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ABSTRACTS

Avian ichnia from the Miocene red beds of NW Iran

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The red beds of Iran extend over the time period of Devonian through Miocene. The Miocene red beds known as the Upper Red Formation (URF) are known to yield footprints of terrestrial vertebrates (e.g. Abbassi & Amini, 2008; Abbassi 2010). The red beds are also distributed in the Alborz Mountains where they are commonly recognized as the Neogene red beds (NRB), a stratigraphic equivalent of the URF. These terrigenous sediments mainly red in color filled the intermontane sedimentary basins that formed in the Alborz Mountains during the post-Eocene collision events (Alavi 1996). More precise age of these beds is unknown as they did not yield any index fossils so far. Furthermore, the stratigraphic correlation between the URF and the NRB remained unresolved. Therefore the both red bed units have been attributed to the Neogene subsystem in general (Clark et al., 1975). The NRB were preliminarily studied in the Taleghan Alamut, Tarom and Hashtajin valleys that are situated in the western part of the Alborz Mountains. The NRB of Taleghan and Alamut were subdivided to the Gand Ab (32.7-32.9 Ma) and Narijan (8.7 Ma) units (Guest et al., 2007) indicating their origin in Oligocene and Miocene, respectively. Stratigraphy of the NRB present in the Tarom valley were discussed by several authors (e.g. Abbassi, 2005), who suggested that the NRB were deposited in Miocene and are correlable to the URF in Central Iran and to the Narijan unit in the Taleghan valley.

Here we report on vertebrate ichnia discovered in the NRB of the Tarom valley. The locality was found about 2 km west of the village Gilankesheh in the Zanjan Province (Fig. 1A). At this site the NRB section is 288 m thick, and shows, that red sandstone combined here with sandy mudstones (unit 2+3 *sensu* Abbassi 2005) lie unconformable on dark purple sandy marls (unit 1 *sensu* Abbassi 2005); perhaps of the Oligocene origin), and are overlaid by the unit 4 (*sensu* Abbassi 2005) that comprise thin sandstone and siltstone intercalations inside of gypsum layers (Fig. 1B). One of these intercalations provided numerous slabs with preserved abundant ichnia. The ichnia refer to bird tracemakers and include footprints of different shape and size (Fig. 1C) as well as traces of feeding activity (Fig. 1D) of the tracemakers. All avian footprints are preserved as hyporeliefs. Our comparisons have revealed similarities to such ichnotaxa as *Aviadactyla vialovi*, *Avipeda filiportatis*, *Charadriipeda disjuncta*, and *Ornithotarnocia lambrechtii*. We assume that the specimens from the Tarom valley may represent the sample of a local assemblage of Miocene lakeshore birds that differ in taxonomy and ontogenetic age.

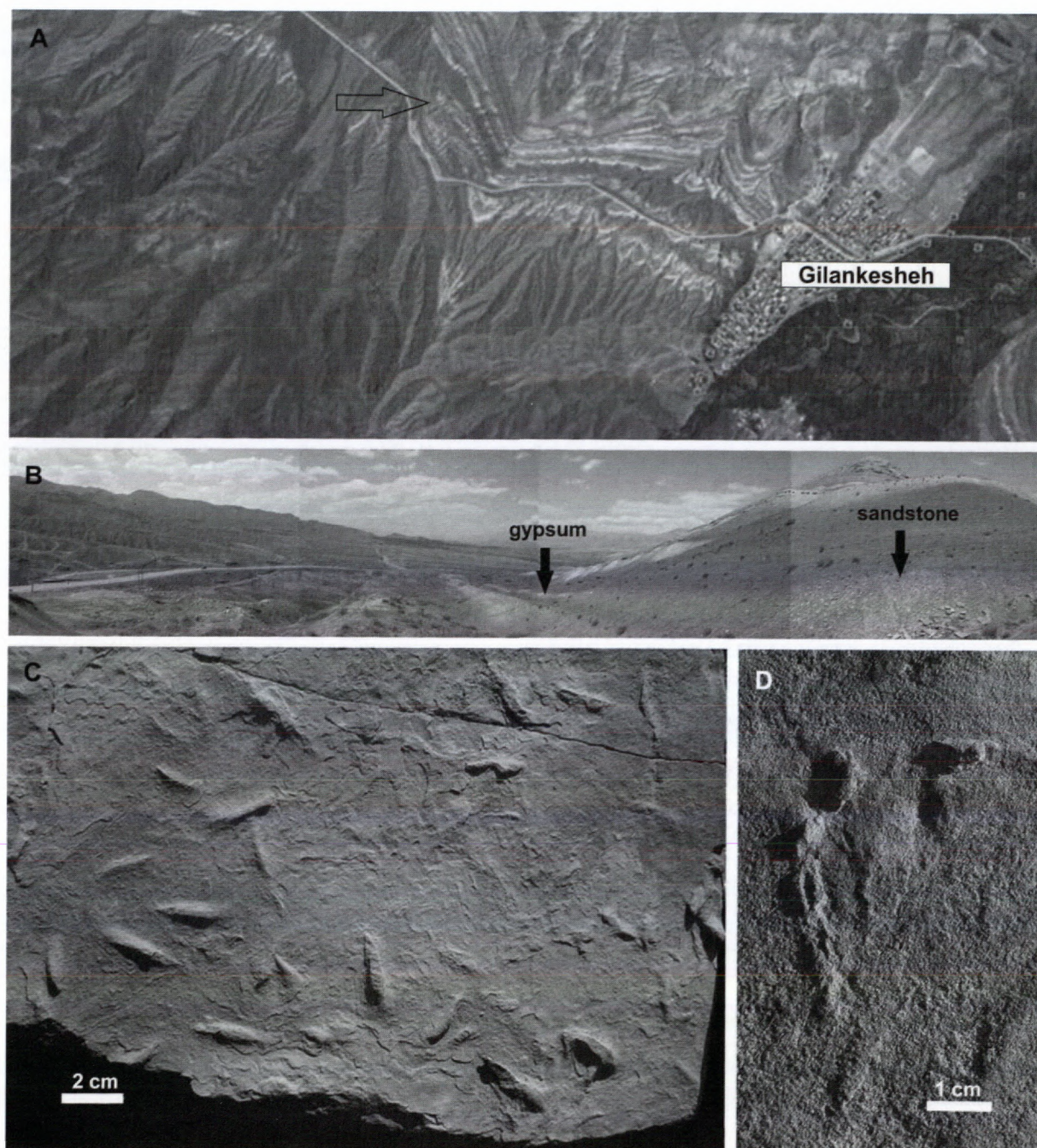


Fig. 1 **A.** Geographic location of the ichnolocalities in the Tarom Valley. **B.** The NRB outcrop showing distribution of gypsum and ichnia-bearing sandstone. **C.** An example of the small-size type of the avian footprints. **D.** An example of the chain type of feeding traces.

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Ascocerid cephalopods from the Silurian of the Prague Basin (Bohemia) and Gotland (Sweden)

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Ascocerids are morphologically unique early Palaeozoic cephalopods in which periodical truncation of juvenile shell portion occurs. A mature, inflated ephebic shell is then developed where phragmocone chambers are situated above the living chamber being separated by sigmoidal, lacunate septa. The ascocerids have been rather rarely found within the Ordovician and Silurian strata of N. America and Europe. Largest collections of Silurian ascocerids counting up to tens of specimens were collected and described from Gotland and Bohemia during the 19th century by G. Lindström and J. Barrande, respectively.

In Gotland, Lindström (1890) described first ascocerids (*Ascoceras dolium*, *Ascoceras cochleatum*) from the Telychian-Sheinwoodian boundary. Four species were recorded in the upper Sheinwoodian Slite Group (*A. lagena*, *A. ampula*, *A. fistula*, *Choanoceras mutabile*). No ascocerids are known from the Homeric and lowermost Gorstian. Highest number of ascocerid species (seven) was recorded during upper Gorstian and lower Ludfordian. The ascocerids are missing in the *N. kozlowskii* to re-appear during the upper Ludfordian with three species (*A. collare*, *A. bohemicum*, *A. gradatum*). Last ascocerids were recorded in Gotland in the Sundre Formation (uppermost Ludfordian) with two species (*A. decipiens*, *A. gradatum*).

In the Prague Basin, stratigraphical distribution of ascocerids is much more precisely determined. The first ascocerid was illustrated by Barrande (1877) and assigned by him to species „*Glossoceras gracile*“. The age of the illustrated specimen corresponds to the early Gorstian *N. nilssoni* Biozone. In the late Gorstian and most of the Ludfordian, the ascocerids are represented with only two species (*Ascoceras verneuilli* of the *L. scanicus*-*S. chimaera* and *S. leintwardinensis* (*S. linearis*) Biozone; *Glossoceras gracile* of the *N. kozlowskii* Biozone). In the following *P. dubius postfrequens* Biozone, no ascocerids were recorded possibly due to the *Kozlowskii* Event. The ascocerids re-appear in the *P. latilobus*-*S. balticus* Biozone with species *Parascoceras decipiens*. In the Prague Basin, ascocerids reached their maximum diversity in the latest Ludfordian and early Přídolí (*P. fragmentalis*, *M. parultimus* and *M. ultimus* Biozones) when up to five ascocerid species have been recorded. Presumably, migration from Baltica and Avalonia occurred at that time as species from both regions are present in the Prague Basin, as well. Further evolution of immigrants and subsequent origin of endemic forms (cf. Manda 2008) might have possibly taken place in the early Přídolí. During the late Přídolí, ascocerids are represented by *Parascoceras* sp. in the *M. bouceki* and *M. transgrediens* Biozones and *Ascoceras murchisoni* in the *M. transgrediens*

Biozone. The latter species marks stratigraphically youngest occurrence of ascocerids in the Prague Basin.

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Early Carboniferous trilobite remains from limestones of the Raclawka Valley, southern Poland

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The proetids were the only trilobite order which auspiciously survive the Late Devonian biodiversity crisis. They first appeared in the Ordovician and terminated at the end of the Permian. During their long evolution they survived also the end-Ordovician mass extinction and even underwent a moderate diversity in the Carboniferous.

The presence of proetid trilobites remnant is reported for the first time from the Lower Carboniferous limestones of the Dębnik Anticline outcropping in the Raclawka Valley, situated in the eastern part of the Upper Silesian Block (southern part of the Cracow Upland) (Bąk M. et al. 2014). Disintegrated exoskeletons of trilobites are observed in thin sections of fine-grained, peloidal wackstones and packstones. These rocks contain also foraminifers which indicate an early Tournaisian age for this locality. Trilobite exoskeletal fragments are distributed randomly in an area of 2 x 4 square centimeters. They can be observed in thin-sections oriented perpendicular to the rock bedding. Only some of the skeletal elements are identifiable. The trilobite remnants are mixed, and may belong to several specimens. Some of them appear to be crushed by predators. They are mixed with surrounding material by bioturbation. Other parts of exoskeletons are incorporated into fecal pellets. Trilobite remnants represent both dorsal and ventral parts of the skeletons. Pleural bands from thoracic and pygidial parts prevail. Other recognizable parts are cephalon elements, the axial ring, and some small spine elements of the prosopon.

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Iron Related Bacteria in the Lower Cretaceous marine sediments from the Carpathian realm (Silesian Unit and Tatra Massif)

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The fossilization of bacteria is most possible if they precipitated extracellular inorganic coatings. The more resistant to later re-mobilization are metallic bacterial coatings such as those created by Iron Related Bacteria (IRB). Encrustations usually left as the only remnants after bacterial cells, rods and filaments, providing the only information to bacterial type recognition in the fossil record.

In the present study, we report possible morphological and chemical evidences of IRB from the Lower Cretaceous (Albian–Cenomanian) marine sediments in the Carpathians, which has been recognized by the authors in turbidite layers of the Silesian Nappe (Outer Carpathians) and in condensed phosphatized limestone of the High-Tatric units (Inner Carpathians).

In the Silesian Unit sediments, IRB has been recognized in the Mikuszowice Cherts and Middle Lgota Beds, in four types of microfacies (Bąk, M. 2011) as: (1) sublitharenite with microfossils, (2) sublitharenite with sponge spicules, (3) spiculitic sublitharenite, and (4) biomicrite with foraminifers, radiolarians and sponge spicules. They are visible macroscopically as brown, ferruginous staining, parallel to lamination. The detailed structure of ferruginous discoloration is visible only in microscopic studies of thin sections, where they are present in different positions as: (1) cover of microfossils and detrital grains, (2) filling of primary pore space between grains, and (3) micro-laminae which are several to tens of micrometre thick.

In the Tatra Massif, IRB remnants are present in brown, ferruginous stainings, which are usually located in hardground cover (up to 15 cm thick), developed on echinoderm wackstone. The detailed microscopic view of thin sections shows that ferruginous discoloration form continuous, parallel microlayers of several micrometre thick, inside stromatolite, infill small pore space or replace echinoderm plates.

The singular grain coatings and those one formed the mats consist of densely packed elongated capsules, of 3–5 µm width, with wall of 0.1 µm thick, which resemble bacterial sheath. Thin filaments attached to iron coatings externally resemble IRB of the *Sphaerotilus* – *Leptothrix* group. Further evidence of IRB are the circular forms, which may represent cross-section of bacterial sheaths, and fuzzy brown disk-like forms resembling bacterial holdfasts, surrounded usually by fibres, flocks and aggregates.

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Foraminiferal assemblage from the Tournaisian limestones of the Dębnik Anticline, Raclawka Valley, southern Poland

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Lower Carboniferous deposits, containing foraminifer assemblage outcrop in the Dębnik Anticline, which belongs to the Dębnik–Siewierz fold belt (Żelaźniewicz et al. 2011), formerly named the Upper Silesian fold belt (Buła & Habryń 2008), which creates an eastern part of the Upper Silesian Block. This fold belt occurs between Tarnowskie Góry, Siewierz and Krzeszowice towns and contains Carboniferous–Devonian folded sediments, this unit is built of several synclines and anticlines, which are cut by numerous faults. The studied sediments belong to the Upper Devonian–Lower Carboniferous succession that creates the Dębnik Anticline. Total thickness of the Lower Carboniferous strata exceeds 1200 m (Paszkowski 1995). These sediments have been came from various environments that include deep-water intra-shelf basin, open shelf platform and ramp, and shallow water environments with lagoons, intertidal parts of the basin floor and sabkha (Łaptaś 1982, Paszkowski 1995). The investigations has been carried in one of the karst valleys (the Raclawka Valley) which cut the Dębnik Anticline. Samples used in this study came from grey, massive limestone, strongly cemented, forming strata from several up to 20 cm thick. The studied succession shows low textural variation. It consists mainly of fine-grained, peloidal, skeletal wacke- and packstone (Figs 3, 4). Intragranular authigenic mineralization is visible in thin sections of the rock. Bioclasts are common (up to 40%), however superficially are not well visible. Bioclasts contain numerous calcispheres, moderately diverse foraminifer assemblages and ostracods. Age of the studied deposits has been stated as the early Tournaisian, based on the presence of foraminiferal assemblages, which belong to earlandid and chernyshinellid groups. In the assemblage, age-diagnostic forms such as *Earlandia elegans* (Rauser-Chernousova & Reitlinger) and *Eochernyshinella crassithec*a (Lipina) are common. The studied limestones have been correlated with the *Chernyshinella disputabilis* Foraminiferal Zone of the South Ural (Kulagina 2013), which corresponds to the *Siphonodella belkai* Conodont Zone in the same region.

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Coal-bearing submarine slump sediments from Oligocene–Miocene transition of the Eastern Carpathians (Bieszczady Mountains, SE Poland)

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Coaly organic matter, characterized by variable coal rank from dull and bright brown coal to bituminous coal occurs commonly in the Cretaceous–Neogene flysch sediments of the Carpathians (e.g., Dżułyński & Ślaczka, 1958; Ladyzenski & Sawkiewicz, 1968; Kotlarczyk, 1978; Wagner, 1996; Machajová *et al.*, 2002; Zielińska, 2010). A new finding of lustrous coal particles from the youngest flysch sediments of the Silesian Nappe, Polish Eastern Carpathians, outcropped in the Bieszczady Mountains is here presented. The coal particles occur in sandstones of a submarine slump layer, correlated with the uppermost Oligocene–lowermost Miocene, based on planktonic foraminifera (Bąk, 1999, 2005). Composite sedimentary, petrological and micropalaeontological studies allowed for interpretation of features of the source area for organic and siliciclastic material, which was supplied to deep Silesian–Subsilesian basin floor (Bąk *et al.*, submitted).

Based on a vergence of folds within the slump layer, which is different than the transport directions of turbidite currents, the source area for the land-derived material, which is preserved in the slump layer, could represent the SE termination of the Silesian Ridge, an intrabasinal cordillera in the Western Carpathian Basin, which supplied large amount of siliciclastic material to the Silesian–Subsilesian basin during the lower–middle Oligocene (Haczewski *et al.*, 2007). Taking into account the mineral composition of sandstones from the slump layer, the SE termination of this cordillera was built mainly of metamorphic rocks during the latest Oligocene–earliest Miocene, associated by calcareous sedimentary strata.

The features of lustrous coal pebbles from the slump layer show on an occurrence of coastal plains or lagoons within that area, where terrestrial organic matter including plants producing waxes could be partly degraded under oxic/dysoxic conditions without burial, and where it was a subject to quick gelification. Nonetheless, most of the organic material underwent gelification processes after transport and burial at the deep basin floor, partly under dysoxic conditions, what is interpreted on the basis of an occurrence of pyrite framboids in organic particles.

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Late Maastrichtian fauna assemblage from the Lviv Trough, Western Ukraine

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The upper Maastrichtian deposits occur in a narrow band in the axis of the Lviv Trough (southwestern part of the East European Platform). They are exposed at the several outcrops in Lviv and environs. The upper Maastrichtian strata are represented by the grey clay marls of the Lviv suite and contain numerous fossils. It is lying on the lower Maastrichtian deposits and is covered by Neogene and Quaternary sediments. The maximum thickness is 80 m (Gavrylyshyn et al. 1991). Species *Belemnitella junior*, *Hoploscaphites constrictus livensis*, *Hoploscaphites constrictus crassus*, *Hoploscaphites tenuistriatus* and *Spyridoceramus tegulatus* (v. Hagenov) indicate a position of the Lviv suite in the *Spyridoceramus tegulatus* – *Belemnitella junior* Zone of the lower upper Maastrichtian (Machalski 2005). The microfossils indicate *Praeglobobulimina imbricata* Zone with *Spiroplectammina excolata*, *Orbignyna sacheri*, *Plectina ruthenica*, *Cibicidoides bembix*, *Grammostomum incrassatum* var. *crassa*, *Praeglobobulimina imbricata*, *Bolivinoidea draco*, *B. peterssoni*, *B. delicatulus*.

Abundant fauna assemblage of the Late Maastrichtian consist of corals, brachiopods, molluscs, sea urchins, sponges, serpulids, shark teeth, ostracods, foraminifers and plant remains. Most of them are autochthonous with good preservation. Corals, scaphopods, gastropods, infaunal bivalves, nautiloids and ammonites are represented by molds and traces, while brachiopods, serpulids, epifaunal bivalves and belemnite guards are well preserved and often occur with the whole shell. Fossils are spread in the sediments irregularly and are of relatively small size, which are not unusual however. The most frequent there are molluscs, mainly bivalves which form almost 60 % of the whole fauna with dominant species *Nuculana producta*. Common taxa are *Microchlamys acuteplicata*, *Limopsis rhomboidalis*, *Limatula decussata*, *Pycnodonte vesicularis*, *Nucula truncata*, *Nucula ascendens*. Gastropods are about 20 %; among them dominate *Aporrhais pyriformis* and *Drepanocheilus substenoptera* and common taxa are *Avellana inversestriata*, *Calliophthalmus inaequ coastatus*, *Haustator planus*. Cephalopods are not more than 10%. Brachiopods are about 5 % with a substantial prevalence of *Carneithyrus carnea*. The other taxonomic groups are rare (less than 1 %).

Bivalves and gastropods are represented by the deposit-feeders (*Nuculana*, *Nucula* and *Aporrhais*), the suspension-feeder (*Spyridoceramus*, *Limatula*, *Haustator* and *Turritella*) and herbivorous feeders (cerithiid and trochid gastropods). Predators are gastropods (*Natica*, *Avellana*, *Cylichna*), cephalopods and sharks. The occurrence in the assemblage of algal-feeding gastropods and plant remains as well as a large percent of infauna indicate an inner shelf environment, located not far from the shore with plant vegetation, and not too firm bottom substrate to burrow into.

Fauna assemblage from the Late Maastrichtian is less varied compared to the Early Maastrichtian, that had been reflected in the decreasing of species diversity of the taxonomic groups, e.g. at the Early Maastrichtian there were 75 gastropods species and 8 inoceramid bivalves, while at the Late Maastrichtian was found only one *Spyridoceramus tegulatus* and 53 gastropods (Bakayeva 2011). The decreasing of the fauna diversity could be caused by the changing of the sedimentation conditions: a slight deepening of the basin and increasing of the concentration of hydrogen sulfide in the sediment (Pasternak et al. 1987).

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Pannonian biostratigraphy and palaeoenvironment of the north western part of Lake Pannon - based on palynological data from Danube Basin

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During the Late Miocene a wide brackish lake, Lake Pannon formed in the Alpine-Carpathian-Dinaride realm covering the territory of the Pannonian Basin system. After its isolation from adjacent Paratethyan and Mediterranean areas during the Sarmatian marine microplankton became extinct and new endemic forms originated. These endemic dinoflagellate cysts play a crucial role in the biostratigraphic subdivision of these deposits.

We present the preliminary data on the late Miocene (Pannonian) dinocyst zonation for the Danube Basin (Slovakia) and correlation possibilities with other Paratethyan biozonations. Additionally, the facies evolution and vegetation patterns are studied based on organic-walled microplankton and sporomorphs. The Modrany (M-1) core contained the most complete microplankton assemblage, the other studied cores (Nová Vieska, Diakovce, Kolárovo, Dunajská Streda) provided only additional data. Three zones were distinguished in the M-1 core: the *Spiniferites bentorii* pannonicus-*Spiniferites bentorii* oblongus Zone, the *Spiniferites bentorii* coniunctus-Pontiadinium pecsvaradensis Zone and the *Spiniferites paradoxus* Zone. The last two zones are correlatable to Early Pannonian assemblages in Hungary and Croatia. The lack of the *Mecsekia* plexus in the lowermost Pannonian samples points to either a time gap between the Sarmatian and Pannonian stages or questions the interregional feasibility of the Hungarian and Croatian zonations and suggests a very strong facies control on time equivalent microplankton assemblages. The signal of the late Early Pannonian transgression of the lake is visible in the increasing number of proximate dinoflagellate cysts in the two older zones indicating open-more distal environments with regard to the former coastal line. The youngest *S. paradoxus* Zone is equivalent with the early Late Pannonian zones in Croatia and Hungary. These assemblages are very poor and host only a few dinoflagellates indicating unfavourable habitats for dinocysts in the Danube Basin. Younger dinoflagellate assemblages were not recorded, as in the younger part of the Late Pannonian the study area was filled up by fluvial sediments and smaller lakes only prevailed isolated from Lake Pannon. In the pollen spectra from Early Pannonian broad-leaved deciduous elements dominate with some thermophilous elements, e.g. *Engelhardia*, *Laevigatosporites* suggesting a warm-temperate

climate and mixed mesophytic forests with deciduous oaks, *Pinus* and *Cathaya* together with abundant mountain conifers *Picea* and *Abies*. *Tsuga* is present in smaller proportions. Lowland vegetation is represented by *Alnus*, *Liquidambar* *Ulmus*, and indicating well-developed riparian forests and local swamps (Cupressaceae, *Myrica*).

