



Maria G. Corrigan
Carlo Corradini
Monica Pondrelli
Luca Simonetto

LOCHKOVIAN (LOWER DEVONIAN) CONODONTS FROM RIO MALINFIER SECTION (CARNIC ALPS, ITALY)

**CONODONTI LOCHKOVIANI (DEVONIANO INFERIORE)
DELLA SEZIONE RIO MALINFIER
(ALPI CARNICHE, ITALIA)**

Riassunto breve - Vengono presentati i dati a conodonti della sezione Rio Malinfiere, situata nell'area del Passo del Cason di Lanza. Sono stati riconosciuti dodici taxa appartenenti a otto generi (*Ancyrodelloides*, *Dvorakia*, *Icriodus*, *Lanea*, *Oulodus*, *Ozarkodina*, *Pseudooneotodus* e *Zieglerodina*), che consentono di datare la sezione al Lochkoviano medio (Devoniano Inferiore). Il limite litostratigrafico tra la Formazione del Nölbling e la Formazione de La Valute è datato alla biozona a *transitans*.

Parole chiave: Biostratigrafia, Conodonti, Devoniano Inferiore, Alpi Carniche.

Abstract - Conodont data from the Rio Malinfiere section, located in the Cason di Lanza area (Carnic Alps, Italy) are presented. Twelve taxa belonging to eight genera (*Ancyrodelloides*, *Dvorakia*, *Icriodus*, *Lanea*, *Oulodus*, *Ozarkodina*, *Pseudooneotodus* and *Zieglerodina*) allow to state a middle Lochkovian (Lower Devonian) age for the section. The lithological boundary between the Nölbling and the La Valute formations is dated to the *transitans* Zone.

Key words: Biostratigraphy, Conodonts, Lower Devonian, Carnic Alps.

Introduction

This paper is a contribution to a project run by several Italian and Austrian Institutions on "formal lithostratigraphy of the pre-Variscan sequence of the Carnic Alps". The goal of the project is to achieve a common and unified terminology, formally subdividing the lithostratigraphic column in well defined geological units with a precise time constraint. For this purpose it is necessary to date formation boundaries in as much localities and sections as possible.

This paper deals on the boundary between the Nölbling and the La Valute formations in the Rio Malinfiere section.

The Rio Malinfiere section is located a few kilometres west of Passo del Cason di Lanza, along the road to Paularo (Carnic Alps, NE Italy, fig. 1).

In the Passo del Cason di Lanza-Mt. Zermula area rocks from Ordovician to Lower Permian are exposed: they belong to the Variscan and the Permo-Carboniferous sequences of the Carnic Alps. In the Rio Malinfiere area an overturned Ordovician-Upper Devonian sequence crops out just north of the important tectonic lineage known as "Cason di Lanza line" (VENTURINI 1990). Despite the severe tectonic disruption, the stratigraphic succession

is fairly continuous. For a detailed description of the geology and stratigraphy of the area refer to CORRADINI et al. (2012).

The Lochkovian of the Carnic Alps

In the Carnic Alps Lochkovian deposits are represented either by carbonatic or pelitic units. The carbonatic rocks belong to the Rauchkofel, La Valute and Findenig formations; the pelitic Bischofalm Formation, while the Nölbling is made by alternating shales and limestone (fig. 2).

The Silurian/Devonian boundary in the Carnic Alps is more or less coincident with the lithostratigraphical boundary between the Alticola and the Rauchkofel formations. In fact, in some places is located in the uppermost part of the Alticola Fm., as in the Cellon (WALLISER 1964) and in the Rauchkofel Boden (FERRETTI et al. 1999) section, whereas elsewhere it is equivalent to the lithostratigraphical boundary, like in the Rio Malinfiere section (CORRIGA 2011).

The Rauchkofel Fm. is the oldest Devonian unit of the Carnic Alps. It is represented by dark wackestones to packstones with black shales locally interbedded.

