Ann. Naturhist. Mus. Wien	111 A	233–244	Wien, April 2009

An ozarkodinid conodont cluster from Kirchfidisch (Lower Devonian, Austria)

By Thomas J. SUTTNER[1]

(With 3 figures)

Manuscript submitted on December 10th 2008,
the revised manuscript on January 14th 2009

Abstract

An ozarkodinid conodont cluster from the Baron von Kottwitz Quarry near Kirchfidisch (Austria) is described. According to the conodont assemblage found within the investigated section, an Early Devonian age (*woschmidti* Zone) is suggested for the unit. Until this discovery, three beds have been discovered producing, several icriodid clusters. The fused cluster discussed herein consists of one ozarkodinid M element and two S elements. According to composition and orientation it is most probable that the clustered elements once belonged to the apparatus of the one conodont individual.

Keywords: Ozarkodinida, conodont cluster, Lower Devonian, Burgenland, Austria.

Zusammenfassung

Ein ozarkodinider Conodonten-Cluster aus dem Baron von Kottwitz Steinbruch bei Kirchfidisch (Österreich) wird beschrieben. Aufgrund der vorliegenden Conodonten Vergesellschaftung aus dem beprobten Profil, konnte ein frühes Devonalter (*woschmidti* Zone) des Conodonten-Cluster führenden Profilabschnitts betätigt werden. Bis jetzt wurden innerhalb dieses Intervalls 3 Bänke entdeckt, die neben dem einen ozarkodiniden Cluster auch einige icriodide Cluster führen. Der hier vorgestellte Cluster setzt sich aus einem M-Element und zwei S-Elementen zusammen. Aufgrund von Komposition und Orientierung ist zu vermuten, dass die Elemente dem Apparat eines einzelnen Individuums angehört haben.

Schlüsselwörter: Ozarkodinida, Conodonten-Cluster, Unterdevon, Burgenland, Österreich.

Introduction

The Palaeozoic sequence in southern Burgenland was mapped first by HOFFMANN (1877) who proposed a Silurian to Devonian age for the dolomite and limestone rocks cropping out near Kirchfidisch and Hannersdorf. This age was supported by TOULA (1878), after monographing HOFFMANN's fossil collection (rugose and tabulate corals, and crinoids). Furthermore he suggested a Middle Devonian age (Eifelian Stage) for at least some parts of the sequence, comparing them to the Rhenish Slate Mountains and the Graz Palaeozoic.

[1] Austrian Academy of Sciences, Commission for the Palaeontological and Stratigraphical Research of Austria (CPSA) c/o University of Graz, Institute of Earth Sciences (Geology and Palaeontology), Heinrichstrasse 26, 8010 Graz, Austria; e-mail: thomas.suttner@uni-graz.at

A first detailed stratigraphic overview of the low metamorphic rocks exposed in the Baron von Kottwitz quarry near Kirchfidisch was given by POLLAK (1962). In his thesis he attempted to constrain the age of the carbonates by obtaining conodonts, but was unsuccessful. SCHÖNLAUB extracted a small conodont fauna from the Weinhandl quarry near Hannersdorf (SCHÖNLAUB 1994: *Neopanderodus* sp. aff. *N. gracilis* (BRANSON & MEHL, 1933), *Icriodus* sp., *Ozarkodina carinthiaca* (SCHULZE, 1968), *Oz. steinhornensis* ssp. and *Polygnathus serotinus* TELFORD, 1975) and near Sulz (SCHÖNLAUB 1984: *Ozarkodina exc. excavata* (BRANSON & MEHL, 1933)). He also reported that carbonate rocks of the Baron von Kottwitz quarry (SCHÖNLAUB 1994, 2000) produced few, but indeterminable specimens. According to new conodont data from the latter quarry (SUTTNER 2009), the interval discriminated as unit 4 can be assigned to the lowermost Devonian (*woschmidti* Zone). The assemblage consists of *Icriodus w. woschmidti* ZIEGLER, 1960, *Ozarkodina exc. excavata* (BRANSON & MEHL, 1933), *Oz. remscheidensis eosteinhornensis* (WALLISER, 1964) beta morph MURPHY et al. 2004, *Oz. r. remscheidensis* (ZIEGLER, 1960) and a few simple cones which probably belong to the genus *Belodella* and *Dvorakia*. In some of the sampled beds icriodid and ozarkodinid conodont clusters were discovered; the ozarkodinid cluster is presented herein. Conodont clusters and bedding plane or natural assemblages are rarely reported from Austria; the cluster presented herein is the first from an area where identifiable conodonts have not previously been reported.

