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11th International conference of young geologists

Medzinárodná konferencia mladých geológov, 11. ročník

Svätý Jur, Slovak Republic; 29. April – 1. May 2010

B. Chalupová, M. Kováčová, L. Zahradník, M. Gregáňová, J. Kondela, Ľ. Štrba, L. Vizi, M. Dwornik, J. Bazarnik and J. Majka

Abstract: *The 11th International conference of young geologists was held in Svätý Jur (near Bratislava) on 29. 4. – 1. 5. 2010. During two days of lecturing 60 contributions were presented in several thematic blocks. Participants were informed also about some expedition or research work on the localities in Germany, led in excursion in Malé Karpaty Mts. The article reports the event and principal presentation.*

Key words: *geological conference, geology, tectonics, mineralogy, biostratigraphy, technology*

The 11th International conference of young geologist was held in hotel Eva in Svätý Jur near Bratislava from 29. April to 1st May 2010. It was organized under the auspices of Faculty of Natural Sciences of Comenius University in Bratislava, Faculty BERG of Technical University in Košice and the AGH University of Sciences and Technology in Krakow. The members of the scientific board remain already several years unchanged: Prof. RNDr. Dušan Plašienka, DrSc., Prof. Ing. Tibor Sasvári, CSc. and Dr. hab. Anna Świerczewska. The logistics in the conference was provided by the members of Geological Club from Bratislava.

During the years, the variety of participants evolved. Slovak participants in first years were later accompanied with students from Czech Republic and Poland. Nowadays students and young scientists from Russia, Belorussia or Bulgaria have participated in the conference. Nearness of the Slavic languages allows presentations and communication in participants´ native languages, which helps to keep and maintain kind atmosphere, being typical for the conferences of young geologists.

Invitation ceremony has started by the speech by Prof. RNDr. Dušan Plašienka, DrSc., being the scientific guarantee of the conference. Following his introductory words, the conference gradually started to fulfil its target. During first two days of the conference 60 contributions were presented in several thematic blocks. The best presentation was awarded by the Galicia Tectonic Group Award after precise evaluating of each contribution. The winner of the Galicia Tectonic Group Award was Mgr. Matúš Hyžný from the Faculty of Natural Sciences, Comenius University in Bratislava. The award was presented by the member of GTG doc. František Marko. During two "evening dinner discussions" the photographs and report from the expedition (J. Kondela, P. I. Lunev) and research work on the Bromacker localities in Germany (A. Čerňanský) were presented. The last day of the conference was traditionally devoted to excursion in the Malé Karpaty Mts.

The next conference will be in Poland.

Fig. 1. The winner of the Galicia Tectonic Group Award M. Hyžný from the Comenius University being awarded by F. Marko.

P. BOŻĘCKI: **Identification of poorly crystalline iron minerals using the DXRD and SE methods**

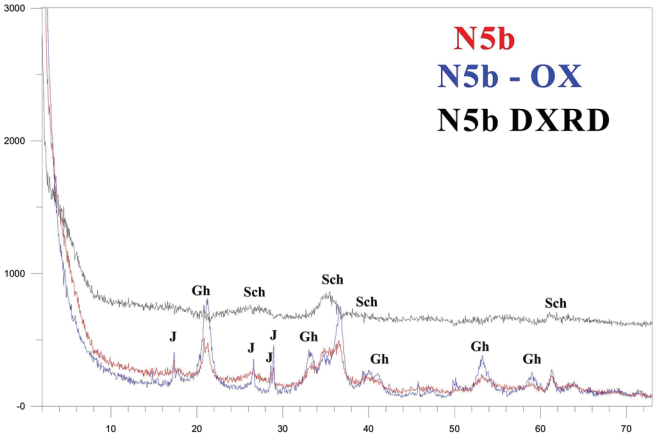
Department of Mineralogy, Petrography and Geochemistry, AGH-UST, Cracow, Poland

The presented work shows the results of the research conducted over the sediments present in the Leknica region (W Poland) – a former lignite mining area. Brown coal in this research area was excavated in numerous pits and mines, from the late 18th to the late 20th centuries. The last active mine pit "Babina" (located south east of Łęknica) was closed in the early 1970-ties. The abandoned mining areas were filled with water, forming so-called "anthropogenic lakeland". Oxidation of sulphide minerals causes formation of highly acidic waters. Released iron and sulphates precipitate forming ochreous Fe-rich accumulations – research material for this study.

The analysed sediments consist mainly of phases such as goethite, jarosite and schwertmannite. The last mentioned mineral was recently discovered by famous pedologist Udo Schwertamanna in 1994 in Finland. In Poland the research area is a third known occurrence of this mineral (after Wieściszowice and Radzimowice). Schwertmannite is characterized by a rather very low crystallinity level, which, combined with the fact that it often co-occurs with goethite, camouflaging him in the X-ray diffraction image, its identification in the sample is very difficult or even impossible.

The main object of DXRD method is to obtain differential diffractogram by subtracting a diffractogram of a sample after a selective extraction (SE) process from a diffractogram of a raw sample. This method is used to identify minerals that are dissolved in each subsequent step of selective extraction process. The first application of this method was observed in the early 1980s. The first research materials for these methods were soil, whereas identified poorly crystalline minerals were iron oxides and iron hydroxides like ferrihydrite and lepidocrocite.

Presented figure shows an example set of diffractograms. The lowest line represents diffractogram of a sample obtained after modified SE method (N5b OX). The middle line represents diffractogram of a raw sample (N5b) and the upper line represents DXRD diffractogram (N5b DXRD). On the differential diffractogram, diffraction reflects from schwertmanitte can easily be seen. These reflects due to the presence of much more crystalline goethite in a sample are not visible on a raw sample diffractogram. Presented researches are in the preliminary stage. However, obtained results show a great potential for the use of this method. The restriction consists in the difficulty to identify poorly crystalline minerals. This requires further more detailed studies.



An example set of diffractograms. Explanation of symbols: Sch – schwertmannite, Gth – goethite, J – jarosite

J. BUČOVÁ, V. ŠIMONOVÁ and D. PLAŠIENKA: **Paleostress reconstruction of selected localities in the Pieniny Klippen Belt in the western Slovakia**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

The Pieniny Klippen Belt (PKB) is an internally complicated narrow structural belt, which stretches in a broad arc for hundreds kilometres from the Alpine-Carpathian junction area as far as the northern Romania. Regardless of its length, the PKB preserves its tectonic integrity, indicated by the omnipresence of its typical (Oravic) units that do not occur in other Carpathian zones. In addition, certain parts of the PKB involve also the "non-Oravic" units of the CWC provenance, which were incorporated into the PKB and attained its tectonic style after their nappe emplacement during mid-Cretaceous times (e.g. Klape and Manín units). Probably they all represent frontal nappe elements of the Fatric nappe system.

This study is concentrated on the paleostress analysis of two localities in the western part of the PKB: Červený Kameň and Butkov quarries. The first locality – Červený Kameň is composed of two PKB units: the Kysuca and Czorsztyn units and of the sediments of the Flysch Belt. In the second locality – the Butkov quarry, a sequence of the Upper Jurassic and Lower Cretaceous age, ascribed to the Manín Unit by tradition, is exposed.

Based on kinematic analyses of meso-scale faults (slickensides), several brittle deformation stages characterized by certain properties of the reconstructed stress field have been discerned. We have used the program Win Tensor for the separation of the faults into homogeneous groups and for determination of paleostress fields. Relative superposition of individual paleostress states was derived from the field structural relationships; their stratigraphic age was estimated mainly by a comparison with other published data.

The area of Červený Kameň underwent several brittle deformational phases. The oldest one was transpression, which is well preserved also in the rocks of the Flysch Belt. This stage was accompanied by the formation of the strike-slip faults (mainly right--lateral faults) and by reverse faults. The σ_1 axis was oriented in the E–W direction. Transpression continued also during WNW–ESE to NW–SE oriented compression. The noticeable change of the tectonic regime occurred during the younger NNE–SSW compression. Predominantly left-lateral and normal faults were formed as a result of transtension. On the contrary, mostly right-lateral and normal faults were created as the last record of transtension (the ENE–WSW oriented σ_1 axis). The last deformational phase is characterized by a number of conjugate normal faults and the NW–SE oriented σ_3 as the result of the extensional tectonic regime.

The area of the Butkov quarry also documents a complex deformational history. The oldest recorded deformation phase is characterized by the E–W oriented σ_1, as a result of transpressive tectonic regime. The formation of strike-slip faults (mainly right-lateral faults) and reverse faults is typical for the second stage. Transpression continued during NW–SE oriented σ_1, dominated by the strike--slips faults (mainly dextral) and reverse faults. The change of the tectonic regime occurred during the younger NNE–SSW oriented σ_1. Normal faults and mostly sinistral strike-slips were formed as a result of transtension. Transtension continued during ENE–WSW compression. The youngest stage – extensional tectonic regime – was characterized by the normal faults originating during the NW–SE oriented tension.

Summing up, the oldest brittle tectonic phase (Late Oligocene – Early Miocene) with roughly E–W to the NW–SE oriented maximum compression is characterized as a transpression. The following tectonic stages (Middle to Late Miocene) are marked by approximately N–S to the NE–SW trending σ_1 developed under transtension regime. The last deformational phase (NW–SE extension) has been dated to the Pliocene – Quaternary period.

The localities Červený Kameň (Oravic units and Flysch Belt) and Butkov quarry (Manín Unit) have the same brittle tectonic

history during the activity of similarly oriented compression axes of paleostress fields in the Late Oligocene – Quaternary period.

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B. BUKOWSKA-BELNIAK: **Thermographic images de-noising methods**

Department of Geoinformatics and Applied Computer Science, AGH-UST, Cracow, Poland

Typical thermographic images are noisy and low-contrasting, especially when differences in observed temperatures are not high (usually few degrees). Additionally, their spatial resolution is low, most often 320 x 240 pixels, up to 640 x 480 pixels for the most recent thermographic cameras. Thermal resolution is about 0.05–0.1 Celsius degrees. Those properties cause that objects detection in the thermographic images requires advanced methods of the image processing. In comparison with the digital images registered in the visible light (for example using digital cameras or optical microscopes) the analysis is much more complicated, because the information contained in the thermographic images is lower than in digital images registered in the visible light (monochromatic image with low number of pixels).

The thermographic image processing begins with the de--noising. Noise in thermographic images has few sources. First one is the accuracy of sensors on the matrix. Second is connected with the conditions of thermographic measurements. Numerous external conditions are responsible for measurements accuracy, for example: humidity, ambient temperature, distance, emissivity and surface type of observed objects. The recognizing of the noise character in thermographic image is important. Depending on the type of observed process the noise can be different. The de-noising methods for thermographic images are similar to methods used for de-noising of other monochromatic digital images. In the picture below we can see the result of several de--noising methods. From the left to right and from the top to bottom: 1 – original thermographic image (size of the image is 256 x 256 pixels), which presents the illegal leakage of the wastewater to the river; 2 – image 1 after median filtration; 3 – image 1 after Wiener filtration; 4 – image 1 after Butterworth filtration; 5 – image 1 after curvelet reconstruction; 6 – original image in the visible light. For the first five thermographic images colour scale is linear from 0 Celsius degree (black) up to 15 Celsius degree (white). As we can see, the best result was reached in image 5, after curvelet partial reconstruction.

De-noising of thermographic images is very important for the further image processing. It should be used for all types of thermographic images before the localization of objects and analysis. It could be helpful in many applications, for example in the environmental analysis, for the leakage detection and illegal wastewater escape localization.

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V. ČAVAJDA[1], P. UHLÍK[1], M. MADEJOVÁ[2], M. SMOLÁRIK[1] and M. ČAPLOVIČOVÁ[1]: **Mineralogy of talc from Gemerská Poloma, Hnúšťa and Kohútik**

[1]Department of Geology of Mineral Deposits, Comenius University, Bratislava, Slovak Republic
[2]Institute of Inorganic Chemistry, Slovak Academy of Sciences, Bratislava, Slovak Republic

Talc is one of strategic industrial minerals of Slovak Republic. The most of deposits are found in Veporic unit (Lower Paleozoic Sinec belt) and in Gemeric unit (Lower Paleozoic Gelnica Group). Majority of talc occurrences in Slovakia belongs to the deposits in association with Mg-carbonates. These days, a big talc deposit is opened near the village Gemerská Poloma. The objective of this study is a mineralogical characterization of talc from Gemerská Poloma deposit and its comparison with talc from others areas (Hnúšta-Mútnik and Kohútik) and also determination of structural order and mean crystal thickness. Research was performed on bulk rock and clay fraction (< 2 μm).

Selected samples consisted of various ratios of talc and chlorite. The results from XRD quantitative mineral analysis by the RockJock software show that amount of talc in the Hnúšťa-Mútnik samples varies from 85 % to 1 %. Samples from Gemerská Poloma contain 90–25 % of talc. IR spectroscopy was used for partial crystallochemical characterization of the samples. The specific talc bands were significant in the samples with dominant amount of talc (e.g. OH-stretching band (Mg_3OH) at 3 676 cm^{-1} and bending band at 669 cm^{-1}. The weak stretching band (Mg_2FeOH) at 3 660 cm^{-1} probably determined small amount of Fe in the talc structure. Stretching bands at 3 571 and 3 428 cm^{-1} were significant in samples with the high amount of chlorite. The position of these stretching bands points out the presence of trioctahedral chlorite, probably clinochlore.

The mean thickness of fraction < 2 μm was analysed by BWA (Bertraut-Warren-Averbach) technique (MudMaster software). Differences were indicated in the mean thickness of crystallites. Samples from Gemerská Poloma have bigger mean thickness (23.4 nm) than samples from Hnúšťa-Mútnik (15.6 nm), samples from Kohútik have mean thickness of 21.7 nm. Talc samples are typically composed of platy crystals. Planar surface is almost isometric with dominant dimensions from X to X0 μm in our samples. According to SEM study, shapes of crystals are anhedral and subhedral.

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A. ČERŇANSKÝ[1] and M. VENCZEL[2]: **A rare record of a worm lizard (Squamata: Amphisbaenidae) from the Lower Miocene of central Europe**

[1]Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic
[2]Tării Crişurilor Museum, Oradea, Romania

The Amhisbaenians or worm lizards represent a peculiar group of squamate reptiles, adapted to a burrowing lifestyle, with about 200 species located in six families (Rhineuridae, Bipedidae, Blanidae, Trogonophidae, Amphisbaenidae and the cryptic Cadeidae) and distributed across Africa, South America, Caribbean Islands, North America, Europe and the Middle East. In spite of the relatively abundant fossil record of Amphisbaenians, many aspects of their evolutionary biology including prevalent modes of speciation, patterns of diversification, and geographical structuring of population genetic diversity, are still poorly understood. The first occurrence of amphisbaenid lizard from the Early Miocene (MN 3a) locality Merkur--North (Bohemia) is presented. The low tooth count and subpleurodont tooth implantation are satisfactory to refer the specimen to Blanidae. The anterior part of the dentary is broken off and accordingly the anterior teeth might not contribute to the diagnosis. However, the remaining teeth display the classic formula for *Blanus* including the positions of the two labial foramina. In fact the specimen from Merkur--North is closer morphologically to that described by Roček (1984) from Dolnice, because of its similarly underdeveloped *crista splenialis* and of its rather shallow *sulcus dentalis* in its posterior segment. On the other hand, the posterior part of the dentary differs completely from all the specimens previously described, due to its extremely short and low coronoid process. In *Blanus* (both fossil and recent specimens),

the coronoid process is distinctly longer and slanting posterodorsally and the dorsoposterior limit of the coronoid process is always higher than the apices of the largest mandibular teeth. Furthermore, except for *Campinosaurus*, the presence of striation at the base of the teeth in Amphisbaenia has never been reported. Consequently, the Ah-771 SGDB specimen may represent a new species, but the material is too fragmentary to demonstrate it completely.

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M. CHUCHRO: **Application of data mining methods in time series analysis**

Department of Geoinformatics and Applied Computer Science, AGH-UST, Cracow, Poland

Data mining is the process of extracting information and patterns from data, especially from the large databases. It has been estimated that the amount of data stored in the world´s databases doubles every 20 months. Large data sets and commonplace of machines that can undertake the searching, the opportunities for data mining increase.

The time-ordered data typically can be aggregated with an appropriate time interval, yielding a large volume of equally spaced time series data. Time series analysis is often associated with the discovery and the use of patterns such as periodicity, seasonality, cycles. Therefore one may wonder what are the differences between traditional time series analysis and data mining methods. The answer to this question is the main aim of this paper.

Wastewater Treatment Plants (WWTPs) data was analysed. Daily resolution of time series and length of data are large enough for complete data mining analysis. Preprocessing of WWTPs time series shown, that data have high right-sided bias of distribution (around 3). Also variance of data is high, near to 20 %. In this step seasonal and cyclical structure of data were recognized. We observed 3.5, 7, 14, 30, 60, 180 and 365.25 days periodicity in terms of the time structure of the data.

From the data mining analysis there were chosen the step-wise regression from the classical data mining methods and supervised neural networks types from next generation techniques. As an independent variables in the step-wise regression there were used: day of week, precipitation, season, precipitation as a qualitative data. During analysis as important component were obtained: day of week, precipitation as a qualitative data. This method explains more than 70 % of data variation.

