17TH CZECH - SLOVAK - POLISH PALAEONTOLOGICAL CONFERENCE
KRAKÓW 2016

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Cover design by: Monika Cyrklewicz

Layout & typesetting: Brygida Grodzicka, Ewelina Leśniak

Editorial Office: Polish Geological Institute – National Research Institute,
4, Rakowiecka St., 00-975 Warsaw, Poland

Print: ERGO BTL Sp. z o.o., sp. kom., 4, Szkoły Orląt St., 03-984 Warsaw, Poland
Circulation: 150 copies

ISBN 978-83-7863-666-3

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PREFACE

The Czech-Slovak-Polish Palaeontological Conference is an annual meeting for presentation and discussion of research conducted by palaeontologists dealing with a variety of fossils of various age. All aspects of palaeontology and interdisciplinary studies based on traditional and innovated methods are presented on this scientific forum. Presented results are mainly based on present studies, but also on archival data and museum collections and they document wide range of topics including taxonomy, biostratigraphy, palaeoecology, palaeoclimate, and also palaeogeogeography. They are of great importance not only for scientific issues but also for practical use in various industries and environmental protection.

Tradition of the Palaeontological Conference has started originally as a platform for scientific exchange within Czech, Slovak and Polish palaeontological communities but it is held every year with interest of researches from the Middle-East European region. This meeting supports the development of palaeontological research in the region by maintaining contacts between different scientific centers including universities and research institutes, as well as industry units.

Every next conference takes place in one of three founder countries. In 2016 has come back to Kraków but for the first time takes place in the Carpathian Branch of the Polish Geological Institute – National Research Institute. This institution as the State Geological Survey and research agency has an influence on development of the regional geology. It is a successor of the first geological field station of the Polish Geological Institute, which was established in 1919 in Borislav (presently Ukraine) to recognize the geological structure of the Carpathians for oil exploration. After the 2nd World War these tasks were took over by the Carpathian Branch in Kraków.

The first Director of the Carpathian Branch (1954–1960) was Professor Marian Książkiewicz who became its patron. As a cartographer and a student teacher at various scientific centers in Kraków he paid close attention to the usefulness of palaeontological data for determining age and conditions of the formation of the Carpathian rocks. His activities led to creation of the post-war Polish Geological School. The interdisciplinary studies including various aspects of palaeontology, which were initiated by him in the Carpathian Branch are carried out along with geological mapping today.

In 2016 we celebrate the 110th anniversary of Professor Książkiewicz birth (1906–1981) and on this occasion we want to recall many palaeontologists (see this Abstract Volume) who worked with him and continued multidisciplinary research after his leaving the Branch. Some of them, for instance Professor Barbara Olszewska – eminent and still scientifically active Carpathian micropalaeontologist worked at the Carpathian Branch in the years 1961–2011 celebrates 55th anniversary of her scientific career in this year.

We wish to thank all the members of the Organizing Committee as well as everyone who made this meeting possible. We are also grateful to the Polish Geological Institute – National Research Institute for financial support.

We hope that this conference will offer good opportunities for interesting discussions and presentations of new ideas and it will be an occasion to intensify cooperation.

On behalf of the Organizing Committee
Andrzej Szydło

MARIAN KSIĄŻKIEWICZ AND HIS CONTRIBUTION TO THE CARPATHIAN MICROPALAEONTOLOGY

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Professor Marian Książkiewicz (1906–1981) was the most outstanding, internationally recognized, Polish geologist of the 20th century. His life, academic career and scientific achievements are well known due to his numerous publications and several memoirs dedicated to him (see: Morycowa & Ślączka, 2007; Alexandrowicz, 2008). However, it seems appropriate to recall some facts from his rich biography and underline his merits and contribution to the development of the Carpathian micropalaeontology.

Marian Książkiewicz was a student and junior assistant when the Geological Cabinet of the Jagiellonian University was led by Professor W. Szajnocha. Then, in the years 1929–1939 when Professor J. Nowak chaired the Geological Department, M. Książkiewicz received a doctor's degree in 1929, followed by his habilitation in 1933 and the position of an associate professor in 1935. When the II World War began he was in Mozambique, where he was sent by the Polish Government to conduct research on mineral resources. With the Polish Army he was evacuated to England via France where during the war he continued his professional activity. In 1945 he returned to Poland and to the Jagiellonian University, and in 1946 was nominated an ordinary professor and the head of the Geological Department. In 1951 due to a political decision, departments of geosciences of the Jagiellonian University were moved to the Academy of Mining and Metallurgy. After six years Professor M. Książkiewicz returned to his post at the Jagiellonian University. In the years 1954–1960 he was also chief of the Carpathian Branch of the Polish Geological Institute and from 1970 to 1973 he was head of the Institute of Geological Sciences of the Polish Academy of Sciences.

Professor M. Książkiewicz was an excellent teacher gathering a great number of students during his lectures. However, when the geological studies were reactivated at the Jagiellonian University in 1975 he did not continue his lecturing. His handbook on "Dynamic geology", first published in 1947, reached six issues and is still valid and used by successive generations of students.

It has been commonly acknowledged that Professor M. Książkiewicz established the famous Polish school of the Carpathian geology. His main scientific activity was focused on various aspects of geology of the Carpathians since his university education. The results of his geological mapping, studies on sedimentation of flysch deposits, palaeogeography, geodynamics, tectonics, litho- and biostratigraphy and palaeontology were presented in hundreds of publications and unpublished papers. As a mapping geologist he highly appreciated and evaluated necessity and importance of microfauna as the basic and sometimes the only tool in biostratigraphy. Professor M. Książkiewicz was aware of the results of the pioneering works performed by Józef Grzybowski (1869–1922) and during his lectures he always mentioned him as "the father of applied micropalaeontology". His assistants at the Department of Geology of the Jagiellonian University were working on the Carpathian agglutinated foraminiferids (S. Geroch), calcareous nannoplankton (A. Radomski) and on corals microfacies (E. Morycowa). During his management of the Carpathian Branch of the Polish Geological Institute the micropalaeontological studies were performed by J. Blaicher, J. Liszkowa and J. Morgiel on foraminiferids and by W. Nowak on calcareous dinocysts. He always encouraged younger geologists to study various

Photo from the collection of Elżbieta Morycowa groups of microfossils apart from their main geological interests and tasks.

His personal studies on foraminiferal assemblages and their differences let him distinguish three complexes of variegated marls in the Flysch Carpathians as well as identify and illustrate some of the Cretaceous index planktonic foraminifera (Książkiewicz, 1950). In his extensive publication, presenting Jurassic and Cretaceous of Bachowice he described 20 species of the Cretaceous planktonic foraminifera (*Globotruncana* s.l.), illustrated in the form of his perfect hand drawings (Książkiewicz, 1956). With deep knowledge and understanding of professional micropalaeontologist he used foraminifera in his considerations on the life conditions and bathymetry of the Carpathian Flysch basins (Książkiewicz, 1961, 1975). He is the author or co-author of great number of publications concerning biostratigraphy of the flysch successions based on foraminifera. One of the most important and still being in use is the publication prepared on the occasion of the Xth European Micropaleontological Colloquium hold in Poland in 1967 (Geroch *et al.*, 1967). This short overview seems to be sufficient proof of Professor M. Książkiewicz significant contribution to the development of the Carpathian micropalaeontology.

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PALAEONTOLOGICAL INVESTIGATIONS IN THE CARPATHIAN BRANCH (PGI-NRI) – HISTORICAL OVERVIEW

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Polish Geological Institute (PGI) was established in 1919. At the beginning it had two geological stations among which that situated in Borysław (presently Ukraine) has become the ancestor of the Carpathian Branch. The aims of the intensive works were recognition the geological structure of the Eastern Carpathians and Carpathian Foredeep. In cooperation with the oil industry exploratory drilling for hydrocarbons were supervised. In 1921 the geological station in Borysław was taken over by the oil industry and the geological investigations in the Carpathians were, into the 1940, carried out by Warsaw as a part of the Carpathian Regional Group. In April 1940 the occupation forces incorporated the Institute into the *Amt für Bodenforschung* with the central office in Kraków where after the liberation due to the war damage in Warsaw, the Institute starts its activity. In this place the idea of reactivation of the Carpathian Regional Station, renamed for the Carpathian Branch was born. Presently the Branch is one of the seven regional units included into the Polish Geological Institute – National Research Institute (PGI-NRI).

Since its founding the Carpathian Branch concentrated mainly on geological cartography that was supported by the stratigraphic and palaeontological investigations (Bieda *et al.*, 1963). The Stratigraphic Laboratory in the Carpathian Branch was supervised firstly by J. Syniewska, then successively by J. Liszkowa, R. Zając and J. Morgiel. The last head of the Laboratory was B. Olszewska. The palaeontological investigations were originally based mainly on foraminifers and then the other groups of fossils were studied. The fossils which were collected during the cartographic investigation and deep boreholes studies became the basis of many synthetic palaeontological studies. Among the authors was J. Morgiel, which analyzed the Cretaceous and Paleogene foraminifers of the Silesian, Skole, Subsilesian and Magura units and also Pieniny Klippen Belt (1959, 1969). In 1981, Morgiel and Olszewska published the biostratigraphical scheme of the Polish part of the Carpathians based on agglutinated foraminifera. In 1982 these micropalaeontogists published the correlation of the foraminiferal assemblages of the Moroccan Rif and Polish Carpathians. J. Liszkowa elaborated the Paleogene foraminifers of the Subsilesian and klippen successions (Liszkowa & Nowak, 1960, 1964; Liszkowa, 1967, 1972; Liszkowa & Morgiel, 1985). Blaicher studied the foraminifers of the Magura, Skole (Niebylec Shales, Globigerina Marls) and Dukla units (Blaicher, 1961, 1970; Blaicher & Ślączka, 1962). The foraminifera of the Magura Unit were inspected also by E. Malata (1981) and E. Malata & N. Oszczypko (1981). The mainly Cretaceous foraminifers of the Pieniny Klippen Belt were analysed by M.A. Gasiński (1983, 1984). The Paleogene large-foraminifera, of which an outstanding researcher was F. Bieda, were also object of interest of A. Kulka (1984, 1985).

For a short time S.W. Alexandrowicz was associated with the Carpathian Branch. He compiled stratigraphy of the Upper Cretaceous and Miocene deposits of the Kraków region (1958). Based on the foraminiferal assemblages he divided the Miocene sediments of the Upper Silesia Basin (1963). The Miocene foraminifera of the Foredeep were studied also by W. Porębska-Szotowa, and J. Strzępka. Miocene biofacies and molluscs fauna from this region were examined by J. Urbaniak (1963, 1985, 1986).

Among the stratigraphers was W.A. Nowak – researcher with wide range of interests, which was tied with the Carpathian Branch till his death in 1987. He was the first, to describe the Eocene planktonic foraminiferal species *Hantkenina* in marly sediments of the Polish Carpathians, (Nowak, 1954). Together with S. Geroch (Geroch & Nowak, 1986) he presented the biostratigraphic scheme for the flysch Carpathians based on agglutinated foraminifera (Tithonian–Eocene). He also started the investigations of calpionellids and calcareous dinoflagellate in Polish Flysch Carpathians. The results of these studies were included in many papers including the monograph about stomiosphaerids of the Cieszyn Beds (Nowak, 1968). Based on calpionellids he designated the new zone "*Semichitinoidella–Praetintinnopsella*" in the lowest Tithonian (Nowak, 1978). Based on these microfossils Nowak attempted to determine the Jurassic/Cretaceous boundary in the Polish Carpathians. The results of the many years of researches were of the Ciliata group have been presented in Atlas Guide Fossils (1980, 1984). In 70-ties of the 20th century the Late Jurassic stomiosphaerids of the Carpathian basement were studied by I. Garlicka (1974, 1976). Nowak's scientific interests concerned also the trace fossils, diatoms and calcareous nannofossils. He is mentioned as a pioneer of study of the Carpathian stratigraphy based on planktonic foraminifers and calcareous nannoplankton. The calcareous nannoplankton investigations were carried on in the Carpathian Branch by M. Smagowicz until she retired in 1995. She described in the Paleogene deposits of the Dukla Unit the nannoplankton zones which were correlated with foraminiferal zones by Olszewska (Olszewska & Smagowicz, 1977). Basing on drilled material she dated the flysch sediments of the Podhale Basin (Smagowicz, *in*: Chowaniec *et al.*, 1990; Poprawa *et al.*, 1992).

Since the 1961 the wide range of the palaeontological studies mainly based on foraminifers, calpionellids and calcareous dinoflagellate also was led in the Carpathian Branch by B. Olszewska. She is still scientifically active and authored many publications (1982, 1983, 1984a–c, 1985, 1997, 1999, 2001, 2004, 2005a, b, 2014; Olszewska *et al.*, 2008, 2012).

The important stratigraphical data for the recognition of the structure of the Carpathians and their basement contributed also the studies of A. Tomaś (1975, 1977) and R. Zając (1981). The Carboniferous megaspores were elaborated by M. Brzozowska (1968) and Paleozoic and Mesozoic microfacies of the carbonate rocks were worked out by J. Golonka (1978) and J. Golonka & W. Sikora (1981).

On the occasion of the field works many mapping geologists showed interests in palaeontological problems. We need to mention the first director of the Carpathian Branch – M. Książkiewicz (1950, 1956, 1961, 1975) who used the fossils to determine the age and depositional environment of the Carpathians deposits. Based on the ammonites F. Szymakowska (1965, 1981) worked out unique at that time stratigraphy of the Lower Cretaceous sediments of the Polish Carpathians. The other Carpathian geologist A. Ślączka, which worked in the Carpathian Branch (1954–1977), documented and described the fossil imprints of the jellyfish-like organisms (1964, 1971).

Despite current organizational changes in the PGI-NRI the palaeontological studies in the Carpathian Branch are continued. Apart from the statutory activities within the geological mapping and regularly carried expertises for geohazards and hydrogeology the investigations in the field of taxonomy, biostratigraphy, palaeoenvironment, palaeogeography and palaeoclimate are conducted. They are based mainly on foraminifers and calcareous nannoplankton (Jurassic-Miocene), pollen and spores (Quaternary), and recently on brachiopods, molluscs and crustaceans (Paleozoic, Mesozoic).

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FORAMINIFERAL ASSEMBLAGE FROM THE CRETACEOUS BASAL PHOSPHORITE LAYER OF PODILLYA (WESTERN UKRAINE)

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The basal phosphorite layer lies at the base of the Cretaceous sequence on Podillya and is distributed locally (Melnytsya-Podilska district of Ternopil region) (Bakayeva & Tuzyak, 2015). It have been found various macro- and microfossils in it. Macrofossils have been studied previously and descriptions of some taxa have been published (*e.g.*, gastropods (Bakaeva, 2004, 2011), bivalves (Pasternak *et al.*, 1968)). Microfossils have not been described – only species list was published (Rozumeyko, 1988). However foraminifers in this layer are numerous and diverse. There are also fossils of problematic systematic position because of their poor preservation.

By the preservation investigated foraminiferal remains can be divided into phosphatized (dark brown – strong phosphatization, light brown – medium phosphatization and beige – weak phosphatization) and not phosphatized (transparent and translucent rounded casts of agglutinated and secreted calcium carbonate forms). Among phosphatized forms benthic foraminifers are dominated – there are forms with saved morphological elements (test sculpture and apertura) or without sculpture with preserved aperture only. Plankton is rare (single brown forms of poor preservation). This fossils are of different sizes (from small to large) and are composed of the representatives of *Lagena*, *Nodosaria*, *Patellina* (0.16–0.38 mm) and *Arenobulimina*, *Pseudonodosaria* (0.61–0.68 mm), that occur in the Upper Albian deposits of other regions (Dnipro-Donetsk basin, Poland, Germany, England). Also it has been found rare small dark brown strongly rounded samples, that indicate stronger degree of phosphatization and prove their redeposition from the older deposits (probably Valanginian–Barremian or Aptian).

Transparent and translucent large foraminifers (>1 mm) had been saved much worse and almost cannot be determined. Among them are representatives of agglutinated (*Haplophragmoides*) and secreted calcium carbonate forms (benthic: *Lenticulina*, *Gyroidinoides*, *Cibicides*, *Gavelinella etc.*, plankton: ?*Hedbergella*, ?*Rotalipora*). There are also small transparent forms that are still failed to identify.

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MIDDLE TRIASSIC CEPHALOPODS FROM UPPER SILESIA

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In the paper the authors present and characterize some of the Cephalopoda specimens, mainly ammonites and nautiloids, found in the parts of Upper Silesia, not presented in the literature before.

The class Cephalopoda, particularly Ceratitida from order Ammonitida are of great stratigraphic importance for correlation of Triassic sediments. The first ammonites reached the Upper Silesia area in the end of Early Triassic (in the Late Rethian). Recently, the members of the subfamily Beneckeiidae have been found in the calcareous-marly sediments of Gogolin Beds in Wojkowice (one specimen), in Warpie – a district of Będzin (one specimen) and five specimens probably of *Beneckeia tenuis* (Seebach) in Pogoń – a district of Sosnowiec.

Several incomplete ceratites of another genus have been collected in Pogoń. They have been found in the upper part of the Gogolin Beds, in the lithological sequence located 4.5–6.5 m below their top. These are mainly the internal moulds of the evolute ceratites or the fragments of their whorls. The largest one was 12 cm in diameter. The outside shapes of the incomplete specimens from Pogoń were misshapen due to compaction, erosion and dissolution of carbonates under pressure. In the result of this processes the morphological elements of mould surfaces, *i.e.* ribs, nodes, tubercles are partially obliterated and the small fragments of shells are preserved only exceptionally. Usually it is also difficult to determine the presence, outline of the shape and length of living chambers. Despite the doubts, it seems that 3 or 4 specimens belong to genus *Balatonites*, family Balatonitidae.

Poorly preserved ceratites found in the Pogoń lithological succession of the Gogolin Beds may be correlated with the specimens from the longer, much better studied and described by Vörös (2003) section of the Triassic sediments from the Balaton Highland. When comparing the ceratites from Pogoń and these ones from the Balaton Highland area it can be noticed that the two metres long part of the Pogoń section corresponds to the Balatonicus Zone, Balatonicus Subzone or Pelsonian substage of the Anisian.

Within that part of the Pogoń lithological succession the storm deposits – several beds of tempestites have been distinguished. The two of them are intercalated by the greyish-yellowish-greenish, marly-clayey deposit, in which the fossils occur in large number and locally they dominated the volume of the layer. That intercalating marly-clayey layer is up to 4 cm thick. The number of ceratites alone contained in the layer is about 10 specimens per 1 m^2 of the layer surface; in most cases they are poorly preserved.

In Upper Silesia it is easier to find the members of the subclass Nautiloidea than Ceratitida. In the conglomeratic horizon of the upper Gogolin Beds, within the grey, marly limestone in Wojkowice, seven specimens of *Nautilus* sp. have been found. All of them are uncompleted, different in dimensions (the biggest one was about 20 cm in diameter). In most cases, on the surfaces of internal moulds, there are outlines of living chambers and septa perceptible.

Two of the specimens seem to be *Germanonautilus bidorsatus* known from the Wilkowice Beds of the Fassanian (Early Ladynian), which are younger than the Gogolin Beds. However, the supposed *G. bidorsatus* presented in this work is more slender than the other specimens known from the Triassic deposits of other areas. The phragmocones of the three specimens are partly crushed and curved under the living chamber due to compaction stress. The empty spaces around the umbilicus centres of the inner moulds are usually partly filled with calcite crystals.

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APPLICATION OF PALYNOFACIES ANALYSIS TO THE PALAEOGEOGRAPHIC RECONSTRUCTIONS – AN EXAMPLE FROM LATE CRETACEOUS OF SOUTHERN POLAND

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Quantitative and qualitative distribution of microscopic particulate organic matter – palynofacies analysis is presented as a tool to recognize Upper Cretaceous carbonate sediments in terms of distance from terrigenous sediment source in Miechów Synclinorium. Monotonous lithology, absence of turbidity currents and other synsedimentary incidental-catastrophic processes ensure stable palaeoenvironmental conditions required for palynofacies analysis. All these parameters predestine studied area to reconstruct untouched image of distribution of particulate organic matter in sedimentary basin.

The study was stratigraphically controlled by means of inoceramid fauna enabling for the first time to distinguish early Late Maastrichtian in the studied area and precise correlation of studied sections. All counted particulate organic matter have been plotted on Tyson ternary diagram in order to place studied outcrops within particular sedimentary environments. In spite of monotonous lithology and lack of other macrofaunistic and sedimetological indicators, distribution of sedimentary organic matter suggests occurrence of proximal to distal shelf facies with well developed intermediate facies zone in studied area. Cluster analysis enabled to group of the samples along transect from proximal to distal shelf transect and determine typical palynofacies associations. Lateral variations of black woody phytoclasts sizes is presented to extrapolate distance form source area indicating close distance of studied area from the shore. It is also confirmed by increased abundance of freshwater algae, increases cuticle particles in proximal samples.

According to palynofacies analysis the occurrence of uplifted area forming land or archipelago system is postulated in the Holy Cross Mts part of the Danish-Polish Trough. The presented results improve contemporary palaeogeographical interpretations for this part of the Late Cretaceous central European Basin. These new data also shed some light on the time and rate of inversion of the Danish-Polish Trough.

LATE ALBIAN FORAMINIFERA FROM RECORD OF CARBONATE PLATFORM DROWNING ON THE TATRIC RIDGE, A PART OF THE CARPATHIAN DOMAIN: STRATIGRAPHIC AND PALAEOENVIRONMENTAL INFERENCES

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The planktonic and benthic foraminifers have been studied from the Upper Albian echinoderm-foraminiferal limestones in the Tatra Mountains, Inner Carpathians. These sediments terminated the carbonate sedimentation on the Tatric Ridge, which lasted through the Late Jurassic–Early Cretaceous. The material studied was sampled from the limestone bed that lies directly below the hardground with stromatolites in the Żeleźniak gully section, Kościeliska Valley.

Planktonic foraminifers show that the breakup of carbonate platform took place in this area during the *Parathalmaninella appenninica* Chron (Bąk, 2015). The composition of benthic foraminiferal assemblages, including both agglutinated and calcareous taxa suggests that during the last phase of a carbonate platform development, the sea floor of elevated blocks occurred relatively deep, corresponding to the outer shelf depths. The comparison of foraminiferal morphogroups from the limestones shows that sea floor of this area was characterized by well-oxygenated bottom water conditions with an enhanced rate of primary organic matter flux.

Based on the positive excursion in $\delta^{13}C$ values in the sediments studied (Bąk *et al.*, 2016) corresponding to the *Parathalmanninella appenninica* Zone, the echinoderm-foraminiferal limestone layer is here regarded as sediments related to Oceanic Anoxic Event 1d.

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AMBROSIELLA-LIKE FUNGI IN FOSSIL RESIN FROM JAMBI PROVINCE IN SUMATRA ISLAND – POSSIBLE PHORETIC ORGANISMS INTERACTED WITH INVADED INSECTS

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Most of modern highly invasive plant pest like beetles from systematic group as Coleoptera: Scolytinae and Platypodinae, are closely tied to fungal and probably bacterial symbionts. The beetles excavate tunnels in trees tissues in which they cultivate fungi, which are their sole source of nutrition. After landing on a suitable tree beetle excavates a tunnel in which it releases spores of its fungal symbiont. The fungus penetrates and digests the plant's xylem tissue, and concentrates the nutrients on and near the surface of tree bark. Larvae and adults beetles typically feed on the growth and sporulation of fungi. Adult beetles may bore into the sapwood and inoculate the galleries with fungal symbionts that grow within sacs, called mycangia. Excretions into the mycangium apparently support growth of the fungi. A wide variety of fungi are phoretic organisms to modern beetles. Most of the identified specimens belong to genera as *Raffaelea* and *Ambrosiella*, which are closely related to *Ophiostoma* and *Ceratocystis* (*e.g.*, Cassar & Blackwell, 1996). To protect against pests invasion, tree can produce the resin. The volatile phenolic compounds of resin may attract benefactors or predators of the herbivores that attack the plant. The sign of such tree defence is supposed to find in fossil resins and amber.

The studied herein samples of resin, which may include such signs, come from the Sumatra Island, 15 km south of Jambi city. The fossilized resins are mined from coal and lignite beds dating usually to the Early Miocene (20–23 Ma) and found in numerous levels, including the Talang Akar formation in South Sumatra. The fossil resins on the Sumatra Island came from angiosperms (flowering plants), derive from the family Dipterocarpaceae, particularly the genera *Shorea* and *Hopea* (Brackman *et al.*, 1984).

The studied pieces of resin are double-coloured, consist of alternating honey-coloured and cream-coloured irregular bands and seams. In microscopic view cream-coloured band display spongy structure. It contains bubbles fill in by honey-colour type of resin, which are a few up to 100 microns across. Bubbles are usually elongate in one direction which might by the direction of resin's flow. The resin inside bubbles contains filamentous structures resembling fungous hyphae. The space between bubbles is usually opaque, with visible inside biogenic-like structures resembling palisade of fungus mycelium as formed on tree wood inside tunnels formed by beetles. The fungal structures strongly resembled those one produces by fungi from presently known genus *Ambrosiella*. These may suggests that double-coloured resins found on Sumatra Island was produced as an effect of tree defence against some kind of beetles similar to modern *Ambrosia* beetles associated with *Ambrosiella*-like fungi.

Current study was financially supported by AGH University of Science and Technology: grants 11.11.140.173 and 11.11.140.319, and Polish Geological Institute – National Research Institute grant No. 61.2801.1502.000.

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RADIOLARIANS AND CEPHALOPODS FROM THE CZAJAKOWA RADIOLARITE FORMATION IN THE STRATOTYPE SECTION, PIENINY KLIPPEN BELT, POLAND

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The Czajakowa Klippe section, located in the Homole Gorge in the central part of the Małe Pieniny Mts, is the stratotype section of one of the lithostratigraphic unit of the Pieniny Klippen Belt (PKB) – the Czajakowa Radiolarite Formation (Birkenmajer, 1977). The Czajakowa Radiolarite Formation (CRF) contains Upper Jurassic, red to green radiolarian cherts. It is subdivided into three members (Mb.) as the Kamionka Radiolarite Mb., the Podmajerz Radiolarite Mb., and the Buwałd Radiolarite Mb. based on dominant colouration. CRF has many reference sections in Polish and Slovak part of the PKB (*e.g.*, Birkenmajer, 1977; Ozvoldová, 1988).

The studies of the CRF focused on fossils, lithology and age have been carried out mainly in reference sections, whereas the stratotype section at the Czajakowa Klippe have never been investigated in detail, probably because problems of accessibility to almost vertical rock wall.

The fossils have been collected and analysed in 25 samples taken along the whole section outcropped. All members of CRF contain radiolarians as a main fossils. The identified radiolarian assemblage consist of 37 well preserved taxa. Cephalopod remnants as aptychi (Ammonoidea), belemnites and rynchonelites (Nautiloidea) are very rare. All remnants of cephalopods are present in three samples located in the Podmajerz Radiolarite Mb. The material studied is of varying quality, usually incomplete or fragmentary, probably as a result of diagenesis and strong tectonic distribution of the host rocks. Rostra of belemnites belong to species as *Hibolites jumaranisis*, *Hibolites longiscissus*, *Hibolites budhaichus*. The studied aptychi are thick-shelled and represent adult stage. The *Lamellaptychus* and *Laevaptychus* have been recognized.

The age of the whole sequence has been stated based on radiolarians as Early Oxfordian through Early Kimmeridgian. Singular occurrences of aptychi (Ammonoidea) and belemnites indicated that green radiolarite of the Podmajerz Radiolarite Member represent Lower and Middle Oxfordian.

Current study was financially supported by NCN project 2012/07/B/ST10/04361 and AGH University of Science and Technology 11.11.140.173 grant.

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LATE EOCENE (PRIABONIAN) BRACHIOPOD FAUNA FROM DNEPROPETROVSK, EASTERN UKRAINE

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Eocene brachiopods, although of low diversity, are widely distributed in Europe. From Ukraine they have been described by Zelinskaya (1962, 1975, 1977) who identified more than 20 species. However this fauna badly requires revision and re-description due to misidentification and over-splitting.

