Environmental, Structural and Stratigraphic Evolution of the Western Carpathians

WECA

PALEOGEOGRAPHICAL PALEOECOLOGICAL PALEOCLIMATICAL DEVELOPMENT OF CENTRAL EUROPE

1. Czech and Slovakian Paleontological Seminary
2. ESSEWECA/EEDEN Workshop
3. International Visegrad Fund – Paleoclimate workshop

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Foreword

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In fact, this scientific meeting will comprise three autonomous seminaries: the 3rd Czech and Slovakian Paleontological Seminary, followed by the ESSEWECA / EEDEN Seminary, supported by the European Science Foundation, and, finally, terminated by the final workshop of the International Visegrad Fund Project No 045-2001-IVF. This project has been named as the „Warning against abrupt climatic change as followed from the knowledge of evolution of climate in the geological past of the Earth. Despite of close time - proximity of another, even larger geological assembly in the same town (the XVIIth Congress of the Carpathian – Balkan Geological Association will be held in September 1-4th in Bratislava), we are convinced that the paleoenvironmental aspects, which are the main goals of our Conference oriented on, deserve a special attention.

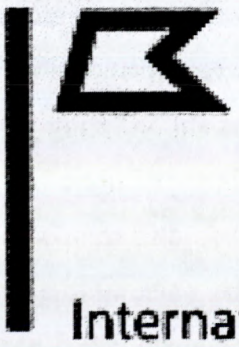
The Stable Czech and Slovak Paleontological Seminary

continues in good traditions of the former Czechoslovak Society for Mineralogy and Geology, which controlled the progress and activity of geoscientific research in Slovakia and Bohemia for many decades. This relatively small community has been always keeping close mutual relationships between specialists of two mid-European nations and utilizing the advantage given by similarity of these two Slavonian languages. It was also thanks to this co-operation, why the paleontological research in former Czechoslovakia has kept on good level in the 20th Century. We would like to welcome Polish friends who also do not need to learn any further language and who are able to communicate with us in their mother language without any translator, too.

Štátny geologický ústav Dionýza Štúra
GEOLOGICKÁ KNIŽNICA

The EEDEN (Ecosystem Dynamics in European Neogene) Project is one of the most successfull geoscientific projects of the European Science Foundation. Modelling of terrestrial as well as marine paleoenvironments and depositional systems is a prerequisite step on the way to a „total system view" on the processes controlling ecosystem change, collapse and recovery during the Neogene. Recent advances in high-resolution chronology, paleogeographic and palinspastic reconstructions and modern insights into the biological validation of paleoproxy records shooul be assimilated in this field. EEDEN programme is considered a pioneering and most challenging attempt to examine terrestrial and marine Neogene ecosystems in the framework of temporal and spatial reconstructions.

European Science Foundation



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Warming are well up on the current political agenda. Various activists, political movements and parties appeal to break the passivity concerning rising human contribution to climate deterioration. According to media allert, indicators of global warming during last decades seem to show our little word is drag towards conditions close a hot hell on the Earth.

The countries of the Visegrad Agreement (Hungary, Slovakia, Poland and Czech Republic) are situated in the centre of Europe, in a continent with old industry tradition producing all its negative impact on the nature and life environment. Our territory is more afforested than several neighbouring countries, which are consuming more oxygen from the atmosphere, than they produce. Our territory is called „the roof of Europe". With the exception of the Danube River, all our rivers are taking their water from springs on our

territory. The only new water is coming from the rain- and snow precipitations. Therefore, the question of climate change is necessarily in the centre of attention.

Three major issues are often put stressed together in people´s mind. It is global warming, ozone depletion (the „ozon hole") and acid rain. In various degree, all these issues should be leveridged by human activity. Houghton (2001) summarized several urgent questions everyone is asking:

- Are human activities really altering the climate ?
- Is the global warming something more than a fashioned hypothesis ?
- If so, how big are the changes likely to be ? Can we adapt them ?
- Will there be more serious disasters ? When ?
- Can we change the way we do things so that we can slow down the change or event prevent it occuring ?

To answer at least a part of them, we must identify precisely the sources and understand properly the climate change mechanism. Maybe, Hansen et al. (2001) were right, arguing that the role of human fossil fuel combustion in this mechanism uses to be overappreciated. The trend of individual greenhouse gasses increase in the atmosphere is not directly related to human waste production. The anthropogenic activity leading to global warming acts on the background of natural processes. The mechanism of these processes was operating along decades of millions-, instead of bare decades of years. Therefore, it would be insufficient to precess data obtainable within limits of our direct observation: we must encounter rich ancient database written by geological record (see Moore at al., 1992, Hay 1994, or Michalík et al., 1999).

With no doubts, the environmental change has been in operation since the Earth as a planet came into existence. Since that time, dynamic systems of energy and material transfer have operated to effect gradual and sometimes catastrophic transformations of the atmosphere, hydrosphere, biosphere and lithosphere (Mannion, 1997).

We would like to preserve the best of informations contained in papers presented in three meetings mentioned above. This is because we collected extended abstracts of both oral contributions and posters. We are grateful to the International Visegrád Fund, which provided means for this abstract book. Selected papers from this ESSEWECA conference will be published in full version in the Geological Carpathica journal.

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Radiolarian biostratigraphy of the Upper Cenomanian–Lower Turonian deposits in the Subsilesian nappe (Polish Outer Carpathians)

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Key words: mid-Cretaceous, Radiolaria, biostratigraphy, Subsilesian Nappe, Poland

The Upper Cenomanian–Lower Turonian flysch deposits of the Subsilesian nappe of the Outer Carpathians have been investigated in relation to their age based on radiolarian fauna. These deposits comprise green and black, siliceous shales with manganese concrections, tuff and benthonites. "Green radiolarian shales" represent the most distinctive horizon of the Outer Carpathians. They are present in the Skole nappe (so-called "Dołhe Formation"), Silesian nappe (the Barnasiówka Radiolarian Shale Formation), Subsilesian nappe ("Green radiolarian shales") and Magura nappe (the Hulina Formation) in the Polish part of the Outer Carpathians.

The studied section is situated at Zasań settlement, near the Trzemeśnia village, about 10 km east from Myślenice town. The Albian–Turonian deposits of the Subsilesian nappe in this area are represented by the Gaize Beds, which are followed by the "green radiolarian shales" and the lower part of the "Variegated Shales".

The results presented here are based on micropalaeontological analysis of twenty-eight samples collected from the "Green radiolarian shales". Thirty species of Radiolaria have been identified. The assemblage is dominated by spherical cryptothoracic and cryptocephalic Nassellaria. They consist of 60-99 % of the radiolarian fauna. Spumellarians are less common but more diversified. They consist up to 40%, and are represented mainly by genera such as *Patellula, Crucella, Paronaella, Praeconocaryomma* and *Alievium*. This association is characteristic of the fauna around the Cenomanian–Turonian Boundary Event.

The radiolarian association from the lower part of the Zasań section is well correlated with *Holocryptocanium barbui-Holocryptocanium tuberculatum* assemblage proposed by Dumitrică (1975) for radiolarian-bearing deposits of the Romanian Carpathians. The first occurrence of Alievium superbum (sample Zas-6) marks the base of Alievium superbum radiolarian Zone of Pessagno (1976) which includes the radiolarian assemblage from the upper part of the section.

Two radiolarian species: Alievium superbum and Crucella cachensis have been proposed as biomarkers for setting the Cenomanian – Turonian boundary in the deposits of the Subsilesian nappe in the Polish Outer Carpathians.

Nannoplankton study of the Paleogene deposits of the Rajecká kotlina Depression

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Key words: Upper Priabonian, calcareous nannofossils, biozonation.

Paleogene sequence of the Rajecká kotlina Depression contains a nannoplankton-rich marls. Their assemblage comprises of the index species, which indicate the NP 19 - 20 Biozone (e.g. *Isthmolithus recurvus, Cribrocentrum reticulatum, Pontosphaera latoculata*, etc.).

Paleogene sequence of the Rajecká kotlina Depression consists of the following formations: basal transgressive formation (organogenic limestones and conglomerates), marly sandstones with bryozoans, light-brown and ochreous marls, menilitic shales and cherts and flysch formation (Andrusov et al. 1962, Köhler 1967, Šalaga et al. 1976, Zágoršek 2000, etc.). The sequence ranges stratigraphically from the Bartonian to the Upper Rupelian, belonging to the foraminiferal zones P-15 up to P-21 (Köhler 1998). The most important data for stratigraphic determination come from the calcareous marls, which are rich in planktic foraminifers (Globigerina Marls with *Globigerapsis mexicana, G. index, Globigerina eoceana, G. pseudoampliaperta, Turborotalia* ex. gr. *cerroazulensis*, etc., in Šalaga, Borza, Köhler, Samuel & Snopková 1976). Globigerina Marls also contain a very rich and well preserved calcareous nannoplankton, which provides an aditional data for parastratigraphic determinations.

Nannoplankton-rich marls were sampled from the Kunerad locality. Nannoplankton assemblage of the calcareous marls dominates in the following species: *Coccolithus pelagicus* (Wallich), *Reticulofenestra umbilica* (Levin), *Cribrocentrum reticulatum* (Gartner & Snnith). Less abudant to sporadical are *Cyclococcolithus formosus* (Kamptner), *Chiasmolithus oamaruensis* (Deflandre), *Dictyococcites bisectus* (Hay, Mohler & Wade), *Laternithus minutus* Stradner, *Zygrhablithus bijugatus* (Deflandre), *Isthmolithus recurvus* Deflandre, *Sphenolithus moriformis* (Bronnimann), *Sphenolithus radians* Deflandre, *Cyclicargolithus floridanus* (Roth & Hay), *Braarudosphaera bigelowii* (Gran & Braarud), *Discoaster saipanensis* Bramlette & Riedel, *Discoaster barbadiensis* Tan, *Transversopontis pulcher*

(Deflandre), *Pontosphaera latoculata* Bukry & Percival, *Pontosphaera multipora* (Kamptner), *Neococcolithes dubius* (Deflandre), *Coronocyclus nitescens* (Kamptner), *Nannotetrina fulgens* (Stradner), *Helicosphaera bramlettei* Muller, *Corannulus germanicus* Stradner, *Rhabdosphaera* sp. Haeckel, (Perch-Nielsen 1985).

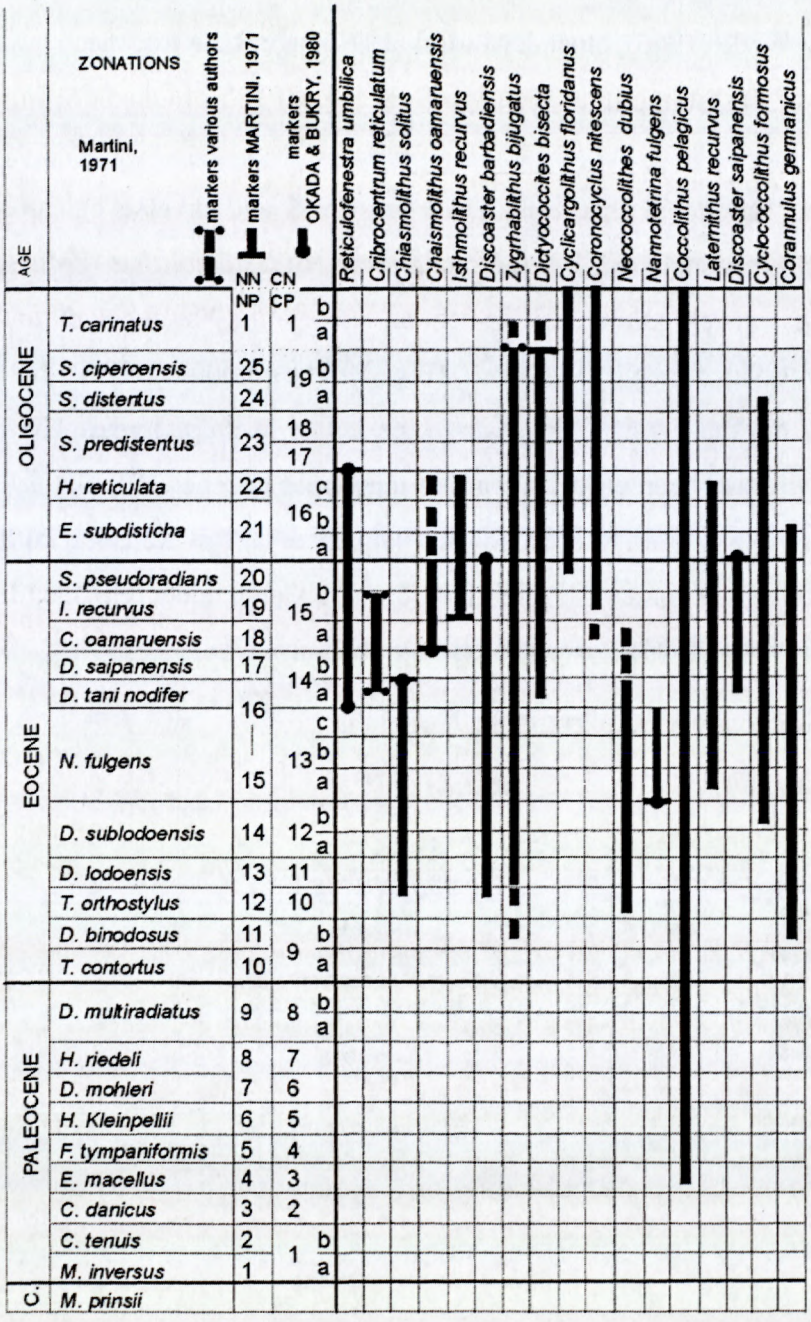


Fig. 1 Distribution of calcareous nannofosils in the Kunerad locality

Nannoplankton assemblage of the calcareous marls provides an index fossils reliable for the stratigraphic determination (Fig. 1). The most indicative nannoplankton datum is the FO of Isthmolithus recurvus, which coincides with the base of the NP 19 Biozone (Upper Priabonian). Similarly, the extinction datum of Cribrocentrum reticulatum links with the end of the NP 19 Biozone. However, the species of Pontosphaera latoculata seems to appear close to the Eocene/Oligocene boundary (NP 20 Biozone). Nannoplankton assemblage dominates by cool-water species (Laternithus minutus, Isthmolithus recurvus, Pontosphaera latoculata), decreasing in portion of warm-water discoasterids. The later shown the LO of Discoaster saipanensis on the Eocene/Oligocene boundary. Such type of nannofossil association with predominance of cool-water taxa and only few diskoasterids indicates the Late Eocene cooling. Based on the index

fossils and cool-water preferences, the nannoplankton assemblage of the light-brown marls corresponds to the Isthmolithus recurvus Zone (NP 19 – NP 20). This zone is defined as follows:

Definition: The base of the zone is defined by the first occurence (FO) of Isthmolithus recurvus to FO of Sphenolithus pseudoradians.

Authors: Hay, Mohler & Wade (1966), emend. Martini (1970), age: Late Eocene.

Correlation: Lower part of the Isthmolithus recurvus Subzone, CP15b of Okada & Bukry (1980).

Remarks: The examined sample in this zone yield preserved and diverse calcareous nannoplankton assemblages, characteristed by the occurrence of *Isthmolithus recurvus, Discoaster barbadiensis, Discoaster saipanensis.* Such an association is believed to be indicative of the combined interval zone NP 19 – NP 20 (Fig. 2). The combined NP 19-NP 20 of Aubry (1983) is defined from the FO of *I. recurvus* to the LO of *D. saipanensis.* The FO *Isthmolithus recurvus* has traditional been used as a base of the Upper Eocene – NP19.

Conclusions: Calcareous marls from the Paleogene sequence of the Rajecká kotlina Depression, which occur above the basal transgressive formation and under the menilitic shales, are assigned to the NP 19 – NP 20 Biozone (Upper Priabonian).

The paper is a contribution to the VEGA grant No 7068.

		OKADA & BUKRY (1980)			MARTINI, 1971	
AGE		ZONE		SUB-ZONE	ZONE	
OLIGOCENE	E	CP16	*Helicosphaera reticulata*	CP16c CP16b CP16a	NP22	*Helicosphaera reticulata*
					NP21	*Ericsonia subdisticha*
EOCENE	L	CP15	*Discoaster barbadiensis*	CP15b	NP19-20	***Isthmolithus recurvus***
				CP15a	NP18	*Chiasmolithus oamaruensis*
	M	CP14	*Reticulofenestra umbilica*	CP14b	NP17	*Discoaster saipanensis*
				CP14a	NP16	*Discoaster tani nodifer*
		CP13	*Nannotetrina quadrata*	CP13c CP13b CP13a	& NP15	*Nannotetrina fulgens*
	E	CP12	*Discoaster sublodoensis*	CP12b CP12a	NP14	*Discoaster sublodoensis*

Fig. 2 Calcareous nannoplankton biostratigraphy of the Late Eocene and Early Oligocene (Martini, 1971; Okada & Bukry, 1980)

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Ammonite fauna of Psiloceratacеae Hyatt, 1867 superfamily from Lower Jurassic limestone formation of the Veľká Fatra Mts (Central Western Carpathians, Slovakia).

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Key words: Early Jurassic, ammonites, paleobiogeography, Adnet Formation, Tethyan Realm, Boreal Realm

The outcrops studied (southern slope of the Frčkov Hill, the Rovné Valley, Bystrická Valley and western slope of The Zvolen Hill; text-figure 1) are situated in southern part of the Veľká Fatra Mts. Generally, Sinemurian age of the Hierlatz Fm is characteristic in this part of the mountain. It is represented by thick layered crinoidal-, massive varicoloured oncoidal-, massive grey-brown- and pink micritic limestones and/or sandy marls. Lotharingian, Pliensbachian and Toarcian Adnet Formation is represented by red and pink micritic and nodular limestone (10 – 40 cm wight) in its lower part, and, higher-up, by brick-reddish marly limestones and marls higer-up terminated by 2 cm thick stromatolitic condensed bed.

Three subzones were distinguished here The Oxynotum Subzone indicated by Oxynoticeras oxynotum (Quenstedt), the Raricostatum Subzone with Echioceras raricostatum Zieten, E. raricostatoides (Vádász), Paltechioceras favrei (Hugh) and P. cf. boehmi (Hugh)

and the Macdonneli Subzone with Paltechioceras charpentieri (Schafhäutl) and Leptechioceras meigeni (Hugh).

Echioceras is known from the Euroboreal region, but sometimes it occurs together with Juraphyllites libertus (Gemmellaro), a typical Tethyan ammonite. Paltechioceras charpentieri (Schaufhäutl) and P. favrei (Hugh) are of Euroboreal affinity, but P. boehmi (Hugh) occcurs with Tethyan ammonites, again.

This faunal composition indicates the Sinemurian age. The occurence of Oxynoticeras oxynotum (Quenstedt) proves for Late Sinemurian age of the basal part of the Adnet Fm.. Dominance of Boreal ammonites over Tethyan forms is important from the paleogeographical point of view.

This paper is a contribution to the VEGA grants No 7215 and No 7068.

Late Cretaceous foraminiferids from the Frydek - type marls (Subsilesian Unit, Polish Outer Carpathians) - preliminary results

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Key words: Late Cretaceous, Foraminiferida, planktonic, benthic associations, Subsilesian Unit

Within the Polish Outer Carpathians, the Subsilesian Unit appears mostly in tectonic windows. The area studied is located in the Nowe Rybie village close to the Żegocina tectonic window. That tectonic window is part of the Lanckorona-Żegocina Zone (Gasiński et al.,1999, Skoczylas-Ciszewska, 1960), which belongs to the Subsilesian Unit. Foraminiferids examinated have been collected from the Frydek - type marls which occur along Pluskawka creek and its tributary. Marls are represented by grey, rather hard marls and marly-shales with intercalations of thin - bedded sandstones.

The foraminiferal associations consist of agglutinated as well as planktonic and benthic calcareous taxa. The neritic fauna has been found as well. Although few samples include only agglutinated foraminiferids, in majority samples there have been found also planktonic foraminiferids, which helped to establish the Late Cretaceous age of the studied materials (Robaszyński, Caron, 1995). Recognized planktonic foraminiferids that come from the Frydek - type marls are represented by: *Globotruncana arca* (Cushman), *Globotruncana aegyptiaca* Nakkady, *Pseudotextularia elegans* (Rzehak), *Racemiguembelina fructicosa* (Egger),

Heterohelix div sp. These foraminiferids associations indicate the Late Campanian and Maastrichtian age of the examinated materials.

Within benthic foraminiferids taxa such as have been found: *Ammodiscus* sp., *Hormosina* sp., *Rzehakina epigona* (Rzehak), *Glomospira charoides* (Jones et Parker), *Geossella rugosa* (Hanzlikova), a few specimens of *Reussella szajnochae* (Grzybowski). Moreover, among agglutinated taxa there have been found tubular forms (*Rhabdammina* sp., *Bathysiphon* sp.). The composition of these species do not allow to establish the age of the deposits studied.

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Integrated biostratigraphic study of the type locality of the Schrambach Formation (Schrambachgraben, south of Salzburg)

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Key words: Early Cretaceous, calpionellids, calcareous dinoflagellates, ammonites, Schrambach Fm, Eastern Alps.

The type section of the Schrambach Formation in the locality of Schrambachgraben (4 km SSE of the town of Hallein) exposed in the Schrambach stream is limited by the sequence of strata beginning at the base of the lower (main) waterfall and ending below the upper waterfall. The Schrambach Formation is underlain by the Oberalm Formation and covered by the Rossfeld Formation.

In the studied section, the first problem consisted in the determination of the base of the Schrambach Formation, as a continuous transition occurs between the Oberalm Formation and the overlying formation. Therefore, we put the base of the Schrambach Formation on the first sandy limestone intercalation. Above the waterfall, merely thin-bedded, light grey to

brown-grey siliceous silty marlstones intercalated with slabs of compact marlstones to siliceous limestones follow.

In the lower part of the section, still in the Oberalm Formation, *Calpionella elliptica, Tintinopsella carpathica* and rarely *Crassicollaria intermedia, Cr. massutiana* (redeposited forms) and *Cr. parvula* were found. By the base of the Schrambach Formation, *Tintinopsella subacuta* and the first remaniellids appeared for the first time; in the immediate underlying beds, *T. longa* occurred. *T. subacuta* appeared in the lower part of the Upper Berriasian for the first time. Moreover, the presence of *Lorenziella hungarica* indicates the Late Berriasian age as well. In the deposits mentioned, cysts of dinoflagellates characteristic of both the Upper Jurassic and the middle Berriasian occur together.

What is surprising in the part above the upper edge of the waterfall is the occurrence of *Calpionellites darderi* (upper Early Valanginian) here. The assemblage of dinocysts is stratigraphically inconclusive here.

In the overlying beds Pseudoceratium pelliferum that can be taken as an indicator of the Late Berriasian appears for the first time. The finding of the ammonite, *Erdenella paquieri*, corresponds to it, too. The occurrence of *Beriasella* cf. calisto and shortly after that the first occurrences of *Dissiliodinium globulus*, Cribroperidinium edwardsii indicate the Valanginian base. The Early Valanginian age of the overlying beds is confirmed by the findings of the zonal index ammonite, *Thurmanniceras pertransiens*, as well as *Calpionellites* cf. *darderi* and *Ct.* cf. *major*. This is the end of the exposure.

According to all indicators introduced, stratigraphic range of the Schrambach Formation in its type locality is from the Late Berriasian to the upper part of the Early Valanginian.

Early Paleozoic Conulariids of the Barrandium: The most important representatives and their world equivalents

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Key words: Ordovician – Carboniferous, Conulariida, stratigraphic distribution, paleozoogeography, Barrandium.

The Barrandium area in Bohemian Massif represents one of the richiest conularian fossil site in the world. 29 conularian species were found here, which represents one tenths of total connularian taxa described in the world.

The peak of conularian specific diversification happened during Ordovician and Silurian, important decrease of specific diversity was recorded since Carboniferous. In the Barrandian area, range of Conulariida is since Early Ordovician (Tremadocian) until mi Devonian (Eifelian). The first conulariids appeared in the Mílina Formation (*Conularia* (*Archaeoconularia*) *insignis* Barrande 1867). Number od species in younger formations gradually increases to the maximum of twelve species in both the Šárka- and Dobrotivá formations (Llanvirn / Caradoc). Specific diversity gradually decreases higher-up, the minimum is reached in the Bohdalec Formation. Low diversity continues to Silurian strata, it moderately rises in their higher parts (Ludlowian, Přídolian), and in lower Devonian beds (Lochkovian, Pragian). The last conulariids were found in mid Devonian Choteč Formation, being represented by *Conularia* (*Plectoconularia*) *ultima* Želízko, 1913.

Ordovician conularians are represented by 8 species in the Barrandium, which can be regarded as the most ecologically successfull due to abundant findings in various lithofacies. Most of all, *Conularia* (*Archaeoconularia*) *insignis* Barrande, 1867 and *Metaconularia imperialis* (Barrande, 1867) show considerable biometric variability and occur in sedimentary iron ores, shales and quartzitic sandstones as well. Consequently, these species probably constituted ecophenotyps dependent on certain environment.

Mentioned genera are abundant in Moroccan Ordovician associations occurring in quartzose sandstone facies and in shale concretions as well. Their size and biometric variability is mostly large, similarly to Czech representatives. Identic conularian fauna (if compared with the Czech associations) occurs in Germany (Rhinian Slate Mts) a Great Britain. The paleobiogeographic distribution of conularians is in accordance to modern

paleogeographic concepts (Scotese a McKerrow 1990) and it corresponds with occurrences of other paleozoological groups (trilobites, problematics).

Exuviation in trilobites – a process of shedding of the old exoskeleton

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Key-words: Paleozoic, Trilobita, exuviation, taphonomy.

Trilobites like other arthropods periodically shed their old exoskeleton. This process is called exuviation or molting. In Recent arthropods it includes the processes of preparation for shedding their old exoskeleton, the shedding itself and subsequent stages of growth. In trilobites it is supposed that the sequence of these events was similar. After the exuviation followed a relatively short period of postecdysial stage with soft integument and with possible rapid growth. Then followed the secretion of the principal layer of the new exoskeleton.

