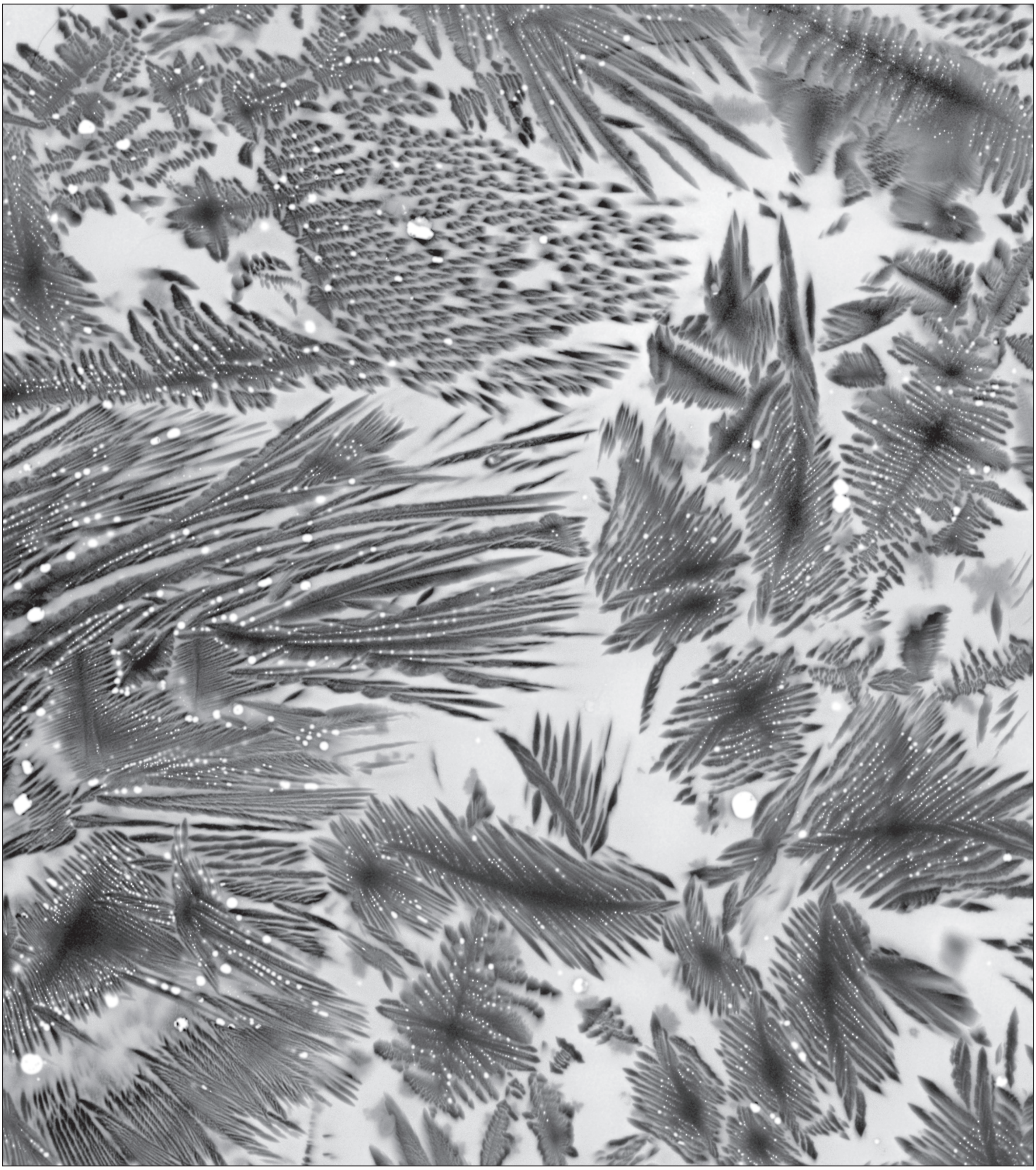
RESEARCH REPORTS 2011

Institute of Geology AS CR, v. v. i.



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Praha, January 2013

Cover photo: Lead-rich slag (silicate matrix with high lead content and white spots – a CuFeS alloy with 90 wt.% Pb) found in the slack-water sediments of the Litavka River (Příbram city area). A photomicrograph from the Tescan (Vega3) scanning electron microscope. Photo by Z. Korbelová.

2011

Research Reports

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The English version was kindly revised by J. Adamovič.

published in Prague,

January 2013

by the Institute of Geology

Academy of Sciences of the Czech Republic, v. v. i.

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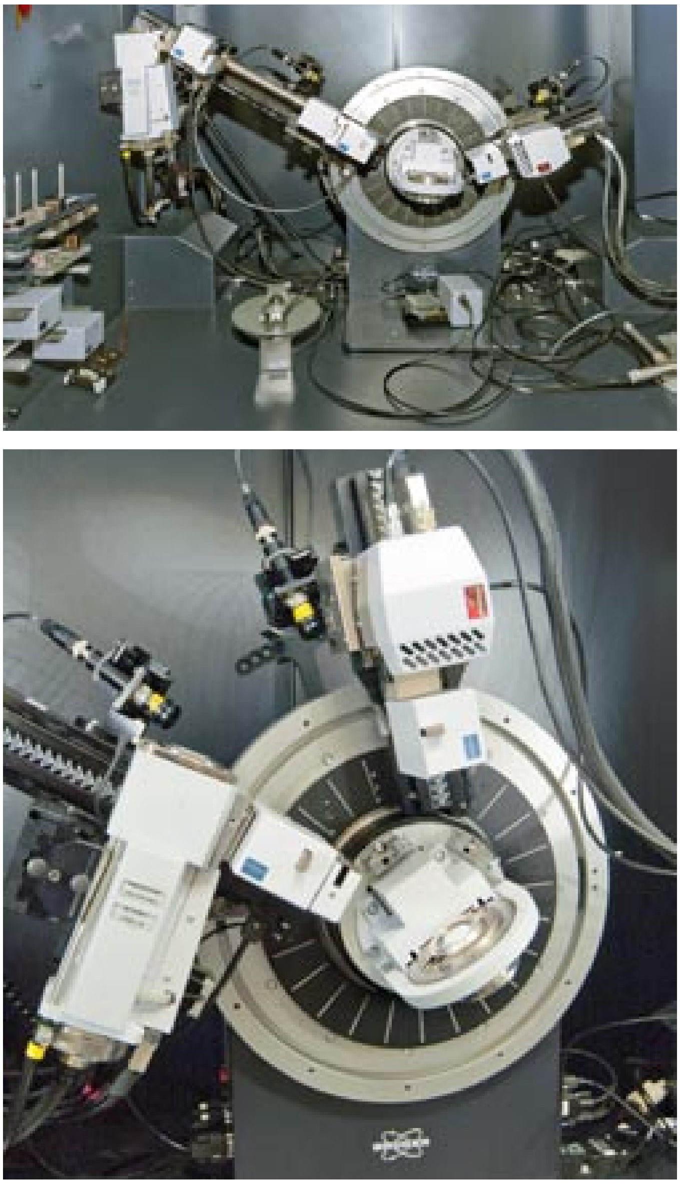
Introduction

The Institute activity was focused especially to the completion of the long-term Institutional Research Plan (2005–2011), which represented the main financial income of the institution. The number of research projects decreased due to the dissolution of the Grant Agency of the Academy of Sciences of the Czech Republic, the resources of which were partly re-directed to the Czech Science Foundation, now the principal provider of project financing in our state. Nevertheless, the publication activity of the Institute research staff was not influenced; the production of books, chapters in books and peer-reviewed articles remained still high with increasing value of article impacts. The autumn season was characterized by the elections of the new Executive Board (active as of January 4, 2012) and by the preparation of a tender for a new Institute director, as Dr. Václav Cílek decided to finish after 8 year in this position. We thank him for all his activities!

Pavel Bosák, Chairman of the Executive Board



■ Multipurpose X-ray powder diffractometer Bruker D8 DISCOVER with DAVINCI design and LynxEye silicon-strip position sensitive linear detector. In image on top to the left, the reflecting geometry setup with primary monochromator is shown. Note accesory parts including polycapillary assembly and collimators (racks to the left), capillary sample stage (left of the goniometer base plate), and part of XYZ-stage for micro-diffraction (bottom right corner). In image at the bottom to the right, the goniometer is converted to classic Bragg-Brentano reflecting geometry. In both images two lasers (slim black tubes) for sample positioning in micro-diffraction setup are identifiable (Photo by R. Skála).

2. General Information

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

The Institute of Geology of the ASCR, v. v. i., is a research institute belonging to the Academy of Sciences of the Czech Republic (ASCR). 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 ASCR, 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 the 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 ASCR, v. v. i., and the evaluation of its results lie within the responsibility of the Executive Board and Supervisory Board which include both the internal and external members. Institutional Research Plans are evaluated by the Committee for Evaluation of Institutional Research Plans of ASCR 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 the spread of the most important scientific results in the public media.

3. Publication activity of the Institute of Geology

3a. Journals

The Institute of Geology ASCR, 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 fields of geology (geochemistry, geochronology, geophysics, petrology, stratigraphy, paleontology, 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.

Volume GeoLines 23 (2011) "High-Pressure/Ultrahigh-Pressure Rocks in the Bohemian Massif" contains reviewed papers and also desription of localities focused on the recent research from high-pressure and ultrahigh-pressure rocks in Germany, Austria and the Czech Republic. Contributions were presented at the 9th International Eclogite Conference held in Mariánské Lázně, August 6–9, 2011. The content of special GeoLines volume is available on the website: *http://geolines.gli.cas.cz/index.php?id=223, pages 1–136, ISSN 1210-9606, ISBN 978-80-874443-03-3.*

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Andrzej ŹELAZNIEWICZ (Polish Academy of Sciences, Wroclaw, Poland)

Since 2000, the Institute of Geology ASCR, 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 rendered 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 2011, six issues (1 to 6) of Volume 62 were published with 41 scientific papers and short communications. For the contents and abstracts see *www.geologicacarpathica.sk*.

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3b. Monographs, proceedings, etc.

PŘIKRYL T. & BOSÁK P., (Eds., 2011): Research Reports 2009. – Institute of Geology ASCR, v. v. i.: 1–116.

4. Research Reports

4a. Foreign Grants, Joint Projects and International Programs

Bilateral co-operation between Czech Geological Survey, Praha and Geologische Bundesanstalt Wien, Austria: **Palynology of Lower Gosau-Subgroup of St. Gilgen village for explanatory text of Mondsee mapsheet** (H. Lobitzer, Geologische Bundesanstalt, Wien, Austria, L. Švábenická, Czech Geological Survey, Praha, Czech Republic & *M. Svobodová*; 2011)

Grey marls of the Lower Gosau-Subgroup exposed at the locality of St. Gilgen provided relatively well-preserved palynological assemblage with prevailing planispiral forms of chitinous microforaminiferal linings, dinoflagellate cysts tolerating the salinity changes, i.e. *Odontochitina operculata, Palaeohystrichophora infusorioides,* rare pteridophyte spores, gymnosperm pollen grains, and triporate pollen grains of the Normapolles group (*Complexiopollis microrugulatus, C. complicatus, C. christae, C. helmigii*). The composition of angiosperm pollen corresponds to the Middle-Late Turonian age as well as the finds of the stratigraphically important calcareous nannofossil *Lithastrinus septenarius* indicating UC 9a Zone (upper part of Middle Turonian to lower part of the Late Turonian, Burnett 1998). The paleoenvironment was warm and dry as evidenced by the presence of *Ephedripites* pollen and thick-walled pteridophyte spores. Numerous microforaminifers, dinocysts of *Odontochitina operculata,* acritarchs *Micrhystridium* sp. and calcareous nannofossils *Lucianorhabdus* and *Braarudosphaera* are significant for shallow marine settings.

BURNETT J.A. (1998): Upper Cretaceous. – In: BOWN P.R. (Ed.): *Calcareous Nannofossil Biostratigraphy*: 132–199. British Micropalaeontological Society, London.

Bilateral co-operation between CMRI Regional Centre, CBRI Campus, Roorkee, India and Institute of Geology of the ASCR, v. v. i., No. 6: **Assessment of micro-cracks in rocks using acoustic emission and ultrasonic techniques** (R. K. Goel, R. D. Dwivedi, A. Swarup, Central Mining Research Institute and Regional Centre, Central Bhabha Research Institute, Campus Roorkee, India, *T. Lokajíček* & *V. Rudajev*; 2009–2011)

The influence of thermal heating on P-wave elastic wave velocities, crack length and crack density measurement in granulite was tested. The study was carried out on a spherical sample gradually heated up to 600 °C. The original (unheated) granulite sample subjected to a confining pressure of up to 400 MPa shows fast crack closing from 0.1 MPa to 50 MPa. Above this pressure, low linear increase of P-wave velocities is observed in all directions. Similarly, the coefficient of anisotropy displays a fast decrease from 8 % to 2 % up to 50 MPa. Step-by-step thermal heating up to 600 °C and subsequent cooling cause a nearly linear decrease of P-wave velocities in the whole heating range. The maximum P-wave velocity decreases by about 47 % and the minimum P-wave velocity drops by about 52 %. The coefficient of anisotropy increases from 4 % to 19 %. Due to the thermal heating up to 600 °C, a change of elastic anisotropy symmetry is observed. The confining pressure loading of thermally degraded granulites, due to the crack closing, causes a significant increase in the P-wave velocity in all directions. At 400 MPa the velocity reaches nearly the values of the unheated specimen. It is only 3 % lower than the unheated specimen. The coefficient of anisotropy is also nearly the same, i.e., k=2 %, 400 MPa for an unheated specimen and k=3 %, 400 MPa, for a heated specimen. Thermal heating up to 600 °C of the granulites specimens is higher than alpha–beta transition of quartz at 573 °C and due to this fact anisotropy symmetry changes at atmospheric pressure could be explained by phase transition or by intragrain cracking of the material. The SEM analysis proved the linear increase of both crack length and crack density with temperature, starting from 30 °C. The change of elastic anisotropy properties (P-wave velocity, crack density) of thermally loaded rock materials starting from low temperature values (above 30 °C) is documented. The study of thermal heating is important in investigating the stability of underground engineering works, which form parts of nuclear waste and spent nuclear fuel deposits affected by temperatures much higher than 30 °C.

Bilateral co-operation between Institute of Geology of the ASCR, v. v. i., and State Nature Conservation – Slovak Caves Administration, Liptovský Mikuláš, Slovakia: **Dating of Karst Sediments – application to geomorphological analyses: case study from Belianská Cave** (P. Bella, State Nature Conservation – Slovak Caves Administration, Liptovský Mikuláš, Slovakia, *P. Bosák*, *P. Pruner* & *S. Šlechta*, M. Komar, Institute of Geological Sciences NAU, Kiev, Ukradne, H. Hercman, Institute of Geological Science, Polish Academy of Sciences, Warszawa, Poland; since 1997)

The reconstruction of multi-phased genesis of the Belianska Cave (northern Slovakia), based on cave morphology and its spatial relations, paleomagnetism, U-series dating and pollen analyses of cave deposits, provides some implications for the denudation chronology of landforms in the eastern part of the Belianske Tatry Mts. including evolution phases of the fluviokarst Biela River Valley entrenched in nappe structure composed of Mesozoic carbonates.

The vertical-horizontal multiple branched cave, with a length of 3,504 m and a depth range of 160 m, consists of two irregularly north–south-trending inclined branches. They are joined at the lower, northern part of the cave. Phreatic oval corrosion domes, halls and large inclined passages, with ceilings dissected by high cupolas, present the dominant morphological features sculptured by ascending deep phreatic waters (Głazek et al. 2004; Bella et al. 2007, 2010). Downward-inclined smooth facets (planes of repose), developed in the lower parts of the walls of halls and inclined passages, are additional morphological indicators for the genesis of major segments of the cave in calm and stagnant water conditions with an accumulation of insoluble fine-grained clastic sediments (Bella & Osborne 2008) as residues from solution of carbonates (Zimák et al. 2003; Głazek et al. 2004; Hlaváč et al. 2004; Kicińska & Głazek 2005). The main inclined cave branches are vertically dissected by several vertical and steeply sloping chimneys and shafts. Subhorizontal segments in the upper and lower parts of the cave developed during long-lasting phases of water-table lowering in the cave related to phases of entrenchment of the Biela River Valley (Bella & Pavlarčík 2002). Facets developed below lateral water-level notches, reflecting younger epiphreatic phases of cave development (Bella & Osborne 2008). Later, meteoric water inflows into the cave partially remodelled primary phreatic morphologies or formed some conduits hydrographically inclined to the palaeovalley of the Biela River. At present, meteoric waters seeping into the cave merge into occasional streamlets mostly at the bottom of shafts in the lower parts of the cave.

The cave was significantly filled with fine-grained clastic sediments, mainly during the phreatic phase of its development. These deposits were largely washed out during younger epiphreatic and vadose phases. Normal and reverse magnetized zones alternate in remnants of the sediments (Pruner et al. 2000; Pruner & Bosák 2001). Their magnetostratigraphy indicates an age older than 1.77 Ma (the upper boundary of Olduvai epoch), but the sediments can be related to Gilbert epoch (ca. 4.18–6.15 Ma). Speleothem crusts on the surface of some profiles are older than 1.25 Ma (Bosák et al. 2004). Palynospectra of Miocene and Lower Pliocene age are included in these speleothems. The age of subaerial speleothems deposited on the eroded surface of the fine-grained clastic sediments is approximately 4–5 Ma (Bella et al. 2007).

Some implications from the morphology and age of deposits in the Belianska Cave are relevant for the determination of tectonically dissected residues of planation surfaces in the eastern part of the Belianske Tatry Mts. and development of the Biela River Valley. The upper cave parts of phreatic origin reach 65–80 m below the small plateau below the top of Kobylí Hill at 1,080 m a.s.l. that presents a residue of mid-mountain planation surface (Sarmatian–Early Pannonian). In the central crest of Belianske Tatry Mts., residues of this planation surface have been tectonically uplifted at 1,850–2,000 m a.s.l. (Lukniš 1973) during the basic dome-like morphostructural formation of the Western Carpathians which began at 4–6 Ma (Minár et al. 2010). Before the main tectonic uplift of the Tatra Region, subhorizontal epiphreatic segments in the upper part of the cave, oscillated at 1,000–1,015 m a.s.l. (240–255 m above the present river bed), have originated along a piesometric surface and spring level of deep phreatic waters ascending along steep fault between the central and edge eastern part of the Belianske Tatry Mts., probably during the formation of submontane pediment (Pontian?). The development of younger phreatic and subhorizontal epiphreatic conduits in the lower part of the cave at 915 m a.s.l. (Upper Pliocene) and 890 m a.s.l. (Lower Pleistocene) is correlated with developmental phases of the Biela Valley. These outflow conduits, developed during phases of slight or interrupted entrenchment of the valley, occur 155 m and 130 m above the present river bed of Biela River.

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HLAVÁČ J., ZIMÁK J. & ŠTELCL J. (2004): „Jeskynní hlíny“ zpřístupněných jeskyní Nízkých a Belianských Tater. – *Výskum, využívanie a ochrana jaskýň: Zborník referátov zo 4. vedeckej konferencie, Tále 5.–8. 10. 2003*: 89–94. Správa slovenských jaskýň. Liptovský Mikuláš.

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PRUNER P., BOSÁK P., KADLEC J., VENHODOVÁ D. & BELLA P. (2000): Paleomagnetický výzkum sedimentární výplní vybraných jeskyní na Slovensku. – *Výskum, ochrana a využívanie jaskýň: Zborník referátov z 2. vedeckej konferencie, Demänovská Dolina 16. –19. 11. 1999*: 13–25. Správa slovenských jaskýň. Liptovský Mikuláš.

PRUNER P. & BOSÁK P. (2001): Palaeomagnetic and magnetostratigraphic research of cave sediments: theoretical approach, and examples from Slovenia and Slovakia. – *Proceedings, 13th International Speleological Congress, 4th Speleological Congress of Latin America and the Carribean, 26th Brazilian Congress of Speleology, Brasilia, July 15–22, 2001*: 94–97. Brasilia.

ZIMÁK J., ŠTELCL J., ZELINKA J. & HLAVÁČ J. (2003): Přirozená radioaktivita horninového prostředí Belianské jeskyně. – *Aragonit*, 8: 26–29.

Bilateral co-operation between Institute of Geology of the ASCR, v. v. i., and Karst Research Institute, Scientific Research Centre, Slovenian Academy of Sciences and Arts: **Palaeomagnetism and magnetostratigraphy of Quaternary cave sediments in Slovenia** (N. Zupan Hajna, A. Mihevc, Karst Research Institute, SRC SAZU, Postojna, Slovenia, *P. Pruner* & *P. Bosák*; since 1997)

Magnetostratigraphy data and the arrangement of obtained magnetozones by the team of N. Zupan Hajna, A. Mihevc, P. Bosák and P. Pruner often indicated ages of sediment fill over 1.77 Ma and lower age limit can be even over 5 Ma. Three principal periods of deposition of the cave fills in Slovenia can be distinguished as follows: a. sediments younger than 0.78 Ma; b. sediments dated from about 0.78 Ma up to more than 4.0 Ma (palaeomagnetic age); and c. sediments older than 1.2 Ma (numerical age)/1.77 Ma (palaeomagnetic age) up to or greater than 5.0 Ma (fission track data).

Caves containing sedimentary fill younger than the Brunhes/Matuyama boundary share a common and typical feature – some of them are still hydrologically active, with one or more streams flowing in the lower levels (e.g., Postojnska jama, Križna jama, Planinska jama). We therefore interpreted most of the sediments as being younger than 0.78 Ma, belonging to different depositional events within the Brunhes chron. This category includes also young depositional phase(s) in caves with older fills (e.g., Jama pod Kalom, Račiška pečina, Divaška jama).

The cave system of the Postojnska jama – Planinska jama and number of other smaller caves around contain rich and lithologically diversified cave fill, ranging from autogenic speleothems to allogenic fluvial sediments. Cave fill was originally expected not to be older than Mid Quaternary (i.e. about 0.4 Ma). Later numerical dating (Th/U and ESR) indicated ages older than 0.53 ka.

Palaeomagnetic and magnetostratigraphy data obtained by our research partly confirmed previous results, but indicated also a different age interpretations. Samples from most profiles were normal (N) polarized. Three short reverse (R) magnetozones (excursions) were detected only in places (Spodnji Tartarus). Data indicate that profiles of Spodnji Tartarus North, Pisani rov and Biospeleološka postaja show declination (D) and inclination (I) directions close to the present one (within the frame of 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 clockwise rotation since 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. Nevertheless, the N polarization in some profiles can be linked with older N polarized subchrons 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. from 1.77 to over 2.15 Ma). Several deposition and erosion phases alternated in the Postojnska–Planinska cave system as resulted from obtained data and field observations. Individual cave segments or passages were fully filled and exhumed several times during the cave evolution, as indicated, for example, by paragenetic features and remains of cemented sediments on walls and ceilings in the main passage of Stara jama or in other places, and different palaeomagnetic parameters (D, I). The deposition was not uniform throughout the entire cave at the same time. Repeated reworking and re-deposition of the same sedimentary material is typical for long, voluminous and complicated cave systems like Postojnska–Planinska system. Some passages underwent repeated flooding and deposition (e.g., Pisani rov).

In Križna jama we studied two paleontological excavations and profiles in the Medvedji rov to contribute the solution of dating of bone-bearing lithological horizons. The Križna jama I profile consist of alternation of speleothem layers (flowstone sheets with small stalagmites, sometimes with in situ cemented *Ursus gr. spelaeus* bones) and fine-grained siliciclastics often with bones of cave bear. It can be correlated with the upper part of the Križna jama II profile, but with slightly less preserved stratigraphic record. Radiocarbon and Th/U dates clearly indicate two different ages of cave bear thanatocenoses in the Križna jama I profile: those above flowstone crusts were dated to ca. 47–45 ka by radiocarbon dating; those included speleothem layers and clay interbeds are older than 94 ka (U-series date). According to the paleomagnetic parameters (prevailing N polarization), the deposition took place within the Brunhes chron (<780 ka). In total, four short-lived reverse excursions of magnetic field were discovered. According to U-series data, the upper one (profile I) might be correlated with the Blake excursion. The lower ones are older than ca. 190 ka and can be correlated with some of Jamaica-Pringle Falls, Namaku, Calabrian Ridge, Portuguese margin or Calabrian Ridge 1 excursions. Sediments in the studied profiles were deposited during the Last Glacial (Weichselian), Eemian interglacial, Saalian glacial and Holsteinian interglacial.There are also caves (e.g., Račiška pečina, Črnotiče II, Tajna jama, Markov spodmol) which contain a succession of detected ages in their sediments and part of the sediments are of less than 0.78 to about 2 Ma (palaeomagnetic ages); i.e. somewhere between the Brunhes/Matuyama boundary (and slightly younger) and the base of the Jaramillo and/or Olduvai subchrons (and slightly older). Dates from some parts of Postojnska jama (Male jame, Spodnji Tartarus – white sandstone) and Zguba jama do not allow more detailed age determinations.

Project of Joint Institute for Nuclear Research, Dubna, Russia, No. 04-4-1069–2009/2015: **Investigations of nanosystems and novel materials by neutron scattering methods** (*T. Lokajíček*, *V. Rudajev*, A. Nikitin & T. Ivankina, Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics, Dubna, Russia; 2009–2015)

Subproject 1: **Experimental and theoretical study of elastic wave field pattern in anisotropic texturized rocks**

The study of reflection and refraction of elastic waves on the interface between the isotropic and anisotropic media (or two anisotropic media) is an actual problem of deep seismic sounding and prospecting seismology.

This work focuses on the experimental verification of the theoretical calculations. The propagation of elastic waves was studied in bilayer sample, which is composed of isotropic and anisotropic parts. The plexiglas was chosen as an isotropic material. It allows simulate an isotropic media of different shape and size. Synthetic quartz and polycrystalline porous graphite were used as anisotropic materials. The velocity and the propagation time of elastic waves propagating through the bilayer sample were calculated. The calculations were carried out by solving the Christoffel equation and boundary conditions. We used two approaches: (1) the anisotropy of medium is described with one known anisotropy direction as the so-called "anisotropy vector" (Nikitin et al. 2010; Phan et. al. 2011) (2) classical approach, when the anisotropy of medium is described by a tensor (Nikitin et al. 2012a, b; Vasin et al. 2012; Phan 2012).

Crystallographic texture of polycrystalline graphite was measured by neutron diffraction using SKAT texture diffractometer at the reactor IBR-2 at JINR (Dubna, Russia).

The propagation time of ultrasonic waves between two resonant piezoelectric transducers was measured during the experiments (Institute of Geology ASCR, v. v. i., Prague). The transmitter was fixed in a certain point of the isotropic part of the sample, while the receiver was scanning the surface of the anisotropic part. The propagation time of the first-arrival wave (refracted quasi-longitudinal wave) was determined by a high-order statistics approach.

Theoretical calculations and experimental measurements show:

1. According to the theory of elasticity at the interface between the layers Plexiglas-Quartz and Plexiglas-Graphite, in general, we observe a splitting of the incident elastic waves into double reflection in the isotropic layer and a trirefringence in the anisotropic one.
2. It has been shown that, upon decreasing of the grazing angle of the incident elastic quasi-longitudinal wave at the interface between Plexiglas-Quartz, several body waves (refracted quasi-longitudinal wave and two quasi-transversal waves) transform into the surface waves.
3. Velocities of elastic waves refracted at the interface between Plexiglas-Quartz and Plexiglas-Graphite substantially depend on the grazing angle of the propagating elastic wave, as well as on the anisotropy (elastic property symmetry) of single quartz and polycrystalline graphite.
4. The predicted propagation times and velocities of elastic quasi-longitudinal waves passed through a bilayer sample sufficiently agree with the measured ones. This fact allows us to supplement the processing and interpretation of field seismic data with new characteristics.

NIKITIN A.N., IVANKINA T.I., KRUGLOV A.A., LOKAJÍČEK T., PHAN L.T.N. & VASIN R.N. (2010): Propagation of quasi-longitudinal and quasi-transverse elastic waves at an interface between isotropic and anisotropic media: theoretical and experimental investigation. – *Proceedings of XXXII General Assembly of European Seismological Commission. Abstracts. France, 2010*: 256. Montpellier.

NIKITIN A.N., VASIN R.N., IVANKINA T.I., KRUGLOV A.A., LOKAJÍČEK T. & PHAN L.T.N. (2012a): Peculiarities of the propagation of quasi-longitudinal elastic waves through the interface between isotropic and anisotropic media: theoretical and experimental investigations. – *Crystallography*, 57, 4: 611–620.

NIKITIN A.N., VASIN R.N., IVANKINA T.I., KRUGLOV A.A., LOKAJÍČEK T. & PHAN L.T.N. (2012b, accepted): Investigation of seismo-acoustic properties of specific polycrystalline materials to be used in nuclear reactors. – *Crystallography*.

PHAN L.T.N. (2012): Seismo-acoustic effects observed during the propagation elastic waves through layered isotropic and anisotropic media. – *Unpublished PhD Thesis*. JINR. Dubna.

PHAN L.T.N., IVANKINA T.I., KRUGLOV A.A., LOKAJÍČEK T., NIKITIN A.N. & VASIN R.N. (2011): Propagation of a quasi-longitudinal elastic wave at the interface between isotropic and anisotropic media: theoretical and experimental investigations. – *Stress and texture investigations by mean of neutron diffraction. Abstracts the International Conference (Dubna, June 6-9, 2011)*: 50. Dubna.

VASIN R.N., IVANKINA, KRUGLOV A.A., LOKAJÍČEK T., NIKITIN A.N. & PHAN L.T.N. (2012): Some experimental results of propagation of quasi-longitudinal elastic waves through polycrystalline porous graphite. – *Proceedings of the TulGU, Natural sciences series*, 32, 2: 151–163.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 575: **Pennsylvanian terrestrial habitats and biotas in southeastern Europe and northern Asia Minor and their relation to tectonics and climate** (International leader: C.J. Cleal, National Museum Wales, Cardiff, United Kingdom; International co-leaders: S. Opluštil, Charles University, Praha, Czech Republic, I. van Waveren, Naturalis Biodiversity Center, Leiden, Netherlands, M.E. Popa, University of Bucharest, Bucharest, Romania, B.A. Thomas, University of Aberystwyth, Aberystwyth, United Kingdom; Czech national coordinator: S. Opluštil, Charles University, Praha; Czech participants: J. Drábková, Czech Geological Survey, Praha,

P. Matysová, Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, Praha, J. Prokop, Charles University, Praha, J. Pšenička, West Bohemian Museum, Plzeň, I. Sýkorová, Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, Praha, Z. Šimůnek, Czech Geological Survey, Praha, S. Štamberg, Museum of Eastern Bohemia, Hradec Králové & *J. Zajíc*; 2010–2015)
Data for the special acanthodian database and the database of Permain and Pennsylvanian faunas of the limnic basins of the Czech Republic were collected and evaluated.

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 leader: A.C. da Silva, Belgium; international co-leaders: M.T. Whalen, USA, *J. Hladil*, D. Chen, China, S. Spassov, F. Boulvain & X. Devleeschouwer, Belgium; Czech group representative and organizer: *L. Koptíková*; Czech participants: *S. Šlechta*, *P. Schnabl*, *P. Čejchan*, *L. Lisá*, *P. Pruner*, *G. Kletetschka*, *T. Navrátil*, *M. Chadima*, *K. Šifnerová*, *L. Slavík*, *O. Man*, *J. Kadlec* & O. Bábek, Palacký University in Olomouc; 2009–2013)

Czech participants of the IGCP580 project took part and present their results at two international conferences: “IGCP 596 Opening Meeting in Graz, Austria, September 19–24” – the first conference of this year released IGCP project No. 596 where one of the scientific sessions was joint with IGCP 580. The second one was organized by Czech team and held at the Institute of Geology ASCR, v. v. i. in Prague in mid-October (12–18) – “The 2011 IGCP-580 Annual Meeting in Prague – The 2011 Miroslav Krs Conference: Time, Magnetism, Records, Systems and Solutions” (Fig. 1). A one-day conference field trip was directed to the development of the Silurian to Middle Devonian sedimentary sequences in the Prague Synform. Following field sampling campaign parallelly in the Prague Synform and the Moravian Karst (October 16–18) was realized during the meeting for participants to obtain comparative material to those obtained in the China and Belgium IGCP 580 meetings (2009, 2010). Field work in the Prague Synform was focused on the magnetic susceptibility sampling and gamma-ray measurements across the Lau event interval (Ludlow, Silurian), Frasnian–Famennian boundary and Devonian–Carboniferous boundary in the Moravian Karst. Pilot study on magnetic susceptibility logs of the Pragian–Emsian GSSP in Kitab (Uzbekistan) and Prague Synform strata and its long-distance stratigraphic correlation using dynamic time warping method (DTW) was realized in 2011. The respective paper is in review process now. A study of the Jurassic-Cretaceous boundary in the Pieniny Klippen Belt (Tatra Mts., Western Carpathians, Poland) continues, and a detailed study of magnetic, geophysi-

■ **Fig. 1.** Group photo of the participants of the “2011 Miroslav Krs Conference: Time, Magnetism, Records, Systems and Solutions, The 2011 Annual IGCP 580 Meeting” which was held in Prague during October 2011. More than 50 participants from 15 countries and 4 continents attended this meeting focusing on the use of magnetic susceptibility measurements and techniques across different scientific branches (photo by P. Lisý).

cal and geochemical properties of the rocks is in the final stage of preparation.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 596: **Climate change and biodiversity patterns in the Mid-Paleozoic (Early Devonian to Late Carboniferous)** (International leaders: P. Königshof, Germany,T.J. Suttner, Austria, I.A. Boncheva, Bulgaria, N.G. Izokh,Russia, Ta Hoa, Phuong, Vietnam, T. Charoentitirat, Thailand, J.A. Waters, USA, W. Kiessling, Germany; Czech participants: *L. Koptíková*, *J. Hladil*, *L. Slavík*, *P. Čejchan*, *P. Štorch*, *A. Galle*, O. Bábek, Palacký University in Olomouc, J. Frýda, P. Tonarová, P. Hanžl, J. Otava, P. Budil, S. Vodrážková, Czech Geological Survey, O. Fatka, P. Kraft, V. Kachlík & J. Kvaček, Charles University, Praha; 2011–2015)

This year launched a new IGCP 596 project focused on Mid-Paleozoic climate and biodiversity as well as climate changes. Two conferences were held in 2011. Two Czech participants took part in the "International Conference on Biostratigraphy, Paleogeography and Events in Devonian and Lower Carboniferous in memory of E.A.Yolkin, Novosibirsk, Russia, July 27–28, 2011 & SDS/IGCP 596 Joint Field Meeting, Ufa – Novosibirsk, July 20 – August 10, 2011" and presented one talk and one poster. Official Opening meeting was held in September 19–24 in Graz and the "state-of-the-art" of biodiversity, main goals and schedule of scientifc works in next years within this project were discussed. One abstract and a talk were given at this conference by Czech team.

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 a civilization influenced by climatic changes** (*V. Cílek*, *L. Lisá*, M. Bárta, Czech Institute of Egyptology Faculty of Liberal Arts, Charles University, Praha, Z. Sůvová, A. Pokorná, J. Novák, private sector, Czech Republic & A. Fahmy Faculty of Science, University of Helwan, Egypt; 2008–2011)

The research activities were due to the political unrest in Egypt in the last two years mostly oriented to Sudan, to the area of the 6th Nile cataract north of Khartoum, where a series of archaeological sites were found including very rich microregion with 20 documented Neolithic and Mesolitic sites including villages, graveyards and felsite mines. The research has concentrated on a paleoenvironmental analysis of the former lake basin in the hinterland of Nile and on the actual archaeological excavations. Geoarchaeological research was focused on the origin of lithic material – for the first time the brown microcrystalline felsite (rhyolite) that is one of the most common Neolithic materials of Sudanese Nile was found at *in situ* manufactures at the Nile banks. The Neolithic and Mesolithic excavations (burial mound, pit houses) discovered rich assemblages of molluscs, mammal and fish bones and vegetational remnants. The lake basin profile extremely rich in phytoliths was sampled and several new sites including Mesolithic burials were discovered. The detailed interdisciplinary research is likely to take several more years, but what seems to be clear at this stage is that a whole microcosmos of a Mesolithic/Neolithic densely inhabited landscape was dicovered alongside the large perennial lake basin. The excavations have continued in the springtime of 2012 (Czech Institute of Egyptology, Charles Univ.), and 28 Mesolithic skeletons together with aprox. 40 bone artefacts with geometric patterns and other lithic and environmental materials were transported to the Czech Republic as one of the largest ever recovered Mesolithic assemblages.

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

The project is a part of the long-term palynological and palaeobotanical research of the author in the tuffitic rocks of Carboniferous and Permian coal basins in the Czech Republic and China (e.g., Bek et al. 2008, 2009; Libertín et al. 2009a, b; Opluštil et al. 2009). Results of the research are well-known and were presented in the global scope. For example, famous international scientific journal Review of Palaeobotany and Palynology dedicated the whole issue to the work of the group of Czech palynologist and palaeobotanists in 2009. J. Bek was the co-editor of this special issue. Czech edition of the National Geographic published an article about this research. The results were also presented in 43 media outputs.

The fossilization of Carboniferous and Permian plants in tuffitic rocks is very exceptional and this type of *in situ* preservation is available only in the Czech Republic, China, Germany and partly in USA and Spain. The best preservation is in the Czech Republic and northern China. It was the reason why international collaboration between Institute of Geology ASCR, v.v.i. and Geological and Palaeontological Institute of Chinese Academy of Sciences was started several years ago (e.g., Bek et al. 2006; Feng et al. 2006; Wang et al. 2004, 2009a, b). The first results of the project were published by Wang et al. (2009a, b) and Bek & Libertín (2010) who described the first *in situ* record of important miospore species *Dictyotriletes muricatus* from cones of sphenophyllalean affinity.

Fossil forests buried in growth position are quite common in the Pennsylvanian successions. They usually occur on discrete horizons often associated with a certain type of facies thus indicating that their origin was related to particular environments and processes. Fundamental controls on the origin of these phenomena are related to rapid burial in a geological instant preserving the plant relationships in space and time and removing or reducing many taphonomical biases. Such conditions are achieved especially by crevasse splay deposition, earthquake-induced subsidence which catastrophically drops the vegetated area beneath the water table, rapid eustatic sea-level rise or permineralization of vegetation by hot springs or its burial by ashfalls proximal to volcanic centres. Particular mechanisms and their "products" differ in fidelity in which they preserve the ecosystem. One of the most reliable archives of fossil vegetation is provided by volcanic ash beds due to the fast burial which prevents the fossil record from any time averaging and transport from the place of growth thus generating real plant assemblages. Such taphocoenoses often preserve even subtle ecological details, e.g. lianas scrambling along trees or arachnids preserved on a cordaitalean leaves. Limited taphonomic bias makes these assemblages potential for the analysis of tree density, spatial heterogeneity, assemblage diversity, whole-plant reconstructions, plant interaction and other ecological parameters which can be rarely obtained from any other type of fossil records.

Data were obtained from about ~40 m² large excavation called "Sternberg Excavations 3 and 4" located about 100 m from the eastern edge of the former Ovčín open-cast mine and the former Jiří Mine, both close to Radnice in the Radnice Basin, western Bohemia. The purpose of our excavations was to expose the Bělka tuff bed and to study carefully its plant fossil content to obtain data for palaeoecological reconstruction of the buried plant assemblage. Therefore, between 1.5 and 2.5 m thick overburden composed of the Brousek Bed was removed down by an excavator to a level just above the Bělka Bed. Fossiliferous parts of the Brousek Bed were carefully split and searched for identifiable plant remains. These were collected for later comparison with plant assemblage buried *in situ* by volcanic ash of the Bělka Bed. The exposed Bělka surface was divided by a string into 1 m² units that formed an XY-coordinate system for accurate location of plant fossils. The tuff bed was then carefully quarried in about 10 cm thick slabs which were further split to find as many fossils as possible. Fossil remains found in each square unit were identified and their precise positions were drawn onto a sheet of a graph paper prepared for each square unit separately for each species. Special attention was paid to the contact of the Bělka Bed with the Lower Radnice Coal which preserves mostly plant litter in various stages of decay and therefore sometime difficult to identify. This is further obscured by thin muddy coating, which has to be washed out in the lab. In addition, 5 to 10 mm at the base of the Bělka Bed are usually full of fossils representing partly plant litter but mostly small herbaceous plants, which were buried soon after the onset of the volcanic ash fall. For the above-mentioned reasons, 2–3 cm thick blocks of the basal part of the Bělka were often taken and searched for fossils.

In the second step, material was prepared, fixed and re-determined if necessary, and results were used to upgrade the data in sheets of graph paper containing the localised graphical presentation of fossils found in the excavation. Subsequently all these data-containing sheets of the graph paper were scanned and redrawn in CorelDRAW. For each species a separate layer representing the whole excavated area was constructed. Small fragments or herbaceous plant remains were indicated by representative icons or hatch. Large specimens were redrawn from the photograph to the corresponding layer and square units. Information on height above the tuff base of each finding or group of findings and diameter of axis was finally added. Resulting graphical processing/treatment of field data served as a base for 3D reconstruction of the vegetation cover and interpretation/estimation of some ecological parameters of the plant assemblage, especially the density of vegetation, distribution pattern or life strategy. Some unusually complete specimens will be used to improve the whole plant reconstruction of the species, however, such studies will be published elsewhere. Although lycopsids possessed only little wood, their thick periderm ring had probably similar mechanical properties like more woody *Cordaites*. Therefore we used for these plants allometric equation for "woody" species. Another parameter, adopted from modern ecological studies is estimation of so-called minimal area, which is minimal area that can be considered as representing the plant assemblage and comprises all the characteristic species. The area is usually estimated using a graph where number of species is plotted against the quadrat area which is progressively doubled in size. As the area enlarges the number of species increases and the area where the curve becomes flat is considered as the minimum area. We estimated this parameter although our excavation was too small compared to the minimum area of modern forest assemblages, which usually varies between 200 and 500 m². To make this estimation more reliable we involved into this analysis also the results from five previous excavations which were done during 2002 and 2006. These previous excavations are grouped into two clusters some hundred metres apart. The Ovčín Excavation cluster consists of three adjacent Ovčín Excavations 1, 2, 3 and the Sternberg cluster comprises two adjacent excavations Sternberg Excavation 1 and 2.

Two excavations were done in the Czech Republic from 2009 to 2011. The first and very sucessful was located at famous Ovčín locality, Radnice Basin in 2009 and the second was at former Jiří Mine close to Radnice, Radnice Basin in 2011, both of them in western Bohemia with plant assemblages dated to about 300 Ma. The area of about 40 m² was uncovered during the two excavations. Several specimens of fossil plants were discovered including erected stems of arborescent lycopsids and calamites. Common were also arborecent cordaitalean trees. Sphenophyte plants were represented by calamites and sphenophylls with liana habit. Several types of ferns were found. Czech Carboniferous and Chinese Permian localities yielded different types of ferns. Localities of both countries are important especially from evolutionary view, because specimens of zygopterid ferns were found. Only one species of zygopterid ferns, *Corynepteris angustissima* was found during both excavations in the Czech Republic. Big fronds of this species were excavated for the first time and enabled the first whole-plant reconstruction of this species. Fertile fronds of different stages of maturity of *Corynepteris angustissima* belong to unique finds because such specimens are very rare in the global scope. This species occurred in an open forest or close to arborescent trees. It means that *Corynepteris angustissima* was a ground or voluble plant species. Only one type of zygopterid ferns was excavated in the Wuda locality, Inner Mongolia, China. It belongs to some new species of the genus *Nemejcopteris*.

Interesting is the comparison of arborescent forms of true ferns from both countries. Only one species, *Lobatopteris aspidioides* is known *in situ* within the volcanic horizon in the Radnice Basin. The situation is different in China because there are several taxa of these ferns. Such number of arborescent ferns at Wuda locality corresponds with the results of several palaeobotanists because there is a high increase in the number of these ferns at the Moscovian-Kasimovian boundary in a global scale.

A world-known result was the find of a new species of Carboniferous spider, because Carboniferous insects are preserved only very exceptionally. Another important result was the first description and demonstration of several plant levels in the Carboniferous tropical forests.

Excavation at the Wuda locality, Inner Mongolia, China was very rich and sucesssful. The area of about 75 square meters was excavated with the collaboration of Chinese colleagues. Permian tropical forest of the Wuda locality dates to about 280 Ma. Its plant assemblage is characterized by the occurrence of several types of ferns, progymnosperms, cordaites and sphenophylls. One of the most important achievements in the global scope was the specimen of a new species of a Permian scorpion.

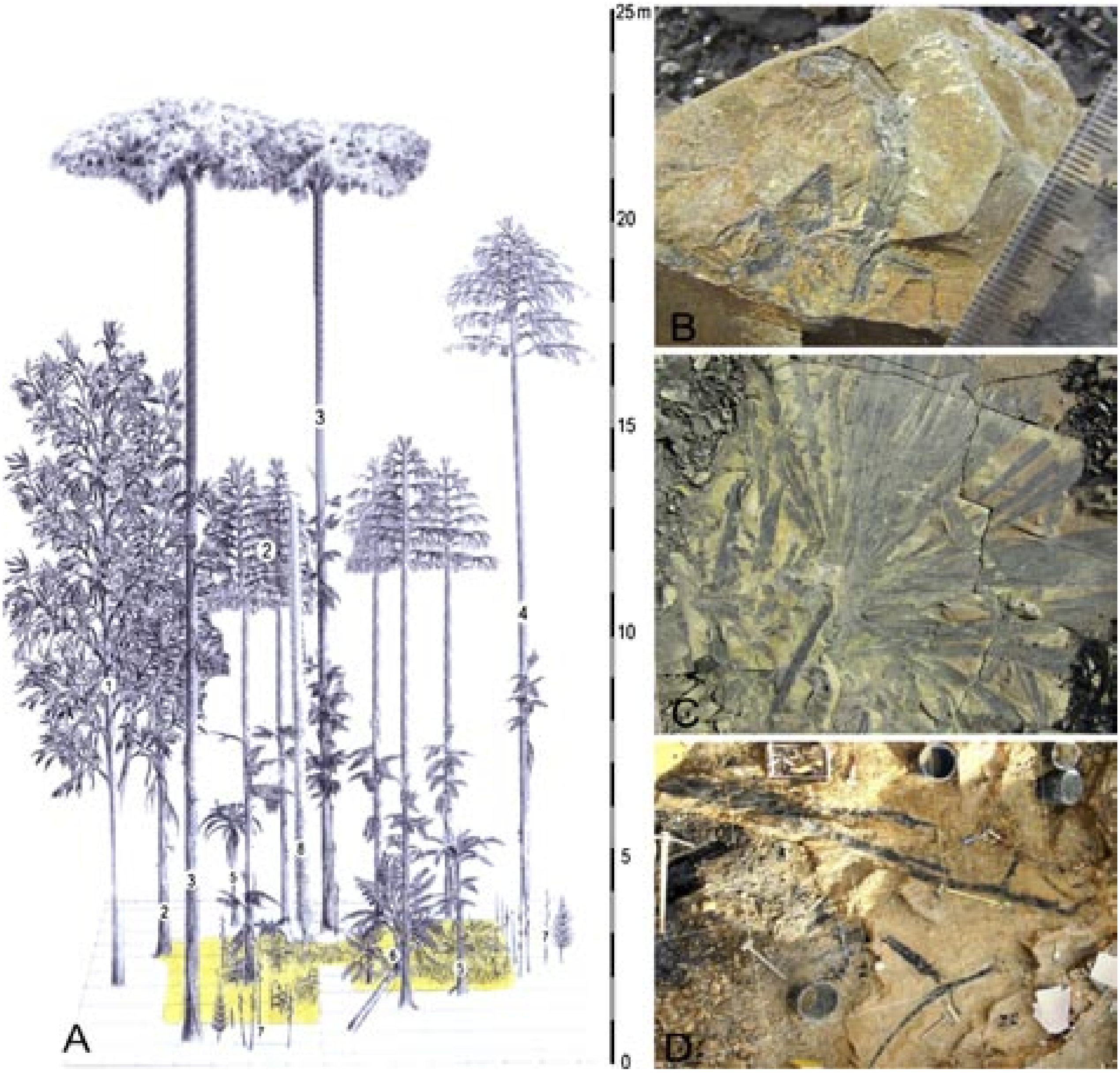
Two different plant assemblages were found in the Wuda Basin. A common feature is the occurence of progymnosperms but local differences exist in the representation of cordaites (mainly southern part) and arborescent lycopsids (mainly northern part). Interesting is that the fern genus *Senftenbergia* is shared in the Carboniferous of the Czech Republic and Permian of China.

Tab. 1 shows the list of plants found at the Ovčín locality in 2009. Fig. 2 represented cordaitalean leaves from the Wuda locality, Inner Mongolia, China found in 2011.

BEK J., DRÁBKOVÁ J., DAŠKOVÁ J. & LIBERTÍN M. (2008): The sub-arborescent lycopsid genus *Polysporia* Newberry and its spores from the Pennsylvanian (Bolsovian–Stephanian B) continental basins of the Czech Republic. – *Review of Palaeobotany and Palynology*, 152, 3–4: 176–199.

BEK J., FENG Z. & WANG J. (2006): Spores of Carboniferous sigillarians. – *Journal of Stratigraphy*, 31, 1: 14–17.

BEK J. & LIBERTÍN M. (2010): *In situ* reticulate sphenophyllalean spores Pennsylvanian (Bolsovian) of the Czech Re-



■ **Fig. 2. A.** A reconstruction of Carboniferous tropical forest at the Ovčín locality, Radnice Basin, Czech Republic. **B.** Permian scorpion from the Wuda Basin, Inner Mongolia, China. **C.** Cordaitalean leaves from the Wuda Basin, Inner Mongolia, China. **D.** A trunk, several metres long, and branches of Cordaites from the Wuda Basin, Inner Mongolia, China (original).

	Plant groups			Species	O1	O2	O3	S1	S2	S3
1	Lycopsida	Arborescent forms	Cone	*Flemingites sp.*			+	++	++	++
2				*Lepidostrobus sp.*	+		+	++	++	+
3				*Lepidocarpon majus*		+				
4			Stems	***Lepidodendron simile***	+	+	++	++	++	++
5				*Lepidodendron lycopodioides*	++	++	++	+		+
6				*Lepidodendron longifolium*					+	
7				***Lepidophloios acerosus***	+	+	+	++	++	+
8		Sub-arborescent forms		*Spencerites havlenae*	+	+	++	+		
9		Herbaceous forms		*Selaginella* cf. *gutbieri*		+	+			+
10				Herbaceous bisporangiate lycopsid					+	++
11	Sphenopsida	Calamites	Leafy shoots	*Asterophyllites longifolius*		+	+			+
12				*Asterophyllites equisetiformis*		+	+			
13				*Asterophyllites* cf. *grandis*	+	+	+			+
14				*Asterophyllites* sp.				+		
15				*Calamariophyllum sp.*		+	+			+
16			Cones	*Palaeostachya gracillima*	+	+		+		
17				*Palaeostachya distachya*	+	+	+			
18			Stems	***Stylocalamites sp.***	++	++	++	++	++	++
19				*Calamitina sp.(C.*cf. *goeppertii)*	+	+	+		+	
20		Sphenophylls		***Sphenophyllum* cf. *majus***	++	+	++	++	+	++
21				*Sphenophyllum pseudoaquense*	+		+	+	++	+
22				*Sphenophyllum cf. cuneifolium*			+			++
23	Filicopsida	Marattialean ferns		*Pecopteris aspidioides*	+	++	+	+	++	
24		Zygopterid ferns		***Corynepteris angustissima***	++	++	++	+	+	++
25				*Desmopteris longifolia*	++	+	++	+		+
26		Other ferns		*Hymenotheca sp.*	+		++	+		
27				*Hymenophylithes sp.*						+
28				*Senftenbergia plumosa*		+	+			
29				*Sonapteris bekii + S.* sp.	+					+
30				*Oligocarpia lindsaeoides, O.* sp.	+	+	+			+
31				*Sphenopteris sp.*				+		+
32	Pterido-spermopsida	Medullosalean pteridosperms		*Laveineopteris loshii*	++	++	+	++		+
33				*Laveineopteris* cf. *tenuifolia*						+
34		Lyginodendrid Pteridosperms		*Sphenopteris mixta*	++		++	+	+	++
35				*Mariopteris muricata*				++	+	+
36				*Palmatopteris furcata, Tetratmema*	++	+	++	+		+
37				*Sphenopteris spinosa*	+		+			+
38				***Eusphenopteris nummularia***	+	++	++	+	++	++
39	Progymnospermopsida			*Adiantites sp.*		+				
40	Cordaitopsida	Cordaites	Cones	*Cordaitanthus sp.*	+		+		+	
41			Seeds	*Cardiocarpus sp.*	+		+	+		+
42			Leaves	***Cordaites borassifolius***	++	+	++	++	++	+
43			Pith casts	*Artisia sp.*	+	+	+	+	+	+
Number of morphospecies				Excavations separately	27	26	32	24	17	29
				Excavation groups	36			27		29
Estimated number of biological species				Excavations separately	**20**	**18**	**22**	**18**	**13**	**23**
				Excavation groups	**24**			**20**		**23**
Area of sampling (m²)				Excavations separately	21	22.5	50	25	25	33.5
				Excavation groups	93.5			50		33.5

■ **Tab. 1.** The list of plants found at the Ovčín locality in 2009.

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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)

One paper, a chapter in a book, several abstracts and a description of localities in the special issue of GeoLines journal were published in 2011. The main topic of these outputs is the P-T reconstruction and geochemistry of high-pressure/ultrahigh-pressure rocks from the Bohemian Massif (Czech Republic).

Three equilibrium stages were identified for the Plešovice peridotite (Blanský les granulite massif, Moldanubian Zone). The temperature of Stage I was estimated at 1020 ±15 °C, using the Al-Cr orthopyroxene thermometer for orthopyroxene megacrysts. Stage II is defined by the spinel-garnet lherzolite assemblage in the matrix, and equilibrium conditions were estimated at 23–35 kbar and 850–1030 °C, based on the application of two-pyroxene thermometry, Grt-Cpx thermometry, Grt-Opx barometry, Grt-Cpx barometry and an empirical Spl barometer for Spl-Grt lherzolite. Stage III is defined by aluminous ortho- and clinopyroxene, aluminious spinel, amphibole, and phlogopite in kelyphite. Temperature conditions at stage III were estimated to be 730–770 (±27) °C at 8–15 kbar. The mineral assemblage in the multiphase solid inclusions (MSI) in spinel (?) is composed of phlogopite, dolomite, apatite and calcite with minor amounts of chlorite and magnesiohornblende. Crystallization conditions of the MSI assemblage were at relatively low-P and low-T ($T < 750$ °C; $P < 16$ kbar). The study of the MSI also reveals mineralogical evidence for precursor ultra-deep conditions (~6 GPa) for the Plešovice peridotite. Such minerals are carbon phases, including a micro-diamond grain obtained by various graphitic carbons.

■ **Fig. 3.** Layers of thin greenish garnet pyroxenite in the Bečváry garnet peridotite (photo by M. Svojtka).

