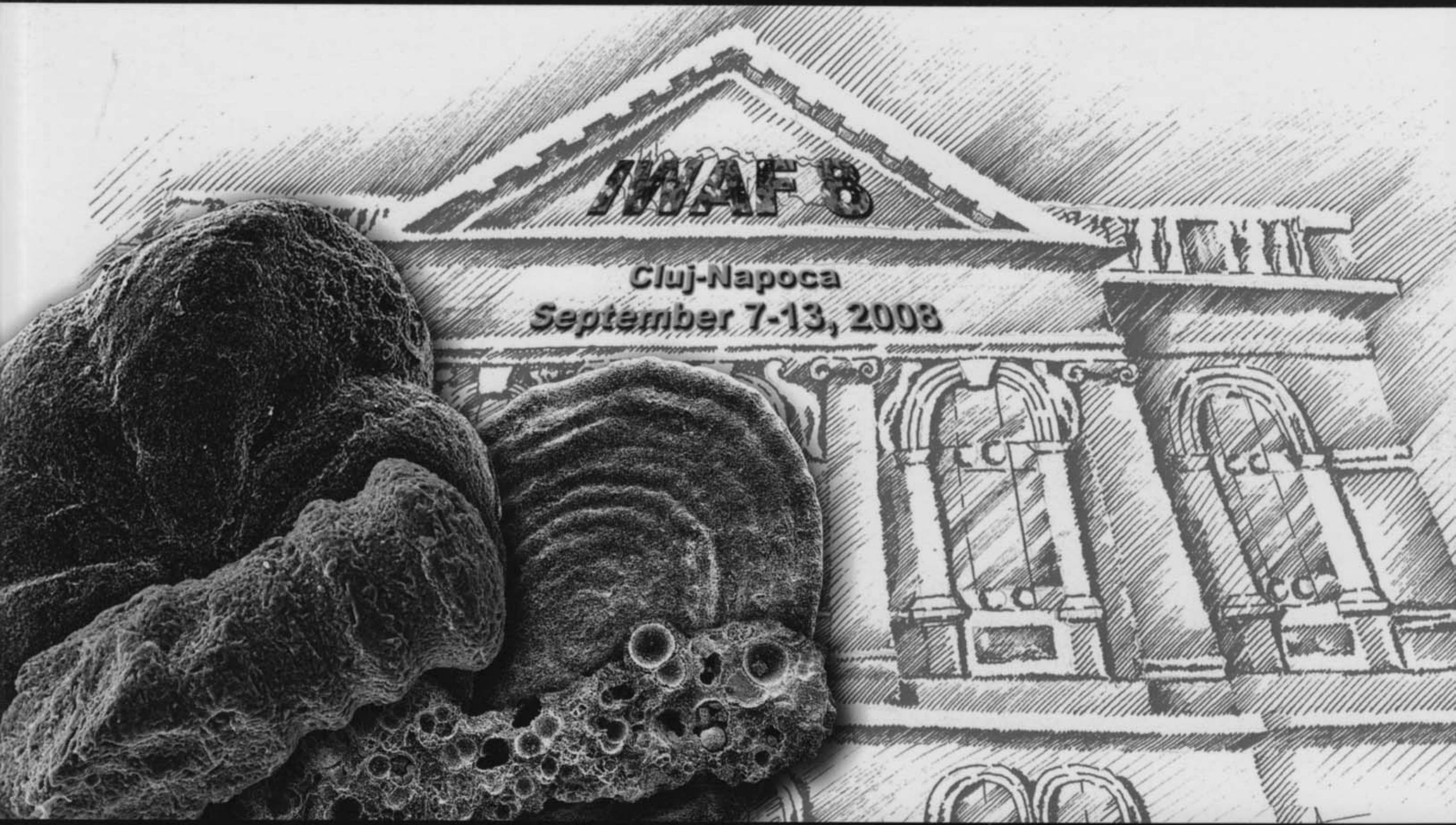
Eighth International Workshop on Agglutinated Foraminifera

Abstract Volume



Edited by:

S. Filipescu

& M.A. Kaminski

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Eighth International Workshop on Agglutinated Foraminifera

Cluj-Napoca, Romania

September 7–13, 2008

IWAF VIII

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PREFACE

The International Workshop on Agglutinated Foraminifera (IWAF) is a series of meetings held approximately every four years devoted primarily to the systematics, (palaeo)ecology and evolution of the largest single group of foraminifera. The IWAF meeting in Urbino was the seventh meeting in this series and followed previous meetings held in Amsterdam (1981), Vienna (1986), Tübingen (1989), Kraków (1993), Plymouth (1997), Prague (2001) and Urbino (2005). The main idea behind this meeting and this abstract volume is to present a "snapshot" of current research on the agglutinated foraminifera. The Organizing Committee of the 8th International Workshop on Agglutinated Foraminifera is pleased to welcome you to Cluj-Napoca, the heart of Transylvania!

The Babeș-Bolyai University, having an academic tradition that started in the 16th century, is one of the largest universities in Romania. As a part of the university, the Department of Geology has been striving to maintain a tradition in education and research since the late 19th century. This tradition is about to become stronger by hosting the IWAF-8, as always a top international scientific meeting.

We are certain that the IWAF-8, with almost 50 young and mature scientists registered, and over 50 interesting contributions, will be the perfect environment for discussions and knowledge sharing on the wonderful, amazing, incredible, and challenging world of the little "acquiring beasts" which make us all happy.

We are grateful to all the participants to IWAF-8 for helping with the international promotion of micropaleontology and earth sciences and hope that everyone arriving curious in Cluj will leave at the end of the meeting with new, interesting, and useful knowledge, and also with the desire of coming back.

We also take this opportunity to thank our sponsors who contributed to the organizational costs of the meeting – Babeș-Bolyai University, the Grzybowski Foundation, and The Micropalaeontological Society.

For the IWAF-8 Organizing Committee

Sorin Filipescu &
Mike Kaminski

Callovian Agglutinated Foraminifera and their Applications for Palaeoenvironment and Correlation of the Tuwaiq Mountain Limestone Formation, Saudi Arabia

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Tuwaiq Mountain forms the most prominent topographical structure in central Saudi Arabia. Marine sediments comprising the Tuwaiq Mountain Formation were deposited on a very extensive shallow submarine platform that extended over most of the Arabian Peninsula. Scattered across the platform were localized deeper areas considered to be intra-shelf basins, and localized highs that formed the sites of stromatoporoid and coral reefs. The T.M.F. is subdivided into three informal units, from bottom to top, T1, T2 and T3. The T1 and T3 units of the Tuwaiq Mountain Formation contain the Upper Fadhili and the Hadriya reservoirs respectively which have been drilled and produced oil in many fields in east Saudi Arabia and other Gulf countries. The assigned age for Tuwaiq Mountain Limestone Formation is middle to late Callovian.

This study is based on semi-quantitative micropalaeontological analysis of closely-spaced thin sections from subsurface and outcrop sections. The subsurface samples came from two carbonate reservoirs in eastern Saudi Arabia. The outcrop samples came two road-cut sections and one shallow core in central Saudi Arabia.

The initial results of this study have led to the identification of a large-scale shallowing upward sequence. This large shallowing upward sequence has three small shallowing upward cycles. All these shallowing upward cycles start with an open marine mud-dominated succession with a foraminiferal Lenticulina-Nodosaria-sponge spicule dominated assemblage in its lower part, which is considered as linked with a transgressive system tract. On the other hand, the upper part of each shallow cycle has different agglutinated foraminifera assemblages that can be attributed to highstand shallowing depositional sequence. The upper part of the lower cycle is dominated by *Pseudomarssonella* sp., *Riyadhella regularis* and *R. elongata*. The upper part of the middle one is dominated by *Palaeopfenderina trochoidea*, *Meyendorffina bathonica* and *Kurnubia wellingsi* with some influx bearings of coral and stromatoporoid. The uppermost of the formation is dominated by *Redmondoides lugeoni*, *Praekurnubia crusei* and *Levantinella* sp. with the packstone-coral-stromatoporoid dominated succession. These three agglutinated foraminifera assemblages might be highly important in distinguishing the boundaries among the lithostratigraphic units (T1, T2 and T3), where uncertainty of knowing them is high in both outcrop and subsurface sections.

Utilizing the environmental sensitivity of benthic foraminifera combined with associated microfossils and macrofossils can provide a potentially valuable technique for determining subtle variations in the depositional environment, and provides a tool for calibrating the local reservoir compartments to regional outcrop units of the Tuwaiq Mountain Limestone Formation.

Keywords: Saudi Arabia, Jurassic, Callovian, Tuwaiq Mountain Limestone Formation, agglutinated foraminifera.

Abundance, diversity and similarity of agglutinated foraminifera assemblages of the Hida Formation (NW Transylvanian Basin, Romania)

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The Lower Miocene outcrops mainly in the northern parts of the Transylvanian Basin, and consists of deep-marine turbidites (Tischler, 2005) and coarse-grained fan deltas grouped together, in a broad sense, in the Hida Formation. Well data and regional interpretations indicate that the Hida Formation is a large-scale shallowing-upward succession (Krézsek & Bally, 2006).

Foraminifera were colected from several typical outcrops of median to distal turbidites (Chiuieşti, Spermezeu, Suciu de Sus etc.) in order to analyze the morphology of the specimens and the diversity of assemblages in relation to the main depositional environments (Filipescu & Beldean, in press).

The assemblage diversity and the proportion between identified morphogroups (mainly tubular, elongated, and planispiral) gives information on the microhabitat preferences, bathial distributions, and organic flux events.

Data on morphotype habitat preferences and test functional morphology were correlated to the main sedimentological features. The species diversity was measured by Shannon-Wiener diversity index and for similarity we used Morisita index. Early Miocene agglutinated foraminifera in the Hida Formation lived in distal and middle turbiditic depositional settings.

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Agglutinated and calcareous recent benthic foraminifera at shallow sites of Northern Adriatic Sea

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The study of the distribution of the foraminiferal fauna can provide important data to define environmental conditions of a particular site. Foraminifera are useful tools for the environmental studies showing sensitivity to the changes of their habitat. Possible future changes in their distribution can provide useful information in order to evaluate the status of the environment.

The purpose of this work is the analysis of the calcareous and agglutinated component of the benthic foraminiferal assemblage of recent sediment samples collected from four stations located in the Gulf of Trieste in the Northern Adriatic Sea. This study is complementary to Sabbatini et al. study (this volume) that describes in detail the soft-shelled monothalamous component of the same samples. Sediment samples were taken by means of box corer during the ANEMRE cruise along a transect located in the Gulf of Trieste in May 2006. The samples correspond to the water-sediment interface (2 cm thick). In Station 123, we investigated the microhabitat distribution in the superficial sediment (5 cm depth). All the samples were preserved in 4% formaldehyde solution buffered with sodium borate, Rose Bengal stained and sieved with a 63 μm mesh sieve.

The distribution of the most important species of foraminifera in the superficial sediment is different between the four stations corresponding differences in water depth and water temperature. The dominant species found in Station 120 are *Ammonia perlucida* and morphotypes belonging to genera *Cribrostomoides* and *Haplophragmoides*. These species are absent or just less represented in the other stations. In the Station 121 we found a high presence of *Textularia agglutinans,* abundant also in the Station 122. Station 122 is also characterized by high percentage of *Reophax nana*, *Leptohalysis scottii* and *Nonionella stella*. This calcareous foraminifera is the most abundant species found in the Station 123 where agglutinated specimens *Reophax nana* and *Textularia conica* are also well represented.

The vertical distribution analysis performed on station 123 allows defining the microhabitat of the calcareous and agglutinated species. In particular, cluster analyses evidences three main groups: 1) epifaunal/shallow infauna clustered *Gavelinopsis lobatulus*, *Lagennamina pacifica*, *Nonion pauciloculum*, *Nonionella stella* and *Trochammina* spp.; a second group of intermediate infaunal taxa composed by *Leptohalysis scottii*, *Nonionella stella* and *Reophax nana* and a third group that shows a deeper infaunal microhabitat, in particular *Bolivina* spp. prevails at 4–5 cm while *Reophax nana* at 2-3 cm.

Benthic foraminifera communities of the Cretaceous-Palaeocene Oceanic Red Beds in the northern Iran: comparison to the West and East

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In the Upper Cretaceous, a colour of hemipelagic sediments turns from black and grey to red in many ocean basins worldwide. This global phenomenon received more attention during last years when triggering mechanisms were searched and discussed by geoscientists (IGCP 463). The red colouration due increased oxygenation is most often explained by a decrease in sediment accumulation rate and changes in oceanic circulation. While the Cretaceous oceanic red beds of the central Tethys in Europe are well known from the beginnings of geology, the equivalent sediments in eastern Tethys were described recently (southern Tibet, see Wang et al. 2005). Red beds found in the Ahar vicinity, northern Iran, during the 2007 field works fill the gap between these two distant areas of the Tethys. Various facies of oceanic red beds comprise tectonic slices surrounded by Paleogene siliciclastic turbidite formation and their paleogeographical relations and basinal history is not known yet. Following different lithofacies with specific microfossil record was encountered till now:

1) Red brown nodular limestone with inoceramids (upper part of the Turonian): outer shelf, mixed assemblage (*Arenobulimina* sp., *Glomospira charoides*, “*Rhizammina*” sp., *Tolypammina* sp., *Lenticulina* spp., *Buchnerina* sp.) with abundant plankton.

2) Red cherty limestone (upper Santonian-basal Campanian): upper slope, mixed assemblage (*Ammodiscus* sp., *Nothia* sp., *Praebulimina* sp., *Aragonia velascoensis, Stensioeina exsculpta, Osangularia* sp.) with plankton and abundant cadosinids.

3) Variegated platy marlstones (Upper Maastrichtian): middle slope, flysch-type assemblage (*Bathysiphon* sp., *Glomospira charoides, Ammodiscus* sp., *Caudammina ovuloides, Rzehakina inclusa, R. epigona, Recuroides* sp., *Paratrochamminoides intricatus*) with rare plankton and calcareous benthos.

4) Red brown marly shale (Middle-Upper Palaeocene): middle slope, mixed assemblage (*Rhabdammina* sp., *Caudammina ovuloides, Spiroplectammina spectabilis, Pseudoclavulina subparisiensis, Thalmannammina simpla, Aragonia ouezzanensis, Neoflabellina delicatissima*) with abundant radiolarian ghosts.

Microfossil taphocoenoses of red beds show a deepening trend in the basin during the Upper Cretaceous. Comparing with the eastern Tethyan red beds from the Chuangde Formation of southern Tibet, the benthic foraminifer communities are similar and indicating slope setting near the CCD. The deeper-water facies of the red beds from northern Iran bear the cosmopolitan deep-sea flysch-type agglutinated fauna common in the central Tethys (Flysch Carpathians, Alps etc.)

Biochronology of Upper Cretaceous deep-water agglutinated foraminifera in the Contessa section of Italy

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The Upper Cretaceous to Lower Eocene limestones of the Scaglia Bianca and Scaglia Rossa from the Gubbio area have been investigated in a multitude of isotopic, paleomagnetic, and micropaleontological studies, making this section one of the standard reference sections for the Tethys area. The two formations were deposited in a bathyal setting, with a deposition depth situated between 1500 and 2500m (Premoli-Silva & Sliter, 199x). A low-resolution study of agglutinated foraminifera from the Upper Cretaceous of the Contessa and Bottacione sections was carried out by Kuhnt (1990), revealing a diverse assemblage of mostly small size, finely agglutinated foraminifera.

We undertook a detailed sampling programme for agglutinated foraminiferal biostratigraphy in the Upper Cretaceous part of the Contessa Highway section, which we correlate with the planktonic foraminiferal biostratigraphy of the Bottacione section (Premoli-Silva & Sliter, 199x). First occurrences of important biostratigraphical species are compared with the first occurrences in the Upper Cretaceous variegated marls of the Romanian Eastern Carpathians. The agglutinated foraminiferal biozones of the Carpathian schemes of Geroch & Novak (1984) and Neagu (1992) and the North Atlantic scheme of Kuhnt et al., (1992) cannot be applied entirely to the Contessa Highway section owing to the scarce presence of the some of the index taxa. The highly oligotrophic palaeoenvironmental conditions of this section make the occurences of some flysch-type species such as *Uvigerinammina jankoi* and *Caudammina gigantea* to be very rare and, in the case of *Rectoprotomarssonella rugosa*, the index species used for the Lower Campanian, to be absent. Nevertheless, the *Uvigerinammina yankoi* biozone in Contessa can be correlated with the Carpathian Basins and the North Atlantic.

Agglutinated foraminiferal faunas are very similar to those of the Carpathian Basins but in addition a series of small, abyssal–types of *Haplophragmoides* are common in the Contessa Highway section, probably as a result of the oligotrophic conditions. The abundance of agglutinated foraminifera in the Contessa Highway Section decreases during maximum sea level observed in the Late Turonian, Middle Coniacian, Lower Campanian, lower part of Upper Campanian, and in the Lower and Middle Maastrichtian. It is possible that these low abundance assemblages can indicate even more oligotrophic conditions as result of sediment starvation of the area during high level stands. The diversity of the agglutinated assemblages increases upsection in the Upper Cretaceous, with more first occurrences in the Upper Turonian – Santonian and an increase in the diversity and abundance of flysch-type faunas in the Upper Campanian – Maastrichtian interval.

