RESEARCH REPORTS 2009

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Cover photo: Eolian landforms covered by snow and ice on James Ross Island (Antarctic Peninsula). Photo by M. Svojtka.

2009

Research Reports

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Contents

1. Introduction

The year 2009 was of particular importance for the history of the Institute of Geology AS CR. The new building was completed after about 2 years of construction works owing to a very good collaboration with the construction company (Kočí, a. s. Písek). On the turn of August and September, the Institute moved after almost 50 years of its existence. The anniversary will be celebrated together with our neighboring Institute of Chemical Processes AS CR in the new building in May 2010. The old building was demolished at the end of 2009. The building housing the laboratories (building B) started to be reconstructed at the end of 2009. We believe that these achievements will stabilize the discipline of geology among other academic sciences. The completion of the building has helped in a number of ways for a more efficient function of the institute – e. g., the library will finally start to serve its purpose in new spaces, the funds scattered in different storages will become re-united, and a new organization of the laboratories will allow their better function. A new clean laboratory for ICP and sample preparation was built. The transfer from the old building into the new one was surprisingly swift and has helped to "sort out" the obsolete furniture, samples and laboratory equipment.

The principal thread of research has not changed much – we continue our studies in paleoecology, past changes of the environment, rock and environmental geochemistry, paleomagnetism, rock dynamics and other fields, as reflected in this report. The financial budget was reduced at the end of the year (-12 % for salaries), but we solved the situation by reducing the number of already retired experts. However, the expected new reduction may endanger the function of some scientific departments. Future development will thus rather depend on the macroeconomic situation than on the Institute achievements. The number of published papers has followed the general rising trend, but the attention was also given to teaching, popular sciences and usual scientific administration such as reviews or participation in editorial and scientific boards. We feel that in the last two decades Earth sciences have become less important and maybe even neglected disciplines, but this situation seems to be changing possibly due to the rising prices of mineral commodities and energy sources.

Václav Cílek, Institute CEO

Pavel Bosák, Chairman of the Executive Board

- **Fig. 1A.** New building just before the moving of personnel, furniture etc. (Photo by J. Brožek; August 26, 2009).
- **Fig. 1B.** Preparation for final moving. A corridor on the second floor of the original building A (left: V. Cajz, right: P. Bosák, back: B. Trenzeluková; photo by J. Brožek; August 20, 2009).
- **Fig. 2A.** Building A at the start of demolition (Photo by J. Brožek; November 25, 2009).
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2. General Information

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The Institute of Geology of the AS CR, v. v. i., is a research institute belonging to the Academy of Sciences of the Czech Republic (AS CR). It concentrates on the scientific study of the structure, composition and history of the Earth's lithosphere and the evolution of its biosphere. Although the Institute does not have the opportunity to cover all geological disciplines (in the widest sense) or regionally balanced geological studies, the methods of its activity span a relatively broad spectrum of problems in geology, geochemistry, paleontology, paleomagnetism and rock mechanics. The Institute takes part in the understanding of general rules governing evolutionary processes of the lithosphere and biosphere at regional as well as global scale; for this purpose, the Institute mostly employs acquisition and interpretation of relevant facts coming from the territory of the Czech Republic.

The Institute of Geology AS CR, v. v. i., is a wide-spectrum institute developing essential geological, paleontological, petrological, mineralogical and other disciplines, lately accentuating environmental geology and geochemistry. The major research areas covered by the Institute are:

- Petrology and geochemistry of igneous and metamorphic rocks
- Lithostratigraphy of crystalline complexes
- Volcanology and volcanostratigraphy
- Structural geology and tectonics
- Paleogeography
- Terrane identification
- Taxonomy and phylogeny of fossil organisms
- Paleobiogeography of Variscan Europe
- Paleoecology (incl. population dynamics, bioevents)
- Paleoclimatology as evidenced by fossil organisms and communities
- Biostratigraphy and high-resolution stratigraphy
- Basin analysis and sequence stratigraphy
- Exogenic geochemistry
- Exogenic geology, geomorphology
- Quaternary geology and landscape evolution
- Karstology and paleokarstology
- Paleomagnetism
- Magnetostratigraphy
- Petromagnetism
- Physical parameters of rocks

The Geological Institute of the Czechoslovak Academy of Sciences (ČSAV) was founded on July 1, 1960. Nevertheless its structure had developed in period of 1957 to 1961. During the period, several independent laboratories originated: Laboratory of Paleontology, Laboratory of Engineering Geology, Laboratory of Pedology and Laboratory of Geochemistry; Collegium for Geology and Geography of the ČSAV represented the cover organization. On July 1, 1960, also the Institute of Geochemistry and Raw Materials of the ČSAV was established. This Institute covered technical and organization affairs of adjoined geological workplaces until their unification into Geological Institute of the ČSAV on July 1960.

On August 1, 1964 the Institute of Geochemistry and Raw Materials of the ČSAV was integrated into the Geological Institute. On July 1, 1969 the Institute of Experimental Mineralogy and Geochemistry of the ČSAV, successor of the Geochemistry and Raw Materials was newly established. A part of the staff of the Geological Institute joined the new institute. On January 1, 1979 the Institute of Experimental Mineralogy and Geochemistry was integrated into the Geological Institute.

On March 1, 1979, the Geological Institute was united with the Mining Institute of the ČSAV under the Institute of Geology and Geotechnics of the ČSAV, and finally split from the latter on March 1, 1990 again.

On January 1, 1993 the Academy of Sciences of the Czech Republic was established by the transformation from the ČSAV, and the Geological Institute became a part of the ASCR. The Institute belongs to the I. Department of Mathematics, Physics and Earth Sciences and to the 3rd Section of Earth Sciences. On January 1, 2007 the Institute became a public research institution (v. v. i.) by the change of legislation on research and development.

The economic and scientific concept of the Institute of Geology AS CR, v. v. i., and the evaluation of its results lie within the responsibility of the Executive Board and Supervisory Board that include both the internal and external members. Institutional Research Plans are evaluated by the Committee for Evaluation of Institutional Research Plans of AS CR Institutes at the AS CR. Besides research, staff members of the Institute are involved in lecturing at universities and in the graduate/postgraduate education system. Special attention is also given to presentation of the most important scientific results in the public media.

3. Publication activity of the Institute of Geology

3a. Journals

The Institute of Geology AS CR, v. v. i., is the publisher of **GeoLines**. GeoLines (www.geolines.gli.cas.cz) is a series of papers and monothematic volumes of conference abstracts. GeoLines publishes articles in English on primary research in many field of geology (geochemistry, geochronology, geophysics, petrology, stratigraphy, palaeontology, environmental geochemistry). Each issue of GeoLines journal is thematically consistent, containing several papers to a common topic. The journal accepts papers within their respective sectors of science without national limitations or preferences. However, in the case of extended abstracts, the conferences and workshops organized and/or co-organized by the Institute of Geology are preferred. The papers are subject to reviews. One volume was published in 2009.

The volume GeoLines 22 (2009) "*Proceedings of the 11th Coal Geology Conference*" contains fourteen reviewed papers presented at the 11th Coal Geology Conference held in Prague, May 26–30, 2008. The content of volume is available on web-page: geolines.gli.cas.cz, pages 1–104, ISSN 1210-9606.

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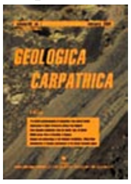
Since 2000, the Institute of Geology AS CR, v. v. i., has been a co-producer of the international journal **Geologica Carpathica** (www.geologicacarpathica.sk), registered by Thomson Reuters WoS database. The Institute is represented by one journal co-editor (usually Institute Director) and several members of the Executive Committee (at present P. Bosák and J. Hladil).



Geologica Carpathica publishes contributions to: experimental petrology, petrology and mineralogy, geochemistry and isotope geology, applied geophysics, stratigraphy and paleontology, sedimentology, tectonics and structural geology, geology of deposits, etc. Geologica Carpathica is published six times a year. The distribution of the journal is done by the Geological Institute, SAS. Online publishing is also possible through Versita on MetaPress platform with rich reference linking. Online ISSN 1336-8052 / Print ISSN 1335-0552.

In 2009, six numbers (1 to 6) of Volume 60 were published with 38 scientific articles. For the contents and abstracts see www.geologicacarpathica.sk.

Address of the editorial office: Geological Institute, Slovak Academy of Sciences, Dúbravská cesta 9, P. O. BOX 106, 840 05 Bratislava 45, Slovak Republic, Phone: +421 (02) 5477 3961, Fax: +421 (02) 5477 7097, www.geol.sav.sk
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3b. Monographs, proceedings, etc.

The following title was published in 2009.

ČEJCHANOVÁ A. & *CAJZ V.* (2009): *Geologické mapy Českého středohoří J.E. Hibsche [Die geologischen Karten des Böhmischen Mittelgebirges von J. E. Hibsch; Geological maps of the České středohoří Mountains by J. E. Hibsch]*. – Česká geologická služba a Geologický ústav AV ČR v. v. i.: Thirty unnumbered pages of A3 format and one page of A2 format. Praha. ISBN 978-80-7075-736-9.

The book mediates the unique historical map work from a world famous volcanic area to the audience of geological and historical interest. The work of J. E. Hibsch continues to have scientific validity. The publication consists of high-definition reprints (600 dpi) of 22 historical geological maps, printed on A3 format (former scale 1 : 25,000) and A2 format (1 : 100,000); and of accompanying text in three languages. The book is intended for geologists, historiographers, museums, universities, regional scientific centers and specialized bookshops. It promotes geosciences among the public.

4. Research Reports

4a. Foreign Grants, Joint Projects and International Programs

Bilateral co-operation between Czech Geological Survey, Praha and Geologisches Bundesanstalt Wien, Austria, No. 0051: **Palynological evaluation of plant-bearing freshwater localities of Lower Gosau-Subgroup on map sheet 95 St. Wolfgang and 96 Bad Ischl** (H. Lobitzer, GBA, Wien, Austria, L. Hradecká, L. Švábenická, Czech Geological Survey, Praha, Czech Republic & *M. Svobodová*; 2009)

Samples from the fossiliferous grey calcareous siltstones from the Gosau Subgroup (St. Gilgen and Wolfgangsee area) provide a relatively poor and less diversified palynomorph assemblage. Nevertheless, the presence of angiosperm pollen from the Normapolles group – *Plicapollis serta, Complexiopollis funiculus* etc. suggests a Santonian age. Unfortunately, no other localities of the Gosau Group along the road from Wolfangsee to Hochkreuz were found.

In the area of Gosau village along so-called Herrenweg, some interesting trace fossils were ascertained. R. Mikuláš determined *Planolites* cf. *P. beverleyensis* (Billings), *Protovirgularia* isp., *Lockeia* isp. and *Arthrophycus linearis*. *Protovirgularia* and *Lockeia* represent locomotion (*P.*) and resting (*L.*) traces of minute bivalves. The sample shows a clear example of *Protovirgularia* connected with *Lockeia*; this situation upholds both the determination of the traces and the assumption of their common tracemaker. All the above mentioned ichnotaxa have already been found in the Cretaceous flysch (e.g., Uchman 1999); the most common of them, i.e. *Planolites* isp., is a facies-crossing form. Also *Arthrophycus* and *Scolicia* have been reported manifold; they can be considered typical flysch ichnofossils of post-Jurassic strata. Bivalve traces (*Protovirgularia*, *Lockeia*) are not frequent in Cretaceous flysch; if present, they occur rather in middle parts of turbidite fans, in well-oxygenated, moderately dynamic settings.

UCHMAN A. (1999): Ichnology of the Rhenodanubian flysch (Lower Cretaceous-Eocene) in Austria and Germany. – *Beringeria*, 25: 65–171.

Project of Joint Institute for Nuclear Research, Dubna, Russia, No. 04-4-1069–2009/2011: **Investigations of nanosystems and novel materials by neutron scattering methods** (*T. Lokajíček*, *V. Rudajev*, A. Nikitin, T. Ivankina & R. Vasin, Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics, Dubna, Russia; 2009–2011)

In 2009, elastic properties of reactor graphite GR-280 and their anisotropy were investigated by neutron diffraction and ultrasonic measurements. Elastic properties of reactor graphite GR-280 were thoroughly studied in a series of experiments. The lattice-preferred orientation (LPO) of graphite was measured by time-of-flight neutron diffraction, and bulk elastic properties of polycrystalline graphite with such texture were recalculated. These were then compared with the longitudinal sound velocities measured in GR-280 *via* special experimental set-up at hydrostatic pressures up to 150 MPa. Static Young's modulus of GR-280 was measured *in situ* by high resolution neutron diffraction under loads up to 30 MPa. Its value was estimated at 30–40 MPa and is significantly higher than the dynamical modulus. For comparison, the Young's modules of two types of pyrographite were measured. The discrepancies and similarities in acquired data are discussed.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 510: **A-granites and related rocks through time** (Leader: Roberto Dall'Agnol, Federal University of Pará, Brazil, contribution by *K. Breiter*; 2005–2010)

The Erzgebirge-Krušné Hory Variscan magmatic province differs from other parts of the Variscan belt in Europe by the coexistence of two contrasting types of granite plutons: (1) strongly peraluminous P-rich granites (S-type) and (2) mildly peraluminous P-poor granites (A-type; Breiter et al., 1999). Both types of granites are similar in age (325–310 Ma with scarce exceptions down to 298 Ma), shallow intrusions levels with breccia-filled vents, and greisen-style Sn-W mineralization. The granites differs in the relative abundance of trace elements, chemical composition of rock-forming and accessory minerals, related volcanic activity, and structural style of the Sn-W mineralization.

Whereas S-type granites appear only in the western and central part of the area, granites and volcanic rocks of A-type are distributed irregularly through the whole Erzgebirge, volcanic equivalents of both types of granites erupted namely in the eastern Erzgebirge.

Quartz, P-rich K-feldspar, P-rich plagioclase (oligoclase → albite), Li-mica (Li-biotite → zinnwaldite), topaz and apatite dominate in mineral composition of S-type granites. Due to high F-content, all micas and topaz are fully saturated in F; content of OH^- in their structure is negligible. In the A-type granites, both feldspars are P-free, Li-mica may reach composition of lepidolite, and magmatic fluorite is major host of F and Ca. Topaz is subordinate and apatite completely absent. Magmatic quartz from S-granites is relatively enriched in P, B, and Ti, whereas quartz from A-granites in richer in Fe, Be and Ge. Contents of Al and Ti are similar.

Among primary accessory minerals, zircon rich in P, U, and Al, and poor in Th, Y, and Yb, together with uraninite, monazite, and rare xenotime, are typical for the S-granites. The A-granites and rhyolites contain Th, Y, Yb-rich zircon, common thorite, and xenotime. Transition phases among zircon, thorite, and xenotime are in A-granites quit common, namely in small stocks of subvolcanic character. Fast cooling probably prevented decomposition of theoretically unstable mineral phases.

Magmatic evolution of some plutons of both geochemical types culminates in formation of Sn-W deposits. In S-granites, main Sn, W-greisen formational events followed immediately the magma emplacement *via* fluid-melt immiscibility and pervasive fluid-crystal interaction (Krásno deposit). In stocks and cupolas of A-granites, solidification of the granite was followed by intensive hydrofracturing and fracture-related greisenisation, later by formation of hydrothermal veins (Cinovec/Zinnwald and Altenberg deposits).

BREITER K., FOERSTER H.J. & SELTMANN R. (1999): Variscan silicic magmatism and related tin-tungsten mineralization in the Erzgebirge-Slavkovský les metallogenic province. – *Mineralium Deposita*, 34, 5-6: 505–521.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 580: **Application of magnetic susceptibility as a paleoclimatic proxy on Paleozoic sedimentary rocks and characterization of the magnetic signal** (International Leaders A.C. da Silva, F. Boulvain, Liège University, Belgium, M.T. Whalen, University of Alaska Fairbanks, U.S.A., *J. Hladil*, D. Chen, Chinese Academy of Sciences, Beijing, China, S. Spassov, Royal Meteorology Institute, Dourbes, Belgium, X. Devleeschouwer, Université Libre de Bruxelles, Belgium; National Coordinator *L. Koptíková*; participated by *P. Schnabl, S. Šlechta, P. Čejchan, M. Chadima, L. Lisá*, F. Vacek, Faculty of Science, Charles University, Praha, Czech Republic & O. Bábek, Palacký University, Olomouc, Czech Republic; 2009–2014)

The new IGCP project No. 580 "Application of magnetic susceptibility on Paleozoic sedimentary rocks" was launched in 2009 (Fig. 3). It is the only IGCP project currently running in our country with the leadership from the Czech Republic (J. Hladil). Main topics and studies deal with the Devonian limestones, magnetism, mineral phases as a carriers of magnetic susceptibility signal, complex impurities in these limestones using the magnetic susceptibility as a paleoclimatic proxy. This new IGCP project is interconnected also with IGCP projects Nos. 499 and 497 (both on extended term in 2009) due to the discussed problems of Earth system evolution, paleoenvironment, biostratigraphy and lithology. For further detailed information see official web pages of the project: http://www2.ulg.ac.be/geolsed/MS/. A database of already published and established data-sets of magnetic susceptibility logs was released (http://www2.ulg.ac.be/geolsed/MS/database.html) where links and detailed information are available for further cooperation in a multidisciplinary field including specialists on geochemistry, geophysics, paleontology, sedimentology and other branches. Now, more than 120 scientists from 35 countries participate in this project. The Czech working group comprises 15 active members from 5 geological institutions. Within the frame of the Regional Devonian Workshop, Prague & Graz held in Prague on May 25–27, 2009 a relationship to this project was claimed, and new IGCP project was presented (Koptíková et al. 2009). In December 2009 the first official IGCP meeting "Magnetic susceptibility, correlations and paleoenvironments" was held in Belgium in Liège on December 2–6, 2009 where participants from the Institute of Geology AS CR (L. Koptíková, J. Hladil, P. Čejchan, P. Schnabl, S. Šlechta, M. Chadima & L. Lisá) reported 5 lectures, 2 invited lectures and 2 posters. Current papers by Hladil et al. (2009) and Machado et al. (2009) solve the correlation of magnetic susceptibility signal using not only this single method but whole novel integrated system of magnetic susceptibility – gamma-ray spectrometry – trace element chemical and mineral phases determination. Lower to Upper Devonian limestone beds including Central Europe (Barrandian area, Moravian Karst in the Czech Republic and Ardennes in Belgium), southern Europe (Portugal), Nevada (United States of America) and Central Asia (Uzbekistan) were studied and correlated. The significance of the atmospheric dust input into depositional environment of these carbonates is proposed and discussed.

HLADIL J., KOPTÍKOVÁ L., GALLE A., SEDLÁČEK V., PRUNER P., SCHNABL P., LANGROVÁ A., BÁBEK O., FRÁNA J., HLADÍKOVÁ J., OTAVA J. & GERŠL M. (2009): Early Middle Frasnian platform reef strata in the Moravian Karst interpreted as recording the atmospheric dust changes: the key to understanding perturbations in the *punctata* conodont zone. – *Bulletin of Geosciences,* 84, 1: 75–106.

KOPTÍKOVÁ L., HLADIL J., DA SILVA A.C., WHALEN M.T., BOULVAIN F., CHEN D., SPASSOV S. & DEVLEESCHOUWER X. (2009): The IGCP Project 580 Application of magnetic susceptibility on Paleozoic sedimentary rocks has been

■ **Fig. 3.** Leader of the IGCP project No. 580 Anne-Cristine da Silva showing biostromes of the Lower Frasnian Presles Formation in the Tailfer Quarry (Philippeville Anticline, Belgium) and Hautmont Quarry near Vodelée, Late Frasnian Petit-Mont Member (Philippeville Anticline, Belgium; photo by L. Koptíková).

launched: the project outlines, scope and the first results related to Central European region. – *Regional Devonian Workshop Prague & Graz, Prague, May 25–27, 2009, Berichte der Geologischen Bundesanstalt,* 79: 25–27.

MACHADO G., HLADIL J., KOPTÍKOVÁ L., FONSECA P.E., ROCHA F.T. & GALLE A. (2009): The Odivelas Limestone: evidence for a Middle Devonian reef system in western Ossa-Morena Zone (Portugal). – *Geologica Carpathica*, 60, 2: 121–137.

Project of the Universities of Málaga and Granada, Ministerio de Educación y Cultura del Reinado Español, Project. No. BTE 2000-1150: **Genesis of phyllosilicates in low-grade metamorphic conditions: Natural paragenesis (Intermediate units of the northern Rif) and experimental synthesis** (M.D. Ruiz Cruz, F. Franco, C. Sanz de Galdeano, Universities of Málaga and Granada, Spain & *J.K. Novák*; 2007–2009)

Sub-project: **The illitization of dickite: chemical and structural evolution of illite from diagenetic to metamorphic conditions** (M.D. Ruiz Cruz, M.D. Rodríguez, Universities of Málaga and Granada, Spain & *J.K. Novák*)

The Alpine Orogeny in southern Spain and Morocco (Upper Cretaceous to Miocene) involved the collision of the Internal and External Zones of the Betic-Rif Cordillera. The widespread development of kaolinite and dickite was recognized in Triassic units that have shown intermediate position between the uppermost nappe (the Maláguide/Ghomaride Complex) and the underlying tectonic nappe (the Alpujárride/Sebtide Complex), mainly in red-colored quartzose sandstones and conglomerate. The difference between the two nappes is based on a/ variations in lithology and metamorphic grade and b/ their paleogeographic position (extensional one in Maláguide and collisional one in Alpujárride). The underlying nappe mainly consists of blue-colored phyllite and marble, while products of diagenesis and incipient low-grade metamorphism were found in the Maláguide-type lithology. The latter include an association of dickite (or kaolinite) ± illite ± Na-K illite ± sudoite ± pyrophyllite, where the formation of well-ordered dickite from kaolinite has been assigned to burial and increasing temperature. The transformation of kaolin-group minerals into illite is a commonly observed process in deeply buried sandstone sequences, in contrast to shales, where illite typically results from smectite transformation. The present work seems to be the first one explaining the Na-illite formation from kaolinite (or dickite) in the presence of detrital albite. The results reported here indicate that, under diagenetic conditions (T ~150 °C), illitization process after dickite preferably consumed K and produced 1M illite/mica, probably through a topotaxic replacement of dickite. At these low-T conditions, Na contents in illite are low. Under low anchizonal conditions (T = 150–200 °C), Na is also incorporated into the illite structure, leading to mica with intermediate Na-K composition. The 2 M1 K-illite coexists with minor dickite, sudoite, and 1 M intermediate Na-K illite. At incipient metamorphic conditions (T = 200–300 °C), dickite transformation produces Na-free illite and pyrophyllite.

Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project

Code: M100130902: **Environmental history of Egyptian Western desert: the case study of the civilization development and the failure due to the climatic changes** (*V. Cílek,* M. Bárta, Faculty of Arts, Charles University, Praha, Czech Republic & A. Fahmy Faculty of Science, University of Helwan, Egypt; 2009–2011)

The geoarchaeological and geobotanical research of Egyptian Western desert is an interdisciplinary project of continued long-term research of Czech Egyptological Institute (Philosophical Faculty, Charles University, Praha). In 2009, geoarchaeological research in the area of Sabaloka and the Sixth Nile Cataract, Sudan, was carried out. The objective of the research was to attain better understanding of the history of the Nile, climatic changes in the Holocene, and their impact both on the landscape and the human society. One of the main tasks of the geoarchaeological research was to study the sedimentological record of the Nile alluvial zone. The area included in the study covers approximately 25 km of the Nile banks within the Sabaloka gorge and by the Sixth Cataract. The alluvial plain within the gorge lies generally 5 m above the water level and extends over tens of meters at some places. The first stage of the research gives us a general idea about the degree of deposition and erosion within the Sabaloka gorge, about the age and possible climatic record hidden in the alluvial deposits, and the degree of anthropogenic influence.

Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project Code: M100130903: **Comparison of Czech and Chinese Carboniferous and Permian plant and spore assmeblages preserved in tuff beds of Upper Carboniferous coalfields** (*J. Bek,* W. Jun, H. Zhu, Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjiing, China & Z. Feng, University of Kunming, Kunming, Yunnan, China; 2009–2011)

Noeggerathiales are a little known group of Carboniferous and Permian plants of uncertain systematic position that have been variously considered to be ferns, sphenopsids, progymnosperms, or a separate group. These heterosporous plants carry adaxial sporangia on leaf-like or disk-shaped sporophylls that form cones. Leaves are pinnate with a rather stiff appearance, and pinnulesare attached in either two or four rows. In the present report, we present the top of a noeggerathialean plant with leaves and strobili attached, *Paratingia wudensis*, from an earliest Permian volcanic ash fall tuff in Inner Mongolia. The excellent preservation allows the reconstruction of the whole plant, the complex three-dimensional leaves with anisophyllous pinnules, the heterosporous strobili, and the spores *in situ*. The homology of leaves and strobili can be elucidated, and contributes to an understanding of the debated taxonomic position of Noeggerathiales. The “anisophyllous” leaves carry pinnules arranged in four rows. The strobili are bisporangiate and have disc-shaped sporophylls, each with one ring of 10–14 adaxial sporangia around the strobilus axis. Megaspores have an equatorial bulge. This new species expands the known diversity of Noeggerathiales. It grew in a peat-forming forest, thus changing earlier interpretations of the growth of noeggerathialean plants with anisophyllous pinnules.

The generic name *Discinispora* was originally created for spores with an operculum-like structure that were found in a permineralized Noeggerathialean cone. Subsequently it was observed that up to three round and smooth openings can occur at different positions on the surface of a single spore. In light of the new observations, the previous interpretation as an operculum cannot be sustained. An interpretation implicating insect punch-and-sucking activity was suggested for these round structures. This new interpretation makes it necessary to withdraw the original diagnosis and the taxon. The insect-inflicted damage now is assigned to the ichnotaxon *Circulipuncturites discinisporis* under the rules of the ICZN, rather than those of the ICBN that typified the insect damaged host-plant spore.

Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project Code: M100130904: **Polyphase evolution of the highly metamorphosed rocks in collisional orogens: an example from Bohemian Massif (Czech Republic)** (*M. Svojtka*, *J. Sláma*, *L. Ackerman*, S.W. Faryad, Faculty of Science, Charles University, Praha, Czech Republic, T. Hirajima, & T. Kobayashi, Kyoto University, Japan; 2009–2012)

A new lithotype of peridotite, phlogopite- and apatite-bearing spinel–garnet peridotite, associated with leucocratic granulite, has been recognized at the Plešovice quarry in the Gföhl Unit within the Moldanubian Zone of the Bohemian Massif, Czech Republic. There are three equilibrium stages in the Plešovice peridotite. The existence of Stage I, the precursor spinel ± garnet peridotite stage, is supported by the presence of an aluminous (Al_2O_3 3.0 wt. %) orthopyroxene megacryst in the matrix. The minimum temperature of Stage I was estimated to be 1,020 ± 15 °C. Stage II is defined by the cores of relatively large (<3 mm long) grains of olivine, low-Al orthopyroxene (Al_2O_3 1.3–1.7 wt. %), clinopyroxene, and chromian spinel [Cr/(Cr+Al) = 0.50–0.57], along with relatively small (<1 mm long) Ba-rich phlogopite (BaO = 1.0–4.0 wt. %), Sr-rich apatite (SrO 1.7 wt. %) and rare potassic (K_2O 0.9–1.2 wt. %) amphibole. Garnet generally occurs as large spheroidal grains (up to 20 mm in diameter). It contains inclusions of olivine, orthopyroxene, chromian spinel, and phlogopite, all of which have similar compositions to their matrix counterparts. Therefore, garnet appears to be in equilibrium with the matrix phases at Stage II. Application of appropriate geothermobarometers to the assemblage at Stage II yielded temperatures of 850–1,030 °C and pressures of 2.3–3.5 GPa. Stage III is defined by aluminous orthopyroxene (Al_2O_3 2.1–4.0 wt. %), aluminous clinopyroxene and aluminous spinel along with pargasitic amphibole and Ba-rich phlogopite in kelyphite; temperature conditions at this stage were estimated to be 730–770 (± 27) °C at 0.8–1.5 GPa. Multiphase solid inclusions, mainly composed of phlogopite, dolomite, apatite and calcite with minor amounts of chlorite and magnesiohornblende, are present only within large grains of chromian spinel, which are surrounded by kelyphites. The idiomorphic outline of the multiphase solid inclusions suggests that frozen remnants of carbonatite melts or supercritical fluids were trapped in the spinel. The mineral assemblage in the multiphase solid inclusions suggests relatively low-P and low-T conditions

(T <750 °C; P <1.6 GPa) for its crystallization. Furthermore, the timing of the crystallization of the multiphase solid inclusions appears to predate Stage II, as most multiphase solid inclusions are completely surrounded by the host chromian spinel. These data suggest that the Plešovice peridotite experienced cooling after Stage I and was then transformed to spinel–garnet peridotite by subsequent subduction processes.

Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project Code: M100130905: **Geoarchaeological research of Early Slavic pithouses from the Roztoky near Prague locality** (*L. Lisá* & Milek, Department of Archeology, University of Aberdeen, Aberdeen, Scotland, United Kingdom; 2009)

Small, semi-subterranean buildings are commonly found at Viking Age farmsteads in Iceland (9th to 11th Century AD). How these buildings were used, and who used them, has been a subject of debate since the 1960s. Perhaps the most controversial interpretation links the form and internal features of pit houses, especially the distinctive corner hearths, with close parallels in Slavic areas that date to the 6th–8th centuries. Urbańczyk (2002, 2003) has suggested that the pit houses were constructed by the first generation of Slav settlers in Iceland, before they were culturally assimilated by the dominant Norse population. In order to test this hypothesis, and to develop a more detailed understanding of how Icelandic and Slavic pit houses were used, the composition and formation processes of floor sediments of Icelandic and Slavic pit houses were compared using a suite of techniques, including soil micromorphology. Based on case studies at Hofstaðir in northeast Iceland, and Roztoky u Prahy in the Czech Republic, the analysis demonstrated that there were fundamental differences between how the Slavic and Icelandic buildings had been used and how the floors had been maintained. While the buildings of the Prague Culture were multi-functional dwellings, with floors that were usually covered (e.g., by skins or timbers), the Icelandic buildings were more specialized for woollen textile production, had floor coverings along only one or two walls, and had a central space that was treated with fuel ash residues. There is therefore little evidence to support the hypothesis that Icelandic pit houses were built by Slavs, although, as previously suggested by Schmidt (1994, p. 161), it is perfectly feasible that Slavic houses of the 6th–7th centuries were forerunners of the later Scandinavian pit houses.

The large agglomeration of settlement features from the 6th and 7th centuries AD has been discovered at Roztoky u Prahy. These finds belong to the so-called Prague Culture which is believed to represent the earliest Slavic populations in Central Europe. The unusually high number of early medieval houses (more than 600 houses) and their location on the floor of a deep canyon-like valley largely enigmatic. Hypothetically, this concentration of people can be explained by the site being located not only on the major long-distance route, but also at a ford across the river.

The geoarchaeological study applied to this site is concerned to the infillings of sunken houses. A similar pattern is visible in many infillings of houses. The site is located in the so-called dusty to sandy overbank deposits. Former houses were probably 1 m deep, but recently 40–70 cm thick sedimentary infilling composed of three to four layers is preserved. A typical floor layer is usually missing and just trampled background is preserved rich in clay minerals and with less voids. This fact can be interpreted as an appearance of cleaning activities in the house. The layer sometimes preserved above is 1 cm thick, rich in decomposed organic matter, remains of bones and charcoal together with strong bioturbation. This layer is interpreted as remain of the last human activities in the house before the destruction or a part of a destructed roof. Some 20–40 cm thick layer above, poor in charcoal and remains after other human activities is characterized by light orange spots features, which were interpreted as concentrations of clay minerals. These concentrations develop in post-sedimentary stage during the change of pH which induced movement of clay minerals down the profile. The change in pH was inhibited by the presence of ashy layer in the final destruction layer. This layer composes the last preserved layer and usually contains a huge amount of charcoal, stones from destroyed ovens and decomposed organic matter.

SCHMIDT H. (1994): *Building Customs in Viking Age Denmark*. – Aarhus University Press: 1–178. Copenhagen.

URBAŃCZYK P. (2002): Ethnic aspects of the settlement of Iceland. – *In*: CRAWFORD B. (Ed.): *Papa Stour and 1299: Commemorating the 700th Anniversary of Shetland's First Document*: 155–165. The Shetland Times. Lerwick.

URBAŃCZYK P. (2003): Breaking the monolith: multi-cultural roots of the North Atlantic settlers. – *In*: LEWIS-SIMPSON S. (Ed.): *Vínland Revisited: The Norse World at the Turn of the First Millennium*: 45–50. St. John's NL: Historic Sites Association of Newfoundland and Labrador. Newfoundland and Labrador.

Czech–American Joint Programme "KONTAKT", Ministry of Education, Youth and Sports of the Czech Republic, Project No. MEB08011: **Middle Paleozoic climatic and sea-level changes and their influence on marine community evolution: a comparison of models from Perunica microcontinent and Laurasian continent** (J. Frýda, Š. Manda, L. Ferrová, S. Berkyová, Czech Geological Survey, Praha, Czech Republic, M. Elrick, University of New Mexico, Albuquerque, New Mexico, United States of America & *L. Koptíková*; 2008–2012)

In 2009, magnetic susceptibility stratigraphy and field gamma-ray logging as a high-resolution stratigraphic tools for the paleoclimatic proxy studies were integrated into the running Czech – American KONTAKT project focused on the comparisons of paleoclimate and sea-level changes in the middle Paleozoic of the Perunica microcontinent and Laurasia continent and L. Koptíková joined the project. Data-sets on magnetic susceptibility and gamma-ray spectrometry (concentrations of K, Th and U) of the Silurian and Devonian beds in the Prague Basin in the Czech Republic and Central Great Basin in central Nevada (USA) were acquired and compared. In the Central Great Basin (Eureka County), magnetic susceptibility logs were established on 4 sections and stratigraphic levels ranging from the Silurian/Devonian boundary (Birch Creek II section) across the Lower Devonian (end of Pragian and Emsian; Dry Creek I, II sections) up to Lower/Middle Devonian boundary (Lone

Mountain section; Fig. 4). Gamma-ray logs were acquired on 2 sections – Birch Creek II and Lone Mountain. The data from the latter one was compared with the Lower–Middle Devonian sections affected by the Basal Choteč Event in the Prague Basin in the Czech Republic and preliminary data show also a certain similarity and correlatable trends in the Ossa Morena Zone in Portugal and Central Asia in Uzbekistan (Machado et al. 2009). Comparable patterns to Prague Basin sections were found mostly in the lithological log and trends in gamma-ray from the Lone Mountain section in Central Great Basin. A likely equivalent of the Basal Choteč Event might be marked here by a significant decrease both in magnetic susceptibility signal and concentrations of K as well as a distinct decrease in the concentrations of Th and U. The point of reversal of Th/U ratio might be identified here. Lithological log across the event interval also shows a similarity in the sharp change from the bioclastic wackestones/packstones with relatively abundant pelagic faunal forms below the event interval to crinoidal grainstones above the event interval. This change seems to be globally correlatable, and a further detailed study on this level is needed next year.

MACHADO G., SLAVÍK L., KOPTÍKOVÁ L., HLADIL J. & FONSECA P. (2009): An Emsian-Eifelian mixed carbonate-volcaniclastic sequence in Western Ossa-Morena Zone (Odivelas Limestone). – *First IGCP 580 Meeting, Magnetic susceptibility, correlations and paleoenvironments, Liege University, Liege, Belgium, December 2–6, 2009, Abstract Book*: 38. Liège.

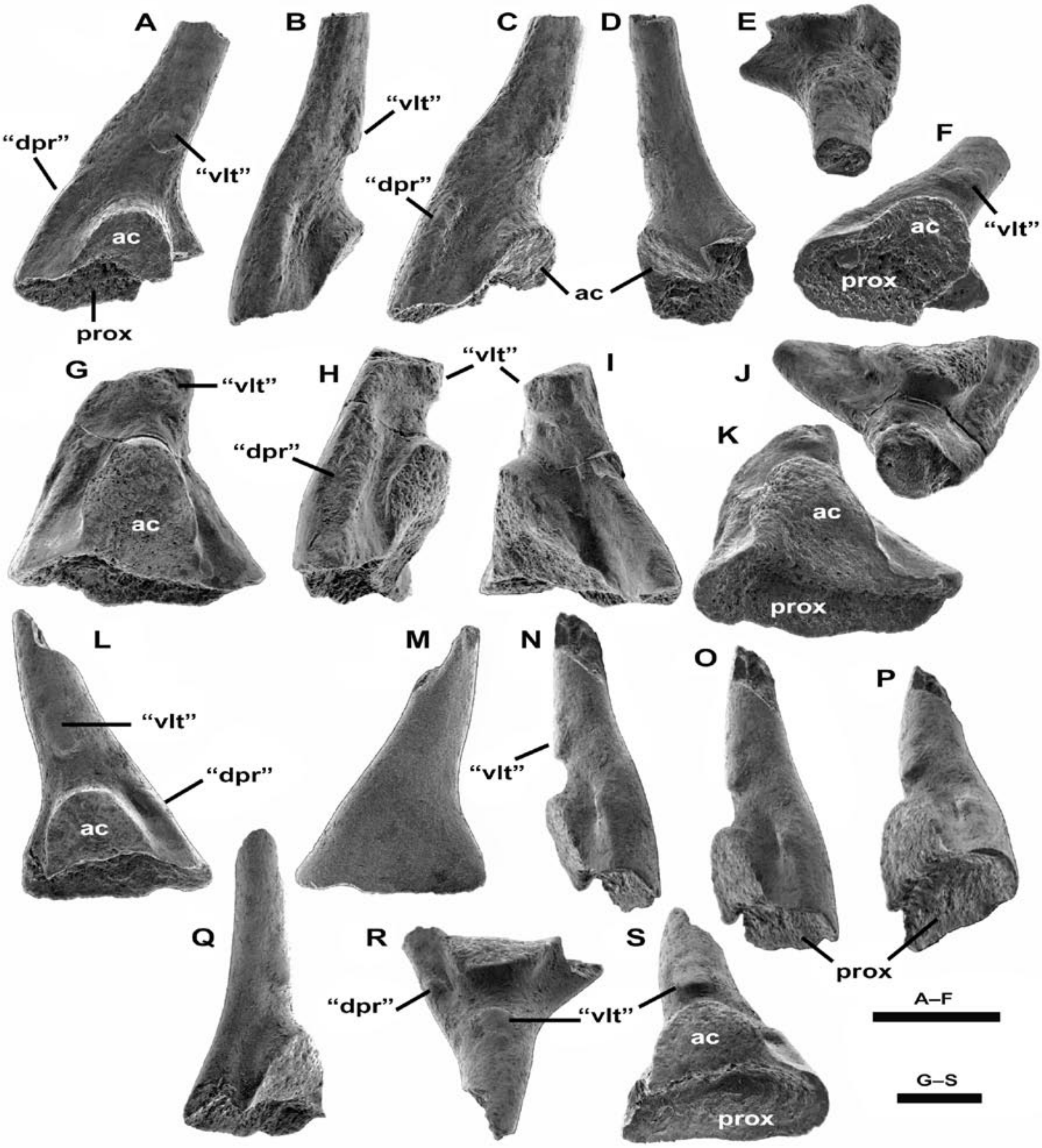
■ **Fig. 4.** Lower Devonian limestones of McColley Canyon Formation, Lone Mountain (Eureka County, Nevada, USA; photo by L. Koptíková).

Ministry of Education, Youth and Sports of the Czech Republic, Czech-USA Joint Programme "KONTAKT", Project Code MEB08066: **Evolution of the anuran assemblages during the Cretaceous in western part of North America; comparisons with the anuran fossil record in Eurasia** (*Z. Roček, T. Přikryl* & J.G.Eaton, Department of Geosciences, Weber State University, Ogden, Utah, United States of America; 2008–2009)

Several hundred isolated anuran bones recovered from 37 localities in southern Utah provide a relatively continuous record of the evolution of anuran assemblages in the central part of the North American Western Interior that spans almost 25 million years, from the early Cenomanian to the late Campanian. Although it is difficult to associate isolated anuran bones from different parts of the skeleton with each other, it is possible to identify distinctive morphs for certain bones (e.g., ilia, maxillae) that can be used to make inferences about the taxonomic diversity of fossil assemblages. Because the samples document a relatively long interval of time, they also can be used to recognize trends in the anatomical evolution of anurans and in the evolution of anuran assemblages. Small-bodied anurans prevailed until the early Campanian, while larger-bodied anurans started to dominate the assemblages from the late Campanian onwards. Using ilial morphs as a proxy for taxonomic diversity, it is apparent that some local assemblages were surprisingly diverse. When coupled with previously reported fossils, the new specimens from Utah help to document when did certain anatomical features appear and radiat among anurans. Ilia in the majority of early anurans (including the earliest anuran *Prosalirus*) had an oblique groove on the dorsal margin but lacked a dorsal tubercle. Through the Late Cretaceous, there is a trend towards an increasing majority of ilia having a well developed dorsal tubercle; this osteological change could be associated with changes in locomotor behaviour. *Procoelous* vertebrae are already present in the Cenomanian samples, which indicates that this derived anuran vertebral condition must have appeared before the Late Cretaceous.

Is *Nezpercius dodsoni* Blop et al. 2001 an anuran? The Mesozoic record of anurans (frogs) in North America is heavily biased towards isolated bones, and it is widely recognized that interpreting the taxonomic identities and associations of such fossils can be challenging. Blob et al. (2001) described three incomplete but distinctive ilia (Fig. 5) from the Judith River Formation (middle–late Campanian) of Montana, USA, which they interpreted as belonging to a new anuran genus and species that they named *Nezpercius dodsoni*. This was criticized by Holman (2003), but he did not offer any alternatives. The three described *Nezpercius* specimens are admittedly difficult to interpret because they are tiny and preserve only the proximal portion of the ilium. They also exhibit several features – such as an anteroposteriorly elongate tuberosity on the lateral surface of the proximal portion of the ilial shaft – that are not known in any unequivocal anurans but which are seen in at least some urodeles (salamanders). Isolated fossil urodele ilia have been rarely reported in the literature and, to our knowledge, detailed criteria for identifying urodele ilia have never been presented. In this paper (1) we provide and evaluate a suite of features that are potentially useful for differentiating ilia of anurans and urodeles, (2) use this information to assess whether the topotypic ilia of *Nezpercius* come from an anuran or a urodele, and (3) document the occurrence of similar ilia in several other Upper Cretaceous units in the Western Interior.

Anuran Ilia from the Late Cretaceous of Utah – Diversity and Stratigraphic Patterns. An extensive sample of nearly 200 anuran ilia gathered by the team from the Weber State University, Ogden, Utah at 36 localities from the Upper Cretaceous strata of southern Utah offered a possibility to assess taxonomic diversity of the Late Cretaceous anuran assemblages from the American Western Interior, and to use these skeletal elements



■ **Fig. 5.** Scanning electron micrographs of topotypic ilia of Nezpercius dodsoni Blob et al. 2001, all from the Upper Cretaceous (Campanian) Judith River Formation, in Blaine County, Montana, USA. Specimens depicted here as coming from urodeles, rather than from anurans (i.e., the shaft directed dorsally and slightly posteriorly vs. anteriorly and slightly dorsally), and interpreted as being from opposite sides of body than originally identified by Blob et al. (2001). A–F, FMNH PR 2078, holotype, left ilium (vs. right, according to Blob et al. 2001: Fig. 2), missing distal part of the shaft and posteroventral corner from proximal end of acetabular region, in (A) lateral view, oriented in approximate life position with shaft projecting posterodorsally, (B) anterior and slightly dorsal view, (C) anterolateral and slightly dorsal view, (D) posterolateral and slightly ventral view, (E) dorsolateral and slightly anterior view, and (F) ventral (= proximal) and slightly lateroposterior view. G–K, FMNH PR 2079, left ilium (vs. right, according to Blob et al. 2001: Fig. 3A), missing all but a base of the shaft and only small sections of medial and posterior edges from proximal end of acetabular region, in (G) lateral view, oriented in approximate life position with shaft projecting posterodorsally, (H) anterior and slightly dorsolateral view, (I) posterolateral view, (J) dorsal and slightly lateral view, and (K) ventrolateral and slightly anterior view. L–S, FMNH PR 2080, right ilium (vs. left, according to Blob et al. 2001: Fig. 3B), missing distal part of the shaft and a small section of anterior edge from proximal end of acetabular region, in (L) lateral view, oriented in approximate life position with the shaft projecting posterodorsally, (M) medial view, oriented in approximate life position with the shaft projecting posterodorsally, (N) anterodorsal and slightly lateral view, (O) anterodorsal and more lateral view, (P) anterolateral and slightly ventral view, (Q) posterolateral and slightly ventral view, (R) dorsolateral view, and (S) ventrolateral view. Scale bars eaqual to 1 mm (after Gardner et al. 2010).

for distinguishing Upper Cretaceous units. In order to avoid the erection of redundant taxa, we decided to create a parataxonomic system consisting of recognizable morphotypes. Three basic groups of ilia can be recognized in the sample, (1) the ilia with an oblique groove crossing its dorsal margin, (2) ilia without the groove and dorsal tubercle, and (3) ilia with a dorsal tubercle at the level of the anterior margin of the acetabulum. In the first group, 26 morphotypes can be recognized which, however, could easily be derived from one single basic form. It is therefore hard to decide whether morphological differences between the morphotypes reflect taxonomic diversity or result from anatomical variation. In contrast, the second and third groups both involve morphotypes which are difficult to derive from one another. Thus we conclude that the morphotypes belonging to these groups better reflect taxonomic diversity and can be used for stratigraphic purposes. This seems to be confirmed also by the complete absence of the ilia with the dorsal tubercle in some units (Coniacian, Lower Santonian, Upper Campanian).

Similarities and Differences in the Ilia of Late Cretaceous Anurans and Caudates. Extensive wet screen-washing of the material quarried at 35 Late Cretaceous localities in southern Utah yielded a rich sample of anuran disarticulated bones, including nearly 200 anuran ilia. Because of their small size (snout–vent length of some of these anurans did not exceed 20 mm) and secondary transport of the fossil bones caused that the ilial shafts (a significant anuran autapomorphy) in all of them were broken off; thus an important source of diagnostic information was lost. The preserved portion of the ilium may bear some important features which reliably distinguish between anuran and caudate ilia (e.g., the dorsal tubercle or an oblique groove), however, these characters do not occur in all of them. Here we propose some distinguishing characters which reflect different anatomical situations in the caudate and anuran articulated skeletons, namely the widely separated and vertically located ilia in the former. This results in a broadly convex and smooth inner surface of the acetabular portion of the bone, extensive contact surface between the ilium and cartilaginous puboischial plate, and ventrolateral orientation of the acetabulum. In contrast, anuran ilia are in contact with one another, which is reflected in a triangular scar on the inner surface of the bone, their contact surface with the pubis and ischium is relatively narrow, and the acetabulum is oriented laterally. In order to avoid variation overlap, it is advised that all these characters are used in combination.

BLOB R.W., CARRANO M.T., ROGERS R.R., FORSTER C.A. & ESPINOZA N.R. (2001): A new fossil frog from the Upper Cretaceous Judith River Formation of Montana. – *Journal of Vertebrate Paleontology*, 21, 1: 190–194.

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Ministry of Education, Youth and Sportsof the CR, Project KONTAKT No. MEB090908: **Karst sediments: tools for the reconstruction of tectonic and geomorphic evolution of karst regions (exemplified on karst territories of Slovenia)** (*P. Bosák*, *P. Pruner*, *O. Man*, N. Zupan Hajna & A. Mihevc, Karst Research Institute SRC SASA, Postojna, Slovenia; 2009–2010)

Small-scale domal stalagmite from Pečina v Borštu Cave (younger than ca 200 ka) and large-scale domal stalagmite from Račiška pečina Cave (older than ca 3.2 Ma; both sites in the Classical Karst, SW Slovenia) were sampled for the fold test. The AF and TD demagnetizations applied to speleothem specimens from the same sample belonging to the same layer yielded identical results. Blocking temperatures (ca 540 to 560 °C) and magnetic saturation values (80 to 200 mT) identified magnetite as primary magnetization carrier. The reversal test was applied to both groups of paleomagnetic directions. The reversal test was classified as 'A'. The convincing result of the test represents the definite evidence that the characteristic component is primary. Fold tests on both dome-like stalagmites of different sizes, ages, polarities and locations clearly showed that the mean paleomagnetic direction of characteristic primary component is *in situ* oriented and indicates that the domelike structures are primary.

Czech–Hungarian Bilateral Project, Theme 2: **Comparative volcanostratigraphy of the Neoidic volcanics of the Bohemian Massif and the Pannonian Basin** (*J. Ulrych* & K. Balogh, Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary; 2007–2009)

In the last triennial part (2007–2009) of the long-lasting project (since 1997) results of four subprojects were in the individual Annual Reports reported and presented in following publications:

FILIP J., ULRYCH J., ADAMOVIČ J. & BALOGH K. (2007): Apatite fission-track implications for timing of hydrothermal fluid flow in Teriary volcanics of the Bohemian Massif. – *Journal of Geosciences*, 52, 3–4: 211–220.

ULRYCH J., DOSTAL J., HEGNER E., BALOGH K. & ACKERMAN L. (2008): Late Cretaceous to Paleocene melilitic rocks of the Ohře/Eger Rift in northern Bohemia, Czech Republic: insights into the initial stages of continental rifting. – *Lithos*, 101, 1–2: 141–161.

ULRYCH J., JELÍNEK E., ŘANDA Z., LLOYD F.E., BALOGH K., HEGNER E. & NOVÁK J.K. (in press, 2010): Geochemical characteristics of the high- and low-Ti basaltic rocks from the uplifted shoulder of the Ohře (Eger) Rift, Western Bohemia. – *Chemie der Erde, Geochemistry*, 15 pp. doi:10.1016/j.chemer.2010.05.001

ULRYCH J., ACKERMAN L., KACHLÍK V., HEGNER E., BALOGH K., LANGROVÁ A., LUNA J., FEDIUK F., LANG M. & FILIP J. (2010): Constraints on the origin of gabbroic rocks from the Moldanubian–Moravian units boundary (Bohemian Massif, Czech Republic and Austria). – *Geologica Carpathica*, 61, 3: 175–191.

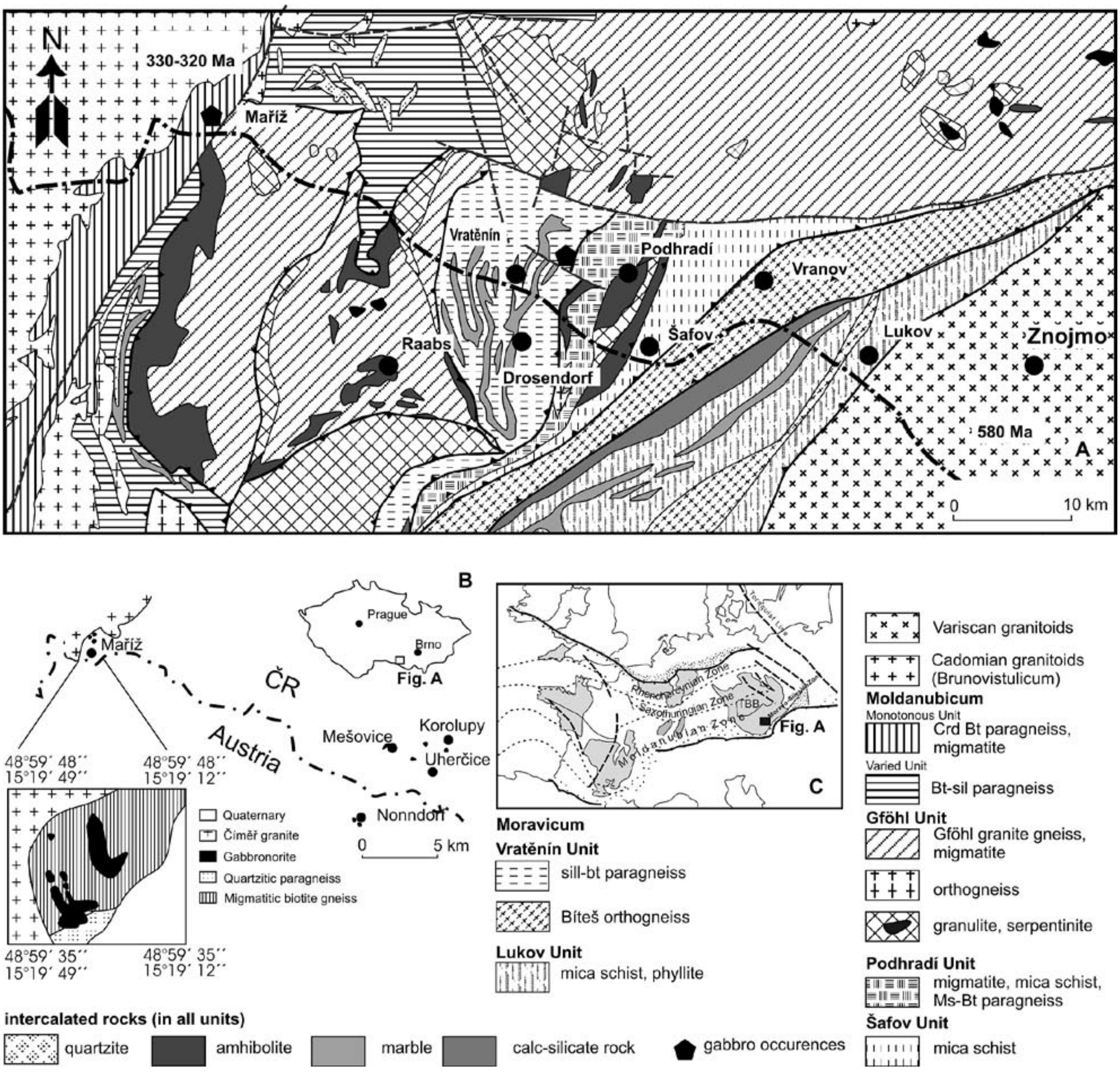
Sub-project: **New constraints on the origin of gabbroic rocks from the Moldanubicum around the Moravia – Austria border** *(J. Ulrych*, *L. Ackerman*, *A. Langrová*, *M. Lang*, *J. Filip*, K. Balogh, Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary, E. Hegner, University of Munich, Munich, Germany, F. Fediuk, Geohelp, Praha, Czech Republic & J. Luna, Jihlava, Czech Republic)

Preliminary results of this Subproject of the Czech–Hungarian Bilateral Project were included in the Final Report of the

Project No. IAA3013403 (2007–2008). The character of the mantle/lower crust beneath the Bohemian Massif was based on geochemical signatures of (ultra)mafic xenoliths in Cenozoic volcanics (see Institute of Geology AS CR, v. v. i. Research Report 2007 and 2008).

During the continued study of the problem in the year 2009, partly also under the Project IAA300130902 (apatite fission track), new results (Ulrych et al. 2010) were presented.

Petrological, geochemical, Sr-Nd isotopic and K-Ar studies of gabbroic cumulates from the Moldanubian Monotonous Unit and the Moravian Vratěnín Unit provide the following constraints on the sources, evolution and age of these rocks: (1) both complexes represent pre-Variscan, partly differentiated ultramafic–mafic intrusions of probably Cadomian age (ca. 570 Ma), with very similar geochemical and isotopic characteristics. They were emplaced into units of different microcontinent fragments derived from the African part of the Neoproterozoic Avalonian–Cadomian orogen. They were heterogeneously involved in the Variscan collision of the Moldanubian and the Brunovistulian microcontinents; (2) coronitic texture, present in the gabbroic rocks of the Vratěnín Unit, could have originated more probably during both magmatic (orthopyroxene coronas) and/or the solid-state fluid-enhanced metamorphic reactions. Amphibole- and spinel-bearing, scarcely also garnet coronas were produced at



■ **Fig. 6. A.** Geological map of the Moldanubian/Moravian units boundary (modified after map 1: 500,000 – Cháb et al. 2007); **B.** A sketch map of the occurrences of the studied gabbroic rocks from the Moravia/Austria border, with the map of the Maříž gabbroic body based on new geological studies and geomagnetic measurements; **C.** Location of the study area in the frame of major zones of the Variscan orogen (marked by a dark rectangle; afer Ulrych et al. 2010).

contact between symplectitized orthopyroxene and plagioclase. According to the strong amphibolite-facies imprint in some gabbroic samples passing to garnet amphibolites, we assume that amphibole–garnet coronas could have originated during underthrusting of the Brunovistulian margin below the Moldanubian Unit. Later, they were equilibrated in the amphibolite-facies conditions, during exhumation and final imbrication of the Drosendorf stack; (3) the studied gabbroic rocks crystallized from magma which was derived from moderately depleted mantle sources but enriched by subduction-related fluids before their emplacement. More probably they were differentially contaminated by heterogeneous crustal material into two lithologically distinct crustal units during the emplacement in pre-Variscan times. This would explain the wide range of obtained ε_{Nd} values (+5 to –8). Close spatial relation of the gabbroic cumulates to garnet amphibolites and marbles suggest that their emplacement was connected with fragmentation and rifting of a passive margin sequence in the case of the Vratěnín Unit suite. This is supported by the presence of gabbros of alkaline character and positive ε_{Nd} values of ca. +5, which suggest a lower contamination by slab fluids or a continental crust assimilation. Their original geochemical characteristics were strongly influenced by the assimilation–fractional crystallization process. The cumulate gabbro complexes are relatively heterogeneous; their example, the Maříž suite, was contaminated by larger volume of continental crust compared to the Vratěnín Unit. Based on geochemical, isotopic and age similarities with the Panafrican (ultra)mafic layered intrusive complexes in Hoggar and the geological background, we prefer the Cadomian age of intrusions, and (4) apatite fission-track analysis of gabbroic samples from Korolupy and Maříž and the Číměř granite indicate very similar ages of 150.2 ± 18.0 Ma (s. d. ±1σ). Furthermore the samples show comparable track length distribution and shorting of initial fission-track lengths implying a slow and continuous cooling from total annealing zone (i.e., >120 °C) from the Late Jurassic to the present.