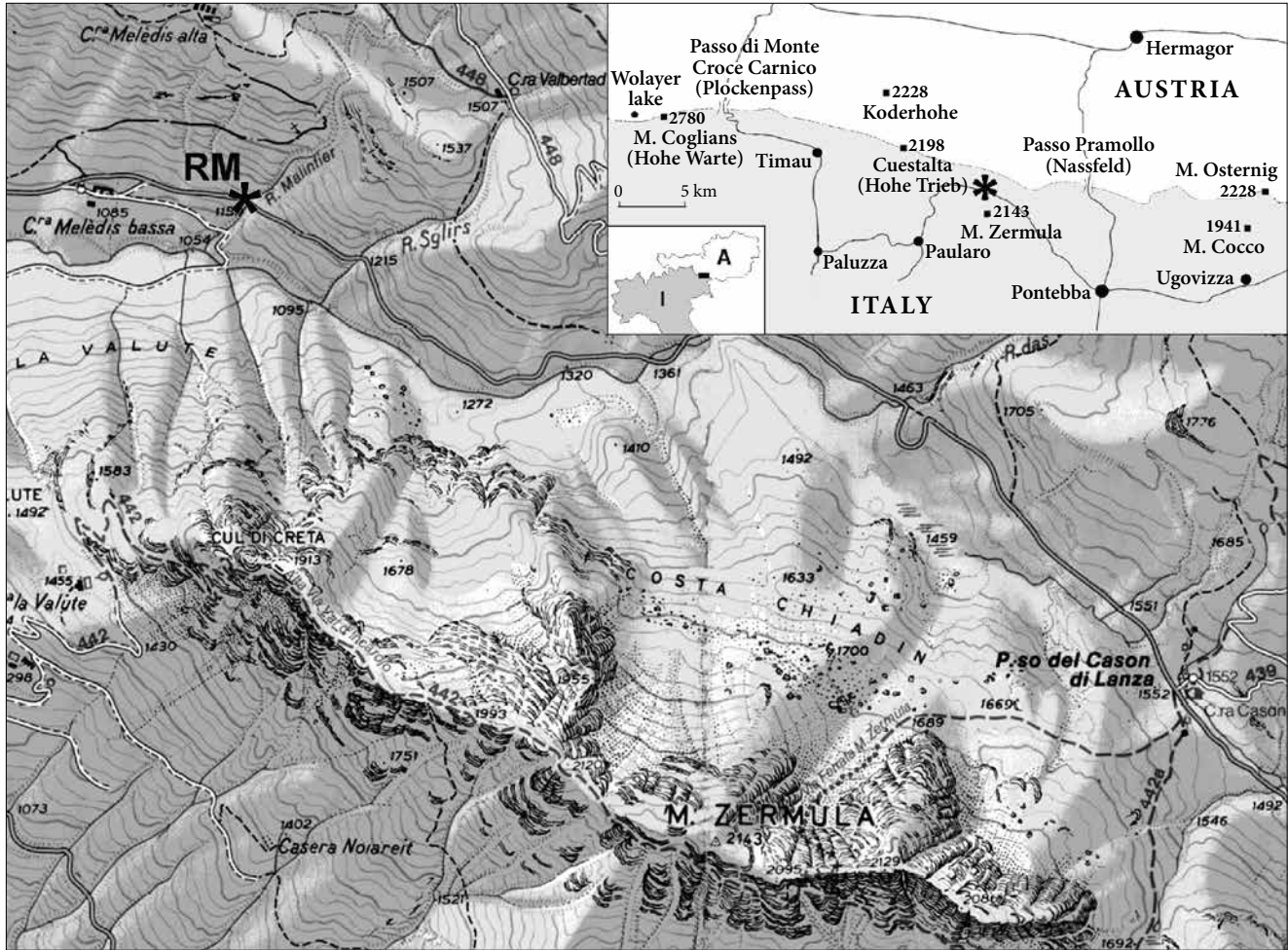


Fig. 1 - Location map (scale 1:25.000) of the Rio Malinfier section.
 - Ubicazione della sezione Rio Malinfier (scala 1:25.000).

