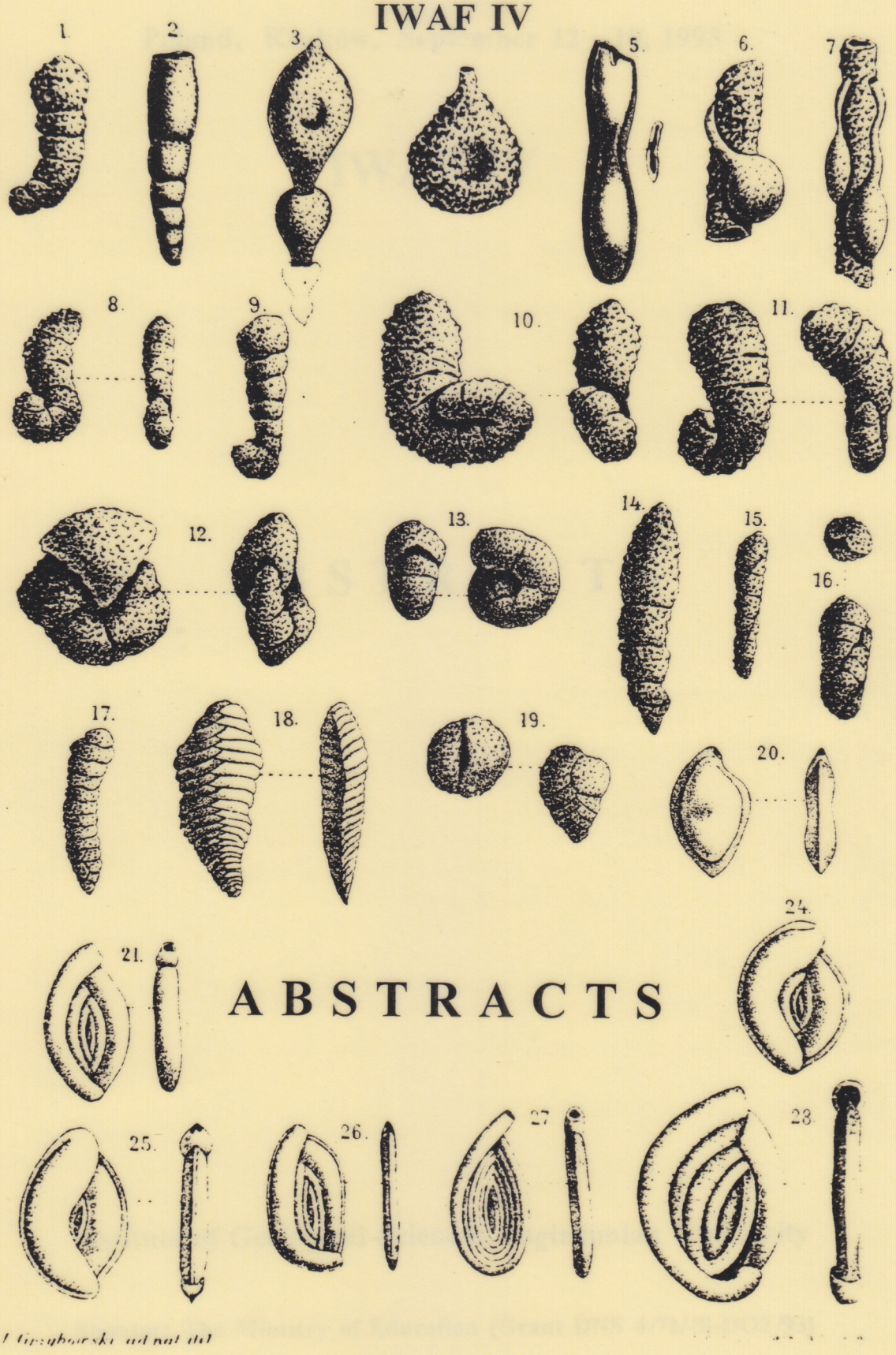
FOURTH INTERNATIONAL WORKSHOP ON AGGLUTINATED FORAMINIFERA

Poland, Kraków, September 12 - 19, 1993

IWAF IV



ABSTRACTS

Institute of Geological Sciences, Jagiellonian University

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Sponsor: The Ministry of Education (Grant DNS 4-71/48-DOT/93)

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QUATERNARY DEEP-WATER AGGLUTINATED FORAMINIFERA FROM THE RED SEA

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The distribution of agglutinated foraminifera was determined in core material taken in central Red Sea by the R/V Meteor cruise 5, leg 2. The sedimentary record presents the last 380 ky including four glacial/interglacial cycles. Due to the marginal nature of the Red Sea the hydrographic variations are largely regulated by the interplay between strait dynamics and the regional climate exerting significant control on the deep water oxygen level, salinity and $CaCo_3$ content. The agglutinated foraminifera are a minor component among the benthic foraminifers, constituting in average 14% of the benthic foraminifers (which comprise a small fraction, <5% of the foraminiferal assemblage). The agglutinated foraminifera assemblage is a low diversity one comprising up to 10 species/sample. Nine species belonging to the following genera: *Plotinikovina, Psammonsphaera, Pseudogaudryna, Reophax, Siphotextularia, Spiroplectinella, Spirotextularia* and *Textularia* dominate in different intervals along the core. Some of these species are abundant in strata older than 200 ky and occur in very low frequencies in younger sediments. Unusual bottom water conditions during the last 70 ky causes a remarkable decrease in the abundance and diversity of the agglutinated foraminifera (constituting less than 3% of the benthic foraminifers with only 1-3 species/sample): Between approx. 26-70 ky the decrease in the agglutinated foraminifers is attributed to a pronounce decrease in oxygen level following a sluggish deep water circulation resulting from a milder climate and enhanced productivity. Between 13-26 ky an extreme highly saline deep water (> 50‰) prevailed in the Red Sea. Three agglutinated species survived during this period among them *Textularia cushmani* which occur throughout most of the period. Agglutinated foraminifers disappeared from the deep water of the Red Sea during a short period between 9.6 -12.9 ky when anoxic conditions prevailed in the bottom (= Red Sea sapropel). During the last 9 ky the agglutinated foraminifers colonize gradually the deep water in a relatively slow rate. A well diversified assemblage is found in Holocene sediments only in the core top sample.

Experiments to determine the origin and palaeoenvironmental significance of agglutinated assemblages

E Alve (Oslo, Norway) and J W Murray (Southampton, England)

The wall cement of agglutinated foraminifera may be exclusively organic or may, in addition, be calcitic. Fossil assemblages solely composed of organic-cemented agglutinated foraminifera may be original or they may be secondary as a consequence of calcite dissolution. Modern analogues of such fossil assemblages are found only on high intertidal marshes and in the ocean basins deeper than the CCD. Syndepositional dissolution of calcareous foraminifera is known from a variety of environments from intertidal to the deep sea, with partial to total loss of the calcareous components.

Our experimental approach to understanding the origin of organic-cemented agglutinated assemblages has been to compare original assemblages (typically dominated by calcareous hyaline taxa) with residual assemblages derived from them by gently dissolving the samples in acid. Results obtained to date are from intertidal and shallow waters and from the continental slope and rise.

The dissolution residual assemblages from shallow waters are low in diversity, and commonly have high dominance of one or two taxa. Typical genera are *Jadammina* and *Trochammina* on marshes, *Textularia, Ammoscalaria, Cribrostomoides* and *Miliammina*, often with transported *Eggerelloides*, in the intertidal zone, and *Ammobaculites, Ammoscalaria, Eggerelloides* and *Paratrochammina* in shallow subtidal areas.

The original assemblages from the slope and rise contained small numbers of calcareous-cemented taxa such as *Eggerella, Karreriella, Sigmoilopsis*, and *Siphotextularia*. These were lost during acid treatment. The dissolution residual assemblages are highly diverse. Typical taxa include trochamminids (many undescribed), *Cribrostomoides, Lagenammina, Psammosphaera*, and *Adercotryma. Repmanina* is dominant in the transition from Mediterranean Water (MW) to Labrador Sea Water and *Haplophragmoides* in the upper part of North Atlantic Deep Water(NADW). Tube fragments are also common in MW assemblages. Other forms associated with NADW are *Eratidus, Glomospira* and *Cystammina*.

From these initial results it can be concluded that organic-cemented agglutinated assemblages are readily derived from original, almost completely calcareous assemblages. Furthermore, the diversity and dominance characteristics of the original calcareous assemblages are mirrored in the dissolution residual assemblages. This means that the latter have great potential for palaeoecology.

Further studies are in progress on various modern environments and on fossil assemblages. The aim is to produce a data base on modern agglutinated assemblages which will serve as an analogue for the interpretation of the fossil examples. This is an important new approach to the understanding of agglutinated assemblages in the fossil record.

Test structure and classification in agglutinated foraminifers

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Examinations of test microstructures of agglutinated foraminifers have gained importance especially since the existence of "textulariid" biomineralizate has been demonstrated (IWAF II Vienna 1986). While only a few authors have contributed important new data on microstructure analysis, a number of publications has compiled these data to draw systematic and phylogenetic conclusions. This paper presents an attempt to provide a well founded basis for these far-reaching conclusions.

Within the framework of a 3-year study test arrangement and wall structure of 150 recent agglutinated species were investigated in scanning electron moicroscope. According to the new treatise of Loeblich and Tappan (1987) the species examined represent 14 of the 19 textulariid superfamilies and are split into 78 genera. The aim of this extensive study was a synoptic catalogue of the fundamental structures of the test based on standarized diagnostic methods. The catalogue comprises the analysis of cement composition, classification of cement microstructures, diagnosis of a pore system, as well as examinations of organic layers. The hierarchical classification of these diagnostic test characteristics will be presented and discussed.

Cretaceous to Paleogene deep-water agglutinated foraminifera of the Bílé Karpaty Unit (West Carpathians, Czech Republic)

Miroslav BUBÍK

A taxonomy of deep-water agglutinated foraminifera (DWAF) was studied for the first time in detail from the Lower Cretaceous to the Lower Eocene of the Bílé Karpaty Unit (the Magura group of nappes). Biostratigraphy of the Upper Senonian to the Lower Eocene is based mostly on the calcareous nanoplankton investigations performed by L. Švábenická. The Lower Cretaceous Hluk Formation contains bathyal assemblages with Dorothia hauteriviana, Pseudobolivina variabilis and Plectorecurvoides alternans. The Upper Cretaceous (?abyssal) variegated beds (so called Gbely Beds) are characterized by P. alternans, Uvigerinammina jankoi and Hormosina gigantea assemblages. A turbiditic sedimentation accompanied by flysch-type DWAF started in the Campanian and was continuing in the more external Hluk Development to the Lower Eocene. The oldest flysch formation from Blatnice - 1 borehole contains Senonian fauna with Hormosina excelsa, Spiroplectammina subhaeringensis and frequent Hyperammina nuda. The Maastrichtian to Paleocene flysch of the Svodnice Formation and the Upper Paleocene Nivnice Fomation is characterized by diversified assemblages with Rzehakina epigona, Remesella varians, frequent representatives of Glomospira, Trochamminoides, Recurvoides and tubular astrorhizids. Reophax nodulosus and R. elongatus occure in the terminal sedimentation of the Lower Eocene Kuželov Formation. In more proximal and more psamitic Vlara Development above the Upper Cretaceous variegated shales the sedimentation of the Javorina Formation started. Low-diversity flysch-type are dominated by bathysiphons. Rarely Hormosina gigantea and Sphaerammina gerochi was found. DWAF zonation of Geroch - Nowak (1983) was used with some difficulties, as some of index-species are missing or extremly rare. Working local DWAF zonation scheme is proposed. The DWAF assemblages of the Bílé Karpaty Unit are compared with assemblages of the Laab Nappe on the SW and of the Krynica (Orava) Unit on the NE. Some new species for Carpathians are reported (Conotrochammina whanghaia etc.).

PALAEOGENE AGGLUTINATED FORAMINIFERA FROM THE NORTH SEA: DISTRIBUTION, PALAEOECOLOGY AND APPLICATION TO SEQUENCE STRATIGRAPHY.

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ABSTRACT

This paper tests and applies some of the observations described in previous workshop meetings by reference to Palaeogene agglutinated foraminifera from the North Sea.

