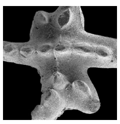
Upper Silurian conodonts from the Ockerkalk limestone of southeastern Sardinia (Italy)

Maria G. Corriga, Annalisa Ferretti & Carlo Corradini



The large conodont collection from the upper Silurian Ockerkalk limestone exposed in southeastern Sardinia is herein revised and integrated with new data. The eleven studied sections are briefly described and characterised biostratigraphically. The recovered fauna includes 48 taxa at species and subspecies level, belonging to 19 genera. Seven biozones from the uppermost part of the *Kockelella variabilis variabilis* interval Zone (top Gorstian) to the Lower *Oulodus elegans detortus* Zone (upper Přídolí) are discriminated. Sedimentation of the Ockerkalk did not reach the Silurian–Devonian boundary, as previously supposed. The new species *Pelekysgnathus crispus* sp. nov., *Wurmiella arcuata* sp. nov., *Wu. lucae* sp. nov., *Wu. pulchra* sp. nov., and *Wu. silurica* sp. nov. are described, and two more taxa (*Pelekysgnathus* sp. B and *Wurmiella* sp. C) are left in open nomenclature. The species *Ozarkodina* cf. *nasuta* (Viira, 1983), *Parazieglerodina auriformis* (Simpson, 2003), *Wurmiella alternata* Corradini & Corriga, 2010, *Zieglerodina ivochlupachi* Carls *et al*., 2007, and *Zieglerodina zellmeri* Carls *et al*., 2007 are reported for the first time in Sardinia. • Key words: Ludlow, Přídolí, taxonomy, biostratigraphy, chronostratigraphy, new taxa.

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The Ockerkalk limestone is an informal calcareous lithostratigraphical unit well exposed in southeastern Sardinia. The name highlights the presence of ochre-coloured thin intercalations in a blue-grey limestone, creating a peculiar flaser-like texture that reflects the high argillaceous content. The Ockerkalk is about 25 m thick and is sandwiched between two black shale units, called the "Lower Graptolitic Shales" and the "Upper Graptolitic Shales", respectively (Barca & Jaeger 1990, Corradini *et al*. 1998a, Corradini & Ferretti 2009), replicating the classic Thuringian facies triad introduced for the first time in Germany by Jaeger (1976, 1977). Macrofossils are extremely rare, just a few orthoconic nautiloids (Gnoli 1993), small scattered solitary corals (Jaeger 1977) and crinoids, with a distinct lobolith horizon exposed in the upper part of the unit (Helmcke 1973; Jaeger 1976, 1977; Barca & Jaeger 1990; Corradini *et al*. 1998b, 2009b, c). The poor macrofossil content resulted in little interest by palaeontologists, who were mainly attracted by the rich coeval black limestones exposed in the southwestern part of the island that are dominated by spectacular associations of cephalopods (see, among others, Ferretti & Serpagli 1996; Ferretti *et al*. 1998b, 2009b). As a consequence, the age of the Ockerkalk was estimated only indirectly on the basis of the graptolites present in the "Lower" and "Upper Graptolitic Shales" (Jaeger 1976, 1977; Barca & Jaeger 1990).

A new approach started in the 1990's, when a few sections in southeastern Sardinia were preliminarily tested for conodont investigation. The research focused on the area around the Silius village for the thick and apparently continuous Genna Ciuerciu and Silius sections exposed there (Barca *et al*. 1995). These sections were resampled in detail in the following years and preliminarily described at the field trip of the Seventh International Conodont Symposium held in Europe (Corradini *et al*. 1998b, Serpagli *et al*. 1998). Further sampling of new localities in nearby areas, for a total of eleven sections (Fig. 1), added more conodont data. Biostratigraphical results from the Genna Arrela, Monte Fruccas and Ponte Monte Lora sections were preliminarily published by Corradini & Olivieri (1997), and from the San Basilio Fenugu by Corradini *et al*. (2001), whereas other investigated sections remained unpublished. More recently, the Silius sections became the reference sections for the Ockerkalk

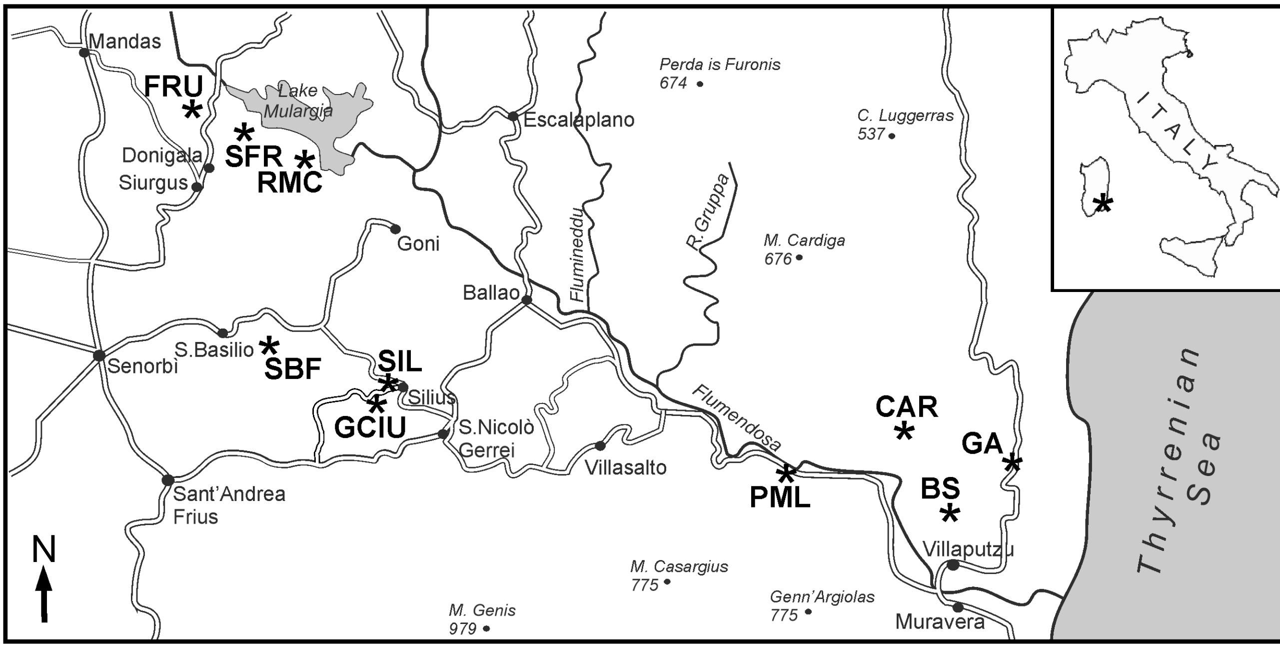


Figure 1. Location map of the studied sections (asterisks). Abbreviations: BS – Baccu Scottis; CAR – Punta Carroga; FRU – Monte Fruccas and Monte Fruccas B; GA – Genna Arrela; GCIU – Genna Ciuerciu; PML – Ponte Monte Lora; RMC – Riu Murru de Callus; SBF = San Basilio Fenugu; SFR – Su Forreddu; SIL – Silius.

unit (Corradini *et al.* 2009a). An updated bio- and chronostratigraphy of the Ockerkalk resulting from additional sampling in key-intervals were discussed at the meeting of the International Subcommission on Silurian Stratigraphy held in Sardinia in 2009 (Corradini *et al.* 2009a, b; Corriga *et al.* 2009). Beside these mainly biostratigraphical contributions, conodonts from the Ockerkalk were figured in taxonomic papers devoted to selected taxa: *Coryssognathus* (Serpagli *et al.* 1997), *Kockelella* (Serpagli & Corradini 1998, 1999), *Pseudooneotodus* (Corradini 2001, 2008), and *Walliserognathus* and *Polygnathoides* (Corradini & Corriga 2018). Anomalous conodonts were illustrated by Corradini *et al.* (1995).

In spite of the rich conodont literature discussed above, a complete and comprehensive taxonomic study of this huge conodont collection was never achieved. The aim of this paper is to provide a systematic description of the conodont fauna from the Sardinian Ockerkalk, updated to recent developments in conodont taxonomy and biostratigraphy, and to offer a discussion of its global significance. The study is based on the classic available conodont collections, supplemented by new additional samples from key intervals.

Material and repository

The material studied herein consists of about 15000 conodont elements collected since year 1989 in various Ockerkalk sections (see below for details) and supplemented with recent additional sampling. All the material was prepared with conventional unbuffered acid leaching techniques using formic and/or acetic acid in the laboratories of the Universities of Modena and Reggio Emilia, and of Cagliari. With the only exception of the Su Forreddu section, stored in the Museo di Paleontologia "Domenico Lovisato" (MDLCA) of the University of Cagliari, Italy, all the other material is deposited in the "Inventario di Paleontologia dell'Università di Modena e Reggio Emilia (IPUM)" at the Department of Chemical and Geological Sciences, University of Modena and Reggio Emilia, Italy.

Geological settings

The Sardinian basement is part of the South European Variscan Belt (Carmignani & Pertusati 1979) in which metamorphic rocks of Cambrian to Mississippian age are exposed. The Variscan Orogeny affected the whole basement producing various degrees of deformation and a tectono-metamorphic zonation from the amphibolitic facies in NE Sardinia to a very low grade in SW Sardinia, representing the foreland area of the chain (Funedda & Oggiano 2009, and reference therein).

During the middle Palaeozoic, Sardinia represented a terrane within the assemblage of the north Gondwana margin known as the Armorican Terrane Assemblage

(Torsvik & Cocks 2013) or the Galatian Terranes (von Raumer & Stampli 2008). The palaeogeographic position of these terranes, which include also Bohemia, the Graz Palaeozoic, the Carnic Alps, the Montagne Noire and part of Spain, among others, is still debated. For a review and discussion of the palaeogeographical position of Sardinia during the Silurian, refer to Ferretti *et al*. (2009b).

Different sequences are exposed in the southwestern and in the southeastern part of the island. These resemble the coeval sequences of Bohemia and Thuringia, respectively (Corradini *et al*. 1998a, 2009a; Corradini & Ferretti 2009). The studied sections crop out in the Gerrei tectonic unit of southeastern Sardinia, where the more complete mid-Palaeozoic sequence of the whole island is exposed.

The Gerrei tectonic Unit

In the Gerrei tectonic Unit, rocks of low-grade metamorphic grade, ranging in age from the middle Cambrian to the early Carboniferous, are exposed (Corradini *et al*. 1998a, Corradini & Ferretti 2009). Most of the components of the Gerrei Unit are not yet officially defined and informal names are still in use for lithostratigraphical units.

The Gerrei sequence starts with more than 500 m of terrigenous sediments, the "San Vito Sandstone", that were deposited in an intertidal to a wide fan-delta system environment swept by turbidity currents. The age of the unit spans from the middle Cambrian to the Early Ordovician. The Ordovician sequence continues, after an important disconformity (Sarrabese Phase), with up to 500 m of volcanites, volcanoclastites and epiclastites, representing the "Ordovician Volcanic Complex", overlain by a thick sequence of quartzites, sandstones and rarely conglomerates, greyish siltites and argillites with a variable carbonatic content. The topmost calcareous beds are mainly echinoderm-or bryozoan packstones intercalated in fossiliferous mudstones. These limestones have been dated on the basis of conodonts to the Late Ordovician *Amorphognathus ordovicicus* Zone (Ferretti *et al*. 1998a, Ferretti & Serpagli 1999, Loi *et al*. 2023).

The Silurian and Lower Devonian strata are represented by the classical Thuringian facies triad: Lower Graptolitic Shales, Ockerkalk and Upper Graptolitic Shales, respectively.

The Lower Graptolitic Shales (30–40 m) are silica-argillaceous and siltitic shales rich in carbon and pyrite ("alum slates"; Jaeger 1977). Lydites (cherts) are interbedded in the lower part, and phosphorites occur in the middle-upper part of the unit. The age of the unit spans from the Llandovery to the earliest Ludlow. A detailed biostratigraphy has been provided thanks to the abundant graptolite fauna (La Marmora 1856; Gortani 1923a, b; Jaeger 1977; Barca & Jaeger 1990; Štorch & Piras 2009). The fossil association includes also chitinozoans, microplankton and sponge spicules (Pittau & Del Rio 2000; Pittau *et al*. 2002, 2006; Corradini *et al*. 2009c).

In the uppermost part of the "Lower Graptolitic Shales" some large limestone nodules are present (Štorch *et al*. 2009) and the unit grades to the overlying Ockerkalk by a few metres of interbedded shales and nodular limestones (see below for a detailed description of this calcareous unit).

Above the Ockerkalk, the sequence continues with the Upper Graptolitic Shales, about 30 m thick, that are composed exclusively by alum slates (Barca & Jaeger 1990). Pelagic graptolites are the only abundant fossils (Jaeger 1976, 1977; Piras & Paschina 2009) and document the first three lower Lochkovian graptolite biozones: *Uncinatograptus uniformis*, *U. praehercynicus* and *U. hercynicus*. Crinoidal stems, calyxes and loboliths occur at the base of the unit. Rare *Ceriatocaris* (Jaeger 1977) and bivalves (Barca & Jaeger 1990) have been also reported.

A few metres of poorly fossiliferous, thin nodular grey limestone may locally cover the shales, which otherwise grade to an alternation of dark and black phyllites and nodular limestones ("Tentaculitic shales and limestones"). On the basis of tentaculitids (Alberti 1963, Gessa 1993) and rare conodonts (Bagnoli 1980, Corradini *et al*. 2001), this strongly tectonised complex may be referred to the Early–Middle Devonian.

The succession continues with a thick sequence of massive limestone ("Clymeniae Limestones") of Late Devonian–earliest Carboniferous age, dated by conodonts (Olivieri 1965, 1970; Corradini 1998, 2003; Corradini *et al.* 2003, 2021; Mossoni *et al*. 2015). Several dozen meters of sandstones and conglomerates ("Conglomerato di Villasalto", *Auct*.) are present above the "Clymeniae Limestones". They represent the transition to the terrigenous sedimentation that concludes the pelagic sequence of the Palaeozoic in SE Sardinia. Clasts and blocks of various Silurian and Devonian ages are recorded within this unit.

The Ockerkalk

The Ockerkalk is an informal lithostratigraphic unit represented by an argillaceous limestone with a blue-grey colour, weathering into ochre-coloured spots (wherefrom the name), and a typical irregular flaser texture (Fig. 2). The thickness is about 25 metres, decreasing slightly from east to west. The only macrofossils visible in the outcrops are crinoidal stems, loboliths (Corradini *et al*. 2009c), and rare cephalopods (Gnoli 1993). A distinctive lobolith level with bulbous holdfasts of pelagic scyphocrinoids occurs at the base of the *Oul. el. detortus* conodont Zone. Trace fossils and very small solitary corals were reported by Jaeger (1977).

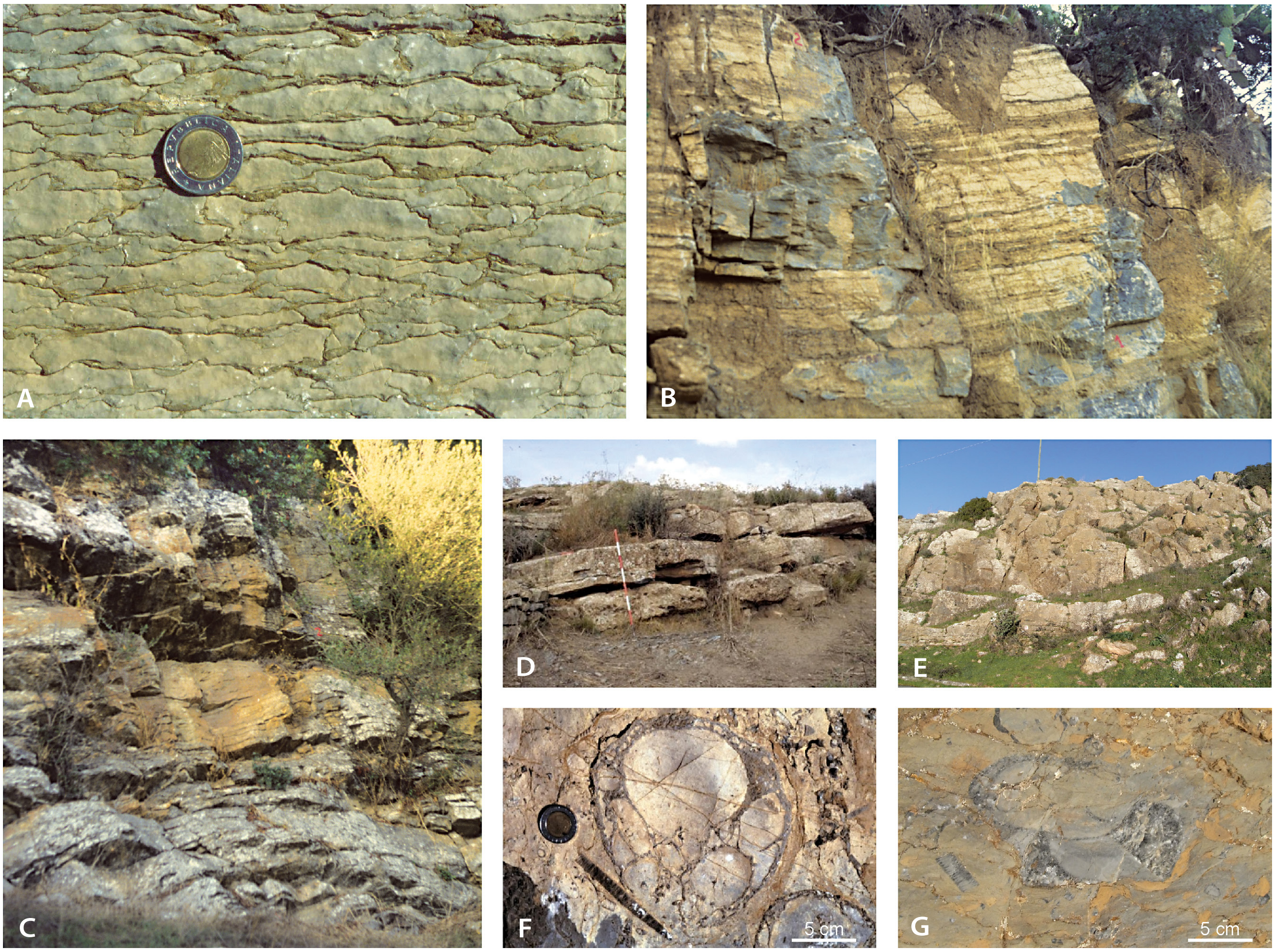


Figure 2. Views of the Ockerkalk in the field. • A – typical nodular limestone exposed in the Silius section. • B – view of the central part of the Ponte Monte Lora section. • C – the lower part of the Riu Murru de Callus section. • D – the Monte Fruccas section. • E – panoramic view of the Genna Ciuerciu section. • F – detail of a slab with loboliths in cross section and crinoidal stems in the San Basilio Fenugu section. • G – a lobolith visible in the Genna Ciuerciu section.

The microfacies analysis reveals a fine-grained limestone with a sparse bioclastic content, represented by scarce thin-shelled bivalves (Fig. 3C), brachiopods, gastropods, trilobite fragments, crinoids (Fig. 3D), small cephalopods (Fig. 3C) and sponge spicules scattered in the matrix and only locally concentrated in millimetric shell-lags (Barca *et al*. 1995; Ferretti & Serpagli 1996; Corradini *et al*. 2009a, b). Phyllocarids (mainly mandibles) and the problematic *Eurytholia* were recovered from the conodont heavy-fractions.

A rich conodont fauna indicates that the unit was deposited between the upper Gorstian and the upper Přídolí, from the *K. v. variabilis* to the Lower *Oul. el. detortus* zones (*e.g.* Barca *et al*. 1995; Corradini & Olivieri 1997; Corradini *et al*. 1998b, 2000, 2009a, b; Serpagli *et al*. 1998; Corriga 2011). Finally, carbon and oxygen isotope signals were investigated in the Silius section within a global study on the Lau event (Corradini *et al*. 2009a, Jeppsson *et al*. 2012).

Conodont biostratigraphy

The first conodont zonation for the Silurian period was proposed by Walliser (1964), who based his scheme primarily on the Cellon section in the Austrian Carnic Alps, taking in account also data from Bohemia and Spain. The author defined twelve successive appearance zones spanning the Silurian and the lowermost Devonian. Several zones of Walliser's original scheme have been widely recognised, but its poor applicability in other parts of the world inevitably led to the development of local zonations. Additionally, the Cellon section is complete only from the Ludlow through the Lochkovian, with several hiatuses documented in the lower part (Corradini *et al.* 2015, Arts *et al*. 2024).

