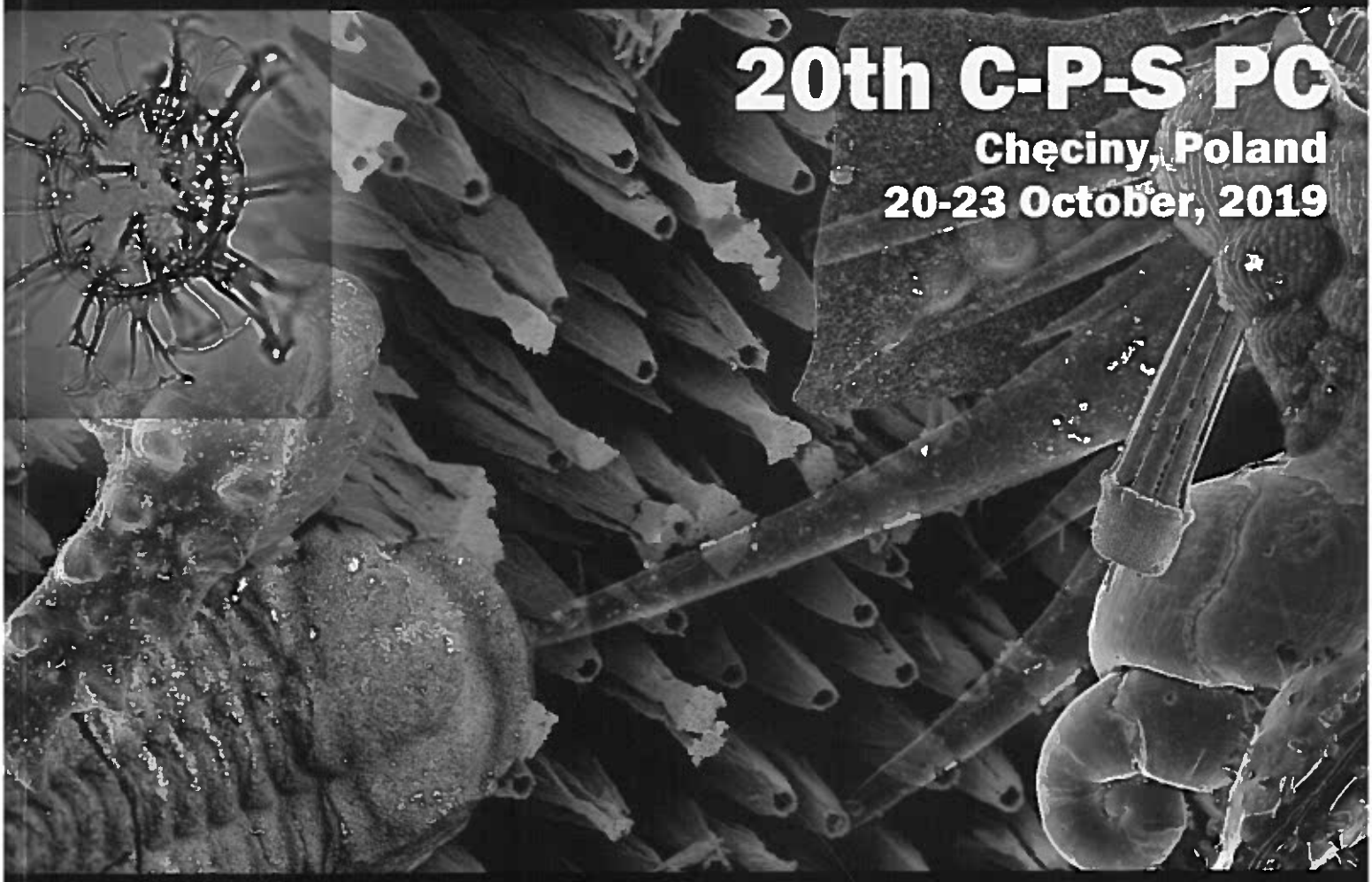
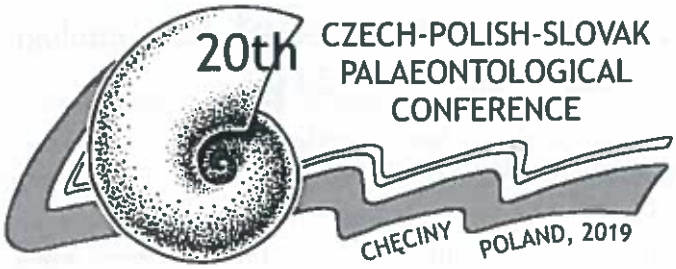
# 20th Czech-Polish-Slovak Palaeontological Conference

***Abstracts***




20th CZECH-POLISH-SLOVAK PALAEONTOLOGICAL CONFERENCE

CHĘCINY POLAND, 2019




# 20th CZECH – POLISH – SLOVAK PALAEONTOLOGICAL CONFERENCE

## Chęciny, 20 – 23 October 2019

## ABSTRACTS

Edited by Anna Żylińska

Faculty of Geology, University of Warsaw

**Warszawa 2019**

# Foreword

The 20th edition of the Czech–Polish–Slovak Palaeontological Conference (CPSPC) shows that this international paleontological society is creative, ambitious and timeless. The CPSPC has been gathering palaeontologists from the Czech Republic, Poland and Slovakia for 20 years. Recently, scientists from Russia, Ukraine, the Baltic countries and Western Europe have also been actively participating in our gatherings. Each conference is focused on the latest research and discoveries in the field of broadly understood palaeontology and related topics. By the lively discussion on a wide range of subjects from different fields we demonstrate that palaeontology is an integral part of geology and Earth sciences. In addition to information exchange, during this event scientists from Central Europe share their experience and establish international and interdisciplinary collaboration, often proliferating in joint research projects.

For the jubilee conference we invite you to the European Centre for Geological Education, a winner of The Best Public Facility Award within the framework of European Property Awards. The Centre is a research and conference facility operating within the structures of the University of Warsaw – Faculty of Geology. Beautifully located within a closed-down dolomite quarry near the historical town of Chęciny, in the Świętokrzyskie voivodeship, it offers the charm of the nearby medieval castle, and a perfect research and educational environment for geologists.