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Native American *Ectobius* rewrites ecology textbooks

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Representatives of the cockroach genus *Ectobius* are present in ecology textbooks as examples of invasive species in America with synantropic behaviour absent in their original habitats in Eurasia (including Poland, Czech Republic and Slovakia) and Africa. While in Europe the genus has a long history evidenced by the Baltic amber (~44Ma), the first of four living species were recorded in U.S.A. just some 65 years ago and were evidently absent prior to that. Discovery of *Ectobius kohlsi* Vršanský, 2014 (named after the collector David Kohls) and three common undetermined species of genus *Ectobius* Stephens, 1835 in the lower Middle Eocene Green River Formation in Colorado (U.S.A.) was entirely unexpected. The deposits in Colorado are about five million years older than Baltic Amber and more obscure than its sudden extinction in American continent is the dozens million year lasting emptiness of its ecological niche. Thus textbooks are to be rewritten and invasive genus turns to be the native occupant of the American continent. Both males and females of *E. kohlsi* had well developed wings suited for flying (females of recent *Ectobius* species are commonly brachypterous) and the distribution of sensillar apparatus is of modern type. The ratio of males and females was almost equal unlike it is in other species of the genus. When compared with living species of the genus, *E. kohlsi* was neutral or plesiomorphic in all of its characters, and most similar to *E. kraussianus* Ramme, 1923, *E. ticus* Bohn, 2004 and *E. vittiventris* (Costa, 1847).

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Synopsis and revision of limpet *Patella anceps* MICHELOTTI, 1847 (Gastropoda: Patellogastropoda: Patellidae) from the Middle Miocene deposits of Devínska Kobyla (Vienna Basin, Slovakia)

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In the Miocene shallow-water marine sandy facies of the Devínska Kobyla Hill (eastern edge of Vienna Basin) were discovered a rare finds of the fossil shells of limpet gastropod *Patella anceps* MICHELOTTI, 1847 (Patellogastropoda: Patellidae). These gastropods were

discovered in the Upper Badenian layers of Sandberg Member of the Studienka Formation at the localities Sandberg (16 specimens), Waitov lom (1 specimen), Lingulová lavica (1 specimen) and Šibeničník (6 specimens). They were found also in the deposits of Holíč Formation of the sites Dúbravská hlavica (10 specimens) and Pekténová lavica (1 specimen), that correspond to the Early Sarmatian age. For more details about geological settings of these localities see Hyžný et al., 2012. The fossil material composed of the older and new additional samples has been examined from the paleontological collections of the Slovak National Museum in Bratislava, Balneological Museum in Piešťany, Faculty of Natural Sciences of Comenius University in Bratislava and from the personal collection of author.

The first mention on the patellid gastropods from the Devínska Kobyla area was introduced by Schaffer (1908). From the sandy sediments of the locality Sandberg at Devínska Nová Ves (formerly Neudorf an der March, Dévény-Ujfalú) he presented the taxon *Patella ferruginea* GMEL. var.. Horusitzky (1917) reported from the same locality a new finds of the limpets, which were identified as *Patella ferruginea* GMEL. Shells of limpets from the various sites of Devínska Kobyla were published later by other authors too (see Švagrovský, 1981; Michalík & Zágöršek, 1986; Hyžný et al., 2012). Švagrovský (1981) identified this species from the Upper Badenian sandy strata of the locality Devínska Nová Ves – Sandberg as *Diodora italica* (DEFRANCÉ, 1820). Remnants of limpets from the Upper Badenian site of Devín – Záhradky (Šibeničník Hill) were considered by Michalík & Zágöršek (1986) as *Patella (Patella) miocaerulea* SCHAFFER, 1912. The result of a new research of these patellid gastropods suggests that all specimens belong to the species *P. anceps*.

Occurrences of patellogastropod limpets at the studied sites of Devínska Kobyla are allochthonous, shells of these gastropods were from their native habitat transported with currents at the short distance towards the adjacent shallow-water marine environments with sandy bottom. Presence of limpet gastropods indicates proximity of the rocky bottom and/or shore in the intertidal zone with conditions of high-energy environment at the studied localities vicinity during the Middle Miocene.

Finds of *P. anceps* are known from the Miocene deposits of Slovakia so far only from the localities at Devínska Kobyla. New discoveries of this gastropod come from the sites Lingulová lavica and Pekténová lavica. In the Early Sarmatian sediments of the localities Dúbravská hlavica and Pekténová lavica has been recorded uncommon, relict occurrence of the studied limpet species, what enlarges the boundary of its stratigraphic range in the Miocene of Central Paratethys.

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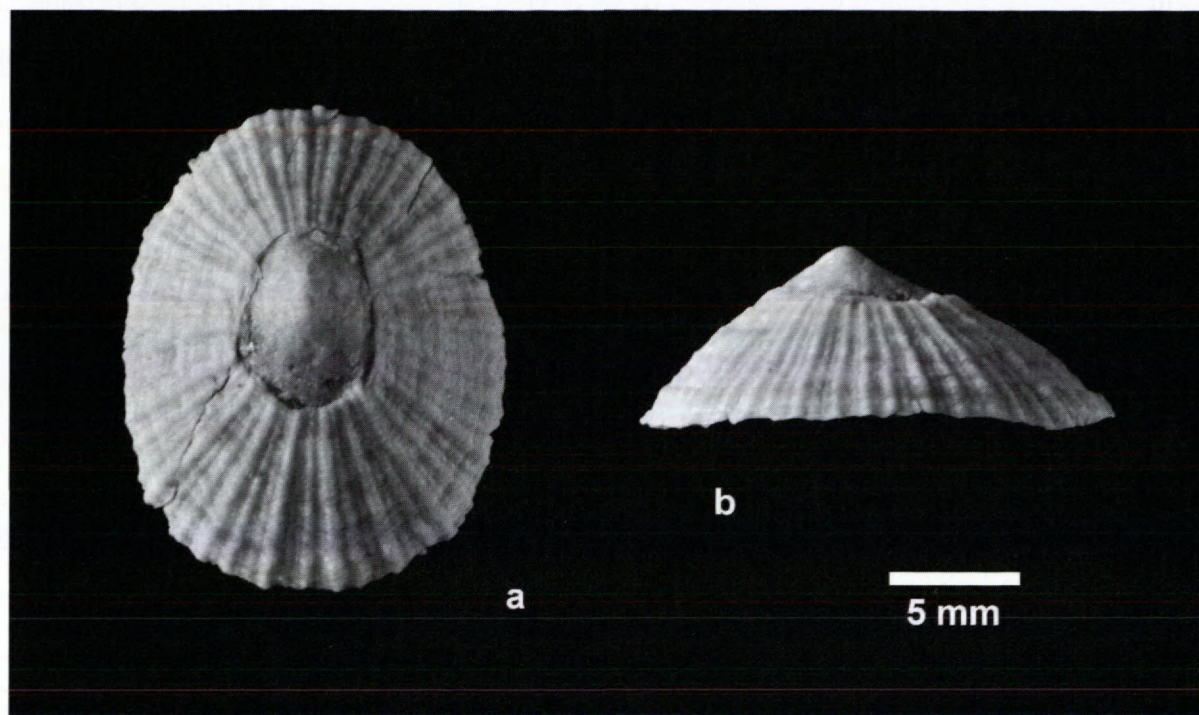


Fig. 1 *Patella anceps* MICHELOTTI, 1847. Devínska Nová Ves – Sandberg, facies of pale-grey sands with sandstone beds, Upper Badenian. A – dorsal view, B – lateral view.

Results of the foraminiferal study on the Lunz beds of Hronicum

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We present results of the initial biostratigraphical research of the basal part of the reingraben (Halobia) shales, i. e. the lower part of the siliciclastic sediments of the lunz beds, in the realm of the Biely Váh Hronicum basin (sensu Havrila 2011). The research was effectuated on samples collected from localities Liptovská Osada, Liptovské Matiašovce, Turík, Liptovský Ján and Svarín, in the western and central part of the Biely Váh facies distribution (Eastern part of the Veľká Fatra Mts., Choč Mts. and Nízke Tatry Mts.). As in the Northern Calcareous Alps, also in inner Western Carpathians we collected large spectra of organic remnants. Mostly it concerns of foraminifera, also fish remnants, smooth walled Ostracoda, Porifera rhaxes, juvenile Brachiopoda shells, small Gastropoda and casts of limnivora tubes. At localities Liptovská Osada, Liptovský Ján and Svarín free foraminifera shells were collected for the first time. Individual localities dispose by diversity of foraminiferal association, according to their position in the bed sequence, paleogeographic position and/or sedimentary

conditions (Havrila et al., 2013). The most rich and diverse microfauna was detected at localities Turík and mainly Liptovský Ján, where rich association of benthic species is represented by *Hyperammina stabilis* KRISTAN–TOLLMANN, *Ammodiscus* sp., *Pachyphloides dracosimilis* (OBERHAUSER), *Pachyphloides* ex gr. *oberhauseri* CIVRIEUX et DESSAUVAGIE, *Nodosaria levifracta* KRISTAN–TOLLMANN, *Nodosaria* ex gr. *nitidana* BRAND, *Dentalina* ex gr. *subsiliqua* FRANKE, *Pseudonodosaria sphaerocephala* KRISTAN–TOLLMANN, *Pseudonodosaria vulgata multicamerata* (KRISTAN–TOLLMANN), *Lenticulina* (*Lenticulina*) cf. *gottingensis* (BORNEMANN), *Lenticulina* (*Lenticulina*) ex gr. *matutina* (d' ORBIGNY), *Lenticulina* (*Lenticulina*) *nautiloides* (BORNEMANN), *Astacolus carnicus* (OBERHAUSER), *Marginulina erromena turica* SAMUEL, *Lingulina infirmis* OBERHAUSER, *Lingulina esseyana* DEECKE, *Fronicularia sulcata* BORNEMANN, *Duostomina alta* KRISTAN–TOLLMANN, *Duostomina biconvexa* KRISTAN – TOLLMANN, *Variostoma cochlea* KRISTAN–TOLLMANN (sample 1096). The last two mentioned localities contain practically identical associations. At the locality Liptovská osada we find the foraminiferal association which differs from the others by existence of highly convex forms of *Lamelliconus multispirus* (OBERHAUSER), *Lamelliconus procerus* (LIEBUS), *Pragsoconulus robustus* OBERHAUSER and/or *Lamelliconus ventroplanus* (OBERHAUSER). We also noticed the association consisting dominantly of *Ophthalmidia* sp. The poorest sample and worst preservation of benthic foraminifera which consist of *Hyperammina* and *Duostomina* issued the locality Liptovské Matiašovce. At the Svarín locality dominates the „*Duostomina*“ assemblage, just the foraminiferal diversity is higher and better off the forms against the Liptovské Matiašovce locality. The *Duostomina* dominance we noticed also at the Turík locality. Determined foraminifera enabled us to determine the Carnian - Julian age of the reigraben shales at the studied localities. Some of the forms identified in the reigraben beds of the Western Carpathians were originally reported from other (mainly younger) stratigraphical horizons.

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Middle Miocene mammals from the Czujan's sand-pit (Mikulov, Czech Republic)

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Czujan's sand-pit (2 km east of Mikulov, Czech Republic) represents a unique locality with a Middle Miocene mammalian assemblage. Although Czujan's sand-pit is mentioned only occasionally in published sources, it is the type locality of *Tethyragus stehlini* (THENIUS, 1951) described on the basis of fragmentary horns (Thenius 1951, Azanza & Morales 1994).

The remaining fossil mammalian was not described in detail with the only exception of proboscidean teeth (Seitl 1985). The stratigraphical age of this locality was last discussed by Čtyroký *et al.* (1990) who considered it as most likely corresponding to the Upper Badenian substage.

Studied material is placed in collections of Anthropos Institute, Moravian Museum in Brno. In total 11 taxa were identified in Czujan's sand-pit including Proboscidea: *Zygolophodon turicensis* (SCHINZ, 1824), *Gomphotherium angustidens* (CUVIER, 1817), *Prodeinotherium bavaricum* (von MEYER, 1831), Cervidae: *Heteroprox larteti* (FILHOL, 1890), Bovidae: *T. stehlini*, Palaeomerycidae indet., Rhinocerotidae: *Hoploaceratherium* sp. GINSBURG & HEISSIG, 1989, *Brachypotherium* cf. *brachypus* (LARTET, 1851), Equidae: *Anchitherium* sp. (MEYER, 1844), Chalicotheriidae: *Anisodon grande* (BLAINVILLE, 1849) and Carnivora: *Amphicyon* cf. *major* BLAINVILLE, 1841.

Czujan's sand-pit probably represents fluvial deposits of deltaic channel. Biostratigraphic comparisons between the mammalian species corresponds the age of 14,9–13,5 Ma (Middle-Late Badenian; Astaracian, MN 6 Zone – lower part of MN7+8 Zone). Taphonomical study suggests that most of fossil remains includes individuals who died in the immediate vicinity of the sedimentation area. These individuals represent both forest as well as species of open environment. The presented taxa are typical for subtropical climate during the latest part of the Miocene Climatic Optimum. High number of young proboscideans can be explained by climate changes at the end of Miocene Climatic Optimum (Ivanov & Bohme 2011, Domingo *et al.* 2012), because bone accumulations of young elephants usually indicate deaths during dry seasons (Haynes 1991).

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Paleocene limestone of reef facies of the Western Carpathians

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In the contribution the results of the study of Paleocene limestones of reef facies of the Western Carpathians covering a time period of 65-56 million years, collected from 7 regions

(Little Carpathians, Myjava Upland, Middle Váh Catchment – Považská Bystrica and Hričovské Podhradie, Orava, Spišská Magura Mts. and Eastern Slovakia) are presented. Of particular importance are the Western Carpathians in the light of the fact that the Paleocene carbonate platforms are located between 48° 30' and 49° 20' north latitude, which represents by far the most northerly known occurrence of Paleocene reef shallow water carbonates on the Earth.

Biostratigraphic study consisted of analyses of 1152 thin sections from 59 sites. Since the Western Carpathian Palaeocene platforms are always associated with their Upper Cretaceous substrate (sediments of Campanian-Maastrichtian), the data on the immediate basement of these platforms in individual areas are provided.

The Paleocene limestones of reef facies of the Western Carpathians occur in the form of olistoliths, blocks/boulders redeposited within younger Palaeogene strata. They are found in formations of Myjava-Hričov Paleogene group, with the exception of the Orava region; there, they occur in Biely Potok Member of Paleogene Subatric group.

The Paleocene reef complex of the Western Carpathians does not represent a continuous strip of barrier reefs, but 7 areas separated from each other. Except of Little Carpathians Mts. they always follow the internal margin of the Klippen Belt. It is obvious that, as in other areas of the northern Tethys, in the Western Carpathians it incurred in complex tectonic conditions of isolated carbonate platforms, which had a short duration of time.

According to the evaluation of individual areas, the sediments of Danian age (SBZ 1) have not been identified. Evidence of shallow water sedimentation starts with Selandian (SBZ 2) and hiatus at the interface Cretaceous/Tertiary due Laramian movements had a duration of 4 million years and more. Late-Laramian movements by the end of Thanetian caused disappearance of carbonate platforms in the area of Klippen Belt. The most diverse representation of organisms on carbonate platforms (probably also due to climate change - warming) is reflected in the Lower Thanetian (SBZ 3).

When analysing the Western Carpathians setting, an extraordinary similarity of evolution and termination of platforms with Italian Maiella area is striking. Many common features can be detected even when compared with the sites in the Pyrenees, Slovenia and Turkey. Markedly numerous common characteristics has the Paleocene platform of the Little Carpathians with the facies in the Northern Limestone Alps and in this regard the Little Carpathians Mountains can be considered their easternmost termination.

A new extinct clade of lizards from the locality Messel, Germany

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A new taxon is presented from the Middle Eocene locality Messel in Germany based on a nearly complete skeleton. The specimen derives from the Messel Pit, a middle Eocene lake deposit near Frankfurt am Main which is famous for the extraordinary preservation of its fossils (Schaal & Ziegler, 1988). The new taxon shares many characters with enigmatic *Eolacerta robusta* Nöth, 1940, a large lizard originally described by Nöth (1940) from the middle Eocene of the Geiseltal (eastern Germany). However, it also shows several important differences, e.g., distinctly smaller body size, distinctly shorter nasal process of premaxilla, thinner postorbital process of jugal, a long suborbital process of jugal, longer anterior region

of the frontal, V-shaped groove separating frontal and frontoparietal scutes (sulcus interfacialis), and shorter maxillary posterior process. Micro-CT technology was used for the first time to study an eolacertid, and it brings important new information about several key characters on interior surfaces of the cranial bones. In some places, soft tissue structures (keratin) preserve aspects of the lepidosis. The new discovery sheds light on the paleodiversity of these lizards in the middle Eocene of Europe. The new clade name is proposed to encompass these species. There are several opinions about the affinities of *Eolacerta robusta*. Nöth (1940) assigned this taxon to the family Lacertidae, emphasizing its close relationship to extant representatives. Rieppel (1980) first recognized this misunderstanding. He investigated material from Messel and argued that *E. robusta* does not belong to Lacertidae, but could be considered only, at most, as a primitive “scincomorphan.” (In previous taxonomies, Scincomorpha would be considered as a clade, but paraphyly of this group is indicated by all genetic-based phylogenetic analyses [e.g. Townsend et al. 2004; Vidal & Hedges 2009; Pyron et al., 2013]. For this reason, here we used just the term scincomorphans.) Later, Müller (2001) redescribed its osteology based on a complete skeletal material from Messel. According to his analysis, *Eolacerta* is not associated with lacertids, but nested within the clade including *Xantusia*, *Chalcides*, *Cordylus*, *Gerrhosaurus*, *Tarentola*, and *Varanus*, i.e. Autarchoglossa sensu Estes et al (1988) and Gauthier et al. (2012). The conclusion of Müller (2001) was that this taxon is so primitive that it could not be assigned to any modern lizard “families” and should at best be classified as Scleroglossa incertae sedis. One year later, Müller (2002) also described disarticulated material from the Eocene of the locality Prémontré (France) as *Eolacerta* sp. More recently, Conrad (2008) suggested that *E. robusta* is the most basal known relative of the clade Anguimorpha. In Müller et al. (2011), *Eolacerta* forms a sister taxon with Mesozoic *Meyasaurus*. The new taxon from the Messel locality, closely related to *Eolacerta*, sheds new light on this problematic taxon and demonstrates the paleodiversity of this archaic lizard clade in middle Eocene of Europe. Our analysis supports the view that this taxon plus our new one cannot be attributed to any modern lizard “families”.

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Soft parts in trilobites from the Barrandian area (Czech Republic)

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Trilobites represent one of the best documented Palaeozoic groups with about 4000 genera (Jell & Adrain 2003) and more than 20 000 species (Adrain 2008). However, preservation of their digestive structures is extremely rare and our knowledge of internal anatomy is very limited; Lerosey-Aubril et al. (2011) reported that remains of the digestive system of trilobites had been described in less than 25 species and in most cases, from a single specimen only.

Trilobite exoskeletons are abundant in the Barrandian area with more than nine hundred Cambrian to Devonian species. Remains of internal organs are, however, also very rare and specimens with rests of digestive system were established at nine levels of Cambrian Ordovician sequences.

Cambrian. Skryje-Týřovice Basin, Unnamed Cambrian series 3 (Buchava Formation). Two exoskeletons of adult specimens of *Ptychoparia dubinka* were described by Jaekel (1901). Four specimens of the genus *Ctenocephalus* were recently described (Fatka et al. in press b). Recently, several specimens of genera *Conocoryphe* and *Ptychoparioides* were discovered (unpublished observation).

Příbram-Jince Basin, Unnamed Cambrian series 3 (Jince Formation). Two specimens of *Ptychoparia striata* with rest of gut were recently collected.

Ordovician. Prague Basin, Lower Ordovician (Mílina Formation). Fatka et al. (2013a) studied digestive structures preserved in the holotype of harpidid species *Harpides grimmi* of Tremadocian age.

Middle Ordovician (Šárka Formation). Two specimens of *Colpocoryphe bohémica* and two specimens of *Trinucleoides reussii* showing rests of digestive structures are known (Fatka et al. submitted, unpublished observation).

Upper Ordovician (Letná Formation). Earlier known specimens of *Deanaspis goldfussi* and *Dalmanitina socialis* (see Beyrich 1846, Šnajdr 1990, 1991) have been recently supplemented odontopleurid *Selenopeltis buchi* and asaphid *Birmanites ingens* (see Fatka et al. 2013b). One exceptionally preserved specimen of *Flexicalymene (Flexicalymene) pragensis* was collected from the Bohdalec Formation (Fatka et al. submitted).

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Microfacies analysis of the „Urgonian“ complex in the Butkov Quarry, the Manín Unit (Western Carpathians)

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The Manín Unit is originally Central Carpathian unit which has become a part of accretionary prism in the front of Central Carpathian block. It was incorporated into the region of the Pieniny Klippen Belt. It was deformed during younger phases of the Alpine Orogeny together with the Outer Carpathians.

In the Butkov Quarry a sequence of the Lower Jurassic and Lower Cretaceous beds of Manín Unit was exposed. "Urgonian complex" consists of the thick bedded Podhorie Fm. and of the massive Manín Fm. The Podhorie Fm consists of Barremian to Lower Aptian organodetrritic as well as micritic limestones with cherts, rarely with fragments of basic extrusives. In limestones of the Podhorie Fm orbitolinid foraminifers are common (*Orbitolina* (*Mesorbitolina*) *parva* Douglas). They associate with other benthic foraminifers that lived in fore-reef and back-reef lagoons of carbonate platforms. They are represented e.g. by *Bolivinopsis labeosa* Arnaud-Vanneau and *Sabaudia minuta* (Hofker). Texture of limestones is biomicritic (biogenic packstone). The formation reaches thickness of 65 – 75 m. Upwards it gradually passes into carbonate platform limestones of the Manín Fm. It is developed in complex of mainly gray to light gray massive organogenic limestones with numerous Aptian to Albian fossils: benthic foraminifers (*Palorbitolina lenticularis* (Blumenbach), *Globigerinelloides ferreolensis* (Moullade), fragments of crinoids, echinoids, molluscs, ostracods, corals and calcareous algae. Limestones are characterized by intrabiosparitic texture (intraclast - biogenic grainstone) Total thickness of the formation attains around 50 meters. The Manin Fm is terminated by hardground surface, which is followed by deep-sea clay sediments of the Albian - Cenomanian Butkov Fm (Borza et al., 1987). This "Urgonian" carbonate complex of biotrititic and biogenic limestones of shallow-sea carbonate platform

gradually covered the basin deposits of the region. In the Butkov area, the major part of these carbonates is developed as the carbonate platform facies and its slope (Michalík et al., 2005).

