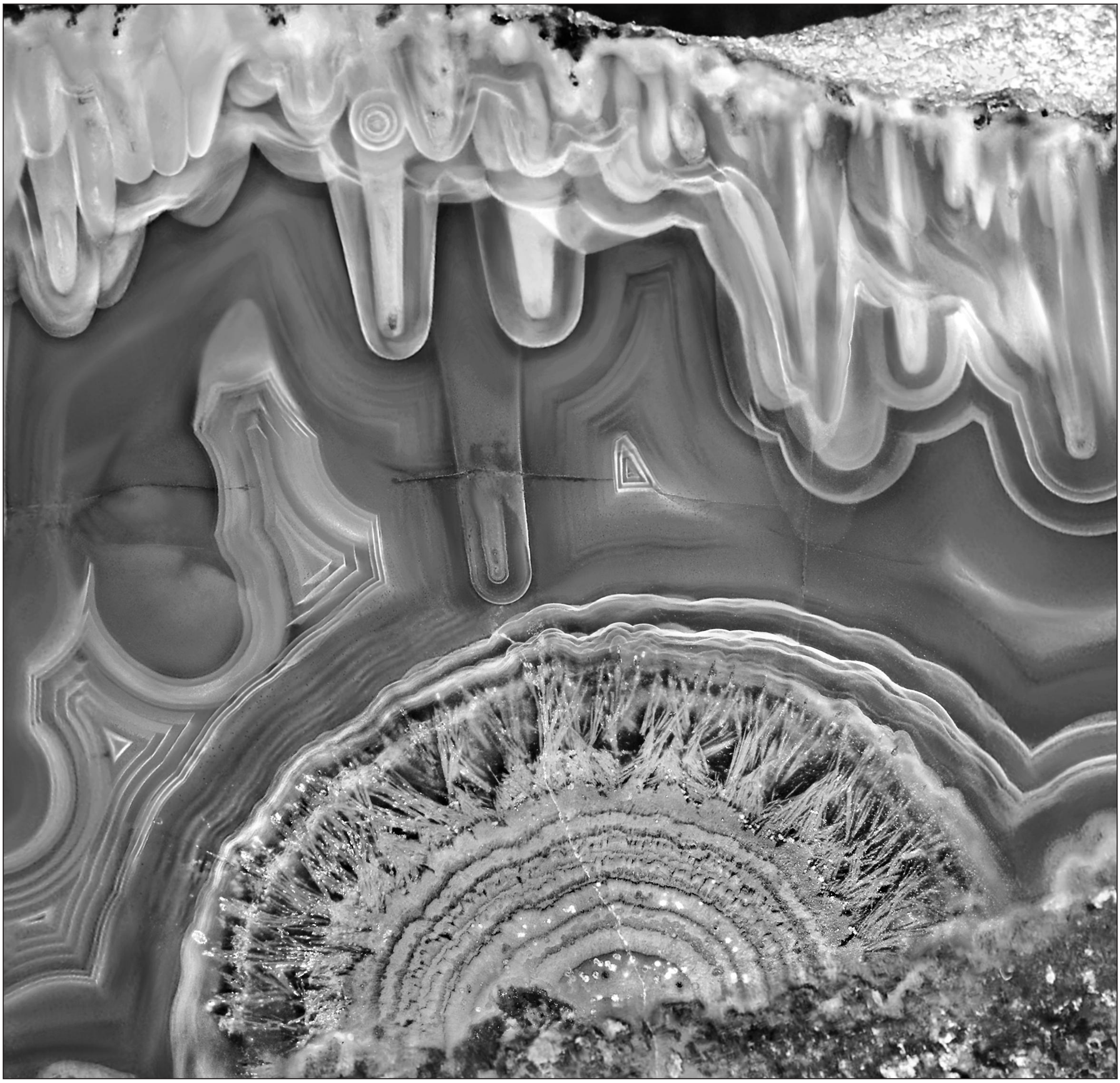
RESEARCH REPORTS

2015

Institute of Geology of the Czech Academy of Sciences, v. v. i.



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

Praha, December 2016

Cover photo: Complex and abstract is the texture of this agate from a Permian volcanic rock. The Železnice site near Jičín, Czech Republic. Photo by M. Filippi

2015

Research Reports

This report is based on contributions of the individual authors; the contents and scientific quality of the contributions lie within the responsibility of the respective author(s).

The report was compiled and finally edited by T. Svitek and P. Bosák. The English version was kindly revised by J. Adamovič.

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by the Institute of Geology
of the Czech Academy of Sciences, v. v. i.

Contents

Introduction

This year, 2015, differs from some of preceding ones. Not only by extraordinary warm and dry weather, which is expected as a consequence of the global warming due to human activities according to some persons. Nevertheless, green-house periods during Paleozoic, Mesozoic and Tertiary were substantially warmer than recent climate and without human impact, as well as some of Pleistocene interglacials. Clearly we are facing the end of interglacial period characterized in the geological past by abrupt climate changes, sudden jumps in temperatures and other events. More, the geomagnetic field has been substantially weakening in last years, indication of approaching change of polarity of Earth magnetic field? But to return to our topics: similar hot climate was also within the Institute itself. The institute personnel were very busy by the preparation of the cyclic evaluation of all institutes of the Czech Academy of Sciences according to new unified methodology prepared by the Academy management and approved by the General Assembly of the Academy. As usually, great amount of paper was used for documentation of our activities in 2010 to 2014, although most of data were available electronically, economic data even on-line. The whole evaluation passed in two periods, in the first one Institute departments had to decide on selection of extraordinary published outputs. Selected papers, mostly peer-reviewed, were reviewed again by 2 independent reviewers from over the whole world, and special commission was established for each evaluated science branch. The second period represented the evaluation of departments and Institute activities and was summarized by the visit of the Evaluation Commission at the beginning of November. Now, preliminary results are available, and it seems that the evaluation resulted highly positively, lets only to hope, that good evaluation results will be reflected in better financing on the Institute by institutional sources from Academy chapter in the state budget.

Except above mentioned exercises, the life in the Institute passed quite smoothly. I have to mention also some good results and successes. The Institute staff was highly successful in the Grant Agency of the Czech Republic (Czech Science Foundation), we obtained altogether 7 grant projects with the start in January 2016! Our personnel was also successful in obtaining different kinds of fellowships, Dr. Jiří Sláma, returning from University of Bergen, Norway, after several years, obtained prestigious Purkyně Fellowship donated by the Czech Academy of Sciences for 2016–2020, sponsored by nice financial sum not only for research. The investment money to renewal of the laser ablation equipment of our ICP-MS in amount of about 6 mio CZK are linked to this fellowship; the investment was obtained in annual tender organized by the Academy. Dr. Filip Tomek was successful in competition for Post-doctoral Fellowship also established by the Czech Academy of Sciences.

Except the Institute evaluation, we realized the cyclic evaluation of whole scientific staff for period of 2012 to 2014 important for evaluation of personnel productivity and for planning of human sources in near future. The tender for new positions was also successful, number of external young scientists attended again. Three of them will be accepted from February 2016 to strengthen the Department of Paleobiology and Paleoecology. In spite of such time-consuming activities, the publication output of the Institute personnel remained at similar level as during past years (see Chapter 5a), and lot of papers were submitted during 2015, number of them waiting for early print in 2016. The Institute was also visited by number top geoscientists, some spending their sabbatical here. International cooperation in research and development of new methods continued successfully and intensively. Popular science, especially in the frame of complex Academic project Strategy 21, has been developing explosively.

Pavel Bosák

2. General Information

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The Institute of Geology of the CAS, v. v. i., is a public research institute belonging to the Czech Academy of Sciences (CAS). 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, its activities 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 scales; 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 of the CAS, v. v. i., is a broad-scope scientific institute performing 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 the period of 1957 to 1961. During this period, several independent laboratories were constituted: Laboratory of Paleontology, Laboratory of Engineering Geology, Laboratory for 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 within the Geological Institute of the ČSAV in 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 was founded; a successor of the Institute of 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.

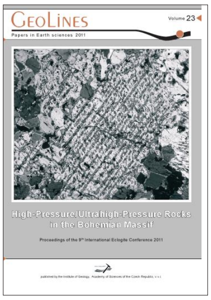
On March 1, 1979, the Geological Institute was united with the Mining Institute of the ČSAV under the Institute of Geology and Geotechnics of the ČSAV, and finally split from the latter on March 1, 1990 again.

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

The economic and scientific concept of the Institute of Geology of the CAS, v. v. i., and the evaluation of its results lie within the responsibility of the Executive Board and Supervisory Board which include both internal and external members. Plans of the Institutional Financing are evaluated by the special Committee at the CAS. 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 CAS, 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 the 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.

No volume of GeoLines was published in the year 2015.

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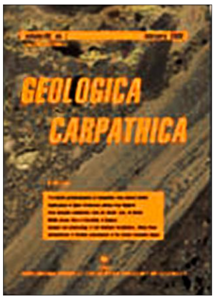

Since 2000, the Institute of Geology of the CAS, v. v. i., has been a co-producer of the international journal Geologica Carpathica (www.geologicacarpathica.sk), registered by Thomson Reuters WoS database. The Institute is represented by one journal co-editor (usually Institute Director) and several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

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 2015, six issues (1 to 6) of Volume 66 were published with 35 scientific papers and short communications. Impact factor for 2015 is 1.523. For the full version see www.geologicacarpathica.sk.

Address of the editorial office: Earth Science Institute, Slovak Academy of Sciences, Dúbravská cesta 9, P. O. BOX 106, 840 05 Bratislava 45, Slovak Republic, Phone: +421 2 3229 3209, Fax: +421 2 5477 7097, www.geol.sav.sk
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Since 2014, the Institute of Geology of the CAS, v. v. i., has become a co-publisher of the international journal **Bulletin of Geosciences** (http://www.geology.cz/bulletin/scope; bulletin@geology.cz), registered by the Thomson Reuters WoS database. The Institute is represented by several journal co-editors.

The Bulletin of Geosciences is an international journal publishing original research papers, review articles, and short contributions concerning paleoenvironmental geology, including paleontology, stratigraphy, sedimentology, paleogeography, paleoecology, paleoclimatology, geochemistry, mineralogy, geophysics, and related fields. All papers are subject to international peer review, and acceptance is based on quality alone.

Its impact factor for 2014 is 1.515.

The Editorial Board of the Bulletin of Geosciences has decided to reaffirm the status of the Bulletin as an open access journal. The Bulletin of Geosciences is published as a non-profit making journal and the vast majority of people (including members of the editorial board) receive no payment for their work. The budget covers costs for type-setting and printing. Online ISSN 1802-8555 / Print ISSN 1214-1119.

In 2015, four issues (1 to 4) of Volume 90 were published with 40 scientific papers and short communications. For the full version see http://www.geology.cz/bulletin.

Address of the editorial office: Bulletin of Geosciences, Czech Geological Survey, Klárov 3/131, 11821 Praha 1, Czech Republic
Co-publishers: West Bohemia Museum in Plzeň, Palacký University Olomouc and Institute of Geology of the CAS, Praha, v. v. i.

3b. Monographs, proceedings, etc.

BAJER A., LOŽEK V., LISÁ L. & CÍLEK V.: *Krajina a geodiverzita; neživá příroda jako základ krajinných a kulturních hodnot.* Mendelova univerzita v Brně, 2015. 159 s ISBN 978-80-7509-279-3 a ISBN 978-80-87443-11-8.

CÍLEK V., MUDRA P., SŮVOVÁ Z., ŽÁK K., ŠIMEK R., ROHOVEC J., MIKULÁŠ R. & LOŽEK V.: *Střední Brdy, hory uprostřed Čech.* Středočeský kraj – Geologický ústav AV ČR – AOPK ČR. 182 s. ISBN 978-80-7363-720-0.

4. Research Reports

4a. Foreign Grants, Joint Projects and International Programs

Finished projects

Bilateral co-operation between Czech Geological Survey, Praha and Geologisches Bundesanstalt Wien, Austria: **Palynology of Gosau Group sediments on maps 95 St. Wolfgang and 97 Bad Mitterndorf** (H. Lobitzer, Geologisches Bundesanstalt, Wien, Austria, L. Švábenická, Czech Geological Survey, Praha, Czech Republic & *M. Svobodová*; 2015)

Biostratigraphically important angiosperm pollen of the Normapolles group – *Oculopollis* spp., *Plicapollis, Trudopol-*

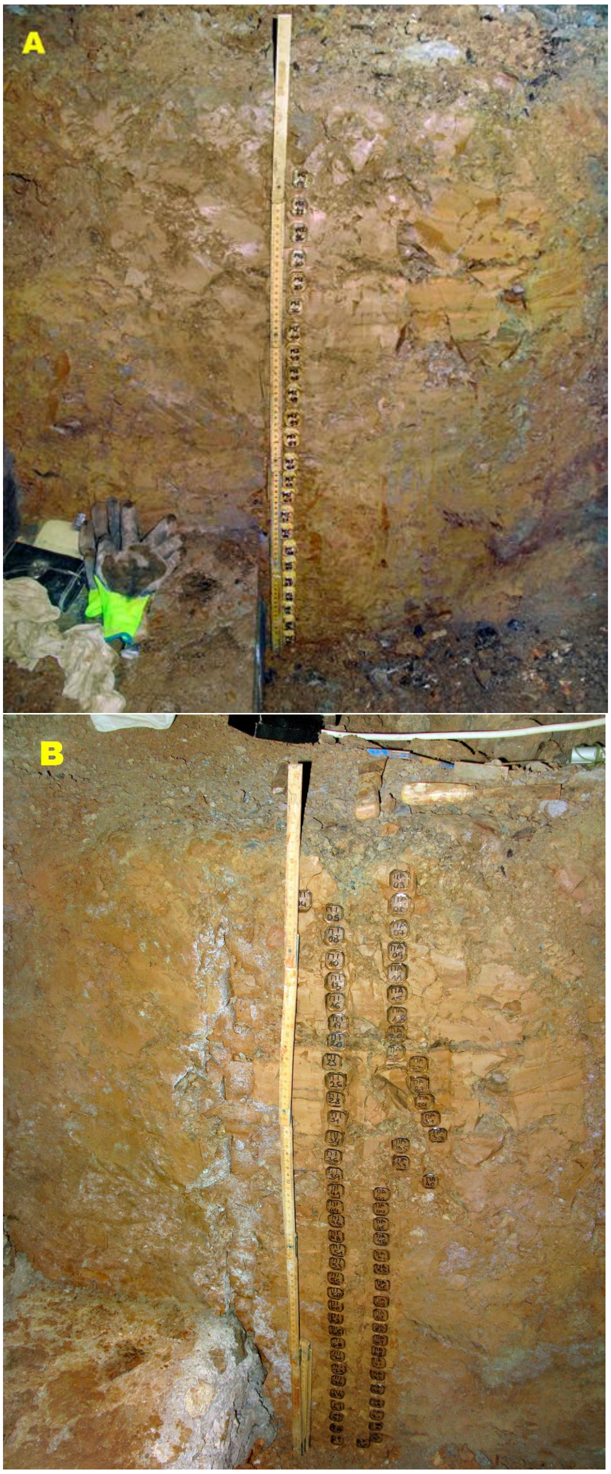
lis as well as calcareous nannofossil *Lithastrinus grillii*, Zone UC11 – Zone UC12 evidenced the Coniacian-Lower Santonian age of grey marlstones at the exposures of Ausseer Weissenbachalm near Bad Aussee, Upper Gosau Formation, Northern Calcareous Alps. Prevailing foraminiferal linings, broken and rare dinoflagellate cysts and acritarchs reflected shallow-marine depositional conditions. The Campanian age of the exposure Hornspitz documented angiosperm pollen of *Papilopollis clarescendus, Suemegipollis triangularis* and calcareous nannofosil *Uniplanarius sissinghii*, Zone 14 c-d.

Rakow Grant Award 2015 from The Corning Museum of Glass (USA): **The chemical research of glass objects from Salma's Palace in Prague** (*Š. Jonášová*; 2015)

The work was focused on the archaeometric survey of elegant and ordinary glass materials from the archeological research of Salm's Palace in Prague. These glasses were found in a cesspit. The glass finds are well documented, however less is known about their chemical composition and the production technology. The aim of the project was to determine chemical composition of these glasses and help to understand the details of their manufacturing. The chemical analysis of glass samples mostly proved a composition of potassium-calcium glass and therefore points to domestic origin. Only small part of analyzed glass samples was made from sodium-calcium glass.

Grant Agency of Ministry of Education of the Slovak Republic and Slovak Academy of Sciences Project No. VEGA 1/0032/12: **Hypogene caves in Slovakia: speleogenesis and morphogenic types. Case Study: Malužinská Cave** (project principal researcher: P. Bella, State Nature Conservation – Slovak Caves Administration, Liptovský Mikuláš and Catholic University in Ružomberok, Slovakia; *P. Bosák* & *P. Pruner*; internal code 7448; supported by RVO67985831; 2012–2014)

The Malužinská Cave is located on the right side of the Bocianka Valley (Nízke Tatry Mts., northern Slovakia). By its nature and position, it represents one of the most important caves in the area. It is developed in Middle Triassic Gutenstein limestones, dolomites and breccias of the Choč Nappe. It was expected, that the cave was formed by dissolution by seeping meteoric rain- and melt-waters or by underground waters from sinking allochthonous Bocianka Stream. The origin of primary solution halls and passages with numerous blind chimneys, ceiling pockets and cupola-shaped cavities was controlled by steep faults of NW–SE, NE–SW, N–S and E–W directions. In some cave segments, original phreatic morphologies were remodelled by breakdowns along intensively faulted bedrock, mainly along intersections of faults with different directions and inclinations. In addition to breakdown products, only fine-grained allothonous sediments (yellowish-brown clay) occur in the cave. Allochthonous gravels and sands are completely absent here, in spite of aggraded fluvial fill in nearby surface Bocianka riverbed. The resurgence of gently warmed waters is located at the Malužiná Village just below the cave. The original solution morphologies in the cave serve as clear indicator of phreatic speleogenesis by (slightly heated) waters ascending along faults, which is also supported by the absence of coarser-grained allochthonous fill. The termination of speleogenesis can be dated to Middle Pleistocene from the relative altitude of cave floor at 35–38 m above the recent valley bottom and by the normal polarity of fine-grained sediments (Brunhes chron, younger than 0.78 Ma) deposited during phreatic/epiphreatic phase of speleogenesis (Bella et al. 2015). Mean values of paleomagnetic directions from samples taken in 2014 (Fig. 1A) show higher mean



■ **Fig. 1.** Paleomagnetic sampling in the Malužiná Cave, Slovakia. A – in 2014, B – in 2015. Photos by P. Bella.

declination value and anomalous declination value (over 90°), which can result from primary orientation of elongated clastic grains, irregularities on the depositional plane, secular variation and/or stress. To solve this problem, another two profiles were sampled in 2015 (Fig. 1B).

BELLA P., LITTVA J., PRUNER P., GAÁL Ľ., HAVIAROVA D. & BOSÁK P. (2015): Malužinská jaskyňa v severovýchodnej časti Nízkych Tatier: freatická speleogenéza spôsobená vodami vystupujúcimi pozdĺž zlomovej zóny [The Malužinská Cave in the north-eastern part of the Nízke Tatry Mts.: phreatic speleogenesis by waters ascending along the fault zone]. – *Slovenský kras (Acta Carsologica Slovaca)*, 52 (2014), 2: 111–126.

Program Mobility supported by the Ministry of Education, Youth and Sports, Project Code: 7AMB 12AR024: **Reconstruction of uplifting history in the Fuegian Andes central belt (southern Tierra del Fuego, Argentina** (*M. Svojtka*, *D. Kořínková*; D. Nývlt, Czech Geological Survey, Praha; E. B. Olivero & P. J. T. Carbonell, El Centro Austral de Investigaciones Científicas (CADIC – CONICET), Ushuaia, Argentina; 2014–2015)

The Mobility Program supports activities of international cooperation in research and development to promote the mobility of researchers. The aim of the proposed project is dating of the main tectonometamorphic phases and also reconstruction of low-temperature evolution of the eastern part of the Cordillera Darwin on Argentine territory of Tierra del Fuego. During our joint Czech–Argentinian October 2015 fieldwork stay in Argentina, we focused on traditional geological and petrological field research of Upper Oligocene to Miocene samples (Fig. 2**)** in the Fuegian Andes. We collected 10 samples of fine- to medium-grained sandstones in the above mentioned stratigraphic sequence. These samples will be prepared in order to define provenance ages and low-temperature evolution of the Austral (or Magallanes) Basin using fission-track analyses. In 2015, we dated fine-grained sandstone sample from the Cabo Campo del Medio area (Eocene Punta Torcida Formation) using laser ablation ICP-MS technique. U-Pb measurements of 22 zircons yield range of concordant ages between 45 Ma and 47 Ma with a resulting calculated concordia age of ca. 46.3 ± 0.1 Ma (1 sigma error).

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, I. Hradská, West Bohemian Museum Plzeň; J. Prokop, Charles University, Praha; J. Pšenička, West Bohemian Museum, Plzeň; I. Sýkorová, Institute of Rock Structure and Mechanics, Czech Academy of Sciences, Praha; Z. Šimůnek, Czech Geological Survey, Praha; S. Štamberg, Museum of Eastern Bohemia, Hradec Králové & *J. Zajíc*; 2010–2015)

■ **Fig. 2.** Collecting of marine episodic sandstone sequence (Cabo Domingo Group – Middle Miocene) from the cliffs situated on the Atlantic coast of the Tierra del Fuego (Argentina), the uppermost records of the Austral or Magallanes foreland basin. Photo by M. Svojtka.

A regular duration of the project was planned for 2010–2014. The prolongation up to 2015 served mainly for the preparation of a formal and/or informal subsequent project, for ending of some field works (borehole examination and sampling in Amasra coalfield, Turkey) and for the preparation of a collective output of the finishing project. The upcoming project concerning the global marine-nonmarine correlation during the Late Carboniferous–Permial–Early Triassic interval was discussed on the International Congress on the Carboniferous and Permian in Kazan, August 2015.

A concrete example of such cooperation and preparation of a final common publication was proposed by Schneider & Lucas (2015). Manuscript of a common publication summarising the results achieved by the whole international IGCP 575 team will be finished by the end of 2016.

SCHNEIDER J.W. & LUCAS S.G. (2015): Late Carboniferous-Permian-Early Triassic Nonmarine-Marine Correlation: Call for global cooperation. – *Permophiles*, 61: 28.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 587: **Identity, Facies and Time: The Ediacaran (Vendian) Puzzle** (International leader: P. Vickers-Rich (Australia); Czech group representative and organizer: *R. Mikuláš*; other Czech workers: *M. Vavrdová* & O. Fatka, Faculty of Science, Charles University, Prague; 2010–2015).

The mysterious Ediacaran biota (i.e. the oldest macroscopic, multicellular biota, discovered chiefly in shallow marine platform sediments of most paleocontinents) has several times attracted the Czech national paleontological community, regardless no convincing finds of "Vendobionta" have so far been found in the Czech Republic. The reasons of this interest are twin:

1. the presumption that certain portion of the Neoproterozoic sediments of the Teplá-Barrandian Unit of the Bohemian Massif are shallow marine, fine-grained and negligibly metamorphosed; thereby, they could provide finds of "classical" Ediacaran taxa. The expectations have been increased by recent radiometric dating of the respective strata, putting the age of siltstones, fine-grained greywackes and clayey shales close to the Ediacaran-Cambrian boundary.
2. the theory that Ediacaran organisms did not extinct during the Cambrian Explosion and some of them might survive to the Lower Palaeozoic time in suitable settings. If the theory is valid, then it is advisable to search for Ediacaran-type type taphonomic windows for non-shelly biota. It means, among others, that the surviving Ediacaran forms could preserve in settings with minimum bioturbation and little fungal/bacterial activity. One of the possibilities is pure quartz sands that slowly accumulated in partly protected, most probably lagoonal settings. Such taphonomic windows could be repeatedly opened in Ordovician of the Barrandian area

Results: In the Neoproterozoic of the Barrandian area, several localities were studied in detail to assess the sedimentary settings and possible biotic features or fossils. No macroscopic fauna was fond, but three of the sites (Kocába River at Stará Huť, Pustověty, Praha-Zbraslav, Fig. 3) yielded structures that can be interpreted as microbial mats. There do not represent

■ **Fig. 3.** Possible microbialite – a knobby surface on the upper bedding plane of the Ediacaran shale, quarry at Praha-Zbraslav. Photo by M. Souček.

the evidence of shallow marine settings, potentially inhabited by multicellular organisms; even in the Neoproterozoic, heterotrophic (e.g., fungal) MISS (microbially induced sedimentary structures) are presumed to exist.

Introduction to the topic and popular science information was given by Mikuláš (2015a, b) and Vavrdová (2015), aimed to attract non-specialists and fellow workers to search for the MISS phenomena and potentially also macrofossils. Possible MISS described from the Ediacaran of the Barrandian area were subsequently described in a specialized, peer-reviewed journal (Vavrdová 2016).

The team focused on possible Ediacaran-type taphonomic windows in the Cambrian of the Skryje area. The studied sequences contain undoubted microbially induced sedimentary structures but the previous reports on non-shelly fauna comparable to *Cyclomedusa* were not confirmed; instead, the proposed *Medusites* radiates was re-interpreted as a trace fossil (Mikuláš & Fatka, in press).

The probable Ediacaran biota was recorded in the Late Ordovician of the Barrandian area. Because the collected material is still increasing and diversifying, its publication is to be postponed after the finish of the fieldwork.

To summarize, the Ediacara-related material from the Bohemian Massif has not substantially contribute to the general knowledge of the topic, but the IGCP 587 Project was a welcome motivation to refresh and increase the regional knowledge; further contributions are to expected during the several next years.

MIKULÁŠ R. (2015a): Nejstarší doklad existence svalové tkáně? Nové zkameněliny z konce starohor. – *Vesmír*, 94, 1: 31–34.
MIKULÁŠ R. (2015b): Stromatolity. Edice Věda kolem nás No 35, Academia, Praha: 1-20.
MIKULÁŠ R. & FATKA O. (in press): Ichnogenus *Astropolichnus* in the middle Cambrian of the Barrandian area, Czech Republic. *Ichnos*.
VAVRDOVÁ M. (2015): Existovala v Čechách ediakarské fauna? – *Vesmír*, 94, 1: 26–30.
VAVRDOVÁ M. (2016): Ediakarské mikrobiality z okolí Nového Knína (tepelsko-barrandienská oblast) / Ediacaran microbialites from the Town of Nový Knín surroundings (Teplá-Barrandian Unit). *Gescience Research Reports*, 49: 37-41.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 591: **Early to Middle Paleozoic Revolution** (International leader: B.D. Cramer, USA, international co-leaders: T.R.A. Vanderbroucke, France, Renbin Zhan, China, M.J. Melchin, Canada, Z. Zigaite, Lithuania, K. Histon, Italy, G.L. Albanesi, Argentina & M. Calner, Sweden; Czech participants: *L. Slavík*, *P. Štorch*, J. Frýda, Š. Manda, Czech Geological Survey, Praha; 2011–2015)

Research on faunal dynamics, biostratigraphy and taxonomy of the early–middle Llandovery, late Wenlock and early Ludlow graptolites of the Prague Synform continued (Štorch 2015, Štorch et al. in press) being supplemented by minor study on late Llandovery cyrtograptids of Shaanxi Province, China (Wang et al. 2015). A monograph of the late Rhuddanian and early Aeronian graptolites from Všeradice comprising 45 taxa represents a primary reference in current studies on Rhuddanian-Aeronian boundary sections in the Prague Basin and elsewhere. Late Homerian and Wenlock–Ludlow boundary graptolites from Kosov and Nesvačily sections shed light on so far unknown nature and details of the late Homerian–Early Gorstian graptolite rediversification and adaptive radiation following the mass extinction (late Homerian *lundgreni* or Mulde Event). Apart from a number of graptolite taxa previously known from low-palaeolatitudinal regions (Baltic area, Arctic Canada), lowest occurrences of many biostratigraphically important species refined biozonation and located precisely the Wenlock–Ludlow boundary in the Czech Silurian sedimentary succession.

Revision of late Katian and earliest Hirnantian graptolites of the Králův Dvůr Formation (Kraft et al. 2015) enabled so far the most precise biostratigraphic correlation of peri-Gondwanan terranes with Baltica (Bornholm, southern Sweden) and contributed to current research on Late Ordovician graptolite palaeobiogeography and faunal dynamics conducted in collaboration with international research team (Sheets, H.D., Mitchell, C.E., Melchin, M.J., Loxton, J., Carlucci, K.L., Hawkins, A.D.).

In the Kosov quarry, limestone beds and calcareous concretions were sampled for conodonts. Total of 7 samples were taken from two parallel sections at the 5th level of the quarry (K1 and K2 sections). The sampled interval covered *lundgreni*, *parvus* and *ludensis* Biozones. All the samples of average weight of 4–5 kg have been already processed (maceration in carboxylic acids) and the extremely voluminous residues have been then concentrated in heavy liquids. Several samples have already provided conodonts. The obtained conodont fauna is promising for age determination and includes index taxa of the *Ozarkodina bohemica* group.

KRAFT P., ŠTORCH P. & MITCHELL C.E. (2015): Graptolites of the late Katian Králův Dvůr Formation (Ordovician, Prague Basin, Czech Republic). – *Bulletin of Geosciences*, 90, 1: 195–225.
ŠTORCH P. (2015). Graptolites from Rhuddanian-Aeronian boundary interval (Silurian) in the Prague Synform, Czech Republic. – *Bulletin of Geosciences*, 90, 4: 841–891.
ŠTORCH P., MANDA Š., SLAVÍK L. & TASÁRYOVÁ Z. (in press). Wenlock-Ludlow boundary interval revisited: New insights from the off-shore facies of the Prague Synform, Czech Republic. – *Canadian Journal of Earth Sciences*
WANG JIAN, ŠTORCH P., WANG XIN & ZHANG YU (2015). A new graptolite species of *Cyrtograptus* from the uppermost Llandovery of Ziyang, Shaanxi Province, China. – *Palaeoworld* 24, 1–2: 215–220.

International Geoscience Programme (IGCP) of UNESCO & IUGS, Project Code IGCP No. 596: **Climate change and biodiversity patterns in the Mid-Palaeozoic** (International leader: P. Koenigshof, Germany, international co-leaders: T. Suttner, I.A. Boncheva, N.G. Izokh, T.H. Phuong, T. Charoentitirat, J. Waters, W. Kiessling & E. Kido M.T.; Czech group representatives *J. Hladil*, *A. Hušková*, *L. Chadimová*, *L. Slavík*; P. Budil, L. Ferrová, S. Vodrážková, Czech Geological Survey, Praha; 2011–2015).

By the end of 2015 the five-year IGCP 596 came to its end. In the last year of the project, the members of the Institute of Geology took part in various activities:

■ **Fig. 4.** Fieldwork in the South Tien-Shan Mts., Uzbekistan. View point from the Zinzilban Gorge where the present Basal Emsian GSSP is located. Photo by L. Slavík.

1. In August 2015, Ladislav Slavík and Aneta Hušková took part in fieldwork under the auspices of the International Subcommission on Devonian Stratigraphy in Tien-Shan Mountains in Uzbekistan. The main task of the small international team of specialists was resampling of the geological section in Zinzilban Gorge (Fig. 4) for obtaining new data for future redefinition of the international stratotype (GSSP) of the basal Emsian boundary. Around 150 kg samples for biostratigraphy were taken and shipped to Europe and Siberia. The samples are now being processed in three laboratories (University of Valencia, RAS Novosibirsk and Institute of Geology of the CAS).
2. In September, part of the results related to the IGCP 596 was presented at the final meeting of the programme joined with the annual business meeting of the International Subcommission on Devonian Stratigraphy (SDS/IUGS) that took place in Brussels (Da Silva et al. 2015; Hušková et al. 2015; Slavík et al. 2015). Two Czech members took part in the Post-meeting field excursion "Devonian–Tournaisian succession of the Eifel area, the northern and southeastern Rhenish Massif".
3. There are several chapters published by members of the Czech working group in a large, comprehensive book "Planet Earth – In Deep Time" that was accepted for publication (Suttner et al., eds). 114 specialists from more than 30 countries introduce the most instructive outcrops locations of mid-Paleozoic strata occurrence worldwide. The locations were studied as part of the UNESCO/IUGS project to identify climate change and biodiversity patterns in the mid-Palaeozoic (Devonian and Carboniferous).
4. Biostratigraphic analyses of the Mongolian samples taken during the field work in the Baruunhuurai terrane (Western Mongolia) in Sumer 2014 have been accomplished. Several samples from the Devonian and Carboniferous sections contain good conodont fauna for age determinations and various macrofauna.

