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(Article begins on next page)

Fwd: [NOS] Editor Decision

1 messaggio

Carlo Corradini <carlcorr66@gmail.com>

19 gennaio 2017 18:58

Rispondi a: corradin@unica.it

A: Schoenlaub Hans-Peter <hp.schoenlaub@aon.at>, Annalisa Ferretti <ferretti@unimore.it>, Corriga Maria <corrigamaria@hotmail.it>

Dear all,

as you can see below the manuscript on Rauchkofel Boden section has been accepted!!

Another step of our cooperation is done. Thank-you very much

All the best,

Carlo

----- Messaggio Inoltrato -----

Oggetto:[NOS] Editor Decision**Data:**Thu, 19 Jan 2017 15:43:21 +0000**Mittente:**Borntraeger Science Publishers <mail@schweizerbart.de>**Rispondi a:**Jochen Erbacher <jochen.erbacher@bgr.de>**A:**Prof. Carlo Corradini <corradin@unica.it>

Dear Prof. Carlo Corradini:

I have reached a decision regarding your submission to Newsletters on Stratigraphy, "Chrono-, Litho- and conodont Bio-stratigraphy of the Rauchkofel Boden Section (Upper Ordovician-Lower Devonian), Carnic Alps, Austria".

My decision is: ACCEPT MANUSCRIPT.

If you have not already uploaded the final files to the system, please store all submission related files in one compressed archive and make sure that the maximum file size does not exceed 25 mB per upload.

Please upload the final files as new authors version under the Editors Decision tab of your submission entry.

Please wait until the revised uploaded file is visible on the submission page. This will make identification of submission files easier and speed up the processing time.

Please be aware that extensive modifications to the text will have to be approved by the Chief Editor and that this file will be used for typesetting. In the galleys only typographical errors will be corrected, any content related correction will have to be charged.

Thank you very much for choosing "Newsletters on Stratigraphy" for publishing your work.

Best regards,

Jochen Erbacher

jochen.erbacher@bgr.de



DIPARTIMENTO SCIENZE CHIMICHE E GEOLOGICHE
UNIVERSITA' DEGLI STUDI DI CAGLIARI
Via Trentino 51, 09127 – CAGLIARI ITALIA

Cagliari, January 13th, 2017

Dear Prof. Erbacher,

we submit the revised version of the manuscript:

Chrono-, Litho- and conodont Bio-stratigraphy of the Rauchkofel Boden Section (Upper Ordovician-Lower Devonian), Carnic Alps, Austria

by Hans Peter Schönlaub, Carlo Corradini, Maria G. Corrigan and Annalisa Ferretti

We followed most of the reviewer suggestions, and all the variations in the text than the previous version are in red in the file "*Schoenlaub et al text post referees*".

In the file named "*Replay to reviews*" we summarized the variations in the text according to reviewers comments, and in a few cases why we do not agree with their notes.

The paper includes 6 figures and 3 plates.

With best regards,

Carlo Corradini

Reviewer A:

68 significant gap is present at the Ordovician/Silurian boundary, where possibly part of the
typing error corrected (line 71)

98 clearly to the Katian Stage. Based on the heavy minerals zircon, tourmaline and rutile for these
typing error corrected (line 101)

127 adult, partly oriented nautiloids associated with articulate brachiopods, bivalves and gastropods (deleted d from articulated)
typing error corrected (line 130)

146 147 148 The Silurian/Devonian boundary is drawn in the uppermost part of the unit, about 40 cm below its top, where the basal Devonian conodont *Icriodus woschmidti* was recovered.

Carls, Slavik, and Valenzuela-Rios, 2007. Revisions of conodont biostratigraphy across the Silurian-Devonian Boundary, *Bulletin of Geosciences* 82 (2), 145-164. They consider *Icriodus woschmidti* s.s. to not be a good index for the base of the Devonian. In fact, the level of the FAD of the holotype is considered to be slightly younger than the level of the FAD of *Icriodus postwoschmidti* at another location.

Carls et al 2007 based their notes on material from Bohemia and Germany. Later *Icr. woschmidti* was documented to enter together with the conodont index of the boundary (*Icr. hesperius*), or slightly above in Sardinia and in the Carnic Alps (Corriga & Corradini 2009, Corriga 2011, Corradini & Corriga 2012, Corradini et al. 2015, Corriga et al 2016). We added some sentences to explain this in the Chronostratigraphy chapter (section 6, lines 533-539)

182 the Přídolí was preliminarily attempted. Faunas from the uppermost part of the Alticola Fm.
typing error corrected (line 186)

213 the Wolayer Fm. (Fig. 4). Conodonts are abundant in the upper part of the unit (samples 309 (deleted and from abundant and in the)
typing error corrected (line 186) and slightly rephrased the last part of the sentence (line 188)

218 219 The Pt. am. *amorphognathoides* Zone as defined by Walliser (1964) corresponds to the total range interval of the index Pt. am. *amorphognathoides* Walliser. This interval was later considered a "Zonal group" by Jeppsson (1997), who subdivided it into four zones.

The total range interval of Walliser was based on the range of that species in the section at Cellon, which does not likely represent the entire range. Jeppsson (1997) recognized a Pt. am. *amorphognathoides* Zone and a Pt. am. *amorphognathoides* Zonal group. The latter includes two additional zones, the Lower and Upper *Pseudooneotodus bicornis* Zones, for a total of THREE, not four, zones.

right!. we corrected (Line 225)

222 (Fig. 4) in millimetric carbonatitic infillings of small pocket on the irregular (infillings are of carbonate, so to make that an adjective, probably need to drop the e and add itic)

"carbonatic" is already adjective!

223 224 225 The conodont association includes *Pt. p. procerus* (Walliser) and *Distomodus staurognathoides* (Walliser) and coniform taxa, and does not allow to recognize any of the zones proposed by Jeppsson. Therefore we refer to the *Pt. am. amorphognathoides* Zone by Walliser. Jeppsson (1997) showed that the ranges of those two taxa and *Pt. am. amorphognathoides* overlap in his *Pt. am. amorphognathoides* Zone and also in the Lower and Upper *Ps. bicornis* Zones. The co-occurrence of those three taxa in the infillings of small pockets on the Wöls surface do permit recognition of the *Pt. am.* Zonal group. Additionally, since Jeppsson (1997) shows that the end of discontinuously represented and beginning of continuously represented *Pt. procerus* is in the upper part of the Upper *Ps. bicornis* Zone, it would seem most likely, as is concluded in lines 226-228, but stated differently, that the Upper *Ps. bicornis* can be recognized, the only zone of the *Pt. amorphognathoides* Zonal group that is likely just above the Llandovery/Wenlock boundary.

226 227 228 However, since all these taxa range up to the top of the Zone, and due to the continuity in the sedimentation with the overlying beds, the interval can be likely attributed to the uppermost part of the Zone, just above the Llandovery/Wenlock boundary.

The reviewer comment is interesting, but does not add anything sure: the dotted line traced in Jeppsson (1997) for the lower range of *Pt. procerus* indicates that the taxon may occur in the lower part of his *Pt. amorphognathoides* zonal. Therefore we cannot use the beginning of the solid line to state the age of this level, since the species may occur below. We maintain our previous text

232 233 234 Jeppsson (1997) subdivided this interval into two biozones at Gotland, and this scheme is accepted in various papers in Baltica and Laurentia (i.e.: Cramer et al., 2010; Männik et al., 2014), but this subdivision is not applicable in the condensed sequence of the Carnic Alps.

(deleted very detailed from but this very detailed subdivision is not applicable because a two-part subdivision is not really very detailed, and it is a two-part, not a four-part, subdivision, at least in Jeppsson (1997))

OK. rearranged lines 238-240

242 243 244 Jeppsson (1997) subdivided this interval into seven zones, that are impossible to discriminate in the Rauchkofel Boden Section. However, two of them (*K. patula* Zone and *K. o. ortus* Zone) were recognized in the Cellon Section by Corradini et al. (2015a).

Jeppsson (1997) recognized seven zones if the post *K. walliseri* interregnum is considered as a zone, and Jeppsson did consider it a zone in all of his figures. right!. we corrected (Line 248)

256 *Oz. s. rhenana* is present in the lowermost part of the Zone (sample 313), as documented in other areas of the Carnic Alps (Corradini et al. 2016).

I do not have a copy of Corradini et al. 2016, however, I do think it would be likely that *Oz. s. rhenana* would co-occur with *Oz. s. sagitta* within the lower part of its range. It is difficult to determine what the difference is between the P1 element identified as that of *Oz. s. rhenana* (Plate 2, fig. 1) and the P1 element identified as that of *Oz. s. sagitta* (Plate 2, fig. 4). The former is larger, but appears to have just as many denticles above the basal cavity, perhaps even more, than the latter. The denticles anterior to the basal cavity on the specimen identified as the P1 element of *Oz. s. sagitta* do appear to be really small and numerous, but it is difficult to determine that they are more numerous than the denticles anterior to the basal cavity in the specimen identified as the P1 element of *Oz. s. rhenana*. Lateral views of those two specimens, in addition to the upper views, would be helpful. It would also be helpful if a specimen of *Oz. s. rhenana* from the *Oz. s. rhenana* Zone were also included on Plate 2, to show the similar and different characteristics of earlier and later populations of *Oz. s. rhenana*.

Unfortunately it is not possible take a new photo of the figured specimen of *Oz. s. rhenana*: we took a new photo of the specimen figured by Schönlaub (1980), but the specimen is still stucked on the original stub. Moving from there after almost 40 years may be very dangerous, since the conodont could be damaged or even destroyed.

Also, we do not have now accessibility to the samples stored at Geological Survey in Vienna: so it is not possible take now photos from that material in a reasonable time (beside difficult arrangements)

269 270 not present in the lowermost part of the Zone (Calner & Jeppsson 2003), it looks more appropriate to name this interval as the classical *Oz. bohémica* Zone, even if the definition of the upper boundary is different than the original definition by Aldridge & Schönlaub (1989).

Since no subspecies of *Oz. bohémica* occur in this 20-cm thick interval tentatively identified as the classical *Oz. bohémica* Zone, and the lower boundary of Calner & Jeppsson's (2003) upper subdivision of the *Oz. bohémica* Zone is recognized, the *K. o. absidata* Zone, then it would seem to be just as appropriate to tentatively identify this 20-cm interval as the *Oz. bohémica longa* Zone.

For this point we accepted the suggestion by reviewer B, naming the Zone as *Oz. bohémica Interval Zone*" (lines 268-276)

292 In the Rachkofel Boden section is recognized in the central-upper part of the Kok Fm. (Fig. 4).

We have not understood this comment... since it is reported the same sentence than the text.

342 *Panderodus recurvatus* has its last occurrence in the section
typing error corrected (line 351)

346 347 348 5.14 "*Ozarkodina*" *eosteinhornensis* s.l. Interval Zone, Corriga & Corradini (2009)

The "*Oz.*" *eosteinhornensis* s.l. Interval Zone is defined as the interval between the last occurrence of *Oz. crispa* and the first occurrence of *Oulodus elegans detortus* (Walliser) (Corradini & Corriga 2012)

Which publication is the one that truly defines this Interval Zone, Corriga & Corradini (2009) or Corradini & Corriga (2012)

Corriga & Corradini (2009) introduced the name of the zone, renaming the former "*remscheidensis interval Zone*", whereas Corradini & Corriga (2012) described it in detail. We report both the quotation in line 357-358

352 in a similar position as in other sections in the region, like the Cellon Section (Corradini et al. 2015a).

Ok. text corrected (line 362)

363 in a similar position as at other sections in the Carnic Alps, like Cellon

Ok. text corrected (line 372)

373 At Rachkofel Boden this zone has

Ok. text corrected (line 383)

391 392 393 In the Rachkofel Boden Section these two species are not present, therefore the lower and upper boundaries were detected by the entries of *Icr. woschmidti* (Walliser) and *Pandorinellina optima* (Moskalenko), respectively: in many sections *Icr. woschmidti* enters at the same level of *Icr. hesperius* (Corradini & Corriga 2012).

