Pragian-Emsian in the Baliera 6 section

José I. Valenzuela-Ríos[1], Carlos Marínez-Pérez[2,3] & Jau-Chyn Liao[1]

[1]Department of Botany and Geology, University of Valencia, c/Dr. Moliner 50, E-46100 Burjasot, Spain; jose.i.valenzuela@uv.es; jau.liao@uv.es
[2]Cavanilles Institute of Biodiversity and Evolutionary Biology, Universitat de València. C/Catedrático José Beltrán Martínez nº 2, Paterna, Valencia (Spain), 46980, Spain; carlos.martinez-perez@uv.es
[3]School of Earth Sciences, University of Bristol, Life Sciences Building, 24 Tyndall Avenue, BS8 1TQ, Bristol, UK.

Locality - In the slope mountain heading to Collada Sarronal, on the south flank of San Silvestre stream.
Lithostratigraphic unit - Basibe Fm., Llaviero Mb.
Age - Pragian-Emsian (Lower Devonian).
What to see - A nice section spanning through the Pragian-Emsian boundary in any sense.

How to get there

The locality is accessible through the local paved road from Castanesa to Fonchanina that continues north in a forest track following upstream the Baliera River, until the wrecks of the San Silvestre Chapel. Then, a demanding hike up via the grazing land close to the San Silvestre brook leads to the section (Fig. 1).

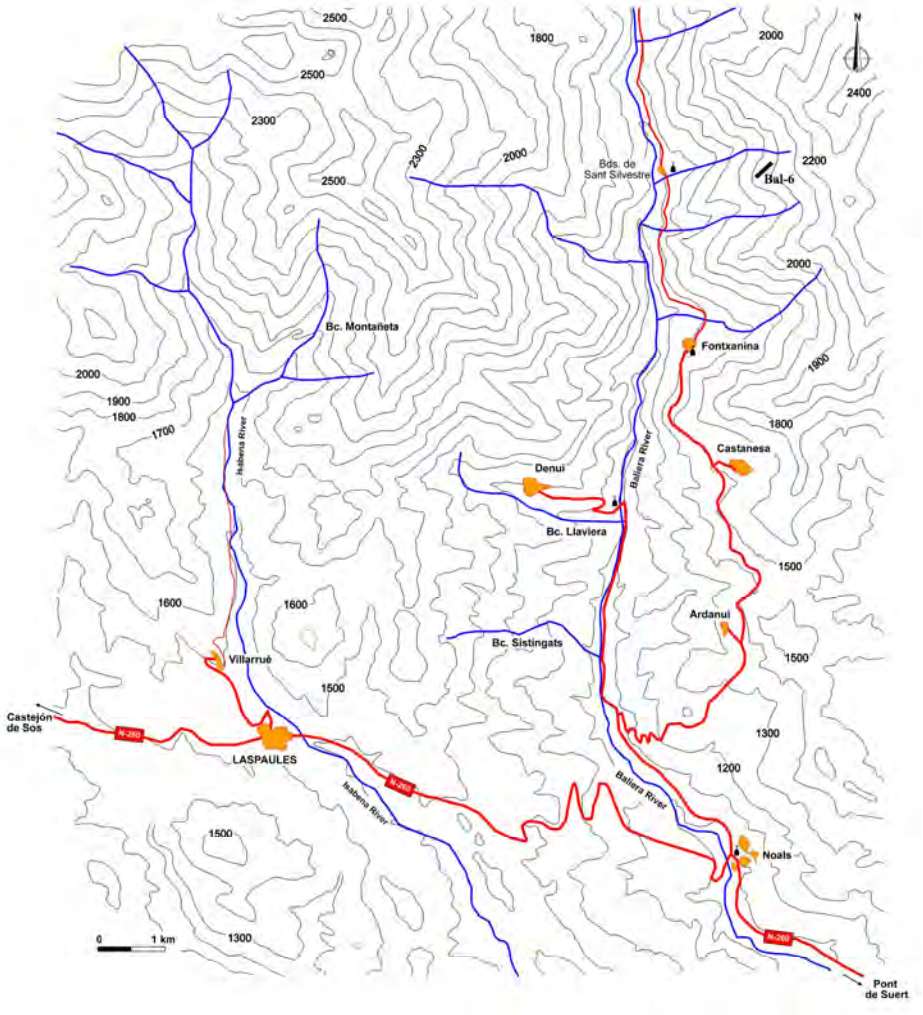

Figure 1. Location map of Baliera 6 section.