CHÁB J., STRÁNÍK Z. & ELIÁŠ M. (2007): Geologická mapa České republiky, 1 : 500 000. – *Česká geologická služba*, Praha.

ULRYCH J., ACKERMAN L., KACHLÍK V., HEGNER E., BALOGH K., LANGROVÁ A., LUNA J., FEDIUK F., LANG M. & FILIP J. (2010): Constraints on the origin of gabbroic rocks from the Moldanubian–Moravian units boundary (Bohemian Massif, Czech Republic and Austria). – *Geologica Carpathica*, 61, 3: 175–191.

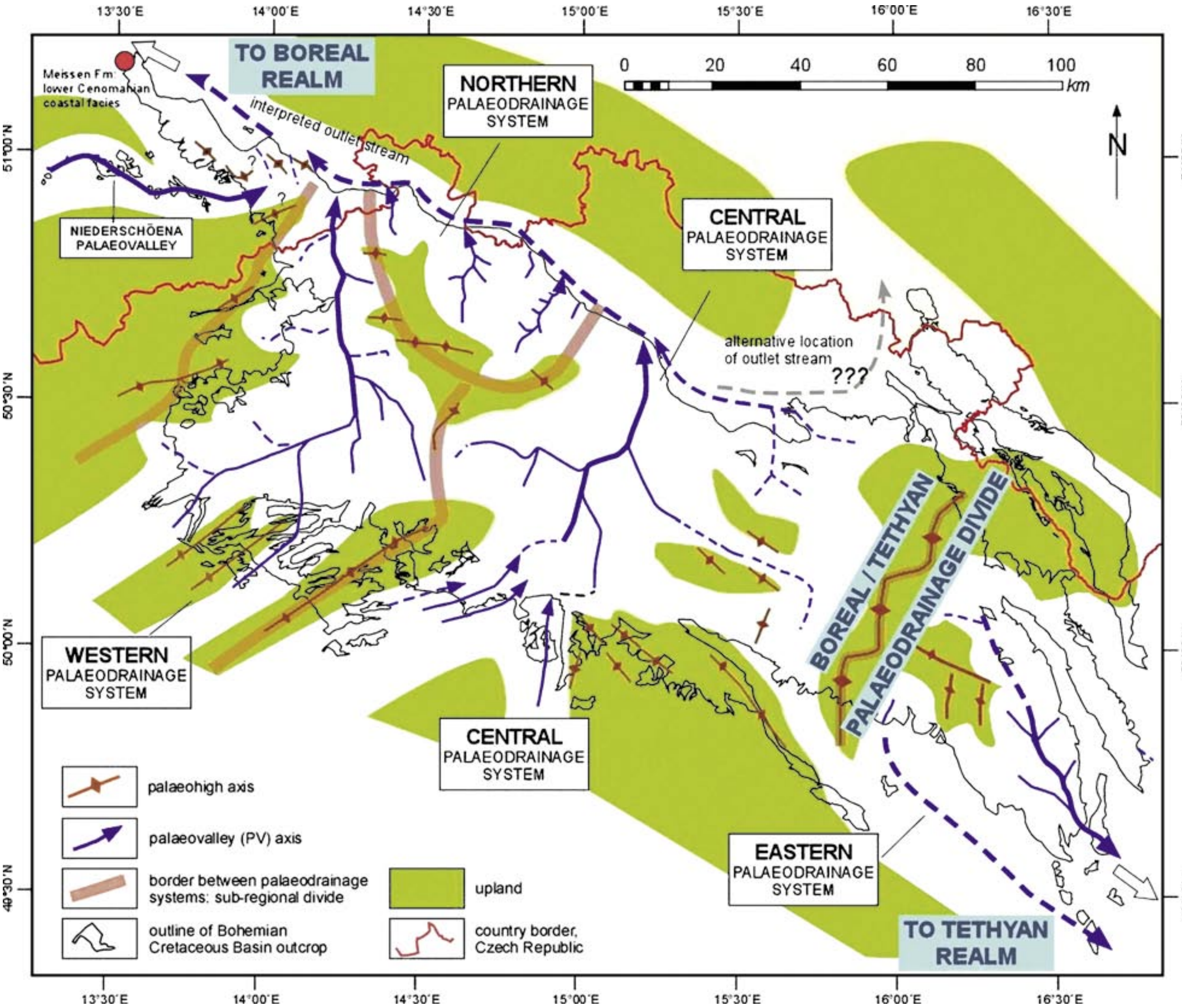
4b. Grant Agency of the Czech Republic

Finished projects

No. 205/06/1823: **Record of tectonic processes and sea-level change during inception of an intracontinental basin: Cenomanian of the Bohemian Cretaceous Basin** (L. Špičáková, Geophysical Institute AS CR, v. v. i., Praha, Czech Republic, R. Grygar, Technical University Ostrava, Czech Republic & *M. Svobodová*; 2006–2009)

A multi-disciplinary study of fluvial, paralic and shallow-marine depositional systems of Cenomanian age was carried out in the Bohemian Cretaceous basin, in order to assess the relative roles of tectonics and eustasy during the inception of basin formation and filling. Between 2006 and 2009, new and revised borehole and outcrop data from the tectonically complicated western part of the Bohemian Cretaceous Basin (BCB) were integrated with previously acquired data from other parts of the basin. Palynological study was an important part of the palaeoenvironmental analysis of several time slices of the Cenomanian depositional systems. The first outcome of this research is the paper by Uličný et al. (2009) devoted to the relationship between the basement tectonics of the Bohemian Massif and the palaeodrainage systems that existed during the onset of Cretaceous deposition in the BCB. A synthesis of available data on the distribution of Cenomanian-age palaeodrainage systems, filled by fluvial and estuarine strata, and an interpretation of their relationships to the basement units and fault systems, was finished recently (Uličný et al. 2009). Much of the progress, compared to previous studies, was made possible by a recent basin-scale evaluation of Cenomanian genetic sequence stratigraphy in approximately 2,600 boreholes, supplemented by data from natural exposures. The tectonic layout of the Bohemian Cretaceous Basin played a dominant role in determining the orientation of palaeovalleys and the general palaeosurface slopes towards the basin-bounding faults. The distribution of basin-scale topographic lows was similar to the distribution of depocentres during later depositional phases of late Cenomanian–Coniacian times. Individual palaeodrainage systems were separated by drainage divides of local importance and one major divide – the Holice–Nové Město Palaeohigh – which separated the drainage basins of the Tethyan and Boreal palaeogeographic realms (Fig. 7). This divide was located in the eastern part of the basin and followed the same strike as the modern North Sea/Black Sea drainage divide.

While bedrock lithology had a subordinate effect of narrowing or broadening valleys on more vs. less resistant substratum, respectively, the locations and directions of palaeovalleys were strongly controlled by positions of inherited Variscan basement fault zones. The intrabasinal part of the palaeodrainage network followed the slopes toward the WNW-striking basin-margin faults of the Labe Fault Group. Most palaeovalley axes followed the NNE-striking structures of the Jizera Fault Group, prominent also in the alignment of modern streams in the area. The outlet streams that drained the basin area are interpreted to have followed the Lužice Fault Zone toward the Boreal province to the northwest, and the Železné Hory Fault Zone toward the Tethyan province to the southeast. At both the northwestern and southeastern ends of the BCB, shallow-marine or estuarine conditions are proven to have existed during the early Cenomanian. The onset of deposition by fluvial backfilling of the palaeodrainage systems, followed by incremental marine flooding of the basin area throughout the Cenomanian, was caused mainly by the long-term, stepwise rise in global sea level. The earliest basin-scale episode of tectonic subsidence, accompanied by establishment of new source areas and by local intrabasinal uplifts, is documented from the late Cenomanian. Direct evidence for syndepositional subsidence during the early to mid-Cenomani-



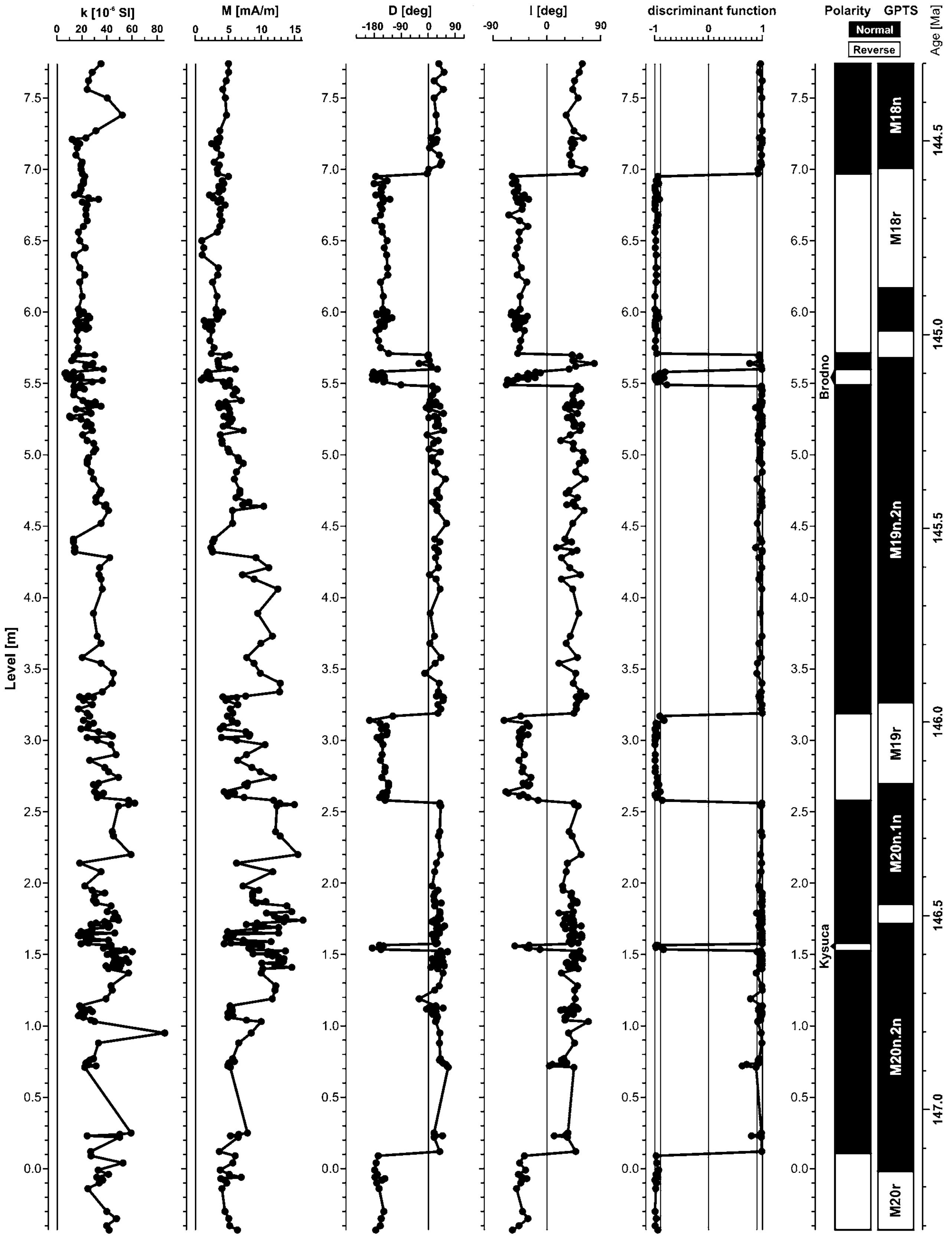
■ **Fig. 7.** Schematic map of the palaeogeographic setting of the Bohemian Cretaceous Basin before the beginning of deposition on the base-Cretaceous unconformity. The reconstruction of palaeodrainage corresponds to late early to early middle Cenomanian time. Main topographic palaeohighs (yellow) and lows with generalized palaeodrainage axes (blue) are illustrated, together with the proven occurrence of early Cenomanian coastal facies in the NW (red dot). Transparent brown lines indicate the axes of regional palaeodrainage divides, including the main divide between the Boreal and Tethyan drainages (modified after Uličný et al. 2009).

an fluvial to estuarine phase is very rare. It is inferred that subtle surface warping, mostly without detectable discrete faulting, was caused by the onset of the palaeostress regime that later, with further stress accumulation, led to the onset of subsidence in fault-bounded depocentres of the BCB and to the uplift of new source areas.

ULIČNÝ D., ŠPIČÁKOVÁ L., GRYGAR R., SVOBODOVÁ M., ČECH S. & LAURIN J. (2009): Palaeodrainage systems at the basal unconformity of the Bohemian Cretaceous Basin: roles of inherited fault systems and basement lithology during the onset of basin filling. – *Bulletin of Geosciences*, 84, 4: 577–610.

No. 205/07/1365: **Integrated stratigraphy and geochemistry of the Jurassic/Cretaceous boundary strata in the Tethyan and Boreal Realms** (*P. Pruner*, *K. Žák*, *O. Man*, *D. Venhodová*, *S. Šlechta*, *P. Schnabl*, M. Košťák, J. Jedlička, M. Mazuch, L. Strnad, Faculty of Science, Charles University, Prague, Czech Republic, J. Mizera, Z. Řanda, Nuclear Physics Institute of the AS CR v. v. i., Řež, Czech Republic & P. Skupien, Technical University Ostrava, Czech Republic; 2007–2009)

Tethyan Realm – Puerto Escaño. Magnetostratigraphic studies were applied to an 8.1 m thick part of the section embracing upper Tithonian and lower Berriasian strata at the locality of Puerto Escaño, Spain. The average sampling interval was 30 mm. The analysis of the IRM (isothermal remanent magnetization) acquisition curves proved the presence of magnetite and hematite, the former mineral being the main carrier of the remanent magnetization. Due to almost parallel beds, the fold test applied to this component did not give convincing results. In contrast, the reversal test received the best classification 'A'. The detected polarity zones could be unequivocally identified against the M-sequence of polarity intervals drawn from the



■ **Fig. 8.** Palaeomagnetic data plotted along the section. From the left: the measured values of both bulk magnetic susceptibility (*k*) and NRM (*M*), the direction of the ChRM, found by the line fitting of the demagnetization path and expressed by declination *D* and inclination *I*, and the discriminant function of this direction. Polarity zones expressed by the black (normal) and white (reverse) bar diagram are compared with the corresponding part of the GPTS 2004 (on the right; after Olóriz et al. 2009).

Geomagnetic Polarity Time Scale 2004. This fact, together with the results of the reversal test, confirmed the ChRM to be the primary component. The sampled part of the section included a part of magnetozone M20r, full magnetozones M20n to M18r and a part of magnetozone M18n. Especially the detection of two reverse subzones M20n.1r and M19n.1r with thicknesses only 40 and 90 mm, respectively, required much effort when sampling the section (Fig. 8). The calculated sedimentation rate varied from 1 to 5 mm.ka^{-1} (Pruner et al. 2010).

The positions of the individual events of tintinnoid biostratigraphy (mainly calpionellids) relative to the global magnetic polarity timescale are precisely defined. The base of the Calpionella Standard Zone, which is considered to be a potential J/K boundary indicator in ammonite-free sections in the Tethyan realm, or in sections where calpionellid stratigraphy applies, lies within magnetozone M19n at the level of 35 % of its local thickness. None of the boundaries in the calpionellid zonation coincide precisely with any of those in the palaeomagnetic zonation, but the first appearance datum (FAD) of *Calpionella grandalpina* Nagy, indicating the base of the Intermedia Subzone, lies in close proximity to the base of magnetozone M19r. The last appearance datum (LAD) for *Praetintinnopsella andrusovi* Borza in Bed 14A corresponds approximately to the base of the Kysuca Subzone.

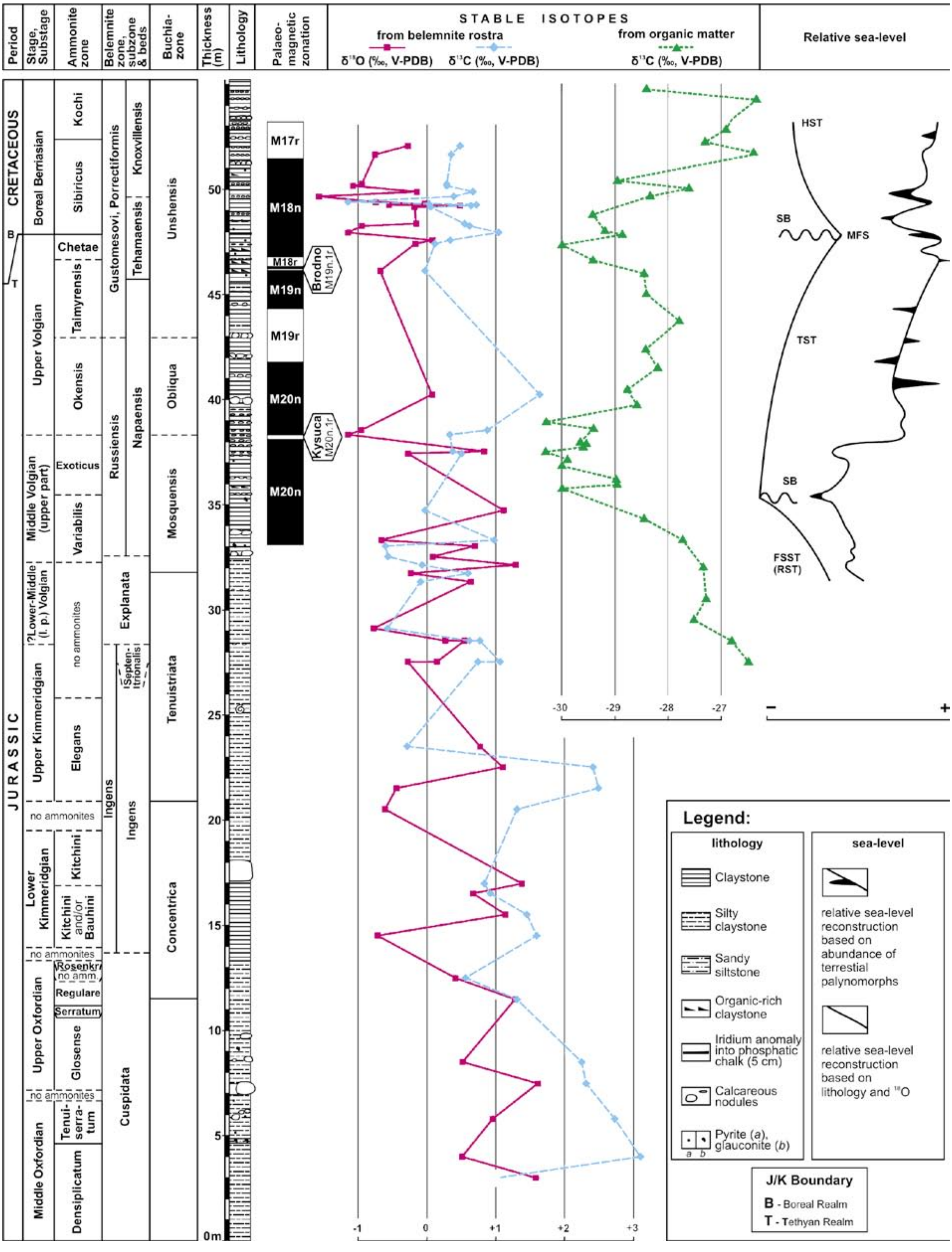
Tethyan Realm – Nutzhof. The main key objective of the investigation of hemipelagic sediments from the Gresten Klippenbelt (Blassenstein Formation) was to shed light on the environmental changes around the Jurassic–Cretaceous boundary at the northern edge of the Penninic Ocean. The Nutzhof section is located in the Gresten Klippenbelt (Lower Austria) tectonically wedged into the deep-water sediments of the Rhenodanubian Flysch Zone. In the Late Jurassic–Early Cretaceous time, the Penninic Ocean was a side tract of the proto-North Atlantic Oceanic System, intercalated between the European and the Austroalpine plates. Its opening started during the Early Jurassic, induced by sea floor spreading, followed by Jurassic–Early Cretaceous deepening of the depositional area of the Gresten Klippenbelt. These tectonically induced paleogeographic changes are reflected in the lithology and microfauna that record a deepening of the depositional environment from the Tithonian to the Berriasian sediments of the Blassenstein Formation at Nutzhof. The lithological turnover of the deposition from more siliciclastic pelagic marl-limestone cycles into deep-water pelagic limestones is correlated with the deepening of the southern edge of the European continent at this time. Within the Gresten Klippenbelt Unit, this transition is reflected by the lithostratigraphic boundary between siliciclastic-bearing marl-limestone sedimentation in the uppermost Jurassic and lowermost Cretaceous limestone formation, both within the Blassenstein Formation.

Systematic acquisition of palaeomagnetic data across the J/K boundary strata at Nutzhof allowed the construction of a detailed magnetostratigraphic profile which, in the range of 5 to 10.5 m, has the character of a high-resolution profile. In this interval, the frequency of orientated samples was so high that an almost continuous record of magnetic and palaeomagnetic parameters was obtained, especially for the critical intervals containing boundaries of magnetozones M19n up to M20n. Two reverse subzones, Kysuca and Brodno were detected within magnetozones M20n and M19n, respectively. According to magnetozones M19n and Brodno subzone the J/K boundary lies in the interval of 6.5–7 m. No significant change can be noted at the J/K boundary strata. The jump of remanent magnetization and magnetic susceptibility at 10 m lies in magnetozone M20n below the Kysuca subzone. A similar jump in natural remanent magnetization (NRM) and susceptibility in the Bosso section was detected in the M20n just above the Kysuca subzone. The average sedimentation rate in the Nutzhof section is around 3.7 m.Ma^{-1}, but with a wide variation (2–11 m.Ma^{-1}). Magnetomineralogical analyses and unblocking temperatures show that magnetite and goethite are the main carriers of remanent magnetization (Pruner et al. 2009).

The main lithological change is observed at Nu 10.0 (*Crassicolaria* Zone, M20N) whereas the J/K boundary can be precisely fixed at Nu 7.0 (*Crassicolaria–Calpionella* boundary, M18R) within the limestone part. The lithological turnover of the deposition on the northern edge of the Penninic Ocean shelf from siliciclastics enhanced pelagic marl-limestone intercalations into the deep-water carbonates is correlated with the deepening of the southern edge of the European continent at this time.

The cephalopod fauna (ammonites, belemnites, aptychi) from the Blassenstein Formation, correlated with micro- (calpionellids, calcareous dinoflagellates) and nannofossil data combined with isotope and paleomagnetic data from the marly unit and the limestone unit, indicates an Early Tithonian to Middle Berriasian age (*Hybonoticeras hybonotum* Zone up to the *Subthurmannia occitanica* Zone; M17r–M21r). According to these data, the entire succession of the Nutzhof section embraces a duration of approx. 6 Ma (approx. 149–143 Ma). The deposition of the limestones, marly limestones and marls in this interval occurred under depositionally (e.g., tectonics) unstable conditions. Along with the integrated biostratigraphic, geochemical and isotopic analyses, the susceptibility and gamma-log outcrop measurements were a powerful tool in interpreting the stratigraphy and the paleogeographic setting in the outcrop.

Boreal Realm – Nordvik Peninsula. The faunal bariers in the J/K boundary interval were strict, and almost no Boreal–Tethyan faunal exchanges were observed. Resulting differences in the taxonomic composition especially in marine biota between the two provinces complicate a reliable determination and biostratigraphic correlation of a global J/K boundary. Laboratory procedures and processing have been already published by Chadima et al. (2006) and Houša et al. (2007). For a detailed and precise correlation of the J/K boundary interval in the Tethyan and Boreal regions based on high-resolution magnetostratigraphy, the Nordvik profile has been selected in the Boreal realm. Three normal (N) and three reverse (R) polarity zones were established in the main interval of the Nordvik section. Two narrow subzones of reverse polarity (M20n.1r and M19n.1r), detected in the lower and middle N-zones of the Nordvik section, are important evidence in favour of the section range from Chron M20n to Chron M17r. Analogous narrow R-subzones "Kysuca" and "Brodno" have been distinguished previously within chrons M20n and M19n in the Tethyan sections: Brodno (Slovakia; Houša et al. 1999), Bosso section (Bosso Valley, Italy; Houša et al. 2004), Puerto Escaño (Spain; Pruner et al. 2010). Exactly these subzones of reverse polarity substan-



■ **Fig. 9.** Integrated stratigraphy of the Jurassic/Cretaceous boundary strata in the Nordvik section, Russia (modified after Zakharov & Rogov 2008).

tiate our conclusion that two zones of normal polarity established in the Nordvik section are correlative with chrons M20 and M19. The Kysuca Subzone in Chron M20n is 17 cm thick, and the interval of the Brodno Subzone of Chron M19n is only 5 cm thick. Mean paleomagnetic directions and the virtual pole position (VGP) 76.9°N, 179.3°E are not very different from the positions given by other authors for the near localities and the Late Jurassic to Early Cretaceous period.

The relative sea-level variation is based on $\delta^{18}O$ curves obtained from belemnite rostra, which are well distributed from the Middle Oxfordian to the Lower Berriasian, the T/M index and lithology. The Jurassic part of the section with two major cooling phases is currently discussed by Žák et al. (submitted). The J/K boundary interval (Middle Volgian – Lower Berriasian) is interpreted herein in more details. The sea-level rise interpretation (TST in Fig. 8) towards the Boreal J/K boundary is supported by micro-, macropalaeontologic, geochemical, lithological and especially stable isotopic data. Oceanic sea-level variations are related to cooling and warming phases with more or less negative and positive $\delta^{18}O$ values. Three positive peaks in $\delta^{18}O$ values inside the Explanata belemnite zone, Variabilis ammonite zone (Middle Volgian) and ca 1 m below the base of the Okensis ammonite zone are related to a relative sea-level fall. Of high stratigraphic importance is the marked negative peak of $\delta^{18}O$ value just above the Kysuca M20n.1r. magnetosubzone. Similar $\delta^{18}O$ values are well recorded at the Boreal J/K boundary and may represent sea-level rise. Relative sea-level falls partly correspond also to negative $\delta^{13}C$ values of organic matter and T/M index. However, the Okensis and Taimyrensis ammonite zones lack relevant $\delta^{18}O$ data from belemnite rostra, several peaks of the T/M index may indicate some particular trangressive/regressive pulses (probably of the 4th–5th orders sea-level change; Fig. 9).

The Boreal and the Tethyan Jurassic/Cretaceous boundary strata were successfully correlated for the first time using high resolution magnetostratigraphy, geochemistry, sequence stratigraphy and eventostratigraphy. According to present knowledge, the presently used provisional Boreal and the Tethyan J/K boundaries are heterochronous. All attempts to correlate the boundary J/K beds between the Boreal and the Tethyan realms by biostratigraphic methods failed. Several pilot localities (e.g., Brodno–Slovakia, Bosso–Italy, Puerto Escaňo–Spain; Nutzhof–Austria; Nordvik Peninsula–Russia) were successfully correlated using high-resolution magnetostratigraphy together with detailed microbiozonation. Geochemical analyses of the Brodno section show Ni and Sb spikes close to the J/K boundary which is located below subchron Brodno M19n-1r at the boundary between zones *Crassicollaria* and *Calpionella*. The Ni and Sb spikes are accompanied by a significant enrichment in several other elements, particularly U, Zr, Ba, Cr, Hf, Na, and Th. However, their spikes near the J/K boundary do not represent their maximum levels within the studied profile. They show even more pronounced maxima 2.3 m below. Besides that, there is a significant Co spike 1 meter above the J/K boundary. The spikes found at the Brodno section, much like at the Nordvik section, are probably caused by an anoxic event and element concentration in sulphides.

International Commission on Stratigraphy (Subcommission on Cretaceous) submitted a new proposal of fixing J/K boundary. The base of M18r (M18r / M19n interval) has been chosen in preference to short magnetic intervals and precise calibration of stratigraphic markers on wider geographical areas.

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HOUŠA V., KRS M., KRSOVÁ M., MAN O., PRUNER P. & VENHODOVÁ, D. (1999): High-resolution magnetostratigraphy and micropaleontology across the J/K boundary strata at Brodno near Žilina, western Slovakia: summary results. – *Cretaceous Research*, 20, 6: 699–717.

HOUŠA V., KRS M., MAN O., PRUNER P.,VENHODOVÁ D., CECCA F., NARDI G. & PISCITELLO M. (2004): Combined magnetostratigraphic, paleomagnetic and calpionellid investigations across Jurassic/Cretaceous boundary strata in the Bosso Valley, Umbria, central Italy. – *Cretaceous Research*, 25, 5: 771–785.

HOUŠA V., PRUNER P., ZAKHAROV V.A., KOŠŤÁK M., CHADIMA M., ROGOV M.A., ŠLECHTA S. & MAZUCH M. (2007): Boreal–Tethyan Correlation of the Jurassic–Cretaceous Boundary Interval by Magneto- and Biostratigraphy. – *Stratigraphy and Geological Correlation*, 15, 3: 297–309.

PRUNER P., HOUŠA V., OLÓRIZ F., KOŠŤÁK M., KRS M., MAN O., SCHNABL P., VENHODOVÁ D., TAVERA J.M. & MAZUCH M. (2010): High-resolution magnetostratigraphy and biostratigraphic zonation of the Jurassic/Cretaceous boundary strata in the Puerto Escaño section (southern Spain). – *Cretaceous Research*, 31, 2: 192–206.

PRUNER P., SCHNABL P. & LUKENEDER A. (2009): Preliminary results of magnetostratigraphic investigations across the Jurassic/Cretaceous boundary strata at Nutzhof, Austria. – *Annalen des Naturhistorischen Museums in Wien*, 110, A: 331–344.

No. 526/07/P170: **Biogeochemistry of mercury in the forest ecosystems** (*T. Navrátil*; 2007–2009)

Ecosystems of the Planet Earth are contaminated by toxic elements, major part of which is usually of anthropogenic origin. Although natural cycle of mercury (Hg) was not affected as much by anthropogenic activities as, i.e., the cycle of lead, its effects on human health and health condition of ecosystems are incomparable. The environment of the Czech Republic is bearing several loads, which originated in its past industrial processing, similarly to selected areas in Poland or Germany. Existing data on the mercury content in top horizons of forest soils indicate significant contamination, namely in the central Czech Republic. This project was aimed at the evaluation of mercury concentrations and pools in the compartments of the forest ecosystem with a special focus on Lesní potok (LP) catchment in the central Czech Republic.

The primary targets included the evaluation of the Hg mass fluxes into the forest ecosystem. The evaluated fluxes were bulk Hg deposition, deposition of Hg below the canopy (throughfall) and Hg deposition through the forest litter from vegetation (litterfall). The concentrations of Hg in bulk precipitation ranged from 1.5 to 75.0 $ng.l^{-1}$. The annual deposition fluxes in bulk precipitation averaged 8.7 $\mu g.m^{-2}.yr^{-1}$. Throughfall solutes in beech and spruce stands are naturally evaporated and chemical composition of solution has been modified through ionic exchange between the canopy and precipitation. Concentrations of Hg in beech and spruce throughfall ranged from 1.1 to 52.8 $ng.l^{-1}$ and from 1.1 to

180.8 ng.l^{-1}, respectively. Throughfall fluxes have been slightly lower than those in bulk precipitation. The annual flux in beech and spruce throughfall averaged 6.9 and 6.1 µg.m^{-2}.yr^{-1}. The lower concentrations of Hg in throughfall and consequentially lower annual fluxes of Hg may indicate adsorption of Hg from the precipitation solutes into the canopy. The greatest and thus the most important flux has been found to be litterfall. In beech stands the average annual deposition flux of Hg in litterfall was 22.6 µg.m^{-2}.yr^{-1} and in spruce stands 18.5 µg.m^{-2}.yr^{-1}, respectively. Thus the annual litterfall flux has been at least three fold compared to the throughfall fluxes.

Regular monitoring of the Hg concentrations in assimilatory organs of beech trees with a monthly step indicated that the Hg concentration in leaves increased from 19 to 96 µg.kg^{-1} in the vegetation period of beech trees (usually May to November). This almost five fold increase resulted not only from scavenging Hg from precipitation solutes but dominantly from adsorption of gaseous atmospheric Hg by the beech leaves. In the case of spruce needles the increase of Hg has been assessed by comparing annual needle classes. The concentration increased from about 20 µg.kg^{-1} of Hg in one year old needles to 62 µg.kg^{-1} in four years old needles. The annual increment of Hg in needles was about 14 µg.kg^{-1} of Hg. The observation of increasing Hg concentrations in assimilatory organs of forest trees is especially important because they represent the base material forming the forest litter soil horizons after their deposition onto the forest floor.

The forest litter soil horizons were found to contain the highest concentrations of Hg in the soil profiles due to the increased content of organic material (humus). On the contrary, the Hg concentrations found in the bottom mineral horizons were usually one order of magnitude smaller than those in top organic horizons. The low concentrations in the mineral horizons resulted mostly from low Hg concentrations in bedrock and from low content of organic material in the mineral soils. The Hg concentrations in top organic horizons averaged at 332.6 µg.kg^{-1} but in the mineral horizons 22.6 µg.kg^{-1}, only.

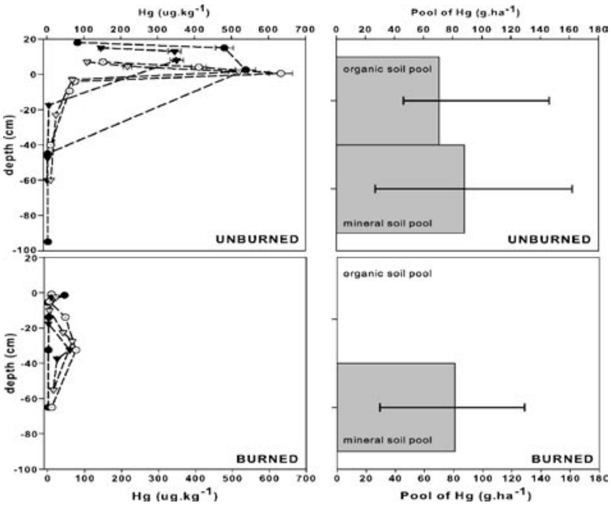
The greatest pools of Hg in soil were found in Gleyic Cambisols of the riparian zone (i.e., close to the stream). The pools of Hg calculated for 6 soil profiles ranged from 690 to 902 g.ha^{-1} of Hg. It is necessary to point that the increased Hg pools in riparian zones are especially due to the increased density of Gleyic Cambisols caused by greater content of clay minerals. The Hg pools found in soils located farther away from streams, usually classified as Dystric Cambisols, ranged from 404 to 724 g.ha^{-1} of Hg (data from 5 soil profiles). The differences between the pools in deciduous and coniferous stands were statistically insignificant.

In order to construct the mass balance of Hg in the forested ecosystem it is necessary to quantify the export of Hg from the ecosystem by the surface runoff. It was possible to conclude that the concentrations of Hg in stream water were very low. The average concentration of Hg in the stream water at LP catchment was 15.8 ng.l^{-1}. It was observed that the stream water concentrations of Hg were positively correlated with the dissolved organic carbon (DOC) concentrations. The average DOC concentration at LP catchment was 8 mg.l^{-1}. The highest DOC concentrations in stream water at LP catchment occur during spring and autumn periods. In the spring, melting snowpack causes significant percolation of solutions in the top organic-rich soil horizons which results in increased DOC in stream water and increased Hg concentrations (up to 54.4 ng.l^{-1}). Due to increased discharge in the spring period these Hg concentrations play an important role in the cumulative annual export of Hg from the catchment. The spring flood in year 2009 was monitored in detail. The stream water was sampled daily during the first 10 days, and with 2-days step later. The results indicated that the water output summed up to 60 % of the annual water flux during the 42 days of the spring flood. The dissolved Hg concentrations ranged from 9.8 to 54.4 ng.l^{-1} and the spring flood flux (0.6 ng.l^{-1}) of Hg represented 50 % of the annual Hg export flux (1.2 ng.l^{-1}) from LP catchment. Another part of Hg in the stream water is the particulate Hg. The concentrations of particulate Hg have been assessed by analyzing the glass fiber filters (pore size <0.4 µm) used for filtering of individual samples. Increased turbulence of the water in streams during the spring high flow caused increased outputs of particulate Hg. The export flux of particulate Hg during the spring flood summed up to 0.2 µg.m^{-2} Hg, which is an output flux that should not be omitted.

The increased DOC in the autumn period has different reasons such as leaching of biomass (deciduous leaves) in the stream channel. Due to low discharges, this period was less important for the cumulative annual export of Hg. The average export of Hg from the LP catchment summed up to 1.2 µg.m^{-2}. The concentrations of particulate Hg in stream water up to 4.1 µg.l^{-1} result from relatively high concentrations of Hg in the streambed sediment.

It is straightforward that, compared to the input fluxes (precipitation + litterfall) 20.6 µg.m^{-2}.yr^{-1}, the export stands for maximum of 10 % of the inputs. The inputs from weathering were omitted due to very low Hg concentrations in the bedrock as it was indicated from the mineral soil horizons. The Hg has been accumulating in the forested catchment with time. In particular, Hg has been accumulating in biomass and consequently with the decay of the biomass accumulated on the forest floor Hg is temporarily blocked in the humic soil horizons. Top humic horizons in the forests are the soil horizons with the greatest dynamics.

One of the most important factors affecting the distribution of Hg in forest ecosystems is the forest fire. In year 2006, there was a unique opportunity to study a site affected by forest fire in the Bohemian Switzerland National Park. The area of 17.9 ha has been impacted by forest fire which caused a total volatilization of organic soil horizons and significantly changed the distribution of Hg in the soil profile. The results of soil survey indicated that the total pool of Hg in unimpacted soils ranged from 126 to 202 g.ha^{-1} Hg but on burned sites it was from 83 to 85 g.ha^{-1} of Hg, only. Comparing the average data from burned and unburned areas enabled to estimate the Hg emissions originating in this single forest fire. It was estimated that burning of 4,039 tons of forest litter caused emissions of 1.34±0.07 kg Hg. and after recalculation for the burned area the emissions reached 75.1 g.ha^{-1} Hg. The average burned forested areas in CR for the period 2000–2006 were reported at 356 ha with estimated Hg emissions at 26.7 kg.yr^{-1}, while the average anthropogenic emissions in the same period amounted to 3 t.yr^{-1}. Thus the estimated mean emissions of Hg from burned forest soil in the period 2000–2006 reached 1 % of the annual anthropogenic



■ **Fig. 10.** Hg concentration throughout the soil profiles at unburned and burned plots (left panel). Four profiles were sampled at each type of plot. Calculated Hg pools on unburned and burned plots (right panel). Bars indicate mean, error bars indicate minimum and maximum pools (original).

Hg emissions. The results of the case study of forest fire effect on the distribution of Hg in the Bohemian Switzerland National Park have been summarized in Navratil et al. (2009).

NAVRÁTIL T., HOJDOVÁ M., ROHOVEC J., PENÍŽEK V. & VAŘILOVÁ Z. (2009): Effect of Fire on Pools of Mercury in Forest Soil, central Europe. – *Bulletin of Environmental Contamination and Toxicology*, 83, 2: 269–274.

Continued projects

No. 202/09/1206: **Soluble and insoluble fraction of inorganic pollutants in various types of precipitation, their quantification and input into the ecosystems** (J. Fišák, D. Řezáčová, P. Chaloupecký, Institute of Atmospheric Physics AS CR, v. v. i., Praha, Czech Republic, M. Tesař, M. Štír, J. Polívka, Institute of Hydrodynamics AS CR, v. v. i., Praha, Czech Republic, *J. Rohovec* & *P. Skřivan*; 2009–2014)

The project is focused on the estimation of the occult and total precipitation and the formulation and validation of pollutant concentration (PC) in different precipitation types (PT) on meteorological conditions, on air particles transport, nature and conditions of the formation of precipitation. Water and pollutant input is evaluated by ICP EOS technique for selected rain/fog events at experimental sampling sites taking into account the local and distant pollution sources.

The main goals of the project are: (i) to estimate the amount of occult deposition using water balance of the forest canopy; (ii) to specify the PC differences in different PT, and (iii) to estimate pollutant sources and their impact on the natural environments.

In the course of work on the project in 2009 a sample set was collected according to the collection protocol described previously, at five collection sites. Namely, precipitation, throughfall and stream water were collected in the Lesní potok catchment. The samples were worked-up and stabilised according to the validated procedure before the analysis. Another set of liquid samples was collected by the principal investigator. In total, up to 120 samples were worked-up.

In the course of the project solution, solid particles suspended in the liquid samples were collected from each sample on a filter disc made of RC with the pore size 0.45 μm. The filtration discs bearing the collected particles were dried at 105 °C and decomposed in a microwave oven, acquired in the first year of the project as an essential equipment for the project solution.

The methodical approach applicable for particle solubilisation was one of the main tasks for the first year of project solution. Due to the high iron oxide content in the solid material, as well as the presence of silica, this was a quite delicate task from the chemical point of view. We have found a one-step procedure based on the combined action of concentrated nitric, hydrochloric and hydrofluoric acids in the microwave field in a high-pressure vessel, which offers a solubilised material for the following analytical works. The decomposition conditions were optimized in order to avoid a loss of volatile chlorides, such as arsenic chloride in the course of the procedure. The decomposition procedure was tested using spiked samples, the recovery found was better than 98 %.

Liquid samples and the solutions obtained by the decomposition of solid particles were analysed by ICP EOS. The content of major elements (Al, Ca, Fe, K, Mg, Mn, Na, P, S, Si) and some of the microelements (As, Cd, Pb, Co, Ni, Ba, Sr, Be) were determined.

The comparison of macro- and microelement contents in the analytical study of the solid particles pointed out a dependence between the composition of the solid phase in macroelements and the microelements transported on the solid. The samples rich in iron, probably present in the form of iron oxides, bear increased amounts of As, Cd and Pb. In some samples, up to several tenths ppm of As were found. On the other hand, the particles based on silica do not transport the mentioned microelements. The composition of the solid phases (in macro- as well as microelements) does depend on meteorological conditions at the time of collection.

No. 205/08/0676: **Three-dimensional fabric of pore space in sedimentary rocks: correlation to the physical and mechanical properties** (R. Přikryl, Faculty of Science, Charles University, Praha, Czech Republic, Z. Weishauptová, Institute of Rock Structure and Mechanics AS CR, v. v. i., Praha, Czech Republic, J. Přikrylová, Academy of Fine Arts in Praha, Czech Republic & *T. Lokajíček*; 2008–2010)

In 2009, combined piezoelectric transducers were designed and developed for the study of pore space properties of sedimentary rocks. The transducers enable ultrasonic sounding of rocks not only by longitudinal waves, but also transverse ones. The transducers are constructed to have a point contact with the spherical or 5 mm linear contact with cylindrical samples. The construction of the transducers enables ultrasonic sounding of the rock samples by means of transverse waves S1 and S2, polarization of which is in perpendicular direction. The couple of transverse transducers are complemented by one longitudinal transducer. The construction of the transducers is lined up according to sample surface normal in the following order – S1, S2 and P. Active size of the transducers is 5 × 5 mm and the overall height is 7.5 mm. A similar type of combined ultrasonic transducers was developed for ultrasonic sounding of spherical rock samples in a high-pressure vessel. The transducers have a point contact with spherical samples. New transducers consist of two perpendicularly oriented transverse transducers S1 and S2. Active size of the transducer is 3.5 × 3.5 mm and total height 5 mm. As a contact medium between the transducer and rock sample, two types of contact media were tested: dense synthetic resin and contact gel – Olympus. Both media have a very high viscosity and are very good for the transfer of not only longitudinal, but also transverse waves. Resonant frequency of the transducers is about 700 kHz. Small combined transducers were tested under hydrostatic pressure. It was found that such transducers can be used for ultrasonic measurement up to 150 MPa. Above 200 MPa, the transducers lose significantly their sensitivity. To study the process of pore space closing under hydrostatic pressure applied, 150 MPa is sufficient. It is mainly in the range between 0.1 to 150 MPa of hydrostatic pressure that significant changes in pore pressure closing are observed. Majority of rocks have significantly closed above 150 MPa pore pressure. S1 and S2 transducers will be used for longitudinal waves recording, too, as they record longitudinal waves although at a lower sensitivity. All transducers were calibrated to determine exact arrival time of individual waves.

No. 205/08/0767: **Neutron texture analysis of carbonates and gabbros** (L. Kalvoda, M. Dlouhá, S. Vratislav, M. Dráb, P. Sedlák, A. Grishin, Faculty of Nuclear Science and Physical Engineering, Czech Technical University, Praha, Czech Republic, *J. Hladil*, *L. Koptíková*, *M. Chadima*, *S. Šlechta*, *P. Kubínová*, M. Machek & P. Špaček, Geophysical Institute AS CR, v. v. i. Praha, Czech Republic; 2008–2010)

Anisotropy of recrystallized and deformed limestone and strongly inherited features of early diagenetic origin. The main emphasis was put on applications of neutron diffraction analysis (NDA). The respective 2009 case study relates to Early Middle Devonian calcitubidites from the locality of Na Škrábku Quarry (Choteč), Barrandian units W of Praha, where intensely folded, more than 10-cm thick beds of relatively homogeneous original granularity of about 3–5 Φ were subjected to scrutiny. One of small recumbent folds underlying a large fault-propagation fold was selected in a zone of local thrust fault, and the sampling points followed two different limbs of this single subhorizontal fold. The anisotropy was studied by means of the neutron diffraction analysis. The measurements found that there is a considerable similarity of experimental pole figure (PF) distributions of all the measured planes of calcite and (001) PF of α-quartz. This is in spite of the fact that these structural relationships relate to various crystal generations in the polycrystalline aggregate of the natural carbonate rock, and namely, that the carrier of the quartz signal corresponds to small-sized and accessory prismatic quartz of one type of late diagenetic products. These relatively complex relationships do not contain any clearly displayed crystallographic preferred orientations (CPOs) typical for deformation fabric. Under the diagenetic conditions that can be assumed for our samples, i.e., generally not exceeding the p/T fields of 80–120 °C and 0.1–0.3 GPa by advanced stages of decreased porosity, the most important deformation mechanism of calcite would be twining on {e}(011)plane in direction [100] leading to the c axis rotation towards the orientation parallel to the maximum stress, whereas the second significantly shown phase of α-quartz should, if deformed at low temperature, show (in both coaxial and non-coaxial deformation regime) the typical cross girdle pattern of c axis produced by basal <a> slip. And all these features were not developed to that magnitude that can significantly change the older (diagenetic) texture patterns. Thus, the lack of the deformational CPO patterns and the apparent similarity between the SPO of calcite and the CPO of the crystallographically well-constrained α-quartz grains suggest that the origin of the fabrics is in early diagenetic or compaction processes.

Application of the high-resolution neutron powder diffraction method combined with Powley diffraction profile analyses provided us with the opportunity to characterize not only the CPO of the principal (effective) constituting phases, i.e. calcite and α-quartz, but also the SPO of the calcite phase. The NDA approach significantly eliminates the effects of arrangements of accessory iron oxides and other impurity-related phases in mineral inclusions which commonly represent old fabrics and anisotropy analysis disturbing elements. Knowledge of the SPO character was then found to be indispensable for the interpretation of the obtained CPO results. Pole figures of calcite were found to be strongly influenced by the SPO distribution, i.e., the shape anisotropy of calcite grains dominates over their lattice preferred orientation.

Such behaviour can be understood supposing that: (i) the diagenetic processes do not imply microscopic deformation and orientation of grains resulting in the typical deformation fabric, and (ii) the principal features of the original sedimentary fabrics are transferred through the diagenetic transformation into the final fabrics. Although the exact mechanism remains unclear, one of the possible scenarios can include the growth of calcite and α-quartz grains populations, likely inheriting (at least to some extent) the shape (calcite) and the orientation (α-quartz) of micro-pores and fractures, geometry of the latter correlated with the orientation of the original sedimentary particles. The NDA manifested that the role of this method is not substitutable for the understanding of the evolution of fabrics in so complex crystalline aggregates, and may provide solution to details of anisotropy compared to anisotropy-of-magnetic-susceptibility (AMS), optical or X-ray diffraction, or various tomography imaging types of results.

No. 205/09/0184: **Small mammals at time of the middle Pliocene faunal turnover: aspects of faunal and phenotypic rearrangements in Central Europe** (*J. Wagner*, *S. Čermák*, I. Horáček & O. Fejfar, Faculty of Science, Charles University, Praha, Czech Republic; 2009–2012)

The present project is intended to extend our knowledge of the history of mammalian communities and several model taxa during the Early Pliocene to Lower Pleistocene in Central Europe and open a possibility of a detailed paleobiogeographical comparison. The first year covered 3 main areas of interest: (1) field prospection for new sites and the revisions of existing ones including excavations and extensive resampling (Pliocene sites of Vitošov and Měňany 3, Lower Pleistocene sites Měňany 1 and Malá Panama); (2) taxonomic and paleoecological analyses of available material with special attention to the stratigraphical position of the studied localities (Vitošov, Měňany 3, and Hosťovce 2); (3) detailed morphometric and phyletic analyses of selected taxa (e.g., *Hypolagus*; see Čermák, 2009), including comparisons with populations from the Pliocene and Lower Pleistocene sites abroad.

Preliminary results focused on the stratigraphy and faunal assemblages of the studied localities can be expressed as follows: **Vitošov (MN 15b/16a):** The fauna (26 taxa) composed mostly of bats (11 spp.) and insectivores (7 spp.), e.g., *Mafia* n. sp. or *Desmanella* sp. Among rodents murids and glirids predominate over arvicolids with archaic design. **Měňany 3 (MN 15b/16a):** The fauna (10 taxa, 40 MNI) is characterized by massive predominance of arvicolids over murids and a low frequency of insectivores. Despite these characters, the low degree of enamel linea sinuosa undulation in *Mimomys* clades suggests the age older than Hajnáčka I. Among others, the presence of *Plioctomys/Lemmus* sp. can be noted. **Hosťovce 2 (MN 16a):** Rather abundant fauna (34 taxa) yielded diversified insectivore (19 taxa) and rodent assemblages. Besides archaic sciurids or cricetids (e.g., *Baranomys*), *Mimomys* of *hassiacus-polonicus* clade is present with more hypsodont molars that in "*hajnackensis*" niveau.

Despite its fragmentary character and the above mentioned common features, the Mid-European fossil record of the period of supposed MN15/MN16 transition shows the following specifics: (i) particular assemblages exhibit considerable differences in combination of the expected states of community structure – the diversity of community characteristics does not fit to the expected model of gradual rearrangements of the community design, and (ii) the tentative stratigraphic arrangements based on expected trends in community development do not always correspond to the arrangements based on evolutionary divergence of arvicolid index taxa.

ČERMÁK S. (2009): The Plio-Pleistocene record of *Hypolagus* (Lagomorpha, Leporidae) from the Czech and Slovak Republic with comments on systematics and classification of the genus. – *Bulletin of Geosciences*, 84, 3: 497–524.

No. 205/09/0619: **The Silurian sedgwickii Event: Carbon isotope excursion, graptolite mass extinction, sedimentary record** (*P. Štorch*, *R. Mikuláš*, J. Frýda, Czech Geological Survey, Praha, Czech Republic & O. Fatka, Faculty of Science, Charles University, Praha, Czech Republic; 2009–2011)

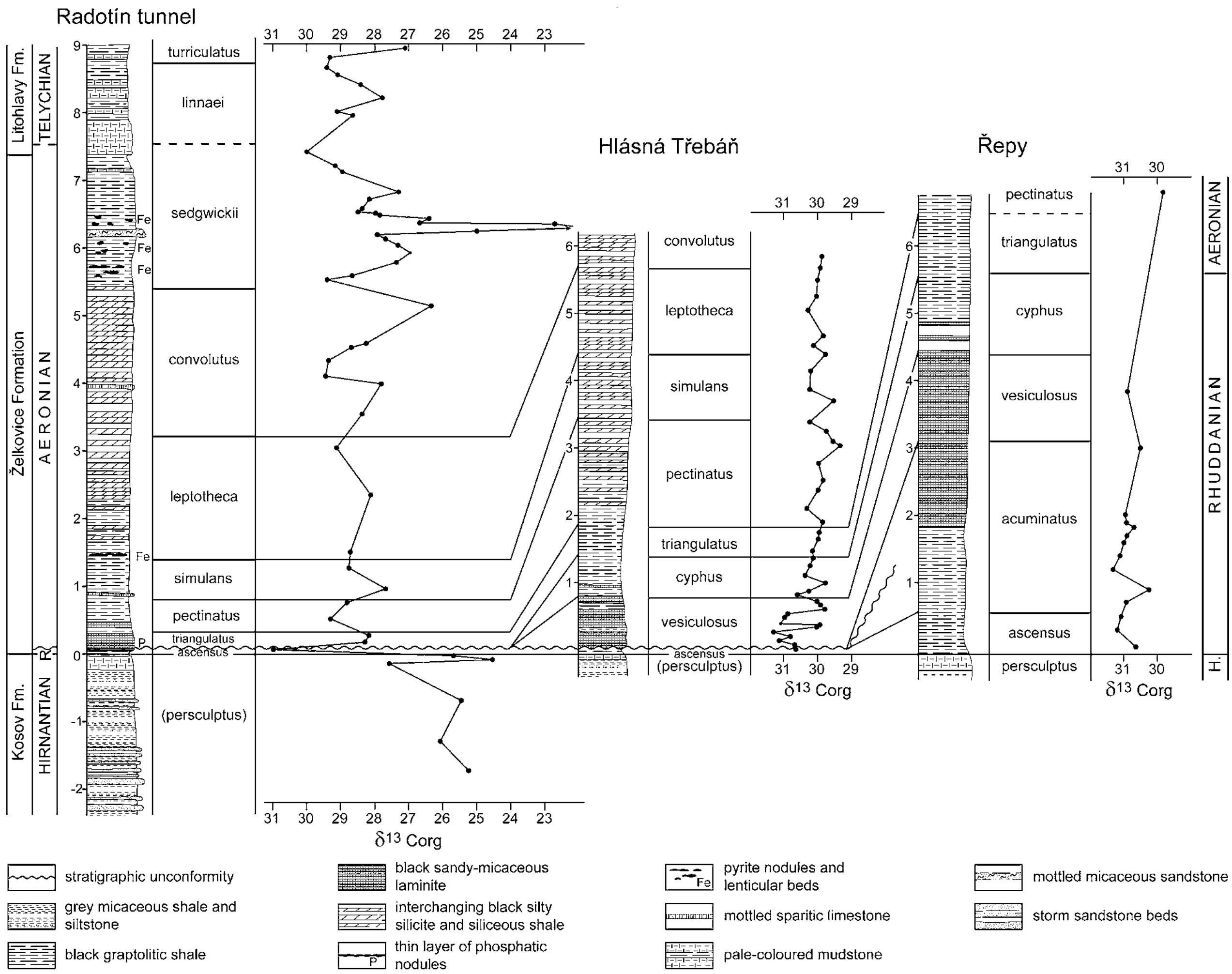
Late Ordovician and Silurian carbon isotope record exhibits a series of positive excursions which coincide with mass faunal extinctions and changes in sedimentation indicating considerable, presumably glacioeustatic fluctuation in sea level. The $\delta^{13}C_{org}$ values recovered from from the uppermost Hirnantian to lower Telychian strata of the Hlásná Třebaň, Řepy and Radotín tunnel sections of the Barrandian area (Fig. 11) have been plotted against high-resolution graptolite biostratigraphy and data on graptolite faunal dynamics.

Significant negative shift in $\delta^{13}C_{org}$ from late Hirnantian baseline values to *ca*. 31 ‰ is associated with graptolite-rich black shale that appears just below the base of the Silurian *Akidograptus ascensus* Biozone. Further increase in the organic carbon content coincides with a magnificent adaptive radiation among graptolites and gradual increase of $\delta^{13}C_{org}$. This trend extends from *A. ascensus*, through *Parakidograptus acuminatus* to *Cystograptus vesiculosus* biozones in Řepy and Hlasná Třebáň sections. A prominent gap in sedimentation, embracing upper *A. ascensus* – *Coronograptus cyphus* biozones, was documented in the Radotin tunnel section. A sequence boundary expressed by this stratigraphic unconformity (Štorch 2006) coincides with a sudden rise in organic carbon content and minor positive shift in $\delta^{13}C_{org}$ in the Radotín tunnel. The $\delta^{13}C_{org}$ values fluctuate between 28 and 30 ‰ during early and middle Aeronian *Demirastrites triangulatus* – *Lituigraptus convolutus* biozones, whereas maximum total organic carbon (TOC) values of the late Rhuddanian *C. cyphus* Biozone and early Aeronian *D. triangulatus* Biozone decline through to the lower part of late Aeronian *Stimulograptus sedgwickii* Biozone. Rich and diverse mid-Aeronian graptolite fauna vanished from the black shale at about the top of the *convolutus* Biozone, hence the lower part of the *sedgwickii* Biozone, remarkable by silty fraction and abundant pyrite, exhibits few graptolite rhabdosomes.