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Eobigenerina, n.gen., a cosmopolitan deep-water agglutinated foraminifer, and remarks on species formerly assigned to the genera *Pseudobolivina* and *Bigenerina*

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The genera *Bigenerina*, d'Orbigny, 1826 and *Pseudobolivina*, Wiesner 1931 served in the last decades as a sort of rubbish bin for all the deep-water Cretaceous biserial or biserial to uniserial forms with a non canaliculate wall and a round terminal aperture. Out of the four species of *Pseudobolivina* described by Krasheninnikov (1973, 1974), only one – *Pseudobolivina normalis* — is a true *Pseudobolivina*. In the Carpathians (Poland, Czech Republic and Romania), designations to *Bigenerina* and later *Pseudobolivina* were used in Lower Cretaceous biostratigraphy in several schemes based on agglutinated foraminifera However, there is no mention of the nature of the agglutinated wall of the Carpathian species, and they are incorrectly assigned to one of these genera either based on the nature of wall either on the type and position of aperture. Later, many authors just reported these forms as "*Bigenerina*" or *Pseudobolivina* sp. 1, 2, (Moullade et al. 1988; Kuhnt, 1990; etc.) from North Atlantic OPD sites and outcrops in Europe.

One of the species that becomes uniserial is *Bigenerina variabilis* Vašiček, 1947 (with the synonym *Pseudobolivina* sp. 2, Moullade *et al*. 1988). This seems to be an opportunistic taxon that was able to live under low oxygen conditions, playing a major part in the post recovery faunas after the Cenomanian – Turonian anoxic event (OAE 2), both in North Atlantic ODP Hole 641A (Kuhnt, 1992), in the Scaglia Bianca, at Gubbio, Italy (Coccioni *et al*., 1995) and in the Dumbrăvioara Formation, Ceahlău Nappe, Eastern Carpathians, Romania (Cetean *et al*., 2008). Thus, we consider that a new genus, *Eobigenerina*, is necessary to accommodate the biserial to uniserial forms with a noncalcareous, noncanaliculate agglutinated wall and a terminal round aperture situated on a short collar.

Neagu & Neagu (1995) recognised the taxonomical problem with the noncalcareous nature of some Jurassic taxa (found in acid residues) that were formerly known as *"Bigenerina"*. These authors described three new genera: *Haghimashella, Rashnovammina* and *Bicazammina* (Neagu & Neagu, 1995) in which all the Cretaceous to Paleogene biserial forms with a terminal rounded aperture can be placed (as Krasheninnikov's species of *Pseudobolivina*). However, none of these genera has a truly uniserial terminal stage – they are terminally "loosely biserial or laxuniserial".

Using material from Cretaceous sections in the Eastern Carpathians (Romania) and well material from the North Atlantic and southwestern Barents Sea, we introduce a new genus, *Eobigenerina*, (type species *Bigenerina variabilis*), to accommodate noncalcareous forms that are initially biserial and become terminally uniserial. We also transfer some cosmopolitan agglutinated taxa described previously from deep-water Cretaceous deposits as *Pseudobolivina* and "*Bigenerina*" to the genera *Haghimashella, Rashnovammina* and *Bicazammina* (Neagu & Neagu, 1995), extending the known stratigraphic range of these genera into the Paleogene.

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Agglutinated foraminifera as a proxy to identify mangal environment of Miocene age from eastern Colombia

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A micropaleontological analysis (using foraminifera, thecamoebians and pollen) was conducted on Miocene sediments from two wells located in eastern Colombia belonging to the León Formation.

The foraminiferal microfauna results to be totally composed by agglutinated foraminifera mainly belonging to the genera *Ammobaculites, Ammotium, Arenoparrella, Haplophragmoides, Jadammina* and *Miliammina*. Agglutinated foraminiferal specimens belonging to the genera *Ammoastuta, Ammomarginulina, Gaudryina, Polysaccammina, Reophax, Tiphotrocha* and *Trochammina* have a rare occurrence. The thecamoebians are present with the genera *Centropyxix, Difflugia, Heleopera,* and *Pontigulasia*.

The above-mentioned foraminifera are for the first time described in Miocene sediments of Colombia whereas the thecamoebian microfauna constitute the first fully-documented Miocene record reported worldwide.

The recovered specimens were compared either with the ones occurring in Recent associations from similar environment or (were possible) with same-age microfauna and finally used to interpret the paleoenvironment. The comparison of the microfauna with modern foraminiferal and thecamoebians associations and the results of the pollen analysis suggest that these sediments were deposited in brackish environment such as a mangrove swamp or marsh.

Deep-Sea Foraminifera in the Gulf of Lions: Taxonomic and Ecological Considerations

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The dominant living foraminiferal species occuring in the Gulf of Lions are presented. 6 deep-sea stations were sampled on the open slope between the Grand Rhône Canyon and the Petit Rhône Canyon (eastern part of the Gulf of Lions, NW Mediterranean). The 6 stations describe a bathymetric transect between ~350 and ~2000 m depth. The main objectives of our study were to investigate the changes of the foraminiferal density, composition and microhabitat along this transect in response to the physico-chemical conditions at and below the sediment-water interface. The study area reveals a relatively important diversity of agglutinated and calcareous taxa living either in infaunal microhabitats or attached on hard substrates (bioclasts). Free and attached single-chambered agglutinated species are sometimes problematic in terms of identification (?*Psammosphaera*, ?*Thurammina*, *?Storthosphaera, ?Tholosina,* ?*Hemisphaerammina*). Hyaline calcareous species are dominated by *Uvigerina mediterranea*, *Uvigerina peregrina* (senso lato), *Amphicoryna scalaris*, *Bulimina aculeata, Melonis barleeanus*, *Gyroidina orbicularis* and *Hoeglundina elegans*. They all live in the sediment with clear preferences for different redox zones. Some other calcitic taxa (*Planulina ariminensis*, *Rosalina bradyi*) prefer elevated substrates. The lipids concentration in the upper sediment is apparently the major parameter controlling the foraminiferal distribution at our open slope stations. From station E (552 m) to station A (1987 m), the foraminiferal standing stocks and diversity decrease with depth, as the result of the increasing scarcity of labile organic compounds at the sediment-water interface. The oxygen penetration depth and the intensity of bioturbation seem to play only a secondary ecological role. Other, putative hydro-sedimentary processes (winnowing by strong bottom currents, sand bed deposition) appear as additional parameters controlling the foraminiferal community structure. At station F (~350 m), the live foraminiferal fauna can be considered as a non-equilibrium assemblage thriving in frequently disturbed and food-impoverished sediments. At stations D (745 m) and C (980 m), the occurrence of suspensivorous epibenthic/epilithic species suggests the presence of strong bottom water current velocities, and the related suspension of organic particles. Finally, the foraminiferal changes recorded along the bathymetric transect are related to a complex association of physicochemical parameters (hydro-sedimentary processes, organic detritus, redox conditions in the sediment).

Bathymetric distribution and ecological characterization of agglutinated foraminifera along an inner neritic to upper bathyal transect in the Marmara Sea

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Living (stained) and dead (unstained) agglutinated foraminifera have been investigated along a transect ranging from 15 to 350 m water depth (mwd) on the southern shelf of the Marmara Sea. The Marmara Sea is a critical oceanographic gateway connecting the Aegean Sea, to the west, and the Black Sea, to the northeast, and serves as the only link between the Black Sea and the Mediterranean.

Due to the lack of studies on foraminifera from the Marmara Sea the aim of this study is to elucidate the modern agglutinated foraminiferal fauna and its relation to sediment properties and water mass properties. Diversity, faunal composition and statistically defined foraminiferal associations are analyzed for living and dead agglutinated foraminifera. We compare the results of several benthic foraminiferal diversity indices and statistically defined foraminiferal associations, including Fisher's alpha and Shannon-Wiener diversity indices.

Assemblages are well-diversified and composed of species derived from both the Mediterranean and the Black Sea. The most abundant species are *Eggerelloides scabrus*, *Bigenerina nodosaria*, *Spiroplectinella wrightii*, *S. sagittula*, *Reophax scorpiurus*, *Textularia conica*, *T. cushmani*, *T. agglutinans*, *Ammobaculites exiguus*, *A. agglutinans*, *Lagenammina fusiformis*, *Nouria polymorphinoides*, *Glomospira charoides* and numerous tubular forms such as *Rhabdammina abyssorum*, *Technitella legumen* and *Schizamina labyrinthica*. The fauna is dominated by *Textularia*, *Spiroplectinella* spp. and *Eggerelloides scabrus*. *Trochammina inflata* is only present up to 15 mwd. *Bigenerina nodosaria*, *B. cylindrica* and *Siphotextularia concava* occur below 44 mwd, while *S. labyrinthica* occurs at greater depth (325 mwd).

Middle – upper Albian Agglutinated foraminifera in the Upper Magdalena Valley, Colombia.

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The presence of abundant agglutinated foraminifera within benthic microfauna in the Tetuan member of the Villeta Formation (middle – late Albian of Colombia) let us infer a shallow platform environment in an epicontinental sea.

The agglutinated benthic foraminifera recovered in the studied section belong to the genera: *Ammobaculites*, *Haplophragmoides*, *Lagenammina*, *Rephax*, *Saccammina*, *Textularia* and *Trochammina*.

The assemblage is dominated by infaunal agglutinated foraminifera occurring together with calcareous benthic foraminifera mainly the genus *Praebulimina*. This assemblage indicates low oxygenation (dysoxic) at the bottom water surface, associate with cold waters.

New observations on xenophyophores (Protista: Foraminifera) from the Nazare canyon (Portuguese margin)

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Xenophyophores are spectacularly large testate protists that are often abundant in the bathyal and abyssal deep sea (Tendal, 1972). Despite attracting considerable interest, their phylogentic relationships have remained obscure until recently. Cruises to the Portuguese margin, conducted in recent years within the framework of the EU HERMES Integrated Project, have revealed a variety of xenophyophores living in the submarine canyons that characterise this region. These giant protists are most abundant at a 4300-m site in the lower part of the Nazare canyon where two species were photographed in situ and sampled using a Remote Operated Vehicle (ROV) during the RRS *James Cook* cruise 10 (JC10, June 2007). *Galatheammina* sp. nov., has a 'brain-like' hemisphaerical test up to 7-8 cm diameter, consisting of branching or reticulated plate-like elements. Tests are visible in survey photographs where they have an overall density of 0.51 indiv.m^2 within the photographed area of 745 m^2. However, distributions are distinctly patchy; the numbers of specimens in particular frames (46.5 m^2 area) varied between 9 and 44. The second species, *Aschemonella ramuliformis* Brady 1884, has been known since the Challenger Expedition but has always been found in a fragmentary state. In the Nazare Canyon, this species forms patches, up to about 10 cm across, on the seafloor. Each patch is composed of a thicket of irregular, often branching, tubular elements that are buried to some extent below the surface but also project above the sediment-water interface. When teased apart, these clusters are found to consist of separate, interlocking tubular components, presumed to be individuals. *Aschemonella ramuliformis* is less common than *Galatheammina* sp. and cannot be seen clearly enough in survey photographs to estimate densities. It is also present at 4518 m in the Setubal canyon. Additional xenophyophores were collected in megacorer samples at the 4300-m Nazare canyon site during the earlier RRS *Discovery* cruise 297. In addition to the two already mentioned, they included undescribed species of *Reticulammina* and *?Syringammina* and a remarkable plate-like species which will be described as a new genus. A third xenophyophore species was photographed during JC10 clinging to a very steep slope in the upper part of the Nazare canyon (1555-m water depth). In situ photographs and tiny fragments derived from a specimen collected by the ROV using a butterfly net suggest that it was a species of *Syringammina*. Xenophyophores are known to favour areas of enhanced food flux and presumably benefit from the enhanced current flow in submarine canyons.

Xenophyophores possess some highly distinctive features (e.g. thread-like cytoplasm enclosed within an organic sheath, intra-cellular barite crystals) and have been classified as a distinct group of protists. SSU rDNA gene sequences derived from *Aschemonella ramuliformis, Galatheammina* sp. nov. and the plate-like xenophyophore, however, indicate that these species branch within the monothalamous Foraminifera. This supports existing molecular data from *Syringammina corbicula* (Pawlowski et. al., 2003) and a new Pacific xenophyophore genus (Lecroq et al., in press), suggesting that xenophyophores are giant Foraminifera. It appears from our present evidence that these protists, together with *Rhizammina algaeformis,* a species that has several xenophyophore-like characteristics, form a coherent group within the complex radiation of monothalamous taxa. However, their apparent monophyly requires confirmation from additional molecular analyses.

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Recent Developments in the Geologic Timescale

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Stratigraphic standardization through the work of the International Commission on Stratigraphy (ICS) is actively refining the international chronostratigraphic scale. Several traditional European-based stages have been replaced with new subdivisions that allow global correlation.

New stratigraphically meaningful linear age dates and improved insights in processing methods for extracting such high-precision age assignments improve age assignments of key geologic stage boundaries and other global correlation horizons.

Statistical techniques of compiling integrated linear scales within zones and stages are maturing. Orbital tuning is greatly refining Neogene, Paleogene and part of Mesozoic geochronology.

Anticipated advances in the Geologic Time Scale during the few years include:

- A Planetary scale and a geologically realistic Precambrian scale
- Formal definition of all Phanerozoic stage boundaries.
- Orbital tuning of polarity chrons, fossil and physical events for entire Cenozoic and Cretaceous.
- A detailed database of high-resolution radiometric ages with "best practice" procedures.
- Full error analysis, monitor ages and conversions.
- Resolving age dating controversies (e.g. zircon reworking and statistics).
- Improved dating of several 'neglected' intervals (e.g. Upper Jurassic – Lower Cretaceous).
- Detailed integrated stratigraphy for Upper Paleozoic through Lower Mesozoic.

The TS-Creator@ visualization package lets the user create onscreen and downloadable charts of any portion of the geologic time scale with a choice of bio-magneto-chemo-sequence and other events and trends of Earth History

Reference

(see *www.stratigraphy.org*).

Increasing Resolution in Exploration Biostratigraphy using Crossplots of RASC and CONOP

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A combination of Ranking & Scaling (RASC) and Constrained Optimization (CONOP) increases stratigraphic resolution and correlation potential of fossil distribution range charts for wells through rapid identification of average and maximum event positions. The new methodology solves the problem that conventional zonations do not rank taxa according to the degree of diachroneity of range endpoints in a correlation scheme. The method is useful to evaluate local and total ranges of Deep Water Agglutinated Foraminifera.

To understand the new approach, we have to understand how RASC and CONOP are similar, and particularly how they differ in results. The RASC and CONOP methods yield the following results:

A. (RASC) Most likely optimum sequence of events; this is an ordinal composite standard, where calculated event positions in the composite are averages of all (well) section positions encountered. The composite standard levels show estimates of event variance.

B. (CONOP) Composite standards with display of penalty (misfit) of events, according to three strategies:

1) event positions in the composite are unconstrained, and can move either up or down, not unlike RASC
2) event positions in the composite are maximized, either stratigraphically upwards (for tops) or downwards (for bases), as in conventional graphic correlation seeking total stratigraphic ranges. Using this strategy, events from the lower part of ranges generally move downwards in the composite standard, and events in the upper part of ranges upwards.
3) event positions are not allowed to move, and are correlated as locally observed.

Stratigraphic crossplots of the results with methods A versus B1, B2 and B3 show which events do not deviate much their stratigraphic position from well to well, and which ones do. The latter often also have above normal variance, and are least useful for tracking a stratigraphic level. This enables well-site paleontologists to predict with confidence what the chances are a particular horizon has been identified, using best marker criteria. Since the methods target all data, not a regional 'mindset', correlation potential of wells is optimized.

Four large datasets demonstrate the new findings, three from petroleum basins, offshore NW Europe using Last Occurrence and and Last Consistent Occurrence events of dinoflagellates and foraminifers, and one for the deep GOM, using LO, LCO, Acme, First Common Occurrence and First Occurrence events of nannofossils and foraminifers. The more reliable events with high stratigraphic fidelity, are called Prime.

The Cretaceous zonation, offshore Norway, based on 1758 records in 30 wells, contains 80 events in 17 interval zones; 60% of events are prime. The Cenozoic zonation, based on 1548 records in 27 wells offshore Norway, contains 102 events in 18 zones; over 75% of events are prime. The Cenozoic zonation for the North Sea, based on 1347 records in 30 wells, consists of 107 events in 19 zones, over 60% of events track in the prime category. The Neogene zonation for the Gulf of Mexico, using 1688 records in 13 wells, is based on 85 events in 15 zones; over 75% have high stratigraphically fidelity.

Recovery of benthic foraminifera after the eruption of the Soufrière Hills Volcano (Montserrat), May 20th 2006 and other recent volcanic activity

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Since the beginning of 2004, the University of Plymouth has been working in collaboration with the University of Bristol, University of Paris and the National Oceanographic Centre (University of Southampton) on a major project in the Caribbean Sea. In 1995 the Soufrière Hills volcano (part of the Lesser Antilles Volcanic Arc) began erupting and this activity has continued to the present day. Our involvement was specifically:

- To document the microfossils in a number of marine borehole collected in the area;
- To establish a stable isotope stratigraphy for the cores;
- To provide AMS radiocarbon dates for selected horizons; and
- To date the volcanic deposits present in the cores with a view to generating a tephrochronology of the volcanic activity.

Using cores collected during the cruise of the RV. *L'Atalante* in 2002 the tephrochronology back to 260,000 years b.p. has been established (Le Friant *et al*., 2008). The cores collected by the RRS *James Clark Ross* (May, 2005) have been used to document the fate of pyroclastic flows entering the ocean (Trofimovs *et al*., 2006) and the presence of major carbonate turbidite flows in the marine areas adjacent to carbonate platforms (Trofimovs *et al*., in preparation). Throughout these investigations the benthic foraminifera have been documented and compared to the faunal changes described by Hess & Kuhnt (1996) and Hess *et al*. (2001) in the South China Sea near Mt Pinatubo.