Brachiopods investigated here come from the Rybalskij quarry, near Dnepropetrovsk, eastern Ukraine. Based on the calcareous nannoplankton the very fossiliferous detrital limestones cropping out in the Rybalskij quarry were assigned to the zone NP 19, corresponding with the Priabonian (Müller & Rozenberg, 2003). The brachiopod fauna comprises eleven species belonging to eight genera, *i.e. Discradisca*, *Novocrania*, *Terebratulina*, *Megathiris*, *Argyrotheca*, *Megerlia*, *Platidia*, and *Lacazella*. Five genera: *Discradisca*, *Novocrania*, *Megathiris* [specimens attributed to *Megathiris* by Zelinskaya (1962, 1975) belong undoubtedly to *Argyrotheca*], *Megerlia*, and *Platidia*, are recorded for the first time from the Eocene of Ukraine. Additionally, the occurrence of *Megerlia* extends its stratigraphical range from the Oligocene (Bitner *et al.*, 2013) to the Eocene.

The megathyridids, *Megathiris detruncata* (Gmelin, 1791) and the species belonging to *Argyrotheca*, and thecideide *Lacazella mediterranea* (Risso, 1826) constitute more than 90% of the material. The dominance of megathyridids and thecideides indicates a warm, shallow-water environment.

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STABLE ISOTOPES FROM MIOCENE TO PLIOCENE PLANKTONIC AND BENTHIC FORAMINIFERA: PRELIMINARY RESULTS FROM IODP EXPEDITION 354 (BENGAL FAN)

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The northern Indian Ocean constitutes the Earth's strongest hydrological region involving large inter-hemispheric exchanges of mass and energy between the ocean, atmosphere and continents. These exchanges produce seasonal monsoon winds and precipitation in India and surrounding areas. The monsoon ultimately delivers surface runoff into the Bay of Bengal, resulting in changing seasonal surface salinity and ocean currents due to wind forcing. The climates of Asia are affected significantly by the extent and height of the Himalayan Mountains and the Tibetan Plateau. Uplift of this region began about 50 Ma, and further significant increases in altitude of the Tibetan Plateau are thought to have occurred through the Miocene and more recently. However, the climatic consequences of this uplift remain unclear. There are contradictory summer monsoon reconstructions that highlight the importance of long continuous sediment records and robust proxies to achieve consensus about the timing of monsoon intensification, which can then potentially be correlated to changing topography in central Asia and the tectonic history of the Himalaya. Given that the present day monsoon brings large changes in precipitation to the Bay of Bengal, one way to characterize this is by reconstructing the $\delta^{18}O$ of the sea surface, which is linked to salinity and temperature.

International Ocean Discovery Program (IODP) Expedition 354 to the Bay of Bengal (February–March 2015) cored a series of seven sites along a longitudinal (8°N) transect, and recovered 1727 m of sediment spanning the Cenozoic. IODP Sites U1450 (1350 m below sea level) and U1451 (1307 mbsl) recovered material from a succession of Late Miocene to Recent distal turbidites. The sediments predominantly consist of sand, silt and clay with occasional bioturbated calcareous clays containing varying proportions of foraminifera. These calcareous clays were interpreted as representing hemipelagic sedimentation during channel-levee inactivity, and were sampled for this study. We generated paired records of surface and deep $\delta^{18}O$ and $\delta^{13}C$ from planktonic and benthic foraminifera. We use benthic $\delta^{18}O$ to constrain the biostratigraphic age model produced on the ship, and surface water changes to put constraints on the possible long-term evolution of surface water salinity from the Late Miocene to the Pliocene. These results are compared with other core records from the region (*e.g.*, DSDP Sites 217, 218 and ODP Site 758).

MICROFAUNA, MICROFACIES AND TRACE FOSSILS FROM CALCISPHAERULID LIMESTONES IN THE MANÍN STRAITS (MANÍN UNIT, WESTERN CARPATHIANS, SLOVAKIA)

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The Manín Straits is situated east of the Považská Teplá village. It encovers Jurassic–Cretaceous sequence of the Manín Unit. In the Manín Straits (first tectonic slice), above massive rudist limestones of the Manín Fm. (Urgonian facies s.l.) on which the hardground surface is developed, a thin layer (3–5 cm) of gray, brownish weathered so called calcishaerulid limestone occurs. Calcisphaerulid limestones are known also from other localities of the Manín Unit (Borza *et al.*, 1983). On the weathered surface, but mainly in polished sections, *Chondrites* can be observed. They represent cross sections of three-dimensional trace fossils filled with high-contrast dark matter. It is a system of tree-like branching, downward penetrating tunnels, 0.5–1.0 mm in diameter. Fu (1991) describes it as a result of use of sediment by chemosymbiotic organisms. *Chondrites* can originate in the deeper parts of the substrate in an environment with very low oxygen content (Bromley, 1996). Among other trace fossils in the form of thin (about 1 mm) rusty-brown burrows, *Trichichnus* isp. and *Pilichnus* isp. can be observed. They are branched or unbranched, hair-like, cylindrical, straight to sinuous trace fossils, oriented at various angles (mostly vertical) with respect to the bedding. Burrows are filled with pyritized material. Possibly, the producers of *Trichichnus* and *Pilichnus* were chemosymbionts – small filamentous bacterias (Kędzierski *et al.*, 2015), that occur more deeply in very poorly oxygenated sediments. The studied limestones represent calcisphaerulid–foraminiferal wackestone/packstone. The age of calcisphaerulid limestone has been determined as the top of the Late Albian. Planktonic foraminifers from the *Thalmanninella appenninica* Zone represented by the index form *Thalmanninella appenninica* and other such as *Planomalina buxtorfi*, *Pseudothalmanninella ticinensis ticinensis*, *P. ticinensis conica*, *Praeglobotruncana delrioensis*, *P. stephani*, *Muricohedbergella delrioensis*, *M. planispira*, *Macroglobigerinelloides caseyi*, *Ticinella raynaudi* and *Heterohelix* sp. were identified. Benthic foraminifers are rare. From calcareous dinoflagellates, *Calcisphaerula innominata* occurs commonly, *Pithonella ovalis*, *P. trejoi*, *Bonetocardiella conoidea* occur occasionally. Rare *Cadosina oraviensis* and *Colomisphaera gigantea* from the Innominata Acme Zone are included into Late Albian by Reháková (2000). Other fossil remains are represented by fragments of echinoids as well as filaments, thick-walled bivalves and bioclasts. A phosphate minerals, pyrite, rare autigenic quartz and glauconite are present, sometimes filling shells and chambers of foraminifers.

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THE KRPEĽANY SECTION – LECTOSTRATOTYPE OF THE GADER LIMESTONE (MICROFOSSILS, MICROFACIES) (HRONICUM UNIT, VEĽKÁ FATRA MTS, WESTERN CARPATHIANS)

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The section is located in the north-western part of the Veľká Fatra Mts, 1 km NNW from the Krpeľany village. It is part of the Kopa tectonic outlier (Hronicum Unit). This tectonic outlier is a denudation relict of carbonate platform (Havrila, 2011). According to Polák *et al.* (1997), its sedimentary sequence consists of Ramsau Dolomite, Gader Limestones (in the sense of Polák *et al.*, 1996) and Wetterstein Dolomite. The Gader Limestones should reach thickness about 100 m in the Vápenná dolina valley. According to Havrila (2011) this sequence is made of Gutenstein Limestone, Steinalm Limestone and crinoidal limestone on both the type locality and the Kopa outlier. After redefinition (Havrila, l.c.), the crinoidal limestone is considered to Gader Limestone and it represents several topmost meters of the original section. It is this uppermost part of the limestone sequence that is uncovered in the Krpeľany section. Two limestone types occur in it. Lower part consists of Jasenie Limestones with intrabiopelmicrosparites/intrabiopelmicrites (wackestone) microstructure. Filaments, radiolarians, sponge spicules, fragments of echinodermates, juvenile bivalve shells, smooth-shelled ostracods, gastropods, foraminifers and fragments of thick-shelled bivalves are present. *Paulbronnimannella whittakeri* indicates the Upper Pelsonian for this sequence. In association with this species, *Paulbronnimannia judicariensis*, *Meandrospira* cf. *dinarica*, *Nodosaria* sp., *Dentalina hoi* and *Frondicularia woodwardi* are found. Jasenie Limestone is related to the SMF 1 (bioturbated). Upper part consists of Gader Limestones. They have intrabiopelmicritic/intrabiopelmicrosparitic (wackestone/packstone) and intrabiopelsparitic (grainstone) microstructure with areas of the original micritic matrix. It belongs to pilamina, pilamina-echinoderm, echinoderm-bivalve, resp. echinoderm-bivalve-pilamina microfacies. *Pilammina densa* is an index form of zone bearing the same name (Acma-zone) selected by Salaj *et al.* (1983). Pelsonian-Illyrian boundary is located between samples 19–20. *Permodiscus pragsoides* (sample 20), is an interval-range zone foraminifera of Illyrian age (Salaj *et al.*, 1983). *Pilamminella grandis*, *Paulbronnimannia judicariensis*, *Paulbronnimannella whittakeri*, *Meandrospira* sp., *Planiinvoluta carinata*, *Ophthalmidium* sp., *Austrocolomia* sp., *Diplotremmina* sp. and *Variostoma* gr. *pralongense-exile* occur. Other organic remains consist of echinodermates, thick-shelled bivalves, brachiopods, smooth-shelled ostracods, gastropods, holoturians, rare filaments (lower part of the section) and incertae sedis. The Gader Limestone represent an SMF 12. Underlying rocks of the studied section are not uncovered, overlying are Wetterstein Dolomites. Jasenie Limestones represent the drowning event of the Steinalm carbonate platform. Wetterstein Dolomites represent the new Wetterstein carbonate platform.

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LOWER FAMENNIAN (UPPER DEVONIAN) ICHTIOFAUNA FROM KOWALA QUARRY (HOLY CROSS MOUNTAINS, CENTRAL POLAND)

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Kowala quarry (south-western part of the Holy Cross Mountains, Central Poland) is one of the most interesting places for investigation of Devonian life. Upper Devonian strata outcropping in the quarry are very rich in fossils. During last three years part of Lower Famennian profile (*crepida* conodont Zone) was investigated in great detail. So called "Kowala Lagerstätte" provided many well-preserved fossils, including abundant arthropods: thylacocephalans, phyllocarids and angustidontids (Zatoń *et al.*, 2014; Broda *et al.*, 2015), non-calcifying algae (Zatoń *et al.*, 2014; Filipiak & Zatoń, 2016), rare Conulariids and of course fish remains. This rich fossil assemblage allowed also to investigate the trophic relationships between inhabitants of this unique pelagic palaeoecosystem.

Fish remains in Kowala are quite rare. Currently, the collection consists of only 12 specimens. They are represented mostly by isolated elements of cranial skeleton and scales. Among them there are 3 semi-complete specimens and one complete, with preserved good content. Inside the its body cavity conodont elements have been found. Except one semi-complete specimen, which is still unidentified, every fossil belongs to coelacanth-type fishes.

Basing on the morpohology of opercula and jaw elements we can state that they belong to new, undescribed species, similar to *Diplocercides kayseri* (see Szrek, 2007). To confirm if coelacanths from Kowala represent a new genus, more well-preserved specimens are still needed. Thanks to the research led on preserved fish coprolites (Zatoń & Rakociński, 2014) and damaged thylacocephalan carapaces (Broda *et al.*, 2015) it was possible to state that the main predators in the ecosystem were fishes. Basing on the acquired data it is possible to provide an analysis of the intensity of predation in the environment, which is 13% basing on coprolites and 29% basing on thylacocephalan carapaces.

The discovery of well-preserved Late Devonian ichnofauna in Kowala allows us to investigate the palaeobiology, diversity and taphonomy of Devonian coelacanths. Thanks to it, the full reconstruction of pelagic palaeoecosystem preserved in Kowala is one step closer.

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EVOLUTIONARY HISTORY AND DISTRIBUTION PATTERN OF PHACOPID TRILOBITES IN THE DEVONIAN OF THE PRAGUE BASIN (BARRANDIAN AREA, CZECH REPUBLIC)

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Evolutionary history of phacopid trilobites is characterised by gradual radiation after their origin in the uppermost Ordovician, modest crisis near the Silurian/Devonian boundary followed by the acme of diversity and disparity in the Devonian. The Lower and Middle Devonian thus represent exciting time, when numerous new lineages of phacopids originated and successfully inhabited different niches. This extensive radiation continued up to the Upper Devonian, when especially Frasnian/Famennian Kellwasser Event presented a deep evolutionary crisis of the entire group. This crisis was followed by new radiation in Famennian that was interrupted by still unexplainable disappearing of phacopids at the Devonian/Carboniferous boundary during the Global Hangenberg Crisis. The evolution of phacopids has been, however, affected also by several lower-order events. Such evolutionary history and distribution pattern in the Lower and Middle Devonian strata of the Prague Basin (Barrandian area, Czech Republic) is discussed. Phacopid trilobites obviously preferred rather deeper-water, low-energy environment than the shallow-water, high-energy carbonates. They are entirely absent at the Koněprusy reef and they form specific, moderate-diversity and low-abundancy associations at the reef periphery. In lower Lochkovian, phacopids are absent in the Prague Basin. A monospecific middle-upper Lochkovian association is characterised by rich occurrence of *Lochkovella*. In the uppermost Lochkovian, *Reedops* (represented by rare *R. limespragensis*) onsets. The Pragian and Zlíchovian phacopids of the Prague Basin belong to the richly diversified *Reedops-Odontochile* "Assemblage". This association is characterised by abundant occurrence of lifelong *Reedops* and *Boeckops* that are accompanied by several, less common taxa (*Prokops*, *Viaphacops*, *Kainops*) with stratigraphically restricted occurrence, the last two being confined to the shallower-water facies. For the late Zlíchovian, dominance of *Pedinopariops* and *Nephranomma* is characteristic, together with rare occurrence of first *Chotecops*. The onset of Daleje Event totally rebuilt the phacopid associations. This event presents decline of *Reedops*, *Nephranomma*, *Boeckops* and *Paciphacops* in the Prague Basin. Only unaffected genus was *Pedinopariops*. In the late Dalejan Třebotov Limestone, diversity of phacopids increased. *Pedinopariops* is still very common. *Struveaspis* appeared for the first time in the Prague Basin (*S. marocanica*). There is also sporadic occurrence of *Eocryphops*. In shallower-water Suchomasty Limestone, endemic *Signatops* occur. The Basal Choteč Event presents a decline of *Pedinopariops* lineage but *P. insequens* crosses the Lower-Middle Devonian boundary and extinct in the lower part of the Choteč Formation. *Signatops* disappears meanwhile *Struveaspis* is represented by common *S. micromma eomicromma* with reduced eyes in lower part of the Choteč Limestone and by *S. fugitiva* in its higher part. Eifelian presents the acme of *Chotecops* lineage in the Barrandian area. Rare *Eocryphops* have been also documented. In shallow-water Acanthopyge Limestone, endemic *Cordapeltis* occurs. The onset of the Kačák-otomari Event presents abrupt collapse of phacopid associations in the Barrandian area. Kačák Member does not contain any remains of trilobites. At the base of the lower Givetian Roblín Member, youngest occurrence of phacopids in the Prague Basin (*Chotecops* aff. *hoseri*) has been documented.

The contribution was supported by the Grant Agency of the Czech Republic (Project No P210/12/2018), and by the Czech Geological Survey Project 338800, respectively.

THE LARGE CRUSTACEAN BURROW ?*THALASSINOIDES SAXONICUS* GEINITZ, 1842 FROM THE CONIACIAN OF THE NORTH SUDETIC SYNCLINORIUM (CZAPLE QUARRY, SW POLAND)

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Thalassinoides saxonicus (*Spongites saxonicus* Geinitz, 1842 or *Cylindrites spongioides* Göppert, 1842) crustacean burrow was found in the Coniacian quartz sandstones of the North Sudetic Synclinorium (Czaple quarry). This large burrow has 127 cm in length and consists of 8 swollen chambers (diameter 6.5–8.0 cm) connecting with tunnels (diameter 2.0–3.0 cm). The presence of swollen portions ("turn-arounds") suggests assignment to *Thalassinoides saxonicus*. This ichnotaxon has been reported and described for the first time by Geinitz (1842) in Saxony and Bohemia Quadersandstones. On the other hand, the regular occurrence swollen parts suggests some similarities to *Asterosoma ludwigae* Schlirf, 2000. *Thalassinoides* is regarded as domichnion/fodinichnion or agrichnion. The most possibly tracemakers are crustaceans: shrimps or crabs. *Thalassinoides saxonicus* (earlier *Spongites saxonicus* or *Cylindrites spongioides*) was regarded by several authors as: crinoid remains or cavities left by vagile starfish, algae (fucoids) (Göppert, 1842, 1847; Otto 1952), sponges (Geinitz, 1842), giant foraminifer and in the end trace fossil (see Keenedy, 1967 and references therein). Göppert (1842) described *Cylindrites spongioides* and other fucoid-like structures from the Lower Silesia (Bystrzyca, Idzików; Upper Nysa Kłodzka Graben) and Nowa near Bolesławiec (North Sudetic Synclinorium). It is amazing, that after over 150 years it was possible to report this interesting finding again from the Upper Cretaceous of Lower Silesia. Beside Germany, this ichnotaxon was encountered also in England (Kennedy, 1967). In the Czech Republic it occurred within Jizera Formation, Upper Turonian (Pokorný, 2008 and references therein). Recently, in the literature there are only few reports concerning mainly smaller specimens of *Thalassinoides saxonicus* Geinitz, 1842, only in one case (*e.g.,* Göhler, 2011) so large as it had been earlier described. Additionally, an assemblage of bivalves – inoceramids and two specimens of starfish were also encountered in the Czaple quarry. The sandstones of the Czaple quarry (so called Upper Quadersandstones) were deposited in a shallow environment, probably in the shoreface zone.

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CALCAREOUS DINOFLAGELLATE CYSTS FROM THE UPPER ALBIAN HEMIPELAGIC SEDIMENTS RELATED TO OCEANIC ANOXIC EVENT 1D (OAE1d) FROM THE HIGH TATRIC UNIT: PALAEOENVIRONMENTAL INTERPRETATION

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A study of calcareous dinoflagellate cysts has been undertaken from the sediments of the Żeleźniak and Kamienne members crop out in the Żeleźniak gully, a left tributary of the Kościeliska Valley (Polish part of the Tatra Mountains). The succession consists of limestone gradually passing into marls, whose deposition corresponds to the *Parathalmanninella apenninica* Zone in the Late Albian, during the final phase of OAE1d. These sedimentation was related to a sudden change in the circulation pattern at the margins of the Tatric-Zliechov sedimentary basin, connected with a sea level rise (Bąk *et al.*, 2016). The coastal upwelling along the Tatric Ridge that dominated during the early Late Albian gradually weakened or disappeared and was replaced by a downwelling current flowing from the shallow parts of the basin that transported land-derived organic matter from submerged coastal plains.

Three low diversity assemblages of the calcareous dinoflagellate cysts have been recognized in the studied deposits: (1) assemblage with high dominance of *Pithonella ovalis*, which usually occur in off-shore sediments, (2) assemblage dominated by *Pithonella sphaerica*, which is usually associated with near-shore, with influenced of costal conditions, and (3) assemblage dominated by *P. ovalis*. The first assemblage occurs in the lower part of the section contained platform limestone. The second assemblage is present in the middle part of the section represented by grey marlstones, and the third in the uppermost part within green marlstones. The presence of these microfossils is interpreted as indicators of high nutrient content in the surface water in marine environment. The vertical changes of cysts association may reflect the unstable conditions, related with seasonal changing of water regime, likely associated with higher seasonal influence of run off and off-shore conditions, accompanying by slight changing of the nutrient content. The assemblages dominated by *P. ovalis* represent the environment rather influenced by off-shore conditions, accompanied by high nutrient content, due to operation of upwelling. The assemblage dominated by *P. sphaerica* is related with the phase of higher run off, accompanying by increase of the nutrient content.

Current study was supported by NCN project 2011/01/B/ST10/ 07405 and AGH University of Science and Technology 11.11.140.173 grant. The paper resulted in the frame of the IGCP Project No 609.

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DIVERSITY OF BADENIAN PELLETS FROM BOREHOLE CHEŁM 7 (KŁODNICA FORMATION, CARPATHIAN FOREDEEP, POLAND)

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Badenian deposits, occurring the west of Kraków, are represented mainly by the Skawina and Kłodnica formations (Alexandrowicz *et al.,* 1982; Pilarz, 2012). Kłodnica Formation, which occurs in core Chełm 7, is a diverse complex of clay-sandy sediments, developed in terrestrial, freshwater and brackish environments, spread on the Carboniferous base (Alexandrowicz & Pawlikowski, 1978). Previous studies of these deposits (Pilarz & Ciurej, 2011; Pilarz, 2012) document the shallow water and dynamic environment, with rapidly changing conditions on littoral zone. In this paper we present details of examination of pellets, found in large amounts in a sample on a depth of 139.5 m. The loose specimens were studied under an optical microscope and specimens glued and polished on thin section were studied under scanning electron microscope, using various modes of observation (see Ciurej, 2010).

The numerous pellets were found and divided into three groups, which differ in texture and structure:

A) Dark-gray pellets (approx. 45% of all pellets) of 300 to 800 µm sizes, and oval, lenticular, cylindrical and spindly shapes. They contain of fine particles of clay minerals, calcareous grains, quartz, pyrite, gypsum, organic matter also coccolith plates (mostly badly preserved) and bioclasts;

B) Light-gray pellets (about 35%) with size, shape and composition similar to the group above, however these pellets contain a bit more coccolith material;

C) White pellets (approx. 20%) of 100 to 300 µm size, oval, lenticular, cylindrical and rarely spindle shapes with a roughened surface and sometimes broken. They contain calcareous particles (50%) of mainly coccoliths, including coccospheres (badly to moderately preserved). There are also clay minerals, quartz, pyrite, small amounts of organic matter.

The composition of white pellets suggests that they probably represent the fossilized marine planktonic fecal pellets of zooplankton (likely Copepods), which grazed coccolithophore in photic zone (*e.g.,* Honjo & Roman, 1978). Dark-gray and light-gray pellets are probably the benthic fecal pellets and produced by molluscs: snails and/or bivalves – as their remains are common in the studied sediment. We cannot exclude that some are fecal pellets of polychaetes – Polychaete worms (Bałuk & Radwański, 1979). The composition of dark-gray and light-gray pellets, indicates that unevenly aged material was scavenged, included redeposited Cretaceous deposits and coeval biogenic material from photic zone.

Numerous benthic fecal pellets may suggest the favorable conditions for scavenging and thus the strong live activity of benthic organisms and hence well oxygenated conditions at the bottom. Crushed, white planktonic pellets may indicate a relatively high energy in the water column.

The study was supported by the AGH, research project No. 11.11.173.

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STRATIGRAPHY OF THE ISTEBNA BEDS IN THE BYSTRE SLICE (SILESIAN NAPPE, BIESZCZADY MTS) BASED ON THE DINOFLAGELLATE CYSTS – PRELIMINARY WORKS

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Bystre slice is located in the eastern part of the Polish Outer Carpathians, within the Silesian Unit and it belongs to the Fore-Dukla Zone. Istebna beds revealing in the Bystre slice forms a complex of sandstones and shales with a total thickness of approximately 770 m. They are divided into four parts: the lower Istebna sandstones, the lower Istebna shales (the lower Istebna beds) and the upper Istebna sandstones and upper Istebna shales (upper Istebna beds). The age of lower Istebna sandstones is assigned to the Upper Cretaceous (Campanian–Maastrichtian) whereas the age of the rest of Istebna beds is determined as Paleogene (Paleocene) (Ślączka, 1959).

For the study samples from the Jabłonka and Rabski creeks were taken. Analyzed preliminary samples contains dinoflagellate cysts. The material is characterized by a different state of preservation. Part of cysts are well preserved, whereas the rest is mechanically destroyed, making it impossible to recognize. The richest dinoflagellate cyst assemblage comes from samples taken in the Jabłonka creek, from the upper part of Istebna sandstone.

In studied material numerous *Apectodinium* sp. specimens were found. These are *A. homomorphum* and *A. hyperacantum* taxa. Also abundant *Axiodinium augustum* (previously *Apectodinium augustum*) is found.

A known stratigraphic range of *Apectodinium homomorphum* is Late Paleocene–Middle Eocene (*e.g.*, Powell *et al.*, 1996), however some authors restricted its range only to Early Eocene (Lentin & Williams, 1981). *Apectodinium hyperacathum* is known from Late Paleocene to Early Eocene (Powell *et al.*, 1996). *Axiodinium augustum* is restricted to Late Paleocene (Thanetian) (Lentin & Williams, 1981). However Williams *et al.* (2015) provides for the *Axiodinium* genus a stratigraphic occurrence from the Early to Middle Eocene.

Moreover, *Apectodinium* genus is tropical dinoflagellate cyst. According to Crouch *et al.* (2001) the high abundance of these genus in studied material can indicate the record of Paleocene/Eocene thermal maximum (PETM). During the PETM *Apectodinium* sp. was very abundant and its ACME was found in many localities (*e.g.*, New Zealand, Austria) (Sluijs *et al.*, 2005) and it is very possible that in the Polish Outer Carpathians this event was found as well. PETM is dated at 55.5 Ma and according to Luterbacher *et al.* (2005) it is the Early Eocene.

The presence of *Apectodinium* and *Axiodinium* taxa allows to determine the age of the upper Istebna sandstones to the uppermost Paleocene (Thanetian) or, what is more probable, Lower Eocene (Ypresian).

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PRELIMINARY PALYNOLOGICAL STUDIES OF SEDIMENTS OF THE SPŁAWA SECTION IN THE SKOLE NAPPE, OUTER CARPATHIANS (POLAND)

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Palynological analysis of 30 samples (20–30 g each) from the profile of the Spława section in the Skole Nappe, Outer Carpathians (Poland) were studied. Examinated sediments comes from the Cenomanian–Turonian transition interval (Bąk *et al.*, 2001). The Spława section consists of green non-calcareous shales, siliceous marls with green, grey and black layers of shale, organic-rich sediments with bentonites and siliceous-manganiferous shales. All samples were processed following standard palynological procedure.

Palynological study confirmed the occurrence of organic matter (OM) with different numerous and composition. Quantity and type of palynofacies components depends on lithology of investigated sediments and type of environment.

The OM includes palynomorphs (dinoflagellate cysts, spores and pollens) and palynoclasts (phytoclasts and amorphic organic matter). In further palynological studies it is possible to distinguish palynofacies ingredients as derived from land, marine or freshwater.

Based on the ratio of the individual components it is possible to divide the examined deposits into three packages. Package 1 is dominated by marine palynomorphs – dinocysts and (in samples examinated from inserts of black shales) land origin palynoclasts – black, opaque woody parts (phytoclasts). Package 2 (organic-rich facies) is composed mainly of black and brown phytoclasts and amorphic organic matter. In the Package 3 which consists of green and red, non-calcareous shales – the amount of organic matter is very low. These palynofacies are composed practically only of phytoclasts, no occurrence of dinoflagellate cysts, sporomorphs or zoomorphs were observed. In some samples (*e.g.*, samples number 72, 107 or 110) OM is absent.

Obtained palynofacies differs due to the composition. In first package which consists Calciturbidite Succesion with inserts of black shales the environment is mainly suboxic with anoxic black shales. The second one – Organic-rich facies and underlaying green and red shales are anoxic. Variegated shales with red non-calcareous shales represents dysoxic to oxic oxygen level.

By studying components of palynofacies it is possible to determine predominance of material supply – marine or terrestrial. In these sediments most of palynological matter is originated from marine water (phytoplankton – dinoflagellate cysts). Inserts of black shales suggests episodes of land origin material delivery.