Historical outline

Valenzuela-Ríos (1994) described and sampled the section Baliera 6 (Bal 6) for the first time. Subsequently, Valenzuela-Ríos (2001) demonstrated the relevance of the section in the context of the redefined base of the Emsian, aka *kitabicus* boundary. Later Martínez-Pérez (2010), Martínez-Pérez et al., (2010, 2011) and Martínez-Pérez & Valenzuela-Ríos (2014) expanded the study of this section and document an important conodont succession.

Figure 2. General view of the Baliera 6 section in the field (yellow line). The outstanding cliff corresponds to the sandy/quarzitic San Silvestre Member of the Basibé Fm.

Lithology and fossil content

The section has a thickness of about 28 m and consists of dominant bluish and blackish platy limestone with a few thicker beds, mainly at the base and the upper part and very thin shale beds, except for Bed 50 that measures up to 80 cm (Fig. 2-4). The whole section belongs to the Llaviero Member of the Basibé Fm. The section is overturned and the contact with the underlying Member (San Silvestre) is covered. Besides conodonts, silicified remains of dacryoconarids, styliolinids, bivalves, brachiopods, orthoceratids, crinoids, trilobites, ostracods, bryozoan and a few corals are also observed. Small scale (centimetre) ripples and cross bedding are common. Some beds show accumulation of fossil fragments.

Palaeoenvironment

Habermehl (1970) carried out a thoroughly petrological study of the Basibé Fm. He concluded that the sedimentary sequence of the Basibé Fm. was deposited in open shallow marine environments. The predominant sediment of the Llaviero Member is lime mud, which was probably deposited in an open shallow marine or in a deeper offshore environment, but in any case below the base wave and action of currents. The presence of some sedimentary structures and fossil fragments suggest local agitation of waters, probably due to local currents. The Llaviero Member represents a sudden stop of the sand supply that formed the underlain San Silvestre Member probably linked to a marked subsidence that permitted the sedimentation of lime mud.

Fossil content

119 conodont samples have been collected from the Baliera 6 section (Fig. 3) from all limestone beds. Abundance is low except for samples 23, 26, 33 and 49, and sixteen samples were barren. The preservation is moderate; some conodonts are strongly deformed and other exhibit the “zebra” pattern. Conodont colour is black to grey, corresponding to a Color Alteration Index (CAI) of 5 to 6.
25 taxa belonging to four genera (*Polygnathus, Icriodus, Pandorinellina*? and *Criteriognathus*) have been identified (Figs. 3, 5, 6).

Biostratigraphy

The record of *P. pireneae* together with *I. curvi-cauda* in Bed 1b and below the lowest record of *P. exc. excavatus* in Bed 3, suggest that the lowermost part of the section belong either to the upper part of the *pireneae* Zone or already to the *kitabicus* Zone. Delayed entry of *P. kitabicus* is recorded in Bed 8.

