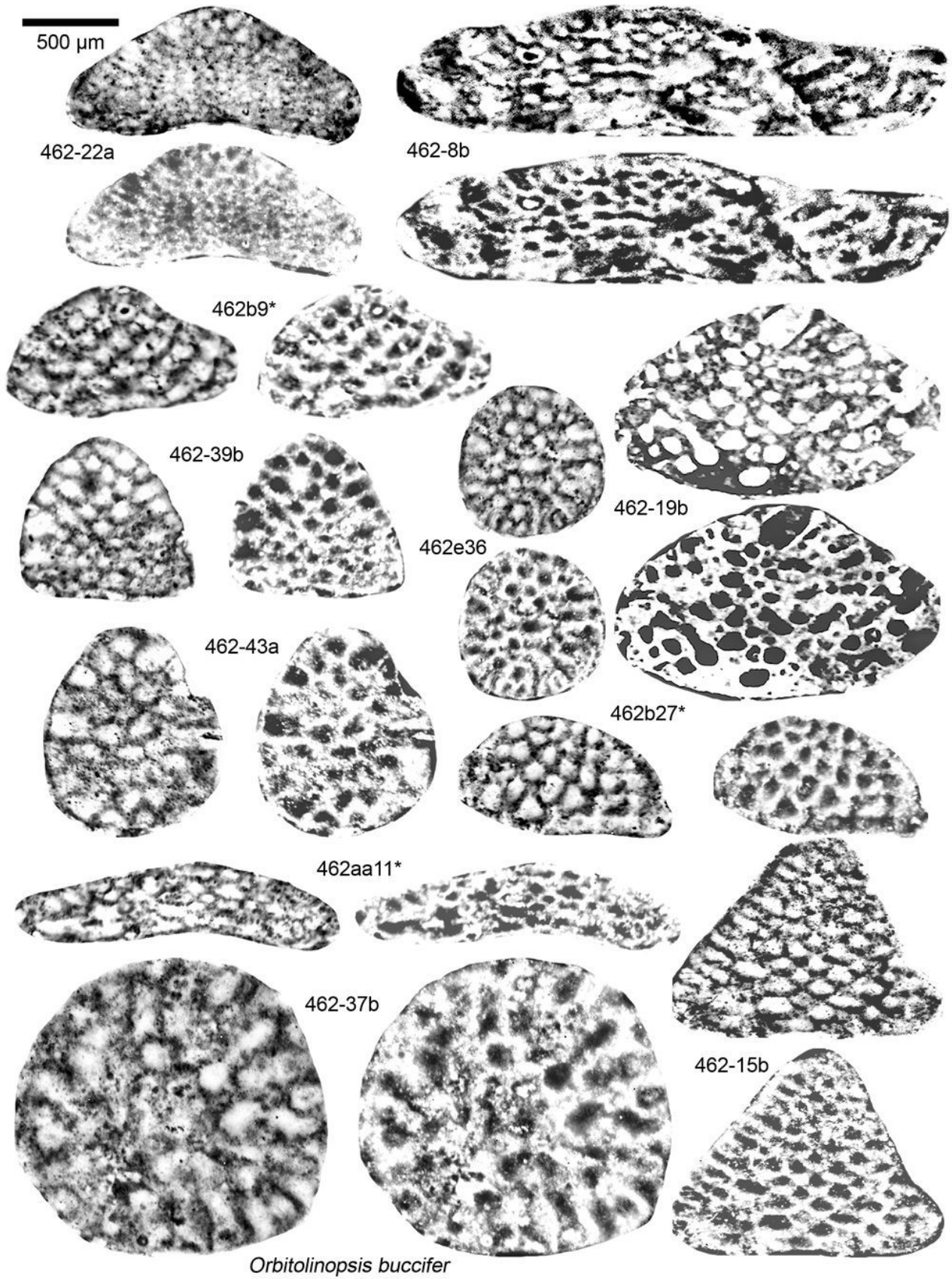


Plate 98: Orbitolinids of the Vandenheckei Zone at Col de Rousset. *Orbitolinopsis buccifer*: 462-8b, 462-15a, 462-19b, 462-22a, 462-32a, 462-37b, 462-39b, 462-43a, 462aa11*, 462b9*, 462b27*. Scale bar = 500 µm.

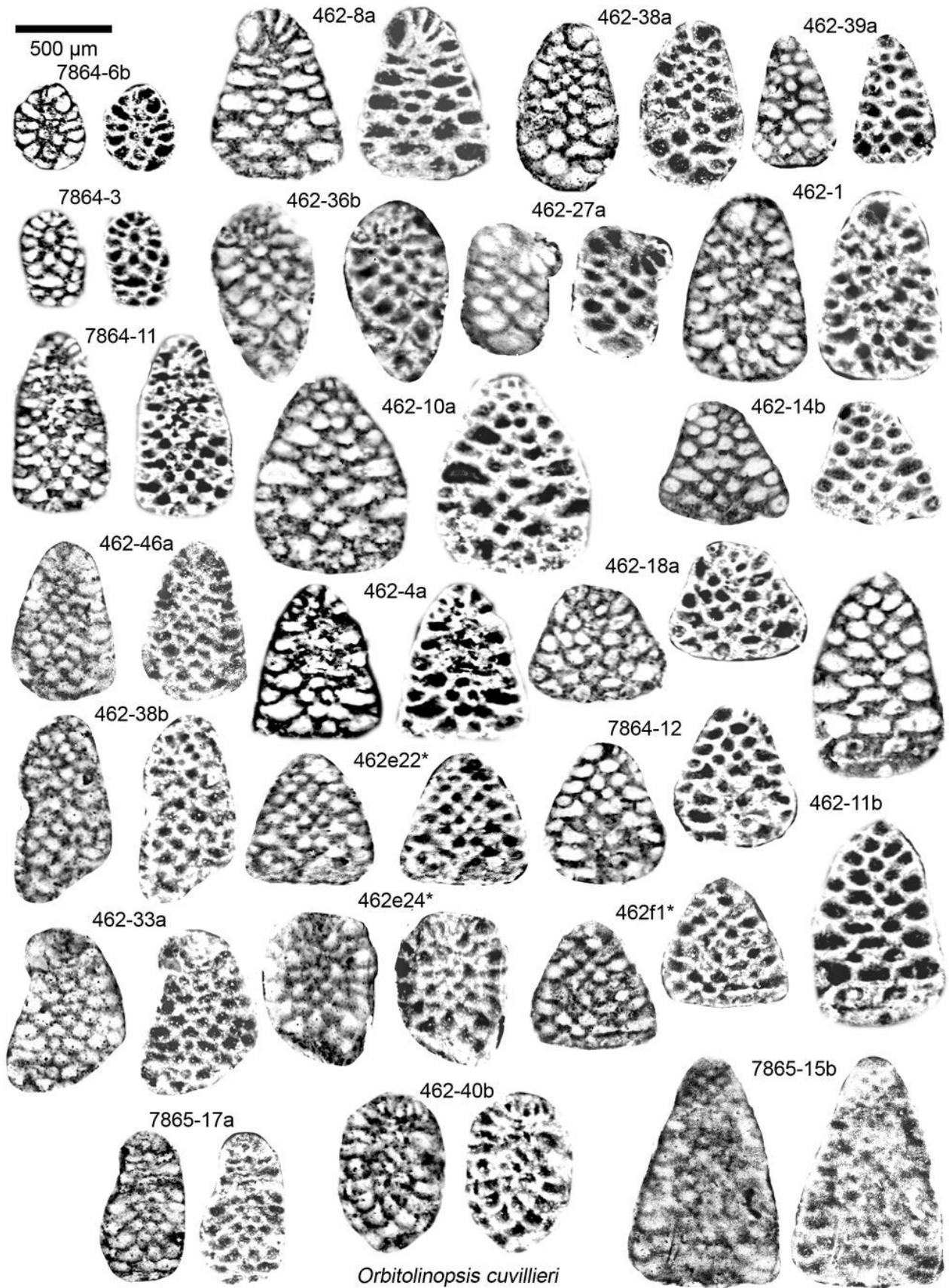


Plate 99: Orbitolinids of the Vandennecke Zone at Col de Rousset. *Orbitolinopsis cuvillieri*: 462-1b, 462-4a, 462-8a, 462-10a, 462-11b, 462-14b, 462-18a, 462-27a, 462-33a, 462-36b, 462-38a, 462-38b, 462-39a, 462-40b, 462-46a, 462e22*, 462e24*, 462f1*, 7864-3, 7864-6, 7864-11, 7864-12, 7865-15b, 7865-17a. Scale bar = 500 μm.

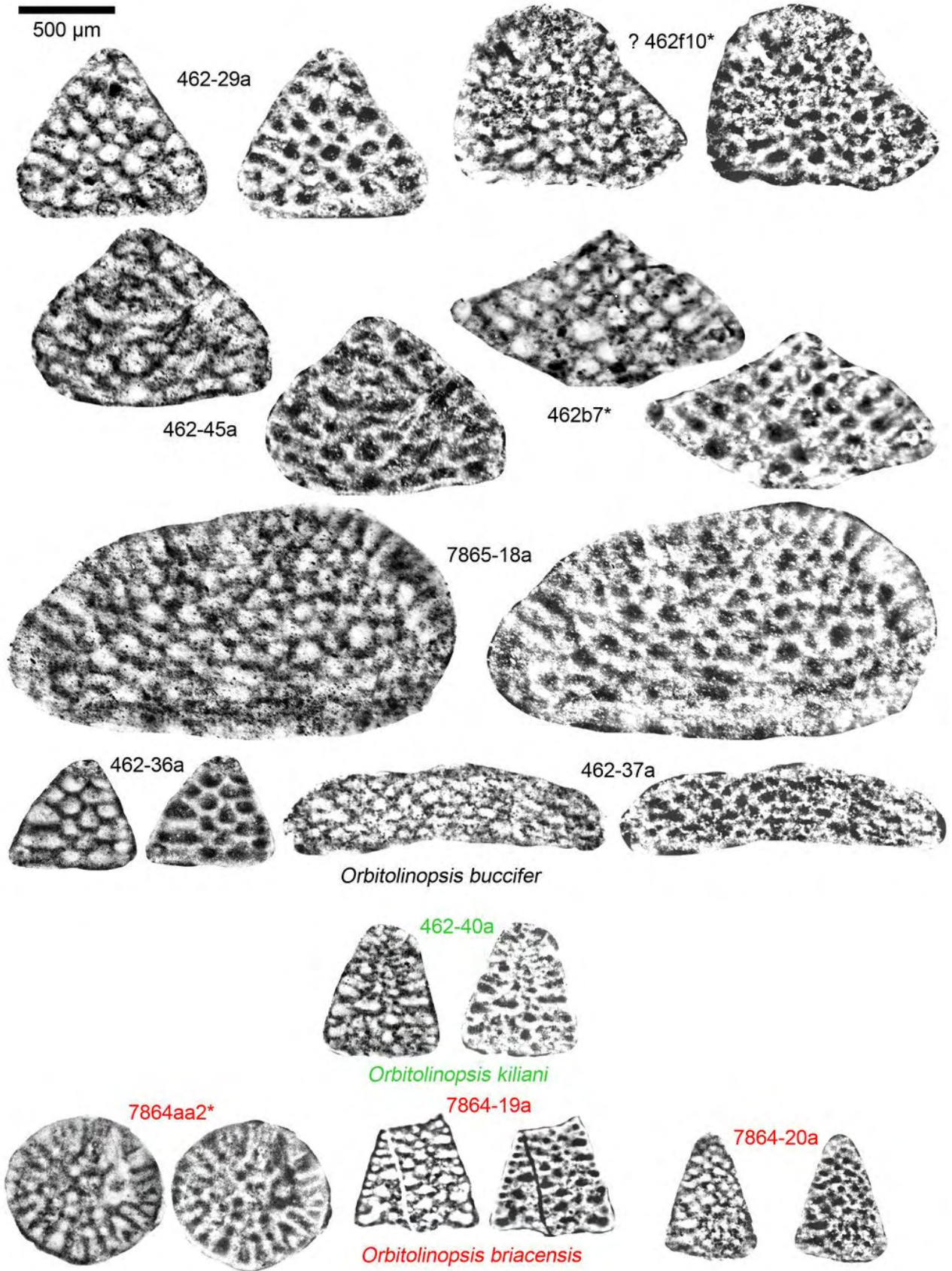


Plate 100: Orbitolinids of the Vandennecke Zone at Col de Rousset. *Orbitolinopsis briacensis*: 7864-19a, 7864-20a, 7864aa2*; *Orbitolinopsis buccifer*: 462-29a, 462-36a, 462-37a, 462-45a, 462b7*, ? 462f10* [NF], 7865-18a; *Orbitolinopsis kiliani*: 462-40a. Scale bar = 500 µm.

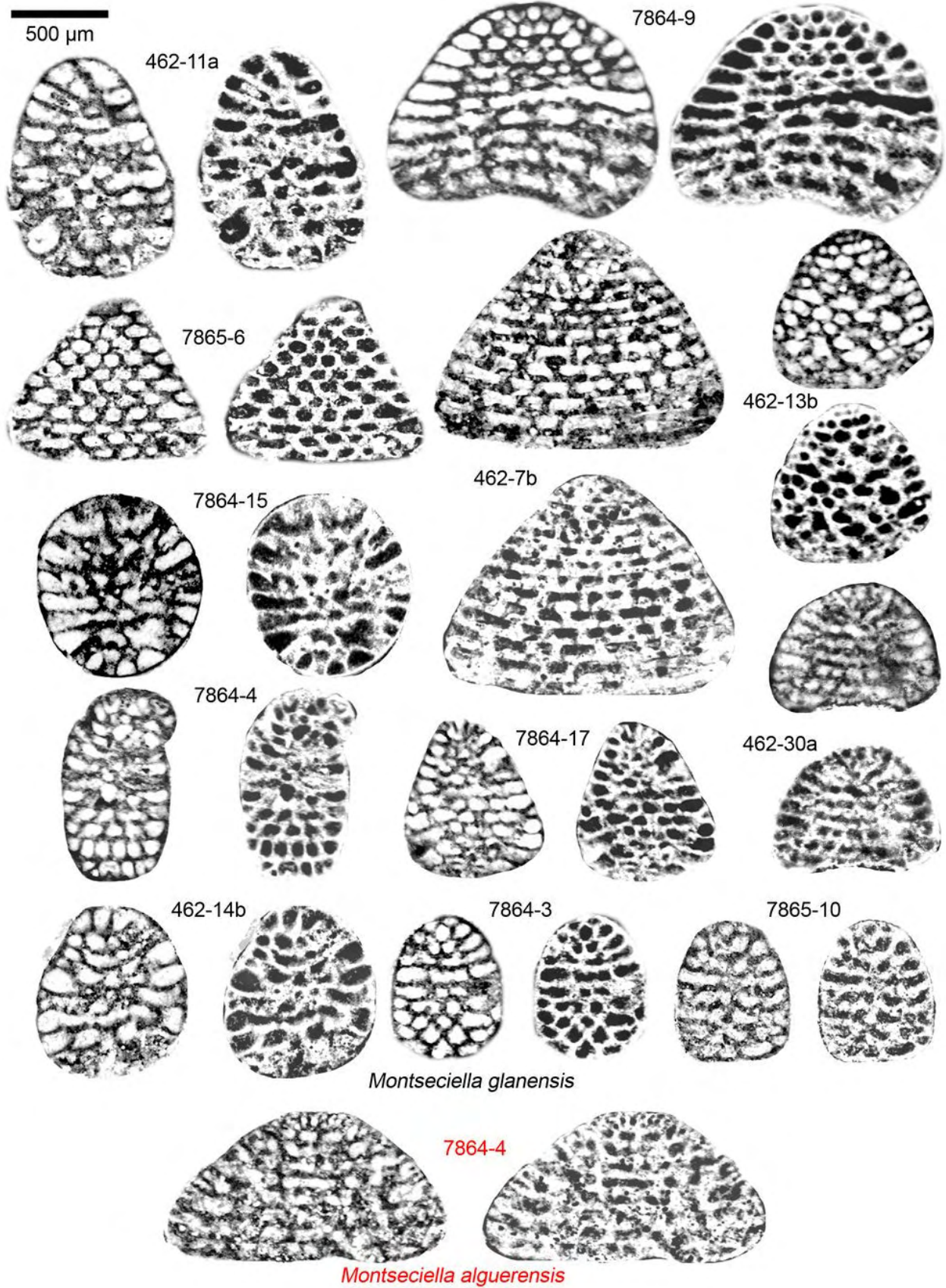


Plate 101: Orbitolinids of the Vandennecke Zone at Col de Rousset. *Montseciella alguerensis*: 7864-4; *Montseciella glanensis*: 462-7b, 462-11a, 462-13b, 462-14b, 462-30a, 7864-3, 7864-4, 7864-9, 7864-15, 7864-17, 7865-6, 7865-10. Scale bar = 500 μm.