Also multiple equilibrium stages were identified from garnet-rich gneiss at Ktiš in the Lhenice shear zone of the southern Bohemian Massif. Based on a combination of Grt-Bt and Grt-Crd geothermometers with Grt-Als-Qtz-Pl (GASP) and Grt-Crd geobarometers, we defined the following equilibrium stages: Stage 1, 1.5–2.3 GPa at 700–900 °C; Stage 2, 730–830 °C and 1.0–1.3 GPa;

and Stage 3, 740–850 °C and 0.6–0.8 GPa. Finally, the peak-T condition of the Ktiš garnet-rich gneiss in the Lhenice shear zone is intermediate between the HP-granulite of the Gföhl Unit and LP/HT metamorphic rocks of the Varied and Monotonous Units and studied rock experienced the HP-metamorphism in the early stage (Stage 1) represented by the growth of Grs-rich and phosphorus-poor core of garnet. The P-T conditions for the Stage 2 are slightly higher than the peak P-T conditions for gneisses of the Varied/Monotonous Units in the previously published papers. The inferred P-T conditions of the Ktiš gneiss, a model petrogenetic grid, and a pseudosection analysis suggest that the Ktiš gneiss experienced an isothermal decompression from the Grt rim stage (Stage 2, 1.0–1.3 GPa) to the matrix stage (Stage 3, 0.6–0.8 GPa). The gneiss shows an isothermal decompression or the decompression with cooling from Stage 2 to Stage 3.

We also presented *in situ* laser ablation ICP-MS trace element data for clinopyroxenes and garnets of selected pyroxenites from localities in the Gföhl Unit of the Bohemian Massif (Nové Dvory, Horní Kounice, Níhov, Bečváry and Horní Bory; Fig. 3). Significant differences in trace element concentrations exist among individual localities and also within the framework of lithological types of pyroxenites in one locality. Calculated REE compositions of hypothetical equilibrium melts for the studied pyroxenites show significant differences reflecting variable compositions of clinopyroxene and garnet. Although these melts show compositions of basalts in general, various REE patterns within different textural types of rocks at one locality point to its modification most probably by melt-rock reactions with peridotites.

Participation in a research project of the Institute of Nature Conservation, Polish Academy of Sciences, Krakow, No. NN306 522 738, Granted by the Polish Ministry of Science and Higher Education: **Phases of initiation and development of mass movements in Polish Flysch Carpathians in the Late Glacial and the Holocene, on the basis of speleothems and sediments in the non-karst caves** (W. Margielewski, J. Urban, Institute of Nature Conservation PAS, Krakow, Poland; M. Schejbal-Chwastek, AGH University of Science and Technology, Krakow, Poland & *K. Žák*; 2010–2013)

The phases of movement of landslides in Polish Flysch Carpathians are studied using a set of research methods applied on speleothems. In several lithologies of the flysch abundant carbonate cement in sandstones resulted in formation of usual types of speleothems also in non-karst caves. These caves are are formed by mass movements in the sandstone lithologies. These speleothems are commonly destroyed or inclined as a result of later phases of landslide movement. Speleothems are studied by a set of geochronological and geochemical methods, which enable determination of the chronology of landslide movements since the late Glacial until the present.

Bilateral co-operation between Institute of Geology ASCR v. v. i. and Russian Academy of Science (Institute for the History of Material Culture of Russian Academy of Science, Stone Age Archaeology Department), Sankt Peterborough, Russian Federation: **Cultural adaptations to natural (climatic) fluctuations in the Upper Palaeolithic of Eastern (Kostenki group) and Central Europe (Moravian group)** (A. Sinitsin, RAV, Sankt Peterborough, Russian Federation & *L. Lisá*; 2009–2011)

The cooperation is based on the interdisciplinary project including sedimentological, pedological (paleosols) and botanical (pollen record) research of the geological background, with comparison of zooarcheological and archaeological records from the same localities. The results will be used for broader interpretations of similarities of the climatic and environmental conditions during the Upper Palaeolithic of the Central and Eastern Europe. During the season of 2011, L. Lisá organized the stay of four Russian colleagues in the Moravian Musem who arrived to study Palaeolithic artefacts and lithics comparative with the Kostenki locality.

4b. Czech Science Foundation

Finished projects

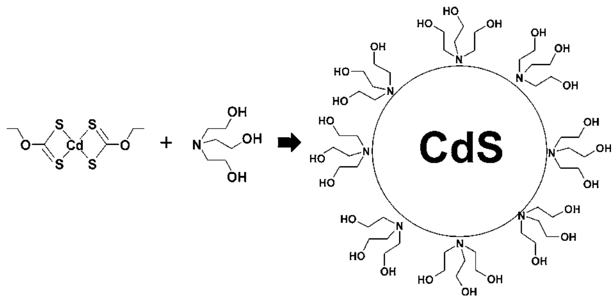
No. 202/09/1206: **Nanocrystalline heterogeneous photovoltaic solar cells** (F. Schauer, I. Kuřitka, P. Sáha, V. Křesálek, J. Vilčáková, Tomas Bata University in Zlín, Czech republic, J. Toušková, J. Toušek, I. Křivka, Faculty of Mathematics and Physics, Charles University, Praha & *J. Rohovec*; 2009–2011)

The project envisages to devise, but, before all, to optimize, 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 optimized absorption and transport properties will be needed.

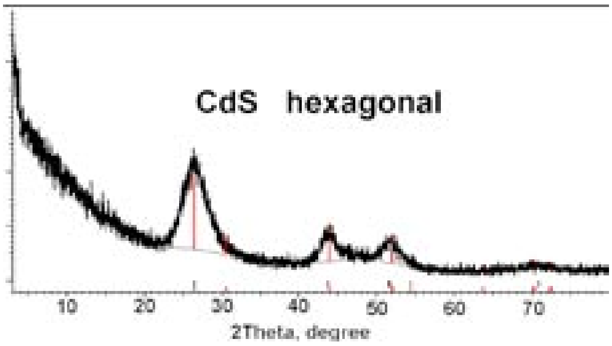
The main goal of the project is to optimize electron devices of radiation by means of the minimization of the loss of photons, successive photoexcited excitons and photogenerated charge carriers. The first step is to optimize the nanostructures (quantum rods, tripods and nets) used. The project aims 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.

A new material based on nanocrystaline cadmium sulfide was prepared by a new bench-top mild temperature procedure and characterized. The new nanocrystalline CdS-based material consists of a CdS nanoparticles in the hexagonal modification, being covered by a protective shell of alcoholamines, like diethanolamine DEA or triethanolamine TEA. The whole formation of the nanocrystalline material can be visualized by the reaction equation depicted in Figure 4.

The new material was characterized by various physical methods, like TEM microscopy, PXRD etc. According to the PXRD, the nanoparticles of CdS were obtained as the hexagonal modification. The PXRD signals are quite broad due to the



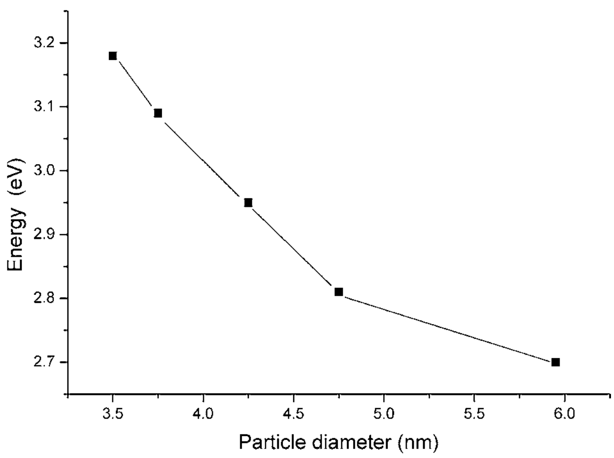
■ **Fig. 4.** Reaction scheme for the preparation of the CdS nanoparticle covered by protective shell of TEA molecules (original).



■ **Fig. 5.** PXRD of nano-CdS/TEA (original).

small particle size of the material. Only the most intense reflections were observed and indexed. An example of the PXRD record is shown in Figure 5.

Surface photovoltage method (SPV) was used for the evaluation of exciton diffusion length in MEH-PPV layers. TEM amd SPV techniques were applied to CdS nanoparticles synthesized by thermal decomposition of Cd-xanthates in TEA and Sigma-Aldrich CdS nanocrystals to evaluate the size of the nanoparticles. The results of SPV measurements are graphically presented in Figure 6. As the particle size increases, the band gap decreases sharply in the 3.5–4.5 nm range. The energy gap of the



■ **Fig. 6.** Nano-CdS particles studied by the SPV technique: dependece of the energy gap E (eV) on the nano-CdS particles diameter (nm) (original).

CdS particles of higher diameter also decreases, but to a smaller extent than for the smaller particles. The particle size/diameter was also studied by TEM microscopy. The TEM results obtained for particles suspended in water/ethanol mixtures are in accordance with the SPV results.

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 & O. Fatka, Faculty of Science, Charles University, Praha; 2009–2011)

Late Aeronian mass extinction of planktic graptolites recorded in the Barrandian area, Spanish Ossa Morena Zone and elsewhere was correlated with carbon isotope record and subtle changes in off-shore black-shale sedimentation. Combined signatures, which account for considerable fluctuations in sea-level, oceanic circulation and organic productivity/burial, are consistent with major palaeoenvironmental perturbation.

Correlation of the Radotín highway tunnel section (Štorch et al. 2009) with other upper Aeronian sections of the Barrandian area (Barrande's Colony Lapworth near Zdice, Zadní Třebaň, Nové Butovice, and Hýskov) revealed a striking similarity of graptolite assemblages and lithological successions including tiny details such as forms and abundance of sedimentary and early diagenetic pyrite. Basin-wide changes in lithology, calibrated with high-resolution intrazonal biostratigraphy and plotted with quantitative approach on graptolite faunal dynamics, shed new light on graptolite mass extinction called the *sedgwickii* Event and on subsequent recovery.

The Middle Aeronian *Pribylograptus leptotheca* and *Lituigraptus convolutus* graptolite biozones exhibit ecologically well ballanced, high-diversity graptolite faunas with a particularly low degree of dominance and high values of evenness indices. 33 species were described by Štorch (1999) from a single locality of the *L. convolutus* Zone at Tmaň near Beroun. The baseline extinction rate accelerated and diversity suddenly declined across the *convolutus*/*sedgwickii* zonal boundary (*Rivagraptus*, *Neodiplograptus* and most species of *Campograptus* and *Rastrites* became extinct). Some of the surviving taxa disappeared in the subsequent earliest part of the *sedgwickii* Zone (*Monograptus limatulus* group, *Pribylograptus*). Graptolite extinction coincides with subtle changes in black shale lithologies and initial positive shift in $\delta^{13}C_{org.}$ Siliceous black shales of the *convolutus* Zone are replaced by pyrite-rich and graptolite-poor black shale with lower TOC (ca. 3%).

The early part of the *sedgwickii* Zone saw further turnover of the graptolite taxa. *Campograptus* gave origin to *Stimulograptus sedgwickii*, the lowest occurrence of which defines the formal base of this zone. Torquigraptids proliferated as *Torquigraptus decipiens*, and *T.*? aff. *cerastus* were replaced by *T. magnificus*, *T. pulcherrimus* and *T. circularis*. *Normalograptus* (*N. scalaris*), the last representatives of ancorate *Petalolithus* (*Pet. clandestinus*) and those of the *Rastrites peregrinus* lineage (*R. gracilis* Přibyl) are still important elements of this assemblage. The unancorate *Parapetalolithus* (*Parapet. praecedens*) first appears in the uppermost part of this interval. Graptolite diversity decreased to 23 species if counted for the whole lower *sedgwickii* Zone. Diversity recorded for individual sampling levels dropped still more significantly. A low degree of dominance accounts for persisting stable conditions whereas conspicuously low graptolite abundance, generally lower but fluctuating TOC, and high pyrite content indicate changing conditions such as primary organic productivity and oceanic circulation. Palynological analysis failed due to the lack of adequately preserved organic-walled microfossils.

In the middle *sedgwickii* Zone a major sea-level drawdown can be inferred from silty-sandy sedimentation and/or temporary nondeposition. Heavily bioturbated bed of micaceous siltstone appeared along with the TOC fluctuations and a strong positive $\delta^{13}C_{org}$ excursion with a peak shift of more than 7 ‰. Some part of the $\delta^{13}C$ excursion may not be preserved in the Radotín tunnel section due to a possible stratigraphic break associated with the siltstone. A siltstone bed encountered in the Radotín-tunnel and Nové Butovice sections occurs at the same level as a further change in the graptolite fauna.

The level with $\delta^{13}C$ excursion is overlain by micaceous black shale characterized by a rapid return to moderately elevated $\delta^{13}C_{org}$ values, particularly high TOC (up to 7 %), and rapid proliferation of the graptolite assemblage with low species richness and high evenness. Graptolites become abundant in this upper part of the *sedgwickii* Zone but bedding plane assemblages are commonly dominated by two species (*St. sedgwickii* and *Metacl. undulatus*), both persisting from the lower part of the *sedgwickii* Zone. Extinction and speciation rates are low in this interval and overall diversity declined further to 17 species. The uppermost *sedgwickii* Zone saw the third positive shift in $\delta^{13}C$ before its return to baseline values. Low species richness and high evenness of the fauna continued through much of the *Lituigraptus rastrum* Biozone recognized by Štorch & Frýda (in press). Graptolite assemblages are dominated, for the most part, by one or two species (*Metacl. undulatus* and *L. rastrum*).

A detailed insight by Štorch & Frýda (in press) into the graptolite crisis known as the *sedgwickii* Event (Melchin et al. 1998) revealed a substantial reorganization of the graptolite fauna with taxonomic impoverishment and concomitant increase in species dominance rather than a sudden collapse of the pre-extinction assemblage. Associated changes in lithology, TOC and the pronounced, possibly tripple $\delta^{13}C_{org}$ excursion suggest a relatively extended and multi-phase period of stressed conditions which affected the pelagic realm inhabited by graptolites in the course of the late Aeronian. Eustatic sea-level drawdown, temporarily weakened sea-floor anoxy and perturbation to carbon cycle and palaeobiodiversity are consistent with the conception of short-term glaciation centered in the South American part of Gondwana. Temporary weakening of the oceanic anoxia in the upper Aeronian may be attributed to better circulation of well-oxygenated waters due to greater palaeolatitudinal temperature gradient. Its effect is coupled with a higher siliciclastic input in many offshore and basinal environments and nondeposition elsewhere due to glacio-eustatic sea-level drawdown. Positive carbon isotope excursion, temporally more extended, has been recorded in the *sedgwickii* Biozone also in Dob`s Linn, Scotland and Cornwallis Island of Arctic Canada (Melchin & Holmden 2006). Recent studies carried out in less condensed outer-shelf succession in Nova Scotia, Canada revealed triple excursion resembling pattern recognizable in the Barrandian area (Melchin et al. 2011). The likely scenario is complex, and more fossiliferous sections with preserved carbon isotope record are needed for its elaboration and high-resolution chemostratigraphic correlation.

Barren mudstones which separate the black shale of the *rastrum* Zone from that of the *linnaei* Zone of the lowermost Telychian hide the subsequent recovery interval in the Barrandian area. Graptolite assemblages sub- and suprajacent to the barren mudstone, when correlated with coeval successions of Wales (after Loydell 1991) and Spain (current research), suggest that the boundary interval of the *halli* and *guerichi* zones is barren of graptolites in the Barrandian area. Only four graptolite species were found both below and above the mudstone in the Radotín-tunnel section. The first black shale intercalation above the mudstone hosts higher-diversity and lower-dominance assemblages, composed for the most part of likely descendants of the taxa recorded from the upper *sedgwickii* and *rastrum* zones. Surprisingly, a significant graptolite radiation probably commenced during the course of the more oxic sedimentation of this barren mudstone.

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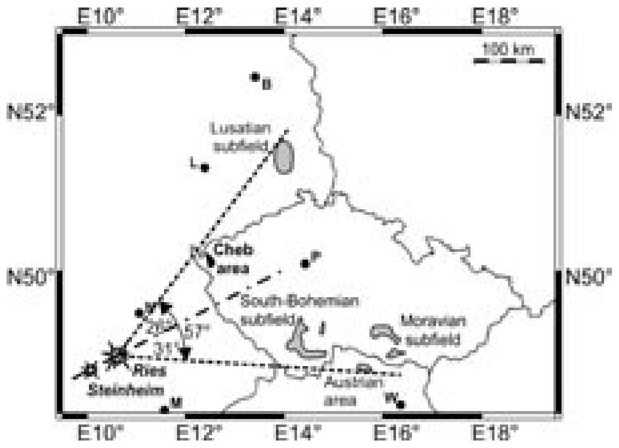
No. 205/09/0991: **Origin of moldavites – complex geochemical study** (J. Mizera, Z. Řanda, V. Havránek, J. Kučera, Nuclear Physics Institute, Řež, Czech Republic, *R. Skála*, *K. Žák* & *A. Langrová*; 2009–2011)

Moldavites belong to a group of natural, silica-rich, reduced, and dry glasses (tektites) produced by the Ries impact event at ~14.5 Ma. They occur in discrete, regionally limited areas (substrewn fields or partial strewn fields) in southern Bohemia, western Moravia, northern Austria, the Lusatia region in Germany, and in the Cheb Basin in western Bohemia (Fig. 7). Possible redistribution of moldavites from their original strewn fields by fluvial processes was tested through the study of metallurgical slag pebble size in the channel of the Berounka River, Czech Republic. Data show that the fluvial transport of moldavites along river bottoms is improbable for distances longer than several tens of kilometers. Nevertheless, individual moldavites can be transported over longer distances, either incorporated in floating ice, or with floating trees during flood events (Žák 2009).



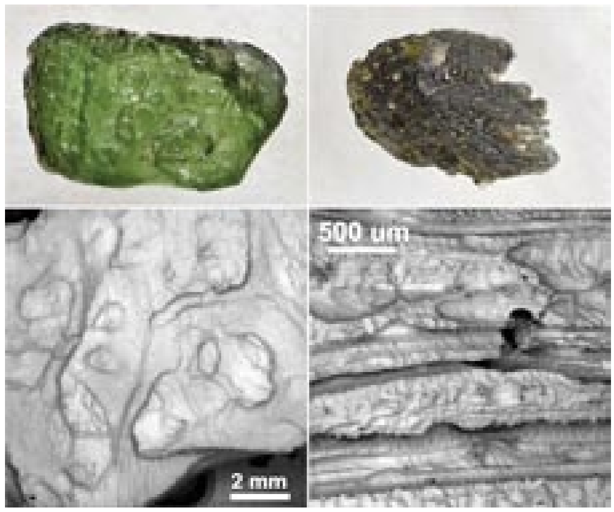
■ **Fig. 7.** The distribution of moldavite finds within the Central European Tektite strewn field (original).

For the purpose of the project, a representative set of 160 samples of the moldavites – covering the main parts of the Central European tektite strew field – was gathered. The set was for comparative purposes supplemented with samples of tektites and impact glasses from the distal impact glass strewn fields in other parts of the world. In addition to tektites, also a unique collection of samples of potential source materials for moldavites consisting of various sedimentary lithologies from localities both outside and inside the Ries crater was collected.

Moldavites were first characterized and documented megascopically. Subsequently, they were divided into several pieces for different analytical methods. Part of the material was used for the preparation of polished thin sections. These sections were prepared to allow potential subsequent analysis using LA-ICP-MS; their thickness was 400 µm. Thin sections were studied by polarizing microscope to yield information on internal fabric, presence, density and shapes of bubbles, lechatelierite (silica glass) inclusions, schlieren as well as to merely test overall homogeneity of the sample. Parts of the samples were crushed and ground and then prepared for chemical activation analyses. Remaining material is being kept for potential future research.

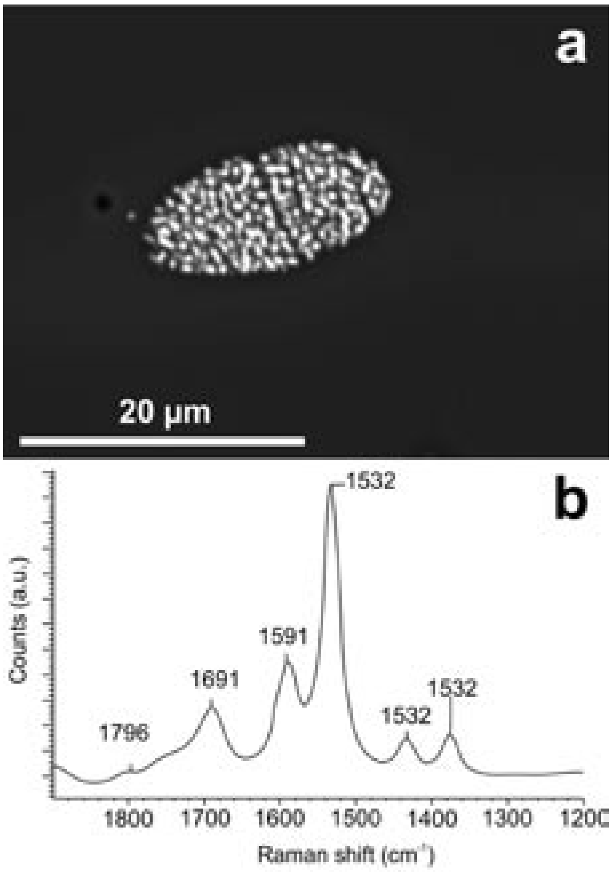
Color belongs among basic characteristics of moldavites. However, the perception of the color is highly subjective. Formerly, an attempt has been made to evaluate the color of moldavites in reflectance spectra and to develop the special comparative color scale. However, only two such scales were available making the method of color evaluation cumbersome. Also this approach does not account for thickness of the material which may obliterate the color significantly. We adopted the different approach measuring transmission spectra from polished thin sections. Subsequently these spectra were recalculated to CIE La*b* color space and statistically evaluated. Quantitative characterization of color distribution among 86 moldavites showed seven distinct groups which fairly correlated with regions where they were collected. This number is also in fair agreement with previously empirically determined color scale.

Megascopic and microscopic investigation showed that moldavites are frequently heterogeneous to some degree, containing numerous schlieren, bubbles and lechatelierite inclusions. Among the studied samples also several extremely heterogeneous specimes were found displaying features similar to the so-called Muong Nong type tektites defined in the Austral-Asian strewn field. Indeed, these materials show shapes and surface features otherwise not observed in ordinary, so-called splash-form, moldavites. In particular, they are darker than more commonly found splash-forms and also they are often layered or strongly deformed and bent to various shapes. This unusual structure is apparent also at higher magnification as documented by SEM images. Comparison of splash-form and



■ **Fig. 8.** Comparison of the megascopic appearance and SEM image of the common so-called splash-form moldavite (left) and extremely heterogeneous Muong Nong-type sample (right) (photo by L. Švardalová).

Muong Nong-type moldavites is shown in Figure 8. The extreme heterogeneity of these moldavites is reflected also by their chemical composition as confirmed by cathododuminiscence and BSE imaging, and EPMA. Similar to Austral-Asian analogues, these heterogeneous moldavite contain minute inclusions of refractory minerals or their decomposition products: micro granular aggregates of baddeleyite as a decomposition



■ **Fig. 9.** Back-scattered electron image of micro granular aggregate of baddeleyite in the Muong Nong-type moldavite (a) and the Raman spectrum of this grain (original).

product of zircon (Fig. 9a), and possibly also droplets of apatite and monazite. Whereas the former was unequivocally identified based on the chemistry and Raman spectroscopy (Fig. 9b) the presence of apatite and monazite is inferred solely from chemical data.

Bulk chemical compositions of tektites in the studied set were determined using various modes of instrumental neutron activation analysis, supplemented by instrumental photon activation analysis. In total, about 50 elements were quantified in each sample. Chemical data are summarized in Table 2. The widespread elemental patterns of South Bohemian moldavites point to mixing of the 3 source components in various ratios. Moldavites from the Radomilice area are characterized by enrichment in silica. Moravian moldavites (and a single available moldavite from Lusatia) represent samples with the most pronounced imprint of the clay component, expressed mainly by higher content of Al and other elements associated with aluminosilicates. The Ca-Mg component is lowest of all moldavites in these samples. Moldavites from the Cheb Basin have bimodal elemental patterns different from the other groups, with a key role of the Ca-Mg component. They can be divided into two different groups. One group is characterized by the enrichment in K, Ca, Mg, Mn, U, and depletion of, e.g., Al, Na, Sr, Ba, and Th. In the other group of Cheb Basin moldavites, these trends are

	SB	Rd	Mv	CBa	CBb
n	84	18	13	17	13
wt.%					
SiO_2	79.48	82.27	79.77	79.19	79.40
TiO_2	0.30	0.29	0.35	0.36	0.23
Al_2O_3	9.87	9.16	10.57	9.77	8.44
FeO	1.48	1.38	1.74	1.56	1.18
MnO	0.07	0.05	0.04	0.10	0.12
MgO	2.10	1.67	1.40	2.19	2.84
CaO	2.62	1.80	1.36	2.96	4.06
Na_2O	0.40	0.33	0.53	0.58	0.29
K_2O	3.37	2.93	3.54	3.08	3.40
ppm					
Sc	4.43	4.38	5.42	5.21	3.60
V	24.9	23.1	30.1	26.7	23.1
Cr	23.4	21.4	30.1	20.2	18.2
Mn	564	384	284	760	915
Co	4.85	4.42	5.35	4.73	4.30
Zn	17.5	16.3	15.6	71.7	59.0
Rb	121	112	136	104	113
Sr	127	119	127	187	116
Zr	253	243	275	274	232
Cs	13.3	13.3	14.3	16.0	13.0
Ba	721	640	773	1043	617
La	27.9	26.9	30.3	32.7	23.1
Ce	52.9	51.7	56.9	62.4	44.6
Nd	23.0	21.7	23.6	26.9	19.5
Sm	4.38	4.25	4.80	5.14	3.70
Eu	0.90	0.85	0.95	1.02	0.78
Gd	3.64	3.25	3.75	4.03	3.19
Tb	0.54	0.48	0.57	0.57	0.45
Dy	3.97	3.63	4.42	4.10	3.27
Ho	0.60	0.57	0.68	0.64	0.53
Yb	1.55	1.49	1.62	1.50	1.29
Lu	0.24	0.26	0.26	0.24	0.21
Hf	6.05	6.07	6.62	6.29	5.33
Ta	0.59	0.59	0.67	0.56	0.47
Au	0.019	0.016	0.011	0.019	0.022
Th	10.66	9.93	11.57	13.44	8.64
U	2.35	2.70	2.32	3.30	2.95
K_2O/Na_2O	8.57	9.26	7.07	5.20	11.46
CaO/MgO	1.20	1.12	1.03	1.34	1.46
K/U	11696	9385	12615	8037	9863
K/Rb	230	224	219	244	248
Th/U	4.5	4.0	5.1	4.3	3.0
Zr/Hf	41.4	40.9	40.0	43.4	43.6
Rb/Sr	0.95	0.86	1.12	0.57	0.99
Eu/Eu*	0.68	0.67	0.67	0.67	0.68
$(La/Yb)_N$	12.0	12.1	12.7	14.3	11.9

■ **Tab. 2.** Medians of the bulk chemical composition of moldavites from South Bohemian (SB), Radomilice (Rd), West Moravian (Mv), and Cheb Basin (CBa and CBb) partial strewnfields.

generally reverse. Both these groups have extremely high Zn contents, 2–5 times higher compared to other moldavites.

For selected samples of moldavites compositional data were collected also by ICP-MS; the technique also allowed determination of lead isotopic ratios. Results substantiate the data yielded by activation analyses: the moldavites from the Cheb Basin differ from those from South Bohemia and Moravia. They are highly enriched in Zn, Ba, Pb, and U while they display significant depletion in Cr and Ni. Moravian moldavites display either no or significantly less differences when compared to South Bohemian moldavites. Chondrite-normalized REE contents overlap existing literature data. HREE tend to be enriched in Moravian samples whereas the samples from the Cheb Basin appear to be depleted in HREE compared to the moldavites from the South Bohemian field. Concentrations of LREE remain more or less invariant among all regions. In the plot $^{208}Pb/^{206}Pb$ *vs.* $^{206}Pb/^{207}Pb$ the moldavites from the Cheb Basin are clearly separated from the rest of the samples analyzed; samples from South Bohemia and Moravia overlap.

Local chemical composition of samples was characterized by an electron probe microanalyzer (major elements) and laser-ablation inductively-coupled-plasma mass spectrometry (minor and trace elements). These analyses allowed assessing compositional heterogeneity on the scale of micrometers (EPMA) or tens of micrometers (LA-ICP-MS). The EPMA analyses generally agreed well with the data from INAA, although in some heterogeneous samples we found rather unique compositional domains heavily enriched in CaO and MgO.

In Muong Nong-type tektites found in Asia it appeared that water content and pore spatial- and size-distribution represent important intrinsic properties of these glasses. However, the smaller size and much more complex structure of moldavites proves sometimes difficult to reveal fine details of the water content and the pores distribution. Consequently the water content was studied using micro-Infrared spectroscopic analysis and pore distribution and density by X-ray microtomography. 2D maps of the intensity of the absorption bands at 3,600 cm^{-1} reveal a layered pattern whose orientation parallels the layered structure visible both in optical microscopy and in backscattered electron SEM images. The total water content measured at 4 selected layers ranges from 71 to 211 ppm. 3D tomographic analysis allowed to observe pores sizes ranging between 10 to 150 μm and to quantitatively determine pore distribution across the whole sample. Determined pore density (80 pores.mm^{-3}) and volume (0.5 % of the total volume) do not show appreciable variations across the sample, nor do they mimic the layered pattern of the water content in the area studied by microFTIR. Comparison between micro FTIR and X ray Microtomography data confirm that the observed intensity variations of the 3,600 cm^{-1} band are truly related to water content variations and are not an artifact due to uneven pore density distribution.

Moldavites, similar to other tektites, commonly contain bubbles. We reviewed the published data on pressure and composition of a gas phase contained in the tektite bubbles and data on other volatile compounds, which can be released from tektites by either high-temperature melting, or by crushing or milling under vacuum. Gas extraction from tektites using the high-temperature melting generally produced higher gas yield and different gas composition (usually CO, CO_2, H_2, sometimes N_2, CH_4, O_2, H_2O, traces of other gases) than the low-temperature extraction using crushing or milling under vacuum (usually CO_2, H_2, sometimes N_2, O_2, traces of other gases). The high-temperature extraction obviously releases volatiles not only from the bubbles, but also volatile compounds contained directly in the glass. The gas composition can be modified also by reactions between the released gases and the glass melt at the thermal extraction. Published data indicate that besides CO_2 and/or CO in the bubbles, another carbon reservoir is present directly in the tektite glass. To clarify the question of carbon content and carbon isotopic composition of the tektite glass, three moldavites were analyzed. The samples contained only 35–41 ppm C with $\delta^{13}C$ values in the range from −28.5 to −29.9 ‰ VPDB. This indicates that terrestrial organic matter was a dominant carbon source during the moldavite formation (Žák et al. 2012).

Lithium represents an important element useful in tracing of source materials. Consequently, abundances and isotope compositions were also determined in moldavites next to Austral-Asian tektites, Ivory Coast tektites and bediasites, impact-related glasses (Libyan Desert Glass, zhamanshinites and irghizites), and glass fragment from the suevite from the Ries impact crater. This study should test a possible susceptibility of Li to fractionation during hypervelocity impact events. Generally, the data show a large spread in Li abundance as well as isotope composition across all studied samples but the values for a particular group of glasses are always similar. The results show that any significant high-temperature Li isotope fractionation can be excluded (Magna et al. 2011). Instead, the Li isotope compositions in tektites and impact-related glasses are probably diagnostic of the precursor materials and their pre-impact geological histories.

The major achievement of the project, next to a sole collection of the large amount of chemical data from a well-defined set of moldavite samples, was the confirmation of previously postulated hypothesis that organic matter ashes participated in the formation of the moldavite melt. In particular, high K/Na and K/Rb ratios coupled with overall enrichments in and positive correlations between K, Ca, Mg and Mn observed in moldavites may point to plant ash as a possible component of the moldavite source materials. Composition of plant ashes is generally governed by high Si, Ca, K, P and Mg contents, paralleled by high K/Na ratios and elevated Mn concentrations. In biological systems, enrichment in elements essential for plants and depletion of non-essential elements is often observed. For example, Ca/Sr, Ca/Ba, K/Rb and ratios increase with increasing trophic position. Obviously, formerly defined Ca-Mg component, which was traditionally assigned to carbonates, may well be ascribed to the "biogenic" component (ash). A conservative estimate of the total ash contribution to the moldavite melts is several percent, but higher contribution may be associated with some specific moldavite specimens. The results of carbon isotopic studies undoubtedly supports this idea and are well consistent with a participation of unoxidable residue formed by pyrolysis and oxidation of biomass (ash) from the surface. It should be stressed, however, that the bulk of moldavite source material was formed from the uppermost layers of pre-impact sedimentary lithologies and unconsolidated sediments (quartz sands, clays, clayey marls, soils) in the Ries region.

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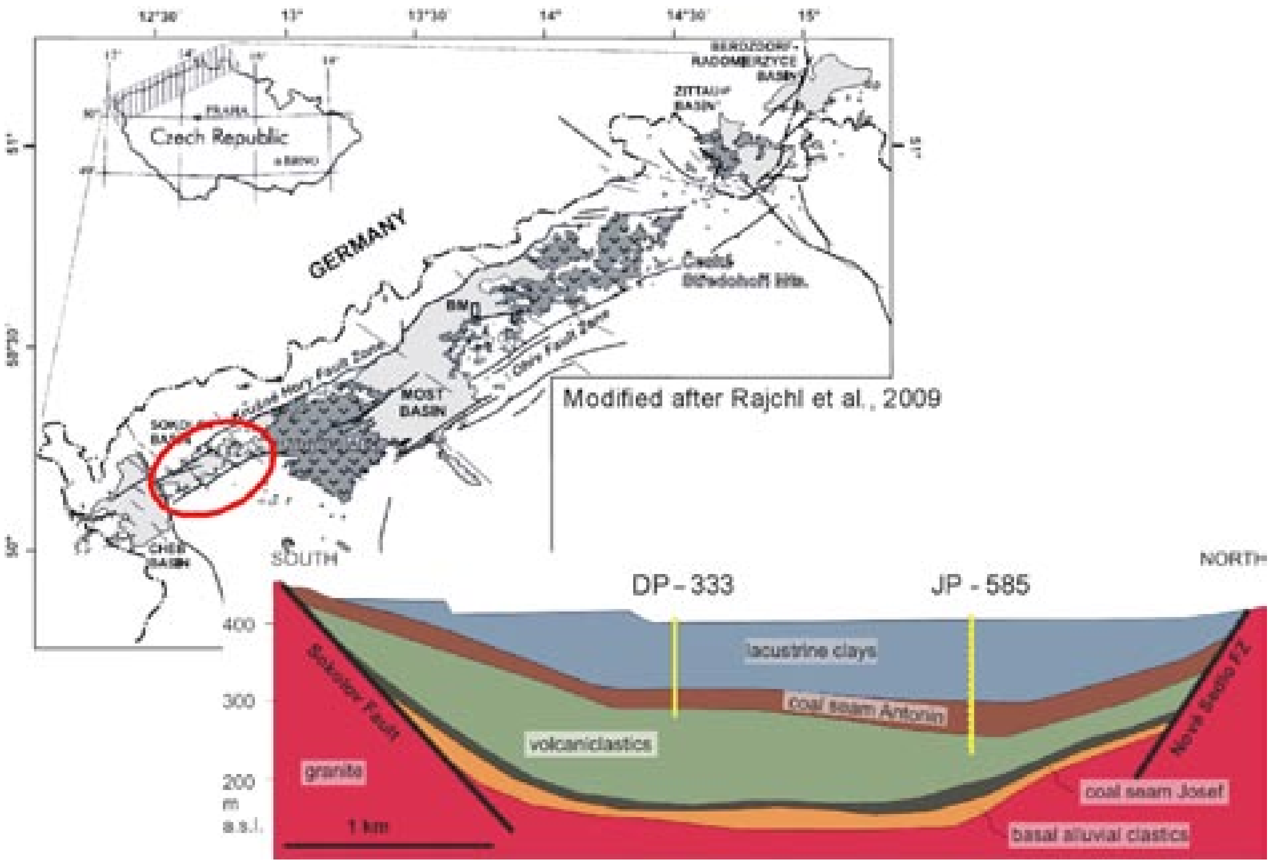
No. 205/09/1162: **Lacustrine and coal deposits of the Sokolov Basin, Eger Graben, as an archive of Miocene continental paleoenvironments, paleoclimate and tectonics** (K. Martínek, S. Opluštil, Z. Kvaček, J. Sakala, Faculty of Science, Charles University, Praha, Czech Republic, J. Franců, B. Kříbek, E. Franců, Czech Geological Survey, Praha, Czech Republic, I. Sýkorová, M. Havelcová, M. Matysová, H. Trejtnarová, M. Vašíček, Institute of Rock Structure and Mechanics ASCR, 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)

The main objective of the study was to interpret the paleoenvironmental and paleoclimate history of the Cypris Formation of the Sokolov Basin using sedimentological, petrological, geochemical, rock magnetic, paleomagnetic and palynological data. This include the reconstruction of the sedimentary environments and the interpretation of the immediate controls (e.g., siliciclastic flux, lake metabolism) and the primary controls (e.g., climatic changes, autocyclicity, episodic faulting) on depositional stacking pattern of the Cypris Formation (Fig. 10).

Mineral magnetic characteristics of the Cypris Formation, i.e. low field bulk magnetic susceptibility (MS) together with anisotropy of magnetic susceptibility (AMS), help to better understand the depositional as well as post-depositional processes. MS values are influenced by concentration of magnetic particles (ferro-, para-, and diamagnetic), type of magnetic mineralogy and mineral grain size. AMS reflects the preferred orientation of magnetic minerals and can be used as magnetic fabric indicator in sedimentary rocks. The magnetic anisotropy can be visualized by an ellipsoid with three perpendicular principal axes ($k_1 \geq k_2 \geq k_3$). The maximum axis (k_1) is denoted as magnetic lineation and the plane perpendicular to minimum axis (k_3) defines a magnetic foliation. The AMS ellipsoid magnitude can be presented as a ratio k_1/k_3, known as the degree of anisotropy, *P* (Nagata 1961). The AMS ellipsoid shape can be described by the shape parameter, *T* (Jelínek 1981); oblate shapes corre-



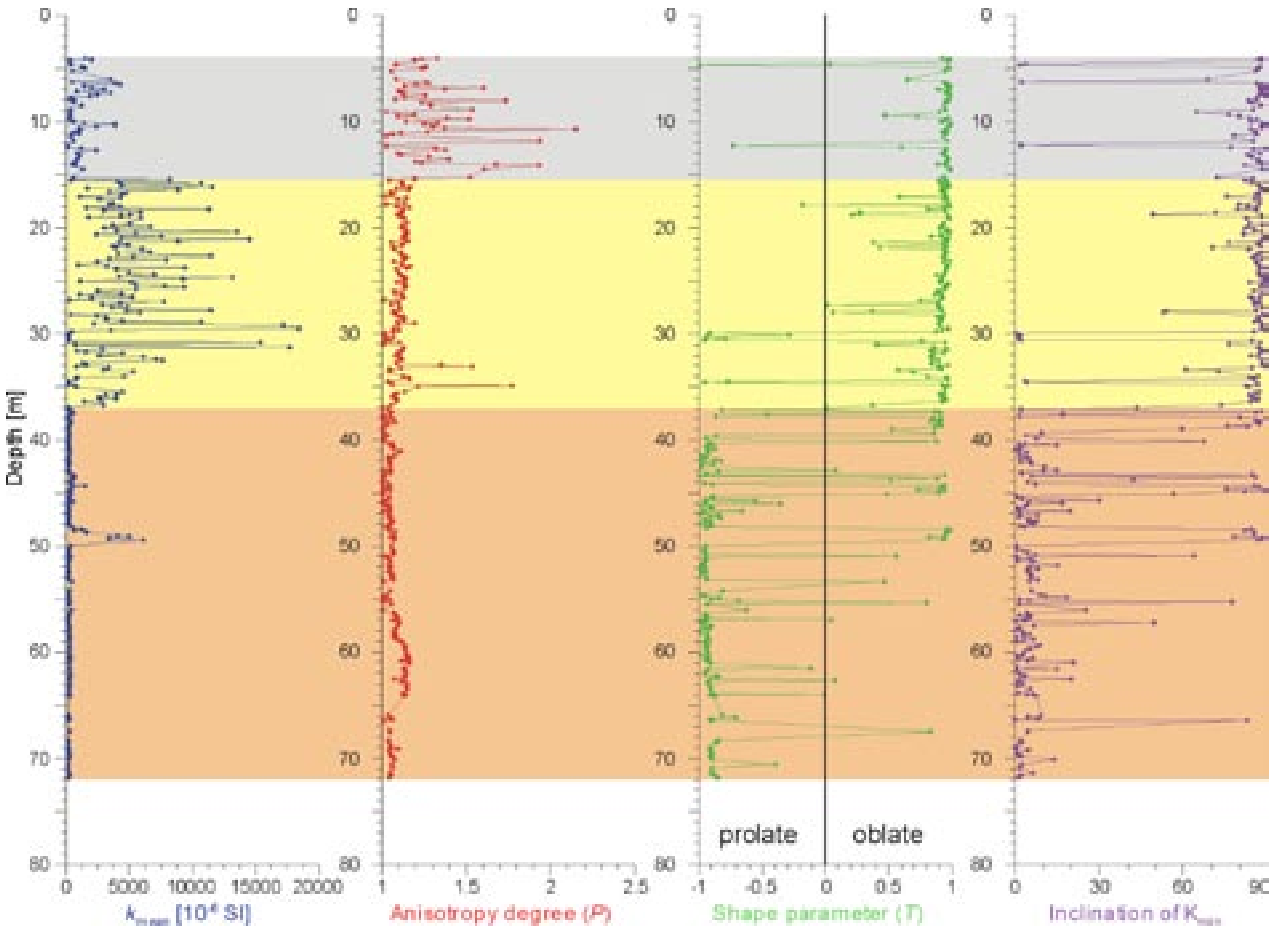
■ **Fig. 10.** Top – a schematic map of the Eger Graben with location of individual sedimentary basins (light gray) and volcanic domains (dark). The Sokolov Basin is marked by a red circle. Bottom – a vertical section across the Sokolov Basin fill with positions of two studied drill core sections (yellow) (modified after Rajchl et al. 2009).

spond to $0 < T \leq 1$, prolate shapes correspond to $-1 \leq T < 0$. The degree and shape of the AMS depend on the magnetic mineralogy controlled by iron-bearing minerals. Ferrimagnetic sulfides (mainly smythite-greigite and pyrrhotite) as well as paramagnetic pyrite are formed during post-depositional processes in the lake environment when oxygen deficiencies occur (e.g., Thompson & Oldfield 1986).

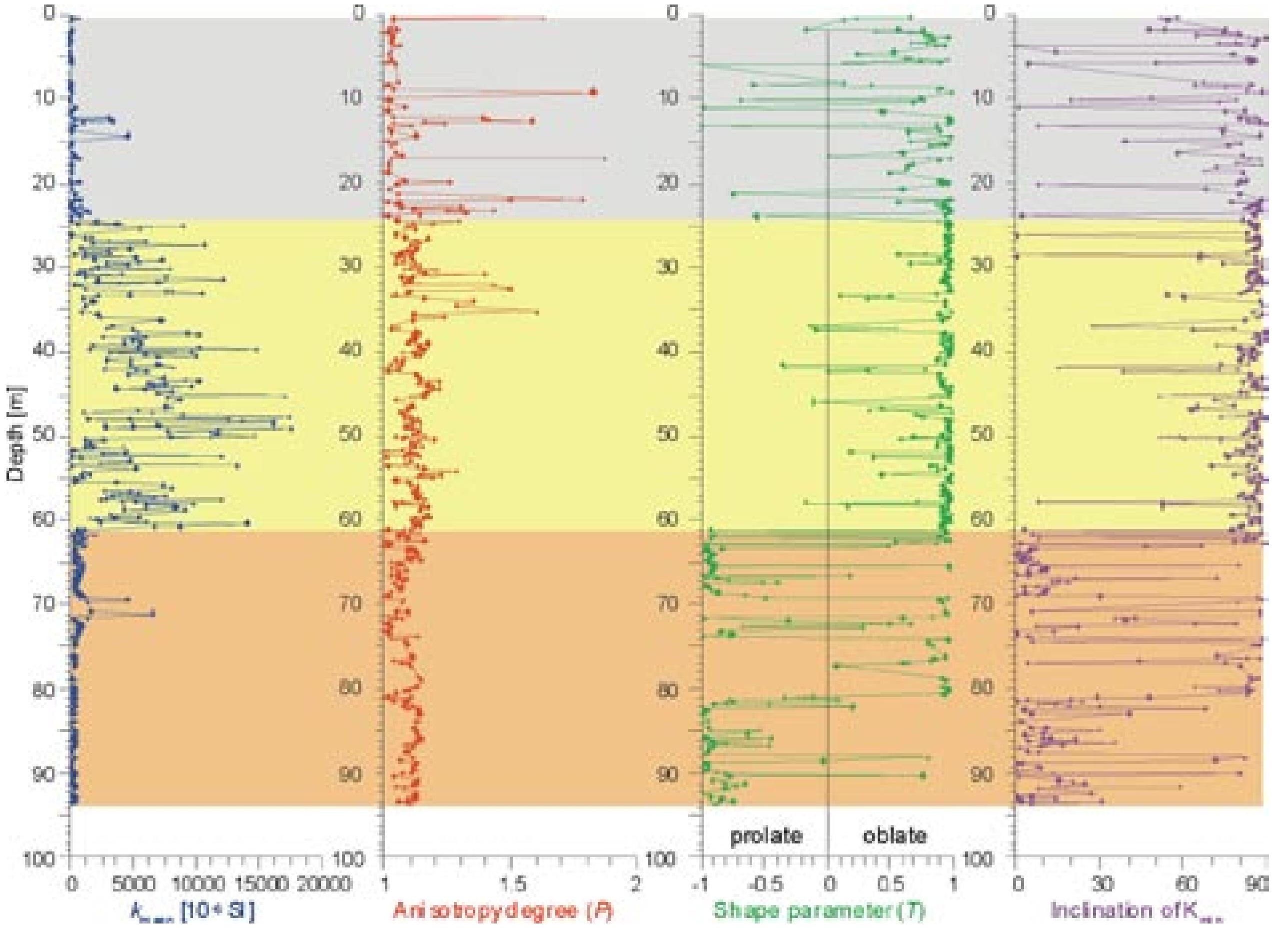
Oriented samples of sediments from both drill cores were cut to cubes (volume of 8 cm³). For each sample MS and AMS were measured using Agico KLY-4 Kappabridge (alternating field amplitude of 425 A/m and operating frequency of 875 Hz). Iron sulfides were identified based on Fe:S ratio (Snowball & Torii 1999) using microprobe CAMECA SX-100 device.

The both studied sections can be divided to three segments based on measured rock magnetic and magnetic fabric characteristics (Figs. 11 and 12). The boundaries between these segments are less than 3 cm thick. Both drill core sections can be divided to three segments based on measured rock-magnetic and magnetic fabric parameters. The upper drill core segments show intermediate MS values with median $k_m = 854 \times 10^{-6}$ (SI) and a high AMS degree $P_m = 1.224$ or $k_m = 189 \times 10^{-6}$ (SI) and $P_m = 1.035$, respectively (Figs. 11 and 12). Oblate AMS ellipsoid shape with horizontal magnetic foliation corresponds with characteristic magnetic fabric of sediments settled in the lake environment. The highest MS values were measured in the middle segments of the sections. The values reach $k_m = 4{,}026 \times 10^{-6}$ (SI) and $P_m = 1.11$ or $k_m = 4774 \times 10^{-6}$ (SI) and $P_m = 1.12$, respectively. Dominating oblate AMS ellipsoid shape with horizontal magnetic fabric indicates again the primary sedimentary structure. Very low MS values $k_m = 254 \times 10^{-6}$ (SI) and $P_m = 1.051$ or $k_m = 403 \times 10^{-6}$ (SI) and $P_m = 1.086$ are characteristic for the lower core segments. Prolate AMS ellipsoid shape with vertical orientation of magnetic foliation dominates in the sediments. The boundaries between the segments are less than 3 cm wide indicating sudden changes in the lake environment. However, these boundaries are not isochronous as indicated by geochemical data and a coal marker representing a short event across the whole basin. This marker was found at the depth of 57 m in the DP–333 core whereas the same marker is presented 62 m deep in the JP–585 core.

Using the microprobe Fe:S ratio (in atomic %) assessment, we found dominating iron sulfidic grains with average ratio 47:53 in the upper segment of the section. These grains are pyrrhotite (see Snowball & Torii 1999). Grains with average ratio 43:57 (greigite) are abundant in the middle segment of the section and significantly prevail over pyrrhotite. A few grains of pyrite (ratio



■ **Fig. 11.** Drill core section DP-333. Magnetic susceptibility and anisotropy of magnetic susceptibility measured in the Cypris F. kmean – bulk magnetic susceptibility, P – AMS degree, T – AMS shape parameter, kmin – inclination of shortest axis of the AMS ellipsoid (original).



■ **Fig. 12.** Drill core section JP-585. Magnetic susceptibility and anisotropy of magnetic susceptibility measured in the Cypris Formation. For explanation see Fig. 11 (original).

33:67) were found in the topmost part of the middle segment. Rare grains of greigite and pyrrhotite were identified in the lower segment of the section.

The magnetic mineralogy and magnetic fabric characteristics of the sediments were controlled by paleoenvironmental changes in the lake basin. Sediments in the lower segment (36.94–71.80 m) carry mostly magnetically weak signal. Dominating inverse prolate magnetic fabric was induced by post-depositional formation of paramagnetic siderite (cf., Chadima et al. 2006). Microprobe analyses reveal a very low concentration of greigite and pyrrhotite in this part of the section. Greigite is dominant in the middle segment (15.40–36.94 m) of the section where the highest magnetic susceptibility values and mostly oblate magnetic fabric were detected. Formation of this iron sulfide was controlled mostly by bacterial activity under anoxic conditions in the lake probably during early diagenetic processes as supposed by Krs et al. (1990) and Chang et al. (2009). As evidenced by microprobe data, pyrrhotite and smythite are present in the upper segment of the section (4.01–15.40 m) with moderate MS signal and a relatively high degree of anisotropy. Pyrrhotite tends to have a strong crystalline anisotropy (Tarling & Hrouda 1993) which increases the anisotropy degree of pyrrhotite-bearing rocks (e.g., de Wall & Worm 1993; Hajna et al. 2010). The change in the iron sulfide mineralogy could reflect decrease of organic sulfur concentration in the lake due to water ventilation amelioration (Jones & Bowser 1978).

Only samples with primary sedimentary fabric were involved in the paleomagnetic polarity interpretations. Also samples with a high pyrrhotite concentration indicated by a high degree of the AMS were excluded. Pyrrhotite is responsible for self-reversed behavior during the demagnetization process (Krs et al. 1992; Horng et al. 1998). Three normal and three reversed polarity zones were interpreted in both drill core sections (Fig. 13). The obtained geomagnetic polarity record was correlated with the Geomagnetic Polarity Time Scale (GPTS; Gradstein et al. 2004) to determine the sedimentary sequence age. The magnetostratigraphic interpretation is verified by paleontological evidence (Fejfar 1974). The Cypris Formation probably spans the time interval between paleomagnetic chrons C5Er and C5Cr.

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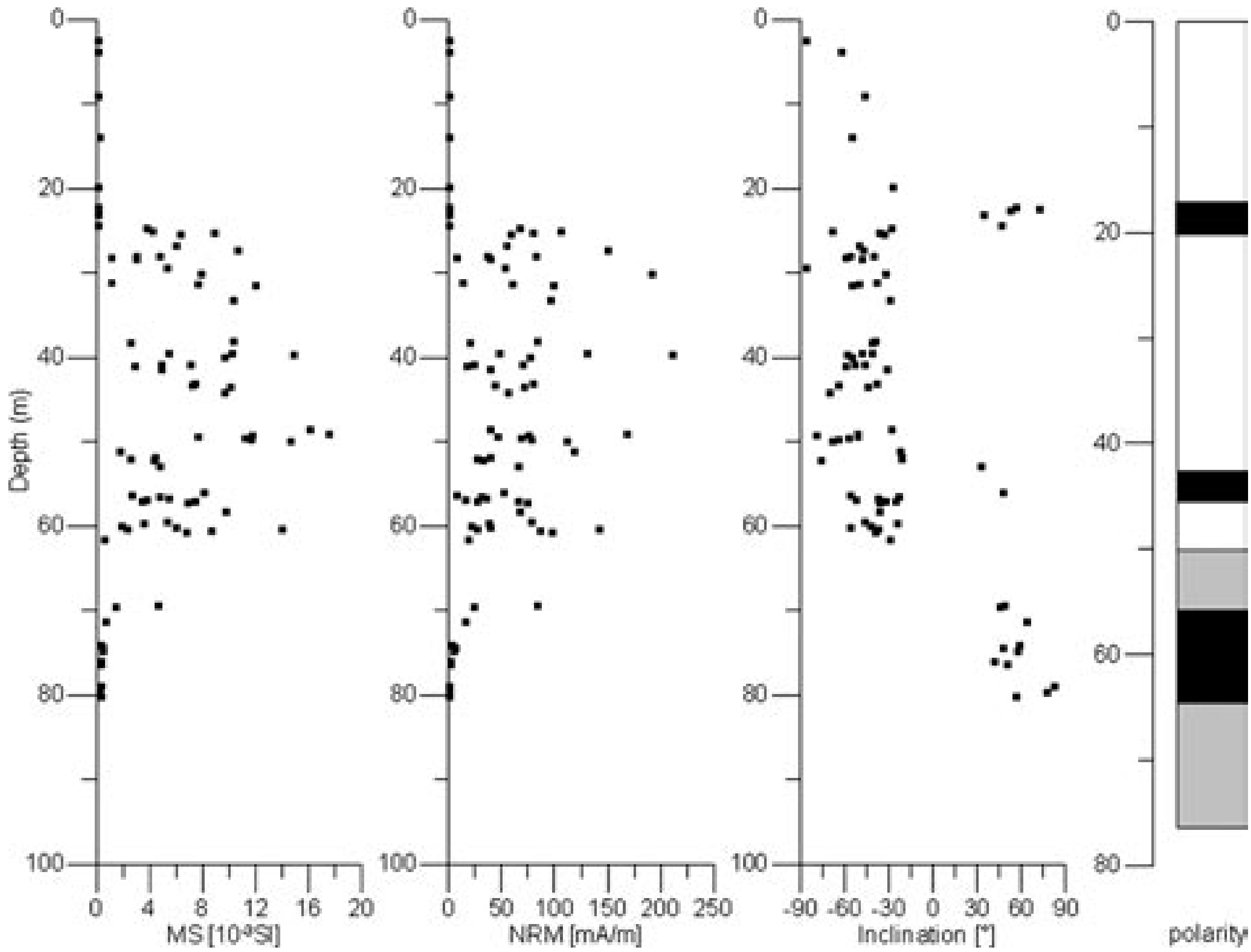

■ **Fig. 13.** Drill core section JP-585, rock-magnetic and paleomagnetic record in the Cypris F. MS – bulk magnetic susceptibility, NRM – natural remenent magnetization, Inclination – interpreted paleomagnetic inclination (half-oriented samples), polarity: normal polarity – white, reverse polarity – black, post-depositional disturbed polarity – gray (original).

