Tenth International Workshop on Agglutinated Foraminifera

Abstract Volume

Edited by:

J. Soták
M.A. Kaminski
K. Fekete
& J. Kowal-Kasprzyk

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Smolenice Castle, Slovakia, April 19–23, 2017

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Grzybowski Foundation, 2017

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SLOVAK RESEARCH AND DEVELOPMENT AGENCY

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Preface

The Organizing Committee of the 10th International Workshop on Agglutinated Foraminifera (IWAF-10) is pleased to welcome you in Slovakia. The Micropaleontology has a long tradition in Slovakia, and therefore we are most honoured to held the next IWAF meeting in our country. We hope that this event will bring together specialists from all over the world to share new ideas and cooperate in the study of agglutinated foraminifera.

The micropaleontological research in Slovakia and in Central Europe has its roots in the 19th century. For all professionals should be mentioned Maximilian Hantken and János Kocsis followed by Anton Rzehak, László Majzon, Edward Passendorfer, Franciszek Bieda and Antonia Jednorowska. Research was later supported by the foundation of Laboratory for Stratigraphy and Paleontology of the Slovak Academy of Sciences (1953), State Geological Institute of Dionýz Štúr (1940) and Department of Geology and Paleontology at the Faculty of Natural Sciences of the Comenius University in Bratislava (1952). These institutions released a numerous outstanding scientists, such as Jozef Salaj, Ondrej Samuel, Eduard Köhler, Viera Scheibnerová, Otília Jendrejáková, Viera Kantorová, Karol Borza, Edita Brestenská, Viera Gašparíková, Hedviga Bystrická, Margita Vaňová, Ružena Lehotayová and others, whose work has brought many significant contributions to foraminiferal research.

The IWAF-10 held in the Congress Centre of the Slovak Academy of Sciences in Smolenice Castle follows previous meetings held in Amsterdam (1981), Vienna (1986), Tübingen (1989), Kraków (1993), Plymouth (1997), Prague (2001), Urbino (2005), Cluj-Napoca (2008) and Zaragoza (2012). The main idea of the IWAF-10 meeting and this abstract volume is to present the latest investigations on largest single group of Foraminifera. We would like to thank for the participation of almost 50 scientists attending over 25 oral presentations on topics concerning agglutinated foraminifers,- their classification, systematics and taxonomy, test structure, wall mineralogy, taphonomy and paleoecology, paleobathymetry, biostratigraphy, modern DWAF, laboratory culturing etc. So, we believe in a high-quality scientific contributions, constructive discussions, friendly and cooperative atmosphere during the IWAF-10.

The IWAF-10 meeting will comprise three days of the plenary and technical sessions and two days of field excursions. The IWAF-10 will start with the meeting of Commision for Classification of Agglutinated Formaninifera and workshop providing opportunity to check and study Western Carpathians collections of agglutinated foraminiferal microfauna collected by O. Samuel and J. Salaj and from deposits of the Micropress Europe in Kraków (April 19th). The IWAF-10 will continue by two days of the field trip (April 22th – 23th). During the first day in the Middle Váh Valley, the participants will see the Lower Cretaceous hemipelagic and flysch-type formations, the Upper Cretaceous red-beds, Paleocene to Middle Eocene shallow- and deep-water formations and Upper Eocene turbiditic formations with DWAF. In the second day of the field trip, the Senonian marly formations, Oligocene turbidite formations, Lower Miocene sandy calcareaous sandstones („Schlier“) and Neogene formations of the Vienna Basin will be visited.

We take this opportunity to thank for financial support to the Slovak Research and Development Agency (project APVV-14-0118), and our sponsors, who supported this meeting and contributed to the organizational costs (The Grzybowski Foundation, Slovak Commission for UNESCO, Ministry of Foreign and European Affairs of the SR, UNESCO/ IGCP 609, IGCP 632 projects, The Micropaleontological Society, city of Bratislava, Kreativika Microslides, Beta Analytic). We want to thank the Institute of Earth Sciences of the Slovak Academy of Sciences, Faculty of Natural

Sciences of Comenius University, State Geological Institute of D. Štúr and Slovak Geological Society for providing all support for the IWAF-10 meeting. The Organizing Committee worked together with enthusiasm and passion to make this meeting possible. Therefore, we wish to thank all those who helped with different aspects of this meeting.

With all the various scientific and social activities planned during the meeting, we are certain that there will be many opportunities to explore scientific networks and to share new ideas for advancing foraminiferal research.

We hope you enjoy the meeting, and wish you a successful and pleasant stay in Smolenice.

The IWAF-10 Organizing Committee

Volume dedicated to oustanding work of Josef Salaj and Ondrej Samuel in the Carpathian micropaleontology and foraminiferal research

The remembrance of RNDr. JOZEF SALAJ, DrSc.

Adriena ZLINSKÁ[1] and Ján SOTÁK[2]

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Dr. Jozef Salaj was born on January 11, 1932 in Želovce near Veľký Krtíš. After graduation at the Faculty of Geology and Geography of Charles University in Prague, where under the supervision of excellent pedagogues, such as Prof. J. Augusta and Prof. J. Špinar as well as academics V. Pokorny, R. Kettner and O. Kodym, he received apart from geology also solid knowledge about paleontology and stratigraphy.

In August 1956, he joined the State Geological Institute of Dionýz Štúr in Bratislava (SGIDŠ). Right from the start, he focused on geological mapping and microbiostratigraphical research of the Myjava Hills. As first he cartographically and stratigraphically defined lithostratigraphic units of the Senonian and the Paleogene, known as the Paleogene Gosau Development. He created the first concept of the Cretaceous and Paleogene biostratigraphic division which was accepted for the whole Mediterranean area.

Concomitantly he also engaged in research of the Cretaceous marly and flysch sequences of the Tatric and Fatric units. He proved their Barremian-Aptian, Albian and Cenomanian age.

Between years 1961–1965 he was mainly focused on the Cretaceous and Paleogene sediments of the Middle Váh Valley, especially, in the Manín and Klape units. He paid special attention to the Cretaceous formations that were previously dated only by rare macrofauna findings.

His sphere of research gradually spread to the entire Pieniny Klippen Belt (PKB). He significantly contributed to the refinement of individual lithostratigraphic units, but also brought a new perspective on the paleogeographic evolution of the most complex tectonic units of the Western Carpathians. Along with his closest associates, he demonstrated a continuous sedimentation between the Middle and the Upper Cretaceous and diachronic age of the Upohlav conglomerates. He demonstrated the presence of Sennonian deposits in the Manín Unit, Paleocene and Lower Miocene age of sediments of the Peri-klippen area. As a result of these facts, he fundamentally changed the interpretation of tectonic evolution of the PKB, Paleogene transgression to Central Carpathian basins, and the paleogeographic position of the Manín Unit.

In the early sixties, intensive studies of Triassic foraminifers began worldwide. In line with this trend and in collaboration with other authors, he focused on this current issue and worked on it during the following years, which ranked him among the leading experts of fossil microorganisms. As first he significantlly contributed to the division of Triassic complexes of the Western Carpathians on the basis of foraminifers, biozonation and interregional correlations of this system. He published the results of his research in numerous articles and in cooperation with K. Borza and O. Samuel in the monography "Triassic foraminifers of the West Carpathians" (1993). Publications about the Triassic attracted a great international acclaim.

In years 1967–1974, the focus of his research moved to North Africa, where he worked in the "Service Géologique de Tunisie" in Tunisia. He presented new findings at the VI African Micropalaeontological Colloquium (1974), and was its general secretary. On this occasion, he presented a proposal to the wide community of professionals about Cretaceous and Paleogene hypostratotypes for the Mediterranean area. In a cooperation with K. Pozaryska and J. Szczechurova (1976), they suggested Paleocene developments in the area of El Kef for the Paleocene stratotype in marine development. The stratotype boundary between the Cretaceous and the Paleocene in this area was approved at the International Geological Congress in Washington. Dr. Salaj suggested that stratotypes for the Middle (Harien) and the Upper (Mellégien) Paleocene were also in this area.

Results of his research activities in Tunisia were published in numerous articles and in a comprehensive monograph "Microbiostratigraphie du crétacé et du paléogéne de la Tunisie septentrionale et orientale (hypostratotypes Tunisiens)". In 1976, based on this work, he was awarded by the title of Docteur d'Etat (as DrSc.) in Paris (Université de Paris VI). In 1982, he defended his doctoral dissertation thesis on the Triassic foraminifers of the Western Carpathians and the Mediterranean area at the Presidium of the Czechoslovak Academy of Sciences in Prague.

After the return from Tunisia and two-year work stay in Libya and Iraq, he was actively involved in the microbiostratigraphic research on sheets 1:25,000 in the Middle Váh Valley and worked on the formulation of regional geological maps (1:50,000) of the Myjava Hills, Brezovské and Čachtické Karpaty Mts. with explanatory notes in a co-operation with other geologists. As first, here as well as in the Manín area, he pointed out on the possibility of occurrence of hydrocarbons on the basis of favorable geological setting (Salaj, 1966).

He was working for a relatively long time on a monograph about geology of PKB and the Peri-klippen zone of the Middle Váh Valley. It was published together with geological map of this area at 1:50,000 in 1995.

He also applied his rich experience in organizing the 18th European Micropalaeontological Colloquium in Czechoslovakia as a general secretary as well as in international microbiostratigraphical research in various IGCP projects. But equally important is his contribution to co-operation in some special biostratigraphical studies at Columbia University (ESRI) and Amoco Co. in Tunisia.

Within international co-operation in the various bilateral agreements of SGIDŠ, he actively participated in research of Mesozoic, especially, Triassic formations. As a coordinator, in co-operation with E. Trifonova, D. Gheorghian and V. Coronet, he was involved in the development of an interregional microbiostratigraphical scheme of the Triassic of the Western Carpathians, the Balkans and Helenids on the basis of foraminifers.

Since 1994, RNDr. J. Salaj, DrSc. worked at the Geological Institute of the Slovak Academy of Sciences. This opportunity gave him a creative space for completion of unfinished issues about the Cretaceous and Paleogene of Tunisia and Slovakia, which he published in a series of articles and extensive compendia in the edition of "Zemný Plyn a Nafta Hodonín" magazine (1997a, b; 1998a, b, c; 1999 etc.). He contributed significantly to the scientific education of young domestic and foreign researchers, especially, in the field of micropaleontology. In the following years, he also educated PhD students from North Africa at the Faculty of Natural Sciences of Charles University in Prague.

In 2000, on behalf of the 60th anniversary of the SGIDŠ, he was awarded by a Golden Commemorative Medal for science development and promoting of Slovakia abroad. He published his substantial works on the stratigraphy of the Súľov Paleogene, taxonomic revisions of foraminifers, and paleoclimatic researches in Geologica Carpathica (1997, etc.), Mineralia Slovaca (2001), and others. He worked on new grant projects VEGA and APVV focused mainly on microbiostratigraphical research of the Upper Cretaceous and Paleogene formations in the PKB, Manín and Klape units. In addition to research work, he was involved in organizing important international events such as the International Symposium on Cretaceous in Vienna in 2000, the 17th Congress of the Carpathian-Balkan Geological Association in Bratislava in 2002, the IGCP workshops, research programs at Columbia University (ESRI) and others.

In 2005, the Presidium of Foundation on Foraminiferal Research at the Smithsonian Institute in Washington nominated RNDr. J. Salaj, DrSc. on the "Cushman Award" which is one of the most important micropaleontological awards obtained by only few European scientists.

In 2007, the Presidium of the Slovak Academy of Sciences honored his scientific contribution with the "SAS prominent figure of the year 2007". For the development in the field of micropaleontology, he received a letter of thanks on the occasion of the 8th Czech-Slovak-Polish Palaeontological Conference held at SGIDŠ.

During his extremely fruitful professional life, RNDr. Jozef Salaj, DrSc. published more than 300 scientific contributions with the highest scientific credit and great international acclaim. He represented a generation of the post-war period, thanks to which micropalaeontology and stratigraphy of Central European countries have reached a high scientific level. His research, however, exceeded the level of local science and brought progress to micropalaeontology and stratigraphy across the Tethyan realm.

RNDr. Jozef Salaj, DrSc. passed away on February 18, 2011 in Bratislava.

RNDr. ONDREJ SAMUEL, DrSc. - 15. death anniversary

Adriena ZLINSKÁ

State Geological Institute of Dionýz Štúr, Bratislava

Dr. Ondrej Samuel was born on February 10, 1931 in Palárikovo, near Nové Zámky. He graduated at the Faculty of Geology and Geography of Comenius University in Bratislava in 1956. During the last year of his studies, Dr. Samuel was an assistant of D. Andrusov. From 1956 to 1994 he was employed at the State Geological Institute of Dionýz Štúr (SGIDŠ), as a deputy director (1972–1982), head of the Paleontology Department (1982–1983), and head of the Biostratigraphy Department (1982–1993). At the SGIDŠ he was also elected to chairman of the convocation (1980–1994) and member of the editorial board (1972–1994). From 1963 to 1986 he was a scientific redactor of the editorial series "Západné Karpaty" (Western Carpathians), the sequence "Paleontológia" (Paleontology), and a long-time scientific redactor of the edition "Geologické práce – Správy" (Geological Works – Reports) (1964–1997), "Mineralia Slovaca" (1973–1995), "Časopis pro mineralogii a geologii" (Magazine for Mineralogy and Geology) or "Časopis Českej geologickej spoločnosti" (Magazine of the Czech Geological Association) (1985–1994).

Thanks to his wide scientific and management abilities, he was a member of various scientific institutions. Within the scientific board for Earth and Space Sciences of the Slovak Academy of Sciences, he worked for the Commission for Geology and Geography. He was a chairman of the Terminological Commission and a deputy chairman in the Board for Geology and Geography of the Czechoslovak Stratigraphical Commission of the Czechoslovak Academy of Sciences, as well as a member of the Common Scientific Board of ÚÚG (General Office of Geology), SGIDŠ and the Czechoslovak (and Slovak) National Committee. Beside scientific activities, he was also active in organizing various scientific undertakings, for instance, X Anniversary Meeting of CBGA (Carpathian-Balkan Geological Association) in Czechoslovakia (1973) and XIII National Geological Conference of the Slovak Geological Society (SGS). It is especially important to mention his meritorious activities for the Slovak Geological Society. He became its member in 1960, he was appointed a secretary in 1974, and served as a deputy chairman from 1982 to 1994. From 1983 to 1995 he was a president, representing Czechoslovakia (and from 1993 Slovakia) in CBGA, where he was a member of the International Subcommittee for Paleontology. He was a chairman of the board for defense of candidate dissertation thesis (CSc.), specialization Paleontology, and an alternating chairman of the board for defense of doctoral dissertation thesis (DrSc.).

In 1964, he defended his candidate dissertation thesis (CSc.) entitled "Microbiostratigraphy of external and internal flysch of eastern Slovakia, Paleogene of the Klippen Belt and Central-Carpathian Paleogene". He obtained the Doctor of Sciences (DrSc.) degree in Bratislava in 1972.

During his scientific-research activities, his major specialization was stratigraphy of the Paleogene, the Cretaceous, and later also of the Triassic as well as paleontology of foraminifers. The published monographs about these issues are so far the most complex reviews and represent the stratigraphic value of foraminifers in the Western Carpathians. He described more than 70 new taxa whose validity has been recognized in most cases also in the prestigious monograph "Foraminiferal Genera and Their Classification" (by Loeblich -Tappan), published in New York (1988). His works have had influence on improvement of the accuracy of flysch sequences and the Klippen belt at the territory of Slovakia, which also improved the theory about paleogeographic and also tectonic development of the Western Carpathians. An important feature of his published works is also a comparison of planktonic foraminifers with other fossil series (giant foraminifers, nanoplankton, palynology) and biozoning of the Cretaceous and the Paleogene, which enables interregional stratigraphic parallelism and correlation with the international geochronological scale.

Beside monographic works, he had also an essential contribution to three volumes of the Stratigraphic Dictionary (1983, 1985, 1988) which he not only edited but he was also one of its major authors. These thee volumes represent the first lithobiostratigraphic classification of the Western Carpathian system. Chronostratigraphic and synoptic table, reflecting the present state of chronostratigraphy at the world-wide scale, is a suitable part of the Stratigraphic Dictionary in the first (1980) and also the second (1987) edition. Beside the aforementioned works, he also participated on two volumes of The Encyclopedia of Geological Sciences (1983) and The Encyclopedia of Slovakia. Reference-Terminology Dictionary (2000), specialization paleontology, is a result of his long lasting activity in the Terminological Commission. It contains 3500 entries.

His scientific·research activities were awarded on international forums, for example, during the scientific meeting about the Eocene in Hungary, where he was honored by a medal for his contribution in solving problems on microbiostratigraphy of the Paleogene in Europe. For his extensive international cooperation in Central Europe, he was awarded by a honor plaque of the Hungarian Geological Institute, Polish Geological Institute (1970), Central Geological Institute in Prague (1979), as well as by honor memberships in the Poland Geological Society (1990), Czechoslovak Society for

Mineralogy and Geology of the ČSAV (1990), Slovak Geological Society (1997), and the Hungarian Geological Society (1998). The Committee of SGS awarded him by a medal of Ján Slávik (1982) for his extensive activities in the Slovak Geological Society.

His work was also awarded by national authorities. He obtained the governmental award "The Best Worker of the Geological Survey" (1969) and a state governmental award for his loyalty to the employer in 1971. He was awarded by a Dionýz Štúr plaque for his contribution to the development of geology (1974) and a SGIDŠ honor plaque (1980). For his contribution to Earth sciences, he was awarded by a Dionýz Štúr golden plaque as well as by the Slovak Academy of Sciences (1991). In 2000, at the occasion of the 60th anniversary of foundation of the State Geological Institute of Dionýz Štúr, he was awarded by the medal for his contribution to the development of geology and propagation of Slovakia abroad.

He published about 250 scientific works in national and international journals and proceedings from various symposiums and meetings. There are also numerous (about 200) unpublished research reports as well as five monographs in which he presented the most complex morphological descriptions and the stratigraphic value of Western Carpathian foraminifers. In the following works, he described more than 70 new taxa:

1. Foraminifera of the Western Carpathians • Cretaceous (J. Salaj – O. Samuel, 1967; SGIDŠ, in German)
2. Microbiostratigraphy and Foraminifera of the Slovak Carpathian Paleogene (O. Samuel – J. Salaj, 1968; SGIDŠ, in English)
3. The Geology of the Eastern Slovakia Flysch (B. Leško – O. Samuel, 1969; SAV, in Slovak)
4. Microfauna and Lithostratigraphy of the Paleogene and adjacent Cretaceous of the Middle Váh Valley (West Carpathians) (O. Samuel – K. Borza – E. Kôhler, 1972; SGIDŠ, in English)
5. Triassic Foraminifera of the West Carpathians (J. Salaj – K. Borza – O. Samuel, 1983; SGIDŠ, in English).

A very valuable feature of the mentioned works is a comparison of planktonic foraminifers with other fossilized groups, mainly large foraminifers, and biozoning of the Cretaceous and the Paleogene on the basis of planktonic foraminifers that enables intercontinental parallelism and correlation with international geochronological stratigraphic scale. This gives European and global weight to his works in the microbiostratigraphic field.

The value of his publications is also enhanced by the fact that they deal with synonymics and taxonomic value of species which were paralelly described in the former Soviet Union and in western contries. This critical approach made his publications to be internationally recognized, which is best proven by the great international interest about results of his research and by numerous quotations practically emerging in all prestigious scientific journals.

The research works of RNDr. O. Samuel, DrSc., represent a certain milestone in the development of micropaleontology in our country. They influenced present opinions on stratigraphy and in such a way also on geology, tectonics and paleogeography of the Cretaceous and the Paleogene of the Western Carpathians in Slovakia. His results have exceeded the regional frame and they are important contribution to those scientific disciplines at international level.

RNDr. Ondrej Samuel, DrSc. passed away on December 20, 2002 in Bratislava.

Scientific contributions

Distribution of Agglutinated foraminiferal groups in the Arabian Gulf

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[1]Department of Geosciences, College of Petroleum Engineering and Geosciences, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran 31261, Saudi Arabia
[2]Research Institute, Center for Environment and Water-Marine Section, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran 31261, Saudi Arabia; kaminski@kfupm.edu.sa

The distribution, taxonomy and systematics of the agglutinated foraminiferal groups i.e. astrorhizida, lituolida, loftusida, textularida, in the Arabian Gulf is poorly understood. The region is interesting to study because of its arid, subtropical climate and its prominent sedimentary realm; autochthonous pure carbonate with siliciclastic admixture dominating the west-southern Arabian ramp and the north-eastern fluvial Iranian shores. The region also experiences extremes of summer temperature and salinity due to its enclosed nature. A survey of published articles on foraminifera in the region (1965-2016) reveals that a total of 271 benthic foraminiferal species and subspecies have been identified belonging to 66 genera, 37 families, 23 superfamilies and 6 orders. Agglutinated forms account for 11%, hyaline (37%), porcelaneous taxa (52%) and the while spirillinid group, which is often referred to as having an optically single crystal or a mosaic of few has 1% representation. The orders identified with an agglutinated wall include the order **Astrorhizida** is represented by two superfamilies (Hippocrepinoidea and Saccamminoidea), two families (Hyperamminidae and Saccamminidae), and two genera (*Hyperammina* and *Lagenammina*). Seven superfamilies (Hormosinoidea, Lituoloidea, Recurvoidoidea, Rzehakinoidea, Spiroplectamminoidea, Trochamminoidea and Verneuilinoidea), thirteen families (Reophacidae, Discamminidae, Haplophragmoididae, Lituolidae , Ammosphaeroidinidae, Trilocularenidae, Nouriidae, Pseudobolivinidae, Spiroplectamminidae, Trochamminidae, Prolixoplectidae, Verneuilinidae and Carterinidae) and eighteen genera (*Reophax*, *Ammoscalaria*, *Haplophragmoides*, *Ammobaculites*, *Cribrostomoides*, *Recurvoides*, *Falsagglutinella*, *Nouria*, *Pseudobolivina*, *Spiroplectammina*, *Spiroplectinella*, *Arenoparella*, *Lepidodeuterammina*, *Rotaliammina*, *Trochammina*, *Eggerelloides*, *Carterina* and *Gaudryina*) were reported for the order **Lituolida**. The order **Textulariida** is represented by two superfamilies (Eggerelloidea and Textularioidea), three families (Valvulinidae, Pseudogaudryinidae and Textulariidae) and eight genera (*Connemarella*, *Pseudoclavulina*, *Clavulina*, *Bigenerina*, *Sahulia*, *Siphotextularia*, *Spirotextularia* and *Textularia*. 80% of the papers sampled in this study focus on environment pollution and apply Rose Bengal as a staining media to differentiate between living and dead assemblages. This technique has been shown to indiscriminately underestimate the agglutinated components of samples. As such, we speculate that the diversity of the agglutinated foraminifera might even be higher, if time averaged samples were studied. This study updates the knowledge on the diversity, types and distribution of agglutinated benthic foraminiferal groups in the Arabian Gulf.

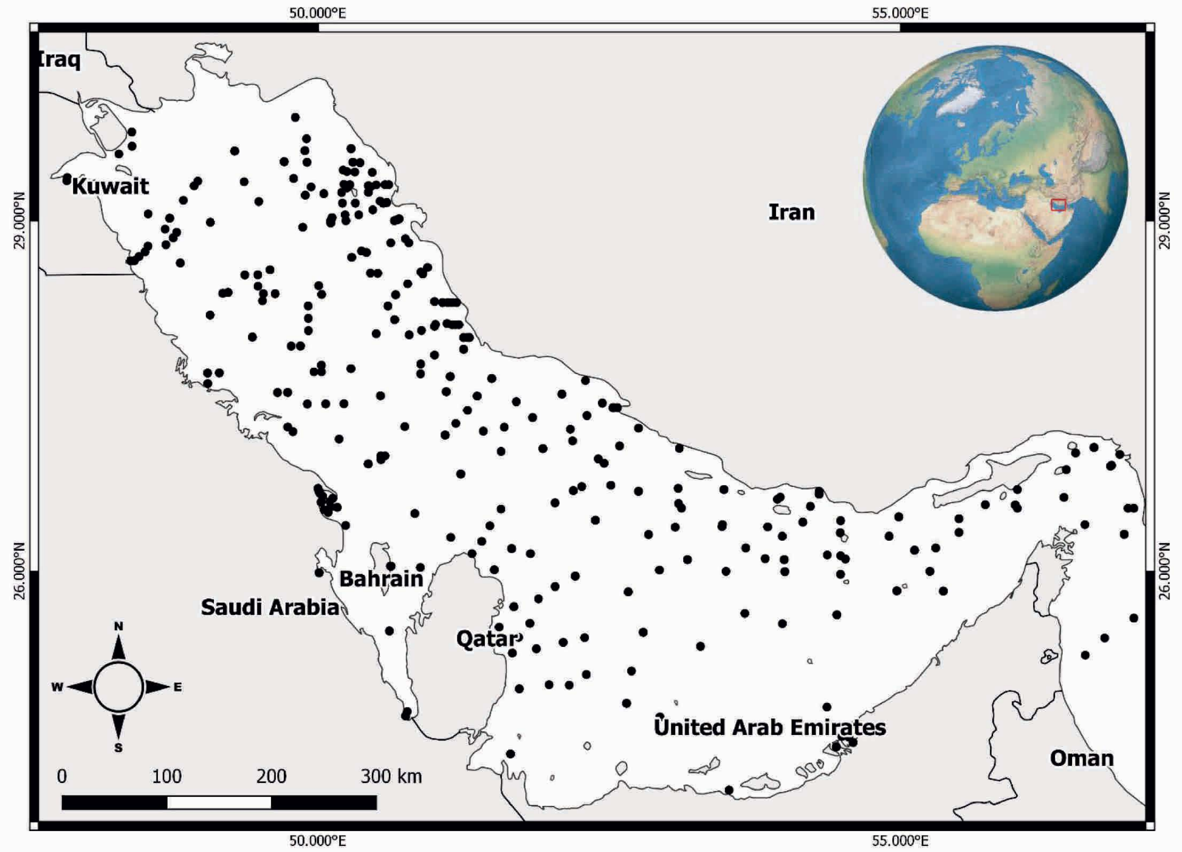

Fig. 1. Locations of samples collected with agglutinated foraminifera in the Arabian Gulf (1965-2016) based on a synthesis study of 32 publications.