Neural networks with multilayer perceptron (MLP) and radial basis function (RBF), were chosen from data mining techniques. Numbers of neurons in the inner layers for MLP were from 2 to 20, for RBF from 2 to 100. The MLP neural networks had better results of learning (0.64), testing (0.67) and validation (0.63) for small number of inner neurons. When the number of neurons in inner layers growing, the results of RBF networks growing slowly too. The big disadvantages of RBF neural networks is their time- consuming. The results of analysis were used for prediction models, one day and two days ahead. Prediction results were quite similar for both neural networks. Mean Absolute Percentage Error (MAPE) calculation shown that simple neural networks are not good models for environmental WWTP time series.

Data mining methods for large scale time series are very good equivalent for standard time series analysis. The advantage of the data mining methods is that no specialized knowledge of analysts is required for the advance analysis. Gaps in data are also easy to fill up with many complimentary methods. Results of analysis have the same quality as the normal time series methods, but they can be also used for the database records. Data mining is user- friendly and very wide equivalent for traditional time series analysis.

This paper was written as a part of the statutory research project No. 11.11.140.561 of the Department of Geoinformatics and Applied Computer Science, Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology.

A. DUDZIAK: **Varied world of Slovakian caves**

Department of General Geology Environmental Protection and Geotourism, AGH-UST, Cracow, Poland

Caves represent the unquestionable natural resources of Slovakia. Almost all of them (with an exception of the Ochtinská Aragonite Cave) are developed in the Mesozoic carbonate rocks but nevertheless differ from each other in the location as well as in their flowstone fill, hydrology, genesis or even archeological cave discoveries.

The Slovak caves present an extreme diversity of the flowstone fill, which causes that every one of them is worth to be visited. Four types of caves can be distinguished for the presentation of speleothems and cave fill variety as well as for their classification.

The most widespread are the caves with typical carbonate flowstone fill developed by classic way. This group is represented by (for example) Belianska Cave, Demänovská Cave of Liberty and Jasovská Cave. There can be found various types of stalactites, stalagmites, columns and other flowstone forms such as courtains or waterfalls. In spite of a fact that their flowstone fill represents the same type, each of these caves possesses a unique, inimitable charm and they cannot be compared with others.

Another type of caves is those where typical carbonate flowstone fill developed in a specific way. Domica Cave and Gombasecká Cave can be included into this group.

Domica Cave is distinguished by the huge accumulation and extreme variety of specific forms represented by the flowstone shields and drums. These forms developed as a result of punctual water outflow from the crack and still are weakly examined.

Gombasecká Cave attracts the tourists by the occurrence of thin straw stalactites. They can achieve even 3 meters length with about 1 cm diameter. Their accumulation makes an impression of stone rain.

Next type of caves is those where beside the typical carbonate flowstone fill another kind of cave fill appears.

First group is represented by the caves where in spite of typical carbonate speleothems aragonite fill can be found. Ochtinská Aragonite Cave is an unique object for the World scale. Specific microclimate inside the cave and the presence of ochres enabled the precipitation of aragonite. There are three generations of aragonite forms.

Second group are the caves with an ice fill. This category is represented by the Demänovská Ice Cave and Dobšinská Ice Cave.

In the Demänovská Ice Cave specific air circulation and temperature caused that the cave bottom is covered by the floor ice. There are also the ice stalactites, stalagmites and columns which age is estimated for about 500 years. In non-glaciated parts of the cave flowstone fill can be also found.

Dobšinská Ice Cave is mostly glaciated. The ice appears in the form of floor ice (cave glacier), which moves at 2–4 km per year from the entrance to the deeper parts of cave. Inside the cave the forms like the ice stalactites, stalagmites, columns and icefalls can be also found and they developed when soaking water froze. In the non-glaciated parts there are relief elements which show the modelling by flowing water. Beside of them there are also carbonate flowstone forms – stalagmites, stalactites, flowstone crusts or even layers of moonmilk. This is one of the most valuable ice caves in the world.

M. DWORNIK and A. PIĘTA: **Influence of the elliptical anisotropy on results of inversion of traveltime tomography data**

Department of Geoinformatics and Applied Computer Science, AGH-UST, Cracow, Poland

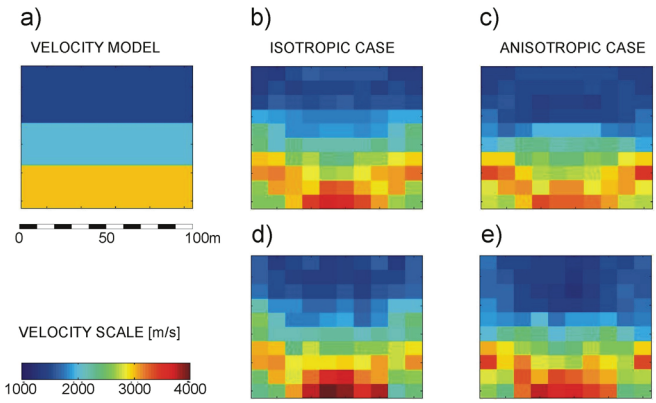
Seismic traveltime tomography is a method of estimation of the velocity distribution in geological medium. The most popular methods of reconstruction of the velocity models assume isotropic wave

propagation. In this work we concern on influence of anisotropic layer on inversion process in the traveltime tomography.

The most popular methods of solving the inverse problem were tested: Algebraic Reconstruction Technique (ART), Simultaneously Iterative Reconstruction Technique (SIRT) and Singular Value Decomposition (SVD). ART and SIRT methods are iterative methods, which requires initial velocity model. All mentioned above methods were tested on theoretical data and evaluate for a quality and calculation time of obtained results.

Velocity model with horizontal layers was used in calculation. The middle layer has elliptical anisotropy of P-wave propagation, which is described by velocities ratio Vz/Vx = 1.0 for isotropic case and 0.7 for anisotropic case. Theoretical first breaks times that are used in calculation, were obtained from full wave form modellings. Seismic wave propagation in anisotropic media was calculated using the finite – difference method and specific computational grid, so called staggered grid. Two methods of the ray tracing were used in calculation of matrix of model geometry and estimation time in forward problem: the straight line propagation between shot point (SP) and receiver point (RP) and the shortest time method using the sparse graph theory. The second method gives realistic ray trajectory in heterogeneous geological medium, but is more computational intensive. This method was used for iterative calculation for SIRT method.

Velocity distribution obtained from the SVD method for isotropic (b) and anisotropic (c) middle layer and SIRT method for isotropic (d) and anisotropic (e) case respectively for the assumed velocity model (a) are presented on the picture below.



Anisotropy has significant influence on seismic inversion for all methods. Straight line propagation gives more accurate results in the isotropic case and in the shorter calculation time. SVD method gives better results for theoretical data, but is very sensitive for additional noise. SIRT method was used for non-linear propagation scheme, because of relative faster calculation and better results than ART method.

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A. FIGUŁA, U. JANICKA and T. BAJDA: **Formation of brom--pyromorphite on surfactant-modified smectite**

Department of Mineralogy, AGH-UST, Cracow, Poland

Surfactant-modified smectites can be used for the removal of toxic compounds from solutions. They were often used for sorption of anions, and recently there is studied, how to progress the process of "alternating" sorption of anions and cations. Clay minerals and zeolites can be modified with the use of the high-molecular--weight quaternary amines, one of them can be HDTMA-Br (brome hexadecyltrimethylammonium). It changes the charge of natural minerals from positive to negative. But not all of charge is changed; in microporous it is still positive. And therefore surfactant-modified clay minerals can be used as an effective sorbent for inorganic cations, inorganic anions and neutral organics from solutions. The next method of reclamation of heavy metals from the contaminated soils and solutions is immobilizing them through the formation of insoluble crystalline phases induced by phosphate amendments. In the case of Pb ions that phase is pyromorphite, one of the most stable phases of Pb in environmental conditions. The objective of this study was to evaluate potential application of surfactant-modified smectite for the sorption of PO_4^{3-} and Pb^{2+}, and for characterizing of new crystalline phase (brom-pyromorphite).

In the first experiment the smectite sample was modified with the use of HDTMA-Br. Modified smectite reacted with solutions containing 5 to 20 mM/L of Pb or PO_4. Initial pH was 3.5. Sorption of PO_4 was highest on Pb-surfactant-modified smectite while the sorption of Pb was highest on surfactant-modified smectite. Formation of brom--pyromorphite $Pb_5(PO_4)_3Br$ was also noted in the reaction products, which was identified with the use of X-ray diffraction. The precipitation takes place either in the volume of the solution (homogeneous crystallization, reaction of PO_4 ions with Pb desorbed from ion--exchange positions) or on the surface of a surfactant–modified smectite (heterogeneous crystallization, Pb ions react with PO_4 absorbed and still present on the organic HDTMA bilayers).

The goal of the second experiment was the synthesis of brom--pyromorphite to comparison his mineralogical composition with this obtained in the above experiments. Synthesis of the solids was carried out by the dropwise mixing of aqueous solutions of $Pb(NO_3)_2$, KBr and K_2HPO_4 in molar proportions based on the stoichiometry of the phases [Pb : P : Br = 5 : 3 : 1]. The only products formed in the reaction was $Pb_5(PO_4)_3Br$ detected by the Infrared Spectroscopy (IR) and X-Ray powder diffraction (XRD). Brom-pyromorphite was also characterized with the use of scanning electron microscopy (SEM). In the mass of 1–2 μm grains there are idiomorphic crystals in the form of hexagonal prism with the hexagonal pyramid reaching a length of 5–10 μm.

The results suggest that "alternating" sorption of anions and cations on surfactant-modified smectite can be effectively used for immobilization of Pb and PO_4 pollution from contaminated soils and solutions, and the formation of the brom-pyromorphite strengthen this effect. Brom-pyromorphite is as efficient in neutralization of Pb and PO_4 contamination as chlor-pyromorphite.

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M. HOFFMAN: **Preliminary results of investigation of the direction and kinematics of faults in the Považský Inovec Mts.**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

In the western part of the Považský Inovec Mts. the faults were investigated using methods of structural geology. Analysing the slickensides on faults by the paleostress software WinTensor, the directions of principal paleostress axes were established. Outcrops in the Mesozoic rocks are located at the edge of the Považský Inovec Mts. Main investigated localities were Hrádok, Jastrabie, Hubina, Hubina-kameňolom, Modrová, Závada and Nová Ves nad Váhom. Investigated faults represent conjugate faults systems of strike-slips. The very good representation of the conjugate fault system is at the locality Nová Ves nad Váhom, where the paleostress with the maximum compressional stress axis σ_1 177°/06° and the minimum stress axis σ_3 268°/12° were calculated. Strike of σ_1 is NNE–SSW. At the locality Jastrabie, in the northern part of the Považský Inovec Mts. a change of kinematics of the strike-slips was observed (sinistral to dextral strike-slips) with the paleostress field rotation from the direction W–E (for activation of sinistral strike-slips oriented NW–SE)

Tab. 1
Results of faults analysis from the Považský Inovec

Code	Latitude	Longitude	Kinematics	n	n_T	S_1	S_2	S_3	R	α	Q	R´
Hrádok												
PIHR-1	48.6986	17.9033	conjugate strike slips	11	18	341/10	221/70	74/16	1,18	13,63	C	_
Mitice												
PIMIT-1	48.8142	18.1064	strike slips	20	21	81/02	175/56	350/33	0,45	10,33	B	1,55
PIMIT-2	48.8142	18.1064	strike slips	3	3	343/29	176/60	75/05	0,67	4,23	E	1,33
PIMIT-3	48.8142	18.1064	normal faults	9	13	263/42	137/33	26/29	0,8	2,76	E	0,8
Nová Ves nad Váhom												
PINV-1	48.7372	17.9008	conjugate strike slips	11	11	177/06	60/75	268/12	0,77	6,08	C	1,23
PINV-2	48.7372	17.9008	x	4	5	53/70	160/05	252/18	_	1,42	E	_
Závada												
PIZA-1	48.6402	18.0652	conjugate strike slips	8	8	293/23	126/66	025/04	0,43	8,1	D	1,57
PIZA-2	48.6402	18.0652	invers	4	7	310/08	40/01	130/81	0,75	1,55	E	2,75
Hubina_kameňolom												
PIHUK-1	48.6258	17.8797	strike slips	6	8	318/23	71/41	208/39	0,55	1,47	D	1,45
PIHUK-2	48.6258	17.8797	conjugate strike slips	6	6	154/07	48/63	248/24	0,58	4,4	D	1,42
Hubina_cesta												
PIHUC-1	48.6194	17.8844	invers	1	1	118/18	006/31	223/52	0,5	15,15	E	2,5
Modrová												
PIMO-1	48.6447	17.8972	strike slips	3	5	310/16	75/63	213/20	0,33	18,2	E	1,67

to direction N–S (for activation of the dextral strike-slips similarly oriented). These data from the Považský Inovec Mts. were compared with data from the Malé Karpaty Mts. and the results were similar.

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M. HYŽNÝ: **Paleobiogeography of Retroplumidae (Crustacea: Malacostraca: Decapoda: Brachyura)**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

The Retroplumidae Gill, 1894 is a relatively small predominantly deep-water family of brachyuran crabs. The fossil record of the family extends back to Turonian. It consists of eight genera, of which six are exclusively fossil. There are some 40 species known, of which ten are extant.

The paleobiogeography of Retroplumidae was in various extent discussed by several authors (Vía Boada and Cals, 1979; Vía Boada, 1980; Vega and Feldmann, 1992; Fraaije et al., 2006; McLay, 2006; Armstrong et al., 2009). However, there are only few (Vía Boada and Cals, 1979; Vía Boada, 1980; Vega and Feldmann, 1992) considering the whole to date known fossil record of the family. Since the last rather comprehensive study on this topic (Vega and Feldmann, 1992) many new occurrences were described from different parts of the world, which both extend the stratigraphic span of known genera or species (e.g. Feldmann and Portell, 2007) and describe the new ones (e.g. Beschin et al., 1996).

The genus *Archaeopus* Rathbun, 1908 known from the Upper Cretaceous of Japan, Alaska, and Canada is considered the oldest member of the family. It migrated southwards to Mexico and gave rise to *Costacopluma* Collins and Morris, 1975 (Vega and Feldmann, 1992). This genus stratigraphically spans from Coniacian to Early/Middle Eocene and has a very broad geographic distribution which makes more detailed paleobiogeographic conclusions difficult. However, it is clear, that it experienced rather big radiation, as it is known from Greenland to Argentina and from Mexican Bay through Western Africa to India. It seems that *Costacopluma* gave rise to a stock of Tethyan retroplumids represented by several genera known from Eocene and Oligocene of Spain, France, Italy, Hungary and Belgium: *Retropluma* Gill, 1894; *Loerenthopluma* Beschin, Busulini, De Angeli and Tessier, 1996; *Loerentheya* Lőrenthey in Lőrenthey and Beurlen, 1929; and *Retrocypoda* Vía Boada, 1959. During the Eocene or Miocene *Retropluma* migrated to Indo-Pacific Ocean from which it is known also today. The only fossil record of this genus in that area is *R. laurentae* Collins, Lee and Noad, 2003 from the Middle/Late Miocene of Sabah (Collins et al., 2003). This migration route in that time is very well documented also by the molluscs and other decapod faunas as well, however, the precise timing of the migration of *Retropluma* is unknown.

Recently the presence of *Retropluma borealis* Fraaije, Hansen and Hansen, 2005 was recorded in the Lower Badenian (Middle Miocene) strata of the Plášťovce member of (Sebechleby Fm.) the Slovak part of Novohrad-Nógrád basin. This species has been until now known only from the Late Miocene of Denmark (Fraaije et al., 2005). It is interesting to note that along with *Retropluma* there are many specimens of another crab *Tasadia carniolica* (Bittner, 1884) recorded from both localities. Such co-occurrence of taxa raises the question of possible migration routes, and therefore open seaways, between the Paratethyan and Boreal realms during the Middle Miocene. *Retropluma* persisted in the Mediterranean at least until the Late Pliocene with *R. craverii* (Crema, 1895) known from Italy. It seems that the genus survived the Messinian salinity crisis or it was reintroduced to Mediterranean. However, today the genus is completely absent in this area.

Beside *Retropluma* there is one known more retroplumid genus, *Bathypluma* de Saint Laurent, 1989, which, however, has no fossil record. It could be derived from *Retropluma*.

As a conclusion, the paleobiogeography of Retroplumidae is a good example of the tracing the decapod migration routes in the geologic past. This approach is able to test independently the paleobiogeographic hypotheses based on molluscs.

The research was funded by APVV-02-80-07.

B. CHALUPOVÁ: **Fossil fish from the locality Bystré nad Topľou**

Slovak National Museum – Natural History Museum, Bratislava, Slovak Republic

This paper brings further information about the fossil fish derived from the locality Bystré (700 m northwest from the village Bystré) situated in the valley of nameless brook. It was studied in the Beskydy foothill, the district of Vranov nad Topľou. The nameless brook encovers the Middle Oligocene to Rupelian sequence of Huty Fm. built of claystones and siltstones with sporadic sand admixture. The claystones are grey, greyblack to black with tabular to slate disintegration. The rare sandstone beds situated in the lower part of the sequence are decimetre in size. They are fine to middle-grained, brown to greybrown coloured. Its lowermost parts are pelitic passing locally to laminated pelocarbonates with prismatic disintegration. The direction of layers is 120° to the southeast with inclination of 30–40°.