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⁸⁷Sr/⁸⁶Sr in the Western Carpathian Neogene fossil mollusc shells –age and paleoenvironmental indicator

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Neogene mollusc shells contain trace concentrations of strontium, composed from four natural isotopes ⁸⁴Sr, ⁸⁶Sr, ⁸⁷Sr, ⁸⁸Sr. The ⁸⁷Sr/⁸⁶Sr isotopic ratio in seawater continually varied over time (Burke et al., 1982). Because the open ocean water on the Earth at the same time have same ⁸⁷Sr/⁸⁶Sr isotope ratio, it was possible to define its variability over time. The ⁸⁷Sr/⁸⁶Sr in Neogene marine environment is systematically growing, so the value of ⁸⁷Sr/⁸⁶Sr in marine fossils allows us to convert the value to numerical age, or vice versa (Look-Up Table, Howarth & McArthur, 1997). Strontium Isotope Stratigraphy (SIS) has become a suitable additional tool and support for classical biostratigraphic methods (Veizer, 1989). Defined variability of the ⁸⁷Sr/⁸⁶Sr isotopic composition in seawater during the Phanerozoic also allows significant isotope-geochemical applications. Because the ⁸⁷Sr/⁸⁶Sr ratio in seawater at a given time on a global scale is identical it provides reference data to compare different aquatic environments and/or identify seawater and freshwater mixing process.

The ⁸⁷Sr/⁸⁶Sr ratio were analyzed in mollusc fossil shells from marine and freshwater environment (freshwater limestones) come from Neogene sediments (outcrops, boreholes) of the Vienna and Danube Basin, and Turčianska, Lučenecká kotlina Depressions. From the stratigraphic point of view the samples cover range from the Egerian to the Pontian. According to the results obtained, marine mollusc generally showed compatibility of the central Paratethys ⁸⁷Sr/⁸⁶Sr seawater ratio with the world ocean waters at that time. But in part of samples, incompatibility of stratigraphic and SIS ages indicate the problems with the preservation of original isotope signal, caused probably by secondary changes (diagenetic processes and recrystallization). The SIS ages from shells of the Egerian sediments (Kováčov, drilling DV-1 and MV-1) vary from 22.15 to 23.11 Ma, and from the Egenburgian (Sverepec, Lipovany, Rapovce) the SIS age between 18.56 to 20.35 Ma was obtained. In the Badenian samples, the measured ⁸⁷Sr/⁸⁶Sr corresponds to following SIS ages:

- the Lower Badenian (Trenč) – 15,94 Ma
- the Upper Badenian (Sandberg) from 12,76 to 13,12 Ma

The youngest sample whose isotopic composition is still compatible with contemporary seawater comes from the Lower Sarmatian Danube Basin sediments (Malý Pesek) –12.42 Ma.

From Turčianska kotlina Depression, which represents a closed the Late Neogene freshwater lake evolving from Sarmatian to the Pontian (Kováč et al., 2011), mollusc and limestones have been studied from almost the entire stratigraphic sequence. Obtained data represent a unique record of the isotopic composition $^{87}\text{Sr}/^{86}\text{Sr}$ changes in fresh water, which had a significantly lower $^{87}\text{Sr}/^{86}\text{Sr}$ as contemporary seawater. We confirmed also the differences in $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic composition in the southern and northern part of the basin found by Pipík et al. (2012), due to different isotopic composition of water draining around the northern and southern area of the lake, probably with a circulating barrier which prevented in isotopic homogenization of the whole lake water volume.

From the Danube Basin, which was formed in the northern gulf of the Pannonian Lake, samples from the bottom (zone B), middle (Zone E) and upper (zone H) of the Pannonian were studied. It was found that $^{87}\text{Sr}/^{86}\text{Sr}$ of the sample from zone B is compatible with samples of Turčianska kotlina Depression. The remarkable data provide samples from zone E Pannonian (Pezinok, Borský Jur) whose $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic composition converted to a numeric SIS scale give ages, compatible with their stratigraphic classification (9.35 to 10.31 Ma). Samples from zone H Pannonian (freshwater limestone) are characterized by a large scatter of $^{87}\text{Sr}/^{86}\text{Sr}$, which was most likely caused by local inhomogeneities in isotopic composition of waters flowing into the small isolated ponds in which freshwater limestone originated.

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Carboniferous ferns, revision of the genus *Boweria*

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The ferns represented an important component of the tropical Carboniferous forests. They were very widespread and abundant plants. The genus *Boweria* belongs to the leptosporangiate ferns. Leptosporangiate ferns are the largest group of living ferns and were important also during Carboniferous time. Leptosporangiate ferns have a specialized mechanism, the annulus for opening the sporangium, in which the spores are made. Sporangia arise from a single epidermal cell and not from a group of cells as in eusporangiate ferns. The leptosporangiate ferns are characteristic by reproductive organs which are represented by

sporangium organized into synangium (Jennings & Millay, 1977), sorus (Galtier, 2004) or solitary (Pšenička et al., 2005). Leptosporangiate ferns with sphenopterid type of leaves were studied including their sporangia and *in situ* spores (*Granulatisporites* and *Leiotriletes*-type) and morphological details. Principal genus of the research is *Boweria* which comprises of *Boweria schatzlarensis* with lateral annulus and *Boweria minor* with band-lateral annulus and *Boweria neurodensis* sp. nov. The specimens were studied on the basis of Kidston's type collection which is stored in the British Geological Survey in Keyworth and Stur's type collection which is stored in the Geologische Bundesanstalt in Vienna and part stored in Museum für Naturkunde in Berlin. The research is supported by the grant of the Grant Agency of the Czech Republic, project No. P 210/12/2053 and by the Institute of Geology of the ASCR, v.v.i., project No. 9348.

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Position of *Reticulofenestra lockeri* Müller in biostratigraphic scheme of the Polish Flysch Carpathians

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The first rare specimens of *Reticulofenestra lockeri* (and *R.ornata*) were described from the upper part of the Globigerina Marls of the Skole Unit assigned, based on the occurrence of *Isthmolithus recurvus*, *Lanternithus minutus*, *Reticulofenestra umbilica* and the lack of *Ericsonia formosa* to the NP22 calcareous nannoplankton zone (Garecka, 2012). Dudziak (in: Smoleńska & Dudziak, 1989) mentioned this species (as *R.cf.lockeri*) in the assemblage of the NP22 zone stated in the sub-Cergowa Marls of the Dukla Unit. At the turn of NP22/NP23 zones the increase in the number of *R.lockeri* individuals was observed. The Lower Menilite beds of the Skole Unit based on the mass occurrence of *R.ornata*, *R.lockeri* and *Transversopontis fibula* were included into NP23 Zone. The same assemblage indicating NP23 zone was described by Oszczytko-Clowes (2001) from the Smereczek Shale Member of the Krynica Zone of the Magura Nappe. Also, in the outermost Siary Zone of the Magura Nappe already in the bottom part of the Budzów Beds related to the Early Oligocene *R.lockeri* was presented. In the calcareous assemblage of the NP24 Zone *R.lockeri* occurred as one of the most resistant species with other *Reticulofenestra*, *Dictyococcites* and *Coccolithus* specimens. It was more frequently in the Lower Menilite beds of the Skole Unit than in the Lower Krosno Beds of the Silesian Unit. The last occurrence of this species took place probably within or in the upper part of NP25 zone. In analyzed samples *R.lockeri* occurred only as single specimens (the Łopian Beds of the Skole Unit and the Lower Krosno Beds of the Silesian Unit) or did not occur (the Menilite Beds of the Skole Unit). The investigations confirmed information e.g. Krhovský (1981) and Nagymarosy & Voronina (1992) that

R.lockeri appeared in the lower part of Early Oligocene (NP22) or even marked the Eocene/Oligocene boundary (NP21).

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Calcareous nannofossils from the Menilite Beds (Oligocene-Miocene) of the Skole Unit (Polish Flysch Carpathians)

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The changes that occurred in the Oligocene and Lower Miocene in the Skole Unit are reflected in calcareous nannofossils assemblages. Their distribution, growth, species diversity and abundance are closely related to the condition that prevailed in the basin, controlled by its location on the periphery of the Paratethys. From the Early Oligocene, the character of the calcareous assemblages changed. In the Skole Unit (and in whole Carpathian arc) dark, bituminous shales of the Menilite Beds with abundant fish fauna appeared. Sedimentation of these deposits is associated with the period of isolation of the Paratethys from the Tethys at the end of the NP22 and in NP23 zones. The calcareous assemblage is composed of temperate- and temperate to cold-water species, which are successively replaced by the endemic species of the NP23 zone which showed extreme environmental conditions (Garecka, 2012 and references therein). In dark varieties of the Menilite Beds the occurrence of *R.ornata*, *T. fibula* and *R.lockeri* confirmed suggestion of shallow water depths, decreased salinity and high nutrient supply. The shallow, nearly near-shore environment is indicated also by the presence of *Pontosphaera* species which occur almost in mass in the dark-type shales of the Lower Menilite Beds. An almost monospecific assemblages in the Lower Menilite Beds is formed by *Dictyococcites bisectus* and *D.bisectus/D.scrippsae*. The large number of these species is characteristic of near-shore facies and with increase of nutrient form blooms. At the turn of NP23/NP24 and in the NP24 zones the palaeogeographical situation changed and normal marine conditions returned in the Paratethys. At that time two horizons of the coccolith limestones originated. In contrast to Tylawa horizon (NP23), which is composed of endemic species (*R.ornata*), the Jasło and Zagórz limestones record the bloom of cosmopolitan *Cyclicargolithus* species. In the Late Oligocene assemblages an increase in number of the *Helicosphaera* and *Pontosphaera* species is observed. It confirms a warm climate (the global Late Oligocene Warming), shallow depths, stable marine conditions and

slight salinity fluctuations. The latest Oligocene and the Early Miocene is the period of subsequent changes in the Carpathian calcareous nannoplankton assemblages. Apart from a few exceptions from the Skole Unit there is no biostratigraphical record of the Late Oligocene – early Miocene interval. In the bottom part of the Upper Menilite Beds the common species of *Helicosphaera* sp., *H. euphratis* and *Pontosphaera* were noticed. In the upper part of these beds the lower Miocene *Helicosphaera* species: *H. scissura*, *H. mediterranea*, *H. kamptneri*, *H. truemmpyi* and common small reticulofenestrids were stated.

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The Early Badenian transgression – Hluchov case study (Carpathian Foredeep, Czech Republic)

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At Hluchov (Carpathian Foredeep - CF, Czech Republic), sediments documenting Early Badenian marine transgression occur in two boreholes (HI-1, HI-2). In the basal parts of their profiles, there are coastal marine deposits reflecting transgression on the weathered pre-Neogene basement, followed by gradual deepening connected with a landward shift of facies. Upwards, carbonates occur indicating shallow marine conditions, continuous sea level rise, and the reduction of siliciclastic input. The heavy minerals confirm that local rocks played an important role at the beginning of transgression, partly together with the reworking of older (? fluvial) deposits. Upwards, sources from a broader area appeared, along with tephra input comparable with the Early Badenian tephra known from the CF, and interpreted as distal air-fall tephra connected with rhyolitic to rhyodacitic volcanism (Nehyba, 1997). Sediments with tephra can be correlated with similar ones at the nearby locality of Přemyslovice (Zágoršek et al., 2012). At Hluchov, the sediments are rich in fossils (foraminifers, bryozoans, brachiopods, molluscs, echinoderms, among others). Brachiopods, molluscs, bryozoans, and echinoderms indicate normal marine conditions and higher water dynamics reducing upwards. Foraminifers indicate some salinity fluctuations in the basal parts and normal salinity rising upwards. Molluscs confirm a mixing of elements from rocky medio/sublittoral and somewhat deeper infralittoral in the lower parts of the profiles, and deeper infralittoral in the upper parts. The $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values of the molluscan shells are mostly shifted in a negative direction by several ‰, indicating that diagenesis may have played an important role. The *Crassadoma* shells are generally more ^{13}C - and ^{18}O -enriched relative to the *Flexopecten*, *Aequipecten* and

Chlamys shells. Elevated Th/K ratios found in layers with very negative $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values (i. e., strongly affected by diagenetic alteration) suggest that the permeability was determined by the relative amount of clay minerals compared to siliciclastic detritus. The lower amount of clays would mean increased permeability and stronger effects of diagenetic fluids.

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Response of calcareous nannoplankton and foraminiferal assemblages from epeiric sea on Miocene climatic transitions (Mi-1 and Mi-3 events) in the Central Paratethys

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In the Miocene of the Central Paratethys two cooling events were studied: (1) Short-time event in the Oligocene/Miocene boundary which coincide with global Mi-1 event. The cooling was accompanied by increase of seasonality; (2) The Middle Miocene event was connected with environmental and climatic changes called the Middle Miocene Climate Transition. In terrestrial climate, the MMCO/MMCT transition is characterized by increased seasonality principally expressed in the seasonality of precipitation.

Agglutinated foraminifera are common during both climatic optimums, though different morphogroups were recorded in the Early and Middle Miocene. During both climatic transitions, stress-tolerant small *Reticulofenestra minuta* appeared as a consequence of increased seasonality.

Changes in foraminiferal and calcareous nannoplankton assemblages reflect the difference in amount of precipitation during the two periods being compared:

Increase of relative abundances of genera *Ammonia* and *Cassidulina* during the Early Miocene cooling event indicates increase in humidity what increase riverine input related to salinity decrease and high phytodetritus input.

In contrary during the Middle Miocene cooling event, eutrophic markers disappeared in phytoplankton as well as among planktonic and benthic foraminifera. In inner shelf, coarser clastics were replaced by small limestone bodies in which epiphytic foraminifera dominated. It may indicate decrease of riverine input including clastic material as well as nutrients due to aridification events.

Decapod crustaceans as ecosystem engineers: fossorial shrimps and interpretation of their fossil record

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Several higher taxa of decapod crustaceans (Astacidea, Gebiidea, Axiidea Brachyura) independently evolved the construction of permanent burrows that in many cases serve as new microhabitats for other life forms. Some of them, especially fossorial shrimps of the families Upogebiidae and Callianassidae belong to major bioturbators of intertidal and subtidal habitats and occur in huge quantities. Through digging complex burrow systems they influence the geochemistry of the substrate (Ziebis et al. 1996) and several taxa interact closely with seagrasses (Berkenbusch et al. 2007). Thus, the fossorial shrimps in many aspects regulate community composition and ecological processes and are considered ecosystem engineers.

Investigating the evolution of this particular type of ecosystem engineering is rather difficult; there are two major reasons for that:

- 1) The fossorial shrimps are lightly calcified, thus their body fossil record is strongly biased. Understanding of evolution of these animals is poor because the most commonly found fossil remains – isolated claws – are usually not considered taxonomically important. Search for proxies on these elements (as a counterpart to soft-part morphology used for taxonomy of extant members) is crucial in providing insight into the evolution of fossorial shrimps.
- 2) Identifying the fossorial shrimps as producers of fossil burrow systems represented by respective ichnogenera (e.g. *Gyrolithes*, *Ophiomorpha*, *Thalassinoides*) can be done indirectly through study of their extant analogues or with direct evidence of *in situ* preservation. Both approaches have their pitfalls. The ichnofossils usually do not contain any body fossils (*in situ* preservation is considered rare; Bishop & Williams 2005; Hyžný 2011); moreover, because of the high bioturbation of the surrounding sediment the body fossils (if present) are often fragmentary and they easily escape the attention during the survey in the field.

Currently, the taxonomic revision of the fossil record of fossorial shrimps (e.g. Hyžný 2012; Hyžný & Müller 2012; Hyžný & Gašparič 2014) is aimed to provide solid basis for its interpretation both in terms of calibration points of divergence events and in identifying primitive character states which can be used in future phylogenetic analyses. Similarly, the investigation of the taphonomical aspects of *in situ* preservation of fossorial shrimp remains within the burrow structures as well as sheer collecting of these relatively rare occurrences (Neto de Carvalho 2007; Hyžný 2011) can help in better understanding of relationship between trace fossils and their supposed producers, i.e. shrimps.

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Morphological disparity in the endoneurocranial patterns of basal and derived tyrannosauroids: quantitative geometric analysis

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The central nervous system controls critical cognitive and sensory-motor mechanisms of behavioral interactions in vertebrates. The brain is entirely composed of soft tissue and as such it rarely fossilized. Its proportions have usually been inferred from the endocast in some extinct vertebrates such as dinosaurs (e.g. Hopson 1979; Kundrát 2007; Witmer and Ridgely 2009). Here we present the multistep procedure used to restore a partly distorted endoneurocranium of a small size feathered basal tyrannosauroid *Dilong paradoxus* (Xu *et al.* 2004). Most of the braincase of *Dilong* (IVPP 14243) is still encased in the matrix. Therefore we used the computed micro-tomography scanning to collect primary virtual data which were further processed by the multistep 3D imaging procedure including: 1) segmentation – delineation of inner surfaces of the endoneurocranial cavity using segmentation tools of the VGStudio MAX; 2) recombination – dismemberment of the endocast into anatomically definable sectors and restoration of their original topographic relationship using Surface Editor and Transform Editor of the Amira; and 3) geometric surface interpolation – completion of missing surfaces between the sectors by Poison Surface Reconstruction filter of the MeshLab. Having the final model correlated with general endoneurocranial topography of other coelurosaurians, we have adjusted the pre-cerebellar sectors of the *Dilong* endocast accordingly (Fig. 1).

We compared the endocast of *Dilong* with that of *Tyrannosaurus rex* nicknamed as ‘Sue’ (FMNH PR 2081; see Brochu 2000). Using the original scan, we decided to prepare a new endocast model of this particular specimen of *Tyrannosaurus* in order to correct mistaken proportions and volumes presented in the original paper (Brochu 2000). We have found that the endoneurocranial morphology of *Dilong* differs significantly from that of

Tyrannosaurus. It appears that the endocast of gigantic tyrannosauroids had secondarily simplified by getting more linerized. We suggest that the linear pattern of the *Tyrannosaurus* endocast is an adaptation and does not reflect the original conditions of the tyrannosauroid clade which are more similar to those revealed by the endocast of *Dilong*. Our quantitative analysis also shows different proportions of the endocast (and likely brain) compartments between the primitive and derived tyrannosauroids. We conclude that encephalic configuration of the basal tyrannosauroid *Dilong* is more similar to that of maniraptoran theropods rather than to those seen in the terminal tyrannosauroids (Witmer and Ridgely 2009).

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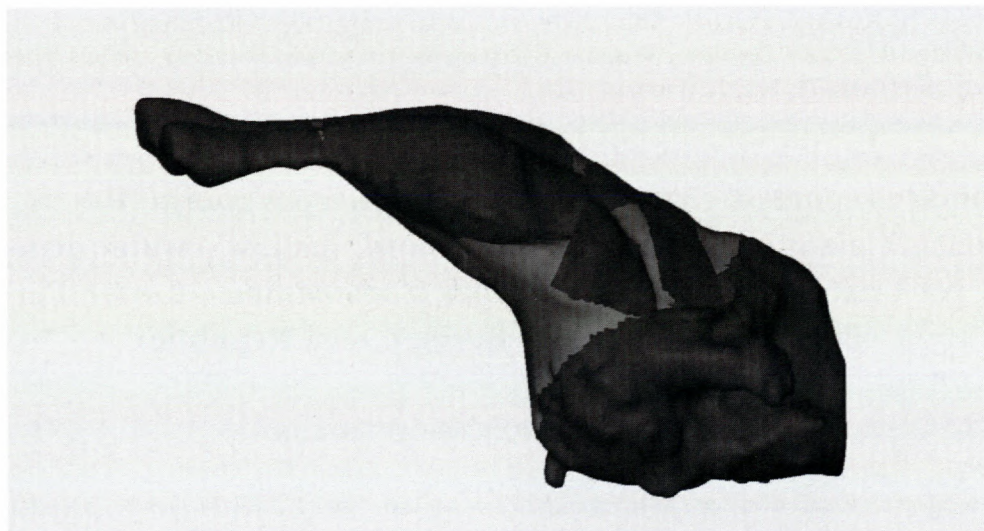


Fig. 1 The endoneurocranial um of *Dilong paradoxus* after applying our 3D retrodeformation imaging approach.

Preliminary report on the tube dwelling polychaetes from the Upper Badenian locality Devín-Meríce (Lingula Bed) of the Central Paratethys (Middle Miocene – Slovakia)

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The preliminary report mentioned 7 taxa [*Protula canavarii* ROVERETO, *Serpula* (*Cementula*) *subanfracta* ROVERETO, *Vermiliopsis quinquesignata* (REUSS) ?, *Spriobranthus triqueter* (LINNAEUS), *Ditrupa arietina* (MÜLLER); *Spirorbis* (*Laeospira*) CAULLERY & MESNIL and genus *Pileolaria* CLAPARÉDE belonging to subfamilies Serpulinae, Ditrupinae and Spirorbinae which were collected from Late Badenian (Middle Miocene) fine – grained sands and sandstones at Lingula Bed. This account represents the first description of Serpulidae from the Central Paratethys of Devínska Kobyla area at Slovakia. The studied material was amassed during 2007 - 2014 by authors and was compared with Reuss's original types of serpulids which are housed in NHM - Vienna as well as with Schmidt (1955) and Jäger, M. – Schneider, S. (2009) specimens. More than 200 kg sandstones was dried, treated with sodium carbonate and wet – sieved into fractions. The most of specimens are relatively large serpulids which are attached on the both sides of valves - *Ostrea digitalina* and, excepting *Protula canavarii* and *Ditrupa arietina*, the most of them are preserved as epibionts. In *D. arietina* were observed two outlines of drillhole – circular and elliptical belong to *Oichnus paraboloides*. The minority of samples are epibionts in spatangoids and bryozoans. All specimens were studied under binocular microscope and the less spirorbids (genus *Spirorbis* or *Pileolaria*) and drillholes were photographed using scanning electron microscope (SEM) at the National Museum in Prague.

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Preliminary report on cirripede species *Scillaelepas conica* (REUSS, 1844) (Thoracica, Calanticidae) from the nearshore, shallow – water deposits at Kaňk – Na Vrších in Kutná Hora (Upper Cenomanian – Lower Turonian, Bohemian Cretaceous Basin, Czech Republic)

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During 2014, the authors conducted several field work sessions at Kaňk – Na Vrších during which 200 kg of rubble were amassed from an outcrop exposing the Upper Cenomanian and Lower Turonian strata. These sessions have confirmed the occurrence of cirripede specimens only in the Upper Cenomanian sediments whereas the Upper Turonian part did not contain any cirripede material. All specimens are preserved as disarticulated, isolated capitular plates, which is typical of almost all Mesozoic cirripedes. The residue was washed and screened through a 1 mm-sieve with a result of 336 new cirripede capitular plates (scuta, carinae, rostra ? subcarinae, ? subrostra, rostral latera, upper latera and carinal latera). The cirripede material from Kaňk – Na Vrších was extensively recorded by Withers (1935), who studied and described 84 capitular plates which were purchased from Dr A. Frič to the Natural History Museum (NHM) in London. Withers's research has resulted in the description of a new

species of *Calantica* (*Scillaelepas*) *conica* (REUSS, 1844). Our newly recovered material was compared with aforementioned specimens deposited in the NHM in London as well as with the holotype which is deposited in the NHM in Vienna. The poorly preserved holotype (carina), which comes from Kyselka near Bílina, was described by Reuss in 1844 as *Pollicipes conica*. Our analyses have confirmed that all yielded cirripede plates from the Upper Cenomanian strata at Kaňk – Na Vrších belong to calanticid species *Scillaelepas conica* (REUSS, 1844).