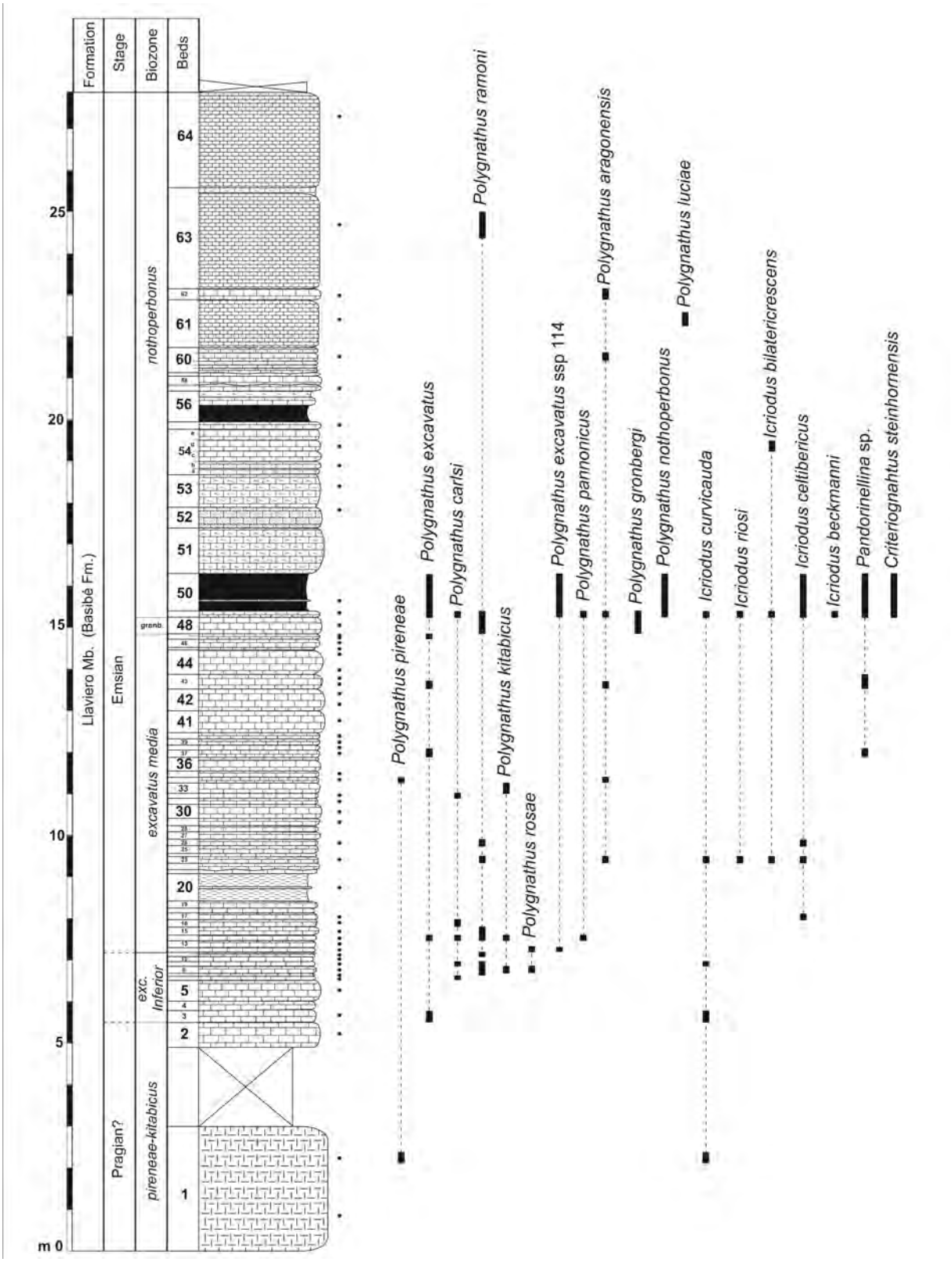

Figure 3. Stratigraphic column of the Baliera 6 section and conodont distribution (based on Martínez-Pérez, 2010).