Pyrite-rich interval is overlain by a heavily mottled, silty/sandy-micaceous bed. Rapid sea-level drawdown, supposed by Loydell (1998) manifests itself by an increased input of the silty/sandy-micaceous fraction, that correlates with a gap in sedimentation elsewhere in the Barrandian and abroad. Siliciclastic signal is compatible with low organic content and heavy bioturbation in this particular level and further coincides with a strong positive carbon isotope excursion. Positive excursion, recorded also in Dob`s Linn, Scotland and Cornwallis Island of Arctic Canada (Melchin & Holmden 2006), is rather short-term, perhaps incomplete in the Barrandian area. It clearly postdates, however, the major phase of graptolite extinction known as *sedgwickii* Event. Lithology, sequence architecture, organic carbon content, isotope record, as well as graptolite faunal dynamics, are consistent with a conception of short-term advance in continental glaciation in Gondwana. A detailed study of the corresponding stratigraphic interval in the black-shale succession at El-Pintado in southwestern Spain encountered the same patterns and timing of the graptolite extinction and subsequent brief silty incursion.

In the Radotín tunnel the level with positive δ13C excursion is overlain by micaceous black shale characterized by a rapid return to normal δ13Corg values, rapid increase in TOC, and rapid proliferation of low diversity-high abundance graptolite fauna belonging to the middle part of the *S. sedgwickii* Biozone. Though the anoxic black shales are intercalated with pale-coloured marlstones in the succeeding lowermost Telychian *Rastrites linnaei* and *Spirograptus turriculatus* biozones in the Barrandian sections, and TOC values fluctuate, the δ13Corg record is steady.

LOYDELL D.K. (1998): Early Silurian sea-level changes. – *Geological Magazine*, 135, 4: 447–471.
MELCHIN M.J. & HOLMDEN C. (2006): Carbon isotope chemostratigraphy of the Llandovery in Arctic Canada: implications for global correlation and sea-level change. – *GFF*, 128, 2: 173–180.



■ **Fig. 11.** A correlation chart of selected lower Silurian (Llandovery) sections of the Barrandian area with organic Carbon isotope record. Arrows indicate major positive excursions in $\delta^{13}C_{org}$ (in ‰; original).

ŠTORCH P. (2006): Facies development, depositional settings and sequence stratigraphy across the Ordovician-Silurian boundary: a new perspective from the Barrandian area of the Czech Republic. – *Geological Journal*, 41, 5: 163–192.

No. 205/09/0703: **Integrated late Silurian (Ludlow–Přídolí) stratigraphy of the Prague Synform** (*L. Slavík*, *P. Štorch*, Š. Manda, J. Kříž, J. Frýda & S. Berkyová, Czech Geological Survey, Praha, Czech Republic; 2009–2013)

Together with graptolites, conodonts are fundamental tools in Palaeozoic biostratigraphy. There, however, still exist significant problems concerning the stratigraphical distribution of the two fossil groups, and especially conodonts, and their global correlation. The problems were mostly caused by natural constraints (e.g., dearth of biostratigraphic information, environmental aspects), but also by diverse scientific approaches to taxonomy and nomenclature. The use of ill-defined biostratigraphic units seriously distorted the global correlation in various intervals of the Paleozoic and particularly in the late Silurian. The global correlation of the Silurian is, at the same time, based principally on conodonts (carbonate-dominated sequences) and graptolites (shale-dominated facies). The aim of the project is to fill blank spots in the late Silurian stratigraphy of the classic area (Praha Synform) and enhance the correlation potential of sections which may have crucial implications for the precision of global late Silurian stratigraphy.

We present the first results from detailed sampling for hi-res stratigraphy in the Všeradice section (late Silurian) where shales alternate with subordinate carbonate beds. This kind of lithology thus provides a good possibility for both graptolite and conodont study. Two grooves comprising stratigraphic interval from Ludlow (upper Gorstian–Ludfordian) to late Přídolí were uncovered by an excavator. Siltstones yielded numerous specimens of graptolites that enabled delimitation of the following graptolite biozones: *chimaera* and *scanicus* in the Gorstian, *linearis*, *tenuis*, *inexpectatus*, *kozlowskii*, *latilobus* and *fragmentalis* in the Ludfordian and *parultimus* at the base of the Přídolí. Of the total of 28 conodont samples taken from carbonate beds, only few yielded conodont elements. In the Ludfordian, conodont biozones *ploeckensis*?, *siluricus*, *latialatus*?, *snajdri* and *crispa* were directly or indirectly determined. A relatively rich macrofauna of bivalves, ostracods, cephalopods and phyllocarids obtained from the Všeradice section will be useful especially for paleoenvironmental reconstructions. All carbonate beds were sampled for carbon isotope analysis. Data showed, however, an open system with negative influence of post-diagenetic fluid migration. The main result at this stage is the integration of stratigraphic data from graptolites, conodonts and associated macrofaunas in the Všeradice section.

No. 205/09/0991: **Origin of moldavites – complex geochemical study** (J. Mizera, Z. Řanda, V. Havránek, J. Kučera, Nuclear Physics Institute, Řež, Czech Republic, *R. Skála*, *K. Žák* & *A. Langrová*; 2009–2011)

Major element composition has been determined in thin sections of the part of the studied samples. Moldavites revealing megascopic or microspcopic heterogeneity have been selected for analysis at this stage. Some of the moldavites indeed display compositional heterogeneity; other, however, do not show substantial differences in composition among individual parts of the sample and the observed heterogeneity is obvious due to melt character. For 29 samples, lithium isotopic composition was determined using the MC–ICP–MS method. Total content of Li varies between 30 and 60 ppm and ^{7}Li (in ‰) attains values between –3.2 and 0.2. These values support previous hypotheses identifying the source of moldavites among surface sedimentary rocks excluding the influence of basement crystalline lithologies.

Quantitative determination of color allowed a definition of 7 partial groups among the studied moldavites. These groups more or less correspond with those defined earlier by Bouška and Povondra. Regional correlations, however, are less obvious than expected. Cathodoluminescence appears quite effective when imaging details of internal structure of heterogeneous moldavites (see Fig. 12).

Fluvial transport of gravel was studied using pebble size analysis and pebble lithology in the channel of the Berounka River, Czech Republic. Fluvial transport of pebbles of metallurgical slag in the gravels is discussed as an analog for moldavite redistribution from its original strewn fields by fluvial processes.

A 70 km long river section, between 74.2 and 4.5 km above the confluence of the Berounka River with the Vltava River, was studied using 5 gravel samples collected from fresh gravel bars formed in the river channel after the major 2002 flood. The studied river section is characterized by moderate gradient (0.8 m.km^{-1}), average flow of 36.6 m^{3}.s^{-1} (Beroun gauge) and peak recorded flow close to 3,000 m^{3}.s^{-1} during the 1872 flood. Typical size of largest pebbles forming the gravel bars in the channel is slightly above 100 mm (the pebble longest axis). Samples (weight 55.41 to 60.02 kg) contained 675 to 1.187 pebbles sized over 16 mm, of which the 100 largest pebbles were determined petrographically in each sample. The pebbles of metallurgical slag were separated and studied from the whole fraction over 16 mm.

Pebble lithology largely reflects local rock sources around the river. The longest transport of pebbles on the order of tens of kilometers was found for several types of SiO_2-rich rocks, like vein quartz, silicites, quartzites, and quartz conglomerates. With respect to numerous steep-sloped inflows into the Berounka River, no obvious gravel size fining was observed along the river course.

The metallurgical slag was incorporated into the river especially after the major flood of 1872, when iron works located near the river were destroyed. After 137 years of fluvial redistribution (with several subsequent major floods) the metallurgical slag represents 8.78 wt. % of the >16 mm pebble fraction at a site located 1 km below the former iron works, while samples collected 17 and 34 km downstream contained 1.12 and 0.11 wt. % of the slag, respectively.

Based on these data, and discussion of other observations and data from literature, fluvial transport of moldavites in river channels is interpreted as improbable for distances longer than several tens of kilometers. Nevertheless, a single moldavite can be transported for a longer distance incorporated in floating ice or with floating trees during flood events.

No. 205/09/1162: **Lacustrine and coal deposits of the Sokolov Basin, Eger Graben, as an archive of Miocene continental paleoenvironments, paleoclimate and tectonics** (K. Martínek,

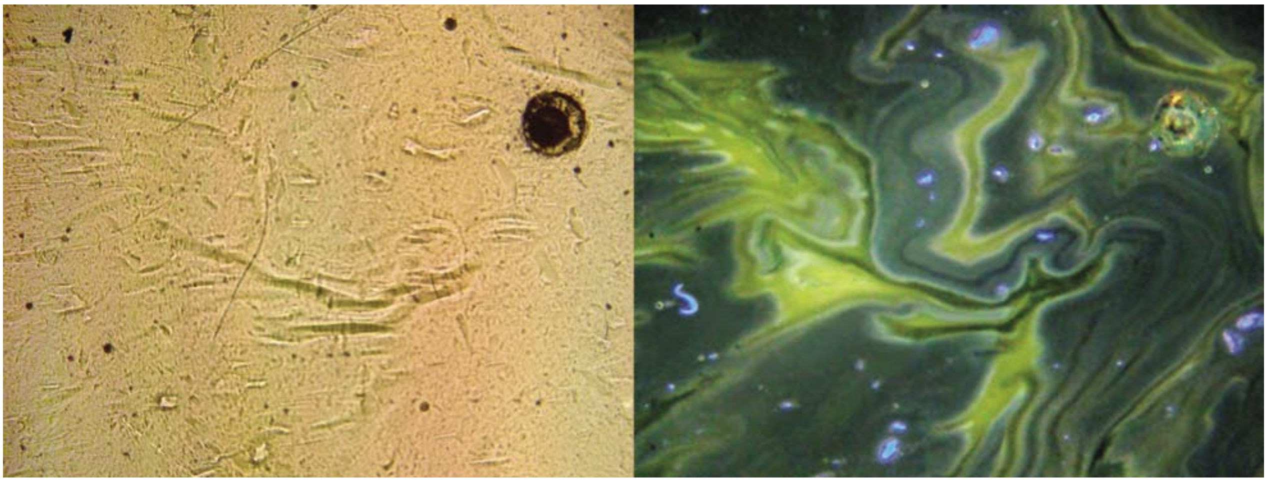


Fig. 12. Optical microscope and hot cathodoluminescence image of a heterogeneous moldvite. Yellow domains in CL image are enriched in Ca and lechatelierite grains are bright blue (Photo by L. Dziková).

S. Opluštil, Z. Kvaček, J. Sakala, Faculty of Science, Charles University, Praha, Czech Republic, J. Franců, B. Kříbek, E. Franců, Czech Geological Survey, Praha, Czech Republic, I. Sýkorová, M. Havelcová, M. Matysová, H. Trejtnarová, M. Vašíček, Institute of Rock Structure and Mechanics AS CR, v. v. i., Praha, Czech Republic, *J. Kadlec*, *O. Man*, *P. Pruner*, *P. Schnabl*, *S. Šlechta*, *J. Dašková* & P. Rojík, Sokolovská uhelná, právní nástupce, a.s., Sokolov, Czech Republic; 2009–2011)

Lacustrine sediments are sensitive indicators of paleoenvironmental changes. Lake metabolism is very responsive not only to global climatic and geotectonic changes, but also to local climatic, vegetation, erosional and tectonic changes. The project is focused on the detailed study up to 200 m thick succession of lacustrine Cypris Formation and the underlying Antonín Coal Seam in the Sokolov Basin, where depositional rhythmicity of several orders was observed. The high-resolution magnetostratigraphic approach is applied to dating of the Cypris Fm. deposition. Oriented samples were collected continuously from a 71 m long core No. 333 drilled in the Družba Quarry. Low-field specific mass magnetic susceptibility was measured continuously in all samples collected from the core. Susceptibility values in the upper portion of the section (0–37 m) range between 8 and 1 700 x 10^{-8} m^3kg^{-1} whereas lower part shows lower values between 10 and 500 x 10^{-8} $m^3.kg^{-1}$. Anisotropy of low-field magnetic susceptibility shows inverse magnetic fabric in the lower portion of the sequence recording low magnetic susceptibility values. Pilot samples at vertical distance of 15 cm were cut into cubes 2 x 2 x 2 cm for paleomagnetic analyses. These samples were demagnetised by alternating field in 9 fields from a natural state to 50 mT. The magnetic moment behaviour during demagnetisation indicates three possible remanence carriers – greigite, goethite and haematite. The interpreted paleomagnetic inclinations allow us to subdivide the section to segments recording normal or reverse polarities. The obtained polarity pattern will be subsequently correlated with the reference geomagnetic polarity time scale.

No. 205/09/1170: **Upper mantle beneath neovolcanic zone of the Bohemian Massif: xenoliths and their host basalts** (P. Špaček, Geophysical Institute AS CR, v. v. i., Praha, Czech Republic, *L. Ackerman* & *J. Ulrych*; 2009–2012)

Occurrences of mantle (ultra)mafic xenoliths in the Bohemian Massif are associated with basaltic Late Cretaceous and especially Cenozoic alkaline extensional intraplate volcanism.

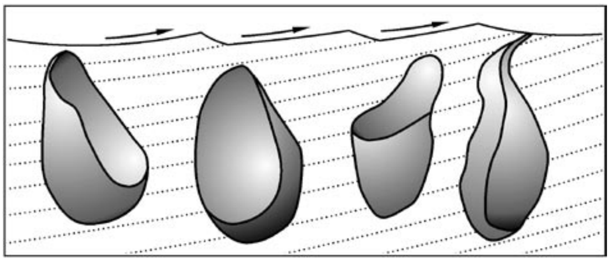
The xenoliths were collected from various lava flows, usually of Tertiary age (e.g., Dobkovičky, Prackovice highway cut, Plesý–Brtníky, Homole, Číhaná, Medvědín) and from rarely preserved vents (e.g., Kuzov, Jetelí vrch Hill near Kraslice). Whole-rock major element chemistry of the xenolith host rocks ranges from nepheline basanite to olivine nephelinite compositions. The xenoliths are predominantly of harzburgitic/dunitic composition accompanied with rare lherzolites, wehrlites and pyroxenites. Such composition points most likely to prevalent depleted nature of the upper mantle.

Previously studied mantle xenoliths of lherzolitic composition from Kozákov Hill, which sampled upper mantle profile between 30 and 70 km, provided unique insights on the trace element fractionation during melt percolation. Fractionation of large ion lithophile elements (LILE), rare earth elements (REE) and high field strength elements (HFSE) is strongly dependent on melt-rock ratios and porosity.

No. 205/09/1521: **Feeding strategies from the Cambrian to the Middle Devonian of the Barrandian area** (O. Fatka, Faculty of Science, Charles University, Praha, Czech Republic, *R. Mikuláš*, P. Budil, Czech Geological Survey, Praha, Czech Republic, M. Mergl, Department of Biology, University of West Bohemia, Plzeň, Czech Republic & M. Valent, National Museum, Praha, Czech Republic; 2009–2011)

Shallow-marine Middle Cambrian sandy sediments of the St. Petersburg Region (i.e., sedimentary cover of the Baltic Shield) bear non-shelly, cup-like fossils, interpreted tentatively as descendants of Ediacaran organisms. The ichnoassemblage accompanying this occurrence consists of *Skolithos*, *Diplocraterion* and indeterminable biogenic sedimentary structures. The ichnofabric index is low (1–2). The probable body fossils are crosscut by the trace fossils. Though simple, the ichnoassemblage recorded here yields valuable information on the environment that could have hosted Ediacaran organisms during the earliest Phanerozoic.

NATALIN N.M., MIKULÁŠ R. & DRONOV A.V. (2010): Trace fossils accompanying possible "Ediacaran organisms" in the Middle Cambrian sediments of the St. Petersburg Region, Russia. – *Acta Geologica Polonica*, 60, 1: 71–75.

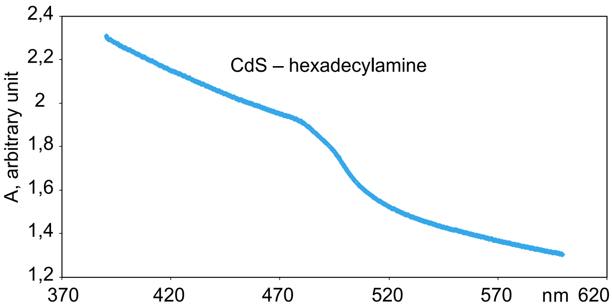


■ **Fig. 13.** A three-dimensional reconstruction of the "cup-like" body fossils from the top of the Middle Cambrian at Sablino and their presumed position in the substrate. Presumed mechanism of shifting the substrate (i.e., current ripples) is also marked. The height of the cup-like forms ranges from 2 to 3 cm (after Natalin et al. 2010).

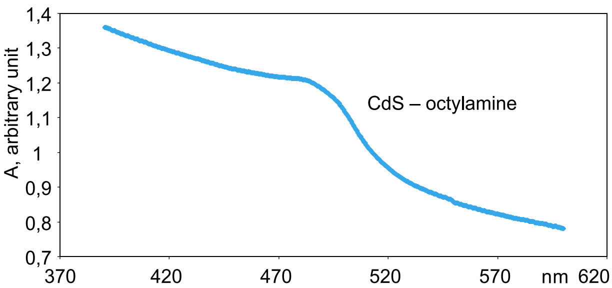
No. 205/09/1918: **Nanocrystalline heterogeneous photovoltaic solar cells** (F. Schauer, I. Kuřitka, P. Sáha, V. Křesálek, J. Vilčáková, Tomáš Baťa University in Zlin, Czech Republic, J. Toušková, J. Toušek, I. Křivka, Faculty of Mathematics and Physics, Charles University, Praha, Czech Republic & *J. Rohovec*; 2009–2011)

Project envisages to devise but, before all, to optimise, thin film photovoltaic cells on the principle of donoracceptor systems with charge-transfer, specifically with organic polymers and inorganic nanoparticles on sulfide materials. The synthesis of polymers will be needed with appropriate long wave absorption in 600–800 nm region, and outstanding transport properties and stability, but before all nanomaterials with optimised absorption and transport properties will be needed.

The main goal of the project is to optimise electron devices of radiation by means of the minimization of the loss of photons, successive photoexcited excitons and photogenerated charge carriers. The first step is to optimize the nanostructures (quantum rods, tripods and nets) used. The project is aiming at two application areas: sensors for the electromagnetic radiation in a wide spectral range 300–1,200 nm for the general-purpose applications and photovoltaic cells for low-cost applications, aiming at the techniques of stamping and nanoprinting of electronic circuits.



■ **Fig. 14.** UV VIS spectrum of CdS nanoparticles after 45 h of reaction, CdS-HDA sample (original, measured by J. Rohovec).



■ **Fig. 15.** UV VIS spectrum of CdS nanoparticle covered by shell of octylamine, CdS-octylamine sample (original, measured by J. Rohovec).

■ **Fig. 16.** Samples of CdS prepared in the course of the first year of the project solution (Photo by J. Rohovec).

The task of the co-investigator in the first year of the project solution was the preparation and characterisation of various nanocrystalline materials based on cadmium sulfide, in the form of nanospheres, nanorods etc., by variation of crystallisation conditions applied during the preparation. In order to keep the nanoparticles formed far from coagulation and to increase the stability of the particles formed, a covering shell was created on the surface of the particles. The particles were characterised by UV VIS spectra. In Figure 14, an example of spectra of CdS covered with hexadecylamine protective shell is demonstrated, while in Figure 15, a spectrum of CdS covered with octylamine shell is shown. In both cases, the quality of nanomaterial is given by the presence and position of the plasmon band in the spectrum. In Figure 16, samples of CdS particles are shown.

No. 206/09/1564: **Multi-proxy paleoecological research of unique sediments from ancient Komořany Lake, Most Basin, Czech Republic** (J. Novák, University of South Bohemia, České Budějovice; V. Jankovská, Institute of Botany, AS CR, v. v. i., Brno, Czech Republic & *L. Lisá*; 2009–2013)

The Komořany Lake formed the largest water body (ca. 25 km^2) in the Czech Republic and nearly completely dried in the 19th century. Its origin is linked with the tectonic subsidence of the part of the Most Basin and assumed damming of the Bílina River near the medieval town of Most at the end of the Last Glacial period. Sediments at the base are composed of gravelly sands, lake sediments began to form during the Late Pleistocene–Early Holocene transition. This large but relatively shallow lake was extraordinary also due to its location where southern and northern parts were exposed to very different abiotic conditions.

The absolute majority of the lake sediments were removed due to the progress in coal mining in the 1980s. Their remains were buried under the spoil banks and are not accessible today. Paleoecological potential of the locality was irretrievably lost, and the last chance for saving paleolimnological information from probably the most valuable sediment in the Czech Republic is a detailed analysis of four rediscovered (PK-1-C, PK-1-CH, PK-1-I and PK-1-W) sediment cores gathered during sampling in 1983. During 2009, the cores were precisely sampled and a number of palaeocological analyses were applied.

The existence of preserved littoral sediments near the villages of Černice and Dolní Jiřetín (northern shore) and in the neighborhood of the route close to the former village of Komořany (southern shore) was accepted during the field sampling in 2007 summer. In 2009, new lake deposits in this area were excavated by our team and sampled for geological and paleoecological analyses.

Intended multi-proxy study comprising detailed analyses of diatoms, chironomids, cladocerans, pollen, coccal green algae, macrofossils, charcoal shows a quite stable type of environment in the case of PK-1-CH core. Also geochemistry together with magnetic studies shows the phases of lake stability. Together with radiocarbon dating, it meets the conditions needed for modern paleolimnological investigation. Radiocarbon results show that the bases of most of our investigated cores started to develop at the same time at the beginning of the Boreal (9,150 a 9,145 yr cal BP). One of the cores situated in the centre of the former lake started to originate in the Preboreal period (ca 11,200 yr cal BP).

Gathered data will presumably enable a reconstruction of local climatic events and their implications on the regional and global scale. The history of the lake was closely linked with human presence. The first settlement in the Krušné hory Mts. piedmont basin was documented from the Paleolithic. Finds of Mesolithic artefacts (flint flake) and the great number of artefacts originated in the Baden culture in the sediment suggest a settlement in the immediate neighbourhood of the lake. Evidence of fires in littoral parts and a bare bottom of the lake comes from the age of Baden culture (Rudolph 1926; Losert 1940; Vencl 1970; Neústupný 1985). Although the archeological potential of the locality was not fully utilized due to coal mining, existing data offer an interesting comparison with the intended paleoecological research and tracking human impact on the lake ecosystem.

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VENCL S. (1970): Das Spätpaleolithikum in Böhmen. – *Antropologie*, 8, 1: 3–68.

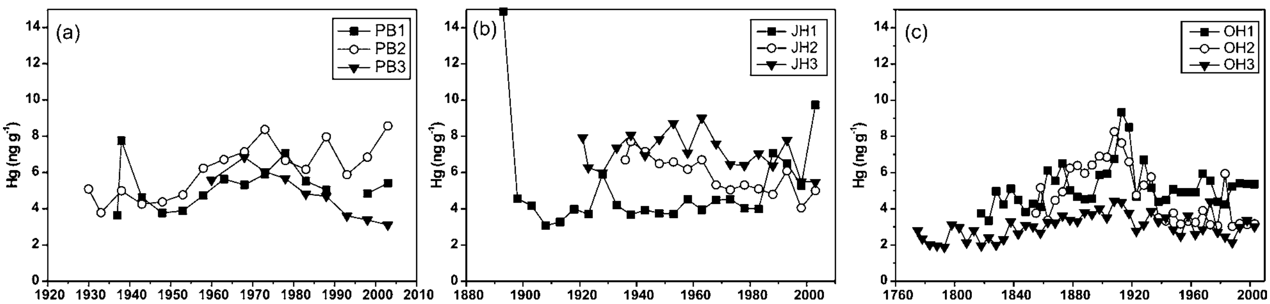
No. 526/08/0434: **Impact of soil structure on character of water flow and solute transport in soil environment** (R. Kodešová, M. Kutílek, M. Kočárek, M. Rohošková, L. Pavlů, Czech University of Life Science, Faculty of Agrobiology, Food and Natural Resources, Praha, Czech Republic & *A. Žigová*; 2008–2011)

Soil structure stability was studied in every diagnostic horizon of six soils (Haplic Chernozem on loess, Greyic Phaeozem on loess, Haplic Luvisol on loess, Haplic Luvisol on loess loam, Haplic Cambisol on paragneiss, Dystric Cambisol on orthogneiss) using different techniques investigating various destruction mechanisms of soil aggregates. Soil aggregate stability, assessed by the index of water stable aggregates (WSA), varied depending on the organic matter content, clay content and pH_{KCl}. Coefficients of aggregate vulnerability resulting from fast wetting (KV_1) and slow wetting (KV_2) tests showed similar trends of the soil aggregate stability as the WSA index, when studied for soils developed on the similar parent material. A close correlation was found between the WSA index and the KV_1 value, which depended also on the organic matter content, clay content and pH_{KCl}. Less significant correlation was obtained between the WSA index and the KV_2 value, which depended on the organic matter content and clay content. The KV_3 value depended mostly on cation exchange capacity, pH_{KCl} and organic matter content. High aggregate stability was found in both Cambisols although micromorphological images showed weakly developed soil aggregates.

■ **Fig. 17.** Vysoké nad Jizerou – Dystric Cambisol on orthogneiss (Photo by A. Žigová).

No. 526/09/P404: **Reconstruction of historical change in mercury deposition recorded in tree rings and tree bark pockets** (*M. Hojdová*; 2009–2011)

Mercury is considered to be one of the most important pollutants due to its ecotoxicological effects. Geochemical archives such as peat bogs, tree rings or lake sediments are widely used for the reconstruction of historical trends of environmental pollution. Metal mining and processing in the central Czech Republic led to contamination of surrounding soils and vegetation. Mercury concentrations were measured in tree rings from Norway spruce (*Picea abies* L.) and European beech (*Fagus sylvatica* L.) to monitor historical Hg deposition the area. The highest Hg concentrations (max. 15 $ng.g^{-1}$) were found in a spruce growing near the site contaminated by HgS smelting, probably reflecting smelting activities at the end of the 19^{th} century. In the vicinity of Pb smelter, Hg concentrations were increasing from the 1950s on, with maxima (max. 8.4 $ng.g^{-1}$) in the 1970s, corresponding to the peak metallurgical production and smelter emissions in the mid1970s. A decreasing trend in Hg concentration since the 1980s was probably related to the improvement of flue-gas cleaning technologies. Beech trees, studied at a site located between both smelters and ranging in age from 150 to 220 years,



■ **Fig. 18.** Concentrations of Hg in spruce tree rings (a) in the vicinity of a Pb smelter, (b) in the historical Hg ore mining area and (c) in an old beech stand in the vicinity of both previous sites (after Hojdová et al., in press).

seem to reflect deposition from both point sources. Mercury levels in beech trees were lower than in spruce, as a result of greater distance from the pollution sources, but the concentration trend strongly correlated with metal production. Analysis of basic cations (Ca, Mg, K and Mn) in wood revealed environmental changes related to emissions from smelting, but no relation between concentration trends of basic cations and Hg was documented. The present study showed that tree rings may provide a good record of the course in Hg deposition in the area affected by ore mining and smelting. Nevertheless, further research on Hg cycling in trees is necessary to interpret satisfactorily the historical record of Hg in this archive.

4c. Grant Agency of the Academy of Sciences of the Czech Republic

Finished projects

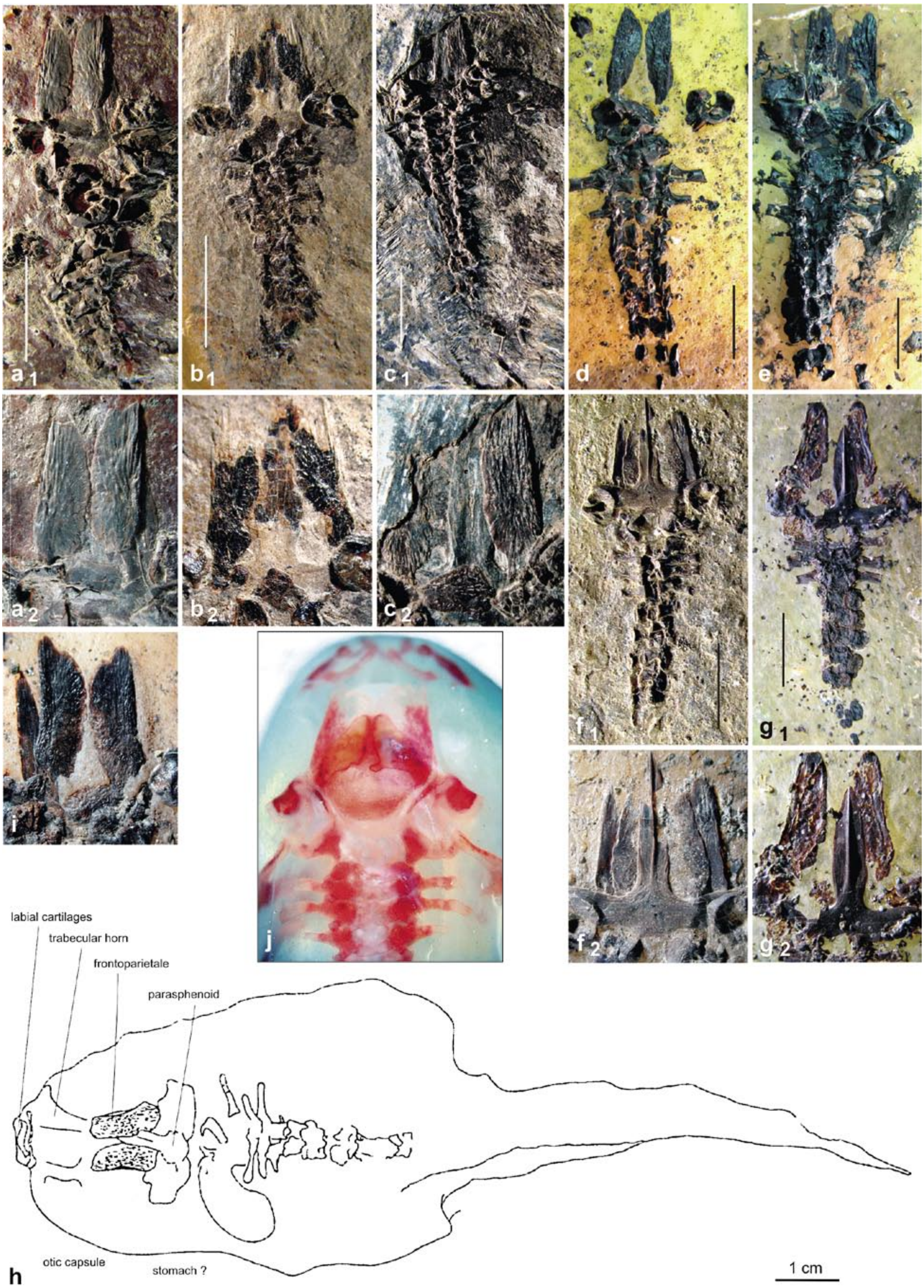
No. IAA300130705: **Larval development in the Oligocene frog Eopelobates (Pelobatidae) and general features of the development in fossil non-pipoid anurans** (*Z. Roček*; 2007–2009)

Main task of this project was to compare the developments of fossil and recent representatives of the family Pelobatidae, namely of *Eopelobates* from the Late Oligocene of the locality Bechlejovice (Czech Republic) and *Pelobates* from the Late Oligocene of the locality Enspel (Germany), with extant *Pelobates fuscus* (for comparisons, we used whole mounts that were cleared-and-stained by alizarine and toluidine blue) from central Europe. It turned out that although adults of fossil *Eopelobates anthracinus*, *E. bayeri* (and *E. wagneri* from the Eocene of Germany) are well discernible both from each other and from *Pelobates decheni*, the larvae are much more uniform and their taxonomic assignment is mainly inferred from associations with adults. Nevertheless, we found significant differences among the larvae of these taxa in the rate of their ossification. Besides reassessment of the larval development in the Pelobatidae, we were able to investigate, for the first time, larval development of the Ranidae, from the Lower Miocene of the locality Shanwang (Shandong Province, east China). The developmental series included pre-ossified stages which were identified on the basis of morphological peculiarities of their cartilaginous cranial skeleton. Some of the metamorphic individuals reach a large size, which is in contrast with the size of the adults.

The Amphibia from the Late Oligocene (MP 28) locality Enspel, Germany, are represented by two caudates – a hyperossified salamandrid *Chelotriton paradoxus* and an indeterminate salamandrid. Anurans comprise several specimens of the genus *Palaeobatrachus*, *Pelobates* cf. *decheni*, and one specimen of *Rana* sp. Besides these adults, however, there is a comparatively large series of tadpoles (Fig. 19) whose assignment to the Pelobatidae is clearly evidenced by tripartite frontoparietal complex. Most of them are premetamorphic larvae, few older ones pass metamorphosis but they do not exceed Gossner stage 42. One specimen is a large premetamorphic tadpole (no rudimentary limbs) with total body length of 147 mm. Anatomically, it can be equally assigned to *Pelobates* or to *Eopelobates*; the second possibility was excluded only on the basis of the absence of adult *Eopelobates* at the locality.

Fossil frogs from Shanwang (Middle Miocene; Shandong Province, China). Current revision of all available fossil anurans and their larval stages from the middle Miocene of Shanwang Basin (Shandong Province, eastern China) deposited in the collections of the Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, Museum of Shandong Province, Jinan, and Shanwang Paleontological Museum, Shanwang, revealed that most of these frogs belong to the Ranidae, namely to *Rana basaltica* Young, 1936 and some other, closely related forms. A series of tadpoles (Fig. 20) ranging from very early larval stages (stage 43 of Nieuwkoop and Faber) up to metamorphosing individuals (stage 57) made it possible to reconstruct basic features of their development. This is the first assessment

■ **Fig. 19.** *Pelobates* cf. *decheni*, larvae. a[1] – Specimen 1997-PW-5122, dorsal aspect. a[2] – Detail of its frontoparietal complex. b[1] – Specimen 1997-PW-5039b, dorsal aspect. b[2] – Detail of its frontoparietal complex. c[1] – Specimen 1997-PW-5048, dorsal aspect. c[2] – Detail of its frontoparietal complex. d – Specimen 2002-PW-5011, dorsal aspect. e – Specimen 2003-PW-5002, dorsal aspect. f[1] – Specimen 1997-PW-5121, ventral aspect. f[2] – Detail of the skull. g[1] – Specimen 1998-PW-5051, ventral aspect. g[2] – Detail of the skull. h – Premetamorphic giant tadpole of Pelobatidae, dorsal view. Deposited in the collections of the University of Mainz, uncatalogued. i – Frontoparietal complex of specimen 2002-PW-5010, dorsal aspect. j – Recent *Pelobates fuscus* (DP FNSP 6568), tadpole in metamorphosis, dorsal view. Ossified parts (dark) stained by alizarin. Scales represent 1 cm (after Roček & Wuttke 2010).



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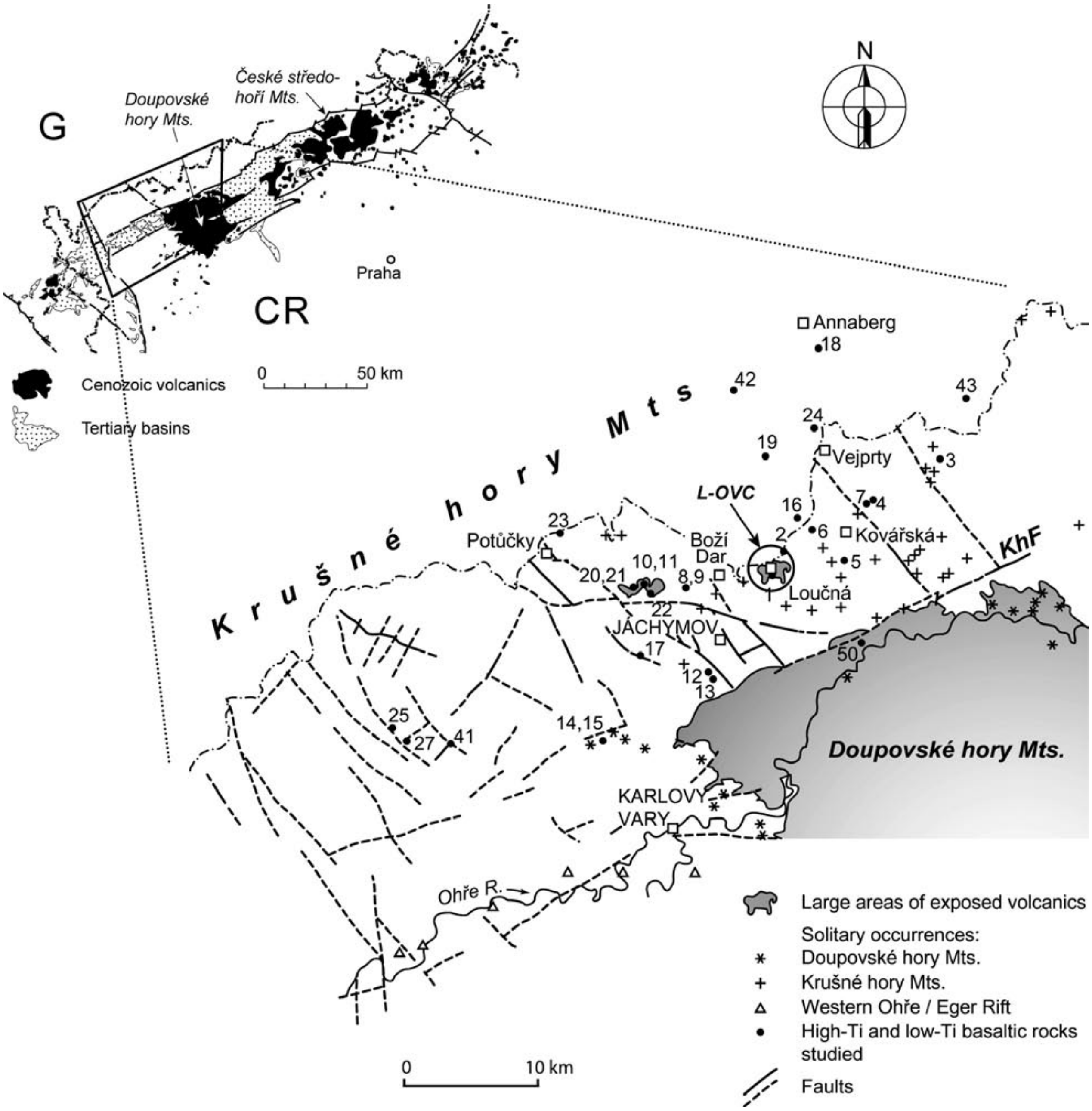
■ **Fig. 20.** Premetamorphic tadpoles of the Ranidae. a – SPM 9900016; b – SPM 2000001-1; c – SPM 9900009; d – SPM uncatalogued; e – SPM 9900010; f – SPM 9800001; g – SPM uncatalogued; h – SPM 9800008; i – SPM 9900040; j – SPM 9900008; k – IVPP V12357a; l – IVPP V12358a; m – IVPP V-14279a, arrow points to the vertebral column; n – SPM 2000001-2; o – SPM 2000007; p – SPM uncatalogued; q – SPM uncatalogued; r – MSPJ QiLin 09. s, t – Tadpoles of *Rana dalmatina* used for comparisons (s – NF stage 47; t – NF stage 51). All specimens, except for s and t, are in the same scale (from Roček et al., in press).

of the larval development of non-pipoid anurans, other than Pelobatidae. Besides, the holotype specimens of a giant pelobatid frog *Macropelobates cratus*, and of a bufonid *Bufo linquensis* were redescribed and illustrated. Since the latter two taxa were purchased from the local private collectors who did not provide precise stratigraphic information, an attempt was made at the locality to determine stratigraphic intervals from which the two specimens had been obtained.

No. IAA300130706: **Geochemistry, petrography, and rock magnetic properties of the high- and low-Ti alkaline basalts from intra-plate riftogenic setting** (*J.K. Novák*, *J. Ulrych*, *L. Ackerman*, *P. Pruner*, *R. Skála*, *G. Kletetschka*, *M. Lang*, Z. Řanda, J. Kučera, Institute of Nuclear Physics, Řež, Czech Republic, E. Jelínek & M. Mihaljevič, Faculty of Science, Charles University, Praha, Czech Republic; 2007–2009)

The close association between intra-continental rifting and bimodal alkaline volcanism is well established, but the high-Ti basaltic rocks, medium-Ti phonotephrite, and some of the alkaline lamprophyres (monchiquite), all spatially associated, are considered extraordinary. This unique region with the satellitic subvolcanic bodies (eroded basaltic lava flows and vents) is located around the Loučná-Oberwiesenthal composite paleovolcano and in the close vicinity of maar structure at České Hamry, western Krušné hory/Erzgebirge (Fig. 21). This region is also associated with the boundary between the Saxothuringian and the Teplá-Barrandian terranes and is highly faulted. Volcanic



■ **Fig. 21.** Geological map showing the distribution of anomalous basaltic rocks within the western Krušné hory Mts. (Bohemia/Saxony; after Schnabl et al. 2010). Abbreviations: L-OVC – Loučná–Oberwiesenthal Volcanic Complex, Khf – Krušné hory fault.

activity is closely linked with the Krušné hory Mts. Fault Zone, and particularly with its intersection with the transverse Jáchymov Deep Fault Zone.

Local enrichment of low-Ti nephelinites in TiO_2 is related to the effects of mixing/mingling with the alkali pyroxenite–ijolite xenoliths, as shown at Loučná–Vyhlídka. Due to the existence of deep crustal/lithospheric alkaline complex, alkali pyroxenite in composition, the xenoliths are also found in high-Ti (mela)nephelinites and (phono)tephrites.

The hypothesis that specific high-Ti (mela)nephelinites (3.8–5.9 wt. % TiO_2) and medium-Ti evolved phonotephrites (2.3–3.5 wt. % TiO_2) represent melts derived from the modally metasomatized lithospheric mantle, was tested geochemically. Unlike in the primitive mantle melts, a higher degree of fractionation has resulted in a marked decrease in compatible element contents (Cr, Ni, Co), in an increase in incompatible elements, and lowered Mg # (44–59). Spider-diagrams for selected samples of both (mela)nephelinite and phonotephrite display broadly similar patterns with a large negative trough at K. They are LILE-enriched (Ba, Th, U) and show elevated HFSE (Nb,Ta, Zr, Hf and Ti) and LREE (La, Ce, Nd, Sm) concentrations compared to primitive mantle. Steeply dipping HREE patterns as well as low HREE contents indicate residual garnet in a garnet lherzolite mantle source. The incompatible element ratios, such as Ba/Nb and La/Nb, are generally OIB-like.

The $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ isotope ratios for (mela)nephelinite and phonotephrite show overlapping values. They vary between $Sr_i = 0.7034$ and 0.7039 suggesting a consistency with mantle source of the HIMU affinity. They plot on the array between the depleted mantle (DM) and HIMU, and enriched mantle similar to EM-1. A much wider range in εNd_i (0.00 to +4.9) possibly represents an assimilation-fractional crystallization process, particularly for phonotephrite. The Sr and Nd isotopic values for phonotephrite are identical to those of their mafic counterparts, precluding an origin by weak contamination of mafic magma by radiogenic crust and intracrustal alkali pyroxenite chamber.

As a group, the temporal evolution (by K/Ar radiometric dating) suggests at least the existence of two bimodal suites and that of the youngest independent suite: (1) Late Eocene–Middle Oligocene (33–28.5 Ma) suite, low-Ti (mela)nephelinitic to phonolitic in composition for the Loučná–Oberwiesenthal Volcanic Centre (LOVC), with two high-Ti melanephelinite bodies at Rudná Hill near Potůčky village and Velký Špičák Hill near Kovářská village; (2) Late Oligocene to Middle Miocene (25.8–11.9 Ma) suite, which is high-Ti melanephelinitic and (phono)tephritic in composition; it is mostly characterized by solitary bodies located in the vicinity of Kovářská, Vejprty, Annaberg, Boží Dar, Jáchymov, and Abertamy, and (3) the youngest low-Ti basanite and olivine-bearing nephelinite suite (± peridotite xenoliths), which was derived from an independent mantle source. It lies on the distal periphery at Děpoltovice and Rotava, implying spatial – temporal migration of volcanic activity toward the west.

Coexisting dominant $Ti\text{-}Fe^3$ diopside and ulvöspinel-rich titanomagnetite are principal hosts for the titanium in the high-Ti melanephenilite and medium-Ti (phono)tephrite bodies. Further Ti-bearing phases involve kaersutite, Ba-Ti phlogopite, perovskite, titanite, ilmenite, and low-Ti titanomagnetite with Cr-spinel core.

To identify the behavior of titanomagnetite as a dominant magnetic carrier in selected rocks, the rock-magnetic experiments were combined with magnetic mineralogy data of a) the high-Ti melanephelinite, b) medium-Ti (phono)tephrite, and low-Ti basanite. These experiments included: (1) continuous susceptibility measurements at low temperatures (from -192 °C to room temperature); (2) those at high temperatures (from room temperature to 700 °C), and (3) hysteresis measurements. The low temperature variation of susceptibility provides an almost exponential increase without inflection points for most samples (see Fig. 22). This behavior is typical for paramagnetic Ti-rich titanomagnetite (Moskowitz et al. 1998). In the high-temperature regime, the heating and cooling *k-T* curves are not perfectly reversible, which may be due to the oxidation of titanomagnetite into ilmenite and magnetite. Only three samples show reversible results, with unchanged magnetic susceptibility before and after heating (e.g., sample TiB-19).

The content of substituted titanium in titanomagnetite structure is also reflected in the Curie temperature *Tc*. Representative *k-T* curves for almost all studied samples are relatively similar, demonstrating the thermally induced magnetization and titanomagnetite oxidation. Two prominent humps *(Tc1*= at 200–320 °C and *Tc2* = 500–580 °C) frequently occur. The influence of tiny magnetite, which originated by breakdown of olivine (e.g., that in both basanite and olivine nephelinite) seems to be negligible.

While the pure magnetite is field-independent, the AC field-dependence parameter of *kHD* for the studied rocks ranges from 5.3 to 18.6 %, corresponding with an increasing TiO2 content in the magnetite – ulvöspinel system. A moderate positive correlation was found between ulvöspinel and/or hercynite componets in titanomagnetite and filed-dependent susceptibility *kHD*. A lower degree of correlation is caused by the small variability in ulvöspinel component. The parameter *kHD* for sample TiB-19 is exceptionally low (*kHD* = 0.86 %), showing the presence of low-Ti titanomagnetite.

Two distinct compositions from present populations of titanomagnetite can be generally recognized using microprobe analyze: (i) titanomagnetite composed of dominating ulvöspinel, magnetite and (magnesioferrite), and (ii) that of dominating ulvöspinel, magnesioferrite and (magnetite) end-members. As an exception, Cr-rich spinel with a variable proportion of oxides, such as Cr_2O_3 (19.4–34.5 wt. %), Al_2O_3 (12.8–18.5 wt. %), MgO (6.7–9.9 wt. %), and TiO_2 (0.12–8.2 wt. %), is wholly mantled by titanomagnetite in two of samples.

Magnetic susceptibility variations of Ti-rich titanomagnetite (12.7–20.1 wt. % TiO_2) are reflected in the Curie temperature (*Tc*) which was measured in the heating/cooling cycles.

Magnetic hysteresis data document that most samples have pseudo-single domain (PSD) and multi-domain state, while two samples of basanite contained a mixture of superparamagnetic (SP) and single-domain particles (Schnabl et al. 2010).

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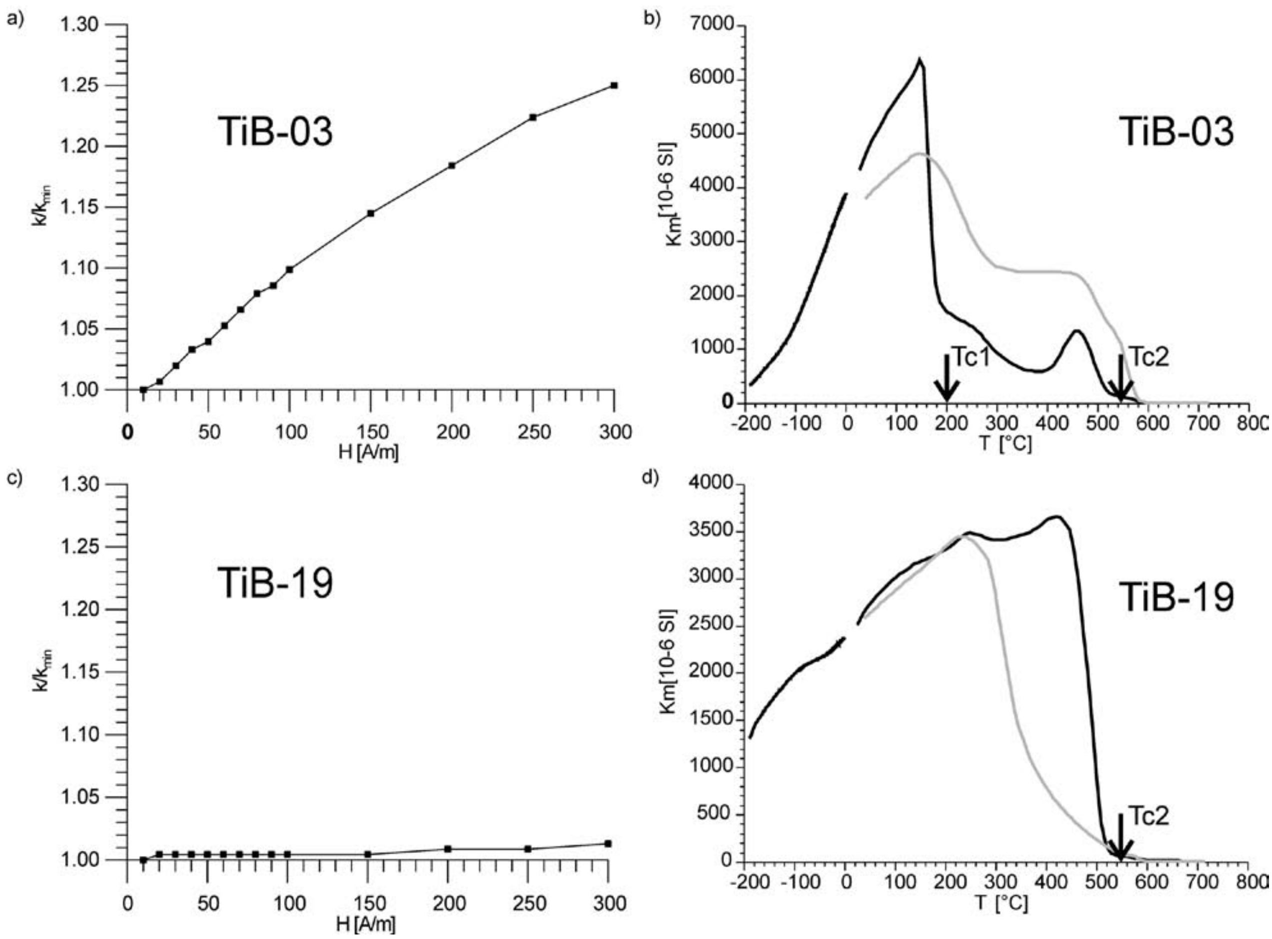


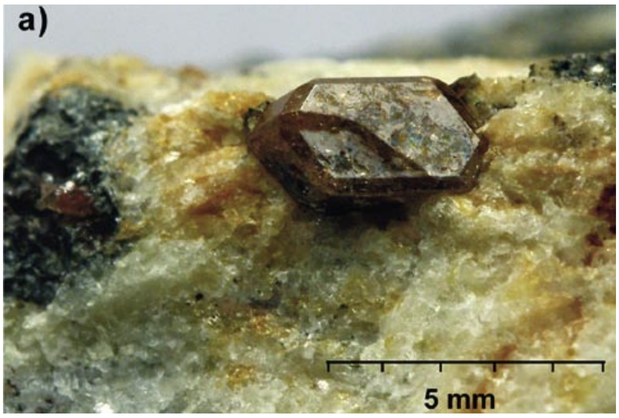
Fig. 22. Representative curves of temperature and field variations of magnetic susceptibility for two different Ti-rich (mela)nephelinite samples (after Schnabl et al. 2010).

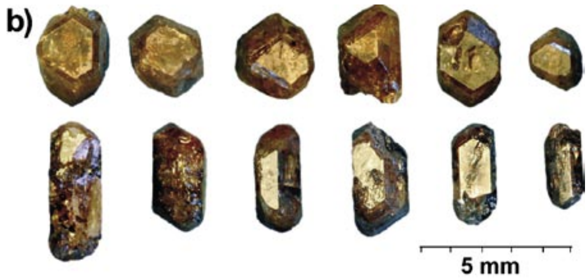
high-Ti basaltic rocks from the Krušné hory/Erzgebirge Mts. (Bohemia/Saxony), and their relation to mineral chemistry. – *Studia Geophysica et Geodetica*, 54, 1: 77–94.

No. KJB300130701: **Zircon growth and its modification during polyphase granulite-facies metamorphism – case study in the Moldanubian Zone of the southern Bohemian Massif** (*J. Sláma*, *M. Svojtka*, J. Haloda, P. Týcová & J. Košler, Czech Geological Survey, Praha, Czech Republic; 2007–2009)

In the southern part of the Bohemian Massif in the Czech Republic, the Moldanubian Zone consists of several crustal segments with different polyphase thermotectonic histories. Structurally highest unit of the Moldanubian Zone is the Gföhl Unit, which is composed of a heterogeneous assemblage of high-pressure crustal and upper mantle rocks (granulites, peridotites, pyroxenites and eclogites) exhumed during Variscan orogeny. The studied zircon samples come from the Blanský les granulite Massif (BLGM; part of the Gföhl Unit) located SW of the town of České Budějovice. The Blanský les granulite Massif is the largest body of the granulite facies rocks in the southern part of the Bohemian Massif and contains mainly calc-alkaline high-pressure felsic garnet ± kyanite granulites with subordinate mafic pyroxene-bearing granulites, banded garnet-biotite and K-feldspar gneisses and garnet peridotites. Further, the felsic granulites contain deformed discordant leucocratic garnet-K feldspar layers (dykes) and felsic granulites are cut by late intrusions of deformed muscovite- and biotite-bearing granites. The age of granulite-facies metamorphism in the Moldanubian Zone of south Bohemia is well constrained by number of U-Pb zircon and monazite ages at ca. 340 Ma. This age has been interpreted as a peak of HP-HT metamorphism, or alternatively, as the age of zircon crystallization from partial melt during decompression along the retrograde P-T path.

We have employed combined U-Pb and Hf *in situ* laser ablation ICP–MS isotopic analyses of zircons from various rock types from BLGM. Uranium, lead and hafnium isotope measurements were performed with Thermo Finnigan Neptune multi-collector ICP–MS coupled to the New Wave Research UP-213 laser system. The CL and BSE images of studied zircons indicate complexly zoned zircon grains, many of which reveal core and rim structures with patchy patterns which occasionally transect the zircon zoning. Zircon U-Pb spot analyses of individual domains gave a wide range of apparent ages. Zircon U-Pb dating indicates that the zircon cores of felsic granulites are probably scattered between protolith intrusion (up to ca. 600 Ma) and HP metamorphism at ca. 340 Ma, while pyroxene-bearing granulites yielded only ages of ca. 340 Ma. The εHf(t) values for pyroxene-





■ **Fig. 23.** a) Large, short prismatic crystal of the Plešovice zircon in K-feldspar matrix of the host potassic granulite; b) typical crystal shapes of the Plešovice zircons with prevailing equant morphology (top) and less common prismatic morphology (bottom); after Slama et al. 2008.

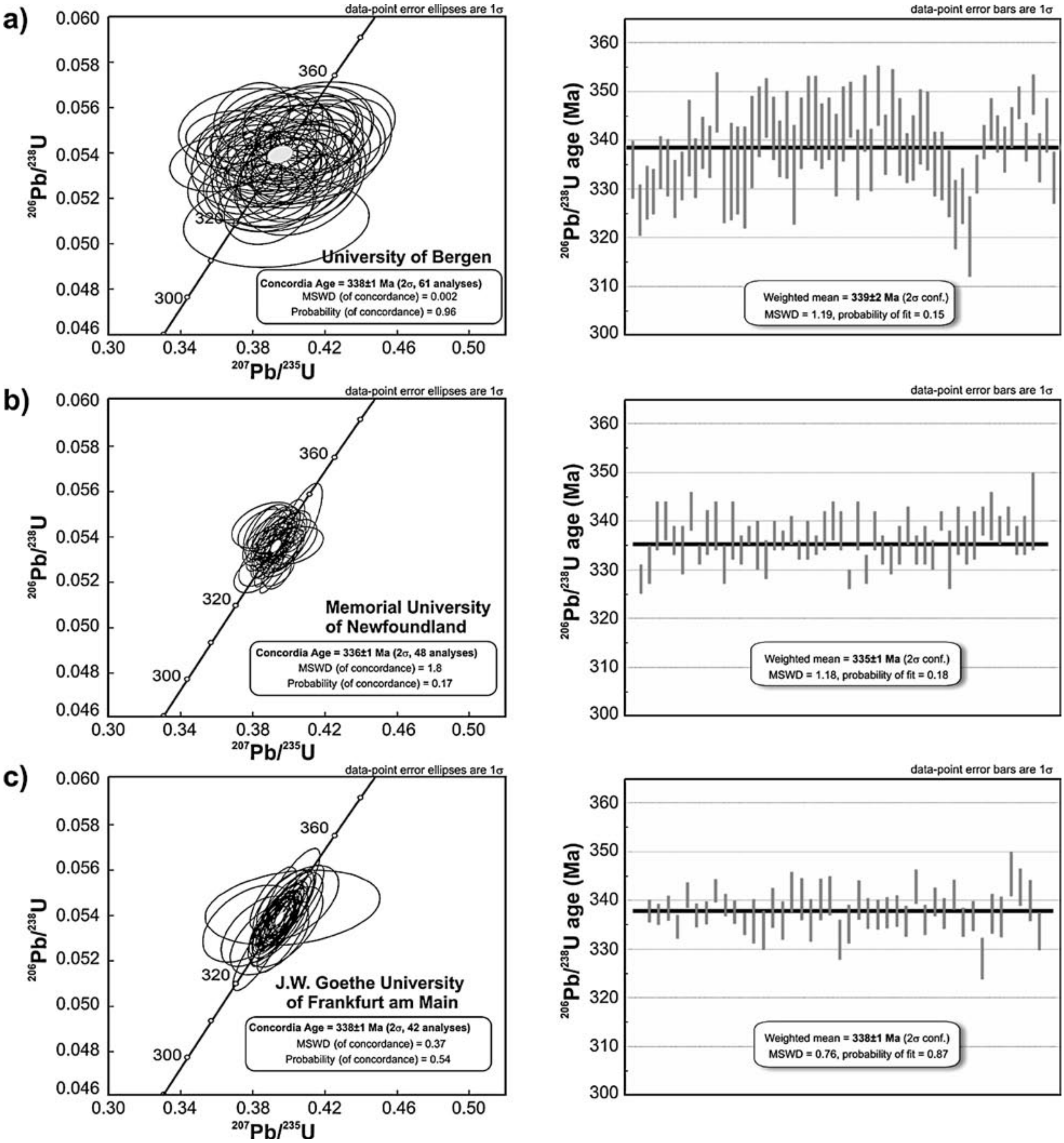


Figure 24 caption – see next page.

bearing granulites vary from slightly positive (+2 to +6) to negative values of ca. –7, and from +1 to –18 are for felsic granulites. Combining the zircon ages with εHf(t) data suggests either mixing of mantle-derived magma with older crust or recycling of an older crust.