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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, *R. Mikuláš*, P. Budil, Czech Geological Survey, Praha, M. Mergl, Department of Biology, University of West Bohemia & M. Valent, National Museum, Praha; 2009–2011)

Ichnologic studies (i.e. the study of trace fossils and all aspects adjacent to bioturbation and bioerosion) completed during the project were focused chiefly on the interrelationships between body and trace fossils. These relationships have so far been only inadequately studied, and – more important – they show exceptional features in the Early Phanerozoic fossil record, which is the time span of the study. For the appearance of the common behaviour generally known as *sediment feeding*, the origin of bacterial and fungal-bacterial consortia growing at organic matter of carcasses was important (Mikuláš et al. in press). Skeletal parts could serve to support tunnels and galleries. Both the possibilities can be documented for the trace fossil *Arachnostega* (Fatka et al. 2011) and for "*Gordia-like structures*" (Mikuláš et al. in press).

For *Arachnostega*, two possible interpretations of the ethology take into account. First, we can consider *Arachnostega* to be analogous to "open substrate" burrows such as *Chondrites*, *Gordia* or *Protopaleodictyon*. These can be classified as chemichnia, fodinichnia or agrichnia. The analogy is supported by the uniform size of tunnels in the framework of each *Arachnostega* network, which suggests that the network was a feeding trace (fodichnion) constructed during a relatively short period (e.g., a single feeding event), because there is no evidence of the growth of the tracemaker. However, the possibility that *Arachnostega* represents a dwelling burrow (domichnion) cannot be excluded with certainty since the netlike form is also characteristic of some domichnia, such as *Ophiomorpha*. Some authors regard also *Thaassinoides* as a fodinichnion and *Arachnostega* could be an analogue of this type of trace fossil. In this case, it is more probable that the tracemaker always formed a new burrow system when an existing one became too small, rather than re-burrowing the old network. In our material, there is no evidence of such re-burrowing. The existence of more-or-less clearly defined development phases (Fig. 14) suggests that the tracemaker probably changed the "host shell" several, or even many times; hence, we presume its active searching for food.

The presence of *Arachnostega* on skeletons lying on and/or partly embedded in the clastic sea bottom evokes a possible connection between the *Arachnostega*-type behaviour (strategy) and the appearance of numerous large animals with skeletons as early as in the the Cambrian. The sudden appearance and worldwide distribution of shallow-burrowing animals is one of the typical features of the "Cambrian substrate revolution" and the strategy of animals producing *Arachnostega*-like traces was obviously a very successful behaviour pattern. The "explosion" of this behaviour culminated in the Ordovician, and was probably connected with the general increase in the bioturbation of muddy substrates in the Ordovician (Fatka et al. 2011).

Whilst *Arachnostega* and similar burrows can be interpreted as feeding/dwelling burrows, "*Gordia*-like traces" (Mikuláš et al. in press; in our concept classifiable as *Gordia*-like traces, *Cochlichnus*-like traces, *Treptichnus*-like traces and *Chondrites*-like traces) adjacent to slightly skeletonized body fossils in the Cambrian of the Barrandian area are "purely feeding" structures. Substrate in the immediate contact with weakly mineralized carapace of an arthropod (or a similar biologic material) became enriched in microbial halo, which served as the main food source. The feeding strategy of producers of *Gordia*-like traces and *Cochlichnus*-like traces was relatively common in the Cambrian and was close to a planar grazing. The procedure practiced by the *Treptichnus*-like tracemaker shows to be less usual. Considering the low degree of compaction of tunnels of *Treptichnus*-like traces in the studied material, we presume that the structures originated in the late stage of the substrate exploitation, when the mud was partly consolidated. Individual probes were probably used repeatedly. The same can be presumed for *Chondrites*-like traces, but the interpretation is problematic because of the low number of specimens and their incompleteness. *Planolites*-like traces resulted most probably from fortuitous contacts of in-fauna and buried animal bodies (Mikuláš et al. in press).

Locally, as early as during the Mid Cambrian, some substrates became so rich in nutrients that economical feeding strategies could be successful even far form decaying organic remains (trace fossil *Zoophycos*; Doucek & Mikuláš 2011).

Trace fossils accompanying soft-bodied fossils of the "Ediacara-like" taphonomic window were discovered in the Middle Cambrian of the St Petersburg Region, Russia (Natalin et al. 2010). Bioturbation is very weak, being represented by a nearly monospecific ichnoassemblage with *Diplocraterion* isp., which can be a recurrent feature of the (otherwise rare) taphonomic windows of this type in the Phanerozoic.

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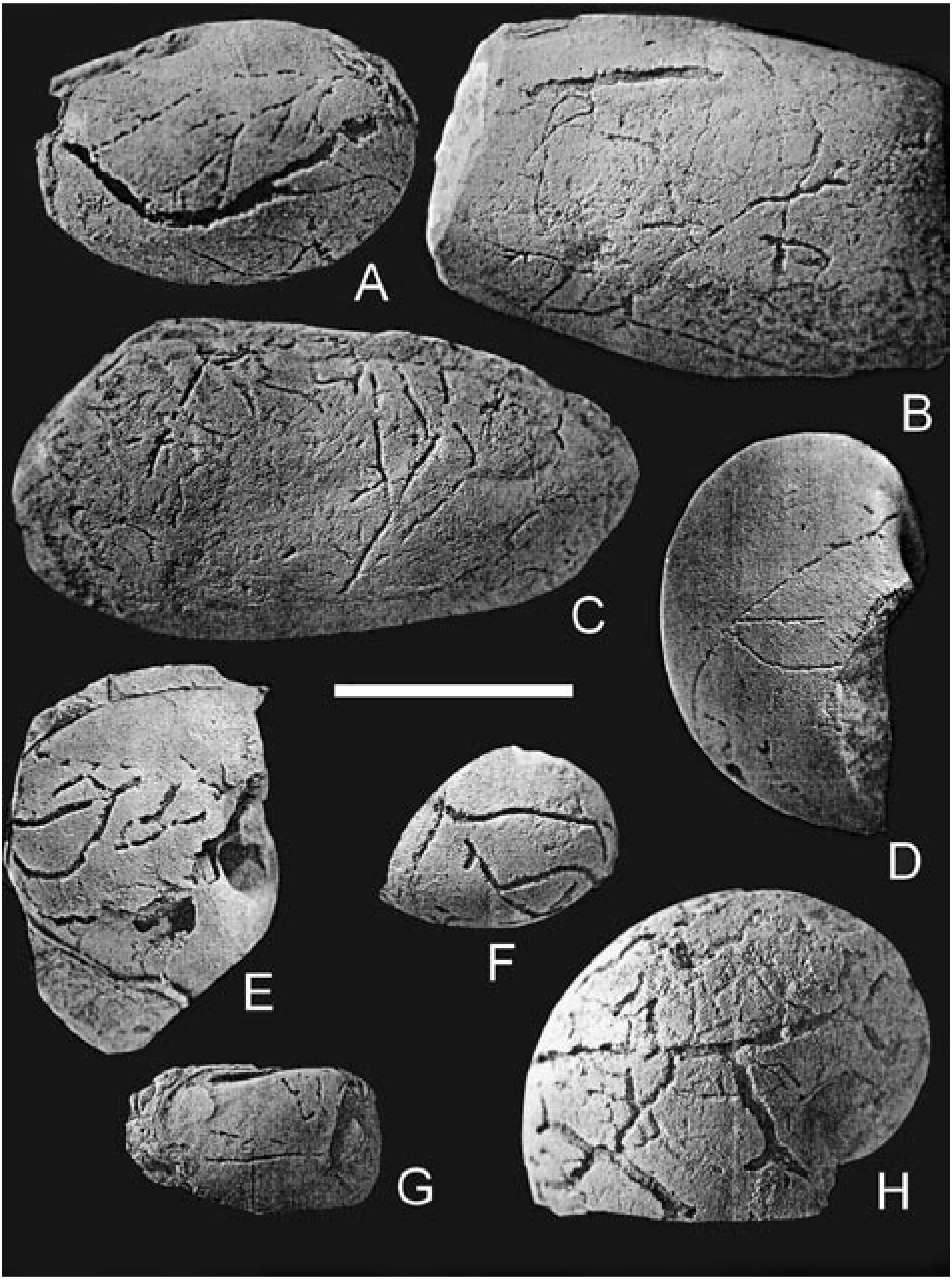

■ **Fig. 14.** A-H, Initial development stages of the dwelling/feeding trace *Arachnostega* in mollusks (*Coxiconcha*, *Sinuites* and *Redonia*). Scale bar = 1 cm. Middle Ordovician, Ossa Morena, Spain (according to Mikuláš & Gutiérrez Marco 1992).

in the Middle Cambrian sediments of the St. Petersburg Region, Russia. – *Acta Geologica Polonica*, 60, 1: 71–75.

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 Sciences – Faculty of Agrobiology, Food and Natural Resources, Praha & *A. Žigová*; 2008–2011)

Soil structure is a very important property, which has influence of many processes in the soil. Soil structure is a spatial distribution of soil particles and aggregates. Structural form is inluenced mainly by the soil propreties, by the climatic factors (wetting and drying, freezing and thawing), and by human and biological activity as a tillage, growth of roots, microflora and fauna activity. Aggregates develop either by the aggregation or by the disagregation processes.

Soil water regime is highly affected by soil aggregate stability. Soil aggregation is under control by soil of different mechanisms in different soil types. Flocculated clay particles or their complexes with humus (organomineral complexes) and soil organic matter are the main cementing agents in soil aggregates development.

Water flow and contaminant transport in structured soils is frequently influenced either by water and solute temporal immobilization inside soil structure elements (e.g., the concept of mobile and immobile water) or by passing the soil matrix due to enhanced water flow and contaminant transport in macropores (e.g., the preferential flow). Different compositions of soil structure components are reflected in soil properties that affect water and solute transport, such as the soil structure and the configuration of the soil porous system, the aggregate stability, and soil hydraulic properties. Soil aggregation is under the controll of different mechanism in different soil types.

The main aims of the project were: (1) the evaluation of a soil structure impact on character of water flow and contaminant transport in soils and (2) the evaluation of an agriculture management impact on a soil structure and consequently on transport processes in soils. The list of localities with the altitude, parent material, stratigraphy of soils profiles and classification according to the World Reference Base for Soil Resources (WRB Classification) is presented in Table 3.

Undisturbed large soil aggregates, undisturbed 100 cm^3 soil samples and disturbed soil samples were taken in diagnostic horizons of selected soil types under different use to evaluate agricultural management impact. In addition, soil samples were taken from surface horizon several times during the year to study seasonal variability. A complex micromorphological study was performed on the basis of a detailed analysis of elements fabric, aggregates, voids, microstructures, rock fragments, mineral and organic components, coatings, infillings, nodules and excrements from individual soil horizons. X-ray diffraction spectra for analysis of mineral composition of soil particles < 0.001 mm were obtained on a diffractometer Philips X'Pert PW3020. Semiquantitave values were calculated from individual mineral basal peaks.The soil hydraulic properties were defined using the multi-step outflow experiments performed on the 100 cm^3 soil samples. Other soil physical and chemical properties (moisture, suction, water capacity, maximum capillary capacity, bulk density, particle density, porosity, particle size distribution, pH, organic

■ **Fig. 15.** Greyic Phaeozem on loess under the conventional tillage, Čáslav (photo by A. Žigová).

Locality	Altitude	Parent material	Stratigraphy of soil profile	WRB Classification
Čáslav	276 m	loess	Ap-Bth-BthCk-Ck	Greyic Phaeozem
Hněvčeves L	273 m	loess	Ah-AhE-Bt_1-Bt_2-Ck	Haplic Luvisol
Hněvčeves PP	272 m	loess	Ap_1-Ap_2-Bt_1-Bt_2-Bt_2C-Ck	Haplic Luvisol
Humpolec L	526 m	paragneiss	Ah-Bw-C	Haplic Cambisol
Humpolec PP	523 m	paragneiss	Ap-Bw-C	Haplic Cambisol
Ivanovice na Hané	233 m	loess	Apk-Ahk-AhkCk-Ck	Haplic Chernozem
Kostelec nad Orlicí	287 m	loess loam	Ap-Bt_1-Bt_2-C	Haplic Luvisol
Vysoké nad Jizerou	680 m	orthogneiss	Ah-Bw-Cr	Haplic Cambisol

■ **Tab. 3.** Location and basic information about the studied soil profiles.

carbon, total nitrogen, cation exchange capacity) were studied using standard procedures. Pressure heads and soil water contents were monitored using an appropriate sensor. Soil solute was collected below the soil container or using the suction cups in the field. Soil samples within the soil container or within the soil profile were analyzed to obtain tracer content within the monitored soil column/profile. The HPLC technique was used to determine the solute content. Laboratory experiments and field experiments were performed to monitor water flow and tracer transport. The numerical inversion was used to analyze the cumulative outflow and soil-water retention data points to obtain hydraulic parameters characterizing different soil-water flow models: the single-porosity model, the dual porosity model, and the dual-permeability model. The ratio of different pore domains was estimated on the basis of micromorphological studies.

Majority of studies were performed on selected soil types as Greyic Phaeozem (Fig. 15), Haplic Luvisol (Fig. 16) and Haplic Cambisol (Fig. 17) for the seasonal and annual variability of the soil properties of the arable horizons during a 4-years' period.

The study of comparision of aggregate stability in Haplic Chernozem on loess, Greyic Phaeozem on loess, Haplic Luvisol on loess, Haplic Luvisol on on loess loam, Haplic Cambisol on paragneiss and Haplic Cambisol on orthogneiss in condition of conventional tillage (Kodešová et al. 2009) showed the water-stable aggregates test provides data that may used to asses different aspects of aggregate stability within and between various soil profiles.

Soil porous system and subsequently soil hydraulic properties are influenced by the mineralogical composition. One of the studies (Žigová et al. 2010) presents data about the mineralogy of Haplic Cambisols developed on paragneiss (Humpolec) and orhogneiss (Vysoké nad Jizerou). The results showed that the cambic horizon is dominated – among clay minerals – by illite and also kaolinite (Humpolec), and by chlorite (Vysoké nad Jizerou).

Another paper (Žigová & Šťastný 2011) was conducted on the comparison of mineral composition of different soil types formed on loess. The mineralogical composition of soil particles < 0.001 mm has a polymineral character. The studied soils were found to be dominated by quartz, kaolinite and illite. Other minerals including feldspar, plagioclase and chlorite are represented in minor amounts. Amphibole was detected only in some horizons in Haplic Luvisol and Haplic Chernozem. Gypsum was identified only in the Ap horizon of Haplic Chernozem. Semi-quantitative analyses of mineral composition of the Greyic Phaeozem (Čáslav), Haplic Chernozem (Ivanovice na Hané) and Haplic Luvisol (Hněvčeves) revealed differencies in association of respective minerals. The Greyic Phaeozem has practically the same amount of illite and kaolinite and a relatively high con-

■ **Fig. 16.** Haplic Luvisol on loess under the conventional tillage, Hněvčeves (photo by A. Žigová).

■ **Fig. 17.** Haplic Cambisol on paragneiss under the conventional tillage, Humpolec (photo by A. Žigová).

tent of smectite. Haplic Luvisol shows the same occurence of illite and kaolinite with a small portion of smectite. Haplic Chernozem contains more illite than kaolinite. Smectite was identified only in the lowest part of these soil.

The study on the effect of different managment of Haplic Luvisol developed on loess on the soil structure and consequently soil hydraulic properties was published by Kodešová et al. (2011). Soil structure in condition of conventional tillage and permanent grass cover was analyzed using the micromorphological method. The land management impacted macropores and matrix pores in the Ap, Ah and Bt_1 horizons. Due to the periodical periodical tillage, consequent soil structure breakdown and particle transport, the fraction of the large capillary pores and also matrix pores were smaller in the Ap and Bt_1 horizons of the arable land that in grassland soil. On the other hand, due to seasonal soil structure changes (tillage, soil cracking, biopored etc.), the proportion of gravitational pores in arable land horizon was larger than those of grassland horizons. Haplic Luvisol under a permanent grass cover established 30 years ago indicated well reestablished stable soil structure with favourable soil hydraulic properties: a higher porosity and soil water retention; a higher proportion of large capillary pores which are important for water flow and various substances transport in soils; a lower proportion of gravitional pores, which may enlarge contaminant leakage into the subsurface layeres and consequently into the groundwater.

The soil properties modification by organic compost and pesticide transport was presented (Kodešová et al. 2012a).This study evaluates the posibility to improve the soil physical, hydraulic and chemical properties using organic compost. Despite precautions taken when preparing homogeneous soil and compost materials (which were next used for mixing) no substantial gradual changes of soil mixture properties (pH_{KCl}, pH_{H2O}, exchaneable acidity, cation excange capacity, hydrolitic acidity, basic cation saturation, sorption complex saturation, oxidable organic carbonc content, $CaCO_3$ content, sand, silt and clay content, soil particle density) were obtained with increasing compost content. The most evident change was the increasing C_{ox} content with an increasing compost content. Values of pH_{KCl} and pH_{H2O} showed a decreasing and increasing trend, respectively, with increasing compost fraction. Values of cation excange capacity also indicated an increasing trend with compost fraction. Measured physical properties (bulk density and saturated water content) and soil hydraulic parameters resulting from numerical analysis of measured transient water flow data did not show noticeable changes (demonstrating soil hydro-physical properties improvement) with increasing compost fraction. Final chlorotoluron distributions in soil columns and estimated transport parameters also showed a high variability. However, the results indicated a decreasing trend of chlorotoluron mobility up to the compost fraction of 6 %. Above this value, herbicide mobility is noticeably (7 %) and slightly (8 %) increasing. These findings correspond to herbicide adsorption studied using a batch experiment on all soil mixtures. Multiple linear regression revealed that the other properties (not only organic carbon content) play a noticeable role in pesticide adsorption in soils. A negative impact of pH_{KCl} (which was positively affected by compost adition), clay content, and $CaCO_3$ content (which were mostly characteristic of soil, but could be affected by composition as well) was documented.

The detection of a nonequilibrium water flow and solute transport in structured soil at various scales is described by Kodešová et al. (2012b). This study focused on the visualization of preferential flow in a Haplic Luvisol and Haplic Cambisol and in horizons by performing field ponding dye infiltration experiments. In addition, thin soil sections were made and micromorphological images were used to study soil aggregate structure and dye distribution at the microscale. The staining patterns within the vertical and horizontal field-scale sections documented the different nature of preferential flow in different soil types and also within the soil profiles. While preferential flow in the Haplic Luvisol was caused by soil aggregation and biopores, preferential flow in the Haplic Cambisol was caused only by biopores, large soil fractures, and incorporated straw material. Micromorphological images showed that, in the case of the Haplic Luvisol, the dye was primarily distributed either in the interaggregate pores and then in the pores inside the aggregates or in the isolated large pores connected to the dye source and then into the matrix pores. The dye distribution in the soil matrix was uneven as well. Accumulated organic matter, clay coating, and isolated larger capillary pores, which initially did not contain the dye tracer, behaved as less-permeable or impermeable barriers. An uneven distribution was caused by hierarchical pore size distribution of the soil matrix. The results indicated a multimodal character of preferential flow in this soil. In the case of the Haplic Cambisol, the dye pattern studied at the microscale was mostly affected by fractures and the size and shape of mineral grains.

The studies revealed that water flow and contaminant transport is frequently impacted by a preferential flow. The degree and complexity of the preferential flow depends on a soil type and its horizon. In some soils a multimodal preferential flow may appear (documented in the Haplic Luvisol). In addition, organomineral coatings on soil aggregates or inside larger pores may slowdown water and dissolved substances transfer into the soil matrix (documented in the Bt horizons of the Haplic Luvisol).

The studies also showed that transport processes are influenced by a soil structure stability.

The studies documented the application of soil micromorphology (which may be combined with a dye tracer experiment) to obtain information about the multi-modal pore system, and experimental and mathematical methods to obtained parameters describing hydraulic and solute (mainly pesticide) transport properties of the dual-permeability systems.

The impact of the agricultural management was documented by comparing soil properties of all soil horizons of one soil type used as arable land and grassland.

The modification of soil properties by organic compost and pesticide transport in compost amended soil was also presented.

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ŽIGOVÁ A., ŠŤASTNÝ M. & KREJČOVÁ J. (2010): Mineral composition of the clay fraction in soils with a cambic horizon in the Czech Republic. – *5th Mid-European Clay Conference*, *Budapest, 21-27 August*, *Acta Mineralogica-Petrographica, Abstract Series*, 6: 648. Szeged.
ŽIGOVÁ A. & ŠŤASTNÝ M. (2011): Mineral composition of agricultural soils developed on loess. – *In*: BADALÍKOVÁ B. (Ed.): *Proceedings from International Conference 2011. Crop management practices adaptable to soil conditions, Research Institute for Folder Crops. Ltd., Troubsko:* 109–114. Průhonice.

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

Tree rings were used as geochemical archives for the reconstruction of historical mercury deposition (Hojdová et al. 2011). To test the applicability of dendrological analysis, tree cores were sampled at three localities with different level of Hg contamination. The first sampling site was located in the close vicinity of the Příbram smelter (Fig. 18), which has been in operation for over 220 years. Historically, the smelter processed Pb-Ag-Zn±Sb ores mined in the area; since the cessation of mining in 1972, the plant has been recycling Pb from scrap materials, mainly car batteries. The second site is located 30 km SE of Prague and is affected by prevailing winds containing urban emissions (dust, emissions from incinerator facilities etc.). A reference site, with the lowest Hg contamination in the Czech Republic, was located in the Šumava National Park.

In the Příbram area, dendrological cores were collected from Norway spruce trees (*Picea abies* L.) and European beech (*Fagus sylvatica* L.) at different distances from the smelter stack. The highest Hg concentrations (up to 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 19th century. In the vicinity of the Pb smelter, Hg concentrations were increasing from the 1950s on, with maxima (up to 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 the two smelters and ranging from 150 to 220 years in age seem to reflect deposition from both point sources. Mercury levels in beech trees were lower than those in spruce as a result of greater distance from the pollution sources, but the concentration trend strongly correlated with metal production.

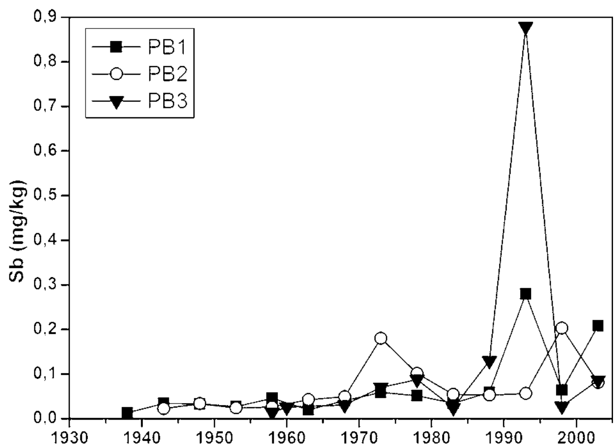
At the second site, influenced by urban emissions, three dendrological cores form Norway spruce (*Picea abies* L.) were sampled. All cores showed similar Hg concentration trends with the highest concentrations in the 1950s and 1960s (up to 6 $ng.g^{-1}$) followed by a decrease in the 1970s. Mercury concentrations slightly increased at the beginning of the 21st century. Nevertheless the concentration increase in the last wood segments could be influenced by migration of elements in the sapwood.

At the reference site in the Šumava National Park, Norway spruce trees older than 200 years were sampled. Mercury concentrations at the reference site were low, often below the detection limit (0.06 $ng.g^{-1}$). The Hg concentration slightly increased at the beginning of the 20th century (up to 3.9 $ng.g^{-1}$). Mercury concentration peak was also observed in the last wood segments, but migration in the sapwood could not be excluded.

This study shows that tree rings may be a good record of Hg deposition in areas affected by ore mining and smelting or area with other point sources of pollution. Interpretation of the results in areas with lower contamination was complicated, probably because of mixing of many pollution sources and larger distances from the point sources of contamination. Analyses of nutrient elements (Ca, Mg, K, Mn) in wood revealed environmental changes related to acid deposition, but a relation between the concentration trend of nutrients and Hg was not found.

Tree rings from the Příbram ore area were studied in more detail to test the applicability of dendrological analysis for other trace elements. Antimony (Sb), as one of the important anthropogenic contaminants, has been chosen. The present distribution, cycling and mobility of antimony (Sb) confirm the increasing interest in this metalloid, and mining and smelting activities currently represent the principal point sources of Sb in the environment. Antimony is an accompanying element in all smelting operations at Příbram. The occurrence of Sb-bearing minerals (such as boulangerite $Pb_5Sb_4S_{11}$, tetrahedrite $Cu_{10}(Fe,Zn)_2Sb_4S_{13}$, bournonite $PbCuSbS_3$ and stibnite Sb_2S_3) was observed in the smelted base-metal ores and Sb is also present as a hardening agent in Pb in processed car batteries and in the production of alloys in the smelter factory. The primary results showed very low concentrations of Sb in the wood with maximum Sb concentrations in 1970s and 1990s. The highest Sb concentrations correlate with the peak of metal production in the 1970s (Fig. 18).

Metallic mercury and some mercury compounds are volatile and unstable. Volatile components may escape from the sam-



■ **Fig. 18.** Concentrations of Sb in spruce tree rings in the vicinity of the Pb smelter (original).

ple throughout intensive sample preparation. Therefore, different drying methods (freeze-drying, air and 105 °C oven drying) were applied on soil samples and reference materials to assess the influence of sample pretreatment on final Hg concentration. Two soils with different levels of contamination and three reference materials were examined: (1) forest soils influenced by acid deposition with mercury concentrations 540 $ng.g^{-1}$ in organic horizons and 128 $ng.g^{-1}$ in mineral horizons, (2) soils contaminated by cinnabar (HgS) mining with concentrations up to 10,000 $ng.g^{-1}$ and (3) reference materials River Sediment (1,550±140 $ng.g^{-1}$), Soil Orthic Luvisol (78.5 ± 10.3 $ng.g^{-1}$) and Soil Eutric Cambisol (171±16 $ng.g^{-1}$).

Differences between the drying methods were obvious only in samples with higher Hg concentrations (>2,000 $ng.g^{-1}$) and in reference materials with mercury concentrations ~1,200 $ng.g^{-1}$. Soils contaminated by mining of Hg ores showed higher Hg concentrations in freeze-dried samples. Results of an analysis of variance showed that Hg concentrations were not significantly different ($p<0.05$) either in less or in more contaminated soils. Hg recoveries from the 105 °C oven-dried reference materials were slightly lower compared to freeze- and air drying. Nevertheless, no significant ($p<0.05$) differences were found between individual drying methods. Different drying showed only little influence on the total Hg concentrations in solid samples. Thus any of these three methods seem to be acceptable for solid sample preparation prior to the analysis of Hg concentrations, and therefore air drying was applied to wood samples.

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Continued projects

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; 2009–2012)

The present project is intended to enlarge 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. Main results of the third year, focused mainly on the stratigraphical and paleobiological aspects of selected localities and/or taxa, can be expressed as follows:

(1) The proposal of a new model of short migration events of oriental faunal elements during European Plio-Pleistocene was provided. Based on the revision of Pleistocene record of black bears in Europe, as well as the critical literature review, it can be concluded that the East Asiatic forms (*Pliopentalagus* spp., *U. thibetanus* s. l., *Petauria* spp., *Manis* sp., *Macroneomys* sp.) are recorded near the important biogeographical boundaries (Ruscinian/Villányian, Villányian/Biharian, Biharian/Toringian).

(2) The revision of Mio-Pliocene lagomorphs from Central and Eastern Europe was continued. (a) The type material of the Pliocene species of the genus *Prolagus* of Central Europe was revised. The taxonomical variability and geographic range of particular taxa were clarified (Čermák & Angelone in press). (b) The first Hungarian record (MN 15) of leporid *Trischizolagus* was proved. The taxonomy, phylogeny and paleobiogeography of the genus, were provided in the context of Eurasiatic record (Čermák & Wagner in prep).

(3) New material of Pliocene and Pleistocene bat species from selected south Hungarian localities was studied in detail. A new species from the *Myotis frater*-group was recognized.

Field prospection for new sites and the revisions of the existing ones including excavations and extensive resampling in the Czech Republic (Měňany 1, 3, Chlum 8) as well as abroad (Snežna jama, Črnotiče, Slovenia), including a standard processing of material, were continued.

ČERMÁK S. & ANGELONE CH. (in press): Revision of the type material of the Pliocene species *Prolagus bilobus* Heller, 1936 (Mammalia, Lagomorpha), with comments on the taxonomic validity of *P. osmolskae* Fostowicz-Frelik, 2010. – *Bulletin of Geoscience*.
ČERMÁK S. & WAGNER J. (in prep): Pliocene Leporinae (Lagomorpha, Mammalia) of Central Europe with comments on taxonomy and evolutionary history of *Trischizolagus* and *Pliopentalagus*.

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

The main result of the "conodont part" of the project in 2011 was the establishment of the provisional conodont zonal scale for the Přídolí Series in the Prague Synform. In spite of relatively long duration, the Přídolí Series has been characterized for a long time solely by one conodont Zone – *eosteinhornensis*. The conodont biozonation was largely discussed and modified several times during the past four decades, but with only a little progress. The Přídolí time is dominated by spathognathodontid conodonts which exhibit mostly rather conservative morphologies. These are the major constraint for taxonomical progress and resulting biozonal refinement. The provisional conodont biozonation for the Přídolí in the Prague Synform is based on several morphologically distinct forms which are short-lived and can thus precisely characterize very short time spans (~100 ka). A wide regional use of the proposed scale still has to be tested both within and outside peri-Gondwana.

Fossil faunal assemblages from non-carbonate facies of lower Ludlow were studied in the Bykoš section (near Bykoš village in the Prague Synform) which represents a parallel auxiliary section to the recently studied Všeradice section where integrated conodont–graptolite biostratigraphy has been established. Relatively rich macrofauna – e.g., bivalves, gastropods, cephalopods, crinoids and ostracodes provided important data for paleoenvironmental reconstructions. Preliminary processing of graptolite faunas obtained from the Bykoš section confirmed the presence of graptolite biozones *vulgaris, nilssoni* and *progenitor* that enable a detailed correlation with Baltica. Graptolite assemblages of this time interval are the richest in global scope.

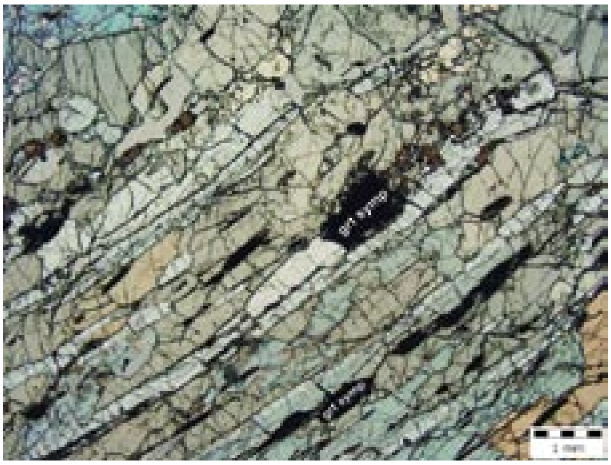
No. 205/09/1170: **Upper mantle beneath neovolcanic zone of the Bohemian Massif: xenoliths and their host basalts** (P. Špaček, Geophysical Institute of the Academy of Sciences of the Czech Republic, v.v.i., *L. Ackerman* & *J. Ulrych*; 2009–2012)

The research continued in several areas. Garnet (Grt) decomposition was documented in mantle xenoliths from Zinst (Bavaria, Germany) containing complex, fine-grained, zoned Opx-Sp-Plg symplectites representing garnet pseudomorphs. These have been studied in detail to understand the relative timing and mechanisms of garnet breakdown in the sub-volcanic upper mantle. The current research suggests the multi-phase process including (1) the pre-volcanic, relatively slow reaction Ol+Grt→Opx+Cpx+Sp related to lithospheric thinning in the Tertiary or lithospheric thinning/underplating in the Permian; (2) high-temperature (1,200–1,300 °C) isochemical breakdown of Grt to Al-Opx+Al-Sp+An symplectite, most likely related to the underplating of the sampled mantle by Na-rich (carbonate-rich) magmas in the Oligocene, and (3) syn-volcanic (Oligocene), isochemical breakdown of Grt to Al-Opx+Al-Sp+An ultrafine-grained symplectite + local penetration of basanite magma into xenoliths and related transformations of the symplectites. Element transfer during garnet decomposition was studied by the *in situ* LA-ICP-MS analyses. In general, laser ablation profiles from cores (Zone IV) to rims (Zone III) reveal a significant LREE (La, Ce, Pr, Nd), LILE and other trace element (e.g., Li, U) enrichment coupled with Zr-Hf depletion towards the rims. These chemical features, as well as microstructural observations, suggest that garnet decomposition was likely associated with the introduction of mantle-derived melts and/or fluids.

The nature and origin of Quaternary volcanism is poorly understood. We studied several localities (e.g., Železná Hůrka – Fig. 19) of Plio-Pleistocene volcanism in terms of major/trace element geochemistry, Sr-Nd isotopic composition and K-Ar age. Based on our data, volcanism took the place between 6 and 0.26 Ma, and two volcanic series were distinguished (basanitic and melilitic). The former is older and more primitive in terms of Sr-Nd isotopes, while the latter is younger and shows partly evolved Sr-Nd signatures. From the trace element composition it is clear that parent magmas underwent only a very limited process of assimilation-fractional crystallization. Conversely, trace element variations in both series can be explained by mixing of asthenospheric and metasomatized mantle. The mantle xenoliths are extremely rare in Quaternary volcanics, but it is clear that mantle composition is different in Western Bohemia (metasomatized) from that in the Northern Moravia (depleted).

Cenozoic alkaline basalts from the Bohemian Massif contain abundant mantle peridotite xenoliths. Additionally, rare pyroxenite xenoliths (wehrlites, olivine-bearing clinopyroxenites and websterites) are found. We studied pyroxenites from Dobkovičky, Kuzov (both in Ohře/Eger Graben), Kozákov and Lutynia. The studied xenoliths have different textures and some of them show typical cumulate textures (Dobkovičky). In one xenolith from Kozákov, well-developed symplectites after pre-existing garnets were discovered (Fig. 20). The pyroxenites from Kozákov, Dobkovičky and Lutynia yield a range of two-pyroxene equilibration temperatures from 820 to 900 °C. In contrast, the Kuzov websterite has a higher equilibrium temperature of 1,050 °C. The #Mg numbers of clinopyroxene and orthopyroxene from Kozákov and Lutynia fall within the same range as reported for peridotite, and the trace element clinopyroxene composition from the Kozákov pyroxenite suggests its formation from basaltic melt derived in the spinel-bearing peridotite stability field. In contrast, the Dobkovičky clinopyroxenite shows a lower #Mg and, taking into account this low value and its texture, it is likely that it represents a cumulate from the host basalt.

■ **Fig. 19.** Quaternary scoria cone of Železná Hůrka (photo by J. Ulrych)



■ **Fig. 20.** Garnet symplectite lamellae in clinopyroxene from the Kozákov pyroxenite (photo by L. Ackerman)

In mantle xenoliths from Lutynia, the origin of "tablet" grains of olivine – near-perfect idiomorphic olivine grains growing at the expense of old, deformed olivine grains – was studied using a detailed EBSD mapping and small-scale microprobe compositional profiles. These analyses confirmed a preferential development of (010) and the important role of crystal anisotropy during static, liquid-assisted recrystallization of olivine.

No. 205/09/1918: **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 ASCR, M. Tesař, M. Štír, J. Polívka, *J. Rohovec*, *P. Kubínová* & *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. Pollutant input is evaluated in liquid and solid samples by ICP EOS and ICP MS technique, respectively. The samples are collected for selected rain/fog events at experimental sampling sites taking into account the local and distant pollution sources.

The experimental work was performed applying the already tested and validated methods of samples collection and analysis. Samples of throughfall, precipitation on a free area as well as additional samples of stream water were collected by the co-investigator at the Lesni potok site. The majority of the analysed liquid samples were collected by the principal investigator of the project.

Liquid samples were filtered through the 0.45 µm filtration nitrocellulose discs and acidified by ultrapure nitric acid before being analysed. In liquid phase dissolved macroelements (Al, Ca, Fe, K, Mg, Mn, Na, S, Si) were quantified by ICP EOS technique on the Intrepid Duo instrument. The trace and ultratrace elements (As, Ba, Be, Cd, Co, Cs, Ni, Pb, Sr, Tl, Th, U, rare earths) were quantified by ICP MS technique on the Element II instrument applying the cyclone nebulizer. The set of elements already quantified on the Element II was extended to phosphorus, as the ICP MS technique was proved to be more precise and sensitive for the quantification of P than the ICP EOS technique. The basic anions (Cl, NO_3, SO_4, PO_4) in the liquid samples were quantified by ion-chromatographic technique on HPLC. A comparison of the total amount of sulfur present in the samples with the sulfate amount quantified by HPLC demonstrates that practically all sulfur is present as a sulfate one. In total, 133 liquid samples were analysed in the 2011 project year.

In about 1/3 of the analysed liquid samples the lead concentration was sufficient for the study of isotopic ratios of this element. In the previous year of the project it was found that the isotopic ratios $^{206}Pb/^{207}Pb$ and $^{208}Pb/^{206}Pb$, respectively, can be used as parameters reflecting the source of lead, i.e., the source of contamination. The isotopic ratios in a region of 1.17 and 2.00, respectively, can be interpreted as related to lead arising from coal burning processes. Due to the lower occurence of the ^{206}Pb, ^{207}Pb in natural materials, a higher concentration of total Pb is needed for a precise quantification of the isotopic ratios in such samples.

Solid particles collected on filters by filtration of the total precipitation samples represent a solid phase equilibrated with the liquid phase. The filters togehter with the collected particles were decomposed before analysis by the action of concentraded nitric and hydrofluoric acid in a microwave Mars unit applying the methodology established in 2009. The decomposition was practically quantitative, the filtration disc (nitrocellulose) was conveted to gaseous by-products escaping after opening of the decomposition cell. The excessive amount of acids was removed by evaporation, and the samples were diluted by ultrapure water and analysed by the sampe ICP-EOS and ICP-MS procedures as liquid samples.In total, 69 samples of solid particles were analysed. Practically all samples of the solid particles were concentrated enough for lead isotopic ratios study.

The interpretation of the numerical data obtained is based on the results gained in this project during previous years. While the macroelement cations (K, Na, Mg and partially Ca) are typically present as constituents of the liquid phase, being compensated by SO_4 and Cl anions, others (Al, Fe, Si) represent typical consitutents of the solid phase. The phosphate anion is also typically present in the solid phase. Further, it is possible to divide the micro and ultramicro elements present into several groups. Microelements with non-metallic or metalloid character (As) are transported together with the solid phase, indicated by the increased concentration of As bound on solid particles. At the same time, this group of microelements is quite easily released back into the liquid phase. Transition metal microelements with typical metallic character like Co, Ni, Cd, and further Ba, Tl are transported with the solid state, but they are not released back in an appreciable extent. In the liquid phase, only about 5 % of them are present. An even lower proportion of trace elements like Th, Pb is present in the liquid.

No. 206/09/1564: **A multi-proxy paleoecological investigation of the unique sediments from the former Komořanské jezero Lake, Most Basin, Czech Republic** (J. Novák, University of South Bohemia, České Budějovice; V. Jankovská, Institute of Botany, ASCR, v. v. i., Brno & *L. Lisá*; 2009–2013)

The Komořanské jezero Lake formed the largest water body (ca. 25 km^2) in the area of the Czech Republic and was nearly completely drought in the 19th Century. Its origin is linked with the tectonic subsidence of a 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. In the 2009 season, these cores were precisely sampled and a number of palaeocological analyses were applied.

Sediment profiles of the Komořanské Lake including the interval of 7200–2100 yrs BC were studied by means of a multi-proxy analysis. The data gathered were compared to settlement density. Diatom inferred total phosphorus (di-TP = 60–80 $\mu g.l^{-1}$) and pH (di-pH = ±7.6) along with concentrations of analysed elements indicated very stable aquatic conditions during the period 7200–2700 BC. An enhanced concentration of microcharcoals with 4 peaks of ca. 400 yrs amplitude was recorded at ca. 6500–4800 BC corresponding to the Atlantic period. Natural fires of mixed-oak forest were suggested by the regular nature of burning and undetectable human impact. No evident shift in the fire regime and aquatic environment were detected at the Mesolithic/Neolithic border at ca. 5600 BC. The high and steady microcharcoal concentration at ca. 4800–2900 BC corresponding to the Late Neolithic was apparently caused by alternations in land use.

The diploma thesis of Daniela Valentova was finished during this project with the title "Geochemical study of the lacustrine deposits of the extinct Komořany Lake".

COMPLETE REFERENCE IS: CÍLEK V., BÁRTA M., LISÁ L., POKORNÁ A., JUŘÍČKOVÁ L., BRŮNA V., MAHMOUD AM., NOVÁK J. & BENEŠ J. (accepted for print): The origin and life cycles of the Lake Abusir, Cairo, Egypt. – *Quaternary International*.

No. P210/10/1105: **Trace elements in igneous quartz – frozen information about silicate melt evolution** (*K. Breiter*, *M. Svojtka*, *L. Ackermann*, *Z. Korbelová*; J. Leichmann & K. Švecová, Masaryk University Brno; 2010–2012)

The aim of the project is the utilization of the chemical composition of magmatic quartz to better understanding of the genesis of Variscan granites and rhyolites in the Bohemian Massif.

Quartz is the relatively most stable rock-forming mineral during majority of post-magmatic processes. Quartz, its internal texture and chemical composition, provide detail information about pT and chemical evolution of silicic magma.

Internal texture of quartz crystals visualized by cathodoluminescence (CL) and *in situ* determination of trace element using laser-ablation ICP-MS is combined with existing data of whole-rock chemistry, accessory mineral assemblage, isotopic geochemistry to reconstruct the evolution of several contrasting types of Variscan granitoid magmas in the Bohemian Massif.

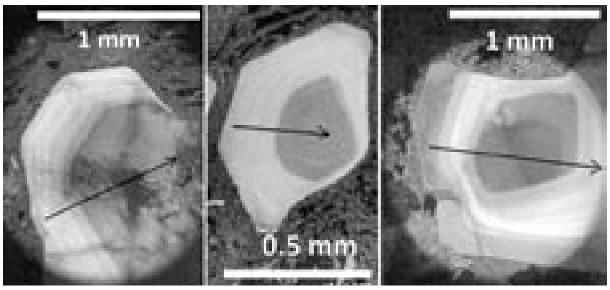
Geological background. The late Variscan Altenberg-Teplice Caldera (ATC) is situated in the Eastern Krušné Hory Mts./ Erzgebirge on both sides of the Czech–German border. The studied borehole Mi-4, situated in the western part of the ATC, crossed all volcanic units of the caldera fill in the thickness of 950 m. According to Breiter et al. (2001), the ATC consists of five volcanic phases. Two oldest units composed of the basal rhyolites (BR) and overlying dacites (DC) are calc-alkaline in character and may probably represent a product of high-degree melting of a immature material of the lower crust. Three younger units of Teplice rhyolite (TR1-3) are high-K calcalkaline in character, significantly enriched in Rb, Th and HREE. This younger part of the ATC should be interpreted as a product of low-degree high-temperature melting of much more evolved crustal material.

Methods. The inner structure of quartz crystals was studied using cathodoluminescence with a hot-cathode (HC 2) and scanning luminescence (CAMECA SX100 microprobe) at the Masaryk University, Brno. Trace element concentrations in polished quartz thin sections (> 100 μm) were measured at Institute of Geology, Academy of Sciences CR in Prague using a Thermo-Finnigan Element 2 sector field ICP-MS coupled with 213 nm NdYAG laser (New Wave Research UP-213). The laser was fired at a repetition rate of 20 Hz, laser energy of 8-10 $J.cm^{-2}$, 55 μm beam size of 100 μm long patterns. The ablated material was transported by high-purity He gas from the laser ablation cell at a flow rate of 0.8–0.9 $l.min^{-1}$. Data for the gas blank were acquired for 35 s followed by 100 s of laser ablation signal. The washout time was 90 s between the measurement of individual laser spot lines.

Relation between cathodoluminescence and chemical composition of quartz. Quartz grains from the ATC show intensive zonning in both modes of observations. The oldest unit, BR is characteristic with nearly violet luminescence with weak zonning. In many cases these are just fragments of much larger grains and there are carbonate veins going through the quartz. In the DC unit, quarz grains have dark blue luminiscence and no zoning. Quartz grains in three younger units TR1–3 have blue luminescence in hot CL with a dark center and lighter margins. Significantly more intensive zonation appears in scanning luminescence.

Very tiny zones symmetrically rim the core; dissolution of individual zones could be often documented. Some grains appear as fragments only. Majority of grains were corroded during their evolution. This has resulted in sometimes very bizarre shapes of grains. Quartz grains from the uppermost extrusive unit, rhyolite lava (TR3) are mostly rounded (2 mm diam.), often with granophyric overgrowth.

Quartz grains from the upper part of the TR3-rhyolite unit show a remarkable zoned structure. The CL-patterns of grains correlated well with their chemical composition. Crystallization of all quartz grains started with Al-rich and Ti-poor core, dark in CL, i.e. from the relatively evolved Si-rich melt in the upper part of the stratified magma reservoir (compare Breiter 1997; Muller et al. 2005). Later, the grains equilibrated with less evolved and relatively Si-poorer and Ti-richer melt in the deeper part of the magma reservoir, and the outer zone, rich in Ti and poor in Al, crystallized (Fig. 21). Borders between core and rims are sharp in some cases (crystal A with 5→45 ppm Ti and 380→125 ppm Al in core-to-rim profille), or transitional (crystal B with 5→45 ppm



■ **Fig. 21.** Typical patterns of cathodoluminescence of quartz from the Teplice rhyolite. From left to right: crystal A, B and C. The measured profile is marked by an arrow. For further explanation see text (photos by K. Švecová and M. Svojtka).

Ti and 350–100 ppm Al). Even more complicated evolution was experienced by crystal C with 25→100 ppm Ti (from core to rim) and nearly homogeneous Al (100–125 ppm). Movement of the crystals between different parts of the magma reservoir can be explained by tectonically driven magma flow rather than thermo-gravitational forces in high-viscose silica-rich melt.

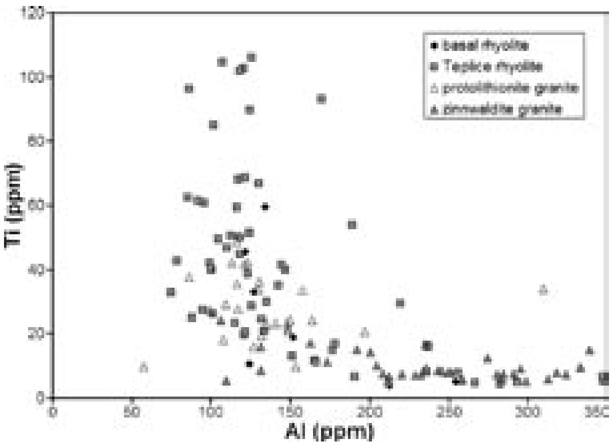
Al/Ti-ratio of igneous quartz as a mirror of magma fractionation. A decrease in the Ti content and an increase in the Al content (i.e., an increase in the Al/Ti-ratio, Fig. 22) in quartz are believed to be one of the most pregnant indicators of granitic magma fractionation (Breiter & Müller 2009).

Quartz from the basal rhyolite (BR) is Ti-poor (60→5 ppm) and moderately Al-enriched (120→250 ppm), which is typical for quartz crystallized from the peraluminous S-type melt. The following sequence of comagmatic A-type rocks reflects the complicated crystallization history of quartz phenocrysts within the caldera magmatic system.

Strongly zoned quartz grains from TR3 rhyolite (5→100 ppm Ti, 200→100 ppm Al) document nearly adiabatic movement of magma from the deep primary magma herd at the depth of about 20–25 km to the temporal sub-caldera reservoir at the depth of 5–10 km.

Biotite granite (BiG) started fractionation of the new magma portion. This quartz is only slightly zoned and, in contrast to the TR3-quartz, its crystallization passed from the Al-poorer cores to Al-enriched rims (50→10 ppm Ti, 100→200 ppm Al).

Advanced fractionation of the zinnwaldite (→lepidolite) granite resulted in the crystallization of the most evolved quartz grains (20→5 ppm Ti, 150→350 ppm Al).



■ **Fig. 22.** Contents of Ti and Al in quartz from rhyolites and granites from the Tepliec caldera (original).

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No. P210/10/1309: **Behaviour of geochemical twins Al/Ga and Si/Ge in different types of acid silicate melts** (*K. Breiter*, *L. Ackermann*, *Z. Korbelová*; V. Kanický, T. Vaculovič & N. Kohoutková, Masaryk University Brno; 2010–2012)

The aim of the project is to define the contents of Ga and Ge and establish the Al/Ga- and Si/Ge-ratios in different types of natural silicate melts (granitoids) representing partial melting and following evolution (fractional crystallization, mixing, reaction with fluid) in different positions in the Earth crust. The contents of Ga and Ge are studied in whole-rock samples and in major rock-forming minerals – quartz, feldspars, micas, and amphiboles etc. Evolution of Si/Ge and Al/Ga will be compared with the K/Rb, Zr/Hf, Nb/Ta and Y/Ho of the analyzed rocks. A model of Ga and Ge behavior in the magmatic process will be developed.

Studied samples. Several contrasting types of fractionated granite plutons and related volcanics of Paleozoic age occurring within the Bohemian Massif were studied during the first and second years of the project solution: (1) South Bohemian Pluton – complex of Variscan peraluminous granites in the southern Bohemia a northern Austria. Pluton intrudes in several pulses (330–315 Ma) and comprises of relatively older two-mica granites (Mrákotín Čímĕř and Aalfang types), younger fractionated two two-mica granites. These rocks represent product of voluminous melting of crustal rocks (Breiter & Koller 1999); (2) Highly fractionated peraluminous and phosphorus rich rare-metal granites of Nejdek-Eibenstock pluton in the western Erzgebirge represent water and fluxing agents enriched melt. Its fractionation terminated in the extremely fractionated P, F, Na, Li, Sn, Nb, Ta, W-enriched Podlesí stock, and (3) Late-Variscan volcano-plutonic complex of the Eastern Erzgebirge comprises older strongly peraluminous (S-type) "basal rhyolite", younger slightly peraluminous (A-type) "Teplice rhyolite" and the youngest A-type rare metal granite (Breiter et al. 1999).

Analytical processing. Solid-state samples of silicate rocks were analyzed in Masaryk University Brno by fusion with $LiBO_2$, dissolved in 0.7 M HNO_3 and filled in with deionized water. Blank and reference material (GBW07406) were prepared using the same technique.

Solution was diluted 10x before every measurement; previously verified parameters in ICP-MS (Agilent, 7500CE, Japan) were set up. Se was used as an external standard, which allowed reduction of oversalting effects.

Thin polished sections of rocks were measured using LA-ICP-MS (Masaryk University Brno on the instrument New Wave, USA), and were calibrated in relation to certified reference material NIST 612 and normalized to results from EPMA (Cameca SX100). All measurements were conducted according to previously set parameters. Si was chosen as a comparison element.

Five ablation spots were measured in every rock grain (K-feldspar, Na-feldspar, biotite, quartz, topaz, garnet) in each of 40 samples.

Whole-rock contents of Ga and Ge. Ga and Ge abundances of the analyzed granites and rhyolites are summarized in Table 4. The content of Ga ranges from 8 to 77 ppm. All the less and moderately fractionated rock types fall in the interval of 15–35 ppm. The highest values are found in strongly fractionated rare-metal granites of the A-type (up to 40 ppm) and namely strongly peraluminous granites of S-type (up to 77 ppm). The lowest contents are found in hydrothermal greisens of peraluminous granites (less than 10 ppm). The Al/Ga ration varied from ca. 7,000–9,000 in greisens to ca. 2,200–1,200 in the most fractionated granites. The Al/Ga ratio during magmatic fractionation generally decreased (due to increase of the Ga-content in rock), but increased during post-magmatic high-temperature hydrothermal greisenization (strong decrease of Ga). So, the content of Ga is much more variable than the content of Al.

Ge contents vary from 1.1 to 8.8 ppm. Most of the moderately fractionated granitoids range from 1.5 to 2.5 ppm, the highly fractionated from 2.5 to 5 ppm. The highest values, about 8 ppm, are found in metasomatic greisens. The Si/Ge-ratio varied from ca. 570,000 in less fractionated two-mica granites to ca. 73,000 in greisens. This ratio generally decreases during magmatic fractionation, for example in the western Erzgebirge from ca. 300,000 in biotite granites to ca. 130,000 in albite-zinnwaldite granite.

Contents of Ga and Ge in co-existing rock-forming minerals. Results of analyses of Ga and Ge in silicate rock-forming minerals are presented in Table 5.

The highest contents of Ga and Ge among all common granite-forming silicate minerals are found in micas of the biotite-zinnwaldite series. Values of Ga vary from ca. 60 to ca. 100 ppm in Cínovec and between 100–150 ppm in the Western Erzgebirge, but without a clear correlation to the fractionation grade. The highest Ge values in mica are found in Cínovec, mostly between 15–25 ppm and somewhat lower in the western Erzgebirge (mostly 3–5 ppm).

K-feldspars contain about 20–40 ppm Ga and 2–3 ppm Ge, albite contains c. 30–60 ppm Ga and 2–4 ppm Ge. There are only small differences in the Ga and Ge contents in feldspars among particular plutons. Quartz generally contains only about 1.0–1.5 ppm Ge and less than 0.5 ppm Ga.