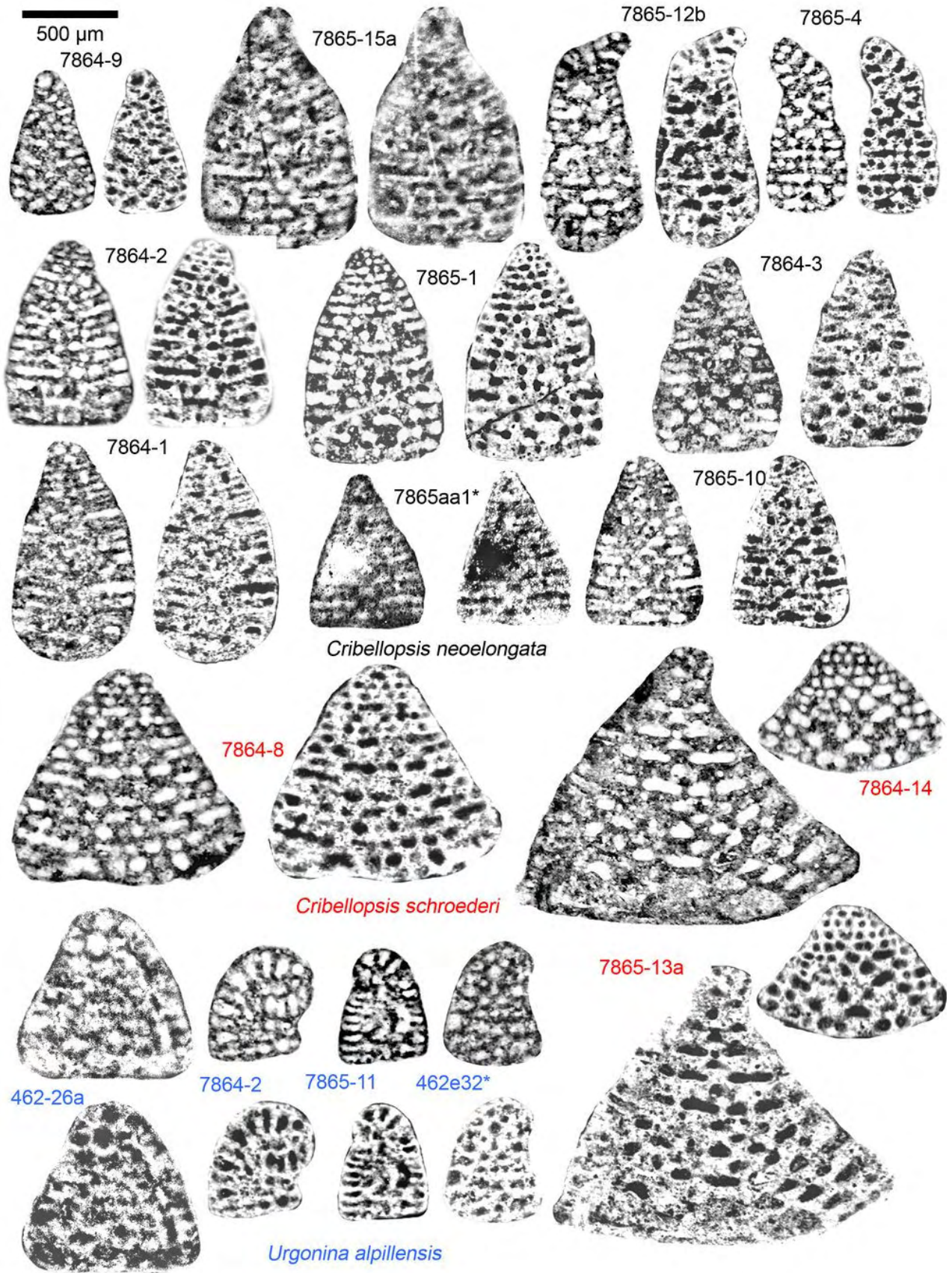
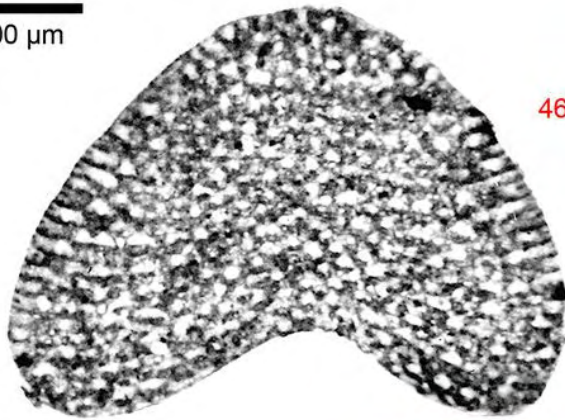


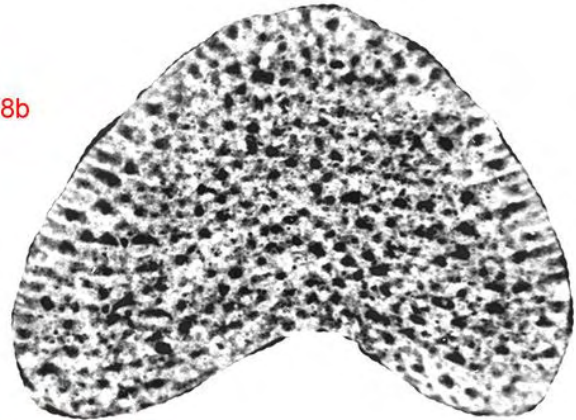
Plate 102: Orbitolinids of the Vandenheckei Zone at Col de Rousset. *Cribellopsis neolongata*: 7864-1, 7864-2, 7864-3, 7864-9, 7865-1, 7865-4, 7865-10, 7865-12b, 7865-15a, 7865aa1*; *Cribellopsis schroederi*: 462-5a, 7864-8, 7864-14, 7865-13a; *Urgonina alpillensis*: 462-26a, 462e32*, 7864-2, 7865-11. Scale bar = 500 µm.



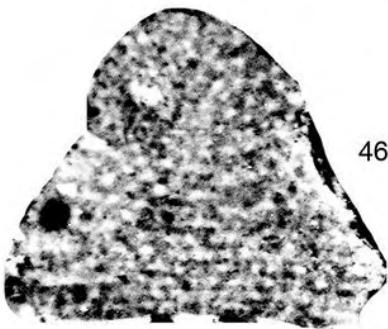
500 μ m



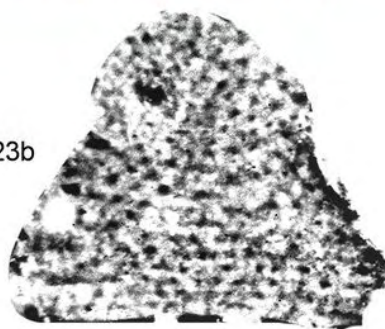
462-18b



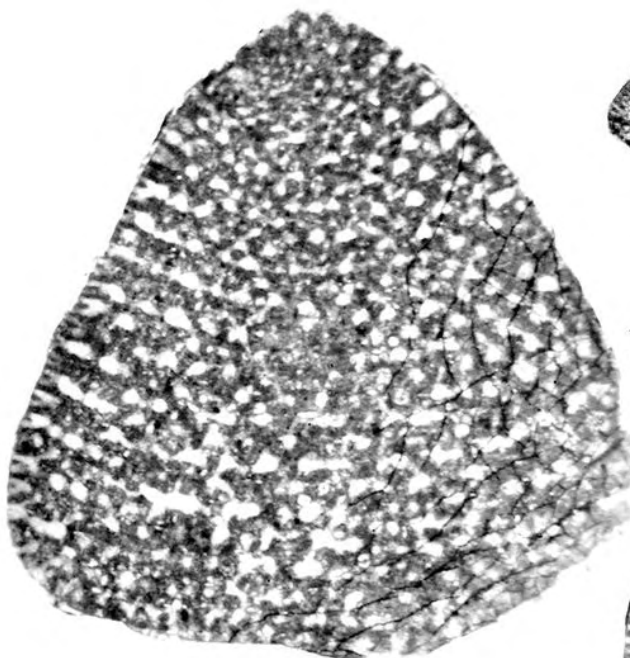
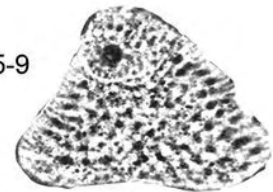
Paleodictyoconus actinostoma



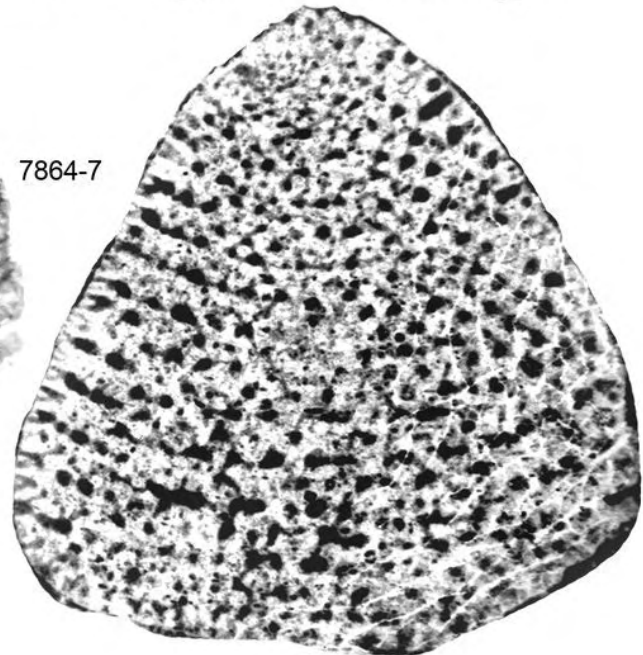
462-23b



7865-9



7864-7



Paleodictyoconus cuvillieri

Plate 103: Orbitolinids of the Vandenheckei Zone at Col de Rousset. *Paleodictyoconus actinostoma* : 462-18b; *Paleodictyoconus cuvillieri*: 462-23b, 7864-7, 7865-9. Scale bar = 500 μ m.

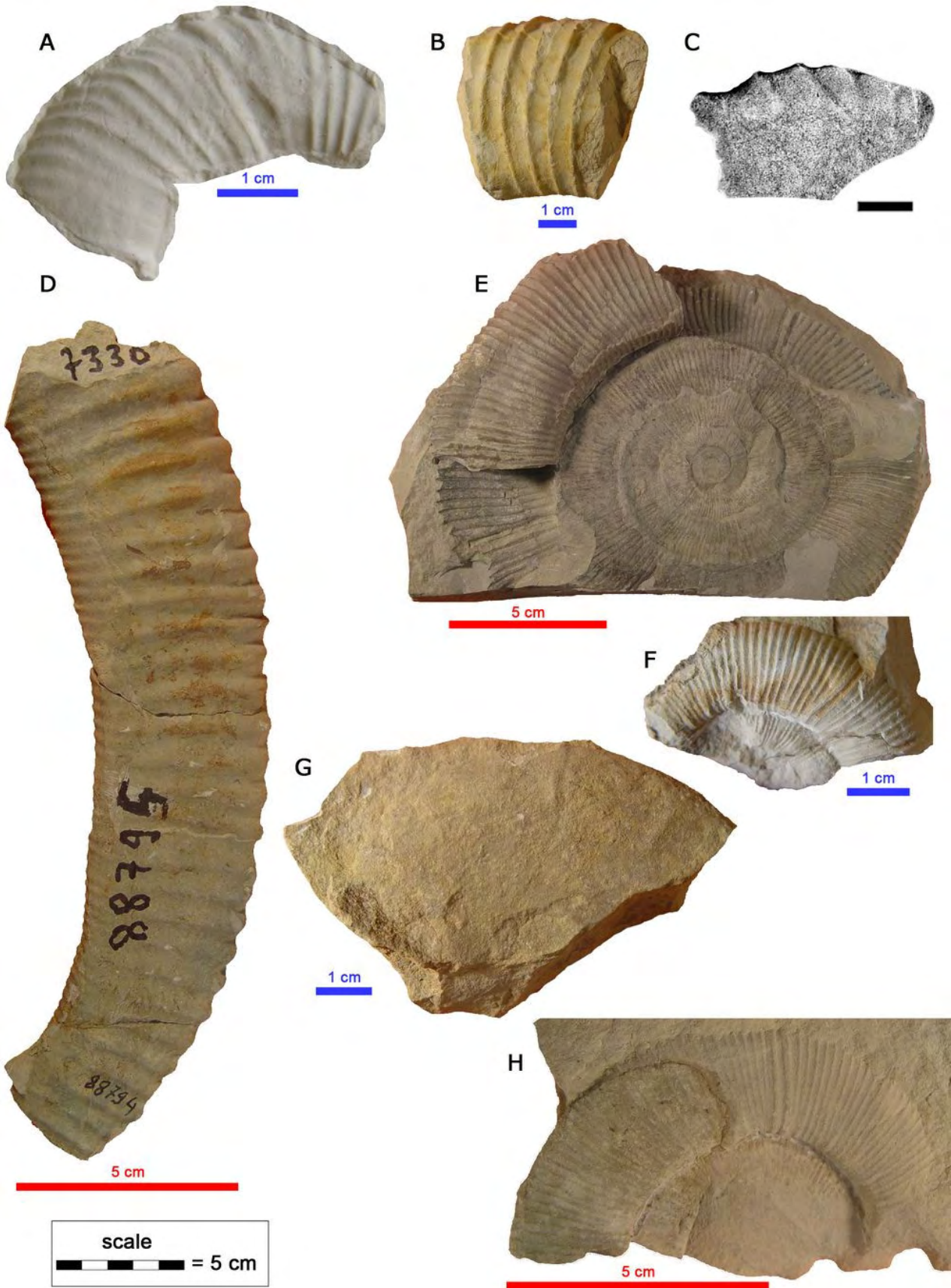
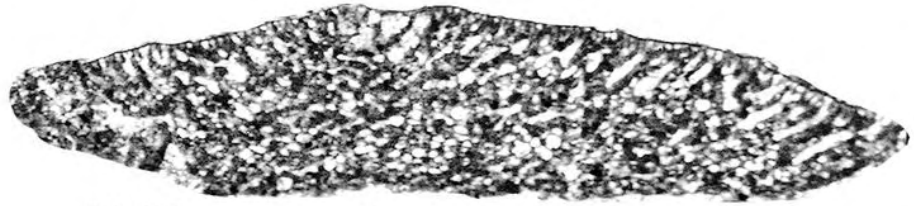


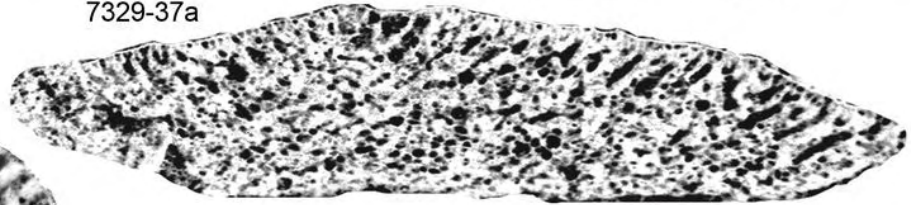
Plate 104: Ammonites of the Vandennecke and Giraudi zones at La Charce. A) cast of *Silesites seranonis*, FSL 88810; B) *Costidiscus recticostatus*, FSL 88812; C) *Gerhardtia sartousiana* -RB- {or ? -DB-}, FSL 88808; D) *Moutoniceras moutonianum* -RB- {or *Moutoniceras eigenheeri* -DB-}, FSL 88795; E) *Costidiscus olcostephanoides*, FSL 88807; F) *Costidiscus olcostephanoides*, FSL 88802; G) *Barremites hemiptychum*, FSL 88800; H) *Costidiscus olcostephanoides*, FSL 88801. Scale bars = either 1 cm or 5 cm.