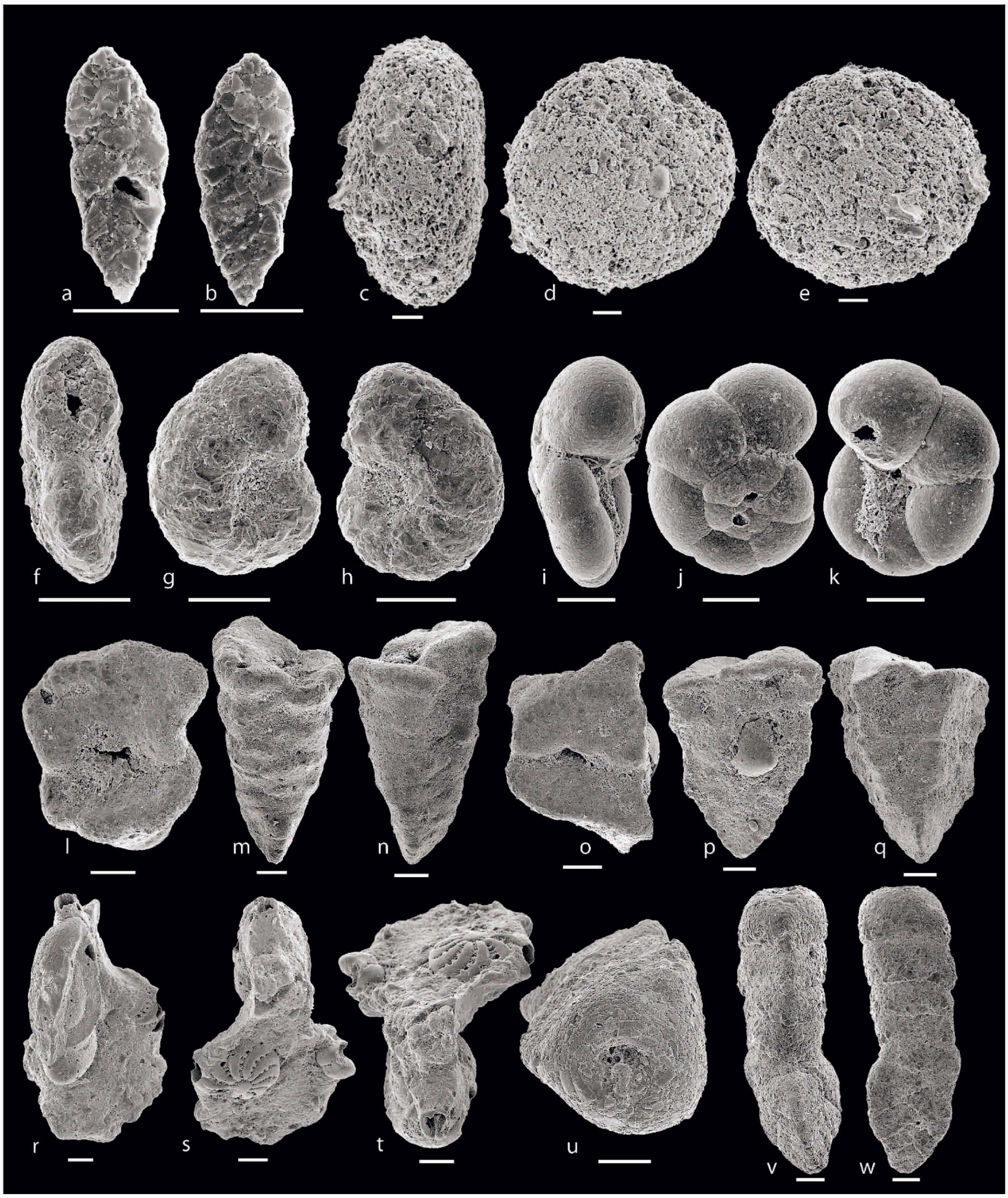

Fig. 2. Selected agglutinated foraminifera from the Arabian Gulf. **a-b.** ?*Agglutinated sp*, **c-e.** *Daitrona* sp., **f-h.** *Haplophragmoides pusillus*, **i-k.** *Trochammina inflata*, **l-n.** *Gaudryina attenuata*, **o-q.** *Gaudryina* sp., **r-t.** ?*Lagenammina* sp., **u-w**. ?*Clavulina angularis*.

Salt marsh agglutinated foraminifera and testate amoebae used for local and eustatic sea level change: true proxies or patchiness response?

Eric ARMYNOT du CHÂTELET[1] and Fabio FRANCESCANGELI[1]

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Foraminifera (Rhizaria) and testate amoebae (Rhizaria and Amoebozoa) have marine and continental affinities. They are valuable indicators of changes in transitional areas such as tidal flats and salt marshes and then widely used for (paleo) environmental/ecological characterization. In coastal areas they are valuable indicators of local and eustatic variations. When dealing with recent foraminifera and testate amoeba, a long lasting debate regularly reappears on the mutual use of living and dead fauna to accurately represent modern environments. Moreover environmental survey based on benthic foraminifera and testate amoebae needs a reliable sampling strategy particularly because patchiness complicates the observations and the interpretations.

The objectives of the present study are: 1) to study both foraminifera and testate amoebae in salt marsh - tidal areas, and to define the representativeness of dead fauna compared to living ones in such dynamic environments for paleoenvironmental / paleoecological studies; 2) to define the sampling strategy for an ecological / environmental study based on living benthic foraminifera and testate amoebae (i.e., define the minimal number of replicates); 3) to define the parameters that govern the spatial distribution of foraminifera and testate amoebae at a centimeter scale to explain the patchiness distribution.

Both surface samples (spatial variability) and cores (temporal variability) were selected from the tidal flat / salt marsh transitional zone along the Canche Estuary (Northern France). A panoply of statistical tools was applied on faunal and physico-chemical parameters. The conclusions are: 1) the dead fauna is far more diverse than the living one but results from a mix of autochthonous and more marine fauna; 2) all the replicates (total surface of 0.5 m^2) should be used to models the real foraminiferal and testate amoebaean density's variations/ patchiness; 3) the sediment grain size (i.e., transport) may be the only factor that triggers patchiness at the sampling scale. As a consequence, it is only thanks to both narrow and large environmental requirement of the species, coupled with environmental physico-chemical parameters that eustatic changes can be reconstructed.

An old method newly applied - Agglutinated foraminifera from the Albian to Turonian from Wunstorf (NW-Germany)

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A 250 m thick section was combined by four drill cores from Wunstorf near Hanover in NW-Germany from Upper Albian (?) to Upper Turonian. The Albian is characterized through typical claystones, but the following interval consists mostly out of marl-/limestone alternations with extremely high $CaCO_3$ ratios with an average of around 90%. Only typical blackshales of the OAE2 at the Cenomanian/Turonian Boundary are interrupting the succession. Overall, 64 samples were taken, 50 of them in 5m intervals over the whole section and 14 at previously proposed stage and lower stage boundaries.

With this newly applied method, based on formic acid and derived from research on conodonts in Paleozoic ages, all samples were treated, then washed and examined. The method is simple to apply and has medium acetolysis durations of one day, whereas the total loss of faunal elements seems to be minimal. With approximately 40 different genera and between 400 and 1500 specimen per 350g sample, the total number of agglutinated foraminifera is comparable to other studies on carbonate rich succession like from Kaminski et al. (2011) in Tethyan limestones.

Boreal, as also Tethyan taxa are attendant. The main faunal elements are simple tubular genera like *Nothia*, *Rhizammina* and *Tolypammina,* genera from the suborder Ammodiscina like *Ammodiscus*, *Glomospira* and *Repmanina*, but also Ataxophragmioidea like *Arenobulimina*.

Corresponding to that, evidence of high diversity associations of agglutinated foraminifera from Albian to Turonian is provided in carbonate-rich marl- and limestone succession from the boreal influenced Lower Saxony Basin. Significant changes in the faunal composition during lithological homogenous material suggest a reasonable utility in paleoecological and paleobiogeographical approaches, as also for stratigraphical reasons in typical carbonate related deposition zones in boreal shelf-seas.

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Way of Czechoslovak foraminiferal micropalaeontology (1918-1992) and its contribution to agglutinated foraminifer research

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After establishing of independent Czechoslovak state in 1918 the study of Foraminifera in this territory was mostly domain of German-speaking community. Among the most active researchers we should commemorate Adalbert Liebus, Anton Rzehak and Heinrich Jedlitschka. Systematic guide to foraminifer genera "Die fossilen Foraminiferen" written by Liebus with unformal morphology-based classification became the first foraminifer guidebook published in Czechoslovakia. Occasional but precise studies were published also by Egon Oppl, Hugo Storm and Richard Hiller. The only Czech researcher Jaroslav Šulc started foraminifer studies, besides his main focus - fish otoliths.

German occupation of Czech countries in 1939 brought a closing of Czech Universities and a persecution of any opposition (J. Šulc was prisoned by Gestapo and executed). In such times young Vladimír Pokorný (1922-1989) took a position of assistant at the micropalaeontological laboratory of the oil mines in Hodonín under supervision of experienced Rudolf Grill. After the war he studied palaeontology at the Charles University Prague a started there his scientific career. In 1954 Pokorný published a Czech textbook "Principles of zoological micropalaeontology" later translated also to German and English. It became one of fundaments of Czechoslovak micropalaeontological school. In 1938 Dimitrij Andrusov (1897-1976), member of Russian emigration, left his position at the Prague University and became professor of geology and palaeontology at the Comenius University in Bratislava. His institute after the war served as another training center of Czechoslovak micropaleontology.

Pokorny's papers on agglutinated foraminifers from the Carpathian flysch illustrated with precise line drawings are classical (foraminifera from Nikolčice, Heršpice, *Thalmannammina* nov. gen. etc.). Other famous foraminifer micropalaeontologists were affiliated to Czech Geological Survey. Miloslav Vašíček (1909-??) contributed to agglutinated foraminifer studies by describing new taxa from the Magura flysch (*Hippocrepina depressa, Eobigenerina variabilis, Praesphaerammina subgaleata* etc.). Eva Hanzlíková (1925-1995) besides applied foraminifer biostratigraphy systematically described foraminifer faunas (mainly agglutinated) of single formations. Ivan Cicha (1932-2013) was active in biostratigraphy of Neogene basins in Moravia and together with Irena Zapletalová taxonomically described Miocene textulariids and lituolids. Jitka Hercogová studied foraminifers of the Bohemian Cretaceous Basin and contributed by systematic description of Cenomanian agglutinated taxa, *Gaudryina* representatives and attached forms *Bdelloidina, Axicolumella* etc. Other Czech workers were D. Štemproková-Jírová and P. Čepek working in the epicontinental Cretaceous, V. Schütznerová-Havelková, E. Benešová, J. Čtyroká, F. Jurášová, V. Molčíková and M. Holzknecht in Carpathians in Moravia.

Josef Salaj (1932-2011) and Ondrej Samuel (1931-2002) from the Slovak Geological Survey were among leading persons of foraminifer research in Slovakia. They publish a number of papers and books together. One of their most important books is "Triassic foraminifers of the West Carpathians" describing numerous new taxa of foraminifers from carbonate facies of the Central Carpathians. They publish also comprehensive studies on foraminifer biostratigraphy of the Central Carpathian Cretaceous (1966) and Paleogene (1968). O. Samuel taxonomically described flysch-type agglutinated foraminifers of Carpathian flysch in Slovakia bringing some new taxa (*Bathysiphon microrphaphidus, Subreophax pseudoscalaria*). Other Slovak foraminifer micropalaeontologists were H. Bystrická, V. Scheibnerová, R. Lehotayová, O. Jendrejáková, V. Gašparíková, V. Kantorová, E. Brestenská, M. Mišík and large-foraminifer specialists E. Köhler and M. Vaňová.

Promising development of the Czechoslovak micropalaeontology enhanced by a placement of the International Geological Congress to Czechoslovakia in 1968 was damaged by occupation of country and consequent political changes. Some micropalaeontologists leaved Czechoslovakia and stay in emigration (V. Scheibnerová, P. Čepek). Others headed limited travelling possibilities and limited freedom generally. V. Scheibnerová reached in Australia excellent results – i.e. describing Permian cold water agglutinated fauna related to southern Gondwana glaciation (including *Hyperammina, Ammodiscus, Ammobaculites, Haplophragmoides, Trochammina* etc.). During 70ies and 80ies new generation of foraminifer micropalaeontologists raised, represented by J. Kalvoda (Devonian-Carboniferous foraminifers), J. Krhovský (Cretaceous-Paleogene of south Moravia), J. Soták (Triassic faunas), L. Hradecká (Bohemian Cretaceous Basin) and A. Zlinská (Carpathian biostratigraphy). Organization of the 18th European Colloquy on Micropaleontology in Czechoslovakia (1983) was a milestone for Czech and Slovak micropalaeontologists of that period. Since 1993, after separation of Czech and Slovak states, the micropaleontology of both nations still profits from Czechoslovak micropalaeontological school.

Some remarks on quantitative analysis of deep-sea foraminifer taphocoenosis with special attention to tubular astrorhizids

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Besides taphonomic loss of information, the quantitative study of deep-sea foraminifer taphocoenosis is often biased by fragmentation of foraminiferal tests. Especially fragile tubular tests of astrorhizids may break to numerous fragments. Common practice, to count test fragments as specimens - individuals, results in significant exaggeration of tubular taxa share in benthic foraminifer assemblages. Only way to get reliable data on original composition of taphocoenosis is recalculation of fragments to complete tests. This recalculation may be sometimes easy, but in some cases quite complicated or questionable. Different morphotypes may demand different approach:

1) Fragile forms with well-known test shape (*Ammodiscus, Glomospira, Haplophragmoides, Saccammina, Karrerulina, Spiroplectammina*). Large fragments of these taxa may be simply transformed to whole tests based on their proportional part.

2) Uniserial tests (*Reophax, Hormosinella, Pseudonodosinella, Caudammina, Subreophax, Kalamopsis*). Test fragments of hormosinids are usually broken to short fragments or single chambers. For taxa surviving in modern habitats or having modern shape analogues we can simply establish average number of chambers and recalculate fragments to complete specimens. For extinct *Caudammina* we may use as a shape analogue *Hormosinoides guttiger* (Brady), for extinct *Subreophax* representatives may play this role *Subreophax aduncus* (Brady) etc. Extinct *Kalamopsis grzybowskii* (Dylazanka) was apparently very elongated uniserial form that broke to numerous small fragments. In this case, strongly elongated astrorhizid forms like *Bathysiphon beatum* Saidova may serve as closest morphotype.

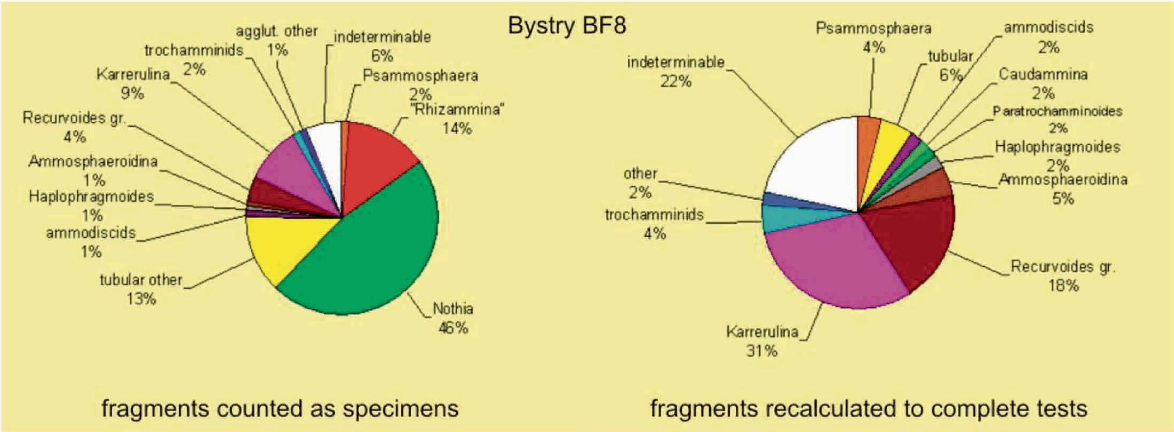
3) Simple tubular agglutinated taxa (*Hyperammina, Rhabdammina, Saccorhiza, Bathysiphon*). From washed residues we usually recover short fragments of tubular test. We may measure summary length of the fragments in picked set and divide it by mean tube diameter. If we calculate length/breadth ratio for complete tests of modern representatives of these or closely related taxa, we may deduce how many individuals can be composed from our fragments. Directly we can use modern tests of *Rhabdammina discreta* Brady. For *Hyperammina, Saccorhiza* and *Bathysiphon* we can compare numerous similar modern species. In case of *Bathysiphon* we may even find complete fossil tests in flysch facies.

4) Branched tubular forms (*Nothia, Rhizammina*). Similarly as in simple tubular forms we can measure all fragments and divide them by mean diameter to receive summary length/breadth ratio for tubular branches. The calculated value compared with value for complete individual shows, how many individuals, or how large part of individual, the fragments represent. Complete specimens of *Nothia* were found in hemipelagites, sometimes attached on the sole of turbidite sandstones in the Late Cretaceous-Paleogene strata of Carpathians. Based on the most complete specimens, a summary length/breadth ratio calculated for *Nothia dichotomica* (Neagu) varies between 200 and 252 and for *Nothia* gr. *excelsa* (Grzyb.) between 209 and 426. Until now, no complete specimens of *Rhizammina* sp. were found in Carpathians. Comparing with complete specimens of modern representatives, the summary length/breadth ratio may be similar as in *Nothia*.

An example from Silesian Unit (sample Bystrý BF8) illustrates difference between counting fragments and individuals.

Fragments of *Nothia* and *Rhizammina* dominating a count of 300 specimens represent in fact less than one complete individual and these taxa are rather an accessoric element of community.

Counts of tubular fragments distort diversity and equitability values. This also produces false picture on morphogroup share in benthic assemblage. Biofacies dominated by tubular astrorhizids should be reconsidered with respect to all these facts.



Agglutinated Foraminifera of Tithonian-Valanginian radiolaria-rich Kurovice Limestones in Moravia (Western Carpathians, Czech Republic)

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The Kurovice Limestones represent deep-sea carbonates deposited in external part of the Magura Basin during the Tithonian-early Valanginian. Only small remnants of originally widely distributed pelagic limestones are preserved in tectonic slices in the front of the Rača Nappe near Kurovice and near Vigantice.

The Kurovice Limestones are light grey bedded pelagic limestones. Microscopically they may be characterized as radiolaria-spiculite wackestones to packstones, intercalated by mudstones and few coarse-grained turbidites with accumulations of aptychi. Chert nodules are rather rare. Presence of aptychi and lack of ammonites indicate bathyal depth (upper to middle slope).

In Kurovice early Tithonian-early Valanginian strata were micropalaeontologically proven in composite section by Eliáš et al. (1996). Recently integrated high-resolution stratigraphic study started at new continuous section in the Kurovice quarry in coincidence with Cretaceous system boundary studies (project GA16-09979S). Besides the biostratigraphically fundamental planktonic groups also foraminifer fauna was recorded. The foraminifers were studied in thin sections and acid-residues prepared by method of Lirer (2000). This method provides 3D foraminifer tests but, comparing with thin-section assemblages, destroys most of nodosariid tests and completely miliolid and calcareous-agglutinated forms.

Foraminifer fauna from the Kurovice section is generally poor. Benthic foraminifer assemblages are dominated by long-ranging involutinids and nodosariids. Miliolids are rare (*Ophthalmidium, Quinqueloculina*). Agglutinated foraminifers are minor element of the assemblages or completely missing. Only some samples contained more frequent and diversified agglutinated taxa.

Astrorhizids are unfrequent, represented by bent tubular fragments of *Rhizammina* or rare *Hippocrepina depressa* Vašíček. Ammodiscids are represented especially by *Glomospira variabilis* (K. et Z.). Hormosinids are rather rare – mainly small juvenile forms of *Pseudonodosinella* cf. *troyeri* (Tappan). Typical *P. troyeri* appears in the Berriasian part of the section. Lituolids are practically missing except single find of juvenile *Everticyclammina praekelleri* B. & H.. Among more advanced multichambered forms following species were observed: *Bicazammina jurassica* (Haeus.), *Uvigerinammina uvigeriniformis* (Seib. & Seib.), *Paleogaudryina magharaensis* Said&B., ?*Parurgonina caelinensis* Cuvill. & al., *Verneuilina subminuta* Gorb. and *Trochammina* sp. Several specimens of *Pseudomarssonella dumortieri* (Schwag.) were encountered in turbiditic layers and are probably reworked from shallower depths of upper slope.

Biostratigraphy of the section is established on calcareous dinoflagellate cysts and calpionellids that clearly separate lower Tithonian, upper Tithonian and lower Berriasian strata. Among agglutinated species *Verneuilina subminuta* may be promising marker of the Jurassic-Cretaceous boundary. Foraminifer study is still in progress and very probably will bring new findings.

The Kurovice limestones at Vigantice are lithologically, sedimentologically and biofacially identical with that in Kurovice. The limestones form about 150 m long tectonic slice at the front of the Rača Nappe. They are early Berriasian in age based on calcareous dinoflagellate cysts and calpionellids.

Besides the typical poor assemblages dominated by involutinids, one sample contained the most diversified agglutinated fauna in the Kurovice Limestones ever found. Abundant *Rhizammina* sp., *Glomospira variabilis* (K. & Z.) and *Pseudoreophax cisovnicensis* Geroch are accompanied by less frequent *Glomospira* aff. *glomerata* Hoegl., *Hippocrepina depressa* Vašíček, *Pseudonodosinella*? *helvetica* (Haeusl.), *Haplophragmoides globigerinoides* (Haeusl.), *Ammogloborotalia quinqueloba* (Geroch), *Verneuilinoides* sp., *Eobigenerina variabilis* (Vašíček) and some calcareous forms (*Spirillina, Neotrocholina, Globospirillina*).

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Fossil agglutinated foraminifera and their relationship to the depositional environments in the Northern part of the Eastern Carpathians, Romania

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Several studies focused on the biostratigraphic and paleoenvironmental potential of the fossil foraminifera assemblages from the northern part of the Eastern Carpathians in Romania have been have been carried out during the recent years (Bindiu et al., 2013; 2016; Mare, 2014). These added data on the previous contributions, which were usually limited to the general description of assemblages and taxonomy. Stratigraphically correlable bioevents have been identified and described based on the relationship of the assemblages to the depositional environment deduced from micropaleontological observations and statistical methods statistical and micropaleontological methods. This study focuses on the Cretaceous to Paleogene agglutinated foraminifera assemblages recovered from the turbiditic sequences from the northern Eastern Carpathians (Tarcău Nappe). Most analyses include quantitative and qualitative description of the fossil foraminifera assemblages, morphology, taxonomy, biostratigraphy and paleoecology. Statistically interpreted data have been correlated to the sedimentology in order to gather a clear picture of the distribution and evolution in time and space of the paleoenvironmental parameters under the influence of base level changes, sedimentary input and nutrient supply.

The foraminiferal assemblages are dominated by deep-water agglutinated foraminifera. The composition of morphogroups (Jones & Charnock 1985, Nagy et al., 1995, Van der Akker et al., 2000, Kaminski & Gradstein, 2005) and the statistic diversity analyses (Murray, 2006) show that all populations belong to the „flysch type" foraminifera biofacies, consisting of coarsely agglutinated individuals.

Six zones of agglutinated foraminifera covering the Late Cretaceous to Late Eocene have been identified based on characteristic regional bioevents (first and last occurrences, peculiar abundances - Geroch & Nowak, 1984): *Caudammina ovulum giganteea* Zone, *Rzehakina fissistomata* Zone, "*Glomospira*" Zone, *Reticulophragmium amplectens* Zone, *Reophax pilulifer* Zone, and the *Spiroplectammina spectabilis* Zone. Local control on biostratigraphy has been possible based on planktonic foraminifera (*Globotruncana ventricosa*, *Eoglobigerina eobulloides*).

The current overview shows the distribution of foraminifera assemblages and of the sedimentation history in the basin. It provides criteria for local and regional facies and age correlation, allowing the reconstruction of a part of the basin's history controlled by the dynamics of the Carpathians.

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Live (stained) benthic foraminiferal assemblages offshore South Georgia, Southern Ocean

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The modern benthic foraminifera from South Georgia, Southern Ocean, have not yet been thoroughly documented. Here we analysed assemblages and the depth distribution and stable isotopes of living (Rose Bengal stained) benthic foraminifera from two box cores collected on the South Georgia shelf (ranging from 250–300 m water depth). A comprehensive taxonomic analysis of the benthic fauna demonstrates the existence of 79 taxonomic groupings, which shows close affinities with shelf assemblages from around Antarctica including the Peninsula. We find live specimens of the majority of species from a range of depths in the top 13 cm of the sediment column. Stable isotope ratios ($\delta^{13}C$ and $\delta^{18}O$) were measured on stained specimens of three species, *Astrononion echolsi*, *Cassidulinoides porrectus* and *Buccella* sp. 1, at 1 cm depth intervals within the down-core sediment sequences. In agreement with studies in deep water settings, we find no significant intra-species variability in either $\delta^{13}C$ or $\delta^{18}O$ with sediment living depth. Our findings add to the growing evidence that infaunal benthic foraminiferal species calcify at a fixed depth. Given the wide range of depths that we find living 'infaunal' species, we speculate that they may actually calcify at the sediment-water interface, where carbonate ion concentration and organic carbon availability is at a maximum.