Locality and Regional Geology

The Baron von Kottwitz Quarry is located at the Hohensteinmaißberg south of the village of Kirchfidisch (southern Burgenland). It can be reached via a small forest road diverging southwards between Kohfidisch and Kirchfidisch (access to the quarry only by permission of the owner). The investigated section begins near the entrance in the north-eastern part of the quarry and continues along the south-western wall (fig. 1). The entire sequence measures approximately 100 meters or more and consists of shale, siltstone, dolomite and limestone. From the investigated lower part of the profile (approx. 40 m), five lithological units can be discriminated (Ki/01-Ki/05). The outcrop is one of four localities in southern Burgenland, recognized as representing the Upper Silurian to lowermost Middle Devonian sequence of the Palaeozoic succession in southern Burgenland. According to FLÜGEL (1988) the sequence is assigned to the Blumau Formation defined on the basis of a drilling core some 30 km west of Kirchfidisch (EBNER 1988).

Beds equivalent to those cropping out in the Baron von Kottwitz Quarry are exposed in another abandoned quarry near the village of Sulz (SCHÖNLAUB 1984). Succeeding units are found in the small abandoned quarry in the Punitz Woods (age unknown) and at the Weinhandl Quarry near Hannersdorf (Pragian? to Emsian age: SCHÖNLAUB 1994, 2000).

Lithology, Facies and Diagenesis

Within the lower 40 meters of the sequence cropping out at the Hohensteinmaißberg, conodonts are restricted to units 4 and 5. Unit 4 produced the icriodid and ozarkodinid

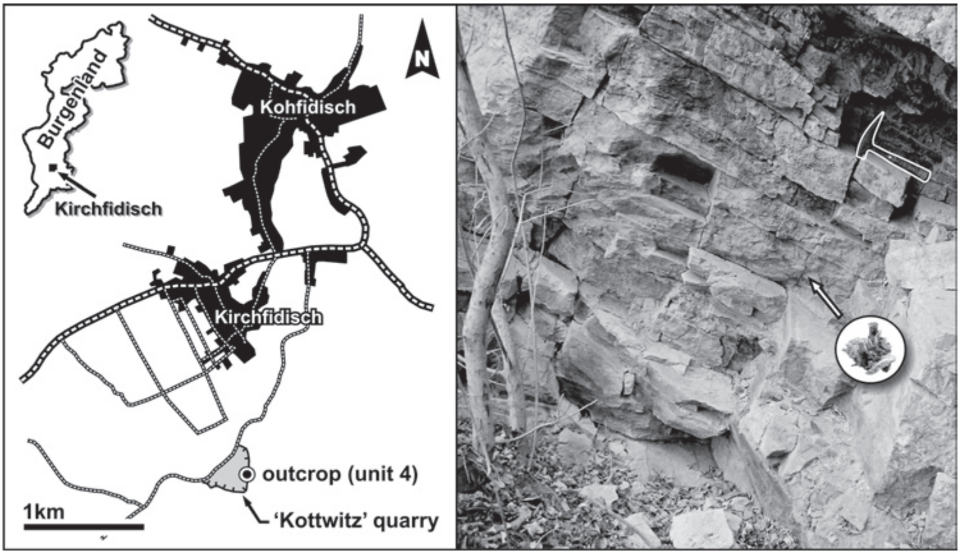

Fig. 1: Simplified map of the Kirchfidisch area in southern Burgenland. The conodont cluster bearing interval (unit 4) is indicated with a black circle in the map and illustrated on the right half of the figure. The arrow-head in the photo points to sample Ki/04/1c which produced the ozarkodinid cluster.

fused clusters as previously mentioned; it consists of 7 m of well-bedded limestone and dolomite. This unit, however, is tectonically out of its original position and should succeed unit 5, a unit consisting of limestone beds densely packed with serpulid tubes and intercalated by thin layers of unfossiliferous brownish siltstone (SUTTNER & LUKENEDER 2004; HUBMANN & SUTTNER 2007; SUTTNER 2007).

Microfacies analyses of unit 4 shows that deposited limestone beds (approx. 7-15 cm in thickness) consist of bituminous, laminated, argillaceous limestone layers alternating with bioclastic wacke- to packstone (fig. 2.1). Some beds were affected by a higher degree of diagenesis yielding brachiopod shells and filaments which are totally re-crystallized (fig. 2.2). Due to burial and tectonic stress, conodont elements are dark brown to black (figs 3.3, 3.4) with a conodont colour alteration index (CAI) of 5.