DA SILVA A.C., CHADIMOVÁ L., HLADIL J., SLAVÍK L., HILGEN F.J. & DEKKERS M.J. (2015): Unravelling orbital climatic cycles from Devonian magnetic susceptibility signal – The quest for a better age model for the Lochkovian and Pragian stages (Czech Republic). – In: MOTTEQUIN B., DENAYER J., KÖNIGSHOF P., PRESTIANNI C. & OLIVE S. (Eds.): IGCP 596 – SDS Symposium Climate Change and Biodiversity Patterns in the Mid-Palaeozoic, Abstracts; *Strata, Travaux de Geologie sedimentaire et Paleontologie, Serie 1 – communications,* 16, 1: 39. Gaillac-Toulouse.

HUŠKOVÁ A., SUTTNER T.J., SLAVÍK L., VALENZUELA-RÍOS J.I., LIAO J.-C., GATOVSKY Y.A., ARIUNCHIMEG Ya., KIDO E., GONCHIGDORJ S., WATERS J.A., CARMICHAEL S.K. & BATCHELOR C. (2015): Late Devonian conodonts of western Mongolia: preliminary results. – In: MOTTEQUIN B., DENAYER J., KÖNIGSHOF P., PRES-

TIANNI C. & OLIVE S. (Eds.): IGCP596 - SDS Symposium Climate Change and Biodiversity Patterns in the Mid-Palaeozoic, Abstracts; *Strata, Travaux de Geologie sedimentaire et Paleontologie, Serie 1 – communications*, 16, 1: 75. Gaillac-Toulouse.

SLAVÍK L., HLADIL J., CHADIMOVÁ L., VALENZUELA-RÍOS J.I., HUŠKOVÁ A. & LIAO J.C. (2015): Cooling or warming in the Pragian? The sedimentary records and petrophysical logs from the key peri-Gondwanan sections. – In: MOTTEQUIN B., DENAYER J., KÖNIGSHOF P., PRESTIANNI C. & OLIVE S. (Eds.): IGCP 596 - SDS Symposium Climate Change and Biodiversity Patterns in the Mid-Palaeozoic, Abstracts; *Strata, Travaux de Geologie sedimentaire et Paleontologie, Serie 1 - communications*, 16, 1: 130–131. Gaillac-Toulouse.

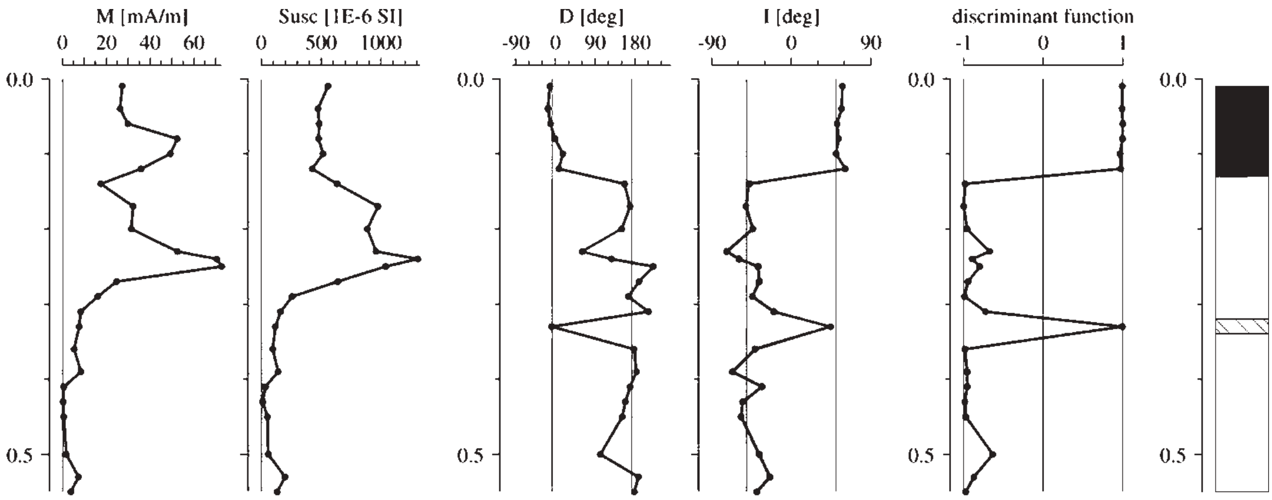
SUTTNER T.J., KIDO E., KÖNIGSHOF P., WATERS J.A., DAVIS L. & MESSNER F. (Eds., 2016): *Planet Earth - In Deep Time. Palaeozoic Series: Devonian & Carboniferous*. Schweizerbart Science Publishers, 264 pp. Stuttgart.

Slovak Research and Development Agency Project No. APVV-0625: **New synthesis of relief evolution of the Western Carpathians. Case Study: Ochtinská Aragonite Cave** (sub-project responsible researcher: P. Bella, State Nature Conservation – Slovak Caves Administration, Liptovský Mikuláš and Catholic University in Ružomberok, Slovakia; *P. Bosák* & *P. Pruner*; internal code 7448; supported by RVO67985831; 2012–2015)

The well-known Ochtinská Aragonite Cave (Revúcka Highlands, southern Slovakia) is characterized by remarkable geological, morphological, genetic and mineralogical features (see summaries in Bella 2004 and Bosák et al. 2002). Its complicated multi-phased genesis is still the object of ongoing researches. Revision high-resolution paleomagnetic sampling of the sedimentary profile in the Oválna Passage followed original pilot sampling from 1999. In September 2013, 40 paleomagnetic samples covered 60 cm thick profile. Following the study of Bosák et al. (2002), the paleomagnetic Bunhes/Matuyama boundary (0.78 Ma) was more precisely determined at 13 cm below the top of the profile. Newly, the short normal polarized magnetic zone at 33 cm below the profile top was interpreted as the Jaramillo event (0.99 to 1.07 Ma; Fig. 5). The depositional rate between the Brunhes/Matuyama boundary and the upper boundary of the Jaramillo magnetic zone is about 0.09 cm.ka^{-1} (19 cm long section deposited during 210 ka). The very slowly depositional rate resulted from slow water flow with only occasionally turbid water loaded only in extremely fine-grained material (clays; i. e. highly sieved material). If the depositional rate has been similar also in the lower section of the studied profile under the Jaramillo magnetic zone (28 cm long section deposited during 310 ka), the sedimentation on the bottom bedrock began ca 1.3–1.4 Ma ago. The prevailing NE–SW direction of the magnetic lineation from the anisotropy of magnetic susceptibility measurements indicates uniform direction of water flow during the accumulation of sediments, i. e. from the Hlboký Dome through Oválna Passage to Sieň mliečnej cesty Hall. As the flowstone cover is 177 ka old (Bosák et al. 2002), the underlying sediments were eroded in the period from ca >780 to ca 177 ka, probably as a result of upwelling oscillations of underground water table from the lowest cave part, still flooded. The corrosion of the principle flat ceiling between the Oválna Passage and Hlboký Dome that cut an older ceiling hollow with aragonite and calcite fills is related to the striking upraised oscillation and long-lasting stagnation of water table. Based on U-series dating of calcite and aragonite in the hollow (Bosák et al. 2002), this oscillation can be dated between 405 and 177 ka. The new results of paleomagnetic research contributed to the geochronological reconstruction of epiphreatic developmental phases of the Ochtinská Aragonite Cave (Bella et al. 2015).

BELLA P. (2004): Geomorfologické pomery Ochtinskej aragonitovej jaskyne. – *Slovenský kras*, 42: 57–88.

BELLA P., PRUNER P. & BOSÁK P. (2015): New results of paleomagnetic research in the Ochtinská Aragonite Cave, Slovakia and their speleogenetic interpretation. – *Aragonit*, 20, 1: 56.



■ **Fig. 5.** Principal magnetic and magnetostratigraphy parameters, profile in the Oválna Passage, Ochtinská Aragonite Cave, Slovakia (original). M – natural remanent magnetization; Sucs – magnetic susceptibility; D – declination; I – inclination; black – normal polarization; white – reverse polarization.

BOSÁK P., BELLA P., CÍLEK V., FORD D.C., HERCMAN H., KADLEC J., OSBORNE A. & PRUNER P. (2002): Ochtiná Aragonite Cave (Western Carpathians, Slovakia): Morphology, Mineralogy of the Fill and Genesis. – *Geologica Carpathica*, 53, 6: 399–410.

Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project Code: M100131201: **Hi-res correlation and dating of Mid-Paleozoic sedimentary sequences of Peri-Gondwana using integrated biostratigraphy and chemo-physical methods** (*L. Slavík*, *L. Chadimová*, *A. Hušková*; J.I. Valenzuela-Ríos, J.-Ch. Liao & H. Sanchíz-Calvo, University of Valéncia, Spain; 2012–2015).

The Prague Synform (Barrandian area, Czech Republic) and the Spanish Central Pyrenees are two key areas of European peri-Gondwana. Both areas show an excellent correlation by means of conodont biostratigraphy during Lochkovian and early Pragian times. Detailed correlation, based on conodont sequences, between middle and upper Lochkovian carbonate successions was attained for the first time and resulted in considerable refinement of the biostratigraphic scale at this stratigraphic level (Valenzuela-Ríos 2015). This correlation facilitates the definition of tie points for further multidisciplinary studies that seek to establish high-resolution temporal subdivision and global correlation. Some intervals have a precision of less than 0.5 Ma, which is significantly greater than in previous studies. The estimated elapsed time considered herein is about 3.2 Ma and is subdivided into five major zones of global scope: transitanstrigonicus, trigonicus-kutscheri, kutscheri-pandora b, pandora b-gilberti and gilberti-steinachensis b. By providing tie points and globally applicable criteria, this research contributes to the international cooperative effort to subdivide the Devonian standard stages into globally recognised substages.

The original aim of the finished Czech-Spanish project "Hi-Res correlation and dating of mid-Palaeozoic sedimentary sequences of Peri-Gondwana using integrated biostratigraphy and chemo-physical methods" was to apply auxiliary correlation tools in intervals where the density of biostratigraphic time-marks is low. The correlation was then based on application of several methods in the sections: the detailed biostratigraphical framework is supplemented by multiple chemo-physical measurements (i.e. gamma-ray spectrometry and magnetic susceptibility) in order to avoid discrepancies in correlation of the peri-gondwanan successions. In many regions, the complex petrophysical characteristics of the biostratigraphically well constrained Early Devonian strata are urgently needed in order to provide the most complete image of the impacts of possible global environmental changes. The principal environmental instabilities in the Early Devonian are well expressed, especially by the obvious differences between the classical megasequences that represent traditional hercynian (Bohemian) stages (Lochkovian, Pragian, Zlichovian, and Dalejan). These stages are

■ **Fig. 6.** The Castells I section in the Spanish Central Pyrenees. Photo by L. Slavík.

characterized by typical marine successions/formations whose boundaries are independent of the official global Devonian subdivision. These may reflect the global or, at least, supra-regional trends in environmental dynamics and can very distinctively be recognized as turnovers in the marine faunal communities, described from many parts of the world.

The interpretation of petrophysical data from two key perigondwanan regions lead us to the following conclusions (Slavík et al. 2016): (1) the progressive condensation and shallowing-up tendency observed in the end-Lochkovian limestones, both in the Spanish Central Pyrenees and Barrandian area, indicate a major palaeoenvironmental phenomenon that may be connected with enormous seal level fall and rapid cooling of the sea water masses. (2) The Pragian time is characterized by relatively well oxygenated sediments, where dysoxic conditions in the water column and stratification of oceanic waters were strongly suppressed. Possible frequent mixing of sea water in conditions of relatively depressed sea level resulted in formation of equivalents of oceanic red beds. An increased content of chemically weathered components in the Pragian carbonates indicate still hot but relatively humid climate conditions, governing the mid-latitude landmasses adjacent to peri-Gondwanan seas. (3) With no evidence of polar ice sheets or alpine glaciers in Iapetus-collision mountain ridges, the Pragian must be characterized a very "hot" period, even though it was possibly cooler compared to the Lochkovian. (4) The sedimentation of the middle to upper Pragian rocks is characterized by alternation of very contrastings rocks with an increased delivery of siliciclastics and extremely elevated and highly fluctuating GRS–MS patterns. This reflects a period of great climatic instability that could have been possible in conditions of sufficiently hot and humid climate. (5) The subsequent stabilization of the climatic system and partial cooling can be seen in the upper Pragian to lower Emsian where amounts of non-carbonate impurities decrease considerably.

SLAVÍK L., VALENZUELA-RÍOS J.I., HLADIL J., CHADIMOVÁ L., LIAO J.-C., HUŠKOVÁ A., CALVO H. & HRSTKA T. (2016): Warming or cooling in the Pragian? Sedimentary record and petrophysical logs across the Lochkovian-Pragian boundary in the Spanish Central Pyrenees. – *Palaeogeography, Palaeoclimatology, Palaeoecology,* 449: 300–320.

VALENZUELA-RÍOS J.I., SLAVÍK L., LIAO J-C., CALVO H., HUŠKOVÁ A. & CHADIMOVÁ L. (2015): The middle and upper Lochkovian (Lower Devonian) conodont successions in key peri-Gondwana localities (Spanish Central Pyrenees and Prague Synform) and their relevance for global correlations. – *Terra Nova*, 27: 409–415.

Grant-in-aid internal program of international cooperation projects Academy of Sciences of the Czech Republic, Project Code: M100131203: **Origin and characterization of mantle and crustal rocks: answer for deformation, thermal and geochemical evolution of orogenic zones** (*M. Svojtka*, *J. Sláma*, *L. Ackerman*; T. Hirajima, D. Naemura, K. Yoshida & T. Kobayashi, Kyoto University, Japan; 2012–2015)

During the last year of the project, we presented results (Naemura et al. 2015) focused on petrological study of garnet peridotites from an orogenic garnet peridotite body enclosed in high pressure garnet kyanite bearing quartzo feldspathic Gföhl granulite in the Bohemian Massif (Moldanubian Zone, south Bohemia). The garnet peridotite contains ubiquitous phlogopite and was interpreted to be derived from the mantle wedge formed at the convergent plate margin. The earliest generation of chromian spinel, surrounded by kelyphitized garnet, ubiquitously contains multiphase solid inclusions (MSIs), which are mainly composed of phlogopite, dolomite, calcite, apatite, graphite, monazite, thorianite, and sulfides, and priderite and burbankite are newly identified as rare accessory minerals in MSIs. Most of these MSIs contained significant amounts of carbonates. The presence of peculiar accessory minerals in MSIs characterizes the nature of parental melts. The formation of priderite requires an ultrapotassic condition, which is usually defined by K_2O >3 wt% and K_2O/Na_2O >2 in bulk composition, and high Cr_2O_3 content in priderite (15–18 wt%) suggests that it was formed as a reaction product between a melt inclusion and a host chromite. Burbankite contains significant amounts of Na_2O and K_2O (~3 wt%) and REE concentration (>31 wt%). The formation of burbankite requires a per18 wt%) suggests that it was formed as a reaction product between a melt inclusion and a host–requires more sodic composition. The presence of priderite and burbankite in MSIs suggests that some of them crystallized from ultrapotassic melts, whereas others crystallized from sodic peralkaline melts. Such alkali carbonate melts could be present in the mantle wedge peridotite before incorporation into the granulite.

During March of 2015, the master student Atsushi Yasumoto from Kyoto Univerzity (Japan) visited Department of Geological Processes and we together contuined on analytical work on a joint Czech–Japanese bilateral project. Using laser ablation ICP-MS technique, we analysed prograde and retrograde parts of garnets from HP–HT rocks located in the Moldanubian Zone (Bohemian Massif). Subsequently, we carried out joint field work in the Bohemian Massif including active quarries at Plešovice and Zrcadlová Huť (south Bohemia) and we collected samples from Ktiš and Nové Dvory. These research activities are focused on studies deals with P–T reconstruction and geochemistry of high-pressure/ultrahigh-pressure rocks from the Bohemian Massif (Czech Republic).

We presented results at the Goldschmidt conference 2015 (Haluzova et al. 2015) and data were focused on Re–Os and Lu–Hf geochemistry of mantle pyroxenites from the Bohemian Massif. These presented results were summarized in manuscript, which are now in review process in *Lithos* journal. Studied rocks are spinel and garnet pyroxenites from the Bohemian Massif (Czech Republic and alsoAustria) occurring as veins, layers and/or pockets. Set of these samples were analyzed for their Lu–Hf and Re–Os isotopic compositions. Lu–Hf mineral isochrons of three pyroxenites yield undistinguishable values in the range of 336–338 Ma while one sample gives slightly older age of 354 ± 11 Ma. Similarly, the slope of Re–Os regression for most samples yields an age of 327 ± 31 Ma. These values overlap previously reported Sm–Nd ages on pyroxenites, eclogites and associated peridotites from the Gföhl Unit suggesting contemporaneous evolution of all these HT–HP rocks and may provide an evidence for extensive subduction-related melt percolation in the Bohemian Massif upper mantle in that time. The whole-rock Hf isotopic compositions are highly variable with initial e_{Hf} values ranging from –6.4 to +66. Most samples show negative correlation between bulk rock Sm/Hf and e_{Hf} and when taking into account other characteristics (e.g., high $^{87}Sr/^{86}Sr$), this may be explained by the presence of recycled oceanic sediments in the pyroxenite parental melts. A pyroxenite from Horní Kounice has decoupled Hf–Nd systematics with highly radiogenic initial e_{Hf} of +66 for a given e_{Nd} of +7.8, the values have not been reported so far for mantle-derived melts. This characteristic is consistent with the presence of a melt derived from a depleted mantle component with high Lu/Hf. Finally, one sample from Bečváry plots close to the MORB field in Hf–Nd isotope space consistent with its previously proposed origin as metamorphosed oceanic gabbro. Some of the websterites and thin-layered pyroxenites have variable, but high Os concentrations paralleled by low initial γ Os. This reflects the interaction of the parental pyroxenitic melts and depleted peridotite wall rock. In turn, the radiogenic γ Os values in most pyroxenite samples is explained by mixing between unradiogenic Os derived from peridotites and a low-Os sedimentary precursor with highly radiogenic $^{187}Os/^{188}Os$. Steep increase of $^{187}Os/^{188}Os$ at nearly uniform $^{187}Re/^{188}Os$ found in a few pyroxenites may be connected with the absence of primary sulfides, but presence of minor late stage sulfide-bearing vein-lets most likely associated with HT–HP metamorphism at crustal conditions.

In 2015, we have incorporated reviewer's comments in the manuscript submitted in *Journal of Petrology* and now we are waiting for final decision. The manuscript is focused on comprehensive geochemistry and petrology of several lithological types of pyroxenites from the Moldanibian Zone. We have analysed major and trace elements, Sr, Nd and oxygen isotopes for a suite of pyroxenites, which vary in composition and origin, from nine localities (Bečváry, Horní Bory, Drahonín, Níhov, Mohelno, Nové Dvory, Horní Kounice, Karlstetten and Meidling–im–Tal) in the Gföhl Unit and Kutná Hora Complex. Based on conventional geothermobarometry, most pyroxenites yield a restricted range of temperatures (~875–975 ºC) over a wide span of pressures (~1.0–3.0 GPa). The pyroxenite suite exhibits large variations in elemental and isotopic compositions, reflecting their complex origin and evolution. Based on REE compositions of clinopyroxene (Cpx), three different types of pyroxenites can be distinguished: Type I with a LREE–depleted pattern, Type II with a LREE–enriched pattern and Type III with a convex–upward REE pattern. Such REE compositions reflect different sources for the melts derived from suboceanic (Type I) and enriched (Types II and III) mantle sources. Most pyroxenites have originated as high-pressure crystal cumulates from transient basaltic melts migrating through lithospheric mantle. However, at one locality (Bečváry), pyroxenites exhibit positive Eu anomalies, low $^{87}Sr/^{86}Sr$ ratios, and high eNd values, which may indicate their origin as fragments of metamorphosed gabbroic cumulates of oceanic crust. For the pyroxenite suite as a whole, a positive correlation between Sr/Nd and Eu/Eu*, radiogenic $^{87}Sr/^{86}Sr$ accompanied by negative eNd values in clinopyroxene, and variable $d^{18}O$ values in coexisting garnet argue for the presence of a crustal component in the parental pyroxenite melts. Variations in compatible elements (Ni, Sc, and Co) indicate that combined assimilation and fractional crystallization was important in evolution of most of the pyroxenite parental melts, but that fractional crystallization alone is recorded by the fragments of oceanic crust, perhaps reflecting their pre-subduction crystallization behaviour.

Further aim of the joint Czech–Japanese project is Re–Os and Lu-Hf isotopic systematics of mafic layers from the Horoman Complex (Japan). The Horoman Complex is the peridotite massif derived from shallow oceanic mantle settings located at the northern Japan (Hokkaido). It consists of various lithological types of layered ultramafic and mafic rocks including plagioclase lherzolite, lherzolite, harzburgite and dunite interlayered with mafic layers of variable thickness (several centimetres to a few meters) with "gabbroic" mineralogy. The Horoman peridotites represent residues after partial melting in the garnet stability field at a MORB settings and later metasomatized/refertilized in a supra-subduction zone mantle wedge. Among the mafic layers, four different types (Gabbro I–IV) with different mineralogy and chemistry can be distinguished as a result of their different origin and melt sources. We did detail elemental and isotopic study of layered sections of peridotite-gabbro I and peridotite-gabbro II, where we analyzed this lithology section for their major/trace element contents together with Re–Os and Lu–Hf isotopic compositions (Fig. 7). Major element compositions of thin Type I and II gabbro layers and associated peridotites are similar to those reported by previous studies with the highest Al_2O_3

■ **Fig. 7.** Alternating mafic layers (pyroxenites, Type II) and peridotites from the Horoman Massif (Hokkaido, northern Japan). Photo by M. Svojtka.

contents (11.6–13.2 wt. %) found in thin-layered Type I gabbros and massive Type II gabbro. Thin-layered Type II gabbros are characteristic by their lower Al_2O_3 and CaO values (7.1–11.0 and 5.8–12.8 wt. %, respectively). The Type I gabbros exhibit highly LREE-depleted patterns with La_N/Yb_N between 0.03 and 0.2 paralleled with low abundances of large ion lithophile elements (LILE). In contrast, Type II gabbros are characterized by less pronounced LREE depletions (La_N/Yb_N = 0.5–0.7) coupled with highly positive Eu (Eu/Eu* = 1.3–1.6), Pb and Sr anomalies. Interlayered peridotites show highly variable trace element concentrations reflected by mildly LREE-depleted to slightly LREE-enriched patterns. Studied gabbros show variable whole-rock Lu–Hf concentrations and Hf isotopic compositions. The Type I gabbros yield significantly higher Lu–Hf contents of 0.07–0.55 and 0.26–3.2 ppm, respectively in comparison to the Type II gabbros with Lu and Hf values at range from 0.02 to 0.04 and 0.03 to 0.07 ppm, respectively. This different composition is reflected also by $^{176}Hf/^{177}Hf$ ratios and e_{Hf} values. While present-day e_{Hf} values of the Type I gabbros varies from +13.7 to +48.1, the Type II gabbros exhibit generally more radiogenic e_{Hf} between +40.4 and +117. The Re-Os systematics of the studied mafic layers partially followed Lu-Hf composition with divergent compositions of the Type I and II gabbros. The former type is characterized by high Re contents in the range of 0.35 and 1.9 ppb paralleled by radiogenic $^{187}Os/^{188}Os$ values between 0.2465 and 0.6108 and high $^{187}Re/^{188}Os$ ratios of 8.28–29.5. In comparison, the latter type exhibit significantly lower Re concentrations (0.026–0.50 ppb) and consequently less radiogenic $^{187}Os/^{188}Os$ and lower $^{187}Re/^{188}Os$ ratios in the range of 0.1349–0.3277 and 0.211–2.85, respectively. Our new data on mafic layers from the Horoman Complex suggests different sources and/or evolution of melts parental to the Type I and II gabbros. While the Type I gabbros display trace element signatures similar to MORB-related melt sources, their Hf-Os isotopic compositions argue for significant contribution of the crustal material and/or long term (~1 Ga) closed Hf-Os evolution. Conversely, trace element and Os–Hf compositions of the Type II gabbros may be best explained by their crystallization from the MORB-related melts at shallow depths. Very low Lu–Hf contents paralleled by highly radiogenic Hf isotopic composition of the most Type II gabbros requires highly depleted melt source. These entire data were presented at the 2nd European Mantle Workshop in Wroclaw (Ackerman et al. 2015).

ACKERMAN L., SVOJTKA M., HALUZOVÁ E., SLÁMA J. & NIIDA K. (2015): Re-Os and Lu-Hf isotopic systematics of mafic layers from the Horoman Complex, Japan. – *2nd European Mantle Workshop, Wroclaw, August 25-28, 2015, Mineralogia – Special Papers*, 43: 24–25. Wroclaw.

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Continuing projects

Bilateral co-operation between Institute of Geology of the CAS, v. v. i., and Karst Research Institute, Scientific Research Centre, Slovenian Academy of Sciences and Arts: **Paleomagnetism and magnetostratigraphy of Cenozic cave sediments in Slovenia. Case Study: Divača Karst** (N. Zupan Hajna, A. Mihevc, Karst Research Institute, ZRC SAZU, Postojna, Slovenia; *P. Pruner & P. Bosák*; inernal code *7448*; supported by RVO67985831; since 1997)

Karst surface above the Škocjanske jame Caves, known as the Divaški kras (Divača Karst), represents the SE part of the Kras Plateau (so-called Classical Karst) between the sinks of the Reka River and the village of Divača (Fig. 8). It is built mostly by Cretaceous and Paleogene limestones. The levelled surface cutting them is inclined slightly towards the NW from 420 (Divaški Karst) to 50 m a. s. l. (Trieste region). Karst features here are exceptional: ponors of the Reka River, 15 large collapse dolines and hundreds of other kinds of dolines. Together 64 known caves are known here with the total passages length of 18,500 m, the largest ones are the Škocjanske jame Caves, 5,800 m long and 250 m deep. They were formed by the sinking Reka River flowing farther underground through the Kačna jama Cave to the Labodnica Cave and then to Timavo Springs north of Trieste in Italy. The largest collapse dolines are: the Radvanj double collapse doline (volume of 9 mio m^3), Sekelak (8.5 mio m^3, 122 m deep), Lisični dol (6.2 mio m^3), Globočak (4.6 mio m^3), Risnik (1.5 mio m^3) and others (Fig. 8). As underground rooms so big are not usual in the Classical Karst, it can be expected that collapse dolines of such large sizes could develop only by subsurface rock removal (dissolution) related to great groundwater oscillations under pressure. After uplift and chemical denudation of the surface, hollows are open to the surface. If this model is not real, the hollow would be filled up with caved-in rock and only collapse dolines of much smaller size than the primary cave would appear on the surface (Mihevc et al. 2015).

Old allochthonous fluvial sediments are preserved on the surface of the Divaški Karst and in some of the caves (see summary in Zupan Hajna et al. 2008, 2010). They were transported into the caves by the sinking Reka River and its predecessors. Recent sediments, their origin and grain-size in the Škocjanske jame Caves were studied by Kranjc (1986) and older fluvial deposits, gravels and collapse rocks by Gospodarič (1984). Gospodarič (1988) connected them with Pleistocene depositional/exhumation history and climate changes not older than 400 ka. Fluvial sediments in the karst surface (mostly chert pebbles) were linked to surface river flow of the Reka River in the past, during the so-called "pre-karst" phase (Roglič 1957). The morphological analysis of several unroofed caves on the Divaški Karst (Mihevc 1996, 2001 and others, see summary in Zupan Hajna et al. 2008, 2010) and paleomagnetic dating of sedimentary fills on the highway (Divača profile, Kozina; see summary in Zupan Hajna et al. 2008, 2010; Knez et al. 2016) and Divaška jama and Trhlovca caves (se summary in Zupan Hajna et al. 2008, 2010), however, indicated the cave origin and deposition of cave sediments took part before few millions of years.

During the construction of the Risnik Industrial Zone southwest of the Divača village, a large amount of flowstones on the surface and more cavities filled by sediments were uncovered. We analyzed two profiles: in cave fluvial deposits and in the layered flowstones. Sedimentary profile records at least 7 different zones with different magnetic polarities (4 normal and 3 reverse polarized ones). The magnetostratigraphy indicates a minimum age of sediments more than 2 Ma; cave is clearly much older. About 2 m thick flowstone above the sedimentary profile also records several different polarized magnetic zones, which means, that the youngest top flowstone layer is clearly much older than 780 ka. The age of clastic sediment and flowstone here correlates to the other dating results in the Divaški Karst with cave sediments as old as some 5 Ma (see summary in Zupan Hajna et al. 2008, 2010). In the Škocjanske jame Caves, cave sediments from profile at the tourist path in the Tiha dvorana Hall are only normal polarized, i. e. younger than 780 ka (Brunhes Chron; Mihevc et al. 2015).

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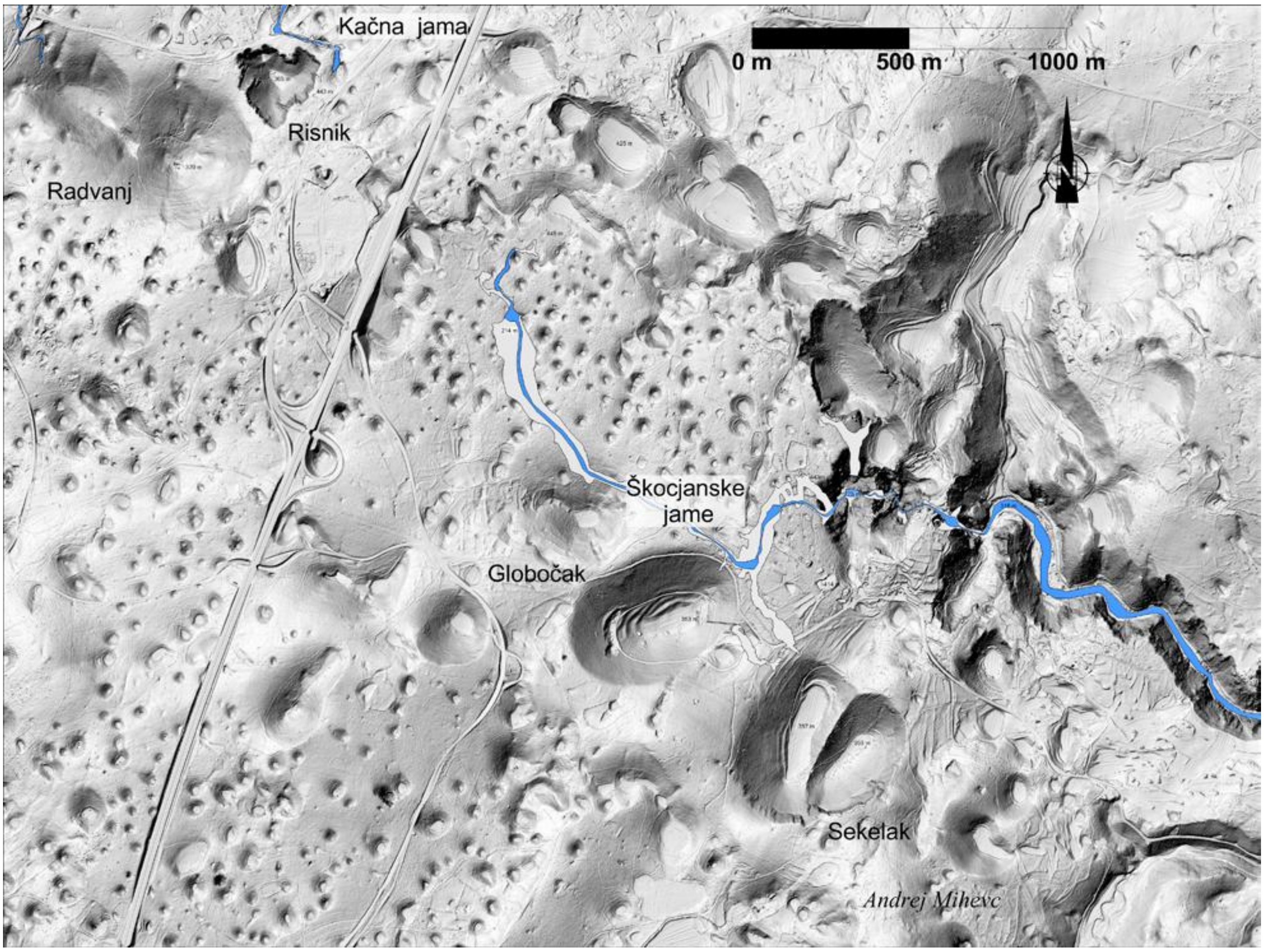

■ **Fig. 8.** The surface of the Divača karst above the Škocjanske jame Caves (LiDAR data, Geodetski oddelek ARSO; courtesy A. Mihevc, original). Blue – sinking Reka River on surface and in its known underground course.

