

Late and latest Famennian conodonts at the Malpasso section

Claudia Spalletta¹, Maria Cristina Perri¹ & Monica Pondrelli²

¹Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Alma Mater Studiorum Università di Bologna, via Zamboni 67, I-40126 Bologna, Italy. claudia.spalletta@unibo.it, mariacristina.perri@gmail.com

²International Research School of Planetary Sciences, Università d'Annunzio, viale Pindaro 42, I-65127, Pescara, Italy. monica@irsps.unich.it

Locality - The cliff behind Casera Malpasso (Rifugio Forestale Morgante), Pramosiso area, at coordinates N 46°35'29.9", E 13°02'05.7" (base of the section), N 46°35'29.0", E 13°02'04.3" (top).

Lithostratigraphic unit - Pal Grande Fm.

Age - Famennian (Late Devonian); Pseudopolygnathus granulatus–Bispathodus ultimus zones (Upper trachytera–Lower praesulcata zones).

What to see - Levels rich in ammonoids.

How to get there

The Malpasso (ML) section is located at altitude 1619 m near Casera Malpasso, about half an hour walking along the path number 402 from Casera Pramosiso to north (Fig. 1). Casera Pramosiso is reachable by car traveling along the white road departing from the National road 52b Udine-Monte Croce Carnico Pass in locality Laipacco.



Figure 1. Location map of the Malpasso section.

Historical outline. Conodont biostratigraphic and taxonomic analysis of the Malpasso section were presented by Perri & Spalletta (1991, 1998). The abundant ammonoid fauna was studied by Korn & House (1997) and Korn (1998). In Spalletta & Perri (2001) the section was proposed as possible candidate for the subdivision of the Famennian. The upper part of the section was re-sampled for conodonts and geochemical analysis by Kaiser (2005). The geochemical and conodont data have been reported also in Kaiser et al. (2008, 2009). According to Perri & Spalletta (1998) and Kaiser et al. (2009) the conodont data from the Malpasso section are perfectly correlatable with the ammonoid data of Korn (1998). Hartenfels & Becker (2009) on the base of the identification of a typical UD V-A1 ammonoid assemblage, including *Endosiphonites* sp., *Kosmoclymenia lamellosa* (Wedekind), *Nanoclymenia* sp., *Nodosoclymenia* sp., *Rectoclymenia* cf. *disciforme* (Schindewolf), *Rect. lineare* (Münster), and *Procymaclymenia pudica*

(Czarnocki), and the opportunistic bivalve of eutrophic facies *Buchiola* in bed ML6k, inferred the position of the Dasberg Crisis Interval between bed ML6k and ML7. The Malpasso section is one of the reference sections of the Pal Grande Formation, showing the typical features of the formation constituted mainly of grey mudstone and wackestone here particularly rich in ammonoids (Spalletta et al., 2015).



Figure 2. View of the Malpasso section.

Lithology and fossil content

The section has a thickness of about 22 m. It consists of a monotonous sequence of wackestone-packstone rich in conodonts, ammonoids, and trilobites. In the residues from acid-leaching some vertebrate microremains were also found. In the Malpasso section, as well as in the near Pramosio Bassa section, levels of black shales equivalent to the *Annulata* Black Shales are not present. The exposure of the section in an almost vertical cliff preventing close examination and enhancing the weathering precluded to note the possible presence of ammonoid-rich level equivalent to the Wagnerbank (Figs. 2, 3).

Palaeoenvironment

The Pal Grande Fm. deposited in a pelagic environment far away from coast in a basin of low to moderate depth, likely no more than some dozens of meters. In some time-intervals, e.g. those represented by deposits referred to the *Bispathodus aculeatus* Zone of Spalletta et al. (2017) corresponding to the lower part of the Middle *expansa* Zone of Ziegler & Sandberg (1990), the sedimentation rate was low, as reflected in condensed beds.

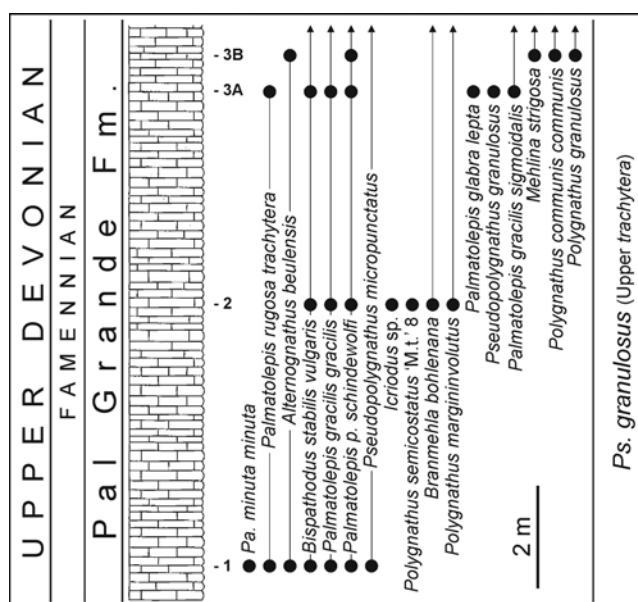


Figure 3. Stratigraphic column and conodont distribution of the lower part of the Malpasso section (modified after Perri & Spalletta 1998).