Firstly, their palaeogeographic distribution is assessed in both the Viking and Central Graben areas using the palaeoslope transect approach of G. Jones (1988) and the results are compared with the published data.

Secondly, the relationship between agglutinated species and the degree of sea floor oxygenation based on specimen and sediment colour, lithological type and calcareous dissolution is documented following the work of Kuhnt *et al.* (1989) and more recently Morlotti and Kuhnt (1992). The results are tabulated in the form of a simple index and the associations are compared to other areas including the northern Appenines, Italy.

Thirdly and finally, the role of foraminifera in the identification and interpretation of depositional sequences and systems tracts in the North Sea Basin is described in the manner of McNeil *et al.* (1990) following their interpretation of the Cenozoic succession of the Beaufort - Mackenzie Basin, Canada.

"Coskinophragma", an unusual agglutinated foraminiferan from the Turonian of Southern England

Malcolm Hart

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Within the mid-Turonian chalks of Southern England an exceptionally large agglutinated foraminiferan can be found. This has variously been cited as *Coscinophragma, Coskinophragma* and *Bdelloidinia.*

Within the Turonian of Southern England, large, uncoiled (but unbranched) specimens are recorded. The wall structure is complex but fine-grained. The latter is probably due to the nature of the mid-Turonian chalk environment; there being no detrital grains in the succession at this level. The aperture has been almost impossible to identify in detail at the present time as it is almost always infilled with fine sediment.

Within the succession at this level there is a very high percentage of planktonic foraminifera, including "Tethyan" deeper-water taxa. The benthonic diversity is low and this all seems to indicate the maximum water depth of the mid-Turonian (see Haq *et al.,* 1987, 1988). The occurrence of this taxon therefore appears to identify the maximum flooding surface within the mid-Turonian eustatic rise.

Other taxa, such as *Labyrinthidoma dumptonensis* Adams, Knight & Hodgkinson and *Bulbophragmium aequale* (Roemer), also occur in the UK Cretaceous succession in intervals in which it is suspected that there is increased water depth. The overall distribution of such taxa will be discussed.

Late Cretaceous agglutinated foraminifera from the South Atlantic, North Atlantic and Indian Oceans

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Water depth models of Cretaceous communities of benthonic foraminiferids have been developed for the Atlantic margin of Brazil where good palaeodepth evidence exists. The same communities can be identified on the Goban Spur (N.E. Atlantic Ocean) and on the Exmouth Plateau (Indian Ocean).

Data will be presented to demonstrate the reliability of the community model despite the slight taxonomic and latitudinal changes involved in the study of these other areas. The depths postulated on the Brazilian margin are also thought to be quite reliable. The agglutinated assemblages (dominated by straight, coiled, branching and internally complex forms) are seen to dominate the Middle to Lower Bathyal zones, and indicate water depths of 500-1000 metres.

The genus *Marssonella* Cushman and related taxa in the Cretaceous chalks of the United Kingdom

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The genus *Marssonella* Cushman (1933) is a characteristic element of the late Cretaceous fauna. The stratigraphic value of the taxon has, however, been diminished by taxonomic confusion. Barnard (1963) reviewed the situation but now, some 30 years later, there is more stratigraphic data available from the chalk facies. The species involved in this discussion are *M.conoidea* (Marie, 1941), *M.ellisorae* Cushman, 1936, *M.oxycona* (Reuss, 1860), *M.turris* (d'Orbigny, 1840) and *M.ozawai* Cushman, 1936.

The general shape, apical angle and overall rugosity are all seen to be controlled by environmental conditions (water depth, dissolved oxygen, nature of substrate, etc.) and it is this that has caused the present taxonomic confusion.

Water depth also appears to be the controlling factor on the distribution of *Pseudotextulariella cretosa* (Cushman, 1932).

The distribution of the various taxa will be discussed and their individual distributions related to new models of sequence stratigraphy and sea-level change.

Late Jurassic (Oxfordian - Volgian) to basal Cretaceous (early Berriasian) Foraminiferal Succession in the Beaufort - Mackenzie Basin, Arctic Canada

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The late Jurassic - basal Cretaceous succesession within the Beaufort - Mackenzie Basin is characterized by a very rich and diverse (34 genera, 120 species) agglutinated foraminiferal fauna with pronounced boreal affinities. Four assemblage zones are tentatively recognized, viz. ?early Oxfordian - ?mid Kimmeridgian, late Kimmeridgian to ?mid Volgian, late Volgian and early Berriasian. While calcareous foraminifers (nodosarids, epistominids) are also present, their occurrence is erratic and they cannot be consistently relied on for zonal purposes.

The microfauna has a markedly "boreal" affinity and carries such characteristic boreal genera as Recurvoides, Arenoturrispirillina and Saturnella. It is most closely comparable with coeval assemblages in western Siberia, and the Sverdrup Basin, less so with northern Alaska and not at all with faunas in the western interior of North America (Williston Basin) and eastern Canada.

Agglutinated foraminifera from the Callovian and Oxfordian succession of Dorset, Southern England

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The Upper Jurassic (Oxford Clay - Corallian - Kimmeridge Clay) of North Dorset and the Dorset Coast has been studied for its foraminiferal content.

Two boreholes from North Dorset (East Stour and Cannings Court), covering most of the Corallian succession from the Hazelbury Bryan Formation to the *Trigonia clavellata* Formation, have been provided by the British Geological Survey. The succession and microfaunas from these boreholes have been correlated with the classic, coastal exposures between Weymouth and Ringstead Bay. Facies variations between the two areas make direct lithological correlation difficult, although certain formations (e.g. *Trigonia clavellata* Fm.) are common to both areas.

The foraminiferal assemblage is dominated by nodosariids and *Ammobaculites* spp., including *Ammobaculites coprolithiformis.* This latter species demonstrates a wide range of morphology which, at present, cannot be used in a biostratigraphical context. *A.coprolithiformis* extends upwards into the mid-*Aulacostephanus mutabilis* Zone of the Lower Kimmeridge Clay Formation. The last occurrence of this taxon is usually taken to indicate a near top-Oxfordian position in Dorset (see Medd, 1982).

*it is interesting to report that the Corallian sediments of the East Stour borehole are extremely rich in holothurian sclerites [see Henderson, Talwar & Hart, 1992, *Proceedings of the Ussher Society,* 8, 11-14].

HYDROTHERMAL-VENT AGGLUTINATED FORAMINIFERAL COMMUNITIES OF THE DEEP SEA

JONASSON, Karina E., SCHRÖDER-ADAMS, Claudia J., and PATTERSON, R. Timothy, Ottawa-Carleton Geoscience Centre and Department of Earth Sciences, Carleton University, Ottawa, Canada, K1S 5B6.

The discovery of an exotic macro-fauna associated with hydrothermal vents along mid-ocean ridges incited this study. Within the Area of Active Venting in Middle Valley, located at the northern end of the Juan de Fuca Ridge, the microfauna from hydrothermal mounds were examined, with emphasis on the foraminiferal component of the biota. The Area of Active Venting (AAV), located at a depth of 2420 m, is approximately 700 m long by 250 m wide. It has over 20 vent sites, each composed of a distinctive mound, 2-15 m high and topped by a prominent vent. Each mound is surrounded by an apron of highly indurated sediment and underlain by a cone of indurated, highly altered sediment. Temperatures at vent sites were recorded up to 275°C. The seafloor beyond the mounds is characterized by unaltered soft pelagic mud. The presence of hydrothermal mounds in the AAV causes local temperature anomalies, ranging from 2.5°C to 12.5°C, in both the water and the surface sediment. Sample sites are located near active or recently active vents. Areas in close proximity to active vent sites are colonized by a dense network of attached agglutinated foraminifera, which find a suitable substrate in the indurated sediment. Other organisms such as small sponges and possibly bryozoans complement the assemblage. Where clam beds are found in association with active hydrogen sulphide venting, the substrate is barren of foraminifera. The site consists of loose pyritic mud and is toxic to all but species (e.g. the clam *Calyptogena*) that co-exist symbiotically with sulphur-oxidizing bacteria.

Calcareous benthic foraminifera are rare in the vent area. This could be the result of increased carbonate dissolution or rapid environmental changes due to changing chemical conditions. Only a few attached species were found, including the enigmatic occurrence of *Patellina corrugata*, a species previously documented only from neritic environments.

A revision of foraminiferal species from the Grzybowski Collection

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ABSTRACT

Józef Grzybowski's collection at the Jagiellonian University is perhaps the single most important reference collection for the taxonomy of "flysch-type" deep-water agglutinated foraminifera. Grzybowski and his research student Maria Dylazanka described 127 new species and varieties of agglutinated foraminifera, and validated an additional 17 species listed by Rzehak (1887a,b) as *nomen nudum* (the authorship of these species has been transferred to Grzybowski under Article 21 of the International Code of Zoological Nomenclature). Several additional taxa, which Grzybowski either left in open nomenclature or reported as previously established species, have been designated synonyms of new species by subsequent authors. In this study, we re-illustrate the new taxa from the type collections of microfossils from the Silesian and Magura Units of the Carpathian flysch collected by Grzybowski (1898, 1901) and Dylazanka (1923). We selected those taxa from Grzybowski's Krosno (1898) and Gorlice (1901) collections which bear Grzybowski's name as author or as the patronymic species name. For the sake of completeness we have also included the taxa described by Dylazanka (1923) from Szymbark. We designated lectotype specimens from the collections (or in certain cases neotypes from new material) and emended the descriptions of taxa whenever necessary. In total, we have illustrated and revised 61 foraminiferal species described as new taxa by Grzybowski or Dylazanka. We additionally illustrate three taxa previously erected by Rzehak (1887) as *nomen nudum* that were validated by Grzybowski (1898), as well as two that serve as reference material for species described by later authors.

Of these 66 taxa illustrated in this study, we regard 50 to be valid species. Four taxa are still regarded as *nomen dubium*. Ten of Grzybowski's species and two of Dylazanka's are either combined or regarded as junior synonyms of other species. Lectotypes have been designated for 42 species, neotypes designated for two species, and five species (*Hyperammina subnodosiformis*, *Haplophragmium immane*, *Ammodiscus gorayskii*, *Trochammina deformis*, and *Trochammina stomata*) are emended in this study. The type specimens of all species are illustrated using light microscopy and are presented in 17 plates.

RESPONSE OF AGGLUTINATED BENTHIC FORAMINIFERA TO DYSOXIC CONDITIONS IN THE CALIFORNIA BORDERLAND BASINS

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Analysis of agglutinated benthic foraminifera from surface samples collected in the San Pedro and Santa Catalina Basins reveals a predictable relationship between the proportions of morphogroups with decreasing bottom water oxygen levels and with the Total Organic Content of the surficial sediment.

Living (Rose Bengal stained) foraminiferal faunas from dysaerobic environments display low diversity and high dominance, suggesting stressed conditions. There is an inverse relationship between oxygen and the relative abundance of the deep infaunal morphogroup.

Samples collected from shallow stations above the oxygen minimum zone, are comprised of epifaunal and shallow infaunal morphotypes. At intermediate depths (~500 m), there is a peak in the abundance of suspension-feeding and "climbing" forms (watchglass-shaped trochamminids attached to *Rhabdammina*). Specimens from intermediate stations display the largest overall size. Deeper in the San Pedro Basin the living fauna is dominated by a small, flattened, tapered, species that is interpreted as having a deep infaunal microhabitat. In the dysaerobic environments off California the greatest degree of faunal change occurs when bottom water dissolved oxygen values drop from 0.5 ml/l to 0.2 ml/l.

The effect of TOC content on the benthic fauna is demonstrated at two stations from the same depth in the San Pedro Basin. The station with the higher TOC content (4.2% vs. 2.9%) contains greater proportions of the small, deep infaunal morphotype. These faunal changes may be attributed to differences in the depth of the oxygenated zone within the sediment surface layer. This causes a displacement of benthic foraminiferal niches, with deep infaunal forms migrating to the surface.

Agglutinated faunas from areas that experience seasonal anoxia are comprised of opportunistic forms such as *Reophax* and *Psammosphaera*. These are the same taxa that colonised abiotic sediment trays in a recolonisation experiment in the Panama Basin. This study further demonstrates that agglutinated foraminiferal morphotypes respond in a similar manner to calcareous benthic foraminifera in dysaerobic environments.