According to the conodont assemblage composed mainly of ozarkodinid and icriodid platform elements shallow marine, near-shore settings are proposed for this part of the sequence. The depositional environment suggests lagoonal development dominated first by laminated limestone followed by patches of serpulid-tubes (LUKENEDER & SUTTNER 2007), overlain by laminated limestones alternating with shell layers, and dolomite beds. Within this environment coprolites of predators with a specialized diet of conodonts, should have potentially shown good preservation. Not only the evidence of being protected from disarticulation by its coprolite envelope should be considered as one of the most important factors for preservation, also a certain diagenetic overprint might have been necessary. According to present investigations it remains unclear to what degree sediment compaction and pressure solution are responsible for fusing discrete elements or if the clusters were baked nearby stylolites as they were found in acid leached residues only. It seems that conodont elements were fused by encrustation of dolomite particles (figs. 2.3, 2.4) or mobile fluids settling on the contacting zones of elements during sediment compaction. An interesting study concerning post-depositional taphonomic bias of conodont clusters is presented by von Bitter & Purnell (2005).

Material & Methods

Usual techniques (acid bath: Jeppsson & Anehus 1995; heavy liquid separation: Savage 1988) were used to extract conodont material from rock samples (argillaceous and dolomitic limestone, each sample weighing between 3-5 kg). Samples were crushed to pieces of about 3-4 cm³ and put in acid bath for about 1 week. Formic acid (HCOOH, 85%, concentrated) was used in 1:5 ratios with warm water. Insoluble residues were sieved and dried. Only the 125-250 µm and the >600 µm fractions were picked after heavy liquid separation (Sodium polytungstate, suspension density: 2.79 g/cm³ at room temperature). SEM scans were made by using a Zeiss DSM, 982 Gemini electron microscope. Conodonts were coated with gold/palladium alloy for 10 minutes. Stereo microscope images were taken with Zeiss microscope (SteREO Discovery.V12/V20; software: Carl Zeiss AxioVision Rel. 4.7.1). A 3-dimensional SEM image of the conodont cluster (fig. 3.1) was produced by using a common stereoscopic technique (e.g. Schallreuter 2004). The ozarkodinid conodont cluster is stored at the Department of Geology and Palaeontology of the Naturhistorisches Museum in Wien (NHMW). Additional and previously published conodont material from this unit is stored in the Landesmuseum Joanneum (Graz, Styria). – Abbreviation of sample numbers: e.g. Ki/04/1c (Kirchfidisch/unit 04/sample 1c).

Systematic Part

Architecture of conodont apparatuses is addressed in several articles by studies concerning natural assemblages or fused clusters (e.g. Aldridge et al. 1995; Donoghue et al. 2008; Dzik 1991; Purnell et al. 2000; Rieber 1980; Tolmacheva & Purnell 2002). Ozarkodinids represent one of the better documented groups, although only few taxa are recovered in their naturally aligned composition. Best studied are late Palaeozoic apparatuses of genera such as *Gnathodus*, and *Idiognathus*. Other taxa are illustrated and reconstructed as 3-dimensional models by Purnell & Donoghue (1997, 1998). Late Devonian conodont clusters of *Palmatolepis* obtained from the Kellwasser limestone (Rhenish Slate Mountains) were figured by Lange (1968). Other late Devonian species such as *Ancyrodella curvata* and *Polygnathus webbi* from Montagne Noir were published by Schülke (1997). An early Devonian natural assemblage of '*Ozarkodina steinhornensis*' [= syn. *Ozarkodina remscheidensis* (Ziegler, 1960), *Zieglerodina* Murphy et al., 2004] – most important for the present study – is documented from the Fana Mountains (Tajikistan) by Mashkova (1972). Older conodont clusters and natural assemblages of Silurian age belonging to the apparatus of *Ozarkodina excavata* have been studied from the Eramosa Lagerstätte (Ontario, Canada) by von Bitter & Purnell (2005) and von Bitter et al. (2007). – Additional references to bedding plane or