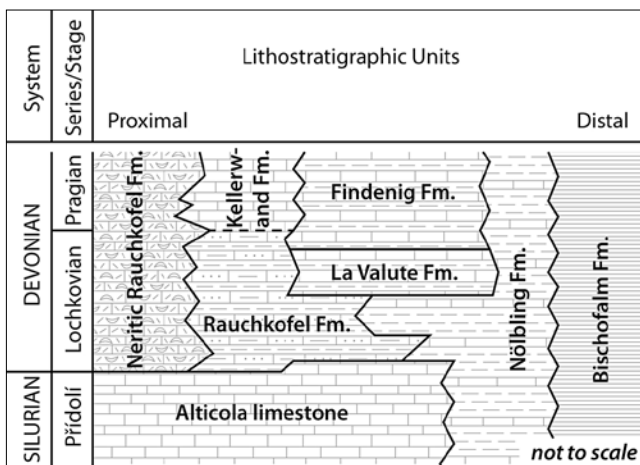


Fig. 2 - Stratigraphic scheme of the Lochkovian of the Carnic Alps (NE Italy). In rough approximation the units succeeds west to east in the western-central part of the Carnic Alps.
 - Schema stratigrafico del Lochkoviano delle Alpi Carniche. In prima approssimazione le unità si susseguono da ovest a est nelle Alpi Carniche centro-occidentali.

Coarser levels suggesting redeposition possibly by storm and/or currents are locally present. The abundant fossil fauna is dominated by orthocerathid cephalopods, crinoids and conodonts; graptolites, brachiopods, bivalves are also present. A coeval shallow water facies ("neritic Rauchkofel Fm.") is documented in the western part of the Carnic basin, mainly in the Lake Wolayer area.

At places, the Rauchkofel Fm. is superposed by the La Valute Fm., which is represented by about twenty meters of centimetric thick light grey-ochre nodular mudstones and wackestones with orthoceratids and conodonts. The upper part of the unit grades into the overlying Findenig Fm. The boundary have been dated to the upper Lochkovian (*pandora* β conodont Zone) in the La Valute section (CORRIGA et al. 2011).

The Findenig Fm. is about 25 meters thick and consists of centimetric thick layers of nodular purple red mudstones and wackestones with marly millimetric thick intercalations. Locally, for example in the Malinfier gorge, centimetric thick levels of gray packstones are interbedded with the the red mudstone



Fig. 3 - View of the Rio Malinfier section with location of conodont samples.
- Veduta della sezione Rio Malinfier con ubicazione dei campioni a conodonti.

and wackestone suggesting gravity driven redeposition from the shallower part of the basin (BANDEL 1972; VAI 1980).

The Nölbling Fm. (JAEGER & SCHÖNLAUB 1977) ranges from lower Silurian to Lochkovian and consists of black shales, with mudstone and wackestone lenses interbedded. Pyritized fossils and rare conodonts are present in the carbonatic levels, while at places graptolites can be obtained from the shales. This unit is widespread only in the central part of the Carnic Alps and reaches its maximum thickness (about 40 meters) in the Valute and Nölblinggraben areas; however, tectonic duplication may have occurred.

The Bischofalm Fm. was deposited in the deepest part of the basin and consists of graptolitic black shales. The unit ranges from lower Silurian to Lower Devonian.

The Rio Malinfier Section

The Rio Malinfier section is located along the road connecting Paularo to the Passo del Cason di Lanza, just west of the bridge on the Rio Malinfier waterfall.

More precisely the section is measured at coordinates N 46°34'48", E 13°7'53" (fig. 1).

The section has a total thickness of about 5 m and exposes an overturned sequence of rocks belonging to the Nölbling and the La Valute formations (figs 3, 4).

The section starts with 2.7 m of dark limestones and shales of the Nölbling Fm. The calcareous content decreases in the upper part of the unit, where the shales are dominant and only a few limestone lenses are present. A few orthoceratid nautiloids from the limestone are the only macrofossils observable in the field; a rich pyritized microfauna (bivalves, gastropods, brachiopods, cephalopods and ostracods) is present in some levels, testifying the scarcity of oxygen in the depositional basin.