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HYPOSTOMES IN CAMBRIAN AGNOSTIDS FROM THE BARRANDIAN AREA (CZECH REPUBLIC)

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Remains of agnostid hypostomes are rare and have been reported in about fifty specimens assigned to ten Cambrian species. Up to now, these ventral structures have been documented only in eight Cambrian genera, namely in *Acadagnostus*, *Agnostus*, *Onymagnostus*, *Peronopsis*, *Proagnostus*, *Ptychagnostus*, *Redeagnostus* and *Triplagnostus*. Major part of up to now described agnostid hypostomes is preserved due to an early diagenetic silicification and/or phosphatisation in limestones and limestone nodules (*e.g.*, Robison, 1972; Müller & Walossek, 1987). So far, only two agnostids with hypostome were reported from siliciclastic sediments (Rushton, 1979; Fatka *et al.*, 2009). Hypostomes are still unknown in Ordovician agnostids.

A large collection of Cambrian skeletal fauna from the Barrandian area includes articulated agnostids with *in situ* preserved hypostomes in four species from the Příbram–Jince Basin and in two species from the Skryje–Týřovice Basin. Undoubted remains of hypostomes are newly established in *Condylopyge rex*, *Peronopsis integra*, *Onymagnostus hybridus*, and *Phalagnostus prantli*. Possible remains of hypostomes are described in *Hypagnostus parvifrons* and *Skryjagnostus pompeckji*. The studied material provides the first information on morphology of hypostome in the Superfamily Condylopygoidea, and in four other Cambrian agnostid genera. Hypostome without apical boss, earlier known only in *Oidalagnostus trispinifer*, is most probably present also in *P. prantli* and *S. pompeckji*. Earlier supposed chemical composition and placement of agnostid hypostome are briefly discussed.

Conclusions

1. Within thousands of agnostids collected from the Jince and Buchava formations, only twelve exoskeletons assigned to six species contain remains of hypostome. Such a low frequency of hypostomes in agnostids reflects tiny dimensions of these exoskeletal elements combined with their poor preservation potential and weak attachment to ventral body surface.
2. Observed difference in preservation of mineralized dorsal exoskeleton and hypostome *in situ* could be explained by weak (if any) mineralisation of these ventral elements.
3. During ontogeny the position of hypostome changed, it moved posteriorly from an early anteroglabellar to the later posteroglabellar placing.
4. In agnostids, two basic types of hypostomes seem to be present:
   – hypostomes with fenestrules;
   – more rounded hypostome (without apical boss).
5. Described agnostids with *in situ* hypostome collected in Cambrian clastic sediments of the Barrandian area anticipate occurrence of agnostid hypostomes in non-carbonate (clastic) sediments in other areas.

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ALBIAN CARBONATE PLATFORM EVOLUTION IN THE MANÍN UNIT: SEDIMENTARY FACIES, BIOSTRATIGRAPHY AND GEOCHEMISTRY (WESTERN CARPATHIANS, SLOVAKIA)

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The demise of Lower Cretaceous platforms is considered to coincide with the "mid-Aptian crisis" of the Tethyan platform systems (Masse, 1989). However, input of clasts of platform sediments in allodapic facies indicated that the platform growth was still active during the Late Aptian–Albian, suggesting that the carbonate factory production in the Western Carpathians terminated later than in other Tethyan regions (Mišík, 1990; Michalík *et al.*, 2012). New sedimentological and palaeontological analyses at the Manín Straits as the type locality of the Manín Unit shows that the platform succession of Albian age exhibits top to slope biofacies stacked in a prograding pattern. The platform sequence starts with recessive clinoforms of the upper slope facies characterized by reworked associations of rare Late Aptian–Early Albian tintinids from the Colomiella Zone: *Colomiella mexicana* (Bonet), *C. recta* (Bonet) in the basal part of the formation and by planktonic foraminifers of the lower part of Late Albian Ticinella primula Zone represented by *Ticinella primula* Luterbacher, *T. roberti* (Gandolfi), *T.* cf. *madecassiana* Sigal and *Globigerinelloides bentonensis* (Morrow). Calcareous nannoplankton is represented by *Nannoconus bucheri* Brönnimann, 1955, *Watznaueria barnesiae* (Black in Black & Barnes, 1959) Perch-Nielsen, and by rare *Cretarhabdus* sp.

The carbonate succession passes upwards into the massive platform limestones characterized by accumulations of poorly preserved rudist shells represented by small fragments (1–2 cm) of the Caprinidae family (*Caprina* sp., *Praecaprina* sp., *Offneria* sp.). The foraminiferal association of these caprinid-bearing beds consists predominantly of orbitolinids related to *Palorbitolina* ex gr. *lenticularis*, with signs of redeposition because they occur in clasts. Limestones are affected by selective dolomitization, typical of peritidal and shallow neritic facies zones. Four dominant microfacies associations (urgonian facies s.l.) share similarities with the Urgonian-type facies from SE France. $\delta^{13}C$ and $\delta^{18}O$ isotopes change over abroad range: $\delta^{13}C$ is in range +1.03 to +4.20‰ V-PDB and $\delta^{18}O$ is in range –0.14 to –5.55‰ V-PDB. The $\delta^{13}C$ isotope data suggest shallow-water conditions and continual diagenesis in the marine condition. Carbonate platform progradation was connected with submarine sliding, redeposition from older deposits, and carbonate clastic accumulation on toe of the slope. After stabilization and aggradation stage, carbonate platform growth was stopped and the platform collapsed during Albian. A hardground surface was formed, overlain by Albian–Cenomanian pelagic beds with a thin layer of calcisphaerulid limestones characterized by calcareous dinoflagellates from the Late Albian Innominata Acme Chron and planktonic foraminifers from the Thalmanninella appenninica Chron related to the top of the Late Albian.

This work was supported by Slovakian Grant Agency, VEGA 2/0057/16, 2/0094/14 and by the Slovak Research and Development Agency, APVV-14-0118.

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PALYNOSTRATYGRAPHY OF THE POŁOMIA FORMATION (SOUTHERN POLAND)

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Three samples were taken from the mudstones of the Polomia Formation from a gravel pit at Kamienica Śląska (Upper Silesia). Presently this is the biggest outcrop of the Polomia Formation in Southern Poland with a total thickness of about 30 m. Thick gravel complexes are separated by four mudstone horizons: lowermost (M1), lower (M2), upper (M3) and uppermost (M4).

The sample from M1 horizon does not contain any palynomorphs whereas the samples coming from the two other mudstone beds M2 and M3 contain relatively reach miospore assemblages representing a palynological subzone c of the C. meyeriana zone distinguished in the Zbąszynek Beds by Orłowska-Zwolińska (1985) and dated as late Norian–early Rhaetian. The precise determination of the age of the subzone c is difficult due to problems with stratigraphy of the Norian–Rhaetian in the German Basin. Kürscher and Herngeen (2010) correlated the whole zone C. meyeriana with the Norian zone G. rudis as shown in Figure 2, whereas in the text (p. 76) they correlated the c subzone with the zone R. germanicus. Szulc *et al*. (2015, Fig. 18) have also suggested the late Norian age of this subzone. Based on presence of the Rhaetipollis germanicus Schulz Fijałkowska-Mader *et al*. (2015) have correlated the c subzone with lower part of the Rhaetian R. germanicus zone of Herngreen (Kürscher and Herngeen, 2010).

Due to the problems mentioned above, the age of the Polomia Formation can be determined as the late Norian–early Rhaetian what remarkably limits the previously suggested wide stratigraphic range of this formation reaching from the Keuper to the Middle Jurassic (Jakubowski, 1977).

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UPPER PLEISTOCENE AND HOLOCENE MOLLUSCS FAUNA FROM DANUBIAN PLAIN AREA (SLOVAK REPUBLIC)

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The territory of the Danubian Plain is covered with Upper Pleistocene and Holocene fluvial sediments of the rivers Danube and Váh and its tributaries. They are represented by litologically and facially diverse sediments. There is preserved local mollusc fauna – mainly gastropods and occasionally bivalves in these sediments. Associations of molluscs have been found at sites Štrkovec and Most pri Bratislave. Gastropod shells from both localities have been dated using AMS technique in Poznań Radiocarbon Laboratory in Poland.

From locality Štrkovec were dated gastropod shells of *Succinella oblonga* (Draparnaud) from a depth of 1 m (13 370 ±90 uncal. BP) and 3.5 m (13 410 ±70 uncal. BP). Obtained ages indicate Upper Pleistocene age of fossiliferous sediments. From locality Most pri Bratislave was dated gastropod shell of *Arianta arbustorum* (Linnaeus) from a depth of 0.75 m (1835 ±30 uncal. BP). This age indicate Subatlantic period.

The site Štrkovec (48°12'6.87"N; 17°50'37.89"E) is located between the villages Šoporňa and Dlhá nad Váhom. Upper Pleistocene terrace sediments of river Váh occur there. They are represented by sandy gravels changing to sands, in which in two horizons (1.0 and 3.5 m) mollusc fauna were found. Associations of mollusc fauna from the qualitative point of view are very similar in both depth horizons, differing only in quantitative representation of individual taxa. In mollusc associations occur terrestrial gastropods of loess steppes (*Pupilla muscorum* (Linné) and *Columella columella* (Martens)), hydrophilic (*Succinella oblonga* (Draparnaud) and *Euconulus fulvus* (Müller)) and freshwater (*Anisus vortex* (Linné), *Galba truncatula* (Müller), *Gyraulus laevis* (Alder) and *Stagnicola palustris* (Müller)) gastropods and bivalves (*Pisidium amnicum* (Müller)).

Based on the palaeoecological requirements of mentioned gastropod species can be state, that sands with the fauna of molluscs were deposited during the Last Glacial (Würm) in the former floodplain of the river Váh in overgrown stagnant to slow flowing waters – in the river branches, swamps and small, periodically flooded shallow lakes.

In the gravel pit near Most pri Bratislave (48°03'10,5"N; 17°15'44,1"E) are exposed Holocene flood deposits (0.6–1.9 m) overlying Upper Pleistocene fluvial gravels of river Danube. In the flood sediments – calcareous silts, was developed fossil soil (0.9–1.35 m; age of 4 760 ±35 uncal. BP; Subatlantic). In the calcareous silts (0.6–0.9 m) was found rich but poorly diversified association of gastropods.

In the gastropod association dominated species *Arianta arbustorum* (Linné). In large numbers have also occurred *Fruticola fruticum* (Müller) and *Trochulus striolatus* (Pfeiffer) in the association. In small amounts species *Cepaea hortensis* (Müller), *Ena montana* (Draparnaud), *Petasina unidentata* (Draparnaud), *Succinea putris* (Linné) and *Oxychilus cellarius* (Müller) were presented.

Based on the mentioned gastropod association it can be stated that during Subatlantic there was riparian forest located in the vicinity of Most pri Bratislave.

This work was suported by the project 05-12 Ministry of Environment of the Slovak Republic: Geological map of the Danubian Lowland – Danubian Plain in the scale of 1 : 50 000.

PALAEOZOIC FERNS WITH RACHIAL ANATOMY

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Ferns belong to the most common Palaeozoic plants. They were abundant and important component of the tropical forests. Several specimens of leptosporangiate ferns with sphenopterid type of leaves were studied including isolated sporangia, *in situ* spores and rachial anatomy. The most important species, *Dendraena pinnatilobata* Němejc from the Stradonice locality yielded well-preserved penultimate 3D preserved rachis. Compression specimens of *D. pinnatilobata* have penultimate rachis with C-shaped xylem strand and recurved slightly tapered arms which appertains to permineralised *Anachoropteris robusta* Group (Galtier & Phillips, 2014). Rachis of *Anachoropteris robusta* Group belongs to the pinnae of *Dendraena pinnatilobata*. It was possible to observe stomium, apical as well as ordinary cells and annulus with band-lateral-upper type. *In situ* spores of the *Microreticulatisporites harrissi* type are described for the first time.

The research was supported by the Grant Agency of the Czech Republic (GAČR P210-12-2053), partly supported by the research plan of the Institute of Geology of the Czech Academy of Sciences, v.v.i., RVO67985831 and also partly supported by the Grant Agency of Faculty of Science, Charles University in Prague (GAUK 704216).

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UPPER CRETACEOUS GLACIAL RAFTS IN THE VICINITY OF SZTUM AND DZIERZGOŃ (NORTHERN POLAND) – NEW PALAEONTOLOGICAL DATA

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Studied area is located in NW part of Iława lake district between of the Lower Vistula Valley and Żuławy Wiślane in northern Poland. First geological observations in this region have been made before origin of the Prussian Geological Survey, in 60's of 19th century, by German geologists, and A. Jentzsch mainly, who prepared geological map of Elbląg sheet. Unfortunately, this map is unattainable in Poland but the most important results of these detail studies were published in annual reports of this Survey. In the same time the first more precise information about Upper Cretaceous (Senonian) glacial rafts represented by siliceous/cherty marls and opokas were mentioned (Jentzsch, 1886) in Kalwa–Trankwice area. Publication new geological maps has been disrupted by the II World War, but fortunately, the manuscript of Sztum sheet (Körnke, 1939), has been made available for authors of reambulated detailed geological map of Poland (Gałązka *et al.*, 2013) by courtesy of dr A. Börner from archive of the German Geological Survey. Körnke (1939) investigated intentionally one of the biggest glacial raft, located *ca* 400 m south of Kalwa village, and determined of Cretaceous rocks at least 12 m in its original thickness by some dozen drills.

In 50's of the 20th century only Roszko (1955) mentioned again on these rafts, and therefore 150 years after their discovery we have some possibilities to made new, relatively deep borehole (153 m) up to Paleocene on the bottom, and first time drilled across whole Cretaceous ice raft, at least 30 m in thickness. The cherty, glauconitic limestones and hard marls are full of sponge, belemnite and bivalve fragments (indeterminate) and different type of trace fossils (*Planolites*-type mainly). In several thin sections we determined calcareous bioclasts, sponge spicules, echinoderm remains and foraminifers. Foraminiferal microfauna is mainly represented by planktonic forms belonging to numerous Senonian species of *Heterohelix* (*H. globulosa*), *Hedbergella*, and *P. elegans*, which are characteristic for Maastrichtian while washed rock material contains Campanian–Maastrichtian assemblages including mainly various benthic forms (osangulariids, anomalinids) accompanying with single planktonic foraminifera (*heterohelicids*) and ostracods. In studied samples numerous and good preserved calcareous nannoplankton also is noted. The presence of some species: *Calculites obscurus*, *Markalius inversus*, *Ceratolithoides verbeekii*, *Prediscosphaera honjoi*, and especially *Arkhangelskiella cymbiformis* and also lack of the younger forms suggested at least the early Late Campanian (CC 21). Finally micro- and macrofossils indicate the Late Campanian-Maastrichtian age for studied samples and probably for another rafts in studied region as well.

This study was supported by project of the Polish Geological Survey and AGH (DS No. 11.11.140.173).

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THE OCCURRENCE OF THE EARLY BADENIAN *HELICOSPHAERA WALTRANS* SPECIES IN THE POLISH PART OF THE CARPATHIAN FOREDEEP (KRAKÓW – OŚWIĘCIM AREA) AND POLISH OUTER CARPATHIANS

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Two biohorizons were distinguished by Švábenická (2002) within the Lower Badenian (Czech part of the Carpathian Foredeep) basing on calcareous nannoplankton analyses: *Helicosphaera waltrans* and *Sphenolithus heteromorphus* ones. The first one was divided into two parts; the lower is characterized by rare presence of *H. waltrans* and *H. ampliaperta*, discontinuously presence of *H. mediterranea* and occurrence of rare *S. heteromorphus*, *Discoaster variabilis* and *Calcidiscus premacintyrei* species. The upper part is featured by the common occurrence of *H. waltrans* in association with *H. carteri*, rare *H. walbersdorfensis*, *Reticulofenestra pseudoumbilica*, *Cd. premacintyrei*, *D. variabilis*, *Pontosphaera multipora*, *Umbilicosphaera rotula* and *S. heteromorphus* (discontinuously) and high number of reworked (mostly Late Cretaceous and Middle Eocene) forms. This species was presented under the name of *Helicopontosphaera* cf. *sellii* and regarded as synonym of *H. mediterranea* in association with *S. heteromorphus* from Karpatian and Badenian deposits of Hungarian part of Central Paratethys. Then Nagymarosy (Nagymarosy, 1985) admitted that the form described as *H.* cf. *sellii* represents the *H. waltrans* species. This characteristic large elliptical helicolith with two triangular openings with normally inclined broad bar in the central area and prominent wing differs decidedly from *H. mediterranea* and *H. sellii*. H. waltrans biohorizon has not been distinguished in the Polish sector of Carpathian Foredeep (and in Carpathians). As a species it was mentioned by Ślęzak (Oszczypko *et al.*, 1992) in the Late Badenian nannoassociation of the Nowy Sącz Basin. The *H. waltrans* species has been stated in the samples from the Kłodnica and Skawina formations designated in ten investigated boreholes of the western part of the Carpathian Foredeep in the Kraków-Oświęcim area (Garecka, in press; Pilarz, 2012). In Kłodnica Fm. it occurred in the Early Badenian (NN5) association with *C. pelagicus*, *H. carteri*, small *Reticulofenestra* spp., *R. pseudoumbilica*, reworked Cretaceous forms, sporadic *S. heteromorphus* and *H. walbersdorfensis*. It occurred in the samples from lowermost part of the Skawina Fm. (Dąb 4 borehole) in which the IIA (Moravian) foraminiferal assemblage was determined (Pilarz, 2012). The main part of this association was composed of *H. carteri*, *H. walbersdorfensis*, *H. intermedia*, *Calcidiscus* and *Umbilicosphaera* specimens and *S. heteromorphus*. In the samples from the upper part of the Skawina Fm. *H. waltrans* appeared mainly as individuals. In Cieszyn-Zebrzydowice area it occurred frequently in the nannoassemblage which indicating the lower part of NN5 Zone. In the Mała borehole in Skole Unit the association with *H. waltrans* and *H. ampliaperta* suggests the lower part of NN5. The specimens of *H. waltrans* were marked also in the samples from the Middle Miocene (Badenian) deposits investigated during the mapping of the detailed Polish Geological Map at a scale 1 : 50 000 sheets of Wojnicz, Tuchów, Pilzno, Głogów Małopolski and Krosno.

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AGE OF THE BROWN COAL DEPOSITS AT ZŁOCZEW, CENTRAL POLAND

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By means of pollen analysis 372 samples of organic sediment from four profiles of the lignite deposits (Złoczew 40, Złoczew 78, Złoczew 93, and Złoczew 96) were studied.

For sporomorph extraction 2 cm^3 of the peaty sediment were taken. The extraction was performed using a heavy liquid (flotation) method with $ZnCl_2$ (1.88 g/cm^3) and then followed by Erdtman's acetosysis. The results are summarized in 4 pollen diagrams.

The pollen taxa indicate that we are dealing in all the profiles with the deposits forming under warm and humid climate conditions, and floristic composition of pollen spectra unambiguously point for the Miocene age of these sediments.

The most complete pollen successions were obtained from the profiles: Złoczew 40 and Złoczew 93. A huge quantity of the Palaeotropical plant elements like *Engelhardtia*, *Platycarya*, *Fususpollenites fusus*, and *Quercoidites microhenrici* exclude the first (I) layer of brown coals (Ziembińska-Tworzydło, 1964; Ziembińska-Tworzydło & Niklewski, 1996; Worobiec, 2009). The pollen spectra of these two profiles very much resemble the spectra of brown coal from layers II and III indicating the early-mid Miocene age. Mentioned high share of the Palaeotropical elements even allows for a slightly suggestion that these sediments strictly correspond to the III brown coal layer. The similar situation is in pollen diagram from the profile Złoczew 78. In contrast, a slightly smaller share of the Palaeotropical elements in the profile Złoczew 96 may suggest that in this case the correlation with the II layer seems to be more plausible.

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NEW PALAEOBOTANICAL RESEARCH IN THE BOHEMIAN CRETACEOUS BASIN: TWO CASE STUDIES

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The studied material comes from sandstone of the Peruc-Korycany Formation of the Bohemian Cretaceous Basin. The Peruc flora was documented in two case studies.

In the first study, nearly five hundred Late Cretaceous plant fossil impressions from eleven institutions were analysed, based on their macromorphology (Greguš & Kvaček, 2015). All specimens came from the fluvial Cenomanian sandstone of Maletín, in the eastern part of the Bohemian Cretaceous Basin, and were first described by Heer (1869). Heer's type material was studied in detail, and several lectotypes were selected. In contrast to earlier observations, an important number of gymnosperms (12 taxa) were recorded. Ferns are represented by two taxa, and angiosperms by ten taxa. The following fossil plants were reported from Maletín for the first time: cf. *Microzamia gibba* (Reuss) Corda in Reuss, cf. *Zamites bayeri* Kvaček in Knobloch et Kvaček, *Cunninghamites ubaghsii* (Debey *ex* Ubaghs), *Dammarophyllum* sp., *Thuites alienus* (Sternberg), *Conago* sp. 1 and 2, *Masculostrobus* sp. 1 and 2; *Araliaephyllum kowalewskianum* (Saporta et Marion ex Velenovský) Greguš et Kvaček, *Dicotylophyllum* sp. 1–4. The following new combinations are published: *Gleicheniaceaephyllum kurrianum* (Heer) Greguš et Kvaček, *Myrtoidea geinitzii* (Heer *ex* Schimper) Kvaček et Greguš, *Araliaephyllum formosum* (Heer) Greguš et Kvaček, *Araliaephyllum kowalewskianum* (Saporta et Marion ex Velenovský) and *Dicotylophyllum macrophyllum* (HEER) Greguš et Kvaček.

The second study concerns fossil charcoal from several Czech Cenomanian localities, such as Pecínov, Brník and Prague – Hloubětín. The material was studied with regard to both taxonomy and palaeoenvironment, mainly using a scanning electron microscopy (SEM), but also a microCT. The first result will be presented during an upcoming meeting.

The study is supported by the Charles University in Prague, project GA UK 2016 No. 992916.

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STRATEGIES OF THE BRYOZOAN GROWTH-FORMS IN THE SARMATIAN REEFS: RESPONSE TO PALAEOECOLOGICAL FACTORS (CENTRAL PARATETHYS, WESTERN UKRAINE)

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The early Sarmatian bryozoans of cyclostomes and cheilostomes are important constituent of the carbonate buildups, and they are particularly well-represented in the facially different sediments of the serpulite-microbialites, organodetritic, and silty-marly deposits of the Medobory Hills situated between Ternopil and Kamianets Podilskyi of the northern Carpathian Foredeep (W Ukraine). The most conspicuous element in the reefs contributes to the multilamellar bryozoan bioconstructions differentiated in size and form, which show patchy distribution, and limited constructional role as frame-builder among the algae-dominated cryptic microhabits, formed by the superimposed, densely packed calcareous algal laminae, which act as a baffler and binder, associated with bryozoans as well as other organisms such as serpulids, and vermetids. Multilamellar constructions are evidentally formed by the *Schizoporella tetragona* (Reuss), particularly in north-central part of the Medobory reef-complex, where they build an erect, giant, massive, lamellar buildups, composed of hundreds of laminae and topographically widespread through the tens of kilometers, forming the main rigid multilamellar framework. These constructions show a rhythmic growth pattern and are composed of series of self-overgrowing layers varies from 20 up to more than 100 in number, fluctuating in thickness from 0.4–0.6 mm. A high diversity of solitary encrusters such as serpulids possibly belonging to *Hydroides*, foraminifers and ostracods incorporated into these colonies is probably connected with a periods of dormancy or cessation of growth of these colonies. In the thin-section the colonies are usually oriented horizontally as superposed, slightly bended or loosely packed laminar or concentric sheets with rather rare associated organisms confined to the interlaminar spaces. The multilamellar schizoporellids, which belong to the membraniporiform morphotype such as similar to crustones, which contribute to the frame construction and small dome-shaped, similar to globstone type colonies as well as laminar, peat-shaped, mushroom-shaped, plate-like ones are connected with environmental factors such as current intensity and availability of substratum, and their shape seems to depend on their location in the Sarmatian basin, where the colonies grew. The bryozoan growth forms can be correlated with various environmental factors such as water depth, substrate, water energy and sedimentation rate. The presence of membraniporiform as well as celleporiform morphotypes may suggest the shallow marine setting, moderate to high energy environment and relatively slow sedimentation rates of the Early Sarmatian basin, W Ukraine. The origin of the bryozoans is connected with the transgressive series of the Early Sarmatian in the top of a reef in the underlying Upper Badenian coralline algal-vermitid reefs. Frequently, massive colonies are developed in a high energy environment with rocky or coarse sandy bottoms in shallow and warm water, which occur at the base of a transgressive series. The analysis of the bryozoan growth-forms of the Medobory bryozoan assemblage with the dominant membraniporiform colonies either unilamellar and multilamellar suggests that the Medobory buildups were deposited at the shallow depth environment and the presence of the calcareous algae certainly implies deposition within a photic zone. The multilamellar, probably seasonal and cyclic growth, represented by the schizoporellid morphotype is helpful to define a hypothetical model of colonization of the Sarmatian basin of the Central Paratethys by the bryozoans, taking into account a number of local, regional and global factors. Usually, the development of the schizoporellid and celleporid colony growth-patterns occurs in the spatially restricted, transitional, geologically short-term settings, where most of the bryozoans are not able to cope.

CRETACEOUS ICHNOFOSSILS FROM CZECH REPUBLIC VISUALIZED WITH MICRO-TOMOGRAPHY

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Micro CT is also promising for investigation of palaeontological material. The importance of this technique for taxonomical purposes has been rising during last two decades. Virtual palaeontological data-capture techniques have improved enormously in recent years. Virtual specimens allow sectioning, where parts of the specimen can be isolated for clarity with no danger of damage to the actual specimen. Non-destructive tomographic techniques are diverse, and include many variants of X-ray computed tomography or CT, neutron tomography, magnetic resonance imaging or optical tomography (Sutton *et al.*, 2014). The aim of the present study is to show trace fossils of different types from the Czech Cretaceous, including insect eggs, visualized with micro-tomography in several case studies.

Micro CT study provides new perspectives of internal burrowing structures in marine shark coprolites, studied in the context of diagenesis and processes of phosphatisation. Up to now, such structures have been studied in thin slabs using optical microscopy.

Insect fossil coprolites are associated with many Cretaceous mesofossil floras. Absence of internal structures is typical for them. Micro CT observation of small hexagonal fossils from the Klikov and Peruc-Korycany formations proves their affinity to coprolites. From the same strata, there are recovered several types of insect eggs. They are assigned to genera *Knoblochia*, *Palaeoaldrovanda* and *Costatheca.*

The internal shell cavity of brachiopods presents a specific microhabitat for postmortem biological activity. Despite the material showing shell/infill contrast too weak for shell observations, it is still possible to observe trace fossils, and internal build-ups. This is the case of some brachiopods from the Late Turonian hemipelagial limestones of the Bohemian Cretaceous Basin. A sample *Gibbithyris semiglobosa* shell is shown. Morphological information gained from a micro CT can be fruitfully combined with other instrumental techniques such as SEM, optical microscopy or sectioning, allowing study of ultrastructure in detail.

Non-destructive tomographic techniques are also useful for study of microborers, macroborers and encrusters, for example of serpulid tube worms *Cementula* sp. from the Late Cenomanian near-shore facies of the Bohemian Cretaceous Basin. Encrusters are represented by cyclostome and cheilostome bryozoans, oysters and foraminifers. Boreholes were drilled by marine organisms like polychaete worms (*Trypanites*), female of acrothoracican cirripedes (*Rogerella*) or predatory gastropods (*Oichnus*).