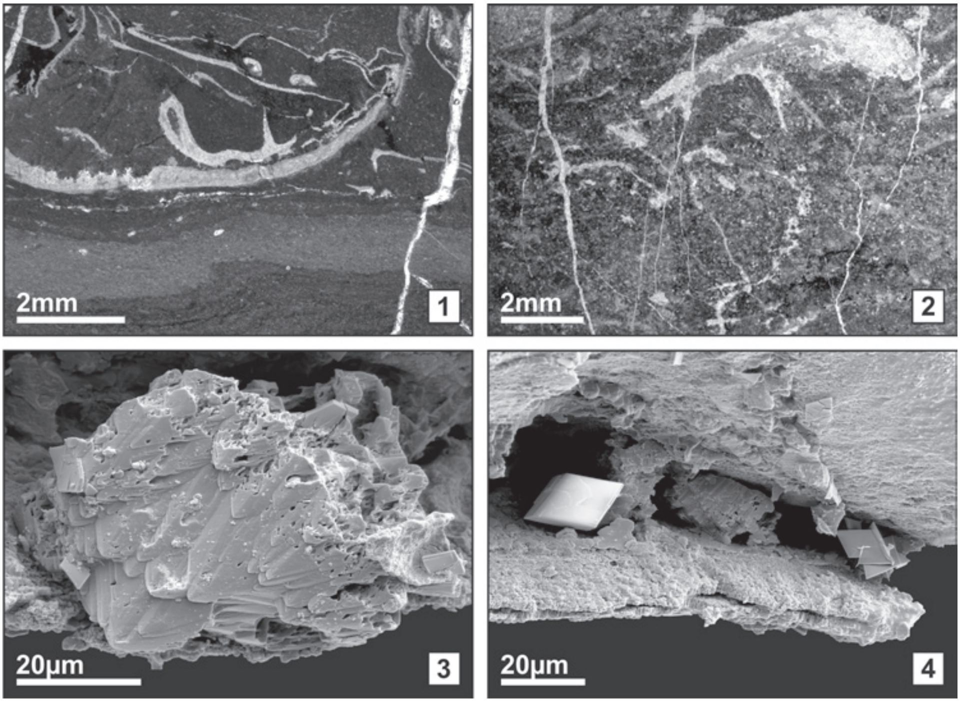

Fig. 2.1: Laminated argillaceous limestone (lowermost part of the photo) succeeded by bioclastic wackestone which yields quite well preserved thin shelled brachiopods, thin section (Ki/04/1a); 2.2: bioclastic limestone bearing re-crystallized brachiopods and other filaments, thin section (Ki/04/1c); 2.3: Detailed view of dolomite particles encrusting conodont elements, SEM photo (Ki/04/1c); 2.4: Rhombohedral dolomite grains, SEM photo (Ki/04/1c).

natural assemblages and conodont clusters (except for prioniodontid and coniform taxa) are given in PURNELL & DONOGHUE (1998).

Please note that I have, for the present study, chosen to retain the use of the genus *Ozarkodina* as set out in the Catalogue of Conodonts (KLAPPER et al. 1973) rather than following MURPHY et al. (2004) in elevating the commonly known Silurian and earliest Devonian subspecies of *Ozarkodina remscheidensis eosteinhornensis* (WALLISER, 1964) and *Ozarkodina rem. remscheidensis* (ZIEGLER, 1960) to the genus: *W* and *Zieglerodina*. As pointed out by more conservative workers such as MAWSON & TALENT (personal comment, 2008), the exercise in splitting of genera needs to be examined carefully from the evolutionary point of view and by applying shape analysis to at least the Pa elements involved (e.g. KLAPPER & FOSTER 1986, 1993; SLOAN 2003). Additional comments regarding the subspecies *Ozarkodina remscheidensis* ssp. (including comprehensive synonymy listings) can be found in MAWSON et al. (2003), SIMPSON & TALENT (1995) or CARLS et al. (2007). Latter authors refer to the taxonomic names as introduced by MURPHY et al. (2004).

Ozarkodinid conodont cluster
(figs 3.1-3.4)

M a t e r i a l : One ozarkodinid cluster, NHMW 2008z0307/0001; Early Devonian (*woschmidti* Zone); sample Ki/04/1c, Baron von Kottwitz quarry at the Hohenstein-maißberg, south of Kirchfidisch, southern Burgenland, Austria.

D e s c r i p t i o n : The fused cluster consists of three elements belonging to an ozarkodinid conodont apparatus, one M element and two S elements. The figured material shows that the M element and the lower S element are almost in lateral view possessing same orientation. The second S element lies at an angle of about 60 degrees with its denticles aligned to both other elements (figs 3.1-3.4). Both S elements present a view on the basal groove which is very narrow becoming closed towards the distal ends; each is broken with the longer posterior process preserved only. The blade of the processes of each S element is relatively low (figs 3.1, 3.2). Denticles are discrete, somewhat irregular in size and inclined posteriorward. At the posterior end of the blade some denticles are slightly enlarged and form a kind of gently arcuate fan of any S element. The M element is nearly complete. Its posterior process is arched and steep including a relative acute angle of about 100 degree to the prominent but broken cusp. No denticles are observed anterior of the cusp (fig. 3.4). Denticles of the posterior process are discrete and of irregular size, similar as observed in the S elements, pointing to the oral side.