Specimens recognized as *Icr. woschmidti* have been recognized in uppermost Pridoli samples at some localities, as well as from different levels in the lower part of the Lochkovian. Carls et al. (2007) do indeed conclude that *Icr. hesperius* (formerly *Icr. woschmidti hesperius*) is best for recognizing the base of the Devonian. Carls et al. (2007) also discussed the problem with the use of other subspecies of *Icr. woschmidti* for recognition of the base of the Devonian, including *Icr. woschmidti woschmidti*, which they indicated may even have an FAD higher than that of *Icr. postwoschmidti*. Since *Icr. hesperius* does not occur in the Rauchkofel Boden Section, and since the P1 element identified as that of *Icr. woschmidti* is incomplete and not identified as *Icr. woschmidti woschmidti*, the base of the *Icr. hesperius* Zone could be either slightly higher or lower than recognized. This is particularly so because the means for recognizing the *Icr. postwoschmidti* Zone, *P. optima*, as is stated in the manuscript, has not been shown to have an FAD that correlates with that of *Icr. postwoschmidti*. Carls et al 2007 based their notes on material from Bohemia and Germany. Later *Icr. woschmidti* was documented to enter together with the conodont index of the boundary (*Icr. hesperius*), or slightly above in Sardinia and in the Carnic Alps (Corrigo & Corradini 2009, Corrigo 2011, Corradini & Corrigo 2012, Corradini et al. 2015, Corrigo et al 2016). We added some sentences to explain this in the Chronostratigraphy chapter (section 6, lines 533-539) Also, there are no subspecies of *Icr. woschmidti* described, since the only former one is now considered a true species (*Icr. hesperius*)

433 beside the Carnic Alps (i.e.: Corrigo et al. 2011) it is detected in Bohemia
Ok. text corrected (line 449)

434 and Sardinia (Corrigo 2011
Ok. text corrected (line 450)

489 part or the whole Hirnantian and
typing error corrected (line 511)

510 511 the Silurian/Devonian boundary occurs in the uppermost part of the Alticola Fm., at level of sample 201, where the conodont *Icr. woschmidti* first appears. It is likely close to that level, but the FAD of *Icr. woschmidti*, while certain populations/subspecies can have an FAD at about the same level as *Icr. hesperius*, others can have an FAD in the late Pridoli or later in the early Lochkovian. We added some sentences reporting recent data from the Carnic Alps, on which the boundary is recognized (lines 533-539)

Reviewer B:

In general, I think that zones listed here without presence of indexes or other relevant markers and thus without clear limits and factual proof of the presence are only guessed and should be indicated as „tentatively proposed“ in all cases (in some cases it is mentioned, in others it is written „zone is dicriminated“ - not fully correct.

line 171 MGC, not MCG
typing error corrected (line 172)

Chapter 5.6. It would be good to mention shortly also the similar situation in the Prague synform (a sister area) whre the problems with the lower limits of the bohemica zone and subzones is commented (Slavík 2014).

I suggest to use “Oz. bohemica Interval Zone” as this is the typical case for that.

We agree on this (lines 268-278)

Just a surprise for me: No bohemica in the section! - very strange that it did not liked this place:-)...

We remarked the fact that Oz. bohemica has not been found in teh Carnic Alps up to now (line 273)

Chapter 5.7. The same issue related to that above, K. ortus absidata is treated as Subzone in the PS (and the reasons are hopefully clearly explained). There is doubtful lower and upper limit and most probably the taxon range is completely overlapped by the range of various morphotypes of bohemica. Moreover, the zonation in Cramer et al. (2011) is full of errors caused by oversimplifications. Therefore, to copy it should be better avoided.

the base of the K.o.absidata Zone is defined by the FAD of the index species, and therefore is easily applicable everywhere the taxon is present.

Slavik (2014) treated the K.O. absidata Zone as subzone in Bohemia, due to the overlap of the stratigraphical distribution of Oz. b. longa and K. o. absidata and the long ranging of the latter (Slavik 2014, p. 309). Maybe that in his mind he intended total range zones, only, but the definition of the K.o.absidata Zone is evident and easy to apply.

Therefore we stay with our zonation

Chapter 5.10.

Formal - the text should be a bit clarified: genreal definition of the given zone should be distinguished from the local definition of the zone, e.g., “Herein, the base of the zone...” Otherwise is seems confusing.

OK: rephrased (line 307)

Chapter 5.12.

This is very interesting and the composition of faunas exactly confirms the typical crisis of the Lau interval and the Post-Lau recovery of faunas (starting with re-appearing of spathognathodontids, which are at the very beginning very small and slender, then comes Ped. latialatus and then the larger snajdri-like morphologies in the Prague Synform).

Would be good to say something about this striking coincidence with the PS (Slavik & Carls 2012) because it is fantastic correlation!

Ref: Slavík, L., Carls, P. 2012: Post-Lau Event (late Ludfordian, Silurian) recovery of conodont faunas of Bohemia. - Bulletin of Geosciences 87(4), 815-832. DOI: 10.3140/bull.geosci.1368

Added a sentence to remark this important similitude (lines 339-341)

5.13. *Ped. latialata* becomes extinct within this zone...- Yes, a nice confirmation of the succession from the PS (Slavík & Carls 2012), see above.

5.14. Pity that *Z. zellmeri* - a promising basal Přídolí marker is not present here, but strangely it occurs in the upper part... Is it really *zellmeri*? (no figure was provided). This makes me a bit inquiet as this taxon is so typical for the early Přídolí and in the Požáry section enters together with the *parultimus*! (cf. Carls et al. 2007).

The taxon was reported from the lower Přídolí in Bohemia (Carls et al 2007), whereas is documented in the whole Přídolí in the Carnic Alps (Corradini and Corriga 2010, 2012, Corradini et al. 2015a, Corriga et al. 2016). We added a sentence to remark this (lines 391-394)

5.15.-5.16.

Although I understand the reasons for such a subdivision, it is clear from here that to use the coniform element for the zonal limit is extremely problematic. Especially for the bias of occurrence of coniform elements largely caused by depositional conditions - e.g., material sorting in calciturbidites...

We do not agree with this comment. Coniform elements are almost always an important part of the fauna, but many workers do not consider them because are more difficult to study than ozarkodinids and prioniodinids. The zonation proposed by Corradini and Corriga (2012) for the Carnic Alps and Sardinia, here followed, works well in several other areas (Morocco, Estonia, Montagne Noire, ...)

We will have to search jointly for better markers in near future.

We agree on this (and we already have some ideas...

5.16. Here is a problem with the zonal boundary - in the figure D. *obliquicostatus* is marked by blind dot = "problematic identification" in samples 7X-200! Therefore there cannot be discriminated any boundary limit based on that!

We checked again the incomplete specimen of *Daps. obliquicostatus* in sample 7, and the identification is sure. So we corrected Fig. 5: in the previous version we reported a blind dot because the specimen is incomplete. Now a full dot is reported

In the second paragraph, *Z. zellmeri* is mentioned in the uppermost Silurian, but this is in contradiction to Corradini & Corriga (2012) where *zellmeri* is typically lower Přídolí taxon (as it is also in the PS - cf. Carls et al. 2007).

see comment above (at paragraph 5.14). We added a sentence on the occurrence of *Z. zellmeri* in the Carnic Alps, and another possibly explaining the late entries of many taxa in the Rauchkofel Boden section, where are missing in the lower and middle Přídolí (lines 389-396)

5.17. formal - Is it 30cm or 40cm interval? - two different numbers in the chapter.

40 cm is correct. We erased the sentence in the final part of the paragraph, where the wrong thickness was reported

5.18. I would be very careful with usage of *I. postwoschmidti* and its superposition above *woschmidti* and *hesperius* (cf. extensive comments in Carls et al. 2007). It would be good to mention at least "some doubts" due to date from other regions.

We state at the beginning (Chapter 5 - lines 193-202) which zonations we follow in this paper. However we agree that a different scheme for the upper part of the lower Lochkovian should be proposed soon, possibly combining data from various areas. We added a sentence in this respect (lines 420-421)

"The *I. poswoschmidti* Zone is discriminated" - in this case (also following the general remark above) it should be mentioned as "tentatively suggested" or something alike.

OK. we corrected the text (line 422)

5.19. Yes, *carlsi* was suggested for the base of the middle Lochkovian in Slavík (2011) and then by Corradini & Corrigan (2012) and also again in zonation for the PS in Slavík et al. (2012).

added the citation of Slavík et al (2012) (Line 428)

5.21. *Anc. kutscheri* - I disagree that the taxon is "very rare and therefore it looks hardly usable for long distance correlation". In fact, it has almost the same dispersal as *trigonicus*!

We disagree with this note: up to now the taxon is not documented in the Carnic Alps, whereas in Sardinia only one specimen has been collected. Also, in the Pyrenees (one of the areas on which the Valenzuela Ríos et al 2015 zonation is base) it is missing in some sections... Also in North America *A. kutscheri* is a rare component of the faunas (M. Murphy personal communication to CC, dec 2016). The fact that a taxon is sometimes present in many areas does not mean that it is abundant, nor that it can be a good stratigraphical index taxon!

We added a sentence to make this more clear (lines 453-454)

If we compare the potentials of *kutscheri* and *D. obliquicostatus* for boundary subdivision... Is *D. obliquicostatus* in this comparison better?

Definitely better! (see comments above)

Fortunately the Lochkovian is much easier for detailed subdivision:-).

5.22.

"*trigonicus* LAD just below the entry of *pandora*" - I think, it is not completely right as in other areas there is *trigonicus*, then *kutscheri* + other crazy morphologies (e.g., *sequeirosi*, and in the PS many others not yet described branching morphs), often with *Kimognathus limbacarinatus* and then a small gap (few meters) and then the entry of *pandora* morphs. So not just above in more complete succession.

Pitty is that the uppermost Lochkovian is often hardly condensed in peri-gondwana (PS, Pyrenees), probably it is also the case of the Carnic Alps?

We refer to distribution in the Carnic Alps (added in line 469)

5.24. *Icr. steinachensis beta* - actually, the original proposal for the base in Slavík (2004) was *Icr. steinach. eta*. But later in Slavík et al. (2007) the base has been modified to *beta* morph, because it has been found together with early eognathodontids. So, for the meantime, it seems the *beta* and earliest eognathodontids have the same entry.

ref. Slavík, L., Valenzuela-Ríos, J.I., Hladil, J. & Carls, P. (2007): Early Pragian conodont-based correlations between the Barrandian area and the Spanish Central Pyrenees. - Geological Journal, 42, p. 499-512. ISSN 0072-1050

We added a few lines with the "story" of the zone (lines 487-491). We also added the quotation of Slavik et al 2007 in references

line 489- parts instead of pars
typing error corrected (line 511)

lines 513-514. I do not want only to push my citation, but in general it should be cited the original paper (Slavík & Hladil 2004) and not the compilation by Becker et al. (2012).
ref. Slavík, L. & Hladil, J. (2004): Lochkovian/Pragian GSSP revisited: evidence about conodont taxa and their stratigraphic distribution. - Newsletters on Stratigraphy, 40/3: 137-153. ISSN 0078-0421. Berlin, Stuttgart.
We agree with this comment: we changed the reference and added this paper in the reference list (Line 542)

1 **Chrono-, Litho- and conodont Bio-stratigraphy of the Rauchkofel Boden Section (Upper**
2 **Ordovician-Lower Devonian), Carnic Alps, Austria**

3

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5

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14

15 **Abstract**

16 An updated stratigraphy of the Rauchkofel Boden Section, a classical reference section for the
17 Carnic Alps that exposes rocks from the Katian (Upper Ordovician) to the Pragian (Lower
18 Devonian) is here presented, following latest developments in conodont taxonomy and
19 biostratigraphy, as well as in chronostratigraphy, and the recent introduction of a new
20 lithostratigraphic outline of the Carnic Alps. The original conodont collection of the '70s and '80s
21 was restudied and complemented by a detailed resampling in order to achieve a more precise
22 conodont biostratigraphic assignment. Twenty-five conodont Zones are now documented. The
23 lithostratigraphy is precisely fixed to the new lithostratigraphic scheme of the Pre-Variscan
24 sequence by definition of seven distinct formations. Finally, the position of chronostratigraphic
25 boundaries is discussed.

26

27

28 **Key words**

29 Carnic Alps, Ordovician, Silurian, Devonian, conodont biostratigraphy.

30

31

32 **1. Introduction**

33 The Rauchkofel Boden Section is one of the classical and most spectacular sections of the Carnic
34 Alps. An almost continuous calcareous sequence ranging from the upper Katian (Upper
35 Ordovician) to the Pragian (Lower Devonian) is there exposed, representing a reference section for
36 this long time interval in the Southern Alps **and in the peri-Gondwana area**. Several papers dealt
37 on various aspects of geology and fossil content of the section. The stratigraphic assignment was
38 **mainly** based on the detailed conodont studies by H.P. Schönlaub in the '70s. However, later
39 conodont studies have introduced new taxa and proposed more refined zonal schemes. The
40 lithostratigraphic scheme of the Pre-Variscan sequence of the Carnic Alps was recently updated
41 (Corradini and Suttner 2015), and all the formations are now established according to the
42 International Stratigraphic Guide.