In December 2007 another cruise to the Montserrat area, on the RRS *James Cook* provided the opportunity to collect further samples from the Caribbean Sea that had been affected by the major eruption of the Soufrière Hills volcano on the 20th May 2006. Samples were collected, fixed in buffered formalin, washed and stained in Rose Bengal on board the RRS James Cook with a view to investigating both the impact of this major eruption on the planktic and benthic foraminifera and the level of recovery by the benthic foraminifera only 18 months after the eruption. Work is still in progress but we have a number of interesting findings to date:

- To the west of Montserrat, where the 20th May eruption produced a major ash-fall (9-10 cm thick), there appears to be a significant "kill layer" of foraminifera and pteropods below the ash layer; the aragonite shells of the pteropods in this "kill layer" are badly etched, perhaps reflecting the acidification of the ocean as the ash fell through the water column (see Jones & Gislason, *in press*); and
- There are living specimens of *Reophax* within the upper layers of the ash from the eruption of the 20th May 2006, and this would suggest recolonisation within 18 months. The mechanisms for this recolonisation are not known. These individuals are accompanied by living specimens of *Bulimina* spp., some of which are "at depth" within the sediment.

To the south-east of Montserrat, there are two extinct submarine volcanic centres that are now cloaked with hemipelagic sediment. Core JR123-11V, collected in 2005, recorded the presence of benthic foraminifera within the ash-rich sediments in the very crater of one of the volcanic centres. AS the water depth in the crater is ~750 m (though it may have been less in the Last Glacial Maximum) and the surrounding water depths are in excess of 1 – 2 km, the mechanism by which these foraminifera migrated into the crater is unknown.

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Agglutinated foraminifera across the K/T boundary, Brazos River, Texas

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As the debate continues as to whether the Chicxulub impact caused - or is even synchronous with - the end-Cretaceous extinctions, the Brazos River succession in Texas has increased in both relevance and importance. Some authors (Smit *et al*., 1996) regard the sequence of sands and muds in the vicinity of the boundary to be the direct result of a tsunami following the impact while others (Gale, 2006; Keller *et al*., 2007) have questioned almost every aspect of this interpretation. Most authors have studied the planktic foraminifera and the stable isotope record, largely ignoring the quite abundant benthic fauna (aside from using *Lenticulina* spp. for stable isotope determinations). The benthic foraminifera from the Maastrichtian of Texas were monographed by J.A. Cushman in 1946 and this remains the standard reference on this subject.

In order to gain "fresh" material many workers (e.g., Gerta Keller and co-investigators) have used small diameter boreholes with some success, but the resulting samples are rarely large enough to contain a significant benthic fauna. During a field visit to the Brazos River in February 2007, SRS (with Gerta Keller and co-workers) collected a number of larger field samples to supplement the borehole material. These samples contain significant benthic assemblages. All of the species recorded in the field and borehole samples, including very large *Plectina watersi* Cushman and *Verneuilina cretosa* Cushman, were identified by Cushman and the faunal succession is quite "normal" in the sense that no exotic material was recorded that could be attributed to transport from other environments by the proposed tsunami.

The so-called "event deposits" are composed of sands, shell debris and spherules (attributed the Chicxulub). Included within these coarse-grained sediments are clasts of re-worked Corsicana Marl Formation which underlies the "event deposit". None of these rounded mud clasts contain anything other than the expected fauna and all appear to be of (very) local origin; rip-up clasts of the sort seen in many sedimentary successions. The benthic foraminiferal assemblage, throughout, appears just as described by Cushman (1946) with some of the agglutinated taxa being both large and coarse-grained. The agglutinated foraminifera are largely found in the Corsicana Marl Formation below the "event deposits" and are very rare above, in the Littiq Member of the Kincaid Formation (preceding the palaeontological K/T boundary as defined on planktic foraminifera). The changes in the benthic foraminifera across the K/T boundary are negligible.

The K/T boundary succession at Stevns klint (Denmark), while not the GSSP for the base of the Paleocene, is still regarded as an important succession. Recent work by Hart *et al.* (2004, 2005) has focussed on an expanded succession of the Fish Clay at a previously understudied part of the cliff section (Kulstirenden), as well as the normally visited sections at Højerup, Harvig and Rødvig. The Stevns Klint succession is not just one locality but is a 14 km long cliff profile with almost all authors (e.g., Schmitz *et al*., 1992) focussing on the section exposed near the church at Højerup. A key feature all along the cliff section is the presence of a double (in places single) hardground a few metres below the Fish Clay (and the K/T boundary). Below the level of the hardgrounds is "normal" white coccolith chalk with black flints. These chalks display a Milankovitch cyclicity that is picked up by the stable isotope record and the distribution of flints. Above the hardgrounds is a grey, coarse-grained, bryozoan-rich chalk that shows definite dune bedding. Agglutinated foraminifera, which are present below the level of the hardgrounds, are almost absent in the overlying grey chalk; a pattern very similar to that in the Brazos River section above and below the "event deposits".

Using the key lithological markers, the stable isotope stratigraphy and the distribution of the foraminifera in the Stevns Klint and Brazos River successions it is possible to make a relatively simple graphical correlation and generate a sequence stratigraphical interpretation of the events and sea level changes across the K/T boundary interval. The Brazos River "event deposits" appear to be a sequence boundary (see also Gale, 2006) caused by a forced regression. This sea level fall also accounts for the hardgrounds in the Stevns succession and the overlying shallower-water grey chalks. Other parts of Europe (e.g., Maastrricht in Holland) also seem to fit in with this interpretation. If the Brazos River "event deposits" were a one-off, tsunami event, then it is unlikely that their interpretation would fit other areas thousands of kilometres away in Europe. The fact that the benthic foraminifera (both calcareous and agglutinated) appear to be distributed in a perfectly normal way might be regarded as un-exciting, but does – in itself – call into question some of the interpretations of the Brazos River succession.

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Foraminiferal assemblages of Upper Triassic to Middle Jurassic offshore shelf to marginal marine deposits of the Barents Sea area

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Foraminiferal assemblages and biofacies of Upper Triassic to Middle Jurassic sediments of the Kapp Toscana Group have been investigated. The sand-shale sedimentary package of this group is widely distributed both in Svalbard and in the Barents Sea, where it comprises shallow marine, prodelta, delta front, delta plain and coastal plain deposits. In this study we apply micropaleontological data in combination with sedimentological and geochemical data to recognize, characterize and correlate specific depositional conditions within the marine to non-marine facies development. Therefore foraminiferal assemblages of an offshore section in central Spitsbergen and two well sections in the Hammerfest Basin (Barents Sea) were quantitatively analyzed.

In central Spitsbergen, the foraminiferal record of the Kapp Toscana Group contains a foraminiferal assemblage succession dominated by calcareous taxa in the lower part, and composed exclusively of agglutinated forms in the upper part. Microfaunal assemblage zones based on the stratigraphic occurrence and abundance of species and diversities are discussed, each being characteristic for a period of certain depositional environment. The succession of benthic foraminiferal assemblages can be subdivided into five assemblages:

1) *Lingulina alaskensis* assemblage: The assemblage is named after the common occurrence of its most distinctive species *Lingulina alaskensis,* which is present in increased relative abundance compared to overlaying assemblages. Especially the basal part of the assemblage is dominated by this calcareous species. The top of the interval is defined by the last occurrence of *Vaginulinopsis acrulus* and two *Astacolus* species. Other important forms throughout the interval are *Kutsevella* sp. 1, *Trochammina* aff. *squamataformis*, *Thurammina* aff. *papillata*, *Reophax metensis*, *Nodosaria* spp. and *Laevidentalina* spp. The species diversities of this interval are moderate (Fisher alpha: 5-7), containing the greatest values observed in the whole studied succession. The assemblage contains both calcareous and agglutinated species. This kind of foraminiferal assemblage is known as indicating normal marine shelf conditions.

2) *Thurammina* aff. *papillata* – *Verneuilinoides* aff. *subvitrius* – *Trochammina* aff. *squamataformis* assemblage: This assemblage is characterized by the common occurrence of *Thurammina* aff. *papillata*, *Verneuilinoides* aff. *subvitrius* and *Trochammina* aff. *squamataformis*. The agglutinated faunal component increases upward, while the species diversity decreases (Fisher alpha between 1.7 and 4.5). This assemblage indicates a transitional development from normal marine shelf to coastal or prodeltaic environments.

3) *Kutsevella* sp. 1 - *Ammodiscus* sp. 1 - *Reophax metensis* assemblage: This assemblage is characterized by the common occurrence of *Kutsevella* sp. 1, *Ammodiscus* sp. 1. and *Reohax metensis*. During this interval *Kutsevella* sp. 1 and *Ammobaculites* aff. *vetustus* reappear but have their last occurrence at the top of the period. The assemblage has low diversities and agglutinated species are dominant. Few calcareous specimens are still present. The assemblage indicates marginal marine, already slightly restricted environments.

4) *Ammodiscus* sp. 1 - *Trochammina* aff. *squamataformis* assemblage: This foraminiferal assemblage is strongly impoverished. *Ammodiscus* sp. 1 and *Trochammina* aff. *squamataformis* are the most common species. They both have their last occurrence during this interval. Other important species are *Thurammina* aff. *papillata* and *Reophax metensis*.

Species diversities are the lowest observed in the studied succession. Only agglutinated species appear. On top of this interval 9 samples contain no foraminifera. The faunas indicate deposition in environments with extremely low salinities owing to high fresh water influx (back barrier, lagoon or delta plain). Only few agglutinated species could survive under these extremely restricted conditions.

5) *Ammodiscus* aff. *yonsnabensis* assemblage: This foraminiferal association is named after the common occurrence of the species *Ammodiscus* aff. *yonsnabensis*, which has its first occurrence at the base of the interval. Other important species are *Lagenammina* aff. *inanis* and *Trochammina* aff. *annae*. The assemblage consists only of agglutinated taxa. Species diversity is still low, with Fisher alpha values ranging between 0.9 and 2.7. The foraminiferal test size is strongly reduced suggesting growth under restricted environmental conditions. The faunal composition indicates a deposition during a transgressional phase in restricted shallow marine environment with tendency to hyposaline bottom water conditions.

Preliminary investigations of two well sections located in the Hammerfest Basin (7119-12/1 and 7119-12/2) reveal the occurrence of foraminiferal assemblages in dark mudstone layers of the sand-dominated Stø Formation (early to middle Jurassic). The assemblages consist exclusively of agglutinated taxa and show extremely low diversities with high dominances of *Ammodiscus* and *Trochammina*. These reduced agglutinated assemblages are interpreted to indicate a salinity stratified brackish water column created by extensive fresh water input from nearby deltaic sources. The succession was deposited during a transgressive phase in restricted shallow marine environments with tendency to hyposaline conditions. The dark mudstone horizons indicate intervals with maximum flooding surfaces which might be used as regional marker horizons.

Can fresh-water thecamoebians fossilize?

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Though pre-recent fresh-water thecamoebians are known probably from the Neoproterozoic (Porter & Knoll, 2000) and the numbers of reports of pre-recent occurrences increase (Scott et al. 2001), their occurrences in fresh-water deposits are rare. Based on their very common occurrences in Recent fresh-water bodies, thecamoebians could be expected practically in every fresh-water deposit.

The discrepancy between common occurrences of thecamoebians in recent water-bodies and rare occurrence in fossil fresh-water sediments evoke a hypothesis that thecamoebian tests have low ability to fossilize and can be easily destructed.

The destruction of tests was studied using different methodology of their isolation from the stream sediments. Thecamoebian diversity and abundance were compared for the Recent superficial and shallow subsurface samples to analyze destruction of tests in sediment.

1. Washed and non-washed samples

Washing of samples from clastic sediments destroyed part of tests of genera *Euglypha* and *Trinema*.

2. Dry and wet samples

Desiccation of washing residuum destroyed mainly autogenous tests (Fig. 1).

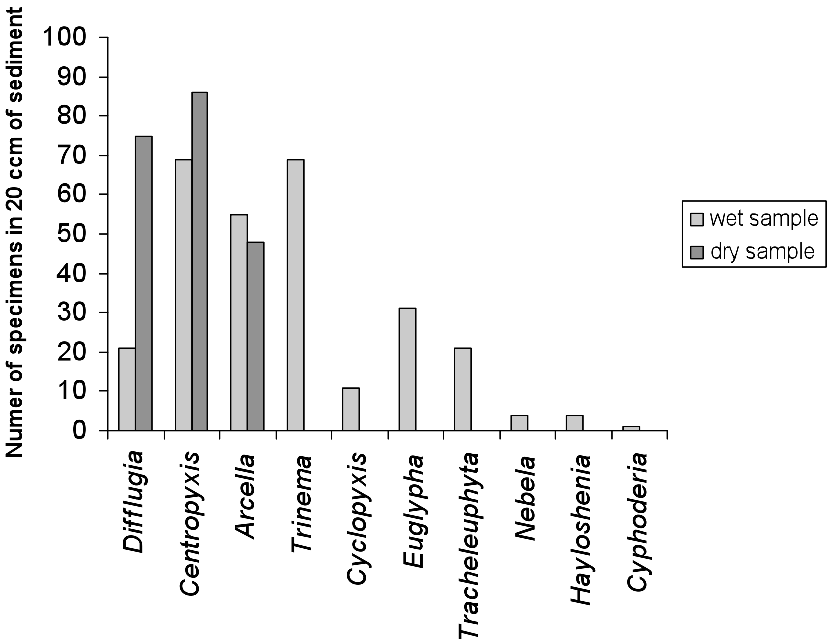

Fig. 1 Abundance of genera in dry and wet sample ("Modřanské tůňky" ponds near Prague)

Decreasing of thecamoebian abundance in sediment

In the Lipno Reservoir (Šumava Mts. Southern Bohemia), abundances of thecamoebian tests in sediment were evaluated for the superficial samples as well as for the samples from the sediment (Fig. 2). Already the first subsurface assemblages showed abrupt decrease of thecamoebian abundance. Diversity of assemblages also decreases (Fig. 3).

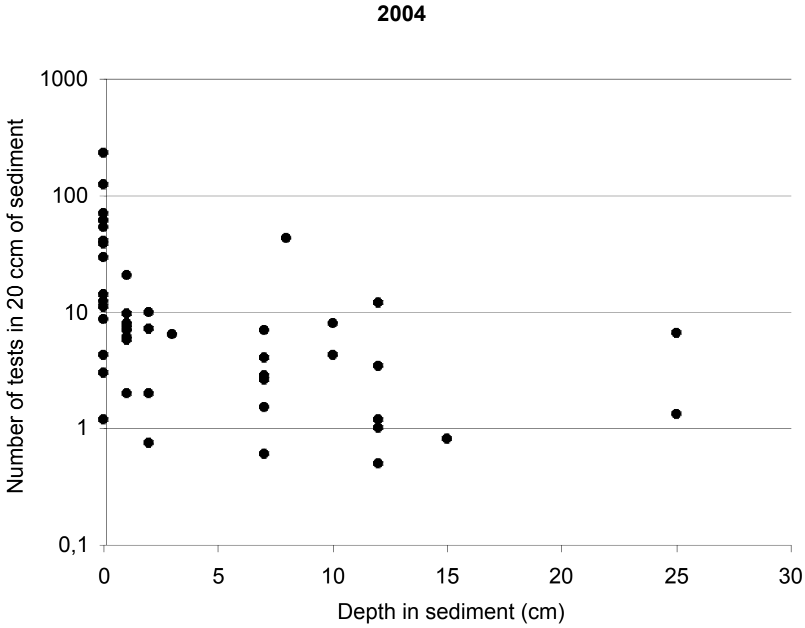

Fig. 2 Abundance of thecamoebian tests in sediments of Lipno Reservoir (Šumava Mts., southern Bohemia) depending on the depth

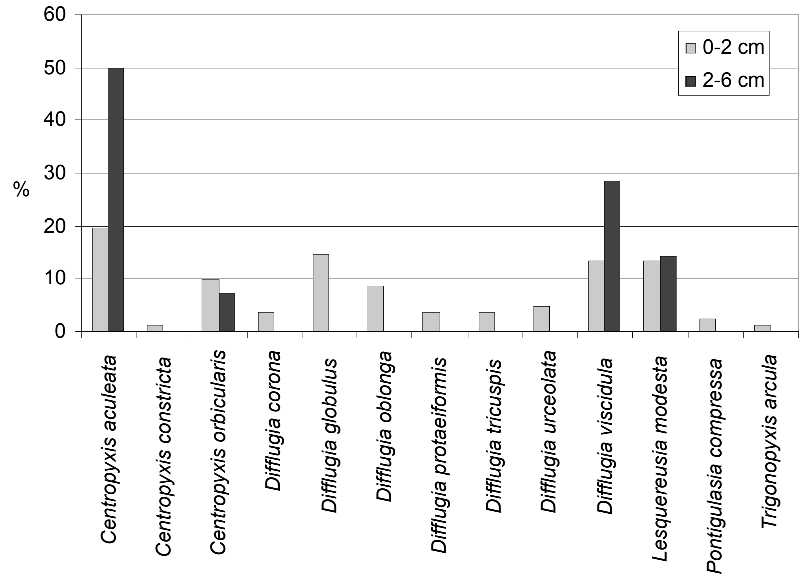

Fig. 3 Shift of species composition of thecamoebian assemblages depending on the depth in sediment

Acknowledgement

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Agglutinated Foraminifera in the Bryozoa-rich communities in the Middle Miocene of the Central Paratethys

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A rapid increases in bryozoan abundance informally termed „bryozoan events"were observed in several stratigraphical levels of the Central Paratethys. They are interpreted as related to the establishment of a specific palaeoenvironment. The Middle Miocene (Early Badenian) event triggered the expansion of Bryozoa which settled in the narrow shallow-water zone of the basin and were accompanied by five foraminiferal assemblages (*Elphidium – Amphistegina* , *Asterigerinata*, *Bolivina-Cassidulina, Cibicidoides pachyderma* and *Nonion commune* - *Bulimina elongata*).