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FORAMINIFERAL BIOSTRATIGRAPHY AND BATHYMETRY OF THE PALEOCENE–EOCENE DEPOSITS OF URDA AND BOBRUK FORMATIONS (SVYDOVETS NAPPE, UKRAINIAN OUTER CARPATHIANS)

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The Svydovets Nappe (corresponds to the Blyznytsia Sub-Nappe of the Dukla Nappe and prolongs the Silesian Nappe) belongs to the Outer Eastern Carpathians of the Inner Flysch Nappes (Fore-Marmarosh accretionary prism) formed in the front of the Tisza-Dacia Terrane (see Hnylko *et al.*, 2015 with references therein). This nappe is placed in the south-eastern part of the Ukrainian Carpathians and comprises: Lower Cretaceous black shales and quartzitic turbidites (Shypot Formation); Upper Cretaceous pelagic/hemipelagic variegated shales (Yalovets Formation) and dark grey claystones, marls, and psammites (Lolyn Formation *ca* 500 m thick); Senonian-Paleocene sandy thick- and medium-bedded turbidites (Urda Formation *ca* 1000 m thick); Paleocene–Eocene sandy predominantly thick-bedded turbidites (Bobruk Formation *ca* 1500 m thick) and minor extensions in the outer thrust sheet of the nappe Oligocene deposits (Menilite and Krosno formations).

The several sections of the Urda and Bobruk formations were investigated along the Luzhanka River and Skorohovatyi Stream (Teresva River Basin) and preliminary partly described (Hnylko & Hnylko, 2012).

A total of 61 species of foraminifera were identified in the studied sections: 55 species of agglutinated foraminifera, 3 species of planktonic foraminifera and 3 species of calcareous benthic foraminifera. Determination of agglutinated species was carried out following to Kaminski and Gradstein (2005). The foraminiferal zonations of the Ukrainian Carpathians (Hnylko & Hnylko, 2012) in accordance with the zonations of Olszewska (1997) is applied here. Paleocene, Lower to Upper Eocene deposits were established in the studied sections. Biozones based on agglutinated foraminifera have been identified in these deposits.

Rzehakina fissistomata sensu lato Zone (Paleocene) was identified in the part of the Urda Formation and in the lower part (up to 550 m thick) of the Bobruk Formation. *Glomospira charoides–Recurvoides smugarensis* Zone (Lower Eocene) was distinguished in the portion of the Bobruk Formation (100–700 m in thickness). The *Reticulophragmium amplectens* Zone (Middle Eocene) was identified in the higher portion of the Bobruk Formation (180–450 m). The *Ammodiscus latus* Zone (upper Middle Eocene) was identified in the green mudstones (up to 30 m thick) and *Reticulophragmium rotundidorsatum* Zone (Upper Eocene) was recognized in the green and red mudstones (50 m thick) in the topmost part of the Bobruk Formation.

The foraminiferal assemblages from studied sections of Urda and Bobruk formations made up of agglutinated forms (98–100%). Paleocene and Middle-Late Eocene assemblages are characterized by moderate and high special diversity. Impoverished Early Eocene assemblage is characterized by lower special diversity and contains monoassociations "Glomospira" and "Karrerulina". The foraminiferal assemblages from studied deposits indicate bathyal and abyssal palaeodepth, according to palaeobathymetry of agglutinated species (Kaminski & Gradstein, 2005) in the Tethys region.

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RHAETIAN NANNOPLANKTON FROM THE TATRA MOUNTAINS, WESTERN CARPATHIANS

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The Kardolína section crops out on western slope (the Husár Hill) of the Mt Lendacká Pálenica at the easternmost termination of the Tatra Mts near the Tatranská Kotlina. This section belongs to the Bujačí partial nappe (a part of the Krížna Nappe). It yields the most complete record of the Rhaetian marine transgression into the Zliechov Basin (Fatric Domain) of the Austro-Alpine – Central West Carpathian block. The sequence exposed continues up to the Triassic/Jurassic boundary interval. A comprehensive study of numerous fossils, lithology, mineralogy, lithostratigraphy, cyclostratigraphy, geochemistry and rock magnetism has provided excellent detailed information on environmental changes during the latest Triassic time (Michalík *et al.*, 2010).

The fossil fauna comprises important index bivalve molluscs (*Rhaetavicula contorta*, *Placunopsis alpina*, *Chlamys valoniensis*), brachiopods (*Rhaetina gregaria*, *Austrirhynchia cornigera*), corals, echinoderms, fish teeth and foraminifers (*Triasina hantkeni*, etc.) and many other forms (Michalík *et al.*, 2013). These data have been recently supplemented by finding of calcareous nannoplankton remnants. Besides calcispheres and spherical nannoliths also monospecific assemblages of small (2.5–4.0 µm) circular coccoliths with small central opening were recorded. Coccoliths are very rare, usually 2–5 coccoliths were recorded per 100 fields of view of microscope. Exceptionally, abundances reach 1–3 specimens per one field of view.

Preliminary conclusions showed that:

1) spherical nannoliths strongly prevail; coccoliths are very rare;
2) distribution of nannoplankton negatively correlates with the degree of diagenetical alteration;
3) surprisingly, coccoliths appear already in lower part of the sequence deposited in mixed (semi-restricted marine lagoon affected by sea storms) environment of shallow carbonate ramp;
4) nannoplankton disappeared before the Triassic/Jurassic boundary after two partial extinction events affecting both benthos and microfauna.

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A MULTI-PROXY STUDY ON SEDIMENTS AND MAMMAL REMAINS FROM ŁAWY PALAEOLAKE (EAST POLAND) – EEMIAN AND VISTULIAN RECORD OF THE PALAEOENVIRONMENTAL CHANGES

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In the area of the South Podlasie Lowland (SE Poland) nearly 100 sites with biogenic sediments of the Eemian Interglacial (MIS 5e) have been discovered. Such a large amount of sites indicates the presence of the fossil Eemian Lakeland.

The Ławy site, in the Paterebo stream valley, is another very important location with deposits of Eemian to the Vistulian, where on the basis of interdisciplinary research (palynological, Cladocera, ostracods, molluscs, mammal remains, lithological and radiocarbon dating) managed to reconstruct palaeoenvironmental changes caused by the climatic conditions and their resulting fluctuations in the water level and reconstruction of local conditions in a wide context of global climatic changes.

At the Ławy palaeolake pollen succession is a reflection of climate change from the Eemian to the Vistulian. At the end of the Eemian Climatic Optimum, the area was dominated by deciduous forests mixed with *Carpinus* and *Corylus* (E5). The gradual cooling resulted in the spread of forests of *Picea* and *Pinus* (E6) to total domination of *Pinus* at the end of the interglacial (E7). From the beginning of Vistulian retreated communities of forest and open areas communities was dominated. Because of probable sedimentary gaps we cannot attribute all zones to a specific succession phase definitively. Probably just the Herning Stadial (EV1, GS-26) is in chronological accordance.

The Cladocera assemblages mainly reflected changes as regards temperature, trophic levels, but also changes of water level in the analyzed palaeolake. The highest water level and favourable conditions for zooplankton development occurred during the Eemian optimum (E5), and at the beginning of the Eemian post-optimum (E6, E7) and Early Vistulian, when probable influence of Paterebo stream took place. The highest trophic level took place in the optimum of the Eemian.

Pollen, cladocerans, molluscs and ostracods at Ławy indicate the existence of a small, shallow, well-vegetated palaeolake in a warm climate of the Eemian optimum. Then the lake was transformed into a mire during the final phase of the Eemian. In the Early Vistulian, the variable hydrological conditions were the main stimulus for the development of the study area. Further functioning of the Ławy site was closely associated with periodic coexistence of limnic, telmathic and river environments.

The remains (teeth and bones) of four representatives of megafauna "*Mammuthus – Coelodonta*" complex were recognized: *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Bison priscus* and *Equus ferus*. Well-preserved mammal fossil remains was accompanied by organic deposits which also have been subjected to pollen analysis. It indicates on the stadial age of sediment from the remains. It is probably the Hengelo Interstadial (GI-8c), which has been established thanks to the ^{14}C date from the mammoth mandible. Ławy site is the first site in Poland where the remains of Pleistocene mammals were found in the Vistulian peat.

JURASSIC OSMUNDACEAE AND MATONIACEAE FERNS FROM CENTRAL AND SOUTHERN POLAND

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Ferns were dominant elements of land vegetation and represented almost all contemporaneous families during the Mesozoic (van Konijnenburg-van Cittert, 2002). Palaeobotanical and palynological research shows that two fern families – Osmundaceae and Matoniaceae were important components of floral composition in central and southern Poland during the Jurassic (Rogalska, 1956, 1976; Ichas, 1986; Ziaja, 2006; Pacyna, 2013; Barbacka *et al.*, 2014; Jarzynka, unpubl.; Krupnik *et al.*, 2014). The Early Jurassic Osmundaceae ferns from the Holy Cross Mts. included the genera *Cladophlebis* and *Todites* while Matoniaceae were represented by *Phlebopteris*. Osmundacean spores were noted in the palynological samples from Gutwin (Rogalska, 1976) and Odrowąż (Ziaja, 2006). Similar dispersed spores were described also from Lower Jurassic sediments of the area Mroczków-Rozwady (central Poland) by Rogalska (1956). The taxonomic diversity of Osmundaceae and Matoniaceae from the Middle Jurassic flora of Grojec (southern Poland) was higher: eleven species from one locality belonged to the families mentioned (Jarzynka, unpubl.). The palynological research of Grojec clays confirmed the presence of both families (Ichas, 1986; Ziaja, unpubl. data). Similar spore taxa (*Todisporites* sp., *Osmundacidites* sp. and *Matonisporites* sp.) were observed in the Middle Bathonian sediments of Gnaszyn (Gedl & Ziaja, 2012) and in Aalenian to Bathonian sediments of Gutwin well core (Rogalska, 1976). So far, neither macroremains nor spores of Osmundaceae and Matoniaceae have been noted from the Late Jurassic of central and southern Poland.

This project was supported statutory funds of the W. Szafer Institute of Botany, Polish Academy of Sciences.

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SEASONAL RECORD OF THE STABLE OXYGEN AND CARBON ISOTOPES IN THE LATE BADENIAN MOLLUSCS FROM THE CENTRAL PARATETHYS (WESTERN UKRAINE)

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Stable oxygen and carbon isotopes have been analyzed along the growth transect on shells of the gastropod genus *Turritella* Lamarck and bivalve scallop species *Flabellipecten besseri* (Andrzejowski) collected from the shallow marine Upper Badanian deposits in the western Ukraine (Central Paratethys). The *Turritella* sp. comes from calcareous sands in the Zhabiak section which is located in the Medobory backreef setting whereas the scallop comes from quartz sands in the Varovtsi section in more nearshore position. A deposit containing analyzed shells formed in normal marine water as is indicated by the presence of rich marine biotic assemblages with stenohaline elements.

Measured isotopic profiles both in the case of *Turritella* sp. and *Flabellipecten besseri* cover *ca* two years of shell growth. Both shells show distinct seasonal variations in oxygen isotopic values that mirror annual temperature oscillation. The *Turritella* $\delta^{18}O$ variations are as large as 1.7‰ (from *ca* –0.5 to 1.3‰ PDB) what corresponds to *ca* 8°C temperature range (from *ca* 15 to 23°C assuming $\delta^{18}O$ of the Badenian water equal to 0‰ SMOW). Measured $\delta^{18}O$ variations in the scallop shell reach almost 3.5‰ (from *ca* –2.6 to 0.85‰ PDB) which corresponds roughly to 12°C (from *ca* 12 to 27.5°C if assume $\delta^{18}O$ of water 0‰ SMOW). $\delta^{13}C$ profiles generally do not show any seasonal variability both in the analyzed gastropod and in the scallop shells. The *Turritella* $\delta^{13}C$ values range generally between 3 and 3.5‰ PDB increasing slightly in the course of the snail ontogenetic growth. The scallop shell, in contrary, shows distinct decrease in $\delta^{13}C$ with age from *ca* 1.6 to around 0‰ PDB in the analyzed shell segment.

PARADOXES OF THE CALCAREOUS NANNOPLANKTON BIOSTRATIGRAPHY OF THE UHRYŃ SECTION (BYSTRICA SUBUNIT OF THE MAGURA NAPPE)

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The Paleogene litho- and biostratigraphical profiles of the Nawojowa, Łabowa and Uhryń sections belong to the best recognized, in middle sector of the Bystrica Subunit in Poland (Węcławik, 1969; Sikora, 1972; Oszczypko, 1973, 1979; Bromowicz & Górniak, 1988). In this area Oszczypko (1991) distinguished the following lithostratigraphic units: Łabowa Formation (variegated shales), Beloveza Fm. (thin-bedded flysch), Żeleźnikowa-Bystrica Fm. (medium-bedded flysch with Łącko type marls) and Magura (thick-bedded muscovitic sandstones) Fm. The age determination of Early Eocene, Early/Middle Eocene, Middle Eocene and Middle/Late Eocene of these formations was based on foraminifera and calcareous nannoplakton studies (Dudziak, 1991; Oszczypko *et al.*, 1992). In later years, the disbelief aroused, when Early Miocene nannofossils assemblages were found in sediments of Bystrica zone near Biegonice and at the mouth of Żeleźnikowa Stream to Poprad River (Oszczypko *et al.*, 1999; Oszczypko-Clowes & Oszczypko, 2002).

In the Uhryń Stream the Paleogene deposits of the Bystrica Subunit are exposed in the 3 thrust-sheets of the North–East vergency. The first two thrust-sheets are composed of the Łabowa, Beloveza and Żeleźnikowa formations, while the third thrust-sheets displays the Beloveza, Żeleźnikowa and the Magura formations. During the field works geological profiling and samples collecting were conducted.

The vast majority of the examined samples yield very poor and badly-preserved nannofossil assemblages. For the purpose of biostratigraphic analysis the standard zonation of Martini (1971) was used. The scarcity of index species makes the age determination very difficult. However, in some cases the assemblages were rich enough, enabling zonal assignment. The age results from Uhryń section are as follows: Łabowa Fm. – Early/Middle Eocene (NP15–16), Beloveza Fm. – Middle Eocene (NP16–17), and Żeleźnikowa Fm. – Late Oligocene (NP23–24). The biostratigraphical results show the stratigraphical gap spaning from NP18 until NP22 nannozones. The origin of this gap need to be explained and further research is necessary.

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EARLY SILURIAN FORAMINIFERA FROM THE QUSAIBA SHALE, QASIM REGION, SAUDI ARABIA

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An Early Silurian foraminiferal assemblage has been found in the Qusaiba Shale Formation in the Qusaiba type section in Old Qusaiba Village, in the Qasim Region of Saudi Arabia. The Qusaiba Shale is of great importance due 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, near the contact with the overlying Sharawra Sandstone Formation. Samples from the lower part of the Qusaiba Shale are barren of microfossils owing to the anoxic palaeoenvironment. Foraminifera-bearing samples were recovered from clastic silty shale 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 comprised of thirteen genera: *Saccammina*, *Thuramminoides*, *Thurammina*, *Tolypammina*, *Hyperammina*, *Bathysiphon*, *Rhizammina*, *Rhabdammina*, *Psammosphaera*, *Glomospira*, *Lituotuba*, *Lagenammina* and *Ammodiscus*. Some of the foraminiferal species are likely to be new to science. Our finding represents the first discovery of Early Silurian Foraminifera in northern Gondwana.

BERING SEA INSIGHTS INTO HIGH LATITUDE STRATIFICATION, PRODUCTIVITY AND UPWELLING OVER THE PAST 1.5 MYR

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The mid-Pleistocene Transition (MPT), *ca* 1.2–0.6 Myr ago, marks the shift from small amplitude 41 kyr to large amplitude *ca* 100 kyr glacial-interglacial cycles, characterised by global cooling, ice sheet expansion and ocean circulation changes. As there was no long term shift in Earth's orbital insolation to account for the lengthening glacial cycles and global cooling, the ultimate cause of the MPT is still under debate, with hypotheses focussing on the carbon cycle, ocean circulation, ice sheet dynamics and sea ice changes at high latitude. At the approximate mid-point of the MPT, the so-called 900-kyr event of Marine Isotope Stages (MIS) 22–24 marks the onset of the first 100-kyr cycle, stepwise ice sheet build up on Antarctica, and a fall in deep ocean $\delta^{13}C$ signifying a reorganisation within the global carbon cycle. Ocean circulation studies indicate a global slowdown may have occurred, and hypothesise CO_2 removal from the atmosphere and storage in the deep ocean. However, there is still a paucity of high resolution proxy records with which to characterise these palaeoceanographic changes, particularly in the subarctic North Pacific which is a region of upwelling CO_2-rich water today.

The Bering Sea is the third largest marginal sea in the world after the Mediterranean and South China Seas. Site U1343, IODP Expedition 323, is situated near the continental slope, and its high latitude location makes it sensitive to changes in sea ice and glacial meltwater input, which caused large fluctuations in stratification, primary productivity and deep water properties. The Bering Sea has open connections to the North Pacific making it an important location to monitor subarctic North Pacific palaeoceanography. New high-resolution proxy records presented here, including foraminiferal isotopes, bulk sediment isotopes and dinoflagellate assemblages, elucidate deep and surface ocean changes over the time period 1.04–0.84 Ma ago (MIS 28–21). Results indicate a significant shift occurred in the cyclicity of primary production, sediment accumulation and deep sea stratification, from the 40-kyr glacial cycles into MIS 22. Comparison with other records worldwide indicates a step change occurred in the high latitudes, with the enhancement of stratification and upwelling possibly impacting global climate.

A NEW CHIONELASMATINE BARNACLE (CIRRIPEDIA: BALANOMORPHA) FROM THE BOHEMIAN CRETACEOUS BASIN (CZECH REPUBLIC) THE FIRST BONA FIDE NEOBALANO FORM FROM THE MESOZOIC – PRELIMINARY REPORT

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This is an exceptional fossil record of a new sessile cirripede from a nearshore/shallow water facies at Předboj near Prague, Czech Republic. The specimen is comprised of four articulated parietal plates – carina, right carino-lateral, right rostro-lateral and a fragment of the rostrum. The left carino-lateral, left rostro-lateral and the bulk of the rostrum are not preserved. The nature of the operculum and imbricating plates is unknown. The shell is smooth, medium-low conic, and would have comprised six compartmental plates – the unpaired C & R and the paired RL & CL. Parietal margins with proto-radii overlap alae that extend from the RL and CL; these are wider nearer the summit, with width increasing by accretion of fine ridges, separated by well-formed longitudinal grooves, running sub-parallel to the articular margin. These ridges represent successive growth increments, with new ridges and grooves gradually added towards the summit; RL and CL rhomboid, with summits parallel to the base; C semi-conic; RL height, 16 mm, width at base 9.9 mm; CL height 9 mm, width at base 13 mm. A reconstruction of this specimen shows a moderate profile which is similar to that of the "turtle barnacles". We suggest the form of this specimen is consistent with that required in attachment to living substrates such as ammonites or reptiles, both of which are recorded in the Bohemian Cretaceous Basin. This new chionelasmatine, with a 6–plated configuration, is similar to the most primitive known living balanomorph, *Eochionelasmus*. A transverse-section of the compartment wall shows ghosts of what appear to be interlaminate figures. The compartmental configuration in this specimen was evidently derived from the brachylepadomorph wall, R-C+IPs (Newman, 1987, Fig. A, C; Newman & Yamaguchi, 1995) by transfer of a pair of CLs and subsequently RLs from the imbricating whorls to the primary wall. An intermediate configuration, R-CL-C+IPs, between these two, is preserved in *Epibrachylepas* from the upper Lower Campanian at Ivö Klack (Gale & Sørensen, 2015, Fig. 4A). Although Gale & Sørensen (2015) proposed that homologies of lateral plates in balanomorph are incorrect and that the CL be re-designated as M (marginal) we are confident that their M plate is actually a perfectly acceptable CL.

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ALBIAN–CENOMANIAN AND SANTONIAN–CAMPANIAN MICROFOSSILS AS INDICATORS OF CHANGING PALAEOCLIMATES (EASTERN EUROPE SECTOR OF RUSSIA)

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The main palaeoceanographic features of the Russian Platform and Crimea–Caucasus area were controlled by the Tethyan/Boreal connection through straits and the influence of sea-level changes. Tectonics during Albian–Cenomanian formed the whole area when rifting took place in the Crimea–Caucasus area. This event resulted in the closing of the Russian Platform longitudinal strait and the opening of a latitudinal sea connection with the European basins and the Tethys region (Nikishin *et al.*, 2008). It is reflected in the foraminiferal zonations for the Upper Cretaceous which are very similar for Western and Central Europe.

The Cenomanian was a time of diversification of the rotaliporids. In the Cenomanian successions of the study area, there are at least 4–5 species of the genera *Thalmanninella* and *Rotalipora.* The most important group for biostratigraphy of the Russian Platform was calcareous benthic foraminifera, for which a detailed zonation was proposed recently. The planktonic foraminiferal associations with Tethyan assemblages are known only from the Crimea and from the North Caucasus. Among radiolarians, most of *Crolanium* species and last representatives of dictyomitrids, cyrtocapsids, and stichocapsids with the sagittate initial chamber and distinct longitudinal rows of pores became extinct at the Albian–Cenomanian boundary. Simultaneously, new genera *Guttacapsa* and *Lipmanium* appeared, being accompanied by mass development of pseudoaulophacoid discoid forms. These data indicate a warming and replace links between basins, that is, the prevailing influence of the Tethys.

During the Turonian–Coniacian interval the Tethyan Ocean extended to the north as evidenced by: (1) the increase in taxonomic diversity of planktonic foraminifera, (2) by the dominant role of specialized morphotypes such as the new group marginotruncanids; (3) high and stable relationship planktonic/benthic foraminifera (50–70%, sometimes higher). The Turonian–Santonian interval is also characterized by the development of most radiolarian morphotypes.

Since the latest Santonian within the water mass of the Russian Platform there was a gradual cooling. The uppermost Santonian–Lower Campanian are characterized by taxonomically poor assemblages of planktonic foraminifera as the variety of marginotruncanids reduced, and new morphotypes such as globotruncanids developed gradually and not immediately achieved a high diversity (Kopaevich & Vishnevskaya, 2016). The cold water near the Santonian–Campanian boundary confirmed depletion of nannoplankton, the appearance of family Prunobrachidae among radiolarians and the presence of taxa adapted to the boreal environment. The cold Boreal water influence (siliciclastic facies) is recognized along the northern margin of the Russian Platform. The later factor determines the importance of the siliceous microfauna (radiolarite) for this region. Periodical opening of the Turgai and Middle Ural straits (Coniacian–Early Campanian) resulted in migration of some species in both directions. The distribution of foraminifera and radiolarians in key sections of Baksan and Urukh (North Caucasus) showed co-occurence of tropical and boreal species, which can be used as a link for the Boreal and Tethyan correlation of biostratigraphic schemes (Kopaevich & Vishnevskaya, 2016).

This work was supported by IGCP project 609, RFBR grants 15-05-04700 and 15-05-04099.

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PALAEOENVIRONMENT OF MIXED SILICICLASTIC – CARBONATE DEPOSITION IN BOREHOLE BRUS-1 (CARPATHIAN FOREDEEP, CZECH REPUBLIC)

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The Neogene deposits of studied area represent the sedimentary infill of the westernmost part of the Carpathian Foredeep. The basin-fill consists mainly of the Early Badenian deposits. Miocene sedimentation history of the Brus denudation relict was studied on the material from the borehole Brus-1 drilled with the depth of 20 m of the various silt/siltstones, sand/sandstones and limestones. The drill core was sampled by 0.5 m in the range of 3.0–20.0 m. Detailed multiproxy lithofacies and biofacies analysis based on sedimentological, gamma spectrometric, foraminiferal, calcareous nannoplankton, molluscs, brachiopods and otoliths data allows facies and palaeoenvironment interpretation. The studied profile is represented by two lithologically different associations: FA1 (20.0–7.5 m, monotonous siliciclastic lithofacies) and FA2 (7.5–3.0 m, carbonate lithofacies). FA1 supposed shallow marine depositional environment, below the normal wave base, above the photic zone and the base of storm waves. Start of deposition of FA2 reveals dune movements on the sea bottom. The upper carbonate facies of FA2 represents a wave-worked, shallow-marine littoral environment. Shallow, subtropical, marine environment is indicated also by present molluscs (pectinids, oysters), brachiopods (*Discradisca* sp., *Argyrotheca* spp., *Joania cordata*) and fish fauna (*Diplodus* spp., *Sparus* spp., *Pagrus* spp.) as well as by large benthic foraminifera (*Planostegina* spp., *Heterostegina* spp.) and epiphytic foraminifera (*Elphidium* spp., *Asterigerinata planorbis*, *Cibicidoides* spp.). The FA1/FA2 boundary shows a drop of the K and Th concentrations, and the Th/U ratio, but a rise in the Th/K ratio. This change in radioactive element contents may indicate a significant decrease in terrestrial sediment input, which is further confirmed by the onset of limestone deposition. Generally, the causes of reduction of clastic material into the basin may be different (*e.g.*, changes of sea level, climatic changes). Changing of deposition regime and the decrease in clastic input into the basin may be related to changing of a precipitation regime. In the range of 20.0–13.0 m, the low salinity foraminifera (*Ammonia tepida*, *Porosononion granulosum*) are highly abundant which could indicate increased rainfall. Linked to this is the nutrient enrichment of the sea bottom water evidenced by the presence of the high nutrient taxa (*Valvulineria complanata*, *Melonis* spp.). This caused the mixing of bottom and surface waters accompanied by the occurrence of abundant calcareous nannoplankton "upwelling" taxa *Coccolithus pelagicus*, fluctuation of cold and warm water planktonic foraminifera (*Globigerina bulloides/praebulloides* and *Globigerinella regularis*) as well as benthic suboxic taxa (*Bolivina* spp., *Bulimina* spp., *Uvigerina* spp.). Alternation of siliciclastic lithofacies by limestone ones could be due to a significant reduction in the rainfall amount and the decrease in the input of terrestrial material into the basin. Limestone facies is characteristic by marked decrease of abundance and diversity of fossil assemblages with disappearance of large benthic foraminifera, planktonic, high nutrient and suboxic taxa and accompanied by marked increase of epiphytic taxa. The differences in the abundance of fossil organisms between FA1 and FA2 associations probably reflect temperature and water chemistry differences caused by carbonate productivity.

CALPIONELLID ZONATION OF THE TITHONIAN–BERRIASIAN EXOTIC LIMESTONES FROM THE POLISH OUTER CARPATHIANS (SILESIAN AND SUB-SILESIAN NAPPES)

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Upper Jurassic–Lower Cretaceous limestones occur in the form of klippen (*e.g.*, Andrychów Klippen), boulders and pebbles in the Outer Carpathians. They represent remnants of carbonate sedimentation which took place along the margins of the proto-Silesian Basin. These exotic rocks are located among the younger deposits belonging to various formations. The studied rocks were collected from 31 localities situated within the western part of the Silesian and Sub-Silesian nappes of the Polish Outer Carpathians, from deposits of the Early Cretaceous to the Oligocene age.

Calpionellids have a significant biostratigraphic importance for Tithonian and Lower Cretaceous rocks. Species and assemblages typical of the Chitinoidella, Crassicollaria and Calpionella zones (latest Early Tithonian–Early Berriasian) (zonation after Reháková, 1995) were found in 130 studied samples.

Only few samples represent the Dobeni Subzone (latest Early Tithonian) of the Chitinoidella Zone, and only 2 species were determined: *Daciella danubica* and *Dobeniella colomi*. The Boneti Subzone (earliest Late Tithonian) with numerous chitinoidellid species (*Chitinoidella boneti*, *Ch. carthagensis*, *Ch. elongata*, *Ch. hegarati*, *Ch. popi*, *Dobeniella cubensis*, *D. tithonica*, *Daciella* aff. *almajica/banatica*, *Longicollaria* cf. *dobeni*, *L. insueta*, *Popiella oblongata*) more often can be recognized.

The Praetintinnopsella Zone was not evidenced, but numerous exotic limestones belong to the Crassicollaria Zone (latest Tithonian). *Tintinnopsella remanei*, *T. carpathica*, *Crassicollaria intermedia*, *Cr. massutiniana*, *Cr. parvula*, *Praetintinnopsella andrusovi* and single *Calpionella alpina* occur in the oldest subzone (Remanei Subzone). *Cr. parvula*, *Cr. massutiniana*, *Cr. brevis*, *Cr. intermedia*, *Cr. colomi*, *T. carpathica* as well as morphologically diversified forms of *C. alpina* are typical of the younger part of the Crassicollaria Zone, but subzones – Brevis and Colomi – are usually hard to distinguish.