The withdrawing from the old intergument is preceded by the weakness of the old cuticula or their dissolving. This weakness is remarkable mainly on the sutures connecting the cephalon with thorax or thorax with pygidium.

The old exoskeletons – exuviae can be distinguished from the dead specimens according to several marks such as presence of opened ecdysial lines; disarticulation of exoskeletal parts attributable to movements of the soft trilobite leaving its old exoskeleton; tendency for a certain type of exoskeleton configuration, and others. Also probably the mode of exuviation of any trilobite species may not be characterised by a single way and one species can show different modes of exuviation.

As is noted above the exuviation could yield a huge number of exoskeletal configurations in the dependence on the place where the old exoskeleton was broken and which movements the trilobite used to leave its old intergument. To the well known configurations belongs the axial shield (also called Harrington´s configuration) – the librigenae, rostral and hypostomal plates are isolated. The Salterian position is typical for trilobites with non-functional facial suture. The cephalon is isolated from the rest of the exoskeleton, inverted and turned by 180^0. Inversion and rotation of other parts of exoskeleton such as thorax, pygidium, pleurae etc. also was observed in other molting configurations.

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Stratigraphic range of myctophid species (otoliths) in the European lower and middle Miocene and its significance in the Central Paratethys Realm

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Key-words: Miocene, otoliths, stratigraphic distribution, paleobiogeography, Central Paratethys.

In the last decade the fish otoliths of mesopelagic family Myctophidae have been widely studied and revised in the European Oligocene and Miocene (Brzobohatý & Nolf 1995, 1996, 2000, Nolf & Brzobohatý 1997, 2000). The comparison of their distribution in the Mediterranean, Transeuropean, Atlantic and Boreal bioprovincies shows some stratigraphical evidence of otoliths in the lower and middle Miocene of the Central Paratethys which wider employment in other basins is a matter of discussion.

In Europe 26 species of otoliths of the family Myctophidae were documented in the lower and middle Miocene. Their stratigraphical distribution indicates two important events:

1) First occurrence of 6 species Symbolophorus meridionalis, Diaphus haereticus, D. cahuzaci, D. regani, Hygophum derthonensis and H. hygomi at the level of nannoplankton zone NN1 correlating with the decline of typical Oligocene species Diaphus alcoholicus, D. longirostris, D. perspicilatoides and D. pristismetalis. The Oligocene/Miocene boundary is thus very distinct in associations of mesopelagic fishes.

2) First occurrence of 5 species of Diaphus (D. befralai, D. cavallonis, D. holti, D. rafinesquei, D. splendidus) in the Mediterranean Serravallian. The absence of these species in the lower Badenian of the Central Paratethys is not compatible with some new correlations of the Serravallian and lower Badenian based on nannoplankton (Švábenická in print). The diversity and the composition of mesopelagic and bathypelagic fish fauna in lower Badenian illustrates good communication of both regions. The Serravallian entry on mentioned species some of which show cosmopolitan or wide Atlantic distribution represents evidently a younger event than the lower Badenian one.

Another conclusion of the revision work is that Lampanyctus carpaticus and Hygophum weileri represent species so far found only in the Karpatian of the Central Paratethys and can be thus used as an important stratigraphic marker in the region. The endemism is, however, not very probable in myctophid fishes. The occurrence of Hygophum murbani, Lampadena speculigeroides and Lampichthys schwarzhansi has been reported so far only in the lower Badenian of the Central Paratethys. Recent Lampichthys is restricted to southern oceans under

the influence of South Temperate Convergence and the fossil record is reported in the Tongaporutuan of New Zealand. Consequently, Lampichthys may represent a south oceanic element which is in the lower Badenian fish fauna corroborated also by representatives of mesopelagic Woodsia (Phosichthyidae).

Distribution of Cambrian "homalozoan"echinoderms

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Key-words: Cambrian, Echinodermata, Ctenocystoidea, Homostelea, paleoecology, distribution, evolution.

Echinoderms usually constitute only a small percentage of Cambrian assemblages. Published data show, that Lower Cambrian echinoderm faunas are dominated by spectacular creatures like the helicoplacoids, early edrioasteroids and the first eocrinoids, being supplemented by "homalozoans"and very probably also by the earliest crinoids during the Middle Cambrian time. Based on the gross morphology, two principal feeding strategies have been supposed for the Middle Cambrian echinoderms:

1. Sessile low-to-high-level epifaunal suspension feeders.
2. Mobile benthic or shallow burrowing detritus feeders.

For the bilaterally symmetrical "homalozoans", utilization of the thin surface organic detritus rich layer is supposed. The "Homalozoa" comprises four groups - Homoiostelea, Stylophora, Homostelea and Ctenocystoidea. They all are small, spectacular, nearly bilaterally symmetrical creatures bearing several tens to hundreds calcium carbonate thecal plates. However, the stratigraphical ranges and palaeogeographical patterns of distribution show surprisingly different scenarios for these four groups.

Stratigraphy: Ctenocystoidea and Homostelea occur solely in Middle Cambrian, while the other two groups - Homoiostelea and Stylophora range since the Middle Cambrian up to Devonian and/or Upper Carboniferous, respectively.

Palaeogeography: Ctenocystoids are characterized by a global distributional pattern, being established in Laurentia, Gondwana (Tasmania), peri-Gondwanan Europe (Wales, Spain, France, Bohemia), and Baltica (Poland), while homosteleans are commonly represented in the peri-Gondwanan Europe (Britain, France, Spain, Bohemia, Sardinia, Germany), occur sporadically also in the Gonwanan Africa (Morroco) and Siberia.

Stylophorans are documented from the peri-Gondwanan Europe (Germany, Bohemia, Wales, Montagne Noire, Sardinia), Baltica (Sweden, Danemark), Gondwana (Australia, Korea) and Laurentia. Cambrian species of the class Homoiostelea are geographically limited to Laurentia only.

Serranus budensis (Heckel 1856) from Paleogene Huty Formation (Western Carpathians, Eastern Slovakia)

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Key words: Teleostei, Paleogene Huty Formation, Western Carpathians.

The "menilite"- type claystones belonging to the Paleogene Huty Fm contain unique remnants of fossil fish. The occurrence of Serranus budensis (Heckel 1856) was described by Gregorová & Fulín (2001) and by Chalupová (2001) predominantly from the Western Carpathian regions, situated outside of the Slovakian territory.

This paper brings further information on Serranus budensis (Heckel 1856) derived from the Bystré locality (700 m northwest from the Bystré village) situated in the valley of unnamed brook. The are studied is situated on Beskydy foothill, the district of Vranov nad Topľou. Mentioned brook encovers middle Oligocene to Rupelian sequence of the Huty Fm built of claystones and siltstones with sporadic sand admixture. The claystones are grey, grey-black to black with tabular to slate disintegration. Rare sandstone beds situated in lower part of sequence are decimeter in size. They are fine to medium-grained, brown to grey-brown coloured. Pelitic lowermost part is passing locally to laminated pelocarbonates with prismatic disintegration. The direction of layers is 120^0 to the southeast with inclination of $30 - 40^0$. The grey-black claystones containing fossil fish were encovered by brook erosion. These grey-black claystones are differently lithified from crumble to slate and platy disintegration types. Dark coloured claystones sedimented in anoxic environments (Gregorová & Fulín 2001).

Serranus budensis (Heckel 1856) belongs to the order of Perciformes. It is a fish with oval body and with high spine. It has big eyes, broad mouth and eyelid thorn on the head. The backbone has 24 vertebras. The dorsal fin is long, it begins behind the head reaching nearly the tail; it has 10 hard rays and 10 soft rays. The anal fin has three hard rays and 8-9 soft rays. The pectoral fins consists of one hard ray and 5 soft rays. The back of the tail is rounded. S. budensis is widespread in Eocene – Miocene sediments of Europe.

Study of the fossil fish of the genus Serranus budensis (Heckel 1856) from the flysh sediments of the Bystré nad Topľou locality gives valuable information about connection of the Central and Outer Carpathian Paleogene basins. Serranus budensis derived from the locality Bystré nad Topľou indicates a littoral shalow water conditions near the coast during the sedimentation of the Oligocene Menilite Beds, which belong to the IMP 2 Zone sensu Jerzmańska (1975).

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Fossil snake assemblages from French Middle Miocene (MN 7+8) localities of La Grive L7 and La Grive M

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Key words: Fossil snake, French Middle Miocene, La Grive L7 and La Grive M.

La Grive L7 and La Grive M (France) represent the unique European palaeoherpetological Middle Miocene (MN 7+8) sites. Representatives reported at La Grive L7 are as follow: Typhlopidae: Typhlops cf. grivensis; Colubridae: Coluber sp. 1, Coluber sp. 2, Texasophis sp. (cf. T. meini), cf. Elaphe sp., Natrix sp., Natrix sp. 1, Natrix sp. 2; Elapidae: Naja romani, Naja sp. 1, cf. Micrurus sp.; Viperidae: Vipera (or Daboia) sp., Vipera sp. ('aspis' complex). Representatives reported at La Grive M are as follow: Typhlopidae: Typhlops cf. grivensis; Boidae: cf. Boidae, Erycinae gen. et sp. indet.; Colubridae: Coluber sp. 1, Coluber sp. 2, Coluber sp. 3, Elaphe sp. 1, Elaphe sp. 2, Paleoheterodon sp., Texasophis sp., cf. Texasophis sp., Colubrinae A & B, cf. Palaeonatrix sp., Neonatrix sp., Natrix cf. sansaniensis, Natrix aff. longivertebrata (or N. n. aff. longivertebrata), Natrix sp., Natrix sp. 1, Natrix sp. 2, Natrix sp. 3, Natricinae gen. et sp. indet.; Elapidae: Naja cf. romani, Micrurus sp., Elapidae A, Elapidae gen. et sp. indet.; Viperidae: Vipera (or Daboia) sp., Vipera sp. 1, Vipera sp. 2, Vipera sp. 3. Several morphotypes probably may represent new species. In representatives of Natrix sp. 2, which were partially (La Grive L7) affiliated to Natrix longivertebrata ("Natrix aff. N. longivertebrata" sensu Rage & Szyndlar 1986) in older publications (Rage & Szyndlar 1986; Szyndlar 1991), preserved cranial elements really resemble that of Natrix longivertebrara reported first from the Polish Upper Pliocene locality

of Rębielice Królewskie 1A (MN 16). However, vertebral morphology of the type material from Poland is different (with much more shorter vertebral centra) from Natrix sp. 2. Vertebrae of Natrix sp. 2 are much more massive than it is in remaining extinct and living representatives of the genus Natrix. Snake assemblages at La Grive L7 and La Grive M give evidence of rapid adaptive radiation of colubroid snakes in European Neogene.

Early Vallesian rodents from Borský Sv. Jur (Slovakia)

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Key-words: Miocene, Rodentia, taxonomy, Vienna Basin.

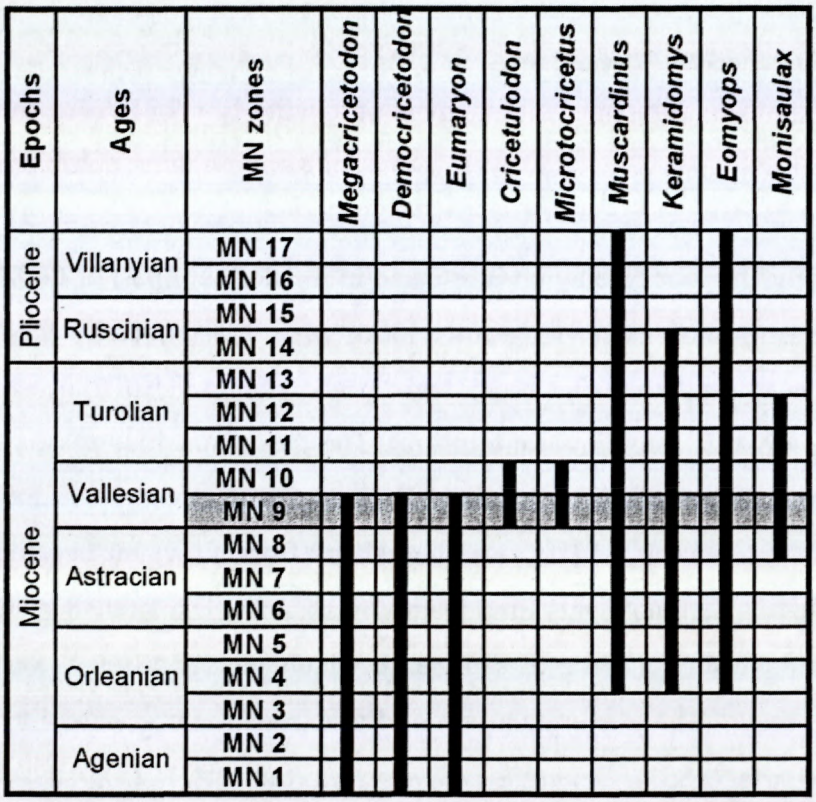
This paper specifies a biostratigraphical arrangement of locality Borský Sv. Jur and some paleoecological results are given here. However, some biostratigraphical problems still persist.

The locality Borský Sv. Jur - brick clay pit is situated in the northern part of the Záhorie Lowland in the Vienna Basin. Litological filling of the locality is characterized by clayey silts with some sandy ones, silty sands and fine sands, which contain fossils of the ostracods, molluscs and vertebrates (Pisces, Reptilia, Mammmalia). The most numerous fossils among the vertebrates are the mammals of the orders Rodentia, Insectivora, Artilodactyla, Perissodactyla and Carnivora. During the last year, the locality Borský Sv. Jur became again an object of interest in fossil mammals, this time mainly in rodents. The studied material is derived from one test sample (cca 120 kg of sediment), which yielded a lot of vertebrate remains, mainly rodent teeth. The representatives of these rodent taxa were identified: *Megacricetodon minor* (Lartet, 1851), *Democricetodon brevis* (Schaub, 1925), *Cricetulodon* sp., *Microtocricetus molassicus* Fahlbush & Mayr, 1975, *Eumyarion latior* (Schaub & Zapfe, 1953), *Muscardinus hispanicus* De Bruijn, 1966, *Keramidomys mohleri* Engesser, 1972, *Eomyops catalanicus* (Hartenberger, 1966), *Trogontherium* sp..

On the basis of the rodent assemblage, it seems that biostratigraphical position of locality Borský Sv. Jur corresponds to the Early Vallesian (Tab.1). The occurrence of significant taxon *Microtocricetus molassicus* in this assemblage, is typical for the MN 9 biozone (FEJFAR et. al., 1997). The coexistence of Middle Miocene association of genera *Megacricetodon, Democricetodon* and *Eumyarion* with first true cricetine genera *Cricetulodon* supports also this age determination (AGUSTÍ et al., 2001). However, there is some contradiction between

finding of the large mustelid *Eomellivora wimani* ZDANSKY, 1924 (LUPTÁK, 1995), which is meanwhile known in Europe during the Early Turolian only (MN 11 to MN 12 biozones; GINSBURG, 1999). In this case, the rodent asseblage seems to be more stratigraphically important as stratigraphic range of *Eomellivora wimani*.

From paleoecological point of view, the dominance of cricetids (*Megacricetodon, Democricetodon* and *Eumyarion*) and minor abundance of glirids (*Muscardinus*) and eomydes (*Keramidomys, Eomyops*) can indicate open landscape with less forested formations. There was probably margin of Pannonian Lake with some river inflow (presence of beaver *Trogontherium*).



Tab. 1: Stratigraphical ranges of rodent genera from locality Borský Sv. Jur (Slovakia).

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The skeletal anatomy of tetrapod *Utegenia spinari* from the ?Upper Carboniferous-Lower Permian of Kazakhstan and its position within seymouriamorphs

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Key-words: Upper Carboniferous, Lower Permian, Seymouriamorpha, anatomy, taxonomy, Kazakhstan

The Utegenia spinari is a seymouriamorph tetrapod from the ?Upper Carboniferous-Lower Permian lacustrine deposits of the Kurgalin Formation, Southern Kazakhstan. Its cranial anatomy has been only poorely known so far. The present study revealed many new and taxonomically important features; they include: skull slightly longer than broad; deep and elongate posterior cheek region; toothless transverse pterygoid flange extending below ventral cheek margin; low radiating ridges with rows of denticles on pterygoid and parasphenoid stem; incipient triangular lip on posterior end of parasphenoid stem; long, smooth posterolateral processes of parasphenoid; possible occurrence of anocleithrum; ilium without pronounced dorsal process and with dorsoventrally broad posterior blade. A new cranial reconstruction of Utegenia differs significantly from previous accounts of this taxon. Several cranial and postcranial features, as well as degree of ossification, suggest that the largest known specimens of Utegenia correspond to late larval and metamorphic Discosauriscus from the Lower Permian deposits of the Boskovice Furrow in Moravia (Czech Republic). A phylogenetic analysis of all adequately known seymouriamorphs, and including several other early tetrapods, places a monophyletic Seymouriamorpha on the amniote stem group, and indicates that the Utegenia is a sister taxon to the discosauriscid clade.

Cenomanian marine gastropods from the Kozomín locality (Bohemian Cretaceous Basin)

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Key - words: mid Cretaceous, Gastropoda, taxonomy, paleoecology, Cretaceous Bohemian Basin.

Kozomín locality represents example of nearshore sedimentary environment of the upper Cenomanian, in the Bohemian Cretaceous Basin (BCB). It is located in the Vltava-Beroun area of the BCB, 7 km east of the city Kralupy nad Vltavou. The locality is situated on the northern slope of the Unhošť – Tursko elevation.

Studied material comes from personal collection of Mr. P. Svoboda. The material was collected in sediments from Korycany Member exposed by an excavation of the transit gas main groove in the beginning of the 70's. Studied sample contains this association of fossils: small plates of asteroids, echinoids, bivalves, oysters, brachiopods, gastropods, belemnites and shark teeth.

Gastropod shells come from the unit B that is formed by fine glauconitic sandstones. An unique assemblage of gastropods is preserved without shell dissolution. Fragmentary mode of preservation prevails (about 80 %). The morphology and sculpture of the remains is often sufficient to determine a species. About 20 % of shells are completely preserved, including body whorl with aperture and protoconch. All specimens have preserved original shells – not only cores or imprints. Gastropods consist a large number of species in sample of approximately 1500 specimens. Small-sized shells of gastropods are common (the smallest observed height is 1,5 mm) but also medium-sized gastropods occur (the largest height is 60 mm). They usually represent many adult individuals of medium-sized species.

Presently 35 species have been determined, belonging to 19 genera. Gastropod fauna consists of archaeo-, meso-, neo- and opisthobranch gastropods with ratio about 29 %; 70 %; 0,5 % and 0,5 % of the total number of species. Cerithiform forms of gastropods are the most frequent (65 % shells of sample), trochiform forms (21 %) then turbiniform follows (13 %) and pateloid forms are rare (1 %).

On the base of described species, their manner of the preservation and ecological roles (etc.) it is possible to make a paleoecological interpretation of this locality. Most of species found in the studied sample prove a specific shallow water environment occurring nearby ranging from the shore into the reef and its slope. Well preserved shells and their sculpture (also well preserved on fragments) show the environment with frequent recycling, intensive mobility of sediments with bioclasts and relatively quick burying. This situation is conformable to another localities of rocky coast facies of BCB.

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Aptychi distribution in the "Samášky" section (Pieniny Klippen Belt, Outer Western Carpathians, Slovakia)

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Key – words: Lower Cretaceous, aptychi, biostratigraphy, Pieniny Klippen Belt.

Typical deep-sea Pieniny development of the Lower Cretaceous limestones is well exposed in an exposure in the cut of the road to an active Horné Srnie limestone quarry called as the "Samášky" section. Rocks of the lowermost Lower Cretaceous are represented by flesh-coloured to pinkish limestones. They pertain to the condensation horizon and were designated as the Horné Srnie Member. Overlying light grey limestones, with chert nodules, with thin layers of pelites are typical representatives of the Pieniny Limestone Formation. The goal of the contribution presented is the biostratigraphic evaluation of the described rock sequence on the basis of preserved calcite valves of aptychi, and also an effort to compare occurrences of aptychi found with those of other present fossils, especially calpionellids (in the lower part of the section) and non-abundant findings of stratigraphically significant ammonites.

Biostratigraphy of the Subsilesian and Silesian units in the Pluskawka Stream section (Zegocina tectonic window, Western Flysch Carpathians)

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Key-words: Late Cretaceous, Foraminiferida, biostratigraphy, paleoecology, Silesian Unit.

The biostratigraphy of Upper Cretaceous sediments of the Silesian Unit as well as Palaeogene Variegated Shales of the Subsilesian Unit, based on foraminiferal assemblages, has been established in the Pluskawka Stream section (near Zegocina).

Foraminiferal assemblages of the Silesian Unit are poorly preserved and are dominated by agglutinated taxa. Presence of Uvigerinammina jankoi (Majzon) dated Godula Beds of the Silesian Unit as middle Turonian - Santonian. In the contrary, foraminiferal assemblages of the Subsilesian Unit contain well- preserved agglutinated, calcareous benthic as well as planktonic foraminiferids. These sediments were dated as Early to Middle Eocene, indicating

several biozones sensu Geroch & Nowak (1984) such as: *Spiroplectammina spectabilis, Cyclammina amplectens, Ammodiscus latus, Cyclammina rotudidorsata.*

Moreover, paleoecological analyses of these sediments have been undertaken. Composition of foraminiferal assemblages indicated that Godula Beds were deposited in the deeper part of the Silesian basin. Nevertheless, Paleogene sediments of Subsilesian Unit deposited more or less at the same depth were in addition influenced by the high stand of the sea level.

Variability of the fresh-water thecamoebian assemblages - Šumava Mts.

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Key words: thecamoebians, actuoecology, statistical analysis, Šumava Mts.

Sixty-eight samples from 9 localities from diverse water bodies (peat bogs, creeks, small rivers, ponds, lakes, artificial channel) from the Šumava Mts. were sampled in years 1998, 1999 and in more detail in 2001. Thirty-nine thecamoebian species were recognised in this material. The aim of this work is to analyse thecamoebian assemblages from different water bodies in the hydrologically variegated area of the Šumava Mts. and compare the differences in thecamoebian assemblages among samples from one locality sampled in more detail vs. differences among these localities.

Chemical composition of some difflugia tests and their biometrical variability were studied. Differences among thecamoebian assemblages from one locality sampled in more detail vs. differences among localities were analysed using multivariate statistics (cluster and factor analyses). Statistical analysis also enabled to distinguish 2 common types of assemblages and 7 rare types of assemblages. Thecamoebian taxa characteristic for these assemblages were determined. The more numerous clusters are characterised by Difflugia viscidula dominating stagnant water with high content of organic mud, Difflugia avellana is characteristic for assemblages from running water with 20-70 % of coarse plant detritus in the bottom sediments. Bullinarias dominated assemblages from stagnant water in large reservoirs with sandy to gravely bottom with low content of coarser organic detritus. Difflugia oblonga characterises samples from running water with fine gravel and <10 % of coarser organic detritus.

Detailed sampling of the localities showed that similar thecamoebian assemblages were observed in homogeneous habitats of stagnant and slowly running water. A specific type of assemblage appeared at each locality with a homogeneous habitat. Similar thecamoebian assemblages were observed at one locality with homogeneous habitat of stagnant and slowly running water. Differences among thecamoebian assemblages from one locality were described from heterogeneous habitat of running water as well as from different depths of the sediment. Similar assemblages from these heterogeneous biotopes appear in similar microhabitats from different localities (Holcová, Lorencová in press).

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Lamellorthoceras (Nautiloidea, Pallioceratida) from Lower Devonian of Bohemia: a contribution to the cameral mantle theory

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Key-words: Devonian, Cephalopoda, Pallioceratida, anatomy, functional morphology, Central Bohemian Basin

Since the time of definition of the term "cameral mantle" by Flower (1939), the problem of its existence has been widely discussed. The problem of communication betwen the cameral mantle tissue and the cephalopod body through the connecting rings of the siphonal tube is the main objection against this theory.

Finds of well preserved specimens of the genus *Lamellorthoceras* in Lower Devonian limestones (Dvorce-Prokop Formation, Barrandian area, Czech Republic) solve the question of the communication of siphonal cord with the shell camerae by a long and wide opening positioned on the dorsal side of the siphonal tube. Siphonal tube thus converted into a form of trough situated inside of camerae, while within siphonal neck it retaines classical tubular form.

Cameral mantle in the genus *Lamellorthoceras* is bilaterally symmetrical. It has a form of numerous thin longitudinal lamellae growing from the dorsal siphonal tube opening to the outer shell wall. In the cross section the lamelae are radially arranged and disposed with distance equal to their thickness. The narrow ventral space below the siphonal tube represents

the only exception, filled by massive cameral deposits. Similar, but not so massive deposits are present also in spaces between the cameral mantle lamellae.

Cameral mantle lamellae are usually longitudinaly undulated and in some taxa also irregularly branched to the periphery. Such branching occurs mainly on the dorsum and in the lateral sides on the adoral portion of camerae. From this reason different patterns of lamellae arrangement (depending on the place and orientation of the shell section) could be observed. The pattern varies from simply radiating (e.g., genus *Gorgonoceras*) too dendritically branching (e.g., genus *Lamellorthoceras*) in the cross section. Longitudinal undulation of lamellae could produce "strange" sinuose structures in longitudinal sections (e.g., Mutvei 1956, pl. 1). Several genera have been established on differences of the lamelar arrangement. Detailed understanding of lamellar morphology could have an important impact for classification of the family Lamellorthoceratidae.

As a whole are cameral mantle complex more developed in camerae adorally then adapicaly and thus forms in the fragmocone a series of lamellar conuses The cameral mantle of each individual camera is wider developed adorally, showing thus a conical outline. The cameral mantle complex of the whole fragmocone is assembled by a series of such conuses After weathering out such cephalopods could be misinterpreted as rugose corrals (see the original description of the genus *Arthrophyllum* Beyrich 1850; Howell 1942, etc.).

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Middle Jurassic brachiopod associations of the Slávnické Podhorie mudmound (Pieniny Klippen Belt)

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Key words: Middle Jurassic, brachiopods, fossil benthic associations, mud-mounds, Stromatactis, Pieniny Klippen Belt, Western Carpathians.

