



CZECH GEOLOGICAL SURVEY

Annual Report **2016**





Director's Introduction

Last year in the Czech Geological Survey mattered above all in the fact that we analyzed thoroughly the situation in the field of geosciences and in view of the changing national and global priorities, we streamlined the strategic trends of further development in our research activities. The CGS' strategic research plan for 2016–2020 (you will find its main goals on the next page) takes into consideration that the 21st century has seen the transformation of geosciences into a really interdisciplinary field, making use of cooperation with the other scientific disciplines, including biology, material science, information technology and social sciences. It is obvious that geoscience information goes on participating in the solution of crucial and even vital questions for our community and therefore, we model our objectives according to these requirements and challenges.

One of our strategic goals we have focused on during the past years, is for instance the research into environmental and geo-energy technologies. November 2016 saw the termination of work on a large-scale Czech-Norwegian project dealing with the CO₂ geological storage in the Czech Republic. The project was led by the CGS and involved more than 120 researchers from seven institutions. At present, our specialists also focus on the energy storage in the subsurface, they map storage potential in suitable geological structures and conduct research on the utilization of geothermal energy on our territory within the national RINGEN infrastructure and the international GEOPLASMA project. Part of the applied research activities are associated with the Czech Republic's plan to build up a safe radioactive waste repository in the underground. So far, available knowledge about all potential sites is being gathered and their 3D geological models are being set up.

An assessment of the groundwater resources also belongs to the natural resources investigation. The year 2016 saw the termination of the CGS' mainstay project "Review of Groundwater Resources" we have worked on since 2010. Thanks to that project, we have acquired detailed knowledge about the groundwater reserves in the Czech Republic within the studied hydrogeological zones. The project has also contributed to improving the knowledge of geologic setting of the hydrogeological zones and brought new information about groundwater retention in rocks and about the climate-change manifestations. This has been paralleled by setting up a new methodology enabling assessment of groundwater resources in various types of hydrogeological zones and moreover, these assessment procedures can be periodically repeated. Project results are thus very important for working out catch-

ment area plans as well as water-piping and drainage plans for national administration authorities deciding about groundwater-water usage. The regional geological investigation concentrated on the Bohemian Massif and parts of the French Vosges and the Massif Central, the Italian Alps in Europe and the Moroccan Meseta in North Africa. In Asia, studies were conducted above all in northern China, in the Chinese Altai, Beishan and on the margin of the Dunhuang Block. The international development cooperation project "Geological mapping at 1:50,000 scale and assessment of the economic potential of Western Mongolia" was successfully terminated.

The geological hazards investigation involves slope-stability assessment at places designed as the main planned transport routes. Related activities were also carried out at landslide-prone localities, such as is the D8 motorway near Dobkovičky or a local road in Dolní Věstonice village.

The project "Monitoring of small forested catchments GEOMON – A research tool for strategic policy decisions in the environment" was also successfully terminated. Reserves of ecologically significant elements in Central Europe's forest ecosystems were brought to light and an improvement in the surface water quality had been signaled, a fact due to acidification decrease. Members of our professional team also carried out isotope (¹⁵N) experiment in the Antarctica which had to detect global climate-change effects influencing uptake of nutrients by plants within the tundra biome.

There are, as usual, several noteworthy events even in our publishing business. Our flagship, the journal *Bulletin of Geosciences*, has reached an impact factor of 1.7, and no one is surprised that it is member of the group rallying three most prominent science journals in this country. Also, we participated in releasing Encyclopedia of Geology in book form or the first Czech monograph describing the nature and history of the Doupovské hory Mts. Within our production, the latter has just marked several records and received an outstanding readers' interest.

To conclude, I would like to emphasize that geoscience cannot do without integrating regular observations with geological and geophysical databases. The CGS has developed for this purpose a geoinformation system at a world-class level. This enables an effective access to all acquired data via modern IT tools. This makes our web maps, databases and other applications accessible both to the administration bodies and the public.

Without the enthusiasm and the zeal for a good cause, which we have, we would not be able to carry out our service so well. Let me express my greatest thanks to all the staff members of the Czech Geological Survey.



Zdeněk Venera



Czech Geological Survey

The Czech Geological Survey is the state organization that compiles, stores, interprets and provides objective expert geological information for the state administration, the private sector and the public.

It is a state-funded body, the resort research institute of the Ministry of the Environment responsible for providing the state geological survey in the Czech Republic. It is the only institution with the mission to systematically investigate the geological composition of the whole territory of the Czech Republic.

The well-established reputation of the Czech Geological Survey is based on the optimum combination of services to society with top-ranking research in geological science, natural resources, geological hazards and environmental protection.

As an internationally respected scientific institution, it responds to the requirements of society for sustainable development and plays a significant role in education and in the popularization of geology.

Main fields of activity

- Geological research and mapping
- Rock environments and their protection
- Mineral resources and the environmental impact of mining
- Geological hazards, prevention and mitigation of their impact
- Geoinformation management and delivery

Mission

- Geological mapping and regional research within the territory of the Czech Republic
- Basic and applied research in geological hazards, mineral resources, rock environments and environmental protection
- Administration of the State Geological Survey in accordance with Act No. 62/1988 Coll. (on geological work)
- Gathering, compilation and interpretation of data on the geological composition, mineral resources and geohazards on the territory of the CR
- Provision of geoscientific information and expert advice to support decision-making on issues of state and public interest
- International cooperation and foreign development aid
- Education in geosciences and environmental protection

Vision

Through innovative research and the use of the most up-to-date technology, the Czech Geological Survey will continue to provide the Czech State with the geoscientific information needed to make crucial policy decisions about energy, water and other critical resources, natural hazards and sustainable development, while working to maintain its position as a leading research institution in the field of Earth sciences.



The strategic research plan

2016–2020



Research of the structure and evolution of the Earth's crust



Research of the biodiversity and global changes in the past



Research and utilization of natural resources



Research of the geosphere-biosphere-atmosphere interaction



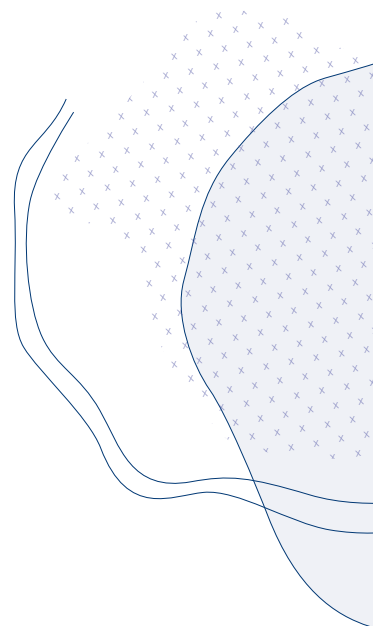
Research of the geohazards



Research and development of the geochemical and mineralogical methods

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Organizational Structure

| Advisory bodies | | Directorate | | Advisory bodies | |
|---|---|---|---|---|--|
| Scientific Board Review Board Editorial Board CGS Map Approval Committee | | Management Project Management Management and Administration of the Brno Branch | Zdeněk Venera Director zdenek.venera@geology.cz | Human Resources Section Internal Audit | Editorial Board of the Bulletin of Geosciences CGS Portal Board CGS Library Board |
| Geochemical Division and Central Laboratories | Economic Division | Geological Division | Geofond Division | Division of Informatics | |
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Management



From the left:

Vít Štrupl – Head of the Geofond Division,

Dana Čápková – Deputy Director for Informatics,

Oldřich Krejčí – Director of the Brno Branch,

Zdeněk Venera – Director of the Czech Geological Survey,

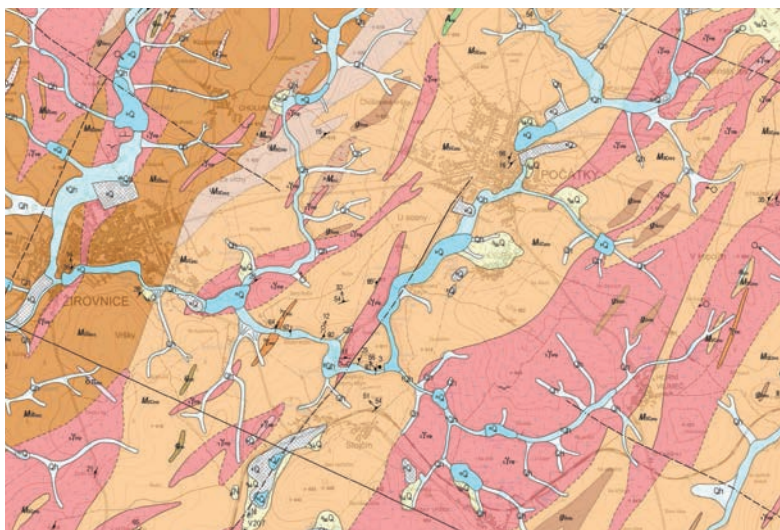
Petr Mixa – Deputy Director for Geology,

Zdeněk Cilc – Deputy Director for Economics,

Jan Pašava – Deputy Director for Research and Head of the Geochemical Division and Central Laboratories.

