N. Jb. Geol. Paläont. Abh. 260/1, 21–31
published online January 2011

Article

The new cheilostome bryozoan *Metrarabdotos nehybai* from the Middle Miocene of Moravia (Czech Republic): palaeofaunistic, taxonomic and ontogenetic aspects

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With 3 figures and 1 table

Zágoršek, K., Ostrovsky, A. & Vávra, N. (2011):The new cheilostome bryozoan *Metrarabdotos nehybai* from the Middle Miocene of Moravia (Czech Republic): palaeofaunistic, taxonomic and ontogenetic aspects. – N. Jb. Geol. Paläont. Abh., **260**: 21–31; Stuttgart.

Abstract: Samples from borehole Vranovice VK 1 (Moravia, Czech Republic) have yielded a bryozoan fauna comparable with two bryozoan faunas of equivalent age (early Badenian, Lower Lagenid Zone) from Austria (Niederleis, Locatelliwald). As previously shown by studies on foraminifera, the bryozoans indicate changes of the environment (mainly shallowing upwards) during the early Badenian. In most of the samples studied a new cheilostome bryozoan (*Metrarabdotos nehybai* sp. nov.) from the family Metrarabdotosidae has been found. A detailed taxonomic description is given. Skeletal thickening of the frontal shield ('secondary calcification') strongly changes the external appearance of the ontogenetically older zooids, but internal features remain stable and permit precise identification.

Key words: Miocene, Moravia, Bryozoa, new species, taxonomy, secondary calcification.

Introduction

Modern studies of biostratigraphy and palaeoecology of the Badenian (Middle Miocene) in the Carpathian Foredeep (Czech Republic) have revealed a rather complex sequence of sediments that is considered to result from rapid changes in the palaeoenvironment caused by sea-level fluctuations. Modern studies on foraminifera from the boreholes Ivan-1 and Vranovice VK 1 have contributed to a better understanding of the details of these complex sedimentary changes (e.g. Petrová & Švábenická 2007).

The borehole Vranovice VK 1 is situated about 5 km east of Pohořelice. This part of the Carpathian Foredeep is filled with Neogene clastic sediments of late Egerian/Eggenburgian (20.43 Ma) to early Badenian (15.97 Ma) age (sensu Gradstein et al. 2004). The foraminifers *Praeorbulina sicana* and *P. glomerosa circularis* in the samples indicate a Middle Miocene age for these sediments, more precisely the planktonic foraminifer zone M5b (sensu Berggren et al. 1995). This is correlated with the Early Badenian in the Central Paratethys regional stage concept (Nehyba et al. 2008). The sediments sampled and studied in this borehole correspond to the Grund Formation (Roetzel & Pervesler 2004) and the Lower Lagenid Zone as defined by Grill (1941) in Austria.

Foraminiferal assemblages often change within the section as shown by Nehyba et al. (2008). Distinctive changes in the planktonic/benthic ratio and in the overall character of foraminiferal assemblages were recorded within several centimetres of cored sedi-

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DOI: 10.1127/0077-7749/2011/0126
0077-7749/2011/0126 $ 2.75

Table 1. List of the bryozoan species and other invertebrates, otoliths and fish teeth associated with *Metrarabdotos nehybai* sp. nov.

