

Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 23	Valencia 2017
<i>International Conodont Symposium 4</i>		Valencia, 25-30 th June 2017	

Lochkovian conodonts in the Rio Malinfier West section

Maria G. Corrigan¹, Carlo Corradini¹, Annalisa Ferretti², Monica Pondrelli³, Luca Simonetto⁴ & Paolo Serventi²

¹Dipartimento di Scienze Chimiche e Geologiche, Università di Cagliari, via Trentino 51, I-09127 Cagliari, Italy. corriganmaria@hotmail.com; corradin@unica.it

²Dipartimento di Scienze Chimiche e Geologiche, Università di Modena e Reggio Emilia, via Campi 103, I-41125 Modena, Italy; ferretti@unimore.it; paolo.serventi@unimore.it

³IRSPS, Università d'Annunzio, viale Pindaro 42, I-65127 Pescara, Italy. monica@irsps.unich.it

⁴Museo Friulano di Storia Naturale, via Sabbadini 22-32, I-33100 Udine, Italy. luca.simonetto@comune.udine.it

Locality - Along the road connecting Paularo to the Passo del Cason di Lanza about 100 m west of the Rio Malinfier Creek, at coordinates 46°34'50.8"N, 13°07'53.7"E (base) and N 46°34'48.8", E 13°07'51.9".

Lithostratigraphic unit - Alticola Fm., Rauchkofel Fm., Nölbling Fm., La Valute Fm. and Findenig Fm.

Age - Pridoli (Silurian)-Lochkovian (Lower Devonian); Upper O.e. detortus Zone to at least Ad. trigonicus Zone.

What to see - Five Lochkovian lithostratigraphic units; levels with beautifully preserved lobolits.

How to get there

The Rio Malinfier section can be reached from Passo del Cason di Lanza moving for about 4 km along the road to Paularo. The section is located in the forest about 100. west of the bridge on Rio Malinfier waterfall (Fig. 1) along a narrow and steep creek, at coordinates 46°34'50.8"N, 13°07'53.7"E (base) and 46°34'48.8"N, 13°07'51.9"E (top).

Historical outline

The section was discovered recently, after a local flood that cleaned the creek in august 2008. Conodonts were studied by Corrigan (2011) and the lithostratigraphic sequence was roughly presented by Corradini et al. (2012).

The Rio Malinfier section is a reference section for the Rauchkofel and La Valute formations (Corradini et al., 2015a, 2015b).

Lithology and fossil content

The section is partly overturned and strongly tectonized, and documents about 100 m of limestones and black shales attributed to the Alticola, Rauchkofel, La Valute, Nölbling and Findenig formations (Figs. 2-3). The section is divided in two parts approximately about 40 m from the base by a north dipping roughly E-W trending fault. While in the footwall of the fault the succession is fairly undisturbed, with just very gentle folding and a minor fault, the hangingwall is characterized by a tight inclined decameter-scale syncline associated to smaller-scale asymmetric folds, in turn gently folded by a larger-scale structure.



Figure 1. Location map of the Rio Malinfier West section.



Figure 2. Views of the Rio Malinzier West section, with indication of the lithostratigraphic units and position of samples. **A.** Panoramic view of the topographically upper part of the section; **B.** The lowermost part of the section with the tectonic boundary between the Alticola and the Rauchkofel formations, and the transition to the La Valute Fm.; **C.** The roughly E-W trending fault separating the Rauchkofel and the Alticola formations in the central part of the section; **D.** The transition from the Alticola to the Rauchkofel formations in the central part of the section, and the lobolith beds; **E.** The sharp boundary between the Nölbling and La Valute formations; **F.** Gradual transition from the La Valute Fm. to the Findenig Fm. in the uppermost part of the section.