Numerous small and circular *C. alpina* are the main component of the Alpina Subzone of the Calpionella Zone (Early Berriasian). *Cr. parvula* and *Tintinnopsella* sp. also appear in this subzone. Middle subzone – Ferasini – was not recognized, whereas co-occurrence of *C. elliptica*, *C. alpina*, *C. minuta*, *Cr. parvula*, *Remaniella duranddelgai*, *Remaniella* sp. and large forms of *T. carpathica* indicates upper subzone – the Elliptica Subzone.

Calpionellids of the Elliptica Subzone were found only in the samples of limestones representing deposits of deeper facies. Calpionellids of lower subzones and zones occurs also in limestones typical of platform and slope of platform (so-called Štramberk-type limestones), what agrees with data from the similar limestones of Štramberk in Moravia (Houša, 1990).

This research has been financially supported by National Science Center in Poland, grant No. N N 307 057740, Brian J. O'Neill Memorial Grant-in-Aid for Ph.D. Research 2014, and grant UJ ING No. K/ZDS/001463.

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THE EARLY JURASSIC *LITHIOTIS*-TYPE BIVALVES BEDS IN OUAOUIZERTH AREA (MOROCCAN HIGH ATLAS) – PRELIMINARY PALAEOENVIRONMENTAL RESULTS

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The so-called *Lithiotis*-facies (*sensu* Fraser *et al.*, 2004) is represented by world-wide Pliensbachian–Early Toarcian limestones with large bivalves (their huge shells are even up to 40–50 cm long) dominated by *Lithiotis*, *Cochlearites*, *Gervileioperna*, *Litioperna*, *Mytiloperna* and/or *Opisoma* genus. After Triassic/Jurassic mass extinction event, when coral reefs decreased and almost collapsed, such type of bivalves occupied shallow-marine/lagoon-type environments and recovered organic buildups (mounds/reefs/biostromes) in numerous places of Tethyan–Panthalassa margins during this time (Krobicki & Golonka, 2009). The Moroccan High Atlas Mountains are one of the classical site of *Lithiotis*-type bivalves-bearing buildups which occur in numerous localities (*e.g.*, Jebel Azourki – Assemsouk section, Er-Rachidia region – Dar-el Hamra and Aït-Athmane sections) (Lee, 1983; Fraser *et al.*, 2004; Krobicki *et al.*, 2008; Wilmsen & Neuweiler, 2008) including Ouaouizerth area as well. In this region one of the best place of *Lithiotis*-facies limestones crop out along road from Ouaouizerth to Beni Mellal. Long, continuous section of over 200 meters in thickness is mainly built by well-bedded different kinds of limestones (*e.g.*, oncolitic/oolitic, biodetritic, laminated) intercalated by multicolored marls (reddish in lower part and yellowish in upper). Bivalves-rich beds constitute at least eight horizons, where they occur both in vertical, autochthonous life position, and in horizontal orientation as parautochthonous accumulations. In a few places lens-shape beds, full of bivalves shells, indicate original, *in situ* biostrome character. Bivalves are dominated by *Litioperna* specimens in lower and upper parts of the section and a few *Gervileioperna* and *Opisoma* which occur in the middle part of it. Another fossils are represented by gastropods, solitary corals and echinoderm fragments and algae remains occur sometimes as well. Numerous shell-beds have typical for tempestites features (sharp soles of beds, fractionation of shell remains). Several omission surfaces occur, and some intercalations of synsedimentary brecciation presumable indicate emersion events during sedimentation of these beds. Such sedimentological and palaeoecological features indicate supratidal and/or peritidal environments for different parts of sequence.

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THE EARLIEST CRETACEOUS (BERRIASIAN) ŠTRAMBERK-TYPE CORALS IN TRANSBORDER ZONE OF THE UKRAINIAN AND ROMANIAN CARPATHIANS

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The Štramberk-type limestones are known exclusively by large olistoliths in the Outer Flysch Carpathians, (*e.g.*, Štramberk vicinity in Moravian part of Czech Republic – Eliášová, 2008; Vašíček & Skupien, 2016; with its famous coral fauna known from the 19th century – Ogilvie, 1897) and/or isolated exotic coral limestone blocks/boulders/pebbles (Kołodziej, 2003; Hoffmann & Kołodziej, 2008; Morycowa, 2012), which occur now within Cretaceous–Paleogene flysch units. Recently we discovered new locations of such type of coral-bearing limestones in the Ukrainian–Romanian transborder zone (both in Ukrainian Carpathians: vicinity of Rachiv (Kamyanyi Potik, and Chyvchynian Mts), and in Romanian Maramureş Mts (Mihailecul Mount)), where Štramberk-type limestones occur within volcanogenic-sedimentary deposits (Kamyanyi Potik Unit – in Ukraine = Black Flysch – in Romania). These deposits (Zapałowicz, 1886; Pazdro, 1934; Hnylko *et al.*, 2015 with references) are represented by: basaltic pillow lavas, volcanic debris flows with olistoliths/pebbles (including Štramberk-type limestones with corals) and/or pyroclastic turbiditic units of the earliest Cretaceous (Berriasian) age, according to calpionellid dating. Corals are dominated by zooxanthellate scleractinian Dermosmiliidae representatives of pseudo-colonial phaceloidal forms (branched, corallites subparallel – *Calamophylliopsis* aff. *cervina* (Etallon, 1860)) and rare solitary flabelloid-meandroid skeletons and broken meandroid coral colonies (Rhipidogyridae: *Rhipidogyra* sp. and *Placogyra* aff. *hykeli* Eliášová, 1973) respectively, and small branched-arborescent (dendroid) forms of hexanthiniarian Amphiastraeidae (*Pleurophyllia* sp.) as well. They occur together with microbial crusts and constructed coral-microbial consortium which occupied relatively quiet, shallow-water environment as reef mounds on the carbonate platform which surrounded active volcanoes.

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JURASSIC CRABS FROM POLAND – A REVIEW OF THEIR DISTRIBUTION, PALAEOECOLOGY AND PHYLOGENY

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Decapod crustaceans are one of the largest association of extant marine invertebrates and are represented by almost fifteen thousand of species (14,750) including brachyuran crabs [over seven thousand species – 7,224 after Davie *et al.* (2015) calculation]. However, in the fossil record are about 3,700 species of decapod crustaceans (over 1,000 genera) (Schweitzer & Feldmann, in press) and over two thousand species (2,100) of crabs (Schweitzer *et al.*, 2010). Therefore the history of evolution of this group is matter of long, hot debate both from stratigraphical and palaeoecological point of view and their phylogenetical consequences. The first, oldest, unequivocal and most "primitive" crab is known from Early Jurassic (Pliensbachian) time – *Eoprosopon klugi* Förster (Schweitzer & Feldmann, 2010; Haug & Haug, 2014; Jagt *et al.*, 2015) and recently was determined by Krobicki & Zatoń (2016) as *Pliensbachian Brachyuran Origin Event*. But Toarcian and Aalenian gap of record of crab caused an enigmatic transition between this species and Middle Jurassic (Bajocian) representatives. The newest discovery of the latest Bajocian crab remains (*Tanidromites muelleri,* Krobicki & Zatoń, 2016) in central Poland constitute the most numerous collection of individuals (46 specimens) of Middle Jurassic crabs in the whole world. They were connected with shallow-water, soft-bottom marine environment during sedimentation of so-called ore-bearing Częstochowa Clay Formation. In another places in Europe the Middle Jurassic species are practically known only by holotypes (42 specimens of 19 species!; Krobicki & Zatoń, 2008, 2016) and mainly occupied oolitic (ferruginous)/oncolitic bioclastic-rich deposits of shallow-sea environments as well (*Bajocian Brachyuran Expansion Event*). In contrast, the Late Jurassic crabs, flourished rapidly due to the origin of Oxfordian sponge-megafacies and Tithonian–Berriasian coralliferous Štramberk/Ernstbrunn-type carbonates in Europe (Müller *et al.*, 2000; Krobicki & Zatoń, 2008) are very abundant and represented by several thousand specimens (*Oxfordian Brachyuran Explosion Event – sensu,* Krobicki & Zatoń, 2016), and for this reason, their phylogenetic relationships are relatively well known.

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ENVIRONMENTAL CHANGES RECORDED IN THE EEMIAN MARINE DEPOSITS FROM THE LINKI PROFILE (LOWER VISTULA REGION)

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Cartographic borehole Linki P2 is located in NW part of Iława Lake District, about 12 km north–east of Prabuty. In the profile occurred series of marine deposits (silt and marine sand). Marine series is located at depth of 93.0–105.5 m (0.0–12.5 m b.s.l.). Pollen analysis of the deposits from depth of 84.5–113.0 m indicate that sedimentation of these deposits occurred during Eemian Interglacial. Pollen succession in Linki profile is less complete, but pollen spectra are very similar to the closest sites located in Licze (Head *et al.*, 2005), Obrzynowo (Knudsen *et al.*, 2012) and Cierpięta (Marks *et al.*, 2004).

Studied series contain marine species of molluscs with different ecological requirements and geographical ranges. The predominants species were: bivalves *Spisula subtruncata* (Da Costa), *Corbula gibba* (Olivi), *Paphia aurea* (Gmelin), and snails *Nassarius reticulatus* (Linnaeus), *Eulimella nitidissima* (Montagu), *Bittium reticulatum* (Da Costa). These species live in waters with salinity more than 15 PSU and at depth 20–30 m. In studied group of molluscs most of the species are characteristic for arctic-boreal and boreal communities. Only the snail *Clathrus clathrus* (Linnaeus) is lusitanian.

In examined profile foraminifera composition is characterized by a very high frequency of individuals, which species composition may indicate the existence of the salty water basin. Increase of salinity indicates appearance of specimens of *Bucella frigida* (Cushman) and *Elphidium excavatum* f. *clavatum* Cushman, which can suggest inflow of the marine cold waters from the Ocean to the Eemian sea through the connection across the White Sea. *E. excavatum* f. *clavatum* and *Bucella frigida* are arctic-boreal species and live on a deeper shelf with salinity of 10–35 PSU. There were also sea-urchins spines, skeleton plates *Echinocardium* sp. and madreporite plates *Asteroidea* of the genus Echinodermata, characteristic for high-salinity waters (28 PSU). Very low frequency of the marine species of thermoeuryplastic and euryhaline ostracods such as *Cyprideis torosa* (Jones), *Cytheromorpha fuscata* (Brady), *Leptocythere pellucida* (Baird), *Loxoconcha elliptica* (Brady), and lack of radiolaria in sediments suggest that in the study area existed shallow water basin with salinity less than 30 PSU.

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NSB – A NEW, EXTENDED VERSION OF THE NEPTUNE DEEP-SEA MICROFOSSIL DATABASE AND IT'S USE IN RESEARCH

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NSB (www.nsb-mfn-berlin.de) is the current version of the Neptune database, which synthesizes occurrence data for planktonic foraminifera, calcareous nannofossils, planktonic marine diatoms and radiolarians. Its main components are information about: 1) taxonomic names; 2) samples from deep-sea sections; 3) the occurrence values of taxa in samples (*e.g.,* species X is "common" in sample Y); and 4) numeric age models – continuous lines that give, for any position in a section, the equivalent geologic age relative to a specific geochronologic age scale (GPTS). NSB in addition has full information on the biostratigraphic, magnetostratigraphic and other geochronologic data used to make the age models. Currently NSB has nearly 800,000 occurrence records for ca 5,000 valid species, from over 60,000 samples from nearly 500 globally distributed deep-sea drilling sections; and over 26,000 geochronologic event occurrences in these sections, from *ca* 1,800 defined biostratigraphic and other events. Most of the data is Cenozoic in age but some data extends well back into the Mesozoic. NSB and earlier incarnations of the Neptune database (*e.g.,* at www.chronos.org) have been cited in more than 80 publications, including several in Science, Nature and PNAS (USA). Many of these papers were written by evolutionary ecologists, who until recently showed more interest in the palaeobiology of microfossils than (micro)palaeontologists. Below we briefly describe some of our own work using the database, in the hope that others in the audience will be motivated to make use of this free resource in their own research. Our own work has concentrated on two themes: methods studies to determine the best way to compute biodiversity; and diversity studies of siliceous microfossils (diatoms and radiolaria). "Pacman" data trimming addresses the problem of temporally misplaced occurrences in sections, due to data errors, and primary problems such as reworking of fossils in sections. Evenness correction modeling addresses an issue present in other areas of biodiversity research: how to estimate diversity using subsampling methods when the relative abundance distributions of species (evenness profiles) are not the same between samples. Our main diversity publication so far is on marine planktonic diatoms (Lazarus *et al.*, 2014, PLoSOne). Here we have shown that diatoms diversified strongly throughout the Cenozoic, tightly tracking globally cooling climate. We have also inferred that future global warming may place a substantial fraction of current planktonic diatom diversity at risk of extinction, particularly several cold adapted species that are important components of the ocean's carbon pump. Using the NSB database for palaeoceanographic research primarily makes use of the large library of age models for deep-sea sections, and combines this age information with externally sourced palaeoceanographic "proxy" data from the same sections. We are currently attempting to understand how the oceans have exported silicon over the Cenozoic (*via* biogenic sedimentation of diatom and radiolarian shells, *e.g.,* using marine sediment compositional data archived in the Pangea database). Marine biogenic opal is the primary global removal mechanism for silica weathering input into the oceans. The silica depositional record can thus be used to document the history of global continental weathering, and from this, give a better understanding of the links between global climate, atmospheric pCO_2 levels, weathering and ocean biology. NSB is a substantially new version of the Neptune database, with much improved data content and scope, which has only been online and available for research for a couple years. The major current challenge is connecting this new resource to community users. Use is still fairly modest but is increasing steadily, mostly by palaeontologists and biologists. There are however numerous scientific questions which have not yet been addressed, and thus many opportunities to carry out research with an international impact. These include palaeobiologic and geochronologic studies of different fossil groups and deep-sea sections; global syntheses of palaeoceanographic proxy data, and integrated studies of both biologic and oceanographic system behavior over geologic time. Anyone interested in working with NSB can obtain an account by contacting either of this talk's authors.

RADIOLARIAN BIOSTRATIGRAPHY ON THREE LOCALITIES IN THE MELIATA UNIT (SLOVAKIA)

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Radiolarites from three localities in the Meliata unit were dissolved with the aim of separating and identifying their radiolarian species. These localities include the Čoltovská roklina ravine, material from which has been presented in the past, and localities near Bohúňovo Village and the Ostrá skala Hill. Collected radiolarites were dissolved in hydrofluoric acid, followed by boiling in hydrogen peroxide.

The sampled radiolarite outcrop from the area south of the Bohúňovo village is mostly formed by massive red radiolarites, which are in contact with olistostromatic blocks. These blocks consist of Triassic carbonatic and radiolaritic clasts, drowned in presumably Middle Jurassic matrix (Lačný *et al.*, 2015). Separated radiolarians consist of a small, poorly preserved association, which was dated to Fassanian age (radiolarian zones *Spongosilicicarmiger italicus*, *Ladinocampe multiperforata* and one unnamed zone in Upper Fassanian). Species like *Eptingium manfredi* Dumitrică, *Oertlispongus* cf. *inaequispinosus* Dumitrică, Kozur & Mostler, and *Bogdanella*, *Paurinella* and *Pseudostylosphaera*? sp. are part of this assemblage.

Čoltovská roklina ravine is located 0.5 km N–E from the Čoltovo village. Our samples were collected from remains of a small quarry, where red radiolarites come into contact with basalts. 21 identified radiolarian species have stratigraphic ranges striking from Pelsonian to Julian (Kozur & Mostler, 1994; Stockar *et al.*, 2012). Stratigraphic ranges of majority of the species intersect in Lower to Middle Fassanian (radiolarian zones *Spongosilicicarmiger italicus* and *Ladinocampe multiperforata*). Identified species from this locality include *Annulotriassocampe campanilis* Kozur & Mostler, *Baumgartneria* cf. *retrospina* Dumitrică, *Eptingium manfredi* Dumitrică, *Novamuria*? and *Pseudostylosphaera* species.

Agglomerates of Senonian age, which are present near the Ostrá skala Hill (area of the Dobšinská Ice Cave), contain clasts of various rock types, radiolarites included. Collected samples of red and green radiolarite clasts have separated from the agglomerates and are present in rubble form on a forest path today. A rather poor radiolarian association of Jurassic age (UA Zones 1–10) was identified, with stratigraphic ranges that are imperfectly intersecting within Lower–Middle Bathonian to Upper Callovian (Baumgartner *et al.*, 1995; O'Dogherty *et al.*, 2009). Identified forms include for example *Eucyrtidiellum* cf. *unumaense* (Yao), *Protunuma turbo* Matsuoka, *Unuma gordus* Hull, and *Hemicryptocapsa* species.

This data was part of the author's dissertation thesis.

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TRACE FOSSIL ASSOCIATIONS FROM THE MORAVICE FORMATION (LATE VISÉAN, NÍZKÝ JESENÍK MTS., CZECH REPUBLIC)

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The Culm facies represents a specific variety of flysch sediments, that are characteristic of sedimentary basins bordering active margins of the Variscan orogeny. The Nízký Jeseník Basin is situated in the NE margin of the Bohemian Massif and is formally subdivided into four lithostratigraphic units (formations): Andělská Hora, Horní Benešov, Moravice and Hradec–Kyjovice Fm.

The Moravice Fm. contains fine-grained sandstones, siltstones and mudstones with thicker sandstone and conglomerate bodies. Relatively frequent fossil finds of horse-tails (*Archaeocalamites*), ferns (*Protopteridium*), bivalves (*Posidonia*, *Streblochondria*) and especially goniatites (*Nomismoceras*, *Girtyoceras*, *Sulcogirtyoceras*, *Goniatites*, *Arnsbergites*, *Neoglyphioceras*, *Paraglyphioceras*, *Hibernicoceras*, *Neoglyphioceras*) allowed dating of the Moravice Fm. to Late Viséan (Go$\alpha_{2\text{-}3}$ to Goβ_{mu} Subzone) (Zapletal *et al.*, 1989).

The deep-water depositional environment is also supported by abundant trace fossil associations. Ichnofossils from the Moravice Fm. represent a diverse assemblage in the Culm facies (Mikuláš *et al.*, 2004; Bábek *et al.*, 2004). Localities in basal parts (sensu Dvořák 1994) are dominated by *Dictyodora liebeana*, *Chondrites* isp., *Phycosiphon incertum*, *Planolites beverleyensis*, *Planolites* isp., *Spirodesmos archimedeus* and rare occurrences of *Cosmorhaphe* isp., *Chondrites* cf. *intricatus*, *Falcichnites lophoctenoides*, *Pilichnus* isp., *Protopalaeodictyon* isp., *Megagrapton* isp. and *Zoophycos* isp. These ichnofossils are most often found in sediments of the "roofing slate" type. The ichnocoenosis can be assigned to the Zoophycos ichnofacies indicating deep-marine environment with low energy levels. In the upper part of Moravice Fm. occurs assemblages with *Diplocraterion* isp., *Rhizocorallium* isp., *Furculosus* isp., *Nereites missouriensis*, *Dictyodora liebeana*, *Cosmorhaphe* isp., *Chondrites* isp., *Gordia* isp., *Palaeophycus* isp. and *Protopaleodictyon* isp. The relatively highly diverse ichnocoenosis corresponds to the Cruziana ichnofacies with traces of the Nereites ichnofacies sensu Frey and Pemberton (1984) and classical Seilacher's (1967) concept.

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NEW DATA ON THE MICROFAUNA FROM THE WADOWICE AREA

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Foraminiferal investigations performed by Józef Grzybowski in the area of Wadowice were published in 1896 in one of his well known papers "Foraminifera of the red clays from Wadowice". The analyzed samples were collected from exploration shaft in search for coal and the lithological log compiled by Grzybowski consisted of menilite shales at the bottom, red clays, gray claystones with marls and green clays with abundant piryte and thin bedded, muscovite sandstones at the top. The most rich assemblages were found in the "red clays" and less abundant from gray claystones with marls and green clays. According to Grzybowski, taxonomic composition pointed to Oligocene age of the studied microfauna. The Wadowice area was the subject of Książkiewicz (1951) research who suggested that the microfauna described by Grzybowski indicated rather Late Cretaceous or Paleocene than Oligocene. The revision of Grzybowski's collection from Wadowice was published by Liszka & Liszkowa (1981) with conclusion that the red clays were Campanian in age, whereas the green shales and marls represented Paleocene. Various authors made comparison of their and Grzybowski's foraminiferal assemblages and suggested different age (see Liszka & Liszkowa, 1981). Recently, during road works in the vicinity of the 19th century exploratory coal shaft, a new outcrop, about 5.5 m high, has been exposed that, apart from the red clays, consists of deposits similar to those recovered and analyzed by J. Grzybowski. 17 samples from this outcrop and another 13 from its surroundings have been collected and studied. The samples varied in amount and composition of microfossils. In the majority of samples the planktonic foraminifera were the most abundant, representing various ages from the Late Cretaceous through Paleogene till Oligocene/Miocene. In the most assemblages there are mixed foraminifera in regard to their age. The most characteristic and one of the youngest planktonic taxa is *Cassigerinella chipolensis* indicating at least Oligocene. Considering the youngest possible age and taxonomic composition of foraminiferal assemblages some analogy can be seen to the assemblages from the latest Oligocene–Early Miocene, known from the uppermost part the Menilite Beds in the Skole Unit as well as from the middle and upper Krosno Beds (Olszewska, 1982). It is very probable that in the area of Wadowice there are mixed elements that belong both to the Skole Unit (the youngest – Oligocene/Miocene deposits) and those older ones of various ages representing the Subsilesian Unit. The presence of the Skole Unit in this area has been already suggested by Golonka (2007). The Grzybowski's results, his followers and our studies suggest redeposition of various deposits during Oligocene or even Miocene time. Such a mixture of various lithostratigraphic elements could have happened in front of the progressively folded and overthrust Flysch Carpathians.

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THE "RIBBED" NAUTILID EPICYMATOCERAS FROM THE UPPER CRETACEOUS OF POLAND: PALAEOBIOLOGICAL IMPLICATIONS

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The Late Cretaceous ribbed nautilid *Epicymatoceras vaelsense* (Binkhorst van den Binkhorst, 1861) is distinguished from all other post-Triassic nautilids by its strongly compressed, evolute conch with subquadrate whorl section. The species was previously recorded from the Lower Maastrichtian of the Netherlands, Belgium and Germany (Binkhorst van den Binkhorst, 1862; Schlüter, 1876; Jagt, 2012). The present study is based on specimens from the Upper Campanian at Strzeżów (Nida Trough) and from the Lower Maastrichtian at Dziurków (Middle Vistula River section). The genus *Epicymatoceras* was established by Kummel (1956) and included into the family Cymatoceratidae Spath, 1927, on the basis of its distinctive transverse ribbing (Kummel, 1964). However, it should be noted that this family is regarded by many workers as an artificial "litter bin" for ribbed offshoots of the smooth nautilid lineages (*e.g.*, Tintant, 1993). A recent study of the morphogenesis of ornament in *Cymatoceras* Hyatt, 1883 (type genus of the Cymatoceratidae) demonstrated that the so-called "ribbing" in *Nautilus pseudelegans* d'Orbigny, 1840 (the type species of *Cymatoceras*) does not represent true ribs, but is composed of overlapping tile-shaped lamellae of the outer prismatic layer (Chirat & Bucher, 2006). Based on this observation, Chirat & Bucher (2006) proposed that this character may be diagnostic for the cymatoceratid clade. Analysis of an external mould of *E. vaelsense* from Dziurków allows to conclude that the external "ribbing" of this species was originally composed of overlapping, tile-shaped lamellae of the outer prismatic layer, like in *Cymatoceras pseudoelegans*. Consequently, *E. vaelsense* is viewed here as a true cymatoceratid (*sensu* Chirat & Bucher, 2006). In addition, casts of embryonic conchs are preserved in the present material. The diameter of the embryonic conch of *E. vaelsense* may be estimated to have attained *ca* 30 mm, which is near the maximum range of hatchling diameters recorded for Cretaceous, Cenozoic and Recent nautilids (Wani *et al.*, 2011).

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CALCAREOUS NANNOPLANKTON IN THE LOWER BERRIASSIAN DEPOSITS OF THE SOUTH-EASTERN CRIMEA

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The cuts of the Lower Berriasian deposits on the cape of Saint Il'ya, near the settlement of Yuzhnoe, and in the basin of the river of Tonas are most studied by many scientists: T.N. Gorbachik, K.I. Kuznetsova, V.V. Drushchits, L.F. Plotnikova, A.A. Fedorova, V.V. Arkadiev, E.Yu. Baraboshkin, B.P. Wimbeldon, and others (Arkadiev *et al.*, 2012).

The analysis of the associations of calcareous nannoplankton in a cut of the Lower Berriasian on the cape of Saint Il'ya showed that it is possible to admit the presence of subzone NJK-d/Nannoconus steinmannii minor only in the lower later of brown limestone 0.5 m in thickness. In all samples taken higher on the cut, the species-index *Nannoconus steinmannii* Kamptner *steinmannii* of the nannoplanktonic zone NK-1/ Nannoconus steinmannii (Bralower, 1989) was observed. The complex is represented by 27 species from 15 genera (Matlai, 2009). Nannocones make up 60–70% of the total number of species. Such bloom of nannocones is characteristic of a deep sea basin with transparent waters and a good aeration. The creation of a joint cut of the Berriasian to the south from the cape of Saint Il'ya is hampered by the strong dislocation of these deposits and requires a micropalaeontological substantiation.

The different conditions in the basin with sedimentation caused a decrease in the number of nannocones (down to 20%) in the associations of calcareous nannoplankton of the Lower Berriasian near the settlement of Yuzhnoe: *Watznaueria* sp., *Cyclagelosphaera margerelii* Noel, *Diazomatolithus lehmanii* Noel, *Biscutum constans* (Gorka) Black, *Helenea chiastia* Worsley, *Zeugrhabdotus erectus* (Deflandre) Reinhardt, *Z. embergeri* (Noel) Perch-Nielsen, *Nannoconus steinmannii* Kamptner *minor* Deres and Acheritequy, *N. steinmannii* Kamptner *steinmannii*, *Conusphaera mexicana* Trejo *mexicana*, *Rotelapillus laffitei* (Noel) Noel, *Schizosphaerella punctulata* Deflandre and Dangeard, *Polypodorhabdus escaigii* Noel, *Podorhabdus grassei* Noel, *Micrantolithus hoschulzii* (Reinhardt) Thierstein, *Cruciellipsis suvillieri* (Manivit) Thierstein, *Retecapsa angustiforata* Black, *Polycostella* sp. (Matlai, 2011). The Lower Berriasian is represented in the volumes of nannoplanktonic zones NK-1/Nannoconus steinmannii and NK-2/Retecapsa angustiforata of Bralower, 1989 (Bown, 1998).

The nannoplanktonic zone NK-1/Nannoconus steinmannii is established by the results of studies of calcareous nannoplankton in clays of the right shore of the river of Tonas. On a mark of 262.1 m, the zonal species *Retecapsa angustiforata* Black of the nannoplanktonic zone NK-2/ Retecapsa angustiforata is identified. The analysis of the associations of calcareous nannoplankton indicates that the stratigraphic break in the deposits of the Lower Berriasian in the basin of the river of Tonas is greater than that on the cape of Saint Il'ya.

In the cuts of the Lower Berriasian under study, the nannoplanktonic subzone NJK-d is represented only partially, which confirms the presence of a break on the Jurassic–Cretaceous boundary.

In the Crimea, the course of nannoplanktonic events on the Jurassic–Cretaceous boundary corresponds to that established by Bralower (1989) with regard for the dependence of the sizes of coccoliths on the salinity of a basin, which was proved by S.I. Shumenko.