The upper part of the section is represented by about 2.5 meters of well bedded light grey limestone of the La Valute Fm., which with a sharp transition stay on top of the Nölbling Fm., demonstrating a sharp regression. Rare, poorly preserved orthoceratid nautiloids are the only fossils present in these limestones.

The top of the section is interrupted by a minor local fault and by the road.

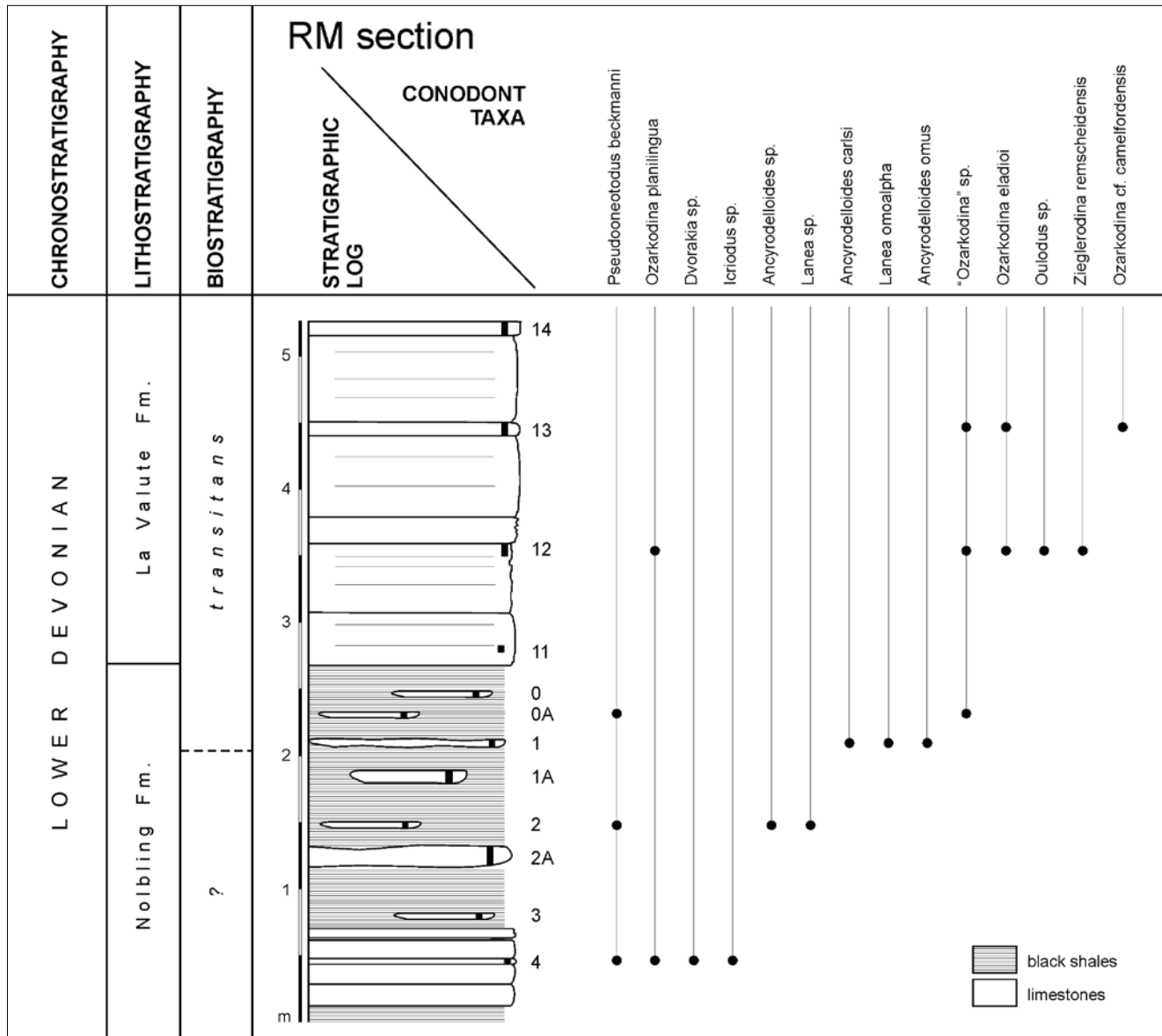


Fig. 4 - Stratigraphic column of the Rio Malinlier section and conodont distribution.
 - Colonna stratigrafica e distribuzione dei conodonti nella sezione Rio Malinlier.