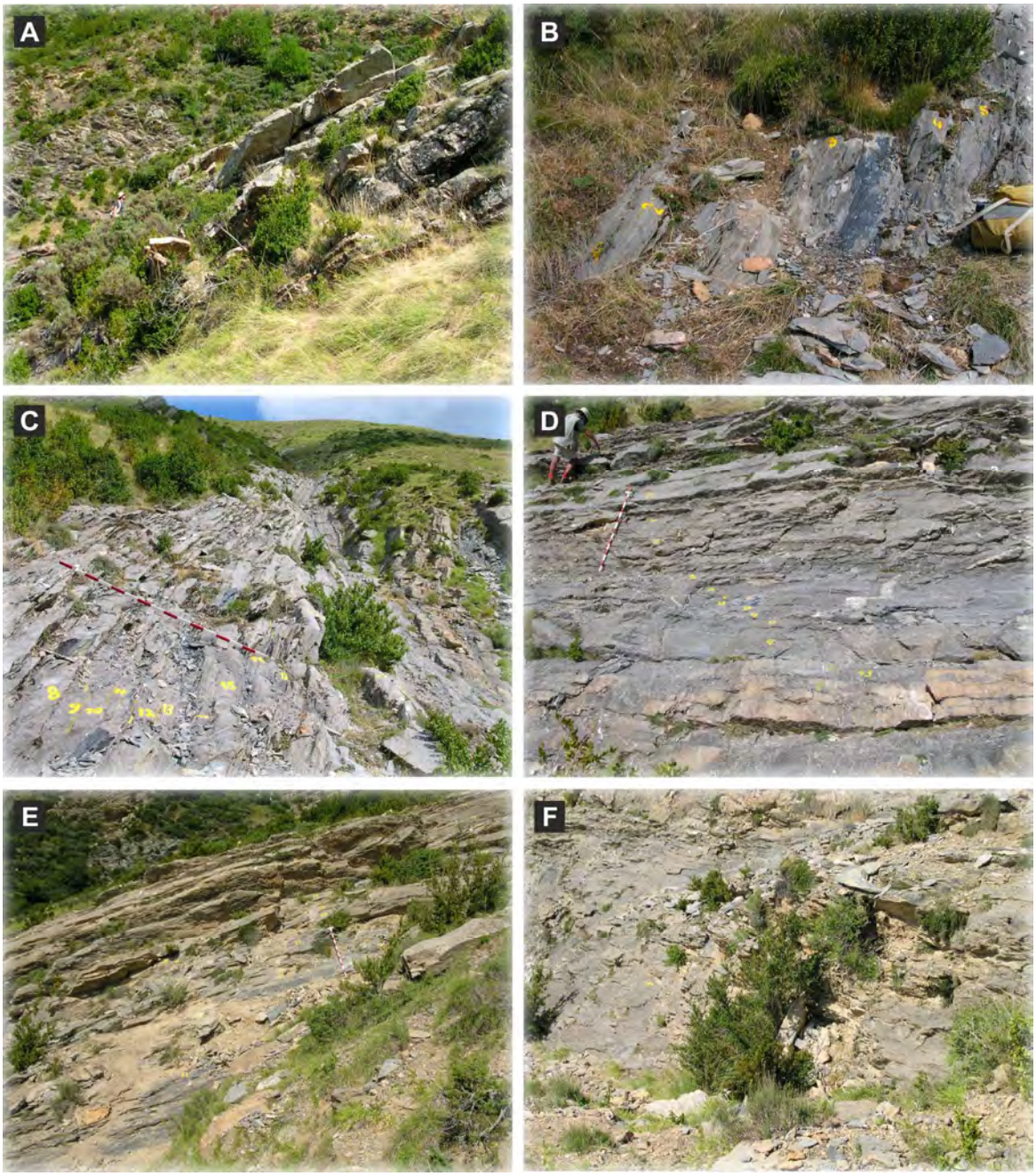

Figure 4. A. Section basal beds; they correspond to the quarzitic beds of the San Silvestre Mb, Basibé Fm. **B.** Lower beds of the Llaviero Member, Basibé Fm. Bed 3 alligns with the base of the lower *excavatus* Zone. **C.** General view up to Bed 50. Bed 12 marks the lower entry of *Polygnathus excavatus* 114. **D.** Detail of middle parts of the sections, Beds 20-43. **E.** Upper Beds from 52 to 63. **F.** Uppermost Beds of the section in the cliff.

Figure 5. Conodonts from the Baliera 6 Section. All scale bars = 200 µm.
1. *Polygnathus aragonensis* Martínez-Pérez & Valenzuela-Ríos, Pa element MGUV-20.849, 1a) aboral view,1b) oral view; Sample Bal 6/60d. **2.** *Polygnathus carlsi* Martínez-Pérez & Valenzuela-Ríos, Pa element MGUV-20.869, 2a) aboral view, 2b) oral view; Sample Bal 6/16. **3.** *Polygnathus exc. excavatus* Carls & Gandl, Pa element MGUV-20.884, 3a) oral view, 3b) aboral view; Sample Bal 6/47. **4.** *Polygnathus exc. excavatus* Carls & Gandl, Pa element MGUV-20.887, 4a) aboral view, 4b) oral view; Sample Bal 6/3. **5.** *Polygnathus exc. excavatus* Carls & Gandl transitional to *Po. excavatus* ssp. 114 Carls & Valenzuela-Ríos, Pa element MGUV-20.889, 5a) aboral view, 5b) oral view; Sample Bal 6/49. **6.** *Polygnathus excavatus* ssp. 114 Carls & Valenzuela-Ríos, Pa