Our conference has attracted almost 50 scientists from 6 countries, including a considerable number of doctoral and graduate students. The meeting will begin with two key lectures, followed by over 20 oral presentations and almost 20 posters presented during special poster sessions. The last day of the conference will be devoted to workshops and field trips.

The Holy Cross Mountains have a long tradition of palaeontological research of macro- (e.g. trilobites, cephalopods, brachiopods, corals) and microfossils (e.g. conodonts, foraminifers, palynomorphs) in rocks of all systems of the Phanerozoic. We can admire and study here rocks of the Palaeozoic succession, which build the central part of the mountains, Mesozoic strata surrounding the Palaeozoic 'core' from the north, west and south-west, and Cenozoic (Miocene) deposits of the Carpathian Foredeep to the south of the area. Being situated at the junction between the Meta-Carpathian arc and the Mid-Polish Swell, the Holy Cross Mountains are a link between the Central European Variscides and the East European Craton, and represent one of the very few areas in Europe where Palaeozoic rocks are exposed in direct neighbourhood of the Teisseyre-Tornquist Line.

During the field trip we will introduce a thick Devonian to lower Carboniferous continuous succession formed during almost 50 million years of Earth's history. The evolution of a basin induced by fluctuating sea levels and changing tectonic regimes in a tropical setting will be presented. The growth and demise of the Devonian carbonate platform, and later substitution by the clay-siliceous Culm facies will be examined in abandoned quarries on hills surrounding the Chęciny Valley and in the impressive active Ostrówka Quarry.

We sincerely hope that our meeting will contribute to exchange of ideas, promote future scientific collaboration and give you a perfect opportunity for interesting scientific discussion. Support from the Institute of Geology of the Faculty of Geology, University of Warsaw, the Grzybowski Foundation, and all sponsors of the meeting is warmly acknowledged.

On behalf of the Organizing Committee
*Marcin Barski*

# ABSTRACTS OF KEY LECTURES

the discovery of tens of complete or partial articulated skeletons of sharks, and among them unmistakable phoebodonts. The body of *Phoebodus* turned out to be rather elongated, as in *Chlamydoselachus*, but not as drastic as in *Thrinacodus* from Montana, and the jaws are normal, U-shaped. There are two ctenacanth-like, ornamented dorsal fin spines. The fish is rather large: the estimated length of the largest specimen reaches 3 m and its skull is almost half a metre long. The teeth are typical of the phoebodonts from the Famennian, but slightly different from all hitherto established species, therefore the shark received its new name and the description of the material will be published soon (Frey *et al.* 2019, in press).

## REFERENCES TO THE NEW DISCOVERY

Frey, L., Coates, M., Ginter, M. & Klug, C. 2017. Skeletal remains of *Phoebodus politus* Newberry 1889 (Chondrichthyes: Elasmobranchii) from a Famennian Konservatlagerstätte in the eastern Anti-Atlas (Morocco) and its ecology. In: Ginter, M. (Ed.), 14th International Symposium on Early and Lower Vertebrates, Chęciny, Poland, 2017. *Ichthyolith Issues Special Publication*, **13**, 36-37.

Frey, L., Coates, M., Ginter, M., Hairapetian, V., Jerjen, I., Rücklin, M. & Klug, C. 2019 (in press). Phylogenetic relationships and ecomorphology of the early elasmobranch *Phoebodus*. *Proceedings of the Royal Society B.*

Klug, C., Frey, L., Pohle, A. & Rücklin, M. 2017. Origin of Konservatlagerstätte of the southern Maïder (Morocco) and gnathostome preservation. In: Ginter, M. (Ed.), 14th International Symposium on Early and Lower Vertebrates, Chęciny, Poland, 2017. *Ichthyolith Issues Special Publication*, **13**, 52-53.

# ABSTRACTS OF ORAL AND POSTER PRESENTATIONS

# New data on non-dimerelloid brachiopods from chemosynthesis-based communities

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Dimerelloid brachiopods are most common and characteristic for ancient hydrocarbon seeps and hydrothermal vents. They commonly occur in mass accumulations and thus could have lived in some form of relationship with chemosynthesizing bacteria. Other brachiopod groups are much less common and in several instances they occur seemingly fortuitously at hydrocarbon seeps. So far, the best known association is that reported from the Upper Cretaceous (Campanian) Omagari site in Japan with the terebratulide *Eucalathis* occurring in significant quantities. Brachiopods were also found in the Oligocene seeps in Japan, being represented by the rhynchonellide *Frieleia* sp. and the cancellothyrid *?Terebratulina* sp. An exceptionally taxonomically diverse brachiopod fauna occurs in the shallow water Late Jurassic–Early Cretaceous seeps in Spitsbergen with the dominance of short-looped terebratulides.

Recently, a new species Neoliothyrina nakremi has been described from the Palaeocene hydrocarbon seeps in Spitsbergen. This species was initially tentatively assigned to *Pliothyrina*, however, investigations of internal structures have proved that it represents the genus *Neoliothyrina*. *Neoliothyrina* is a short-looped terebratulide, characterised by the presence of inner hinge plates, a feature rarely present in terebratuloids. It was known so far from the Upper Cretaceous of Europe, thus it is another example of Cretaceous survivors at generic level.

Brachiopods were also found in the wood-fall communities in the Palaeocene deep-water deposits of the Katsuhira Formation in Hokkaido, Japan. They are represented by the rhynchonellide *?Hemithiris* sp. and the short-looped terebratulide *Abyssothyris* sp.

There are no extant brachiopods that are members of the chemosynthesis-based communities, though some species are recorded in their vicinities and considered rather as primary opportunistic colonisers of available hard substrates.

# Ordovician trilobites with soft parts in African West Gondwana and European peri-Gondwana: a review

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A review of all currently known Ordovician trilobites with soft parts described or figured from West-Gondwa- na and European peri-Gondwana is presented. Remains of the digestive system were found in nineteen species. In comparison, remains of antennae and/or walking legs are known only in five species. From the taxonomical point of view, the soft parts are known in the Asaphidae, Bathycheilidae, Calymenidae, Cheiruridae, Dalmanitidae, Harpidae, Lichidae, Nileidae, Odontopleuridae and Trinucleidae. Exceptionally preserved trilobites originate from the Tremadocian Mílina Formation (Czech Republic) and Fezouata Shale (Morocco), Darriwilian Šárka (Czech Republic) and Llanfallteg (UK) formations, Sandbian Tafilalt (Morocco) and Letná (Czech Republic) Lagerstätten, and Katian Bohdalec Formation (Czech Republic). Levels containing exceptionally preserved trilobites in these units are dominated by fine-grained sediments with the exception of the Sandbian Tafilalt and Letná Lagerstätten.

