

# Cretaceous to Paleogene agglutinated foraminifera of the Bílé Karpaty unit (West Carpathians, Czech Republic)

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## ABSTRACT

Assemblages of agglutinated foraminifers ranging from the Aptian to the lower Eocene were studied in the Bílé Karpaty unit. One hundred ninety species (43 of them undetermined) were studied taxonomically. The species *Glomospira straniki* and *Turritellella reversa* are new. Several species of the abyssal "Krasheninnikov" fauna (*Buzasina inflata*, *Haplophragmoides decussatus*, *H. perexplicatus*, *H. pseudokirki*, *Recurvoidella insueta*, *Recurvoidea cf. pentacameratus*, *R. pseudosymmetricus*, *Plectorecurvoidea parvus*, *Pseudobolivina munda*) previously unknown from the Alpine-Carpathian realm, are recorded for the first time. Other species, previously described from the Romanian and Polish Carpathians, and the Caucasus (*Pseudoreophax cisovicensis*, *Thalmannammina neocomiensis*, *Plectorecurvoidea irregularis*, *Uvigerinammina praejankoi* etc.), were found in Moravia for the first time. The agglutinated assemblages are compared to the biozones of Geroch & Nowak (1984) and to calcareous nannoplankton and planktonic foraminiferal data, and a new local biostratigraphic scheme is proposed. Five paleoecologically significant biofacies of mid-slope to abyssal environment are differentiated. The observed sequence of biofacies can be interpreted as gradual basin deepening having its maximum in the *Uvigerinammina jankoi* Zone and subsequent basin shallowing till the early Eocene. The impact of six paleoceanographic events on the agglutinated assemblages during the Cretaceous and Paleogene are discussed.

## INTRODUCTION

The Bílé Karpaty unit (hereinafter denoted by BKU) continues to be an inadequately known facies-tectonic unit of the external flysch in the West Carpathians. The understanding of its lithofacial development is complicated by its complex tectonic pattern and its low degree of exposure. A lithostratigraphic classification of the BKU has been recently formalised (Eliáš, Schnabel & Stráník, 1990; Stráník *et al.*, in press; Potfaj, 1994). The only published taxonomical paper on foraminifers is restricted to the Cretaceous from the Hluk area (Vašíček, 1947). Calcareous nannoplankton are mostly present only in the younger flysch formations of late Senonian to Eocene age, and were studied by Švábenická (1987; 1988; 1990a,b) and by Švábenická & Bubík (1992).

Within the framework of regional geological exploration of the BKU in the past years, about 400 surface samples and some 300 drill samples were examined for foraminifers. Most of the surface samples have their origin in minor outcrops. Only a few profiles of greater length were available (for the most part in the Vlára succession). Detailed taxonomical studies were made for a set of 174 samples representing all stratigraphic levels from all formations of the BKU. The goal of the studies was the stratigraphical classification of the Cretaceous sed-

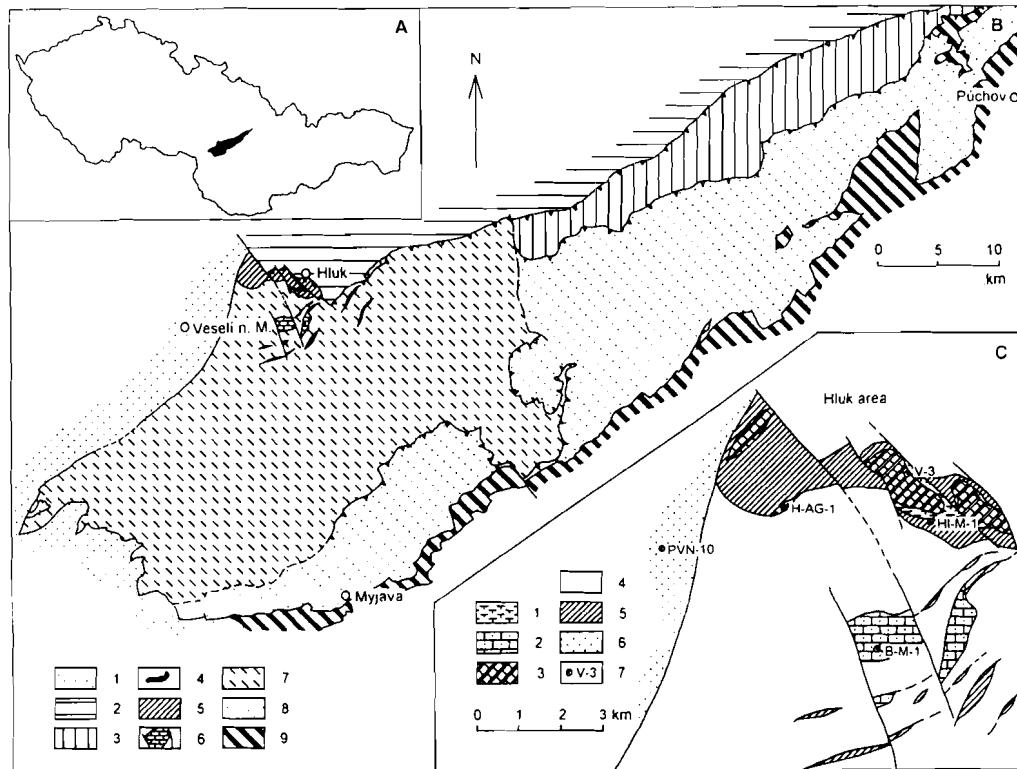
iments in which calcareous nannoplankton is mostly lacking. On the other hand, the greater amount of nannoplankton data from flysch formations of late Senonian to early Eocene age allowed to test the applicability of the biozonation of Geroch & Nowak (1984).

## STUDY AREA

The external flysch of the West Carpathians is an allochthon of nappe structure bordering the Pieniny Klippen Belt towards its foreland. It can be divided into an external (Krosno-Menilitic) and an internal (Magura) group of nappes.

The BKU represents the innermost part of the Magura group of nappes (see Fig. 1). In the NW, the BKU is overthrust over the more externally situated Rača and Bystrica Units while it adjoins the Pieniny Klippen Belt in the SE. In the SW, the BKU disappears below the Neogene sediments of the Vienna Basin and wedges out tectonically in the NE. On the surface, the BKU extends for a distance of 100 km along the direction of the Carpathian belt.

Farther to the NE along the Carpathian arc, the BKU is equivalent, due to its tectonic position, to the Krynicka Unit (=Orava, Čerchov, and Kochanov Units), whereas towards the SE, in the Wienerwald flysch, it is most likely equivalent to the Laab nappe (Eliáš, Schnabel & Stráník, 1990).



**Fig. 1.** The Bílé Karpaty unit. **A** - surfical extent of the BKU in the Czech and Slovak Republics (undivided). **B** - Geological sketch of the BKU: 1 - Neogene of the Vienna Basin; 2 - Rača unit; 3 - Bystrica unit; 4 - 8 Bílé Karpaty unit: 4 - Slope-marls succession, 5 - Hluk succession, 6 - Antonínek succession, 7 - Svodnice succession, 8 - Vlára succession; 9 - Pieniny Klippen Belt. After Vújta, Stráník & Krejčí (unpublished map) and Potfaj (1994). **C** - Geological map of the Hluk area: 1 - Púchov Marls, 2 - Antonínek Formation, 3 - Hluk Formation, 4 - Nivnice and Kuželov Formations, undivided, 5 - Kaumberg Formation, 6 - Neogene of the Vienna Basin, 7 - important boreholes. After Vújta, Stráník & Krejčí (unpublished map).

### LITHOSTRATIGRAPHY

Stráník (1987) distinguished three lithofacial developments in the BKU, defining the Hluk development by the presence of lower Eocene sediments that are missing in the inner Vlára development. The later is characterized by the presence of the Upper Senonian Javorina Formation. The Kopanice development, characterized by the presence of carbonate detritus in clastic rocks, is newly thought to be a part of the Pieniny Klippen Belt (Eliáš, Schnabel & Stráník, 1990). The Hluk development, with pelites prevailing in its sequence, displays a subdued relief. Compared with the younger flysch sediments, the Cretaceous pelitic formations are heavily tectonized, which shows up most distinctly in the frontal part of the BKU (Hluk area). At this location, tectonic slices a few millimetres to many metres thick and assigned to several different stages of the Cretaceous (Aptian - Maastrichtian), alternate with slices of the Rača unit (or Bystrica unit) that were dragged upward from the underlying nappe. This fact, in common with the very low degree of exposure, highly complicates the reconstruction of the lithofacies development of the BKU.

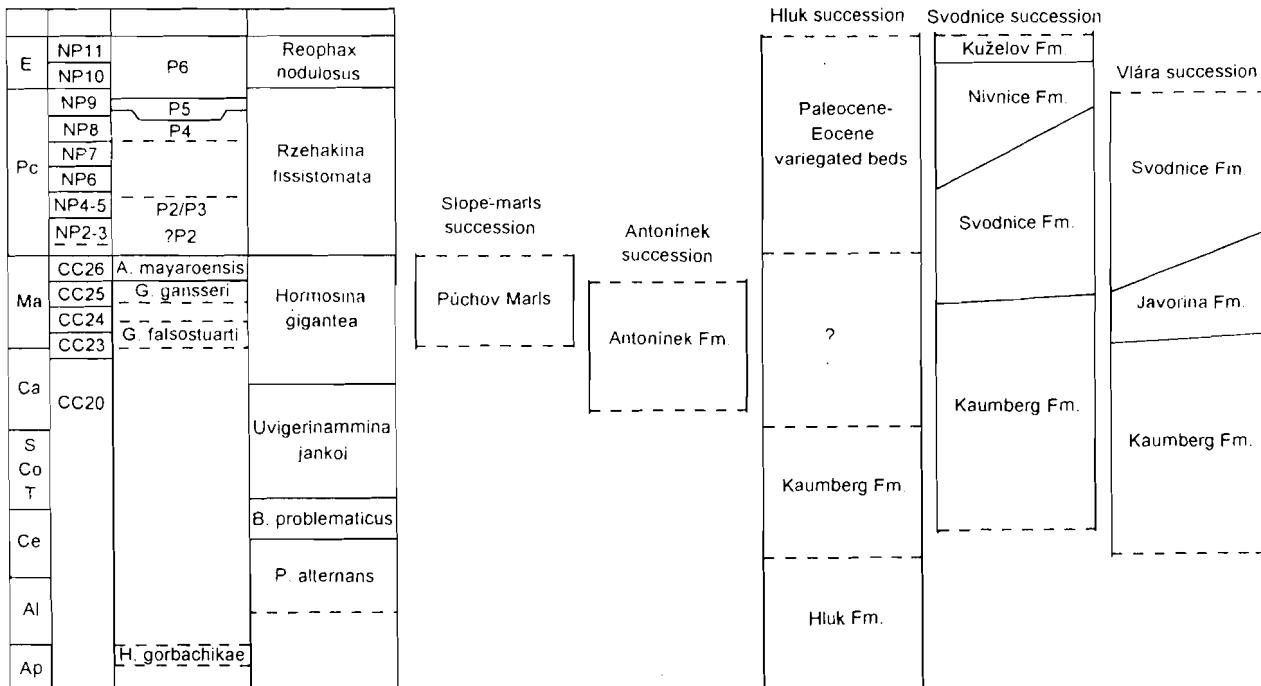
The re-analysed biostratigraphical and paleoecological data allow five successions of beds to be distinguished in the BKU (Figures 1 and 2):

1) Slope-marls succession (upper Campanian - Maastrichtian) is represented by the Púchov Marls. Sedimentation is characterized by monotonous,

predominantly brick-red calcareous claystones and marls. The Púchov Marls are distributed in a tectonic melange of the Hluk area together with sediments of the Hluk succession.

2) Antonínek succession (upper Campanian - lower Maastrichtian) is composed of flysch sediments of the Antonínek Formation (newly described by Stráník *et al.*, in press). Grey, green-grey, and black clays, claystones and marls alternate with grey siltstones, sandstones and marlstones in a predominantly silty claystone flysch. Micritic limestone banks occur sporadically. Fine- to medium-rhythmic sequences are interbedded with thick turbidites graded from medium-grained sandstone through sandy limestone to brown-grey marl. Sediments of the Antonínek succession represent a tectonic fragment of uncertain origin in the frontal part of the nappe.

3) Hluk succession (Aptian - ?Eocene). The oldest Hluk Formation (Aptian - Albian) is characterized by black and grey-green claystones, locally with interbedded light-coloured marlstones and limestones. The Kaumberg Formation (Cenomanian - Santonian, ?lower Campanian) is made up mostly of red-brown non-calcareous claystones and clays. The position of the red-brown clays and claystones containing agglutinated assemblages of Paleocene and Eocene age within the Hluk succession is still uncertain. These may be fragments of the Beloveža Formation tectonically incorporated into the BKU from the underlying nappe (see Discussion).



**Figure 2.** Stratigraphical correlation chart of the Bílé Karpaty unit. 1 - age, 2 - nannozones of Martini (1971) and Sissingh (1977), according Švábenická, 3 - planktonic-foraminifera zones of Blow (1979) and Caron (1985), 4 - agglutinated-foraminifera zones (Geroch & Nowak, 1984, modified).

4) Svodnice succession (Cenomanian - lower Eocene). The Kaumberg Formation (Cenomanian - Campanian, ?Maastrichtian) displays a lithofacies development similar to that in the Hluk succession. The Svodnice Formation (upper Maastrichtian - Paleocene) is built of medium-rhythmic flysch. Grey, greenish grey and brown-grey claystones generally predominate over the sandstones. The intercalations of hemipelagic green-grey non-calcareous clays attain thicknesses of a few centimetres at the most. Sporadically interstratified banks of micritic limestones could be found. In Paleocene times, the Svodnice Formation laterally alternated with the Nivnice Formation. The Nivnice Formation (upper Paleocene - lower Eocene) consists of fine- to medium-rhythmic flysch with predominating pelites. The calcareous turbidity claystones (Te) are light-grey, green-grey, brown-grey, beige and dark-grey in colour. Grey-green hemipelagic non-calcareous clays are, at the most, a few centimetres thick. The Kuželov Formation (lower Eocene) is a pelitic flysch with turbidites that are a few centimetres to 3 m thick. The turbidity claystones (Te) are calcareous, grey, greenish and brownish grey, locally they are pelocarbonaceous in nature and with a red brown weathered surface. Dark-grey non-calcareous hemipelagic clays are frequently present. Characteristic are pelocarbonate intercalations that are not more than 1 cm thick.

4) The Vlára succession (Cenomanian - Paleocene) builds up the principal mountain chain of the Bílé Karpaty Mountains and is characterized by a much higher degree of exposure. The Kaumberg Formation (Cenomanian - Campanian) is mainly built of grey, green-grey and red-brown non-calcareous claystones in its lower part, while the Upper Senonian part

consists of medium- and fine-rhythmic flysch with red turbiditic marlstones and red-brown and grey-green non-calcareous hemipelagites (the Ondrášovec Member of Potfaj, 1994). The Javorina Formation (Campanian - lower Paleocene) is composed of thin bedded flysch. The grey and grey-green, in the main silty claystones are mostly non-calcareous and hemipelagic intercalations often cannot be distinguished. The nature of the Svodnice Formation (Maastrichtian - upper Paleocene) is similar to that in the Svodnice succession; a sandstone-flysch lithosome appears, however, in its upper part.

#### METHODS

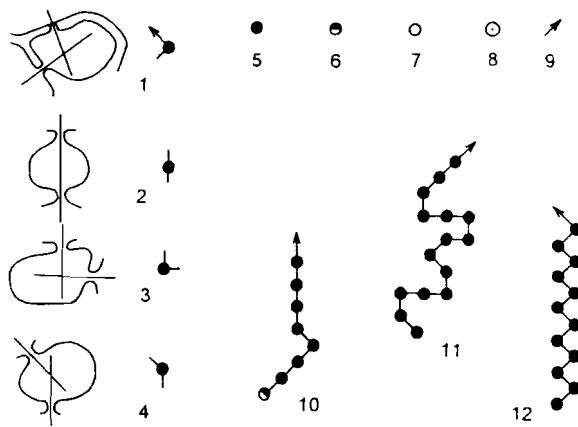
Within the flysch formations, samples were taken from both the turbidite claystones (Te) and the hemipelagites which mostly display the character of grey and grey-green non-calcareous clays.

In the Cretaceous rocks of the Hluk and Kaumberg Formations, where nannoplankton data were lacking, the biostratigraphy was based on agglutinated foraminifers using the zonation of Geroch & Nowak (1984). Where possible, the calcareous nannoplankton and planktonic foraminifers were also utilized. In the flysch sediments, most planktonic fossils were obtained from turbidite claystones.

Paleoecological interpretations are based on microfossils from solely hemipelagic sediments. The biofacies of agglutinated foraminifers as defined in the paper by Kuhnt, Kaminski & Moullade (1989) were used for paleoecological interpretation.

The foraminifers were washed on sieves of 0.1 µm mesh size. The agglutinated foraminifers, the internal structure of which displays diagnostic features important for their determination, were examined in transparency in a drop of distilled water or

glycerine. This refers mainly to all representatives of the group *Recurvoidea* - *Thalmannammina* - *Plectorecurvoidea*. The drawings were made with the aid of a camera lucida on a Zeiss binocular magnifier. For describing and illustrating the representatives of this group, the mode of the surface coiling was graphically demonstrated, following Geroch (1962). The modified terminology and the symbols used are explained in Figure 3. The graphical illustration shows the last whorl uncoiled in a plane along the long axis of the coiling. The extent of change in the coiling direction can be recognized when perpendicularly looking on the test surface, in which case the chamber observed coincides with the proloculus projection. The angle formed by the two connections between neighbouring chambers was thus determined.



**Figure 3.** Graphic description of coiling within the *Recurvoidea* - *Thalmannammina* - *Plectorecurvoidea* group. 1 - 4 - construction of coiling graph: 1 - position of the aperture changing direction close to  $90^\circ$ , 2 - straight coiling direction, 3 - change in coiling direction close to  $90^\circ$ , 4 - change in coiling between  $90^\circ$  and  $180^\circ$ ; 5 - chamber visible on the surface of the test, 6 - chamber partly covered by later coiling, 7 - chamber covered by later coiling, 8 - proloculum, 9 - position of aperture; 10 - 12 - coiling types: 10 - recurvoidiform, 11 - thalmannamminiform, 12 - plectorecurvoidiform.

## RESULTS

### Notes to the biostratigraphy

1. The important index species *Pseudoreophax cisovnicensis*, which has its last occurrence in the Barremian in the Polish Carpathians (Geroch & Nowak, 1984), is present in a somewhat atypical form in the upper Aptian of the Hluk Formation (*Hedbergella gorbachikae* Zone).

2. *Bulbobaculites problematicus* occurs in the Kaumberg Formation with the species *Plectorecurvoidea irregularis* and *Thalmannammina neocomiensis*. This assemblage is thought to be of Cenomanian age. Higher, *Bulbobaculites problematicus* co-occurs with *Plectorecurvoidea alternans*, *Uvigerinammina praejankoi*, and *U. jankoi*, indicating a Turonian age.

3. It is yet impossible to assess with assurance whether the assemblages of small specimens of

*Uvigerinammina ex gr. jankoi* should be assigned to *U. praejankoi* or to the stratigraphically younger *U. jankoi*. Adult specimens only display well-developed diagnostic features. For this reason, it has been found practical to introduce a local *Uvigerinammina ex gr. jankoi* Zone, the base of which is determined by the first occurrence of *U. ex gr. jankoi* while its upper limit is given by the first occurrence of *H. gigantea*.

4. Due to the primary absence of the index species below CCD, the *Goesella rugosa* Zone (*sensu* Geroch & Nowak, 1984) is not developed in the Kaumberg Formation.

5. The *Hormosina gigantea* Zone is developed in the Kaumberg and Javorina Formations and is missing in the stratigraphically corresponding sediments of the Antonínek and Svodnice Formations together with other *Hormosina* representatives. The occurrence of this group has probably been limited by an unknown paleoenvironmental factor.

6. The *Rzehakina fissistomata* Zone is developed in the Svodnice and Vlára successions. However, the rare occurrence of the index species somewhat impairs the applicability of the zone.

7. Contrary to the range reported by Geroch & Nowak (1984), *Spiroplectammina spectabilis* was found in the Lower Paleocene of the Svodnice Formation in both the Svodnice and Javorina successions. Moreover, it has been reported in sediments of Maastrichtian age in the Bottaccione Section of Central Italy (Kuhnt, 1990) and in sediments as old as lower Maastrichtian in Trinidad (Kaminski *et al.*, 1988). Therefore, it is not thought advantageous to delineate this Zone within the BKU.

8. In the Svodnice succession, the lowermost Eocene (NP10 nanoozone) is characterized by the appearance of the species *Reophax?* sp. 7, *Reophax nodulosus* and *R. elongatus*. Stratigraphically higher, in Zone NP11, *Eratidus* sp. and *Glomospira straniki* n.sp. appear. The species *Saccamminoides carpathicus* has not yet been found in the BKU.

For the BKU a new local *Reophax nodulosus* Zone of early Eocene age is proposed. Its lower limit is defined by the first occurrence of *R. nodulosus* Brady. The upper limit of the zone cannot be determined in BKU because younger sediments are missing and the overlying *Cyclammina amplectens* Zone of Geroch & Nowak (1984) is not observed. The stratigraphic range of the zone is probably equivalent to the *Saccamminoides carpathicus* Zone of Geroch & Nowak (1984).

### Paleoecology

Agglutinated foraminifers and taphocenoses of foraminifers generally yield valuable data on the factors governing the paleoenvironment of the deep seas. In addition to rough paleobathymetric determinations, data on the oxygen content in the bottom water masses, on CCD position and fluctuations, and on the influx of detritus and nutrients can be ob-

tained. All this leads to a better understanding of paleoceanographic events. In the heavily tectonized BKU, where continuous sections are essentially absent, agglutinated foraminifers can supply valuable data required to reconstruct the facial development of the basin.

The following biofacies of agglutinated foraminifers (*sensu* Kuhnt, Kaminski & Moullade, 1989, modified) were recognized in the sediments of the BKU in the Lower Cretaceous - lower Eocene interval:

1. "Low-oxygen" biofacies (= Biofacies B, *sensu* Kuhnt, Kaminski & Moullade, 1989, "low-oxygen" assemblages and *Glomospirella* faunas *sensu* Kuhnt & Kaminski, 1989). These poorly diversified assemblages are characterized by abundantly occurring ammoniscids and *Rhizammina*-like tubes.

2. Mixed slope biofacies (= low and mid-latitude slope biofacies, *sensu* Kuhnt, Kaminski & Moullade, 1989). Characteristic of the facies are diversified benthic assemblages of calcareous benthics and those of agglutinated foraminifers with calcareous cement (e.g. *Goesella*, *Clavulinoides*, *Marssonella*, *Dorothia*, *Remesella*, *Spiroplectammina*).

3. The slope flysch-type biofacies (= *Rhabdammina* fauna, *sensu* Brouwer, 1965 and Kuhnt & Kaminski, 1989, lower slope paleobathymetric assemblage, *sensu* Kuhnt, Kaminski & Moullade, 1989) is characterized by pure agglutinated assemblages of taxa with organic cement (astrorhizids, ammoniscids, rzeħakinids, hormosinids, lituolids and verneuilinids). The predominance of tube-like astrorhizids (e.g. *Bathysiphon*, *Rhabdammina*, *Nothia*) and the presence of rzeħakinids is of diagnostic significance. Calcareous foraminifera resistant to dissolution can occur sparsely.

4. Abyssal flysch-type biofacies (=abyssal *Recurvooides-Paratrocchaminoides* assemblage, *sensu* Kuhnt, Kaminski & Moullade, 1989). This assemblage differs from the slope flysch-type biofacies by its higher diversity of *Paratrocchaminoides* and *Recurvooides* species, and by the absence of rzeħakinids and calcareous foraminifers. Typical elements of the "Krasheninnikov" biofacies are impoverished in abundance.

5. Abyssal "Krasheninnikov" biofacies (= abyssal DWAF biofacies and abyssal *Labrospira-Praecystammina* assemblage, Kuhnt, Kaminski & Moullade, 1989). This assemblage of agglutinated foraminifers with organic cement mainly consists of small forms with a smooth test surface. This assemblage was first described by Krasheninnikov (1973; 1974) from the abyssal plains of the Pacific and Indian oceans. Only rare elements of it have been previously reported from the Carpathians (Malata & Oszczypko, 1990).

The paleobathymetric assemblages, defined in the paper by Kuhnt, Kaminski & Moullade, 1989, are, in essence, taphocenoses characteristic of the given depth zone. Mostly they coincide with the biofacies defined above. The following paleo-

bathymetric taphocenoses were determined in the BKU:

1. Mid-slope taphocenoses (mixed slope biofacies, presence of flysch-type elements, the plankton proportion varying as a function of the lysocline position, about 500 - 1,500 m depth).