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Project of Joint Institute for Nuclear Research, Dubna, Russia, No. 04-4-1121–2015/2017: **Investigations of Condensed Matter by Modern Neutron Scattering Methods** (T. Ivankina, Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics, Dubna, Russia & *T. Lokajíček*; 2015–2017)

Subproject 1: **Application of neutron diffraction and ultrasonic sounding to study of the elastic P- and S-waves anisotropy of crustal rock samples and its correlation to mineral crystallographic textures and structures**

There was carried out quantitative texture analysis of anisotropic rock samples with different lithology and different anisotropy of elastic properties using neutron diffraction. A new high-pressure measuring head was designed and constructed for longitudinal and transversal ultrasonic sounding of spherical rock samples in 132 independent directions under hydrostatic pressure up to 100 MPa. Ultrasonic measurements of the 3D velocity distribution of P- and S-waves were performed on spherical samples of: (a) biotite gneiss from the Outokumpu scientific drill borehole; (b) serpentinite from Val Malenco, N-Italy; (c) amphibolite and eclogite exhumed from the subduction channel of the Alpine Orogene were. Measurements of velocities of acoustic waves (P, S1, S2) propagating in different directions through the samples (spheres) were used for full stiffness tensor calculation based on Christoffel equation. From velocity measurements on spheres, elastic properties can be determined without making any assumptions about sample symmetry. Based on neutron diffraction texture measurements, there was made theoretical modeling of P- and S-wave velocities distributions. Ultrasonic and texture based calculated velocity surfaces were compared and analysed.

4b. Czech Science Foundation

Finished projects

No. *GA13-28040S*: **Multi-approach study of processes in sandstone exposures: new view on study and interpretation of selected sandstone landforms** (J. Bruthans, Faculty of Science, Charles University, Praha; *M. Filippi* & J. Schweigstillová, Institute of Rock Structure and Mechanics of the CAS, v. v. i., Praha; 2013–2015)

The grant project was aimed to characterize the properties and processes, which are critical for salt weathering of sandstone. The field research focusing on a migration of water, vapour and dissolved salts in surficial zone of sandstone (surface crust) were the main purpose of the project. Hypotheses concerning fundamental role of evaporation rate temporary changes to cavernous weathering were first tested in lab under the controlled conditions and later tested in the field. The Střeleč Quarry (active sandstone quarry with abandoned exposures of various ages including the incipient crusts) was selected as a valuable natural laboratory to test methods adopted from the laboratory techniques. Newly developed approaches to study and characterize the processes in surface zone of sandstone were successfully applied to natural sandstone exposures also in other sites in the Czech Republic and elsewhere (Buckland, UK; Petra, Jordan, etc.). A review of the work done within the project is listed below.

In 2013, sites for the long-term monitoring of various parameters in the field were selected in the Střeleč Quarry and in natural sandstone cliffs/outcrops in the surrounding Bohemian Paradise area. The sites were selected to include various types of sandstone cliffs (according to their orientation, vegetation cover, cavernous weathering features, etc.). Air temperature and humidity, and moisture content were monitored for more than two years; evaporation rate was measured on semi-sealed cores placed back into drilled holes in the sandstone. An experiment using a fluorescent tracer and micro-tensiometers was performed to characterize the moisture flow in a sandstone cliff. Evaporation from various types of sandstone surfaces was also studied in the laboratory.

A large effort was spent to quantify the differences between sandstone crusts vs. subcrust zones. At selected sites, mainly in the Střeleč Quarry, tensile strength and drilling resistance were measured in the surface crusts and beneath. Drilling resistance, hydraulic conductivity, vapor diffusion coefficients and apparent moisture diffusivity were measured in drill cores. A similar study on analogous weak sandstone was performed in Southern England to confirm our findings (their general validity).

To identify the mineral composition of the cement, we used binocular microscopy, powder X-ray diffraction method, polarization microscopy, and scanning electron and cathodoluminescence microscopy (SEM/CL). Leaching of various crusts and subcrust sandstones by hydrogen peroxide, citric, hydrochloric and hydrofluoric acids, and tensile strength measurements under dry vs. wet conditions showed that the weakest sandstone is commonly cemented by clays and biofilms, which both increase the cohesion of the surface crusts.

In 2014 a new monitoring network was installed at a specific (but valuable for the study) sandstone overhang in arkosic sandstone in the Plzeň area to study the effect of moisture on sandstone weathering rate (Bruthans et al., in review). Honeycomb samples were taken from a collapsed sandstone pillar in the Kokořín area to study honeycomb weathering, salt content and simulate moisture flow by fluorescent dyes. Transport of moisture was studied in sealed (see below) drill holes in the

Střeleč Quarry. Barologgers placed in the Střeleč Quarry demonstrated an instant equilibration of air pressure in sandstone pore space. Drilling resistance was measured to visualize the differences between the crusts and underlying material. Tensile strength of surfaces was measured by means of tensiometers.

Tests with a fluorescent dye were performed at selected localities to visualize the capillary moisture transport. The transport is very slow under high-field RH, therefore, the dye was applied also to 15 cores in a lab for up to 90 days.

In 2015 we test our previous results with small-scale honeycombs and measured larger-scale sandstone tafoni in the Kralupy area. Suction pressure was measured in the hollows and visors of the honeycombs. Salt content was measured in the honeycombs and tafoni at several sandstone localities. Experiments with artificial precipitation demonstrated an important difference between the honeycombs and tafoni. To test whether similar processes and rules apply for tafoni in arid and marine environments, tafoni and honeycombs were also studied in the surroundings of the Petra Heritage Site in Jordan. Experimental data and field measurements from all sites showed that the moisture pattern is critical for the formation of these features. A fluorescent tracer in drill holes was found to be a fast and reliable method for testing of detection of the position of the evaporation front in sandstone subsurface. The transport of dissolved fluorescein tracers in full-scale field conditions was found to be too slow, and fluorescent dyes were not readily visible below the biocrust. Experiments with fluorescent dyes and salts therefore continued in laboratory conditions and also in the field but on small-scale samples with separate moisture sources. Drilling resistance, porosimetry and chemical analyses were used to compare the properties of crusts and subcrust zones, and the material in visors and hollows of honeycombs and tafoni.

The text below summarizes and generalizes the most important results of the project structured by headings which represent major directions of research we followed.

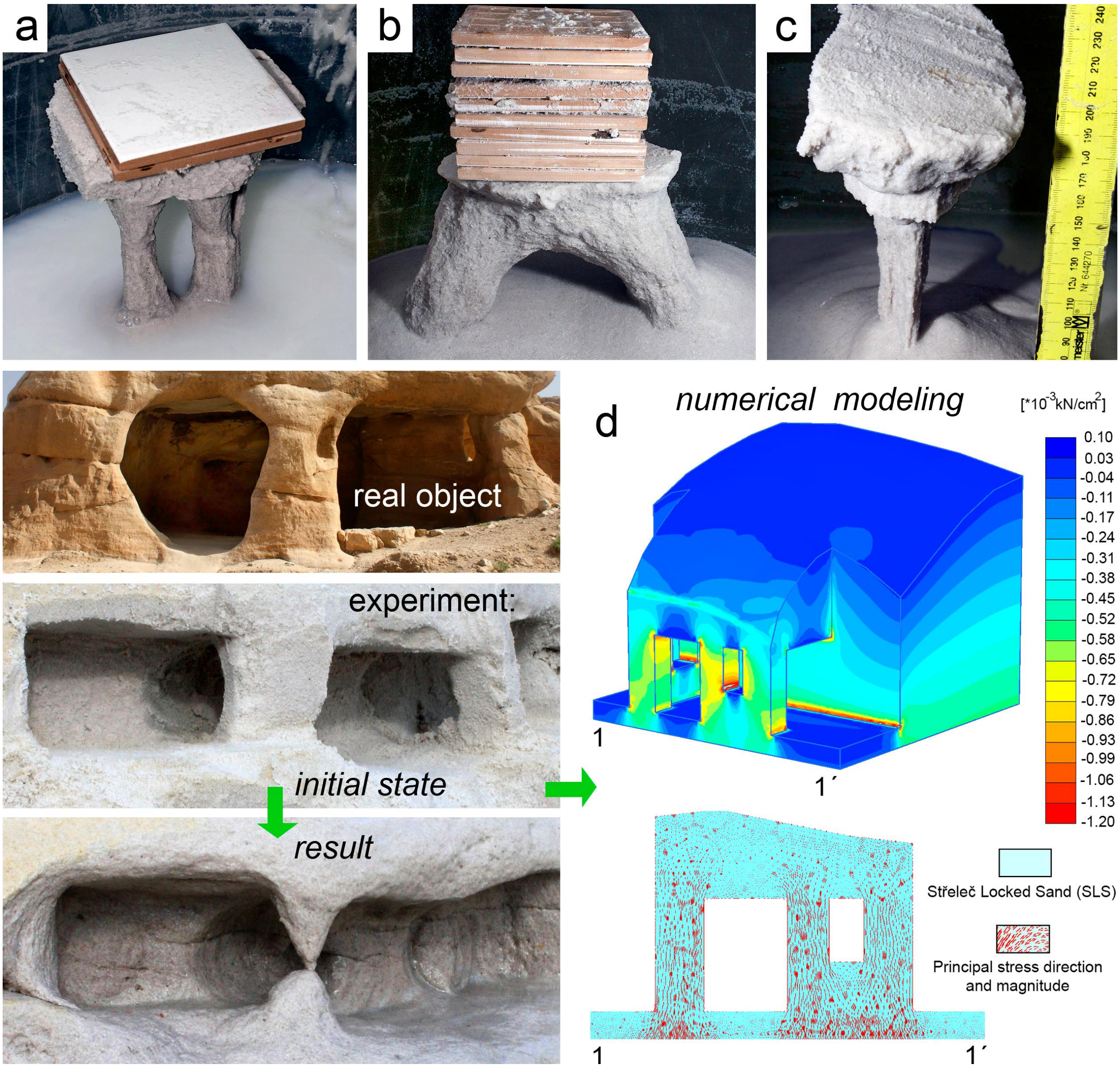
Significance of gravity induced stress. Research originally aimed at the characteristic of mechanical properties of friable sandstone from the Střeleč Quarry demonstrated that gravity-induced stress is the key factor, although as yet neglected, strongly affecting the rate of salt weathering and other erosion processes (Bruthans et al. 2014). The origin of spectacular sandstone landforms like arches, alcoves, etc. was newly explained. For the first time, these forms were created experimentally under controlled laboratory conditions. The application of physical and numerical modeling, and field observations of locked sands and various sandstones from the Czech Republic and Colorado Plateau (US) revealed that an increase in stress reduces the weathering and erosion rates. This means that the material with insufficient loading is rapidly removed by weathering processes and the remaining loaded part of the landform structure is protected from weathering by the fabric-interlocking mechanism. As the sandstone landform evolves, the increased stress results in a slower surface retreat induced by salt and frost weathering. It also inhibits erosion induced by raindrop impact, running water and slaking. Planar discontinuities in the sandstone and negative feedback between stress and weathering/erosion processes are critical and sufficient conditions to create spectacular landforms.

This principle has wide consequences to several other fields of weathering research in sandstone including cultural heritage monuments (Fig. 9). Based on the field observation and salt weathering experiments, we demonstrated an inverse relationship between the stress magnitude and the decay rate in sandstones of ancient city of Petra in Jordan (Rihosek et al., 2016). In addition, physical modeling in the Střeleč Quarry was used to simulate erosion of simplified geometry of Petra monuments and resulted in shapes strikingly similar to strongly weathered tomb chambers. For the first time, physical modeling enabled to visualize the progress of erosion on sandstone monuments. Material that no longer transfers load is quickly eroded away.

Moisture in the sandstone and its relation to weathering. Applicability of techniques adopted from soil science (suction pressure measurements, TDR) was successfully tested. A novel technique for the estimation of evaporation rate from sandstone surface using semi-sealed cores placed back to natural microclimate was developed. We found that evaporation from sandstone can be approximated by exponential function $y = \theta . e^{-\alpha . t}$ where y is the actual weight of water in sandstone core, θ is moisture of material (in wt. %), t is time and α is the coefficient of evaporation rate. This means that the evaporation rate is defined by a single parameter (α) for each sandstone type and microclimate. By means of a fluorescent dye, the evaporation front can be visualized in the sandstone subsurface.

Our 2.5-years' monitoring revealed that sandstone outcrops in the Bohemian Paradise protected from direct insolation by forest canopy show mean annual relative humidity (RH) between 80 and 90 %, while those exposed to direct sunlight show mean annual relative humidity of <70 % and an elevated mean annual temperature. Rock moisture content, suction pressure and potential evaporation were measured at roughly monthly basis at all the localities. *In situ* moisture varies between 1 and 10 vol. %, and suction pressure varies between –3 and –7 kPa in wet sandstone and on surfaces and up to –180 kPa in dry sandstone. Changes in suction pressure and moisture content are gradual and not directly affected by precipitation on overhanging surfaces. Capillary front is mostly situated several centimeters below the sandstone surface.

Artificially wetted overhang in Carboniferous arkosic sandstone between Plzeň and Radčice sites was fond to be an excellent site to observe the effect of moisture transport on weathering processes. The contrast between the erosion rate of wet and dry portions performed there enabled to characterize factors responsible for rapid sandstone weathering and erosion. Erosion rates, moisture, salt content as well as suction were monitored in the field. Mineral phases and water chemistry were analyzed. Measurements of tensile strength, laboratory frost weathering tests, and numerical modeling were performed. As revealed by collected data, an increase in moisture content in pores reduced the tensile strength of the sandstone by the factor of 7, and increased the sandstone weathering and erosion rates by nearly 4 orders of magnitude compared to the same sandstone under natural moisture content. Consequently, frost weathering, in combination with wetting weakening was found to play a major role in weathering/erosion of the sandstone cliff and the overhang. Gravity-induced stress considerably reduces the frost-weathering rate both in the laboratory and in the field, by the factor of 15 or less (Bruthans et al., in review).



■ **Fig. 9.** Examples of the results rising from different approaches – upper line shows results of physical modeling with the Střeleč locked sand: a) rock/cave pillars; b): rock arch; c): pedestal rock ("rock mushroom"; d) numerical modeling showing distribution of major principal stress within the studied object (upward) and model cross-sections with principal stress magnitudes and directions (down). Modified and compiled from Bruthans et al. 2014 and Rihosek et al. 2016.

Role of biologically-initiated rock crust (BIRC) in case hardening: The effects of a BIRC on mechanical and hydraulic properties of friable sandstone were studied at six different sites in the Střeleč Quarry with varying geomorphology, inclination and age of cliff faces. The BIRC developed within the last 8–50 years, but a BIRC can form already within a 2-year period. Drilling resistance technique was found to be an excellent method to distinguish the biocrust from its subsurface (a biocrust ~3 mm thick shows up to 12 times higher drilling resistance than the underlying material). The surface zone with the BIRC shows 3–25 times higher tensile strength than the subsurface material. The BIRC is considerably less erodible than the subsurface based on water jet testing. Saturated hydraulic conductivity of the BIRC is 15–240 times lower than that of the subsurface and its permeability for water vapor is 4–9 times lower than that of the subsurface. The presence of a BIRC slows down capillary absorption of water by the factor of 4–25. The BIRC thus forms a firm surface which protects the underlying material from rain erosion and erosion by running water (Slavík et al., accepted).

Cavernous weathering related forms: Ideas on the origin of cavernous weathering were tested by visualization of capillary transport and evaporation zones by fluorescent dyes in the field and in the laboratory, by the measurement of suction pressure and salt content in outcrops under humid climate (Czech Republic) but also under arid and semiarid climates (Jordan, Italy). The evaporation rate is too slow in the field. In the laboratory, however, it was clearly documented by fluorescent dyes and salts. In the case of high moisture flux the evaporation and deposition of salts dominate in protrusions, while in the case of low moisture flux the evaporation and salt deposition take place in hollows (Bruthans et al., in preparation). Field measurements showed that honeycomb and tafone hollows show a lower suction pressure than the visors. Our experiments and measurements support the theoretical model of cavernous weathering by Huinink et al. (2004).

Symmetrical cavities of mostly spherical shapes, which are considered by some authors to be equivalent of tafoni, were studied in the Czech Republic and other sites in Europe. The obtained results clearly showed that the origin of these forms is linked with the dissolution of carbonate-cemented concretionary precursors (Adamovič et al. 2015).

Involvement of students, popularization: Students were an integral part of the team. Our research generated more than 100 popular contributions outside the Czech Republic, in media like Nature News and Comment, BBC News, New Scientist, Independent, Scientific American, Discovery News, Science News, Financial Times, etc.). The whole list of the popularization results achieved within this project is available at the following link: http://web.natur.cuni.cz/uhigug/masin/bib/mediaNG.htm

In the Czech Republic, the project results were presented in the Czech national TV and National radio broadcast, besides other media.

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SLAVÍK M., BRUTHANS J., FILIPPI M., SCHWEIGSTILLOVÁ J., ŘIHOŠEK J. & FALTEISEK L. (accepted): Biologically-initiated rock crust on sandstone: mechanical and hydraulic properties and resistance to erosion. – *Geomorphology*.

No. GP13-19250P: **Palaeobiological study of marine fossil fishes from the Oligocene of the Hermanowa locality (Poland)** (*T. Přikryl*; 2013–2015)

The project GP13-19250P followed preliminary sampling at the Hermanowa locality that reveals this place as productive site with extraordinarily preserved Oligocene fish fauna. Collecting of specimens was than conducted in 2013–2015, together with, conservation and preparation of new finds (and previously collected specimens also) and their consequent study.

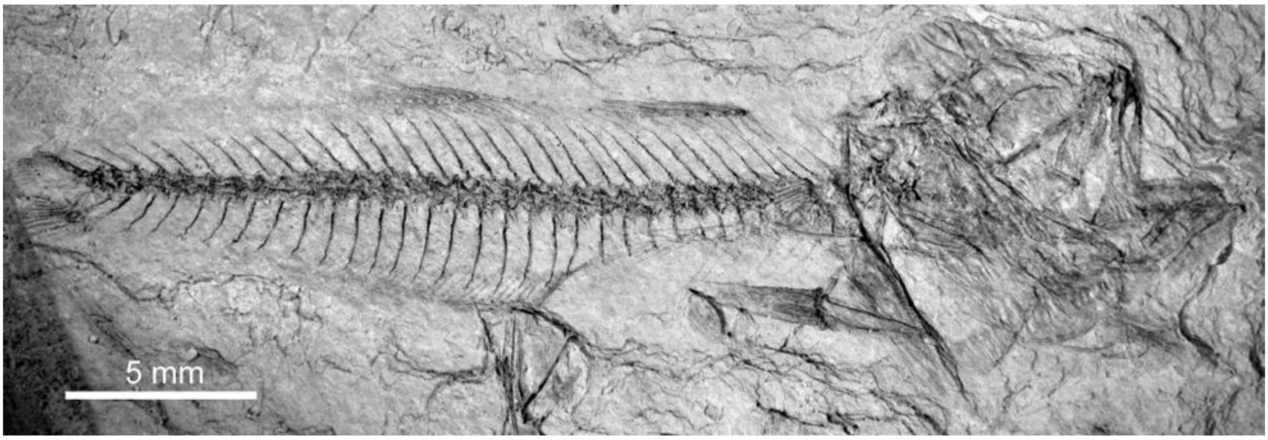
Several hundred specimens of fossil fish collected at the locality (partly before start of the project) were studied by non-destructive methods and compared with selected fossil and Recent representatives. In the assemblage was possible recognize two representatives of sharks (basking shark and ground shark) and 22 types of teleost fishes (two types of herrings and sardines; herring smelts; alepisauriforms; moras; hakes; halfbeaks; two types of pipefishes; shrimpfishes; bigeyes; repropcids; jacks; serranids; sand lances; weevers; two types of boarfishes; mackrels; scabbardfishes; propercarinids; and flat fishes), but collecting campaigns provided also remains of swimming crabs and turtles. The specimens are now deposited in two collections mainly, namely University of Rzesów and Institute of Systematics and Evolution of Animals, Polish Academy of Sciences in Krakow (few specimens are also in National museum in Prague).

The assemblage composition of the locality is thus similar to several other Polish sites, especially upper part of the Jamna Dolna, Leszczawa and Rogi (Jerzmańska 1968; Kotlarczyk et al. 2006). From the qualitative point of view to the assemblage the ground shark (*Physogaleus latus*) was recognized for the first time in the sediments of Polish Carpathians.

Such large amount of specimens from the single locality gives a glimpse of the quantitative composition of fish fauna and unusual preservation allowed also study of non-adult specimens, that are generally poorly preserved in many other localities (if at all). This approach allowed considers skeletal and ontogenetic variability of some taxa and meaning of this variability for taxonomy of groups under consideration.

One of the most interesting finds is represented by small imprint of fish classified to the monotypic family Propercarinidae. The family is tentatively assembled with Stromateoidei group (suborder of the perciform fishes), but propercarinids lack typical toothed saccular outgrowth in the gullet. The distribution of propercarinids is restricted to Paratethys region and in many aspects represent enigmatic group. The newly collected specimen shows unique combination of morphological features and thus classified as a new species named *Propercarina problematica* (Fig. 10). This new taxon was compared with previously described specimens from Romania and Caucasus. Undescribed propercarinid specimens from the locality Frauenweiler (Germany) were also used for comparison and results suggest that usually find small sized specimens are non- or sub-adults and adult specimens can reach much bigger size (Přikryl & Micklich, ongoing research). The morphology of Propercarinidae was also compared with that of extant stromateoids revealing a mixture of primitive and relatively advanced features in the family Propercarinidae (Přikryl et al. 2014).

Numerous specimens of *Trachinus minutus* (Perciformes, Trachinidae) are represented by small sized individuals (with maximal standard length about 35 mm), but unique preservation allow described the morphological changes that occur during growth from a size of about 10 mm to the largest preserved stage. These changes are connected with the origin and changes in the morphology of selected skull bones, the origin of fins



■ **Fig. 10.** *Propercarina problematica*; holotype of the species. Photo T. Přikryl.

and the number of fin rays. In general, it is possible to say, that even the smallest preserved specimen shows a well-developed parts of skull (e.g. skull roof, otic part, bones of the lower jaw, maxillae, anterior part of the premaxillae, preopercles, cleithra, first four spines of the first dorsal fin, and ventral fin spines), and vertebral column is not complete (the caudal portion of the spine was probably not ossified sufficiently and therefore is not preserved and recognizable). Other elements are not so distinctive (or missing) and thus interpreted to be in the initial phases of development or not developed yet. During later stages of ontogeny, the ossification of the skull and postcranial skeleton continue, and new structures form. The morphology of some bones changed rapidly during ontogeny and their appearance is conditioned by the particular age of the specimen. These data were also compared with limited knowledge on Recent trachinids (Přikryl, accepted).

Other numerous specimens allow study of early morid fish of the genus *Eophycis*. The family Moridae (Gadiformes) is well defined by an otophysic connection, a horizontal gas bladder septum, unique otoliths and a specific architecture of the caudal skeleton, but only otoliths *in situ* and caudal skeleton can be used for identification in fossil skeletal record. Newly collected specimens of *Eophycis jamnensis* from the Hermanowa locality allow description and commentary on previously unknown characters and complex state of this early morid fish. The species has an elongated body, a triangular head, and single dorsal and anal fins that are not coalesced with the caudal fin. This species is most similar to the recent species *Guttigadus nana* that differs from it (similarly with other *Eophycis* species) in meristic features, having two dorsal fins and vomer being absent (Přikryl 2015c).

Furthermore, during comparison of specimens with type (or figured) material and with species from other localities, several interesting problems arose that dealing with interpretation of juveniles or small sized non-adult specimens of fossil fishes:

1. a new species of fossil bramid fish was described from the Elam locality (Iran) and named *Paucaichthys elamensis*. The new species is represented by single juvenile individual that is morphologically similar to *P. neamtensis* from Romanian Carpathians, but differs in its morphometric and meristic features as well as its dynamics of ossification. Especially latter feature was surprisingly useful for characterization of fossil species (Přikryl and Bannikov 2014).
2. In revision of fossil record of family Bregmacerotidae (Gadiformes) were provide descriptions of relevant body fossils (including available type specimens), and summarize and discuss the fossil record for the family (Přikryl et al. in press).

Besides, partial (or preliminary) results were also presented in 4 international conferences: 14. Czech-Slovak-Polish Paleontological conference in Krakow (Přikryl et al. 2013); European association of vertebrate paleontologists in Torino (Přikryl 2014); Society of vertebrate paleontology in Dallas (Přikryl 2015a); and 16. Czech–Slovak–Polish Paleontological conference in Olomouc (Přikryl 2015b).

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No. GA CR P104/12/0915: **Quantitative analysis of quartz deformation affecting ASR in concrete** (A. Šťastná, Š. Šachlová, R. Přikryl, Z. Pertold, Z. Seidlová, Faculty of Science, Charles University, Praha; *T. Lokajíček*; 2012–2015)

The project is aimed towards: (1) the quantification of alkali-silica reaction (ASR) potential of quartz-rich aggregates; (2) the identification and quantification of parameters responsible for ASR; (3) the formulation of a methodology facilitating identification of aggregates responsible for ASR in practice, and (4) the improvement of the accelerated mortar bar test (AMBT) with the acoustic emission (AE) method. Aggregates were sampled in various areas in the Czech Republic as well as in Sweden. These rock types were typical with the prevailing content of quartz (respectively quartz-rich matrix) and with the variable degree of quartz deformation and recrystallization The combination of polarizing and electron microscopy with the particle image (PIA) enabled us: to distinguish main minerals and phases; to identify alkali-reactive minerals and phases; to classify petrographically aggregates; and to distinguish quartz originating in various geological conditions. Flint samples were found dominated by the cryptocrystalline quartz (crystallite size of 30–40 nm) instead of the expected amorphous SiO_2. The significant difference was found e.g., comparing flint to pegmatite. The crystallite size of pegmatite quartz was detected around 200 nm. The crystallite size, the type and the form of SiO_2 was found to be closely connected to the width of spectral bands detected by the Fourier transform (FTIR) spectroscopy. Except of the pegmatite quartz, all selected rock types indicated expansion values higher than 0.100 % and they were classified as reactive. The pegmatite quartz indicated the expansion of 0.080–0.083 and was classified as non-reactive. Alkali-silica gels originating in mortar bars were studied. Their chemical composition was compared with alkali-silica gels identified in concrete and mortar samples investigated as a part of previous studies. The ASR potential was also quantified based on the amount of SiO_2 leached into the solution. In 2015, the new demand originated with connection to the long term analysis of ASR potential of aggregates. Concrete prisms were measured in the laboratory established at the Institute of Geochemistry, Mineralogy and Mineral Resources, Charles University in Praha. An etching experiment was developed as a part of current project with the aim to facilitate identification of alkali reactive quartz-rich aggregates. It combined employment of the 1M NaOH solution at 80 °C. The close correlation of etched area values and the mortar bars expansion indicated that the alkaline etching could be an alternative accurate method in the quantification of ASR potential of quartz-rich rocks in practice. Application of this method represented following advantages: (1) visualization of the ASR origin; (2) identification and quantification of alkali-reactive components in aggregates; (3) minimum influence of the operator; (4) small amount of the sample required for the analysis, and (5) possible detection of heterogeneities in aggregates. The main disadvantage of the method was regarded as the restriction to quartz-rich rocks. The AE method was found hardly responsive to changes in mortar bars during the ASR. The AE was successfully used only as an indicator of the initial degradation of mortar bars caused by the ASR. The AE signal decreased in successive phases due to the increasing degree of material degradation. Contrary, the method of US reflected both: normal development of mortar bar microstructure (hardening of mortar), and/or degradation of mortar bar due to the ASR. Steel 316L waveguides, which could persist in 80 °C 1M NaOH solution, were found for recording of the AE and ultrasonic testing. The modification of waveguides, where steel waveguides were positioned through heating chamber walls, was approved. This arrangement enabled to carry out all subsequent ultrasonic experiments. Mortar bars were measured to investigate an influence of their composition, temperature and type of accelerating media on the ultrasonic sounding (US), as well as on their expansion. The testing was performed in two different measurement cycles. The first cycle consisted of semi-continuous ultrasonic testing of four different pairs of mortar bars. During this test, the US as well as the recoding of AE was carried out in the sound test; the heating chamber was used to maintain constant mortar bar test conditions. Every day regular mortar bar US by P- and S-waves was carried out, together with their expansion measurements in the second cycle. During this test, no AE monitoring was carried out. The P- and S-wave sounding enabled calculation of dynamic Young modulus of mortar bars, and its changes over the course of the experiment. All measurements showed very good correlation between mortar bar expansion and different ultrasonic parameters, like P-wave velocity, signal attenuation, frequency changes, Young modulus, etc. It was also found that during the mortar bar hardening at 100% relative humidity (RH) and 20 °C there was no bar expansion observed. However, a significant increase of P-wave velocity was measured from 3.5 $km.s^{-1}$ up to 4.7 $km.s^{-1}$ and S-waves from 2.2 $km.s^{-1}$ up to 2.8 $km.s^{-1}$ respectively. No difference was observed dependent on the type of aggregates used in mortar bars during the hardening. P- and S-wave velocities decreased immediately after mortar bars were stored in 1M NaOH solution at

80 °C. The decrease was dependent on the aggregate type. More reactive aggregates displayed higher decrease of the velocity. Mortar bars with the most reactive aggregate exhibited expansion exceeding 0.4% after 14 days of testing and about 50 % of P- and S-wave velocity decrease. Such a decrease (50 %) can be observed also for Young (48 to 20 GPa) and Shear (from 19 to 8 GPa) dynamic modulus respectively. A unique methodology of the semi-continuous US of mortar bars under alkaline conditions and increased temperature was included in the patent application submitted in 2015.

No. GAP210/12/2053: **High-resolution floristic changes as a response to climatic dynamics during the Late Palaeozoic ice age recorded in the basins of the Bohemian Massif** (*J. Bek*; J. Pšenička, West Bohemian Museum, Plzeň; S. Opluštil, Faculty of Science, Charles University, Praha; M. Libertín, National Museum, Praha & Z. Šimůnek, Czech Geological Survey, Praha, Czech Republic; 2012–2015)

The primary aim of the project was to (a) reconstruct stratigraphic ranges of Carboniferous and Early Permian macrofloras and palynofloras to establish high-resolution biostratigraphy of the Late Paleozoic basins in the Czech part of the Bohemian Massif and to (b) radio-isotopically calibrate lithostratigraphic units, which provided these floras.

As a secondary aim, it was expected that resulting data will provide a base for subsequent studies of biodiversities and their changes and make the floral record from the Late Palaeozoic basins of the Czech Republic as a reference “section/succession” for comparison with similarly studied basins elsewhere in the former tropical Pangea (e.g. South Wales, Pennine, Ruhr, NW Spain). In addition, it was further expected that radio-isotopic calibration of biostratigraphically well-constrained strata will allow for calibration of floral and palynological biozones and west European regional substages. This, in turn, would improve significantly a correlation of these regional substages to the global stages defined in marine strata of East European Platform.

To achieve all the aims of the project implied application of following methods and approaches: (i) construction of a database to store biostratigraphic data, (ii) filling the database with existing macrofloral and palynofloral records, (iii) data processing and their interpretation, (iv) collecting of tuff bed samples and analysis of their zircons by U-Pb CA-IDTIMS for high-precision radio-isotopic ages, and (v) sampling of comparative material from localities outside the Bohemian Massif.