**Acknowledgements.** The Czech Science Foundation (GACR) supported the contribution through project no. 18-14575S and PROGRES Q45 of the Ministry of Education, Youth and Sports of the Czech Republic (OF).

# Foraminiferal assemblages in the context of lithological and geochemical cyclicity in upper Turonian sediments from the Bohemian Cretaceous Basin, Czech Republic

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Upper Turonian hemipelagic deposits in the central part of the Bohemian Cretaceous Basin (Czech Republic) show lithological cyclicity caused by rapidly changing depositional conditions. This cyclicity has been attributed to orbital control. Short-term palaeoenvironmental changes corresponding to these lithological variations are not well understood. Here we present a study of foraminiferal assemblages performed on 68 samples from the Bch-1 drillcore, in which such analysis has not been performed yet. Sampling in depth interval 109.75–253.5 m was made in correspondence with the core lithology. 42 benthic and 19 planktonic foraminifera species were determined in the samples, and their abundances, diversity and P/B ratio were compared to the lithological proxies and to previous interpretations of the longer-term depositional history.

The foraminiferal data are compared to the following geochemical proxies: $CaCO_3$ content, Al and Si contents, and Al/Si and Zr/Si ratios measured continuously in the entire core. The cyclicity displayed by foraminife- ral assemblages seems to be different than the cyclicity observed in geochemical proxies.

In the vast majority of the samples, alternation in abundance is observed between *Heterohelix globulosa* on one side and representatives of *Whiteinella* and *Dicarinella* on the other side. Spearman correlation of foraminifera species and geochemical data reveals two distinct groups in relation to the lithological proxies. Group 1 is represented by *Cassidella tegulata, Praebulimina* sp., *Gaudrinella, Whiteinella paradubia* and *Dicarinella imbricata*, and shows affinity to relatively carbonate-poor, and partly mud-enriched lithologies. Group 2, represented by *Lenticulina* sp. and *Gyroidina nitida*, correlates with carbonate-enriched samples with higher Si/Al and Zr/Al ratios.

**Acknowledgements.** The work was supported by GAUK project no. 204217, project SVV–2017 UK and GAČR project no. 17-10982S.

# Cluster of middle Cambrian trilobites: a case of "frozen" behaviour from the Barrandian area, Czech Republic

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An exceptionally preserved, fully articulated carrion of the large paradoxidid trilobite *Paradoxides* (*Rejkocephalus*) *rotundatus* associated with fifteen articulated specimens of much smaller ellipsocephalid trilobites representing *Ellipsocephalus hoffi* from the middle Cambrian of central Bohemia provides an unequivocal and unique example of preserved mutual interactions in the invertebrate fossil record. The small ellipsocephalids are closely spaced and fourteen of them are positioned with their dorsal exoskeleton dorsum down in relation to the large *Paradoxides*. The small trilobite specimens are interpreted to represent moults. Analyses of distribution and orientation of these fifteen trilobites combined with missing librigenae demonstrate an exceptionally preserved "frozen" behaviour illustrating either a feeding or a cryptic shedding strategy in Cambrian trilobites. We argue that the small trilobites were attracted to the ventral side of the large trilobite carrion (i.e. below the exoskeleton) to find refuge for ecdysis, or to feed either directly on deteriorating soft parts or on the fungal/bacterial consortia developed on the ventral surface of the large carrion. This find of a polyspecific size-segregated cluster of trilobites provides additional evidence of feeding relationships in the middle Cambrian.

**Acknowledgements.** The Czech Science Foundation (GACR) supported the contribution through project no. 18-14575S and PROGRES Q45 of the Ministry of Education, Youth and Sports of the Czech Republic (OF).

# A record of the Carnian Pluvial Phase in the Polish microflora

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The prevalent dry climate during the Triassic in the eastern part of the Central European Basin was interrupted by short-time humid events and longer phases. One of them was the Carnian Pluvial Phase, which took place in the Julian (early Carnian) and can be correlated with the *Aulisporites astigmosus* palynological zone. It is recorded by the significant change in the composition of spore-pollen assemblages, from dominated by xerophytic species of the *Triadispora verrucata* Subzone in the Upper Grabfeld Formation ("Lower Gipskeuper"), to dominated by hygrophytic forms in the Stuttgart Formation ("Schilfsandstein"). Changes in climate were documented based on quantitative spore-pollen analysis and the Sporomorph Ecogroup (SEG) model of 20 miospore assemblages noted in 51 samples occurring in the material from 15 drillcores from Poland.

In the miospore spectra of the *T. verrucata* Subzone, composed most exclusively of conifer pollen, the hygrophytic/xerophytic H/X ratio varies from 0.03 to 0.9 (0.5 on the average) and the average contribution of the Upland SEG is above 80%. The assemblage was composed of arborescent and herbaceous conifers and arborescent pteridosperms.

Differentiation of miospore assemblages within the *A. astigmosus* Zone may be observed. Whereas spectra from its lower part consist almost exclusively of hygrophytic elements – cycadalean pollen and fern spores (above 80% on the average), in assemblages from the upper part, dominated by lycopsid and fern spores, their contribution varies from 40 to 80%. The H/X ratio varies from 1 to 49 (8.3 on the average). The SEG model shows a strong domination of the Lowland and River SEG. The shift from dry to wet climate, observed at the boundary between the Upper Grabfeld Formation and the Stuttgart Formation was documented also in other regions of Europe.

# Fauna and absolute $^{10}Be/^{9}Be$ age of the Volkovce Formation (upper Miocene) in the Danube Basin (Triblavina outcrop, Slovakia)

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** G. Aumaitre, D.L. Bourles & K. Keddadouche

In the Danube Basin, the upper part of the upper Miocene (Beladice and Volkovce formations) was deposited in lacustrine, deltaic and fluvial settings. Such epicontinental sedimentary sequences notoriously face the problem of their geochronology because they do not contain stratigraphically significant fauna. The present study was aimed to constrain the chronology of the Volkovce Formation, which represents an alluvial sequence deposited between 10–6 Ma by rivers draining the Eastern Alps and the Western Carpathians to Lake Pannon. We have combined the biostratigraphy of small mammals and molluscs with radiometric dating based on the authigenic $^{10}Be/^{9}Be$ ratio. Deposits of the Volkovce Formation were studied in an exposure on the highway by the Triblavina stream.