Geological and thematic maps

Geological maps provide comprehensive information on the geological structure of the Czech Republic. They are used for environmental protection, geohazard assessment, mineral deposit exploration and for land use planning.



Preview of the 1:25,000 geological map of the CR, Žirovnice map sheet (23-324).

Geological mapping

Geological mapping is one of the main activities of the Czech Geological Survey. The scope of data collection and archiving was greatly expanded in 2016 due to a new methodology. All field and laboratory data obtained, including information on cutting material and chemical analyses, are stored in a single geological database. The database of geological documentation points currently contains 90,743 records, and over 3,000 new documentation points were created over the past year. Map sheets and explanatory notes to these sheets are compiled on the basis of a single legend, which makes it easy to build on surrounding geological maps.

Geological maps at 1:25,000 scale

The geological mapping project at a scale of 1:25,000 includes the creation of geological maps with a graphic legend, supplemented by marginal data. In addition

to geological maps, the project also includes thematic maps such as mineral deposit maps. Bedrock maps, tectonic maps and others were compiled for certain areas. The explanatory notes to these maps contain information on the character and quality of the rock environment. At the same time, however, they also provide information regarding geochemistry, geophysics, hydrogeology, engineering geology, structural geology, economic geology, pedology and environmental geology. The entire project thus gives readers a comprehensive view of the geological structure and development of a given area. During the mapping process, the national geological map database is gradually being updated with detailed data on the rock environment, and a database is being developed that is available to the public on the geological server www.geology.cz. The new geological mapping project is one of the sources of information for

the safeguarding and inventory of significant geological localities.

At present, the Regional Geological Mapping Project at 1:25,000 scale includes 25 map sheets in various stages of completion. The work is being carried out in the following eight areas: the Železné hory National Geopark, the Novohradské hory Mts, the Pošumaví (Bohemian Forest foothills), the Bohemian Paradise, the Bohemian-Moravian Highlands, Central Moravia, the former Brdy military district, and the Moravian Karst Protected Landscape Area. The Žirovnice (23-324) and Nová Paka (03-432) map sheets were successfully completed during 2016.

Contribution to territorial development and to the ecosystem

Maps of environmental geofactors are an integral part of the newly completed set of geological maps at 1:25,000 scale. A special chapter in the explanatory notes



The map of environmental geofactors exemplifies the relationship between geological and thematic maps, Nová Paka map sheet (03-432).

is also devoted to these environmental issues. The above-mentioned map and the accompanying chapter in the explanatory notes summarize data gathered during field surveys as well as the results from laboratory analyses of soil, rocks and water. They are an important source of information for the protection of the rock environment, including the safeguarding of mineral resources and groundwater. They provide state authorities as well as the professional community with information on groundwater management zones, on the extent of slope instabilities, or on the chemical composition of soils and major rock types. In addition to inorganic pollutants, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB) and organochlorinated pesticides (OCP) are being monitored in the soils near large

conurbations as well. The data then serve to demarcate hazardous areas with respect to potential contamination of the rock environment and conflicts of interest. Areas deserving protection with regard to geology or landscape ecosystems are being identified as well.

The 1:25,000 geological maps provide baseline information for the creation of an integrated map system and database applications, such as the database of significant geological localities, slope instabilities, decorative (dimension) stone, or radon risk maps.

Follow-up research

A number of data obtained during geological mapping are used in expert publications. The year 2016 saw, for example, the publication of the results of a study of the geochemical variability and origin

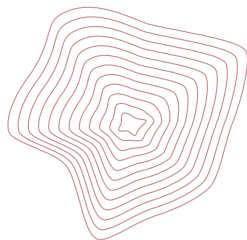
of basic and intermediate plutonic rocks of the Železné Hory Mts Plutonic Complex, the interpretation of the formation of carbonate concretions from sandstones in the Moravian Karst, or the evaluation of a palaeontological survey of the Brloh locality in the Železné Hory Mts. The complex tectonic structure of the bedrock exposed during the construction of new facilities at St. Anne's University Hospital in Brno was described in detail as well.



David Buriánek

Project leader for geological mapping of the Czech Republic 1:25,000

Regional geological research



In 2016, the regional research of the Czech Geological Survey, an important aspect of which is the modelling and visualization of the Earth's crust structure, focused on methodical aspects of 3D modelling or unification of data sources. The research was coordinated with a number of externally funded national and international projects. Intensive research was also dedicated to a wealth of data and samples gathered during the "Review of Groundwater Resources" project. In addition, the study of accretion and collision processes along convergent boundaries continued using advanced geochemical, geochronological and geophysical methods, accompanied by numerical and analogue modelling.

Regional research priorities

Regional research was conducted as a follow-up to mapping and according to the needs of applied research. The modelling and visualization of the Earth's crust structure focused on the methodology of 3D modelling and were coordinated with a series of international and national projects. The "Review of Groundwater Resources" project provided a wealth of data for follow-up research. Regional studies focused on the Bohemian Massif, on parts of the French Vosges and Massif Central, the Italian Alps in Europe, and on the Moroccan Meseta in North Africa. Investigations in Asia took place mainly in northern China, specifically in Tien Shan, in the Chinese Altai, in Beishan, and at the margin of the Dunhuang Block. The development assistance project "Geological mapping at 1:50,000 scale and assessment of the economic potential of Western Mongolia" was successfully completed, and work on a bilateral international assistance project in Ethiopia continued. In total, 53 papers in peer-reviewed periodicals with an impact factor (12 others are being peer-reviewed), 11 papers in peer-reviewed journals, four books, one book chapter, two articles in a peer-reviewed memorial volume, and six explanatory texts were published.

Part of the applied research is related to the Czech Republic's plan to build

a safe deep repository for spent nuclear fuel. The activities focused mainly on 3D modelling of the geological structure of candidate sites, on the study of their geological, hydrogeological and hydrogeochemical setting, and on the petrophysical properties of the host environment. The research also involved the study of the influence of exogenous processes on the repository's stability and on an underground laboratory for in-situ experiments that is being built. The findings on all potential sites were summarized, their 3D geological models were constructed, and the rocks at the site of the Bukov Underground Research Facility were studied and described in detail as well.

Photogrammetry methods utilized to create 3D geoscience models have been used more extensively since 2016, for instance the setting-up of "discrete fracture network" (DFN) models applicable for the interaction of 3D models with 3D maps. In the first half of 2016, CGS staff were involved in the preparation of the "Geology of the Jizerské hory Mts and Liberec Region" exhibition at the North Bohemian Museum in Liberec. The exhibition catalogue included geological topics and the first urban geology map for the city of Liberec. A map of building and decorative (dimension) stone of the South Bohemian Region was also com-

piled, which is a follow-up to a similar map of Prague to be released in 2017.

Metamorphic rocks

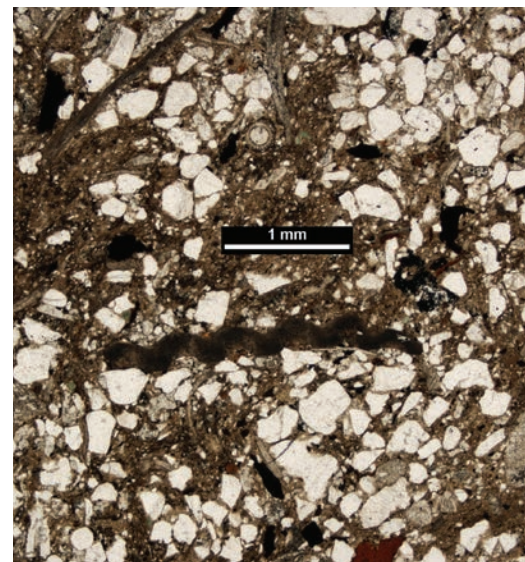
A study of microstructures resulted in a description of the evolution of metamorphic rocks according to deformation mechanisms, which reflects a significant interplay of deformation and chemical processes under conditions of brittle-ductile transition. The microstructures in Al-rich minerals from eclogites were studied using cathodoluminescence. Additionally, the kinetics of metamorphic reactions, the role of partial melting, and the geodynamics of reactions in the eclogites were reconstructed based on coronitic and symplectitic microstructures. Vrána et al. (2016) published a paper on changes in the chemistry of garnet and the enclosed ilmenite-magnetite-spinel spheroids in the peridotite-eclogite associations from the Blanský les Mts.