2. Low-slope taphocenoses (slope flysch-type biofacies, depths of about 1,500 to more than 2,500 m).

3. Abyssal taphocenoses (abyssal flysch-type and "Krasheninnikov" biofacies).

Paleoecological descriptions of the individual formations of the BKU and their paleobathymetric interpretations are given below:

**Hluk formation.** This unit is characterized mainly by poorly diversified assemblages of exclusively agglutinated taxa with organic cement. In single samples, the species diversity is typically lower than 15. The most abundant taxa are "*Rhizammina*", *Ammodiscus*, *Glomospira*, while "*Trochammina*" *vocontiana*, *Reophax*, *Paratrocchaminoides* and *Recurvooides* occur less frequently. This assemblage can be assigned to the "low-oxygen" biofacies. This interpretation is supported by the presence of abundant radiolarians indicating high-productivity conditions. In addition, the Hluk Formation possesses a high percentage of dark organic-rich claystones commonly devoid of benthos. The paleoecological interpretation is made difficult by the fact that sedimentological data are lacking for the former drill samples. As a result, turbidity and hemipelagic pelites cannot be differentiated. The biofacies of agglutinated foraminifers (Kuhnt, Kaminski & Moullade, 1989) defined for the Upper Cretaceous are rather different based on their taxonomy. However, considering the pure agglutinated benthos and lithology (frequent limestone intercalations), the "low-oxygen" assemblages seem to correspond to the lower slope. Flysch-type assemblages of a higher diversity in the *P. alternans* Zone correspond to the lower slope and even to abyssal conditions if the occurrence of *Buzasina pacifica* and *B. inflata* is taken into account.

**Kaumberg Formation.** In all successions this formation is characterized by red brown claystones with a pure agglutinated fauna. The assemblages of the *Plectorecurvooides alternans* and *Bulbobaculites problematicus* Zones usually display a species diversity of 15 to 20, and can be assigned to the abyssal flysch-type biofacies. Tube-like astrorhizids are missing, small smooth haplophragmoids and *Buzasina* representatives occur sparsely. The assemblages with *Uvigerinammina ex gr. jankoi* are characterized by high species diversity (>20, up to a maximum of 37) and they fall within the typical abyssal flysch-type biofacies. Of interest is the association with abundant *Praecystammina globigeri-*

*naeformis* from Hluk M-1 borehole (26,5 - 32,3m) that can be compared to the abyssal "Krasheninnikov" biofacies. The sedimentation within the Kaumberg Formation began to differentiate in late Senonian time (*Hormosina gigantea* Zone). In the Kaumberg Formation of the Svodnice succession, the assemblages of this Zone have been included into the abyssal flysch-type biofacies. In Sample 119Db/51, however, the calcareous agglutinated species *Goesella rugosa*, *Arenobulimina dorbignyi* and *Marssonella* sp., and individual dolomitized (?) calcareous benthic tests are present. To a certain extent, this assemblage can be compared to the abyssal mixed calcareous-agglutinated biofacies, *sensu* Kuhnt, Kaminski & Moullade (1989) and it seems to be related to the Maastrichtian CCD fall (see paleoceanographic events below). In the Vlára succession, the *H. gigantea* Zone is characterized by a pure agglutinated assemblage of higher species diversity (16 - 26) with predominant *Nothia* fragments. Rzehakinids are present randomly. This is a typical slope flysch-type biofacies of the lower slope. At the same time, a flysch lithofacies appears (the Ondrášovec member, *sensu* Potfaj, 1994).

**Púchov Marls.** Mixed calcareous-agglutinated benthos assemblages are typically of the mixed slope biofacies of the mid-slope. The percentage of planktonic foraminifers, which is low in the Campanian to lower Maastrichtian, increases in the upper Maastrichtian, probably as a consequence of the Tethyan lysocline drop.

**Paleocene to lower Eocene variegated claystones.** The Paleocene pure agglutinated assemblage of high diversity (up to 37 species) and with predominant liuolids resembles the abyssal flysch-type biofacies. A solitary *Rzehakina epigona* and tube-like astrorhizids point to the lower slope or redeposition from that environment. The Paleocene to Eocene assemblage of low to higher diversity (up to 25 species) and with predominant tube-like astrorhizids falls within the typical slope flysch-type assemblage of the lower slope. This stratigraphic sequence occurs in thin tectonic slices in the Hluk area melange. We cannot exclude that in this area, parts of the Beloveža Formation from the external units of the Magura flysch were not incorporated and dragged along the partial nappes. This idea is supported by the presence of agglutinated species not known at other locations of the BKU (e.g. *Recurvoidella lamella*, *Verneuilinoides propinquus*).

**Antonínek Formation.** Assemblage of low to higher diversity (14 to 23 species) fall within the slope flysch-type biofacies. Predominant are bathysiphons or *Nothia* sp.; rzehakinids, *Spiroplectammina* div. spp., calcareous and calcareous-agglutinated taxa (*Remesella*) occur sparsely. The taphocenoses are characteristic for the slope environment

of slightly reduced oxygen content, which is also confirmed by the lithology.

**Javorina Formation.** This formation is characterized by low-diversity assemblages (commonly <10 in a single sample), by abundant bathysiphons and paratrocchaminoids. Locally the Javorina Formation passes into the lower Paleocene where it alternates laterally with the Svodnice Formation. The lower Paleocene assemblage is characterized by higher species diversity (up to 17 species) and by the occurrence of rzehakinids. It is identical with the assemblages of the Svodnice Formation. All of the assemblages of the Javorina Formation can be assigned to the slope flysch-type biofacies of the lower slope.

**Svodnice Formation.** Species diversity ranges between 10 and 25 species. All observed assemblages can be assigned to slope flysch-type biofacies of the lower slope. Tubular astrorhizids locally dominate, rzehakinids and calcareous agglutinated species are rare. Rare calcareous benthos indicates depths above CCD.

**Nivnice Formation.** Characteristic is the high diversity in the upper Paleocene (>30 species in a given sample) and its decrease in the uppermost Paleocene to Eocene (<10 in some cases). The benthic assemblages with predominant tube-like astrorhizids (*Nothia*, *Bathysiphon*, "*Rhizammina*") contain a low percentage of calcareous and calcareous agglutinated taxa (*Nuttallides*, *Gyroidinoides*, *Remesella*, *Marssonella*). Rzehakinids are commonly present. Assemblages of higher diversity fall into the slope flysch-type biofacies of the lower slope. Poorly diversified assemblages can be compared to the "low-oxygen" biofacies.

**Kuželov Formation.** The type locality assemblage is dominated by bathysiphons and "*Rhizammina*" sp. It also contains abundant *Ammodiscus cf. planus*, *Karrerulina horrida* and *Saccammina placenta*. The benthic specimens are small in size, resembling the "low-oxygen" biofacies, but assemblages display a higher diversity (up to 29 species). More likely it can be thought to be a slope flysch-type biofacies of the lower slope. The Kuželov Formation represents the youngest preserved sediments of the BKU. There are no indications of shallowing so that sedimentation is believed to have continued. The terminal sediments, however, have been worn away by denudation.

#### Paleoceanographic events

**1. Onset of well-oxidizing conditions at the Albian/Cenomanian Boundary.** During the Early Cretaceous, sedimentation in the Carpathian flysch realm was characterized by dark organic-rich pelites. The dark pelites seem to reflect the restricted circulation of the deep water masses. In

the Cenomanian deposits of most Carpathian flysch units the black facies disappear, and are replaced by red claystone sedimentation (Variegated Godula Member of the Silesian Unit, Kaumberg Formation of the Magura flysch). This event marks the influx of well oxygenated oceanic water that resulted from eustatic rises of the sea level and by the breaching of barriers preventing the entry of deep-sea water masses into the Carpathian troughs. In the Bílé Karpaty unit, this event is reflected by the lithological boundary separating the Hluk Formation from the Kaumberg Formation. Several typical Lower Cretaceous species such as *Pseudobolivina variabilis*, "*Trochammina*" *vocontiana*, *Hippocrepina depressa*, etc. disappear at this stratigraphical level. *Haplophragmoides herbichi* makes its appearance in the red pelites of the Kaumberg Formation. However, this event is difficult to accurately date.

**2. Cenomanian/Turonian Boundary Event (CTBE).** At this boundary, which is situated within the red claystones of the Kaumberg Formation, no organic-rich sediments, radiolarian blooms or "low-oxygen" biofacies typical of the CTBE in other areas (see Thurow, Kuhnt & Wiedmann, 1982; Kuhnt, Kaminski & Moullade, 1989) have been found so far. In the BKU, such phenomena have just not yet been found or noticed. In any case, the CTBE shows up by the extinction of the species *Plectorecurvooides irregularis*, *Thalmannammina neocomiensis* and by the appearance of *Uvigerinammina praejankoi* and *U. jankoi*.

**3. The Lower/Middle Campanian Event (LMCE)** is generally characterized by intercalated biosilicites and a mostly radiolarian biofacies thought to be the result of increased plankton productivity (see Kuhnt, Kaminski & Moullade, 1989). Similarly as for the CTBE, no indications of increased plankton productivity and no increased silica contents could be found in the BKU. Yet its impact on the agglutinated assemblages is clearly evident from the fact that the assemblages with *Uvigerinammina* ex gr. *jankoi* were substituted by an assemblage with *Hormosina gigantea*.

**4. The Maastrichtian drop in CCD** is generally not mentioned in the specification of the Upper Cretaceous paleoceanographic events. In Maastrichtian time, the drop in CCD brought about carbonate sedimentation within the Plantagenet Formation of the North Atlantic (Jansa *et al.*, 1979; Kuhnt, Kaminski & Moullade, 1989). In the BKU, it resulted probably in the occurrence of calcareous agglutinated foraminifers in the abyssal assemblage of the Svodnice succession (*Hormosina gigantea* Zone).

**5. The Cretaceous/Tertiary Boundary Event (KTBE)** did not show up as drastically in deep-sea environment as it did in shallow-water or terrestrial envi-

ronments. However, the breakdown of the marine trophic structure resulted in the extinction of *Hormosina gigantea* and in the appearance of a number of new species such as *Rzehakina fissistomata*. In the BKU, *R. fissistomata*, together with *Spiroplectammina spectabilis*, first appeared in lower Paleocene sediments determined as Zone NP2.

**6. The Paleocene/Eocene Boundary Event (PEBE)** is responsible for the extinction of many species of agglutinated deep-sea foraminifers (e.g. some hormosinids and rzezhakinids). Impoverished assemblages with *Glomospira* representatives became widely distributed throughout the Carpathians. Within the BKU, assemblages of reduced diversity are predominant in the uppermost Paleocene (nannofossil Zone NP9) and in the lowermost Eocene (NP10), with bathysiphons and "*Rhizammina*" sp. dominating in the assemblages. Compared with older strata, *Glomospira* representatives (*G. gordialis*, *G. charoides*, *G. glomerata*) are present in greater abundance, while *Reophax nodulosus* and *R. elongatus* have their first appearance.

## DISCUSSION

Five sedimentary successions in the Aptian to lower Eocene interval can be distinguished in the BKU. Four of them are distinguished within the Hluk development as recently redefined by Stráník *et al.* (in press). The complex tectonic pattern, in particular that of Cretaceous pelitic sediments, makes the scheme constructed questionable to a certain degree.

The "slope-marls" and Antonínek successions are believed to be tectonic fragments of different more external units incorporated within the Bílé Karpaty nappe. The Púchov Marls are usually thought to overlay the Kaumberg Formation (Stráník *et al.*, in press). Nevertheless, there is a strong biofacial contrast between the abyssal assemblages of the older Kaumberg Formation and the younger variegated beds on the one hand and the mixed slope biofacies (middle slope) of the Púchov Marls on the other. The Púchov Marls could represent slope sediments comparable with that of the Hauptklippen Zone of the Wienerwald.

The Campanian to upper Maastrichtian Antonínek Formation does not fit into any of the successional sequences and had to be zoned off separately on account of its stratigraphical range, very external position in BKU (borehole PVN-10) and distinct lithology. However, there exists a certain lithological affinity to the lower part of the Svodnice Formation and to the Javorina Formation (e.g. light-grey micritic limestones).

The other two successions within the Hluk development of Stráník *et al.* (in press) are the Hluk and Svodnice successions. The Hluk succession differs from the later by the presence of variegated pelitic sedimentation in the Paleocene and Eocene. The position of the variegated beds within the BKU is not certain but these have traditionally

been included into the BKU. As stated above (see chapter Lithostratigraphy), the variegated beds may represent parts of the Beloveža Formation that were tectonically dragged from the outer units of the Magura flysch. A detailed comparison of the faunas remains to be made.

Studies of the assemblages of agglutinated foraminifers present in hemipelagic sediments have resulted in the construction of a biofacies chart, (Fig. 4). The biofacies sequence can be interpreted in terms of a phase of basin subsidence lasting from the Early Cretaceous to the *Uvigerinammina jankoi* Zone and subsequent shallowing of the sedimentation until the early Eocene. To a certain extent, the biofacies sequence can be ascribed to CCD fluctuations. A combination of the two factors is probable, however.

When determining the biofacies, certain problems associated with the differentiation of slope and abyssal flysch-type biofacies were posed. Their diversity does not seem to be an advantageous diagnostic criterion. The absence of rzezhakinids in the abyssal zone suffers the disadvantage of a negative feature. On the other hand, taxa of the "Krasheninnikov" type seem to occur in the bathyal zone too (e.g. in the assemblage of the *Hormosina gigantea* Zone in the Vlára succession). As it seems, the abundant occurrence of tube-like astrorhizids (*Nothia*, *Rhabdammina*, *Bathysiphon*) in the bathyal biofacies and their absence in the abyssal zone may be the most distinguishing feature.

The agglutinated foraminiferal biostratigraphy of the Cretaceous is a consequence, in essence, of the expression of "global", or at least Tethyan paleoceanographic events. These events are responsible for faunal turnovers including the index species and, thus, this biostratigraphy to some extent resembles event-stratigraphy. The most marked Paleogene faunal change at the Paleocene/Eocene boundary is also due to a global oceanic event. However, some bioevents in the Paleogene deposits of the Carpathians appear to be local. This shows up in differences from the not very distant Silesian basin of the Polish Carpathians (e.g. the Geroch & Nowak zonation, 1984).

#### SYSTEMATICS

In the taxonomical part of this paper 43 undetermined species from a total of 190 species of agglutinated foraminifers are described. Many of them are undoubtedly new species. Their description as new species will be given in a later paper, because an additional study of variability using biometric methods will be necessary. This concerns especially representatives of the *Recurvooides* - *Thalmannammina* - *Plectorecurvooides* group. The sample material is deposited in the micropalaeontological collections of the Czech Geological Survey, Brno Division. For now, the species are listed alphabetically by genus.

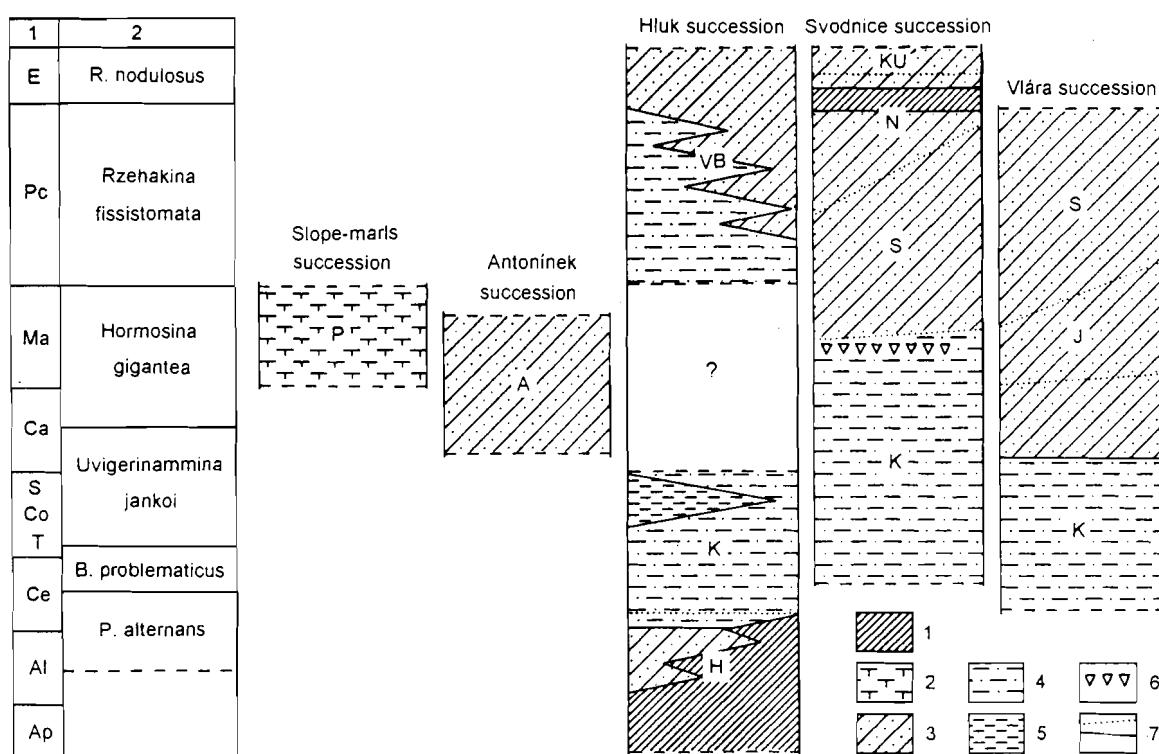


Figure 4. Biofacies chart of the Bílé Karpaty unit 1 - age, 2 - agglutinated foraminiferal zones, modified in this study. Biofacies: 1 - "low oxygen" biofacies, 2 - mixed slope biofacies, 3 - slope flysch-type biofacies, 4 - abyssal flysch-type biofacies, 5 - abyssal "Krasheninnikov" biofacies, 6 - rare occurrence of mixed slope faunal elements in abyssal biofacies, 7 - lithostratigraphic (dotted) and biofacies boundaries. Lithostratigraphy: P - Púchov Marls, A - Antonínek Fm., H - Hluk Fm., K - Kaumberg Fm., VB - Paleocene/Eocene variegated beds, S - Svodnice Fm., N - Nivnice Fm., KU - Kuželov Fm., J - Javorina Fm.

*Ammobaculites deflexus* (Grzybowski, 1901)  
Pl. 4, Fig. 4

*Haplophragmium depressum* Grzybowski, 1901, p. 270, pl. 7,  
figs. 10, 11.  
*Ammobaculites deflexus* (Grzybowski). - Kaminski &  
Geroch, 1993, p. 274, pl. 14, figs. 3a - 4e.

*Ammodiscus bornemannii* (Reuss, 1863)  
Pl. 1, Fig. 22a,b

*Cornuspira bornemannii* Reuss, 1863, p. 39, pl. 1, fig. 3.  
*Ammodiscus bornemannii* (Reuss). - Geroch, 1960, p. 45, pl. 4,  
fig. 7.

*Ammodiscus cretaceus* (Reuss, 1845)  
Pl. 2, Fig 1a, b, Pl. 10, Fig. 5

*Operculina cretacea* Reuss, 1845, p. 35, pl. 13, figs. 64, 65.  
*Cornuspira hoernessi* Karrer, 1866, p. 495, pl. 1, fig. 10.

*Ammodiscus glabratus* Cushman & Jarvis, 1928  
Pl. 10, Fig. 6a,b

*Ammodiscus glabratus* Cushman & Jarvis, 1928, p. 86, pl. 12,  
fig. 6.

*Ammodiscus infimus* Franke, 1936  
Pl. 10, Fig. 1.

*Ammodiscus infimus* (Strickland). - Franke, 1936, p. 15, pl.  
1, fig. 14a, b.  
*Ammodiscus infimus* Franke. - Geroch, 1966, p. 437, fig. 8  
(13, 14). - Geroch & Nowak, 1984, pl. 1, fig. 11, pl. 5, fig.  
13.

*Ammodiscus cf. planus* Loeblich, 1946  
Pl. 1, Fig. 24a, b, Pl. 2, Fig. 2a, b

cf. *Ammodiscus planus* Loeblich, 1946, p. 133, pl. 22, fig. 2.

Test very small, compressed. About six whorls usually barely visible. Wall finely agglutinated, surface finely rough.

*Ammodiscus tenuissimus* Grzybowski, 1898  
Pl. 1, Fig. 23a, b

*Ammodiscus tenuissimus* Grzybowski, 1898, p. 282, pl. 10,  
fig. 35. - Kaminski & Geroch, 1993, p. 253, pl. 5, figs. 1-3b.

*Ammodiscus* sp. 1  
Pl. 2, Fig. 3a, b, Pl. 10, Fig. 4

Test of medium size, usually undeformed, consisting of about eight whorls. Whorls of the later stage are distinctly thicker with sporadic constrictions.

*Ammodiscus* sp. 2  
Pl. 2, Fig. 4a, b, 5a, b

Test large, consisting of four whorls. Wall very finely agglutinated with a smooth surface. Occurs rarely in the *Plectorecurvooides alternans* Zone of the Hluk and (?)Kaumberg Formations.

*Ammodiscus?* sp. 3  
Pl. 1, Fig. 25a, b

*Ammodiscus* sp. 1. - Kuhnt, 1990, p. 311, pl. 1, fig. 7.

Test irregularly planispiral in early stage, later

glomospiral. Intermediate forms to *Paratrochamminoides olszewskii* (Grzybowski) were observed. *Ammodiscus?* sp. 3 could be the ancestor of the later species. Rare in the Kaumberg Formation.

*Ammolagena clavata* (Jones & Parker, 1860)

*Trochammina irregularis* (d'Orbigny) var. *clavata* Jones & Parker, 1860, p. 304.

*Ammosphaeroidina pseudopauciloculata*  
(Myatlyuk, 1966)  
Pl. 12, Fig. 9

*Cystamminella pseudopauciloculata* Myatlyuk, 1966, p. 264,  
pl. 1, figs. 5 - 8, pl. 2, fig. 6, Pl. 3, fig. 3.

*Arenobulimina dorbignyi* (Reuss, 1845)

*Bulimina dorbignyi* Reuss, 1845, p. 38, pl. 13, fig. 74.  
*Arenobulimina dorbignyi* (Reuss). - Hanzlíková, 1972, p. 55,  
pl. 12, fig. 15.

*Arenoturrispirillina aptica* Tairov, 1956  
Pl. 10, Figs. 2, 3

*Arenoturrispirillina aptica* Tairov, 1956, p. 115 (fide Loeblich & Tappan, 1987).

*Ammodiscoidea* sp. - Kaminski, Gradstein & Geroch, 1992,  
p. 252, pl. 2, fig. 1.

*Ammodiscus tenuissimus* Guembel. - Kaminski, Gradstein &  
Geroch, 1992, p. 252, pl. 2, fig. 3.

Both strictly planispiral and low trochospiral forms (see pl. 10, figs. 2 and 3) seem to be only different end members within the variability of a single species. Both types are of an identical whorl thickness and wall character.

*Aschemocella subnodosiformis* (Grzybowski, 1898)  
Pl. 2, Figs. 7, 8

*Hyperammina subnodosiformis* Grzybowski, 1898, p. 274,  
pl. 10, figs. 5, 6.

*Aschemocella* sp. ind.

Undetermined fragments of large sack-like chambers are frequent in the Svodnice and Nivnice Formation, rare in the Púchov Marls. Fragments may predominantly belong to *Aschemocella carpathica* (Neagu):

*Bathysiphon brosgei* Tappan, 1957  
Pl. 1, Figs. 4 - 6

*Bathysiphon brosgei* Tappan, 1957, p. 202, pl. 65, figs. 1 - 5.

*Bathysiphon gerochi* Myatlyuk, 1966  
Pl. 1, Figs. 1 - 3, Pl. 8, Fig. 1

*Bathysiphon?* sp. - Geroch, 1960, p. 37, pl. 1, figs. 16 - 19.  
*Bathysiphon (Silicobathysiphon) gerochi* Myatlyuk, 1966, p.  
261, pl. 1, fig 1a, b, pl. 2, fig. 4, pl. 3, fig. 1.

*Bathysiphon microrhaphidus* Samuel, 1977, p. 19, pl. 11, figs.  
3 - 6, pl. 12, fig. 1 - 4, text fig. 1a.

Test is a flattened tube with rare constrictions. Wall is thin in comparison with other flysch-type bathysiphons. Traces of dissolved sponge spicules, predominantly parallel with the long axis of the

tube, are sometimes visible on the surface.

***Bathysiphon* sp. 1**

Pl. 1, Figs. 7, 8

Coarse quartz grains of very varying amount on the wall surface distinguish this form from other flysch-type bathysiphons. Traces of dissolved sponge spicules, predominantly perpendicular to the long axis of the tube are sometimes visible on the surface.

**"*Bigenerina*" *alternans* Vašiček, 1947**

Pl. 7, Fig. 7

*Bigenerina alternans* Vašiček, 1947, p. 244, pl. 1, figs. 3a,b, 4.

***Bulbobaculites gracile* (Bartenstein & Brand, 1951)**

Pl. 12, Fig. 3

*Haplophragmium inconstans gracile* Bartenstein & Brand, 1951, p. 272, pl. 3, figs. 59 - 61.