Generally, agglutinated Foraminifera are rare in the Bryozoa-rich communities in the Central Paratethys (Fig.1). Usually they do not exceed 5% of assemblages; maximal relative abundance reaches value of 19%. In the Middle Miocene Bryozoa event, agglutinated Foraminifera are represented only by eight species (*Karreriella chilostoma* (Reuss), *Martinottiella karreri* (Cushman), *Semivulvulina deperdita* (d'Orbigny), *Spirorutilus carinatus* (d'Orbigny), *Textularia gramen* d'Orbigny, *T. laevigata* d'Orbigny, *T. mariae* d'Orbigny, *T. pala* Czjzek) in comparison with 46 species described by Cicha et al. 1998 for the Early Badenian of the Central Paratethys. These species can be classified to two morphogroups both elongate (Jones and Charnock 1985): (1) elongate subcylindrical tests which are characterized like deep infauna from the inner shelf to upper bathyal with increased organic matter flux (*Martinottiela, Karreriella*); (2) elongate keeled – epifauna from the shelf to marginal marine environment (*Semivulvulina*, *Spirorutilus*, *Textularia*). Feeding habit of both groups is classified like active deposit feeding. Murray (1991) classified genera *Textularia*, *Karreriella* and *Martinottiella* like herbivore, epifaunal. Deep-water *Textularia kattegatensis* is described as an intermediate infaunal species (Nomaki et al. 2005).

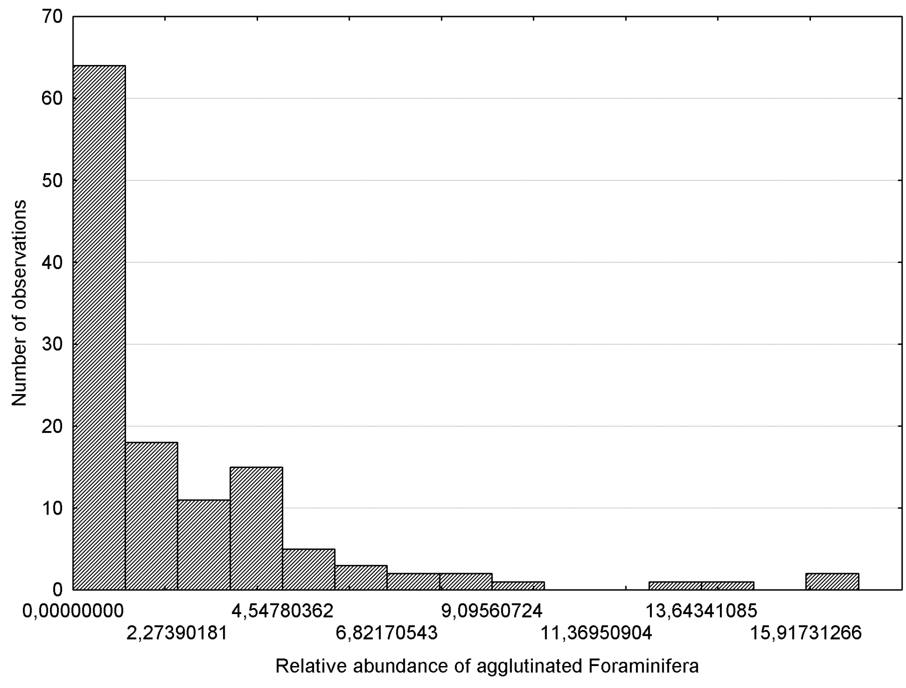

Fig. 1 Distribution of relative abundances of agglutinated Foraminifera in the Bryozoa-rich Middle Miocene assemblages

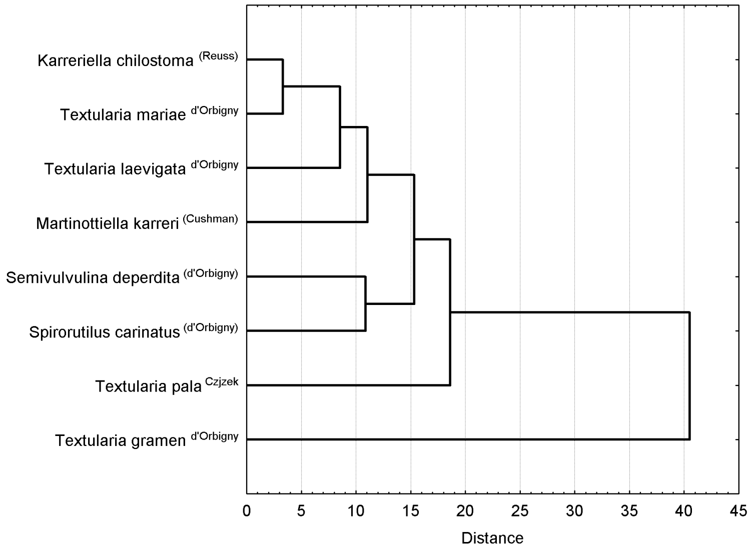

Fig. 2 Classification of agglutinated Foraminifera in the Bryozoa-rich assemblages using cluster analysis by software STATISTICA (Tree Clustering, Ward's method; Euclidean distance)

Cluster analysis classified agglutinated species from the Bryozoa-rich communities into two groups (Fig. 2). It can indicate possibility of two life strategies in the group of eight agglutinated species. (1) *Textularia gramen* occurs in assemblages mainly as only one the agglutinated species and was recorded in cibicidoids and *Elphidium-Amphistegina* assemblages. Its occurrences well-correlated with occurrences of *Lobatula lobatula* (corr. coefficient = 0.74), *Porosononion granosum* (corr. coefficient = 0.76), negatively with infauna (corr. coefficient = - 0.36)

(2) Diversified assemblages with 3-5 agglutinated species (*Karreriella chilostoma, Martinottiella karreri*, *Semivulvulina deperdita, Spirorutilus carinatus,, Textularia gramen, T. laevigata*, *T. mariae , T. pala*). This group of agglutinated Foraminifera occurs in *Bolivina-Cassidulina* assemblage what corresponds with statistically significant correlation between relative abundances of infaunal and agglutinated species (without *T. gramen*) (r = 0.52).

Agglutinated species were practically not recorded in the *Asterigerinata* assemblage.

Comparison with a few analyzed Early Miocene (Eggenburgian) Bryozoa-rich assemblages showed similar low abundances of agglutinated species (to 15%) and dominance of elongate keeled *Semivulvulina pectinata* (Reuss).

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Recent agglutinated foraminifera from Chilean Patagonic channels and fjords. Presence and abundance

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Several workers (among them Marchant, 1993, Zapata & Alarcón 1998, Zapata *et al,* 1995, Zapata & Moyano, 1997, Ishman & Martínez, 1995, Hromic, 2001, 2002, 2006, Hromic & Zúñiga 2005, Hromic *et al* 2006, Violanti *et al,* 2000) foccoused on the study of the benthic foraminifera from the Chilean channels and fjords. The information coming from these papers provided the baseline for performing a number of ecological and biological studies.

In this study, the agglutinated benthic foraminifera collected at 177 stations in the Chilean fjords and channels, between 42º S and 56º S, 20 to 1,300 m depth, were studied. Samples were collected during the cruises CIMAR-FIORDO 2, 3, 7,8,10, and 11, organized by the National Oceanographic Committee (CONA), Chile.

The agglutinated foraminifera were represented by 7,265 specimens, being a 10% of the total benthic foraminifera for the area. Among them 17 families, 26 genera, and 56 species were identified. The families Eggerilladae and Trochamminidae showed the greatest diversity, with 9 and 7 species, respectively. On the contrary, Rzehakinidae and Remaneicidae showed the lowest species diversity.

When considering the total of the stations, only six species showed abundance higher than 5%: *Textularia pseudogramen* (15.49%), *Rhabdammina abyssorum* (10.92%), *Alveolophragmiun orbiculatum* (10.68%), *Labrospira kosterensis* (8,44%), *Labrospira jeffreysii* (6,57%), and *Recurvoides scitullum* (6,49%). However, some other species showed high abundances values at a more local scale (a single station). In this regards, 25 species reached abundance values higher than 20%, and 8 species abundances of 11-20%. Other 19 species showed abundances lower than 5% in all the samples.

Most of the species showed a restricted geographic distribution: 42.4% of the species were present in only 1 to 4 stations; they also showed a low representativity. Consequently, these species are considered as opportunist. *Labrospira jeffreysii* and *L. kosterensis*, the more widespread species, were collected in only 23.2% of the stations.

Keywords: Channels and fjords, Recent agglutinated foraminifera, presence and abundance

A Catalogue of Agglutinated Foraminiferal Genera – Towards a revision of Loeblich & Tappan (1987)

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The descriptions of Genera of Agglutinated Foraminifera are in need of revision and updating. The compilation of Loeblich & Tappan (1987), though an invaluable contribution that brought stability to field of foraminiferal systematics, is now 20 years out of date. At latest count, over 130 new genera of agglutinated foraminifera have been described since 1987 (Kaminski, 2000, 2004, 2008); and many others have been emended based on subsequent study.

In 2002, an international working group was convened to address the problem of updating the systematics of the Foraminifera. New advances in molecular biology and new ideas for the suprageneric classification of the Foraminifera (including changes in rank of the group as a whole), have now made the Loeblich & Tappan classification obsolete.

As a first step towards the eventual task of reclassifying the Foraminifera, we have prepared a compendium of all the agglutinated genera considered valid. The original file (Agglut-2004) consisted of the generic descriptions scanned from Loeblich & Tappan (1987), with updated comments added as remarks. An appendix at the end of the Word file listed all the newly described genera, presented in the same format as in Loeblich & Tappan (1987). Another appendix listed those genera that are considered to be invalid or junior synonyms. In 2005, as a further step toward making a proper database of agglutinated foraminiferal genera, each genus has been copied into a separate file. The file format follows the general format of the Ellis & Messina Catalog of Foraminifera, and contains the name of the genus, the type species, type reference, synonymy, the description and remarks, stratigraphic range, and the illustrations. Since 2006, we have been adding additional illustrations and re-scaning original figures. As part of this work we have lectotypified over 35 type species of genera housed in the collections of the NHM in London. We have now completed the task of revising the Astrorhizida and Schlumbergerinida, and are currently updating the Hormosinina and Lituolida.

In the short term, our goal is to produce a revised compendium of the valid genera of agglutinated foraminifera that can be accessed in electronic form. It is envisaged that this will be the first stage in the revision of foraminiferal genera as a whole.

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The search for the elusive *Entzia*, an enigmatic agglutinated foraminifer from the Transylvanian salt marshes

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Over 120 years ago, Eugen von Daday, a lecturer from the University of Klausenburg, described an enigmatic polythalamian from a salt marsh near Deva. Named *Entzia* after his professor Géza Entz, this species was only known from the colourful lithograph that accompanied his original description.

The genus *Entzia* was recognized by Loeblich and Tappan in 1987 and placed into the Family *Trochamminidae,* Subfamily *Jadammininae*. However, its relationship to the type genus of the subfamily, *Jadammina*, remains to be resolved. Some of our colleagues, including John Whittaker, have always suspected that the genus *Entzia* may be the senior synonym of *Jadammina*. This is likely due the similarities in their habitat. For this reason we visited a number of salt marshes in Transylvania (Ocna Sibiului, Turda, Cojocna) with the hope of recovering additional specimens in order to resolve this taxonomical problem. Although the original site described by Daday in Deva no longer exists, we managed to find other promising localities and collect samples hoping to recapture the elusive *Entzia*.

In October 2007, during the UCL-BBU field excursion, as part of the UCL MSc course in Micropalaeontology, we visited the salt marsh in Turda, next to the public swimming pool. Samples were taken from the surficial mud in the proximity of live *Salicornia* plants, then preserved in ethanol and stained with Rose Bengal in order to separate living specimens.

Recovered specimens are small, with thin, flexible, very lightly agglutinated walls, and with a preference for dark mineral grains. Specimens collapse upon drying.

Additional specimens recovered in 2008 prove an obvious seasonal abundance. More specimens will be recovered in order to document the apertural characteristics and compare them with specimens of *Jadammina* from other European marshes. To our knowledge, this is the first report of "*Entzia*" since 1884. Our new finding confirms the occurrence of living agglutinated foraminifera in continental environments in Transylvania.

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A larger agglutinated foraminifer originally described as a marine plant: The genus *Arthrodendron* Ulrich, 1904 (Foraminifera) and its species

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Larger agglutinated foraminifera commonly occur in Upper Cretaceous and Paleogene flysch deposits worldwide. Some of these specimens have been historically referred to numerous genera of marine plants, body fossils of unknown affinity, or trace fossils. We regard the valid generic name for such fossils to be *Arthrodendron* Ulrich, 1904, which is transferred to the Foraminifera (Kaminski et al., in press).

The large agglutinated foraminiferal genus *Aschemocella* Vialov, 1966 (type species *Aschemonella carpathica* Neagu, 1964), and the body fossil *Halysium* Swidzinski, 1934 (type species *Halysium problematicum* Swidzinski, 1934) are now regarded to be junior synonyms of *Arthrodendron* Ulrich, 1904 (type species *A. diffusum* Ulrich, 1904), a form originally described as a marine alga from Upper Cretaceous flysch sediments of the Kodiak Formation (Yakutat Group), on Pogibshi Island, Alaska. The species *Aschemonella carpathica* Neagu is regarded as subjective junior synonym of *Arthrodendron diffusum* Ulrich.

At least four valid species of *Arthrodendron* have been reported from Late Cretaceous to Paleogene deep-sea sediments under various generic names. In addition to the type species *A. diffusum* (=*A. carpathica* Neagu, 1964), the species *A. moniliformis* (=*Aschemonella moniliformis* Neagu, 1964), *A. grandis* (=*Reophax grandis* Grzybowski, 1898), and *A. subnodosiformis* (= *Hyperammina subnodosiformis* Grzybowski, 1898) are commonly reported from deep-sea turbiditic deposits, mostly in the Carpathians. The latter two species were transferred to the genus *Aschemocella* by Kaminski & Geroch (1993). We also described a new species of *Arthrodendron* from the Eocene part of the Magura Flysch in southern Poland. However, the validity of the 19th century species originally described as fossil algae needs to be evaluated. It is possible that some of the species described by Unger (1847), Heer (1877), and by Fuchs (1894) may be senior synonyms of some names in current usage. We will present a review of the valid (and questionably valid) species of *Arthrodendron*.

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Cretaceous Deep-Water Agglutinated Foraminiferal Biofacies and Paleoceanography

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Cretaceous deep-water paleoceanography is still in an early stage since proxy data from stable isotope analysis and geochemistry data of calcitic benthic foraminifera are generally unavailable owing to an unusually high calcite compensation depth (CCD). The only biological tracers, which are present in virtually all Late Mesozoic deep ocean basins are organically cemented deep-water agglutinated foraminifers (DWAF). Distribution patterns of DWAF in the deep sea are mainly depending on carbonate availability, carbon flux, ventilation of deep water, environmental disturbance (deep sea currents, turbidites and rapid sedimentation events) and substrate and have thus significant potential to reconstruct deep sea environmental conditions. However, their potential as tracers of late Cretaceous deep water masses and as tool for understanding the paleoceanography of non-uniformitarian Cretaceous deep sea sediments such as deep sea "black shales" and the widely distributed oceanic red beds is still insufficiently exploited. Quantitative distribution patterns are only known for few DSDP/ODP sites and mainly concentrate on the North Atlantic Ocean and some key sections in the western Mediterranean and Alpine-Carpathian mountain chains. We review the state of paleoecological information and an expanded database of their distribution, including new data from the West Pacific Ocean and Himalayan Tethys.

Devonian foraminifers of the Góry Świętokrzyskie Mts, Poland

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Diverse assemblages of agglutinated and calcareous foraminifers have been documented in many of the stratigraphic horizons assigned to the late Emsian through latest Famennian of the Devonian Holy Cross Mountains sequence in the Kielce and Łysogóry regions of Central Poland.

The oldest assemblages of foraminifers have been recorded from shallow marine sediments, i.e., claystones, mudstones, limestones and marls of late Emsian age (late *serotinus-patulus* conodonts zone) ascribed to the Grzegorzowie Formation of the Łysogóry region. There are numerous agglutinated foraminifera species of the genera: *Ammodiscus, Amphitremoida, Hemisphaerammina, Hyperammina, Lagenammina, Psammosphaera, Reophax, Saccammina, Saccarena, Sorosphaera, Stegnammina, Tolypammina, Thurammina, Webbinelloidea,* and less numerous specimens of *Semitextularia thomasi* Miller & Carmer and *Pseudopalmula palmuloides* Suchman & Stainbrook, with tests composed of fine carbonate particles or cryptocrystalline calcite. Numerous specimens of *Webbinelloidea similis* Stewart & Lampe with secondary participation foraminifers of the genera: *Hyperammina*, *Amphitremoida*, *Lagenammina* and *Saccammina* are known from shallow water claystones and limestones of brachiopods-tentaculites biofacies at the Emsian/Eifelian boundary - the *patulus*/*partitus* conodonts zones of the Łysogóry and Kielce Regions (Duszyńska, 1959; Malec 1984a,b, 1992; Malec, Studencki, 1988; author's unpublished data).