Agglutinated foraminifera from Recent mangrove environments of the United Arab Emirates (UAE)

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The Benthic foraminifera are widely used to construct zonations of mangrove environments. However, little is known about foraminifera assemblages from hypersaline mangrove environments. The objective of this study is to produce a detailed micropaleontological analysis to identify foraminiferal associations from mangrove swamps and channels located to the east of Abu Dhabi Island (UAE).

Mangals in the Abu Dhabi region are characterized by the mangrove tree *Avicennia marina*. Different sedimentary facies were sampled for the present study including; fine sediment in areas exposed during low tide and close to mangrove trees (*Avicennia marina*) or pneumatophores, fine sediment rich in leaf material, coarse sediment in tidal channels and coarse sediment with a shell lag.

The mud flat at the margin of the channels and the lower (dominantly wet) intertidal areas close to *Avicennia marina* roots show a foraminiferal assemblage characterised by abundant calcareous foraminifera belonging to the genera *Ammonia, Elphidium, Cribroelphidium, Triloculina, Quinqueloculina, Sigmoilinita, Spiroloculina, Peneroplis* and *Spirolina*. Samples from the upper intertidal area (often dry) close to *Avicennia marina* roots and containing leaf material, produced an assemblage exclusively composed of small-sized opportunistic *Ammonia* and *Cribroelphidium*, together with abundant specimens of agglutinated foraminifera belonging to the genera *Trochammina*. Where present, the genus Throcammina may comprise up to the 50% of the foraminiferal assemblage. An assemblage characterized by a high abundance of *Throcammina* has not been previously reported in the Arabian/Persian Gulf.

The distribution of benthic foraminifera from mangrove environments of the Abu Dhabi region are a powerful tool for constructing a zonation of mangrove environments and can be employed as a modern analogue for interpreting ancient mangrove and associated coastline sediments.

Foraminiferal assemblages as a bathymetric proxy: Direct multivariate tests from modern environments

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Benthic foraminifera, single–celled eukaryotes ubiquitous in marine and transitional marine environments, have been widely used in paleoenvironmental and paleoceanographic reconstruction, as proxies of productivity, oxygenation, and other parameters used to characterize marine environments. Foraminifera also represent one of the most commonly used microfossil groups for estimating paleo–water depth. Trends in depth–related niche preference, species diversity, planktic to benthic ratio, wall types, and morphology are among the criteria often considered when estimating paleobathymetry using benthic foraminifera.

The quality of this bathymetric proxy was tested here directly using onshore–offshore transects across two present–day marine basins: (1) Saros Bay (northern Aegean Sea), with sampling sites ranging from 15 to 500 m water depth (Frontalini *et al*. 2014, 2015); and (2) Marmara Sea (between Black Sea and Aegean Sea), with sampling sites ranging from 15 to 350 m water depth (Frontalini *et al*. 2011; Phipps *et al*. 2011).

In order to evaluate whether foraminiferal samples provide reliable proxies of bathymetry, indirect ordination techniques including Correspondence Analysis (CA), Detrended Correspondence Analysis (DCA), and Nonmetric Multidimensional Scaling (NMDS) were used.

A total of 7678 agglutinated (50 species) and 10629 calcareous specimens (180 species) of benthic foraminifera were recovered in 17 samples from the Marmara Sea. A total of 3739 agglutinated (95 species) and 8931 calcareous (168 species) foraminifera were recovered in 18 samples from Saros Bay. For both marine basins, indirect multivariate ordinations of calcareous and agglutinated foraminifera demonstrated that samples varied predictably in faunal composition along regional depth gradients. The multivariate ordination scores and water depth were highly and positively correlated in all cases: $r^2 = 0.91$ (Saros Bay, agglutinated foraminifera), $r^2 = 0.56$ (Saros Bay, calcareous foraminifera), $r^2 = 0.70$ (Marmara Sea, agglutinated foraminifera), and $r^2 = 0.79$ (Marmara Sea, calcareous foraminifera). Comparably robust relationships between ordination scores and water depth were observed when data were pooled across basins and/or foraminifera type. These results suggest that foraminifera represent a robust quantitative proxy of water depth. Multivariate ordinations based on foraminifera may potentially yield numerical estimates of water depth in the geological record and provide a quantitative environmental framework for paleontological and stratigraphic interpretations.

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First report of the lituolid *Navarella* Ciry & Rat (1951) in the Thanetian of northeastern Italy: an upper Paleocene Lazarus occurrence?

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Several large lituolids resembling the genus *Navarella* Ciry & Rat (1951) were recently recovered in Thanetian hemipelagites of the Belluno Basin outcropping in the Forada section, northeastern Italy (Giusberti et al., 2016; Plate 4, figs. 14, 20). These agglutinated foraminifera are quite common in the >500 μm fraction of the washed residues from the uppermost Thanetian and abruptly disappear at the Paleocene-Eocene boundary, in coincidence with the extinction of Paleocene cosmopolitan taxa (Benthic Foraminiferal Extinction Event; Giusberti et al., 2016).

Navarella is a large lituolid, attaining a maximum length of 5 mm, with a first streptospirally enrolled test, later uncoiled and with an aperture varying during the ontogenesis from slit-like to cribrate. The genus was originally described from the Maastrichtian flysch of the Spanish Pyrenees (Ciry & Rat, 1951), and then reported elsewhere in Europe from Campanian-Maastrichtian rocks (e.g., Maync, 1954; Sampò, 1972; Radoičić et al., 2010). The validity of this taxon is, however, controversial and strongly debated (e.g., Stacher, 1980; Riegraf, 1998).

In order to document the internal chamber arrangement and the agglutinated wall microstructure of the Thanetian navarellids and to compare them with individuals recovered from Upper Cretaceous strata, the specimens were sectioned and analyzed through a scanning electron microscope (SEM), equipped with an energy-dispersive X-ray spectrometer (EDX). Our results confirm the attribution of the Thanetian specimens to *Navarella*, thus permitting to expand the stratigraphic distribution of the genus.

Despite intensive researches, we did not find any record of *Navarella* in Danian-Selandian strata of the investigated section, implying at least a 7 Myr gap in the stratigraphic range of this peculiar agglutinated foraminifer. Based on available data, we infer that *Navarell*a reappeared as "Lazarus" genus in the Thanetian having survived the Cretaceous-Paleocene mass extinction, but it was eventually driven to extinction during the environmental perturbations associated to the Paleocene-Eocene Thermal Maximum (Giusberti et al., 2016).

We also argue how the finding of new and well-preserved material from lower Paleogene Scaglia Rossa beds of Italy may help in shed light on both taxonomy and ecological preferences of this still poorly known deep-water lituolid.

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Foraminarium and the SIM-Lab: Culturing foraminifera in Kraków

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According to molecular and morphological analysis (Pawlowski et al. 2013), composition of the wall is no longer a basis of supraordinal classification. Hence, in spite of differences in the wall composition, one can argue that the process of chamber formation is controlled by similar factors within agglutinated and calcareous taxa. Since investigation of chamber formation in foraminifera until now focused only on calcareous species, this statement is still highly speculative and needs to be experimentally tested.

Chamber morphology is more fundamental feature that divides multi-chambered foraminifera into two groups (Tubothalamea vs. Globothalamea). Our preliminary investigations (Tyszka et al., 2015) revealed that cytoskeleton structures are very active during the chamber formation. We therefore suppose that these dynamic structures are actively involved in shaping a new chamber, as well as its biomineralization and/or agglutination.

In order to investigate these morphogenetic and associated phenomena, we established the first in Poland foraminiferal culture laboratory (*foraminarium*) in the Institute of Geological Sciences of Polish Academy of Sciences, Research Centre in Kraków. We have obtained samples from different habitats collected in various marine locations, such as tidal flats of the Atlantic coast (France) and the Wadden Sea (Germany; the Netherland); coasts of the Gulf of Eilat and the Mediterranean Sea (Israel, Cyprus, Croatia), as well as the rocky shore of the Sagami Bay (Japan). Our culture consists of numerous globothalamean and tubothalamean species, including some agglutinated foraminifera.

Alongside the culture laboratory we are currently developing SIM-Lab, i.e. the Structured Illumination Microscopy Laboratory that is dedicated to imaging of sub-cellular processes involved in morphogenesis of foraminifera using the fluorescent microscopy. The lab is equipped in Zeiss Axio Obsever.Z1 inverted microscope with ApoTome.2 system which creates optical sections of fluorescent samples. This system calculates from series of images with different grid positions an optical section that is free of scattered light. We test and apply variable fluorescent staining methods to fulfil project goals and further explore new research frontiers in foraminiferal research.

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Fig. 1. A part of foraminiferal culture laboratory (Foraminarium) in the Institute of Geological Sciences of Polish Academy of Sciences, Research Centre in Kraków. Aquaria consist of samples from the Mediterranean Sea; bottles in the thermostatic cabinet contain controlled cultures of foraminifera collected from tidal flats.

Fig. 2. Epiphytic benthic foraminifers from the Mediterranean Sea of the Israeli coastal plain cultured in the foraminarium of Research Centre in Kraków.

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The salt marsh foraminifer *Trochammina inflata* with a distinct morphotype in the White Sea: a local variety or new subspecies?

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The cosmopolitan salt-marsh foraminifer *Trochammina inflata* (Montagu) is extensively used in both paleoenvironmental reconstructions and ecological surveys of salt-marsh foraminifera, which requires correct identification. Images of the *T. inflata* published over years depict differences in test shape, umbilicus features, incurvation of sutures, and number of chambers in the last whorl (Montagu, 1808; Williamson, 1858; Parker, Jones, 1859; Carpenter, 1862; Brady, 1884; etc.). Thus, Montagu (1808) described a 5-chambered specimen and the revised description by Williamson (1858) as well as the neotype description (Brönnimann & Whittaker, 1984) reported 6 chambers.

At the White Sea the first finding of *T. inflata* belongs to Mayer (1962). These White Sea specimens differ from the neotype mostly in the size and number of chambers in the last whorl, having 6-7 inflated chambers on the umbilical side. Mayer considered reasonable to assign this morph with more numerous chambers, from the White Sea intertidal, to a separate subspecies, namely '*Trochammina inflata* subsp. *maris-albi* subsp.n. Mayer, 1962'. Finally, she claimed one as *Trochammina inflata* (Montagu) subsp. n.? (1962, p.82, fig. 3, 4), but her work was never finalised, and she left the description with a question mark.

Our recently collected specimens of *T. inflata* from the White Sea perfectly fit the Mayer's description. No neotype-like specimens have ever been found in the White Sea salt marshes. All the specimens usually have 6-7 chambers in the last whorl along with the classical *T. inflata*-like aperture. It is still an open question whether it is a separate (sub)species or (eco)phenotype of *T. inflata* in the White Sea salt marshes.

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Early Eocene assemblages of agglutinated foraminifera (Silesian Nappe, Ukrainian Carpathians)

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The Silesian Nappe belongs to the Outer (Flysch) Carpathians (a Cretaceous-Neogene accretionary prism), which are made up of a stack of the nappes overthrusted on the Miocene Foredeep. The Silesian Nappe stretches from Moravia (Czech Republic) to Ukraine. Stratigraphic succession of the Ukrainian Silesian Nappe contains Lower Cretaceous and Paleocene–Early Miocene deposits. Evidently complete sections of the Eocene flysch deposits of the Ukrainian Silesian Nappe are distributed at the upstreams of Latorytsa (Transcarpathian region) and Stryi (Lviv region) river basins into so-called Smozhe Structure – ledge of the Eocene-Oligocene rocks surrounded by the Oligocene deposits. Eocene succession of the Smozhe Structure is subdivided into three divisions. The lower division (thickness up to 100 m) composed by thin- and medium-bedded flysch: alternated black and green mudstones, siltstones, and fine-medium grained sandstones with textures T_{cde}, T_{bcde} of the Bouma sequence. The middle division (thickness 350–400 m) consists of the massive and thick-bedded sandstones or gravelites. The upper division (thickness 150–200 m) composed by thin- and medium-bedded flysch like the lower division.

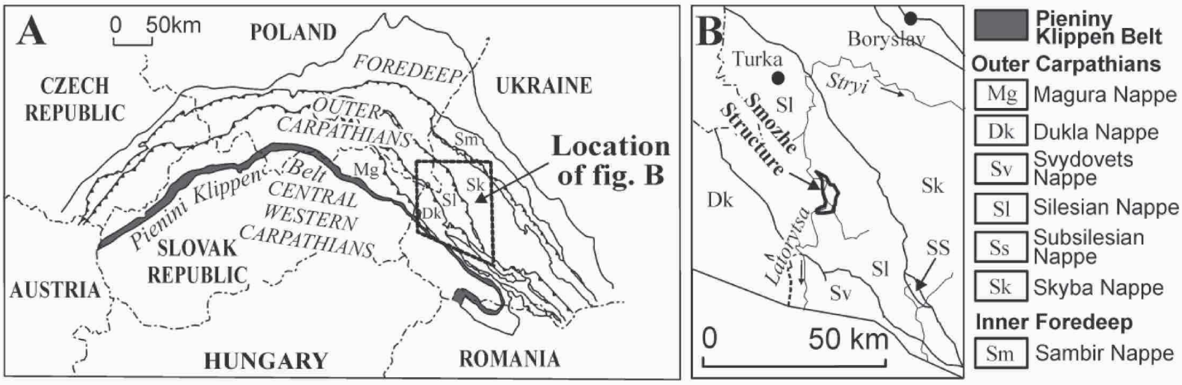

Fig. 1: (**A**) Location of the Ukrainian Silesian Nappe; (**B**) Location of the studied area (Smozhe Structure).

Agglutinated foraminifers in age from Early Eocene to Late Eocene were previously recognized in the sedimentary succession of the Smozhe Structure (Hnylko and Hnylko, 2011). The aim of this paper is to describe Early Eocene assemblages of agglutinated foraminifera found in three studied sections of the flysch deposits located into Smozhe Structure (Fig. 1). Determination of most species was carried out following to Mjatliuk (1970), Kaminski and Geroch (1993), Kaminski and Gradstein (2005).

Early Eocene assemblages of exclusively agglutinated foraminifera were found both below and above of the middle sandstone division of the Eocene succession of the Smozhe Structure. A more than 30 species of agglutinated foraminifera belonging to 15 genera were identified in these assemblages. Typical for Early Eocene of the Carpathians species *Saccamminoides carpathicus* Geroch (single specimen), *Reticulophragmium intermedium* (Mjatliuk) and *Recurvoides smugarensis* Mjatliuk determine the age of the assemblages. Species *Subreophax pseudoscalaris* Samuel, *Ammobaculites deflecsus*

(Grzybowski), *A. jarvisi* Cushman and Renz, *Eratidus gerochi* Kaminski and Gradstein, *Recurvoidella lamella* (Grzybowski), *Recurvoides contortus* Earland were not previously known in the Ukrainian Carpathians.

Green mudstones belonging to the lower division of the Eocene succession of the Smozhe Structure contain abundant assemblages in which dominate *Thalmannammina subturbinata* (Grzybowski) and taxa *Recurvoides anormis* Mjatliuk, *R. smugarensis* Mjatliuk, *R. nucleolus* (Grzybowski) and *Recurvoides* spp. accounting for 20-40% of specimens. There were also found numerous species belonging to genera *Trochamminoides*, *Paratrochamminoides* and *Conglophragmium* (9-12 % of specimens), *Ammobaculites* (6-12 % of specimens) and *Karrerulina* (5-20 % of specimens). Representatives of the genus *Glomospira* predominate of locally, accounting for 60% of the tests.

In the deposits of the miiddle sandstone division, foraminifers were not found. The sandstone division is located between the mud deposits with Early Eocene foraminifera and, on this base, can be correlated with the Ciężkowice Sandstone of the Polish Silesian Nappe.

In the green mudstones of the upper division, number of foraminifers is reduced but the size of the tests, in general, increased. Representatives of the genera *Recurvoides* are dominant accounting up to 70% of specimens. Lage tests of *Recurvoides contortus* Earland are widespread here.

The assemblage of Reticulophragmium amplectens Zone (Middle Eocene) was identified in the studied sections of the Smozhe Structure in the sediments lying above.

Early Eocene non-calcareous deposits of the Smozhe Structure contain exclusively deep water agglutinated foraminifera indicating lower bathyal–abyssal depths of the water paleobasin according to (Kaminski and Gradstein, 2005).

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The genus in biological systematics: dead or could it be reanimated?

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Beside the naming of basic organismic units by the two nouns *genus* and *species*, Linné has established the hierarchical system of classes. While the species is regarded as the only 'natural category' in this hierarchical system, all higher categories, also the genus category, is regarded as artificial, thus not comparable between different higher categories. By the lack of testability, the genus must be regarded as a construct of the human mind and cannot be verified. Therefore, characterizing 'natural' against 'arbitrary' categories is necessary.

The hierarchical system of organisms is inclusive, because one class includes classes of higher connectivity. The grade of connectivity is a measure for constructing a hierarchical system. Homogeneity in characters is the scale for connectivity, thus decreasing homogeneity in class building rate leads to fusion of classes. Continuous class building rates make distinct levels (= categories) within the class building system artificial. Only discontinuous class building rates mark these discontinuities as natural categories (Fig. 1). The main criterion for finding natural classes is consistency of the classification criterion, meaning that the classification criterion must not change during the complete classification process.

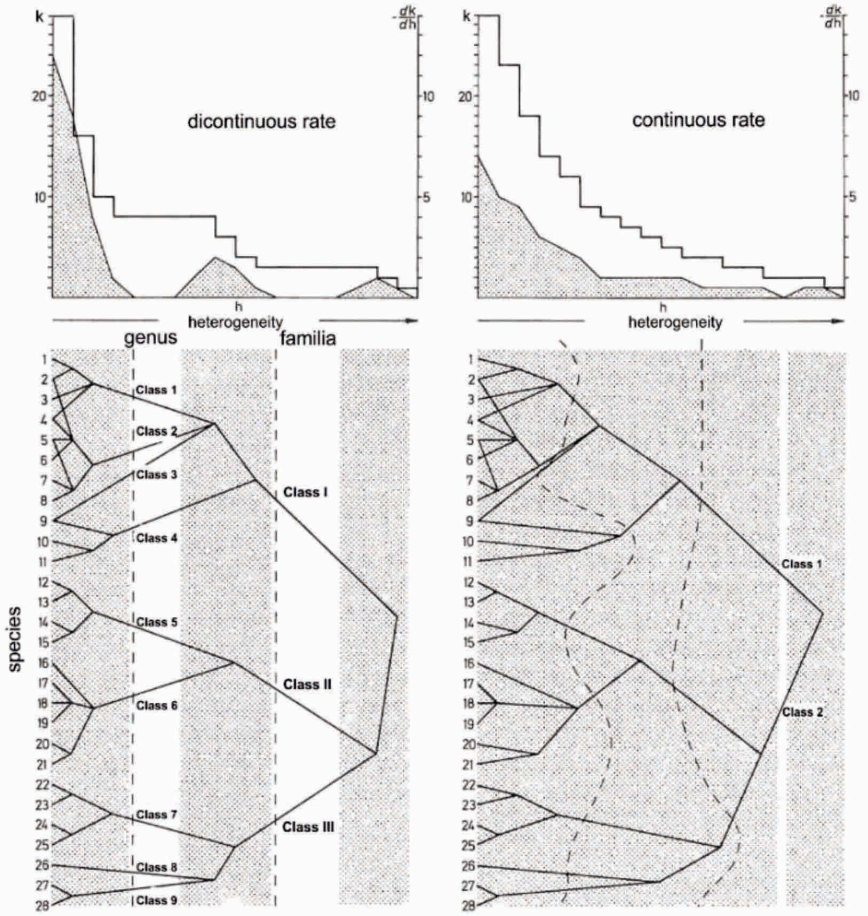

Fig. 1. Differences between natural and artificial categories based on dendrograms with the same topologies.

In phylograms and cladograms, where the connection points (levels) mark phylogenetic relationships, discontinuities are difficult to determine. Phylogenetic trees are also excluded from hierarchical classification based on heterogeneities, because they represent excluding hierarchies where fusion points are objects (species), not heterogeneity levels.

All biological classification systems are based on the biological species. As the basic classification object, species must represent homogeneous groups based on consistent classification criteria. Therefore, they must follow a general concept including all organisms. This has led to numerous species concepts, but none have met the requirement of universal application. Additionally, many concepts are based on criteria that can be used only for recognizing species (operational criteria), not defining the 'being' or make-up of the species (explanatory criteria). Operative methods try to approximate the explanatory species, but fails in delimiting closely related species from subspecies. Methods for species recognition and delimitation are based on morphological or molecular genetic characters or both together. Species described as pools of contemporarily interconnected genotypes possessing their own history lead to evolutionary lines.

The genus category grouping similar species into classes cannot be based on phylogenetic classifications neither using (apomorphic) morphological nor molecular genetic characters. They can only be based on phenetic criteria using morphological characters indicative for the species group. Therefore, three theorems are proposed for defining the genus:

- The genus is a group of species in a nested hierarchical system of an organism group.
- The organism group must be based on a constant number of characters (morphological, physological, molecular genetic etc.) containing the maximum number of species detected.
- The genus is defined by the first significant discontinuity in the class building rate at the lowest heterogeneity level.

Higher natural categories in the specific classification group (e.g., agglutinating multichambered foraminifera) described by a constant set of characters must not be labelled (families, orders etc.), because comparison with other classifications are impossible since they are based on quite different classification criteria (e.g., families in Foraminifera versus families in Mammalia).

Because the genus is solely based on morphological criteria, it also applies for fossil forms. Then it must be checked by stratigraphic investigations, if all species belonging to the genus group are phylogenetically connected. In case of strong stratigraphic discontinuities between the species groups, they must be grouped into different genera.

Agglutinated Foraminifera Horizons (AFH): Phantoms or effective ecostratigraphical tools in the Central Paratethys Sea?

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Key words: Central Paratethys, Agglutinated Foraminifera, Biostratigraphy

The traditional ecostratigraphical concept of the Central Paratethys deposits is based, amongst others, on several AFH (Fig. 1; Grill, 1941, 1948; Papp, 1975; Luczkowska, 1990). Nevertheless, long lasting research of this realm shows that AFH assemblages can be both un-isochronous and locally also altered by other assemblages (Andrejeva Grigorovič et al., 2001; Pezejl et al., 2013).

To accept real regional biostratigraphical value of AFH, the horizons should reflect isochronous paleoenvironmental event (e.g. circulation regime change; significant sea-way opening; climatic change, including changes in temperature and/or precipitation). To test stratigraphical significance of AFH, we revised quantitatively evaluated data from the Western Carpathians based on our own material, available unpublished (Geofond, Nafta a.s) and published data.

For purpose of this study, every foraminiferal assemblage containing more than 10% of agglutinated forms was considered as AFH. Agglutinated taxa were ranked into morphogroups (sensu Jones and Charnock, 1985; Setoyama et al., 2011) and spatiotemporal range of each AFH was compiled. Occurrences of the agglutinated foraminifera blooms were discussed in respect of known paleoenvironmental data from related site.

The Kiscellian "*Tritaxia szaboi* horizon" (Nagy, 1983; this study; Buda Basin) used to be altered by high nutrient and low-oxic "*Uvigerina-Melonis, Sphaeroidina* or *Valvulineria* assemblage". However this horizon appears only locally, endemic *Tritaxia szaboi* points to the specific conditions (basin isolation) during the Kiscellian. Nagy (1983) described also uppermost Kiscellian „*Rhabdammina-Bathysiphon* horizon" from the North Hungarian part of the Buda Basin.

The Early Egerian "*Spiroplectammina* horizon" (NP 25; Horváth, 1983; Nagy, 1983, this study; South Slovak and North Hungarian part of the Buda Basin) have never been broadly biostratigraphically used. *Spiroplectammina* is considered as shallow to deep infauna, scavenging on detritus and bacteria, or as epifaunal active deposit feeder, what is more consistent to our ecological interpretation based on accompanied fauna and lithology.

The Eggenburgian "*Bathysiphon-Cyclammina-Haplophragmoides* horizon" (NN2; Steininger and Seneš et al., 1971; Cicha et al., 1998; Vienna Basin) is similar to the one from the Carpathian Foredeep, and to "*Bathysiphon* horizon" occurring in the uppermost part of Szecseny "schlier" (this study; South Slovak Basin). Agglutinated foraminifera represent the epifaunal suspension feeders to the shallow infaunal active deposit feeders. In the Pannonian realm, this assemblage is altered by the "*Lenticulina* assemblage".

The lower Karpatian "*Cyclamina-Bathysiphon* horizon" (NN4; Špička and Zapletalová, 1964 - Vienna Basin; this study - South Slovak Basin) have never been biostratigraphicaly used. The morphotypes, identical with those present in the Eggenburgian horizon, indicate re-appearing of similar paleoenvironment what triggered the Eggenburgian agglutinated foraminifera thrive. The upper Karpatian "*Bathysiphon* horizon" (NN4; this study; Vienna Basin) have never been biostratigraphicaly used in the Central Paratethys, while in the Eastern Paratethys it is used as a local substage indicator. Agglutinated moprhotypes represent tubular infaunal, suspension feeders.

The Badenian "*Spiroplectammina* Zone" (NN5; Grill, 1941; Papp et al., 1978) was robust stratigraphical unit, defining substage Wielickian, in the traditional Central Paratethys biostratigraphy. In the Wieliczka area, sediments of the uppermost part of the "Wielician" substage contain mainly *Reticulophragmium crassum* and *Pseudotriplasia minuta* (Luczkowska 1990). Agglutinated foraminifera morphotypes are similar to those of the Egerian AFH.

The lower Pannonian „*Trochammina* horizon" (Zone A; Papp, 1951; Széles, 1980) can be recognized in the Zone A of the Vienna and Danube basins (Jiříček, 1985). During the Pannonian, after the Sarmatian/Pannonian dramatic diversity decrease in this realm, only shallow infaunal deposit free mobile feeders are present.