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No. P210/10/1760: **Cryogenic cave carbonates: Mechanisms of formation and relationship to permafrost depth** (*K. Žák*, *M. Filippi*, *R. Živor* & *R. Skála*; 2010–2012)

The main project task is the study of coarse-grained cryogenic cave carbonates (further CCC) formed in caves during freezing of karst waters, and developing them as a tool for the estimation of former permafrost depths. Samples collected during field campaigns in 2010 and 2011 in caves of Czech Republic, Slovakia, Poland and Russia were photo-documented in the field and/or in

		n	Ga	**Ge**
South Bohemian Pluton	two-mica granites	14	16-33	1,3-2,2
	topaz-muscovite granites	2	26-30	4,0-5,4
Eastern Erzgebirge	S-type rhyolites	3	18-22	1.3-1.6
	A-type rhyolites	3	18-21	1.1-1.6
	A-type granites	4	32-40	2.5-3.7
Western Erzgebirge	S-type granites less fractionated	1	21.7	2.0
	S-type granites strongly fractionated	6	32-37	3.3-5.0
	S-type granites extremely fractionated	4	52-77	3.9-4.3
	greisens	2	8-11	7.6-8.8

■ **Tab. 4.** Contents of Ga and Ge in the studied granites and rhyolites (ppm).

pluton	mineral	n	Ga	Ge
Cínovec	quartz	26	<1	<1
	albite	10	29-61	0-4
	Kfs	25	25-40	0-4
	Li-Fe mica	25	38-110	5-23
Nejdek	quartz	13	<0.5	0.7-2.2
	Kfs	7	15-37	1.5-4.2
	Li-Fe mica	9	101-120	3-9
Podlesi	quartz	7	0.1-0.2	1.0-1.4
	Kfs	7	22-77	2.1-3.0
	Li-Fe mica	7	134-188	3.3-5.2
	S-type granites extremely fractionated	4	52-77	3.9-4.3
	greisens	2	8-11	7.6-8.8

■ **Tab. 5.** Contents of Ga and Ge in silicate minerals (ppm).

the lab and studied under binocular microscope. Selected samples were studied by set of mineralogical and geochemical methods including extensive carbon and oxygen isotope studies. At least one sample of CCC from each locality was dated by the U-series method. Cave maps of the studied localities were gathered from local scientific institutions or caving clubs. In some cases the cave maps were improved by our own cave and surface mapping. As a result of these extensive works, all data necessary for preparation of the main planned output of the project, a paper estimating minimum Last Glacial permafrost depth of Central Europe, were gathered. The data show that the proved minimum permafrost depth during the Last Glacial Maximum in the Rheinisch Slate Mountains in Germany, Bohemian Karst and Northern part of Moravia in the Czech Republic, areas of Carpathians in Slovakia located at elevations below 1,000 m a.s.l., and southern part of Poland was in the range between 30 and 70 m under the surface. In mountainous regions (Alps, High Tatras) the CCC were found at depths of more than 250 m under the surface. The CCC discovered by Russian colleagues in caves of the Ural Mts. were also studied. All samples were photo-documented, studied by stable isotope geochemistry and dated by U-series.

One of the sub-topics developed in the first and second project year was finished, i.e., the study of a specific type of cave pearls occurring in ice caves of Slovakia and Romania. The study resulted from cooperation with colleagues from several institutions in Slovakia, Romania and United States. These pearls are formed by a combination of cryogenic and non-cryogenic precipitation in the periglacial zone of ice caves.

No. P210/10/2351: **Palaeomegnetism & geochemistry of volcanic rocks: Implications to palaeosetting and development of the Prague Basin (Late Ordovician–Early Devonian)** (*P. Pruner*, *P. Schnabl*, *P. Štorch*, *L. Koptíková*, *G. Kletetschka*, Z. Tasáryová, T. Hroch, Š. Manda, J. Frýda, V. Janoušek & P. Kraft, Faculty of Science, Charles University, Praha; 2010–2014)

Twenty new localities were visited in the field and effusive + intrusive bodies were determined. Selected twenty-nine suitable outcrops (sites) were sampled for laboratory studies in 2011. Biostratigraphic dating was used for the determination of the ages of underlying (for effusives) and ambient (for intrusives) rocks throughout the entire sampled dataset. Furthermore, volcaniclastics of Ordovician (Červený Vrch) and Silurian (Bykoš, Kosov) age were sampled for stratigraphic correlations.

Based on the whole-rock and electron-microprobe analyses and magnetomineralogical characterization of collected samples, suitable localities (Svatý Jan and Kosov volcanic centres, late Ordovician intusives–Chlustina) were chosen for palaeomagnetic measurements followed by subsequent sampling of basalts and their contact aureolas, underlying and overlying rocks.

Three sets of different acid dissolution experiments were performed and applied on insoluble residues from the Lower Devonian (Lochkovian) limestones from the Požár 3 section near Prague-Řeporyje. The effect of acids on the quality and quantity of the acquired acid-insoluble residue was studied. Mineral compositions, structures and physical characteristics of these residues were revealed (Koptíková et al. 2011) using SEM imaging, X-ray analyses, clay mineral analyses, magnetomineralogical analyses (identification of magnetic carriers, rock-magnetic measurements). Quartz, clay minerals (illite, kaolinite), feldspars (microcline), micas (muscovite, biotite), pyrite and gypsum were identified as the dominant phases.

A database of geochemical characteristics with re-evaluated biostratigraphic ages was constituted with the addition of samples collected in 2011.

Magnetic susceptibility (MS) and gamma-ray spectrometry (GRS) curves were established through the Lau Event interval at the Požár 1 section (Silurian, Ludlow). Magnetomineralogical and detailed rock-magnetic properties measurements are in progress now. A more detailed and accurate MS curve was established for the uppermost Ordovician (through the so-called Perník bed interval, Kosov Formation) at the Levín section, the sampled stratigraphic range was extended.

Fifteen Silurian intrusions and lava flows were sampled for paleomagnetic and rock-magnetic studies. Sections (sites): Jelínkův mlýn – dike and contact aureole near a spring and xenoliths in the same dike 200 m NE away on the ridge. Černidla (another two sites), Kosov Quarry (another five sites), Lištice (three sites) – an old small quarry uphill, Sv. Jan pod Skalou – a dike in the slope in front of a bridge, Chlustina – pilot sampling, Hostim wayside cross – this rock type is suitable only for rock-magnetic investigation. Palaeomagnetic study of samples from new localities and interpretation were selected in order to allow the separation of the characteristic components of remanent magnetization (ChRM) and to determine their geologic origin. All pilot samples were subjected to progressive thermal demagnetization (TD) to 600 °C or AF demagnetization to 120 mT. A multi-component analysis was applied to each sample and revealed two to three RM components. We also analyzed samples with low magnetization from the Barrandian and compared them with Devonian carbonates from southern Holy Cross Mountains. Results of the TD technique, IRM acquisition experiments, Lowrie and fold tests help us for the identification of the time of remagnetization (Szaniawski et al. 2011). Further conclusion related to the tectonic rotations of small-scale structures.

Preliminary paleomagnetic directions acquired by thermal and alternate field demagnetization of pilot samples show typical primary Devonian and/or Silurian direction. Several sites are deeply weathered and show secondary remagnetization during the Carboniferous to the Late Permian, and/or present-day magnetic field.

We started to use new method – magnetic scanner – for the detailed studies of remanent magnetization (NRM) and rock magnetism. We developed in house system dedicated to measurement of the detailed structure of magnetism near the surface of the samples from Silurian and Devonian sections. This ability helped us to locate the sources of magnetization in the samples.

Utilization of the fossil record: We have collected corals and brachiopods that were randomized before they were deposited in these Silurian strata (Barrandian) and used their magnetic signature for the conglomerate to test whether their magnetic signature dates back to the limestone origin. We also counted tidal layers recorded in the corals to date these samples using another method.

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No. P210/11/1369: **The fate of legacy mercury in forest ecosystems in the area of the Black Triangle, Czech Republic** (*T. Navrátil*, *J. Rohovec*, *I. Dobešová*, *J. Buchtová*; P. Krám, J. Hruška, F. Oulehle, O. Myška, Czech Geological Survey, Praha; 2011–2014)

The first task was to determine the concentrations of total mercury (THg), dissolved organic carbon (DOC) and methylated mercury (MeHg) in solutions in the Lesní potok (LP), Lysina (LYS) and Jezeří (JEZ) catchments. The THg concentrations averaged during the first year of the project at 9.55 $ng.l^{-1}$ in the LP catchment (Navrátil 2011), 9.43 $ng.l^{-1}$ in the LYS catchment and 6.38 $ng.l^{-1}$ in the JEZ catchment. The absolute concentrations of THg do not reflect the degrees of pollution at individual sites but rather the concentration of dissolved organic carbon (DOC). Sites with high concentrations of DOC in stream water tend to have higher concentrations of THg. The average DOC concentration in stream water samples were 9.2 $mg.l^{-1}$ in the LP catchment, 13.5 $mg.l^{-1}$ at Lysina and 3.1 $mg.l^{-1}$ at JEZ. Additional measurements of THg were taken at Pluhův Bor (PLB) catchment located near the LYS catchment. Hydrochemical evaluation including THg (average concentration 15.1 $ng.l^{-1}$) at PLB experiencing very high streamwater pH ~ 7.7 (in contrast to extremely acidic LYS) and high DOC concentrations (on average 16.7 $mg.l^{-1}$) was summarized in a conference abstract (Krám et al. 2011). Possible proxy indicator of the contamination level at individual sites with anthropogenic Hg is the ratio of Hg/DOC ($[ng.l^{-1}]/[mg.l^{-1}]$), which averaged at 0.91 at LP, 0.94 at LYS, 0.91 at PLB and at 3.17 at JEZ. The JEZ site as the one with the highest Hg/DOC ratio is in compliance with its position inside the former Black Triangle.

Concentrations of THg were significantly higher in soil solutions than in the stream water at relevant sites due to higher DOC concentrations in the soil solutions. At LP catchment the soil solutions in beech stands contained 17.2 and 14.0 $ng.l^{-1}$ of THg in depth of 5 and 15 cm. Concentrations of THg in soil solutions of spruce plantations at LYS catchment were higher: 38.2, 37.5 and 61.2 $ng.l^{-1}$ at depth of 5, 10 and 15 cm. The most detailed sampling of soil solutions was done in the JEZ catchment and at the near NAC site. The THg concentration in soil solutions from below the organic horizons (approx. 5 cm) at beech stands reached 36.5 $ng.l^{-1}$, while at spruce stands THg concentrations at similar depth reached 49.9 $ng.l^{-1}$. At a depth of 90 cm, THg concentrations decrease to 4.9 and 2.0 $ng.l^{-1}$ in beech and spruce stands. This significant decrease in THg concentrations between 5 and 90 cm depth in soil profile was due to the decrease of DOC concentrations due to microbial activity.

As a part of the assessment of historical anthropogenic Hg deposition load, we sampled and analysed forest soils. The concentrations of THg in soils ranged from 13.7 to 679.3 $\mu g.kg^{-1}$ in the LP catchment and from 12.9 to 437.7 $\mu g.kg^{-1}$ in the LYS catchment. The highest concentrations occurred in organic horizons at both sites, while the concentrations in mineral horizons were significantly lower (an order of magnitude). Pools of mercury at individual sites averaged 541 $g.ha^{-1}$ at LP and 469 $g.ha^{-1}$ at LYS. The mineral soils in the LP catchment were about 20 cm thicker on average. The pools of MeHg will be calculated after the analysis of samples from all sites.

Significant efforts were put into the complicated analytical procedures in the first year of the project. Determination of MeHg was proved to be more complicated than THg quantification, as was expected. For the quantitative determination of MeHg the Merlin instrument produced by the PSA Analytical was used. This instrument was calibrated by a standard solution of MeHgCl of known concentration. This solution was obtained from the PSA Company in order to avoid manipulation of the highly poisonous MeHgCl in concentrated, solid form.

KRÁM P., HRUŠKA J., NAVRÁTIL T. & SHANLEY J.B. (2011): Concentrations and fluxes of toxic metals (Ni, Cr, Hg, Al) in drainage water at Pluhův Bor, a Czech serpentine catchment. – *7th Serpentine Ecology Conference Abstracts, Promoting awareness of serpentine biodiversity, University of Coimbra, Coimbra, Portugal*: 63. Coimbra.
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No. P405/11/1590: **Neolithic rondels from the perspective of micromorphologic and formative analysis** (P. Květina, Institute of Archaeology in Prague ASCR, v. v. i., Praha, Czech Republic & *L. Lisá*; 2011–2013)

The aim of the project is to obtain new answers to frequently formulated questions on the form and demise of Late Neolithic rondels using a special methodology. Micromorphological analysis combined with radiocarbon dating and the classic analysis of archaeological finds will be used to resolve specific questions concerning the existence of Neolithic rondels, especially to clarify the method and time of filling rondel ditches.

No. P405/11/1729: **Medieval Castle in alluvial plain** (M. Plaček, Archaia Brno, o. p. s., Brno, Czech Republic, L. Petr, University of Western Bohemia, Pilsen, Czech Republic & *L. Lisá*; 2011–2014)

The Medieval castle at Veselí nad Moravou represents a uniqe European site with many well preserved wooden buildings, construction elements, and unprecedented volume of organic remains. Using the multidisciplinary approach, the environmental conditions within this locality will be clarified and the anthropogenic influence on the alluvial plain formation will be determined.

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

Finished projects

No. IAA300130701: **Paleomagnetic research of karst sediments: paleotectonic and geomorphological implications** (*P. Bosák*, *P. Pruner*, *S. Šlechta*, *P. Schnabl*, *S. Čermák*, *J. Wagner*, N. Zupan Hajna, A. Mihevc, Karst Research Institute, SRC SASU, Postojna, Slovenia, H. Hercman, Institute of Geological Sciences, Polish Academy of Sciences, Warszawa & I. Horáček, Faculty of Science, Charles University, Praha, Czech Republic; 2007–2011)

The project was focused on obtaining new data concerning the kart evolution and speleogenesis in individual karst regions of central Europe with different tectonic evolution and setting and on their utilization in palaeotectonic reconstructions. Palaeomagnetic and magnetostratigraphic research was carried out applying the high-resolution sampling and data processing, which appeared as the best during previous works. Karst sediments in karst regions of Czech Republic, Slovak Republic, Slovenia and Poland were sampled. We confirmed our previous data on age of karst sediments; in most studied areas, they are much older than expected earlier. The new data allow unusual and novelty interpretation of geomorphological and geological evolution of the respective area (e. g., Belianske Tatry Mts. in Slovakia with impact to whole Carpathian geomorphology scheme; see p. 8; and in the Classical Karst of Slovenia).

High-resolution magnetostratigraphy was applied both to clastic and chemogenic karst sediments. Owing to correlate-age type of results, the method was strongly contributed by numerical-ages dating methods (especially Th/U and ^{14}C) and, where good material is available, also other dating methods (like apatite fission-track analysis). Unfortunately the application of classical biostratigraphy methods is limited due to the scarcity of organic remains, especially in internal cave facies. Nevertheless, new finds of microfauna (Moldovan et al. 2011) enlarge the possibility of further more detailed biostratigraphic research even in pre-Quaternary deposits. Fauna enabled to calibrate the magnetostratigraphy results with the global magnetostratigraphic scale in some profiles (e. g., Koněprusy, Czech Republic; Belianská Cave, Slovakia; Račiška pečina, Snežna jama, Divaška jama and Černotiče, Slovenia).

The generally high age of cave fill at most studied sites in Slovenia contributed substantially also to the knowledge of unroofed caves (caves on present karst surface with denuded roof *sensu* Mihevc 1996). The fill age is always over 1.77 Ma. It was proved that the evolution of the main cave system, now still situated deeply underground but on differing altitudes and in different geomorphological units, is mostly pre-Pleistocene or pre-Quaternary (base at 2.6 Ma; see summary in Zupan Hajna et al. 2008, 2010). The altitude difference was caused by differentiated (neo)tectonic movements in the active collision zone of African and Eurasian lithospheric plates (Vrabec & Fodor 2006). The obtained sets of palaeomagnetic data, especially inclination (*I*) and declination (*D*) values of remanent magnetization, clearly indicate rotations of individual tectonic blocks and/or regional tectonic/geologic units since the deposition of respective karst sediments. Acquired database proves counterclockwise rotations of tectonic units of different orders from the Classical Karst (on SW) up to zone of Periadriatic Fault (on NE), i. e., in accordance with the detected rotation of the Adria block. Our data supply knowledge on rotations younger than 6 Ma in areas with missing Middle Miocene and younger correlate surface deposits (fill of Paratethys and younger tectonic basins). Palaeomagnetic results obtained from cave fills can be correlated with palaeotectonic data from Northern Dinarides, i. e., they provide reliable data for the analysis of rotations in the region.

Two sites provided unique study materials – altered and redeposited volcaniclastic sediments. Siliciclastic fill in the Snežna jama Cave (Kamniško-Julijske Alps) represented slightly bentonitized Upper Oligocene volcaniclastics from the nearby submarine Smrekovec volcanic centre re-deposited over a short distance by sinking streams before the uplift of the Raduha tectonic block. Previous magnetostratigraphy results from complex speleothem (flowstone) profile near the cave entrance indicated ages from ca. 3.5 to more than 5 Ma. New study of siliciclastic fill deep in the cave indicates the same age both by magnetostratigraphy and by rests of small mammals. Over 900 m deep entrenchment of rivers around the Raduha Massif in the last 2.6 Ma correlates the geomorphic evolution of Southern Alps with classical areas of the Northern Calcareous Alps (Mihevc et al. 2010; Bosák et al. 2012). The second cave – Grofova jama (Classical Karst, at the border with Italy) was completely filled with strongly weathered, re-deposited and strongly sieved volcaniclastic material. Apatite fission-track analysis yielded the age of ca. 21±7 Ma indicating a source of volcanism in the Padova region in northern Italy. Owing to the fact that the cave is situated on top of a hill, the reconstruction of palaeogeomorphological situation is very complicated. Cave is a remain of a phreatic system. Therefore we assume that it represented the outflow system from the palaeopolje. The palaeopolje was originally covered by marshes. West trade winds brought fine volcanic ash which was deposited in marshes and rapidly argillized under tropical climatic conditions. After the tectonic uplift started, sediments were re-deposited and strongly sieved underground in a phreatic system with abundant loops, resting only the finest clay and silt-sized particles in presently accessible profiles. The fill is the oldest of all unlithified cave fills studied in Slovenia (a number of lithified real paleokarsts fills of Eocene and older age exist, e. g., Otoničar 2007).

Palaeontological, biostratigraphic and paleoecological analyses of the biotic fossil record were performed on high-volume sediment samples. In the Divaška jama (Classical Karst, Slovenia), finds of *Mimomys* cf. *pliocaenicus* confirmed the results of earlier Th/U and magnetostratigraphy dating, i.e. pre-Olduvai age from the MN 17 biozone. The central part of the Černotiče Quarry opened karst cavity with fragmentary rests of *Sorex* cf. *fejfari*, *Allocricetus* sp., *Apodemus* cf. *atavus*, *Apodemus* cf. *mystacinus*, *Mimomys* sp. 1, *Mimomys* sp. 2., cf. *Clethrionomys*, cf. *Capreolus* , cf. *Xenocyon* – i. e. biozone NM16 to NM 17 somewhat younger than finds in Černotiče 2 site in the same quarry (Horáček et al. 2007). Finds in Plešivec Quarry (Český

Karst, Czech Republic) yielded rich fauna from border zone of MN 15/MN 16 biozones.

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

Introduction. Silicate melt inclusions (MI) are microscopic samples (usually 1–200 μm) of silicate melt enclosed in phenocrysts of intrusive and extrusive igneous rocks. Many MI are chemically representative of the magmatic melt phase and thus provide unique information on magmatic and magmatic-hydrothermal processes. Melt inclusion from felsic magmas, especially quartz, are of particular interest because these magmas form a large part of Earth's crust, some of them exhibit explosive events and/or are genetically associated with a variety of mineral deposits (Webster &Thomas 2006).

The most recent models of evolution of fractionated granites and related mineralizaions are based on the study of melt inclusions: decomposition of evolved silicate melt into two immiscible melts (peraluminous *vs.* peralkaline, Thomas et al. 2006b), or silicate vers. salt melt (Naumov & Kamenetsky 2006). The water- and salt-rich melt types should be responsible for metal transport and enrichment.

Methods used for the MIs-study. Homogenization: MI are crystallized, glassy, or range between both physical states. Some MI may contain a bubble of fluid or vapor. Homogenization of MI before analysis *via* heating, remelting and quenching, to become homogeneous glass, is necessary. Re-homogenization of crystallized MI requires elevated temperatures and extensive heating duration.

The sample was closed in H_2O-bearing silver capsule and heated in cold-seal hydrothermal vessel at 800 °C and 100 MPa for 3–5 days. This approach minimizes decrepitation of inclusion and reduces H_2O loss. After quenching, the samples were polished and then used for microscopic study and chemical analyses.

Chemical analyses: While sufficient international standards with appropriate content of water do not exist, we prepared two new standards from remelted and quenched rare-metal granites from both studied localities, oversaturated in water. Major- and trace-elements composition of these glasses was measured using classical chemical methods.

Abundances of major and some minor elements in homogenized MI glass were determined by electron microprobe analysis (CAMECA SX100 GLÚ). The accelerating voltage and beam current were 8 kV and 4 nA, respectively, with beam diameters between 2–5 μm for analyses of Na, K and F; and a 15 kV/4 nA for Si, Ti, Al, Fe, Mn, Mg, Ca, Rb and P. The following standards were used: fluorite (F), jadeite (Na, Al), quartz (Si), leucite (K), periclase (Mg), apatite (Ca, P), rutile (Ti), spinel (Mn), magnetite (Fe) and RbCl (Rb).

For microprobe analyses, we applied the method "extrapolation to the time zero". This method neutralizes the rapid escape of alkalis, namely sodium, during the several first seconds of the measurement. Simultaneously, we minimized the "dead time" of measurement between the localization of the electron beam on the analyzed area and the real start of the measurement. Applying this procedure to our glass standard, the result of Na measurement was in good agreement with classical chemical method.

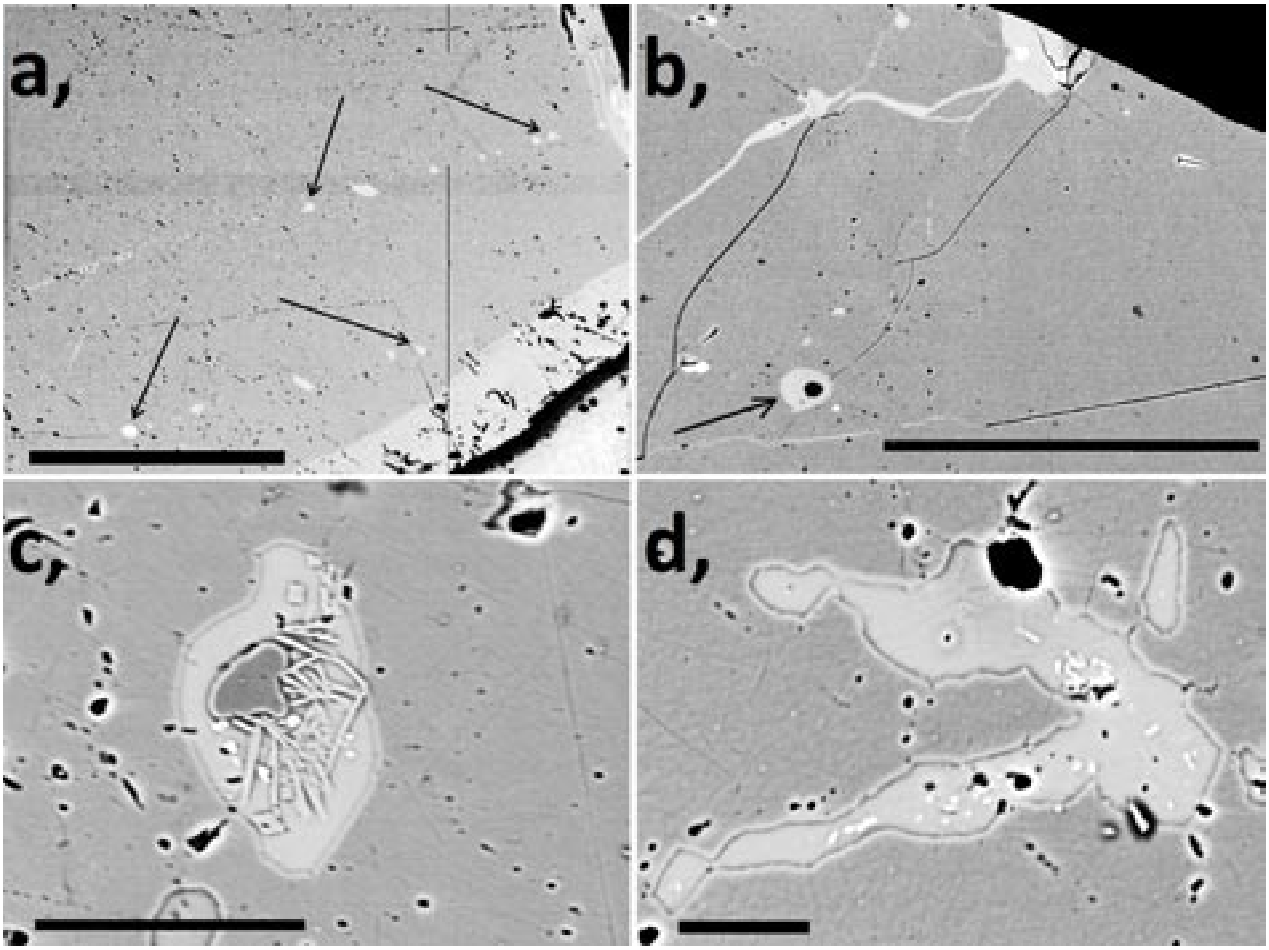
Studied localities. We will study evolution of three magmatic systems; each of them composed of several geologically well-defined evolutionary phases. A comparison of MI in different quartz generations from the same system provides information about the evolution of chemistry of the melt during fractionation of particular evolved melts. Comparison of two different granite systems (highly- and slightly-peraluminous) with a complex pegmatite will help to understand differences among fractionation of granites and pegmatites and evaluate the influence of pressure (=depth) of crystallization to the shape of fractionation.

Podlesí is a type locality of strongly peraluminous F, P-rich granite systems in western Krušné Hory/Erzgebirge Mts. (Breiter et al.1997). The Podlesí granite suite forms a tongue-like intrusion of albite–topaz–protolithionite granite, intercalated with flat dikes of albite–topaz–zinnwaldite granite. Already the protolithionite granite is strongly fractionated and rich in P (~0.5 wt.% P_2O_5), F (0.5–1.2 wt.%), Ga, Rb, Li, Cs, Sn, Nb, Ta, and W. The zinnwaldite granite represents batches of more extremely fractionated residual melts that are even more enriched in P (~1 wt.% P_2O_5), F (1–1.5 wt.%), Rb, Li, Ga, Nb, and Ta. Prominent layering and unidirectional solidification textures proof extreme enrichment of fluxing elements and undercooling of the crystallized melt. The strongest enrichment of lithophile elements is related to the apical parts of dikes of the zinnwaldite granite, where concentration highs approach 4 wt.% for F, 1 wt.% for Li_2O, and 1.5 wt.% for P_2O_5. These portions of the dikes became late-magmatically brecciated and cemented with quartz and albite.

Evolutionary stages are as follows: (1) magmatic crystallization of biotite granite; (2) crystallization of stockscheider at the upper contact of the granite with phyllite cover; (3) 1st brecciation, escape of fluids followed by crystallization of relatively wet melt (upper part of the body of protolithionite granite); (4) enrichment of water during progressive crystallization in the deeper part of the protolithionite granite; (5) intrusion of the residual melt into flat “dikes”, crystallization of zinnwaldite granite; (6) crystallization of large Qtz, Kfs and zinnwaldite crystal in UST, and (7) 2nd brecciation, late Qtz crystal in UST.

Hora Svaté Kateřiny is a type locality of subvolcanic stock of mildly peraluminous F-rich P-poor (A-like type) granite system in central Krušné Hory/Erzgebirge Mts. Small stock of late-Variscan tin-specialized granite intruded lower Palaeozoic crystalline basement. The granite is geochemically specialized: enriched in F, Rb, Li, Sn, Nb, Ta, Th, Y, HREE, Be, As, and poor in P. Some textural features (magmatic brecciation and layering) reveal its subvolcanic character. Evolutionary stages are as follows: (1) crystallization of medium-grained Li-biotite granite; (2) explosive brecciation; (3) intrusion of medium-grained granite with bipyramidal “volcanic” quartz phenosrysts; (4) crystallization of stockscheider; (5) crystallization of quartz-dominated UST, and (6) crystallization of large (2–3 cm long) quartz crystals “floating” in the fine-grained granite.

Results. The melt inclusions (cf. Fig. 23) are usually very small, with a diameter of 20–30 mm. They are mostly rounded



■ **Fig. 23.** Examples of homogenized MIs from Podlesí (BSE): a – two lines of MIs arranged along growing zones of a quartz crystal (scale bar 1 mm), b – large MI with cavity after bubble of fluid or gas (scale bar 500 μm), c – MI with daughter minerals (scale bar 50 μm), d – irregular shape of MI extremely enriched in fluorine (scale bar 20 μm; photo by V. Böhmová).

and approximately isometric in shape, but some are also irregular. MIs in their original state, before homogenization, always include partly devitrified glass in combination with one or two liquid phases, or a gas bubble. Feldspars and topaz were found as common daughter minerals. After homogenization, MIs include glass (Fig. 23), but sometimes undesirable daughter minerals produced during heating (Al-silicates, Fe-oxides). Such MIs could not be analyzed because the composition of glass is not equivalent to the composition of the trapped melt.

Chemical composition of homogenized MIs is highly variable not only among particular samples from the same rock type, but also among individual MIs within one quartz grain. Results of chemical analyses from Podlesí are demonstrated in Fig. 24 and Tab. 6. Within the fractionation path from biotite granite through protolithionite granite to zinnwaldite granite with unidirectional solidification textures (UST), the content of SiO_2 decreases (77→68 wt.%) and the content of Al_2O_3 increases (10→16 wt.%). Simultaneously, the contents of P_2O_5 (0.2→0.5 wt.%) and the Na/K ratio (0.4→1.5) increase. The F content reaches its maximum in some MIs from the protolithionite and zinnwaldite granite. MIs from the stockscheider (border pegmatite) are situated out of this general trend. This may result from crystallization immediately after the 1st explosive brecciation and escape of large portion of fluid from intruded melt to the exocontact.

Chemically, three types of MI can be distinguished in large comb quartz crystals (Tab. 6). A-type MIs are highly irregular in shape, are strongly enriched in F (3.1–3.7 wt.% F), but poor in Na. The B-type MIs are more regular in shape and contain relatively more Na and K and less F. The C-type MIs are the most Na-rich (~4 wt.% Na_2O) and relatively F-poor. This type of MI best represents the whole-rock composition of the granite.

Melt inclusions from the granites from Hora Svaté Kateřiny (Tab. 7) can be divided into two types, similar to types A and B from Podlesí. Also here, the B-type MIs are relatively poor in Na and enriched with Fe, Ca and F. All MIs from Hora sv. Kateřiny are very poor in phosphorus, which is important feature of the A-type granitic magmas.

Contents of borates and carbonates in fluid inclusion. Observations on the micro Raman spectrometer were realized with the help of Dr. R. Thomas at GFZ Potsdam. The contents of borates (H_3BO_3) and carbonates were determined in the fluid phase in natural (not homogenized) MI and associated fluid inclusions.

Magmatic system at Podlesí was enriched in boron at the end of its fractionation; however, boron has a strong tendency to pass into the fluid and the residual melt becomes impoverished. This is consistent with field observations: muscovite-sericite phylites in the exocontact are hydrothermally altered to a quartz-tourmaline rock, whereas the content of B in the granite itself does not exceed 10 ppm. Fluid inclusions (FI) from Podlesí contain up to 7.5 wt.% H_3BO_3, while the associated melt inclusions (MI) contain only sporadically tenth wt.% H_3BO_3 (only once in 2.5% H_3BO_3). The FI are rich in carbonates in the predominance of bicarbonate. Occasionally, some FI are enriched in sulfates and arsenates.

The B content in MIs in samples from Hora Sv. Kateřiny is significantly lower. Only rarely, the content of 4.6 wt.% H_3BO_3 was found in the fluid. High concentrations of carbonates and bicarbonates predominate.

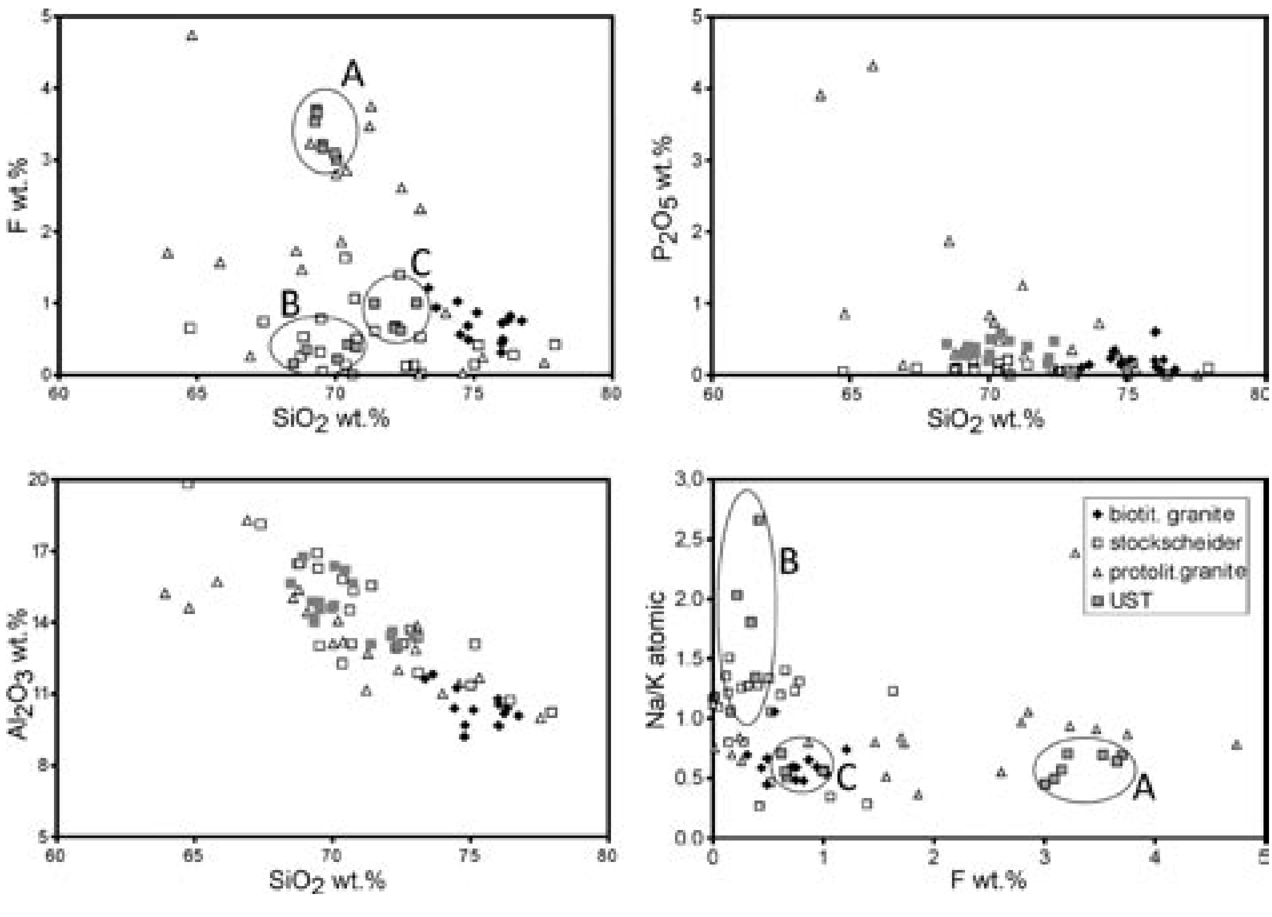
Conclusions. The Podlesí granite system is composed of several geologically well documented evolutionary phases with intrusive contacts. Their sequence is in good agreement with the average composition of melt inclusions. Changes in the composition of MIs from biotite through protolithionite to zinnwaldite granite are consistent with the relative enrichment of rocks in albite, topaz and amblygonite. While crystallization of the less fractionized granites ends with quartz, albite is the last crystallizing phases in strongly fractionized granites (from such observation proceed older idea of "secondary" metasomatic origin of albite). The absolutely highest content of F was found in MI from

	Typ A				Typ B				Typ C
Sample	4645	3361	4650	4011	4645	3361	4650	4011	4011
Rock	Bi-granite	stockscheider	Protolit. granite	Zinnwaldite granite	Bi-granite	stockscheider	Protolit. granite	Zinnwaldite granite	Zinnwaldite granite
n	2	13	3	12	7	9	13	19	19
SiO_2	73,9	70,2	69,5	70,8	75,0	73,2	70,8	71,3	72,4
TiO_2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Al_2O_3	11,4	15,8	15,4	14,8	10,2	12,1	12,8	13,9	13,1
Fe_2O_3	0,2	0,3	0,2	0,5	1,3	1,2	1,1	0,4	0,4
MgO	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,0
MnO	0,0	0,0	0,0	0,1	0,1	0,1	0,1	0,1	0,1
CaO	0,0	0,3	0,0	0,1	0,0	0,2	0,3	0,1	0,0
Na_2O	2,9	3,8	3,6	3,6	2,0	1,6	2,2	1,9	0,8
K_2O	5,0	4,5	6,7	3,2	5,1	3,8	4,1	4,4	4,5
Rb_2O	–	–	–	0,3	–	–	–	0,3	0,4
P_2O_5	0,2	0,1	0,8	0,5	0,2	0,1	1,0	0,2	0,4
F	0,9	0,4	0,7	0,5	0,7	0,6	2,2	2,0	1,0
Total	94,7	95,5	97,0	94,2	94,8	92,9	94,7	94,7	93,2
Na/K (atomic)	0,9	1,3	0,9	1,7	0,6	0,7	0,8	0,7	0,3

■ **Tab. 6.** Average chemical composition of MIs from Podlesí (wt.%).

	Hora svaté Kateřiny					
	Typ A				Typ B	
Sample	4601	4555	4551	4606	4601	4555
Rock	Bi-granite	Comb quartz	stockscheider	UST	Bi-granite	Comb quartz
n	5	13	6	6	4	11
SiO_2	69,2	74,3	73,4	72,0	72,0	72,3
TiO_2	0,0	0,0	0,1	0,0	0,0	0,0
Al_2O3	14,6	12,7	11,8	12,3	11,9	13,2
Fe_2O_3	0,6	0,9	1,7	0,8	1,2	1,2
MgO	0,0	0,0	0,0	0,0	0,0	0,0
MnO	0,0	0,1	0,2	0,1	0,0	0,1
CaO	0,1	0,4	0,0	0,0	0,2	0,7
Na_2O	3,9	3,2	2,9	2,4	2,0	1,8
K_2O	5,4	4,4	3,8	3,9	4,7	4,6
Rb_2O	0,0	0,0	0,2	0,0	0,0	0,0
P_2O_5	0,0	0,0	0,0	0,0	0,0	0,0
F	0,9	0,8	0,2	0,1	1,5	1,4
SnO_2	0,0	0,0	0,0	0,0	0,0	0,0
Total	94,8	96,9	94,5	91,8	93,5	95,3
Na2O/K2O	0,7	0,8	0,8	0,6	0,5	0,4
Na/K atomic	1,1	1,1	1,2	0,9	0,8	0,6

■ **Tab. 7.** Average chemical composition of MIs from Hora Sv. Kateřiny (wt.%).



■ **Fig. 24.** Relations among chemical elements in homogenized MIs from Podlesí (in wt.%). Positions of three types (A, B, C) of associated MIs in comb quartz from the zinnwaldite granites are shown (original).

the protolithionite granite. The zinnwaldite granite has a generally higher content of F, but in time of entrapping of the melt to the inclusions, a larger part of F has been already consumed before the crystallization of mica and topaz.

Three types of MIs found in one large quartz crystal in layered zinnwaldite granite differ primarily in the content of alkalis and fluorine. It is not clear whether these different melts formed during liquation or immiscible liquids, or are merely the result of a local imbalance induced with crystallization of directly associated minerals. Similar compositional variability was already described from the Saxonian Erzgebirge by Thomas et al. (2006a, 2006b). Different fractions of residual melt very likely also differ in their ability to transport elements of the type Sn, W, Nb and Ta, and thereby contributed to the critical concentration of the ore and the formation of disseminated magmatic mineralization.

Study of melt (MI) and their associated fluid (FI) inclusions confirmed the fundamental differences in the composition of magmas of the S- and A-type in the Krušné hory Mts. as were previously interpreted from the rock analysis. MIs from peraluminous S-type rocks are rich in phosphorus and fluorine and associated FIs are rich in boron. MIs from A-type granites are rich in fluorine, and practically phosphorus-free. Associated FIs contain predominantly carbonates.

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NAUMOV V.B. & KAMENETSKY V.S. (2006): Silicate and salt melts in the genesis of the Industrialnoe tin deposit: evidence from inclusions in minerals. – *Geochimija*, 2006, 12: 1279–1289. (in Russian)

THOMAS R., WEBSTER J.D. & DAVIDSON P. (2006a): Understanding pegmatite formation: the melt and fluid inclusion approach. – *In*: WEBSTER J.D. (Ed.): Melt inclusions in plutonic rocks. – *The Mineralogical Association of Canada, series of short-course*, 36: 189–210.

THOMAS R., WEBSTER J.D., RHEDE D., SEIFERT W., RICKERS K., FORSTER H.-J., HEINRICH W. & DAVIDSON P. (2006b): The transition from peraluminous to peralkaline granitic melts: evidence from melt inclusions and accessory minerals. – *Lithos*, 91, 1–4: 137–149.

WEBSTER J.D. & THOMAS R. (2006): Silicate melt inclusions in felsic plutons: a synthesis and review. – *In*: WEBSTER J.D. (Ed.): Melt inclusions in plutonic rocks. *The Mineralogical Association of Canada, series of short-course*, 36: 165–188.

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

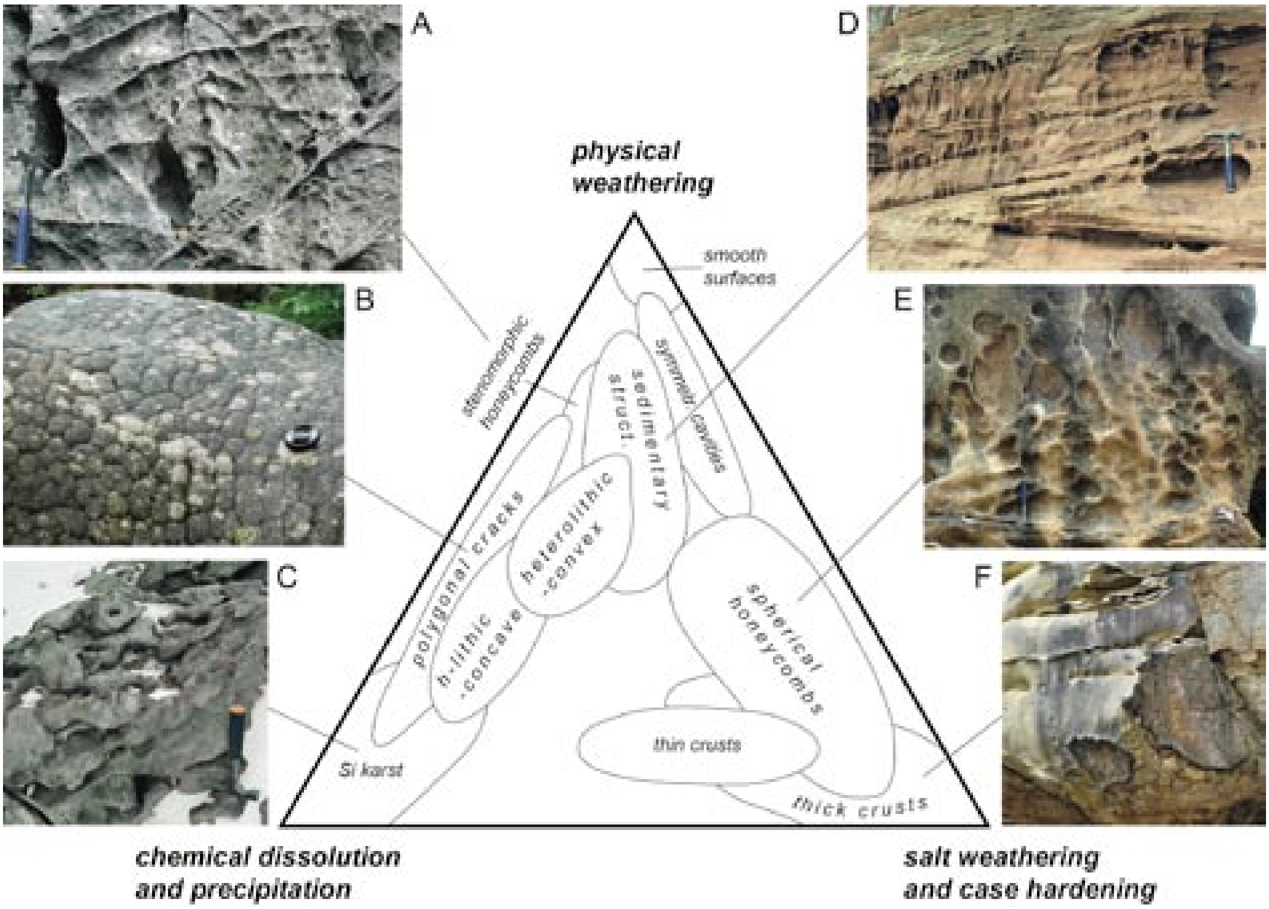
A synthesis of data obtained within the current project allowed to interconnect weathering processes affecting sandstone rock surfaces with the forms of sandstone micro- to mesorelief. The rate and the periodicity of pore water evaporation from the near-surface zone of sandstone is the most important external factor, if not the only one, affecting the complexity of weathering forms on vertical cliff faces. This sole factor depends on a number of site-dependent variables (microclimate, aspect, height above cliff base, height above local base level, vegetation, etc.). Local variations in sandstone relief within the same environmental conditions can be explained by differences in the intrinsic properties of sandstone, a factor previously often overlooked. It can be demonstrated that grain size, sorting, cementation (incl. cement mineralogy), porosity, sedimentary structures, tectonic deformation and other properties determine the geometries of the individual weathering forms and the weathering pattern as a whole.

In our research, we eliminated the effect of climate by restricting our observations to the humid temperate zone, typical for central and western Europe. Such climate is favourable for the complexity of sandstone microrelief, as it combines warm summers with sufficient solar irradiation and noctidiurnal temperature variations, cold winters with regular frost and snow cover, and more or less evenly distributed precipitations throughout the year. Local effects were respected by documenting cliff faces at various settings within one site. This approach permitted us to describe the relationships between the sandstone relief and sandstone lithology with the least possible bias.

Outcrop documentation concentrated on sandstone districts of the Bohemian-Saxonian Cretaceous Basin (Kokořín area, Bohemian Paradise, Bohemian-Saxonian Switzerland, Lusatian Mts., Broumov area), flysch sediments of the Moravian, Polish and Slovak Carpathians, the Petit Suisse region at the Luxembourg/Germany border, Pfälzer Wald sandstones in Germany and the sandstone/quartzite districts in the Paris Basin (Fontainebleau, Larchant) in France. The observed recurrent weathering patterns justified the erection of eleven sandstone weathering *morphofacies* (Fig. 25; Adamovič et al. 2011a). Each of the morphofacies is dominated by a specific microform or a set of microforms: smooth surfaces, symmetrical cavities, accentuated sedimentary structures, spherical honeycombs, thick rock crusts, thin rock crusts with case-hardening function, stenomorphic honeycombs, polygonal cracks, siliceous karst forms, and heterolithic facies with concave forms and that with convex forms. Type localities were selected for each morphofacies and characterized as for the clast and cement composition, sedimentary structures, jointing and faulting, composition of speleothems and salt efflorescences, and pore size distribution.

Based on the information gathered, the contribution of each of the three main agents shaping the sandstone relief (physical weathering, salt weathering/case hardening, and chemical dissolution) can be quantified for each morphofacies. Application of the morphofacies concept allows not only a prediction of weathering patterns to develop on sandstone of a given lithology, but also a determination of the effect of subtle variations in extrinsic factors on sandstone relief at an outcrop scale.

The variety of rock exposure studied allowed a deeper insight in the origin of specific weathering microforms. The most important in this respect are rock crusts: near-surface layers of rock where salt weathering is effective. Crystallization of salts beneath the surface not only leads to physical disintegration (grain-by-grain disintegration, scaling) of rock but also selectively affects



■ **Fig. 25.** A ternary diagram showing the estimated shares of physical weathering, chemical weathering and salt weathering for the individual morphofacies defined by the present research. Photos of some of the morphofacies defined: A – stenomorphic honeycombs, Horní skály near Rynoltice, CR; B – polygonal cracks, Apremont-Bizons near Barbizon, France; C – siliceous karst, Larchant, France; D – accentuated sedimentary structures, Altschlossfelsen in Pfälzer Wald, Germany; E – large spherical honeycombs, Kamienie Brodzińskiego near Bochnia, Poland; F – thick rock crusts, Sokolka Hill near Branžež, CR (original).

pore characteristics of the crust and the rock beneath. Different salt mineralogies, pore-water evaporation processes and weathering microforms led to the differentiation between patterned rock crusts and armoured rock crusts (Adamovič et al. 2011b).

Dissolution of former carbonate cement was found to play a significant role in the origin of weathering microforms even in poorly cemented quartzose sandstones. Remains of carbonate concretions were found in cores of symmetrical cavities in the Bohemian Cretaceous Basin, in the Paleogene flysch sediments in Moravia and in the Jurassic sandstones in Luxembourg. This opens a question as to what proportion of symmetrical cavities is of salt-weathering origin, as has been previously assumed (Adamovič & Mikuláš 2011).

Lithological and porosimetric studies of sandstones hosting rock basins (also called solution basins) on their top surfaces showed that some degree of secondary cementation with total pore volumes not exceeding 15 % is necessary for the formation of the basins. This corresponds with the indispensable effect of standing body of water in the basin formation. Alkaline dissolution of quartz was not confirmed as suggested by the mildly acidic reaction of all water samples taken from the basins. Instead, morphometric analysis of basins of various evolutionary stages pointed to the effect of quartz dissolution by neutral-pH water under high flushing rates followed by basin enlargement due to frost action (Adamovič & Mikuláš 2010).

Climatic changes and man-induced environmental changes in sandstone landscapes in the Holocene can be tracked by the successions of oblique ledges preserved on crevasse walls. These ledges are convex forms which developed at former surfaces of soil cover: they separated a cliff face exposed to salt weathering above from a protected cliff face below. Within restricted areas of small river catchments, separate stages of soil erosion can be mapped based on ledge correlation, and relatively dated (Mikuláš & Adamovič 2011).

ADAMOVIČ J. & MIKULÁŠ R. (2010): Rock basins on sandstones: lithological controls, typology and genesis. – *In*: KŘÍŽEK M., NYPLOVÁ P., VOČADLOVÁ K. & BORSKÁ J. (Eds.): *Geomorfologický sborník 9. 11. mezinárodní konference Stav geomorfologických výzkumů v roce 2010. Branná, 11.-13.5. 2010*: 1–2. Praha.

ADAMOVIČ J. & MIKULÁŠ R. (2011): Vznik některých elipsoidálních dutin rozpouštěním karbonátového tmelu v pískovcích jizerského souvrství na Kokořínsku. – *Zprávy o geologických výzkumech v roce 2010*: 9–13.

ADAMOVIČ J., MIKULÁŠ R. & SCHWEIGSTILLOVÁ J. (2011a): Is there a finite number of sandstone weathering patterns? Evidence from the humid temperate zone of Europe. – *Archean to Anthropocene. 2011 GSA Annual Meeting & Exposition, 9–12 October 2011, Minneapolis. Abstracts with Program*: 480–481.

ADAMOVIČ J., MIKULÁŠ R., SCHWEIGSTILLOVÁ J. & BÖHMOVÁ V. (2011b): Porosity changes induced by salt weathering of sandstones, Bohemian Cretaceous Basin, Czech Republic. – *Acta Geodynamica Geomaterialia*, 8, 1: 29–45.

MIKULÁŠ R. & ADAMOVIČ J. (2011): Oblique notches and ledges on natural surfaces of porous rocks: a record of past level of soil surface (central and western Europe, northeastern Africa). – *In*: SIMMERT J. (Ed.): *Proceedings of the 11th International Symposium on Pseudokarst*: 80–82. Dresden.

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; 2009–2011)

The project was aimed at the determination of longitudinal and shear wave velocity propagation in magmatic rocks, specification of dynamic moduli of these rocks and their anisotropy. Experiments were carried out in laboratory and field conditions. Laboratory testing of sphere samples was based on ultrasonic sounding and monitoring of velocity changes in dependence on increasing hydrostatic pressure. In the field the directional dependence of velocities P and S waves was examined. The results of both measurements were compared and evaluated from the point of view of scale factor in the space and frequency domains. The technical conditions of S waves recording in the field were solved by applying of special sensors and suitable orientation of seismic wave excitation.

Results were published in publications:

SVITEK T., RUDAJEV V. & PETRUŽÁLEK M. (2010): Determination of P – Wave arrival time of acoustic events. – *Acta Montanistica Slovaca*, 15, 2: 145–151.

VILHELM J., RUDAJEV V. & ŽIVOR R. (2011): Assessment of Fracture Properties from P-Wave Velocity Distribution, Treatise. – *In*: ROWINSKI P., BANASZKIEWICZ M., PEMPKOWIAK J. & LEWANDOWSKI M. (Eds.): *Geophysics in Mining and Environmental Protection*: 109–116. Heidlberg.

VILHELM J., RUDAJEV V., ŽIVOR R., LOKAJÍČEK T. & PROS Z. (2010): Influence of crack distribution of rocks on P-wave velocity anisotropy – A laboratory and field scale study. – *Geophysical Prospecting*, 58, 6: 1099–1110.

ŽIVOR R., VILHELM J., RUDAJEV V. & LOKAJÍČEK T. (2011): Measurement of P- and S- Wave Velocities in a Rock Massif and its Use in Estimation Elastic Moduli. – *Acta Geodynamica and Geomaterialia*, 8, 2: 157–167.

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, *P. Štorch*, P. Budil, Czech Geological Survey, Praha & M. Mergl, Faculty of Education, University of West Bohemia, Plzeň; 2009–2011)

Research carried out in the Institute of Geology ASCR, v. v. i., focused primarily on graptolites of the Králův Dvůr Formation in broad palaeonvironmental and palaeogeographic context. The Králův Dvůr Formation corresponds with late Katian and earliest Hirnantian in age, according to biostratigraphic dating and sedimentary and carbon-isotope signatures. The unit hosts graptolite fauna which is rare and low diversity. The fauna is of particular importance, however, considering graptolite-barren upper Katian successions deposited elsewhere in the northwestern Gondwana and peri-Gondwana. The composition and dynamics of mid-latitude graptolite fauna was obtained from the late Katian climatic optimum through the Hirnantian glaciation. A thorough revision of the graptolite fauna, based on all material collected since 19th century (Kraft et al. submitted), revealed ten species [*Dicellograptus laticeps* Štorch, *Diplograptus* cf. *rigidus* (Lee *in* Wang), *Anticostia teres* (Perner), *Paraplegmatograptus uniformis* Mu, *Phormograptus chuchlensis* (Přibyl), *Styracograptus lobatus* (Perner), *Styracograptus* sp., *Normalograptus angustus* (Perner), *Normalograptus*? *fritschi* (Perner) and *Metabolograptus ojsuensis* (Koren & Mikhaylova)], most of them limited to one or two localities of the Králův Dvůr Formation. Lower part of the unit yielded species restricted to the Barrandian area according to our knowledge (e.g. *A. teres*). Some widely distributed species appear in the middle part (*D. laticeps* = *D. preanceps* Rickards) and cosmopolitan taxa prevail in the upper (*P. uniformis, Ph. chuchlensis* = *Ph. connectus* Mu *in* Wang et al., *N. angustus*), and the uppermost part (*M. ojsuensis*). This distribution pattern developed under conditions markedly unfavourable to planktic graptolites. Monospecific assemblage of eurytopic zonal index *M. ojsuensis* appeared briefly below the first level of glaciomarine diamictite and heralded the spreading Gondwanan glaciation. Further graptolite faunal turnover associated with the glaciation is barely seen in the Barrandian area due to incomplete fossil record. Also biostratigraphic correlation is only tentative and limited to the recognition of the late Katian *D. laticeps* Assemblage Biozone and early Hirnantian *M. ojsuensis* Biozone.