Aldridge & Schönlaub (1989), considering all the available data at that time, provided a new biozonation scheme, as a "step on the path to the development of a reference biozonation" (Aldridge & Schönlaub 1989,

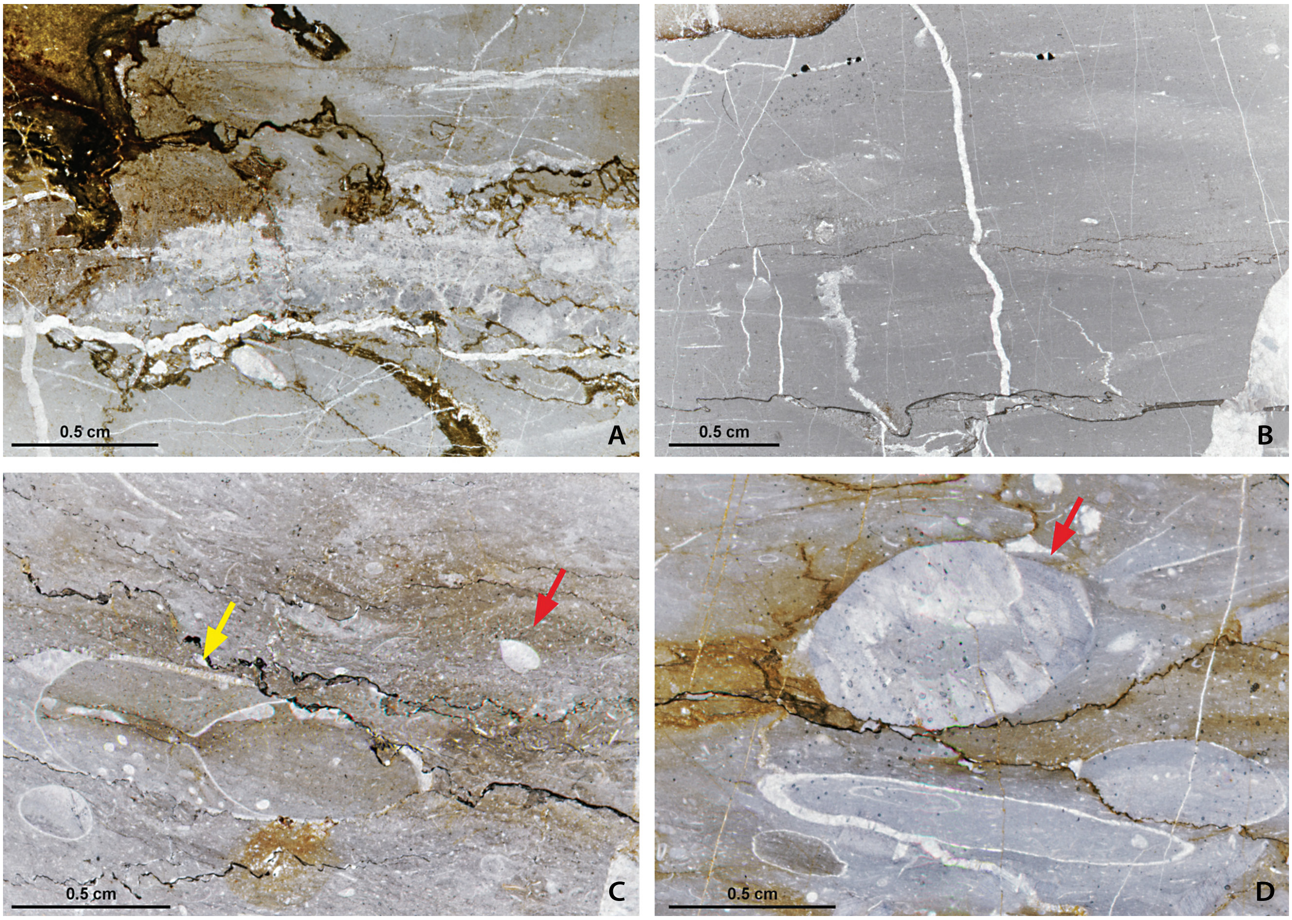


Figure 3. Transmitted-light micrographs of petrographic thin sections illustrating main microfacies of the Ockerkalk. • A – the characteristic ochre-flamed and irregular nodular texture of the Ockerkalk is visible also in thin section; sample RMC 3A, *J. crispa* Zone. • B – view of the fine-grained limestone making most of the Ockerkalk; sample RMC 1A, *Po. siluricus* Zone. • C – bioclastic wackestone with a cephalopod shell (yellow arrow), a bivalve (red arrow), and minor skeletal fragments; sample SBF 11, Lower *Oul. e. detortus* Zone. • D – echinoderm ossicle (red arrow) and sparse bioclasts embedded in the Ockerkalk nodular texture; sample SBF 8, *Z. eosteinhornensis* s.l. Zone. Note the strong dissolution processes occurring in the Ockerkalk.

p. 275). Two years later, a new Conodont Global Zonation significantly different from the previous ones was published (Silurian Times no. 3; Nowlan 1995). This scheme was never fully justified or discussed, and contains several biases, such as the indication of two "not zoned" intervals, and a few zones based on taxa with a limited geographical distribution.

Corradini & Serpagli (1998, 1999) introduced a new scheme based on conodont data from Sardinia. The scheme, similar to Walliser's original one, starts from the topmost Llandovery due to the lack of lowermost Silurian carbonates in the island. The authors demonstrated their zonation is worldwide usable and claimed that it is "of practical use for Silurian biostratigraphy, and therefore more generally useful than extremely detailed schemes, sometimes based on not yet defined or endemic taxa" (Corradini & Serpagli, 1999, p. 270).

Jeppsson (1997) and Jeppsson *et al*. (2006) provided a detailed zonation based on the latest Llandovery to latest Ludlow succession exposed at Gotland (Sweden). However, as already noted (Corradini *et al*. 2015), not all of these zones have widespread applicability because some reflect local environmental conditions on Gotland, some zonal markers are extremely rare, and others are endemic to the Baltic region. Even some common taxa, like *Kockelella walliseri* (Helfrich, 1975), have diachronous first occurrences globally (Cramer *et al*. 2010). A detailed zonation for the Llandovery, which is now widely accepted, was later proposed by Männik (2007).

Following some taxonomic revisions of late Silurian ozarkodinids (Carls *et al*. 2007), the upper part of the Silurian zonation was updated by Corriga & Corradini (2009). This proposal was accepted by Cramer *et al*. (2011) in the revised Silurian conodont zonation, and included by Melchin *et al*. (2012, 2020) in their stratigraphical summary of the Silurian Period. Later, detailed investigation of the upper Silurian in North

Gondwana introduced minor variations of the zonation scheme (Corradini & Corriga 2012, Corradini *et al*. 2015, Schönlaub *et al*. 2017). The more recent global conodont zonation of the Silurian (Corradini *et al*. 2024) is an updated version of these schemes. Recently regional schemes for the Ludlow and the Přídolí were published for Bohemia (Slavík & Carls 2012, Slavík *et al*. 2014, Vacek *et al*. 2018), and Oklahoma (Barrick *et al*. 2024).

In this paper, conodont faunas from the late Gorstian *Kockelella v. variabilis* i.Z. to the upper Přídolí Lower *Oulodus elegans detortus* Zone are documented. The zonation follows the scheme by Corradini *et al*. (2024). Comments and comparison between these zones and those of other recent schemes are discussed below.

Kockelella v. variabilis interval Zone, Cramer *et al*. (2011): This zone is the interval between the last occurrence of *K. crassa* (Walliser, 1964) and the first occurrence of *Ancoradella ploeckensis* Walliser, 1964. Corradini & Serpagli (1998, 1999) discriminated in the upper part a "*Ozarkodina excavata hamata* Zone", whose base is indicated by the entry of the eponymous taxon (now *Walliserognathus hamatus*). However, as the marker *Walliserognathus hamatus* (Walliser, 1964) has a limited geographical distribution, and is in general a rare taxon, it appears more appropriate to consider this interval as a Subzone in the uppermost part of the *K. v. variabilis* i.Z.

Ancoradella ploeckensis Zone, Walliser (1964): The lower boundary of the *A. ploeckensis* Zone is marked by the entry of *Ancoradella ploeckensis*. The upper boundary is traced by the first occurrence of *Polygnathoides siluricus* Branson & Mehl, 1933. According to Cramer *et al*. (2011) the base of the zone approximates the Gorstian–Ludfordian boundary.

Polygnathoides siluricus Zone, Walliser (1964): This zone corresponds to the interval of total range of *P. siluricus* and is one of the zones with widest distribution in the Silurian. The *Polygnathoides siluricus* Zone has been in fact included in all published zonal schemes and its boundaries are defined everywhere on the same criteria.

Jeppsonia snajdri interval Zone, Cramer *et al*. (2011): The lower boundary of the zone is defined by the last occurrence of *Polygnathoides siluricus* and the upper boundary by the first occurrence of *Jeppsonia crispa* (Walliser, 1964). This interval was named differently in the past. Some authors applied the same definition of the boundaries, but named the zone differently: *Pedavis latialata* Zone (Walliser 1964), *Pedavis latialata–Ozarkodina snajdri* interval Zone (Corradini *et al.* 2015). Other subdivided it into two zones (*e.g*. Corradini & Serpagli 1998, 1999; Jeppsson *et al.* 2006; Slavík & Carls 2012), discriminating a lower part characterised by the icriodontid *Pedavis latialata* (Walliser 1964) and an upper part by *Jeppsonia snajdri* (Walliser 1964) or *J. parasnajdri* (Viira & Aldridge 1998).

Jeppsonia crispa Zone, Walliser (1964): The *J. crispa* Zone corresponds to the interval of total range of *J. crispa* and is present in all published zonations. The Ludlow–Přídolí boundary occurs in the uppermost part of the zone (Corradini *et al*. 2015).

Zieglerodina eosteinhornensis s.l. interval Zone (Corriga & Corradini 2009): This zone is equivalent of the "*Ozarkodina*" *eosteinhornensis* s.l. interval Zone (Corriga & Corradini 2009), with the only variation in the name due to the reassignment of the index species to the genus *Zieglerodina*. The lower boundary is defined by the last occurrence of *Oz. crispa* and the upper boundary by the first occurrence of *Oulodus elegans detortus* (Walliser, 1964). This zone embraces the whole lower Přídolí. In the Czech Republic this interval is subdivided in a *Zieglerodina zellmeri* Zone in the lower part, followed by a *Z. ivochlupaci* Zone (Vacek *et al*. 2018), whereas in Oklahoma Barrick *et al*. (2024) named it *O. elegans elegans* fauna.

Lower *Oulodus elegans detortus* Zone, Corradini & Corriga (2012): The lower boundary of this zone is defined by the first occurrence of *Oul. e. detortus* and the upper boundary by the last occurrence of *Dapsilodus obliquicostatus* (Branson & Mehl, 1933). A well-defined horizon characterised by the occurrence of "*Oz.*" *eosteinhornensis* s.s. (Walliser, 1964) is documented in the central part of the zone. Vacek *et al*. (2018) used the entry of this taxon to discriminate the following zone in Bohemia, and introduced a *Z. klonkensis* Zone in the uppermost Přídolí. However, as already pointed out by Corradini & Corriga (2012), even if the *eosteinhornensis* s.s. horizon is useful for correlations, naming a zone after it looks not appropriate due to its extreme narrowness. In addition, the conodont associations immediately below and above this horizon are very similar: if not sampled, being somewhere reduced to a few centimetres of rock, it is not possible to distinguish if we are just below or just above the *Oz. eosteinhornensis* s.s. horizon, in the Lower *detortus* Zone.

Chronostratigraphy

As already written above, the conodont fauna from the Ockerkalk documents the late Gorstian to the late Přídolí interval. In this paper, we apply the proposed subdivision of the Přídolí Series into two stages by Manda *et al*. (2023).

These authors propose to use the FAD of the graptolite *Wolynograptus bouceki* (Přibyl, 1940) as primary criterion for discriminating the lower and upper Přídolí, that proposed to be named Jarovian and Radotinian, respectively. In terms of conodont stratigraphy, the proposed boundary can be approximated by the FAD of the zonal marker *Oulodus elegans detortus*. We agree on this possible subdivision, but since the proposal is still in discussion within the International Subcommission on Silurian Stratigraphy, we informally name the two stages as lower Přídolí and upper Přídolí, respectively.

Conodont fauna

The conodont collection investigated in the present study includes 14,808 elements recovered from the eleven sections described below. In general, the state of preservation is poor, although with differences from section to section, and even between different levels within the same section. Conodonts are often broken or incomplete, sometimes deformed by the strong tectonics which affected southeastern Sardinia. The colour is always black, corresponding to a Colour Alteration Index (CAI) 5.

The fauna includes 48 taxa (species and subspecies), belonging to 19 genera (*Amydrotaxis*?, *Ancoradella*, *Belodella*, *Coryssognathus*, *Dapsilodus*, *Dvorakia*, *Jeppsonia*, *Kockelella*, *Oulodus*, *Ozarkodina*, *Panderodus*, *Parazieglerodina*, *Pedavis*, *Pelekysgnathus*, *Polygnathoides*, *Pseudooneotodus*, *Walliserognathus*, *Wurmiella*, and *Zieglerodina*). Among these, five new species are here erected (*Pelekysgnathus crispus* sp. nov., *Wurmiella arcuata* sp. nov., *Wu. lucae* sp. nov., *Wu. pulchra* sp. nov., and *Wu. silurica* sp. nov.), and two more (*Pelekysgnathus* sp. B and *Wurmiella* sp. C) are left in open nomenclature because the scarcity of elements prevents further considerations. *Ozarkodina* cf. *nasuta* (Viira, 1983), *Parazieglerodina auriformis* (Simpson, 2003), *Wurmiella alternata* Corradini & Corriga, 2010, *Zieglerodina ivochlupachi* Carls *et al*., 2007, and *Zieglerodina zellmeri* Carls *et al*., 2007 are reported for the first time in Sardinia.

The genus *Wurmiella* is largely dominant, representing 64.2% of the entire fauna (Fig. 4A); *Oulodus* and *Ozarkodina* are always present, and make up 8.8% and 6.1% of the fauna, respectively. *Kockelella* represents 7.7% of the fauna, but if we consider only the interval in which the genus existed (up to the *Po. siluricus* Zone), it constitutes 12.4% of the association. Similarly, *Polygnathoides siluricus* represents 2.3% of the association, but its abundance rises to 6.7% in the eponymous Zone, and *Zieglerodina* (3% of the fauna) constitutes the 18.2% in the Přídolí. Among coniforms, only the abundance of *Pseudooneotodus* is significant, representing 4.9% of the fauna, whereas the other taxa are rare; furthermore, it should be noted that coniforms have a very irregular presence even among samples that are stratigraphically very close to each other. The other genera together represent 3% of the association. Anomalous elements are documented starting from the uppermost part of the *A. ploeckensis* Zone, and become more frequent in the *Po. siluricus* Zone.

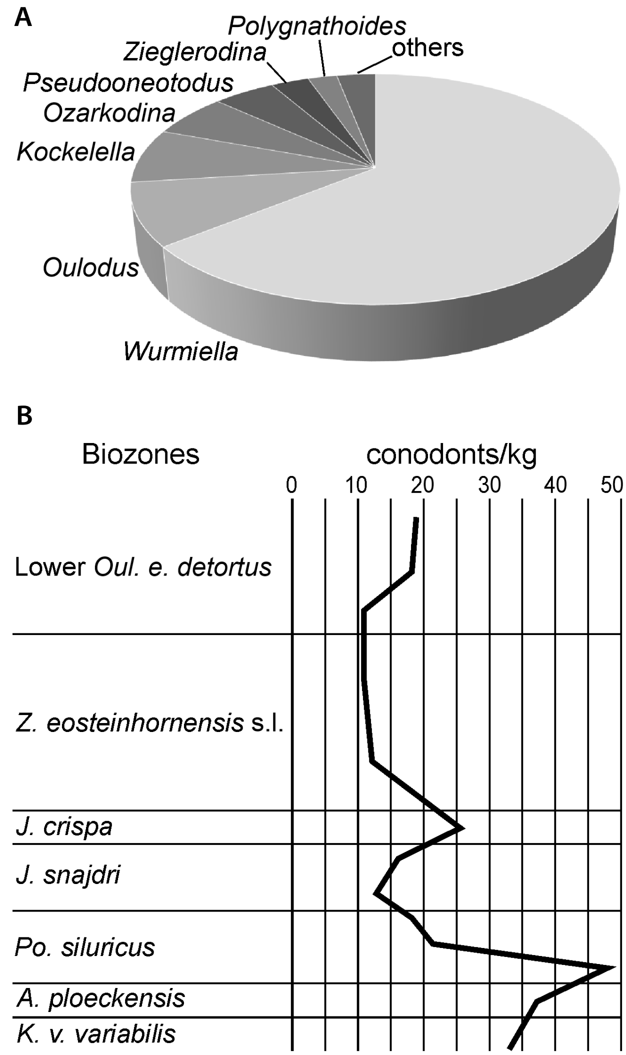


Figure 4. A – relative abundance of conodont genera in the Ockerkalk. • B – abundance of conodonts (number of elements/kg of rock) in the Ockerkalk plotted against conodont zonation. Length of the zones calibrated according to Melchin *et al*. (2020).

Abundance is extremely variable among different sections and within the same section. As a general trend, conodont abundance appears to be higher in older beds (Fig. 4B). In the *K. v. variabilis* Zone (*Wa. hamatus* Subzone) an average of 33.8 elements/kg of rock is documented; abundance rises to 37.8 in the *A. ploeckensis* Zone and up to 48.2 in the lower part of the *Po. siluricus*

Table 1. Distribution of conodonts in the Genna Arrela section.

Genna Arrela (GA)		**1**	**2**	**3**	**4**	**4A**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Kockelella maenniki	P1				5								5
	M			1	2								3
Kockelella ortus absidata	P1	3	1										4
	M	3											3
Kockelella ortus sardoa	P1	1	1		4								6
	M		6		1								7
Kockelella variabilis ichnusae	P1			1									1
Kockelella variabilis variabilis	P1		9										9
	M	3	7	2									12
Kockelella (ramiforms)	P2	1	3		1								5
	S0	1	5	5	1								12
	S1	3	7		2								12
	S2	3	7	5	4								19
Oulodus elegans detortus	S2								1				1
Oulodus elegans elegans	P2								1				1
	M								6			1	7
	S0							1	1				2
	S1											1	1
	S2							1	5				6
Oulodus siluricus	P1					3							3
	P2				1								1
	M					1							1
	S0				1	8							9
	S1					5							5
	S2		2		2	4							8
Oulodus sp.	S2	1											1
Ozarkodina confluens	P1		1			3		2					6
	P2	2	2			2		1					7
	M		2					1					3
	S0	1	1			1		2					5
	S1		8					1					9
	S2		5			1		2					8
Panderodus unicostatus									2				2
Polygnathoides siluricus	P1			4	1	16							21
	P2			4	1	15							20
	M			5	2	2							9
Pseudooneotodus beckmanni				1		2		1	7	7			18
Pseudooneotodus bicornis bicornis									18				18
Pseudooneotodus bicornis contiguus								2	17	2			21
Wurmiella arcuata sp. nov.	P1		1		1								2
Wurmiella excavata	P1		47		6	17	4	6	5	1	1	9	96
	P2		16	2	1	7		6	3			2	37
	M		17			1		2				3	23
	S0		13	1		2		2	2	1		2	23
	S1		17	1	1	2	2	8	2	1		6	40
	S2		25	2	1	10	1	12	5	1		4	61
Wurmiella inflata	P1	1											1
Wurmiella lucae sp. nov.	P1							4					4
Zieglerodina eosteinhornensis s.l.	P1											1	1
	P2											1	1
	S0											1	1
	S2											1	1
Zieglerodina eosteinhornensis s.s.	P1									1			1
Zieglerodina planilingua	P1									1			1
Anomalous elements				7	5	1							13
Indetermined and fragments		14	25	59	8	22	5	8	6	5	8	8	168
Total		37	228	100	51	125	12	62	81	20	9	40	765
Weight (kg)		5.7	4.3	6.5	7.0	5.5	6.9	3.8	8.4	4.1	4.0	4.2	60.4
Conodonts/kg		6	53	15	7	23	2	16	10	5	2	10	13

Zone. Then values drop to 18.5 in the upper part of the *Po. siluricus* Zone and to 13.0 in the lower part of the *J. snajdri* Zone, due to the biological crisis associated with the Lau Event. Abundance increases slowly in the upper part of the *J. snaidri* Zone (16.3 elements/kg) and reaches 25.8 in the *J. crispa* Zone. The values decrease again in the *Z. eosteinhornensis* s.l. i.Z. (12.1 in the lower part and 10.6 in the upper part) and remain low in the lower part of the Lower *Oul. e. detortus* Zone (10.8), before rising to 18.7 in the central part (*Z. eosteinhornensis* s.s. horizon) and in the upper part of the Zone (19.0).

Studied sections

Eleven sections were studied in the Sardinian Ockerkalk (Fig. 1). They are briefly described from east to west.

Genna Arrela

The Genna Arrela section is located about 3 km north of the Villaputzu village along the national road s.s. 125, at coordinates 39° 28′ 31.1″ N, 9° 36′ 19.7″ E. The section was preliminarily described by Corradini & Olivieri (1997), and Corriga (2011) studied the upper part.

The section consists of about 23 meters or nodular grey-ochraceous limestone (Fig. 5), but the sequence is tectonically disturbed by two faults in the central part, evidenced in the field by a 2.5 metres thick cataclastic level. The lower part of the section starts with a few centimetres of black shales, followed by 8.2 m of typical Ockerkalk nodular limestone; the upper part is represented by 11.8 m of nodular limestone with a few thin shaley intercalations.

The conodont fauna is not abundant (Tab. 1): 60.4 kg of rocks produced an average of 12.7 conodont elements/kg. The occurrence of *Kockelella ortus sardoa* Serpagli & Corradini, 1999 in sample GA 1 allows to attribute the lower part of the section to the *A. ploeckensis* Zone, and the occurrence of *Po. siluricus* in samples GA 3–4A documents the eponymous zone. The upper part of the section can be assigned to the Přídolí: the entry of *Oul. e. detortus* in sample GA 7 indicates the base of the Lower *Oul. e. detortus* Zone. The beds below (samples GA 5–6) can be attributed to the *Z. eosteinhornensis* i.Z.

Baccu Scottis

The Baccu Scottis (BS) section is located about 2 km north of Villaputzu, in a steep cliff near the abandoned S'Aqua Rubia mine, at coordinates 39° 27′ 41.1″ N, 9° 34′ 17.9″ E. The section is close to the famous homonymous graptolite locality described by Barca & Jaeger (1990). The section starts with a few black shales followed by about 25 m of Ockerkalk. A level with well-preserved cirrus loboliths is exposed in the upper part of the section (Fig. 5).

Conodont data are extremely discouraging, as most samples revealed to be barren (Tab. 2). Almost 50 kg of rock yielded only 10 conodont elements. A precise age assignment of the section is not possible, but the presence of *Kockelella ortus sardoa* Serpagli & Corradini, 1999 in sample BS 1 indicates an early Ludfordian age, and *Oulodus elegans elegans* (Walliser, 1964) in sample BS 2 suggests the Přídolí. Also, the occurrence of the distinctive lobolith level may indicate that the upper part of the section can be tentatively attributed to the Lower *Oul. e. detortus* Zone, according to the age attribution of the same horizon in other sections.

Punta Carroga

The Punta Carroga (CAR) section is located about 700 metres east of the Brecca village at coordinates 39° 29′ 57.1″ N, 9° 33′ 41.1″ E. There, a few metres of typical Ockerkalk limestone crop out along the unpaved road on the southern flank of the Punta Carroga hill (Fig. 6).

Three samples for a total of 9.4 kg of dissolved rock yielded 41 conodonts that allow to discriminate the upper part of the *Z. eosteinhornensis* s.l. i.Z. and the lower part of the Lower *Oul. e. detortus* Zone (Tab. 3).

Ponte Monte Lora

The Ponte Monte Lora (PML) section is located about 5.8 km northwest of the Villaputzu village along the road

Table 2. Distribution of conodonts in the Baccu Scottis section.