The assemblage of rodents from Triblavina is dominated by the murid *Apodemus lugdunensis*. The second most abundant genera is the eomyid *Keramidomys* represented by *K. ermannorum* and *Keramidomys* sp. The interpretation of the age of the rodent assemblage is based mainly on the presence of typical Turolian taxa e.g. *Epimeriones austriacus* (MN 11) and *Vasseuromys pannonicus* (MN 11–MN 12). The biostratigraphic age of the Triblavina fauna may be correlated with confidence with biozone MN 11 and probably represents the beginning of the Turolian close to the MN 10/MN 11 transition.

The mollusc association from Triblavina consists of freshwater (*Anisus, Planorbarius, Radix, Stagnicola* and *Valvata*) and terrestrial (*Carychium, Discus, Gastrocopta, Strobilops*, etc.) gastropod species. Based on the ranges of stratigraphically important freshwater gastropod taxa we assume that the fossiliferous horizon was deposited during the time interval close to the boundary of biozones G and H.

Small mammal biostratigraphy based on rodent assemblages may be correlated with the lowermost part of Zone MN 11 defined in south-eastern Europe at <8.9 Ma, whereas authigenic $^{10}Be/^{9}Be$ dating from seven samples served for establishing the weighted mean age at 9.29 ± 0.28 Ma.

# Barremian gastropods from Veliko Tarnovo region, Bulgaria

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Gastropods are currently the second largest and diversified group of all living metazoan animals and occupy a large number of ecological niches. They are also well represented in the fossil record that helps exploring their evolution and phylogeny. The Cretaceous is considered as one of the most important periods in the gastropod evolution since it was the time of significant mid-Cretaceous turnover in gastropod faunas probably evoked by the arms race of the Mesozoic marine revolution. Barremian gastropod assemblages are uncommon, thus any new data will provide a better understanding of gastropod taxonomy and evolutionary trends shortly before mid-Cretaceous turnover. We examined 464 Barremian gastropod shells, mostly from the town of Veliko Tarnovo and a few from the village of Pushevo (central north Bulgaria). The material from these localities is being examined for the first time. It consists mainly of small-sized specimens (< 1 cm) and only a few larger ones. The shells are of moderate preservation with well-preserved ornamentation that is generally better than the collections of the same age from Barcelonne and Serre de Bleyton (Departament Drôme, France). In few cases protoconchs are preserved, but embryonic shells are eroded away. Although the important taxonomic characteristics (protoconch and aperture) often are poorly preserved or absent, we were able to preliminarily determine at least 70 species from 19 families with a predominance of cerithiids, nerineids, and mathildids.

# Lower Badenian *Stenocyathus* Portales, 1868 from Borač locality, Moravia, Czech Republic (southern Carpathian Foredeep, Central Paratethys)

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The Borač locality (southern Carpathian Foredeep in Moravia) is situated in the Upper Svratka Highlands approximately 7 km northeast of Tišnov (Brno-venkov). The locality lies about 800 m northwest of Borač village and comprises the denudation remains of Miocene strata, representing the Lower Badenian "Tegels" abundant with marine micro- and macrofossils.

The Borač locality is known for rich findings of coral fauna. Specimens representing 15 genera have been studied in 2015–2019: *Caryophyllia* (*Acanthocyathus*), *Caryophyllia* (*Ceratocyathus*), *Paracyathus*, *Ceratotrochus*, *Trochocyathus*, *Flabellum*, *Stylocora*, *Stylophora*, *Porites*, *Balanophyllia*, *Deltocyathus*, *Peponocyathus*, *Enallopsamia*, *Dendrophyllia* and the newly found *Stenocyathus*.

This contribution focuses on the findings and examination of *Stenocyathus*, a fossil coral genus so far not known from this locality. *Stenocyathus* is a rare solitary coral from the azooxanthellate group of scleractinians. The bathymetrical range of this genus is highly variable (155–1500 m). *Stenocyathus* lived attached to the hard substrate in its juvenile stage but later broke down and grew freely lying on the sea bottom. The basal plate and base of these corals are reinforced with coenostum. The corallites are cylindrical to ceratoid with longitudinal rows of white thecal spots and pores in the wall. The calice consists of trabecullar columella, 3 septal cycles (S1–S3) and 1 pali (opposite S2). The presence of this coral confirms a deeper marine environment for the Lower Badenian deposits at the Borač locality.

The coral specimens studied in this research project were collected in 2015–2019 and are housed in the Department of Geological Sciences, Masaryk University, Brno, and several private collections.

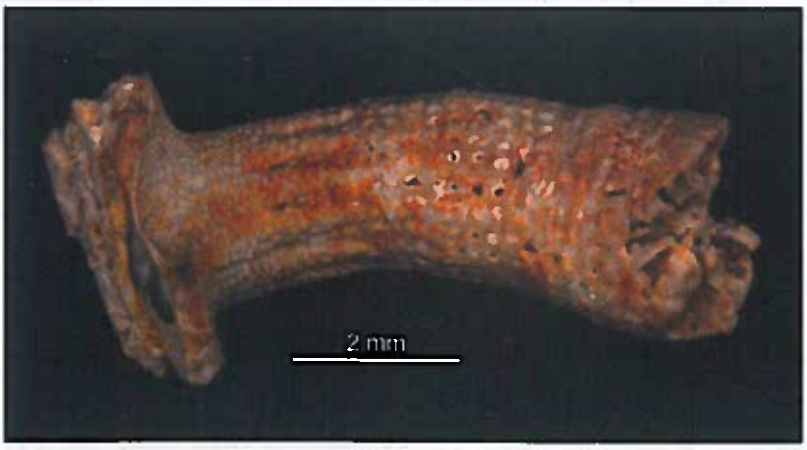


**Fig. 1.** A specimen of *Stenocyathus* from Borač locality, Moravia, Czech Republic.

# Age and synchronicity of planktonic foraminiferal bioevents across the Cenomanian–Santonian interval (Crimea–Caucasus area)

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All Cretaceous sections of the Crimea–Caucasus area contain diverse assemblages of spiral-conical planktonic foraminifera (PF), which generally allow for the correlation of their zonal subdivisions with other territories of the Tethys area.