Figure 4. Stratigraphic column and conodont distribution of the upper part of Malpasso section (modified after Perri & Spalletta 1998, integrated with data from Kaiser et al. 2009 and Hartenfels & Becker 2009, and additional new data). Sample numbers after Kaiser et al. (2009) in italics. Sample numbers after Hartenfels & Becker (2009) in squared brackets.

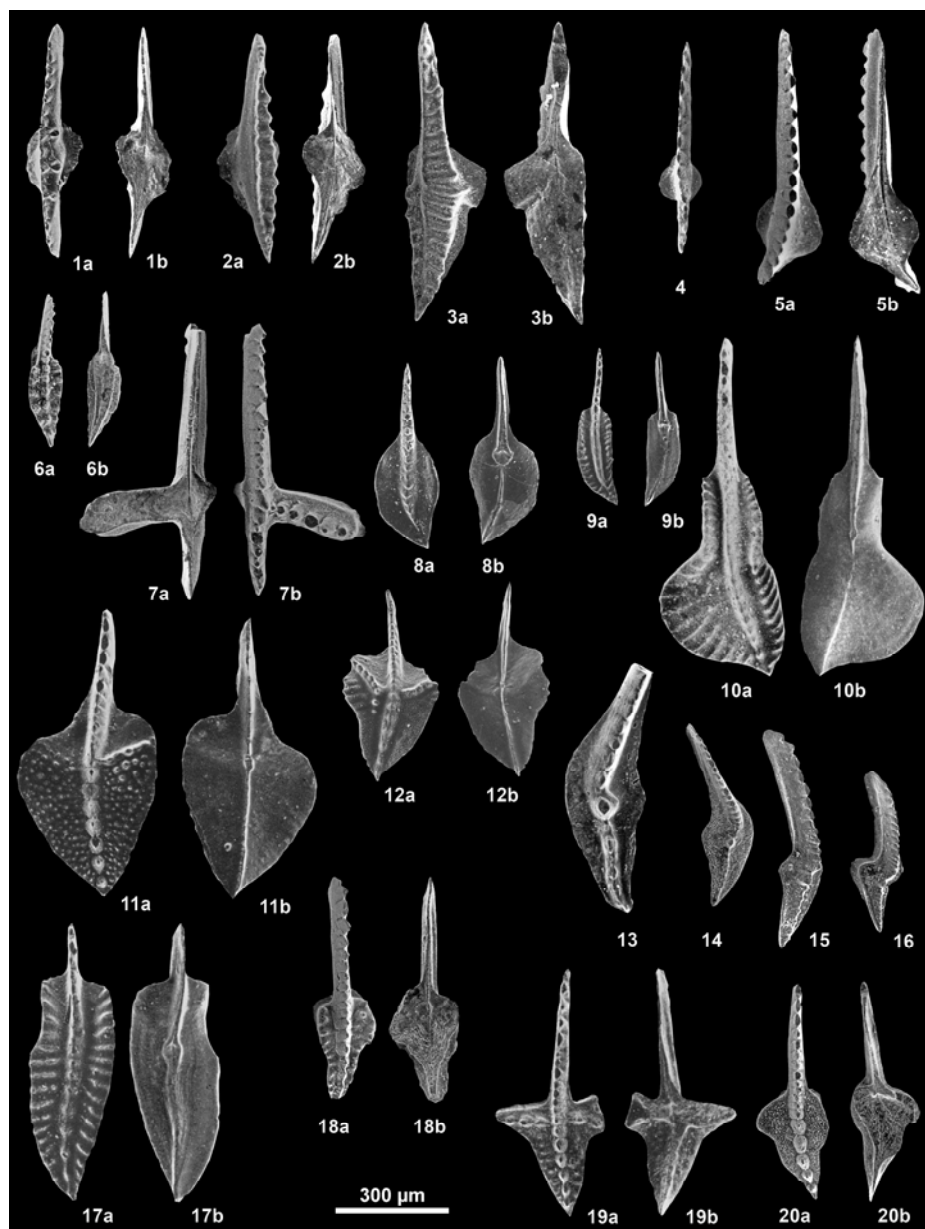


Figure 5. Conodonts from the Malpasso section. Elements 4, 6, 7, 13, 15, 16, 18, and 20 refigured from Perri & Spalletta (1991). Elements 1-3, 5, 10, and 14 refigured from Perri & Spalletta (1991, 1998). Elements 9 and 11 refigured from Perri & Spalletta (1998).