Magmatic rocks

A study of vein and intrusive granitoids with a definitive distinction of individual vein and intrusion types was completed at the southern margin of the South Bohemian granulite complex. These findings may help clarify granitoid legend items in mapping projects. A publication dealing with an analysis of magnetic structures of the Pelhřimov Complex



Block of muscovite-biotite granite worked in situ near the inactive Lisek quarry near Jihlava. Photo by J. Pertoldová.



Calcareous clayey sandstone from a depth of 61.70 m (Teplice Formation): A distinct schlieren structure, black fragments of carbonized plant debris and elongated fragments of bivalve shells; a yellow-brown resin fragment is apparent at the lower edge. Borehole 4730_B Stvolínky. Photo by J. Valečka.

dome structure in the Moldanubian Pluton with implications for the stress and mechanical aspects of the emplacement is being finalized.

Volcanic rocks

The findings of the now completed “Review of Groundwater Resources” project are still being prepared for publication. The first phase involved the processing of the oldest evolutionary stage of the Altenberg-Teplice caldera, the so-called Schönfeld Complex with rhyodacite lavas, ignimbrites and other types of volcaniclastic rocks. Systematic gamma-spectrometry mapping combining ground-based and airborne data collection represents an important source for the findings on the later-stage caldera evolution (Teplice Rhyolite). The resulting image aids in the correlation of units, particularly across the Czech-German border.

Sediments

The microstriations on the interbed surfaces of limestones, historically de-

scribed as “fossil seismograms”, were studied in the Palaeozoic of the Barrandian. The processing of data obtained during the “Review of Groundwater Resources” project continued. Drill cores from the Bohemian Cretaceous Basin that are stored at the CGS repository in Lužná near Rakovník were subjected to systematic sedimentological, petrographic and palaeontological study, which resulted, for example, in the revision of the stratigraphic classification and tectonic structure of the basin. The drill cores also provided new insight into the dynamics of the sedimentary environment at various stages of the basin’s evolution. Palaeontological material from Antarctica (James Ross Island), the Bohemian Cretaceous Basin, and also from the Lower and Upper Cretaceous of Germany, Austria and France were systematically analyzed as well. A model of the Hrádek Basin and of the isopachs of Tertiary and Quaternary sediments in the Hrádek and Frýdlant areas are being constructed with regard to pos-

sible impacts on surface and groundwater in the forefield of the Turów Coal Mine. During fieldwork in the Polabí and Třeboň regions, radiocarbon dating revealed that the horizons of buried soils, discovered beneath aeolian sand dunes, date back to the Late Glacial Period (about 13,5 thousand years before the present). These soils show a characteristic facies development and are most likely correlated with the so-called “Usselo soils”, which were described earlier in Central Europe’s northern regions.



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Research of the biodiversity and global changes in the past

The study of global changes during the geological history is focused mainly on global events ("bioevents") that markedly influenced the evolution of the overall biodiversity of marine or terrestrial ecosystems. Using palaeontological, sedimentological and geochemical methods, the team of scientists from the CGS analyses the changes in selected abiotic characteristics of the palaeoenvironment (for instance changes of sea water temperature or the carbon cycle in marine ecosystem) and parameters describing the evolution of palaeodiversity before, during and after global crises. Palaeodiversity evolution analysis therefore comprises time-consuming taxonomical, palaeoecological and palaeobiogeographical research.

The study results from the year 2016 were published as articles in scientific journals with an impact factor or as articles in peer-reviewed professional periodicals and were presented in the form of lectures and as a poster at international conferences. In 2016, the team of researchers investigating the global changes published or submitted 31 articles in scientific journals with an impact factor. Average publishing efficiency of that team is therefore more than three papers in scientific journals with an IF per a team member and year.

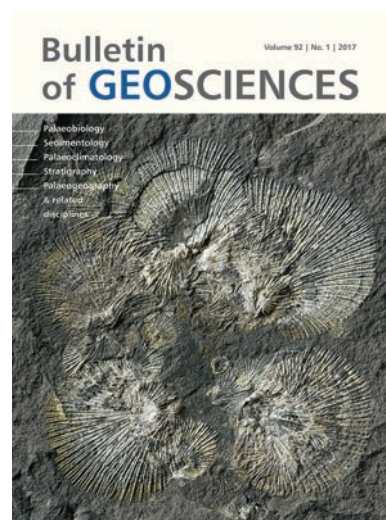
The group studying the marine Paleozoic provides full editing and technical support for the international journal **Bulletin of Geosciences** with an impact factor. In 2016, it published 42 scientific papers on 900 pages (Bulletin of Geosciences, Volume 91, 2016). Bulletin's impact factor is now 1.7. **Thanks to the persistent effort of the current Edito-**

rial Board, the Bulletin of Geosciences is the third most important scientific journal released in the Czech Republic. The Bulletin belongs to the world's top-ranking paleontological journals.

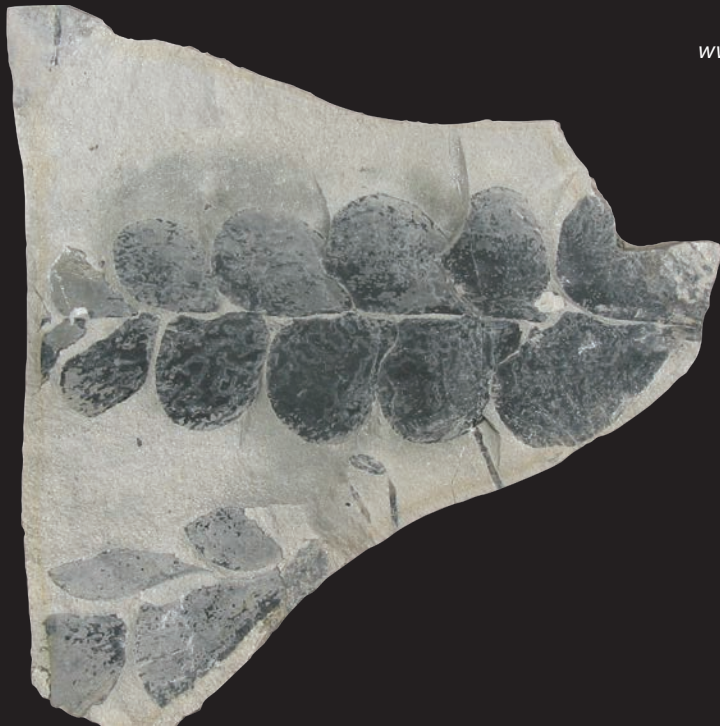
The team members present their results at global and international conferences. They also supervise doctoral students in Charles University and the Czech University of Life Sciences Prague. There, they are guarantees of several professional subjects, providing master's degree students and postdoctoral students a number of lecture-courses such as "Evolution of global ecosystems", "Geochemistry", "Paleoecology" or partly "Zoology".

Jiří Frýda

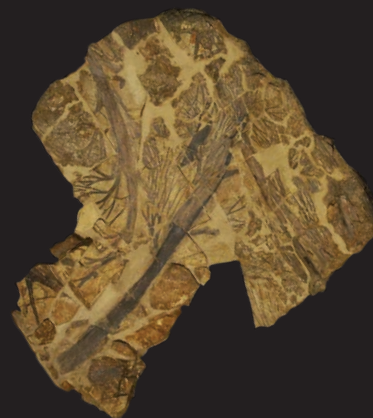
Coordinator of the strategic plan
for research into global changes



Bulletin of Geosciences belongs to the world's top-ranking paleontology journals.



Occasionally, the refuse pile at Lužná provides pinnae of a progymnosperm plant *Noeggerathia foliosa*. This plant reminded of Cycadofilicales with a short stem, yet it had nothing in common with them. The branching stem showed strobili with microspores and macrospores. It represented a blind evolutionary branch that died out towards the end of the Paleozoic along with the tree-like club-mosses. Their age is c. 314,000,000 years.



During field work at Ovčín near Radnice (Radnice Basin), a large branch of a tree-like club-moss *Lepidodendron selaginoides* was discovered. A 1.2 m long piece was collected and is now being kept in the Museum of West Bohemia in Plzeň. The tree-like club-mosses were the commonest element of the coal-forming Carboniferous vegetation, nevertheless, they died out completely towards the end of the Permian (Paleozoic). The find is more than 314,000,000 years old.



A group of various evolution stages of a Silurian trilobite *Aulacopleura koninckii* on the surface plane of a shale. Numerous complete carapaces document a mass extinction of the trilobites due a sudden decrease in oxygen content of the water. Loděnice near Beroun.



The accumulation of Silurian brachiopods *Valdaria budili* on the surface plane of a mudstone is one of the oldest examples of marine epi-planktonic organisms in an open-sea environment. Brachiopods took advantage of the floating algal mats as substrates. Quarry at Kosov near Beroun.