All elements possess fractures with the same orientation remaining from sediment compaction or tectonic stress (compare sketch fig. 3.2). Although these fractures run diagonally through the clustered elements from one end to the other, single bits and pieces remain fused. Additionally the upper S element shows a slight sigmoidal deformation.

D i s c u s s i o n : Following the features of the M element, the cluster could be a subspecies of the *Ozarkodina remscheidensis* group. Preserved elements are very similar to those assigned to '*Zieglerodina* sp.' (Murphy et al. 2004: compare fig. 3.42 for M element and fig. 3.25 for S element, therein). According to earlier apparatus considerations of Mashkova (1972), based on the natural assemblage from the Fana Mountains, the presented fused cluster could belong to '*Ozarkodina steinhornensis remscheidensis*'. [= syn. *Ozarkodina remscheidensis remscheidensis* (Ziegler, 1960), *Zieglerodina remscheidensis* (Ziegler) Murphy, et al. 2004] as features observed at the presented material are close to being identical.

O c c u r r e n c e : Although discrete elements of the *Ozarkodina remscheidensis* group have world-wide distribution, only one natural assemblage (lacking the Sa element only) which was assigned to *Ozarkodina steinhornensis* (Ziegler, 1956) comb. nov. by Mashkova (1972) is known from Lower Devonian beds of the Fana Mountains (Tajikistan, Central Asia). Pollock (1969) figured several fused clusters of Silurian age from northern Indiana, belonging to different species of *Ozarkodina*.

Conclusions

The observed conodont cluster includes three elements (one M, two S elements). Based on the diagnostic features of the elements (as observed for the M, and S elements), the