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Paleogene woods from the Doupovské hory and České středohoří Mts. (Bohemian Massif, Czech Republic): overview and new results

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The Paleogene volcanoclastic sediments of Doupovské hory and České středohoří Mts. are known for their quite abundant fossil woods (e.g., Prakash et al. 1971, Sakala et al. 2010). In a recently defended Master Thesis, Koutecký (2014) dealt with the systematical description of 37 new specimens from the localities Vrbice, Nechranice, Bečov and Divoká rokle. There were identified two types of conifers (Cupressaceae s.l.) and six types of angiosperms (Lauraceae, Betulaceae, Ulmaceae, Malvaceae s.l.). Both conifers (*Glyptostroboxylon rudolphii* and *Taxodioxydon gypsaceum*) are already known in the area (Teodoridis and Sakala 2008), but five angiosperms (*Cinnamomoxylon seemanianum*, *Alnus tsemrylica*, *Ulmoxylon* cf. *kersonianum*, *Grewioxylon ortenburgerse*, *Manilkaroxylon* sp.) are described for the first time there; sixth type of angiosperm wood was labelled only as “Xylotype: Nechranice 1” due to its bad preservation. This research was supported by the grants GA14-23108S and PRVOUK P44.

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Pannonian ostracods from the southwestern part of the Transylvanian basin (Roumania)

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Study of ostracods of the Neogene Paratethys has substantially contributed to the stratigraphic, ecological, and paleogeographic understanding of this huge and complex marine to lacustrine depositional system (Danielopol, 2008). Of the large brackish lakes that repeatedly formed during the history of the Paratethys, the Late Miocene-Early Pliocene Lake Pannon was probably the longest-lived (Magyar et al., 1999). As a consequence, this lake incubated a perplexingly diverse lacustrine biota (Magyar, 1999). The objective is to present the Late Miocene (Pannonian) ostracod fauna from 7 outcrops (Lopadea Veche, Gârbovița, Gârbova de Jos, Mihălț, Oarba de Mureș, Tău, Cunța) of the southwestern Transylvanian Basin (TB), including their biostratigraphic interpretation, to contribute to the existing sedimentology-based reconstructions of the paleoenvironment in each outcrop, and to explore the paleobiogeographic context of these faunas.

Late Miocene deposits have been investigated from few outcrops in TB to reconstruct the biostratigraphical, paleogeographical and paleoecological state of ostracod assemblages. The Pannonian sandstone, conglomerate-rich slope channels and various shallow water, marginal sandstone are exposed at several outcrops. The Lake Pannon endemic species dominate in ostracod associations composed of 20 ostracod taxa. The investigated ostracod and mollusk assemblages settled brackish sublittoral and sublittoral/profundal limnic environments.

The assemblages that characterize the ancient Lake Pannon in the TB are variable and depend on the local mainly taphonomic factors, evolved from littoral habitats to deep water-sublittoral environment. Lopadea Veche and Gârbovița's ostracod assemblages show sublittoral environment with transport from marginal to basinal facies. Oarba de Jos was settled in deep sublittoral environment, below the margin slope. Mihălț and Tău present sublittoral to deep water environment, below the storm wave base. Oarba de Mureș represents the sublittoral/profundal, brackish environment of the Lake Pannon in TB. The ostracod association in Cunța proved sublittoral environment with freshwater influence.

Krstić (1985) and Sokač (1972) biostratigraphical zonations and previous stratigraphical studies (Wanek, 1992; Filipescu et al., 1994), are applied on ostracod associations to evaluate their biostratigraphic potential for TB. Three ostracod biozones: *Hemicytheria hungarica*, *Hemicytheria tenuistriata* and *Propontoniella candeo* - are present in the southwestern part of the TB, and the Pannonian lower part the Slavonian substage is proved. This assumption is supported by the Cunța mollusk fauna dated to about 10-10.5 and the other fauna associations dated to about 10.5-11 Ma.

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Trace Fossils associations and Ichnofacies from the Viséan depositional sequences of Drahany Culm basin and their importance for lithofacial models of the Myslejovice Formation (Lower Carboniferous, Moravosilesian Unit of the Bohemian Massif)

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The objective of this study is paleoichnological investigation of sites with rich associations of trace-fossils in the Southeastern part of Myslejovice Formation in the Drahany Upland basin. Drahany Culm basin is built mostly by products of deep marine fills: polymictic conglomerates, fine-grained greywackes, siltstones and claystones, which are the main components of Protivanov, Rozstání and Myslejovice Formation. According to lithostratigraphical scheme published by Dvořák (1966), the Myslejovice Formation is divided into Studnice Shale, Brodek Greywacke, clast-supported conglomerate facies of Luleč and Račice Members. Depositional sequences of Drahany Culm basin in Western-Culm basin and Eastern-Culm basin controlled as a multiphase tectonic events of convergence between lugodanubian and brunovistulian terrans (Kumpera and Martinec, 1995). The Myslejovice Formation and the localities around Vyškov na Moravě, belong to the late Viséan age (Goa to Goy Zone) (Kumpera, 1975). Thanks to long-term collecting in some particularly rich sites, the obtained extensive material allows to objectively assess the overall character of ichnocoenoses and the variability of individual forms of ichnofossils. Trace fossils occurring in clayey sandy rhythmites can be found near villages: Opatovice, Pístovice, Ježkovice, Rychtářov, Radslavice, Hamiltony, Lhota, Nemojany, Olšany and Račice. The material from these localities was compiled by Lang, Pek and Zapletal (1979). Basis of this study is the collection of V. Lang, nowadays stored in Regional museum of Olomouc. So far was determined 669 specimens which are represented by following ichnospecies: *Cosmorhapse* isp., *Diplocraterion parallelum* TORELL, *Dictyodora liebeana* GEINITZ, *Gordia* isp., *Granularia drahana* LANG-PEK-ZAPLETAL, *Chondrites goepperti* GEINITZ, *Chondrites* isp., *Phycosiphon incertum* FISCHER-OOSTER, *Nereites missouriensis* WELLER, *Planolites beverleyensis* BILLINGS and *Rhizocorallium* isp. The known specimens of trace fossils from these sites were found mostly in laminated sandstones. Analysis of ichnofossils associations in this part of Myslejovice Formation is complicated due to the presence of unique ichnotaxa which do not correspond exactly with the classical ichnofacial models. *Nereites* ichnofaces indicate the presence of e.g. *Diplocraterion parallelum*, *Cosmorhapse* isp., *Dictyodora liebeana* and *Chondrites* isp. In other areas, however, were found ichnotaxa that refers rather to calm sedimentation conditions such as *Diplocraterion* isp., *Rhizocorallium* isp., *Planolites* isp. and *Cosmorhapse* isp. Distribution of ichnofossils does not express a bathymetric

condition of the sedimentary environment, but it is related to the distribution of clasts in basins through turbidite and traction flows. The study of fossil traces is one of the possible aspects of solving the influences of continental conditions to processes in marine Lower Carboniferous basin. These associations can be generally compared with the associations in the Moravice Formation (Go α_{2-3} to Go β_{mu} Subzone) and Hradec-Kyjovice Formation (Go β_{spi} Subzone to E1 Zone) of the Nízký Jeseník Mts..

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Diversity and development of the genus *Calpionella* in the upper Tithonian and lower Berriasian – a case study of exotic limestones of the Polish Outer Carpathians

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Calpionellids are typical late Tithonian and earlier Cretaceous microfossils with a significant biostratigraphic importance. In the Polish Outer Carpathians deposits of this age occur *in situ* only in the Silesian Series (the Cieszyn Beds), but they are also found as boulders and pebbles of exotic limestones which occur among the younger deposits and constitute remnants of carbonate platforms developed along the margins of the proto-Silesian Basin. Calpionellids of the Cieszyn Beds were studied in detail by Nowak (e.g., Nowak 1971), when presented studies concern exotic limestones of the central and western part of the Silesian and Subsilesian Units.

The genus *Calpionella* constitutes one of the most important for the biostratigraphy calpionellid genus. It reveals a large diversity of the largeness and proportions of lorica, which can be observed within time as well as in co-occurring assemblages, when other diagnostic factors (collar, aboral part) remain constant. Because of this I presume that the genus *Calpionella* should be treated as a broad spectrum of forms, with *Calpionella alpina* Lorenz and *Calpionella elliptica* Cadish as the final links, and creation of some transitional forms is not valid. Biometrical analysis of 340 specimens of the genus *Calpionella* of the studied thin sections concerned the largeness of specimens and the ellipticity of their loricas. In the late Tithonian Crassicollaria Zone considerable diversity of the largeness and the ellipticity of *Calpionella alpina* specimens occurs, but presence of the typical of this zone, large and more elliptical specimens ("*Calpionella grandalpina*" Nagy), is well noticeable. On the boundary of the Crassicollaria and Calpionella Zones distribution graph of the largeness and the ellipticity is similar like for the Crassicollaria Zone, but specimens are smaller than in older samples. In the earliest Berriasian Alpina Subzone of the Calpionella Zone distribution of the largeness and the ellipticity is very characteristic – small and medium-sized, globular

specimens prevail. In the upper zones of the lower Berriasian – upper subzones of the Calpionella Zone and the Calpionellopsis Zone – shape of specimens changes considerably: slightly smaller and more elliptical specimens of *Calpionella alpina* are common, but the population of the large and elliptical specimens (*Calpionella elliptica*) appears.

Trends similar to described above can be observed on the whole area of the Tethys (e.g., Nowak 1971; Borza 1984; Remane 1986).

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Significance of *Lithotis*-facies bivalves in Moroccan High Atlas in the Early Jurassic palaeobiogeography

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From the palaeobiogeographical point of view the world-wide distribution of Pliensbachian-Early Toarcian large bivalves of the so-called *Lithiotis*-facies (*sensu* Fraser *et al.*, 2004), dominated by *Lithiotis*, *Cochlearites*, *Litioperna* and *Mytiloperna* genus, indicates very rapid expansion of such type of bivalves (their huge shells are even up to 40-50 cm long) which are most significant representatives of buildup-maker mounds (buildups/reefs) in numerous places of Tethyan-Panthalassa margins during this time. These bivalves from Western (Spain, Italy) and Middle Europe (Slovenia, Croatia, Albania and Romania) through north Africa (Morocco) and westernmost Asia/Arabia (eastern Turkey, Iran, Iraq, Kuwait, Oman, Arabian Emirates) up to central Asia – Timor Island, Himalaya Mts (Nepal, China) and western margin of both Americas (USA, Peru) indicates their world-wide distribution connected with very rapid occupation of specific ecological niches, mainly shallow-marine/lagoon-type carbonate sedimentation, and palaeogeographic/geodynamic regimes during break-up of Pangea in this period (Krobicki & Golonka, 2009 with literature cited therein). In numerous cases the Pliensbachian-Early Toarcian sections represent carbonate and carbonate-clastic shallow-water environments, and these bivalves occurred abundantly, very often in life position, and constructed “reef/biostrome” buildups. One of the best place where such buildup occur is in the Moroccan High Atlas Mountains (Assemsouk section in Jebel Azourki range). The Pliensbachian-Early Toarcian(?) shallowing-upward sequence (regression) is recorded by continuous transition from shallow, full-marine limestones with corals, then lagoon-type limestones with numerous *Lithiotis*-type bivalves, up to nearshore clastic-carbonate deposits with abundant remains of plants which most probably represent lagoonal-paralic environments. This northernmost African example could be a key to determination of the

Early Jurassic migration routes of such bivalves and connected both with break-up of Pangea and oceanic circulation, which facilitated high speed of these bivalves larva's dispersion. The *Lithiotis*-type bivalves during larval-stage episodes could use the numerous terranes within Panthalassa Ocean as „stepping-stones” allowing free migration eastward from the Alpine Tethyan Ocean to the Panthalassa Ocean. But, on the other hand, the narrow sea strait (so-called *Hispanic Corridor* = proto-Atlantic), originated in the Early Jurassic times (most probably in Sinemurian/Pliensbachian transition) across Pangea continent, combined of the Panthalassa Ocean (Proto-Pacific) and western (Alpine) Tethys. Therefore the widespread distribution of numerous fossil invertebrate groups took place during these times. It is still open question, which migration route has been used by *Lithiotis*-facies bivalves to their whole world dispersion – through Hispanic Corridor or by Panthalassa Ocean? (Krobicki & Golonka, 2009).

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Early Tournaisian (Mississippian) unornamented siphonodellid conodonts: biostratigraphic and paleogeographic remarks

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From the all marine faunas whose expansion and diversification took place just after the Hangenberg biotic crisis in the early Tournaisian (early Carboniferous), the siphonodellid conodonts are the most important in the stratigraphic point of view (“standard” early Tournaisian siphonodellid conodont zones; Sandberg et al. 1978). There is also paleoecological significance in distribution of siphonodellids and biofacies models were established (e.g. Ji 1986). The offshore open-marine environment and mesopelagic habitat for the “normal” siphonodellids was interpreted, based on the occurrence in the pelagic facies in western, central and southern Europe, northern Africa and North America. Occurrence of siphonodellids in shallower-water facies in mentioned regions, e.g. in the Namur-Dinant Basin (S Belgium, NE France) is very rare, related only to distal tempestites of the outer to middle carbonate ramp. On the other hand, some “normal” siphonodellids together with an unornamented group occur in SW China, Russia, Uzbekistan and Australia in shallow-water facies (e.g. middle to outer ramp) and unornamented siphonodellids missing there in deep water deposits, where only “normal” siphonodellids occur.

One of the unornamented species - *Siphonodella belkai* - described from Poland and further known from Russian Tournaisian is the index taxa of eponymous *belkai* conodont zone distinguished in these regions. Sudden ventral narrowing of *Si. belkai* platform elements resemble platform features of *Si. sandbergi* and, moreover, presence of three or more (up to 7) rostral ridges is common characteristic with *Si. quadruplicata*. Because *Si. belkai* has been defined by Dzik in 1997, confusing of *Si. belkai* with *Si. sandbergi* and *Si. quadruplicata* is

common in older, but, even in more recent publications. The misleading determination leads to stratigraphic discrepancies and older sediments of the *hassi* Zone are identified as younger ones (*sandbergi* and *quadruplicata* zones). The lower Tournaisian deep-water limestones (upper to lower slope) in the Rhenish Slate Mountains (Oese, Oberrödinghausen) and Moravian Karst (Lesní lom Quarry) recently yielded relatively abundant *Si. belkai* (Fig. 1ab) with rare unornamented *Siphonodella* sp. (Fig. 1c), accompanied by conodonts typical for the *hassi* and *sandbergi* zones. The first appearance datum (FAD) of *Si. belkai* matches with FAD of *Si. hassi* and therefore bases of these zones can be tentatively correlated.

The palaeogeographic and taphonomic data on the unornamented siphonodellids reveal that not only bathymetry limited their occurrence. Distribution of the most diversified assemblages of unornamented siphonodellids in the east and north Paleotethys and Uralian realm points out their paleogeographic provincialism. Migration of the *Si. belkai* into the Rheno-Hercynian ocean (Rhenish Massif and Moravian Karst) may passed from the southern Uralian sea-ways.

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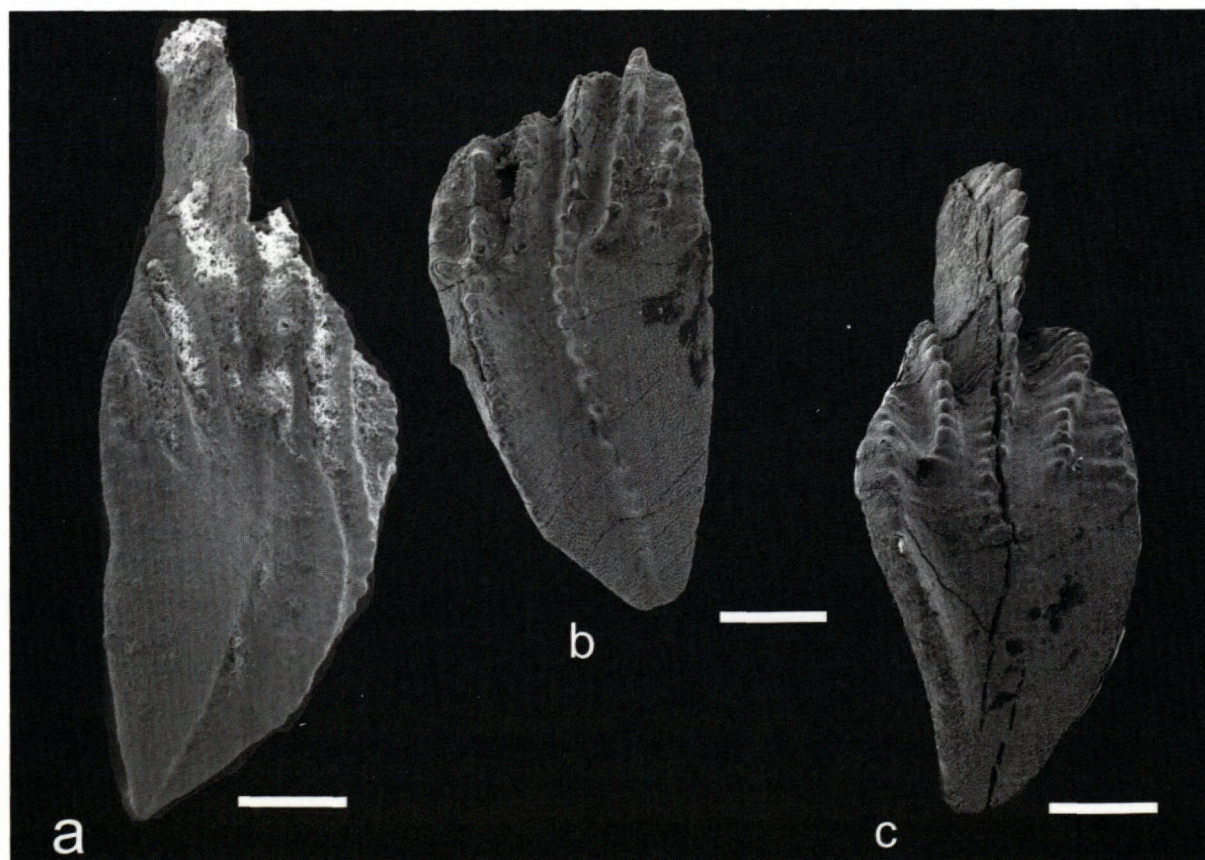


Fig. 1 Selected unornamented siphonodellid conodonts from the Rhenish Slate Mountains and Moravian Karst (Scale bar in all the specimens is 200 microns). (a) *Siphonodella belkai*, upper view, Oberrödinghausen 3c2, *hassi* Zone 3c2; (b) *Si. cf. belkai*, upper view, Lesní lom CA760, *hassi* Zone; (c) *Siphonodella* sp., upper view, Lesní lom CA760, *hassi* Zone.

The evolution of the Bavarian archaeopterygids: new revelations

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The 150-million-year-old fossils of *Archaeopteryx* are the most critical among the other intermediate forms that map out the theropod-bird transition. Although some of its features are typical to reptiles and others resemble birds, the both sets of these characters are combined into the unique appearance of what we have used to call the oldest known bird (Urvogel). Since its first discovery in 1861, only eleven specimens of *Archaeopteryx* have been officially announced to the public (Foth et al. 2014). Some of them are fragmentary, some became known only recently, and some became lost. Despite the enormous investigative efforts, our knowledge of *Archaeopteryx* has paradoxically turned controversial in numerous aspects.

The controversy touches fundamentals of the *Archaeopteryx* biology such as: 1) taxonomy: one species only *versus* more species *versus* generic diversification (reviewed by Wellnhofer, 2009); 2) ontogeny: all specimens represent a juvenile stage *versus* the both juveniles and adults are preserved (Houck et al., 1990; Bennett, 2008); and 3) locomotory preferences: cursoriality- *versus* arboreality-driven aerial specializations *versus* no flapping flight (Feduccia and Tordoff, 1979; Mayr et al., 2005; Nudds and Dyke, 2010). Moreover, the critical significance of *Archaeopteryx* for the origin of birds has become questioned. This issue has recently stemmed from the study that has questioned the very avian status of *Archaeopteryx* (Xu et al., 2011), and hence, its pivotal position in the conventional definition of Aves or Avialae. Thus our current picture of *Archaeopteryx* appears too fragmented, polarizing the scientific community, and eventually undermining its own placement at the base of the bird evolutionary tree.

Research on the theropod-bird transition rests almost entirely on external two-dimensional (2D) observations of these extremely precious and closely guarded fossils. Recently, first information on previously unknown 3D anatomy of the Urvogel, based on a study of the 8th specimen of *Archaeopteryx* were announced (Kundrát et al. 2014a,b). 3D model of the 8th specimen based on synchrotron μ -tomography (Fig. 1A,B) enhances our understanding of the cranial aspects (e.g. tooth replacement, bone fusion, detailed anatomy of individual bones, paleoneurology) and postcranial anatomy (bone microstructure and pneumaticity, configuration of shoulder girdles and carpometacarpus) of *Archaeopteryx*. The 8th specimen is the youngest of all known Bavarian archaeopterygids (Fig. 1C) and therefore critical for better understanding of evolutionary patterns of their morphological diversity and aerial adaptation.

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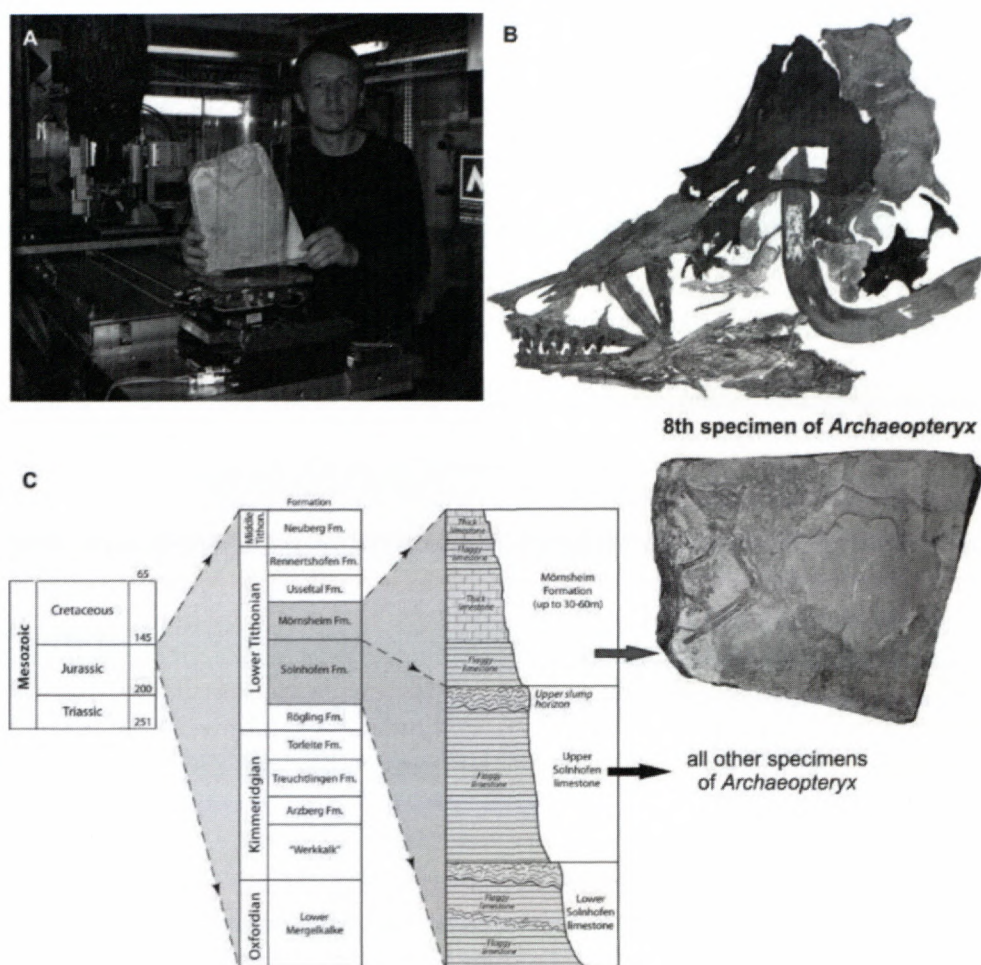


Fig. 1 **A**, High-resolution imaging of the 8th specimen of *Archaeopteryx* was done at European Synchrotron Radiation Facility. **B**, 3D rendered model of the skull. **C**, Stratigraphic sequence of the Lower Tithonian formations in Bavaria; note the Mörsheim Formation (red arrow) that yielded the 8th specimen of *Archaeopteryx*.