Baccu Scottis (BS)		**1**	**1D**	**2**	**3**	**4**	**4X**	**5**	**5D**	**6**	**7**	**7A**	**8**	**9**	**Total**
Oulodus elegans elegans	S2		1												1
Wurmiella excavata	P1	1							1		1				3
Zieglerodina eosteinhornensis s.l.	P1					1									1
	P2					1									1
Fragments		2		1		1		1							5
Total		3	1	1	0	3	0	1	1	0	1	0	0	0	11
Weight (kg)		5.8	4.7	3.8	7.2	5.9	3.2	5.9	1.7	6.5	3.7	5.0	5.0	4.8	48.9
Conodonts/kg		1	0	0	0	1	0	0	1	0	0	0	0	0	0

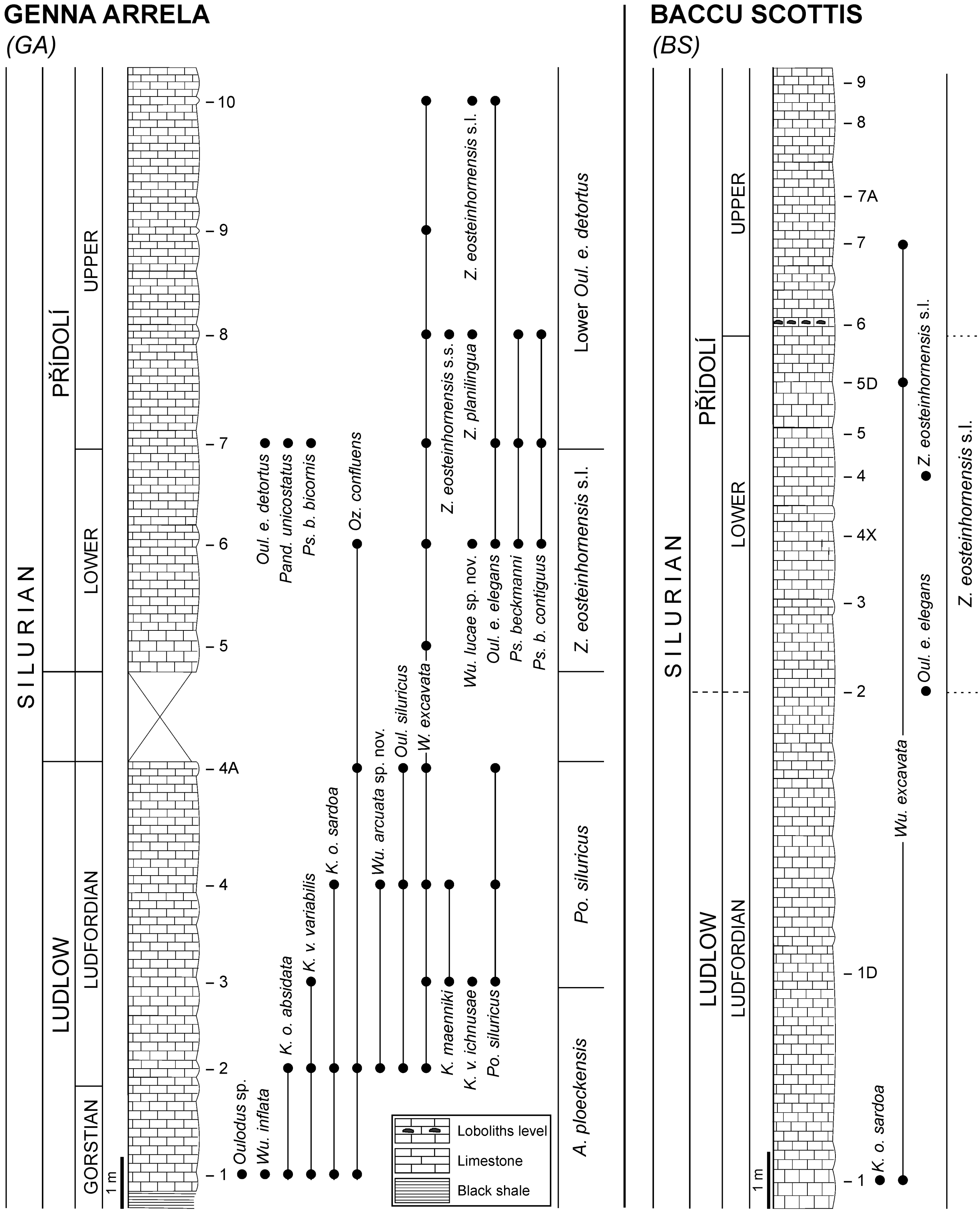


Figure 5. Distribution of conodonts in the Baccu Scottis and Genna Arrela sections. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. Abbreviations: *K. – Kockelella*; *K. o. – Kockelella ortus*; *K. v. – Kockelella variabilis*; *Oul. e. – Oulodus elegans*; *Oz. – Ozarkodina*; *Po. – Polygnathoides*; *Ps. – Pseudooneotodus*; *Ps. b. – Pseudooneotodus bicornis*; *Wu. – Wurmiella*; *Z. – Zieglerodina*.

Table 3. Distribution of conodonts in the Punta Carroga section.

Punta Carroga (CAR)		1	2	3	Total
Oulodus elegans detortus	M		1		1
	S1		2		2
	S2		1	1	2
Oulodus elegans elegans	S0	1			1
	S2	3	1		4
Pseudooneotodus beckmanni		1	1		2
Wurmiella excavata	P1	1	4	1	6
	P2	1	3		4
	M	5	1		6
	S0	1			1
	S1		1		1
	S2		4		4
Zieglerodina eosteinhornensis s.l.	P1	1			1
	P2	1			1
Indetermined and fragments		7	7	1	15
Total		22	26	3	51
Weight (kg)		2.5	3.9	5.3	11.7
Conodonts/kg		9	7	1	4

to Ballao, at coordinates 39° 28′ 45.8″ N, 9° 29′ 34.4″ E. It is a short section exposing only about 6 metres of typical Ockerkalk limestone (Figs 2B, 6), with a covered interval in the central part.

Conodont abundance is scarce, as a total of 16.3 kg of rock yielded only 128 conodont elements, with an average of 7.8 elements/kg (Tab. 4). The whole section can be attributed to the Přídolí: below the covered interval the *Z. eosteinhornensis* s.l. Zone is discriminated, whereas the upper part can be attributed to the Lower *Oul. e. detortus* Zone thanks to the presence of *Zieglerodina eosteinhornensis* s.s. in sample PML 3.

Silius

The Silius (SIL) section is the more complete section measured in the Ockerkalk, and it is considered the reference section for the unit (Corradini *et al*. 2009a). It is located about 500 metres west of the Silius village, at geographic coordinates 39° 31′ 02.9″ N, 9° 17′ 13.9″ E. The lower part of the section, up to bed 24, is well exposed, while the upper part crops out behind the edge of the hill as dip slopes beds.

The section was described by Barca *et al*. (1995), Serpagli *et al.* (1998), Corradini *et al*. (2009a). It consists of about 24 metres of grey-bluish fine grained Ockerkalk limestone (Fig. 7). Neither macroscopical, nor thin-section analyses ever revealed any variations through the section, with exclusion of the lowermost part, where a few intercalations of black shales are present.

Macrofossils are rare and limited to a few orthoconic nautiloids and crinoidal stems, parallel to the bedding. A crinoidal enrichment is observable around beds SIL 26 and SIL 30. The lobolith horizon is poorly exposed around level of sample SIL 30. Among microfossils, phyllocarids (mainly mandibles), microbrachiopods and the problematic *Eurytholia bohemica* were occasionally found in some samples. Carbon and oxygen isotope curves were reconstructed within a global study on the Lau event (Corradini *et al*. 2009a, Jeppsson *et al*. 2012).

Thirty-eight samples were collected from the Silius section. All but sample SIL 38 yielded conodonts, and more than 6000 elements were recovered (Tab. 5). Abundance is extremely variable, ranging between a maximum of 153.2 elements/kg (sample SIL 4) and a minimum of 1.3 elements/kg (sample SIL 32), with an average of 34.8 elements/kg. The conodont taxa *Kockelella variabilis ichnusae* Serpagli & Corradini, 1998, *Pseudooneotodus bicornis contiguus* Corradini, 2008, *Wurmiella lucae* sp. nov. and *Wurmiella silurica* sp. nov. have their type locality here.

The rich conodont fauna allows the recognition of seven conodont zones, from the *K. v. variabilis* i.Z. (*Wa. hamatus* Subzone) to the Lower *O. e. detortus* Zone (Fig. 7). The lowermost part of the section (samples SIL 1-3) is attributed to the *K. v. variabilis* i.Z. (*Wa. hamatus* Subzone) thanks to the occurrence of *Walliserognathus hamatus* (Walliser, 1964) in sample SIL 1. The entry of

Table 4. Distribution of conodonts in the Ponte Monte Lora section.

Ponte Monte Lora (PML)		1	2	3	Total
Coryssognathus dubius	Sa/Sb			1	1
Oulodus elegans detortus	S2			2	2
Oulodus elegans elegans	S0			1	1
	S1	2		3	5
	S2	3	1	1	5
Ozarkodina confluens	P1			2	2
	M			1	1
	S1			2	2
	S2			4	4
Pseudooneotodus beckmanni		2	2		4
Wurmiella excavata	P1	7	9	19	35
	P2		1	2	3
	M	1	4	8	13
	S0	1	1	3	5
	S1	1	4	6	11
	S2	4	7	6	17
Wurmiella lucae sp. nov.	P1	1		1	2
Zieglerodina eosteinhornensis s.l.	P1	1			1
	P2	1			1
Zieglerodina eosteinhornensis s.s.	P1			1	1
Zieglerodina sp.	P1		2	1	3
Indetermined and fragments		6	6	9	21
Total		30	37	73	140
Weight (kg)		4.2	6.3	5.9	16.3
Conodonts/kg		7	6	12	9

Table 5. Distribution of conodonts in the Silius section.

Silius (SIL)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	Total
Ancoradella ploeckensis	P1				1																																			1
Belodella anomalis																														1	1									2
Dvorakia sp.																														1	1									2
Dapsilodus obliquicostatus																						7			1															8
Kockelella maenniki	P1							1	4	10			1																											16
	M							2	4	1																														7
Kockelella ortus absidata	P1	4	1	1																																				6
	M	8		1																																				9
Kockelella ortus sardoa	P1				3	9		5		4	3	4	2																											30
	M					5	2	2		1	1	4																												15
Kockelella variabilis ichnusae	P1	1	4	1	2	13	4	4	2																															31
Kockelella variabilis variabilis	P1	4	3	14	20	16	5																																	62
	M	6		4	14	10	2	2	2																															40
Kockelella (ramiforms)	P2	10	4		2	13	4	2	3	4																														42
	S0	11	7	1	13	24	4	7	13	4			2																											86
	S1	16	15	1	14	30	7	4	10	7	2	1	1																											108
	S2	20	7	5	17	21	4	11	11	4	2	2	2																											106
Jeppsonia crispa	P1																							3	5															8
Jeppsonia snajdri	P1																					4																		4
Oulodus elegans detortus	M																																				1			1
	S2																														3				1		3			7
Oulodus elegans elegans	P1																										2			1	1	1		1						6
	P2																								5		4		1		1									11
	M																								7	1	6		3		3	3					4			27
	S0																								2	1	1			1	1									6
	S1																									1	1	1	1		1	2					1			8
	S2																								17	1	12	1	6		1	2					2		1	43
Oulodus siluricus	P1	7	3	2	8	1	1	6		2		4								1		2				2														39
	P2		1	1	1	2				2		1								5																				13
	M																			7		2	2	2																13
	S0						4		6	3				1						3		1		2																20
	S1			3					3	3			1	1			1			8		2		2																24
	S2	19	10	9	36	43	10	19	12	8	5	16	1	1			3			21	2	4																		219
Oulodus sp.	S1																																				1			1
Ozarkodina confluens	P1					9	1	8	4		16	33	19		2	5		2	1	17	2	13		1					2	1		1								137
	P2			2		3	1	16	1		3	12	4		2	2				7		4			2															59
	M					3		6	2		2	6	1							2		1																		23
	S0					5		6	1		4	16	8		1	1				2		3																		47
	S1					6		4	9		3	12	2		2					6		5																		49
	S2					12		10	10		5	14	9		4	1				5		3			1															74
Ozarkodina cf. *nasuta*	P1																																				1			1
Panderodus recurvatus																				1																				1
Panderodus unicostatus																				10		10		2	5														8	35

Table 5. Continued.

Silius (SIL)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	Total
Panderodus sp.															4				1		1																			6
Parazieglerodina auriformis	P1																	1																						1
Parazieglerodina sp.	P1						2								1																									3
	P2						2																																	2
Pelekysgnathus crispus sp. nov.	P1																							6																6
	P2																							1																1
Pedavis latialata	conif																			1																				1
Polygnathoides siluricus	P1							1	20	1	3	15	16																											56
	P2							1	6	1	1	9	6			2																								26
	M							17	9	1	4	8	1																											40
Pseudooneotodus beckmanni								37	1			1	3		3	1				5		9	1	31			3		2		3	2	2	20			2			126
Pseudooneotodus bicornis bicornis												5	2		2	6	4	2	2	16	1	9	5	33	3															90
Pseudooneotodus bicornis contiguus															1					3		6		24	6		24													64
Walliserognathus hamatus	P1	2																																						2
Walliserognathus posthamatus	P2				2	1																																		3
Wurmiella arcuata sp. nov.	P1		1					2																																3
Wurmiella excavata	P1	63	61	80	282	121	10	107	34	6		12	14	1	9	5	2	3	11	24	5	10	3	61	3	1	5	2	10	30	18	9		54		38	1		3	1098
	P2	43	22	6	100	36	8	134	51	1	10	15	6	2	3	5	4	1	1	12	4	7		34	6	4	3		18	5	8	3		22		17				591
	M	26	14	3	61	44		69	23	1	1	13	3		1		1	1	2	17	1	7		42	3	4	1		4	15	14	11		24		18	1		1	426
	S0	26	25	4	41	19	2	41	20	8	3	13			2	1			1	12		8		24	4				3	3	4	12		20		16	1			313
	S1	22	28	7	56	32	4	77	33	2		4	3	1	7	1			2	12		11	2	77	6	1			11	11	18			24		31			1	484
	S2	56	50	10	103	46	3	75	31	4	4	16	11	4	7		7	2	2	33	5	10	2	51	20	1	3		24	22	21	18		23		46	3		2	715
Wurmiella inflata	P1				1																																			1
Wurmiella lucae sp. nov.	P1																	1						25	1															27
	P2																							1	1															2
Wurmiella silurica sp. nov.	P1							7	4																															11
	P2							1																																1
Wurmiella sp.	P1																	1																						1
Zieglerodina ivochlupaci	P1																															1		1	2					4
Zieglerodina eosteinhornensis s.l.	P1																									1			5	10	1	6	1	1	2	4			4	35
	P2																									1				6		2			1	3			1	14
	M																									1						1			1	1				4
	S0																																		1	1				2
	S1																									1									1	1				3
	S2																									1						4								5
Zieglerodina eosteinhornensis s.s.	P1																																	2	1					3
Zieglerodina sp.	P1																													1		1	1		1		1			5
anomalous elements						1	2	1	1		3	1																												9
Indertermined and fragments		27	20	25	82	60	36	31	31	50	23	35	28	5	3	5	5	4	4	7	7		2	94	27	3	4		17	6	4	29		7	4	8	15		2	710
Total		371	276	180	858	585	118	716	361	128	98	272	146	16	54	35	27	18	27	237	28	138	17	516	125	25	69	4	107	114	104	108	4	199	15	184	37	0	23	6340
Weight (kg)		6.00	6.00	3.20	5.60	7.60	5.10	4.20	7.60	6.40	3.90	5.20	5.20	2.60	4.40	5.60	6.50	3.40	2.00	8.00	1.20	3.00	3.10	4.50	6.50	4.60	5.70	3.70	6.00	5.30	6.00	4.50	3.00	5.00	4.20	4.80	4.30	3.40	5.00	182.30
Conodonts/kg		61.8	46.0	56.3	153.2	77.0	23.1	170.5	47.5	20.0	25.1	52.3	28.1	6.2	12.3	6.3	4.2	5.3	13.5	29.6	23.3	46.0	5.5	114.7	19.2	5.4	12.1	1.1	17.8	21.5	17.3	24.0	1.3	39.8	3.6	38.3	8.6	0.0	4.6	34.8

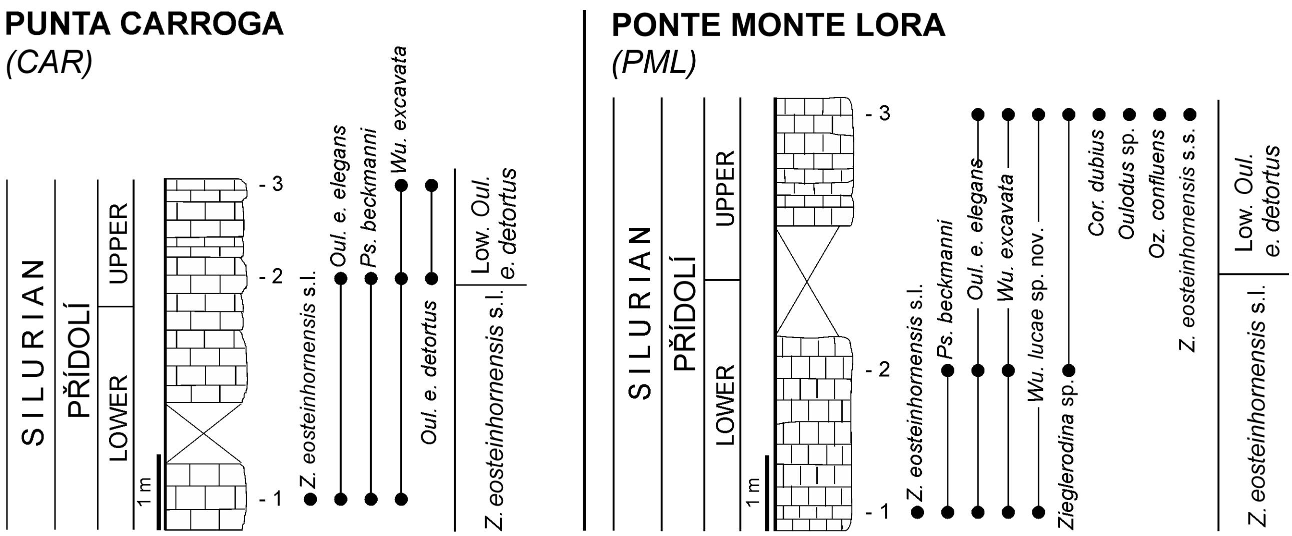


Figure 6. Distribution of conodonts in the Punta Carroga and Ponte Monte Lora sections. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. For lithological symbol refer to Figure 5. Abbreviations: *Cor.* – *Coryssognathus*; *Oul. e.* – *Oulodus elegans*; *Oz.* – *Ozarkodina*; *Ps.* – *Pseudooneotodus*; *Wu.* – *Wurmiella*; *Z.* – *Zieglerodina*.

Ancoradella ploeckensis in sample SIL 4 indicates the eponymous Zone. The *Po. siluricus* Zone is discriminated in samples SIL 7–15 thanks of the presence of the marker. The last occurrence of *Po. siluricus* indicates the base of the *J. snajdri* Zone, that persists up to sample SIL 22. The occurrence of *J. crispa* in samples SIL 23–24 indicates the *J. crispa* Zone. Samples SIL 25–29 are attributed to the *Z. eosteinhornensis* s.l. Zone, whereas the occurrence of *Oul. e. detortus* in sample SIL 30 designates the base of the Lower *Oul e. detortus* Zone, that continues up to the top of the section.

Genna Ciuerciu

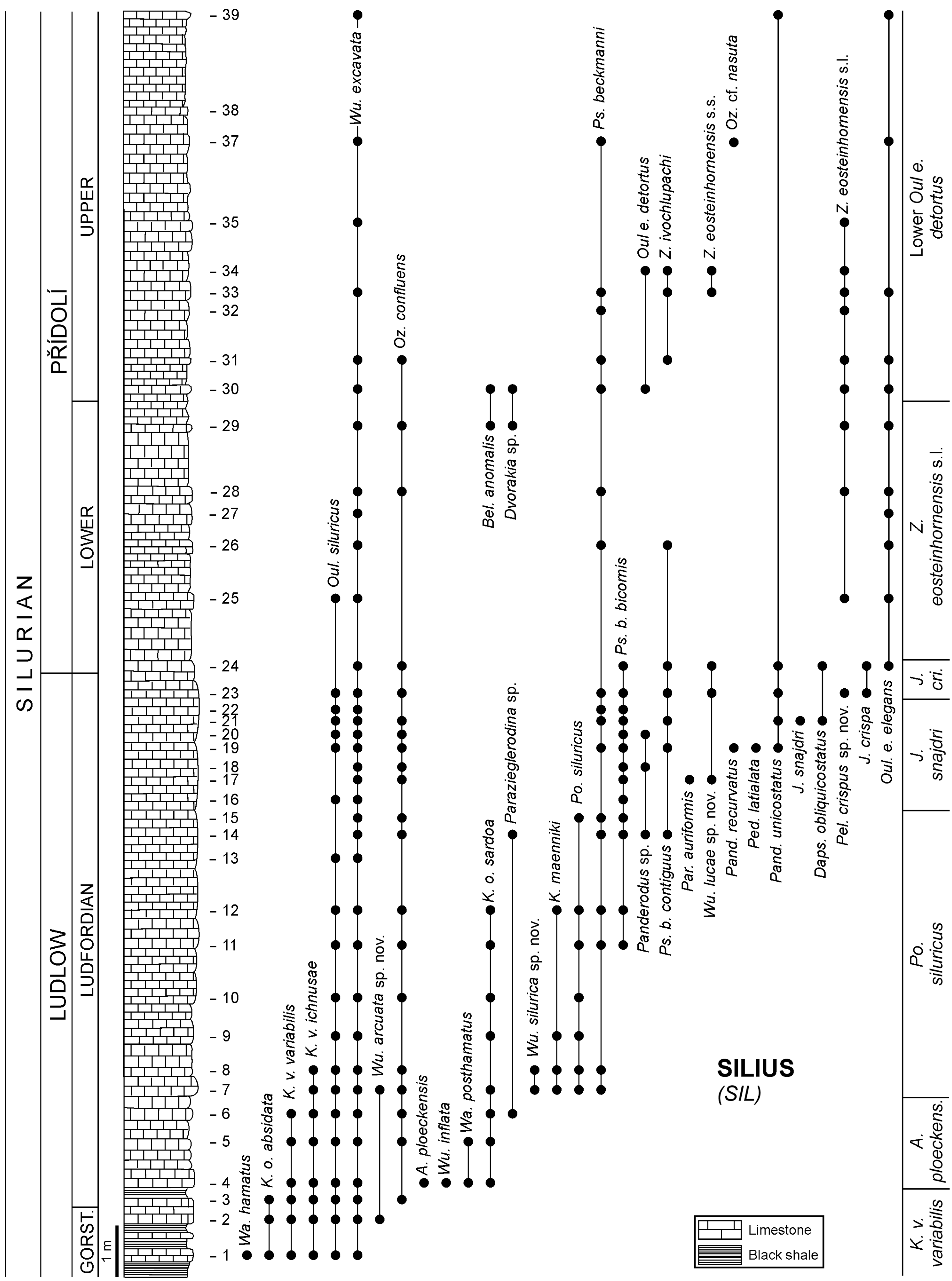
The Genna Ciuerciu (GCIU) section is exposed about 900 meters west of the Silius village along the road to Sant'Andrea Frius, at geographic coordinates 39° 30′ 54.1″ N, 9° 17′ 02.7″ E. It represents a classical exposure that has been thoroughly investigated as it is well-exposed and easy to reach (Barca *et al.* 1995; Corradini *et al.* 1998b, 2002, 2009b; Corriga 2011). Over 25 metres of nodular limestone in typical Ockerkalk facies are exposed (Figs 2E, 8). However, the section is continuous only for about 15 m, up to the top of the hill (level 24); the repetition of some conodont biozones indicates that beds exposed on the eastern slope for a thickness of about 10 metres belong to two tectonic scales.