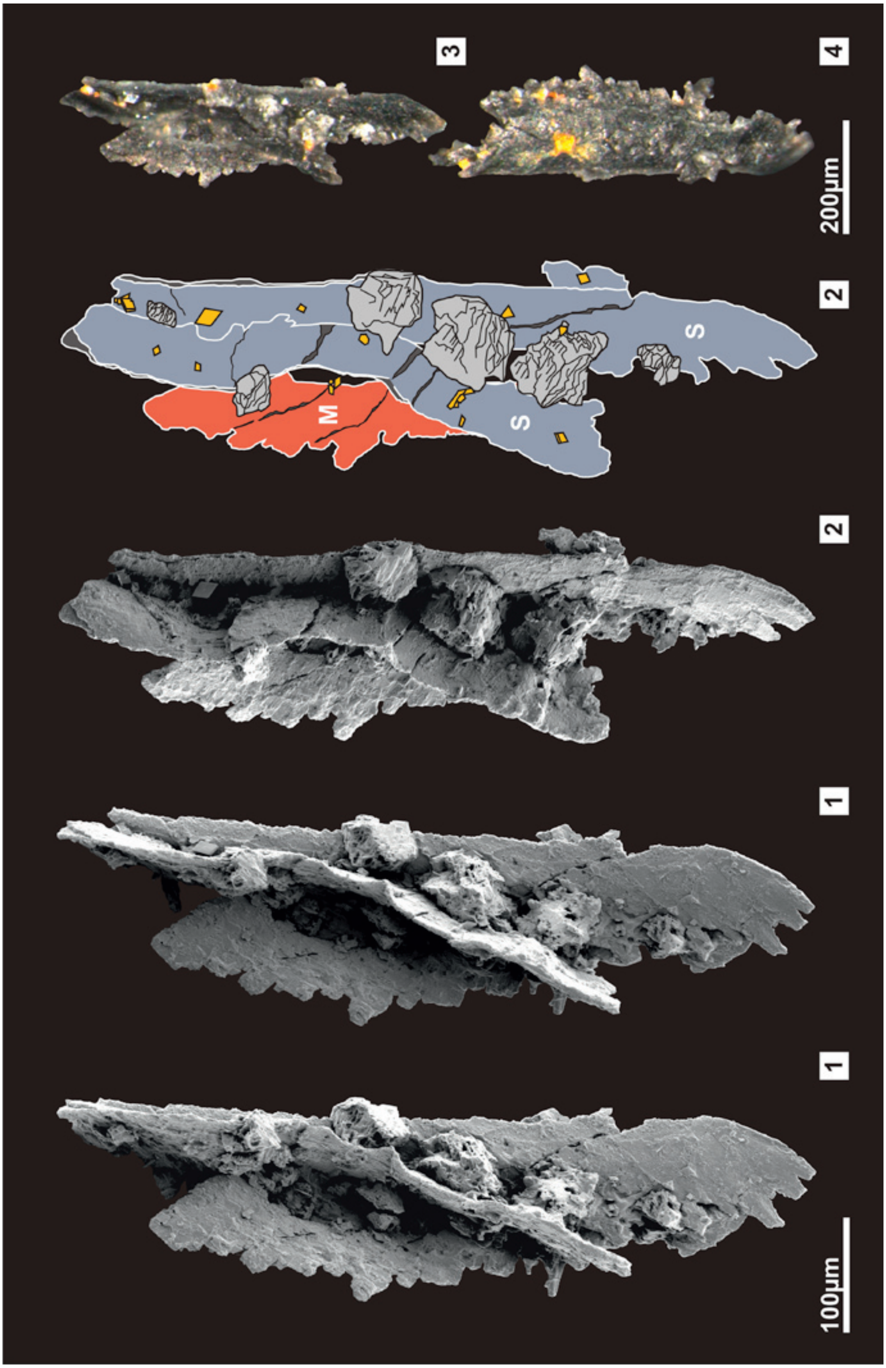

Fig. 3: Ozarkodinid conodont cluster (NHMW 2008z0307/0001; Ki/04/1c) – 3.1: Stereo-pair (1 M element, 2 S elements); 3.2: Sketch of the clustered elements (images 1 and 2 belong to 100 µm scale bar); 3.3: Upper side of the cluster, light microscope image; 3.4: Lower side of the cluster, light microscope image (images 3 and 4 belong to 200 µm scale bar).

fused elements most probably belong to a subspecies of the *Ozarkodina remscheidensis* group. Furthermore it seems that all 3 elements once were part of the apparatus of one individual, based on their orientation and the way the elements are fused.

It seems that the protection by its coprolite envelope is not the only factor responsible for conodont clusters to remain fused after acid treatment and sieving. A diagenetic overprint as well as sedimentary conditions (e.g. porosity and viscosity) probably play a decisive role in obtaining fused clusters.

Acknowledgements

Thanks are due to the owner of the Quarry, Dipl.-Ing. Alexander KOTTWITZ-ERDÖDI, who gave permission and supported the recent study with some notes about the historical development of the outcropping area. Ruth MAWSON and John TALENT (MUCEP, Australia) as well as Ladislav SLAVIK (Academy of Sciences, Czech Republic) are gratefully thanked for constructive comments on a former version of the manuscript. This is a contribution to NAP0001 and IGCP 497.

References

ALDRIDGE, R.J., PURNELL, M.A., GABBOTT, S.E. & THERON, J.N. (1995): The apparatus architecture and function of *Promissum pulchrum* KOVÁCS-ENDRÖDY (Conodonta, Upper Ordovician), and the prioniodontid plan. – Philosophical Transactions of the Royal Society of London, Series B, **347**: 275-291.

BRANSON, E.B. & MEHL, M.G. (1933): Conodonts from the Bainbridge (Silurian) of Missouri. – University of Missouri Studies, **8**/1: 39-52.

CARLS, P., SLAVÍK, L. & VALENZUELA-RÍOS, J.I. (2007): Revision of conodont biostratigraphy across the Silurian-Devonian boundary. – Bulletin of Geosciences, **82**/2: 145-164.

DONOGHUE, P.C.J., PURNELL, M.A., ALDRIDGE, R.J. & ZHANG, S. (2008): The interrelationships of complex conodonts (Vertebrata). – Journal of Systematic Palaeontology, **6**:119-153.

DZIK, J. (1991): Evolution of oral apparatuses in the conodont chordates. – Acta Palaeontologica Polonica, **36**/3: 265-323.

EBNER, F. (1988): Das Paläozoikum in den RAG-Bohrungen Blumau 1, 1a und Arnwiesen 1 (Oststeirisches Tertiärbecken). – Jahrbuch der Geologischen Bundesanstalt, **131**/4: 563-573.

FLÜGEL, H.W. (1988): Geologische Karte des prätertiären Untergrundes. – In: KRÖLL, A., FLÜGEL, H.W., SEIBERL, W., WEBER, F., WALACH, G. & ZYCH, D. (eds): Erläuterungen zu den Karten über den prätertiären Untergrund des Steirischen Beckens und der Südburgenländischen Schwelle, 21-27, Geologische Bundesanstalt, Wien.