Observation of both sexual and asexual reproduction of *Trochammina hadai* Uchio in laboratory

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We observed both sexual and asexual reproduction of agglutinated foraminifers, *Trochammina hadai* Uchio in the laboratory. *T. hadai* is abundant in brackish bays around the Japanese Islands. This species is infered to have biphasic life cycles in the natural environments (Matsushita and Kitazato, 1990).

Sexual reproduction (microspheric generation) is mainly occurred on March. Thousands of gametes released from the apertural part after when several clusters of gametes are risen up from the aperture. Morphology of each gamete is droplet-like outline. They probably have two flagella. Gametes which are released from same parent do not make zygote each other. Release of gametes continues during one hour and half. After gametogenetic process, a part of cytoplasm still remained in the mother test. Pseudopodia are extruded from the test.

Asexual reproduction (microspheric generation) takes place in autumn. Reproductive process is progressed as follows.

1) Blood cyst formation: Blood cyst, which is made from *Chlorella* cells or diatom frustules, is constructed around the mother test with some vacant spaces.
2) Cytoplasm invaded into the blood cyst: Several hours after when blood cyst is constructed, the cytoplasm spreads slowly into the cyst through the aperture and the space is filled with cytoplasm.
3) Multiple division: The multiple division occurred both in the cyst and in the mother test at the same time. First, speed of cytoplasmic streaming is accerelated. Multiple division occurred within a few minutes after cytopasmic streaming is hastened. Megalospheric juveniles were visible in the blood cyst.
4) Spreading of juvenile specimens: A few hours after the multiple division, the juvenile agamont individuals start to leave from the mother test. Juvenile specimen shows a spherical shape without agglutinated test.
5) Formation of arenaceous test: After leaving from the mother test, juvenile specimens start to collect sand grains for agglutination. Sand grains were piled up from one side of the sphere to another end. This means that test formation of agglutinated foraminifera occurs from one side. This is concordant well with the description by Bender (1992) for *Textularia candeiana*.

Asexual reproduction continues *c.a.* 24 hours. The mother test was not destroyed during asexual reproduction.

Deep Water Agglutinated Foraminiferal Assemblages Underneath the Gulf Stream System

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We studied the distribution of living and dead agglutinated foraminifera in box-core samples along a transect from the abyssal oligotrophic gyre of the Sargasso Sea across the Gulf Stream towards the continental rise in the Baltimore Canyon region. Four different faunal assemblages are distinguished. Assemblages from abyssal oligotrophic sites (Sargasso Sea) are characterized by small infaunal agglutinated species and small delicate unilocular forms such as *Rhizammina algaeformis* and Komokiaceans. Assemblages of the continental rise directly underneath the Gulf Stream have higher standing stocks and are dominated by large unilocular astrorhizaceans. Abyssal benthic foraminiferal assemblages underneath the zone of cold core rings south of the Gulf Stream differ from abyssal assemblages of the oligotrophic gyre of the Sargasso Sea and from the Baltimore Canyon continental rise in the following features: (1) the live infauna consists mainly of small, smooth-walled infaunal morphotypes. The number of living individuals is about 2 to 3 times higher than in the Sargasso Sea, although the taxonomic composition is quite similar at both sites; (2) komokiaceans are common, but most of the observed specimens have been found within the uppermost 2 cm of the sediment and not at the sediment surface. These forms have thicker walls and agglutinate larger grains than specimens from the Sargasso Sea. (3) attached agglutinated foraminifera are common (10-20 % of the total surface population) in the zone of cold core rings; (4) large unilocular astrorhizaceans forms are rare or absent in the zone of cold core rings.

We speculate that these peculiar features (a higher standing stock of benthic foraminifera than in other abyssal regions of the Northwest Atlantic and a different taxonomic and quantitative composition of the assemblages compared to the "oceanic desert" of the Sargasso Sea) are related to two special environmental conditions underneath the Gulf Stream and the zone of cold core rings: (1) influence of bottom currents, which may be adverse for delicate epifaunal species; (2) for abyssal environments unusually high and steady supply of nutrients and phytodetritus provided by deep currents.

A PROGRESS REPORT ON FIFTEEN YEARS OF RESEARCH ON AGGLUTINATED FORAMINIFERS IN THE BEAUFORT-MACKENZIE BASIN OF ARCTIC CANADA

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Fifteen years ago, the Upper Cretaceous and Cenozoic biostratigraphy of the Beaufort-Mackenzie Basin was virtually an untouched frontier. Today, a well established biostratigraphic framework consisting of fifteen zones exists for the entire basin based on agglutinated and calcareous benthic foraminifers. They provide the primary dating tools because the palynomorth stratigraphy is still poorly known and both calcareous and siliceous planktonic fossils are virtually non-existent in the basin. About one hundred stratigraphically useful species of agglutinated foraminifers have been documented in Turonian to Miocene strata. Thirty-five of these are new species.

Agglutinated foraminifers provide a great deal of information on the evolution of the basin. Selective preservation appears to have played a critical role in determining the overall agglutinated versus calcareous composition of the assemblages. Major faunal boundaries for agglutinated assemblages are controlled by large scaled oceanographic, tectonic, and climatic events. Localized facies characteristics are important in controlling the distribution of species within particular zones. Extensive seismic profiling through the basin provides an important framework for analyzing the relationship between foraminiferal distributions and sequence stratigraphic boundaries.

The Beaufort-Mackenzie Basin contains a variety of clastic rocks that have undergone a wide range of burial diagenesis. Recognition of burial diagenetic effects on agglutinated foraminifers within these strata has opened up a new window for research which uses agglutinated foraminifers as indicators of geothermal maturity.

An evidence against the autochtony of Upper Cretaceous "*Rhabdammina*-faunas": preliminary data from the Serramazzoni Flysch (Northern Apennines, Italy)

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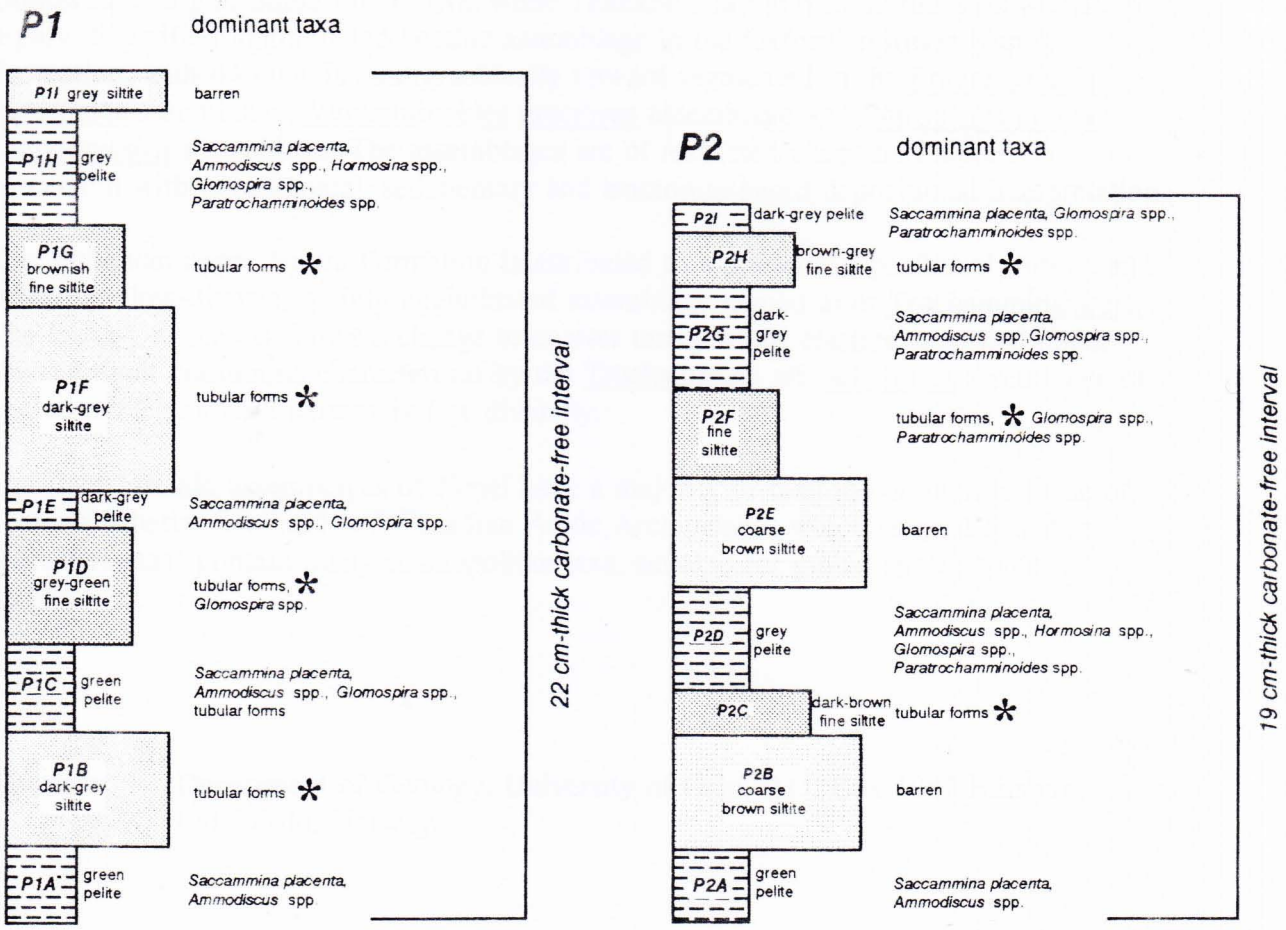
This note presents the results of a sampling on a centimetric scale of two selected intervals of the Campanian-Maastrichtian deep-water Serramazzoni flysch (Modena, Northern Apennines, Italy). The intervals were unusually thick and fulfilled the field diagnostic features for the recognition of hemipelagic layers: no apparent lamination, no reaction with hydrochloric acid, widespread bioturbation.

Actually, after a deep-cleaning of the outcrops, a close-up look provided by careful sedimentologic logs on the two pilot sections (P1, 22 cm-thick and P2, 19 cm-thick) revealed subtle lithological differences which are normally overlooked during the usual hammer-sampling *routine*.

Each sub-interval was sampled parallel to the bedding-plane using a thin and sharp knife; the sampled thickness never exceeded 1 cm. The samples were weighted (500 gr) and the fragments cleaned on the outcrop.



The results of the micropaleontological analysis are summarized in the figure: tubular forms, frequently of the same size, are abundant (*) only in more silty and often very finely laminated sub-intervals, whereas more sophisticated taxa of variable size occur only in bioturbated pelites.

The extremely time-consuming approach here adopted seems to be useful to minimize the "noise" produced by the low sedimentation rate and to obtain samples with a more reliable faunistic "signal". The preliminary data obtained seem to give additional support to the hypothesis that abundance of tubular forms could be due to hydrodynamic sorting and redeposition through bottom currents.

LATE JURASSIC THROUGH EARLY CRETACEOUS FORAMINIFERA FROM NEPAL: PALEOENVIRONMENTS AND GLOBAL CORRELATIONS

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ABSTRACT

This is the first detailed account of Late Jurassic, deeper marine, southern hemisphere, agglutinated benthic fauna, and its close taxonomic affinity to coeval assemblages from northern high latitudes. Over 1100 m of dark shale, siltstone and sandstone in Thakkhola (Nepal) is dated by means of ammonites, dinoflagellate cysts and foraminifera as Oxfordian through latest Albian. The succession was laid down along the northern Gondwana margin, bordering Tethys, while Thakkhola lay at mid latitudes (30-45°S). A highly diversified agglutinated benthic assemblage in the Oxfordian lower Nupra Formation, with 44 taxa, is stratigraphically upward segmented in the Eomarssonella paraconica assemblage, Verneuilinoides graciosus assemblage and Spiroplectammina suprajurassica assemblage. The assemblages are of restricted deep shelf nature, in agreement with geochemical, sedimentary and ammonite-based depositional interpretation.

The Tithonian upper Nupra Formation is attributed to a prodelta depositional setting, and contains a low-diverse, mainly agglutinated assemblage named after Trochammina annae. The Early Cretaceous shows a change to coarser terrigeneous clastics deposited under shallow shelf conditions characterised by the Trochammina aff. schaimica assemblage of agglutinated taxa with extremely low diversity.