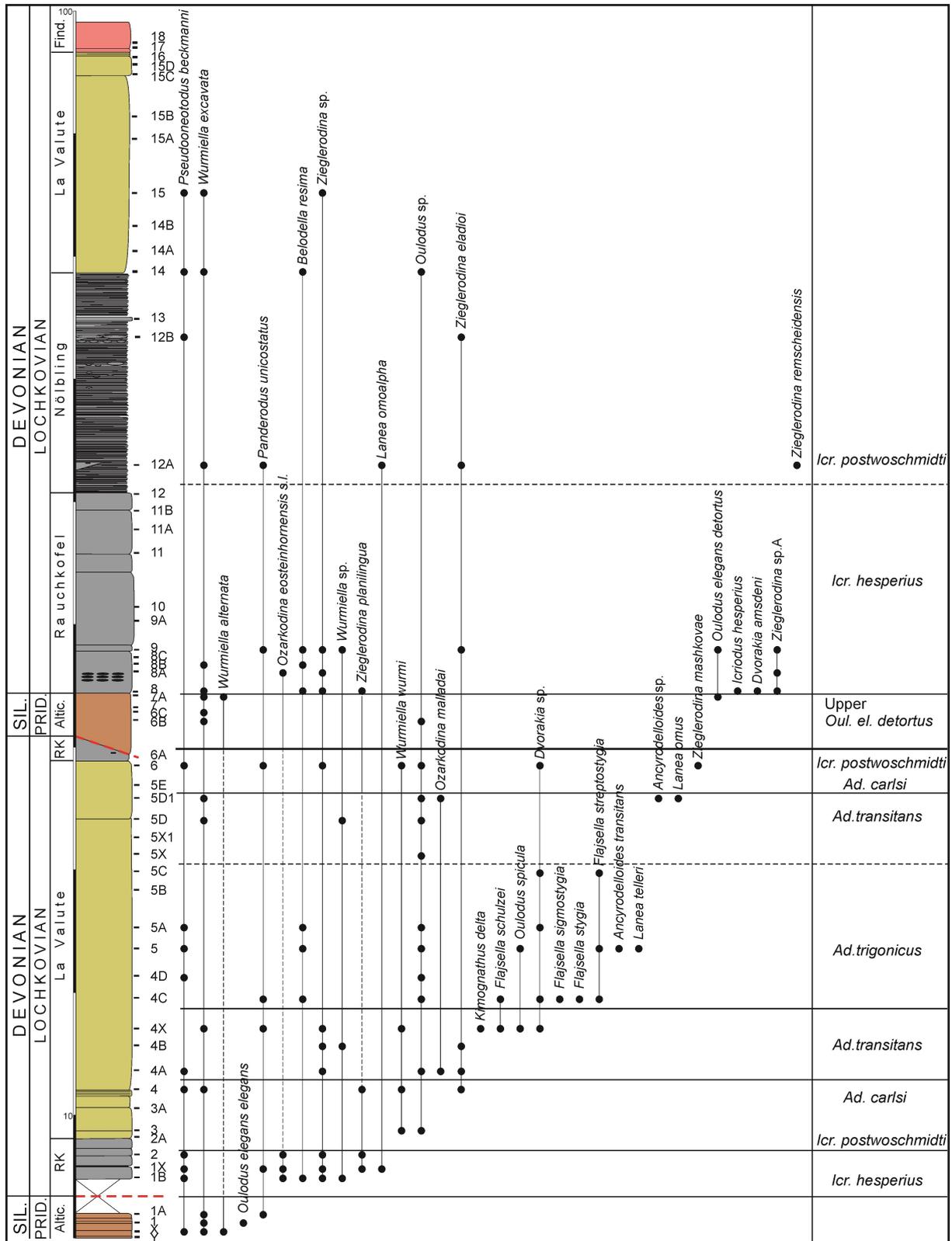


Figure 3. Stratigraphic column of the Rio Malinifer section and conodont distribution (modified after Corradini et al., in press).

Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 23	Valencia 2017
<i>International Conodont Symposium 4</i>		Valencia, 25-30 th June 2017	

The section starts (Fig. 2b) with a steep wall constituted by about 2 m of cephalopod-rich limestones belonging to the Alticola Fm., and continues after 3 m of detrital cover accumulated at the base of the steep cliff, with 3.2 m of dark limestones and intercalated black shales of the Rauchkofel Fm., that passes with a sharp contact into the La Valute Fm. This unit here is more than 30 meters thick, because this part of the section is affected by the afore-mentioned tight fold which causes the repetition of this part of the succession. Close to the repeated transition to the Rauchkofel Fm., the bed thickness seems to decrease, probably because of the ductile shear associated to the fold propagation. Less than 2 m of Rauchkofel Fm. are present before the fault.

In the footwall of the fault, the section continues with about 4 m of limestones of the Alticola Fm., slightly tectonized in the upper part, close to the sharp transition with the Rauchkofel Fm. (Fig. 2d). The Rauchkofel Fm is here represented by about 16 m of dark limestone, with thin black shale intercalations. Limestone beds are thicker in the lower part of the units, where at least three 20-25 cm thick beds bearing crinoid remains (mainly loboliths) are evident. Well preserved nautiloids occur just above the lobolith beds. The thickness of beds decreases in the upper part of the unit before the transition to the Nölbling Fm. This unit is here represented mainly by black shales with a few carbonatic levels and lenses intercalated, and is about 18 m thick. The Nölbling Fm. is overlain by the La Valute Fm. with a sharp conformable contact (Fig. 2e). Compared to the same formation on the lower part of the section the unit is here slightly more marly and the beds are thinner, probably indicating a slightly deeper depositional environment. In the uppermost part the La Valute Fm. is more nodular and marly, and grades into the Findenig Fm. (Fig. 2f), represented by reddish nodular mudstone.

Nautiloid cephalopods are present throughout the section, but the state of preservation is poor, being the specimens weathered by dissolution and frequently recrystallized. A few gastropods, rare trilobites and solitary corals have been collected from the Alticola and the Rauchkofel formations in the central part of the section, and poorly preserved monograptid graptolites from the lower Lochkovian black shales of the Rauchkofel Fm.

Crinoids are the most spectacular macrofossils of the RMW section, where several well preserved loboliths occur just above the base of the Rauchkofel Fm., about 46 m from the base of the section. The lobolith bearing beds are about 20 cm thick, and a few lobolith are present also on thinner beds between the thicker ones. Several loboliths, in general well preserved, are closely spaced on bedding plane. Some specimens maintain the typical wall structure of the plate loboliths.

Figure 4. Conodonts from the Rio Malinfier section (modified after Corradini et al., in press).

1. "*Ozarkodina*" *malladai* Valenzuela-Rios, P1 element MFSNgp 48339, lateral view, sample RMW.
2. "*Ozarkodina*" *malladai* Valenzuela-Rios, P1 element MFSNgp 48340, lateral view, sample RMW 4A.
3. *Flajsella streptostygia* Valenzuela-Rios & Murphy, P1 element MFSNgp 48341, upper view, sample RMW 5.
4. *Flajsella schulzei* (Bardashev), P1 element MFSNgp 48342, lateral view, sample RMW 4X.
5. *Flajsella schulzei* (Bardashev), P1 element MFSNgp 48343, upper view, sample RMW 4C.
6. *Flajsella sigmostygia* Valenzuela-Rios & Murphy, P1 element MFSNgp 48344, upper view, sample RMW 4C.
7. *Flajsella stygia* (Flajs), P1 element MFSNgp 48345, upper view, sample RMW 4C.
8. *Icriodus hesperius* (Klapper & Murphy), Sc element MFSNgp 48346, lateral view, sample RMW 8.
9. *Dvorakia amsdeni* Barrick & Klapper, S1 element MFSNgp 48347, lateral view, sample RMW 8.
10. *Ancyrodelloides* cf. *transitans* (Bischoff & Sanneman), P1 element MFSNgp 48348, upper (a) and lower (b) views, sample RMW 5.
11. *Zieglerodina* sp. A Corrigan et al., P1 element MFSNgp 48349, lateral view, sample RMW 8.
12. *Zieglerodina* sp. A Corrigan et al., P1 element MFSNgp 48350, upper view, sample RMW 9.
13. *Zieglerodina* sp. A Corrigan et al., P1 element MFSNgp 48351, lateral view, sample RMW 8A.
14. *Lanea* cf. *telleri* (Schulze), P1 element MFSNgp 48352, upper view, sample RMW 5.
15. *Panderodus unicostatus* (Branson & Mehl), MFSNgp 48353, latera view, sample RWM 6.