1. *Bispathodus aculeatus aculeatus* (Branson & Mehl), sample ML9, **a.** upper view, **b.** lower view. **2.** *Bispathodus costatus* M1 (Branson), sample ML14, **a.** upper view, **b.** lower view. **3.** *Bispathodus ultimus* M1 (Bischoff), sample ML12, **a.** upper view, **b.** lower view. **4.** *Branmehla fissilis* (Branson & Mehl), sample ML6. **5.** *Branmehla suprema* (Ziegler), sample ML16, **a.** upper view, **b.** lower view. **6.** *Alternognathus beulensis* Ziegler & Sandberg, sample ML1, **a.** upper view, **b.** lower view. **7.** *Branmehla disparilis* (Branson & Mehl), sample ML6, **a.** upper view, **b.** lower view. **8.** *Polygnathus communis communis* Branson & Mehl, sample ML8, **a.** upper view, **b.** lower view. **9.** *Polygnathus obliquicostatus* Ziegler, sample ML4, **a.** upper view, **b.** lower view. **10.** *Polygnathus extralobatus* Schäfer, sample ML7, **a.** upper view, **b.** lower view. **11.** *Polygnathus styriacus* Ziegler, sample ML5, **a.** upper view, **b.** lower view. **12.** *Polygnathus vogesi* Ziegler, sample ML11, **a.** upper view, **b.** lower view. **13.** *Palmatolepis gracilis expansa* Sandberg & Ziegler, sample ML10. **14.** *Palmatolepis gracilis goniclymeniae* Müller, sample ML11. **15.** *Palmatolepis gracilis gracilis* Branson & Mehl, sample ML6. **16.** *Palmatolepis gracilis sigmoidalis* Ziegler, sample ML10. **17.** *Polygnathus* n. sp. A, sample ML12, **a.** upper view, **b.** lower view. **18.** *Pseudopolygnathus brevipennatus* Ziegler, sample ML8, **a.** upper view, **b.** lower view. **19.** *Pseudopolygnathus marburgensis trigonicus* Ziegler, sample ML12, **a.** upper view, **b.** lower view. **20.** *Pseudopolygnathus micropunctatus* Bischoff & Ziegler, sample ML7, **a.** upper view, **b.** lower view.

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Conodonts

Twenty-six conodont samples with average weight of 1.2 kg were collected from the Malpasso section (Figs. 3-4). Only the P1 elements were identified and counted. The abundance of P1 elements varies from 13 per kg of rock in sample ML3C to 652 in sample ML14. In all samples P2 and ramiform elements are scarce. The state of preservation is quite good. The Colour Alteration Index (CAI) is 4.5 (Brime et al., 2008).

Sixty-three taxa belonging to twelve genera (*Alternognathus*, *Bispathodus*, *Bizignathus*, *Branmehla*, *Dasbergina*, *Mehlina*, *Icriodus*, *Palmatolepis*, *Pelekysgnathus*, *Polygnathus*, *Pseudopolygnathus* and *Siphonodella*) were identified (Figs. 3-5).

Biostratigraphy

The occurrence of *Pseudopolygnathus micropunctatus* Bischoff & Ziegler in sample ML1, and the composition of the associated fauna allow referring the interval ML1-ML3B to the *Pseudopolygnathus granulatus* Zone (Upper *trachytera* Zone). The marker *Pseudopolygnathus granulatus* Ziegler enters in sample ML3A together with *Palmatolepis gracilis sigmoidalis* Ziegler. This last taxon allows the identification of the upper part of the zone. The level of sample ML3C was referred to the *Polygnathus styriacus* Zone (Lower *postera* Zone) by the entry of *Palmatolepis rugosa ampla* Müller but the zonal marker enters only in sample ML3D, which level was referred to the *Palmatolepis gracilis manca* Zone (Upper *postera* Zone) due to the entry of the zonal marker. The interval ML4-ML6 was referred to the *Palmatolepis gracilis expansa* Zone (Lower *expansa* Zone) by the entry of *Polygnathus extralobatus* Schäfer in sample ML4, and the composition of the associated fauna. *Palmatolepis gracilis expansa* Sandberg & Ziegler enters in sample ML6g+h together with *Bispathodus aculeatus aculeatus* (Branson & Mehl). The presence of this last taxon allowed referring the interval ML6g+h-ML6l to the *Bispathodus aculeatus aculeatus* Zone (lower part of Middle *expansa* Zone). The interval ML7-ML8f was referred to the *Bispathodus costatus* Zone (upper part of Middle *expansa* Zone) by the entry of *Bispathodus costatus* M1 (Branson). The entry of *Bispathodus ultimus* M2 (Bischoff) in sample ML8g allowed referring the interval ML8g-ML16 to the *Bispathodus ultimus* Zone (Upper *expansa*-Middle *praesulcata* zones). The entry of *Siphonodella praesulcata* Sandberg in sample ML13.1 allowed referring the uppermost part of the Malpasso section to the middle part of the *Bispathodus ultimus* Zone (Fig. 3).

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