The Late Jurassic assemblages of Nepal have a majority of taxa in common to those of Western Siberia, Svalbard and Canadian Arctic Archipelago, which suggest that these "boreal faunas" contain many cosmopolitan taxa, suitable for global stratigraphic correlations.

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SEISMIC AND SEDIMENT–GRAVITY FLOW RISK ASSESSMENT ON THE FRASER RIVER DELTA , BRITISH COLUMBIA, CANADA

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Highly urbanized metropolitan Vancouver, built upon the Fraser River Delta, is one of the most seismically active zones of North America. The combination of seismic setting and the thick late Quaternary deposits of the delta provides considerable threat of earthquake and sediment–gravity flow to the area. In 1982 a large scale sediment-gravity flow — up to 1,000,000 m^3 of sediment — on the delta front nearly destroyed an important shipping installation. Following this near disaster the Geological Survey of Canada was given the task of determining the threat–potential to the metropolitan area. As it was impossible to completely assess seismic risk without understanding the geology of the delta a major initiative was launched to determine the depositional history. Both seismic data and cores have been collected from on-shore and off-shore delta locations.

Results of off–shore research indicate that sediment accumulation rates show considerable variation but generally increase towards Sand Heads sea valley, a submarine channel that is the present active depo–center of the Fraser River. The thickest, coarsest segment of sediment cored yielded minimum accumulation rates of 4.1 cm/year in the main channel of Sand Heads sea valley. The presence at this prodelta core site, and others, of coarse sedimentary units and homogenous allochthonous agglutinated marsh foraminiferal and arcellacean faunas indicate large–scale mobilization of upslope sediments through mass wasting or sediment–gravity flow processes. Correlation using ^{137}Cs analyses indicate a high periodicity of these slumping events. By these mechanisms marsh microfossil bearing sand bypasses the delta slope and is directly delivered to the prodelta environment.

These results suggest that mass wasting and sedimentary–gravity flow processes, triggered either seismically or by sediment loading, may account for higher rates and greater volumes of sedimentation in this deltaic environment than do suspension–traction processes. This characteristic of sedimentation on the Fraser River Delta indicates that occurrences of mass wasting, or sediment–gravity flows, are important factors that must be considered before further major construction on the delta front is undertaken.

ULTRASTRUCTURE AND REPRODUCTION OF *TROCHAMMINA SP.* (FORAMINIFERIDA)

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The aim of the present study is to describe the ultrastructure and mode of reproduction of a small agglutinated foraminiferan *Trochammina sp.* Very little is known about the biology of agglutinated foraminifera [1,2]. The laboratory observations and ultrastructural studies may help to better understand the reproduction and life cycle of this group in comparaison with other foraminifera.

Trochammina sp. was isolated from the algal material collected at the Mediterranean shore at St. Cyr, near Toulon, France, in May 1991. This species was cultured in the sea water of salinity 40‰ , pH 8.0, at 20°C. Heat-killed *Dunaliella salina* cells were used as food. Small pennate diatoms present in the cultures were agglutinated at the test of *Trochammina sp.*, but there was no evidence that the foraminifera were actively feeding on them.

Several generations of *Trochammina sp.* were produced during the period of two years. Only asexual reproduction (agamogony) has been observed. It took place inside a reproductive cyst build up by mature specimen. The cytoplasm left the adult test and moved into the cyst before the cytokinesis began. About 40-60 juveniles are usually released from the cyst after 24-48 hours. The juveniles were formed of proloculus and the second small chamber (deuteroloculus), the next chambers were constructed outside the cyst. The specimens grew for 40-60 days before they reached maturity and started reproduction. The size of proloculus and the maximum diameter of the test was measured in 50 specimens but no morphological evidence has been found for the presence of sexual generation in cultured *Trochammina sp.*

Ultrastructure of *Trochammina sp.* was examined in order to determine the number and characteristics of nuclei. The specimens were fixed overnight in 4% glutaraldehyde buffered with 0.2 M cacodylate at pH 8.0 and postfixed for 1 hr in 1% OsO_4 . Samples were routinely proceeded for TEM and embedded in Spurr's medium. Thin sections were double stained with lead citrate and uranyl acetate and examined under a Zeiss EM-10 electron microscope. The most unusual characteristic of *Trochammina sp.* was its very thick (2-3 um) organic wall. The wall of high electron density was composed of concentrically arranged layers of fibrillar material. The cytoplasm of *Trochammina sp.* contained a large amounts of saturated lipid droplets. The cells of digested algae in various states of degradation were observed.

All examined specimens of *Trochammina sp.* were multinuclear with up to four nuclei in the prolocular chamber suggesting that they represented the agamont stage. All nuclei had similar aspect which indicates the lack of nuclear dimorphism (heterokaryosis). Each interphase nucleus contained a large amount of electron-dense heterochromatin and several nucleoli which were usually attached to the inner nuclear membrane. The so-called nucleolus-associated chromatin was frequently observed at the periphery of the nucleoli. The above ultrastructural characteristic of the nuclei in *Trochammina sp.* resembled that of gamonts in previously described *Rotaliella elatiana* [3,4] , and may indicate that they are involved both in a transfer of genetic information and in a metabolic activity providing the cell with the RNA necessary for a high rate of protein synthesis.

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NEW DATA OF COMPOSITION AND MICROSTRUCTURE OF AGGLUTINATED FORAMINIFER WALL

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Micropaleontological complexes of Cretaceous and Paleogene systems of Western Siberia are dominated by agglutinated Foraminifers. Earlier the composition and microstructure of the agglutinated wall have beeen studied in detail (Podobina 1978, 1990).

On the basis of numerous investigations a classification of different walls has been composed, which are presented below (see figure). Tests are considered to be agglutinated if the wall conteins not less than 25 % agglutinate. The classification of agglutinated shell microstructure ia based upon the percent content of agglutinate, because the size of separate particles of the type of this wall varies even within one test.

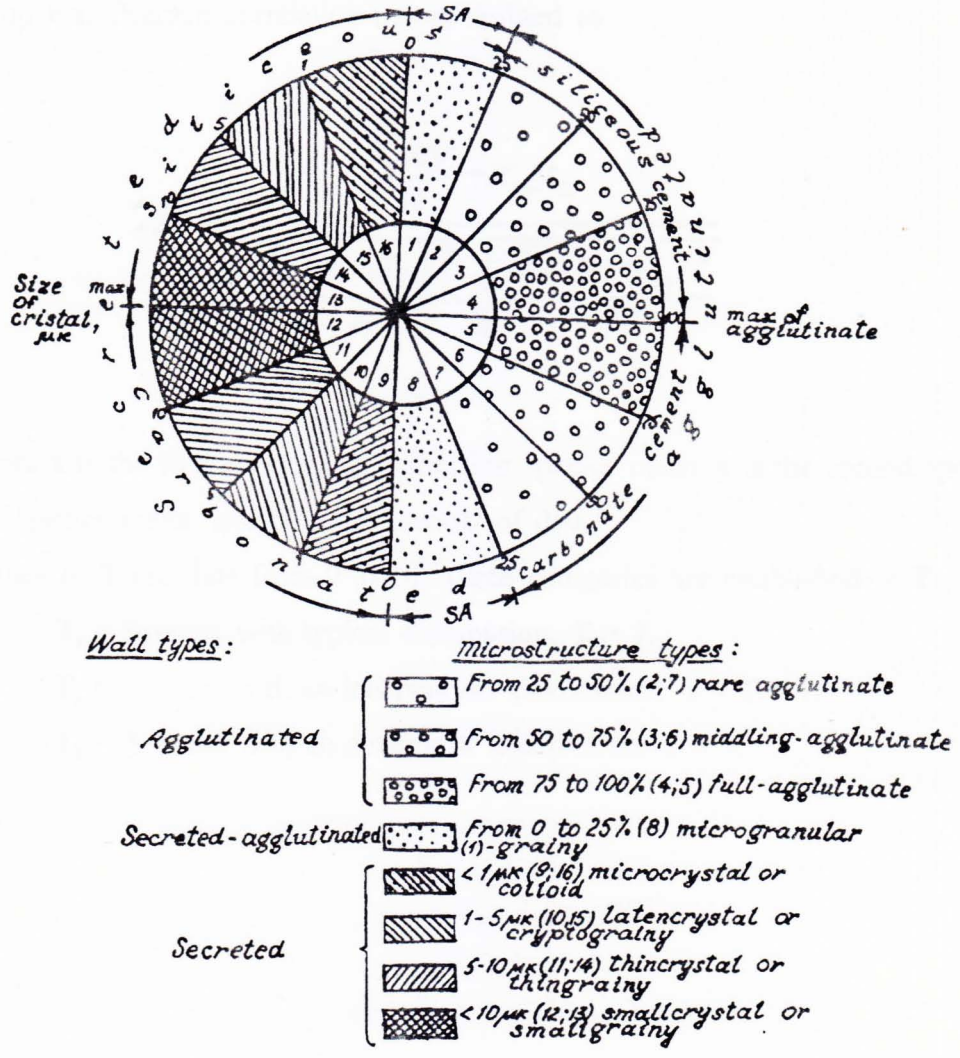

Figure: Diagram of microstructure of Foraminifer mineral tests

A NEW INDEX IN AGGLUTINATED FORAMINIFERA DISTRIBUTION

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A new index is given to measure the fitness degree between the distribution of each species of agglutinated foraminifera with the total of recent benthic foraminifera and between the distribution of each species with the total of agglutinated foraminifera.

This index is defined as the tipicity index, T:

$$T = 5(1+r)$$

using **r** as Pearson correlation index, defined as

$$r = \frac{\frac{\sum xy}{N} - x_m y_m}{\sqrt{\frac{\sum (x-x_m)^2}{N}} \sqrt{\frac{\sum (y-y_m)^2}{N}}}$$

where **x** is the first species; x_m is the first species mean; **y** is the second species; y_m is the second species mean, and **N** is the number of data.

Values of **T** oscillate from 0 to 10. Three categories are established in **T**:

T_t = Species with typical distribution. $T > 7$.

T_i = Species with an independent distribution, $3 < T < 7$.

T_a = Species with an antagonist distribution, $T < 3$.

SOME APPLICATION INDICES IN AGGLUTINATED FORAMINIFERA DISTRIBUTION

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Different indices are applied to the species of recent benthic agglutinated foraminifera in the neritic zone Motril-Nerja, Spain, to determine the character of each species from different points of view.

These indices are:

- The number of species, **S** (Margalef, 1974)
- Diversity index, **H** (based in Shannon-Weaver index, 1949; modified by Margalef, 1957)
- Equitability index, **E** (Buzas and Gibson, 1969)
- Constant index, **C** (Dajoz, 1974)
- Abundance index, **A** (Sanchez Ariza, 1986)
- Distance index, $\mathbf{d}_{ik}$ (Sanchez Ariza, 1983)

The values of these indices determine the relationships between each two species and among different species of agglutinated foraminifera.

MATHEMATICAL MODELS IN AGGLUTINATED FORAMINIFERA DISTRIBUTION.

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Theoric distribution curves are determined in agglutinated foraminifera found in the neritic zone Motril-Nerja, Spain, using depth as variable and relative frecuencies, in percentage, as data.

Likewise, curve formulas are defined as fourth degree polynomes and fitness degree is given in each species. Most of cases present fitness degree bigger than 90%, that indicate the importance of depth as a determinant factor in foraminifera distribution.

Fourth degree polynomes are modified to smaller degree if fitness degree is bigger than 90% in both, to simplify mathematical calculations.

The eight species found are:

Iridia diaphana?, Heron-Allen and Earland; *Trochamina inflata*, (Montagu); *Spiroplectamina wrightii*, (Silvestri); *Bigenerina nodosaria*, d´Orbigny; *Textularia agglutinans*, d´Orbigny; *Textularia gramen*, d´Orbigny; *Reophax scorpiurus*, Montfort and *Eggerella. sp.*

PALEOENVIRONMENTAL CHANGES IN THE CRETACEOUS COLORADO GROUP OF WESTERN CANADA: MICROFOSSIL, SEDIMENTOLOGICAL AND GEOCHEMICAL EVIDENCE

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Foraminifera, dinoflagellates and coccoliths of the late Albian to middle(?) Turonian interval were studied from the Colorado Group in Alberta and Saskatchewan. Integration of fauna, flora, lithology and geochemistry results in the identification of four regionally-mappable lithostratigraphic shale units. In ascending order, these are the Westgate Formation, the Fish Scales Formation, the Belle Fourche Formation and the Second White Specks Formation.