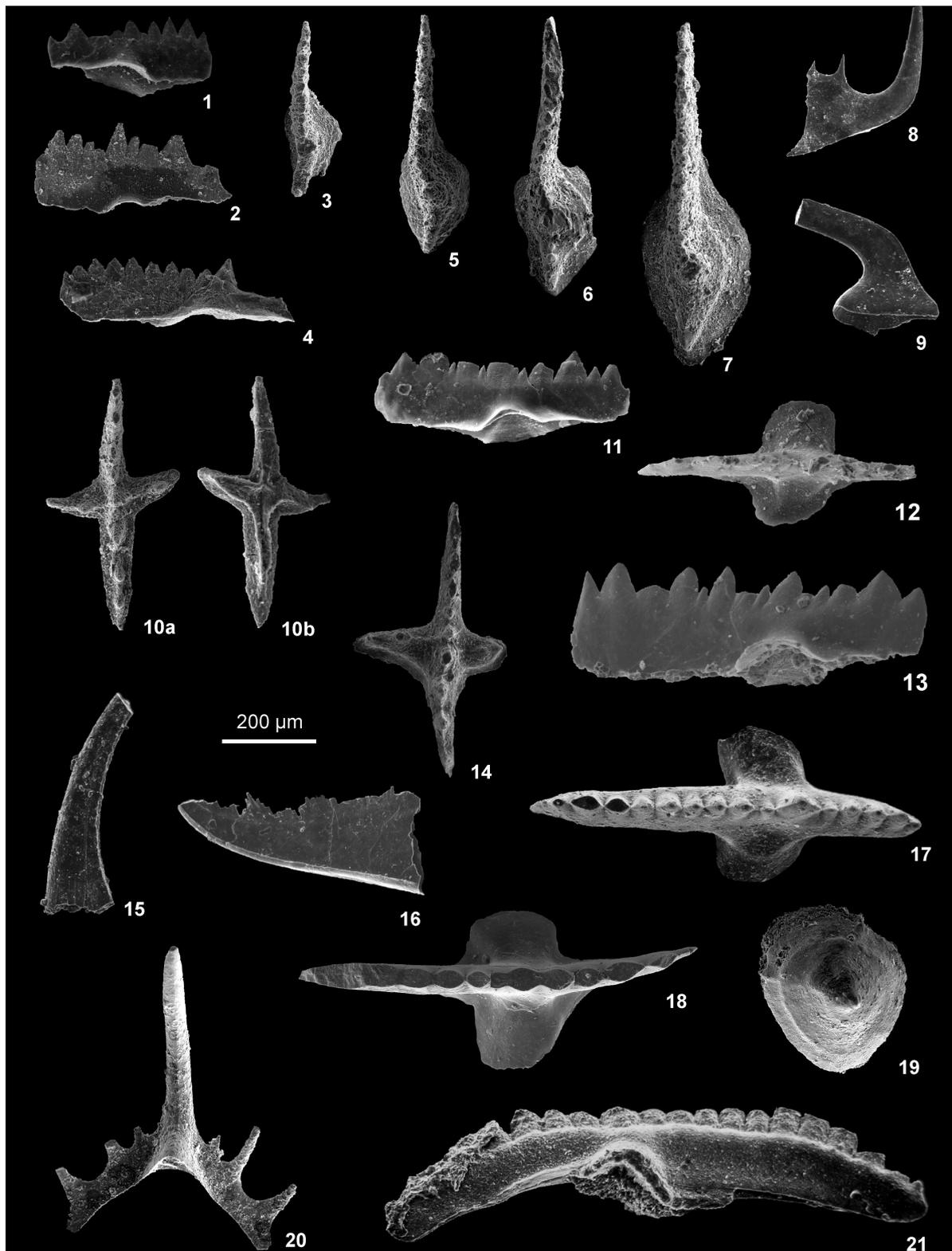


Figure 4. continued.

16. *Belodella resima* (Philip), S0 element MFSNgp 48354, lateral view, sample RMW 8. **17.** *Lanea omoalpa* Murphy & Valenzuela-Rios, P1 element MFSNgp 48355, upper view, sample RMW 1X. **18.** *Zieglerodina planilingua* (Murphy & Valenzuela-Rios), P1 element MFSNgp 48356, upper view, sample RMW 4. **19.** *Pseudooneotodus beckmanni* (Bischoff & Sannemann), MFSNgp 48357, upper view, sample RMW 5. **20.** *Oulodus spicula* Mawson, S0 element MFSNgp 48358, lateral view, sample RMW 5. **21.** *Wurmiella wurmi* (Bischoff & Sannemann, 1958), P1 element MFSNgp 48359, lateral view, sample RMW 4.

Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 23	Valencia 2017
<i>International Conodont Symposium 4</i>		Valencia, 25-30 th June 2017	

Palaeoenvironment

The whole RMW section deposited in a shelf to pelagic environment, but with the lower one possibly deposited in a more distal environment. This is suggested by a major occurrence there of black shales as well as by the presence of the Nöbling Fm., absent in the upper part.

Conodonts

Fifty-six conodont samples, weighting 1.5-3.4 kg each, were collected from the section (Fig. 3-4). Overall about 150 kg of limestone yielded less than 400 conodonts. Abundance is always very low, with an average of 2.7 conodonts/kg. Twenty-three samples, mainly picked in the upper part of the section, were barren. The state of preservation is quite poor, being many elements broken or incomplete, and about 20% is represented by indeterminable fragments. Conodont color is dark brown, corresponding to a Colour Alteration Index (CAI) 4.