A parallel study of selected upper Katian and Hirnantian sections in tropical palaeo-belt revealed that different nature and scenario of graptolite extinction and faunal turn-over developed under different palaeolatitudial and palaeoclimatic conditions.

Graptolite fossil record is rich and more complete at Vinini Creek and Martin Ridge sections of central Nevada (Štorch et al. 2011). Forty-three graptolite species belonging to fifteen genera have been described from the upper Katian *ornatus* and *pacificus* biozones and Hirnantian *extraordinarius-ojsuensis* and *persculptus* biozones. Approximately half of the species described by Štorch et al. (2011) have not been previously recorded from Nevada, albeit six species were left in open nomenclature. Infraorder Neograptina, and *Styracograptus* gen. nov. have been erected. The maximum graptolite diversity was recorded in the lower part of the *pacificus* Biozone. Species diversity decreased abruptly at the top of the *Diceratograptus mirus* Subzone, recognized in the upper part of the *pacificus* Biozone. Faunal turnover reached a peak in the lower part of early Hirnantian *extraor-*

dinarius-ojsuensis Biozone where long-dominant Ordovician clades were rapidly replaced by normalograptids, presumably evolved in, and invading from, a less-temperate higher latitude. This assumption if backed also by the occurrence of *N. angustus* and *N? fritschi* in the Katian Králův Dvůr Formation of the Barrandian area. Several lazarus taxa (*Dicellograptus, Anticostia, Rectograptus, Paraorthograptus, Phormograptus, Styracograptus* and *Appendispinograptus*) reappear in the upper part of the *extraordinarius-ojsuensis* Biozone in Nevada. The uppermost part of the Vinini Creek section, well into the *persculptus* Biozone topped by prominent stratigraphic unconformity, records their second emergence from hypothetical refugia due to temporarily ameliorated conditions. This occurrence accounts for a complex extinction pattern of graptolites rather than a synchronous global collapse of the pre-glacial ecosystem. In medium latitude cool- to temperate-water settings (icluding those of the Barrandian area) the overall graptolite diversity was extremely low already in pre-glacial times. At the beginning of the glaciation, the old fauna entirely vanished. In tropical belt, however, some elements of the old fauna locally survived and the last phase of its extinction took place during postglacial transgression, in the course of a major evolutionary burst among normalogratids and their descendants. Reasons for ultimate extinction of diplograptid-dicellograptid-orthograptid fauna may be biological rather than environmental. Graptolite biozonation applied in the Nevadan sections correlates well with those established in the Yangtze Platform of China, southern Kazakhstan, northeastern Siberia and Northern Canada. The correlation with graptolite-poor sections of England, peri-Gondwanan Europe and Africa remains only tentative.

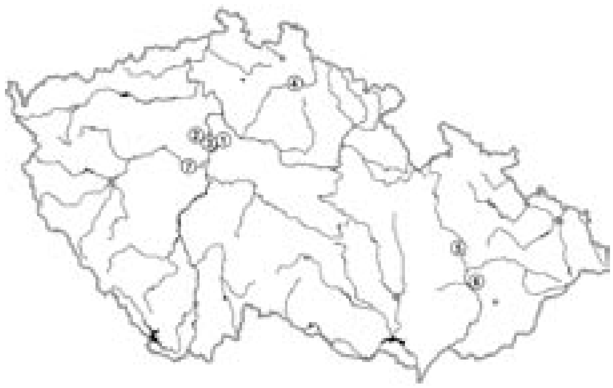
KRAFT P., ŠTORCH P. & MITCHELL C.E. (submitted): Graptolites of the Králův Dvůr Formation (Králodvorian, upper Katian) from the Prague Basin, Czech Republic. – *Bulletin of Geosciences*.

ŠTORCH P., MITCHELL C.E., FINNEY S.C. & MELCHIN M.J. (2011): Uppermost Ordovician (upper Katian – Hirnantian) graptolites of north-central Nevada, USA. – *Bulletin of Geosciences*, 86, 2: 301–386.

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 Archaeology ASCR, Praha, v. v. i.; *J. Hlaváč* & P. Kuneš, Faculty of Science, Charles University, Praha; 2007–2011)

The historic evolution of landscape 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 palaeoecological techniques. While palynology and analyses of plant macroremains show more possibilities to enhance our understanding of the prehistoric landscape used and cultivated by man, malacological evidence is more restricted to specific environmental conditions, such as calcium richness and depositional sequences of depositary fillings.

The project was focused at several localities predominantly in central Bohemia and Moravia from the malacological point of view divided into two groups: (1) localities with palaeoenvironmental information on the molluscan faunas from archaeological excavations with specific sedimentary contexts, and (2) localities with palaeomalacological evidence from the natural profiles based on malacostratigraphic features (Fig. 26).



■ **Fig. 26.** A simplified map showing malacological locations in central Bohemia and Moravia. 1 – Miškovice, 2 – Kněževes, 3 – Žalov, 4 – Rohliny, 5 – Řepčín, 6 – Hulín, 7 – Srbsko-Bříč (original).

A) Important findings were discovered in **Miškovice**, Prague 9 (No. 1), on the basis of archaeological and palaeoecological investigation. There were studied and interpreted the sunken hut fillings of Middle Eneolithic – the Řivnáč culture, based on osteological, macroremains, xylotomic, and malacological analyses, as well as on the analysis of chipped (documenting local production from imported raw material) and bone industry, as well as finds of stone coral and seashells. Analyses of molluscan thanatocoenoses enabled partial palaeoenvironmental conditions at the studied site during the settlement activity in dominating occurrence of open-ground molluscan elements such as *Vallonia*-species, *Pupilla muscorum*, *Truncatellina cylindrica*, steppe *Chondrula tridens*, and *Vertigo pygmaea* species in total amount of 97.42 %, while hygrophilous and shadow-dwelling species were in very low numbers (0.34 %), accompanied by tolerant and adaptable species (2.23 %) in general, and even one woodland element typical for warm and light forest habitats – the species *Fruticicola fruticum*. The malacological investigation based on detailed sampling of 113 mechanical layers for flotation is very rare among the investigation of Eneolithic settlements in the Czech Republic up to this time (Ernée et al. 2007).

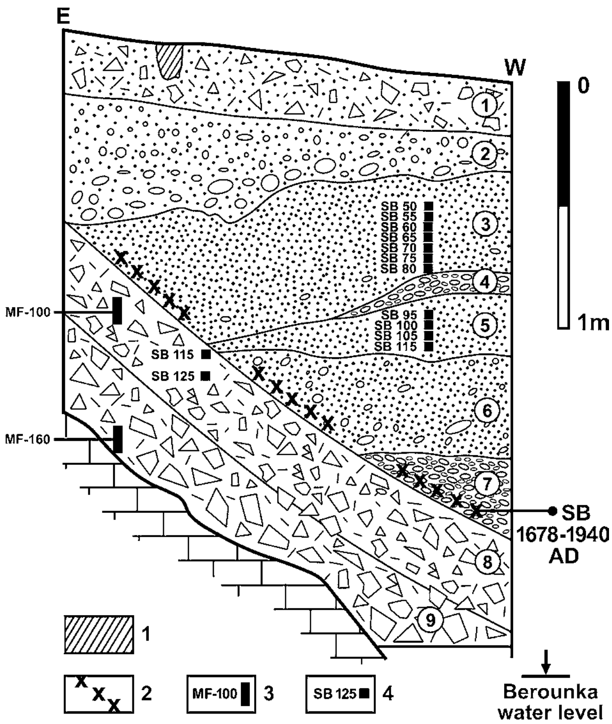
The project continued in analyses of molluscan thanatocoenoses in archaeological features from **Kněževes** near Prague (No. 2). The features were dated to the Late Bronze Age period – the Knovíz culture, and many of them were filled with material containing rich conchological specimens. Two different molluscan groups were identified in 101 samples, with a total of 864 individuals belonging to 22 molluscan species (18 species of terrestrial snails, 4 species of freshwater molluscs). The first group consisted of molluscan species with allochthonous origin – in particular the terricolous blind snail *Cecilioides acicula* plus freshwater molluscs such as the minute snail *Gyraulus albus* and three medium-sized mussel species of the genus *Unio*. The second group consisted of molluscan species with autochthonous origin, i.e. species fossilized in the studied deposits without being intentionally brought into the settlement by humans. In the analysed samples, open-habitat species strongly dominated, which generally indicates the presence of woodless areas. This was probably a secondary steppe habitat, anthropogenically influenced, as indicated by species such as *Chondrula tridens*, *Truncatellina cylindrica*, *Vallonia costata*, *V. pulchella*, *V. excentrica*, and *Pupilla muscorum.* In addition, low numbers of open forest species and open warm forest species such as *Cepaea hortensis*, *Helix pomatia*, and *Fruticicola fruticum* were also found which require certain shaded habitats. Species requiring habitats with higher moisture were also occasionally identified (such as the species *Carychium tridentatum*, confined to damp habitats), as were even true wetland species (*Vertigo angustior*, *Vallonia enniensis*). Based on the molluscs found in these archaeological features, it was possible to reconstruct the natural environment of the settlement and its nearby surroundings. There were likely open areas within the settlement, with ecotonal zones gradually changing to less anthropogenically influenced sites with smaller areas of bushes and tree patches, which became much larger farther from the settlement borders. These locations were occasionally accompanied by smaller damp patches, almost acquiring the characteristics of true wetland habitats (Hlaváč 2011).

Another molluscan thanatocoenoses were analysed in **Žalov** near Prague (No. 3) from the fillings of graves dated to the Bylany culture, Hallstatt Age (800/700 to 550/500 B.C.), and Early Medieval Age. While conchological material of Early Medieval Age was very poor in the determined species level consisting of adaptable and tolerant elements with important portion of species of allochthonous origin (e.g. terricollous species *Cecilioides acicula*), the molluscan thanatocoenoses dated to the Bylany culture were more abundant with evidenced numerous index species of specific palaeoenvironmental characteristics. Those contain open-ground habitats characterized by the occurrence of xerothermophilous species *Truncatellina cylindrica*, *Cochlicopa lubricella*, *Cepaea vindobonensis*, and even the true steppe species *Chondrula tridens*, and the habitats of bush and sporadic tree patches with the species *Euomphalia strigella* and *Fruticicola fruticum*. The high number of freshwater bivalves of genus *Unio* (*U. crassus*, *U. tumidus*) documents an occasional applying of these species for nutrition.

A specific molluscan thanatocoenoses were discovered at Dvojitá brána sandstonerockshelter site near **Rohliny** (Northern Bohemia, No. 4) with continuous settlement activity from the Mesolithic to Medieval. The rich and specific malacofauna was determined in Middle Holocene (Atlantic–Epiatlantic) layers with abundant light forest and shady woodland species such as *Fruticicola fruticum*, *Cepaea hortensis*, *Alinda biplicata*, *Cochlodina laminata*, *C. orthostoma*, *Macrogastra ventricosa*, *M. plicatula*, and *Sphyradium doliolum.* This species composition reflects closed mesic woodland and shows a gradual development from light deciduous forests with demanding woodland malacocoenoses to closed shady forests dominated by species-rich snail communities in which the *Discus ruderatus*-fauna elements decline or already lacking (Eneolithic horizons). The above lying horizons (Late Bronze to Medieval Ages) are nearly or totally sterile in malacofaunal remains caused by decalcification of local environment.

Another two archaeological sites were analysed by malacological approach showing partial results of higher or lower importance. At **Řepčín** site (No. 5), molluscan communities of Late Eneolithic and Middle Bronze Age were determined with important portion of autochthonous species with determined allochthonous admixture of loessic elements. Molluscan analyses from the **Hulín** site (No. 6) allowed findings of conchologic material deposits of numerous freshwater mid-sized bivalves of genus *Unio* dated to the Neolithic and Bronze Age. Specific malacofauna was determined also at the Eneolithic site of **Úholičky** with the occurrence of marine tusk-shell (Scaphopoda; Hlaváč 2008), and in **Vlíněves** and **Karmelitská** in Prague with findings of west-European freshwater pearl mussel *Margaritifera auricularia*, which is nearly extinct in Western Europe at present while it was widely distributed also in west parts of Central Europe in the Neolithic period.

B) A section excavated in the floodplain of the lower reach of the Berounka River (**Srbsko-Bříč**, No. 7) indicated floodplain evolution during the last several hundred years. The section was more than 2 m thick and showed floodplain sediments of different types of clastic deposits. Only two basal layers 8 and 9 consisted of coarse debris with loamy matrix allowed conservation of fossil molluscs due to suitable conditions in presence of calcium carbonate (Fig. 27). The two layers are very similar in molluscan content which is characterized by the presence of high species level with the presence of the most of distinguished ecological and biostratigraphical groups of molluscs. The shady woodland species, such as *Cochlodina laminata* and *Monachoides incarnatus*, occurred in high numbers accompanied by mesophilous woodland elements (*Alinda biplicata*, *Cepaea hortensis*, *Discus rotundatus*) which indicated the presence



■ **Fig. 27.** A section at Srbsko-Bříč showing the relationship between fluvial sedimentation and slope (talus) sedimentation. Explanations: 1 – recent disturbation, 2 – charcoal layer, 3 – malacofauna sampling, 4 – sampling for magnetic analyses (adapted from Žák et al. 2010).

of forest habitats in the floodplain. Locally, the moist to damp patches occurred on the basis of the presence of several species with requirements to higher moisture (*Vertigo antivertigo*, *Zonitoides nitidus*, *Succinea putris*), or even wetland habitats which is documented by the occurrence of freshwater species *Galba truncatula*, *Gyraulus albus, G. crista, Valvata cristata,* and *Bathyomphalus contortus*. On the other hand, the molluscan composition changed towards upper parts of the valley not affected by the river stream: here, light and shiny patches prevailed with the dominance of heliophilous and xerothermic elements, such as *Chondrina avenacea*, *Chondrula tridens*, *Vallonia* species, *Pupilla sterri*, *Truncatellina cylindrica* and even index species *Truncatellina claustralis*, which was the species of Holocene climatic optimum, surviving only at suitable extreme stands at present. Malacostratigraphic dating of these basal beds is restricted to the youngest phase of Young Holocene – Subboreal, which is documented by the positive presence of modern immigrants *Xerolenta obvia* and *Cecilioides acicula*. The overlying bed 7 is strictly separated from layers 8 and 9 by the distinguished layer of charcoals dated to 1678–1940 AD, which is in agreement with molluscan stratigraphy (Žák et al. 2010).

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No. IAAX00130702: **Hydrodynamic concept of stromatactis formation in geology** (Project leader *J. Hladil*; project co-leader M. Růžička; co-investigators *J. Adamovič*, *P. Čejchan*, *J. Janečka*, *L. Koptíková*, *P. Kubínová*, *A. Langrová*, *L. Lisá*, *P. Lisý*, *P. Sedláček*, *P. Schnabl*, J. Drahoš, J. Havlica, L. Kulaviak, S. Orvalho-Kordačová, M. Plzáková, M. Šimčík , M. Večeř, J. Vejražka, M. Zedníková, Institute of Chemical Process Fundamentals ASCR, v. v. i. & research fellowship C. Saint-Lary, ENSIACET, Department of Processes and Chemistry, National Polytechnic Institute of Chemistry in Toulouse, France; 2007–2011)

The five-year interdisciplinary project bridged the gaps between the geological and process-engineering knowledge to understand the sedimentation processes of solid particles in detail. The scope of the project was broad and encompassed many complex tasks which started with lateral inhomogeneities in suspensions and slurries, continued with initial and complete sedimentary fabrics and ended with the post-depositional packing and compaction in the sediment beds. The project was unusually productive and provided a lot of valuable insights into evolution of particle-laden flows, as reflected by a long list of outputs ranging from geology to physics of sedimentary processes (see the Project Pages at *http://home.gli.cas.cz/hladil/www/strmtcB.htm*). The major results of the project are seen in three directions: a) developing the techniques of recording and correlation of the spatial-temporal sediment successions, from micro- to macro-scales, b) characterizing the behaviour of various dust and silt materials in natural and laboratory conditions, with emphasis on viscosity and rheology of the systems, and c) approaching an experimentally validated model of the origin of pattern holes directly induced in the sediment beds (stromatacta – stromatactis). In this report, the latter point is closely described using an original case study on three-component sedimentary materials and their capability to form arched holes in the sediment.

Patterns formation in primary sedimentary deposition process – experiments toward the control of high and low voidage particulate beds (L. Kulaviak, *J. Hladil*, M. Růžička, J. Drahoš, *L. Koptíková* & C. Saint-Lary)

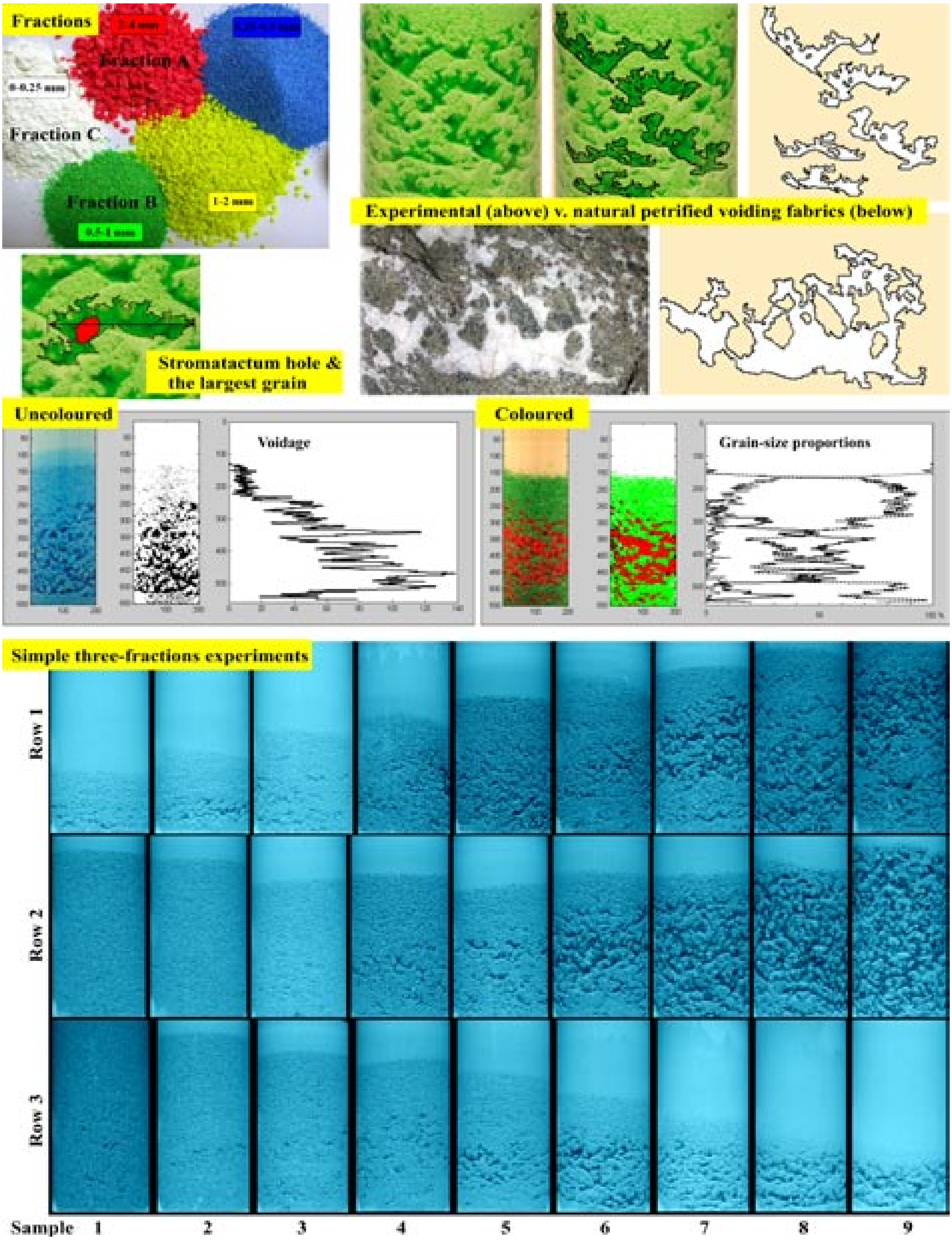
Typically, a large number of fluid-filled cavities are produced during the sediment deposition in many processes, both in nature and in technology. In the former case, they are of great importance in geology, as related to compaction, diagenesis and deformation of sedimentary rocks. In the latter case, they are often unwanted since they reduce the separation efficiency of the sedimentation process, but could be useful for fabrication of cavities if they are required for other applications. This contribution presents experimental results on the structure of the deposit resulting from settling of mixtures of solid particles in a liquid. The goal was to find the conditions under which, regarding the particle polydispersity, a tendency occurs towards cavity formation. Several kinds of solid particles were used, both model and natural materials. The latter were in the form of powders, with a broad range of sizes, from few microns to few millimetres. The laboratory experiments were performed in glass sedimenting cylinders. The solid and liquid phases were mixed and let settle. The images of the deposit were taken by a camera and then image-analysed to evaluate the structure of the sediment. The main result is that a strong tendency to the cavity production was found in systems with non-spherical, anisotropic, rough materials, possessing a specific kind of polydispersity. The phenomenon of arching, known from the soil mechanics and the mechanics of granular media is supposed to endow the cavities their appreciable stability and duration. The liquid-filled cavities contribute much to the total liquid content in the deposit and increase the bulk volume of the sediment that must be handled to the further transport and treatment. Therefore, our knowledge about the cavities, their occurrence, properties and the way of their formation would be useful. On the purely academic side, these cavities present a highly challenging problem at the intersection of several disciplines: fluid mechanics (stability of sedimenting layers), rheology (complex suspensions), multiphase systems (hydrodynamic particle-fluid interactions) and granular media (hydro-mechanic particle-particle interactions, consolidation, etc.). The point is to disclose the physical mechanisms underlying the formation of the wide spectrum of highly complex geometrical patterns, the interconnected liquid-filled dome-shaped cavities of strongly irregular shape, covering a wide span of length-scales (i.e. the pattern formation in strongly heterogeneous multiphase media). Despite the complexity of the subject matter, the key point is to investigate the effect of the particles shape and polydispersity on their ability to form the cavities.

Experiments (see Fig. 28-1 and Fig 28-2). Several kinds of solid particles were employed. Initially, the model particles were glass and polystyrene beads of smooth spherical shape or microporous alumosilicate beads with the more complex surface. Then, more complicated particles mimicking the natural conditions were used. The experimental campaign had three stages: S1, S2, and S3. In the first stage S1, various materials were tested for their ability to produce cavities, under randomly taken conditions (concentration, fractions, containers, etc.), and the high-purity natural calcitic materials were chosen for the extended systematic studies. In the second stage S2, a rough mapping of the parameter space was done with these calcitic materials to assess the effect of the proportion of three different size fractions on the cavity formation; the selected fractions were as follows: A (coarse, 2–4 mm), B (medium, 0.5–1 mm) and C (fine, 0–0.25 mm). These fractions were not overlapping, being separated by two gaps (1–2 mm and 0.25–0.5 mm). Typically, 300 g of the total solid was used, with water up to 500 ml. In total, (3 cases) x (9 proportions) = 27 combinations of fractions A, B, C were tested. In each of the three cases Cxyz, one fraction was increasing (x), one was decreasing (y) and one was kept constant (z) at 20 %. The cases were: Cacb, Cabc, and Ccba. In the third stage S3, based on the results of S2, more detailed measurements were performed with the above three fractions of calcitic materials to find the typical conditions for the cavity formation. Here, the solid content was 30 % and the fractions were presented in the proportions as shown in tabular data of the related text-figure; in total, it relates to 36 different cases denoted as C1–C36. The experiments were repeated many times (up to 50 times) to find the sufficient number of the realization of each measurement to obtain statistically stable result. The error of measurements was estimated to be within 5 % of the evaluated quantities.

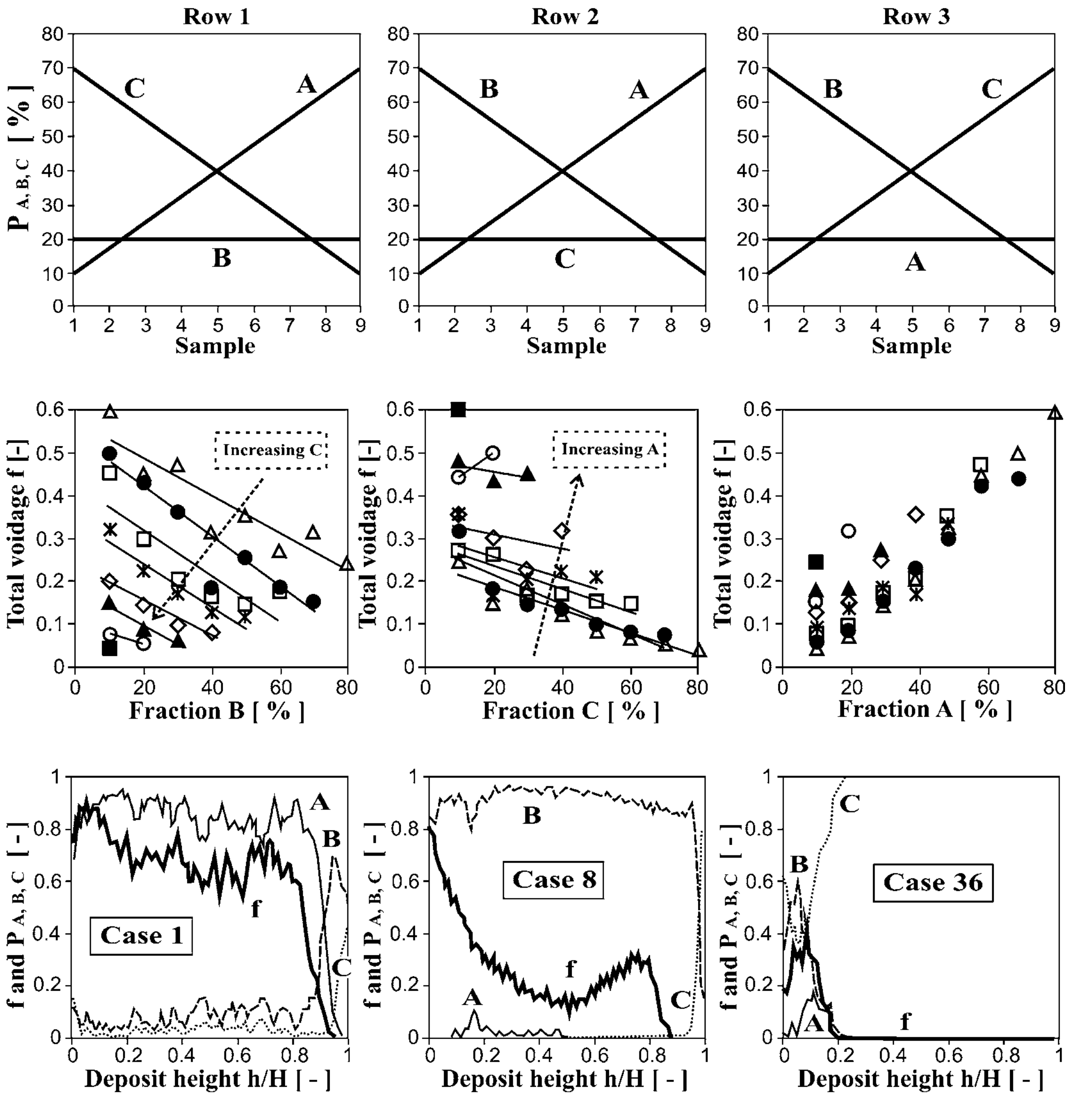
Results and discussion. The results obtained within Stage S1 correspond to a bird-eye-view at the subject and can be summarized in the following way. The cavity formation is a robust property that is particular to materials that exert certain typical features. (Out of the scope of this study are the colloidal and subcolloidal systems where the surface properties play the key role, as well as the particle interactions leading to agglomeration, clustering and precipitation – these were solved separately). One of the significant findings was that the particles of regular spherical shape and smooth surface do not normally tend to form cavities, they could make this only in very extreme conditions. However, when the surface is rough enough, the caverns may appear in the deposit depending on the way the suspension is treated and the settling occurs (flow regime, wall effects, etc.). The material softness and a higher degree of abrasivity can enhance void formation. Smooth particles of nonspherical shape, even with a large degree of anisotropy, are not typically prone to forming cavities with a length-scale much bigger than the largest particle dimension. Monodisperse materials are less potent for producing high voidage in sediment as compared with materials of apparent polydispersity. Then, the polydisperse materials with a "smooth" more-or-less uniform distribution of sizes are weaker void generators than those where the distribution has some pronounced peaks, advantageously separated by a gap or gaps of missing fractions. Although "aborted"/collapsed cavities occurred with a strong prevalence of some fine and middle fractions, majority of well represented patterns structures with voidage in sediment are typically relatively stable structures that can last for a very long time, being resistant to a subsequent shear or vibration damage to a great degree. This resistance of the final fabric around the sedimentary introduced holes is connected mainly to a key physical mechanism for the cavity formation which is known as the arching (also: bridging, doming), and is derived from the behaviour of the wet and dense granular systems. Here, the main supporting structure of the void is a force chain carried by the large grains engaged mutually by their surface roughness, possibly with help of fine fractions as the anti-lubricant.

The results obtained at the experiments during Stage S2 are mostly qualitative/semi-quantitative and are summarized in the figures illustrating this report. There are three rows (Row 1, 2, 3, top to bottom) of nine pictures each (Samples 1–9, left to right) showing the typical specimens of the deposit structure encountered in the measurements. In the first row (top Row 1), the case Cacb is presented, below it (middle Row 2) is the case Cabc, and the lowest (bottom Row 3) is the case Ccba. Within each row the concentration of one fraction (A, A, C) increases from 10 to 70%, one (C, B, B) decreases from 70 to 10 % and one (B, C, A) is fixed to 20 %. From the profiling collection of pictures we can see the samples with almost no cavities but also samples where a large portion of the deposit possesses a rich structure of interconnected caverns of complex shape. Note that a "proper" cavity is one that has at least one dimension reasonably larger than the largest particle size; it provides the definition to the "grain-oversized, primary sediment, high voidage fabrics". We see that the few first (two or three) samples on the left in Rows 2 (case Cabc) and 3 (case Ccba) show only very little effort to produce cavities. The deposit there is almost uniform and the resulting voidage is carried by the voids with length-scales comparable with the particle size; no large-scale patterns were formed. Both these regions have something in common, and it is the large portion of the middle fraction B.

Accordingly, we may conclude that the medium-sized particles serve as an inhibitor of the cavern formation, making the size distribution more uniform. On the other hand, reducing this fraction B increases the size gap between A and C, whence larger cavities, see Rows 2 and 3 rightwards. The deposits in Row 2 have a larger area populated with the cavities than Row 3, since it has a higher amount of big particles A, which likely form the gross coarse structure (skeleton of force chains). A similar effect is seen in Row 1, where the patterns proliferate with raising the content of A. The results obtained in the experiments during Stage S3 concern the quantitative characterization of the void patterns in the deposit. The 36 different combinations of three calcite fractions (A, B, C) tested are shown in the attached tabular data. The pictures are not shown since they are similar to those from the previous stage of the experiments. With validity



■ **Fig. 28-1.** An illustration toward the selected experimental results obtained within Project IAAX00130702. From top to bottom, the figures show the type of particles, appearance of voiding pattern fabrics (stromatactum holes in sediment), basic approaches to document the sedimentation-induced voiding and vertical distribution of grain-size fractions in the bed, and finally, simplest experimental results for the deposition of three fraction mixtures are shown (27 combinations; original).



Fractions	A 2-3 mm	B 0.5-1 mm	C 0-0.25 mm		A 2-3 mm	B 0.5-1 mm	C 0-0.25 mm
Cases			[%]				[%]
C1	80	10	10	**C19**	30	40	30
C2	70	20	10	**C20**	20	50	30
C3	60	30	10	**C21**	10	60	30
C4	50	40	10	**C22**	50	10	40
C5	40	50	10	**C23**	40	20	40
C6	30	60	10	**C24**	30	30	40
C7	20	70	10	**C25**	20	40	40
C8	10	80	10	**C26**	10	50	40
C9	70	10	20	**C27**	40	10	50
C10	60	20	20	**C28**	30	20	50
C11	50	30	20	**C29**	20	30	50
C12	40	40	20	**C30**	10	40	50
C13	30	50	20	**C31**	30	10	60
C14	20	60	20	**C32**	20	20	60
C15	10	70	20	**C33**	10	30	60
C16	60	10	30	**C34**	20	10	70
C17	50	20	30	**C35**	10	20	70
C18	40	30	30	**C36**	10	10	80

■ **Fig. 28-2.** The quantitative design of the 27-combination three-fraction experiments is graphically expressed using three diagrams in the uppermost part of this figure. Below, the total voidage f [-] is plotted vs. the mixture composition. Here, one fraction increases along the ordinate, one fraction parametrizes the set of the data lines, and the last fraction is the complement to unity – i.e. from left to right: fraction B increases (fraction C is the parameter); fraction C increases (fraction A is the parameter); fraction A increases (fraction B is the parameter, but lacks an apparent trend). List of data marks: Δ = 10%, ● = 20%, □ = 30%, ж = 40%, ◊ = 50%, ▲ = 60%, ○ = 70%, ■ = 80%. The lowermost row of three diagrams relates to 36-combination three-fraction experiments, as defined in the tabular data just below. Here, three of 36 cases were selected: cases Nos. 1, 8 and 36. They show the distribution of voidage f and the particle fractions $P_{A,B,C}$ within the deposit layer (ordinate – deposit height h/H [-]; abscissa – void fraction f [-] and particle groups' fractions $P_{A,B,C}$ [-]) (original).

for both the designs of the experiments, the main macroscopic parameter is the void fraction f calculated by the image analysis. Since the pictures are two-dimensional, the voidage is 2D, too (f = area of voids/area of image). There is no trivial way how to convert it into the true 3D bulk void fraction. However, this fact does not matter when f is used for comparative purposes, which is the case of this parametric study, where the fraction proportion is the key parameter. The mean total voidage f corresponding to the individual cases shows some recurrent features, repeating over certain periods apparent on the x-axis. The magnitude of f varies within one order and exerts pronounced maxima. A better insight into the pattern of the voidage behaviour can be gained from the diagrams, where the ordinate is the one fraction that increases, the family of the data lines is parameterized the value of the other fraction (fixed on each of these lines) and the last fraction is the complement to the whole (to 100 %).

Further, it can be easily manifested that the voidage decreases with the amount of fraction B (taken as ordinate) as well as with fraction C (being a parameter). For the visual convenience, the data were fit with a straight line only, with no claim for the linearity of their trend. The length of the data series is progressively reduced with freezing the degrees of freedom of summing all the fractions A, B, C to unity. The adverse effect of the middle fraction B on the cavity formation potential of the sediment is clearly seen when the voidage tends to drop as B increases. At a fixed value of B, the increase in the fine fraction C (vertically downwards) also reduces the voidage, because the rise of C is to the detriment of the largest fraction A, who is the skeleton-making agent in the sediment fabric. Similarly, we can see the same effect in different co-ordinates: the voidage decreases with along C, and, at a given C, it rises with increasing A (vertically upwards). And subsequently, we can see the strong dominant trend of increasing the roughest fraction A, where the other two components, B and C, play only a minor role in the voidage evolution with the gross changes in the mixture composition. Further with the documentation, the vertical particle distribution in the deposit layer was determined. Three typical situations are shown, where the ordinate is the normalized bed height, and the abscissa is the dimensionless concentration of the three fractions A, B, C. In addition, the vertical profile of the voidage along the sediment bed is also shown. Note that this information is 2D and corresponds to the number of pixels of the respective colour found within each horizontal line (i.e. at a given height). This image analysis approach is useful for comparing the deposit structure between different cases. For instance, with the situation where the coarse fraction A dominates (case C1), these big grains are almost uniformly distributed along the bed height, and the voidage graph basically follows that of the fraction A. This case roughly corresponds to the pattern shown in the picture No. 9 in Row 1. The situation where the middle fraction B dominates is the most inhibiting the production of apparent voids in the sediment – see the illustrations. With dominance of C, but similar proportions for A, B (gapped), the room for the pattern voidage formation is moderately to strongly reduced and, mainly, squeezed to the very bottom of the sediment layer, where the bigger and faster-falling fractions A and B can gather, and all fractions can interact. The rest of the layer is covered with a slowly settling fine particle of sort C (see the picture No. 9 in Row 3).

Conclusions. Several granular materials were tested for their ability of forming cavities in their sedimentary deposits. The results indicate that the formation is favored by nonspherical particles with certain surface roughness that are not too hard and the mixture contains more than one size fraction, advantageously two or more fractions, separated by gaps in the size distribution. Our experiments with a granular system with three fractions separated by two gaps showed that the middle fraction acted as an inhibitor of the cavity formation. The phenomenon of arching is supposed to endow the cavities their appreciable stability and duration and present the challenge of further investigation.

Notations. f – void fraction of cavities in deposit, [-] or %; h – deposit height [m]; H – total deposit height [m]; Pn – percentage of n-th particle size fraction in a mixture, [-] or %.

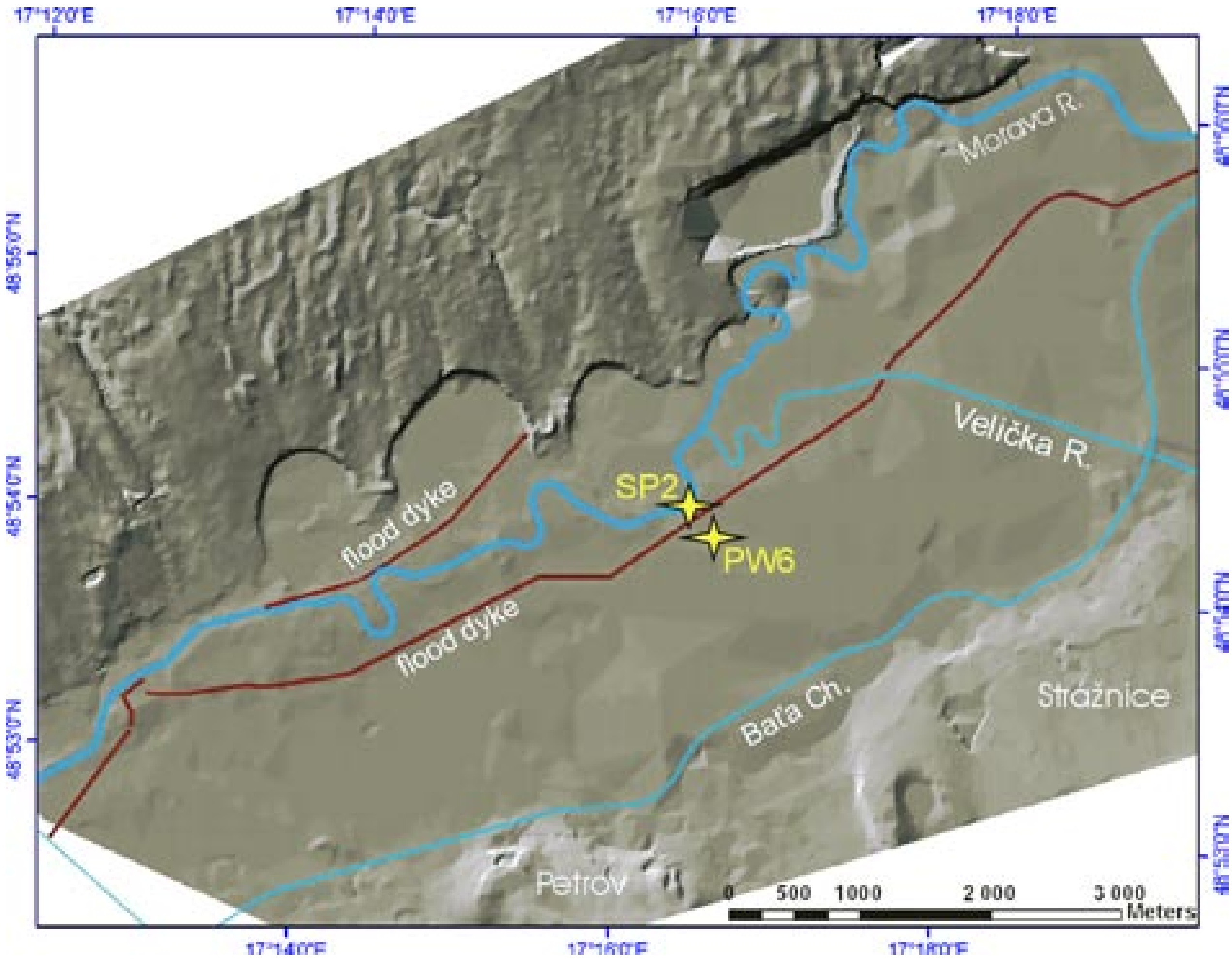
Abbreviations. A, B, C – three size fractions of particles used in measurements; C1–36 – experimental mixtures, cases C1 – C36, as defined in tabular form, see the illustration; S1, 2, 3 – experimental stage No. 1, 2, 3.

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 ASCR, v. v. i., Praha, T. Grygar, Institute of Inorganic Chemistry ASCR, v. v. i., Řež, I. Světlík, Institute of Nuclear Physics ASCR, v. v. i., Řež, R. Brázdil, P. Dobrovolný, Z. Máčka, Faculty of Science, Masaryk University, Brno & V. Beneš, G-Impuls, Ltd., Praha; 2008–2011)

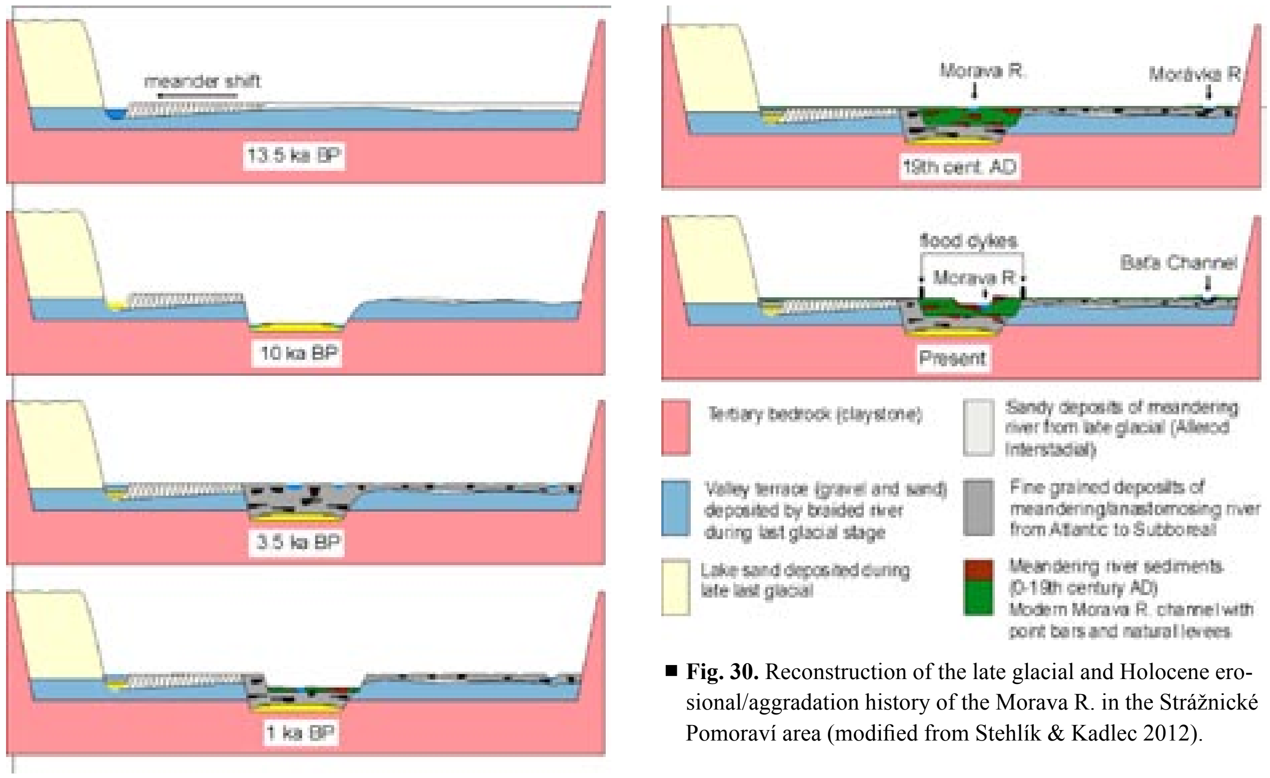
The lower course of the Morava River floodplain in the Strážnické Pomoraví located in the Lower Moravian Basin is an excellent environmental archive example. The length of the meandering river course through the study area is approx. 12 km, floodplain width is about 3 km, and it is one of the last river segment modified by minimal channel regulation (Fig. 29). The Morava R. behaviour during the Holocene was reconstructed using sedimentological approach completed with geophysical measurements, radiocarbon and dendrochronological datings and pollen analyses.

We are able to separate several erosion and agradation periods during the Holocene Morava R. history (Fig. 30). The first erosional period took place during the late glacial and early Holocene. The meandering river eroded older late glacial lake deposits and formed the present valley morphology. The large paleomeander curves 13.5 ka old filled with point bar deposits are preserved at NW edge of the floodplain. Later, the river channel incised up to 17 m deep during Younger Dryas stadial. This channel was filled with younger sediments deposited under anastomosing fluvial style during Atlantic climatic optimum (9–5.5 ka BP). Later climate deterioration (4.5–2 ka BP) triggered next erosional period in the Morava R. history. The channels were filled with fluvial and floodplain sediments during the last 1.5 ka. These youngest fluvial sediments are exposed in the most modern erosional banks of the Morava R.

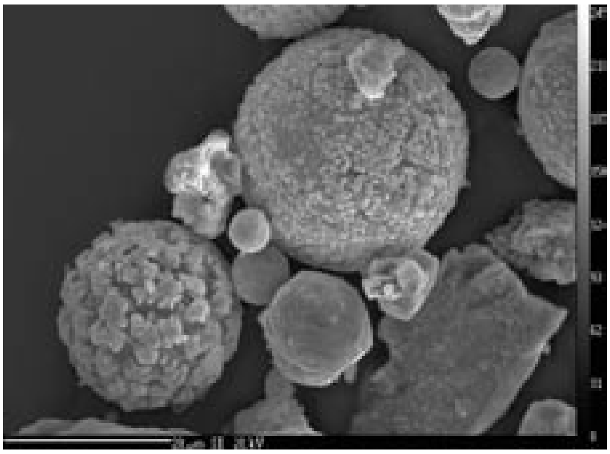
The key sections in the floodplain sediments were studied using mineral magnetic methods (mass specific magnetic susceptibility χ, ARM, ARM susceptibility, IRM, SIRM) and their



■ **Fig. 29.** The Strážnické Pomoraví area. Sections SP2 and PW6 studied for magnetic enhancement assessment (original).



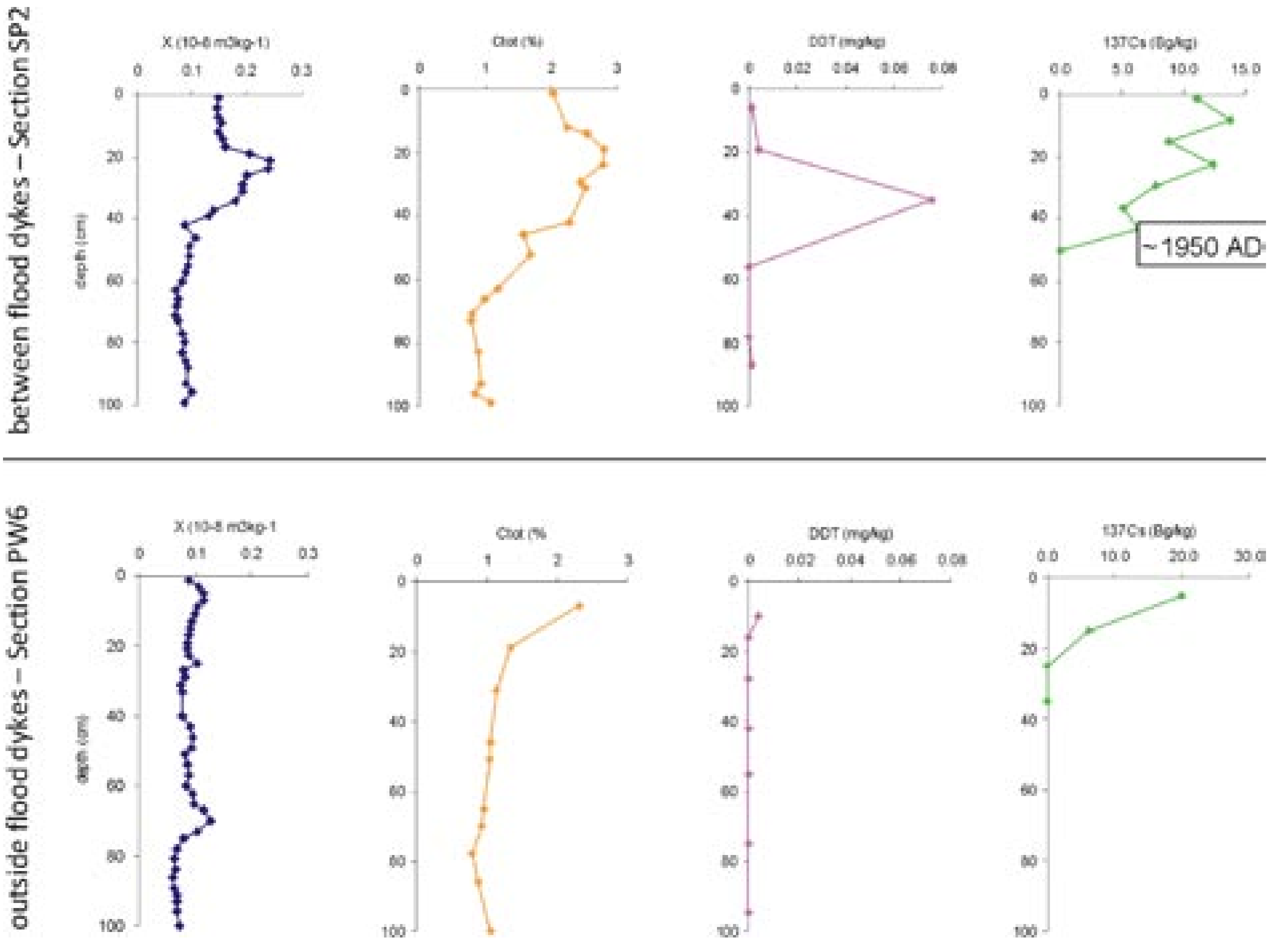
■ **Fig. 30.** Reconstruction of the late glacial and Holocene erosional/aggradation history of the Morava R. in the Strážnické Pomoraví area (modified from Stehlík & Kadlec 2012).



■ **Fig. 31.** Anthropogenic magnetic spheres present in the modern field soil and in the topmost part (50 cm) of the floodplain sequences (original).

intraparametric ratios. Obtained data show similar variations from section to section. The values of magnetic susceptibility are highest in the upper 50 cm of the sections. Both low- and high-temperature VSM measurements verified a significant paramagnetic contribution to χ. This paramagnetic component carried by clay minerals containing Fe often masks the ferrimagnetic signal. MPMS measurements were used to diagnose the magnetic carriers in the sediments. RTSIRM-ZFC sweeps show the presence of an oxidized magnetite in the upper 50 cm in all sections and in several underlying coarser horizons. Drops in RTSIRM-ZFC magnetizations at 120 K indicate a suppressed Verwey transition suggesting the presence of low-temperature oxidation of magnetite to maghemite (Kadlec & Diehl 2005). The causes of magnetic enhancement recorded in the uppermost 50 cm of the floodplain sequences were studied in sediments deposited inside (Section SP2) and outside (Section PW6) flood dikes constructed along the Morava R. channel in the late 1930s. The magnetic enhancement is connected with changes in magnetic grain size and mineralogy. The frequency-dependent magnetic susceptibility variations indicate an increased concentration of superparamagnetic particles formed during field soil cultivation. Anthropogenic spherical magnetic particles present in the sediment (Fig. 31) also significantly contribute to the enhancement.

Based on persistent organic substances (DDT, PCB) and radioactive ^{137}Cs peak determined in the sediments (Fig. 32) we



■ **Fig. 32.** Comparison of magnetic susceptibility, organic matter content, DDT and ^{137}Cs pollution in the floodplain sediments deposited inside and outside of the Morava R. flood dikes (original).

suppose that the magnetic enhancement is a result of soil erosion (and redeposition to the floodplain) triggered by intense agriculture activities conducted in the river catchment since 1950.

Another significant project output is a deciphering of the late Pleistocene history of the Lower Moravian Basin based on newly interpreted lake sediments exposed in the Bzenec sand quarry and in a cut bank of the meandering Morava R., both located about 4 km northwest of Strážnice. The exposed sandy deposits reveal a 9.5 m thick section dominated by cyclic horizontal beds. These beds are 3 to 20 cm thick and are characterized by structureless normal grading. Capping the horizontal beds is an interval of trough cross-stratified beds which are in turn overlain by well-sorted laminated fine sand. We propose the following interpretation for this sedimentary succession: (1) the cyclic beds were deposited by turbidity currents in a lacustrine environment; (2) the uppermost section of the lake turbidites was reworked by running water; and (3) wind-blown sand dunes were formed after draining of the lake. OSL dating of the lake sediments indicates deposition between 20 and 13 ka. Elevation of the sedimentary sequence documents that the lake level was 15–17 m higher than the Morava R. level today. The dam required to produce this lake could have been formed by aeolian sand dunes sourced from the late Pleistocene terraces at the Morava and Dyje river confluence. After collapse of the dam that formed the lake, the Morava R. constructed large meander bends across the newly developed floodplain. Radiocarbon ages together with pollen data from organic fill drilled in a paleomeander located at the floodplain edge document that the Morava R. channel was incised 18–20 m below the former top of the lake sediments during the Alleröd Interstadial.