The *Parathalmanninella globotruncanoides* Zone coincides with the Early Cenomanian. It includes the interval from the lowest occurrence (LO) of the zonal species to the LO of *Thalmanninella deeckie*. PF assemblages are rather monotonous throughout this zone. The *Thalmanninella deeckie* Zone is limited by the LO of the index species and the LO of *Rotalipora cushmani* (Middle Cenomanian). This is the shortest zone in the entire range of Cretaceous planktonic foraminifera, because the "Mid-Cenomanian nonsequence" is present here. The *Rotalipora cushmani* Zone is characterised by the occurrence of the zonal marker (late Middle to latest Cenomanian). The *Whiteinella archaeocretacea* Zone is limited by the highest occurrence (HO) of *Rotalipora cushmani* and the LO of *Helvetoglobotruncana helvetica* (latest Cenomanian – Early Turonian). The extinction of thalmannellids *s.l.* and the flourishing of whiteinellids characterise this Zone, which coincides with Ocean Anoxic Event 2. The *Helvetoglobotruncana helvetica* Zone is characterised by the total range of the zonal marker. It corresponds to the late Early Turonian up to the Middle Turonian. The zonal marker is very rare in Crimea and common in Caucasus.

The mentioned zones are almost identical in the Tethys and the Crimea–Caucasus areas. In the subsequent interval, starting from the Middle Turonian to the end of the Santonian, PF taxonomic diversity and levels of important biological events begin to differ significantly between both areas. This is due to the later appearance, and sometimes absence, of some index species in the Crimea–Caucasus area. However, the Santonian–Campanian boundary can be precisely defined by two bioevents: HO of *Dicarinella concavata/asymetrica* and LO of *Globotruncanita elevata*.

**Acknowledgements.** Financial support for the research was provided by RFBR 18-05-00503a and 18-05-00495a.

# Exotic clasts of the Oxfordian–Kimmeridgian limestones and their relation with the southern part of the North European Platform and the oldest stages of the Outer Carpathian evolution

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In the Late Jurassic, rifting processes led to disintegration of the southern margin of the North European Platform and opening of the Outer Carpathian flysch basins. Sedimentary successions of this pre-flysch phase are not preserved, being consumed during Miocene subduction. Their only remnants are clasts preserved as exotic rocks in the succeeding flysch series.

Our analysis of foraminifera, and calcareous and organic dinoflagellate cysts from these exotics generally suggests an Oxfordian–Kimmeridgian age. For the majority of them a late Oxfordian–early Kimmeridgian age is the most likely. The exotics represent three facies types. The sedimentary setting was related to mid-ramp to outer-ramp, rather without intense land influences, with prevailing pelagic/hemipelagic accumulation. Sponge-microbial limestones can be interpreted as mid-ramp facies, i.e. deposited mostly in low-energy nutrient-rich environments. The oncoid-intraclast-*Crescentiella* limestones are related to mid-ramp settings. The fine-grained biodetrital limestones with *Saccocoma* were possibly deposited in deep-shelf or toe-of-slope environments belonging to the outer ramp setting. The facies types are similar to those widely distributed over the northern shelf of Western Tethys (e.g. extra-Carpathian southern Poland, southern Germany).

Comparison of our data with coeval material from the surrounding areas shows that in the Oxfordian–Kimmeridgian the carbonate platform extended to the adjacent Fore-Carpathian Foredeep basement and the Kraków–Częstochowa Upland. Data from southern Poland indicate that in the late Oxfordian and Kimmeridgian synsedimentary tectonic movements sub-divided the northern Tethys shelf into ridges and grabens. Later, these structures gradually evolved in the Outer Carpathian flysch basin system.

The limestones were possibly deposited within the Silesian and Baška–Inwałd ridges. They originated when differentiation of the south margin of the North European Platform began, which resulted in the opening of the proto-Silesian Basin.

# Is there any connection between the Early Jurassic (Pliensbachian) *Lithiotis*-type bivalve facies of mangrove-type environments (Albanian Alps) and the origin of primitive crabs (Decapoda, Brachyura)?

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*Lithiotis*-type bivalves (*Lithiotis, Cochlearites, Lithioperna, Mytiloperna*, and *Gervileioperna*), are the most significant constructors of shallow marine/lagoonal bivalve mounds ("reefs") in numerous sites around Pangaea during the Pliensbachian–Early Toarcian. In Europe they are known from Alpine countries and constitute the Early Jurassic Alpine–Adriatic–Dinaridic–Hellenidic carbonate platforms with peritidal to subtidal sedimentation regimes. A continuous succession of Upper Triassic (shallow-water Lofer-type facies) to Lower Jurassic carbonates occurs in the Albanian Alps. Lower Jurassic (Pliensbachian) bivalve-rich limestones are intercalated with oolitic/oncolitic layers representing subtidal/peritidal high-energy environments. Moreover, at least five coal-bearing layers full of aired root systems representing coastal swamps of mangrove-type environments intercalate the intertidal carbonate rocks of the full-marine–lagoonal–land transition. Several tempestite horizons occur directly above the root-bearing deposits and indicate catastrophic events that destroyed mangrove-type plants occupying near-shore environments.

Most Early and Middle Jurassic crab species (ca. 70%) are known from holotype specimens only (including the oldest unequivocal and most "primitive" crab, the Pliensbachian *Eoprosopon klugi* Förster, 1986 – the so-called *Brachyuran Pliensbachian* Origin Event) and therefore knowledge about them is limited both with regard to taxonomy and palaeoenvironmental preferences. Due to the lack of Toarcian–Aalenian crab fossil record, the key moment of their history was connected with the *Brachyuran Bajocian Expansion Event* when new species appeared in shallow-marine environments (oolitic, including ferruginous, and/or oncolitic bars/dunes of carbonate platforms; sponge-bearing facies with ooids and coralliferous carbonates; isolated lagoon and/or mangrove-type gulfs) – e.g., *Coelopus bigoti* Hee, 1924. Therefore, roots of the "Brachyuran evolutionary tree" were generally related with carbonate, extremely shallow-marine sedimentation. Therefore, the Albanian Alps succession seems perfect for the fossil record of first steps/origins of crab evolution.