HOFFMANN, K. (1877): Aufnahmsbericht über das Jahr 1876. – Verhandlungen der Geologischen Reichsanstalt, **1877**: 14-23.

HUBMANN, B. & SUTTNER, T. (2007): Siluro-Devonian Alpine reefs and pavements. – In: ALVARO, J.J., ARETZ, M., BOULVAIN, F., MUNNECKE, A., VACHARD, D. & VENNIN, E. (eds), Palaeozoic Reefs and Bioaccumulations: Climatic and Evolutionary Controls. Geological Society, London, Special Publications, **275**: 95-107.

JEPPSSON, L. & ANEHUS, R. (1995): A buffered formic acid technique for conodont extraction. – Journal of Paleontology, **69**/4: 790-794.

KLAPPER, G. & FOSTER, C.T. (1986): Quantification of outlines in Frasnian (Upper Devonian) platform conodonts. – Canadian Journal of Earth Sciences, **23**/8: 1214-1222.

——— & FOSTER, C.T. (1993): Shape Analysis of Frasnian Species of the Late Devonian Conodont Genus *Palmatolepis*. – Journal of Paleontology, **67**/4: 1-35.

———, LINDSTRÖM, M., SWEET, W.C. & ZIEGLER, W. (1973): *Ozarkodina*. – In: ZIEGLER, W. (ed.) Catalogue of Conodonts. E. Schweizerbart'sche Verlagsbuchhandlung, **I**: 211-252.

LANGE, F.G. (1968): Conodonten-Gruppenfunde aus Kalken des tieferen Oberdevon. – Geologica et Palaeontologica, **2**: 37-57.

LUKENEDER, A. & SUTTNER, T. (2007): Kirchfidisch: Altpaläozoische Serpulidenriffe. – In: HOFMANN, T. (ed.), Wanderungen in die Erdgeschichte, **22**: 193-194, Pfeil Verlag, München.

MAWSON, R., TALENT, J.A., MOLLOY, P.D. & SIMPSON, A.J. (2003): Siluro-Devonian (Pridoli-Lochkovian and early Emsian) conodonts from the Nowshera area, Pakistan: implications for the mid-Palaeozoic stratigraphy of the Peshawar Basin. – Courier Forschungsinstitut Senckenberg, **245**: 83-105.

MASHKOVA, T.V. (1972): *Ozarkodina steinhornensis* (ZIEGLER) Apparatus, its Conodonts and Biozone. – Geologica et Palaeontologica, **SB 1**: 81-90.

MURPHY, M.A., VALENZUELA-RÍOS, J.I. & CARLS, P. (2004): On classification of Pridoli (Silurian) - Lochkovian (Devonian) Spathognathodontidae (Conodonts). – University of California, Riverside, Campus Museum Contribution, **6**: 1–25.

POLLAK, W. (1962): Untersuchungen über Schichtfolge, Bau und tektonische Stellung des österreichischen Anteils der Eisenberggruppe im südlichen Burgenland. – unpub. Ph.D. thesis, Univ. of Vienna, 108 pp., Vienna.

POLLOCK, C.A. (1969): Fused Silurian conodont clusters from Indiana. – Journal of Paleontology, **43**/4: 929-935.

PURNELL, M.A. & DONOGHUE, P.C.J. (1997): Architecture and functional morphology of the skeletal apparatus of ozarkodinid conodonts. – Philosophical Transactions of the Royal Society of London, Series B, **352**: 1545-1564.

——— & DONOGHUE, P.C.J. (1998): Skeletal architecture, homologies and taphonomy of ozarkodinid conodonts. – Palaeontology, **41**: 57-102.

PURNELL, M.A., DONOGHUE, P.C.J. & ALDRIDGE, R.J. (2000): Orientation and anatomical notation in conodonts. – Journal of Paleontology, **74**: 113-122.

RIEBER, H. (1980): Ein Conodonten-cluster aus der Grenzbitumenzone (Mittlere Trias) des Monte San Giorgio (Kt. Tessin/Schweiz). – Annalen des Naturhistorischen Museums in Wien, **83**: 265-274.

SAVAGE, N.M. (1988): The use of sodium polytungstate for conodont separation. – Journal of Micropalaeontology, **7**/1: 39-40.

SCHALLREUTER, R. (2004): Stereoskopische Abbildungen von Mikrofossilien. – Mikrokosmos, **93**: 341-346.