The fossil remains (bones, scales, incomplete or complete specimen) were found in the grey-black claystones in many places in the channel of brook. These grey-black claystones are differently lithified from the crumble to slate. The dark colouration suggests the anoxic condition by the sedimentation time, being typical for these facies in all European criteria. Some specimens come also from the Museum in Hanušovce nad Topľou.

In all 4 bony fishes (Osteichthyes) were identified. There are genus: *Clupea sardinites* (Heckel, 1850), *Palaeogadus simionescui* (Simionescu, 1905), *Hemiramphus georgii* (Jerzmańska, 1968) and *Serranus budensis* (Heckel, 1856).

Study of the fossil fish from the flysch sediments from the locality Bystré nad Topľou gives valuable information about the connection of the Central and Outer Carpathian Paleogene areas. The fossil fish remains indicate a littoral shallow water conditions prevailing near the coast during the sedimentation of the Oligocene Menilite Beds, which belong to the IMP 2 Zone sensu Jerzmańska (1975).

We would like to thank for assistance during sampling to Mr. A. Biroň, Mr. R. Kýška and Mr. J. Soták, the head of the Geological Institute of Slovak Academy of Sciences in Banská Bystrica, Mr. M. Dolinský from Bystré nad Topľou and Mr. P. Pjenčák from Homeland Museum Hanušovce nad Topľou.

M. JAMRICHOVÁ: **Preliminary results of the microfacies analysis of the Czorsztyn Unit Pieniny Klippen Belt, Western Carpathians**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

A microfacies study of carbonate sequence of the Middle and Upper Jurassic age of the Czorsztyn Succession in the Pieniny area of the Pieniny Klippen Belt is presented. Studied section – Pod Gregoriánkou is situated about 7 km from the town Stará Ľubovňa. Microfacies studies disclosed dissimilarities of Czorsztyn Unit from the classical development defined by Birkenmajer in 1977. The sequence begins with alternating pink and grey-green crinoidal limestones, which are developed instead of Smolegowa Limestone. The Krupianka Limestones overlie this alternating limestone formation. Upward they pass into micritic crinoidal limestones which contain quantity of brachiopods, foraminifers (especially *Lenticulina* sp.) and filaments of the bivalvia *Bositra buchi*. The limestone sequence contains also abundant clastic admixture, represented by the quartz, muscovite, feldspar and dolomite. Deepening of the sedimentation environment is indicated by increasing of micritic component and appearing of filaments. In this formation, condensed sedimentation was registered, which was indicated by the Fe-Mn crusts. After the interruption of the sedimentation the Czorsztyn Nodular Limestone with filamentous microfacies sedimented. In Oxfordian, the filamentous microfacies were replaced by the Globigerina microfacies in the upper part of the limestone. Transitional filamentous-Globigerina microfacies indicate gradual transition between the microafacies. Onset of planktonic foraminifers Globuligerina, calcified radiolarian tests and globochaetes proves consequent deepening of the sedimentary basin. The Globuligerina microfacies is replaced by Saccocoma microfacies in Kimmeridgian in overlie partly nodular crinoidal limestones. That indicates gradual replacement of Globuligerina by Saccocoma microfacies. The Durstyn Formation is represented by Rogoża Coquina and Korowa Member of Upper Tithonian age. The main components of Durstyn Limestone are calpionellids, globochaetes and calcareous dinoflagellates. The sedimentary environment of this formation is deeper neritic, which indicates mentioned planktonic organisms. The changes of character microfacies corresponded to the cessation of shallow--water limestone deposition and the onset to pelagic sedimentation. The phenomenon was related to the Meso-Cimmerian faulting which split the Czorsztyn Ridge into a series of blocks showing a differential subsidence (Birkenmajer, 1977).

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M. KOPPA and B. SNÁRSKA: **Petrogenetic significance of Cr-spinel in selected ultramafic bodies of Western Carpathians (Sedlice, Komárovce)**

Department of Mineralogy and Petrology, Comenius University, Bratislava, Slovak Republic

The objects of study are the ultramafic bodies placed near Sedlice and Komárovce townships, located in the eastern part of Slovakia. The ultramafic body near Sedlice, with dimensions 400 x 500 metres on the surface, builds smaller ridge in the Šariš Highlands. It is situated SE from the township, in the eastern part of Inner Carpathian Paleogene in the flysch belt. Samples were taken from outcrops. In contrast to ultramafic body near Sedlice, of which geological position is known, is a large body in the SW part of the Košická kotlina basin (area of the body around 100 km^2), known as the body from Komárovce. Samples were provided from drilling cores (KO-1 drill hole located S of Komárovce), where objective body was reached at a depth of 943 m. The bodies are representative of spinel-metaperidotites mostly composed of serpentinized dunitic, harzburgitic and lherzolitic rock-types.

Recent works, dealing with the geodynamic origin and tectonic setting of ultramafic rocks, address an attention to Cr-spinel (Ahmed et al., 2005; Mikuš and Spišiak, 2007; Choi et al., 2008; Dare et al., 2009). The accessory mineral chrome-spinel [(Mg, Fe) (Cr, Al, Fe)$_2$O$_4$], with relative high resistance against the alteration even during the metamorphic processes, partially retains the characteristics of the original magma and is considered to be a useful petrogenetic indicator for the mafic-ultramafic rocks. Therefore Cr-spinels are sensitive indicators of the melt composition and crystal-liquid equilibrium and disequilibrium processes between melts and primary magmatic sources. Based on its chemical composition the origin of the studied metaperidotites can be further characterized.

Chromian spinels in (serpentinized) metaperidotites near Sedlice and Komárovce occur as euhedral to subhedral inclusions in olivine, orthopyroxene, clinopyroxene and serpentine matrix. Cr-spinels represents Al-bearing phase in ultramafic rocks. The main cations are Al, Cr, Fe and Mg. The highest Mg#, i.e. [$Mg^{2+}/(Mg^{2+} + Fe^{2+})$], and Cr and Ni contents reflect the most primitive (mantle) compositions of magma in the primary (magmatic) spinels. Moreover higher amount of Al_2O_3 (> 40 wt.%) is mainly a function of the original composition. Significant is also the TiO_2 dependence on Al_2O_3 concentration in melt. Varying values of spinel chemical composition reflect changes in metamorphic conditions. To determine the geodynamic environment of the origin the rocks diagrams TiO_2 vs. Al_2O_3, Cr# vs. Mg#, Al – (Fe^{3+} + 2Ti) – Cr, Al – Fe^{3+} – Cr, Fe^{2+}/Fe^{3+} vs. Al_2O_3 were used. Basic discriminatory parameters were Mg# [$Mg^{2+}/(Mg^{2+} + Fe^{2+})$], Cr# [Cr/(Cr + Al)], Fe^{2+}/Fe^{3+} ratio, contents of TiO_2 and Al_2O_3 (in per formula units or wt.%) and content of Fo component in olivine, the latter in equilibrium with Cr-spinel. Classification diagrams were used on the basis of chemical composition of volcanic spinel from different geodynamic environments.

The ultramafic bodies near Sedlice and Komárovce reflect primary differences. According to basic discriminatory parameters, defined by the spinel chemical composition, the Sedlice ultramafic body is supposed to represent abyssal (mantle) peridotites of an ophiolite complex, while the Komárovce body a peridotite from the supra-subduction zone of mantle environment.

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M. KLÚZ: **Modelling of the groundwater pollution through transportation modules based on MT3D**

Department of Hydrogeology, Faculty of Natural Sciences, Comenius University, Bratislava, Slovak Republic

Aim of this article is to give a full-range overview of the groundwater pollution and transportation models based on the MT3D modular structure. Basic procedure for building the groundwater transportation model of the pollution is to make a conceptual of groundwater model based on the data from field, open source databases, etc. After the conceptual model is built, the use transportation model is highly recommended. The transportation module is the upper structure of the basic groundwater modelling software such a Modflow or Groundwater Vistas. The evolution of the transportation modules was done by two basic ways. Models designed by the private companies and by the public entities. The differences between models are in approach to the solution of the sorption, reaction and computation itself. The MT3Dv1.1 is three dimensional transportation program for a simulation of the advection, dispersion and chemical reactions in the groundwater. Program uses the modular structure and could be used in any groundwater flowing model with the block-centered grids, finite difference equation and proposition that the concentration has no effect on the groundwater flow itself. MT3D takes information about the groundwater flow and boundary conditions from the model of groundwater flow such a Modflow. Transportation models use mixed Eulerian-Langrangian method for the solution of the advection-dispersion-reaction equations in three basic characteristics: MOC – method of the characteristics, MMOC – the modified method of characteristics and HMOC – hybrid of these two methods. MT3D could be used to simulate: linear or nonlinear sorption with controlled equilibrium, non-reversible decay of the first-order. The successor of the MT3D is MT3D96 designed by C. Zheng in 1996 but recently is replaced by MT3D99. Its advantages are the better performance in computing of equations, using better performance in heterogenic porosity and unsteady flow, use of the non permanent concentration boundaries and better compactibility with Modflow. Additional advantage is the reaction package for BIOPLUME (aerobic and anaerobic reactions, chain reactions of parent-daughter compounds for nonorganic and organic mixtures). The public licensed MT3DMS was developed for the US Army to solve the problems with modelling of the multi-species contaminants in groundwater. It was obsolete and replaced by RT3D generation of reactive multi-spices transport in three dimensional software environment. The newest version RT3Dv2.5 contains a set of pre-programmed general reaction packages including: Tracer Transport, Two Species Instantaneous Reaction, Six Species, First-Order, Rate-Limited, BTEX Degradation using Sequential Electron Acceptors, Rate-Limited Sorption, Double Monod Model, Sequential First-Order Decay, Aerobic/Anaerobic Chlorinated Ethene Dechlorination. RT3D can simulate a multitude of scenarios such: natural attenuation evaluation used to predict fate and transport of groundwater plumes. Active remediation whether it be air sparging, chemical oxidation or accelerated bioremediation. The key is to understand the reaction kinetics of the attenuation or remediation process through scenarios involving contaminants such as heavy metals, explosives, petroleum hydrocarbons, and/or chlorinated solvents. The result of the article is provide the knowledge that the transportation models could be used as tool for the basic science or applied in the real life to find the best solution for designing groundwater treatment plant.

K. KRONOME: **Preliminary results of microfacies analysis of the Upper Triassic limestones of the Silica nappe in the Driečany Karst**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

The Driečany Karst is built by the sequences of the Silica nappe. It is situated in the wider vicinity of the village Slizké in the Revúcka vrchovina Mts. in the southern part of the Slovenské rudohorie Mts. Limestones in this locality were in the past studied mostly by L. Gaál. Currently we mainly focused on the investigations of the Upper Triassic Hallstatt limestones at five outcrops by microfacies analysis. These localities are Kamenný jarok (outcrops A, B), Drienocká pustatina and Budikovany (two outcrops).

On the basis of conodonts the limestones in the locality Drienocká pustatina are Upper Tuvalian to Lower Norian in age; limestones in the locality Kamenný jarok (A) sedimented in Alaunian up to Lower Sevatian and limestones in the locality Kamenný jarok (B) are of Lower to Middle Sevatian age (Gaál, 1982). Limestones on the locality Budikovany show the Lower Sevatian age (Kozur and Mock, 1974).

Hallstatt limestones extend on both sides of the Kamenný jarok gorge between the villages Hostišovce and Slizké. In the northern part they extend to the southern margin of the Drienocká pustatina area, where they pass into the underlying Tisovec limestone. They are overlain by andesitic volcaniclastics. Hallstatt limestones are exposed on the surface in small areas near Budikovany and Driečany villages.

Limestones on the locality Drienocká pustatina are almost microsparitic packstone/grainstones with peloids, echinoderms, agglutinated foraminifers and thin shell bivalvias. They can form lumachelle beds in some positions.

Limestones in the locality Kamenný jarok (A) are almost grainstones with echinoderms, thin shell bivalvias and agglutinated foraminifers. In the upper part of the outcrop the microfacies of the limestones changes into wackestones to mudstones with radiolarians, osteocrinoids and filaments.

Limestones on the locality Kamenný jarok (B) are wackestones with radiolarians and very abundant spicules of calcified silicic sponges. In some layers lithoclasts of shell water grainstones to grapestones with micritic aureole were observed. These beds alternate with cocquina layers. In the uppermost part of the section bioclastic packstones with echinoderms and agglutinated foraminifers are present. The Triassic part of the outcrop terminates with erosive surface of the Hallstatt limestones and transgression of Egerian breccia of the Budikovany Beds.

The limestones in the locality Budikovany are almost bioclastic packstones with radiolarians, echinoderms, sponge spicules and filaments. The second outcrop on this locality is situated in wackestones with radiolarians and silicisponge spicules. The Triassic part of the section ends with limestones sometimes with cherts and is overlain by the Egerian breccia.

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M. KUBIŠ: **Geological and geotechnical problems during the construction of tunnels in the North and West Iceland**

Geofos Ltd., Žilina, Slovak Republic

Iceland is located in the middle of the Atlantic ridge on the rifting plate boundary between the Eurasian and North American plates. Iceland is therefore a relatively active volcanic area. The active zone of rifting and volcanism crosses the country from southwest Reykjanes peninsula to the northeast. The active zone is flanked by strips of Quaternary basalts followed by Tertiary basalts which often dip gently towards the active zone. Three tunnels in the north (Hedinsfjordur, 3.6 km; 6.5 km) and west Iceland (Oshlíd, 5.1 km) were driven

through a Tertiary basaltic formation consisting of basaltic lava sheet with interlayer of sediments and tuffs. A dominant feature of the Icelandic bedrock is the thin layered nature of the basalt succession and the gentle dip of the strata. Lava layer consists of the dense basalt in the middle with top and bottom scoria which is composed of basalt fragments, partially glassy and partially crystalline forming a porous breccias. The crystalline middle part is usually hard, dense basalt often with the light to dark grey colour. Individual layers of basaltic lava are about 10–15 m thick. The volcanic series of strata is intersected in many places by basalt dykes from several meters to several tens of meters thick. The rock has irregular columnar to polyhedral joint pattern resulted by cooling and by the tectonic activity. The joints are usually smooth to slightly rough, undulating with the gauge absent or thin clayey coatings or calcites. The sedimentary rocks are mostly composed of thin, fine grained tuffaceous interbeds and occasional thicker conglomerates. The Icelandic stratum makes tunnelling in the Iceland difficult. The tunnel faces consist frequently of mixed layers with different rock mechanical properties. Dykes and tectonic faults cut through the bedrock and groundwater problems are common. The rock classification (according to the STN 73 1001) was predominantly between R2–R5, the Q value according to the Barton (NGI) classification is from 0.08 to 15.0. The main joint sets were oriented either perpendicularly to the tunnel axis, or parallel to it. In many places the rock was heavily broken as a result of tectonic forces. The main problems were water inflows into the tunnel (150 l/min to 600 l/min, maximal 2 000 l/min).

U. KUBSIK[1] and R. KUBSIK[2]: **Wetlands as natural water purification system illustrated by the example of Matilda Channel valley**

[1]Academy of Science and Technology, Faculty of Geology, Geophysics and Environmental Protection, Cracow, Poland
[2]The School of Management and Banking in Cracow, Faculty of Informatics, Cracow, Poland

The Matilda Channel was a part of Matilda lead ore and Galmei Mine and it was located in Chrzanów industrial district. Zinc and lead mining history of this area begins in 13th century but the most extensive mining was in 19th century. Matilda Mine was opened in 1850 and became the most productive mine before the Trzebionka Mine opening. The Matilda Channel had been a receiver of mine waters, flowing through some fish ponds and then discharging to the left side stream of Wisla, the Przemsza River. In the Matilda Channel valley ground waters horizon is located in the depth of 0.2–0.3 m and because of that there are many wetlands in this area. That allows the heavy metals infiltration with ground waters. At the present there are only about 2–10 dm^3/s of mine water flowing in the channel but in 1960–1970 when there was maximum of Matilda Mine production it was about $1m^3/s$. Matilda Mine was finally closed in 1972.

The highest heavy metals concentrations occur in the upper parts of the valley and they are decreasing after flowing through the fish ponds and wetlands. It can indicate that there is not any erosion of the flume deposit by the current flowing water. It also can be caused by the wetlands natural ability to settle heavy metals. Wetlands can work as a kind of settling basin and biological filters. Heavy metals can be immobilized by the bonding with organic matter. It is significant that the geochemical parameters of Zn, Pb and Cd are causing their easy bioaccumulation in the water plants and helophytes. Unfortunately this ability can cause that there will be high heavy metals concentration in the plants tissue. It can have toxic effect on the plant biocenosis and inhibit waters self-purification.

The lowermost concentrations are located near the Matilda Channel flowing to Przemsza River. That is why it can be indicated that wetlands and ponds which occur in the Matilda valley have a major improvement ability for the water quality in this area.

The significance of wetlands in the improvement of the water quality is widely accepted all over the world. Natural and constructed wetlands are being used to purify water from such sources as storm water drains, agriculture and industry. There are two major processes used – the trapping of suspended and dissolved contaminants. Simple physical presence of wetland plants and their proportionally large and extensive subsurface biomass is causing slowing of water flowing to very low levels and turns the wetland into a very efficient settling basin. Contaminants attached to these suspended particles are removed from the water.

Observed concentrations are consequences of the 20th century mine water flows. Even though that mine had been closed more than 30 years ago, heavy metals concentrations are still very high.