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BYRONIIDS AND SIMILAR TUBE-SHAPED FOSSILS FROM THE DEVONIAN OF THE PRAGUE BASIN (CZECH REPUBLIC)

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Byroniids are phosphatic tube-shaped fossils that were attached to substrate by a disk. They are known from the Cambrian to Permian (Bischoff, 1989) and their scyphozoan affinity is suggested. Recently, byroniid tubes were observed in residues after dissolution of the various limestones by acetic acid solution from several stratigraphic levels (Lochkovian to Eifelian) in the Prague Basin, Czech Republic. They are locally abundant in fossils associations of diverse brachiopods, pelmatozoans and epizoan corals. Morphological diversity of tubes indicates that they belong to more than one species.

Byroniids of the Lochkovian age (Lochkov Formation, Kotýs Limestone) show wrinkled longitudinal septa inside the proximal part of the tube. The septa are arranged in adaperturally convex row on both internal sides of the tube. There are two rows of septa in preserved specimens.

Byroniids of the Emsian age (Zlíchov Formation, Chýnice Limestone) has surface covered with regular annulations and a prominent longitudinal ridge, but other from the same formation (Chapel Coral horizon) has none annulations. Byroniids in the Třebotov and Choteč limestones are rare. The youngest byroniids are known from „dark interval“ at the summit of the Acanthopyge Limestone, which are correlated with the Kačák event and the base of the Givetian.

The attachment discs of byroniis are sometimes preserved at base of tubes or discs were observed separately. Discs have often irregular outline.

Similar small phosphatic tubes with tetraradiate symmetry and surface covered by transverse fine ribs were observed in the Emsian (Chýnice Limestone). They probably belong to undescribed microconulariid similar to the genus *Microconularia*.

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ENVIRONMENTAL CHANGES AND ORGANISM EXTINCTION ON THE TRIASSIC/JURASSIC BOUNDARY

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Triassic era started by disintegration of global palaeoclimatic system, accompanied by average world temperature rise, by oceanic anoxia and by perturbations of the global carbon cycle (Li *et al.*, 2016). Following fifty millions of years represented the driest climate of the Phanerozoic (Haq, 1984), with equalized climatic regimes directed by long eccentricity cycles. Despite of several fluctuations, the most important turnover of this regime happened at the end of the Triassic.

Sedimentary and fossil record of the Kardolina section in the easternmost part of the Tatra Mountains was studied in detail by microscope, isotope geochemistry, and magnetic susceptibility (Michalík *et al.*, 2010, 2013). Well exposed 137 m long uppermost Triassic sequence of the Fatra Formation offers possibility to examine complete rock record of seven 400 ka orbital cycles (with subordinated 100 ky cyclicity) expressed in short-timed influence of monsoonal rain precipitations, transporting quartz grains and other terrigene fragments into marine carbonate sedimentary system. One million of years before the Triassic–Jurassic Boundary, the regular eccentricity regime was affected by acceleration of effect of shorter periodical changes: rapid increase of both content and size of quartz grains indicates growing humidity. Overturn of the sedimentary regime has brought a change in rock composition, as well as the impoverishing (and finally, an extinction) of bentic faunal ecosystems. The Atlantic MORB activity connected with CO_2 production caused rapid sea water acidification reflected in the abrupt decrease of carbonate content, and increase of volcanic ash fall (Ruhl *et al.*, 2011) indicated by increase of rock magnetic susceptibility: these phenomena are well observable in the top part of the section. The distortion of top part of the Rhaetian carbonate sequence by submarine slumping, described from many sections in a wide area of Europe (Lindström *et al.*, 2015) indicates seismic instability connected with rifting of the Atlantic.

The research have been financed by the APVV-14-0118 Project.

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INTEGRATED BIOSTRATIGRAPHY (CALCAREOUS NANNOFOSSILS, CALPIONELLIDS, CALCAREOUS DINOFLAGELLATES) AND RELATED GEOCHEMICAL AND MAGNETIC PROXIES OF THE JURASSIC/CRETACEOUS BOUNDARY INTERVAL AT THE STRAPKOVÁ SECTION, PIENINY KLIPPEN BELT (WESTERN CARPATHIANS, SLOVAKIA)

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A well preserved Upper Tithonian–Lower Berriasian Strapková sequence of hemipelagic limestones completes knowledge on the Jurassic/Cretaceous boundary in the Western Carpathians. Moreover, it is well correlatable with the principal Brodno section (Houša *et al.*, 1996; Michalík *et al.*, 2009). The nannofossils distribution documents Tithonian to Early Berriasian nannofossil zones and subzones – NJT 17b Subzone, NKT and NK-1 zones (*sensu* Bralower *et al.*, 1989; Casellato, 2010). The first occurrence of *Nannoconus wintereri*, that indicates the beginnig of NJT 17b Subzone and at the same time the beginning of the J/K boundary transition has been located in sample 298.1. Three dinoflagellate and four calpionellid zones have been recognised in the section. The onset of the Alpina Subzone of the standard Calpionella Zone, used as a marker of the Jurassic/Cretaceous boundary is defined by morphological change of *Calpionella alpina* tests. Calpionellids are dominating over other microplankton being accompanied by calcified radiolarians. Correlation of calcareous microplankton, of stable isotopes (C, O), and TOC/$CaCO_3$ data distribution was used in the characterization of the J/K boundary interval. $\delta^{13}C$ values (from 1.09 to 1.44‰ VPDB) indicate a balanced carbon regime in sea water during boundary interval. Slightly negative $\delta^{18}O$ trend (from –1.5 to –2.3‰ VPDB) in the Pieniny Formation near the J/K boundary could indicate temperature rise 2–3°C up to the section. The presence of radiolarian laminites interpreted as countourites, and bioturbated levels prove oxygenation events of bottom waters. The lower part of Crassicolaria Zone (up to the middle part of the Intermedia Subzone) correlates with M19r magnetozone. The M19n magnetozone includes upper part of the Crassicollaria Zone and lower part of the Alpina Subzone. The reverse Brodno Magnetosubzone (M19n1r) was identified in the uppermost part of M19n. The top of M18r and M18n magnetozones are located in the uppermost part of the Alpina Subzone and in middle part ofthe Ferasini Subzone, respectively. The Ferasini/Elliptica subzonal boundary is located in the lowermost part of the M17r magnetozone.

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THE ONTOGENY OF *DISCOSAURISCUS* (KUHN, 1933) (SEYMOURIAMORPHA) FROM BOSKOVICE BASIN (CZECH REPUBLIC) AND ITS COMPARISON WITH TEMNOSPONDYLS

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Specimens of *Discosauriscus* are known from hundreds of specimens which were found in the Lower Permian sediments of the Czech Republic (Boskovice Basin). The ontogenetic sequence of the individual skeletal elements of *Discosauriscus* includes the specimens from a small larvae (skull length 6 mm) up to early adults (skull length 62 mm) (Špinar, 1952; Klembara, 1997, 2009).

As in the case many temnospondyls, the dermal bones of the skull and lower jaw of larvae of *Discosauriscus* are already ossified. In temnospondyls, the neural endocranium is completly ossificated and starts with ossification of exoccipitals in metamorphic stage and ends with the otic capsules in adult stage (Witzmann & Pfretzschner, 2003; Witzmann, 2006). In *Discosauriscus*, only exoccipitals, basioccipital and basisphenoid are incomplete ossified. The hyobranchial skeleton is not preserved, although the external gills are in many individuals very good preserved (Klembara, 1997). In contrast, the hyobranchial skeleton of temnospondyls is very good preserved and its loss indicates the metamorphic stage. The bones of postcranial skeleton (except for carpus and tarsus, which weren't ossificated) of *Discosauriscus* larvae are ossificated in the similar degree except for the pelvic region, where is the ossification of the bones weaker (Špinar, 1952). In temnospondyls, the bones of carpus, tarsus and pubis are generally the last ossified bones of postcranial skeleton.

Comparing the ossification sequences of the skeletal elements of seymouriamorphs we can distinguish two groups. The first group includes taxa with a long larval and metamorphic period (*Discosauriscus*, *Ariekanerpeton*) (Klembara, 1997; Klembara & Ruta, 2005) and the second group with significantly shorter larval stage (*Seymouria*, *Karpinskiosaurus*) (Klembara *et al.*, 2007; Klembara, 2011). Generally, the ossification sequences of the clade Seymouriamorpha are similar to temnospondyl clades Stereospondylomorpha and Eryopidae.

This project was partly supported by the VEGA grant, Grant No. 1/0066/16.

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TAPHONOMY OF THE STEM-LESS EOCRINOID GENUS *LICHENOIDES* FROM CAMBRIAN OF THE BARRANDIAN AREA (CZECH REPUBLIC)

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Fossil echinoderms, including Cambrian eocrinoids, could be used as a worthwhile palaeoenvironmental indicator, but studies of eocrinoid taphonomy are still rare. The stem-less eocrinoid genus *Lichenoides* Barrande, 1846 has been known from the Barrandian area of the Czech Republic. The rich fossil material, housed in the Palaeontological Department of National Museum Prague and in the Czech Geological Survey Prague, provides an exceptional opportunity for taphonomic analyses.

In the Barrandian area, the genus *Lichenoides* comprises the abundant type species *L. priscus* Barrande, 1846, known from the Jince Formation of the Příbram-Jince Basin and the slightly smaller *L. vadosus* Parsley & Prokop, 2004, restricted to the Buchava Formation of the Skryje-Týřovice Basin. Both species occur in the Drumian stage of Cambrian Series 3. Fossils are preserved in shales, greywackes and even in fine sandstones in the Barrandian area. Disarticulated remains of *Lichenoides* are abundant in both Cambrian basins. Well-preserved and fully articulated specimens are rare, and restricted to very specific strata.

Detailed evaluation of several tens of specimens of this echinoderm shows diverse levels of skeleton disarticulation, and makes it possible to distinguish semi-quantitative degrees. The main differences between these degrees are in the extent of disarticulation of brachioles and thecal plates. The *in situ* preserved and fully articulated specimens of *Lichenoides* represent a unique taphonomic window into the West Gondwana marine ecosystem.

This research is supported by the GA UK (Grant Agency of Charles University) No. 898416 Revision of eocrinoids echinoderms from Cambrian of the Barrandian area.

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FORAMINIFERAL AND GEOCHEMICAL INDICATORS OF ANOXIC EVENTS DURING THE CRETACEOUS-PALEOGENE: EXAMPLES FROM THE POLISH OUTER CARPATHIANS

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In the Polish Outer Carpathians are often shale deposits of a decidedly dark color. These deposits, which are rich in organic matter and biophile elements were usually formed under conditions of oxygen deficiency resulting from global factors: sea level changes (Erbacher & Thurow, 1996) or palaeogeography and climate (Katz & Pheifer, 1986). Under these settings microfauna existed as benthic epifauna, semiinfauna and shallow or deep infauna (Severin, 1983; Jones & Charnock, 1985; Bernhard, 1986; Koutsoukos *et al.*, 1990) or plankton shallow and deep dwellers (Hemleben *et al.*, 1989). These foraminifers are characteristic for specific depths in water column and sediment. Some of them generally exhibit greater irregularity and asymmetry with increasing depth and decreasing of turbulence in the deposits. Benthic forms dwelling deep in the sediment (*Karrerulina*, *Pseudoreophax*) probably feed on anaerobic bacteria indicating intensified decomposition of organic matter contributing to anoxia. Opportunistic plankton (*Heterohelix*, *Hedbergella*) may correlate with upwelling, increased organic productivity and water stratification.

Morphological features of this microfauna in relation to other palaeontological and geochemical data, and also palaeobiological and palaeogeographic factors confirm that dark deposits reflect global and regional conditions in the Tethys during the Cretaceous–Paleogene (Olszewska, 1984; Khunt *et al.*, 1992; Uchman *et al.*, 2008). The upper Cieszyn shales correspond with the Late Valanginian episode, the Verovice and the Spas shales with the Selli (early Aptian OAE 1a) and the Paquier (early Albian OAE 1b) events, and the Barnasiówka Fm. with the Cenomanian/Turonian OAE 2 and the CBTE. Other Cretaceous and Paleogene deposits (Lgota beds, Istebna beds, Menilite shales) have also specific features and contain geochemical and petrographic elements indicating the impact of unfavorable factors. Especially bitumen rich menilite shales, which contain pyritized Oligocene microfauna.

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NEW LATE TRIASSIC CONIFER CONNECTING ADVANCED VOLTZIALEAN TYPE OF OVULIFEROUS SCALES WITH *BRACHYPHYLLUM*-LIKE TWIGS FROM PATOKA (UPPER SILESIA, SOUTHERN POLAND)

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The Triassic is an exceptionally interesting period in the evolution of conifers. The oldest representatives of some modern families appeared in the fossil record in the Upper Triassic and all recent conifer families probably originated during this time (Taylor *et al.*, 2009). The stages of transformation from primitive Voltziales into evolutionarily advanced families of modern conifers in the Triassic are not fully documented yet. A newly discovered Polish Upper Triassic (Norian) locality in Patoka (SW Poland, Upper Silesia) with a unique fossil record gives a rare opportunity to fill this gap. We describe the well preserved remains of the new conifer from this locality. Based on organic attachment and similar cuticular details of leafy shoots, female cones, seed scale-bract complexes, ovules and developed seeds as well as male cones with pollen grains of *Enzonalasporites* type *in situ*, we reconstruct the whole plant and propose a new genus and species. This plant combines leafy shoots of *Brachyphyllum* type with a new type of seed scale-bract complexes clearly derived from evolutionary advanced Voltziales and male cones somewhat similar to Cheirolepidiaceae (*Classostrobus*) type. Based on this distinctive and hitherto unknown feature combination, a new conifer family is proposed. Female cones were lax, born singly at the end of leafy twigs. Ovulate scales were stalked, trilobate with two lateral oval lobes, each bearing one ovule, and one sterile reduced lobe between them, all in one plane. The bract was small leaf-like. Male cones were simple, with microsporophylls helically arranged, numerous pollen sacks were arranged probably around the microsporophyll stalk. Male cones were born singly at the end of the leafy twigs. Associated tree trunks (*Agathoxylon keuperianum*) preserved as coalified remains and charcoal fragments have been described earlier (Philippe *et al.*, 2015). This is first evidence of relationship of pollen grains *Enzonalasporites* with so far unknown affinities, now found *in situ* in male cones, ovule micropyle and inside seed of this new conifer. This new species extends our view of voltzialean conifers diversity at the roots of modern families.

The project was financed by funds from the Polish National Science Centre (No. DEC-2012/05/B/NZ8/00990), the Jagiellonian University (No. DS/MND/WBiNoZ/IB/5/2012) and the W. Szafer Institute of Botany, Polish Academy of Sciences though its statutory funds.

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ODIFICATIONS OF PIERCING-AND-SUCKING MOUTHPARTS IN THE EXTINCT LATE PALAEOZOIC INSECT GROUP PALAEODICTYOPTEROIDA

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Palaeodictyopteroida is the diverse group of Late Palaeozoic insects that did not survive the Permian–Triassic mass extinction. It is traditionally considered as the specialized group of Palaeoptera. On the other hand the recent perfomed phylogenetic analysis support its placement as a sister group of Neoptera (Sroka *et al.*, 2015). The most striking feature of the whole clade is piercing-and-sucking mouthparts that allows to puncture plant tissues. Mouthparts is in the form of a rostrum that consists of a pair of markedly sclerotized mandibular stylets, paired less sclerotized stout maxillae with multi-segmented long maxillary palps and a hypopharynx. Basal part of stylets is dorsally covered by triangular labrum and ventrally by labium with labial palps. Clypeus is markedly domed and presumably covers the robust muscles of cibarial pump (Kukalová-Peck, 1992).

The length of mouthparts varies among the members of Palaeodictyopteroida, for example in *Eugereon boeckingi* Dohrn (1866) (order Palaeodictyoptera) and *Brodioptera sinensis* Pecharová *et al.*, 2015 (order Megasecoptera) mouthparts is more than five times longer than head. In contrast to this, some groups have very short mouthparts such as family Protohymenidae (order Megasecoptera) and whole order Diaphanopterodea. Some feeding traces are documented on the rhachis of marattialen tree fern *Psaronius* from the Late Pennsylvanian (Labandeira & Phillips, 1996) and as punctures on cordaite seeds from Late Carboniferous and Early Permian (Sharov, 1973; Shcherbakov *et al.*, 2009).

Recent discovery of microstructures on maxillary palps of *Brodioptera sinensis* were distinguished as scattered sensory setae and were probably used as mechanoreceptors for coordinating its mouthparts and manipulation of stylets while feeding (Prokop *et al.*, 2016).

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LATE BADENIAN ENVIRONMENTAL CHANGES IN WESTERN UKRAINE: FORAMINIFERAL EVIDENCE

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The mid-Badenian salinity crises in the Carpathian Foredeep Basin was terminated due to a new, last large transgression over the entire Central Paratethys basin during the Late Badenian. The Upper Badenian deposits in the major, basinal part of the Carpathian Foredeep in western Ukraine are grey-green carbonate siltstones and marls, with local sandy intercalations and tuffite layers, and they contain similar foraminiferal assemblages characterized by the occurrence of arenaceous taxa (*Hyperammina granulosa*, *Ammodiscus miocenicus*, *Haplophragmoides indentatus*, *H. laminatus*) and planktonic species *Velapertina indigena*, as has been recognized by Garecka & Olszewska (2011). My studies (Gedl & Peryt, 2011; Peryt *et al.*, 2014; Gedl *et al.*, 2016) have been focused on the marginal (foreland) part of the Ukrainian Carpathian Foredeep Basin (sections: Kudryntsi and Anadoly) and on its transition to the proper foredeep basin (Shchyrets), aiming to use them for palaeoenvironmental interpretation.

38 species of benthic and 9 species of planktonic foraminifers were recorded in the Shchyrets section. Benthic assemblages are composed entirely of calcareous forms. A low diversity of benthic foraminiferal assemblages, with high dominance of infaunal dysoxic forms, indicates nutrient-rich surface waters and a deficit of oxygen at the sea floor. Fluctuations in relative abundances of dominant infaunal taxa indicate probably not only changes in the quantity of organic matter sinking from the surface but also in its type and/or quality. The composition of benthic foraminifer assemblages as well as both benthic and planktonic $\delta^{13}C$ values indicate nutrient-rich waters, mesotrophic to eutrophic environments at the surface, and low oxygenated environments at the sea floor in the foredeep basin during the Late Badenian.

The Anadoly section yielded 54 species of benthic and 10 planktonic foraminifers. Benthic foraminifers are represented mainly by calcareous forms; agglutinated tests are very rare and only a few species are recorded. The foraminiferal record indicates deposition in a shallow subtidal environment (20 m depth) of normal marine salinity and temperate waters followed by gradual deepening of the basin to >50 m. Bottom waters were highly oxygenated during the deposition of the lower and middle parts of the Anadoly sequence with the exception of the basal sample showing higher proportion of suboxic taxa. During the deposition of the upper part of the sequence oxygenation of bottom water was gradually decreasing, as expressed by a decrease of oxic species and an increase of dysoxic ones.

The Kudryntsi section consists of rhodoid limestone containing diversified assemblages of benthic foraminifers (accompanied by only rare specimens of planktonic *Globigerina bulloides*) that indicate variable environmental conditions. Analysis of changes of microfossil assemblages suggests restricted environment during beginning of the transgression, and gradual passage into marine environment during later stages of Late Badenian deposition.

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TERRESTRIAL MOLLUSCS FROM THE NEOGENE OF THE CRIMEA

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Information on the findings of remains of terrestrial molluscs in the Neogene sediments of the Crimean peninsula (*Helix*, *Pupa*, *etc.*) can be found in the numerous publications concerned with the Neogene stratigraphy. However, only Shtukenberg (1873) and Steklov (1966) have given the lists and descriptions of a small number of terrestrial molluscs from the Karaganian deposits near the Sevastopol as well as from the Maeotian of the Kerch Peninsula.

Molluscs near the Sevastopol are represented by their internal casts. Beily has earlier described five species of Helicoidea, but Shtukenberg (1873) has proved only *Helix duboissi* Baily (*Cepaea*?) and *Helix thortoni* Baily. Rare casts of *Cepaea*? sp. and *Gastrocopta* ex gr. *nouletiana* Dupuy were found along with freshwater molluscs southwestwards of Simferopol. There are lenses enriched with pebbles up to 2–3 cm at the bottom of the Lower Sarmatian oolite limestone. Most of the pebbles are the casts of *Cepaea* cf. *kreijci* Wenz.

The Early Maeotian terrestrial molluscs from the Babchikskaya gulch on the Kerch peninsula were described by Steklov (1966). Our collections from this territory allow to extend the previous list. *Pupilla triplicata intermedia* Rożka, *Truncatellina cylindrica sarmatica* Prysjazhnjuk, *Truncatellina* sp., *Brephulopsis pusanovi* Steklov, *Brephulopsis* sp. (sp. nov.?), *Parmacella* sp., *Platitheba prometeus* (Boettger), *Cepaea*? sp., *Helix* cf. *pseudoligatus* Sinzov, *Helix* sp. were found there in interbeds of sandy-clay rocks among limestones and sandstones.

Late Maeotian molluscs have been occurred near Zavetnoe village, at the bank of Kerch strait, in greenish-grey lumpy clay which underlies sandy detritus with *Mactra superstes* Davidaschvili. There are *Succinea* sp., *Gastrocopta* (*Sinalbinula*) sp. nov., *Pupilla triplicate intermedia* Rożka, *P.* ex gr. *triplicata* Studer, *Platitheba*? sp., *Helicella*? sp. (sp. nov.) in this locality. This assemblage is rather endemic except of some elements from the Western Caucasus and Pre-Dobruja and is slightly less xerophilous as compared with the Babchikskyi complex.

Pontian terrestrial molluscs were collected from the Lower and Upper Pontian in the borehole near Uvarovka village, Nizhnehorskyi district the Eastern Crimea (Kovalenko & Vernigorova, 2011). *Pomatias* cf. *subpictus* Sinzov, *Psevdoleacina*? sp., *Carychium* sp. (2 species), *Gastrocopta nouletiana* Dupuy, *Vallonia* sp., *Clausiliidae* gen. ind. (2 species) were collected in the lower part, while *Gastrocopta nouletiana* Dupuy, *Vertigo* ex gr. *oescensis* Halavats, *Vallonia lepida steinheimensis* Gottscihick et Wenz, *Helicoidea* gen. ind. were observed in the Upper Pontian deposits. Pontian molluscs were more hydrophilic and represented by species which were widespread in the Neogene of Europe.

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PALAEOECOLOGY OF SELECTED CENOMANIAN–TURONIAN OYSTER-BEARING SEQUENCES AROUND THE CENTRAL EUROPEAN REGION

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This contribute summarizes results of detailed sedimentary analysis of several oyster-bearing sequences around the Central European region. For comparison, several Cenomanian and Turonian strata within Bohemian Cretaceous Basin (Peruc-Korycany Fm., Bílá Hora Fm.) and Klippen Belt of Western Carpathians (Orlové Sandstones Fm.) were selected. Studied palaeo-areas, outstanding in occurence of oysters genus *Rhynchostreon* Bayle (as palaeoecologically important part of the Late Cretaceous benthic fauna) were selected as representative of different types of original oyster´s life environment. Thin sections were prepared from siltstones – sandstones rocks collected during field work (bed by bed method). The results of sedimentary analysis (sediment maturity, angularity and grain size) in conjuction with other studied aspects of the Late Cretaceous environment (*e.g.*, palaeotemperature, bathymetry, salinity, biodiversity *etc.*) could help us to deepen the knowledge of Late Cretaceous palaeoenvironment within Central European region. Based on preliminary results we assume the processes of internal dynamics of palaeoenvironment could play an important role in evolution and morphological changes in genus *Rhynchostreon*. Our paper summarizes the preliminary results of new Charles University grant project "Palaeoecological aspects of the evolution of the oyster genus *Rhynchostreon* Bayle".

The study was supported by the Charles University in Prague, project GA UK No. 816416.

MICROBIAL-FORAMINIFERAL LAMINITES FROM THE CAMPANIAN OF ALBANIA: BINDING ROLE OF NUBECULARIIDS AND THEIR PECULIAR TEST STRUCTURES

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Upper Cretaceous shallow-water successions from the carbonate platforms of the peri-Mediterranean region commonly contain laminated limestones referred to peritidal environment. This facies is composed by microbialites associated with benthic algae, foraminifera and microproblematica, including characteristic *Decastronema–Thaumatoporella* association. *Decastronema kotori* (formerly classified as *Aeolisaccus*) is recently assigned to cyanobacteria, while *Thaumatoporella* is treated as an algae or microproblematicum.

Our studies of the Lower Campanian shallow-water carbonates of the Kruja Zone (La Route section, Kruje-Dajt massif) of NW Albania, revealed six microfacies, including: (i) microbial–foraminiferal–thaumatoporellacean bindstone; (ii) fenestral nubeculariid–microbial bindstone; and (iii) *Decastronema* wackestone (Schlagintweit *et al.*, 2015). In contrast to previous descriptions (but poorly illustrated) of the La Route section, we found that *Decastronema* (=*Aeolisaccus*) is rare. Instead, we observed, especially in nubeculariid–microbial bindstones, widespread tubiform microfossils attributed to encrusting nubeculariid foraminifera (Miliolida). Associated biota in this microfacies are rare, mostly *Thaumatoporella* and small miliolid foraminifera. Some of the laminae are composed by abundant nubeculariids. Until now, the only mass-occurrences of nubeculariids in the Upper Cretaceous were known from the Cenomanian of Montenegro. Possibly some of the Late Cretaceous records of *Decastronema* may have been confused with small nubeculariids.

Recent studies of the Lower Campanian laminites from the Borizana section (Kruja Zone, Makareshi massif) revealed *Decastronema*-rich laminae. However, the nubeculariids are much more common, in particular in nubeculariid–microbial bindstones. In both sections two morphotypes occur: (1) unornamented, bended cylindrical tests, and (2) ornamented tests, commonly with lateral spines or irregular appendages, and with spherical hollows (*ca* 10–70 µm in diameter) within the test wall. Some dark laminae are composed by densely distributed nubeculariids, hence their morphology is hardly recognizable. Encrusting nubeculariids are commonly reported from microbial oncoids and microbialites (mostly from the Jurassic and Miocene), however such an imporant binding role in the Late Cretaceous is unique. Nubeculariid morphotype 2 occurs dominantly in microbial laminae (thicker than dense nubeculariid-dominated laminae). Spines/appendages may be interpreted as support of pseudopodia for anchorage or in feeding processes. Globular hollows could be considered as some kind of large ectobionts living in relationship to nubeculariids, however, pore diameter inhabited by ectobionts in tests of the recent foraminifera are much smaller (*ca* 1 µm), and reports of ectobionts are very rare. Alternatively, hollows may be remnants of agglutinated organic grains of unknown origin (algal fertile ampullae?, sponge microscleres?).

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MICROPALAEONTOLOGY OF THE JURASSIC AND CRETACEOUS BOUNDARY DEEP MARINE INTERVAL IN THE SILESIAN UNIT

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New outcrop of the Jurassic/Cretaceous boundary sediments of the Silesian Unit of the Outer Western Carpathians was studied. The section is situated as natural outcrop on left river bluff near Bruzovice village. Lower part of the section is formed by the uppermost part of the Vendryně Formation, which is represented by dark grey calcareous claystones with concretions and blocks of limestones. Limestones represent gravels, blocks and concretions of size at least 1.5 m in size. Limestones are predominantly micritic, grey to dark grey in colour, some of them are spotted. A very small part of limestone gravels are organodetritic. These again are grey to dark grey, often with spines of echinoderms and bivalves on the surface. Accumulation of limestones can be compared with the Ropice horizon (Menčík *et al.*, 1983) which occures in the uppernost part of the Vendryně Formation.

Claystones of the Vendryně Formation provided a relatively poor association of non-calcareous dinoflagellates with *Circulodinium distinctum*, *Cometodinium* sp., *Cribroperidinium* sp., *Endoscrinium* sp., *Gonyaulacysta* sp., *Stiphrosphaeridium anthophorum*, *Systematophora areolata*, *Tubotuberela* sp., *Valensiella* sp. Dinoflagellate cyst association is of Late Tithonian age.