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The oldest Slovak fossil bird

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The Slovak record of bird fossils (prior to Late Pleistocene) is rather scarce and includes representatives of such orders as Anseriformes [Anatidae: *Anas* sp., *Bucephala clangula*], Galliformes [Phasianidae: *Alectoris donnezani*, *Coturnix coturnix*, *Miogallus altus*, *Tetrao tetrix*, *Tetrao urogalus*], Ardeiformes [Phalacrocoracidae: *Phalacrocorax intermedius*], Falconiformes [Falconidae: *Falco tinnunculus*], Strigiformes [Strigidae: *Tyto sanctialbani*] and Passeriformes [Corvidae: *Pyrrhocorax graculus*; Hirundinidae: *Hirundo rustica*; Turdidae: *Turdus* sp.] (reviewed by Mlíkovský 2002). All of these fossils came from at least eight different sites [Hôrka-Ondrej (MQ2c), Gombasek (MQ2a), Včeláre (MQ1b+MN17), Kolíňany (MN17), Hajnáčka (MN16), Host'ovce (MN16/15), Ivanovce (MN15), and Devinská Nová Ves (MN6)] and are restricted to the beds of the Neogene age. Most of the specimens are housed in the recognized institutions outside of Slovakia [Austria: National History Museum; Czech Republic: Anthropos Institute of the Moravian Museum, National Museum; Hungary: Geological Institute of Hungary] (see Jánossy, 1980; Švec, 1986; Mlíkovský 2002, 2004).

Fossil birds are very rare in the Paleogene deposits of the Western Carpathians. One notable exception is relatively rich material unearthed in the Menilite Formation (Bochenski et al. 2013). Recently a brief note about fossilized bird remains (referred to the slab with a few fragments of bones and bone imprints) was reported from the Bystré locality (Fulín and Holec, 2008). Here we provide a detailed diagnosis of the specimen based on the other slab (Fig. 1A) that contains most of bone elements with valuable diagnostic features. The tarsometatarsus (TMT) of the specimen is remarkably short relative to the tibiotarsus, causing the specimen to cluster with the three messelirrisorid upupiform and two apodiform taxa among other short-TMT birds from the Eocene-Oligocene period and with similar pedal anatomy (Fig. 1B). The detailed morphology of the first metatarsal, trochleae metatarsorum II-IV, incisurae intertrochleares, and phalanges suggest that the specimen from Bystré might be related to the Messelirrisoridae, which are stem group Upupiformes (Mayr, 2006). The Slovak upupiform differs from the messelirrisorid taxa (lower Middle Eocene) by: (1) geological age; (2) eco-geographic location, and (3) a set of autapomorphies: crista medianoplantaris present; prolonged apex and inflated trochlea metatarsi I; trochlea metatarsi II expanded by a process projecting latero-plantarly; a slit-like foramen vasculare distale; trochlea metatarsi IV and III equal in size; deep and spacious incisura intertrochlearis medialis; and deeper but very narrow incisura intertrochlearis lateralis. As a potentially new taxon, the specimen extends the occurrence of the messelirrisorid-like upupiforms to the Early Oligocene, and indicates that the stem-group Upupiformes lived in a swamp biotope of Europe when first songbirds, their major ecological competitors, had appeared.

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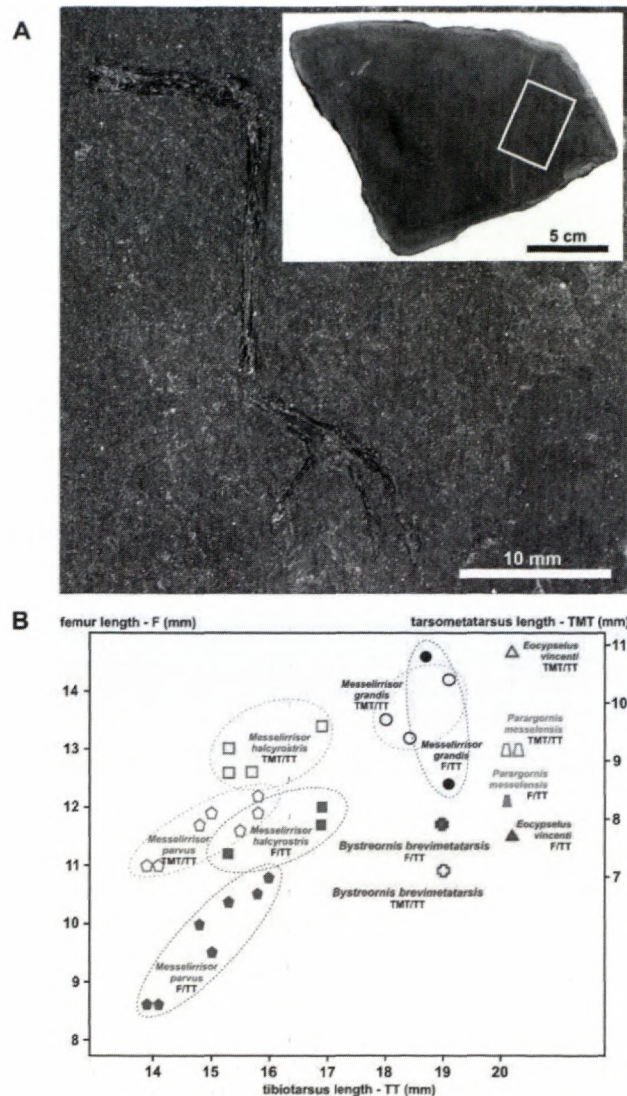


Fig. 1 A. The main slab with remains of the stem-group upupiform bird from Bystré (SNM Z 27188) from the Early Oligocene of Bystré, Slovak Republic. **B.** Plot showing proportional limb differences.

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Evolution of early angiosperms in the cenomanian of Bohemian cretaceous basin

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The Cenomanian fluvial and near shore marine sediments from the Peruc-Korycany Formation of the Bohemian Cretaceous Basin (BCB) provide a window to Cenomanian terrestrial palaeoenvironments dominated by angiosperms. The fossils are frequently preserved as leaf compressions in matrix rich in pyrite, which complicates their collection management. The most interesting angiosperms known from the Bohemian Cretaceous Basin is herbaceous halophytic plant *Pseudoasterophyllites cretaceus*. Its thick linear leaves have an opposite-decussate phyllotaxis. Female structures consist of an elongate, unilocular carpel, borne singly in axils of leaves, containing a single orthotropous ovule. Male flowers are also born in axils of leaves and represent simple inflorescences consisting of very simple flowers. Each flower shows one stamen supported by one bract. Preliminary phylogenetic analyses indicate that *Pseudoasterophyllites cretaceus* is related to the Chloranthaceae-*Ceratophyllum* clade and may represent a stem group of both of those two lineages. The family Chloranthaceae is represented in BCB by the genus *Zlatkocarpus* consisting of two species *Z. pragensis* and *Z. brnikensis*. They show spikes with helically arranged uniloculate and unilocular fruits. Each fruit contains a single, orthotropous seed. The fruits are supported at the base by a small floral cup and a bract. Pollen grains adhering to stigmatic areas and other surfaces of the fossil are of the *Retimonocolpites* type. The family Lauraceae underwent fast evolution in Cenomanian. It is represented in BCB by several genera: *Mauldinia*, *Pragocladus* and *Antocephale*. Inflorescences of *Mauldinia bohemica* consist of distinctly bilobed lateral inflorescence units helically arranged on elongated central axes. The units are dorsio-ventrally flattened and composed of small leaf-like scales that are closely attached in a distichous arrangement on each lobe. Flowers are borne in axils of leaf-like scales on bilobed structures. Flowers are trimerous with two perianth whorls, nine fertile and bivalvate stamens in three whorls, three staminodes and a single carpel.

A complex life cycle in a Cambrian trilobite *Sao hirsuta*

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The Cambrian trilobite *Sao hirsuta* Barrande, 1846 is renowned for its ontogenetic development described by Barrande (1852). Numerous material of various ontogenetic stages makes this species an excellent model organism which may extend our knowledge of trilobite ontogeny.

The trilobite ontogeny is generally divided into three successive periods based on the articulation of the dorsal exoskeleton (protaspid, meraspid and holaspid period). Although this division is still widely used, it can be rather problematic (see Chatterton & Speyer 1997, Park & Choi 2011). Our research is focused on quantitative analysis of cranial morphology

during the ontogeny of *Sao* in order to distinguish an alternative subdivision of trilobite development.

The results show that the morphological development of *Sao* is not characterised by small gradual changes between successive moults only (as initially figured by Barrande 1852). Three phases of rather consistent cranidial morphology separated by two quite rapid and significant changes appear in the dataset instead.

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Separated Radiolaria from radiolarites in the Čoltovská roklina ravine – preliminary results

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During our field work we have collected radiolaritic samples from the remnants of an old quarry in the Čoltovská roklina trough, and from the surrounding area. These radiolarites were deposited in the Meliata Ocean during the time of its closure, and as such they may be an important part of the recorded geologic history.

We collected 10 in-situ samples from the layers in the quarry remnant, and the neighbouring slope, as well as several additional samples from the fallen debris at the bottom of the ravine. The collected samples were dissolved in a solution of hydrofluoric acid, using several different separation techniques for the best results. The dissolution process was followed by straining of the dissolved product, and ended with separation of radiolaria under binocular.

Overall, majority of the picked samples was positive, but the quality of separated radiolaria varied rather significantly. As such, while radiolaria were found in the majority of samples, many of them could not be identified as different species, as no identifiers were preserved.

Until the submission of this abstract we have separated radiolaria from eight different samples, and identified several radiolaria species – including *Acaeniotyle umbilicata*, *Archaeospongoprunum* sp. cf. *implayi*, *Fultacapsa sphaerica*, *Suna* sp. cf. *echiodes* or *Tricolocapsa* sp.. The general stratigraphic range of the mentioned species is Upper Jurassic - Lower Cretaceous (Ožvoldová & Sýkora, 1984; Polák & Ožvoldová, 2001; Suzuki & Gawlick, 2009; Gawlick et al., 2010; Tekin et al., 2012).

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Lower Carboniferous Nautiloids and Orthocone Cephalopods from flysch deposits of Drahaný Upland and Nížký Jeseník Mts. (Moravosilesian palaeozoic Unit of the Bohemian Massif) - preliminary notice

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Lower Carboniferous sediments, forming the Drahaný Upland and Nížký Jeseník Mts., are in the Culm development represented by conglomerates, greywackes, siltstones and claystones. A relatively rare but diverse macrofauna occurs in the fine-grained rocks of the Myslejšovice Formation (Go_α to Go_γ Zone) in Drahaný Upland; and the Moravice Formation (Go_{α2-3} to Go_{β_{mu}} Subzone), and the Hradec-Kyjovice Formation (Go_{β_{spi}} Subzone to E1 Zone) in the Nížký Jeseník Mts. Fossils are there represented mainly by bivalves, cephalopods (nautiloids, goniatites), less trilobites, brachiopods and echinoderms in both studied areas. Trace fossils are very frequent. Studied fossils come from the paleontological collections of Palacký University and Regional museum in Olomouc.

From lower carboniferous culm strata of Drahaný Upland and Nížký Jeseník Mts. are up to date known several taxa of nautiloids and orthocone cephalopods: *Brachycycloceras scalare* (D'ARCHIAC ET DE VERNEUIL), *Cyrtospyroceras rugosum* (FLEMMING), *Dolorthoceras* cf. *kionoideum* SCHMIDT, *D. striolatum* (V. MEYER), *Dolorthoceras* sp., *Kionoceras gesneri* (MARTIN), *Nautilus subsulcatus* (PHILLIPS), *Rayonoceras giganteum* (SOWERBY), *R. irregulare* SCHWARZBACH, *Reticycloceras sulcatum* FLEMMING, *Rinoceras propinquum* (KONINCK), *Subvestinautilus* cf. *crassimarginatus* FOORD, *Vestinautilus* cf. *konincki* (D'ORBIGNY), *V. semiglaber* FOORD, *Vestinautilus* sp. Remains of these specimens are very badly preserved - they are strongly deformed.

Listed species are closely related with German (Nicolaus, 1963), Irish (Histon, 1999) and Polish (Żakowa 1958, 1966, 1971) basins with lower carboniferous sediment filling. Nautiloid genera are all long ranging, so they are not suitable to determine the age of lower carboniferous flysch rocks in the eastern margin of Bohemian Massif.

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Assemblages of foraminifera from the Wadowice area – the Grzybowski's study and present data

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The Wadowice area, situated approximately 50 km south-west from Cracow, belongs to the Flysch Carpathians, and is built mainly by deposits of the Subsilesian Nappe represented by the Oligocene menilite shales and sandstones with cherts. In 1893, thanks to the initiative of dr J. Daniel - a wealthy citizen of Wadowice - digging began on an exploration shaft in search for coal. This 19th century exploratory coal shaft was located near the place known as „Daniel's Garden”. In the following year, after reaching the depth of 84 meters, the further work was abandoned as the coal was not found. Samples collected by Henryk Walter during the digging work were sent to the geological cabinet in Cracow to Józef Grzybowski for micropaleontological analysis. The results of Grzybowski's studies were published in 1896 in one of his well known scientific papers „Foraminifera of the red clays from Wadowice”. The lithological log compiled by Grzybowski consisted of menilite shales at the bottom, red clays, gray claystones with marls and green clays with abundant pyrite and thin bedded, muscovite sandstones at the top. In the examined samples both, the agglutinated and calcareous foraminifera were present. According to Grzybowski most of the agglutinated forms represented deep-water taxa. In his opinion taxonomic composition pointed to Oligocene age of the studied microfauna. Of the 112 foraminiferal taxa, recognised by him, 77 belonged to the red clays and 44 were recovered from marls and green clays. 55 were described as the new agglutinated species. In his paper Grzybowski (1896) described only 2 planktonic species i.e. “*Globigerina triloba* Reuss” common in marls and green clays and rare “*Globigerina bulloides* d'Orbigny”. A few decades later, 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. In 1981, the revision of Grzybowski's collection from Wadowice was published by Liszka & Liszkowa. These authors concluded that the red clays were Campanian in age, whereas the green shales and marls represented Paleocene. Recently, during road works in the vicinity of the former “Daniel's Garden” a new outcrop, about 5,5 m high, has been exposed that consists of deposits similar to those recovered from 19th century exploratory shaft apart from the red clays. 17 samples have been collected to compare the foraminiferal assemblages with those described by Grzybowski (1896). The samples varied in amount and composition of microfossils. The most abundant foraminiferal assemblages consist mainly of planktonic taxa with *Cassigerinella chipolensis* (Cushman and Ponton), indicating at least Oligocene. The

planktonic assemblages of the “*Globigerina* Marl” type have been also recovered. Apart from foraminifera there are diatoms, sponge spicules and fish teeth present as well. The Grzybowski’s results and our preliminary studies suggest redeposition of various deposits during Oligocene or even Miocene time in the area studied.

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Record of latest Triassic organism communities development in sequences of the Tatra Mts area

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NW slope of the Mt Lendacká Pálenica (Mt Husár, east of the Belanské Tatry mountains ridge) above the Kardolína game keeper’s house) exposes the most complete and fossiliferous Upper Triassic/Lower Jurassic section comprising the uppermost part of Carpathian Keuper and Fatra Formation, covered by Hettangian siliciclastic deposits of the Kopieniec Formation (Gaździcki, 1974; Fig. 9, Pls. 4, 5; Michalík et al., 2007; Fig. 9).

The upper part of the Carpathian Keuper is represented by thick bedded yellowish-white weathering dolomites. Lime dolomites to marly limestones at the base of the section contains ostracode tests concentrations. Fragments of vascular plants have been found in dark grey claystone between dolomite layers, *Agathammina austroalpina* tests, ostracods, small bivalve fragments and fish scales in thin layered calcareous dolomites with s clay intercalations in the highest Carpathian Keuper beds.

Remarkable 2 m thick bed of laminated clayey dolomites and aleurolites yielded *Rhizocorallium* trace fossils, both bivalve- and lingulid brachiopod shells, and shark teeth. They have been deposited in shallow low energetic environment with frequent infauna. These beds underlie more than 100 m thick best exposed and the most complete section of the Rhaetian Fatra Formation in the Tatra Mts.

Rhaetian transgression with restricted „*Rhaetavicula* fauna“ penetrated through nearshore swamps and lagoons. Composition of foraminifer, bivalve and shark associations have been controlled by physical factors (Michalík et al., 2009). The sequence starts with the basal member formed by shelly limestones with „Swabian“ bivalve fauna of *Rhaetavicula*, *Modiolus* and *Chlamys*, black claystones and thin dolomite layers. Condensed horizons in 2.2 and 2.3 beds of a „bonebed“ type with a lot of shark teeth (*Hybodus*, *Birgeria*, *Sargodon*) and fish scales are remarkable.

Lower bed surfaces of overlying limestone beds bear load casts and fossil traces of *Thalassinoides*. These layers are of a tempestite type. Bivalve colonies (*Corbula* and *Gervillaria*) were repetitively destroyed by storms and temporary hard substrate was colonized by oyster-like *Placunopsis*. Gradual deepening of depressions was accompanied by return of infaunal (*Propeamussium* and *Entolium*) communities (Golej in Michalík et al., 2013).

Overlying silty claystones enriched with large amount of eolian quartz grains pass upwards into black shales with fish coprolites, spirally arranged shark coprolites, small bivalves, crinoids and fish teeth.

Bottom colonization by pachyodont bivalves, brachiopods and corals started much later, during highstand conditions. Isotope C and O curves reflecting eustatic and climatic changes helped to interpret development of the Rhaetian marine carbonate ramp. The Fatra Formation is composed of 100- and 40-ky cycles, with indications of short-timed monsoon climatic perturbations. The analysis of granulometry and content of clastic quartz indicates periodic fluvial influence, concentration of foraminifer tests (Agathammina) in thin laminae denotes marine incursions. Changes in magnetic susceptibility reflect distribution of authigenic and clastic components in the sequence and coincide with sequence stratigraphic and cyclostratigraphic division (Michalík et al., 2013).

Organodetrital limestone sequence (cycles No 5 to 8) with marlstone intercalations contains rich algal (Girvanella, Halicoryne, Solenopora), foraminiferal (Agathammina, Tolypammina, Glomospirella, Aulotortus), corals (Pamiroseris, Rhaetiophyllia), brachiopod (Rhaetina, Zugmayerella, Austrirhynchia), bivalves (megalodonts Conchodon and Rhaetomegalodon, etc.) associations formed in shallow marine conditions.

The upper part of the section is formed by well bedded detrital limestones with graded bedding, derived from the slope. Abundance of biostromal type of foraminifers (Triasina) and brachiopods (Rhaetina) with only short transport marks indicated proximity of their life place. This part of the sequence contains also striking parts consisting of sphaerulid (beds 53-54) and sandy (beds 64-65) limestones.

The highest part of the section is built of clayey organodetrital, marlstones and oolitic limestones with bivalve molluscs (Placunopsis) and with raised content detrital quartz grains. This part of the Fatra Formation contains paleobiological record of end-Triassic global extinction. Beds near to the Fatra- and Kopieniec formations boundary are affected by submarine slumping. Iron and quartz content in the topmost limestone layers (beds 103-105) is markedly increased. Change in sediment character, increased Fe content, cease of carbonate sedimentation coincided with increase of humidity, CO² content in atmosphere. These changes have been evoked by of mid- oceanic ridge volcanism in opening Atlantic rift system (Hallam, 1997; Götz a Ruckwied 2007; Michalík et al., 2007, etc.). The Fatra Fm carbonates are covered by non-calcareous claystones of the Hettangian Kopieniec Formation.

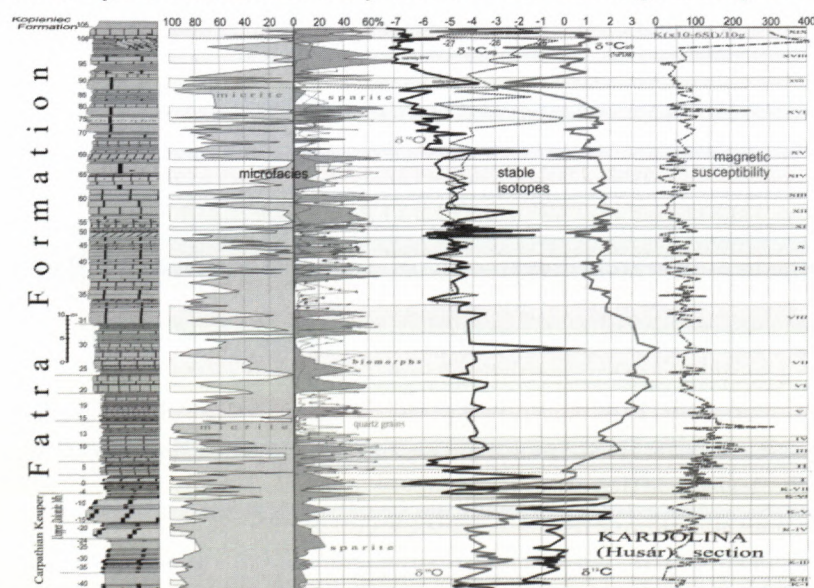


Fig. 1 Compilation of microfacial, stable isotope and magnetostratigraphic data from the Kardolina section.

The origin of the spicules in the middle and upper Lgota beds in the Barnasiówka Quarry (Wieliczka Foothills)

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The investigation focused on the micropaleontological and microfacial analyses of the spicule-bearing deposits from the Silesian Basin of the Outer Carpathians. Mid-Cretaceous was a period of accumulation spicule-bearing deposits, in the Outer Carpathian Basin of Tethyan Domain, spreading-out along the southern edge of the North European Platform. Such huge mass of spicule-rich material derived from the area occupied by dense population of siliceous sponges located in the middle and outer shelf, thrived in the habitat favorable their growth. Locally, spicules of the sponge communities have been redeposited to deep-water environments due to gravitational flows. These spicules could be one of the main components of turbidites in such regions, forming the gaize and chert layers. The Cenomanian deposits in the Silesian nappe of the Outer Carpathians, named the Middle and Upper Lgota beds (the Mikuszowice Chert beds) are example of such facies. The siliceous sponge spicules with calcareous benthic foraminifers, radiolarians and siliciclastic material created the series of fine-grained turbidities there, which are intercalated with deep-water, hemipelagic, non-calcareous clays.

Presence of the sponge-rich communities within the shallower part of the basin were related to ecological factors as quantity and quality of food, and water chemistry.

The sedimentation of the spicule-bearing turbidites started in the upper part of the Middle Lgota Beds. However this moment is not related to the lithological change between the Middle Lgota Beds and the Mikuszowice Chert Beds.

The comparison of the skeletal ossification of *Discosauriscus* (Kuhn 1933) (Seymouriamorpha) with the selected representatives of reptiliomorphs and temnospondyls.