The AFHs are laterally and horizontally alternated with horizons enriched by calcareous foraminiferal assemblages and did not occur within the whole basin. However, spatially restricted blooms of certain agglutinated foraminifera morphotypes corresponds with the definition of ecostratigraphical units.

Three AFHs, *Tritaxia szaboi, Trochammmina* and *Saccammina-Miliammina,* represent endemic associations originated under the ecological stress, as a result of Paratethys isolation, so these have a great ecostratigraphical potential.

The AFHs with elongate keeled forms (*Spiroplectammina*) and tubutar and/or planispiral (*Bathysiphon*, *Cyclammina* and *Haplophragmoides*) re-appeared several times in the Central Paratethys (e.g. Egerian, Eggenburgian, Badenian), what makes their biostratigraphic use problematic. They represent intervals with a variable amount of the different suspended nutrient types of the terrigenous as well as intrabasinal origin (upwelling).

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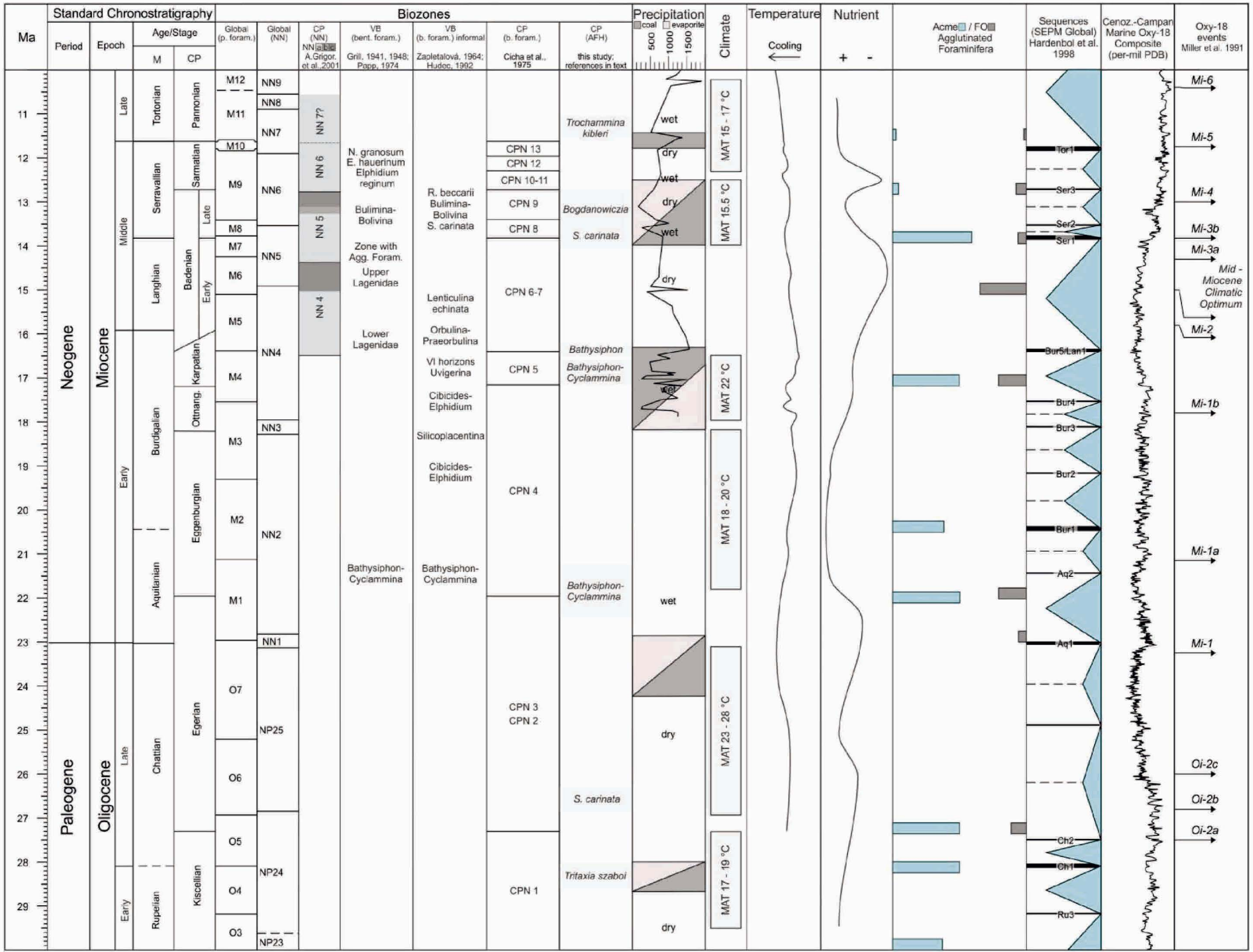

Fig. 1. Cenozoic stratigraphy and biostratigraphy correlation chart enhanced by frequency of the agglutinated foraminifera events, AFH, climatic and nutrient information.

Calcareous vs. agglutinated: test material variation among Early Devonian microfossils

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Studied Devonian sections from the Barrandian area (Lochkovian-Givetian) provided data about evolution of the acid-resistant and calcareous microfossils just before the Middle Devonian radiation of the skeletonized Protists.

Prague Synform is an erosional relict of unmetamorphosed Palaeozoic. Devonian formations of the Barrandian area is considered a peri-Gondwana terrane with affinities to Armorica. Based on paleomagnetic data Devonian paleolatitudes varied between 7-15^{o} S. The studied Lower and early Middle Devonian sequences can be characterized by the continuous, predominantly carbonate sedimentation (Chlupáč et al., 1998).

Calcareous microfossils have been studied from thin-slides, agglutinated microfossils were isolated from acid-resistant washing residue.

Simple mono- to bithalamous forms strongly prevailed among the Barrandian microfossils and are considered to be Protists. Because of the unclear and variegated taxonomic classification, the recorded microfossils were clustered to morphological groups and their taxonomic affinity was eventually discussed. Due to apparent morphological similarity, some 3D acid-resistant microfossils can be paralleled with cross-section of calcareous tests in the thin sections (Fig. 1).

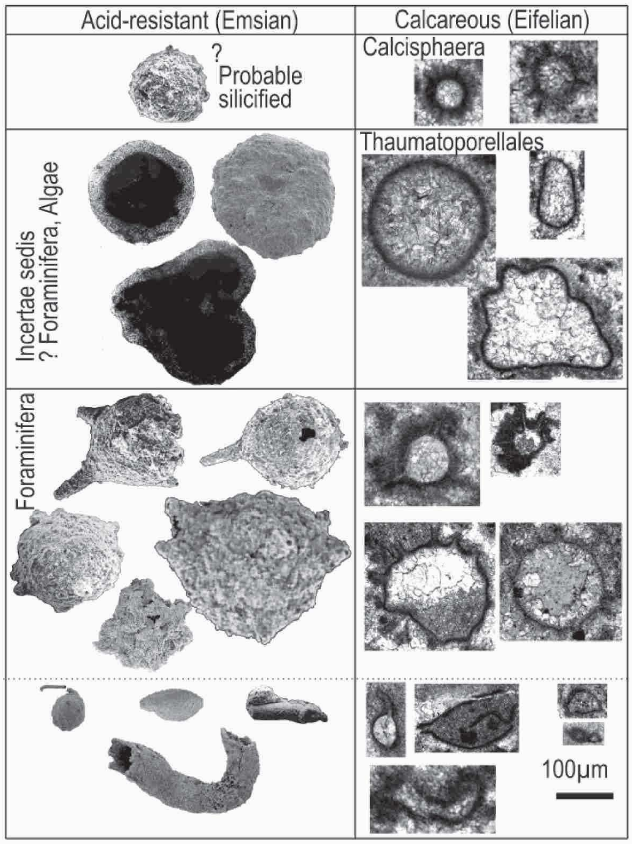

Fig. 1. Homeomorphy between agglutinated and calcareous microfossils from the Emsian and Givetian of the Barrandian area

Two Protist events were recorded in the Devonian of the Barrandian area:

The change from random and irregular microfossil distribution to continuous occurrence was recorded in the upper Emsian. This increase in abundance of microfossils in the fossil record might be a consequence of both theincrease in primary productivity as well as increase in fosilization ability. In any case, morphotype diversity of microfossils remained low and simple morphotypes suggested r-strategists. However, the increase in Protist abundance related to Devonian black-shale events could be a precursor of Protist speciation during the later Middle Devonian.

The appearance of calcareous Protists in the Eifelian coincided with the dissapearance of agglutinated microfossils. The recorded morhotypes were originally described as foraminifera but their classification has been shifted between Foraminifera, Radiolaria and Algae. Due to calcitic ocean in the Devonian, it is possible to expect sceletonization of Protists from analogous groups like in calcitic Jurassic-Paleogene rather than in today oceans. Large globular to irregular forms can be parallelized with Mezozoic green algae Thaumatoporellales or with Paleogene algal cyst Sedalanella (Schlagintweit et al. 2013). Their appearance in the Devonian of the Barrandian area coincided with global increase in distribution of algal reefs (Gradstain et al., 2012). The other recorded morphotypes were assigned to foraminifera (Fig.) The homoemorphy recorded between agglutinated and calcareous foraminifera could reflect a variability in the test material depending on oscillations of paleoenvironmental parameters. Such a variability of test material (secreted vs. agglutinated) is known nowadays in the thecamoebians (Scott et al., 2001).

Acknowledgements:
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An outlook on the molecular diversity of agglutinated foraminifera

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Agglutinated foraminifera comprise single-chambered and multi-chambered forms characterized by the accretion of external particles to their tests. They are present in the three main classes of Foraminifera: Globothalamea, Tubothalamea and monothalamids.

Within the Globothalamea, textulariids form a paraphyletic group that gives rise to Robertinida and Rotaliida. This basal group includes also Carterinida, which represent a distinctive lineage. Carterinids are characterized by calcareous spicules that cover the surface of their tests. It is controversial whether the spicules are secreted or represent foreign particles agglutinated on the surface, as is the case for other agglutinated foraminifera. We have currently more than 200 sequences of textulariids and carterinids in our database of which 3 genera (*Textularia*, *Eggerella*, *Cribrostomoides*) represent half of the sequences.

Within the Tubothalamea, the agglutinated forms are present at the base of the two orders Spirillinida and Miliolida. In the first one, they are represented by the genus *Ammodiscus*, which branches together with *Spirillina* and *Patellina* at the base of this group. In the case of Miliolida, two agglutinated genera, including *Miliammina* and *Siphonaperta* branch prior to the divergence of calcareous forms. Among them, the genus *Miliammina* is particularly variable and comprises many cryptic species.

Monothalamids branch at the base of the foraminiferal tree and are paraphyletic with some clades branching at the base of Globothalamea and Tubothalamea. Monothalamids can be divided in more than 20 clades that contain in general both, organic-walled and agglutinated genera. Some agglutinated genera are polyphyletic such as *Crithionina*, *Saccammina* or *Hippocrepina*. In some monothalamid clades agglutinated foraminifera are particularly well represented. This is the case of clade F including Notodendrodes, Hemisphaerammina, Vanhoeffenella, as well as the clade I composed of Astrammina, Saccodendron and Pelosina. The agglutinated genera are also well represented in Clade C that comprises among others the xenophyophorans, an agglutinated group of deep-sea foraminifera that is highly diverse. The Clade BM contains the agglutinated genus *Bathysiphon* and organic-walled genus Micrometula.

Our molecular data show that agglutinated foraminifera are an extremely diverse and polyphyletic group, which contains numerous undescribed cryptic genera and species that cannot be identified based solely on morphological criteria.

Upper Sinemurian - Lower Pliensbachian Agglutinated foraminifera from the eastern part of the Pieniny Klippen Belt (Transcarpathian Ukraine, Western Carpathians)

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Diverse and well preserved assemblages of foraminifera have been studied from the Upper Sinemurian - Lower Pliensbachian from the Pieniny Klippen Belt paleogeographic domain in the NW European Bioprovince. The studied deposits are exposed as several lithofacies situated in a quarry near Pryboržavs'ke in the Trancarpathian area of Ukraine. The whole foraminiferal assemblage is dominated by nodosarids. Almost all of the studied facies yielded rare to abundant smaller agglutinated foraminifers. The age controll is provided by ammonites and stratigraphically important calcareous benthic foraminifera. The oldest Bucklandi Zone is coresponding with the M. matutina benthic foraminiferal Zone. Among agglutinated foraminifera *Ammodiscus siliceus* (Terquem), *Rhabdammina* sp. and *Ammobaculites vetustum* (Terquem & Berthelin) are characteristic for this zone. The facies is represented mostly by organodetritic limestones and marlstones with rich macrofossil content and abundant echinoderm spines (*Diademopsis*). Up section similar limestone beds with black marls and shales start to occurr. An increase in tiny infaunal many chambered haplophragmoids was noted below the black deposits. This low diversity assemblage includes mostly *Haplophragmoides canui* Cushman less *Haplophragmoides* aff. *cushmani* Loeblich & Tappan and is poor on calcareous benthic foraminifera. Another assemblage which is coeval was noted in other parts of the quarry and records the first appearance of *Textularia agglutinans* d'Orbigny which is particularly common in the samples. The increase of *Haplophragmoides* and *Textularia* which represent the infaunal morphogroups (A5-A7) points to lower oxygen concentrations in the environment. The event dates the onset of black marl and shale sedimentation in the M. spinata calcareous benthic foraminiferal zone and Semicostatum – Turneri ammonite Zones. The increase and maximum abundance of the infaunal agglutinated morphogroups is predated by a microfaunal turnover in the calcareous benthic foraminifera. The M. spinata zone continues higher in the spotted limestones and marlstones of the Algäu Fm. locally known as the "fleckenmergel" facies. This facies records a significant increase in quantity and diversity of the smaller agglutinated foraminifera. Species such as *Rhabdammina* sp., *Bathysiphon* sp., *A. siliceus*, *Haplophragmoides kingakensis* Tappan, *Haplophragmoides tryssa* Loeblich and Tappan, *H. canui*, *Recurvoides canningensis* (Tappan) and *Ammoglobigerina globigerinoides* Häusler are characteristic for the assemblage. The same facies includes the L. speciosa calcareous benthic foraminiferal Zone. At the base of this zone small agglutinated foraminifera dominate over the calcareous ones. The fleckenmergel facies ranges from the Turneri to the Raricostatum ammonite Zones the L. speciosa calcareous benthic foraminiferal Zone however continues higher to the end of the Jamesoni ammonite Zone. The Jamesoni zone is represented by thin bedded limestones and marlstones and a decrease of both agglutinated and calcareous benthic foraminifera. The youngest benthic foraminiferal zone of the section is the I. occidentalis Zone which corresponds with the Ibex to Margaritatus ammonite Zones. The lower part of this zone totally lacks agglutinated foraminifera. Lithology of this zone includes beds of condensed limestones and light packed organodetritic marls with siliciclastic admixture. Above the barren interval the samples yielded only impoverished and scattered assemblages of

smaller agglutinated foraminifera such as *A. siliceus* and *T. agglutinans.* Redeposition of this assemblage is not excluded as most of the recognised foraminifera bear the marks of biostratinomic transport.

Updates to the Classification of the Agglutinated Foraminifera

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The agglutinated foraminifera constitute a large and morphologically diversified group of organisms. At the level of generic taxonomy, there is a need to maintain an up-to-date database of the valid genera. This undertaking must be regarded as the first step in achieving a higher-level classification. In their monumental compilation of foraminiferal genera, Loeblich & Tappan (1987) listed 2,455 genera that they considered as valid. Out of this number, 624 belonged to the agglutinated foraminifera. During the three decades since the publication of Loeblich & Tappan's book "Foraminiferal Genera and their Classification", some 207 additional new genera have been added to the list of validly published names, owing in part to the series of International Workshops on Agglutinated Foraminifera. The IWAF serves as a convenient venue to discuss taxonomy and topics dealing with the ecology and geological history of this group of organisms. A large amount of basic descriptive work has been carried out on the agglutinated foraminifera over this period. The current work is a continuation of previous compilations of newly described, reinstated, or renamed genera (Kaminski, 2000, 2004, 2008, 2011). Examples of the newly described genera will be discussed.

At higher levels of classification, the agglutinated foraminifera can now be accommodated within 7 orders, 18 suborders, 32 superfamilies, 122 families, 142 subfamilies, and the group as a whole consists of over 832 valid genera (Kaminski, 2014).

As we are now 30 years into the post-Loeblich & Tappan era, there is now an urgent need to compile together the various descriptions of ALL the newly published foraminiferal genera (and emendations of existing genera) into a single database of using uniform taxonomic concepts. The current compilation is at least a step towards this idea, but sadly the example provided by our Working Group on Agglutinated Foraminifera has not been followed by researchers working with the other foraminiferal groups.

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Early Silurian Agglutinated Foraminifera from Saudi Arabia

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During the Early Silurian, Saudi Arabia was located on the coast of the southern Gondwanan continent. An Early Silurian foraminiferal assemblage has been found in the Qusaiba shale member and in the lower part of the overlying Sharwara sandstone member of the Qalibah Formation in the type section in Old Qusaiba Village, Qasim Region of Saudi Arabia. Graptolites studied from the nearby Qusaiba-1 core yielded an Aeronian age (Lituigraptus convolutus zone) for the greater part of the Qusaiba shale (Zalasiewicz et al. 2007), while the contact between the Qusaiba and Sharawa members is correlated with the early Telychian based on chitinozoans (Miller & Melvin, 2005). The Qusaiba shale is of great importance owing to its status as a prolific petroleum source rock in North Africa and the Middle East. Exposures are present in northern and central Saudi Arabia, and the formation is also known from the subsurface in other areas.

The foraminiferal assemblage was recovered from the uppermost part of the Qusaiba Shale, and in the interbedded shales in the lower part of the Sharawra Sandstone Member. Samples from the lower part of the Qusaiba shale are barren of foraminifera owing to the anoxic paleoenvironment that prevailed at the time of deposition. Foraminifera-bearing samples were recovered from silty shale of the uppermost part of the formation, which was deposited in an offshore to lower shoreface palaeoenvironment. In this transitional facies near the contact between the Qusaiba and Sharawra formations, interbedded thinly bedded sandstones show signs of bioturbation, indicating that oxygenated conditions existed at the sea floor.

The recovered foraminiferal assemblage is diverse compared with coeval assemblages described from Europe and North America. The assemblage is comprised of thirteen genera: *Saccammina, Thuramminoides, Thurammina, Amphitremoida, Tolypammina, Hyperammina, Bathysiphon, Rhizammina, Rhabdammina, Psammosphaera, Glomospira, Lituotuba,* and *Lagenammina*. Some of the foraminiferal species are likely to be new to science. Interestingly, unlike in the Early Silurian faunas from Ireland and North America (Kaminski et al. 2016) the genus *Ammodiscus /Rectoammodiscus* is absent in our material. Our finding represents the first discovery of Early Silurian Foraminifera from the Arabian Peninsula.

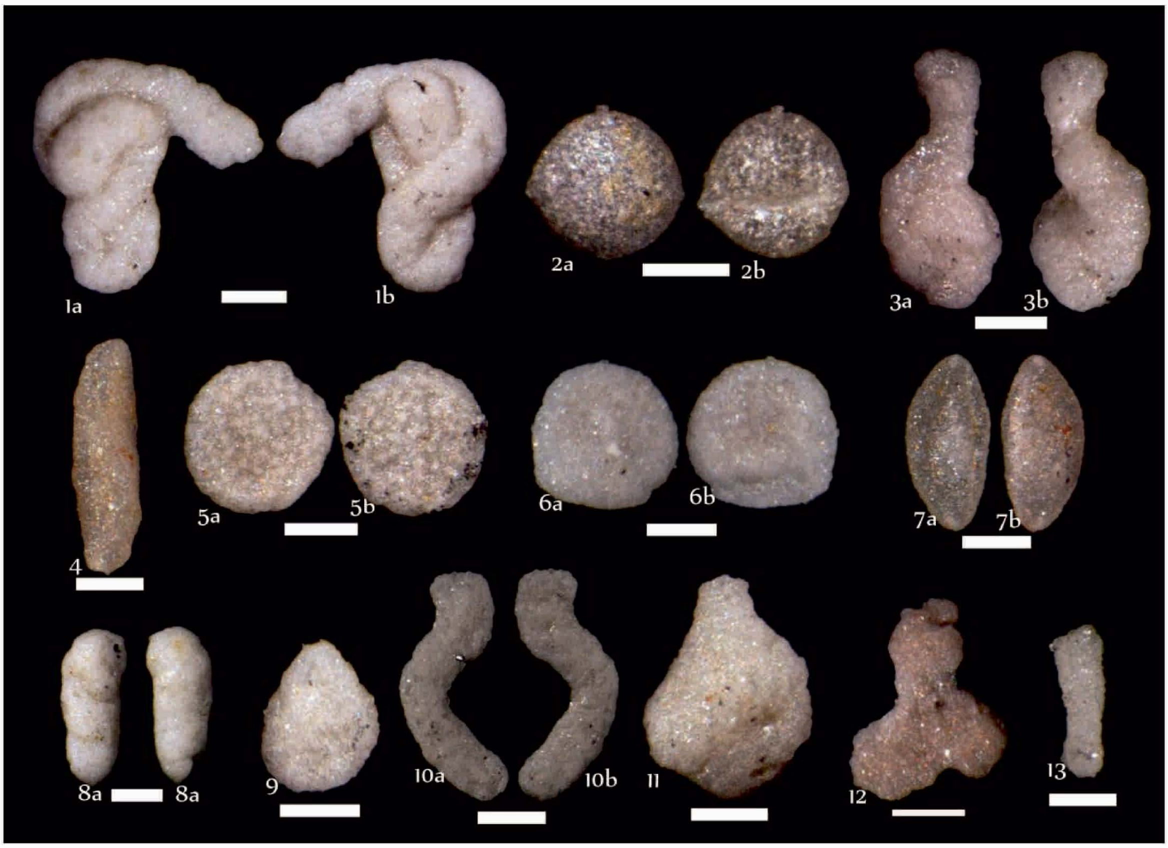

Plate 1. **1.** *Tolypammina* sp., **2.** *Thurammina diforamens*, **3.** *Lituotuba* sp., **4.** *Bathysiphon* sp., **5.** *Thuramminoides sphaeroidalis*, **6.** *Glomospira* sp., **7.** *Amphitremoida* sp., **8.** *Turritellella fisheri*, **9.** *Saccammina vulgaris*, **10.** *Rhizammina* sp., **11.** *Lagenammina* sp., **12.** *Rhabdammina trifurcata*, **13.** *Hyperammina rockfordensis*. Scale = 100 microns.

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Modern deep-water agglutinated foraminifera from IODP Expedition 323, Bering Sea

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The Bering Sea extends over a region comparable in size to the Mediterranean, where the modern agglutinated foraminifera are still virtually unstudied. The interaction of strong currents, upwelling high nutrient water masses, sea ice and strong winds causes high surface water productivity which supports a diverse ecosystem and an expanded oxygen minimum zone (OMZ).

We report the occurrence of modern deep-water agglutinated foraminifera collected at seven sites cored during Integrated Ocean Drilling Program (IODP) Expedition 323 in the Bering Sea. Assemblages collected from core-top samples contained 32 genera and 50 species and are described and illustrated for the first time (Kender & Kaminski, in press).

A total of 524 specimens of agglutinated benthic foraminifera were recorded, identified and described from 19 core-top samples taken at all seven IODP Expedition 323 sites. Commonly occurring species include typical deep-water *Rhizammina, Reophax*, *Rhabdammina, Recurvoides* and *Nodulina*. Assemblages from the northern sites also consist of accessory *Cyclammina*, *Eggerelloides* and *Glaphyrammina*, whilst those of the Bowers Ridge sites consist of other tubular genera and *Martinottiella*. Of the studied stations with the lowest dissolved oxygen concentrations, the potentially Bering Sea endemic *Eggerelloides* sp. 1 inhabits the northern slope, which has the highest primary productivity, and the potentially endemic *Martinottiella* sp. 3 inhabits Bowers Ridge, which has the lowest oxygen concentrations but relatively low annual productivity. *Martinottiella* sp. 3, with open pores on its test surface, has previously been reported in Pliocene to Recent material from Bowers Ridge. Despite relatively small sample sizes, ecological constraints may imply that the Bering Sea experienced reduced oxygen at times since at least the Pliocene (Kaminski *et al.* 2013).

We note the partially endemic nature of the agglutinated foraminiferal assemblages. In the current study of the agglutinated foraminifera, 22% of the species are left in open nomenclature and do not yet appear to have been described. In the Pleistocene calcareous benthic assemblage studied by Setoyama & Kaminski (2015) at Site 1341, 23% of the taxa were identified tentatively or left in open nomenclature. It is therefore possible that environmental conditions in the isolated Bering Sea, such as high productivity and reduced bottom water oxygen, have allowed for the adaptation of certain new species or varieties. Our results indicate the importance of gathering further surface sample data from the Aleutian Basin.

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Agglutinated foraminifera from the latest Jurassic–earliest Cretaceous carbonate platform – a case study from the exotic limestones of the Polish Outer Carpathians

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Upper Jurassic–Lower Cretaceous limestones occur in the form of klippes (e.g. Andrychów, Štramberk), boulders and pebbles in the Outer Carpathians. They represent remnants of carbonate sedimentation which took place along the margins of the Severin-Moldavidic Basin, called also the proto-Silesian Basin. These exotic rocks are located among the younger deposits belonging to the various formations. The studied rocks were collected from 31 localities situated within the western part of the Silesian and Subsilesian nappes of the Polish Outer Carpathians, from deposits of the Early Cretaceous to the Oligocene age. Thin sections prepared of the limestones – mostly Tithonian–Berriasian in age – were studied under the polarizing microscope.

Benthic foraminifera, both agglutinated and calcareous, are numerous in the studied limestones. Most of them represent forms typical of carbonate platforms. Agglutinated foraminifera of these shallow-water environments usually used calcium carbonate creating their tests – they agglutinated calcareous particles diversified in size and origin (also bioclasts) or/and used calcium carbonate as a cement. Some of them have mixed calcareous-agglutinated tests.