*Bulbobaculites inconstans* (Bartenstein & Brand). - Kaminski, Gradstein & Geroch, 1992, p. 252, pl. 4, figs. 9, 10.

***Bulbobaculites problematicus* (Neagu, 1962)**

Pl. 12, Figs. 2, 17(?)

*Ammobaculites agglutinans* (d'Orbigny) ssp. *problematicus* Neagu, 1962, p. 61, pl. 2, figs. 22 - 24.

*Bulbobaculites problematicus* (Neagu). - Kuhnt & Kaminski, 1990, p. 465, text figs. 5, 5A.

***Buzasina inflata* (Krasheninnikov, 1974)**

Pl. 12, Fig. 16a, b

*Labrospira inflata* Krasheninnikov, 1974, p. 637, pl. 2, fig. 6a, b, 7b.

***Buzasina pacifica* (Krasheninnikov, 1973)**

Pl. 4, Fig. 2a - 3c

*Labrospira pacifica* Krasheninnikov, 1973, p. 209, pl. 2, figs. 4a - 5b. - Krasheninnikov, 1974, p. 637, pl. 3, figs 1a - 2b.

***Clavulinoides amorphia* (Cushman, 1926)**

Pl. 15, Fig. 7

*Clavulinina amorphia* Cushman, 1926, p. 589, pl. 17, fig. 5.

*Clavulinoides amorphia* (Cushman). - Kaminski et al., 1988, p. 194, pl. 8, fig. 13.

***Clavulinoides subparisiensis* (Grzybowski, 1896)**

Pl. 15, Figs. 5, 6

*Clavulinina subparisiensis* Grzybowski, 1896, p. 289, pl. 9, fig. 30a - c.

*Tritaxia subparisiensis* (Grzybowski). - Geroch & Nowak, 1984, pl. 4, figs. 10, 11.

***Clavulinoides?* sp. 1**

Pl. 15, Fig. 3

Locally frequent in the uppermost Campanian to uppermost Maastrichtian of the Púchov Marls.

***Dorothia bulletta* (Carsey, 1926)**

Pl. 15, Fig. 10

*Gaudryina bulletta* Carsey, 1926, p. 28, pl. 4, fig. 4.

*Dorothia bulletta* (Carsey). - Hanzlíková, 1972, p. 57, pl. 12, figs. 4, 9.

***Eratidus* sp.**

Pl. 4, Figs. 5, 6

This probably new species was observed in the middle to upper Eocene of the Silesian Unit of the Polish Carpathians (S. Geroch, personal communication). In the BKU it occurs rarely in the lower Eocene of the Kuželov Formation.

***Gaudryina carinata* Franke, 1914**

Pl. 15, Figs. 8, 9

*Gaudryina carinata* Franke, 1914, p. 431, pl. 27, figs. 4-6. - Hanzlíková, 1972, p. 51, pl. 11, fig. 4a, b.

***Gaudryina cretacea* (Karrer, 1870)**

*Verneuilina cretacea* Karrer, 1870, p. 164, pl. 1, fig. 1.

*Gaudryina cretacea* (Karrer). - Hanzlíková, 1972, p. 51, pl. 11, fig. 9a, b.

***Gerochammina conversa* (Grzybowski, 1901)**

Pl. 7, Fig. 4

*Gaudryina conversa* Grzybowski, 1901, p. 285, pl. 7, figs. 15, 16.

*Gerochammina conversa* (Grzybowski). - Kaminski & Geroch, 1993, p. 279, pl. 13, figs. 5a - 11.

***Gerochammina obesa* Neagu, 1990**

Pl. 7, Fig. 3

*Gerochammina obesa* Neagu, 1990, p. 254, pl. 2, figs. 1 - 21.

***Gerochammina stanislawi* Neagu, 1990**

Pl. 7, Fig. 2, Pl. 13, Fig. 8

*Gerochammina stanislawi* Neagu, 1990, p. 253, pl. 1, figs. 1 - 26.

***Glomospira charoides* (Jones & Parker, 1860)**

Pl. 1, Fig. 14, Pl. 8, Fig. 2

*Trochammina squamata* Jones & Parker var. *charoides* Jones & Parker, 1860, p. 304.

*Glomospira charoides* (Jones & Parker). - Berggren & Kaminski, 1990, p. 59, pl. 1, fig. 2, text fig. 4.

***Glomospira diffundens* Cushman & Renz, 1946**

Pl. 1, Fig. 17a, b

*Glomospira gordialis* (Jones & Parker) var. *diffundens* Cushman & Renz, 1946, p. 15, pl. 1, fig. 30. - Geroch, 1960, p. 125, pl. 4, fig. 1, pl. 10, fig. 2.

***Glomospira glomerata* (Grzybowski, 1898)**

Pl. 9, Fig. 14

*Ammodiscus glomeratus* Grzybowski, 1898, p. 285, pl. 11, fig. 4.

*Glomospira glomerata* (Grzybowski). - Kaminski & Geroch, 1993, p. 257, pl. 6, figs. 9 - 12.

***Glomospira gordialis* (Jones & Parker, 1860)**

Pl. 10, Fig. 13

*Trochammina squamata* Jones & Parker var. *gordialis* Jones & Parker, 1860, p. 304.

*Glomospira gordialis* (Jones & Parker). - Berggren & Kaminski, 1990, p. 56, pl. 1, fig. 1, text fig. 2.

*Glomospira irregularis* (Grzybowski, 1898)

*Ammodiscus irregularis* Grzybowski, 1898, p. 285, pl. 11, figs. 2 - 3.

*Glomospira irregularis* (Grzybowski). - Kaminski & Geroch, 1993, p. 256, pl. 6, figs. 6 - 8b.

*Glomospira serpens* (Grzybowski, 1898)

Pl. 1, Fig. 18, Pl. 9, Figs. 11, cf. 13

*Ammodiscus serpens* Grzybowski, 1898, p. 285, pl. 10, figs. 31 - 33.

*Glomospira serpens* (Grzybowski). - Kaminski & Geroch, 1993, p. 256, pl. 6, figs. 2 - 5.

*Glomospira straniki* n. sp.

Pl. 1, Figs. 20a, b, 21

**Derivation of name:** after the flysch geologist Dr. Zdeněk Stráník of the Czech Geological Survey Brno.

**Diagnosis:** Test small, elongated. Undivided tube of constant diameter is enrolled in the early stage, later is arranged to regular S-shaped meanders in a straight band. Wall finely agglutinated from quartz grains, surface finely rough.

**Holotype:** specimen on pl. 1, fig. 20 a, b.

**Material:** 11 specimens in the collection of Czech Geological Survey, Brno Division. Catalog no: MB1-36A, MB1-36B, MB1-36C, MB1-36D.

**Type locality:** clay pit of the brick kiln in Kuželov village (southern Moravia, Czech Republic).

**Type horizon:** Lower Eocene Kuželov Formation.

Dimensions: length of holotype - 0.33 mm, length of paratypes ranges between 0.25 to 0.44 mm.

**Remarks:** Early enrolled stage of the test is preserved in three specimens. Unfortunately the character of the early stage is indistinct. It could be low trochospiral or streptospiral. The plane of coiling may change abruptly in the meandering later stage (see holotype, pl. 1, fig. 20). Rarely, the tube tends to uncoil in the terminal stage (see paratype, pl. 1, fig. 21). Morphotypes with a larger tube diameter, such as the figured paratype, (?megalosphaeric specimens) are less frequent.

*Glomospira straniki* n.sp. is very probably related to *G. glomerata* (Grzybowski). From the later species it differs by its small dimensions and regularly meandering later stage.

*Glomospira* sp. 1

Pl. 1, Fig. 19a, b

Test glomospiral (like *G. gordialis*) to low trochospiral, consisting of two to four slightly irregular whorls. Rare specimens possess a charoides-type arrangement with older enrolled whorls visible. Nevertheless, the axis of the later whorls is nearly orthogonal to that of the earlier whorls. The tubular chamber usually crosses the earlier whorls in later stage. Surface somewhat roughened.

This species is probably related to *Glomospira irregularis* and differs from the latter in possessing

at least two trochospiral whorls. It differs from *Glomospira charoides* by its thicker and more irregular whorls and roughly finished wall.

*Glomospirella grzybowskii* (Jurkiewicz, 1960)

Pl. 9, Fig. 12

*Glomospira grzybowskii* Jurkiewicz, 1960, p. 342, pl. 38, figs. 7, 10, 11.

*Glomospirella diffundens* Cushman & Renz. - Geroch & Nowak, 1984, pl. 1, fig. 10, pl. 5, fig. 8.

*Goesella rugosa* (Hanzlíková, 1955)

Pl. 15, Fig. 4a, b

*Marssonella rugosa* Hanzlíková, 1955, p. 493, pl. 2, figs 5, 7.

*Goesella carpathica* Liszkova, 1959, p. 60, pl. 3, fig. 9a - f.

*Haplophragmoides aff. bulloides* (Beissel, 1891)

Pl. 3, Fig. 7a, b

aff. *Haplophragmium bulloides* Beissel, 1891, p. 17, pl. 2, figs. 1 - 3, pl. 4, figs. 24 - 30.

*Haplophragmoides bulloides* (Beissel). - Huss, 1966, p. 23, pl. 3, figs. 17 - 24.

Specimens from the BKU differ from the typical *Haplophragmoides herbichi* Neagu by their rounded periphery (rather than acute), 6 to 6,5 chambers in last whorl (instead of 7 to 8) and nearly opaque agglutinated wall (instead of transparent and silicified). Nevertheless, it cannot be excluded that these two forms belong to single species as Neagu (1990) suggested.

*Haplophragmoides decussatus* Krasheninnikov, 1973

Pl. 3, Fig. 9a, b

*Haplophragmoides decussatus* Krasheninnikov, 1973, p. 208, pl. 2, fig. 3a, b.

*Haplophragmoides falcatosuturalis* Neagu, 1990

Pl. 3, Fig. 8a, b, Pl. 12, Fig. 12

*Haplophragmoides gigas minor* Nauss. - Geroch, 1966, p. 441, figs. 1a - 3c. Neagu, 1970, p. 37, pl. 3, figs 1, 2.

*Haplophragmoides falcatosuturalis* Neagu, 1990, p. 250, pl. 4, figs. 16 - 20.

*Haplophragmoides horridus* (Grzybowski, 1901)

Pl. 3, Fig. 10a, b

*Haplophragmium horridum* Grzybowski, 1901, p. 270, pl. 7, fig. 12.

*Haplophragmoides horridus* (Grzybowski). - Kaminski & Geroch, 1993, p. 275, pl. 15, figs. 6 - 8.

*Haplophragmoides herbichi* Neagu, 1968

Pl. 3, Fig. 6a, b, Pl. 12, Figs. 6 - 8

*Haplophragmoides herbichi* Neagu, 1968, p. 238, pl. 1, figs. 9 - 12.

*Haplophragmoides cf. menitens* Krasheninnikov, 1974

Pl. 3, Fig. 12a, b

cf. *Haplophragmoides menitens* Krasheninnikov, 1974, p. 636, pl. 2, figs. 3a - 4b.

*Haplophragmoides perexplicatus* Krasheninnikov,  
1973  
Pl. 12, Fig. 14

*Haplophragmoides perexplicatus* Krasheninnikov, 1973, p.  
208, pl. 1, fig. 6a, b.

*Haplophragmoides cf. porrectus* Maslakova, 1955  
Pl. 12, Fig. 11a, b

cf. *Haplophragmoides porrectus* Maslakova, 1955, p. 47, pl.  
3, figs. 5, 6.

*Haplophragmoides pseudokirki* Krasheninnikov,  
1973  
Pl. 3, Fig. 16a, b

*Haplophragmoides pseudokirki* Krasheninnikov, 1973, p.  
635, pl. 1, fig. 8a, b.

*Haplophragmoides suborbicularis* (Grzybowski,  
1896)  
Pl. 3, Fig. 13a, b

*Cyclammina suborbicularis* Rzehak. - Grzybowski, 1896, p.  
284, pl. 9, figs. 5a - 6b.

*Haplophragmoides (Cribrostomoides) suborbicularis* (Grzybowski). - Liszka & Liszkowa, 1981, p. 176, pl. 3, figs. 2a -  
3b.

It seems impossible in many cases to observe the aperture and differentiate this *Haplophragmoides* from robust and coarsely agglutinated recrvoids such as *R. anormis*, *R. retroseptus* and *Recurvooides* sp. 7 (this paper).

*Haplophragmoides walteri* (Grzybowski, 1898)  
Pl. 12, Fig. 13

*Trochammina walteri* Grzybowski, 1898, p. 290, pl. 11, fig.  
31.

*Cyclammina lamella* Vašiček, 1947, p. 243, pl. 2, fig. 13a, b,  
text fig. 1.

*Haplophragmoides walteri* (Grzybowski). - Kaminski &  
Geroch, 1993, p. 263, pl. 10, figs. 3a-7c.

*Haplophragmoides* sp. 1  
Pl. 3, Fig. 11a, b

*Haplophragmoides constrictus* Krasheninnikov. - Moullade,  
Kuhnt & Thurow, 1988, p. 364, pl. 4, figs. 7-9. - Kuhnt &  
Moullade, 1991, pl. 5, figs. D, E.

*Haplophragmoides* sp. 2  
Pl. 12, Fig. 15

*Haplophragmoides* sp. 3  
Pl. 3, Fig. 14a, b

*Haplophragmoides* sp. 4  
Pl. 3, Figs. 17a - 18b

*Haplophragmoides* sp. 5  
Pl. 12, Fig. 10

*Haplophragmoides* sp. 6  
Pl. 3, Fig. 15a, b

*Hippocrepina depressa* Vašiček, 1947

Pl. 8, Fig. 12

*Hippocrepina depressa* Vašiček, 1947, p. 243, pl. 1, figs 1a, b,  
2.

*Hormosina*<sup>1</sup> *crassa* Geroch, 1966  
Pl. 2, Figs. 12 - 13b, cf. Pl. 9, Fig. 1

*Hormosina ovulum crassa* Geroch, 1966, p. 438, figs. 6 (19,  
21 - 26), 7 (21 - 23). - Geroch & Nowak, 1984, pl. 1, fig. 14,  
pl. 5, figs. 20 - 22b.

*Hormosina excelsa* (Dyląžanka, 1923)

*Hyperammina excelsa* Dyląžanka, 1923, p. 66, pl. 1, fig. 3.  
*Hormosina excelsa* (Dyląžanka). - Kaminski & Geroch,  
1993, p. 281, pl. 17, figs. 1 - 4b.

*Hormosina gigantea* Geroch, 1960  
Pl. 9, Fig. 2

*Ataxophragmium arenaceum* Karrer, 1866, p. 495, pl. 1, fig.  
9.

*Hormosina ovulum* (Grzybowski) var. *gigantea* Geroch,  
1960, p. 43, pl. 2, figs. 18, 19. - Geroch & Nowak, 1984, pl.  
1, fig. 20, pl. 5, figs. 15, 16.

In this paper specimens of chamber diameter 0.6 mm and more are only considered to be doubtless *Hormosina gigantea*. Specimens between 0.5 mm and 0.6 mm represent transitional forms between *H. ovulum* and *H. gigantea*, as shown by Geroch (1959, fig. 2). Rögl (this volume) proposes to replace the commonly used name *H. gigantea* by the older name *Caudammina arenacea* (Karrer). However, Karrer's name has not been used since 1866, while *H. gigantea* is the term used by many authors and is the nominate taxon of a partial-range zone of Geroch & Nowak (1984). Conservation of the name *H. gigantea* would therefore be more favourable for the stability of taxonomic nomenclature.

*Hormosina ovuloides* (Grzybowski, 1901)  
Pl. 2, Fig. 9a, b

*Reophax ovuloides* Grzybowski, 1901, p. 223, pl. 7, fig. 3.  
*Hormosina ovuloides* (Grzybowski). - Kaminski & Geroch,  
1993, p. 276, pl. 15, fig. 5a, b.

*Hormosina ovulum* (Grzybowski, 1896)

*Reophax ovulum* Grzybowski, 1896, p. 276, pl. 8, figs. 19 -  
21.

*Hormosina trinitatensis* Cushman & Renz, 1946  
Pl. 9, Fig. 3

*Hormosina globulifera* Brady var. *trinitatensis* Cushman &  
Renz, 1846, p. 14, pl. 1, figs. 15 - 19.

*Hormosina trinitatensis* Cushman & Renz. - Kaminski et al.,  
1988, p. 187, pl. 3, fig. 1. - Kuhnt & Kaminski, 1990, p.  
475, pl. 1, fig. j.

<sup>1</sup> Charnock and Jones (1990) and Rögl (this volume) have proposed to use the generic name *Caudammina* Montanaro-Gallitelli, 1955 for the *Hormosina ovulum* group. *Caudammina* is characterised by flask-like subsphaerical chambers with narrow necks and a smooth surface. Some related flysch-type species could also be included in the genus *Caudammina* (e.g. *Hormosina excelsa*).

***Hormosina velascoensis* (Cushman, 1926)**  
Pl. 2, Figs. 10 - 11b

*Nodosinella velascoensis* Cushman, 1926, p. 583, pl. 20, fig. 9.  
*Nodellum velascoense* (Cushman). - Geroch, 1960, p. 44, pl. 3,  
figs. 4a - 7b.

Chambers of the uniserial test are usually overlapping, rarely they can be connected by short necks like *H. ovulum*. Both types of intercameral connection can be present in the same individual (see pl. 2, fig. 10). One-chambered fragments differ from those of *H. ovulum* by the nearly square outline of the chamber lumina when observed in transparency.

***Hyperammina elongata* Brady, 1884**  
Pl. 8, Fig. 13

*Hyperammina elongata* Brady, 1884, p. 257, pl. 23, figs. 4, 7 - 10.

***Hyperammina gaultina* Ten Dam, 1950**  
Pl. 8, Figs. 14, 15

*Hyperammina gaultina* Ten Dam, 1950, p. 5, pl. 1, fig. 2 -  
Geroch, 1966, p. 435, fig. 6 (14 - 18). - Neagu, 1970, p. 33,  
pl. 1, fig. 8.

***Hyperammina nuda* Subbotina, 1950**  
Pl. 8, Figs. 11, 16, 17

*Hyperammina nuda* Subbotina 1950, p. 69, pl. 1, fig. 5.

***Kalamopsis grzybowskii* (Dylązanka, 1923)**  
Pl. 9, Figs. 5, cf. 4

*Hyperammina grzybowskii* Dylązanka, 1923, p. 65. - Geroch  
& Gradziński, 1955, p. 37, pl. 5, fig. 1a - e.

***Karrerulina horrida* (Myatlyuk, 1970)**  
Pl. 7, Figs. 5, 6

*Karreriella horrida* Myatlyuk, 1970, p. 114, pl. 5, fig. 9, pl.  
33, figs. 15 - 16b.  
*Plectina* cf. *apicularis* (Cushman). - Geroch, 1960, p. 60, pl. 6,  
fig. 9a - c.

***Karrerulina?* sp. 1**  
Pl. 7, Fig. 1, Pl. 13, Fig. 7

*Gaudryina filiformis* Berthelin. - Hanzlíková, 1966, p. 118,  
pl. 9, fig. 6a, b. - Geroch, 1966, fig. 12 (11, 12). - Myatlyuk,  
1970, p. 108, pl. 10, figs. 12 - 14.

Test long with an indistinct early stage (?trochospiral), later distinctly triserial with 4 to 6 chambers in one series and finally biserial with 8 to 14 chambers in one series. Biserial stage is usually twisted and takes up a large part of test length. Subterminal aperture with a slightly arcuate siphon tube has been observed in the biserial stage of the test. Wall agglutinated originally with organic cement, silicified.

This flysch-type species has no relation to the calcareous agglutinated genus *Gaudryina* d'Orbigny, which does not occur in the environments below the CCD. A long and twisted biserial part recalls the genus *Gerochammina* Neagu, while the distinct triserial part resembles *Karrerulina* Finlay. This

species differs from *Gerochammina stanislawi* in its well developed triserial stage and longer biserial stage with lobulate outline. The chambers of *G. stanislawi* are generally more tightly arranged.

In the BKU this species occurs in the Albian - Cenomanian sediments of the Hluk and Kaumberg Formations.

***Marssonella crassa* (Marsson, 1878)**  
Pl. 15, Figs. 12a - 13

*Gaudryina crassa* Marsson, 1878, p. 158, pl. 3, fig. 27.  
*Dorothia crassa* (Marsson). - Geroch & Nowak, 1984, pl. 4,  
fig. 15.

***Marssonella oxycona* (Reuss, 1860)**  
Pl. 15, Fig. 2

*Gaudryina* (*Gaudryina*) *oxycona* Reuss, 1860, p. 229, pl. 12,  
fig. 3.

***Nothia latissima* (Grzybowski, 1898)**  
Pl. 1, Figs. 9, 10

*Dendrophrya latissima* Grzybowski, 1898, p. 273, pl. 10, fig.  
8.

*Nothia latissima* (Grzybowski). - Kaminski & Geroch, 1993,  
p. 245, pl. 1, figs. 1a - c, 14a, b.

***Nothia* sp.**  
Pl. 8, Fig. 7

Flattened tubes of various diameter and wall thickness, rarely branching. Wall consists of poorly selected silt and pelitic material including mica particles. This form differs from *Nothia excelsa* (Grzybowski, emend. Geroch & Kaminski, 1993) by its less frequent branching and more poorly selected agglutinated material, resulting in a non-transparent wall.

***Paratrochamminoides ex. gr. acervulatus***  
(Grzybowski, 1896)  
Pl. 11, Figs. 2a, b, cf. 1

cf. *Trochammina acervulata* Grzybowski, 1896, p. 284, pl. 9,  
fig. 4a - c. - Liszka & Liszkowa, 1981, p. 176, pl. 3, fig. 1a  
- c.

Test usually streptospiral. Irregularly trochospiral forms like the lectotype selected by Liszka & Liszkowa (1981) are rather rare. Chambers nearly round, intercameral sutures hard to define. The coils are sometimes like a rabbit gut. The chambers are smaller in diameter compared with *Paratrochamminoides heteromorphus* and *P. mitratus*.

***Paratrochamminoides contortus* (Grzybowski, 1898)**  
Pl. 11, Fig. 7

*Trochammina contorta* Grzybowski, 1898, p. 287, pl. 11, figs.  
12 - 14.

*Paratrochamminoides contortus* (Grzybowski). - Kaminski &  
Geroch, 1993, p. 260, pl. 8, figs. 1 - 5.

***Paratrochamminoides deformis* (Grzybowski, 1898)**  
Pl. 3, Fig. 1a, b

*Trochammina deformis* Grzybowski, 1898, p. 288, pl. 11,

figs. 20 - 22.  
*Paratrochamminoides deformis* (Grzybowski). - Kaminski & Geroch, 1993, p. 262, pl. 9, fig. 7a - c.

*Paratrochamminoides draco* (Grzybowski, 1901)  
 Pl. 3, Fig. 2a, b

*Trochammina draco* Grzybowski, 1901, p. 280, pl. 8, fig. 10.  
*Paratrochamminoides draco* (Grzybowski). - Kaminski & Geroch, 1993, p. 277, pl. 16, fig. 5a - c.

*Paratrochamminoides heteromorphus* (Grzybowski, 1898)  
 Pl. 11, Figs. 4, 10

*Trochammina heteromorpha* Grzybowski, 1898, p. 286, pl. 11, fig. 16.  
*Paratrochamminoides heteromorphus* (Grzybowski). - Kaminski & Geroch, 1993, p. 258, pl. 7, figs. 3a - 5b.

Fragments of the uncoiled part (see pl. 11, fig. 4) may be confused with *Subreophax pseudoscalaria* (Samuel, 1977).

*Paratrochamminoides irregularis* (White, 1928)  
 Pl. 10, Figs. 7 - 9

*Trochamminoides irregularis* White, 1928, p. 307, pl. 42, fig. 1.

*Paratrochamminoides mitratus* (Grzybowski, 1901)  
 Pl. 3, Fig. 3a, b

*Trochammina mitrata* Grzybowski, 1901, p. 280, pl. 8, fig. 3.  
*Paratrochamminoides mitratus* (Grzybowski). - Kaminski & Geroch, 1993, p. 278, pl. 16, figs. 4a, b, 6a, b.

*Paratrochamminoides olszewskii* (Grzybowski, 1898)  
 Pl. 11, Fig. 3

*Trochammina olszewskii* Grzybowski, 1898, p. 286, pl. 11, fig. 6.  
*Paratrochamminoides olszewskii* (Grzybowski). - Kaminski & Geroch, 1993, p. 257, pl. 7, figs. 1a - 2b.

*Paratrochamminoides uviformis* (Grzybowski, 1901)  
 Pl. 3, Fig. 5a, b

*Trochammina uviformis* Grzybowski, 1901, p. 281, pl. 8, figs. 1, 2.  
*Paratrochamminoides uviformis* (Grzybowski). - Kaminski & Geroch, 1993, p. 278, pl. 16, fig. 7a, b.