43 In this paper we present an updated conodont stratigraphy of the Rauchkofel Boden Section,
44 based on a restudy of the original collections and a consistent new sampling throughout the
45 section. Lithostratigraphy is further implemented by the recognition of seven formations, and the
46 position of the chronostratigraphic boundaries is discussed.

47

48

49 **2. Geological Settings**

50 The Carnic Alps are located on either side of the Italian-Austrian border. Here, one of the best
51 exposed and most complete Palaeozoic successions in the world, ranging from the Middle
52 Ordovician to the Upper Permian, is exposed.

53 During the early Palaeozoic the Carnic Alps belong to those group of terrains (Galatian terranes;
54 von Raumer and Stampfli 2008), that detached from the northern Gondwana margin within the
55 Lower Ordovician, and moved northward faster than the main supercontinent. The drift from
56 about 50°S in the Late Ordovician, to 35°S in the Silurian and to tropical belt in the Devonian
57 (Schönlaub 1992) is reflected by distinct litho- and biofacies patterns.

58 Rocks from the Middle Ordovician to the lower Pennsylvanian, that were affected by the
59 Variscan orogeny during the late Bashkirian and Moscovian (Venturini 1990, Schönlaub and Forke
60 2007) constitute the so-called Pre-Variscan sequence. The lithostratigraphy of this sequence was
61 recently revised and 36 formations were finally discriminated in the Pre-Variscan sequence of the
62 Carnic Alps (Corradini and Suttner 2015). For a recent description of the geology of the Carnic Alps,
63 refer to Corradini et al. (2015e, 2016).

64

65

66 **3. The Rauchkofel Boden Section**

67 The Rauchkofel Boden Section is located on the southwestern slope of Mt. Rauchkofel, at
68 coordinates N 46°36'54", E 12°52'30", and an altitude of 2175 m (Fig. 1). It is easily accessible
69 along the trail running from the Lake Wolayer to the top of Mount Rauchkofel. About 65 m of
70 calcareous rocks documenting the Upper Ordovician-Lower Devonian are exposed (Figs 2-3). A
71 significant gap is present at the Ordovician/Silurian boundary, where possibly part of the
72 Hirnantian and almost the whole Llandovery is missing.

73

74 **3.1 Previous papers on the Rauchkofel Boden Section**

75 The Rauchkofel-Boden section is one of the best known and most fossiliferous sections of the
76 whole Carnic Alps corresponding to the “Wolayer facies” of Spitz (1909). A detailed description
77 was published, among others, by von Gaertner (1931), Heritsch (1929) and later by Schönlaub
78 (1970, 1971, 1977, 1980, 1985, 1997a, b), Ferretti and Histon (1997), Ferretti et al. (1999, 2004),
79 Ferretti (2005), Brett et al. (2009) and Corradini et al. (2015e).

80 Many studies were specifically devoted to describing the rich fossil association. The orthoconic
81 nautiloid fauna was studied by Ristedt (1968, 1969), Bogolepova (in Schönlaub and Bogolepova,
82 1994), Ferretti et al. (1999, 2004) and Histon (1999, 2000). Trilobites were described by Haas
83 (1969) and Santel (2001); bivalves by Kříž (1974, 1979); corals by Pickett (2007); dacryoconarids by
84 Alberti (1985); Problematica by Ferretti and Serpagli (2008) and Ferretti et al. (2013); and peculiar
85 echinodermal holdfasts by Ferretti et al. (2016). Conodonts were illustrated by Schönlaub (1980)
86 and, limited to the Ordovician, by Ferretti and Schönlaub (2001). The firm biostratigraphy from
87 these papers was the basis for other more global studies that have enabled correlation of the
88 Rauchkofel Boden Section outside the Carnic Alps and the peri-Gondwana area: sedimentology
89 and microfacies analysis was run by Dullo (1992), Ferretti and Histon (1997), Ferretti et al.
90 (1999, 2004, 2012a,b) and Ferretti (2005); sequence stratigraphy was investigated by Brett et al.
91 (2009); stable isotopes and geochemistry by Wenzel (1997), Ferretti (2005), Schönlaub et al.
92 (2011), Ferretti et al. (2012b) and Hammarlund et al. (2012). Finally, the heavy minerals of the
93 underlying clastic strata were studied by Schnabel (1976).

94

95 **3.2 Lithostratigraphy**

96 The base of the Rauchkofel Boden section is represented by a more than 100 m thick
97 unfossiliferous clastic sequence named the Himmelberg Formation (Schönlaub 2015). It comprises

98 massive to well bedded greyish to greenish sandstones and interbedded arenaceous shales
99 showing locally cross-bedding, ripples and conglomeratic intercalations indicating a shallow
100 marine environment. This formation is tentatively assigned to the Middle Ordovician and more
101 clearly to the Katian Stage. Based on the heavy minerals zircon, **tourmaline** and rutile for these
102 clastics, a source area of acid plutonic rocks (granites, pegmatites) has been inferred (Schnabel
103 1976).

104 The Himmelberg Formation is sharply overlain by the 10 to 15 m thick Wolayer Formation, the
105 varying thickness of which depends on the amount of erosion upon its deposition (Schönlaub and
106 Ferretti 2015). The Rauchkofel-Boden Section represents the type section for this formation. The
107 massive limestone of the unit is indistinctly bedded and rich in cystoid debris or complete cystoid
108 thecae, bryozoans, rare corals, brachiopods, ostracods, trilobites and conodonts (Ferretti and
109 Histon 1997, Ferretti et al. 1999, 2004, 2012b, Ferretti 2005, Brett et al. 2009). The grain-sized and
110 rudstone fabric indicate a dominant allochthonous accumulation of echinoderm debris and other
111 bioclasts possibly deriving from shallow water high-energy crinozoan mounds (Dullo 1992). On the
112 basis of conodonts, the Wolayer Fm. is dated to the late Katian-?basal Hirnantian (*Am. ordovicicus*
113 Zone; Ferretti and Schönlaub 2001).

114 The contact to the overlying Kok Formation (Ferretti et al. 2015a) is represented by an up to 5
115 mm thick irregular clayish stylolitic seam indicating a distinct disconformity (Fig. 3C). Locally, a
116 limestone-limestone-contact is developed. Stromatolite-like structures along discontinuity
117 surfaces have been associated to a peculiar microbial activity (Ferretti 2005; Ferretti et al. 2012b).
118 The conodont biostratigraphy and sedimentology of the Kok Formation was studied in detail by
119 Schönlaub (1970, 1971, 1977), Ferretti and Histon (1997), Ferretti et al. (1999, 2004), Histon
120 (1999), Ferretti (2005) and Brett et al. (2009). According to Ferretti (2005), hematitic to
121 manganese-rich crusts and thin oolitic grainstones infill small pockets on the upper irregular

122 surface of the underlying Wolayer Formation. The infillings have yielded conodonts of the *Pt. a.*
123 *amorphognatoides* Zone, corresponding to the end-Llandovery or close to the
124 Llandovery/Wenlock boundary. Apparently, most (if not all) of the Hirnantian Stage and most of
125 the Llandovery Series are missing (Ferretti 2005, Brett et al. 2009, Ferretti et al. 2012b).

126 The Kok Formation is 3.50 m thick and is represented by pinkish to greyish nautiloid-rich
127 packstones and wackestones of Wenlock age in the lower part, followed by indistinctly bedded
128 encrinitic, bioclastic and oolitic grainstones with iron-rich shaly partings of lower Gorstian. The
129 uppermost part comprises grayish and pinkish wacke-/packstones with abundant juvenile and
130 adult, partly oriented nautiloids associated with **articulate** brachiopods, bivalves and gastropods
131 (Ferretti and Histon 1997, Ferretti et al. 1999, 2004, 2012b, Ferretti 2005, Brett et al. 2009).

132 The overlying 40-50 cm thick *Cardiola* Formation (Ferretti et al. 2015b) was excavated during
133 World War I as a trench and later covered by soil and loose rocks that were easily dug for current
134 sampling. Black bituminous shales interfinger with lenses of dark micritic limestones yielding
135 nautiloids, bivalve representatives of the genus *Cardiola* (Kříž 1979, 1999) and conodonts of the *P.*
136 *siluricus* Zone. The fauna is dominated by nautiloids embedded in a matrix of bioclasts which are
137 frequently coated by micritic envelopes (Ferretti and Histon 1997, Ferretti et al. 1999, 2004,
138 Ferretti 2005, Brett et al. 2009).

139 With a sharp boundary, the *Cardiola* Fm. is overlain by 18 m thick limestones assigned to the
140 *Alticola* Formation (Ferretti et al. 2015c) of upper Ludfordian to basal Lochkovian age. Its upper
141 part forms a steep southward facing mostly grass-covered slope which ends up at the
142 Silurian/Devonian boundary. The limestone sequence is composed of massive pink to gray
143 wackestones/packstones with locally rich occurrences of large nautiloids, trilobites and solitary
144 rugose corals in the middle part (Ferretti and Histon 1997, Ferretti et al. 1999, 2004, Ferretti 2005,
145 Brett et al. 2009). The Ludlow/Přídolí boundary is drawn in the uppermost part of the steep slope,

146 just below the upper boundary of the *Oz. crispa* Zone. Towards the top, the Přídolíán part of the
147 limestone sequence is represented by dark grey, massive to coarse-bedded wackestones and
148 packstones rich in echinoderms including *Scyphocrinites* debris and even loboliths (Ferretti and
149 Histon 1997, Ferretti et al. 1999, 2004, Ferretti 2005, Brett et al. 2009). The Silurian/Devonian
150 boundary is drawn in the uppermost part of the unit, about 40 cm below its top, where the basal
151 Devonian conodont *Icriodus woschmidti* Walliser was recovered.

152 The following Rauchkofel Formation (Corradini et al. 2015d) is extremely condensed and
153 consists of 1.80 m thick thin-bedded limestone beds interbedded with black shales of Lochkovian
154 age.

155 The flat area south of the steep meadow is represented by 18 m thick limestones of the La
156 Valute Formation (Corradini et al., 2015c) which was previously named “Bodenkalk” by Schönlaub
157 (1985). It is composed of grey, coarse-bedded, very compact cephalopod limestones (mudstones
158 to wackestones). The Rauchkofel Boden Section is the type section of the La Valute Fm. As in other
159 areas (i.e., Mt. Zermula: Pondrelli et al. 2015, Corradini et al. 2016) the upper part the La Valute
160 Fm. becomes more marly and nodular and gradually passes into the overlying Findenig Fm.
161 (Corriga et al. 2011, Spalletta et al. 2015). This unit is represented by 20 m of reddish nodular
162 mudstones and wackestones. Orthoceratid nautiloids and hardly visible dacryconoarids (Alberti,
163 1985) are the only fossils observable in the field. The Lochkovian/Pragian boundary is drawn just
164 above the formation boundary by the occurrence of the dacryconoarid *Nowakia acuaria* (Richter)
165 at the base of the Findenig Fm. (Schönlaub 1980, Alberti 1985).

166

167

168 **4. Conodont fauna**

169 The Schönlaub conodont Collection from Rauchkofel Boden is stored at the Austrian Geological
170 Survey in Vienna. It includes 108 samples, mainly collected between 1969 and 1979, with a few
171 integration on selected intervals in the early '80s. This material was restudied and updated by
172 MGC and CC in 2015, according to the recent taxonomic and biostratigraphic novelties. We
173 complemented the original Schönlaub Collection with 36 new samples collected by AF in the
174 Ordovician and Silurian part of the section, mainly in the Wolayer, Kok and Cardiola formations,
175 and 41 picked by CC and MGC in the Ludlow to Lochkovian part. The additional Ordovician samples
176 are stored at the Palaeontological Museum of the University of Modena and Reggio Emilia (IPUM
177 code), and the Silurian and Devonian ones in the Palaeontological and Geological Museum
178 "Domenico Lovisato" of Cagliari University (MDLCA code).

179

180 Conodonts are in general quite abundant and relatively well preserved throughout the section,
181 but with great differences from level to level. Best preserved and richest associations are derived
182 from the lower part of the section, in the sector morphologically above the steep slope: the
183 associations from the Wolayer to the lower part of the Alticola formations (Katian to Ludfordian)
184 are particularly good. Samples from the steep slope (central and upper part of Alticola Fm.)
185 yielded very scarce and/or poorly preserved conodont elements and a precise biostratigraphy
186 within the Přídolí was preliminarily attempted. Faunas from the uppermost part of the Alticola Fm.
187 (uppermost Přídolí) to most of the La Valute Fm. (middle Lochkovian) are well preserved and
188 relatively abundant, and they suddenly became very scarce in the upper part of the section, where
189 many samples are barren of conodonts.