Construction of database: structure of database was designed to accommodate plant fossil record into stratigraphically narrow basin-wide intervals to achieve as high stratigraphic resolution as possible. Most of the plant-bearing horizons coincide with those that provided palynomorphs, which enabled to define just one set of stratigraphic intervals common for both type of data. In coal-bearing units these stratigraphic intervals correspond mostly with individual coal seams and therefore particular intervals correspond to cyclothems. In some particular cases we distinguished several individual plant-bearing horizons within a single stratigraphic interval if these horizons provided specific and taphonomically different floras. The best example is the Radnice coal group where several such horizons provided distinct floras related to ecologically different habitats. In coal-barren strata identification of individual cycles in a basin-scale was more complicated and, therefore we defined “only” meso-cycles, which are ~40–60 m thick units separated by widespread erosional surfaces. In individual basins we defined between ~40 and 120 individual stratigraphic intervals with fossil record.

Filling the database: Data on Carboniferous and Early Permian macrofloras and palynofloras for our research were searched in museum plant collections, published literature and by significant part in unpublished (archived) reports resulting from mapping activities, systematic collecting in coal mines and from boreholes drilled during several previous decades (mostly during the second half of the 20th century). Storing such data in the database, however, required implication of several steps since the “raw data” are usually lists of floras without precise stratigraphic location, except data from coal mines that are usually directly related to known coal seams. In addition, it was necessary to verify identification of some plant species, and nomenclatorically upgrade lists of floras to be compatible with their present-day names (e.g. sphenopterid ferns). Furthermore, floras found in boreholes (nearly 800 boreholes in the basins in central and western Bohemia and about 120 boreholes in the Sudetic basins) are in the reports arranged according to the depth without detailed stratigraphy indicated. This, however, implies examination of borehole section and, in many cases, construction of cross-section, to be able to precisely locate stratigraphic position of particular plant-bearing beds. Filling database by such data was the most time-consuming activity which took place longer than formerly expected. Nevertheless, we can confirm, that principal part of data is already stored in the database. Currently robust set of data counting 21,957 records with 19,328 specimens of macrofossils and more than 2,629 palynological samples with several tens of thousands of individual miospore records have been inserted into the database.

Data processing: Ones data on macrofloras and microfloras from individual basins were saved in the database, they were sorted and arranged to allow for construction of stratigraphic ranges of individual taxa in defined stratigraphic intervals. It included transfer of data into the Excel spread sheet table with indication of presence/absence of taxa in particular intervals as well as graphic (in Corel Draw) construction of stratigraphic ranges of plant/palynomorph species. Such data were further analysed for diversity in particular intervals and for changes within individual plant groups (lycopsids, sphenopsids, ferns) as well as for changes in overall diversity. Resulting data were or will be (where not done yet) subsequently compared with data from the basins outside the Bohemian Massif and interpretations were made.

Radio-isotopic dating: Embedded in sedimentary successions of the Czech Late Paleozoic basins are numerous volcanites represented mostly by fall-out tuffs and ignimbrites and less common lava bodies. Especially acid volcanites contain numerous volcanic zircons and are suitable for the U-Pb CA-ID TIMS chronology. This is currently the most precise methods allowing for determination of crystallization ages within an interval of uncertainty ~200–300 ka. Such high precision overcomes the resolution of most biostratigraphic zonations (for example Pennsylvanian floral zones are usually

1–2 Ma long). This unprecedently excellent precision allowed us not only to calibrate lithostratigraphic units in individual basins but also to calibrate floral zones and regional substages and to correlate them directly with global stages defined in East European Platform and via marine bands correlated to the Donets Basin. Radio-isotopic ages were measured in the geochronological laboratory (University in Boise, Idaho, USA). In all high-precision radio-isotopic ages of twelve tuff beds were determined during the project. They include by major part tuffs from the Czech basins (Upper Silesia, Intra-Sudetic, Krkonoše-Piedmont, Mnichovo Hradiště, Boskovice basins) as well as few samples from the Ruhr and Saar basins (Germany) for better correlation between both areas.

Comparative material: during the project the team members used an opportunity to study sedimentary sequences and collect plant fossils for comparative study from numerous areas, mostly in Europe (Karnic Alps, Puertollano, Poland, Sardinia) but also in the USA (New Mexico), Turkey (Amasra), Kazakhstan (Ekibastuz) and China (Inner Mongolia). All these field activities provided not only valuable paleontological material and tuffs for dating stored in institutions involved into this project but the participating team members obtained also a unique experience from these studies and discussions with colleagues during the field research. This, in turn, will be very helpful for interpretation of Czech floral data in their accommodation within broader context of Late Paleozoic floras of tropical Pangea.

Scientific results achieved. Establishment of high resolution stratigraphic ranges of macrofloras and palynofloras in the basins of central and western Bohemia as well as in the Intra-Sudetic, Krkonoše-Piedmont and Upper Silesian basins allows for subsequent analysis of plant diversity and its changes throughout the Late Mississippian to Asselian times. This in turn enables to define floral/palynological zones and to compare stratigraphic ranges of floral taxa with those in western European coalfields, where these zonations were established and widely applied. Our data clearly demonstrate that these zones are successfully identifiable also in land-locked continental basins and not only in the large paralic basins of the North Variscan Foreland, where migration of plant species was easier due to absence of orographic bariers. Established stratigraphic ranges of Czech Carboniferous floras thus allowed for improving of correlation of our basins with those in the North Variscan Foreland. The comparison also shows that both floras are comparable in composition and diversity. The major differences are, however, in absence of some species (some of stratigraphical importance) and presence of local endemic taxa typical for continental basins of the Bohemian Massif. Differences in rank of ~1 Ma may occur in stratigraphic ranges of some stratigraphically important plant taxa. On the other hand, major turnovers in plant diversity and composition of floras recorded in large paralic basins were also identified at corresponding stratigraphic levels in the Czech basins and demonstrate that climatic forced floral changes. It includes drastic decrease in populations of arborescent lycopsids in middle Asturian time and onset of fern-dominated low-land floras. New radio-isotopic ages of tuff beds intercalated in the Czech basins provided a base for calibration of their lithostratigraphic units by numerical ages and revealed an existence of two new hiatuses, which has not been previously known from biostratigraphic data. For the first time, calibrated were also floral zones and west European regional substages. Together with our new radio-isotopic ages from the Ruhr and Saar basins (Germany) we were able to improve correlation between both areas and to provide further evidence about common mechanisms driving the floral changes across Variscan Europe. This correlation also shows that ~1–3 Ma alternation of dry and wet phase are for both areas coeval and suggest they are results of common driving mechanism.As a whole, results achieved in this project make from the Czech Carboniferous basins a reference area for detailed high-resolution floral biostratigraphy calibrated by radio-isotopic ages, which can be used for comparisons with other basins in Europe/North America whenever similar data in these areas become available. So-far comparable detail of floral biostratigraphy calibrated by radio-isotopic data exists only in the Donets Basin, Ukraine. Important outputs of the project were papers concerning palaeoecological (Opluštil et al. 2013, 2014) intepretations and palaeobotanical and palynological (Fig. 11) systematic studies (Bek 2013; Bek et al. 2015; Libertín et al. 2014; Opluštil 2013; Opluštil et al. 2013, 2014; Pšenička et al. 2015; Pšenička & Krings 2015; Pšenička & Opluštil 2013, and Thomas & Bek 2014).

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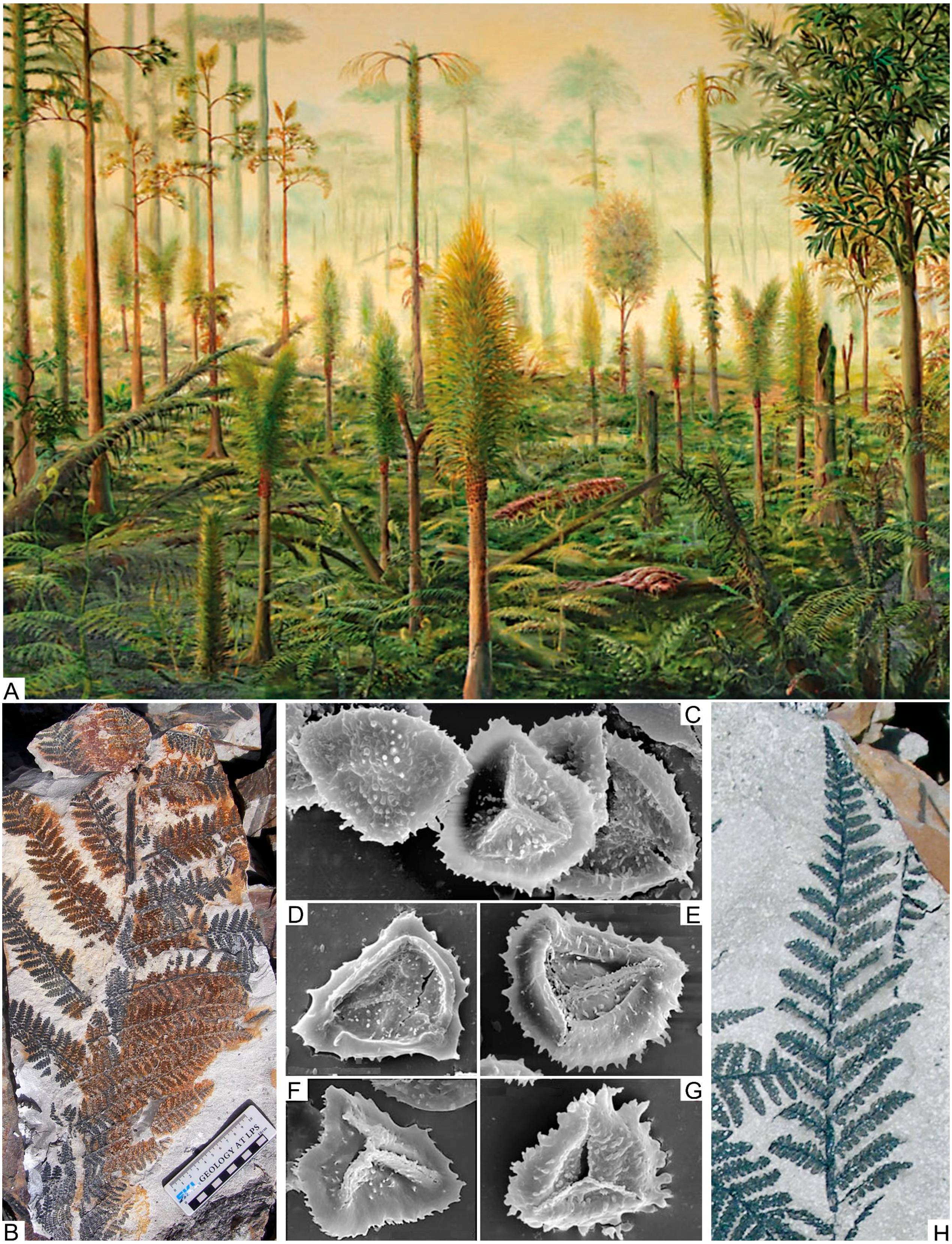

■ **Fig. 11** A – Reconstruction of Pennsylvanian tropical forest (from Bek et al. 2015). B, H – Fronds of Pennsylvanian ferns (Ovčín locality, Radnice Basin). C-G – *In situ* microspores isolated from sub-arborescent lycopsid *Omphalophloios feistmantelii* (modified from Bek et al. 2015).

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Continuing projects

No. GA CR 13-13967S: **Experimental study of crack initiation and crack damage stress thresholds as critical parameters influencing the durability of natural porous stone** (R. Přikryl, A. Šťastná, Faculty of Science, Charles University, Praha; Z. Weishauptová, I. Sýkorová, M. Švábová, Institute of Rock Structuree and Mechanics of the CAS, v. v. i, Praha; *T. Lokajíček*; L. Zamrazilová, Academy of Fine Arts, Praha, Czech Republic; 2013–2017*)*

During the third year of the study, the most important progress in the fulfilment of basic research tasks is connected with: (1) formulation which parts of the stress-strain diagram should be used for the computation of energetic parameters of brittle damage (applicable as one of durability estimators); (2) formulation of energetic parameters that are proportional to the materials resistance to damage, and finally (3) verification of our hypothesis on mode I brittle damage by the study of decayed material sampled from real weathering environments. More detailed description of these partial results is given below:

1) Interpretation of stress-strain behaviour is based on segmentation of stress-strain curve into part starting from zero stress level to crack closure stress threshold level (this part is not pronounced if flat microcracks oriented perpendicularly to the applied load are missing, what was also the case of many of the studied materials in this research project), then to crack initiation stress threshold level, and then to unstable crack growth stress threshold level. The procedure follows with computation of energetic parameters from the respective parts of stress-strain curve. In contrast to previous studies, the energetic parameters are considered not only in the direction parallel to principal load (i.e. in axial direction), but also in lateral directions, resulting in the formulation of energetic parameters related to volumetric strain in the domain of reversible and of irreversible deformation. It was find that lateral curve of stress-strain behaviour can be used for computation of energetic parameters of deformational process up to the crack initiation and unstable crack growth stress thresholds, respectively. The lateral curve of stress-strain behaviour is used due to the fact that the onset of brittle damage in uniaxial compression is associated with the formation of axially oriented mode I (tensile) microcracks. Our hypothesis on the use of this part of stress-strain curve was also based on the presumption that brittle damage phenomena associated with major physical weathering processes (such as freezing/thawing, wetting/drying, thermohygric cycling, etc.) are of the similar mode – i.e. formation of tensile microcractures. To verify this hypothesis experimentally in laboratory through newly designed artificial weathering test, a set of cubic/prismatic specimens was started to be prepared. During the artificial weathering tests, those specimens will be tested bound in special steel frames allowing for only unidirectional expansion (in contrast to multidirectional expansion that is used in conventional laboratory tests). Most of these experiments will continue in 2016.
2) Two energetic parameters of stress-strain behaviour are computed up to these crack initiation and unstable crack growth stress thresholds and are expressed as: (i) modulus of resilience and (ii) modulus of cohesion.
3) To confirm our assumption on the possible use of lateral stress/strain curve and energetic parameters computed from it as a measure of material's resistance to weathering, we have started to collect and analysed decayed surface layers of various natural stones and to analyse them in detail. Process of preparation of sampled material for polished cross-section and applied analytical procedure (combination of reflected light microscopy and scanning electron microscopy with energy dispersive microanalysis and x-ray elemental mapping) benefited from co-operation with experts from School of Restoration of the Academy of Fine Arts. Based on the results obtained from decayed silicites sampled in indoor and outdoor environment, we have been able to confirm that majority of observed brittle damage phenomena are due to formation of mode I (tensile) microcracks. The novelty of our approach in silicite classification is in recognition of importance of intra- and extrabasinal components, and of rock-forming minerals related to the cementation phase of the rock. These are correlated with experimentally derived mechanical properties and durability parameters at present. Employment of chemical data for computation of content of normative minerals in studied rocks (specifically of silicites). Real density and bulk density (obtained from test specimens used for geomechanical tests) were employed for the computation of total porosity. Ratio between open porosity (also obtained from test specimens used for geomechanical tests) to the bulk porosity are key parameters used in the indirect evaluation of durability.

No. 13-15390S: **Re–Os geochronology of ore mineralizations from the Bohemian Massif with possible metallogenic implications** (*L. Ackerman*, *K. Žák*, *M. Svojtka*, *J. Ďurišová*; J. Pašava, F. Veselovský & V. Erban Czech Geological Survey, Praha; 2013–2016)

Re–Os geochronology of molybdenites from the Bohemian Massif was successfully finished. The data resulted in extensive dataset of Re–Os ages for 32 molybdenites from different mineralized systems (Sn–W, Base metal, Cu–Fe–As, Mo, rare element) as well as barren granites from all different geotectonic units of the Bohemian Massif. Such large diversity resulted in highly variable ages from 584 to 302 Ma with respect to individual localities. Within this dataset, first data for extremely Re-poor molybdenites from the Krušné Hory Mts. related to Sn–W mineralizations were also obtained.

The research on Re–Os geochronology of the ore mineralizations from the Bohemian Massif have been continued. This includes sampling on selected localities (e.g., Zlaté Hory

Fig. 12. Sampling on Pb–Zn–Au mine in Zlaté Hory for Re–Os geochronology of pyrite (photo by M. Svojtka).

Pb–Zn–Au deposit; (Fig. 12), but most importantly analyses of more than 100 mineral separates of arsenopyrite, pyrite and arsenide from selected ore mineralizations (e.g., Jílové, Kutná Hora, Příbram, Obří Důl, Cínovec, Krupka, Tisová, Liblín, Voltýřov, Kašperské Hory, Krásno, Hromnice, Horní Slavkov, Jáchymov, Stříbro) for their Re contents and therefore, the suitability for Re–Os geochronology. The results have shown that arsenopyrites and pyrites at several localities contain sufficient Re contents for the geochronology (e.g., Jílové, Kašperské Hory, Liblín, Obří důl) whereas arsenopyrites and pyrites from e.g., Pb–Zn–Ag mineralizations (Příbram, Kutná Hora, Stříbro) show extremely low Re contents (< 0.5 ppm) preventing application of Re-Os chronometer. Arsenides from Jáchymov were tested for their Re with promising results (> 1 ppm of Re). Subsequently, 35 samples of arsenopyrite, pyrite and arsenide were selected and successfully analysed for their Re–Os isotopic compositions at the University of Alberta. The Jílové arsenopyrites yield model ages between 325 and 335 Ma, Líblín pyrites produced an isochron age of 509 ± 20 Ma, Obří důl arsenopyrites define an isochron age of 306.9 ± 5.5 Ma and Kašperské Hory arsenopyrites return an isochron age of 333.8 ± 4.8 Ma. The results from the arsenopyrites at Cínovec, Kašperské Hory, pyrites from Hromnice and Liblín and arsenides from Jáchymov are still evaluated.

A complex study dealing with the Ni–Cu–(PGE) mineralization at Rožany-Kunratice area in N Bohemia was accomplished. The obtained results include U–Pb geochronology of zircon from the host rocks, highly siderophile and Os isotopic composition determination for ore samples and identification of PGE principal carriers (Haluzová et al. 2015). The results have shown that at least origin of some platinum-group minerals was probably closely associated with late-stage hydrothermal processes, causing remobilization of platinum-group elements from the primary base-metal sulphides. The Ni-rich ores have the highest I-PGE (Os, Ir, Ru) concentrations whereas Pd and Pt tend to be enriched in Cu-rich ores. Both types of ores exhibit highly variable initial (349 Ma) γOs values of +50 to +134 in part indicate important, but variable amounts of incorporated crustal material.

To provide more constraints on the age of ore mineralizations from the Bohemian Massif, U–Pb geochronology of zircons at selected localities was applied. This includes U–Pb age determinations of zircons from: (a) host rocks (dolerite) at Rožany (Haluzová et al. 2015); (b) zircons from greywackes at Liblín to provide complementary data to pyrite Re–Os ages; (c) zircons from granitoids of the Dyje massif yielding 603.1 ± 2.4 Ma, and (d) zircons from the Bohutín stock to provide complementary data to molybdenite Re–Os ages (Žák et al. 2015).

HALUZOVÁ E., ACKERMAN L., PAŠAVA J., JONÁŠOVÁ Š., SVOJTKA M., HRSTKA T. & VESELOVSKÝ F. (2015): Geochronology and characteristics of Ni–Cu–(PGE) mineralization at Rožany, Lusatian Granitoid Complex, Czech Republic – *Journal of Geosciences*, 60, 4: 219–236.

ŽÁK K., SVOJTKA M., BREITER K., ĎURIŠOVÁ J., VESELOVSKÝ F. & PAŠAVA J. (2015): Nové U–Pb datování zirkonů z bohutínského pně v příbramské rudní oblasti. – *Zprávy o geologických výzkumech v roce 2014*, 48: 43–49. Praha.

GA No. 13-22351S: **Combined use of novel and traditional stable isotope systems in identifying source components and processes of moldavite formation** (T. Magna, V. Erban & J. Farkaš, Czech Geological Survey, Praha, *K. Žák*, *R. Skála*, *L. Ackerman*; Z. Řanda, J. Mizera, J. Kučera & J. Kameník, Institute of Nuclear Physics of the CAS, v. v. i., Praha; 2013–2016)

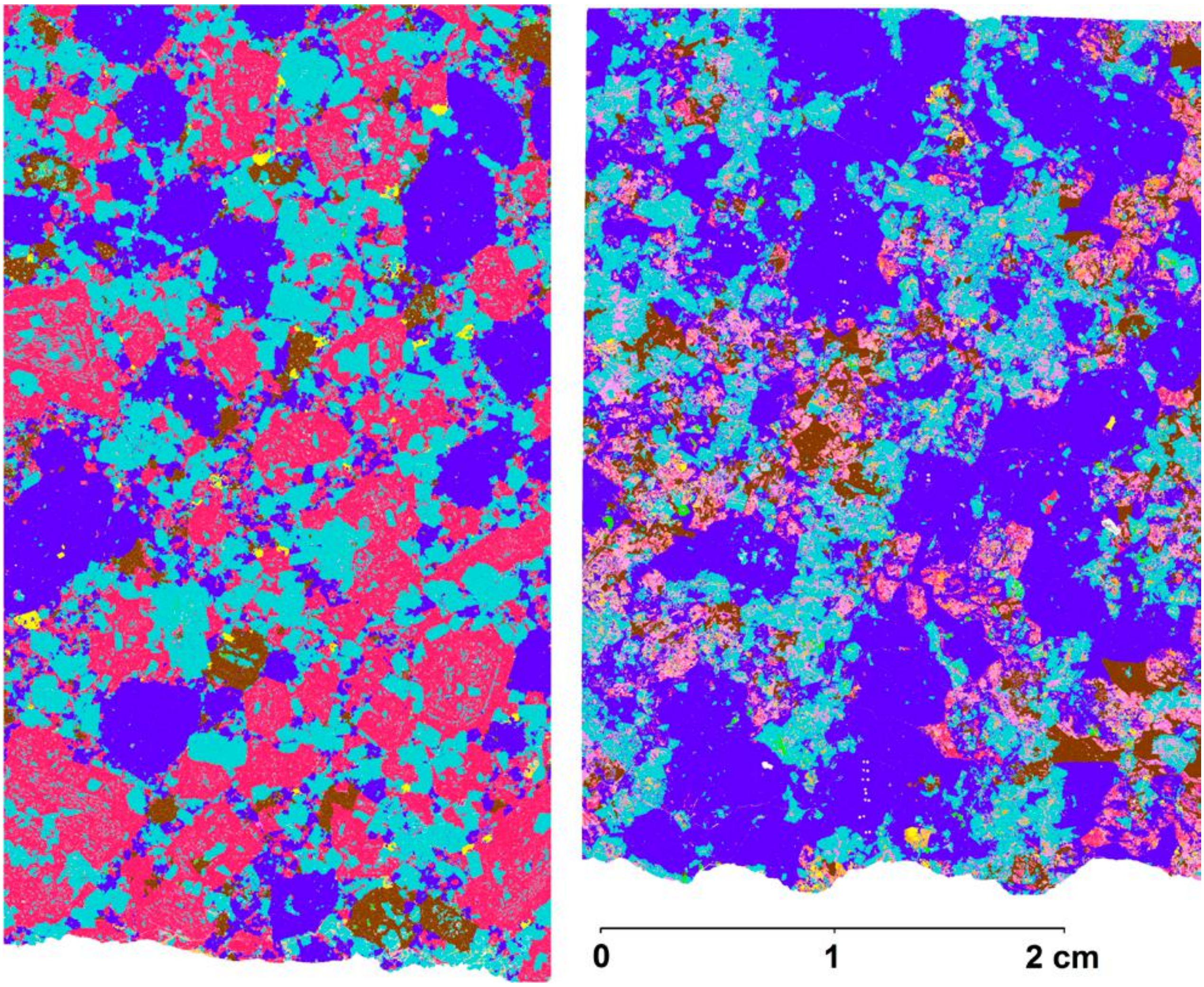
Moldavites, tektites of the Central European Strewn Field, genetically related to the Ries Impact Structure in Germany, are studied using a set traditional and novel isotope systems (triple oxygen isotopes, isotopes of Mg, Ca, Si, Zn, Cu and other). Simlutaneously, distribution of highly siderofile elements is studied in tektites and other types of impact glasses. The scope of the study was widened to the Zhamanshin Impact Structure (Kazakhstan), where promising results have been obtained, which indicates incorporation of the impactor matter into one type of the impact glass. The ongoing studies revealed that the formation of tektites, high-speed distant ejecta of an early phase of the impact process, is accompanied by distinct chemical and isotopic fractionation. While elements like oxygen, carbon, zinc and copper are strongly isotopically fractionated during the tektite formation, some other elements like Sr or Ca do not show any changes in their isotope ratios. The data were incorporated in a new model of moldavite formation (Žák et al., in press). Papers on internal structure, element chemistry including detailed data on highly siderophile elements and osmium isotope data on the Zhamanshin impact glasses and another paper on Zn and Cu isotope systematics of moldavites and their sedimentary precursors are under review also in the Geochimica et Cosmochimica Acta. Other papers are under review in Journal of Geosciences and Meteoritics and Planetary Science.

ŽÁK K., SKÁLA R., ŘANDA Z., MIZERA J., HEISSING K., ACKERMAN L., ĎURIŠOVÁ J., JONÁŠOVÁ Š., KAMENÍK J., MAGNA T. (2016): Chemistry of Tertiary sediments in the surroundings of the Ries impact structure and moldavite formation revisited. – *Geochimicia et Cosmochimica Acta*, 179: 287–311.

No. 14-13600S: **Rock textures and mineral zoning: Insights into open system processes in granitoids** (*K. Breiter*, *J. Ďurišová*, *Z. Korbelová*; V. Kanický, M. Vašinová Galiová, T. Vaculovič & J. Leichmann, Faculty of Science, Masaryk University, Brno; 2014–2016)

Our activities in the second year of the project were focused to acquire data from the deep borehole CS-1, which are necessary for formulation of a new evolutionary model of the granite pluton and associated Sn-W-Li deposit Cínovec. The methods of automated mineralogy (TIMA technology; Fig. 13), cathodoluminescence, laser-ablation ICP-MS of quartz and micas, the electron microprobe (analyzes of oxide ore minerals), and classical whole-rock chemical analyses were used.

The studied Cínovec pluton is composed of two comagmatic intrusions: a relatively older biotite granite and something younger albite-zinnwaldite granite. Following genetic scenario is proposed for the younger ore-bearing intrusion: The intrusion of the primary magma reached subvolcanic conditions. After explosive degassing, a hem of fine-grained porphyritic granite ("microgranite") crystallized along the upper contact. During the next intrusive pulse, the hem was fractured, and blocks of the microgranite plunged into the relatively low-viscosity water-enriched magma. Concurrently, the stockscheider crystallized along the upper contact of the intrusion. The magma crystallized simultaneously from the hanging wall and footwall inwards. Its pronounced fractionation resulted in further increases in F, Li, Rb, Nb and Ta, decreases in K, Zr, Th, Y and REE and nearly constant Na. A high degree of magmatic fractionation is documented by the decreases in K/Rb from 25 to 15 and in Zr/Hf from 10 to 5. The increasing influence of the fluid is highlighted by the decrease in Y/Ho from 29 to 17. The residual melt between both crystallizing fronts became enriched in water and volatiles up to saturation ("second boiling"). The segregated fluid escaped upwards, causing hydrofracturing of the overlying granite, while the water-poor residuum crystallized in situ as a mica-free granite, depleted in F, Li, Fe and all ore elements. The F- and Li-rich fluid caused greisenization and creat-



■ **Fig. 13.** Mineral maps of the granite from Cínovec created by TIMA (compiled by T. Hrstka): Quartz- deep blue, albite- light blue, K-feldspar- red, Li-Fe micas- brown, muscovite-like mica- pink, topaz- yellow, fluorite-green. Left: medium grained albite-zinnwaldite granite in fully magmatic stage without any reaction with fluid (borehole CS-1, depth of 478 m). Right: albite-zinnwaldite from the canopy of the pluton with strongly sericitized K-feldspar and local albitization (borehole CS-1, depth of 205 m).

ed quartz-zinnwaldite veins. Alkalis liberated from feldspars destroyed during greisenization induced local "albitization" in the uppermost 90 m thick part of the cupola. Columbite crystallized both as magmatic disseminated crystals in the zinnwaldite granite and hydrothermal crystals in the greisens. The main episodes of Sn and W transfer and cassiterite, wolframite and scheelite crystallization were contemporaneous with or slightly younger than the greisenization.

No. 14-16124S: **Refinement of lower Silurian chronostratigraphy: proposal of new GSSPs of the Aeronian and Homerian stages** (*P. Štorch*, *L. Slavík*, *L. Chadimová* & Š. Manda, J. Frýda, Z. Tasáryová, Czech Geological Survey, Praha; 2014–2016)

Present studies of the Rhuddanian-Aeronian boundary strata in the Barrandian area gained extensive datasets, necessary for pending decision on a new Aeronian boundary stratotype. The most complete, best accessible and the least thermally and tectonically affected Rhuddanian–Aeronian sedimentary succession crops out at the hillside high above the road from Hlásná Třebaň to Lety. Graptolite and chitinozoan biostratigraphy and taxonomy, sedimentary structures and mineral composition, major and trace element geochemistry, TOC, as well as carbon and nitrogen isotope studies are incorporated in a comprehensive description of this GSSP candidate section. The flavin adenine dinucleotide (FAD) of *Demirastrites triangulatus* (Harkness) at Hlásná Třebaň will be proposed as a new "golden spike" for revised base of the Aeronian Stage. Graptolite fauna from Hlásná Třebaň comprises 65 species recovered from *Akidograptus ascensus*–lowermost *Demirastrites simulans* biozones, including 16 previously unrecorded taxa. Systematic revision of the graptolites benefits from recent study of particularly well preserved specimens from Rhuddanian-Aeronian boundary interval in Všeradice (Štorch 2015). Detailed systematic study of the lower Aeronian demirastritids in collaboration with M.J. Melchin revealed 4 previously unrecognized taxa [*Demirastrites brevis* (Sudbury), *Demirastrites* cf. *raitzhainensis* (Eisel), *Demirastrites major* (Elles & Wood) and *Demirastrites* sp. cf *major*].

A section through Homerian black-shale succession has been studied in the Kosov Quarry near Beroun city. Uppermost part of the *Cyrtograptus lundgreni* Biozone recorded accelerating impoverishment of the flourishing graptolite fauna as a result of global extinction termed "big crisis" or lundgreni extinction Event. In the section studied, the first victims were large and specialized cyrtograptids, plectograptines and some monograptids. The section recorded brief occurrence of a single disaster taxon, latest survivors belong in ubiquitous, ecologically tolerant long-ranging taxa. Also benthic fauna disappeared temporarily in the extinction interval. Post-extinction succession included muddy limestone with minute shelly fauna, pigmy rhabdosomes of a single surviving monograptid and single plectograptid opportunist. A complete history of the post-extinction recovery has been observed in the Kosov Section.

Homerian–Gorstian (i.e. Wenlock–Ludlow) boundary section exposed by a trench near Nesvačily belongs in best Wenlock–Ludlow boundary sections in the World. Shale-dominated offshore sucession, almost 8 m in thickness, comprises upper *Colonograptus ludensis* and lower and middle *Neodiversograptus nilssoni* biozones (Štorch *et al.*, in press). This interval is notorious for its rather low diversity of the graptolite fauna. Despite this precaution, we identified 16 species along with subordinate shelly fauna. Some taxa were new, unknown or little known from the Prague Basin. The section, sampled also for conodonts and carbon isotopes has been presented to ISSS as one of the most important reference sections in the ongoing search for new GSSP of the Ludlow Series (and Gorstian Stage).