Graptolites of species *Demirastrites triangulatus* on the black-shale surface plane. This species is utilized for Lower Silurian oil-measures correlation. Black-shales deposited during the oceanic anoxic period that followed one of the five major Uppermost Ordovician mass extinction events.



Mineral resources

The investigation of Czech Republic's mineral resources in 2016 focused on critical and energy raw materials and strategic metals. Data related to the protection and use of mineral resources were collected, processed and provided as falls within the competence of the state geological survey. Particular attention was paid to the mineralogical and geochemical assessment of minerals, to the evaluation of environmental impacts of mining, and to mining heritage research. Economic geology experts took part in European research projects and in mineral resource investigations in developing countries.

Study of critical raw materials and possibilities of rare metal acquisition

The mineralogical and geochemical research within the scope of the project “Competence Centre for Effective and Ecological Mining of Mineral Resources (CEEMIR)” was preceded by a research analysis of an extensive and, from a geologic and metallogenic perspective, heterogeneous area, which includes the Moldanubian and Teplá-Barrandian zones, the Moravian-Silesian Zone and the Lucicum. Prospective sites were selected and, subsequently, available samples from a number of these were checked for the occurrence of critical raw materials. A detailed investigation of selected minerals using new analyses resulted in the verification of higher In concentrations in the sphalerites of the Staročeské and Turkaňk zones of the Kutná Hora Ore District. New analyses also revealed a

high variability of Nb, Ta, and REE concentrations in wolframite, primarily in the pegmatites of the Vysočina Region. A REE mineralization in the heavy fraction of Tertiary and Quaternary sand and gravel in the wider surroundings of the Nakolice sand quarry in the Novohradské hory Mts was studied as well. Maps of heavy minerals, CRM carriers, were compiled by subcontractor Geomin Ltd., which concluded the inventory of potential, anomalous localities in the above-mentioned areas and which resulted in a recommendation for further investigation of CRM carriers mineralizations, especially in the less explored border areas.

The distribution of trace elements in graphite was studied at localities in the Velké Vrbno Group and Brunovistulicum, and a detailed investigation of the Český Krumlov – Městský vrch graphite deposit was initiated. Samples of

the typical profile were collected here for geochemical-mineralogical study, a technological sample from the K2 chamber was collected and analyzed, and graphite-bearing structures were closely observed in order to develop a spatial model. Indications of platinum metals at the Rožany-Kunratice and Staré Ransko localities were also verified using archived samples.

A detailed study by the company Sedlecký kaolin, a. s., evaluated the Li and Rb concentrations in the washed mica of the Čapí hnízdo, Podlesí II and Ruprechtov deposits during the processing of high-quality kaolin.

The CEEMIR WP5 project included the testing of the biotoxicity of materials deposited in the waste dumps of historical mines in Kutná Hora (Trmandl, Turkaňk, Kuntery, Šmitna and Maří Magdaléna). The experiments were carried out on aqueous extracts by using



Zárubka Quarry in the Pardubice Region. Photo by P. Rambousek.

the aquarium fish *Poecilia reticulata*, the daphnia species *Daphnia magna*, the algae *Scenedesmus subspicatus*, and the roots of *Sinapis alba* as bioindicators. The mortality of the fish and daphnia at all sites was 100%, and allowable limits were exceeded in the case of the other bioindicators. Buffered extracts were tested for exotoxicity using ringed worms and springtails. The results indicated the risk of dermatological problems, particularly in children, from the dust of waste dumps except for those of the Rejské Zone with low As contents.

The TAČR (Technical Agency of the Czech Republic) Beta project “Investigation of technological possibilities of rare element extraction in the Czech Republic with respect to minimizing environmental impacts and providing legislative background”, led by the CGS

in the consortium of VŠB-TU Ostrava (VŠB-Technical University of Ostrava) and the company DIAMO, s. p., culminated with an assessment of the possibilities of using domestic primary and secondary sources of W, Li, Nb, Ta, Rb, Mn, Au and Ag. A certified methodology was developed for their technological processing, and an amendment to Decree No. 429/2009 on the requirements for extractive waste management was proposed.

Other significant grant projects

The GA ČR (Czech Science Foundation) project “Mobilization model and geochemical cycles of potentially hazardous elements and organic materials in burnt-up coal pit heaps”, led by the CGS, continued with an investigation of the waste dumps of the former Novátor Mine in

the Trutnov region. The results have thus far revealed that the river network near the dumps is still being contaminated long after the termination of coal, uranium and ore extraction.

The GA ČR project “Re-Os geochronology of ore mineralizations in the Bohemian Massif and consequences for their metallogeny” was successfully completed.

During the TA ČR Beta project “Comparison criteria for the classification of reserved deposits of the raw mineral material base in the Czech Republic to ensure their compatibility with the internationally recognised PERC and JORC standards”, which was completed last year, the CGS participated in the development of a certified methodology for comparing international economic standards with the existing classification of





Collection of graphite samples at the Český Krumlov – Městský vrch deposit. Photo by M. Poňavič.

mineral deposits and in its application testing.

In cooperation with domestic and foreign institutions, the CGS also participated in an investigation of the Li-W-Sn mineralization in the Krušné hory Mts, in the comparison of the five-element formation in the Krušné hory Mts with the Kongsberg deposit, in isotope analyses of laterite profiles and gossans in Burkina Faso, and in experimental studies of platinum metals and identification of the new mineral norilskite.

Mineral resources map production

Within the scope of the “Geological base mapping of the CR at a 1:25,000 scale” project, mineral resource specialists compiled 11 map sheets of mineral resources including explanatory notes.

Mining heritage research

The Czech-Saxon project involving archaeological, mining heritage and geological research of medieval mining in the Krušné hory Mts continued with the commencement of another phase titled “ArchaeoMontan 2018” (www.archaeomontan.eu). The project's first phase resulted primarily in a newly created exhibit of medieval mining in Dippoldiswalde and in an exhibit in the

newly built info centre in Krupka. A new survey area was expanded to include the medieval mining of Sn ore in the Krupka and Jáchymov areas, where detailed airborne laser scanning (LIDAR) was carried out in the area of interest and auxiliary test pitting in medieval mining settlements and sites. In addition to the region of the Krušné hory Mts, research into the history of mining also continued in the Jeseníky Mts (Horní Město Ore District).

International cooperation and foreign projects

As part of the Czech Republic's development assistance project abroad, the economic geology experts from the CGS contributed significantly to the completion of a mapping project, which was also accompanied by an assessment of Mongolia's mineral resource potential. The GAČR research project “Mining and processing of Cu, Pb, Zn and Co ores in Sub-Saharan Africa – a natural geochemical laboratory for pollutant behavior study” continued in cooperation with the Faculty of Science at Charles University in Prague. Geochemical modelling and the results of electron microscopy showed that the weathering of the dust fallout from the smelter in Tsumeb at

neutral pH results in rapid stabilization of arsenic with the formation of stable Ca-Cu-Pb arsenates and the binding of As in newly formed Fe oxyhydroxides. Incubation experiments with the dust fallout in the mining areas of Zambia and Namibia demonstrated that potentially hazardous elements (PHE) may enter crops at low pH values.

The ProSUM project of the EU under the H2020 programme continued. The CGS completed the metadata catalogue, and CGS experts aided in a detailed classification of mining waste and in the selection of data for a pan-European database (www.prosumproject.eu).

The Czech-Saxon project **ResiBil**, which focuses on a review of water resources in the eastern part of the Czech-Saxon border region, was initiated. The Saxon State Office for Environment, Agriculture and Geology is the lead partner, and the CGS and the T.G. Masaryk Water Research Institute are the Czech partners. The project also deals with the effects of mineral resource occurrence and extraction on water.

CGS representatives worked in expert groups on mineral resources, energy minerals and geochemistry in EuroGeo-Surveys and in the European Innovation Partnership on Raw Materials (EIPRM).



Sampling of a waste dump in the Turkaňk Zone at Kaňk near Kutná Hora. Photo by B. Kříbek.

They also actively cooperated with the Knowledge and Innovation Community (KIC) through the regional centre ESEE in Leoben. In the SGA (Society for Geology Applied to Mineral Deposits), J. Pašava and A. Vymazalová hold important positions involving the organization of international scientific cooperation in the field of mineral resources.

The results of mineral resource research were presented at the 35th International Geological Congress in Cape Town, South Africa (www.35igc.org).