TAXA / depth in metres	6.3	7.0	16.8	30.7	31.5	32.0	35.0	51.2	51.4	51.9
Brachiopods	*									
Corals	*			*	*	*	*	*		*
Decapods						*			*	
Polyplacophores	*	*		*	*	*	*	*	*	
Bivalves	*									
Otoliths					*	*	*			
Sparidae-fish teeth	*						*			
Serpulids					*					
Bryozoans:										
Adeonella polystomella (Reuss, 1847)	*	*	*		*	*	*	*	*	
Adeonellopsis coscinophora (Reuss, 1847)	*		*							
Bicrisina compressa (Reuss, 1847)		*		*			*			
Cellaria cf. *fistulosa* (Linnaeus, 1758)	*	*					*		*	
Cellaria cf. *salicornioides* Lamouroux, 1816	*	*			*	*	*			
Cellepora indeterminable	*	*		*		*	*			
Celleporaria palmata (Michelin, 1847)	*		*							
Cribellopora latigastra (David, 1949)							*			
Cribellopora sp.							*			
Crisia cf. *eburnea* (Linnaeus, 1758)	*	*								
Crisia elongata Milne Edwards, 1838	*									
Crisia haueri Reuss, 1847	*									
Crisia hoernesi Reuss, 1847	*							*	*	*
Crisidmonea foraminosa (Reuss, 1851)		*	*			*	*			
Cupuladria sp.			*							
Diplosolen obelium (Johnston, 1838)							*			
Exidmonea atlantica David, Mongereau & Pouyet, 1972	*		*	*		*	*			
Frondipora verrucosa (Lamouroux, 1821)							*			
Heteropora sp.	*									*
Hornera frondiculata Forbes in Johnson, 1838	*	*	*	*	*	*	*	*	*	*
Hornera striata Milne-Edwards, 1838	*	*	*		*	*	*			*
Hornera subannulata Philippi, 1844							*			
Hornera verrucosa Reuss, 1866						*	*			
Idmidronea coronopus (Defrance, 1822)						*	*			
Iodictyum rubeschii (Reuss, 1847)					*					
Margaretta cereoides (Ellis & Solander, 1786)						*	*			
Mecynoecia pulchella (Reuss, 1847)		*	*	*	*	*	*	*		*
Metrarabdotos maleckii Cheetham, 1968	*	*	*			*	*	*	*	*
***Metrarabdotos nehybai* sp.n.**	P1405	P1408 P1414	P1415	*	P1406 P1418	P1407 P1411 P1413 P1417	P1409	P1410 P1412 P1416	*	*
Microporella ciliata (Pallas, 1766)						*				
Monoporella venusta (Eichwald, 1853)							*			
Oncousoecia biloba (Reuss, 1847)										*
Onychocella angulosa (Reuss, 1847)		*								
Pleuronea pertusa (Reuss, 1847)	*	*	*	*		*	*			*
Polyascosoecia cancellata Canu, 1920	*	*	*	*	*	*	*	*	*	*
Porella circumornata (Reuss, 1847)						*	*			
Porella nuda (Reuss, 1874)	*									
Pseudofrondipora davidi Mongereau, 1970			*			*	*			
Reptadeonella violacea (Johnston, 1847)							*		*	
Reteporella kralicensis Zágoršek, Holcová & Třasoň, 2008							*			
Reteporella sp.	*	*	*			*	*	*		*
Reussirella haidingeri (Reuss, 1847)				*		*	*			
Rhynchozoon sp.							*			
Schizobrachiella ? granosoporosa (Reuss, 1874)					*					
Schizomavella tenella (Reuss, 1847)			*							
"*Schizoporella*" *geminipora* (Reuss, 1847)	*									
Schizostomella grinzingensis David & Pouyet, 1974	*						*			
Smittina cervicornis (Pallas, 1766)	*						*			
Steginoporella cucullata (Reuss, 1847)		*	*			*	*			
Tubulipora dimidiata (Reuss, 1847)	*					*	*	*		
Turbicellepora coronopus (Reuss, 1847)			*				*			*
Turbicellepora sp.				*		*				
Umbonula sp.	*									
Umbonula macrocheila (Reuss, 1847)							*			
Ybselosoecia typica (Manzoni, 1878)	*	*		*	*	*				
Total number of identified species	**26**	**18**	**18**	**11**	**10**	**24**	**36**	**9**	**8**	**12**

ments that corresponds to a very short period of time. The foraminiferal assemblages indicate a warmer shallow sea (infralittoral) of normal salinity with well-oxygenated water and high wave energy. Such foraminiferal assemblages are often intercalated with assemblages indicating low oxygen levels from a deeper sublittoral (circalittoral) environment. In addition, assemblages from a deeper colder environment (circalittoral to probably upper bathyal) of normal salinity lacking dysoxic indicators (Kaiho 1994), and also mixed assemblages of shallow-water and deeper-water benthic foraminifers have been reported (Nehyba et al. 2008).

Bryozoans from the borehole Vranovice VK 1 have been recently studied. Three different associations of bryozoans were distinguished, together containing 55 species in 19 samples (Nehyba et al. 2008; Zágoršek et al. 2005, 2007). The preservation of the colonies is excellent, and species with aragonitic shells are preserved. Among the bryozoans collected, a number of fragments of an undescribed cheilostome colony encountered. Most of these fragments were strongly calcified, hampering their identification. Their interiors, however, showed a number of distinctive features allowing their taxonomic description as a new species, *Metrarabdotos nehybai* sp. nov.

Additionally the sequential stages of 'secondary calcification' have been studied in detail. This term is widely used to describe a thickening of the frontal skeletal walls/shields during ontogeny known in many cheilostomes. According to Sandberg (1983), the term 'superficial frontal calcification' rather than 'secondary calcification' should be used to describe multiple layers successively deposited on the outer side of the frontal shield. The term 'superficial', however, is also not an appropriate term in this context as it is often used to imply 'unimportance' in English, whereas this kind of calcification can account for a high proportion of frontal shield thickness in cheilostome bryozoans. With this in mind, we use the descriptive terms 'the thickening of the frontal shield' and 'skeletal thickening' in the present paper.

The deposition of calcium carbonate often strongly changes the external morphology of the colony making taxonomic identification difficult. Ultrastructural research has revealed that such thickened walls are represented by a variety of skeletal fabrics (Tavener-Smith & Williams 1972; Sandberg 1977, 1983), but fossilization often makes their recognition difficult. Since microstructure is hardly recognisable in our material, we have focused on the description of the external manifestation of this phenomenon in *Metrarabdotos nehybai* sp. nov.