Crinoids are the only macrofossils clearly visible in the outcrop. A few isolated crinoidal stem fragments can be observed in the lower Přídolí part of the section, and their abundance increases progressively from bed 14 to 18. Abundant loboliths occur with their typical ovoidal outline up to 20 cm in diameter in level 18, creating a distinct horizon at the base of the Lower *Oul. e. detortus* Zone. Rare nautiloid cephalopods can be observed in the lower part of the section.

Thirty-three samples were collected in the Genna Ciuerciu section (Tab. 6). All were productive, but abundance is variable between 4.6 (GCIU 0/2) and 118.9 (GCIU 20) elements/kg, with an average value of 21.7. The Genna Ciuerciu section is the type locality of two conodont taxa: *Kockelella maenniki* Serpagli & Corradini, 1998 and *Kockelella ortus sardoa* Serpagli & Corradini, 1999.

The fauna allows the recognition of six zones in the undisturbed part of the section: the *A. ploeckensis* Zone is tentatively identified in the lowermost sample (GCIU 0/2) by the entry of the marker of the following zone in the succeeding sample; the *Po. siluricus* Zone is indicated by the presence of the index species in samples GCIU 0–6; the last occurrence of *Polygnathoides siluricus* indicates the base of the *J. snajdri* i.Z. (samples GCIU 7–10); the *J. crispa* Zone is discriminated by the occurrence of the marker *Jeppsonia crispa* (Walliser, 1964) in

Figure 7. Distribution of conodonts in the Silius section. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. Abbreviations: *A.* – *Ancoradella*; *Bel.* – *Belodella*; *cri.* – *crispa*; *Daps.* – *Dapsilodus*; *J.* – *Jeppsonia*; *K.* – *Kockelella*; *K. o.* – *Kockelella ortus*; *K. v.* – *Kockelella variabilis*; *Oul.* – *Oulodus*; *Oul. e.* – *Oulodus elegans*; *Oz.* – *Ozarkodina*; *Pand.* – *Panderodus*; *Par.* – *Parazieglerodina*; *Ped.* – *Pedavis*; *Pel.* – *Pelekysgnathus*; *ploeckens.* – *ploeckensis*; *Po.* – *Polygnathoides*; *Ps.* – *Pseudooneotodus*; *Ps. b.* – *Pseudooneotodus bicornis*; *Wa.* – *Walliserognathus*; *Wu.* – *Wurmiella*; *Z.* – *Zieglerodina*.


SILURIAN
LUDLOW
PŘÍDOLÍ
GORST.
LUDFORDIAN
LOWER
UPPER
1 m
SILIUS
(SIL)
Limestone
Black shale
Wa. hamatus
K. o. absidata
K. v. variabilis
K. v. ichnusae
Oul. siluricus
Wu. excavata
Wu. arcuata sp. nov.
Oz. confluens
A. ploeckensis
Wu. inflata
Wa. posthamatus
K. o. sardoa
Parazieglerodina sp.
Bel. anomalis
Dvorakia sp.
Wu. silurica sp. nov.
K. maenniki
Po. siluricus
Ps. beckmanni
Ps. b. bicornis
Panderodus sp.
Ps. b. contiguus
Oul e. detortus
Z. ivochlupachi
Par. auriformis
Wu. lucae sp. nov.
Z. eosteinhornensis s.s.
Pand. recurvatus
Oz. cf. nasuta
Ped. latialata
Pand. unicostatus
J. snajdri
Daps. obliquicostatus
Pel. crispus sp. nov.
Z. eosteinhornensis s.l.
J. crispa
Oul. e. elegans
K. v. variabilis
A. ploeckens.
Po. siluricus
J. snajdri
J. cri.
Z. eosteinhornensis s.l.
Lower Oul e. detortus

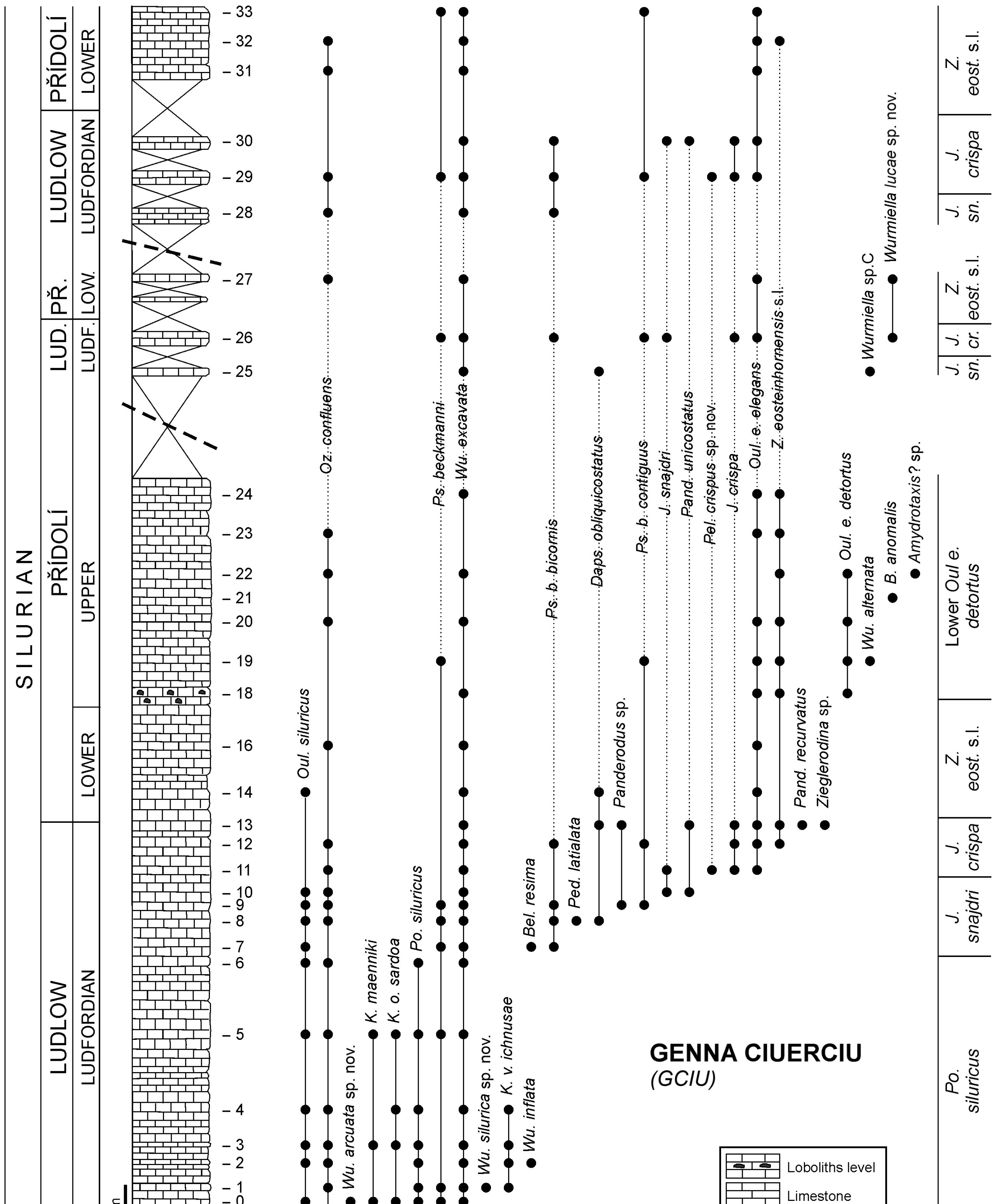


Figure 8. Distribution of conodonts in the Genna Ciuerciu section. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. Abbreviations: *Bel. – Belodella*; *cr. – crispa*; *Daps. – Dapsilodus*; *eost. – eosteinhornensis*; *J. – Jeppsonia*; *K. – Kockelella*; *K. o. – Kockelella ortus*; *K. v. – Kockelella variabilis*; LUD. – Ludlow; LUDF. – Ludfordian; *Oul. – Oulodus*; *Oul. e. – Oulodus elegans*; *Oz. – Ozarkodina*; *Pand. – Panderodus*; *Par. – Parazieglerodina*; *Pe. – Pedavis*; *Pel. – Pelekysgnathus*; *pl. – ploeckensis*; *Po. – Polygnathoides*; PR. – Přídolí; *Ps. – Pseudooneotodus*; *Ps. b. – Pseudooneotodus bicornis*; *sn. – snajdri*; *Wa. – Walliserognathus*; *Wu. – Wurmiella*; *Z. – Zieglerodina*.

samples GCIU 11–13; the *Z. eosteinhornensis* s.l. i.Z. is documented by samples GCIU 14–16; the first occurrence of *Oul. e. detortus* in sample GCIU 18 indicates the base of the Lower *O. e. detortus* Zone. In the upper part of the section both the tectonic scales expose the *J. snajdri* i.Z., *J. crispa* and *Z. eosteinhornensis* s.l. i.Z.

San Basilio Fenugu

The San Basilio Fenugu (SBF) section is located 1.4 km southeast of the San Basilio village along a path on the southern slope of a hill at coordinates 39° 31′ 54.2″ N, 9° 12′ 59.9″ E. It is a long, strongly tectonised section,

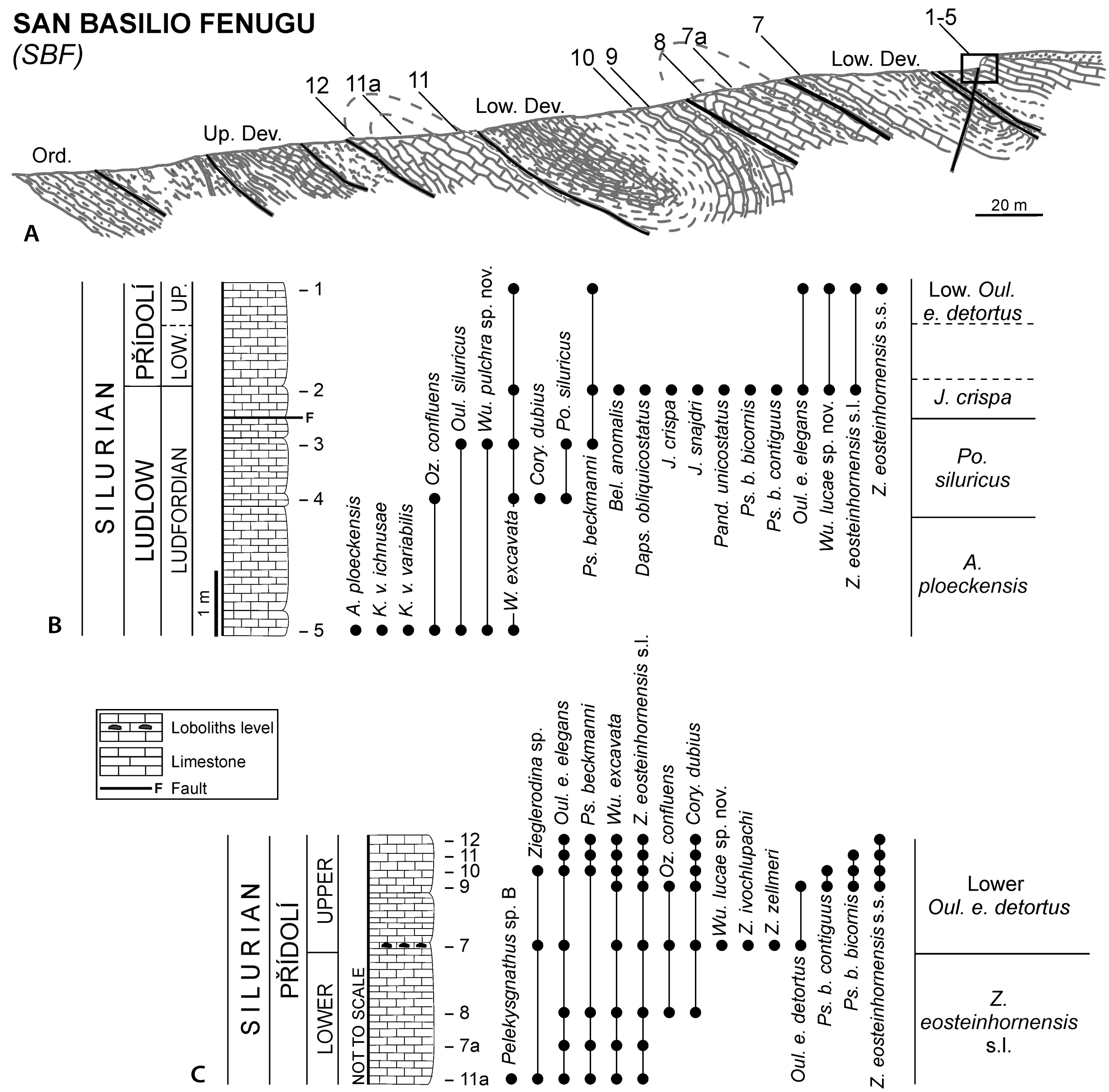


Figure 9. The San Basilio Fenugu section. • A – profile of the section, showing the tectonic deformation, and the position of samples (modified after Corradini *et al*. 2001). Only the samples collected in the Ockerkalk are reported. • B – stratigraphic log of the upper part of the section (box in A). • C – composite section, not to scale, of the tectonically disturbed part of the section. The relative position of samples is inferred on the basis of the tectonic reconstruction and the conodont fauna. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. Abbreviations: *A. – Ancoradella*; *Bel. – Belodella*; *Cory. – Corissognathus*; *cri. – crispa*; *Daps. – Dapsilodus*; *J. – Jeppsonia*; *K. v. – Kockelella variabilis*; *Oul. – Oulodus*; *Oul. e. – Oulodus elegans*; *Oz. – Ozarkodina*; *Pand. – Panderodus*; *Po. – Polygnathoides*; *Ps. – Pseudooneotodus*; *Ps. b. – Pseudooneotodus bicornis*; *Wu. – Wurmiella*; *Z. – Zieglerodina*.

Table 6. Distribution of conodonts in the Genna Ciuerciu section.

Genna Ciuerciu (GCIU)		0/2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Total
Amydrotaxis? sp.	P1																						1												1
Belodella anomalis	S0																					1													1
Belodella resima	S1									1																									1
Dapsilodus obliquicostatus											2					8	1									3									14
Jeppsonia crispa	P1													7	4	2											1			10	3				27
Jeppsonia snajdri	P1												16	4													1				2				23
Kockelella maenniki	P1		2			21		3																											26
	M					4																													4
Kockelella ortus absidata	P1						1																												1
Kockelella ortus sardoa	P1		1			17		3																											21
	M					5																													5
Kockelella variabilis ichnusae	P1			2		3	1																												6
	M			5	3																														8
Kockelella (ramiforms)	P2				3	4																													7
	S0	1		4	7	9																													21
	S1		1	3	5	11		3																											23
	S2	1	2	2	3	2	1																												11
Oulodus elegans detortus	P2																						1												1
	S1																		1																1
	S2																		1	1	1		2												5
Oulodus elegans elegans	P1													2	1	1														1		2	5		12
	P2													1	5	2	7		1		1									3				2	22
	M													2	3		9		2	1					1		1			2	4	4	2	4	35
	S0													1			2			1	1			1	1					7		2	4	1	21
	S1														6	3		1	5		2			1	2					3	1		3	3	30
	S2													4	6	4	13	2		1	2	7			1			1		10	10	7	6	5	79
Oulodus siluricus	P1				1	3						1	2				1																		8
	M		1						1			1	1																						4
	S0		1			3	1					3	4																						12
	S1		1		2	11	2	3	5			4	2																						30
	S2	4	1		8	5	4	4	8	1	2	5	3																						45
Ozarkodina confluens	P1			5	4	15	5	3	9		2	16	14	2				3			18		2	4				1	1						104
	P2	1		7	11	1		1	2			2	10	3				1					1	1				1							42
	M			3	3	6	1	3	1			1	12	5				1			6							1	1			1			45
	S0	1			5	11		2				3	3		1						2								1	1					30
	S1			2		6						2	2		1						2								1						16
	S2	1		11	6	6		1	1			5	2	2	3			2			9												1		50

Table 6. Continued.

Genna Ciuerciu (GCIU)		0/2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Total
Panderodus recurvatus																1					1														2
Panderodus unicostatus													35			3															3				41
Panderodus sp.												4			13																				17
Pelekysgnathus crispus sp. nov.	P1													3																1					4
Pedavis latialata	P1										1																								1
	P2										1																								1
Polygnathoides siluricus	P1		2	10	2	2	6	2	1																										25
	P2		2	3	3	2	6	3																											19
	M			2	17	1	1																												21
Pseudooneotodus beckmanni			1					2		3	1	4								3							1			1				1	17
Pseudooneotodus bicornis bicornis										6	6	6			5												4		4	4	1				36
Pseudooneotodus bicornis contiguus												9			1					3							4			2				1	20
Wurmiella alternata	P1																			1															1
Wurmiella arcuata sp. nov.	P1		4																																4
Wurmiella excavata	P1		12	12	132	47	1	3	7	10	6	17	18	13	53	11	2	1	6		123	1	17		20	11	3	10	6	31	10	23	14	1	621
	P2			22	29	34			5			9	15	8	18	4			6		30		4		1	4	2	1	3	13	4	10	3		225
	M			2	7	14			1		2	4	11	2	9						65		3		1	8	3	1	1	4	5	6	3	1	153
	S0			6	12	16			1	1	5	9	12		20		2		4		55		3		9	5	3		2	14	3	1		1	184
	S1			7	20	19			2		5	8	15	9	15	7			13		1		6		6	8	5		4	16	6	11	3	3	189
	S2			8	39	51			7	3	8	13	28	9	37	7	5		16		97		13		6	12	4	7	12	17	8	17	9	4	437
Wurmiella inflata	P1				2																														2
Wurmiella lucae sp. nov.	P1																										2	2							4
Wurmiella silurica sp. nov.	P1			1																															1
	P2			1																															1
Wurmiella sp. C	P1																									3									3
Zieglerodina eosteinhornensis s.l.	P1														1	2			4	1	3	1	2	2	6								3		25
	P2																		2				1		10								3		16
	M														1				1		1	1	1		3										8
	S0														1																		1		2
	S1														1				13				4										1		19
	S2																		16		2		1		5								1		25
Zieglerodina sp.	P1															2									2										4
Anomalous elements				2	1				2												1														6
Indetermined and fragments		22	24	18	24	25	9	6	1	33	23	14	19	14	32	27	32	8	14	23	100	4	30	7	20	12	16	5	11	10	5	11	2	11	612
Total		31	55	138	349	354	39	42	54	58	64	140	224	91	237	84	74	19	105	35	523	15	92	16	94	66	50	30	47	150	65	95	64	38	3538
Weight (kg)		6.7	3.8	9.1	6.7	5.3	3.5	4.0	2.9	4.4	7.5	5.7	8.0	4.8	5.4	6.5	3.0	3.8	3.6	5.5	4.4	5.8	2.7	3.4	3.7	5.5	6.0	2.6	4.5	3.0	5.0	7.0	4.1	4.8	162.7

affected by several folds, faults and repetitions (Fig. 9). The SBF section was studied by Corradini *et al*. (2001), who deciphered the complicate tectonic overprinting mainly thanks to the conodont fauna. Rocks from the uppermost Ordovician to the Frasnian are here exposed. Gnoli (1993) described a few orthoceratid cephalopods from the Přídolí part, and a level with well-preserved loboliths (Fig. 2F) is documented at the base of the *Oul. e. detortus* Zone.

In this paper, only the samples collected in the Ockerkalk are restudied. The section can be subdivided in two parts: a short section about 5 m thick exposing only the Ockerkalk limestones (samples SBF 1–5; Fig. 9B), and a long tectonised section where the same beds are exposed and repeated several times due to severe folding and faulting. Eight samples were collected in this part, and a tentative reconstruction of the section, based on conodont occurrences, is proposed in Fig. 9C.

Samples SBF 1–5 document the *A. ploeckensis*, *Po. siluricus*, *J. crispa* and Lower *Oul. e. detortus* zones (Tab. 7). In the repeated part of the section the *Z. eosteinhornensis* s.l. and the Lower *Oul. e. detortus* Zones are present. *Wurmiella pulchra* sp. nov. has its type locality in this section.

Table 7. Distribution of conodonts in the San Basilio Fenugu section.

San Basilio Fenugu (SBF)		**1**	**2**	**3**	**4**	**5**	**7**	**7a**	**8**	**9**	**10**	**11**	**11a**	**12**	**Total**
Ancoradella ploeckensis	P1					2									2
Belodella anomalis			1												1
Coryssognathus dubius	Sc				1		1		1	8	1	1			13
	Pc									6				1	7
	Pb									1					1
	con									3					3
	M									1					1
Dapsilodus obliquicostatus			11												11
Jeppsonia crispa	P1		17												17
Jeppsonia snajdri	P1		1												1
Kockelella variabilis ichnusae	P1					2									2
Kockelella variabilis variabilis	P1					5									5
Kockelella (ramiforms)	P2					2									2
	S0					3									3
	S1					3									3
	S2					6									6
Oulodus elegans detortus	S2						1			1					2
Oulodus elegans elegans	P1	7	1				1		2		1	1	1	9	23
	P2		1				3		1		1				6
	M	10	2				2		1		1	1		10	27
	S0	1	1				2		2			2		4	12
	S1	1	2				1		2		9	2		10	27
	S2	22	2				10	1			11		1	1	48
Oulodus siluricus	P1					1									1
	P2			1		3									4
	M					3									3
	S0			3		3									6
	S1			2		3									5
	S2			1		3									4
Ozarkodina confluens	P1				1	6	3		1	3					14
	P2				1	2	5								8
	M					1									1
	S0					3									3
	S2					1									1
Panderodus unicostatus			1												1

Table 7. Continued.