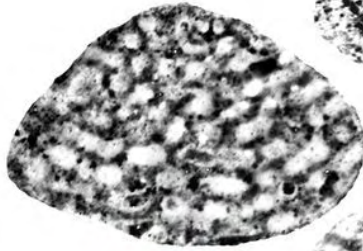
500 µm



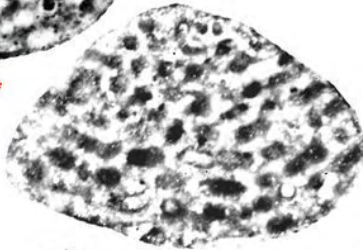
7329-37a



Palorbitolina lenticularis



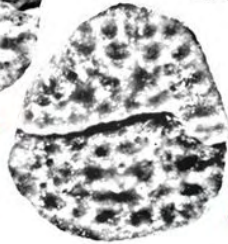
7329a1*



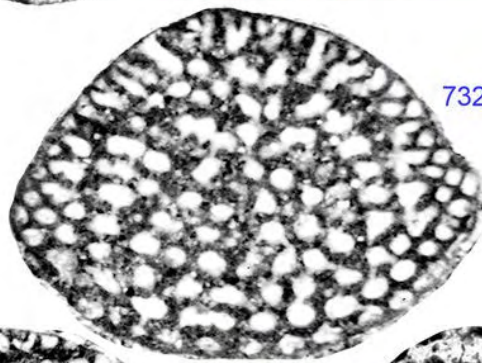
7329-24



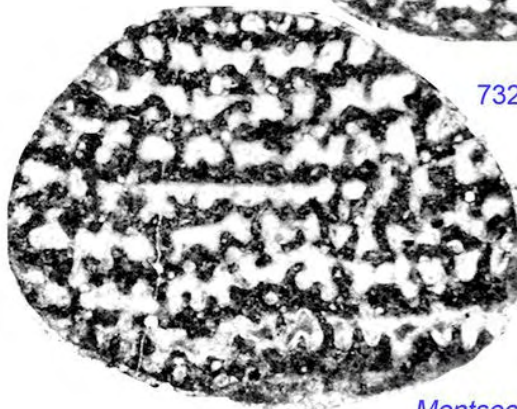
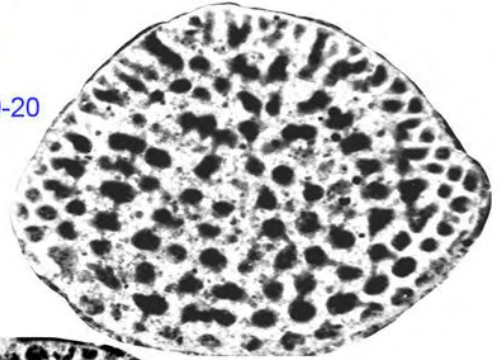
7329a2*



Montseciella glanensis



7329-20



7329-19



Montseciella algerensis

Plate 105: Orbitolinids of the Vandennecke Zone at La Charce. *Montseciella algerensis*: 7329-19, 7329-20; *Montseciella glanensis*: 7329-24, 7329a1*, 7329a2*; *Palorbitolina lenticularis*: 7329-37a. Scale bar = 500 µm.

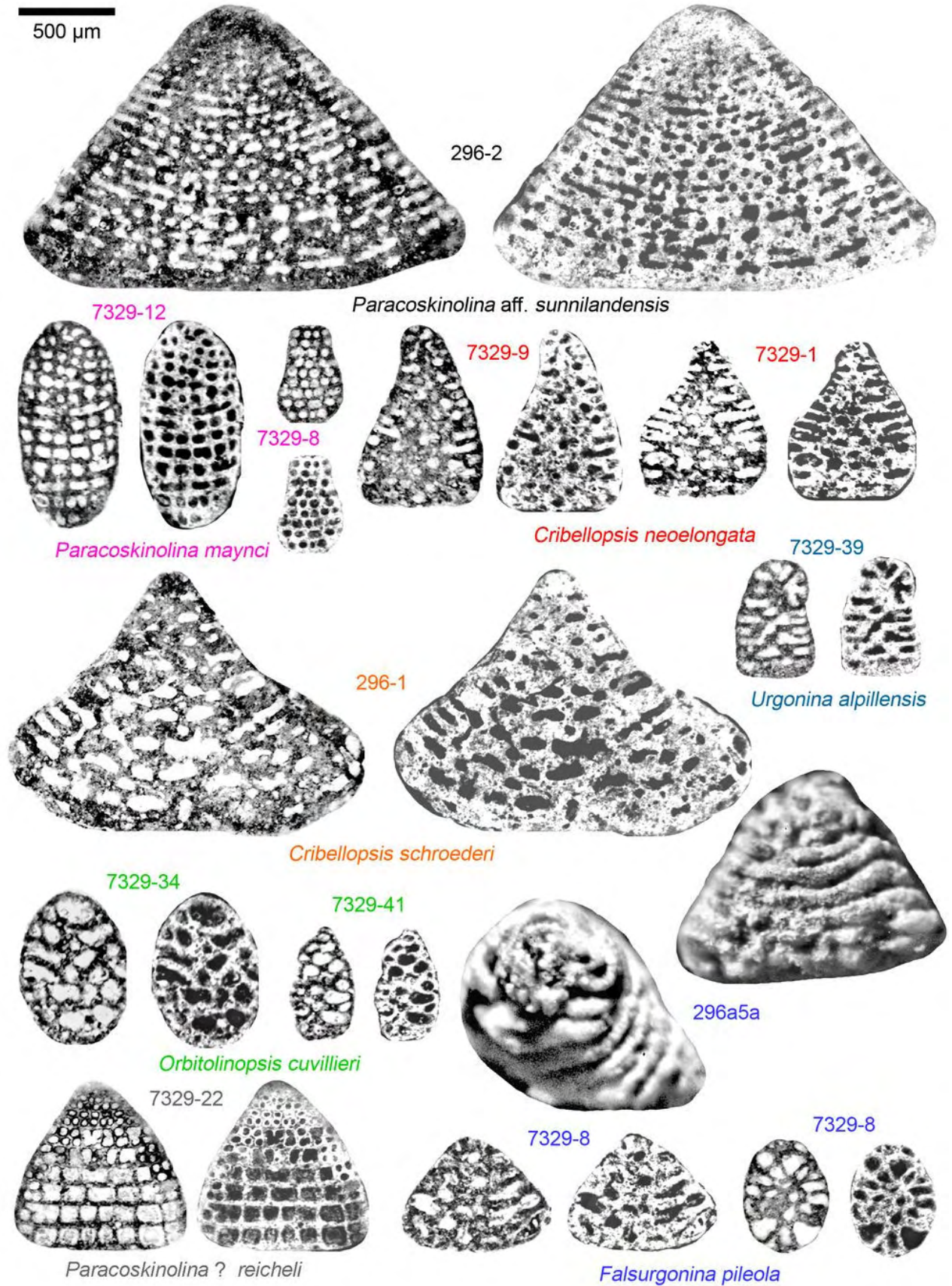
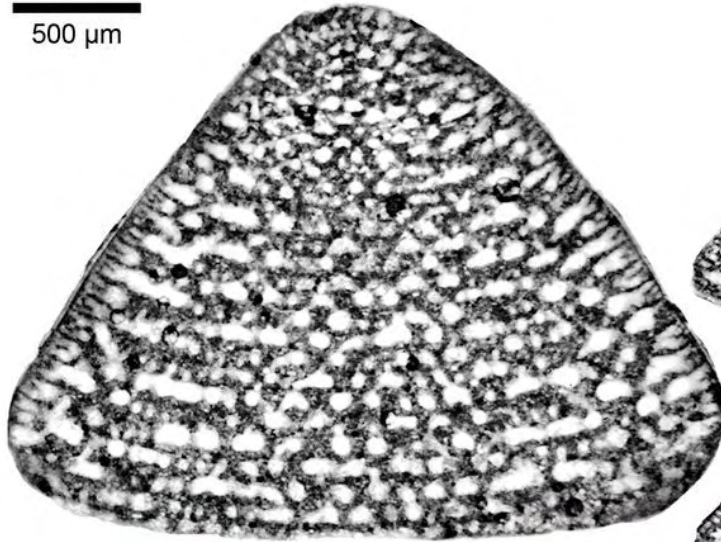


Plate 106: Orbitolinids of the Vandenheckei Zone at La Charce. *Cribellopsis neolongata*: 7329-1, 7329-9; *Cribellopsis schroederi*: 296-1; *Falsurgonina pileola*: 296a5a [loose specimen], 7329-8; *Orbitolinopsis cuvillieri*: 7329-34, 7329-41; *Paracoskinolina maynci*: 7329-8, 7329-12; *Paracoskinolina* ? *reicheli*: 7329-22; *Paracoskinolina* aff. *sunnilandensis*: 296-2; *Urgonina alpillensis*: 7329-39. Scale bar = 500 µm.

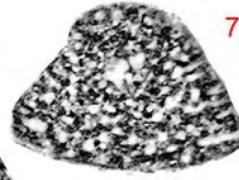


500 µm

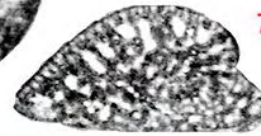
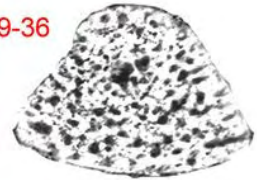


296-2

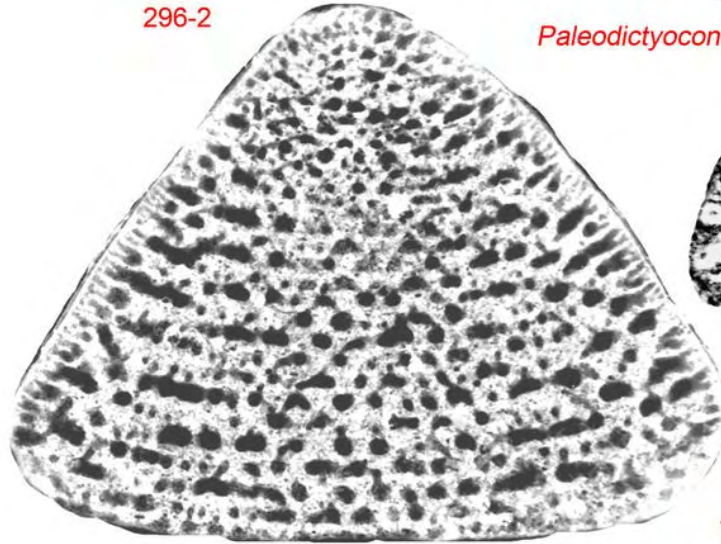
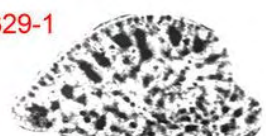
Paleodictyoconus cuvillieri



7329-36

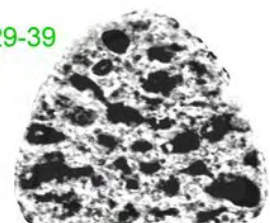
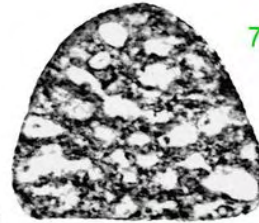


7329-1



7329-39

Orbitolinopsis buccifer



7329-40

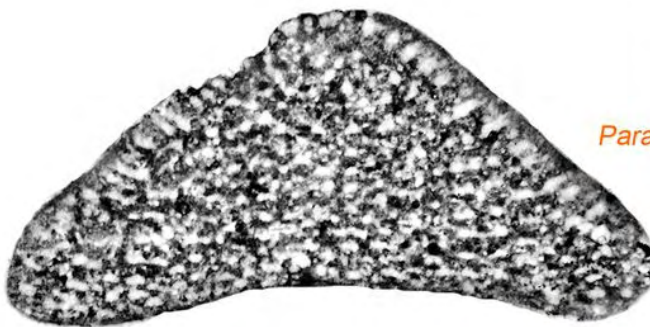
Paracoskinolina querolensis



7329a4*



Orbitolinopsis kiliani



296-2

Paleodictyoconus actinostoma

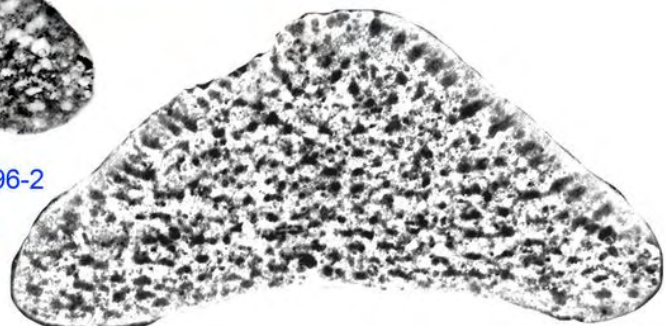


Plate 107: Orbitolinids of the Vandenheckei Zone at La Charce. *Orbitolinopsis buccifer*: 7329-39; *Orbitolinopsis kiliani*: 7329a4*; *Paleodictyoconus actinostoma*: 296-2; *Paleodictyoconus cuvillieri*: 296-2, 7329-1, 7329-36; *Paracoskinolina querolensis*: 7329-40. Scale bar = 500 µm.