Figure 5. continued.
element MGUV-20.904, 6a) aboral view,6b) oral view; Sample Bal 6/12. **7.** *Polygnathus excavatus* ssp. 114 Carls & Valenzuela-Ríos, Pa element MGUV-20.905, 7a) aboral view, 7b) oral view; Sample Bal 6/49. **8.** *Polygnathus excavatus* ssp. 114 Carls & Valenzuela-Ríos, Pa element MGUV-20.906, 8a) aboral view,8b) oral view; Sample Bal 6/50. **9.** *Polygnathus gronbergi* Bardashev, Pa element MGUV-20.920; 9a) aboral view, 9b) oral view; Sample Bal 6/49. **10.** *Polygnathus kitabicus* Yolkin et al., Pa element MGUV-20.924, 10a) aboral view,10b) oral view; Sample Bal 6/8. **11.** *Polygnathus kitabicus* Yolkin et al., Pa element MGUV-20.925; 11a) aboral view, 12b) oral view; Sample Bal 6/14. **12.** *Polygnathus nothoperbonus* Mawson Pa element MGUV-20.970; 12a) aboral view, 12b) oral view; Sample Bal 6/49.

The lowest entry of *P. excavatus* 114 happens in Bed 12. Other relevant records are the entry of *P. gronbergi* in Bed 48 and of *P. nothoperbonus* in Bed 49.
In summary, this sections contain conodonts indicative of the *pireneae*?, *kitabicus,* lower *excavatus,* middle *excavatus* and lower *notho-perbonus*. Besides, a *gronbergi* horizon is located atop of the middle *excavatus* Zone and beneath the lower *nothoperbonus* Zone. In terms of Conodont steps of Carls (1996, 1999) this sequence spans from Conodont step 15 to 18.
The conodont record of this section is meaningful in the context of redefinition of the base of the Emsian stage.

Additional remarks
Between the entries of *P. exc. excavatus* and *P. excavatus* 114 a radiation of early polygnathids in the Pyrenees took place (Fig. 3). This radiation is slightly younger than the one recorded in Zinzilban stratotype. Also an *Icriodus* radiation took place in Bed 23, in the middle *excavatus* Zone. In Bed 50 the last occurrence of all icriodids, except *I. bilatericrescens*, took place.