Large agglutinated foraminifera with complex structure of walls are typical of the inner platform (see also e.g., Septfontaine 1981; Schlagintweit, Ebli 1999; Hughes 2008). Such taxa as *Charentia cuvillieri* Neumann, *Pseudocyclammina lituus* (Yokoyama), *Coscinophragma cribrosum* (Reuss), *Anchispirocyclina lusitanica* (Egger), *Haplophragmium* sp., *Melathrokerion* sp. were recognized. Other foraminifera observed in the studied deposits of carbonate platform are: *Mayncina bulgarica* Laug, Peybernès et Rey, *Pseudotextulariella courtionensis* Brönnimann, *Nautiloculina bronnimanni* Arnaud-Vanneau et Peybernès, *Nautiloculina cretacea* Peybernès, *Nautiloculina oolithica* Mohler, *Paleogaudryina magharaensis* Said et Barakat, *Paleogaudryina varsoviensis* (Bielecka et Pożaryski), *Uvigerinammina uvigeriniformis* (Seibold et Seibold), *Protomarssonella hechti* (Dieni et Massari), *Protomarssonella kummi* (Zedler), *Textularia depravatiformis* Bielecka et Kuznetsova, *Textularia densa* Hoffman, *Bulbobaculites elongatulus* (Dain), *Bicazammina jurassica* (Haeusler), *Haghimashella arcuata* (Haeusler), *Haplophragmoides cushmani* Loeblich et Tappan, *Haplophragmoides joukowskyi* Charollais, Brönnimann et Zaninetti, *Pseudomarssonella*? *dumortieri* (Schwager), *Ammobaculites* sp., *Ammodiscus* sp., *Arenobulimina* sp., *Belorussiella* sp., *Gaudryina* sp., *Glomospira* sp., *Pseudoclavulina* sp., *Redmondoides* sp., *Reophax* sp., *Spiroplectammina* sp., *Trochammina* sp., *Valvulina* sp., *Verneuilina* sp. Some of these foraminifera (e.g., *Ammobaculites* sp., *Glomospira* sp., *Reophax* sp., *Textularia* sp., *Trochammina* sp.) are more common in the limestones representing deposits of deeper zones.

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Type specimens of Agglutinated Foraminifera housed in the collections of the European Micropalaeontological Reference Centre

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Over the time frame of two years (2015-2016), the European Micropalaeontological Reference Centre has become an important repository for published micropalaeontological collections. As of December 2016, the foraminiferal collections consist of over 13,000 faunal slides. The “gem” of the collection is a separate microscope slide cabinet that contains type specimens (holotypes, paratypes and metatypes) of species of agglutinated foraminifera. The slides of type specimens are archived in cabinet drawers together with the reprints of papers in which the species were described.

The EMRC currently houses type specimens of the following species:

Holotypes: *Ammobaculites fragmentarius* Cushman *agglutiniformis* Podobina, 1975 (+ paratypes, metatypes); *Ammobaculoides dhrumaensis* Kaminski, Malik & Setoyama, 2017 (+ paratypes); *Bulbobaculites gorlicensis* Waśkowska, 2014 (+ paratypes); *Pseudonubeculina arabica* Amao & Kaminski, 2016 (+ paratypes); *Uvigerinammina mysaiosi* Neagu, 2011.

Paratypes: *Aaptotoichus challengeri* Holbourn & Kaminski, 1995; *Adercotryma agterbergi* Gradstein & Kaminski, 1989; *Ammodiscus kenderi* Cetean & Kaminski, 2011; *Ammodiscus nagyi* Kaminski, 1989; *Ammomarginulina spectata* Podobina, 1997; *Ammoscalaria antis* Podobina, 1975 (+ metatype); *Annectina biedai* Gradstein & Kaminski, 1997; *Annectina grzybowskii* (Jurkiewicz, 1960); *Arenobulimina advea* (Cushman) *praeadvena* Barnard & Banner, 1980; *Arenobulimina bulletta* Barnard & Banner, 1980; *Arenobulimina macfadyeni* Cushman *elongata* Barnard & Banner, 1980; *Arenobulimina postchapmani s.s.* Barnard & Banner, 1980; *Arenobulimina postchapmani praecursor* Barnard & Banner, 1980; *Arenobulimina pseudoalbiana* Barnard & Banner, 1980; *Arenobulimina voloshinae s.s.* Barnard & Banner, 1980; *Arenobulimina voloshinae praevoloshinae* Barnard & Banner, 1980; *Arenogaudryina granosa* Podobina, 1975; *Barkerina dobrogiaca* Neagu, 1999 (+ metatypes); *Carasuella cylindrica* Neagu, 1999 (+ metatype); *Comaliamma dobrogiaca* Neagu, 1999; *Conotrochammina voeringensis* Gradstein & Kaminski, 1997; *Cribrostomoides carapitanus* Kaminski, Crespo de Cabrera & Gonzalez, 2011; *Cyclammina cyclops* McNeil, 1988; *Cystammina subgaleata* Vašíček, 1947; *Cystammina sveni* Gradstein & Kaminski, 1997; *Danubina obtusa* Neagu, 1997; *Discamminoides evolutus* Cetean & Kaminski, 2011; *Dorothia pupoides* (Orbigny) *ovata* Podobina, 1975 (+ metatypes); *Dorothia seigliei* Gradstein & Kaminski, 1989; *Eratidus gerochi* Kaminski & Gradstein, 2005; *Falsogaudryinella praemoesiana* Kaminski, Neagu & Platon, 1995; *Falsogaudryinella xenogena* Kaminski, Neagu & Platon, 1995; *"Gaudryina" cuvierensis* Holbourn & Kaminski, 1995; *Gaudryinopsis subbotinae* Podobina, 1975 (+ metatypes); *"Gaudryinopsis" pseudobettenstaedti* Holbourn & Kaminski, 1995; *Gerochella cylindrica* Neagu, 1997; *Glomospira grzybowskii* Jurkiewicz, 1960; *Glomospirella bieda* Samuel, 1977; *Haplophragmoides deplexus* Podobina, 1998 (+

metatypes); *Haplophragmoides fastosus* Podobina, 1998 (+ metatypes); *Haplophragmoides nauticus* Kender, Kaminski & Jones, 2007; *Hinogammina danubiana* Neagu, 2000; *Hippocrepina gracilis* Holbourn & Kaminski, 1995; *Hormosinella fusiformis* Kaminski, Cetean, Balc & Coccioni, 2011; *Hyperammina kenmilleri* Kaminski, 1989; *Kaminskia flabellata* Neagu, 1999; *Labrospira macilenta* Setoyama, Kaminski & Tyszka, 2011; *Nonionammina elegans* Neagu, 1999; *Paratrochamminoides gorayskiformis* Kender, Kaminski & Jones, 2007; *Phenacophragma beckmanni* Kaminski & Geroch, 1986; *Phenacophragma elegans* Kaminski, 1986; *Plectoverneuilinella angolaensis* Cetean & Kaminski, 2011; *Popovia johnrolandi* Preece, Kaminski & Dignes, 2000; *Portatrochammina profunda* Kender, Kaminski & Jones, 2007; *Psamminopelta gradsteini* Kaminski & Geroch, 1997; *Pseudotextulariella cretosa* Cushman, 1932; *Patellovalvulina patruliusi* Neagu, 1975; *Recurvoides trochoidalis* Setoyama, Kaminski & Tyszka, 2011; *Recurvoides arctica* Setoyama, Kaminski & Tyszka, 2011; *Reophanus berggreni* Gradstein & Kaminski, 1997; *Reophax guttiformis* Podobina, 1975 (+ metatypes); *Reticulophragmium projectus* Schröder-Adams & McNeil, 1994; *Reticulophragmium mackenzieensis* McNeil, 1997; *Scherochorella congoensis* Kender, Kaminski & Jones, 2007; *Scythiolina filiformis* Neagu, 2000; *Siphogaudryina stephensoni* (Cushman) *distincta* Podobina, 1975 (+ metatypes); *Spiropsammina primitiva* Cetean & Kaminski, 2011; *Subreophax longicameratus* Kaminski, Cetean, Balc & Coccioni, 2011; *Trochammina lomonosovensis* Evans & Kaminski, 1998; *Tetrataxiella subtilissima* Cetean & Kaminski, 2011; *Textularia sibirica* Podobina, 1997; *"Textulariopsis" elegans* Holbourn & Kaminski, 1995; *Trochammina priva* Podobina, 1975; *Trochamminoides lamentabilis* Podobina, 1998; *Uvigerammina una* Gradstein & Kaminski, 1999; *Uvigerinammina carpathica* Neagu, 2011; *Uvigerinammina moesiana* Neagu, 1965.

Metatypes: *Ammobaculites dignus* Podobina, 1964; *Ammogloborotaloides truncatulinoidiformis* Kaminski & Contreras, 2011; *Ammosphaeroidina sphaerica* Podobina; *Cribrostomoides astrictus* Podobina, 1966; *Cribrostomoides cretaceous* Cushman & Goudkoff *exploratus* Podobina, 1966; *Cribrostomoides trinitatensis* Cushman & Jarvis *sibiricum* Podobina, 1966; *Cyclammina flexuosa* Podobina, 1966; *Gaudryinopsis angustus* Podobina, 1975; *Glomospira gordialiformis* Podobina, 1967; *Glomospira straniki* Bubík, 1995; *Haplophragmoides idoneus* Podobina, 1974; *Haplophragmoides tumidus* Podobina, 1966; *Haplophragmium medium* Podobina, 1975; *Hormosina ovula* Grzybowski *gigantea* Geroch, 1960; *Labrospira honesta* Podobina, 1974; *Labrospira fraseri* (Wickenden) *stata* Podobina, 1966; *Labrospira collyra* (Nauss) *senonica* Podobina, 1966; *Phenacophragma beckmanni* Kaminski & Geroch, 1986; *Pseudoclavulina hastata* (Cushman) *admota* Podobina, 1966; *Pseudoreophax cisovnicensis* Geroch, 1961; *Reophanus berggreni* Gradstein & Kaminski, 1997; *Reophax proprius* Podobina, 1975; *Reophax remotus* Podobina, 1975; *Recurvoides magnificus* Podobina, 1966; *Recurvoides memornadus* Podobina, 1964; *Recurvoides optivus* Podobina, 1964; *Trochammina quinqueloba* Geroch, 1966; *Verneuilinoides concinnus* Podobina, 1975.

Agglutinated foraminifera of the Paleocene-Eocene pelagic deposits of the Fore-Magura zone in the western part the Polish Outer Carpathians

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The Fore-Magura zone, built up of thinned flysch and pelagic deposits, has been distinguished in some areas at the northern margin of the Magura Nappe. In the western part of the Polish Outer Carpathians it is represented by the Fore-Magura Thrust Sheet (F-MTS) that can be traced from Moravia in Czech Republic up to Żywiec area in Poland (Żelaźniewicz et al., 2011). The characteristic and distinguishing feature of the F-MTS is the development of the Upper Cretaceous – Eocene deep-water pelagic deposits rich in planktonic and benthonic foraminiferal assemblages.

Burtan and Sokołowski (1956) distinguished two lithostratigraphic sequences of Upper Cretaceous – Oligocene deposits within the F-MTS in the area SW of Żywiec. The northern sequence (about 1500 m thick), with the Menilite – Krosno Beds as the youngest element and the southern sequence (ca. 400 m thick) with the Łużna Limestone and Submagura Beds at the top of the sequence. According to Książkiewicz (1972) only the northern sequence represents Fore-Magura Thrust Sheet while the southern one constitutes a marginal thrust of the Magura Nappe. Accepting this latter opinion, deposits of the northern sequence was the subject of our study.

The Paleocene and Eocene pelagic deposits in the F-MTS are represented by variegated marls, inter-fingering with non-calcareous red and green shales. In the marly deposits agglutinated foraminifera constitute one of the components of mixed assemblages while in the shales they form entirely agglutinated assemblages. In general, they represent DWAF assemblages of two biofacies - slope biofacies, deposited well above local CCD or even above or close to lysocline (FL) and flysch-type biofacies indicating deposition below CCD (eg. Kaminski and Gradstein, 2005).

The following taxa: *Annectina grzybowskii, Rzehakina fissistomata, Haplophragoides miatliukae* (Paleocene)*, Glomospira charoides* and *G. gordialis* (abundant), *Saccamminoides carpathicus* (Early Eocene)*, Reticulophragmium amplectens, Ammodiscus latus* (Middle Eocene), and *Reticulophragmium rotundidorsatum* (Late Eocene) are present in both type of assemblages and allows for local zonation and correlation with Geroch & Nowak (1984) and Olszewska (1997) zonations.

In all the samples of the Paleocene-Eocene deposits studied, the agglutinated foraminifera of mixed assemblages, yielded from marly deposits, display higher taxonomic diversity than those of exclusively agglutinated assemblages, occurring in coeval non-calcareous shales. The Paleocene assemblages are the most diversified with about 50 species in marly biofacies and 26 in flysch-type one. The Early Eocene assemblages show distinct decrease in diversity in both mentioned biofacies. In the Middle Eocene assemblages gradual increase in diversity has been observed up to 37 and 26 species in the early Late Eocene assemblages of marls and non-calcareous shales respectively. Some taxa of agglutinated-calcareous foraminifera (*Gaudryina, Tritaxia, Arenobulimina, Remesella, Dorothia, Eggerella)* occur in the slope-biofacies assemblages while in the flysch-type assemblages they are almost absent.

Development of sedimentation in the Fore-Magura basin took place during the second (Late Cretaceous – Late Eocene) stage of the Outer Carpathian Basin evolution that was marked by very distinct uplifting of the Silesian Ridge, separating Magura and the

Silesian basins and the appearance of red shales and marls (eg. Ślączka and Kaminski, 1998). The sedimentation area of the F-MTS could have been located on the southern slopes of the Silesian Ridge. Thus, the agglutinated assemblages studied reveal the changes along this slope from the sedimentation at the settings above local FL down to the depth below local CCD during Paleocene-Eocene. The presence of typical DWAF assemblages points to a considerable depths of the depositional environment.

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A new Pliocene species of the agglutinated foraminifer *Colominella* Popescu, 1998 from the Mediterranean record

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We report the occurrence of a new agglutinated foraminiferal species belonging to the genus *Colominella* Popescu, 1998, recently recorded in two Pliocene successions of the western Mediterranean region.

The genus *Colominella* Popescu, 1998 has been formally described from the Paratethyan Badenian (middle Miocene) Kostej succession, outcropping in Transylvania (Popescu et al. 1998; Kaminski, 2004) and is based on the type species *Textulariella paalzowi*, first studied by Cushman (1936) from the same locality. The type species has been subsequently recorded in other Badenian localities in central-eastern Europe (e.g., Popescu *et al*., 1998; Spezzaferri *et al*., 2004) but never in the Mediterranean basin.

In 2012, Mancin and co-authors documented the occurrence of *Colominella* specimens in a lower Pliocene record of the Albenga Basin in the western Mediterranean region and, more recently, also in the Piacenzian stratotype section of Castell'Arquato (PC), in the Northern Apennine. The direct comparison between the Mediterranean specimens and the topotype individuals of *C. paalzowi* from the lower Badenian Paratethyan Lăpugiu de Sus section shows that the Pliocene Mediterranean specimens are different from a taxonomic point of view (Mancin & Kaminski, in press), and therefore they cannot be assigned to the type species *C. paalzowi* (Cushman). The Pliocene Mediterranean specimens represent a new, younger, more highly evolved *Colominella* species, that will be formally described in the conference proceedings.

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Compositional analysis of the wall of some textulariid species

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Textulariids are quite common species in the Iberian Continental Margin (Levy et al., 1993, 1995, Mendes et al., 2004; Martins et al., 2012, 2014). Textularia Defrance, 1824 includes organisms with calcarenitic and the arenitic wall (Norvang, 1966). This characteristic is important for the genus definition and its phylogeny. In general it is expected that in shallow environments of siliciclastic continental shelves the wall of the agglutinated foraminifera test is composed essentially by mineralogical particles since these kind of materials are available and are the main constituents of the sediment. However the Energy Dispersive Spectroscopy (EDS) on the Scanning Electron Microscope (SEM; Hitachi, S4100) revealed that in several species of textulariids found both in shallower depths and in deep areas of Iberian Continental Margin the test includes high Ca content. These results indicate that the main constituent of the wall are carbonate particles. The analysed species in this work were *Textularia aglutinans* d' Orbigny, 1839, *Textularia deltoidea* Reuss, 1850, *Sahulia conica* (d'Orbigny, 1840), *Spiroplectammina sagittula* (Defrance, 1824), *Siphotextularia flintii* (Cushman, 1911), *Siphotextularia heterostoma* Fornasini, 1986 and *Karreriella bradyi* (Cushman, 1911). The relative abundance of Ca in the wall of these species vary between ≈23-41% (for *S. sagittula* and *K. bradyi*) and ≈64-95% for the other species. The wall of these species also includes litogenic elements such as Si, Fe, Al, Mg, K and Y. Silicon reaches the highest concentrations in the wall of *S. sagittula* and *K. bradyi* (≈63-23%). Concentrations of the other lithogenic elements is relatively low (generally <15%) in all the analysed species.

The results of the EDS Analysis on the SEM for the general composition of *T. deltoidea* is presented in Figure 1. This analysis reveals that the test of this species is especially carbonated. The analysis of parts of the test indicates variable composition depending on the materials included in the wall. In Figure 2 the analysis of a particle included in the test of *T. deltoidea* is 100% composed by Ca. These results allow to put the following questions. Why these species choose mostly carbonated particles to include in their tests, even in areas where carbonates are rare and silicate substances are almost the only material available for the organism build their tests? Are carbonate particles being manufactured by organisms to build their test?

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==================================================================
RESULT REPORT          X-RAY SPECTROMETRY WITH RONTEC WinTools
Institution:
Operator:
Customer:
==================================================================

===============================   ===============================
    RONTEC EDWIN WinTools          GERAL5     29.07.2016 (15:55)
===============================   ===============================
      version: 3.1 eng             Eo:25.0 keV  (TO:35.0  TI:-4.0)

                     *** PUzaf results ***
elem/line____P/B_____B_______F________c_____c(100%)__%error__h_
Fe K-alpha    3.9  1.03555 1.04113   0.42     1.09     75.5
Mg K-ser   @  1.1  1.00297 1.01129   0.20     0.51    209.1  <
Al K-ser   @  2.0  1.00638 1.02035   0.32     0.83     89.5
Y  L-ser   @  0.2  1.01152 1.05852   0.03     0.08    728.1  <
Si K-ser   @  7.2  1.00952 1.03349   1.01     2.62     26.9
K  K-alpha    3.8  1.02239 1.35677   0.32     0.84     49.5  *
Ca K-alpha  336.7  1.02455 1.00823  36.31    94.05      9.4
-----------------------------------------------------------------
standardless                        38.61   100.00     [2s]
```

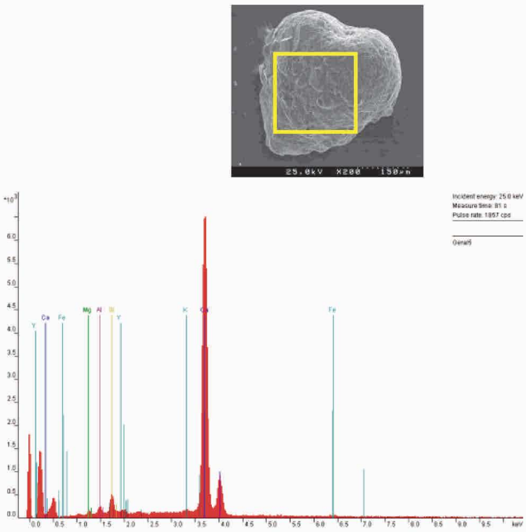

Fig. 1. Results of the EDS analysis of the test of one specimen of *T. deltoidea*.

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==================================================================
RESULT REPORT          X-RAY SPECTROMETRY WITH RONTEC WinTools
Institution:
Operator:
Customer:
==================================================================

===============================   ===============================
    RONTEC EDWIN WinTools          CR     29.07.2016 (15:23)
===============================   ===============================
      version: 3.1 eng             Eo:25.0 keV  (TO:35.0  TI:-18.0)

                     *** PUzaf results ***
elem/line____P/B_____B_______F________c_____c(100%)__%error__h_
Y  L-ser    -16.7  1.01159 1.06742   0.00     0.00      2.9  <
Ca K-alpha  455.8  1.02471 1.00763  49.61   100.00     12.2
-----------------------------------------------------------------
standardless                        49.61   100.00     [2s]
```

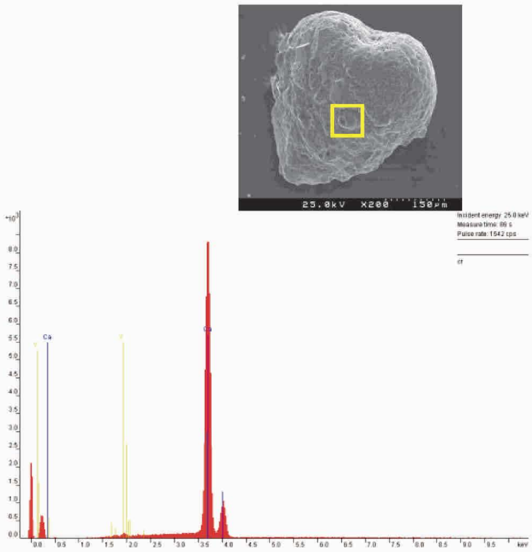

Fig. 2. Results of the EDS Analysis on the SEM of a particle included in the test of one specimen of *T. deltoidea.*

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Rapid uppermost Triassic colonization of the Zliechov Basin (Western Carpathians) by benthic marine ecosystems: foraminiferal responses to eustatic and climatic changes.

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Terminal Triassic environmental changes in the Central Western Carpathian part of the north Tethyan shelf margin were studied by an integrated method comprising lithological, litho- and cyclostratigraphic, mineralogical, geochemical, rock magnetic and paleontological investigations in the Tatra Mts (Michalík et al., 2007; 2013). The Carpathian Keuper sequence has been deposited in an arid environment with only seasonal rivers, temporal lakes and swamps with scarce vegetation. Geochemical proxies indicate dolomite precipitation either from brackish or hypersaline lake water, or its derivation from pore-water comparably to the recent Coorong B-dolostone. Negative $\delta^{13}C$ values indicate microbial C productivity.

During Late Triassic humidification, terrigene Carpathian Keuper deposits were covered by Rhaetian limnic/lacustrine mudstones and quartz sands of the Tomanova Fm. with iron ores, dinosaur footprints, fern macroflora and diverse pollen/sporomorph associations. Chemical and quantitative mineral analyses detected weathering of granites, and kaolinite formation by acid leaching in humid and warm Rhaetian climate in the sediments source area.

Rhaetian transgressive deposits with restricted *Rhaetavicula* fauna accumulated in nearshore swamps and lagoons. Mollusc biostromes were repetitively destroyed by storms, and temporary firm bottom was colonized by oysters and burrowers. Subsequent black shale deposition recorded input of eolian dust. Bottom colonization by pachyodont bivalves, brachiopod and corals started much later, during highstand conditions. Facies evolution also revealed by geochemical data, C and O isotope curves reflect eustatic and climatic changes and help reconstruct the evolution of Rhaetian marine carbonate ramp.

Marine ingression horizons above terrigene sediments of the Carpathian Keuper and Tomanova Fm. also show a high concentration of benthic foraminifers. They belong to the genus *Agathammina*, providing a small size, simple morphology, coiled porcelaneous tests and probably opportunistic strategy. *Agathammina*-rich microfauna in basal part of the Fatra Fm. bloomed in response of hypersalinne conditions, because these homeomorphic groups of foraminifera, like *Rectocornuspira*, *Cyclogyra*, *Earlandia*, *Postcladella* etc., were able to tolerate an elevated salinity (Song et al. 2015). This is also a case of *Meandrospira*-rich horizons in Early Triassic formations, which also imply a colonization of basinal substrates aftermath the Permian-Triassic extinction (Krainer & Vachard 2011). Transgressive marine sediments above to the Tomanova Fm. are also enriched by agglutinated microgranular foraminifers of the genus *Endotheba* (Lintnerová et al. 2013).

Middle part of the Fatra Fm. dominated by large-sized foraminifers with microgranular agglutinated tests and glomospiral and glomospirelloid coiling mode. They comprise species of *Glomospira regularis*, *G. inflata*, *Glomospirella hoae*, *G. expansa*, *G. parallela*, *G. pokornyi*, *G. amplificata*, *G. facilis*, etc. *Glomospira*-type foraminifers belong to B2 morphogroup *sensu* Kuhnt et al. (1989), which involves epifaunal to shallow infaunal forms and active deposit feeders. Considering that, they abundance in the Fatra Fm. could indicate a food availability and meso- to eutrophic conditions.

Higher up in the Fatra Fm., the agglutinated foraminifers became less frequent and successively replaced by hyaline forms of *Aulotortidae* (*Aulotortus tumidus*, *A. sinuosus*), *Duostominidae* (*Oberhauserella alta*), *Nodosariidae* (*Dentalina hoi*) and mainly porcelaneous forms of *Ophthalmidiidae* (*Hoynella inconstance*, *Ophthalmidium carinatum*, etc.). Preference of hyaline and porcelaneous forms reveals a change in behavioral strategy and calcareous and aragonitic wall composition.

The upper boundary of the Fatra Fm is sharp, stressed by a sudden termination of carbonates and followed by non-carbonate “Boundary Claystone” and “Cardinia Sandstone” members of the Kopieniec Fm. The major $\delta^{13}C_{org}$ excursion within the T/J boundary interval documents perturbation of the global C cycle due to MORB volcanism peak.

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The evolutionary approach to the foraminiferal classification

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Why did I choose such a subject for this my presentation?