Upper part of profile is represented by lowest layers of Těšín Limestone, formed by limestones, claystones and marlstones. The micritic limestones provided determinable and stratigraphically important microfossils. Representatives of calpionellids *Calpionella alpina* (Lorenz), *C. grandalpina* (Nagy), *Crassicollaria massutiniana* (Colom), *C. parvula* (Remane), *Tintinnopsella carpathica* (Colom), *T. doliphormis* (Colom) and calcareous dinoflagellates *Cadosina semiradiata fusca* (Wanner), *C. semiradiata cieszynica* (Nowak), *C. semiradiata semiradiata* (Wanner), *Colomisphaera fortis* (Řehánek), *C. radiata* (Vogler), *C. lapidosa* (Vogler) were determined. The association of calpionellids is typical for the uppermost Tithonian to Lower Berriasian age (Lakova & Petrova, 2013).

The study was supported by grants SGS SP2016/12 and GAČR 16–09979S.

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PALYNOLOGICAL STUDIES OF THE MIDDLE MIOCENE FROM SOUTHERN WIELKOPOLSKA

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The palynological research allow to determine the stratigraphic position of rock formations, particularly in the case of fauna lacking. In the Neogene sediments, the succession of the pollen assemblages from different terrestrial plants has the greatest importance. Assignment of fossil pollen grains to pollen producing its plants allows to make the reconstruction of the fossil plant communities and determine their succession, which is closely related to the evolution of climate. Temperature and humidity are the basic climatic factors favorable for the development of extensive marsh sediments which formed thick lignite seams.

Material for the study was obtained from Solniki PGI-1 and Kamień PIG-1 wells. The whole palynological matter assemblage – palynomorphs (sporomorphs and phyto-plankton) and phytoclasts (wood fragments, plants tissue, *etc.*) has been analysed.

Palynological studies of the Miocene deposits from southern Wielkopolska display visible sedimentary cyclicity, allowed to establish the evolution of plant and climate during Middle Miocene. Predomination of extensive swamps of 2nd Lusatian lignite seam in the top part of the Ścinawa Formation has been evidenced and this documented by pollen zone – the climate phase V *Quercoidites henrici*. There was very warm temperate to subtropical climate in this area. In the assemblage from the Kamień profile of the same age, the accumulation of pollen material took place in the intramontane basin in which many pollen grains of coniferous trees growing on the surrounding hills.

During the accumulation of the 2nd A Lubin lignite seam from Pawłowice Formation the Middle Miocene the pollen zone – climate phase VI *Tricolporopollenites megaexactus* occured. A significant role took there the coniferous forest community. However, the swamp forest community was still essential for the lignite formation.

The top of the Middle Miocene sequence is represented by the silty-sand deposits of the Pawłowice Formation upper part, correlated with the pollen zone – climate phase VII *Iteapollis angustiporatus*. Coniferous trees are still frequent, it is however dominated by the mixed mesophilous forest community with some thermophilous plant taxons. The prevailing climate was warm temperature.

DETERMINATION OF PALAEODEPTH ON FORAMINIFERS – EARLY TURONIAN THANATOCOENOSES EXAMPLE

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In 1998, the method of determining the composition of palaeodepth thanatocoenoses foraminifera has been developed. In terms of the protection of shells planktonic foraminifera (PF), in accordance with our methodology, are divided into four groups. For each group introduced its protection factor. For the studied sample evaluated the protection of complex PF shells according to the formula S = (KvgNvg + KgNg + KmNm + KbNb): 100%, where N – number of different shells PF preservation, K – coefficient of shells intact. In the course of numerous calculations, it was found that with decreasing depth, increasing the protection of the complex multiple steps, making three levels. Preservation complexes formed within the first palaeodepth's level ranges from 55 to 80%. PF consists of 60–95% of all amount of foraminifera, of which 4 to 40% – juvenile forms (UF). This level corresponds to palaeodepth least 1,500, that is, it is above the level of the Cretaceous lizoklina. Complexes foraminifera characteristic of sediment accumulated within the second palaeodepth's level (1,500–2,300 m) to 20–60% consists of sculptured, usually large PF shells. UF in the complex is very small (<4%). Preservation of the complex is 20–55%. In ocean sediments formed within palaeodepth the third level, at a depth of more than 2,300 m PF account for 20% of the complex. Their shell is very diluted. PF complex preservation does not exceed 20%. UF absent. The results for a number of well supported by the literature data. So, guided by the developed method of determining palaeodepth sedimentation can, examining any sample of biogenic carbonate rocks rich in shells of foraminifera, to determine within a palaeodepth level there was an accumulation of initial rainfall. In this paper we consider the end of the horizontal cut Early Turonian (*Helvetoglobotruncana helvetica* zone), uncovered seven wells deep-water drilling in the Pacific and cut Carnarvon (Australia). The complex foraminifera from sediment exposed in the boreholes 51 and 869B, consists mainly of benthic forms (BF). PF is 8% (borehole 51) and 12% (borehole 869B). All PF shells have a very poor state of preservation (S51 = 9%, S869 = 13%). They are represented strongly sculptured fragments, shells mostly genera *Marginotruncana*. Juvenile forms are completely absent. This indicates that in the period under review in the studied sedimentation region apparently occurred at great depths (palaeodepth third level), significantly below the level lizoklina. This assumption is confirmed by palaeobathymetrical constructions. In terms of borehole 310A all shells are mostly middle and less well preserved. Preservation of the entire complex is 39%. Part of PF is up to 28% of the whole complex of foraminifera. In thanatocoenoses in small quantities (less than 2%) shells UF are present in very poor state of preservation. The complex of foraminifera, having these features may be peculiar to only sediments that may have formed within the second lizocline level. The studied sediments PF 171 wells account for 67% and are characterized by extraordinary diversity of species and genera. Preservation of the complex as a whole is 60%. Many types of PD are presented by both adults and the juvenile forms, the latter accounts for 10%. The described complex is definitely contained in the sediments formed on palaeodepth considerably less depth lizocline (at the bottom of the first palaeodepth level). Estimated palaeodepth in this region is amounted to 1,200 m. Cut Carnarvon reveals Early Turonian deposits in marginal shelf seas of Australia. The complex foraminifera from these deposits is very similar to a complex borehole 465. Most shells have a good or very good degree of preservation. Despite the absence of the dissolution amount of PF is 84%, including 40% of the juvenile forms. This ratio PF/BF is characteristic for depths not exceeding 100 m. The lack of sediment adult specific deep-sea species in studied section also indicates that the sedimentation in this region went on 50–100 m depth. According to the protection and composition of their shells set for each well is determined within the level of dissolution where was an accumulation of initial rainfall. Dedicated levels correspond to the following palaeodepth: the first level – palaeodepth less than 1,500 m; second – 1,500–2,300 m; third – over 2,300 m. The first level is divided into two levels: 1st – less than 150 m, 2nd – from 150 to 1,500 m.

CRETACEOUS/TERTIARY BOUNDARY IN THE WESTERN CARPATHIANS: PRIOR CONSTRAINTS AND NEW PERSPECTIVES

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Cretaceous/Tertiary (K/T) boundary has been constrained in the Western Carpathian sections several times (see Samuel *et al.*, 1967; Salaj *et al.*, 1978), but its existence is still uncertain due to erosion connected with the Laramian tectogenesis. The sections promising for K/T boundary has been revised with some constraints, pointing out to the absence of lowermost P-serie biozones (P0-P1). New evidences of the K/T boundary has been gathered from the study of the stratigraphic drillings near Veľké Kršteňany, Žilina-Hradište and Krásno n/Kysucou-Čadca.

K/T boundary is most properly marked in the Kršteňany KRS-3 borehole, and that by LO of *Abathomphalus mayaroensis* and FO of *Parvularugoglobigerina eugubina*. Transitional inteval is also well dated by microperforate species like *Globoconusa daubjergensis*, *Eoglobigerina simplicissima*, etc. The section grades upward to the Selandian formation with *Praemurica inconstans* and *Morozovella angulata*, Thanetian formation with predominance of conicate acarininids (*A. wilcoxensis*, *A. coalingensis*, *A. pseudotopilensis*, etc.), Ypresian formation with abundant and diversified morozovellids (*M. formosa*, *M. subbotinae*, *M. aragonensis*, *M. lensiformis*, etc.) and Lutetian formation with *Morozovella gorrondatxensis*, *Turborotalia frontosa*, *Acarinina topilensis*, *Globigerinatheka kugleri*, etc. Considering that, the Kršteňany section provides a most complete stratigraphical record from the K/T boundary up to the Zone E10, that corresponds to the Late Middle Lutetian.

K/T boundary in the ZA-2 borehole near Žilina (Hradisko) is developed in plankton-rich sequence, which allows to obtain a high quality stratigraphic record. The sequence begins with silty marls, which is Maastrichtian in age by presence of globotruncanid and heterohelicid foraminifers like *Contusotruncana*, *Racemiquembelina*, *Ganserina*, etc. This formation passes into dark bioturbated marls with impoverisched microfauna, which higher up abruptly changed to *Parassubotina*- and *Subbotina*-rich associations of the lowermost Paleocene formation. Middle Paleocene sequences is significaltly enriched in large-sized foraminifers like angular and discoidal morozovellids (e.g., *M. angulata*, *M. acuta*, *M. conicotruncana*), numerous species of globanonalinids (e.g., *G. pseudomenardi*, *G. compresa*), muricate acareninids (e.g., *A. strabocela*, *A. soldadoensis*) and others. Marly sequence also contains an intercalations of coralgal limestones, that remind the so-called Kambühel Limestones.

New indications of K/T boundary has been also found in the Outer Western Carpathians in Kysuce region. Deep-water sequence of the Beloveža (Ráztoka?) Formation of the Magura unit contains a rich microfauna of guembelitrids, which indicates *Guembelitria* bloom at the K/T boundary. Herein, this stress microfauna is well documented by species *Guembelitria cretacea*, *G. danica* and *Woodbringina hornerstownensis*, which correspond with the P0 biozone of Arenillas *et al.* (2000). Paleocene sediments above *Guembelitria*-bearing formations differ by appearance of *Parasubbotina* species.

The research has been supported by VEGA project 2/0034/16 and project APVV-14–0118.

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THE BADENIAN/SARMATIAN TRANSITION IN THE CENTRAL PARATETHYS: NEW DATA FROM THE CARPATHIAN FOREDEEP BASIN IN POLAND

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The Badenian/Sarmatian transition corresponds to a major turnover in faunal elements, triggered by strong restriction to the open ocean connections. Accurate dating of the boundary between two regional Middle Miocene Paratethyan stages is crucial to understand what event caused the corresponding major turnover in faunal assemblage at that point in time.

The Polish part of the Carpathian Foredeep Basin represents one of few areas within the Central Paratethys where sedimentation of monotonous siliciclastic deposits – prevailed pelites with rare interbeds of coarse sediments – continued throughout the Late Badenian and the Early Sarmatian. The deposit succession of this time interval was distinguished as the Machów Formation. Two exploratory boreholes: Busko (Młyny) PIG-1 (depth 200 m) and Kazimierza Wielka (Donosy) PIG-1 (depth 191 m) were drilled in 2010 to get the complete core of this formation. Particular attention was put on the most precise location of the Badenian/Sarmatian boundary within the almost homogenous deposits of the Machów Formation which represents generally a deeper open-marine basin of normal salinity, with a dominant deposition of pelites from suspension.

The base of the Sarmatian was defined by the occurrence of a highly endemic fauna, particularly bivalves (Studencka, 2015) and foraminifera (Paruch-Kulczycka, 2015). Lack of correlations between changes in bivalves and calcareous nannoplankton assemblages as well as between changes in microfossil assemblages and geochemical ones suggest that there was no direct relationship between the basin geochemistry, recorded in deposits and micro- and macrofaunal requirements. They also seem to suggest that the causes responsible for faunal evolution and geochemical changes were not related to each other. New faunal assemblages of the Sarmatian type occurred earlier than the geochemistry change in the Machów Fm. sediments of the Kazimierza Wielka (Donosy) PIG-1 borehole, located far offshore in the Miocene marine basin. In the equivalent section interval of the Busko (Młyny) PIG-1 borehole, close to the basin shore, the Sarmatian bivalve and foraminiferal fauna developed just after the recorded geochemical change.

However, bio- and chemostratigraphic methods are neither suitable to settle the boundary firmly nor to allow for wider interregional correlations. The observed R–N–R polarity pattern in the Badenian part of the Kazimierza Wielka (Donosy) PIG-1 core profile suggests a tentative correlation to chrons C5AAr–C5Aan–C5Ar.3r of the GPTS, indicating an age of 12.8 ±0.1 Ma for the Badenian–Sarmatian transition (Sant *et al.*, 2015).

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FAMILY CHIRONOMIDAE IN FOSSIL AND SUBFOSSIL RESINS FROM THE COLLECTION OF THE MUSEUM OF THE EARTH IN WARSAW

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Amber is fossilized resin secreted by plants of wide range of families, mainly conifers. The oldest fossil resin is 230 million years old, the youngest one – approximately 5 million years.

Baltic Amber is dated on Paleogene period, Eocene epoch (56–39 Ma). Europe did not resemble its present shape: it was not any uniform continent but a network of islands. A land, known as Fennoscandia which is now Scandinavia and the Baltic Sea area was covered with "amber" resin producing forests which were more like the subtropical forests of today. The PAS Museum of the Earth's in Warsaw collections of amber (over 26,000 specimens) have been systematically accumulated since 1951 in Amber Department. The representatives of Chironomidae described here are the dominant group in the Diptera order inclusions in amber. 2,721 pieces of Baltic amber with inclusions of chironomids were analysed to date in the Museum of the Earth's collection. Based on the completed research, a large proportion of the subfamily Orthocladiinae has been observed, largely exceeding Chironominae and Tanypodinae in terms of quantity.

The young resin from Dominican Rebublic is copal – it is only approximately 300 years old. The Dominican copal is fossilized resin secreted by *Hymenaea.* Copal was collected from freshly plowed fields. The Museum of the Earth's collections of Dominican copal from Cotui (only 80 specimens) have been donated by John Fudala. Only 20 pieces of copal with inclusions of chironomids have been analysed from the Museum of the Earth's collection. In copal have been observed inclusions of subfamilies: Chironominae, Tanypodinae (only three specimens of females) and Orthocladinae (like in the Baltic amber Orthocladiinae is dominant subfamily of all chironomids).

The Dominican amber is fossilized resin secreted by *Hymenaea protera* (Leguminosae)*.* Dominican amber is dated also on Paleogene period, Oligocene–Miocene epochs (40–33 Ma). It is excavated on Hispaniola Island – amber mines: Los Cacaos, La Toca, Palo Alto, La Bucara, Los Higos, La Cumbre, Carlos Diaz, Palo Quemado. Good quality yellow and blue amber. Younger of Dominican resins are from Eastern Coastline, they are dated on Miocene epoch (17–15 Ma). The Museum of the Earth's collections of Dominican amber (only 138 specimens) were donated by John Fudala and Douglas Lundberg. In the Museum of the Earth's collections only six pieces of Dominican amber with inclusions of chironomids have been analysed. In Dominican amber have been observed inclusions of subfamilies: Chironominae and Orthocladinae.

Chironomidae are frequently found in amber specimens as syninclusions (with *e.g.*, Sciaridae, Mycetophilidae and another Diptera Nematocera; also with Dolichopodidae, Phoridae and another Diptera Brachycera) with many individuals often found in a single piece of amber. The number of females largely exceeds that of males; this is not advantageous for research because the morphology of fossil Chironomidae males is more reliable in taxonomic research and for this reason has been better described in literature so far.

LATE DEVONIAN TO EARLY CARBONIFEROUS FORAMINIFERAL ZONATIONS FROM THE UPPER SILESIAN BLOCK (SOUTHERN POLAND) – PRELIMINARY RESULTS

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The Upper Famenian to Upper Visenian limestones, containing foraminiferal assemblages have been sampled in outcrops located in the Racławka, Szklarka and Czernka valleys (southern part of the Kraków–Częstochowa Upland). The studied deposits belong to the tectonic structure described as Dębnik Anticline, which is a part of the Dębnik–Siewierz Variscan fold belt and creates eastern part of the Upper Silesian Block (Buła *et al.*, 2008).

Age of the foraminiferal assemblage has been assigned based on the correlation with local biozonations from the Czech Republic (Kalvoda, 2002), the Southern Ural (Kulagina, 2013), Belgium – Dinant, and France – Avesnois (Conil & Lys, 1964).

The foraminiferal assemblage studied from outcrops in the Racławka Valley contains taxa as: *Bisphaera malevkensis*, *Earlandia elegans*, *Quasiendothyra bella*, *Q. communis*, *Q. kobeiatusana* and *Q. konensis glomiformis* represents *Q. communis – Q. regularis* and *Q. kobeitusana – Q. konensis* Interval zones of the late through latest Famenian. These Foraminiferal zones could be correlated with *Palmatolepis marginifera* and *Siphonodella praesculata* conodont zones according to Kalvoda (2002).

Limestones studied in the Szklarka Valley contains among others taxa as: *Septabrunsina* sp., *Septatournayella* sp., *Septaglomospiranella* sp., *Pseudoglomospira* sp., *Chernyshinella glomiformis*, *Ch. tumulosa*, *Paleospiroplectammina* sp. Some single-chamber foraminifers represents species from genera as Earlandia, Diplosphaerina, Parathurammina and Bisphaera. This foraminiferal assemblage belongs to *Chernyshinella glomiformis* Interval Zone which indicates on Middle Tournaisian. These foramini-feral assemblage could be correlated with *Siphonodella crenulata* conodont zone *sensu* Kalvoda (2002).

The foraminiferal assemblage from Czernka Valley indicates on the Late Visenian age based on taxa as: *Archaeodiscus* sp., *Cribostromum strictum*, *Climacammina* sp. and *Tetrataxis* sp. Above mentioned taxa belong to the *Neoarchaediscus* Interval Zone, which corresponds to V3b zone according to Belgian division and *Gnathodus bilineatus* conodont zone (Kalvoda, 2002).

Current study was financially supported by AGH UST 11.11.140.173 grant.

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TRENDS IN EVOLUTION OF EARLY ONTOGENETIC STRATEGIES IN NAUTILOIDS

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Evolution, dispersion, diversification and abundance of cephalopods throughout geological past is closely linked with early ontogenetic strategies. The timing of hatching and the degree of hatchling development is inferred in fossil cephalopods from the morphology of their shells. Due to scarcity of published data concerning this topic we focus to bring new reliable information dealing with the earliest ontogenetic development of nautiloids.

Nautiloids (cephalopods with external shell and apex possessing cicatrix, usually without cameral deposits) acquired throughout evolution a variety of early ontogenetic and adult life strategies.

a) Palaeozoic oncocerids and discosorids, booth closely related to oldest nautiloids of the order Ellesmerocerida, possessed cup-like apical part of the shell with highly variable size (shell length approximately between 3–15 mm). Hatched individuals had monoplacophor-like shell with 1–2 phragmocone chamber/s. Their demersal habit is highly probable. Their adult shell was straight, curved or coiled, reflecting different modes of life – from demersal to nektonic.

b) In tarphycerids, evolutionary oldest nautiloids with coiled shell (Ordovician-Silurian), two pathways of early ontogenetic development were supposed: 1 – the curved embryonic shell had one, two, or rarely three phragmocone chambers; 2 – the coiled embryonic conch consisted of five to eight phragmocone chambers; in this case hatchlings did not differ substantially from adults. However, second pathway was not confirmed. Shell morphology of earliest tarphycerid growth stages and distribution pattern indicate planktonic habit of their hatchlings; nektonic habit in later growth stages is linked with development of coiled shell.

c) Early ontogenetic development of earliest Nautilida – Silurian Uranoceratidae and Lechritrochoceratidae – is characterised by prolonged embryonic stage and consequently increasing size of freschly-hatched specimens. Curved shell of hatchlings had several (most likely 3–4) phragmocone chambers that probably resulted in positive buoyancy of juveniles. Their adults having coiled shell were active swimmers like *Nautilus*. Late Devonian–Pennsylvanian nautilids had curved embryonic shell reaching maximally 3/4 whorl. Starting with hatching nektonic mode of life was possible. However, different habit of juveniles in comparison with later ontogenetic stages is supposed.

d) Strongly curved embryonic shell of Triassic Nautilida did not reached complete whorl; post-Triassic nautilids had large, coiled embryonic shell – a result of further prolonged embryonic development. These cephalopods comprise active swimmers not changing habit and mode of life throughout ontogeny.

EARLY CRETACEOUS BELEMNITES FROM LOCALITY ŠTRAMBERK (TAXONOMY, STRATIGRAPHY AND PALAEOECOLOGY)

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Early Cretaceous belemnites belong to the commonly occurring fossils of Carpathian area and its complex study is a great contribution to the knowledge about history of this specific study area. This study is based on more than 3,000 belemnite rostra set from the Lower Cretaceous sediments of locality Štramberk (N Moravia). Investigated rostra set come from the collection of Dr. V. Houša, who collected them during the seventies to eighties of the last century, during intensive excavation of the Lower Cretaceous tectonic block named Š-12 "pocket". Belemnite rostra were divided into species and generas. The majority of belemnite assemblage comes from the Lower Valanginian strata, however the Tithonian, Berriasian and Hauterivian taxa are also presented, what clearly documented the redeposition. The presence of mesohibolitids, known from the Barremian and younger deposits, still remains enigmatic. For better understanding of the redeposition process, the alveolar infill formed by several generations of sediments, was investigated. Study of these sediments outlines the sedimentary development of the Baška elevation inside the Outer Carpathian system. Preliminary stable isotope data $\delta^{18}O$ and $\delta^{13}C$ received from belemnite rostra show different belemnite life-style during the ontogeny – *i.e.,* juvenile adopted bottom life style and adults inhabited in shallow/warmer waters. Negative values of $\delta^{18}O$ should be correlated with the "Valanginian extinction event", which strongly influenced the Early Cretaceous marine ecosystems. Each belemnite taxa is discussed within the NW Tethys context and they are stratigraphically calibrated and correlated with the standard ammonite zonation.

"PSEUDOTHURMANNIID" AMMONOIDS IN THE LIETAVSKÁ LÚČKA QUARRY (LATE HAUTERIVIAN, CENTRAL WESTERN CARPATHIANS, KRÍŽNA NAPPE, SLOVAKIA)

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At the end of last century, I together with J. Michalík documented, in the walls of the quarry for the cement works at Lietavská Lúčka near Žilina, the basic geological structure and collected the macrofauna in the Lower Cretaceous deposits of the Krížna Nappe in the Central Western Carpathians (Vašíček & Michalík, 1988). In several places, but especially on Level 5 of Polomec Subquarry, ammonites of pseudothurmanniid type occurred. In contrast to heteromorphous representatives collected with them, the last mentioned ammonites have not been taxonomically processed in detail yet.

Recently, Hoedemaeker (2013) processed European pseudothurmanniid ammonites monographically. His basic taxonomic conception is based especially on the morphology of juvenile whorls. From Hoedemaeker's detailed processing two basic findings of knowledge follow, namely that, on the one hand, a group of ammonites belonging really to the genus *Pseudothurmannia* Spath, 1923 (divided by Hoedemaeker into 3 subgenera) can be distinguished, and, on the other hand, a large portion of ammonites are represented by representatives of the genus *Crioceratites* Léveillé, 1837 resembling the genus *Pseudothurmannia* (*Crioceratites* mimicking *Pseudothurmannia*). With reference to Hoedemaeker's knowledge, we tried, according to his conclusions, to process taxonomically in detail these ammonites from Lietavská Lúčka that we regarded as pseudothurmanniid ammonites.

In the first phase of our processing, we selected specimens with favourably preserved juvenile whorls, important for the basic generic or subgeneric classification from several hundred findings. They are surprisingly few. In the second phase, we proceeded to photodocumentation of juvenile whorls and subsequently, to genus and species determination according to Hoedemaeker's data.

From our taxonomic processing it follows surprisingly that only a single subspecies of the genus *Pseudothurmannia*, namely *Pseudothurmannia* (*Kakabadziella*) *ohmi ohmi* (Winkler, 1868) occurs sporadically in our material. The other findings belong to the genus *Crioceratites*, partly to the subgenus *Balearites* Sarkar, 1854 (with species *Balearites balearis* Nolan, 1894; *B. shankariae* Sarkar, 1955; *B. theodomirensis* Hoedemaeker, 2013 and *B. oicasensis* Hoedemaeker, 2013) and partly to the subgenus *Binelliceras* Sarkar, 1977 with the species *Binelliceras krenkeli* Sarkar, 1955, *B. rotundatus* Sarkar, 1955 and *B. ibizensis* (Wiedmann, 1962).

According to the simpler ammonite zonation of Upper Hauterivian proposed by Hoedemaeker (2013), the oldest findings of pseudothurmanniid ammonites at Lietavská Lúčka belong to the subgenus *Balearites*, a small portion of them to the subgenus *Binelliceras.* These findings document the ammonite Balearis Zone. The largest portion of the studied material is represented by species of the subgenus *Binelliceras*, occurring especially in the overlying Ohmi Zone. A stratigraphically important finding is then represented by the occurrence of *Pseudothurmannia* (*Kakabadziella*) *ohmi ohmi* that is characteristic of the Ohmi Zone.

In the quarries at Lietavská Lúčka, any pseudothurmanniid ammonites, which would prove the uppermost Hauterivian ammonite Catulloi Zone (in the conception by Hoedemaeker, 2013), were not found.

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THE JURASSIC AND CRETACEOUS BOUNDARY IN SIBERIA AND EASTERN EUROPE

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Mesozoic high-bituminous clay and siliceous and carbonate thicknesses of Western Siberia draw the increasing attention, especially Bazhenov shale. Now it is considered as one of strategically important objects for completion of resource base of oil branch of Russia. There is a question a lower and top limits of high-bituminous clay and siliceous and carbonate deposits of the Bazhenov shale and also definition of position of Jurassic and Cretaceous boundary.

As radiolarians are rock-forming, and other fauna is practically absent, the partition is possible only on radiolarians. Earlier, radiolarians of the Bazhenov shale were studied by G.E. Kozlova (Vishnevskaya & Kozlova, 2012) who has suggested to allocate complexes: Middle Volgian average and Upper Volgian, Upper Volgian and Berriasian. These complexes have been used in the regional scheme of Western Siberia. But, because all complexes have been described on thin sections, and an index species aren't recognized valid, there was a need of application of a new technique. Application of tomography method has allowed to allocate 5 stratigraphic divisions as the biohorizons with radiolarians. All biohorizons are allocated on evolutionary changes of the *Parvicingula* genus.

The lower biohorizon with *Parvicingula elegans* Pessagno et Whalen is established at the highest levels of Abalaksk suite. Presence the *P. elegans* index-species allows to carry this biohorizon to Kimmeridgian.

The biohorizon of *Parvicingula blowi* (the Lower Volgian) is established in a siliceous and carbonate interval of bottoms of the Bazhenov shale.

The biohorizon of *Parvicingula jonesi* Pessagno (the Middle Volgian) is established in the clay and siliceous radiolarites.

Parvicingula haeckeli biohorizon (the Upper Volgian) is established in the Bazhenov shale in the carbonate and siliceous radiolarites.

Parvicingula khabakovi biohorizon (Berriassian) with Williriedellum, Echinocampidae is established at the highest level the Bazhenov shale.

In the biohorizon numerous calcareous dinocysts and nannoplankton appear.

The comparison with Jurassic to Cretaceous boundary sequences of Europe part of Russia indicates the same biohorizons. The comparison with Jurassic to Cretaceous boundary sequences of Eastern Europe (for instance Strapková section) shows changing of limestone with radiolarians of Parvicingulidae family into pithonellides limestone with radiolarians of Williriedellidae family.

Work is performed with partial support of the Russian Federal Property Fund, projects 15-05-04700. I am grateful to Jozef Michalík for samples of Slovakian Strapková section, which it was possible to use for comparison.