Thirty-two taxa (species and subspecies) belonging to thirteen genera were discriminated (*Ancyrodelloides*, *Belodella*, *Dvorakia*, *Flajsella*, *Icriodus*, *Kimognathus*, *Lanea*, *Oulodus*, *Ozarkodina*, *Panderodus*, *Pseudooneotodus*, *Wurmiella* and *Zieglerodina*). Among them, *Pseudooneotodus*, *Wurmiella* and *Zieglerodina* represent the majority of the association.

Biostratigraphy

The lower part of the section, belonging to the Alticola Fm., can be assigned to a general Pridoli age, due to the occurrence of *Wurmiella alternata* in sample RMW X and *Oulodus elegans elegans* in sample RMW 1. The association do not allow a more precise biostratigraphic assignment.

After the covered interval, the lower part of the Rauchkofel Fm. (samples RMW 1B) can be assigned to the *Icr. hesperius* Zone, whereas the entry of *Lanea omoalpha* Murphy & Valenzuela-Rios in sample RMW 1X indicates the base of the *Icr. postwoschmidti* Zone. The base of the succeeding *Ad. carlsi* Zone cannot be placed precisely, but it should be above sample RMW 2, where the last occurrence of "*Ozarkodina*" *eosteinhornensis* s.l. is recorded. The presence of *Ozarkodina malladai* in sample RMW 4A allows the locate at this level the base of the *Ad. transitans* Zone. The succeeding *Ad. trigonicus* Zone is discriminated in beds of samples RMW 4C-5C by the presence of *Flajsella streptostygia* which is exclusive of this Zone. The fold in this part of the section is confirmed by the occurrence of *Lanea omus*, that ranges only in the *Ad. transitans* Zone (Corriga et al. 2014) in sample RMW 5D1. The upper part of the La Valute Fm. can be assigned to an indifferentiated *Icr. postwoschmidti* – *Ad. carlsi* interval, due to the occurrence of *Wurmiella wurmi* and *Zieglerodina mashkovae* in sample RMW 6.