San Basilio Fenugu (SBF)		1	2	3	4	5	7	7a	8	9	10	11	11a	12	Total
Pelekysgnathus sp. B	P1												2		2
Polygnathoides siluricus	P1			7	5										12
	P2			4	9										13
	M				6										6
Pseudooneotodus beckmanni		4	2	3				1	1		3	1	1	1	17
Pseudooneotodus bicornis bicornis			17							2	5	1			25
Pseudooneotodus bicornis contiguus			4							2	4				10
Wurmiella excavata	P1	14	48	4	2	64	12	1	10	57	44	14	5	17	292
	P2	8	22	2	4	25	6		2	36	15	7		14	141
	M	5	21		2	11	4		9	32	9	7			100
	S0	4	22			8	6		3	25	3	6			77
	S1	9	24		3	28	7	1	11	53		21		5	162
	S2	16	24	6	1	16	9	1	9	48	17	17		8	172
Wurmiella lucae sp. nov.	P1	1	23				1								25
	P2		2												2
Wurmiella pulchra sp. nov.	P1			1		1									2
Zieglerodina ivochlupaci	P1						7								7
Zieglerodina eosteinhornensis s.l.	P1	7	1				2	2	2	6	13	1	18	14	66
	P2	1	1								2		1	30	35
	M	3	2								2		1		8
	S0		1				1				1		2		5
	S1		1				1				1		3	4	10
	S2		1				1				2				4
Zieglerodina eosteinhornensis s.s.	P1	8								4	3	3		2	20
Zieglerodina zellmeri	P1						5								5
Zieglerodina sp.	P1						5				1		2		8
	P2						5								5
	M						4								4
	S0						1								1
	S2						5								5
Indetermined and fragments				1				7	5						13
Total		121	256	35	35	205	111	14	62	288	149	85	37	130	1528
Weight (kg)		7.9	8.1	4.8	8.0	6.1	9.1	8.6	8.1	7.5	8.2	8.1	8.5	5.9	78.1
Conodonts/kg		15	32	7	4	34	12	2	8	38	18	10	4	22	20

Riu Murru de Callus

The Riu Murru de Callus (RMC) section is located about 2.8 km east of the Siurgus-Donigala village, at coordinates 39° 35′ 53.5″ N, 9° 13′ 22.0″ E. It is one of the most complete Ockerkalk sections, exposing about 19 metres of Ockerkalk limestone, starting from the boundary with the Lower Graptolitic Shales (Figs 2C, 10). However, the section is continuous only for 12 metres, then a local overthrust repeats some beds, analogously to the Genna Ciuerciu section (Fig. 10).

Nineteen conodont samples were collected from the RMC section (Tab. 8). All were productive, but the conodont fauna is in general poorly preserved and tectonically deformed. Abundance varies from 1.6 (sample RMC 2Y) to 86 (sample RMC 1A) elements/kg of rock, with an average value of 20.8. The species *Pelekysgnathus crispus* sp. nov. has its type locality in this section.

The base of the section, below the entry of *Ancoradella ploeckensis*, is attributed to the *K. v. variabilis* Zone. The occurrence of *A. ploeckensis* in sample RMC 1 allows to attribute this level to the eponymous Zone. The *Po. siluricus* Zone is recognised in samples RMC 1A–2 on the basis of the presence of the marker. The *J. snajdri* Zone is discriminated in samples 2X and 2Y, whereas the presence

Table 8. Distribution of conodonts in the Rio Murru de Callus section.

Riu Murru de Callus (RMC)		0	1	1A	1B	1C	1D	2	2X	2Y	2A	2Z	2B	2C	2D	3	3A	3B	4	4A	Total
Ancoradella ploeckensis	P1		1																		1
Belodella resima	S1																1				1
	T						4														4
Dapsilodus obliquicostatus								40					3					2			45
Jeppsonia crispa	P1										2		2					3			7
	P2																	2			2
Kockelella maenniki	P1				1	2															3
	M				1																1
Kockelella ortus absidata	P1					1															1
Kockelella ortus sardoa	P1					2	1														3
	M						2														2
Kockelella variabilis ichnusae	P1		1		4	2															7
Kockelella variabilis variabilis	P1	2	4	9																	15
	M	1	2	2	2	2															9
Kockelella (ramiforms)	P2	3	3	4	3	3															16
	S0	1		3	3	1															8
	S1	3	2	2	2	2															11
	S2	3	3	7	6	8	1														28
Oulodus elegans detortus	S2													3							3
Oulodus elegans elegans	P1												2					2			4
	P2										1		1	2				3		1	8
	M										1	1		1	4					1	8
	S0										1		1	1		1		1	5	1	11
	S1										1	1		1	2	1		7	10	3	26
	S2										3	1	1	3	2	1		5	5		21
Oulodus siluricus	P1						4														4
	P2	1		1	1			1													4
	M			2	1			2													5
	S0						2														2
	S1						3	2													5
	S2	1					5	4													10
Oulodus sp.	S2			2																	2
Ozarkodina confluens	P1									3	1			3		3					10
	S1															1					1
	S2															1					1
Pelekysgnathus crispus sp. nov.	P1										1							1			2
Polygnathoides siluricus	P1			1	2	2	10	1													16
	P2						6	1													7
	M						3														3
Pseudooneotodus beckmanni							2	75							3			2		2	84
Pseudooneotodus bicornis bicornis								12	2	1	7						1	6	1	1	31
Pseudooneotodus bicornis contiguus								3										3	15	1	22
Wurmiella excavata	P1		10	180	6	9	1	10	2		5	4	1	9	8	2	3	15	7	7	279
	P2		6	115	4		1	2		1	2		1	1	2	2		7	5	5	154
	M		1	46	1			7	1	1		1			1	7		1	2		69
	S0		4	21	1			4			1	1	1	2	1	1		1	1		39
	S1		11	76	1			7	1		3			4	1	5		6	3	3	121
	S2		40	92	1			10	3		3	1	1	5	11	11	3	11	8	2	202
Wurmiella pulchra sp. nov.	P1			3														6			9
Wurmiella silurica sp. nov.	P1			1																	1
Wurmiella sp. C	P1											1									1
Zieglerodina eosteinhornensis s.l.	P1																		1		1
Zieglerodina planilingua	P1													4							4
Zieglerodina sp.	P1													1			1	1			3
Indetermined and fragments		13	4	95	16	22		15				4		37	15	17	1	11	9	2	261
Total		28	92	662	56	56	45	196	9	6	32	15	14	77	50	53	10	96	72	29	1598
Weight (kg)		5.4	6.0	7.7	3.2	3.4	3.3	5.2	2.2	3.8	4.0	2.5	5.2	6.0	6.6	7.3	6.8	5.4	8.0	3.9	76.8
Conodonts/kg		5	15	86	18	16	14	38	4	2	8	6	3	13	8	7	1	18	9	7	21

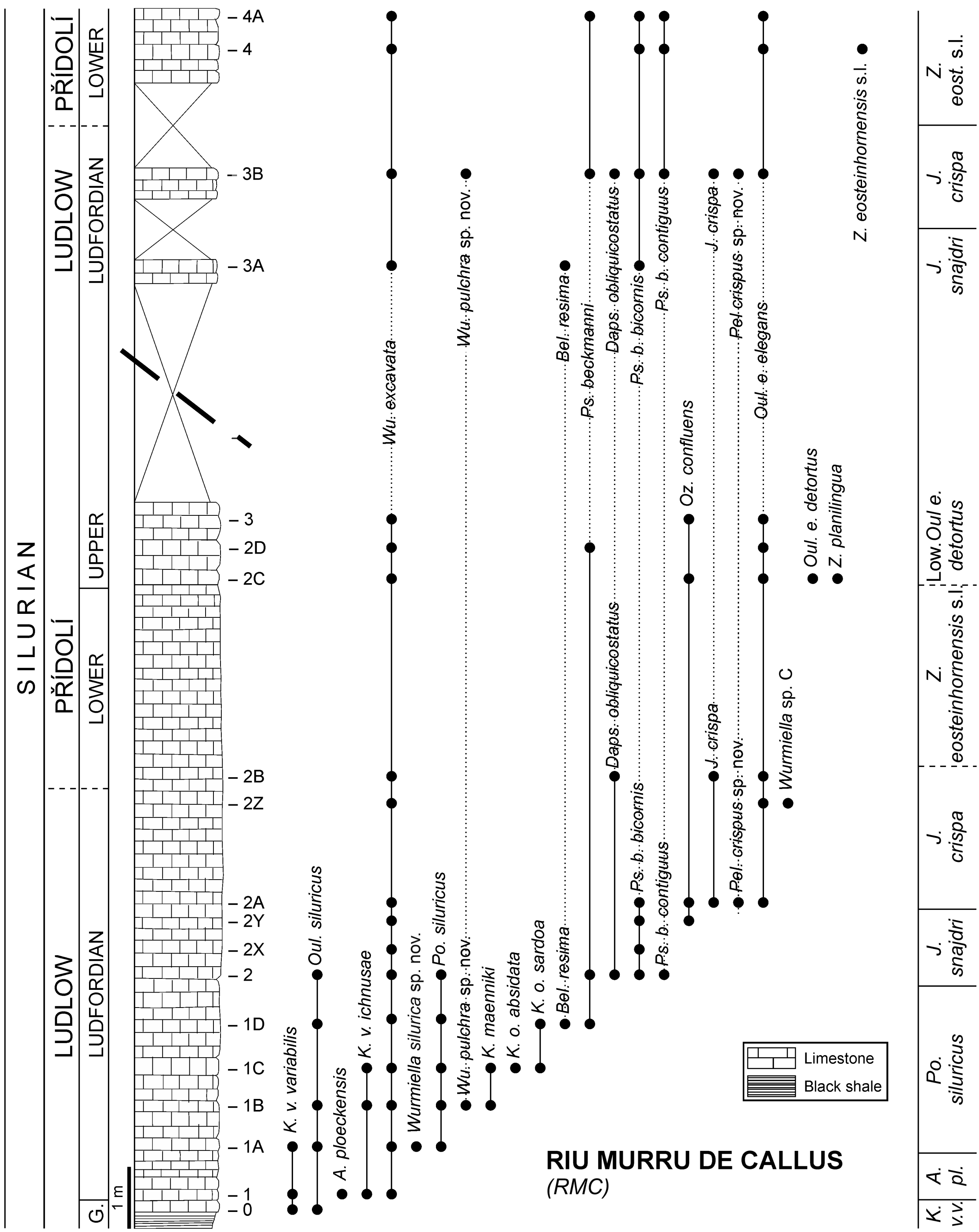


Figure 10. Distribution of conodonts in the Riu Murru de Callus section. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. Abbreviations: *A.* – *Ancoradella*; *A. pl.* – *A. ploeckensis*; *Bel.* – *Belodella*; *Daps.* – *Dapsilodus*; *eost.* – *eosteinhornensis*; G. – Gorstian; *J.* – *Jeppsonia*; *K.* – *Kockelella*; *K. o.* – *Kockelella ortus*; *K. v.* – *Kockelella variabilis*; *K.v.v.* – *Kockelella v. variabilis*; *Oul.* – *Oulodus*; *Oul. e.* – *Oulodus elegans*; *Oz.* – *Ozarkodina*; *Pel.* – *Pelekysgnathus*; *Po.* – *Polygnathoides*; *Ps.* – *Pseudooneotodus*; *Ps. b.* – *Pseudooneotodus bicornis*; *Wu.* – *Wurmiella*; *Z.* – *Zieglerodina*.

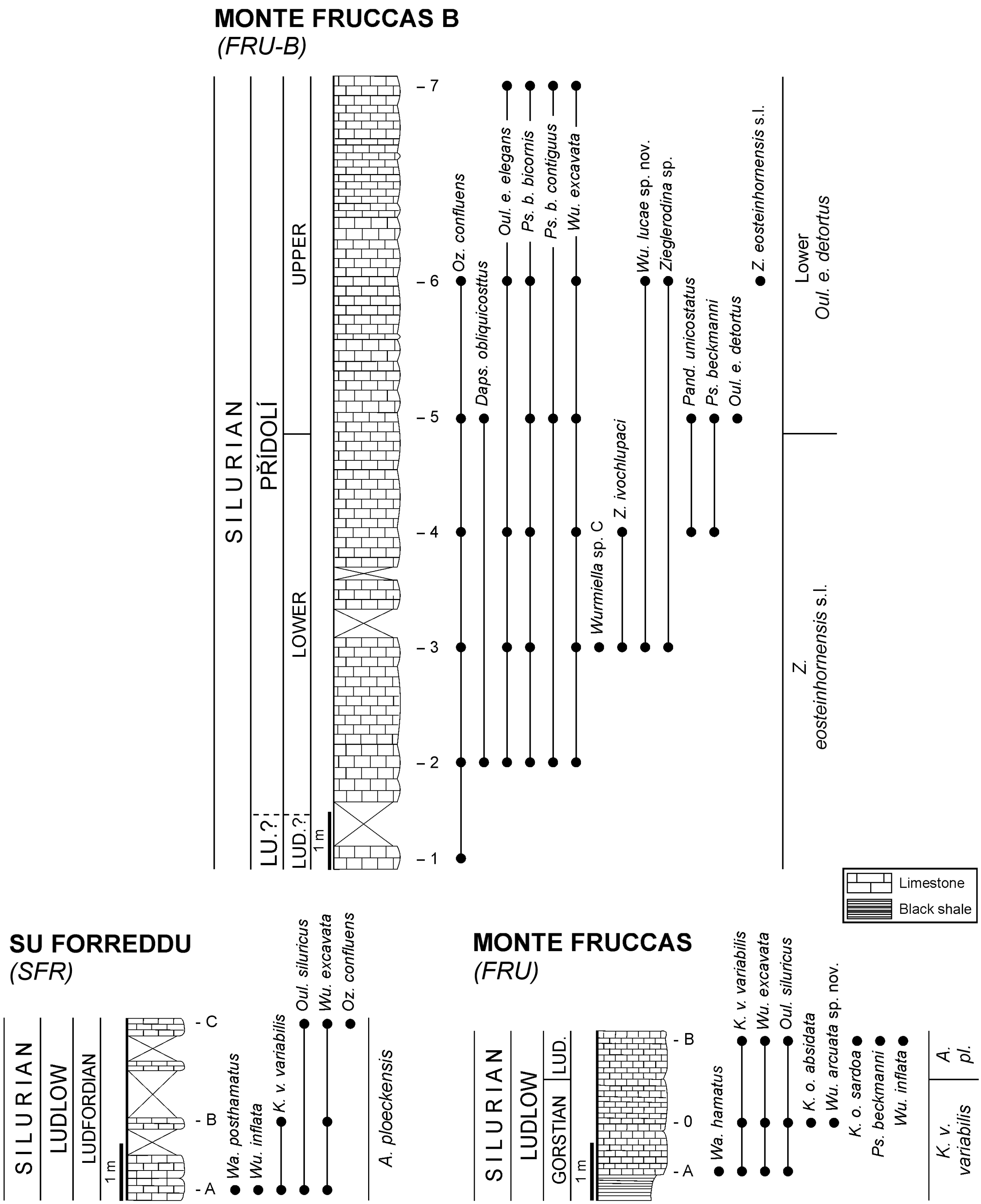


Figure 11. Distribution of conodonts in the Monte Fruccas B, Monte Fruccas and Su Forreddu sections. From left to right: chronostratigraphy (Period, Series, Stage), lithological log, samples, distribution of taxa, zones. Abbreviations: *A. pl.* – *A. ploeckensis*; *Daps.* – *Dapsilodus*; *K.* – *Kockelella*; *K. o.* – *Kockelella ortus*; *K. v.* – *Kockelella variabilis*; LU. – Ludlow; LUD. – Ludfordian; *Oul.* – *Oulodus*; *Oul. e.* – *Oulodus elegans*; *Oz.* – *Ozarkodina*; *Pand.* – *Panderodus*; *Ps.* – *Pseudooneotodus*; *Ps. b.* – *Pseudooneotodus bicornis*; *Wa.* – *Walliserognathus*; *Wu.* – *Wurmiella*; *Z.* – *Zieglerodina*.

Table 9. Distribution of conodonts in the Su Furreddu section.

Su Forreddu (SFR)		A	B	C	Total
Kockelella variabilis variabilis	P1	1			1
	M	2	1		3
Kockelella (ramiforms)	P2	1	1		2
	S0		1		1
	S1	1			1
	S2	5			5
Oulodus siluricus	P2	1			1
	S1	1		1	2
Ozarkodina confluens	S2			1	1
Walliserognathus posthamatus	P1	1			1
	P2	1			1
Wurmiella excavata	P1	10		6	16
	P2	8	1	1	10
	M	6	1	1	8
	S0	1		1	2
	S1	4	2	2	8
	S2	4		2	6
Wurmiella inflata	P1	1			1
Indetermined and fragments		4		1	5
Total		52	7	16	75
Weight (kg)		3.5	3.2	2.9	9.6
Conodonts/kg		15	2	6	8

of *J. crispa* in samples RMC 2A–2B indicates the *J. crispa* Zone. In the following sample (RMC 2C) *Oul. e. detortus* is present, whose entry markes the base of the Lower *Oul. e. detortus* Zone. It results that the *Z. eosteinhornensis* s.l. Zone possibly lies in the still not sampled interval between samples 2B and 2C. Above sample RMC 3, a tectonic repetition occurs: in the upper part of the section the *J. snaidri*, *J. crispa* and *Z. eosteinhornensis* s.l. zones are discriminated.

Su Furreddu

The Su Furreddu (SFR) section is located near the top of the Su Forreddu hill, about 3 km northeast of the Siurgus-Donigala village, at coordinates 39° 36′ 50.1″ N, 9° 12′ 31.4″ E. It is a short section, about 3 meters thick and partially covered, measured in a strongly tectonised area (Fig. 11). Three samples were picked from the section, and a total of 9.4 kg of rock were processed (Tab. 9). The conodont fauna is scarce and poorly preserved, as only 78 conodonts were recovered.

The lower part of the section (sample SFR A) can be attributed to the *A. ploeckensis* Zone by the occurrence of *Walliserognathus posthamatus*, which is restricted to the zone (Corradini & Corriga 2018). The fauna collected in the other samples is compatible with the *A. ploeckensis* Zone, although a slightly younger age cannot be excluded.

Monte Fruccas

The Monte Fruccas (FRU) section is exposed about 2 km north of the Siurgus-Donigala village, at coordinates 39° 37′ 25.0″ N, 9° 11′ 16.0″ E. The section, only 2.1 metres thick, exposes the contact between the "Lower Graptolitic Shales" and the Ockerkalk (Figs 2D, 11). It was preliminarily described by Corradini & Olivieri (1997); the conodont fauna is restudied in this paper. The species *Wurmiella arcuata* sp. nov. has its type locality in this section.

No graptolites were found in the black shales. A few microbrachiopods were collected from the conodont residues. The lower part of the section can be attributed to the upper part of the *K. v. variabilis* i.Z. (*Wa. hamatus* Subzone) thanks to the occurrence of *Wa. hamatus* (Tab. 10), whereas the upper part (Sample FRU B) to the *A. ploeckensis* Zone by the presence of *K. o. sardoa*, that enters at the base of this zone (Serpagli & Corradini 1999).

Monte Fruccas B

The Monte Fruccas B (FRU-B) section is located about 100 m north of the Monte Fruccas section, up to the top

Table 10. Distribution of conodonts in the Monte Fruccas section.

Monte Fruccas (FRU)		A	0	B	Total
Kockelella ortus absidata	P1		1		1
	M		4		4
Kockelella ortus sardoa	P1			1	1
Kockelella variabilis ichnusae	P1			1	1
Kockelella variabilis variabilis	P1	1	4	4	9
	M	1	1	3	5
Kockelella (ramiforms)	P2	3	2	2	7
	S0	3	2	3	8
	S1	2	5	5	12
	S2	1	6	6	13
Oulodus siluricus	P1	1	1		2
	P2			1	1
	S2	3	2	5	10
Pseudooneotodus beckmanni				2	2
Wurmiella arcuata sp. nov.	P1		2		2
Wurmiella excavata	P1	7	37	80	124
	P2	9	16	23	48
	M	1	13	9	23
	S0	8	10	10	28
	S1	2	22	11	35
	S2	3	20	23	46
Wurmiella hamata	P1	2			2
Wurmiella inflata	P1			2	2
Wurmiella sp.	P1			1	1
Indetermined and fragments		14	25	25	64
Total		61	173	217	451
Weight (kg)		5.4	6.2	8.6	20.2
Conodonts/kg		11	28	25	22

Table 11. Distribution of conodonts in the Monte Fruccas B section.

Monte Fruccas B (FRU-B)		1	2	3	4	5	6	7	Total
Dapsilodus obliquicostatus			2			10			12
Oulodus elegans detortus	S2					1			1
Oulodus elegans elegans	P1						2		2
	P2			1			3	1	5
	M						5		5
	S0		1				1	1	3
	S1		1	1	1				3
	S2		2	2	2		1	1	8
Ozarkodina confluens	P1	1	4	1	3	5	1		15
	P2		1						1
	M			2			2		4
	S0			1					1
	S1			2		1			3
	S2			1		1			2
Panderodus unicostatus					1	3			4
Pseudooneotodus beckmanni					1	2			3
Pseudooneotodus bicornis bicornis			3		6	4	2	1	16
Pseudooneotodus bicornis contiguus			1	1		2		2	6
Wurmiella lucae sp. nov.	P1			7			1		8
Wurmiella excavata	P1		3	8	7	6	6	2	32
	P2		5	6	6	5	3		25
	M		3	7	2	8			20
	S0		2	4	2	7	3		18
	S1		3	6	2	7	5	1	24
	S2		5	19	1	10	10	1	46
Wurmiella sp. C	P1			1					1
Zieglerodina ivochlupaci	P1			1	2				3
Zieglerodina eosteinhornensis s.l.	P1						1		1
Zieglerodina sp.	P1			1			1		2
Fragments and indetermined		2	4	2	7	18	8		41
Total		3	40	74	43	90	55	10	315
Weight (kg)		8.5	5.6	8.0	6.2	6.0	5.5	6.6	46.4
Conodonts/kg		0	7	9	7	15	10	2	7

of the hill, at coordinates 39° 37′ 28.4″ N, 9° 11′ 17.8″ E. The lower part of the section is mostly covered and only a few layers are exposed in the field, while the upper part is more continuous (Fig. 11). Due to the existence of covered intervals, tectonic repetitions cannot be excluded.