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CHITINOZOAN RECORD ACROSS THE MID-HOMERIAN EXTINCTION EVENT IN THE PRAGUE BASIN (UPPER WENLOCK, SILURIAN, CZECH REPUBLIC) – PRELIMINARY REPORT

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The *lundgreni* event represents the most eminent extinction in the history of graptolites recognised all-over the world. Nearly synchronous extinction in conodonts has been named as the Mulde event. More recently, the mid-Homerian extinction events have been linked with a prominent $\delta^{13}C$ excursion. A global perturbation in atmospheric-oceanic circulation and shallowing reflecting global cooling and increasing glaciation has been suggested as possible causes of the mid-Homerian extinctions.

Chitinozoans are widely applied in Ordovician–Devonian marine correlations. This group of organic microfossils explain high evolution rate, usually high abundance and rather low facial dependence. However, existing data on the impact of the mid-Homerian extinctions on chitinozoan assemblages is still limited. Data obtained from Estonia and Gotland (Baltica) by Nestor (1997, 2007) shows an extinction of some lower-middle Wenlock species at the Mulde event. A prominent reaction of chitinozoans on the *lundgreni* event has been described in Sardinia (peri-Gondwana) by Pittau *et al.* (2006). Steeman *et al.* (2015) described chitinozoan extinction in Anglo-Wales Basin (Avalonia) and pointed out that the *lundgreni* event affected chitinozoans less than graptolites.

Prague Basin was a part of peri-Gondwanan temperate zone during the Early Silurian. Dufka (in Kříž *et al.*, 1993) suggested an overturn in chitinozoan fauna coeval with *lundgreni* event. This conclusion was, however, based on integration of several incomplete logs and thus remains in a need of further support. The studied Vyskočilka section exposes a complete shale-dominated log throughout late Wenlock including *lundgreni* event and is constrained with graptolite data.

Thirty-four samples were taken from the section – twenty covering the pre-extinction and fourteen the post-extinction phase of *lundgreni* event. Thirty-one samples proved to be productive in chitinozoans, twenty-one of them were well-productive. The preservation of chitinozoans varies from badly to moderately preserved specimens. The state of preservation somewhat confused determination of chitinozoans to species level, therefore, we examined generic diversity in first step. Obtained fauna consists of dominant genera *Ancyrochitina*, *Conochitina* and *Cingulochitina* accompanied by less abundant genera *Linochitina*, *Ramochitina*, *Margachitina*, *Sphaerochitina* and others. Generic diversity of chitinozoans varies among samples. From fourteen determined genera, twelve pass through the *lundgreni* extinction level and only two disappear below the graptolite extinction. The effect of the *lundgreni* event on generic chitinozoan diversity seems to be rather limited.

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REVISION OF CRIBROSPONGIIDAE (PORIFERA, HEXACTINELLIDA) FROM THE BOHEMIAN CRETACEOUS BASIN

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Cribrospongiidae Roemer, 1864 (Hexactinosida, Hexactinellida) represents a substantial component of sponge faunas from the Bohemian Cretaceous Basin. A total number of 960 specimens of cribrospongiids from 45 localities (Upper Cenomanian–Middle Coniacian) have been studied in detail; most of them have been recently collected by the author and part of the material comes from institutional collections (National Museum Prague, Senckenberg Naturhistorische Sammlungen Dresden, Charles University Prague, Czech Geological Survey).

Considering the fact that this large number of specimens comes from various locations (and thus various palaeoenvironments) it was rather surprising that they belong only to four taxa of cribrospongiids, representing genera *Hillendia* Reid (1964) and *Guettardiscyphia* Fromental (1860).

The occurrence of species *Hillendia isopleura* (Reuss, 1846) is restricted to the nearshore facies of Late Cenomanian in Bohemia and Saxony (*e.g.*, Reuss, 1846; Geinitz, 1871), but has been recorded also from numerous Early Turonian outcrops of nearshore facies of Bohemia (Kutná Hora, Kolín and Čáslav districts). The overall shape of the skeleton is quite variable which is a response to the turbiditic environments of nearshore facies; the character of the substrate has also important influence on the size and shape of sponge skeletons. *Hillendia isopleura* represents one of the few sponge taxa, which clearly survived Cenomanian/Turonian boundary.

Species *Hillendia bohemica* (Počta, 1883) shows the highest morphologic variability within all known cribrospongiids and occurs since Middle Turonian to Middle Coniacian in the Bohemian Cretaceous Basin. The peak of abundance of this species is restricted to the lower part of the Upper Turonian (Hyphantoceras Event), which is also the case of occurrences in the United Kingdom (*Hillendia polymorpha* in Reid, 1964) and Poland (Scupin, 1913). Upper Turonian – basal Middle Coniacian occurrences of this species are also documented from the Cretaceous of Germany from the Passau region and from Kassenberg.

The remaining two species of cribrospongiids are represented by *Guettardiscyphia* sp.n. and *Hillendia scyphus* (Počta, 1883). The first species typically occurs in the late Early Turonian sediments of nearshore facies in the Železné Hory, Kolín and Čáslav districts in Eastern and Central Bohemia and the latter is restricted to few localities in the Upper Turonian of north-western Bohemia (Počta, 1883).

This study is a part of the project GAČR GP14–31662P.

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EARLY PLEISTOCENE REPRESENTATIVES OF *URSUS THIBETANUS* LINEAGE – THEIR PHENOTYPIC, TAXONOMIC AND BIOGEOGRAPHIC CHARACTERIZATION

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The Asiatic Black Bear (*Ursus thibetanus* Cuvier, 1823) is an extant bear species inhabiting areas in South and East Asia. In the past, distribution of *U. thibetanus* was more extensive, reaching to the Western Europe, Caucasus, and Middle Ural Mountains (Crégut-Bonnoure 1997; Baryshnikov 2002, 2010 and references therein). But it seems that distribution center was always in the southern part of East Asia. Although the origin of this species was discussed several times in the past, in fact, no relevant evidence about it was available until recently. For a long time, Middle and Late Pleistocene fossil record represented almost all the fossil material available for this species, with only few exceptions (*e.g.,* Juyuandong Cave; Pei, 1987). Neither molecular studies, despite producing many new and important data, provide more accurate basis for solving this problem. They estimate splitting time of *U. thibetanus*-lineage from other ursines from 4.08 Ma (Krause *et al.*, 2008) to 1.56 Ma (Kutschera *et al.*, 2014). The knowledge about early evolutionary history of the species was therefore very limited, until discovering several new Early Pleistocene localities with *U. thibetanus* (*e.g.,* Liu & Qiu, 2009) during last two decades, which provides the opportunity to precise our understanding of this topic. Up to now, the Early Pleistocene record of *U. thibetanus* is almost exclusively limited to the territory of China, from where also a new Gelasian subspecies, *U.t. primitinus* Liu et Qiu, 2009, was described. Moreover, although there is no unambiguous Pliocene record of this species, several Early Pliocene specimens from Europe were assigned to this lineage (Mazza & Rustioni 1994; Baryshnikov & Zakharov 2013). The main goals of present research are therefore to: (1) describe in detail phenotypic character (especially dental one) of Early Pleistocene *U. thibetanus*, (2) characterize the dental morphological changes during Early Pleistocene, if any, (3) verify the possible Pliocene record of *U. thibetanus*-like bears, and (4) evaluate the distribution patterns of *U. thibetanus* during Early and Middle Pleistocene.

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THE BIOSTRATIGRAPHY OF THE SKRZYDLNA OLISTOSTROME DEPOSITS (OUTER POLISH CARPATHIANS) – PRELIMINARY RESULTS

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In so-called Skrzydlna Tectonic Bay, representing the Fore-Magura Unit, the olistostrome is observable on a distance of several kilometers. Within the lithostratigraphic log of this unit, including the upper Eocene to Oligocene rocks, the olistostrome is placed between the Menilite Beds and the Cergowa Sandstones in eastern part of the Skrzydlna Bay or at the base of the Krosno Beds in its western part. Mixture of dark gray to black and red, subordinately green clays, in some parts calcareous, in others non-calcareous, with clasts of fine-grained sandstones and dark and red shales, represents the bulk of the olistostrome. Angular to sub-rounded clasts vary from a centimeter to decimeter in diameter, strongly distorted sandstone-shale packets also occur within muddy matrix. To evaluate the components (clasts and matrix) of olistostrome the biostratigraphical analysis was provided.

The Albian or Albian–Cenomanian foraminiferal assemblages were recognized from dark grey marly shales of the Verovice- or Lhoty-type. The poor preserved and not numerous fauna contain *Trochammina vocontiana* Moullade, *Hippocrepina depressa* (Vašíček) and *Pseudonodosinella troyeri* (Tappan) and *Bulbobaculites problematicus* (Neagu). n

The Campanian–Maastrichtian fauna occur in the brown-gray marly, strongly sanded shales. The fauna consist of well preserved agglutinated and not so well preserved benthic calcareous forms. The presence of *Caudammina gigantea* (Geroch), *Caudammina ovula* (Grzybowski), *Rzehakina inclusa* (Grzybowski), *Spiroplectammina dentata* (Alth) and *Goesella rugosa* Hanzlikova (locally numerous) determinate the age of these deposits. Relatively high number and taxonomical composition of calcareous benthos suggest the similarity to the Subsilesian Late Cretaceous fauna.

Upper Paleocene deposits were recognized as the youngest part of the profile. They are represented by grey-blue marly mudstones with thin-bedded sandstone intercalations. The planktonic, as well calcareous benthic and agglutinated forms partly in good state of preservation occur in the foraminiferal assemblages. The planktonic foraminifera constitute very important component of assemblage; *Subbotina* cf. *cancellata* Blow and *Subbotina* cf. *velascoensis* Cushman were recognized within the upper Paleocene. The benthic foraminifera are represented by forms commonly occurring in Maastrichtian–Paleocene like *Rzehakina epigona* (Rzehak), *Annectina grzybowskii* (Jurkiewicz) as well as *Remesella varians* (Glaessner) with numerous *Glomospira charoides* (Jones et Parker), *Paratrochamminoides* and *Trochamminoides* div.sp., observed especially in the Thanetian.

A single specimen of *Reticulophragmium amplectens* (Grzybowski) occurs in the olistostrome matrix together with the Lower Cretaceous foraminifera. This form is typical for the Middle and Late Eocene. We can rule out the Eocene components of the Skrzydlna olistostrome.

This research has been financially supported by Micropress Europe Foundation and AGH University of Science and Technology in Kraków grant No. 11.11.140.173, National Centre for Research and Development Blue Gas Program (BG2/ShaleCarp/14).

BLACK EOCENE IN THE SILESIAN NAPPE – POST-MECO EVENT IN DEEP WATER ENVIRONMENT?

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Early Paleogene is interval of important climatic changes. The terminal thermal event in the Late Paleocene resulted in the biggest extinction of the benthic foraminifera. From this time global temperatures gradually declined, but this long-ranging trend was interrupted by short-term intervals with higher temperatures. These fluctuations are good record in shallow water foraminifera, which are very sensitive for water temperature changes. In deep-water basins, palaeontological record is more unified, short-time changes are diluted and alleviate. MECO (Middle Eocene Climatic Optimum) is an important Eocene global warming. The high content of CO_2 resulted in the increase of temperatures of 4°C over 600 ky and transient warming of surface and middle-bathyal waters.

The deposits, which could be connected with post-MECO were described from the Eocene of the Silesian Nappe. They belong to the Hieroglyphic beds and represent deep water environments in the Outer Carpathian Basin of the Western Thetys domain. They are predominated by shales – brown mudstones intercalated by grey-green mudstones, thin-bedded fine grained sandstones and very thin laminas of bentonites (Waśkowska, 2015). The particular feature is rapid TOC increase up to 3% in the lowermost its part. The green-grey mudstones with layers of grey quarzitic sandstones with TOC content not exceeding 0.3% are below and above. The studies were carried in the Szczyrzyc Depression, in the Stradomka section (Krzesławice village).

The age and anoxic sedimentary environments of dark deposits could correspond with post-MECO interval. The Early Bartonian age was estimated taking into account the foraminiferal assemblages from underlying and overlaying deposits. The lower part of the Ammodiscus latus biozone after zonations for the Carpathians by Geroch & Nowak (1984) and Olszewska (1997) was distinguish (Waśkowska *et al.*, 2015).

Two samples were taken from organic-rich deposits. Over a dozen species of cosmopolitan agglutinated forms like *Ammodiscus*, *Ammosphaeroidina*, *Bathisiphon*, *Nothia*, *Glomospira*, *Haplophragmoides*, *Karrerulina*, *Paratrochamminoides*, *Recurvoides*, *Saccammina and Psammosiphonella* were recognized. Not numerous specimens, taxonomically poor assemblages and long-ranging forms, with wide tolerance for poor ecological environment are reflection of stress condition during post-MECO. The limitation were connected primarily with oxygen deficit in deep water condition.

This research has been financially supported by Micropress Europe Foundation and AGH University of Science and Technology in Kraków grant No. 11.11.140.173, National Centre for Research and Development Blue Gas Program (BG2/ShaleCarp/14).

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MONOSPECIFIC *TROCHAMMINA* ASSEMBLAGES FROM THE LATEST PALEOCENE OF THE POLISH OUTER CARPATHIANS

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The sampled deposits occur in the Melsztyn Hill (Melsztyn village, 10 km SE from Tarnów). This hill, famous because Melsztyn Castel ruins, is built from the Silesian Nappe deposits. The Ciężkowice Sandstone Formation is underlined by the Istebna Formation, which crop out in the lower part of the northern slope (Cieszkowski *et al.*, 2010). The samples were taken from the uppermost part of the Istebna Formation, so called upper Istebna shales. It consists of muddy shales interbedded by thin-bedded quarzitic sandstones.

Trochamminoidae specimens are the numerous groups in the foraminifera assemblages. Problematic is Trochamminidae taxonomic determination because of the strongly compressed specimens. But it seems, they are at least 2 species: the most numerous are close to the *Trochammina globigeriniformis* (Parker et Jones), and the next close to *Trochamminopsis altiformis* (Cushman et Renz). They constitute 35–55% of all foraminifera. The next numerous group is Astrorhizace (39–28% all foraminifera) occurring in the fragments. The others like Ammodiscidae, Recurvoidacea, Lituolacea, Lituotubacea, Rzehakinacea, Prolixoplectidae, Hormosinellacea, and Saccamminacea occur usually in amount of few percent, except the rich *Spiroplectammina navarroana* Cushman, which represents 13% of all foraminifera.

The age of *Trochammina*-rich assemblages is estimated as Late Paleocene. *Rzehakina fissistomata* (Grzybowski) and *Subbotina velasoensis* Cushman were recognized in studied samples. They co-occur in latest Paleocene time interval.

The assemblages bear features of crisis associations; they are characterized by occurring of monospecific associations predominating by one taxon, dwarf forms (Lilliputian effect) of foraminifera and general low taxonomic diversity. Surprising is the marginal amount of typical cosmopolitan forms like *Paratrochamminoides*, *Recurvoides* or *Glomospira*, which are typical for Thanetian Outer Carpathian deep water assemblages.

In the last years, the wide distributed assemblages with higher number of *Trochammina* were described from the deep water Lower Eocene Hieroglyphic beds deposits of the Silesian Nappe. They are connected with ecological crisis – result of Paleocene–Eocene Thermal Event. The founding of similar assemblages in the uppermost part of Istebna beds suggests that crisis conditions predispose development of *Trochammina*-rich assemblages occurring at least from Upper Paleocene (probably from uppermost Thanetian).

This research was supported by AGH grant 11.11.140.173 and Micropress Europe Foundation.

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PALYNOFLORA AND PALAEOENVIRONMENT OF THE LATE EOCENE ŁUKOWA DEPOSITS (CARPATHIAN FOREDEEP, SE POLAND) – A PRELIMINARY REPORT

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The Łukowa-4 borehole was located in the Carpathian Foredeep, near Tarnogród. It penetrated the Middle Miocene (Badenian), Lower Oligocene (Rupelian), and Upper Eocene (upper Priabonian) strata (Gedl, 2015; Gedl *et al.*, in press). The marine dinoflagellate assemblages in the basal sand show that this part of the Carpathian foreland was flooded by a sea during the latest Eocene (Gedl, 2015).

Ten samples from the lowermost part of the Łukowa-4 borehole (depth 819.0–819.1 and 822.6–822.75 m) were studied for pollen and spores. These samples are very rich in palynomorphs. Results of analysis indicate the presence of vegetation with significant portion of thermophilous taxa. Trees and shrubs from the family Hamamelidaceae were probably well represented. The vicinity of the sedimentary basin was probably covered by forests, composed of *Platanus*, *Platycarya*, members of the family Fagaceae (probably *Trigonobalanus*, *Castanea*, evergreen *Quercus*, and others), *Engelhardia*, *Pterocarya*, members of the families Fabaceae, Sapotaceae, Mastixiaceae, Oleaceae, and others. Members of the family Pinaceae, *Sciadopitys* and *Sequoia* were components of coniferous or mixed forests. *Taxodium*, and presumably *Glyptostrobus*, together with *Nyssa*, might have overgrown the neighbouring area with a higher groundwater level (as elements of swamp forest). Members of the families Cyrillaceae, Clethraceae, Ericaceae, Myricaceae, Arecaceae, *Milfordia* as well as plants producing pollen from the so-called Normapolles group also occurred in the vicinity.

The predominance of trees of the genera growing now under tropical and subtropical climatic conditions and presence of several taxa characteristic for swamps indicate that the climate during deposition of the sediments studied was warm and humid.

Localities with well documented Eocene plant remains are infrequent in Poland (Worobiec *et al.*, 2015). Spore-pollen assemblages are known *e.g.,* from several boreholes, mainly from northern and central Poland (Grabowska, 1968; Słodkowska, 2004a, b; 2009).

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THE LATEST DEVONIAN CONODONTS AND FORAMINIFERS FROM KOWALA QUARRY (HOLY CROSS MOUNTAINS) AND WAPNICA QUARRY (SUDETES) NEAR THE HANGENBERG BLACK SHALE INTERVAL

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The biostratigraphic positions of the uppermost Devonian succession from Kowala Quarry (Holy Cross Mountains) and Wapnica Quarry (West Sudetes) were determined and compared by assemblages of conodonts and foraminifers.

Kowala Quarry is located in the southern part of the Kielce region of Poland. The first conodonts from this interval were studied from Kowala 1 borehole by Nehring-Lefeld (1990) and later by Malec (2014) in exploratory trench dug in vicinity of Kowala and by Dzik (2006) in Kowala Quarry. The investigated interval, is approximately 8 m thick, consists of rhythmic succession of nodular marly limestones and shales. In the lower part of succession the rocks are cherry red, but in the upper part – olive-green. *Wocklumeria sphaeroides* and *Epiwocklumeria applanata* occur here (Woroncowa-Marcinowska, 2011). Bioturbation surfaces at the bottom of cherry red limestones are present and display various type channels. Succession is limited by two black shale horizons. A lower black shale horizon (KBS) is 25 cm thick, an upper (HBS) – is about 100 cm and occurs about 8 m above the lower shale. The studied interval, represented by *Wocklumeria* Genozone limestones and shales yields a conodont assemblage, which indicates so-called the Upper *expansa* and Lower–Middle *praesulcata* zones. Eleven samples provide sufficient conodont faunas, clearly dominated by *Bispathodus*. About 25 pectiniform form-taxa are determined (genera *Bispathodus*, *Branmehla*, *Mehlina*, *Polygnathus*, *Neopolygnathus*, *Palmatholepis*, *Pseudopolygnathus* and "*Siphonodella*"=*Eosiphonodella*).

Wapnica Quarry is located near Dzikowiec in the West Sudetes, southern Poland. The investigated sequence has been known as a classical geological site in Europe since the XIX century. Conodonts were studied by Freyer (1968), Chorowska (1979) and Dzik (2006). The uppermost part of succession, so-called Wocklumeria Limestone, is composed of red and grey micritic limestones, having a typical nodular appearance in several layers. The investigated interval (approximately 2 m thick) is located at the northern end of quarry and yields a conodont assemblage, which indicates the Upper *expansa* and Lower–Middle *praesulcata* zones. It has the such conodonts as listed above.

The studied samples from investigated sequences include not only conodonts but lots of agglutinated foraminifers and fish remains. The material under study includes such genera as *Hyperammina*, *Tolypammina*, *Thurammina* and *Paratikhinella*.

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REGIONAL STAGES OF PALEOGENE OF THE SOUTHERN AND NORTHERN UKRAINE: BIOSTRATIGRAPHY AND CORRELATION

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Stratigraphy of sedimentary cover of Ukraine is based on the principles of regional stratigraphy which is described in national Startigraphic Code (2012). The main stratigraphic unit is a regional stage (regiostage) (syn.: regional horizon) be regarding as reflection of stages of geological history of depositional basin, *i.e.* peculiarities sedimentation, transgressive–regressive cycles, sequence of fauna and flora and others. Regiostages serve not only for correlation of coeval local stratigraphic units or parts thereof within sedimentary basins, but also for their correlation with stages of ISC.

In Paleogene on the territory of Ukraine there were three sedimentary basins: Western, Northern and Southern. Modern Regional Stratigraphic Chart of Paleogene of Northern Ukraine (NU) consists of the Pselian, Merlian, Kanevian, Buchakian, Kievian, Obukhovian, Mezhigorian, Berekian regiostages. Regional Stratigraphic Chart of Southern Ukraine (SU) includes the Belokamenskian, Kachian, Bakhchisaraian, Simferopolian, Novopavlovkian, Kumian, Almian, Planorbellian, Molochnaian and Kerleutian regiostages. Interregional correlation mainly is based on biostratigraphical researches, *i.e.* studied sequence of zonal associations of dinocysts, nanoplankton, plankton and large foraminifera, diatoms, radiolaria and the ratio of characteristic complexes of plankton and benthic fossils. So, the biostratigraphical characteristics of regiostages are as follows:

- NU: Pselian (lower part: zones *E. taurica* – *Pr. inconstans*, NP2 – NP4 (part)), Merlian (zones *C. speciosum* s.l., *Tr. ventriculosa*, NP8), Kanevian (lower part: beds with *D. oebisfeldensis*, beds with *Dr. simile*, zone *H. proteus*, bed with *Pl. circularis*; upper part: beds with *Ch. coleothrypta*, zones *Sp. (O.) biconstrictus*), Buchakian (beds with *Wil. echinosuturatum, A. bullbrooki* – *A. rotundimarginata*, molluscs), Kievian (lower part: NP15 (part) – NP16, beds with *A. kiewensis*, zone *W. articulata*; upper part: zones *Rh. draco*, *Rh. porosum*, beds with *St. kossutii*, zones *Cr. succinctus*, El. (A.) chabakovi, Obukhovian (zone *Ch. clathrata angulosa/Rh. perforatum*, beds with *Pl. paleogena*, beds with St. (H.) zonata), Mezhigorian (zones *Phth. amoenum/W. symmetrica* – *W. gochtii*, beds with *Dr. birostratus birostratus*), Berekian (lower part: beds with *Hystrichokolpoma* spp. /*Batiacasphaera* spp. of zone *W. gochtii*; upper part: beds with *C. galea*);
- SU: Belokamenskian (zones *E. taurica*, *Pr. inconstans* – *G-sa daubjergensis*, *M. angulata* s.l., NP1 – NP5 (part), *Car. cornuta* s.l., macrofauna), Kachian (zones *I. djanensis*, *A. subsphaecica*, *A. acarinata*, NP5 (part) – NP9, *C. speciosum* s.l., *Ap. homomorphum*, molluscs), Bakhchisaraian (zones *M. subbotinae* s.l., NP10 – NP12 (part), *N. planulatus*, *W. meckelfeldensis*, *Dr. simile*, *Dr. varielongitudum*, molluscs), Simferopolian (zones *M. aragonensis* s.l., *A. bullbrooki*, NP12 (part) – NP14, *N. distans*, *N. polygyratus*, *Ch. coleothrypta* s.s., macrofauna), Novopavlovkian (zones *A. rotundimarginata*, *Gl-ka subconglobata* – *H. alabamensis*, NP15 – NP16 (part), *En. arcuata*, *W. articulata*, molluscs), Kumian (zones *S. turcmenica*, NP16 (part) – NP17, Rh. draco, Rh. porosum), Almian (zones *Gl-ka tropicalis* s.l., NP18 – NP21 (part), *Ch. clathrata angulosa/Rh. perforatum*), Planorbellian (zones *Phth. amoenum/W. symmetrica*, *W. gochtii* (part), NP21 (part) – NP22, *Pyx. reticulata*, molluscs), Molochnaian (beds with *Hystrichokolpoma* ssp. within zone *W. gochtii*, beds with *R. ornata*, Tr. fibula of zone NP23, molluscs), Kerleutian (zones *C. galea*, molluscs).

Interregional correlation (NU→SU): Pselian → Belokamenskian; Merlian → Kachian; Kanevian → Bakhchisaraian and lower part of Simferopolian; Buchakian → upper part of Simferopolian and lower part of Novopavlovkian; Kievian → upper part Novopavlovkian and Kumian; Obukhovian → Almian; Mezhigorian → Planorbellian; Berekian → Molochnaian and Kerleutian.

Correlation with stages ISC: Pselian, Belokamenskian → Danian and part of Selandian; Merlian, Kachian → Thanetian; Kanevian, Bakhchisaraian, lower part of Simferopolian → Ypresian; Buchakian, lower part of Kievian, upper part of Simferopolian, Novopavlovkian → Lutetian; upper part of Kievian, Kumian → Bartonian; Obukhovian, Almian → Priabonian; Mezhigorian, lower Berekian, Planorbellian, Molochnaian → Rupelian; upper Berekian and the most of Kerleutian → Chattian.

NEW BIOSTRATIGRAPHIC DATA FROM THE GEOLOGICAL SURVEY OF THE BIELA ORAVA REGION (MAGURA NAPPE, SLOVAKIA)

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The region of Biela Orava, as one of the few regions in Slovakia, had not yet compiled and published geological map at a scale 1 : 50 000. The absence of geological map, as well as the need to do research of the geological setting of this region, led to submission of the project Geological map of the Biela Orava region at a scale 1 : 50 000.

Three tectonic–lithofacial units of the Magura nappe are distinguished in the Biela Orava region: the Rača, Bystrica and Krynica (Oravská Magura) units, consisting of the deep-sea flysch sediments prevailingly of Paleogene, less of the Late Cretaceous age (Teťák *et al.*, 2015).

The study of the total number of 119 samples of calcareous nannoplankton has confirmed the age affiliation of individual formations in majority of samples, resp. made it more precise. The Lower Miocene age of the sample M446i2 from the Hruštín locality became controversial, being sampled from the Racibor Formation s.s. of the Krynica unit. The assemblage of calcareous nannoplankton indicates the Late Miocene, based on the representation of species *Calcidiscus leptoporus* (Murray et Blackman) Loeblich et Tappan, *Calcidiscus* aff. *macintyrei* (Bukry et Bramlette) Loeblich, *Helicosphaera carteri* (Hay et Mohler) Locker, *Helicospheara* aff. *carteri* (Hay et Mohler) Locker, *Helicosphaera* aff. *scissura* Miller and *Reticulofenestra pseudoumbilicus* (Gartner) Gartner. The Late Egerian is characteristic with species – *Coccolithus pelagicus*, *Cyclicargolithus abisectus*, *Cyclicargolithus floridanus, Helicosphaera euphratis.* From the youngest species there are present the *Helicosphaera* aff. *scissura*, *Calcidiscus leptoporus*, *Calcidiscus* aff. *macintyrei* and *Helicosphaera carteri*, *Helicosphaera* aff. *carteri*, which were found in the assemblage. According to Bown (1998), the presence of *Helicosphaera carteri* in the assemblage is a positive indicator of the Neogene age.

Based on small foraminifers from Oravská Jasenica, Soták *et al*. (2012) state the age of the latest Oligocene to Early Miocene, the calcareous nannoplankton indicates the zone NN2 (Early Miocene). Similar results manifest also Oszczypko & Oszczypko-Clowes (2010) from the mountain ranges of Beskid Sądecki and Ľubovnianska vrchovina.

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ISBN 978-83-7863-666-3

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