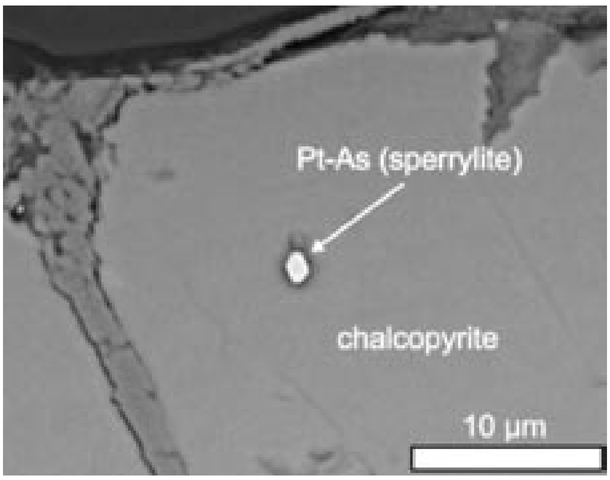
KADLEC J. & DIEHL J.F. (2005): Magnetic properties of flood plain deposits along the banks of the Morava River (Czech Republic). – *The IRM Quarterly*, 5, 3: 2–3.

STEHLÍK F. & KADLEC J. (2012): Dolní tok Moravy v holocénu aneb Co řeka napsala do svého archívu. – *Vesmír*, 91, 2: 100–102.

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

Highly siderophile element geochemistry of two mantle suites with different compositions and geotectonic positions were studied during this project. Additionally, a new method for the determination of total sulfur in mantle-derived rocks by inductively coupled plasma optical emission spectrometry (ICP-OES) was developed.

Highly siderophile element (HSE) geochemistry of upper mantle rocks from Horní Bory and Sklené, Bohemian Massif. The Horní Bory locality represents a unique suite of upper mantle rocks with different Mg-numbers and evolution (Mg-lherzolite, Fe-dunite/wehrlite, pyroxenite). Major/trace element and Sr-Nd geochemistry of previous studies have shown that the exchange between peridotite and SiO_2-undersaturated Fe-rich melts results in the production of dunite/wehrlite with similar modal and chemical composition to that of the Fe-dunite/wehrlite suite. In such a model, pyroxenites represent the crystalline product (±trapped liquid) of melts migrating along conduits in peridotite. Seventeen samples of Mg-lherzolite, Fe-dunite/wehrlite and pyroxenites were analyzed for total highly siderophile element (HSE) concentrations (Os, Ir, Ru, Pd, Pt) and osmium isotopic ratios. Furthermore, HSE contents were analyzed in major sulfide phases by laser ablation ICP-MS (LA-ICP-MS). The sulfides, as principal HSE carriers, were studied in detail by optical and electron microscopy. Different types were identified with respect to bulk rock geochemistry of the source rocks. The Mg-lherzolite predominantly contain Ni-Fe-sulfides (pentlandite, heazlewoodite, godlevskite, pyrrhotite), while the Fe-dunite/wehrlite contain more abundant pyrrhotite and common Cu-phases (chalcopyrite, cubanite) and NiAs (maucherite). Pyroxenites show much lower sulfide contents but contain very abundant chalcopyrite in the form of veinlets suggesting mobility of sulfides. Whole-rock and sulfide HSE concentrations have shown that sulfides host only up to 1–5 % of total HSE. Therefore, the rest of HSE must be concentrated in HSE-bearing alloys or sulfides. This was confirmed at least for platinum because scanning electron microscope (SEM) analysis revealed the presence of two Pt-As phases (most likely sperrylite – ~500 nm in diameter; Fig. 33) detected in a magnetite rim and within chalcopyrite. In Mg-lherzolite, whole-rock HSE analyses point to a primitive, unfractioned HSE distribution and subchondritic $^{187}Os/^{188}Os$ ratios. Conversely, the Fe-dunite/wehrlite suite exhibits very low I-PGE (Os, Ir, Ru) concentrations, enrichment in P-PGE (Pt, Pd)-Re and superchondritic $^{187}Os/^{188}Os$ ratios. Pyroxenites are depleted in all HSE and their distribution is very similar to other basalts worldwide. The $^{187}Os/^{188}Os$ ratios show up to extremely high, radiogenic values (up to 1.23). All studied rocks from Horní Bory yield Re-Os isochron age of 334 ±19 Ma. The HSE composition of the Horní Bory suite can be explained by the interaction between mantle peridotite and subduction-related melts. In the case of Mg-lherzolite, the interaction took the place at very low melt/rock ratios. On the other hand, the Fe-dunite/wehrlite suite underwent a complete recrystallization of the mantle protolith at high melt/rock ratios. During this process, primary sulfides were decomposed and replaced by metasomatic Cu-Fe sulfides with a highly

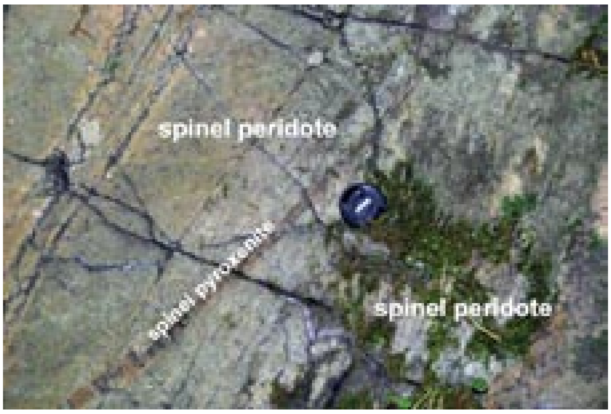


■ **Fig. 33.** Pt-As phase (likely sperrylite) enclosed in chalcopyrite. The Horní Bory Fe-dunite/wehrlite suite (photo by L. Ackerman).

radiogenic ^{187}Os signature. The composition of pyroxenites does not reflect primary Os signature, but they rather represent relicts after peridotite-melt interaction.

The Sklené peridotite boudin shows a HSE composition very similar to that of Mg-lherzolite from Horní Bory. When normalized to the primitive upper mantle, the Sklené peridotite exhibits an unfractionated pattern for the I-PGE and Pt but a significant depletion in Pd and Re. This pattern reflects the presence of pentlandite and late-stage heazlewoodite in the Sklené peridotite and their influence on HSE contents. The ^{187}Os/^{188}Os isotopic ratio of the Sklené lherzolites is similar to those for many samples of European subcontinental lithospheric mantle, but lower compared to Primitive upper mantle and estimates for convecting mantle.

Highly siderophile element (HSE) geochemistry of upper mantle rocks from Mohelno, Bohemian Massif. The Mohelno-Biskoupky peridotite body represents different type of peridotite and pyroxenite suite than other ones located in Gföhl Unit, Moldanubian Zone, Bohemian Massif. Previous major/trace element and Sr-Nd isotopic studies have shown that this suite most likely represents a relict of oceanic, primitive lithosphere (LREE depleted patterns, highly radiogenic Nd isotopic composition). The Mohelno body is well exposed in the Jihlava River valley (Fig. 34) but the occurrence of pyroxenite is rare.



■ **Fig. 34.** Spinel pyroxenite layer enclosed in peridotite. The Mohelno peridotite body in the Jihlava River valley (photo by M. Svojtka).

During our study, it has been revealed that most of the previously described pyroxenite occurrences are recrystallized orthopyroxene-rich layers of the host peridotite. Therefore, the study was focused on mantle peridotite with different major/trace element geochemistry and modal composition. In total, 10 samples were analyzed for HSE concentrations and Re-Os isotopic ratios. Primitive, unfractioned patterns in terms of I-PGE and the absence of rhenium depletion with respect to primitive upper mantle suggest that the Mohelno peridotites underwent a typical partial melting history. On the other hand, highly variable rhenium concentrations may reflect metasomatic processes of different intensity and/or interaction between peridotite and crustal materials. Homogeneous Os contents similar to primitive upper mantle estimates are in agreement with similar Ir and Ru contents and reflect only a limited role of metasomatism in the fractionation of highly siderophile elements. The ^{187}Os/^{188}Os ratios varied from subchondritic to superchondritic values and indicate that at least some of the studied rocks underwent metasomatic processes that modified (increased) ^{187}Os/^{188}Os ratios. Therefore, our data have shown that Mohelno-Biskoupky body likely represents relict of oceanic litshosphere, but its composition reflects some modification by percolating melts.

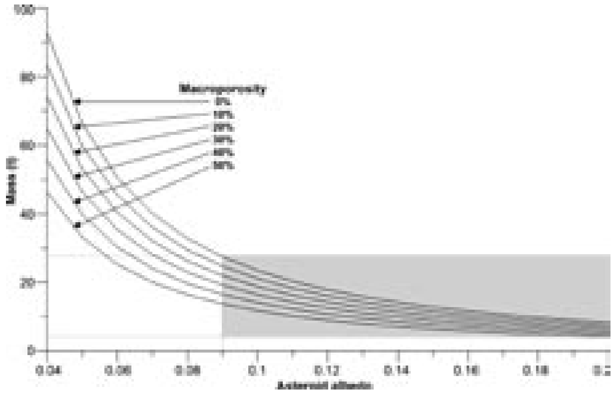
Determination of total sulfur contents by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES). Sulfides are principal carries of HSE in most upper mantle rocks. Therefore, an accurate method for total sulpur determination is highly requested in order to discuss the behavior of sulfides and HSE. Nevertheless, the published values for sulfur in various reference materials show large errors and differences. We developed a method for the determination of total sulfur in geological materials by inductively coupled plasma-optical emission spectrometry (ICP-OES) and show that good results can be obtained using this method even for samples with very low (< 20 ppm) sulfur concentration (e.g., peridotites). Sulfur was determined in thirteen geological reference materials with different major element compositions and sulfur contents. ICP-OES sulfur results for measured reference materials have relative standard deviation (RSD) better than 10 % for RM with sulfur concentrations higher than 100 ppm (except reference material W-2a diabase with RSD of 16 %). Reference materials with lower sulfur contents (<40 ppm) show a much higher RSD (17–18 %). The ICP-OES data were compared to data obtained by combustion infrared detection method, which generally yields higher sulfur concentrations, but better RSD (≤ 8 % for all reference materials except DTS-2b) compared to ICP-OES data.

No. KJB300130903: **Low-temperature magnetic properties of iron-bearing sulfides and their contribution to magnetism of cometary bodies** (*T. Kohout*, P. Týcová, J. Haloda, Czech Geological Survey, Praha, Czech Republic & R. Zbořil, Palacký University, Olomouc, Czech Republic; 2009–2011)

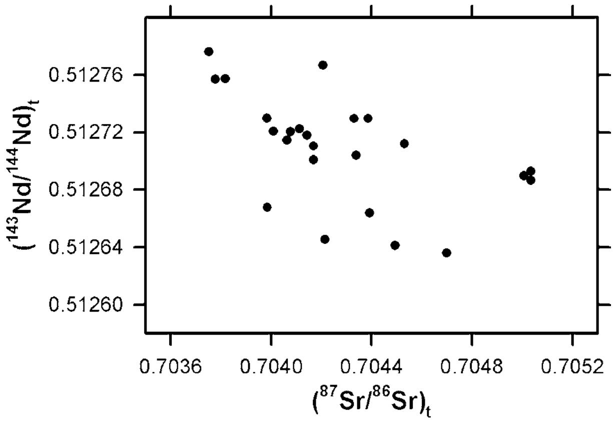
Certain iron- and manganese-bearing sulfide minerals present within extraterrestrial material undergo various magnetic transitions at low temperatures and thus have significantly different magnetic properties at temperatures of the cold interplanetary environment compared to terrestrial conditions. This opens us a new look on asteroids and comets and on their interactions with magnetic fields in the Solar System. A detailed research of the low temperature magnetic properties of such sulfides is being done with natural and synthetic samples. Data are used to model and interpret magnetic observations and magnetic properties of minor bodies of the Solar System.

In 2011, a series of new low-temperature magnetic measurements were performed with the alabandite (MnS) samples in order to get a better understanding in a magnetic transition occuring in this mineral at ~50 K. The new study excluded the transition to be ferrimagnetic to antiferomagnetic transition in alabandite as previoulsy reported in literature and proved that the transition is caused by the occurrence of Mn_3O_4 (and its Curie temperature) as an oxidation product within MnS samples.

The density measurements of Almahata Sitta ureilites revealed a bulk density of ~3.1 g.cm^{-3}. This value, together with the 2008 TC3 asteroid shape model and albedo, was used to



■ **Fig. 35.** The dependence of asteroid 2008 TC3 mass on its albedo and macroporosity (original).



■ **Fig. 36.** Variation in isotopic ratios $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ in subvolcanic rocks of the Roztoky Intrusive Center (original).

estimate the asteroid's mass. Based on the study of recovered meteorites and the atmospheric entry observations, the asteroid 2008 TC3 is compositionally heterogeneous and of low mechanical strength. Thus we consider the presence of significant macroporosity likely, lowering asteroid's bulk density compared to that of the Almahata Sitta ureilites. Most realistic albedos lie in a range of 0.09–0.2 and the presence of significant macroporosity leads to mass estimates below 20x103 kg, which is lower than previously estimated (Fig. 35). The presence of a non ureilitic fraction and space weathering may affect the albedo and also influence the mass estimates. However, current data do not allow to quantify this effect.

Continued projects

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 České stredohoří Mts., Ohre/Eger Rift)** (*R. Skála*, *J. Ulrych*, *V. Böhmová*, *L. Ackerman*, *J. Filip*, Z. Řanda, J. Mizera, J. Kučera, Nuclear Physics Institute, Řež, E. Jelínek & D. Matějka, Faculty of Science, Charles University, Praha; 2009–2013)

Following the research plan, the bulk chemical composition of subvolcanic rocks from the area of the Roztoky Intrusive Center (RIC) was determined. Next to major elements, the attention was given to the determination of contents of minor and trace elements. Results yielded by various modes of INAA in the past years were supplemented by data acquired by ICP-MS technique.

Strontium and neodymium isotope ratios show very narrow ranges varying from 0.7038 to 0.7050 ($^{87}Sr/^{86}Sr$) and from 0.5126 to 0.5128 ($^{143}Nd/^{144}Nd$), respectively (Fig. 36).

Besides bulk rock analyses also chemical composition of individual major mineral phases was studied using an electron probe microanalyzer. In particular, chemical data were collected for feldspars, biotites, amphiboles, pyroxenes and apatites from various rock types of the RIC.

The apatite fission track analysis (AFTA) method with an external detector was used to determine the age and time-temperature development of selected subvolcanic rocks. Muscovite detectors were attached to polished surface and together with standard glass detectors CN5 packed to an irradiation cassette. The cassette has been irradiated by thermal neutrons in the Triga reactor, Radiation Center, Oregon State University, Oregon, USA.

Densities and lengths of spontaneous and induced fission tracks were measured in a microscope. The age of the samples studied was determined *via* zeta calibration method after Hurford and Green. The temperature history of the rocks was finally determined by the AFTSolve program with implemented multi-kinetic annealing model of Carlson, Donelick and Ketcham.

Comparative samples of apatites – e.g., sample S21 (Havírky) from the Central Bohemian pluton underwent an ascent from the zone of the complete annealing (≥ 120 °C) at 180 Ma (Jurassic) *via* rapid decrease in temperature followed by the period of thermal stability at about 90–100 °C lasting to ca. 30 Ma (Eocene, Oligocene). After that, the rock rapidly cooled and ascended to the surface (Recent). All studied samples from the Central Moldanubian pluton (S11, S12, S13, S14, S15: Třebíč, Malý Beranov, Mrákotín, Terezín) display very similar time-temperature development. From the zone of the complete annealing (≥ 120 °C) these rocks ascended – similarly to the material from the Central Bohemian pluton – at 180 Ma (Jurassic) through rapid decrease of temperature. After that, there was a period of the stability at ca. 40 °C (or even less) to almost 30 Ma (Eocene, Oligocene) and then the rocks underwent rapid cooling and they reached the surface.

To put the studied subvolcanic rocks into a general geologic context, the complex investigation of Cenozoic and Upper Cretaceous volcanic activity of the Bohemian Massif has been performed (Ulrych et al. 2011) with following results:

Cenozoic anorogenic volcanism of the Bohemian Massif represents an integral part of the Central European Volcanic Province. The temporal and spatial distribution of the Cenozoic and Upper Cretaceous volcanic rocks in the Bohemian Massif, their chemical and mineralogical composition as well as their tectonic setting and paleostress data are used to characterize and classify this volcanic activity. Three main volcanic periods can be recognized based on K–Ar data and known paleostress fields: (i) pre-rift (79–49 Ma), (ii) syn-rift (42–16 Ma), and (iii) late-rift (16–0.3 Ma), with the youngest period further subdivided into three episodes. The mafic rock types (>7 wt.% MgO) dominate among volcanics of all periods and they are of nephelinite–basanite/tephrite composition. Exceptionally also suites of melilitic ultramafic rocks of the pre-rift period and of the final episode of the late-rift period occur in northern Bohemia and in western Bohemia, respectively. The most abundant are volcanic rocks of the syn-rift period occurring in the Ohře Rift Graben. The initial $^{87}Sr/^{86}Sr$ (0.7032 to 0.7050) and $^{143}Nd/^{144}Nd$ (0.51264 to 0.51301) ratios of the mafic volcanic rocks of the Bohemian Massif are characteristic of magmas derived from a sub-lithospheric mantle source. The isotopic ratios resemble those of the HIMU mantle source ($^{206}Pb/^{204}Pb$ ca. 19 to 20). These rocks have the most isotopically depleted compositions among the Central European Volcanic Province volcanic rocks.

ULRYCH J., DOSTAL J., ADAMOVIČ J., JELÍNEK E., ŠPAČEK P., HEGNER E. & BALOGH K. (2011): Recurrent Cenozoic volcanic activity in the Bohemian Massif (Czech Republic). – *Lithos*, 123, 1–4: 133–144.

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

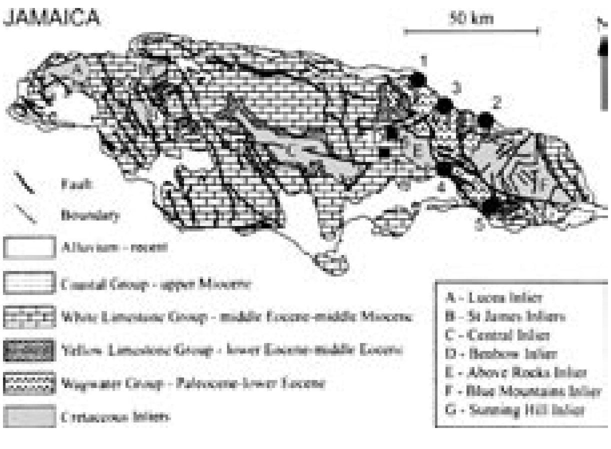
GAUK No. 3010: **Uranium and thorium content in macrofungi from pristine and polluted areas** (J. Kubrová, Faculty of Science, Charles University, Praha, Czech Republic & *J. Borovička*; 2010–2011)

The project was focused on the accumulation of uranium, thorium, and rare earth elements (REE) in macrofungi. These elements have not been extensively studied and the few literature data are contradictory. Whereas some authors published, e.g., very low concentrations of uranium (at ppb level in dry matter), a recent study reported units of ppm. The aim of this project was to clarify this problem and gain high-quality data on uranium, thorium and REE concentrations in macrofungi using high-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS) and non-destructive epithermal neutron activation analysis (ENAA). In order to recognize possible influence of anthropogenic environmental pollution, macrofungi from uranium mining area in the vicinity of Bytíz near Příbram were analyzed. Mobility of uranium and several other metals (Th, Ag, Pb) was investigated in a representative soil profile. In conclusion, macrofungi do not accumulate high levels of uranium. Furthermore, the uptake of particular metal in macrofungi is particularly influenced neither by metal concentration in the underlying soil, nor by its mobility.

4e. Grants of the State Departments

Ministry of Industry of the Czech Republic, No. 12/01-10/MPO/B-II: **Mining and processing of industrial minerals on Jamaica and selected CARICOM countries** (L. Opekar, GET, Ltd. Praha, Czech Republic, *J.K. Novák*, *M. Šťastný*, *P. Bosák*, *J. Ulrych* & *J. Pavková*)

The aim of the project is to explore industrial minerals in Jamaica and to help to develop their extraction. The studies were focused especially on exploration and characterization of different deposits of carbonate rocks (including high-grade limestones) and corrective raw materials (mostly volcanics and volcaniclastics) for the production of cements and limes to support the local construction industry and to decrease import of such building materials. The sites studied in 2011 are shown in Figure 37.



■ **Fig. 37.** Location of the studied sites on Jamaican sketch map (completed after Hastie et al. 2008). I – Northern Coastal Zone (1. St. Mary; 2. Buff Bay); II – Wagwater Graben (3. Nutfield, 4. Ginger River, 5. Bito); III – platform margin, east flank of Benbow Inlier (6. Ham Walk, 7. Dover Castle).

Subproject No. 7305/2: **Supplementary cementing raw materials and carbonate rocks from the St. Mary region, Jamaica** (*J.K. Novák*, *P. Bosák* & *J. Pavková*)

Jamaica has benefited from both the availability of high-calcium limestone and its processing (to carbonate fillers, pigments, whitings, and lime) as well as from commercial grade karstic bauxite (to alumina) over last several decades. By contrast, the calcareous marl(stone), argillaceous limestone, marly claystone, and kaolinitic clay for manufacturing the Ordinary Portland cement (OPC) become harder and harder to find. From the technological point of view, the unusual purity of the Jamaican platform limestones (97.5–99.0 % $CaCO_3$; low-Mg calcite) and the limited reserves of corrective raw materials adversely affect a cement production in Jamaica and pose problems for compliance of the Caribbean Cement Company Ltd. at Kingston. Magnesium carbonate, the main undesirable impurity for cement making is not a problem, if the cement producer requires an upper limit of 3–5 wt.% MgO. Little information has been collected regarding the mixed siliciclastic-carbonate facies and marly chalk, which may become important in the future. In the present economic climate, the deficiency in silica and alumina contents in the feed for the kiln is compensated by using the supplementary cementing materials (SCMs), rich in unaltered volcanic glass. The supply of such pozzolanic material from the Island of Martinique (McKenzie 2005) becomes an absolute necessity. The certified composition is almost universally accepted among the CARICOM countries and used either a/ directly in preparing the blends to be formulated a slag cement or b/ as a pozzolanic admixture to the ground Portland clinker for intergrinding the Portland-pozzolana cement. If the composition of the artificial blends is standardized carefully, the mixing of one or more of components is a remarkably flexible process. Deficiencies which are consistent with the low proportion of ferric iron and alumina could be compensated by laterite soil. Being easy of access, the good-quality gypsum (and associated anhydrite) are available from open-air quarries at Brooks and Bito (southern part of the Wagwater belt), where they are exposed in the form of folded bodies and/or separate lenses. A correct amount of the gypsum is usually mixed with ground Portland clinker to control setting characteristics of the OPC.

In commercial use, the selected vitric and/or zeolitized tuffs, popularly known as natural pozzolans, are widely consumed in the pulverized and dry state (after removal of the coarser >45 µm particles). Unlike selected clay types, the vitric and zeolitized tuffs or pumices do not require a heat treatment to enhance the pozzolanic lime-consuming reactivity. By contrast, the deeply altered (bentonitized) tuffs that include a substantital proportion of the Ca-montmorillonite clay as well as the kaolinite-type clay could be effectively used after heating for 2 hours, at the level of 810 °C and 540 °C, respectively. Experience in producing the artificial pozzolans, metamontmorillonitic and metakaolinitic in composition, has shown that such heating process leads to the origin of disordered alumosilicate structure and to an increase in specific surface and microporosity.

Further principal use of the SCMs concerns the pozzolanic addition into hydrated concrete or cement-based mortar and as a substitute for the OPC. In finely divided form and in the presence of moisture, these admixtures react with free calcium hydroxide at ordinary temperature to form additional compounds possessing cementitious properties. The main technical advantage from use of the SCMs provides (a) the improvement in concrete performance, (b) reducing the heat of hydration, and (c) the enhanced resistance of concrete to cracking by alkali-aggregate and alkali-silica reactions. An extra bonus obtained in utilizing is the optimum strength development after 91-day maturation. Furthermore, a partial replacement of the OPC in hydrated concrete mixes by the SCMs (in the range of 5–25 wt.%) represents a viable solution to the mitigation of industrial CO_2 emissions, which is urgently needed worldwide. Potentially deleterious or alkali reactive materials in concrete include: fines (smectite and illite/montmorillonite clays, and silt), micas, organic matter, pyrite and soluble salts, all tending to reduce the ultimate strength and durability of the concrete.

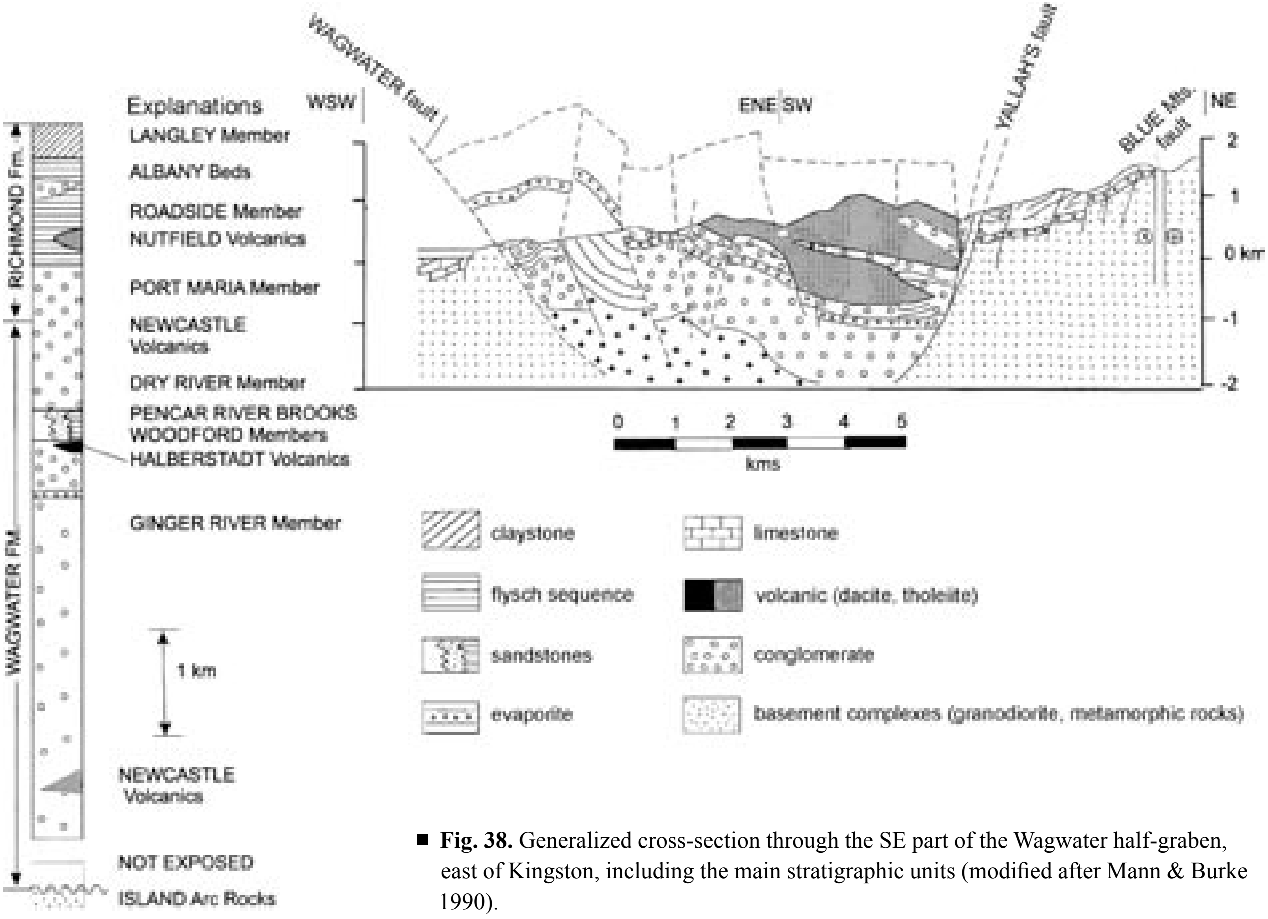
Our own research has been focused on the petrographical-chemical recognition of: (1) vitric pozzolana-like tuff and hyaloclastite in local volcanic centres, e.g., around the village of Bito (lowemost succession of the Wagwater Formation); (b) laminated mudstone/siltstone exposed at Albany and Rio Sambre valley, and (c) thin-bedded shales in sea cliffs between the Pagee Point and the Forges Point. Regarding the corrective cement-making materials, the coeval (Middle Eocene in age) but lithogically contrasting localities of mudstone-marl(stone) facies are available (forming the Langley Member of the Richmond Formation and Font Hill Formation, respectively; Fig. 38). The successions of the deep-sea mudstone/siltstone and neritic marl(stone) have been reported by Jiang & Robinson (1987) and Robinson (1994). Both desirable sources occur at a reasonable distance from the seaport of St. Mary. A relevant technological question to be resolved is whether or not the baked mudstone/siltstone and shale metaproducts become sufficiently lime-reactive and should be accepted as the pozzolanic material.

Apart from recrystallized (dolomitized) limestone types (occurring around the Galina Point, coastal zone near St. Mary), all high-grade limestones and bioclastic facies (97.5–99.0 %; 1–2 % $MgCO_3$ by weight) including silica-bearing chalky limestone (91–92 wt.% of low-Mg calcite, up to 6 wt.% of opaline biosilica) appear to be suitable for cement clinkering, if corrective cement-making resources are available.

For a variety of reasons, the compilation is also focused on the white coastal cliffs facing the Buff Bay/Portland. Generally, the chalky-marly limestone package of strata is approximately 50 m thick and relevant for the future manufacturing of the chalk-based cement. Regarding the geologic conditions, the Buff Bay Formation, Middle Miocene in age, has fairly uniform composition over the entire deposit, although the biosilica-bearing chalk and chalky limestone succession is interbedded with marly limestone. The only erosional surfaces are observable as the debris-flow conglomerates, which contain the Paleocene limestone pebbles within fine-grained marly matrix. In the uppermost marl-dominant part of the succession, there is a series of major erosion surfaces and the Buff Bay Formation is unconformably overlain by the lateral equivalent of the Bowden Formation. The gradual transition from the Buff Bay Formation into the underlying Spring Garden Member of the Montpelier Formation is evident.

At number of isolated exposures, with a lateral extent up to 1.2 km from coastal road, the dominantly sponge- and spicule-rich chalk and chalky limestone are common. Maturation of biogenic opaline skeletons to microcrystalline chalcedony and quartz is here known to have resulted in the chert lamination and patches (Land 1979). The faunal evidence for deposition in lower bathyal to abyssal-water depths is reported by Robinson (1998), Maurrasse (1993), and Aubry (1993) using (1) the age-diagnostic foraminiferal taxa; (2) the planktonic to benthic (P/B) ratio, and (3) the change in siliceous content. Silica-bearing and calcareous nannofossils in the form of radiolarians, Hyallospongea, and foraminiferal assemblages dominate. According to Maurasse (1993), the environmental shift during the Middle Miocene time was stimulated by the inception of the Northern Atlantic deep- and cool-water paleocurrent into the Cayman Through.

The equivalent Bowden Formation forms a sandy-marly allostratigraphic overburden, 1–12 m thick. It reflects the hiatus of 4 Ma in succession at Late Miocene-Pliocene boundary and sharp changes in sedimentation style affected by gravitational processes (Berggren 1993; Robinson 1998). Because of submarine slumping, the considerable redeposition is evident. Numerous erosional surfaces involve separate periods of tectonic uplift, down-slope erosion, and terrigenous sedimentary supply. Of particular relevance with respect to the possible use, is the fact that massive marlstone unit may be valuable as a source of corrective raw material.



■ **Fig. 38.** Generalized cross-section through the SE part of the Wagwater half-graben, east of Kingston, including the main stratigraphic units (modified after Mann & Burke 1990).

The problems we are currently facing are to do with the transition between both the traditional and unconventional manufacturing of the chalk-based cement, the environmental issues, and the technological limitations.

There are two principal constitutional aspects: (1) the chalky limestone package with marly intercalations (as cement raw material), and (2) the non-carbonate fraction containing opaline sponge skelets, unimodal in size (as the siliceous pozzolana for concrete). Due to fineness, high total specific surface, and moisture (15–20 %), the friable chalk is interpreted as a very special cement-making raw material, requiring relevant assessment procedures. All known technologies to make the OPC from chalk and the operational experience were summarized by Kapphahn (2010). The employment of quarry-wet chalk requires the specific ways of extraction, hydraulic handling of filter cake, storage of dried lumpy chalk, and in particular semi-wet preparing the feed for the kiln operations. The impurities, which may adversely affect the rheologic behavior of the filter cake, refer to a/ the presence of macrofossils, flint and clayey particles, pyrite nodules and organic matter, and b/ soluble salt content. The chalk purity (over 93 wt.% $CaCO_3$), has, however, a negative effect on the rheologic behavior of the filter cake and consequently on the storage and hydraulic transport. Under certain conditions, particularly the availability of white kaolinitic clay, the white cement manufacturing (WPC) will remain a value-added product for foreseeable future.

When both the grade of whiteness and the purity of white chalk (with acceptably fine particles) are sufficiently high, a product becomes the white carbonate filler for many industrial applications. Moreover, siliceous fraction, such as biogenic opal-A and cryptocrystalline quartz chert, may be useful in raw state as the pozzolanic admixture for hydrated concrete, although it is more suitable to treat it by heating to a temperature of about 900 °C.

An improved understanding of the geology, petrographical-chemical composition of the cement-making and pozzolanic raw materials, and specifications of cement and concrete are essential from the future exploration perspective. The keywords in this regard are: chalk-based cement; the SCMs and corrective raw materials; chert-bearing fraction.

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Subproject No. 7391/4: **Geochemistry of volcanic rocks from the Bito–Ramble and Devils Racecourse Formation areas, Jamaica** (*J. Ulrych*, *J. Pavková* & *P. Bosák*)

Volcanic rocks of the Bito–Ramble area and the Devils Racecourse Formation have undergone substantial hydrothermal alteration followed by intense tropical weathering. With regard of a long time known migration of mobile elements during rock alteration it was suitable to replace the conventional classification diagrams as TAS, K_2O *vs.* SiO_2, AFM and FeO/MgO *vs.* SiO_2 using main mobile elements by diagrams using immobile elements. The Zr/TiO_2 *vs.* Nb/Y diagram using exclusively immobile elements was used to replace and check the results of the broadly used TAS diagram, based on mobile alkali and SiO_2 contents. The classical K_2O *vs.* SiO_2 diagram was from the same reasons replaced by the Th–Co diagram using immobile elements focused to the altered island arc volcanic rocks. The Th/Yb *vs.* Ta/Yb discrimination diagram, using exclusively immobile elements, is also a useful tool.

On the basis of geochemical criteria, based on immobile elements, the volcanic series in both areas were determined. The **Bito–Ramble** volcanic succession, composed of minor mafic to intermediate tuffs and prevailing acidic lavas and ignimbrites of: (i) basaltic andesite/andesite – dacite/rhyolite (including latite and trachyte) of calc-alkaline series in the Th–Co diagram (the diagram does not involve alkaline series!); (ii) alkali basalt (Nb-high basalts) – trachyandesite of alkali series in Zr/TiO_2 *vs.* Nb/Y diagram. The **Devils Racecourse Formation** comprising mafic lavas and dominant acidic tuffs of: (i) basaltic andesite/andesite – dacite/rhyolite (including latite and trachyte) of tholeiitic (IAT) character in the Th–Co diagram; (ii) basalt – andesite/dacite/rhyolite of sub-alkaline character in Zr/TiO_2 *vs.* Nb/Y diagram (Fig. 39).

The normalized trace-element patterns of both volcanic rock sets show only minor differences in trace element distribution. The Nb–Ta and P troughs characteristic for majority of the rocks associate with Fe–Ti minerals and apatite fractionation. Residual rutile or amphibole in source material can be responsible for negative Nb–Ta anomalies in siliceous melts.

Nevertheless, the normalized REE patterns of the compared rock sets show substantial differences (Fig. 40). The Bito–Ramble rock set is characterized by lower REE contents with characteristic LREE enrichment typical for evolved rocks. On the contrary, the Devils Racecourse Formation rock set is higher in REE contents and shows a flat course of the REE patterns, characteristic for primitive (e.g., tholeiitic) rocks. Majority of rocks are free of substantial Eu/Eu* anomaly. Differences in chemical composition within set B as well as rock subsets D are mostly minor.

Concentrations of the economically important incompatible elements in volcanic rocks of both localities are beyond present economic interests. Their contents can be considered as low or only insubstantially increased compared to the MORB, PM data and clarke concentration in the lithosphere. Only the barite vein should be of economic interest, after a detailed reconnaissance of the locality and adjacent area.

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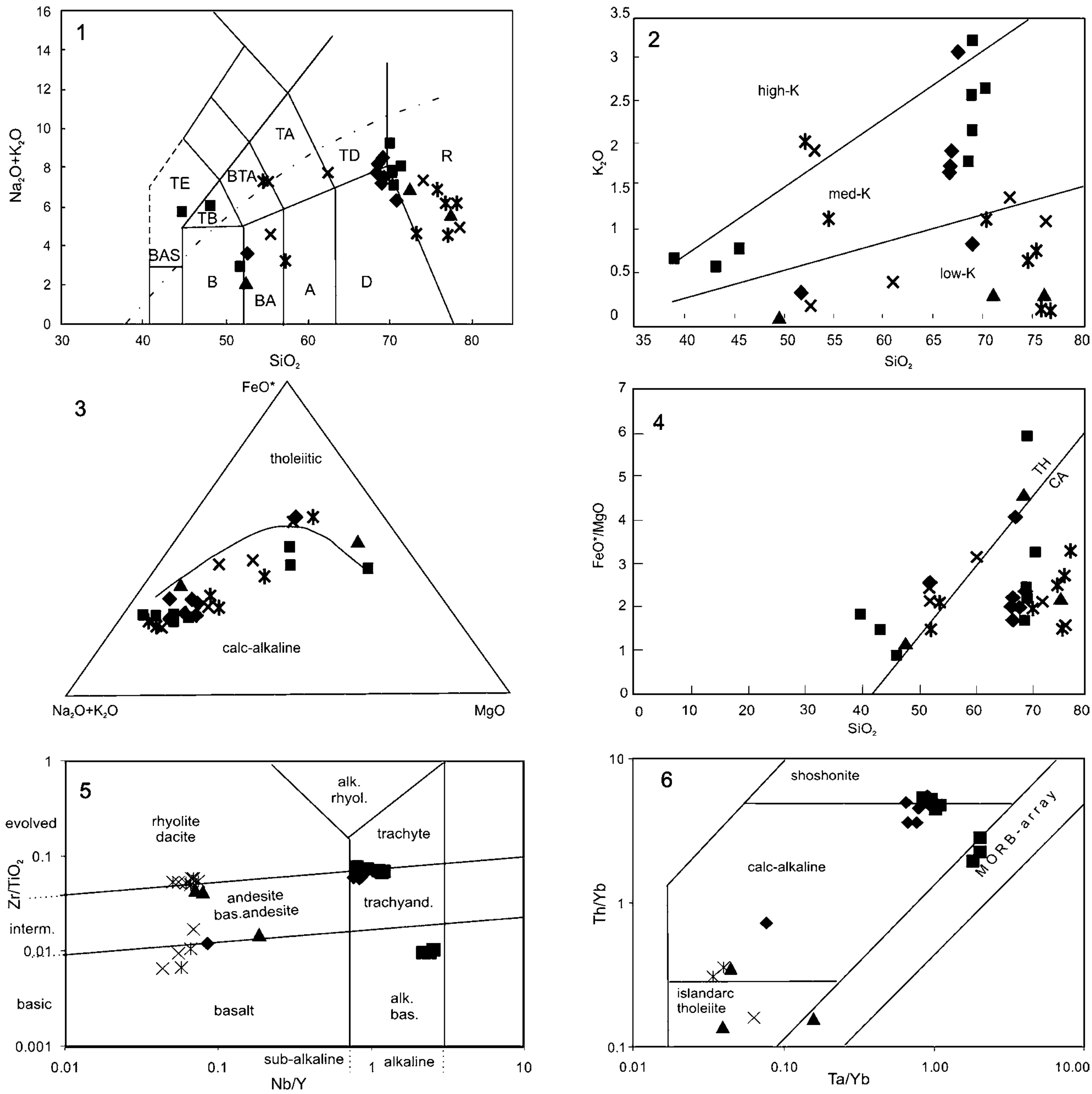
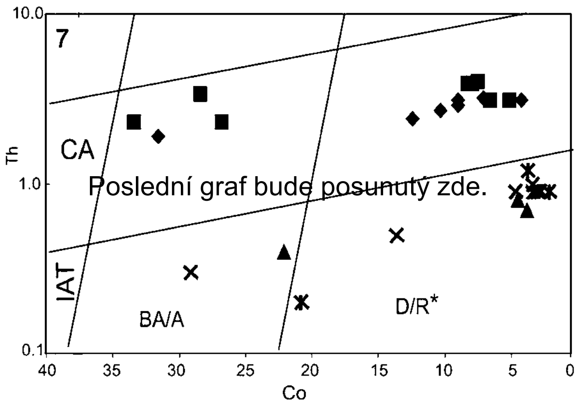
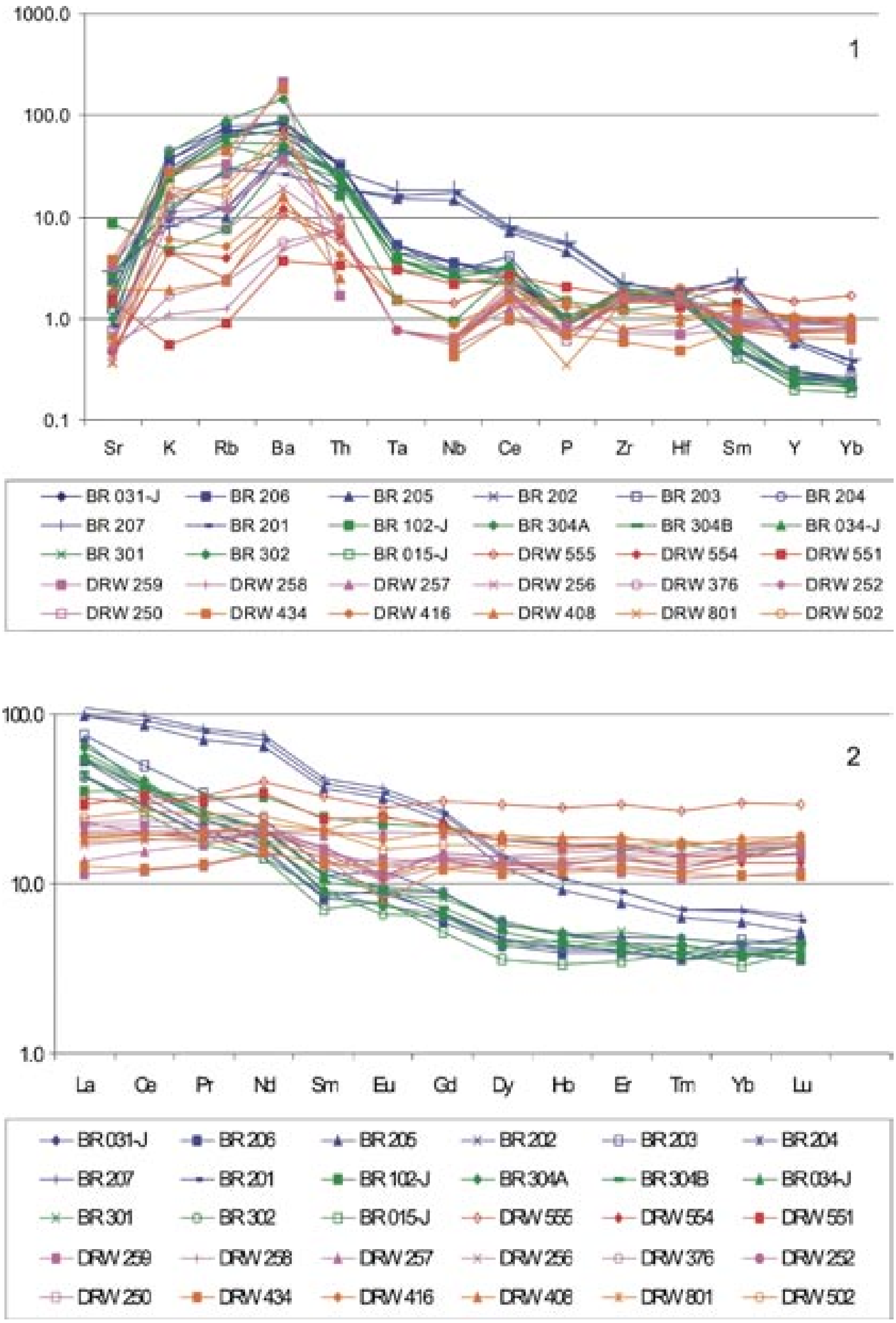




■ **Fig. 39.** Volcanics of the Bito–Ramble area: subset B1 (western and northwestern part) – full-square; subset B2 (central and eastern part) – full diamond. Devils Racecourse Formation area: subset D1 (Western gully) – full-triangle; subset D2 (Central Valley) – star; D3 (Middle gully, Eastern gully and Central Ridge) – cross. 1 – Total alkali-silica (TAS) diagram of Le Maitre (2002). BAS – basanite (ol > 10 %), TE – tephrite (ol < 10 %), BA – basalt, TB – trachybasalt, B – basalt, BA – basaltic andesite, BTA – basaltic trachyandesite, A – andesite, TA – trachyandesite, D – dacite, TD – trachydacite (q > 20 %), T – trachyte (q < 20 %), R – rhyolite. The dividing line between alkalic and sub-alkalic magma series is from Miyashiro (1978); 2 – K_2O vs. SiO_2 discrimination diagram of Peccerillo & Taylor (1976); 3 – AFM diagram using discrimination criteria of Irvine & Baragar (1971); 4 – FeO*/MgO vs. SiO_2 discrimination diagram from Wilson (1993): TH – tholeiite field, CA – calc-alkaline field; 5 – Classification Zr/TiO_2 vs. Nb/Y diagram of Pearce (1996) after Winchester & Floyd (1977); 6 – Th/Yb vs. Ta/Yb ratio plot of Pearce (1982). 7 – Th vs. Co discrimination diagram of Hastie et al. (2007): CA – calc-alkaline field, IAT – island arc tholeiite field (according to Ulrych et al. 2011).



■ **Fig. 40.** Volcanics of the Bito–Ramble area (subset B1, full square; subset B2, full diamond) and Devils Racecourse Formation area (subset D1, full triangle; subset D2, star; subset D3, cross). 1 – N-MORB-normalized incompatible trace element patterns. The order of the elements are from Wilson (1993) and values of the normalizing constants are from Sun & McDonough (1989); 2 – Chondrite-normalized REE patterns. The normalizing constants are from Sun & McDonough (1989) (according to Ulrych et al. 2011).

Subproject No. 7391/11: **High-grade limestones from Biddiford, north Jamaica** (*M. Šťastný*, *P. Bosák* & *J. Pavková*)

The report was designed to describe the petrography of limestone samples that were taken in Biddiford (Trelawny Parish). In addition to petrographic determination, the study concentrated on normative mineral composition, presence of pollutants and on other physical tests to determine the suitability of the use of limestone for industrial purposes. Microscopic examination showed the presence of foraminifers, especially pseudoorbitic, which are typical of very pure limestone. The studied rocks are comparable to white limestone from the western and central parts of the island (Novák et al. 2006, 2007, 2010). Most of the micritic limestone to calcarenites formed from the shells and newly formed calcite called scald. It is a high percentage of calcite (90.7 to 95.2 % calcite). Rare magnesium, which is not dolomitic, represents only an isomorph of calcite. Dolomite is missing. SiO_2, Al_2O_3 contents are very low. Only appears in the footsteps of Fe_2O_3. The whiteness and brightness of the rocks is high (81.8 to 82.4 % whiteness is R457 nm and from 87.04 to 87.47 % RY). The content of other pollutants is very low. It is a very suitable raw material for processing. The blocks of limestone in the northern part of the island may complement its operations in other parts of the island. The good quality of limestone deposits in other parts of the island combines with high added value for industrial products.

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NOVÁK J.K., BOSÁK P. & PAVKOVÁ J. (2010): *Limestone types at Grange Hill, western Jamaica. Initial report*. – Unpublished Report, Instit. Geol. ASCR, v. v. i. for GET, Ltd.: 1–29. Praha.

Subproject No. 7391/11: **High-grade limestones at Sherwood Forest, eastern Jamaica** (*M. Šťastný*, *P. Bosák* & *J. Pavková*)

The report was designed to describe the petrography of limestone samples that were taken in the Sherwood Forest area (province of Portland). The parameters studied included petrographic determination, normative mineral composition, presence of pollutants and other physical tests to determine the suitability of the use of limestone for industrial purposes. Microscopic examination showed the presence of foraminifers, especially pseudoorbitalia, which are typical of very pure limestone. Most of the rocks are the so-called calcarenites, formed from the shells and authigenic calcite called scald. The rock contains a high proportion of calcite (98 %). Rare magnesium is not dolomitic and represents only an isomorph of calcite. Dolomite is missing, quartz is low. The whiteness and brightness of the rocks is high (80.0 to 93.2% whiteness is R457 nm and from 85.93 to 94.28% RY). The content of pollutants is very low. The rock is a very suitable raw material for processing. These new blocks of limestone are located in the eastern part of the island, where mining is not so widespread. High-quality limestone can be produced from other parts of the island with high added value for industrial products.

Subproject No. 7391/11: **Shales and clay materials from Jamaica** (*M. Šťastný*, *P. Bosák* & *J. Pavková*)

The report was designed to describe the petrography of the shale samples collected in several areas of Jamaica. It was also described by a clay site in Frome and waste material from the Windalco Battersea site. In addition to petrographic determination, normative mineral composition, grain size and the presence of pollutants were assessed. Other tests were designed to determine the appropriateness of the use of shale for industrial purposes. Microscopic observations showed that individual shales are of differnt grain size and structure (spherical, planar). They are comparable to conventional clay shales commonly occurring in various parts of the world. The membranes often contain organic matter or fine laminae. Laminar or spathic decay is caused primarily by weathering. The levels of pollutants in the shales are very low. Clay has been identified as montmorillonitic clay, not very suitable for industrial purposes. Waste material contains mainly iron and aluminum in the form of boehmite, gibbsite, goethite and hematite. Furthermore, technological tests were conducted on different types of LWA firings. Their evaluation is not included in this report.

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 total of 84 sites, mostly abandoned quarries, coal strips and kaolin open pits located in 9 regions of the Czech Republic in the area between Tachov in western Bohemia and Ostrava were monitored by 14 team members (biologists and geologists) for five years in order to determine the speed and quality of natural revitalization. Extensive lists of avifauna, mammals, higher plants, algae, some insect groups, mushrooms and the geological and geomorphological phenomena were compiled on the basis of annual field work. Several kinds of previously unrecorded species for area of Czech Republic and many endangered species were found during the research. The results point to a conclusion that at least 30 % of abandoned mining sites recover within 20–30 years to a stage where a certain protection is needed.

However, the most important practical result is the "Methodics" (240 pages in prep. for printing, end of 2012 or beginning 2013) that proposes individual management and nature protection for the different types of mining sites such as limestone quarries, granite quarries, coal sites, kaolin dumps, sand pits etc. Legislative changes were proposed including a new type of "natural reclamation" where at least 30–60 % of the affected area is left for spontaneous development. This solution is more sensitive to the nature and saves money that can be used for the so-called "old environmental loads". Besides the "Methodics", a large monograph (ca. 300 pages, 14 authors) based on the final report is being edited.

4f. Industrial Grants and Projects

Velkolom Čertovy schody, Inc., Project No. 7302: **Documentation of progress of quarry walls – reclamation of the Quarry–West** (*P. Bosák*)

The reclamation exploitation of the Koněprusy Limestone (Pragian, Lower Devonian) was limited to two benches in the quarry in 2011. Continuation of cavities of the thermomineral paleokarst with calcite crystals along calcite veins discovered in 2009 and 2010 was documented.

Museum of Central Bohemia in Roztoky, Project No. 7321: **Velké Přílepy – the study of floor deposits of Prehistorical objects** (*L. Lisá*)

The aim of the research was the evaluation of floor deposits of two sunken houses from the locality of Velké Přílepy, located north of Prague. The age of the sunken houses was determined on the basis of ceramic and "švartna" findings in first case as Hallstatt Age and in the second case as La Tene Age. The main idea of this research was to find out if there is information value about the way of maintenance of the houses hidden in the studied infilling. Based on micromorphological evaluation, the floor deposits were found to be composed of a set of layers rich in organic matter and carbonates. This fact was interpreted as phases of using of the house followed by sanitary maintenance. The sedimentary infilling located above the floor deposits was accumulated in a relatively short time due to the colluvial processes on the slopes above the locality.

Department of Archaeology, Faculty of Philosophy, Masaryk University, Brno, Project No. 7364: **Rokštejn near Jihlava, micromorphology of the castle ditch infilling** (*L. Lisá*)

The aim of this research was the sedimenthological and micromorphological evaluation of the castle ditch infilling within the castle area of Rokštejn near Jihlava. Five main lithologically different layers were identified. The final interpretation based mainly on micromorphology and geochemistry shows that castle ditch was infilled in different time phases by construction material and never served as animal stabling, corridor or the depository of organic material or waste material.

Institute of Archaeology ASCR, v. v. i. in Praha, Project No. 7368: **Micromorphological characterization of a pellet from the locality of Stradonice** (*L. Lisá*)

The aim of this research is to interpret the origin of a pellet found in the depository during the revision research of the archaeological excavations of A. Stocky from 1929 in Stradonice site near Beroun. This pellet is coming from the context of Celtic cultural layer and is composed of calcified organic matter. It was interpreted as an excrement of a herbivore, in this case comparable for example with excrements of horse, sheep or goat. The preservation is probably due to the type of secondary deposition, in this case unfortunately not documented.

Institute of Archaeology SAV, Slovakia, Project No. 7376: **Micromorphological characterization of samples from the locality of Trenčianské Teplice, Pliešky** (*L. Lisá*)

The aim of this research is the micromorphological evaluation and possible interpretations of a cultural layer interpreted as Szelletien Age from the locality of Treničianské Teplice – Pliešky, Slovakia. The evaluated sample was mineralogically and micromorphologically homogeneous and can be interpreted as a not redeposited Bt horizon of Holocene soil developed on colluvial deposits. This sample contained no relicts of interstadial soils, only buried partly decomposed organic matter in the form of nodules which can be connected with colluvial processes. The methods used did not confirm any connection with the context of Szelletian Age and interstadial soil.