Material and methods

The borehole Vranovice VK 1 was drilled in South Moravia (Czech Republic) by the Brno Branch of the Czech Geological Survey. The borehole was located close to the contact of Lower/Middle Miocene deposits as determined by geological mapping. A depth of 60 m was reached. Drill profiles were fully cored.

Altogether 121 samples were taken, with fossilized bryozoan skeletons occurring in 19 of them. Fragments of *Metrarabdotos* were found in 10 samples (Table 1). Samples were washed and sieved as described by Zágoršek & Vávra (2000) using 0.09 mm mesh.

Selected fragments were cleaned ultrasonically and studied using a Jeol JSM 6400 scanning electron microscope in the Department of Palaeontology, University of Vienna (DPUV) and Hitachi S 3700N from National Muzeum Prague. All measurements were made with SemAfore 3.0 pro Jeol software at DPVU and image manager for Hitachi S 3700N. Studied samples are stored in the National Museum, Prague.

Results

The results of our studies are shown in Table 1. Altogether, in the 19 samples taken from the borehole Vranovice VK 1, 55 bryozoan species belonging to 43 genera and 25 families were identified. Among those are 33 cheilostome species belonging to 27 genera and 18 families, and 22 cyclostomes belonging to 16 genera and 7 families.

The average number of species per sample varies from 20 to 25, except the sample from 32m depth where 34 species have been determined. In contrast, there are some samples containing fewer than 10 species. Cyclostome bryozoans belonging to the genera *Hornera* and *Polyascosoecia* dominate the entire section. Among cheilostome bryozoans, species belonging to the genus *Reteporella* are the most abundant (see also Zágoršek et al. 2005, 2007).

Systematic Palaeontology

Terminological note: No "primary orifice" is preserved in the *Metrarabdotos* skeletons, as only the distal part of the orifice is calcified, and its proximal part is formed by the frontal membrane (Cheetham