There are numerous specimens of agglutinated foraminifer belonging to the genera: *Hyperammina*, *Tolypammina* and *Webbinelloides* occurring in shallow marine limestones, marls and claystones of brachiopod and tentaculite biofacies of late Eifelian age – the *kockelianus-ensensis* conodont zones of the Skały Beds in the Łysogóry region. Scarce, though locally abundant in these sediments, are multilocular foraminifers with calcareous tests assigned to *Semitextularia thomasi* Miller & Carmer. This species is often noted in shallow marine limestones and marly sediments of Givetian age; they correspond to the *varcus* conodont zone, in upper part of the Skały Beds and the biostromal Pokrzywianka Beds (Duszyńska, 1956; author's unpublished data).

Scarce foraminifers of the genus *Nanicella* and *Semitextularia* were derived from the upper Givetian biostromal complex of the Kielce region. Abundant assemblages of calcareous multilocular foraminifers, i.e., *Eonodosaria*, *Lunucammina*, *Multiseptida*, *Nanicella*, and *Paratikhinella*, occur in Frasnian reef and fore-reef limestones of the Kielce region (Ozonkowa, 1961; Racki, Soboń-Podgórska, 1993). In this area, in limestones and marls clayey shale interbeds correspond to uppermost part of upper Famenian deep-water deposits of conodont *expansa-praesulcata* zones. These rocks contain rich assemblages of agglutinated foraminifers belonging to the genera: *Hemisphaerammina, Hyperammina, Lagenammina*, *Nanicella, Paratikhinella*, *Psammosphaera*, *Pseudoastrorhiza*, *Septatournayella, Tolypammina* and *Webbinelloidea* (Olempska, 1983; Jurkiewicz, Żakowa, 1983; Żakowa et al., 1985).

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A Shallow-Water *Reticulophragmium* Biofacies in the Arctic Paleocene

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Reticulophragmium boreale (Petracca, 1972) was first described from well cuttings and core of the Reindeer D-27 exploration well in the subsurface of the Mackenzie Delta. The Reindeer D-27 well, drilled in 1965, was the first deep borehole on the Arctic margin of Canada and soon became controversial for a number of reasons including erroneous species identifications and mistaken age and paleoenvironmental determinations complicated at least in part by contamination of microfossil samples during laboratory processing whereby Arctic Paleocene agglutinated foraminifera were mixed with Eocene/Oligocene foraminifera from the Pacific margin. Regardless of the problems caused by contaminated samples, there still remained the problem of paleoenvironmental interpretation.

Because of its alveolar wall structure, *R. boreale* was initially classified as a species of *Cyclammina* and a deep-water habit was automatically assumed, although it was known that *Cyclammina* occurred also in reduced numbers on the mid- to outer shelf in the both the Recent and the fossil record. These assumptions on the paleoenvironmental distribution of *Cyclammina*, and *Reticulophragmium*, are probably still generally correct for most of the Recent and geological record with one important exception – the Arctic.

In Paleocene (Selandian) strata of the Canadian Arctic, *Reticulophragmium* (*R. boreale*) is found widely in relatively well-developed marine shelf assemblages containing agglutinated and calcareous benthic foraminifera. In a landward or southern direction, these assemblages diminish in species diversity to the point of being reduced to a monospecific *Reticulophragmium* assemblage/biofacies occurring in marginal-marine sediments close to terrestrial coaly strata.

The *Reticulophragmium* biofacies and its more diverse offshore biofacies equivalents are widespread on the margin of Arctic Canada, having been documented from the Mackenzie Delta area to Ellesmere Island in the high Canadian Arctic. The distribution of the *Reticulophragmium* biofacies and its proximal marine limit is a proxy for maximum marine flooding in the Paleocene of Arctic North American.

Shell wall ultrastructure of some Recent agglutinated Antarctic genera

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Twenty one of the recent species of different agglutinated genera from the "Ob"1956, "Polarstern" 1996 and "Vityaz"1963 gatherings mostly from the Antarctic area (but some samples were taken also on the vessels way to the Antarctic region through the tropical part) were studied in SEM. The details of the wall ultrastructure were studied on the broken shells. In the widely accepted classification of Loeblich & Tappan, 1987 features of the shell wall texture and of its ultra structure is one of the basic taxonomic characters of high taxa. Meanwhile the majority of the genera are not investigated from this point of view, and for some genera there are rather contradictory data and their reinvestigation is necessary. The present study deals with the species having unilocular (*Thurammina protea, Th. favosa reticulata, Tholosina laevis, Tholosina vesicularis, Saccammina basispiculata, Rhabdammina antarctica*) and pseudocolonial shell (*Sorosphaera confusa, Psammophax consociata*), as well as the multichambered forms of different taxonomic groups (subclass Hormosinana: *Hormosinella distans antarctica, Ginesina guttifera, Reophax subfusiformis, Nodosinum gaussicum*; subclass Textulariana: *Cribrostomoides antarcticus, Haplophragmoides umbilicatum, Cyclammina orbicularis asellina, Pauciloculina antarctica*; *Clavulina pacifica, Dorothia ergella, Matanzia bermudezi, Gaudryinoides apicularis, Verneuillinula pusilla*) (the last three species defined by H.M. Saidova are from the tropical Pacific).

The general conclusions of this study are the following. All the species studied including the unilocular ones have pseudopore openings in their shell wall easily seen under the bigger magnifications (from x200 to x4000) though previously the shells of many of them were indicated as being imperforate. Usually between the bigger sand grains the pseudopores have irregular or fissured form. In the case of the very small sand particles the pseudopores looks usually as small rounded openings sometimes little elevated above the surface. In the case of strongly variable size of sand particles the both types of the pore openings may present in the wall of the same species. In the multichambered species with the distinct sutures the density of the pore openings is higher in the sutural area or near this area. At the apertural faces of the multichambered shells the pseudopore openings are usually smaller in their size and rarely and irregularly dispersed, sometimes these apertural areas have fully imperforated character. In the wall of *Clavulina pacifica, Dorothia ergella, Matanzia bermudezi, Verneuillinula pusilla* the canaliculi are present as well as in the wall of the eleven Verneuilinid species of the previous study (Mikhalevich, Peryt, 2007). Canaliculi are usually situated in their lateral shell wall. Their openings at the inner shell wall are seen as rather dense circular openings at the lateral sides of the chambers, the bottom of the chambers is covered by the imperforated organic sheet. At the transverse broken canaliculate shell wall canaliculi could be often seen only at some parts of this wall being destroyed and unclear in its other parts. This circumstance could explain some contradictory data on the same genus or species especially concerning the fossil forms. The peculiar character of the pseudopore size, form and their distribution on the shell surface among the species studied shows that such features could be used as the particular taxonomic qualities of the species studied.

The work represents a part of the future work on comparison of the agglutinated shell wall ultrastructure of recent and fossil (Cretaceous) forms in co-operation with D. Peryt.

Agglutinated foraminiferal trends and assemblages from the Sedili Besar River and the adjacent offshore area, southeastern Peninsular Malaysia

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The Sedili Besar River is strongly tidal in its lower reaches with a well-developed estuary. It enters the sea along the wave dominated southeastern coast of the Malay Peninsula. A total of 103 surface sediment and 48 shallow core samples from the tidal part of the river and the offshore area were studied for foraminifera to determine the number of foraminiferal species per unit weight of sediment in each facies type. Preliminary results of the Recent foraminiferal assemblages recorded from the study area are discussed here. The distribution of the agglutinated foraminifera shows clear abundance trends from the river estuary to the shallow marine offshore. Foraminiferal abundance using both calcareous and agglutinated forms increases with water depth. However the agglutinated foraminifera shows the reverse trend. Five biofacies zones can be differentiated based on the abundance and species make up of the main agglutinated foraminifera. These coincide with the upper intertidal, lower intertidal, estuary mouth, nearshore and shallow marine depositional settings. Identification of these assemblages within the rock record from the Malay Basin and elsewhere will help considerably in the more precise characterization of the paleoenvironments.

Monothalamous Foraminifera and gromiids from the Black Sea

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The Black Sea has a positive water balance, in which the inputs from freshwater sources exceed losses by evaporation. This strong input of fresh water determines the presence of a halocline at 150-200 m depth below which anoxic condition prevails.

We report the preliminary analyses of foraminiferal assemblages in recent sediment samples collected in the Black Sea in the framework of the European Programme HERMES – WP1. Samples were taken along three transects at 160-200 m (oxic-anoxic interface) and 2000 m depth, previously mapped by GeoEcoMar and IFREMER and further investigated in detail for bottom topography. This work is based on multicorer samples collected along the stable transect located west of the Danube delta. The Rose Bengal stained wet residues were sorted for benthic foraminifera. The three first sediment slices (0-0.5, 0.5-1 and 1-1.5 cm) were investigated unstained and all organisms apparently alive were collected and put in a plastic vials with Guanidine for future molecular analysis.

At the shelf station (175 m water depth), species richness and diversity were high. Several soft-walled monothalamous foraminifera, including *Psammophaga*, Silver *Saccaminid*, *Tinogulmia* sp., and *Vellaria* sp. and indeterminate allogromiids were present. At the deepest stations (respectively, 645 and 2025 m water depth), only stained specimens of an undetermined organism (morphologically similar to a Saccaminid) were present. Instead, the slope station (975 m water depth) was barren of meiofaunal organisms. These preliminary data reveal the presence of foraminiferal assemblages dominated by soft-walled monothalamous foraminifera and particularly by unidentified organisms. Further investigations (for example molecular analysis) will be essential in order to determine whether refer these unidentified organisms to Foraminifera.

Agglutinated foraminiferal assemblages of the Paleogene of Spitsbergen: responses to a semi-isolated Arctic Ocean

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The study is concentrated in the Central Tertiary Basin of Spitsbergen, which contains a ca. 2300 m thick Paleogene sedimentary succession. In addition, data from the Forlandsundet Graben (western Spitsbergen) are also included. These basins were marginal to, and communicated directly with the Paleo Arctic Ocean. We expect that overall environmental conditions of the ocean are reflected in the sediment infill of these Spitsbergen basins, but modified by local facies changes ranging from delta plain, prodelta to marine shelf.

In the Central Tertiary Basin, facies analyses are based on foraminiferal assemblage parameters combined with sedimentary data derived from the following deposits: 1. Lagoonal and prodelta mudstones occurring in the Firkanten Formation; 2. Outer to inner shelf shales and mudstones composing the Basilika Formation; 3. Prodelta mudstones of the Marstranderbreen Member (Frysjaodden Formation); 4. Marine shelf to prodelta mudstones of the Gilsonryggen Member (Frysjaodden Formation).

The foraminiferal succession of the Central Basin consists of agglutinated taxa, except for a few scattered samples where calcareous benthics occur in very low amounts. The species diversities are low in all of the studied intervals with average alpha value of 2.3 (range 1.2 to 3.0). The assemblages are of endemic nature as shown by dominance of species belonging to *Reticulophragmium, Convalina, Labrospira* and *Thurammina*. In these deposits, the total organic carbon content of is on average 1.1% (range 0.5 to 2.6%), while the calcium carbonate content averages 0.4% (range 0.0 to 17.1%).

The low diversity agglutinated nature of the foraminiferal assemblages indicates restricted environmental conditions. The main restricting factor was apparently low salinity, which is in accordance with the generally extremely low carbonate content. Low salinity as a restricting factor can originate also from local deltaic influx in lagoonal and prodelta settings (e. g. the Firkanten and Battfjellet formations). Reduced salinity in marine shelf settings (e. g. the Basilika and part of the Frysjaidden Formation) requires, however, much more extensive delta developments of regional scale.

Low diversity agglutinated assemblages of endemic nature, closely similar to those of the Central Tertiaty Basin, are recorded from the Beaufort-Mackenzie Basin and Western Siberia. The assemblages suggest that reduced salinity conditions prevailed in the upper part of the water column of the Arctic Ocean in Paleocene-Eocene times. These foraminiferal facies developments accord with the *Azolla* (freshwater fern) boom recorded from the Lomonosov Ridge, and explained by episodic presence of fresh surface waters in the Eocene Arctic Ocean.

Low salinity carbonate-starved conditions in the Arctic Ocean developed owing to the absence of deep-water connection between the Polar Basin and the world ocean during Paleocene-Eocene times. At the Eocene-Oligocene transition, deep-water connection with the North Atlantic became established by sea-floor spreading between Spitsbergen and Greenland, leading to development of normal marine salinity conditions in Arctic Ocean waters. This turnover is signaled by occurrence of calcareous foraniniferal assemblages of Western European affinity in the Oligocene of the Forlandsundet Graban.

Upper Eocene agglutinated foraminifera form Buciumeni, Ialomița Valley

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A well-preserved assemblage of benthonic and planktonic foraminifera was obtained from the Upper Eocene deposits outcropping near Buciumeni village alongside Ialomita Valley. Here were identified about 40 species of agglutinated foraminifera.

Biostratigraphically, the investigated section covers the interval from AE8 Zone (*Subbotina eocaena*) to AE10 (*Globigerinatheka* index).

First Middle Ordovician (Darriwilian) Foraminifers from the San Juan Formation, Cerro Viejo, Central Precordillera, Argentina

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The first Middle Ordovician (Darriwilian) foraminifers are described from strata of the upper part of the San Juan Formation from the Precordillera terrane in Argentina and represent the first discovery of Ordovician foraminifers in South America. The Ordovician succession consists of carbonate rocks of the extensive platform that characterizes the Precordillera, and are exposed in La Rioja, San Juan and Mendoza provinces. The carbonate sequence is represented by the La Silla and San Juan formations and is overlain by the Gualcamayo or Los Azules formations that consist of black shales with intercalated deep water calcareous mudstones.

The Cerro Viejo is a classical area for the study of the Ordovician in the Central Precordillera. There, the San Juan Formation of Dapingian and Darriwilian age forms the core of the Huaco anticline, on the western flank of which crops out the shaly succession of the Los Azules Formation of Darriwilian age. The area of this study is located in San Juan province on the western flank of the Huaco anticline about 4km southeast from La Cienega village. The northernmost section, the source of foraminifers, is located on Del Aluvión creek. The San Juan Formation bears a rich shelly fauna of brachiopods, trilobites, nautiloids, echinoderms, gastropods, sponges, conodonts, ostracods and foraminifers.

The foraminifers are found together with conodonts of the *Eoplacognathus pseudoplanus* /*Dzikodus tablepointensis* Zone that enhances the stratigraphic significance of the foraminifers. The assemblage of foraminifers consists of the agglutinated genera *Lakites*, *Amphitremoida*, *Lavella*, *Ordovicina* and *Pelosina*. The distribution of the genera *Lakites* and *Lavella*, previously known only from the Lower Ordovician, Floian (*Tetragraptus phyllograptoides* graptolite Zone), now can be extended up into the Middle Ordovician (Darriwilian). The discovery of representatives of the xenophyophorean genus *Pelosina* extends the first appearance of this genus down into the Middle Ordovician.

Agglutinated foraminifera from the Badenian (Middle Miocene) of Eastern Slovenia

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Previous research has shown the ranges of agglutinated foraminifera in Middle Miocene sediments of Slovenia. Their acme was shown to be throughout the Middle Badenian; resulting in the designation of the foraminiferal zone *Spirorutilus carinatus* (RIJAVEC, 1977, RIJAVEC & DOZET, 1996). Despite of their wide use in biostratigraphy, based mostly on the number of agglutinated tests present, their taxonomy has not been studied in detail before. In this study, 121 Badenian samples from six sections of the Planina syncline (Eastern Slovenia, Central Paratethys) have been studied. Sections contain sediments from the lower Lower Badenian up to the upper Upper Badenian in a continuous sequence (OBLAK, 2006).

Seventeen agglutinated species were recognized and classified according to LOEBLICH and TAPPAN classification (1987, 1992). From the order Astrorhizida only *Bathysiphon taurinensis* SACCO was determined. The order Lituolida is represented by species *Reophax scorpiurus* DE MONTFORT, *Spirorutilus carinatus* (D'ORBIGNY), *Vulvulina pennatula* (BATSCH), *Pavonitina styriaca* SCHUBERT, *Pseudotriplasia robusta* MAŁECKI, and the order Textulariida by species *Karreriella chilostoma* (REUSS), *Martinottiella communis* (D'ORBIGNY), *Bigenerina agglutinans* D'ORBIGNY, *Semivulvulina pectinata* (REUSS), *Semivulvulina sagittula* (REUSS), *Textularia gramen* D'ORBIGNY, *Textularia mariae* D'ORBIGNY, *Textularia pala* CZJZEK, *Siphotextularia concava* (KARRER), *Siphotextularia inopinata* ŁUCZKOWSKA and *Cylindroclavulina rudis* (COSTA).

In the Planina syncline, agglutinated foraminifera are present throughout the Badenian. The Lower Badenian is characterized by dominance of species *T. mariae, T. gramen* and *S. carinatus*. In the upper-most Lower Badenian the species *C. rudis, M. communis* and *K. chilostoma* got also abundant. In the Early Middle Badenian, *B. agglutinans* and *M. communis* became dominant, *B. agglutinans* stays dominant throughout the Late Middle Badenian. An association of *P. styriaca* and *S. inopinata* characterizes the lower Upper Badenian. In the only sample from the upper Upper Badenian, agglutinated foraminiferal tests were absent. Stratigraphic ranges of recognized species from this study are seen to correspond to known stratigraphic ranges for the Central Paratethys (CICHA et al., 1998).