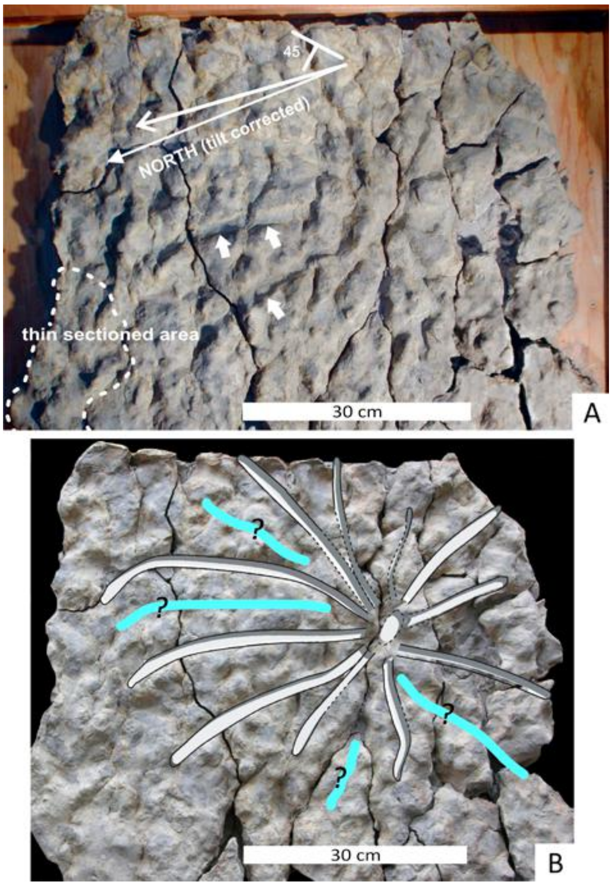
ŠTORCH P. (2015). Graptolites from Rhuddanian-Aeronian boundary interval (Silurian) in the Prague Synform, Czech Republic. – *Bulletin of Geosciences*, 90, 4: 841–891.

ŠTORCH P., MANDA Š., SLAVÍK L. & TASÁRYOVÁ Z. (in press). Wenlock-Ludlow boundary interval revisited: New insights from the off-shore facies of the Prague Synform, Czech Republic. – *Canadian Journal of Earth Sciences*.

No. GA14-18183S: **Sequence stratigraphy of Devonian bioevents – sea level changes at the transition from greenhouse to icehouse world** (O. Bábek, M. Faměra, D. Šimíček, Faculty of Science, Palacký University, Olomouc; *J. Hladil*, *H. Poukarová*, *L. Slavík*, *L. Chadimová*; J. Kalvoda, T. Weiner, T. Kumpan, H. Poukarová, Faculty of Science, Masaryk University, Brno, Czech Republic; 2014–2016).

The project is characterized by combination of a great, possibly unprecedented number of methods in the fields around sequence stratigraphy and climate assessment of the Devonian carbonate successions, as the correct understanding of events requires much more and detailed knowledge about sedimentary bodies. The Institute's workers participated preferentially in the studies of the Lower Devonian limestones preserved in the Prague Synform (~ "central or upper Barrandian structures" or "Prague Basin"). The principal tasks for the 2nd year were: (i) cyclostratigraphy, possible record of orbital climatic cycles; (ii) sedimentary processes and shallow burial diagenesis; (iii) the understanding the calciturbidite-to-pelagic "red" and "grey" beds; (iv) distinctiveness of the Pragian sediments, composition and environment; (v) the application of quantitative microfacies approach; (vi) the refinement of biostratigraphic correlation, on short and long distances; and finally, (vii) attempts to understand the isotopic signatures of highly siderophile elements (HSEs). A special emphasis was given to informal international cooperation with world's leading teams in the individual disciplines, adjusting the most contemporaneous techniques for our specific needs (e.g., University of Liège, Univ. of Utrecht, University of Wisconsin in Madison, VU University Amsterdam, University of Valencia in Burjassot, GeoZentrum Nordbayern in Erlangen and Durham University). In this short annual report, only the descriptions of the first two tasks are involved. For other points we refer to publication and conference papers searchable according to names of project participants in this volume of Research Reports.

Cyclostratigraphy: in this direction, we face the problems of numerous hiatuses as well as condensation/swelling in stratigraphic sections. Studies were based on magnetic susceptibility (MS) signals. With respect to sediment accumulation rate, the sections were subdivided into individual portions according to continuous wavelet transform (CWT), evolutive harmonic



■ **Fig. 14.** Illustration of a large star-like trace fossil with rays that intersected the primitive limestone nodules which originated almost on the sea floor together with solidification of sediment (compare Mikuláš & Hladil 2015). The trace spread over the calciturbidite bed surface during a period of sediment starvation. Branická skála, Praha; Lower Devonian, Praha Formation, its early Emsian part. A – The plate sampled by R. Mikuláš, original orientation and other details are marked; arrows point to contacts between the trace and partly damaged nodules. B – Graphical highlighting of the star-like ichnofossil. Original photographs and graphics by J. Hladil & R. Mikuláš.

analysis (EHA) and detailed lithological observations in field and laboratory. Subsequently, the multitaper method (MTM) and multitaper harmonic analysis (F-test) were used to extract the frequencies reaching 95% confidence level. These frequencies were further treated by means of the average spectral misfit procedures (ASM) to have a more realistic chance of comparison with orbital tuning target. Combining these techniques in several sections, 405 ka cyclicity was identified, giving us a powerful duration chronometer. The new results indicate duration of 7.7 ± 2 Ma for the Lochkovian stage and of 1.7 ± 1.4 Ma for the Pragian stage, differently from the latest ICS Chronostratigraphic Chart concluding the durations of 8.4 ± 6 Ma and 3.2 ± 5.4 Ma, respectively (Da Silva et al. 2015).

Sedimentary processes: the data about early origin of limestone nodules were found in the Emsian part of the Praha Formation at Branická skála, where a wide, gently inclined trough or depression formed a submarine step which forms an obstacle to normal movement of gravity flows to ocean depths. This step led to submarine gravity flow deceleration, collapsing, density increase and deposition. The beds episodically deposited from calcisiltitic slurries were separated by relicts of material deposited on sediment-starved, current-washed seafloor. The findings based on sedimentology and diagenetic successions around stiffgrounds, firmgrounds and hardgrounds were significantly supported by ichnology. The relatively large and deep radial rays of a 0.6 m large, star-shaped surface feeding trace ?*Capodistria* isp. intersected (abraded, dismantled) the upper parts of limestone nodules as early as at their early stage of formation, whereas the locally observable additional deformation of the linear and smooth trace fossil's "radiating grooves to tunnels" was caused by a subsequent reshaping of some nodules due to continued diagenesis and tectonic shear (Fig. 14). Thus, this biogenic activity was contemporaneous with the first diagenetic formation of undulated bed surfaces, indicating that the primitive nodules originated very early, almost on the seafloor. In addition, also *Trypanites* hardground borers provide the evidence about surprising solidification of seafloor at such depths of few hundred metres (Mikuláš & Hladil 2015).

DA SILVA A.C., CHADIMOVÁ L., HLADIL J., SLAVÍK L., HILGEN F.J. & DEKKERS M.J. (2015): Unravelling orbital climatic cycles from Devonian magnetic susceptibility signal – The quest for a better age model for the Lochkovian and Pragian stages (Czech Republic). – *AGU Fall Meeeting, December 14–18, 2015, San Francisco, Abstracts*: GP43D-08, Pap. 74022. American Geophysical Union, San Francisco.

MIKULÁŠ R. & HLADIL J. (2015): A large trace fossil in nodular limestones (Lower Devonian, Czech Republic): sedimentological consequences, ethology and taphonomy. – *Ichnos-An International Journal for Plant and Animal Traces*, 22, 2: 69–76.

4c. Technology Agency of the Czech Republic

Continuing projects

No. TA03021289: **Measurement of migratory properties of rocks with fracture permeability using fluorescent solutions** (*J. Rohovec*; V. Lachman, R. Kovářová, P. Bílý, P. Novák, ISATech, Ltd., Praha; R. Vašíček, Czech Technical University (ČVUT), Praha; V. Frydrych, Z. Patzelt, R. Šigut, L. Vachudová, M. Durajová, K. Koděrová, Geomedia, Ltd., Praha; 2013–2016)

In 2015, laboratory models were tested in order to obtain experimental data describing tracer passage through artifically created fracture. Experimental models were constructed using granite blocks, separated by an inert distance shim, defining apreture of the fracture. The model fracture was filled either by innert material with well-defined packing properties, or by sorbing material. Glass beds were used as inert filling material. Due to appreciable weight of experimental block set, all the experimental work was performed in the Underground Research Center Josef, managed by the ČVUT Praha. In this laboratory, crane equipment is accessible for manipulations.

In one group of experiments, the influence of fracture apreture and glass beds diameter on tracer migration parameters was studied. Increase of bed diameter, as well as fracture apreture, lead to increase of time needed for tracer passage through the system, but did not change the parameter of tracer sorption loss in the material. Observed recovery was higher than 90% in all experiments employing Fluorescein as tracer, while 80–90% recovery was obtained with Rhodamine WT tracer. Actual concentrations of tracer were quantified in variable positions on experimental blocks set using fluorescence probes. As a result, the function c (x, y, t) was obtained.

In order to better understand the role of sorption phenomena on fracture filling and support of mathematical modelling, a special filling material was prepared in GEO labs, starting from the inert glass beds already tested. By techniques of surface chemistry, the inert glass surface was modified introducing quarternary ammonium groups, hence a dramatical increase of sorption coefficient of fluorescent tracers was reached. At the same time, all other parameters of material, expecially geometrical and granulometric ones were preserved. This modified material was employed as fracture filling in second group of experiments. The same data sets were collected as in the first group of experiments. Comparision of the data obtained allowed separation of sorption effects in matematical models from other parameters govering the in the artificial fracture.

Tracer experiments on real fractures were performed starting from summer 2015 also in the Josef gallery. In JP47 experimental site, the fracture system was identified and described. Appropriate natural fracture was carefully selected in the massif, equipped with packers and other gear for hydrological tracing and pilot tracing experiments were performed using Fluorescein and Rhodamine WT as tracers. Collected data sets were restricted in comparison to the experiments on atrificial blocs, as the function c(x,y,t) was not accessible for the natural fracture. Nevertheless, the concentration of tracer in solution on inlet and outlet site (i.e. functions $c_{in}(t)$, $c_{out}(t)$) were subjected to matematical modelling procedures and reasonably described by current optimised parameter sets introduced to models.

4d. University Grant Agencies

Finished projects

GAUK No. 742213: **Vertebrate dentition: mineralogical and crystallographic characterization of inorganic components** (*A. Kallistová*, *R. Skála*; I. Horáček, & P. Hanousková, Faculty of Science, Charles University, Praha, Czech Republic; 2013–2015)

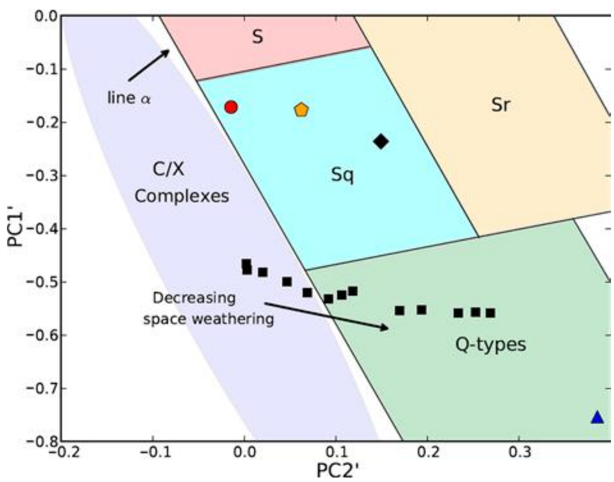
The intricate crystallization patterns and high content of inorganic hydroxylapatite present key factors of functional significance of vertebrate teeth. Consequently, the mineralogical and material science is expected to provide a key information on these structures. The present project is intended to gather a relevant amount of comparative data on crystallographic properties of mineralized teeth tissues in major vertebrate clades and principal mammalian orders, with aid of a refined standardized technique of crystallographic analysis focused to microstructure and texture analysis, combined with standardized SEM analyses of enamel architecture, and contextual information on functional specificities of particular teeth. A set of these data is expected to provide a reliable basis for a multifactorial analyses of functional correlates of particular crystallographic variables and their phylogenetic representation.

4e. Grants of the State Departments

Finished projects

Ministry of Education, Youth and Sports, "KONTAKT II", Project No. LH12079: **Laboratory simulations of space weathering - the role of iron nanoparticles in the reflectance spectra of asteroids** (*T. Kohout*, *G. Kletetschka*, *R. Skála*; J. Čuda, J. Filip, R. Zbořil & J. Tuček, Palacký University Olomouc, Czech Republic; 2012–2015)

The project focused on the optical effects of asteroid surface space weathering associated with the micrometeorite bombardment and related occurrence of the nanosized metallic iron. A new laboratory space weathering simulation method was developed. The method is based on a thermal treatment of silicate minerals (olivine and pyroxene) and meteorites (chondrites, HEDs) resulting in controlled production of nanosized metallic iron particles on a surface of the powdered mineral grains. Resulting changes in reflectance spectra of such modified minerals and meteorites were measured and correlated with the spectra of silicate asteroids (S-type, V-type) in order to reveal the spectral trends of the space weathering.



■ **Fig. 15.** Space weathering optical trends are clearly distinguishable from shock related spectral darkening in principal component analysis space.

The main results of the study are: (1) spectral changes progress logarithmically with time and amount of the nanophase iron. This explains rapid onset of the optical effects of the space weathering on fresh planetary surfaces. The space weathering slows down on mature planetary surfaces (Fig. 15); (2) space weathering optical trends are clearly distinguishable from shock related spectral darkening, and (3) contrary to previous studies lunar-type space weathering is possible on Vesta.

Ministry of Education, Youth and Sports, "KONTAKT II" – Project No. LH13102: **Kinematic and dynamic anisotropy of sedimentary and crystalline rocks: Ultrasonic, synchrotron and neutron diffraction study** (H.R. Wenk, University of California, Berkeley, Earth&Planetary Science, USA; *T. Lokajíček*, *T. Svitek* & *M. Petružálek*; 2013–2015)

The fundamental result of the project was a design of new high pressure measuring head enabling simultaneous ultrasonic sounding by longitudinal and transversal sounding up to 100 MPa of hydrostatic pressure. Determined P and fast and slow shear wave 3D velocity components enabled calculation of full stiffness's tensor. There was characterized rock microstructure and designed complex model media.

Knowledge of shear wave velocities in loaded rocks is important in describing elastic anisotropy. A new high-pressure measuring head was designed and constructed for longitudinal and traversal ultrasonic sounding of spherical rock samples in 132 independent directions under hydrostatic pressure up to 60 MPa. The velocity is measured using a pair of P-wave sensors and two pairs of S-wave sensors (TV/RV and TH/RH) with perpendicular polarization. An isotropic glass sphere was used to calibrate the experimental setup. A fine-grained anisotropic quartzite sample was examined using the P- and S-wave ultrasonic sounding. Waveforms are recorded by pairs of TP/RP, TV/RV and TH/RH transducers in a range of confining pressure between 0.1 to 60 MPa. The recorded data showed a shear wave splitting in three basic structural directions of the sample. The measurements proved to be useful in investigating oriented micro-cracks, lattice (LPO) and shape-preferred orientation (SPO) for the bulk elastic anisotropy of anisotropic rocks subjected to hydrostatic pressure.

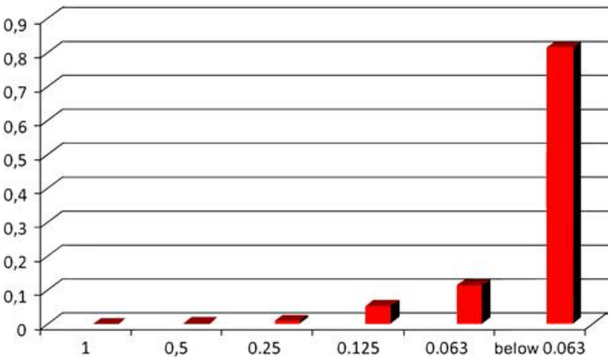
The most common type of waves used for probing anisotropy of rocks in laboratory is the direct P-wave. Information potential of the measured P-wave velocity, however, is limited. In rocks displaying weak triclinic anisotropy, the P-wave velocity depends just on 15 linear combinations of 21 elastic parameters, called the weak-anisotropy parameters. In strong triclinic anisotropy, the P-wave velocity depends on the whole set of 21 elastic parameters, but inversion for 6 of them is ill-conditioned and these parameters are retrieved with low accuracy. Therefore, in order to retrieve the complete elastic tensor accurately, velocities of S-waves must also be measured and inverted. For this purpose, we developed a lab facility which allows the P- and S-wave ultrasonic sounding of spherical rock samples in 132 directions regularly distributed over the sphere. The velocities are measured using a pair of P-wave sensors with the transmitter and receiver polarized along the radial direction and using two pairs of S-wave sensors with the transmitter and receiver polarized tangentially to the spherical sample in the mutually perpendicular directions. On synthetic tests we demonstrate that the success of the inversion for elastic parameters depends on several conditions. We analyzed differences between theoretical and calculated velocities based on different precision of readings of the S1- and S2-wave onset times (*x*-axis on individual plots), different initial *Vp/Vs* ratio (*y*-axis on individual plots) as well as the different type of wave used in the inversion: P-wave velocities (P only method), P- and S1-wave velocities (P, S1 method) or P-, S1- and S2-wave velocities (P, S1, S2 method) are included (individual rows). Our results show that inversion is more robust and stable if velocities of both S waves are included.

We made a combined study of a classical rock sample from Val Malenco, Italy, by investigating the microstructure and texture with state-of-the art synchrotron X-ray, neutron diffraction methods and measuring ultrasonic velocities both with a multianvil apparatus and a novel instrument to measure P and S velocities on spheres. Petrological properties were studied by thin section analysis. Both, synchrotron and neutron diffraction data were analyzed for preferred orientation with the Rietveld method. The program MAUD was used for texture analysis. Velocity measurements were done by classical measurements of P- and S-wave velocities using the pulse transmission technique at room temperature and pressures up to 600 MPa with a triaxial apparatus. There was also measured 3D velocity distribution of spherical samples by P- and S-wave ultrasonic sounding. Determination of P, S1 (fast) and S2 (slow) wave velocities enables to calculate a full stiffness tensor. The crack distribution from non-linear approximation of P-wave measurements on sphere was determined. From quantitative texture measurements, elastic properties are modelled by self-consistent averaging. Comparison of experimental and model Cij parameters is done based on microstructures. Both, results from diffraction methods and velocity measurements are compared. Good agreement between the velocity and microstructural models is observed.

Ministry of Environment of the Czech Republic, Administration of the Krkonoše National Park, internal No. 115V16200-1172: **Research of the Celní Cave in Horní Albeřice village with the respect to protection of karst phenomena** (R. Tásler, Czech Speleological Society, Caving Club No. 5-02 Albeřice Svoboda nad Úpou, Czech Republic; *M. Šťastný* & *P. Bosák*; internal code: 7302; 2015)

The Celní Cave developed in crystalline limestones in the Krkonoše Mountains (Albeřice Karst; northern Bohemia) in two levels (totally 119 m long and 22 m deep). The cave contains interesting fine-grained sediments especially in the Transportní (Transport) Dome, Severní (Northern) Passage and also in some narrow inaccessible side channels. The sediments are macroscopically homogeneous with dark brown color, they contain fragments of vein quartz (up to 5 mm in size) and weathered phyllites in places. They differ from more common layered fine-grained sediments of lighter colors (e.g., in the Vlhký – Moist – Dome). The sample for detailed petrologic and mineralogic analyses was sampled in the Transportní Dome from about 60 cm thick profile, at 25 to 40 cm below the profile top.

Grain-size	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm	< 0.063 mm
Rest on sieve	0.0 %	0.34 %	1.06 %	5.46 %	11.49 %	81.65 %



■ **Fig. 16.** Results of grain-size analysis: rest on sieves. The Celní Cave.

Studied sediment is very fine-grained (ca 82 % of grains have size below 0.063 mm; Fig. 16) with high amount of organic matter and muscovite predominance (cca 65 %) in the anorganic part of the sediment. The XRD analysis detected also quartz, feldspars (K- and Na-bearing) and some clay minerals (chlorite, kaolinite). The organic content detected by the dissolution method constitutes 28.8 % of sample. Heavy minerals (separated in heavy liquids) are composed of association with nonmagnetic: apatite and rutile, and magnetic: haematite, goethite and lepidocrockite; the XRD analysis indicated the presence of clinochlore (modification of chlorite, product of weathering of Fe-bearing minerals; Šťastný 2015; Tásler et al. 2015).

The analyzed sediment represents highly non typical cave sediment composed dominantly of silty grain-size fraction and organic matter; muscovite predominates in anorganic part and proportion of clay mineral fraction is very low. Muscovite could be derived, together with quartz, from weathering (dissolution) of crystalline limestones (autochthonous insoluble residue) or phyllite intercalations in them. With the respect to the fact, that in the Albeřice Karst, the communication of subterranean caves with surface was never identified and proved, therefore also the transport of material from matrix of surface screes and/or weathering profiles and soils as a source of studied sediments is highly improbable. This fact can indicate, that caves there are cryptokarstic (*sensu* Fink 1976) and the homogeneous fine-grained sediment could represent phreatic clay. Nevertheless, the high content of organic matter demands further study and explanation.

FINK M.H. (1976): Zum Stand der phänomelogischen und typologischen Karstforschung. – *Mitteilungen der Österreichischen Geographishen Gesellschaft*, 118, II: 211 – 236. Wien.

ŠŤASTNÝ M. (2015): *Mineralogické zhodnocení sedimentů z Celní jeskyně (Krkonoše)*. – Nepublikovaná výzkumná zpráva, Geologický ústav AV ČR, v. v. i. pro Českou speleologickou společnost, základní organizace 5-02 Albeřice: 1–10. Praha.

TÁSLER R., BOSÁK P., FEDIUK F., ŠŤASTNÝ M. & ZIKA V. (2015): *Výzkum Celní jeskyně v Horních Albeřicích s důrazem na ochranu krasových jevů*. – Nepublikovaná zpráva, Česká speleologická společnost Albeřice pro Správu KRNAP, arch. číslo 0470: 1–34, 7 příl. Svoboda nad Úpou.

4f. Industrial Grants and Projects

Energoprůzkum Praha, spol. s r. o., Project No. 7006: **Paleomagnetic investigation of rocks in vicinity of Nuclear Power Plant Dukovany** (*P. Schnabl, P. Pruner, K. Čížková, J. Petráček* & Š. Kdýr)

Paleomagnetic measurement of weathered crystalline rocks of the Moldanubian in vicinity of Dukovany Nuclear Power Plant proved that: (1) pre-Variscan paleomagnetic component survived in gneiss; (2) Variscan paleomagnetic component survived in garnet amphibolite, and (3) the studied area was during the main phase of weathering on the latitude 40.7 ± 3° which is approximately 5–11° southerly than recently. According the paleopole position, the weathering episode ended earlier than 4 Ma ago. From the paleomagnetic point of view the Neogene, Paleogene or upper Cretaceous cannot be excluded

Palacký University, Olomouc, Project No. 7006: **Magneto-mineralogy of Devonian limestones from of Branžovy Quarry** (*K. Čížková, T. Elbra, P. Pruner* & *P. Schnabl*)

Devonian limestones were subjected to several magneto-mineralogical analyses such as acquisition curve of isothermal remanent magnetisation and thermal dependence of magnetic susceptibility followed by demagnetization by alternating field. High and low coercivity minerals were distinguished and critical temperatures of some magnetic minerals were interpreted.

Severočeské doly, a.s., Project No. 7006: **Magnetostratigraphy of Lom and Libkovice layers, drill core HK772** (*P. Schnabl, P. Pruner, K. Čížková, J. Petráček* & Š. Kdýr)

Paleomagnetic investigation of sediments of the Lom and Libkovice formations from drill core HK772 proved that the studied 90 m long sequence contain four magnetozones; two with normal and two with reverse polarity. The correlation of the drill core HK772 with SP269 and HK591 proves the age between 16.4 and 16.8 Ma.

Czech Geological Survey, Praha, Project No. 7004: **Re–Os and highly siderophile element systematics of carbonatites from India** (*L. Ackerman*)

The project is focused on the determination of highly siderophile elements and $^{187}Os/^{188}Os$ compositions of the selected carbonatites from southern India. It represents the external project connected with the project of Czech Science Foundation held in Czech Geological Survey (Dr. Magna).

Karadeniz Technical University, Trabzon, Project No. 7004: **Re–Os and highly siderophile element analyses of chromitites**

and associated peridotites from Anatolia, Turkey (*L. Ackerman, E. Haluzová & J. Ďurišová*)

Joint project with Karadeniz University (Dr. Uysal) focused on the determination of highly siderophile elements and $^{187}Os/^{188}Os$ compositions of selected peridotites and chromitite separates from ophiolites in Anatolia, Turkey.

Cadic-Conicet, Ushuaia; Project No. 7012: **Laser ablation ICP-MS U–Pb zircon dating of sandstone sample from the Eocene Punta Torcida Formation (Tierra del Fuego, Argentina)** (*M. Svojtka*)

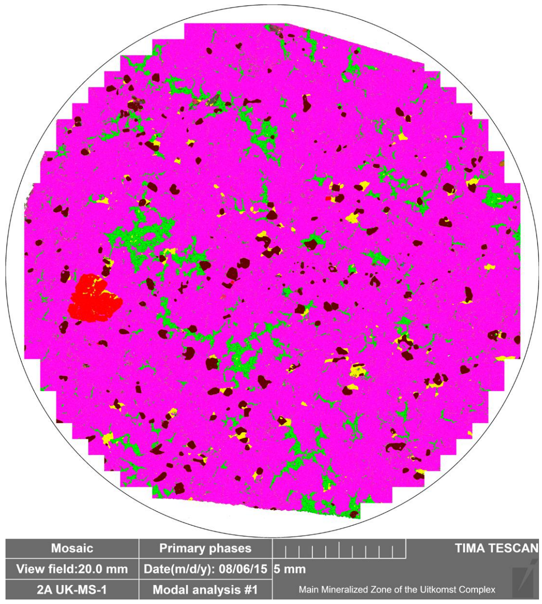
In order to define precise stratigraphic age of Eocene Punta Torcida Formation (Tierra del Fuego, Argentina), we dated zircons from sandstone sample using laser ablation ICP-MS U–Pb technique. Before dating, the internal structures were studied using cathodoluminiscence imaging. Most of studied zircons are clear and by the morphological zircon population are present equant to prismatic (stubby) grains and also limited number of euhedral needles. Internal zircon structures revealed predominant growth zoning texture-oscillatory zoning, typical for igneous zircon. U–Pb measurements yielded age of ca 46 Ma.

Archeologické centrum, Olomouc, Project No. 7020: **Neředín – výplň příkopu** (*L. Lisá*)

The main aim of the project was to evaluate the sedimentary infill of the Roman Age ditch surrounding the temporary camp. The locality is situated in Neředín (Olomouc District). Micromorphological evaluation of four samples from the infill revealed different formation processes for macroscopically divided layers as for example colluviation followed by the illuviation, the presence of limestones clasts which are trust to be a part of rampart or the presence of organic matter coming from the antropogenically deposited grass accumulations.

Institute of Geology of the CAS, v. v. i. Project No. 7041: **Establishment of a testing laboratory for automated and applied mineralogy** (*T. Hrstka*)

The TIMA GMH Mineralogical analyzer, a highly automated scanning electron microscope (SEM), is currently hosted at the Institute of Geology to establish an application and testing laboratory for applied and automated mineralogy in collaboration with TESCAN ORSAY HOLDING, a.s. This instrument is a first installation of its type in the Czech Republic and provides fast acquisition of statistically robust modal data. It also provides data on textural relationships between the individual minerals/phases (Fig. 17). Fully digitalized hyperspectral maps can be produced with the resolution down to 0.1 µm on samples with size up to ~160 cm^2. Mapping of a classical thin section with resolution of 10 µm providing BSE, EDS and phase identification data can be obtained in less than 3 h. Automated search for a specific mineral or phase of interest BPS "Bright phase search" can scan a thin section in resolution of 0.5 µm in less than an hour to identify the bright phases like gold, PGM or REE minerals. Among other projects the instrument helped in characteristics of Ni–Cu–(PGE) mineralization at Rožany, Lusatian Granitoid Complex, Czech Republic, or in multi



■ **Fig. 17.** Polished section from the Main Mineralised Zone of the Uitkomst Complex, South Africa. Mineral distribution map in false colors showing: Pyrrhotite (pink), Pentlandite (green), Pyrite (red), Spinel-group (brown) and Cu-sulphides (yellow). Photo by T. Hrstka.

proxy study of sedimentary rocks and the search for the source of Th in middle Pragian sediments which was determined to be strongly linked to occurrences of monazite. Similar automated mineralogy approach has been also successfully tested on ash residues from incineration and other high-temperature waste treatment systems to provide information on modal distribution of phases which could be potentially recycled, as well as information on deportment of harmful elements such as lead, cadmium, copper and zinc. Apart from the research into application of automated mineralogy and petrology in geosciences the laboratory helps the further developments of software for TIMA Mineralogical analyzer.

Biology Centre CAS, v. v. i., České Budějovice, Project No. 7130: **Mineralogical and petrological description of granite samples from the Vysoké Tatry Mts.** (*K. Breiter, Z. Korbelová & J. Jabůrková*)

The report describes petrographical, mineralogical and geochemical character of three samples of granitoids of the High Tatra Mts. Samples were identified as Variscan biotite-amphibole granodiorite and muscovite leucogranit all affected by Alpine processes. The cause of easy extraction of calcium from biotite-amphibole granodiorite in an acidic environment is likely the presence of carbonates along the cracks.

Czech Geological Survey, Praha, Project No. 7130: **Geochemical, petrological and mineralogical description of samples from the old boreholes at Cínovec** (*K. Breiter*)

This report describes petrographical, mineralogical and geochemical characteristic of the granitoids from the borehole CS-1 in Cínovec/Zinnwald Sn–W–Li deposit. Distribution of selected chemical elements along the drilling profile was discussed in detail and a new evolutionary model of the granite pluton fractionation and Sn–W–Li–Nb–Ta mineralization was developed.

Universidad de Granada, Spain, Project No. 7272: **Paleoenvironmental comparison of south and northwest-Tethyan margins, paleomagnetic and magnetostratigraphic studies** (*P. Pruner*, *P. Schnabl*, *K. Čížková*, *J. Petráček*, *P. Petráček* & F. Olóriz Sáez, Universidad de Granada, Spain)

Studied condensed sections embracing the Middle/Upper Jurassic transition are located far eastwards from Granada (Carcabuey, Puerto Nuevo, Cañada) and northwards from Murcia (Fortuna, Corcue Sierra) in Spain (Fig. 18). Sections complies with our aims in three fundamental criteria, it has: (a) essentially continuous sedimentation, uninterrupted by marked diastems; (b) rich fossil associations (calpionellids, ammonites) allowing its detailed biostratigraphic division, and (c) rocks with magnetic properties that are favourable for reliable determination of palaeomag-

■ **Fig. 18.** Discussion before sampling in the Carcabuey locality, Spain. Prof. Olóriz Sáez with Dr. Schnabl. Photo by J. Petráček.

LOCALITY	MS [10^{-6} SI]	NRM [mA.m^{-1}]	N	Polarity/n	D [°]	I [°]	α_{95} [°]
Canada	53.40	12.12	22	N/9	60.6	51.8	7.2
Fortuna East	21.53	3.95	52	N/18	136.5	55.1	4.7
Fortuna	30.57	4.38	125	N/44	104.4	50.1	5.2
				R/12	299.4	–31.6	12.7
Carcabuey	51.18	10.94	89	N/26	57.9	46.5	4.1
				R/8	226.9	–47.4	11.2
Puerto 22	32.70	9.36	51	N/23	30.7	43.9	6.0
				R/10	196.1	–38.9	8.2
Carcabuey Kimmeridge	68.11	11.71	78	N/8	42.1	46.5	5.2
				R/29	211.7	–39.9	3.6
Carcabuey Tithonian	47.69	10.97	188	N/42	45.5	48.3	2.3
				R/14	211.2	–42.0	5.5
Carcabuey Oxford	75.18	11.24	18	N/9	51.0	50.8	4.9
Corque Sierra	27.16	5.87	45	N/3	160.6	57.9	26.3
				R/39	330.6	–33.2	3.0

■ **Tab. 1.** Mean values of the magnetic quantities in the groups of samples from different localities
Note: MS — volume magnetic susceptibility; NRM — natural remanent magnetization; N — number of samples; Polarity: N — normal polarity, R — reverse polarity; n — number of analysed samples; D, I — declination and inclination of the remanent magnetisation after dip correction; α_{95} — semi-vertical angle of the cone of confidence at the 95% probability level.

netic polarity. The average sampling density for the whole section is around three samples per metre – of true stratal thickness.