Above the fault, the Alticola Fm. can be assigned to the Upper *Oul. el. detortus* Zone by the presence of the marker *Oulodus elegans detortus* and *Wurmiella alternata* in sample RMW 7A. The Silurian/Devonian boundary is coincident with the formational boundary between the Alticola and Rauchkofel formations, as demonstrated by the occurrence of *Icriodus hesperius* in sample RMW 8. The interval up to sample RMW 9 can be assigned to the *Icr. hesperius* Zone, probably to the lower part of the Zone, because of the presence of *Zieglerodina* sp. A, that is documented only from the lower part of the Zone (Corriga et al. 2016, Schönlaub et al. 2017). No conodonts have been found in the rest of the Rauchkofel Fm., and the next datum is the presence of *Lanea omoalpha* in sample RMW 12A, indicating an age not older than the *Icr. postwoschmidti* Zone. The scarce fauna on the upper part of the section prevents any sure biostratigraphic assessment.

References

CORRADINI, C., CORRIGA, M.G., PONDRELLI, M., SCHÖNLAUB, H.P. & SIMONETTO, L. (2015): La Valute Formation. - In: CORRADINI, C. & SUTTNER, T.J. (eds): The Pre-Variscan sequence of the Carnic Alps (Austria and Italy). - Abhandlungen der Geologischen Bundesanstalt, 69: 77-80.

CORRADINI, C., CORRIGA, M.G., PONDRELLI, M., SCHÖNLAUB, H.P., SIMONETTO, L., SPALLETTA, C. & FERRETTI, A. (2015): Rauchkofel Formation Formation. - In: CORRADINI, C. & SUTTNER, T.J. (eds): The Pre-

Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 23	Valencia 2017
<i>International Conodont Symposium 4</i>		Valencia, 25-30 th June 2017	

Variscan sequence of the Carnic Alps (Austria and Italy). - Abhandlungen der Geologischen Bundesanstalt, 69: 77-80.

CORRADINI, C., PONDRELLI, M., CORRIGA, M.G., SIMONETTO, L., KIDO, E., SUTTNER, T.J., SPALLETTA, C. & CARTA N. (2012): Geology and stratigraphy of the Cason di Lanza area (Mount Zermula, Carnic Alps, Italy). - Berichte des Institutes für Erdwissenschaften, Karl-Franzens-Universität Graz, 17: 83-103.

CORRIGA, M.G. (2011): Biostratigrafia a conodonti attorno al limite Siluriano-Devoniano in alcune aree del Nord Gondwana. - Ph.D. thesis, University of Cagliari, 152 p., Cagliari.

CORRIGA, M.G., CORRADINI, C., SCHÖNLAUB, H.P. & PONDRELLI, M. (2016): Lower Lochkovian (Lower Devonian) conodonts from Cellon section (Carnic Alps, Austria). - Bulletin of Geosciences, 91(2): 261-270.

CORRIGA, M.G., CORRADINI, C. & WALLISER O.H. (2014): Upper Silurian and Lower Devonian conodonts from Tafilalt, southeastern Morocco. Bulletin of Geosciences, 89(1): 183-200. DOI:10.3140/bull.geosci.1473

SCHÖNLAUB, H.P., CORRADINI, C., CORRIGA, M.G. & FERRETTI, A. (2017): Litho-, Chrono- and conodont bio-stratigraphy of the Rauchkofel Boden Section (Upper Ordovician-Lower Devonian), Carnic Alps, Austria. - Newsletters on Stratigraphy: 25 pp. doi: 10.1127/nos/2017/0391