The conodont fauna is scarce and poorly preserved (Tab. 11). The abundance varies from 0.4 (sample FRU-B 1) to 15 elements/kg (sample FRU-B 5), with an average of 6.8. The whole section is attributed to the Přídolí: in the lower part the *Z. eosteinhornensis* s.l. i.Z. is recognized, and the entry of the marker *Oul. e. detortus* in sample FRU-B 5 indicates that the upper part of the section belongs to the Lower *Oul. e. detortus* Zone.

Systematic Palaeontology

The taxa documented are illustrated in Figures 12–15. Systematic notes are limited to necessary taxonomic remarks and to taxa newly reported from Sardinia. For supra-generic classification the scheme proposed by Sweet (1988) is followed. Descriptions and remarks are restricted to P1 element, unless specifically indicated.

Class Conodonta Pander, 1856
Order Ozarkodinida Dzik, 1976
Family Spathognathodontidae Hass, 1959

Genus *Jeppsonia* Barrick, Klapper & Peavey, 2024

Type species – *Spathognathodus sagitta* Walliser, 1964.

Remarks. – Barrick *et al*. (2024) erected the genus *Jeppsonia* to include Silurian ozarkodinids with a P1 elements characterised by an expanded basal cavity, which can be sagittate to rounded. Basically, we agree with the proposal, but we are not sure that *Jeppsonia* is a monophyletic genus, because there is a temporal gap between the older and younger species attributed to it, even if the phylogenetic analysis by Gómez *et al*. (2021) suggests a connection between the two groups. The older group includes *J. sagitta* (Walliser, 1964), *J. rhenana* (Walliser, 1964), *J. bohemica bohemica* (Walliser, 1964) and *J. bohemica longa* (Jeppsson, 2003) *in* Calner & Jeppsson (2003), and ranges from the base of the Sheinwoodian to the Homerian in Europe, or into the Gorstian in North America, where rare specimens of *J. bohemica*-like morphotypes occurs (J.E. Barrick, pers. comm.). The younger group includes *Oz. snajdri* (Walliser, 1964), *Oz. parasnajdri* (Viira & Aldridge, 1998), *J. crispa* (Walliser, 1964) and *J. huenickeni* (Gomez *et al*., 2021) and is documented from the upper Ludfordian to the Přídolí. The gap between the two groups includes at least the lower Ludfordian.

***Jeppsonia crispa* (Walliser, 1964)**
Figure 12O–R

1964 *Spathognathodus crispus*; Walliser, pp. 74, 75, pl. 9, fig. 3; pl. 21, figs 7–13.
1975 *Ozarkodina crispa* (Walliser, 1964). – Klapper & Murphy, p. 33, pl. 8, fig. 10.
1989 *Ozarkodina crispa* (Walliser, 1964). – Walliser & Wang, pp. 114–119, pl. 1, figs 1–16; text-fig. 1.
1995 *Ozarkodina crispa* (Walliser, 1964). – Simpson & Talent, p. 146, pl. 8, fig. 15. (*cum syn.*)
1998 *Ozarkodina crispa* (Walliser, 1964). – Viira & Aldridge, p. 39, pl. 2, figs 1–22; pl. 3, figs 1–11.
2009 *Ozarkodina crispa* (Walliser, 1964). – Corriga & Corradini, pp. 114–119, fig. 4g, h.

2010 *Ozarkodina crispa* (Walliser, 1964). – Wang & Aldridge, p. 88, pl. 22, figs 9, 10, 13, 14 (only).
2010 *Ozarkodina crispa* (Walliser, 1964). – Corradini *et al*., fig. 3g.
2010 *Ozarkodina crispa* (Walliser, 1964). – Corradini & Corriga, p. 245, pl. 3, figs 20, 21.
2012 *Ozarkodina crispa* (Walliser, 1964). – Slavík & Carls, fig. 12r, t.
2023 "*Ozarkodina*" *crispa* (Walliser, 1964). – Manda *et al*., fig. 8b–f.
2024 *Jeppsonia crispa* (Walliser, 1964). – Barrick *et al*., p. 314, pl. 3, figs 14–19, 27.

Material. – Fifty-nine P1 and two P2 from samples GCIU 11, GCIU 12, GCIU 13, GCIU 26, GCIU 29, GCIU 30, RMC 2A, RMC 2B, RMC 3B, SIL 23, SIL 24 and SBF 2.

Remarks. – *Jeppsonia crispa* is characterised by a wide basal cavity that extends posteriorly than the posterior termination of the blade. Walliser & Wang (1989) distinguished four morphotypes of the P1 element, based on the occurrence and the morphology of a furrow at the oral margin. The P1 elements of *J. crispa* from the studied collections belong to α and β morphotypes: α-morphs show partially fused denticles above the platform (Fig. 12O, Q), whereas β-morphs have a distinct not interrupted furrow which lacks sinuate widenings (Fig. 12P, R).

Stratigraphic distribution. – The species is the marker of the eponymous *J. crispa* Zone and is limited to this interval. The *J. crispa* Zone occurs in the uppermost part of the Ludfordian and enters a little in the lower Přídolí.

Genus *Ozarkodina* Branson & Mehl, 1933

Type species. – *Ozarkodina typica* Branson & Mehl, 1933.

***Ozarkodina* cf. *nasuta* (Viira, 1983)**
Figure 12V

1983 *Spathognathodus primus nasutus* ssp. n.; Viira, pp. 60, 61, pl. 6, figs 1, 3, 7–13; text-figs 12, 13.
1990 *Spathognathodus primus nasutus* Viira. – Männik & Viira, pl. 18, fig. 21.
1999 *Ozarkodina nasuta* (Viira). – Viira, pl. 4, figs 7, 8.
2000 *Ozarkodina nasuta* (Viira). – Viira, pp. 59, 60, pl. 2, figs 3–5.
2020a *Ozarkodina nasuta* (Viira). – Spiridonov *et al*., fig. 5s.

Material. – One fragmented P1 elements from samples SIL 37.

Remarks. – *Ozarkodina nasuta* is characterised by a strong and high cockscomb in the anterior part of the blade, which bears fused denticles. The only element tentatively attributed to this species is a large fragment showing the high cockscomb bearing fused denticles at the anterior end of the blade.

Stratigraphic distribution. – *Ozarkodina nasuta* is documented in the Přídolí of Baltica. The specimen from Sardinia came from the Lower *Oul. e. detortus* Zone.

Genus *Parazieglerodina* Carls, Slavík & Valenzuela-Ríos, 2005

Type species. – *Parazieglerodina plodowskii* Carls, Slavík & Valenzuela-Ríos, 2005.

Remarks. – Carls *et al.* (2005) erected the genus *Parazieglerodina* based on a short and high P1 element and ramiform elements with an "incipient development of alternating denticulation" (Carls *et al*. 2005), and designated *Parazieglerodina plodowskii* n. sp. as type species of the genus.

Barrick *et al.* (2024) observed that such feature of the ramiform elements is not evident in the illustrations, while the denticulation appears irregular, with different sizes and spacing of denticles. These authors moved two species to *Parazieglerodina*: *Ozarkodina martinssoni auriformis* Simpson, 2003 and *Ozarkodina remscheidensis baccata* Miller & Aldridge, 1997. Barrick *et al.* (2024) also suggested that *Par. plodowskii* can be a junior synonym of *Par. baccata*, because "the outline of the blade and the medially located, vaulted, constricted basal cavity lobes fit easily in the concept of *Parazieglerodina*, and *P. baccata* may be a senior synonym of *P. plodowskii*" (Barrick *et al*. 2024, p. 314). We agree on the attribution of the species *baccata* to the genus *Parazieglerodina*, but we believe that *Par. plodowskii* and *Par. baccata* are different species because of the different denticulation pattern of the P1 element. In fact, denticles in *Par. baccata* are strong, broad and with a subtriangular shape, whilst in *Par. plodowskii* are smaller and closely spaced, partly fused above the basal cavity, apart from two distinct large denticles on the posterior process.

***Parazieglerodina auriformis* (Simpson, 2003)**
Figure 12M

2003 *Ozarkodina martinssoni auriformis* n. ssp.; Simpson, pp. 76–78, pl. 1, figs 1–20. (*cum syn*.)
2005 *Ozarkodina martinssoni auriformis* Simpson, 2003. – Talent *et al*., pp. 282–284, fig. 8a, b.
2024 *Parazieglerodina auriformis* (Simpson, 2003). – Barrick *et al*., pp. 314, 315, pl. 4, figs 1–8, 10.

Material. – One P1 element from sample SIL 17.

Remarks. – The only element attributed to *Parazieglerodina auriformis* has a general shape very similar to the holotype. *Parazieglerodina auriformis* differs from *Par. plodowskii* mainly by not having fused denticles above the basal cavity and a longer posterior process.

Stratigraphic distribution. – The species is documented from the upper Ludlow and lowermost Přídolí of Australia and North America, often in association with *Pedavis latialata* (Barrick *et al*., 2024). The element from Sardinia came from the lower part of the *J. snajdri* interval Zone (= *Ped. latialata* Zone of former zonations).

Genus *Walliserognathus* Corradini & Corriga, 2018

Type species. – *Spathognathodus inclinatus posthamatus* Walliser, 1964.

***Walliserognathus hamatus* (Walliser, 1964)**
Figure 12E

- 1964 *Spathognathodus inclinatus hamatus* n. subsp.; Walliser, p. 76, pl. 7, fig. 18; pl. 19, figs 26–28.
- 1973 *Ozarkodina excavata hamata* (Walliser). – Klapper *in* Ziegler (ed.), p. 227, pl. *Ozarkodina* 1, fig. 6.
- 1995 *Ozarkodina excavata hamata* (Walliser). – Barca *et al*., pl. 4, fig. 12.
- 1998 *Ozarkodina excavata hamata* (Walliser). – Serpagli *et al*., pl. 1.2.1, figs 11, 12.
- 1998b *Ozarkodina excavata hamata* (Walliser). – Ferretti *et al*., pl. 2.2.1, figs 8, 9.
- 2009a *Wurmiella hamata* (Walliser). – Corradini *et al*., pl. 1, fig. 7.
- 2009a *Wurmiella hamata* (Walliser). – Ferretti *et al*., pl. 1, fig. 7.
- 2021 *Wurmiella*? *hamata* (Walliser). – Corriga *et al*., p. 201, pl. 2, figs 9–13.

Material. – Four P1 elements in samples FRU A and SIL 1.

Remarks. – *Walliserognathus hamatus* is characterised by a lateral process on both sides of the blade. Some elements, including the holotype (Walliser 1964, pl. 18, fig. 26), bear a narrow platform across the entire element, which is a diagnostic feature of the genus *Walliserognathus*. This feature, however, is only present in some elements. The P2 element figured by Ferretti *et al.* (1998b) as belonging to "*Oz. e. hamata*" shows an enlargement of the blade, like a small flange, below the insertion of denticles, somehow recalling the P2 element of *Wa. posthamatus*, but with a less developed platform, and supports the attribution of the species to genus *Walliserognathus*.

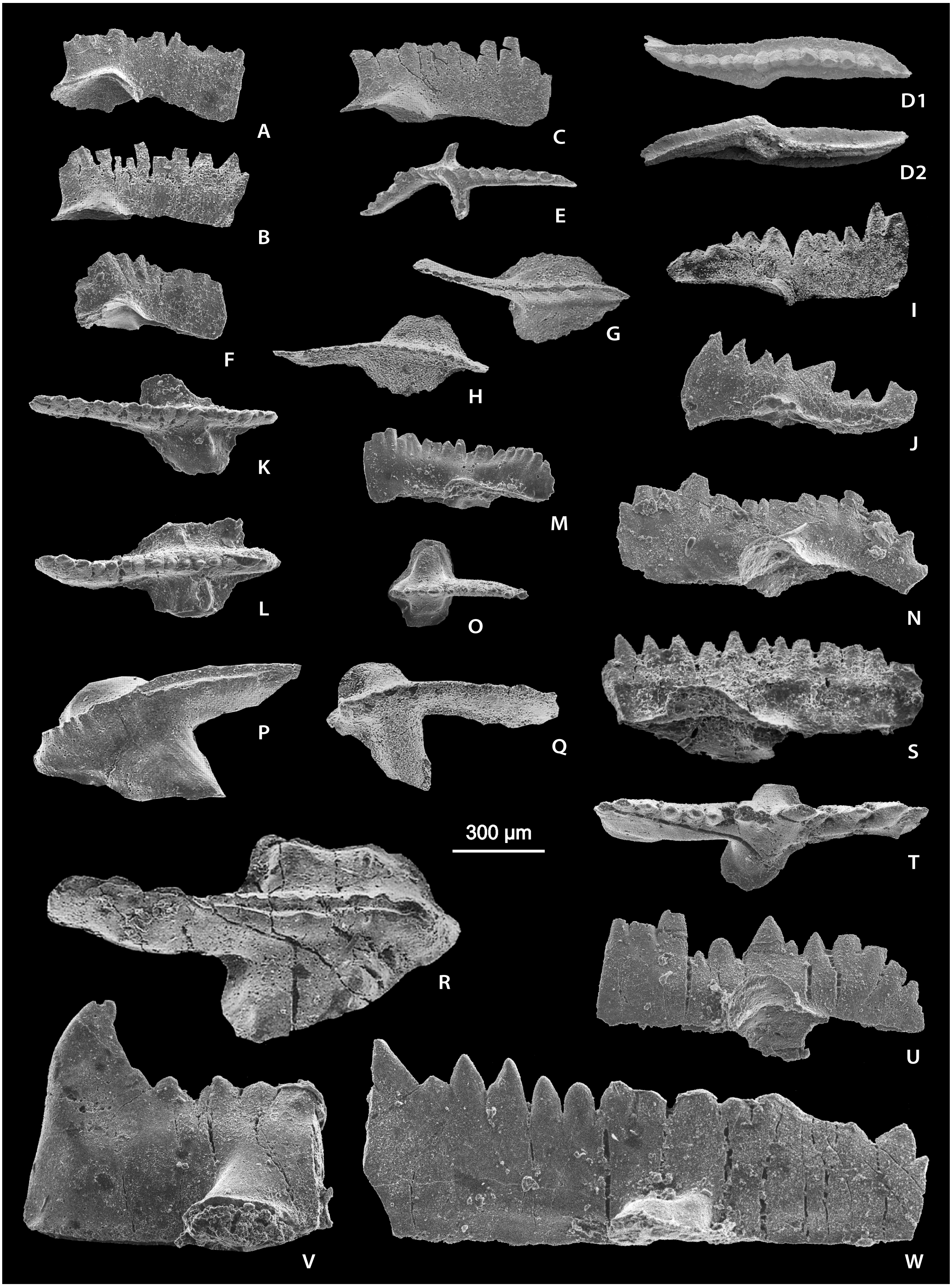
Stratigraphic distribution. – *Walliserognathus hamatus* ranges from the upper part of the *K. v. variabilis* interval Zone into the *A. ploeckensis* Zone. The entry of the species may be used to discriminate the *Wa. hamatus* Subzone in the uppermost part of the *K. v. variabilis* interval Zone.

Genus *Wurmiella* Murphy, Valenzuela-Ríos & Carls, 2004

Type species. – *Ozarkodina excavata tuma* Murphy & Matti, 1983.

Remarks. – Barrick *et al*. (2004) removed the genus from the Order Ozarkodinida and argued that it should be placed in the Order Prioniodinida, arguing that the features of some elements of the apparatus, mainly P2 and M, are

Figure 12. A–C – *Pelekysgnathus crispus* sp. nov. A – lateral view of holotype, P1 element IPUM 35151, sample RMC 3B, *J. crispa* Zone. B – lateral view of paratype, P1 element IPUM 25932, sample SIL 23, *J. crispa* Zone. C – lateral view of the holotype, P1 element IPUM 25933, sample SIL 23, *J. crispa* Zone. • D, E – *Walliserognathus posthamatus* (Walliser, 1964). D – upper (D1) and lower (D2) views of P1 element MLDCA 30414, sample SFR A, *A. ploeckensis* Zone. E – upper view of P1 element IPUM 25905, sample SIL 1, *K. v. variabilis* Zone. • F – *Pelekysgnathus* sp. B. Lateral view of P1 element IPUM 35152, sample SBF 11A, *Z. eosteinhornensis* s.l. Zone. • G, H – *Jeppsonia snajdri* (Walliser, 1964). G – upper view of P1 element IPUM 25930, sample GCIU 10, *J. snajdri* Zone. H – upper view of P1 element IPUM 25931, sample SIL 21, *J. snajdri* Zone. • I, J – *Ozarkodina confluens* Branson & Mehl, 1933. I – lateral view of P1 element IPUM 25884, sample GCIU 9, *J. snajdri* Zone. J – lateral view of P1 element IPUM 35154, sample GCIU 22, Lower *Oul. e. detortus* Zone. • K, L – *Zieglerodina eosteinhornensis* s.s. (Walliser, 1964). K – upper view of P1 element IPUM 35155, sample SBF 1, Lower *Oul. e. detortus* Zone (*Z. eosteinhornensis* s.s. horizon). L – upper view of P1 element IPUM 35156, sample SBF 1, Lower *Oul. e. detortus* Zone (*Z. eosteinhornensis* s.s. horizon). • M – *Parazieglerodina auriformis* (Simpson, 2003). Lateral view of P1 element IPUM 35153, sample SIL 17, *J. snajdri* Zone. • N – *Zieglerodina* sp. Lateral view of P1 element IPUM 35157, sample SBF 7, Lower *Oul. e. detortus* Zone. • O–R – *Jeppsonia crispa* (Walliser, 1964). O – upper view of P1 element IPUM 35158, sample SBF 2, *J. crispa* Zone. P – upper-lateral view of P1 element IPUM 25929, sample SIL 23, *J. crispa* Zone. Q – upper-lateral view of P1 element IPUM 25927, sample GCIU 11, *J. crispa* Zone. R – upper view of P1 element IPUM 25928, sample GCIU 11, *J. crispa* Zone. • S – *Zieglerodina eosteinhornensis* s.l. (Walliser, 1964). Lateral view of P1 element IPUM 28207, sample GCIU 20, Lower *Oul. e. detortus* Zone. • T – *Zieglerodina planilingua* (Murphy & Valenziela-Ríos, 1999). Upper view of P1 element IPUM 35159, sample RMC 2C, Lower *Oul. e. detortus* Zone. • U – *Zieglerodina ivochlupachi* Carls, Slavík & Valenzuela-Ríos, 2007. Lateral view of P1 element IPUM 35160, sample SBF 7, Lower *Oul. e. detortus* Zone. • V – *Ozarkodina* cf. *nasuta* (Viira, 1983). Lateral view of P1 element IPUM 35161, sample SIL 37, Lower *Oul. e. detortus* Zone. • W – *Zieglerodina zellmeri* Carls, Slavík & Valenzuela-Ríos, 2007. Lateral view of P1 element IPUM 35162, sample SBF 7, Lower *Oul. e. detortus* Zone.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different than other genera attributed to Ozarkodinida. We agree that the P2 element of *Wurmiella* has not the subtriagular shape of the P2 elements of other genera (e.g. *Ozarkodina*, *Jeppsonia* and *Zieglerodina*), but it is very different than the P2 element of genera attributed to Prioniodinida, as, for example, *Oulodus*. The same for the M element. Therefore, we believe that the classical attribution to Ozarkodinida is preferable. Also, the only recent cladistic analysis available (Donoghue *et al*. 2008) considered the group *W. excavata*–*Yaoxianognathus* as the basal clade of the Ozarkodinina.

***Wurmiella* cf. *alternata* Corradini & Corriga, 2010**

2010 *Wurmiella alternata* n. sp.; Corradini & Corriga, pp. 245–248, pl. 2, figs 1–8.
2012 *Wurmiella* ex gr. *excavata* (aff. *alternata* Corradini & Corriga). – Slavík & Carls, fig. 3c.
2020 *Wurmiella* cf. *alternata* Corradini & Corriga. – Chen *et al*., fig. 7l, 7s.
2021 *Wurmiella alternata* Corradini & Corriga. – Corriga *et al*., p. 201.

Material. – One poorly preserved P1 element from sample GCIU 28.

Remarks. – *Wurmiella alternata* is characterised by alternate denticulation, a feature which distinguishes *W. alternata* from all the other species of *Wurmiella*. The species was first described from the Carnic Alps and was later reported from the Czech Republic (Slavík & Carls 2012), central Spain (our unpublished data) and, possibly, from China (Chen *et al*. 2020). This is the first documentation of *Wu. alternata* in Sardinia. However, the only element attributed to this species is a fragmentary P1 element.

Stratigraphic range. – Wurmiella alternata is documented from the Ludfordian and the Přídolí: the oldest recovery is documented from the *J. snajdri* Zone at Cellon (Corradini *et al*. 2015), and ranges to just below the Silurian–Devonian boundary (Corradini *et al*. 2020, Ferretti *et al*. 2022).

***Wurmiella arcuata* sp. nov.**
Figure 14K, L

Holotype. – P1 element IPUM 35177, illustrated in Fig. 14K.

Paratypes. – Published P1 elements IPUM 35178; unpublished P1 elements IPUM 35212, 35213, 35214/1-4, 35215/1-2.

Type horizon and locality. – Bed of sample FRU 0. Monte Fruccas section, north of the Siurgus Donigala village, SE Sardinia, Italy.

Material. – Eleven P1 elements from samples FRU 0, GA 2, GA 4, GCIU 0, SIL 2 and SIL 7.

Etymology. – From the Latin *arcuata* = arched.

Diagnosis. – A species of *Wurmiella* which P1 element is characterised by an arched profile with processes bearing closely spaced denticles.

Description. – The P1 element of *Wu. arcuata* sp. nov. is asymmetrical, with the anterior process longer and higher than the posterior one. Both processes are curved downward, giving to the element an arched profile, and bear discrete and closely spaced denticles, rounded in cross section; a few larger denticles may be present above the distal part of the anterior process. The cusp is high, strong and slightly posteriorly reclined. The wide basal cavity is located under the cusp and the proximal part of the posterior process, and extends as a narrow grove beneath the processes.