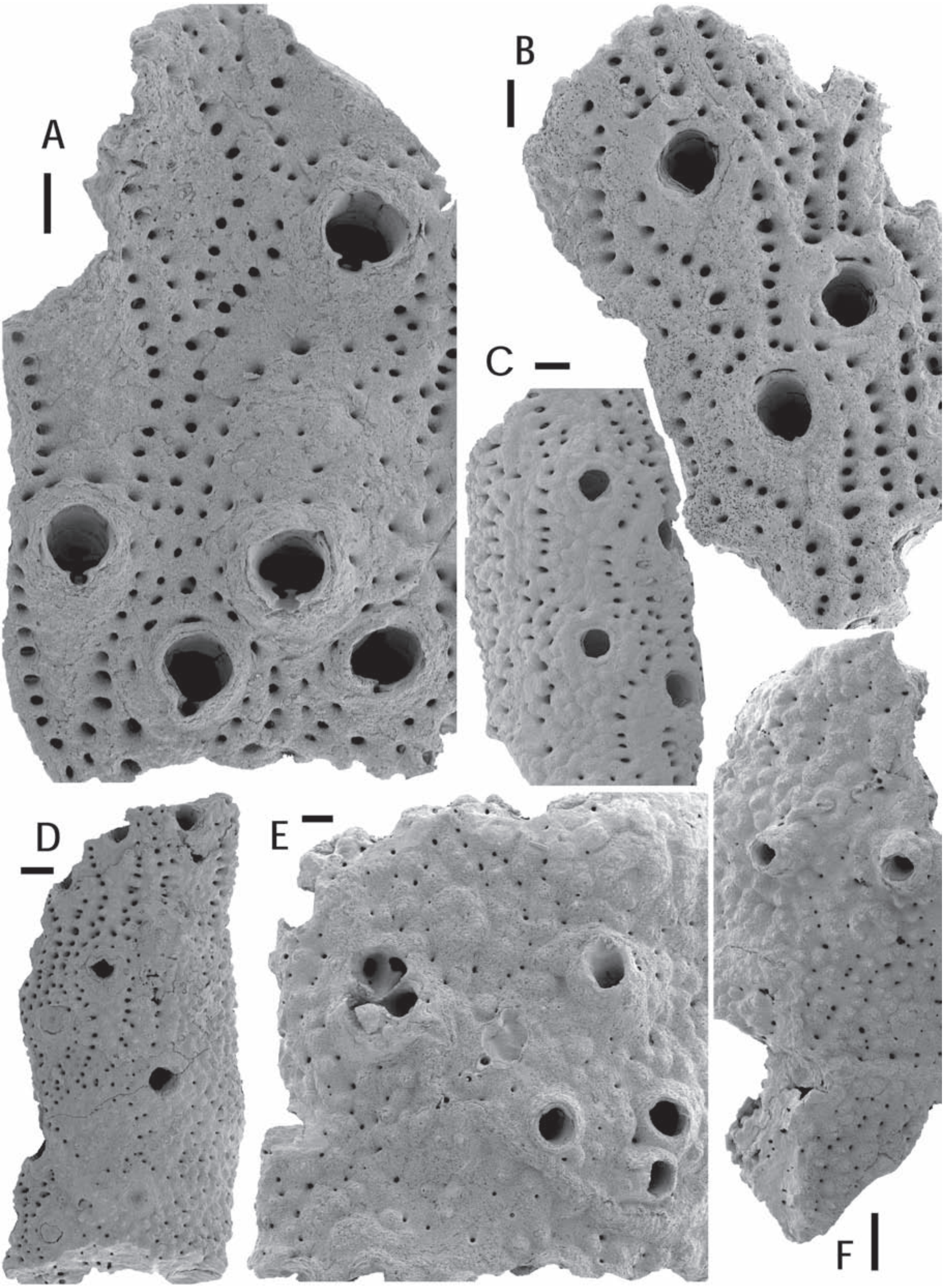

Fig. 1 (Legend see p. 25)

1968, Bock 2010). Following Cheetham et al. (2007) we term the autozooecial opening as "secondary orifice". The opening of the peristome is termed as "peristomiala perture".

Family Metrarabdotosidae Vigneaux, 1949
Genus *Metrarabdotos* Canu, 1914

Metrarabdotos nehybai sp. nov.
Fig. 1-3

Diagnosis: Colonies erect, robust, with autozooecia arranged in 4-8 longitudinal rows. Autozooecia elongated, tapered proximally, with marginal areolar pores. Inner side of autozooecia with a smooth umbonuloid frontal shield, and square-shaped canals of marginal areolae in the lateral walls. Secondary orifice with median columnar process expanded terminally, two pairs of pointed condyle-shaped marginal processes and a circular sinus. Later in ontogeny a relatively long, tubular peristome with smooth internal walls and round aperture is formed. Ovicells and avicularia not observed.

Holotype: Specimen PM2 – P1405 (Fig. 1, A, Fig. 2, B_1 and B_2) from borehole Vranovice VK 1, near Vranovice, Czech Republic, depth 6.3 m.

Paratypes: Thirteen specimens with the numbers PM2 – P1406 to PM2 – P1418 collected from borehole Vranovice VK 1, near village Vranovice, Czech Republic (depth for each specimen is given in Table 1). Additional 25 specimens have been studied but, due to their poor preservation, these have not been chosen as paratypes.

Derivatio nominis: In honour of Dr. S. Nehyba, who intensively studied Carpathian Foredeep sediments in the Czech Republic.

Locus typicus: Borehole Vranovice VK 1, near the village of Vranovice, Czech Republic. Sampling depth: 6.3 m.

Stratum typicum: Langhian = early Badenian.

Dimensions (in µm) x = average from 10 to 30 measurements
Diameter of branch: 1230 – 1421
Length of zooecia: 631 – 876; x = 727
Width of zooecia: 200 – 339; x = 265
Length of secondary orifice: 115 – 171; x = 143
Width of secondary orifice: 114 – 183; x = 142
Width of median process: 19 – 23; x = 22
Width of sinus: 25 – 70; x = 52
Thickness of frontal shield: 158 – 248; x = 208
Diameter of areolar pores: 26 – 75; x = 56
Width of 'channels' situated left and right of lyrula: 23 – 39; x = 30

Description

Type material consists of 14 fragments of erect, strongly calcified colonies with flattened or/and columnar stems. The thickening of the frontal shield ('secondary calcification') drastically changes the external colony morphology in the 'older' fragments.

Less calcified 'younger' fragments show 4-8 regular rows of elongated autozooecia with large marginal areolar pores, and oval or almost circular secondary orifices, with a deep rounded sinus and pronounced marginal processes. Also a thin collar with a smooth surface is visible inside the orifice when viewed frontally (Fig. 1A). Autozooecia are normally elongated, tapered proximally, but some variation can often be observed with occasional shorter and more rectangular zooids. The frontal wall is smooth or slightly granular.

Fig. 1. *Metrarabdotos nehybai* sp. nov. A) Holotype (PM2 – P 1405): colony fragment with less developed thickening of the frontal wall ('secondary calcification'); sinuses of secondary orifices, distinct areolar pores and the almost smooth frontal wall can be easily recognized. B) Paratype (PM2 – P 1406): next stage of calcification: sinuses are slight and secondary orifices are circular; shape of the autozooecia is still recognizable. C) Paratype (PM2 – P 1407): next stage with granular frontal wall and circular secondary orifices. D) Paratype (PM2 – P 1408): fragment showing the difference in the degree of the frontal shield thickening between proximal and distal parts; areolar pores are strongly reduced basally; two zooidal orifices are plugged. E) Paratype (PM2 – P 1412): one of the last stages of the thickening of the frontal shield showing long peristomes, granular frontal wall and small pores (strongly reduced areolar pores) which enables recognition of the shape of autozooecia. F) Paratype (PM2 – P 1410): the ultimate stage of 'secondary calcification'. Scale bars = 100 µm.