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The *Discosauriscus* clade represents one of the best studied reptiliomorph amphibians. Unfortunately, the smallest developmental series are extremely rare. A short time ago were found almost 50 small specimens of *Discosauriscus* with skull length from 6mm to 25 mm. This provides a special opportunity for an examination of the early skeletal ossification. The material comes from the Lower Permian of the Czech Republic (Boskovice Basin). The degree of skeletal ossification of discosauriscids is very common with *Utegenia* and *Karpinskiosaurus*. They differ only in several details. Contrariwise, *Seymouria* and other reptiliomorphs with preserved partial ontogenetic series (diadectid *Orobates*, embolomere *Proterogyrinus*) show much higher skeletal ossification. On the basis of actual knowledge the ontogenetic conditions of *Gephyrostegus* probably fall within intermediate position between these reptiliomorphs. The degree of skeletal ossification of *Discosauriscus* in comparison with the smallest specimens of selected permo-carboniferous temnospondyls, the skull and the

postcranial skeletal structures of *Discosauriscus* are much more ossified. However, we can see several similarities with the eryopoid temnospondyls (ossification of pelvic region).

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Net-winged beetles of the Baltic and Dominican Amber (Coleoptera: Lycidae) and dated phylogenies

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The net-winged beetles (Lycidae) are representatives of the elateroid lineage. Due to their morphology they were classified together with other soft bodied beetles in the superfamily Cantharoidea. Recent advances in analyses of DNA sequences showed close relationships of net-winged beetles, fireflies, and soldier beetles, while sister group relationships of Lycidae remain controversial. The Tertiary fauna of beetles (Coleoptera) is predominantly congruent with recent fauna. Particularly, this applies when supergeneric taxa are considered, while generic assignment of beetle fossils was anticipated as different. Net-winged beetles with their soft bodies are difficult to preserve and therefore, paleontological findings of the family Lycidae are limited. Most of lycid fossils were found in Baltic and Dominican amber. Currently, five fossil lycid species have been described. The first lycid representative was presented from Florissant Fossil Beds from Upper-Lower Eocene in North America. All other fossil lycids were found among amber inclusion and encompass three different subfamilies: Dictyopterinae, Leptolycinae, and Lycinae. From these only recently discovered *Electropteron avus* from the Dominican amber represents a taxon with presumably apterous females, which suggests that female aptery in net-winged beetles of the tribe Leptolycini is at

least 30 mil. years old. Absence of older lycid fossils makes any calibrations for dated phylogenies difficult.

Middle Pleistocene stratigraphy of the deposits in Za Hájojnou Cave (Javoříčko Karst, northern Moravia, Czech Republic)

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Za Hájojnou Cave (Javoříčko Karst, northern Moravia, Czech Republic) is a unique Middle Pleistocene locality. Paleontological material comes from different types of sediments in superposition of fluvial deposits of the sinkhole which was active until the maximum of the Cromerian Interglacial I, MIS 19 (B/M palaeomagnetic boundary, 781 ka). Stratigraphic interpretation was based mainly on ²³⁰Th/U dating (Lundberg et al. 2014), sedimentology, study of mammal assemblages and palynology (Doláková in print, Ivanov in print, Kadlec et al. in print, Musil in print, Sabol in print). Sediments were divided into 5 groups of layers on the basis of lithological content and character of bone preservation. The 2nd group of layers was the most important for the stratigraphy of the Middle Pleistocene deposits.

Three warm stages were documented by the study of sediments and their palaeontological content. We presuppose two stratigraphical alternatives. **Alternative A:** warm stage III corresponds most probably to MIS 9a, warm stage II could correspond to MIS 9c, warm stage I corresponds to MIS 11. **Alternative B:** warm stage III corresponds most probably to MIS 9a, warm stage II could correspond to MIS 9c, warm stage I corresponds to MIS 9e. The alternative A (warm stage I corresponds to MIS 11) is supported by the exclusive presence of evolutionary older forms of *P. fossilis*. If the alternative A is valid than very warm MIS 9e is absent. The alternative B (warm stage I corresponds to MIS 9e and all discussed warm stages agree with MIS 9) is supported by palynological record. The presence of *Pterocarya* is considered to be typical for Holsteinian with the last occurrences in Central Europe in MIS 9a. Against the alternative B speaks exclusive occurrence of evolutionary older lions in layers of the 2B group. Although both above mentioned alternatives are possible, the exclusive presence of evolutionary older group of lions in sediments of warm stage I support strongly alternative A. The youngest warm stage III does not exceed MIS 9a. Therefore, we consider all three warm stages in Za Hájojnou cave as belonging to Holsteinian *sensu lato*.

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Morphology of brachioles in Cambrian eocrinoid genus *Akadocrinus* from the Barrandian area, Czech Republic

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Eocrinoidea is an ancient echinoderm class, which ranges stratigraphically from early Cambrian to Silurian. Eocrinoids belong to dominant group of echinoderms during the Cambrian (Sprinkle 1973, Zamora et al. 2013). They are the first echinoderms which develop erect feeding brachioles (Sprinkle & Collins 2006).

Material used for this study has been collected from several outcrops of the Jince Formation in the Příbram-Jince Basin, namely in the *Paradoxides* (*P.*) *paradoxissimus gracilis* Zone of early Drumian age. All studied specimens are deposited in the collections of the National Museum in Prague. Several parameters such as total length of brachioles and size of individual brachiolar plates were measured on 20 specimens of the genus *Akadocrinus* Prokop, 1962. Material is excellently preserved and makes possible to measure even dimensions of ambulacral furrow.

The brachioles of eocrinoids are free standing and have biserial structure. They taper distally and never are branched. Juvenile specimens of *Akadocrinus* have less brachioles composed of generally smaller brachiolar plates in comparison with mature specimens. Juvenile specimens usually have 2-4 brachioles, whereas mature specimens have 7-14 brachioles. There are also differences in total length of brachioles. Maximal brachial length is 2 mm in juvenile specimens and reaches 20 mm in adult specimens.

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Artificial populations - a tool for validating morphometric techniques in trilobite research

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Application of morphometric techniques is a standard procedure in modern palaeontology. Advantages of this group of methods should not be underestimated, but its practical use often lacks evidence for technical correctness in the statistical sense. One of the reasons of this disadvantage, specific for palaeontology, is the lack of independent samples. All collected data bear a certain amount of disturbance, derived from such sources as tectonics or the sedimentary environment. Without the possibility to examine an entire, non-deformed population, the assessment of statistical results becomes difficult. Artificial (or virtual) populations may be a solution to this problem. A similar technique has been implemented in other scientific areas (for example “Virtual Ecologist” – see: Zurell et al., 2010), but it never has been used in palaeontology. This kind of approach consists of three elements: 1) a virtual population, from which the samples can be taken and modified to simulate e.g. tectonic deformations; 2) sampling and classification – the term “virtual palaeontologist” can be used in reference to the previously mentioned research; this element should simulate such aspects as the selective preservation of fossils and invalid classification; and 3) validation of statistical methods; this should be possible due to knowledge of a true state, i.e. an entire artificial population. Practical implementation of this technique has been applied using the R environment (R Core Team, 2014). The presented procedure has been performed using classical morphometric data, i.e. linear measurements; in the future, similar research will be conducted using landmark-type data. A function for generating populations was written based on real ontogenetic development in trilobites – it simulated several stages, starting from the initial one generated from a given set of measurements. New stages were generated according to Dyar’s rule (Fusco, Garland, Hunt, & Hughes, 2012) with possible modifications (allometry, differences in sagittal and transversal growth). Simulation of sampling by “virtual palaeontologists” consisted of several ways of data collection. The simplest was of course random sampling, but, to simulate selective preservation, modifications of draw probability were also applied (preferring a specific size of the specimens). The second part of the collecting process was classification; the techniques applied included e.g. half-random choice depending on proportions or machine learning methods (clustering, neural networks) with real, misclassified data [Cambrian trilobites from Poland (Żylińska, Kin, & Nowicki, 2013)] used as a training set. Lastly, statistic and “data mining” methods were applied (including linear correlation, PCA, discriminant analysis). Validation of the results was proceeded using permutation techniques, and the confidence intervals for different base conditions (including sample size, allometry, tectonic deformations) have been calculated. These results show the estimated probability of committing an error, however, they represent artificial data generated for specific parameters and their role is to show possible traps, give the ability to rate the risk of error, and, finally, yield a base for validating real data.

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Diatom diversity, biostratigraphy and palaeoecology in the Neogene lake system of Central Slovakia

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The Middle and Upper Miocene lacustrine basins of the Central Slovakia preserved diverse diatom assemblages. More of these materials need new taxonomical documentation and reconsideration by scanning electron microscopy of the original material and more precise description of the taxa. This report provides a preliminary description of the diatom bearing deposits within Central Slovakia, their origin and precise age, as well as preliminary taxonomical remarks on the diatom flora.

In the studied profile near the village of Močiar, the dominant complex of the investigated diatom flora is monotaxonic, generally consisting of the extinct species *Aulacoseira scala* (Ehr.) comb. nov. This species was also found in the Lutila profile with subdominant periphytic diatoms of the genera *Fragilaria*, *Eunotia*, *Anomoeoneis*, *Cymbella*, *Amphora*, *Gomphonema*, and *Surirella*. Similar subdominants were determined in the Dúbravica profile. The dominants are centric forms of the genera *Aulacoseira*, *Melosira*, and *Ellerbeckia*. Planktonic centric species again of the genus *Aulacoseira* dominate the studied profile nearby Turova Village (Kremnica Mts.), but the species of the genus *Aulacoseira* in this assemblage are represented by extant forms: *Aulacoseira granulata* (Ehr.) Sim. and *A. ambigua* (O. Müll.) Sim. The above discussed diatom assemblages show strong difference from the Neogene diatom assemblages of the Balkan Peninsula (Ognjanova-Rumenova, 2000, 2006).

The long-lived Late Miocene Turiec Lake hosted the unique fossil diatom flora which support hypothesis on endemic character of the preserved fossil faunae. The fossil diatom flora consists of 42 species and varieties, which belonged to 22 genera. The diatom assemblage studied from the Turiec Basin bears a strong resemblance to non-marine Miocene assemblages from Rudenschwinden (Central Germany), as well as - from Bes Konak Basin (Turkey). The investigated profile is generally dominated by *Miosira* Krammer, Lange-Bertalot et Schiller of class Coscinodiscophyceae accompanied by *Fragilaria* Lyngb. sensu lato of class Fragilariophyceae. The similarities and differences within a group of species belonging to genera *Aulacoseira* Thw., *Alveolophora* Moiss. et Nevretd. and *Miosira* are discussed. The most interesting forms are these belonged to genus *Staurosirella* - *S. grunowii* (Pant.) Morales, Buczko, Ector, *S. leptostauron* (Ehr.) Williams et Round, *S. martyi* (Herib.) Morales et Manoylov and two very unusual forms left in open nomenclature. Ecological data for the diatom taxa and the frustules/chrysophycean stomatocysts ratio are used in an attempt to reconstruct the palaeoecological conditions at the time of sediment deposition in detail.

Additional information about paleoenvironmental changes is provided by the assessment of the extent of diatom preservation.

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Radiolarian assemblages from uppermost Cenomanian-Turonian Scaglia Bianca/Scaglia Rossa Formations (Umbria-Marche basin, Italy) - preliminary studies

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The Umbria-Marche basin is a part of the foreland of the Umbria-Marche Apennines of central Italy. The studied section is located in NE part of Vispi quarry on SE slope of Contessa Valley, near Gubbio. In the Contessa Valley, the Lower Cretaceous to Upper Miocene sediments are exposed. This investigation is focusing on uppermost Cenomanian-Turonian sediments represented by two formations: Scaglia Bianca (uppermost part of W4 Greyish member) and Scaglia Rossa (lower part of R1 member) (Montanari & Koeberl 2000). The W4 Greyish member in studied section is represented by thin to medium-bedded limestones. Limestones are gray and white with light to dark grey cherts. The intercalations by shale are very rare. The lower part of R1 member of Scaglia Rossa formation is represented by thin to thick, but mostly medium-bedded limestones. Limestones are light to dark red with red, less gray or black cherts.

Two radiolarian taxon range zones were recognized in studied section: *Hemicryptocapsa polyhedral* Interval Zone (Bąk 1999) and *Alievium superbum* Taxa Range Zone Pessagno 1976 (Bąk 2011). Radiolarian assemblages in *H. polyhedra* Zone contain: *Holocryptocanium barbui* Dumitrică (dominated), *Archaeocenosphaera mellifera* O'Dogherty, *Pseudodictomitra pseudomacrocefala* (Squinabol), *Stichomitra communis* Squinabol, *Crucella cachensis* Pessagno. In radiolarian assemblages of *A. superbum* Zone, *H. barbui* is in minority, moreover there is no dominant species. Radiolarian assemblages contain: *Praeconocaryomma californiensis* Pessagno, *P. lipmane* Pessagno, *Stichomitra communis* Squinabol, *Orbiculiforma* sp., *Patellula verteroensis* Pessagno, *Dictomitra multicostata* Zietzel. Radiolarian assemblages allow to indicate the Cenomanian-Turonian boundary. The Turonian assemblages have less specimens than the lower Cenomanian, and in many samples from uppermost part of section radiolarians do not occur.

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Sodium hexametaphosphate as a useful tool in the preparation of radiolarian

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Sodium hexametaphosphate (SHMP) is a hexamer of composition $(\text{NaPO}_3)_6$. SHMP is widely used in food industry as e.g. sequestrant and stabilizer in production of juices, fish in a tin or flux in production of cream cheese (Makara *et al.* 2010). Another attribute of sodium hexametaphosphate is water softening and it has used as a basic component in Calgon[®]. In many palynological papers, Calgon[®] is mentioned as one of the chemical used in preparation. The SHMP method of palynological preparation is the subject of research and it is compared with H_2O_2 or HCl/HF methods (e.g. Riding & Kyffin-Hughes 2006, 2010, 2011), and in foraminifera preparation compared with H_2O_2 and sodium pyrophosphate methods (Feldmeijer *et al.* 2013).

De Wever *et al.* (2001) described the technique of radiolarian preparation using Calgon[®], as a replacement of tetrasodium pyrophosphate or hexametaphosphate, with a combination of hydrogen peroxide or in comprehensive preparation with using acids. These methods was unsatisfactory for preparation from non-calcareous silt shale.

For extracting radiolarian from non-calcareous silt shale the liquid nitrogen (LN_2) method was used (Remin *et al.* 2012). The samples had a weight of 100 to 200 g. After 15 cycles of freeze-thaw method, samples were washed through sieves with mesh diameter of 500 and 64 μm and dried. The residue was 40-70 g weight. Another disintegration with using LN_2 method reduced the weight by 2-5 g. The microscope examination indicated the residue consisted primarily of silt aggregates. Using sodium hexametaphosphate method the residue was boiled in 5% solution of SHMP on gas burners by 15-30 minutes, then washed through 64 μm sieve and dried. The residue was 1-5 g weight and consisted of siliceous grains including radiolarian and benthic foraminifera, whose were good preserved.

The advantages of combined method of LN_2 and SHMP are: fast disintegration of sample, safe (non-acid) extraction of radiolarian, low cost, concentration of microfossils and non-destructive for radiolarian.

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Calcareous nannofossils and foraminiferal microfauna of the Huty Formation from the the Liptov basin: implications for biostratigraphy and paleoenvironments

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The Huty Formation of the Ružomberok section and Vlachy-1 borehole has been studied in purpose of biostratigraphic and lithofacial correlation of the Liptov basin.

Vlachy-1 borehole section represents shelf-margin sediments with claystone – sandstone lithology, which belong to NP22 - NP24 zones (*sensu* Martini 1971). Preservation and abundance of calcareous nannofossils is moderate (M). Dominance in the nannoplankton assemblage reaches low value (0,2 of 1,0), equitability is mean (0,7 of 1,0) and diversity with 29 autochthonous and 22 allochthonous species reaches the value of 1,7. The assemblage shows the predominance of eutrophic species (65%) and species with temperate – water preferences (80%) .

Foraminiferal assemblage consists predominantly of *Pseudohastigerina micra*, *Globoquadrina tapuriensis*, *Chiloquembelina cubensis* and another species typical for the Lower Oligocene formations.

Ružomberok section represents upper-shelf sediments with mudstone-dominant lithology, which belong to NP21 - NP24 zones. Preservation and abundance of calcareous nannofossils is similar such as in the Vlachy-1 borehole (M-moderate), Dominance of the assemblage is low (0,3 of 1,0) and Equitability values are mean (0,7 of 1,0). Diversity of the nannofossils assemblage with 27 autochthonous and 9 allochthonous species reaches the value of 2,0. Eutrophic species (54%) and temperate – water nannofossils (82%) predominated.

Rupelian microfauna of planktonic foraminifers consists of species *Turborotalia ampliapertura*, *Pseudohastigerina micra*, *P. nagewichiensis*, *Tenuitella gemma*, *Chiloquembelina cubensis*, *Globorotaloides suteri*, etc. Their association in the Chattian formation differs by appearance of younger species, such as *Paragloborotalia opima*, *Paragloborotalia pseudokugleri*, *Paragloborotalia pseudocontinua*, *Paragloborotalia birnageae*, *Tenuitella inaequiconica*, *Globigerina falconensis*, etc.

The paleoenvironmental conditions in the Liptov basin during the Oligocene were variable in temperature and nutrients. Diversity of calcareous nannofossils decline mainly in NP 23 zone, where the foraminifers also show a significant dwarfing and predominance of small-sized tenuitellinids and chiloquembelinids. Low diversity nannofossils and small-sized

foraminifers thus indicate onset of Paratethyan isolation with brackishening, eutrophization and shallowing of sea-water conditions (Nagymarosy, 1991, Soták, 2010).

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Early Pennsylvanian fossils from Xiaheyan locality in northwestern China: a review

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Early Pennsylvanian fossils from Xiaheyan locality near Zhongwei (Ningxia Hui Autonomous Region, China) have been intensively studied for about a decade. Fossil plants from this locality belong to well known Cathaysia flora composed mainly of lycopods, sphenopsids, ferns, pteridosperms and cordaitan gymnosperms (Sun 2006). Fossil ray-finned fishes of order Palaeonisciformes and cartilaginous fishes of genus *Listracanthus* (Holocephali) allowed a reconstruction of the sedimentary paleoenvironment. The depositional environment of the Tupu Formation is thus interpreted as marine-lagoonal with tidal flats and marshlands (Zhang *et al.* 2012). Due to the occurrence of index ammonoid and conodont fossils known from Russian, European and North American strata, the Tupu Formation can be correlated with Early Bashkirian ranging from Namurian B to C (Peng *et al.* 2005, Menning *et al.* 2006).

Insects known from this locality as Quilianshan entomofauna are exceptional due to their remote palaeogeographical location with respect to coeval entomofaunas and Bashkirian age simultaneously. The studies were focused on members of the following insect groups: Palaeodictyoptera, Odonatoptera, stem-Grylloblatodea, stem-Dictyoptera, stem-Orthoptera and stem-Plecoptera. Some of the abundant species were discovered in tens of specimens, allowing registration of the intra-specific variability mainly in wing venation rarely documented.

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The first record of osteolepiform sarcopterygian from the Moravian Karst (Famennian, Czech Republic)

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Devonian and Carboniferous sequences of the Moravian Karst were deposited in the Rheno-Hercynian basin at the southern margin of Laurussia. All the previously known sarcopterygian remains from these deposits belong to onychodontiform fishes (eg. Ginter in Hladil et al. 1991). One of the plesiomorphic features in sarcopterygians is a unique complex of hard and soft tissues known as cosmine (e.g. Sire et al. 2009). The histology of cosmine in various sarcopterygians was discussed by several authors, e.g. Gross (1956), Meinke (1984), Chang & Smith (1992) and Sire et al. (2009).

Recently, a cosmine-covered dermal bone was found in a small abandoned pit-quarry near the road leading from Brno Líšeň to Ochoz u Brna, where the two meters thick section of the Famennian Křtiny Limestones (Líšeň Formation) is exposed. This specimen was obtained from darker grey biodetrital limestones close to the boundary of the Upper *Palmatolepis rugosa trachytera* and the Lower *Palmatolepis perlobata postera* conodont zones (the bed “B” *sensu* Weiner & Kalvoda 2013).

The dermal bone is subtriangular in outline and bears characters of the lateral extrascapular (see fig. 1). The absence of overlapped area at the median margin suggests that the lateral extrascapulars overlapped the median extrascapular. This condition is usual in osteolepiforms (Jarvik, 1980). The openings of tubules leading to the main sensory and supratemporal commissural canals are numerous and evenly distributed at the upper surface of the bone. In contrast to many other known cosmine-bearing osteolepiforms the course of sensory canals cannot be distinguished by tracing these openings. The pit line is developed. The absence of Westoll lines and buried odontodes, enamel/enameloid not dipping into the flask shaped pore-canals, relatively small size of the pore-canals surface openings together with the shape of the pore-canals and interconnecting mesh canals also resemble conditions common in osteolepiforms. The lower mesh canals were not observed. The shape of interconnecting mesh canals is similar to those described or depicted in some other osteolepiforms, e.g. *Cladarosymblema* (Fox et al. 1995) or *Megalichthys* (Gross 1956).

Osteolepiform fishes were previously reported from freshwater, brackish and marine sediments. The new specimen was obtained from clearly marine deposits. This is the first record of osteolepiform sarcopterygian from the Moravian Karst.

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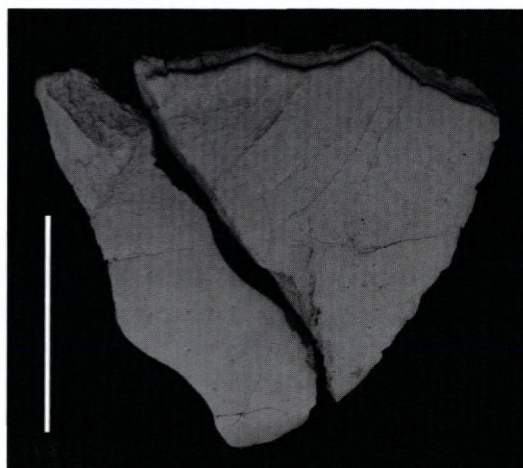


Fig. 1 Lateral extrascapular of osteolepiform fish from the Moravian Karst. The specimen was coated with ammonium chloride. Scale bar: 1 cm.

Palaeoecological aspects of the evolution of the oyster genus *Rhynchostreon* Bayle

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This paper presents an analysis of palaeoecological aspects of the evolutionary processes in the oyster genus *Rhynchostreon* Bayle, 1878. According to the latest results of research, the evolution of genus appears to be more dynamic than previously assumed. The processes of internal dynamics of the environment in conjuncture with other studied aspects of the late Cretaceous environments (e.g. paleotemperature, salinity, etc.) were significant factors that initiated selective pressure and represent important components for the evolution of the group. Furthermore, we provide the overall hypothesis about co-evolution of intrageneric lineages in

Rhynchostreon. The definition of evolutionary trends of intrageneric lineages within the presented hypothesis (including a description of new oyster species) is supported by various analytical methods, which anchors them in the current zoological nomenclature system. Scanning electron microscopy, isotope geochemistry and biometrical analysis of the shell in combination with sedimentological methods suggest a relation of lithofacies (as a result of environmental aspects) and evolutionary processes. The concept of proposed ecological-evolutionary model is based on the data from various paleogeographic regions of the Cretaceous world. This fact increases their applicability in the genus *Rhynchostreon*. We consider this absolutely necessary for any future steps in order to resolve similar huge taxonomic problems.