190

191

192 **5. Conodont Biostratigraphy**

193 The biostratigraphic assessment is based on the conodont zonation schemes in use for the
194 Upper Ordovician to the Lower Devonian. Bergström and Ferretti (2016) have recently re-tuned
195 the conodont biostratigraphic schemes in use for the Ordovician. The scheme by Cramer et al.
196 (2011) was followed for the Silurian, with the emendations by Corradini and Corriga (2012) and
197 Corradini et al. (2015a). However, the scheme by Corradini and Serpagli (1999) was utilized for the
198 Wenlock, as the detailed subdivision of the Wenlock by Cramer et al. (2011) revealed to be
199 unfitting for the Carnic Alps, as already pointed out by Corradini et al. (2016). The zonation
200 schemes provided by Corradini and Corriga (2012) and Valenzuela-Ríos et al. (2015) are applied for
201 the Lochkovian, with the variations suggested by Corriga et al. (2016) in the lower Lochkovian.
202 Finally, the scheme by Slavík (2004) is adopted for the lower Pragian.

203

204 The studied conodont fauna allows the discrimination in the Rauchkofel Boden Section of
205 twenty-five biozones documenting an interval ranging from the Katian (Upper Ordovician) to the
206 lower Pragian (Lower Devonian) (Figs 4-6). However, as reported above, possibly the Hirnantian
207 and the Llandovery are missing (Fig. 2). The conodont zones are briefly discussed below. For each
208 zone, its original definition, relative interval in the Rauchkofel Boden Section, occurrence of the
209 most characteristic taxa, and a few comments, if necessary, are provided. The complete conodont
210 distribution data are provided in Figures 4-6. Main taxa are illustrated in Pls. 1-3.

211

212 **5.1 *Amorphognathus ordovicicus* Zone, Bergström (1971)**

213 The *Am. ordovicicus* Zone was defined by Bergström (1971) as corresponding to the total range
214 of the marker index *Am. ordovicicus* (Branson and Mehl). For a review of the *Amorphognathus*
215 evolutionary lineage, on which the Late Ordovician conodont biozonation is based, refer to Ferretti
216 et al. (2014) and Bergström and Ferretti (2015). The population of *Amorphognathus* present in the

217 Rauchkofel Boden Section includes both *Am. ordovicicus* and *Am. duftonus*. The Zone is
218 documented in the Wolayer Fm. (Fig. 4). Conodonts are abundant in the upper part of the unit
219 (samples 309 and 309 top), where the fauna is dominated by coniform elements of *Walliserodus*,
220 associated with numerous elements of *Amorphognathus* and rare *Hamarodus* and *Plectodina*.

221

222 **5.2 *Pterospathodus amorphognathoides amorphognathoides* Zone, Walliser (1964)**

223 The *Pt. am. amorphognathoides* Zone as defined by Walliser (1964) corresponds to the total
224 range interval of the index *Pt. am. amorphognathoides* Walliser. This interval was later considered
225 a "Zonal group" by Jeppsson (1997), who subdivided it into three zones.

226 In the Rauchkofel Boden Section the *Pt. am. amorphognathoides* Zone is discriminated at the
227 very base of the Kok Fm. (Fig. 4) in millimetric carbonatic infillings of small pocket on the irregular
228 erosive surface of the underlying Wolayer Fm. The conodont association includes *Pt. p. procerus*
229 (Walliser) and *Distomodus staurognathoides* (Walliser) and coniform taxa, and does not allow to
230 recognize any of the zones proposed by Jeppsson. Therefore we refer to the *Pt. am.*
231 *amorphognathoides* Zone by Walliser. However, since all these taxa range up to the top of the
232 Zone, and due to the continuity in the sedimentation with the overlying beds, the interval can be
233 likely attributed to the uppermost part of the Zone, just above the Llandovery/Wenlock boundary.

234

235 **5.3 *Kockelella ranuliformis* interval Zone, Corradini and Serpagli (1999)**

236 The *K. ranuliformis* interval Zone is defined as the interval between the LAD of *Pt. am.*
237 *amorphognathoides* and the FAD of *Oz. s. rhenana* Walliser (Corradini and Serpagli 1999).
238 Jeppsson (1997) subdivided this interval into two biozones at Gotland, and this scheme is accepted
239 in various papers in Baltica and Laurentia (i.e., Cramer et al., 2010, Männik et al. 2014), but this
240 subdivision is not applicable in the condensed sequence of the Carnic Alps.

241 The named Zone is discriminated at the Rauchkofel Boden Section in the lower part of the Kok
242 Fm. (Fig. 4), in the 40 cm thick interval between samples 310 and 312, where the fauna is
243 dominated by coniform elements of genera *Dapsilodus*, *Panderodus* and *Pseudooneotodus*.

244

245 **5.4 *Ozarkodina sagitta rhenana* Zone, Aldridge and Schönlaub (1989)**

246 The *Oz. s. rhenana* Zone is defined as the interval between the FAD of the index taxon *Oz. s.*
247 *rhenana* and the FAD of *Oz. s. sagitta* Walliser (Aldridge and Schönlaub, 1989). Jeppsson (1997)
248 subdivided this interval into seven zones, that are impossible to discriminate in the Rauchkofel
249 Boden Section. However, two of them (*K. patula* Zone and *K. o. ortus* Zone) were recognized in the
250 Cellon Section by Corradini et al. (2015a).

251 At Rauchkofel Boden, the *Oz. s. rhenana* Zone is discriminated in the lower part of the Kok Fm.
252 by the entry of *Oz. s. rhenana* in sample 312, and is 30 cm thick only (Fig. 4). In the Carnic Alps the
253 Zone has been documented a few km to the East in the La Valute area in a different facies
254 represented by an alternation of shales and limestone, and is about 3 m thick (Corradini et al.,
255 2016).

256

257 **5.5 *Ozarkodina sagitta sagitta* Zone, Aldridge and Schönlaub (1989)**

258 The Zone corresponds to the interval of total range of *Oz. s. sagitta* (Jeppsson 1997, Jeppsson
259 and Calner 2002). In the Rauchkofel Boden Section the Zone is discriminated from sample 313 to
260 322/2 by the occurrence of *Oz. s. sagitta* (Walliser), and is 45 cm thick (Fig. 4). Within the Zone,
261 the index taxon largely dominates the association. *Oz. s. rhenana* is present in the lowermost part
262 of the Zone (sample 313), as similarly reported in other areas of the Carnic Alps (Corradini et al.
263 2016). *Ps. lingucornis* Jeppsson has its only occurrence within this Zone (sample 321/1), as
264 documented also in other areas (Männik and Małkowski 1998, Jeppsson (in Calner and Jeppson)

265 2003, Corradini 2008, Corradini et al. 2016). *Kockelella o. ortus* (Walliser), that normally has a
266 longer range is here documented only from the upper part of the Zone.

267

268 **5.6 *Ozarkodina bohémica* Interval Zone**

269 The interval between the LAD of *Oz. s. sagitta* (Walliser) and the FAD of *K. ortus absidata*
270 Barrick and Klapper is assigned to the *Oz. bohémica* Interval Zone. This interval was named *Oz. b.*
271 *longa* Zone by Calner and Jeppsson (2003), who subdivided the former *Oz. bohémica* Zone by
272 Aldridge and Schönlaub (1989) into two parts, the *Oz. bohémica longa* and *K. o. absidata* zones
273 respectively. However, since *Oz. bohémica bohémica* (Walliser) and *Oz. b. longa* Jeppsson have not
274 been found in the Carnic Alps so far, and because the latter taxon is not present in the lowermost
275 part of the Zone (Calner and Jeppsson 2003), it looks more appropriate to name this interval as *Oz.*
276 *bohémica* Interval Zone.

277 In the Rauchkofel Boden Section the *Oz. bohémica* interval Zone is tentatively detected in the
278 short (20 cm thick) not sampled interval between samples 322/2 and 323/1 (Fig. 4).

279

280 **5.7 *Kockelella ortus absidata* Zone, Calner and Jeppsson (2003)**

281 The *K. o. absidata* Zone represents the interval between the FAD of *K. o. absidata* and the FAD
282 of *K. crassa* (Walliser), and includes the top Homeric strata (Cramer et al. 2011).

283 At Rauchkofel Boden the Zone is detected in the narrow interval of sample 323/1 by the entry
284 of the index taxon (Fig. 4).

285

286 **5.8 *Kockelella crassa* Zone, Walliser (1964)**

287 The *K. crassa* Zone corresponds to the interval of the total range of the marker *K. crassa*
288 (Corradini and Serpagli 1999). The base of this Zone coincides with the base of the Ludlow series
289 (Cramer *et al.* 2011).

290 In the Rauchkofel Boden Section the Zone is discriminated in a 40 cm interval in the central part
291 of the Kok Fm., from sample 313/3 to 314 (Fig. 4). *Kockelella v. variabilis* Walliser enters within the
292 Zone, and *Coryssognathus dubius* (Rhodes) in its upper part.

293

294 **5.9 *Kockelella variabilis variabilis* Interval Zone, Cramer et al. (2011)**

295 The *K. v. variabilis* Interval Zone corresponds to the interval between the LAD of *K. crassa* and
296 the FAD of *Ancoradella ploeckensis* Walliser (Cramer et al. 2011).

297 In the Ranchkofel Boden Section it is recognized in the central-upper part of the Kok Fm. (Fig.
298 4). The lower boundary is marked by the last occurrence of *K. crassa* in sample 314, and the upper
299 boundary is here detected by the entry of *Kockelella o. sardoa* Serpagli and Corradini in sample Y,
300 because the index taxon *A. ploeckensis* is not present. *Wurmiella excavata* (Branson and Mehl)
301 and *Belodella resima* (Philip) have their first occurrence in the lower part of the Zone.

302

303 **5.10 *Ancoradella ploeckensis* Zone, Walliser (1964)**

304 The *A. ploeckensis* Zone is defined as the interval between the FAD of *A. ploeckensis* and the
305 FAD of *Polygnathoids siluricus* Branson and Mehl. However, as pointed out by other authors (i.e.:
306 Corradini and Serpagli 1999; Slavík 2014), *A. ploeckensis* is a rare species, which has not been
307 found also in the Rauchkofel Boden Section. The base of the Zone is here recognized by the entry
308 of *Kockelella o. sardoa*, which has its FAD coincident with the FAD of *A. ploeckensis* (Serpagli and
309 Corradini 1999).

310 The *A. ploeckensis* Zone is discriminated in the uppermost 90 cm of the Kok Fm. (Fig. 4).
311 *Wurmiella inflata* Walliser occurs only in this Zone, whereas elsewhere it appears in older strata
312 (Corradini and Serpagli 1999, Corrigan *et al.* 2009). *Wurmiella? posthamata* Walliser has its only
313 occurrence in samples 325 and X, both collected in the uppermost bed of the Kok Fm. *Kockelella v.*
314 *ichnusae* Serpagli and Corradini and *Wurmiella* sp. A, characterized by an asymmetrical P1
315 element, enter in the upper part of the Zone, in the same level where *C. dubius* has its last
316 occurrence.

317

318 **5.11 *Polygnathoides siluricus* Zone, Walliser (1964)**

319 This Zone corresponds to the interval of total range of *P. siluricus* and is one of the zones with
320 widest distribution in the Silurian: it has been indicated in all published zonal schemes and
321 everywhere its boundaries are defined on the same criteria.

322 In the Rauchkofel Boden Section this Zone is discriminated in the Cardiola Fm. and in the lower
323 50 cm of the Alticola Fm. (Fig. 5). The lower boundary is recognized by the entry of the marker
324 *Polygnathoides siluricus*, and the upper boundary by the last occurrence of elements of the genus
325 *Kockelella*. In fact, all the last representatives of this genus became extinct in the uppermost part
326 of the zone (Serpagli and Corradini 1999, Slavík *et al.* 2010). Among them *Kockelella maenniki*
327 Serpagli and Corradini occurs only within this Zone. *Ozarkodina confluens* (Branson and Mehl)
328 enters in the central part of the Zone.

329 Within this Zone a few anomalous elements, represented mainly by ramiforms with branched
330 processes, are present. Such specimens are documented in various intervals of the Silurian and
331 Lower Devonian, but are particularly abundant in the *P. siluricus* Zone (e.g., Corradini *et al.* 1996,
332 2015a, 2016, Slavík *et al.* 2010, Corrigan *et al.* 2014).

333

334 **5.12 *Pedavis latialata*–*Ozarkodina snajdri* Interval Zone, Corradini et al. (2015a)**

335 This Zone corresponds to the interval between the *Po. siluricus* and the *Oz. crispa* zones
336 (Corradini et al. 2015a). For the reasons of defining the Zone by the two more representative taxa
337 refer to Corradini et al. (2015a, p. 60).