The preliminary paleomagnetic and magnetostratigraphic investigation of limestones from the profile, the measurement of basic magnetic properties and the results of multi-component analysis of remanence of the Middle/Upper Jurassic limestones has yielded new information on the correlation of palaeomagnetic events with biozones, and with events elsewhere in Tethys. Mean values of volume magnetic susceptibility (MS), the moduli of natural remanent magnetization (NRM), polarities and paleomagnetic directions for studied samples of Jurassic limestones are shown in Table 1. In the first stage of laboratory studies, pilot samples were subjected to the analysis of isothermal remanent magnetization acquisition and alternating field demagnetization curves with the aim to establish magnetic hardness of the magnetically active minerals contained in limestones. Both magnetic polarities are present in the characteristic component directions.

The identification of the individual magnetozones in the sections will be possible with the use of palaeontological data, because the magnetostratigraphic scale for the Middle/Upper Jurassic has several characteristic features which allow unambiguous determination of the individual polarity periods. A precise determination of the position of significant biostratigraphic horizons relative to the global magnetic polarity time scale is fundamental to making any progress in correlating diferent biostratigraphic data. In the studied sections, this aim was achieved with high precision using calpionellids and ammonites because the positions of the individual paleomagnetic zones were determined precisely.

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

The reclamation exploitation of the Koněprusy Limestone (Pragian, Lower Devonian) in the Giant Quarry of Devil Steps was limited only to the Bench. No. 338 also in 2015 (Bosák 2016a, b). The evaluation of walls after each blasting showed the continuation of calcite veins from past years and proved relatively rapid branching of thick calcite veins and their pinching out towards SSW in the distance of tens to hundreds of meters. Unfortunately, no cavities of the thermomineral paleokarst were discovered in 2015 due to the limited progress of quarry benches.

BOSÁK P. (2016a): *Postup těžebních stěn Velkolomu Čertovy schody–západ. Akce sanace a rekultivace severní stěny. Posudek. Období: leden až prosinec 2015*. – Nepublikovaná zpráva, Geologický ústav AV ČR, v. v. i. pro Velkolom Čertovy schody, a. s.: 1–20 + 1–78. Praha.
BOSÁK P. (2016b): *Postup těžebních stěn Velkolomu Čertovy schody–západ. Akce sanace a rekultivace severní stěny. Zhodnocení. Období: leden až prosinec 2015*. – Nepublikovaná zpráva, Geologický ústav AV ČR, v. v. i. pro Velkolom Čertovy schody, a. s.: 1–8. Praha.

Bohemian Switzerland National Park Administration, Krásná Lípa; Project No. 7407: **Monitoring of Atmospheric Precipitation in the Bohemian Switzerland National Park** (*T. Navrátil, I. Dobešová, J. Rohovec & Š. Matoušková*)

The monitoring of atmospheric deposition at Kuní vrch site in the territory of the Bohemian Switzerland National Park continues since year 2008. According to the bulk precipitation, the hydrological year 2014 can be assessed as below-average, the bulk precipitation at the Kuní vrch locality reached 728 mm and at the spruce throughfall locality 477 mm.

The precipitation pH at an open place ranged between 4.3 and 6.0, which was comparable with the pH values in hydrological years 2011–2013. The spruce throughfall pH values at KV-thsf locality ranged from 3.7 to 5.9. The deposition fluxes in the hydrological year 2014 of most terrigenous elements (Ca, Al, Sr etc.) were lower or comparable (Mn, Fe) with the past years. Due to the lower annual precipitation height fluxes of the most important acidificant SO_4^{2-} decreased with respect to year 2013. The open place flux reached 9.2 kg.ha^{-1}.yr^{-1} of SO_4^{2-} and spruce throughfall flux amounted at 24.7 kg.ha^{-1}.yr^{-1} of SO_4^{2-}. Similarly, the annual deposition fluxes of trace elements Cu, Zn, Sr, Pb, Rb, and Cd were lower than in the hydrological year 2013.

Nature Conservation Agency of the Czech Republic (AOPK), contracts No. PR-6/25/2015-01026/KV/2015; 02387/KV/15, internal Project No. 7454: **Evaluation of requests for speleological research in the Bohemian Karst Protected Landscape Area; Preparation of a database of former mining activities in the Křivoklátsko Protected Landscape Area** (*K. Žák, M. Filippi, J. Wagner & P. Bosák*; 2015–2016)

Two contracts both financed by the Central Bohemian Regional Office of the Nature Conservation Agency of the Czech Republic were focused on speleological activity in the Bohemian Karst and on the former mining sites in the Křivoklátsko Protected Landscape Area (PLA). Within the first contract individual requests to perform speleological cave prospection and research in the caves of the Bohemian Karst, submitted by individual caving clubs, are evaluated from the scientific point of view. Our expert opinions are used in the process of issuing permision for these activities by the nature protection authorities. The second contract, which is financed by the same ordering institution, is focused on preparation of a database of former mining sites in the Křivoklátsko PLA. Both contracts continue into 2016.

Czech Society for Ornithology – Branch Vysočina, Jihlava, Project No. 7463: **Natural diversity of Vysočina region. Part III. – Mollusca** (*J. Hlaváč*)

The deliverable is a revision and determination of the terrestrial molluscs collections, excerption of published data, available unpublished data and additions to the occurrence of a field survey in the Vysocina region. The data has been processed in the Žďárské Hills and selectively at the locations in the river basin Rokytná, serpentine quarry at Borek and forest and wetland sites around the village of Horní Dubenky on which was detected species-rich and diverse malacofauna with some faunistically and zoogeographically remarkable species (eg. *Nesovitrea petronella*, *Vertigo antivertigo*, *Vertigo substriata*, *Vertigo pusilla*). Data on terrestrial molluscs were obtained during Malacological days 2013 were revised from several localities in the vicinity of Brtnice such as the castle ruin Rokštejn, National Reserves The valley of Brtnice river, Na Podlesích, and Opatovské zákopy with specific malacofauna represented by woddland, wetland and hemisynanthropic species and index species, a glacial relic snail *Vertigo geyeri*.

4g. Programmes of Institutional Research Plan

Project No. 9332: **Study of brittle fracture; additional thin sections and X-ray analysis** (*M. Coubal* & *M. Šťastný*)

Paleostress/tectonic phases acting in the Bohemian Massif during the Late Eocene and Oligocene were characterized and dated. For this purpose, brittle deformation of a number of geochronologically dated neovolcanic bodies was studied. These bodies were selected based on the criterion of their age: they are almost evenly distributed over an age range of 40–23 Ma. The study focused on bodies lying in the proximity of the Lusatian Fault and in the eastern part of the Eger Rift. A comparison of characteristics of the identified stress fields in rocks of different age showed the effects of two basic stress fields/tectonic phases in this interval: older NNW–SSE compression and younger WNW–ESE dilation. The boundary between the two can be dated to ca. 33 Ma. Based on field, petrographic and X-ray study, mineral composition of the core of the Lusatian Fault from the Doubice site was determined. In addition, a hitherto unknown block of Permian rhyolites was discovered.

Project No. 9338: **Preparation and irradiation of apatite and titanite standards for fission track analysis** (*D. Kořínková*)

Institutional financial contribution was used for the preparation new apatite and titanite standards for fission track analysis (FTA). They were made and laboratory-prepared polished sections of Durango apatite standards, Sljudjanka apatite, and also Fish Canyon Tuff titanite and Mt. Dromedary titanite standards for FTA. These samples were irradiated in nuclear reactor at the Nuclear Research Institute Řež, a. s. (Husinec, Czech Republic) and assessed for the possibility of further FT-dating.

Project No. 9343: **Palynology of nearshore deposits of the Plaňany quarry (Lower Turonian) of the Bohemian Cretaceous Basin** (*M. Svobodová*)

The palynological data presented in this study were collected with the aim of supplementing the biostratigraphical and palaeoenvironmental interpretation. The palynological study of rich association of non-calcareous dinoflagellate cysts, bryophyte and pteridophyte spores, conifers and angiosperm pollen grains of the Normapolles group (126 species) in the nearshore deposits in the exposures of the Plaňany Quarry (Bohemian Cretaceous Basin) provided biostratigraphic data to evidence the Lower Turonian age. The composition of dinoflagellate cysts as well as the presence of microforaminiferal linings and acritarchs evidenced the gradual deepening of the sea. Pyrite crystals abundant in basal deposits of the quarry are connected with sulfate reduction processes.

Project No. 9344: **Preliminary U/Pb isotope measuring in zircons from Třebenice area** (*J. Ulrych*, *M. Svojtka* & *J. Ďurišová*)

The homogeneous and oscillatory zoned isometric subhedral to euhedral redbrown low-hafnium zircon megacrys (up to 10 mm long) occur in gravels in the volcanic province of the České středohoří Mts. U-Pb age of zircon (35 ± 1.0 Ma) fit the K-Ar age (Eocene to Oligocene 36–26 Ma) and lithostratigraphic position of surrounding basanitic lavas of the main group of flows of the České středohoří Mts.

Project No. 9346: **Roots impact on soil structure and soil porous system** (*A. Žigová*)

Factor that greatly influenced soil structure is plant roots. The root distribution depends on the plant species and its interaction with soil condition. The goal of this study was to visualize preferential flow due to plant root influences at macro- and micro scale. This study provides information required to upscale from rhizospere to plot scale processes. It is directly relevant to understanding water capture by plants and the potential preferential flow or fertilzer and other chemicals to the root-soil interface.

The present research was conducted at the experimental station in Čáslav. The studied soil was a Greyic Phaeozem developed on loess. The conventional tillage with the 3-year rotation system was applied at selected field. This study used a dye tracer to visualize the impact of plants on water flow in the Ap horizon. Briliant blue was ponded to 10 cm height in a 1 m × 1 m frame in the field immediately after harvest of winter wheat. After complete infiltration, staining patterns within the vertical and horizontal field scale section were studied. During the vertical and horizontal soil profile excavation undisturbed stained samples were taken from Ap horizon to characterize various mechanism of the dye distribution at the micro-scale. Micromorphological properties characterizing the soil pore structure and the dye distribution were studied on thin soil section section prepared for the soil samples.

The results confirmed a multimodal character of preferential flow in the Ap horizon. The field-scale sections clearly documented uneven dye penetration into the soil surface, which increased due to presence of roots and in some cases decreased due to mechanical compaction of the soil surface. The micromorphological images showed that roots and stalk grow compressed soil and increased the bulk density near the roots and dye tracer could not penetrate into these regions. On the other hand, a preferential flow along the root was observed.

Project No. 9351: **Experiments of various materials for pressure cell construction** (*T. Elbra* & *K. Čížková*)

The purpose of the project was modified to complement the project No. 9367 *A preliminary magnetic study of iron oxides and sulfides*. Laboratory materials for rock magnetic investigations were acquired and magnetite samples subjected to thermomagnetic measurements. As a result, a new and improved data of magnetite crystals is gained. The results of the project help to extend the knowledge on nature and behavior of pure magnetic minerals, and therefore to understand of crustal structures and sources of magnetic anomalies which often reside deep in the crust under elevated pressure and temperature conditions.

Project No. 9354: **Petrographic variations of metabasic rocks of the Želešice type at newly discovered archaeological site „na Hojnarkách“** (*L. Krmíček*)

Metabasic rocks of the Želešice type were one of the most intensively utilized raw materials used for the manufacture of Neolithic polished industry in the Middle Danube region. Primary sources are located in the Ophiolite Belt (formerly Metabasite Zone) of the Brno Batholith, approximately 5 km SW of Brno.

All sites represent secondary workshops that are not located at the outcrops. Quarrying at the outcrops has not been directly confirmed for this period. Recently obtained data has revealed new information about the lithic operational stages, morphology, dimensions and procurement of the raw material. Petrographic analysis reveals several subvarieties of metabasic rocks which were utilized to different degrees (Fig. 19).

BARTÍK J., KRMÍČEK L., RYCHTAŘÍKOVÁ T. & ŠKRDLA P. (2015): Primárně zpracovatelská dílna na amfibolitové metabazity u Želešic [Primary workshop utilizing amphibole-bearing metabasic rock near Želešice]. – *Přehled výzkumů*, 56, 1: 31–57. Brno.

■ **Fig. 19.** Example of the stone tool (core) made from the metabasic rock of the Želešice type. Photo by J. Bartík.

Project No. 9363: **The development of external detector method of fission track dating analysis by using of titanite** (*J. Filip*)

The new apatite and titanite standards (Durango and Fish Canyon) were prepared for fission track dating. The apatites and titanites were processed and etched by standard methods, titanites especially in accordance with Wagner–Jonckheere method. The titanite samples from Demitz–Thumitz and Brno–Obřany and apatite sample from Sljudjanka (Siberia, Russia) were processed by similar manner. Low-uranium muscovite detectors were fastened on polished surfaces of samples and stacked in irradiation cassette with CN5 glass neutron dosimeters and irradiated at the suitable irradiation channel of Řež reactor (Nuclear Physics Institute of AS CR, Řež). The densities of spontaneous and induced tracks were measured by an Imager M1.m (Zeiss) microscope equipped with AUTOSCAN™ stage. The fission track age was calculated from the ratio of spontaneous and induced track densities using zeta calibration method. The ages were determined by using of AUTOSCAN program. The measuring was done with good agreement by two independent observers. The use of new prepared age standards reveals good agreement with results obtained before, but the more titanite age measurements is recomended for future.

Project No. 9367: **A preliminary magnetic study of iron oxides and sulfides** (*K. Čížková* & *T. Elbra*)

In order to find the best localities for sampling of iron oxides and sulfides suitable for magneto-mineralogical experiments we collected samples of magnetic rocks from 10 localities around Měděnec area. Rocks were crushed and magnetic minerals separated in the Department of Geological Processes and will be subjected to various magneto-mineralogical measurements.

Project No. 9369: **Methdology of Re–Os dating (black shales)** (*E. Haluzová*)

Acquire knowledge of laboratory and methodology skills about Re–Os dating of black shales was the main aim of the visit at the University of Alberta (Canada). Introducing this method into laboratory routine condition will benefit to date directly sulfide minerals and some natural metals in the black shales.

Project No. 9523: **The use of ICP-MS for U-series dating of cave carbonates** (*Š. Matoušková*, *J. Rohovec* & H. Hercman, Institute of Geological Sciences, Polish Academy of Sciences, Warsaw)

The continuing methodological project is based on a dating method, which is frequently used to determine the age of cave carbonates. This method works with the radioactive disequilibrium of some members of decay series. It is realized by the measurement of activity ratios of different uranium and thorium isotopes using alpha spectrometry. There are some disadvantages of the alpha spectrometry (high sample weight, overlap of emitted energy of key isotopes, time question, troubles with the detection of low concentration samples). The TIMS is also used, but this method is arduous, the preparation of samples is very difficult and time-consuming and the measurement is quite expensive. These are reasons why we decided to find a new possibility of the measurement of activity ratios – the Sector Field Mass Spectrometer with Inductive Coupled Plasma, Element II Thermo Scientific. In 2013 the ICP-MS measurement was optimized on artificial (from standards prepared) samples, during 2014 the method was verified on natural samples prepared extra for the ICP-MS and the data from ICP-MS were compared with data from the same parts of cave carbonate formerly measured using alpha spectrometry. This year we started to analyse real natural samples from many different localities and ages. A really big and laborious issue is the sample preparation using column separation – this step is performed on the cooperative institution in Warsaw, Poland (H. Hercman). In this cooperation a computer programme for data recalculating was created and the age of analysed samples is calculated. After the development of this method is finished, its implementation at our institute will be beneficial for many of its scientific departments.

4h. Defended theses

Habilitation thesis

Ackerman L. (2015): Geochemistry of selected mantle rocks from the Bohemian Massif (in Czech)

The thesis consists of two different parts. First part represents an overview on the Earth`s upper mantle with emphasis to major/trace element and isotopic geochemistry together with presentation of processes causing their variations. The second part presents the review of occurrences of mantle rocks in the Bohemian Massif and the results of the studies on the selected localities made by author and his co-workers with direct links to the papers published. This includes research on mantle xenoliths enclosed in Cenozoic volcanic rocks as well as large peridotite bodies within HT–HP terranes of the Bohemian Massif, which combine bulk-rock and mineral geochemistry with isotopic (Sr–Nd–Os) geochemistry. For the Habilitation procedure, the compilation of 10 papers published in impact journals from 2007 to 2014 by the author and/or his co-workers with the author`s participation is selected. These papers are given in the supplement of the thesis.

Ph.D. theses

Petružálek M. (2015): Characterization of migmatite fracturing using ultrasonic methods (in Czech)

The Ph.D. thesis is focused on fracturing process of migmatite, which is a low porosity anisotropic rock. Based on the interpretation of acoustic emission and ultrasonic sounding data, there was found a different way of micro and macro fracturing, in dependence of mutual orientation between migmatite foliation and loading axis. The dominance of tension microcracking, in combination with sliding and shearing in foliation plane, lead to a formation of single shear plane and subsequent failure of samples with subhorizontal foliation. In case of samples with oblique foliation, shearing and sliding mechanism played main role in their failure along the foliation. Due to the favourable orientation of primary microcrack system (parallel with loading axis), the combination of tension and shear microcracking lead to a formation of extension macrocracks in foliation plane of sample with subvertical foliation.

Tomek F. (2015): Magnetic fabric, magma flow and deformation in volcano-plutonic systems

This Ph.D. thesis examined emplacement dynamics and tectonic history of selected volcano–plutonic complexes in a continental c setting. The thesis consists of five essential chapters, four of which are published as individual papers in international peer reviewed journals while one is still under review. The studied units included: (1) andesitic lava domes and (2) sub-volcanic magma chambers (<3 km deep) of the Miocene Štiavnica volcano–plutonic complex, Western Carpathians, (3) Shellenbarger pluton (<3 km depth) within the mid-Cretaceous Minarets caldera, Sierra Nevada in California, and ~7–10 km deep granitoids of (4) Lower-Cretaceous Wallowa batholith, Blue Mountains province in Oregon and (5) Late Devonian Staré Sedlo complex, central Bohemian Massif. The research was based on detailed field and structural mapping, supported by analysis of magmatic textures (optical and BSD microscopy) and anisotropy of magnetic susceptibility (AMS). Additional methods included analysis of magnetic mineralogy and U–Pb radiometric on zircons dating obtained by laser ablation–inductively coupled plasma–mass spectrometry (LA–ICP–MS). The Ph.D. thesis showed that preexisting environment and active faulting of volcano–plutonic systems may largely control emplacement of volcanic and plutonic rocks as exemplified by the dynamics of growth and construction of lava domes and subvolcanic magma chambers. Furthermore, as opposed to theoretical models, it has been demonstrated that even very shallow-level small-scale intrusions are able to record subtle tectonic strains still in magmatic state. Although the fabrics in plutons preserve only one short snapshot of the inferred instantaneous strain, detailed analysis of syntectonic plutons characterized by hypersolidus fabrics together with precise radiometric dating could unravel complex deformation histories at regional scale over a long period of time. Finally, it has been proposed that pluton fabrics may be used to decipher kinematics of lithospheric plate convergence or divergence and changes in their past relative motions.

Trubač J. (2015): The Origin of Compositional and Textural Zoning of Shallow-level Granitoid Plutons

The main charge of the thesis was the study of the mechanism of compositional and textural zoning of granitoid plutons. A great emphasis was placed on the useof entire spectrum of the quantitative methods (e.g., structural analysis, anisotropy of magnetic susceptibility, texture analysis, isotope geochemistry, thermal modelling of intrusions cooling history, GIS). This topic was studied in detail at a few well-chosen, concentrically zoned plutonsin the Bohemian Massif (e.g., Říčany, Štěnovice, Čistá, and Melechov plutons).

A key aim of the Ph.D. thesis was a critical contribution to the debate of "incremental" formation of magmatic plutons hypothesis, which is currently being discussed in the literature and could be tested and developed by the study of compositional zonation of granitoid plutons. The result should be a precise definition of the various models of granitoid plutons zoning, a quantitative testing methods application and ultimately the general conclusions concerning the magma transport in the crust and development of magma chambers in upper crust.

Svitek T. (2015): Laboratory study of 3D elastic anisotropy of rocks (in Slovak)

The thesis consists of three main parts. The first part is devoted to the study of anisotropy of rocks as a main theme of the thesis. This part also describes theoretical determination of the elastic tensor parameters as well as practical aspects of laboratory data acquisition and deals with methods used for the development and analysis. The main part consists of a set of six authors‘ papers published in peer-reviewed journals. While the first four works are directly related to the topic of the thesis, two other publications relate to the studied topics only marginally. The four key works are discussed in more detail in Chapter 5, further papers are given only in their published version as a supplement (Chapter 8). The final part of the work (Chapter 6) summarizes published findings and highlights the objectives of the thesis.

The thesis evaluates influence of shear waves on rock anisotropy determination. Based on synthetic test and experimental measurements on spherical samples it was found that the knowledge of shear wave velocities is necessary for determining a full elastic tensor (21 elastic parameters) with sufficient accuracy. The comparison of individual calculation methods of elastic tensor: a) P-waves only, b) P- and S1-waves and c) P-, S1-, and S2 waves; showed that individual elastic parameters reach best results when P-, S1- and S2-wave velocities are considered into the algorithm.

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

5a. Papers published

*publications in journals included in the ISI Web of Science (IF value according to a list from 2014)

5.300* *BOROVIČKA J.*, OBORNÍK M., STŘÍBRNÝ J., NOORDELOOS M.E., PARRA SÁNCHEZ L.A. & GRYNDLER M. (2015): Phylogenetic and chemical studies in the potential psychotropic species complex of *Psilocybe atrobrunnea* with taxonomic and nomenclatoral notes. – *Persoonia*, 34: 1–9.

5.107* TRIGO-RODRIGUEZ J.M., LYYTINEN E., GRITSEVICH M., MORENO-IBANEZ M., BOTTKE W., WILLIAMS I., LUPOVKA V., DMITRIEV V., *KOHOUT T.* & GROKHOVSKY V. (2015): Orbit and dynamic origin of the recently recovered Annama's H5 chondrite. – *Monthly Notices of the Royal Astronomical Society*, 449, 2: 2119–2127.

4.884* MUNDL A., NTAFLOS T., *ACKERMAN L.*, BIZIMIS M., BJERG A. & HAUZENBERGER C.A. (2015): Meso- and Paleoproterozoic subcontinental lithospheric mantle domains beneath southern Patagonia: Isotopic evidence for its connection to Africa and Antarctica. – *Geology*, 43, 1: 39–42.

4.482* MEDARIS L. G., *ACKERMAN L.*, JELÍNEK E., MICHELS Z., ERBAN V. & KOTKOVÁ J. (2015): Depletion, cryptic metasomatism, and refertilization of Variscan lithospheric mantle: Evidence from major elements, trace elements, and Sr-Nd-Os isotopes in a Saxothuringian garnet peridotite. – *Lithos*, 226: 81–97.

4.482* *ACKERMAN L.*, *ULRYCH J.*, ŘANDA Z., HEGNER E., ERBAN V., MAGNA T., BALOGH K., FRÁNA J., *LANG M.* & *NOVÁK J.K.* (2015): Geochemical characteristics and petrogenesis of phonolites and trachytic rocks from the České Středohoří Volcanic Complex, the Ohře Rift, Bohemian Massif. – *Lithos*, 224-225: 256–271.

4.147* FARYAD S.W., KACHLÍK V., *SLÁMA J.* & HOINKES G. (2015): Corona formation in metatroctolite from the Moldanubian zone (Bohemian Massif). – *Journal of Metamorphic Geology*, 33: 295–310.

4.099* *FILIPPI M.*, DRAHOTA P., MACHOVIČ V., *BÖHMOVÁ V.* & MIHALJEVIČ M. (2015): Arsenic mineralogy and mobility in the arsenopyrite-rich historical mine dump. – *Science of the Total Environment*, 536: 713–728.

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3.453* GATTA G.D., SCHEIDL K.S., PIPPINGER T., *SKÁLA R.*, LEE Y. & MILETICH R. (2015): High-pressure behavior and crystal-fluid interaction under extreme conditions in paulingite [PAU-topology]. – *Microporous and Mesoporous Materials*, 206: 34–41.

3.444* HOFMEISTER J., HOŠEK J., BRABEC M., DVOŘÁK D., BERAN M., DECKEROVÁ H., BUREL J., KŘÍŽ M., *BOROVIČKA J.*, BĚŤÁK J., VAŠUTOVÁ M., MALÍČEK J., PALICE Z., SYROVÁTKOVÁ L., STEINOVÁ J., ČERNAJOVÁ I., HOLÁ E., NOVOZÁMSKÁ E., ČÍŽEK L., IAREMA V., BALTAZIUK K. & SVOBODA T. (2015): Value of old forest attributes related to cryptogam species richness in temperate forests: A quantitative assessment. – *Ecological Indicators*, 57: 497–504.

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3.318* ŽÁK J., VERNER K., *TOMEK F.*, HOLUB F.V., JOHNSON K. & SCHWARTZ J.J. (2015): Simultaneous batholith emplacement, terrane/continent collision, and oroclinal bending in the Blue Mountains Province, North American Cordillera. – *Tectonics*, 34: 1107–1128.

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2.999* PROVENZANO V., SHULL D.R., *KLETETSCHKA G.* & STUTZMAN E.P. (2015): Gd90Co2.5Fe7.5 Alloy Displaying Enhanced Magnetocaloric Properties Journal of Alloys and Compounds. – *Journal of Alloys and Compounds*: 622, 15: 1061–1067.

2.866* KEPPLER R., ULLEMEYER K., BEHRMANN J.H., KURZAWSKIR.M. & *LOKAJÍČEK T.* (2015): Crystallographic preferred orientations of exhumed subduction channel rocks from the Eclogite Zone of the Tauern Window (Eastern Alps, Austria), and implications on rock elastic anisotropies at great depths. – *Tectonophysics,* 647–648: 89–104.

2.785* HÄUSELMANN PH., MIHEVC A., *PRUNER P.*, HORÁČEK I., *ČERMÁK S.*, HERCMAN H., SAHY D., FIEBIG M., ZUPAN HAJNA N. & *BOSÁK P.* (2015): Snežna jama (Slovenia): interdisciplinary dating of cave sediments and implication for landscape evolution. – *Geomorphology*, 247: 10–24.

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2.639* *SLAMA J.* & PEDERSEN R.B. (2015): Zircon provenance of SW Caledonian phyllites reveals a distant Timanian sediment source. – *Journal of the Geological Society London*, 172: 465–478.

2.543* HROUDA F., BURIÁNEK D., KREJČÍ O. & *CHADIMA M.* (2015): Magnetic fabric and petrology of Miocene sub-volcanic sills and dykes emplaced into the SW Flysch Belt of the West Carpathians (S Moravia, Czech Republic) and their volcanological and tectonic implications. – *Journal of Volcanology and Geothermal Research*, 290, 1: 23–38.

2.339* KVAČEK J., HALAMSKI A.T., *SVOBODOVÁ M.* & DURSKA E. (2015): Coniacian flora of the Sudetes (south-western Poland): Palaeoecological and palaeoclimatic interpretations. – *Palaeogeography, Palaeoclimatology, Palaeoecology*, 436: 178–187.

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2.309 DAGSSON WALDHAUSEROVA P., ARNALDS O., OLAFSSON H., *HLADIL J.*, *SKÁLA R.*, *NAVRÁTIL T.*, *CHADIMOVÁ L.* & MEINANDER O. (2015): Snow–Dust Storm: Unique case study from Iceland, March 6–7, 2013. – *Aeolian Research*, 16: 69–74.

2.259* MRÁZEK J., POTEL M., BURŠÍK J., MRÁČEK A., *KALLISTOVÁ A.*, *JONÁŠOVÁ Š.*, BOHÁČEK J. & KAŠÍK I. (2015): Sol-gel synthesis and crystallization kinetic of dysprosium-titanate $Dy_2Ti_2O_7$ for photonic applications. – *Materials Chemistry and Physics*, 168: 159–167.

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2.093* *ACKERMAN L.*, MEDARIS L.G., ŠPAČEK P. & *ULRYCH J.* (2015): Geochemical and petrological constraints on mantle composition of the Ohře(Eger) Rift, Bohemian Massif: peridotite xenoliths from the České Středohoří Volcanic complex and northern Bohemia. – *International Journal of Earth Sciences*, 104, 8: 1957–1979.

2.062* HÁJKOVÁ P., PETR L., HORSÁK M., *ROHOVEC J.* & HÁJEK M. (2015): Interstadial inland dune slacks in south-west Slovakia: A multi-proxy vegetation and landscape reconstruction. – *Quaternary International*, 357: 314-328.

2.062* *LISA L.*, KOMOROCZY B., VLACH M., VÁLEK D., BAJER A., KOVÁRNÍK J., RAJTÁR J., HÜSSEN C.M. & ŠUMBEROVÁ R. (2015): How were the ditches filled? Sedimentological and micromorphological classification of formation processes within graben-like archaeological objects. – *Quaternary International*, 370: 66–76.

2.062* WISNIEWSKI A., PLONKA T., JARY Z., *LISA L.*, TRACZYK A., KUFEL-DIAKOWSKA B., RACZYK J.

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1.913* *BOROVIČKA J.*, BUŠEK B., MIKŠÍK M., DVOŘÁK D., JEPPESEN T.S., DIMA B., ALBERT L. & FRØSLEV T. G. (2015): *Cortinarius prodigiosus* – a new species of the subgenus *Phlegmacium* from Central Europe. – *Mycological Progress*, 14: 29.

1.904 * *ŽÍTT J.*, *VODRÁŽKA R.*, HRADECKÁ L., *SVOBODOVÁ M.*, *ŠŤASTNÝ M.* & ŠVÁBENICKÁ L. (2015): Depositional and palaeoenvironmental variation of lower Turonian nearshore facies in the Bohemian Cretaceous Basin, Czech Republic. – *Cretaceous Research*, 56: 293–315.

1.805* *LOKAJÍČEK T.* & *SVITEK T.* (2015): Laboratory measurement of elastic anisotropy on spherical rock samples by longitudinal and transverse sounding under confining pressure. – *Ultrasonics*, 56: 294–302.

1.762* *KLETETSCHKA G.*, VYHNANEK J., KAWASUMIOVA D., *NABELEK L.* & PETRUCHA V (2015): Localization of the Chelyabinsk Meteorite from magnetic Field Survey and GPS data. – *IEEE Sensors Journal,* 15, 9: 4875–4881.

1.656* PLAN L., SCHOBER A., SCHULZ D., SPÖTL CH., *PRUNER P.* & *BOSÁK P.* (2015): Speleogenesis of the Hermannshöhle cave system (Austria): Constraints from ^{230}Th/U-dating and palaeomagnetic analysis. – *International Journal of Speleology*, 44, 3: 315–326.

1.606* COUFALÍK P., ZVĚŘINA O., *KRMÍČEK L.*, POKORNÝ R. & KOMÁREK J. (2015): Ultra-trace analysis of Hg in alkaline lavas and regolith from James Ross Island. – *Antarctic Science*, 27, 3: 281–290.

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1.515* *ŠTORCH P.* (2015): Graptolites from Rhuddanian-Aeronian boundary interval (Silurian) in the Prague Synform, Czech Republic. – *Bulletin of Geosciences*, 90, 4: 841–891.

1.515* KRAFT P., *ŠTORCH P.* & MITCHELL C.E. (2015): Graptolites of the late Katian Králův Dvůr Formation (Ordovician, Prague Basin, Czech Republic). – *Bulletin of Geosciences*, 90, 1: 195–225.

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1.477* ANGELONE C. & *ČERMÁK S.* (2015): Two new species of *Prolagus* (Lagomorpha, Mammalia) from the Late Miocene of Hungary: taxonomy, biochronology, and palaeobiogeography. – *Paläontologische Zeitschrift,* 89, 4: 1023–1038.

1.444* POKORNÝ R., *KRMÍČEK L.* & ÁRTING U.E. (2015): The first evidence of trace fossils and pseudo-fossils in the continental interlava volcaniclastic sedimentary rocks on the Faroe Islands. – *Bulletin of the Geological Society of Denmark*, 2015, 1: 45–57.

1.405* *TRUBAČ J.*, VRÁNA S., *HALUZOVÁ E.* & *ACKERMAN L.* (2015): Petrology and geochemical characteristics of phlogopite pyroxenite related to durbachites, Moldanubian Zone, Bohemian Massif. – *Journal of Geosciences*, 60: 73–90.