As a part of the project, a compilation of structural, trace element and isotopic data of zircon from a potassic granulite that occurs in the BLGM (Plešovice quarry) in the southern Czech Republic has been obtained. This zircon (Fig. 23) is now being used as a new natural standard material for U-Pb and Hf isotopic microanalysis by laser ablation inductively coupled plasma mass spectrometry (LA ICP–MS).

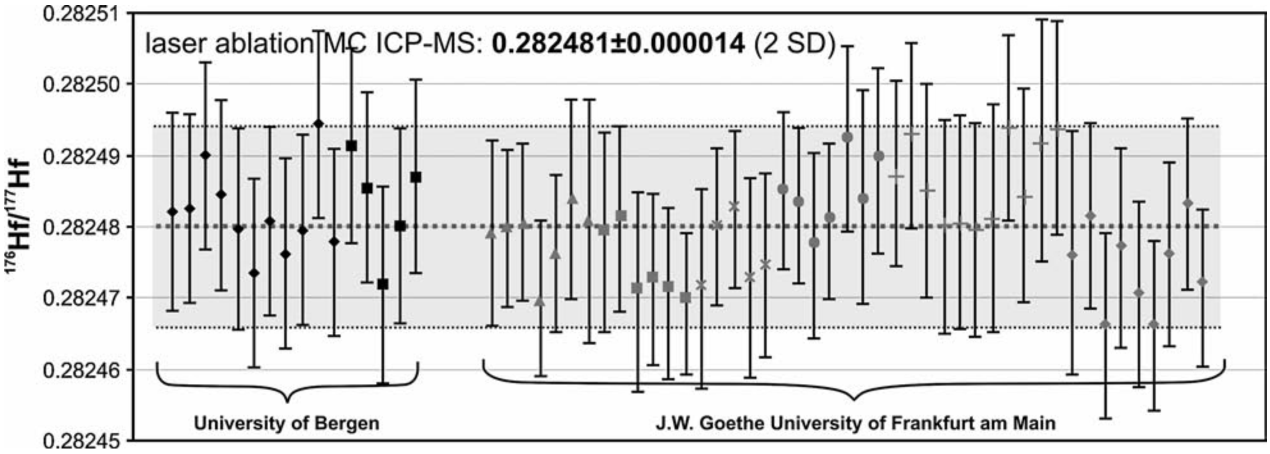
Data obtained by different techniques (ID–TIMS, SIMS and LA ICP–MS; Fig. 24) in several laboratories suggest that the Plešovice zircon has a concordant U-Pb age with a weighted mean $^{206}Pb/^{238}U$ date of 336.9 ± 0.2 Ma (ID–TIMS, 95% confidence limits) and U-Pb age homogeneity on the scale used in LA ICP–MS dating. This date is on average by ca. 1 My younger than the previously reported U-Pb date of zircon from this potassic granulite.

Solution and laser ablation multicollector (MC) ICP–MS analyses of a multigrain sample of the Plešovice zircon (>0.9 wt. % Hf) suggest a homogenous Hf isotopic composition within and between the grains (Fig. 25). The low Lu/Hf (up to 0.001) and Yb/Hf (up to 0.005) ratios in the zircon result in only a small influence of the choice of isobaric interference correction procedure on the value and uncertainty of the corrected $^{176}Hf/^{177}Hf$ ratios.

The mean $^{176}Hf/^{177}Hf$ value of 0.282481 ± 0.000013 (2SD) is considered as the best estimate of the Hf isotopic composition in the Plešovice zircon. At this stage of characterization, the homogeneity of Hf isotopic composition in the Plešovice zircon is superior to other natural zircon standards used for laser ablation ICP–MS analysis.

Raman spectroscopy, optical and BSE imaging and trace element analysis revealed the presence of strongly radiation-damaged domains in ca. 10 % of the studied Plešovice zircon grains. These domains are rich in actinides (up to ~3,000 ppm U and up to ~520 ppm Th) and appear as bright patches on BSE images that can be easily avoided during the laser ablation ICP–MS analysis. Although there has been no significant Pb loss found in these zones, they should be avoided during routine laser ablation ICP–MS analysis because of likely space charge effects and different ablation properties. Similarly, occasional inclusions of K-feldspar and apatite can be easily identified in optical microscope and avoided during the analysis.

Despite the significant variations in trace element contents that preclude the use of the Plešovice zircon as a standard/reference material for *in situ* trace element analyses, the age and Hf isotopic homogeneity of the Plešovice zircon together with its relatively high U and radiogenic Pb contents makes it an ideal calibration and reference material for laser ablation ICP–MS measurements, especially when using low laser energies and/or small diameters of laser beam required for improved spatial resolution.

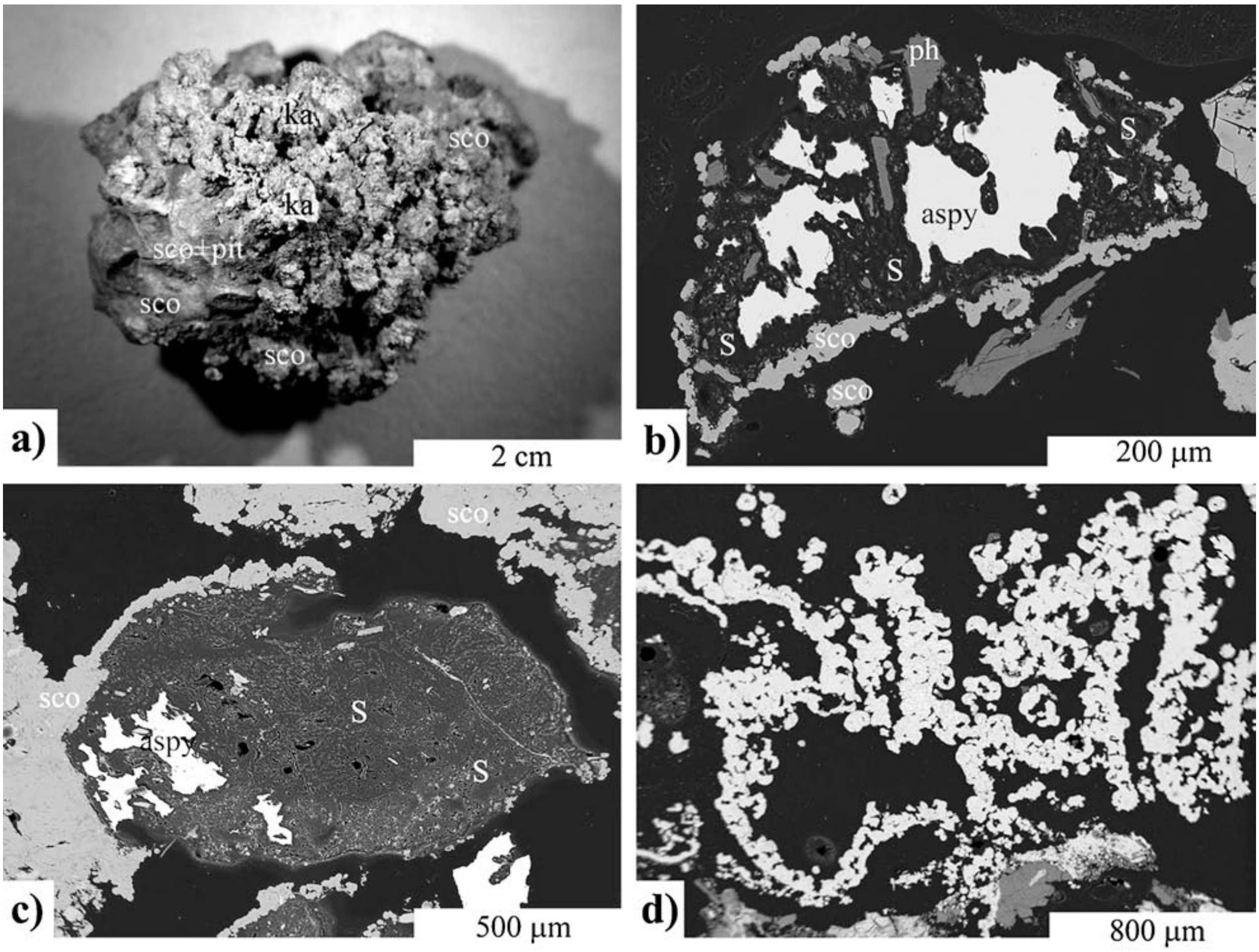


■ **Fig. 25.** Hf isotopic composition of the Plešovice zircon sample obtained by laser ablation MC ICP–MS analyses. The mean $^{176}Hf/^{177}Hf$ composition with 2σ uncertainty for all analyses is shown as gray shaded area. Different symbols indicate individual zircon grains (after Slama et al. 2008).

■ **Fig. 24.** Laser ablation ICP-MS U-Pb ages obtained at: a) University of Bergen, b) Memorial University of Newfoundland and c) J.W. Goethe University of Frankfurt am Main. Concordia plots are on the left and $^{206}Pb/^{238}U$ dates are on the right. Error ellipses in the concordia plots and error bars on the $^{206}Pb/^{238}U$ plots are 1σ, Concordia age ellipses (filled in gray) are 2σ. Note the differences in uncertainties of individual data between a) and b), c) which is a result of different data reduction procedures used by individual laboratories (after Slama et al. 2008).

No. KJB300130702: **Speciation and mobility of arsenic in the soil-water system in locality affected by historical mining** (*M. Filippi* & *P. Drahota*; 2007–2009)

This project was aimed at speciation and mobility of arsenic in soil and waste of the Giftkies medieval mining dump that is located in the NW part of the Jáchymov ore district (NW Bohemia). Analyses of arsenic contents in groundwater and solids in soil and waste dump environment were integrated with detailed mineralogical and geochemical observations and specia-



■ **Fig. 26.** Typical arsenate nodule composed of complex arsenate matter and surficial crusts (a); backscattered electron micrographs of the studied mineral phases: (b) arsenopyrite partly replaced by native sulphur and rimmed by scorodite; (c) arsenopyrite totally replaced by native sulphur and partly rimmed by scorodite; (d) kaňkite aggregates (the light phase). Abbreviations: aspy – arsenopyrite, ka – kaňkite, S – native sulphur, sco – scorodite, ph – aluminosilicates, pit – pitticite (modified from Filippi et al. 2009).

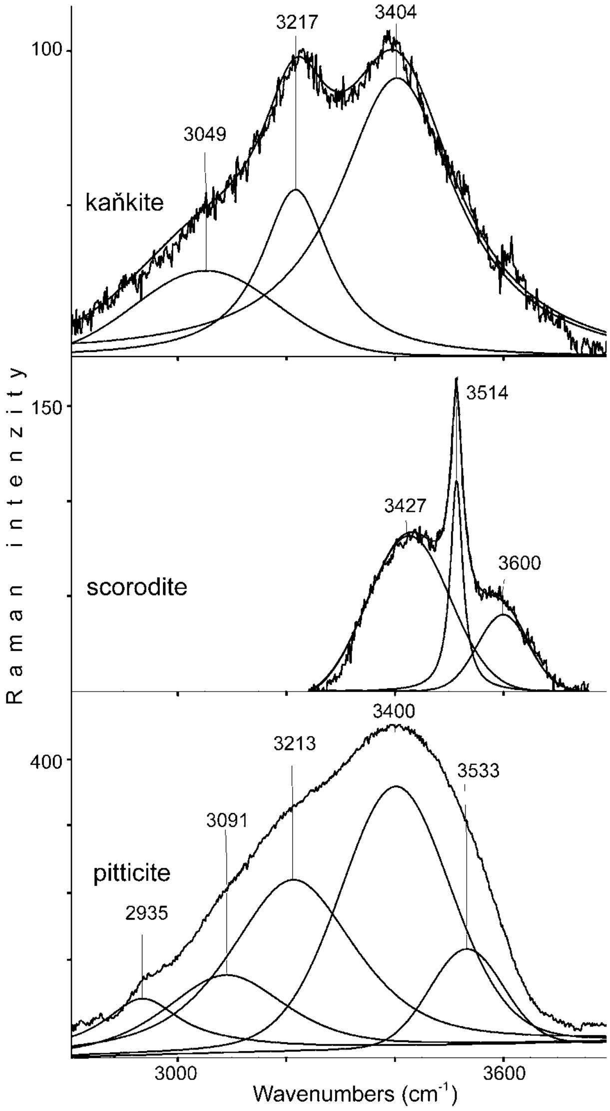
tion analyses. Eleven shallow probes and five deeper profiles were excavated to document and sample soils and mine dump material.

The main arsenic carriers in the dump (scorodite, kaňkite, pitticite and less frequently also As-goethite and As-jarosite) were determined and characterized by X-ray diffraction (XRD), Raman micro-spectroscopy and electron microprobe analysis (EMPA). During the project we demonstrated that combined application of XRD, EMPA and Raman micro-spectroscopy is an available and powerful approach for the identification and characterization of iron arsenate minerals in complex environmental samples. Scorodite and kaňkite form mixed nodules and crusts, which are locally coated by hardened gel-like amorphous pitticite. Pitticite also borders fractures in the mineralized rock fragments in the dump. The Raman spectra presented in the paper can serve as comparative data for phase identification in other contaminated areas. New Raman data for the hydroxyl stretching region of scorodite (important bands: 3,514, 3,427 and 3,600 cm^{-1}) and the whole Raman spectrum for pitticite (important bands: 472, 831, 884, 2,935, 3,091, 3,213, 3,400 and 3,533 cm^{-1}) are a valuable output of this project. The stalactitic forms of some arsenates point at mobility of As-rich solutions and latter precipitation of arsenic secondary products in the body of the mine dump. Arsenic speciation in goethite and other ferric oxyhydroxides absolutely prevails in soil samples. The highest arsenic contents (up to 13 wt.%) were determined in the dump material. Much lower arsenic contents (up to 0.6 wt.%) were determined in soils below the dump and these contents are similar to those determined in soils outside the mining area. This finding points to low arsenic mobility, although the arsenic source (mining dump) is located on a steep slope and in the area with high annual precipitation.

Arsenic speciation was studied using selective leaching by the following reagents: (1) $[(NH_4)_2SO_4]$ – representing the free bonded arsenic; (2) $[(NH_4)_2HPO_4]$ representing the specifically sorbed arsenic, and (3) $[(NH_4)_2C_2O_4/H_2C_2O_4]$ representing arsenic strongly bound namely in amorphous and crystalline ferric oxyhydroxides and also in arsenates as was proved by this project. Arsenic contents in all three extractions positively correlate with the total arsenic contents. The results show that the most significant amounts of arsenic are bound in positions that are leachable by the oxalate as the strongest reagents (leaching step 3). This is in accord with the mineralogical findings when arsenates and ferric oxyhydroxides are well soluble in oxalate step. Arsenic extracted by the second extraction step is usually more significant in soils, compared to the samples from mining dump, which point at arsenic adsorption in such positions that enabled arsenic mobilization by competitive ions like phosphorus.

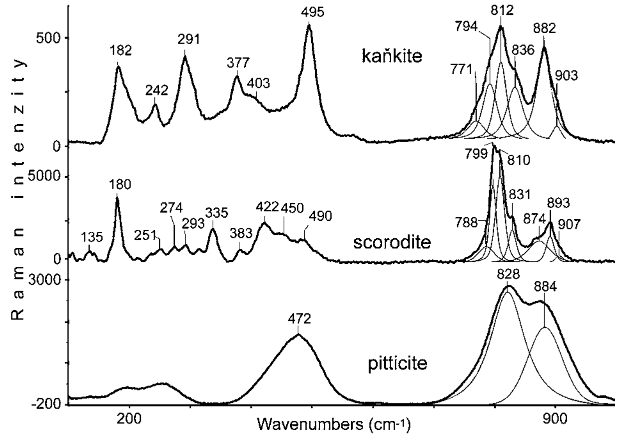
Stability of the arsenate minerals was investigated by a set of solubility experiments. The same reagents were used as for the leaching experiments of the whole samples. Amorphous arsenate (pitticite), scorodite, ferrihydrite and schwertmannite doped by arsenic(V) were prepared synthetically and used for experiments. The following congruent solubility rate was determined in the oxalate extraction (with pH = 3): pitticite, schwertmannite, ferihydrite and scorodite. Arsenic release in the phosphate and sulphate extractions was incongruent, probably due to combination of dissolution and ion exchange.

Groundwaters were sampled *via* four suction lysimeters that were installed in the mining dump and in surroundings soils.



■ **Fig. 27.** Comparison of the Raman spectra and curve fitting in the hydroxyl stretching region of the studied arsenates (range between 2,800 and 3,800 cm^{-1}; modified from Filippi et al. 2009).

The arsenic speciation was measured by HG–CT–ICP–OES (hydride generation-cryogenic trapping-optical emission spectrometry) that was made during the project. All analyses showed only the presence of inorganic arsenic(V). The absence of arsenic(III) is in agreement with the PHREEQC modeling. This result excludes potential influence of the microbial activity in the studied samples. Chemical analyses of the mining dump material showed that the content of the dissolved arsenic is controlled by the scorodite solubility (from 1.4 to 2.8 mg.l^{-1} of arsenic, in pH 3.3 to 4.1). Chemical analyses of the soil samples indicate very low contents of the dissolved arsenic. The highest concentration (112 µg.l^{-1}) was found in soil below the mining dump, however, other data from soil water showed much lower arsenic contents (usually below 20 µg.l^{-1}). The reason for such low concentrations of the dissolved arsenic is the strong sorption affinity of arsenic(V) onto Fe(III) oxyhydroxides (namely goethite).

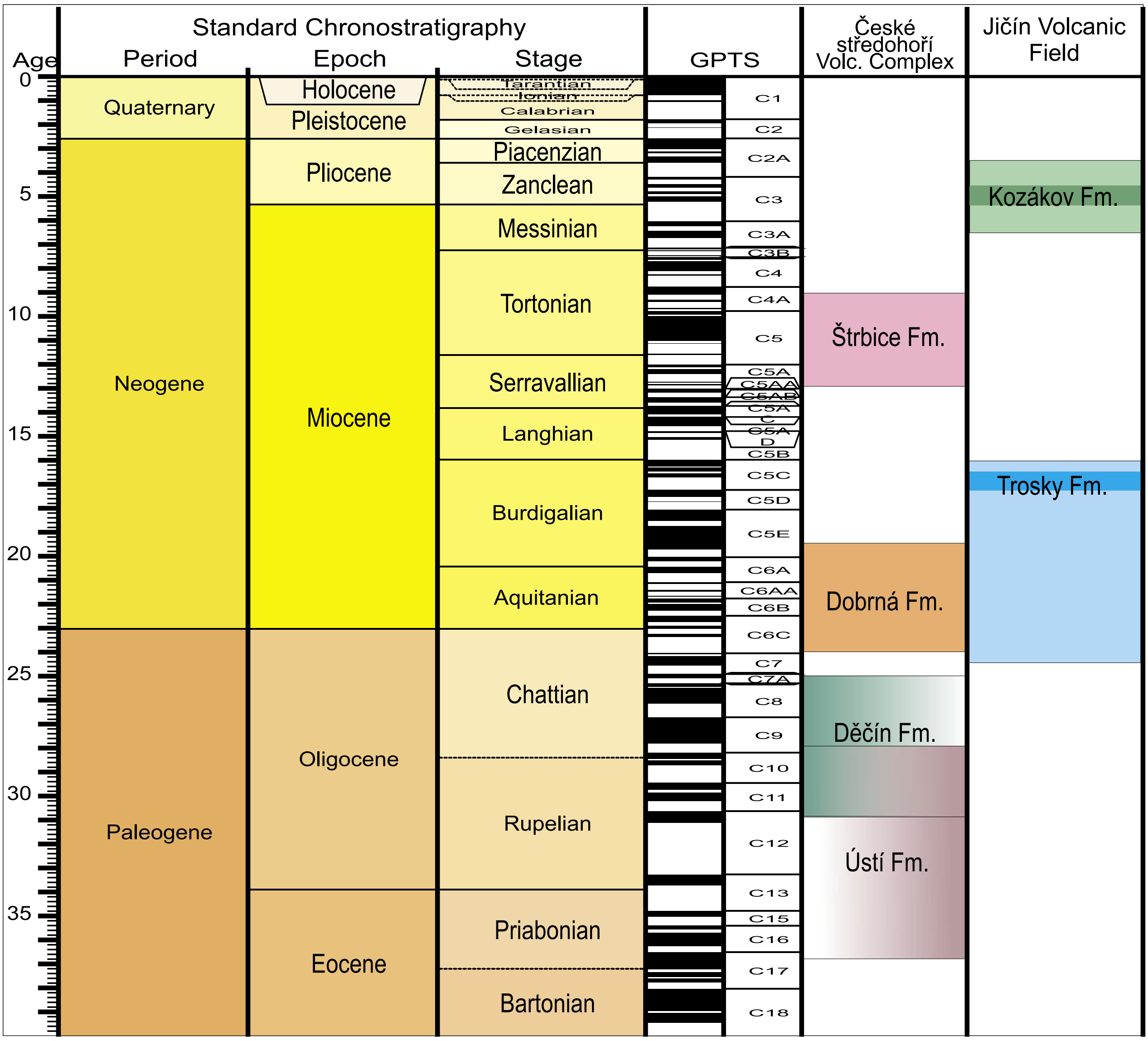


■ **Fig. 28.** Raman spectra of the arsenates in the range between 100 and 1,000 cm^{-1} including the curve fitting in the AsO_4 stretching region (modified from Filippi et al. 2009).

Continued projects

No. IAA300130612: **Combined magnetostratigraphic studies of Cenozoic volcanics, Bohemian Massif** (*V. Cajz*, *J. Dašková*, *M. Chadima*, *P. Pruner*, *P. Schnabl*, *S. Šlechta*, *J. Ulrych*, *D. Venhodová*; F. Holub, F. Hrouda, V. Rapprich & V. Tolar, Faculty of Science, Charles University, Praha, Czech Republic; 2006–2010)

Based on complex research, the stratigraphy of Cenozoic volcanics in the territory of Eastern Bohemia was proposed (Cajz et al. 2009a). Two formations were distinguished: Trosky Fm. (Upper Miocene; 15.7–18.3/24.6? Ma), and Kozákov Fm. (Lower Pliocene; 4.6–5.2 Ma). Both of them are represented by products of Strombolian- or phreatomagmatic-type volcanic activity with preserved relics of cinder/tuff cones and filled maar craters (Trosky Fm.) and lavas with their feeder (Kozákov Fm.). Accuracy of radiometric data of the volcanic activity was evaluated using results of paleomagnetic research. Thus, the former time span of more than 3 Ma for the activity of one Strombolian volcano (Prackov feeder of Kozákov Fm. lavas) could be reduced to 0.5 Ma, which corresponds to this type of volcanic activity.



■ **Fig. 29.** The defined Cenozoic volcanic formations of the Bohemian Massif and their mutual relationships. Shortening of the duration of the activity inside the Kozákov and Trosky fms. is demonstrated in the right column. The questionable overlap of the Děčín and Ústí fms. is visible on the left (after Cajz et al. 2009).

Formerly proposed lithostratigraphy of the České středohoří Mts. Volcanic Complex (CSVC) was elaborated by extending the knowledge of the youngest volcanism of this region. Three new superficial bodies of Late Miocene volcanic activity were found in the western part of CSVC and described in detail (Cajz et al. 2009b). Their K-Ar ages (9.59 ± 0.36 Ma, 9.61 ± 0.51 Ma and 11.36 ± 0.42 Ma) correspond to the age of alkaline basaltic rocks of the youngest known Intrusive System of this area (Štrbice Fm.). Unlike the previously known subvolcanic bodies of this system, the newly observed bodies are represented by superficial products: two scoria cones with remnants of lava flows and one exclusive lava flow produced from a lava cone. Magmas forming all three occurrences correspond to basanite. Their chemical and Sr-Nd isotope compositions ($^{87}Sr/^{86}Sr$ 0.703486–0.703624 and $^{143}Nd/^{144}Nd$ 0.512799–0.512850) are similar to those of the products of two preceding basanite formations (Ústí Fm. and Dobrná Fm.). Their scoria cones suggest an eruptive style for this youngest formation. The presence of superficial products of this volcanic formation, together with clear superposition relations to sedimentary formations and the chemical character of the youngest magmas in the central part of the Eger Graben support the stratigraphic scheme of volcanic activity in the České středohoří Mts. (Cajz 2000) and offer a comparison with other Tertiary volcanic products on the Bohemian Massif (see Fig. 29). These youngest eruptions were purely magmatic (Strombolian) with no phreatic influence. Now, the recent definition of the Štrbice Fm. is fully comparable to other formations of the CSVC.

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CAJZ V., RAPPRICH V., ERBAN V., PÉCSKAY Z. & RADOŇ M. (2009a): Late Miocene volcanic activity in the Čes-

ké středohoří Mountains, Ohře (Eger) Graben, northern Bohemia. – *Geologica Carpathica*, 60, 6: 519–533.
CAJZ V., RAPPRICH V., SCHNABL P. & PÉCSKAY Z. (2009b): Návrh litostratigrafie neovulkanitů východočeské oblasti (A proposal on lithostratigraphy of Cenozoic volcanic rocks in Eastern Bohemia). – *Zprávy o geologických výzkumech v roce 2008*: 9–15. Praha.

No. IAA300130701: **Paleomagnetic research of karst sediments: paleotectonic and geomorphological implications** (*P. Bosák*, *P. Pruner*, *G. Kletetschka*, *O. Man*, *A. Langrová*, *S. Šlechta*, *P. Schnabl*, *D. Venhodová*, *R. Skála*, *S. Čermák*, *J. Wagner*, N. Zupan Hajna, A. Mihevc, Karst Research Institute, SRC SASU, Postojna, Slovenia & I. Horáček, Faculty of Science, Charles University, Praha, Czech Republic; 2007–2011)

The cave system of the Postojnska jama–Planinska jama and a number of other smaller caves contain rich and lithologically diversified cave fill, ranging from autogenic speleothems to allogenic fluvial sediments. The most common clastic sediments from the studied sites are fine-grained (lutitic) laminated sediments (laminites). They were deposited from suspension from waning floodwaters or other pulsed flow or as a result of ponding due to the blockage of outflow routes. The prevalence of a lutitic clastic component indicates low dynamics in the catchment area and/or the fact that the coarse-grained load was already deposited. The deposition of fine-grained material was due to the regular flooding, characteristic for sinking rivers. Homogeneity of paleomagnetic data may indicate fast and continuous deposition during short-lasting (few thousand years) single-flood events. Depositional style was favourable for record of short-lived excursions of the paleomagnetic field, which is rarely reported from cave deposits.

Mineral composition of the studied fluvial sediments indicates that the catchment area of allogenic streams was situated on weathered flysch rocks in the Pivka Basin for a very long time. The uniformity of mineral and petrologic compositions found in all studied profiles resulted from homogenization before the sediment deposition in caves and from multiple reworking and re-deposition in the subsurface. The *in situ* weathering inside the cave was also detected.

Numerical dating identified speleothem growths within many phases. Coatings of flood loams inside stalagmites dated repeated flood events in some parts of the cave system. Some dates clearly indicate a substantial age of the underlying cave sediments. The sediments, especially at several sites of the Postojnska jama, and dating of speleothems, even if the errors are large, show some clear phases of erosion and collapsing alternating with sediment and flowstone deposition.

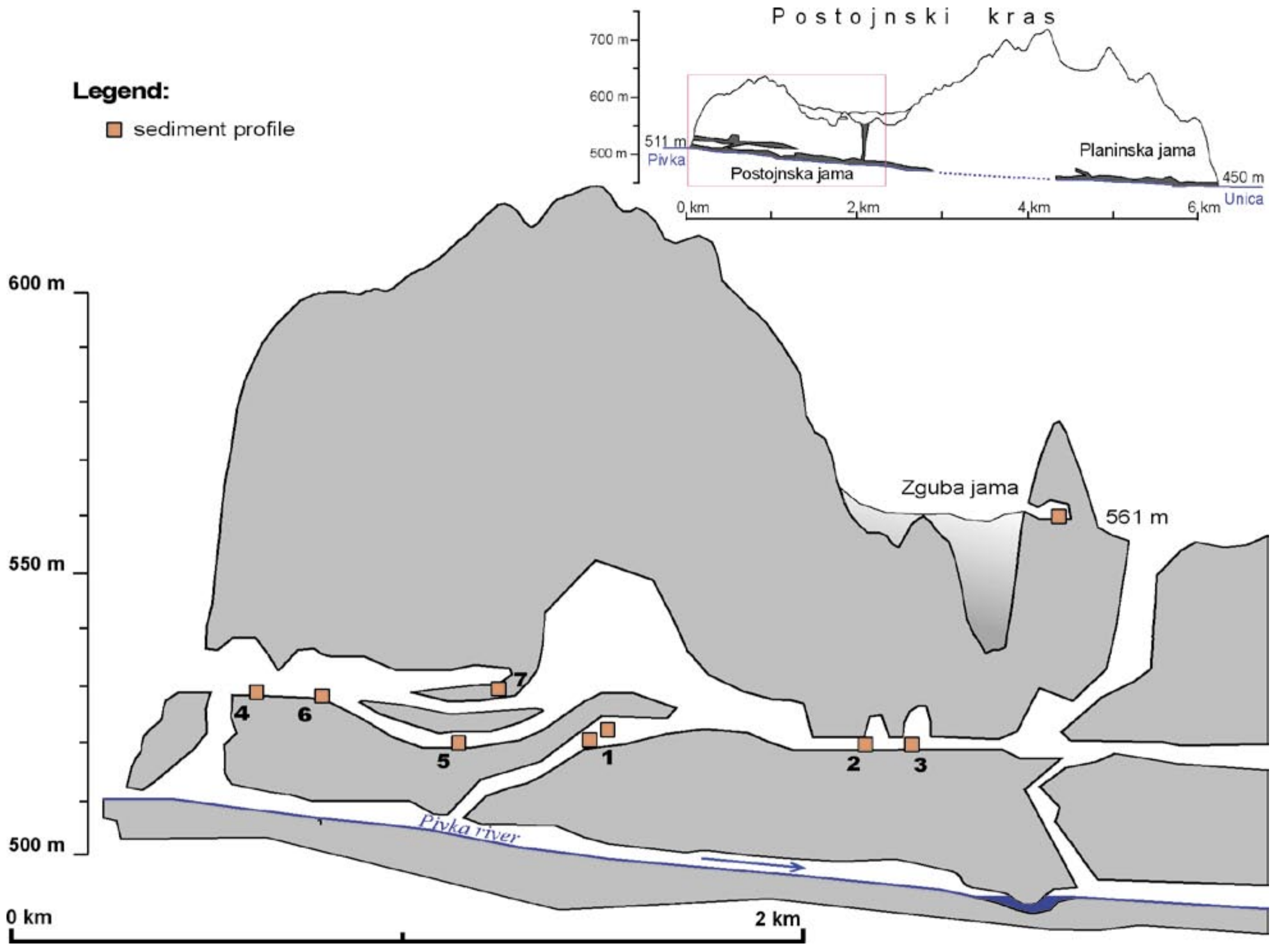
The application of the multi-component analysis shows that sediment samples mostly display a three-component remanent magnetization. Magnetomineralogical analyses and unblocking temperatures (520 to 560 °C) determined indicate that magnetite is the carrier of the remanent magnetization for the studied samples.

Paleomagnetic and magnetostratigraphy data obtained by our research partly confirmed previous results, but indicated also a different age interpretations. Samples from most profiles were N polarized. Three short R magnetozones (excursions) were detected only in places (Spodnji Tartarus). Data indicate that the profiles of Spodnji Tartarus North, Pisani rov and Biospeleološka postaja show declination and inclination directions close to the recent one (within the statistical error). Profiles of Rudolfov rov, Spodnji Tartarus South, Umetni tunel I, Male jame and Zguba jama must be older due to detected slight to distinct counter-clockwise rotation. Palaeomagnetic directions of Stara jama profile indicate a clockwise rotation after the profile was deposited. The inclination in N polarized samples from Spodnji Tartarus South and Umetni tunel I profiles is anomalously low. Therefore we interpreted most of the studied sediments as younger than 0.78 Ma, belonging to different depositional events within the Brunhes chron. Nevertheless, the N polarization in some profiles can be linked with N polarized subchrons older than 0.78 Ma, as in the Umetni tunel I site or Zguba jama. The lithological situation in Male jame is questionable. Sediments in Umetni tunel I are the oldest sediments of the system (below gravel with coloured chert) not included in older stratigraphic schemes. They can be correlated with Olduvai, Reunion or even older chrons (i.e., 1.77 to over 2.15 Ma).

According to regional analysis of data from the Kras, the studied cave fill can be hardly older than Pliocene (in the traditional sense). Deposition in the Postojnska jama–Planinska jama cave system can be placed in two principal deposition periods dated: (1) from about 0.78 Ma (paleomagnetic age) up to more than 4.0 Ma (paleomagnetic age) – Pliocene to Pleistocene (Günz/Mindel) – this group contains a succession of detected ages: (a) more than 0.78 up to about 3.58 Ma (paleomagnetic ages), and (b) less than 0.78 to about 2 Ma (paleomagnetic ages), and (2) sediments younger than 0.78 Ma – Pleistocene (Mindel) to Holocene.

Data interpretation indicates a quite prolonged evolution of the system of the Pivška kotlina–Postojnska jama–Planinska jama–Planinsko polje in relatively stabilized hydrological situations related to the function of the Planinsko polje. General stabilizations of the hydrological system for a long time span was characterized by low hydraulic head, and led to the formation of a long and complex cave system with presently accessible three cave levels in the ponor area, the middle one being the most extensive evolved mostly in epiphreatic zone.

The proposed model of prolonged evolution of the cave system is based on: (1) all numerical and correlative ages (dates over 530 ka from speleothems and up to 3.58 Ma from cave sediments); (2) the morphology of Planinsko and Cerkniško poljes, whose present limits are far behind marginal faults of the Idrija fault zone; their lateral enlargement and bottom aplanation by corrosion to the present extent needed a prolonged stabilization of the karst water table than the earlier proposed 30 to 100 ka, and (3) dynamics of filling and erosion phases in the system, where several depositional and erosion events/phases alternated especially in epiphreatic evolution phase. Individual cave segments or passages of the system were fully filled and exhumed several times during the cave evolution. The deposition was not uniform throughout the entire cave at the same time. There was erosion in one part of the cave and deposition in another. The alternation of depositional and erosion phases may be connect-



■ **Fig. 30.** A cross-section of the Postojna cave system and the position of the studied profiles (after Zupan Hajna et al. 2008).

ed with changing conditions within the cave system, functions both of the catchment basin and the resurgence area, climatic changes, tectonic movements, collapses, and the intrinsic mechanisms of the contact karst.

No. IAA300130702: **Growth rhythms as an indicator of the Earth's rotation and climate changes in the geological past** (*A. Galle*, *J. Hladil*, *P. Čejchan*, *L. Koptíková*, *J. Filip & L. Slavík; C. Ron, J. Vondrák, Astronomical Institute AS CR, v. v. i., Ondřejov, Czech Republic; D. Novotná, Institute of Atmospheric Physics, v. v. i., Praha, Czech Republic & L. Strnad, Faculty of Science, Charles University, Praha, Czech Republic*; 2007–2010)

Fossil and recent organisms with accretionary skeletons show growth rhythms recognized as a record of changing seasons, days and nights, lunar cycles. Other changes give a count of days per year and thus the rate of the Earth's rotation in the geological past. Measured data will be compared to astronomically computed ones, and differences will be correlated with geotectonic events. The goal of the project is also to reconstruct weather in the Paleozoic: coral colonies were moved through storms or hurricanes, and their corallites then assumed different growth direction. As the year's growth periods are manifested as light and dark bands, we plan to compute the length of the periods between successive storms, and to determine the frequency of such events. The measurements can show the pattern of successive longer or shorter increments corresponding to favorable or less favorable conditions. Comparing of such patterns can lead to local sclerochronometry.

No. IAA300130703: **Paleoecology, Paleogeography, Stratigraphy and Climatic Changes of the Upper Stephanian (Gzhelian) of the Central and Western Bohemian Basins** (*J. Zajíc*, *P. Bosák*, *P. Čejchan*, *R. Mikuláš*, K. Martínek, S. Oplluštil, Faculty of Science, Charles University, Praha, Czech Republic, Z. Šimůnek, J. Drábková, V. Prouza, T. Sidorinová & Z. Táborský, Czech Geological Survey, Praha, Czech Republic; 2007–2010)

Samples and measurements of previous field works were processed. Sedimentology of the Klobuky outcrops was summarized in the Bachelor's Thesis by Daniela Valentová.

Heavy minerals were separated from the samples of the sections Klobuky A, B, C, D, E, and F. Compositions of detrital garnets were analyzed using the microprobe from samples A1 (arenaceous sequence), A3 (tuff) and Kl-1 (arcose).

A borehole thirty meters deep was realized near sections A to D. The underlying reddish brown mudstones were reached by drilling and tentatively interpreted as the base of the Klobuky "Horizon". The borehole permitted to safely correlate all the studied sections.

Study of the rare carbonate pebbles from the Líně Formation is continued.

Study of the main fossiliferous beds of the Klobuky "Horizon" was focused on selected samples with high density of microremains (notably with the scales of *Sphenacanthus carbonarius* or teeth of xenacanthid sharks on the bedding planes). One of the most outstanding zoopaleontological finds is the second known tooth of *Sphenacanthus carbonarius*. The first one was described by Frič from the Kounov Member in the 19th century. Unfortunately, the hunt for other rare teeth of *Lissodus lacustris* was unsuccessful. The old borehole Be-1 Bechlín yielded exceptional faunal remains. This extraordinary borehole passed through all main "horizons" of the Líně Formation. All "horizons" together with sequences between them contained determinable faunal remains. The most important is fauna of the uppermost Stránka "Horizon". The last scales of the index taxon *Sphaerolepis kounoviensis* were found 28 m below the base of the "horizon". Seven small xenacanthid teeth were discovered in the "horizon", and their determination could therefore solve the question of age (Carboniferous or Permian) of the upper part of the Líně Formation. However, a taxonomic revision of xenacanthid teeth is necessary first.

Flora coming from the Klobuky excavations was summarized according to various criteria. This tabular processing will become a basis for the overall floral evaluation of the Líně Formation in correlation with lithology, sedimentology and stratigraphic level.

Palynological analysis of the samples from the Klobuky "Horizon" (both from the Klobuky excavations and Be 1 Bechlín borehole). Existing partial outcomes were published in Review of Palaeobotany and Palynology (Šimůnek and Martínek) and presented at the 32th Symposium on Geology of Coal-bearing Strata of Poland, Kraków (Šimůnek, Martínek, Zajíc, Drábková, Mikuláš and Valentová). The web presentation of the project (http://www.gli.cas.cz/IAA300130703/Projekt%20IAA300130703.htm) was continuously filled in (see there for additional information).

No. IAA300130801: **Chemical evolution of contrasting types of highly fractionated granitic melts used for melt inclusions study** (*K. Breiter*, *L. Ackerman*, *V. Böhmová*, J. Leichman, S. Honig, R. Škoda, M. Holá, Masaryk University, Brno, Czech Republic & M. Drábek, Czech Geological Survey, Praha, Czech Republic; 2008–2011)

In 2009, we continued the study of samples from two granites systems in the Krušné Hory Mts.: Podlesí and Hora Svaté Kateřiny, and started investigation of samples from the Brno pluton. We prepared synthetic rock glasses from typical granite facies from both localities from the Krušné Hory Mts. The glasses were synthesised at the pressure of 100 MPa and the temperature of 800 °C in order to simulate expected composition of glasses entrapped as melt inclusions in minerals. Homogeneity of glasses was controlled by BSE-imaging and microprobe analyses. Chemical composition was tested using classical chemical methods of wet chemistry. These glasses will serve as secondary standards for microprobe analyses of melt inclusions in quartz. We finished methodical experiments for chemical *in situ* analyses of melt inclusions on the microprobe. For the analyses of alkalis (Na, K) we use the "extrapolation to time zero" method, which gives results well comparable with the classical chemical methods on standards.

A brief study of fluid inclusions associated with the melt inclusions distinguished three types of inclusions: (1) two-phase gas-rich low-saline H2O-inclusions (up to 15 µm) with homogenization temperatures of ~384 °C; (2) secondary two-phase liquid-rich saline (8.7 wt. % NaCl) inclusions with homogenization temperatures of 140–255 °C, and (3) secondary one-phase, very small (less than 5 µm) inclusions building long trails.

Melt inclusions in quartz were homogenized using two techniques: (1) quartz chips were heated in quartz capsules for 24 hours at atmospheric pressure and temperature about 800 °C, or (2) the sample was closed in H_2O-bearing gold capsules and heated in cold-seal hydrothermal vessels at 850 °C and 100 MPa for 24 hours. This approach minimizes inclusion decrepitation and reduces H_2O loss. After quenching, the samples were polished and then used for microscopic study and chemical analyses. As yet identified melt inclusions are 20–30 µm in size and show a highly variable chemical composition (Tab. 1). Larger data sets are necessary to obtain statistically acceptable results.

Rock	Li-biotite granite		Zinnwaldite granite	
SiO_2	76.00	76.02	68.78	70.20
TiO_2	0.00	0.00	0.10	0.00
Al_2O_3	10.80	10.56	15.37	14.09
Fe_2O_3	0.42	0.32	0.76	0.49
MgO	0.00	0.05	0.02	0.02
MnO	0.00	0.07	0.03	0.19
CaO	0.00	0.01	0.11	0.43
Na_2O	2.34	2.55	2.07	0.98
K_2O	4.60	4.95	2.99	3.10
P_2O_5	0.59	0.61	0.30	0.74
F	0.44	0.72	1.47	1.86
Total	94.64	95.26	91.50	91.87

■ **Tab. 1.** Representative microprobe analyses of melt inclusions from Podlesí (wt. %).

No. IAA300130806: **The concept of micro- to mesoscale sandstone weathering morphofacies in the temperate zone** (*J. Adamovič*, *R. Mikuláš*, *R. Živor*, *A. Langrová*, *V. Böhmová*, J. Schweigstillová, Institute of Rock Structure and Mechanics, AS CR, v. v. i., Praha, Czech Republic; 2008–2011)

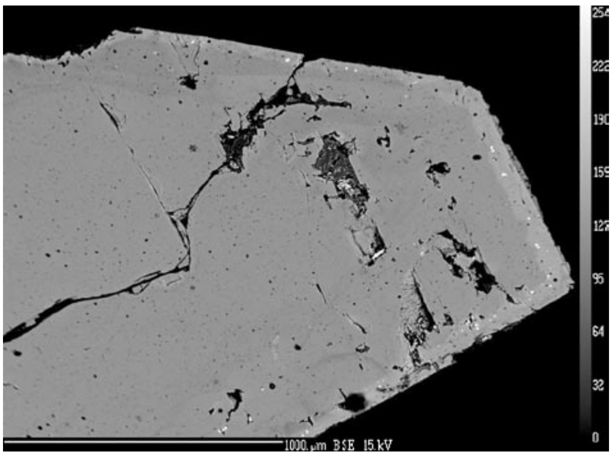
After a comparison of the weathering forms on sandstones in the Bohemian Cretaceous Basin, Czech Republic, Jurassic Luxembourg Sandstone in Germany and Luxembourg, and the Paleogene Fontainebleau Sandstone in the Paris Basin, first three characteristic sandstone morphofacies were defined: (1) the heterolithic facies is controlled by enclaves of cemented sandstone (beds, concretions) dispersed in less resistant host sandstone. Typical microrelief forms are rock ledges, spherical and tunnel-shaped cavities, tensional columns and mushroom rocks.

The type locality of this facies was defined in the calcareous sandstone at Perekop near Berdorf, Luxembourg, although very similar microforms are developed on the silica-cemented Fontainebleau sandstone; (2) the facies of case-hardening crusts is developed on quartzose sandstone with dominance of opal precipitation. It is characterized by well-defined honeycomb pits, "bubbles" or "wasp nests" formed by opal-hardened rock crusts. Its type locality lies in the Chipka Pass near Berdorf, and (3) the polygonal tesselation morphofacies can be found on sandstones with dispersed silica cement, reducing the pore spaces. Polygonal facettes are a characteristic feature, lined by fractures due to thermal expansion/contraction. These are often combined with rock basins. The type locality is Apremont-Bizons near Barbizon, France.

No. IAA300130902: **Characteristics of the mantle sources and crystallization history of the subvolcanic alkaline rock series: Geochemical and Sr-Nd isotope signature (an example from the Ceské stredohorí Mts., Ohre/Eger Rift)** (*R. Skála*, *J. Ulrych*, *V. Böhmová*, *L. Ackerman*, *J. Filip*, Z. Řanda, J. Mizera, J. Kučera, Nuclear Physics Institute, Řež, Czech Republic, E. Jelínek & D. Matějka, Faculty of Science, Charles University, Praha, Czech Republic; 2009–2013)

At this stage, the activity focused on sampling of materials suitable to attain goals of the proposed research. Altogether 25 samples covering lithological variability of the Roztoky volcanic center (RVC) have been collected. For the purpose of comparison of results of the fission-track study of apatites in subvolcanic rocks of the RVC, five samples of plutonic rocks from the Central Moldanubian Massif and three samples of pegmatoid rocks from the Central Bohemian Massif have been acquired.

The sampled materials were processed in a standard way to obtain materials for further mineralogical and petrologic studies (mineral separations, thin sectioning, homogenization). Also, the first analyses were performed (mineral composition in thin sections, major and minor element composition of bulk samples, isotopic composition). Pyroxenes, amphiboles and biotites are chemically studied in sectioned separated loose grains as well as in thin sections of rocks. Pyroxenes and amphiboles reveal negligible or no chemical zoning (see Fig. 31). Pyroxenes reperesent diopside or augite, and amphiboles kaersutite.



■ **Fig. 31.** A back-scattered electron image of a pyroxene phenocryst from the locality of Holý kluk near Proboštov shows a compositional zoning. Brighter rim is characterized by reduced contents of Si and Mg and elevated contents of Ti, Al, Fe and Ca, compared to the grain core (Photo by A. Kallistová and A. Langrová).

The first 15 samples were analyzed by the INAA methods. Short-term activation (ST–ENAA and ST–INAA) was used to determine Si, U, Na, Mg, Al, K, Ca, Ti, V, Mn and Dy. Long-term variant served to determine the concentrations of Na, K, Ca, Sc, Cr, Fe, Co, Zn, As, Br, Rb, Sb, Cs, Ba, La, Ce, Nd, Sm, Eu, Gd, Tb, Tm Yb, Lu, Hf, Ta, Th a U. The IPAA technique was used to measure Mg, Ca, Ti, Ni, Sr, Y, Zr, Nb, Ba, Ce a Pb. Obviuosly, several elements were determined by multiple methods making the analyses to comply with "self-verification principle".

No. IAA300130906: **Relation between elastic moduli determined by seismic methods in laboratory and in the field** (*V. Rudajev*, *T. Lokajíček*, *M. Petružálek*, *R. Živor*, J. Vilhelm & T. Svitek, Faculty of Science, Charles University, Praha, Czech Republic; 2009–2011)

Special two- and three-component acoustic sensors were bought for shear wave identification, and adapters for their connection to rock samples were made. Sensors were tested on the wide frequency band. First laboratory experiments of ultrasonic sounding were realized during loading of granite samples.

A couple of piezoceramic sensors and a registration by a new two-channel osciloscope were tested during the field measurement at the locality of granodiorite quarry Prosečnice.

Special orientation of the three-component sensors was applied for measurement in Kostiviarska limestone quarry at Banská Bystrica (Slovakia). Sensitivity axes of all three sensors included an angle 35.26° with horizontal plane. This arrangement is suitable for the identification not only of P-wave, but also of S-wave.

Follow-up research was realized in the Lubeník magnesite mine (Slovakia) at a depth of 300 m. The anisotropy of P-wave propagation in the vertical plane was measured by applying the method of shallow seismic refraction. The rock samples were picked up for laboratory testing from this locality.

No. IAA300460602: **Upper crustal model of the Ohře Rift and its vicinity** (*V. Cajz*, *J. Adamovič*, J. Málek, Institute of Rock Structure and Mechanics, AS CR, v. v. i., Praha, Czech Republic, J. Novotný, J. Mrlina, Geophysical Institute AS CR, v. v. i., Praha, Czech Rpublic, Z. Skácelová & B. Mlčoch, Czech Geological Survey, Praha, Czech Republic; 2006–2010)

A succession of Cenozoic paleostress fields for the N part of the Bohemian Massif was further refined based on the study of strike-slip displacement on faults of the Elbe Zone. In the Late Miocene, the courses of faults became largely modified by compressional phases *gamma* and *delta*. Whereas a uniform N–S compression was interpreted from Cretaceous sediments in the NE part of the Eger Graben, two compressional phases can be identified in the Tertiary Most Basin. Mutual cross-cut relations in the Elbe Zone suggest an older *gamma* phase of ENE–WSW compression and a younger *delta* phase during which the maximum principal stress rotated from NW–SE direction to N–S direction. The most prominent effects of these phases include strike-slip displacements on NNE–SSW- and NNW–SSE-striking offsets of the southern graben margin between Litoměřice and Doksy and (mostly right-lateral) strike-slip movements on WNW–ESE-striking faults in a zone between the Lusatian Fault and the Ploučnice Fault 20 km farther south. Horizontal displacement, mostly not identified by former surveys, can be estimated at as much as several kilometers on some faults based on offsets of basaltic dykes and earlier tectonic structures.

No. IAA301110701: **Reproductive organs and their spores from Carboniferous plants from coalfields in North America** (Z. Kvaček, Faculty of Science, Charles University, Praha, Czech Republic, *J. Bek*, J. Pšenička, West Bohemian Museum, Plzeň, Czech Republic, M. Libertín, National Museum, Praha, Czech Republic & J. Drábková, Czech Geological Survey, Praha, Czech Republic; 2007–2010)

Specimens of compression strobili from the Bolsovian of the Kladno-Rakovník Basin, Czech Republic, were studied for *in situ* spores. Only fragments of sphenophyllalean axes and sphenophyllalean leaves occur in the rock together with the sporangia and sporangiophores. Direct evidence about sphenophyllalean affinity of strobili is that sporangia are connected with the axis by a short non-scutelliform sporangiophore that is typical only for the genus *Bowmanites* Binney. Reticulate spores comparable with the dispersed species *Reticulatisporites muricatus* are reported for the first time as *in situ* from compression cone specimens and represent new morphological type of sphenophyllalean spores.

Three specimens of the genus *Omphalophloios* from the Upper Silesian Coal Basin, Poland, are described. Two of them are the holotypes of *Sporangiostrobus orzeschensis* and *S. rugosus* which represent fragments of fertile zones with microsporangia. The specimens were revised to provide more precise data on their morphology and spores necessary for reliable comparison with other species of this genus. Only microspores were macerated from sporangia of both specimens. All of them are of the same type and can be assigned to several species of the spore genus *Densosporites* due to their variable morphology. *In situ* densospores are of the same type as all the previously described ones from other *Omphalophloios* species. Thus the main criterion used for establishing the two species, the different spores, was proved to be useless. Additional criteria, which could justify retaining these two specimens as two different species were not found, since a cell pattern of sporangia wall is principally the same for all the species where it has been studied. Therefore, the two species were synonymized and a new combination *Omphalophloios orzeschensis* (Bode) comb. nov. was proposed since *Sporangiostrobus* is a younger synonym of *Omphalophloios*. The third specimen is a fragment of a vegetative stem bearing *Omphalophloios*-type of leaf cushions which has not been previously described yet. It is described as a new species *Omphalophloios bodei* n.sp. because its correlation as a parent stem to *O. orzeschensis* from the same locality is impossible to prove due to fragmentary nature of both specimens. *O. bodei* also differs from all the known vegetative stem species so far described from other coalfields especially in having less raised leaf cushions.

No. IAA301110908: **Dynamics of the Upper Ordovician climax-stage faunal assemblages before global crisis controlled by climatic changes: a record from the Králův Dvůr Formation of the Barrandian area** (P. Kraft, O. Fatka, Faculty of Science, Charles University, Praha, Czech Republic, *P. Štorch*, P. Budil, Czech Geological Survey, Praha, Czech Republic & M. Mergl, Faculty of Education, University of West Bohemia, Plzeň, Czech Republic; 2009–2011)

The Králův Dvůr Formation of the late Katian age is developed, for the most part, in the form of greenish-grey hemipelagic shale with occasional limestone nodules. Moderate-diversity benthic faunal associations belong to deep-water *Foliomena* fauna. Faunal diversity shortly culminated with closely related *Proboscisambon* Community which is confined to a thin carbonate-rich "Pernik Bed". This maximum diversity is, however, followed by a dramatic impoverishment in response to global climatic changes. Two levels of glaciomarine diamictite and mid-shelf storm sandstones of the overlying Kosov Formation account for rapid deterioration of the climate and glacio-eustatic sea-level drawdown due to large glaciation on southern situated supercontinent Gondwana. Positive organic carbon isotope excursion recorded in Zadní Třebaň and Levín sections suggests that climatic change commenced at, or just below, the Pernik Bed. Major faunal turnover and mass-extinction, however, followed shortly afterwards, between the Pernik Bed and first diamictite.

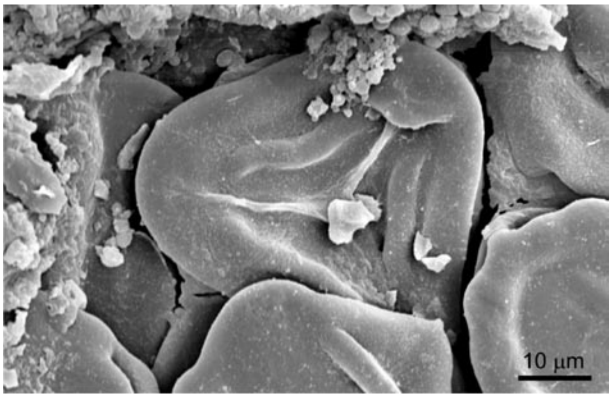
Graptolite fauna is quite rare to even absent in the majority of the Upper Ordovician successions of the high-latitude northwestern peri-Gondwana. The Kralův Dvůr Formation with its graptolite fauna represents an exception among graptolite-barren upper Katian successions in this area. Uncommon normalograptids and dicellograptids have been reported in the Králův Dvůr Formation since the end of 19th century. Lower part of the Králův Dvůr Formation yielded "*Glyptograptus*" *teres* Perner, assigned to the genus *Anticostia* Stewart & Mitchell by the present authors, and some as yet undetermined biserial rhabdosomes. Two dicellograptid species (*Dicellograptus laticeps* Štorch and *Dicellograptus* cf. *morrisi* Hopkinson) associated with rare plegmatograptids ("*Plegmatograptus chuchlensis* Přibyl"), early normalograptids (*Normalograptus angustus* (Perner)), and some undescribed climacograptids and pararetiograptids come from the middle and upper parts of the formation. *Normalograptus ojsuensis* (Koren' & Mikhaylova) and *Normalograptus* tentatively assigned to *N.?extraordinarius* (Sobolevskaya) occur in the topmost part of the formation. The observed patterns of graptolite occurrence reflect global climatic changes along with specific local conditions. Specific and uncommon graptolite fauna allows only limited biostratigraphic correlation with graptolite-rich late Katian successions of low-latitude realms, such as China or Nevada.