338 At Rauchkofel Boden the Zone is discriminated in the lower part of the Alticola Fm. and is about
339 4 m thick. This interval documents the “Lau event” and the “post-Lau recovery”, with an evolution
340 of faunas similar to that documented in other nearby areas (i.e., Prague Synform, Slavík and Carls
341 2012): in the lower part of the Zone the conodont diversity is scarce, and the association is
342 dominated by coniform elements (*Panderodus*, *Belodella* and *Dapsilodus*). *Pedavis latialata*
343 (Walliser) enters in the upper part of the Zone, and *Oz. cf. snajdri* (Walliser) and *Wurmiella* sp. B
344 occur in the upper part, only. The latter species is characterized by a distinct enlargement of the
345 blade in the P1 element, just below the insertion of denticles.

346

347 **5.13 *Ozarkodina crispa* Zone, Walliser (1964)**

348 The *Oz. crispa* Zone corresponds to the interval of total range of *Oz. crispa* Walliser (Corradini
349 and Serpagli 1999). At Rauchkofel Boden it is detected in a 1.5 m interval in the lower part of the
350 Alticola Fm., around the upper edge of the steep slope (samples 81/27-2l; Fig. 5). *Pedavis latialata*
351 became extinct within the Zone; *Panderodus recurvatus* has its last occurrence in the section at
352 the top of the Zone, whereas it normally ranges longer in the upper Přídolí (Corradini and Corrigan
353 2012).

354

355 **5.14 "*Ozarkodina*" *eosteinhornensis* s.l. Interval Zone, Corrigan and Corradini (2009)**

356 The "*Oz.*" *eosteinhornensis* s.l. Interval Zone is defined as the interval between the last
357 occurrence of *Oz. crispa* and the first occurrence of *Oulodus elegans detortus* (Walliser) (Corrigan

358 and Corradini 2009, Corradini and Corriga 2012). Conodonts are very rare in samples collected in
359 the steep slope, and *O. e. detortus* enters only at a younger level. It appears therefore impossible
360 to locate precisely the upper boundary of the "Oz." *eosteinhornensis* s.l. Interval Zone, which is
361 tentatively drawn a couple of meters below the "Oz. " *eosteinhornensis* s.s. horizon, in a position
362 similar to other sections in the region, like the Cellon Section (Corradini et al. 2015a).

363

364 **5.15 Lower *Oulodus elegans detortus* Zone, Corradini and Corriga (2012)**

365 The lower boundary of the Lower *O. e. detortus* Zone is defined by the first occurrence of *O. e.*
366 *detortus* and the upper boundary by the last occurrence of *Dapsilodus obliquicostatus* (Branson
367 and Mehl) (Corradini and Corriga 2012).

368 In the Rauchkofel Boden Section the Zone has been discriminated along the lower part of the
369 steep slope, but it not possible to precisely place its lower boundary. The index taxon *O. e.*
370 *detortus* enters higher in the section, and other diagnostic taxa are missing. Therefore the base of
371 the Zone is tentatively located about 2 m below the occurrence of "Oz." *eosteinhornensis* s.s.
372 (Walliser), in a similar position than other sections in the Carnic Alps, like Cellon (Corradini et al.
373 2015). The upper boundary is placed just above sample 7 (Fig. 5), from where an incomplete
374 specimen of *D. obliquicostatus* was collected.

375 Conodonts are very rare in this interval, and mainly represented by *W. excavata* and coniform
376 elements. In the central part of the Zone *W. alternata* Corradini and Corriga and "Oz."
377 *eosteinhornensis* s.s. are present: the latter taxon always marks a well defined horizon, that can be
378 used for correlations (see discussion in Corradini and Corriga 2012, p. 647).

379

380 **5.16 Upper *Oulodus elegans detortus* Zone, Corradini and Corriga (2012)**

381 The Upper *O. e. detortus* Zone is the interval between the LAD of *Daps. obliquicostatus* and the
382 FAD of *Icriodus hesperius* Klapper and Murphy (Corradini and Corriga 2012). At Rauchkofel Boden
383 this Zone has been discriminated in the upper part of the Alticola Fm. (beds of samples 7X-200): its
384 lower boundary is placed just above the last occurrence of the index taxon, and the upper
385 boundary by the first occurrence of *Icriodus woschmidti* (Walliser), that has its FAD together with
386 the marker (Corradini and Corriga 2012).

387 Anomalously *Oulodus el. elegans* (Walliser) and *Oul. el. detortus* occur only in the lower part of
388 this Zone, and *Zieglerodina planilingua* (Murphy and Valenzuela-Ríos) enters within this Zone,
389 whereas elsewhere in the Carnic Alps these taxa have their first occurrences in the middle Přídolí
390 (*Oul.el. detortus* and *Z.planilingua*) or in the uppermost Ludlow (*Oul. el. elegans*) (Corradini and
391 Corriga 2012, Corradini et al. 2015a). Also, *Zieglerodina zellmeri* Carls et al. that is documented in
392 most of the Přídolí in the Carnic Alps (Corradini and Corriga 2010, 2012, Corradini et al. 2015a,
393 Corriga et al. 2016) and in the lower part of the Series in Bohemia (Carls et al.2007) at Rauchkofel
394 Boden occurs only in this Zone. These late first occurrences may be related to the scarcity of
395 conodonts within the “steep slope” of the section, where the Alticola Fm. appears to have a more
396 marly facies than the classical one of the unit.

397 In the upper part of the Zone the typical succession of events documented in other parts of the
398 Carnic Alps (Corradini and Corriga 2010, 2012; Corradini et al. 2015; Corriga et al. 2016) occurs:
399 last occurrence of *Oz. confluens* (Branson and Mehl) in sample 7Z, just followed by the entries of *Z.*
400 *remscheidensis* (Ziegler) and *Z. eladioi* (Valenzuela-Rios) in sample 199, and by the last occurrence
401 of *Z. zellmeri* (sample 7W).

402

403 **5.17 *Icriodus hesperius* Zone, Corriga et al. (2016)**

404 The *Icr. hesperius* Zone is discriminated in a very short interval, 40 cm thick, across the
405 boundary between the Alticola and the Rauchkofel Fm. (Fig. 5). The lower boundary is defined by
406 the FAD of *Icr. hesperius* Klapper and Murphy, and the upper boundary by the FAD of *Icr.*
407 *postwoschmidti* Mashkova (Corriga et al. 2016). In the Rauchkofel Boden Section these two species
408 are not present, therefore the lower and upper boundaries were detected by the entries of *Icr.*
409 *woschmidti* (Walliser) and *Pandorinellina optima* (Moskalenko), respectively: in many sections *Icr.*
410 *woschmidti* enters at the same level of *Icr. hesperius* (Corradini and Corriga 2012).

411 *Ziegerodina* sp. A Corriga et al. 2016, characterized by an alternate denticulation (Pl. 3, Fig. 3),
412 occurs in this Zone.

413

414 **5.18 *Icriodus postwoschmidti* Zone, Corriga et al. (2016)**

415 The *I. postwoschmidti* Zone is defined as the interval between the FAD of *Icr. postwoschmidti*
416 and the FAD of *Ancyrodelloides carlsi* (Boersma). As *Icr. postwoschmidti* was not recovered in the
417 Rauchkofel Boden Section, the lower boundary is tentatively aligned with the entry of
418 *Pandorinellina optima*, that has been already used as zonal index in the lower Lochkovian of
419 Bohemia (Slavík et al. 2012). However, the alignment of the FAD of *Pand. optima* with the FAD of
420 *Icr. postwoschmidti* is still to be demonstrated. **A new, more precise zonation for the upper part of**
421 **the lower Lochkovian should be developed in the near future.**

422 The *I. postwoschmidti* Zone is **tentatively suggested** in a 80 cm thick interval in the lower part of
423 the Rauchkofel Fm. (Fig. 5). *Lanea omoalpha* Murphy and Valenzuela-Ríos enters within the Zone.

424

425 **5.19 *Ancyrodelloides carlsi* Zone, Corradini and Corriga (2012)**

426 The *Ad. carlsi* Zone is defined as the interval between the FAD of *Ad. carlsi* and the FAD of *Ad.*
427 *transitans* (Bischoff and Sannemann) (Corradini and Corriga 2012). Slavík (2011), Corradini and

428 Corriga (2012) and Slavík et al. (2012) proposed the entry of the index taxon to be used to define
429 the base of the middle Lochkovian.

430 At the Rauchkofel Boden Section the Zone is discriminated in the upper part of the Rauchkofel
431 Fm. and in the lowermost part of the La Valute Fm. (Figs 5-6). "*Ozarkodina*" *malladai* Valenzuela-
432 Ríos enters in the upper part of the Zone, just above the last occurrence of *Z. planilingua*.

433

434 **5.20 *Ancyrodelloides transitans* Zone, Valenzuela-Ríos (1994)**

435 The *Ad. transitans* Zone is defined as the interval between the FAD of *Ad. transitans* and the
436 FAD of *Ad. trigonicus* Bischoff and Sannemann, and includes the *Ad. transitans* and *L. eleanorae*
437 zones by Corradini and Corriga (2012). The latter taxon in fact was reported before the entry of
438 *Ad. transitans* in the Pyrenees (Valenzuela-Ríos et al. 2015) and cannot be used for correlations.

439 In the Rauchkofel Boden Section the Zone occurs in the lower part of the La Valute Fm., in a 2 m
440 interval between samples 208 and 211 (Fig. 6). The lower boundary is discriminated in sample 208
441 by the entry of *Flajsella schulzei* (Bardashev), that has its FAD in the lower part of the Zone
442 (Valenzuela-Ríos et al. 2015), whereas *Ad. trigonicus* enters 30 cm higher in sample 209. *Flajsella*
443 *stygia* Flajs, *Lanea telleri* (Schulze) and *Wurmiella wurmi* (Bischoff and Sannemann) enter within
444 the Zone.

445

446 **5.21 *Ancyrodelloides trigonicus* Zone, Valenzuela-Ríos and Murphy (1997)**

447 The *Ad. trigonicus* Zone includes strata between the FAD of *Ad. trigonicus* and the FAD of
448 *Masaraella pandora* β (Murphy, Matti and Walliser) (Corradini and Corriga 2012). The Zone is
449 widely used worldwide: beside the Carnic Alps (i.e., Corriga et al. 2011) it is detected in Bohemia
450 (Slavík et al. 2012), Nevada and Pyrenees (Valenzuela-Ríos and Murphy 1997), and Sardinia
451 (Corriga 2011). Recently Valenzuela-Ríos et al. (2015) subdivided the Zone, discriminating in the

452 upper part an interval characterized by *Ancyrodelloides kutscheri* Bischoff and Sannemann.
453 However, this taxon is always a minor component of the conodont association and up to now has
454 not been documented in the Carnic Alps. Therefore it looks hardly significant for long distance
455 correlations.

456 In the Rauchkofel Boden Section the Zone is discriminated in a 6 m interval from samples 212 to
457 222, and corresponds to the range interval of the marker *Ad. trigonicus* (Fig. 6). Several species
458 occur only within this interval: *Fl. sigmostygia* Valenzuela-Ríos and Murphy, *Fl. streptostygia*
459 Valenzuela-Ríos and Murphy, *Kimognathus delta* (Murphy and Matti) and *K. limbacarinatus*
460 (Murphy and Matti). All the late taxa of the genera *Ancyrodelloides*, *Lanea* and *Flajsella* became
461 extinct within this Zone, as well as *Z. remschiedensis* and *Z. eladioi*.

462

463 **5.22 *Masaraella pandora* β Zone, Valenzuela-Ríos (1994)**

464 The upper and lower boundaries of the Zone are defined by the FADs of *Masaraella pandora* β
465 and *Pedavis gilberti* Valenzuela-Ríos, respectively (Valenzuela-Ríos 1994). The base of the Zone
466 indicated the base of the upper Lochkovian (Valenzuela-Ríos et al. 2015).

467 The Zone is detected in the upper part of the La Valute Fm., and is 3.2 m thick (Fig. 6). Because
468 the index taxon is missing, the lower boundary is recognized by the last occurrence of *Ad.*
469 *trigonicus*, which in the Carnic Alps has its LAD just below the entry of *M. pandora* β (Corradini and
470 Corriga 2012). In this Zone the conodont abundance is lower than in the strata below. A single
471 specimen of *Pedavis robertoi* Valenzuela-Ríos was collected from sample 224a, and the younger
472 representatives of the genus *Zieglerodina* occur in the upper part of the Zone.

473

474 **5.23 *Pedavis gilberti* Zone, Slavík et al. (2012)**

475 The *P. gilberti* Zone, defined as the interval between the FAD of the index taxon, *P. gilberti*, and
476 the FAD of *Icr. steinachensis* β Al Rawi, represents the uppermost part of the Lochkovian (Slavík et
477 al. 2012).