Conodont fauna

Twelve conodont samples have been collected from the Rio Malinlier section (fig. 4, tab. I). About 30 kg of rock have been dissolved with conventional formic acid technique and only 64 conodont elements (mainly P1 elements) have been found. Abundance is always very low, except sample RM 2, and five samples resulted barren of conodonts.

In general state of preservation is poor, being part of the fauna is represented by indeterminable fragments. Conodont color is black, corresponding to a Color Alteration Index (CAI) of 5, but this value is probably affected by the abundance of organic matter in the shales of the Nöbling Fm.

Twelve taxa belonging to eight genera (*Ancyrodelloides*, *Dvorakia*, *Icriodus*, *Lanea*, *Oulodus*, *Ozarkodina*,

Pseudooneotodus and *Zieglerodina*) have been identified (fig. 4, tab. I). Among them a specimen attributed to the Australian species *Ozarkodina cf. camelfordensis* FARRELL is here reported for the first time in North Gondwana.

The entire fauna is housed in the Museo di Paleontologia Domenico Lovisato of the Department of Chemical and Geological Sciences, University of Cagliari (MDLCA), under numbers 30186-30200. Horizon and catalogue numbers of figured specimens (fig. 5) are given in the plate captions.

Biostratigraphy

The conodont zonation scheme of lower and middle Lochkovian have been recently updated by CORRADINI & CORRIGA (2012), who subdivided the middle Lochkovian