The Albian foraminiferal assemblage of the Westgate Formation consists entirely of agglutinated species. High faunal abundance and species diversity coincide with increased bioturbation. The texture of agglutinated taxa corresponds to lithological variations and is related to subtle sea level changes. The foraminifera and dinocyst assemblages indicate a near shore, open-marine environment. The organic matter is dominantly Type III (terrestrially derived).

The lower Cenomanian Fish Scales Formation is barren of foraminifera and represents dominantly anoxic deposition. Bioturbation is sparse and the organic matter is a mixture of Type II (marine) and Type III. The contact with the overlying Belle Fourche Formation is gradational.

The Belle Fourche Formation is characterized by a poorly developed benthic fauna associated with dysaerobic conditions. Short events of downward advection of oxygen allowed a temporary increase in benthic oxygen levels which resulted in recolonization of a few opportunistic species. Organic matter is dominantly Type III.

The Second White Specks Formation represents deposition during maximum sea level in the Cretaceous of Western Canada. A pelagic fauna, consisting of planktonic foraminifera and coccoliths, represents the latest Cenomanian to early or middle(?) Turonian. The increased input of marine organic matter produced an oxygen-minimum zone near the bottom resulting in the absence of benthic foraminifera and bioturbation.

THE RECENT AGGLUTINATED FORAMINIFERAL ASSEMBLAGES OF THE EUROPEAN NORTH SEA

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A total of 81 box cores were sampled in the course of a micropaleontological survey of recent benthic Foraminifera in the European North Sea between 66 N and 81 N. The size fraction >250 m was studied in particular consideration of the living fauna.

Because of its geographic position the European North Sea is subject to an extreme seasonality in all biological processes in the pelagial as well as in the benthal.

Generally the whole benthic foraminiferal fauna is characterized by a very low diversity decreasing greatly with depth and a patchy standing stock density. This can be regarded as a consequence of the extreme feeding conditions caused by the seasonal food input.

The foraminiferal fauna in the European North Sea is dominated by agglutinated Foraminifera. Nearly in the whole investigated area they reach at least percentages >50%, in regions above 2000 m values >80% are common. On the shelves this suborder partly makes up the whole foraminiferal fauna >250 m. *Reophax difflugiformis, Saccammina sphaerica, Saccorhiza ramosa, Rhabdammina abyssorum* and *Labrospira crassimargo* characterize the assemblages above 1000 m; *Reophax scorpiurus, Cribrostomoides subglobosum, Hyperammina elongata* and Hyperammina crassatina occur in high abundances in the depth range between 100 and 2000 m; below 2000 m *Critionina hispida* and *Hippocrepinella hirudinea* are significant.

Fauna groupings (agglutinated and calcareous forms) were established using a cluster analysis, resulting in five species assemblages. All show almost identical distribution on both sides of the European North Sea, and apparently depth dependent horizontal faunal boundaries. But there is also a vertical faunal boundary at 71 N. This boundary separates the *Cribrostomoides subglobosum*-dominated community from the *Reophax scorpiurus*-dominated community. The distribution areas are in the same depth range, but they differ completely in their morphological settings. The ecological factors controling the distribution of *Reophax scorpiurus* and *Cribrostomoides subglobosum* are discussed.

FACTORS CONTROLLING DISTRIBUTION OF AGGLUTINATED FORAMINIFERA IN AALENIAN-BAJOCIAN DYSOXIC FACIES (PIENINY KLIPPEN BELT, POLAND)

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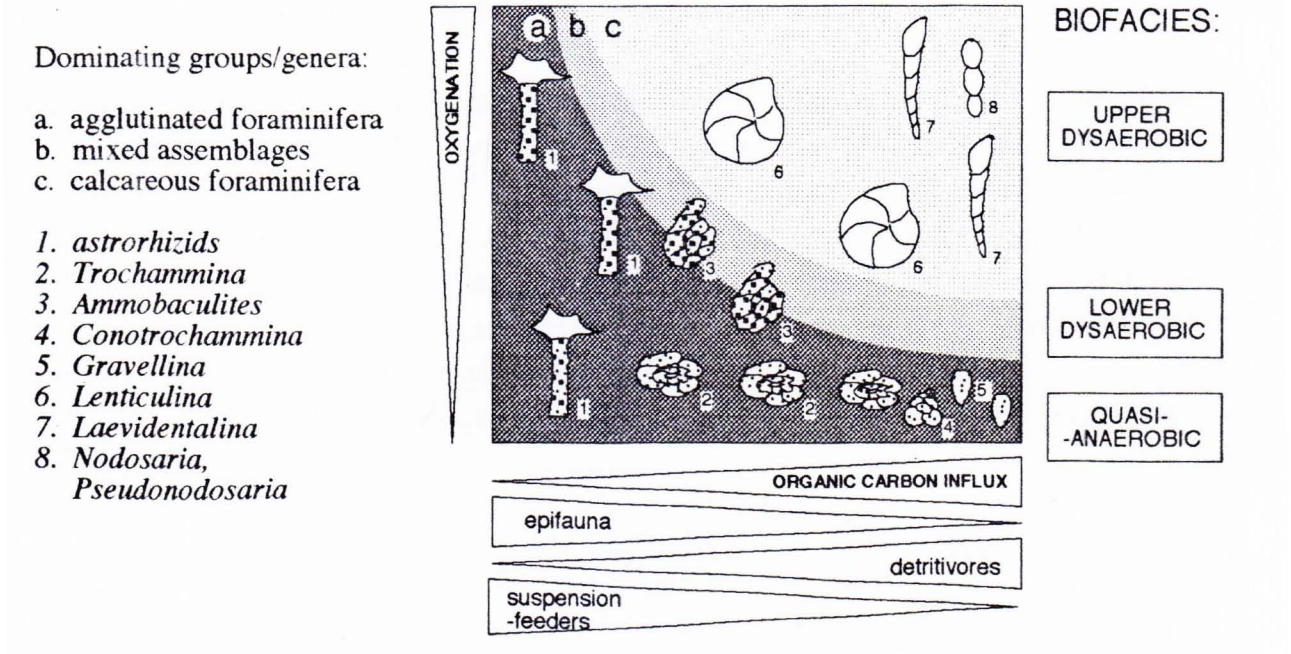
The upper Aalenian-lower Bajocian Skrzypny Formation in the Klippen Basin has been chosen for this palaeoecological study because of its wide palaeobathymetric range and uniform, synchronous deposition.

The lower portion of the formation was deposited under cyclically anoxic to severely dysoxic conditions. The benthic microfauna was dominated by agglutinated foraminifera with, in particular, epifaunal *Trochammina* thriving over the middle neritic to upper bathyal zone. The outer neritic was the only zone colonized by very abundant infaunal morphogroups including *Gravellina* and *Conotrochammina*. The greater proportion of infaunal morphogroups may be attributed to increased food supply and, consequently, to a higher organic carbon influx (OCI).

The upper part of the formation was dominated by diverse calcareous foraminifera co--occurring with abundant ostracods, crinoids, gastropods. These associations indicate improved oxygenation of bottom water. In contrast to the lower part of the formation, the dominant agglutinated morphogroups were suspension feeders, such as astrorhizids. This would suggest a lower sedimentation rate and periodically decreased OCI. The agglutinated infaunal morpho-groups were scarce and limited to *Ammobaculites fontinensis* (Terquem), which probably preferred better oxygenated conditions. The infaunal niche, which was cyclically colonized during periods of higher OCI, therefore, appears to have been taken over by calcareous foraminifera.

The figure below summarises the relationships between dominant assemblages (morphogroups/genera) and main controlling factors (inferred bottom water oxygenation and OCI). Finally, the agglutinated assemblages were also affected by dissolution of calcareous foraminifera, evolutionary trends, palaeogeographic position, and other factors.



Lectotypes of some Recent Deep-Water Agglutinated Foraminiferal genera housed at the Natural History Museum, London (BMNH): A Tale of Ten Taxa

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The Natural History Museum houses many important collections of modern Deep-Water Agglutinated Foraminifera. The type specimens of Brady, Carpenter, Parker and Jones, Heron-Allen and Earland, Norman, and others are all available for inspection. In the course of revisionary work for an atlas of Cenozoic Deep-Water Agglutinated Foraminifera, we have studied the type specimens of 19 taxa housed in BMNH. The purpose of this presentation is to establish lectotypes for 10 taxa which are type specimens of their respective genera. These are:

Original Designation:	**Type species of genus:**
Rhabdammina linearis Brady, 1879	*Oculosiphon Avnimelech*, 1952
Psammosphaera fusca Schultze, 1875	*Psammosphaera* Schultze, 1875
Saccammina sphaerica Brady, 1879	*Saccammina* Carpenter, 1869
Trochammina irregularis var. *clavata* Jones et Parker, 1860	*Ammolagena* Eimer and Fickert, 1899
Reophax distans Brady, 1881	*Hormosinella* Shchedrina, 1969
Reophax nodulosa Brady, 1879	*Pseudonodosinella* Saidova, 1970
Trochammina bradyi Robertson, 1891	*Recurvoidella* Uchio, 1960
Trochammina ringens Brady, 1879	*Buzasina* Loeblich and Tappan, 1985
Trochammina lituiformis Brady, 1979	*Lituotuba* Rhumbler, 1895
Recurvoides contortus Earland, 1934	*Recurvoides* Earland, 1934

During the course of this study, some interesting observations were made which have lead us to expand or emend the definitions of four genera (*Ammolagena, Lituotuba, Recurvoidella* and *Recurvoides*). For example, *Ammolagena* is observed to have a supplementary aperture, coiling in *Recurvoides* is not streptospiral, but changes at abrupt 90° angles, and *Recurvoidella* is assigned a different type species because of synonymy of *R. parkerae*. Lectotypes of type species and revisions of the above genera will be formally erected in the accompanying manuscript. The value of carrying out taxonomic revisions based upon a thorough examination of the original material cannot be overemphasized.

POSTERS

STRATIGRAPHIC RANGE OF SOME AGGLUTINATED FORAMINIFERA FROM THE CRETACEOUS OF THE PIENINY KLIPPEN BELT; CALIBRATED BY PLANKTIC FORAMINIFERA, DINOCYSTS AND RADIOLARIA

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Stratigraphic distribution of some Albian-Turonian agglutinated foraminifers is calibrated by planktonic Foraminifera (from *Ticinella roberti* to *Marginotruncana sigali* zones), dinocysts (*Litosphaeridium siphonophorum*, *Ovoidinium scabrosum*, *O. verrucosum*, *Oodnadattia alata*) and Radiolaria (*Holocryptocanium barbui* - *H. geysersensis* zone).

For Late Albian-Cenomanian the local foraminiferal zonation is established. The agglutinated species analyzed are: *Haplophragmoides gigas minor*, *H. nonioninoides*, *Plectorecurvoides alternans*, *P. irregularis*, *Hyperammina depressa*, *Tritaxia* ex.gr.*gaultina*, *Spiroplectinata annectens*, *Ammmobaculites problematicus* and *Uvigerinammina jankoi*.

Radiolarian taxa are especially abundant as well as diversity ofdinocysts assemblages reveals a trend to rise in sediments aboveblack shales reflecting episodes of anoxia.

Albian-Cenomanian sediments are developed as pelagic facies with turbiditic intercalations passing into Turonian-Campanian flysch facies. It is evident, that increasing abundance of the agglutinated taxa is correlated with progress of flysch sedimentation. Presence of the agglutinated taxa is one of the main tool for palaeobathymetric reconstruction of the Pieniny Basin. Palinspastic reconstruction of the Cretaceous Pieniny Klippen Belt Basin allow us to distinguish several zones, each with characteristic foraminiferal assemblages, from the shelf to the depth located below CCD.