In Slovenia, 13 species from Badenian sediments were determined for the first time. Species *B. taurinensis* and *S. carinatus* previously only known from the Lower and Middle Badenian, show extended stratigraphic range up to the Upper Badenian. Contrary to previous research, agglutinated foraminifera do not reach an acme in the Middle Badenian; but are found to be most abundant in the Late Lower Badenian. This could be a result of local palaeoecological conditions occurring within the studying area.

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Response of agglutinated benthic foraminifera to different paleoenvironmental events across the lower Paleogene of the Zumaya section (N Spain)

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We studied the response of agglutinated benthic foraminifera to different paleoenvironmental events recorded across the lower Paleogene of the Zumaya section (Basque-Cantabrian Basin, Northern Spain). Multidisciplinary studies have been carried out at several quarries at Zumaya, which contain some of the most complete and expanded deep-water successions across the Paleocene and Eocene so far reported. The Zumaya section contains abundant calcareous-cemented (*Arenobulimina truncata, Clavulinoides trilatera, Dorothia, Marssonella, Remesella varians*) and organically-cemented (*Hyperammina, Karrerulina, Saccammina placenta, Rhabdammina, Recurvoides, Trochamminoides, Paratrochamminoides*) agglutinated foraminifera belonging to DWAF (Deep Water Agglutinated Foraminifera) taxa of the flysch-type fauna (Kuhnt & Kaminski, 1997). Mixed calcareous-agglutinated benthic foraminiferal assemblages indicate deposition above the CCD for most part of the Zumaya section. Kaminski & Gradstein (2005) included the lower Paleogene from Zumaya into the low to mid-latitude slope-type biofacies of Kuhnt et al. (1989).

Global events such as the collapse of calcareous primary producers, sea-level changes and warming events, including a benthic foraminiferal extinction, are recorded during the Cretaceous/Paleogene (K/Pg) boundary, the Danian/Selandian (D/S) boundary, the mid-Paleocene biotic event (MPBE) and the Paleocene/Eocene (P/E) boundary. Benthic foraminiferal assemblages living at the seafloor were more or less affected by these events depending on the nature and extent of each event, but also depending on their paleoecological preferences. We carried out quantitative and morphotype analyses of agglutinated benthic foraminiferal assemblages in order to investigate the paleoecological response of different taxa to these well-known events.

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Recent benthic foraminifera of West Mediterranean Sea and Gulf of Cadiz

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The Mediterranean Sea, one of the most oligotrophic basins in the world, is characterized by a west-east productivity gradient because of the hydrographic differences between its two sub-basins, the different productivity levels in the surface waters and the variability in vertical fluxes of organic carbon to the seafloor. Relatively nutrient rich waters enter the Mediterranean in a surface flow through the Strait of Gibraltar (North Atlantic surface waters) and during eastward transport, the salinity and temperature of these waters increase, while nutrient concentrations decrease. This nutrient gradient is expressed in declining primary productivity values from west to east. Sediment samples collected during the 1st leg of the TRANSMED Cruise in the Mediterranean Sea and Gulf of Cadiz (depth range 1850 - 4385m) were analysed for 'living' (rose Bengal stained) benthic foraminiferal species in order to study their distribution patterns and ecological preferences. We studied the 63-150 and >150 μm fractions of surface sediments (0-2 cm, sliced into four layers, 0.5 cm thick) from four box cores collected in the Western Mediterranean Sea (BC V2A, BCV3C, BCV3A and BCV4A) and three box cores from the Gulf of Cadiz, (BCVAA, BCVKA and BCVM). All sampling stations were located at >2000 m water depth except for BCVM, which was at 1850 m depth. The richest samples were BCV3A (Algero-Provencal Basin) and BCV4A (Alboran Basin) where monothalamous species dominate, especially in the finer fraction. Both sieve fractions at the deep-water sites (>2000m) were characterized by low foraminiferal abundance (30-55 specimens/20 cm^3) and low diversity. The assemblages were mainly composed of *Glomospira charoides* and organic-walled monothalamous species, including *Nodellum*-like forms. Moreover, the finer fractions of box cores BCV2A, BCV3A and BCV4A (2680 - 3570 m depth) yielded the monothalamous species *Resigella moniliforme*. This species is typical of deep-water environment in the Pacific Ocean. The coarser fraction of box cores form the Gulf of Cadiz shows high percentage of *Rhizammina*, *Sacchoriza ramosa* fragments and different types of komoki fragments. We hypothesize that the different distribution of the stained assemblage corresponds both hydrographic differences and the decline of primary productivity from west to east.

Agglutinated foraminifera from the transitional beds between the Maiolica and Fucoid Marl Formations at Gorgo a Cerbara, Umbria-Marche Basin, Italy

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In order to investigate the dramatic changes in sedimentation across the OAE1a in the Umbria-Marche basin, Italy, detailed sampling has been carried out along the *Gorgo a Cerbara* section. This section has been proposed as the worldwide reference for the magnetostratigraphically defined Barremian/Aptian boundary (Gradstein *et al*. 2004). In addition to the Selli layer and Barremian/Aptian boundary, the studied interval contains the lithological boundary between the *Maiolica* Formation (U. Tithonian – L. Aptian) and the *Marne a Fucoidi* Formation. (L. Aptian – U. Albian).

We have logged a 34 m thick section centered on the Selli layer and collected 50 samples to examine their micropalaeontological content. Limestone samples were treated with hydrochloric acid in order to survey the siliceous/agglutinated assemblage.

The assemblage changes are in phase with lithological changes throughout the interval. The Barremian part of the section is characterised by cyclical alternation (period of 80 cm ± 25 cm) of more massive, hard, whiter pelagic limestones and darker intervals, characterized of black clay layers, beds of black chert, and softer, greyish marly limestones. When samples from this part of the section are treated with hydrochloric acid, from 200 g of original material a total of 0.1 – 0.5 g of insoluble residue is obtained. This is mainly composed of radiolarians (largely spumellarians) and agglutinated foraminifera. Around 300 specimens of agglutinated foraminifera are present in 100 g of original material. Among them, tubular forms (*Rhizammina* type) are predominant, followed by rare *Bathysiphon* sp., and *Reophax minutus*. Diversity of DWAF in the uppermost *Maiolica* Formation is very low.

Samples extracted from the white pelagic limestones are characterized by rare radiolarians and a richer, more diversified agglutinated fauna, with some remarkably larger specimens; samples from the darker marls are typified by a fairly high ratio radiolarians/foraminifera and by a poorer, less diversified agglutinated assemblage. The faunal content reflects the presence of productivity cycles. Among the couplets, below -5.00 m from the base of the Selli layer, well-oxygenated settings appear to be prevalent, whilst above this level the dysoxic intervals are thicker.

The samples collected in the first 50 cm above the top of OAE1a are mainly characterised by radiolarians, both spumellarians and nassellarians. Remarkably, from only 1 g of original material of a clayey sample collected at +0.15 m, about 500 specimens of well-preserved radiolarians have been extracted.

From +0.50 m to +3.00 m foraminifera appear in the samples. Among the agglutinates, the background fauna of tubular forms is still present, but is augmented by a growing percentage of *Reophax minutus* and *Ammodiscus* spp.

The relationship between food supply to the deep sea and sediment niche differentiation; implications for the ecologies and microhabitat of *Glomospira charoides*

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Glomospira charoides is a species that is typically found to be more abundant in the dead component as opposed to the live component of foraminiferal assemblages observed from deep sea bathyal mud cores (Fontanier, personal communication). Where it has been found stained by rose-bengal, *Glomospira charoides* is found to express infaunal tendancies with maximum abundances occurring below the uppermost 1 and 1.5 cm (Mackensen & Douglas 1989). However, these studies have only observed the >125 µm fractions. In this study, we present new data for live *Glomospira charoides* from a deep sea core collected on the Portuguese Margin for both the 63-150 µm and >150 µm size fractions. Live occurrences of adult forms display a maximum at 2-3 cm downcore in the > 150 µm fraction, whereas in the 63 – 150 µm fraction, live occurrences peak at 4-5 cm where juvenile forms dominate the live assemblage.

Mackensen & Douglas (1989) remarked that taxa such as *Cribrostomoides bradyi, Glomospira charoides* and *Labrospira wiesneri* with very fine agglutinated, smooth, light brown coloured tests are found to be characteristically infaunal, living below the uppermost 1.5 cm of sediment in the Eastern Weddel Sea. Here, we present new data of live (Rose Bengal stained) foraminifera from 9 cores obtained from a depth transect on the Portuguese margin with a depth range of 110m to 4000m. The taxa identified by Mackensen & Douglas (1989) are found to display the same infaunal characteristics in our samples from the most mesotrophic settings (1400m to 2500m) where food and oxygen availability are at an optimum, allowing for the existence of deeper infaunal niches.

We suggest that juveniles of *Glomospira charoides* occupy a deeper niche compared with adults, and rise up the sediment column to more superficial niches as their food? requirements increase along with test size. Interestingly, dead adult forms are not present in the juvenile horizon. This observation raises the question: Do adults reproduce at shallow depth in the sediment and juveniles subsequently migrate to deeper depth within the sediment?

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Late Cretaceous and Paleogene foraminifera of Western Siberia, their role in zoning and interregional correlation

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The Late Cretaceous and Paleogene foraminifera of Western Siberia are a widespread and rapidly evolving group of the microfauna. They are grouped through the section into the age assemblages differing by the systematic composition and quantitative characteristics. The careful monographic studies enabled local foraminiferal zones to be established, which are dominantly traced within the continuous section of marine deposits of the central district of Western Siberia (Podobina, 1998, 2000). In the marginal districts strata with fauna are established, because they are often isolated within a section and characterized by the foraminiferal assemblages distributed locally. In places these latter differ from the coeval zonal assemblages of the central district in their species composition. The establishment of the zonal assemblages has been based on the widespread species associations, of which differences in the systematical composition result from both the divergence of environmental conditions and the phylogenesis of separate foraminiferal groups. The zonal borders have been established by the primary appearance of new species and also by the extinction of a number of pre-existing taxa. The paleontological data, and specifically, foraminiferal assemblages, play the leading role not only in a zonation of sections and dating of stratons, but also for their interregional correlation. In high latitudes (the Arctic Circumpolar Belt and partially the Boreal Belt) benthic foraminifera are used for this purpose, because planktonic forms are usually represented here by separate uncharacteristic species, if ever occur. Thus, in Western Siberia they are only distributed in the lower strata of the Maastrichtian and entirely absent in the rest of the Upper Cretaceous section. The similar peculiarities in the distribution of the planktonic foraminifera are observed within the marine Paleogene section.

Due to the sharp difference in the systematic composition in the Upper Cretaceous, two groups of foraminiferal assemblages of different age have been established: the Cenomanian-Santonian group of dominantly agglutinated quartz-siliceous foraminifera and Campanian-Maastrichtian group of secreted calcareous forms. It should be mentioned however that in the marginal districts of Western Siberia corresponding to the shallow and warmed parts of the basin the secreted calcareous tests are met along with the agglutinated quartz-siliceous forms. The Cenomanian-Santonian group of foraminifera appeared to be similar to a certain extent in the systematic composition with Canadian and Alaskan assemblages assigned to the Arctic Realm of the Arctic Circumpolar Belt (Podobina, 1975, 1995, 2000). The Campanian-Maastrichtian assemblages of Western Siberia composing the second group of foraminifera are mainly represented by secreted calcareous benthic forms. They are slightly similar with tests from northern part of Central Asia and East-European Platform in the systematic composition. On account of the systematic composition of the foraminiferal assemblages, all above-stated regions have been included into the Boreal-Atlantic Realm of the Boreal Belt. The Paleogene foraminiferal assemblages of Western Siberia are similar with the Late Cretaceous associations in their characteristics of the systematic compositions and distribution through the sections. But all these assemblages include numerous endemic species and until recently were correlated with coeval associations from the adjacent regions conventionally by single taxa. The West-Siberian foraminiferal zones were previously correlated to the Upper Cretaceous and Paleogene chronozones of the International Stratigraphic Chart by their position within the section and separate finds of mollusks.

The data obtained recently from new boreholes of the south-eastern areas of Western Siberia enabled us to establish in the adjacent provinces and correlate the Late Cretaceous and

Paleogene foraminiferal assemblages by the systematic composition (Podobina, 2006, 2007; Podobina and Kseneva, 2006, 2007). Straits seem to exist in this part of the West-Siberian Basin in the Late Cretaceous and Paleogene, connecting it directly with southern seas. Later the neotectonic movements, probably, resulted in uplifts in south-eastern areas, isolating these basins.

As early as at the first stage the studies on the new materials demonstrated that the Late Cretaceous and Paleogene foraminiferal assemblages were composed by separate agglutinated quartz-siliceous forms along with secreted calcareous species association varied in the systematic composition and previously unknown in this province. The agglutinated forms of the south-eastern margins are similar with species association from the central district of Western Siberia. The secreted calcareous tests of the like systematic composition have previously been unknown from Western Siberia and seem to find their way to its south-eastern borderland from southern seas. They correspond almost closely to the foraminiferal assemblages from the adjacent provinces. These assemblages have preliminary been studied, and the obtained results promise solving the problem of the age of West-Siberian stratons, including West-Siberian foraminiferal zones and strata along with the lithological subdivisions – horizons and suites.

The establishment of the stratigraphic position of the Late Cretaceous and Paleogene stratons of Western Siberia offers the prospect of the interregional correlation of the coeval deposits. This enables the problems of paleogeography and paleobiogeography to be solved along with the peculiarities of formation and preservation of different mineral resources, including accumulation of industrial hydrocarbons, sedimentary iron ores, middle drink waters and others.

Besides, studies on the morphological arrangement, systematics, phylogeny of separate foraminiferal groups along with a search for criteria for the establishment of a paleontological species will be of great importance for the knowledge of the evolution of this group of organisms.

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The environmental effect on the composition of West-Siberian Late Cretaceous foraminiferal assemblages

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In the Late Cretaceous the West-Siberian marine basin was dominantly populated by benthic foraminifera of diverse systematic composition and aspect. The most prominent changes were previously traced within the Late Cretaceous section of the central district of Western Siberia where two foraminiferal groups were established: Late Cenomanian-Santonian and Campanian-Maastrichtian distinguished by the systematic composition at the level of higher taxa – orders and families (Podobina, 2000). The Late Cenomanian-Santonian foraminiferal assemblages of this district are mainly composed of quartz-siliceous forms as opposed to the subjacent Campanian-Maastrichtian calcareous tests. In the marginal districts of the West-Siberian Basin such sharp distinction between the systematic compositions is not observed: the calcareous forms appear in the coastal, more heated part of the basin since the beginning of the Late Cretaceous. During the time of the formation of the Late Cenomanian-Santonian group of foraminifera the West-Siberian Basin was directly connected with Arctic Regions, and agglutinated quartz-siliceous foraminifera are supposed to dwell in this territory with unobstructed passage to the lower latitudes. The positive tectonic movements starting since the Campanian resulted in uplifts in the Arctic territory involving the almost complete isolation of the West-Siberian Basin from the side of northern seas.

The studies on the material from the recently bored holes of the south-eastern areas of Western Siberia (the vicinity of town Seversk, boreholes ZN-1, ZN-2, ZN-3, N-15 and N-33) have disclosed that along with separate agglutinated quartz-siliceous forms, the first group of foraminifera (Cenomanian-Santonian) is dominated by calcareous tests of taxa widely distributed in southern provinces (Podobina & Kseneva, 2007a, b). The straight is supposed to exist in the Late Cretaceous in the south-east of the West-Siberian Basin, connecting it with southern seas. Through this straight the West-Siberian Late Cretaceous assemblages became enriched with southern migrants, among which were the index species from the assemblages of southern provinces. Subsequently, these straights were closed in the result of new tectonic movements.

The similar changes were revealed in the systematic composition of the second group of foraminifera (Campanian-Maastrichtian), however the presence of southern taxa, including the index species of the assemblages of southern provinces, did not so abruptly changed their assemblages. This made it possible to correlate West-Siberian foraminiferal zones containing the assemblages of both groups with the coeval zones of the Kazakh and East-European provinces.

Thus, the Late Cretaceous foraminiferal assemblages were formed in the changing ecological conditions, and this defined the difference in their systematic compositions both through the Upper Cretaceous section and laterally, especially from the north southwards. The systematic composition of the first group of northern foraminiferal assemblages (the central and northern districts) is similar to that of Canadian and North-Alaskan associations in the predominance of agglutinated quartz-siliceous forms, that have migrated from the Arctic Basin. Meanwhile, at the same stratigraphic level of the new borehole sections of southern district, the taxa of calcareous foraminifera were distinguished which had dwelled in relatively warm-water conditions of Western Siberia and the above-mentioned adjacent provinces. (Table).

Correlation of Upper Cretaceous foraminiferal zones and beds of West-Siberian and East-European Provinces

Table

System	Subsystem	Stage	Substage	Horizon	West-Siberian Province: Central district (zones)	West-Siberian Province: South-eastern district (nearby towns Tomsk and Seversk) (beds)	East-European Province (zones)
CRETACEOUS	UPPER	Maastrichtian	lower	Gankinskian	*Spiroplectammina variabilis, Gaudryina rugosa spinulosa*	*Spiroplectammina variabilis, Gaudryina rugosa spinulosa*	*Brotzenella complanata, Angulogavelinella gracilis*
		Campanian	upper		*Cibicidoides primus*	*Cibicidoides primus*	*Globorotalites emdyensis, Brotzenella monterelensis*
			lower	Slavgorodskian	*Bathysiphon vitta, Recurvoides magnificus*	*Recurvoides magnificus*	*Gavelinella ñlementiana*
		Santonian	upper		*Cribrostomoides exploratus, Ammomarginulina crispa*	*Gavelinella stelligera*	*Gavelinella stelligera*
			lower		*Ammobaculites dignus, Pseudoclavulina admota*	*Gavelinella infrasantonica*	*Gavelinella infrasantonica*
						Ammobaculites dignus, Pseudoclavulina admota	

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Agglutinated foraminifera from the Wielician from Călan

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In a sample coming from the left slope of the Strei River, near Calanu Mic, in a gypsum quarry, about 5 m above the first gypsum level, a rich foraminiferal assemblage occurs.