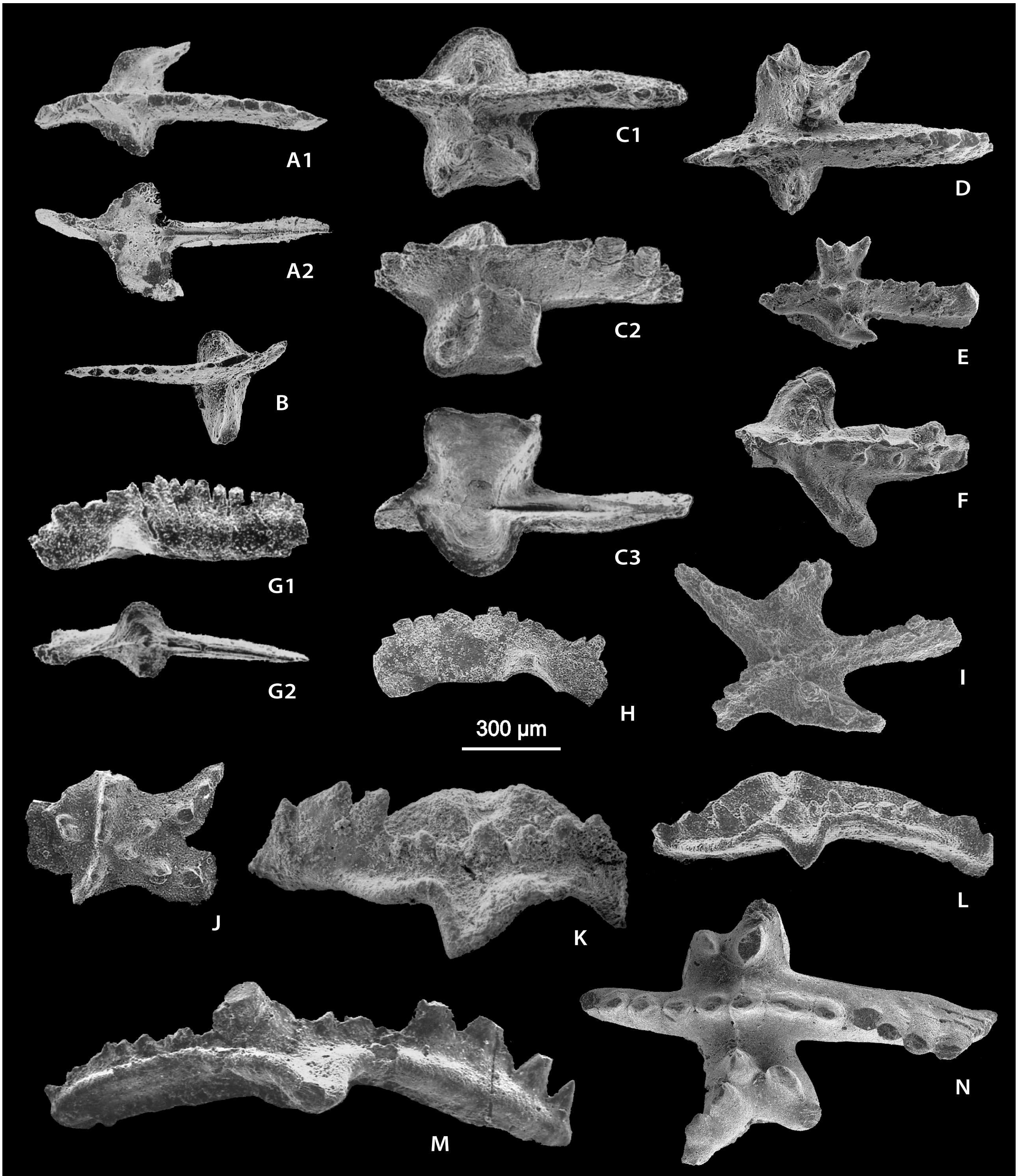
Remarks. – The arched profile distinguishes *Wu. arcuata* sp. nov. from *Wu. excavata*, *Wu. pulchra* sp. nov., and *Wu. lucae* sp. nov. It differs from *Wurmiella silurica* sp. nov. for the less developed posterior process. *Wu. arcuata* sp. nov. is different from *Wu. inclinata* (Rhodes, 1953) because the latter has triangular discrete denticles on both processes.

Stratigraphic distribution. – From the uppermost part of the *K. v. variabilis* Zone (*Wa. hamatus* Subzone) into the *Po. siluricus* Zone.

***Wurmiella lucae* sp. nov.**
Figure 14A–G

1998 *Wurmiella excavata* (Branson & Mehl, 1933). – Serpagli *et al*., pl. 1.2.2, fig. 1.
2001 *Wurmiella excavata* (Branson & Mehl, 1933). – Corradini *et al*., pl. 1, fig. 20.

Figure 13. A, B – *Kockelella maenniki* Serpagli & Corradini, 1998. A – upper (A1) and lower (A2) views of the holotype, P1 element IPUM 25845, sample GCIU 3, *Pol. siluricus* Zone (refigured after Serpagli & Corradini 1998). B – upper view of P1 element IPUM 35163, sample GA 4, *Pol. siluricus* Zone. • C, D – *Kockelella variabilis ichnusae* Serpagli & Corradini, 1998. C – upper (C1), upper-lateral (C2) and lower (C3) views of the holotype, P1 element IPUM 25834, sample SIL 5, *Pol. siluricus* Zone (refigured after Serpagli & Corradini 1998). D – upper view of P1 element IPUM 25835, sample SIL 5, *Pol. siluricus* Zone. • E – *Kockelella variabilis variabilis* Walliser, 1957. Upper view of P1 element IPUM 35164, sample



RMC 1A, *Pol. siluricus* Zone. • F – *Pedavis latialata* (Walliser, 1964). Upper view of P1 element IPUM 25924, sample GCIU 8, *J. snajdri* Zone. • G – *Kockelella ortus sardoa* Serpagli & Corradini, 1999. Lateral (G1) and lower (G2) views of the holotype, P1 element IPUM 227481, sample GCIU 3, *Pol. siluricus* Zone (refigured after Serpagli & Corradini 1999). • H – *Kockelella ortus absidata* Barrick & Klapper, 1976. Lateral view of P1 element IPUM 25835, sample SIL 5, *Pol. siluricus* Zone. • I, J – *Ancoradella pleockensis* Walliser, 1964. I – upper view of P1 element IPUM 35165, sample SBF 5, *A. ploeckensis* Zone. J – upper view of P1 element IPUM 25923, sample SIL 4, *A. ploeckensis* Zone. • K–M – *Polygnathoides siluricus* Branson & Mehl, 1933. K – upper-lateral view of P1 element IPUM 29027, sample GCIU 1, *Pol. siluricus* Zone. L – upper-lateral view of P1 element IPUM 25898, sample GCIU 4, *Pol. siluricus* Zone. M – lateral view of P2 element IPUM 29029, sample GCIU 2, *Pol. siluricus* Zone. • N – *Kockelella variabilis variabilis* Walliser, 1957. Upper view of P1 element IPUM 35166, sample RMC 1B, *Pol. siluricus* Zone.

2009 *Wurmiella excavata* (Branson & Mehl, 1933). – Corriga & Corradini, fig. 4c.
2011 *Wurmiella excavata* (Branson & Mehl, 1933). – Corriga, pl. 2, fig. 9.

Holotype. – P1 element IPUM 35167, illustrated in Fig. 14A.

Paratypes. – Published P1 elements IPUM 35168, 35169, 35170, 25171, 25172; published P2 element 35173. Unpublished P1 elements IPUM 25908, 35203/1-2, 35204/1-2, 35205, 35206, 35207/1-22, 35208/1-4, 35209, 35210/1-22; unpublished P2 element IPUM 35207/23-24, 35211.

Type horizon and locality. – Bed of sample SIL 23. Silius section, just west of the Silius village, SE Sardinia, Italy.

Material. – Seventy P1 and four P2 elements from samples FRU-B 3, FRU-B 6, GA 6, GCIU 26, GCIU 27, SBF 1, SBF 2, SBF 7, SIL 17, SIL 23 and SIL 24.

Etymology. – After our good friend Luca Simonetto, technician at the Friulian Natural History Museum of Udine, Italy.

Diagnosis. – A species of *Wurmiella* which P1 element is characterised by a very short, laterally curved posterior process, which tapers towards the distal end.

Description. – The P1 element of *Wu. lucae* sp. nov. is asymmetrical and laterally curved. The anterior process is longer than the posterior one, that is very short, laterally flexed and tapers towards the distal end. In upper view the element is curved; in lateral view the upper margin is straight, whilst the lower margin appears to flex upwards due to thinning of the anterior process. The cusp is stronger than the adjacent denticles and is posteriorly reclined. The processes bear closely spaced, laterally compressed and posteriorly reclined denticles. The large basal cavity is located below the cusp and extends as a narrow grove beneath the processes.

The P2 element is laterally compressed and consists of two straight process forming an angle of about 100°. The cusp is high and strong, slightly reclined posteriorly. The ovoidal basal cavity is located below the cusp and continues as a narrow grove below the processes. The posterior process is slightly longer than the anterior one. Both processes bear numerous closely spaced and laterally compressed denticles.

Remarks. – The P1 element of *Wu. lucae* sp. nov. differs by all other species of *Wurmiella* by the short and curved posterior process, which tapers towards the distal end. The P2 element is distinguished from that of *Wu. excavata* for the more acute angle between the processes.

Stratigraphic distribution. – *Wurmiella lucae* sp. nov. ranges from the *J. snajdri* to the lower part of the Lower *Oul. e. detortus* Zone. The species is especially abundant in the *J. crispa* Zone.

***Wurmiella pulchra* sp. nov.**
Figures 14H–J

2017 *Wurmiella* sp. A. – Schönlaub *et al*., pl. 2, fig. 15.
2021 *Wurmiella* sp. A. – Corriga *et al*., pp. 201, 202, pl. 2, fig. 5.
2024 *Wurmiella* sp. A Corriga *et al*., 2021. – Ferretti *et al*., fig. 3.
2024 *Wurmiella excavata* (Branson & Mehl, 1933). – Barrick *et al*., pl. 1, figs 7, 13 (only).

Holotype. – P1 element IPUM 35176, illustrated in Fig. 14J.

Paratypes. – Published P1 elements IPUM 35174, 35175; unpublished P1 elements IPUM 35200, 35201/1-6, 35202/1-2.

Type horizon and locality. – Bed of Sample SBF 5. San Basilio Fenugu section, SE Sardinia, Italy.

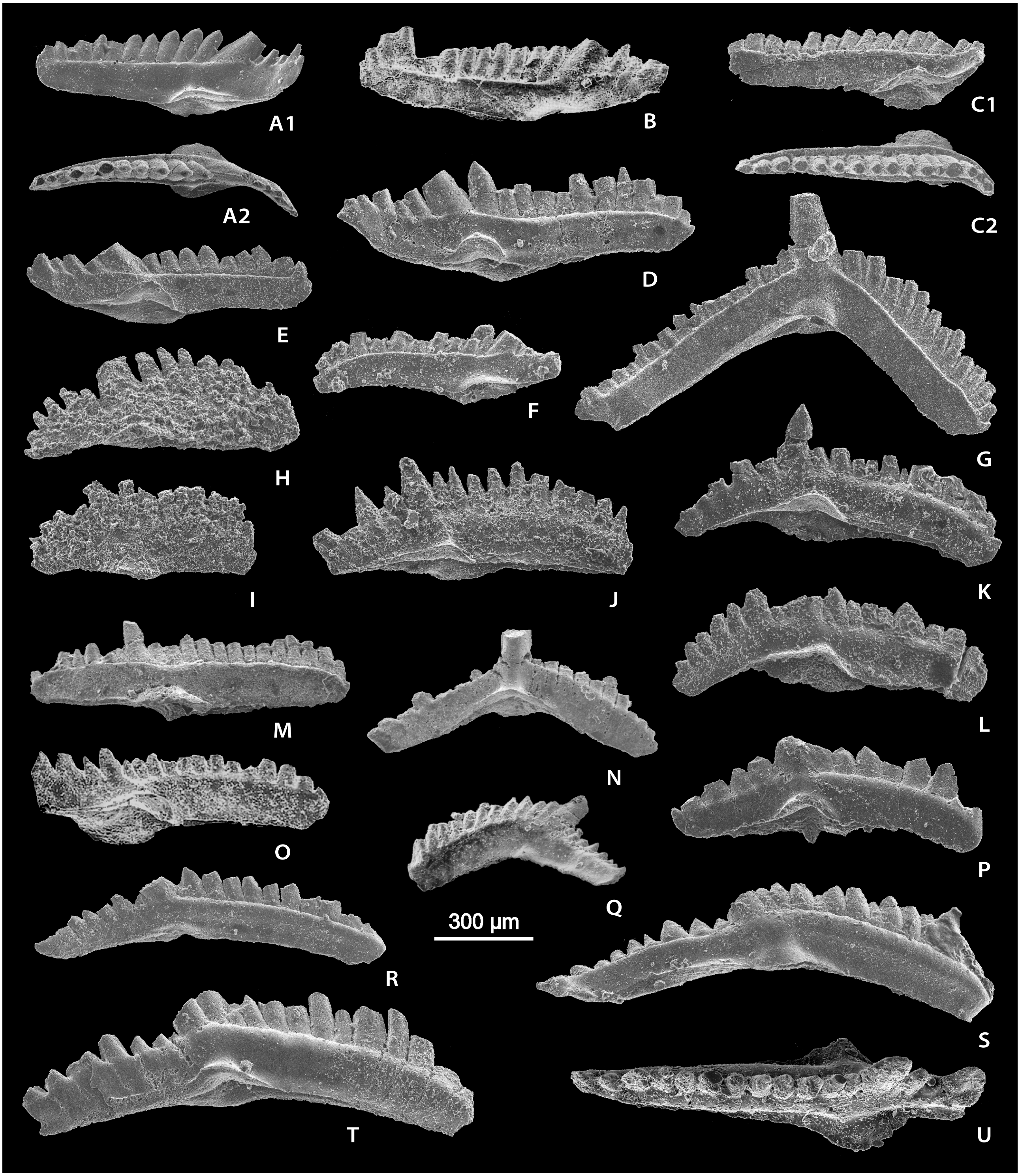
Material. – Eleven P1 elements from samples RMC 1A, RMC 3B, SBF 3 and SBF 5.

Etymology. – From the Latin *pulchra* = nice.

Diagnosis. – A species of *Wurmiella* which P1 element has an anterior process longer and higher than the posterior one, and a distinct cusp posteriorly reclined.

Description. – The P1 element of *Wurmiella pulchra* sp. nov. is straight, characterised by a strongly asymmetrical

Figure 14. A–G – *Wurmiella lucae* sp. nov. A – lateral (A1) and upper (A2) views of holotype P1 element IPUM 35167, sample SIL 23, *J. crispa* Zone. B – lateral view of paratype P1 element IPUM 35168, sample SBF 2, *J. crispa* Zone. C – lateral (C1) and upper (C2) views of paratype P1 element IPUM 35169, sample GCIU 26, *J. crispa* Zone. D – lateral view of paratype P1 element IPUM 35170, sample SBF 2, *J. crispa* Zone. E – lateral view of paratype P1 element IPUM 35171, sample SIL 23, *J. crispa* Zone. F – lateral view of paratype P1 element IPUM 35172, sample SIL 24, *J. crispa* Zone. G – lateral view of paratype P2 element IPUM 35173, sample SIL 23, *J. crispa* Zone. • H–J – *Wurmiella pulchra* sp. nov. H – lateral view of paratype P1 element IPUM 35174, sample RMC 1A, *Pol. siluricus* Zone. I – lateral view of paratype P1 element IPUM 35175, sample SBF 5, *A. ploeckensis*



Zone. J – lateral view of holotype P1 element IPUM 35176, sample SBF 5, *A. ploeckensis* Zone. • K, L – *Wurmiella arcuata* sp. nov. K – lateral view of holotype P1 element IPUM 35177, sample FRU 0, *K. v. variabilis* Zone. L – lateral view of paratype P1 element IPUM 35178, sample SIL 2, *K. v. variabilis* Zone. • M, N – *Wurmiella excavata* (Branson & Mehl, 1933). M – lateral view of P1 element IPUM 35179, sample GCIU 30, *J. crispa* Zone. N – lateral view of P2 element IPUM 35180, sample GCIU 30, Lower *Oul. e. detortus* Zone. • O – *Wurmiella inflata* (Walliser, 1964). Lateral view of P1 element IPUM 25902, sample SIL 4, *A. ploeckensis* Zone. • P – *Wurmiella* sp. C. Lateral view of P1 element IPUM 35181, sample GCIU 25, *J. snajdri* Zone. • Q–U – *Wurmiella silurica* sp. nov. Q – lateral view of paratype P2 element IPUM 35182, sample GCIU 1, *Pol. siluricus* Zone. R – lateral view of paratype P1 element IPUM 35183, sample SIL 8, *Pol. siluricus* Zone. S – lateral view of holotype P1 element IPUM 35184, sample SIL 8, *Pol. siluricus* Zone. T – lateral view of paratype P1 element IPUM 35185, sample SIL 8, *Pol. siluricus* Zone. U – upper view of paratype P1 element IPUM 35186, sample RMC 1A, *Pol. siluricus* Zone.

blade, being the anterior process longer and higher than the posterior one, that is very short. The lower margin of the element is straight, whereas the upper margin looks slightly arched, because both processes taper towards the extremities. The basal cavity is located in the posterior third of the element and extends as a narrow grove beneath the processes. The subtriangular cusp is larger than the other denticles and is posteriorly reclined. The closely spaced denticles are more or less of equal size above the two processes, becoming smaller close to the distal ends, and are posteriorly reclined.

Remarks. – *Wurmiella pulchra* sp. nov. differs from *Wu. excavata* for the asymmetrical blade and a generally arched aspect. It is different from *Wu. inclinata* (Rhodes, 1953) because the latter has a more arched blade bearing triangular discrete denticles; also, *Wu. inclinata* is documented in a lower stratigraphic position on the Llandovery.

Beside Sardinia, the species is documented in the Carnic Alps (Schönlaub *et al*. 2017, Corriga *et al*. 2021; our unpublished data) and in North Africa (Ferretti *et al*. 2024)

Stratigraphic distribution. – The species is documented from the *A. ploeckensis* to the *J. crispa* Zone.

***Wurmiella silurica* sp. nov.**
Figure 14Q–U

1998 *Wurmiella excavata* (Branson & Mehl, 1933). – Serpagli *et al*., pl. 1.2.1, fig. 4.
2010 *Wurmiella excavata* (Branson & Mehl, 1933). – Slavík *et al*., fig. 6i, j, m? (only).

Holotype. – P1 element IPUM 35184, figured in Fig. 14S.

Paratypes. – Published P1 elements IPUM 35183, 35185, 35186; P2 element IPUM 35182; unpublished P1 elements IPUM 25909, 35216, 35217/1-2, 35218/1-4; P2 element IPUM 35217/3.

Type horizon and locality. – Bed of sample SIL 8. Silius section, just west of the Silius village, SE Sardinia, Italy.

Material. – Thirteen P1 and two P2 elements in samples GCIU 1, RMC 1A, SIL 7, SIL 8 and SIL 16.

Etymology. – Because the species occur only in the *Pol. siluricus* Zone.

Diagnosis. – A species of *Wurmiella* which P1 element is characterised by a slightly arched shape and an anterior process bearing a weakly developed platform.

Description. – The P1 element of *Wu. silurica* sp. nov. is strong and slightly arched. The anterior process is higher and longer than the posterior one, and enlarges in the upper part, forming a very narrow platform. The posterior process is thin and shorter. The cusp is strong and larger that the denticles, and slightly posteriorly reclined. Denticles are closely spaced, and circular in cross section, and almost of equal size, although a few larger one may occur on the posterior process. The basal cavity is large and extends as a narrow grove beneath the processes.

The P2 element is laterally compressed and consists of two processes forming an angle of about 120°, giving to the element a somewhat arched shape. The posterior process bears small, closely spaced denticles, reclined toward the cusp; the anterior process is short and lower than the posterior one and bears small subtriangular denticles. The cusp is strong and posteriorly reclined. The small basal cavity is located below the cusp.

Remarks. – The P1 element of *Wu. silurica* sp. nov. differs by all other species of *Wurmiella* by the enlargement of the anterior process forming a narrow platform. The slightly arched shape distinguishes it from *Wu. excavata*.

Beside Sardinia, the species is documented in Czechia (Slavík *et al.* 2010) and is present in the Carnic Alps (our unpublished data).

Stratigraphic distribution. – The species is documented only from the *Po. siluricus* Zone.

***Wurmiella* sp. C**
Figure 14P

Material. – Five P1 elements from samples FRU-B 3, GCIU 25 and RMC 2Z.

Description. – *Wurmiella* sp. C is characterised by a slightly arched subtriangular profile and strong denticles on both processes. The anterior process is longer and somewhat higher than the posterior process. The cusp is strong and subtriangular, larger than adjacent denticles and slightly reclined. The wide, ovoidal basal cavity is located under the cusp and extends as a narrow grove beneath the processes.

Remarks. – The big denticles distinguish *Wurmiella* sp. C from all coeval species of *Wurmiella*. The general shape of the element may recall *Wu. inclinata*, but the latter has smaller triangular denticles.

Stratigraphic distribution. – *Wurmiella* sp. C occurs from the upper part of the *J. snajdri* Zone to the lower part of the *Z. eosteinhornensis* s.l. Zone.

Genus *Zieglerodina* Murphy, Valenzuela-Ríos & Carls, 2004

Type species. – *Spathognathodus remscheidensis* Ziegler, 1960.

***Zieglerodina eosteinhornensis* s.s. (Walliser, 1964)**
Figure 12K, L

1964 *Spathognathodus steinhornensis eosteinhornensis* n. ssp.; Walliser, pp. 85, 86, pl 9, fig. 15; pl. 20, figs 19–22 (only).
1990 *Ozarkodina remscheidensis eosteinhornensis* (Walliser, 1964) beta morphotype. – Olivieri & Serpagli, pp. 69, 70, pl. 4, figs 14, 15.
2011 *Ozarkodina eosteinhornensis* s.s. (Walliser, 1964). – Corriga, p. 113, pl. 2, figs 11, 12; pl. 5, fig. 9.
2014 *Ozarkodina eosteinhornensis* s.s. (Walliser, 1964). – Corriga *et al*., fig. 6d.
2017 *Ozarkodina eosteinhornensis* s.s. (Walliser, 1964). – Schönlaub *et al*., pl. 2., fig. 5.
2024 *Zieglerodina eosteinhornensis* (Walliser, 1964). – Barrick *et al*., p. 317, pl. 4, fig. 17.