Since Ch. Darwin, the century later the strong evolutionary school arose in Russia (V. Dogiel, A. Severtzov, V. Beklemishev , V. Kovalelvski, N. Vavilov, N. Timofeev-Resovski, S. Mejen, A. Lubistschev and some others). As a consequence of this the biological University courses were based on the ideas of this school, on a strong and wide evolutionary basis. Of course, the previous achievements of the European school, such as laws formulated by Muller and Gekkel, Depéret, Dollo, Cope, Osborn, Simpson and some others were also considered.

What advances gives such an approach in taxonomic studies?

Some examples may be taken to demonstrate this.

1. For in stance, we have such agglutinated genera as 1. *Saccammina*, 2. *Reophax*, 3. *Verneuilinella*, 4. *Karreriella*, 5. *Rectogerochammina*,6. *Olgia* with gradually enlarging number of chambers.

It would be just clear to everybody that multichambered shells of *Reophax* and of all the others in this row are more evolutionary advanced forms then unilocular *Saccammina*. But what about multichambered shells of the 3d, 4th, 5th and 6th genera, where *Verneuilinella* has 4 rows with 5- to 8 chambers in each row , in *Karreriella* - chamber number in the rows changes from 5- 6 to 4 -3, and finally - 2, in *Rectogerochammina* from several chambers in each trochospiral whorl to 2 and 1, and finally in *Olgia* – from 3 in each initial whorl to final uniserial part? Which of them is more progressive? Is not the decrease of the chamber number in the last rows in these forms the result of regressive process? The evolutionary theory gives here the clear answer – this process of reduction of the number of chambers in the final shell parts comparing their bigger number in the earlier ones represents according to the Dogiel's law the process of oligomerization which could have place only on the base of the preceding polymerization and hence could be regarded as a progressive step in their development. More over, the degree of advancement of a group could be characterized by the degree of development of the oligomerizational processes.

Another example: the strict evolutionary approach based on the morphological analyses of the big protistan groups permits to the team of Russian scientists in St. Petersburg to make some significant changes in the protistan macrotaxonomy (Krylov et al., 1980). For instance, the previous Sarcomastigophora were splitted into Sarcodina and Mastigophora, amd the rank of both of them was elevated to the phylum level for the first time. The rank of many of the others protistan groups was also elevated and a lot of the new high rank taxa newly described. This scientific group had not appropriate possibilities to use the new laboratory methods, equipment, so on. But "the ideas go first" (A. Einstein). At the end of the 20 th and beginning of the 21st centuries the majority of their taxonomic results were discovered and supported with the use of the new equipment and the new molecular methods by the outstanding discoveries of Pawlowski school and other teams of the Western specialists.

Participating in the work of the St. Petersburgian team mentioned above I also elevated the rank of Foraminifera to the phylum level and during the later period (1981 – 2000) tried to revise foraminiferal system in the view of their evolution and the evolutionary significance of the features put at the base of the distinctive diagnoses as Foraminifera give the unique opportunities of such evolutionary approach owing to their long well documented geologic history and also to their complex morphology striking for the organisms of the unicellular level. In the frame of the evolutionary approach the following diagnostic features were put at the base of their new system: first of all the plan of their shell structure reflecting the plan of their organism which concerns not only the disposition of the organism parts but connection of these parts with the organism functions. The main of these features include the number of chambers and their form, mode of their coiling, position and structure of the main and additional apertures, presence and degree of development of the inner integrative systems along with some cytological features firstly used in the foraminiferal taxonomy. Shell wall composition and ultrastructure were considered as important but subordinate features. As a result of such approach the phylum Foraminifera was regarded as a system of one unilocular and 4 multichambered classes (Mikhalevich, 1992, 2000, 2013) the majority of which were later supported by the molecular data (Pawlowski, 2003, Pawlowski & Holzmann, 2002, Pawlowski et al., 2013). These classes arose independently and in parallel at different times. In the process of construction of the new system such evolutionary notions as parallelism and convergence were mostly considered. The distinction between parallel and convergent forms is the key question in the understanding and definition of the taxonomic position of the studied organisms. The multiplication of the structural elements and the rise and development of the more and more complex apertural and integrative structures within each of the rows (classes) could be predicted in the light of the evolutionary theory. The offered 5 classes (Mikhlavich, 2013, Pl. 1a) resemble the N. Vavilov's homological evolutionary rows of wheat, and even, to some extent, the rows of Mendellev's table. The common feature of all of these three systems is the gradual increase of complexity in each of the rows and of the system as a whole. At this, each of the rows could be characterized with a set of its own peculiar features and their combination. Such evolutionary built systems give the possibility not only to define and understand the studied object but also to predict the discovery of the new objects within the lines of the system. And the possibility of prediction is the basic and permanent property of science – "Ideas go first!" (A. Einstein). Of course, it is necessary to confirm the ideas and the theory with facts and experiments. In the case of foraminiferal system such verification came from the impressive volume of the new fundamental molecular data of outstanding groups of European scientists (Pawlowski, 2003, Pawlowski & Holzmann, 2002, Pawlowski et al., 2013, Flakowski et al., 2005, Bowser et al., 2006 and others).

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Foraminifera reflecting facies changes in transgressive – regressive sedimentary sequences

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The sequence biostratigraphy model developed during the last few years comprises foraminiferal facies trends embracing depositional conditions from alluvial plain through marine shelf to deep basinal settings. The framework of the model is the transgressive–regressive (T-R) sequence, which is bounded by subaerial unconformities and their correlative maximum regressive surfaces, and is divided into a transgressive and regressive systems tract by the maximum flooding surface.

Commonly used biofacies proxies to characterize sequence stratigraphic components (such as systems tracts and flooding events) include distribution of benthic species, faunal diversities and frequency of normal marine contra restricted taxa. In addition, distribution of morphogroups, test size groups and deep water taxa provide useful information.

In the transgressive – regressive framework, biofacies trends are portrayed as assemblage expansion and reduction separated by abrupt trend changes or stable zones with minor assemblage fluctuations. Assemblage expansion means upwards increase in diversity and frequency of normal marine taxa, while assemblage reduction means upwards decrease of the same proxies. In this project, the model is applied on several Mesozoic and Paleogene sections mainly from the Boreal Realm, and is supported by two bathymetric profiles with modern faunas.

The Mesozoic to Paleogene sections portray five settings in the T-R sequence model: 1) A deep basinal setting where the maximum flooding revels peak amount of deep water (flysch type) taxa and assemblage reduction followed by expansion. 2) Offshore shelf setting with hypoxia at maximum flooding: Its transgressive systems tract shows a trend change from assemblage expansion to reduction marking a shift from the restricting effect of shallow water to impact of hypoxia. The maximum flooding reveals a change from assemblage reduction to expansion. 3) Shelf setting with normal marine conditions at maximum flooding is typified by continuous assemblage expansion in the transgressive systems tract, while the maximum flooding shows a change from expansion to reduction. 4) Marginal marine settings show low but increasing diversities from paralic to prodelta conditions. In extremely marginal position, the maximum transgression is marked by very low diversities and relatively homogeneous assemblages. 5) An extensive climatic aberration (the Paleocene-Eocene Thermal Maximum) coincides with the maximum flooding interval of a T-R sequence. This event is marked by a faunal turnover, reduced species diversities and dwarfed assemblages.

The project demonstrates that changing foraminiferal facies trends reflect depositional conditions, and indicate arrangement of sequence components such as flooding events (particularly the maximum flooding) systems tracts and boundaries. Assemblage trend changes are discrete stratigraphic horizons signaling shifts in the effect of environmental factors (water depth, salinity, oxygenation) in the sequence architecture. Thus, biostratigraphy provides a potentially significant supplement to sediment-based assessments of sequence stratigraphic features.

Late Cenozoic agglutinated foraminifera from the northern part of the Mendeleev Ridge (Arctic ocean)

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This study is based on the sediment core KD12-05-23c which was retrieved from the northern part of the Mendeleev Ridge during the cruise of r/v "Kapitan Dranitsyn" - 2012. Sampling site is located near the eastern edge of the flat top of the Trukshin mountain (1890 m water depth). Total core length is just 156 cm, which is very short. But it recovered as we believe ancient, Pliocene, sediments. The age control was provided by one $^{87}Sr/^{86}Sr$ dating: 20-22.5 cm - 100-200 kyr. Sediment sequence was analyzed for planktic and benthic foraminifers from >125 micron fraction with average weight of sample 35 g.

Three foraminifera assemblages may be recognized throughout the core: 1. *Entirely calcareous fauna*, typical for modern Arctic sediments and dominated by *Oridorsalis tenerus*. The base of this zone is dated as middle Pleistocene; 2. *Transitional fauna* (22.5-42.5 cm) – contains sparse fauna, including both calcareous and agglutinated foraminifera – only 1 test per sample; 3. *Entirely agglutinated fauna* (42.5-155 см), predominantly *Cyclammina pusilla*. These three assemblages correspond perfectly to O'Neil's (1981) biofacies. The composition of the agglutinated assemblage in our core (Fig. 1) generally is the same as was found on Lomonosov (Evans and Kaminski, 1998; Kaminski et al., 2009) and Alpha Ridges (O'Neil, 1981). The main genuses are Cyclammina, Cribrostomoides, Cystammina, Psammosphaera, Adercotryma, Recurvoides, Reophax, Trochammina. Oder Astrorhizida is presented by Rhabdammina, Hyperammina and Hormosina – tubular forms which occur through the core only as fragments. Dominant species is *Cyclammina pusilla*. It is absent in modern Arctic sediments, earliest occurrence is recorded from 7-9 marine isotope stage (MIS). In our core we can correlate 20-22.5 cm interval with the 5-7 MIS on the grounds of $^{87}Sr/^{86}Sr$ dating and we believe that the agglutinated zone indicates Pliocene/Early Pleistocene age of the sediments. It could be due to the slow sedimentation rates and/or bottom erosion, viewed from obtained seismic data.

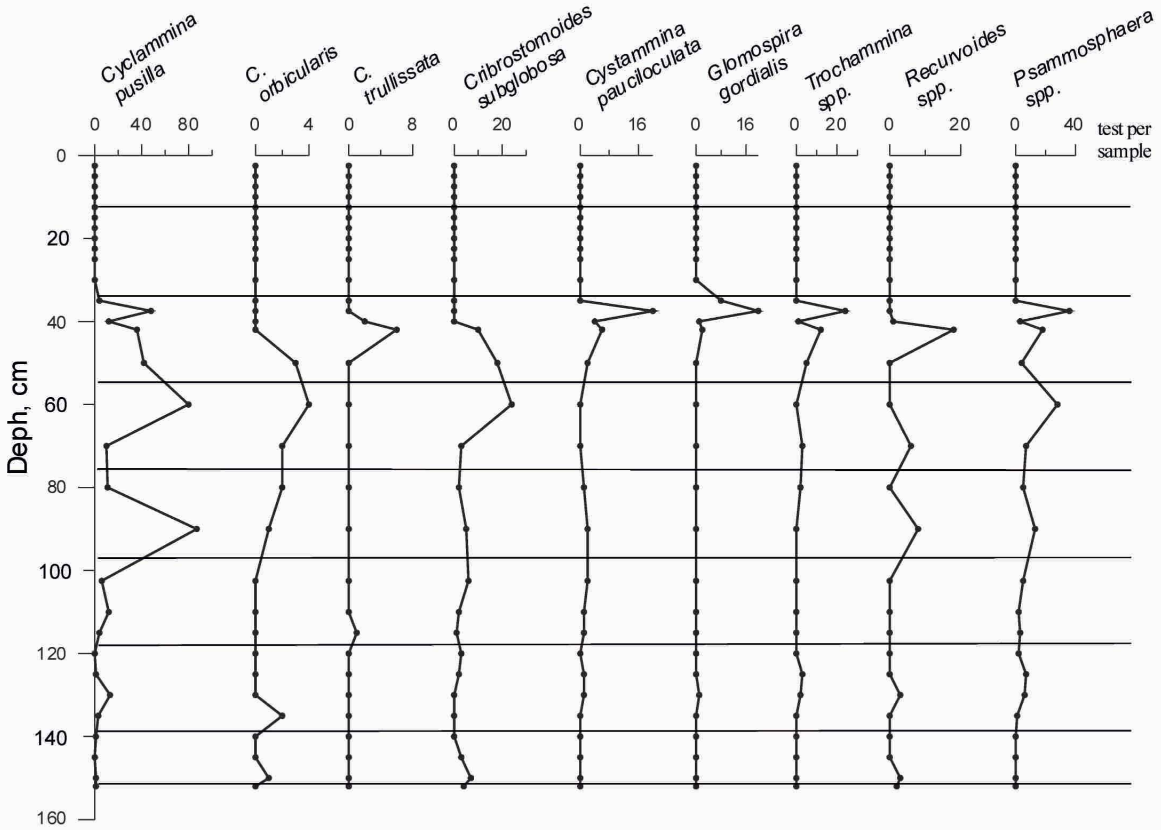

Fig. 1. Downcore foraminiferal abundance (tests per sample), in >125 micron fraction, average weight of sample 35 g.

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Agglutinated foraminifera from Hauterivian of Jebel Rhazouane (Northwestern Tunisia)

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Micropaleontological studies on the sediments of Jebel Rhazouane (NW Tunisia) reported to the lower Cretaceous showed the existence of a rich faunal where agglutinated foraminifera is a significant component of assembly of foraminifera. The rarity of ammonites in this western part of the "Tunisian through», a marine basin situated on the southern margin of the Tethys, has made difficult the establishing stratigraphical subdivision of these deposits. The assemblage is dominated by agglutinated foraminifera occurring together with calcareous benthic foraminifera and at the top rarely planctonic one. The agglutinated foraminifera recovered in this studied section show significant generic and specific diversity belonging to the genera: hyperammina, Haplophragmoides, Ammobaculites, Spiroplectammina, Chauffatella, Bathysiphon, Glomospira, Rhizammina and diversified Dorothia. Calcareous benthic foraminifera show mainly the genus: Lenticulina, Astacolus, Saracenaria, Vaginulina and Epistonima. This research shows the ranges of agglutinated foraminifera to Middle and upper Hauterivian sediments, confirmed by Gorbachikella kugleri at the top of the section. Paleobathymetric interpretation suggests that the formations were deposited from middle bathyal to outer neritic depths.

Results of this research provide scope to define evolutionary lineages of these microfossils in the Tethyan communities during Lower Cretaceous stages and to be use for stratigrafical precisions when planctonic foraminifera and ammonites are sparse or absents.

Spiculidendron from upper Pleistocene cold-water corals from the Inner Sea of the Maldives.

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Cold-water corals of the late Pleistocene (21,400 – 22,500 BP) are recorded from the sea floor of two inter-atoll channels (Kardiva Channel at 457 m depth and Malé Vaadhoo Channel at 443 m depth) of the eastern row of the Maldives archipelago (Reolid *et al.,* 2017). The coral assemblage is composed mainly by *Lophelia pertusa* and secondarily by *Madrepora oculata* and *Enallopsammia rostrata*. The studied samples were recovered during R/V SONNE Cruise SO236 in August 2014 (Betzler 2015). Sea floor sampling was performed with the R/V Sonne video grab sampler and a box corer. *Spiculidendron* was recorded attached to the cold-water coral *Enallopsammia* in the eastern flank of the archipelago in the Kardiva Channel (04°51,26' N, 73°28,05' E), between Gaafaru Atoll and Kaashidhoo Atoll at a water depth ranging from 453 to 457 m.

The assemblage of epibionts encompasses tube-dwelling polychaetes (mainly *Spirorbis* and *Serpula*), bryozoans, benthic microbial mats, encrusting foraminifera, siliceous sponges, solitary corals, gorgonids, and terebellids, as well as abundant ophiuroids, echinoids, barnacles, ostracods, gastropods, and brachiopods living between the coral branches (Reolid *et al.,* 2017). The encrusting agglutinated foraminifera constitute 11% of the epibionts colonizing *Enallopsammia.* Among the sessile foraminifera, the arborescent dendrophryid form *Spiculidendron* with tubular branches is common and generally attached to the downward-oriented *Enallopsammia* surfaces. They are not recorded attached to other genera of cold-water corals or their epibionts. The specimens recorded reach 28 mm length. The test is constituted by spicules of siliceous sponges, elongated diatoms, and planktonic foraminifera. These particles are poorly cemented and they are delicate. The base of the test is directly attached to *Enallopsammia.* Elongated bioclasts such as sponge spicules (mainly monaxon megascleras) and diatoms are aligned longitudinally and planktic foraminifera and other bioclasts are located between. In the distal growth portions of the branches only elongated bioclasts are present parallel to the growth axis. The branches are located in one plane with the main branch ranging from 140 – 110 µm in diameter.

Spiculidendron corallicum was initially described in shallow environments from Caribbean coral reefs from shaded habitats (Rützler & Richardson, 1996) composed exclusively by spicules of siliceous sponges. The new record is represented by smaller specimens from deeper environments of the Maldives, where the growth of the test is guided by sponge spicules and elongated diatoms but with an abundance of planktonic foraminifera. Probably the specimens studied here correspond to a new species of *Spiculidendron.*

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Jurassic benthic foraminifera from the COST G-2 well, Georges Bank Basin, Atlantic Outer Continental Shelf

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The Continental Offshore Stratigraphic Test (COST) G-2 well was drilled in the Georges Bank Basin on the Atlantic Outer Continental Shelf (OCS) in 1977 as an effort to evaluate the petroleum potential in the US North Atlantic OCS area. Following initial reports, the foraminiferal data from the COST G-2 well have been integrated in various regional biostratigraphic and palaeoenvironmental studies of the Atlantic margin of North America (e.g. Ascoli, 1990; Poppe and Poag, 1993). However, despite repeated use of the data, the foraminiferal assemblages have never been fully described and illustrated in the previous studies. This study, therefore, aims to describe the Jurassic foraminifera recovered from the COST G-2 well to supplement and enhance the interpretations made by previous studies as part of an attempt to re-evaluate key wells and petroleum systems of the North and Central Atlantic region (EGI's Oceans Initiative).

The Jurassic foraminiferal assemblages are devoid of planktonic components and composed of agglutinated and calcareous benthic taxa. Specimens recovered from ditch cuttings from the G-2 well are, in general, poorly preserved, and occur very scarcely in the interval interpreted as the upper Bathonian–Callovian by Poppe and Poag (1993) and below. Their abundance and diversity remain low until the Kimmeridgian–Tithonian during the assemblages become richer and more diversified, although foraminiferal populations still fluctuate greatly through the Upper Jurassic. This increase in abundance and diversity coincides with the period of transgression suggested by Poag (1982).

The agglutinated assemblages commonly include *Alveosepta* aff. *jaccardi* up to the middle of the Kimmeridgian–Tithonian interval. Additionally, a few different forms of ?*Everticyclammina* (specimens with planispirally coiled initial whorls followed by a rectilinear portion, a slit-like aperture of various length, and wall that could be alveolar) often dominate the assemblages. The calcareous foraminifera are characterized by various species of *Epistomina* and *Lenticulina*, accompanied by *Trocholina*.

The micropaleonntological re-interpretation of the COST G-2 well is still ongoing, and the new results are going be integrated with palynological and geochemical interpretation for better understanding of paleoenvironmental history of the area

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A new freshwater monothalamid foraminifera from China and its possible relationship to *Allogromia saxicola* (Penard, 1905)

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Monothalamid foraminifera inhabit marine habitats from shallow water to the deep sea and are especially abundant in high latitude regions. Some species have also been described from freshwater environments by scientists in the 19th century. Among them, the Swiss protozoologist Eugène Penard has reported five freshwater foraminiferal species from Lake Geneva.

We found several specimens of monothalamid agglutinated foraminifera in sediment samples from a shallow pond in the city of Yangshuo, China, collected in 2015. The newly discovered species has an agglutinated tubular test with a flexible pseudostome and multiple nuclei. It resembles morphologically *Allogromia saxicola* (Penard, 1905), which is characterized by an elongated agglutinated test and a flexible test wall as well as multiple nuclei.

We extracted DNA from several specimens and amplified and sequenced a fragment of the SSU rDNA typically used as foraminiferal barcode. Nine sequences were obtained from four extractions. Phylogenetic analysis shows that the freshwater foraminifera from China build a strongly supported (100% BV) monophyletic group. The molecular results reveal a close relationship of the new species to an environmental sequence (OTU22) from uncultured foraminifera obtained from sediment samples of the Aire, a river in the Geneva basin. Furthermore, two environmental sequences obtained from lake sediments, in Albany, N.Y. (AF381181-82) branch as a sister to the former group. The whole clade is very well supported (100% BV). Sequence divergence between Chinese foraminifera and environmental sequences suggest that they belong to different species, the mean distance within Chinese foraminifera being 0.011 and within the environmental sequences 0,076 while the between group mean distance is 0.098. Because of morphological similarity between Chinese specimens and *A. saxicola*, it is possible that the OTU from Geneva corresponds to Penard's species and that the clade contains related species.

Assessing the ecological preferences of agglutinated benthic foraminifera morphogroups from western Bay of Bengal

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Agglutinated benthic foraminiferal morphogroups have often been used as a proxy in paleoecological studies. The response of various agglutinated morphogroups may, however, vary regionally. To assess the ecological preferences of agglutinated morphogroups, a total of 42 core top samples have been studied from the depth range of 25 to 2540m, covering the entire shelf-slope to upper abyssal plain in Mahanadi basin, western Bay of Bengal. Both living (rose Bengal stained) as well as fossil agglutinated benthic foraminiferal abundance and their morphogroups has been studied and compared with ambient physico-chemical parameters. Agglutinated foraminifera have been divided into 4 morphogroups (A to D).Out of these, two morphogroups, namely B and C are sub-grouped into (B1-B4) and (C1-C2) respectively, following Jones and Charnock (1985). The tubular (A) and globular (B1) morphogroups are positively correlated with depth and negatively with temperature and coarse fraction. Coiled/flattened morphogroup (B2) is positively correlated with total organic carbon (TOC) and negatively with dissolved oxygen (DO). The response of living and dead planispiral/trochospiral forms (B3) varied. The living planispiral/trochospiral forms are positively related with depth and TOC and negatively with almost all other physico-chemical parameters. Contrary to this, dead planispiral/trochospiral forms didn't show any significant relation except with Corg/TN. Likewise the response of living and dead elongated forms (C1) also varied. The living forms showed negative relation with almost all the parameters except the TOC while fossil forms didn't respond to any parameter, suggesting alteration by taphonomic processes. Elongated quinqueloculine/milioline forms (C2) were positively correlated with DO, temperature, coarse fraction and Corg/TN and negatively with depth, TOC and salinity indicating its affinity with shallow marine environment. The morphogroup (D) trochamminids are distinctive of shallow marine environment. The study suggests a clear ecological preference of a majority of the agglutinated morphogroups and thus its potential application in paleocological interpretations.

Keywords: Agglutinated, benthic foraminifera, morphogroups, ecology, Bay of Bengal.

Made of planktonic foraminifera: a detailed analysis of some *Lagenammina* cf. *atlantica* tests from the Quaternary of the Red Sea

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The deep-sea benthic foraminiferal assemblages occurring in the sedimentary record corresponding to the MIS 6 – MIS 4 interval in the central Red Sea is dominated by calcareous taxa. The few agglutinated species occurring in this interval constitute only a small fraction of the assemblages. However, these species (e.g. *Lagenammina* cf. *atlantica*, *Siphotextularia heterostoma*, *S. bermudezi, Textularia cushmani*) are apparently grain-size selective taxa, and agglutinated rather different grain types.

This study is focused on the *Lagenammina* cf. *atlantica* (previously identified as '*Psammosphera'*), a unilocular flask-shaped benthic foraminifera, which has a relatively thin, single layered wall and agglutinated exclusively planktonic foraminifera, mostly *T. clarkei*. Data by Almogi-Labin et al. (1996) showed that in the stratigraphic record corresponding to the late MIS 6 this taxon has the highest abundance of all agglutinated species present in this interval. Therefore, we focused on the specimens of these species recovered from the gravity core KL09 (19°57.6'N, 38°8.3'E, 814 m water depth, central Red Sea) corresponding to the MIS6 to MIS 4 interval to test our hypothesis regarding the grain-size selectivity of this agglutinated taxa. The morphometrics of the foraminiferal tests, and the particles composing the *L.* cf. *atlantica* tests or present in the samples was performed using SEM images and ImageJ 1.51a (Abràmoff et al., 2004)

Our results show that *L.* cf. *atlantica* agglutinated mostly *T. clarkei*, even if other foraminifera species, which agglutinated calcareous nannoplankton coccoliths (*S. heterostoma* and *S. bermudezi*) or clay particles (*T. cushmani*) were present in the samples. This is so, because the *L.* cf. *atlantica* specimens selected the agglutinated particles from a well-defined size fraction, and the sediment corresponding to this size fraction was dominated by *T. clarkei* tests in the central Red Sea. The lack of significant difference between the particles types agglutinated by the *L.* cf. *atlantica* specimens, and those occurring in sediment corresponding to the size fraction preferred by this taxon suggest that the *L.* cf. *atlantica* test perfectly reflect the sediment composition of the preferred size-fraction.

The size preference during particle selection occurs irrespective of the size of the unilocular shell of the species: larger shell sizes are achieved by agglutinating more particles.

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Studies on some late Cretaceous – Paleocene Agglutinated Foraminifera from different localities in Egypt

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The present work deals mainly with the agglutinated Foraminifera separated from rock samples collect from the Cretaceous- Paleocene of 5 geologic sections in the Eastern Desert, Egypt. These sections consist mainly of the following formations from base to top: Qusier Shale formation, Duwi Phosphate formation, Dakhla shale formation, Tarawan Chalk formation, Esna shale formation and Thebes limestone formation at the top.

About 100 agglutinated foraminiferal species are identified. The wall composition and internal structure of these species have been examined through about 200 prepared thin sections using polarizing microscope.

Two main groups of agglutinated wall compositions are differentiated

a) Areneous agglutinated foraminiferal wall.

b) Calcarous agglutinated wall.