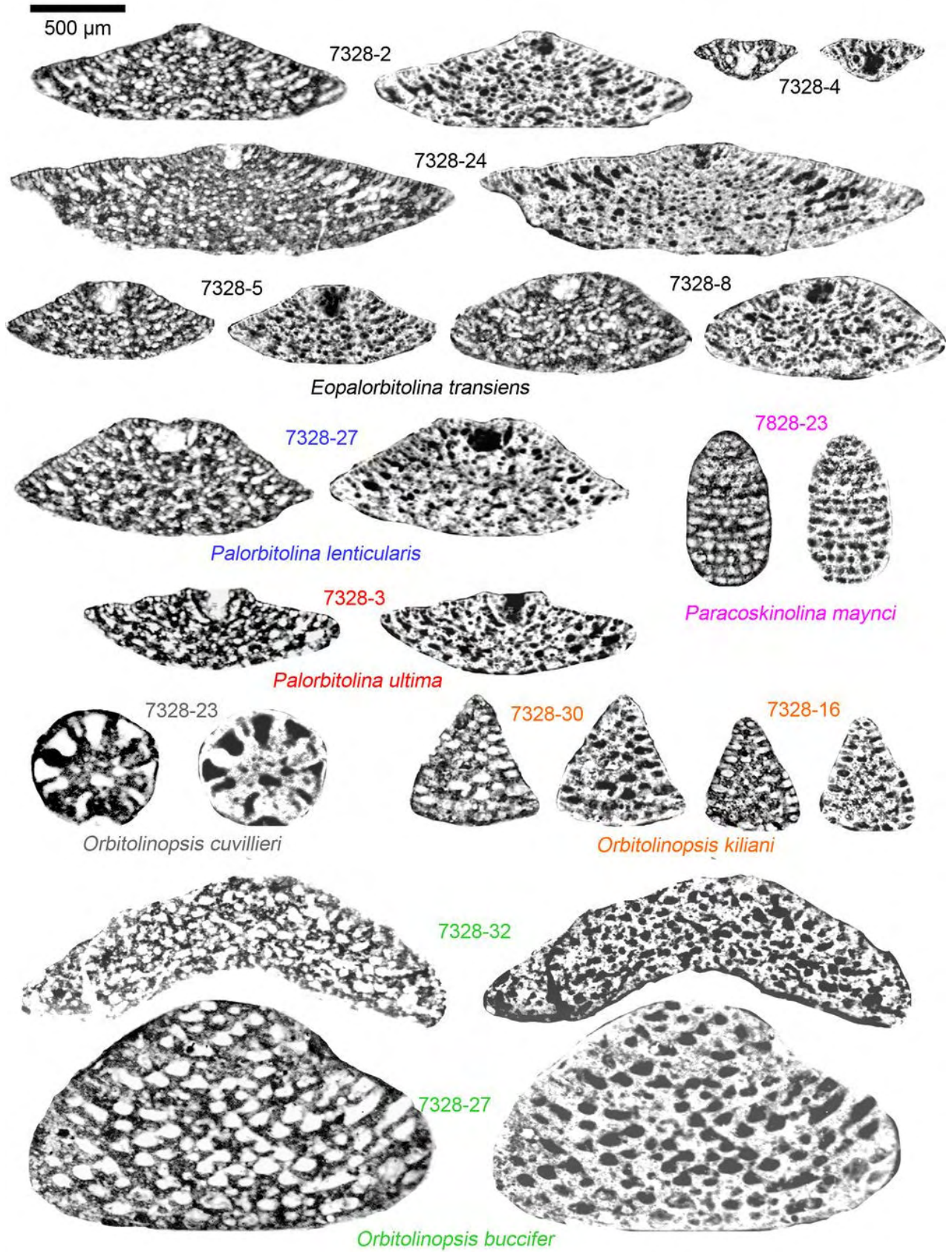
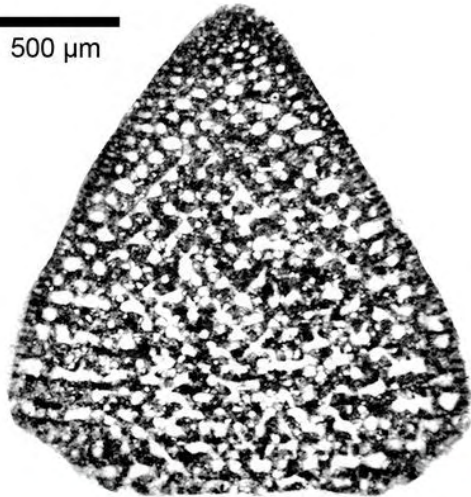


Plate 108: Orbitolinids of the Giraudi Zone at La Charce. *Eopalorbitolina transiens*: 7328-2, 7328-4, 7328-5, 7328-8, 7328-24; *Orbitolinopsis buccifer*: 7328-27, 7328-32; *Orbitolinopsis cuvillieri*: 7328-23; *Orbitolinopsis kiliani*: 7328-16, 7328-30; *Palorbitolina lenticularis*: 7328-27; *Palorbitolina ultima*: 7328-3; *Paracoskinolina maynci*: 7328-23. Scale bar = 500 µm.



500 µm

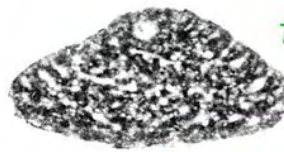
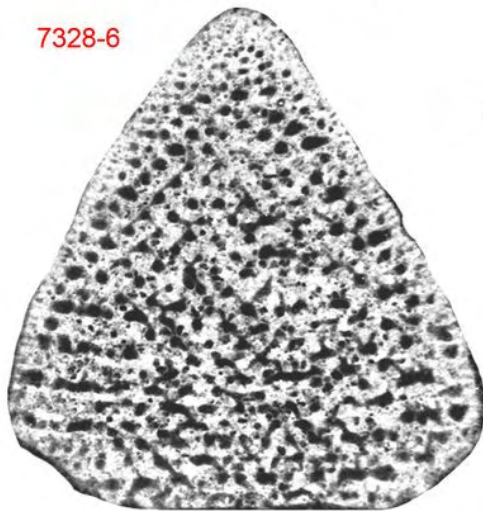


7328-27

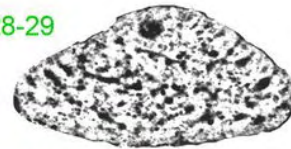


Paleodictyoconus cuvillieri

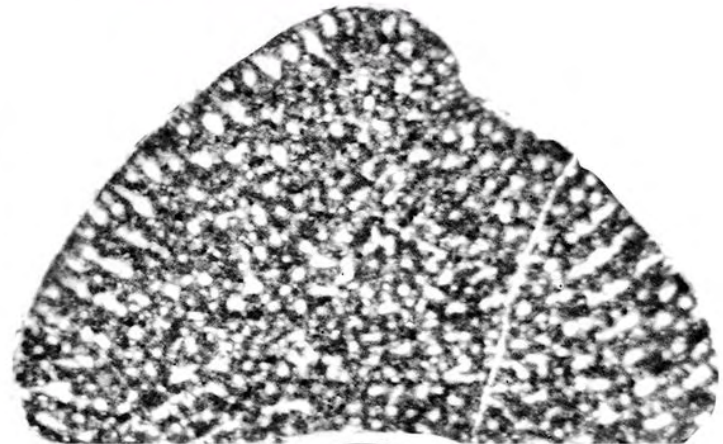
7328-6



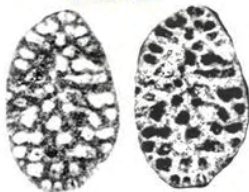
7328-29



Eopalorbitolina transiens



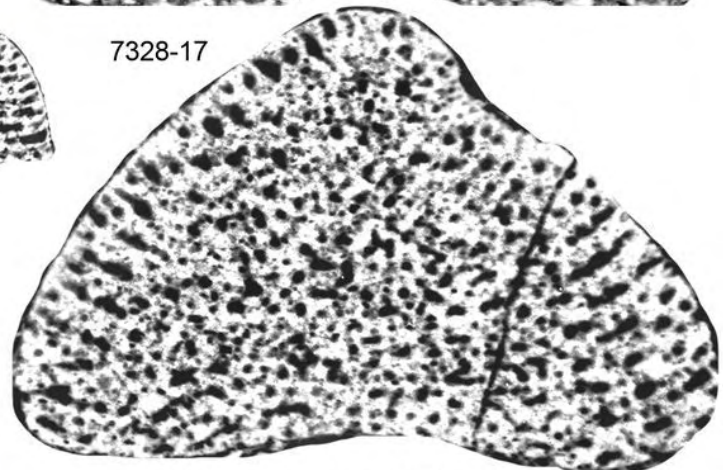
7328-27



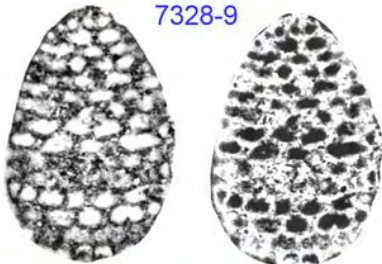
7328-20



7328-17



7328-9



Cribellopsis neolongata

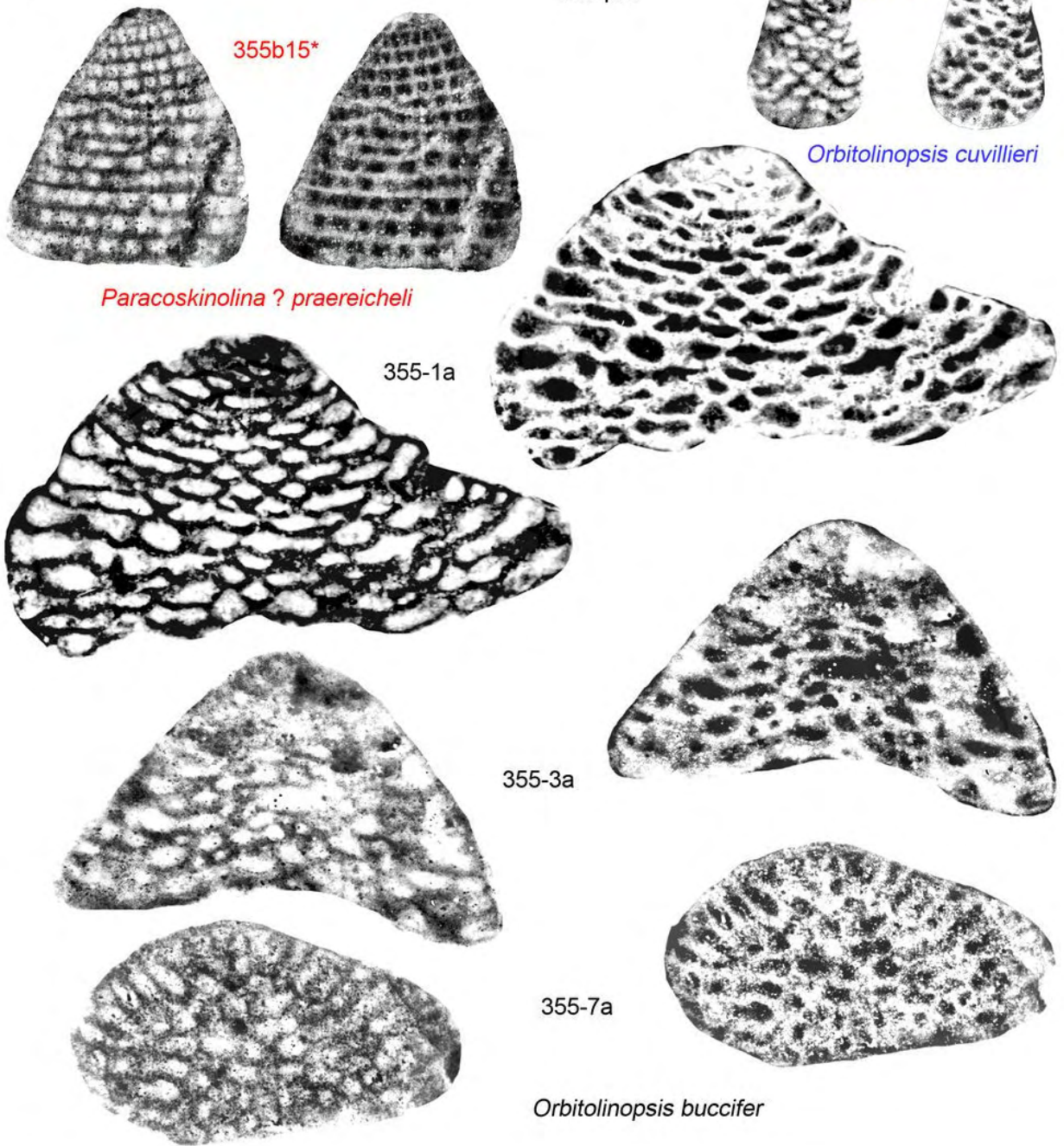
Paleodictyoconus actinostoma

Plate 109: Orbitolinids of the Giraudi Zone at La Charce. *Cribellopsis neolongata*: 7328-9, 7328-20, 7328-27; *Eopalorbitolina transiens*: 7328-29; *Paleodictyoconus actinostoma*: 7328-17; *Paleodictyoconus cuvillieri*: 7328-6, 7328-27. Scale bar = 500 µm.



A

500 µm



B



Plate 110: A) Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Orbitolinopsis buccifer*: 355-1a, 355-3a, 355-7a; *Orbitolinopsis cuvillieri*: 355-4a; *Paracoskinolina ? praereicheli*: 355b15*; B) *Pseudocrioceras* cf. *baylei* -RB- {or ? *Pseudocrioceras* sp. -DB-}, FSL 89446. Scale bar (A) = 500 µm, and ammonite scale bar (B) = 5 cm.

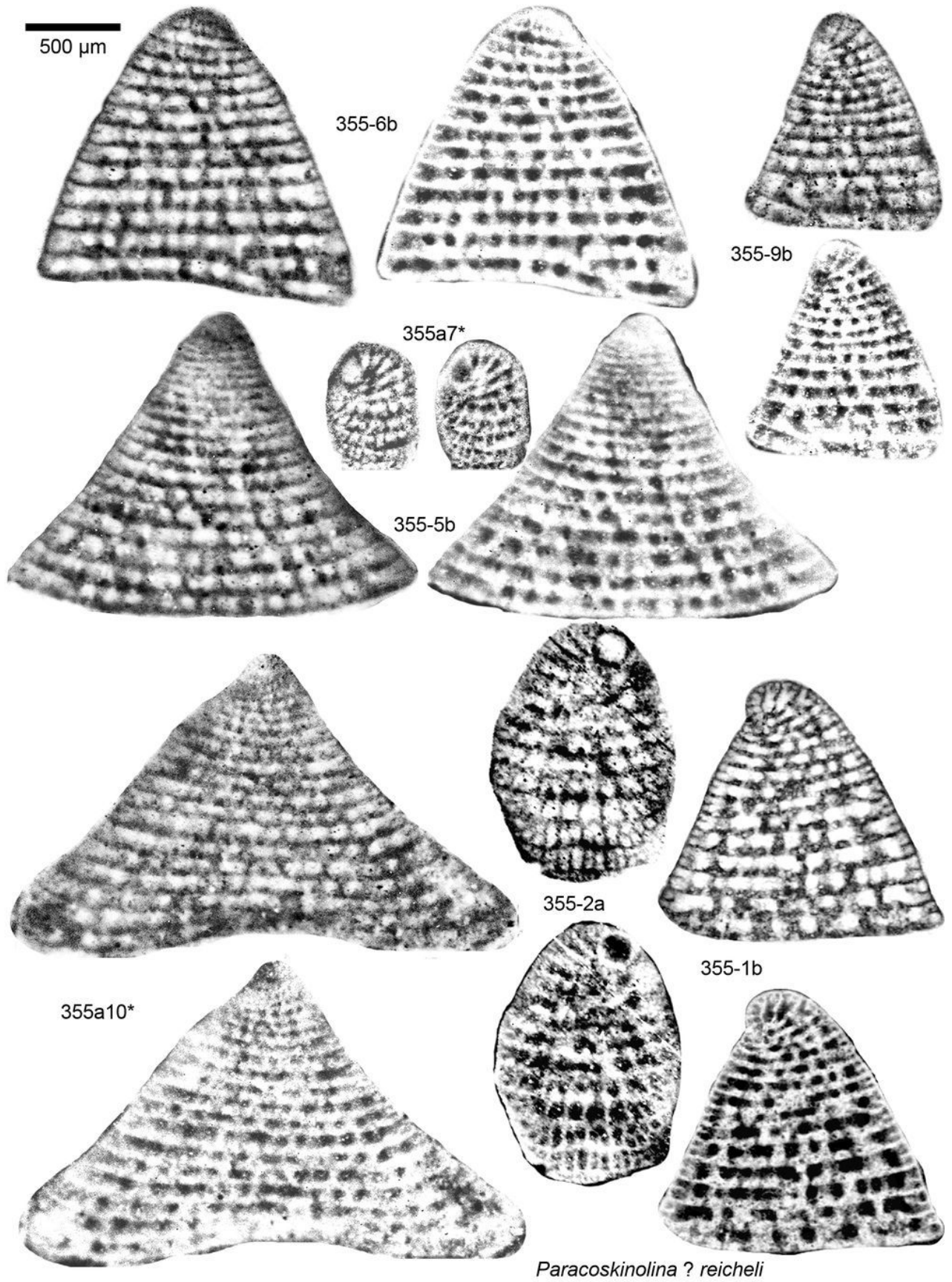


Plate 111: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Paracoskinolina ? reicheli*: 355-1b, 355-2a, 355-5b, 355-6b, 355-9b, 355a7*, 355a10*. Scale bar = 500 μm.