Tasks of the state geological survey

In accordance with sect. 13, par. 1. of Act No. 62/1988 Coll., the geologists of the Mineral Resources Department engaged in the preparation of a numerous expert reports for important administrative decisions or land use planning documents, including the location of selected development and buildable areas in Protected Deposit Areas (CHLÚ). Among the most important were the expert assessments concerning a number of notifications and documentations of plans for the commencement of mineral extraction pursuant to Act No. 100/2001 Coll. (EIA) with regard to the extraction of important construction minerals (Luhov – Brniště – Tlustec with the Luhov

DP (mining lease), Černá Hať – Chrástovice, the Rozstání DP, heap no. 15 in the Příbram region, Dobříň, Počaply near Terezín I, Bystřice nad Úhlavou, Číňov, Pňovice, Kolín, Lovosice-Prosmyky, etc.) particularly in relation to existing valid regional raw material policies. Other significant assessments dealt with mineral fuels (with the development of the neighbouring Turów mine, with the Lazy DP in OKD, with the Medard DP in the Sokolov region, with a proposal for the cancellation of the brown coal reserves in the North Bohemian Lignite Basin – the Modlany CHLÚ, the Proboštov CHLÚ and the Otvice CHLÚ), and also with the granting of exploration permits for reserved minerals (Hrob, Věrovany, Přítok tailing pond, Braňany, Cínovec, etc.), and last but not least with the updates of the ZÚR (“Principles of Urban Development”) for the Karlovy Vary, Central Bohemian, Hradec Králové, South Moravian, Zlín, Olomouc, South Bohemian and Liberec regions.

State raw materials policy and communication with the professional public


CGS experts played a significant role in commenting the “Raw Materials Policy of the Czech Republic” with regard to

mineral resources and in the evaluation of EU’s raw materials initiative at a seminar of the MPO (Ministry of Industry and Trade), the European Commission and Euromines on “How the mining industry can contribute to the economic and industrial growth of the Czech Republic?” and at a seminar of the Chamber of Deputies of the Czech Republic that focused on the “Potential of lithium production in the Czech Republic and its use in advanced technologies”.


The initial seminar “Mineral resources in the Liberec Region and their use” at the Regional Office of the Liberec Region launched the 2nd update of the “Regional Raw Materials Policy”, which will be further implemented during 2017.



Petr Rambousek
Head of the Department
of Mineral Resources Research
and Policy



Groundwater research and evaluation



The year 2016 saw the completion of the Czech Geological Survey mainstay project „Review of Groundwater Resources“ that evaluated the groundwater resources in 58 hydrogeological zones covering about a third of the Czech Republic’s territory. The project resulted in determining the utilizable proportion of groundwater resources in the individual zones, in verifying zone boundaries and provided suggestions for groundwater treatment. CGS specialists tackled the groundwater protection issues by studying the occurrence of nitrogenous substances in the groundwaters and the protection of water resources in the Hrádek nad Nisou and Frýdlant frontier areas endangered by coal mining. The applied part of the hydrogeological investigations was focused on the problems of hazardous waste disposal in the rock environment and on geothermal energy utilization.

Groundwater assessment of selected hydrogeological structures

Review of Groundwater Resources

The year 2016 saw the completion of a mainstay project of the Czech Geological Survey „Review of Groundwater Resources“. This project tackled the problems of groundwater resources in areas of major groundwater reserves within the Czech Republic’s territory.

The project contributed to gaining inside knowledge of geological setting in a number of evaluated hydrogeological zones. It brought new information on the average groundwater delay time in the rock environment and on the current climate change manifestations. The project has demonstrated that no single one routine method being adequate in groundwater resource evaluation. It has created a methodological platform that can serve as a basis for natural groundwater source evaluation in various types of hydrogeological zones.

The project results are pivotal for river basin management plans for development the water supply and sewage systems in areas known for the occurrence of major

groundwater resources. The information necessary for government administration and decision makers on groundwater management has been thus provided.

Study of the vulnerability and protection of groundwater resources

Innovating farming systems in water-resources protection zones

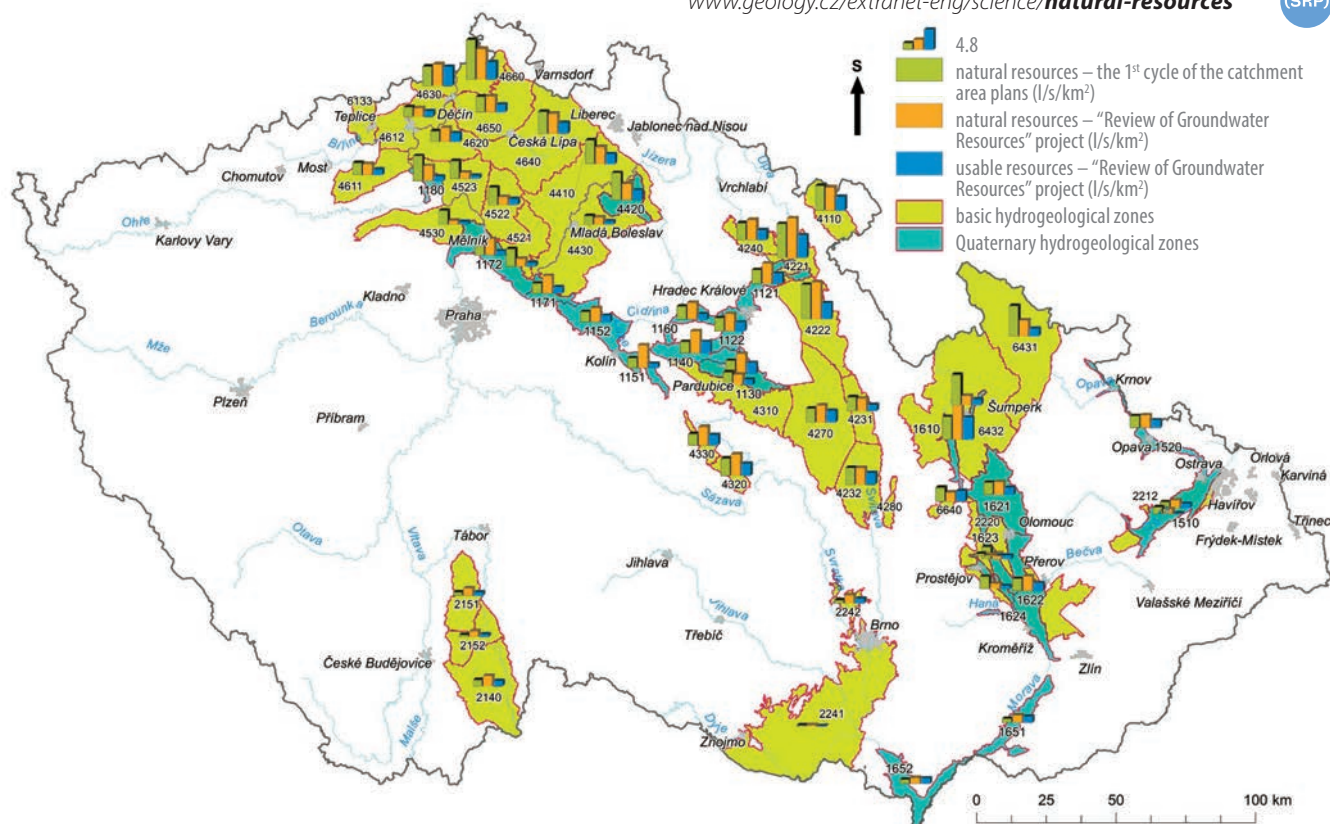
Monitoring of underground and surface waters was run in the areas of intensely utilized agricultural land in an aquifer represented by Quaternary fluvial deposits adjacent to the Jizera River stream northeast of Prague. The zones known for existing denitrification processes have been delimited by using the stable oxygen, nitrogen and hydrogen isotopes. This approach enabled producing special maps indicating the thickness of water-saturated sediments, maps of groundwater chemistry and the land-use maps. The project results will enable setting up agro-technical procedures contributing to a gradual decrease in groundwater contamination in an economically important water reservoir made up of fluvial deposits.

Turów – influence of coal mining on drinking water resources in the Frýdlant area

Since the second half of 2016, the CGS has conducted a study of geological and hydrogeological setting of the Hrádek nad Nisou and Frýdlant areas known for a planned brown-coal mining in the Zittau Basin. The mining area shall be expanded to the Czech-Polish national boundary. A project run by the CGS will provide data enabling to highlight anthropogenic influence related to raw material extraction in that area, specify the role of mining in the depletion of groundwater resources, and thus mitigate its negative impact.

Mineral waters

A research project dedicated to re-interpreting the properties and genesis of mineral waters and fossil salt brines in the Bohemian Massif and the Carpathian Foredeep has been started. New methods of the Cl, Br, Li, Zn, Cu, Cd and Cr isotope determination are being applied in the research.