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Badenian fauna and flora from the locality Dubová (Danube Basin)

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During excavation work for building of winery in Dubová in 2008, species-rich and specimen-rich assemblages of foraminifers, molluscs, anthozoans, ostracods, bryozoans and other invertebrates, vertebrates, palynomorphs and nanoplankton of the Middle Miocene age were obtained. This locality is situated in the north-western margin of the Danube Basin (in the Blatné Depression) at the eastern foot of Malé Karpaty Mountains (Hladilová et al., 2013; Jamrich, 2013).

High resolution sampling was used for examining of this 2,5 m thick lithological section cut in the clays, silts and sands of the Báhoň Formation. A striking accumulation of disarticulated valves of the *Crassostrea gryphoides* occurs in the middle part of the section. Valves of this giant oyster found at this locality are up to 35 cm long. This study is focused on the synthesis of foraminifers, molluscs and palynomorphs. The most abundant molluscan taxa are *Sandbergeria perpusilla* (13,0%);

Loripes (Microloripes) dentatus (11,0%); *Clithon pictus tuberculatus* (9,5%) and *Bittium reticulatum* (8,3%).

Foraminiferal associations could be divided into three distinctive groups. Group 1, where *Elphidium crispum* is the most abundant species, is related to the harder bottom with algal and sea-grass carpets. Group 2, dominated by *Ammonia* and *Elphidium*, indicates environments with sea-grass coverage and more eutrophic conditions with possible lowering of the oxygen content. Group 3, with occurrences of the genus *Borelis*, could be related to algal-coral patch reef environments.

On the basis of the foraminiferal association and occurrence of the gastropod *Clithon pictus tuberculatus*, these sediments could be placed into the Upper Badenian *Ammonia vienensis* Biozone as equivalent of *Bulimina-Bolivina* Zone.

Sediments show a fining-upward trend indicating a decrease in water energy and/or increase in water depth. The co-occurrence of the patches of the *Siderastraea italica* and *Crassostrea gryphoides* is interesting due to their different salinity preferences.

Autochthonous palynomorphs assemblage is documented by common microforaminiferal linings and dinoflagellates. These are associated with allochthonous terrestrial subtropical flora presented by longer distances flying *Cathaya* and *Pinus*, as well as coastal swamp vegetation type with the *Myrica* and *Glyptostrobus* dominance.

Acknowledgement: We would like to thank Slovak Research and Development Agency - APVV-0099-11 and to RNDr. Miroslav Hornáček for introducing this ephemeral locality to the academic world.

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Detailed oxygen and carbon isotopic analysis of the foraminiferal tests from the Lomnice borehole (Mid Badenian, Carpathian Foredeep)

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Borehole Lomnice (LOM1) records nutrient-rich quiet environment of the outer shelf to upper bathyal in the Mid Badenian of the Carpathian Foredeep. Studied section can be correlated with interval 14.6 Ma (the FO of *Orbulina* spp.) to 13.42 Ma (the LO of *Sphenolithus heteromorphus*) what agrees with beginning of the Middle Miocene Climatic Transition. Based on relative abundances of foraminiferal and calcareous nanoplankton paleoenvironmental markers, seasonal succession of assemblages was interpreted: spring bloom of *Globigerina bulloides* accompanied by increase of abundance of small oxyphilic opportunistic *Cibicidoides* spp. at the sea-floor was followed by summer stratification of water column with oligotrophic and warm-water *Globigerinoides* spp., *Globigerinella* spp. and *Orbulina* in the upper layer and low-oxic markers at the sea-floor. The spring bloom could be triggered by seasonal upwelling regime. Seasonal oscillations of nutrient content, temperature and/or salinity are expected.

The oxygen and carbon isotope data from foraminiferal tests were used for verification of the above mentioned interpretations. Contribution of the research is comparison of oxygen and carbon isotopic values of foraminiferal genera from different paleobiotops, including *Globigerina bulloides* (rather cold-water, high-nutrient, shallow dweller) *Orbulina universa* + *Praeorbulina* sp. (warm-water, oligotrophic, shallow dweller), *Uvigerina* sp. (low-oxic, infauna), *Heterolepa dutemplei* and *Cibicidoides* spp. (high-oxic, epifauna).

Specimens were picked from fraction 63-2000 µm; suitability for stable isotope analysis was evaluated from inner wall preservation. Weight of every specimen was recorded as a measure of test size. Single tests weighing typically 10-50 micrograms were analysed for stable C and O isotope composition on MAT253 mass spectrometer coupled with autoprereparation device Kiel IV. Internal precision is 0,005 to 0,025 ‰ and 0,007 to 0,045 ‰ for $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$, respectively. The preliminary results show isotope variability of 48 well-preserved specimens from two samples (8.5m; 12.6m). The correlation between weights and isotopic values were recorded for benthic genera and oxygen isotope values of planktonic *Globigerina bulloides*

what shows variegated environment and/or variegated metabolic processes during growth of benthic specimens and *Globigerina bulloides*. Isotopic results confirmed hypothesis about stratified water column especially in carbon isotope values. However, the isotope analysis does not confirm neither upwelling regime nor significant influx of terrestrial organic matter. Differences in isotopic values well correspond with life position and presumed depth habitat for selected foraminifera genera.

Nevertheless twelve other samples are currently being analysed. After that a serious dataset will be available and furthermore information can be obtained.

Climatic response of the digitate planktonic foraminifers to the Eocene/Oligocene cooling: a case study of *Hantkenina* from the Western Carpathian sections

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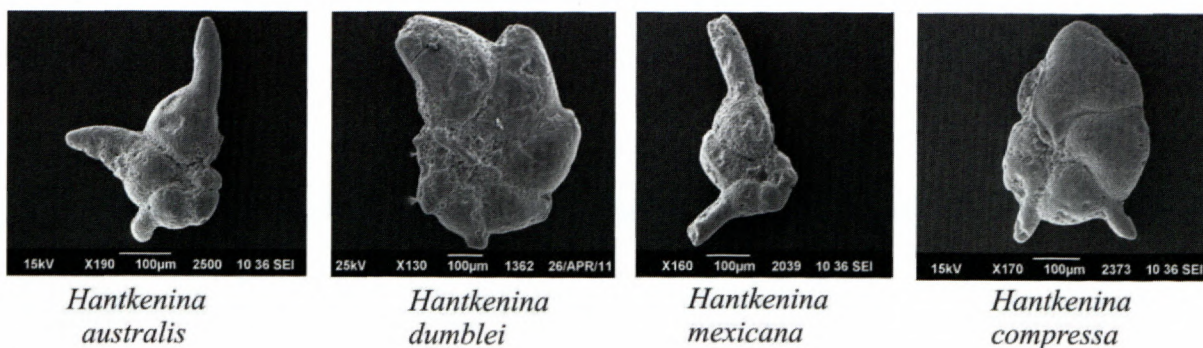
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The digitate planktonic foraminifers like *Hantkenina* include clavate forms with tubulospinose chambers, which were originated as morphological adaptation for enhanced metabolic effectivity and dwelling in near-surface waters (Coxall et al. 2000). The cladogenesis of *Hantkenina* is related to ancestral species of *Clavigerinella* (Coxall et al. 2003) or to smooth-walled species of *Pseudohastigerina* (Banner & Blow 1960).

The digitate planktonic foraminifera are considered to represent warm-water habitats of marine microfauna. In the Middle Eocene they are represented by hantkeninids, which disappeared with climatic cooling on the Eocene/Oligocene boundary. The LAD of *Hantkeninidae* marked the E/O boundary in the GSSP section at Massignano (Premoli Silva & Jenkins 1993).

Eocene formations of the North Peri-Tethyan basins, are not very rich in *Hantkeninidae*. The presence of *Hantkenina* species was recorded in the Transdanubian Mts. (Majzon 1960), Ždánice – Sub-Silesian unit (Vašíček, 1951, Gasiński 1978) and very scarcely in the Central Western Carpathians (e.g. Samuel 1990).

New localities with rich occurrences of *Hantkeninidae* has been found in the Liptov-Orava and Turiec basins. *Hantkenina*-bearing marlstones overlain the Nummulitic limestones or carbonate breccias of the Borové Fm. The hantkeninids are diversified to five different species, comprising of *Hantkenina australis*, *H. dublei*, *H. mexicana*, *H. compressa* and *H. liebusi*. They are associated with large-sized muricate species (*Acarinina topilensis*, *A. rohri*), keeled forms (*Morozovella subbotinae*, *Morozovelloides spinulosa*), smooth forms (*Pseudohastigerina micra*, *P. wilcoxensis*), bullae-like forms (*Globigerinathea subconglobata*, *G. kugleri*) and spinose cancellate forms (*Subbotina eoceana*, *S. corpulenta*). These species provide the biostratigraphic evidences for the E13 zone, which corresponds to the Middle Bartonian age.



Associations with hantkeninids, acarininids, morozovellids, large-sized pseudohastigerinids and globigerinathekids proliferated in warm-water conditions, which changed with climatic cooling during the Priabonian. This is manifested by disappearance of hantkeninids and muricate species in higher formations of the Central-Carpathian Paleogene basin, which after the Bartonian/Priabonian boundary were replaced by temperate-water and eutrophic forms of globigerinathekids and subbotinids, and after the terminal Eocene cooling by dwarfing forms of globigerinids, tenuitellids, pseudohasteriginids, catapsydracids and chiloquembelinids (Soták 2010).

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Calcareous nannofossils of the Jurassic/Cretaceous boundary strata in the Puerto Escaño section (southern Spain)

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The Jurassic-Cretaceous (J/K) boundary interval is currently one of the most studied period, because despite the existing studies (Michalík *et al.* 2009, Wimbledon *et al.* 2011, 2013 etc.), the appropriate stratotype for the base of the Cretaceous still has not been defined. Globally, in this period, specific plankton-assemblages with rock-forming potential have developed.

The radiation of the most important groups (Nannoconids, Calpionellids) significantly increases their biostratigraphical value.

For the purposes of the J/K boundary interval study, material from Puerto Escaño section (southern Spain), has been obtained. The same material has been already processed for magnetostratigraphic studies and biostratigraphic zonation based on tintinnoids (mainly calpionellids) and ammonites (Pruner *et al.* 2010). However, there are no results in calcareous nannofossils biostratigraphy in this study.

The aim of this separate study is to prepare smear slides of already collected samples, to process a micropalaeontological analysis and to compare and calibrate results of calcareous nannofossil biostratigraphic evaluation with already published data from previous studies (Tavera *et al.* 1994, Pruner *et al.* 2010 etc.).

Previous results show the dominance of dissolution-resistant genera such as *Watznaueria*, *Cyclagelosphaera* and *Conusphaera*. Nevertheless, biostratigraphically important species of the family Nannoconaceae (e.g. *Nannoconus steinmannii* subsp. *minor*, *N. steinmannii* subsp. *steinmannii*, *N. wintereri*, *N. kamptneri* subsp. *kamptneri* etc.) are also present.

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New biostratigraphic evidence (texanitid ammonites, inoceramids and calcareous nannofossils) for the Upper and the uppermost Coniacian in the Bohemian Cretaceous Basin

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The re-discovered original specimen of the texanitid ammonite *Texanites pseudotexanus*, described as *Mortoniceras texanus* by Hibschi (1929) and illustrated as *Mortoniceras pseudotexanus* by Storm (1931), as well as three fragments of *Paratexanites*

serratmarginatus documented (and one illustrated) by Fritsch (in Fritsch & Schloenbach 1872) as *Ammonites Texanus*, all from the Bohemian Cretaceous Basin (BCB), were systematically re-evaluated. The occurrence of these two zonal markers confirms the presence of Upper and uppermost Coniacian strata in the BCB. Sediment samples from the specimen of *T. pseudotexanus* provided calcareous nannofossils, including *Lucianorhabdus cayeuxii* and *Lithastrinus grillii*, documenting the uppermost Coniacian, lower part of the UC11c Subzone. These data are in accordance with the occurrence of the inoceramid bivalves *Magadiceramus subquadratus*, *M. crenelatus* and *M. complicatus*. Sediment samples from the specimen of *P. serratmarginatus* provided calcareous nannofossils, including *Lithastrinus grillii* and *Lithastrinus septenarius*, documenting Upper Coniacian (UC11 nannofossil Zone).

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Facies of Holocene tufa at Háj (Slovak Karst)

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Slovak Karst which is a typical karst area of a temperate climate comprises several tufa complexes. The area is built of. The Háj Valley is entrenched down to 300 m in neighboring karst plateaux built of Mesozoic carbonates, mainly Triassic in age. In the valley below the resurgences there are Holocene fossil tufa deposits that exceed 12 m in thickness (Gradziński *et al.*, 2013). The stromatolite, moss and phytoclastic facies form barrages which once dammed the upper reaches of the streams. The phytoclastic, oncoidal, and intraclastic facies with gastropod shells and rare charcoal fragments dominated in dammed segments of the stream. There occurred subordinately some small moss cushions. Tufas in the Háj Valley represent a longitudinal fluvial depositional system. Presently, they are inactive. They stopped growing in the Late Holocene time, after which there was abrupt incision of the streams. This caused downcutting into Holocene tufas, in some places reaching Mesozoic bedrock. At present tufa is being precipitated from the stream in the studied site and form spectacular moss curtains on waterfall faces.

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Trace fossils assemblages from Lower Jurassic (Sinemurian-Pliensbachian) bioturbated marly limestones of the Western Carpathians and the Transcarpathian Ukraine

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Limestones and marly limestones of the Early Jurassic (Sinemurian, Pliensbachian), traditionally regarded to “Fleckenkalk” and “Fleckenmergel” lithofacies (e.g. Mišík 1964), were deposited in deep shelf environment of wide territory of the Northern Tethys (e.g. Wiczeorek 1995; Raucsik & Varga 2008). Ichnological view is based on study of four localities from the Western Carpathians (Skladaná Skala Quarry, Trlenská Valley, Furkaška, Kamenná Poruba) and one locality from the Transcarpathian Ukraine, (Priborzhavske Quarry). Trace fossils were studied on polished slabs, thin sections, serial and cross sections and by an X-ray micro computed tomography. The assemblage of trace fossils consists of horizontal fodinichnia of vagile (*Lamellaeichnus*, *Palaeophycus*, *Planolites*, *Taenidium*) and sessile substrate feeders (*Rhizocorallium*, *Teichichnus*, *Zoophycos*). Chemichnia are presented by *Chondrites* and *Trichichnus*. Rate of bioturbation intensity (ichnofabric index) is relatively high (moderate to heavy and complete bioturbation). Primary sedimentary structures (layered structure) are preserved sporadically. Moreover, sedimentary background with well-preserved younger generation of trace fossils is completely homogenized in most cases. The shallowest tiering level of bioturbation is presented by homogenized sedimentary background. Deeper tier is presented by *Lamellaeichnus*, *Thalassinoides*, *Palaeophycus* and *Planolites*. Below this tiered level are situated *Teichichnus* and *Zoophycos*. *Chondrites* is presented by two forms: larger one (burrow diameters 1.5–3 mm; *Chondrites targionii*) probably coincided with the tiering with *Teichichnus*, *Taenidium*, *Zoophycos* and subtle form of *Chondrites intricatus* (burrow diameter less than 1 mm) is situated inside the deepest tiering level with *Trichichnus*. Pyritic tiny burrows of *Trichichnus* probably originated close to redox potential discontinuity. An idea of probable hypoxic conditions of water and bottom sediment is supported by high abundance of seminafaunal *Bathysiphon*. This implies that infauna was strongly influenced by dysoxic conditions also. This is supported by higher content of total organic carbon (TOC=0.16–0.36) inside burrows (*Lamellaeichnus*), than in paler coloured surrounding rock (TOC=0.09–0.22). This values show that shallow-tier burrows were affected by poor redox cycling. Hypoxic bottom-waters and relatively high sedimentation rate affected poor circulation of mixed-layer (Šimo & Tomašových 2013). On the other hand, substrate feeders explicitly positively influenced oxygen circulation of bottom deposits.

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Middle Miocene deposits at careers near Mykolaiv (Lviv region, Ukraine): fauna and sedimentation features

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A succession of the Middle Miocene strata is exposed in two big quarries near Mykolaiv in the southwestern part of the East European Platform. It is represented by Mykolaiv sands and sandstones (= Mykolaiv beds) (Radwański et al. 2014), which consist of white, light yellow, light gray and greenish-gray glauconitic-quartz detritus-bearing different grained calcareous sands and sandstones with numerous fossils of different taxonomic groups. The thickness is 30-40 m (Venglinsky, Goretsky 1979).

In the sediments have been found foraminifers (*Cibicides dutemplei*, *C. lobatula*, *C. bogdanovi*, *Streblus beccarii*, *Globigerina triloba*, *G. bulloides*, *G. cognate*, *Candorbulina universa*, *Asterigerina planorbis*, *Florilus boucanum*, *Elphidium fichtelianum*, *Sphaeroidina austriaca*, *Uvigerina* sp., *Heterostegina costata*, *H. heterostegina praecostata*, *Amphistegina haueri*), molluscs (*Neopycnodonte navicularis*, *Pseudamussium corneum denudatum*, *Chlamys seniensis lomnickii*, *Chl. seniensis niedzwiedzki*, *Chl. opercularis trigonocostata*, *Chlamys elegans*, *Panope menardi*), brachiopods (*Terebratula grandis*, *Terebratula makridini*), bryozoans (*Exidmonea atlantica*, *Filisarsa elegantissima*, *Ybselosoecia typica*, *Crisia eburnea*, *C. hornesi*, *Exidmonea undata*, *Tervia irregularis*, *Hornera frondiculata*, *Ceriopora globula*, *Lichenopora proposita*), echinoids (*Arbacia monilis*, *Amphidetus intermedius*), serpulids (*Serpula gregalis*, *Polydora* sp.) and shark teeth (*Carcharodon* and *Lamna*).

Sedimentary features and diverse typical marine fauna indicate accumulation of sediments in the sublittoral zone of the sea with intensive hydrodynamic regime. The main feature of the high-energy water environment is bad preservation of bryozoans mainly by fragments of different orientation with rounding traces and without the basis of growth. It could indicate transportation at short distances and burying not at the place of their existence in the basin with high water mobility. In the most zooids elements of morphological structure had been erased or destroyed. The remains of foraminifera *Heterostegina costata* are sorted, oriented, ordered and form a so-called "shell pavement", that also indicates burying not at the place of existence and transportation of water flows over long distances. However, these environment conditions had being unstable. Preservation of brittle thin skeletons and absence of destruction of sea urchins and some molluscs could be explained by quiet water environment and rapid burying that also had being there. There are also sandstones layers with parallel lamination in the lower part of the Middle Miocene section that specify quiet hydrodynamic conditions and could indicate an increasing of the sea depth. A high diversity of marine fauna with partial destruction and the occurrence of the reef-building organisms suggest the existence of organogenic building – a reef nearby, which had been destroyed later. Thus, the Miocene sediments near Mykolaiv were formed in a marine shallow-water environment (depth about 100-150 m) with varying hydrodynamic regime and not far from the sources of the clastic material.

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Dilemma: Independent species or simply morphotypes of lamellaptychi in Late Hauterivian (Lower Cretaceous)?

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The studied material originated from the rich collection of Lower Cretaceous aptychi from sections in France and Spain provided by Dutch colleagues J. Klein and N. Janssen. The advantage of this collection is the occurrence of aptychi in sections which accompany ammonites, which enables to precisely determine the stratigraphy of sediments and age of aptychi.

One of the studied localities is the section of Mt. Tornajo in Spain (Murcia province). In this section which belongs to the Carretero Formation to the ammonite *Subsainella sayni* Zone (basal Late Hauterivian), 17 isolated valves of aptychi were collected. 11 of them were found in the layer of the light-colored marly limestones designated as α 17-18. The valves are fragmentary preserved. However, the majority of the valves is determinable.

All species belong to the genus *Didayilamellaptychus* Turculet, 1994 (see Měchová et al., 2010). The following species were determined: *D. cf. angulicostatus* (Pictet et Loriol) – 2 specimens, *D. andrusovi* (Měchová, Vašíček et Houša) – 4 specimens, *D. cristobalensis* (O'Connell) – 1 specimen, *D. filicostatus* (Stefanov) – 1 specimen, *D. cf. renzi* (Měchová et al.) – 1 specimen.

It is generally assumed that all thick-walled, ribbed calcite valves of Lower Cretaceous aptychi belong to ammonites of the family Haploceratidae Zittel, 1884 (see, for example, Engeser and Keupp, 2002). It is based on the fact that this type of aptychi has been found so far (however only rarely) in the body chambers of *Haploceras*. With the extinction of *Haploceras* at the end of Hauterivian, the aforementioned representatives of aptychi disappeared accordingly.

The one and only ammonite species of the family Haploceratidae, which occurred in Hauterivian, is *Neolissoceras grasianum* (d'Orbigny). 4 species of aptychi, which all originated from the same layer position in Mt. Tornajo, may belong to this only species of ammonites. Even though we may admit that in relation to the sexual dimorphism of ammonites, microconchs and macroconchs could form two types of aptychi with different ribbing, there are two species of aptychi more.

However, it is not evident why the last species of haploceratids may produce 4 morphologically different types of aptychi. Even if we do not exactly know why, one of explanations may be that different types of ribbing cannot belong to the only one ammonite species in the natural biological system. Intraspecific names may describe these different characters of ribbing. Accordingly, representatives of different ribbing types of aptychi cannot correspond to different species of ammonites in the natural taxonomy. They are simply morphotypes.

According to the one example of aptychi valve with a preserved fragment of a shell of a sedentary oyster on its surface, we assume that aptychi valves under study were lying uncovered by sediments on the soft bottom for some time. These valves served some sessile organisms as solid substrate to be anchored to.

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The largest Lower Devonian arthrodire (Placodermi) *Antineosteus rufus* Vaškaninová & Kraft, 2014, from the Emsian of the Barrandian area (Czech Republic)

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Placoderms are a minor component of the fauna from the Devonian of the Barrandian area (southwest of Prague, Czech Republic). The most abundant placoderm remains occur in the basal Lochkov Formation whilst higher up in the section they are rare. Despite of relative uncommon remains the collections are fairly large.

Two fragments of large dermal bony plates described as *Antineosteus rufus* Vaškaninová & Kraft, 2014 were discovered in the upper Emsian strata. The original size of the right central plate of the head shield was larger than the present size, with the preserved width and length both approximately 13 cm. The medial suture with the left central plate is poorly preserved, but appears to be slightly curved. The shape of the posteromedial margin shows that the anterior margin of the nuchal plate was wide and concave. The right anterior dorsolateral plate is slender in the anterior part and widens gradually posteriorly. The anterior part of the plate along with the articular condyle is exposed to the inner bone structure forming a spiny projection in the midline. The articular condyle points dorsally, the shape of the articular area being long, slender and concave ventrally. The length of the plate fragment is 16 cm. Both plates are covered with dermal ornament, partly damaged. In a few areas the typical arthrodire ornament is visible, round tubercles with a shallow ridge separating the tip. Towards the outer margins of both plates, the tubercles tend to be arranged in lines.

Both plates show affinity to the family Homostiidae, with numerous characters in common with *A. lehmani* Lelièvre, 1984. According to the size of the incomplete plates and calculations on the skull length, the total length of the animal alive must have exceeded 3 metres, which makes it the largest Lower Devonian arthrodire known so far (Vaškaninová & Kraft 2014). It was probably much larger than the Australian *Dhanguura* and *Cathlesichthys* (Young 2004) considered to be comparable in size to *Tityosteus rieversae* Gross, 1960.