Material. – Twenty-five P1 elements from samples GA 8, PML 3, SBF 1, SBF 9, SBF 10, SBF 11, SBF12, SIL 33 and SIL 34.

Remarks. – *Zieglerodina eosteinhornensis* s.s. is characterised by the presence of a denticle or a small ridge above at least one side of the platform. This feature is present in the holotype designated by Walliser (1964), and some authors considered to belong to this species only those elements with platform ornamentation (*e.g.* Barrick *et al*. 2024). However, an emended diagnosis strictly stressing this feature is missing: Murphy *et al.* (2004, p. 16) mentioned "… generally one or both platform lobes ornamented by a ridge or denticle", and included in the speces, as beta-morphs, those elements with an unornamented platform.

The generic attribution of the species *eosteoinhornensis* was debated for long time. Murphy *et al*. (2004) placed it in a different genus (Genus W) not defined according to the ICZN code, and therefore not valid. In recent years, several authors reported the species to genus "*Ozarkodina*", remarking an incertitude in the generic attribution (*e.g.* Schönlaub *et al*. 2017, Corradini *et al*. 2020, Spiridonov *et al*. 2020b, Manda *et al*. 2023, Gómez *et al*. 2024). However, all the elements of the apparatus have a very similar morphology to the analogous elements of genus *Zieglerodina*, and it looks more appropriate to attribute the species to the latter genus.

Stratigraphic distribution. – *Zieglerodina eosteinhornensis* s.s. occurs in a narrow horizon in the lower part of the Lower *Oul. el. detortus* Zone (Corradini & Corriga 2012).

***Zieglerodina eosteinhornensis* s.l. (Walliser, 1964)**
Figure 12S

1964 *Spathognathodus steinhornensis eosteinhornensis* n. ssp.; Walliser, pp. 85, 86, text-fig. 9, pl. 20, figs 7, 8, 12–15, 23, 25 (only).
1975 *Ozarkodina remscheidensis eosteinhornensis* (Walliser, 1964). – Klapper & Murphy, pp. 40, 41, pl. 7, fig. 23 (only).
1990 *Ozarkodina remscheidensis eosteinhornensis* (Walliser, 1964) alpha morphotype. – Olivieri & Serpagli, pp. 69, 70, pl. 4, figs 11, 12 [*non* fig. 13 = *Zieglerodina denticulata* (Viira, 2000)].
1992 *Ozarkodina steinhornensis eosteinhornensis* (Walliser, 1964). – Barrick & Klapper, p. 48, pl. 6, figs 2–4.
2009 *Ozarkodina eosteinhornensis* s.l. (Walliser). – Corriga & Corradini, fig. 4f (only).
2011 *Ozarkodina eosteinhornensis* s.l. (Walliser, 1964). – Corriga, pp. 111, 112, pl. 2, fig. 10; pl. 5, figs 7, 8; pl. 10, fig. 3.
2014 *Ozarkodina eosteinhornensis* s.l. (Walliser, 1964). – Corriga *et al*., fig. 6e.
2017 *Ozarkodina eosteinhornensis* s.l. (Walliser, 1964). – Voldman *et al*., fig. 2.14–2.17.
2020 "*Ozarkodina*" *eosteinhornensis* s.l. (Walliser, 1964). – Bremer *et al*., fig, 2a, b (only).
2023 "*Ozarkodina*" *eosteinhornensis* s.l. (Walliser, 1964). – Manda *et al*., figs 8h, k, n; 9o.

Material. – One hundred thirty-one P1, 69 P2, 20 M, 10 S0, 32 S1 and 35 S2 elements from samples BS 4, CAR 1, FRU-B 6, GCIU 12, GCIU 13, GCIU 18, GCIU 19, GCIU 20, GCIU 21, GCIU 22, GCIU 23, GCIU 24, GCIU 32, PML 1, RMC 4, SBF 1, SBF 2, SBF7, SBF 7a, SBF 8, SBF 9, SBF 10, SBF 11, SBF 11a, SBF 12, SIL 25, SIL 28, SIL 29, SIL 30, SIL 31, SIL 32, SIL 33, SIL 34, SIL 35, SIL 36, SIL 39.

Remarks. – *Zieglerodina eosteinhornensis* s.l. is characterised by the blade with upper and lower margins more or less straight and parallel, and denticles of the same size. The morphotype represents the majority of the elements in the type series by Walliser (1964) and differs from the holotype (= *Zieglerodina eosteinhornensis* s.s.) by lacking ornamentation above the platform lobes.

Barrick *et al.* (2024) moved all the elements from Midcontinent and western North America that previously were assigned to this species to their new species *Zieglerodina altidens* Barrick, Klapper & Peavey, 2024. We agree that the two species are very similar, but may be distinguished by the fact that in *Z. eosteinhornensis* s.l. the upper and lower margins of the blade are parallel and bears equal denticles, whereas in *Z. altidens* the upper margin is slightly oblique and a few larger denticles are present on both processes.

Stratigraphic distribution. – From within the *J. crispa* Zone, close to the base of the Přídolí, to the lower Lochkovian *Icr. hesperius* Zone (Corradini & Corriga 2012).

Zieglerodina ivochlupachi **Carls, Murphy & Valenzuela-Ríos, 2007**
Figure 12U

2007 *Zieglerodina ivochlupachi* n. sp.; Carls, Murphy & Valenzuela-Ríos, pp. 159, 160, figs 7a–y, 8q–s.
2023 *Zieglerodina ivochlupachi* Carls, Murphy & Valenzuela-Ríos, 2007. – Manda *et al*., figs 8i, j; 9c–f, k.

Material. – Fourteen P1 element from samples FRU-B 3, FRU-B 4, SBF 7, SIL 31, SIL 33 and SIL 34.

Remarks. – *Zieglerodina ivochlupachi* is characterised by a denticulation pattern with small and larger subtriangular denticles, higher in the distal part of the anterior process. The species was up to now reported only from the Czech Republic.

Stratigraphic distribution. – The species is documented from a short interval in the upper part of the *Z. eosteinhornensis* s.l. Zone (= *Z. ivochlupachi* Zone, *sensu* Vacek *et al*. 2018) and in the lower part of the *Oul. e. detortus* Zone (Manda *et al*. 2023). In Sardinia the species occurs in the lower part of the Lower *Oul. el. detortus* Zone, up to the *Z. eosteinhornensis* s.s. horizon.

Zieglerodina zellmeri **Carls, Murphy & Valenzuela-Ríos, 2007**
Figure 12W

2007 *Zieglerodina zellmeri* sp. nov.; Carls, Murphy & Valenzuela-Ríos, pp. 162, 163, figs 6a–g, j–n; 8m–p. (*cum syn*.)
2010 *Zieglerodina zellmeri* Carls, Murphy & Valenzuela-Ríos, 2007. – Corradini & Corriga, p. 252, pl. 3, fig. 19.
2020 *Zieglerodina* cf. *zellmeri* Carls, Murphy & Valenzuela-Ríos, 2007. – Hušková & Slavík, fig. 6a.
non 2022 *Zieglerodina zellmeri* Carls, Murphy & Valenzuela-Ríos, 2007. – Barrick & Kleffner, pl. 1, figs 1, 2, 8, 19, 20.
2023 *Zieglerodina zellmeri* Carls, Murphy & Valenzuela-Ríos, 2007. – Manda *et al*., figs 8g; 9a, b; 9p.
2024 *Zieglerodina zellmeri* Carls, Murphy & Valenzuela-Ríos, 2007. – Corradini *et al.*, pl. 1, fig. 8.

Material. – Five P1 elements from sample SBF 7.

Remarks. – *Zieglerodina zellmeri* is characterised by a slightly subtriangular shape in lateral view, as the upper margin gently slopes because the anterior process is higher than the posterior one; the denticulation pattern made of discrete denticles of similar size. Barrick *et al.* (2024) suggested that *Z. zellmeri* is a junior synonym of *Z. scanica* (Jeppsson, 1975). We do not agree on this, and we consider the two species distinct, because the general shape of the P1 element and the denticulation pattern are different: P1 elements of *Z. scanica* have the lower anterior margin slightly curved downward and denticles are strong, very close each other and partly fused.

The entry of *Z. zellmeri* approximates the base of the Přídolí Series.

Stratigraphic distribution. – The species is documented from the whole Přídolí.

Order Prioniodontida Dzik, 1976
Family Icriodontidae Müller & Müller, 1957

Genus *Pelekysgnathus* Thomas, 1949

Type species. – *Pelekysgnathus inclinatus* Thomas, 1949.

Pelekysgnathus crispus **sp. nov.**
Figure 12A–C

1995 *Pelekysgnathus index* Klapper & Murphy, 1975. – Barca *et al*., pl. 4, figs 4, 5.
1998 *Pelekysgnathus index* Klapper & Murphy, 1975. – Serpagli *et al*., pl. 1.2.2, figs 4, 5.
2009 *Pelekysgnathus* sp. A. – Corriga & Corradini, pp. 165, 166, fig. 6m.
2009a *Pelekysgnathus* sp. A Corriga & Corradini, 2009. – Corradini *et al*., pl. 1, fig. 9.
2009b *Pelekysgnathus* sp. A Corriga & Corradini, 2009. – Corradini *et al*., pl. 1, fig. 8.
2011 *Pelekysgnathus* sp. A Corriga & Corradini, 2009. – Corriga, p. 134., pl. 2, fig. 4; pl. 10, figs 6, 7.
non 2016 *Pelekysgnathus* sp. A? Corriga & Corradini, 2009. – Mathieson *et al*., pp. 607, 608, fig. 30h–j.
2021 *Pelekysgnathus* sp. A Corriga & Corradini, 2009. – Corriga *et al*., p. 203, pl. 2, fig. 1.

Holotype. – P1 element IPUM 35151, illustrated in Fig. 12A.

Paratypes. – Published P1 elements IPUM 25932, 25933. Unpublished P1 elements IPUM 28208, 35219, 35202/1-2, 35221, 35222/1-4; unpublished P2 element IPUM 35122/5.

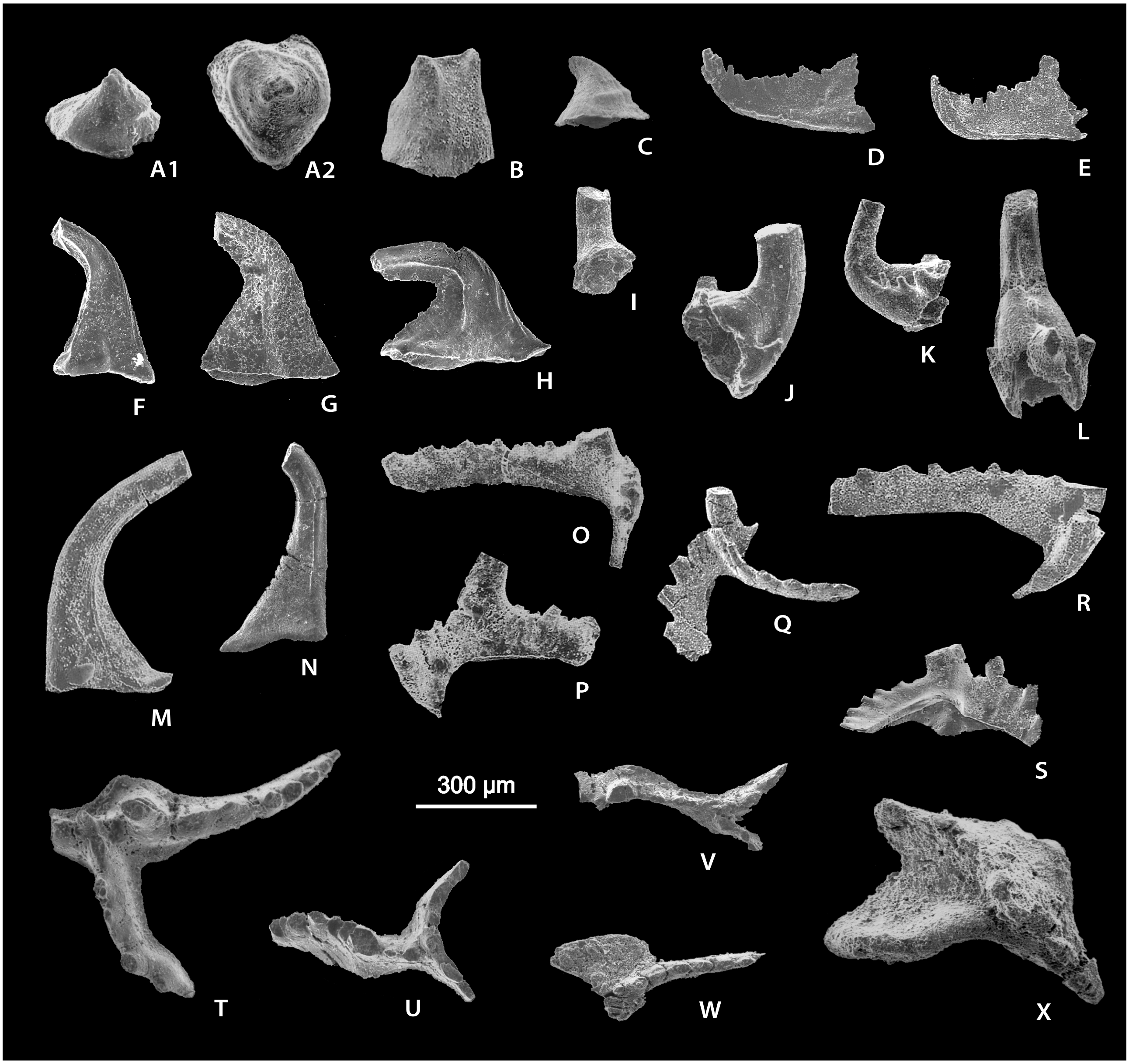


Figure 15. A – *Pseudooneotodus bicornis contiguus* Corradini, 2008. Lateral (A1) and upper (A2) views of the holotype, element IPUM 25869, sample SIL 23, *J. crispa* Zone (refigured after Corradini 2008). • B – *Pseudooneotodus bicornis bicornis* Drygant, 1974. Lateral view of element IPUM 25867, sample GCIU 9, *J. snajdri* Zone. • C – *Pseudooneotodus beckmanni* (Bischoff & Sannemann, 1958). Lateral view of element IPUM 35187, sample GCIU 26, *J. crispa* Zone. • D, E – *Belodella anomalis* Cooper, 1974. D – lateral view of Sa element IPUM 35188, sample SBF 2, *J. crispa* Zone. E – lateral view of Sa element IPUM 25934, sample SIL 29, *Z. eosteinhornenesis* s.l. Zone. • F–H – *Dapsilodus obliquicostatus* Cooper, 1974. F – lateral view of Sa element IPUM 35189, sample RMC 2, *J. snajdri* Zone. G – lateral view of Sb element IPUM 35190, sample RMC 2, *J. snajdri* Zone. H – lateral view of Sc element IPUM 35191, sample RMC 2, *J. snajdri* Zone. • I –L – *Coryssognathus dubius* (Rhodes, 1953). I – lateral view of coniform element IPUM 35192, sample SBF 9, Lower *Oul. e. detortus* Zone. J – lateral view of Pc element IPUM 35193, sample SBF 9, Lower *Oul. e. detortus* Zone. K – lateral view of Sc element IPUM 35194, sample SBF 9, Lower *Oul. e. detortus* Zone. L – lateral view of Sa/Sb element IPUM 35223, sample PML 3, Lower *Oul. e. detortus* Zone. • M – *Panderodus recurvatus* (Rhodes, 1953). Lateral view of element IPUM 25935, sample SIL 1, *K. v. variabilis* Zone. • N – *Panderodus unicostatus* (Branson & Mehl, 1933). Lateral view of element IPUM 35195, sample GCIU 10, *J. snajdri* Zone. • O–Q – *Oulodus elegans detortus* (Walliser, 1964). O – lateral view of S2 element IPUM 35196, sample SBF 9, Lower *Oul. e. detortus* Zone. P – lateral view of S2 element IPUM 25886, sample GCIU 22, Lower *Oul. e. detortus* Zone. Q – lateral view of P2 element IPUM 25890, sample CGIU 11, *J. snajdri* Zone. • R – *Oulodus elegans elegans* (Walliser, 1964). Lateral view of S2 element IPUM 25936, sample SIL 26, *Z. eosteinhornenesis* s.l. Zone. • S – *Oulodus siluricus* (Branson & Mehl, 1933). Lateral view of P1 element IPUM 25914, sample SIL 5, *A. ploeckensis* Zone. • T–V – anomalous element. T – upper view of element IPUM 28209, sample GCIU 1, *Pol. siluricus* Zone. U – upper view of element IPUM 28210, sample GCIU 6, *Pol. siluricus* Zone. V– upper view of element IPUM 35197, sample GCIU 1, *Pol. siluricus* Zone. • W, X – genus and species undetermined. W – upper view of element IPUM 35198, sample GCIU 20, Lower *Oul. e. detortus* Zone. X – upper view of element IPUM 35199, sample GCIU 1, *Pol. siluricus* Zone.

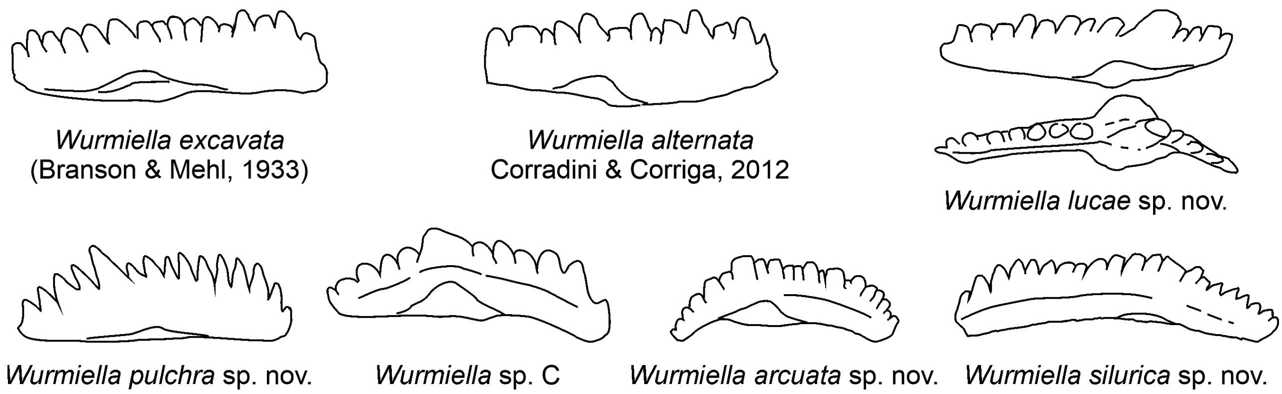


Figure 16. Sketched drawings of the various species of *Wurmiella*.

Type horizon and locality. – Bed of sample RMC 3B. Riu Murru de Callus section, east of the Siurgus-Donigala village, SE Sardinia, Italy.

Material. – Twelve P1 and one P2 element from samples GCIU 11, GCIU 29, RMC 2A, RMC 3B and SIL 23.

Etymology. – Because the species occurs only in the *J. crispa* Zone.

Diagnosis. – A species of *Pelekysgnathus* with the cusp slightly larger than the other denticles, and the basal cavity symmetrical and oval.

Description. – The P1 element is laterally compressed and with the anterior end slightly bent downward. The blade bears denticles partially fused, laterally compressed and of different size. The cusp is slightly larger than the other denticles and posteriorly reclined. The basal cavity is wide, symmetrical and oval, and is located under the posterior third of the element.

Remarks. – This taxon differs from *Pel. index* Klapper & Murphy, 1975 in having a smaller and almost symmetrical basal cavity, a less developed cusp and much more differentiated denticles. Farrell (2006) and Mathieson *et al*. (2016) illustrated P1 elements of *Pelekysgnathus* from the upper Ludfordian and Přídolí of Australia, that differ from *Pel. crispus* sp. nov. in the arched lower margin of the element and in bearing larger and discrete denticles.

The taxon is a rare component of the fauna of the lower part of the *J. crispa* Zone and is up to now documented only in Sardinia and in the Carnic Alps (Corriga & Corradini 2009, Corriga *et al*. 2021).

Stratigraphic distribution. – The taxon has been documented only from the lower part of the *J. crispa* Zone.

***Pelekysgnathus* sp. B**
Figure 12F

Material. – Two P1 elements from sample SBF 11A.

Description. – The P1 element of *Pelekysgnathus* sp. B is laterally compressed and with the posterior end bent downward. The blade bears denticles stronger and straight in the distal part, and reclined towards the cusp in the proximal part. The cusp is slightly larger than the other denticles and posteriorly reclined. One or two small denticles are present posteriorly to the cusp. The basal cavity is relatively wide, symmetrical and oval, and is located under the posterior third of the element.

Remarks. – *Pelekysgnathus* sp. B differs from *Pel. crispus* sp. nov. by the occurrence of at least one denticle posteriorly of the cusp and by the denticulation pattern. Farrell (2006) illustrated P1 elements of *Pelekysgnathus* from same stratigraphic level of Australia, that differ from *Pelekysgnathus* sp. B in the arched lower margin of the element and in bearing larger and discrete denticles.

Stratigraphic distribution. – The taxon occurs in the lower part of the *Z. eosteinhornensis* s.l. Zone.

Conclusions

The main results of this revision of the conodont association from the Ockerkalk of southeastern Sardinia may be summarised as follow:

(1) Eleven sections have been studied and biostratigraphically characterised.

(2) The fauna documents 48 taxa, among species and subspecies, belonging to 19 genera.

(3) Five new species are erected (*Pelekysgnathus crispus* sp. nov., *Wurmiella arcuata* sp. nov., *Wu. lucae* sp. nov., *Wu. pulchra* sp. nov., and *Wu. silurica* sp. nov.), and two more (*Pelekysgnathus* sp. B and *Wurmiella* sp. C) are left in open nomenclature awaiting additional material to be provided.

(4) A few taxa are documented for the first time in Sardinia: *Ozarkodina* cf. *nasuta* (Viira, 1983), *Parazieglerodina auriformis* (Simpson, 2003), *Wurmiella alternata* Corradini & Corriga, 2010, *Zieglerodina ivochlupachi* Carls *et al*., 2007, and *Zieglerodina zellmeri* Carls *et al*., 2007.

(5) The conodont fauna allows to report seven biozones from the uppermost part of the *K. v. variabilis* interval Zone to the Lower *Oul. e. detortus* Zone.

(6) The sedimentation of the Ockerkalk does not reach the Silurian–Devonian boundary as previously supposed, because there is no evidence of the Upper *Oul. e. detortus* Zone, nor of species having their first appearance datum in the latest Silurian beds.

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