Comparison of natural and usable groundwater resources in the hydrogeological zones of the “Review of Groundwater Resources” project.



Collection of groundwater samples from an exploration well, “Review of Groundwater Resources” project.

Applied hydrogeology

Hydrogeological exploration for suitable localities of deep repositories of spent radioactive fuel and radioactive waste

In 2016, the CGS participated in a number of activities initiated by the Radioactive Waste Repository Authority (RAWRA).

A substantial part of work was related to the construction of the Underground Research Facility (URF) Bukov in the Rožná uranium mine. Hydrogeological survey is focused on the evaluation of character, development and variability of the flow system and on the chemical composition of groundwater in the URF as well as in the deep profile of the Rožná mine. The delay time of the groundwater in the massif and its origin were also studied. All these data will provide a basis for mathematical model of the geochemical development of the locality.

The hydrogeological survey and research activities were conducted on seven selected sites potentially suitable for building the deep repository. The research objective is to verify the course of the tectonic

lines defined by the study of archival materials and to determine their hydrogeological significance. The gathered data are used for upgrading and calibration of 3D structure-geological models of the sites and for the groundwater flow models.

Hydrogeological research of the issues of geothermal energy use

Two projects focused on the geothermal energy use were started in 2016. They comprise the RINGEN research infrastructure and the international GeoPlasma CE project. Hydrogeologists from the CGS evaluate the impact of geothermal energy utilization on the environment and study the influence of groundwater flow on the thermal heat extraction procedures.



Lenka Rukavičková

Coordinator for research in hydrogeology

Geoenenergy research



Czech and Norwegian researchers measure properties of groundwater from a shallow aquifer in the area of the planned CO₂ storage site.

Geological storage of carbon dioxide and CCS technology

In November 2016, work on a large-scale Czech-Norwegian project titled “Preparation of a research pilot project on geological storage of CO₂ in the Czech Republic (REPP-CO₂)” was completed. The project, which involved more than 120 researchers from seven institutions (six from the Czech Republic and one from Norway) coordinated by the Czech Geological Survey, was co-funded by Norway Grants. Its purpose was to prepare a pilot CO₂ storage project in a depleted hydrocarbon field. The final phase of the project focused primarily on 3D static and dynamic modelling of the storage complex, simulation of CO₂ injection into the storage reservoir, risk analysis, and development of a monitoring plan and scenarios for further storage site development. Other important project activities included mutual Czech-Norwegian knowledge exchange, presentation of project results, including organization of a conference and several seminars, and raising awareness of CCS technology

among both professional community and lay public.

The four-year European research project ENOS (ENabling Onshore CO₂ Storage), funded by the Horizon 2020 programme, was launched in September 2016. Its aim is to support the development of CO₂ storage in geological structures onshore Europe. The CGS is represented in the project Management Board and plays a significant role in project execution.

Energy storage in the rock environment

In 2016, the CGS participated in the European project ESTMAP (Energy Storage Mapping and Planning), the aim of which was to create a pan-European database of existing and planned energy storage projects, both above surface and in subsurface storage sites, including mapping of energy storage potential in suitable geological structures. ESTMAP was a two-year Horizon 2020 project. The CGS was member of a quinary project consortium and was jointly responsible for the subsurface data of the resulting database.

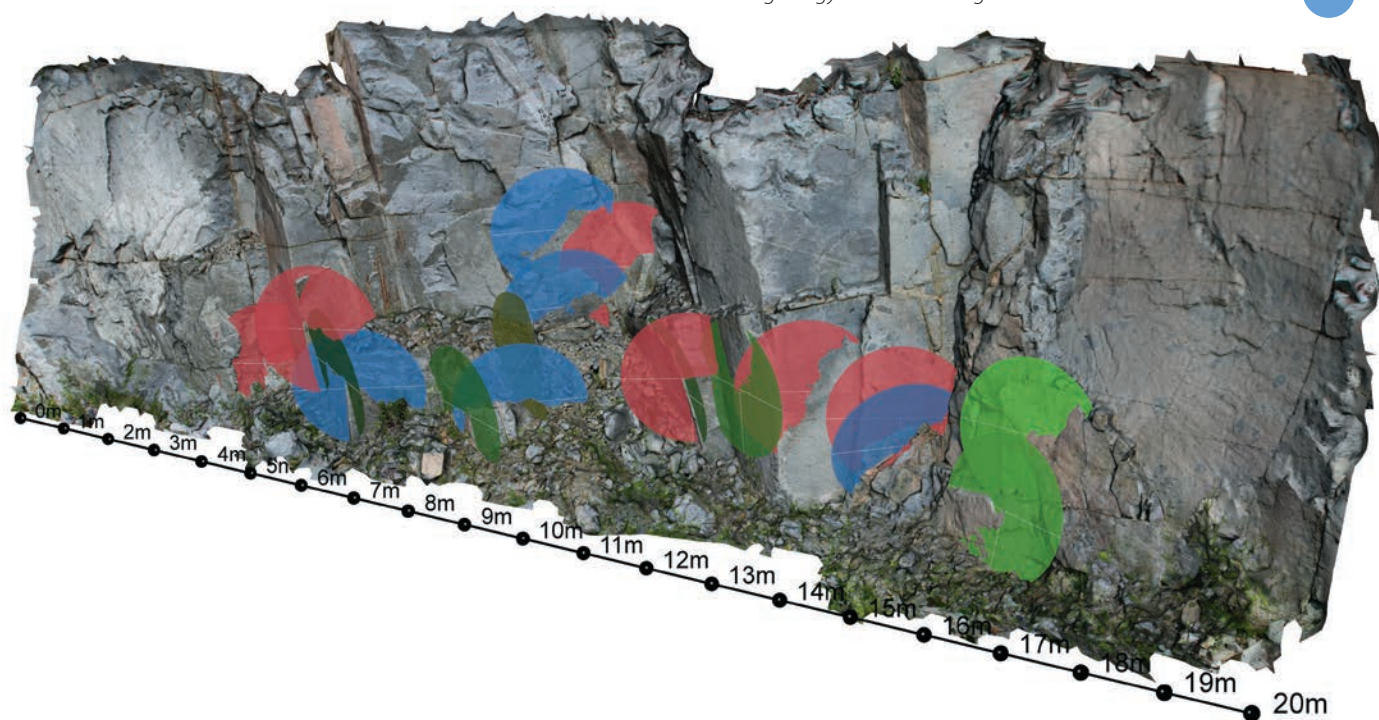
Radioactive waste disposal

The main strategic goal of research in this area is to support – from the geological knowledge perspective – the construction of a safe deep radioactive waste repository. In 2016, most extensive work involved the creation of regional-scale structural-geological models of seven candidate sites and of the Bukov Underground Research Facility. The work included compilation of archive data, definition of main structural geological elements, representation of geological features, model creation and export, and verification of the correct import of their geometry into a hydraulic modelling software.

In addition, an extensive background research report was compiled that details the current knowledge level in the fields of geology, petrography and structural geology at the seven candidate sites and discusses individual sites with regard to the occurrence of homogeneous rock blocks potentially suitable for the location of a deep waste repository.

Geothermal energy

The research infrastructure RINGEN



Detailed structural geological models of the sites of interest are supplemented by statistical models of discrete fracture networks (DFN), which allow for a more accurate estimation of the magnitude and anisotropy of hydraulic conductivity of a rock massif. The 3D image of a granodiorite quarry wall section was reconstructed using photogrammetry. Model placement and visualization of structural data were then performed using the MOVE software, which the CGS uses for 3D and 2D geological modelling. The model includes several colour-coded sets of brittle structures, based on similar orientation.

(Research Infrastructure for Geothermal Energy), which includes the Czech Geological Survey, was launched in the beginning of 2016. RINGEN comprises a consortium of partners from Czech universities and research institutions. The infrastructure aims to create and link a team of experts and technical background for research on the use of geothermal energy in the Czech Republic. The primary activities included a basic geological survey and additional preparatory work aimed at drilling of a 4.5 km deep geothermal well in the locality of Litoměřice, and subsequent research on the most suitable way of extracting Earth's heat from the hot dry rock environment.

Another successful step in the field of geoenery research was the approval of the international GeoPlasma-CE project, funded by the Interreg CENTRAL EUROPE Operational Programme. It focuses on the mapping and evaluation

of the potential of shallow geothermal sources in Central Europe, concretely in West Bohemia and the Broumov region in the Czech Republic. The project also includes activities to rise the awareness of the public and public authorities in the area of strategy for installing facilities utilising these local geoenery sources and the deployment of low-carbon technologies. The project includes 11 partners from geological surveys, public entities and the commercial sphere from the Czech Republic, Germany, Poland, Slovakia, Austria and Slovenia.