J. KUČEROVÁ: **Paleoclimate interpretation at the Locality Cigeľ**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

The locality Cigeľ is situated in the Upper Nitra depression of the Handlová-Nováky brown-coal basin. The Cigeľ mine itself is located around five kilometres southeast of the district town Prievidza. The mine belongs to the principal coal-bearing Nováky Formation. It consists of clay, sand with tuffaceous layers and coal seams. Studied fossil flora comes from the "overlying clays" belonging to the Upper Badenian to Lower Sarmatian Koš Formation. This material is stored in the Hornonitrianske Múzeum in Prievidza.

The application of the CLAMP (Climate Leaf Analysis Multivariate Program) method was the main goal of the present study. Further research is focused on the anatomical interpretation of leaf macrofossils, statistics, quantitative paleoecology and taphonomical interpretation. Different predictive models demonstrate definite relationships both of the climatic variables and the leaf characters, but the precision of these relationships varies depending on the statistical model applied to the data. Application of the CLAMP method to the fossil flora assumes that if climatic parameters can explain physiognomic variation, then that variation can be used to predict climatic parameters. The analysis involves the relating of the fossil flora on the group of climate parameters. The multivariate data set should describe the leaf physiognomy more accurately; and thus reveal more precise relationship between physiognomy of woody dicot flowering plants and climate. Individual morphological data, for each taxon, are used for paleoclimatic reconstruction and ecological interpretation.

From all fossil leaves from the collection were chosen dicots only. They were sorted into morpho-species and were examined for the presence or absence of each of the 31 morphological characters used after CLAMP categorization. A total of 210 fossil samples were studied. The predicted climate parameters for the locality Cigeľ are:

- Man Annual Temperature (MAT): 19.59 °C
- Warm Month Mean Temperature (WMMT): 26.44 °C
- Cold Month Mean Temperature (CMMT): 13.07 °C
- Length of the Growing Season (GROWSEAS): 9.50 months
- Mean Growing Season Precipitation (MGSP): 215.60 mm
- Mean Monthly Growing Season Precipitation (MMGSP): 24.34 mm
- Precipitation During the Three Wettest Months (3WET): 98.11 mm
- Precipitation During the Three Driest Months (3DRY): 46.32 mm
- Specific Humidity (SH): 11.19 g/kg
- Relative Humidity (RH): 76.11 %
- Enthalpy (ENTHAL): 32.21 kJ/kg

Vegetation used in the dataset for this study indicate subtropical climate. The results presented here show the paleoclimatological picture of the locality Cigeľ. The leaf morphology is strongly correlated with the temperature and precipitation. With help of these parameters we are able to reconstruct the paleoenvironment and it can be used for the further interpretation and paleoclimate reconstruction.

The study of fossil flora from the geological collection of the Hornonitrianske Múzeum in Prievidza was made under the permit issued by the relevant authorities of this museum. Funding for this study was provided by financial support of grants UK/256/2009, VEGA 2/0060/09 and APVV-0280-07.

M. KWAŚNIAK-KOMINEK, M. MANECKI and T. BAJDA: **Limitations of cerussite as a mineral controlling lead pollution**

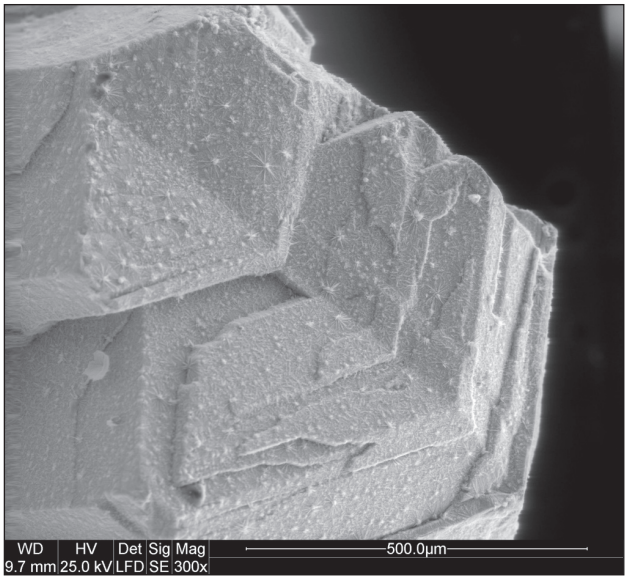
Department of Mineralogy, Petrography and Geochemistry, AGH-UST, Cracow, Poland

The toxicity of Pb in contaminated soils is strongly affected by mineral speciation. Cerussite $PbCO_3$ is a mineral often associated with galena in oxidation zones surrounding the lead ores. In the presence of phosphates, however, cerussite is expected to transform into less soluble and more thermodynamically stable pyromorphite $Pb_5(PO_4)_3Cl$. The objective of this study was to identify the conditions and the mechanisms of lead carbonate transformation into lead phosphate. The experimental design was based on published study of pseudomorphic replacement of calcium carbonates by apatites (Kasioptas et al., 2008).

In the first set of experiments, natural cerussite was reacted with a solution of 0.05 M KNO_3 and 0.025 M K_2HPO_4 at pH = 4.5 for 22 hours. SEM imaging (see photo below) indicates the formation of a new phase on the surface of cerussite, which was later identified with the use of XRD as $PbHPO_4$. This is in contradiction to the results of hydrochemical modelling by PHREEQC suggesting that pyromorphite is the most oversaturated phase in the experimental setup. Clearly, the mechanisms of nucleation at the conditions of the experiment are not driven by the simple thermodynamic relationships.

In the second set of experiments, 1 g of synthetic cerussite was placed in the 0.025 M KNO_3 solution together with 1 g of crushed natural apatite $Ca_5(PO_4)F$. This part of study builds upon the results of Zhang and Ryan (1999). After several days, formation of crystalline pyromorphite was observed with the SEM on the surface of some grains of apatite. This location of the precipitate may suggest that dissolution of Ca-apatite is slower than dissolution of $PbCO_3$ limiting the reaction to the proximity of the source of PO_4. This was further confirmed by batch kinetic experiments: dissolution of cerussite is much faster (0.00423 ± 15 % mmol/min) than the dissolution of apatite (0.00175 ± 12 % mmol/min). As a result, the equilibrium in solution with cerussite was established within 3 minutes while the apatite did not reach the saturation in 96 days.

Preliminary results of all these experiments indicate that the system cerussite-pyromorphite is much different from the system calcite-apatite and more research is needed to fully understand the thermodynamic and kinetic constrains of cerussite stability in the presence of phosphates. The research is funded by the MNiSW grant N N307 101535.



M. LAHO[1], M. BEDNARIK[1], Š. HURTÍK[2], R. HOLZER[1] and A. GREGOVÁ[3]: **Building stone in Banská Štiavnica – resources and properties**

[1]Department of Engineering Geology, Comenius University, Bratislava, Slovak Republic
[2]Ing. Štefan Hurtík, ul. A. Bernoláka č. 3, Banská Štiavnica, Slovak Republic
[3]Mgr. Andrea Gregová, KPU Banská Štiavnica, Slovak Republic

There are few places in the Central Europe, which have had such economic importance and the centre of a technological advancement, as a former royal city of Banská Štiavnica. The city was the centre of several centuries of precious metals mining activities. Contemporary importance of the city and the confirmed presence of the main mine management for the entire area of the former Lower and mid-18th century emergence of the mining academy, has reached a level that it has become in some respects a model for some other major European educational centres. With a large mining development in the 18th century, Banská Štiavnica became the area with the greatest accumulation of mining and the second largest city (in population) in Ungarn. From the period when the region of Banská Štiavnica began to create settlements (in the stream Štiavnica village and mountain mining village Glanzenberg Bana) are not identified remains of buildings. Intensive development of the region comes after the arrival of German colonists in the 12th and 13th century, bringing significant structural objects maintained until today in a rebuilt form. Current city (its formation is timed to the second quarter 13th century), especially its central part has undergone very complex evolution. Various historical events were the cause of development. The overall urban planning and construction characteristics of this extraordinary group are a result of the synthesis of all historical factors in the city in the time they took place. For the development and nature of Banská Štiavnica and the surrounding area had a major impact the building material for the objects of different nature (mine-service, church, residential, etc.). The most commonly used building material was a natural stone, being a product of mining operations. For the purposes of the required size of the blocks separate quarries were opened. The positive factor for the choice of a suitable stone was a rugged terrain of the Štiavnické vrchy Mts. with plenty of natural outcrops and permanent mining operation, which produced throughout the centuries large amounts of different rock material. In historical times, probably one of the most important criteria for the use of stone for building purposes was its surface and the availability of sufficient strength. These criteria are confirmed at construction sites in the Glanzenberg, where the Šobov clinopyroxene quartzite and the Paradajz andesite type were used. At the time of Roman and Gothic constructions there was the increased demand for building stone, intending to meet the required size blocks, the satisfactory workability, its texture and structure and decorativeness. According to the results of the observation focussed on the building stone (from the late 19th century) the buildings in Banská Štiavnica and its surroundings came only from the Štiavnické vrchy Mts. built predominantly of the neovolcanic complex.

G. LATO: **Preliminary characteristic mineralization in the river alluvium Mamuja (Halmahera Island, Indonesia)**

Department of Geology, Geophysics and Environmental Protection, AGH-UST, Cracow, Poland

The study area is located in the northern part of the Halmahera Island. The drainage basin of Mamuja River is built by igneous rocks of the calc-alkaline character, mainly tuffs, andesites, basalts, rhyolites and dacites. Fragments of mentioned rocks and heavy minerals are the principal components of Mamuja´s alluvium.

Two samples collected from the Mamuja River terrace and seaside sands near estuary, were the object of detailed studies. The topic of these studies was determining the mineral composition of the

river´s alluvium. The fraction of samples is below 1 mm. Sand in the samples is black in colour and also shows magnetic properties.

Magnetic fraction was separated using the hand size magnet. Both magnetic and non-magnetic fractions were the objects of microscopic studies in transmitted and reflected light. The Energy Dispersive Spectrometry (EDS) and XRD analysis were used for detailed studies of minerals and their chemical composition.

Black sands are composed at 75–80 % magnetic fraction each. It is composed of fine magnetite crystals dispersed within at groundmass and glassy groundmass. Feldspars (anorthite, albite), pyroxene, olivine, magnetite, hematite, pyrrhotite, ilmenite, rutile and chalcopyrite have been identified. Crystals of magnetite and hematite occur as separate grains of sands or form intergrowths with the waste rocks or minor sulphides. These crystals form the intercalation between the cleavage planes of pyroxenes. Occasionally the magnetite crystals are affected by martitization. The presence of mineral phase of chemical composition between magnetite and ilmenite was confirmed by the Energy Dispersive Spectrometry. Some admixtures of magnesium, aluminium, manganese and vanadium have been detected in this mineral phase. Apatite, pyrite and diopside were confirmed in samples using the EDS method.

Non-magnetic fractions comprise a 20–25 % of the samples. It is composed by feldspars, pyroxene, hematite and groundmass originating from igneous rocks. Hematite crystals replace waste rock. 1 μm magnetite inclusions were observed in rock fragments. The presence of sulphides was documented. There were mainly chalcopyrite, bornite and pyrite. Sulphides have rounded shape less than 20 μm in diameter. Sulphides occur in the form of inclusions in feldspar and pyroxenes. The presence of Na–Ca feldspar and Mg–Ca pyroxenes were found out by the XRD analyses.

P. I. LUNEV and S. V. POPOV: **Subglacial topography along the scientific traverse Vostok-Progress, East Antarctica**

Polar Marine Geosurvey Expedition, St. Petersburg, Russia

During the field season of 2008/2009 the Polar Marine Geosurvey Expedition (PMGE) in the framework of the Russian Antarctic Expedition (RAE) carried out geophysical investigations along two regional radio-echo sounding profiles on the route Vostok – Komsomolskaya – Progress. Its total distance is 1.280 km. As a result, an important information on the subglacial relief and ice sheet of the earlier unexplored area was obtained, combining the important geological objects, without which the understanding of the structure of the continent as a whole is impossible. The subglacial relief in the investigated area is characterized by the vertical dissection – the height of the subglacial relief varies from – 315 m to 1.500 m with the average value of 400 m. The area is distinctly divided into three regional rock massifs (Komsomolskie Mts. and two nameless mountains) separated by the wide and deep valleys.

The mountain relief is also strongly dissected – deep (several hundred meters) valleys with the prevailing slope angle of 4–7° predominate. Judging by the symmetrical V-shaped form, they have similar orientation (perpendicular to the ice sheet flow direction) and are effluent channels for the ice flow. They are likely to be formed as a result of the glacier activity. The data obtained suggest that the Komsomolskie Mountains (adjoining the western side of the Lake Vostok) are characterized by a much bigger size than was suspected before and can extend for about 500 km in the western direction.

The radio-echo sounding studies revealed in the structure of the ice sheet several contrast layers with the wide occurrence. Some of them correspond well to the layers revealed in the area of 5G-1 borehole by the depth and boundary character which allows their dating. The revealed layers have a relatively permanent thickness and correlate well with the bedrock topography.

In addition, three subglacial water reservoirs were revealed along the profiles. They are situated at the 155th, 328th and 408th km from the starting point of the traverse. The length of the fragment of the first one is 2.2 km. The ice thickness there is 3.110 m. The part of the second one has the length of 1.5 km and the overlying ice thickness of 3.120 m. The extent of the third object is bigger. Its fragment has the length of about 7 km. These objects, as well as all other subglacial water caves, are limited to negative structures and have an even, sometimes sloping surface; they are characterized by an increased effective reflection coefficient and almost complete absence of lateral waves. The presence of subglacial water caves may be related to an increased heat flow, as it was established with respect to Lake Vostok, the rift nature of which is confirmed by many geomorphological, geological and geophysical studies. Thus, the data obtained prove that the Lake Vostok graben represents only a fragment of a more extensive rift zone, which spreads in the north--western direction.

Funding for this work was provided by the Russia Fund of Basic Research (RFBR grant 10-05-91330-NNIO-a).

J. MACEK: **Geochemical characteristic of oil and natural gas from Korňany oil spring (Western Carpathians, flysch belt)**

Department of Geochemistry, Comenius University, Bratislava, Slovak Republic

The occurrence of crude oil and natural gas can represent a serious impact on the environment. Korňany village is well known for its oil spring. Resources of crude oil and earth gases were discovered in the Kysuce area by the year 1901, followed by production of small amounts of oil products from wells of depths up to 200 m. Focus area lies in the Magura flysch belt of Western Carpathians, that has a certain potential for large accumulations of oil and earth gas in deeper layers of the geological profile. The Korňany oil spring is from the year 1993 classified as Protected natural monument. Oil is leaking from an excavation located above the local creek, so in the case of a bigger yield it could affect the water system. This study aims the geochemical study of the discharged hydrocarbons and natural gasses, their structure and exposure to biodegradation processes. Oil sample density was set to 856 kg/m^3, with the highest proportion of aliphatic compounds (76 %), followed by aromatic compounds (16 %) and those of non-hydrocarbon origin (11 %). Gas chromatography proved its Tertiary genesis and the distribution of n-Alkanes shows, that we deal with the light oil, an condensate. The major component of the earth gas is methane (65 %) with a large volume of higher hydrocarbons (butane to heptane; 21.57 %) thus indicating oil formation phase.

V. V. MAKHNACH: **Paleogeography of Pripyat Strait in Callovian-Oxfordian**

Belarusian State University, Belarus

In the Early Callovian time the territory of Belarus as of spore-pollen of the analysis was found in the zone coniferous – broad-leaved wood, which developed mainly on denudation – lowland land form. Whole territory of the country was included into the East-European province of subboreal area. During the time of *Macrocephalites hervey* on the territory of Belarus the migration of boreal faunas in the south latitudes was registered, conditioned by the cool arctic currents, getting into the Middlerussian Sea. This event in the Polish Sea was not reflected, indicating that no connection between the Russian and Polish basins has existed. During the time of *Sigaloceras calloviensis* the Pripyat Bay was formed and there began the migration of a new type of the shellfish from the Caucasian basin (*Sigaloceras mangischlakense* Sok et al.). In the time of *Kosmoceras jason* and at the end of the time of *Sigaloceras calloviensis* the Pripyat Strait started to be formed. This was evidenced by the delta sediments in the eastern part of Podlyassko-Brestskaja depression. The active migration of the fauna from the Polish basin in Middlerussian Sea has begun, lasting up

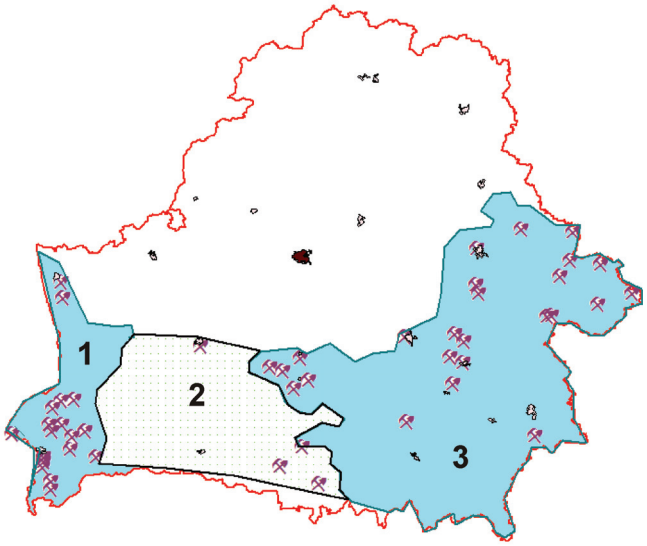


Fig. 1. Paleogeography map of Jurassic of Belarus (Callovian--Oxfordian). 1 – Remote area of the Polish Sea. 2 – Pripyat Strait. 3 – Remote area of the Middlerussian Sea. The symbol of crossed hummer and shovel indicates the location of Jurassic sediments penetrated by boring.

to the end of the time of *Amoeboceras ilovaiskii*. The fauna of the shellfish obtained the subboreal, boreal or mediterranean traits.