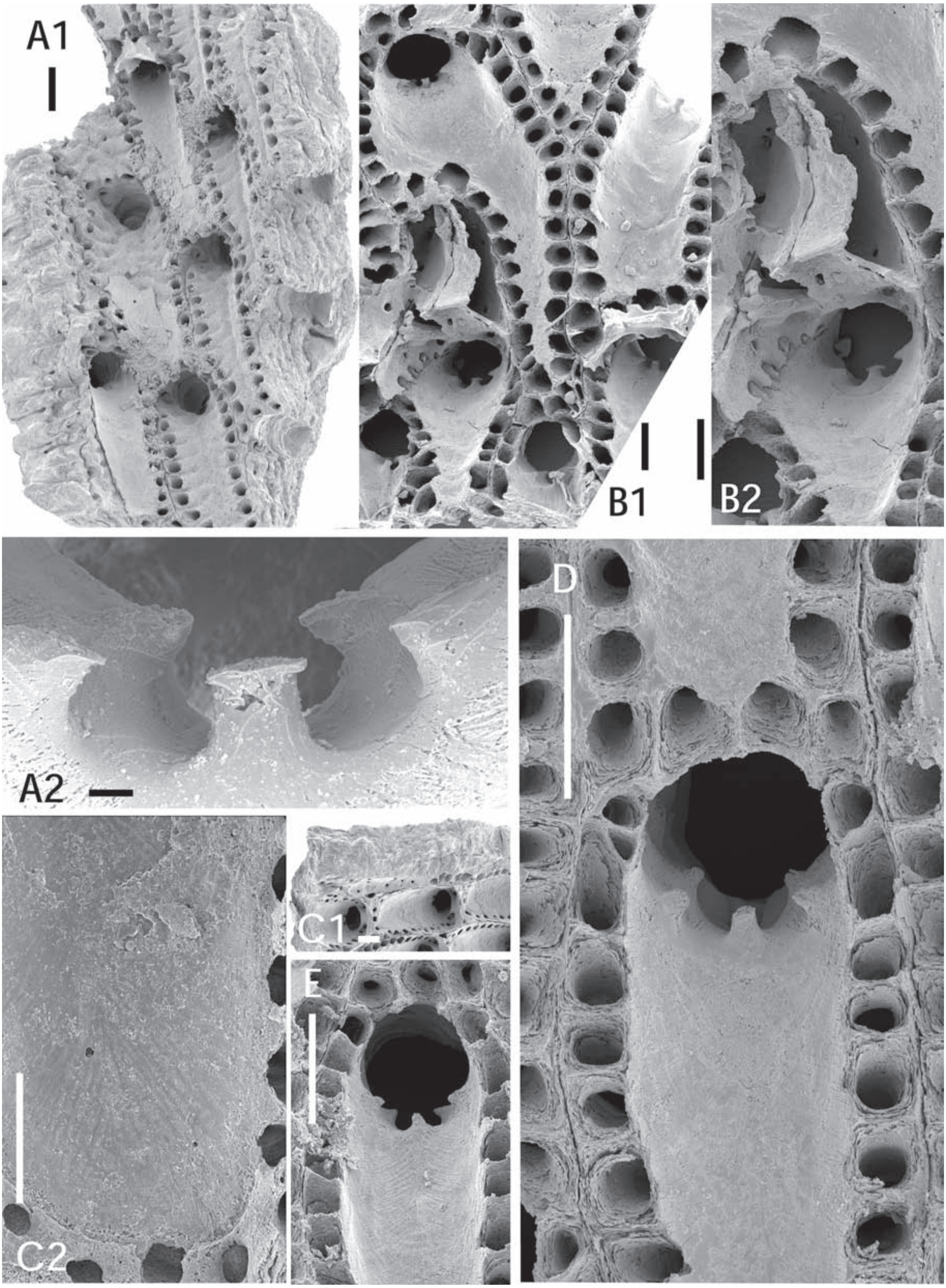

Fig. 2 (Legend see p. 27)

As skeletal thickening proceeds, the sinus of the secondary orifice becomes very shallow and finally disappears, and the orifice itself becomes circular (Fig. 1B, C). Further thickening of the frontal shield leads to a reduction in the size of the marginal areolae, and to a more granular frontal wall (Fig. 1D-F).

The last stage of calcification is characterized by formation of long tubular peristomes with smaller circular apertures (Fig. 1E, F), and a highly granular (pustulose) frontal surface. Finally, the shape of the autozooecia is no longer recognizable. Also the orifices of some autozooids are occluded (Fig. 1D). Some areolae are probably occluded too.