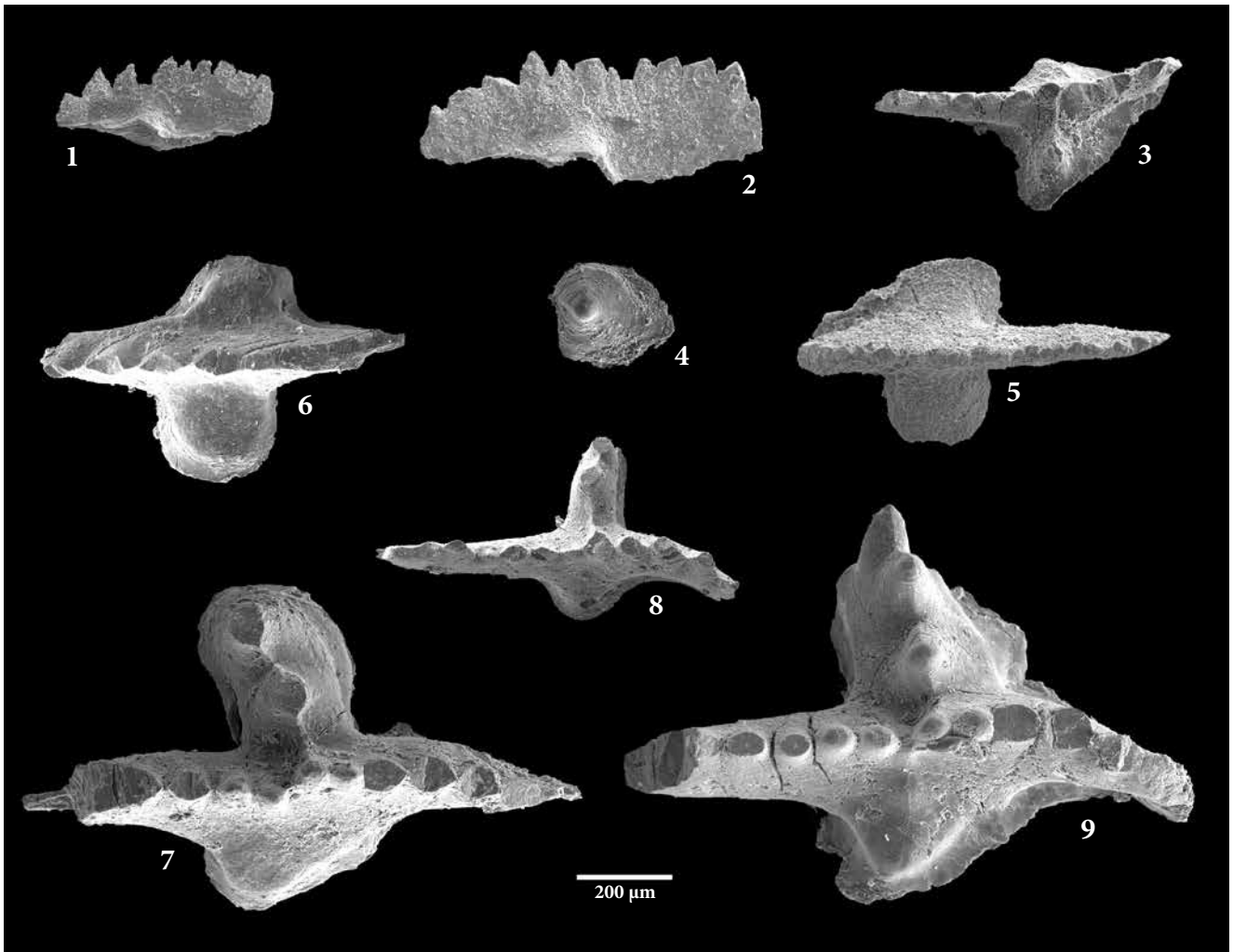


Fig. 5 - Conodonts from Rio Malinfier section. 1) *Zieglerodina eladioi* (VALENZUELA-RÌOS, 1994), P1 element MDLCA 30187, lateral view, sample RM 13; 2) *Ozarkodina cf. camelfordensis* FARRELL, 2004, P1 element MDLCA 30188, lateral view, sample RM 13; 3) *Ancyrodelloides omus* MURPHY & MATTI, 1983, P1 element MDLCA 30189, upper-lateral view, sample RM 1; 4) *Pseudooneotodus beckmanni* (BISCHOFF & SANNEMANN, 1958) MDLCA 30190, upper view, sample RM 2, (*Biozona a transitans*); 5) *Lanea omoalpha* MURPHY & VALENZUELA-RÌOS, 1999, P1 element MDLCA 30191, upper view, sample RM 12; 6) *Lanea omoalpha* MURPHY & VALENZUELA-RÌOS, 1999, P1 element MDLCA 30192, upper view, sample RM 1; 7) *Ancyrodelloides carlsi* (BOERSMA, 1973); P1 element MDLCA 30186, upper view, sample RM 1; 8) *Ancyrodelloides carlsi* (BOERSMA, 1973); P1 element MDLCA 30193, upper view, sample RM 1; 9) *Ancyrodelloides carlsi* (BOERSMA, 1973); P1 element MDLCA 30194, upper view, sample RM 1.

- *Conodonti della sezione Rio Malinfier*. 1) *Zieglerodina eladioi* (VALENZUELA-RÌOS, 1994), elemento P1 MDLCA 30187, veduta laterale, campione RM 13; 2) *Ozarkodina cf. camelfordensis* FARRELL, 2004, elemento P1 MDLCA 30188, veduta laterale, campione RM 13; 3) *Ancyrodelloides omus* MURPHY & MATTI, 1983, elemento P1 MDLCA 30189, veduta obliqua, campione RM 1; 4) *Pseudooneotodus beckmanni* (BISCHOFF & SANNEMANN, 1958) MDLCA 30190, veduta superiore, campione RM 2; 5) *Lanea omoalpha* MURPHY & VALENZUELA-RÌOS, 1999, elemento P1 MDLCA 30191, veduta superiore, campione RM 12; 6) *Lanea omoalpha* MURPHY & VALENZUELA-RÌOS, 1999, elemento P1 MDLCA 30192, veduta superiore, campione RM 1; 7) *Ancyrodelloides carlsi* (BOERSMA, 1973); elemento P1 MDLCA 30186, veduta superiore, campione RM 1; 8) *Ancyrodelloides carlsi* (BOERSMA, 1973); elemento P1 MDLCA 30193, veduta superiore, campione RM 1; 9) *Ancyrodelloides carlsi* (BOERSMA, 1973); elemento P1 MDLCA 30194, veduta superiore, campione RM 1.