1.405* PAŠAVA J., VESELOVSKÝ F., DRÁBEK M., *SVOJTKA M.*, POUR O., KLOMÍNSKÝ J., ŠKODA R., *ĎURIŠOVÁ J.*, *ACKERMAN L.*, HALODOVÁ P. & *HALUZOVÁ E.* (2015): Molybdenite-tungstenite association in the tungsten-bearing topaz greisen at Vítkov (Krkonoše-Jizera Crystalline Complex, Bohemian Massif): indication of changes in physico-chemical conditions in mineralizing system. – *Journal of Geosciences,* 60, 3: 149–161.

1.405* *HALUZOVÁ E.*, *ACKERMAN L.*, PAŠAVA J., *JONÁŠOVÁ Š.*, *SVOJTKA M.*, *HRSTKA T.* & VESELOVSKÝ F. (2015): Geochronology and characteristics of Ni-Cu-(PGE) mineralization at Rožany, Lusatian Granitoid Complex, Czech Republic. – *Journal of Geosciences*, 60: 219–236.

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1.021* ŠEVČÍKOVÁ H. & *BOROVIČKA J.* (2015): *Pluteus floccipes*, a new species from the Czech Republic. – *Sydowia*, 67: 157–165.

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5c. Extended abstracts and abstracts, lectures and poster presentations

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ADAMOVIČ J.: Vznik, krása a zánik pískovcových krajin. *Lecture. Rezidence RoSa, April 13, 2015*. Praha.

ADAMOVIČ J.: Vznik, krása a zánik pískovcových krajin. *Lecture. Rezidence RoSa, April 13, 2015*. Praha.

ADAMOVIČ J.: Halucinogenní houby. *Lecture. Středisko ekologické výchovy Hl. m. Prahy Toulcův dvůr, November 23, 2015*. Praha.

ADAMOVIČ J.: Moderní metody určování makromycetů. *Lecture. MK Pardubice, November 11, 2015*. Pardubice.

BOSÁK P.: Vývoj ložiska vysokoprocentního vápence Koněprusy od počátku do kvartéru [The evolution of the deposit of high-grade limestone at Koněprusy strom beginning to Quaternary]. *Lecture*. *Evropské minerální dny 2015, September 26, 2015. Velkolom Čertovy schody*. Tmaň.

CÍLEK V. & BARTUŠKA V.: Energetika. *Lecture. Diplomatická akademie. December 7, 2015.* Praha.

CÍLEK V.: Budoucnost bezpečnosti. *Lecture. Poslanecká sněmovna, February 17, 2015.* Praha.

CÍLEK V.: Co je domov a jak vzniká? *Lecture. ČVÚT, katedra architektury, July 16, 2015.* Praha.

CÍLEK V.: Co se děje se světem. *Lecture. Topvision, City Congress, May 13, 2015.* Praha.

CÍLEK V.: Co se děje se světem? *Lecture. Café Barrande, January 29, 2015.* Praha.

CÍLEK V.: Co se děje se světem? *Lecture. Club Otto Blanc, September 9, 2015.* Praha.

CÍLEK V.: Co se děje se světem? *Lecture. Komunitní centrum Matky Terezy, November 4, 2015.* Praha.

CÍLEK V.: Co se děje se světem? *Lecture. Městská knihovna, March 4, 2015.* Pelhřimov.

CÍLEK V.: Co se děje se světem? *Lecture. Prague Business Club, June 15, 2015.* Praha.

CÍLEK V.: Co se děje se světem? *Lecture. Městská knihovna, February 26, 2015.* Vsetín.

CÍLEK V.: Franz Kafka na zahrádce. *Lecture. Cafeidoskop, November 10, 2015.* Praha.

CÍLEK V.: Israel and Jerusalem. Slavonice. *Lecture. Centre for the Future, June 19, 2015.* Slavonice.

CÍLEK V.: Jak porozumět současnému vývoji. *Lecture. Seminář pro učitele, March 25, 2015.* Plzeň.

CÍLEK V.: Jak porozumět světu: zdroje a prostředí. *Lecture. Zoologická zahrada, October 5, 2015.* Liberec.

CÍLEK V.: Jak se mění svět. *Lecture. Městská knihovna, March 24, 2015.* Praha.

CÍLEK V.: Klima a svět. *Lecture. Fyzikální ústav AV ČR, December 15, 2015.* Praha.

CÍLEK V.: Klima a svět. *Lecture. Golem Club, September 22, 2015.* Praha.

CÍLEK V.: Klima, prostředí a proměna civilizace. *Lecture. Křesťanská akademie - Emauzy. December 18, 2015.* Praha.

CÍLEK V.: Klimatická a environmentální perspektiva. *Lecture. Topvision, January 26, 2015.* Frýdek-Místek.

CÍLEK V.: Klimatická změna. *Lecture. Městská knihovna, January 8, 2015.* Kutná Hora.

CÍLEK V.: Mining Traditions of Krušné Hory Mts. *Lecture. Frontiers of Solitude, September 19, 2015.* Jezeří.

CÍLEK V.: O uprchlících. *Lecture. Výstavní síň, January 31, 2015.* Polička.

CÍLEK V.: Posvátná krajina. *Lecture. Křížový vrch u Stodu, Západočeské baroko, July 13, 2015.* Křížový vrch u Stodu.

CÍLEK V.: Proměna světa. *Lecture. TOP a Evropský parlament - Břevnovský klášter, October 31, 2015.* Praha

CÍLEK V.: Prostor vzdělanosti. *Lecture. Technická knihovna, May 28, 2015.* Praha.

CÍLEK V.: Svět kolem nás. Cyklus pro důchodce. *Lecture. Radnice Praha 9, January 20, 2015.* Praha.

CÍLEK V.: Thaya River and Climate change. *Lecture. Fratres, May 30, 2015.* Fratres, Austria.

CÍLEK V.: Uprchlíci a environmentální situace. *Lecture. Městská knihovna - Mariánské náměstí, October 20, 2015.* Praha.

CÍLEK V.: Voda a klima. *Lecture. Botanická zahrada, February 27, 2015.* Praha.

CÍLEK V.: Voda ve světě. *Lecture. Městská knihovna, October 14, 2015.* Havlíčkův Brod.

CÍLEK V.: Vzdělanost a proměna světa. *Lecture. Technická knihovna, February 10, 2015.* Aperio. Praha.

FROJDOVÁ J.: Karbonské kapradiny. *Lecture. Přednáškový cyklus pro Paleontologickou sekci Společnosti Národního muzea a Palaia, společnosti pro paleontologii, January 6, 2015.* Praha.

HALAŠ J., BEDNÁŘ P., KOŘEN V. & *MIKULÁŠ R.*: Otevření Didaktického centra geologie v Říčanech. *Welcoming lecture, Muzeum Říčany & První Základní škola Říčany. April 9, 2015.* Říčany.

HLAVÁČ J.: Vrkoči Českého lesa a Tachovské brázdy. *Lecture. Muzeum Českého lesa v Tachově, October 10, 2015.* Tachov.

KLETETSCHKA G.: Jak Osedlat vlnu. *Lecture. Přednáškové fórum SYMPOSION 2015, Gymnázium Jana Keplera, November 17, 2015.* Praha.

KLETETSCHKA G.: Nebezpečí jiných dimenzí. *Lecture. 11. ročník vědeckých přednášek, Kirwitzerův den, Františkánský klášter, October 24, 2015.* Kadaň.

KRMÍČEK L.: Arktida a Antarktida očima řečkovického polárníka Lukáše Krmíčka. *Lecture. Přednáškový cyklus MČ Brno-Řečkovice a Mokrá Hora, March 19, 2015.* Brno.

MIKULÁŠ R.: Divoká příroda dvojměstí Kladno-Praha. *Lecture. Science Café Kladno, May 14, 2015.* Kladno.

MIKULÁŠ R.: *Divoká příroda Prahy*, In: HRUŠKOVÁ J. et al: *Otvírání studánek. Lecture. Městská část Praha-Kunratice, April 18, 2015.* Praha.

MIKULÁŠ R.: Geologické zajímavosti okolí Řeporyjí. *Lecture and excursion, Jarní týdny vědy a techniky, Czech Academy of Sciences, June 9, 2015.* Praha.

MIKULÁŠ R.: Základy geologické stavby JZ okolí Prahy. *Lecture and excursion, Jarní týdny vědy a techniky, Czech Academy of Sciences, June 11, 2015.* Praha.

MIKULÁŠ R.: Zkamenělé stopy živočichů. *Lecture. Cyklus přednášek Věda v muzeu, Muzeum Dr. Aleše Hrdličky, April 2, 2015.* Humpolec.

MIKULÁŠ R. & PAVLÍČKOVÁ R.: Paměť krajiny na Mostecku. *Lecture and excursion, Základní umělecká škola v Mostě and Frontiers of Solitude International Project, September 24, 2015.* Most.

MIKULÁŠ R. & ŠTURMA J.A.: Divoká příroda Prahy a blízkého okolí. *Lecture. Přírodovědný klub Café Barrande, November 19, 2015.* Praha.

MIKULÁŠ R., ŠUBRTOVÁ D. & PAVLÍČKOVÁ R.: Krajiny ovlivněné těžbou surovin. *Lecture. Základní umělecká škola v Mostě and Frontiers of Solitude International Project, September 23, 2015.* Most.

POUKAROVÁ H.: Byla by chyba tvrdit, že to není ryba, aneb cesta za určením jednoho vzorku. *Lecture. Mineralogický klub Česká Třebová, občanské sdružení, October 21, 2015.* Česká Třebová.

ŠPIČÁK A., STEMBERK J., SUNEGHA T. & *MIKULÁŠ R.*: Předpověď zemětřesení – geologické, fyzikální a také právní aspekty. *Lecture. Akademická kavárna, Rada pro popularizaci vědy AV, December 9, 2015.* Praha.

ŠTURMA J., VĚTVIČKA V. & *MIKULÁŠ R.*: Divoká příroda Prahy a blízkého okolí. *Lecture. Sládečkovo vlastivědné muzeum v Kladně, Skanzen Dolu Mayrau, April 17, 2015*. Kladno.

ŠTURMA, J.A & *MIKULÁŠ R.*: Hranicko neznámé. Prohlídka areálu cementárny a krasové krajiny. *Lecture and excursion, Fond dalšího vzdělávání & European Social Fund (ESF), June 6, 2015*. Hranice na Moravě.

5h. Unpublished reports

BLAŽKOVÁ K., STOLZOVÁ D., STOLZ D., *ŽÁK K.*, ANDERLE J., ČIBERA J. & ŠÁMAL Z. (2015): *Zpráva o první průzkumné sezoně vytipovaných archeologických lokalit v Lánské oboře*. – Muzeum T.G.M. Rakovník pro Kancelář prezidenta republiky. Deposited: archiv nálezových zpráv Archeologického ústavu AVČR, v. v. i.: 1–29. Praha.

BOROVIČKA J. (2015): *Mykologický průzkum NPP Hadce u Želivky, závěrečná zpráva*. – Institute of Geology of the CAS, v. v. i. pro ČSOP Vlašim: 1–9. Praha.

BOSÁK P. (2015): *Postup těžebních stěn Velkolomu Čertovy schody-západ. Akce sanace a rekultivace severní stěny. Posudek. Období: leden až prosinec 2014*.– Geologický ústav AVČR, v. v. i. pro Velkolom Čertovy schody, a. s.: 1–21, 1–87. Praha.

BOSÁK P. (2015): *Special diagenetic and hypergenic features in the Koněprusy Limestone, Koněprusy deposit, Barrandian*. – Institute of Geology of the CAS, v. v. i. for Velkolom Čertovy schody, a. s.: 1–231. Praha.

BREITER K. (2015)**:** *Geochemická a petrograficko-mineralogická charakteristika vzorků z archivních vrtů v oblasti Cínovce. (Geochemical and petrological-mineralogical description of samples from old boreholes from the Cínovec deposit)*.– Institute of Geology of the CAS, v. v. i. for Czech Geological Survey: 1–36. Praha.

BREITER K. (2015): *Mineralogicko-petrografická charakteristika vzorků tatranské žuly. (Characterization of three samples of granites from the Tatry Mts.)* – Institute of Geology of the CAS v. v. i. for Biology Centre CAS, v. v. i., České Budějovice: 1–22. Praha.

ČÍŽKOVÁ K., *ELBRA T.*, *PRUNER P.* & *SCHNABL P.* (2015): *Magnetomineralogie devonských vápenců z lokality Branžovy. Závěrečná zpráva* – Institute of Geology of the CAS, v. v. i. for Univerzita Palackého v Olomouci: 1–20. Praha.

JONÁŠOVÁ Š. (2015): *Chemický průzkum skel z období vrcholného středověku I*. – Geologický ústav AVČR, v. v. i. pro Archeologický ústav AV ČR v. v. i.: 1–51. Praha.

JONÁŠOVÁ Š. (2015): *Chemický průzkum renesančních skel II*.– Geologický ústav AV ČR, v. v. i. pro Archeologický ústav AV ČR v. v. i.: 1–72. Praha.

JONÁŠOVÁ Š. (2015): *Chemický průzkum skel z období vrcholného středověku II*. – Geologický ústav AV ČR, v. v. i. pro Archeologický ústav AV ČR v. v. i.: 1–39. Praha.

JONÁŠOVÁ Š. (2015): *Chemický průzkum skel z období vrcholného středověku III*. – Geologický ústav AV ČR, v. v. i. pro Archeologický ústav AV ČR v. v. i.: 1–43. Praha.

NAVRÁTIL T., *DOBEŠOVÁ I.*, *ROHOVEC J.* & *HUBIČKOVÁ S.* (2015): *Monitoring srážkových vod na území NPČŠ. Zpráva za rok 2014*. – Institute of Geology of the CAS, v. v. i. for Administration of National Park Bohemian Switzerland: 1–17. Praha.

PETRUŽÁLEK M. (2015): *Laboratorní zkoušky betonu a hornin VD Orlík*. Závěrečná zpráva.– Geologický ústav AVČR, v. v. i. pro GEOtest, a.s.: 1–40. Praha.

PETRUŽÁLEK M. (2015): *Laboratorní zkoušky hornin na vzorcích z lokality NJZ EDU-Dukovany*. Závěrečná zpráva.– Geologický ústav AV ČR, v. v. i. pro Energoprůzkum Praha, spol. s r.o.: 1–68. Praha.

SCHNABL P., *PRUNER P.*, *ČÍŽKOVÁ K.*, *PETRÁČEK J.* & *KDÝR Š.* (2015): *Magnetostratigrafie lomských a libkovických vrstev vrt HK7 2. Zpráva za rok 2015*.– Institute of Geology of the CAS, v. v. i. for Severočeské doly, a. s.: 1–15, 1–79. Praha.

SCHNABL P., *PRUNER P.*, *ČÍŽKOVÁ K.*, *PETRÁČEK J.* & *KDÝR Š.* (2015): *Paleomagnetický výzkum horninového podloží v okolí jaderné elektrárny Dukovany. Zpráva za rok 2015*. – Institute of Geology of the CAS, v. v. i. for Energoprůzkum Praha, spol. s r. o.: 1–16, 1–10. Praha.

SVITEK T. (2015): *Measurements of dynamic modules on drilled cylindrical rock samples – Nokia, Finland*. – Institute of Geology of the CAS, v. v. i. for Stress Measurement Company Oy: 1–12. Prague.

TÁSLER R., *BOSÁK P.*, FEDIUK F., *ŠŤASTNÝ M.* & ZIKA V. (2015): *Výzkum Celní jeskyně v Horních Albeřicích s důrazem na ochranu krasových jevů*. – Česká speleologická společnost Albeřice pro Správu KRNAP, arch. číslo 0470: 1–34, 7 příl. Svoboda nad Úpou.

6. Organization of conferences and scientific meetings

International conference: **ISSS GSSP Workshop – Prague 2015: GSSPs of the Silurian stages revisited, Prague, July 29-30, 2015**. Organized by Institute of Geology of the CAS, v. v. i. and Czech Geological Survey, Prague, Czech Republic. Organizing committee: *Štorch P.*, Melchin M.J., Manda Š., Tasáryová Z.

The primary focus of the ISSS GSSP Workshop was on candidate sections for Aeronian, Telychian and (prospective) Homerian GSSPs. The meeting was attended by 16 participants from 5 countries – titular and corresponding members of the ISSS and additional members of the stratigraphic community interested in current agenda and research devoted to restudy of the GSSPs of some Silurian stages and series. 10 oral presentations summarized, in particular, recent progress achieved in detailed multi-proxy studies carried out at potential GSSP candidate sections. The session culminated with presentation on analysis and testing of GSSPs using Horizon Annealing application in high-resolution correlation. Narrow focus of the meeting facilitated expert and detailed discussion on various aspects of the Silurian GSSP business. A one-day indoor session of the working group was held at the Geological Institute of the Czech Academy of Sciences. A field trip on the second day brought participants to important reference sections of the Silurian stratigraphy, including potential candidates for the Aeronian and Homerian GSSPs situated near Prague. Institute of Geology contributed by excursion guidebook [*Štorch P.*, Manda Š. & Tasáryová Z. (2015): Silurian chronostratigraphy and global extinctions events: Selected insights from Prague Synform, Czech Republic. *ISSS GSSP Workshop Prague 2015 GSSP of the Silurian stages revisited, Excursion guide book*.– Institute of Geology of the CAS and Czech Geological Survey: 1–24. Praha.] and lecture [*Štorch P.*, Frýda J., Manda Š., Tasáryová Z. & *Chadimová L.*: Rhuddanian-Aeronian boundary beds in the Prague Synform with particular reference to Hlásná Třebaň section, Czech Republic].

International Conference Field Trip: **Goldschmidt 2015, Post-conference field trip Bohemian geological enigmas: Variscan High-Pressure Granulites, Ultrapotassic Magmatites and Tektites (Moldavites), Prague, August 22–24, 2015**. Organized by Czech Geological Survey, Prague and Institute of Geology of the CAS, v. v. i., Prague, Czech Republic. 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. Also included in the field trip were visits to a mining museum in the famous base-metal and uranium mining district of Příbram and to museums of tektites in Týn nad Vltavou and Český Krumlov. [Janoušek V. & *Skála R.* (Eds., 2015): *Bohemian Enigmas: Granulites, Ultrapotassic Magmatites and Tektites (Moldavites). Field trip guide*. – Czech Geological Survey: 1–110. Praha.]

International Conference Field Trip: **Goldschmidt 2015, Post-conference field trip Bohemian mosaic: Spinel peridotites, great monuments and small breweries, Prague, August 22–24, 2015**. Organized by Czech Geological Survey, Prague and Institute of Geology of the CAS, v. v. i., Prague, Czech Republic. Organizing Committee: *Ackerman L.*, Kochergina Y. & Erban V.

The field trip with duration of three days was organized for 22 participants from eight different countries (Australia, China, France, Japan, New Zealand, Russia, Switzerland, USA). The main topic of the field trip were spinel and garnet peridotites occurring as mantle xenoliths enclosed in volcanic rocks as well as large peridotite bodies within HT-HP terranes such as Moldanubian Unit or Kutná Hora Crystalline Complex. The scienfitic program was combined with several social stops, which include Trosky and Kost castle and two small microbreweries.

Field trip during International Conference: 27th International Meeting on Organic Geochemistry: **Sandstone rock cities of the Bohemian Paradise, Prague, September 13, 2015**. Organizing Committee: Franců J. & *Adamovič J.*

Field trip attended by 22 participants was focused on depositional style of quartzose sandstones in the Bohemian Paradise region and subsequent tectonic deformation. The visited sites included the Hrubá Skála rock city, the Trosky Castle and sites along the Lusatian Fault.

International Workshop: **Modern analytical methods in study of vertical zoning of ore-bearing granite plutons, Prague, October 6–7, 2015**. Organized by Institute of Geology of the CAS v.v.i. Organizing Committee: *Breiter K.*

This workshop attended 20 persons from 2 countries. The scope of the workshop was to present new data acquired within the frame of Czech Science Foundation project No. P210/14/13600S, to provoke discussion about the most plausible evolutionary model of this granite and deposit, and compare this object with other rare-metal granites worldwide. After the workshop, a one-day trip to visit old tin mine in Zinnwald (Saxony) was organized.

International Conference: **31st International Association of Sedimentologists, Kraków, June 22–25, 2015.** Organized by The International Association of Sedimentologists and Jagiellonian University, Kraków. Poland. Organizing Committee: *Mikuláš R.*

R. Mikuláš (Institute of Geology of the CAS, v. v. i.) was a leader of the pre-conference field trip in the area of Carboniferous Culm Facies in eastern Moravia and Silesia, Czech Republic. 17 persons from four different continents attended the 3-day excursion on a dozen large outcrops of the Carboniferous turbidite systems in the Variscan foreland. The excursion itinerary and detailed description of localities can be found in: Bábek O., *Mikuláš R.* & Šimíček D. (2015): Sedimentary evolution and trace fossils of Carboniferous turbidite systems in the Variscan foreland, Czech Republic. – In: Haczewski G. (Ed.): *Guidebook for field trips accompanying 31st IAS Meeting of Sedimentology held in Kraków on 22nd–25th of June 2015*: 115–143. Polskie Towarzystwo Geologiczne. Kraków.

7. Undergraduate and Graduate Education

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

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

ČERNÝ J.: *Recognition of fossils and structures* (G3131). Undergraduate Course, Faculty of Science, Masaryk University. Brno.

ČERNÝ J.: *Structural geology and geotectonics* (G4101). Undergraduate Course, Faculty of Science, Masaryk University. Brno.

CÍLEK V.: *City environment*. 5-day excursion in Prague, Vienna, Budapest and Bratislava, USAC Praha.

CÍLEK V.: *Landscape and history*. Undergraduate Course, Collegium Hieronymi Pragense. Praha.

CÍLEK V.: *Landscape, society and architecture*. Undergraduate and Graduate Seminary, School of Architecture of Academy of Fine Arts in Prague (AVU). 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. Plzeň.

KLETETSCHKA G.: *Geotechnology in Global Changes* (MG451P10). Undergraduate / Graduate (required) Course, Faculty of Science, Charles University. Praha.

KLETETSCHKA G.: *Physics of the Earth* (MG452P04G). Undergraduate / Graduate (required) Course, Faculty of Science, Charles University. Praha.

KOHOUT T.: *Planetary geophysics* (535021). Graduate/Doctor (optional) Course, Faculty of Science, University of Helsinki. Finland.

KRMÍČEK L.: *Geology* (BF01). Undergraduate Course, Faculty of Civil Engineering, Brno University of Technology. Brno.

KRMÍČEK L.: *Principles of modern geochemical modelling in magmatic petrology* (G9271). Undergraduate (optional) Course, Faculty of Science, Masaryk University. Brno.

KRMÍČEK L.: *Principles of regional geology of the Czech Republic for civil engineers* (BF92). Undergraduate (optional) Course, Faculty of Civil Engineering, Brno University of Technology. Brno.

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

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

MIKULÁŠ R: *Mass extinctions in the Eart History*. In: BÁBEK O. et al: *Palaeontological seminar* (KGE/APG03). Faculty of Science, Palacký University. Olomouc.

NAVRÁTIL T. & *HOJDOVÁ M.*: *Heavy metals in the environment* (MG431P92). Undergraduate (optional) 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.: *Comparative anatomy of vertebrates* (MB170P47). Undergraduate (optional) Course and Practical Study, Faculty of Science, Charles University. Praha.

ROHOVEC J.: Olympiad in Chemistry. Competition tasks (inorganic chemistry) for national category B, 2015/2016. *National Institute of Children and Youth, 2015*. Praha.

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

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

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

TOMEK F.: *Laboratory course in physical geology I* (MG421C21A). Undergraduate (obligatory) Course, Faculty of Science, Charles University. Praha.

TOMEK F.: *Laboratory course in physical geology II* (MG421C21B). Undergraduate (obligatory) Course, Faculty of Science, Charles University. Praha.

TRUBAČ J.: *Informational services in geosciences* (MG422P42). Undergraduate (optional) Course, Faculty of Science, Charles University. Praha.

7b. Supervision in Undergraduate Studies

BC. Theses

ADAMEKOVÁ K., Faculty of Science, Masaryk University. Brno (*co-supervisor/advisor L. Lisá, since 2014*)

BAŘINA T., Faculty of Civil Engineering, Brno University of Technology. Brno (*supervisor L. Krmíček, defended in 2015*)

BOSÁK F., Faculty of Civil Engineering, Brno University of Technology. Brno (*supervisor L. Krmíček, defended in 2015*)

HUŠKOVÁ A., Faculty of Science, Charles University. Praha (*supervisor L. Slavík, since 2013*)

KAMENÍKOVÁ T., Faculty of Science, Charles University. Praha (*supervisor/advisor G. Kletetschka, since 2014*)

KOTEK J., Faculty of Science, Charles University. Praha (*co-supervisor/advisor P. Štorch, since 2014*)

KRÖGER A., Faculty of Science, University of Helsinki. Finland (*supervisor/advisor T. Kohout, since 2015*)

MIČKAL P., Faculty of Civil Engineering, Brno University of Technology. Brno (*supervisor L. Krmíček, defended in 2015*)

OLŠANSKÁ I., Faculty of Science, Charles University. Praha (*supervisor/advisor G. Kletetschka, since 2014*)

PÖNTINEN M., Faculty of Science, University of Helsinki. Finland (*supervisor/advisor T. Kohout, since 2015*)

ZAŤKO P., Faculty of Civil Engineering, Brno University of Technology. Brno (*supervisor L. Krmíček, defended in 2015*)

MSc. Theses

CHMELOVÁ K., Faculty of Science, Charles University. Praha (*supervisor T. Přikryl, since 2013*)

CVIRÍK R., Faculty of Science, Charles University. Praha (*supervisor K. Holcová, co-supervisor/advisor R. Mikuláš, since 2015*)

GRACIA DE C., Faculty of Science, Charles University. Praha (*supervisor T. Přikryl, since 2015*)

JANKO J., Faculty of Science, Charles University. Praha (*supervisor T. Navrátil, co-supervisor/advisor J. Rohovec, defended in 2015*)

KALIŠOVÁ L., Silesian University in Opava, Opava (*co-supervisor/advisor Š. Jonášová, defended 2015*)

MÉSZÁROSOVÁ N., Faculty of Science, Charles University. Praha (*supervisor R. Skála, defended 2015*)

NÁBĚLEK L., Faculty of Science, Charles University. Praha (*supervisor/advisor G. Kletetschka, since 2014*)
NEPOMUCKÁ Z., Faculty of Science, Charles University. Praha (*supervisor T. Navrátil, since 2013*)
POLÁK L., Faculty of Science, Charles University. Praha (*supervisor L. Ackerman, since 2015*)
ŠMEJKAL R., Faculty of Science, Charles University. Praha (*supervisor S. Čermák, since 2015*)
ŠNELLEROVÁ Z., Faculty of Science, Charles University. Praha (*supervisor R. Skála, since 2012*)
VALA V., Faculty of Science, Charles University. Praha (*supervisor T. Přikryl, since 2013, defended 2015*)

7c. Supervision in Graduate Studies

Ph.D. Theses

DZIKOVÁ L., Faculty of Science, Masaryk University. Brno (*supervisor R. Skála, since 2007, temporarily suspended in 2013*)
GREŇOVÁ I., Department of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University. Praha (*supervisor J. Borovička, since 2014*)
HALUZOVÁ E., Faculty of Science, Charles University. Praha (*supervisor L. Ackerman, co-supervisor M. Svojtka, since 2014*)
HERICHOVÁ E., Faculty of Liberal Arts, Charles University. Praha (*supervisor V. Cílek, since 2010, defended in 2015*)
HOŠEK J., Faculty of Science, Charles University. Praha (*supervisor L. Lisá, since 2010*)
HRUBÁ J., Faculty of Science, Charles University. Praha (*supervisor/advisor G. Kletetschka, since 2013*)
JONÁŠOVÁ Š., Faculty of Science, Charles University. Praha (*supervisor R. Skála, since 2014*)
KALLISTOVÁ A., Faculty of Science, Charles University. Praha (*supervisor R. Skála, since 2010*)
KOCHERGINA Y., Faculty of Science, Charles University. Praha (*co-supervisor L. Ackerman, since 2014*)
KOŘÍNKOVÁ D., Faculty of Science, Charles University. Praha (*supervisor J. Adamovič, co-supervisor M. Svojtka, since 2015*)
KUBROVÁ J., Department of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University. Praha (*supervisor J. Borovička*, *since 2011*)
KUBROVÁ J., Department of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University. Praha (*since 2011*)
MARKLEY M.M., Faculty of Science, Charles University. Praha (*supervisor/advisor G. Kletetschka, since 2014*)
MOREAU J., Faculty of Science, University of Helsinki. Praha (*supervisor/advisor T. Kohout, since 2015*)
PETRUŽÁLEK M., Faculty of Science, Charles University. Praha *(co-supervisor T. Lokajíček, since 2006, defended in 2015)*
SIDORINOVÁ T., Faculty of Science, Charles University. Praha (*supervisor R. Skála, since 2009, temporarily suspended in 2013*)
ŠIMEČEK M., Faculty of Science, Charles University. Praha (*supervisor T. Navrátil, since 2015*)
SOUMAR J., Faculty of Science, Charles University. Praha (*supervisor R. Skála, since 2011*)
SVITEK T., Faculty of Science, Charles University. Praha *(supervisor T. Lokajíček, since 2008, defended in 2015)*
VAŠKANINOVÁ V., Faculty of Science, Charles University. Praha (*co-supervisor J. Zajíc, since 2010*)
VEJROSTOVÁ L., Faculty of Science, Charles University. Praha *(supervisor L. Lisá, since 2013)*

7d. Membership in scientific and academic boards

BOROVIČKA J.
Member, Presidium, Scientific Secretary, Czech Mycological Society. Praha.

BOSÁK P.
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–April 2015)
Chairman, Committee for degree of Doctor of Sciences (DSc.) in geological sciences at Czech Academy of Sciences. Praha.
Member of the Executive Board of Institute of Geology of the CAS, v. v. i. Praha.
Member, Academic Assembly of the Czech Academy of Sciences. 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.

CHADIMOVÁ L.
Committee Member, International Geoscience Programme of the UNESCO and IUGS – Czech National Committee for IGCP.
Corresponding Member, Subcommission on Devonian Stratigraphy of the ICS and IUGS.
FILIPPI M.
Vice-Chairman, Executive Board of the Institute of Geology of the Czech Academy of Sciences, v. v. i. Praha.
HLADIL J.
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, Executive Board of the Institute of Geology of the Czech Academy of Scienecs, v. v. i. Praha.
KLETETSCHKA G.
Member, Advisor board Scientific activities, Ministry of tranport of the CR. Praha.
Member, Advisor board Cosmic activities, Ministry of tranport of the CR. Praha.
Member of Review Board, National Aeronautics and Space Administration, USA.
LOKAJÍČEK T.
Member, Board of Graduate Studies in Applied Geology, Faculty of Science, Charles University. Praha.
MIKULÁŠ R.
Vice-Chairman, Advisory Board of the Institute of Geology of the Czech Academy of Sciences, v. v. i. Praha.
Alternating Member of the Doctoral Examination Committee in Geology, Faculty of Science, Charles University. Praha.
Member, Editorial Board of the Czech Academy of Sciences. Praha.
Member, Advisory Board of the Czech Academy of Sciences for Science Communication. Praha.
Member, Academy of Sciences – Chamber of Deputies, Parliament of the Czech Republic Co-operation Committee. Praha.
Chair, IGCP-UNESCO National Committee. Praha.
NAVRÁTIL T.
Member of the Committee for Finals of Doctoral Students in Applied Geology, Faculty of Sciences, Charles University. Praha.
Member of the Committee for Doctoral Thesis Defense in Applied Geology, Faculty of Sciences, Charles University. Praha.
Member, Earth Science Panel (geophysics, geochemistry, geology mineralogy and hydrogeology) of Czech Science Foundation. Praha.
PRUNER P.
Member of the Board of the Graduate Studies in Geophysics, Faculty of Science, Charles University. Praha.
Member of the Commitee for degree of Doctor of Sciences (DSc.) in geological sciences at Academy of Sciences of the Czech Republic. Praha.
Member of the Permanent Working Group of Geosciences Accreditation Commission, Czech Republic. Praha.
Member of the Executive Board of the Institute of Geology of the CAS, v. v. i. Praha.
SCHNABL P.
Member of Review Board, Deutsche Forschungsgemeinschaft (DFG), Berlin. Germany.
SKÁLA R.
Chairman, Committee for Finals of Undergraduate Students in Geology, specialization Mineralogy and Crystallography, Faculty of Sciences, Charles University. Praha.
Member, Committee for Finals of Undergraduate Students in Geology, specialization Geochemistry, Faculty of Sciences, Charles University. Praha.
SLAVÍK L.
Member of the Executive Board of the Institute of Geology of the CAS, v. v. i. Praha.
Alternating Member of the Doctoral Examination Committee in Geology, Faculty of Sciences, Charles University. Praha.
Member of the Undergraduate (MSc.) and Doctoral Committee in Geology-specialization Geobiology, Faculty of Sciences, Charles University. Praha.
SVOJTKA M.
Member, Committee for Finals of Undergraduate and Doctoral Students in Geology, Faculty of Sciences, Charles University. Praha.
Member, Committee for Finals of Doctoral Thesis Defense in Geology, Faculty of Sciences, Charles University. Praha.
Member, The National Polar Research Centre. Praha.
ŠTORCH P.
Alternating Member, Committee for Degree of Doctor of Sciences in Geological Sciences, Academy of Sciences CR. Praha.
Vice-chair / Secretary, Czech Commission on Stratigraphy. Praha.
Member of the Expert panel 06 (Earth Sciences) for Evaluation of Results of Research and Development. Office of the Government of the Czech Republic, Research, Development and Innovation Council. Praha.
ULRYCH J.
Member, Committee for degree of Doctor of Sciences (DrSc.) in geological sciences at Slovak Academy of Science. Bratislava. Slovakia.
Member, Committee for degree of Doctor of Sciences (DSc.) in geological sciences at the Academy of Sciences. 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 Geochemistry and Mineralogy, Charles University, Faculty of Science. Praha.
ZAJÍC J.
Alternating Member, Committee for the Ph.D. Examination and Defence of Theses in Geology, Faculty of Science, Charles University. Praha.