A view from the inner side of the colony shows more uniform features. Autozooecia are elongated, with a smooth, umbonuloid frontal shield bordered by lateral walls with square-shaped canals leading to areolar pores (Fig. 2B1, B2, C1, D, E). Often, the umbonuloid part of the frontal shield shows a radiating pattern of crystallites ("planar spherulitic fabric" of Sandberg 1977, 1983) (Fig. $2C_2$, D, E). The secondary orifice shows a columnar lyrula-shaped process with a terminal expansion. On each side of it is a pointed triangular condyle-shaped process. More distally a broad circular sinus is placed being bordered by two additional condyle-shaped processes (Fig. 2A2, B1, B2, D, E). Older fragments show a vestibule of the peristome connecting the secondary orifice with a circular peristomial aperture exposed at the surface. In some cases a shallow median groove is visible in the proximal wall of the peristome (Fig. 2E). Walls of the vestibule are smooth apart from growth lines.

The sinus of the secondary orifice with two pairs of marginal processes presumably functioned as a funnel to allow water to flow into or out of the space between frontal membrane and frontal wall when the tentacles were protruded or retracted, respectively (Cheetham et al. 2007). Two channels between the median lyrula-shaped and two marginal processes merge into a single one above forming a sinus, while the median terminally expanded process would have prevented the lophophore from stuffing the proximal channel when quickly retracted.

Two kenozooecia have been found in one of the specimens. They are irregularly shaped, with perforated frontal walls (Fig. 2B1, B2).

Comparison: The internal autozooecial structure shows large similarities between the new species and *Metrarabdotos maleckii* Cheetham, 1968 from the Middle Miocene of the Paratethys (Zágoršek et al, 2009). Appearance of lyrula-shaped process, sinus of the orifice and its marginal processes are very similar (compare Figs. 2A2, D-E and 3D1, E).

The main differences include shape of autozooecia and secondary orifices, and presence or absence of avicularia. The shape of the autozooecia in *M. maleckii* is more rectangular, while it is more oval in *M. nehybai* sp. nov. (compare Figs. 1B and 3D2). Secondary orifices in *M. maleckii* are mainly oval, and their length varies from 79 to 117 µm (average 107 µm) and the width from 115 to 156 µm (average 135 µm, 16 orifices measured). *Metrarabdotos nehybai* sp. nov. normally has circular secondary orifices (average length 143 µm, average width 142 µm, for measurements see above). Moreover, *M. maleckii* is characterized by a pair of small suboral avicularia which may, however, not be present in all specimens (see Cheetham et al. 2007). Avicularia have not been found in any of the studied specimens of *M. nehybai* sp. nov. Also, in *M. maleckii* we never observed such a strong secondary thickening of the zooidal frontal shield as described for *M. nehybai* sp. nov.

Fig. 2. *Metrarabdotos nehybai* sp. nov. A1) Paratype (PM2 – P 1410): view of the inner surface of a colony fragment showing the thickness of the frontal shield and large square-shaped canals of areolar pores. B1) Holotype (PM2 – P 1405): view of the inner surface of a fragment with two kenozooecia. B2) Holotype (PM2 – P 1405): close-up of the same fragment: detail of kenozooecia. A2) Paratype (PM2 – P 1410): proximal edge of the secondary orifice (with lyrula-shaped median process, two pairs of marginal processes and a sinus). Scale bar = 10µm. C1) Paratype (PM2 – P 1408): part of a fragment showing the thickness of the frontal shield. C2) Paratype (PM2 – P 1408): detail of the umbonuloid frontal shield with radiating pattern of crystallites. D) Paratype (PM2 – P 1411): close-up of the inner surface of an autozooecium showing umbonuloid frontal shield, details of the secondary orifice and a peristome with a medial groove. E) Paratype (PM2 – P 1406): detail of autozooecium with the secondary orifice; the umbonuloid frontal shield shows radiating pattern of crystallites. Scale bars (except A2) = 100 µm.