Bathonian / Callovian stromatactis mud-mound was recognized in the abandoned Skalica quarry near Slávnické Podhorie (middle Váh Valley, western Slovakia) by Aubrecht et al. (in print). Micritic to pelmicritic mudstone, wackestone - packstone with sparitic (radiaxial fibrous calcite) infilling of stromatactis cavities, brachiopod-, bivalve-, crinoid-, echinoid fauna (known already to Pevný 1969) including occasional ammonites form the main wall-rock.

The mud-mound developed on Bajocian-Bathonian submarine fan formed by white, yellowish and red crinoidal limestones (Smolegowa Formation) in the Czorsztyn Unit of the Pieniny Klippen Belt. The limestones contain sporadic abraded disarticulated shells of rhynchonellids and large terebratulids. More complete rhynchonellid shells were derived from the uppermost crinoidal limestone beds.

The Bohunice Limestone is formed by biogenic white microsparite – micrite - mudstone limestones containing rich Bajocian-Bathonian benthic fauna dominated by brachiopods: *Morrisithyris* aff. *phillipsi* (Morris), *Monsardithyris buckmani* (Davidson), *Monsardithyris ventricosa* (Zieten), *Linguithyris bifida* (Rothpletz), *Zeilleria waltoni* (Davidson), *Zeilleria emarginata* (Sowerby), *Zeilleria* aff. *subbucculenta* Chapuis-Dewalque, *Lobothyris ventricosa* (Hartmann), *Loboidothyris perovalis* (Sowerby), "*Terebratula*" *retrocarinata* Rothpletz, "*Terebratula*" *varicans* Rothpletz, *Antiptychina puchoviensis* Pevny, *"Sphenorhynchia" rubrisaxensis rectifrons* (Rothpletz), *Acantotharis* sp., *Gnathorhynchia trigona* (Quenstedt), *Sphenorhynchia* aff. *plicatella* (Sowerby), *Sphenorhynchia rubrisaxensis rectifrons* (Rothpletz), *Rhactorhynchia subtetrahedra* (Davidson), "*Rhynchonella*" aff. *obsoleta* (Sowerby), *Cymatorhynchia quadriplicata* (Sowerby), ?*Weberithyris* sp., ?*Caucasella trigonella* (Rothpletz), *Parvirhynchia* sp. The basis of the mudstones is therefore of ?Bajocian-Bathonian age. Some forms as *Caucasella* and *Weberithyris* indicate rather younger, Bathonian-Callovian age. This is also supported by a *Pygope* aff. ianitor in the debris found near the entrance of the quarry.

The mudstones overlying the crinoidal deposits are dominated by filament microfacies with Bositra sp. These „banded" limestones contain sporadic brachiopods only (Fig.1). It is noteworthy that rare foraminifers (*Globuligerina* sp.) have been found in the section studied only in contrast with Oxfordian mass occurrence of these planktonic foraminifera described by Myczynski & Wierzbowski (1994) or Wierzbowski et al. (1999). Thus, it is possible that our section probably does not reach the Oxfordian strata.

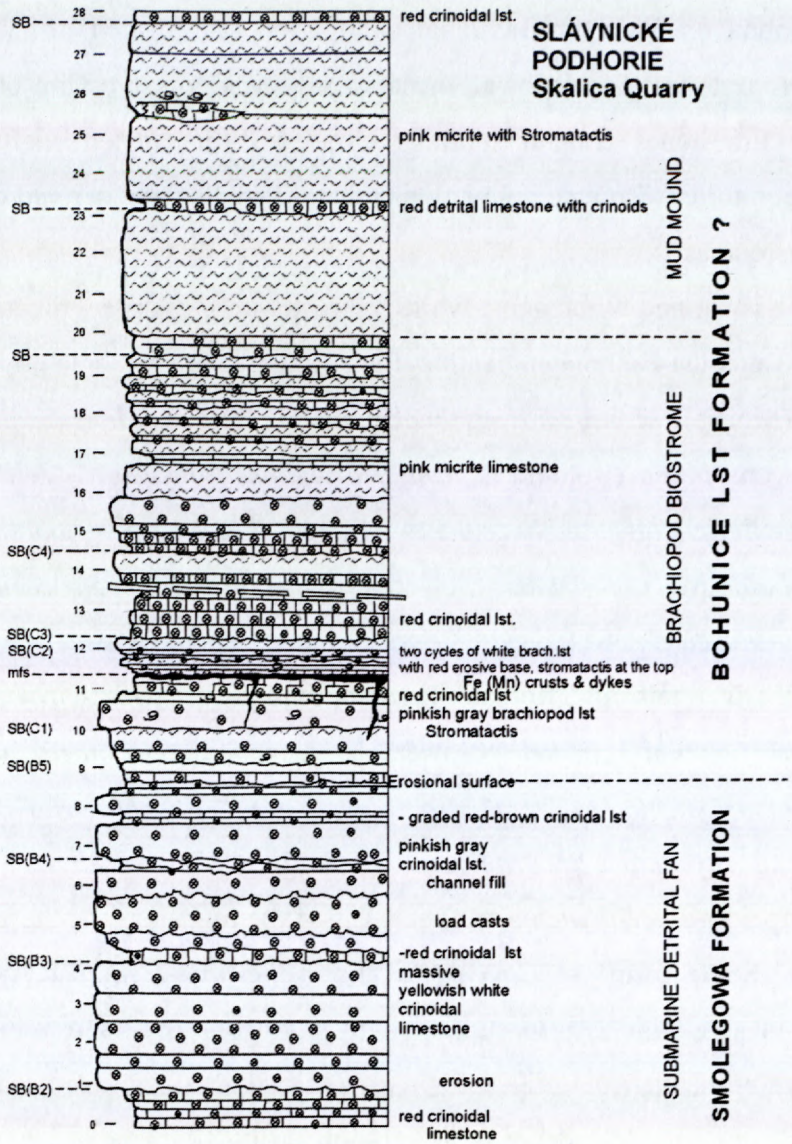


Fig.1

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Ludlowian *Chitinozoa* from the locality „Na Požárech" (Silurian, Prague Basin, Barrandian area) – preliminary results

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***Key-words**: Silurian, Chitinozoa, distribution, Prague Basin.*

The section "Na Požárech" represents the international stratotype of the Ludlow/Přídolí series boundary. For the definition of base of the Přídolí Series, distribution of *Chitinozoa* was studied by Paris in the early 1980´s. The goal of my thesis is to complete the existing data on Chitinozoan distribution in the stratotype section (Přídolí Formation) with the emphasis on the relatively pourly studied lower part of the stratotype section (Kopanina Formation).

The studied section begins on the fault by the bed No. 0 (new marking) and continues to the bed No. 86 (oficial marking of stratotype). Micropalaeontological samples were taken from each limestone beds. Shales or tuffitic shales were not sampled due to high degree of weathering. The samples were treated on the Geological Survey Prague – Barrandov, using the method developed by Dufka.

Up to date the folowing *Chitinozoan* genera have been assertained: *Eisenackitina*, *Ancyrochitina*, *Angochitina*. In palynological residues of some samples spores, scolecodonts and mazueloids (*Muellerisphaerida*) were discovered, too.

Upper Jurassic and Lower Cretaceous microgranular calpionellids - implication for palaeoecology and palaeooceanography of the Western Carpathian pelagic enviroments

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Key-words: chitinoidellids, praecolomiellids, bioevents, paleoecology, Late Jurassic, Lower Cretaceous, Western Carpathians, Tethys.

Chitinoidellids represent a very small group of ancient planktonic ciliates with microgranular, axialy symetrical lorica. The genus comprised all ciliate forms showing a dark wall in transmitted light. It was previously supposed that chitinoidellid wall is built of chitinous matter. Due their studies of the chitinoidella wall ultrastructure by SEM method,

Reháková and Michalík (1992, 1993) confirmed the hypothesis of Borza (1966) and Remane (1969) who stated that chitinoidellids have microgranular calcitic loricas. The SEM observations showed that the wall of chitinoidellid lorica is composed of three zones. Two outer zones are built by scalenohedral calcite crystallites perpendicular to the lorica wall, the central dark zone consist of small rhombohedral transversaly oriented calcite crystallites and also of remains of organic substance.

Chitinoidellids attained a dominant position in the plankton during the Middle Tithonian. Later, new microgranular calpionellids appeared again at the beginning of the Middle Aptian. The evolution of small Middle Tithonian chitinoidellids of Dobeni Subzone followed by their radiation of more advanced and diversified forms in Boneti Subzone was finished by chitinoidellid exctinction and their substitution by hyaline calpionellids of the Praetintinnopsella Zone having an inner hyaline and an outer microgranular wall layer. The appearence of hyaline calpionellids coincides with the rapid evolution of nannoplankton associations.

At the beginning of the Middle Aptian new forms of microgranular praecolomiellids appeared. The vertical span of the specified calpionellid is short, microgranular loricas are less frequent, but, on the other hand, their are twice or several times larger than those of Middle Tithonian chitinoidellids. Nomismogenesis of planktonic foraminifers lowered the selectional stress among calpionellids and such competitive environment led to a growth expansion of their loricas. During the Early Albian praecolomiellids were substituted by a new group of hyaline colomiellids. Reháková and Michalík (1997) pointed out that microgranular calpionellid forms gave rise to hyaline ones several times independently. The calcite composition of calpionellid loricas changed several times during their evolution. During the periods of calcium carbonate hypersaturation of sea-water, the calcite deposited in the walls of the lorica could replace their original chitinous substance. From this point of view, authors considered chitinous forms as direct relatives of calcareous "true" calpionellids. The change of the lorica composition was synchroneous with the Early Albian peak in nannoconid abundance, similarly, as during previously described Late Tithonian change of a chitinoidellid microgranular structure. The revival of microgranular calpionellids allows to speculate about a similar climatic and paleoceanographic conditions during the both time intervals mentioned (Reháková 2000).

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New findings of insectivores from Hajnáčka I locality

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Key-words: Pliocene, Mammalia, Insectovora, taxonomy, S Slovakia.

The paleontological locality Hajnáčka I in the territory of Slovakia is one locality type of the European Neogene Mammal time scale, dated to the MN 16a zone (Early Villafranchian, Late Pliocene) (Fejfar & Heinrich 1987). The fossiliferous layers are situated in a maar depression (the Bone Valley maar). Its filling mainly consists of the fine sand, tuffite, tuff, and fragments of basalt. The fossil findings have been found in sediments, which were disrupted especially in the process of soil slides during the Quaternary Period.

After more than 35 years (since Fejfar in 1955-58), new systematic research was begun in 1996. During this new research, five vertical pits (1/96, 2/96-97, 4/98, 5/98 a 6/98) and one horizontal pit (3/98) have been dug. Their research yielded a large quantity of new vertebrate material. Besides fossils of large mammals, the new remains of micromammals have been found too. The insectivore fossil remains have been found in sediments of all pits besides 1/96 and 4/98.

Fejfar et al. (1990) mentions four insectivore taxa of two families from the site. However, during new research, six taxa of insectivores have been found. Two of them have been already found formerly (*Desmana nehringi* Kormos, 1913 and *Blarinoides mariae* Sulimski, 1959)

(Fejfar 1964), but further four taxa have been tentative determined as new elements of Hajnáčka biocenosis (*Talpa* cf. *fossilis* Petényi, 1864; *T.* cf. *minor* Freudenberg, 1914; cf. *Deinsdorfia* sp.; Soricidae gen. et spec. indet.). Generally, eight taxa of two insectivore families are known from the locality now (Tab. 1). From the occurrence point of view, two insectivore taxa (*Blarinoides mariae* and *Talpa* cf. *fossilis*) are probably represented by fossil remains of two individuals. Other insectivore taxa are represented by one specimen only.

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Insectivorid fauna	Fejfar *et al.*, 1990	Hajnáčka I (1996 – 2000)			
		2/96-97	3/98	5/98	6/98
Talpidae					
Desmana nehringi Kormos, 1913	+			+	
Talpa cf. fossilis Petényi, 1864			+	+	
Talpa cf. minor Freudenberg, 1914					+
Soricidae					
cf. Deinsdorfia sp.			+		
Petenyia hungarica Kormos, 1934	+				
Blarinoides mariae Sulimski, 1959	+	+	+		
Beremendia fissidens (Petenyi, 1864)	+				
Soricidae gen. et spec. indet.			+		

Tab. 1. Insectivorid fauna of the Hajnáčka I. locality (Lower Villafranchian, MN 16a).

Novelties in the research of the fossil wood in the Tertiary of northern Bohemia

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Key-words: Tertiary, fossil wood, taxonomy, Northern Bohemia.

It has been mentioned already (e.g., Sakala 2000) that the Tertiary of northern Bohemia presents the ideal area for an application of the so-called "Whole-Plant Concept". This approach consists in combining several detached organs (leaves, wood, fruits etc.) in order to reconstruct the whole plant. As the fossil wood from the Tertiary of northern Bohemia is relatively poorly known, new systematic research is focused right on it. Its first results are summarised chronologically in the present note.

New finds from the Oligocene locality of Žichov have revealed a wood with affinities to *Cercidiphyllum* (Sakala 2000). The wood is in some aspects, e.g. regarding the rays, which are thin, uni- to biseriate, very long and often articulated, closer to the extant *Cercidiphyllum* than the original *Cercidiphylloxylon* described by Prakash et al. (1971) from another locality of northern Bohemia. The newly discovered fossils could represent the oldest known wood of *Cercidiphyllum*. However, further studies are required to solve definitely this problem.

Another angiosperm wood was described as *Castanoxylon bavaricum* Selmeier from the Upper Oligocene sediments of Velká Černoc (Sakala & Teodoridis 2001), which belong to the so-called "Neogene accumulations of Central Bohemia". In the neighbouring locality of Nesuchyně, foliage of *Castanea*-type has also been discovered. Therefore, we proposed that the wood and the leaves had belonged to the same natural species. A huge trunk, found recently at Velká Černoc, is preliminary determined as *Taxodioxylon gypsaceum* (Göppert) Kräusel.

In the Lower Miocene of Bílina, a fossil angiosperm wood was attributed to *Ulmoxylon marchesonii* Biondi (Sakala in press). This is the first angiosperm wood described from this famous locality. The wood can be compared to extant North American soft elms, also to *Ulmus macrocarpa* Hance and *U. parvifolia* Jacq. from China or to the European common elm *U. carpinifolia* Gled. The wood together with fossil leaves/fruits of *Ulmus pyramidalis* Goeppert formed a single natural fossil species. Differences in the wood structure of two described specimens were interpreted as due to two different types of preservation of the same wood species.

Finally, the botanical affinity of *Podocarpoxylon helmstedtianum* Gottwald, described by Březinová et al. (1994) from the Late Eocene locality of Kučlín, is presently reviewed. Březinová et al. (1994) attached the wood to the twigs and the cone scales of extinct *Doliostrobus*. In fact, it seems more plausible that the wood from Kučlín belongs to another conifer, perhaps to *Tetraclinis*, found also in the locality.

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The Cenomanian – Turonian boundary delimited on microfauna in Western Carpathians

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Key words: Microfauna, Cenomanian, Turonian, Western Carpathians.

Cenomanian/Turonian boundary in Western Carpathians was estimated both in variegated marly sequence and in the flysch facies. It was documented by planktonic foraminifers, practically always accompanied by both calcareous and agglutinated benthic microfauna. This association proves for well aerated and ventilated environment. We were not able to record any poorly ventilated or even anoxic event, known from North African sections e.g. in Tunisia (Burollet 1956, Maamouri et al. 1994).

Upper Cenomanian and Lower Turonian deposits in Western Carpathians are documented by planktonic foraminiferal zones (Rotalipora cushmani- , and Dicarinella imbricata Zone, respectively). It is worth of mention, that the *Whiteinella* associations were not recorded in these zones. There are no arguments in favour of the presence of independent

Whiteinella gigantea Zone (syn. Whiteinella achaeocretacea Zone). Salaj et Gašpariková (1983) argued that a new independent evolutionary lineage isolated geographically formed in Northern Tethys.

In the Pieniny Klippen Belt (the Fodorka succession), black Lower Cretaceous succession is covered by a mid-Cretaceous flysch complex. In pelagic Upper Cenomanian – Lower Turonian strata, sporadic tiny agglutinated foraminifs occur, represented by *Rhizammina* , *Rhabdammina* and *Nothia.* It is evident, that they lived in little oxygenated environment. This is because calcareous benthic foraminifers are not present.

In the Czorsztyn Unit, mid-Cretaceous variegated marls rest transgressively on Tithonian limestones: their base is formed by Lower Albian marls (Dolný Mlyn, Vršatec), or by Upper Cenomanian clastics (Horné Srnie). Foraminifer association is rich in benthic forms represented by *Gyroidina, Gavelinella* and *Anomalina.*

In the Kysuca Unit, benthic foraminifers mentioned are abundant, too. They were described by Samuel (1961) in the Beňatiná locality, or by Scheibner & Scheibnerová (1958) in the Brodno-Snežnica locality. The last classical section was revisited by the author. Beside of calcareous benthos, large agglutinated foraminifers *Clavulina, Clavulinoides, Spiroplectammina, Marssonella* etc. occur abundantly in the whole Turonian sequence. They indicate well aerated neritic environment.

In the Drietoma Unit, flysch development prevails in the Cenomanian-Turonian sequence. Planktonic foraminifs are accompanied by both agglutinated and calcitic benthic forms. Turonian sequence, characterized by shallower facies (including conglomerate intercalations), frequent redeposited foraminifers occur. They were derived either from emerging „archipel-like" island zone, or from the Kysuca sedimentary zone (Kysuce area) or from part of the Drietoma sedimentary area (Myjava area).

In the Hatné area in the Drietoma Succession, Orlové Sandstone interbeds and variegated marlstones are present. Benthic microfauna is not present in the Cenomanian-Turonian transition beds. Echinoid spines occur rarely.

In the Klape Unit, the Cenomanian Turonian boundary was identified in the shallow-water Orlové Sandstone sequence (Vrtižer area). Relatively frequent smooth-shelled ostracods, echinoid spine fragments and bryozoans occur in the beds belonging to Early Turonian Dicarinella imbricata Zone.

Interbeds of characteristic „exotic" Upohlav Conglomerate occur in the Púchov area in Cenomanian flysch complex rich in orbitolinas. These conglomerates frequently occur in the

area of Kozinec. Turonian strata with seldomly present *Dicarinella imbricata* are represented by a fluxoturbidite- rich flysch complex.

The Manín Unit (Horný Lieskov, Horný Moštenec, Belušské Slatiny), and the Podháj Unit (Sverepec) as well, are characterized by Cenomanian-Turonian flysch complex. Besides of Cenomanian planktonic foraminifers, the Praznov Formation (Scheibner & Scheibnerová,1958) contains abundant both calcareous and agglutinated benthic foraminifers (Gašpariková & Salaj, 1984). With the exception of sole representatives of *Rhabdammina* and *Rhizammina*, they practically disappeared during Early Turonian.

This facies development with Upper Cenomanian intercalations of the „exotic" Upohlava Conglomerate, dated by foraminifers of the Rotalipora cushmani Zone, is identical with this in the Kostolec Unit of the Hradná Succesion in broader environs of the Hradná and Súľov area. Reatively abundant benthic microfauna in Súľov indicates Early Turonian age. Besides of this facies development near Praznov, Cenomanian – Turonian variegated marlstones contain planktonic foraminifers along with frequent benthic foraminifers dominated by calcareous species.

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Morphology and variability of *Turriglomininae* Zaninetti (Triassic Foraminiferida, Western Carpathians).

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Key-words: Triassic, Foraminiferida, taxonomy, stratigraphy, Western Carpathians.

The Turriglomininae represent a specific foraminiferal fauna of the Reifling limestones. Their variability depends on the coiling mode, sexual dimorfism with two generations of megalospherical and microsphaeric forms, growing diameter of whorls, thickness of columella, dimensions, etc. Based on this, the following species of Turriglomininae have been distinquished: Turriglomina sp. div., Turriglomina mesotriasica (Koehn-Zaninetti), Turriglomina scandonei Zaninetti et al. and Turriglomina robusta Bérci-Makk. Turriglomina species survived since Illyrian until Cordevolian.

Turriglommina nov. gen. has been established by Zaninetti in Limongi et al. 1987, including foraminifers known under the name of *"Turritellela" mesotriasica* KOEHN-Zaninneti, 1968. Emendation has been required because of the presence of glomospiroid segments in initial tests, which are not congeneric with *Turritellela* Rhumbler. *Turriglomminidae* are common in the pelagic limestones of the Middle Triassic formations of the Western Carpathians. The study of sectioned tests allows us to recognize their species variability and detail taxonomy.

Classification of *Turriglomininae* is based on the mode of initial coiling, test dimensions, character of columella and growth rate of helicoidal whorls. Type species *Turriglomina mesotriassica* (Koehn-Zannineti) is diagnostic by initial coiling like the *Glomospira*, which is followed by trochospiral coiling around a columella in helicoidal stage. *Turriglomina* species exhibiting a simmilar pattern belong to the "mesotriassica" group (Bérci-Makk 1993). They include the following taxa: *Turriglomina carnica* (Dager), *T. lataxis* (He et Yue), *T. shizishanensis* (Kristan-Tollmann) and *T. guangxiensis* He Yan & Cai Lian. Different type species of *Turriglomininae* is represented by *Turriglomina scandonei* (Zaninetti et al.). This species is defined by meandrospiroid type of initial coiling, which lately passes to spiral loobs of helicoidal stage. *Turriglomininae* with meandrospiroid initial phase belongs to the "scandonei" group, which encloses the species *Turriglomina conica* (He), *T. magna*

(Urosevic) and *T. robusta* (Berci-Makk). Based on the Meandrospira-type morphology, the *Turriglomininae* has been attributed to family *Meandrospiridae* Saidova (Zaninetti et al. 1987).

In the Western Carpathians, the Turriglomininae comprise of the following taxa:

Turriglomina sp. div. - the test is strongly elongated, initial coiling phase and its dimorphism is not known. Tubular second chamber is highly spiralled around axial narrow columella. The tube consists of numerous whorls (19-23), which are coiled in constant or slowly increasing width. The whorls are closely packed and slightly oblique to test axis. Regular whorls pass sucessively to triangular point, where they change coiling plane and obliquity.

Since the paper of Soták (1985), where the species was illustrated and tentatively attributed to *Turritellella mesotriassica*, Zaninetti et al. (1990) have recommended to establish it as a new species.

Turriglomina mesotriasica (Koehn-Zaninetti) – the species known for the macrosphaeric and microsphaeric generations, the latter with meandrospiroid segments, followed by the trochospiral part of consecutive loops.

Turriglomina scandonei Zaninetti et al. - initial stage of the test consists of sphaerical proloculus, followed by regular Meandrospira-like whorls (max 4). In later stage, the meandrospiral loops leave the initial test, becoming straight and helically coiled.

Turriglomina robusta Bérci-Makk - the test is large-sized, having a thick columella and conical shape. Trochospiral whorls are widely spaced, growing in diameter, whorl lumen and wall thickness.

The *Turriglomininae* are a quite common foraminifers of the Reifling limestones (e.g. Jendrejáková et al., 1981, Masaryk et al., 1984). Their stratigraphic range corresponds to the Illyrian - Cordevolian (*Turriglomina mesotriasica* range-zone sensu Salaj et al. 1988). Besides of *Turriglommina* species, the Reifling-type assemblage of foraminifers comprises mostly of *Nodobacularia vujisici* Uroševič & Gaździcki, *Ophthalmidium tricki* and *Paleomiliolina judicariensis* (Premoli-Silva). Conodont fauna of the *Turriglommina*-bearing limestones belong to *bifurcata* up to *mostleri* zones (Pelsonian – Cordevolian).

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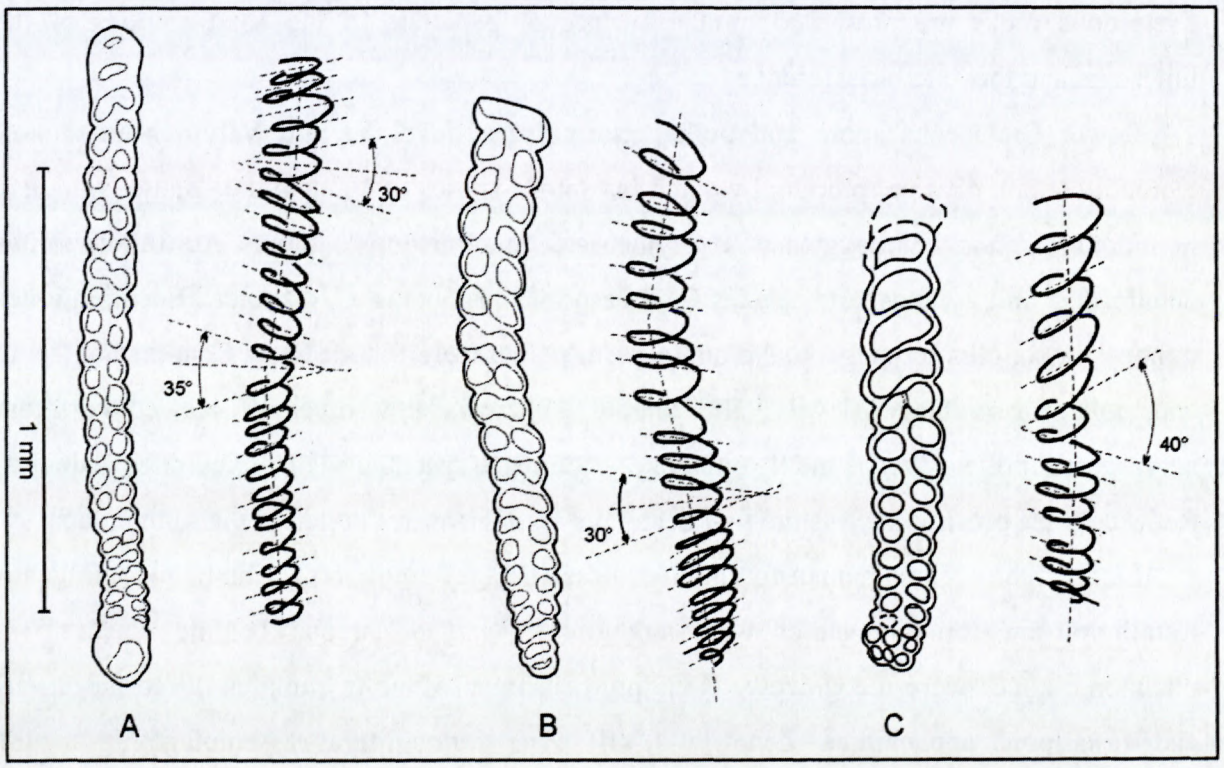


Fig. 1

Figure caption:

Fig. 1: Coiling mode of *Turriglomininae*. A) *Turriglomina* sp. div.; B) *Turriglomina mesotriasica* (Koehn-Zaninetti); C) megalosphaeric form of *Turriglomina mesotriasica* (Koehn-Zaninetti) after Limongi, P. et al. 1987, fig. 2A.