into four zones: *carlsi*, *transitans*, *leanorae* and *trigonicus*. The base of the *carlsi* Zone can be considered as the base of the middle Lochkovian (SLAVIK 2011; CORRADINI & CORRIGA 2012). The scarcity of fauna and the absence of markers in the lower part of the section does not allow to define a precise age for this interval; however, the occurrence of *Ancyrodelloides* sp. and *Lanea* sp. suggests a middle Lochkovian age for samples up to RM 1A. In

terms of biozones, according to the attribution of the upper part of the section, these levels may belong to the *carlsi* Zone or the *transitans* Zone.

The upper part of the section may be attributed to the *transitans* Zone due to the entry of *Ancyrodelloides omus* in sample RM 1: in fact, this taxon is exclusive of this zone (MURPHY & VALENZUELA-RÌOS 1999; CORRADINI & CORRIGA 2012).

Rio Malinfier section		4	3	2A	2	1A	1	0A	0	11	12	13	14	total
<i>Ancyrodelloides carlsi</i>	P1						9							9
<i>Ancyrodelloides omus</i>	P1						2							2
<i>Ancyrodelloides</i> sp.	P1				1									1
<i>Dvorakia</i> sp.		2												2
<i>Icriodus</i> sp.	P1	2												2
<i>Lanea omoalpha</i>	P1						1							1
<i>Lanea</i> sp.	P1				1									1
<i>Oulodus</i> sp.	P1										1			1
	S1										1			1
<i>Ozarkodina cf. camelfordensis</i>	P1											1		1
<i>Ozarkodina eladioi</i>	P1										1	1		2
<i>Ozarkodina planilingua</i>	P1	1									1	2		4
<i>Ozarkodina</i> sp.	P1						1	1			3			5
<i>Pseudooneotodus beckmanni</i>		1			5			1						7
<i>Zieglerodina remscheidensis</i>	P1										1			1
	P2										1			1
<i>Zieglerodina</i> sp.	P1							1						1
Fragments				4	7		11							22
Total		6	0	4	14	0	24	3	0	0	9	4	0	64
kg. rock		2,80	2,05	2,15	0,85	2,60	2,00	3,55	1,50	3,10	2,80	3,80	2,20	29,4
conodonts/kg		2,1	0,0	1,9	16,5	0,0	12,0	0,8	0,0	0,0	3,2	1,1	0,0	2,2

Tab. I - Conodont distribution chart of the Rio Malinfier section.
- *Tabella di distribuzione dei conodonti nella sezione del Rio Malinfier.*

Conclusions

The conodont fauna allows to date the Rio Malinfier section to the Lochkovian (Lower Devonian). The boundary between the Nöbling Fm. and the La Valute Fm. in the Rio Malinfier section occur within the middle Lochkovian (*transitans* conodont Zone).

Manuscript received on 01.X.2012, accepted on 22.X.2012.

Acknowledgements

This paper is a contribution to IGCP Project n. 596 "Mid-Palaeozoic climate and biodiversity". We wish to thank Claudia Spalletta for constructive reviews that improved our manuscript.