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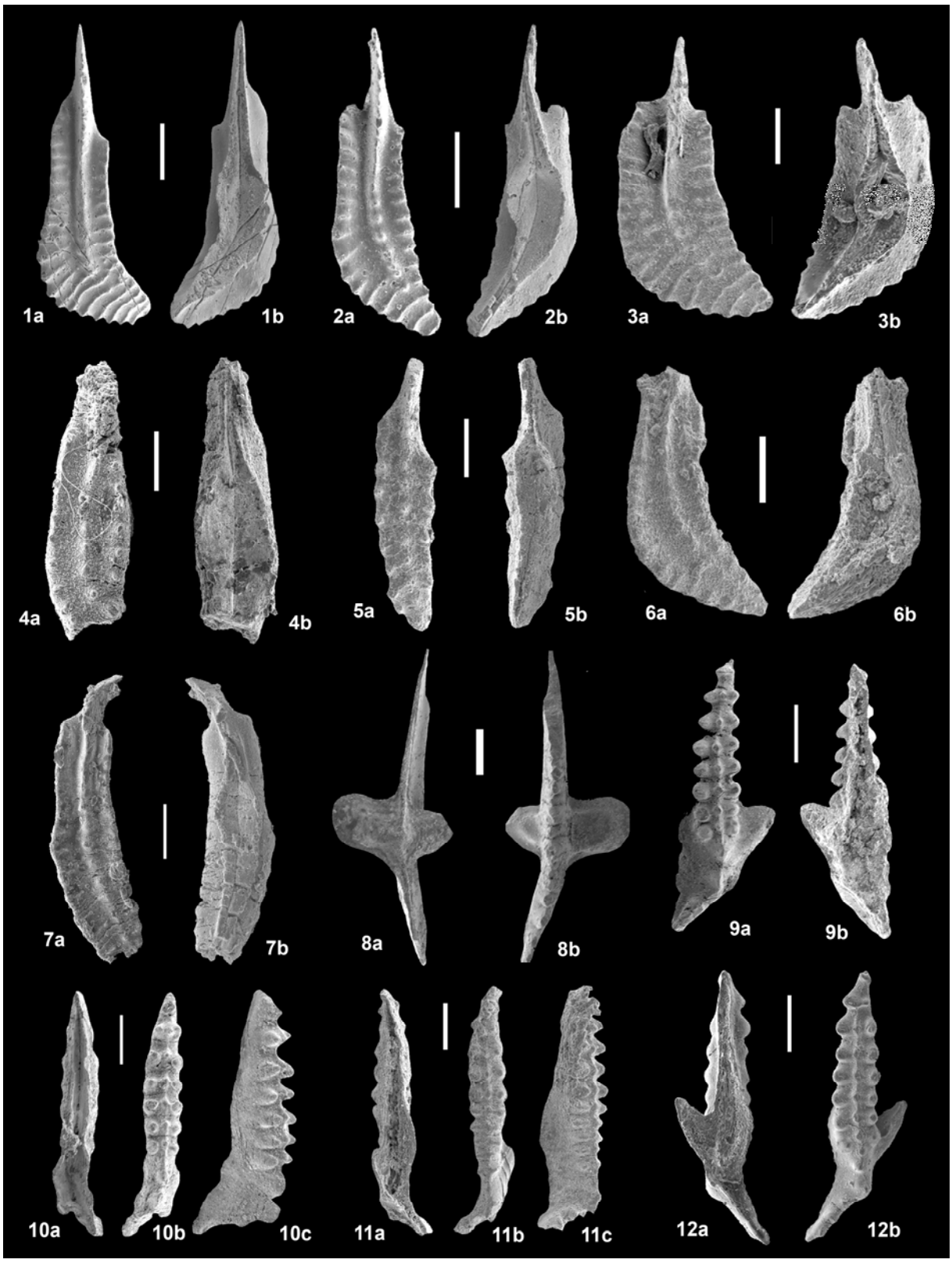
Figure 6. Conodonts from the Baliera 6 Section. All scale bars = 200 µm.
1. *Polygnathus nothoperbonus* Mawson, Pa element MGUV-20.972, 1a) oral view, 1b) aboral view; Sample Bal 6/50. **2.** *Polygnathus nothoperbonus* Mawson, Pa element MGUV-20.973, 2a) oral view, 2b) aboral view; Sample Bal 6/50. **3.** *Polygnathus pannonicus* Mashkova & Apekina, Pa element MGUV-20.991, 3a) oral view, 3b) aboral view; Sample Bal 6/49. **4.** *Polygnathus pireneae* Boersma, Pa element MGUV-21.002, 4a) oral view,4 b) aboral view; Sample Bal 6/1b. **5.** *Polygnathus pireneae* Boersma, Pa element MGUV-21.003, 5a) oral view, 5b) aboral view; Sample Bal 6/1b. **6.** *Polygnathus ramoni* Martínez-Pérez & Valenzuela-Ríos, Pa element MGUV-21.033, 6a) oral view, 6b) aboral view; Sample Bal 6/26. **7.** *Polygnathus rosae* Martínez-Pérez & Valenzuela-Ríos, Pa element MGUV-21.082, 7a) oral view, 7b) aboral view, Sample Bal 6/12. **8.** *Criteriognathus steinhornensis* ssp. (Ziegler), Pa element MGUV-21.093, 8a) aboral view, 8b) oral view; Sample Bal 6/50. **9.** *Icriodus bilatericrescens* Ziegler, I element MGUV-21.148, 9a) oral view, 9b) aboral view; Sample Bal 6/49. **10.** *Icriodus celtibericus* Carls & Gandl, I element MGUV-21.167, 10a) aboral view, 10b) oral view,10c) lateral view; Sample Bal 6/23. **11.** *Icriodus curvicauda* Carls & Gandl, I element MGUV-21.219, 11a) aboral view, 11b) oral view, 11c) lateral view; Sample Bal 6/49. **12.** *Icriodus bilatericrescens* Ziegler, I element MGUV-21.147, 12a) aboral view, 12b) oral view; Sample Bal 6/49.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