*Paratrochamminoides sp. 1*  
 Pl. 3, Fig. 4a - c

Test irregularly trochospiral with three reniform chambers in the last whorl. This species most closely resembles *Trochamminoides variolarius* (Grzybowski), differing in possessing only three chambers in the final whorl and in its distinctive reniform (rather than rounded-triangular) shape.

*Plectorecurvoidea alternans* Noth, 1952  
 Pl. 6, Fig. 1a - c, Pl. 13, Fig. 1a, b

*Plectorecurvoidea alternans* Noth, 1952, p. 117, figs. 1a - 2b.

*Plectorecurvoidea irregularis* Geroch, 1962  
 Pl. 6, Figs. 2a - 3c

*Plectorecurvoidea irregularis* Geroch, 1962, p. 297, fig. 3 (9, 10).

*Plectorecurvoidea parvus* Krasheninnikov, 1973  
 Pl. 6, Fig. 4a - d

*Plectorecurvoidea parvus* Krasheninnikov, 1973, p. 210, pl. 2, figs. 6a - 7c.

*Plectorecurvoidea* sp. 1  
 Pl. 6, Figs. 5a - c

This species with subglobular test differs from other *Plectorecurvoidea* representatives by its fewer chambers in the final whorl (three chambers in one series). The streptospiral form here designed as *Thalmannammina* sp. could belong to this species. Its streptospiral arrangement can be interpreted as irregular plectorecurvooidal (like *P. irregularis*).

*Praecystammina globigerinaeformis*  
 Krasheninnikov, 1973  
 Pl. 12, Fig. 4

*Praecystammina globigerinaeformis* Krasheninnikov, 1973, p. 211, pl. 2, figs. 1a - 2.

*Psammosphaera fusca* Schulze, 1875  
 Pl. 1, Fig. 14, Pl. 8, Fig. 2

*Psammosphaera fusca* Schulze, 1875, pl. 2, fig. 87a - f.

*Psammosphaera irregularis* (Grzybowski, 1896)  
 Pl. 1, Figs. 15 - 16b

*Keramosphaera irregularis* Grzybowski, 1896, (part) p. 273, pl. 8, (?) fig. 12, not fig. 13.  
*Psammosphaera irregularis* (Grzybowski). - Liszka & Liszkowa, 1981, p. 161.

Test unilocular, flattened, predominantly oval in outline. Wall thick, finely to medium agglutinated from quartz grains of bimodal size fractions. Surface finely rough.

*Psammosphaera* sp. 1  
 Pl. 1, Figs. 11a - 13b

Test small, unilocular, flattened, subcircular in outline. Wall agglutinated from fine quartz grains. Surface finely rough. This form differs from *P. irregularis* by its smaller size.

*Psammosphaera* sp. 2  
 Pl. 8, Fig. 3

*Psammosphaera laevigata* White. - Hanzlíková, 1972, p. 33, pl. 1, figs. 7, 8.

Unilocular test of medium size is flattened and circular in outline. This species differs from *Psammosphaera irregularis* by its coarsely agglutinated wall.

*Pseudobolivina munda* Krasheninnikov, 1973  
 Pl. 13, Fig. 14

*Pseudobolivina munda* Krasheninnikov, 1973, p. 210, pl. 2, figs. 10, 11.

*Pseudobolivina variabilis* (Vašíček, 1947)  
Pl. 13, Fig. 15

*Bigenerina variabilis* Vašíček, 1947, p. 246, pl. 1, figs. 10-12.  
*Pseudobolivina variabilis* (Vašíček). - Geroch, 1966, p. 445,  
fig. 14 (1 - 4).

*Pseudoreophax cisovnicensis* Geroch, 1961  
Pl. 7, Fig. 8

*Pseudoreophax cisovnicensis* Geroch, 1961, p. 164, pl. 17,  
figs. 1 - 20, text fig. 1.

Specimens from the Hluk Formation of the BKU differ from the Polish specimens described by Geroch (1961) by their smaller dimensions.

*Recurvoidella lamella* (Grzybowski, 1898)  
Pl. 4, Fig. 1a - c

*Trochammina lamella* Grzybowski, 1898, p. 290, pl. 11, fig.  
25.

*Recurvoidella lamella* (Grzybowski). - Kaminski & Geroch,  
1993, p. 263, pl. 10, figs. 8a - 9c.

*Recurvoidella insueta* (Krasheninnikov, 1974)  
Pl. 3, Fig. 19a - c, Pl. 12, Fig. 1a, b

*Trochammina insueta* Krasheninnikov, 1974, p. 642, pl. 6,  
fig. 6a - c.

Specimens from the BKU are often subplanispiral in the later stage. Abrupt changes of coiling direction also occur.

*Recurvoides anormis* Myatlyuk, 1970  
Pl. 5, Fig. 5a - c

*Recurvoides anormis* Myatlyuk, 1970, p. 84, pl. 18, fig. 4a - g,  
pl. 19, figs. 1a - 4.

*Recurvoides gerochi* Pflaumann, 1964  
Pl. 5, Fig. 9a - c

*Recurvoides* sp. 1 - Geroch, 1960, p. 52, pl. 3, fig. 13a - f.  
*Recurvoides gerochi* Pflaumann, 1964, p. 102, pl. 14, figs. 1a -  
d.  
*Thalmannammina immanis* (Grzybowski). - Hanzlíková &  
Pesl, 1964, pl. 2, fig. 4a - c.

Test streptospiral, gradually changing in the coiling direction. Fourteen to 16 chambers visible on the surface. Quasi-trochospiral forms such as the specimen figured by Geroch (1960) predominate within the variability of this species. Large gerontic specimens may be planispirally coiled in the terminal stage (see pl. 5, fig. 9) or develop one meandering whorl.

*Recurvoides immane* (Grzybowski, 1898)  
Pl. 4, Fig. 7a - c

*Haplophragmium immane* Grzybowski, 1898, p. 281, pl. 10,  
fig. 25.

*Recurvoides immane* (Grzybowski). - Kaminski & Geroch,  
1993, p. 252, pl. 4, figs. 3a - 4.

*Recurvoides imperfectus* (Hanzlíková, 1966)  
Pl. 4, Fig. 8a - c, cf. 9a - c, Pl. 13, Fig. 2

*Haplophragmoides imperfectus* Hanzlíková, 1966, p. 111, pl.  
5, figs. 1a - 8c.

*Recurvoides nucleolus* (Grzybowski, 1898)  
Pl. 4, Fig. 10a - c

*Trochammina nucleolus* Grzybowski, 1898, p. 291, pl. 11,  
figs. 28 - 29.

*Recurvoides nucleolus* (Grzybowski). - Kaminski & Geroch,  
1993, p. 265, pl. 11, fig. 4a - d.

*Recurvoides cf. pentacameratus* Krasheninnikov,  
1974

Pl. 5, Fig. 4a - c, Pl. 13, Figs. 4, 5

cf. *Recurvoides pentacameratus* Krasheninnikov, 1974, p.  
638, pl. 3, fig. 6a - c.

*Recurvoides cf. subturbinatus* (Grzybowski). - Kaminski et  
al., 1988, p. 191, pl. 6, figs. 8a - 9b.

Differs from the type description in having a broad  
slit-like aperture.

*Recurvoides pseudosymmetricus* Krasheninnikov,  
1974

Pl. 5, Fig. 6a - c; Pl. 6, Fig. 12a - c (?)

*Recurvoides pseudosymmetricus* Krasheninnikov, 1974, p.  
638, pl. 3, fig. 3a - c.

Some specimens differ in having an umbilically  
depressed test.

*Recurvoides recurvoidiformis* (Neagu & Tocorjescu,  
1970)

Pl. 4, Figs. 11a - 12c

*Thalmannammina recurvoidiformis* Neagu & Tocorjescu. -  
Neagu, 1970, p. 38, pl. 4, figs. 1 - 12, pl. 40, figs. 10 - 15.

*Recurvoides variabilis* Hanzlíková, 1973

Pl. 4, Fig. 13a - c

*Recurvoides variabilis* Hanzlíková, 1973, p. 148, pl. 4, figs.  
5a - 8, text fig. 3A - F.

Test streptospiral with one abrupt change of coiling  
direction. Usually seven oval chambers visible on  
the surface. This species is connected by morpho-  
logical transition with *Recurvoides imperfectus* (see  
pl. 4, fig. 9).

*Recurvoides walteri* (Grzybowski, 1898)  
Pl. 4, Fig. 15a - c

*Haplophragmium walteri* Grzybowski, 1898, p. 280, pl. 10,  
fig. 24.

*Recurvoides walteri* (Grzybowski). - Kaminski & Geroch,  
1993, p. 252, pl. 4, figs. 1a - 2c.

*Recurvoides aff. primus* Myatlyuk, 1970  
Pl. 5, Fig. 10a - c

aff. *Recurvoides primus* Myatlyuk, 1970, p. 80, pl. 20, figs.  
2a - 3e, pl. 21, fig. 1, pl. 27, fig. 3.

This species recalls *R. primus* by its very rapidly  
increasing chamber size. It differs from the above-  
mentioned Cretaceous species in possessing fewer  
chambers, indistinct sutures, and in its coarsely  
agglutinated wall.

*Recurvooides* sp. 1

Pl. 4, Fig. 14a - c

*Haplophragmoides* aff. *nonioninoides* (Reuss). - Geroch, 1966, p. 464, figs. 9 (1 - 19), 11 (1).

*Haplophragmoides nonioninoides* (Reuss). - Hanzlíková, 1966, p. 112, pl. 3, figs. 1a - 3b, pl. 4, figs. 1a - 5.

This species was erroneously assigned by earlier authors to *Haplophragmoides*, although the areal position of aperture was already noted by Geroch (1966, p. 464). It is now considered by Neagu & Platon (personal communication) to be a new species of the genus *Recurvooides*.

*Recurvooides* sp. 2

Pl. 5, Figs. 1a - 2c

Test subsphaerical slightly umbilically compressed. Irregularly planispiral last coil consisting of seven (rarely up to nine) narrow and broad chambers. Aperture is slit-like near the base of the last chamber. Wall roughly finished. From *Recurvooides pseudosymmetricus* it differs by its tighter coiling, slit-like aperture and larger dimensions.

*Recurvooides* sp. 3

Pl. 5, Fig. 3a - c

Test rather large, umbilically flattened. Axis of the later planispiral whorl is orthogonal to that of the earlier whorl. Wall very coarsely finished.

*Recurvooides* sp. 4

Pl. 5, Figs. 7a - 8c, Pl. 13, Fig. 6

Test small, streptospiral, usually strongly deformed. Five (rarely six) chambers visible on the surface. Position of aperture is indistinct, but seems to be areal. Wall is coarsely agglutinated with a rough finish.

*Recurvooides* sp. 5

Pl. 5, Fig. 11a - c

Test globular with eight chambers visible on the surface. Coiling direction changes twice in the surface whorl. This form is close to *Recurvooides walteri* and could belong to its variability.

*Recurvooides?* sp. 6

Pl. 6, Fig. 11a - d

This form combines all plectorecurvoidiform, thalmannamminiform and recurvoidiform coiling types in its surface coiling. Chamber lumina are sub-angular (often triangular) and elongated. Variability is rather high.

*Recurvooides?* sp. 7

Pl. 6, Fig. 14a - c

Test of nearly tetrahedral shape. In the early stage the coiling is streptospiral, later tending to be planispiral. This form may represent immature

stages of some *Bulbobaculites* species.

*Remesella varians* (Glaessner, 1937)

Pl. 15, Fig. 11

*Textulariella? varians* Glaessner, 1937, p. 366, pl. 2, fig. 15. *Remesella mariae* Vašíček, 1947, p. 246, pl. 2, fig. 14a, b, text fig. 2.

*Reophax duplex* Grzybowski, 1896

Pl. 2, Fig. 15

*Reophax duplex* var. *alpha* Grzybowski, 1896, p. 276, pl. 8, figs. 23, 24.

*Reophax duplex* Grzybowski. - Liszka & Liszkowa, 1981, p. 167, pl. 1, fig. 12.

*Reophax elongatus* Grzybowski, 1898

Pl. 2, Fig. 18

*Reophax elongata* Grzybowski, 1898, p. 267, pl. 7, fig. 2.

*Reophax elongatus* (Grzybowski). - Kaminski & Geroch, 1993, p. 250, pl. 3, figs. 1 - 5.

*Reophax nodulosus* Brady, 1879

Pl. 2, Figs. 20 - 22

*Reophax nodulosa* Brady, 1879, p. 52, pl. 4, figs. 7, 8.

*Reophax subnodulosa* Grzybowski, 1898, p. 279, pl. 10, figs. 17 - 18.

*Reophax parvulus* Huss, 1966

Pl. 9, Fig. 6

*Reophax parvulus* Huss, 1966, p. 21, pl. 1, figs. 26 - 30.

*Reophax minutus* Tappan. - Hanzlíková, 1966, p. 103, pl. 1, figs. 15, 16 - Geroch, 1966, p. 439, fig. 7 (7 - 17).

*Reophax pilulifer* Brady, 1884

Pl. 9, Fig. 7

*Reophax pilulifera* Brady, 1884, p. 292, pl. 30, figs. 18 - 20.

*Reophax* sp. 2

Pl. 2, Fig. 16a, b

*Reophax* sp. 2 - Kaminski et al., 1988, p. 187, pl. 3, figs. 2 - 3 - Kuhnt, 1990, p. 324, pl. 3, figs. 7 - 9.

Tests of this species are usually undeformed, which distinguishes it from the always flattened tests of *Reophax parvulus*.

*Rhabdammina cylindrica* Glaessner, 1937

Pl. 8, Fig. 6

*Rhabdammina cylindrica* Glaessner, 1937, p. 354, pl. 1, fig. 1.

*"Rhizammina"* sp.

Pl. 8, Fig. 8 - 10

Under this name were placed all curved tubular forms with a rough surface. Branching fragments were found among thin rough forms from the lower Eocene of the BKU. Nevertheless, it is thought that these tubular forms belong to different astrorhizid forms and have no relation to the komokiacean genus *Rhizammina*.

*Rzechakina epigona* (Rzechak, 1895)

## Pl. 10, Fig. 12

*Silicina epigona* Rzehak, 1895, p. 214, pl. 6, fig. 1a - c.

*Rzehakina fissistomata* (Grzybowski, 1901)

Pl. 10, Fig. 10

*Spiroloculina fissistomata* Grzybowski, 1901, p. 261, pl. 7, figs. 22 - 24.

*Rzehakina fissistomata* (Grzybowski). - Kaminski & Geroch, 1993, p. 272, pl. 15, figs. 1 - 2.

*Rzehakina inclusa* (Grzybowski, 1901)

*Spiroloculina inclusa* Grzybowski, 1901, p. 260, pl. 7, fig. 20.

*Rzehakina inclusa* (Grzybowski). - Kaminski & Geroch, 1993, p. 272, pl. 15, fig. 4a - c.

*Rzehakina minima* Cushman & Renz, 1946

Pl. 10, Fig. 11

*Rzehakina epigona* (Rzehak) var. *minima* Cushman & Renz, 1946, p. 24, pl. 3, fig. 5.

*Saccammina placenta* (Grzybowski, 1898)

Pl. 8, Fig. 1

*Reophax placenta* Grzybowski, 1898, p. 276, pl. 10, figs. 9 - 10.

*Saccammina placenta* (Grzybowski). - Kaminski & Geroch, 1993, p. 249, pl. 2, figs. 5 - 7.

*Sphaerammina gerrochi* Hanzlíková, 1972

Pl. 12, Fig. 5

*Sphaerammina gerrochi* Hanzlíková, 1972, p. 45, pl. 8, figs. 4 - 7.

*Spirolectammina costata* Huss, 1966

Pl. 15, Fig. 1

*Spirolectammina costata* Huss, 1966, p. 33, pl. 6, figs. 18 - 19.

*Spirolectammina dentata* (Alth, 1850)

Pl. 7, Fig. 10a, b

*Textularia dentata* Alth, 1850, p. 262, pl. 13, fig. 13.

*Spirolectammina dentata* (Alth). - Huss, 1966, p. 34, pl. 5, figs. 13 - 15.

*Spirolectammina laevis* (Roemer, 1841)

Pl. 14, Figs. 6a - 7

*Textularia laevis* Roemer, 1841, p. 97, pl. 15, fig. 17.

*Spirolectammina laevis* (Roemer). - Kuhnt & Moullade, 1991, pl. 2, figs. F, G.

*Spirolectammina navarroana* Cushman, 1932

*Spirolectammina navarroana* Cushman, 1932, p. 96, pl. 11, fig. 14. - Kaminski et al., 1988, p. 193, pl. 7, figs. 13 - 15.

*Spirolectammina lanceolata* Huss, 1966, p. 36, pl. 5, figs. 16 - 20.

*Spirolectammina rosula* (Ehrenberg, 1854)

Pl. 14, Fig. 11

*Spirolecta rosula* Ehrenberg, 1854, pl. 2, fig. 26.

*Spirolectammina spectabilis* (Grzybowski, 1898)

Pl. 14, Figs. 9, 10, 13

*Spirolecta spectabilis* Grzybowski, 1898, p. 293, pl. 12, fig. 12.

*Spirolectammina spectabilis* (Grzybowski). - Kaminski & Geroch, 1993, p. 267, pl. 12, figs. 4a - 5c.

*Spirolectammina subhaeringensis* (Grzybowski, 1896)

Pl. 14, Figs. 8a, b, 12

*Textularia subhaeringensis* Grzybowski, 1896, var. alpha, p. 285, pl. 9, fig. 16a - c, var. beta, p. 286, pl. 9, fig. 13a - c.

*Spirolectammina subhaeringensis* (Grzybowski). - Liszka & Liszkowa, 1981, p. 178, pl. 3, figs. 6a - 7b.

*Spirolectammina* sp. 1

Pl. 7, Figs. 11 - 12b

Test small, elongated, broadly elliptical in cross section. Early stage distinctly coiled, later biserial and somewhat twisted, with four to five chambers in one series. Wall is roughly finished.

*Subreophax guttifer* (Brady, 1884)

Pl. 2, Figs. 14a, b, 17a, b.

*Reophax guttifera* Brady, 1884, p. 295, pl. 31, figs. 10 - 15.

*Subreophax guttifer* (Brady). - Kuhnt & Moullade, 1991, pl. 1, figs. G, H.

*Subreophax scalaria* (Grzybowski, 1896)

Pl. 9, Figs. 8, 9

*Reophax guttifera* Brady var. *scalaria* Grzybowski, 1896, p. 277, pl. 8, fig. 26a, b.

*Reophax scalaria* Grzybowski. - Liszka & Liszkowa, 1896, p. 168, pl. 1, fig. 15.

*Subreophax splendidus* (Grzybowski, 1898)

Pl. 9, Figs. 10, 15, cf. Pl. 2, Fig. 19

*Reophax splendida* Grzybowski, 1898, p. 278, pl. 10, fig. 16.

*Reophax splendidus* Grzybowski. - Kaminski & Geroch, 1993, p. 251, pl. 3, figs. 11a, b, (?) 12a, b.

*Thalmannammina gerrochi* (Hanzlíková, 1972)  
n.comb.

Pl. 6, Fig. 9a - c, Pl. 13, Fig. 3a, b

*Recurvoides gerrochi* Hanzlíková, 1972, p. 43, pl. 6, figs. 4 - 6.

Test somewhat assymetrical, consists of meandering (thalmannaminiform) coiling. Usually 9 to 11 chambers are visible on the surface. The meandering is very various but generally the morphotypes with three meander curves per whorl predominate. Chamber lumina are oval and subangular in outline.

*Recurvoides gerrochi* Hanzlíková is the younger primary homonym of *Recurvoides gerrochi* Pflaumann. According Article 59d of the ICZN, the new combination *Thalmannammina gerrochi* can be considered to be a valid name.

*Thalmannammina ex gr. gerrochi* (Hanzlíková, 1972)

Pl. 6, Figs. 10a - c, 13a - c

This morphotype differs from *T. gerrochi* by 12 to 16 chambers visible on the surface and four (rarely five) meanders in the surface whorl.

*Thalmannammina meandertornata* Neagu & Tocorescu, 1970  
Pl. 6, Fig. 8a - c

*Thalmannammina meandertornata* Neagu & Tocorescu. - Neagu, 1970, p. 38, pl. 3, figs. 9 - 15, pl. 40, figs. 1 - 9.

Test thalmannamminiform, with one to four meanders in the surface coiling. Ten to 14 chambers are visible on the surface. Differs from members of the *T. gerochi* group by its rounded to globular chambers in all stages of the test growth.

*Thalmannammina neocomiensis* Geroch, 1962  
Pl. 6, Fig. 7a - c

*Thalmannammina neocomiensis* Geroch, 1962, p. 282, fig. 1 (1a - 7c), 3(5 - 8).

*Thalmannammina?* sp. 1  
Pl. 6, Fig. 6a - c

Test small, a little asymmetrical. Surface coiling of intermediate plectorecurvoidiform to thalmannamminiform type, consisting of six chambers. This species slightly reminds *Thalmannammina subturbinata* Grzybowski in its arrangement, but differs in having three chambers per meander instead of four. It could represent an irregular variety of *Plectorecurvooides* sp. 1 (this paper).

*Thurammina papillata* Brady, 1879  
Pl. 8, Fig. 4

*Thurammina papillata* Brady, 1879, p. 45, pl. 5, figs. 4 - 8.

*Tolypammina vagans* (Brady, 1879)

*Hyperammina vagans* Brady, 1879, p. 33, pl. 5, fig. 3.

Only one specimen was found in "Paleocene-Eocene variegated beds" of the BKU. Its thin, tightly meandering tube is attached on a large specimen of *Paratrochamminoides heteromorphus*.

*Trochammina cf. abrupta* Geroch, 1966  
Pl. 7, Fig. 13a - c

cf. *Trochammina abrupta* Geroch, 1966, p. 468, figs. 5, 14 (13 - 17).

Specimens from the BKU differ from the type description by having fewer chambers and more rapidly growing chamber size.

*Trochammina cf. globigeriniformis* (Jones & Parker, 1865)

cf. *Lituola nautiloidea* Lamarck var. *globigeriniformis* Jones & Parker, 1865, p. 407, pl. 15, figs. 46, 47.  
*Trochammina ex gr. globigeriniformis* (Jones & Parker). - Geroch, 1960, p. 65, pl. 7, fig. 2a - c.

*Trochammina gyroidinaeformis* Krasheninnikov, 1974  
Pl. 14, Figs. 4, 5

*Trochammina gyroidinaeformis* Krasheninnikov, 1974, p. 641, pl. 5, figs. 7a - 9c.

*Trochammina umiatensis* Tappan, 1957  
Pl. 13, Fig. 11

*Trochammina umiatensis* Tappan, 1957, p. 214, pl. 67, figs. 27 - 29. - Tappan, 1962, p. 156, pl. 38, figs. 5 - 8.

"*Trochammina*" *vocontiana* Moullade, 1960  
Pl. 13, Fig. 16

*Trochammina concava* Chapman var. *vocontiana* Moullade, 1960, p. 200, pl. 1, figs. 1a - 3b.  
*Trochammina vocontiana* Moullade. - Geroch, 1966, p. 450, fig. 14 (5 - 12).

*Trochammina* sp. 2  
Pl. 7, Fig. 14a - c

*Trochammina* sp. 3  
Pl. 14, Fig. 1

*Trochammina?* sp. 4  
Pl. 7, Fig. 21a, b, Pl. 14, Fig. 3a, b

*Trochammina* sp. 5  
Pl. 7, Fig. 16a - c

*Trochammina* sp. 6  
Pl. 7, Fig. 17a - c

*Trochammina* sp. 7  
Pl. 7, Fig. 15a - c

*Trochammina* sp. 8  
Pl. 7, Fig. 18a - c

*Trochammina* sp. 9  
Pl. 7, Figs. 19a - 20c, Pl. 14, Figs. 2a, b, 14

*Trochamminoides dubius* (Grzybowski, 1901)  
Pl. 11, Fig. 11

*Ammodiscus dubius* Grzybowski, 1901, p. 274, pl. 8, figs. 12 - 13.  
*Trochamminoides dubius* (Grzybowski). - Kaminski & Geroch, 1993, p. 275, pl. 15, figs. 9a - 12b.

*Trochamminoides folius* (Grzybowski, 1898)  
Pl. 11, Fig. 5

*Ammodiscus dubius* Grzybowski, 1901, p. 274, pl. 8, figs. 12 - 13.  
*Trochamminoides dubius* (Grzybowski). - Kaminski & Geroch, 1993, p. 275, pl. 15, figs. 9a - 12b.

*Trochamminoides grzybowskii* Kaminski & Geroch, 1992  
Pl. 11, Fig. 12

*Trochammina elegans* Rzehak. - Grzybowski, 1898, p. 287, pl. 11, fig. 10.  
*Trochamminoides grzybowskii* Kaminski & Geroch, 1992. - Kaminski & Geroch, 1993, p. 260, pl. 8, figs. 6a - 7d.