The following biozones have been established according to the distributed Agglutinated foraminiferal species. These biszones are arranged from older to younger as:

1. Ammodiscus mangusi zone. 2. Trochammina undulsoa zone. 3. Lituola difformis-Lituola taylorensis zone	Campanian
4. Haplophragium compressum zone 5. Ammobaculites khargensis zone 6. Haplophragmoides excavatus zone	Late Maestrichtian age
7. Spiroplectammina carinata zone	Danian age
8. Valvulina colei zone. 9. Gaudryine inflate – limbata zone.	Early-Late Paleocene

These mentioned Agglutinated Foraminifera biozones are partially corretable with the following planktonic Foraminifera and nanoplankton biozones recorded from the same studied Formations. The biozones are from older to younger.

Racemiguembelina fructicosa (CF4), ***Pseudoguembelina hariaensis*** (CF3), ***Pseudoguembelina palpebra*** (CF2) ***and Plummerita hantkeninoides*** (CF1) ***of late Maastrichtian age; Parasubbotina pseudobulloides*** (P1a), ***Subbotina triloculinoides*** (P1b), ***Praemurica inconstans*** (P1c), ***Praemurica uncinata*** (P2), ***Morozovella angulata*** (P3a), ***Igorina albeari / Praemurica carinata*** (P3b partial) zones of the Danian age, ***Igorina albeari*** (P3b), ***Globanomalina pseudomenardii*** / ***Parasubbotina variospira*** (P4a), ***Acarinina subsplzaerica*** (P4b), A ***carinina soldadoensis*** / ***Globanomalina pseudomenardii*** (P4c), ***Morozovella velascoensis*** (P5,) of Selandian-Thanetian age.

The calcareous nannofossils zones and subzones representing the late Maastirchtian — Late Paleocene interval from older to younger as: ***Lithraphidites quadratus Subzone*** (CC25b), ***Micula murus Subzone*** (CC25c) and ***Nefrolithusfrequens Subzone*** (CC26a) of late Maastrichtian age, ***Chiasmolithus danicus*** (NP 3), ***Ellipsolithus macellus*** (NP4), ***Fasciculithus tympaniformis*** (NP 5), ***Heliolithus kleinpelli*** (NP 6), ***Discoaster mohieri*** (NP7/8), ***Discoaster multiradiatus*** (NP9a) of Paleocene Epoch.

The wall composition of the studied species, the distribution and the stratigraphic importance will be discussed during the presentation.

How agglutinated foraminifera survived in pelagic realm of the Western Carpathian basins: Late Cretaceous – Paleogene events and environmental proxies

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Agglutinated foraminifera survived under a high productivity of the planktonic foraminifers, such as in Púchov Marls, Kysuca Beds, Domaniža Fm., Kršteňany Fm., Globigerina Marls, etc. Their abundance increases in responce of bathymetric changes, continental runoff, trophic conditions, substrate collonization, etc.

Senonian formation rich in agglutinated foraminifers belongs to flysch-type sediments, like Snežnica Beds, Stromovce Beds, Jarmuta Beds, etc. They contain species such as *Nothia excelsa*, *Kalamopsis grzybowski*, *Ammodiscus glabratus*, *Spiroplectammina spectabilis*, *Trochamminoides grzybowskii, Gerochammina conversa*, etc.

K/T boundary is indicated by *Rhizammina*-rich horizons in the Kršteňany borehole section (KRS-3), which predated the appearance of *Parvularugoglobigerina egubina*. Lower Paleocene sequence implay a full pelagic sedimentation with abundance of morozovellids, parasubbotinids, globanomalinids and another planktic foraminifers in the Central-Carpathian basins. Shallowing of these basins is connected with progradation of Kambühel reef platform, which is recorded by collonization of soft-bottom substrates by large-sized agglutinated formaninifers in the deep-sea. Such conditions were favorable for deep infaunal species like *Remesella varians*, *Gaudryina pyramida*, *Dorothia cf. retusa*, and another foraminifers from tapered morphogoups. Tube-like astrorhizids are also very common in Late Paleocene marlstones.

Paleocene-Eocene transition in the red-bed sediments of the Central Western Carpathians is evidenced by increase in abundance and test-size of ammodiscid foraminifera. This bioevent corresponds to so-called *Glomospira* acme (Kaminski & Gradstein 2005), where the agglutinated taxy boomed by opportunistic species (Arreguín-Rodrígues et al. 2013). Glomospira-rich interval in the Žilina (Hájik) Fm. contains species *Repmannina charoides*, *Glomospira serpens, G. cf. diffundens,* etc.

Pelagic productivity in the Central-Carpathian Paleogene basins ceased under debris-flow and turbiditic deposition of the synorogenic basins (e.g. Súľov-Domaniža Basin). These basins implay a gradual deepening to the abyssal zone, indicated by agglutinated foraminifera of *Paratrochamminoides* assemblages. They comprise of species *Paratrochamminoides olszewskii, P. deflexiformis*, *Trochamminoides subcoronatus, T. contortus, T. proteus*, *Haplophragmoides horridus, Psammosiphonella cylindrica*, *Bathysiphon gerochi*, *Nothia robusta*, *Ammodiscus cretaceus*, *A. serpens* and *Psammosphaera irregularis*.

The deepening of the Central-Carpathian Paleogene basins culminated during the Middle Lutetian by deposition of red and variegated non- or weakly calcareous claystones mostly with alveolar and planispiral taxa of agglutinated foraminifera. The most abundant species are *Reticulophragmium amplectens* (= *R. amplectens* acme), *R. rotundidorsatum*, *Haplophragmoides walteri*, and another epifaunal species. Post-Lutetian assemblages of the turbiditic basins are impoverished, comprising mostly tube-shaped morphogroups of agglutinated foraminifers, like *Bathysiphon gerochi*, *Nothia robusta*, *Pseudonodosiphonella sp*., etc.

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Distribution of living (stained) *Reophax* spp. in an oligotrophic area

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Living (Rose Bengal stained) *Reophax* spp. specimens were quantified in superficial sediment samples (0-2cm), from 34 stations located between 400 m and 3000 m, in the southeastern Brazilian continental margin (21°S to 24.5°S-Figure 1) during austral summer of 2009.

Our main objective was to discuss the spatial variability of *Reophax* spp., in relation to some possible ecological controlling factors. Sedimentological parameters such as, total organic carbon, total nitrogen content, lipid biomarkers (fatty acids, sterols and alcohols), bacteria biomass as well as the vertical flux of particulate organic matter were analysed.

Analyses of living (Rose Bengal stained) benthic foraminifera (hyaline, porcelanaceous, agglutinated and tubular) were performed in 50 cm^3 of wet sediment. The percentage of *Reophax* spp. was calculated in relation to the community composition.

A total of 44 living species of *Reophax* were identified in Campos Basin. *Reophax* spp. were observed at 31 of 34 stations in Campos Basin, mainly in middle-lower slope (1300-1800 water depth). The percentage of *Reophax* spp. ranged from 0.5 to 49.4%. The species identified with the highest percentage (ind./50cm^3) were: *Reophax scorpiurus*, *Reophax spiculotestus* and *Reophax subfusiformis.*

No Spearman correlation was observed between *Reophax* spp. and $CaCO_3$, phaeopigment, sortable silt and sand, total organic carbon (TOC), total nitrogen content, lipid biomarkers contents (terrigenous/TOC, zooplankton and fauna/TOC, primary productivity/TOC and bacteria/TOC), bacteria biomass, and the vertical flux of particulate organic matter.

However *Reophax scorpiurus* exhibit a moderate and positive correlation with bacterial biomass (0.41) and primary productivity/TOC (0.40), and a weak and positive correlation with TOC (0.35), zooplankton/TOC (0.37), phaeopigment (0.35) and total lipids/TOC (0.34). Apparently, this species seems to have an opportunistic behaviour, which corroborates the observations of Jones and Charnock (1985). The species *Reophax subfusiformis* did not present significant correlation with the analysed parameters. *Reophax spiculotestus* presented a moderate and positive correlation with phytoplankton concentration (0.43), terrigenous/TOC (0.40), zooplankton fauna/TOC (0.44), primary productivity/TOC (0.43) and total lipids/TOC (0.41), and positive and strong correlation with TOC (0.51), indicating that this species would be an euryitrophic, probably migrating in the sedimentary column (Kitazato, 1994), depending on the availability of food.

The food supply seems to be the most important controlling factor in the distribution of living *Reophax* spp. in the southeastern Brazilian margin. In addition, the food input in the area is controlled by hydro-sedimentary processes (e.g. action of the Brazil Current and Intermediate Western Boundary Current), and features of mesoscale (meanders and Cabo Frio, Cabo de São Tomé and Vitória eddies), thereby determining changes in living benthic foraminifera in Campos Basin.

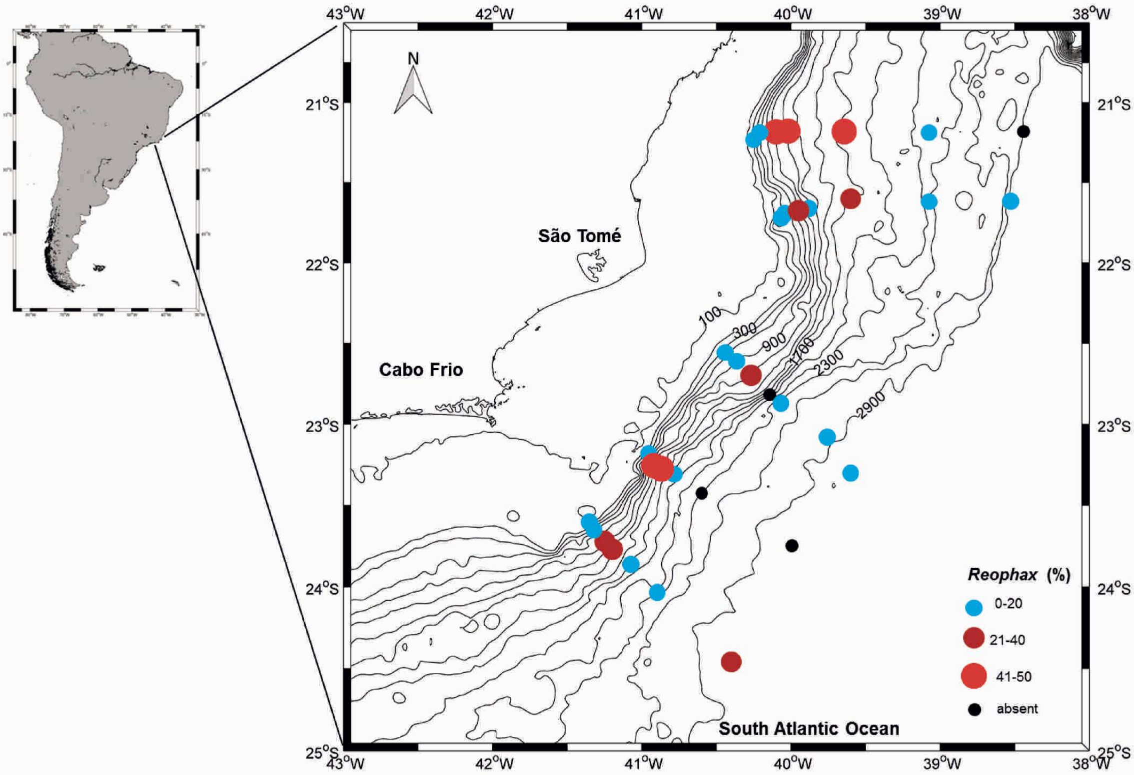

Fig. 1. Location of Campos Basin, sampling sites and *Reophax* spp. percentage (%).

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Response of agglutinated foraminifera to changes in depositional environment during the Cretaceous-Paleogene transition in the Carpathian Basin (Silesian zone, Poland)

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Changes in plate tectonic system and ocean circulation initiated by massive comet and asteroid impact during the Cretaceous-Paleogene associated with changes in sea level, carbon cycle and climate resulted in mass extinction of plant and animal species (KTBE). This biotic event reflects drastic changes in land and marine conditions which studied based on agglutinated foraminifera from the Silesian series of the Polish Outer Carpathians. In this marginal area of the northern Tethys, presently divided into tectonic zones, deposition were strongly controlled by geodynamic processes (Jankowski, 2015). Under these setting siliciclastic-carbonate turbidities mainly sandstones and variegated or dark organic-rich shales including siderites were formed as the Istebna Formation in the Silesian zone (Menčík *et al.*, 1983). Studied deposits outcrop in the Silesian and Żywiec Beskids in the west and also in the foothills of the Niski Beskids or in the Bieszczady Mts in the est.

Microfauna from the lower (Campanian-Maastrichtian) and the upper (Paleocene) part of this Formation has been analyzed. In the first represented by dark calcareous turbidities siliceous- (*C. gigantea, R. inclusa, R. epigona, B. spectabilis*) and calcareous-cemented (*R. varians*) taxa correspond to *C. gigantea* (Santonian/Campanian) and *R. inclusa* (L. Campanian-Maastrichtian) zones *sensu* Olszewska (1997). Co-existed with them species belonging to genera: *Gerochammina, Karrerulina, Glomospira,* and *Glomospirella* also occur in the upper part of the Istebna Fm. In this sequence variegated and also brown-greenish shales including siderites contain new species of *Rzehakina* (*R. fissistomata*), *Haplophragmoides* (*H. stomatus, H. horridum*), *Recurvoides* (*R. nucleolus*) and *Recurvoidella* (*R. lamella*) corresponding to *R. fissistomata* zone (Paleocene) and also sometimes reworked plankton and calcareous benthos. Their local occurrence is often limited to slumped muds.

More opportunistic and specialized forms with fain-grained tests belonging to epifauna (*Rzehakina*) and shallow infauna (*Caudammina*) survived in nutrient-rich waters under conditions of siliceous sedimentation in the Campanian-Maastrichtian. At this time forms characterized by large size of the tests (*C. gigantea*) probably needed more stable and longer-term periods of low tectonic activity and restricted water circulation while active epifaunal taxa which may attach to substrate (*Rzehakina*) colonized most sediment from coarsely laminated sandstones to very fine-grained facies (Scott, 1961). In opposite to the *C. gigantea* involute and often small specimens like *R. inclusa* and similar *C. ovulum* were better adapted to frequently and rapidly changing environments shaped by turbiditic deposition at the end of the Cretaceous. Moreover species of the genus *Glomospira* (*G. gordialis, G. diffundens*) occurring under lower oxygenation also existed during the formation of variegated shales in the Cretaceous-Paleogene. Some infauna having coarse-grained tests cemented by siliceous (*Karrerulina, Gerochammina*) and calcareous material (*Remesella*) also existed in more detrital sediment close to the CCD under progressive oxygenation induced by an increase activity of bottom currents. In addition forms of the genus *Bolivinopsis* reflecting cool, turbid and poorly aired bottom waters including pelagic substrates with high organic matter content (Kaminski, 1984) also occur in variegated shales. These shales may also include lituolids (*Haplophragmoides, Recurvoides*).

The studied microfauna tolerates siliciclastic influx caused by drastic changes in sea level under humid warm conditions during periodic marine flooding. Under these conditions intensive continental runoff led to progressive acidification and hypoxia of stratified waters in which foraminiferal assemblages in low number and diversity were dominated by epifauna (Nagy *et al*., 2009) and also some infauna. These active deposit feeders related to the *Glomospira-Ammodiscus* (*Biofacies B*) and *Recurvoides* assemblages which occurred in dark organic rich deposits under unfavorable (euthrophic) conditions (Kaminski *et al.,* 1999). Periodic, short or long-term increase in activity of turbidity currents contributed to renewal of bottom waters in which forms occurring under lower oxygenation usually were adapted to more comfortable conditions or were replaced by taxa existing in oligotrophic environments.

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Giant *Bathysiphon* - significant microfacies features of Lower Jurassic bioturbated marly limestones (Fleckenmergel/Fleckenkalk) of the Western Carpathians

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Lower Jurassic hemipelagic marls, marly limestones and silicified limestones are typically bioturbated, therefore are traditionally called as "spotted limestone". Original description of Lower Jurassic spotted limestone came from the North Calcareous Alps of Fleckenmergel and Allgäu formations (Gawlick et al., 2009). Lower Jurassic spotted limestones from the Western Carpathian region are included in the Janovky and/or the Sołtysia formations (Gaździcky et al., 1979; Lefeld et al., 1985). The Western Carpathians spotted limestones are characterised by assemblage of trace fossils (*Chondrites*, *Lamellaeichnus*, *Paleophycus*, *Planolites*, *Rhizocorallium*, *Taenidium*, *Teichichnus*, *Thalassinoides*, *Trichichnus*, *Zoophycos*) (Šimo and Tomašových, 2013) but the most frequented macro body fossil is presented by *Bathysiphon* agglutinated tests. Lower Jurassic *Bathysiphon* from the Fleckenmergel lithofacies of the Western Carpathians has been found in localities the Skladaná Skala Quarry, the Furkaska (Western Tatras Mts), the locality under the Havran peak (the Belianske Tatry Mts), the Bobrovec Waterfall (the Western Tatras Mts), the Kuricovci (the Strážov Mts), Priborzhavske (the Pieniny Klippen Belt, Ukraine), the Kamenná Poruba (Malá Fatra Mts) and the Trlenská Valley (Veľká Fatra Mts). Frequently occurring and macroscopic observable cross sections of *Bathysiphon* cylindrical test are comparable in size with agglutinated shells of modern and fossil polychaetes (e.g. genus *Diopatra*). Tests are easily visible on weathered surfaces and polished slabs of spotted limestones, but high frequency of occurrence are detect in thin sections. Fragmentary material of agglutinated tests in thin sections is presented by clusters of sponge spicules which are identical with structure of *Bathysiphon* test. *Bathysiphon* is the most often recognizable (on weathered rock surface) in cross sections when the dark coloured silicified test of the wall is more significant with the surrounding rocks. Tests are cylindrical in shape, in some instances are markedly flattened, they are firmly embedded in the rock and it do not weathered out. *Bathysiphon* is presented by two forms of agglutinated test: i) silicified tests which contain sponge spicules mainly and fragments of minerals in minority; ii) tests with sponge spicules which were partially or completely pyritised, but spicules and other pyritised fragments are embedded in siliciferous matrix. Pyritised sponge spicules morphology and arrangement within tests were detected and visualised by micro-computed tomography. Diameters of cross-sections attain 1.4 mm to 6.6 mm. The most frequented diameter is 3.4 mm. The widths of the test attain values from 0.2 mm to 2 mm and diameters of lumens are from 0.6 to 3.6 mm. Maximal length of the tests is estimated to about 10 cm. The longest fragment of the test in nearly longitudinal sectional achieves a measured length of 3.6 cm. This nearly longitudinal section shows that tests were gently curved as well as it is at modern and fossil genus *Bathysiphon*. Terminations of the tests have not been found. Spicules arrangement in the wall is chaotic with no sign of internal organization. Positions of the agglutinated tests are parallel to subparallel with bedding plane. Lumen of the tests are smooth, occurrences of sponge spicules inside lumens are rare. The outer surfaces of the tests contain a number of protruding sponge spicules. Statistically 60 samples with *Bathysiphon* from the Skladaná Skala Quarry and 40 samples from the Priborzhavske Quarry were evaluated. Samples from of these localities have been studied by the micro-computed tomography also. Studied agglutinated test of *Bathysiphon* are comparable on the basis of the morphology and arrangement of sponge spicules with the current major *B. major* de Folin, 1886 (Gooday, 1988). An abundant semi-epibenthic *Bathysiphon* indicates palaeoecological bottom conditions under relatively low oxygen level during sedimentation of Lower Jurassic bioturbated ("spotted") marly limestones within sedimentation area of the Zliechov Basin.

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Morphogenesis of chamber formation in globothalamean Foraminifera

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Globothalamean foraminifera (Pawlowski et al., 2013) colonized nearly all marine paleoenvironments, including benthic and planktonic habitats. Their tests are used for biostratigraphic markers and palaeoenvironmental proxies, recently further applied for monitoring studies. Globothalamean tests, like tubothalamean ones, are either agglutinated or secreted from the calcium carbonate. Molecular phylogenenetic studies show a complex polyphyletic pattern of wall composition. Both types of tests are mainly polythalamous and grow by successive additions of chambers. The clades of Globothalamea (Fig. 1A, B) and Tubothalamea (Fig. 1A, B) are primarily defined by globular and coiled tubular chamber shapes (Pawlowski et al., 2013). These important morphological characters of chambers are related to the relative distance between successive apertures. Globothalamean foraminifera tend to minimize the distance between successive apertures (Fig. 1B) that is opposite to tubothalameans (Fig. 1D).

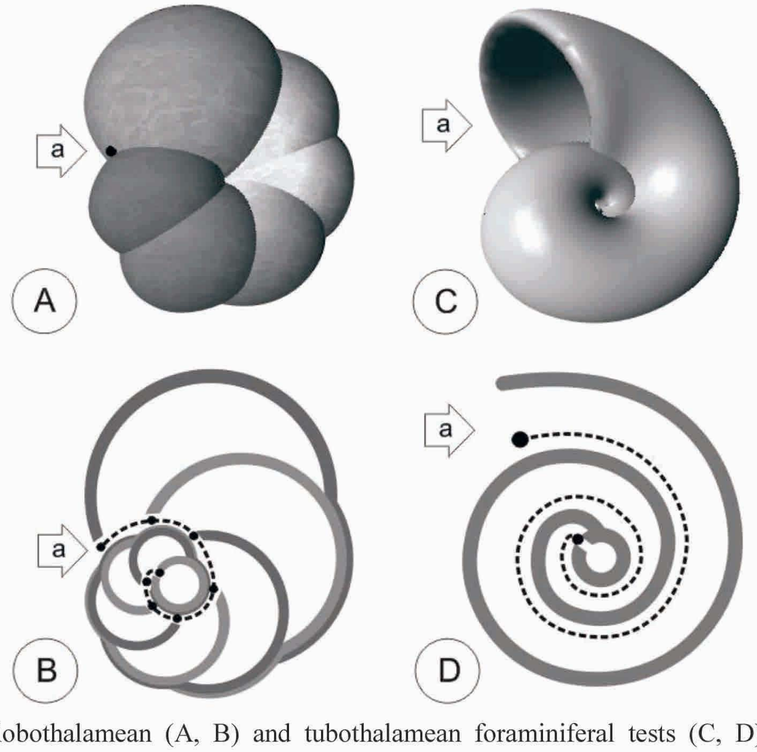

Fig. 1. Models of globothalamean (A, B) and tubothalamean foraminiferal tests (C, D). Apertures are indicated by arrows. **A**. Globothalamean test with globular chambers (simulated with eForams 1.0); **B**. Minimized distances between apertures (foramina); **C**. Tubothalamean test with tubular chambers (simulated with ShellyLibV2.3); **D**. Maximized distances between apertures and foramina.

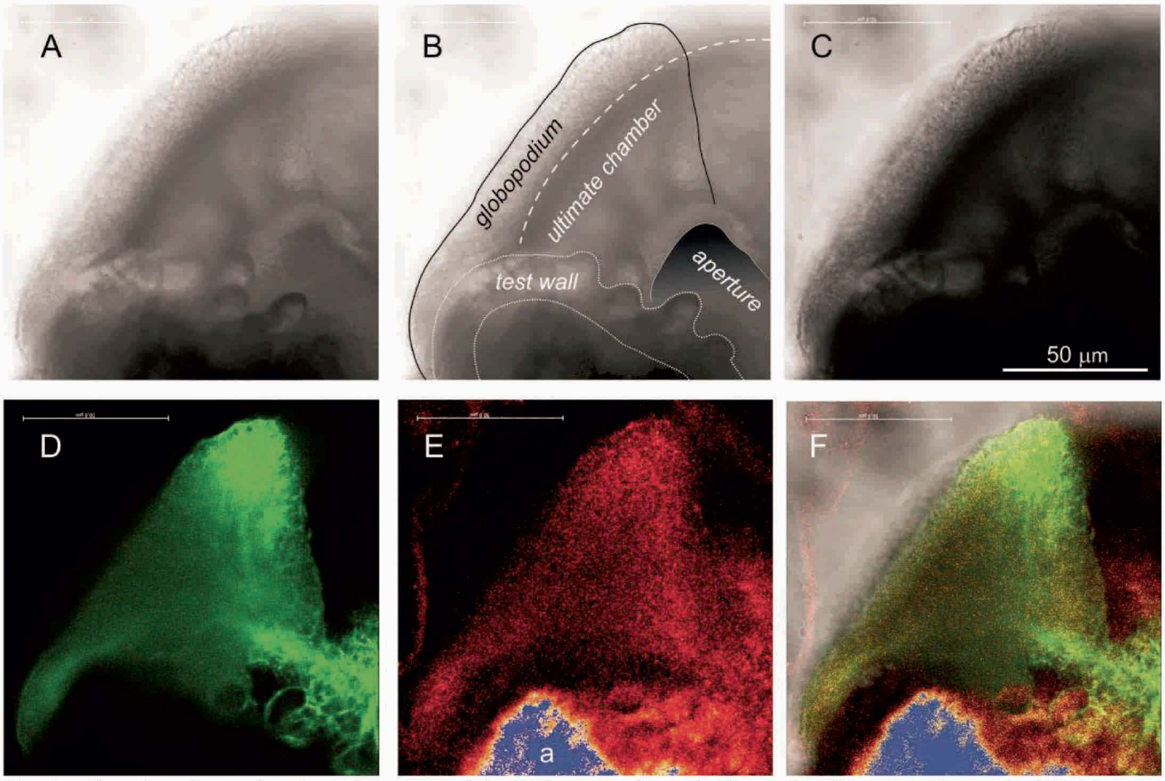

Fig. 1. Chamber formation in calcareous globothalamean foraminifer - *Amphistegina lessonii* d'Orbigny at the stage of globopodium prior biomineralization of chamber wall. **A-C**. Transmitted light (TL) photographs in different contrast values; Globopodium labelled with (**D**) Calcein AM (for intracellular Ca^{+2}); (**E**) SiR-Actin (for F-actin); (**F**) Calcein AM and SiR-Actin double-staining superimposed on TL picture; a – autofluorescence (blue) of symbiotic diatoms. All observations - Leica Confocal SP2 equipped with lasers (AWI).