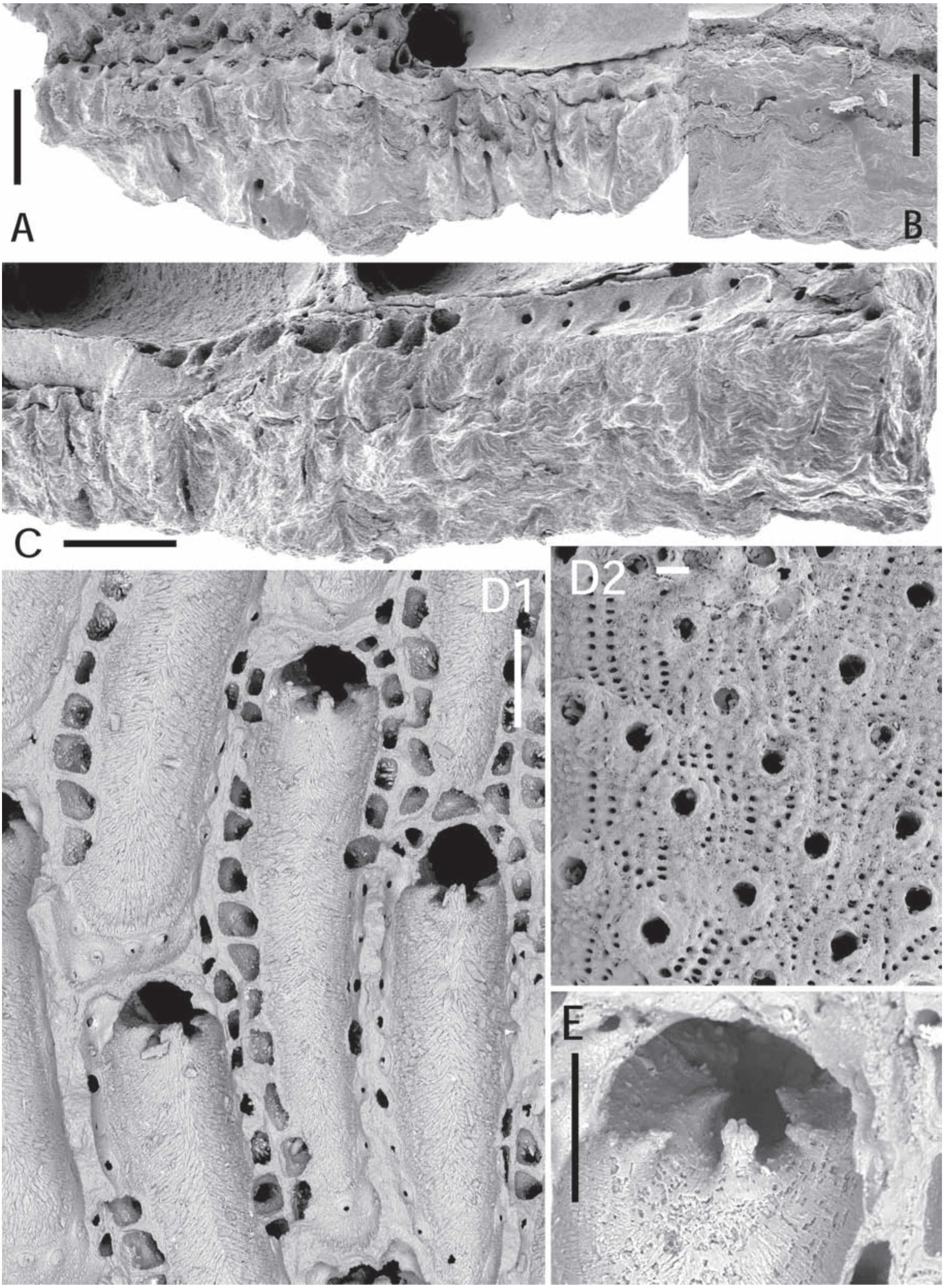

Fig. 3 (Legend see p. 29)

Discussion

Remarks on the thickening of the frontal shield

As demonstrated in Fig. 3, longitudinal sections through the frontal zooidal shield show very thick calcification with laminated structure, but we were not able to recognize different ultrastructural fabrics.

Metrarabdotos nehybai sp. nov. represents a very remarkable example how the skeletal thickening may change the appearance of bryozoan colonies resulting perhaps even in complete misidentification of specimens. Such strongly calcified specimens should be treated with caution, and only complete series showing different stages of secondary skeletal changes or examining the interior of the frontal shield should be used for taxonomical work.

Palaeofaunistic and palaeoenvironmental considerations

The bryozoan fauna from the samples of borehole Vranovice VK 1 shows quite a number of interesting features. First, the total biodiversity is rather low compared to faunas from the Upper Lagenid Zone with the most diverse sample yielding only 36 species. This is in good agreement with data from Austria (Vávra 2000), where also only about 40 species have been found, in comparison with highly diverse bryozoan fauna (more than 100 species) from late Badenian sediments (Vávra 1977). Moreover, comparisons of different samples from different depths show distinct differences in bryozoan diversity, reflecting minor local changes of the environment as indicated by previous studies of foraminiferal assemblages (see above).

A number of taxa identified are of particular importance as a basis for ecological inference. The presence of *Crisia*, which shows a remarkably high diversity in the samples, can tentatively be regarded as an indicator of plant substrata nearby. However, single internodes of the lightly calcified, fragile colonies of crisiids can be easily transported across large distances (e.g. Bobies 1958). Relying on "*Schizoporella*" *geminipora* (Reuss, 1847) as a possible indicator of seagrass meadows (Vávra 1979; Holcová & Zágoršek 2008) is consistent with this suggestion – this species was only found in the uppermost part of the profile (6.3 m – see Table 1). *Metrarabdotos* and *Steginoporella* have been suggested as indicative of subtropical to tropical environments (see Vávra 1980 and references therein).

Of great interest for taxonomists is also the fact that quite a number of rather rare and uncommon species were identified in the course of our studies: *Adeonellopsis coscinophora* (Reuss, 1847), *Monoporella venusta* (Eichwald, 1853), *Reteporella kralicensis* Zágoršek, Holcová & Třasoň, 2008 and *Schizostomella grinzingensis* David & Pouyet, 1974 may be mentioned as such examples.