No. IAA304070701: **Cretaceous fossil flowers and inflorescences bearing pollen in situ** (*J. Dašková* & J. Kvaček, National Museum, Praha, Czech Republic; 2007–2010)

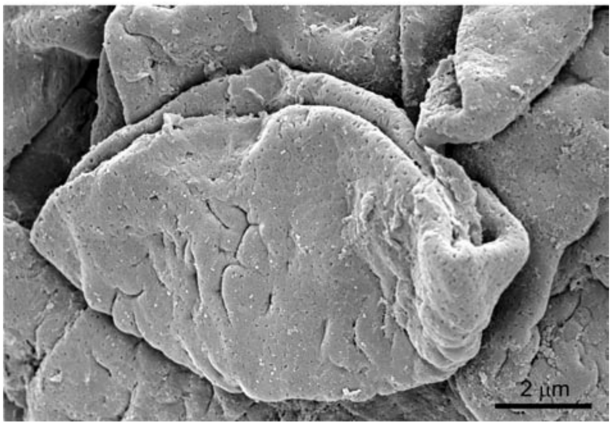
A new genus *Konijnenburgia* Kvacek et Daskova was established for fertile, well preserved ferns of the family Matoniaceae, which were previously assigned to the genus *Nathorstia* Heer. It is based on *Konijnenburgia latifolia* (Nathorst) comb.

nov. This material originated from the Upper Cretaceous of Greenland. The lectotype for *Konijnenburgia latifolia* was designated. New species (*Konijnenburgia bohemica*) is described from the Upper Cretaceous, Cenomanian of the Czech Republic and compared to *Konijnenburgia latifolia* and other Cretaceous members of this family. Introduction of the genus *Konijnenburgia* induced new combinations which are the following: *Konijnenburgia galleyi* (Miner) Kvacek & Daskova (2010) and *Konijnenburgia alata* (Halle) Kvacek & Daskova (2010); Fig. 32.

New palaeontological material was collected at the Pecínov and Zliv localities. New and older samples were washed and sorted at once.The fertile stamen founded in the sediments of the Brník locality contained well preserved pollen *in situ.* These grains (Fig. 33) are described as psilate, foveolate pollen and are very similar to monocolpate grains described by E.M. Friis from the Portuguese Lower Cretaceous. However, these Portuguese findings are not botanically determined. THey seem to be related to the pollen of the Recent family Sauraraceae. This hypothesis will be confirmed or rejected using transmission electron microscopy (TEM, in progress).



■ **Fig. 32.** Spores of the genus *Konijnenburgia* (from Kvaček & Dašková 2010).



■ **Fig. 33.** A monocolpate pollen grain (Photo by J. Dašková).

No. IAAX00020701: **Long-term development of cultural landscape in Central Bohemia as a co-evolution of human impacts and natural processes** (P. Pokorný, Institute of Archeology AS CR, v. v. i., Praha, Czech Republic, *J. Hlaváč* & P. Kuneš, Faculty of Science, Charles University, Praha, Czech Republic; 2007–2011)

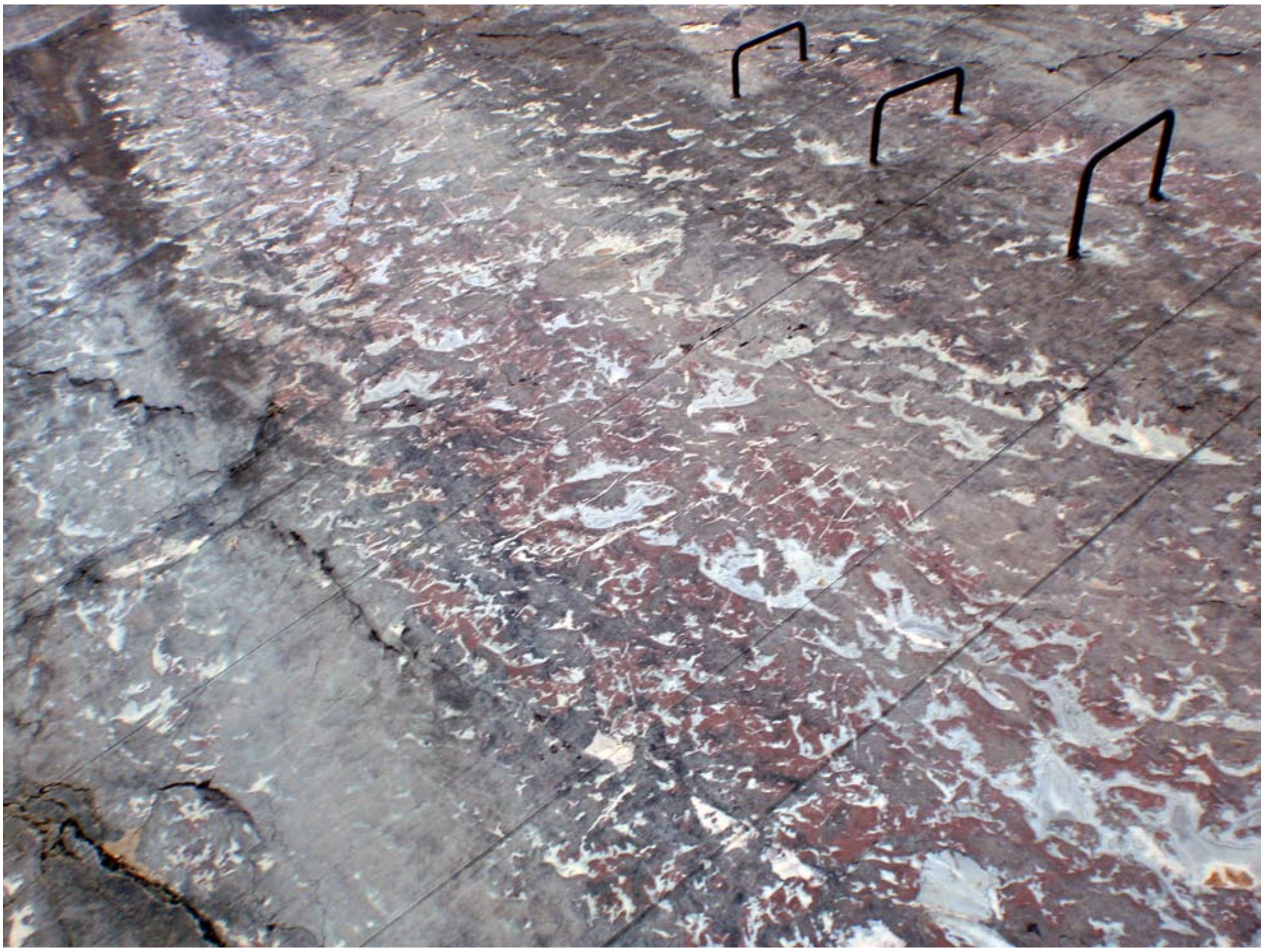
The project aims to enhance our understanding of the Prehistoric landscape used and cultivated by man, to identify key stages in its long-term evolution and to study individual processes that cause it to change. The landscape's historic evolution is a highly complex process that can be studied only by using an interdisciplinary approach – one of the most efficient being the application of archaeology closely combined with paleoecological techniques (like palynology, analysis of plant macroremains, paleomalacology). The questions we ask have both historical and methodological focus. They deal with: spatial structure of settlement areas and the possibilities of its depiction in the landscape, the identifiability and form of prehistoric farming systems (including the importance of pastures and the role of forest in the prehistoric economy), the regeneration capacity of natural ecosystems and the reliability of pollen analysis in tracing settlement history.

No. IAAX00130702: **Hydrodynamic concept of stromatactis formation in geology** (*J. Hladil*, *L. Koptíková*, *L. Lisá*, *J. Adamovič*, *P. Kubínová*, M. Růžička, J. Drahoš, L. Kulaviak, J. Havlica, J. Vejražka, M. Zedníková, S. Kordac-Orvalho, M. Šimčík & P. Stanovský, Institute of Chemical Process Fundamentals AS CR, v. v. i.; Praha, Czech Republic; 2007–2011)

Stromatactis-containing sediments increased in abundance after the catastrophic events. The modern and ancient pure carbonate sedimentary environments in oceans recorded the variations of atmospheric mineral dust inputs which are often related to long-transported fine particulates and have an inter-regional to global correlation significance. The embedding of impurity into pure limestones on large and isolated carbonate platforms and slopes are considered to be roughly similar to impurity records in major ice sheets. With the case of limestones, there is a significantly longer stratigraphical range compared to ice, so we obtain interesting sets of data about climate changes and occurrence of rare catastrophic events even deep in the past of the Earth. A detailed exploration of these impurity records in limestones has, for example, potential to explain circumstances of major global events or environmental crises. This research can be exemplified by studies on major environmental disturbances which hit the terrestrial environments in early Late Devonian (Middle Frasnian mid-punctata) times when vigorous but complex structured changes were roughly coincident with the Alamo impact, west of the Great Basin and North American craton. The structure of this event across facies together with possible distal effects of the Alamo impact catastrophe were studied at localities which were far distant from the impact structure, mainly in platform reef units in Moravia (Czech Republic).

The mid-punctata event in the Devonian platform-reef facies of the Moravian Karst area was preceded by an interval which represents a low sea fall but, concurrently, also steady-stable conditions with considerably reduced aeolian and other detrital inputs. An abrupt rise in sea level marks the event base, and the event related beds are characterized by extremely high energy sedimentation, which is reduced upward, but still marked by the mixed carbonate and impurity material that was collected across the facies and with signs of material recycling. A series of magnetic susceptibility (MS) stratigraphic measurements is indicative of the presence of an anomalous pattern in the middle of the early Middle Frasnian punctata Zone. This MS pattern consists of a pronounced low, followed by a composite high that is first sharp at the base and gradually fades upward. This relatively robust and specifically shaped valley-and-peak segment in the MS plots was termed as A–B, and its stratigraphic correlation potential was assessed both in the terms of the regional and interregional correlation. The natural gamma-ray signal is high, both closely below and above the relevant flooding surface. The comparison of MS–GRS–INAA results was tested as an effective and promising approach in the search for coarse grains of atmospheric dust embedded in pure limestones. A complex of separation and extraction techniques, with measures for monitoring possible contamination, was optimized for well cemented and slightly recrystallized pure limestones by maximum yield of suspect exotic particles. In sequentially separated heavy fractions, an assemblage of exotic silt- to fine-sand-sized grains (5–150 μm) was found. The suspect assemblages contain a small but significant number of iron-rich silicate microspherules that have onion-like fabric and striated surfaces. Devitrified glasses of An-rich plagioclase, diopside and complex compositions are common. These give examples of fluid-plastic textures and contain also wrinkled and foamed varieties. The glassy materials are rich in Ti and Ba, while Cr and Ni concentrations are relatively low. Fragments of minerals and rocks contain olivines, plagioclases, dotted with symplectic exsolutions, and pyroxenes. The ablated surfaces of olivine particles are often striated, and the pyroxene particles frequently host iron-rich lamellae. Phlogopites and various Ti, Ba, Fe-bearing secondary minerals are common in crystalline/ subcrystalline pellets and coatings of smaller particles.

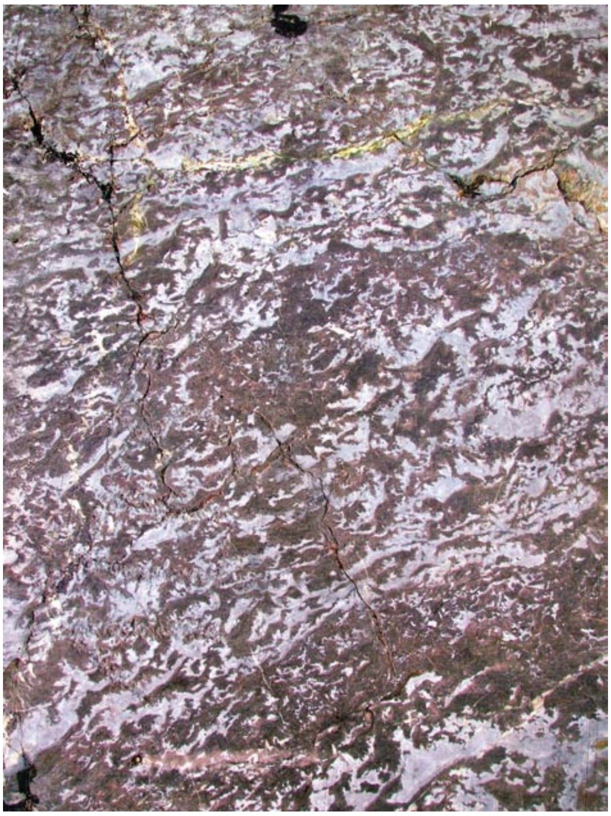
Delivery of these suspect grains may have been most likely connected with the Alamo impact catastrophe, but this connection is not completely understood in details. The suspect exotic particles can be either indicative of deeply dissected crust-mantle rocks in the oceans rimming the North American craton (vigorously extruded, with melting and condensations with



■ **Fig. 34.** Swarms of stromatactis cavities with the earliest internal sediments of fine carbonated mud (red color hues), filled by isopachous sparry cements (whitish-grey objects in the picture). The swarms of cemented cavities follow the middle parts of the thick, mud- and biogenic detritus-rich beds deposited at the carbonate slope break at medium depths of possibly a few hundreds of metres. Note the about 10–20 degree difference between the beds or lenses deposited on the slope and the geopetal levels which are indicated by the smooth floors of the stromatactis structures. The classical stromatactis outcrops in marble quarries of Belgium – Les Wayons Quarry, NW part of the Philippeville Anticlinorium, Ardennes, Belgium; Petit-Mont Member, Neuville Formation, lowermost Upper Frasnian, Upper Devonian. For scale: The iron steps in the quarry wall are ca. 20 cm wide (Photo by J. Hladil & L. Koptíková).

cooling of impact-vapour plumes) or, more speculatively, they may also contain some components from unusually composed lithic nuts in the comets which are mostly considered with the case of the Alamo impact or Alamo impact series. However, a single collision with a cometary impactor cannot be the direct cause of all the long-term and robust disturbances in the early Middle Frasnian. The most interesting evidence of this is seen in the existence of up to hundreds of thousands years long calm period of global climates, when atmospheric ocean circulation was remarkably attenuated and the overall burden of dust in the atmosphere was reduced. Also carbonate productivity dropped. These pre-impact calm settings (MS pattern A) are connected with lowering of sea level and may tentatively be explained by means of decreased insolation, where lower radiant energy delivered by the Sun was combined with increased cloud formation. And a combination of these two factors can particularly be caused by higher concentrations of interplanetary dust before one or more Alamo cometary bodies hit the Earth. The long-term depressions in MS signal of limestones before the major crises on the Earth are not exceptional and are worth of further theoretical investigations.

The above described anomalies were particularly harmful to reef invertebrates and decreased carbonate production on platforms. With the facies scenario, this was often combined with the occurrences of stiffground-hardground formations (reflecting also an increased attack of microborers), origin of diversified microbialite and organomineralized rocks and clasts, as well as increased abundance of crinoids and sponges, which also contributed to the wild spectrum of components in highly polydisperse and broadly multimodal mixtures of carbonate sedimentary material. The appropriate conditions for hydrodynamic separation of a mixture containing both the fine lime-mud or silt particles and rugged and light skeletal or porous lithogenic grains arose after the end of calm climatic period and with the beginning of stormy turbulent settings. Consequently, the number of sedimentary stromatactis (more exactly precursors' stromatacta) fabrics rapidly increased at the platform margin and slope, and even the counts of microstromatactis and stromatactoid fabrics in relatively shallow sedimentary rocks were significantly higher than for the calm period before.

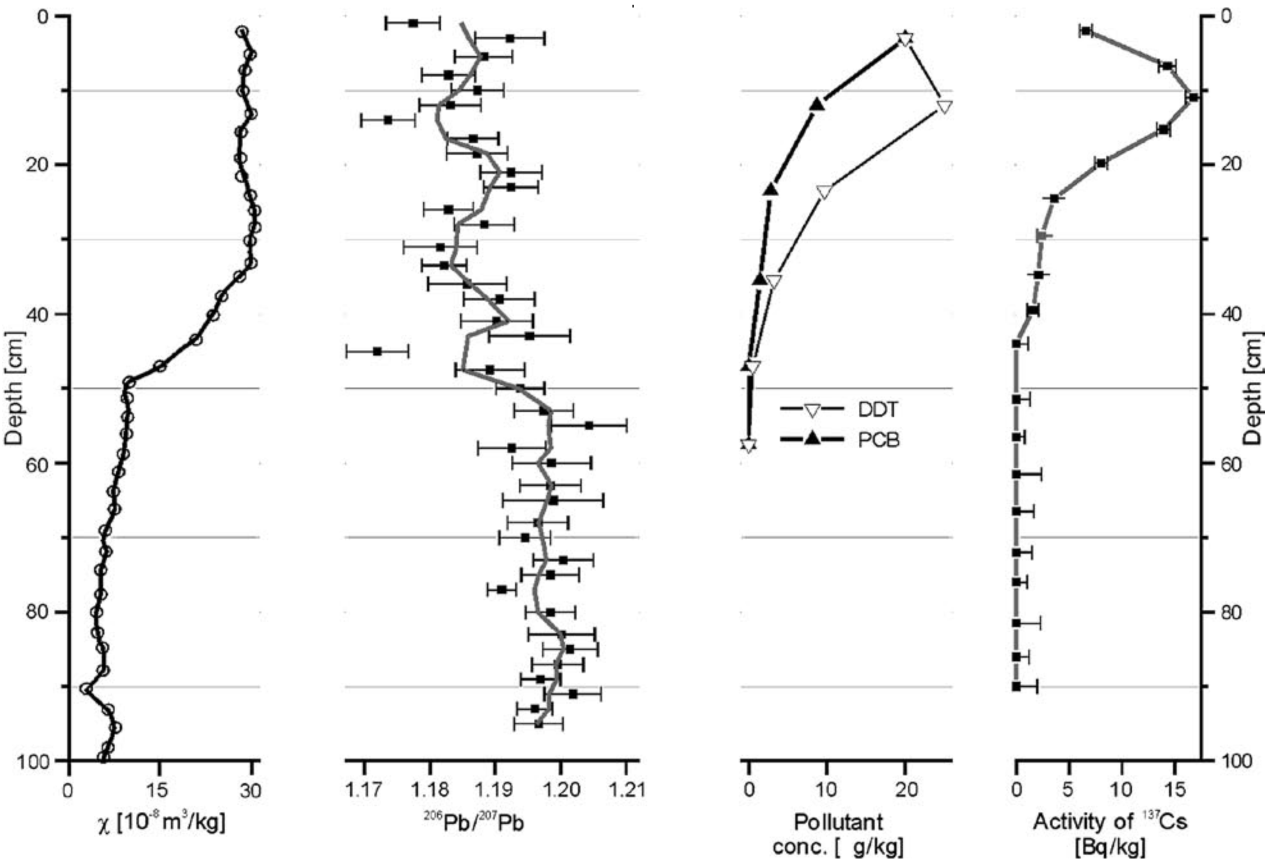


■ **Fig. 35.** Unusually richly developed stromatactis swarms in thick and rapidly succeeding slope deposits of stromatactis-generating multimodal polydispersions. The same locality and stratigraphic age as the previous photograph; horizontally ca. 1 m (Photo by J. Hladil & L. Koptíková).

The data from Moravian Karst can be compared to the Middle Frasnian expansion of the true event-sedimentation-controlled types of stromatactis structures in the Ardennes, where these Frasnian stromatactis bearing formations were developed under most favourable local conditions at the opportune time. The Lower Frasnian "stromatactis" types of the Ardennes differ from the above mentioned stromatactis types, being mostly related to the zebra-type textures and also those which are indicative of response of sediment to methane bubble growth. On the other hand, a great abundance of exemplary stromatactis structures of event-sedimentation-controlled types in the early rhenana sediments after the Middle/Upper Frasnian environmental change in the sections of the Ardennes manifest an outstanding phenomenon which may substantiate an emerging hypothesis about the relationship of these stromatactis swarms and speculatively extraterrestrial triggering of the carbonate-production crisis in the jamiae conodont zone.

No. IAAX00130801: **Interplay of climate, human impact, and land erosion recorded in the natural archives of Strážnické Pomoraví (CR)** (*J. Kadlec*, *L. Lisá*, *S. Šlechta*, *F. Stehlík*, H. Svitavská-Svobodová, Institute of Botany AS CR, v. v. i., Praha, Czech Republic, T. Grygar, Institute of Inorganic Chemistry AS CR, v. v. i., Řež, Czech Republic, I. Světlík, Institute of Nuclear Physics AS CR, v. v. i., Řež, Czech Republic, R. Brázdil, P. Dobrovolný, Z. Máčka, Faculty of Science, Masaryk University, Brno, Czech Republic & V. Beneš, G-Impuls, Ltd., Praha, Czech Republic; 2008–2011)

Behavior of the Morava River in the Strážnické Pomoraví is reconstructed based on a multidisciplinary study of both fluvial and eolian natural archives. Fluvial sediments exposed in erosional river banks record processes operating mainly during the last millennium based on radiocarbon and AMS dates. We found older Holocene and Late Pleistocene organic sediments using pollen, diatom and AMS dating analyses only at the edge of the Morava River flood plain. River behavior and changes of the fluvial styles are reconstructed based on floodplain architecture analysis supported by geophysical survey. The age of sediments is specified using radiocarbon and dendrochronological datings completed with ^{137}Cs and persistent organic pollutant concentrations. Pollen analyses allow us to reconstruct the local vegetation changes.



■ **Fig. 36.** Anthropogenic pollution (from 45 cm upward) corresponding to the last ca. 60 years recorded in the flood-plain sediments of the Morava River. Mass specific magnetic susceptibility, Pb isotope ratio, concentration of DDT, PCB, and specific activity of ^{137}Cs. The line in the panel with Pb isotope composition is a 3-pt running average (original).

Lithology of the floodplain deposits is conformable along a modern river channel. Sections exposed in erosional river banks reveal basal sands and sandy gravels often containing tree trunks or branch fragments. Charcoal or tree branches are preserved in the overlying greenish, sandy clay or clayey sand, usually with reductimorphic stains. The upper part of the sections is composed of sandy or clayey silts with intercalated smaller lenses or sand beds up to 20 cm thick. Geophysical survey suggests that the clayey cohesive sediments are present in the whole area of the studied floodplain overlying the basal sand and sandy gravel. Most of these fine sediments were deposited in a low-energy river system during the last millennium based on radiocarbon dating. These deposits were later partly eroded and replaced by medium-energy river system sediments in the northern part of the studied floodplain.

An aggradation rate was increased due to accelerated anthropogenically induced erosion (deforestation, agriculture). Maximum erosional and following aggradational rates have started around 1950. The values of magnetic susceptibility, magnetite concentration and magnetic grain size have significantly increased since then. Also organic and inorganic pollutant concentrations (DDT, PCB, Pb, ^{137}C) are increasing. The mean sedimentation rate has increased to 0.8 cm per year compared to 0.2 at the beginning of the last millennium. Lateral erosion has increased to several meters during the last flood events.

No. KJB300130902: **Highly siderophile element and Re–Os isotope geochemistry of mantle pyroxenites: implications for mantle refertilization** (*L. Ackerman* & *J. Rohovec*; 2009–2011)

Many recent studies have documented significant changes in Re–Os systematics of mantle derived rocks caused by several processes (weathering, partial melting, melt percolation). It has been shown that melt percolation represents one of the most important processes, during which Re–Os import or loss and Os isotopic modification can occur depending on several parameters (e.g., melt/rock ratios, sulfur saturation of the percolating melt etc.).

Rhenium and osmium concentrations as well Os isotopic compositions were determined for mantle peridotites and associated pyroxenites from Horní Bory, Bohemian Massif, Czech Republic. Mantle peridotites are of two types: Mg-Cr lherzolite and Fe-rich dunite/wehrlite associated with Fe-Ti pyroxenites. The Fe-rich suite formed by melt/rock reaction between lherzolite and SiO_2-undersaturated basaltic melt with subduction-related signature. Associated pyroxenites represent a crystalline product of such transient basaltic melt.

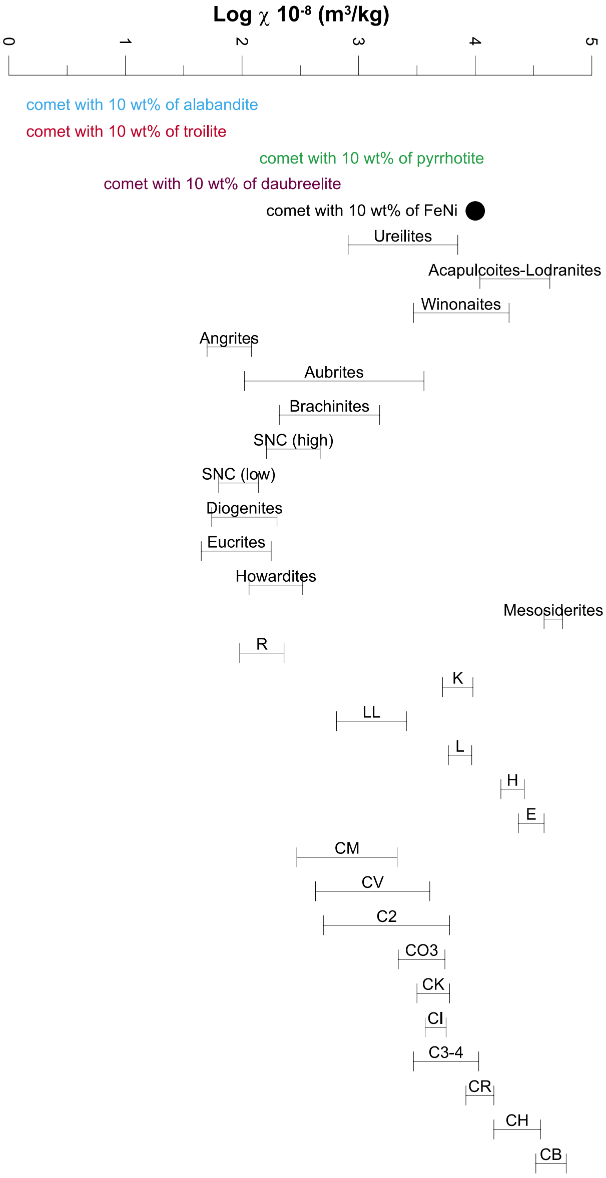
Mg-lherzolite samples have variable Re and Os concentrations of 131–512 ppt and 3.7–7.5 ppb, respectively, and ^{187}Os/^{188}Os ratios of 0.1220–0.1224. Therefore Re-Os contents are similar or ~2 times higher than Primitive upper mantle (PUM) estimates, whereas Os isotopic composition is lower than PUM. In contrast, Fe-rich suite and associated pyroxenites are highly enriched in rhenium (0.946–2.2 ppb), depleted in Os (0.1–1.8 ppb) and show very heterogeneous and highly radiogenic $^{187}Os/^{188}Os$ of 0.1717–0.6812 compared to PUM.

Very high Re contents coupled with radiogenic Os isotopic composition of Fe-rich dunite/wehrlite and pyroxenite imply a significant Re and radiogenic Os import from basaltic melt during subduction-related mantle refertilization. For these rocks, such process resulted in the removal of primary Os from the source rock. On the other hand, higher and coupled Re-Os concentrations in one sample of Mg-lherzolite suggest that also this suite was modified during melt infiltration with respect to Re-Os, however, Os remains compatible most likely due to lower melt/rock ratios.

No. KJB300130903: **Low temperature magnetic properties of sulphides present in meteoritic material** (*T. Kohout*, P. Týcová, J. Haloda, Czech Geological Survey, Praha, Czech Republic & R. Zbořil, Palacký University, Olomouc, Czech Republic; 2009–2011)

Iron-, chromium- and manganese-bearing sulfides have been reported in interplanetary dust particles (IDP's) and in cometary dust. Moreover, these sulfides are volumetrically more abundant than an iron–nickel metallic phase. Therefore, magnetic properties of these sulfides must be considered when interpreting magnetic observations of cometary bodies. Low-temperature magnetic properties of these sulfides were investigated in order to model magnetic properties of a cometary body (Fig. 37).

The results indicate that besides FeNi alloys mainly daubreelite ($FeCr_2S_4$) with its strong induced and remanent magnetizations may be a significant magnetic mineral in cold environment. Modeling revealed that interactions of a comet with interplanetary magnetic fields will result in weak, but detectable signal. This will be tested by European Space Agency Rosetta space mission heading towards comet 67P/Churyumov–Gerasimenko.

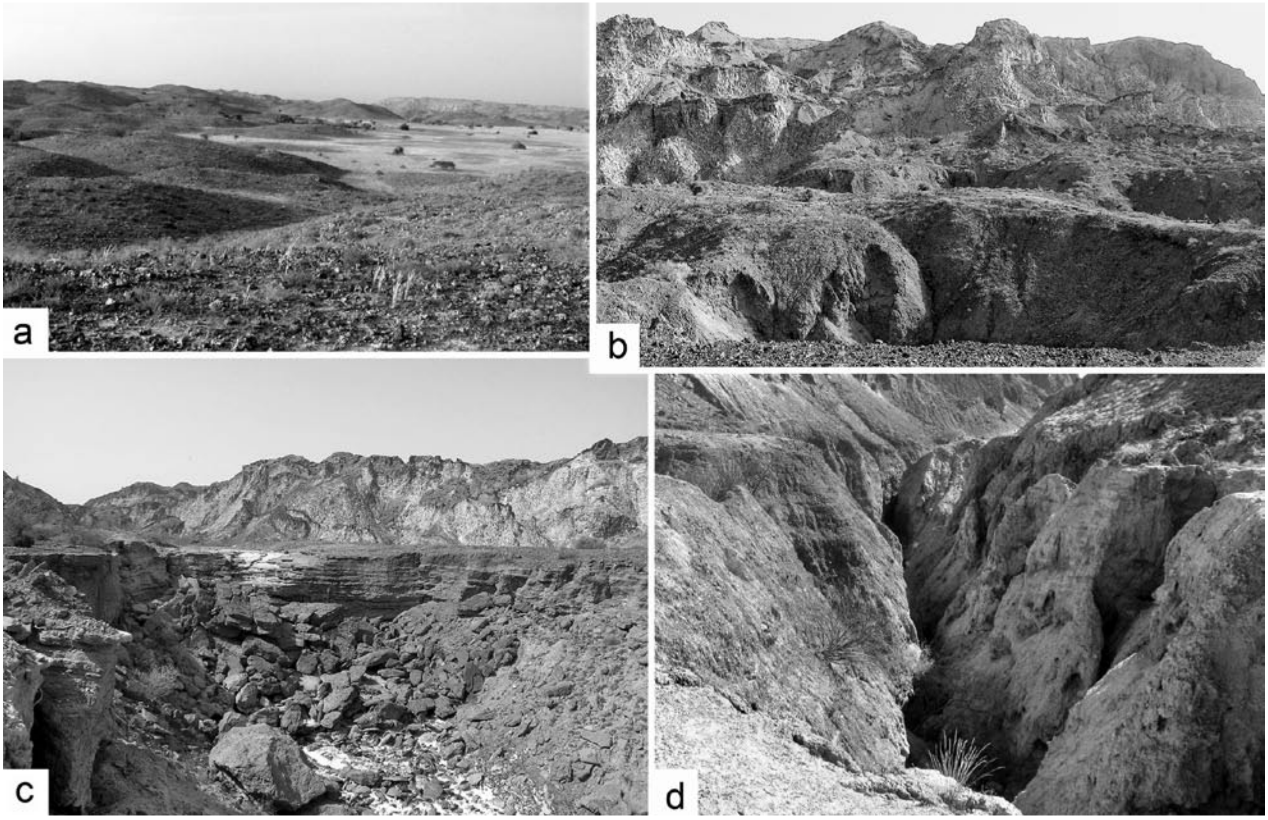


■ **Fig. 37.** Model magnetic susceptibility of an icy comet containing dispersed 10 wt.% fine–powder fraction of various sulfides and FeNi metal and its comparison to susceptibility of meteorites (after Kohout et al. 2010).

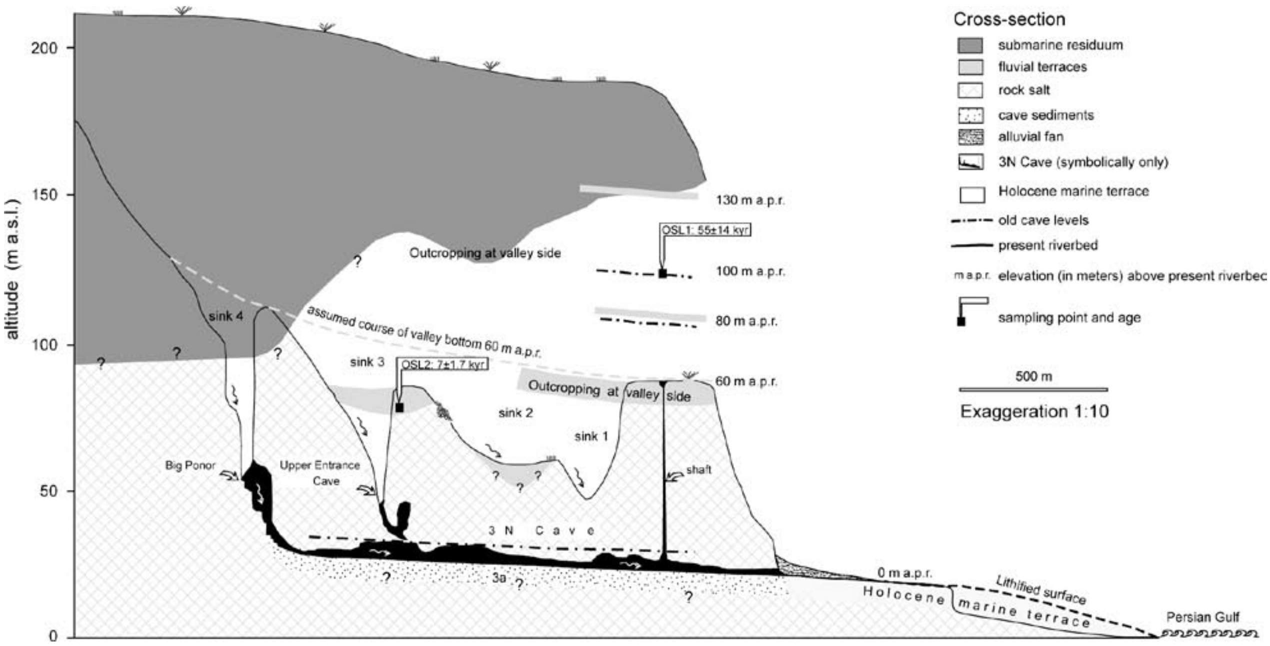
No. KJB315040801: **Salt karst in Zagros Mts., Iran: Hydrogeology, dating and evolution** (J. Bruthans, Faculty of Sciences, Charles University, Praha, Czech Republic & *M. Filippi*; 2008–2010)

Marine, fluvial and cave sediments, and karst phenomena were studied and dated by radiocarbon, U/Th, and OSL methods to evaluate the evolution of the Namakdan salt diapir and the world's longest salt cave (3N Cave) during the Holocene and the Last Glacial. Sea-level oscillations, the uplift rate of the diapir and its surroundings, and erosion are the main factors forming the diapir morphology. Although the diapir uplift rate has been constant for the last 50 kyr (~4 $mm.yr^{-1}$ at a distance of 600 m from the diapir edge), the uplift rate decreases with the distance from the diapir center. Drag-induced host rock deformation extends for ~300 m from the outside edge of the diapir and has an uplift rate of 0.4–0.6 $mm.yr^{-1}$, which is 2–3 times higher than the regional uplift rate.

Based on known sea-level oscillations, radiometric dating, and geological evidence, the Namakdan diapir was repeatedly flooded by sea water at 130 to 80 ka. Submarine residue containing gypsum and dolomite and a carbonate cap formed on the diapir. After ~80 ka, a surficial drainage network and karst development started. Blind valleys and their corresponding cave systems evolved continuously for ~20–30 ky. Between 9–6 cal ka BP the rate of sea-level rise exceeded the Namakdan diapir uplift rate by the factor of 3. As a consequence, upward incision of cave streams (paragenetic trend) occurred, and blind valleys near the seashore were filled with gravels. Cave passages now accessible on the Namakdan and Hormoz diapirs started to form 3–6 cal ka BP when the sea level stabilized and downward inci-



■ **Fig. 38.** a) Central part of the Namakdan diapir with karst depressions filled with fine sediments; b) Eastern side of a valley above 3N Cave. Several subhorizontal terraces are visible at valley side together with old cave levels lined by white subhorizontal strips of salt sinters; c) Marine terrace with a resistant surface layer forming cascades. Abrasion cliffs formed by rock salt line the terrace; d) A blind valley above the Upper Entrance Cave (modified from Bruthans et al. 2010).



■ **Fig. 39.** Vertical section of 3N Cave and Holocene marine terrace and vertical sections with radiocarbon ages. Terraces outcropping at valley sides are also added to the picture (seemingly hanging in the air). Based on precise altitude and positional measurements (modified from Bruthans et al. 2010).

sion by streams began. Older cave levels are still preserved but filled with sediments and salt precipitates. The general scheme of the evolution of the Namakdan diapir is believed to be partly applicable to many other diapirs in coastal settings.

Other part of the project focused on the description of water flow and its residence time in underground. This is investigated *via* chemical and isotopic analyses, dating by means of environmental tracers. During the last field trip (in 2009), the Mesijune, Namak and Jahani salt diapirs were studied geologically and speleologically during the three weeks field trip to Iran. We sampled large amounts of liquid and solid samples that were transported to the Czech Republic for analyzing. Strong rains during the stay on the Jahani diapir enabled a good insight into the salt karst evolution and helped us to specify our knowledge about the dynamics of the running processes. On all above mentioned diapirs the solid samples were collected from sediments on the surface and in the underground for the OSL and AMS dating.

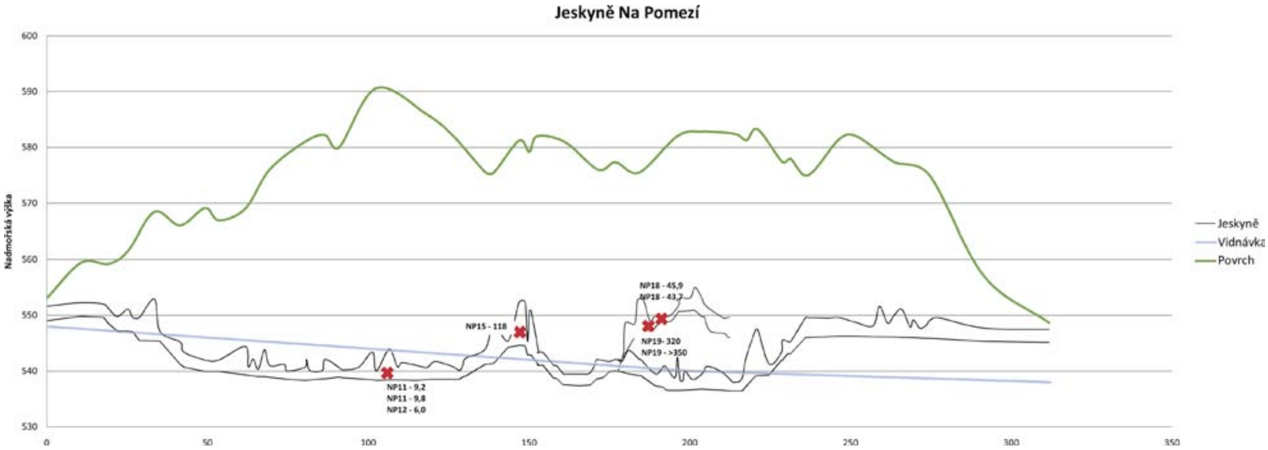
■ **Fig. 40.** Subhorizontal old cave levels filled with sediments exposed in the walls of 3N cave. Varicoloured folds of rock salt in the cave ceiling (Photo by M. Filippi).

4d. Grant agency of the Charles University (GAUK)

GAUK No. 140207: **Karst of Eastern Sudetes and its importace for the study of relief evolution in the Rychlebské hory Mts.** (V. Altová, Faculty of Science, Charles University, Praha, Czech Republic & *P. Bosák*; 2007–2009)

The caves of Na Pomezí and Rasovna (vicinity of the town of Jeseník) have been a point of interest for decades. They are developed in crystalline limestones belonging to the Branná Zone (Silesicum) of presumably Devonian age (*cf.* Morávek 2009) near the zone of Sudetic Fault. Their evolution was connected with the evolution of relief, mostly with the entrenchment of the Vidnavka River valley. The Na Pomezí Cave is about 1 km long, developed in two levels. Total cave depth is 45 m. Rasovna Cave is about 270 m long and 60 m deep; it isa maze cave (Morávek 2009). Both caves, together with some smaller caves, form the uniform system with total depth over 100 m. Detailed gemorphological study of cave interior and dating results indicate that the system represents cavities developed in phreatic to deep phreatic conditions. Ceiling channels connect feeders in the cave bottom with outlet points (mostly open fractures) in the cave roof. They are covered by two to three generations of scallops. Ceiling channels originated probably as a paragenetic feature, when cave passages were filled with sediments. Feeders have very rugged morphology with distinct pendants, they are narrowing upwards and they are situated mostly at ends of small side passages. Outlets have also very rugged morphology with abundant pendants, anastomoses, partly modified by mixing corrosion. Passage walls indicate also some vadose rocky relief forms, like paragenetically bevelled roofs or wall niches. Speleothem crusts at different positions were dated by Th/U dating (H. Hercman, 2008 pers. comm.) at 6.0–9.8 ka at the cave bottom, to 43.9–45.9, 118, 172, 215, 320 ka, up to over 350 ka. The crusts represent a rest after numerous periods of filling and exhumation of cave fills, up to different altitudes, as indicated by younger data at higher altitudes than some older ones. Sediments at lower positions of the cave along tourist trail contain Subrecent bat bones, and magnetization of sediments is of normal polarity. Morphology of the upper part of the Na Pomezí and Rasovna caves is modified by strong collapses and condensation corrosion. Bevel-like forms in the Rasovna Cave resulted from collapses of limestone blocks along subhorizontal cleavage planes rather than from corrosive action of karstwater (Laugdecken).

The system of Na Pomezí–Rasovna caves represents a typical example of hypogenic caves formed by *per ascendum* groundwater movement. The term of hypogenic cave is used here in the sense of Ford & Williams (1998), but not in the sense of Klimchouk (2007). Our approach is close to cryptokarst of Fink (1973) – i.e., caves developed in limestones folded in insoluble sequences with confined aquifers and without prominent karst forms on the surface (*cf.* Panoš 2001). The system is not connected with the entrenchment of surface rivers (Král 1958; Panoš 1959). The age of some speleothem crusts indicates the substantial age (over 350 ka), which may indicate a relatively old age of the cavities. The system was formed in phreatic to deep phreatic zone by ascending water of deep karst circulation. It was completely filled with cave clastic sediments several times and subsequently exhumed partially or completely. The present state represents the exhumation period. It is expected that clastic load was transported into the cave system by surface waters in period when groundwater level was slowly lowering. Ceiling channels, inflow semi-channels and paragenetic features developed when groundwater level was rising. Rapid fall of the groundwater level resulted in an exhumation of the cave fill; rests of speleothem crusts indicate the level of the infill phases. The Rasovna Cave is a vertical outlet part of a deep-seated (or bathyphreatic) system connecting the cave with the surface. Intensive geomorphic processes on the surface during the Quaternary (e.g., Král 1958; Panoš 1959) destroyed the original surface outlet forms. Vertical oscillation of groundwater can be connected with (1) the stress field orientation along the Sudetic Fault and associated faults and fissures; when in a tensional regime, groundwater level lowered, when under compressive stress, groundwater level was rising, and/or (2) with the Pliocene–Quaternary climate changes and water supply from the upper zones of the Rychlebské hory Mts. drained by the Marginal Sudetic Fault. Collapses are rather connected with the tectonic unrest, than with climate-driven processes (Panoš 1959), although some fine-grained screes resulted from the frost activity.



■ **Fig. 41.** Na Pomezí Cave. A section with the results of Th/U dating (V. Altová, original).

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4e. Grants of the State Departments

Ministry of Economics and Trade of the CR, "POKROK", Project No. 1H-PK/31: Methods and tools for evaluation of effect of engineered barriers on the distant interactions in the environment of deep repository facility (M. Vaněček, Isatech Ltd., Praha, Czech Republic, M. Milický, Progeo Ltd., Roztoky, Czech Republic, J. Záruba, Stavební geologie–Geotechnika, a. s., Praha, Czech Republic, *T. Navrátil* & *J. Rohovec*; 2004–2009)

The evaluation of engineered barriers influences on distant interactions in deep repository responds to the social need of solution for safe and long-term storage of the radioactive waste in the rock environment. The safety of the waste storage can be secured by fixation of radionuclides in the deposited waste material and by engineered barriers. Engineered barriers involve insulation materials usually based on natural components. They fill manipulation and technological space of the underground structure and also the fracture system of the host rock.

The aim of the project was to propose and test methodical procedures for the evaluation of the effectiveness of applied engineered barriers in a fracture system of non-sedimentary rocks and to verify the ability to predict influence of applied engineered barriers on migration parameters in water-bearing fracture systems of non-sedimentary rocks.

Hydrodynamic and migration tests performed in the laboratory were used particularly to verify the abilities and possibilities of mathematical models, which were later used as a proxy for hydrodynamic and migration tests in the field. The laboratory tests also yielded index characteristics of used materials needed as parameters for modeling. At the same time, various injection mixtures suitable as engineered barriers were tested.

All the field work was concentrated on the test site of Panské Dubénky, located in southwestern part of the Jihlava District in the Vysočina Region. The network of monitoring wells has been built in three phases. Twelve wells were drilled in years 2005 and 2006. During the last year of project 2009 these were supplemented with additional two wells needed for planned tests and yielding additional information on the network of fractures in the rock. Information on the threshold conditions of the polygon used for mathematical modeling was gathered through two pumping tests.

The project has been generally aimed onto the testing of resources and tools for analysis of hydrogeological properties of fracture systems in granitic rocks. The significant part of the project was the realization of numerous model groundwater flow simulations and transport of the tracer. The initial assumptions of the project included the evaluation of appropriate requirements for the processing of the model solutions. Two verified software models NAPSAC and FEFLOW were selected as tools to be used in the modeling part. NAPSAC is specific software used for modeling of the geometry, flow and transport in the environment of discrete fracture networks, and it has been used as primary model application. Software FEFLOW enables to insert individual fractures into the environment with pore permeability and into the impermeable environment. It is not able to geometrically reproduce real fractures and fracture networks such as NAPSAC but it allows simulation of flow in fractures filled with porous material. FEFLOW has been applied before all during the simulations of laboratory tests and for evaluation of the engineered barriers effectiveness.

Several geometrical bodies with and without fractures and/or with or without engineered barriers were tested. Abilities of both software programs were tested against analogous simulations and methods for simulations of laboratory scale samples have been processed. Ways of possible conceptual approach or alternative parameter inputs and model calibration were produced.

Field tests of the hydrogeological properties in the environment with genuine fracture permeability were performed at the test site of the Panské Dubénky granite quarry. The results of multiple tests and methods enabled to compose discrete deterministic geometrical model of the fracture network. Furthermore, the tests yielded sufficient amount of information to calibrate resistance parameters of the individual fractures. Evaluation of the migration parameters was more difficult and due to smaller number of parameters obtained by measuring, greater level of simplifications and generalizations had to be applied. Analogous and predictive simulations with applied engineered barriers performed on the basis of the test with hypothetical gradient were successful. The applications to the natural field groundwater flow regime was typical, with an increased inaccuracy of model simulations arising from insufficiently precise determination of the threshold conditions on the borders of the modeled domain.

Very important function of the mathematical hydrogeological modeling was the supplementation of data inaccessible to direct measuring by means of inverse calibration. The most significant obtained parameter was the value of the mean hydraulic resistance of the fracture gaping (fracture transmissivity) in the environment of the laboratory geometrical bodies and in the field. The fracture gaping together with fracture network connectivity defines the hydraulic resistance of the environment. In the anisotropic heterogeneous environment it is not possible to evaluate this parameter by means of simple analytical calculation such as in the idealized porous environment and under satisfactory amount of data appears the estimation by calibration as more appropriate. The resistance parameters of the engineered barriers were also calculated by the mathematical modeling.

One of the most important aims of the project was the evaluation of mathematical tools for prediction of test results in the area of predicting the effectiveness of barriers. The engineered barriers were simulated by the clay-cement insulation mixtures. The model predicted the length of tests needed for positive results depending on resistance parameters of the clay-cement material. In the final part of the project, a similar simulation was performed in the environment of fracture network at the test field site. Comparison of the results from the laboratory and the field with the reference measurements yielded information on the rate of possibility to predict flow and transport by means of mathematical model in a discrete fracture network, with an applied engineered barrier.

The results showed that mathematical models are very effective and practical tools for hydrogeological evaluation of the rock environment properties. The quality of the geometrical model and quality of model is always dependent on the amount and quality of input data and on calibration of data. In the fractured environment of crystalline complexes, gathering of sufficient amount of data for completion of trustworthy model is a very complicated task. It requires numerous drilling works, field tests and measurements and also a significant amount of time and financial resources.

Application of an artificial hydraulic barrier to the rock environment further increases its heterogeneity and thus increases the demands for mathematical modeling. The results of this project will enable to better predict and eliminate numerous problems as well as to increase the advantages of mathematical hydrogeological modeling.

Ministry of the Environment of the CR, Project TYPE No. SPII1a9/23/07: **The contribution of the Czech Republic to the detection of the stage of the Earth Ozone layer and solar UV-radiation in Antartica, paleoclimatological and paleogeographical reconstruction of the selected area of Antartica and related geological research** (P. Mixa, Czech Geological Survey, Praha, Czech Republic, *M. Svojtka* & *J. Filip*; 2007–2011)

Zircon and apatite fission track (AFT) thermochronology was applied to the James Ross Basin sedimentary rocks from James Ross and Seymour islands. The probable sources of these sediments were generated in Carboniferous to Early Paleogene times (315 to 60 Ma). The total depths of individual James Ross Basin formations are discussed. The AFT data were modelled, and the thermal history model was reconstructed for samples from the Seymour Island. The first stage after a period of total thermal annealing (when the samples were above 120 °C) involved Late Triassic cooling (230 to 200 Ma) and was followed by a period of steady cooling through the whole apatite partial annealing zone (PAZ, 60–120 °C) to minimum temperature in the Paleocene/Early Eocene. The next stage was the maximum burial of sedimentary rocks in the Eocene (35 Ma, 1.1–1.8 km) and the final cooling and uplift of the Seymour Island sedimentary rocks at 35 to 20 Ma.

Ministry of the Environment of the CR, Project TYPE No. SP/2d1/141/07: **Reclamation and management of non-natural environments** (T. Gremlica, Institute of Ecopolitics, Praha, Czech Republic & *V. Cílek*; 2008–2011)

The research was focused on the quarry reclamation and revitalization where the natural succession seems to be the most efficient tool of management. The complex research consists of geological characteristics including substrate and soil development and then biological research (fungi, higher plants, entomology, zoology – amphibians etc.). A summary monograph is planned for the next year, but the main general result should be an applied output of a new legislative norm that allows a spontaneous succession in the area of at least 30 % (preferably 60 %) of the former mining areas. This simple step may not only save a considerable budget but also create new valuable natural or quasi-natural biotopes.

4f. Industrial Grants and Projects

Czech Geological Survey, Praha, Project No. 7117: **Biogeochemical monitoring in the Lesní potok catchment (Kostelec nad Černými Lesy area)** (*I. Dobešová* & *P. Skřivan*)

Bulk precipitation, throughfall (both beech- and spruce-), and surface water were sampled monthly in the Lesni potok catchment (situated in the Voděradské bučiny National Nature Reserve near the town of Kostelec nad Černými Lesy) within the contract with the Czech Geological Survey (CGS), Prague. Simultaneously, main characteristics of the collected samples were determined: volume of all types of precipitation, instant discharge of the surface water, and conductivity and pH value of all liquid samples. Data concerning monthly precipitation were also collected at the nearby breeding station (Truba) of the Czech Agricultural University. Collected liquid samples were transferred in a laboratory of the Institute of Geology AS CR, v. v. i. (GLI) into storage vessels, stabilized with diluted nitric acid (Merck, Suprapur) and stored in a cooler until their transport to the analytical laboratory of the CGS. The contract also involved maintenance and innovation of sets of collectors and of other field equipment. The contractor was also provided with the obtained field and laboratory data concerning the monitored samples.

Bohemian Switzerland National Park Administration, Krásná Lípa, Project No. 7214: **Monitoring of Atmospheric Precipitation in the Bohemian Switzerland National Park** (*T. Navrátil*, *I. Dobešová*, *J. Rohovec* & *T. Nováková*; 2007–2010)

Systematic monitoring of the atmospheric deposition in the area of the Bohemian Switzerland National Park (BSNP) started in May 2008. Monitoring of atmospheric precipitation aims to assess the current state and changes in chemical composition of precipitation over area of NPBS. A comparison of newly gathered data with data from previous stages of monitoring enables to evaluate the development of the atmospheric deposition quality and quantity.

The main anion in bulk precipitation at the area of the BSNP was nitrate composing 47 % of the total anion sum. Another abundant anion was sulfate which represented about 23 %, and finally chlorides and bicarbonates took 16 and 13 %, respectively. The least abundant anion from the group of monitored elements was fluoride. Similarly to other sites in the Czech Republic, fluoride concentrations in bulk precipitation were recently oscillating close to the detection limit of the analytical method used. The main cation, besides hydrogen with 36 %, was ammonium ion composing over 40 % of the total cation sum. Smaller but still important parts in the total sum of cations were allocated to sodium, potassium and calcium, which represented 10, 6 and 5 %. Other cations and elements were unimportant.

The detected negative correlation between the concentrations of H^+ and K, Ca, NH_4^+ means that increased amounts of these elements in precipitation are typical for samples with decreased concentrations of H^+ and thus increased pH value. These increased concentrations can in fair number of samples originate from contamination of bulk precipitation sample by organic debris. Very strong statistical relationship has been found between concentrations of Na and Cl. Common source of Na and Cl concentrations are marine aerosol or the dusts originating from road salts during dry periods in winter. Significant correlation between concentrations of Ca and Al was rather interesting. The relationship between NO_3^- and NH_4^+ concentrations could be primary due to similar emission source but could be also a result of bacterial transformation processes especially in the summer period. The relatively high correlation between NO_3^- and SO_4^{2-} concentrations indicates their mutual source – thermal power plant emissions.

A well known phenomenon in the area of BSNP are salt efflorescences on sandstone cliffs and the connected unwanted erosion and collapsing of the rock formations. The most important minerals forming the salt crusts were found to be sulfates – gypsum ($CaSO_4$ $2H_2O$) and K- alum [$KAl(SO_4)_2$ $12H_2O$]. The source of sulfur has been detected as atmospheric sulfur originating from fossil fuel burning by means of isotopic analysis, but the source of elements such as Ca, K and Al has not been resolved yet. Some of the existing papers speculate on atmospheric origin of Ca found in gypsum efflorescences. The laboratory evaporation experiment proved that gypsum can form directly from the precipitation solution sampled at the BSNP. The gypsum crystal grains in solid residue were identified by XRD analysis and by optical analysis.

Labrys, o. p. s., Project No. 7221: **Geoarchaeological report from the Sobín locality** (*L. Lisá* & L. Petr, Philosofical Faculty, Univeristy of West Bohemia, Plzeň, Czech Republic)

Geoarchaeolgical report from Sobín describes mainly general geomorphological and sedimentohological conditions within the studied area. Research applied at the Sobín locality includes micromorphological study of exposed sediments together with the application of environmental methods such as pollen and phytolith analyses. It is obvious that the relatively stable geological background composed by sandstones of the Bohemian Cretaceous Basin, when covered by vegetation, became very unstable once it was strongly influenced by the Knovíz culture. Deforestation together with ploughing of large areas started the processes of slope destabilization and probably the final collapse of the Knovíz settlement in this area. This collapse is readable in archaeological as well as sedimentological record. Huge amounts of perfectly bedded colluvia were redeposited during a relatively short period covering years or tens of years. These fast gravitational processes, on the other hand, preserved redeposited soil, pollens, organic material as well as excrements which are features not very common in this type of material. Results of geoarchaeological research from Sobín show a very nice example of the way how humans influenced and totally changed the morphology and local environmental conditions in the past. As a result of these changes, the landscape was totally abandoned for generations until natural processes stabilized the landscape again.

Institute of Archaeology Praha AS CR, v. v. i., Project No. 7234: **Micromorphological assessment of deposits accumulated in "rondel" structures near Kolín** (*L. Lisá*)

The rescue excavations connected with the road construction near Kolín exposed well preserved rounded structures interpreted as Neolithic rondels based on archaeological finds.

During this research, 7 micromorphological samples were acquired in total for the purposes of geoarchaeological study. According to http://www.bylany.com/aktualne.html, the sampled object was one of the biggest in Europe.

The question applied to the geoarchaeological research was the way of the rondel structures were built, used and filled. And how strong was the influence of natural or human processes during the period of their infilling.

All the material studied in this research was redeposited into the rounded structures by gravitational processes, where sometimes water played an important role. Because the structural and textural features of the studied deposits show some kind of similarities, it was possible to distinguish several types of processes which played an important role during the process of infilling: (1) the phase of common bioturbation; (2) the phase of fast redeposition; (3) the phase of sedimentation from suspension (water level); (4) minimum number of microchacoal, charcoal and artefacts; (5) intensification of slope processes and phases of water level, and (6) the presence of horizontal voids connected with freezing and thawing phases.

The general interpretations are based on the points mentioned above. Some kind of elevation must have existed in the very close proximity: it was the source of material later redeposited naturally into the rondel depression. The facies in the rondel infilling reflect the phases of stabilization of this elevation. The very visible lack of microcharcoal which is usually very common in every case of settlement suggests that any long-term settlement probably didn't exist in the close proximity of the rondels. As visible from the section studied, no phases of cleaning this depression were found. The first phases of infilling probably originated very quickly and the velocity of infilling slowed down together with the landscape (the near elevation) stability and with the missing source of detrital material.