Primitive brachythoracid arthrodires in the Lower Devonian are known from various regions of the world: from the Rhineland, Aragón and Minusinsk Basin, south-eastern Australia and Morocco – the northern and eastern continental margins of Gondwana - and from Spitsbergen. Mostly in shallow tropical to subtropical marine environments. The occurrence of *A. rufus* is in favour of the possible migration route along the northern continental margin of Gondwana.

These animals were apparently adapted to plankton-feeding. This successful feeding strategy made them the first vertebrates occupying the nutrient-rich ecospace producing the largest animals up to the present.

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Stromatolites and possible Ediacaran metazoa from the Teplá-Barrandian Unit

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Clastic sequences from the upper part of the Neoproterozoic Teplá-Barrandian Unit yielded possible remains of soft-bodied organisms. Fossils are preserved as discoidal, circular, conical and cylindrical molds and casts. *?Aspidella* sp., *?Nemiana* sp., *Spriggia* sp., and possible ichnofossil *Bilinichnus simplex* Palij, 1976 have been preliminarily identified. Recovered fossils have been collected at outcrops of Kocába river banks, in vicinity of Dobříš conglomerate. The same locality contains well preserved columnar stromatolites of conophyton-type, not yet recorded in the Štěchovice Group.

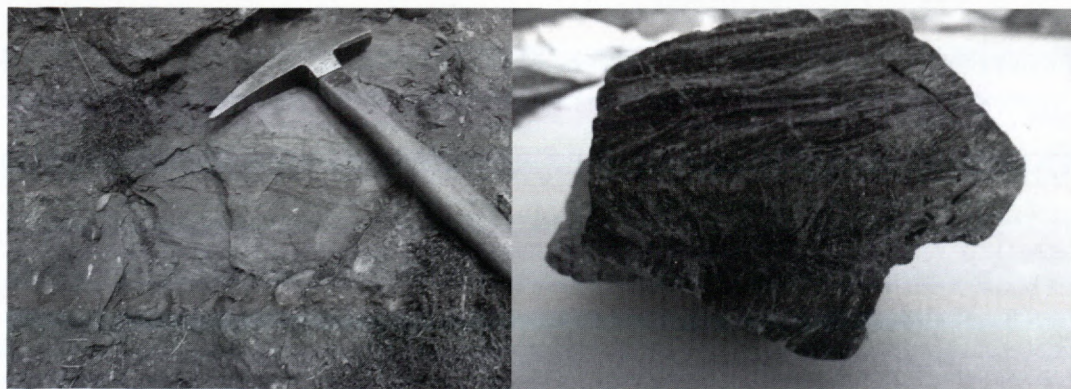


Fig. 1, 2 Stromatolitic textures of the conophyton type. Locality: Kocába river bank near Mokrovrata, Ediacaran Štěchovice group.

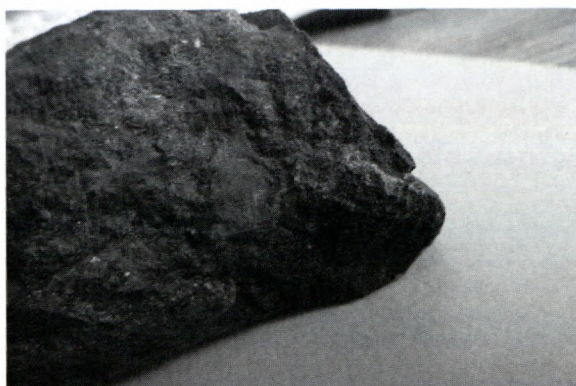


Fig. 3 aff. *Spriggia* (al. *Cyclomedusa minuta* Fedonkin). Size: 9x8mm. Locality: Kocába river bank, near Mokrovrata, Ediacaran Štěchovice group.

The latest knowledge from Pliocene/Pleistocene boundary research in Danube Lowland sediments.

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The presented abstract summarizes information from 11 years of new palaeontological and sedimentological research at the important locality Nová Vieska (Slovakia). The village Nová Vieska is situated in the Slovakian part of the Danube Basin, in its geomorphological part Hronská pahorkatina upland. The locality itself is located SW from this village and it's formed by an abandoned sand pit.

Sediments exposed in a sand pit are sorted into two sedimentary cycles. The first, underlying type consists mainly of fine sands with large planar cross stratification. These sediments, earlier known as "pontian sands", can be correlated with Volkovce Fm., that was deposited on prograding upper to lower delta plain to delta front in time span 8.9-4.1? Ma (Kováč et al., 2011). Overlying sediments, which are divided from Volkovce Fm. by an erosive contact, are correlated with Kolárovo Fm. 4.1-2.6? Ma (Kováč et al., 2011). Sedimentary body can be characterised by planar and trough cross stratification of coarse sands and fine gravels. It refer to sedimentation in the conditions of a braided river with short transport, probably paleo-Žitava.

The site is rich in fossil remains of mammals. Characteristic taxa from the locality are shown in Tab. 1. Most of the species and genera indicate the Middle Villafranchian age („biozones“ MN16b or MN16b/MN17a). But there also occurs the fossil material of *Stephanorhinus* cf. *megarhinus*, *Hipparion* ex gr. *crassum* and *Castor* ?*praefiber*, that should come from older time period (MN15), but precise determination of this material is still uncertain or impossible due to its bad preservation, or stratigraphic occurrence of taxon is disputable (Vlačíky et al., 2008; 2010).

Except fossil mammal remains at the locality were also found silicified pieces of wood. Their detailed xylotomic analysis is in progress, but already now it can be stated that in addition to 2-3 types attributable to deciduous trees (one type is probably a sycamore), most of them corresponding to conifers. One sample has significant cavities after insects drilling; another was placed in the genus *Cathaya* of the pine family. The overall character of the fossil wood pieces and also the presence of the genus *Cathaya* indicate their Neogene origin - they were most probably redeposited into younger sediments.

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EPOCH	Pliocene				Pleistocene				
MAMMAL AGE	Ruscinian		Villafranchian					Galerian	
			Early	Middle		Late		Early	
TAXON*"BIOZONE"	MN14	MN15	MN16a	MN16b	MN17a	MN17b	MNQ18	MNQ19	MNQ20
<i>Anancus arvensensis</i>									
" <i>Mammut</i> " <i>borsoni</i>									
<i>Mammuthus meridionalis</i>									
<i>Stephanorhinus megarhinus</i>									
<i>Stephanorhinus jeanvireti</i>									
<i>Stephanorhinus etruscus</i>									
<i>Eucladoceros</i> sp.									
<i>Metacervoceros rhenanus</i>									
<i>Croizetoceros</i> sp.									
<i>Sus strozzi</i>									
<i>Hipparion</i> ex gr. <i>crassum</i>									
<i>Paradolichopithecus</i> sp.									
<i>Castor praefiber</i>									
<i>Tapirus arvensensis</i>									
<i>Agriotherium</i> sp.									

Tab. 1 Biochronological range of mammal taxa from the locality Nová Vieska. Biochronological ranges of single taxa after Palombo (2007) and Palombo & Valli (2004).

Preliminary results on the Ordovician chitinozoans of the Letná Formation (Prague Basin, Czech Republic)

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The Upper Ordovician of the Prague Basin is represented by a set of mainly siliciclastic sedimentary related rocks, which crop out along both margins of the Prague Basin synclinorium. The Kazín section is a typical representative of the Upper Ordovician, being composed by a set of vertically alternating quartzose sandstones, greywackes, siltstones and pelites. The section is assigned to the Letná Formation, Upper Sandbian (Fatka et al. 2013). Nevertheless, no fossils have been reported from the Kazín section.

Five pilot samples were investigated with the goal to test a presence of OWM (Organic Walled Microfossils). Palynological residues contain a highly diversified assemblage of chitinozoans associated with rare scolecodonts. No prasinophytes or acritarchs are present.

Chitinozoans show bad to moderate preservation. The composition of the assemblage is typical for the Upper Ordovician, with abundant specimens of genera *Belonechitina*, *Conochitina*, *Euconochitina* and *Cyathochitina*. Genera such as *Hercochitina*, *Desmochitina* or *Linochitina* occur scarcely in some of samples. The degree of preservation excludes exact determination of numerous specimens. The chitinozoan assemblage contains taxa of the *Linochitina pissotensis* Biozone sensu Paris (1990). However, this biozone is indicative for the late Darriwillian (late Middle Ordovician) in West Gondwana (Webby et al. 2004) and stratigraphic position of the sequence disclosed at the Kazín section is discussed.

This study confirms the exceptional potential of chitinozoans for dating of otherwise unfossiliferous Ordovician rocks; such studies could provide decisive data for interpretation of tectonic and sedimentary history of the Prague Basin.

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***Ammolagena clavata* (Jones and Parker) in the Cretaceous and Paleogene formations of the Outer Carpathians (Poland)**

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Ammolagena clavata is the cosmopolitan agglutinated species known from the Early Cretaceous and recent assemblages from deep-water environments. It belongs to the organisms preferring an attached lifestyle, which is rather unique in flysch environments. On the one hand this species is common in deep environments, on the other hand its occurrences are rare.

The occurrence of *Ammolagena clavata* was found in 25 within 31 analyzed sections (in total 600 samples) of Cretaceous-Paleogene deposits (in profiles containing continuous sedimentary sequences) of the Outer Carpathians in Poland. 16.8% of Paleogene samples and 3.12 % of Cretaceous ones contained this species, mostly as a single specimen in foraminiferal assemblage. *Ammolagena clavata* occurs irregularly, as an ephemeral, accessory form. The abundant representatives of *Ammolagena clavata* are rare (maximum number: 41

specimens per sample – sample received from about 500 grams of dray mudstone or claystone). Usually its amount reaches 0.01% - 0.4% of all foraminifera in the sample, exceptionally exceed 1%. The maximum percentage is 7.5% (Waškowska, 2014).

Ammolagena clavata occurs irregularly in the assemblages within each section. The most common specimens occur in the hemipelagic Middle Eocene mudstones. It appears only in high-diversity assemblages (average generic diversity is 19, and species diversity is 32) represented by numerous specimens and forms of various epi- and infaunal feeding strategies. These types of assemblages of flysch-type of sedimentation are known as being indicators of favorable environmental conditions i.e., a high supply of organic matter, well oxygenated bottom sediment, and calm water conditions with low terrigenous supply (Waškowska, 2014). An attached form like *Ammolagena clavata* lives on hard elements available at the sea floor. In the studied material, it was usually observed on the tests of other agglutinated foraminifera. *Ammolagena clavata* was not found on inorganic clasts, although detrital grains are one of main components of deposits in flysch environments and are much more common than foraminiferal tests. The inhabited foraminiferal substrates belong to sessile epifauna (*Psammosiphonella*, *Rhabdammina*), mobile epifauna (*Ammodiscus*, *Trochammina*, *Trochamminoides*, *Paratrochamminoides*), as well as shallow infauna (*Reticulophragmium*, *Recurvoides*) and deep migrating forms (*Reophax*, *Karrerulina*). The most commonly occupied tests are *Reophax*, *Psammosiphonella* and *Reticulophragmium*, these forms are common in assemblages but not dominant. It seems that *Ammolagena clavata* at least partly inhabited dead parts of the other foraminifera (Waškowska, 2014). It was observed on certain parts of the agglutinated foraminifera, mainly single chambers of *Reophax*. The tubular chamber of *Ammolagena* extends across the sutures between the chambers of the inhabited foraminifera, which were not exposed during their lifetime. It also often covers and blocks the main aperture of the inhabited tubular foraminifera.

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Mississippian trilobites from the newly discovered trilobite-bearing bed in the vicinity of Brno-Líšeň (Líšeň Formation, Moravian Karst, Czech Republic)

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The Mississippian trilobites from the Moravian Karst were previously recorded from various Tournaisian and Viséan localities of the Líšeň and Březina Formations (e.g. Chlupáč 1966, Rak 2012). The newly discovered trilobite-bearing bed is intercalated in the succession of the Hády-Říčka limestones (Líšeň Formation) in an old abandoned quarry SE of Brno-Líšeň. Stratigraphy and facies at this locality were previously studied by Synek (1999) and subsequently by Poukarová (2014). The lower Viséan foraminifers indicating MFZ 10 and conodonts suggesting *Gnathodus homopunctatus* zone were currently recorded within about

2m thick interval below the bed with trilobites. The previously described lower Viséan trilobites from the Moravian Karst were recorded only in the Březina Formation (Chlupáč 1966, Rak & Viktorýn 2010, Weiner et al. 2012) and include the genera *Archegonus*, *Spinibole*, *Liobole*, *Chlupacula* and *Carbonocoryphe*. The newly discovered association from the Líšeň Formation include the taxa *Bollandia* cf. *persephone*, *Carbonocoryphe* (*Winterbergia*) cf. *parahahnorum*, *Gitarra* cf. *gitarraeformis*, *Liobole* aff. *galaxaura*, *Liobole* cf. *glabroides*, ?*Namuropyge* sp., *Proliobole* cf. *nitida holzapfeli* and ?*Waribole* sp. The previous studies documented the similarity of Mississippian trilobite associations from the Moravian Karst with associations from other European areas. The newly discovered trilobite association confirm the affinity especially with Erdbach limestones (Rhenish Slate Mountains, Harz Mountains, Germany) but also with other areas (e.g. Cantabrian Mountains, Spain).

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New biostratigraphic data from the Paleogene deposits of the Turiec Basin

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In the vicinity of Martin, we studied foraminifers from until now not studied Paleogene parts of earlier realized wells (ZGT – 3 Martin and GT – 5 Žabokreky) in the frame of hydrogeological and basic geological research of the Turiec Basin.

In the ZGT – 3 well, the earlier upper boundary of the Paleogene deposits (Middle to Upper Priabonian, Huty Formation), based on nannoplankton and palinology, was dated in the depths of 1027 m, and the lower boundary was probable in around 2169,5 m; since the depth span of the drill 2097–2103 m reached still Paleogene formations, and the depth span 2199–2204,5 m reached rocks of the Križna nappe Albain. The well was realized under the hydrogeological partial research in 1989–1990.

In the first studied depth of 899 – 900 m, there was present a recrystallized microfauna with continuous appearance from Eocene and Upper Kiscellian, for ex.: *Globigerina praebulloides* Blow, *Hansenisca soldanii* (Orb.), *Oridorsalis umbonatus* (Rss.) and *Siphotextularia concava* (Karrer) (tab. 1). One of the few forms with more narrow stratigraphic range was *Globigerina*

ouachitaensis Howe-Wallace, which appears from Rupelian up to Lower Aquitanian. If the association of foraminifers is original, the deposits correspond to this age. The nannoplankton assemblages correspond to NN1 zone.

In the depth of 1196 – 1197 m we already recognized foraminifers with typical species *Almaena* sp. and *Paragloborotalia opima* (Bolli), starting in the Rupelian up to Lower Chattian (Kiscellian to Lower Egerian) in the central Paratethyan basins. The last mentioned species, appears only in Chattian. The nannoplankton assemblages correspond with NN1 zone.

In the sample, taken from the depth 2199 m (grey marl and marlstone), there are increasing Upper Eocene forms and the agglutinated portion (this was found already in the depth 2101 – 2102 m), indicating deeper water environment. Out of the Upper Eocene to Lower Rupelian (Kiscellian) foraminifers, there are present for ex. : *Subbotina tapuriensis* Blow – Banner and *Subbotina pseudovenezuelana* (Blow - Banner).

After a consultation with the author of the lithostratigraphic unit, we reclassified also the Zuberec and Huty Formation extent. Upper part of the Paleogene deposits is represented by the Zuberec Formation, from, 899 m down to depth of 1406 m. It's underlayer is represented by Huty Formation, down to depth of 2199 m. Besides microfauna the Egerian age is proven also by nannoplankton.

In the GT – 5 well, from undated Eocene deposits from the depth of 300,5 – 500 m, we obtained foraminifers, showing a time span from Rupelian – Chattian (Kiscellian up to Egerian) and we co-ordinated them to the Zuberec Formation.

At the same time, we revised also the surface samples, studied microfaunistically in 80's, for the needs of the 1:25 000 scale geological mapping. Also here, we made the age of individual formations younger.

Microfauna and biostratigraphic correlation of the Biely Potok and related formations of the Central-Carpathian Paleogene Basin

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The Paleogene sediments of the Handlová, Horná Nitra/Bánovce and Rajec Depressions exhibit a different facial character in comparison both to the Podtatranská skupina Group and to the Buda Basin. In the Handlová Depression, the Biely Potok Fm. is developed as the massive sandstones and conglomerates of the Chrenovec Beds and coarse-grained to boulder conglomerates of the Sub-Remata Beds (Gross, 2008). The sediments of the Chrenovec-type lithofacies are known also from the Rajec Depression under the name of Kónská Sandstones (Andrusov & Köhler, 1963). Lithofacial equivalents of the Chrenovec beds occurred also in the Bánovce Depression near Vysočany village.

The biostratigraphic age of these sediments has been dated for the first time at the stratotype locality in the sand-pit near Chrenovec-Brusno village (Zlinská, 2013). The intercalations of non-calcareous claystones of the Chrenovec Beds provide a poor association of small planktonic foraminifers, some large foraminifers (*Operculina* sp., *Planostegina costata*), bryozoans (*Hornera subangulata*), echinoids spines and molluscan fragments. The planktic foraminifers belong to the species of *Paragloborotalia opima*, *Tenuitella munda*,

Chiloquembelina gracillima and *Globigerinoides trilobus*. Benthic organisms consist of These foraminifers provide the biostratigraphic data for the age of the Chrenovec Beds, which was established based on the highest occurrences of *Ch. gracillima* and *P. opima* and in the Late Kiscellian and Early Egerian and lowest occurrence of *G. trilobus* in the Early Egerian. The age of the Chrenovec Beds corresponds to the O5-O6 Zone (sensu Berggren & Pearson, 2005). The foraminifers are well preserved, they are not corroded and sorted, only some of globular form exhibit traces of bioerosion. Therefore, it is not possible to exclude their redeposition and the Late Eggerian age of the Chrenovec Beds.

Chrenovec Beds in the area of Malá Čausa (ČH - 1 borehole) contain a not-fully marine association foraminifer with *Ammonia beccari*, *Heterolepa dutemplei*, *Cibicidoides* sp., *Elphidium* species, *Spiroplectinella carinata*, only with rare planktonic species (*Globigerina praebulloides*, *G. officinalis* Subbotina).

Sandstones of the Chrenovec Beds in the Bánovce Depression contain the claystone intercalations with richer planktic foraminifers. Their association comprises of species *Globigerinoides primordius*, *Globoturbotalita ouachitaensis*, *Globigerina anguliofficialis*, *Paragloborotalia opima*, *P. siakensis*, *Globorotaloides hexagonus*, *Cassigerinella* cf. *chipolensis*, *Chiloquembelina cubensis*, *Protentella* sp., etc. Benthic foraminifers are less frequent, consisting of species *Heterolepa dutemplei*, *Almaena osnabrugensis*, *Planulina cryptomphala*, *Elphidium* sp., etc. The stratigraphic age is dated by the HO of *Globigerinoides primordius*, which corresponds to Early Egerian. The Chattian age is also proved by another planktonic foraminiferal species.

Konská Sandstones of the Rajec Depression were studied in the Kľače section. Their poor microfauna is composed mostly by some agglutinated foraminifers, such as *Rhabdammina eocenica*, *Bathysiphon* sp., *Reophax ampullacea*, *Saccamina* sp., etc. Planktonic foraminifers are very scarce, represented by small-sized tenuitellids (*T. pseudoedita*, *T. gemma*), globigerinids (*G. officinalis*, *Globigerinella pseudoobesa*), dentoglobigerinids (*D. globularis*) and paragloborotaliids. The presence of *Tenuitella pseudoedita* provide the stratigraphic data for the Oligomiocene age of the Konská Sandstones.

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Calcareous nannoplankton biostratigraphy of the Zlín Formation from Krivá Oľka Section (Rača Unit, Magura nappe, Eastern Slovakia)

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A quarry, located south-east of the village of Krivá Oľka, provides for study a bed succession of the Zlín Formation of the Magura nappe. The quarry has dimensions 20 x 5 m (Žec et al., 2005).

Originally, the Zlín Formation was defined by Zapletal (1937) as a formation built of shales and fine-grained sandstones. Later this formation was revised by several authors. Stratigraphic span of the formation is Middle to Upper Eocene.

In the quarry, the grey-green to grey variegated calcareous claystones dominate over sandstones. Sandstones are in prevailing scale fine-grained with well-preserved gradation, horizontal, corrugated and in lesser extent convolute lamination. The distinct prevalence of claystones and the character of lithofacies testify their deposition from turbiditic currents in distal northern part of sedimentary system of the Magura basin, infilling from the south-southeast (Žec et al., 2005).

The nannoplankton assemblages were evaluated from samples (8), taken from the sequence of calcareous claystones. Found assemblages of calcareous nannoplankton have demonstrated the Middle to Upper Eocene age of the Zlín Formation in the quarry of Krivá Ol'ka.

All found assemblages of the calcareous nannoplankton were relatively poor and contained badly preserved coccoliths, previously suffering strong corrosion, which made difficult their precise identification.

Middle Eocene (NP 16 – 17) has been demonstrated only in the sample 3, where a poor assemblage of nannofossils was found with badly preserved coccoliths. Middle Eocene age was demonstrated by the species *Helicosphaera compacta* Bramlette et Wilcoxon, *Cyclicargolithus floridanus* (Roth et Hay) Bukry and *Reticulofenestra hillaie* Bukry. Zone NP 16 is based on the presence of species *Helicosphaera compacta* Bramlette et Wilcoxon and *Cyclicargolithus floridanus* (Roth et Hay) Bukry. According to Aubry (1986) it is the first occurrence of *Cyclicargolithus floridanus* (Roth et Hay) Bukry in the zone NP 16, first occurrence of the species *Helicosphaera compacta* Bramlette et Wilcoxon is usually put to higher part of the zone NP 17 (Perch-Nielsen, 1985), but Aubry (1983) gives the first occurrence of this species lower than the upper part of the zone NP 16 (cf. Theodoridis, 1984; Varol, 1998).

Upper Eocene (NP 19/20) was found from samples 1, 2, 4, 5 and 8 by the presence of the species *Isthmolithus recurvus* Deflandre. The base of this zone is defined by the first occurrence of the species *Isthmolithus recurvus* Deflandre and the last occurrence of the species *Discoaster saipanensis* Bramlette et Riedel and/or *Discoaster barbadiensis* Tan, being present in majority of samples.

Probable Lower Oligocene assemblage (?NP21) was found in samples 5 and 7, where a species *Reticulofenestra* cf. *lockeri* Müller was found. The base of the zone NP 21 is defined by the last occurrence of the species *Discoaster barbadiensis* Tan and/or *Discoaster saipanensis* Bramlette et Riedel and the uppermost parts of the zone by the last occurrence of the species *Coccolithus formosus* (Kamptner) Wise. The assemblages of this zone are characteristic with common occurrence of the species *Isthmolithus recurvus* Deflandre. According to numerous authors (Monechi, 1986; Perch-Nielsen, 1985; Krhovský a kol., 1992), the increase of the abundance of the species *Isthmolithus recurvus* Deflandre represents a characteristic biostratigraphic event on, or below, the Eocene/Oligocene boundary. Despite, in our samples the presence of species *Isthmolithus recurvus* Deflandre was less abundant, and in the sample 7 it was even not present, though there have appeared the individuals resembling the species *Reticulofenestra* cf. *lockeri* Müller, which according to our investigation in the area of the Nízke Beskydy Mts., has its first occurrences bound to Lower Oligocene (NP 21).

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