# Origin and geochemistry of the bone-bearing beds in Miedary, Upper Silesia, Poland

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We have investigated a former clay pit in Miedary (Upper Silesia, Poland), best known for numerous vertebrate remains. The succession begins with red and green siliciclastics, passing into red, grey and bluish claystones, and terminating with layers of dolomites with thin sandstone interbeds. Bone-bearing horizons were identified within siliciclastic and dolomitic deposits. The recognised invertebrates (*Costatoria* sp., *Modiolus* sp., *Unionites* sp.) and fish fauna (*Polyacrodus keuperianus, Serrolepis suevicus*) indicate that the Miedary succession belongs to the Lower Keuper facies (Lettenkeuper). However, its origin and exact stratigraphic position remain unknown. In the first step to obtain more information we have prepared thin sections from the dolomites. Traditional microfacies interpretation was supplemented with geochemical analysis coupled with EDS. Here, we present the preliminary results of our research.

# Colonisation of ancient brackish water systems in the beginning of marine transgressions: Triassic examples from the Western Carpathians

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The colonisation of marginal marine environments was a long term process. Five major phases (based mostly on trace fossils) have been distinguished in estuarine deposits of different ages. They mostly followed a sea-level rise associated with environmental crises. The fossil record of this process was subject to preservation.

Western Carpathian examples of this process are related with Mesozoic and Cenozoic habitats (phases 3-5). Scythian environments developed in areas devastated during the Permian / Triassic Extinction. Although incompletely studied, the clastic complexes of this age have recorded the colonisation of restricted marginal habitats: from torus-shaped structures produced by microbial trapping (like *Intrites* sp.) to aggregates of lingulid burrows. In the hypersaline carbonate mud of an Anisian carbonate ramp (Vysoká Formation), typical burrow galleries were formed.

The Upper Triassic Carpathian Keuper facies was deposited in arid, emerged central West Carpathian zones. In rising humidity preceding the Rhaetian transgression, nearshore swamps and lagoons formed in the Zliechov Basin. They were mostly recorded by black shale beds below the base of the Fatra Formation. In turn, the Kardolina section comprises a several meters thick succession of grey marlstones containing an association of foraminifers (*Agathammina austroalpina*) in its basal part. The bivalves *Modiolus minutus*, *Bakevellia praecursor*, *Isocyprina ewaldi*, *Modiolus minutus*, *Neoschizodus*? sp. and *Pleuromya*? sp., shark teeth of *Hybodus minor* and *Lissodus minimus*, and burrows of *Rhizocorallium jenense* indicate a low-energy environment. Thin dolostone layers with condensed bone-bed surfaces enriched in phosphates, fine breccia, the fish *Lissodus minimus*, *Sargodon tomicus*, and *Severnichthys acuminatus*, and bone fragments are overlain by full-marine limestone tempestites.

# New echinoderm Lagerstätte from the Letná Formation (Sandbian, Upper Ordovician) of Bohemia

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The Upper Ordovician (Sandbian) Letná Formation of Bohemia (Czech Republic) provides an important insight into the Early Palaeozoic diversification of marine ecosystems. In this formation, several levels can be interpreted as *Konservat Lagerstätten*: they have yielded abundant fossil remains, including exceptionally preserved, non-mineralised and poorly mineralised organisms. Non-trilobite arthropods (e.g. *Duslia*, *Furca*, *Zonozoe*) occur together with well-preserved trilobites, echinoderms, brachiopods and bivalves.

Recently, a new locality at Chrustenice was discovered in the Letná Formation. It is characterised by the mass occurrences of articulated echinoderms, which can be interpreted as storm-induced accumulation levels (*Konzentrat Lagerstätten*) of living or freshly killed individuals. The Chrustenice echinoderm assemblages are particularly diverse and dominated by solutans, associated with various asterozoans, blastozoans, crinoids, edrioasteroids, and stylophorans. The forthcoming description of these new assemblages will bring a wealth of new data on their systematics, functional morphology, taphonomy, palaeoecology, palaeobiogeography, and evolutionary implications. Preliminary investigations of the Chrustenice faunas show the occurrence of several ontogenetic stages among the ophiuroids, as well as examples of ecological interaction, e.g. between solutans and edrioasteroids.

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# New data on the evolution of lower Miocene snake fauna from the Wintershof-West locality (Germany)

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The high diversity of the well-known late early Miocene (MN 4–MN 5 zones) snake fauna of Central Europe resulted from the warmest stages of the Miocene Climatic Optimum. However, snake communities from MN 1–MN 3 zones, whose composition reflects quick replacement of European Palaeogene snakes by modern colubroids, mostly of Asian origin, are still poorly known. The Wintershof-West locality, Germany (MN 3b; 19.5–18.8 Ma) yields a diverse snake community including representatives of five families: Boidae: *Bavarioboa* sp., Boinae gen. et sp. indet.; Tropidophiidae: *Falseryx petersbuchi*, *Falseryx* sp.; Colubridae: *Coluber hungaricus*, cf. *Telescopus* sp., Colubrinae gen. et sp. indet., *Neonatrix* cf. *nova*, *Natrix* sp.; Elapidae: *Micrurus gallicus*; and Viperidae: *Vipera* sp. – 'Oriental vipers' group. Three extinct species (*Falseryx petersbuchi*, *Coluber hungaricus* and *Micrurus gallicus*) have their first known occurrence in the fossil record. Moreover, *Bavarioboa* sp. and *Natrix* sp. represent new species. Numerous large vertebrae of 'Oriental vipers' document one of the first occurrences of those large vipers. Based on the palaeobotanic record from the North Alpine Foreland Basin, the Wintershof-West vertebrate assemblage developed under humid climate with a mean annual precipitation of 1000–1300 mm. The known amphibian and reptile taxa indicate the presence of open water reservoirs with overgrown banks and sandy shores, as well as rather dry biotopes covered by low vegetation. Temperatures probably did not drop below 17.4°C, as can be deduced from chamaeleonid presence. Despite numerous booid snakes in Wintershof-West, we assume that the Colubroidea represented a substantial part of the snake community in the site. Similarly, other Central European MN 3 localities, e.g. Merkur-North, Czech Republic (MN 3a), contain diversified colubroids. Therefore, we presuppose that MN 3 zone corresponds to the advanced stage of snake turnover in Europe.