At the beginning of Oxfordian there occurred changes: coniferous – broad-leaved wood exchange by the more thermophilic wood with marsh mode, and the sea transgression reached the maximum. During time of *Cardioceras cordatum* in the sea conditions the coral reefs have developed, which buildings were tracked from the eastern part of the Polish basin to the south-western part of the Middlerussian basin. The Pripyat Strait has existed during the all time of *Cardioceras cordatum*. Later, during the time of *Cardioceras densiplicatum* the paleogeographical transformations are registered, being caused by the climatic changes. Flora and fauna obtains the boreal marks. The significant provinciality in the structure of fauna was registered. On the west of the Pripyat Strait there was formed the Middleeuropean province, but in the east – the Middle-Russian province. Since the time of *Amoeboceras alternoides* the Pripyat Strait was closed and to the end of the Oxfordian it had an unstable mode.

These events have conditioned many differences in the stratigraphy and paleogeography. The uniqueness of the paleogeographical history of the Pripyat Strait was explained by the location in the active zone of the boreal and the Tethys (Mediterranean) of the areas, but simultaneously accompanied with several paleobiological events. The detailed study of the stratigraphy of sediments, morphologies of the fossils, species composition of fauna and the paleogeographical changes will allow solving the problems of correlations of geological events in the boreal and Tethys area.

D. A. MAMONTOV and O. A. ORLOVA: **Interpretation of the results of the palynological research of the Visean deposits from the borehole 1P/A, Kaluga region (Russia)**

Department of Paleontology, Moscow State University, Moscow, Russia

The palynological research of the Viséan deposits from the Kaluga region, Russia (the borehole 1P/A, southern wing of the Moscow syneclise) has been carried out. Main attention was devoted to the changes of the vegetation during the Viséan Age. As a result of palynological analysis of the miospores distribution five

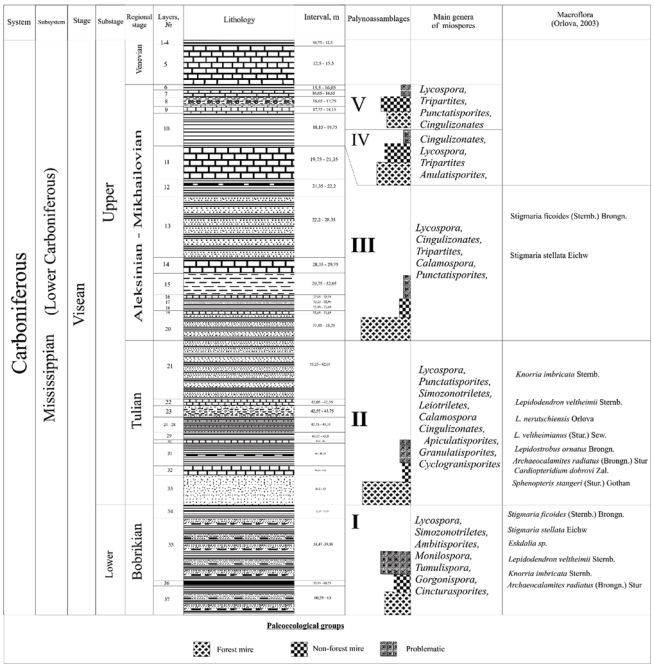


Fig. 1. Paleobotanical, lithological and paleoecological characterization of the section of the borehole IP/A (Kaluga region, Russia).

palynoassemblages have been determined. The palynoassemblage **P I** is defined by the following miospore genera: *Lycospora* (36 %), *Simozonotriletes* (9 %), *Ambitisporites* (9 %), *Monilospora* (7 %), *Tumulispora* (6 %), *Gorgonispora* (5 %), and *Cincurasporites* (3 %). The palynoassemblage **P II** is characterized by the predominance of *Lycospora* (72 %), first appearance of *Cingulizonates* (2 %), and increase of diversity miospores of the triangular to circular outline, with laevigate, granulose, spines and cones ornamentation (*Leiotriletes*, *Granulatisporites*, *Apiculatisporis* etc). *Tripartites vetustus* Schem. (6 %) has been firstly found in the palynoassemblage **P III**. *Cingulizonates* (47 %) dominates in the palynoassemblages **P IV**, but percentage of *Lycospora* (7 %) is decreased here. Amount of *Lycospora* (28 %) and *Tripartites* (16 %) is increased in the palynoassemblage **P V** in comparison with the previous one. Paleoecological interpretation of the palynoassemblages based on the affinity of dispersal spores with the in-situ spores has been proposed. Thus, the miospores of the studied palynoassemblages have been subdivided into 3 paleoecological types: forest-mire, non-forest mire and problematic. Percentage of the forest-mire type is reduced upward the section (Fig. 1). In the same direction the amount of non-forest mire type is increased (Fig. 1). Miospores from the palynoassemblage **P I** are the most difficult for defining their paleoecological position. Most probably, that terrestrial parent vegetation was changing from the forest mire to the non-forest mire landscapes during the Viséan age. Our palynological results correspond with macrofloral data of Kaluga region (Orlova, 2003).

The research was supported by the Russian Foundation for Basic Researches, project No. 08-04-00633.

K. MANGOVÁ and P. ŠPANEK: **Possibility of the successful reclamation of the tailing dump in abandoned ore deposit Smolník**

Department of Mineral deposits, Comenius University, Bratislava, Slovak Republic

Closed Cu-pyrite ore deposit Smolník is located in the southern part of the Slovak Ore Mts. between villages Smolnícka Huta and

Smolník. The mining lasting more than 700 years was finished in 1990. The pyrite oxidation and the acid mine drainage (AMD) generation are the main environmental risks in the abandoned mine area. The AMD risk assessment must be done in the reclamated tailing impoundment, too. Despite the reclamation, it represents the serious source of the water pollution by Fe, As, sulphates a. o.

The acidification of the soil horizons and the distribution of reminded pollutants in the antropogenic soil of tailing surface were studied in our research. A set of 90 samples was taken from the tailing surface in three horizons (surface 0–20 cm, middle 40–50 cm, bottom 80–100 cm). Sampling points were distributed in regular network with extent 50 x 50 m. The results of pH measurement in tree depth-layers, the sulphates content in 40–50 cm layer, nitrates and organic carbon contents in the selected points of the network were determined in the first part of research.

It is discussed whether the decreasing pH values in the antro--soil horizons (0–20 cm, 40–50 cm, 80–100 cm) directly relate to the sulphate, nitrate and organic carbon contents and how they can be related to the potential As and other metals mobilization.

M. MARUTA: **The Inoceramian Sandstones of the oil--bearing Łodyna Oil Mine & Chwaniów Anticlines in the Strwiąż drainage area – fracturing parameters**

Department of Fossil Fuels, AGH-UST, Cracow, Poland

So far, the discovered hydrocarbon fields in the marginal zone of the Skole napple in the Inner Depression, which can be characterized by the substantial Oligocene dynamics resulting in the potential source rocks of the Middle Cretaceous and Early Oligocene, which reached the thermal maturity necessary for generating the liquid hydrocarbons.

The greatest oil and gas resources have been documented in the Łodyna Oil Mine Anticline in the Kliwa Sandstones of the Menilite Beds, which have good effective porosity and intergranular permeability.

An estimate of the influence of the Inoceramian Sandstones fracturing on their reservoir properties has been presented. It is based on the author´s own geological studies in the area of Brzegi Dolne – Krościenko. In this area, such studies have not been carried out previously and the cores from the wells have not been preserved.

Results of the studies, as well as the results of porosimetric analyses, have shown that the Inoceramian Sandstones belong among the rocks with low reservoir capacity, they are slightly permeable and have low effective-fracturing coefficient. Furthermore, the results have confirmed the influence of the Inoceramian Sandstones fracturing on their potential permeability.

M. MATEJOVÁ: **Geological research of the western Orava part of the Pieniny Klippen Belt focused on sedimentology and tectonics**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

Studied area is situated on the eastern side of the north-south trending structure – Zázrivá fault, which dislocates the narrow tectonic unit called the Pieniny Klippen Belt. The area of interest is remarkable by the presence of tectonic units as Orava unit, Czorsztyn and Kysuca unit, as well as the succession of Fatric unit. Rocks of the Magura nappe and Central Carpathian Paleogene are also present and they are in a close contact. This is the only place of its appearance in the whole Western Carpathian arc. In the studied area the most commonly occurred unit was the deep-water Kysuca unit, with shallow-water Czorsztyn unit following. In these units two sedimentological profiles where demarcated – Revišné 1 and Revišné 2. Both profiles were microfacially analysed. Profile Revišné 1 is represented by one strata of Mesozoic pale limestones with cherts, where time succession was determined by the change of cadosina zones. The profile Revišné 2 crosses through the whole Czorsztyn unit and it encompasses also the Krasín breccia, which was not described in the Orava part of Pieniny Klippen Belt before.

Structural data as slickensides, veins and folds were measured. Structures occurred mostly in the Upper Jurassic to Lower Cretaceous limestones and in siltstones and sandstones of Central Carpathian Paleogene sediments. Structural data were processed in the software application Win-Tensor (Damian Delvaux, 2008), where data was separated into homogeneous groups and the affected stresses were calculated. The oldest paleostress event was characterized by the compression in a NW–SE direction and extension in NE–SW direction. Change in tectonic regime came with rotation of compression to the direction N–S. Last documented paleostress event had NW–SE oriented extension and caused creating of normal faults, tension fractures and veins.

Results shall be specified by more detailed study of structures extracted from the Central Carpathian Paleogene rocks, because they have more accurate information about the young tectonics which formed the Pieniny Klippen Belt in the last events of its shaping.

V. MIKUŠ[1], D. PLAŠIENKA[1], R. PAŠTEKA[2], M. BIELIK[2], M. ŠUJAN[3], H. ZEYEN[4] and Č. TOMEK[5]: **Application of the geophysical methods to the Pieniny Klippen Belt tectonic research**

[1]Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic
[2]Department of Applied and Environmental Geophysics, Comenius University, Bratislava, Slovak Republic
[3]EQUIS, Bratislava, Slovak Republic
[4]Départment Sciences de la Terre, Université Paris-Sud, France
[5]Czech Geological Survey, Brno, Czech Republic

The studied area is situated in the Pieniny section of the Klippen Belt in the eastern Slovakia, near the village Jarabina. The aim of our research was to clarify its tectonic structure by combination of the surface geological mapping and structural investigation with the interpretation of the subsurface structure using various geophysical methods.

The detailed gravimetry was one of the applied geophysical methods. The gravity survey consists of the high accurate gravity profile measurements. These data have been processed into the Bouguer gravity anomalies. The interpretation is illustrated by the geological-geophysical profiles, which show the lithological members and their density parameters. The influence of surrounding geological units is clearly observed in the southern and northern parts of the profile. They represent large sedimentary units (Central Carpathian Paleogene Basin and the Magura nappe, respectively), composed of low density rock masses. The rocks included in the Pieniny Klippen Belt (PKB) have a higher density and the graph of the Bouguer anomalies creates an elevation above it. Consequently, the lateral limits of the PKB are relatively clear. The anomalies within the PKB are not so sharp, what results from the small differences between the density values of its lithological members. Continuation of the klippen bodies from the surface to the depth and their geometrical limitation was inferred by the density modelling. The computed graph line corresponds considerably to the klippen structures continuing to the depth. The bodies on the surface have only a weak effect.

It is also interesting to compare the density modelling results with the results of the interpretations of the geoelectrical and seismic measurements, which were performed on the same locality, too. The method of the vertical electrical sounding (VES) detects the variability of electric resistivity to the depth. It is indicative for the horizontal geological boundaries. The physical boundaries in the measured profile are nearly identical with the gravimetric ones. The boundary between sediments of the Central Carpathian Paleogene Basin and

PKB, as well as the information about the distribution of the klippen mantle are well comparable with the results obtained by the gravity measurements.

The seismic tomography was the third method used. It was applied only on a short part of the gravimetric profile, however (120 m). The velocity of the seismic waves depends on the petrophysical properties of subsurface sediments and generally increases from the surface to the depth. The highest values were found in the klippen bodies. Similar high seismic velocities were recognized also at the shallow subsurface depths (somewhere it was at the 3 m depth), which may be interpreted as hidden klippes.

There was made a large seismic investigation in the eastern Slovakia (Mořkovský et al., 1981). The seismic reflection profile 30/80 was measured about 13 km SE of Jarabina. It shows the situation in the depths up to 5 km. The boundaries among the Central Paleogene Basin, PKB, Magura flysch and substratum are clearly visible. Moreover, it also brings good information about the internal structures of these geological units.

The section-based, high-resolution geophysical methods combined with the surface geological investigations brought results that are applicable for the tectonic interpretations. They were also used for localization of two short (200 and 140 m), but continuously cored boreholes that generally confirmed the interpreted subsurface structure, at least up to these depths. Therefore the capability of such an approach for unravelling the structure of internally complicated zones, like the PKB, appears to be satisfactory and has been applied also in the other PKB regions.

This work has benefited from the financial support provided by the Slovak Research and Development Agency (projects APVV--0465-06 “Tectogen” and LPP-0225-06 “Bradlo”), which is gratefully acknowledged. M. Bielik and R. Pašteka are also grateful to the VEGA partial support of this work (grants Nos. 1/0461/09, 2/0107/09 and 2/0072/08).

D. OKUPNY and J. FORYSIAK: **Relationships between biogenic sediment age and its lithological type in the central Poland peatlands**

Department of Quaternary Research, University of Lodz, Lodz, Poland

The research into the peatland geology and stratigraphy of the central Poland conducted at the University of Lodz for the past 10 years has provided a wealth of interesting information on chemical composition and lithology of biogenic sediments. The laboratory work led to the identification of the main chemical components of biogenic sediments, i.e. organic matter, inorganic matter, and calcium carbonate. Determining the proportions of these compounds makes it possible to reconstruct environmental changes in the lakes, the peatland´s ecosystem and its surroundings.

The results of geochemical analyses of several hundreds biogenic sediments are presented from 10 peatlands in the central Poland: *Bartochów*, *Czarny Las*, *Czarny Ług*, *Ługi*, *Ner-Zawada*, *Światonia*, *Świnice Warckie*, *Wierzbowa*, *Wilczków* and *Żabieniec*. The analyses consisted of two methods: First, loss on ignition test (incineration of a few grams of the sediment in a muffle furnace at 550 °C for 4 hours) was employed and then the Scheibler volumetric method (determination of the carbonate content in the soil) was also used. The results obtained in the laboratory were analysed by means of the *Statistica* programme. The calculated measure of average, dispersion, measure of asymmetry and concentration were compared with the stratigraphy of biogenic sediments. The age of biogenic sediments indicated by means of radiocarbon dating and palynology was based on existing relevant publications. Measure of average was broken down for each parameter according to median. Furthermore, measure of variability showed how the values of individual parameters cluster around the central value. Variation in the parametres values was studied by means of interval of variation, standard deviation, variation of coefficient and quartile interval. The coefficient of skewness and kurtosis were used to examine the data structure for populations at each site. The co-efficient of skewness is classified as a measure of asymmetry, while kurtosis belongs to measure of concentration.

Documented by the studies of sediments, the geochemical stratification made it possible to distinguish a few evolution phases of the central Poland peatlands. Identified in the bottom part of the majority of collected cores, the geochemical layer corresponds to basins with low biological productivity and with considerable mineral suspended matter from the catchment of *Czarny Las*, *Czarny Ług*, *Światonia*, *Wierzbowa*) and considerable chemical denudation (*Ługi*, *Świnice Warckie*, *Żabieniec*). In the case of peatlands in *Wierzbowa* and *Czarny Las* this stage should be associated with the mineral matter enrichment due to fluvial processes in the Late Glacial and aeolian activity in Sub-Atlantic period (*Czarny Ług* and *Światonia* peatlands). In the biogenic sediments of peatlands in *Ługi*, *Świnice Warckie* and *Żabieniec*, large variation of coefficient of calcium carbonate (even over 70 %) is due to products of the catchment rocks dissolution in the Late Glacial. In the top part of the sediment in the *Bartochów* and *Ner-Zawada* peatlands, the chemical composition of sediments is relatively constant and it could be attributed to appreciable concentration of organic matter. An increase in calcium carbonate should be associated with the circulation of groundwater after the melting of permafrost at the beginning of Holocene. An increase in inorganic matter, documented in the top part of peatland body in all peatlands, results from human activity in Holocene (e.g. deforestation of catchment area and surface wash of soil).

This study shows that the main chemical components of the biogenic sediments depend on the morphological position, the fed way, changes in the intensity of denudation in the catchment area, lithology in the catchment area and the human activity.