Biostratigraphy of the Cretaceous pelitic deposits overlying the Štramberk limestone body (Silesian Unit, Outer Western Carpathians) Preliminary results

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Key-words: Tithonian, Berriasian, palynomorphs, dinocysts, foraminifers, calcareous nannoplankton, Outer Carpathians.

Sporomorphs, foraminifers, dinoflagellate cysts and calcareous nannofossils are recovered from the dark grey to black pelitic sequences of the Silesian Unit (Outer Western Carpathians) overlying the Tithonian-Lower Berriasian Štramberk limestone body. The Cretaceous rocks are preserved on the surface or penetrate in the karst cavities of the limestone and they are of different age.

Lower Cretaceous spore and pollen assemblages (level VI and VII in Main quarry Kotouč) contain diverse pteridophyte and bryophyte spores of Valanginian-Hauterivian age, i.e. Foraminisporis wonthaggiensis, F. asymetricus, Staplinisporis caminus, Auritulinasporites deltaformis, and gymnosperm species Callialasporites trilobatus, C. dampieri, Eucommiidites minor, Classopollis torosus a.o. No angiosperm pollen were found. Early Cenomanian spore and pollen assemblage (level VIII, sample 2) shows low diversity but contain rare angiosperm pollen, very small reticulate tricolpate specimens of Tricolpites minutus, Retitricolpites prosimilis . It is the first occurence of angiosperm pollen in the Main quarry.

Late Albian – Cenomanian foraminiferal assemblages are diverse. The planktonic genus Rotalipora are found together with agglutinated and calcareous benthic species.Two planktonic zones were recognized: Rotalipora cushmani Zone in samples 0/VII and 2/VIII and Rotalipora appenninica Zone in 1/VIII .The foraminiferal assemblages from the stratigraphicly lowest sediments (Valanginian and Hauterivian) are characterized by small size test of benthic species with prevalence of genus Lenticulina. The Hauterivian age of 11/VII is evidenced by Citarina seitzi. Rare occurrence of planktonic genus Hedbergella were recorded in samples 6/VII and 11/VI. Both belongs to Hedbergella sigali/delrioensis planktonic zone.

Dinoflagellate cyst assemblages (level VI, VII) are characterized by high number of *Circulodinium brevispinosum, C. distinctum, Cribroperidinium orthoceras, Kiokansium*

polypes, Oligosphaeridium complex, Systematophora scoriacea. The studied samples are of Late Valanginian to Late Hauterivian age based on the presence of *Cymososphaeridium validum* and *Kleithriasphaeridium fasciatum.* Dinocyst assemblage with the *Batioladinium jaegeri, Gardodinium trabeculosum, Hystrichoshaerina schindewolfii* is comparable to the Late Hauterivian – Early Barremian. The composition of dinocyst indicates a shallow marine environment.Dinocyst assemblage of the VIII level is characterized by species of *Hystrichodinium pulchrum, Oligosphaeridium complex, Spiniferites ramosus* and *Surculosphaeridium* sp. The Albian-Cenomanian age is evidenced by the occurrence of *Litosphaeridium siphoniphorum* and *Palaeohystrichophora infusorioides.* Assemblage characterizes deeper part of the neritic sea.

Calcareous nannofossils evidenced the stratigraphic range from the Late Jurassic up to the basal part of Upper Cretaceous.The Late Jurassic age is documented by rich nearly monogeneric assemblages where *Watznaueria britannica* dominates and where *Cyclagelosphaera margerelii* and *C. deflandrei* occur in very low numbers. The Lower Cretaceous assemblages are characterized by high number of Watznaueria barnesae (60-80 %) and by presence of long-range species the first occurrence of them is known from the Tithonian. The Berriasian age is evidenced by species of *Nannoconus stenmannii minor, N. steinmanii steinmanii, Cruciellipsis cuvillieri* and *Retacapsa angustiforata*, Valanginian, zone CC3 (Sissingh 1977) by *Calcicalathina oblongata* and the Late Valanginian-?Early Hauterivian interval, zone CC4 by association of *Eiffellithus striatus* and *C. cuvillieri.* The uppermost Albian, zone BC27/UC0a (Bown et al. 1998 and Burnett 1998) is characterized by the abundance of *Watznaeuria barnesae* (50-70 %) and rare specimens of *Eiffellithus turriseiffelii* and *Axopodorhabdus albianus.* The lowermost Cenomanian, zone BC27/UC0c (upper part) is marked by the first occurrence of *Gartnerago theta* and *Prediscosphaera cretacea.*

Shell preservation of the Upper Triassic brachiopod *Rhaetina*

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Key words: Upper Triassic, Brachiopoda, shell ultrastructure

Three basic methods have been used for the study of shell structure of terebratulid brachiopod *Rhaetina* from the Rhaetian deposits of the West Carpathians, involving the examination of uncovered, slightly etched thin sections, coated with gold, under scanning

electron microscopy (SEM) in transversal and longitudinal sections, the examination of free fragments of the secondary shell layer, under scanning electron microscopy (SEM), and the examination of non-etched, uncovered thin sections coated with carbon, analyzed by a hot-cathode cathodoluminescence (CL) microscope. Samples have been derived from the Fatra Formation (Fatric Unit) representing predominantly carbonate deposition in a shallow intrashelf restricted lagoon (*R. gregaria, R. pyriformis*) and from the Hybe Formation (Hronic Unit) which originated in more stable marine environment (*R. hybensis, R. pyriformis*). Shell preservation has been primarily studied in order to find out the suitability of brachiopods for isotopic analyses.

The preservation of original shape of secondary fibres ranges from good to moderate. In the first case (Bystrý potok, Hybe), traces of secondary amalgamation are uncommon and taphonomic/diagenetic overprint is indicated only by the disappearance of intercrystalline organic matrix, as secondary fibres are in contact, although not coalesced, and by the presence of microborers. In the second case (Ráztoky, Borišov, Krížna dolina, Dedošova dolina, Sviniarka, Kardolína), original anvil shape is mostly visible in transversal sections, but secondary fibres are commonly amalgamated due to continuous coalescence. Their boundaries are often irregular or crenulated. However, diagenetic modification did not lead to deletion of internal microgrowth increments and microborings. Blocky crystallites have been observed, commonly originating due to progressive modifications of the original calcitic granules in consequence of biodegradation (Gaspard 1993).

Internal growth increments visible under CL are not associated with changes in optical density of shells. Alternation of luminescent and non-luminescent internal increments within secondary layer is here interpreted as the reflection of changes in growth rate. After etching with acetic acid, non-luminescent increments correspond to well preserved secondary fibrous structure, whereas luminescent increments are represented by more or less amalgamated and irregular calcitic layer, pointing to change of shell secretory regime during periods of reduced growth rate.

The pedicle collar shows different preservation, fibres are coalesced, usually with total deletion of their original boundaries. No internal cover of pedicle collar comparable to some other terebratulids (Williams & Hewitt 1977) is preserved. Relicts of individual fibres are only locally distinguishable in the transversal section. Luminescent growth increments are abruptly bended at the posteromedian boundary of the pedicle collar and then follow its curvature in the longitudinal section. Whole pedicle collar is strongly luminescent, in contrast to shell valve and internal structures. This is probably due to the secondary re-alignment of

secondary fibres and continuous resorption of most posterior parts of the delthyrial cover near pedicle.

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Hyoliths in the Bohemian Middle Cambrian – preliminary report

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Key words: Middle Cambrian, Hyolithida, taxonomy, Prague Basin

In the Barrandian area, hyoliths have been described from the Middle Cambrian to the Middle Devonian. High merit in recognition of the Bohemian hyoliths beholds to Barrande (1847, 1867), Novák (1891), Zázvorka (1928) and Marek who in the Barrandien area from the 1960 described 36 new hyolith species, another 29 species revised and established 22 new hyolith genera.

The target of my thesis is revision of Marek`s monography about hyoliths in the Bohemian Middle Cambrian and its preparation for publication. Marek`s proposed names for new species, genera and families will be retained. In this unpublished mohography seven new species, five new genera and two new families of order Hyolithida Marek, 1966 have been described. Herewith Marek (1983) mentioned first representatives in the Bohemian Middle Cambrian of the order Orthothecida Syssoiev, 1957 describing six new species and one new genus. Other four new hyolith species (two of them probably of the order Hyolithida, Marek 1966 and the other two of the order Orthothecida Syssoiev, 1957) from the Barrandian area are known, but formally not described (Fatka, in press)

Total number of described Cambrian hyolith species in the Barrandian area incorporates twenty-one species and number of possible species amounts 25. Nineteen hyolith species are described from the Skryje-Týřovice Area, four species are mentioned from the Příbram-Jince Basin and two species are known from the both areas. Globally, 123 hyolith species are known from the Middle Cambrian to the Middle Devonian in the Barrandian area (Valent, in press).

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Strontium isotope composition of the ostracod- and mollusc valves from the Turiec Basin

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Key-words: Upper Miocene, strontium isotopes, ostracods, molluscs, Turiec Basin

The Sr isotopic composition ($^{87}Sr/^{86}Sr$ ratios) was measured on ostracod and mollusc valves from the Upper Miocene deposits of the Turiec Basin to estimate a supposed connection of the Turiec Basin with the Central Paratethys. Transparent ostracod valves were cleaned in a ultrasonic bath and their anterior and posterior part were removed because small clayey and quartz grains were often caught in the vestibulum. The fine structural details (SEM photos) of the mollusc tests do not reveal any diagenesis of the deposits.

The ostracod samples show a certain homogeneity. They vary from $^{87}Sr/^{86}Sr$=0.708005+/-15 up to 0.708341+/-20 and they are in accordance with the results obtained from the bivalves ($^{87}Sr/^{86}Sr$=0.708005+/-9 to 0.708320+/-16).

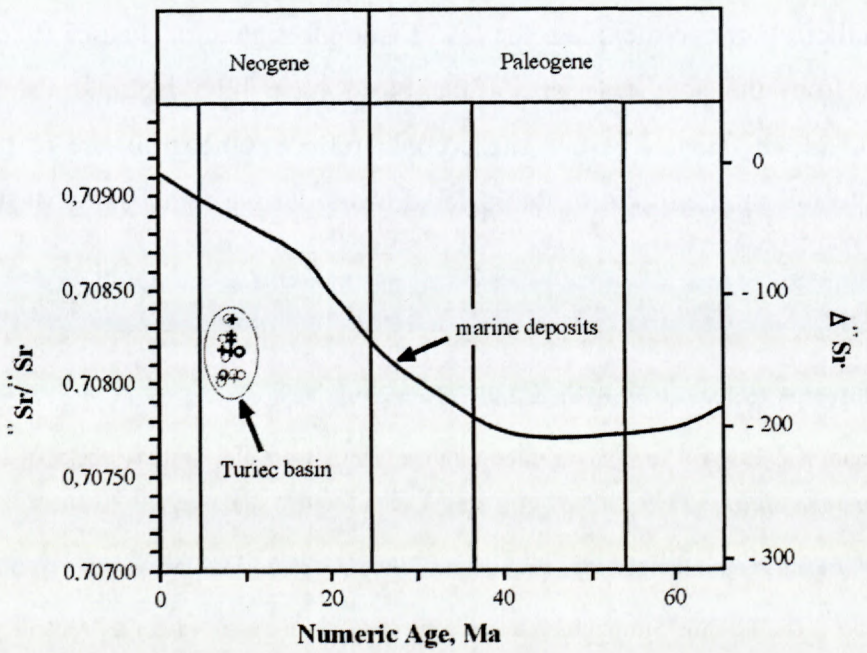


Fig. 1:Variation of $^{87}Sr/^{86}Sr$ during Cenozoic (after MCARTHUR, 1994) and isotopic compositions of the ostracod and mollusc valves from the Turiec Basin; cross – molluscs; circle – ostracods; thick line – samples from the northern part; thin line – samples from the southern part.

The strontium isotopic characteristics of the Turiec Basin are lower than values from the Cainozoic marine deposits (McArthur 1994; see the figure). They also differ from the isotopic composition measured on the Sarmatian brackish molluscs of the Central Paratethys ($^{87}Sr/^{86}Sr$=0.708611+/-10, Kráľ et al., 1995). Moreover the rich endemic mollusc and especially ostracod fauna of the Turiec Basin differs significantly from the Sarmatian and Pannonian assemblages. As the Sr-isotopic compositions of these fauna do not reveal a Paratethys influence to the basin, we suggest that the supposed connection between the Turiec Basin and the Central Paratethys, indicated by the Paratethys fauna (*Euxinocythere, Melanopsis, Congeria*) was very short in time.

It is plausible that the isotopic signatures reflect the evolution of an isolated basin. It would thus reflect the lithological composition of the adjacent geological units or two different water sources (Semhi et al., 2000). High isotopic ratios ($^{87}Sr/^{86}Sr \approx 0.70816 - 0.70832$) are observed in the northern part of the basin where Paleogene claystone and sandstone and flowing water environment are documented. The low isotopic ratios (0.70800 – 0.70809) characterise the southern part of the basin inhabited principally by sublittoral to deep ostracod assemblages. The presence of the Mesozoic carbonate formations and the Miocene volcanic rocks in the southern part could explain the lower isotopic signature (Faure, 1986). Three ostracod samples from the southern part of the basin have high isotopic values ($^{87}Sr/^{86}Sr$= 0.70814; 0.70824; 0.70834) (fig. 1). These could reflect some influence of the northern water masses into the southern part of the isolated basin during higher input of the river waters.

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Development and lithofacies connections of the Mútne Sandstones, Paleocene, Magura Nappe, Outer Carpathians, Poland

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Key-words: Paleocene, lithofacies analysis, heavy minerals, Mútne Sandstone, Magura Nappe.

The Mútne Sandstone (Paleocene) are widespread in the outermost facies zone of the Magura Nappe (northern Rača subunit = Siary subunit) in the area beetwen Sucha Beskidzka and Koniaków. Those are thick-bedded, amalgamated, medium- to coarse-grained sandstones, occasionally with intercalations of conglomerates. The sandstone grains consist of quartz, feldspars, clasts of sedimentary, magmatic and metamorphic rocks cemented with clayey and calcareous material. The haevy mineral assemblages are composed of: quartz 27-54%, tourmaline 16.33%, rutile 25-31%, zircon 8-17% and single staurolite and chromite. Mutne Sandstone overlaid the Inoceramian beds (Senonian-Paleocene, northern, biotite facies) and underlaid the Łabowa Shale Formation with Skawce Sandstone Mb. (Late Paleocene-Middle Eocene).

In the Mutne Sandstone sections, clasts of the Upper Cretaceous carbonates (limestones and marls) occur in a few levels. A sandstone-conglomerate bed of debrites, with clasts of carbonate rock up to 30 cm in diameter, occur in the Mutne Sandstone at Stryszawa village near Sucha Beskidzka. Moreover some thick sandstone layers of the Mutne Sandstone which crop out east of Żywiec town at Jeleśnia and Mutne villages, contain clasts and olistolites of marls and limestones, even up to several metres in diameter. Some of microsparitic limestones are rich of calcareous foraminifers (Globotruncana, Hedbergella, Heterohelix), radiolarians and sporadic algal remnants. The olistolites and smaller clasts of marls and limestones have been supported by the high-density flows from the northern margin of the Magura Basin, where carbonate sedimentation took place in the middle or upper slope during the Late Cretaceous.

Facies developement and heavy mineral composition (cf. Cieszkowski et al. 1999) suggest that the northern facies of the Inoceramian beds and Mutne Sandstone could be an equivalent of the Solan beds distunguished in the Magura Nappe in Moravia, as well as of the Altlengbach beds in the Rhenodanubian Flysch in the Eastern Alps.

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Ecology of foraminifera and calcareous nannofossils across the Karpatian-Badenian transition in the Wagna Section (Styrian Basin, Austria). Results from Project P-13743-Bio

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Key-words: Miocene, Foraminiferida, calcareous nannoplankton, paleoecology, Styrian Basin, Eastern Alps

The Styrian Basin (Central Paratethys) is located in the western part of the Intracarpathian Pannonian Basin system. We present here an ecological study based on benthic and planktonic foraminifera and calcareous nannofossils from the Wagna Section outcropping in the Wagna brickyard, approximately 20 km south of Graz, close to the town of Leibnitz. Three profiles (A, B and C) were sampled; profile C is the more representative and gives the best ecological results. Sediments consist of 2 to 5 meters-thick levels of dark-gray calcareous shales with cm-thick intercalations of siltstones ("Schlier"). Crystalline pebbles occur at about 5 m from the base and represents a channel deposit. The Karpatian/Badenian transition is located at 61 m in Profile A and at 7 m and at 20 m in Profiles B and C, respectively. Silt and sand increase upward. A 2.5m-thick horizon representing a massive *Porites* patch reef occurs at 7.5 m from the base. At 17 m sediments consist of dominat sand passing upward to a carbonate platform. The nannoplankton Zone NN4/NN5 boundary is recorded at about 13 m from the bottom of the section (Wag 02-19).

The ecological significance of microfossils is investigated through quantitative analyses. Assemblage structures and environmental stress are investigated through the Shannon-Wiener - H' and Eveness - J' Indices. Paleodepth is assessed through a new method developed within the framework of Project P-13743-Bio. Statistical treatment was also applied to quantitative data using the Software PRIMER 5 (Plymouth Marine Laboratory). Hierarchical agglomerative clustering (UPGMA) and Non-metric Multidimensional Scaling (nMDS) were obtained using the Bray-Curtis Similarity. The Similarity Term Analysis (Simper) was also

applied to highlight the contribution of each species to the total average similarity and dissimilarity within groups.

Interpretation of data suggests that the drastic change from Karpatian deep-water assemblages (outer shelf to upper bathyal) to Badenian littoral assemblages dominated by *Ammonia* spp is related to a sharp change in the marine hydrography. The *Ammonia* assemblage reflects input of fresh water as supported also by the ostracofauna. An additional shallowing in the water depth corresponds to the Porites level. The cold water - species *Coccolithus pelagicus* decreases sharply in abundance from the *Porites* level to the top of the section indicating rapid changes in paleotemperature. In the same level, small reticulofenestrids dominate and indicate increased climatic stress.

Miocene fauna of micromammals from the Bonanza locality (Devínska Nová Ves, SW Slovakia)

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Key-words: Miocene, Mammalia, carstic fissure trap.

The Bonanza locality is situated in the abandoned Stockerau limestone pit near Bratislava - Devínska Nová Ves in northern slope of the Devínska Kobyla hill. The site is represented by a broad fissure infilling comprising marine sands, sandstone and large limestone boulders. Sandy sediments contain fossil remnants of marine and terrestrial vertebrates and invertebrates (Holec et al. 1987; Ivanov 1998). Hereby, fossil frogs (Špinar et al. 1993) indicate presence of an fresh-water environment in near-vicinity of the locality.

So far, nine mammal taxa were known from this site. However, new elements have been determined in the fossil assemblage of the Bonanza fissure during the new study. Generally, 18 new taxa have been found. *Plesiodimylus chantrei* Gaillard, 1897; *Dinosorex* cf. *zapfei* Engesser, 1975; *Spermophilinus bredai* (von Meyer, 1848); *Bransatoglis* cf. *astaracensis* (Baudelot, 1970); *Democricetodon vindobonensis* (Schaub et Zapfe, 1953); and *Neocometes brunonis* Schaub et Zapfe, 1953 belong among the most important of all (Tab. 1).

The age of the Bonanza sediments was determined as the Badenian on the basis of the presence of bivalve species *Pecten aduncus* Eichwald only (Holec et al. 1987). However, on the basis of new micromammal fossils and the lithological circumstances, we are able to specify the age which has been determined as the upper part of the MN 6 biozone (MN 6b,

Late Badenian) more exactly. Thus, the sediments of the Bonanza locality are younger than those of the Neudorf-Spalte site (MN 6a, Middle Badenian) (Fejfar 1990). It is in good agreement with the age of the Sandberg locality which is also situated in the territory of Devínska Kobyla hill and its transgressive deposits are dated to the Late Badenian, too (upper part of the MN 6 biozone to MN 7+8?). However, it is not out of question that they are probably little bit younger than these from the Bonanza fissure are.

Thus, three paleontological sites are situated in slopes of the Devínska Kobyla hill, where it is possible to regard the succession of sediments from middle Badenian (Neudorf-Spalte, MN 6a) to the Upper Badenian (Bonanza, MN 6b – Sandberg, MN 6b to MN 7+8?).

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Mammal Taxa	Old results	New results	MN range
Insectivora			
Dinosorex cf. *zapfei* Engesser, 1975		+	6
Plesiodimylus chantrei Gaillard, 1897		+	4 – 11
Erinaceidae gen. et spec. indet.		+	
Soricidae gen. et spec. indet.		+	
Talpidae gen. et spec. indet.	+	+	
Insectivora gen. et spec. indet.		+	
Chiroptera			
Chiroptera gen. et spec. indet.		+	
Carnivora			
Devinophoca claytoni Koretsky (tentative name)	+		6 – 7+8?
Pristiphoca vetusta (Zapfe)	+		7+8?
Trocharion albanense F. Major, 1903	+		5 - 9
Phocidae gen. et spec. indet.	+		
Mustelidae gen. et spec. indet.		+	
Viverridae gen. et spec. indet.		+	
Rodentia			
Bransatoglis cf. *astaracensis* (Baudelot, 1970)		+	4 – 9
Democricetodon vindobonensis (Schaub et Zapfe, 1953)		+	6
Democricetodon sp.		+	4 - 9
Eomyops sp.		+	5 - 14
Eumyarion sp.	+	+	4 - 9
cf. *Megacricetodon* sp.		+	4 - 9
Neocometes brunonis Schaub et Zapfe, 1953		+	6 - 8
Spermophilinus bredai (H. von Meyer, 1848)		+	6 – 7+8
Gliridae gen. et spec. indet.		+	
Sciuridae gen. et spec. indet.		+	
Rodentia gen. et spec. indet.		+	
Proboscidea			
Zygolophodon turicensis (Schinz, 1824)	+		3b - 10

Artiodactyla		
Lagomeryx parvulus (Roger, 1898)	+	4 - 6
Mammalia		
Mammalia gen. et spec. indet.	+	

Tab.1. Fauna of mammals from Upper Badenian sediments of the Bonanza locality.

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Fauna and nannoflora of Badenian sediments in the Stupava HGP-3 borehole (Slovak part of the Vienna Basin)

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Key words: Neogene, Badenian, Foraminiferida, Mollusca, calcareous nannoflora, Vienna Basin.

At the southeastern margin of the Slovak part of the Vienna Basin, sediments of Badenian age are cropping out (Devínska Nová Ves – Sandberg and clay pit) and were encountered in the DNV-1 (Devínska Nová Ves) and HGP-3 (Stupava) boreholes. On the basis of foraminifers the mentioned sediments were attributed to the Middle to Upper Badenian. Besides foraminifers from the mentioned sediments molluscs, ostracodes, otholites of fish, calcareous nannoplankton, algae, pollen, macroflora and vertebrates were studied in the past.

Upper Badenian sediments are represented by the Studienka Formation, the marginal part of which is called the Sandberg Member. Calcareous clays represent characteristic deep-water member of the formation.

Middle Badenian sediments are represented by the Jakubov Formation, the marginal part of which is Devínska Nová Ves Member.

As a results of the study of sediments in HGP-3 borehole situated east of the Stupava township, further knowledge of fauna and lithology of Middle to Upper Badenian sediments of the Vienna Basin was obtained.

The Studienka Formation in the HGP-3 borehole (6,0-22,9 m) was formed by grey thin-bedded clays. Foraminifers *Bulimina dilatata maxima* C.-Z., *B. elongata* Orb., *Globigerina bulloides* Orb., *G. concinna* Rss., *G. diplostoma* Rss. were found in sediments. Calcareous nannofossils assemblage from this interval contains *Helicosphaera carteri* (Wallich), *Pontosphaera multipora* (Kamptner), small *Reticulofenestra pseudoumbilicus* (Gartner). *Rhabdosphaera sicca* Stradner, *Braarudosphaera bigelowi* (Gran and Braarud), smaller *Umbilicosphaera rotula* (Kamptner) are also present, the lack of discoasters was noticed. The Studienka Formation in the HGP-3 borehole (22,9-197,0 m) is underlain by sediments of the Jakubov Formation. The basal part of the formation is represented by the distal part of the Devínska Nová Ves Member, which is formed by greenish-grey unsorted sandstones, a thin bed of lignite and grey clays with layers of conglomerates and gravels, the materials of which consists of angular and half-rounded fragments of granitoids. They are overlain by grey sands with rich associations of molluscs, in which mostly gastropods were represented, *Chithon pictus* (Fér.), *Rissoa turricula* (Eichw.) and bivalves of the species *Parvilucina dentata* (Defr.). Besides molluscs, foraminifers *Elphidium* macellum (F.-M.), *E. fichtelianum* (Orb.), *Ammonia beccarii* (L.) *Asterigerinata planorbis* (Orb.) were found. In clayey sediments overlying the sands, foraminifers *Uvigerina aculeata orbignyana* Czjz. and *U. semiornata adolphina* Daniels-Cicha, indicating a middle Badenian age of these sediments and bivalves *Nuculana fragilis* (Chemnitz), *Cyclocardia scalaris* (Sowerby) and *Corbula gibba* (Olivi) were determined.