The clue to understand growth of globothalamean shells is to disentangle their chamber and aperture formation processes. The most efficient methodology includes a high resolution fluorescent confocal microscopy combined with live staining protocols (Tyszka et al. 2015). We labeled intracellular Ca^{+2} level (see Ohno et al. 2016), as well as major cytoskeletal proteins (actin, tubulin) during the chamber formation (Fig. 2). The staining results show that chamber shape is predefined by a globular structure (globopodium), which acts as a dynamic organic scaffold supported by the F-actin meshwork (Fig. 2E). This meshwork seems to interact with microtubules and associated proteins, which are involved in the morphogenesis and biomineralization of skeletal structures. We predict that agglutinated globothalamean foraminifera follow a similar morphogenetic system of chamber formation.

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Agglutinated foraminifera from changing oxygen conditions in Paleocene turbidities (Outer Carpathians, Poland) – preliminary results

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The deep water environments are dependent on many different factors which change over time. This is particularly evident within the basin environments where the turbidic sedimentation is dominated. The foraminiferal assemblages, functioning in these conditions, can inhabit the bottom depending on e.g. oxygenation, the amount of nutrients or sediment supply regime.

Study area, lithostratigraphy and lithology

The turbiditic deposits sedimented in different environmental conditions prevail within the sedimentary record of the Carpathian Magura Basin (Western Tethys Ocean).The structures of foraminiferal assemblages from turbidities deposited in changing conditions of oxygenation were observed. These turbidites belong to the Paleocene Świątkowa Member (Jaworzynka Formation) from the Siary zone of the Magura Nappe. The general lithologic development represents classic sequences - the single turbidity layer starts with thin- to medium-bedded usually fine-grained sandstone part and has continuation with shales. The shaly intervals are mainly heavy grey, sometimes green. The graduation from dark grey mudstones up to the grey-greenish and at the top green mudstones is visible in parts of these intervals. TOC content in grey mudstones is from 0.73% up to 1.7%, while in green parts from 0.34%-0.55%. Several tens of samples, 0.5 kg each, were taken from shales in the Ropica village section during preliminary work.

Structures of agglutinated assemblages

Two types of assemblages were estimated: first was represented only by not numerous, partly pyritized tubular forms from grey deposits and second was represented by numerous diversified but primitive agglutinated foraminifera form green shales. The clear correlation between the TOC content and numbers and diversity of foraminifera was observed. The gradually decreasing amount of foraminifera, from about 2100 to 1200 specimens per sample is observed within green shales containing TOC in 0.34%-0.55% range. Dynamic microfauna number decrease (up to about 200 crashed specimens per sample) is associated with 0.55% - 0.73% TOC content. Therefore, oxygen conditions changed cyclically from anoxic to suboxic conditions during every deposition of turbidity layer of Świątkowa Member. The oxygenation factor is critical and controls the development of foraminifera at the bottom in those environments. Within the anoxic deposits, only *Bathysiphon* and *Nothia* are present - forms known for very wide ecological tolerance. Next, assemblages are more complicated in taxonomy structure and contain rare *Psammosiphonella* and *Rhabdammina*, *Recurvoides* and *Palcentammina* forms, subsequently *Paratrochamminoides*, *Ammodiscus,* Subreophax and *Reophax* appear. Finally, 18-23 genera were recognized in green uppermost parts of turbidites, which corresponds with suboxic conditions. Together with higher diversity the general decrease of average of tubular form is observed.

Assemblages from green shales

The most numerous and taxonomically varied agglutinated foraminifera are present in the upper parts of turbidities. The epifaunal forms prevail in amount 85-90% and one third to one fourth of those belong to the mobile epifauna. The primitive, mostly coarse grained forms prevail. Beside taxa listed above, *Ammodiscus*, *Glomospira*, *Saccammina*, *Ammosphaeroidina*, *Caudammina* and *Haplophragmmoides* are common in assemblages. The relatively high number of Saccamminnacea represented by *Saccammina grzybowski* (Schubert) and *Palcentammina palcenta* (Grzybowski) was noticed. They quota reaches about 10% of all specimens in samples. The occurrence of the "big-sized" foraminiferal test, bigger than typical in the Carpathian flysch constitutes the special feature of these assemblages.

The shaly intervals record step by step the cyclic recolonization process with the improving oxygen condition. The authors are planning detail sampling of single turbidity layers of Świątkowa Member in order to observe the paleontological record of this process in relation to oxygenation changes within the sediments.

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Taxonomical status and variability in *"Ammodiscus" latus* Grzybowski, 1898

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Ammodiscus latus Grzybowski, 1898 is a cosmopolitan form, commonly recorded from mid-Paleogene deposits. In the External Carpathians, it is widely known as one of the most important stratigraphical index species for the upper Eocene. The species was first described by Grzybowski (1898) in one of the first micropaleontological monographs from the Carpathian region.

Ammodiscus latus Grzybowski is an agglutinated form, consisting of a globular proloculus and a long tubular planispirally coiled second chamber. It possesses a simple aperture at the end of the youngest part of the coiled chamber. Its test wall is thick, and made of fine to medium grained clastic material – as a result, the surface of the test is somewhat rough. It is often translucent. The number of whorls varies from 2.5 to 4.5 whorls. In its final growth stage, it displays a tendency to uncoil and form a rectilinear portion. The initial part of the test is coiled in a glomospiral manner, in which the initial coil is inclined at an angle to the planispiral subsequent coils, which are evolute.

Among the specimens of *Ammodiscus latus* we observe variation in the overall outline of the test. We distinguish two forms: the first form has a circular outline and is referred to *Ammodiscus latus*. The second form is oval in outline, and we place this form in *Ammodiscus latus* forma *ovoidalis*. In the younger portion of the coiled chamber we observe subtle deformations of the tubular second chamber. These are coincident with constrictions of the chamber lumen. These subtle constrictions partially subdivide the chamber into long pseudochambers. At the place where the chamber is deformed, the chamber wall is thickened, and this arrangement is the cause for the asymmetrical oval shape of the test. The occurrence of internal structures that result in pseudochambers in the younger portion of the test means that *Ammodiscus latus* forma *ovoidalis* is transitional to the species described by Grzybowski (1898) as *Ammodiscus septatus*, which was transferred to the genus *Trochamminoides* by Kaminski & Geroch (1993).

The mode of coiling in *Ammodiscus latus* changes during ontogeny. The initial whorl is inclined at an angle to the latter planispiral portion of the test. Such a coiling mode is incompatible with the definition of *Ammodiscus* Reuss, 1862, in which the second chamber is wholly planispiral. A review of the semi-planispiral forms (those in which a part of the test is not coiled planispirally), reveals a number of taxa with comparable modes of coiling. These are: *Glomospirella* (*sensu* Plummer, 1945), in which the initial part of the second chamber is coiled streprospirally, *Annectina* Suleymanov, 1963, in which the initial part is coiled in a triloculine manner and the test tends to be oval in outline; *Dolgenia* (*sensu* Kemper, 1995) which possesses a planispirally coiled initial part that then becomes irregular and eventually uncoils. *Rectoammodiscus* (*sensu* Reitlinger, in: Vdovenko et al., 1993) is initially planispiral and then uncoils and becomes rectilinear; *Spirillinoides* (*sensu* Rhumbler, 1938) has a proteinaceous tubular chamber that is either planispiral or slightly trochospiral. The generic assignment of the species *"Ammodiscus latus"* Grzybowski is problematical, and a revision of the Ammodiscidae would be therefore needed in order to accommodate the species.

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Record of living (stained) *Marsipella elongata* Norman, 1878 in Campos Basin, southeastern Brazilian continental margin

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The study material consists of sediment samples collected at 53 oceanographic stations, located between 400 m and 3000 m of water depth in Campos Basin (Southeast Brazilian Continental Margin (Fig. 1). This study compiles the presence of living specimens of *Marsipella elongata* Norman, 1878, in the upper 0-2 cm of bottom sediments describing its occurrence for the first time in Campos Basin.

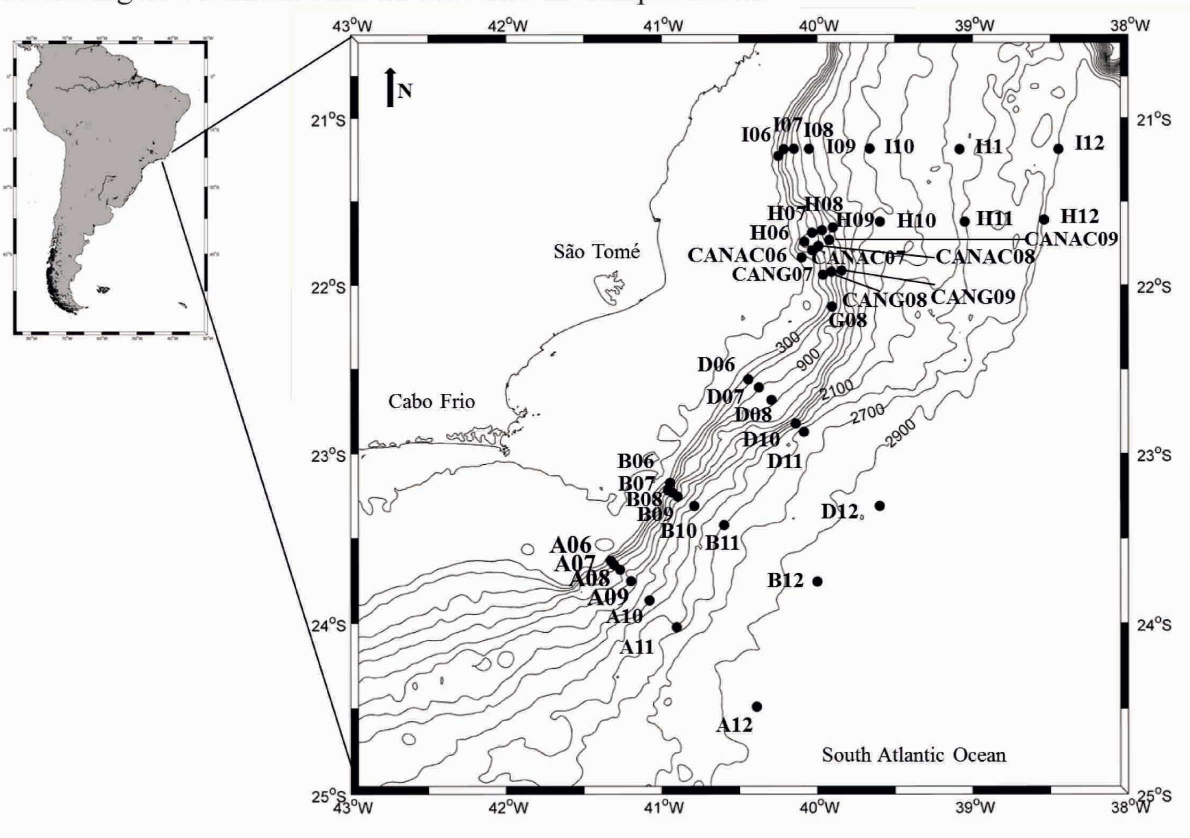

Fig. 1. Location of Campos Basin and sampling sites. Datum SAD69.

The living (stained) specimens identified were recorded in 26 of 53 stations in Campos Basin. *Marsipella elongata* is observed in canyons (Almirante Câmara and Grussaí) and open slope mainly in upper-middle slope, between 400 and 1300 m depth and became infrequent in deeper regions. In deeper stations, it was identified only in the station I10 located at 1900 m depth, in the northern region of the study area and at the station A12 located at 3000 m in the southern region of the basin.

The most labile organic matter availability in the sediment was found in the depth range between 400 m and 1300 m (Yamashita, 2015). However Yamashita (2015) observed a correlation between the density of *M. elongata* and bacteria biomass, but not with total organic carbon, total nitrogen content, lipid biomarkers (fatty acids, sterols and alcohols) in the sediments, and the vertical flux of particulate organic matter. These results suggest that *M. elongata feed on bacteria.*

Marsipella elongata was also observed in areas under Brasil Current (BC), Intermediate Western Boundary Current (IWBC) and the Deep Western Boundary Current (DWBC) in the study area (Silveira et al., 2000). The BC occurs from the surface down to intermediate waters and flows south-southwestward, reaching speeds up to 0.8 $m.s^{-1}$. The IWBC occurs from 500 m to 1200 m depth, and is centered at 800 m depth, exceeding 0.3 $m.s^{-1}$ (Silveira et al., 2004; Silveira et al., 2015). Below 2000 m depth, the DWBC flows south-southwestward, but the interaction of the western boundary current system (BC and IWBC) with DWBC is reduced in the study area, due to its shift towards offshore, as a result from the presence of the São Paulo plateau (Silveira et al., 2015). Therefore, *M. elongata* occurs under current speeds of approximately 0.3-0.8 $m.s^{-1}$ in Campos Basin, resembling what was observed by Thomsen (1999), in an experiment with sediments from the Iberian continental margin at 1645 and 3098 m water depth underneath the main path of the Gulf Stream (mean velocity of 1.12 $m.s^{-1}$).

Based on the results of this work, we can conclude that: *M. elongata* in the southeastern Brazilian continental margin can be used as indicator of high bottom current speeds (0.3-0.8 $m.s^{-1}$) and; this species seems to use be bacteria in its feeding.

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Agglutinated foraminifera from Miocene-Pleistocene section of the Rio Grande Rise (drill-hole L2P3), South Atlantic

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The Rio Grande Rise (RGR) is the most prominent bathymetric feature of the South American plate, located in the Southwestern Atlantic Ocean. The RGR separates Brazil Basin, to the north, from Argentine Basin, and is composed of two areas characterized by distinct morphologies, which are separated by an abyssal plain (Gamboa & Rabinowitz, 1984). The eastern portion of the RGR is parallel to the Mid-Atlantic Ridge and seems to represent an abandoned spreading center. The western portion of the Rio Grande Rise constitutes a broad plateau with mean depth of 2,000mbsf, which is topped by numerous guyots and seamounts (Gamboa & Rabinowitz, 1984). The northern flank of the RGR is cut up by a system of erosional canyons with hundreds meters deep (Berggren, 1977).

Although four DSDP sites were drilled at RGR (Maxwell *et al.*, 1970, Supko, *et al.*, 1977; Barker *et al.*, 1981), only site 516, in the western portion of the RGR, cored a continuous section of carbonates and reached the basaltic basement. An almost continuous sedimentary record spanning Coniacian-Santonian to Pliocene was recovered from site 516 (Tjalsma, 1983).

Scarce information is available so far on the eastern portion of the RGR, where drilling was not performed by the date. In this context, the drill-hole L2P3 (30° 53.12' S / 34° 08.25' W) was carried during the PROERG cruise, led by the Geological Survey of Brazil (CPRM), at a water depth of 919 m, recovering 42.63m of sediments. It represents an exceptional opportunity to study the microfauna of deep-sea foraminifera of the South Atlantic. The present work is an initial approach to the agglutinated foraminiferal fauna from the drill-hole L2P3. The analyzed section recovered a succession of calcareous ooze rich in planktonic foraminifera, with a subordinated fauna of benthic foraminifera and ostracods. A total of 84 samples were collected. The samples were washed on a 63μm sieve and, subsequently, benthic foraminifera were picked from the 150 μm sieve.

Based on the evaluation of the planktonic foraminifera assemblage, it was possible to infer that the section under analysis represents a record deposited between the upper Miocene and Pleistocene. The top of the Miocene section is marked by the highest occurrence of *Globorotalia merotumida*, while the top of the section is characterized by an association typical of a late Pleistocene age. The boundary Miocene/Pliocene was established at the highest occurrence of *Globoquadrina dehiscens*.

The benthic foraminifera association varies in abundance and preservation throughout the section, with levels of pervasive dissolution and fragmentation. Agglutinated foraminifera occur with variable abundances, being absent in some levels.

Foramiferal tests were classified into morphogroups according to the classification of Valchev (2006). The agglutinated foraminifera assemblage is composed mainly by tapered/cylindrical (T/C) and the flattened tapered (FT) morphogroups. Robust tests are concentrated in the upper portion of the studied section while in the base predominates smaller forms. Agglutinated foraminifera recovered belong to the genera *Eggerella, Gaudryina*, *Karreriella, Magnesoina, Siphotextularia* and *Spiroplectinella*.

Further studies focusing diversity and quantitative distribution of morphotypes can provide information not only on deep-sea agglutinated foraminifera microfauna of South Atlantic but also can provide unique approach to the paleoenviromental/paleoceanographic setting, such as oxygenation conditions or other environmental factors across upper Miocene-Pleistocene of the Rio Grande Rise.

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New foraminifers described by O. Samuel from West Carpathians of Slovakia. In memory of RNDr. Ondrej Samuel, DrSc. (*10. 2. 1931 - † 20. 12. 2002)

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From the Paleogene flysch formations in West Carpathians of Slovakia has by O. Samuel (1977) 4 new agglutinated foraminifers described: *Bathysiphon microrhaphidus*, *Glomospirella biedai* (synonym of the species *Annectina biedai* Gradstein & Kaminski, 1997)*, Hyperammina rara* and *Reophax pseudoscalaria*.

Dr. O. Samuel described 74 new animal and 3 vegetal taxons in Triassic, Cretaceous and Paleogene sediments of Western Carpathians. From this amount, he is the author of 17 taxons, the rest is in co-authorship with Borza, Salaj, Köhler and Snopková.

As far as foraminifera, it concerns species and subspecies: *Agathammina multispira* Salaj - Borza - Samuel, 1983; *Agathammina parafusiformis* Salaj - Borza - Samuel, 1983; *Ammobaculites alveolatus* Salaj - Borza - Samuel, 1983; *Ammobaculites hoheneggeri* Salaj - Borza - Samuel, 1983; *Amphorella bicamerata bicamerata* Borza - Samuel, 1977; *Amphorella bicamerata intermedia* Borza - Samuel, 1977; *Amphorella bicamerata minuta* Borza - Samuel, 1977; *Amphorella bilongicamerata bilongicamerata* Borza - Samuel, 1977; *Amphorella lageniformis* Borza - Samuel, 1977; *Amphorella subsphaerica* Borza - Samuel, 1977; *Angulodiscus glomospirelloides* Salaj - Borza - Samuel, 1983; *Arenobulimina gerochi* Samuel - Salaj, 1962; *Arenoturrispirillina concavata* Samuel - Salaj, 1962; *Austrocolomia primitiva* Salaj - Borza - Samuel, 1983; *Bispiranella ovata* Samuel - Borza, 1981; *Bispiranella subcarinata* Samuel - Salaj - Borza, 1981; *Bathysiphon microrhaphidus* Samuel, 1977; *Discorbis ornatus* Samuel, 1962; *Endothyra elegans* Salaj - Borza - Samuel, 1983; *Fissurina carpathica* Samuel, 1975; *Glabratella hronica* Samuel, 1975; *Globigerina baconica* Samuel, 1972; *Globigerina bolivariana pannonica* Samuel, 1972; *Globigerina linaperta transdanubica* Samuel, 1972; *Globigerinatheca globosa* Samuel, 1981; *Globorotalia hungarica* Samuel, 1972; *Globorotalia irregularis* Samuel, 1981; *Globorotalia pseudospinulosa* Samuel, 1972; *Globotruncana biconvexa biconvexa* Samuel - Salaj, 1962; *Globotruncana biconvexa gigantea* Samuel - Salaj, 1962; *Globotruncana turonica* Samuel - Salaj, 1962; *Glomospirella biedai* Samuel, 1977; *Gyroidinella carpathica* Samuel - Köhler, 1979; *Haddonia praeheissigi* Samuel - Köhler - Borza, 1977; *Hyperammina rara* Samuel, 1977; *Labyrinthina falsomirabilis* Salaj - Borza - Samuel, 1983; *Lituotuba carpathica* Salaj - Borza - Samuel, 1983; *Miliola andrusovi* Samuel - Köhler - Borza, 1977; *Multiseptida arcata* Salaj - Borza - Samuel, 1983; *Multiseptida elongata* Salaj - Borza - Samuel, 1983; *Nodobacularia cylindriformis* Salaj - Borza - Samuel, 1983; *Nodosaria trifonovae Salaj* - Borza - Samuel, 1983; *Ophthalmipora falsoexiguum* Salaj - Borza - Samuel, 1983; *Paraophthalmidium carpaticum* Samuel - Borza, 1981; *Paratintinnina tintiniformis* Borza - Samuel, 1977; *Paratintinnina tulipaformis* Borza - Samuel, 1977; *Permodiscus praecommunis* Salaj - Borza - Samuel, 1983; *Permodiscus praeimpressus* Salaj - Borza - Samuel, 1983; *Permodiscus praetenuis* Salaj - Borza - Samuel, 1983; *Pilamminella falsofriedli* Salaj - Borza - Samuel, 1983; *Planiinvoluta irregularis* Salaj - Borza - Samuel, 1983; *Planiinvoluta regularis* Salaj - Borza - Samuel, 1983; *Pseudocucurbita campanulaformis* Borza - Samuel, 1978; *Pseudocucurbita fusani* Borza - Samuel, 1978; *Pseudocucurbita globosa* Borza - Samuel, 1978; *Pseudocucurbita subglobosa* Borza - Samuel, 1978; *Pseudonodosaria gemerica*

Salaj - Borza - Samuel, 1983; *Pseudonodosaria gombaseki* Salaj - Borza - Samuel, 1983; *Rakusia ploechingeri* Salaj - Borza - Samuel, 1983; *Reophax pseudoscalaria* Samuel, 1977; *Rotalipora bicarinata* Samuel - Salaj, 1962; *Sigmoilina excentrica* Salaj - Borza - Samuel, 1983; *Sigmoilina multicarinata* Salaj - Borza - Samuel, 1983; *Spiriamphorella carpathica carpathica* Borza - Samuel, 1977; *Spiriamphorella carpathica gemerica* Borza - Samuel, 1977; *Spiriamphorella irregularis* Borza - Samuel, 1977; *Spiriamphorella ovata* Borza - Samuel, 1977; *Spiriamphorella rectilineata districta* Borza - Samuel, 1977; *Spiriamphorella rectilineata rectilineata* Borza - Samuel, 1977; *Spiroplectammina spiralis* Salaj - Borza - Samuel, 1983; *Turborotalia* (*Acarinina*) *alteconica* Samuel, 1972; *Turborotalia* (*Acarinina*) *istropolitana* Samuel, 1972; *Turborotalia* (*Acarinina*) *vicespinuloinflata* Samuel, 1972; *Urnulinella andrusovi* Borza - Samuel, 1977; and vegetal taxons: *Pentagonium obidum* Snopková - Samuel, 1982; *Pleurozonaria fusani* Snopková - Samuel, 1981 and *Pleurozonaria kedvesi* Snopková - Samuel, 1981.

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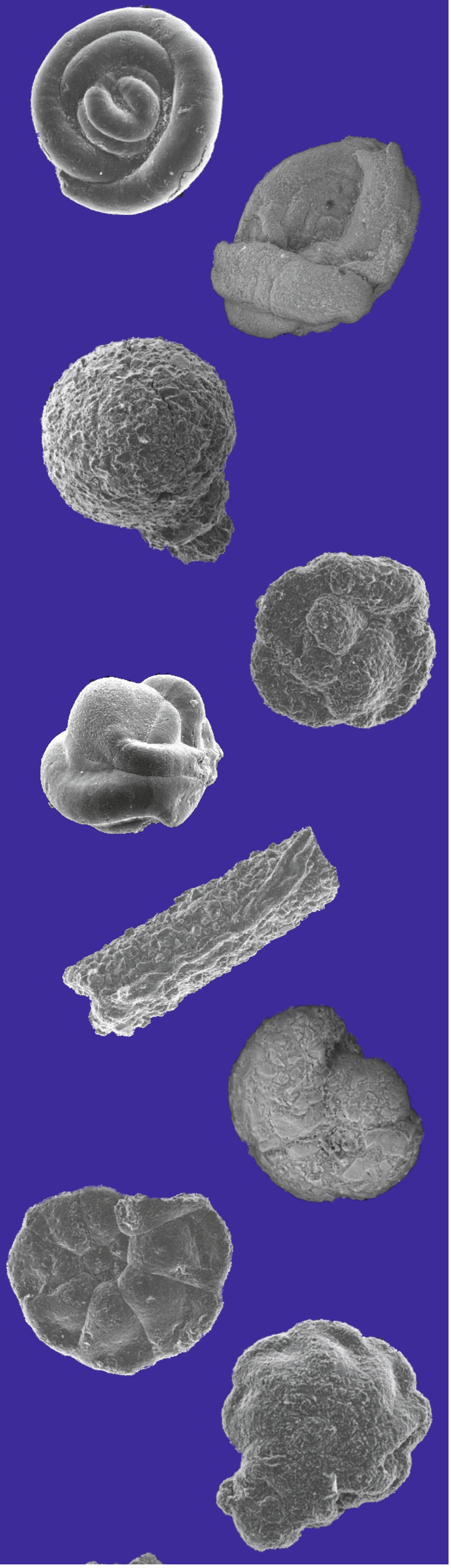
Register of authors

Notes



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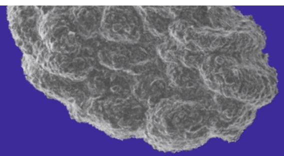

Tenth International Workshop on Agglutinated Foraminifera

Smolenice Castle, Slovakia, April 19–23, 2017

The Tenth International Workshop on Agglutinated Foraminifera was organised by the Slovak Academy of Sciences and the Grzybowski Foundation. The IWAF in Smolenice was the tenth meeting in this series and followed previous meetings held in Amsterdam (1981), Vienna (1986), Tübingen (1989), Kraków (1993), Plymouth (1997), Prague (2001), Urbino (2005), Cluj-Napoca (2008) and Zaragoza (2012).

This volume includes collection of abstracts summarizing the contributions presented at the meeting, which was held at the Congress Centre of the Slovak Academy of Sciences at Smolenice Castle in April, 2017.