O. A. ORLOVA, A. L. JURINA and D. A. MAMONTOV: **Developmental rectigradation of stelar elements of the arthrophytes in the Upper Paleozoic**

Department of Paleontology, Moscow State University, Moscow, Russia

The research was devoted to the integrated study of anatomical structure of the Upper Paleozoic arthrophytes and to definition of the developmental trend lines in the evolution of their stelar elements. The collections of anatomically preserved arthrophyte stems from the Upper Devonian–Carboniferous deposits of Russia have been studied. The oldest member of arthrophytes is represented by the unique plant of *Pseudoborniales* (Frasnian-Fammenian, Upper Devonian). The anatomical structure of the branches of different orders of *Pseudobornia* has been studied. Only the long tracheids of the primary xylem were found. Most likely the stems of *Pseudobornia* did not have secondary growth. The second order of arthrophytes – *Sphenophyllales* (Upper Devonian (Fammenian)–Permian) is characterized by the primary xylem of protoslele-type and secondary xylem with fascicular tracheids. To compare with *Sphenophyllales* the stems of *Calamitales* (Upper Devonian–Permian) had arthrostele-type of stele with abundant secondary xylem. Secondary tissues of the last arthrophyte order – *Equisetales* (Carboniferous–recent) are absent in most cases. Consequently, first arthrophytes (*Pseudoborniales*, Frasnian age) could be reconstructed as the high herbaceous plants without secondary tissues. The secondary growth firstly appears in low scrambling plants of *Sphenophyllales* at the Fammenian. Arborescent plants of *Calamitales* with a thick secondary wood dominate among other arthrophytes from the Carboniferous to the Lower Permian. Recent arthrophytes belonging to the single genus of *Equisetum* are herbaceous plants. They are characterized by the lacking of secondary tissues as the first arthrophytes of *Pseudobornia*.

The research was supported by the Russian Foundation for Basic Researches, project No. 08-04-00633.

S. OZDÍNOVÁ: **Lower Oligocene cooling term and calcareous nannofossils from the Paleogene basins of the Western Carpathians**

Geological Institute, Slovak Academy of Sciences, Bratislava, Slovak Republic

The Eocene-Oligocene is a critical period in Cenozoic climate evolution that coincided with the development of the first East Antartic ice–sheet, close to the Eocene Oligocene boundary. During the Upper Eocene the nannofossil assemblage data reveal that there were several minor SST decreases (coolings) from 36–34 MA, before Eocene/Oligocene boundary (Persico and Villa, 2004).

Biotic events are linked to major changes in the ocean circulation and climatic change, calcareous nannoplankton, has been affected by the oceanic and climatic evolution. The nannoassemblages are subdivided into four categories, based on their temperature preferences: warm–water, temperate water, cool water and no preferences (Wei et al., 1992).

The Upper Eocene and Lower Oligocene calcareous nannofossils were studied in the two Paleogene basins from the Western Carpathians: the Liptovská kotlina Depression – Vlachy borehole and in the Upper-Nitra Basin – Kocurany borehole. The calcareous nannofossils from the nannoplankton zones NP 21 – NP 23 (Martini, 1971) were found in the Oligocene sediments from both boreholes.

Zone NP 21 Ericsonia subdisticha – beginning in the Upper Eocene with association *Istmolithus recurvus*, *Discoaster saipanensis*, *Discoaster barbadiensis*, *Discoaster deflandrei*, *Dictyococcites bisectus*, *Reticulofenestra umbilica*, *Lanternithus minutus*, which were found in the borehole Kocurany. The upper part of this zone getting along to the Lower Oligocene and in the nannoassemblage *Discoaster saipanensis* and *Discoaster barbadiensis* absented or very scattered. The upper part of Zone NP 21 was found in both boreholes, and calcareous nannofossils typical for this zone were enriched by the *Biantolithus spinosus*, *Helicosphaera compacta*, *Helicosphaera perch-nielseniae*, *Chiasmolithus oamaruensis*, *Reticulofenestra hillae*, *Reticulofenestra* cf. *lockeri*.

Zone NP 22 – Helicosphaera reticulata – was assigned in both boreholes on the basis of first occurrences *Chiasmolithus altus*, *Sphenolithus distentus*, and sporadical presence of *Isthmolithus recurvus*. Species *Cyclococcolithus formosus*, *Reticulofenestra umbilica* and *Lanternithus minutus* have the last occurrence in this zone. The assemblage was represented by the stratigraphical important species – *Chiasmolithus oamaruensis*, *Reticulofenestra hillae*, *Reticulofenestra lockeri*, *Sphenolithus predistentus*.

Zone NP 23 – Sphenolithus predistentus – was determined in both boreholes on the basis of absence *Lanternithus minutus* and outcrop of *Reticulofenestra ornata*, which is endemic form for the Paratethys, typical for the Zones NP 23 and NP 24. In the series were observed stratigraphical important species like *Helicosphaera compacta*, *Sphenolithus predistentus*, *Reticulofenestra lockeri*, *Reticulofenestra hillae*. The species *Cyclococcolithus formosus* and *Reticulofenestra umbilica* were outcropped sporadically. The most extensive group of the species was composed from *Coccolithus pelagicus*, *Cyclicargolithus floridanus*, *Dictyococcites bisectus*, *Zygrhablithus bijugatus*.

Paleoecology:

Cool-water trend of the nannoassemblage is characterized by the abundance of genera *Reticulofenestra*, *Dictyococcites*, *Chiasmolithus* and by a big size of the specimens from these genera. Cool-water sedimentation environment were eutrophic, excepting some intervals with the species preferring shelf and warm water – *Braarudosphaera bigelowii*, *Pontosphaera discopora*, *P. rothii*, *P. enormis*. Appearance and occurrence of the endemic form *Reticulofenestra ornata* in the Zone NP 23 signalized decreases of the salinity and proceeding brackish character of the sedimentary area.

The research is supported by the Slovak Research Agency (APVV-51-011305).

M. PAWLIKOWSKI[1], R. PFITZNER[2] and A. BIENEK[1]: **Comparison of human carotids and peripheral artery atheromatous plaques**

[1]Department of Mineralogy, Petrography and Geochemistry, AGH-UST, Cracow, Poland
[2]Department of Cardiovascular Surgery and Transplantology, Jagiellonian University Medical College, Cracow, Poland

The researches were carried out on sclerosis lodgment removed from human carotids and peripheral arteries. The material for the examinations was retrieved during operation from 42 patients who had atheromatosis. The main aim of these researches was to indicate possible similarities and differences between mineralization of human carotids and peripheral arteries. The examinations were conducted with digital microscopy, polarizing (PLM) and scanning (SEM) microscope, infrared absorption spectroscopy (IRS), x-ray diffraction analysis (XDF) and x-ray spectroscopy (EDS). Researches allowed to state that analysed atheromatous plaques have similar character in carotids as well as in peripheral arteries. This character can be purely mineral (phosphatic), organic (cholesterol-phospholipids) or mixed mineral-organic, where both elements remain in variable proportion of quantity. Researches suggest that regardless of character of the mineralization in most of analysed examples, atheromatous plaques in examined carotids were more massive than atheromatous plaques in peripheral arteries.

Recognized, diverse character of the mineralization of atheromatous plaques, which is a result of specific biochemical processes appearing in organism, should be involved proper prophylaxis and treatment.

Ľ. PEČEŇA and R. VOJTKO: **Structural style frontal part of the Krížna nappe in the Strážovské vrchy Mts. (Western Carpathians, Slovakia)**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

The original paleographical domain of the Fatric Unit was located between the Tatric and Veporic realms and was represented by a rhomb-shaped basin. The unit is extended from the Vienna Basin on the west to the Humenské vrchy Mts. on the east. While the axial part of this structure is represented by the Zliechov deep-water succession, the margins consist of shallow water sedimentary successions. The Belá partial nappe is composed of a shallow marine Jurassic succession, which was located in the northern margin of the Zliechov Basin. In the Zliechovská hornatina highland of the Strážovské vrchy Mts., the Belá partial nappe is overridden by the huge Krížna nappe, the zone between them is formed by the "Kremeniny imbricated zone". This transitional zone is composed of both deep-water (the Zliechov type) and shallow-water (the Belá type) Jurassic sedimentary sequences. The contemporary structure of the Krížna nappe system is a result of three main tectonic events. The first one is represented by thrusting of the nappe body over the Tatric Unit after the Turonian. This thrusting was followed by tectonic disintegration of the nappe body into several independent tectonic duplexes and the imbricated structure of the Krížna nappe developed. As a consequence of this process, also the recumbent fold of the Belá nappe was formed. The second event occurred during the Paleogene compressional tectonic regime. General antiform structure was formed during this deformation phase. The Early Miocene transpression/transtension tectonic regime produced south-verging backthrusts that influenced large part of the Krížna nappe.

This study was supported by the Slovak Research and Development Agency under the contract No. APVV-0465-06.

L. RYŠAVÁ: **Microfacial analysis of the Mesozoic sequence of the Choč Nappe of the Čachtické Karpaty Mts. in the Bzince pod Javorinou/Hrušové (Western Carpathians)**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

Studied area is located as the natural outcrop of the forest road near Hrušové village. This area offers partially exposed sequence of Triassic to Lower Cretaceous, which was sampled for microfacies analysis. The following lithofacies types were recognized:

Reifling Limestone (Anisian – Carnian) is represented by pelbiomicrosparite microfacies (wackestone) with the transition into filament microfacies (packstone) with the rare occurrence of foraminifers, fragments of bivalves, crinoid occicles, ostracods, microproblematics (*Baccinella floriformis* Pantić, *Aelisaccus gracilis* Pantić). Matrix is intercalated by stylolites and calcite veins with abundant concentrations of pyrite.

Wetterstein Dolomite (Ladinian – Carnian) – dolomitic limestone to dolomite contains very rare fragments of crinoid collumnalia, foraminifera (*Nodosaria* sp.) and small pellets.

Dachstein Limestone (Latest Norian – Rhetian) is built of packstones to grainstones of pelbiomicrosparite microfacies locally with the transition into oosparite microfacies. They contain fragments of Dasycladaceae, gastropods, ostracods, bivalves, hyaline and agglutinated foraminifers, *Nodosaria* sp. and crinoids.

Hierlatz Formation (Sinemurian – Pleinsbachian) is built by limestones composed entirely of crinoid collumnalia (grainstones). Most of them are reworked showing twin lamella; some of organic fragments are impregnated by Fe-oxides. Crinoids are bordered by many stylolits. There are also fragments of molluscs, foraminifers, echinoid spines, the extraclasts of pelmicrosparite limestones and shales and sporadically rich glauconite scattered in the matrix.

Rotenstein Limestone (Callovian – Oxfordian) belongs to wackestones to packstones of the filament microfacies passing locally to the radiolaria-filament microfacies. They contain also globochaetes, foraminifers, crinoids and molluscs fragments. The Rotenstein Limestone was previously defined as only Oxfordian in age; the Callovian age could be considered on the base of results obtained by this study.

Tegernsee Formation (Kimmeridgian – Tithonian). Limestones of the wackestone to packstone structure have globochaete--saccocoma, globochaete-filament and radiolaria-sponge, microfacies. Limestones contain sponge spicules, calcified radiolarias, cysts of calcareous dinoflagellates – *Stomiosphaera moluccana* Wanner, *Schizosphaerella minutissima* (Colom), *Cadosina parvula* Nagy, *Colomisphaera nagy* (Borza), *Colomisphaera pieniniensis* (Borza), *Cadosina semiradiata semiradiata* Wanner, *Colomisphaera fibrata* (Nagy) *Colomisphaera carpathica* (Borza), *Carpistomiosphaera borzai* (Nagy), *Parastomiospahera malmica* (Borza). Radiolarians and cores of dinoflagellate cysts are sporadically silicified. Fragments of brachiopods, bivalves, aptychy and crinoids are also present. On the base of biostratigraphically important biomarkers limestones studied belong to the Upper Kimmeridgian Borzai Zone and Lower Tithonian Malmica Zone (sensu Reháková, 2000). Began et al. (1982) included this formation in the Oberalm strata.

Oberalm Beds (Late Tithonian – Late Berriasian) represented wackestones of radiolaria-calpionella, calpionella-globochaete microfacies. They contain crinoids, bivalves, sporadically saccocomas, sponge spicules, ostracods, aptychy, fragments of foraminifers, *Involutina* sp., *Crassicollaria parvula* Remane, *Crassicollaria colomi* Doben, *Calpionella alpina* Lorenz, *Calpionella elliptica* Cadisch, *Tintinopsella carpathica* (Murg. et Filip.), *Remaniella ferasini* (Catalano), *Remaniella borzai* Pop, *Remaniella catalanoi* Pop, cysts – *Schizosphaerella minutissima* (Colom), *Cadosina semiradiata fusca* Wanner. Calpionellid markers indicate Late Tithonian Crassicollaria Zone (Colomi Subzone) and the Berriasian Calpionella Zone with its Elliptica Subzone (sensu Reháková, 1995).

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D. SALA and G. RZEPA: **Geology and mineralogy of ochreous sediments from Zabratówka – Preliminary results**

Faculty of Geology, Geophysics and Environmental Protection; AGH-UST, Cracow, Poland

The subject of this work is the accumulation of ochre in Zabratówka village located about 20 km south-east from Rzeszów. The area is situated in the eastern part of the Outer Carpathians, within the Dynowskie Foothills which are built of the Skole unit formations (flysch sediments of the Lower Cretaceous-Lower Miocene age). It is characterized by a varied relief with mild hills and cut-up stream valleys.

The ochre layer is located in an elongated valley surrounded from three sides by the hills. It is covered with the layer of younger deluvial clays and in its bedrock there may be found fragments of the Menilite Formation. In the bottom of the considered area the soil is a bit wet and in its central part there are peat inserts.

It was found out that the accumulations of the considered mineral are in the form of ochreous sediments of different colours, from yellow through different shades of red to brown. In several cases also the presence of cemented ferruginous concretions of up to several centimeters was identified. Iron compounds are dispersed in brown, grey and bluish clays. Moreover, there were observed yellow and rust-coloured eruptions of iron compounds emerging during outflows of underground waters and black layers of manganese compounds covering gravels of the nearby creek.

The main aim of the study was the mineralogical and geochemical characterization of ochreous sediments as well as the analysis of the spread of the layer, its thickness and its variability. In the initial phase of the project 16 examinations were performed. In order to develop the preliminary chemical characterization, content of iron and manganese, both complete (after dissolution in HF and HCl) and associated with amorphous oxides (after extraction with oxalic buffer), were marked in the sediments using the AAS method. Mineral composition was estimated using X-ray Powder Diffractometry (XRD) and thermal analyses.

It has been proven that the content of iron and manganese in the ochre sediments changes significantly depending on the location of the sample. The total Fe content varies from 6.66 to 48.04 wt.% (av. 19.02 wt.%), with the largest concentrations found in concretions. Relatively large amount of Fe may be also found in the surrounding clay – it ranges from 3.28 to 13.61 wt.% (av. 5.64 wt.%). Content of iron extracted with oxalic buffer range from 0.69 to 20.94 wt.% (av. 8.92 wt.%) in the case of ochre and 1.24–8.68 wt.% (av. 2.98 wt.%) in the case of clay sediments. Concentrations of manganese in samples of ochre and ochre clays are visibly smaller and come to: 0.004 to 1.188 wt.% (av. 0.369 wt.%) and 0.018–0.239 wt.% (av. 0.069 wt.%).

Results of the diffractometric analysis indicate that goethite is a dominant iron mineral phase present in the ochre. It is characterized by a weak structural reorganization and is accompanied by small amounts of quartz and alkali feldspars, and in some cases, by manganese oxides. However, the ochre clay is dominated by clay minerals (illite), next to which appear in variable quantities goethite and clastic minerals (quartz and feldspar). Moreover, significant concentrations of iron extracted with oxalic buffer indicate the presence both in ochre and clay of amorphous ferruginous connections and/or of ferrihydrite.

On the basis of the field observations and laboratory research a conclusion can be made that ochreous sediments were probably formed as a result of chemical weathering of the lid sludge ochre menilite formation. Iron present in the menilite layers in the form of sulfides and glauconite were mobilized and washed with sediments by chemical processes, possibly with the help of micro-organisms. After transferring into mobile forms it came out on the land surface along with the outflowing underground water, where it underwent hydrolysis and precipitation in the form of hydroxides, which with time crystallized into the goethite.

M. SENTPETERY: **Neo-Alpine tectonic evolution of the Krivánska Fatra Mts. (western part)**

Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic

Geological and structural mapping was focused on selected areas and outcrops in the western part of the Krivánska Malá Fatra Mts.. The research works takes place mainly in the Tatric sedimentary cover, the nappes of the Fatricum and Hronicum tectonic units and the Paleogene sediments. Typical for the tectonic settings is the fold thrust style of structures, which can be observed from the map view (major folds) and from the minor folds occurring in the outcrops. The older structures shows NW–SE direction, the younger we can consider those with the NE–SW direction, with the vergency to SE. In the southern part of the area, an overturned fold limb faulted with the imbricate thrust faults propagated to the south occurred. Processes and events, which led to the formation of these south--vergent structures was activated surely after the Paleogene, in compare with the previous studies in the Early Miocene.

I would like to thank to the Grant UK G-09-147-00 Neo-Alpine tectonic evolution of the Krivánska Malá Fatra Mts. for the financial support.