Institute of Archaeology Brno AS CR, v. v. i., Project No. 7243: **Micromorphology of two samples from the Paleolithic locality of Moravany (Slovakia)** (*L. Lisá*)

Two micromorphological samples were studied. Sample A located up the slope in trench III/08, at a depth of 50 cm, contains low amount of organic matter. The most typical feature is *in situ* not redeposited limpid crescent clay coating. This feature is typical for soil B horizon development and it is very sensitive feature for recognising redeposition of soil material. This material is also characterized by a higher accumulation of Fe, Al and Mg which goes together with clay leaching down the section. This horizon was micromorphologically described as *in situ* soil B horizon.

Sample B, located down the slope in trench II/08, at the depth of 80 cm, represents at least three or four different climatic stages. The presence of organic matter, root channels and bioturbation is explained by the activity of soil fauna and flora under stable climatic conditions. The slightly higher amount of organic matter is visible from thin section as well as from analytical data. The value of magnetic susceptibility is quite low due to the presence of diamagnetic organic matter and secondary calcium carbonates. The intrusive accumulations of secondary calcium carbonate in root channels and their surroundings probably also represent a relatively stable, more arid environment (Bezce-Deak et al. 1997), with phases characterized by desiccation and slow matrix impregnation along the root channels. The topmost part of the sample contains microstructures typical for at least one stage of freezing and thawing. These features were described as a product of last glacial period seasonal temperature changes. It is obvious that there was no redeposition after the development of these features. The presence of Fe hydroxides impregnating matrix below as a thin layer are interpreted as the result of more humid conditions. The described features probably developed under the same, very cold environmental conditions. According to the state of the organic matter and surrounding matrix, together with the increase in values of P, Ca/Mg and S, this layer can be possibly designated as buried A soil horizon, secondarily influenced by more arid and lately cold and humid conditions. The landscape configuration plays an important role in the development and preservation of this horizon. The material of this horizon doesn´t show any features typical for long-distance redeposition.

BEZCE-DEAK J., LANGOHR R. & VERRECCHIA E.P. (1997): Small scale secondary $CaCO_3$ accumulation in selected sections of the European loess belt. Morphological forms and potential for paleoenvironmental reconstruction. – *Geoderma*, 76, 3–4: 221–252.

GEKON, Ltd., Praha, Project No. 7300, 7303: **Detrital mineral associations of the glass-making raw sands from the Holany locality** (*J.K. Novák*, *J. Adamovič*, *M. Svobodová*, *P. Bosák* & *J. Pavková*)

A thick body of the quartzose sandstone from the northern neigbourhood of Holany, occurring above the top of the Jizera Formation (Upper Cretaceous), is recorded as a source of glass-making sands. The main dataset is drawn from five exploratory drillholes. The study of mineralogy, grain size, quartz grain shape and adhering particle data led us to conclude that the dominant sand-sized fractions in the range of 0.2–0.6 mm are sufficiently pure. The coarse sand fraction (over 2 mm) and deleterious clayey one occur in a low proportion. The former consists of friable quartzite fragments with kaolinite coatings and semi-translucent quartz. Other lithoclast types are absent. Heavy minerals, such as ilmenite, sagenite, additional ferruginized biotite, feldspars, and quartz grains with hematite and goethite coatings within the 0.08–0.2 mm fraction are undesirable, because of worse smeltability and colouring. Like other glass-making sands from the Bohemian Cretaceous Basin, those from exploration boreholes represent a feasible source for future supply, if economic advantage will be considered. Evidence from geological framework and sedimentology and that from palynology of associated siltstones (Záluží and Podolí) point to Upper Turonian age.

A well preserved and diversified palynomorph assemblage was ascertained (especially in sandy pelitic sample with rich organic admixture). Marine elements prevailed in all three studied samples. The composition of dinoflagellate cysts is comparable to that found in hemipelagic deposits of the Úpohlavy section – channel (Svobodová et al. 2002; Uličný et al. 1996). Both open-marine (gonyaulacoid) and shallow-marine (cavate and peridinioid) types were found. Biostratigraphically important angiosperm pollen of the Normapolles group – *Trudopollis* sp., *Plicapollis* sp., *Minorpollis* sp. have their first occurrence from the Middle Turonian. Dinocyst species *Chatangiella tripartita* characterizes the Upper Cretaceous deposits. Therefore, the Upper Turonian age of the sandy siltstone samples is highly probable.

SVOBODOVÁ M., LAURIN J. & ULIČNÝ D. (2002): Palynomorph assemblages in a hemipelagic succession as indicators of transgressive-regressive cycles: example from the Upper Turonian of the Bohemian Cretaceous basin, Czech Republic. – *In*: WAGREICH M. (Ed.): *Aspects of Cretaceous, Stratigraphy and Paleobiogeography, Verlag der Österreichischen Akademie der Wissenschaften, Schriftenreihe der Erdwissenschaftlichen Kommissionen, Band 15*: 249–267. Wien.

ULIČNÝ D., ČECH S., VOIGT T., WEJDA M., KVAČEK J., ŠPIČÁKOVÁ L., SVOBODOVÁ M., HRADECKÁ L., HLADÍKOVÁ J., ŠTEMPROKOVÁ D., LAURIN J., ŠTAFFEN Z., ŠVÁBENICKÁ L. & TRÖGER K.A. (1996): Stratigraphy and facies of the Bohemian-Saxonian Cretaceous Basin. – *Proceedings of the 5th International Cretaceous Symposium and Second Workshop on Inoceramids, September 16–24, Freiberg/Saxony, Germany, Field Trip B1*: 1–23. Freiberg.

Velkolom Čertovy schody, Inc., Project No. 7301: **Documentation of progress of quarry walls – reclamation of the Quarry–West** (*P. Bosák*)

Special syngenetic, diagenetic and hypergenic features in the Koněprusy Limestone (Pragian, Lower Devonian, Koněprusy deposit, Barrandian, Czech Republic) are analyzed from the point of view of possible harmful components for the production of cement, lime and other high-grade products. The detailed analysis of fully cored boreholes (355), quarry faces and blasted limestone enabled to reconstruct the horizontal and vertical distribution of some of the most important features occurring and detected in the Koněprusy Limestone and partly also in the underlying Kotýz Limestone (Lochkovian, Lower Devonian). The succession of features is closely connected with the evolution of the depositional basin, i.e., southwestern part of the Prague Synform (Barrandian). The Koněprusy Devonian has been known as a shallow marine segment of the Barrandian Devonian, typically with a number of hiatuses in the depositional sequence. This kind of deposition and quite pronounced expression of tectonic- and/or eustatic-driven sea-level changes was also related to the activity of synsedimentary pennate, dextral-transpression fault. Its activity is recognizable at the time of the deposition of the Kotýz Limestone (Lochkovian, Lower Devonian), it continued during the whole Devonian depositional activity and terminated during Variscan Orogeny (Upper Carboniferous) by its transformation into the Očkov Overthrust.

The position of the Koněprusy Devonian and the activity of synsedimentary transpression fault zone, together with the number of abrupt eustatic sea-level changes, resulted in repetition of sequences of diagenetic processes and products, such as neptunian dykes, paleokarst porosity, invasion of hypogenic fluids, dolomitization. Polycyclic and polygenetic products overlapping in time and space can be identified within the individual periods only with problems or with doubt owing to complete paleontological sterility, except for the neptunian dykes. The lithological and geochemical character of the fill can represent the only guideline for correlations. The succession of diagenetic processes, especially in the Pragian Koněprusy Limestone, is characteristic by the activity of (1) common phreatic and vadose, meteoritic and marine diagenetic environments in the relation to sea-level changes and evolution of fresh-water lens with dissolution, corrosion and geochemical processes resulting in mostly light-colored internal sediments, cements, dolomitization, microbial activity and origin of local anoxic conditions, and (2) hypogenic processes related to the ascent of heated petroleum-rich basinal waters from the underlying formations; internal sediments are mostly dark-colored and sometimes organic-rich and depositional environment was almost exclusively anoxic. The alternation and/or mixing of both diagenetical realms is well-preserved in a number of diagenetic features, from neptunian dykes to vuggy paleokarst porosity and fracture fill. Geochemical parameters resulting both from organic geochemistry and evaluation of trace elements (REE) clearly indicate that the products of hypogenic processes had the same source – mature terrigenous material and volcanics from the underlying Lower Paleozoic sequences.

Hydrothermal activity was represented by two kinds of activities: (1) syndepositional processes related to the ascent of heated petroleum-rich basinal waters from the underlying Lower Paleozoic formations along faults of the transgression zone and (2) post-diagenetic ascent of deeply circulating meteoric and karst waters mixed with some connate waters expelled from the underlying carbonate and non-carbonate sequences during the late stage of burial and tectonic stress in two stages during (a) the Variscan Orogeny (ca 380–315 Ma) and (b) during some of the phases of the Alpine Orogeny (from ca 79 Ma, i.e., topmost Cretaceous to ca 20 Ma, i.e., Lower Miocene). Hydrothermal activity during the Variscan and Alpine orogenies was responsible both for veining and karstification and the origin of cavities. Variscan ones are completely filled with crystalline calcite and dolomite, a part of the Alpine ones is still accessible. Intergranular corrosion was connected rather with Alpine processes than with the Variscan ones.

GET, Ltd., Praha, Project No. 7302: **Clay-dominated raw materials from the Myslinka locality: petrography** (*J.K. Novák & P. Bosák*)

In the Plzeň Basin, most of the kaolin deposits are (a) generally residual regoliths (exposed or hidden) derived from Carboniferous arkoses and arkosic sandstones under humid climate, or (b) transported granitoid regoliths located elsewhere outside the basin, which were re-sedimented as fans and aluvial deposits during hiatuses. The kaolin outwash is higher in the northern part of the basin (e.g., Kaznějov, Horní Bříza deposits) than in its southern part (e.g., Chlumčany deposit), due to a higher proportion of the pseudomorphed feldspar. The Myslinka locality is constituted by (a) Tertiary-aged kaolinitic sandstones and/or conglomerates, which are attributed to the river macrofacies; (b) *in situ* weathered Carboniferous hyaloclastite and volcanogenic siltstone, as well as (c) eluvial breccia after Algonkian schist. The kaolinitic sandstones exhibit quite a wide variety of detrital kaolinitic clay and mica, kaolinitic pseudomorphs after K-feldspar and plagioclase, silt-sized quartz cement. They reflect a variety of depositional conditions and diagenetic processes. It is clear that this sedimentary kaolin sort is by no means homogeneous either mineralogicaly or chemically. A comparison with kaolin deposits studied in more detail reveals a much lower supply of kaolin.

Archaia Brno o. p. s., Project No. 7304: **Geoarchaeological report on the Padovec locality, Bašty 2, Brno** (*L. Lisá*, A. Bajer, Mendel University of Agriculture and Forestry, Brno, Czech Republic & M. Gregor, Institute of Geology, Faculty of Natural Sciences, Comenius University, Bratislava, Slovakia)

One of the main interests of Medieval urban archaeology is the research of town development. There are unfortunately available only archaeological sources with limited information for the study of beginnings of Moravian towns (13th Century). To divide the relicts of dwelling-houses from farming buildings is important for the demarcation of the Medieval burghers' plots. This demarcation is usually quite problematic, because the oldest buildings are mostly made from timber and earth, and the floor plans together with the types of building constructions are usually very similar. One of the possibilities how to solve this problem seems to be the geoarchaeological study of house infillings.

One of the case studies when the function of houses was interpreted by geoarchaeological approach (especially using the method of micromorphology) is the archaeological research of medieval burgher plot in Brno, Czech Republic. Within this plot, located in the street of Bašty 2, objects dated to the 13th and 14th centuries were found. Two objects with laminated floor layers were chosen to be compared. According to the microstratigraphical and micromorphological study, these layers were interpreted as an infilling of the dwelling house (trampled floor layer) in the first case and as the infilling of a farm building (stable) in the second case.

The sedimentary infilling of the farm building is composed of a set of layers. Some of them have laminated structure. The base of the object is composed of loess material, secondarily influenced by P derived from organic matter deposited above. The material of laminated as well as non-laminated infilling is composed of redeposited loess material and decomposed organic matter. The layering is a relict of the preserved *in situ* stabling, micromorphologically visible as microlaminae of loessic material pressed together with organic matter, *in situ* phytoliths and excrements.

The sedimentary infilling of the dwelling house located in the close surroundings also preserved microlamination. This one is composed of laminae of microcharcoal and redeposited loessic material. This lamination is a result of the daily house using. Pieces of microcharcoal were redeposited into the house on the soles in dry periods or at the time of using the oven. Loess material was redeposited in rainy periods, when the surroundings of the house was muddier.

Our suggestion for further research is to perform a systematic micromorphological sampling of floor layers. The geoarchaeological approach is the way how to interpret the function of the studied objects which seems to be the key for more general interpretations of the Medieval urban archaeology.

GET, Ltd., Praha, Project No. 7305: **Vein barite from the Benbow Inlier, Central Jamaica** (*J.K. Novák*, *P. Bosák* & *Z. Korbelová*)

This report provides a review of the current state of knowledge about barite utilization and barite composition from the target region. Barite and chemically inferred witherite have been widely used in many sectors of industry, medical units, and nuclear power plants where radioactive impermeability, chemical purity, inertness, and high specific gravity are required. This report draws attention to the ground barite as a raw material for radioactive shielding and heavyweight concrete, the accelerated rate of clinkering process, for restoration mortar and cement additives, improving the physical and mechanical properties of hydrated concrete, and for durable airport and road surfacing. The southern part of the Benbow Inlier is the most significant Jamaican region where the vein barite occurs alone, or more commonly, in association with quartz, jasper and minor carbonate, but without fluorite. The most conspicuous features of the screened barite crystals include high chemical purity, brightness of about 85–88 % (related to visual white color), and the presence of Sr-bearing patches (up to 3.67 wt. % SrO; 40–50 μm in size). Exploration target for barite has shown that low-grade veins give lesser geological reserves than residual barite deposits, which may be of major commercial importance.

GET, Ltd. Praha, Project No.7306: **Petrography of deformed spilite from the Družec quarry** (*J.K. Novák* & *P. Bosák*)

Proterozoic metabasite lavas of the Unhošť-Křivoklát-Radnice belt are embedded into complexly folded and faulted slates and phyllites. Although the mineralogical-chemical composition and common resistance to weathering are roughly similar, the subvariolitic spilite and spilitic porphyrite have preferred direction patterns, from brecciated to schistose varieties. The latter resemble metamorphic rock, rod-like subvariolitic spilite fragments remain preserved. An instructive example of these structures is found at the Družec quarry, which is now operated for crushed rock aggregates. Fabric-dependent anisotropy, parallel foliation planes and complexity of phase boundaries are undesirable for the use in concrete.

Prospecto Ltd., Praha, Project No. 7309: **Mineral magnetic study of loess/paleosol sequences exposed in the Blanka Tunnel** (*J. Kadlec* & *S. Šlechta*; 2009–2010)

Loess/paleosol sequence deposited above the Mid Pleistocene Vltava River terrace was exposed during a construction of the Blanka road tunnel in Prague. The thickness of loess underlain by the fossil soil horizon is 4 m. Oriented samples were collected for mineral magnetic and paleomagnetic polarity measurements. Low-field volume magnetic susceptibility (MS), anisotropy of low-field magnetic susceptibility (AMS) and detrital remanent magnetization (DRM) analyses were conducted with the aim to reconstruct sedimentary and post-sedimentary processes and to estimate the age of the deposits. Samples were collected from the section into non-magnetic plastic boxes (6.7 cm^3) with 5 cm vertical distance between specimens. Measured MS values range between 124–372 x 10^{-6} SI. Besides magnetic parameters (concentration and type of magnetic minerals, magnetic grain size), MS variations are influenced by pedogenic carbonate and calcareous sandstone clasts in variable concentration.

The AMS reflecting preferred orientation of magnetic minerals in the rock has been widely used as an indicator of mineral fabric in sediments. Information about mineral fabric allows us to reconstruct wind direction changes or post-depositional deformation due to slope processes. The maximum susceptibility direction ($k1$) is called magnetic lineation. The plane perpendicular to minimum susceptibility direction ($k3$) and containing maximum and intermediate directions ($k1$, $k2$) defines magnetic foliation. The magnitude of anisotropy is presented as a ratio of maximum and minimum susceptibility, known as the anisotropy degree, P, whereas the anisotropy shape can be described by shape parameter, T. Oblate shapes correspond to $0 < T \leq 1$, while prolate shapes correspond to negative values, $-1 \leq T < 0$. According to laboratory experiments, the primary depositional magnetic fabric should be oblate ($T > 0$) with magnetic foliation subparallel to the bedding. When the rock is deposited in a current, magnetic foliation may be imbricated, dipping at an angle of <15° in the direction opposite to the flow direction. Magnetic lineation is either parallel to the flow direction or, in the case of high current velocity, perpendicular to it. The AMS values measured in the uppermost part of the loess section show deposition in rainwash conditions. Transport with rain water and deposition in a shallow depression is indicated by lamina bedding in the central part of the section. Magnetic imbrication detected in the rest of the section indicates the wind direction from SE (S) to the NW. The DRM directions obtained by AF demagnetisation of pilot samples show normal paleomagnetic polarity of the sediments. It is no surprise because the loess sequence is younger than the underlying Middle Pleistocene river terrace.

Project of the Ministry of Environment of the Czech Republic (Code SP/2E6/97/0) "The UNESCO European Geopark Bohemian Paradise – development of a geoscientific information system for region's development and geological heritage protection" (L. Švábenická, Czech Geological Survey, Praha,T. Řídkošil, Museum of the Bohemian Paradise, Turnov, *M. Svobodová* & *J. Zajíc*)

Sub-project No. 7310: **Study of plant microfossils from the Rokytnice borehole** (*M. Svobodová*)

Angiosperm pollen grains from the Normapolles group *Complexiopollis vulgaris, Complexiopollis* sp., and *Atlantopollis* sp.indicate a Late Cenomanian age for the studied borehole which is situated in the northern part of the Cenomanian-age Central paleodrainage system. Shallow marine deposition was documented by the presence of dinoflagellate cysts, acritarchs and foraminiferal chitinous linings.

Sub-project No. 7311: **Permo-Carboniferous Zoopaleontology** (*J. Zajíc*)

Chapter Zoopaleontology of the Permo-Carboniferous was compiled for the explanatory text to the Geological map No. 03-413 Semily (1: 25,000). Three formations with five fossiliferous "horizons" were documented from the area of the map. Upper Carboniferous fauna of the Štěpanice–Čikvásky Lake (Semily Formation) deposits is of Stephanian C age (*Sphaerolepis* local bio/eco subzone). The Vrchlabí Formation is famous mainly for the Lower Permian fauna of the Rudník Lake deposits which is of Asselian age (*Acanthodes gracilis* bio/ece zone). Lesser known fauna of the Kozinec "Horizon" is probably of the same age. The Prosečné Formation is of Sakmarian age (*Xenacanthus decheni* local bio/eco zone). Fauna of the lower Arkose "Horizon" is known from one borehole (Kh-1 Kruh). The upper Kalná "Horizon" is well known and was identified in the area of the map both from borehole Kh-1 Kruh and from opencast localities.

Czech–Moravian Cement, Inc., Project No. 7315: **Environmental record of magnetic minerals in the clastic cave deposits** (*S. Šlechta* & *J. Kadlec*)

The character of magnetic assemblage preserved in the fluviolacustrine cave deposits is influenced by magnetic properties of bedrock in the stream catchments, from where the sediments were transported into the caves. The Lower Carboniferous graywackes and shales of the Drahany Upland are the main source of clastic sediments found in the caves of the Moravian Karst. The Pleistocene eolian sediments and soils represent another significant source of magnetic minerals, which were transported by streams into the caves. The origin of these Quaternary deposits, which cause a rise of ferromagnetic mineral content in the cave sedimentary sequences, is strongly controlled by environmental factors. The increased eolian input, typical for Pleistocene cold stages, is indicated by coarser magnetic grains (usually MD magnetite) blown up either from the weathering products of crystalline bedrock of the eastern margin of the Bohemian Massif or from the Quaternary glaciofluvial and fluvial deposits. A significant amount of antiferromagnetic goethite is also present in the eolian silts. The fine SD, PSD or SP magnetic particles found in cave deposits represent pedogenic products of warmer stages, which were later transported from the surface into the caves. The soil formation is connected with magnetic enhancement caused by increased presence of maghemite originating by magnetite oxidation Ultra-fine magnetite is also formed during redox cycles or under bacterial microorganism influence. A typical pedogenic iron oxide is also SD high-coercive hematite.

Detailed sampling in sedimentary sections in two caves was carried out. Samples were radiometrically dated and several rock magnetic proxy parameters were measured, namely the frequency dependence of magnetic susceptibility, anhysteretic remanent magnetization, and hysteresis parameters.

In the Ochozská Cave, sediments were subdivided into sub-groups according to the lithological characteristics. Magnetic fabric (anisotropy of magnetic susceptibility) is typical for sedimentary rocks. Magnetic susceptibility values in two sampled sections indicate that the upper part of these sections is composed of the same material, thus deposited during the same flood event. Elevated susceptibility values were found in the basal layer of the "U zkamenělé řeky" section. This layer is assumed to be a relic of an older cave fill. Flow direction of water discharge was changed several times during sedimentary deposition as a result of blocking and re-opening of cave corridors.

Faculty of Science, Charles University, Praha, Project No. 7316: **Strength properties of limestones** (*R. Živor*)

Various types of limestones from Italy were tested and their simple compressive strengths were determined. An average value of the simple compressive strength was 114 MPa and its values varied from 44 to 193 MPa.

Arcadis Geotechnika a. s., Praha, Project No. 7317: **Dynamic modulus of rock elasticity determination** (*R. Živor*)

Dynamic modulus of rock elasticity and Poisson's ratio various types of rocks (sandstones, granites) were determined by ultrasonic method. Dynamic moduli were calculated from P and S waves velocities which were found during ultrasonic wave propagation through rock specimens.

Institute of Archaeology Brno AS CR, v. v. i., Project No. 7318: **Micromorphology of loess section from Tvarožná near Brno (Czech Republic)** (*L. Lisá*)

The block of 1.58 m thick Quaternary deposits from the archaeological site of Tvarožná near Brno was sampled by P. Škrdla and subjected to geochemical and micromorphological investigations. The main aim of this study is to identify the origin of macroscopically defined horizons, and the processes which took part during and after the deposition.

Geoarchaeological approach was used including micromorphology, geochemistry, magnetic susceptibility and grain size analyses to solve key questions given at the beginning of research. Micromorphological approach covers descriptive microstratigraphical analyses (Bullock & Murphy, Eds. 1983) including microfabric types, structural and porosity features, natural inclusions, anthropogenic inclusions and pedofeatures (Macphail & Cruise 2001). Such an application of soil micromorphology to archaeology was introduced mainly by Goldberg (1983) and lately well established in the literature (French 2003; Goldberg & Macphail 2006). The chemical methods employed include analyses of major elements (Ca) using the VARIAN Spectr AA 300 AAS spectrometer. Magnetic susceptibility was measured by the KLY-4s CS3 equipment. Calcium carbonate was removed by boiling in HCl and then particle-size distribution was measured by laser granulometric equipment (CILAS 1064 Liquid) at Masaryk University in Brno.

The site is located approximately 3.7 km E of the former border of Brno City at the altitude of 265 m a. s. l. The study area is composed mainly of loess and loess- like deposits (Lisá, Buriánek & Uher 2005; Lisá & Uher 2006) of Würmian age. The basement is formed by conglomerates of the Myslejovice Formation (Lower Carboniferous of the Drahany Upland) and by Tertiary calcareous clays.

The studied section was macroscopically divided into six units marked as A–F. This horizon description is not based on pedological nomenclature. The uppermost unit marked as A was according macroscopical and micromorphological description interpreted as ploughed and eroded slightly humic horizon (Apk) weakly developed on loess deposits. We are not able to include this horizon into systematic soil nomenclature, because human and erosion impact of ploughing was so high that no typical features of distinctive soil type were preserved. Ploughing was interpreted based on a typical sharp border between brown colored ploughed horizon and yellow loessic subsoil situated below. Such a typical Apk homogeneous plough zone must have been produced only by repeated ploughing (Holliday 2004) which is documented also historically in this area. Magnetic susceptibility becomes higher which is a typical response to pedogenesis. Ploughing can initiate or increase rates of accumulation of illuvial silt, clay and humus just under the plough zone. According to micromorphological observations, a 5 mm thin zone was described immediately under the sharp ploughing border which is typical by concentrations of micritic dissolved calcite concentrations containing decomposed organic matter. This unit is also typical by the increase in Ca/Mg ratio and still quite high values of Fe, S and P. There is no visible increase in silt and clay fraction in the grain size analyses, because fine fraction is composed mainly of carbonates removed before grain-size analyzing. The ploughed zone is also characterized by the lack of undisturbed calcite crystals forming root infillings. Just single cells isolated in the groundmass are preserved. The formation of calcified root cells is related with the period of loess deposition with a pronounced dry season and for example Forrest-Steppe pedogenesis (Bezce-Deák et al. 1997). The relationship between the origin of calcified root cells and the presence day surface processes is known only from the regions with Mediterranean moisture regime pronounced warm and dry season or with an aridic moisture regime (Courty & Fedoroff 1985). Becze-Deák interpreted the abundance of *in situ* position of calcified root cells as a product of possible long stability of soil surface under favorable climatic conditions.

Macroscopically massive yellow horizon is composed of silt material re-deposited by aeolian processes. The prevailing coarse grain fraction is not composed of quartz as in the case of south Moravian loess deposits (Lisá 2004), but of partly dissolved calcite crystals. These crystals originally composed root infillings of some stratigraphically older loess deposits, were lately re-deposited by wind to this position and compacted by grass roots. New compaction caused re-calcification. Jaillard (1987) described the origin of these features as a typical biomineralision process of roots mainly in strongly calcareous soils. Calcium carbonate in the soil matrix is dissolved by H^+/HCO^{3-} exchange and the excretion of organic acids as visible mainly in A and E horizons. The available Ca^{2+} is taken up by the roots, absorbed by the cells and accumulates in the vacuole where it precipitates as calcium carbonate (Bezce-Deák et al. 1997). This process is quite rare and occurs mainly in well drained soils. Because loess material of all studied sections is composed of *in situ* calcium crystals on root infillings or reworked calcium crystals with primarily same origin, the whole area must have been probably well drained not only in the phase of Holocene climatic stage. Together with loess material, also some amorphous pedofeatures and small rock fragments were reworked, which suggests that material suggested to re-deposition included some soil material as well as material from the colluvial layer below. Magnetic susceptibility of this horizon is very low and corresponds to the magnetic susceptibility of typical loess (Lisá, Buriánek & Uher 2005).

Lower part of the section contains artifacts and was formed by colluvial processes. Material of horizons C, D, E and F is again typical by the presence of abundant reworked calcite crystals from some older loessic deposits and by common re-deposited amorphous pedofeatures. The climate during this re-deposition must have been arid, with only occasional moisture as suggested by typical calcite hypocoatings and concentrations in the lower parts of the section. These were re-deposited from the dissolved calcite crystals above. The values of pH, Al, Fe and Mn show an increasing trend and probably reflect the presence of weathered rocks clasts and increased amount of re-deposited amorphous pedofeatures. The values of P are also quite high, probably reflecting the presence of organic matter. According to Wieder & Yaalon (1982), hypocoatings are the result of rapid precipitation of $CaCO_3$ from the water suction and desiccation effect due to root metabolism. On the other hand, Brewer (1964) proposed that calcium hypocoating can originate by evaporation of Ca-rich solution by precipitation from soil solutions percolating along the pores and penetrating into the soil matrix. According to Kemp (1995), impregnative hypocoating is most widely associated with vertical leaching from surface to subsurface horizons under semiarid regimes. Horizons are characterized by the presence of *in situ* originated calcite crystals forming infillings of root channels, which is a typical key of stabilization. Coarse particles composed of rock fragments are too big and heavy to be redeposited by wind. The slope is too low to allow slope processes without the presence of water. Interestingly, no freezing processes are present in matrix microstructures. The correlation between magnetic susceptibility and different grain size fraction shows that the best correlation is between MS and clay fraction (0.23), the worst correlation is between MS and sand (–0.29). In contrast, a very good correlation was indicated between MS and clay + sand fraction. This fact suggests that the best correlations are between the finest material and the most poorly sorted material.

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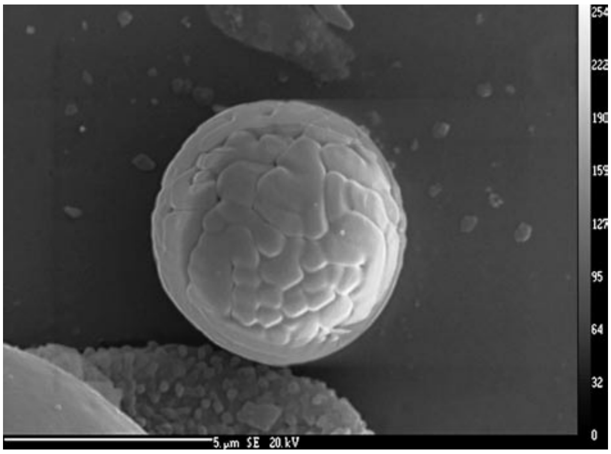
Institute of Atmospheric Physics AS CR, v. v. i., Praha No. 7319: **Analysis of the fly ash samples – feasibility study** (*T. Navrátil*, *J. Hladil*, *L. Koptíková*, *J. Rohovec*, *P. Schnabl*, *P. Pruner* & *T. Nováková*)

The initial aim of the project monitoring the composition of sampled fly ashes with the electronic optical microscope appeared unrealistic or very complicated to realize especially due to time demands. The study of the existing scientific literature indicated that geophysical methods represent promising potential for the solution of similar problems. We tested magnetic susceptibility of sampled fly ashes and concluded that it is a relatively accessible, easy and descriptive method to indicate relative differences between individual samples.

The results of geophysical measurements indicated significant differences between the main individual source materials. The coal power plant ashes exhibited high contents of magnetic minerals, thus high values of magnetic susceptibility. On the other hand, the contents of magnetic minerals in materials originating from mining such as coal and mine spoil materials was very low so these materials exhibited very low values of magnetic susceptibility. Collected road dust samples exhibited elevated values of magnetic susceptibility indicating that the effect of emissions from coal burning power plants on the overall composition of fly dusts and ashes has been significant.

The fly dust samples collected from the air also indicate a significant proportion of magnetic particles. This evidence indicates that the effect of emissions from coal burning power plant has not been negligible during the monitored period. The question is what is the origin of the magnetic particles? There are various sources such as power plant emissions, home heating fire furnaces, secondary dusts and others but these sources are not associated with mining.

For more detailed conclusions, more sophisticated geophysical measurements are needed. In particular, the measurements such as SIRM (Saturation Isothermal Remanent Magnetization) could yield more hints on the content and properties of the magnetic particles in the sampled dusts. The geophysical measurements will have to be further supported by the other analyses of the dust samples. Another difficulty is the weight of individual samples which usually reaches the first units of milligrams.



■ **Fig. 42.** Spherical magnetic object found in a sample of fly dust (Photo by Z. Korbelová).

GET, Ltd. Praha, Project No.7322: **Rheoignimbrite of the Sommerfield Group, Central Jamaica** (*J.K. Novák* & *P. Bosák*)

The andesitic-dacitic rheoignimbrite (62.3–63.3 wt.% SiO_2) and intimately associated fused breccia occur as products of a low-explosive eruption in the westernmost part of the Central Inlier, forming the top of the Sommerfield Group. The fission track analysis of apatite indicates a late Paleocene–early Eocene (55.3 Ma) age. Low-energy collapsing column, resembling pyroclastic fountain, was created by eruption of less-volatile-rich silicic magma from a deep-seated magma chamber. Viscous magma, forming some pyroclasts and ejecta, was near the liquidus temperature ("high-grade" plastic spatter) and promoted welding and compaction processes under the influence of gravity. High-discharge-rate fountaining produced sufficient accumulations of molten spatter around the vent.

The petrographic characterization of collected samples, including whole-rock chemical, textural, and mineral chemical analyses, define a densely welded rheomorphic ignimbrite with zoned plagioclase and amphibole crystalloclasts. The attention should be drawn to the devitrified massive rheoignimbrite, which can be classified as mechanically strong, resistant to abrasion and durable in tropical climate.

Faculty of Science, Charles University, Praha, Project No. 7323: **Strength and deformational properties of rocks** (*R. Živor*)

Preparation of rock specimens and strength and deformational tests were carried out. Simple compressive strength and cross-tensile strength (by Brazilian test) were found out and stress–strain diagrams were constructed from the results of deformational measurements under uniaxial loading.

Volcanic rocks from various localities of the Bohemian Massif were investigated: basalt, melaphyre and spilite. Basalts from the Mokrá locality show the best quality of the strength properties. The value of the simple compressive strength reaches up to 375 MPa and the value of cross-tensile strength is 19 MPa. On the contrary, spilites from the Sýkořice locality have the smallest values of the strength properties – up to 150 MPa for simple compressive strength and 15 MPa for cross-tensile strength, respectively.

Sandstone samples were also investigated. Their values of the simple compressive strength range from 40 to 111 MPa and they predominantly oscillated about 70–80 MPa. The value of cross-tensile strength of sandstones is about 8 MPa in most cases.

GET, Ltd., Praha, Project No. 7325: **Petrography of building raw materials from the Bamako region, southern Mali** (*J.K. Novák* & *P. Bosák*)

Equatorial Western Africa comprises (a) the Precambrian Man Shield which has been stable since Early Proterozoic; (b) Eburgian plutons of intermediate composition in southern Mali and Mauretania, and (c) Neoproterozoic arenite sequences covering the huge Taoudéni Basin. Calc-alkaline granitic rocks, Jurassic tholeiitic dolerite to gabbrodiorite, and Neoproterozoic quartzose arenites are described in terms of mineralogical-chemical composition, petrographical properties, and practical utilization.

Cataclastic granodiorite, bearing amphibole and chloritized biotite (from Kemalé near Bamako City), resembles that of the Sodioula granodiorite (2.074 Ga, zircon-inferred age). Leucoctratic two-mica granite of Massigua type (from Sibí) was interpreted as material for both crushed rock aggregate and artificial sand. The initial fragmentation of the Pangea supercontinent was accompanied by extensive tholeiitic magmatism and rifting at late Triassic/Jurassic boundary. Spherical-textured dolerite dykes and ophitic gabbrodiorite laccoliths, now linked with the Central Atlantic Magmatic Province (CAMP), differ from mid-ocean ridge basalts (MORB) geochemically. Mafic dyke swarms are common throughout western African margin, Guyana, Brasil, and elsewhere. In unweathered state, they are hard and strong. The aggregate characteristics, particularly compressive strenght, the resistance to abrasion and crushing as well as durability in savannah-like landscape define their suitability for crushed rock production. The largest segment for sale of dolerite is as a processed rock aggregate used in various types of roadstone, concrete, and bound in bituminous mixtures. The use of dolerite waste from quarries and bleached dolerite zones as a source of both the macro- and micronutrient elements for depleted lateritic soils can slow down any detrimental effects on the environment.

Quartz arenite of Souroukoro type is hard, fine-grained, well sorted and densely packed one, being potentially acceptable as building stone. Quartz overgrowths on spherical detrital quartz and regeneration silica cement are conspicuous features. The slightly arkosic arenite (Sotuba type) is composed of recycled fine-grained arenite fragments with quartz-chlorite cement. Owing to the attractive beauty, change in colour from violet to greenish, "reduction eyes", and mechanical properties, this arenite is suitable for the use as sculptural stone.

The residual regoliths after dolerite and/or gabbrodiotite occurring in southernmost Mali and Guinea represent economically significant deposits of lateritic bauxite. It is of interest that the overlying laterite soil, containing appreciable clay content, may be an alternative to pozzolanic material for Portland cement and concrete after additional treatment.

Institute of Archaeology Praha AS CR, v. v. i., Project No. 7329: **Preliminary results from geoarchaeological research at Stará Boleslav** (*L. Lisá*)

The principal aim of this research was to interpret three micromorphological samples from the Slavic locality of Stara Boleslav, located to the North of Praha on the banks of the Labe River. First stage of this research covers the interpretation of situation in outcrop, to the east from Švabinského Street in the northern vicinity of the present alluvial plain of the Labe River (southern part of Stará Boleslav City). The fourth sample comes from a close neighbourhood: it was found in the infilling of a sunken object.

The main question applied to the environmental research was to interpret the origin and the stratigraphy of layers exposed during rescue excavations. Another aim was to interpret the type of settlement agglomeration and the former environmental conditions within the studied area.

The origin of sedimentary layers was interpreted based on sedimentological and micromorphological study. Two samples originated by natural alluvial deposition, subsequently, one of them is influenced by the close presence of a sand elevation (former sand dune). All samples (i.e., former as well as present alluvial plain) are strongly influenced by the human presence. Another sample interpreted as a cultural layer is *in situ*, but was probably temporarily flooded. The infilling of a sunken house contains a huge amount of clastic material typical for stabling. Remains of carnivore excrements were found, and the object was interpreted as a pig stabling in alluvial zone, which was probably temporarily abandoned during flooding events.

This site became progressively abandoned as a result of increasingly common flooding events, which accompanied alluvial plain aggradation.

Cave Administration of the Czech Republic, Project No. 7330: **Upgrade of cave cadastre of the Bohemian Karst** (*K. Žák*)

Within this project digital data from the database of caves of the Bohemian Karst were transferred into the official national cave cadastre "JESO". The national cave cadastre "JESO" (Czech abbreviation of Unified System of Evidence of Speleogical Objects) is maintained by Cave Administration of the Czech Republic and by Agency for Nature Conservation and Landscape Protection of the Czech Republic. The regional detailed database – Bohemian Karst Cave Cadastre – is maintained and continuously updated in the Institute of Geology AS CR, v. v. i.

The Bohemian Karst is a small karst region with an area of approximately 144 sq. km. Caves are contained partly in Lower and Upper Silurian, and mostly in Lower Devonian Limestones. The database of caves of the Bohemian Karst (as of October 1, 2009) contains 683 caves with a summary length of 22,830 m. Of these caves, 117 have been either destroyed by quarrying in limestone quarries or covered by quarry dumps, and are thus inaccessible. Because of the cave protection, 41 caves are equipped by lockable doors. Each record in the Bohemian Karst Cave Cadastre contains 20 fields, including all published names (synonyms) coordinates of entrance location, description of cave history, etc.

Bohemian Switzerland National Park Administration, Česká Lípa, Czech Republic, Project No. 7335: **Strength properties of sandstones** (*R. Živor*)

Simple compressive and tensile strengths were determined on sandstone samples from the area of the Bohemian Switzerland National Park. Tensile strength was determined by indirect methods as cross-tensile strength (by Brazilian test). Both strength properties were found during three various conditions of the rock moisture – natural (laboratory) moisture (about 0.7 %), minimum moisture (dry sample – 0.03 %) and maximum moisture (fully water saturated rock – about 7 %).

The dry samples show the maximum values of compressive strength – 26 to 42 MPa, while the saturated samples have strength of 19 to 28 MPa only. The cross-tensile strengths of sandstones with natural moisture and dry samples are almost equal – 1.8 to 2.4 MPa, or 1.3 to 2.4 Mpa, respectively. The lowest values of cross-tensile strength were also found for water-saturated sandstones – 1.4 to 1.9 MPa.

Institute of Geology, Slovak Academy of Aciences, Project No. 7340: **Magnetostratigraphic investigation across the Paleogene strata in the Western Carpathians (Kršteňany KRS-1)** (*P. Pruner*)

The magnetostratigraphic study concentrated on the investigation of the Kršteňany section, 57 m thick, with the aim of preliminary determination of boundaries of magnetozones C20 to C26 (according to the correlation with Paleogene Time Scale), it means six reverse and seven normal zones. The reverse polarity zone (C24) at 40.2 m corresponds to the boundary of the Paleocene/Eocene. The average sampling density for the whole section was around one sample per 2.5 m of true thickness of strata in these preliminary results. The next step of investigation is to precisely determine the boundaries of magnetozones including narrow reverse and normal zones with high-resolution sampling density for the whole section.

4g. Programmes of Institutional Research Plan

Project No. 9100: **Complex insight in the development of the environment in the period from the Neogene to the youngest geological history with a special respect to the present era (interactions and development of processes)** (Co-ordinator: *M. Filippi*, contributions: *P. Kubínová*, *P. Skřivan*, *S. Šlechta*, *K. Žák*, *J. Borovička*, *F. Stehlík* & *M. Vach*)

The project deals with natural changes of the Earth system, especially the understanding of climatic oscillations and paleoenvironmental changes in the youngest geological history, and influence of human impacts on the environment. Research activities of particular members of the team cover scientific fields such as mineralogy, geochemistry, sedimentology, pedology, climatology, geomorphology, ecology, etc. Significant activities have been focused on the biogeodynamics of chemical elements in the environment and the main focus is the determination of the impact of human activities on the landscape.

During the year 2009, the sampling and treatment continued in the Lesní potok experimental catchment. The study of element biogeodynamics was supplemented by the identification of transport trajectories of selected chemical substances in wet atmospheric precipitation samples. Evaluation of transport trajectories of most of the monitored elements agree with the location of their supposed sources (*P. Kubínová*).

Geochemical projects were focused on continued monitoring of inputs, outputs and internal fluxes of H^+, Na, Ca, K, Mg, Mn, Fe, Zn, Al, Cu, Pb, Be, As, Cd, Sr, Ba, Rb, Ni, Co, SO_4^{2-}, NO_3^-, NH_4^+, Cl^- and F^- in the Lesní potok catchment in Central Bohemia. Mutual comparison of annual inputs of individual chemical components through atmospheric deposition (expressed in mg of the element/ion deposited on the area of 1 m^2) shows that the deposition of main metallic contaminants and acidifiers is generally stable throughout past 8 to 10 years, and that the differences in the individual years follow from the oscillations in particular meteorological and climatic situations. To improve the monitored data, innovated collectors of throughfall and bulk precipitation were proposed and constructed using the components of polyethylene terephtalate polymer. They replaced all collectors of spruce- and beech throughfall throughout the year. Their usage has been recently verified also for the bulk precipitation at the sampling locality LP-Arboretum (*P. Skřivan*).

Further, evaluation of chemical composition of samples of wet atmospheric deposition (precipitation episodes) collected at the Louňovice locality was performed. Results, statistically adjusted time series of the relative contents of measured elements were correlated with the transport trajectories of the air masses in the atmosphere, corresponding to the sampling time of particular precipitation episodes. It was revealed, among other results, that Zn, Cd and Cu are imported mainly from the westerly directions; on the other hand, Pb and As were transported from the northeasterly and easterly directions (*M. Vach*).

Specimens of ectomycorrhizal and saprobic macrofungi growing in the auriferous area of Mokrsko near Nový Knín were analyzed for gold. Gold contents, ergosterol content and 0.05 EDTA extractable Au fractions were determined in two soil profiles. In conclusion, macrofungi are involved in the biogeochemical cycling of gold, apparently for their ability to accumulate it in mycelium and fruit-bodies (*J. Borovička*).

In the Holštejn Cave, a 2m-thick interval of laminated silts records surface processes in the karst area above the cave, e.g., the intensity of rainfall, Medieval deforestation, and agriculture. A detailed study of magnetic minerals in this interval was carried out in order to understand natural and anthropocentric controls on transport of sediments into the cave. Variations in frequency dependence of magnetic susceptibility reflect the intensity of mineral weathering caused by agriculture, and fire deforestation. Charcoal is very abundant in several sedimentary horizons. Two dated charcoal pieces indicate the age of 1660–1950 and 1480–1650. The results from the Holštejn Cave are complementary to the results from the Spirálka Cave situated nearby (*S. Šlechta*)

The effort was concentrated on finalization of the paper about cryogenic carbonate formation in the Cold Wind Cave (Slovakia). The Cold Wind Cave is located at elevations ranging between 1,600 and 1,700 m a. s. l. in the main range of the Nízke Tatry Mountains, and is linked in its origin with the adjacent Dead Bats Cave. Together, these caves form a major cave system located within a narrow tectonic slice of Triassic sediments. Both caves have undergone complex multiphase development. A system of sub-horizontal cave levels characterized by large, tunnel-like corridors was formed during the Tertiary, when elevation differences surrounding the cave were less pronounced than today. The central part of the Nízke Tatry Mountains, together with the cave systems, was uplifted during the Neogene and Lower Pleistocene, which changed the drainage pattern of the area completely. The formation of numerous steep-sloped vadose channels and widespread cave roof frost shattering characterize cave development throughout the Quaternary.

In the Cold Wind Cave, extensive accumulations of loose, morphologically variable crystal aggregates of secondary cave carbonate ranging in size between less than 1 mm to about 35 mm was found on the surface of fallen limestone blocks. Based on the C and O stable isotope compositions of the carbonate ($\delta^{13}C$: 0.72 to 6.34 ‰, $\delta^{18}O$: –22.61 to –13.68 ‰ V-PDB) and the negative relation between $\delta^{13}C$ and $\delta^{18}O$, the carbonate crystal aggregates are interpreted as being cryogenic cave carbonates (CCC). Published models suggest the formation of CCC in slowly freezing water pools, probably on the surface of cave ice, most probably during transitions from stadials to interstadials. The $^{230}Th/^{234}U$ ages of three samples (79.7 ± 2.3, 104.0 ± 2.9, and 180.0 ± 6.3 ka) are the oldest so far obtained for CCC in central Europe. The paper is the first description of CCC formation in one cave during two glacial periods (Saalian and Weichselian; *K. Žák*).

Aggradation rates along the lower course of the Morava River floodplain in the Straznice area were studied. The exponential decrease in aggradation rates was proved to depend on the distance from the active channel. Average aggradation rates are almost stable in time, but the frequency and magnitude of floods was changeable (*F. Stehlík*).

Project No. 9200: **Development of the Bohemian Massif before and after its consolidation – Interaction and evolu-**

tion of processes (Co-ordinator *V. Cajz*, contributions: *J. Fiala*, *J. Filip*, *M. Chadima*, *O. Man*, *P. Schnabl*, *M. Lang*, *L. Koptíková*, *R. Živor*, *T. Svitek*, *T. Hrstka* & *D. Venhodová*)

This project summarizes basic research of different courses. The Bohemian Massif is a unique comparative standard in global sense. Thus, general geological development of the Bohemian Massif in theoretical level during both stages represents a unifying attribute of a different kind of research.

Complex geological and geophysical studies in Western Bohemia resulted in a model of the structure and development of the entire lithosphere beneath the western Ohře (Eger) Rift. In this model, the crustal architecture and paths of Cenozoic volcanism are closely related to boundaries of upper mantle domains distinguished by different orientations of olivine fabric, derived from 3-D analysis of seismic anisotropy. Three different fabrics of the mantle lithosphere belong to the Saxothuringian, Teplá–Barrandian and Moldanubian domains assembled during the Variscan orogeny. Fossil (pre-assembly) olivine dip orientations, consistent within each unit, do not support any supposed voluminous mantle delamination. The elaborated evolutionary scenario emphasises particularly a subduction of the Saxothuringian lithosphere to depths of around 140 km followed by rapid exhumation of HP–HT rocks as a consequence of the closure of the intervening Saxothuringian Ocean (*J. Fiala*).

Magnetic mineralogy of Precambriam sediments in the Teplá–Barrandian Unit was investigated for the purpose of tectonic interpretation of magnetic anisotropy. In addition to phyllosilicates, pyrrhotite and siderite were found as the carriers of magnetic fabric. Pyrrhotite and siderite-bearing samples cannot be interpreted together with phyllosilicate-bearing samples (*M. Chadima*).

The frequency dependence of magnetic susceptibility in weakly magnetic Quaternary sediments was measured in a loess/paleosol complex of Červený vrch Hill, Brno, in order to determine the amount of very fine-grained superparamagnetic grains. Elevated amounts of superparamagnetic grains are supposed to reflect pedogenic processes due to the changes in climatic conditions (*M. Chadima*).

Apatite fission-track analysis (AFTA) was processed to determine the age of ultrabasic rocks from Southern Moravia. Very similar ages were obtained for the Korolupy norite 153.9 ± 29.3 Ma, Mařížnorite 150.2 ± 18.0 Ma and Číměř granite 154.4 ± 14.6 Ma. Similarly, the samples revealed comparable track length distributions and shortenings of the initial fission track lengths (mean length 11.5 µm). This implies a slow and continuous cooling in the Late Jurassic – from the total annealing zone (temperatures above 120 °C) to the present. On the contrary, dyke rocks from Western Bohemia (Matčina hora Hill near Zbiroh) show the total annealing zone at the Triassic/Jurassic boundary and a long period in the Late Jurassic and Cretaceous with temperatures between 40–60 °C. During the Paleogene, the rocks were reheated to temperatures of approx. 100 °C and uplifted (*J. Filip*).

Over 140 samples of Bohemian garnets from the České středohoří Mts. were chemically analyzed in our attempt to better understand their genesis and appropriate classification. Using the crystallochemical calculations their theoretical formulas were produced. Our result shows that nearly 10 % of the analysed garnets do not correspond to pyrope. Applying a newly developed crystallochemical calculation/computations we were able to identify 13 of the analyzed samples as a mineral knorringite with crystallochemical formula ($Mg_3Cr_2(SiO_4)_3$). This mineral is usually reported as a rare component of some ultramafic kimberlite nodules (*M. Lang*).

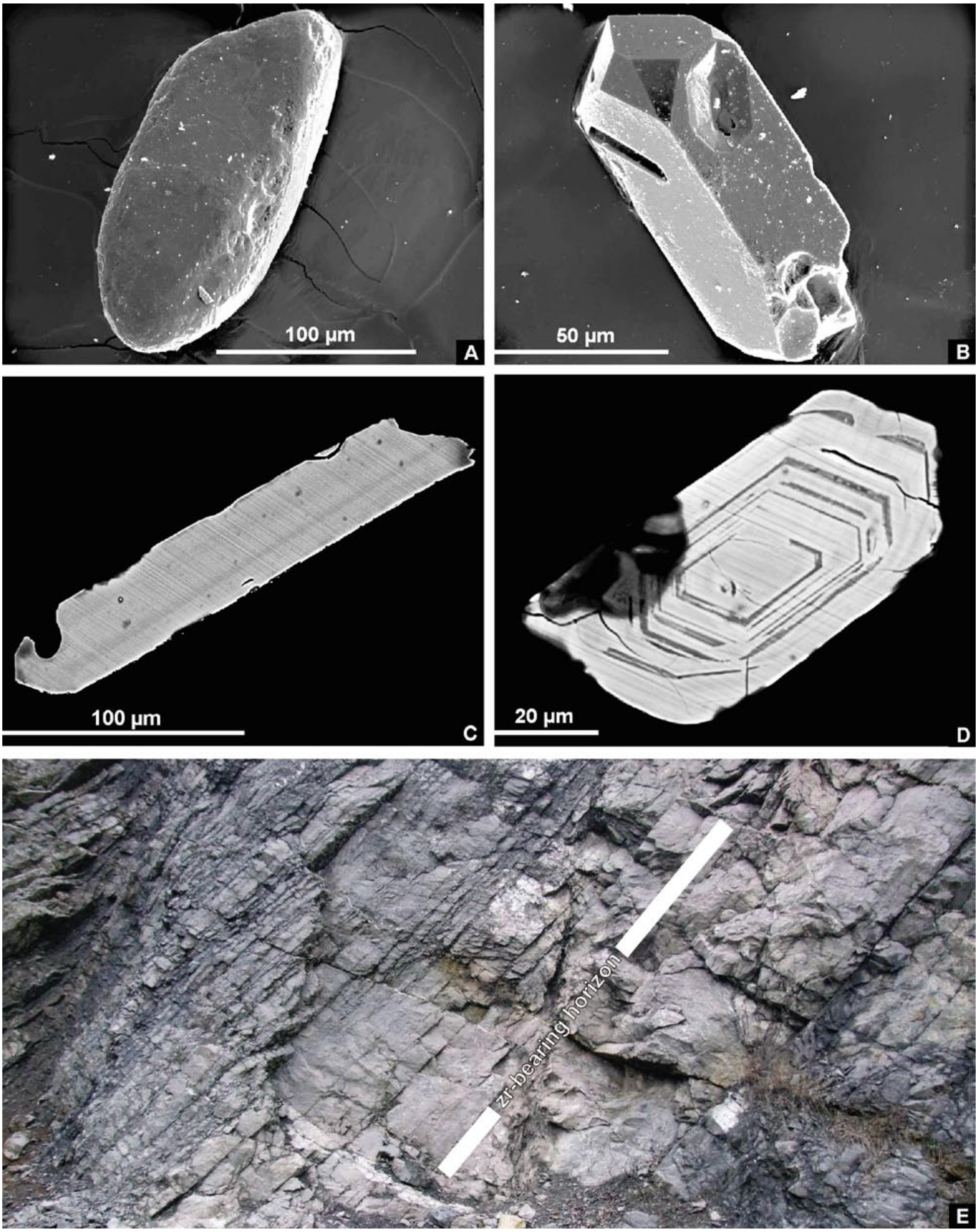
Six detrital zircon-enriched horizons were identified in the Lochkovian to lower Emsian limestone beds in the Prague Synform (Koptíková et al. 2009a, b). Detrital zircons from such unmetamorphosed and pure limestones have never been reported yet. The morphology of zircon populations is indicative of different provenance, sources and delivery pathways of zircon grains (Fig. 43). The occurrence of rounded grains with no crystal faces (Fig. 43-A) indicates multiple resedimentation whereas the presence of prismatic type (up to 200 µm in diameter, often unbroken and non-fractured grains; Fig. 43-C) points to the volcanic origin and a short-distance transport in the form of atmospheric dust rather than transport with fluvial material (*L. Koptíková*).

Carbonate sedimentary rocks often contain an admixture of fine-grained basaltic tuff, which causes an increase in magnetic susceptibility (MS). Evaluation of this amount is extremely complicated, since the primary material is altered, modified during diagenesis and enriched by secondary processes. One of the possible solutions is a magnetomineralogical study. Titanomagnetite is the key mineral, because it has a field-dependent MS, while other present minerals are field-independent. Field-dependent MS is quantified by the formula: k_{HD} [%] = 100 x (k_{300}–k_{30})/k_{300}, where k_{30} and k_{300} is the susceptibility measured in the magnetic field of 30 and 300 A.m^{-1}, respectively. Although this method was successfully used on volcanic rocks, its use in carbonate sediments is more problematic (Fig. 44; *P. Schnabl*).

An algorithm for the identification of geomagnetic polarity zones against a reference scale was completed and implemented into the *Identification* program, which is accessible online on http://www.gli.cas.cz/man/ together with a tutorial file. This algorithm is based on a stochastic model of deposition, and its application to many published data sets proved that it may be of great importance for the dating of sedimentary sections by means of magnetostratigraphy (*O. Man*).

Strength characteristics of various types of rocks (andesite, limestone, claystone) and cohesive soil (Tertiary clay) were investigated under conditions of a triaxial compressive load regime. The tests were realized by a conventional triaxial apparatus with confining pressures of up to 50 MPa for rocks, and 30 MPa for clay. In the case of clay, extraordinarily high values of confining pressure were used which cannot be reached by standard tests of soil mechanics. Triaxial strength of clay under confining pressure of 30 MPa is by 125 % higher than the value under zero confining pressure. The highest strength increase (by 65 %) was found under the minimum confining pressure of 2 MPa already (*R. Živor*).

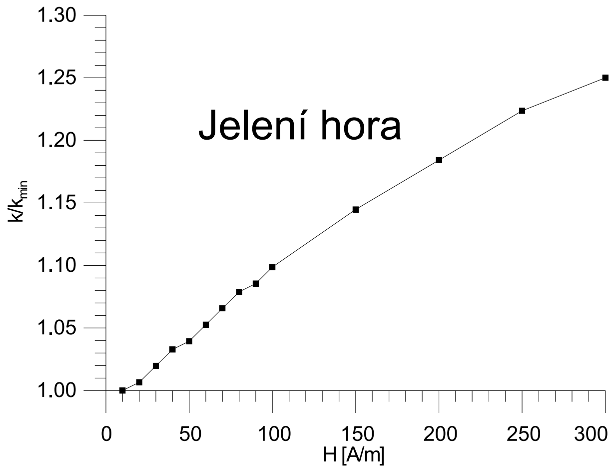
A method of automated determination of accurate arrival time of acoustic waves was developed. The waves were recorded during loading of rocks samples. Using such a method, it is possible to obtain arrival times automatically (without manual assistance), much like during the processing of huge amounts of experimental data. Such an approach saves time and gives consistent results without an operator bias. The effectiveness of



■ **Fig. 43.** A, B – SEM images of zircon grains, C, D – images of polished grains in backscattered electrons, E – host rocks of detrital zircons in the Požár-3 section (Photo by L. Koptíková).

this method is 80 % when compared to manual determination, with an accuracy of ± 2 samples which corresponds to ± 2 µs (*T. Svitek*).

A complex study of paleofluid evolution at the Libčice orogenic gold deposit located in the Central Bohemian Plutonic Complex (CBPC) was performed. Thermodynamic modeling of our fluid



■ **Fig. 44.** Demonstration of field-dependent magnetic susceptibility (original).

inclusion data in the C-O-H system allowed for better understanding of processes leading to observed unusual CO_2/CH_4 variations in paleofluid composition and its PTX history. Investigation into effects of Variscan (CBPC) intrusives on the main Libčice quartz vein and surrounding rocks revealed importance of H_2 diffusion related in time with thermal recrystallization. It was shown that many primary looking fluid inclusions were affected by hardly recognizable post-entrapment modifications (inward H_2 diffusion) and would give misleading data if not deciphered properly (*T. Hrstka*).