*Trochamminoides proteus* (Karrer, 1866)  
Pl. 11, Fig. 13

*Trochammina proteus* Karrer, 1866, (part) p. 494, figs. 8, (?) 7, not 1 - 6.  
*Trochammina subcoronata* Rzehak. - Grzybowski, 1896, p.

283, pl. 9, fig. 3a, b.

*Trochamminoides septatus* (Grzybowski, 1898)  
Pl. 11, Fig. 6

*Ammodiscus septatus* Grzybowski, 1898, p. 283, pl. 11, fig. 1.

*Trochamminoides septatus* (Grzybowski). - Kaminski & Geroch, 1993, p. 255, pl. 5, fig. 9a - c.

*Trochammina ammonoides* Grzybowski, 1901, p. 279, pl. 8, figs. 4, 15.

*Trochamminoides ammonoides* (Grzybowski). - Kaminski & Geroch, 1993, p. 277, pl. 16, fig. 3a - c.

The internal arrangement (number of chambers per whorl and chamber lumina shape) of *T. septatus* and *T. ammonoides* is very similar, and this causes difficulties in separating them.

*Trochamminoides variolarius* (Grzybowski, 1898)  
Pl. 11, Fig. 9

*Trochammina variolaria* Grzybowski, 1898, p. 288, pl. 11, fig. 15.

*Trochamminoides variolarius* (Grzybowski). - Kaminski & Geroch, 1993, p. 261, pl. 9, figs. 5a - 6c.

*Trochamminoides vermetiformis* (Grzybowski, 1898)  
Pl. 11, Fig. 8

*Trochammina vermetiformis* Grzybowski, 1898, p. 286, pl. 11, fig. 19.

?*Lituotuba vermetiformis* (Grzybowski). - Kaminski & Geroch, 1993, p. 259, pl. 7, fig. 6a, b.

*Turritellella reversa* n. sp.  
Pl. 2, Fig. 6a, b

*Turritellella shoneana* (Siddall). - Pokorný, 1953, p. 10, text fig. 2 - Huss, 1966, p. 20, Pl. 3, figs. 14 - 16.

*Turritellella* sp. - Kuhnt & Moullade, 1991, pl. 4, fig. D. cf. *Glomospira irregularis* (Grzybowski). - Maslakova, 1955, p. 45, pl. 3, fig. 3.

**Derivation of name:** reversa because of its characteristic reverse changes of coiling direction.

**Diagnosis:** Test highly conical, consisting of a tubular undivided chamber coiled in a high and more or less irregular trochospire. Coiling direction can abruptly change during ontogeny. Wall is distinctly agglutinated and roughly finished.

**Holotype:** specimen on pl. 2, fig. 6a, b.

**Material:** Two specimens in the collection of the Czech Geological Survey, Brno Division. Catalog no: MB1-169A, MB1-169B.

**Type locality:** Borehole Gbely H-6, interval 1433,4 - 1434,4 m (holotype) and interval 1476,3 - 1478,9 m (paratype). Western Slovakia.

**Type horizon:** Albian - Cenomanian *Plectorecurvoides alternans* Zone, sensu Geroch & Nowak (1984), of the Bílé Karpaty unit (the Hluk and Kaumberg formations undivided).

**Dimensions:** length of holotype: 0.60 mm, diameter of tube: 0.10 mm (holotype), 0.14 mm (paratype).

**Remarks:** The somewhat deformed test of the holotype shows an interesting change of coiling direction from left to right. The same feature is visible on the specimen figured by Huss (1966, pl. 3, fig. 14). In the terminal stage the holotype tends to uncoil. The un-

figured paratype is fragmented with three regular, highly trochospiral whorls. *Turritellella reversa* n.sp. is connected by morphological transition with *Glomospira irregularis*. Such a transitional form was figured by Maslakova (1955) and similar specimens were observed also in the Bílé Karpaty unit. Transitional forms consist of irregularly trochospiral to meandering whorls, which did not cross the earlier ones. *Turritellella reversa* n.sp. probably represents a descendent of *G. irregularis*. A similar morphotype to *T. reversa* n.sp. designated as *Turritellella* sp. was figured by Kaminski, Gradstein & Geroch (1992) from the Tithonian to Lower Cretaceous of the Indian Ocean. This form nevertheless differs in having a smooth surface. From *Turritellella shoneana* (Siddall) this new species differs by its more irregular coiling with reverse changes of coiling direction and by its roughly finished wall.

*Uvigerinammina jankoi* Majzon, 1943  
Pl. 13, Fig. 13

*Uvigerinammina jankoi* Majzon, 1943, p. 158, pl. 2, fig. 15a, b. - Geroch, 1957, p. 240, pl. 14, figs. 1 - 10, pl. 15, figs. 1 - 16.

*Uvigerinammina praejankoi* Neagu, 1990  
Pl. 7, Fig. 9a, b, cf. Pl. 13, Fig. 17

*Uvigerinammina praejankoi* Neagu, 1990, p. 255, pl. 3, figs. 1 - 33.

*Verneuilinoides neocomiensis* (Myatlyuk, 1939)  
Pl. 13, Fig. 9

*Verneuilina neocomiensis* Myatlyuk, 1939, p. 50, pl. 2, figs. 34, 40a, b.

*Verneuilinoides neocomiensis* (Myatlyuk). - Geroch & Nowak, 1984, pl. 2, fig. 4, pl. 7, figs. 13, 14.

*Verneuilinoides polystrophus* (Reuss, 1846)  
Pl. 13, Fig. 10

*Bulimina polystropha* Reuss, 1846, p. 109, pl. 24, fig. 53.  
*Verneuilinoides polystropha* (Reuss). - Kaminski et al., 1988, p. 194, pl. 8, fig. 9.

*Verneuilinoides propinquus* (Brady, 1884)

*Verneuilina propinqua* Brady, 1884, p. 387, pl. 47, figs. 8-14.  
*Eggerella propinqua* (Brady). - Geroch, 1960, p. 58, pl. 7, fig. 12.

*Verneuilinella* sp.  
Pl. 13, Fig. 12

Test is highly conical, trochospiral. Each whorl consists of four inflated chambers. Aperture is a low arch at the base of the last chamber. Wall coarsely agglutinated, roughly finished.

This species resembles *Verneuilinella azerbaijanica* Tairov, the type species of the genus *Verneuilinella*. The coiling of this species seems to be trochospiral rather than quadriserial as given in the type description of the genus (Tairov, 1956, fide Loeblich & Tappan, 1987).

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**Appendices 1 - 3.** Distribution of deep-water agglutinated foraminifera in the Bílé Karpaty unit. \*1. Lithostratigraphy: P - Púchov Marls; A - Antonínek Fm.; Hluk succession: H - Hluk Fm., Kh - Kaumberg Fm., VB - Paleocene-Eocene variegated beds; Svodnice succession: Ks - Kaumberg Fm., Ss - Svodnice Fm., N - Nivnice Fm., KU - Kuželov Fm.; Vlára succession: Kv - Kaumberg Fm., J - Javorina Fm., Sv - Svodnice Fm. \*2. Nannozones of Martini (1971) and Sissingh (1977). \*3. Planktonic foraminifera zones of Blow (1979) and Caron (1985): gorba - z. *Hedbergella gorbachikae*, falso - z. *Globotruncana falsostuarti*, ganss - z. *Gansserina gansseri*, mayar - z. *Abathomphalus mayaroensis*. \*4. Agglutinated foraminifera zones (Geroch & Nowak, 1984, modified). \*5. Benthonic diversity: number of benthonic-foraminifera species (including calcareous foraminifera in parenthesis). \*6. Sedimentology: H - hemipelagite, Te, Td - Bouma turbidite intervals.

## Appendix 1.

sample	lithostratigraphy <sup>7</sup>	age	nannoplankton zones <sup>7,2</sup>	planktonic foraminifera zones <sup>7,3</sup>	agglutinated foraminifera zones <sup>7,4</sup>	benthonic diversity <sup>7,5</sup>	sedimentology <sup>7,6</sup>
1 H-1R	P	Ma		mayar	44(17)	?H	
2 35-112/49A	P	Ma	CC22-23	ganss	33(23)	?H	r
3 HAG-1 (14,26 m)	P	Ma		(Ma)	21(10)	?H	
4 HAG-1 (0,0 m)	P	Ma		mayar	40(17)	?H	r ?
5 35-112/32	P	Ca/Ma	CC23		34(22)	?H	r ?
6 HI-M-1 (122,8 m)	P	Ca-Ma	CC22-23		38(24)	?H	r ?
7 HI-M-1 (97,5 m)	P	Ca-Ma	CC22-23		44(25)	?H	r
8 HI-M-1 (92,7 m)	P	Ma	CC22-23	falso	18(9)	?H	
9 HI-M-1 (83,5 m)	P	Ca-Ma	CC22-23		H.gig	41(16)	?H r
10 HI-M-1 (75,5 m)	P	Ca-Ma	CC22-23		H.gig	52(27)	?H r f
11 HI-M-1 (66,5 m)	P	Ca-Ma	CC22-23		H.gig	39(21)	?H r r ?
12 HI-M-1 (59,5 m)	P	Ca-Ma	CC22-23		43(21)	?H	r
13 HI-M-1 (50,5 m)	P	Ca-Ma	CC22-23		H.gig	42(19)	?H r r r ?
14 HI-M-1 (46,5 m)	P	Ca-Ma	CC22-23			51(24)	?H r r
15 HI-M-1 (40,7 m)	P	Ca-Ma	CC22-23		H.gig	31(18)	?H r
16 HI-M-1 (10,3 m)	P	Ca-Ma	CC22-23			23(8)	?H r
17 HI-M-1 (9,9 m)	P	Ca-Ma	CC22-23			19(9)	?H
18 HAG-1 (126,8 m)	VB	Ca-Pc				28	?H
19 HAG-1 (121,1 m)	VB	?Pc				37	?H r
20 35-112/48	VB	Pc-E				25	?H
21 35-112/33	VB	E1		R.nod	11	?H	
22 HI-M-1 (32,3 m)	Kh					13	?H r r
23 HI-M-1 (31,8 m)	Kh					12	?H r r
24 HI-M-1 (30,7 m)	Kh					3	?H
25 HI-M-1 (26,5 m)	Kh					8	?H
26 R2/11	Kh	S-Pc				36	?H r ? r r
27 R2/17	Kh	T		U.jan	37	?H ?r r	
28 R2/9	Kh				30	?H r	
29 R2/8	Kh	T-S		U.jan	22	?H r ?	
30 R1/10	Kh	Ce		P.alt	15	?H	
31 R19/1	Kh	T		U.jan	24	?H	
32 HAG-1 (41,0 m)	Kh	T		U.jan	21	?H	
33 H-6 (1476,3 m)	Kh	Al-Ce		P.alt	16	?H	r
34 H-6 (1459,5 m)	Kh	Al-Ce		P.alt	21	?H r ? r	
35 H-6 (1433,4 m)	Kh	Al-Ce		P.alt	20	?H r r	
36 H-6 (1380,0 m)	Kh	Al-Ce		P.alt	16	?H	
37 H-6 (1354,0 m)	Kh	Al-Ce		P.alt	8	?H	r ?
38 HAG-1 (122,0 m)	Kh	Ce		B.pro	14	?H	
39 HI-M-1 (11,4 m)	Kh	Ce/T		U.j.s.l.	15	?H r	
40 HI-M-1 (10,6 m)	Kh	Ce/T		U.j.s.l.	20	?H r	r ?
41 HI-M-1 (16,3 m)	H	?Ce		P.alt	21	?H r r	r ?
42 HAG-1 (87,3 m)	H	Al		P.alt	25	?H r r	r ? r
43 HAG-1 (74,3 m)	H	?Ce		P.alt	14	?H r	
44 HAG-1 (63,5 m)	H	?Ce		P.alt	24	?H r r	
45 HAG-1 (55,5 m)	H	Al		P.alt	13	?H r	
46 12R/2	H				5(2)	?H	r
47 12R/1	H				9	?H	f f
48 10R/2	H	Al		P. alt	8	?H r	
49 10R/1	H	Al		P.alt	16	?H	
50 9R/2	H				22	?H r r	r
51 8R/2	H	?Ap			12	?H r	
52 V-3 (23,7 m)	H	Ap	gorba		14(1)	?H	
53 V-3 (11,5 m)	H	Ap	gorba		11	?H r ?	
54 V-3 (5,3 m)	H	Ap	gorba		13(3)	?H r	
55 35-112/16C	H	Ap	(Ap)		9	?H r	r ? r

### **Appendix 1 (continued).**

## **Appendix 1 (continued).**

1	r	Recuvroides cf. pentacamerulus	
2		Recuvroides recurvoidiformis	
3		Recuvroides variabilis	
4		Recuvroides walleni	
5	r?	Recuvroides sp. 1	
6	r r	Recuvroides sp. 2	
7	r	Recuvroides sp. 3	
8		Reophax duplex	
9		Reophax nodulosus	
10	r	Reophax parvulus	
11		Reophax pilifer	
12	r	Reophax sp. 2	
13	r	Rhabdammmina cylindrica	
14	r r	"Rhizammmina" sp.	
15	r	Rzezhakina epigona	
16		Saccammina placenta	
17	r	Spiroplectammmina costata	
18	r	Spiroplectammmina dentata	
19	r	Spiroplectammmina laevis	
20	r?	Spiroplectammmina navarroana	
21		Spiroplectammmina rosula	
22		Spiroplectammmina subhaeringensis	
23		Subreophax scalaria	
24		Subreophax splendidus	
25		Thaimannammmina ex gr. gerochii	
26	r	Thaimannammmina meandertornata	
27	r	Thaimannammmina neocomiensis	
28	r	Thaimannammmina? sp. 1	
29		Thuramminima gerochii	
30	r?	Thuramminima? abrupta	
31	r	Trochammina cf. globigeriniformis	
32	r	Trochammina gyrodiniaeformis	
33	r?	Trochammina umiatensis	
34	r	"Trochammina" vocaniana	
35	r?	Trochammina sp. 2	
36	r	Trochammina sp. 6	
37		Trochammina sp. 7	
38		Trochammina sp. 8	
39		Trochammina sp. 9	
40	r?	Trochamminoidea dubius	
41		Trochamminoidea iolius	
42		Trochamminoidea gizibowskii	
43		Trochamminoidea proteus	
44	r r	Trochamminoidea septatus	
45		Trochamminoidea variolarius	
46		Turritella reversa	
47		Vernuillinoidea vernophilus	
48	r	Uvigerinammmina tankoi	
49	r	Uvigerinammmina praejankoi	
50	r	Vernuillinoidea neocomiensis	
51	r	Vernuillinoidea propinquus	
52			
53			
54			
55	r		

## Appendix 2.

sample	lithostratigraphy/ <sup>1</sup>		nanoplankton zones / <sup>2</sup>		plant/tonic foraminifera zones / <sup>3</sup>		agglutinated foraminifera zones / <sup>4</sup>		benthonic diversity/ <sup>5</sup>		sedimentology/ <sup>6</sup>	
	age											
1 35-114/74I	KU	E1	NP11	P6	R.nod	28	H				Ammodiscus bornemannii	
2 35-114/74M	KU	E1	NP11	P6	R.nod	21	?Te				Ammodiscus cretaceus	
3 35-113/78-10	N	E1	NP10	P5-P6	R.nod	9	Te				Ammodiscus glaberatus	
4 35-113/78-9	N	E1	NP10	P5-P6	R.nod	16	H				Ammodiscus infimus	
5 35-113/78-7	N	E1	NP10	P5-P6	R.nod	24	H				Ammodiscus cf. planus	
6 35-114/64K	N	E1	NP10	P6		17(1)	H				Ammodiscus tenuisimus	
7 35-114/64J	N	E1	NP10	P6		8(1)	?H				Ammoligena clavata	
8 35-114/64F	N	Pc	NP9	P6		17	H				Amnospherooidina pseudopauciloculata	
9 35-113/64D	N	Pc	NP9	P6		9(1)	H				Arenobulimina dorbignyi	
11 35-112/44C	N	Pc	NP9			13	H	r?			Aschheimocella subnodosiformis	
12 35-112/44B	N	Pc	NP9			9	Te	r			Aschheimocella sp. ind.	
13 35-112/38-4	N	Pc	NP9			5	H				Bathysiphon brosquei	
14 35-112/38-1	N	Pc	NP9			2	H				Bathysiphon genochi	
15 35-121/43F	N	Pc	NP8-NP9	?P4		30(5)	Te	r			Bathysiphon sp. 1	
16 35-121/43B	N	Pc	NP8-NP9	?P4		34(4)	Te		r		Bulbobaculites problematicus	
17 35-121/43A	N	Pc	NP8-NP9	?P4		13(5)	Te	r	r		Buzasina pacifica	
18 35-114/58No	N	Pc	NP8	P4(?P5)		31	?H	r	r	r	Eralidus sp.	
19 35-113/58K	N	Pc	NP8	P4(?P5)		28(3)	Te		r	r	Gerochammina conversa	
20 35-113/58J	N	Pc	NP8	P4(?P5)		33(2)	H		r	r	Gerochammina obesa	
21 35-113/58I	N	Pc	NP8	P4(?P5)		17	Td		r	r	Gerochammina stanišiawi	
22 35-113/58G	N	Pc	NP8	P4(?P5)		19(2)	Te			r	Gliomospira charoides	
23 35-113/58F	N	Pc	NP8	P4(?P5)		36(3)	H	r r	r?	r?	Gliomospira diffundens	
24 35-121/103A	N	Pc	NP6			26(1)	Te		r	r	Gliomospira glomerata	
25 35-114/62	Ss	Pc	NP9			7(1)	Te			r	Gliomospira gordialis	
26 35-114/80A	Ss	Pc	NP8			7	Te		r?	r	Gliomospira irregularis	
27 35-114/79E	Ss	Pc	NP8			18	H		r	r?	Gliomospira serpens	
28 35-114/79A	Ss	Pc	NP8			7	Te		r			
29 35-114/143	Ss	Pc	NP4-NP5	P2/P3		15(2)	Te		r	r?		
30 35-114/150	Ss	Pc	NP4-NP5			5	Te			r?		
31 120Ac/35	Ss	Pc	NP2-NP3	?P2		12(?)	Te+H					
32 120Ac/32A	Ss	Pc	NP2-NP3	?P2		25	H	r r				
33 120Ac/32o	Ss	Pc	NP2-NP3	?P2		30(3)	Te	r	r?	r		
34 35-114/135B	Ss	Pc	NP2			8(3)	Te		r?	r		
35 35-114/201C	Ss	Ma	CC26			11	H		r?	r?		
36 35-114/17B	Ss	Ma	CC26			13(3)	Te		r?	r		
37 120Ac/37-10	Ss	Ma	CC25			18(1)	H	r	r?	r?		
38 120Ac/37-9	Ss	Ma	CC25			6(1)	Te			f		
39 120Ac/37-4	Ss	Ma	CC25			17(1)	H	r r	r?	d		
40 119Db/3	Ks	Ca-Pc				37	?H	r	r?			
41 119Db/51	Ks	Ca-Ma			H.gig	39(?)	?H	r				
42 119Db/20	Ks	Ca-Ma			H.gig	28	?H	r r				
43 119Db/34	Ks	T-S			U.jan	37	?H	r				
44 119Db/20A	Ks	T-S			U.jan	27	?H			r?		
45 119Db/46	Ks	Ce			B.pro	23	?H	r r r		f		
46 PVN-10(190,3 m, 3	A	Ma	CC25			15(3)	Te+H		r?	r		
47 PVN-10(189,4 m, 6	A	Ma	CC25			17	H		r	r		
48 BM-1 (98,5 m)	A	Ca	CC20			24(1)	H	r				
49 BM-1 (97,8 m)	A	Ca	CC20			24(1)	H					
50 BM-1 (80,65 m)	A	S-Ma	CC20			19(3)	Te			f		
51 BM-1 (80,6 m)	A	Ca-Ma	CC20			21(3)	H					
52 BM-1 (70,48 m)	A					17	H		r?	r?		
53 BM-1 (57,45 m)	A					14	H	r?	r?	f		
54 BM-1 (29,0 m)	A	Ca/Ma	?CC23			29(2)	Te	r	r r	f r		
55 BM-1 (13,6 m)	A	Ma	CC24			22	H	r	r	d r		

## **Appendix 2 (continued).**

## **Appendix 2 (continued).**

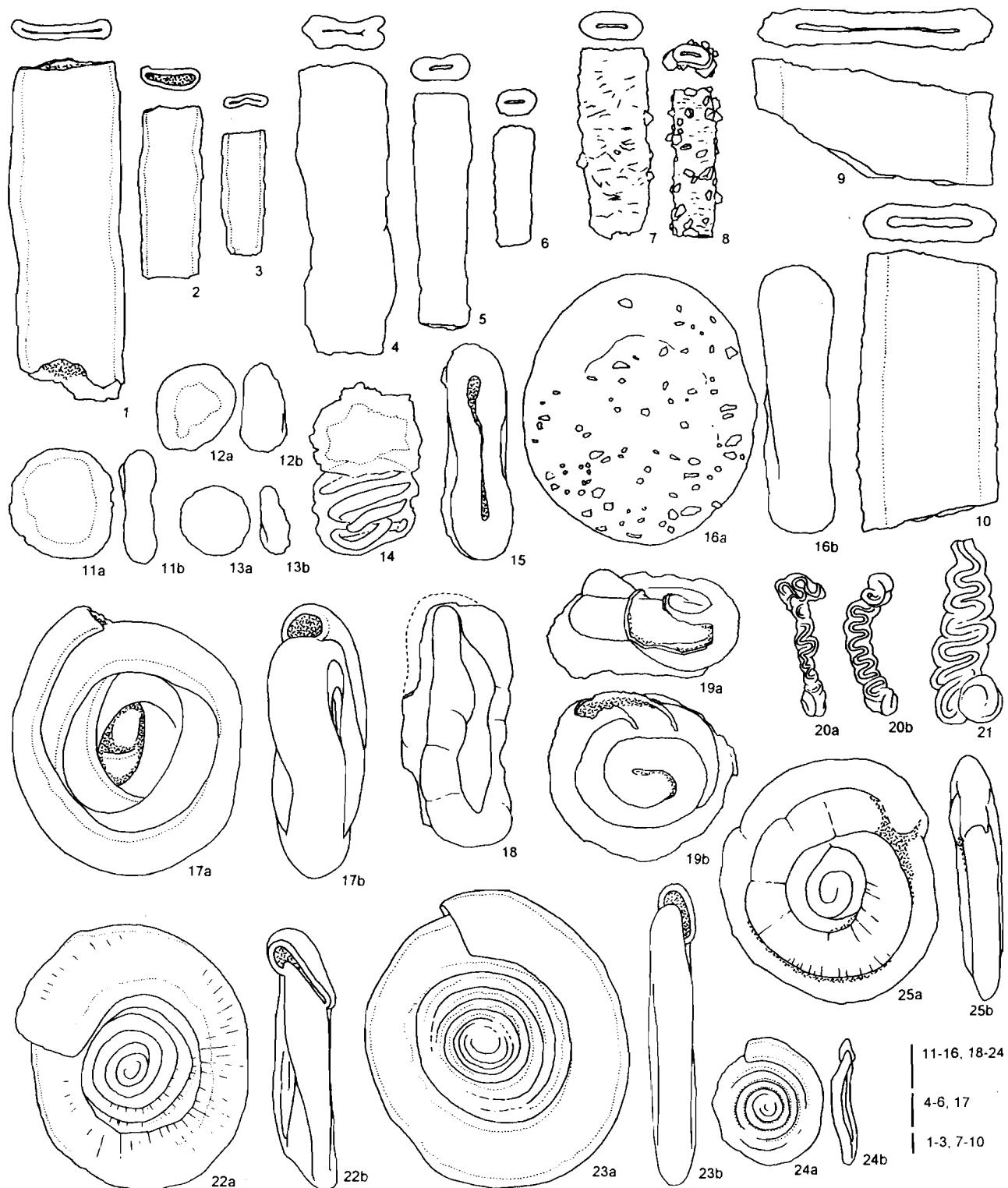
## Appendix 3.

sample	lithostratigraphy/ <sup>a</sup> 1		age	nanoplankton zones / <sup>a</sup> 2		planktonic foraminifera zones / <sup>a</sup> 3		agglutinated foraminifera zones / <sup>a</sup> 4		benthonic diversity / <sup>a</sup> 5		sedimentology / <sup>a</sup> 6	
1 97Ca/14	Sv	Ma	CC25B			3	Te			r?	r?		
2 35-121/39	Sv	Pc	NP9	P5		26(6)	Te			r?	r?		
3 35-121/8B	Sv	Pc	NP7			7(1)	Te			r?	r?		
4 35-121/31C	Sv	Pc1	NP3	P2		39(6)	H+Te	r	r?	r	r?		
5 35-121/31B	Sv	Pc1	NP3	P2		40(8)	Te	r r r	r	r r?	r		
6 108Dd/35A	Sv	Ma	CC26			5(1)	Te						
7 108Dc/14A	Sv	Ma	CC25b			29(1)	Te	f		r		r	r
8 97Ca/12A	Sv	Ma	CC26	Ca-Ma		2	Te						
9 97Ca/12	Sv	Ma	CC26	Ca-Ma		3(1)	Te						
10 108Dd/42	J	Pc1	NP2		R.fis	11	Te	r	r			r	
11 108Dd/42A	J	Pc1	NP2		R.fis	18(1)	?H	r?	r	r	r		
12 120Ac/29	J	Ca-Ma			H.gig	4	Te			d			
13 35-123/24	J	Ca-Ma			H.gig	7(1)	Te			r			
14 35-123/16A	J	Ca-Ma			H.gig	7	H	r					
15 35-123/1B	J	Ca-Ma			H.gig	5	Te					d?	
16 35-121/11	J	Ca-Ma			H.gig	7	?H		r?	d			
17 108Dd/32B	J	Ma				13	Td			d			
18 108Dd/51C	J	Ca-Ma			H.gig	28		r	r r	d		r	r?
19 108Dd/43A	J	Ca-Ma			H.gig	4	Te			r			
20 108Dd/43	J	Ca-Ma			H.gig	15	?H	r?	r	d			
21 97Cc/31	J	Ca-Ma		Ca-Ma		5	Te			d			
22 35-123/69	J					5	Te		r	d			
23 35-123/58A	J					8	?Te						
24 35-123/9B	J					5	?Te		r				
25 120Ba/63	J					5	?H			r?			
26 120Ba/66	J					5	?H			f		r	
27 97Cb/53	J					11		r		f			
28 97Ca/9	J					9	?H			d	r		r?
29 97Ca/8B	J					5	H+Te			d			
30 97Ca/8A	J					8	H			d			
31 97Ca/7B	J					4	?Te			d			
32 97Ca/7A	J					7	Te						
33 120Bc/13F	Kv	Ca/Ma	CC23			18	?H	r?	r	f	r?		r?
34 120Bc/13C	Kv	Ca/Ma	CC23			16	?H	r	r?	r?	r		
35 120Bc/13B2	Kv	Ca/Ma	CC23	H.gig	17	H	r			r		r	r
36 120Bc/13B1	Kv	Ca/Ma	CC23	H.gig	23(1)	Te	r	r	r		r?	r	
37 120Bc/13A	Kv	Ca/Ma	CC23			18	?H	r?	r?	d		r	r?
38 120Bc/14B	Kv	Ca	CC23			21	?H	r?	r	r		r	r
39 120Bc/14A	Kv	Ca	CC23			13	Te			r		r	
40 120Ca/31	Kv	Ca-Ma		H.gig	16	?P		r	r?	d		r	
41 35-123/68A	Kv	Ca-Ma		H.gig	27	?Te		r	r		r?	r	r?
42 120Bc/16B	Kv	Ca	CC20			27	Te	r r	r			r	
43 120Bc/16D	Kv	Ca	CC20			26	H	r r	r			r	r
44 35-123/46B	Kv	T-Ca	U.jan	28	H	r r				r r r r r			
45 97Cc/123B	Kv	Ce-T	B.pro	14	H	r				r r r r			
46 97Cc/80C	Kv	Ce		P.att	18	?H	r				r		r?
47 35-123/41B	Kv	Ce		P.att	13	Te				r?	r		r?