Alternating Member, Committee for the Master's and RNDr. Doctoral Examination in Paleontology, Faculty of Science, Charles University. Praha.

ŽIGOVÁ A.

Member of the Committee of Soil Science and Soil Conservation of Scientific Council of Research Institute for Soil and Water Conservation, v. v. i. Praha.

Member of the Committee of the Czech Society of Soil Science. Praha.

Member of the Board of the Committee of Soil Science of the Czech Academy of Agricultural Science. Praha.

Member of the Board of the Doctoral Examination Committee in Physical Geography and Geoecology, Faculty of Science, Charles University. Praha.

7e. Membership in Foreign Academies

BOSÁK P.

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

Corresponding Member, Slovenian Academy of Sciences and Arts in Ljubljana (elected 2005).

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

Ph.D.

PETRUŽÁLEK M.: Characterization of migmatite fracturing using ultrasonic methods. – Ph.D. Thesis, Institute of Hydrogeology, Engineering Geology and Applied Geophysics, Charles University in Prague: 1–59. Praha (defended on September 9, 2015).

TOMEK F.: Magnetic fabric, magma flow and deformation in volcano-plutonic systems. – Ph.D. Thesis, Institute of Geology and Paleontology, Charles University in Prague: 1–154. Praha (defended on September 3, 2015).

TRUBAČ J.: The Origin of Compositional and Textural Zoning of Shallow-level Granitoid Plutons. – Institute of Petrology and Structural Geology, Charles University in Prague: 1–518. Praha (defended on September 11, 2015).

SVITEK T.: Laboratory study of 3D elastic anisotropy of rocks. – Ph.D. Thesis, Institute of Hydrogeology, Engineering Geology and Applied Geophysics, Charles University in Prague: 1–54. Praha (defended on June 2, 2015).

Doc. (Assoc. Prof.)

ACKERMAN L.: Geochemie vybraných hornin svrchního pláště Českého masivu (Geochemistry of selected upper mantle rocks of the Bohemian Massif). – Habilitation Thesis, Institute of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University: 1–280. Praha (defended on April 16, 2015).

KOHOUT T.: What can we learn about asteroids from their reflected light spektra (habilitation presentation) Faculty of Science, University of Helsinki. Finland (defended on September 4, 2015).

7g. Awards

CÍLEK V.: Nomination – UNESCO Award for popular Science Kalinga. Nomination by Czech UNESCO Committee, Ministry of Foreign Affairs & Ministry of Environment.

CÍLEK V.: Nomination – book "*To Breathe with Birds: A Book of Landscapes*", for the John Brinckerhoff Jackson Book Prize sponsored by the Foundation for Landscape Studies, University of Pennsylvania Press. Philadelphia. USA.

CÍLEK V.: Nomination – book "*To Breathe with Birds: A Book of Landscapes*", for Sigurd F. Olson Nature Writing Award sponsored by Northland College, University of Pennsylvania Press. Philadelphia. USA.

MIKULÁŠ R.: The Medal of Vojtěch Náprstek for promotion of science to the public (given by the President of the Czech Academy of Sciences).

TOMEK F.: Deans award for the best Ph.D. thesis, Faculty of Science, Charles University in Prague.

TOMEK F.: Radek Melka Price (best student paper of the Central European Tectonics Groups CETeG in 2015)

TRUBAČ J.: Deans award for the best researcher, Faculty of Science, Charles University in Prague.

7h. Institute staff on Fellowships and Stages

SLÁMA J.: Fellowship J. E. Purkyně for outstanding creative scientists, Institute of Geology of the Czech Academy of Sciences. Praha for 2016–2020. Awarded 2015 for 2016–2020.

TOMEK F.: Internal post-doctoral fellowship for the CAS institutions, Program of supporting perspective human sources. Awarded 2015 for 2016–2017.

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, Czech Republic (since 2007).

BREITER K.

Journal of Geochemical Exploration (Elsevier), Associate editor, Amsterdam, Netherlands (since 2015)

Zprávy o geologických výzkumech (Geoscience Research

Reports), Member of Editorial Board, Czech Geological Survey, Praha, Czech Republic (since 2014)

BOROVIČKA J.

Mykologický sborník, Editor-In-Chief, Czech Mycological Society, Praha, Czech Republic (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, (Co-editor 2001–2005 and since 2012; Member of the Executive Committee 2005–2012), Official journal of the Carpathian-Balkan Geological Association, Bratislava, Slovak Republic.

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; Member of the Editorial Board in 1976 to 1998), Regional journal published by the Museum of the Czech Karst in Beroun, Beroun, Czech Republic.

Research Reports of the Institute of Geology, Co-editor, Academy of Sciences of the Czech Republic, Praha, Czech Republic (since 2007).

Slovenský kras/Acta Carsologica Slovaca, Member of the Editorial Board, published by the Slovak Museum of Nature Protection and Speleology and Slovak Caves Administration, Liptovský Mikuláš, Slovakia (since 2014)

Speleo (Prague), Member of Editorial Board, bulletin of the Czech Speleological Society, Praha, Czech Republic (since 1990).

Speleofórum, Co-editor, published by the Czech Speleological Society, Prague, Czech Republic (since 2000).

Editorial Board of the Czech Speleological Society, Member (since 1990).

CÍLEK V.

Slovenský kras, Member of Editorial Board. Liptovský Mikuláš, Slovakia (since 2004).

Vesmír, Member of Editorial Board, Vesmír Ltd, Praha, Czech Republic (since 1998).

HLADIL J. Praha Prague, Czech Republic (since 2006).

Geologica Carpathica, Member of Editorial Board – Executive Committee, Geological Institute of the Slovak Academy of Sciences, Bratislava, Slovakia (since 2001).

Geological Quarterly, Member of Editorial Team – Consulting Editor, Polish Geological Institute – National Research Institute, Warsaw, Poland (since 2004).

HLAVÁČ J.

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

KRMÍČEK L.

Acta Musei Moraviae – Scientiae geologicae, Member of Editorial Board, Moravian museum, Brno, Czech Republic (since 2013).

LISÁ L.

Geologica Carpathica, Member of Editorial Board – Executive Committee, Geological Institute of the Slovak Academy of Sciences, Bratislava, Slovakia (since 2015).

MIKULÁŠ R.

Geolines, Member of Editorial Board, Institute of Geology CAS, v. v. i., Praha, Czech Republic (since 1998).

Acta Musei Nationalis Pragae, Series B, Historia Naturalis, Member of Editorial Board, National Museum, Praha, Czech Republic (since 2008).

NAVRÁTIL T.

Journal of Geology & Geosciences, Member of Editorial Board, OMICS Publishing Group, Los Angeles, USA (since 2013).

PRUNER P.

Geolines, Member of Editorial Board, Institute of Geology of the CAS, v. v. i., Praha, Czech Republic (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).

PŘIKRYL T.

Research Reports of the Institute of Geology, Editor, Czech Academy of Sciences, Praha, Czech Republic (since 2009).

ROČEK Z.

Palaeobiodiversity & Palaeoenvironments, Member of Editorial Board, Frankfurt a.M., Germany (since 2011).

SKÁLA R.

Journal of Geosciences, Member of the Editorial Board, Czech Geological Society, Praha, Czech Republic (since 2006).

SLAVÍK L.

Bulletin of Geosciences, Member of Editorial Board Czech Geological Survey, Praha, Czech Republic (since 2013).

SVOJTKA M.

Geolines, Research Reports, Editor-in-chief, Institute of Geology of the CAS, v. v. i., Praha, Czech Republic (since 1996).

ŠTORCH P.

Bulletin of Geosciences, Co-editor, Czech Geological Survey, Praha, Czech Republic (since 2011).

*Paleontological Contribution*s, Member of Editorial Board, Electronic Journal, University of Kansas, Lawrence, USA (since 2008).

Northwestern Geology, Member of Editorial Board, Xi'an Centre of Geological Survey, China Geological Survey, Xian, China (since 2012).

WAGNER J.

Bulletin of Geosciences, Member of Editorial Board, Czech Geological Survey, Praha, Czech Republic (since 2011).

ZAJÍC J.
Bulletin of Geosciences, Member of Editorial Board, Czech Geological Survey, Praha, Czech Republic (since 2001).

ŽÁK K.
Český kras, Member of the Editorial Board (since 2007), Co-editor (since 2008), regional journal published by the Museum of the Czech Karst, Beroun Czech Republic.

8b. Positions in International Organizations

BOSÁK P.
Honorary Member, the UIS Bureau, the International Union of Speleology (UIS, affiliated to the IUGS; elected in 2009)
Member, Advisory Committee, the International Union of Speleology (UIS, affiliated to the IUGS; elected in 2009, re-elected 2013)

HLADIL J.
Committee Member and Web Site Administrator, International Geoscience Programme of the UNESCO and IUGS – Czech National Committee for IGCP (since 1994).
Corresponding Member, Subcommission on Devonian Stratigraphy of the ICS and IUGS (renewed, since 2013).

SLAVÍK L.
Secretary & Titular Member, Subcommission on Devonian Stratigraphy of the ICS/IUGS (since 2012).
Corresponding Member, Subcommission on Silurian Stratigraphy of the ICS/IUGS (since 2011).

SVOBODOVÁ A.
Secretary of the Czech IGCP National Committee; joined as Co-Opted Member in December 2014.

ŠTORCH P.
Titular Member, Subcommission on Silurian Stratigraphy of the ICS/IUGS (since 2004).

ZAJÍC J.
Committee Member, International Geoscience Programme of the UNESCO and IUGS – Czech National Committee for IGCP (since 2003).

9. Institute structure and staff

9a. Organization units

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

1. *Department 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. *Department 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, amphibians and mammals), palynology of Carboniferous and Cretaceous sediments, and paleoichnology in a broad stratigraphic range from the Ordovician to the Recent.
3. *Department 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. *Department 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. *Department of Analytical Methods* represents a service analytical unit.

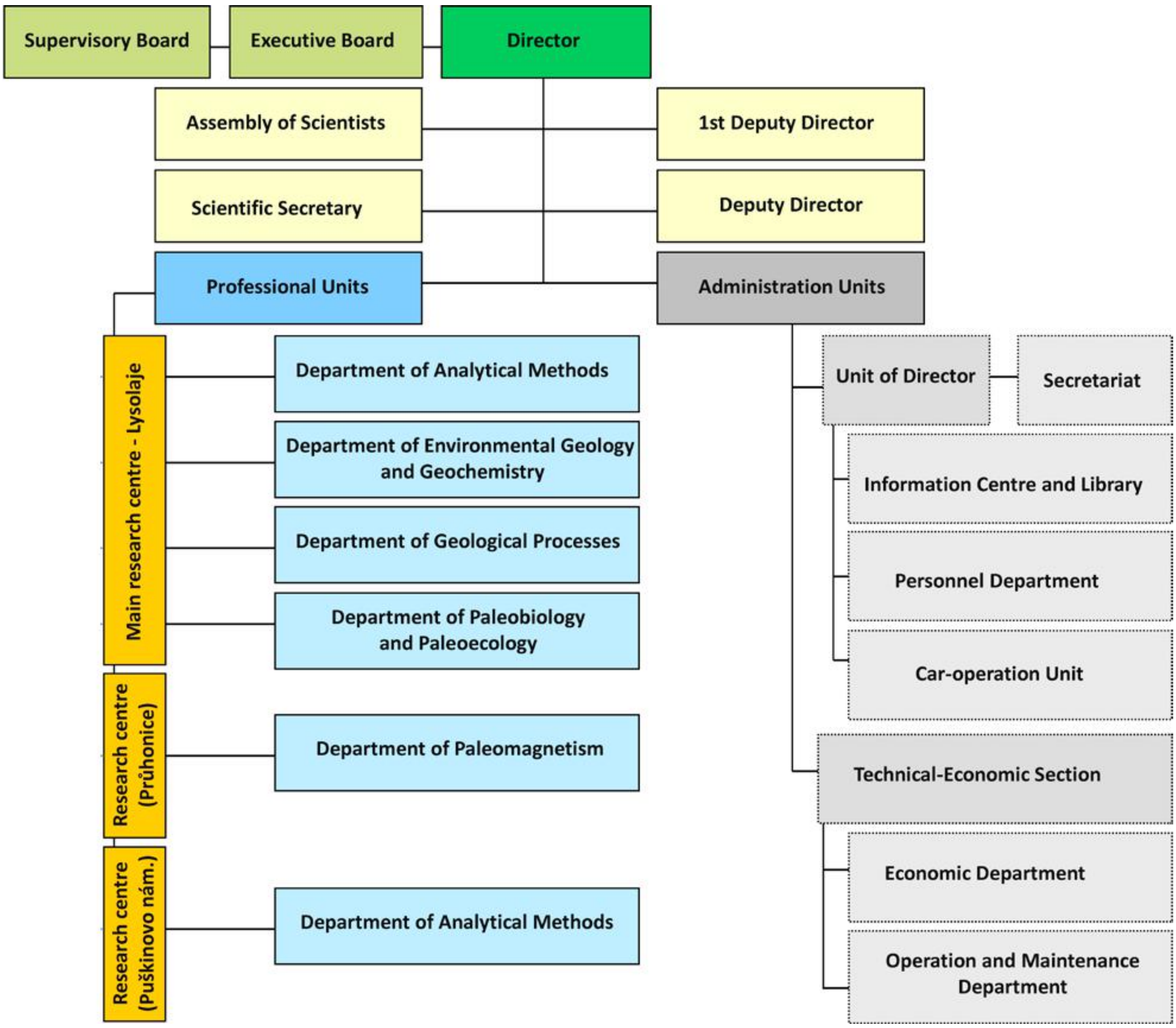
Specialized laboratories

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 powder diffraction laboratory (Head: RNDr. Roman Skála, Ph.D.).
4. Scanning electron microscope and electron microprobe laboratory (Supervised by RNDr. Roman Skála, Ph.D.).
5. Laboratory of rock processing and mineral separation (Head: RNDr. Martin Šťastný, CSc.).
6. Laboratory for thin and polished sections (Head: RNDr. Roman Skála, Ph.D.).

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, Ph.D.).
11. Mercury analysis laboratory (Head: Doc. RNDr. Tomáš Navrátil, Ph.D.).
12. LA-ICP-MS Laboratory (Supervised by Ing. Jana Ďurišová, Ph.D. & Mgr. Šárka Matoušková, Ph.D)
13. Clean Chemistry Laboratory (Supervised by Doc. Mgr. Lukáš Ackerman, Ph.D.)
14. Laboratory of rock behavior under high pressure (Head: Ing. Tomáš Lokajíček, CSc.).
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

e-mail address book

Ackerman Lukáš	ackerman@gli.cas.cz
Adamovič Jiří	adamovic@gli.cas.cz
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Bosák Pavel bosak@gli.cas.cz
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Cílek Václav cilek@gli.cas.cz
Coubal Miroslav coubal@gli.cas.cz
Čejchan Petr cej@gli.cas.cz
Čermák Stanislav cermaks@gli.cas.cz
Černý Jan jcerny@gli.cas.cz
Čížková Kristýna cizkovak@gli.cas.cz
Chadima Martin chadima@gli.cas.cz
Dobešová Irena dobesova@gli.cas.cz
Ďurišová Jana durisova@gli.cas.cz
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Frojdová Jana frojdova@gli.cas.cz
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Hladil Jindřich hladil@gli.cas.cz
Hlaváč Jaroslav hlavac@gli.cas.cz
Hojdová Maria hojdova@gli.cas.cz
Holomčíková Lucie holomcikova@gli.cas.cz
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Kocová Alena kocova@gli.cas.cz
Kohout Tomáš kohout@gli.cas.cz
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Lisá Lenka lisa@gli.cas.cz
Lisý Pavel lisy@gli.cas.cz
Lokajíček Tomáš lokajicek@gli.cas.cz
Ložek Vojen * lozek@gli.cas.cz
Man Ota ** man@gli.cas.cz
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9c. Staff (as of December 31, 2015)

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Mgr. Michal Filippi, Ph.D. . . . . 1st Deputy Director

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Secretariat
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Mgr. Václava Škvorová – deputy head (librarian)
Bc. Sabina Bielská (librarian)
Bc. Jana Popelková (librarian)

Personnel Department
Veronika Šťastná (human resources)

Car Operation Unit
Jaroslav Kratochvíl (garage attendant, driver, storeman, janitor)

Technical-Economic Section
Ing. Bohumil Pick – Head

Economic Department
Alena Kocová (phone operator, mail service)
Eva Petráčková (accountant)

Operation and Maintenance Department
Jaroslav Kratochvíl (technical service)

Scientific departments

Departments of Geological Processes

Scientific Staff:
Mgr. Martin Svojtka, Ph.D. – Head (geochronology, geochemistry)
RNDr. Leona Koptíková–Chadimová, Ph.D. – Deputy Head until May 13, 2015 (sedimentary petrology, metasediments, magnetic susceptibility)
Doc. Mgr. Lukáš Ackerman, Ph.D. – Deputy Head from May 14, 2015 (geochemistry, mantle petrology)
Mgr. Jiří Adamovič, CSc. (basin analysis, tectonics)
RNDr. Karel Breiter, Ph.D. (petrology, mineralogy)
RNDr. Miroslav Coubal, CSc. (structural geology, tectonics)
Ing. Jiří Fiala, CSc. (petrology and structure of lithosphere, western and northern)
Doc. RNDr. Jindřich Hladil, DrSc. (Devonian environments, experimental sedimentology, dust deposition)
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Mgr. Hedvika Poukarová (sedimentary petrology, metasediments, magnetic susceptibility)
RNDr. Lukáš Krmíček, Ph.D. (geochemistry, igneous petrology)
Mgr. Lenka Lisá, Ph.D. (Quaternary sedimentology)
Mgr. Filip Tomek (magmatic petrology, structure geology)
Mgr. Jakub Trubač (magmatic petrology, geochemistry)
Doc. RNDr. Jaromír Ulrych, DrSc. (igneous petrology, geochemistry)

Technical Staff:
ing. Jana Ďurišová, Ph.D. (ICP-MS analyst)
Mgr. Jiří Filip, CSc. (technician, fission track dating)
Mgr. Eva Haluzová (Ph.D. student, clean laboratory analyst)
Mgr. Dagmar Kořínková (Ph.D. student, fission track methods)
Mgr. Šárka Matoušková, Ph.D. (ICP-MS analyst)
Ing. Jaroslava Pavková (secretary, technician)
Jana Rajlichová (graphics)
RNDr. Martin Šťastný, CSc. (technician, chemical analyst)

Departments 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)
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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. Andrea Svobodová (Cretaceous palynology)
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:
RNDr. Petr Čejchan, CSc. (technician)
Pavel Lisý (technician)

Departments of Environmental Geology and Geochemistry

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RNDr. Jan Rohovec, Ph.D. – Deputy Head (analytical chemistry, ICP analyses)
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RNDr. Anna Žigová, CSc. (pedology, paleopedology)

Technical Staff:
Ing. Irena Dobešová (environmental monitoring)
Mgr. Martin Šimeček (environmental monitoring)
Světlana Hubičková (technician)
Michaela Uldrychová (secretary)

Departments of Paleomagnetism

Scientific Staff:
Ing. Petr Pruner, DrSc. – Head (geophysics, paleomagnetism)
Mgr. Petr Schnabl, Ph.D. – Deputy Head (geophysics)
M.Sc. Tiiu Elbra, Ph.D. (paleomagnetism, geophysics)
Mgr. Martin Chadima, Ph.D. (geophysics, paleomagnetism)
RNDr. Günter Kletetschka, Ph.D. (paleomagnetism, geophysics)
Mgr. Tomáš Kohout, Ph.D. (physical properties of meteorites)

Technical Staff:
Mgr. Kristýna Šifnerová – Čížková (geophysics)
Jiří Petráček (technician)
Bc. Nábělek Ladislav (geophysics)

Departments of Analytical Methods and Physical Properties of Rocks
RNDr. Roman Skála, Ph.D. – Head (X-ray powder diffraction)
RNDr. Zuzana Korbelová – Deputy Head (microprobe and scanning microscope analyst)
Ing. Tomáš Lokajíček, CSc. – Deputy Head (rock elastic anisotropy)
Ing. Vlasta Böhmová – Mocová, Ph.D. (microprobe and scanning microscope analyst)
Mgr. Anna Kallistová (X-ray powder diffraction analyst)
Mgr. Noemi Mészárosová (microprobe and scanning microscope analyst)
Ing. Šárka Jonášová (microprobe and scanning microscope analyst)
Mgr. Matěj Petružálek (geophysics, acoustic emission analysis)
Mgr. Tomáš Svitek (geophysics, elastic anisotropy analysis)
Ing. Libor Svoboda (technician, rock sample preparation, grinding)
Vlastimil Filler (technician, electrician)
Jaroslava Jabůrková (technician, grinding, preparation of thin/polished sections)
Vlastimil Nemejovský (mechanic, technician, rock cutter)
Lucie Holomčíková (technician, administrative)

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 Sřrensen (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.	Ph.D.
DrSc.	DSc
Doc.	Assoc. Prof.
Ing.	Dipl.-Ing.

Staff News

Left the Institute:		Joined the Institute:	
Čejchan Petr	September 8	Holomčíková Lucie	January 1
Erdingerová Julie	July 13	Hrstka Tomáš	December 1
Fridrichová Michaela	September 31	Mészárosová Noemi	October 1
Jeřábek Karel	June 30	Nábělek Ladislav	July 1
Schmelzová Radka	March 27	Popelková Jana	July 1
Sláma Jiří	January 1	Poukarová Hedvika	January 1
Sychová Petra	December 31	Schmelzová Radka	March 1
Šlechta Stanislav	December 31	Šimeček Martin	January 1
Štarmanová Jana	February 28	Šťastná Veronika	November 9
Štěrbová Věra	December 31		

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 1×10^{-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.

3D scanner (Head: RNDr. Jaroslav Zajíc, CSc.)

Two devices enable to collect and evaluate 3D data (as spatial data clouds) of the real geologic or paleontological objects. The utility software allows many ways of measurements. With help of the additional software solution is subsequently possible to model the virtual surfaces, virtual closed objects and any cross-sections. All virtual objects can be visualised and rotated with help of 3D modeling programs.

The *MicroScribe® MX* is a portable measurements system with metrology-level accuracy in six degrees of freedom. This system enables the 3D data collection efficiency of coordinate measurement systems at an affordable price. The counter-balanced and intuitive articulation of the arm allows to quickly position the stylus into even tight spaces. The arm can reach up to 63 cm and the work sphere diameter is 1.27 m. The device works with precision up to 0.0508 mm and its weight is 5.4 kg.

MicroScribe Utility Software (MUS) allows data acquisition for some applications that do not provide native support.

The *Kreon Skiron* is a very compact, light and ergonomic 3D laser scanner. Fully integrated on the MicroScribe® desktop digitizer (MX series), this laser scanner dramatically reduces digitizing time. Laser of the class II can scan at speed up to 45 000 points/second with accuracy of 50 μm. Maximum laser line is 75 mm, the measuring field is 65 mm, and stand-off distance is 50 mm. The line resolution is 83 μm and vertical resolution (sub-pixel) is 16 μm. Dimensions of the device are 112 x 61 x 76 mm and its weight is only 260 g.

Scantools 3D software gives access to the functionalities of the Skiron scanner. This easy to use software allows data collection in a very short time as well as processing them.

The data processing is solved with help of the *3D NURBS modeling software Rhinoceros®*. Two plug-ins are applied with the Rhinoceros: the *Flamingo* to raytrace rendering and the *Bongo* to animation creation.

X-ray powder diffraction laboratory (Head: RNDr. Roman Skála, Ph.D.)

X-ray powder diffractometer Bruker D-8 DISCOVER is a multipurpose powder X-ray diffraction instrument 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 (either foil or capillary) geometry. Optional focusing primary asymmetric monochromator of Johansson type produces spectrally pure $K\alpha 1$ radiation. Diffracted radiation is collected with a position sensitive 1D silicon strip detector LynxEye. In the microdiffraction setup used for bulk samples, the primary monochromator is replaced by polycapillary optics (i.e. $K\alpha 1,2$ radiation is used) and beam limited with a collimator and a sample is placed on a special motorized xyz-stage. For routine analytical work also a compact X-ray powder diffractometer *Philips X'Pert* can be used. Reliable quantitative local chemical analysis and/or acquisition of element distribution maps using EPMA/SEM require planar polished conductive surfaces. Such prerequisites are fulfilled when bulky solid samples are sectioned, polished and coated. For that purpose a *suite of cutting, grinding, lapping and polishing machines* to prepare polished sections or thin sections is available at our laboratory. To make the specimens conductive for EPMA/SEM chemical analyses, a coating by carbon is used. For imaging of rough surfaces using secondary electrons in high vacuum, samples are sputtered with gold to prevent their charging. The laboratory owns necessary instruments to carbon-coat or gold-sputter the specimens including carbon-coater and metal-stutterer Quorum Q150T ES that allows controlled deposition of conducting media on samples to be investigated.

Scanning electron microscope and electron microprobe laboratory (Head: RNDr. Roman Skála, Ph.D.)

Scanning electron microscope (SEM) TESCAN VEGA3XMU is an SEM 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 detectors of secondary and back-scatted electrons as well as energy-dispersive (ED) spectrometer Bruker QUANTAX 200. Also available are low vacuum secondary electron (LVSTD) and color cathodoluminescence (detection range 350–850 nm) detectors. The source of electrons is a tungsten heated cathode.

Electron probe microanalyzer (EPMA) CAMECA SX-100 is used mainly for non-destructive quantitative analysis of solid-state materials on the micrometer scale from selected spots down to a few microns across. The instrument is equipped with four wave-dispersive crystal spectrometers. Two of them carry 4 individual standard crystals each (LIF; PET; TAP; PC0 and PC1, respectively), two other house two so-called large crystals each (i.e. crystals with lower detection limits; LLIF; LTAP; LPET; LPC2). Instrument allows analysis of specimens for elements from B to U. To image studied samples, the back-scattered-electron (BSE) and secondary-electron (SE) detectors are used.

Reliable quantitative local chemical analysis and/or acquisition of element distribution maps using EPMA/SEM require planar polished conductive surfaces. To make the specimens conductive for EPMA/SEM chemical analyses, a coating by carbon is used. For imaging of rough surfaces using secondary electrons in high vacuum, samples are sputtered with gold or its alloys to prevent sample charging. The laboratory owns necessary instruments to carbon-coat or gold-sputter the specimens. In 2014, a new instrument for carbon-coating and metal-sputtering (Quorum Q150T ES) was purchased to allow controlled deposition of conducting media on samples to be investigated.

Raman micro-spectrometer Laboratory (Head: RNDr. Roman Skála, Ph.D.)

In 2015, a Raman micro-spectrometer S&I MonoVista CRS+ has been acquired. It is based on Olympus BX-51 WI upright microscope, Princeton Instruments SpectraPro SP2750 spectrometer (750 mm focal length and aperture ratio f/9.7) and a CCD detector ANDOR iDus 416 with 2,000 × 256 pixels (pixel size 15 μm). Excitation lasers have wavelengths of 532 nm and 785 nm; lasers of other wavelengths may be added to the system later. Microscope is designed for sample observation in either reflected or transmitted light; an option of (cross-) polarization is available. Objective lenses with following magnifications are installed on microscope turret: 10×, 50×, 50× LWD and 100×. Samples are placed on computer controlled motorized stage. Spatial resolution with 100× objective is 1 μm laterally and 2 μm axially. System allows collection of spectra within the range of 60–9,300 cm^{-1} with 532 nm excitation laser and 60–3,500 cm^{-1} with 785 nm excitation laser. Spectral resolution is better than 1.0 cm^{-1} for 1,800 $gr.mm^{-1}$ grating and 532 nm excitation laser and 0.65 cm^{-1} for 1,200 $gr.mm^{-1}$ grating and 785 nm excitation laser.

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 for thin and polished sections (Head: RNDr. Roman Skála, Ph.D.)

To prepare the samples for optical microscopic, SEM and/or EPMA studies a suite *of cutting, grinding, lapping and polishing machines* to manufacture polished sections or thin sections is available.

Laboratory of microscopy (Head: Mgr. Michal Filippi, Ph.D.)

Laboratory of microscopy is used for the first identification of the studied samples and for a detailed preparation for other more sophisticated methods. The equipment of the laboratory enables a photographic documentation of samples and also basic image analyses (for example in case of the thin sections).

Polarization microscope OLYMPUS BX51 with digital camera OLYMPUS DP70 and U-RFL-T fluorescence light source equipped by X-ray fluorescence with wavelength filters; QuickPHOTO MICRO 2.2 software (2006) and Deep Focus modul

Binocular microscope OLYMPUS SZX16 with digital camera CANON EOS 1200

software Deep Focus 3.0 (2007)

Binocular microscope OLYMPUS SZ51 (2007)

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)

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, Ph.D.)

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: Doc. RNDr. Tomáš Navrátil, Ph.D.)

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, Ph.D. & Mgr. Šárka Matoušková, Ph.D.)

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 analysing solid samples and backup power system *UPS PW9355 POWERWARE* (Eaton).

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

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 and **Laboratory of rock elastic anisotropy** (Head: ing. Tomáš Lokajíček, CSc.)

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

The new methods are developed for assessment of stability mechanically loaded rocks, for multichannel monitoring of seismoacoustic signals occurring during various loading regime.

The special software programs are created for automatic pre-processing of acoustic signals and for processing of acoustic series. Processing of acoustic series is based on the correlation and fractal analysis.

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

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 the CAS	35 405
2.	From the Grant Agency CR (accepted research projects)	7 588
3.	From theTechnological Agency CR (accepted research projects)	687
4.	From the internal research projects of the CAS	1 953
4.	From other public sources	1 078
5.	Applied research	4 393
6.	Investment (instruments)	14 108
7.	Investment (constructions)	0
TOTAL INCOMES		**65 212**

B. EXPENSES		
1.	Scientific staff (wages, insurances)	30 947
2.	Research and scientific activities	11 627
3.	Administration and technical staff (wages, insurances)	5 706
4.	General expenses (service, maintenance of buildings, energies, transport, office supplies, miscellaneous, etc.)	1 842
5.	Library	831
6.	Editorial activities	151
7.	Investment (instruments)	14 108
8.	Investment (constructions)	0
TOTAL EXPENSES		**65 212**

Notes

Notes

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