The association, characteristic for the Kossovian, is made of only a few species, but many specimens. They belong to the genera *Tritaxis*, *Evolutinella*, *Marginulina*, *Neobulimina*, *Bolivina*, *Uvigerina*, *Virguloides*, *Cassidulina*, *Astrononion*, many globigerinas (*Globigerinoides*, *Globoturborotalita*, *Globigerina* and *Velapertina*) and rare specimens of *Limacina* (as inner casts).

The genera *Tritaxis* and *Evolutinella* are the object of our study.

Agglutinated foraminiferal morphogroups in dysoxic shelf deposits from the Jurassic of Spitsbergen

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The material studied was collected from the Janusfjellet section of central Spitsbergen (Agardhfjellet Formation). The Callovian to Kimmeridgian succession in this section consists mainly of shales with variable organic carbon content. Five foraminiferal morphogroups (A to E) have been established according to their shell morphologies.

Morphogroup A: tubular and unilocular shells with inferred epifaunal suspensivorous habit (e.g. *Rhizammina*).

Morphogroup B: globular, pseudospheric and unilocular shells including epifaunal passive depositivorous forms (e.g. *Thuramminoides*).

Morphogroup C: elongated, subcylindrical, multilocular shells, with infaunal life-habit being detritivorous bacterial scavengers forming three subgroups: subgroup C1: uniserial forms, living in shallow to deep infaunal habitats (e.g. *Reophax*); subgroup C2: planispiral or streptospiral initial stage and uniserial final stage, living as shallow infauna (e.g. *Ammobaculites*); subgroup C3: biserial, triserial or elongated trochospiral forms, with shallow to deep infaunal strategies (e.g. *Verneuilina*).

Morphogroup D: spiral multilocular shells, living as epifaunal detritivores forming two subgroups: subgroup D1: globular and plano-convex shape and trochospiral coiling (e.g. *Trochammina*); subgroup D2: rounded, planispiral forms (e.g. *Cribrostomoides*).

Morphogroup E: flattened shells with two chambers with spiral or irregular coiling, living as epifaunal and phytal herbivorous and detritivorous (e.g. *Ammodiscus*).

The paleoenvironmental evolution of the Callovian to Kimmeridgian succession can be interpreted from the stratigraphic distribution of these morphogroups and sedimentological features. The lower part of the section is a fining-upward succession with a conglomerate at the base, sandstones, siltstones and shales (Oppdalen Member). The upward trends are characterised by increasing organic carbon content and expanding proportion of epifaunal foraminifera, while diversity and deep infaunal foraminifera (subgroups C2 and C3), decrease; this is congruent with upward decreasing oxygenation. In this interval a major regional transgressive event is recorded. The fining-upward trend terminates in black paper shales containing high amounts of organic matter (Lardyfjellet Member). The foraminifera show minimum diversity values in this interval. Morphogroups B and D1 increase and D2 diminishes. The assemblage is composed mainly of epifaunal forms. These features suggest dysaerobic to anaerobic conditions. Absence of oxygen in infaunal microhabitats explains the dominance of epifauna. The shales have been interpreted to represent a maximum flooding interval and a stagnant bottom water.

The second part of the studied section consists of sandstones and silty shales (Oppdalsåta and Slottmøya Mbs.), with an upwards decrease in organic carbon content. At its base, the interval is characterised by low frequency of epifauna (subgroup D1), and high values of shallow infauna (subgroup D2), while above this interval, an increasing in organic carbon content and epifauna is registered. The trend in lithofacies and foraminifera from the top of the black shales suggests an initial upward increasing oxygenation interpreted in a regressive phase, while the top of this interval is interpreted in a transgressive context.

Morphological and molecular studies of komokiacean and komokiacean-like foraminifera from the Porcupine Abyssal Plain (NE Atlantic) and Weddell Sea (Southern Ocean)

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Although hard-shelled Foraminifera are well known, we still know little about the delicate, soft-shelled species that have little fossilization potential. In fact, as recently as 1977, Tendal and Hessler created a new family (Komokiacea) of delicate agglutinated Foraminifera that constitute a very important component in the abyssal and oligotrophic sediments. Subsequent studies of this group were made by a number of authors, but most researchers ignored komokiaceans because they resemble organic detritus, sediment mudballs or small fragments of other organisms.

We observed many morphotypes of monothalamous Foraminifera in the superficial sediment samples from the Porcupine Abyssal Plain (PAP, 48° 51' N; 16° 30' W). Many of the species and morphotypes, and about 75% of the specimens, were Komokiaceans; the remainder belonged to other soft-bodied taxa or informal, undescribed groups. Among the Komokiaceae we recognised the families Baculellidae and Komokiidae and two other groupings, chain-like taxa and komokiaceaens *incertae sedis*, each with 5, 35, 9 and 68 morphospecies respectively. We made a particular effort to distinguish between complete and specimens and fragments. The komokiaceans *incertae sedis* included a variety of mudballs in which the organisation of the tubules that constitute the test is very difficult to discern. Almost all these mudballs are undescribed. Some komokiacean morphospecies, for example, those belonging to the genus *Septuma*, are very similar to species from the Weddell Sea described by Gooday et al. (2007a, 2007b). We emphasise the importance of documenting these large, macrofaunal Foraminifera in the deep samples, and the need for their careful examination in order to arrive at a meaningful morphology-based classification supported by molecular data. A systematic tree obtained from molecular data (partial SSUrDNA sequences) revealed the distribution of several "komokiacean DNA sequences" with environmental DNA sequences or "not common foraminiferal DNA sequences" in a clade of monothalamous agglutinated Foraminifera from several habitats. These DNA sequences most likely belong to parasitic organisms living in the sediment particles agglutinated by Komokiacea.

Soft-shelled monothalamous foraminifera at shallow sites of Adriatic Sea

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There have been a number of studies of modern benthic foraminiferal assemblage at shallow sites in the Mediterranean Sea. These studies have focused almost exclusively on hard-shelled, mainly polythalamous foraminifera and excluded soft-shelled monothalamous taxa.The purpose of this study is to draw attention to the fact that monothalamous foraminifera are common at several shallow water sites on the north cost of Italy and to express the importance of soft-shelled monothalamous species, most of them undescribed that represent the major component of stained foraminiferal assemblage in this benthic environment. We describe monothalamous soft-shelled foraminifera from the Adriatic basin and we present the first record of occurrence and distribution of this group of organisms in the Northern Adriatic Sea.

Box corer surface sediment samples (0-2 cm layers) were taken during the ANEMRE cruise in the Gulf of Trieste from the oceanographic station Paloma in May 2006. The wet residues (63 micron) were sorted for foraminifera and an exhaustive effort was made to identify all the taxa with particular attention to monothalamous morphotypes. The morphological work follows the standard method using for foraminiferal studies. The sediment samples were sieved on a 63 micron mesh sieve and the residues wet sorted for foraminifera, including soft-shelled monothalamous species, under a binocular microscope; the residues were stained with Rose Bengal and preserved in 10% formalin buffered with sodium borate. Specimens were placed in cavity slides in glycerol and all soft-shelled monothalamous species were examined further and photographed under a compound microscope. More than 1000 stained benthic foraminifera were picked from the three sediment samples from the Gulf of Trieste. We identified all the foraminiferal taxa with particular attention to monothalamous morphotypes and a total of 342 unilocular and 717 multilocular foraminifera were recognized. Biodiversity was high among the monothalamous morphotypes represented in particular by allogromiids and saccamminids. The polythalamous agglutinated taxa dominated in the station 121 and 122 while the calcareous group was abundant in the outer station 123 as discussed in the abstract by Bonatto et al. The station 120 represents the only sample of the transect where the soft-bodies monothalamous taxa dominate and in particular the allogromiids group; instead the total abundance of the foraminiferal assemblage is the lowest among other samples.

In the category other monothalamous we considered the Lagenammina taxa and other soft-bodied taxa, informal and undescribed groups. Biodiversity analysis reveal that biodiversity is high and taxa well distributed in the station 121 and 122 while the dominance is high for the station 120 and 123 where respectively few monothalamous (allogromiid sp.1, saccamminid sp.8 and psammosphaerid sp.4) and few polythalamous taxa dominate. Soft-shelled monothalamous foraminifera contribute at least from 27 to 41% of the stained foraminiferal assemblage in surface sediments from studied sites in the north coast of Italy. All monothalamous taxa are previously unreported from Italian Adriatic waters: most of the morphotypes are undescribed and several genera (*Psammophaga*, *Vellaria*) are common in other shallow water settings while *Micrometula*, usually reported from deep and Antarctic environments, appears here with a new undescribed morphotypes. Among the allogromiids, one morphotype (Allogromiids sp. 5) is particularly interesting for the hook aperture and really similar to one morphotypes from the Black Sea (Sergeeva and Anikeeva, 2006); morpholology of *Psammophaga* is variable and aperture character is different between Adriatic and Black Sea.

Early Eocene Agglutinated foraminifera from the Kohat Basin, Northwest Pakistan

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The Eocene time records the closure of the Tethys Ocean between Indian and Eurasian Plates. Very distinctive and well-preserved remnants of the Tethyan marine sedimentation are seen in Kohat Basin northwest Pakistan.

For the first time an attempt has been made to document the presence of agglutinated foraminifera from the Early Eocene Panoba Formation, in the Kohat Basin.

In present study twelve agglutinated foraminifer species are described, emphasizing the taxonomy and their value for paleoenviromental interpretation.

Agglutinated Foraminifera of the La Pica Formation (Late Miocene to Early Pliocene), Eastern Venezuela Basin

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The La Pica Formation is observed in the Northern Monagas area from Santa Bárbara to Pedernales oilfields, in the Delta Amacuro State, Eastern Venezuela Basin. In the type section the formation is divided into an upper part composed of intercalations of fissile, gray and occasionally silty shales, often showing a reddish-brown banding, probably due to siderite staining, with very few beds of fine grained sandstones and carbonaceous inclusions. The lower part is also characterised by the same type of shales and fine to medium grained "salt and pepper" sandstones, with a thin bed of hard, greenish gray, arenaceous and micaceous limestone below.

A micropaleontological study is carried out in core samples from the type locality (Well La Pica-1) and 10 other wells. All the taxa were identified photographed and abundance were calculated in terms of percentages for each specie. The general aspect of the microfauna varies geographically. Towards the west between the Santa Bárbara and Pedernales oilfields, the agglutinated forams are small-sized, white colour and poorly preserved. From Pedernales to the east (offshore) the size of these forms considerably increase, turning brown in colour and shows a very good preservation. Calcareous foraminifera are very scarce and small. Additionally a mixed shallow and deep-water assemblages are observed at some intervals in the west. This, combined to the fact that in some wells the same stratigraphic intervals are completely barren (showing only micro molluscs) allow to interpret a reworked origin for the deep water microfauna found in the La Pica Formation towards the east.

Carpathian foraminiferal taxa in the Upper Cretaceous of the southwestern Barents Sea area

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Foraminiferal assemblages are documented from Late Cretaceous sediments (the Kveite and Kviting Formation) recovered from exploratory wells (7119/9-1, 7119/12-1 and 7120/7-3) in the southwestern Barents Sea. The Kveite Formation is thought to represent shallow to deep shelf environments, while the Kviting Formation deep open shelf environments. The study of Cretaceous agglutinated foraminifera in this region is essential to understand geographical distribution of deep-sea fauna between Boreal and Tethyan regions, which, in turn, would help to improve our understanding of palaeogeography and palaeoceanography of these regions.

The upper Kveite and Kviting formations contain rich and diverse foraminiferal assemblages, though the richness and diversity decrease with depth. The assemblages predominantly consist of agglutinated foraminifera except a few horizons where common occurrence of planktonic foraminifera is recorded. *Ammodiscus* spp., *Glomospira* spp., *Haplophragmoides* spp., *Recurvoides* spp. and tubular forms dominate the assemblages. Elongated and tapered forms, such as *Spiroplectammina spectabilis* and *Karrerulina* spp., are also common. Furthermore, a few horizons with frequent inoceramid fragments and radiolarians have been identified.

Along with the dominant taxa, deep-water Tethyan forms, such as *Caudammina* spp., *Gerochammina lenis* (Grzybowski), *G. obesa* (Neagu), *Paratrochamminoides olszewskii* (Grzybowski), *Rzehakina epigona* (Rzehak) *and Uvigerinammina jankoi* (Majzon) are recorded. These forms are also known from the North Atlantic, and thus the occurrence of these species in the area under study suggests that a benthic faunal connection already existed between the Tethys and the Barents Sea through new rift basins of the proto-North Atlantic by the Late Cretaceous. On the contrary, Late Cretaceous foraminiferal assemblages from the Arctic Ocean are taxonomically very different from those of the study area, suggesting that the Arctic was biogeographically isolated from the Tethys – North Atlantic region and the end of the faunal connection from the Tethys was somewhere in the north of the southwestern Barents Sea region during the time period considered here.

Agglutinated foraminifera from the Middle Miocene (Sarmatian) of the Transylvanian Basin, Romania

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Rare agglutinated foraminiferal specimens, accompanied by very frequent rhizoliths, were identified in Sarmatian sandy-silty shales outcropping close to Chinuşu in a road section at 46.25682N / 25.34543E, in the south-eastern part of the Transylvanian Basin. The section belongs to the marginal marine facies of the Sarmatian sea occupying the Transylvanian Basin. This shallow water (paralic) facies is rarely preserved, owing to its local development along the basin margin, and subsequent erosion caused by tectonic uplift of the Carpathians.

The Sarmatian *Ammodiscus* specimens are small, consist of 5 irregularly coiled whorls and have relatively coarsely agglutinated walls. They compare morphologically to the modern *Ammodiscus gullmarensis* (Höglund, 1948), differing only in their smaller size, possession of fewer whorls, and having a slightly wider tubular chamber. These features only warrant application of open nomenclature, and consequently, the specimens are designated as *Ammodiscus* aff. *gullmarensis*.

The original *Ammodiscus gullmarensis* and closely related small-sized forms are known from brackish environments of several fjords with estuarine water column stratification. Höglund (1947) reported *A. gullmarensis* to be most common in 35 to 45 m depth in the Gullmar Fjord, whilst in Sandebukta, (Oslo Fjord) it was found in waters with salinities between 25.4-34.7 ‰, at depths ranging from 8 to 59 m (Alve & Nagy, 1986). A closely related small form *A.* aff. *gullmarensis* is abundant in low diversity foraminiferal assemblages of the Drammens Fjord at depths from 15 to 36 m (Alve 1995). This depth interval is characterized by low salinity and reduced oxygen content. Based on these morphological and environmental features, we presume the existence of a similar restricted paleoenvironment for the *Ammodiscus* aff. *gullmarensis* bearing Sarmatian strata at Chinuşu. The close association of this small-sized *Ammodiscus* with rhizolites suggests brackish deltaic environments as a hyposaline lagoon or an interdistributary bay.

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Contributions to the deposition environment of the lower part of Kiscell Clay on the basis of agglutinated foraminifers

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This study reports on a quantitative and qualitative analysis of foraminiferal faunas from Felsőpetény, North Hungary (Nógrád Valley, between Börzsöny Mountains and Cserhát Mountains. There were 19 samples studied from 3 boreholes (FP-389, FP-292, M-25). The examinations involve the palaeoecological evaluations as well.

The foraminiferal fauna of the boreholes were studied earlier by HORVÁTH, the nannoplankton flora were analysed by NAGYMAROSY, and BÁLDI examined the molluscs and summarized the results (BÁLDI, 1983, BÁLDI et al., 1981, 1982).

The aim of the current work was made an exact palaeoecological reconstruction of the environment of the assemblages. More over purpose was to determine the depth of Kiscell Sea and oxygen level of the bottom water.

Three boreholes were drilled in 1974 and 1981 by the National Ore and Mineral Mines (Országos Érc- és Ásványbányák). The boreholes cut the following formations: upper Triassic Dachstein Limestone, upper Eocene Szépvölgy Limestone. The Oligocene stratas begin with Tard Clay Formation (dark grey, clayey silt with significantly low carbonate content, and its upper part is finely laminated). Some parts of the Felsőpetény area the Hárshegy Sandstone can be found between Tard Clay and Kiscell Clay (FP-389). The Hárshegy Sandstone is built up quartz sandstone and conglomerate with sandy silt and sandy kaolin intercalations (BÁLDI, 1986). The typical Kiscell Clay is grey non-stratified, non-laminated, though there is section in which laminated intercalation was recognized (FP-389, 113 m).

A normal marine environment is indicated by a relatively diverse association. The stressed environments have low diversity and the fauna is dominated by one or a few species (MURRAY, 1973, 1991). Value of Fisher-α shows the scale of the diversity of a sample. In the studied faunas this index varied 2,5 and 11,1. The Shannon-Weaver-index expresses the diversity of the sample too, but its value considers the number of the individuals as well as the number of taxa. The Shannon-Weaver-index alters between 1,86-3,5 in the samples. In this paper the Fisher-α and the Shannon-Weaver-index used after MURRAY 2006. The diagram of Fisher-α (x coordinate) and Shannon-Weaver (y coordinate) illustrate different types of the quondam environments. There are three unusual samples (FP-389, 173 m; M-25, 10 m and 13 m) in which the Fisher-α index is relatively low because of the absent of species-level determination of planktonic forms and Lenticulina.