### **Appendix 3 (continued).**

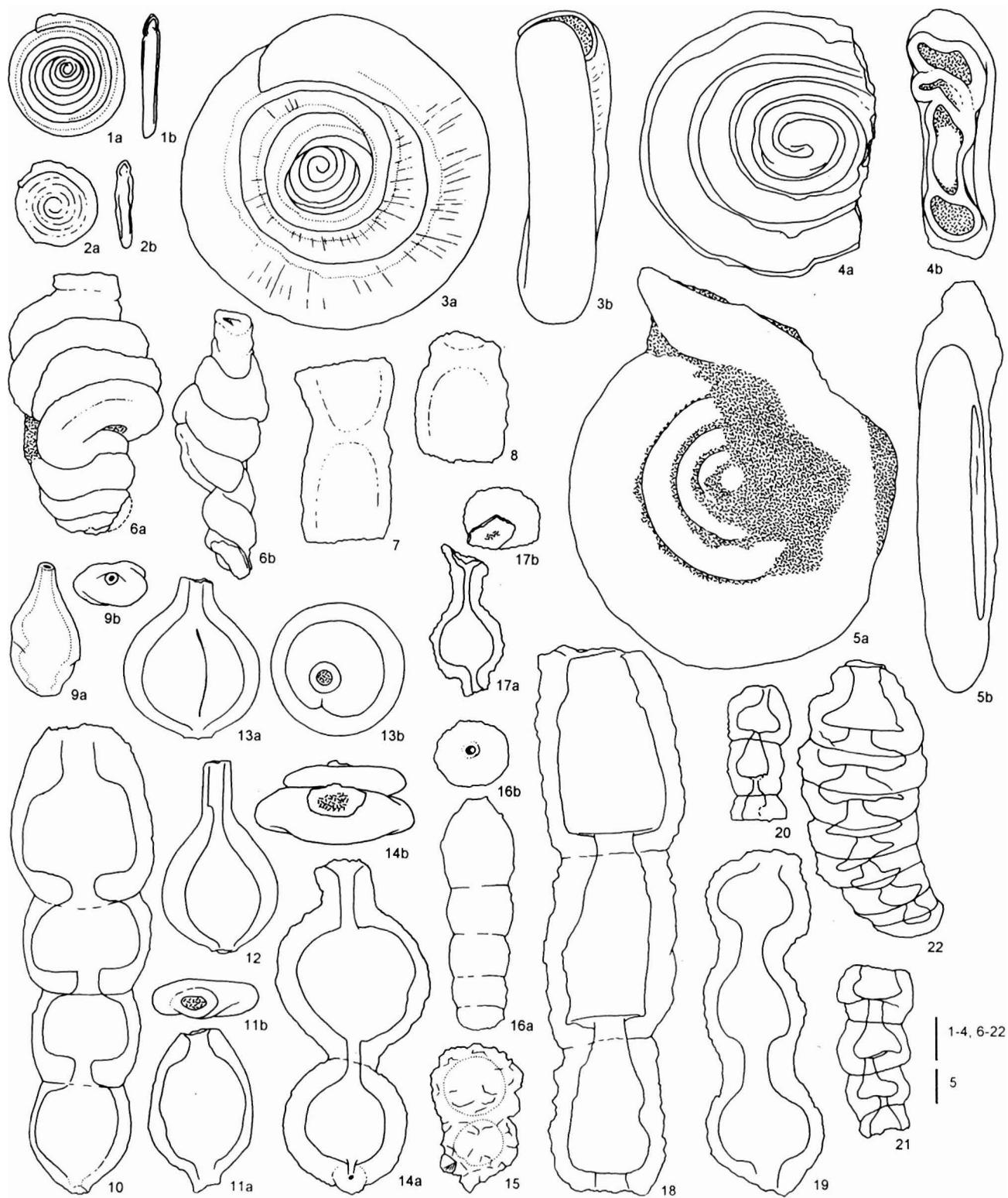
## Appendix 3 (continued).

	<i>Spiroplectammina costata</i>	<i>Spiroplectammina dentata</i>	<i>Spiroplectammina rosula</i>	<i>Spiroplectammina spectabilis</i>	<i>Spiroplectammina subhaeringensis</i>	<i>Subeophax splendens</i>	
1							<i>Thaimannammina gerochi</i>
2			r?			r	<i>Thaimannammina ex gr. gerochi</i>
3							<i>Thaimannammina meanderiorata</i>
4	r	r r?				r r f	<i>Thaimannammina neocomiensis</i>
5	r	r r?			r	r?	<i>Thaimannammina? sp. 1</i>
6							
7	r	r r				r	
8							
9							
10	r						
11	r	r				r?	
12							
13							
14							
15		r				r?	
16							
17	r?					r r	
18		r r r r			r	r r r	
19							
20		r			r?	r	
21							
22			r				
23				r		d? r	
24							
25					r		
26							
27						r?	
28		r			r		
29							
30			r?			r?	
31							
32							
33				r?	r r	r?	
34							
35			r		r		r
36	r		r?		r r?	r	
37					r?	r	
38	r?		r r?		r?	r	
39					r r	r?	r?
40					r?	r	
41		r?	r r		r r	r?	r
42			r r?	r?	r	r r	r
43			r r r r		r		
44			r r r r?		r r		
45							
46					r		
47			r?		r?		

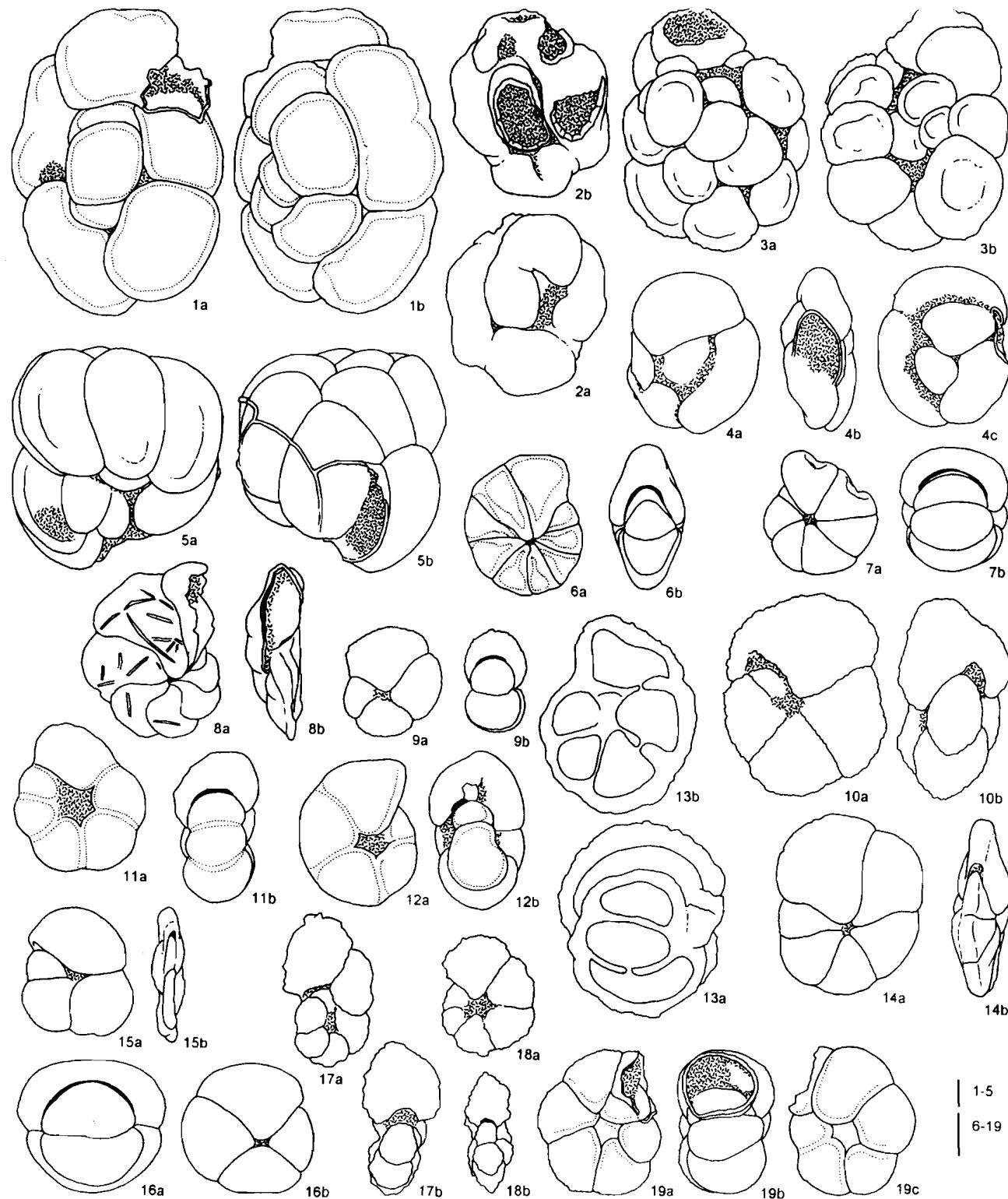


**Plate 1.** 1 - 3. *Bathysiphon gerochi* Myatlyuk, BM-1 (29,0 m). 4 - 6. *Bathysiphon brosgei* Tappan, 35-112/38-1. 7, 8. *Bathysiphon* sp.1, BM-1 (97,8 m). 9, 10. *Nothia latissima* (Grzybowski), BM-1 (13,6 m). 11 - 13. *Psammosphaera* sp. 1, 35-113/58J. 14. *Psammosphaera fusca* Schultze attached on the test of *Glomospira charoides* (Jones & Parker), 35-113/78-7. 15, 16. *Psammosphaera irregularis* (Grzybowski), 35-113/58J. 17. *Glomospira diffundens* Cushman & Renz, HLM-1 (59,5 m). 18. *Glomospira serpens* (Grzybowski), R2/17. 19. *Glomospira* sp. 1, R2/17. 20, 21. *Glomospira straniki* n.sp.: 20 - holotype (CGU-2-36A1), 35-114/74I, 21 - paratype (CGU-2-36B1), 35-114/74M. 22. *Ammodiscus bornemanni* (Reuss), 35-113/58No. 23. *Ammodiscus tenuissimus* Grzybowski, BM-1 (13,6 m). 24. *Ammodiscus* cf. *planus* Loeblich, 35-114/74I. 25. *Ammodiscus?* sp. 3, 120Bc/16D. Length of bars: 0,1 mm.

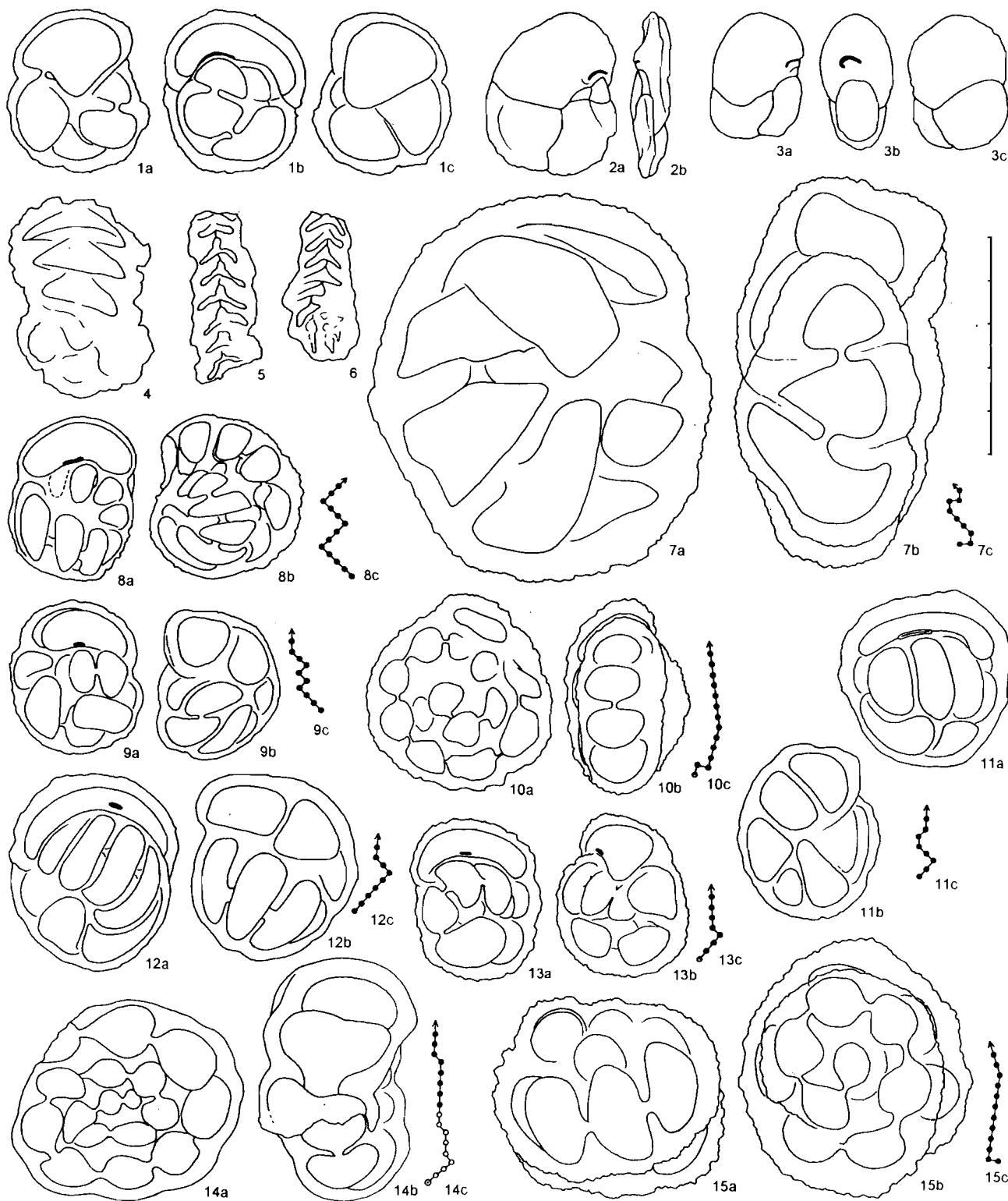
Cretaceous to Paleogene agglutinated foraminifera from the Bílé Karpaty unit



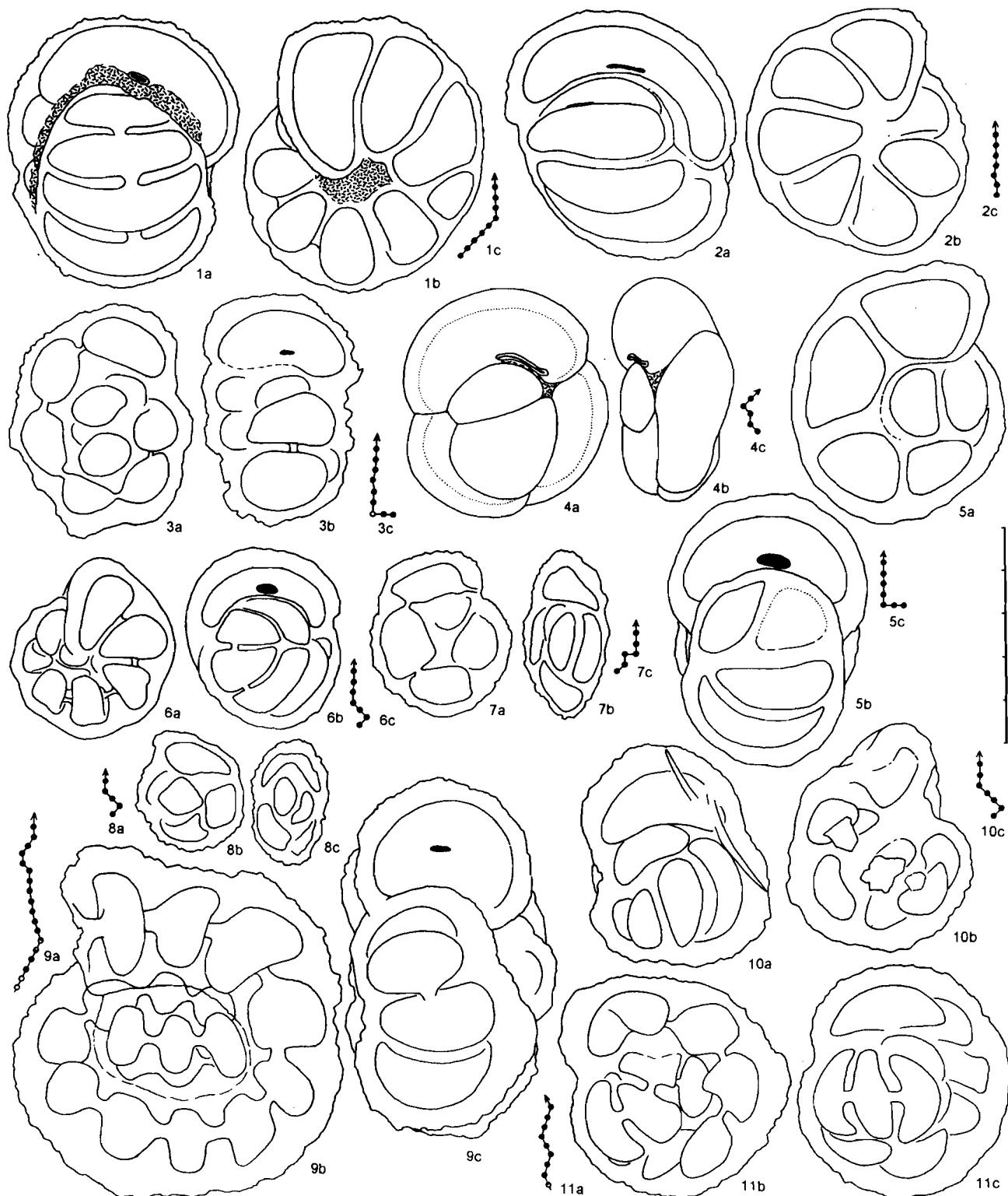
**Plate 2.** 1. *Ammodiscus cretaceus* (Reuss), 120Bc/16D. 2. *Ammodiscus* cf. *planus* Loeblich, 35-114/74I. 3. *Ammodiscus* sp. 1, HAG-1(41- 43 m). 4, 5. *Ammodiscus* sp. 2, 9R/2. 6. *Turritellella reversa* n.sp., holotype (CGU-2-169A), Hluk H-6 (1433,4 m). 7, 8. *Aschemocella subnodosiformis* (Grzybowski), 120Ac/37-9. 9. *Hormosina ovuloides* (Grzybowski), 119Bd/3. 10, 11. *Hormosina velascoensis* (Cushman), 119Bd/3. 12, 13. *Hormosina crassa* Geroch, H-6 (1459,5 m). 14, 17. *Subreophax guttifer* (Brady): 14 - BM-1 (97,8 m), 17 - 119Db/51. 15. *Reophax duplex* Grzybowski, 35-114/74I. 16. *Reophax* sp. 2, HLM-1 (10,3 m). 18. *Reophax elongatus* Grzybowski, 35-113/78-9. 19. *Subreophax* cf. *splendidus* (Grzybowski), 35-113/78-9. 20 - 22. *Reophax nodulosus* Brady, 35-113/78-9. Length of bars: 0,1 mm.