Obtained calcareous nanoflora of the NN6 Zone contains *Calcidiscus premacintyrei* Teodoridis, *Sphenolithus abies* Deflandre, *Helicosphaera wallichii* (Lohmann), *H. wahlbersdorfensis* Müller, *Discoaster brouweri* Tan, *D. variabilis* Martini & Bramlette, *D. exilis* Martini & Bramlette, *D. musicus* Stradner, large forms of *Umbilicosphaera rotula* (Kamptner), *Triquetrorhabdulus rioi* Olafsson, *Tr. farnsworthi* (Gartner), *Tr. rugosus* Bramlette & Wilcoxon, *Calciosolenia murrayi* Gran, *Syracosphaera histrica* Kamptner, *Rhabdosphaera sicca* (Stradner), *Reticulofenestra pseudoumbilicus* (Gartner). None *Sphenolithus heteromorphus* Deflandre was found.

Korneuburg Basin - an Early Miocene estuarine palaeoecosystem from NE Austria

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Key-words: Early Miocene, estuary, paleoecology, cluster analysis, Korneuburg Basin.

The Korneuburg Basin (NE Austria) is a SSW-NNE elongated basin of about 20 km length and attains a maximum width of 7 km. Its protected position - strongly cut off from the open Paratethys Sea in the south, but variously connected in the north - caused a complex interplay of marine and coastal-terrestrial conditions during Karpatian (Late Burdigalian) time.

The extensive regional geological and palaeobiological data sets with emphasis on composition and distribution of molluscs and lower vertebrates allowed its detailed palaeoecological and palaeogeographical mapping. Hence a presence of a small, narrow estuarine and wetland ecosystem rimed by abrupt tectonic margins is indicated in the southern part of the basin. In contrast the northern basin part displays a normal marine embayment, which hardly exceeded 20-30 m water depth. Typically, in estuaries the fresh river water discharge is blocked from streaming into the open sea by either surrounding mainland, peninsulas, barrier islands, or fringing salt marshes. In the Korneuburg Basin the eastern ridge of the Flysch Zone might have acted as such a barrier. Additionally a transversal topographic swell between its northern and southern part indicated by our data around Obergänserndorf-Mollmannsdorf acted as barrier regulating the water exchange between them. In respect to the diverse, normal marine fauna of the northern basin including a minor brackish influence in its northernmost tip, and the estuarine facies in the southern basin, a marine connection was most likely established along the north-eastern coast.

Hierarchical Cluster Analysis and non-metric Multi-Dimensional Scaling carried out in order to investigate the similarities of investigated fauna clearly underpinned former interpretation. They showed the presence of two distinct groups differentiated by habitat preferences and palaeogeography. The first cluster included samples from the southern part of the basin characterized by *Crassostrea gryphoides* and *Crenomytilus*? *aquitanicus* accumulations, coal lenses and occurrence of terrestrial snails. The second group included marine sites from the northern Korneuburg Basin and NE neighbouring Kreuzstetten Bay.

Herein typical stenohaline organisms like *Macrochlamis*, *Pecten* or *Aporrhais* occur being all absent in the first, southern Korneuburg Basin cluster.

Definition of delta body in the northern closure of the Vienna Basin (Sarmatian, Czech Republic)

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Key words: Sarmatian, delta body, seismic profile, Vienna Basin.

Structural reinterpretation of the earlier reflection seismic profiles and drill logs was performed during geological maping 1:25 000 in the map sheet 34 - 223 Hodonín. This area is situated in the northern part of the Vienna Basin in the Moravian Central depression closed to Slovak and Austrian frontiers. On the basis of seismic profiles, drill logs and lithological profiles of the boreholes was distinguished the large delta body in the sediments of Sarmatian. The delta body is typical by higher values of electrical resistance and spontaneous polarization in electrical well logging diagram and also by character of wave field of reflex seismic profile.

We present the structural map of the basis of Neogene sediments with the boundary of delta body. It is situated nearby to Steinberg Fault system that represents the important extensive structure in the area and it has character of „flower structure".

Using by combine geological, logging and seismic data was constructed the interpretative geological-geophysical cross-section. It is situated from NW to SE and it connects boreholes Mutěnice-1, 2, 5, 6 and Kapřiska-2. In the reflection seismic profile and also in geological profile were distinguished complex of flysch sediments (Zlín Formation) and sediments of middle and Upper Badenian (Hrušky Formation), Sarmatian (Bílovice Formation) and Pannonian (Bzenec, Dubňany and Gbely Formation). The profiles show complicated development of the northern part of the Vienna Basin (synsedimentary faults, „wrench faults", „flower structures" etc.).

Comparison of the Upper Badenian sediments in the Danube and Vienna Basins (Central Paratethys area) on the basis of Foraminifera and calcareous nannoplankton

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Key words: Middle Miocene, Pratethys, Paleoecology, Foraminifera, Nannoplankton

Evolution of the Alpine – Carpathian – Pannonian junction to its present form started from the Middle Miocene. Geographically it can be situated to the subsiding Danube Basin, surrounded by uplifted mountain ranges of Eastern Alps on the west, Western Carpathian core mountains on the north (Malé Karpaty Mts., Považský Inovec Mts. and Tribeč Mts.), and Transdanubian Central Range on the southeast, while the Vienna Basin is situated between the East Alpine and Western Carpathian mountain chains (Malé Karpaty Mts.) on the East. The basins neogene infill comprises Early to Late Miocene, and Plio-Quaternary deposits. The Early and Middle Miocene sediments were mostly deposited in marine environments. The latest Middle and Upper Miocene sediments were deposited in the brackish water conditions and the youngest ones in the freshwater, limnic to fluvial environments.

In this work we present paleoecological comparison of the two Upper Badenian formations, the Studienka Fm. in the Vienna Basin and Pozba Fm. in the Želiezovce depression of the Danube Basin. Both consist of the gray calcareous claystones (up to 400-600 m thickness) in its basin facies, which are laterally changed into the transgressive beds with algae biohermal limestone. There are epiclastic volcanic sandstones beside listed facies in the Pozba Fm.

Biostratigraphically are ranked to foraminiferal Bulimina/Bolivina Zone and calcareous nannoplakton NN6 Zone, which according to belongs to the middle part of the Serravallian stage. As results we can assume, that it is not possible to divide the NN6 Zone into the subzones (sensu Marunteanu 1999) in both the Vienna Basin and the Danube Basin sediments, because in all sections a gradual lowering of salinity was found out together with missing stenohaline nannofossils, e.g. sphenolithes, helicolithes, rhabdolithes. In the nannoplankton assemblages of the Vienna Basin section prevail portion of the placolite forms (*Coccolithus pelagicus, Reticulofenestra pseudoumbilicus, Reticulofenestra minuta,*abundant are specimens of *Syracosphaera pulchra* and others).

From the paleoecological point of view we consider the two cooler events (monoassociations consist of *Coccolithus pelagicus* a *Reticulofenestra pseudoumbilicus*) in the warm water basin characterised by the subtropic to tropic nannoplankton species. The assemblages of the planktonic foraminifers indicate a paleoclimatic trend from warm to more temperate conditions from the bottom to the top of the section during Zone NN6 based on lower abundance of the *Globigerinoides* and *Praeorbulina-Orbulina* groups. Data of planktonic foraminifera suggest also higher productivity in the upper part of the water column during Zone NN6, which is probably related to high nutrient availability.

In the pollen spectra from both of areas have been dominantly present hydrophilous to swamp vegetation elements with *Taxodiaceae, Alnus, Myrica, Salix*. There were also a rich occurrences of *Carya, Ulmus, Zelkova* and *Pinus*. Based on presence of the termophilous taxons *Engelhardia* or *Olea* the climate could be characterized like subtropical.

Late Miocene to Pliocene sedimentary environments and climatic changes in the Alpine – Carpathian – Pannonian junction area: a case study from the Danube Basin northern margin (Slovakia).

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Key words: Late Miocene, Pliocene, sedimentology, paleoclimate, Danube Basin.

Biostratigraphy of the HRI 2

The Early Pannonian (11.5-11 Ma) can be defined by the first occurrence of the Early Vallesian (MN 9) mammal fauna with "hipparions", molluscs and ostracods of the Pannonian A-B zone (Tab. 2, 3), the calcareous nannoplankton zone of Praenoelaerhabdus banatensis and the dinocysts zones Spiniferites bentorii.

The Middle Pannonian (11-9? Ma) can be defined by mammal fauna of the Vallesian MN 9 zone upper part and the lower part of the MN 10 zone, by molluscs and ostracods of the brackish zones C – E, calcareous nannoplankton of the Noelaerhabdus bozinovicea zone and by dinoflagellate Spiniferites paradoxus zone.

The Late Pannonian F – H zones time interval (9-7.8 7.1?) can be characterized by the fresh water molluscs in aquatic environment. Upper part of sedimentary record (Hlavina Mb.) can be correlated with the Early Turolian MN 11 zone. The nannoplankton of the

Noelaerhabdus bonagali zone and dinoflagellate of the Spiniferites validus zones (F - H zones) were not found in the northern Danube Basin due to restrict of the Pannonian Lake towards SE.

Biostratigraphy of the HRI 1

The Early Pontian in the Danube Basin marginal parts is represented by hiatus, possibly broader equivalent of the Messinian salinity crisis. For biostratigraphy only scarce findings of mammal fossils can be used. Findings from the Veľké Bielice locality are tentatively dated between the Late Pontian and Pliocene (MN 13-15, 6.5 – 3.6 Ma). The Ivanovce biocenosis from karstic fissures was dated to the Early Pliocene (Dacian, Late Ruscinian (MN 15, 4.2 – 3.6 Ma) and the Hajnáčka mammal fossils were dated as the lower part of Villafranchian (MN 16a, 3.3 – 2.8 Ma).

B. Paleogeography of the HRI 2 and HRI 1 was influenced by collisional tectonics of the Carpathian orogen soft docking in the European platform margin and development of the Pannonian back arc basin, which passed through stadium of synrift and wide rifting during the Sarmatian and Early Pannonian, followed by thermal postrift subsidence during the Middle – Late Pannonian and Pontian time. The development led from the isolated bay of Central Paratethys to Caspibrackish to freshwater Pannonian Lake and later to alluvial plane. The Pliocene evolution characterized the onset of tectonic inversion.

C. Aquatic paleoenvironment of the Danube Basin gradually changed due to Central Paratethys isolation from brackish (Sarmatian) to caspi-brackish (Pannonian). During the Early Pannonian the salinity was less than 10-15 ‰, in the Middle Pannonian below 10 ‰ and in the Late Pannonian freshwater lakes developed. Finally, alluvial environment prevailed in the Pontian to Pliocene (Tab.1). Short time connections with Eastern Paratethys are expected beside Early-Middle sarmatian boundary during the early and Middle Pannonian.

D. Terrestrial environment of the Early Pannonian (Vallesian MN 9) is characterized by changes in paleogeography documented by extinction of the Middle Miocene elements and immigration of "hipparion" fauna to the Alpine Carpathian – Pannonian junction area. The first appearance of "hipparions" - the *Hippotherium primigenium* in the Vienna Basin was dated to 11.2 Ma (Rögl & Daxner-Höck, 1996). The Middle Pannonian time interval from MN 9 to early MN 10 biozone can be characterized by the terrestrial ecosystems preferring open grassy areas with sparse forests. It is not out of question that this change was caused by more continental climate with seasonal changes. The subsequent reduction of the Pannonian lake extent led to next important humidity decrease during the Late Pannonian and Early Pontian. Red beds were deposited.

The Late Pontian to Pliocene (after the Messinian salinity crisis) environment of alluvial plains, characterized by fossil remains belonging to two proboscidean taxa (*Anancus arvernensis* and *Mammut borson),* tentatively dated to the Late Turolian – Ruscinian (MN 13-15, 6.5 – 3.6 Ma) suggests restoration of the humid temperate zone climate, convenient for development of woody land with rivers alternating with the open grassy areas. The Early Pliocene, Late Ruscinian (MN 15. 4.2 – 3.6 Ma) biocenosis indicates a presence of humid woodland with rivers and lakes in the temperate zone. The terrestrial environment of somewhat younger Hajnáčka locality, belonging to the lower part of the Villafranchian (MN 16a, 3.3 – 2.8 Ma), was characterized by bushy humid primeval forest with flowing streams and backwater alternating with steppe or open grassy land. Towards the end of Pliocene a next lowering of humidity is expected (Lukáčovce Mb. red beds).

E. Climate changes during the HRI 2 are characterized by change of the Sarmatian subtropic vegetation to flora of temperate zone. A gradual humidity decrease is also registered. The Early Pannonian swamps vegetation was replaced by the Middle Pannonian flora with typical high portion of mountain vegetation elements, which can be interpreted as a consequence of higher relief in hinterland of the basin or onset of seasonality leading to retreat of deciduous forest. The palynospectra point out to frequent winds blowing towards the Pannonian Lake as well.

The Pontian vegetation with scarcity of evergreen elements could refer to more continental climate with severe winter season and lower precipitation. Comparison of the Pontian and Dacian sites points to increase of humidity during the HRI 1 towards the Pliocene. Decreasing tendency of the mountain vegetation elements in comparison with the Pannonian strata, as well as swamp vegetation elements and herbs document moderate temperate climate of wet lowlands during this time, which corresponds with the results of mammal paleoecology and sedimentary record of aluvial plains.

F. Relative sea level changes in the Danube Basin can be characterized by the 3rd order cycles similar to global sea level changes (sensu Haq, 1988; Hardenbol et al., 1998). The Early Sarmatian to Early Pannonian (Late Serravallian – Early Tortonian) 3rd order cycle with sequence boundaries of SB 1 type can be observed on the basin margin. The next Middle Pannonian (Middle Tortonian) 3rd order cycle is composed from the caspibrackish sequences of the Pannonian lake. The last Late Pannonian (Late Tortonian) 3rd order cycle includes deposits of freshwater lakes and alluvial plains characterized by SB 1 and SB 2 type sequence boundaries. Correlation of the Danube Basin cycles of relative sea level changes with the

global sea level fluctuations documents indirect connection of the Pannonian Lake with the world ocean during the HRI 2 time interval.

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Eolic sediments´ comparison in SE Moravia based on magnetic attributions and heavy minerals assemblages

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Key-words: Quaternary, sand, loess, magnetic properties, heavy minerals, SE Moravia

Eolic sediments are represented by loess and air-borne sands in the region of SE Moravia. The most expanded loess cover represents of the last part of Würm glacial (it was marked as W3). The age of air-borne sands of SE Moravia is not known exactly, generally it is assumend, that they are Holocene in their age. However, these two sediments have never been found in the superposition.

Anisotropy of magnetic susceptibility (AAS) and the content of heavy transparent minerals were determinated on the four localities enough. There are localities of loess (Hulin and Orechov) and air-borne sands localities (Hulin–rybniky and Polesovice) AMS reflects the preferred orientation of the magnetic minerals in the rock thus the rock fabric may be inferred. In the unmetamorphosed and very low-grade metamorphosed sediments the direction of

maximum susceptibility (magnetic lineation) reflects the flow direction. The plane perpendicular to the minimum susceptibility (magnetic foliation) reflects the bedding. We can determinate the provenance area of the sediments by comparition of heavy minerals content.

AMS data were plotted on a Lambert projection on the lower hemisphere (Fig.1). Magnetic foliation of the loess of (Fig. 1A) and Orechov (Fig.1B) is sub-horizontal. Magnetic lineation is sub-horizontal, prevailing direction NE-SW (Hulin) or NW-SE (Orechov). This direction may reflect the prevailing wind direction NE-SW of NW-SE, Hulin of Orechov respectively. The principal AMS directions of the air-borne sands, Hulin and Polesovice, respectively) seem to be randomly distributed. The uniform distribution can be due to the low content of the randomly oriented fine-grained magnetic minerals in the coarser sand matrix. The AMS method seems to be unsuitable for the determination of the fabric of air-borne sands (Fig. 1C and 1D, Hulin and Polesovice, respectively).

The main diferencies in the semiquantitative analyses of the heavy transparent minerals are in the contents of amphibole, garnet, epidote, zircon and turmaline. There were determinated by this percentual content:

	Hulin-rybniky (air-borne sands) %	Hulin-loess %	Orechov-loess %	Polesovice (air- borne sands) %
Amf	38,7	57,5	49,2	49,3
Grt	35,3	15,9	7,3	24,3
Ep	11,5	19,3	16,1	16
Tur	1,7	1,3	7,2	2,9
Zrn	1,3	3	11,1	2,1
Other akcesories	11,5 (Ky,And,Sil,Ttn,St)	3 (Ap,Rt)	10,1(Ttn,St,Ky ,Ap,Rt)	5,4 (Ttn,Rt,St)

Grain diferences berween these sediments did some statistic mistake, but from the semiquantitative analyses it is obvious that localities of the air borne sands which are laid in the near neighbourhood display a diferent provenance area after all.

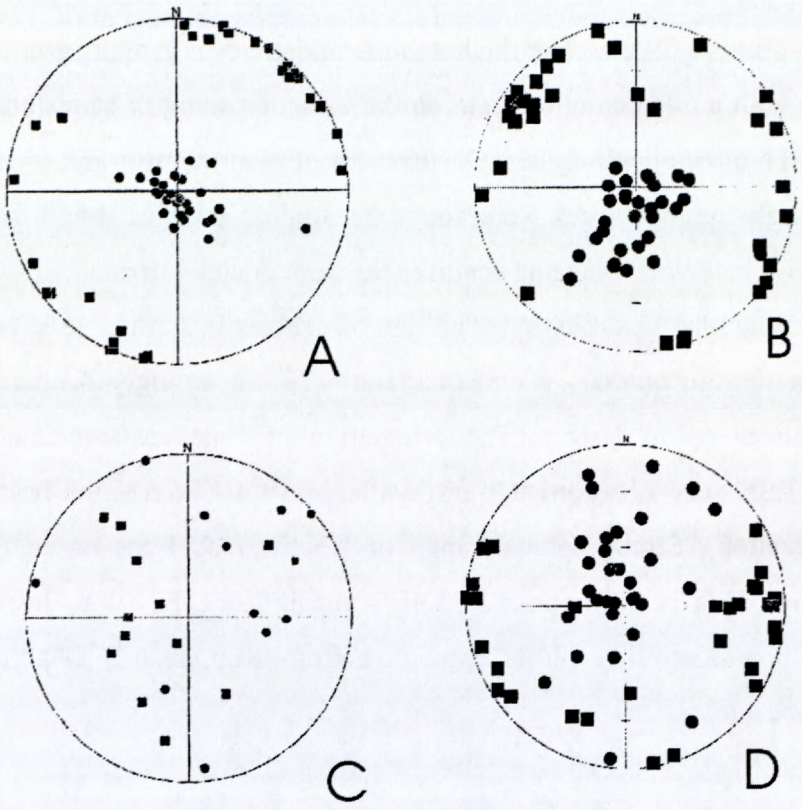


Fig.1.

A – loess from Hulin,

B – loess from Orechov,

C – air-borne sands from Hulin-rybniky,

D - air-borne sands from Polesovice

The Lower Miocene deposits of the Krynica Subunit of the Magura Nappe near Humenné (eastern Slovakia)

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Key-words: Early Miocene, sedimentology, Kochanovce Beds, Krynica Subunit

The mapped area, situated in the Laborecká vrchovina Mts. (northern from Humenné) is built by Mesozoic limestones of the Smolegowa and Krupianka Fm. and by the Paleocene to lower Eocene Proč Beds (Potfaj 1997 advises the Proč Beds to the Magura unit „s. l.“) of Pieniny Klipen Belt. Moreover, it is also built by the Paleogene Strihov and Beloveža Beds of the Krynica Subunit of the Magura Nappe. Based on stratigraphy, lithology, tectonic position and heavy mineral study, new litostratigraphical unit – the Kochanovce Beds has been described.

The Kochanovce Beds are overthrusted to north on the Krynica Subunit, but part of the structure is lying on the Proč Beds. The thickness of the Kochanovce Beds is 500 - 700 m. The base of the Kochanovce Beds is characterised by thick bedded sandstone – conglomeratic flysch, with a transition to medium and thin bedded sandstone – claystone flysch. The

thickness of claystone beds is 1 cm to 70 cm. The thickness of sandstones is ranging from 3 cm to more than 2 m, usually with a microconglomerate on the basis. Bedding of sandstones is equivalent with Ta, Tb, Tc, Td of Bouma intervals. Occurrences of plant detritus and micas in laminas are usual. No conglomeratic layers were found in studied profiles, but in an unnamed creek nothern from Kochanovce village its occurrences were documented.

Conglomerates have typical graded stratification. The size of pebbles is 2 cm or less, but larger pebbles were found there: vein quartz - 5 cm, quartzite - 20 cm, strongly K altered rhyolite - 25 cm and limestones up to 60 cm. The orientation of flute casts indicates paleotransport direction from ESE to NWN (corrected of a value of 10° CCW rotation based on the paleomagnetic investigation). Stratigraphical range of Kochanovce Beds based on association of calcareous nanofossils is the uppermost Oligocene biozone NN 1 to lower Miocene NN 3 biozone, with a possibility of its extending from Ruppelian - Chattian boundary to the middle Miocene age.

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Relicts of Miocene sediments on the eastern margin of the Bohemian Massif and their paleoenvironmental and paleogeographical interpretations

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Key words: Miocene, sedimentology, paleoenvironments, paleogeography.

In the last years, the isolated relicts of Miocene freshwater, brackish and marine sediments situated on the rocks of the Brno unit as well as of the Bohemian Massif in western Moravia and eastern Bohemia (Czech Republic) are studied in detail (e. g. Hladilová et al., 1999). This study is based on the independently made sedimentological and paleontological analyses, the application of particular methods being modified according to factual conditions of individual profiles. At convenient localities even the isotopic analyses enlarge the spectrum of used research methods.

The relatively greatest attention was paid to the numerous relicts of the Miocene sediments, predominantly rich in fossils, representing largely marginal facies of the second phase of the Lower Badenian transgression (Kralice nad Oslavou, the broader surroundings of

Znojmo and Moravské Budějovice – Chvalovice-Šatov, Hostim, Nové Syrovice and others). The results are mutually correlated and detailed interpretations of stratigraphic positions, sedimentary conditions and paleoenvironmental changes are made on individual relicts followed by the correlations with other Miocene sediments of the corresponding time intervals from the deeper parts of the Carpathian Foredeep (e. g. from the wider surroundings of Brno and Olomouc).

This study enables a more precise interpretation of the Carpathian Foredeep paleogeography, namely of its reach limits on the Bohemian Massif. Furthermore, the achieved results are of value for the sequence stratigraphic model of the Carpathian Foredeep.

Acknowledgement: The study was supported by the Grant Agency of the Czech Republic (Grant 205/00/0550).

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The Late Oligocene to Early Burdigalian paleogeography of the Carpathian Foreland Basin (Southern Poland)

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Key-words: Oligocene, Miocene, paleogeography, Carpathian Foreland Basin.

In the Southern Poland the Upper Oligocene to Lower Burdigalian deposits are known both from the Outer Carpathians as well as from their foreland. In the 1970's the Upper Oligocene/ Lower Burdigalian deposits have been recognised as the youngest member of the Menility-Krosno flysch succesion in the Skole and Silesian units. Recently the flysch deposits of the same age have been found in the middle and southern part of the Magura Nappe. At same time, the Aquitanian to Lower Burdigalian fan delta conglomerates onlapped by shelf mudstones, have been discovered in the platform basement, beneath the Carpathian nappes. This new data enable us to conclude that in the northern part of the Outer Carpathians and the adjacent part of the European Platform existed broad Aquitanian/ Early Burdigalian marine basin. For this time interval the following paleogeographic scenario could be proposed.

During the Late Oligocene/ Aquitanian, simultaneously with overthrust of the Magura Nappe onto the terminal Krosno flysch basin, the Magura piggy-back basin begun to

developed. The Late Aquitanian through Early Burdigalian global rise of sea level enabled marine transgression onto the Carpathian foreland, deepening of the residual Krosno flysch basin as well as the opening of the sea-way connection between the Magura piggy-back basin and Vienna Basin. At the end of the Early Burdigalian (NN3), the Late Krosno basin shifted towards the NE (Skole/ Boryslaw Pokuty Basin) and finally underwent desiccation (the Lower Miocene salt formations in the Ukrainian and Romanian Carpathians were deposited).

This work has been carried out with the financial support of the Polish State Science Foundation (KBN) Projects 6P04D 04019 and 6P04D 05521.

Environmental significance of bioturbations in the Grund Formation (Miocene, Lower Badenian) in northern Lower Austria

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Key-words: Early Badenian, sedimentology, bioturbation, ichnofacies, Grund Fm, NE Austria

Sedimentology, Paleontology and Ichnology of the lower Badenian (early Middle Miocene) Grund Formation could be studied during field campaigns in 1998 and 1999. Several deep trenches (profiles A, B, C, D, E, F, G, H) were excavated in the farmland between the villages of Grund and Guntersdorf north of Hollabrunn in northern Lower Austria.

The profiles at the type locality Grund show sediments from a shallow marine, highly erosive environment with small channels. The channel-fill with densely packed (bioclast supported) shell-layers at the base, fining upward cycles of coarse to fine sands, and thin pelitic layers on the top indicate periodically high-energy events with rapidly decreasing energy level. The channels always have a sharp erosive base and maximum visible extentions of 7 to 8 meters with depths of 0.5 to 1 meter.

In the lower part of the sequence (profiles A, B) sandy beds with a thickness from 60 to 120 cm contain up to 40 cm thick layers of pelitic clasts, showing strong reworking. Besides the clasts these layers contain a mixed allochthonous fauna with marine mollusks, terrestrial gastropods and bones of different vertebrates (turtles, whales, rhinos, small carnivores and micro mammals).

Towards the top of the sequence thickness and grain size of the beds are decreasing. In the middle part of the sequence in profiles C and D 20 to 45 cm thick medium to fine grained sandy beds show fining upward and even lamination. Current ripples and plant debris at the top of some beds show the reduction of current velocity too. Several cm-thick pelitic layers mostly

cover the laminated sands. Intense but monospecific bioturbation (*Asterosoma*) starts from these layers but reaches down only up to 5 cm into the sandy layers. The sandbodies in this part are mostly tabular sometimes slightly wedge-shaped. In rare cases small and narrow runnels, 60 to 80 cm wide and 10 to 25 cm deep, with erosive base and filled with pelitic clasts can be found.