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# The Badenian rocky shore environment of the Kalcit Quarry (South Moravia, Czech Republic)

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The vicinity of Brno city was subjected to several transgressions during the Miocene. The most significant one was the Badenian transgression. Badenian transgressive sediments are usually represented by the Brno Sands Member, but a few examples of a rocky shore type of environment are also known.

The most significant example of a rocky shore environment in the vicinity of Brno city is the Kalcit Quarry (formerly known as the Na Kopaninách Quarry) located about 8 km SE from the Špilberk castle in the Brno city centre. Besides siliciclastic deposits, erosional surfaces with borings, developed on Devonian limestones, are also preserved. The borings are occasionally filled by angular siliciclastic material with a carbonate matrix. A 20 cm thick bed of the same material, overlying the limestone, is developed in the southern part of the outcrop. The observed borings were determined as *Gastrochaenolites* isp. (small and large forms), *Gastrochaenolites lapidicus* Kelley & Bromley, 1984, *Circolites kotoucensis* Mikuláš, 1992 and *Ericichnus* cf. *bromleyi* Santos *et al.*, 2015. *Gastrochaenolites* isp. represent bivalve borings in a high energy shallow marine environment. *Circolites* isp. and *Ericichnus* isp. are borings associated with sea urchins. They used these structures for protection and as a space for gardening. The succession of colonisation is assumed as: large *Gastrochaenolites* isp. → *Circolites kotoucensis* + *Ericichnus* cf. *bromleyi* → small *Gastrochaenolites* isp. → sedimentation of conglomerate with a calcareous matrix.

The studied locality represents a multistage development of hardground communities of boring bivalves and sea urchins with the new locality of *Ericichnus* cf. *bromleyi*.

# Middle Miocene sedimentary sequence of the Voronyaky Hills (western Ukraine, Paratethys)

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Since the 19th century the middle Miocene sands of the Voronyaky Hills (forming the NW border of the Podolia Upland) have been famous for their fossil content. Diverse and well preserved molluscan fauna from Olesko–Biała Góra, Podhorce, Jasionów and Hołubica housed in many European museums led to numerous taxonomic studies. However, no detailed facies investigation, stratigraphic and taphonomic studies were carried out.

Therefore in 2018 we undertook field work with the prime aim of identifying the precise location of these fossiliferous sites, describing their lithology and sedimentary structures, recognising the taphonomy of the shelly assemblages and collecting samples for petrographic and biostratigraphic studies.

Several isolated occurrences of the middle Miocene were examined but our efforts were concentrated mainly on a small sandpit located at Bila Mt. (*Biała Góra*), 3 km to the east of Oles'ko town (49°57'11.4"N, 24°56' 48.3"E) and a natural outcrop observed along a cut of a dirt road, 3 km to the south of Yaseniv village (*Jasionów*, 49°57' 10.9"N, 25°03'05.6"E).

The first section, with an obscure base, attains a thickness of 4.0 m. The fine-grained quartz sands are very rich in molluscs, bivalves in particular. Twenty layers were discriminated based on lithology, sedimentary structures, bioturbations and macrofossil content. Nine samples for the investigation of planktonic foraminifera and calcareous nannoplankton were taken from approximately 0.4 m intervals. The second section has a thickness of 6.0 m. Coralline algal limestones and marls directly overlying there Upper Cretaceous marls were also investigated according to the presented procedure; however, the taxonomic diversity of the bivalves preserved mostly as composite moulds is much poorer.

Altogether about 12 m of both sandy sediments and carbonate deposits have been studied for palaeoenvironmental reconstruction. The contact of sands and overlying marls is still observed in the large abandoned Voluiky quarry (49°56'05,1"N, 24°52'30.2"E).

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# Trace fossils preserved on Upper Devonian vertebrate remains from the Holy Cross Mountains, Poland

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Among the hundreds of collected Devonian vertebrate macrofossils in the Holy Cross Mountains, placoderms dominate and provide data on their morphology, distribution and taphonomy. New studies are also focused on sarcopterygians and chondrichthyans. Seventeen out of more than 500 studied specimens have revealed bones with surfaces covered by sediment-infilled trace fossils. The traces must have been made on the vertebrate remains before their final burial. The burrows, oval in cross-section, include dendroidal networks of shallow tunnels on the bone surface. Their width varies from 0.4 mm to 1 mm and the length ranges from a few millimetres to 2 cm. They are branched and there is no reduction of diameter at the ramifications. The burrows are present on both sides of the bones: visceral and external. Their form suggests a bioerosional origin of all structures. The morphology, dimensions and development were studied and different ichnotaxa were taken into consideration. The most plausible are *Arachnostega* and/or *Talpina*. Such trace fossils were never identified on vertebrate carcasses and may represent a new ichnotaxon. Previous cases were described exclusively on invertebrate remains and carbonates. In the studied collection one tooth reveals microburrows, which probably represent *Mycelites* isp. However, precise specific identification requires additional research.

The presence of such trace fossils in the Upper Devonian (Famennian) of the Holy Cross Mountains may have impact on further interpretations of sea-floor productivity.

# Rare Lower Cretaceous ammonites from the Butkov Quarry (central Western Carpathians, Slovakia)

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The Butkov Quarry located close to the Ladce municipality belongs to the Manín Unit of the Central Western Carpathians. The exploited pelagic marly limestones are famous for the wealth of fossils, above all cephalo- pods. A small portion of older collections and our new collections have not been studied yet. This contribution deals with unpublished, usually only sporadic species of Early Cretaceous ammonites from the Butkov Quarry and other localities in the Western Carpathians.

Fossiliferous Lower Cretaceous deposits range from near the base of the Valanginian to the top of the upper Barremian. The oldest sporadic finds representing *Olcostephanus drumensis* come from the base of the Ladce Formation in a section close to the sanctuary. A richer ammonite association is present in the upper part of the Ladce Formation. From among the so far undescribed early Valanginian ammonites, *Vergoliceras salinarium* and *Neocomites neocomiensis* should be mentioned.

The varied spectrum of late Valaginian ammonites includes *Bochianites neocomiensis*, representatives of the genera *Criosarasinella* and *Olcostephanus* and, close to the Valanginian/Hauterivian boundary, representatives of *Teschenites*. The association around the studied boundary interval is accompanied by *Jeanthieuloyites keyserlingiformis, Spitidiscus rossfeldensis, Crioceratites primitivus* and *C. coniferus*.