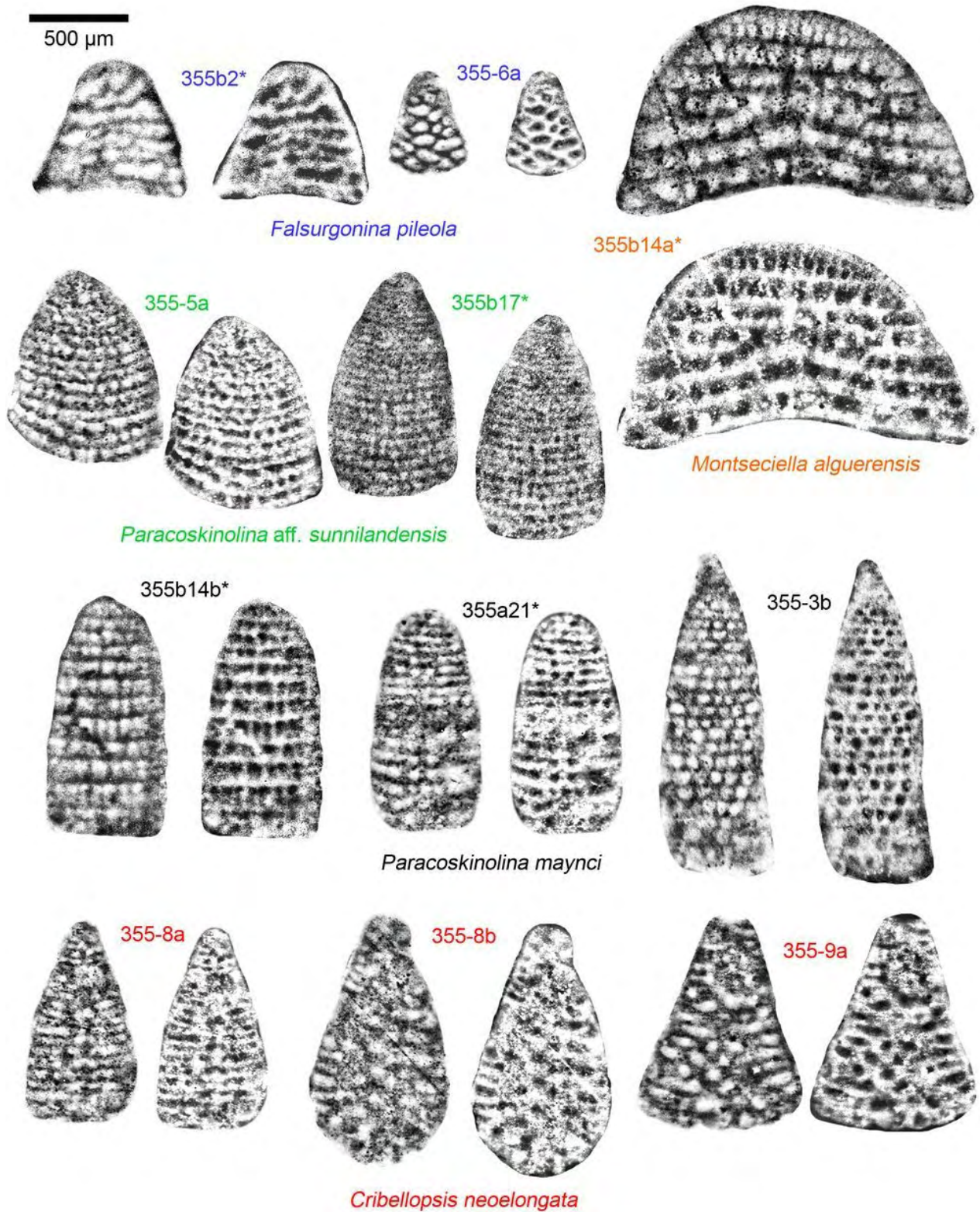
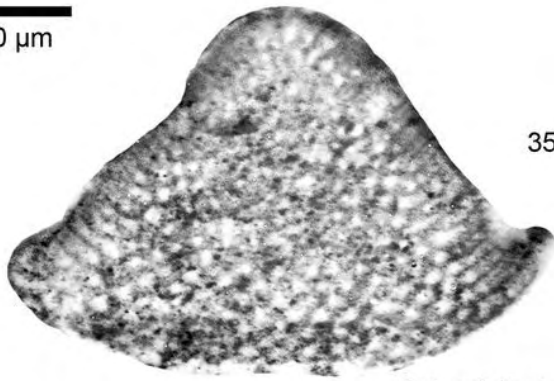


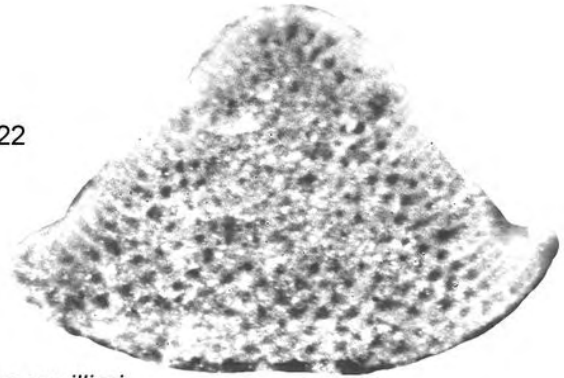
Plate 112: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Cribellopsis neoelongata*: 355-8a, 355-8b, 355-9a; *Falsurgonina pileola*: 355-6a, 355b2*; *Montseciella alguerensis*: 355b14a*; *Paracoskinolina maynci*: 355-3b, 355a21*, 355b14b*; *Paracoskinolina aff. sunnilandensis*: 355-5a, 355b17*. Scale bar = 500 μ m.



500 μ m



355a22



Paleodictyoconus cuvillieri



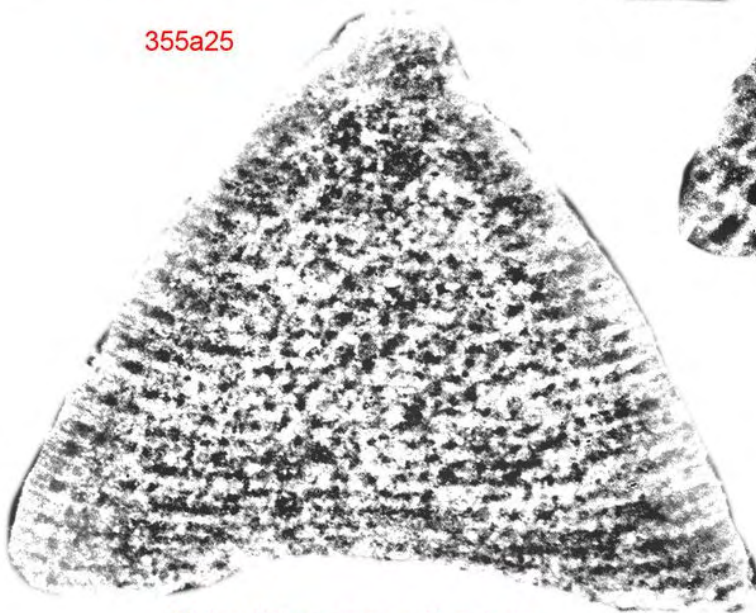
355a25



355a1



Montseciella arabica

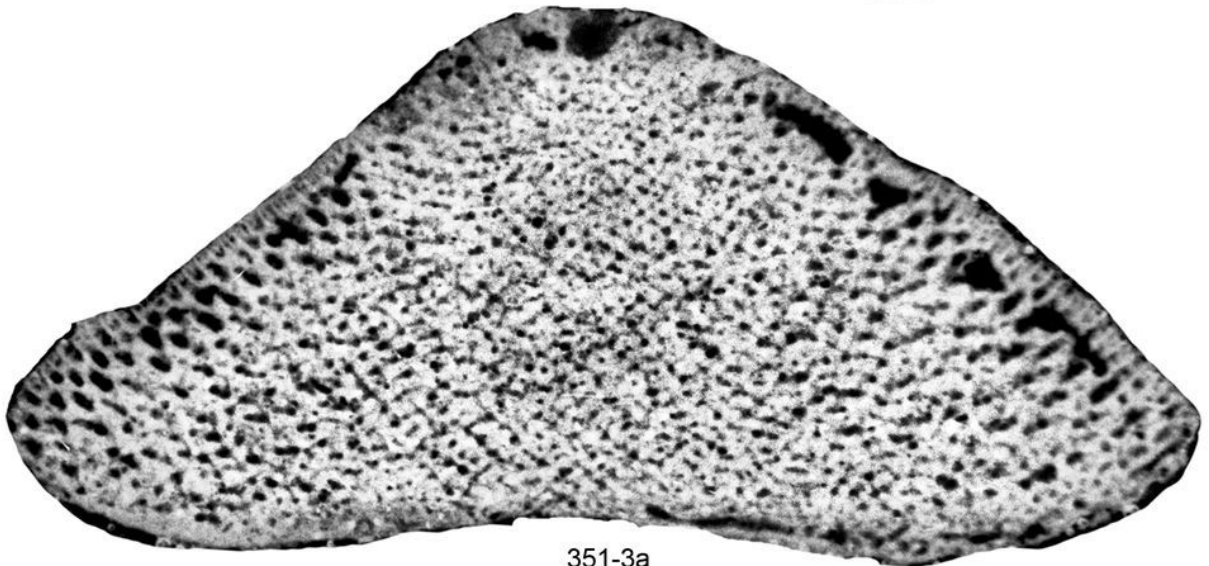
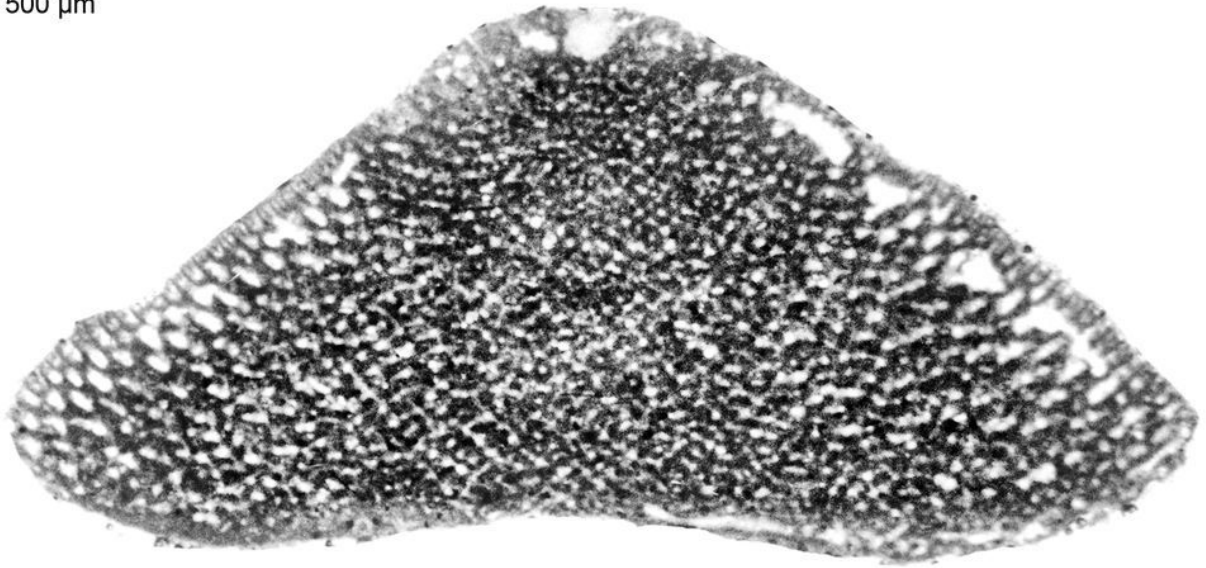


Paleodictyoconus actinostoma

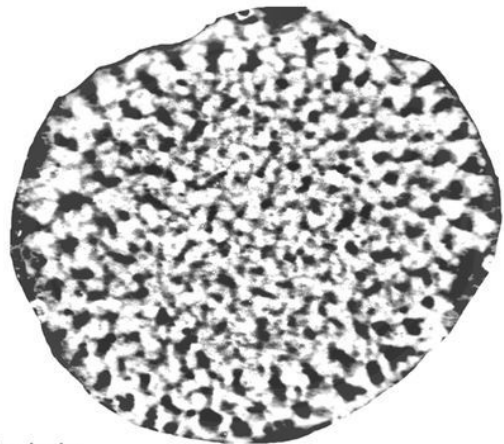
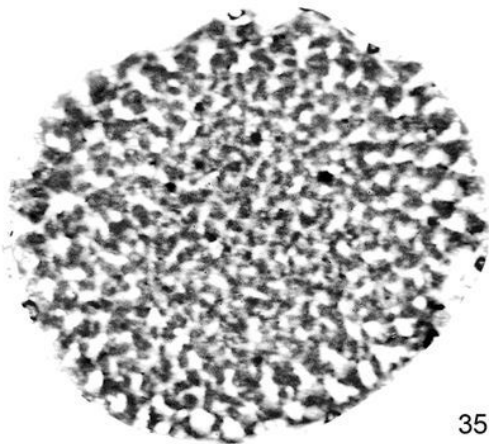
Plate 113: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Montseciella arabica*: 355-10a; *Paleodictyoconus actinostoma*: 355a25*; *Paleodictyoconus cuvillieri*: 355-b2. Scale bar = 500 μ m.



500 μm



351-3a



351-1a

Palorbitolina lenticularis

Plate 114: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Palorbitolina lenticularis*: 351-1a, 351-3a. Scale bar = 500 μm .

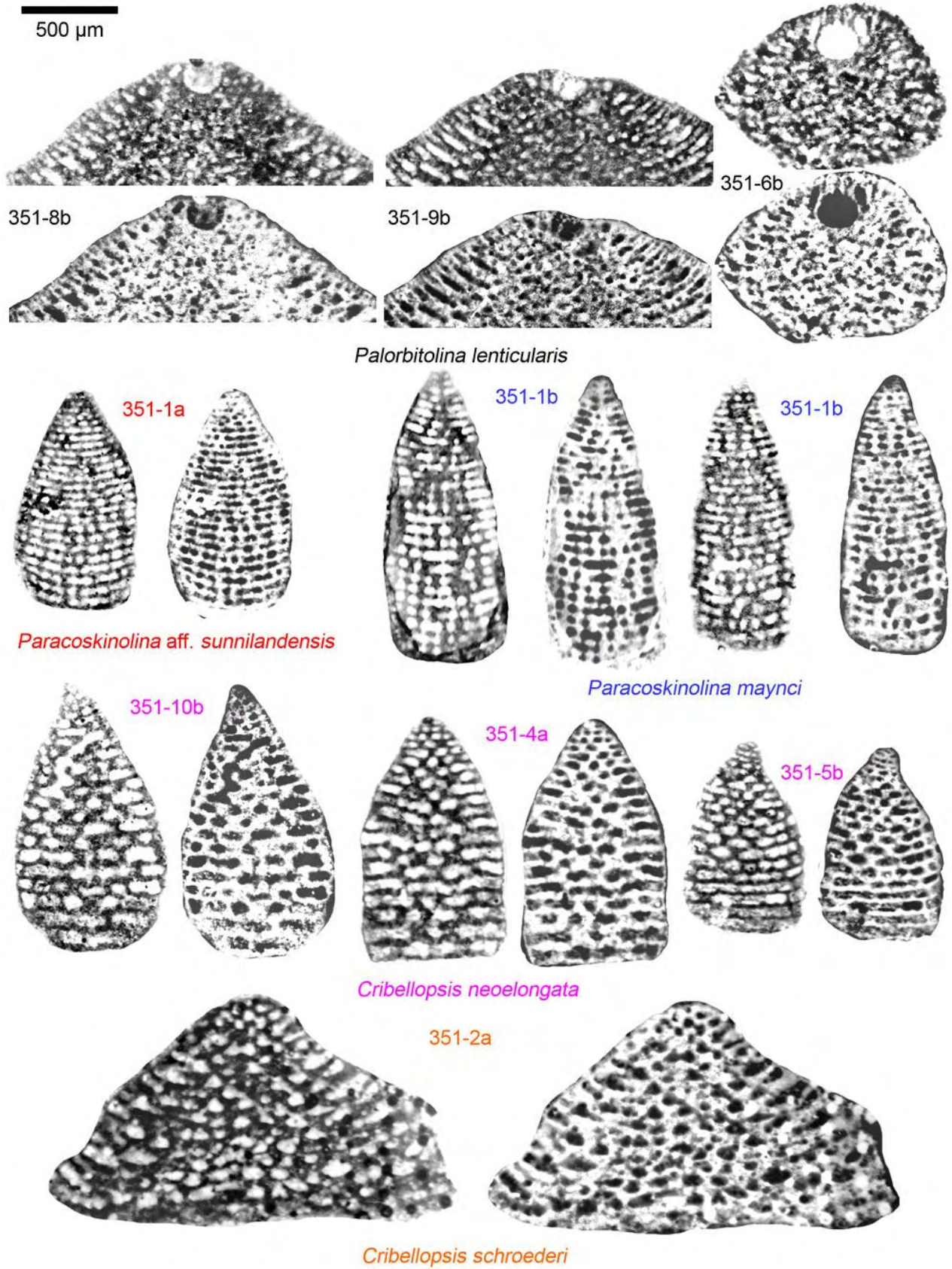


Plate 115: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Cribellopsis neolongata*: 351-4a, 351-5b, 351-10b; *Cribellopsis schroederi*: 351-2a; *Palorbitolina lenticularis*: 351-6b, 351-8b, 351-9b; *Paracoskinolina maynci*: 351-1b; *Paracoskinolina aff. sunnilandensis*: 351-1a. Scale bar = 500 μ m.