AGGLUTINATED PALEOTEXTULARIID AND OTHER MICROFORAMINIFERS FROM THE UPPER CARBONIFEROUS - PERMIAN DEPOSITS OF THE WESTERN URALS AS A PROBABLE INDICATOR OF UNFAVORABLE ENVIRONMENT

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Rather rare tiny biserial and planospiral microforaminifers with quantitative predominance of textularid and rotalid forms have been found in some palynological preparations from Upper Paleozoic, mainly terrigenous deposits of the Western Urals. These forms may be 10-20 times smaller than their morphological relatives from carbonate rocks. Microforaminifera are dispersed in the stratigraphic interval from the Upper Carboniferous to Upper Permian of the Western Urals. Most of them have been found in the facies unfavorable for nekton and benthic typically marine organisms.

Important agglutinated foraminifers in the Miocene of Moravia and Slovakia

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Stratigraphic distribution of some of agglutinated foraminifers documents their important role for fine biostratigraphic division and correlation of Miocene deposits in various basins of the Western Carpathians. Most important representatives from the Miocene of Moravia and Slovakia belong to families Astrorhizidae, Ammodiscidae, Haplophragmoididae, Cyclamminidae, Spiroplectamminidae, Amosphaeroidae, Eggerellidae, Pavonitidae and Hauerinidae.

1/ Species with the continuous distribution from Egerian, Eggenburgian to Badenian:
Bathysiphon taurinense Sacco, *Ammodiscus incertus* (d'Orb.), *Repmanina charoides* (J & P), *Haplophragmoides fragilis* Hoeglund, *H. vasiceki pentacamerata* Cicha & Zaplet., *H. vasiceki vasiceki* Cicha & Zaplet., *Budashevaella willsoni* (Smith), *Spiroplectinella acuta* (Reuss), *S. carinata* (d'Orb.), *Martinotiella communis* (d'Orb.), *Semivulvulina pectinata pectinata* (Reuss), *Textularia deperdita* d'Orb., *T. gramen deltoidea* Reuss, *T. gramen* d'Orb..

2/ Species distributed in Karpatian Badenian only:
Cribrostomoides columbiensis columbiensis Cushman, *C. kjurendagensis* (Morozova), *Reticulophragmium venezuelanum* (Maync), *Cyclammina carpathica* Cicha & Zaplet., *C.* cf. *complanata* Chap., *Karreriella gaudrynoides* (Forn.), *Textularia articulata* d'Orb., *T. laevigata laevigata* d'Orb..

3/ Species of short-time distribution within a stage or substage:

Haplophragmoides periferoexcavatus Subbotina - Moravian
Alveolophragmium crassum (Reuss) - Moravian to Kosovian
Cyclammina zemplinica Cicha & Zaplet. - Kosovian
Pavonitina sp. div., - Kosovian
Pseudotriplasia sp. div., Wieliczkian
Karreriella bradyi (Cushman) - Moravian
Bigenerina nodosaria Cushman, Wieliczkian
Paravulvulina serrata (Reuss) - Wieliczkian
Textularia gramen subangulata d'Orb. - Wieliczkian to Kosovian
Textularia laevigata aplanata Cicha & Zaplet. - Moravian to Wieliczkian
Textularia mariae d'Orb. - Moravian to Wieliczkian
Textularia pala Czjzek - Moravian to Wieliczkian

Agglutinated Foraminifera from ODP Site 766 (Leg 123): The Birth and Evolution of a Cretaceous Ocean.

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The Early Cretaceous foraminiferal assemblages at ODP Site 766 offer a unique insight into the early evolution of the Indian Ocean. This site, situated at the foot of the Exmouth Plateau off Western Australia was part of an extensive continental rift zone during the Early Cretaceous when the supercontinent Gonwana fragmented and the Indian Ocean started to open.

Agglutinated foraminifera are present in significant numbers in two main intervals during the Early Cretaceous at this Site: in the upper Valanginian to lower Hauterivian and in the upper Aptian to Cenomanian.

The late Valanginian to early Hauterivian taxa consist of organically cemented forms such as *Haplophragmoides, Recurvoides, Trochammina, Hyperammina, Ammobaculites,* and *Bulbobaculites* species. This fauna consists of a large proportion of coarsely agglutinated taxa recovered from sandy, glauconitic sediments. Low numbers of tubes, large fluctuations in the proportions of (infaunal) *Bulbobaculites* and coarsely agglutinated forms point to an outer neritic environment with some deltaic influence. The relatively low diversity and the marked variations in the size of the agglutinated particles suggest cyclic sedimentation along a subsiding rifted margin. This is in stark contrast to the truly abyssal faunas recovered at nearby Site 765.

The late Aptian to Cenomanian agglutinated forms with calcareous cement are, by contrast, more varied with a predominance of elongated infaunal types, such as *Gaudryina, Dorothia, Pseudogaudryinella, Tritaxia,* and *Spiroplectammina* species. These lower-slope to upper-bathyal assemblages have a widely cosmopolitan component indicating true oceanic conditions with open connections to other major oceans. An enhanced level of oceanic productivity is also suggested from the high number of infaunal morphotypes although fluctuations are detected which may be related to changes in sea-level or patterns of oceanic circulation.

These intervals represent two main phases of ocean evolution: a "juvenile" stage in the late Valanginian to early Hauterivian during which restricted basinal conditions prevailed, and a "mature" stage in the late Aptian to Cenomanian when the ocean had become widely opened to global oceanic changes in sea-level, circulation and productivity. The taxonomic and stratigraphic investigations and the palaeoenvironmental analysis of the agglutinated foraminifera at ODP Site 766, thus, provide useful tools to retrace the early history and the subsequent evolution of the Indian Ocean.

A revision of Lower Cretaceous *Falsogaudryinella* and *Uvigerinammina* from the North Sea and Romania

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Abstract

We emend the definition of the genus *Falsogaudryinella* Bartenstein, 1977 based on our observations of the type species, *F. tealbyensis* from the Barremian Lower Tealby Clay of Lincolnshire, U.K. The genus was described by Loeblich and Tappan (1988) as having initial triserial coiling which reduces to biserial and finally uniserial. However, topotype specimens in fact display high trochospiral coiling in the microsphaeric generation, with at least four chambers in the initial whorl. The genus therefore does not belong in the family Verneuilinidae, but must be transferred to the Prolixoplectidae. The wall is solid, non-canaliculate. The connections between chambers are in the form of tubes that extend from the basal part of the chamber lumina toward a terminal aperture. This tubular connection is partially separated from the main part of the chamber lumina by a septum. The presence of this tubular connection in *F. tealbyensis* is closely analogous that observed in the type species of *Uvigerinammina* Majzon, 1943. The two genera therefore are separated mainly on the basis of cement type, with *Falsogaudryinella* possessing calcareous cement, and *Uvigerinammina* organic cement.

We illustrate three species of *Falsogaudryinella* from the Barremian of Lincolnshire and the U.K. sector of the Central North Sea. These are compared with type specimens of *Uvigerinammina moesiana* Neagu, 1965 from the Albian of Romania (now transferred to *Falsogaudryinella*). Our comparisons reveal that Barremian specimens from the North Sea that have been previously regarded as *F. moesiana* (e.g. King, et al. 1989) are in fact a new species. This species differs in its larger dimensions, more rounded cross-section, and in the presence of a well-developed biserial part. Evolution within the mid-Cretaceous *Falsogaudryinella* group appears to progress by reduction of the terminal uniserial part, since the coiling in the stratigraphically youngest form (*F. moesiana*) is predominantly triserial. Our interpretations of the phylogeny of the mid-Cretaceous *Falsogaudryinella* lineage are presented on the poster.

TITLE: AGGLUTINATED FORAMINIFERA FROM THE KIZIMBANI SHALE FORMATION OF KILWA, TANZANIA.

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ABSTRACT: The area of study was at Kilwa, about 250 km South of Dar-es-Salaam. (Fig. 1). The material used was collected during drilling in 1979 of the Kizimbani No. 1 well, from the horizon of the Kizimbani shales Formation. Twenty four samples were collected from this section. The Kizimbani No. 1 well is located in the Kilwa area of Tanzania on longitude 39° 22′ 30" E and latitude 9° 02′ 25" S. This was an onshore well, begins with the Lower cretaceous sediments of the Upper Albian at the top and reaches down to the basement at 2697M. Fig. 2. The Kizimbani shales lie between 991M-1335M depth of Callovian age.

This sequence is subdivided into three foraminiferal assemblages 991M-1021M characterised by Arenaceous foraminifera. 1021.5M-1097M interval is characterised by few agglutinated foraminifera Nodosariids and floods of radiolarians assemblages. Assemblages at 1097M-1335M interval is characterised by Porcelaneous and few Nodosariids. Twenty four samples were subjected to standard micropalaeontological analysis. Foraminifera fauna recovered from the studied section were typical of five distinct assemblages characterised by Astrorhizids, Lituolids and Nodosariids, Robertinids and Miliolids. The Assemblages described is shown to be typically Callovian in composition.

Ten species of agglutinated foraminifera were identified within the Kizimbani shales formation. Mainly Astrorhizids and Litudids. They are classified according to Haynes (1981) based on wall structure, composition, apertural and foraminal structures are used for classification to species level. Sculpture is used with caution in distinguishing certain genera and species for they vary through ontogeny and with environment.

Foraminiferal Stratigraphy and Facies of the Brora Argillaceous Formation (Callovian), NE Scotland.

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The foraminiferal succession of the Brora Argillaceous Formation has been analysed, and a total of 89 species have been identified. The lithologies vary from black shales, with faunas consisting generally of agglutinated species, to silty shales and siltstones, containing mainly calcareous species. Changing conditions during deposition of the formation are discussed on the basis of major faunal parameters (diversity and frequency of genera) combined with lithological features (organic carbon and calcium carbonate content).

The base of the Brora Shale is a thin fining upwards sequence formed during a transgression. Normal marine to slightly dysaerobic conditions are suggested by the relatively low organic carbon content (2 - 3%), silty lithologies, presence of bioturbation and up to 30 % calcareous species. These strata are overlain by about 15 meters of black shales with a high organic content (max. 10%). They display an extremely low - diversity foraminiferal fauna of agglutinated taxa attributed to dysaerobic bottom conditions. The middle and upper parts of the formation shows a coarsening upwards development from silty shales to sandy siltstones, overlain by sandstones. The organic carbon content decreases and the amount of calcium carbonate increases upwards. The foraminiferal assemblages in the silty lithologies consist mainly of calcareous taxa, and show high diversities suggesting normal marine depositional condition.

MAASTRICHTIAN AND PALEOCENE AGGLUTINATED FORAMINIFERA FROM DEEP TROUGHS OF THE SE MARGIN OF THE BOHEMIAN MASSIF

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Up to 1500 m deep canyon-like river valleys were eroded in Late Cretaceous (during Middle Campanian?) in southern Moravia when the SE margin of the Bohemian Massif was uplifted. Two deepest, the Nesvačilka and Vranovice Grabens, were filled in several cycles by late Campanian to Paleogene deposits of northern European Tethys. The filling is in autochthonous position now buried under the nappes of the Western Carpathian Flysch Belt and Neogene Foredeep.

In Maastrichtian of the Těšany-1 borehole, agglutinated foraminifera dominated. Among 18 species determined, Sphaerammina gerochi is the most frequent. Foraminiferal assemblage indicate an environment with pelitic substrate and reducing conditions at the sediment/water interface. Rather low percentages of planktic micro- and nannofossils show to the possibility that they were transported by currents from the open sea into the area of the Nesvačilka Graben.

In shallow-water Danian deposits of Nesvačilka-1 borehole, *Subtilina lamella, Plectina* aff. *apicularis* and *Haplophragmoides* higly dominate. During Thanetian the grabens were maximally flooded. They formed submarine valleys several hundreds of meters in depth. Oxygen depleted bottom conditions are supposed. In dark claystones and siltstones with sandy intercalations agglutinated foraminifers highly dominate (*Trochammina, Haplophragmoides, Budashevaella, Recurvoides, Spiroplectammina, Plectina, Reticulophragmium* etc.). Next shallowing was near Paleocene/Eocene boundary; rare fragments of *Dendrophrya ? maxima* were found in Nesvačilka-1 borehole. Eocene and Oligocene agglutinated foraminifera have not yet been studied from the Nesvačilka and Vranovice Grabens in detail.