Taxa like *Reussirella haidingeri* (Reuss, 1847) and *Cupuladria* sp. are known to occur in environments with a considerable amount of fine sedimentation. Accordingly, cupuladriids possess modified zooids with vibracular setae capable of cleaning sediment from the colony surface (see Baluk & Radwański, 1984 and references therein). *Schizostomella grinzingensis*, found in two of the samples studied, is known from a number of Austrian localities too, where it has been observed to undergo considerable calcification (similar to *Metrarabdotos nehybai* sp. nov.) – a possible way to strengthen initially rather fragile, erect colonies.

In view of the fluctuations in ecological conditions shown by changes in biodiversity, as well as by the occurrence of single species and also by 'prominent absences' in different samples, it is worth mentioning that *Metrarabdotos nehybai* occurs in ten studied samples (Table 1).

Fig. 3. *Metrarabdotos nehybai* sp. nov. and *Metrarabdotos maleckii* Cheetham, 1968. A) *Metrarabdotos nehybai* sp. nov. Paratype (PM2 – P 1410): longitudinal section through the skeleton showing the thickness of the frontal shield. B) *Metrarabdotos nehybai* sp. nov. Paratype (PM2 – P 1407): detail with visible lamination of the frontal shield. C) *Metrarabdotos nehybai* sp. nov. Paratype (PM2 – P 1408): detail with canals of the marginal areolar pores inside the lateral walls and lamination of the frontal shield. D1) *Metrarabdotos maleckii* Cheetham, 1968 (PM2 – P 1929): section Podbřežice, sample Př-12: view of the inner surface of a colony fragment showing the shape of autozooecia, umbonuloid frontal shield and canals of the areolar pores in the zooidal walls. D2) *Metrarabdotos maleckii* Cheetham, 1968 (PM2 – P 1929): section Podbřežice, sample Př-12: frontal surface of the colony. E) *Metrarabdotos maleckii* Cheetham, 1968 (PM2 – P 1930): detail of the secondary orifice showing lyrula-shaped median process, two pairs of marginal processes and a sinus. Scale bars = 100 µm

Notes on similar faunas in Austria

The bryozoan fauna as studied from the borehole at Vranovice is of considerable interest also in respect to comparisons with faunas from the Austrian Neogene. Similar sediment, with typically transgressive character, covers also the area of the Molasse Zone in the direction towards Mailberg. Here Leitha limestone overlies the 'Grund-formation', limestones exposed in an abandoned quarry near Mailberg (Buchberg) and in the Locatelliwald. These limestones contain Corallinaceae (red algal fragments), molluscs, barnacles and echinoids (for details see Rohatsch & Thinschmidt 1997; Wessely 2006 and references therein).

From Locatelliwald, a rather rich and well-preserved bryozoan fauna has been collected and studied by one of us (N.V.). The frequent finds of *Pleuronea pertusa* (Reuss, 1847) and *Polyascosoecia cancellata* Canu, 1920 throughout most of the samples is reminiscent of faunas from borehole Vranovice VK-1.

One more bryozoan fauna from the early Badenian has been studied from the small Neogene basin of Niederleis. The palaeoecology, biostratigraphy and sedimentology of this area have recently been described by Mandic et al. (2002), confirming that these sediments belong to the upper part of the Lower Lagenid Zone. A general feature of the two bryozoan faunas from the Lower Lagenid Zone of Austria is the remarkably low diversity of bryozoan assemblages; in contrast, faunas from the Upper Lagenid Zone have yielded the highest bryozoan biodiversity from the Austrian Neogene (Vávra 2000).

The low faunal diversity of bryozoans from the Lower Lagenid Zone corresponds rather well with the various samples as studied from the borehole of Vranovice. Higher up in the sequence of this borehole the diversity of bryozoan taxa shows a distinct increase (sample 32.0 and 35.0, see Table 1), followed by another decrease higher up the sequence. Nevertheless, the total number of taxa identified remains rather small throughout the entire profile.

Acknowledgements

We thank Dr P. Petrová-Tomanová from the Czech Geological Survey branch in Brno for allowing us to study the material from borehole Vranovice VK 1. The research was financed by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung (FWF grant P19337-B17), Grant Agency of the Czech Republic (GAČR grant 205/09/0103), and the Ministry of Culture of the Czech Republic (grant DE06P04OMG009). The authors are grateful to B. Berning (Oberösterreichische Landesmuseum Linz) and to P. Moissette (Centre des Sciences de la Terre/Geode Université de Lyon) for review of the previous version of the manuscript and valuable contributions to taxonomy. We are thankful also to Dr P. D. Taylor from the Natural History Museum, London for his important remarks and improving the English of the paper.

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Manuscript received: 29. 6. 2009.
Revised version accepted by the Tübingen editor: 25. 11. 2009.

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