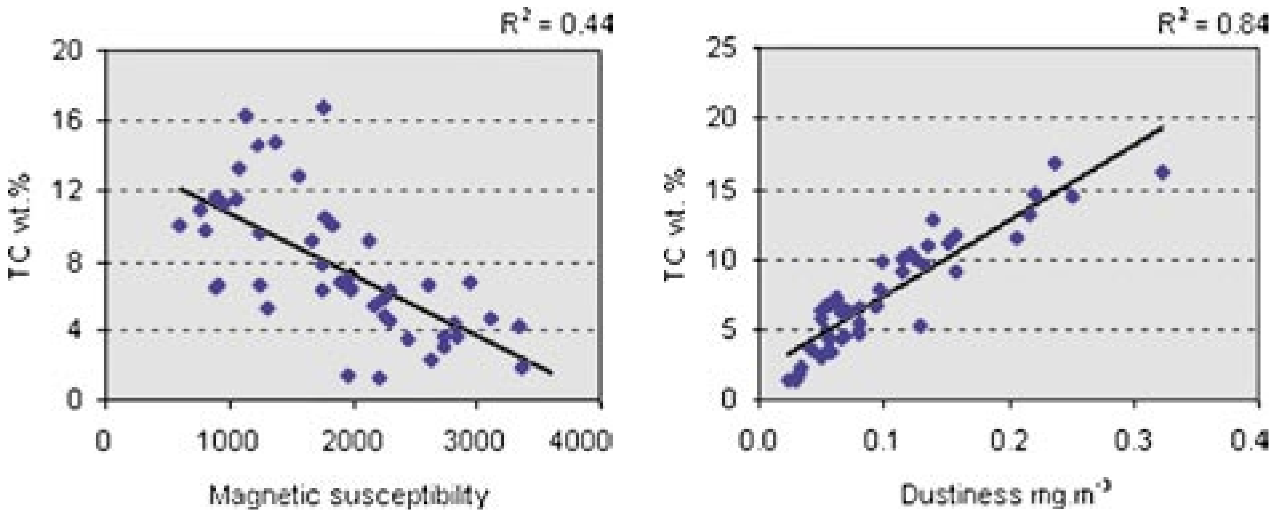
Department of Prehistory, University of Szczetin, Poland, Project No. 7393: **Preliminary report on geo-archaeological research in the Stajnia Cave (Poland)** (*L. Lisá*)

During 2009 and 2010, geoarchaeological investigations including the basic geochemistry and micromorphology were carried out in Stajnia Cave fill, Poland. The investigations were performed with the aim to distinguish different cave sedimentary facies types and to interpret their origin and post-depositional changes. A kind of blind test was used, when 30 samples were taken from different horizons selected by archaeologists. The horizons differ in color and grain-size composition; some of them have the same context according to archaeologists. This should be proved also by the applied geoarchaeological methodology. In this preliminary report, 19 samples taken during the first season are described and interpreted.

Different facies types within the studied 19 micromorphological samples were distinguished which sometimes correspond to the archaeological description and in some cases gave us a quite new type of information. All of them have some typical features represented for example by the typical grain-size distribution, the state of the preservation of the coarse-grained fraction, the post-depositional processes, or by the human influence.

Doly Bílina Inc., Project No. 7394: **Evaluation of expected effect of Bílina mine on concentration of the fly dust in its vicinity** (Leader of Project: Z. Sokol, Institute of Atmospheric Physics ASCR, v. v. i., *T. Navrátil*, *Š. Matoušková*, *L. Koptíková*, *J. Rohovec*, *J. Hladil* & *S. Hubičková*)

Geochemical-geophysical monitoring of atmospheric dust properties continued at the former Ledvice monitoring station and at the new Braňany station. Magnetic susceptibility of the weekly sampled dusts at the Ledvice station ranged from 692 to 5,519 10^{-9} m^3 kg^{-1}, but the range of magnetic susceptibility for Braňany station was from 878 to 2,786 10^{-9} m^3 kg^{-1}, only. Lower magnetic susceptibility of samples at the Braňany station was probably due to the greater distance from the major source of magnetic particles from the Ledvice powerplant. The lowest magnetic susceptibility values (605–971 10^{-9} m^3 kg^{-1},) of the at-



■ **Fig. 41.** Left panel – magnetic susceptibility (10^{-9} m^3 kg^{-1}) vs. total carbon content (TC wt.%) in weekly dust samples. Right panel – dustiness vs. TC (wt.%) in weekly dust samples (original).

mospheric dusts at the Ledvice station occurred during the period with a snow cover in years 2010 and 2011.

The concentration of total carbon in atmospheric dusts sampled by dry filtration of air at the Ledvice station ranged from 1.4 to 16.7 wt.%, while the content of total sulfur ranged from 0.14 to 1.8 wt.%. Total carbon content of dust samples was statistically significantly negatively correlated with the magnetic susceptibility and positively with the concentration of suspended dust – dustiness (Fig. 41). Therefore the colder months (December to March), characterized by increased dustiness and increased content of total carbon, typically showed lower values of magnetic susceptibility. On the other hand, summer months such as June and July were typical with low concentration of dust in the atmosphere, low total carbon content and relatively high magnetic susceptibility. This demonstrates the effect of two main drivers: (1) meteorological conditions, and (2) function of local home heating.

Further research should be aimed at the detection and evaluation of carbon speciation in atmospheric dust samples, which may help to identify the main sources.

The State Office for the Nuclear Safety, Praha, Project No. 7403: **Safety criteria for new nuclear power plants** (*V. Cílek*, *R. Mikuláš*, *J. Adamovič*, *K. Breiter*, J. Štuller & D. Drábová, State Office for Nuclear Safety, Praha)

The Fukushima disaster has changed the nuclear safety map on the international as well on the national level. The International Atomic Energy Agency in Vienna has asked its members to revise the existing guidelines for different aspects of the nuclear safety for new or proposed sites. The most suitable solution would be a new version of the Atomic Code, but such legislative task is likely to take place 3-4 years while ČEZ has announced that the reconsideration and possible enlargement of Temelín nuclear power plant is expected to start during the fall 2012.

In a series of meetings with the State Office for Nuclear Safety (SÚJB) experts, ČEZ partners and other specialists we proposed a new version of the safety guidelines (innovative version of the Act 215/1997 Coll.) in the field of geological and hydrological risks. The guidelines were published as official SÚJB material: "Interpretation of criteria for new nuclear facilities siting", Safety guidelines JB. The modification of Act 215/1997 Coll. is mostly focused on seismic hazards and new conditions of hydrological safety.

Czech Geological Survey, Praha, Project No. 7406: **Regional geology and geological mapping – zoopaleontological explanatory texts to geological maps 1: 25 000** (*J. Zajíc*)

Chapter Zoopaleontology of Lower Permian was compiled for the explanatory text to the Geological map 03-423 Svoboda nad Úpou (1: 25 000). Nine outcrops and eleven boreholes contain animal fossils. Fossil fauna is known from the Rudník (Lower Vrchlabí Formation) and Kalná (Upper Prosečné Formation) "Horizons" which are of Lower Rotliegend and Upper Rotliegend I age, respectively. Animal remains of the Rudník "Horizon" are represented by the *Acanthodes gracilis* bio/ecozone, and the Kalná "Horizon" by the *Xenacanthus decheni* bio/ecozone. The Rudník lake suggests relatively shallow and near the bottom better oxygenated waters. The area of Arnultovice represents a near-shore region of the Kalná lake with on-shore periods.

Chapter Zoopaleontology of the Upper Carboniferous was compiled for the explanatory text to the Geological map 03-424 Trutnov (1 : 25 000). Two outcrops were mentioned. All still known animal remains come from the Vernéřovice "Horizon" of the Vernéřovice Member (Chvaleč Formation) which is of Upper Stephanian (probably Stephanian C) age. Upper Carboniferous fauna is typical for the local bio/ecozone *Sphaerolepis-Elonichthys* and the local bio/ecosubzone *Sphaerolepis* is presumptive.

Chapter Zoopaleontology and ichnology of the Upper Carboniferous was compiled for the explanatory text to the Geological map 03-422 Žacléř (1 : 25 000). Three outcrops contain important animal fossils and ichnofossils. All fossil remains are known from the Jan Šverma Group of Coal Seams (Lampertice Member of the Žacléř Formation) which is of Westphalian B age.

Ichnofauna includes invertebrate trace fossils, Arthropodichnia and Tetrapodichnia. Eurypterid arthropod *Adelophthalmus* was still known from only two sites in Bohemian and Moravian limnic basins (both in the Plzeň Basin).

Správa Národního Parku České Švýcarsko, Krásná Lípa, Project No. 7407: **Monitoring of atmosperic deposition in the Bohemian Switzerland National Park** (*I. Dobešová*, *T. Navrátil*, *J. Rohovec* & *S. Hubičková*)

Monitoring of atmospheric deposition of selected major and trace elements in the Bohemian Switzerland National Park started in 2002 and included 3 sampling sites (Stříbrné stěny, Dolský mlýn and Kuní vrch). In year 2011, the number of sampling sites has been reduced to one site – Kuní vrch. Two types of precipitation were collected at site Kuní vrch: the bulk precipitation and spruce throughfall. Over 60 samples of the rainfall were collected, 20 analytical samples were processed, and 520 assessments of physical and chemical parameters were performed.

The calculated rainfall balance shows that the bulk precipitation in year 2011 was average with respect to the long-term average for the area. The total amount of bulk precipitation in hydrological year 2011 was 787 mm in the open area and 644 mm in the spruce cover, respectively. The pH values ranged from 4.36 to 6.15 in the open area, and from 3.84 to 5.74 in the spruce cover. The deposition fluxes of elements originating from combustion processes (Cd, Cu, Zn, NO_3^-) are comparable with long-term average values. The 2011 bulk flux of the SO_4^{2-} anion was lower than the long-term average. It reached 12 $kg.ha^{-1}.year^{-1}$ in the open area, and 32 $kg.ha^{-1}.year^{-1}$ in the spruce tree canopies, respectively.

Správa Chráněné krajinné oblasti Křivoklátsko, Zbečno, Project No. 7410: **A catalogue of Tertiary and Quaternary localities and geomorphologic evolution of the Křivoklátsko area** (*K. Žák* & V. Ložek)

A list of localities important for the understanding of the geomorphological and environmental evolution of the Křivoklátsko Protected Landscape Area during the Tertiary and Quaternary was compiled as a part of studies related to the planned proclamation of a part of this area as a National Park. The catalogue contains descriptions of 71 localities, including a list of published papers related to each of them. While the Tertiary localities contained in the catalogue are represented mostly by fluvial sands and gravels, the Quaternary localities include a wider range of sediment types, including fluvial gravels and sands of river terraces, aeolian sediments (loess), slope sediments including abundant secondary talus cementation, and calcareous tufa deposits.

4g. Programmes of Institutional Research Plan

Project No. 9105: **Biogeodynamics of Ni and Co in a small river basin** (*P. Kubínová* & *M. Vach*)

The aim of this project is to extend general knowledge of geochemistry and mineralogy of selected elements (Ag, As, Au, Cd, Cu, Hg, Zn, and others) in various geological environments. This requires a complex research with the employment of various complementary techniques and approaches. In 2011, the works was focused especially on biogeodynamics of selected elements in a small catchment. The data treatment and identification of transport trajectories of selected chemical substances in wet atmospheric precipitation samples at the Lesní potok experimental catchment continued. The study confirms probable origin of Na in the marine aerosol. The backward trajectories of K also exhibit similar origin as that of Na. Further, the transport trajectories of K show relatively significant (50 %) sources in the northern and southern directions as is the case of Mn, which is due to the biogenic character of these elements. Potassium belongs (together with, e.g., Mn and P) to a group of elements which play a significant role in plant metabolism. Another group consists of Zn, Cu and Co. These elements are transported mainly from the north, where they are sourced in the industrial areas of Poland and eastern part of Germany.

Project No. 9108: **The possibility of study of the biogeodynamics of selected ecotoxic trace elements in a forested catchment with granite bedrock** (*P. Skřivan*, *J. Rohovec*, *I. Dobešová*, *J. Borovička*, *T. Navrátil* & *J. Buchtová*)

The study focused on the biogeodynamics of heavy trace metals Tl, Th, U, and Cs in a forested ecosystem with granite bedrock (the experimental Lesni potok catchment). In comparison with the Project, the study was supplied with Cs owing to the similarity of Cs^+ ion with Tl^+ and with respect to the environmental hazards of the radionuclide ^{137}Cs (half-life of 30 years) as a fission product of the nuclear power plants.

It was found that the annual atmospheric input of the elements is similar – 5 to 20 $\mu g.m^{-2}.yr^{-1}$ – and does not exceed the global background values. Metabolic activity of trees strongly affects the cycling of Cs (similarly to other alkali metals K and Rb) – the Cs flux in spruce throughfall 6 times exceeds that in bulk deposition on an open place. Higher flux of Tl in spruce throughfall (more than two times compared to bulk) indicates the root uptake of the Tl^+ ion together with the alkali metals.

The analyses of assimilatory organs (beech leaves and 5 age classes of spruce needles) have shown that the content of Cs, Th and U is generally higher in beech leaves, whereas the content of Tl is always higher in all age classes of needles of the shallow-rooting spruce. This is in accordance with the higher Tl content in spruce throughfall. The content of U, Th and U in spruce needles is growing with their age, but this trend in not so unambiguous for Cs. The Rb/Cs ratio in spruce needles is decreasing with the needle age.

Comparison of the deposition fluxes of the elements (as their main input into the ecosystem) with their output through surface water discharge shows a decrease in mobility in the order U≫Th-Tl>Cs. Mobility of the most mobile element (U) positively correlates with the Eh value of surface water, as the more mobile ion UO_2^{2+} prevails above U^{4+} at more oxidative conditions.

The incorporation of the elements was also studied in the sporocarps of fungi *Paxillus involutus* collected within the catchment. The results will be presented in a prepared paper.

The obtained results of the field and laboratory biogeochemical study of Cs, Tl, Th and U provided valuable pieces of information for further research and confirmed the convenience of the ICP-MS analysis for this purpose.

Project No. 9109: **Environmental record in the sediments of karst areas** (*S. Šlechta*, *P. Bosák*, *P. Pruner*, *K. Žák*, *J. Kadlec* & *L. Koptíková*)

Paleomagnetic records in karst areas of the Czech and Slovak republics have been applied to the dating of cave fills and magnetomineralogical analysis at the following sites: Bozkovské Dolomite Caves, Poniklí Cave, Býčí skála – Barová Cave (Czech Republic), Demänovské Caves – the Razcestie corridor (Slovak Republic).

Project No. 9121: **Deposition and transport of inorganic pollutants in the atmosphere** (*M. Vach*)

Inorganic pollutants were monitored in wet deposition. Suitable sampling equipment was used for sampling of wet-only precipitation episodes, i.e. an automated rain collector. The sampling site is located at the site of Lounovice outside built-up areas and is shielded very well by forest stands from any effect of small local sources of air pollution. In order to identify the transport trajectories and possible common emission sources of the monitored elements, dependence was sought between data on chemical composition of the sampled precipitation episodes and the corresponding meteorological data using the HYSPLIT model.

Project No. 9124: **Metals in mushrooms and soils at a uranium polluted site** (*J. Borovička*)

The scope of the project was focused on concentrations of Ag, Pb, U and Th in mushrooms at the Bytíz locality in the Příbram ore district. The pedological research was made at selected sites, and concentrations of the above listed metals in soils and mushroom samples were determined. Ag was found in the highest concentrations showing clear accumulation of this metal in mushrooms.

Project No. 9125: **Study of arsenic-rich soils and pore waters at localities affected by historical mining** (*M. Filippi*)

Historical mining waste dump and its surroundings close to the Giftkies arsenic mine in the Jáchymov ore district (Czech Republic) were studied from the mineralogical and geochemical point of view. The principal primary and secondary arsenic-bearing minerals were identified and their environmental stability was evaluated using a set of leaching tests. Scorodite, kaňkite, amorphous ferric arsenate pitticite and As-bearing hydrous ferric oxyhydroxides were found as the most important minerals that control the As retentions in the mining dump. Only As-bearing hydrous ferric oxyhydroxides, especially goethite, are the prevailing As-carriers in the surrounding soil.

Several other localities affected by high As concentrations were visited. Knowledge obtained from the field observations and from laboratory experiments was used for the understanding of arsenic mineralogical behavior in areas highly affected by historical mining.

Project No. 9126: **Plio-Pleistocene volcanism of the Bohemian Massif (W Bohemia, N Moravia and Czech Silesia): geochemical and isotopical characteristics** (*J. Ulrych*, *V. Cajz*, V. Babuška, Institute of Geophysics ASCR v. v. i., Praha, A. Přichystal, Masaryk University, Brno, E. Hegner, Department of Geowissenschaften, Universität München, Germany & K. Balogh, Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary)

The Plio-Pleistocene volcanic rocks of the Bohemian Massif comprise a compositional spectrum with (i) an older basanitic series of 6.0 to 0.9 Ma consisting of weakly differentiated alkali basalt and trachybasalt showing a small degree of SiO_2 undersaturation, moderately to almost primitive mantle-derived composition (Mg# 62 to 70), moderately elevated concentrations of incompatible elements and depleted mantle $^{87}Sr/^{86}Sr$ ratios of 0.7032–0.7034 and $^{143}Nd/^{144}Nd$ of 0.51286 to 0.51289; (ii) a younger melilititic series of 1.0 to 0.26 Ma, characterized by a higher degree of SiO_2 undersaturation, and primitive-mantle-derived composition as indicated by high Mg# of 69 to 72, mildly elevated concentrations of incompatible elements and overlapping and in some case more enriched $^{87}Sr/^{86}Sr$ ratios of 0.7034 to 0.7036 and $^{143}Nd/^{144}Nd$ of 0.51285 to 0.51287. Variations in incompatible element concentrations and isotopic compositions in the basanitic and melilititic rock series can be explained by mixing of melt batches derived from the depleted mantle and a metasomatized subcontinental lithosphere. Assimilation of crustal material is considered negligible for the data presented here. Sr and Nd isotopic compositions of both rock series are similar to those of the European Asthenospheric Reservoir. Minor differences in geochemical characteristics of the melilititic and basanitic rock series may be related: (i) to different settings with respect to crust-lithophere conditions for the rock series in W Bohemia (WB) and NE Bohemia (NEB), and N Moravia and Czech Silesia (NMS), respectively, (ii) a modally metasomatized mantle lithosphere in WB *vs.* a cryptically metasomatized domain in the NEB and NMS, (iii) different degrees of partial melting with very low degrees in WB *vs.* higher degrees in NEB and NMS. The geochemical and isotopic similarity among the Plio-Pleistocene volcanic rocks and those of the Late Cretaceous and Cenozoic volcanic events between 79 to 6 Ma suggest that intraplate magmas were sourced from similar mantle melted at similar degrees over almost 80 My, implying a chemically homogeneous source.

Project No. 9127: **Mineral magnetic study of Pleistocene loess and paleosols of the Czech Republic and Slovakia** (*J. Kadlec*, *M. Chadima*, *S. Šlechta*, *G. Kletetschka*, *O. Man* & *K. Šifnerová*)

Selected key loess/paleosol sequences located along the eastern margin of the Bohemian Massif (Červený kopec, Bulhary, Borčice, Medlovice) were sampled with the aim to assess the magnetic fabric and magnetic mineralogy of the sediments.

Samples for the OSL dating were collected from eolian sediments deposited at Strážnice and Malacky sites.

Project No. 9128: **Magnetostratigraphy of the Jurassic/Cretaceous boundary strata** (*P. Pruner*, *O. Man*, *P. Schnabl*, *D. Venhodová*, *K. Šifnerová*, *J. Drahotová*, *J. Petráček* & *S. Šlechta*)

Selected key localities of the Jurassic/Cretaceous boundary strata located in the Tethyan realm (Le Chouet – France, Strapková – Slovakia) and in the nonmarine Sub-Tethys (Purbeck – United Kingdom) were sampled with the aim to obtain individual polarity subzones. Palaeomagnetic and petromagnetic analyses will be carried out on pilot samples from key intervals of localities as a basis of new proposal of the project. Owing to the fact that all sedimentary profiles have been already sampled in detail and samples are stored in our laboratories, there is no necessity to make detailed sampling of the whole logs at all sites. New work on the magnetostratgraphy was started with preliminary acquisition of pilot samples at Komshtitsa/Barlya (Bulgaria) in October. The activities were published in Progress Report of Berriasian Working Group, ISCS at the Sofia meeting in October 2011.

Project No. 9129: **Paleomagnetic properties of basaltic rocks in Saxonian part of Lusatia** (*V. Cajz* & *P. Schnabl*)

Cenozoic volcanic activity in the Eger Rift continues from the volcanic complex of the České středohoří Mts. in the NE direction to the Lužické hory Mts. and crossing the state border, to the part of Lusatia in Saxony. Paleomagnetic properties of Cenozoic basaltic rocks have been recently studied in the territory of the Czech Republic with the support of the Grant Agency of the Academy of Sciences CR and similar studies from Silesia were published in Poland. Rock magnetism and magnetostratigraphy were used as the main methods. Combined with existing and newly obtained radiometric data on the age of these rocks, stratigraphical considerations may result in precise timing of Cenozoic volcanic activity of the Bohemian Massif.

Similar methods will be used for the evaluation of young volcanism in Lusatia. In total, 32 locations of volcanic rocks were sampled in Saxony in co-operation with the Senckenberg Museum of Natural History in Görlitz. They will be discussed at the International Conference "Basalt 2013". The results from Saxonian and Czech parts of Lusatia can clarify stratigraphy and define the sequence, time and possibly tectonic relations of young volcanism there.

Project No. 9130: **Post-variscan temperature evolution of North Bohemian sedimentary basins studied via fission-track analysis, Bohemian Massif** (*D. Kořínková* & *M. Svojtka*)

Statement of the problem. Late Cretaceous to Paleogene tectonic processes in the Elbe Zone (EZ), partly responsible for the uplift of blocks and Bohemian(-Saxony) Cretaceous Basin (BCB) inversion and partly for accelerated basin subsidence, will be characterized as for their timing and dynamics.

Late Cretaceous basin inversion, as reaction to the stress conditions in the lithosphere in the Pyrenean–Alpine–Carpathian foreland, followed by strong compressive deformation can be observed in the whole Central and Western Europe between the Alpine deformation front and the Tornquist Zone. Opinions on the timing of the onset of the Late Cretaceous compression in the EZ are still different (Adamovič & Coubal 1999; Uličný et al. 2009). New thermochronological data (from apatite fission-track analysis, U-Pb and (U–Th)/He chronology) applying to the magnitude and timing of uplift/subsidence of individual blocks (Lange et al. 2008; Danišík et al. 2010) contribute to clarify these dissimilarities in the study area. A subject to discussion is the character of the BCB. Some of the present stress-field and sedimentology indicators are contradicted by considering that the BCB is a basin of strike-slip type (Uličný 2001) or a "transtensional basin" (Uličný et al. 2009). These contradictions must be solved in the future.

Methods. The used methods include apatite and zircon fission-track analysis (FTA) of rocks from the basins and uplifted blocks, provenance analysis and U-Pb zircon chronology.

Aims of the project. This project allows to reconstruct post-Variscan evolution of the studied basins and source areas. The following problems will be solved: (1) dynamics of Late Cretaceous to Paleogene vertical movements of individual blocks; (2) uplift of blocks north of the Zone: was it continuous or punctuated?, and (3) the age of maximum uplift.

Current statement of the work. During the year 2011, sampling was realized in N and NE Bohemia. Seventeen rock samples (various types of granitoids and three sandstones) were prepared during laboratory work which includes crushing, apatite and zircon separation, thin sections and polished sections for the FTA. Irradiation of samples in a nuclear reactor, determination of apatite and zircon chemistry using electron microprobe, fission-track analysis, U-Pb zircon chronology, provenance analysis, modelling and interpretation will follow in the next years.

Expected results. The age of the earliest/maximum movements on the Elbe Zone faults assigned by FTA contributes to clarify the kinematic position of the Lausitz Block among other uplifted blocks in the Alpine foreland. Similarly, this will clarify the tectonic style of the BCB.

Characterization of the dynamics of the Late Cretaceous to Paleogene vertical block movements should extend our knowledge about the Late Cretaceous crustal deformation in the whole Alpine foreland.

The FTA will be applied for the first time in this range in the study area. Its results should be significant for more exact interpretation of the thermal evolution and for the timing of basin inversion.

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der Deutschen Gesellschaft für Geowissenschaften, 159, 1: 123–132.
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Project No. 9131: **Reconstructing the denudation, erosion and surface uplift history of rocks in the Hunza Karakoram by fission-track method** (*M. Svojtka*)

Different lithological types of rocks from Hunza Karakoram (N Pakistan) were studied using apatite fission-track dating method. The aim of this study is to define the rate of uplif/denudation in this mountain range. Dating of samples yielded ages between 3.9±0.2 Ma to 9.7±0.4 Ma. The total amount of uplift of the denuded and eroded high-mountain georelief in the Hunza Karakoram during the Quaternary can be determined at approximately 6,000 m. The high intensity of present denudation and transport of weathered and eroded material correlates with a striking absence of older Quaternary sediments. This suggests a long-term influence of these geomorphological processes on the exhumation of deeper parts of the Earth crust and the dynamics of orogenic uplifts of the Hunza Karakoram.

Project No. 9132: **Dynamic Time Warping: a novel tool for quantitative biostratigraphic correlation** (*P. Čejchan*)

The main problem of any stratigraphic correlation is that the time is nonlinearly mapped onto the sediment thickness *via* varying sediment accumulation rate, and/or non-corresponding local hiatuses. We proposed to use the Dynamic Time Warping (DTW) to find optimum match between two given stratigraphic sequences. The method turned out to perform quite fine on artificial time series of species abundances, with introduced gaps. After the algorithm is thoroughly tested on both artificial (modelled) and real-world data, and published, it will be freely accessible at *http://DTW.stratigraphy.cz*.

Project No. 9133: **Kinematic and dynamic analysis of brittle deformation of the Lusatian Fault Zone: A key to deciphering post-orogenic tectonic history of the N part of the Bohemian Massif** (*M. Coubal*)

Activities of this project focused on the study of brittle deformation of rocks along the Lusatian and South Krkonoše Faults with the aim to elaborate a model of their post-Variscan kinematic activity.

Both faults are situated at the foothills of mountain ranges in the N part of the Bohemian Massif, and they probably played a decisive role in their post-Variscan uplift. The two faults are alike in many aspects: their strike (WNW–ESE to E–W), kinematics (N-over-S reverse faults dipping at medium to steep angles) and in the prominent drag of sedimentary strata in the footwall block in fault proximity. Some authors (e.g., Kunský 1968) consider the South Krkonoše Fault an eastern continuation of the Lusatian Fault. This paper defines the South Krkonoše Fault as a >2 km broad zone of intensive rock fracturing along the boundary between the sediments of the Krkonoše Piedmont Basin and the Krkonoše-Jizera Crystalline Complex. The name was originally used by Chaloupský et al. (1989) for a deep-seated fault of the same location, defined on the basis of the presumed basement structure.

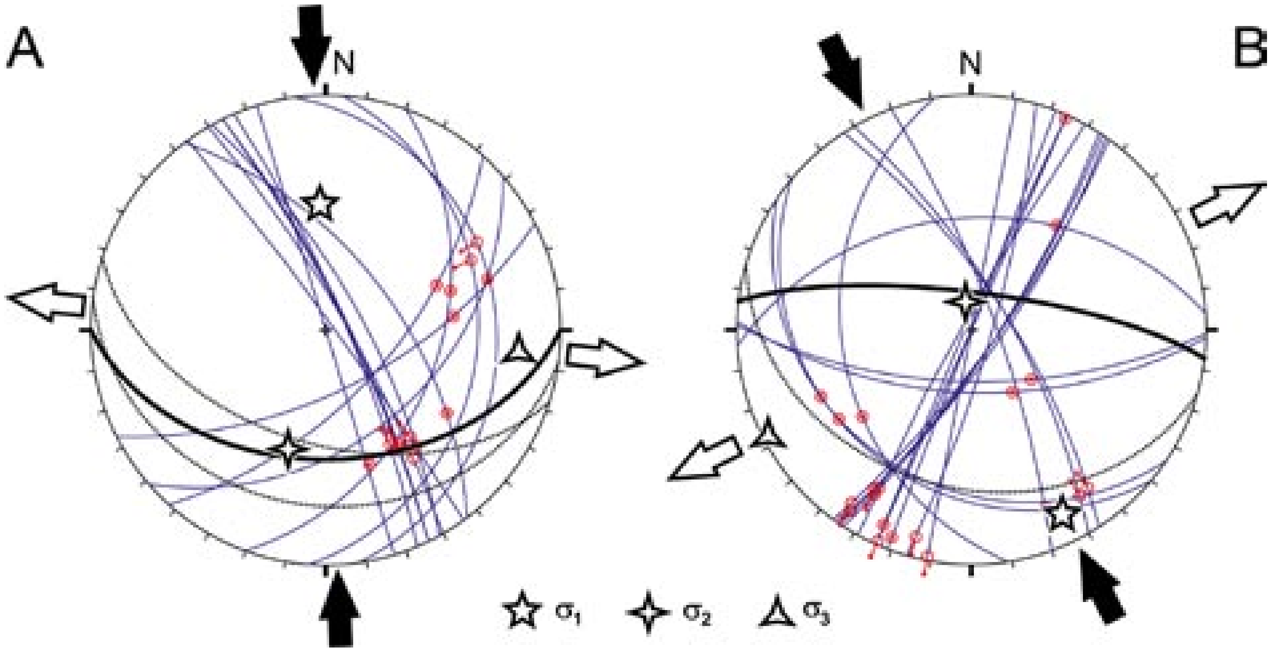
A detailed structural study was performed in a road cut 1,100 m long bypassing the town of Vrchlabí. It displays a unique, perfectly exposed transverse cross-section of the South Krkonoše Fault Zone. From the S to the N, inclined sedimentary strata of the Vrchlabí Formation (Permian, Autunian) are followed by the underlying Semily Formation (Upper Carboniferous, Stephanian C). In the south, the latter formation dips at 5–10° toward SSW, which corresponds with the situation in the adjacent part of the Krkonoše Piedmont Basin (*Prouza & Tásler 2001)*. Towards the N, however, the dip angles increase by the effect of near-fault drag, finally reaching as much as 60° at the border with the crystalline complex (Šimůnek et al 1990).

Sedimentary rocks are deformed by a wide range of ductile and brittle structures. The brittle structures are dominated by E-W-striking reverse faults mostly dipping to the N at steep (60–85°) angles, occasionally to the S. The planes of major faults show zones of fracturing and tectonic clay (fault gouge) often exceeding 1 m in thickness. Rocks in their vicinity are intensely fractured. The reverse character of major faults is confirmed by major gaps in stratigraphy as revealed by a detailed paleontological study of the locality (Šimůnek et al. 1990).

The analysis of movements on striated faults (Fig. 42) proved that these faults were activated by a paleostress field having the character of NNW–SSE compression in a strike-slip regime. Variations in the plunge of the maximum principal stress σ_1, found in blocks of various dip angles (compare Figs. 42 A and B), points to an interconnection between fault movement and block rotation. Compressive stress identified by the analysis acted almost normal to major fault planes; consequently, its effects can be vaguely referred to as a “bulldozer effect”. The explanation of the origin of these faults and the extensive shear movements on thie planes must have involved the effect of a yet older paleostress field of different orientation.

Brittle deformation poses a younger developmental stage in a succession of ductile and brittle structures. As suggested by geological setting, the deformations are younger than Autunian, hence post-Variscan in age. The performed structural study involved a preparation for their geochronological dating.

CHALOUPSKÝ J., ČERVENKA J., JETEL J., KRÁLÍK F., LÍBALOVÁ J., PÍCHOVÁ E., POKORNÝ J., POŠMOURNÝ K., SEKYRA J., SHRBENÝ O., ŠALANSKÝ K., ŠRÁMEK J. & VÁCL J. (1989): *Geologie Krkonoš a Jizerských hor*. – Ústřední ústav geologický: 1–288. Praha.
KUNSKÝ J. (1968): Fyzický zeměpis Československa. – SPN: 1–537. Praha.
PROUZA V. & TÁSLER R. (2001): Podkrkonošská pánev. – In: PEŠEK, J. et al. (Eds.): Geologie a ložiska svrchnopale-*ozoických limnických pánví v České republice: 128–166. Český geologický ústav, Praha.*



■ **Fig. 42.** Paleostress orientations obtained for the zones of the two major faults in a road cut near Vrchlabí. Arcs in full line: major fault planes; dotted arcs: bedding planes; σ1–σ3 : maximum, intermediate and minimum principal stresses (original).

ŠIMŮNEK Z., DRÁBKOVÁ J. & ZAJÍC J. (1990): *Paleontologické zpracování sběrů z lokality Vrchlabí – zářez silnice na jz. okraji města*. – Unpublished report, Český geologický ústav. Praha.

Project No. 9134: **Ichnology of selected geologic units of Eurasia** (*R. Mikuláš*)

Miocene (Badenian) clays in the eastern Bohemian locality of Česká Třebová provided finds of a microboring *Planobola macrogota* Schmidt which is significant for shallow marine settings (few dozens of metres of depth at the maximum). In comparison, South Moravian localities of the same age and rock composition provided different assemblages of microborings that are significant for depths of hundred of metres. Borings of the ichnogenera *Gastrochaenolites* and *Entobia* were found on transgressive sediments of the Late Jurassic at the top of the Hády Quarry. Finds of *G.* cf. *lapidicus* Kelly & Bromley, 1984 come from limestone, marlstone and claystone pebbles of basal conglomerate and detrital limestones. A more diversified assemblage comes from large bioclasts found in the overlying biodetritic limestones. The assemblage is contemporaneous with the earliest occurrences of complex multicamerate entobians.

Project No. 9135: **Ichthyofauna of limnic Permo-Carboniferous of the Czech Republic** (*J. Zajíc*)

The uppermost Stephanian (Upper Pennsylvanian) sediments that come mainly from several localities at Klobuky village yielded hundreds of microvertebrate remains. The remains are represented by acanthodians (scales, fragments of the fin spines, gill rakers), xenacanth sharks (teeth, scales and fragments of calcified cartilage tissue), euselachian sharks (teeth and scales), actinopterygians (scales, teeth, bone fragments including jaws, segments of lepidotrichia), dipnoans (scales and remains of postcranial skeleton), crossopterygians (scales) and amphibians (jaws). Rare invertebrate microremains are represented by ostracodes (quartz casts) and arachnids (abdomen fragments).

Project No. 9136: **Elastic anisotropy study of rocks by means of logitudinal and transversal waves under higher p-T conditions** (*T. Lokajíček*, *R. Živor*, *M. Petružálek*, *T. Svitek* & *V. Rudajev*)

Project solution was split to two directions. First: the design and production of high pressure pump, which was based on diesel pump Bosch and it was driven by electric motor. The high pressure unit was designed as autonomous, as it simultaneously supplies information about current hydrostatic pressure. It will be possible to control the acting hydrostatic pressure at high-pressure vessel up to 2,000 bar. Second: ultrasonic transducers were produced which enable ultrasonic sounding of rock sample by means of shear waves. The transducers structure is solved as a sandwich one, where every sensor (transmitter/receiver) is composed of two perpendicularly polarized piezoceramic shear wave sensors. Two sets of piezoceramic transducers holders were produced, which enable ultrasonic sounding of spherical rock sample by means of shear waves, as by a couple of sandwich transducers with resonant frequency 400 kHz as well as by a four single shear Olympus transducers with resonant frequency of 5 MHz. As the ultrasonic sounding of spherical sample by means of shear wave transducers requires to cover the sphere surface by means of high viscosity medium, it was necessary to equip the transducer holders by special DC motor drive, which, before the arm and sphere movement, release the contact between the transducers and the sphere. After checking of the sphere and arm position, the transducers are again pressed to the sphere sample. At present, a new mechanical solution is tested by means of measurement of isotropic spherical samples, as aluminum, glass and also by transversal anisotropic samples. All testing measurements were done under atmospheric pressure. Based on data obtained, software environment will be designed enabling manual/semiautomatic reading the arrivals of individual wave phases.

Project No. 9137: **Soil condition of selected forest areas in the Czech Republic** (Co-ordinator: *A. Žigová*, contribution: *M. Šťatný*)

Different conditions of water regime influenced the character of soil development. The study is focused on the comparison of the humification process in automorphic and semihydromorphic condition.

The selection of soil profiles was solved on the basis of soil survey. The research in automorphic conditions was provided on the soil type of Cambisol developed on spilite (Šance, Křivoklátsko Protected Landscape Area) and diabase (Zahrabská, Bohemian Karst Protected Landscape Area and Prague, Radotínsko-Chuchelský háj Natural Park). Cambisols are characterized by slight or moderate weathering of the parent material. The study in semihydromorphic condition was performed on the soil type of Stagnosol developed on colluvial deposits (Jouglovka, Křivoklátsko Protected Landscape Area) and Permo-Carboniferous (Krymlov, region of Prague-východ). One site from Krymlov was originally arable soil. A change in land use to the forest at this locality was done 50 years ago. Stagnosols are characterized by strong mottling due to redox processes caused by periodically stagnating water. Soils were classified according to the World Reference Base for Soil Resources. Description of individual soil profiles was done by the FAO procedure (Guidelines for Soil Description). Soil profiles were excavated down to the C horizon. Samples were collected from individual horizons of soil profiles. Colors were identified by the Munsell Soil Color Charts. The individual analyses were determined using the standard laboratory techniques. Chemical soil properties from individual horizons, such as pH_{H2O}, pH_{KCl}, cation exchange capacity, base saturation and mineralogy of the fraction <0.001 mm were used for the decription of basic properties of soils. Mineral composition was evaluated on the basis of XRD analyses. The process of humification was evaluated on the basis of values of C_{ox}, N_t, C/N ratio and micromorphological analysis.

Cambisols show an acid reaction in the upper part of soil profiles and a neutral reaction mainly in C horizons. Stagnosols have a strong acid reaction. Cation exchange capacity coresponds to the character of parent material and also in humic horizons to the content of soil organic matter. Low values of base saturation were obtained by the Stagnosols and higher values by the Cambisols. Mineral composition of the studied soils is controlled by the parent material. The results revealed differences in the process of humification in automorphic and hydromorphic conditions. Cambisols have lower contents of C_{ox} and N_t than Stagnosols. Qualitatively parametrs of humification as the C/N ratio and micromorphological characteristics are more favourable for Cambisols. The intensity of litter decomposition and formation of A horizons is higher in soils with automorphic development.

Project No. 9203: **Meso-Proterozoic terrane in the South Bohemian Moldanubian: recent indications and new data** (*J. Fiala*, *M. Svojtka* & *L. Ackerman*)

Recent studies (J. Fiala) have indicated orthogneiss bodies of 2.1 Ga intrusive ages within the South Bohemian Moldanubian complex. It has to be supposed that the original plutonic rocks necessarily intruded into some older (meta-) sedimentary complex which should be still present up to a certain distance from the studied orthogneiss bodies. The aim of the first phase of the present project is to study and characterize these anticipated metasediments geologically and to take relevant samples for further petrological, geochemical and geochronological studies. From this viewpoint, four localities were selected and sampled: two of them in the vicinity of small orthogneiss bodies near the Rájov village and the remaining localities in the western and eastern surroundings of the Světlík main orthogneiss body.

Project No. 9204: **A new method of fission track dating analysis by using titanite developed at Institute of Geology ASCR in cooperation with Nuclear Physics Institute ASCR (reactor facility and radiation dosimetry department)** (*J. Filip*, *M. Šťastný*, *M. Svojtka* & *J. Hladil*)

For experimental purposes, samples of various sedimentary rocks were collected from South Moravia.

Standard titanites and titanites from real samples were similarly processed following the Wagner-Jonckheere and Coyle method. Then, the methods were evaluated and the Wagner-Jonckheere method was selected as suitable in our laboratory conditions. For the first time the selected standards and real samples were irradiated in nuclear reactor of Oregon University (USA) and their main characteristics and geological ages were measured after irradiation. The same samples were irradiated in Řež reactor in a channel with a higher portion of thermal neutrons and again their ages were determined. The results were unambiguous. The ages from Oregon reactor were comparable with Řež in a 10% interval, but the age of the standard was highly overestimated. Higher ^{60}Co activity was registered at the same time. The Mylar as external detector was tested in cooperation with the radiation dosimetry department, but was not acceptable for dating. Testing of the irradiation channel at Řež will be continued and its acceptability for dating will be determined. The ages and the time-temperature histories were determined for rocks of the Tehov and Mirovice metamorphic island of the Central Bohemian pluton and for conglomeratic sandstone from Soběslav. The samples revealed very similar time-temperature histories.

The rocks were uplifted from the zone of total annealing (120 °C) at 180 to 150 Ma, and then remained at temperatures from 60 °C to 80 °C until the beginning of the Miocene (ca. 20 Ma). Then, a period of relatively quick uplift to the present surface followed. The cooling rate was approximately 3 °C·My^{-1}.

Project No. 9206: **Mechanical and thermal effects of dike emplacement on ambient rock: columnar jointing of host sandstone as evidence of water-saturated environment** (*J. Adamovič*)

Columnar jointing of sandstone is one of the effects of sandstone alteration by injected magma. The phenomenon has been previously reported from ca. 25 sites of the world, of which 15 sites are located in sandstones of the Bohemian Cretaceous Basin (BCB) in the Czech Republic and Germany. Field documentation and laboratory study at type localities was chosen as a tool for satisfactory explanation of this phenomenon.

Besides classical sites of Dutý kámen, Holička and Brenná in the BCB, samples from two world sites were petrographically studied: previously visited site on Isle of Bute, Scotland, and a newly discovered site north of Khartoum, Sudan (sampled within a parallel project).

All samples of sandstone columns share many common features: two of the bounding joints planes correspond to confining joints in outcrop size, always perpendicular to the source of heat. They are straight, cutting across grains, with joint morphologies compatible with shear movement. Other bounding joints are less straight, and their angles to the confining joints are variable, with occasional grain crushing and pressure solution features near the edge, suggesting a compressive stress roughly perpendicular to the joint plane.

Secondary silica cement is an early post-emplacement one, more or less evenly distributed in the sandstone. The highest intensity of cementation is not located directly at the dike contact but at a distance of first metres to ca. 20 m from the primary heat source. This corresponds to a pore volume loss by as much as 50 %, detected in this zone. Rocks at the immediate contact are often corroded, with a high proportion of secondary pores, some of which are filled with kaolinite (Dutý kámen).

The observed phenomena cannot be attributed to volume contraction due to post-emplacement cooling but rather to syn-emplacement compression, possibly induced by the instantaneous expansion of pore water and water vapour. This necessitates the presence of water in the host rock at the time of the emplacement, which does not conform with the shallow emplacement depths suggested by Summer & Ayalon (1992). Silicification, kaolinization and other hydrothermal processes were post-emplacement, steady processes, which equally require high fluid fluxes. Future examination of hydraulic parameters of the target aquifer rocks should therefore yield information on the basin hydrogeology at the time of the dike emplacement.

SUMMER N.S. & AYALON A. (1995): Dike intrusion into unconsolidated sandstone and the development of quartzite contact zones. – *Journal of Structural Geology*, 17, 7: 997–1010.

Project No. 9215: **Development of method of elastic waves arrival time determination on rocks samples** (*T. Svitek*)

The research of elastic parameters of rock material continued with the analysis of shear waves that are detected by the newly developed measuring head. Shear waves bring information that can increase our knowledge about media (elastic properties, crack preffered orientation, etc.) they propagate through. They also provide real data needed for complete calculation of the elastic tensor. Processing of new data was compared with old procedures.

Project No. 9305: **Triassic and Jurassic brachiopod assemblages of the Northern Calcareous Alps** (*M. Siblík*)

The collection and study of the brachiopod assemblages in the Alpine Mesozoic continued in 2011 in the area of the Grimming Massif near Liezen in the Styria. The first results in the northern parts of the Massif revealed rich but only Sinemurian assemblage with prevailing *Securina partschi, Prionorhynchia, Bakonyithyris, Cuneirhynchia retusifrons* and *Linguithyris aspasia*. The specific content of the local occurrences is not as large as in the neighbouring Totes Gebirge Mts.

Project No. 9307: **Diversity and distributional dynamics of the Palaeobatrachidae (Amphibia: Anura)** (*Z. Roček* & *T. Přikryl*)

We investigated a recently discovered palaeobatrachid frog specimen from the Late Eocene of Kučlín, Czech Republic and compared it with Middle Eocene palaeobatrachids from Messel and from Geiseltal, Germany. In order to assess taxonomic variation within the Palaeobatrachidae, we studied variation in the frontoparietal, one of the most frequently preserved skeletal elements in the palaeobatrachids, in a sample of *Palaeobatrachus grandipes* from Bechlejovice, Czech Republic. The distribution of Eocene palaeobatrachids, encompassing only western and central Europe, contrasts with the distribution of palaeobatrachids in post-Eocene times. This suggests a shift in their distribution between the Late Cretaceous and Palaeocene (western Europe) and the Pliocene and Pleistocene (eastern Europe). The last palaeobatrachids were recorded from the Muchkap interglacial (621–568 ka) in Russia. This implies that palaeobatrachids, as obligate water dwellers, did not survive the Oka glaciation (474–425 ka).

Project No. 9307: **Fossil frogs from the Lower Cretaceous of Liaoning Province (China)** (*Z. Roček*)

Taxonomic analysis of fossil frogs from the Lower Cretaceous of the Liaoning Province, northeast China, started with the assessment of the individual age of the specimens, the aim of which was to identify both size independent characters that can be used for taxonomic comparisons among individuals of various sizes and ontogenetically variable characters that can only be used for comparisons across corresponding developmental stages. Specimens of a single but currently undetermined species of the anuran genus *Liaobatrachus*, including four articulated skeletons preserved on a single block of sediment plus two skulls and several additional adult skeletons on other slabs, illustrate postmetamorphic developmental stages from early juvenile to fully-grown adult.

Project No. 9309: **Fossil fishes at selected localities of the Paratethyd region** (*T. Přikryl*)

The research of the Oligocene fish fauna continued at the localities of Loučka, Kelč and Osíčko during year 2011. Plenty of new material (Teleostei and Selachii) was collected; preliminary results show the presence of ichnofossils, coprolites, body fossils of members of families Alopiidae, Cetorhinidae, Clupeidae, Argentinidae, Gonostomatidae, Merlucciidae, Trichiuridae and others. The finds are compared with the material from other localities in the Czech Republic and in Poland.

Project No. 9313: **Palynology at selected nearshore localities of the Bohemian Cretaceous Basin (Lower Turonian)** (*M. Svobodová*)

Palynological research of the Lower Turonian assemblages continued on the nearshore localities of Plaňany and Markovice. Marine microplankton (dinoflagellate cysts, chitinous foraminiferal linings, acritarchs) dominate in all studied samples. Both calcareous environment and the presence of pyrite influenced the poor state of preservation of the dinocysts. Black amorphous matter is abundant and occasional scolecodonts are present. The dinocyst assemblage consists mostly of "long-ranging" forms. Depositional environment reflects shallow-marine conditions. The presence of the Normapolles pollen confirms the Lower Turonian age (*Complexiopollis praeatumescens*, *Complexiopollis turonis*, *Atlantopollis* sp.).

Project No. 9314: **Faunal communities and sedimentary environments during the Late Cenomanian – Early Turonian (rocky-coast facies) and the Late Turonian (hemipelagic and siliciclastic facies) of the Bohemian Cretaceous Basin** (*J. Žítt*)

Investigations of the Early Turonian condensed horizon continued in the nearshore settings at Plaňany village near Kouřim. Coprolitic deposits are mostly uniform vertically, reflecting relatively stable conditions and composition of producer's communities. Intensive phosphogenesis and taphonomic processes enabling the preservation and concentration of phosphatic particles are studied in connection with phosphatic crust formation and encrusting epifaunas. Lithological, macrofaunal (echinoderms, sponges), palynological and foraminiferal investigations provided new data on the age and sedimentary environments. Similar studies at Markovice village near Čáslav and in the Kolín surroundings (Nová Ves, Připeklí) are in progress. Echinoid studies (*Micraster*, Upper Turonian) are in their final stage with the prospect of submission of the results in 2013. Palynological studies in the Late Turonian/Coniacian beds at the Střeleč site provided new data on biostratigraphy and palaeoecology.

4h. Defended theses

Bek J. (2010): Importance of the research of Palaeozoic *in situ* spores. DSc Thesis.

This work summarises the most important results of the palynological studies of *in situ* spores achieved by the author including three main meanings of this research. The main significance of the work of the author is that he studied thousands of specimens of fertile parts of Carboniferous plants systematically and in an intensive way in several collections in the Czech Republic, Europe (Germany, Austria, Poland, France, Great Britain, Spain, the Netherlands), northern America (Canada, USA) and Asia (China).

It is possible to recognize three main meanings of the research of Palaeozoic *in situ* spores. The first is the importance for the classification of spores and their parent plants: *In situ* spores are very important and sometimes the only reliable criterion for a correct specific or even generic classification, especially for the compression preservation of the plants. Spore taxa produced by the only type of the parent plant are defined (e.g., *Lycospora, Cirratriradites, Crassispora*). Sometimes one spore taxon should be produced by several parent plants species or genera (e.g., *Calamospora, Laevigatosporites, Punctatosporites, Apiculatisporis*).

The author macerated several *in situ* spores of the *Lycospora* type from eighteen species of the genus *Lepidostrobus* which are associated mainly with parent plant genera *Lepidodendron* and *Lepidophloios*. The morphological variations of *in situ* lycospores are very small, and all specimens isolated from one parent cone are of the same type and can be correlated with the only one dispersed lycospore species. It is possible to propose a new classification of lycospores based also on their *in situ* records.

Another example of the influence of *in situ* spores on the classification of their parent plants is the group of sphenophyllalean cones. It was documented that sphenophylls are, in fact, a heterogeneous group, based on their *in situ* spores. This was proved based on the maceration of hundreds of specimens of sphenophylls from Czech and foreign collections. A new system of their classification will consist of seven new genera, according to the morphological types of sphenophyllalean *in situ* spores.

The author mentioned the examples of ontogenetic stages of some *in situ* spores (*Calamospora-Raistrickia, Laevigatosporites-Punctatosporites-Torispora, Apiculatisporis-Punctatisporites-Cyclogranisporites-Verrucosisporites*) produced by parent plant taxa, such as the species *Senftenbergia plumosa* and the genera *Pecopteris* and *Acitheca*.

The second significance of the research of *in situ* spores concerns the reconstructions of ecological conditions and palaeoenvironmental changes. It is possible to propose qualitative and quantitative reconstructions more precisely based on the fossilization potential of spores that is much better than their parent plants. A palynological study can give us a significantly higher number of parent plants than can be found at the localities, if we know the affinities of spores. It is also possible to estimate some quantitative characteristics of plants based on the palynological research using Conversion factors (R-values). This method was used by the author for compression flora for the first time. Localities where plant specimens were not transported and the whole assemblage was buried *in situ* by volcanic ash represent the best possibility for such research. As a result, it can be stated whether the spore taxon is over- or underrepresented in comparison with its parent plant.

The third significance of the research of *in situ* spores is the study of ultra-thin sections of exine of spores using a transmission electron microscope (TEM). This method is used especially for the reconstruction of phylogenetic lineages of spores and their parent plants.

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

5a. Papers published in 2011

*publications in journals included in the ISI Web of Science (IF value according to a list from 2011)

5.378* *LOKAJÍČEK T.*, LUKÁŠ P., NIKITIN A.N., PAPUSHKIN I.V., SUMIN V.V. & VASIN R.N. (2011): The determination of the elastic properties of an anisotropic polycrystalline graphite using neutron diffraction and ultrasonic measurements. – *Carbon*, 49, 4: 1374–1384.

4.259* MAGNA T., DEUTSCH A., MEZGER K., *SKÁLA R.*, SEITZ H.-M., MIZERA J., ŘANDA Z. & ADOLPH L. (2011): Lithium in tektites and impact glasses: Implications for sources, histories and large impacts. – *Geochimica et Cosmochimica Acta*, 75, 8: 2137–2158.

4.173* ŠEBEK O., MIHALJEVIČ M., STRNAD L., ETTLER V., JEŽEK J., ŠTĚDRÝ R., DRAHOTA P., *ACKERMAN L.* & ADAMEC V. (2011): Dissolution kinetics of Pd and Pt from automobile catalysts by naturally occurring complexing agents. – *Journal of Hazardous Materials*, 198: 331–339.

3.587* MOLDOVAN O.T., MIHEVC A., MIKÓ L., CONSTANTIN S., MELEG I., PETCULESCU A. & *BOSÁK P.* (2011): Invertebrate fossils from cave sediments: a new proxy for pre-Quaternary paleoenvironments. – *Biogeosciences*, 8: 1825–1837.

3.465* ZUNA M., MIHALJEVIČ M., ŠEBEK O., ETTLER V., HANDLEY M., *NAVRÁTIL T.*, *ROHOVEC J.* & GOLIÁŠ V. (2011): Recent lead deposition trends in the Czech Republic as recorded by peat bogs and tree rings. – *Atmospheric Environment*, 45, 28: 4950–4958.

3.385* *KOHOUT T.*, KIURU R., MONTONEN M., SCHEIRICH P., BRITT B., MACKE R. & CONSOLMAGNO G. (2011): 2008 TC3 asteroid internal structure and physical properties inferred from study of the Almahata Sitta meteorites. – *Icarus*, 212, 2: 697–700.

3.246* *ULRYCH J.*, DOSTAL J., *ADAMOVIČ J.*, JELÍNEK E., ŠPAČEK P., HEGNER E. & BALOGH K. (2011): Recurrent Cenozoic volcanic activity in the Bohemian Massif (Czech Republic). – *Lithos*, 123, 1–4: 133–144.

3.246* KOBAYASHI T., HIRAJIMA T., KAWAKAMI T. & *SVOJTKA M.* (2011): Metamorphic history of garnet-rich gneiss at Ktiš in the Lhenice shear zone, Moldanubian Zone of the southern Bohemian Massif, inferred from inclusions and compositional zoning of garnet. – *Lithos*, 124, 1–2: 46–65.

3.094* GROSCH E.G., KOŠLER J., MCLOUGHLIN N., DROST K., *SLÁMA J.* & PEDERSEN R.B. (2011): Paleoarchean detrital zircon ages from the earliest tectonic basin in the Barberton Greenstone Belt, Kaapvaal craton, South Africa. – *Precambrian Research*, 191, 1–2: 85–99.

3.021* LEER K., GOETZ W., CHAN M. A., GOREVAN S., HANSEN M. F., JENSEN CH. J., *KLETETSCHKA G.*, KUSACK A. & MADSEN M. B. (2011): RAT magnet experiment on the Mars Exploration Rovers: Spirit and Opportunity beyond sol 500. – *Journal of Geophysical Research*, 116, E00F18: 1– 8.

3.021* CUDA J., *KOHOUT T.*, TUCEK J., HALODA J., FILIP J., PRUCEK R. & ZBORIL R. (2011): Low-temperature magnetic transition in troilite – a simple marker for highly stoichiometric FeS systems. – *Journal of Geophysical Research*, 116, B11205: 1–9.

2.823* *BOROVIČKA J.*, KUBROVÁ J., *ROHOVEC J.*, ŘANDA Z. & DUNN C.E. (2011): Uranium, thorium and rare earth elements in macrofungi: what are the genuine concentrations? – *Biometals*, 24, 5: 837–845.

2.520* PÁNEK T., TÁBOŘÍK P., KLIMEŠ J., KOMÁRKOVÁ V., HRADECKÝ J. & *ŠŤASTNÝ M.* (2011): Deep-seated gravitational slope deformations in the highest parts of the Czech Flysch Carpathians: Evolutionary model based on kinematic analysis, electrical imaging and trenching. – *Geomorphology*, 129, 1–2: 92–112.