The uppermost part (profiles E, F, G, H) also contains evenly laminated, medium to fine sands with graded bedding but thickness of the pelitic layers is increasing towards the top of the sequence. In some cases shell-layers and small pelitic clasts at the base and plant debris on the top still occur in the sands. Developing from the 10 to 20 cm thick pelitic layers a diverse trace fossil community reaches down into the sands. *Rhizocorallium*, *Teichichnus* and *Zoophycos* are very frequent structures but also *Ophiomorpha* can be observed. The chemosymbiontic bivalve *Thyasira michelottii* occurs as exclusively autochthonous inhabitant of these layers. The Thyasira-shells sometimes are connected with deep shafts, but in most cases with *Chondrites*-like ventral tunnels.

The distribution and diversity of bioturbations is highly correlated to the hydrodynamic level. The basal sections of the sequence show the highest disturbance of the benthos. Only oportunistic organisms with burrowing strategies fitting to the mobile sediment can settle during short periods of quiet conditions.

Probably the deepening of this environment caused the increase of calm periods toward the top. Longer periods of benthic recovery after physical disturbances lead to the increase of burrowing depth and diversity. Deposit feeding and chemosymbiontic strategies are characteristic features of the uppermost parts in the excavated sections of the Grund Formation.

The decrease of the hydrodynamic energy level from the base of the sequence to its top is obvious in the sedimentological record as well as in the development of trace fossil assemblages. This fits very well to the regional transgressiv trend of the lower Badenian.

Chemosymbiosis, fossil lucinoid bioturbations and the *Chondrites* enigma

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Key-words: Miocene, ichnofossils, bioturbation, life strategies.

The trace fossil *Chondrites*, although widespread in different trace fossil assemblages, is used as an indicator of low-oxygen (dysaerobic) conditions if occurring as single feature. Sediment-ingesting polychaetes, sipunculids, or even detritus-feeding arthropods had been regarded as potential constructors of *Chondrites*-like structures, yet solid proof is missing. Here, we present the unique in situ preservation of the burrowing bivalve *Thyasira michelottii* (R. Hörnes, 1875) together with its *Chondrites*-like bioturbations and provide evidence for chemosymbiontic life strategies under dysaerobic conditions.



Thyasira michelottii from shallow marine sediments of the Austrian Miocene (Grund Formation, Lower Badenian) produced not only the inhalant tube but also a system of ramifications below their life position. The circular to blade-shaped and weakly to densely branching shafts have diameters up to 3 mm and reach down to 10 cm into the sediment below the ventral shell margin. The *Chondrites*-like posterio-ventral tunnel branchings reflect the search of the burrowing, worm-shaped foot for short-lived pockets of sulfidic material in an otherwise low-sulfide environment.

Chemosymbiontic strategies are responsible for the morphological similarity between recent *Thyasira* burrows and *Chondrites* trace fossils. In chemoautotrophic symbioses, bacteria provide the host with some form of chemosynthetically fixed carbon obtained through the oxidation of reduced sulfur; the bacteria benefit from a protected environment. Among the Lucinoidea, special anatomical and morphological features like thick gills, reduced palps, short simple gut, and an elongated burrowing foot are interpreted as an adaptation to oxygen- and nutrient-poor habitats. The *Chondrites*-like branching burrow systems are formed when the clams use their extendable feet to obtain hydrogen sulphide from interstitial water in the underlying sediments.

Palaeoecology and biostratigraphy of Karpatian based on studies of foraminifers (Carpathian Foredeep, Czech Republic)

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Key words: Karpatian, Foraminiferida, palaeoecology, biostratigraphy, Carpathian Foredeep.

The geological structure and position of the Carpathian Foredeep (CF) is complex, palaeoecological data are incomplete. Stratigraphical knowledge has long evolution from usage of terms like "Helvetian" to Karpatian and many authors such as Cicha, Čtyroká, Molčíková, Zapletalová, etc have dealt with biostratigraphy of Karpatian.

In this paper, the assemblages of foraminifers from the southern part of the CF, mainly from the Nosislav-3, Cf-4 Židlochovice, HV-304 Hrušovany nad Jevišovkou, HV-305 Slup, HV-306 Hevlín, Mikulov-1 (etc) boreholes were studied.

By means of the statistical evaluation diversity according to Shannon-Wiever index, ratio p/b, similarity (Jaccard index), constance, percentage of foraminifera genera etc were followed. Several types of assemblages: with only teleostei bones, reduced (often with pyrit tests), rich and nondiversified or rich and diversified ones have been found.

On the basis of the study of 7 correlation diagrams several horizons with taxa such as *Siphonodosaria* sp., *Uvigerina* sp., *Pappina* sp., agglutinated foraminifers etc were ascertained across the Carpathian Foredeep. Palaeoecological conditions of Karpatian changed; I suppose reduced conditions during beginnig of Karpatian. Infralitoral-circalitoral, locally upper bathyal sediments originated containing reduced microfaunal association (low oxygen supply). Foraminifers assemblages were dominated by euryoxybionts (*Bolivina* sp., *Bulimina* sp., *Uvigerina* sp., *Praeglobobulimina* sp. etc.), diverse faunal associations alternate with reduced ones. The upper part of Karpatian sequence is strongly reduced. In the uppermost parts of the boreholes (with the exception of eastern slopes of the Bohemian Massif) several shallow-water foraminiferal assemblages have been found.

Sedimentology of Pliocene and Quaternary deposits of southern part of the Považský Inovec Mts.

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Key words: Pliocene, Quaternary, sedimentology, paleoclimates, Považský Inovec Mts

In this paper we are present result of the sedimentology study from Považský Inovec Mts. and anjacent Blatné and Rišňovce depression. Field works were oriented to sedimentological study of the Pliocene and Quaternary deposits and main goal of works was reconstruction of depositional environments during changing tectonic and climatic conditions.

The Pliocene and Quaternary sedimentary represent fluvial, alluvial fan and eolian deposits. The Dacian/Romanian boundary is represented by sediments of the Piešťany and Koplotovce Members. There are deposits of Paleo-Váh River and its tributaries. From sedimentological point of view, they are interpreted as large braided river deposits. Paleotransport was oriented generally from NE to SW and from E to W (Paleo-Váh River tributaries). During Romanian were deposited sediments of the Syslie vŕšky Mb, which represent meandering rivers deposits with different degree of river sinusoidy. In these deposits were recognized sedimentary facies of channel lags and bars, point bars, levees and flood plains. Paleocurrent analysis documents transport from NNE and NE toward SSW and SW, across area of "future" southern part of the Považský Inovec Mts. The Early Pleistocene sedimentation reflects varying tectonic and climatic condition. On slopes of the Považský Inovec Mts. and Rišňovce depression the Lukáčovce Mb were deposited. They are represented by small braided rivers and streams deposits with channel lags, channel bars and flood plains sedimentary facies. Paleotransport direction suggests uplifting of southern part of the Považský Inovec Mts. During the Middle and Late Pleistocene river network similar to present day were created. On western slopes of the Považský Inovec Mts sediments of small alluvial fans were deposited and the area has been covered by eolian loesses.

Anomalous paleomagnetic directions of Karpathian and Badenian rocks, Southern Slovakia

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Key words: paleomagnetism, CW rotation, Karpathian, Badenian

The declination of the remanent magnetic polarisation (RMP) of the Sečianky Member, Modrý Kameň Formation, Karpathian in age and the Hrušov Member, Vinica Formation, Badenian in age display a clockwise (CW) rotation, which is an anomaly in the relation to the recent knowledge concerning the RMP of the contemporaneous rocks of Southern Slovakia and Northern Hungary. The volcano – tectonic activity of the Šahy – Lysec Zone had been the reason of the CW rotation. The biostratigraphic age of the rocks studied and character of the chron C5Cr (17,2 – 17,7 Ma) and the Hrušov Member (Middle Badenian) with the older normal event of the chron C5Bn (15,15 – 15,03 Ma).

Neotectonics of southern part of the Považský Inovec Mts.

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Key-words: Pliocene, Quaternary, neotectonics, Považský Inovec Mts

Results of the neotectonic research are divided into two groups: The first one forms results of the structural paleostress analysis and second one forms results of slip-rate analysis on the main faults segmenting the studied area.

The Považský Inovec Mts is one of the core mountains which is situated in the external part of the Tatric orogenic belt. Its southern part is surrounded by the Blatné and Rišňovce depressions belonging to the Danube basin. We collected and analysed structural data of observed fault planes from several localities (Veľké Ripňany, Dolné Trhovište, Lukáčovce, Ducové). The structural measurements were very complex in the field because tectonic slickensides were poorly preserved on the fault planes. Kinematics of many faults was identified on the basis of the fault plane shape and structure. These data sets were recalculated

and used for the paleostress analysis, two deformational stages from the Pliocene to Quaternary period we determined. During the Pliocene to Middle Pleistocene was studied area under the older deformational stage characterizing generally by the NE-SW compression and perpendicular NW-SE tension. After the Middle Pleistocene was paleostress field totally reorganized and principal maximum stress axes rotated counter clockwise on ca 70° which is documented on the localities with the Pliocene to Quarternary sedimentary sequences.

The second part of the structural research was oriented at the degree of tectonic activity of the main fault zones (Hlohovec, Malé Karpaty, Čachtice, Kátlov, Madunice-Kostolany, Dudváh-Trakovice, Považský Inovec faults) during the Pliocene to Quaternary period. Using slip-rate analysis we quantified rate of motion on the faults which neotectonic activity formed geomorpozvojov drainage network and sedimentation of the area. Generally, the average rate of motion on the main fault zone was computed as 0,01-0,1 mm per year, but fault activity was different during the Pliocene-Quaternary (Kováč et al. 2001).

Complex internal structure of the Silicic Nappe system in the Muránska planina Mts

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Key words: Paleoalpine nappes, tectonic structure, Silicic Superunit, Muránska planina.

The geological structure of the Muránska planina Mts. is formed by several superimposed paleoalpine tectonic units (Veporic, Gemeric, Silicic units) having nappe and duplex-like character and the post-nappe Paleogene cover sediments. This structure is cutted by the subvolcanic bodies of the Neogene volcanites. This work is devoted to study of the facies development of the Silicic nappe system, which is characterized by a complex internal structure. In general, the lower duplex system is formed by relatively deep-water sequences and the upper one is formed by biohermal and lagoonal sequences of the Middle-Upper Triassic age.

The study of five lithostratigraphic sections has been oriented to detailed documentation of facies development of the lower duplex system and its upper boundary. It starts with the Bodvaszilas and Szin formations. The Gutenstein Formation is formed by thick-bedded bioturbated dolomites and dolomitic bio-wackestones and mudstones with wavy algal mat and

parallel current lamination in the lower part. In the upper part, thin- and thick-bedded bioclastic limestones are present, locally strongly bioturbated, with ostracods and foraminifers and fragments of crinoids, gastropods and brachiopods. The uppermost part is characterized by higher proportion of fragments of calcareous algae, forming continuous transition to the Steinalm Formation.

Higher, the Steinalm Formation is overlained by dark grey cherty thin- or thick-bedded limestones. In some sections (Strelnica), bio-wackestones/packstones with juvenile bivalves, locally forming laminations, are typical, indicating deeper and calm environment below storm wave base. However, in other places, more shallow facies are present (wackestones and mudstones with ostracods and fenestral structure, well sorted calcarenitic biointra-packstones).

The upper boundary of this duplex is affected by high diagenetic/tectonic overprint. Boundary strata between the lower and upper duplex locally consist of tectonic lenses of the Bajocian-Bathonian radiolarites, marly limestones and clastic sediments.

The upper duplex is characterized by typical facies development of the Silicic Nappe, formed by biohermal facies of the Steinalm, Wetterstein, Tisovec and Furmanec formations of the Middle-Upper Triassic age.

K/Ar dating of the Middle Triassic tuffs from the Central Carpathians and its paleotectonic context

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Key words: K/Ar dating, Middle Triassic tuffs, Central Carpathians

Several pyroclastic horizons representing the "pietra verde" type, have been recently found in the late Anisian-Ladinian Reifling beds of the Hronicum unit (Choč Nappe) from the Central Carpathians. They form intercalations up to 10 cm thick within the Reifling nodular limestones. All studied pyroclastics are sharply bounded and in contrast to the host carbonate sediments are lacking of micro- and macrofossils. They are green or grey plastic deposits, composed of clay minerals (mainly non-swelling 10 Å dioctahedral mineral of the illite type) (Koszowska et al. 2001) and minor amount of carbonate extraclasts, derived from the adjacent sediments. Biostratygraphical data yield late Anisian-Ladinian age of the studied pyroclastics.

Two samples of the authigenic illite separated from the tuffs have been selected for K/Ar dating. The first sample comes from the Polish Tatra Mts (Wielkie Koryciska Valley) and gave age of 115 Ma (±1.5 Ma). The other one derived from the Považský Inovec (Beckov site, Slovakia) was dated for 90 Ma (±1.2 Ma). Authigenic illites originates at temperature > 70°C. Such conditions may result from burial reaching at least 2000 m in depth or/and under influence of hydrothermal solutions. The both studied sites display any effects of hydrothermal activity. Therefore the illite origin should be exclusively ascribed to the geothermal heating under deep burial conditions. The illite date obtained for the Tatra sample indicates the Aptian age of its origin (time scale by Gradstein et. al. 1995). The main thrusting and folding phase in the Tatra Mts is dated as late as Turonian (Lefeld 1997). This indicates that the illite evolved under sedimentary burial before the nappe has been emplaced. Since the recently preserved cover thickness (encompassing rocks from the Ladinian to lower Jurassic), hardly excess 1200 m, one may infer that the primary cover had to include also the younger formations, (up to Cretaceous rocks) that underwent erosion after the Turonian thrusting.

The illite from Považský Inovec developed in middle Turonian time. Since the youngest sediments from the overlying package are of Hauterivian age (Plašienka et al. 1997), origin of this illite should be ascribed to diastrophic phenomena. The tectonically-driven burial resulted already during the early phase of the thrusting, that is dated in the western Central Carpathians for the Turonian-Paleogene interval.

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International Visegrad Fund

WARNING AGAINST ABRUPT CLIMATE (GREENHOUSE) CHANGES FOLLOWING FROM THE KNOWLEDGE ON THE EARTH CLIMATE EVOLUTION

Abstracts

Problem of the Barremian-Aptian hiathus in the Czorsztyn Unit resolved (Pieniny Klippen Belt, Western Carpathians)

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Key-words: Early Cretaceous, sedimentology, karstification, Czorsztyn Unit, Pieniny Klippen Belt

The Czorsztyn Unit is the shallowest Pienidic unit of the West Carpathian Pieniny Klippen Belt. Almost the whole Barremian and Aptian time-span was the time of non-deposition in this unit. Tithonian-Lower Cretaceous limestones are overlain by pelagic Albian marlstones and marly limestones. A nature of this gap was many times discussed in the literature. Most authors favoured a submarine non-deposition and erosion (Birkenmajer 1958 1973), whereas others proposed an emersion of the ridge (Mišík 1994).

In the last years, 5 formerly known sites were re-examined and 3 new sites were found with the preserved contact between the Albian and the underlying formations of the Czorsztyn Unit. They are: Dolný Mlyn, Vršatec (3 sites), Horné Sŕnie, Lednica, Jarabina and Kamenica. At two sites, the Albian marlstones and limestones are in contact with the rocks older than Tithonian or Neocomian. In Jarabina, the Barremian-Aptian erosion reached the level of Kimmeridgian red micritic limestones but clasts of limestones with "filamentous" microfacies indicate that Bathonian-Callovian limestones had to be uncovered too. At Horné Sŕnie, where the deepest erosion was indicated, the Albian deposits overlay Bajocian-Bathonian crinoidal limestones. Except of deep erosion, unequivocal signs of subaerial exposure and karstification (karren landform with vertical drainage grooves (Fig. 1, 2), small cavities in the bottom rock filled with younger sediment, bizarre fractures and veinlets filled with calcite - Fig. 3), were revealed, mainly in Horné Sŕnie and Lednica sites. This was followed by pelagic deposition, documented by Albian marlstones and limestones with pelagic fauna. In this time, the

paleokarst was bored by boring bivalves and owergrown by deep-water Fe-Mn to phosphatic stromatolites. This suggests a very rapid relative sea-level rise, most likely due to a marine ingression. A tectonic platform collapse and drawning is not excluded. Very similar case of Cretaceous paleokarst was reported from Betic Cordillera, Spain (Martín-Algarra & Vera 1996).

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Fig. 1 Tectonically overturned contact of the Bajocian-Bathonian cronoidal limestones (C) with Albian marlstones (m) in Horné Sŕnie locality. Note deep karren eroded in the crinoidal limestones and grooves normal to the original surface (arrows) created by rain water.

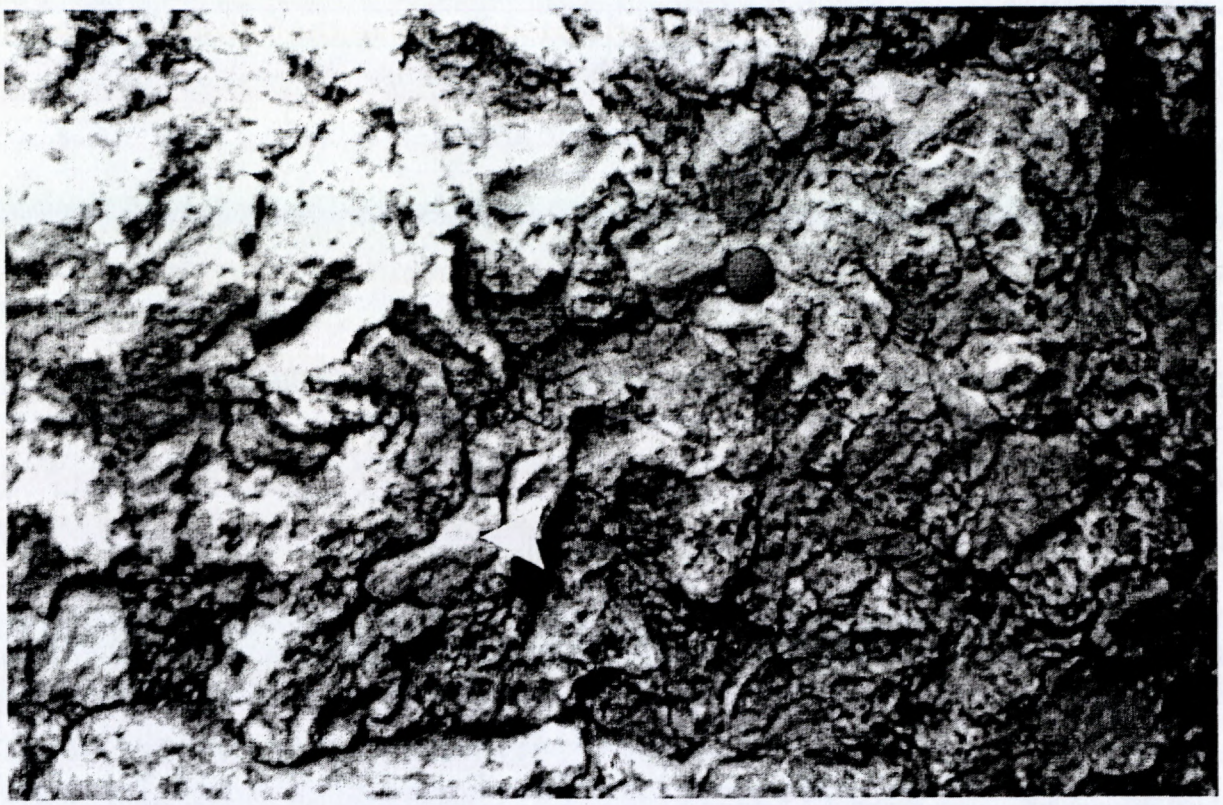


Fig. 2 Karstified pre-Albian surface on Berriassian limestones in Lednica locality. Remnants of the Albian pelagic marly limestones fill the karren depressions (arrow).

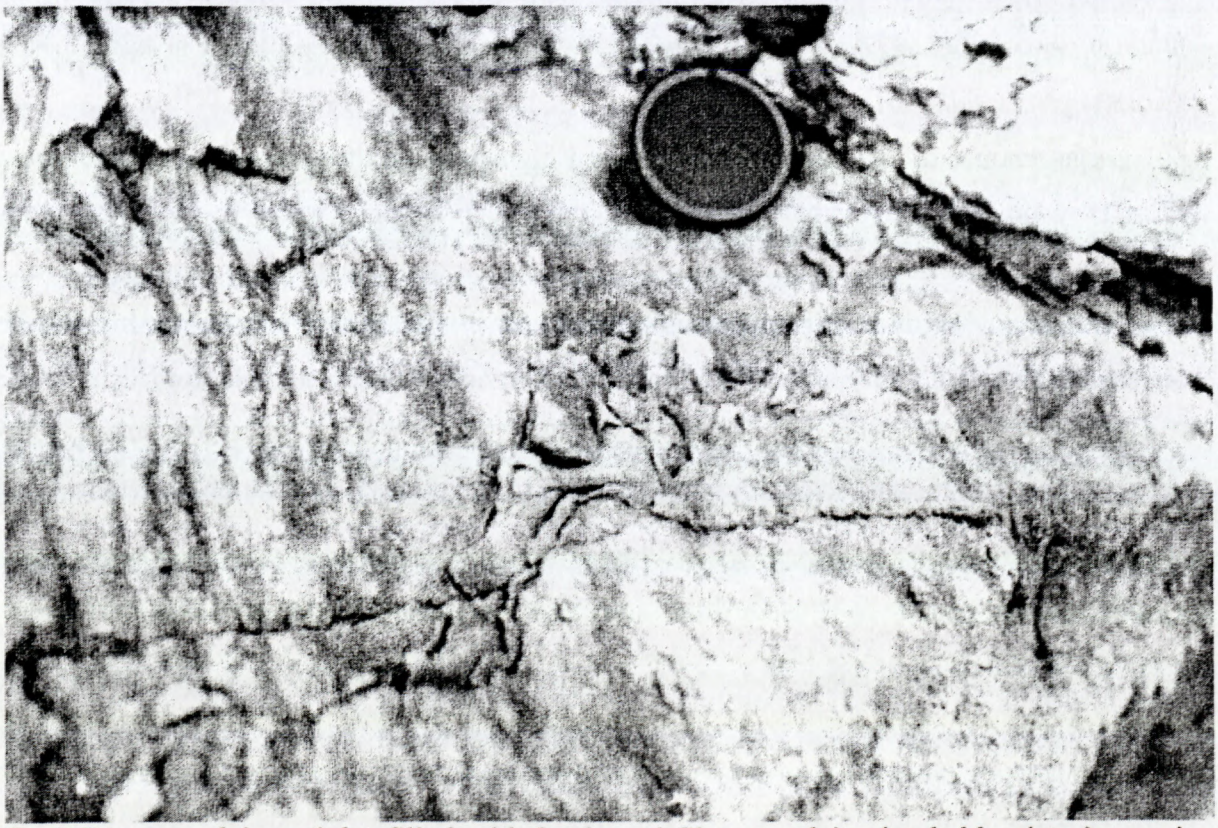


Fig.3 Bizarre calcite veinlet filled with laminated fibrous calcite (probably sinter), running down from the pre-Albian surface. Horné Sŕnie locality.

Radiolaria in the Lower Eocene Variegated Shales of the Subsilesian nappe, Polish Flysch Carpathians

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Key words: Early Eocene, Radiolaria, upwelling, ocean dynamics, Subsilesian Nappe

Variegated shales are characteristic deposits in the Flysch Carpathians and include red, green and grey shales, claystones and mudstones. These deposits extend in the Flysch Carpathians from the Cenomanian to the Upper Eocene (Książkiewicz 1962). Similar red clay facies occur also in the Alps, Appeninnes, North Atlantic and Pacific.

The studied section is located in the Wiśniowa tectonic window (Czerwin stream). Greenish to brown clayey shales with thin sandstone intercalations are exposed here. These deposits are characterized by very abundant radiolarians.

All radiolarian skeletons are well-preserved and pyritized. The most abundant species in the assemblage are *Calocycloma ampulla* (Ehrenberg), *Buryella clinata* Foreman, *Phormocyrtis striata striata* Brandt, *Lychnocanomma bellum* (Clark & Campbell), *L. auxilla* Foreman, *L. babylonis* (Clark & Campbell), *Amphisphaera minor* (Clark & Campbell) and *Stylosphaera coronata coronata* Ehrenberg. This assemblage can be placed in lower part of *Phormocyrtis striata striata* radiolarian zone of Sanfilippo et al. (1985).

Large amount of radiolarians documents a high productivity within the surface waters caused by upwelling system. Upwelling of cold deep oceanic water is possible in high dynamic glacial oceanic regime. Like in the present-day oceans, high nutrient levels in upwelling regime promote higher phytoplankton productivity, in turn causing the higher rates of radiolarian productivity and deposition of radiolarian-rich deposits (Blueford, King 1983; Blueford 1988). High productivity of organic matter generated a zone of anoxic water, which may caused dissolution of calcareous plankton and pyritization of radiolarian skeletons within a water column (model of Bąk & Sawłowicz 2000).

Paleogeography of the Pieniny- and Outer Carpathian basins during the Jurassic time

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Key-words: Jurassic, paleogeography, Outer Western Carpathians

The Ligurian Ocean, as well as the central Atlantic and Penninic Ocean were opening during Early – Middle Jurassic. The oldest oceanic crust in the Ligurian-Piedmont ocean is dated as late Middle Jurassic in Southern Apennines and in the Western Alps. Pieniny data fit with supposed opening of the Ligurian and Penninic Ocean basins. Stampfli (2001) recently postulates a single Penninic Ocean separating Apulia and Eastern Alps blocks from Eurasia. We propose similar model for the Pieniny Klippen Belt Ocean in the Carpathians. The orientation of this ocean was SW-NE. The Pieniny Ocean was divided into northwestern and southeastern basins by the mid-oceanic Czorsztyn Ridge. The deepest parts of both basins are documented by deep water, extremely condensed, Jurassic-Early Cretaceous radiolarites and by pelagic limestones (Maiolica facies). The shallowest sequence is known as the Czorsztyn Succession deposited on the southeastern slope of the Czorsztyn Ridge. In this succession the Early Jurassic Fleckenkalk/Fleckenmergel facies are followed by Middle Jurassic-earliest Cretaceous crinoidal and nodular limestones and the Late Cretaceous pelagic marls. The transitional slope sequences between deepest basinal units and ridge units consist of mixed cherty, limestone and marly facies.