Agglutinated Foraminifera and Paleoenvironment of Upper Cretaceous Multicolored Claystones in the Parma Apennines

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Upper Cretaceous (Turonian-Santonian) multicolored claystones of the Parma Apennines contain assemblages of agglutinated foraminifera similar to deep oceanic sub-CCD settings in the Atlantic, Pacific and Indian ocean as well as in the remainders of the Tethyan ocean within the Alpine-Carpathian mountain chain. The Upper Cretaceous foraminiferal micropaleontology of the Northern Apennines has not yet been formally described. Thus, the first objective of this study is to document deep water agglutinated foraminifers (DWAF) from an area which is paleogeographically intermediate between the well-investigated basins of the North Atlantic and the Carpathians. The observed inventory of DWAF consists mainly of cosmopolitan forms and indicates an open deep-water connection from the North Atlantic ocean through the Western Mediterranean flysch basins to the Alpine/Carpathian basin at least until the Santonian.

A second objective is to assess the palecological significance of these purely agglutinated assemblages. Assemblage composition, morphotypes and inferred habitat preferences of red claystone faunas are comparable to modern deep-water assemblages. Generally infaunal morphotypes such as *Karrerulina, Recurvoides* and *Uvigerinammina* dominate and suggest a generally oxygenated, relatively cool bottom water mass and low organic matter flux to the seafloor. Prevailing red sediment colors and the common occurrence of authigenic rhodochrosite are further indications for generally oxygenated conditions at the sediment water interface. Intercalated in these red deep-sea claystones occur green layers, which contain foraminiferal assemblages dominated by epifaunal detritus-feeders probably indicating enhanced organic fluxes to the seafloor. These intercalations sometimes occur in a rhythmic pattern and may indicate climatically forced cyclic changes in productivity and deep water mass properties.

AGGLUTINATED FORAMINIFERA FROM THE DANIAN SEDIMENTS, NORTHEASTERN SIRT BASIN

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Twenty two species assigned to sixteen genera of flysch-type cosmopolitan agglutinated foraminifera, associated with radiolaria, are reported for the first time from the subsurface Danian sediments in Northeastern Sirt Basin, Libya.

The most diagnostic genera recorded are: A) tubular medium sized, finely agglutinated *Rhizammina, Hyperammina*, and *Bathysiphon*; B) small to medium sized, finely agglutinated *Ammodiscus, Glomospira, Rzehakina* and *Saccammina*; and C) large, often pyritized, coarsely agglutinated *Clavulinoides* and *Dorothia.* This assemblage is assigned to the "*Rzehakina epigona fissistomata*" Zone of Geroch and Nowak (1984).

Based on a comparison with similar flysch-type assemblages of Maastrichtian-Danian Guayaguayare and Lizard Spring Formations in Trinidad, it is concluded that the studied Dasnian sediments were deposited on a poorly oxygenated upper to lower bathyal depths.

Late Cretaceous Flysch Fauna of the Trochamminoides proteus Type Locality (Wien - Hütteldorf, Austria)

Fred Rögl, Naturhistorisches Museum Wien

The Rheno-Danubian Flysch in the region of the Vienna Woods is tectonically subdivided in three nappes of somewhat different sedimentary history. The type locality of Trochamminoides proteus (Karrer, 1866) is situated in the Kahlenberg nappe, belonging to the Kahlenberg formation. Nannoplankton determinations have proved a Campanian (- ?early Maastrichtian) age.

Karrer's original sample is originating from soft layers within a gray marly limestone sequence and has been collected in 1865. The quarry at Hütteldorf is overbuilt today. But the sample has been preserved together with the described material in the Vienna museum's collection. During the restudy of the sample some middle Miocene well preserved foraminifera have been observed, caused by contamination. This explains the remark of Karrer (p.493) questioning some Vienna Basin species. The flysch assemblage is agglutinated, of rather small growth and fine agglutination; tubiform, glomospirid, and trochamminoid specimens are dominating.

Some important species have been described by Karrer (1866). From these, Trochammina proteus has been selected as type of the genus Trochamminoides by Cushman (1910). Cushman has studied the original material, and the specimen figured by him has been selected as lectotype by Kaminski & Gradstein (in press). The species is characterized by a discoidal test, starting with an irregular inner coiling. The nearly planispiral outer coils consist of one to one and a half somewhat embracing whorls. The tube is subdivided by equidistant constrictions of about the same length as the diameter of the tube. The maximum diameter is about 0.5 mm with a maximum thickness of about 0.15 mm in average.

Ataxophragmium arenaceum is a senior synonym of the commonly used Hormosina ovulum (Grzybowski, 1898). Cornuspira hoernesi is very fine agglutinated, translucent, and comprises a junior synonym of Ammodiscus cretaceus (Reuss, 1845). Both species, Lagena globosa asperella and Rosalina ? sp. are different preservations of Hormosina arenacea. Polymorphina globosa Münst. is a contaminated Globulina gibba (d'Orbigny) from the Vienna Basin Miocene.

Most of the specimens included by Karrer in Trochammina proteus are belonging to Glomospirella irregularis (Grzybowski), some to Trochamminoides variolarius (Grzybowski). Other common genera and species are: Psammosphaera, Rhizammina, Psammosiphonella cylindrica (Glässner), Bathysiphon, Bogdanowiczia ?, Glomospirella serpens (Grzybowski), ?Hyperammina gaultina (Ten Dam), Kalamopsis grzybowskii (Dalyzanka), Subreophax, Trochamminoides dubius (Grzybowski), Paratrochaminoides variolarius (Grzybowski), Recurvoides.

PALEOECOLOGY OF LATE CENOMANIAN BENTHIC FORAMINIFERA ACROSS THE WESTERN INTERIOR SEAWAY

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We conducted analyses of benthic foraminifera from three localities in the Western Interior of the United States, which represent an east-west transect across the Late Cretaceous to Middle Turonian deposits of the seaway which existed there during much of Mesozoic time. The similarities and differences among the three localities suggest that, while each of the sites represents a different paleoceanographic setting, at times similar conditions influenced benthic population structures.

Through most of *Sciponoceras* (late Cenomanian) time, benthic populations at Lohali Point (LP) and Mesa Verde (MV) were dominated by *Neobulimina*, a calcareous infaunal morphotype . At Rock Canyon (RC), a high-diversity, low-dominance calcareous benthic fauna characterize the interval. However, in mid-*Sciponoceras* time, there was an increase the proportion of agglutinated specimens, accompanied by an increase in other calcareous benthics. The agglutinated specimens (mostly epifaunal) constitute about 40% of the benthic population at LP and MV. At RC, they represent less than 5%, but this is the only appearance of agglutinated foraminifera at this site. This shift may have been diachronous across the seaway, and, because there is a coincident drop in the planktonic-to-benthic ratio at all three localities, probably represents changes in the entire water column. During latest *Sciponoceras* time, epifaunal calcareous benthics (*Gavellinella*) abruptly increase at the expense of the infaunal calcareous specimens at all three sites. At LP, the PB ratio increases, while at MV and RC it decreases slightly, continuing a previous trend.

During middle *Neocardioceras* (latest Cenomanian) time, a sudden decrease in planktonic specimens at LP and MV (and a less severe one at RC) is accompanied by an increase in epifaunal agglutinated benthics at LP and in epifaunal calcareous benthics at MV and RC, again at the expense of *Neobulimina*. Since there is no rapid decrease in planktonic specimens at RC, it appears that, while benthic conditions across the seaway may have been similar, conditions higher in the water column were not.

Across the Cenomanian-Turonian boundary, agglutinated specimens disappear at MV, and nearly do at LP. Those which persist at LP are infaunal. Calcareous benthics are mostly infaunal morphotypes at all three localities. This assemblage dominates samples through *Mammites* zone, which represents peak transgression at LP. At RC, benthics disappear altogether in late *Watinoceras* time.

These data, taken with geochemical evidence from the same localities, sometimes contradict the model of Koutsoukos and Hart (1990). We suggest that further study of the relationship between physical morphology and biological function in modern environments will resolve this paradox. In particular, more detailed study should be made of epifaunal vs. infaunal modes of life of arenaceous and calcareous benthics. In this study, samples in which arenaceous taxa are dominated by specimens considered epifaunal also contain calcareous populations consisting of mostly infaunal specimens. It may be possible that the arenaceous forams are responding differently than calcareous forams under similar environmental conditions.

Agglutinated foraminiferans from estuarine and inter-tidal environments in N.E. and S.W. England

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There is a continuing programme of investigating estuarine and inter-tidal foraminiferal populations on-going in Plymouth. This work is partly in collaboration with the Plymouth Marine Laboratory (Marine Biological Association of the UK). Data are available from the Kingsbridge Estuary, Erme Estuary, Plymouth Sound, Looe Estuary, River Fal and Restronguet Creek (in S.W. England) and Budle Bay (in N.E. England).

Common in many of these inter-tidal areas are the species *Trochammina inflata* (Montagu), *Jadammina macrescens* (Brady) and *Milliammina fusca.* The distribution of these taxa is reviewed and the details of their wall structure assessed.

Cultures of living foraminiferans are on-going in the University and populations collected in Plymouth Sound are being established. Progress on this work will be reported, although agglutinated foraminifera have not yet (April, 1993) been established.

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POSTER 1

LIFE OBSERVATIONS ON *RHIZAMMINA ALGAEFORMIS* BRADY 1879

During the METEOR-cruise M11/1 several individuals of *Rhizammina algaeformis* were observed on the absolutely undisturbed sediment surfaces of multicover samples.

The test of *R. algaeformis* is a complex, flexible, widely branched tube system running through the uppermost 15-20 mm of the muddy sediment. One individual has several apertures, developed as simple openings at the end of the tube. Those open endings protrude like little chimneys into the watercolumn, while the most larger part of the test is found in the sediment. The rhizopodia are developed as a bushy web. This life position is characteristic for suspension feeding Foraminifera. Although *R. algaeformis* occupies an infaunal habitat it can be assumed that this species must be a suspension feeder - at least temporary or facultative.

POSTER 2

MASS OCCURRENCES OF GIANT HYPERAMMINIDS AND REOPHAXINIDS

During the METEOR-cruises M 7/5 and M 10/3 in the European North Sea, mass occurrences of giant primitive agglutinated Foraminifera were discovered on box core surfaces. Most of them belong to the species *Hyperammina crassatina* BRADY (THIES in prep.), the others to the genus Reophax. One single individual may reach a test length of 2-3 cm, the largest one reaches 4-5 cm.

The tests are laying close by each other, covering the sediment surface as carpet-like layers, which reach a thickness of about 1 cm. However, this mass occurrence deceives about the fact that only a few of the uppermost individuals are alive. The standing stock density ranges between 3 and 8 individuals per 10 cm. The living individuals are laying somewhat obliquely on the empty tests. The aperture is directed upward protruding the web-like rhizopodia into the watercolumn. From this life position and high contents of chlorophyll per individual it can be assumed that these foraminifera are suspension feeders.

PRESERVATION INDEX OF FORAMINIFERAL TESTS AS A TAPHONOMICAL AND PALAEOECOLOGICAL INDICATOR

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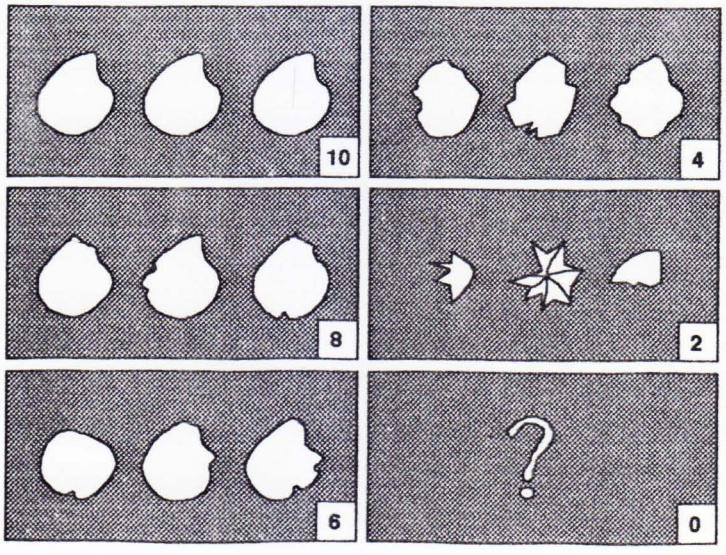
Dissolution of calcareous foraminiferal tests can considerably alter a fossil assemblage. Thus far, there is no quantitative method to estimate the state of preservation. A new method is proposed here as a tool for reconstruction of "real" calcareous and agglutinated benthic foraminiferal assemblages.