Cenozoic volcanic rocks of the Bohemian Massif were subjected to detailed AF demagnetization in 7–15 fields and/or TD method in 7–11 steps. Multi-component analysis was applied to separate the respective remanent magnetization (RM) components for each sample. We confirmed that both demagnetization methods have to be applied. Results of the multi-component analysis of remanence show that the samples of rocks display one- or two-component RM. The A-component is undoubtedly of viscous origin and can be demagnetized at a field range of 2 (5) mT or at temperature below 100 °C. The C-component is the stable one and can be demagnetized in the AF or at temperature range of ca 10 (20) to 80 (100) mT or 180–320 °C resp. 320 to 520 (560) °C. This result suggests a primary origin of the characteristic remanent magnetization (*D. Venhodová)*.

KOPTÍKOVÁ L., HLADIL J., SLAVÍK L. & FRÁNA J. (2009): Mineralogy of fine-grained non-carbonate particulates embedded in neritic to pelagic limestones, and connection to magnetic susceptibility and gamma-ray signals: a case study based on Lochkovian, Pragian and lower Emsian strata from the Pozar-3 section. – F*irst IGCP 580 Meeting, Magnetic susceptibility, correlations and paleoenvironments, Liège University, Liege, Belgium, December 2–6, 2009, Abstract Book*: 34–35. Liège.

KOPTÍKOVÁ L., HLADIL J., SLAVÍK L., & FRÁNA J. (2009): Lochkovian – Pragian boundary in the Prague Synform: lithological, mineralogical, geophysical and geochemical aspects as results of sea-level fall. – *Berichte der Geologischen Bundesanstalt*, 79: 28–31. Wien.

Project No. 9300: **Study of fossil ecosystems and their dependence on global climatic and paleogeographic changes (interaction and development of processes)** (*Co-ordinator: M. Svobodová; contributions: M. Vavrdová, J. Žítt, M. Siblík, T. Přikryl, J. Zajíc*)

The investigations concentrated on biostratigraphical and paleoecological study of the fossil ecosystems. Several new brachiopod assemblages of the Sinemurian and Pliensbachian age were studied in the area of the Totes Gebirge, Austria. Early Givetian microflora from the borehole Uhřice – 1 indicated shallow marine conditions. Moreover, index species of the Densosporites devonicus – Grandispora naumovii palynozone were identified.The comparison of two Late Turonian palynomorph assemblages documented neritic conditions for the microflora of the Jičín outcrop while open marine dinocysts characterized the Úpohlavy section. Echinoidea of the Upper Turonian and Crinoidea of the Lower Turonian (Bohemian Cretaceos Basin) were studied from the taphonomical and evolutional point of view. New data on trophic web of the fossil fish assemblages of the Menilitic and Ždánice-Hustopeče formations (Moravia) as well as those of the Stephanian age (Mšec lake) was recovered.

The existence of 2 stratigraphically different brachiopod assemblages was confirmed also at some new places in the southern parts of the Totes Gebirge Mts. New Sinemurian localities in the light Hierlatz Limestone were ascertained at Klaushöfl SW of Flodring (1385 m a. s. l.), in the area of Flodring top, Plankeraumoos and Klobenwand-Mahkar. Red micritic limestones of the Pliensbachian age yielded brachiopod fauna at SSW. slopes of Flodring and NE of Zwicker (1353 m a. s. l.). The leading species are for Sinemurian *Prionorhynchia greppini* (OPP.), *Prionorhynchia polyptycha* (OPP.), *Calcirhynchia zugmayeri* (GEMM.), *Liospiriferina brevirostris* (OPP.), *Liospiriferina alpina* (OPP.), *Zeilleria alpina* (GEYER), *Zeilleria mutabilis* (OPP.) and *Bakonyithyris ewaldi* (OPP.).As most important Pliensbachian species *Apringia paolii* (CAN.*), Apringia atlaeformis* (BÖSE), *Prionorhynchia flabellum* (MENEGH. in GEMM.), *Viallithyris gozzanensis* (PAR.), *Bakonyithyris apenninica* (ZITT.) and *Bakonyithyris ovimontana* (BÖSE) were proved (*M. Siblík*).

Bioturbated siltstones from the Uhřice-1 borehole (depth of 3,600 m) yielded palynomorphs which indicate their shallow marine origin. Palynological residue contained unicellular marine microplankton, dispersed miospores and rare chitinozoans. Genera *Acinosporites*, *Apiculiretusispora* and *Retusotriletes* dominated in the assemblage. Ferns, sphenopsids and lycopsids prevailed in the near-shore, swampy environment. Microfossils of marine origin, mostly prasinophycean algae, suggest a homogeneity of the Middle Devonian marine communities from palaeotropical to palaeo-polar areas. The early Givetian age of recovered microflora is documented in the presence of index species, which characterize the Densosporites devonicus – Grandispora naumovii palynozone (Zone AD lem). Less abundantly represented acritarchs, not previously recorded in the Moravian Middle Devonian, confirm the early Givetian age of the marine transgression in the investigated area (*M. Vavrdová*).

The feeding and dietary habits of fossil fishes can be studied in two ways. There are direct and indirect indications, which can be used. Direct evidence is represented by prey remains in the stomach or alimentary canal of a predator; information provided by comparative anatomy and functional morphology can be used as indirect evidence.

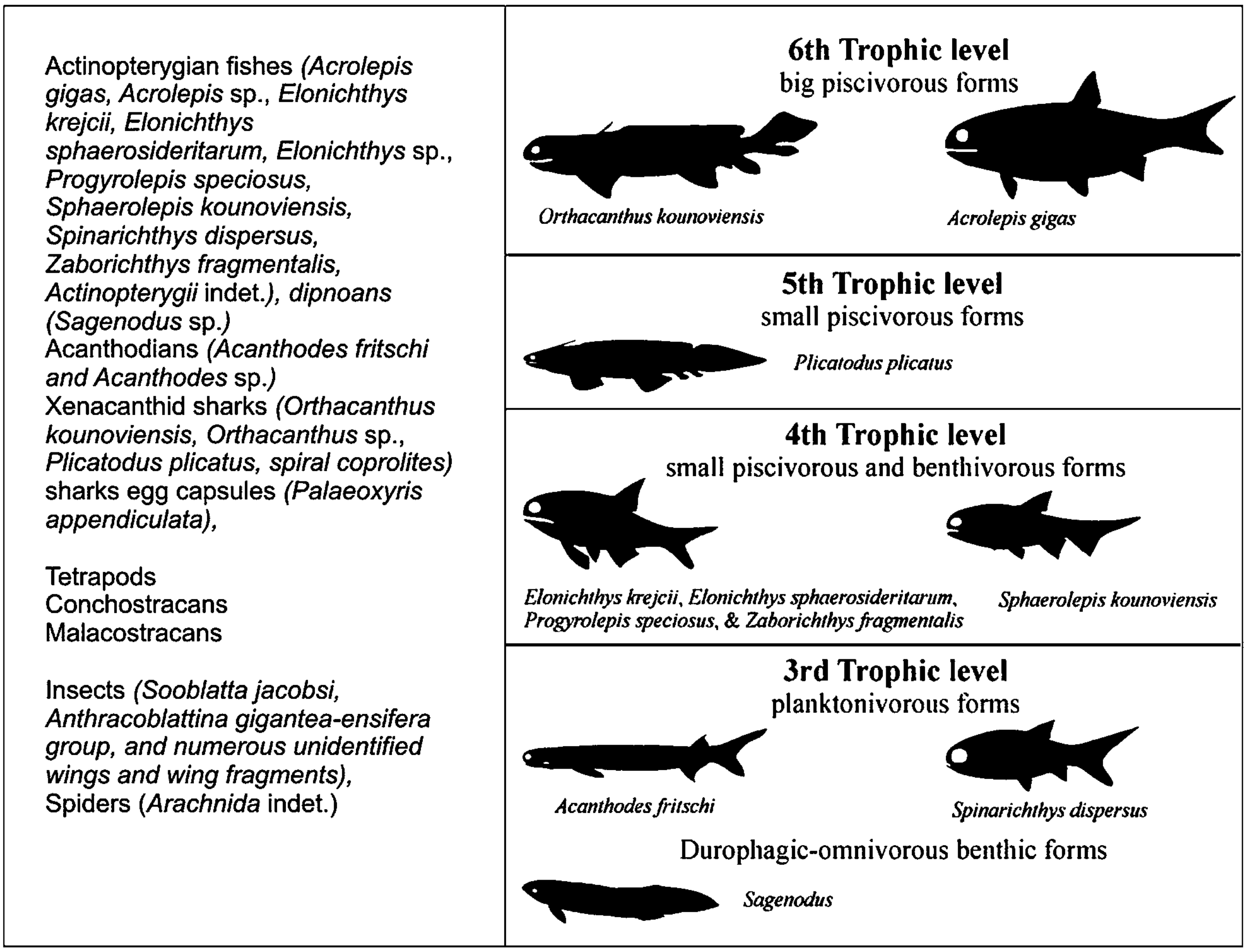
The predatory feeding habits of fossil fishes were recognized in various stratigraphic positions, but many of them were noted only as interesting palaeoecological facts without larger ecological context. On the basis of direct evidence feeding habits were recognized in the following taxa from the Menilitic Menilite and Ždánice-Hustopeče formations: *Scopeloides glarisianus*, *Anenchelum glarisianum*, *Lepidopus glarisianus*, *Trachinus minutus*, *Serranus budensis*, *Merluccius latus*, and *Oligophus moravicus*. These information allows to construct partial trophic diagram within the Menilitic and Ždánice–Hustopeče formations. Also highly specific behavior called cannibalism (the act of a species eating its own individuals) in the species *Anenchelum glarisianum* (Přikryl & Novosad 2009) and *Scopeloides glarisianus* has been recognized (*T. Přikryl*).

Palynological assemblages from the hemipelagic marls of the eastern part (Jičín area) of the Bohemian Cretaceous Basin were studied. The assemblages from eastern and western facies (Úpohlavy quarry near Lovosice) of the Jizera Formation differ markedly. Dinoflagellate cysts from the outcrops near Jičín evidenced neritic conditions while those from Úpohlavy sections were deposited in deeper marine environment. Angiosperm pollen from the Normapolles group, i.e., *Interporopollenites* sp., *Plicapollis serta, Pseudoplicapollis* sp. Most of the dinocyst species represent "long-ranging" types with no biostratigraphic significance (*M. Svobodová*).

Additional studies of micrasterid echinoids from the Upper Turonian of the Bohemian Cretaceous Basin (Teplice Formation) confirmed high differences in species between the Ohře and Jizera lithological developments. While the siliciclastic Jizera Formation contains only the primitive *Micraster michelini*, marly deposits of Ohře area are characterized by the evolutionarily more advanced *Micraster leskei*. The study is linked to the grant project finished in 2008. *Cyathidium depressum* (Crinoidea, Cyrtocrinida) from the Early Turonian of Chrtníky offered abundant new data on taphonomy and individual growth of theca. The substrate-theca relationships are elucidated based on rich cementing epifaunas (mainly bryozoans) and the mechanical erosion and boerosion.

The preparation of the Catalogue of localities with the occurrence of the surf high energy deposits and faunas continues. More than 150 items are presently included (*J. Žítt*).

The Mšec Lake was formed in eastern equatorial Pangaea during Stephanian B and represents the largest of any European Permo–Carboniferous freshwater lakes so far described. Continuous sedimentation of organic-rich, seasonally laminated



■ **Fig. 45.** List of fauna found in the Mšec Member and trophic web of fish assembly in the Mšec Lake (according to Table 1 in Lojka et al. 2009) clayey–silty lake deposits produced a unique high-resolution record. An extraordinarily large trophic web of fish assemblages also proves the temporal stability of this meromictic oligotrophic lake. The lake passed through several stages of development including an initial highstand with peak productivity, a stepwise increase in mineralization accompanying gradual lake regression, a lowstand in the middle part of its lifetime, a partial lake recovery, and then a final transition to a shallow lacustrine-deltaic system. Considerable vegetation response to fluctuating lake levels suggests complex environmental changes. The entire Stephanian B period was more humid than the preceding Barruelian and subsequent Stephanian C in the Czech basins.

Faunal remains from the old (1967) borehole MB-9 Hostín were studied. Samples from the Jelenice Member yielded actinopterygian fish scales including *Sphaerolepis kounoviensis*. Most of findings come from the Mšec Member. Fauna of the Mšec and Hředle Members is represented by fragments of insect wings, actinopterygian fish scales including *Elonichthys* sp. and coprolites including the spiral ones which were produced by xenacanthid sharks (*J. Zajíc*).

LOJKA R., DRÁBKOVÁ J., ZAJÍC J., SÝKOROVÁ I., FRANCŮ J., BLÁHOVÁ A. & GRYGAR T. (2009): Climate variability in the Stephanian B based on environmental record of the Mšec Lake deposits (Kladno–Rakovník Basin, Czech Republic). – *Palaeogeography, Palaeoclimatology, Palaeoecology*, 280, 1–2, 78–93.
PŘIKRYL T. & NOVOSAD B. (2009): Direct evidence of cannibalism in the Oligocene cutlassfish *Anenchelum glarisianum* Blainville, 1818 (Perciformes: Trichiuridae). – *Bulletin of Geosciences*, 84, 3: 569–572.

4h. Defended theses

ČERMÁK S. (2009): Lagomorpha (Mammalia) of the Pliocene and Pleistocene of Europe: a revision of selected taxa.

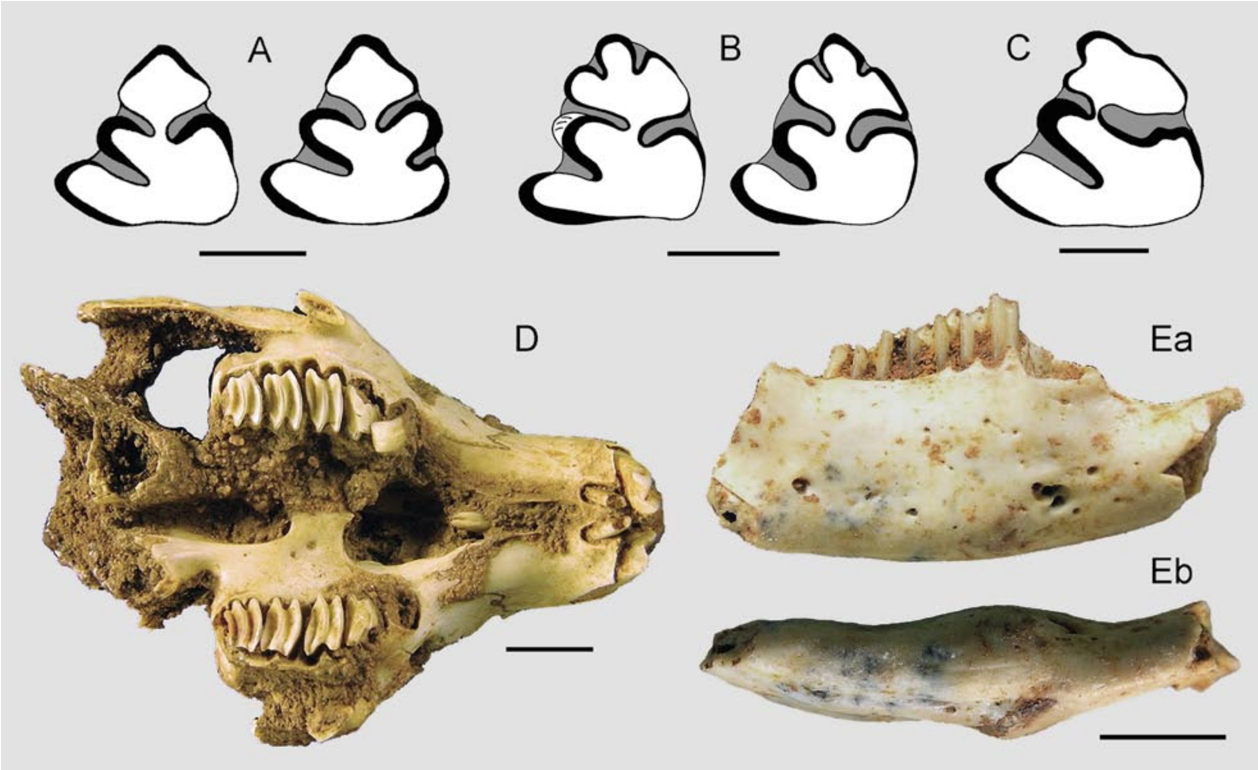
The dissertation thesis is concerned with selected taxa of lagomorphs, an ancient conservative group of herbivorous mammals, in the Pliocene and Pleistocene (Ruscinian–Biharian) of Europe. The main objectives of the dissertation thesis were to provide: (1) Ochotonidae – a detailed revision of poorly known pikas of "*Ochotona* group" from the Pliocene (Ruscinian) of eastern and southeastern Europe; a detailed morphometric survey of the currently available fossil record of *Ochotona* from the Pleistocene (MN 17–Q1) localities of the Czech and Slovak Republic, thereby extending our knowledge of these ochotonids based, up to now, on the relatively scarce fossil record from France, Germany, Poland, and Hungary; (2) Leporidae – a comprehensive revision of *Hypolagus* – the important and dominant genus of Leporidae in the Pliocene and Pleistocene (MN 15–Q2) of central and southeastern Europe, and with a survey of all currently available, as yet unstudied in detail, finds from the localities of the Czech and Slovak Republic to supplement the revisions provided from the area of Poland, Austria, and partly from Hungary.

Using techniques of detailed morphometric analysis of 42 metric and 14 non-metric features, the fossil material (mostly new, unpublished) of dental and cranial remains of Lagomorpha from 38 localities of central, southeastern, and eastern Europe covering stratigraphically the period from Early Ruscinian to Late Biharian (MN 14–Q2) was analyzed in detail. The work extends knowledge of the taxonomy, nomenclature, phylogeny, and paleobiogeography of the studied taxa in the Pliocene and Pleistocene (Ruscinian–Biharian) of Europe.

Ochotonidae

The abundant new material of *Ochotona antiqua* (Fig. 46A) from the Early Pliocene (MN 14) of southern Ukraine was analyzed in detail and compared with the type material. The results are expressed in a redescription of the taxon and evaluation of its intraspecific variation, including the outlying and/or aberrant forms closely related to it. *Pseudobellatona relicta* confined to the Krasnopol type locality (MN 14) is redescribed and considered therein as a taxon *incertae sedis* (of uncertain taxonomic position) within the Ochotonidae clade. Specificities of the Early Pliocene taxa from the Kuchurganian sedimentary series are discussed in the context of phylogeny and systematics of Eurasian ochotonids. Climatic changes during Latest Pliocene – Pleistocene, characterized by many aridisation waves throughout Europe, triggered several migrations of the genus *Ochotona* towards central-western Europe. A detailed survey of all currently available fossil material of the genus from twelve Pleistocene (Late Villányian–Early Biharian, MN 17–Q1/Q2) localities of the Czech and Slovak Republic were provided. From the Pleistocene (Q1/Q2) site of Honce (SK) a new species *O. horaceki* Čermák, 2004, represented by a nearly complete skull (Fig. 46D), was described. Based on the detailed morphometric analysis of the available fossil material and critical review of all published data, at least 3 distinct phenotypic entities/types of *Ochotona* were identified in the Pleistocene (Late Villányian–Early Biharian, MN 17–Q1) of the central Europe. All the studied taxa were compared and discussed, in the Eurasian context, with other relevant finds.

A new material of *Ochotonoma csarnotana* (Fig. 46B, Ea–Eb) found at Beremend 26 (Late Ruscinian, MN15b) is reported, compared with type material, and analyzed in detail. The results are expressed in a redescription of the taxon and its variation. New data on the paleobiogeography and phylogeny are discussed. The nominal taxa *Ochotonoma anatolica* Sen, 1998 from Çalta, Turkey (MN 15), and *O. ortalicensis* (Ünay & de Bruijn, 1998) from Ortalica, Turkey (MN 15), do not differ morphometrically from the Hungarian taxon and are regarded a junior subjective synonym of *O. csarnotana* (Kretzoi, 1959). *Ochotonoma csarnotana* is reported there from the Late Ruscinian (MN 15) localities Csarnóta 2, Beremend 26 (Hungary), Ciuperceni 2 (Romania), Muselievo (Bulgaria), and Çalta, Ortalica, Taşova (Turkey). On the other hand, in the p3 proportions or morphology, the forms from the Pliocene (MN 15–?16) localities Sürsürü, Kömürlük Dere (Turkey), and Apolakkia (Greece) differ distinctly from all the above mentioned finds. It is possible that these ochotonids represent two new species of this genus. Nevertheless, they cannot be adequately characterized because of the limited material. Thus, they are tentatively assigned here



■ **Fig. 46.** Ochotonids (Ochotoninae, Lagomorpha) in the Pliocene and Pleistocene of Europe. Morphology of lower premolars (p3): A – *Ochotona* (after Čermák & Rekovets in press, modified), B – *Ochotonoma* (after Čermák 2007, modified), C – *Pliolagomys* (Čermák & Rekovets in prep.); D – skull (ventral view) of the new Pleistocene species *Ochotona horaceki* (after Čermák 2004, modified), Ea–Eb – mandible (Ea – buccal view, Eb – ventral view) of the Pliocene species *Ochotonoma csarnotana* (after Čermák 2007, modified). Scale bars: 1 mm for teeth, 3 mm for skull and mandible.

to *Ochotonoma* sp. 1 (Apolakkia and Kömürlük Dere) and *Ochotonoma* sp. 2 (Sürsürü).

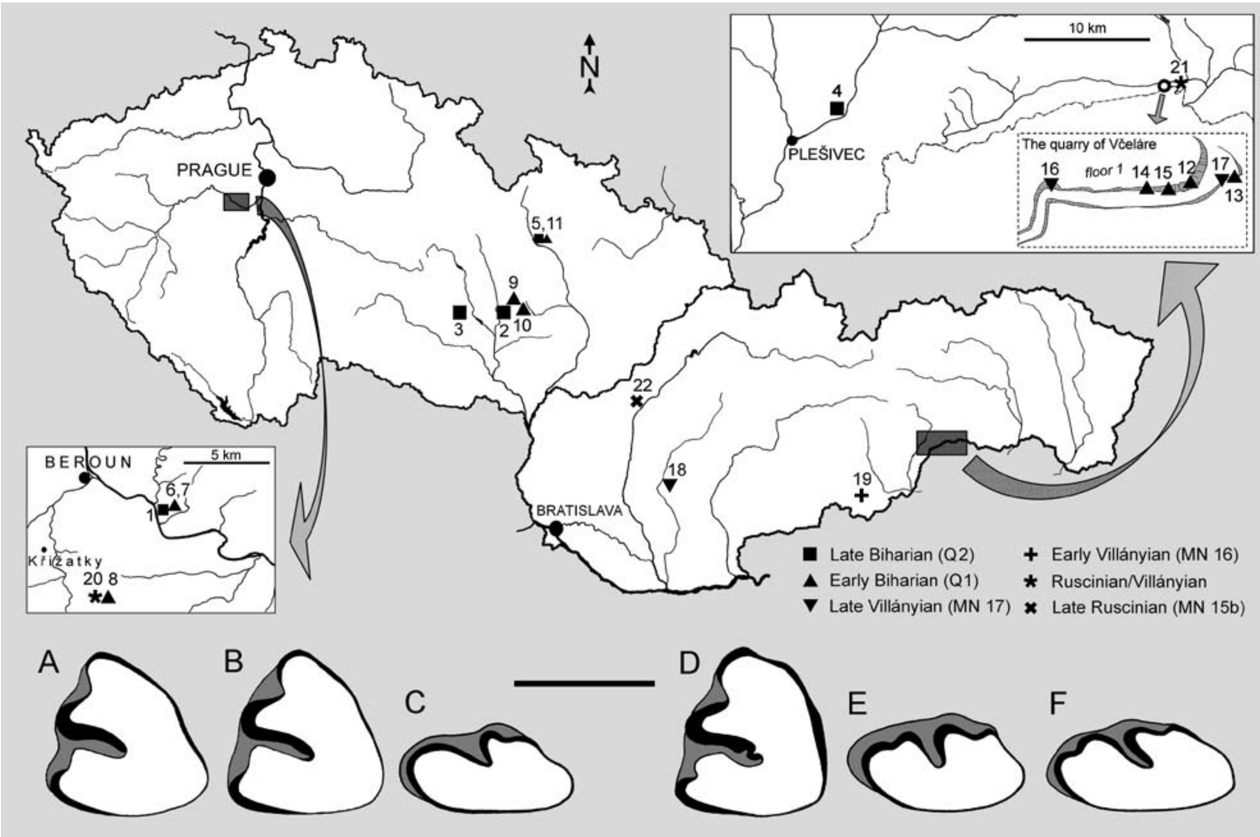
The extended knowledge of phenetic variability of the above Pliocene–Pleistocene (MN 14–Q1/Q2) forms is essential to the understanding of the evolution of ochotonids in Eurasia. Based on the detailed morphometric analysis of the above mentioned Ruscinian (MN 14–15) taxa and critical review of published data on other relevant finds of Ochotoninae from the Ruscinian–Villányian (MN 14 – 17) of Eurasia, the taxonomic concept of *Ochotona, Ochotonoma, Ochotonoides*, and *Pliolagomys* as separate genera is supported in this work (Fig. 46A–C). These genera differ from each other particularly in these, there analyzed, discriminant parameters: (a) the size; (b) the frequency and proportion between reentrant folds (cemented and/or non-cemented) and depressions on the anteroconid of p3 (c); the frequency and proportion of enamel plication on proto- and paraflexid of p3; and (d) the position of anteroconid-posteroconid junction of p3.

Leporidae

A proven record of *Hypolagus* from twenty two Pliocene and Pleistocene (ca between 3.9 and 0.7 Ma) localities of the Czech and Slovak Republic was presented (Fig. 47); from eight localities the genus was reported or described for the first time. A detailed description and morphological analysis of the currently available dental and cranial material proved the presence of two species in the study area, and enabled to assess their intra- and interspecific variability, as well as the phylogenetic level of some paleopopulations.

The complete history of research on the central European *Hypolagus* was summarized, accompanied by nomenclatural revision and synonymy. The revision and designation of the type material were provided. The name *Hypolagus brachygnathus* (Kormos, 1930), with neotype designated in Čermák (2009), is regarded the oldest available name for the more advanced form known from the Pleistocene (Late Villányian – Late Biharian) of central Europe. The use of the name *Oryctolagus beremendensis* in Kormos (1930) is regarded a *nomen nudum* in this study. The nominal taxon of *Hypolagus brachygnathus* Kormos, 1934 is regarded a junior objective synonym (the same name-bearing type) in this study, and simultaneously a junior secondary homonym of *Hypolagus brachygnathus* (Kormos, 1930). The nominal taxa of *Pliolagus beremendensis* Kormos, 1934 from the Late Villányian (MN 17) locality Villány 3 and *Pliolagus tothi* Kretzoi, 1941 from the Biharian (the Betfia stage) locality Betfia 5 are regarded subjective junior synonyms of *Hypolagus brachygnathus* (Kormos, 1930) in this study. The gracile and less advanced form known from the Late Ruscinian–Late Villányian (?Earliest Biharian) of central Europe is described in Čermák (2009) as the new species *Hypolagus petenyii* Čermák & Fladerer (type locality Beremend, Hungary; the Early Villányian, MN 16).

In the study area: (1) the gracile and less advanced *H. petenyii*, characterized with simple premolars P2 and p3 (Fig. 2A–C),



■ **Fig. 47.** *Hypolagus* in the Pliocene-Pleistocene of the Czech and Slovak Republic. Proven occurrences: 1 – Chlum 4, 2 – Stránská skála, 3 – Lažánky 2, 4 – Gombasek, 5 – Mladeč 3, 6 – Chlum 6, 7 – Chlum 8, 8 – Měňany 2, 9 – Holštejn, 10 – Mokrá 1, 11 – Mladeč 1, 12 – Včeláre 4E, 13 – Včeláre 6/8, 14 – Včeláre 10B, 15 – Včeláre 5, 16 – Včeláre 3/B3, 17 – Včeláre 7, 18 – Koliňany 1, 19 – Hajnáčka I, 20 – Měňany 3, 21 – Hosťovce 2, 22 – Ivanovce 1. Morphology of premolars: A-C – *Hypolagus petenyii* (a new species), D-F – *H. brachygnathus*; A, B, D – lower premolars (p3); C, E, F – upper premolars (P2); Scale bar: 3 mm. (after Čermák 2009, modified)

is available from the Pliocene localities of Měňany 3 (CZ), Ivanovce 1 (SK), Hajnáčka I (SK), and Hosťovce 2 (SK); (2) *H. brachygnathus* (Kormos, 1930), the larger and more robust species with a greater variability of more advanced premolars P2 and p3 (Fig. 2D–F), is reported there from the Biharian localities of Chlum 4, 6, 8 (CZ), Gombasek (SK), Holštejn (CZ), Lažánky 2 (CZ), Mladeč 1, 3 – point [7/10] (CZ), Stránská skála (CZ), and Včeláre 4E, 5, 6/8, 10B (SK). The material from Koliňany l (SK), Měňany 2 (CZ), Mokrá 1 (CZ), and Včeláre 3/B3, 7 (SK) is tentatively assigned here to *Hypolagus* cf. *brachygnathus* (Kormos, 1930). The last appearance of *Hypolagus* of the studied area is in the Late Biharian locality of Chlum 4. The taxonomical review and/or revision of Central European finds is provided and discussed in the context of phylogeny and systematics of Eurasian Archaeolaginae leporids.

A list of respective papers included in the Ph.D. thesis:

ČERMÁK S. (2004): A new ochotonid (Lagomorpha) from the Early Pleistocene of Slovakia. – *Neues Jahrbuch für Geologie und Paleontologie, Monatshefte*, 2004, 11: 662–680.

ČERMÁK S. (2007): New finds of *Ochotonoma csarnotana* (Lagomorpha, Ochotonidae) from the Pliocene of Hungary: a new look on the species. – *Neues Jahrbuch für Geologie und Paleontologie Abhandlungen*, 246, 2: 247–256.

ČERMÁK S. (2009): The Plio-Pleistocene record of *Hypolagus* (Lagomorpha, Leporidae) from the Czech and Slovak Republics with comments on systematics and classification of the genus. – *Bulletin of Geosciences*, 84, 3: 497–524.

ČERMÁK S. & REKOVETS L. I. (in press): Early Pliocene ochotonids (Mammalia, Lagomorpha) of Southern Ukraine. – *Geodiversitas*.

ČERMÁK S., WAGNER J., FEJFAR O. & HORÁČEK I. (2007): New Pliocene localities with micromammals from the Czech Republic: a preliminary report. – *Fossil Record*, 10, 1: 60–68.

KUBÍNOVÁ P. (2009): Abiotic, biotic and anthropogenic impacts on the geochemical cycles of Mn, Fe, Co, and Ni in forest ecosystem.

The doctoral thesis attends to the study of the biogeochemical cycling of the Fe-Co-Ni triad of metals (and Mn) in the forested catchment in central Bohemia. The studied catchment of Lesní potok has been systematically monitored since 1989 and is a part of the monitoring net of the GEOMON.

The elements from ferrous group of metals have been chosen especially as they are typical representatives of the transition element group. The second reason was that the selected elements are also the essential elements as they play important role in metabolism of living organisms. From that reason was also the element Mn added, because its biogeochemical cycle is significantly influenced by the vegetation. This feature can be well studied in a forested catchment.

The studied problematic is supplemented by the study of specific meteorological conditions during the hydrological year 2007. Changing climatic conditions, particularly the evolution of precipitation during the year, could affect the behavior of certain elements in forest ecosystem.

The aims of individual topics of the dissertation are presented in particular chapters in greater detail, but the principal aim of this work was: (1) to summarize the information about the biogeochemical cycles of the elements Mn, Fe, Co and Ni. This is in other words the evaluation of the major sources of the studied elements in the forest soils and thestimation of their input/output balance in the studied ecosystem; (2) to assess the role of the studied elements in the metabolism of woody plants with respect to its impact on their biogeochemical cycles. All the studied elements are the essential elements, which play an important role in the metabolism of woody plants, and (3) to evaluate the importance of the anthropogenic impacts on the biogeochemical cycles of the selected elements. Consequently, major pathways and transport trajectories of the studied elements were surveyed.

Methods

The Lesní potok catchment is located approximately 30 km SE from the capital Prague in the Voderadské buciny National Nature Reserve. It covers an area of 0.765 km^2. Two additional sampling sites (Milešovka Hill and Kopisty) were also chosen in northern Bohemia in order to compare the analyses of the precipitation samples.

In the scope of monitoring of the element fluxes, the samples of atmospheric deposition, stream and groundwater have been continuously taken in the experimental catchment. Further, the estimation of the weathering rate has been preceded. The information about the reservoirs was evaluated from sampling the soil profile, assimilatory organs and bole wood of spruce (*Picea abies*) and beech (*Fagus sylvatica*).

All the samples were processed and analyzed in the laboratories of the Institute of Geology AS CR, v. v. i. A detailed description of the analytical procedures can be found for example in Skřivan et al. (2000), Navrátil et al. (2007).

A comparison of the basic characteristics of the studied elements

The content of the elements in the soil profile and in the bedrock indicates their relative mobility. Whereas the concentration of Mn is lower throughout the soil profile than in the bedrock, in the case of the other studied elements an inverse relation was observed (Tab. 2). Iron (and Co) are less mobile under oxidizing conditions, which results in the enrichment of these elements in soils (Navrátil et al. 2004).

The distribution of the elements in the soil profile designates the effect of the input of atmospheric protons. These protons mobilize the metals toward deeper horizons, where the soil percolates are partly neutralized (and the metals consequently immobilized). High contents of leachable forms of Mn in the uppermost horizon result from higher contents of Mn in the tree tissues (especially in the assimilatory organs). Lower leachable Mn contents in deeper horizons (AB and Bv horizons) indicate a higher biological uptake of the element.

The highest total concentration of Co and Ni in the upper soil layer should verify mainly the atmospheric (mainly anthropogenic) input, which is in agreement with the findings of Nriagu (1990). It could be suggested that the deposition of Co and Ni was much higher in the past and got reduced since then, but the content in the soil profile remains unchanged. Apart from that, relatively low concentration of mobile forms of Co and Ni in the uppermost horizon indicates their strong binding in the organic material.

Generally, it can be suggested that no important specific changes of element concentrations occur in the soil cover. This

		Mn		Fe		Co		Ni	
Bedrock* ($mg.kg^{-1}$)	Monzogranite	191		9452		3.3		12.2	
	Syenogranite	96		2991		1.2		6.6	
	Biotite, 8.1 % vol.	2310		105500		26.8		85.1	
Soil concentration ($mg.kg^{-1}$)	Horizon	Tot	Leach	Tot	Leach	Tot	Leach	Tot	Leach
	of (0–10 cm)	74	45.4	4501	576	2.1	0.4	49.2	3.6
	A (10–27 cm)	33	4.0	3528	392	1.3	0.5	9.6	3.0
	AB (27–51 cm)	43	1.8	3166	86	1.4	0.0	5.6	0.3
	Bv (51–71 cm)	68	1.6	7114	746	1.7	0.1	10.7	0.3
	Bc (71–111 cm)	85	5.8	4371	344	1.9	0.1	10.9	0.2
	Mean	61	12	4536	429	1.7	0.2	17.2	1.5
Assimilatory organs ($mg.kg^{-1}$)	Spruce needles	416		33		0.12		0.87	
	Beech leaves	1050		102		0.14		1.21	
	Spruce – wood	184		137		N/A		1.86	
	Beech – wood	48		65		N/A		1.82	
	Spruce needles/soil ratio	8.42		0.03		0.13		0.13	
	Beech leaves/soil ratio	17.9		0.05		0.13		0.16	

*(Minařík et al. 2000)

■ **Tab. 2.** The concentration of the studied elements in different environmental pools affirmation is encouraged by the concept of proportional indices (PI) related to the most common element Fe. The obtained data suggest that Mn and Co behave under the actual conditions of the system similarly to the behaviour of Fe. On the contrary, Ni seems to be relatively enriched in the soil system compared to the control content of Fe.

Relative contents of the individual elements in the tree tissues were also compared (Tab. 2). A pronounced enrichment of Mn and Ni in bole wood was found. Further, the enrichment of Ni in beech was twice higher than that in spruce wood. This can be explained by differences in the depth of rooting systems and increased Ni availability in deeper horizons. Enrichment of Co in the tree tissues is also evident. Generally, it can be said that relative contents of the studied elements in assimilatory organs and bole wood correspond to their enrichment in throughfall. It decreases in the order of Mn>>Ni>Co>Fe.

Differences in bulk precipitation and throughfall chemistry

The two types of atmospheric deposition differ in their chemistry mainly due to the enrichment of throughfall after the contact of falling precipitation with the above ground layer of the vegetation, and also due to its thickening caused by evapotranspiration (Heinrichs & Mayer 1980). Vegetation plays an important role in the mass budgets of the studied elements.

Generally, the mobilization of the studied elements by vegetation is decreasing in the order of Mn>>Ni>Co>Fe. Especially in the case of Mn, the enhanced concentration in the throughfall samples is evident. The same applies to Ni and Co, which are also bound to organic matter.

Apart from that, the flux of Fe in spruce throughfall and in bulk precipitation is not significantly different. Higher content of Fe in bulk precipitation is caused by its high content in terrigenic dust. Further, there was observed a difference among the two types of throughfall. Markedly lower content of Fe in beech throughfall than in spruce throughfall flux indicates that Fe is, to a certain degree, of metabolic origin.

These ascertained presumptions were also tested by correlation analyses. Manganese correlation shows no dependence or coherency among the individual types of the atmospheric deposition. Similarly, in the case of Co and Ni, there was not found any correlation relationship between the chemistry of bulk precipitation and both types of throughfall. However, a strong correlation was found between the matter fluxes of both types of the precipitation below tree canopies in the case of Fe. However, the relation between the Fe fluxes of the bulk precipitation, and both types of throughfall, is also evident.

Transport trajectories in the atmosphere

The elements, which are the main subject of the presented thesis, have different supposed sources. Co and Ni have not been discussed in this part of the thesis due to the lack of input data. Conversely, the backward trajectories of other elements have been examined in order to summarize the consequences of the origin of the remaining ones.

In the case of Mn, the most probable and dominant local source is of biogenic origin. This finding corresponds with its essential role in the metabolism of forest vegetation. Also Nriagu (1989) suggested that absolute majority (89 %) of Mn emissions to the atmosphere come from the natural sources. It can be therefore suggested that the direction of the backward transport trajectories corresponds to the source of emissions from burning wood, or possibly the effect of local throughfall or guttation of tree assimilatory organs.

The backward trajectories of Fe and their similarity to those of Al suggest the element origin in terigennic dust. This theory maintains also different transport trajectories of Al and Fe at the sampling site of Milešovka Hill, which is not influenced by the terrain orography. Further, a similarity was found among the backward trajectories of Al, Fe and S at the locality LP. This suggests the combustion processes to be the dominant source of these elements in the region.

The backward trajectories of S at all the monitored sites affirm that LP catchment is an example of background locality which is not significantly influenced by any bigger local emission producing source. There was no significant predominant course of trajectory of S identified. This is probably caused by the diverse position of major S sources in relation to the sampling site.

Chemical forms of the studied elements present in the stream waters of Lesní potok

The distribution of the elements in the stream water discharge also reflects their relative mobility, decreasing in the order of Mn>Ni>Co>Fe. The dominant factor affecting the occurrence of chemical form of the element in the stream water is the pH value and redox potential. Study of the species distribution of individual elements in stream water has been preceded with the help of computer program PhreeqC (Parkhurst & Appelo 1999).

The dependency upon pH value is evident especially in the case of Mn. Manganese was present mainly in the divalent form during the studied season. Its concentration in the stream water increased when the pH value decreased. This release of the Mn (and Co) ions into the stream water system was caused by the exchange for the H^+ ions in the stream sediment.

The dependency of the chemical form of element occurrence in the stream water upon redox potential can be documented in the case of Fe. Iron occurred mainly in divalent form in the stream water discharge in the studied time period resulting from its very low concentration and prevailing conditions (Eh and pH). The enhanced concentration of trivalent chemical states occurred only during the spring snow melt, when the pH value of water decreased and redox potential increased.

The behavior of Ni occurrence in the stream waters of Lesní potok was not adequately explained. The tendency of Ni distribution was increasing during the studied winter and spring period. However, the studied period should be prolonged and the results should be confirmed.

Anomalous hydrological year 2007

The hydrological year 2007 was atypical in several aspects in the experimental catchment in central Bohemia. Data obtained during the HY 2007 were compared with data from a longer time period 1995–2006. It was concluded that the annual precipitation in the hydrological year 2007 (758.8 mm) was similar to the mean annual value from 1995–2006 (735.7 mm). However, the distribution of the precipitation events during the year was anomalous as far as the occurrence of the anticyclonal situations in the warmer period of the year probably supported the limited occurrence of local precipitation events. Consequently, mild winter and lack of snow layer could be counted as other factors contributing to the atypical conditions.

These atypical conditions, prevailing during the hydrological year 2007, result in considerably low stream water discharge and consequently to the increased values of stream water pH in the LP catchment.

Higher pH value of stream water in 2007 (volume weighted mean 5.20 compared to the long-term 4.94) resulted from a longer residence time of pure water and decreased input of atmospheric acidifiers, in particular when compared with the last decade of the 20th century (Fišák et al. 2006).

The anomalous conditions affected the mass budgets of pH-sensitive elements towards more positive values. The depletion of base cations was considerably reduced. Fine example is the positive trend of Ca (net change shift from –1,460 to –128 $mg.m^2.yr^{-1}$).

In the case of Mn, Ni (and other elements), the factors caused a significant increase in their accumulation in the experimental catchment. Namely, in the case of Mn, the net change shifts from 2,840 (during the compared time period) to 14,300 $\mu g.m^2.yr^{-1}$ in the hydrological year 2007.

Interesting and notable example is the value of the net change in the case of Fe. The net change has been reduced from 381,000 (mean of the 1995–2006) to 366,000 $\mu g.m^2.yr^{-1}$ in the hydrological year 2007. This was caused by the decreased value of Fe output through stream water discharge (67.5 % of the mean discharge in the compared time period). This decrease was probably caused by lower value of redox potential during the year 2007.

Consequently, the prevailing synoptic situations and climatic conditions in 2007 significantly affected the input/output balance of numerous elements in the monitored forested catchment. The described circumstances in that year induced favorable conditions which allowed for the recovery of the formerly disturbed acid-sensitive ecosystem.

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Together with cosmic spherules, interplanetary dust particles and lunar samples returned by Apollo and Luna missions, meteorites are the only source of extraterrestrial material on Earth. They represent samples of various space bodies from asteroids to other planets. Some are remains of parent bodies, which completely disintegrated during giant collisions and no longer exist in the Solar System.

The physical properties of meteorites, especially their magnetic susceptibility, bulk and grain density and porosity, have wide applications in meteorite research such as meteorite classification, studies of their origin, level of terrestrial weathering, shock history and in the estimation of the physical appearance of their parent bodies – asteroids. For example, the comparison of a meteorite's density, porosity or magnetic susceptibility to that of a compositionally similar asteroid may reveal its internal structure. For such purposes, an expanded database of meteorite physical properties was compiled with new measurements done in meteorite collections across Europe using a mobile laboratory facility.

However, the scale problem may bring discrepancies in the comparison of asteroid and meteorite properties. Due to inhomogeneity, the physical properties of meteorites studied on a centimeter or millimeter scale may differ from those of asteroids determined on kilometer scales.

Further difference may arise from shock effects, space and terrestrial weathering and from difference in material properties at various temperatures. As demonstrated on rock magnetic studies of the Neuschwanstein meteorite, compared to room temperature, sulphides present in extraterrestrial materials have distinct magnetic properties with newly discovered magnetic transitions at temperatures of the "cold" Solar System environment. This draws significant constraints on modeling the interaction of minor Solar System bodies with interplanetary magnetic fields.

Close attention was given to the reliability of the paleomagnetic and paleointensity information in meteorites. A modified method, based on coercivity distribution of the remanent magnetization efficiency, was tested on various terrestrial and extraterrestrial samples. The results show that impact related shock effects on remanent magnetization can be distinguished or atypical magnetic carriers can be identified. Further, the reliability of the thermoremanent magnetization efficiency as the paleointensity tool was studied and calibrated for various minerals of different grain sizes. These studies give us a tool for reliable interpretation of magnetic information carried in extraterrestrial materials. Such information provides constraints on ancient magnetic field intensities and on the evolution of minor bodies in our Solar System.

5. Publication activity of staff members of the Institute of Geology

5a. Papers published in 2009

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KADLEC J. & *ŠLECHTA S.* (2009): *Magnetomineralogické studium souvrství spraší a fosilních půd odkrytých během stavby tunelu Blanka – Roční etapová zpráva.* – Inst. Geol. AS CR, v. v. i. for Prospecto, Ltd.: 1–8. Praha.

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LISÁ L. (2009): *Předběžná zpráva z geoarcheologického výzkumu ve Staré Boleslavi*. – Inst. Geol. AS CR, v. v. i. for ARUP v. v. i. Praha: 1–20. Praha.

LISÁ L., BAJER A. & GREGOR M. (2009): *Geoarcheologické zhodnocení lokality Padovec, Bašty 2, Brno*. – Inst. Geol. AS CR, v. v. i. for Archaia Brno o. p. s.: 1–18. Praha.

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NOVÁK J.K., *BOSÁK P.* & *KORBELOVÁ Z.* (2009): *Pyroclastic rocks from the Bito and Ramble areas, Jamaica: Trachydacitic ignimbrite, Progress report 2*. – Inst. Geol. AS CR, v. v. i. for GET, Ltd.: 1–25, 1–5. Praha.

NOVÁK J.K., *BOSÁK P.* & *KORBELOVÁ Z.* (2009): *Vein barite from the Benbow Inlier, Central Jamaica. Initial Report*. – Inst. Geol. AS CR, v. v. i. for GET, Ltd.: 1–19. Praha.

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NOVÁK J.K., *BOSÁK P.* & *PAVKOVÁ J.* (2009): *Supplementary cementing raw materials from the Hanover Block, western Jamaica: Initial report*. – Inst. Geol. AS CR, v. v. i. for GET, Ltd.: 1–24, 1–5, 1–19. Praha.

NOVÁK K., *ADAMOVIČ J.*, *BOSÁK P.* & *PAVKOVÁ J.* (2009): *Detritické minerální asociace sklářského písku (k průzkumnému úkolu Holany). Závěrečná zpráva*. – MS, Geol. úst. AV ČR, v. v. i. for GEKON, Ltd.: 1–41. Praha.

ROHOVEC J. (2009): *Stopovací barviva pro studium mezizrnné propustnosti granitu. Studie*. – Inst. Geol. AS CR, v. v. i. for ISATECH, Ltd.: 1–27. Praha.

RUDAJEV V. & *ŽIVOR R.* (2009): *Rámcový projekt geomechanické laboratoře.Expertíza.* – Inst. Geol. AS CR, v. v. i. for Centrum pro výzkum energetického využití litosféry, v. v. i.: 1–12. Praha.

SVOBODOVÁ M. (2009): *Palynologická analýza klastik z krasových výplní lomu Na Kurtovej skale*. – Inst. Geol. AS CR, v. v. i. for Project of Faculty of Science, Komensky University in Bratislava: 1–5. Praha.

SVOBODOVÁ M. (2009): *Palynologie vybraných vzorků z vrtů Holany.* – Inst. Geol. AS CR, v. v. i. for GEKON, Ltd.: 1–11. Praha.

ZAJÍC J. (2009): *Zoopaleontologie permokarbonu pro vysvětlivky ke geologické mapě list Semily (03-413). Závěrečná zpráva*. – Inst. Geol. AS CR, v. v. i. for Czech geological survey: 1–12. Praha.

ŽÁK K. (2009): *Úvodní zpráva k problematice separace plynů obsažených v bublinách ve vltavínech a jiných tektitech a stanovení chemického a izotopového složení těchto plynů.* – Inst. Geol. AS CR, v. v. i. for Ústav jaderné fyziky AV ČR, v. v. i.: 1–33. Praha.

ŽIVOR R. (2009): *Pevnostní zkoušky pískovců z NP České Švýcarsko (lokality Hřensko a Pravčická brána). Závěrečná zpráva.* – Inst. Geol. AS CR, v. v. i. for ČR – Správa Národního parku České Švýcarsko: 1–12. Praha.

6. Organization of conferences and scientific meetings

National Conference: **Evolution as seen by biologists and paleontologists, Prague, March 18, 2009**. Interdisciplinary Workshop focused to broader public and media. Institute of Experimental Botany, AS CR, v. v. i. & Institute of Geology, AS CR, v. v. i. Organizing Committee: Štorchová H. & *Mikuláš R.*

Twenty-five experts in evolution working with biological and paleontological data from the academic and university research institutes of the Czech Republic prepared brief and comprehensible presentations on their present evolution research topics. Most of the presentations were subsequently turned into a broadcast form of the Czech Nationwide Radio (e. g., http://www.rozhlas.cz/radionaprani/archiv/_audio/00985851.mp3) and to the series of articles in the scientific-popular journal Živa (*cf.* http://ziva.avcr.cz/?z=20095).

International Conference: **Regional Devonian Workshop Prague & Graz, Prague, May 25–27, 2009.** Organized by University of Graz, Austria, Institute of Geology, AS CR, v. v. i. and Czech Geological Survey, Praha, Czech Republic. Organizing Committee: Suttner T., Berkyová S., Hubmann B., *Koptíková L.* & *Slavík L.*

For this workshop 26 persons from 8 countries enhanced the volume with contributions on some of their present studies on Devonian stratigraphy, paleontology, paleoecology and geochemistry. Additionally to the abstracts a second part is included with some Lower and Middle Devonian excursion points visited during the past two years. These localities do mainly accord to shallow marine sequences which were studied for correlating the evidence of biotic events (and their triggers) known from deeper marine sections as mentioned above. Finally a listing of references from Lower to Mid Palaeozoic deposits of Austria is added to the meeting volume: Suttner T., Berkyová S., Hubmann B., *Koptíková L.* & *Slavík* L. (Eds., 2009): Regional Devonian Workshop Prague & Graz. – *Berichte der Geologischen Bundesanstalt*, 79: 1–124. Wien.

International Conference: **Subcommission on Silurian Stratigraphy field meeting: Time and Life in the Silurian: A multidisciplinary approach. Villa Simius, Sardinia, June 4–11, 2009**. Organized by Universitá degli Studi di Cagliari and Universitá degli Studi di Modena a Reggio Emilia. Organizing committee: Corradini C., Ferretti A., *Štorch P.*, Barca S., Corriga M.G., Del Rio M., Gnoli M., Histon K., Leone F., Loi A., Pillola G.L., Piras S., Pittau P. & Serventi P.

Bi-annual meeting and conference brought together 54 participants from 17 countries, focused on diverse aspects of geology, geochemistry, stratigraphy and paleontology of the Silurian System. The program involved oral presentations, a poster session, the Silurian subcommission and graptolite working group business meetings, and excursions in the Lower Paleozoic of southern Sardinia. Special volume on the Silurian of Sardinia, edited by C. Corradini, A. Ferretti and P. Štorch, was published along with abstract volume and excursion guide book.

International meeting: **Meeting of the Geomorphology-Quaternary Group of the Czech Geological Society, June 3-6, 2009.** Organized by the Institute of Geology AS CR, v. v. i. and Czech Geological Society. Organizing Comitee: *Lisá L.*

This meeting was attended by 25 participants from three countries. The following lectures were presented: Veselí na Moravě Medieval locality from 12th century with salvage excavations, lectures on alluvial sedimentology, excursion to Bzenec village (aeolian sands) with a lecture and the excursion to former Vracov Lake with a lecture.

International meeting: **Meeting of the Geomorphology-Quaternary Group of the Czech Geological Society, November 15, 2009.** Organized by the Institute of Geology AS CR, v. v. i. and Czech Geological Society. Organizing Comitee: *Lisá L.* & Neruda P.

This meeting was attended by 16 participants from two countries. Cave localities with archaeological context were presented (Býčí skála Cave, Výpustek Cave and Kůlna Cave with lectures.)

7. Undergraduate and Graduate Education

7a. Undergraduate and Graduate Courses at Universities given by Staff Members of the Institute of Geology AS CR

ACKERMAN L.: *Geochemistry of endogenic processes* (MG431P02). Untergraduate (obligatory) Course, Faculty of Science, Charles University, Praha.

BEK J.: *Evolution of Palaeozoic spores* (MG422P54). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

CAJZ V.: *Regional geology – field excursion* (KGEO – 0109). Undergraduate Course, Faculty of Science, Jan Evangelista Purkyně University, Ústí nad Labem.

CAJZ V.: *Regional geology and volcanology of the České středohoří Mts.* (KGEO – 0105). Undergraduate Course, Faculty of Science, Jan Evangelista Purkyně University, Ústí nad Labem.

CAJZ V. & CHVÁTALOVÁ A.: *Geology* (KGEO – P226/P417). Undergraduate Course, Faculty of Science, Jan Evangelista Purkyně University, Ústí nad Labem.

CÍLEK V.: Czech Landscape. Seminar, Academy of Fine Arts (AVU), Praha.

CÍLEK V.: European history and mentality. CHP, Collegium Hieronymi Pragense (Consortium of U.S. Universities), Praha.

CÍLEK V.: Excursion USAC and Erasmus: Five days excursions "Vienna-Budapest-Bratislava: Town and its environment". Faculty of Liberal Arts, Charles University, Praha.

DAŠKOVÁ J.: *Field Trip of Historical and Stratigraphical Geology* (MG421T05). Untergraduate Course, Faculty of Science, Charles University, Praha.

DATEL J. & *MIKULÁŠ R.*: *Principles of Geology.* (PVP APA500029). Untergraduate Obligatory Course, Department of Archaeology, Philosophical Faculty, Charles University, Praha.

DRAHOTA P.: *Environmental aspects of mining* (MG432P25). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

HOJDOVÁ M.: *Fundamentals of geology* (APA35E). Untergraduate Course, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Praha.

JELÍNEK E., MIHALJEVIČ M., ETTLER V. & *DRAHOTA P.*: *Geochemistry* (MG431P01). Undergraduate Course, Faculty of Science, Charles University, Praha.

KADLEC J.: *Causes and consequences of Quaternary climatic features* (MG421P15). Graduate and Postgraduate Course, Faculty of Science, Charles University, Praha.

KADLEC J.: *Geology of Quaternary period* (MG421P18G). Untergraduate Course, Faculty of Science, Charles University, Praha.

KUBÍNOVÁ P.: Tutorial in: *Vach M.*: *Environmental chemistry I* (ZVL02E). Undergraduate Course, Faculty of Environmental Sciences. Czech University of Life Sciences, Praha.

KUBÍNOVÁ P.: Tutorial in: *Vach M.*: *Environmental chemistry I* (ZVZ05E). Undergraduate Course, Faculty of Environmental Sciences. Czech University of Life Sciences, Praha.

KUBÍNOVÁ P.: Tutorial in: *Vach M.*: *Environmental chemistry PRM* (ZVL03E). Undergraduate Course, Faculty of Environmental Sciences. Czech University of Life Sciences, Praha.

LISÁ L.: *Environmental archaeology* (B7105). Undergraduate (optional) Course Faculty of Philosophy, University of West Bohemia in Plzeň, Plzeň.

MIKULÁŠ R.: *Geologic Aspects of Landscapes.* Occasional lecture for undergraduate students, Studio of Sculptory of Academy of Arts, Architecture and Design in Praha, April 28, 2009, Hradec nad Moravicí

MIKULÁŠ R.: *Trace fossils and ichnofabric of sedimentary rocks* (MG421P40). Untergraduate and Postgraduate (optional) Course, Faculty of Science, Charles University, Praha.

NAVRÁTIL T & HOJDOVÁ M.: *The heavy metals in the environment* (G431P92). Graduate Course, Faculty of Science, Charles University, Praha.

PAVLÍČKOVÁ L. & *KUBÍNOVÁ P.*: *Drinking water treatment and sewage treatment* (ZVZ14Z). Undergraduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

PAVLÍČKOVÁ L. & *KUBÍNOVÁ P.*: *Drinking water treatment and sewage treatment* (ZVZ28E). Graduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

PŘIKRYL T.: *Comparative Anatomy of Vertebrates* (MB170P47). Undergraduate (optional) Course and Practical Study, Faculty of Science, Charles University, Praha.

PŘIKRYL T.: *Morphology of animals* (MB170P46). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

PŘIKRYL T.: *Morphology of animals* (MB170C46). Practical Study, Faculty of Science, Charles University, Praha.

PŘIKRYL T.: *Paleoecology* (MG422P51). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

PŘIKRYL T.: *Systematic Paleontology II* (MG422P19). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

PRUNER P.: *Paleomagnetism in plate tectonics* (MG440P61). Undergraduate and Graduate Course, Faculty of Science, Charles University, Praha.

ROČEK Z.: *Comparative anatomy of animals* (MB170P47). Undergraduate (obligatory) Course, Faculty of Science, Charles University, Praha.

ROČEK Z.: *Evolution of global ecosystem* (MB170P44). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

ROČEK Z.: *Evolution of vertebrates* (MB170P43). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

ROČEK Z.: *Morphology of animals* (MB170P46). Bachelors Course (Biology; Molecular Biology and Biochemistry of Organisms; Ecological and Evolutionary Biology), Faculty of Science, Charles University, Praha.

ROČEK Z.: *Origin and evolution of the amphibians*. Department of Biology, Faculty of Science, Masaryk University, December 10, 2009, Brno.