V. ŠIMO: **Unusual radiate trace fossil from the Maastrichtian sediments of Kosovska Mitrovica flysch (Novi Pazar, Serbia)**

Geological Institute, SAS, Bratislava, Slovak Republic

The Upper Cretaceous flysch sediments close to Novi Pazar lying transgressively over Paleozoic unit and represent member of Novi Pazar syncline. One sample with trace fossils was found in the younger flysch sequences in the Novi Pazar – Raška road cut. The sample with new trace fossil from this Upper Cretaceous flysch sediment contains two delicate radiate structures that are connected to each other by one of the arms. Central part of the trace fossil is unclear and branching of the arms is three dimensional, not plain. The trace fossil can be compared with radiate branched of *Glockerichnus*. Trace fossils Planolites and ?*Ophiomorpha* and fossils of ?*Cardinia*, *"Turritella"*, *"Cardium"* – *Pseudolimea* sp. and punctate shell fragments of brachiopods are presented in the described sample.

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K. SLAVOVA: **Environmental and geological events as a result from the climatic dynamic in the Black Sea region after the Last Glacial Maximum**

Department of Marine Geology and Archaeology, BAS, Varna, Bulgaria

On a nine-day expedition on R/V Akademik, a Bulgarian research vessel, on June 2009 we had opportunity to mapped and cored, taking samples for dating on the submerged shorelines of the Black Sea off the coast of Bulgaria (Fig. 1). The majority of the scientific party came from the Institute of Oceanology and another party from the Lamont Doherty Earth Observatory, USA.

On board the R/V Akademik we had two different gravity cores and a vibracorer. At first we used a 12 cm-coring device. The device had a 350 kg head on the end of a 4-meter metal tube 12 cm in diameter. The second gravity corer was smaller being on 7.5 cm. During the cruise 22 cores were recovered. Initially cores were taken

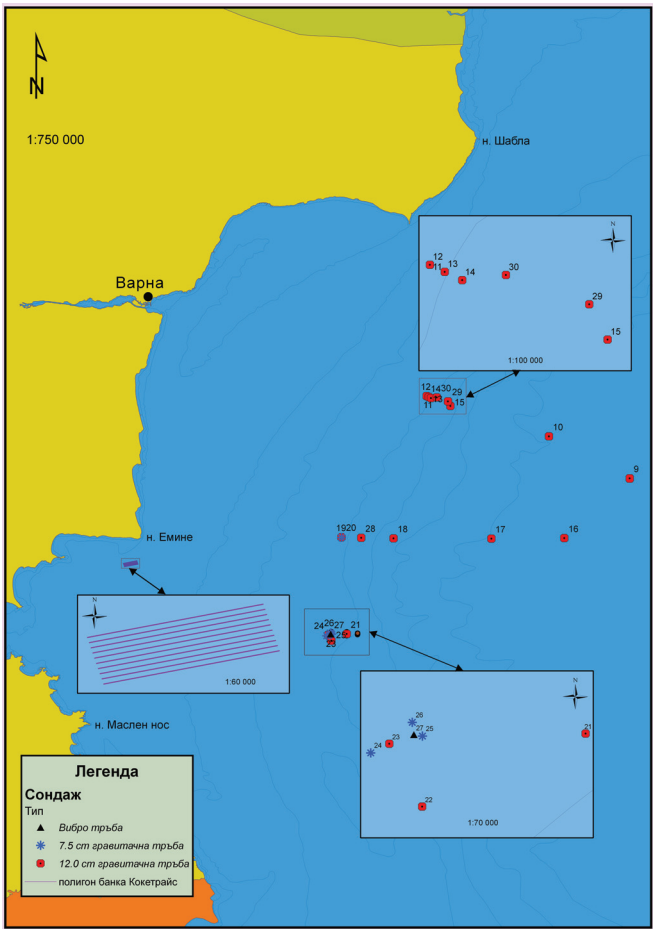

Fig. 1. 22 cores taken during the expedition on the R/V Akademik on June 2009.

in deep water away from the submerged shoreline to sample cores for pollen sampling. After a few cores we began to core into the submerged shorelines.

Despite there being no full dates a few conclusions can be drawn from our expedition: First is that gravity cores are not capable of penetrating into the submerged coastline of the Black Sea. The sun hardened the Submerged Coastline when it was exposed. To overcome this obstacle we used a vibracorer, because it has the extra power to break through the hardened surface of the submerged shoreline. Second is that the submerged shoreline where we cored consisted of shelly gravel. Leading us to believe that the Black Sea once had a water level above these shorelines, which allowed the molluscs to thrive. Then there was a drawdown leaving these molluscs exposed. Their shells were then weathered forming the shelly gravel observed in the core. Third is that a series of reddish--brown clay layers were deposited at core 10 and core 18. The occurrence of the red layers may be linked to high latitude climate variations. In comparison with the dates of red layers in GeoB 7608-1, the transgression occurred between 15.5 and 18 kyr BP.

It is consider that the isolated Black Sea lake reacted very sensitive to climate forcing also on the solar insolation resulting from variations in Solar Luminosity. The established cycle of Solar Luminosity can explain paleoenvironmental changes in the Black Sea region after the Last Glacial Maximum.

This study is financial supported by Project DO 02-337, National Science Fund, Bulgarian Ministry of Education.

S. A. SLEPOV: **The Lower Tournaisian (Mississippian) conodonts from the Moscow Basin (Russia)**

Moscow State University, Moscow, Russia

Conodonts are extinct chordates resembling eels, classified in the class Conodonta. Conodonts were first recognized in the 1856 by the Russian paleontologist Christian Pander. The earliest conodont teeth are known from the Cambrian about 500 million years ago and remained wide-spread throughout the whole 300 million years of the Paleozoic. The first conodont body fossil was described by Briggs, Clarkson and Aldridge in 1983. Conodonts are widely used in biostratigraphy.

Conodonts are studied in the Moscow Basin, which is located 200 km to the south-west of Moscow, in the Kaluga Region, in the central part of Russia. The Alexandrovskaya borehole was drilled in this region in 2008. It is situated on the south-western margin of the Moscow Syneclise (the East European Platform). The depth of the borehole is about 300 m. The geological succession at the borehole represents the carbonate-terrigenous deposits of the Upper Devonian and the Lower Carboniferous and the Quaternary sediments. These sediments are composed of the Malevkian and the Upian horizons of the Lower Tournaisian.

13 species of conodonts were recognized in these deposits. Five genera were described as *Bispathodus*, *Clydagnathus*, *Patrognathus*, *Polygnathus* and *Pseudopolygnathus*. Two assemblages of conodonts have been recognized. The lower assemblage is characterized by a predominance of the species *Patrognathus crassus* and *P. variabilis*, the upper assemblage by *Patrognathus andersoni*. The lower assemblage corresponds with the Malevkian horizon, and the upper with the Upian horizon. The remains of fishes, brachiopods, crinoids, ostracods and foraminifers were found together with conodonts. Imprint of the plants has been discovered at the bottom of the Malevkian horizon. A similar conodont assemblages were obtained earlier in the other boreholes (Glubokovskaya, Suvorovskaya and Tabolskaya), which are located on the southern margin of the Moscow Syneclise.

The Lower Carboniferous conodont zonation was constructed based on phylogeny of members of the deepwater genus *Siphonodella*. But this conodonts are absent in the sections of the Moscow Syneclise. Species of the genus *Patrognathus* are abounded in the shallow-water carbonate deposits of the Moscow Basin. The regional conodont zonation was identified based on phylogeny of this genus.

Analysis of conodonts shows that the regional conodont zonation can be correlated with the standart conodont zonation. As a result the Malevkian horizon corresponds with the lower part of the Lower Tournaisian (conodont zones *sulcata* and *duplicata*) and the Upian horizon with the upper part of the Lower Tournaisian (conodont zones *sandbergi* and *crenulata*).

M. SMREČKOVÁ: **Cenomanian–Turonian radiolaria from PKB and their paleoecological implications and biostratigraphic zonation**

Faculty of Natural Sciences, Matej Bel University, Banská Bystrica, Slovak Republic

The radiolarian microfauna from silicified horizons in localities Červená Skala and Vršatec was investigated. The samples were also collected from the klippe Dolný Mlyn near Stará Turá, where this interval was described by Scheibnerová (1969). However, it was not identified during my field works. This part of horizon was probably removed during the mining works. Variegated marlstone formations of the Czorsztyn succession of the Pieniny Klippen Belt (Jaworki Formation) were biostratigraphically interpreted. In the locality Červená Skala they correspond to the stratigraphic range from the Middle Cenomanian to Turonian and in the locality Vršatec they correspond to Turonian – Coniacian. Detailed radiolarian biozonation for the Mediterranean area of O´Dogherty (1994) was applied. Radiolarian associations from the lower part of the profile in the locality Červená Skala contained the association characteristic for the Lower Turonian. Similarly, it was also possible to place the association being acquired from the upper parts of the profile to the Lower Turonian, but except of its lowermost part. The uppermost radiolarian horizon contained the association representing relatively wide range – Turonian. The associations of radiolaria from the Vršatec locality come from the upper part of the section. They represent stratigraphic range of the Lower Turonian. The uppermost radiolarian horizon, from which the sample richest in radiolarian microfauna was acquired, contained the Lower Turonian association, except of its lowermost part.

Based on the proportion of diversity and composition of foraminiferal microfauna in the samples from Červená Skala and Vršatec localities it may be stated that the biosilicite productivity and concentration of radiolarians are a clear evidence of eutrophication of underground water segments. In both locations, radiolarians dominated by forms indicative of unstable environmental conditions, which correspond to the Ocean Anoxic Event 2 from the Late Cenomanian to the Early Turonian.

The productivity peak of the radiolarians, the Cenomanian/Turonian boundary, is also marked by the pronounced changes in their taxonomic composition.

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M. SOŚNICKA: **Mineralogy of beach sediments, NE part of Halmahera Island, Indonesia**

Faculty of Geology, Geophysics and Environmental Protection, AGH-UST, Cracow, Poland

The Halmahera Island is situated in the south-eastern Asia and is a part of the Indonesian territory. The area of eastern Indonesia is a place of junction between the Philippine and Australian lithospheric plates with micro-plates forming the Eurasian Plate margins. The Halmahera Plate is a part of the Philippine Sea Plate. It is surrounded by the micro-plate called Molucca Sea Plate on the west and by the Sorong Fault Zone, separating it from the Australian Plate, on the south. The western part of the island, the Halmahera arc, is an earthquake prone area where occur active volcano belt associated with a subduction of oceanic lithosphere of Molucca Sea Plate descending beneath the Halmahera Plate.

The Halmahera Island comprises of Cretaceous, ophiolitic Basement Complex, being the part of fore-arc, covered unconformably by the different generations of volcanic arcs rocks and the Miocene carbonate platform. The age of volcanic rocks is ranging from Paleocene to Eocene. Investigated area is built of ophiolitic, fore arc associations, marine back arc sediments and volcanic debris originated by the erosion of volcanic chains in the western and northern parts of the island.

The samples were collected on the eastern coast of the island in the vicinity of the rivers estuary. There were 2 research points established. Point 1 is situated about 3 km from the Wayamli village in the direction of Buli town and point 2 is nearby the Wayamli village. The samples were taken from the excavations made on the beach. That place is close to the deeply incised river of an anastomosing character. The beach material partially is derived from the deep--seated river erosion. The sediments contain dark sands of greenish tint with addition of conglomerate fraction. The methodology includes microscopic observation in reflected and transmitted light, SEM analysis by Energy Dispersive X-Ray Spectroscopy detector (EDS) and XRD analysis.

Observations in reflected light indicated that the beach sediments are mostly abundant of iron-bearing minerals ranging from magnetite through maghemite, hematite to iron oxide-hydroxide. The sands contain also fewer amounts of titanomagnetite, chromite, ilmenite, other titanium minerals, sulphides: pyrite, chalcopyrite, minor contents of pyrrhotite, bornite and nickel sulphides. There are more than three

generations of magnetite. The primary magnetite is rare and hard to recognition, it forms euhedral grains affected by corrosion due to the fast melt. Magnetite crystals form intergrowths with chromite or titanium dioxides are frequently covered by a mesh of elongated hematite crystals forming martite. Observation indicates that primary euhedral chromite crystals are surrounded by younger magnetite rind. It occurs also as veins crosscutting chromite or filling fractures between dismembered crystals. In some crystals there is noticeable the chemical zonation which is marked by paler halos on the edges of that crystals. The observation in transmitted light revealed that the sands contain mineral association related to andesites, basalts, gabbroids and serpentinites. The different degree of alteration of rocks grains suggests a presence of many generations of volcanic material mostly built of pyroxene, hornblende, plagioclase phenocrysts and fine grained or partially glassy groundmass of various dark tints. In thin sections there were many volcanic textures observed. XRD analysis indicates the abundance of diverse mafic plagioclases. The EDS analysis shows large variety of chemical composition of pyroxenes, chromites and titanium minerals.

S. STAŇOVÁ and N. HUDEC: **phpSedistat – a simple command line application not only for deep-water clastic sedimentology**

Geological Institute, SAS, Banská Bystrica, Slovak Republic

A "phpSedistat" is a simple command line application, which was designed with the purpose to make comfortable statistical computations used in sedimentological analysis and interpretation of field data. It has been applied in analysis and the interpretation of turbiditic successions from the outcrops in the Outer Western Carpathians. However, instead of deep-water deposits, at least the first one of implemented statistical methods (Markov Chains) has been used in analysis of data from a broader variety of depositional environments (e.g. alluvial plain, peritidal carbonates, etc.).

In analysis of the field data sedimentologists are commonly confronted with the question if there is a natural order in vertical successions of deposits. Some simple statistical techniques have been applied to examine the possible presence of order in sedimentary successions. Almost all utilize the probability matrices and make use of the idea of Markov Chains. The algorithm for calculation of possibility of vertical transitions of sedimentary facies was implemented into the "phpSedistat" software and then applied for the determination of statistically significant successions of facies in the sedimentary successions of the Kýčera Mb. of the Magura Unit from the NW part of the Outer Western Carpathians. Then, the statistically significant successions of descriptive facies in the investigated sedimentary sequences were compared to facies models of deep--water deposits providing the evidence that apart from classical turbidites (composed of Bouma succession of descriptive facies), an important part of studied sedimentary sequences are the deposits of density flows. In addition to a variety of deposits of deep-water gravity flows, sedimentary successions of the Kýčera Mb. contain fine grained facies, which deposited from suspension fallout. In some cases, primary sedimentary structures of investigated sediments were overprinted by syn- and/or post-sedimentary deformation.

Traditionally, the interpretation of submarine-fan depositional sub-environment of turbiditic formations is based on the identification of asymmetric vertical sequences of bed thickness and/or grain sizes. Although such interpretations were questioned, the interpretation of channel-levee deposits as a thinning and fining upward sequences or the interpretation of lobe/interlobe deposits as a thickening and coarsening upward sequences is still conventionally applied. As an alternative, Chen and Hiscott (1999) suggested that combining facies characteristics with the results of statistical analysis of facies clustering in submarine-fan turbidite successions by employment of the Hurst statistic provides reliable criteria for the identification of the submarine-fan depositional sub-environments. This method is based on the estimation of the Hurst coefficient K and the deviation from the mean (K´= field-based Hurst K – mean K for 300 randomly shuffled series). The algorithm for calculation of Hurst coefficient (K) random shuffling of data and calculation of deviation from the mean (K´) was incorporated into the "phpSedistat" software. The aim of this step was to create a user-friendly environment allowing to estimate K and K´ for a wider range of computer users without profound knowledge of programming. The facies characteristics of the Kýčera Mb. together with their statistical analysis using the Hurst statistic provided the evidence for their deposition in the lobe-interlobe depositional environment of the submarine-fan.

The program phpSedistat was programmed under GNU General Public License as an open source software product. It can be downloaded from http://phpsedistat.sourceforge.net.

R. SYNAK[1], M. KOVÁČ[1] and K. FORDINÁL[2]: **Sequence stratigraphy of the Danube Basin in the Upper Miocene**

[1]Department of Geology and Paleontology, Comenius University, Bratislava, Slovak Republic
[2]State Geological Institute of Dionýz Štúr, Bratislava, Slovak Republic

The Danube Basin represents a north-western margin of the Pannonian Basin System. The present-day shape and sedimentary architecture of the basin is a result of multiphase tectonics and accumulation of deposits in various environments. Late Neogene paleogeography and geodynamics, resembling to the North Pannonian domain, can be characterized by the development of extensive back ark basin system, its gradual infill, followed by the Pliocene uplift and denudation. Marine connections of the Lake Pannon are assumed only during the early Late Miocene (towards the Eastern Paratethys). Influence of the Messinian salinity crisis and coeval sea level fall in this closed alluvial to lake system was overprinted by tectonics, acting in the Western Carpathian orogene. All mentioned events are well recorded in the sedimentary succession of the basin, where the deep water setting brackish offshore deposits gradually change to shallow water setting near the shore marches and deltaic deposits and are followed by the freshwater alluvial sedimentation. The Late Miocene changes of the Danube Basin depositional systems are dated by tools of bio- and sequence stratigraphy.

Interpretations of seismic data and well-logs from the central and southern parts of the Danube Basin, together with the contribution of already described sequence stratigraphic boundaries and key surfaces in the area of Pannonian Basin, made it possible to establish three 3rd order cycles: **DB1 11.6–9.7? Ma, DB2 9.7–6.3? Ma and DB3 ?4.1–2.6 Ma**. The time span between 6.3–4.1 Ma could represent denudation during basin structural inversion stage. Revaluation of the existing data specified until now used time range of the Danube Basin formations and members in Slovakia as following: Ivánka Formation 11.6–9.7? Ma, Beladice and Volkovce Formation 9.7–6.3? Ma, Kolárovo Formation ?4.1–2.6 Ma. The Hlavina limestone Member age was dated about 8.2 Ma.