The most common taxon is chosen for the analysis. All picked specimens of this taxon are classified into five groups (classes) representing different states of preservation (Figure). Each group is numbered from 10, for very well preserved tests,to 2 for poorly preserved ones. Any other relative numerical characteristics can be used. Preservation Index "PI" as an average value of the preservation for one sample is given by a simple equation: PI=(Ep)/n where "p" represents the name (number) of the preservation class, "n" is a total number of examined specimens within a particular sample.

This method has been tested on *Lenticulina* assemblages from black shales of the Skrzypne Formation (Middle Jurassic, Pieniny Klippen Belt, Polish Carpathians). Regression analyses reveal a positive correlation between the Preservation Index with *Lenticulina* and calcareous foraminifera abundance, and generic diversity. Poorly preserved tests were found in lower diversified and less abundant assemblages. Therefore, they should be considered as post-mortem depleted assemblages that do not represent 'real-living' suites. Tests were most likely dissolved under corrosive dysoxic conditions causing enrichment in agglutinated foraminifera.

Advantages and disadvantages of this method are discussed.



A contribution to taxonomy of some agglutinated foraminifers in the Miocene of Moravia and Slovakia

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A short contribution deals with taxonomy of some species of agglutinated foraminifers of families Spiroplectamminidae (species *S. carinata* and *S. acuta*), Pavonitidae (species *P. styriaca* and *P. elongata*), Eggerellidae (species *M. communis*) and Textulariidae (species *P. serrata, S. pectinata pectinata, T. gramen gramen, T. deperdita* and *T. mariae*).

The revision of the material of foraminifers from the Badenian (Miocen) of the Vienna Basin in Czech and Slovakia brought by the study of oriented thin-sections of the species *S. carinata* and *S. acuta* some new data. The internal fine layer covering the internal wall of single chambers and presence of irregular pseudoporoses on the surface of test were documented. Such pores were described by Halicz and Reiss (1979) on the recent material. This structure was not described by the author of the Genus Spiroplectinella Kiselman 1972 and it is contraversion with the diagnosis of this genus by Loeblich and Tappan (1988).

Further study of the oriented sections brought the new data documenting the position of the species *Textularia deperdita* d'Orbigny and *T. mariae* d'Orbigny to the genus Textularia Defrance. It was found that by the species *Martinottiella communis* (d'Orbigny) the generic name of Listerella Cushman should have a priority.

MIDDLE AND UPPER JURASSIC FORAMINIFERA OF STAFFIN BAY (ISLE OF SKYE, SCOTLAND); PALAEOECOLOGY AND PALAEOENVIRONMENTAL ANALYSIS

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POSTER ABSTRACT

The marine Staffin Shale Formation (Callovian to Lower Kimmeridgian) sequence exposed at Staffin Bay, NE Skye was analysed for micropalaeontological content. This outcrop provides a window that enables study and correlation of similarly aged offshore sequences, especially within the Inner Moray Firth Basin. The ammonite biostratigraphy is well established and is used as the template to compare foraminiferal palaeoecological events. As many benthic foraminifera are facies controlled in their distribution this provides a powerful tool to study palaeoenvironmental changes that occcurred through time within a basin. Analysis of morphological adaptation, generic and specific abundance associated with relevant distribution patterns and facies types can therefore be used to delineate the extent and timing of basinal changes that occurred within the Inner Hebrides region. Agglutinated foraminifera formed an important component of the microfaunas developed, with specific assemblages aiding palaeoenvironmental interpretation. The Callovian of the Inner Hebrides and Moray Firth Basins represented a major transgressive event, with the rapid establishment of a low diversity, but high abundance agglutinated dominated foraminiferal fauna, which may be indicative of an initially oxygen depleted palaeoenvironment. Expansion of ecological niches, associated with improved bottom conditions allowed the developmnet of a high diversity and high abundance, generally calcareous dominated microfauna through the Upper Callovian to Middle Oxfordian. This period was represented by an increasingly more regressive facies, which was subsequently overturned by a transgressive event initiated in the Upper Oxfordian. The foraminiferid faunas of the transgressive facies of Upper Oxfordian and Lower Kimmeridgian were again dominated by agglutinated taxa. However, the assemblages were characterised by a high diversity, high abundance microfauna, indicative of a somewhat less restrictive and possibly deeper water environment than developed with the initial Callovian transgressive facies.

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* - non-attending, abstract only

PROGRAMME

Lecture Hall - Kolegium Polonijne, Przegorzały ul. Jodłowa 13

Monday, September 13 - **Modern Agglutinated Foraminifera**

9:00 Introductory Keynote Address by Stanisław Czarniecki
9:30 Almogi Labin, A. & Hemleben, Ch.: Quaternary deep-water agglutinated foraminifera from the red sea.
10:00 Alve, E. & Murray, J.V.: Experiments to determine the origin and paleoenvironmental significance of agglutinated assemblages.

10:30 Coffee break

11:00 Jonasson, K., Shröder-Adams, C.J., and Patterson, T.R.: Hydrotermal-vent agglutinated foraminiferal communities of the deep sea.
11:30 Kaminski, M.A., Boersma, A., Tyszka, J., & Holbourn, A.E.: Response of agglutinated benthic foraminifera to dysoxic conditions in the California Borderland Basins.
12:00 Kitazato, H. & Matsushita, S.: Observation of both sexual and asexual reproduction of Trochammina hadai Uchio in laboratory.

12:30 Lunch

2:00 Kuhnt, W. & Collins, E., and Scott, D.B.: Deep water agglutinated foraminiferal assemblages underneath the Gulf Stream system.
2:30 Patterson, R.T., Evoy, R., Moslov, T.F., and Luternauer, J.L.: Seismic and sediment-gravity flow risk assesment on the Fraser River delta, British Columbia, Canada.
3:00 Pawłowski, J., Swiderski, Z., and Lee, J.J.: Ultrastructure and reproduction of Trochammina sp. (Foraminiferida).
3:30 Thies Andrea: The recent agglutinated foraminiferal assemblages of the European North Sea.
4:10 Kitazato H. - Video-film - Main Building, Room No 105 (1 floor)
4:30 Refreshments at the Poster display

Tuesday, September 14 - **Fossil Agglutinated Foraminifera**

Morning - Tethyan faunas

9:00 Bubik, M.: Cretaceous to Paleogene deep-water agglutinated foraminifera of the Bile Karpaty Unit (West Carpathians, Czech Republic).
9:30 Hart, M., Koutsoukos, E., Tewari, A., and Carroll, M.: Late Cretaceous agglutinated foraminifera from the South Atlantic, North Atlantic and Indian Oceans.
10:00 Morlotti, E.: An evidence against the autochtony of Upper Cretaceous "Rhabdammina faunas": preliminary data from the Serramazzoni Flysch (Northern Apennines, Italy).
10:30 Coffee break

11:00 Tyszka, J. & Kaminski, M.: Factors controling distribution of agglutinated foraminifera in Aalenian-Bajocian dysoxic facies (Pieniny Klippen Belt, Poland).

11:30 Dignes, T. - TBA
12:00 Podobina V. or Moorkens T. - TBA

12:30 Lunch

Afternoon - Boreal faunas

2:00 Charnock, M.A. & Jones, R.W.: Palaeogene agglutinated foraminifera from the North Sea: distribution, palaeoecology and application to sequence stratigraphy.
2:30 Hedinger, A.: Late Jurassic (Oxfordian - Volgian) to basal Cretaceous (Early Berriasian) foraminiferal succession in the Beaufort - Mackenzie Basin, Arctic Canada.
3:00 McNeil, D.H.: A progress report on fifteen years of research on agglutinated foraminifers in the Beaufort - Mackenzie Basin of Arctic Canada.
3:30 Nagy, J., Gradstein, F.M., et al.: Late Jurassic through Early Cretaceous foraminifera from Nepal: Paleoenvironments and global correlations.
4:00 Schröder-Adams C.J., et al.: Paleoenvironmental changes in the Cretaceous Colorado Group of Western Canada: microfossils, sedimentological and geochemical evidence.

4:30 Refreshments at the Poster display

Wednesday, September 15 - **Taxonomy**

9:00 Hart, M.: "Coskinophragma, an anusual agglutinated foraminiferan from the Turonian of Southern England.
9:30 Bender, H.: Test structure and classification in agglutinated foraminifers.
10:00 Hart, M., Leary, P., and Swiecicki, A.: The genus Marssonella Cushman and related taxa in the Cretaceous chalks of the United Kingdom.

10:30 Coffee break

11:00 Kaminski, M.A. & Geroch, S.: A revision of foraminiferal species from the Grzybowski Collection.
11:30 Podobina, V.: New data of composition and microstructure of agglutinated foraminifera wall.
12:00 Whittaker, J. & Kaminski, M.A.: Lectotypes of some Recent Deep-Water Agglutinated foraminiferal genera housed at the Natural History Museum, London (BMNH): A tale of Ten Taxa.

Wednesday Afternoon

Institute of Geological Sciences, Jagiellonian University, ul. Oleandry 2a
2:30 - 6:00 - Microscope session

Wednesday Evening
Social Events at the Old Geology Department Building at Anny Str. 6

6:30 - Opening of The Grzybowski Memorial Exibition
Old Geology Lecture Theatre, First Floor
7:30 - Conference Dinner in the Dungeon Cafe

Excursion A

September 16 (Thursday)

8:30 - Departure from Przegorzały
Itinerary : Kraków - Nowy Sącz - Szymbark - Siary - Gorlice - Iwonicz Zdrój
Exp. 1 Grybów - Late Cretaceous Inoceramian Beds - equivalent of Grzybowski's fauna described in 1901
Exp. 2. Szymbark - Late Cretaceous Inoceramian Beds - Dylążanka's neotype locality (1923)
- Lunch in the field about 1:00 - 2.00 pm.
Exp. 3. Ropica - Grzybowski's locality (1901)
Arrival at Iwonicz Zdrój - about 6:00 pm.
Overnight and dinner at the hotel "Pod Jodłą"

September 17 (Friday)

9:00 - Departure from Iwonicz Zdroj
Itinerary : Iwonicz - Bóbrka - Dukla - Krosno - Węglówka
- Visit to Bóbrka Oil Museum
Exp. 4. Trzciana near Dukla - Grzybowski's locality (1984) - Oligocene Menilite Beds
- Lunch in the field
Exp. 5. Krosno - Grzybowski's locality (1898) - Middle - Late Eocene
Exp. 6. Węglówka - equivalent of Grzybowski's fauna described in 1896 - Late Cretaceous (Campanian)
Additional exposure - Domaradz - Middle Eocene Variegated Shales - Silesian Unit
-Return to Iwonicz - about 6:00 pm.; overnight and dinner at the hotel "Pod Jodłą"

September 18 (Saturday)

8:30 - Departure from Iwonicz Zdrój
Itinerary: Iwonicz - Ropczyce - Zawada - Wieliczka - Kraków
Exp. 7. Międzybrodzie - Late Albian - Campanian deposits of the Silesian Nappe
Exp. 8. Dębna - Oligocene deposits of the Skole Nappe
- Lunch in the field
Exp. 9. Zawada, Stobierna, Stasiówka - Friedberg's locality (1901) - Campanian - Early Mastrichtian
Exp.10. Szczepanowice - Early Cretaceous - Senonian of the Skole Nappe
Exp.11. Sułków - Badenian deposits of the Carpathian Foredeep
Return to Kraków about 7:00 pm., overnight and dinner at Przegorzały

Excursion B — September 19 (Sunday)

8:00 - Departure from Przegorzały
Itinerary: Kraków - Cieszyn - Bielsko-Biała - Wadowice - Kraków
Exp. 14. Gumna - ?Kimmeridgian-Tythonian of the Silesian Nappe
Exp. 15. Goleszów - Late Berriasian of the Silesian Nappe
- Lunch in the field
Exp. 13. Lipnik - Early Cretaceous of the Silesian Nappe
Exp. 12. Bujaków - Middle Eocene of the Subsilesian Unit


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