2.425* KODEŠOVÁ R., JIRKŮ V., KODEŠ V., MÜHLHANSELOVÁ M., NIKODEM A. & *ŽIGOVÁ A.* (2011): Soil structure and soil hydraulic properties of Haplic Luvisol used as arable land and grassland. – *Soil & Tillage Research*, 111, 2: 154–161.

2.420* *MAN O.* (2011): The maximum likelihood dating of magnetostratigraphic sections. – *Geophysical Journal International*, 185, 1: 133–143.

2.392* *ŽÁK K.*, KOŠŤÁK M., *MAN O.*, ZAKHAROV V.A., ROGOV M.A., *PRUNER P.*, *ROHOVEC J.*, DZYUBA O.S. & MAZUCH M. (2011): Comparison of carbonate C and O isotope records across the Jurassic/Cretaceous boundary in the Boreal and Tethyan realms. – *Palaeogeography Palaeoclimatology Palaeoecology*, 299, 1–2: 83–96.

2.392* *KOPTÍKOVÁ L.* (2011): Precise position of the Basal Choteč event and evolution of sedimentary environments near the Lower–Middle Devonian boundary: The magnetic susceptibility, gamma-ray spectrometric, lithological, and geochemical record of the Prague Synform (Czech Republic). – *Palaeogeography Palaeoclimatology Palaeoecology*, 304, 1–2: 96–112.

2.392* NYVLT D., KOSLER J., MLCOCH B., MIXA P., *LISÁ L.*, BUBIK M. & HENDRIKS B.W.H. (2011): The Mendel Formation: Evidence for Late Miocene climatic cyclicity at the northern tip of the Antarctic Peninsula. – *Palaeogeography Palaeoclimatology Palaeoecology*, 299, 1–2: 363–384.

2.342* *BREITER K.* (2011): Comments to the article by Verner et al.: Magmatic history and geophysical signature of a post-collisional intrusive center. – *International Journal of Earth Sciences*, 100, 4: 889–891.

2.342* ŽÁK J., KRATINOVÁ Z., TRUBAČ J., JANOUŠEK V., *SLÁMA J.* & MRLINA J. (2011): Structure, emplacement, and tectonic setting of Late Devonian granitoid plutons in the Tepla–Barrandian unit, Bohemian Massif. – *International Journal of Earth Sciences*, 100, 7: 1477–1495.

2.342* MÜLLER A., LEISS B., ULLEMEYER K. & *BREITER K.* (2011): Lattice-preffered orientation of late-Variscan granitoids derived from neutron diffraction data: implications for magma emplacement mechanisms. – *International Journal of Earth Sciences*, 100, 7: 1515–1532.

2.044* GRYNDLER M., HRŠELOVÁ H., SOUKUPOVÁ L., ŠTREIBLOVÁ E., VALDA S., *BOROVIČKA J.*, GRYNDLEROVÁ H., GAŽO J. & MIKO M. (2011): Detection of summer truffle (*Tuber aestivum* Vittad.) in ectomycorrhizae and in soil using specific primers. – *Fems Microbiology Letters*, 318, 1: 84–91.

2.000* *FILIPPI M.*, BRUTHANS J., PALATINUS L., ZARE M. & ASADI N. (2011): Secondary halite deposits in the Iranian salt karst: general description and origin. – *International Journal of Speleology*, 40, 2: 141–162.

1.889* GRYGAR T.M., NOVÁKOVÁ T., MIHALJEVIČ M., STRNAD L., SVĚTLÍK I., *KOPTÍKOVÁ L.*, *LISÁ L.*, BRÁZDIL R., MÁČKA Z., STACHOŇ Z., SVITAVSKÁ-SVOBODOVÁ H. & WRAY D.S. (2011): Surprisingly small increase of the sedimentation rate in the floodplain of Morava River in the Strážnice area, Czech Republic, in the last 1300 years. – *Catena*, 86, 3: 192–207.

1.625* VAŘILOVÁ Z., *NAVRÁTIL T.* & *DOBEŠOVÁ I.* (2011): Recent Atmospheric Deposition and its Effects on Sandstone Cliffs in Bohemian Switzerland National Park, Czech Republic. – *Water, Air and Soil Pollution*, 220, 1–4: 117–130.

1.625* *HOJDOVÁ M., NAVRÁTIL T., ROHOVEC J., ŽÁK K.,* VANĚK A., CHRASTNÝ V., BAČE R. & SVOBODA M. (2011): Changes in Mercury Deposition in a Mining and Smelting Region as Recorded in Tree Rings. – *Water, Air and Soil Pollution*, 216, 1–4: 73–82.

1.554* *BOROVIČKA J.,* NOORDELOOS M.E., GRYNDLER M. & OBORNÍK M. (2011): Molecular phylogeny of Psilocybe cyanescens complex in Europe, with reference to the position of the secotioid Weraroa novae-zelandiae. – *Mycological Progress*, 10, 2: 149–155.

1.537* *SLÁMA J.*, WALDERHAUG O., FONNELAND H., KOŠLER J. & PEDERSEN R.B. (2011): Provenance of Neoproterozoic to Upper Cretaceous sedimentary rocks, eastern Greenland: Implications for recognizing the sources of sediments in the Norwegian Sea. – *Sedimentary Geology*, 238, 3–4: 254–267.

1.488* *SLAVÍK L.* (2011): *Lanea carlsi* conodont apparatus reconstruction and its significance for subdivision of the Lochkovian. – *Acta Palaeontologica Polonica*, 56, 2: 313–327.

1.486* PROCHÁZKA V., SEYDOUX-GUILLAUME A.-M., TROJEK T., GOLIÁŠ V., *KORBELOVÁ Z.*, MATĚJKA D. & NOVOTNÁ P. (2011): Alteration halos around radioactive minerals in plutonic and metamorphic rocks of the northern Moldanubian area, Bohemian massif. – *European Journal of Mineralogy*, 23, 4: 551–566.

1.418* NADRI D., BÓNA A., BRAJANOVSKI M. & *LOKAJÍČEK T.* (2011): Estimation of stress-dependent anisotropy from P-wave measurements on a spherical sample. – *Geophysics*, 76, 3: WA91-WA100.

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1.099* *ŠTORCH P.*, MITCHELL C.E., FINNEY S.C. & MELCHIN M.J. (2011): Uppermost Ordovician (upper Katian – Hirnantian) graptolites of north-central Nevada, USA. – *Bulletin of Geosciences*, 86, 2: 301–386.

1.099* SCHNEIDER S., NIEBUHR B., WILMSEN M. & *VODRÁŽKA R.* (2011): Between the Alb and the Alps – The fauna of the Upper Cretaceous Sandbach Formation (Passau region, southeast Germany). – *Bulletin of Geosciences*, 86, 4: 785–816.

1.099* EL-SHAZLY S., KOŠŤÁK M., ABDEL-GAWAD G., KLOUČKOVÁ B., SABER S.G., SALAMA Y.F., MAZUCH M. & *ŽÁK K.* (2011): Carbon and oxygen stable isotopes of selected Cenomanian and Turonian rudists from Egypt and Czech Republic, and a note on changes in rudist diversity. – *Bulletin of Geosciences*, 86, 2: 209–226.

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SOKOL Z., *NAVRÁTIL T.*, SVOBODA J., FIŠÁK J. & PEŠICE P. (2011): *Posouzení předpokládaného vlivu provozu Dolu Bílina na koncentraci polétavého prachu v okolí - Výzkumná zpráva.* – Inst. Atmospheric Physics ASCR, v. v. i. for Doly Bílina, a. s.: 1–67. Praha.

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ŠŤASTNÝ M., *BOSÁK P.* & *PAVKOVÁ J.* (2011): *High-grade limestones from Biddiford, north Jamaica. Initial report*.– Inst. Geol. ASCR, v. v. i. for GET, Ltd.:1–15. Praha.

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SUKOVÁ L., *CÍLEK V., LISÁ L.* & *LISÝ P.* (2011): *Geoarchaeological Research in the area of Sabaloka and the Sixth Nile Cataract.* – Inst. Geol. ASCR & Institute of Egyptology FF UK for NCAM Khartoum (Sudan): 1–20. Praha & Khartoum.

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6. Organization of conferences and scientific meetings

International Conference: **The 2011 Miroslav Krs Conference: Time, Magnetism, Records, Systems and Solutions, The 2011 Annual IGCP 580 Meeting, October 12–18, Czech Republic.** Organized by Institute of Geology ASCR, v. v. i. Praha, Czech Republic. Organizing Committee: *Koptíková L.*, *Hladil J.* & Bábek O.

This conference was a follow-up to two conferences that were held in Belgium (2009) and China (2010). The main goal of the conference was to interconnect the knowledge from different scientific branches through the utility of magnetic susceptibility techniques and generally principles of magnetism: the use of magnetic susceptibility in Palaeozoic and younger rocks, magnetic methods in environmental studies, magnetism in biological sciences, material science, records, signal analyses and complex systems behavior. In total 51 persons from 15 countries and 4 continents contributed and presented the results of studies on magnetic susceptibility logs, sedimentological analyses, stratigraphy and global correlations. Five special invited lectures exceeding the project theme and were given by specialists from different scientific fields on magnetic particles in different environments, the use in nano- and biotechnologies, mapping and identifying of anthropogenic pollution, processing and treating of data. One-day field trip brought all participants to the Barrandian area to investigate Lower Palaeozoic rocks. Three-days working and sampling campaign parallelly in the Barrandian area and in the Moravian Karst was focused on the sample collecting for comparative studies with the material obtained during previous field works in China and Belgium. The abstract volume was released: Koptíková L., Hladil J. & Adamovič J. (Eds., 2011): 2011 Miroslav Krs Conference: Time, Magnetism, Records, Systems and Solutions. *The 2011 Annual IGCP 580 Meeting, October 12 – 18, Czech Republic. Abstract Volume*: 1–60. Praha.

International Conference: **9th International Eclogite Conference 2011, Mariánské Lázně, August 6–9, 2011.** Organized by Charles University, Institute of Geology ASCR, v. v. i., Czech Geological Survey. Organizing committee: *Svojtka M.* & *Ackerman L.*

More then 150 people from abroad participated in the 9th International Eclogite Conference 2011 held in Mariánské Lazně. During the conference, actual research studies were presented together with localities illustrating the geological relations, lithological and geochemical features, and metamorphic evolution of different high-pressure and ultrahigh-pressure crystalline segments that formed by subduction and collision during the Variscan orogeny. The seven-day field trips covered most of the localities of HP and UHP rocks in the Saxothuringian and Moldanubian Zone of the Bohemian Massif in Germany, Austria and the Czech Republic. Special volume of Geolines journal (http://geolines.gli.cas.cz/index.php?id=223) from this meeting was published: Faryad S.W., Medaris G.L. & Svojtka M. (Eds., 2011): High-Pressure/Ultrahigh-Pressure Rocks in the Bohemian Massif (Proceedings of the 9th International Eclogite Conference 2011) – *Geolines*, 23: 1–136. Praha.

International Conference: **Conference of Environmental Archaeology (KEA), Brno, February 9–10, 2010.** Organized by the Institute of Archaeology ASCR, v. v. i. in Brno and by the Institute of Geology ASCR, v. v. i., by Czech Geological Society and by University of Southern Bohemia. Organizing Committee: Nývltová Fišáková M. & *Lisá L.*

The conference was joined by more than 70 participants from the Czech Republic and by 4 participants from Poland. Different papers concerning the natural sciences in context of archaeology were presented. The conference lasted two days and included oral presentations as well as poster session. As a result, a Book of Abstracts was published in paper version and on the internet. The project was supported by the Institutional research plan of the Institute of Geology ASCR, v. v. i. No. Z3013 0516. Some papers presented at this conference were lately published in journal Interdisciplinaria archaeologica – Natural Sciences in Archaeology.

Nývltová Fišáková M. & Lisá L (Eds., 2010): KEA 2011. *Institute of Archaeology ASCR, v. v. i. in Brno, Brno, February 9–10, 2010*: 1–45. Brno. *http://www2.gli.cas.cz/kvarter/abstrakt%20book%20kea%202011.pdf*

International Conference: **Late Cenozoic Mammals: fossil record, biostratigraphy, paleoecology. International Colloquium in honor of Prof. Oldřich Fejfar, Prague, May 16–19, 2011.** Organized by Institute of Geology, ASCR, v. v. i., Charles University Prague and by National Museum Prague. Organizing Committee: Horáček I., *Čermák S.* & *Wagner J.*

51 participants from 11 countries took part in this international conference. Their contributions were dealing with the current achievements in research of fossil mammals and biostratigraphy of the Paleogene, Neogene and Quaternary age. Among the most important information, new data about updated record and stratigraphical distribution of the Miocene to Pleistocene rodents of Eastern Europe, as well as the new paleoecological interpretation of the Eocene primate *Darwinius*, were presented. The conference excursion covered the classical Paleogene and Neogene localities with mammals in northern Bohemia.

Horáček I., Wagner J. & Čermák S. (Eds., 2011): Late Cenozoic Mammals: fossil record, biostratigraphy, paleoecology. *International Colloquium in honor of Prof. Oldřich Fejfar. Program, abstracts and an excursion guide, Prague, May 16–19, 2011*: 1–68. Praha.

International Conference: **19th International Karstological School "Classical Karst", Postojna, June 20–25, 2011.** Organized by the Karst Research Institute, Scientific Research Centre of the Slovenian Academy of Sciences and Arts, Postojna, Slovenia. Organizing & Scienttific committee: Afrasibian A., Filho A., Baioni D., Bartholeyns J.P., Bočič N., *Bosák P.,* Brana S., Cigna A., Dravec L., Gabrovšek F., Gostinčar P., Häuselmann P., Kadebskaya O., Knez M., Kogovšek J., Kostelič B., Kranjc A., Mihevc A., Mulaomerovič J., Mulec J., Otoničar B., Perne M., Persoiu A., Petrič M., Pipan T., Polak S., Prelovšek M., *Pruner P.,* Shaw T., Slabe T., Stamenkovič S., Šebela S., Turk J., Vlcek L., De Waele J., Zupan Hajna N. & Zakšek V.

The aim of this Karstological School is to shed light on the issues of the multiple pressures on underground karst, set out the causes of these pressures and offer preventive and remedial solutions to them, propose alternatives to the frequently inappropriate management of underground karst, and at the same time raise awareness of the importance of underground natural heritage. We will raise awareness of protection of the underground karst and collect basic Slovenian – Croatian knowledge by publishing Protection of the underground karst – cases from Slovenia and Croatia.

Workshop: **Results of natural archive study from the Strážnické Pomoraví area and from other localities located in the Lower Moravian Basin, Brno, November 22, 2011.** Organized by the Institute of Geology ASCR, v. v. i. Organizing committee: *Kadlec J.*

Topics presented during the workshop summarized results obtained within the multidisciplinary research project No. IAAX00130801: Interplay of climate, human impact, and land erosion recorded in the natural archives of Strážnické Pomoraví (CR) supported by the Grant Agency of the Academy of Sciences of the Czech Republic. Participants (35 in total) from the Institute of Geography MU in Brno, Czech Geological Survey and Institute of Botany ASCR, v. v. i. discussed late glacial eolian and lake processes as well as Holocene floodplain processes.

International Conference Field Trip: **Goldschmidt 2011 post-conference field trip: Bohemian geological enigmas: Variscan High-Pressure Granulites, Ultrapotassic Magmatites and Tektites.** Organized by Czech Geological Survey, Prague, Faculty of Science, Charles University, Prague, and by Institute of Geology ASCR, v. v. i., Prague. Organizing Committee: Janoušek V. & *Skála R.*

The field trip was focused to present several remarkable geological features that may be observed in the southern part of the Bohemian Massif. The stops thus included quarries exhibiting sequence of magmatic and metamorphic rocks recording the continental collision and metamorphic climax producing high-pressure granulites, (ultra-) potassic syenitic to melagranitic rocks (durbachites), related to the granulite occurrences and the sandpit where Czech tektites (moldavites) are exploited. The field trip also included a visit to a mining museum in the famous base-metal and uranium mining district of Příbram.

Janoušek V. & Skála R. (Eds., 2011): *Bohemian Enigmas: Granulites, Ultrapotassic Magmatites and Tektites. Field trip guide*:1–96. Praha.

7. Undergraduate and Graduate Education

7a. Undergraduate and Graduate Courses at Universities given by Staff Members of the Institute of Geology ASCR, v. v. i.

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.

BRUTHANS J. & *ŠLECHTA S.*: *Field hydrogeology training (practice)* (MG451T10). Untergraduate (optional) Course, Faculty of Science, Charles University, Praha.

CÍLEK V.: *Landscape in Czech Republic*. Academy of Fine Arts (AVU) and School of architecture, Praha.

CÍLEK V.: *Study Abroad*. Collegium Hieronymi Pragensis, Praha.

DATEL J. & *MIKULÁŠ R.*: Geology for archaeologists (APA500029-PVP). Undergreaduate (compulsory) Course, Faculty of Philosophy, Charles University, Praha.

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

DRESLEROVÁ D., *LISÁ L.*, KOČÁR P., POKORNÝ P., RENÉ P. & ŠEFRNA L.: *Environmental Archaeology (lecture on Quaternary geology and geoarchaeology)* (KAR_ENV). Undergraduate (optional) Course, Faculty of Philosophy, University of West Bohemia, Pilsen.

HOJDOVÁ M.: *Fundamentals of Geology* (APA35E). Undergraduate Couse, 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.

KOHOUT T.: *Solid Earth Geophysics laboratory course* (535020). Untergraduate and Graduate Course, Faculty of Science, a Univerzity of Helsinki, Finland.

LISÁ L.: *Geoarchaeology* (AEB_133) Graduate (optional) Course, Faculty of Philosophy, Masaryk University, Brno.

LISÁ L.: *Geoarchaeology* (KAR_GEOA) Graduate (optional) Course, Faculty of Philosophy, University of West Bohemia, Pilsen.

LISÁ L.: *Geoarchaeology* (UAR/MGA) Graduate (optional) Course, Faculty of Philosophy, University of South Bohemia, České Budějovice.

MAZUCH M. & *PŘIKRYL T.*: *Palaeontology of fossil Vertebrates* (MG422P36). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

MIKULÁŠ R. IN HOLCOVÁ K. et al.: *Principles of paleobiology I* (MG422P02). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

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.*: *Heavy metals in the environment.* (MG431P92). Graduate Course, Faculty of Science, Charles University, Praha.

PŘIKRYL T. in HOLCOVÁ K. et al.: *Principles of paleobiology I* (MG422P02). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

PŘIKRYL T. in KOŠŤÁK M. et al.: *Paleoecology* (MG422P51). Undergraduate (optional) Course, Faculty of Science, Charles University, Praha.

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

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

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

ROČEK Z.: *Morphology of animals* (MG422P54). Undergraduate (optional) Course, Faculty of Science, Masaryk University, Brno.

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

SKÁLA R.: *Chemical crystallography* (MG431P64). Undergraduate and Postgraduate (optional) 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 and Postgraduate (optional) Course, Faculty of Science, Charles University, Praha.

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

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

ULRYCH J.: Systematic Mineralogy (D 108003). Graduate (optional) Course, Faculty of Chemical Technology, University of Chemical Technology, Praha.

VACH M.: *Air Protection* (ZVZ22E). Undergraduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

VACH M.: *Atmospheric processes* (ZVZ01E). Undergraduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

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

VACH M.: *Environmental chemistry I* (ZVZ04E). Undergraduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

VACH M.: *Modeling of Processes in Environment* (DZVX02Y). Graduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

VACH M.: *Physicochemical aspects of processes in environment* (ZVZ09E). Undergraduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha.

VACH M.: *Transport of contaminants in atmosphere* (ZVL24E). Undergraduate Course, Faculty of Environmental Sciences, Czech University of Life Sciences, 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.

7b. Supervision in Undergraduate Studies

Mladá Věda

MELZEROVÁ E. Gymnázium Benešov, Czech Republic (*supervisor J. Rohovec, since 2011*)

BC. Theses

GREŇOVÁ I., Faculty of Environmental Sciences, Czech University of Life Sciences (*co-supervisor/advisor J. Borovička, since 2011*)

GRÖSSLOVÁ Z., Faculty of Science, Charles University (*supervisor P. Drahota, defended 2011*)

KIURU R., Department of Phsics, Faculty of Science, a Univerzity of Helsinki, Finland (*supervisor T. Kohout*, *defended 2011*)

NÁBĚLEK L., Faculty of Science, Charles University (*supervisor G. Kletetschka, since 2011*)

RODOVSKÁ Z., Faculty of Science, Charles University (*supervisor P. Drahota, since 2011*)

SOCHOROVÁ K., Faculty of Science, Charles University (*supervisor P. Drahota, since 2011*)

SVOBODA O., Faculty of Science, Charles University (*supervisor P. Drahota, since 2011*)

VARGOŠ K., Faculty of Science, Charles University (*supervisor P. Drahota, completed 2011*)

MSc. Theses

GOLL J., Faculty of Science, Charles University, Praha (*supervisor R. Skála, defended 2011*)

GRÖSSLOVÁ Z., Faculty of Science, Charles University (*supervisor P. Drahota, since 2011*)

HRUBÁ J., Faculty of Science, Charles University (*supervisor G. Kletetschka, since 2011*)

KINDLOVÁ H., Faculty of Science, Charles University (*supervisor P. Drahota, since 2011*)

KOHOUTOVÁ I., Faculty of Science, Charles University (*supervisor L. Ackerman, since 2010*)

KUBROVÁ J., Faculty of Science, Charles University (*supervisor J. Borovička, defended 2011*)

KUČEROVÁ CHARVÁTOVÁ K., Faculty of Science, Masaryk University, Brno (*supervisor J. Hladil, since 2010*)

MÁLKOVÁ K., Faculty of Science, Charles University (*supervisor G. Kletetschka, since 2011*)

NOVÁKOVÁ B., Faculty of Science, Charles University (*supervisor P. Drahota, completed 2011*)

OBERSTEINOVÁ T., Faculty of Science, Charles University (*advisor J. Kadlec, defended 2011*)

REDLICH A., Faculty of Science, Charles University (*supervisor P. Drahota, completed 2011*)

SOUMAR J., Faculty of Science, Charles University, Praha (*supervisor R. Skála, defended 2011*)

SVATUŠKOVÁ A., Faculty of Philosophy, University of South Bohemia, České Budějovice (*co-supervisor/advisor L. Lisá, defended 2011*)

VALENTOVÁ J., Faculty of Science, Charles University (*co-supervisor/advisor L. Lisá, defended 2011*)

7c. Supervision in Graduate Studies

PhD. Theses

AXMANN D., Faculty of Sciences, Masaryk University, Brno (*supervisor R. Mikuláš, since 2009 till October, 2011 when ceased*)

BRADOVÁ M., Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Praha (*co-supervisor P. Skřivan, since 2011*)

BUCHTOVÁ J., Faculty of Science, Charles University, Praha (*supervisor T. Navrátil, since 2011*)

DOUCEK J., Faculty of Science, Charles University, Praha (*supervisor R. Mikuláš, since 2010 till July, 2011 when ceased by the student*)

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

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

HERICHOVÁ I., Archeological institute ASCR, Praha (*supervisor V. Cílek, since 2007*)

HOŠEK J., Faculty of Sciences, Charles University, Praha (*supervisor L. Lisá, since 2010*)

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

KALLISTOVÁ A., Faculty of Science, Charles University, Praha (*supervisor R. Skála, since 2010*)

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

KOŘÍNKOVÁ D., Faculty of Science, Charles University, Praha (*supervisor M. Svojtka, since 2011*)

KUBROVÁ J., Faculty of Science, Charles University, Praha (*supervisor J. Borovička, since 2011*)

KULAVIAK L., Faculty of Chemical Engineering, Institute of Chemical Technology, Praha (*co-supervisor/advisor J. Hladil, since 2005*)

MATOUŠKOVÁ Š., Faculty of Science, Charles University, Praha (co-*supervisor J.Rohovec, since 2007*)

PETRUŽÁLEK M., Faculty of Science, Charles University, Praha (*co-supervisor T. Lokajíček, 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 2009*)
ŠLECHTA S., Faculty of Science, Charles University, Praha (*co-supervisor J. Kadlec, since 2005*)
SOUMAR J., Faculty of Science, Charles University, Praha (*supervisor R. Skála, since 2011*)
STEHLÍK F., Faculty of Science, Charles University, Praha (*advisor J. Kadlec, since 2008*)
ŠTOR T., Faculty of Science, Charles University, Praha (*co-supervisor J. Kadlec, since 2011*)
SVITEK T., Faculty of Science, Charles University, Praha (*supervisor T. Lokajíček, since 2008*)
VALENTOVÁ J., Faculty of Science, Charles University, Praha (*supervisor L. Lisá, since 2011*)
VAŠKANINOVÁ KAŠPAR V., Faculty of Science, Charles University, Praha (*co-supervisor/advisor J. Zajíc, since 2010*)
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, Accreditation Commission of the Slovak Academy of Sciences for the 1st Department of Sciences (Slovak Academy of Sciences, Bratislava)
Member, the International Advisory Board, Research Potential Programme of the EU FP7-REGPOT-2011-1 Action towards laboratories enhancement and know-how exchange for advanced research on geosystem – ATLAB (Institute of Geological Sciences PAS, Warszawa, Poland; October 2011–September 2013)
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 Institute of Geology of the ASCR, v. v. i., Praha
Member, Scientific Council of Faculty of Science, Masaryk University, Brno (until June 2011)
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 Geography and Geoecology, Faculty of Science, Charles University, Praha
Member, Committee for State Doctoral Examinations, PhD Study Program of Physical Geography and Geoecology, Faculty of Science, Charles University, Praha
Member, Committee for State Rigorosum Examinations in Geology (general geology), Faculty of Science, Charles University, Praha

GOTTSTEIN O.
Member, Executive board of the Institute of Geology of the ASCR, v. v. i.

HLADIL J.
Member, Czech Commission on Stratigraphy, Praha
Member, Committee for Degree of Doctor of Sciences (DSc.) in Geological Sciences at Academy of Sciences of the Czech Republic, Praha
Member, Board of Graduate Studies in Geology, Faculty of Science, Charles University, Praha
Member, Board of Graduate Studies in Geology, Faculty of Science, Masaryk University, Brno
Member, Committee for Finals of Undergraduate Students in Geology, Faculty of Science, Masaryk University, Brno
Member, Examination Committee for Degree of Doctor of Natural Sciences (RNDr.) in Geological Sciences, Faculty of Science, Masaryk University, Brno

HOJDOVÁ M.
Member, Committee for Finals of Doctoral Students in Applied Geology, Faculty of Science, Charles University, Praha

KADLEC J.
Member, Czech Commission on Stratigraphy, Praha
Member, International Geosphere-Biosphere Programme – National Committee
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 of the Doctoral Examination Committee in Geology, Faculty of Science, Charles University, Praha
Deputy Chairman, Board for Popularization of Sciences, Academy of Sciences of the Czech Republic, Praha
Secretary, Czech National Geologic Committee, Praha
Member, Editorial Board of the Academy of Sciences of the Czech Republic, Praha

NAVRÁTIL T.
Member, Committee for Finals of Doctoral Students in Applied Geology, Faculty of Science, Charles University, Praha
Member, Committee for Doctoral Thesis Defense in Applied Geology, Faculty of Science, 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 of the Commitee for degree of Doctor of Sciences (DSc.) in geological sciences at Academy of Sciences of the Czech Republic, Praha
Member, Executive board of the Institute of Geology ASCR, v. v. i.

RUDAJEV V.
Member, Supervisory board of the Institute of Astronomy ASCR, v. v. i.
Member, Supervisory board of the Institute of Theoretical and Applied Mechanics ASCR, v. v. i.
Member, Executive board of the Institute of Geology ASCR, v. v. i.
Member, Czech National Committee of Geodesy and Geophysics
Chairman, Commission for defending Doctor of Sciences Thesis (DSc.) in Geological Sciences, Academy of Sciences of the Czech Republic
Member, Committee for degree of Doctor of Sciences (DSc.) in geophysical sciences at Academy of Sciences of the Czech Republic, Praha
Member, Committee for State Doctoral Examinations, PhD Study Program of Geophysics, Faculty of Mathematics and Physics, Charles University, Praha
Member, Committee for Defenses of Dissertations, PhD Study Program of Geophysics, Faculty of Mathematics and Physics, Charles University, Praha
Vice-Chairman of Grant Agency of Academy of Sciences of the Czech Republic, Praha

SKÁLA R.
Chairman, Committee for Finals of Undergraduate Students in Geology, specialization Mineralogy and Crystallography, Faculty of Science, Charles University, Praha
Member, Committee for Finals of Undergraduate Students in Geology, specialization Geochemistry, Faculty of Science, Charles University, Praha

SLAVÍK L.
Member, Academic Assembly of the Academy of Sciences of the Czech Republic, Praha

ŠTORCH P.
Alternating Member, Committee for Degree of Doctor of Sciences in Geological Sciences, Academy of Sciences CR, Praha
Vice-chairman and Secretary. Czech Commission on Stratigraphy, Praha
Member, Earth Science Panel (geophysics, geochemistry, geology, mineralogy and hydrogeology) of Czech Science Foundation, Praha

SVOBODOVÁ M.
Secretary, Grant Commission of the Academy of Sciences, Council No. 3 (OR3) Earth and Space Sciences, Praha
Member, Executive Board of the Institute of Geology ASCR, v. v. i., Praha

ULRYCH J.
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 the Academy of Sciences, Praha
Vice-chairman, Grant Commission of the Academy of Sciences, Council No. 3 (OR3) Earth and Space Science, Praha
Member, Board of Graduate Studies in Geology, Faculty of Science, Charles University, Praha
Member, Committee for Finals of Undergraduate Students in Geochemistry, Faculty of Science, Charles University, Faculty of Science, Praha
Member, Committee for Finals of Undergraduate Students in Mineralogy, Faculty of Science, Charles University, Faculty of Science, Praha
Member, Examination Committee for Degree of Doctor of Natural Sciences (RNDr.) in Gechemistry and Mineralogy, Charles University, Faculty of Science, Praha

VACH M.
Member, Board of Graduate Studies in Environmental Modeling, Faculty of Environmental Sciences, Czech University of Life Sciences, Praha

ZAJÍC J.
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 Science, Charles University, 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, Committee of the Czech Society of Soil Science, Praha
Member, Board of the Doctoral Examination Committee in Physical Geography and Geoecology, Faculty of Science, Charles University, Praha

Member, Board of the Graduate Studies in Geography, Faculty of Science, Charles University, Praha
Member, Board of the Committee of Soil Science of the Czech Academy of Agricultural Science, Praha

ŽÍTT J.
Alternating Member of the Doctoral Examination Committee in Geology, Faculty of Science, Charles University, Praha

7e. Membership in Foreign Academies

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

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

7f. Degrees obtained by the staff of the Institute of Geology ASCR

DSc.

BEK J. (2011): *Importance of the research of Palaeozoic in situ spores.* – DSc. Thesis, Institute of Geology, Academy of Sciences of the Czech Republic v. v. i.: 1–52. Praha (defended on May 12, 2011).

7g. Awards

BOROVIČKA J.: 21. století journal award, Praha; award for a young scientist.

BOROVIČKA J.: Otto Wichterle Award, Academy of Sciences of the Czech Republic, Praha; award for a young scientist with outstanding results

LOKAJÍČEK T.: The first prize of the Joint Institute for Nuclear Research, 2011, for the work „New theoretical and experimental investigations of seismic properties of earth's lithosphere on the basis of neutron diffraction data", member of the research team

MIKULÁŠ R.: Award for the Best Books of the Year 2010, Academia Publishers, Praha; winning in the category of the Visual Feat with the book Ledové Čechy (Icy Bohemia)

7h. Institute staff on Fellowships and Stages

DAŠKOVÁ J.: *Marie Curie Fellowship* (Researcher, Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK, June 1, 2010–May 31, 2012, 24 months).

Research is done in the following areas: Work on the Paleocene–Eocene Thermal Maximum, testing plant extinction across the Paleocene/Eocene boundary (Europe, North America).

ROČEK Z.: *Visiting Research Fellow* (Professor at Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, 2009–2013).

Research is done in the following areas: Anura of Jehol Biota (Lower Cretaceous, Liaoning Province, NE China); Middle Miocene Anura of the locality of Shanwang (Shandong Province, China).

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, 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).
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 Český 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, Geological Institute of the Slovak Academy of Sciences, Bratislava, Slovakia (since 2004).
Slovenský kras, Member of Editorial Board, Slovak Museum of Speleology, Liptovský Mikuláš, Slovakia (since 2004).
Vesmír, Member of Editorial Board, Vesmír Ltd, Praha (since 1998).

HLADIL J.: *Geological Quarterly*, Member of Editorial Team – Consulting Editor, Polish Geological Institute – National Research Institute, Warsaw, Poland (since 2004).
Geologica Carpathica, Member of Editorial Board – Executive Committee, Geological Institute of the Slovak Academy of Sciences, Bratislava, Slovakia (since 2001).
Bulletin of Geosciences, Member of Editorial Board – Co-editor, Czech Geological Survey, Praha (since 2006).

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

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

LISÁ L.: *Journal Interdisciplinaria archaeologica – Natural Sciences in Archaeology*, Member of Editorial Board, Archaeological Centre Olomouc, Goverment Funded Organisation (since 2010).

MIKULÁŠ R.: *Geolines*, Member of Editorial Board, Institute of Geology ASCR, v. v. i., Praha (since 1998).
Acta Musei Nationalis Pragae, Series B, Historia Naturalis, Member of Editorial Board, National Museum, Praha (since 2008).

PRUNER P.: *Acta Universitatis Carolinae, Geologica*, Member of Editorial Board, Charles University, Praha (since 2000).
Geolines, Member of Editorial Board, Institute of Geology ASCR, v. v. i., Praha (since 1997).
Research Journal of Earth Sciences, Member of Editorial Board, IDOSI Publications, Dubai, UAE (since 2009).
Journal of Hydrocarbons Mines and Environmental Research, Member of Editorial Advisory Board, Rennes, France (since 2010).

ROČEK Z.: *Palaeodiversity & Palaeoenvironments*, Member of Editorial Board, Senckenberg Gesellschaft für Naturforschung, Frankfurt a.M. (since 2010).

RUDAJEV V.: *Acta geodynamica et geomaterialia*, Member of Editorial Board, Institute of Rock Structure and Mechanics ASCR, v. v. i. Praha (since 1990).

SKÁLA R.: *Journal for Geosciences*, Member of the Editorial Board, Czech Geological Society, Praha (since 2006).

SVOJTKA M.: *Geolines*, Editor-in-chief, Institute of Geology ASCR, v. v. i., Praha (since 1996).

ŠTORCH P.: *Bulletin of Geosciences,* Member of Editorial Board, Czech Geological Survey, Praha (since 2001), Co-editor (since 2011).
Geolines. Member of Editorial Board, Institute of Geology ASCR, v. v. i., Praha (since 1995).
*Paleontological Contribution*s. Member of Editorial Board. Electronic Journal, University of Kansas, Lawrence (since 2008).

ZAJÍC J.: *Bulletin of Geosciences*, Member of Editorial Board, Czech Geological Survey, Praha (since 2001), Coeditor (since 2008).

ŽÁK K.: *Bulletin of Geosciences*, Co-editor, Czech Geological Survey, Praha (since 2006).
Český kras, Member of the Editorial Board (since 2007), Co-editor (since 2008), regional journal published by the Museum of the Český Karst, Beroun.

8b. Positions in International Organizations

BOSÁK P.: Honorary Member, the UIS Bureau, the International Union of Speleology (UIS; elected in 2009)
Member, Advisory Committee, the International Union of Speleology (UIS; elected in 2009)

DAŠKOVÁ J.: Councillor, Organization of Czech and Slovak palynologists in the International Federation of Palynological Societies (OCSP in IFPS; 2008–2011)

HLADIL J.: Committee Member and Web Site Administrator, International Geoscience Programme of the UNESCO and IUGS – Czech National Committee for IGCP (since 1994)
Titular Member, Subcommission on Devonian Stratigraphy of the ICS and IUGS (since 2003)

KADLEC J.: National Co-ordinator, IGBP-PAGES Project (since 1998)

KOPTIKOVA L.: Committee Member, International Geoscience Programme of the UNESCO and IUGS – Czech National Committee for IGCP (since 2010)

MIKULÁŠ R.: Czech Representative, International Paleontological Association (since 2005).
Working Group of the Treatise on Invertebrate Paleontology, Part W, Trace Fossils (since 2001)

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 the Committee C – Soil and regolith morphology and genesis, Division on Soil System Sciences, European Geosciences Union (since 2006)

9. Institute structure and staff

9a. Organization units

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

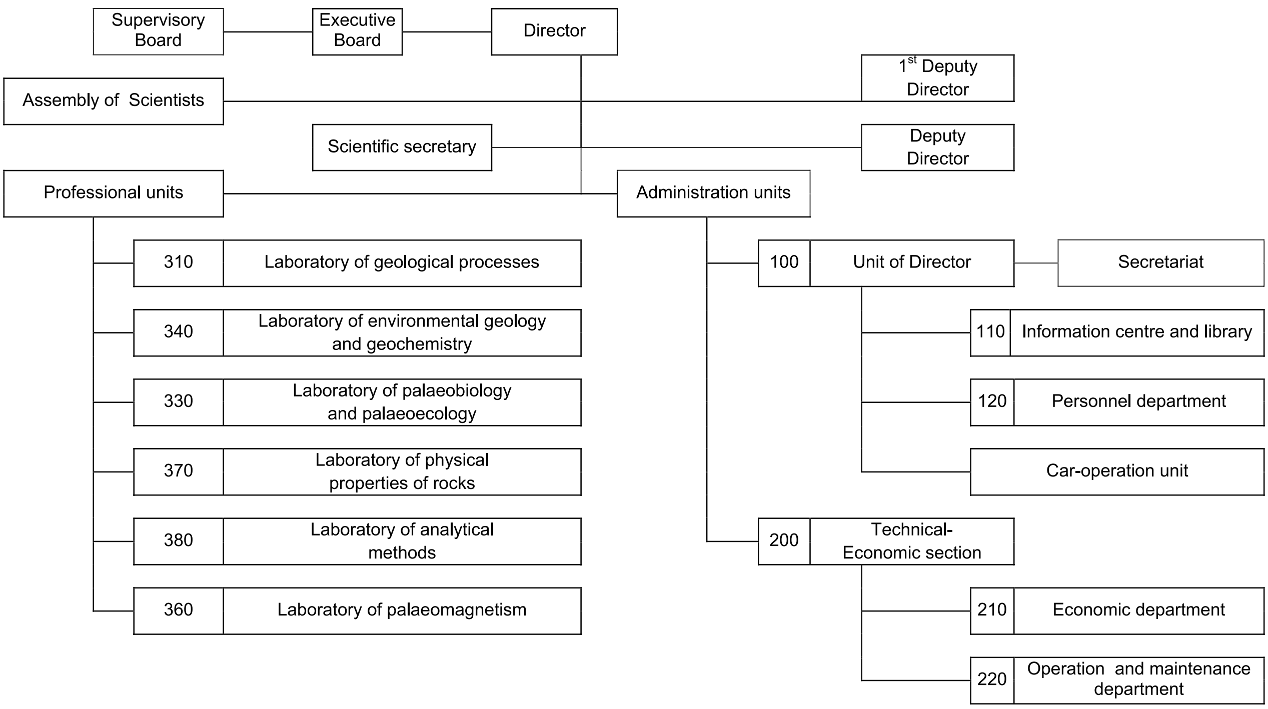
1. *Laboratory of Geological Processes* extends the knowledge of temperature, pressure and time conditions of different stages of magmatic process in crustal and upper mantle settings as well as of the set of hydrothermal, low- and high-grade metamorphic processes. The evolution of sedimentary basins 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 the environment with the geological processes, as they are recorded in sediments and soils formed during the Tertiary and Quaternary. Basic attention is given to the study of complicated interactions between biotic and abiotic components of the nature, climatic oscillations and environmental changes in the past, and anthropogenic impact on the present natural processes.
4. *Laboratory of Paleomagnetism* deals with paleomagnetism, magnetostratigraphy, mineral magnetism, geological interpretation of obtained data, and development of new laboratory techniques. Research is focused on the 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 in their elastic anisotropy under high pressure are also investigated.
6. *Laboratory of Physical Methods* represents a 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. Ladislav Slavík, CSc. & Pavel Lisý).
3. X-ray and DTA/TG laboratory (Head: RNDr. Roman Skála, PhD.).

Organization chart



4. Electron scanning and microprobe laboratory (Head: Ing. Anna Langrová).
5. Laboratory of rock processing and mineral separation (Head: RNDr. Martin Šťastný, CSc.).
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. Mercury analysis laboratory (Head: RNDr. Tomáš Navrátil, PhD.).
12. LA–ICP–MS Laboratory (Supervised by Ing. Jana Ďurišová & Mgr. Šárka Matoušková)
13. Clean Chemistry Laboratory (Supervised by Mgr. Lukáš Ackerman, PhD.)
14. Laboratory of rock behavior under high pressure (Head: RNDr. Vladimír Rudajev, DrSc.).
15. 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 the presentation of the most important scientific results in the public media.

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, 2011)

Advisory Board

Prof. Jiří Chýla, CSc. (Head Office ASCR) . . . . Chairman
Doc. Ing. Petr Skřivan, CSc. . . . . Vice-Chairman
Prof. Ing. Jiří Čtyroký, DrSc. (Scientific Council ASCR) . . . . Member
Prof. Jiří Pešek, DrSc. (Faculty of Science, Charles University, Praha). . . . . Member
Doc. Ing. Richard Šňupárek, CSc. (Institute of Geonics ASCR, v. v. i. Ostrava) . . . . Member

Executive Board

Prof. RNDr. Pavel Bosák, DrSc. . . . . 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
Mgr. Pavel Kavina, PhD (Ministry of Industry and Trade of the Czech Republic, Praha) . . . . Member
RNDr. Jan Krhovský, CSc. (Ministry of the Environment of the Czech Republic, Praha) . . . . Member
Doc. RNDr. Jiří Souček, CSc. (University of Finance and Administration, Praha) . . . . Member

Management

RNDr. Václav Cílek, CSc. . . . . Director of the Institute (CEO)
Prof. RNDr. Pavel Bosák, DrSc. . . . . 1st Deputy Director

Administration units

Unit of Director

Secretariat
Michaela Uldrychová (assistant to the Director)
Marcela Nováková (assistant to the Director, international exchange)

Information Centre and Library
Bc. Jana Štarmanová – Head (librarian)
Mgr. Václava Škvorová (librarian)
Bc. Sabina Bielská (librarian)

Personnel Department
Věra Štěrbová (human resources)

Car Operation Unit
Karel Jeřábek (garage attendant, driver, storeman, janitor)

Technical-Economic Section
Ing. Ondřej Caha – Head
Ing. Ottomar Gottstein, CSc. – Deputy Head

Economic Department
Jana Klímová (accountant)
Božena Trenzeluková (phone operator, mail service)
Alena Chadrabová (accountant)

Operation and Maintenance Department
Ing. Ottomar Gottstein, CSc. – Head
Antonín Čejka (technical service)
Petr Vachalovský (technical service)

Scientific laboratories

Laboratory of Geological Processes

Scientific Staff:
Mgr. Jiří Adamovič, CSc. – Head (basin analysis, tectonics)
Mgr. Leona Koptíková – Deputy Head (sedimentary petrology, metasediments, magnetic susceptibility)
Mgr. Lukáš Ackerman, Ph.D. (geochemistry, mantle petrology)
RNDr. Karel Breiter, PhD. (petrology, mineralogy)
RNDr. Vladimír Cajz, CSc. (volcanology)
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)
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:
Josef Forman (topography, geodetic maps, GPS)
Ing. Jaroslava Pavková (secretary, technician)
Jana Rajlichová (technician)
RNDr. Martin Štastný, CSc. (technician, chemical analyst)

Laboratory of Paleobiology and Paleoecology

Scientific Staff:

RNDr. Ladislav Slavík, CSc. – Head (Silurian–Devonian stratigraphy, conodont biostratigraphy, sedimentary sequences, paleogeography)
RNDr. Marcela Svobodová, CSc. – Deputy Head (Cretaceous palynology)
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)
RNDr. Jiřina Dašková, Ph.D. (Cenozoic palynology)
RNDr. Radek Mikuláš, CSc. (ichnofossils)
RNDr. Tomáš Přikryl, Ph.D. (vertebrate paleontology, fishes)
Prof. RNDr. Zbyněk Roček, DrSc. (origin and evolution of the Amphibia, Tertiary Anura and Sauria)
RNDr. Petr Štorch, DrSc. (graptolite stratigraphy, stratigraphy in general, sedimentary sequences, paleogeography)
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:

Pavel Lisý (technician)

Laboratory of Environmental Geology and Geochemistry

Scientific Staff:

RNDr. Tomáš Navrátil, PhD. – Head (aquatic and environmental geochemistry)
Mgr. Michal Filippi, PhD. – Deputy Head (mineralogy, environmental geochemistry)
Mgr. Jan Borovička (biogeochemistry)
Prof. RNDr. Pavel Bosák, DrSc. (karstology, geomorphology, sedimentology)
RNDr. Václav Cílek, CSc. (Quaternary and environmental geology)
Mgr. Petr Drahota (environmental geochemistry)
Mgr. Jaroslav Hlaváč, PhD. (Quaternary geology, malacozoology)
RNDr. Maria Hojdová (environmental geochemistry)
Ing. Petra Kubínová (biogeochemistry)
RNDr. Jan Rohovec, PhD. (analytical chemistry, ICP analyses)
Doc. Ing. Petr Skřivan, CSc. (exogenic and environmental geochemistry)
Mgr. Marek Vach, PhD. (environmental geochemistry)
RNDr. Karel Žák, CSc. (Quaternary geology, environmental geochemistry)
RNDr. Anna Žigová, CSc. (pedology, paleopedology)

Technical Staff:

Ing. Irena Dobešová (environmental monitoring)
Světlana Hubičková (technician)
Michaela Uldrychová (secretary)

Laboratory of Paleomagnetism

Scientific Staff:

Ing. Petr Pruner, DrSc. – Head (geophysics, paleomagnetism)
Mgr. Petr Schnabl – Deputy Head (geophysics)
Mgr. Martin Chadima, PhD. (geophysics, paleomagnetism)
RNDr. Jaroslav Kadlec, Dr. (environmental magnetism)
RNDr. Günter Kletetschka, PhD. (paleomagnetism, geophysics)
Mgr. Tomáš Kohout, Ph.D. (physical properties of meteorites)
prom. fyz. Otakar Man, CSc. (geophysics)
Mgr. Filip Stehlík (paleomagnetism)
Mgr. Stanislav Šlechta (geophysics)

Technical Staff:

Jana Drahotová (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 powder diffraction)
RNDr. Zuzana Korbelová – Deputy Head (microprobe and scanning microscope analyst)
Ing. Anna Langrová (microprobe and scanning microscope analyst)
Ing. Vlasta Böhmová, PhD. (microprobe and scanning microscope analyst)
Jiří Dobrovolný (X-ray powder diffraction, technician)
Jaroslava Jabůrková (technician, grinding, 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, Potsdam, Germany)
Prof. Dr hab. Ryszard Kryza (Institute of Geological Sciences, Wroclaw University, Poland)
Prof. Henri Maluski (Université Montpelier II, Montpelier, France)
Prof. Ronald Parsley (Department of Geology, Tulane University, New Orleans, USA)
Prof. Dr. Franz Pertlik (Institut für Mineralogie und Kristallografie, Universität Wien, Geozentrum, Austria)
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 the Institute:

Brožek Josef (photographer)	June 14
Podhradská Martina (librarian)	September 30
Fišerová Michaela (librarian)	September 30
Dobrovolný Jiří (technician)	December 31
Drahotová Jana (technician)	December 31
Erdinger Zdeněk (technician)	December 31
Fiala Jiří (scientist)	December 31
Grusman Zdeněk (technician)	December 31
Man Otakar (scientist)	December 31
Rudajev Vladimír (scientist)	December 31
Skřivan Petr (scientist)	December 31
Trenzeluková Božena (technician)	December 31

joined the Institute:

Kořínková Dagmar (PhD student)	January 3
Buchtová Jana (PhD student)	January 3
Coubal Miroslav (scientist)	January 4
Fišerová Michaela (librarian)	February 16
Matoušková Šárka (PhD student)	March 1
Ďurišová Jana (PhD student)	September 1
Kallistová Anna (PhD student)	September 1
Štarmanová Jana (librarian)	October 17
Bielska Sabina (librarian)	November 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 paleomagnetic 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-4S 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 MMPM 10 PULSE MAGNETISER (2006) and 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. Ladislav Slavík, CSc. & Pavel Lisý)

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 powder diffraction 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.

X-ray powder diffractometer Bruker D-8 DISCOVER (http://www.bruker-axs.com/x_ray_diffraction.html) was acquired in December 2011. It is a multipurpose diffractometer with a variable measuring radius designed to study powder samples or solid polycrystalline blocks (polished (thin)sections, rock chips etc.). Diffractometer is of the θ-2θ design and allows studying materials in both reflection and transmission geometry. Optional focusing primary asymmetric monochromator of Johansson type [Ge (111) for copper tube] produces almost spectrally pure Kα1 radiation. With unmounted monochromator the diffractometer may be operated in the classical parafocusing Bragg-Brentano arrangement with Ni-filter to remove part of continuous radiation and Kβ spectral line. Diffracted radiation is collected with a position sensitive 1D silicon strip detector LynxEye. The detector may cover, based on the diffractometer radius and chosen setup, an angle of up to 3 to 4 degrees. For data collection in reflecting geometry, the sample is placed either in a cavity of a PMMA sample holder or atop of a zero-background silicon holder. In transmission geometry, the powdered sample can be loaded either between two kapton foils or in a capillary positioned in a goniometric head. Both standard sample stage (designed for reflecting as well as transmission geometry) and a capillary stage allow spinning of the sample to minimize effects of possible preferred orientation. Next to these standard arrangements also various sections or irregular chips of polycrystalline materials can be studied in microdiffraction setup. In this particular arrangement, the primary monochromator is replaced by a polycapillary optics with a collimator (available diameters of collimators are 1.0, 0.5, 0.3 and 0.1 mm) and a sample is placed on a special motorized xyz-stage instead of standard rotation sample stage.

The diffractometer is operated via a proprietary Bruker Measurement Centre program and data can be processed in software products EVA or TOPAS. The EVA software is primarily dedicated to basic data reduction and phase identification. The latter is carried out with either Crystallography Open Database (COD) or International Center for Diffraction Data Powder Diffraction File (ICDD PDF-2) database. The TOPAS represents state of the art software for detail powder patterns analysis using profile fitting of either individual peaks or whole pattern; also implemented are codes for Rietveld structure refinement and structure solution.

Electron scanning and microprobe laboratory (Head: RNDr. Roman Skála, PhD.)

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.

Scanning electron microscope (SEM) TESCAN VEGA3XMU (http://www.tescan.com/cz/produkty/vega-sem/vega3-xm) was acquired in October 2010. SEM is of a variable pressure construction and allows observation and analysis of not only carbon-coated or gold-sputtered materials but also of uncoated specimens including biological materials. It is equipped with proprietary TESCAN detectors of secondary and back-scatted electrons as well as *energy-dispersive spectrometer Bruker QUANTAX 200* (resolution 129 eV on MnKα line at 100 kcps; Bruker Nano GmbH; http://www.bruker-axs.com/quantax_eds_for_sem.html). Also available are a low vacuum secondary electron (LVSTD) and color cathodoluminescence (detection range 350 nm – 850 nm) detectors. The source of electrons is a tungsten heated cathode. The accelerating voltage can be set between 200 V and 30 kV. Under the optimum conditions the magnification of the SEM may reach up to 1,000,000× which translates to a resolution of 3 nm. The minimum magnification is 1.5× that means that objects as large as 127 mm (at working distance of 110 mm) across can be observed at once. The width of SEM chamber doors is 280 mm. The height of the sample may reach up to 143 mm providing no sample rotation is required. The compucentric motorized sample stage allows in-plane movements along two mutually perpendicular axes in the range from -50 to +80 mm for X-axis and from -65 to +65 mm for Y-axis, complete rotation perpendicular to and shift of 100 mm along Z-axis and inclination between -20° and +80°. Microscope is operated through proprietary TESCAN software offering extensive possibilities of image manipulation. Also possible is 3D surface metrology using MeX program from Alicona Imaging GmbH.

Energy dispersive spectrometer collects the entire spectrum allowing data acquisition typically within a minute. The spot which the analytical data are collected from may be on the order of 1 μm in diameter. Elements from B to Am can be detected and quantified from the collected spectra. Quantitative analysis can be carried out either applying a standardless approach or using standards. Element contents reliably measured with the device are as low as 0.X – X wt.% depending on the element analyzed, matrix, and SEM operation conditions. The spectrometer is operated through the ESPRIT program package.

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.

Laboratory of rock processing and mineral separation (Head: RNDr. Martin Šťastný, CSc.)

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)
Muffle oven LAC LMH 11/12 (2011)
Hydraulic slab cutter 4H HYDROTRONK MONTOLIT (2011)

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

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 wavelength 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.)

ICP-EOS spectrometer Thermo Iris Intrepid XSP (2004)
HPLC system (Knauer 2010): anion analysis in aqueous samples using ion-exchanging column and conductivity detector.
Microwave digestion unit Mars (2009) – with 8 fully equipped PTFE digestion vessels.
Microwave digestion unit Milestone mls 1200 mega (2009) – with 6 fully equipped PTFE digestion vessels.
UV-VIS Spectrometer CINTRA 303
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 Mettler-Toledo (2011)
Analytical weights BALANCE 2000G (1999)

Mercury analysis laboratory (Head: RNDr. Tomáš Navrátil, PhD.)

Mercury analyser AMA 254 (2008) – mercury analysis in solid and liquid samples on CV-AAS principle.
PSA Millennium Merlin (2009) – ultra low mercury analysis in liquid samples on CV-AFS principle. Extension of this analytical procedure with a single-purpose HPLC enables mercury species separation and analysis.
DOC/TOC analyzer Shimadzu (2010): Dissolved organic carbon content, total organic carbon content, inorganic carbon in aqueous samples.

LA-ICP-MS Laboratory (Supervised by Ing. Jana Ďurišová & Mgr. Šárka Matoušková)

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 fume-hood 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 preprocessing 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.

MTS 815 – 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 confining 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 of permeable and low permeable materials under constant hydraulic incline (2006).

Piezo-ceramics sensors for monitoring P and S waves 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 ASCR	41 583
2.	From the Grant Agency of the ASCR (accepted research projects)	3 651
3.	From the Grant Agency CR (accepted research projects)	7 317
4.	From the internal research projects of the ASCR	2 041
5.	From other public sources	82
6.	Applied research	3 232
7.	Investment (instruments)	7 148
8.	Investment (constructions)	0
TOTAL INCOMES		65 054
B. EXPENSES		
1.	Scientific staff (wages, insurances)	39 240
2.	Research and scientific activities	9 939
3.	Administration and technical staff (wages, insurances)	6 179
4.	General expenses (postage shipping, maintenance of buildings, energies, transport, office supplies, miscellaneous, etc.)	2 065
5.	Library	351
6.	Editorial activities	132
7.	Investment (instruments)	7 148
8.	Investment (constructions)	0
TOTAL EXPENSES		65 054

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