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M. A. TKACHENKO: **Sequence stratigraphy for studying of oil and gas potential of Triassic deposits in the eastern part of Barents Sea**

St.-Petersburg, Russia

The Barents Sea is the most studied aquatory among the Arctic seas of Russia, but this area demands the additional investigations.

The researching area is situated in the eastern part of the Barents Sea west of Novaya Zemlya island. In the west it structurally belongs to terrace Fersmanovskaya, the center of studying area belongs

to North-Stockman depression and Ludlovskaya saddle, in the south belongs to Luninsky deflection. The eastern part of one belongs to Admiralty High.

In the course of work there were studied 4 wells: Fersmanovskaya, Ludlovskaya, Krestovaya and Admiralteyskaya.

Using descriptions of each well, the stratigraphic columns at a scale of 1 : 5 000 were constructed and the detailed correlations of the Triassic sections were carried out. The next step was the construction of the biolithostratigraphical correlation scheme based on fauna, palynological and lithological studies.

For understanding of paleostructural and sedimentary environments the area was divided into several structural-facial zones.

As a sequence-stratigraphy is often dealing with the global eustatic fluctuations of the sea level, allocated units may have a significant correlation potential and allow comparing deposits of different facies.

Using the sequence analysis data we can identify on seismic profiles a regressive tract – potential reservoir and the transgressive tract – cover rock or oil source rock and then we can trace this tracts in the other areas of Barents sea. And if we will have coincidence of three factors – the structure, reservoir and cover rock, we will make a conclusion concerning the petroleum prospects.

Thus, the sequence stratigraphy method can be successfully used for the forecasting of oil and gas perspective areas.

M. UDIČ: **Interpretation of the deformation and stress field evolution of the Sub-Tatra fault system**

Department of Geosciences, Technical University, Košice, Slovak Republic

The northern part of the Western Carpathians was affected by a polyphase deformation near the boundary between their Central and Outer parts. Paleostress analysis in the Sub-Tatra fault system region revealed the existence of five different stress fields. Their orientations were determined by the detailed structural analysis of the fault slip data. The evolution of the stress fields shows an apparent clockwise rotation from beginning of the Sub-Tatra fault system development to Quaternary. During the initial phase, E–W compression and perpendicular tension affected this area. This was the time when the Central Carpathian Paleogene Basin formed. After this phase, the paleostress field rotated approximately 30–40° to NW–SE compression and NW–SW tension. Next phase, which affected the region, is characterized by the progressive rotation of the paleostress from NW–SE to the NE–SW direction of the maximum principal compressional stress axis (σ_1). Following this one there was a change of orientation axis σ_1 from horizontal to vertical direction and the orientation of the maximum extension axis (σ_3) has SE–NW trend. The Quaternary stress field was reconstructed on the basis of structural measurements in the Quaternary sedimentary formation of the Poprad Basin. The results of the paleostress analysis show that the Quaternary stress field is characterized by SSW–ENE oriented maximum horizontal extension σ_3 and vertical oriented maximum compression σ_1.

J. K. UPPSTAD: **Protection of a historical spring in the vicinity of tunnel construction**

Norconsult AS, Sandvika, Norway

A historically important, natural spring in Tønsberg, South Norway, has its recharge area in a hill Frodeåsen, where one road tunnel was constructed in 2004 and another crossing railway tunnel is under construction. To avoid loss in the spring discharge and other negative consequences caused by the leakage of the groundwater into the tunnels, several counter measures and a comprehensive groundwater surveillance program was implemented. In connection with the railway improvements there will also be a slope cutting only few meters above the spring. The spring itself is located directly below the existing railway line outside the tunnel.

The geology consists of romb porphyry with numerous diabase intrusives in N–S trending fractures. There are several, partially artificial lakes on the hill. Some of these were formerly used as the water supply for the Tønsberg town. The hill and the town are below the marine limit, and therefore they are partly covered by the Holocene marine clays.

Injection of the tunnels is done by the systematic pre-injection, using industrial cement, micro-cement and controlled hardening. The maximum leakage limits for the road tunnel were set to 4–10 l/min/100 m tunnel to avoid negative consequences for the natural spring and for the other elements in the environment on the top and around the hill.

Use of systematic injection and close follow-up of the injection in progress and the groundwater surveillance program was found to be vital during the first tunnel construction. Use of mainly industrial cement, little micro-cement and less controlled hardening was found to give the best results.

V. VAŠKANINOVÁ: **Placoderm localities in the Barrandian area (Czech Republic)**

Institute of Geology and Paleontology, Charles University, Prague, Czech Republic

Placoderms are a group of Lower Paleozoic early vertebrates characterized by a head- and trunk- shield composed of dermal bone plates. In the Prague Basin their occurrence is restricted to the Devonian strata. Placoderm fossils have been found in all formations of the Lower Devonian there. The majority of the specimens reposited in the National Museum in Prague come from old collections assembled since Barrande´s time.

Černá rokle – an old quarry near Kosoř southwest of Prague is the only placoderm-bearing locality in the Lochkov Formation. Active quarrying was carried out there since the 19th century and ceased in the 1960s. A great number (231 pcs.) of well preserved specimens of two species, *Radotina kosorensis* Gross, 1950 and *Kosoraspis peckai* Gross, 1959, was collected throughout the years. Even today they can be found in the dark greyish, fine-grained platy limestone of the Radotín facies that emerge in the eastern part of the former quarry.

The main locality in the Prague Formation is situated near Koněprusy, south of Beroun. The original Barrande´s localities were destroyed by the still active Čertovy schody quarry complex, hence the origin of many specimens is hard to determine. Two species were described – *Radotina tesselata* Gross, 1958 and *Holopetalichthys primus* (Barrande, 1872), being preserved in the white bioclastic limestone from the reef facies of the Koněprusy Limestone. Scarce fragments of Placoderm dermal plates have been found in the Dvorce-Prokop Limestone at the Damil hill near Tetín, southeast of Beroun.

Isolated or partly articulated dermal plates of indeterminate members of the order Arthrodira have only been recorded throughout the Emsian. Both known localities in the Zlíchov Formation are nowadays inaccessible. Barrande´s locality Choteč, situated on the northern slope of the Radotín valley southwest of Prague, is overgrown with vegetation. Švagerka is a completely covered old quarry in Praha-Hlubočepy, partly exposed at the railway cut.

Placoderm fossils were collected at three localities in the Daleje-Třebotov Formation. The largest placoderm dermal bones embedded in the gray and red crystalline Suchomasty Limestone were collected at Koňeprusy and nearby Suchomasty quarries. A larger number of specimens were found in Praha-Hlubočepy at the eastern part of the Prokop valley where the old quarries and small outcrops are now partly urbanized and protected.

The presence of placoderm fossils in the Choteč Formation is questionable. Some of the specimens from Hlubočepy may come from this level. One fragment of dermal bone plate was found near Srbsko, southeast of Beroun, in the Srbsko Formation.

M. VESELSKÁ: **The occurrence and systematic revision of selected groups of the order Decapoda Latreille, 1802 from the Bohemian Cretaceous Basin**

Institute of Geology and Paleontology, Charles University, Prague, Czech Republic

Presentation reports about the occurrence and systematic revision of the selected groups of the Upper Cretaceous decapods from the Bohemian Cretaceous Basin (BCB). The preliminary study detected approximately 170 specimens, from 32 localities in the BCB, which belong to four infraorders: Astacidea Latreille, 1802 with two genera, Glypheidea Winckler, 1882 with two genera, Axiidea de Saint Laurent, 1979 with one genus and Brachyura Latreille, 1802 with seven genera. The most of these specimens are stored at the Paleontological collections in Prague: National Museum, Czech Geological Survey and Institute of Geology and Paleontology (Charles University in Prague, Faculty of Science). Many decapod´s specimens are also stored at Museum in Krupka (a part of the Regional Museum in Teplice). Stratigraphical distribution of these decapods is described from the Upper Cenomanian to the Lower Coniacian in the BCB. The Upper Cenomanian crustacean record is sparse, all of specimens belong to genus *Protocallianassa* Beurlen, 1930 (infraorder Axiidea). Turonian decapods are more abundant and diversified. The most of them came from the Lower–Middle Turonian sediments at Bílá Hora in Prague (this locality is already destroyed). Lower Coniacian taxa consist predominantly of brachyuran crabs. These crabs are originally described from the type locality at Březno near Louny. The most abundant fossil decapods from the BCB, which are also commonly found at this time, are referred to the genera *Enoploclytia* M´Coy, 1849 (infraorder Glypheidea) and *Protocallianassa* Beurlen, 1930. The fossil record of the other decapods from the BCB is sparse and fragmentary.

P. VRŠANSKÝ: **Origin of mantises revisited**

Geological Institute, SAS, Bratislava, Slovak Republic
Paleontological Institute, Russian Academy of Sciences, Moscow, Russia

Based on new Mesozoic and Tertiary material, the phylogenetical scheme of the earliest mantodeans and their ancestors is provided. The predatory cockroach (Liberiblattinidae), representing ancestral or sister taxon to all mantodeans and predatory cockroaches of the family Eadiidae, is reported from the Late Jurassic of Karatau in Kazakhstan. Mesozoic Jantarimantidae (Fig. is 98Ma old amber mantis) and Juramantidae are the sister taxons to the rest known mantodeans; *Santanmantis* was the most primitive ambush mantodean known to date. Similarly as in the sedimentary record, all amber mantises (possibly except for *Ambermantis wozniaki*) represent primitive pursuit mantises, which replaced primitive pursuit carnivorous cockroaches of the family Raphidiomimidae during the earliest Cretaceous. Advanced ambush mantises were evolving parallel since the Berriasian, but became dominant much later, along with the origin of modern mantis lineages.

F. ZALEWSKI: **Structural changes of chondrules on the surface of Allende meteorite**

Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland

The Allende meteorite fragments originated by a fall that was observed on February 8, 1969 when bright bolide consisting of two meteoroids flew over northern Mexico. After the entry into denser layers of the atmosphere over the Chihvahua province it exploded, spreading the meteorites of varying sizes over an area of 500 km^2. It was studied by the NASA scientists and has been classified as carbonaceous chondrite CV 3.2, consisting of a protoplanetary matter.

Objects of interest for the author of the paper are the olivine--pyroxene chondrules (olivine-$(Mg,Fe)_2SiO_4$, pyroxene – $AB(Si_2O_6)$, A – is substituted by calcium or sodium and B – by magnesium, iron, aluminium. Those chondrules probably crystallized in the cosmic space about 4.6 billion years ago and are the oldest matter in our Solar System.

The study was conducted in the open microscopic slide by means of Carl Zeiss Jena polarizing microscope using up to 200x magnification and Nikon 120 microscope with a magnification of up to 500x in a transmitted and reflected light. To extend the results of chondrules´ structure, scanning electron microscope (FESEM) Hitachi S-4700 with spectrometer (EDS) NORAN Vantage was used.

The results of studies carried out by these methods revealed the presence of isotropic-amorphous layer on the surface of a meteorite beyond the fusion crust, as well as a partial transformation of the olivine-pyroxene chondrules´ structure into isotropic – amorphous matter. It has been observed that changes of olivine and pyroxene in such chondrules occur initially in the central part of chondrule and not on its periphery. Within the body of chondrules the presence of the iron-nickel spherules was documented with a size varying from 1 to 200 microns and a different Fe/Ni ratio, which also has been partially or completely replaced by (or transformed) into the isotropic – amorphous phase. This layer was found in thin sections made of successive meteorites DAG 949 L6, NWA 5500.

For these results it can be concluded that spherules located inside the chondrules are older than the objects in which they were located.

Subsequently, the formation of an isotropic – amorphous layer on the surface of meteorites is caused by a high speed flight in the upper layers of atmosphere where the oxygen is present in small quantities, and on the forehead of meteorite plasma is formed or inductive waves´ activity. These waves cause changes not only on the surface of the flying object but also in the matrix and chondrules located beneath the ablation zone.

T. ZGŁOBICA[1], T. BAJDA[1], M. MANECKI[1] and D. SZREK[2]: **Immobilization of Zn, Pb, and Cd in soils by phosphate fertilizers**

[1]Department of Mineralogy, Petrography and Geochemistry, AGH-UST, Cracow, Poland
[2]Polish Geological Institute, Holy Cross Mountains Branch, Kielce, Poland

Years of mining and processing of lead and zinc ores results in a progressive contamination of soils surrounding the mines and

smelters. In accordance with the current law these soils have to be rehabilitated. The problem of an extensive contamination of soils with the heavy metals in the Upper Silesia region (S Poland) may be addressed, using a modern in situ chemical immobilization technology. The objective of this study was to determine the effect of phosphate fertilizers on Zn, Pb and Cd phytoavailability and leacheability from smelter-contaminated soils.

The soils used in this experiment were collected from sites located in proximity to a Zn and Pb smelter and a sludge landfill near the town of Bukowno. Soils were air-dried and sieved (< 2 mm). The research was conducted in the laboratory conditions. Five types of phosphate compounds and phosphate fertilizers, namely phosphoric acid, Polifoska 15, ammonium phosphate, phosphosilicate glass, and bone meal, were tested to determine their efficiency in immobilizing of Zn, Pb and Cd in contaminated soils. Reagents were added to the contaminated soils based on the total molar concentration of Pb, Zn, and Cd in the soil samples. Phosphate amendments were based on preliminary experiments that included and 2 : 3 P to M_{total} molar ratio treatment (M_{total} = Σ of total Pb, Zn, and Cd determined). Two chemical extractions were used to assess the relative availability of metals in the treated and untreated soils: 1) 0.01 M $CaCl_2$ solution at pH 7 and 2) TCLP – standard Toxicity Characteristic Leaching Procedure. Both that are widely reported in the scientific literature as proxies for bioavailability and toxicity, respectively, of metals in soils.

Effective reduction of leachable and bioavailable Zn, Pb and Cd concentrations in soil was observed after addition of ammonium phosphate, Polifoska 15 and phosphoric acid. Results of experiments confirmed the efficiency of these amendments at low pH and temperature. The experiments allowed to determine the optimal conditions for zinc, lead and cadmium immobilization in studied soils. These laboratory experiments confirmed that phosphates amendments are effective way of immobilization of Zn, Pb and Cd contaminations.

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J. ŠURKA: **Sedimentological analysis of Borové Formation (Paleogene) in the Orava area**

Geological institute, Slovak Acad. of Sciences, Ďumbierska 1, 974 11 Banská Bystrica, Slovak Republic; surka@savbb.sk

Sediments of the Borovské Formation were deposited in various depositional environments. Using the sedimentological analysis we are able to study various depositional environments of sediments also in the Orava region.

Three sedimentological profiles were studied in the Zázrivá area. The profiles were located only several hundreds of meters away from each other. However each of the profiles represents different depositional environment. Fining upwards pattern of the sediments shows that the "Čapica" profile represents typical transgressive evolution of the Borovské Formation. Sediments at the bottom of this formation are built by the coarse-grained homogeneous dolomitic breccias, which belong to the Mesozoic underlying rocks. They are gradually altered by conglomerates in the upper parts of the profile. The uppermost part of the profile is formed by the sandstones. Presence of nummulites in these sandstones indicates the existence of marine depositional environment. According to above summarized knowledge we can argue that the lower parts of the profile were formed by sediments of pre-transgressive alluvial fans with very short transport of material, which gradually changed to marine environment.

The "Čremoš 1" profile is different when compared to "Čapica" profile. No coarse grained material is present at the basal part of the profile. The base of the profile is formed by carbonates (mudstone and wackestone types), which are characteristic for relatively calm depositional environments. We can assume in this case that sediments were presumably deposited in protected (lagoon) environment. The upper parts of the profile are formed by the packstone type limestones, which are replaced by fine grained conglomerates and sandstones in the uppermost part of the profile. The sandstones contain various species of the great Foraminifers, of which the Alveolinas are the most abundant. The Alveolinas prefer shallow marine environment, which is represented in this case by the transgressive sediments of upper shoreface. Sandstones deposited above them (also containing "drowned" occasional bigger clasts) are probably tempestite deposits. There are abundant nummulite clusters present in the sandstones showing the marks of bioturbation, which indicates that the upper part of the sediments were deposited between the fairweather wave base and the storm wave base (lower shoreface).

Another profile was studied in the area of "Ježov vrch" near Oravice. The Borovské Formation in this region has distinct features when compared to previous studied areas. The profile is formed solely by carbonates. Coarse grained sediments are not present at all. The limestones contain numbers of fossils, it is possible in this case to talk about organodetritic to organogenic carbonates. Based on the information obtained from thin sections were the carbonate rocks classified to packstone and bindstone classes. If we suppose that the formation of limestones was bound to carbonate ramp, the packstone type of limestones should be present in the shallow sector, which is affected by fairweather wave base. This is supported also by the relatively frequent streamlined arrangement of the great Foraminifers in the thin sections. Bindstone type of limestones is characteristic by the presence of eukaryotic algae, which often form crusts on shells of dead Foraminifers and on carbonate fragments. Their position within the carbonate ramp should be in calmer, but still shallow marine environment, which could allow formation of such accruals.