References

- BANDEL, K. 1972. Palökologie und Paläogeographie im Devon und Unterkarbon der zentralen Karnischen Alpen. *Palaeontographica A* 141, n. 1-4: 1-117.
- BISCHOFF, G., & D. SANNEMANN. 1958. Unterdevonische Conodonten aus dem Frankenwald. *Notizblatt des Hessischen Landesamtes für Bodenforschung zu Wiesbaden* 86: 87-110.
- BOERSMA, K.T. 1973. Description of certain Lower Devonian platform conodonts of the Spanish central Pyrenees. *Leidse Geologische Mededeelingen* 49: 285-301.
- CORRADINI, C., & M.G. CORRIGA. 2012. A Pridoli-Lochkovian conodont zonation in Sardinia and the Carnic

- Alps: implications for a global zonation scheme. *Bulletin of Geosciences* 87, n. 4: 635-50. DOI 10.3140/bull.geosci.1340
- CORRADINI, C., M. PONDRELLI, M.G. CORRIGA, L. SIMONETTO, E. KIDO, T.J. SUTTNER, C. SPALLETTA & N. CARTA. 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. Tesi di dottorato di ricerca, Università di Cagliari. 152 pp.
- CORRIGA, M.G., T.J. SUTTNER, E. KIDO, C. CORRADINI, M. PONDRELLI & L. SIMONETTO. 2011. The age of the La Valute limestone-Findenig limestone transition in the La Valute Section (Lower Devonian, Carnic Alps, Italy). *Gortania. Geologia, Paleontologia, Paleontologia* 32: 5-12.
- FARRELL, J.R. 2004. Siluro-Devonian Conodonts from the Camelford Limestone, Wellington, New South Wales, Australia. *Palaeontology* 47, n. 4: 937-82.
- FERRETTI, A., K. HISTON & H.P. SCHÖNLAUB. 1999. The Silurian and Early Devonian of the Raunkofel Boden Section, Southern Carnic Alps, Austria. *Berichte der Geologischen Bundesanstalt* 47: 55-63.
- JAEGER, H., & H.P. SCHÖNLAUB. 1977. Das Ordoviz/Silur-Profil im Nöblinggraben (Karnische Alpen, Österreich). *Verhandlungen der Geologischen Bundesanstalt* 1977: 349-59.
- MURPHY, M.A., & J.C. MATTI. 1983. Lower Devonian conodonts (*hesperius-kindlei* Zones), Central Nevada. *University of California Publications in Geological Sciences* 123: 1-83.
- MURPHY, M.A., & J.I. VALENZUELA-RÍOS. 1999. *Lanea* new genus, lineage of Early Devonian conodonts. *Bollettino della Società Paleontologica Italiana* 37, n. 2-3: 321-34.

- SLAVIK, L. 2011. *Lanea carlsi* conodont apparatus reconstruction and its significance for subdivision of the Lochkovian. *Acta Palaeontologica Polonica* 56, n. 2: 313-27.
- VAI, G.B. 1980. Sedimentary environment of Devonian pelagic limestones in the Southern Alps. *Lethaia* 13, n. 1: 79-91.
- VALENZUELA-RÍOS, J.I. 1994. Conodontos del Lochkoviense y Praguense (Devónico inferior) del Pirineo Central Español. *Memorias del Museo Paleontológico de la Universidad de Zaragoza* 5: 1-178.
- VENTURINI, C. 1990. *Geologia delle Alpi Carniche centro orientali*. Udine: Pubblicazioni del Museo Friulano di Storia Naturale 36.
- WALLISER, O. 1964. Conodonten des Silurs. *Abhandlungen des Hessischen Landesamtes für Bodenforschung zu Wiesbaden* 41: 1-106.

Authors' addresses - Indirizzi degli Autori:

- Maria G. CORRIGA
Dipartimento di Scienze Chimiche e Geologiche
Università degli Studi di Cagliari
Via Trentino 51, I-09127 CAGLIARI
e-mail: maria.corriga@unica.it
- Carlo CORRADINI
Dipartimento di Scienze Chimiche e Geologiche
Università degli Studi di Cagliari
Via Trentino 51, I-09127 CAGLIARI
e-mail: corradin@unica.it
- Monica PONDRELLI
International Research School of Planetary Sciences
Dipartimento di Ingegneria e Geologia
Università degli Studi d'Annunzio
Viale Pindaro 42, I-65127 PESCARA
e-mail: monica@irsps.unich.it
- Luca SIMONETTO
Museo Friulano di Storia Naturale
Via Marangoni 39-41, I-33100 UDINE
e-mail: luca.simonetto@comune.udine.it