Major plate reorganization happened during the Tithonian time. The Ligurian-Penninic-Pieniny Ocean reached its maximum width and stopped spreading. Subduction jumped at this time to the northern margin of the Inner Carpathian terranes and began to consume the Pieniny Ocean .

The more northern Outer Carpathian rift had developed in Late Jurassic with the sedimentation of pre-flysch black, mainly redeposited marls (?Kimmeridgian-Tithonian). This Western Carpathian, so-called Silesian Basin probably extended in the Eastern Carpathian (Sinaia or „black flysch") as well as to the Southern Carpathian Severin zone. The marls pass gradually upwards into calcareous turbidites which created several submarine fans. The remnants of carbonate platforms with coral reefs (Štramberk-type limestones) along the margin of Silesian Basin and around intraoceanic cordillera (Silesian) and now known only

from exotic material occurring within Upper Cretaceous/Palaeogene flysch deposits of the Outer Carpathians, were results of the fragmentation of the European platform in this area. The Silesian Ridge separated the and Magura. The eastward-northeastward subduction along the Silesian Ridge and Bucovinian-Getic Terrane was perpendicular or oblique to the southward subduction at the northern margin of the Inner Carpathian–Eastern Alps terrane. The Latest Jurassic blueschists metamorphic rocks found as pebbles (exotics) in the Albian flysch in the Pieniny-Magura Basin indicate existence of such a subduction. The Silesian–Sinaia Basin developed as a back-arc basin.

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Pieniny Klippen Belt and Outer Carpathian geodynamic evolution stages and climate changes

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Key-words: Late Jurassic, Cretaceous, Tertiary, geodynamics, climate evolution, Outer Carpathians.

The following geodynamic evolution stages could be distinguish in the Dukla and Fore-Magura set of basins, the Silesian Basin, the Sub-Silesian Ridge and the Skole Basin on the Outer Carpathians:

Stage I – synrift (Late Jurassic–early Cenomanian), three global supersequences – Lower Zuni III, Upper Zuni I and Upper Zuni II. Two major global Oceanic Anoxic Events (OAE) happened during this time. Basin subsidence and common occurrence of black shales characterize this period. During the Late Jurassic the southern part of the North European Platform, started to be rifted and small basins, with black, mainly redeposited marls have been created.

Stage II — postrift-collisional (Cenomanian – late Eocene), Generally, the oxic conditions prevailed, and the appearance of the red and green shales is characteristic. This period corresponds generally to three global supersequences – Upper Zuni III, Upper Zuni IV and Lower Tejas I. The global OAE, which occurred during the first supersequences, is reflected by mixed green and black sediments. In the foreland of the Inner Carpathian folded area,

within the Outer Carpathian realm ridges and underwater swells distinctly separated several basins.

Stage III – orogenic (latest Oligocene–Burdigalian) This stage is characterized by collision, perhaps terrane – continent, with the accompanying convergence of two large continents. The anoxic condition prevailed, the variegated shales disappeared, and bituminous brown shales and gray marly siltstones and sandstones were deposited. This period corresponds generally to three global supersequences – Lower Tejas II Lower Tejas III and Upper Tejas I. At the beginning of this period global cooling took place. This event was connected with the glaciation in Antarctica. Trough the Miocene tectonic movements caused final folding of the basins infillings and created several imbricated nappes which generally reflect the original basin configurations. The nappes became uprooted from the basement and the Outer Carpathians allochtonous rocks overthrust onto the North European platform.

Stage IV – postorogenic (Burdigalian – future). During and after the main orogenic phase and the suture of the continents an initial rifting system was initiated in early-Miocene time behind the Carpathian arc in the Pannonian Basin. Extension in the Alpine-Carpathian system continued during the Miocene-Pliocene, forming horst and grabens within the orogen as well as in its foreland. This period corresponds generally to two full global supersequences – Upper Tejas II, Upper Tejas III, the third supersequence will last into the future. This was a cool period, entering the icehouse at the end.

The geodynamic evolution of the Pieniny Klippen Belt is more complicated. The synrift stage lasted from late Early Jurassic to Tithonian. This period corresponds generally to three global supersequences – Upper Absaroka III, Lower Zuni I and Lower Zuni II. Only during the Absaroka III OAE anoxic condition prevailed and black shales were common. During the Middle-Late Jurassic Pieniny Klippen Belt Basin went into the oceanic spreading phase with a rapid subsidence and extremely condensed pelagic limestones and radiolarites in the basinal parts.

During Tithonian south-dipping subduction began to consume the Pieniny Klippen Belt Basin. The post-rift stage lasted during latest Jurassic–early Cenomanian time or three global supersequences – Lower Zuni III, Upper Zuni I and Upper Zuni II. At the end of this period flysch sedimentation developed with the occurrence of black shales (Wronina Formation) in the northern (Magura) Basin. Since Albian-early Cenomanian time Magura Basin was incorporated into the Outer Carpathian system sharing its geodynamic and climatic history.

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„Warning against abrupt climatic (greenhouse) changes following from the knowledge on the Earth climate evolution".

The upper Triassic continental limestones in Upper Silesia (southern Poland) and their paleoenvironmental context

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Key-words: Upper Triassic, freshwater limestone, paleoevironment, paleoclimate, Upper Silesian Basin.

The upper Triassic (?Norian-Rhaetian) freshwater carbonates, reaching 40 m in thickness, occur in the northern part of Upper Silesian basin. These sediments called Woźniki Limestone form a SE-NW striking elongate carbonate body, stretching at the distance of some 100 km and occupying ca 600 km^2.

The Woźniki Limestone overlies (mostly discordantly) the Carnian gypsiferous red beds ("Gipskeuper") and underlies the uppermost Triassic-lower Jurassic continental clastic deposits.

Several facies types have been recognised within the discussed freshwater limestones; travertine, fluvial, ephemeral lacustrine and palustrine/pedogenic facies. Palustrine limestones form a major part of them. Common tepee deformations, karst breccia, silicification horizons and weathering breccia indicate that the palustrine carbonates underwent subaerial exposition and pedogenic diagenesis. The southeastern, marginal part of the carbonate body is built of travertine limestones.

As mentioned above, the carbonates are overlying the evaporitic Keuper sediments. Generally, the contact between both units is erosional, but in some instances more gradual transition has been observed. Red mudstones were replaced by greyish marls and limestones including sporadic gypsum pseudomorphs. Evaporitic deposition has been interrupted by catastrophic flooding event. The fluvial deposits, laid upon erosionally truncated older sediments, comprise basement lithoclasts, oncoids and pyritised plant debris including stems of 0,5 m in diameter. The flooding event marks a substantial climate pluvialisation and commences the palustrine carbonate deposition.

The discussed basin was bound to the south by uplifted older rocks, mostly the Middle Triassic and Paleozoic limestones. It is noteworthy, that the Woźniki Limestone body is tightly linking to the SE segment of the Cracow-Hamburg master fault.

Considering the tectonic setting of the basin, its paleoenvironmental controls (e.g. pluvial climatic regime) and significant contribution of the travertine deposits we presume that the carbonates were deposited within a shallow foothill depression, fed by deep-circulating groundwater (partly of hydrothermal nature) as infer from stable isotope signals. The travertine precipitated directly nearby the spring zone whereas the remnant solutions maintained a broad swamp area where palustrine carbonates formed. It seems very likely that the carbonate-bearing solutions were causally related to the karst ore deposits occurring within the Triassic and Paleozoic basemental limestones.

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Late Cretaceous and Early Palaeocene foraminiferids of the Western Sirt Basin (WSB, Libya)

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Key – words: Late Cretaceous, Early Paleocene, Foraminiferida, biostratigraphy, W Sirt Basin, Libya

Significance of micropaleontological research for basin analysis is twofold: (1) It provides the most precise biostratigraphy and correlation of the basin-fill, (2) it offers data necessary for a comprehensive reconstruction of the basin bathymetry. Both of these aspects are addressed in this study in respect to the late Cretaceous and Early Palaeocene of WSB.

Main conclusions are as follows: (1) Upper Cretaceous exposed on the Western margin of WSB represents the Globotruncana aegyptiaca and Gansserina gansseri foraminiferal zones and belongs to Late Campanian and Early Maastrichtian and does not represent only Maastrichtian, as previously thought, (2) The latest Maastrichtian on the Western margin of the Sirt Basin is represented by shallow marine to non-marine facies of the Lower Tar Member (i.e. the Socna Bed and its correlatives). These deposits contain no planktonic foraminiferids and are characterized by breaks in sedimentation, (3) In contrast the Upper Cretaceous strata in the subsurface of the WSB show continuous sedimentation across the K/T boundary (evidenced by Abathomphalus mayaroensis) into Paleocene (from P 0 to P 1 zones) and contain rich assemblage of pelagic foraminiferids, (4) Vertical succession of the foraminiferal assemblages and facies within the Upper Cretaceous is consistent with the global regression at the end of Cretaceous Period and need not be explained in terms of

tectonically driven changes of the sea level on a local scale, as previously thought. Composition of foraminiferal associations indicate the palaeobathymetric conditions / changes during the Late Cretaceous – Early Palaeocene of the Western Sirt Basin.

Sedimentary and diagenetic environments of the Triassic from the Kominy Tylkowe Massif (Tatricum Unit, Tatra Mts., Poland).

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Key words: Scythian, Anisian, neritic carbonates, Tatra Mts.

Carbonate rocks from the Kominy Tylkowe Massif represent the Triassic platform developed at the northern margin of the Meliata Ocean. Several stages of basin evolution have been recognised on the base of sedimentological and geochemical data. The transgressive succession studied begins with the lower "Campil" sabkha cavernous dolomites that pass gradually to the upper "Campil" lagoonal sediments (so called Myophoria beds). The second stage of basin evolution is represented by Anisian-Ladinian shallow-marine carbonates. Dominating sedimentary facies indicate low energy paleoenvironments, with significant influence of sub-tropical storms. The Ladinian rocks abound in synsedimentary deformational structures and they bear also signals of metasomatic processes (hydrothermal dolomitisation). The third, upper Triassic stage of the basin evolution is represented by the Carnian shallow-marine clastic sediments interbedded with dolomites and finally by Norian dolomites interlayered with dark shales.

Lower/Middle Jurassic facies of the Krížna Unit, Western Tatra Mts, Poland

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Key words: Lower Jurassic, middle Jurassic, marine lithofacies.

Detailed studies of the Lower / middle Jurassic deposits of the Krížna Unit in the Western Tatra Mts have been made in the area between the Kościeliska Valley in the east and the Polish-Slovak boundary in the west. The most distant exposures lie 6 km away. The deposits of the Lower / middle Jurassic boundary are there developed as (i) spiculites, (ii) crinoidal grainstones, (iii) manganiferous limestones, (iv) dark limestones and marls, (v) red nodular

limestones and (vi) *Bositra* limestones, overlain by radiolarites. The deposits described above were laid down in Domerian-Bajocian time.

The studied sediments occur above spiculites and below *Bositra* limestones and they display marked lateral variability. The spiculites in the whole area are overlain by crinoidal grainstones whose thickness varies from 16 m in the central part of the area to 5 m in the west. Manganiferous limestones, up to 2.5 m thick, occur above the crinoidal grainstones in the central and eastern parts of the area. These cement is enriched in manganese (up to 40%). They are overlain by red nodular limestones with stromatolites and macrooncoids and with horizons rich in nektonic macrofossils. These deposits are succeeded by *Bositra* limestones (up to 4 m thick).

In the western part of the area, the crinoidal grainstones, manganiferous limestones and a large part of the nodular limestones are laterally replaced by a series of dark bedded deposits, up to 6 m thick. It is composed of alternations of limestone and marl. They contain poorly preserved, abundant shells of *Bositra*, ostracods and benthic foraminifers. The limestones are bioturbated and dominated by ichnofossils *Chondrites* isp., *Planolites* isp. and *Thalassinoides* isp. Some parts of the marls are not bioturbated and they display primary lamination. The TOC contents do not exceed 0.18% wt in the limestones, while in the marls the TOC reaches 1.37 % wt.

These features suggest that the series of dark sediments was laid down in a basin where dysoxic - anoxic conditions. The described above facies variation in the Lower/middle Jurassic deposits of the Krížna Unit are the result of bathymetric differentiation of their depositional environment. Crinoidal limestones and red nodular limestones were deposited on submarine elevations, while the dark limestones and marls in the deeper parts of the basin. The manganiferous limestones were deposited on the submarine elevation during the anoxic event of the *falciferum* stage. This event seems responsible for the dysoxic conditions recorded in the dark basinal deposits. This is also confirmed by the enrichment of carbonate in the dark sediment in the heavier carbon isotope ($\delta 13_{carb}$ up to 2.7 ‰). The differentiation of sedimentary environments at the Early and Middle Jurassic break was caused by a remodelling of the Krížna Basin during drowning of the northern Tethys margin.

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Climatic processes during Upper Pleistocene and Holocene era and their consequences for molluscs assemblages

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Key-words: Quaternary, paleoclimates, Mollusca, Slovakia

We were studied and reconstructied of molluscan fauna of some regions in Slovakia. The reconstruction of fossil ecosystems has been supported by information acquired from the abiotic component. This study has been based on the quantitative and qualitative analysis of fauna, searching the structure of assemblages, on the biometrical measurements, zoogeographical distribution of taxa, their ecological and climatic conditions. The paleoclimatic characteristics of the Slovakia's Upper Pleistocene has been created, with help of the malacothermometer method by Szöör et al. (1991).

We were able to divide some warmer climatic periods of different intensity, from the interglacial through the interstadial up to the sub-interstadials, dividing an older and younger phase of the last glacial (Würm) stadials. Development of all stadials of the Würm glacial went on cyclically, while from the first stadial of the Würm to the late glacial, a global increase of the climatic humidity can be observed.

116 taxons filed into 31 families by Falkner (1990) have been determined. They can be grouped into 9 main areatypes according to their geographical location.

Changes in the zoogeographical distribution of taxa can also be observed at the sub-interstadials level. They prove the ability of seemingly little flexible taxa to migrate in time and space by different migration passages. As to the migrations, it is necessary to stress the existence of the Danube migration passage, which was important for many Alpine and west-European taxa.

All of these knowledge was summarized into correlative stratigraphic scheme of the Upper Pleistocene of Slovakia with the basical characteristics of fauna and summer (July) paleotemperatures for different periods.

Palynological interpretation of the Upper Cretaceous sequences from the Dobšinská Ice - Cave locality

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Key-words: Late Cretaceous, palynomorph assemblages, paleoclimate, Dobšiná Ice Cave.

The Dobšinská Ice Cave is situated in the central part of Slovakia, approximately 10 km north from the Dobšiná village. The locality studied belongs to the Gossau formation on the Stratená Nappe. Upper Cretaceous limestones are rarely present in the Dobšiná locality. The palynomorph association in the samples studied has been dominated by the angiosperm plant pollen grains, which belong to the Normapolles group. Two assemblages different in age have been distinguished here. The first one, Santonian in age, is represented by *Oculopollis orbicularis*, *Papilopollis* sp., *Complexiopollis* sp. The second one, Campanian in age, is represented by *Semioculopollis* sp., *Krutzschipollis crassus*, *Krutzschipollis* sp., *Longanulipollis* sp., *Trudopollis* cf. *minimus*. With the exception of taxa of the Normapolles group, also spores of the plants (*Echitriporites trianguliformis*, *Echinatis* sp.), fungi, gymnosperm plant (*Monosulcates* sp.) other angiosperm plants (*Tricolpites* sp.), acritarchs (*Mistridium* sp.) have been present in the palynospectrum. Based on the paleontological study, the sediments studied from the Dobšinská Ice Cave belong to the "Normapolles" province.

It is possible to characterize the Late Cretaceous climate during sedimentation of mentioned formations as a tropical-like one.

The model of fresh and mineral water flow in the Szczawnik watershed in Zlocki near Muszyna with a use of visual modflow software package

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Key-words: Fresh water, mineral water, wisual modflow software, deep water circulation, paleoclimate, Magura Nappe.

The conditions of occurrence of mineral waters in Muszyna are rather complex. Their assumed infiltration origin requires their flow system to be considered together with fresh waters. One of the elements helpful in verifying the hypothesis on the relationship between the mineral and fresh waters is a hydrogeologic model based on the Visual MODFLOW software (Nilson, Thomas, 1995-1997). Such a model was created for the Szczawnik watershed. Simplifications of the model resulted from the current understanding of the problem and computational abilities.

The author participated in the realization of the model within the Scientific Research Committee's project named "Numerical modeling of the underground runoff in the Szczawnik watershed in Zlockie near Muszyna" no 6P04D 067 19.

The basis for the hydrogeologic model was a numeric geologic map prepared and digitalized and values of conductivity developed by the author.

The first stage of the project was the development of 12 hydrogeologic profiles (sections) cutting regularily the modeled watershed and their digitalization. The digitalization of profiles enabled implementation into the numeric model the conductivity distribution within the 12 profiles lines. In the similar way, with the use of geologic map and hydrogeologic profiles, the differentiation of hydraulic conductivity.

With the use of digitalized hydrographic map the boundary conditions were applied to the river package. Recharge of underground waters was differentiated according to the range of partial watershed separated from the numeric map of the region.

After implementation of the basic structure of the model, calibration of the model was performed.

The model in this current stage presents the author's based concept of the conditions of groundwater flow in the Szczawnik watershed.

A three-dimensional model of groundwater consistent with regional trends in isotope research and field hydrogeological observations was elaborated for Szczawnik watershed (Magura Nappe). The most intensive groundwater flow takes place in the shallow zone represented by 1st, 2nd, 3rd layer of the model (up to 100 m below surface). Below this depth the groundwater flow is less active, but the hydraulic head distribution, which is controlled by the surface topography, suggests that the very slow water exchange up to the depth of 700 m is possible. The model has been used for a deeper regional flow component evaluation that can be identified as disposable resources of the mineral medicinal waters. The Visual Modflow model enables to determine the difference in hydraulic heads and flow between the layers. The new developed three-dimensional model is very important to understanding the groundwater flow system and protection of medicinal mineral waters in Szczawnik watershed.

Palaeobiogeography of the Late Cretaceous foraminiferal assemblages of the Weglowka-type marls (Polish Outer Carpathians)

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Key-words: Late Cretaceous, Foraminifera, paleobiogeography, paleoecology, Subsilesian Unit

Palaeogeographical position of the Subsilesian basin between the Tethyan and transitional domains was analysed on the basis of foraminiferal assemblages (cf. Gasiński 1997, 1998).

The Late Cretaceous foraminiferal assemblages of the Węglówka type marls of the Subsilesian Unit are highly differentiated. Species of Tethyan and transitional affinities dominate studied assemblages. Planktonic foraminifers *Gansserina gansseri* (Bolli) and *Globotruncanita calcarata* (Cushman) are characteristic only of the Tethyan associations (cf. Sliter 1972, 1977; Olsson, Wise 1987).

However, these species are scarce in the Węglówka marls assemblages. Foraminiferids of the variegated marls of the Węglówka area suggest Tethyan affinity, though the calcareous nannoplankton is characteristic for the Transitional province (Gasiński et al. 1999). Samples collected from the Węglówka type marls locality do not contain *Gansserina gansseri* (Bolli) and *Globotruncanita calcarata* (Cushman) or these species are occur rarely in other localities (e.g. the Sułkowice tectonic window). Presence of *Globotruncana arca* (Cushman) and *Rosita fornicata* (Plummer) denote the Transitional property of the studied assemblages (Olsson & Wise, 1987). Both species are occur in the studied assemblages of the Węglówka type marls, despite of *G. arca* is more abundant. Dominance of epipelagic *Hedbergella* indicates palaeobathymetry and is less informative for palaeobiogeographical purposes.

Interpretation of mid-Aptian Selli Event (Koňhora Formation) at the northern Tethyan margin

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Key words: Early Aptian, Selli Event, sedimentology, biostratigraphy, radiolarians, C and O isotopes, Western Carpathians.

Lower Cretaceous pelagic carbonate (Maiolica) sedimentation has been interrupted by terrigeneous input in consequence of late Early Aptian humid event heralding onset of the Mid Cretaceous climate perturbance. The occurrences of foraminifers, radiolarians, non-calcareous dinocysts and nannoplankton in the West Carpathian Rochovica section enable comparison of black shale part of upper Lower Aptian Koňhora Formation (Fig.1) with the famous Selli Event (Michalík et al. 1995, 1999). The abundance of radiolarian fauna was controlled by upwelling, expansion of oxygen-minimum zone and salinity changes. Three

anoxia models (depositional, productivity and stagnant one) have been discerned in the depositionary regime. Early Aptian climate perturbations both in Outer Western Carpathians, Swiss Prealps (cf. Strasser et al. 2001; situated in a similar position on a distal southern edge of the former Paleoeuropean shelf) and/or in many other parts of the world are traceable by sedimentological, biological and chemical proxies.

Pelagic marine sediments exposed in both sections studied show a rhythmic pattern comparable with precipitation / runoff cycles. Rhythmic pattern is punctuated 1) by limestone marl alternation in highstand tracts of upper part of the formations, 2) by contourite intercalations of Hauterivian transgressive tracts of the Pieniny Fm, as well as 3) by fine alternating terrigenous and biogene laminae in both the Koňhora and Intyamon fms. 4) This pattern was disturbed by calciturbidite regime of the Vranie Member, which registered carbonate platform growth in Barremian decreasing sea level stand conditions. Similar tendences appeared in the Upper Aptian/Lower Albian Brodno Formation.

During late Early Aptian humid climatic event, a huge amount of terrigenous material was repeatedly transported from the Paleoeuropean continent towards the ocean. Deposition of the material brought by rivers has been interrupted by temporal drier seasons with high primary production of radiolarian- and (later) nannoconid - foraminiferal skeletal material. Three (detrital, productive and stagnant) models of anoxia have been recognized in the sedimentary regime of the Koňhora Formation (Michalík et al. 1999, in print).

Two major partial δ^{13} C excursions have been recognized in the Upper Barremian - lowermost Albian record of this isotope ratio. The lower one coincides with the increased C_{org} content in the uppermost part of the Vranie Member. The upper one starts in the uppermost parts of the Koňhora Fm and continues in the Brodno Formation. These two peaks are separated by less positive part of the δ^{13} C curve belonging to the Koňhora Fm, representing runoff / temperature perturbations of the marine productivity regime.

Noticeably, decreased values of $\delta^{18}O$ in a part of the rock column studied could be connected with a temperature decrease and/or with an intensified freshwater input into the cean.

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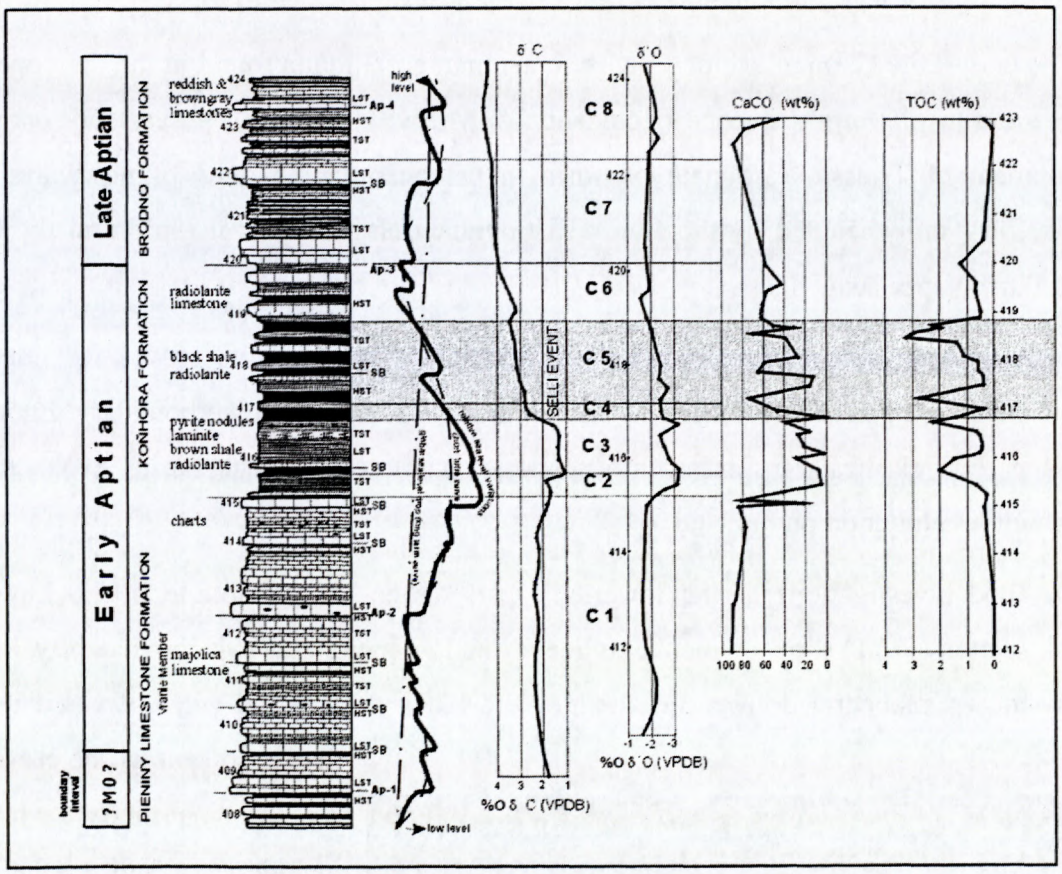


Fig.1

Paleoclimatic and environmental changes above the Ladinian/Carnian boundary

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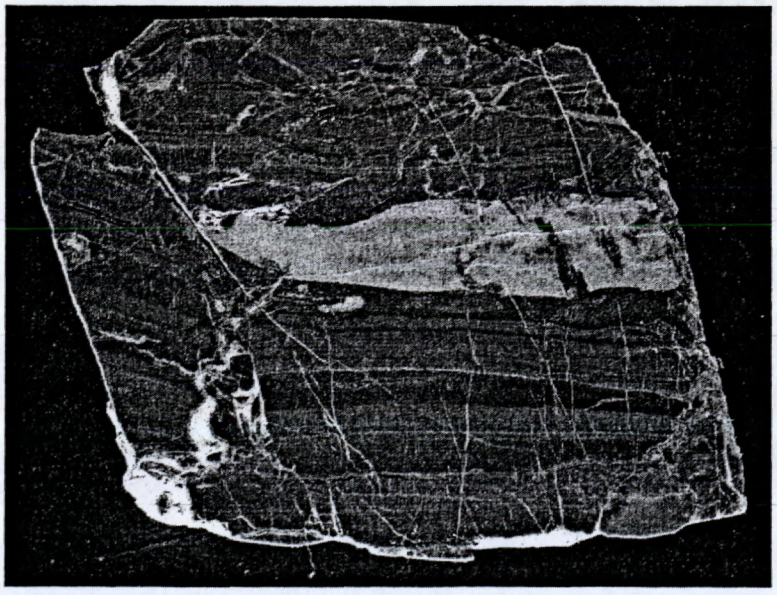
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Key words: sedimentology, paleoclimates, paleoenvironments, Lunz event, Upper Triassic.