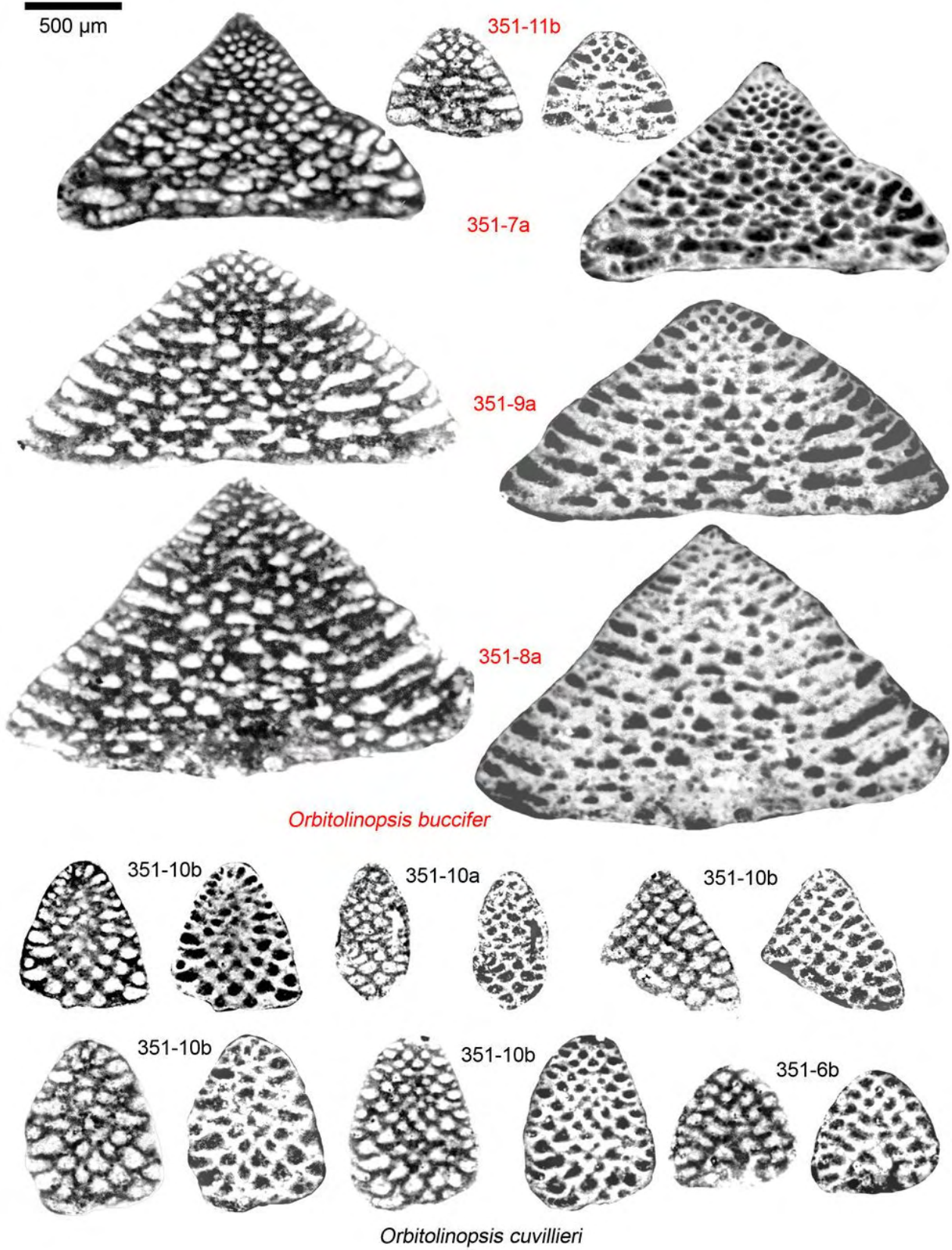


Plate 116: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Orbitolinopsis buccifer*: 351-7a, 351-8a, 351-9a, 351-11b; *Orbitolinopsis cuvillieri*: 351-6b, 351-10a, 351-10b. Scale bar = 500 μm.

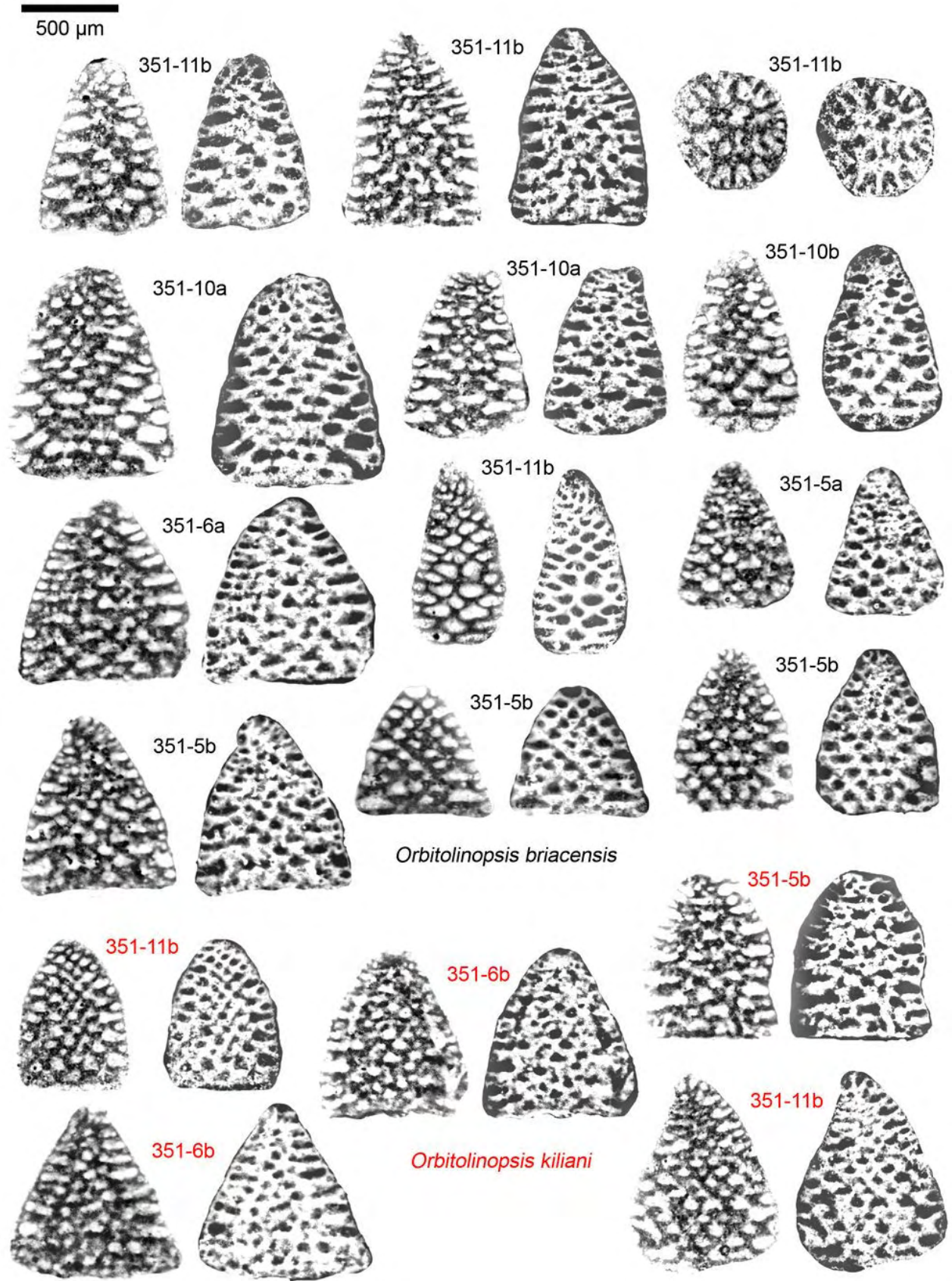


Plate 117: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Orbitolinopsis briacensis*: 351-5a, 351-5b, 351-6a, 351-10a, 351-10b, 351-11b; *Orbitolinopsis kiliani*: 351-5b, 351-6b, 351-11b. Scale bar = 500 µm.