478 The Zone is documented in the Rauchkofel Boden Section in the uppermost part of the La Valute
479 Fm. by the occurrence of a single specimen of *P. gilberti* recovered in sample 224d. The conodont
480 association is very scarce in this interval, and mainly represented by long-ranging taxa, therefore
481 the upper boundary is approximatively placed just below the first evidence of the Pragian
482 tentaculite *Nowakia acuaria*, documented by Schönlaub (1980) in the bed of sample 227, within
483 the lithostratigraphic gradual transition between the La Valute and Findenig formations.

484

485 **5.24 *Icriodus steinachensis* β Zone, Slavík (2004)**

486 The lower and upper boundary of the Zone are defined by the FADs of *Icr. steinachensis* β and *Pel.*
487 *serratus* Jentzsch, respectively. Slavík (2004) introduced a “*steinachensis* Zone” on the basis of the
488 first occurrence of *Icr. steinachensis* η -morph to discriminate the earliest Pragian beds in Bohemia.
489 Later Slavík et al. (2007) modified the definition of the base of the Zone with the entry of *Icr.*
490 *steinachensis* β -morph, because it has been documented at the same level as the entry of
491 *Eognathodus sulcatus* (Philip), the index taxon for the base of the Pragian.

492 In the Rauchkofel Boden Section the Zone is discriminated in the lower part of the Findenig Fm.
493 (Fig. 6). Conodonts are very scarce in this interval, and many samples are barren. The lower
494 boundary is indirectly placed by the entry of *Nowakia acuaria*, and the upper boundary by the first
495 occurrence of *Pel. serratus*. A few poorly preserved specimens possibly attributed to *Icr.*
496 *steinachensis* have been collected in the upper part of the Zone from sample 234-236.

497

498 **5.25 *Pelekysgnathus serratus* Zone, Slavík (2004)**

499 The *Pel. serratus* Zone is "determined by the first and last occurrence of taxa belonging of the
500 *Pelekysgnathus serratus* group" (Slavík 2004, p. 62).

501 At Rauchkofel Boden it is discriminated in the uppermost part of the section, by the entry of *Pel. s.*
502 *serratus* in sample 237. *Belodella devonica* is the only other conodont taxon occurring in this Zone.

503

504

505 **6. Chronostratigraphy**

506 As reported above, the Rauchkofel Boden Section exposes an almost continuous sequence from
507 the Katian (Upper Ordovician) to the Pragian (Lower Devonian), and therefore contains several
508 chronostratigraphic boundaries. The conodont fauna allows to locate, or approximate, these
509 boundaries, even if many of them are defined by the FAD of a graptolite species:

510 - the Ordovician/Silurian boundary is drawn between the Wolayer Fm. and the Kok Fm. It should
511 be noted that a large hiatus is present, corresponding to **part** or the whole Hirnantian and
512 Llandovery.

513 - the Sheinwoodian/Homerian boundary can be traced in the lowermost part of the *Oz. s. sagitta*
514 Zone, about 80 cm above the base of the Kok Fm. The index taxon for the base of the Homerian is
515 the graptolite *Cyrtograptus lundgreni* Tullberg, and its FAD is correlated with the lowermost part
516 of the *Oz. s. sagitta* Zone (Corradini and Serpagli 1999, Cramer et al. 2011, Melchin et al. 2012).

517 - the Wenlock/Ludlow boundary (= Homerian/Gorstian boundary) is placed 1.55 m above the base
518 of the Kok Fm., where *K. crassa* is found in sample 313/3. The base of the *K. crassa* Zone is aligned
519 with the FAD of *Neodiversograptus nilssoni* (Lapworth), the index taxon for the base of the
520 Gorstian stage (Melchin et al. 2012).

521 - the Gorstian/Ludfordian boundary can be tentatively traced at the base of the *A. ploeckensis*
522 Zone, about 85 cm below the top of the Kok Fm. The boundary is defined by the FAD of the

523 graptolite *Saetograptus lentwardinensis* (Hopkinson). According to Cramer et al. (2011, p.194) "the
524 position of the base of the *A. ploeckensis* conodont Zone with respect to the base of the *Sa.*
525 *leintwardinensis*/*Sa. linearis* graptolite Zone, and the position of the base of either of these
526 biozones with respect to the base Ludfordian GSSP remains uncertain and these three positions
527 are tentatively correlated at the same level here".

528 - the Ludlow/Přídolí boundary can be tentatively located in the lower part of the Alticola Fm., in
529 the uppermost part of the steep slope, in the upper part of the range of *Oz. crispa*. In the Cellon
530 Section, the index graptolite species *Neocolonograptus parultimus* Jaeger, occurs slightly below
531 the upper boundary of the *Oz. crispa* conodont Zone (Corradini et al. 2015a).

532 - the Silurian/Devonian boundary occurs in the uppermost part of the Alticola Fm., at level of
533 sample 201, where the conodont *Icr. woschmidti* first appears. **The base of the Devonian is defined**
534 **by the FAD of the graptolite *Monograptus uniformis* Přibyl, and the conodont taxon "with wide**
535 **distribution that appears closest to the Lower Devonian boundary" is *Icr. hesperius* (Carls et al.**
536 **2007, p. 157-158). In the Carnic Alps at places *Icr. woschmidti* enters together with *Icr. hesperius***
537 **(i.e., Monte Cocco II section, Corrigan and Corradini 2009), whereas elsewhere it enters a few**
538 **centimetres above (i.e., 10 cm in the Cellon Section, Corradini et al. 2015, Corrigan et al. 2016), and**
539 **therefore its entry is a good tool to precisely approximate the boundary.**

540 - the Lochkovian/Pragian boundary is defined by the FAD of the conodont *Eognathodus sulcatus* in
541 the Velka Chuchle Section (Czech Republic), but recent taxonomic revisions demonstrate that the
542 FAD of the taxon is no more aligned with the GSSP (Slavík and Hladil 2004). Slavík (2004) indicates
543 that the boundary can be detected by the entry of *Icriodus steinachensis* and this level was used to
544 locate the base of the Pragian in the nearby Seekopf Section (Suttner 2007). In the Rauchkofel
545 Boden Section conodonts are very scarce in the boundary interval and no diagnostic taxa have
546 been recovered. Therefore the base of the Pragian is approximately traced around the transition

547 from the La Valute Fm. to the Findenig Fm., where the dacryoconarid *Nowakia acuaria* is reported
548 at level of sample 227 (Schönlaub 1980; Alberti 1985). However, this datum differs from other
549 areas in the Carnic Alps (i.e., Mt. Zermula area), where the transition between the two formations
550 is dated to the uppermost Lochkovian by conodonts (Corrigan et al. 2011, Pondrelli et al. 2015,
551 Corradini et al. 2016).

552

553

554 **7. Conclusions**

555 The main results of this paper can be summarized as follows:

556 - the conodont association from the Rauchkofel Boden Section has been revised. Ninety-seven
557 taxa (species and subspecies) were recognized.

558 - the conodont fauna allows the discrimination of 25 biozones, from the Katian (Upper Ordovician)
559 to the Pragian (Lower Devonian).

560 - in terms of chronostratigraphy, all the Silurian and two Lower Devonian stage boundaries have
561 been located in the section. However, the Llandovery series is completely missing, and possibly
562 the upper Hirnantian strata, too.

563 - the lithostratigraphy of the section has been updated according to the new lithostratigraphic
564 scheme of the Carnic Alps.

565

566

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580

581

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- 831

832 **Figures and Plates**

833

834 Fig. 1 - Location map of the Rauchkofel Boden Section.

835

836 Fig. 2 - Chronostratigraphy and lithostratigraphy of the Rauchkofel Boden section. Stratigraphic log
837 modified after Schönlaub (1980). Lines on the right side of the log indicate the parts of the section
838 illustrated in Figs 3-6.

839

840 Fig.3 - Selected views of the Rauchkofel Boden Section. A) Lower part of the section from the
841 upper part of the Wolayer Fm. to the lower part of the Alticola Fm. B) Orthoceras limestone in the
842 uppermost bed of the Kok Fm. C) The transition between the Wolayer and the Kok formations. D)
843 Encrinitic limestone in the Wolayer Fm. E) Panoramic view of the upper part of the section from
844 above the steep cliff. F) The steep cliff with the Přídolí part of the Alticola Fm., and the Rauchkofel
845 (covered) and the lower part of the La Valute formations. G) Well bedded light gray limestone in
846 the lower part of the La Valute Fm. H) View of the upper part of the section, with the transition
847 between the La Valute and Findenig formations.

848

849 Fig. 4 - Distribution of conodonts in the lower part (Wolayer and Kok formations) of the Rauchkofel
850 Boden Section. From left to right: system, series, stage, formation, lithological log, samples,
851 sample number, distribution of taxa (white dots indicate taxa identified with question), zones.
852 Arrows at the end of distribution lines indicate that the taxon also occurs above/below the
853 illustrated interval. Horizontal lines mark boundaries of chrono-/litho-/biostratigraphical units. For
854 graphical reason not all the sample numbers are reported. Abbreviations: Card.=Cardiola;

855 Hirn.=Hirnantian; Ordov.=Ordovician; *abs.=absidata*; *bohem.=bohemica*; *ranulif.=ranuliformis*;
856 *amorph.=amorphognathoides*.

857

858 Fig. 5 - Distribution of conodonts in the central part (Cardiola, Alticola and Rauchkofel formations)
859 of the Rauchkofel Boden Section. From left to right: system, series, stage, formation, lithological
860 log (modified after Schönlaub 1980), samples, sample number, distribution of taxa (white dots
861 indicate taxa identified with question), zones. Arrows at the end of distribution lines indicate that
862 the taxon also occurs above/below the illustrated interval. Horizontal lines mark boundaries of
863 chrono-/litho-/biostratigraphical units. For graphical reason not all the sample numbers are
864 reported. Abbreviations: Card.=Cardiola; L.V.=La Valute; *postwosch.=postwoschmidt*;
865 *eosteinhorn.=eosteinhornensis*; *ploeck.=ploeckensis*.

866

867 Fig. 6 - Distribution of conodonts in the upper part (La Valute and Findenig formations) of the
868 Rauchkofel Boden Section. From left to right: system, series, stage, formation, lithological log
869 (modified after Schönlaub 1980), samples, sample number, distribution of taxa (white dots
870 indicate taxa identified with question), zones. Arrows at the end of distribution lines indicate that
871 the taxon also occurs above/below the illustrated interval. Horizontal lines mark boundaries of
872 chrono-/litho-/biostratigraphical units. For graphical reason not all the sample numbers are
873 reported. Abbreviations: RK.=Rauchkofel; *steinachens.=steinachensis*.

874

875 **Plate 1**

876

877 Selected Ordovician conodonts from the Rauchkofel Boden Section. All from the *Am. ordovicicus*
878 Zone.

879

880 1-7. *Amorphognathus* sp. 1: upper view of Pa element IPUM 27544, sample 309 top, refigured
881 after Ferretti and Schönlaub (2001); 2: lateral view of Pb element IPUM 29023, sample 309; 3:
882 lateral view of Pb element IPUM 29024, sample 309 top; 4: lateral view of Sa element IPUM
883 27549, sample 309 top, refigured after Ferretti and Schönlaub (2001); 5: lateral view of Sb element
884 IPUM 27547, sample 309 top, refigured after Ferretti and Schönlaub (2001); 6: lateral view of Sc
885 element IPUM 27548, sample 309 top, refigured after Ferretti and Schönlaub (2001); 7: lateral
886 view of Sd element IPUM 27550, sample 309 top, refigured after Ferretti and Schönlaub (2001).

887 8-9. *Amorphognathus ordovicicus* Branson and Mehl, 1933b. 8: posterior view of M element IPUM
888 29025, contact sample 309/Silurian; 9: posterior view of M element IPUM 27551, sample 309,
889 refigured after Ferretti and Schönlaub (2001).

890 10. *Amorphognathus duftonus* Rhodes, 1955; postero-lateral view of element IPUM 29026, sample
891 309/Silurian.

892 11-14. *Hamarodus brevirameus* (Walliser, 1964). 11: lateral view of M element IPUM 29027,
893 contact sample 309 top/Silurian; 12: lateral view of Pb element IPUM 29028, sample 309 top; 13:
894 lateral view of Sa element IPUM 29029, contact sample 309 top/Silurian; 14: lateral view of Sc
895 element IPUM 29030, contact sample 309 top/Silurian.

896 15. *Panderodus gracilis* (Branson and Mehl, 1933b); element IPUM 29031, contact sample 309
897 top/Silurian.

898 16. ?*Drepanodus* sp., element IPUM 29032, contact sample 309 top/Silurian.