The subordo diagram shows the percentaged distribution of the specimens in the samples between the three subordo, Textulariina, Milionina, Rotaliina, which is consist Lagenids, Robertininas, Rotaliinas and Spirilininas (LOEBLICH & TAPPAN, 1987). In this paper is used a modified and simplified variation of subordo diagram, which is consider only the wall structure of a specimen. This diagram was used first by MURRAY (2006). This method is good for rating of the deposition environment. All of samples indicate the normal marine environment.

JONES & CHARNOCK (1985) divided four morphological groups or morphogroups that related test shape to prefer trophic habitats. This concept has been refined by subsequent authors (e.g. GOODAY 1993). In the borehole samples every morphogroups were represented but not all of the submorphogroups. The dominant groups are the M3 and M4 (flattened planispiral – M3a, rounded planispiral – M4a, elongate subcylindrical – M4b) (KAMINSKI & GRADSTEIN, 2005). The members of the identified groups live in surficial epifauna and shallow-deep infauna. They are passive or active feeders in habitat and they range from outer shelf to upper bathyal environment. More over the life position of M4b taxa is deep infauna and indicate the increased organic matter flux.

CONCLUSION

1. The ratio of agglutinated and hyaline foraminifers was approximately equal on the base of Kiscell Clay in the investigated boreholes. The cause of the differences in the samples is the appearance of many planktonic forms.
2. The deposition of Kiscell Clay was upper bathyal zone on the basis of agglutinated foraminifers as well.
3. The bottom water was oxygen deficient but it was not anoxic. The hyaline forms show the same features.

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A marine foraminiferal association at the Maeotian / Pontian boundary in the Dacic Basin (Romania)

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Detailed biostratigraphic and paleomagnetic sampling recently done in the Upper Miocene deposits from the curvature zone of the Eastern Carpathians evidenced the presence of a marker level containing benthonic foraminifera. This level is situated at the uppermost part of the Maeotian Stage, near the boundary with the Pontian Stage. Until now it has been identified in the sections Vale Ramnicului, Valea Slanicului de Buzau and Valea Doftanei in the Dacic Basin. The identified benthonic foraminifera (agglutinated and calcareous) are similar to those recorded from age-equivalent deposits on the Taman peninsula located in the NE Black Sea region, Russia (M. Stoica, unpublished data). The marker level thus has a regional extension and accompanies the Congeria novorossica Level.

Beside agglutinated foraminifera, a rich microfauna of biseral planktonic foraminifera of *Streptochilus* type is present, together with a few specimens of miliolids, ammonias and porosononions. The biserial planktonic foraminifera were earlier described from the Upper Maeotian deposits of the Western Caucasus as belonging to the genus *Bolivina*, and some Bolivina species were also reported from the Taman peninsula (Maissuradze, 1988).

We present here the first evidence for such a marine foraminiferal association at this stratigraphic level in the Dacian Basin. The presence of a very short stratigraphic interval immediately below the Maeotian / Pontian boundary, containing almost identical faunas in the area between the Carpathians and the Caucasus, is considered as an argument for a strong and sudden marine influx, strongest in the east (Black Sea) and diminishing to the west (Dacian Basin).

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Agglutinated foraminifers from slumped deposits of the Northern Outer Carpathians

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The facies influenced by tectonic events are known as episodic sediments in Northern Carpathians.. They are mainly mappable units, without true bedding and intercalated in regularly bedded turbidite sequences of the Czech, Polish and Ukrainian Outer Carpathians. These deposits consist of unstructured and deformed masses including heterogeneous blocks (olistolits, exotics) and mud (marls, marly and calcareous shales) that were accumulated as semi fluid bodies by submarine gravity sliding and slumping. These depositional processes were generated by the tectonic transformation of the Outer Carpathian Basin during the Jurassic-Paleogene times. It were initiated by the Late Jurassic-Early Cretaceous rifting on the southern margin of the North Europaen Plate and complied by the Early Miocene tectogenesis (Golonka *et al*., 2000). At that time, the Carpathian Basin included few sub-basins, which temporary divided and associated. Skole, Subsilesian and Silesian sub-basins were the most external of them.. Their shelves with shallow water deposition were frequently rebuilding during the evolution of the Carpathian Basin. Part of the sediments, previously accumulated on shelves, were totally slumped from the slope. Some of them were partly reworked and distributed by turbiditic currents to more distal part of the basin. Other slumped sedimentes comprise clastic material originating from shallow parts of the basin and form facies, which make local intercalations in the turbidite series.

In all cases microfauna present in the different units are allochthonous. The redeposition was usually documented by dissolution traces, abraded or corroded surfaces, and also by rather small size shells of calcareous foraminifers. Agglutinated microfauna is partly autochthonous. Tithonian foraminiferal assemblages comprise numerous and diversified shelf agglutinated and calcareous foraminifera. The first belonging to arenaceous forms and these ones agglutinated by carbonate cement are represented by Verneulinidae (*Paleogaudryina*, *Belorussiella*, *Verneuilina*), Andercotrymidae (*Praedorothia*, *Protomarssonella*, *Pseudomarssonella*) and Textulariopsidae (*Textulariopsis*). In the Createceous-Paleogene assemblages agglutinated foraminifers belonging to genus: *Rhabdammina*, *Caudammina*, Rzehakina, *Dorothia*, *Spiroplectammina*, *Matanzia*, *Arenobulimina etc*. also occur.

Generally variability and preservation of foraminifers were closely related with deposits accumulated under depositional and environmental instabilities affected by tectonic activity during the evolution of the Northern Carpathian Basin.

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Recurvoides born of hell: a foraminiferal assemblage from the Toarcian black shales associated with the hydrothermal vent (Tatra Mountains, Western Tethys)

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Very little is known about Jurassic foraminiferal assemblages associated with hydrothermal vents. Recently, Jach & Dudek (2005) described the Toarcian manganese carbonate/silicate deposits in the Križna unit of the Tatra Mountains interpreting them as the shallow exhalative submarine vent. Just above these manganese deposits, we have discovered an endemic foraminiferal assemblage dominated by *Recurvoides* and preserved in a thin horizon of "black shales". We suspect that this finding represents nearly the earliest record of this genus and the whole subfamily Haplophragmoidinae. The assemblage is characterised by a high abundance and a lack of any other foraminifers, except for single phosphatised casts of *Lenticulina*. It is hard to distinguish a number of species included in the assemblage, but we can suspect at least two *Recurvoides* species that should be described as new taxa. All varieties are documented in the light microscope, SEM, and as rolograms.

The primary lamination of the black claystones, the lack of any macrofauna, and an enhanced TOC content point to suboxic conditions during deposition. Furthermore, the exclusive occurrence of agglutinated foraminifers suggests a low pH level. There are no doubts that a continuous source of food attracted opportunistic occurrence of this microfauna. It is likely that foraminifers colonised suboxic bacterial mats thriving on exhalations reach in simple hydrocarbon compounds. Such exhalations, although associated with mid-oceanic ridges, have recently been discovered in active hydrothermal vents. We further suppose that the black shale horizon was possibly contemporaneous with the Early Toarcian Ocean Anoxic Event. Such possible association of manganese deposits with the Toarcian black shales are known from at least four localities of the Western Tethys. Are there any causal links of this coincidence? Do we know any other vent related Jurassic microfauna? How common were such assemblages in the Jurassic and in other fossil records? What are the main characteristics of vent-related assemblages? Do we know any modern analogues including endemic assemblages of foraminifers? Further extensive studies are necessary to solve these and many other questions.

Theory vs. practice: how shall we analyse foraminiferal morphospaces?

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The theoretical morphospace of foraminiferal shells have revealed a great variety of shapes closely corresponding to real foraminifera classified to Textulariida and Rotaliida. Both polythalamous groups employ chamberwise growth and use similar or even same rules to create analogous morphologies, following the local minimization of the distance between successive apertures. The classical foraminiferal taxonomy based on the wall composition keeps both groups aside; nonetheless, the molecular biology has proven their close affinity. This is not that surprising because morphology is controlled by genes coding organization of cytoskeletal proteins (such as the tubulin). We can therefore suspect that similar morphologies are created by similar organization of the cytoskeleton during chamber formation. Thus, Textulariida and Rotaliida use the same flabellate pattern of microtubules shaping every chamber during its formation, in contrast to tubular foraminifers constructing streaming patterns of longitudinal microtubules stimulating the accretionary growth of a test. Tubular forms include miliolids, rzehakinids and ammodiscids, which employ tubular growth for construction of agglutinated and calcareous tests. In order to understand fundamental differences between flabelar and longitudinal patterns, we plan extensive studies focused on cytoskeleton organization. Their results should help understanding foraminiferal morphogenesis and stimulate further advances in the theoretical morphology.

On the other hand, we still know very little about the empirical foraminiferal morphospace, which includes variety of shapes represented by nearly 4000 genera and more than 60 000 foraminifera species. There are no quantitative methods measuring foraminiferal morphology. Our aim is to find a semiquantitative system analysing the empirical foraminiferal morphospace. We will present the first attempt at describing such a system based on the analysis of selected foraminiferal genera.

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Haplophragmoides nauticus Kender, Kaminski & Jones in the Eocene of the Flysch Carpathians

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Haplophragmoides nauticus Kender, Kaminski & Jones was formally defined as a new species only last year (2007). This form was described from deep-water Oligocene and Miocene, black shales of the Congo Fan – Angola area. Its occurrence in the Lower Eocene of Magura Unit in Polish Carpathians was noted too (Kender, *et al*., 2007, Kender *et al*., 2005).

Haplophragmoides nauticus is a common taxon in Paleogene deposits of the Silesian Unit. Documentation of stratigraphic range is based on selected profile of this unit in Krzeszów village (Szczyrzyc depression, Dobczyce area). First occurrence with single, a bit evolute specimens is noted in Late Paleocene / Early Eocene assemblages with *Rzehakina minima* Cushman & Renz, *Hormosina velascoensis* Cushman, *Glomospira diffundens* Cushman & Renz coming from variegated shales. Numerous and well developed forms of *Haplophragmoides nauticus* with evident evolute coiling was found in Lower, Middle and Upper Eocene deposits, in assemblages typical for: *Reticulopragmium amplectens*, *Ammodiscus latus* and *Reticulophragmium rotudindorstaum* zones (zones *sensu* Olszewska, 1997). This interval in analyzed profile belongs to the Hieroglyphic beds lithostratigraphical subdivision. The Late Eocene great change of condition in Silesian Basin was reflected in foraminiferal associations and assemblages with calcareous, both benthic and planktonic foraminifera are characteristic for this interval (Globigerina associations). Within Latest Eocene – Oligocene assemblages no *Haplophragmoides nauticus* was noted in studied material. Environmental changes limited the occurrence of this species in Silesian Basin, but younger - Oligocene and Miocene stratigraphic range is documented in flysch deposits of Congo Fan of Angola (Kender *et al*., 2007).

This species is also observed in other facial zones corresponding to different part of Carpathian basins (e.g. Skole, Silesian, Magura basins and Subsilesian Sedimentary Zone). Since the definition *Haplophragmoides nauticus* in Carpathian literature was joined into *Haplophragmoides walteri* (Grzybowski) species. In some previous descriptions of *Haplophragmoides walteri* was remarks about partly evolute coiling (e.g. Olszewska, 1996) and such forms with evolute coiling or trapezoidal chambers from Carpathian area was illustrated too (e.g. Morgiel, 1959; Geroch, 1960; Kaminski & Gradstein, 2005; Cieszkowski et al, 2006).

Common occurrence is connected with flysch deposits predominated by shaly rocks, with second-rate participation of sandstones lithosome, mainly in environments below local CCD level interpreted as batial. *Haplophragmoides nauticus* occur among agglutinated forms, in most causes typical for group of deep-water foraminifera.

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The Grzybowski Foundation publishes books and monographs on the subject of Micropalaeontology, with special emphasis on the Foraminifera. Ten books have appeared to date. Special Publ. nr. 2 (The IWAF-4 field excursion guidebook) and 3 (Proceedings of the Fourth International Workshop on Agglutinated Foraminifera) are now out of print. However, Special Publ. nr. 2 has been superseded by nr. 6. The following publications are available:

1. "The Origins of Applied Micropalaeontology: The School of Józef Grzybowski", edited by M.A. Kaminski, S. Geroch, & D.G. Kaminski (1993). Translations of the original micropaleontological monographs of J. Grzybowski, W. Friedberg, and M. Dylazanka; with a revision of foraminiferal species in the Grzybowski Collection. Format: B5, 336 pp. hardback. ISBN: 83-901164-0-5. Price: ~~£25.00.~~ *Sale Price:* £15.00 ($28.00)

4. "Lower Cretaceous deep-water benthic foraminifera of the Indian Ocean" by A.E.L. Holbourn & M.A. Kaminski (1997). A monograph detailing 260 species from 12 DSDP-ODP sites in the Indian Ocean. Format: A4, 172 pp. hardback. ISBN: 83-901164-4-8. Price: £22.00 or $40.00.

5. "Contributions to the Micropaleontology and Paleoceanography of the Northern North Atlantic" edited by H.C. Hass & M.A. Kaminski (1997). A collection of 17 research articles by the GEOMAR Bungalow research group. Format: A4, 271 pp. hardback. ISBN: 83-901164-5-5. Price: £25.00 or $48.00.

6. "A Guide to Excursions in the Polish Flysch Carpathians" by Andrzej Slaczka & M.A. Kaminski (1998). The geology & stratigraphy of the Polish Carpathians explained for students and visitors to the region. Format: A5, 180 pp. Paperback. ISBN: 83-901164-7-2 Price: £6.00 or $10.00.

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8. "Proceedings of the Sixth International Workshop on Agglutinated Foraminifera" edited by M. Bubík & M.A. Kaminski (2004). Twenty-seven research articles on agglutinated foraminifera presented at the IWAF-6 in Prague, September 2001. Format: A4, 485 pp. ISBN: 83-912385-4-7. Price: £40.00 or $75.00 (individuals); £49.00 or $89.00 (Libraries).

9. “Proceedings of the First Italian Meeting on Environmental Micropaleontology” edited by R. Coccioni, S. Galeotti, & F. Lirer (2004). Seven contributions to Cretaceous – Modern Environmental Micropaleontology, presented at the IMEM meeting in Urbino, June 2002. Format: A4, 98 pp. ISBN: 83-912385-5-5; Price: £12.00 or $22.00.

10 “Atlas of Paleogene Cosmopolitan Deep-Water Agglutinated Foraminifera”, by M.A. Kaminski, F.M. Gradstein, and collaborators (2005). The Taxonomy, Biogeography, and Biostratigraphy of 130 DWAF species. A companion volume to the “Van Morkhoven Atlas” of calcareous benthic foraminifera, Format: A4, 547 pp. ISBN: 83-912385-8-X, Price £49.00 or $89.00 (Individuals); £59.00 or $109.00 (Libraries).

11. “Proceedings of the Second and Third Italian Meetings on Environmental Micropaleontology” edited by R. Coccioni, & A. Marsili (2006). Papers on Paleogene – Modern Environmental Micropaleontology, presented at the IMEM meetings in Urbino. Format: A4, 101 pp. ISBN: 83-912385-7-1; Price: £15.00 or $25.00.

12. “Proceedings of the “Giornata de Paleontologia, 2005” edited by R. Coccioni, & A. Marsili (2007). Collected contributions from the Paleontology meeting in Urbino, May 2005. Format: A4, 109 pp. ISBN: 878-83-924869-0-9; Price: £15.00.

13. “Proceedings of the Seventh International Workshop on Agglutinated Foraminifera" edited by M.A. Kaminski & R. Coccioni. Sixteen-research articles on agglutinated foraminifera presented at the IWAF-7 in Urbino, September 2005. Format: A4, 265 pp. ISBN: 83-912385-4-7. Price: £35.00 or $65.00 (individuals); £39.00 or $75.00 (Libraries).

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Essential Romanian Phrases:

Bună Dimineața, Bună Ziua	Good Morning, Good Afternoon
Da, mulțumesc, Nu, mulțumesc	Yes, thanks, No, thanks
Mulțumesc foarte mult	Thank you very much
Scuzați	Sorry (to apologise)
Poftim?	Sorry (when you want something repeated)
Vorbiți engleza?	Do you speak English?
Ce mai faci? / Ce mai faceți?	How are you? (familiar / more formal)
Bine, Foarte bine	Well, very well.
La revedere	Good-bye
Unde este strada Kogălniceanu?	Where is Kogălniceanu street
Unde este piața mare?	Where is the main square?
Aici, acolo	here, there
Mergeți drept inainte	You go straight ahead
La dreapta, la stinga	turn right, turn left
Știu / Nu știu	I know / I don't know
Ce doriți?	What would you like?
Doresc un ceai / o cafea	I would like a tea / a coffee
Cu lapte, cu zahăr	with milk, with sugar
O bere, vă rog	a beer, please
Apă minerală, vă rog	mineral water, please
Unu, doi, trei, patru, cinci,	One, two, three, four, five
Aveți ….. ?	Do you have?
Nu avem ……	We don't have
Cât costă?	How much does it cost?
Nota de plată, vă rog	the bill, please
Sunt in Cluj pentru o conferință	I am in Cluj for a conference

How to pronounce:

ș - sh, like in "ship"	ț - ts, like in "cats"
ă – like 'a' in "about"	â (î) – like 'e' in "roses" (phoneme ɨ)
ce, ci – che, chi	che, chi – ke, ki

The emergency phone number is **112**

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