ROČEK Z.: *Review of fossil vertebrates* (MB170P45). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

ROČEK Z.: *Review of fossil vertebrates* (Zoologie fosilních obratlovců, KZO/375). Undergraduate (optional) Course, Faculty of Science, University of South Bohemia, České Budějovice.

RUDAJEV V.: *Physics of rock fracturing – selected topics*. Postgraduate Course (individual program), Faculty of Science, Charles University, Praha.

SKÁLA R.: *Advanced methods in processing of diffraction data* (MG431P70). Undergraduate course, Faculty of Science, Charles University, Praha.

SKÁLA R.: *Chemical crystallography* (MG431P64). Undergraduate course, Faculty of Science, Charles University, Praha.

SKÁLA R.: *Impact cratering and shock metamorphism* (MG431P39). Undergraduate course, Faculty of Science, Charles University, Praha.

SKÁLA R.: *Introduction to systematic mineralogy* (MG431P48). Undergraduate course, Faculty of Science, Charles University, Praha.

SKÁLA R.: *Meteorites, their origin and composition* (MG431P40). Undergraduate course, Faculty of Science, Charles University, Praha.

SKÁLA R.: *Principles of mineralogy* (MG431P52/MG431P52U). Undergraduate course, Faculty of Science, Charles University, Praha.

ŠTORCH P.: *Principles and methods of stratigraphy* (MG421P25). Untergraduate (optional) Course, Faculty of Science, Charles University, Praha.

VACH M.: *Air Protection* (ZVZ22E). Undergraduate Course, Forestry and Environmental Faculty, Czech Agricultural University, Praha.

VACH M.: *Atmospheric processes* (ZVZ01E). Undergraduate Course, Forestry and Environmental Faculty, Czech Agricultural University, Praha.

VACH M.: *Environmental chemistry I* (ZVL02E). Undergraduate Course (Bc.), Forestry and Environmental Faculty, Czech University of Life Sciences, Praha.

VACH M.: *Environmental chemistry I* (ZVL05E). Undergraduate Course (MSc.), Forestry and Environmental Faculty, Czech University of Life Sciences, Praha.

VACH M.: *Environmental chemistry PRM* (ZVL03E). Undergraduate Course (MSc.), Forestry and Environmental Faculty, Czech University of Life Sciences, Praha.

VACH M.: *Physico-chemical aspects of processes in environment* (ZVZ09E). Undergraduate Course, Forestry and Environmental Faculty, Czech Agricultural University, Praha.

VACH M.: *Transport of contaminants in atmosphere* (ZVL24E). Undergraduate Course, Forestry and Environmental Faculty, Czech Agricultural University, Praha.

ZACHARIÁŠ J., PŘIKRYL R., OPLUŠTIL S., *DRAHOTA P.* & GOLIÁŠ V.: *Nonrenewable and renewable resources I.* (MG432P30). Undergraduate Course, Faculty of Science, Charles University, Praha.

ŽIGOVÁ A.: *Geography of soils and protection of soil resources of the Czech Republic* (MZ330P90). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

7b. Supervision in Undergraduate Studies

Bc. Theses

JAROŠOVÁ M., Faculty of Science, Masaryk University, Brno (*co-supervisor/advisor L. Lisá, since 2009*)

KOCOUREK M., Faculty of Science, Charles University, Praha (*supervisor Z. Roček, since 2009*).

KUCHOVÁ-BREBURDOVÁ H., Faculty of Science, Charles University, Praha (*supervisor Z. Roček, since 2009*).

SOUMAR J., Faculty of Science, Charles University, Praha (*supervisor R. Skála, since 2009*)

VLČEK V., Faculty of Science, Charles University, Praha (*supervisor R. Skála, since 2009*)

MSc. Theses

DOUCEK J., Faculty of Science, Charles University, Praha (*supervisor R. Mikuláš, since 2008*)

DRÁBKOVÁ V., Faculty of Science, Charles University, Praha (*supervisor L. Strnad, co-supervisor/advisor J. Hladil, defended in 2009*)

GOLL J., Faculty of Science, Charles University, Praha (supervisor *R. Skála, since 2009*)

HOŠEK J., Faculty of Science, Charles University, Praha (*advisor J. Kadlec, since 2008*)

IŠKOVÁ P., Faculty of Science, Charles University, Praha (supervisor *R. Skála, since 2009*)

KALLISTOVÁ A., Faculty of Science, Charles University, Praha (supervisor *R. Skála, since 2009*)

KOCÁBKOVÁ M., Faculty of Science, Charles University, Praha (*supervisor Z. Roček, since 2007*).

KOŘÍNKOVÁ D., Faculty of Science, Charles University, Praha (*supervisor M. Svojtka, since 2009*)

KOVÁCS A., Faculty of Science, Charles University, Praha (*supervisor L. Ackerman, since 2008*)

KOVÁČIKOVÁ V., Faculty of Science, Charles University, Praha (*supervisor T. Navrátil, since 2008*)

KUBROVÁ J., Faculty of Science, Charles University, Praha (*supervisor J. Borovička, since 2009*)

KUČEROVÁ K., Faculty of Science, Masaryk University in Brno (*supervisor J. Hladil, since 2002*)

NOVÁKOVÁ B., Faculty of Science, Charles University, Praha (*supervisor P. Drahota, since 2009*)

POLECHA R., Faculty of Science, Charles University in Praha (*co-supervisor/advisor J. Hladil, since 2008*)

REDLICH A., Faculty of Science, Charles University, (*supervisor P. Drahota, since 2009*)

SOUMAR J., Faculty of Science, Charles University, Praha (supervisor *R. Skála, since 2009*)

SVATUŠKOVÁ A., Faculty of Science, South Bohemian University, České Budějovice (*co-supervisor/advisor L. Lisá, since 2009*)

7c. Supervision in Graduate Studies

PhD. Theses

ALTOVÁ V., Department of Physical Geography and Geoecology, Faculty of Sciences, Charles University, Praha (*co-supervisor P. Bosák, since 2006*)

AXMANN D., Faculty of Sciences, Masaryk University, Brno (*supervisor R. Mikuláš, since 2008*).

BAJO P., Nova Gorica University, Faculty of Post-graduate Studies, Post-graduate study program Karstology, Nova Gorica, Slovenia (*foreign supervisor P. Bosák, 2009*)

DRÁBKOVÁ J. (PhD. thesis), Faculty of Science, Charles University, Praha (*co-supervisor J. Bek, since 2005*)

DZIKOVÁ L., Faculty of Sciences, Masaryk University, Brno (*supervisor R. Skála, since 2007*)

JANEČKA J., Faculty of Science, Masaryk University in Brno (*supervisor J. Hladil, since 2004*)

KOPTÍKOVÁ L., Faculty of Science, Charles University in Praha (*supervisor J. Hladil, since 2004*)

KRÁLOVEC K., Faculty of Science, Charles University, Praha (*supervisor Z. Roček, since 2000*)
KUBÍNOVÁ P., Czech Agricultural University, Faculty of Environmental Sciences, Praha (*supervisor M. Vach, co-supervisor P. Skřivan, defended in 2009*)
KULAVIAK L., Faculty of Chemical Engineering, Institute of Chemical Technology (*co-supervisor/advisor J. Hladil, since 2007*)
MACHADO G., SFHR/237887/2005 The Portugese Science and Technology Foundation Aveiro University Faculdade de Ciéncias, Centro de Minerais Industriais e Argilas, Dep. Geociencias, Aveiro, Portugal (*co-supervisor M. Vavrdová, since 2007*)
MATOUŠKOVÁ Š., Faculty of Science, Charles University, Praha (co-*supervisor J. Rohovec, since 2006*)
PETRUŽÁLEK M., Faculty of Science, Charles University, Praha (*co-supervisor T. Lokajíček, since 2006*)
POKORNÝ R., Institute of Geology and Paleontology, Charles University, Praha (*co-supervisor R. Mikuláš, since 2005*).
PŘIKRYL T., Faculty of Science, Charles University, Praha (*supervisor J. Zajíc, since 2006*)
SCHNABL P., Faculty of Science, Charles University, Praha (*supervisor P. Pruner, since 2004*)
SIDORINOVÁ T., Faculty of Science, Charles University, Praha (*supervisor R. Skála, since 2008*)
ŠLECHTA S., Faculty of Science, Charles University, Praha (*co-supervisor J. Kadlec, since 2005*).
ŠPIČKOVÁ-DUBROKOVÁ J., Faculty of Science, Charles University, Praha (*supervisor P. Skřivan, defended in 2009*)
STEHLÍK F., Faculty of Science, Charles University, Praha (*advisor J. Kadlec, since 2008*)
SVITEK T., Faculty of Science, Charles University, Praha (*supervisor T. Lokajíček, since 2008*)
VACEK F., Faculty of Science, Charles University, Praha (*supervisor P. Bosák, co-supervisor/advisor J. Hladil, defended in 2009*)
ŽIVOR R., Faculty of Science, Charles University, Praha (*co-supervisor V. Rudajev, since 2006*)

7d. Membership in scientific and academic boards

BOROVIČKA J.
Member, Presidium, Scientific Secretary, Czech Mycological Society, Praha
BOSÁK P.
Member, Interdepartamental Evaluation Committee for Evaluation of Proposals and Results of Research Plans from the Field of Physics, Mathematics and Earth Sciences, Ministry of Education, Youths and Sports of the Czech Republic, Praha
Vice-Chairman, Committee for degree of Doctor of Sciences (DSc.) in geological sciences at Academy of Sciences of the Czech Republic, Praha
Chairman of Executive Board of the Institute of Geology of the AS CR, v. v. i., Praha
Member, Scientific Council of Faculty of Science, Masaryk University, Brno
Member, Academic Assembly of the Academy of Sciences of the Czech Republic, Praha
Member, Board of Graduate Studies in Geology (4 years), Faculty of Science, Charles University, Praha
Member, Committee for Interdisciplinary study of Quaternary at the Board of Graduate Studies in Geology, Faculty of Science, Masaryk University, Brno
Supervisor for PhD studies, Faculty of Science, Masaryk University, Brno
Member, Committee for State Doctoral Examinations for Interdisciplinary study of Quaternary at the Board of Graduate Studies in Geology, Faculty of Science, Masaryk University, Brno
Member, Committee for State Doctoral Examinations, PhD Study Program of Applied Geology, Faculty of Science, Charles University, Praha
Member, Committee for Defenses of Dissertations, PhD Study Program of Applied Geology, Faculty of Science, Charles University, Praha
Member, Committee for Defenses of Dissertations, PhD Study Program of Physical Gegraphy and Geoecology, Faculty of Science, Charles University, Praha
Member, Committee for State Doctoral Examinations, PhD Study Program of Physical Gegraphy and Geoecology, Faculty of Science, Charles University, Praha
Member, Committee for State Rigorosum Examinations in Geology (general geology), Faculty of Science, Charles University, Praha
CÍLEK V.
Member, Scientific Board, Faculty of Humanistic Studies, Charles University, Praha
Member, Scientific Board of the Czech Geological Survey, Praha
Member, Academic Assembly of the Academy of Sciences of the Czech Republic, Praha
Vice-chairman, Executive Board of the Institute of Geology ASCR, v. v. i., Praha
GOTTSTEIN O.
Member, Executive Board of the Institute of Geology of the AS CR, v. v. i., Praha
HLADIL J.
Alternating Member, Committee for Degree of Doctor of Sciences in Geological Sciences, Academy of Sciences CR, Praha
Member, Board of Graduate Studies in Geology (4 years), Faculty of Science, Charles University, Praha
Member, Board of Graduate Studies in Geology, Faculty of Sciences, Masaryk University, Brno
Member, Committee for Finals of Undergraduate Students in Geology, Faculty of Sciences, Masaryk University, Brno
Member, RNDr. Doctoral Examination Committee in Geology, Faculty of Sciences, Masaryk University, Brno
Member, Committee for Finals of Undergraduate Students in Geology, Faculty of Sciences, Masaryk University

HOJDOVÁ M.
Member, Committee for Finals of Doctoral Students in Applied Geology, Faculty of Science, Charles University, Praha
KADLEC J.
Member, Board of the Doctoral Studies in Applied Geology, Faculty of Science, Charles University, Praha
Member, Committee for Finals of Doctoral Students in Applied Geology, Faculty of Science, Charles University, Praha
Member, Committee for Finals of Graduate Students in Geology, Faculty of Science, Charles University, Praha
Member, RNDr. Doctoral Examination Committee in Geology, Faculty of Science, Charles University, Praha
LOKAJÍČEK T.
Member, Board of Graduate Studies in Applied Geology, Faculty of Science, Charles University, Praha
MIKULÁŠ R.
Alternating Member, Doctoral Examination Committee in Geology, Faculty of Sciences, Charles University, Praha
Deputy Chairman, Board for Popularization of Sciences, Academy of Sciences of the Czech Republic, Praha
Secretary, Czech National Geologic Committee, Academy of Sciences of the Czech Republic, Praha
NAVRÁTIL T.
Member, Committee for Finals of Doctoral Students in Applied Geology, Faculty of Sciences, Charles University, Praha
Member, Committee for Doctoral Thesis Defense in Applied Geology, Faculty of Sciences, Charles University, Praha
External Member, State Magisterium and Rigorosa Examinations in Geology, Faculty of Science, Charles University, Praha.
PRUNER P.
Member, Board of the Graduate Studies in Geophysics, Faculty of Science, Charles University, Praha
Alternating member, Commitee for degree of Doctor of Sciences (DSc.) in geological sciences, Praha
Member, Executive Board of the Institute of Geology of the AS CR, v. v. i., Praha
ROČEK Z.
Member, Committee for degree of Doctor of Sciences (DSc.) in geological sciences at Academy of Sciences of the Czech Republic, Praha
Member, Committee for degree of Doctor of Sciences (DSc.) in zoology and physiology at Academy of Sciences of the Czech Republic, Praha
RUDAJEV V.
Member, Council for Sciences of Academy of Sciences of the Czech Republic, Praha (until end of March, 2009)
Chairman, Committee for degree of Doctor of Sciences (DSc.) in geological sciences at Academy of Sciences of the Czech Republic, Praha
Member, Supervisory board of the Astronomical Institute of the AS CR, v. v. i., Praha
Member, Supervisory board of the Institute of Theoretical and Applied Mechanics of the AS CR, v. v. i.
Member, Executive Board of the Institute of Geology AS CR, v. v. i., Praha
Member, Commission for defending Doctor of Sciences Thesis (DSc.) in Geophysical Sciences, Academy of Sciences of the Czech Republic, Praha
Member, Board of Graduate Studies in Applied Geology, Faculty of Science, Charles University, Praha
Member, Board of Graduate Studies in Geophysics, Matematical Physical Faculty, Charles University, Praha
SKÁLA R.
Chairman, Committee for Finals of Undergraduate Students in Geology, specialization Mineralogy and Crystallography, Faculty of Sciences, Charles University, Praha
Member, Committee for Finals of Undergraduate Students in Geology, specialization Geochemistry, Faculty of Sciences, Charles University, Praha
SKŘIVAN P.
Member, Committee for Finals of Undergraduate Students in Geology, specialization Geology of the Environment, Faculty of Science, Charles University, Praha
Member, Committee for Finals of Undergraduate Students in Applied and Landscape Ecology, Faculty of Environmental Sciences, Czech Agricultural University, Praha
Member, PhD. Doctoral Examination Committee in Geochemistry, Faculty of Science, Charles University, Praha
Member, Board of Graduate Studies in Applied and Landscape Ecology, Faculty of Forestry, Czech University of Agriculture, Praha
Vice-chairman, Advisory Board of the Institute of Geology AS CR, v. v. i., Praha
ŠTORCH P.
Member, Czech Science Foundation, Discipline Committee No 2: "Natural Sciences", and member & vice-chairman of Discipline Committee No 205: "Earth and Planetary Sciences", Praha (since April, 2009)
Alternating member, Committee for Degree of Doctor of Science in Geological Sciences, AS CR, Praha
Vice-Chairman, Czech Commission on Stratigraphy, Praha
SVOBODOVÁ M.
Secretary, Grant Commission of the Academy of Sciences, Council No. 3 Earth and Space Sciences, Praha
Member, Academic Assembly of the Academy of Sciences of the Czech Republic, Praha
Member, Executive Board of the Institute of Geology AS CR, v. v. i., Praha
ULRYCH J.
Member, Committee for Degree of Doctor of Science in Geological Sciences, Bratislava
Alternating member, Committee for Degree of Doctor of Science in Geological Sciences, Praha
Member, Board of Graduate and RNDr. Studies in Mineralogy and Geochemistry, Faculty of Science, Charles University, Praha
Member, Habilitation Committee in Mineralogy and Geochemistry, Faculty of Chemical Technology, University of Chemical Technology, Praha
Vice-chairman, Grant Commission of the Academy of Sciences, Council No. 3 Earth and Space Sciences, Praha
Member, Commitee for degree of Doctor of Sciences (DrSc.) in geological sciences at Slovak Academy of Science, Bratislava
Alternative member, Commitee for degree of Doctor of Sciences (DSc.) in geological sciences at Academy of Science of the Czech Republic

Member, Board of Graduate and RNDr. studies in Mineralogy and Geochemistry, Faculty of Science, Charles University, Praha
Vice-chairman, Grant Commission, Council No. 3 Earth and Space Science, Academy of Science

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Member, Committee for the PhD Examination and Defence of Theses in Geology, Faculty of Sciences, Charles University, Praha
Member, Committee for the Master's and RNDr. Doctoral Examination in Paleontology, Faculty of Sciences, Charles University, Praha

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Member, Czech Science Foundation, Discipline Committee No 2: "Natural Sciences", and member & chairman of Discipline Committee No 205: "Earth and Planetary Sciences", Praha (until end of March, 2009)
Member, Working Group Geology of the Accreditation Commission of the Czech Ministry of Education, Youth and Sports, Praha

ŽIGOVÁ A.
Member, Committee of Soil Science and Soil Conservation of Scientific Council of Research Institute for Soil and Water Conservation, v. v. i., Praha
Member, Board of the Graduate Studies in Physical Geography, Faculty of Science, Charles University, Praha
Member, Board of the Doctoral Examination Committee in Physical Geography and Geoecology, Faculty of Science, Charles University, Praha
Member, Board of the Committee of Soil Science of the Czech Academy of Agricultural Science, Praha

7e. Membership in Foreign Academies

BOSÁK P.: Foreign Member, Polish Academy of Arts and Sciences (election approved by the Polish President in 2007)

BOSÁK P.: Corresponding Member, Slovenian Academy of Sciences and Arts (elected 2005)

LOŽEK V.: Foreign Member, Polish Academy of Arts and Sciences (election approved by the Polish President in 1999)

7f. Degrees obtained by the staff of the Institute of Geology AS CR

PhD.

ČERMÁK S. (2009): *Lagomorpha (Mammalia) of the Pliocene and Pleistocene of Europe: a revision of selected taxa.* – Ph.D. Thesis, Department of Geology and Paleontology, Charles University: 1–214. Praha (defended on September 14, 2009).

KUBÍNOVÁ P. (2009): *Abiotic, biotic and anthropogenic impacts on the geochemical cycles of Mn, Fe, Co, and Ni in forest ecosystem*. – Ph.D. Thesis, Czech University of Life Sciences: 1–86. Prague (defended on December 9, 2009).

KOHOUT T. (2009): *Physical Properties of Meteorites and Their Role in Planetology* – Ph.D. Thesis, Department of Physics, Faculty of Science, University of Helsinki, Helsinki, Finland and Institute of Hydrogeology, Engineering Geology and Applied Geophysics, Faculty of Science, Charles University in Prague, Prague, Czech Republic, Report Series in Geophysics No. 60, 1–148, Helsinki (defended on July 29, 2009).

7g. Awards

BOSÁK P.: Honorary Member, the UIS Bureau, the International Union of Speleology.

ROČEK Z.: Visiting Research Fellow, Chinese Academy of Science.

RUDAJEV V.: Honest medal of František Pošepný for merit in geological sciences, awarded by the Academy of Sciences of the Czech Republic.

SVOBODOVÁ M.: Correspondent of the Geological Institute Vienna/Korespondentin der Geologischen Bundesanstalt Wien.

7h. Institute staff on Fellowships and Stages

KLETETSCHKA G.:*Temporary research position* (Professor at Catholic University of America, January 1, 2009–December 31, 2009, 12 months).

Research is done in the following areas: Testing of microshutters for James Web Space Telescope, Development of flux gate sensors for space flight magnetometers, Testing of empirical law for use in rock magnetism, Development of bolometers for X-ray detectors, Analysis of magnetic anomalies on Mars, Analysis of magnetic properties of meteorites.

KOHOUT T.: *Researcher* (University of Helsinki, Finland, January 1, 2009–December 31, 2009, 12 months).
- study of physical properties of meteorites and asteroids
- study of low temperature magnetic properties of astromaterials

LISÁ L.: Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project Code: M100130971: **Geoarchaeological research of Early Slavic pithouses from the Roztoky near Prague locality**

(*L. Lisá*, *Department of Archeology, University of Aberdeen, Aberdeen, Scotland, United Kingdom*, August–November; 3 months, 2009)
Research areas within the research fellowship:
- Micromorphological investigations on sedimentary infillings within Early Slavic pithouses in Roztoky
- Micromorphological training
- Training on pedological science

PETRUŽÁLEK M.: International Joint Graduate School (*National Institute for Material Science, Japan*, January – December 2009, 12 months)
- non-contact measurement of acoustic emission in materials by laser interferometry and its application for monitoring of rock fracturing process
- automatic picking of arrivals of seismic waves
- acoustic emission localization and determination of source mechanism of AE events

SLÁMA J., Postdoc (November 2007–August 31, 2009) and *Research Fellowship (*September 1, 2009–December 31, 2009*)* (Department of Earth Sciences, University of Bergen, Norway).
Research areas within the research fellowship:
- Volcanic and geodynamic evolution of the Jan Mayen Island, North Atlantic
- Detrital provenance of the sediments in the North Atlantic area
- Reliability of the provenance studies – an experimental approach
- Developement of *in-situ* Sm-Nd LA MC ICP-MS dating of minerals
- Hf isotopes in crust growth processes

8. Positions in Editorial Boards and International Organizations

8a. Editorial Boards

ADAMOVIČ J.: Příroda, Member of Editorial Board, Agency for Nature Conservation and Landscape Protection CR, Praha (since 2007).

BOROVIČKA J.: Mykologický Sborník, Editor-In-Chief, Journal of the Czech Mycological Society, Praha (since 2007).

BOSÁK P.: Acta Carsologica, Member of Executive Board (since 2007), International journal, published by Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia; (Member of Advisory Committee 2004–2007).
Aragonit; Member of Editorial Board, published by the Administration of Slovak Caves, Liptovský Mikuláš, Slovakia (since 2008).
Geologica Carpathica, Member of the Executive Committee (since 2005), Official journal of the Carpathian-Balkan Geological Association, Bratislava, Slovak Republic (Co-editor 2001–2005).
Geologos, Member of Editorial Board, Scientific journal published by Faculty of Geology, Adam Mickiewicz University, Poznań, Poland (since 2000).
International Journal of Speleology, Member of Advisory Board, Official international journal of the Union Internationale de Spéléologie and Societá Speleologica Italiana, Bologna, Italy (since 1994).
Kras i Speleologia, Member of editorial board, Scientific journal published by Silesian University, Sosnowiec, Poland (since 2004).
Theoretical and Applied Karstology, Member of editorial board, Scientific journal published by Speleological Institute "Emil Rakoviţa", Bucuresti – Cluj, Romania (since 2000).
Český kras, Co-editor (since 1998), Regional journal published by the Museum of the Czech Karst in Beroun, Czech Republic (Member of Editorial Board since 1976).
Research Reports of the Institute of Geology, Co-editor, Academy of Sciences of the Czech Republic (since 2007).
Speleo (Praha), Member of Editorial Board, Society bulletin published by the Czech Speleological Society, Praha, Czech Republic (since 1990).
Speleofórum; Co-editor, published by the Czech Speleological Society, Praha, Czech Republic (since 2000).

CÍLEK V.: Geologica Carpathica, Co-editor, Official journal of the Carpathian-Balkan Geological Association, Bratislava, Slovak Republic (since 2005).
Vesmír, Member of Editorial Board, Vesmír, s. r. o., Praha, Czech Republic (since 2006).

CAJZ V. Essentia, Member of Editorial Board, Internet journal (www.essentia.cz) (since 2003).

GALLE A.: Bulletin Západočeské Univerzity, Member of Editorial Board, West Bohemia University journal, Plzeň, Czech Republic (since 2007).

HLADIL J.: Geologica Carpathica, Member of Editorial Board, International Journal, Official Journal of the Carpathian-Balkan Geological Association, Geological Institute SAV, Bratislava, Slovakia (since 2001).
Geological Quarterly, Member of Editorial Board, International Journal, Polish Geological Institute, Warsaw, Poland (since 2004).
Bulletin of Geosciences, Member of Editorial Board, International Journal, Czech Geological Survey, Praha, Czech Republic (since 2006).

HLAVÁČ J.: Malacologica Bohemoslovaca, Member of Editorial Board, International journal, Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia (since 2006).

KADLEC J.: Geolines, Member of Editorial Board, Institute of Geology, v. v. i., Praha (since 1999).

LOŽEK V.: Studia Quarternaria, Member of Editorial Board, Polish Academy of Sciences, Krakow, Poland; (since 1999).

MIKULÁŠ R.: Member, Editorial Board of the Academy of Sciences of the Czech Republic (since 2009).
GEO – Czech Version, Member of Scientific/Editorial Board, Praha (2005–May 2009).
Geolines, Member of Editorial Board, Institute of Geology AS CR, v. v. i., Praha (since 1998).

PRUNER P.: Research Journal of Earth Sciences, IDOSI; Member of Editorial Board, © IDOSI Publications (since 2009).
Acta Universitatis Carolinae, Geologica, Member of Editorial Board, Praha (since 2000).
Geolines; Member of Editorial Board, Institute of Geology AS CR, v. v. i., Praha (since 1997).

ROČEK Z.: *Revija Biota. Revija za biologio in ekologijo.* Member of the Editorial Board, International journal, Društvo za proučevanje ptic in varstvo narave, Rača, Slovenia (since 2003).
RUDAJEV V.: *Acta geodynamica et geomaterialia*, Member of Editorial Board, Institute of Rock Structure and Mechanics AS CR, v. v. i., Praha (since 1990).
SKÁLA R.: *Journal of Geosciences*, Member of Editorial Board, International journal, Czech Geological Society, Praha (since 2005)
SVOJTKA M.: *Geolines*, Editor-in-chief, Institute of Geology AS CR, v. v. i., Praha (since 1996).
ŠTORCH P.: *Newsletters on Stratigraphy*, Corresponding Editor, International journal, Gebruder Borntraeger, Berlin, Stuttgart (since 1999).
Paleontological Contributions, Member of Editorial Board, Electronic Journal, University of Kansas, Lawrence (since 2008).
Bulletin of Geosciences, International journal, Czech Geological Survey, Praha (since 2001).
Geolines; Member of Editorial Board, Institute of Geology AS CR, v. v. i., Praha (since 1995)
ULRYCH J.: *Academia*, Member of Editorial Board, Academy of Sciences CR, Praha (2004–2009).
ZAJÍC J.: *Bulletin of Geosciences*, Member of Editorial Board, International journal, Czech Geological Survey, Praha (since 2001).
ŽÁK K.: *Bulletin of Geosciences*, Co-editor, International journal, Czech Geological Survey, Praha (since 2006).
Český kras, Co-editor (since 2008), Member of the Editorial Board (since 2007), regional journal published by the Museum of the Czech Karst, Beroun.

8b. Positions in International Organizations

BOSÁK P.: Honorary Member, the UIS Bureau, the International Union of Speleology (UIS; elected in 2009)
Vice-President & Treasurer, the International Union of Speleology (UIS; 2005–2009)
Member, Advisory Committee, the International Union of Speleology (UIS; since 2009)
Member, Commission for Physico-Chemistry and Hydrogeology of Karst, the International Geographical Union (IGU; since 1978)
Member, Commission on Paleokarst and Speleochronology, the International Speleological Union (UIS; since 1986)
DAŠKOVÁ J.: Councillor, councillor of the Organization of Czech and Slovak palynologists in the International Federation of Palynological Societies (since 2008)
DRAHOTA P.: Vice-president, Joint SGA Student Chapter Praha-Freiberg (since 2002).
HLADIL J.: Commitee Member (voted), International Geoscience Programme of the UNESCO & IUGS – Czech National Committee for IGCP (since 1994)
Titular Member (voted), Subcommission on Devonian Stratigraphy of the IUGS (since 1993)
KADLEC J.: Co-ordinator for the Czech Republic, IGBP – PAGES Project (since 1998)
MIKULÁŠ R.: Czech representative, International Palaeontological Association (since 2006).
Working Group of the Treatise on Invertebrate Paleontology, Part W, Trace Fossils (since 2001).
SIBLÍK M.: Subcommission on Triassic Stratigraphy of the IUGS (since 1981, at present corresponding member)
SLAVÍK L.: Corresponding Member, Subcommission on Devonian Stratigraphy of the IUGS (since 1999)
ŠTORCH P.: Titular Member, Subcommission on Silurian Stratigraphy of the IUGS (since 2004)
ŽIGOVÁ A.: Member of Committee C – Soil and regolith morphology and genesis, Division on Soil System Sciences, European Geosciences Union (since 2006)

9. Institute structure and staff

In 2009, a slight change in the organization scheme of the Institute was adopted.

9a. Organization units

The research potential of the Institute is divided into 6 units:

1. *Laboratory of Geological Processes* extends the knowledge of temperature, pressure and time conditions of different stages of magmatic process in crustal and upper mantle settings as well as of the set of hydrothermal, low- and high-grade metamorphic processes. The evolution of sedimentary basins is studied with special reference to processes affecting the character of sedimentation and diagenesis, and to tectonic deformation of basin fills. Besides the employment of a classical set of geological, petrographic and geochemical methods, new, progressive laboratory approaches have been developed.
2. *Laboratory of Paleobiology and Paleoecology* develops in four principal directions. These comprise the study of living conditions and biostratigraphy of invertebrate fossil groups (conodonts, corals, brachiopods, echinoderms and graptolites), evolution of vertebrate groups (fishes and amphibians), palynology of Carboniferous and Cretaceous sediments, and paleoichnology in a broad stratigraphic range from the Ordovician to the Recent.
3. *Laboratory of Environmental Geochemistry and Geology* integrates the studies of chemical elements dynamics in environment with the geology processes, as they are recorded in sediments and soils formed during the Tertiary and Quaternary. Basic attention is paid to studies of complicated interactions between biotic and abiotic compartments of the nature, climatic oscillations and environmental changes in the past, and anthropogenic impact on the present natural processes.

4. *Paleomagnetic Laboratory* deals with paleomagnetism, magnetostratigraphy, mineral magnetism, geological interpretation of obtained data, and development of new laboratory techniques. Research is focused on a determination of basic magnetic and paleomagnetic characteristics of Phanerozoic terrestrial and extraterrestrial materials including high-resolution magnetostratigraphy, and environmental magnetism. Data interpretations encompass geotectonic, stratigraphic and paleogeographic synthesis including paleoclimatic and human-impact reconstructions.
5. *Laboratory of Physical Properties of Rocks* concentrates on the study of strain response of ultrabasic rocks to a dual regime of loading and the analysis of changes of acoustic emission and ultrasound permeability during sample loading. Ultrasonic sounding of rocks and changes of their elastic anisotropy under high pressure are also investigated.
6. *Laboratory of Physical Methods* represents service analytical unit.

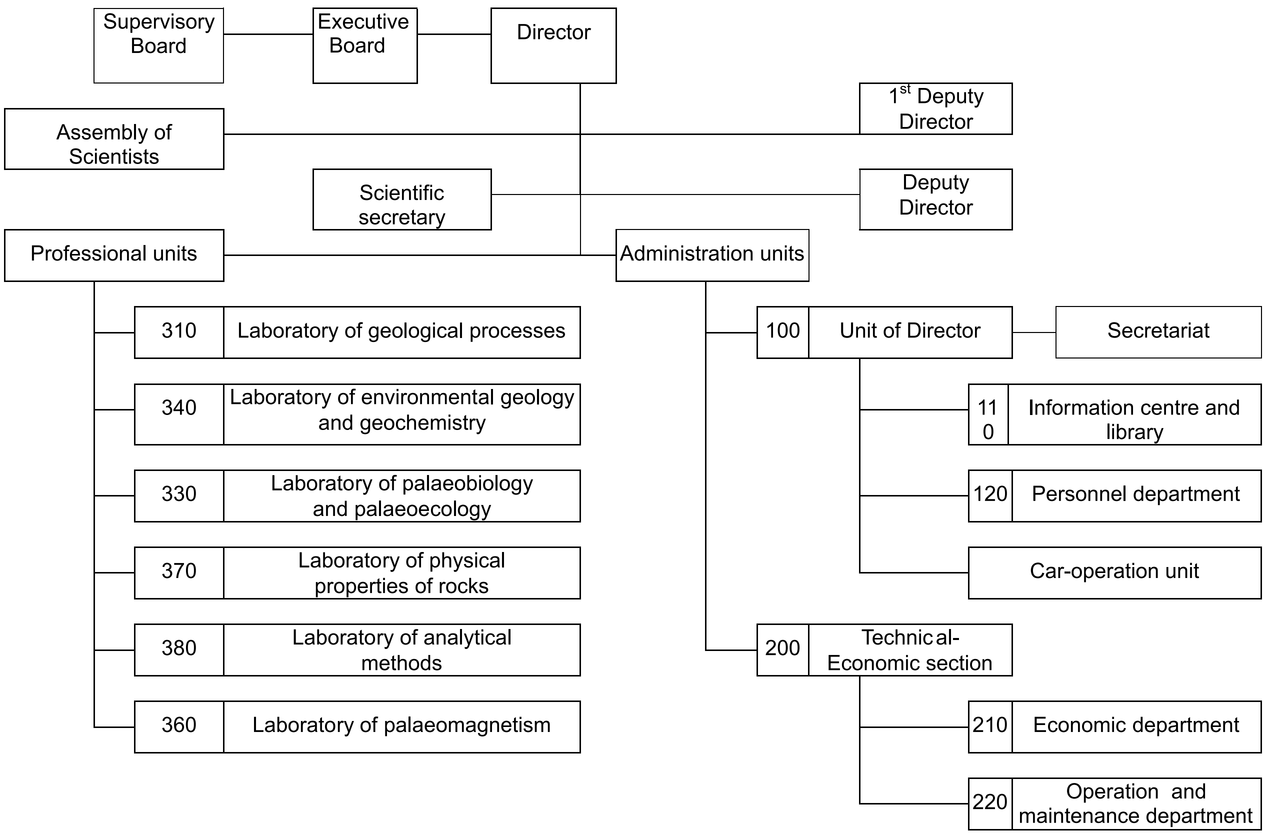
Specialized laboratories

Laboratories of the Institute are not independent units. They are incorporated within the structure of scientific and service departments. The following specialized laboratories have been set up:

1. Paleomagnetic laboratory (Head: Ing. Petr Pruner, DrSc.).
2. Micropaleontological laboratory (Heads: RNDr. Jiří Bek, CSc. & RNDr. Ladislav Slavík, CSc.).
3. X-ray and DTA/TG laboratory (Head: RNDr. Roman Skála, PhD.).
4. Electron scanning and microprobe laboratory (Head: Ing. Anna Langrová).
5. Laboratory of rock processing and mineral separation (Head: Václav Sedláček).
6. Laboratory for thin and polished sections (Head: Ing. Anna Langrová).
7. Laboratory of microscopy (Head: Mgr. Michal Filippi, Ph.D.).
8. Sedimentary laboratory (Head: RNDr. Anna Žigová, CSc.).
9. Fission track laboratory (Head: Mgr. Jiří Filip, CSc.).
10. Laboratory of liquid and solid samples (Head: RNDr. Jan Rohovec, PhD.).
11. LA–ICP–MS Laboratory (Supervised by Mgr. Martin Svojtka, PhD. & Mgr. Jan Rohovec, PhD.)
12. Clean Chemistry Laboratory (Supervised by Mgr. Lukáš Ackerman, PhD.)
13. Laboratory of rock behavior under high pressure (Head: RNDr. Vladimír Rudajev, DrSc.).
14. Laboratory of rock elastic anisotropy (Head: Ing. Tomáš Lokajíček, CSc.).

The scientific concept of the Institute and the evaluation of its results lie within the responsibility of the Executive Board that includes both the internal and external members. Besides research, staff members of the Institute are involved in lecturing at universities and in the postgraduate education system. Special attention is also given to presentation of the most important scientific results in the public media.

Organization chart



9b. Contact information

Information on the Institute of Geology is available on the Internet: http://www.gli.cas.cz

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9c. Staff (as of December 31, 2009)

Advisory Board

RNDr. Jiří Rákosník, CSc. (Head Office AS CR) . . . . Chairman (until October 20)
Prof. Jiří Chýla, CSc. . . . . Chairman (from October 20)
Doc. Ing. Petr Skřivan, CSc. . . . . Vice-Chairman
Prof. Ing. Jiří Čtyroký, DrSc. (Scientific Council AS CR) . . . . Member
Prof. Jiří Pešek, DrSc. (Faculty of Science, Charles University, Praha) . . . . Member
Doc. Ing. Richard Šňupárek, CSc. (Institute of Geonics AS CR, Ostrava) . . . . Member

Executive Board

Prof. RNDr. Pavel Bosák, DrSc. .... Chairman
Vice-Chairman: RNDr. Václav Cílek CSc. .... Vice-Chairman
Ing. Ottomar Gottstein, CSc. .... Member
Ing. Petr Pruner, DrSc. .... Member
RNDr. Vladimír Rudajev, DrSc. .... Member
RNDr. Marcela Svobodová, CSc. .... Member
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RNDr. Jan Krhovský, CSc. (Ministry of Environemtn of the Czech Republic) .... Member
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Prof. RNDr. Pavel Bosák, DrSc. .... 1st Deputy Director

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Marcela Nováková (assistant to the Director, international exchange)

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Scientific laboratories

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Scientific Staff:
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Mgr. Leona Koptíková – Deputy Head (sedimentary petrology, metasediments, magnetic susceptibility)
Mgr. Lukáš Ackerman, Ph.D. (geochemistry, mantle petrology)
RNDr. Karel Breiter, PhD. (petrology, mineralogy)
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Ing. Jiří Fiala, CSc. (petrology and structure of lithosphere, western and northern
Mgr. Jiří Filip, CSc. (fission track dating)
Doc. RNDr. Jindřich Hladil, DrSc. (basins in orogens, terranes, carbonate sediments)
Mgr. Tomáš Hrstka (petrology)
RNDr. Miloš Lang, CSc. (igneous petrology, mineralogy)
Mgr. Lenka Lisá, PhD. (Quaternary sedimentology)
prom. geol. Jiří Novák, CSc. (petrology)
Mgr. Jiří Sláma (metamorphic petrology, isotope dating)
Mgr. Martin Svojtka, PhD. (petrology of deep crustal rocks, fission track methods, geochronology, geochemistry)
Doc. RNDr. Jaromír Ulrych, DrSc. (igneous petrology, geochemistry)

Technical Staff:
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Josef Forman (topography, geodetic maps, GPS)
Ing. Jaroslava Pavková (secretary, technician)
Jana Rajlichová (technician)
Sedláček Václav (technician)

Laboratory of Palaeobiology and Palaeoecology

Scientific Staff:
RNDr. Marcela Svobodová, CSc. – Head (Cretaceous palynology)
RNDr. Radek Mikuláš, CSc. – Deputy Head (ichnofossils)
RNDr. Jiří Bek, CSc. (Devonian and Carboniferous spores)
RNDr. Petr Čejchan, CSc. (paleoecology, Radiolaria, mazuelloids)
RNDr. Stanislav Čermák, Ph.D. (Cenozoic vertebrate paleontology, small mammals)
Mgr. Jiřina Dašková (Cenozoic palynology)
prom. geol. Arnošt Galle, CSc. (Devonian corals and paleogeography)
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RNDr. Petr Štorch, DrSc. (graptolite stratigraphy, stratigraphy in general, sedimentary sequences, paleogeography)
RNDr. Milada Vavrdová, CSc. (Proterozoic, Paleozoic and Mesozoic palynology and plankton)

Mgr. Jan Wagner (Cenozoic vertebrate paleontology, large mammals)
RNDr. Jaroslav Zajíc, CSc. (Carboniferous and Permian vertebrates and stratigraphy, acanthodians)
RNDr. Jiří Žítt, CSc. (Cretaceous and Tertiary paleoecology and sedimentology, echinoids and crinoids)

Technical Staff:
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Vávrová Bronislava (secretary, technician)

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Tereza Nováková (chemical analyst)
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Laboratory of Palaeomagnetism
Scientific Staff:
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prom. fyz. Otakar Man, CSc. (geophysics)
Mgr. Petr Schnabl (geophysics)
Mgr. Filip Stehlík (paleomagnetism)
Mgr. Stanislav Šlechta (geophysics)

Technical Staff:
Jana Drahotová (technician)
Ondřej Marek (technician)
Jiří Petráček (technician)
RNDr. Daniela Venhodová (technician)

Laboratory of Physical Properties of Rocks
Scientific Staff:
RNDr. Vladimír Rudajev, DrSc. – Head (geophysics, seismics, geomechanics)
RNDr. Roman Živor – Deputy Head (geomechanics)
Ing. Tomáš Lokajíček, CSc. (rock elastic anisotropy)
Mgr. Matěj Petružálek (geophysics, acoustic emission analysis)
Mgr. Tomáš Svitek (geophysics)
Doc. RNDr. Jan Vilhelm, CSc. (geophysics)

Technical Staff:
Zdeněk Erdinger (technician, rock cutter)
Julie Erdingerová (technician)
Vlastimil Filler (technician, electrician)
Miroslav Grusman (mechanic)
Vlastimil Nemejovský (mechanic, technician, rock cutter)

Laboratory of Analytical Methods
RNDr. Roman Skála, PhD. – Head (X-ray and thermal analyses)
RNDr. Zuzana Korbelová – Deputy Head (microprobe and scanning microscope operator)
Ing. Anna Langrová (microprobe and scanning microscope analyst)
Ing. Vlasta Böhmová, PhD. (microprobe and scanning microscope operator)
Jiří Dobrovolný (X-ray and thermal analyses, technician)
Jaroslava Jabůrková (technician, grinding, preparation of thin/polished sections)
Ivana Konopáčová (preparation of thin/polished sections)

Foreign consultants
Prof. György Buda (Department of Mineralogy, L. Eötvös University, Budapest, Hungary)
Dr. Pavel Čepek (Burgwedel, Germany)
Prof. Petr Černý (Department of Earth Sciences, University of Manitoba, Winnipeg, Canada)
Prof. Jaroslav Dostal (Department of Geology, Saint Mary's University, Halifax, Canada)
Prof. Peter E. Isaacson (Department of Geology, College of Mines and Earth Resources, University of Idaho, Moscow, USA)
Dr. Horst Kämpf (GeoForschungsZentrum, Postdam, Germany)
Prof. Dr hab. Ryszard Kryza (Institute of Geological Sciences, Wroclaw University, Poland)
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Prof. Henning Sørensen (Geological Institute, University of Kobenhagen, Denmark)

Prof. John A. Winchester (Department of Geology, University of Keele, Great Britain)

Note: Czech scientific and pedagogical degrees are equivalents of:

Czech degree	Equivalent
Bc.	BSc, BA
prom. geol., prom. fyz., Mgr.	MSc, MA
RNDr., PhDr.	no equiv.
CSc.	PhD.
DrSc.	DSc
Doc.	Assoc. Prof.
Ing.	Dipl.-Ing.

Staff News

left:

Bronislava Vávrová (secretary, technician)	June 30
Pořtová Jana (secretary)	August 31
Vlasta Kaiserová (janitor)	December 31
Magdalena Čejková (janitor)	December 31
Václav Sedláček (technician)	December 31
Lang Miloš (scientist)	December 31
Ložek Vojen (scientist)	December 31
Vavrdová Milada (scientist)	December 31

joined:

Ondřej Marek (technician)	February 1

9d. Laboratories

The chapter summarizes the list of the most important laboratory equipment.

Paleomagnetic laboratory (Head: Ing. Petr Pruner, DrSc.)

The *Magnetic Vacuum Control System (MAVACS)* (1984) is a self-contained automatic system creating a limited space with the magnetic field eliminated i. e. a non-magnetic environment or magnetic vacuum. The operation of MAVACS is based on the feedback loop principle. The Earth's magnetic field is compensated for by the triaxial Helmholz Induction Coil System HELICOS. The resulting field difference is continually measured in each of its three axes by the Rotating Coil Magnetometer ROCOMA, which has its sensors installed inside the HELICOS. The output of the ROCOMA controls the Iduction Coil Control Unit ICCON, which supplies the HELICOS generating the compensating magnetic field. In this way the feedback loop is closed in all the three axes, thus securing a variation-free magnetic vacuum. The above mentioned factors formed the basis for the development of a system which creates a magnetic vacuum in a space of about 5 litres below a value of ± 2nT, the typical offset of the magnetic field sensor being smaller than ± 0.1nT. Multicomponent analysis of the structure of the remanent magnetization and reproduction of the palaeomagnetic directions even in rocks whose magnitude of secondary magnetization represents 97 to 99 % of the magnitude of natural remanent magnetization, can be achieved accurately with this system.

The *JR-6A* and two *JR-5A Spinner Magnetometers* (2002, 1997, 2003) – the most sensitive and accurate instruments for measurement of remanent magnetization of rocks. All functions are microprocessor-controlled.

The *KLY-3 Kappabridge*, *CS-23* and *CS-L Furnance Apparatus* (2000) – sensitive, commercially available laboratory instrument for measuring anisotropy of magnetic susceptibility (AMS) as well as bulk susceptibility and for measuring the temperature variation of susceptibility (from –190 to 700 °C).

Two *LDA -3 AF Demagnetizer* (2000, 2002) – the process is microprocessor-controlled and automated.

The magnetizing coil serves for the induction of the isothermal remanent magnetization.

The *AMU-1A Anhysteretic Magnetizer* (2003) is an option to the LDA-3 AF demagnetizer. This equipment permits the deliberate, controlled anhysteretic magnetization of a specimen.

The *KLF-4 magnetic susceptibility meter* (2004) is designed for rapid and precise laboratory measurement of magnetic susceptibility of rocks, soils, and materials investigated in environmental studies in weak magnetic fields ranging in their intensity from 5 A/m to 300 A/m.

755 SRM for Discrete Samples with Automatic Sample Handler and AF Degausser (2007).

Liquid helium-free Superconducting Rock Magnetometer (SRM), type 755 4K SRM (2007) – the set includes a measurement system, alternating field demagnetizer, three-layer permalloy degauss shield, automatic sample holder, electronic unit and software. Sensitivity of the dipole moment is lower than $1x10^{-12}$ Am^2 RMS for aperture size (sample size) of 4.2 cm. A system is including an automatic sample holder, permitting remanent magnetization measurement in three axes. Possibility of remanent magnetization measurement is without sample rotation.

Micropaleontological laboratory (Heads: RNDr. Jiří Bek, CSc. & RNDr. Ladislav Slavík, CSc.)

The laboratory of micropaleontology disposes of room for sample preparation with standard equipment and chemicals and laboratory of sample processing with renovated laboratory hoods and other usual equipment.

X-ray and DTA/TG laboratory (Head: RNDr. Roman Skála, PhD.)

PHILIPS X'Pert APD (1997) is an X-ray powder diffractometer used for phase composition and crystal structures investigations. The diffractometer is of theta-2theta type with moving detector arm. It is equipped with fixed divergence and receiving optics, secondary graphite monochromator and a point proportional counter.

DERIVATOGRAPH Q 1500 Monimex (1982, computerized in 1998) is the system for differential thermo-gravimetry.

No changes in the laboratory in 2009.

Electron scanning and microprobe laboratory (head Ing. Anna Langrová)

Microprobe CAMECA 100 (2002) is the central instrument of the Laboratory used mainly for local chemical analysis of solid geological materials. The microprobe is equipped by four crystal spectrometers and detectors for imaging in secondary and back-scattered electrons. The choice of spectrometer crystals makes the instrument capable of analyzing elements in the range from B to U from (thin-) sectioned and polished solid-state samples.

Microprobe JEOL JXA-50A (1972) was a predecessor of the CAMECA 100 instrument. It was used mainly together with EDAX (see below) for fast chemical analysis.

EDAX System PHILIPS (1996) was the energy dispersive system for fast local chemical microanalysis.

Accesory devices for preparation of samples include carbon coating devices and gold sputtering machine and they are crucial to keep the analytical laboratory running smoothly.

No changes in the laboratory in 2009.

Laboratory of rock processing and mineral separation (head Václav Sedláček)

Electromagnetic separator SIM-I (1968)
Electromagnetic separator (1969)
Laboratory table WILFLEY 13 B (1990)
Vibration processor VT 750 (1992)
*Crusher CD 160*90* (1991)
Laboratory mill RETSCH (1970)
Crusher ŽELBA D 160/3 (1999)
Mill SIEBTECHNIK (1995)

Laboratory of thin and polished sections (head Ing. Anna Langrová)

MINOSECAR (1962, 1970) is a cut-off machine with a diamond cutting wheel

DISCOPLAN (1990) is a precision cutting and grinding machine.

PEDEMOX PLANOPOL (1989) is a grinding and polishing machine

Montasupal (1977) is a grinding machine with a diamond grinding wheel.

DP.U.4PDM-Force (1993) is a lapping machine used with deagglomerated grinding powder (alumina) mixed with water before use.

No changes in the laboratory in 2009.

Laboratory of Microscopy (head Mgr. Michal Filippi, PhD.)

Laboratory of microscopy is used for the first (and free-of-charge) identification of the studied samples and for a detailed preparation for other more sophisticated methods. The equipment of the laboratory enable a photographic documentation of samples and also basic image analyses (for example in case of the thin sections). No changes in the laboratory in 2009.

Polarization microscope OLYMPUS BX51 with digital camera OLYMPUS DP70 equipped by X-ray fluorescence with wave-length filters; QuickPHOTO MICRO 2.2 software (2006)
Binocular microscope OLYMPUS SZX16 with digital camera OLYMPUS SP 350; software Deep Focus 3.0 (2007)
Binocular microscope OLYMPUS SZ51 (2007)
Microscope NIKON ALPHAHOT 2/HP (1995)
Polarization microscope AMPLIVAL ZEISS (1974)
Polarization microscope POLMI (1967)
Binocular microscope (1959)
Polarization microscope ORTHOPLAN Photometre LEITZ (1983)

Sedimentary laboratory (Head: RNDr. Anna Žigová, CSc.).

The laboratory is equipped with apparatus for preparing of samples and measuring of pH:

Analytical balance SETRA EL - 2000S (1999)
Muffle furnace VEB ELEKTRO BAD FRANKENHAUSEN (1984)
Laboratory dryer WST 5010 (1991)
Planetary mill FRITSCH (1986)
pHmeter pH 330 / SET (2000)
Ultrasonic cleaner TESLA (1985)

Fisson track laboratory (Head: Mgr. Jiří Filip, CSc.)

The laboratory develops fission-track dating analysis for determining the age and time-temperature evolution of minerals and rocks.

Analytical system for fisson track:

– Microscope *AXIOPLAN ZEISS* and Trackscan system *452110 AUTOSCAN* (1999)
– Microscope *ZEISS IMAGER M1m* and computer-controlled microscope stage *AUTOSCAN* (2008)

Polishing and grinding machine *MTH APX 010* (2003)

Laboratory of liquid and solid samples (Head: RNDr. Jan Rohovec, PhD.)

AAS Spectrometer VARIAN SpectrAA 300 (1991) lamps As, Be, Cd, Cu, Cr, Fe, Mn, Ni, Co, Pb, Sr, Zn, Rb, Ba+GTA96+VEA76
Analytical weights SARTORIUS Basic analytical (1992)
Filtration blocks B-2A Epi/FL (1996)
Analytical weights BALANCE 2000G (1999)
Decomposition unit PLAZMATRONIKA SERVICE S.C. (1995)
Set of vacuum lysimeters PRENART (1999)
ICP-EOS spectrometer Iris Intrepid XSP (2004)
Ultrasonic Nebulizer CETAC (2004)
Microwave digestion unit Mars, prod. CEM (2009) – with 8 fully equipped PTFE digestion vessels.
Mercury analyser AMA 254 (2008) – for analysis of ultra-low amounts of mercury and mercury speciation was acquired. The apparatus producted by PSAnalytical (England) is working on principle of fluorescence spectroscopy. It is equipped with single-purpose HPLC for various mercury containing species separation. The detection limit is about 0,1 ppt Hg. The apparatus is used for mercury monitoring in the environment. Identification of the mercury species present is considered to be an advanced analytical technique. Speciation analysis is performed after pre-concentration of Hg containing species and followed by separation on HPLC.

LA–ICP–MS Laboratory (Supervised by Mgr. Martin Svojtka, PhD. & Mgr. Jan Rohovec, PhD.)

The laboratory is equipped with high-resolution magnetic sector *ICP-MS* (2009; inductively coupled plasma – mass spectrometer) *ELEMENT 2* (ThermoFisher Scientific). An instrument has high mass resolution to access spectrally interfered isotopes and is used for: (1) multielement analysis (trace and major elements) across the periodic table covering a $mg.l^{-1}$ to sub $pg.l^{-1}$ concentration range, and (2) measuring of high-precision isotope ratios.

Element 2 is coupled with New Wave *UP213 LASER ABLATION SYSTEM* (2009) for analyzing solid samples and backup power system *UPS PW9355 POWERWARE* (Eaton).

Clean Chemistry Laboratory (Supervised by Mgr. Lukáš Ackerman, PhD.)

Laboratories for processing of samples destined for (ultra)-trace and isotopic analyses. Both labs are supplied with HEPA filtered air. One lab (class-100000 filtered air) is using for sample decomposition and labware cleaning. It contains 1 x fumehood designed for the work with strong acids. The other lab (class-10000 filtered air) is using for a clean chemistry (e.g. ion exchange chromatography separation, special chemical procedures for separation of certain elements) and final preparation of the samples for mass spectrometry (HR–ICP–MS, MC–ICP–MS, TIMS). It contains 2 x originally designed laminar flow hoods (class-100 filtered air), 1 x open laminar flow work space (class-100 filtered air), 1 x analytical weight (0.0000X g), 1 x device for the preparation of clean water (Millipore Elix 3 + Millipore Milli-Q Element) and 1 x centrifuge (2009).

Laboratory of rock behaviour under high pressure (Head: RNDr. Vladimír Rudajev, DrSc.) and
Laboratory of rock elastic anisotropy (Head: Ing. Tomáš Lokajíček, CSc.)

The research of the laboratory was focused on grant projects solving, on projects of international cooperation, training of undergraduate and graduate students and solving of special practical problems in terms of the industrial projects in 2009.

The new methods are developed for assessment of stability mechanically loaded rocks, for multichannel monitoring of seismoacoustic signals occurring during various loading regime. The special software programs are created for automatic pre-processing of acoustic signals and for processing of acoustic series. Processing of acoustic series is based on the correlation and fractal analysis.

Special unique apparatus for investigation of elastic anisotropy enables to measure in 132 independent directions. Obtained results are processed by form of isolines of P-wave velocities in the dependence on confining stress.

MTS815– PC controlled servo hydraulic rock testing system with high stiffness for compressive loading up to 4,500 kN (2004).
High pressure chamber for elastic anisotropy measurement under hydrostatic pressure up to 700 MPa (2000).
Electronically controlled high pressure generator *PG-HY-700-1270* (700 MPa; 2007)
Hydraulic press for uniaxial compressive loading up to 3,000 kN (1958) with conventional triaxial cell for confinig pressure up to 150 MPa (1990).
Hydraulic press for uniaxial compressive loading up to 300 kN (1960).
Hydraulic press for uniaxial compressive loading up to 100 kN (1965).
Rheological weight press for uniaxial compressive loading up to 500 kN (1974).
Rheological mechanical presses for uniaxial compressive loading up to 80 kN (1969).
Rheological weight presses for tensile loading up to 3 kN (1974).
Vallen AMSY-5 – multichannel acoustic emission system (2003).
Digital strain meters Hottinger (Centipede-100, UPM-40, UPM-60; 2003).
Permeability apparatus for measurement permeable and low permeable materials under constant hydraulic incline (2006).
Piezo-ceramics sensors for monitoring P and S wave in the wide frequency band.
Equipment for sample preparation (stone saw machines, drilling machines, grinding and milling machines) allows preparation of test samples (specimens) of various shapes (cubic, prismatic, cylindrical, spherical).

10. Financial Report

In thousands of Czech Crowns (CZK)

A. INCOMES		
1.	From the annual budget of AS CR	19 165
2.	From the Grant Agency of the AS CR (accepted research projects)	7 989
3.	From the Grant Agency CR (accepted research projects)	5 429
4.	From the internal research projects of the AS CR	31 990
5.	From other public sources	501
6.	Applied research	1 616
7.	Investment (instruments)	15 018
8.	Investment (constructions)	105 784
TOTAL INCOMES		187 492
B. EXPENSES		
1.	Scientific staff (wages, insurances)	37 974
2.	Research and scientific activities	18 750
3.	Administration and technical staff (wages, insurances)	1 197
4.	General expenses (postage shipping, maintenance of buildings, energies, transport, office supplies, miscellaneous, etc.)	7 382
5.	Library	699
6.	Editorial activities	264
7.	Investment (instruments)	15 018
8.	Investment (constructions)	105 784
TOTAL EXPENSES		187 068

Notes

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