500 µm

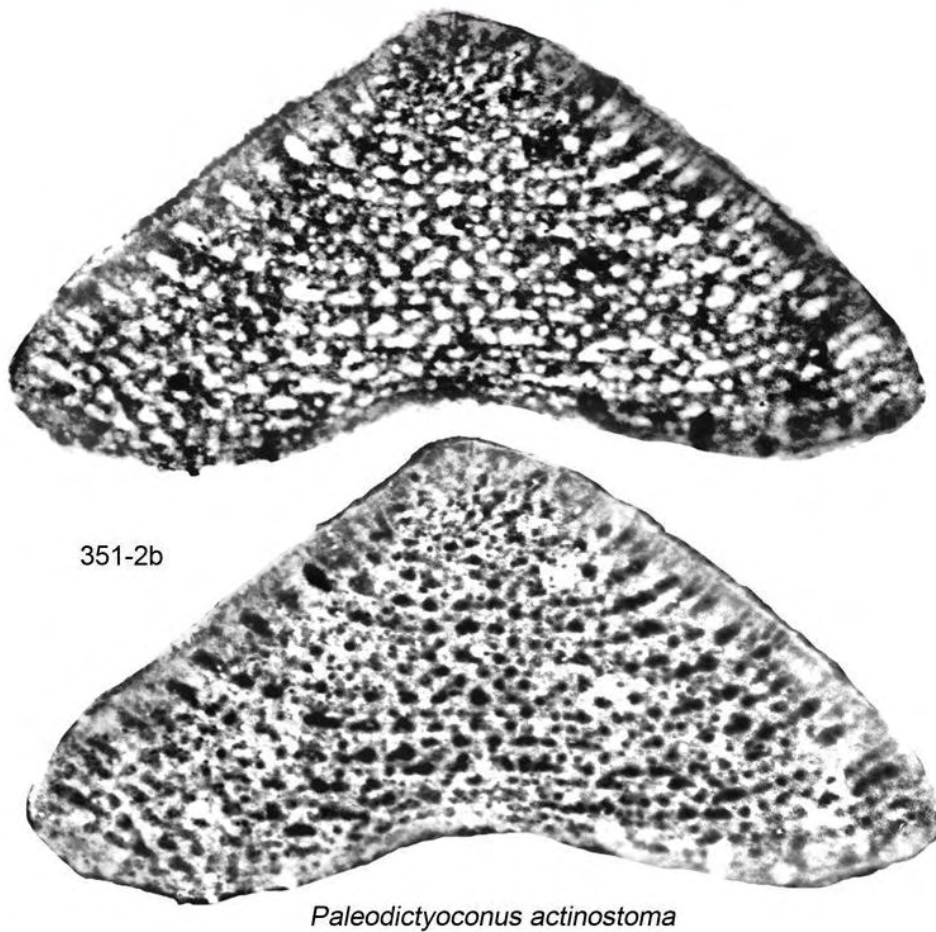
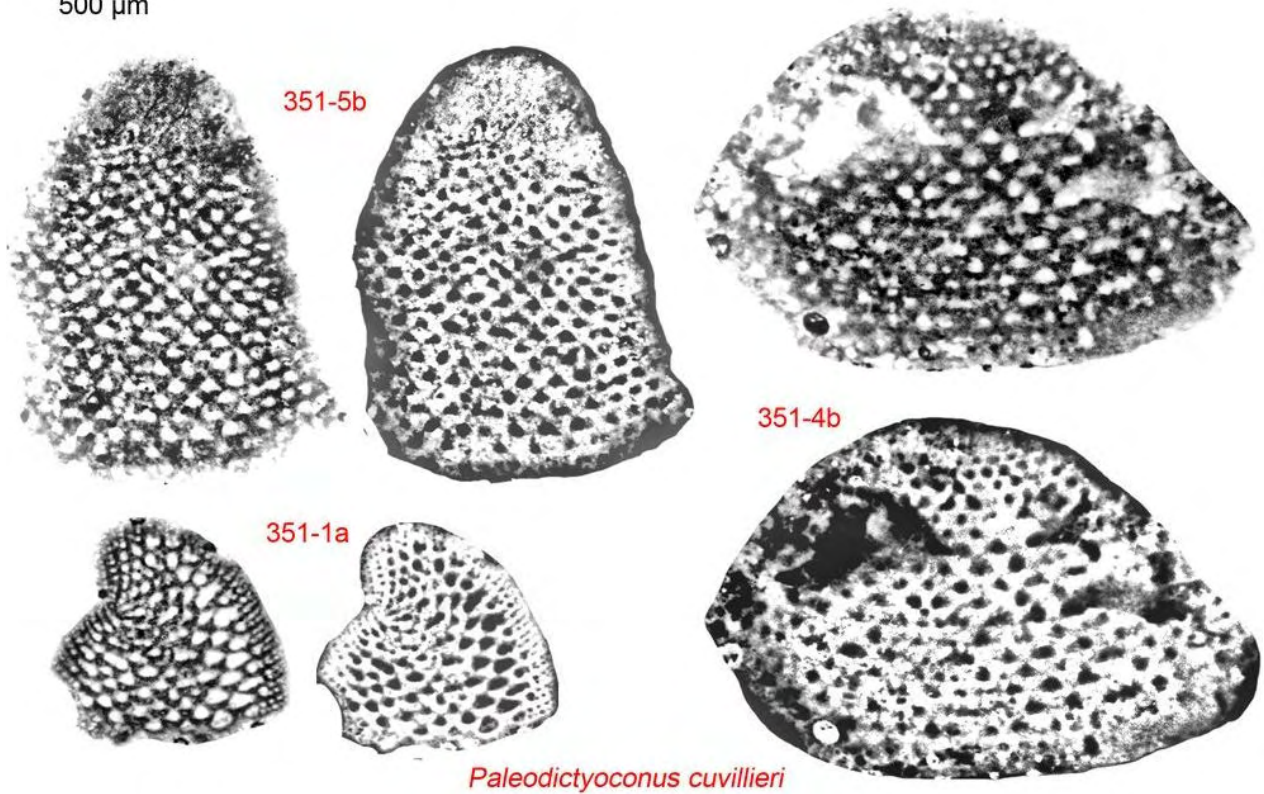
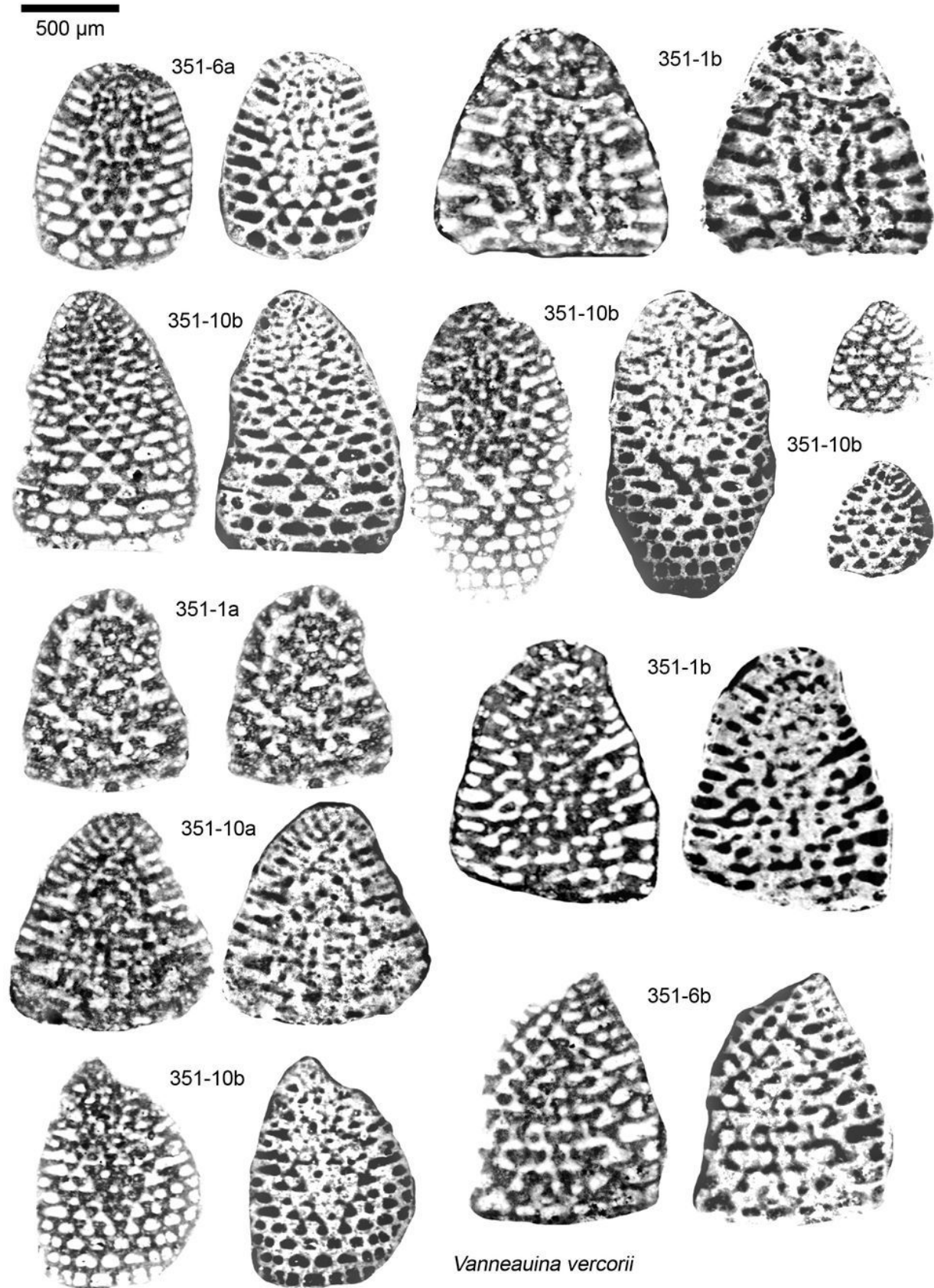
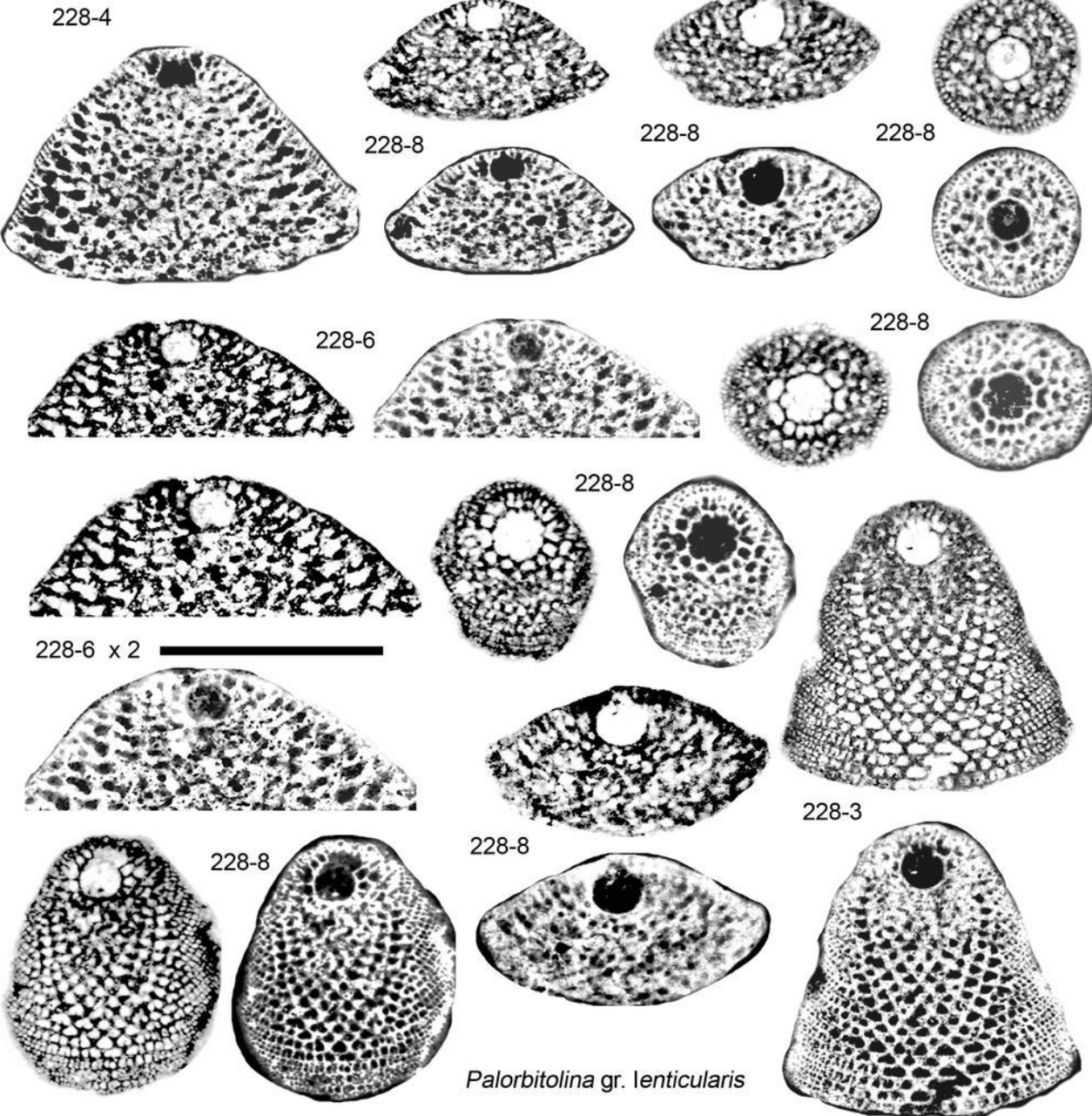
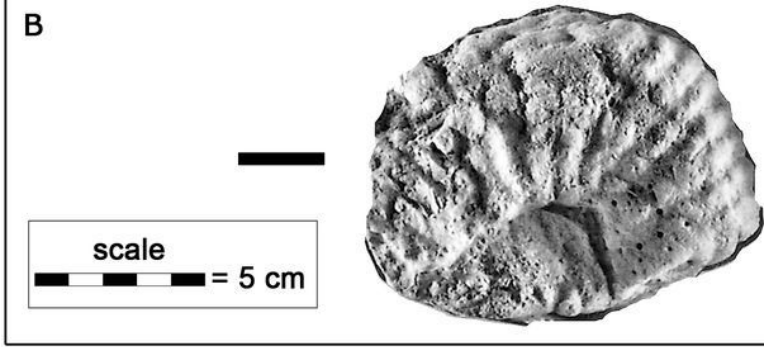
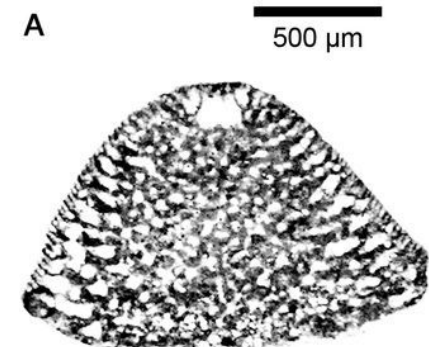


Plate 118: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Paleodictyoconus actinostoma*: 351-2b; *Paleodictyoconus cuvillieri*: 351-1a, 351-4b, 351-5b. Scale bar = 500 µm.



Vanneauina vercorii

Plate 119: Orbitolinids of the Giraudi/Sarasini zones at Pont d'Arc. *Vanneauina vercorii*: 351-1a, 351-1b, 351-6a, 351-6b, 351-10a, 351-10b, Scale bar = 500 μ m.



Palorbitolina gr. *lenticularis*

Plate 120: A) Orbitolinids of the Sarasini Zone at Orgnac. *Palorbitolina lenticularis*: 228-3, 228-4, 228-6, 228-8; B) *Heteroceras* cf. *baylei*, FSL 89455. Scale bar (A) = 500 µm, and ammonite scale bar (B) = 5 cm.

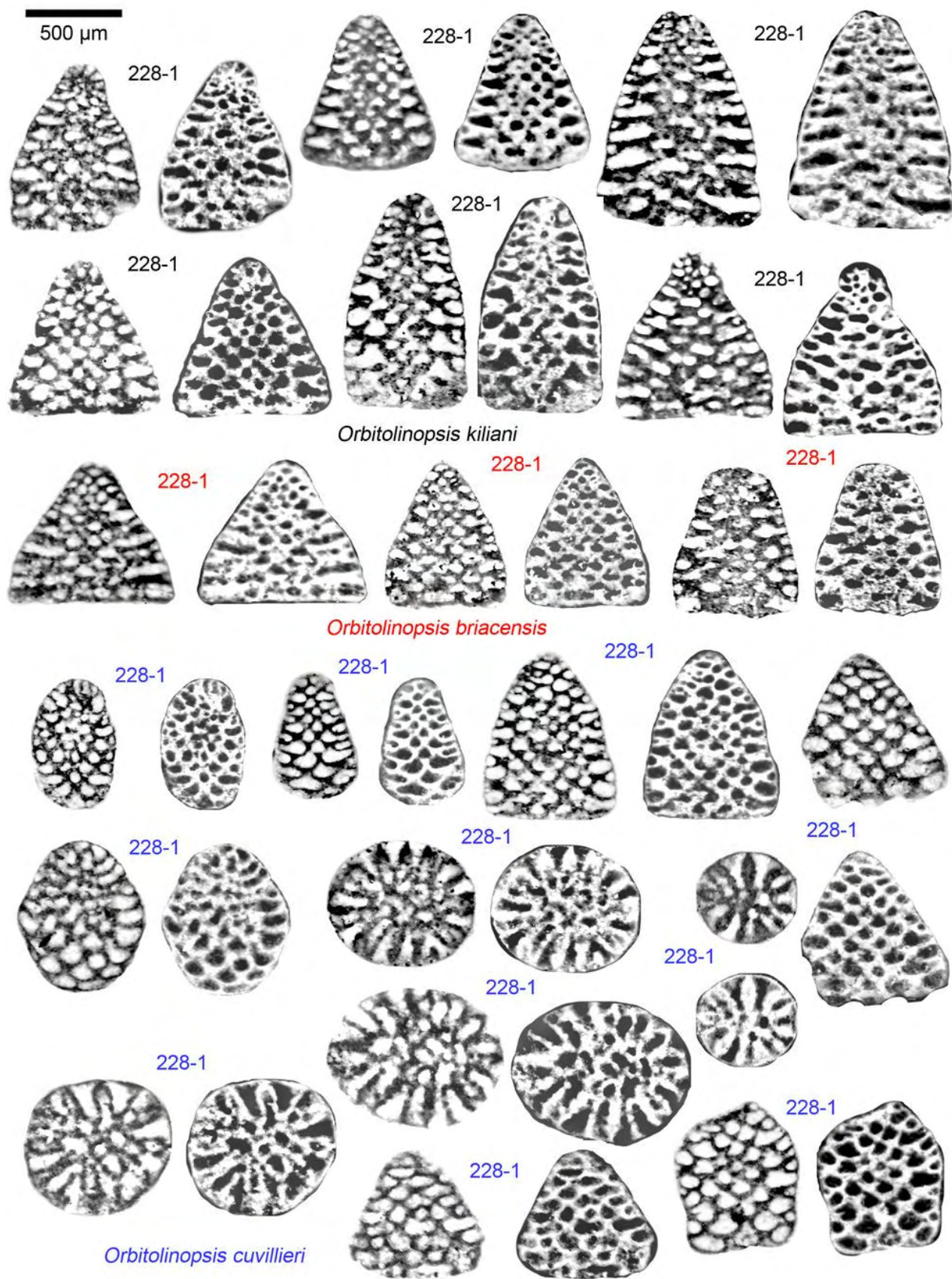


Plate 121: Orbitolinids of the Sarasini Zone at Orgnac. *Orbitolinopsis briacensis*: 228-1; *Orbitolinopsis cuvillieri*: 228-1; *Orbitolinopsis kiliani*: 228-1. Scale bar = 500 µm.

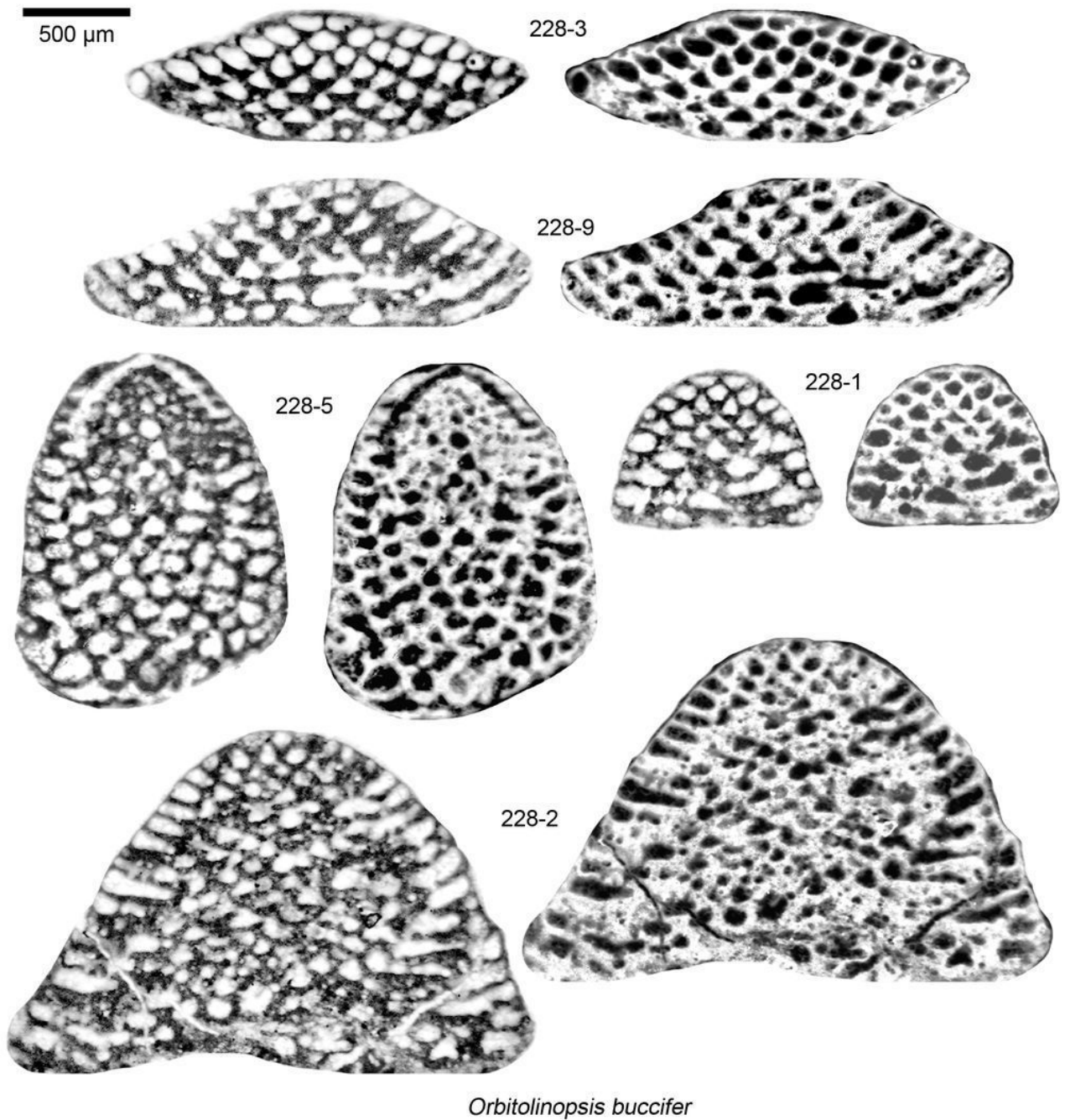


Plate 122: Orbitolinids of the Sarasini Zone at Orgnac. *Orbitolinopsis buccifer*: 228-1, 228-2, 228-3, 228-5, 228-9. Scale bar = 500 μ m.