- 899 17. *Pseudooneotodus* sp., upper view of element IPUM 29033, contact sample 309 top/Silurian.
- 900 18. *Decoriconus costulatus* (Rexroad, 1967); element IPUM 29034, contact sample 309
- 901 top/Silurian.
- 902 19. *Dapsilodus mutatus* (Branson and Mehl, 1933b); element IPUM 29035, sample 309 top.
- 903 20. *Birksfeldia* sp.; lateral view of Sb element IPUM 29036, contact sample 309 top/Silurian.
- 904 21. *Eocarniodus gracilis* (Rhodes, 1955); element IPUM 29037, contact sample 309 top/Silurian.
- 905 22. *Scabbardella altipes* (Henningsmoen, 1948), element IPUM 29038, sample 309 top.
- 906 23-25. *Walliserodus amplissimus* (Serpagli, 1967); elements IPUM 29039-29041, contact sample
- 907 309 top/Silurian (IPUM 29039-29040) and sample 309 top (IPUM 29041).
- 908 26-27. *Plectodina alpina* (Serpagli, 1967). 26: inner lateral view of Pb element IPUM 27561, sample
- 909 309 top refigured after Ferretti and Schönlaub (2001); 27: lateral view of Pa element IPUM 29042,
- 910 contact sample 309 top/Silurian.

911

912

913

914 **Plate 2**

915

916 Selected Silurian conodonts from the Rauchkofel Boden Section.

917

- 918 1. *Ozarkodina sagitta rhenana* (Walliser, 1964); upper view of P1 element 2016/014/0045, sample
- 919 313, *Oz. s. sagitta* Zone. Refigured after Schönlaub (1980).
- 920 2. *Zieglerodina remscheidensis* (Ziegler, 1960); lateral view of P1 element MDLCA 30384, sample
- 921 7A, Upper *Oul. el. detortus* Zone.

- 922 3. *Wurmiella excavata* (Branson and Mehl, 1933a); lateral view of P1 element MDLCA 30385,
923 sample 6, Lower *Oul. el. detortus* Zone.
- 924 4. *Ozarkodina sagitta sagitta* (Walliser, 1964); upper view of P1 element MDLCA 30386, sample K,
925 *Oz. s. sagitta* Zone.
- 926 5. "*Ozarkodina*" *eosteinhornensis* s.s. (Walliser, 1964); upper view of P1 element MDLCA 30387,
927 sample 4A, Lower *Oul. el. detortus* Zone.
- 928 6. *Pterospathodus pennatus procerus* Walliser, 1964; upper view of P1 element MDLCA 30388,
929 sample O/S, *Pt. am. amorphognathoides* Zone.
- 930 7. *Polygnathoides siluricus* Branson and Mehl, 1933a; upper view of P1 element MDLCA 30389,
931 sample 2, *P. siluricus* Zone.
- 932 8. *Kockelella variabilis ichnusae* Serpagli and Corradini, 1998; upper view of P1 element MDLCA
933 30390, sample 2003-22, *A. ploeckensis* Zone.
- 934 9. *Pterospathodus amorphognathoides amorphognathoides* Walliser, 1964; upper view of P1
935 element MDLCA 30391, sample O/S, *Pt. am. amorphognathoides* Zone.
- 936 10. *Kockelella variabilis variabilis* Walliser, 1957; upper view of P1 element MDLCA 30392, sample
937 324, *A. ploeckensis* Zone.
- 938 11. *Dapsilodus obliquicostatus* (Branson and Mehl, 1933a); lateral view of element MDLCA 30393,
939 sample K, *Oz. s. sagitta* Zone.
- 940 12. *Pseudooneotodus linguicornis* Jeppsson, 2003 (in Calner and Jeppsson, 2003); lateral view of
941 element MDLCA 30394, sample K, *Oz. s. sagitta* Zone.
- 942 13. *Wurmiella? posthamata* (Walliser, 1964); upper view of P1 element MDLCA 30395, sample X,
943 *A. ploeckensis* Zone.
- 944 14. *Kockelella maenniki* Serpagli and Corradini, 1998; upper view of P1 element MDLCA 30396,
945 sample 2, *P. siluricus* Zone.

- 946 15. *Wurmiella* sp. A; lateral view of P1 element MDLCA 30397, sample 3X, *Oz. snajdri-Pe. latialata*
947 interval Zone.
- 948 16. *Ozarkodina crispa* (Walliser, 1964); upper view of P1 element MDLCA 30398, sample 2F, *Oz.*
949 *crispa* Zone.
- 950 17. Anomalous element with a branched process; lateral view of element MLCDA 30399, sample
951 RKB 2, *P. siluricus* Zone.
- 952 18. *Kockelella ortus absidata* Barrick and Klapper, 1976; lateral view of P1 element MDLCA 30400,
953 sample 2003-22, *A. ploeckensis* Zone.
- 954 19. *Pedavis latialata* (Walliser, 1964); upper view of P1 element MDLCA 30401, sample 2F, *Oz.*
955 *snajdri-Pe. latialata* interval Zone.
- 956 20. *Kockelella crassa* (Walliser, 1964); upper view of P1 element MDLCA 30402, sample 323-2, *K.*
957 *crassa* Zone.
- 958 21. *Kockelella* sp.; upper view of P1 element MDLCA 30403, sample 324, *A. ploeckensis* Zone.

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962 **Plate 3**

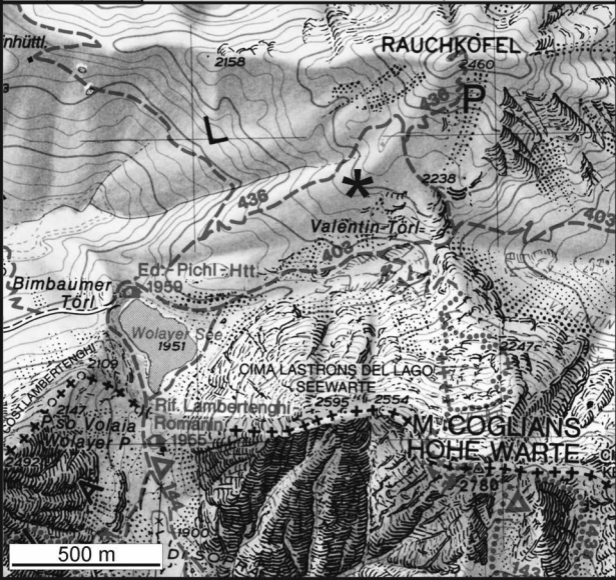
963 Selected Devonian conodonts from the Rauchkofel Boden Section.

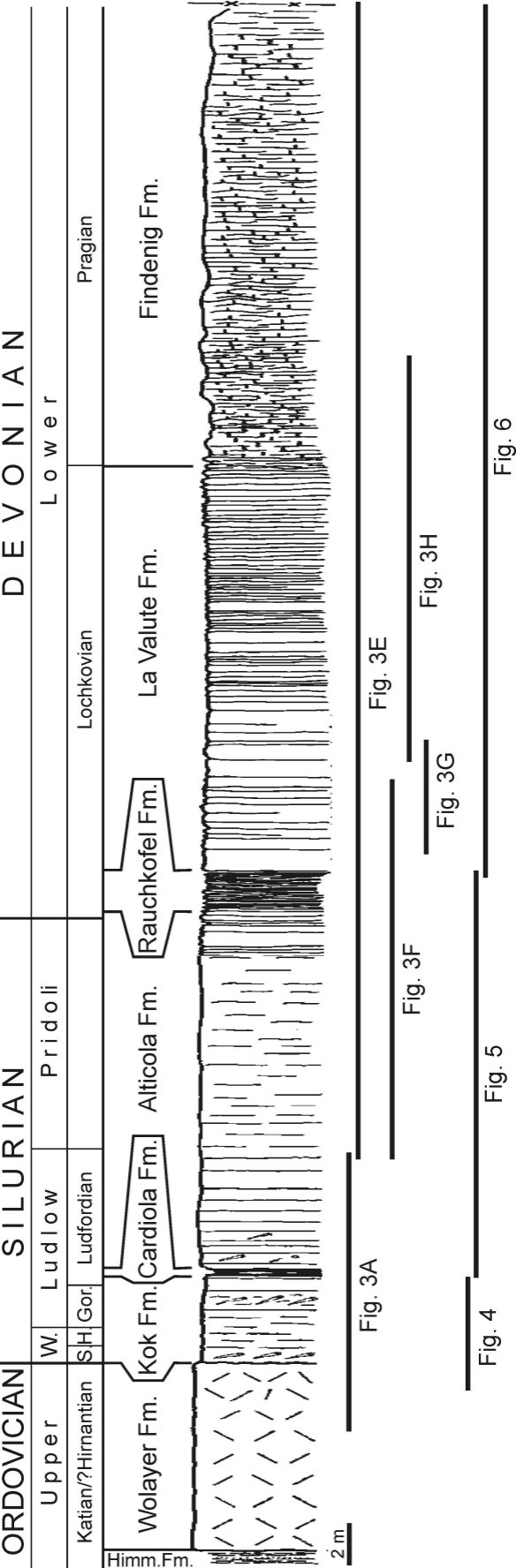
964

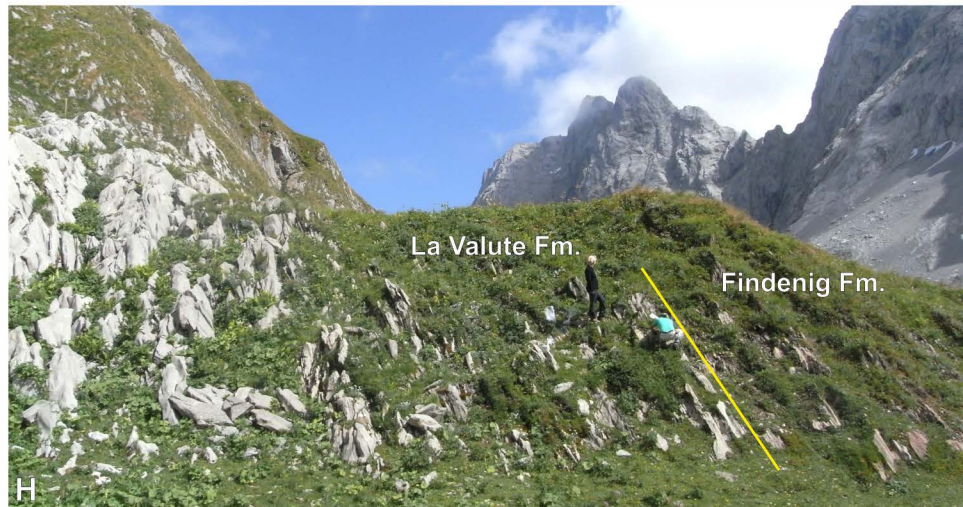
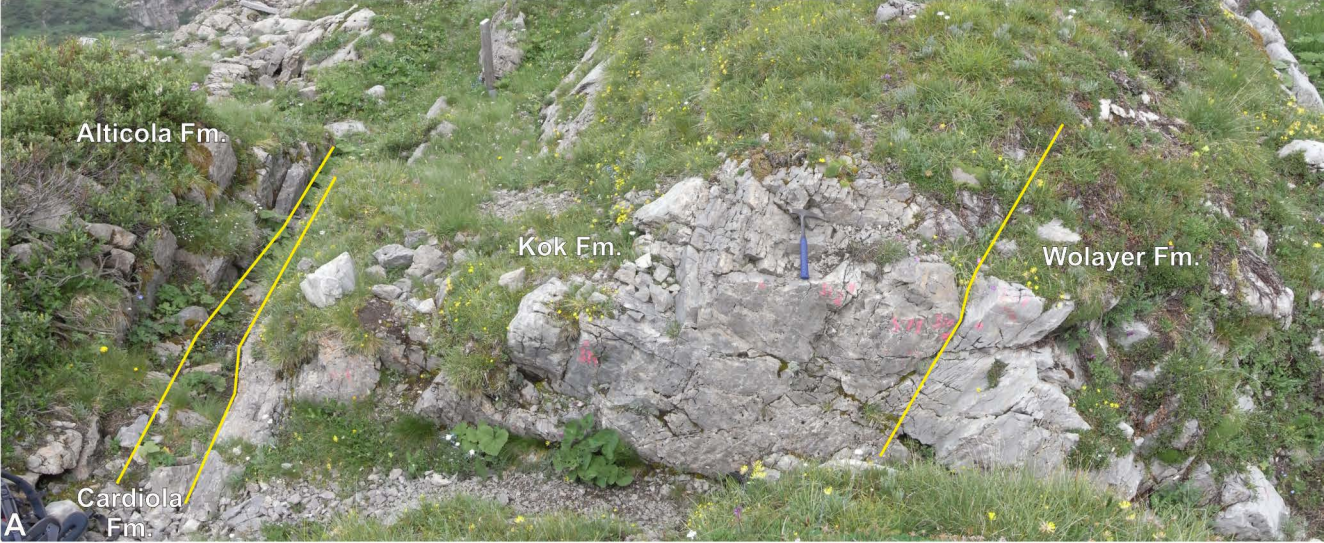
- 965 1. "*Ozarkodina*" *malladai* Valenzuela-Rios, 1994; lateral view of P1 element MDLCA 30404, sample
966 RKB 10, *Ad. transitans* Zone.
- 967 2. *Zieglerodina eladioi* (Valenzuela-Rios, 1994); lateral view of P1 element MDLCA 30405, sample
968 RKB 11, *Ad. trigonicus* Zone.