The early Late Carnian age of small scleractinian coral fauna found in the the upper part of the Veterlín platform sequence (Roniewicz & Michalík, in print), proves for continuous development of Triassic carbonate platform in paleogeographic units of nowadays Malé Karpaty Mts, uninterrupted by the Lunz /Rheingraben clastic interval (unlike to the Choč- and/or Lunz Nappe sequences).

On the other hand, abrupt facies change in northernmore units proves for important paleoclimatic and paleoenvironmental turnover at the Ladinian/Carnian boundary. Enormous masses of fine clastics transported into nearshore shallow carbonate basins evoke sudden increase of precipitation on the land.

Detailed investigations of the lowermost part of the Hauptdolomite in the Liptovský Hrádok section (Fig.1) shows typical extremely fine lamination: 22 pale laminae of yellowish to gray-brown subhedral dolosparite alterate with black dolomicrite with increased organic matter content in one centimeter (Fig.2). Primary textures including ooid phantoms, pseudopellets, sparite voids (bird eyes), evaporite noduls, microbial laminations, and ostracod shells were observed. Moderately increased total organic carbon content (TOC = 1-1.5 %) is typical in almost all dolomite samples. Thicker, less frequent white bands of grained dolomite are tuft- or enterolitic-like deformed. This deformation affects also several adjacent



higher-up lying laminae, where roof-like "tee-pee" structures, subrectangular slabs and "platy" collapse breccias were produced. These phenomena were probably connected with anhydrite-to-gypsum transformation (Kendall 2001, Lugli 2001).

Interpretation of the $^{13}\delta C$ and $^{18}\delta O$ isotopic composition indicates change in dolomitization fluids (sudden decrease of $^{18}\delta O$ values in range of –6 ‰) connected with occasional marine- or meteoric water influx saline lagoon. Probably, these changes were controlled by orbital insolation variations and connected eustatic fluctuations. The sequence indicates seasonal character of the climate with occasional dry episodes, which has been affected by last relicts of the humid Rheingraben / Lunz event regime.

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Orbitally driven rhythmicity, paleoclimate proxies and integrated stratigraphy of the Badenian clay sequence in the Devínska Nová Ves brickyard pit (NE Vienna Basin, Slovakia)

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Key-words: Badenian, laminites, Foraminifera, calcareous nannoplankton, palynomorphs, orbital rhythms, Vienna Basin.

The Vienna Basin represents a typical pull-apart basin situated along tensional fault zone between Eastern Alpine- and Western Carpathian mountain chains and the Bohemian Massif. The basin was filled by Miocene, Pliocene and Quaternary deposits. Lower and Middle Miocene sedimentation started in marine basin, upper middle- and Upper Miocene sediments

were deposited in brackish water conditions and the youngest ones were laid in freshwater, limnic to fluvial environments.

Sediments of Badenian Studienka Formation exposed in the classical Devínska Nová Ves (near Bratislava) locality by an old brickyard pit are represented by calcareous pelites with rare calcitic sand and silt intercalations, biotite leaflets and secondary gypsum. Foraminifers contained indicate the Bolivina/Bulimina Biozone, nannoplankton composition proves for the Late Badenian NN6 Zone.

The section studied starts with massive gray clay with fish scales and skeletons and with floral and faunal detritus. Thin layer of fine to middle grained calcitic sand enriched in biotite leaflets is iontercalated 353 cm above the base. Above it, guttercast formed of two marly limestone layers with slumping structure is present. Twenty meters thick sequence of laminated clays comprises several apparently massive, bioturbated intervals, fossiliferous beds rich in echinoids remnants, fish scales and floral debris and well laminated portions.

The laminae are 0.3 to 1,8 mm thick: they are formed by greenish gray clay with fine skeletal debris alternating with dark gray bituminous clay. This kind of alternation indicates seasonal climate with changing rainy seasons with stronger terrigeneous input and more dry time intervals with raised organic matter productivity. Planktonic remnants are represented by calcareous nannoplankton and foraminifers. The calcareous nannoplankton assemblage rich in *Discoaster (D. brouweri, D. exilis, D. variabilis, D. prepentaradiatus, D. musicus)* dominates over *D. petaliformis, Calcidiscus premacintyrei, Helicosphaera walbersdorfensis, Sphenolithus abies, Helicosphaera carteri – wallichii, Holococcolithus macroporus, Triquetrorhabdulus rugosus, T. rioi* etc. The planktonic foraminiferal assemblage consist mainly of *Globigerina bulloides* dOrb. and *Gl. diplostoma* Reuss supplemented by several benthic species.

Planktonic assemblages indicate a paleoclimatic trend from warm to more temperate conditions from the bottom to the top of the section during Zone NN6 based on lower abundance of the *Globigerinoides* and *Praeorbulina-Orbulina* groups. Data of planktonic foraminifera suggest also higher productivity in the upper part of the water column during Zone NN6, which is probably related to high nutrient availability.

Benthic assemblages altered planktonic ones consist mailnly in *Bolivina dilatata maxima* C. et Z., *Uvigerina* sp. div. and *Pappina neudorfensis* (Toula). Benthic foraminiferal assemblages suggest, indeed, that the sea floor was characterized by suboxic episodes, as

indicated by positive excursions in the abundance of the *Uvigerina* group, at the base of the section. Decreased oxygen levels (enhanced suboxia-dysoxia) at sea floor may have also occurred. This interpretation is supported by a drastic decrease in abundance (and sometimes disappearance) of benthic foraminifera and by sedimentological evidence such as cyclic dark lamination indicating a stagnant environment in the upper part of the section.

The fish association investigated on the locality Devínska Nová Ves – brickyard pit document deep-water conditions (about 200 m depth) prevailing during the sedimentation clays sediments of tropical by subtropical zone. The fossil fish remnants are represented by the Tertiary fish genus – *Argentina* sp., *Clupea* sp., *Engraulis* sp., *Gobius* sp., *Micromesistius* sp., *Trisopterus* sp. and *Sparisoma* sp.

Portion of paleotropical and arctotertiary floral elements reflects Late Badenian climatological changes. Generally, Arcto-Tertiary elements dominated, especially pollen of the warm-temperate and cool-temperate elements. Paleotropical geofloristic elements were rare. Pollen spectra character indicates that the climate favoured swamp forests development with *Taxodium, Nyssa, Alnus,* and *Myrica* and with some drier habitats overgrown with mixed deciduous-coniferous forest represented with *Pinus, Sciadopitys, Picea, Tsuga* and *Quercus, Carya, Juglans, Pterocarya* and *Ulmus.* It seems that climate was rather warm-temperate even subtropical and humid enough for development of swampy communities in this area. According to quantitative representation of individual taxa it is possible to observe decreasing of tropical (P1), subtropical elements (P2) and clear increasing of arctotertiary geoflora. Gradual cooling influenced floral development in whole Europe since Late Badenian until Quaternary.

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A record of the *Castor* Linnaeus, 1758 (Mammalia, Rodentia) from the „C 718" karstic filling at the Koněprusy - Zlatý kůň locality

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Key words: Quaternary, Mammalia, Rodentia, paleoclimate, middle Bohemia.

The "Zlatý kůň" karstic massive is situated near western border of the protected landscape area (CHKO) Český kras, to the south of the Koněprusy village. The area of "Zlatý kůň" is formed by Lower and Middle Devonian carbonates in shallow water and partly also reef development. Several karstic fillings and caverns have been exposed in this area due to the numerous limestone quarries.

The "Koněpruské jeskyně" caverns, formed by three floors, were discovered in the year 1950; part of the cavern system has been opened for public visitors in 1959. Ruined carstic pocket was exposed in 1953 by mining in the flank of the "Císařský lom" quarry. Some fossil osteological material was found in the pocket labelled "C 718". The pocket "C 718" was mined awya after the palaeontological research. A rich fauna was found in 18 layers (labeled A-H8) in the pocket "C 718". Sedimentary sequence of the "C 718" follow sequence of a glacial cycle. The "H" formation with fossil material represents an interglacial with rich thermophillic forest forms. According to the appearance of modern forms of the arvicolid family - voles (Family Arvicolidae, genera *Microtus*, *Pitymys* and *Mimomys*) the late phase of the Biharian Mammalian Stage could be determined. The thickness of sediments containing mammal remains reached 15 meters, and the vertebrate assemblages produce an unique sequence during a short interval of the of the late Biharian (Fejfar, 19621).

The genus *Castor* was found in 2 groups - in the assemblage no. 1A and no. 2.

Tab.: Material (I = incisives, P = premolars and M = molars).

	I	P	M1	M1-2	M2	M3
superior	3	4	4	4	4	5
inferior	3	5	4	2	4	4
cranial	maxilla (3), mandibula (7), os frontale, os nasale, arcus zygomaticus					
postcranial	radius, metacarpus IV, metatarzus III, metatarzus IV, talus, vertebrae caudalis 9-10, vertebrae caudalis 12-15					

Superfamily of Castoroidea GILL, 1872

Family of Castoridae GRAY, 1821 (= Castorina HEMPRICH, 1820)

Subfamily of Castorinae GRAY, 1825 (= CASTORIDAE sensu stricto)

Castor LINNAEUS, 1758; Pliocene - Recent

Předmostí - Evaluation of fauna from research in 1992

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Key words: Quaternary, Mammalia, paleoclimate, Moravian Gate.

Animal bones from certain sites in the area of Předmostí were analysed. Bones and teeth of mammoths, wolves and bears were recognised at the Předmostí I b site. The presence of mammoths, horses, bovids and reindeers was recognised at the Předmostí II site. From osteometrical point of view, the animals are comparable to those from other Palaeolithic sites, including the Bohemian and Moravian Karst, with the exception of the bones of young horses. These sites were settled at the end of a warm period of the last glacial, which was supported by the radiocarbon datings and by the presence of cold climate characterizing animals.

Cenozoic aquatic and water edges insects from paleolakes of northwestern Bohemia (Czech Republic)

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Key-words: Tertiary, Insecta, taphocoenoses, paleoecology, NW Bohemia.

A scarce Cenozoic insect fauna is preserved in fluvio-lacustrine deposits of the Krušné Hory piedmont basins and the České Středohoří Mountains (northwestern Bohemia). All studied localities demonstrate various palaeoenvironments since Late Eocene until Early Miocene represented by diatomaceous ponds, warm-temperate swamps and lacustrine clay sedimentation.

The fossil insect taphocoenoses are correlated with the local palaeoenvironmental conditions such as the distance from the shoreline or water depth. The proposed conclusions

were compared with palaeobotanical results based on plant megafossils and palynological analyses. The presence of particular aquatic and water edges insect groups as Odonata and Plecoptera nymphs, Heteroptera: Notonectidae, Gerridae and Belostomatidae; Coleoptera: Dytiscidae, Hydrophilidae, Dascillidae; Trichoptera: Phryganeidae and Limnephilidae larval cases contribute to fossil insect biodiversity of an aquatic palaeoecosystems. A reconstruction of life conditions and ecological strains is discussed and compared with the modern relatives ones.

Paleoenvironment and Cretaceous "black shales" in the Outer Western Carpathians

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Key words: Early Cretaceous, dinocysts, sedimentology, black shales, Outer Western Carpathians.

Lower Cretaceous sequences of both the Silesian Unit and the Pieniny Klippen Belt in the Outer (Flysch) Carpathians are rich in grey to dark grey complexes of pelitic deposits. The deposits mentioned are usually connected with anoxic environment created by various conditions. With reference to the fact that the dark grey deposits are usually commonly poor in macrofossils and usual microfossils, we used preferentially non-calcareous dinoflagellates for determining the age of the dark grey pelitic deposits.

The facies of "black shales" is developed best in the Silesian Unit. Deposits of the given type: it starts at the Berriasian/Valanginian boundary and it continues through the all Lower Cretaceous to the uppermost Albian strata, where it terminates. It is estimated that the black shales reach a thickness of more than 1 km. The Veřovice Formation of dark grey claystones is almost empty of any fossils. The contents of Corg of about 1.4 to 1.7 % are characteristic. According to stratigraphic position and to an increased content of carbon, it can be considered as a part of the OAE-1 (oceanic anoxic event). The sedimentation then continued during Albian, when dark grey spotted pelites have been deposited. During Cenomanian, a complex of variegated deep-water claystones characterising oxic environment replaced the previous trend of sedimentation in the Silesian Unit. They persisted to the Coniacian in places. At the beginning of Turonian, a layer of "black shale" appeared again. We suppose that this layer represents the second Cretaceous oceanic anoxic event (OAE-2).

In contrast to the Lower Cretaceous in the Silesian Unit, deep-water limestones (primarily the Pieniny Limestone Formation) were prevailingly deposited in the Pieniny Klippen Belt. In many localities, layers of "black shales" occur in them that are, however, they are of different age. We found the oldest deposits of the mentioned type in the Horné Srnie – Na Dlhej locality. They pertain to the higher Hauterivian and the Barremian. In the localities of Podbranč and Myjava, similar sedimentation began only at the end of the Barremian. It is the Aptian anoxic Koňhora Formation at the locality of Rochovica by Žilina that has been most thoroughly studied. It reflects the OAE 1 event. A similar situation developed probably in the locality of Podbiel.

The character of sedimentation in the Silesian Unit is close to the conditions of Boreal sedimentary basins of northwestern Europe, because the Silesian sedimentary basin was situated on the Paleoeuropean shelf margin. The sedimentation area of the Pieniny Klippen Belt was closer to the Central Carpathian block for the reason that it is located in the area directly affected by the Tethyan Ocean. Nevertheless, the origin of the black shales was connected with mid-Cretaceous equalization of global climate which affected oceanic current regimes all over the world.

Paleoclimatic implications across the the Eocene-Oligocene transition in the Central-Carpathian Paleogene Basin

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Key words: Central Western Carpathians, Terminal Eocene Event, climatic cooling, paleoenvironmental proxies.

The Paleogene sequence of the Central-Carpathian Basin comprises records of global climatic deterioration during the Eocene/Oligocene transition. In this basin, climatic deterioration is inferred from demise of carbonate platform and oligotrophic biota in the SBZ 19. Late Eocene formations already indicate isotopic signals of lower temperature, cool-water productivity, and eutrofication increase (Bryozoan Marls, Globigerina Marls). Stepwise cooling during the earliest Oligocene (Oi-1 event) led to carbonate depletion, sapropelitic and biosiliceous deposition, fresh water influx and continental runoff, water mass stratification,

anoxy of bottom waters, eutrofication, current water circulation and upwelling, intoxication and mass faunal mortality, etc (Fig.1).

The Late Eocene was a transitional period between the Middle Eocene climatic optimum and the Oligocene icehouse. By the Oligocene, the climate system tended to "icehouse" word (Pomerol & Premoli-Silva 1986, Kennet & Barker, 1990, Miller et al. 1991, Diester-Haass & Zahn 1996, Zachos et al. 1996, Salamy & Zachos 1999, etc.). The climatic cooling led to significant paleoenvironmental changes in the Carpathian basins.

The Central-Carpathian Paleogene Basin (CCPB) has been established under a sea-level rise during the Middle Eocene climatic optimum, which led to the formation of Nummulitid-rich ramp (SBZ 16). Nummulitic ecosystems were adapted to clear-water and oligotrophic conditions, requiring temperatures above 20°C. Beside of temperature, the large foraminifers was also strongly dependant on trophic regime, which must be oligotrophic. As a consequence of cooling and nutrification, warm-water carbonate factory turned off in the CCPB during the P16 Zone (latest nummulites – Köhler 1998), being suffocated and drowned by mud-rich deposition. Nevertheless, the Late Eocene deposition persisted in carbonate cool-water productivity under a dominancy of bryozoans, indicating an elevated resources of land-derived nutrients or availability of nutrients via upwelling.

Near the Eocene/Oligocene transition, the sequence shows a prominent increase of productivity in the Globigerina Marls. Their microfauna consist of globigerinids with cool-water preference (Olszewska 1983). Initial increase of plankton productivity in the Globigerina Marls resulted in high abundance of r-strategists (*Globigerina praebulloides – Globigerina officinalis* group), later on, tended to the k-mode of strategy and a higher species diversity. Biogenic maxima at the Eocene/Oligocene boundary, like the Gobigerina Marls, resulted from the cool-water productivity (Diester-Haass & Zahn 1996).

Climatic changes culminated in the "Terminal Eocene Event", which corresponds to the global cooling. Ocean temperature fell in the Late Eocene of about 2-5°C world-wide scale (Shackleton & Kennett 1975). Cool-water influx and continental runoff into the CCPB led to fundamental paleoenvironmental changes. Nannofossil assemblages lack a discoasterids, keeping a dominance of cool-water taxa. Foraminiferal diversity gradually decreased untill the Lower Oligocene, when the number of species dropped to a minimum.

Early Oligocene is considered as a time of TA4 euxinity and eutrophication of the West Carpathian basins, which led to sapropelitic and biosiliceous deposition in the Menilitic facies. Early Rupelian sediments reveal the cool-water influence, salinity decrease and semi-isolation, as is indicated by wetzeliellacean dinoflagellates, diatom oozes and „low oxygen"

fauna. Nannoplankton crisis in the menilite facies has been interrupted by episodes of coccolitophorid-rich productivity (Tylawa-type limestones). Fish fauna is common. Their mortality resulted probably from intoxication by H_2S-rich water, which come to surface water from O_2 minimum zone via upweling. Eutrofication could also increase via upwelling, preferentially regenerated nutients from organic matter under anoxic conditions. Widespread anoxia led to precipitation of manganese, iron sulfide and uranium in the CCPB (e.g. manganese ores in Kišovce-Švábovce District).

Oxygen isotopic composition provides a seawater temperature around 22°C in the nummulitec limestones ($\delta^{18}O$ = - 2 ‰). Globigerina Marls from above the nummulitic limestones shows a positive shift of $\delta^{18}O$ (0.4 ‰), known from high-resolution isotope stratigraphy across the Eocene/Oligocene boundary in the ODP Sites (Diester-Haass & Zahn 1996) and type localities (Oberhänsli et al. 1984). This positive $\delta^{18}O$ excursion links with the Oi-1 shift to cooler temperatures (see Ambreu & Anderson 1998), which is coeval with maximum productivity increase of surface waters (Salamy & Zachos 1999, Diester-Haas & Zahn 1996). The $\delta^{18}O$ shift in the Globigerina Marls also indicates a sharp temperature drop of seawater (~ 12° C).

Sedimentary record of the CCPB provides the following proxies of climatic changes around the Eocene/Oligocene transition: - demise of carbonate platform resulted from climatic deterioration and eutrofication during the Terminal Eocene Event; - growth potential of carbonate platform ceased due to overfeeding stress of oligotrophic organisms (e.g. nummulitids); - cool-water productivity in the Bryozoan Marls and Globigerina Marls, indicating a nutrient supply from richer runoff or via upwelling; - peak abundance of the Globigerina Marls links with climate-productivity maximum at 33.7 Ma; - positive shift of oxygen isotopes indicates a decrease in seawater temperature at the Eocene/Oligocene boundary (12 – 15° C); - major climatic turnover took place in the Early Oligocene (Oi-1 event), when the cooling and humidity led to temperate/wet condititions; - runoff excess is inferred in water-column stratification (reduced salinity and nutrification of surface waters), expansion of the oxygen-minimum zone (anoxia) and seasonal upwelling activity (H_2S toxication and a high mortality); - widespread of anoxia and stagnant regime in the Early Oligocene resulted in sapropelitic deposition of menilite shales, fish shales and manganese layers; - nannoplankton blooms indicate a period of runoff stillstand and higher carbonate sources; - relative sea-level lowstand, eutrophication and semi-isolation culminated in the

lower part of NP 23 Biozone, marked by dinoflagellate-rich productivity, appearance of Parathetys-endemic nannofossils and biosiliceous deposition (diatom oozes).

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Figure caption: Sedimentary records of climatic changes in the CCPB, denoted the climatic optimum (Bartonian), climatic deterioration (Lower Priabonian), climatic cooling (Terminal Eocene Event), icehouse period (Lower Oligocene) and glacio-eustatic regression (Mid-Oligocene Event).

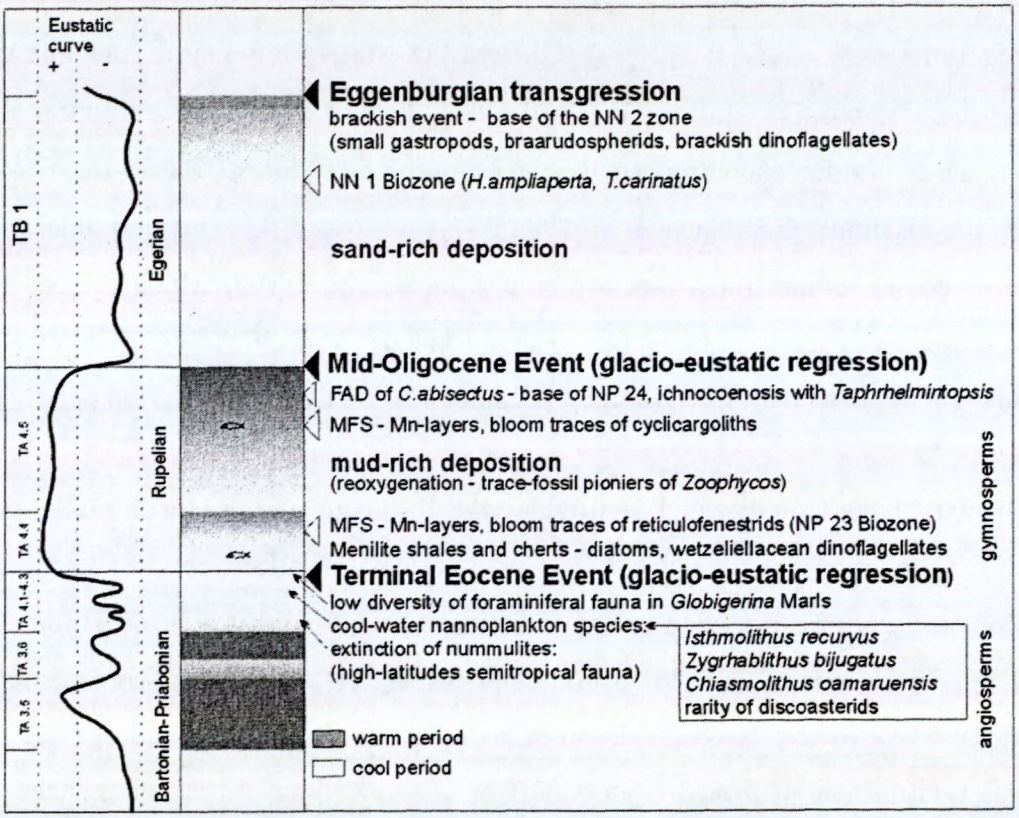


Fig. 1

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Mineralogical comparison of dark sediments from lower courses of Sztolnia and Krupianka creeks (Pieniny Klippen Belt, Poland)

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Key words: mineralogical comparison, Sztolnia and Krupianka creeks, Pieniny Klippen.

Sections investigated are situated near Jaworki, in Eastern part of the Polish Pieniny Klippen Belt (PKB). The samples ware collected from sections located in the lower courses of parallel creeks: Sztolnia and Krupianka. They represent dark, turbiditic deposits of Szlachtowa Formation (Magura Succession).

The complex of dark, clastic rocks has consisted of laminated mudstones with sandy intercalations. Sandy layers are composed of angular and crushed grains of quartz, calcite and feldspar. Feldspar has been sericitized. Mudstones are mostly built of clay minerals. Muscovite appear as slight sheets lying parallel. Chlorite and kaolinite build silt matrix. Quartz occurs as relatively large grains with corroded surfaces. Pyrite is trapped within large mineral particles or it is dispersed in mudy material. "Big-size" (average 10 μm.diam), cubic and octhaedral crystals of FeS_2 occur singly and rare. Thin (1-3 μm) euhedra are more common. They concentrate in framboids or loose-packed, irregular framboidal aggregation (5-15 μm.). These consequently form polyframboids that are interpreted as casts - pyritized planktonic microfauna. Furthermore, benthic, slightly pyritized foraminiferids have been noted. Euhedral microcrystals of dolomite, barite and halite have been also noticed. The amorphous organic matter is dispersed in rock material. TOC range of 0,6 – 0,8 % have been determined.

Conclusions: turbiditic deposition of the studied material took place rapidly after short transport. Planktonic microfauna is completely pyritized and impossible to detail

identification. Uniform size (average 5 μm) of framboids replacing carbonates or silica skeletons are evidence for pyritization in water column. Furthemore, sediment contain substiantaly large framboids with a broader size distribution (10 - 40 μm) and euhedra (recrystalized framboids). These associated with benthic fauna indicate that bottom water was oxic. Moreover, sediment was a subject of intensive diagenetical processes cased by influence of high mineralising pore water. These processes have manifested by: sericitization of feldspar grains, occurence of dolomite, halite and barite microcrystals, appearance of chalcopyrite.

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