SCHÖNLAUB, H.P. (1984): Das Paläozoikum von Sulz bei Güssing im Südburgenland. – Jahrbuch der Geologischen Bundesanstalt, **127**: 501-505.

——— (1994): Das Altpaläozoikum im Südburgenland. – In: LOBITZER, H., CSÁSZÁR, G. & DAURER, A. (eds): Jubilläumsschrift 20 Jahre Geologische Zusammenarbeit Österreich-Ungarn: 365-377.

——— (2000): Das Altpaläozoikum im Südburgenland. – In: SCHÖNLAUB, H.P. (ed.): Burgenland. Erläuterungen zur Geologischen Karte des Burgenlandes 1:200.000. Geologische Bundesanstalt, 31-35, Wien.

SCHULZE, R. (1968): Die Conodonten aus dem Paläozoikum der mittleren Karawanken (Seeberggebiet). – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **130**/2: 133-245.

SCHÜLKE, I. (1997): Conodont clusters and multielement reconstructions from the Upper Kellwasser horizon at La Serre (Late Frasnian, Montagne Noire, Southern France). – Geologica et Palaeontologica, **31**: 37–66.

SIMPSON, A.J. & TALENT, J.A. (1995): Silurian conodonts from the headwaters of the Indi (upper Murray) and Buchan rivers, southeastern Australia, and their implications. – Courier Forschungsinstitut Senckenberg, **182**: 79-215.

SLOAN, T.R. (2003): Results of a new outline-based method for the differentiation of conodont taxa. – Courier Forschungsinstitut Senckenberg, **245**: 389-405.

SUTTNER, T. (2007): Late Silurian accumulations of serpulid tubes, Austria. – In: VENNIN, E., ARETZ, M., BOULVAIN, F. & MUNNECKE, A. (eds), Facies from Palaeozoic reefs and bioaccumulations, chapter III: Silurian, pp. 165-167, Muséum national d´Histoire naturelle, Paris.

——— (2009): Lower Devonian conodonts of the “Baron von Kottwitz” quarry (Southern Burgenland, Austria). – In: OVER, D.J. (ed.) Conodont Studies Commemorating the 150th Anniversary of the First Conodont Paper (PANDER, 1856) and the 40th Anniversary of the Pander Society, Palaeontographica Americana, **62**: 75-87.

——— & LUKENEDER, A. (2004): Accumulations of Late Silurian serpulid tubes and their palaeoecological implications (Blumau-Formation; Burgenland; Austria). – Annalen des Naturhistorischen Museums in Wien, Serie A, **105**: 175-187.

TELFORD, P.G. (1975): Lower and Middle Devonian conodonts from the Broken River Embayment, North Queensland, Australia. – Special Papers in Palaeontology, **15**: 1-96.

TOLMACHEVA, T.Y. & PURNELL, M.A. (2002): Apparatus composition, growth, and survivorship of the Lower Ordovician conodont *Paracordylodus gracilis* LINDSTRÖM, 1955. – Palaeontology, **45**: 209-228.

TOULA, F. (1878): Über Devon-Fossilien aus dem Eisenburger Comitate. – Verhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt, **1878**: 47-52.

VON BITTER, P.H. & PURNELL, M.A. (2005): An experimental investigation of postdepositional taphonomic bias in conodonts. – In: PURNELL, M.A. & DONOGHUE, P.C.J. (eds): Conodont biology and phylogeny - interpreting the fossil record. – Special Papers in Palaeontology, **73**: 39-56.

VON BITTER, P.H., PURNELL, M.A., TETRAULT, D.K. & STOTT, C.A. (2007): Eramosa Lagerstätte - exceptionally preserved soft-bodied biotas with shallow-marine shelly and bioturbating organisms (Silurian, Ontario, Canada). – Geology, **35**: 879-882.

WALLISER, O.H. (1964): Conodonten des Silurs. – Abhandlungen des Hessischen Landesamtes für Bodenforschung zu Wiesbaden, **41**: 1-106.

ZIEGLER, W. (1956): Unterdevonische Conodonten, insbesondere aus dem Schönauer und dem *Zorgensis*-Kalk. – Notizblatt des Hessischen Landesamtes für Bodenforschung zu Wiesbaden, **84**: 93-106.

——— (1960): Conodonten aus dem Rheinischen Unterdevon (Gedinnium) des Remscheider Sattels (Rheinisches Schiefergebirge). – Paläontologische Zeitschrift, **34**/2: 169-201.