In the early Hauterivian, *Olcostephanus hispanicus* and *Lyticoceras nodosoplicatum* occur rarely. *Subsaynella mimica* is present near the base of the late Hauterivian. In the late Hauterivian, the index species *Plesiospitidiscus ligatus* predominates; it is accompanied by *P.* cf. *canalis, Euptychoceras meyrati, E. subundulatum, Binelliceras binelli* and *Discoidellia mariolae*.

The ammonite spectrum in the Butkov Quarry is similar in composition to the Early Cretaceous ammonites from the Vocontian Trough in France.

# Foraminifera from the Fucoid Marls of the Ropianka Formation in the Skole Nappe, Outer Carpathians, Poland

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Foraminifera from the Kropivnik Marl in the Ropianka Formation were examined in exposures near Błażowa. The marls are turbiditic in origin and were deposited in the inner part of the basin. The Kropivnik Marl comprises marly and muddy shales, sandstones, and marls in different proportions. About 16% of the studied section is represented by marly-sandy facies dominated by marls and calcareous shales. The occurrence of hard platy marls with trace fossils informally known as "fucoids" is typical. Their frequency is variable, but usually does not exceed 25% of the thickness of a single section. Hard platy marls are in fact marls or clayey marls, with horizons of both $T_c$ and $T_{E-1}$ lamination constituting carbonate-siliciclastic marly siltstones.

Foraminifera are common in the hard platy marls, especially in intervals enriched in siliciclastic grains. Generally, thin, fragmented calcareous tests of planktonic foraminifera are present. Complete foraminiferal tests are much rarer and include *Macroglobigerinelloides* cf. *bollii*, *Globigerinelloides prairiehillensis*, *Planoheterohelix globulosa*, *Muricohedbergella holmdelensis* and *Globortuncanella havanensis*. Other calcareous foraminifera are very rare and belong to much larger benthic forms, mostly Nodosariinae.

Foraminiferal plankton in the hard platy marls is represented by fragile biserial, planispiral or low-trochospiral forms only; no keeled forms were found. In the Late Cretaceous such planktonic assemblages occupied inner neritic waters, not deeper than a few metres. Such environment was the source area for sediments transported into inner parts of the basin by turbiditic currents. The redeposited material may be older or of the same age as the hosting deposits. The state of test preservation points to a more or less isochronous age. Very thin and fragile foraminiferal tests were probably redeposited from loose, unconsolidated shelf deposits. Planktonic foraminifera present in the hard platy marls indicate the lower part of the *Gansserina gansseri* Zone and a latest Campanian–early Maastrichtian age for the Kropivnik Marl.

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# Bryozoans and brachiopods from the lower Miocene deposits of the Qom Formation in north-east Isfahan, central Iran

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Bryozoans and brachiopods are commonly found as fossils in the Cenozoic deposits of Europe, but they are still poorly known from Iran. So far, fossil bryozoans have been recorded in Iran only from the Abadeh section, encrusting larger benthic foraminifera, and from the Dizlu and Bagh sections, while brachiopods have been only mentioned from the Bagh section of the Qom Formation. The Oligo–Miocene deposits of the Qom Formation developed in the south-eastern margin of the Western Tethys Region. They are represented by marls and marly to sandy limestones. During the Oligocene–early Miocene the investigated area was a part of the Mediterranean–Iranian Province within the Western Tethys Region that comprised also the Eastern Atlantic Province in the west.

We report here a new early Miocene fauna of bryozoans and brachiopods collected from three sections: Varton, Zefreh and Kuh-e-Charkheh of the Qom Formation in the Esfahan–Sirjan Basin. The bryozoans comprise nine cyclostomatous and 21 cheilostomatous taxa, including one new species of the genus *Gigantopora*. Among cheilostomates, *Margaretta cereoides* and encrusting species are dominant. The brachiopods are represented by six species, all reported for the first time from Iran. Megathyridids (*Megathiris*, *Argyrotheca*, *Joania*) and *Lacazella mediterreanea* dominate in the studied assemblage. In taxonomic composition the fauna displays affinities to the late Oligocene and Miocene faunas from the Mediterranean and Paratethys. Both bryozoans and brachiopods indicate a warm, shallow water environment.

# An exceptionally preserved fossil assemblage from the Terreneuvian (Cambrian) of the Holy Cross Mountains, Poland

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Mudstones and siltstones of the Czarna Shale Formation in the southernmost part of the Palaeozoic of the Holy Cross Mountains, central Poland, have long been considered to yield low-diversity and low-abundance fossil assemblages dominated by vendotaenid algae and hyoliths, with an imprecise age in the basal Cambrian. Based on acritarch assemblages, deposits of the Czarna Formation from exposures around Kotuszów village are now referred to the *Skiagia ornata – Fimbriaglomerella membranacea* microfossil zone corresponding to the middle Terreneuvian Series. Therefore, they represent the oldest precisely documented rocks exposed in Poland and some of the oldest Cambrian strata exposed in Europe.

The macrofossil assemblage studied has a slightly higher diversity and abundance than previously considered. It comprises fossils of skeletonised taxa, including the most abundant hyoliths (2 taxa), protomonaxoniid sponges (5 taxa), bradoriids, annelids and other tube-shaped fossils, and a single anomalocaridiid fragment. The alleged vendotaenids are elongated objects, up to 10 mm wide, composed of carbonaceous flakes 1 to 4 mm long; they are now interpreted as compacted faecal pellets filling the burrows of unknown animals.

The fossils usually bear very weak or even no displacement traces caused by bottom currents and/or predation. The fossil-bearing mudstones and siltstones were generally deposited from suspended sediment below storm wave base. This quiet sedimentation was occasionally interrupted by higher-energy, storm-related depositional events. In SEM, all fossils are preferentially covered with pseudomorphs after framboidal pyrite (a few to 20 $\mu$m in diameter).

The domination of benthic fauna, periodical acritarch blooms, shallow horizontal ichnofossils, and layers of framboidal pyrite pseudomorphs indicate oxygenated conditions in the water column and on the sea bottom. Localised, oxygen-depleted microenvironments must have developed directly beneath the water/sediment interface, associated with the colonisation of buried organic remains by sulphate-reducing bacteria. These microenvironments favoured the preservation of various organic remains.