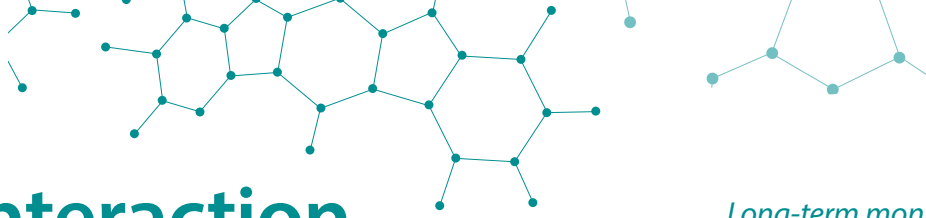
International networking

Active participation in international research networks is an important part of research activities in the field of environmental and geoenery technologies. The CGS is an active member of several such networks (ENeRG, CO2GeoNet, EuroGeoSurveys – Geo-Energy Expert

Group), which allow sharing of the latest knowledge and experience, joint publication of pan-European results, and also participation in consortia preparing new international projects, both bilateral and pan-European. The currently executed REPP-CO₂, ESTMAP, ENOS and GeoPlasma-CE projects are perfect examples of the networking results.



Vít Hladík
Research coordinator –
Geo-energy



Interaction geosphere- biosphere- atmosphere

Long-term monitoring of elemental fluxes, along with applications of novel isotope techniques, provide insights into processes taking place in forests, soils, surface waters and groundwaters, and are instrumental in assessing the health status of ecosystems. Such studies help to identify ecosystems most vulnerable to human interferences/ climate change. Quantification of geohazards, complemented with compilations of data on environmental quality and their presentation to the public, are an integral part of our activities.

Biogeochemical research

2016 was the final year of the project “Monitoring of small forested catchments GEOMON – A research tool for strategic policy decisions in the environment”, supported by EEA grants. The project focused on evaluation of the stores of ecologically relevant chemical elements in forest ecosystems of Central Europe. Long-term hydrochemical data from a system of small headwater catchments revealed positive changes in surface water quality, resulting from retreating acidification. Present-day deposition fluxes of acidifying compounds were used to model historical rates of atmospheric inputs of sulfur and nitrogen on the territory of the Czech Republic. This extrapolation enabled spatial analysis of forest growth dynamics across the country. A detailed study of carbon and nitrogen reserves and fluxes was performed on the research plot Načetín, Krušné hory Mts. In collaboration with the University of South Bohemia, we studied the interplay between changing soil chemism and the cycling of soil organic matter. An isotope tracer experiment using ^{15}N , carried out in the Arctic, has improved our understanding of the effects of climate change on the uptake of nutrients in the tundra biome.

Application of stable isotopes in environmental studies

Isotopes of light elements

Using sulfur and N isotope ratios, we performed source apportionment of atmospheric pollutants in the heavily industrialized Moravia-Silesian Region. Non-conservative behavior of some compounds during atmospheric transport was also considered. For selected densely populated areas, we were able to identify specific local and remote pollution sources. Air pollution in the Ostrava region originates from ore smelting, steel manufacturing, industrial coal burning and traffic, but also from coal and waste incineration in households. Seasonal changes in the provenance of S and N were also determined by means of isotope fingerprinting. In 2016, we launched a new isotope monitoring project in the GEOMON catchments. The $^{18}\text{O}/^{16}\text{O}$ ratio is studied monthly in atmospheric deposition and runoff. Isotope analysis of solutes and extracts from soil profiles is also under way. Time-series of isotope data will elucidate runoff generation.

Chromium isotopes in industrially contaminated aquifers

Concentrations of carcinogenic hexava-

lent chromium Cr and its isotope composition were determined at four sites in the Czech Republic (Zlaté Hory, Loučná nad Desnou, Letňany, and Velešín), and two sites in the eastern U.S.A. (New Jersey, Connecticut). Our data indicated that spontaneous removal of Cr toxicity is under way in the groundwater of all study sites. Cr(VI) is reduced mainly by dissolved organic carbon and Fe^{II} to insoluble, non-toxic Cr(III). A simple Rayleigh model suggested that 30 to 60% of Cr(VI) may have been removed from the solution by natural processes within less than 100 years.

Isotope tracing of cadmium in industrial areas

The main sources of Cd used in a variety of industrial processes were isotopically analyzed. These isotope compositions represent mixing end-members for environmental studies. Our data indicate that Cd isotope ratios are a promising tool for tracing atmospheric emissions and dispersion pathways of Cd-containing pollutants in ecosystems.

Calcium isotopes in forest ecosystems

Calcium is an essential nutrient whose depletion in the era of acid rain (1950s–1980s) still affects high-elevation forest



Laka Lake in the Šumava Mts.

stands. We study Ca isotope ratios in four catchments of the GEOMON network, underlain by contrasting (Ca-rich and Ca-poor) bedrock. Calcium isotope composition is measured in atmospheric deposition, runoff, soil, spruce xylem, bark and fine roots, whole rock, and rock-forming minerals. Calcium in runoff from highly acidified, felsic catchments is mainly derived from organic cycling, with a negligible contribution of bedrock Ca. Mass spectrometric determinations have been performed by Prof. C. Holmden in Canada.

Radon risk

In 2016, maps of radon risk were made available to the following administrative units of the Czech Republic: Ústí nad Labem, Plzeň and Hradec Králové. In all, 246 sheets have been offered to local administrative bodies. This activity is coordinated and financially supported by the State Office for Nuclear Safety.

We investigated spatial variability of radon fluxes in the vicinity of faults in sedimentary rocks. Data collection will be followed by marking fault systems as a radon source in an updated version of radon risk maps. In September 2016, we organized the 13th International Workshop on the Geological Aspects of Radon Risk Mapping. This meeting, coorganized by the Technical University, Prague, attracted 80 delegates from about 30 countries.



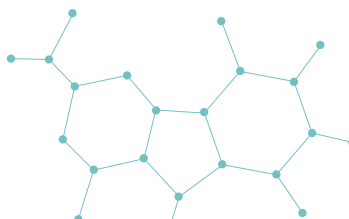
Sample collection at Načetín, Krušné hory Mts.



Martin Novák
Head of the Department
of Environmental Geochemistry
and Biogeochemistry



Multicollector inductively coupled plasma-mass spectrometer (MC ICP MS, Neptune).



Research of the geohazards

Geohazard research included an assessment of slope instability risk along planned major traffic corridors. The research also involves activities at sites that have already been affected by landslides, such as the D8 motorway at Dobkovičky or the third class road 42117 in Dolní Věstonice. Work on IPL Project No. 197 titled “Low frequency, high damaging potential landslide events in low-risk regions – challenges for hazard and risk management” was also completed. The data was used by cities, municipalities and by the SFŽP (State Environmental Fund) to evaluate applications for European funding.

Slope instability

DMR5G high resolution image analysis was used to evaluate the speed of movement and the extent of slope deformations in the Příhrazy Plateau and on Kněhyně Mt. in order to gain new insights into their morphology. Electrical resistivity tomography was used to determine their subsurface structure, while rod dilatometers and mechanical extensometers were used to define their kinematic behavior.

Landslide susceptibility assessment is becoming increasingly important both in land use planning and in crisis management because of increasing extreme climatic events in recent decades. Work commenced on the “Methodology for landslide hazard determination in ar-

reas threatened by slope instability”. The methodology consists of a multivariate statistical analysis, based on simultaneous combination of all input parameter maps and subsequent application of information in areas for which insufficient information on slope instability occurrence exists.

CGS experts continued to work on the landslide stabilization on the D8 motorway at Dobkovičky. Since 2013, CGS employees have been intensively dealing with the landslide in cooperation with other departments. In connection with the stability problems on D8, a study of the landslide area of Výrovna was carried out along the planned route of the D8 – Děčín access road, and the most extensive landslide area in the Czech

Republic with an area of 13 km² was determined.

Activities dealing with an up to 20-km-wide landslide between a rock block at Helfštýn and Teplice nad Bečvou were completed. This landslide affected the course of the Bečva River. The C¹⁴ dating method determined that the age of the movements range from 42,000 to 8,736 years. A palynological study of the landslide sediments enabled a detailed palaeogeographic and paleoclimatic study on a continuous profile from around 13,000 BP to the present.