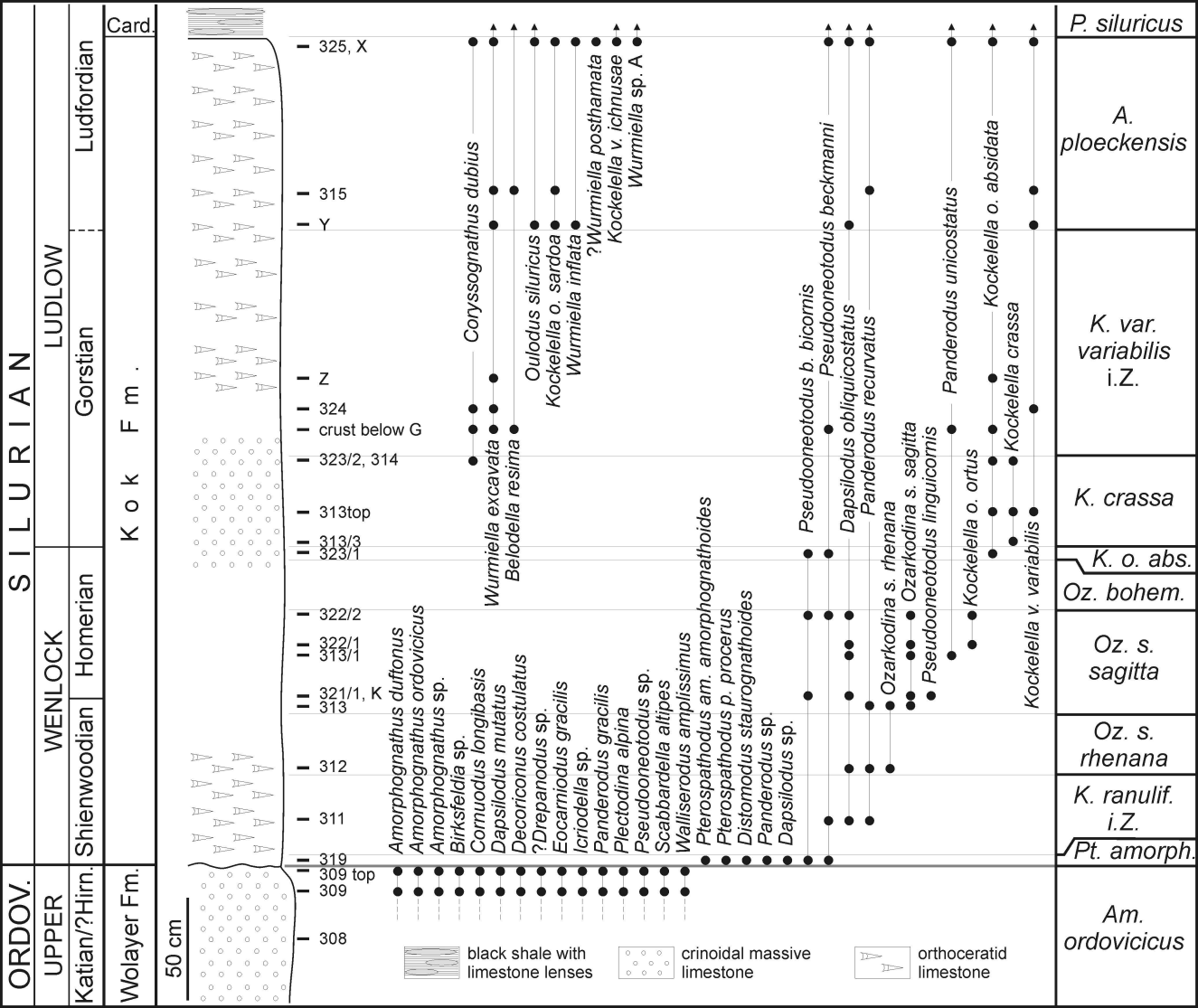
- 969 3. *Zieglerodina* sp. A Corrigan et al., 2016; lateral view of P1 element MDLCA 30406, sample 7A, *Icr.*
970 *hesperius* Zone.
- 971 4. *Flajsella schulzei* (Bardashev, 1989); upper view of P1 element MDLCA 30407, sample 11, *Ad.*
972 *trigonicus* Zone.
- 973 5. *Flajsella stygia* (Flajs, 1967); upper view of P1 element MDLCA 30408, sample 11, *Ad. trigonicus*
974 Zone.
- 975 6. *Flajsella stygia* (Flajs, 1967); upper view of P1 element 2016/014/0024, sample 213, *Ad.*
976 *trigonicus* Zone. Refigured after Schönlaub (1980).
- 977 7. *Icriodus woschmidti* Walliser, 1964; upper view of P1 element 2016/014/0064, sample 201, *Icr.*
978 *hesperius* Zone. Refigured after Schönlaub (1980).
- 979 8. *Ancyrodelloides asymmetricus* (Bischoff and Sannemann, 1958); upper view of P1 element
980 2016/014/0082, sample 220, *Ad. trigonicus* Zone. Refigured after Schönlaub (1980).
- 981 9. *Pandorinellina optima* (Moskalenko, 1966); lateral view of P1 element 2016/014/0069, sample
982 201D, *Icr. postwoschmidti* Zone. Refigured after Schönlaub (1980).
- 983 10. *Kimognathus delta* (Klapper and Murphy, 1980); upper view of P1 element 2016/014/0078,
984 sample 218, *Ad. trigonicus* Zone. Refigured after Schönlaub (1980).
- 985 11. *Pedavis gilberti* Valenzuela-Rios, 1994; upper view of P1 element 2016/014/0088, sample
986 224d, *Pe. gilberti* Zone. Refigured after Schönlaub (1980).
- 987 12. *Ancyrodelloides carlsi* (Boersma, 1973); upper view of P1 element 2016/014/0070, sample RKB
988 201G, *Ad. carlsi* Zone. Refigured after Schönlaub (1980).
- 989 13. *Ancyrodelloides cf. transitans* (Bischoff and Sannemann, 1958); upper view of P1 element
990 MDLCA 30409, sample RKB 13, *Ad. trigonicus* Zone.
- 991 14. *Ancyrodelloides transitans* (Bischoff and Sannemann, 1958); upper view of P1 element MDLCA
992 30410, sample 13, *Ad. trigonicus* Zone.

- 993 15. *Zieglerodina* sp.; lateral view of P1 element 2016/014/0001, sample 204, *Ad. carlsi* Zone.
994 Refigured after Schönlaub (1980).
- 995 16. *Pedavis* sp.; lateral view of coniform element 2016/014/0025, sample 213, *Ad. trigonicus* Zone.
996 Refigured after Schönlaub (1980).
- 997 17. *Pseudooneotodus beckmanni* (Bischoff and Sannemann, 1958); upper view of element MDLCA
998 30411, sample 13, *Ad. trigonicus* Zone.
- 999 18. *Lanea telleri* (Schulze, 1968); upper view of P1 element 2016/014/0033, sample 216, *Ad.*
1000 *trigonicus* Zone. Refigured after Schönlaub (1980).
- 1001 19. *Pelekysgnathus serratus serratus* Jentzsch, 1962; lateral view of P1 element no.
1002 2016/014/0013, sample 237, *Pe. serratus* Zone. Refigured after Schönlaub (1980).
- 1003 20. *Lanea omoalpha* Murphy and Valenzuela-Rios, 1999; upper view of P1 element MDLCA 30412,
1004 sample 9, *Ad. transitans* Zone.
- 1005 21. *Ancyrodelloides trigonicus* (Bischoff and Sannemann, 1958); upper view of P1 element
1006 2016/014/0084, sample 222, *Ad. trigonicus* Zone. Refigured after Schönlaub (1980).
- 1007 22. *Wurmiella wurmi* (Bischoff and Sannemann, 1958); lateral view of P1 element MDLCA 30413,
1008 sample 10, *Ad. transitans* Zone.
- 1009 23. *Pedavis robertoi* Valenzuela-Rios, 1994; upper view of P1 element 2016/014/0085, sample
1010 224a, *M. pandora* β Zone. Refigured after Schönlaub (1980).



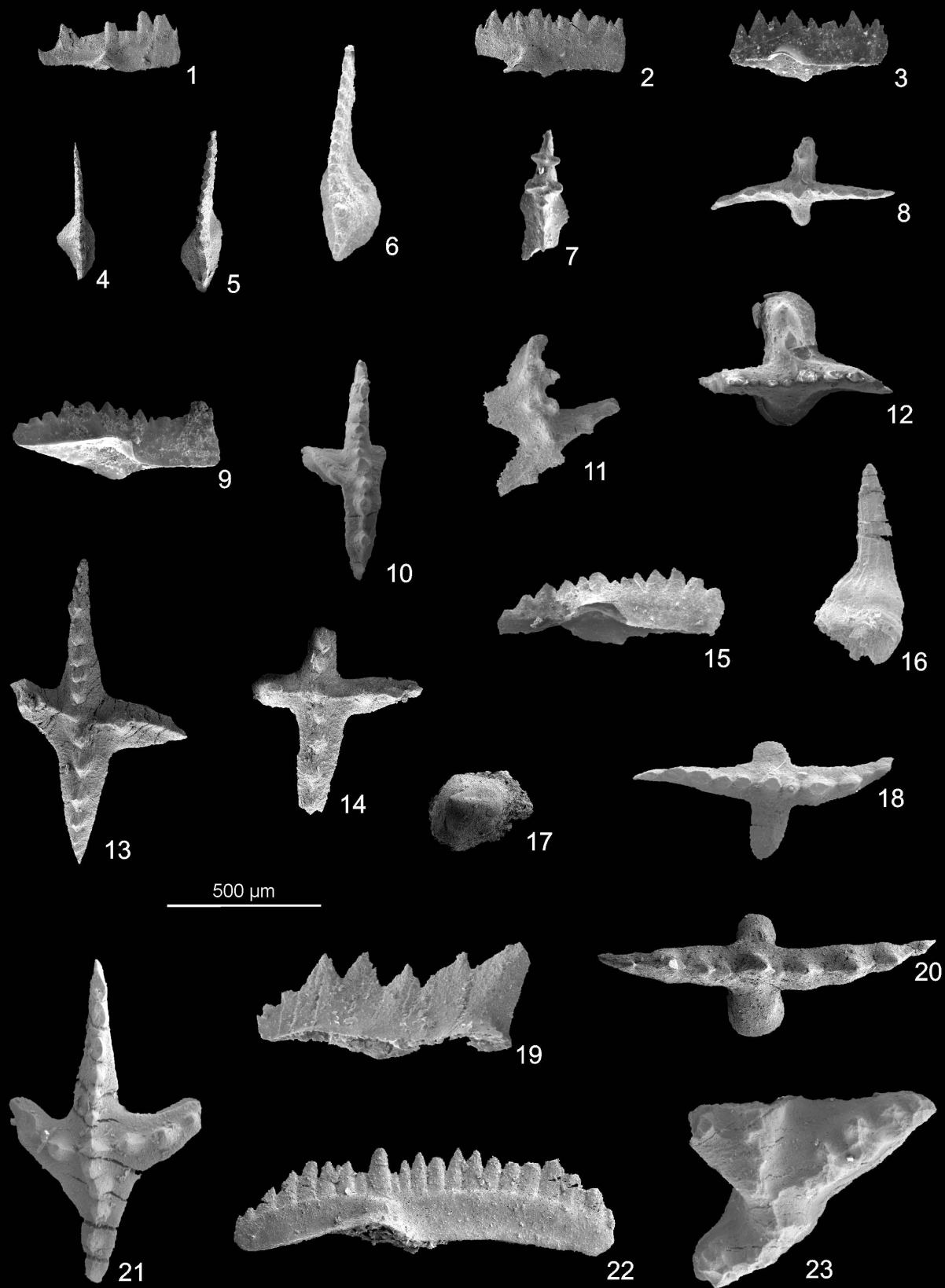














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