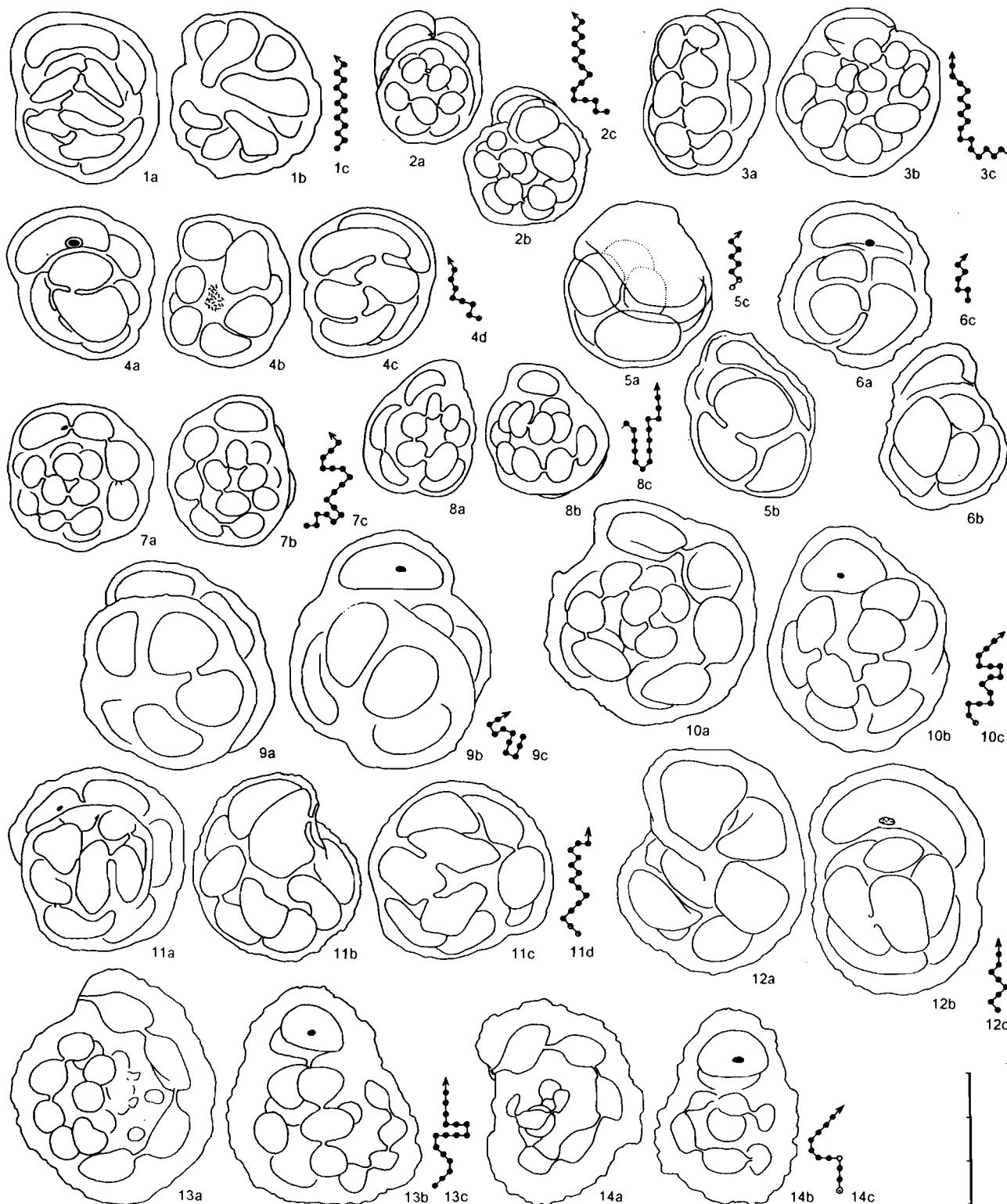
**Plate 3.** 1. *Paratrochamminoides deformis* (Grzybowski), BM-1 (29,0 m). 2. *Paratrochamminoides draco* (Grzybowski), 120Ba/63. 3. *Paratrochamminoides mitratus* (Grzybowski), BM-1 (97,8 m). 4. *Paratrochamminoides* sp. 1, HLM-1 (46,5 m). 5. *Paratrochamminoides uviformis* (Grzybowski), 35-121/103A. 6. *Haplophragmoides herbichi* Neagu, R2/17. 7. *Haplophragmoides* aff. *bulloides* (Beissel), HAG-1 (41 m). 8. *Haplophragmoides falcatosuturalis* Neagu, HAG-1 (63,5 m). 9. *Haplophragmoides decussatus* Krasheninnikov, HAG-1 (41 m). 10. *Haplophragmoides horridus* (Grzybowski), 120Bc/13F. 11. *Haplophragmoides* sp. 1, R2/9. 12. *Haplophragmoides* cf. *menitens* Krasheninnikov, R2/9. 13. *Haplophragmoides?* sp., cf. *H. suborbicularis* (Grzybowski), 97Cc/80C. 14. *Haplophragmoides* sp. 3, 120Ac/32A. 15. *Haplophragmoides* sp. 6, H-6 (1433,3 m). 16. *Haplophragmoides pseudokirki* Krasheninnikov, R2/17. 17, 18. *Haplophragmoides* sp. 4: 17 - 35-114/64D, 18 - 35-114/64F. 19. *Recurvoidella insueta* (Krasheninnikov), R2/17. Length of bars: 0,1 mm.



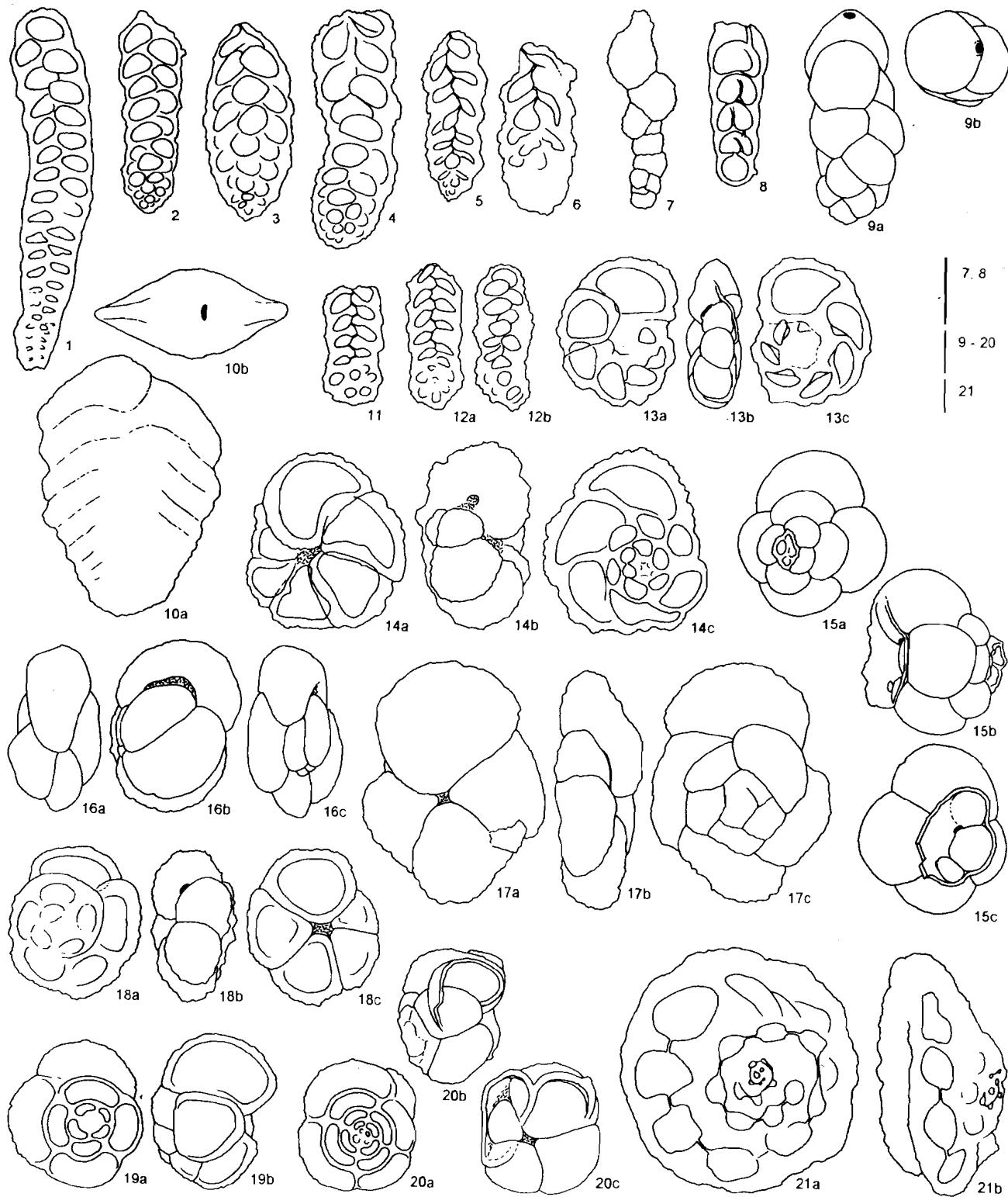
**Plate 4.** 1. *Recurvoidella lamella* (Grzybowski), HAG-1 (121,1 m). 2, 3. *Buzasina pacifica* (Krasheninnikov): 2 - 120Bc/16B, 3 - 35-114/74I. 4. *Ammobaculites deflexus* (Grzybowski), 35-121/31B. 5, 6. *Eratidus* sp., 35-114/74M. 7. *Recurvoides immane* (Grzybowski), 35-113/58No. 8. *Recurvoides imperfectus* (Hanzlíková), H-6 (1459,5 m). 9. *Recurvoides cf. imperfectus* (Hanzlíková), HAG-1 (63,5 m). 10. *Recurvoides nucleolus* (Grzybowski), 108Dd/42. 11, 12. *Recurvoides recurvoidiformis* Neagu & Tocorjescu: 11 - HLM-1 (122,8 m), 12 - HLM-1 (46,5 m). 13. *Recurvoides variabilis* Hanzlíková, H-6 (1459,5m). 14. *Recurvoides* sp. 1, HAG-1 (63,5 m). 15. *Recurvoides walteri* (Grzybowski), 35 - 121/39. Length of bar: 0,5 mm.



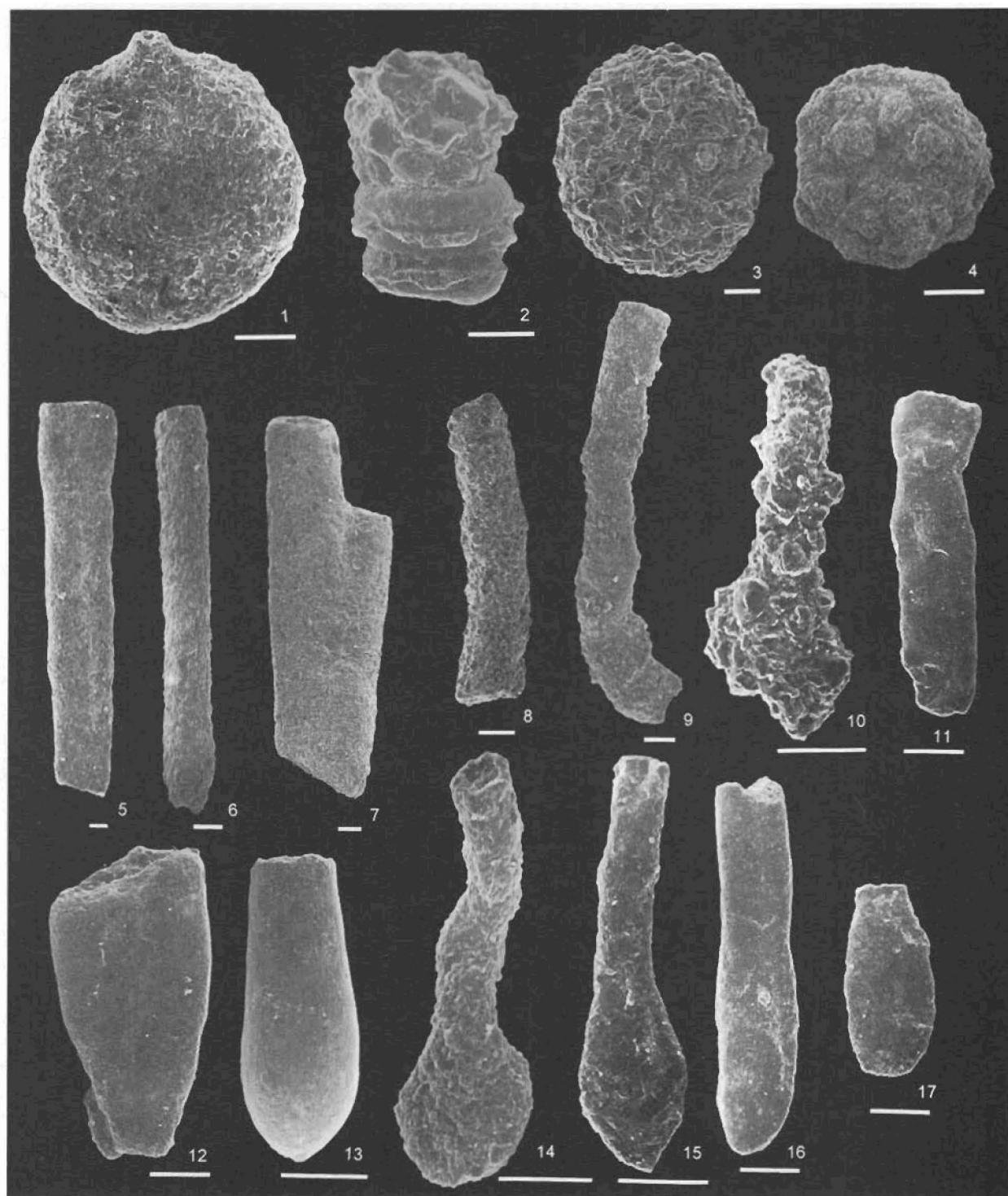
**Plate 5.** 1, 2. *Recurvoides* sp. 2: 1 - R2/9, 2 - HLM-1 (59,5 m). 3. *Recurvoides* sp. 3, 97Cc/80C, 4. *Recurvoides* cf. *pentacameratus* Krasheninnikov, HLM-1 (59,5 m). 5. *Recurvoides anormis* Myatlyuk, HLM-1 (97,5 m). 6. *Recurvoides pseudosymmetricus* Krasheninnikov, 35-114/58J. 7, 8. *Recurvoides* sp. 4: 7 - 35-113/64K, 8 - 35-114/64D. 9. *Recurvoides geruchi* Pflaumann, 35-113/58No. 10. *Recurvoides* aff. *primus* Myatlyuk, 35-113/58F. 11. *Recurvoides* sp. 5, 35-113/58No. Length of bar: 0,5 mm.



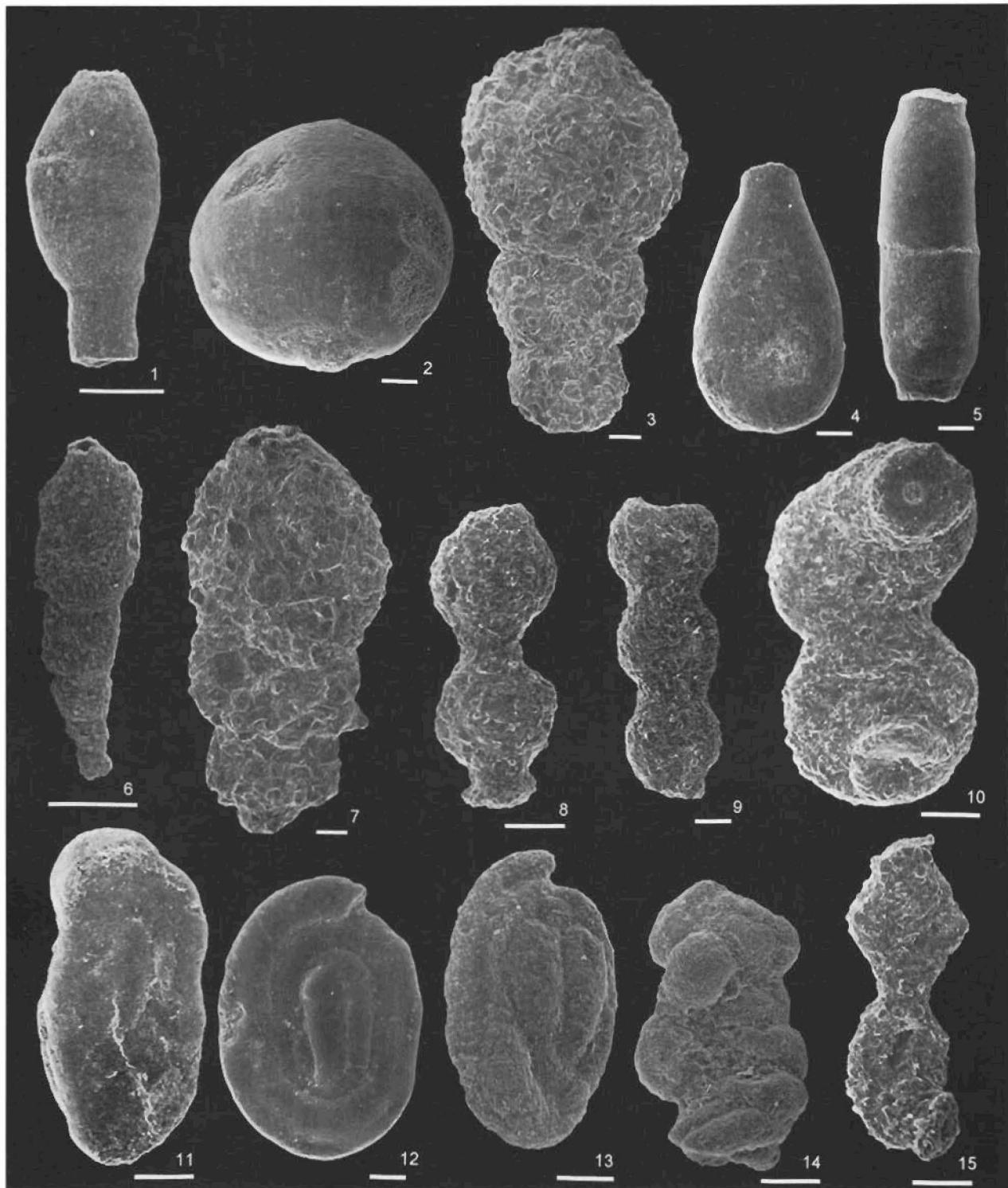
**Plate 6.** 1. *Plectorecurvooides alternans* Noth, 97Cc/80C. 2, 3. *Plectorecurvooides irregularis* Geroch: 2 - H-6 (1459,5 m), 3 - HAG-1 (63,5 m). 4. *Plectorecurvooides parvus* Krasheninnikov, 120Bc/16B. 5. *Plectorecurvooides* sp. 1, HAG-1 (63,5 m). 6. *Thalmannammina?* sp. 1, HAG-1 (63,5 m). 7. *Thalmannammina neocomiensis* Geroch, HLM-1 (11,4 m). 8. *Thalmannammina meandertornata* Neagu & Tocorjescu, HAG-1(63,5 m). 9. *Thalmannammina gerochi* (Hanzlíková), HLM-1 (46,5 m). 10, 13. *Thalmannammina ex gr. gerochi* (Hanzlíková): 10 - BM-1 (29,0 m), 13 - 35-114/74I. 11. *Recurvooides?* sp. 6, 119Db/34. 12. *Recurvooides cf. pseudosymmetricus* Krasheninnikov, 35-113/58K. 14. *Recurvooides?* sp. 7, 35-114/74M. Length of bar: 0,3 mm.



**Plate 7.** 1. *Karrerulina?* sp. 1, HLM-1 (16,3 m). 2. *Gerochammina stanislawi* Neagu, R19/1. 3. *Gerochammina obesa* Neagu, R2/17. 4. *Gerochammina conversa* (Grzybowski), HLM-1 (66,5m). 5, 6. *Karrerulina horrida* Myatlyuk, 35-114/74M. 7. "Bigenerina" *alternans* Vašiček, 12R/2. 8. *Pseudoreophax cisovnicensis* Geroch, 8R/2. 9. *Uvigerinammina praejankoi* Neagu, HAG-1 (41 m). 10. *Spiroplectammina dentata* (Alth), HLM-1 (83,5 m). 11, 12. *Spiroplectammina* sp. 1, 35-112/27. 13. *Trochammina cf. abrupta* Geroch, HAG-1 (87,3 m). 14. *Trochammina* sp. 2., HAG-1 (87,3 m). 15. *Trochammina* sp. 7, HLM-1 (10,6 m). 16. *Trochammina* sp. 5., 120Bc/13B1. 17. *Trochammina* sp. 6, H-6 (1433,4 m). 18. *Trochammina* sp. 8, H-6 (1476,3 m). 19, 20. *Trochammina* sp. 9, 119Db/20A. 21. "Trochammina" sp. 4, 35-121/31B. Length of bars: 0,1 mm.



**Plate 8.** 1. *Saccammina placenta* (Grzybowski), 35-121/31B. 2. *Psammospaera fusca* Schultze attached on *Glomospira charoides* (Jones & Parker), 35-113/78-7. 3. *Psammospaera scruposa* (Berthelin), 35-114/82. 4. *Thurammina papillata* Brady, HLM-1 (16,3 m). 5. *Bathysiphon gerochi* Myatlyuk, BM-1 (13,7 m). 6. *Rhabdammina cylindrica* Glaessner, BM-1 (29,0 m). 7. *Nothia* sp., 120Bc/14A. 8 - 10. "Rhizammina" sp.: 8 - HLM-1 (54,5 m), 9 - 8R/2, 10 - 35-114/74M. 11, 16, 17. *Hyperammina nuda* Subbotina: 11 and 17 - 35-113/58F, 16 - BM-1 (80,6 m). 12. *Hipocreppina depressa* Vašiček, HAG-1 (88,5 m). 13. *Hyperammina elongata* Brady, HLM-1 (32,3 m). 14, 15. *Hyperammina gaullina* Ten Dam, 35-114/74M. Length of bars: 0,1 mm.



**Plate 9.** 1. *Hormosina cf. crassa* Geroch, 35-112/16C. 2. *Hormosina gigantea* Geroch, HLM-1 (83,5 m). 3. *Hormosina trinitatensis* Cushman & Renz, BM-1 (97,8 m). 4. *Kalamopsis? cf. grzybowskii* (Dylążanka), HLM-1 (36,6 m). 5. *Kalamopsis grzybowskii* (Dylążanka), HLM-1 (36,6 m). 6. *Reophax parvulus* Huss, 12R/zel. 7. *Reophax pilulifer* Brady, 35-114/102. 8. *Subreophax scalaria* (Grzybowski), 35-113/78-7. 9. *Subreophax cf. scalaria* (Grzybowski), 35-113/78-9. 10, 15. *Subreophax splendidus* (Grzybowski): 10 - 35-113/58F, 15 - BM-1 (80,6 m). 11. *Glomospira serpens* (Grzybowski), 35-113/58H. 12. *Glomospirella grzybowskii* (Jurkiewicz), 35-113/58D. 13. *Glomospira cf. serpens* (Grzybowski), HLM-1 (16,3 m). 14. *Glomospira glomerata* (Grzybowski), 35-113/78-7. Length of bars: 0,1 mm.