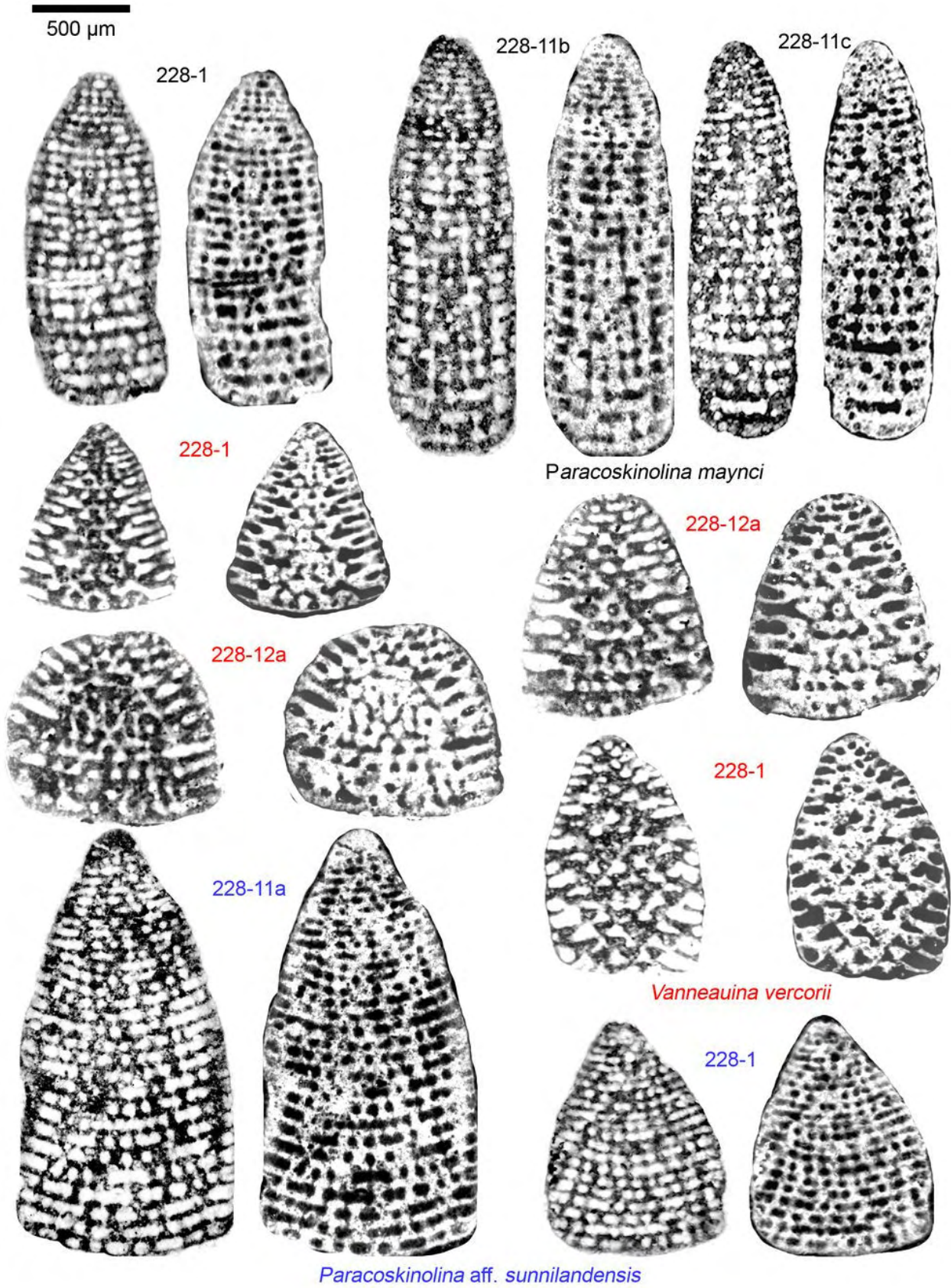


Plate 123: Orbitolinids of the Sarasini Zone at Orgnac. *Paracoskinolina maynci*: 228-1, 228-11b, 228-11c; *Paracoskinolina aff. sunnilandensis*: 228-1, 228-11a; *Vanneauina vercorii*: 228-1, 228-12a. Scale bar = 500 µm.

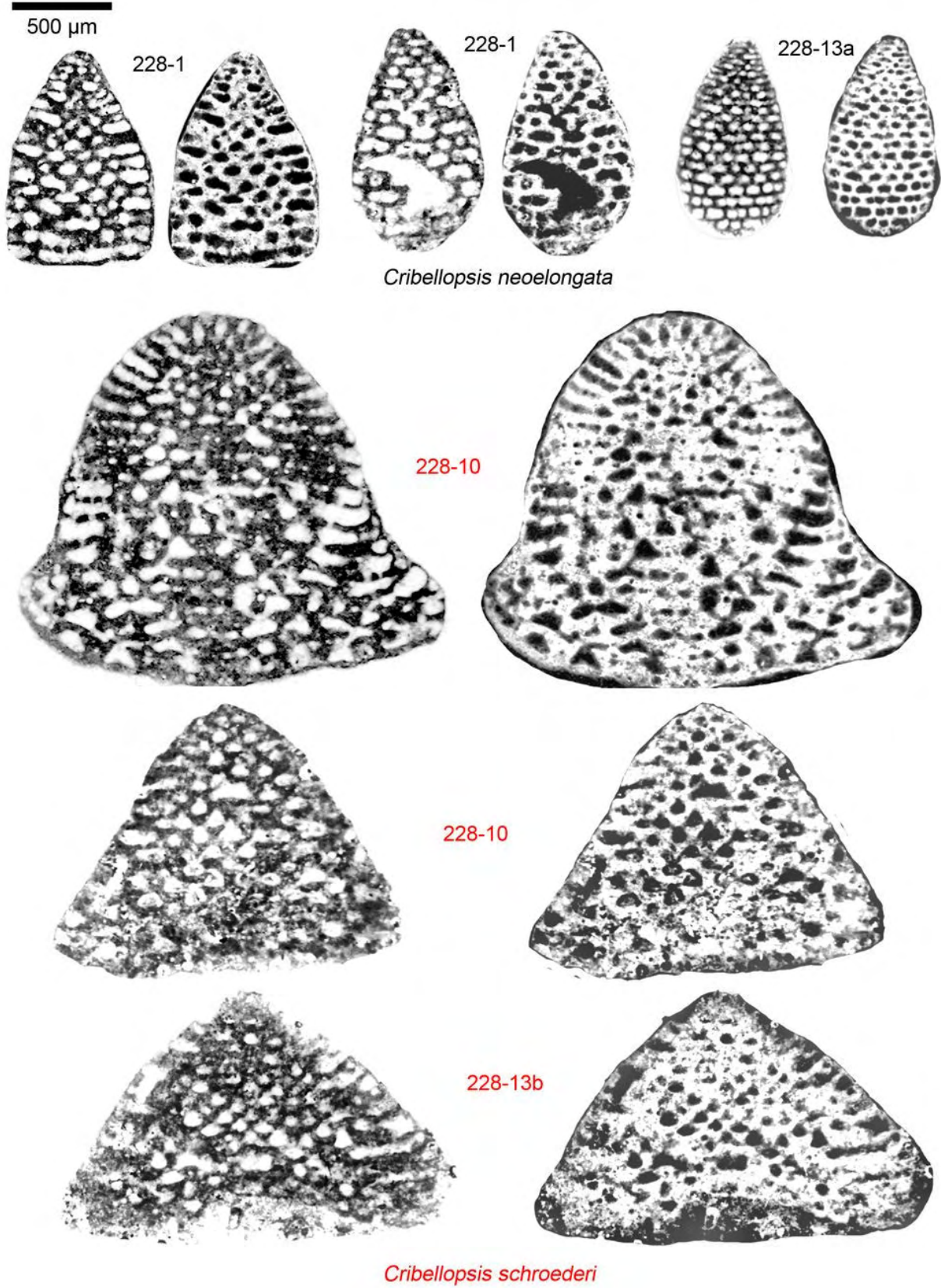
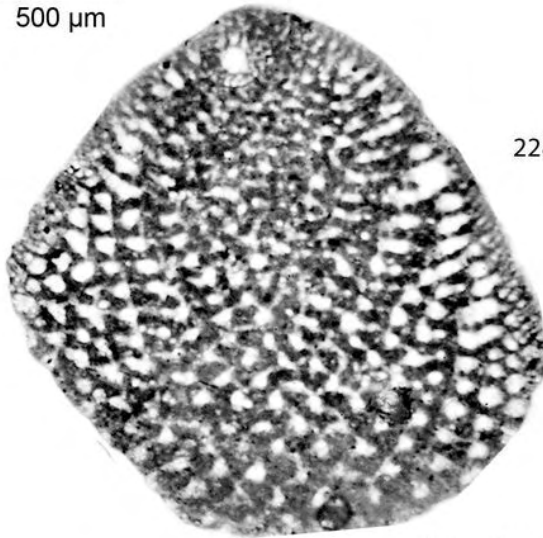


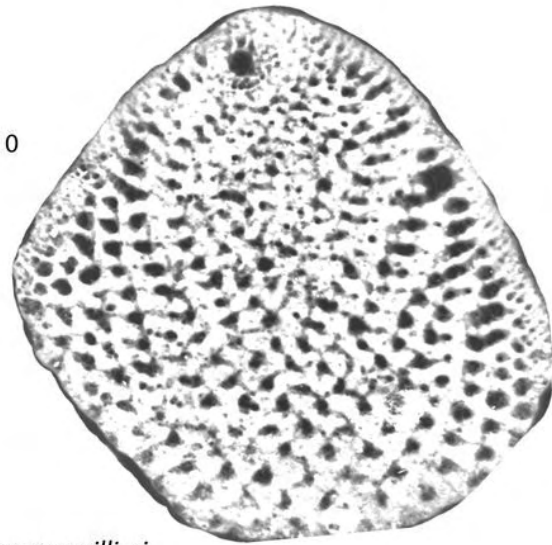
Plate 124: Orbitolinids of the Sarasini Zone at Orgnac. *Cribellopsis neoelongata*: 228-1, 228-13a; *Cribellopsis schroederi*: 228-10, 228-13b. Scale bar = 500 µm.



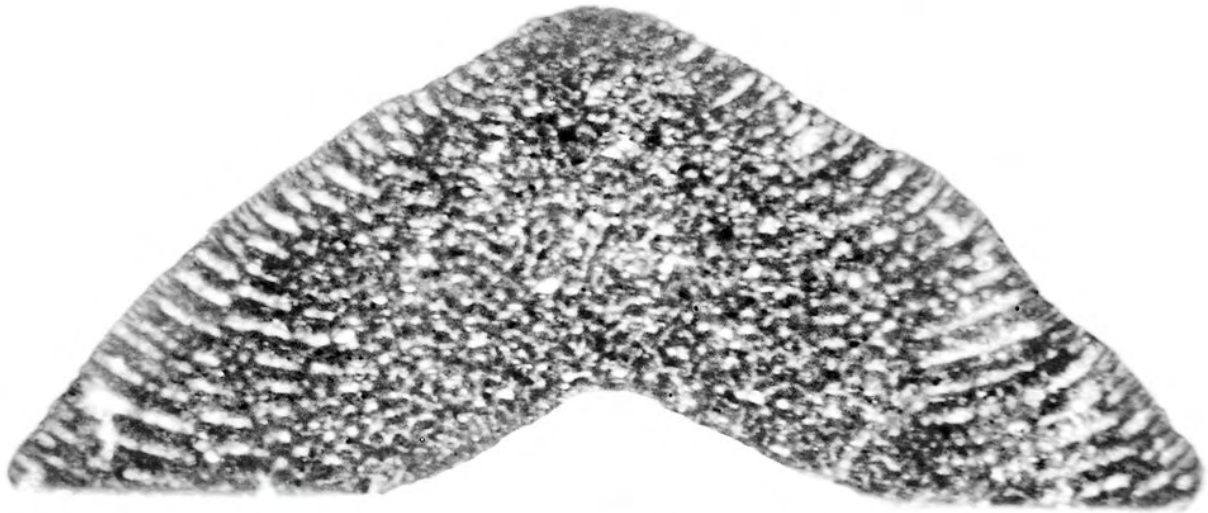
500 μ m



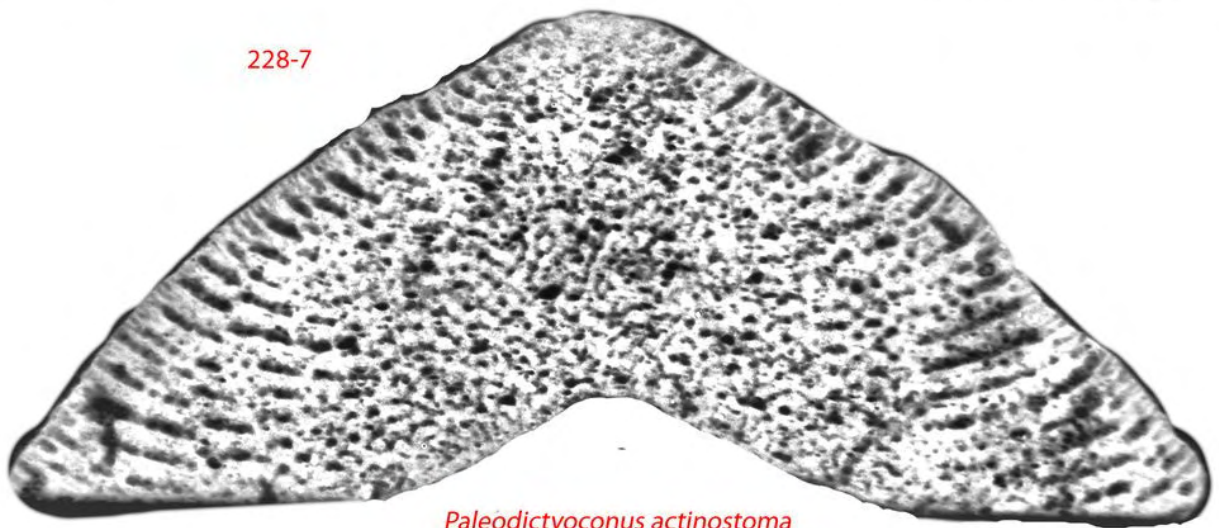
228-10



Paleodictyoconus cuvillieri



228-7



Paleodictyoconus actinostoma

Plate 125: Orbitolinids of the Sarasini Zone at Orgnac. *Paleodictyoconus actinostoma*: 228-7; *Paleodictyoconus cuvillieri*: 228-10. Scale bar = 500 μ m.