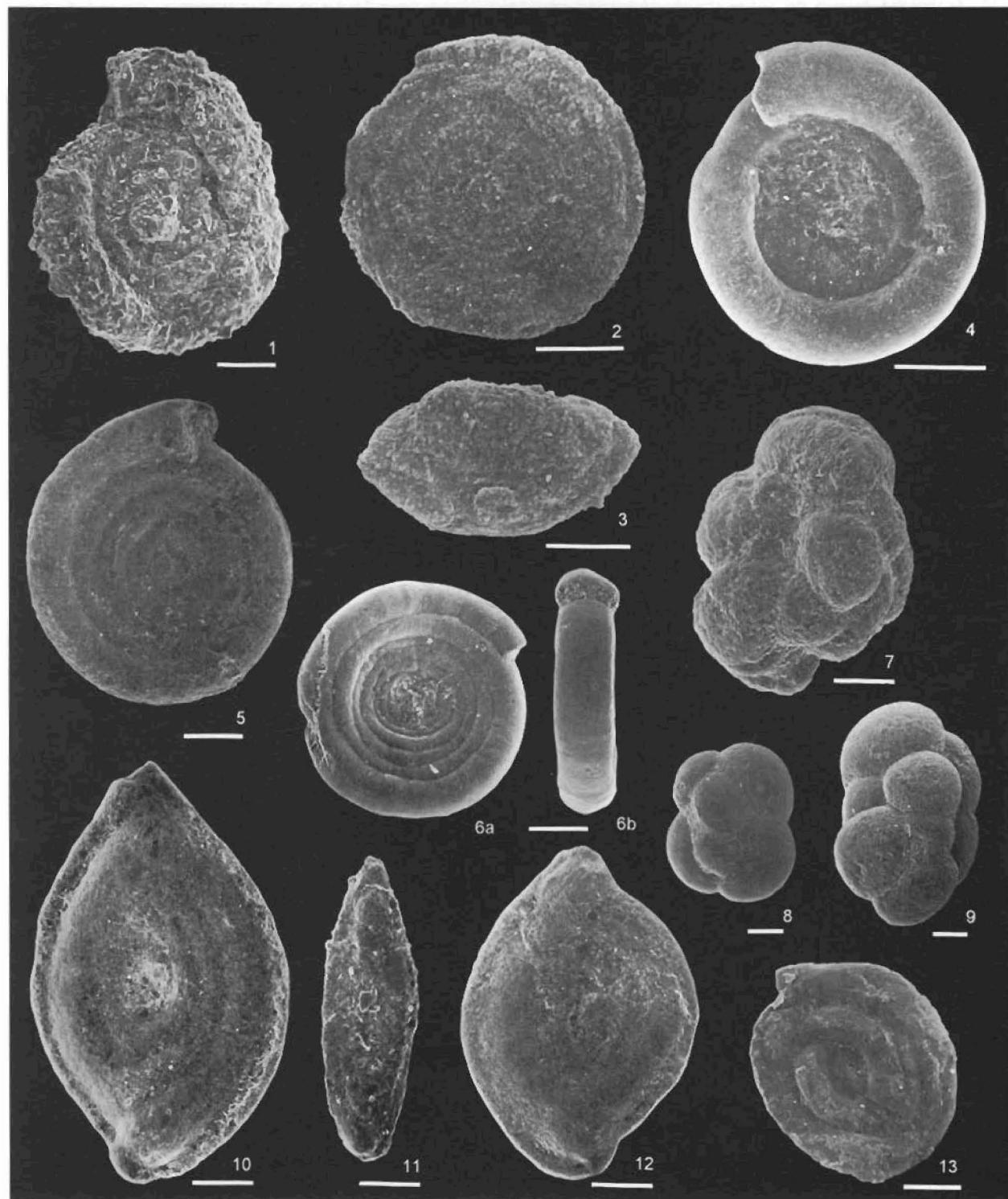
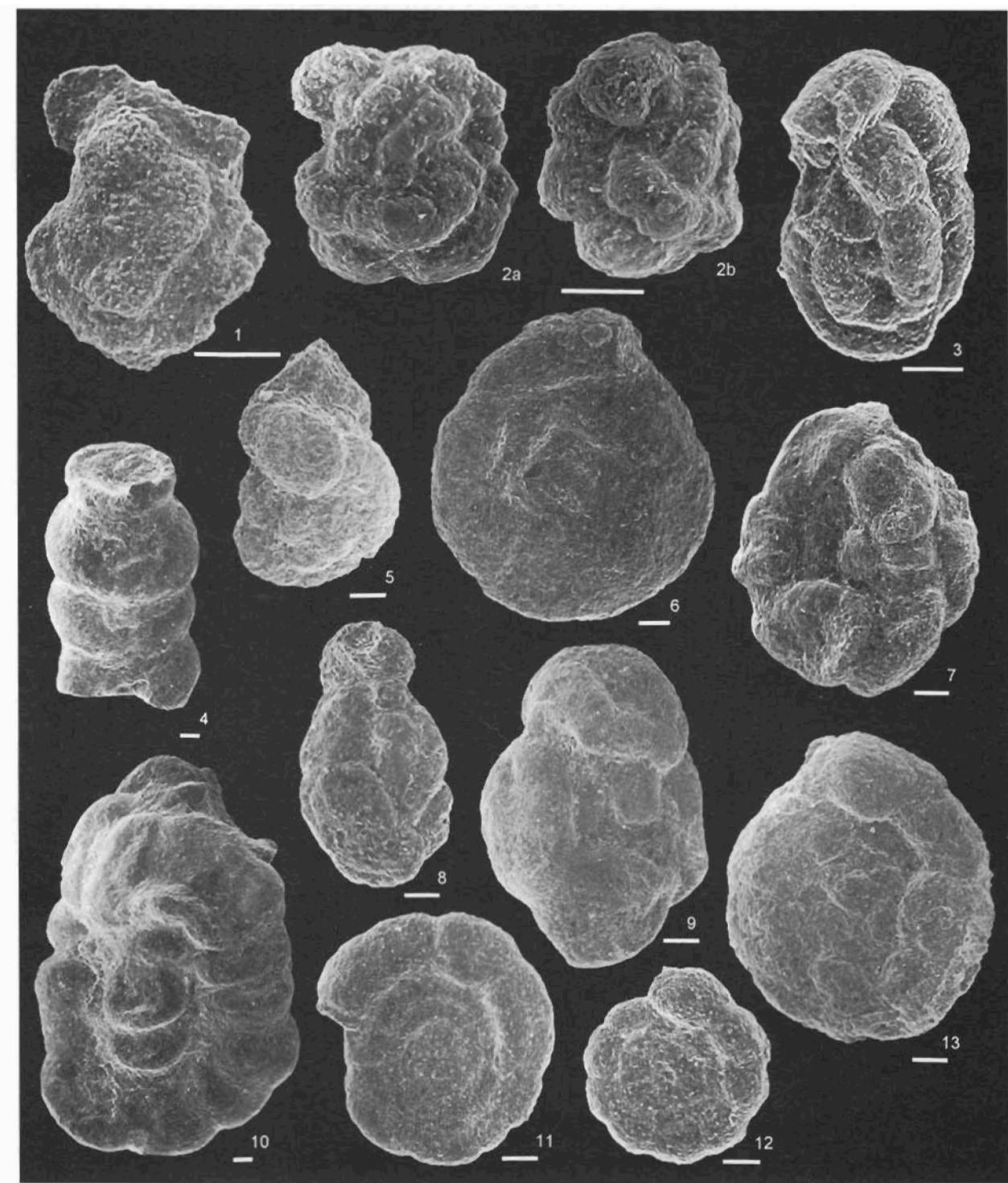
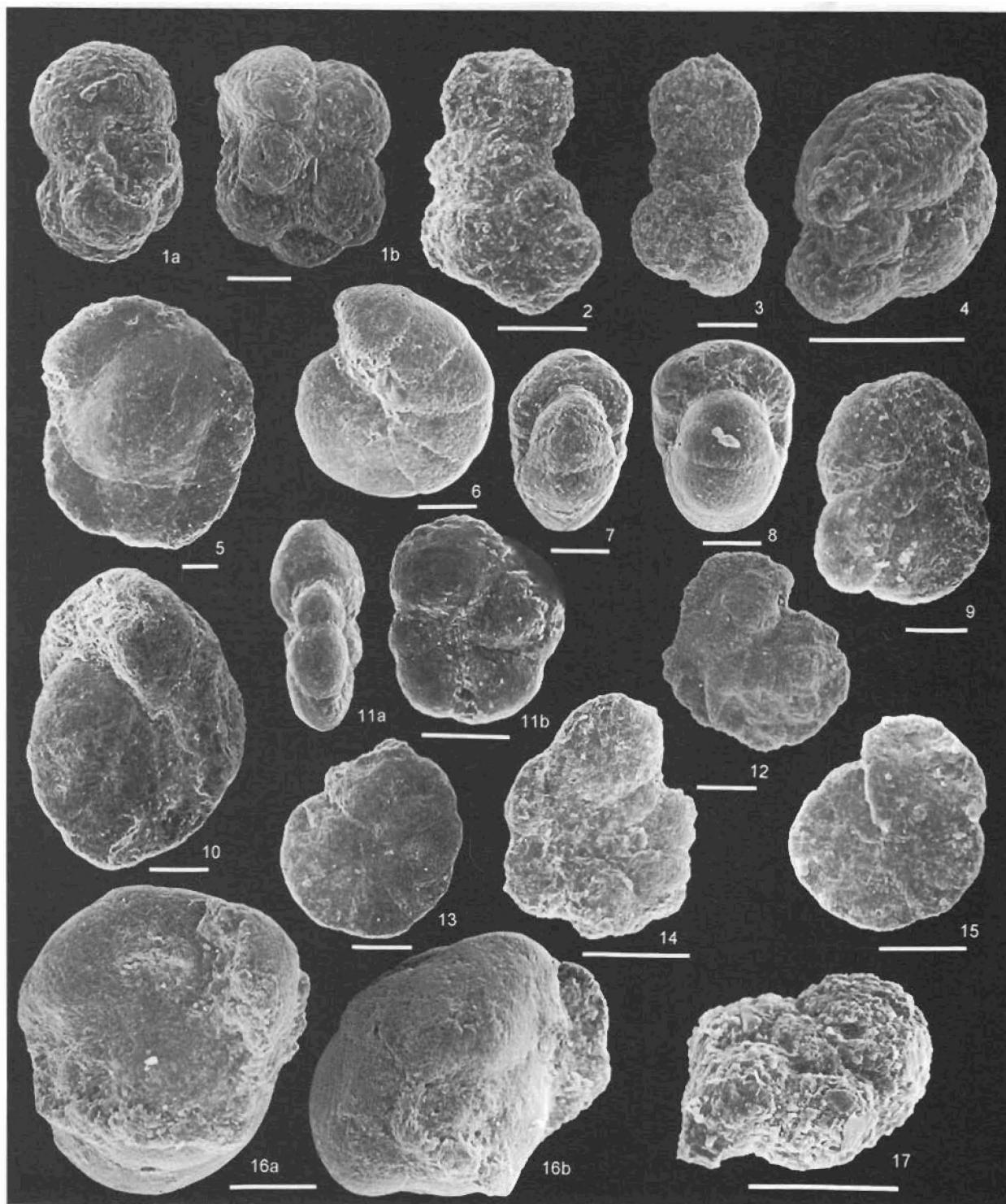


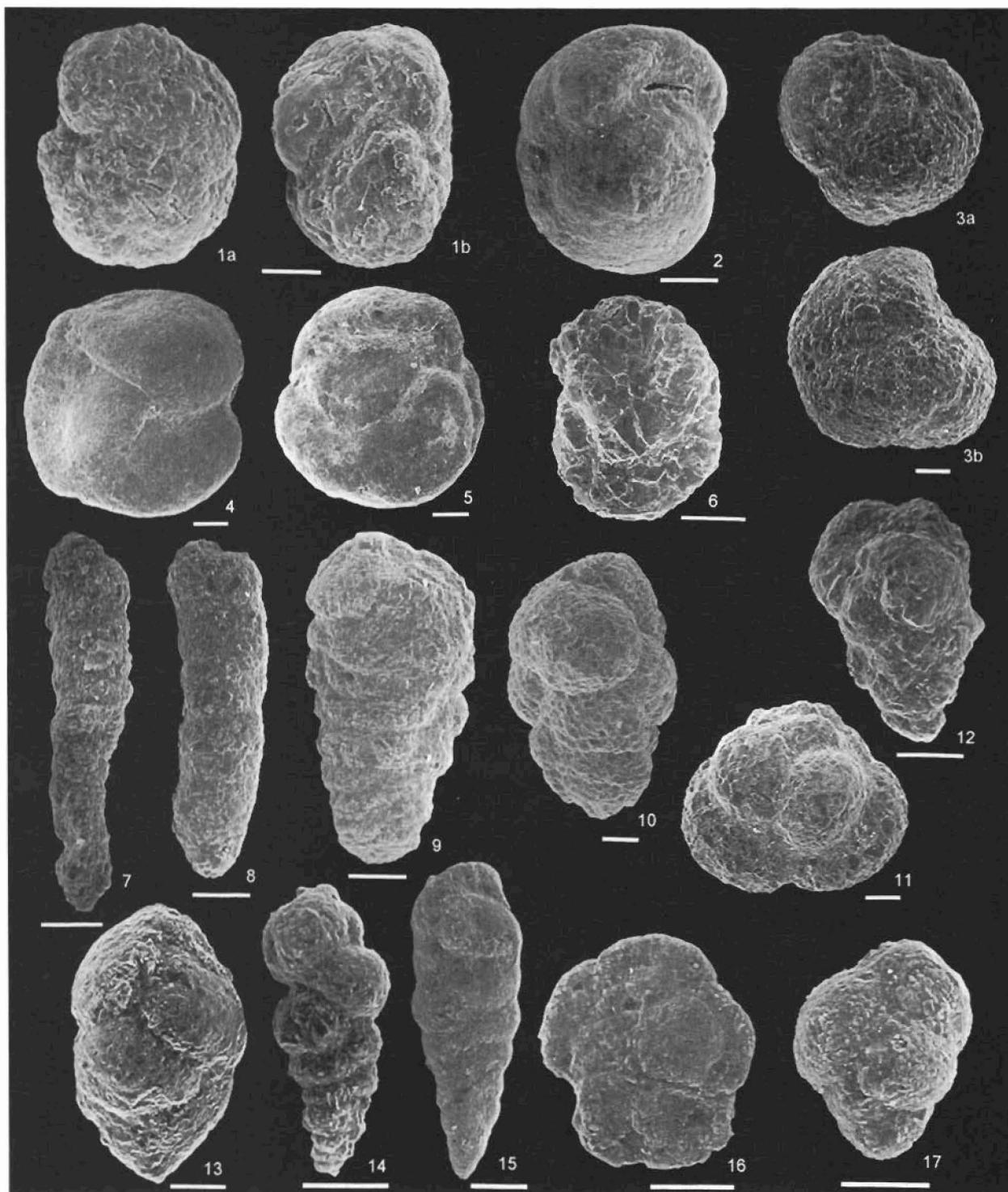
Plate 10. 1. *Ammodiscus infimus* Franke, HLM-1 (16,3 m). 2, 3. *Arenoturrispirillina aptica* Tairov, 12R/zel. 4. *Ammodiscus* sp. 1, HLM-1 (26,5 m). 5. *Ammodiscus cretaceus* (Reuss), 120Bc/13B1. 6. *Ammodiscus glabratus* Cushman & Jarvis, HLM-1 (34,4 m). 7 - 9. *Paratrochamminoides irregularis* (White): 7 - HLM-1 (105,3 m), 8 - HLM-1 (54,5 m), 9 - HLM-1 (59,5 m). 10. *Rzehakina fissistomata* (Grzybowski), 35-113/58Do. 11. *Rzehakina minima* Cushman & Renz, 35-113/58V. 12. *Rzehakina epigona* (Rzehak), 35-113/58D. 13. *Glomospira gordialis* (Jones & Parker), HLM-1 (16,3 m). Length of bars: 0,1 mm.



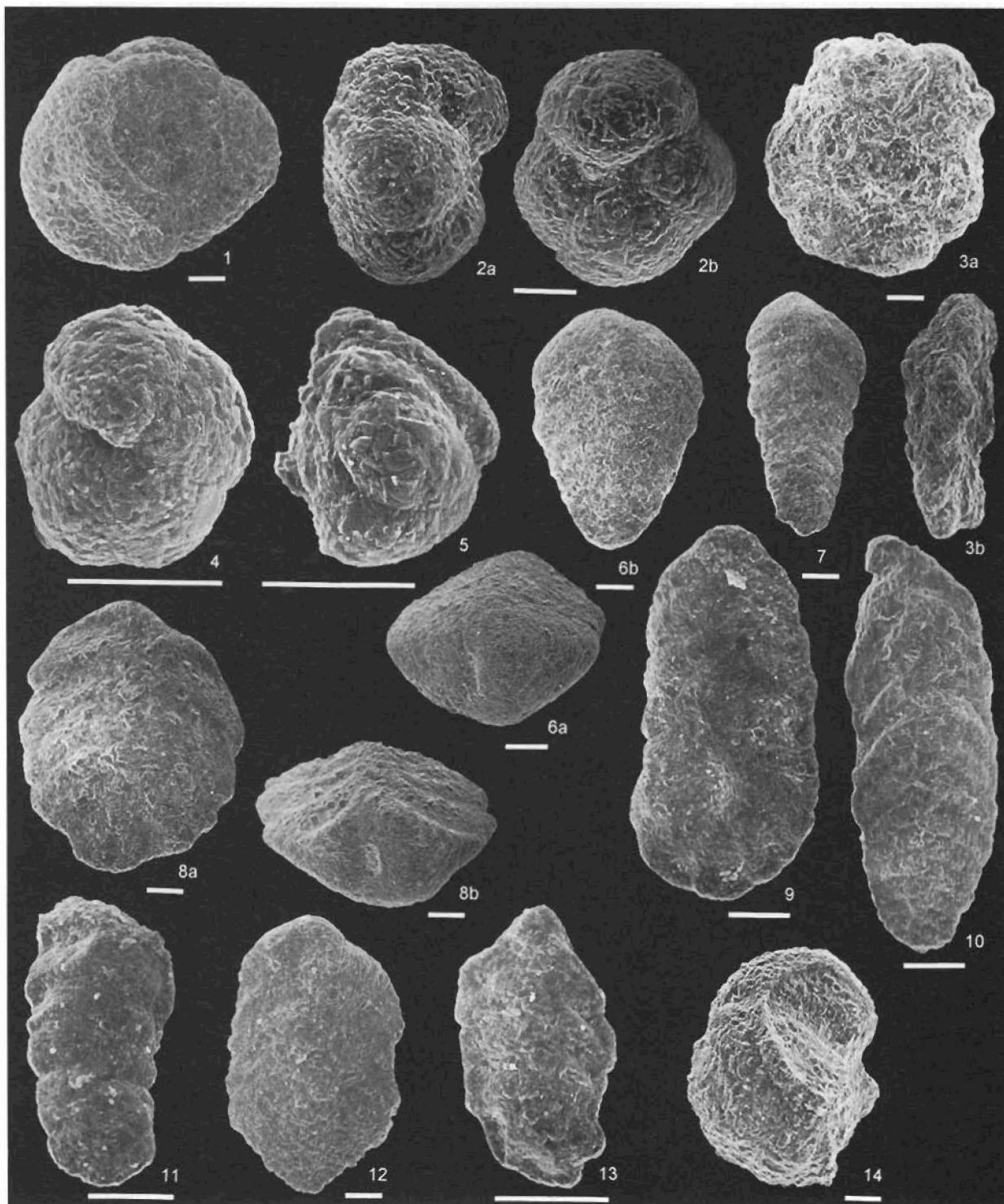
**Plate 11.** 1 - 2. *Paratrochamminoides* cf. *acervulatus* (Grzybowski); 1 - 35-112/16C, 2 - R2/17. 3. *Paratrochamminoides olszewskii* (Grzybowski), R2/17. 4, 10. *Paratrochamminoides heteromorphus* (Grzybowski), 97Cc/84A. 5. *Trochamminoides folius* (Grzybowski), 120Bc/16B. 6. *Trochamminoides septatus* (Grzybowski), R2/11. 7. *Paratrochamminoides contortus* (Grzybowski), R2/11. 8. *Trochamminoides vermetiformis* (Grzybowski), 35-121/31A. 9. *Trochamminoides variolarius* (Grzybowski), 35-121/31C. 11. *Trochamminoides dubius* (Grzybowski), 35-121/43B. 12. *Trochamminoides grzybowskii* Kaminski & Geroch, R2/11. 13. *Trochamminoides proteus* (Karrer), 35-113/58F. Length of bars: 0,1 mm.



**Plate 12.** 1. *Recurvoidella insueta* (Krasheninnikov), R2/17. 2. *Bulbocyclites problematicus* (Neagu), 97Cc/123B. 3. *Bulbocyclites gracile* (Bartenstein & Brandt), 12R/zel. 4. *Praecystammina globigerinaeformis* Krasheninnikov, HLM-1 (30,7 m). 5. *Sphaerammina gerrochi* (Hanzlíková), 35-114/134. 6 - 8. *Haplophragmoides herbichi* Neagu, R2/17. 9. *Ammosphaeroidina pseudopauciloculata* (Myatlyuk), 25-121/31A. 10. *Haplophragmoides* sp. 5, 35-113/58K. 11. *Haplophragmoides* cf. *orrectus* Maslakova, R2/17. 12. *Haplophragmoides falcatosuturalis* Neagu, HLM-1 (16,3m). 13. *Haplophragmoides walteri* (Grzybowski), 35-112/18. 14. *Haplophragmoides perexplicatus* Krasheninnikov, 120Bc/13B2. 15. *Haplophragmoides* sp. 2, BM-1 (70,48 m). 16. *Buzasina inflata* (Krasheninnikov), HAG-1 (55,5 m). 17. (?) *Bulbocyclites problematicus* (Neagu), juv., HLM-1 (10,6 m). Length of bars: 0,1 mm.



**Plate 13.** 1. *Plectorecurvoides alternans* Noth, HLM-1 (16,3 m). 2. *Recurvoides imperfectus* (Hanzlíková), 10R/2. 3. *Thalmannammina gerochi* (Hanzlíková), R2/11. 4, 5. *Recurvoides cf. pentacameratus* Krasheninnikov: 4 - HLM-1 (131,15 m), 5 - HLM-1 (59,5 m). 6. *Recurvoides* sp. 4, 35-113/78-9. 7. *Karrerulina?* sp. 1, HLM-1 (16,3 m). 8. *Gerochammina stanislawi* Neagu, HLM-1 (32,3 m). 9. *Verneuilinoides neocomiensis* Myatlyuk, HAG-1 (90,2 m). 10. *Verneuilinoides polystrophus* (Reuss), 35-114/134. 11. *Trochammina umiatensis* Tappan, HLM-1 (59,5 m). 12. *Verneuilinella* sp., 97Cc/80C. 13. *Uvigerinammina jankoi* Majzon, R2/17. 14. *Pseudobolivina munda* Krasheninnikov, HLM-1 (32,3 m). 15. *Pseudobolivina variabilis* Vašiček, HAG-1 (88,5 m). 16. "Trochammina" *vocontiana* Moullade, 35-112/16C. 17. *Uvigerinammina praejankoi* Majzon, juv., HLM-1 (10,6 m). Length of bars: 0,1 mm.



**Plate 14.** 1. *Trochammina* sp. 3, 35-113/58F. 2, 14. *Trochammina* sp. 9: 2 - R2/17, 14 - R2/11. 3. "Trochammina" sp. 4, 35-121/31B. 4, 5. *Trochammina gyroidinaeformis* Krasheninnikov, HLM-1 (31,8 m). 6, 7. *Spiroplectammina laevis* (Roemer): 6 - HLM-1 (36,6 m), 7 - HLM-1 (40,7 m). 8, 12. *Spiroplectammina subhaeringensis* (Grzybowski): 8 - HLM-1 (34,4 m), 12 - BM-1 (80,65 m). 9, 10, 13. *Spiroplectammina spectabilis* (Grzybowski): 9 - 35-113/58Co, 10, 13 - 35-121/31A. 11. *Spiroplectammina rosula* (Ehrenberg), 35-112/32. Length of bars: 0,1 mm.

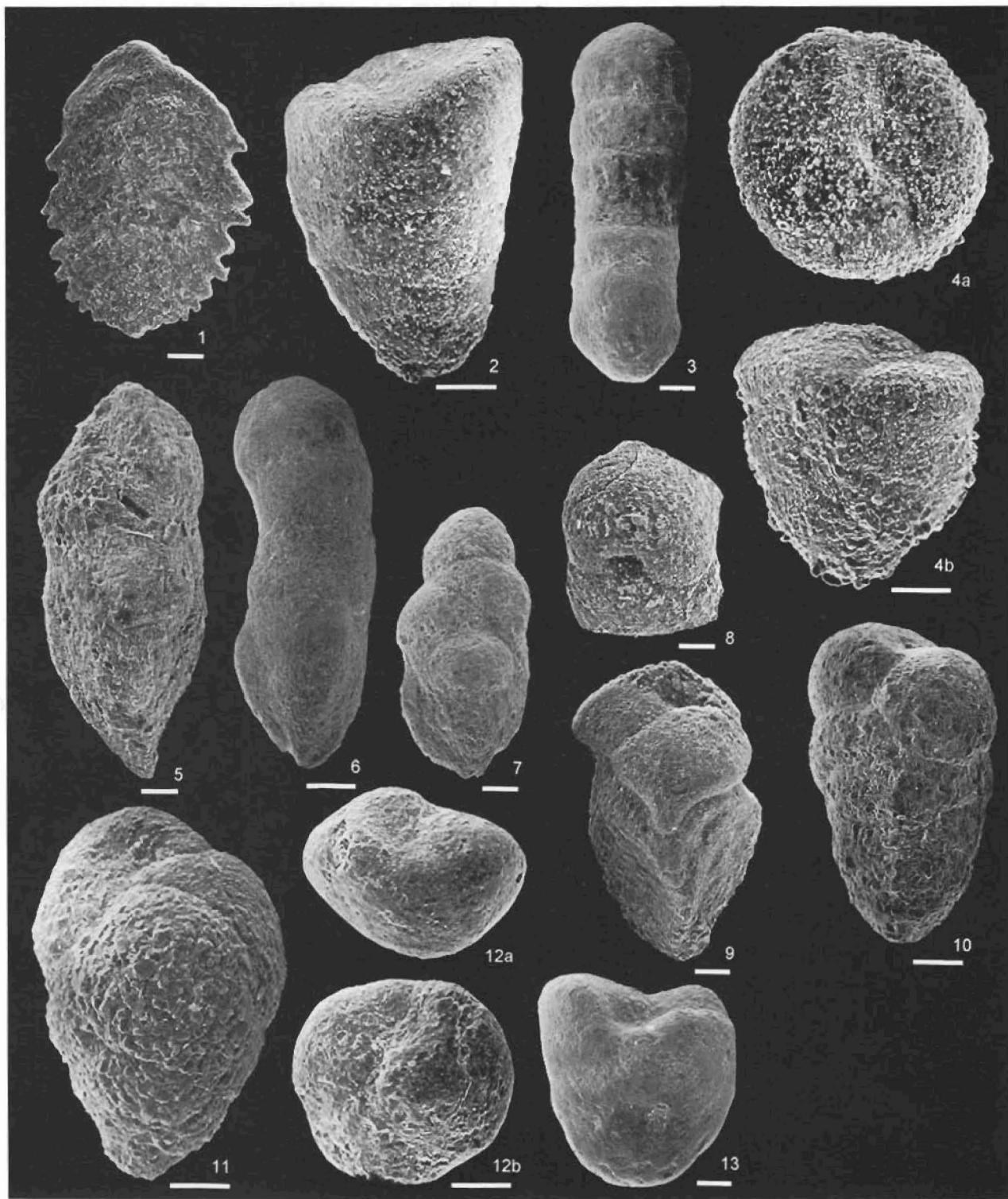


Plate 15. 1. *Spiroplectammina costata* Huss, R2/24. 2. *Marssonella oxycona* (Reuss), R2/24. 3. *Clavulinoides?* sp. 1, HLM-1 (75,5 m). 4. *Goesella rugosa* (Hanzlíková), R2/24. 5, 6. *Clavulinoides subparisiensis* (Grzybowski): 5 - R2/24, 6 - HLM-1 (105,3 m). 7. *Clavulinoides amorphha* (Cushman), HLM-1 (105,3 m). 8, 9. *Gaudryina carinata* Franke, R2/24. 10. *Dorothia bulletta* (Carsey), 35-114/47A. 11. *Remesella varians* (Glaessner), BM-1 (70,48 m). 12, 13. *Marssonella crassa* (Marsson): 12 - 35-113/58K, 13 - HLM-1 (32,7 m). Length of bars: 0,1 mm.