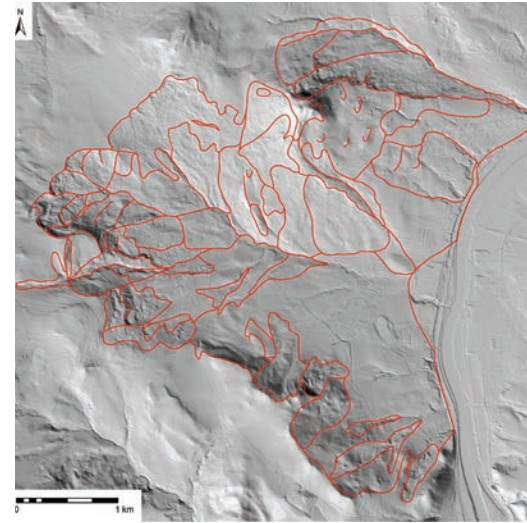
The state seeks to provide long-term and sustainable stabilization of landslides through various funding programmes, thereby reducing their potential risk to property and human health. Because



Panoramic view from Chlum hill of the largest landslide area in the Czech Republic – Bohyně. On the right, in the foreground, Chmelník, beneath which the newly built road I/13 should lead. Photo by P. Kycl.



D8 motorway (km 57,400). Construction of an underground gravel wall along an earthwork with the aid of piles driven to a depth of 16 m. Photo by P. Kycl.



Simplified depiction of the landslide area Bohyně in a digital terrain model of the CR, 5th generation. Prepared by V. Krejčí.

knowing the risk of potentially endangered sites is a prerequisite for every effective mitigation, we carried out several analyses which provide thus far unavailable information on how landslides develop and may thus raise public awareness. The analyses include new ways of updating landslides and the compilation of a database on landslide stabilization expenditures. Most of the reported landslides since 1997 have been associated with floods, and landslide susceptibility maps do not cover the entire territory of the country evenly. The Slope Instability Database is the most comprehensive source of information, but other databases were also used to supplement the slope instability inventory (Google Alerts, NEMETON2013, RUPOK). Legislative research and activities supporting land use planning and the remediation of damage caused by landslides and rock slides were carried out. This mainly involves a methodology for classifying the hazard posed by individual phenomena.

Radon risk in the geological bedrock

In 2016, as part of a SÚJB (State Office

for Nuclear Safety) contract, documents for municipality with extended scope (ORP) were supplemented with map posters depicting the radon risk in the bedrock in the Ústí nad Labem, Plzeň and Hradec Králové regions. The documents were handed over to the relevant staff of individual ORPs, building and regional authorities at the end of 2016. During the research, spatial variations of dose rate input and radon were monitored at detected and presumed faults in sedimentary rocks (OG MŽP – Department of Geology of Ministry of Environment). In total, 42 profiles were measured in sediments. The results were supplemented with measurements on 37 profiles of metamorphic and magmatic rocks, which were carried out during the project's 2015 phase. Comprehensive processing of the resulting variations of dose rate input and radon along faults will allow for maps of the radon risk in the geological bedrock to be updated in the Comprehensive Radon Information application on the CGS Map Server and on the website of the Radon Programme of the Czech Republic with the addition of a fault network as one of the

geofactors posing a risk of radon migration from the bedrock into buildings. The 13th International Workshop on the Geological Aspects of Radon Risk Mapping, attended by approximately 80 foreign and Czech experts, was organized in cooperation with the ČVUT Praha (Czech Technical University in Prague) in September 2016. Maps that were compiled were included in the European Atlas of Natural Radiations, for which gamma spectrometry measurements and dose rate inputs for the Czech Republic were provided. The amendment of the decree on radiation protection and safety of radionuclides and its harmonization with Directive 59/2013 Euratom – Basic Safety Standards was commented in cooperation with the SÚJB Radon Programme coordinator for legislation and its linkage to EU directives.



Oldřich Krejčí
Geohazard research coordinator



Regional Geological Administration



Exercising the duty of state geological survey on a daily basis, according to the requirements of the § 17 of Act No. 62/1988 Coll., on geological work in its later versions, has been methodically organized within the Czech Geological Survey by the Regional Geological Administration since 1998.

According to above mentioned requirements, the advice activity of the regional geologists and specialists for economic geology and for hydrogeology linked with consultancy report preparation covers the whole territory of the Czech Republic and is based on a consistently regional principle. This implies subdivision of the territory into variously defined regions for which pertinent regional geologist or specialist is responsible. Their work is controlled by the existing internal methodological instructions that define the operational reach and responsibilities of regional geologists and specialists (basic-research related, practical, documentary, organizational, advice report writing, etc.). Based mostly on the written requirements of the government or local administration bodies, in 2016, the regional geologists or specialists advised and reported most frequently on the issues of hazardous geo-factors, conflict of interest issues, land-use planning, on the impact of building and technology on the environment, management of construction sites, elimination of old ecological burdens, mining related problems, nature-conservation planning, etc. This systematic acquisition, collection, conservation

and in particular, professional processing and ensuing supply of data on the geologic setting of the national territory, on the protection and use of natural resources and groundwater and data on the geologic hazards, has subsequently served as a basis for political, economic, judicial and ecological decision making. This is, for instance, made use of in land-use planning procedures, environment protection, remediation of old ecological loads, in remedying slope instability effects, landscape and natural resources protection or for establishing the principles of ecologic stability assessment of an area, and other duties.

The increasing number of assignments fulfilled in 2016 has asked for several organizational changes in the processes handled by the Regional Geological Administration and in the staffing of some of the regions. These issues were taken care of in several internal documents of the director of the CGS. Owing to the ever increasing emphasis on the transition from analog to digital documents, the Regional Geological Administration has experienced an important personnel boost since 1st July 2016 with a newly created function of the Protocol Administrator, who shall

handle the integrated agenda of advisory and service activities provided by the Regional Geological Administration. This implied drafting of a user's manual as of 1st September 2016 and discontinuing the usage of documents and contacts exchanged between the Regional Geological Administration and regional geologists and/or specialists until now in analog setting, changing it exclusively to a digital one. This has resulted in acceleration and upgrading of the bi-directional transfer of information and instructions. The complex Regional Geological Administration's external and internal filing agenda was in the last three months of 2016 run completely on-line via the internet portal of the CGS and the Administrator of the agenda exhibits a considerable effort in harmonizing it and upgrading it. The year 2016 saw all written and graphic document output kept in the archives transferred into digital form on the internet in accordance with the requirements of the Document Keeping and Document Discard Regulations of the CGS. Maximal effort to improve communication with the contractors via data boxes throughout the year 2016, while taking advantage of digital signature, largely



Remediation of steep erosion slopes on the left bank of the Klíčava Reservoir in the Lány Game Preserve.

improved the efficiency of expediting all types of the required output. The Regional Geological Administration has also prepared several back-files of its agenda for on-line access by drafting an interactive chart of expert advice reports (<http://mapy.geology.cz/gis-viewer/?mapProjectId=2000>).

In 2016, a five-member unit of the Regional Geological Administration staff working on the project “Geological composition as a factor determining land-use and development territory of the Czech Republic” carried out in total an impressive number of 870 various professional service tasks for the national and local government bodies, for law courts, academia, NGOs, non-profit organizations and other contracting agencies. Professional teams set up on a temporary basis from a total number of 38 regional geologists, 14 regional economic-geology specialists, six regional specialists for hydrogeology cooperating, if necessary, with three to five specialists in engineering geology working across the whole territory of the Czech Republic. In order to lead this heterogeneous team efficiently, it was necessary to update Director’s Directive No.2/2004 with several new supplements.

Considerable draw on human resources of the CGS, in particular on the engineering geology specialists, was recorded in 2016 by carrying out the duties linked with the Czech Government Resolution No. 640 from 14th August 2013 dealing with the emergency situation caused by a landslide on the D8 motorway at Dobkovičky village. In line with the Czech Government Resolution from May 5, 2014, No. 330, which tasks the CGS to carry out on-site professional supervision of all exploration, monitoring and remedying work to be executed by an interdisciplinary working group, drafting and designing the phase II, were prepared in 2016. This involved a build-up of the drainage system and the subsequent removal of the accumulated slumped material on the motorway body itself. The bulk of activity of the professional geological supervision team was gradually transferred to a larger landslide area that includes Prague abutment of the motorway overpass at Prackovice, whose stabilization had to be submitted to an intricate system of technological measures. These measures proved to be necessary just before opening the last segment of the D8 motorway in December 2016. Specialists of the Czech Geo-

logical Survey take advantage of this landslide’s uniqueness in order to teach the coming young generation of engineering geologists, since part of their professional duties is supervising the diploma and doctoral theses dedicated to the causes that triggered this prominent landslide.



Jan Čurda
Head of Regional Geological
Administration

Mine workings and mining waste

In exerting the duty of state geological survey on the Czech Republic's territory, the Czech Geological Survey maintains the Mine Workings Impacts Database and the Inventory of Hazardous Waste Facilities. These activities are based on the Mining Act and on the Mining Waste Treatment Act.



A close-up of a sketch map of Zbiroh forestry with marked mine workings near Knížkowitz. Humel, 19th century. CGS – Geofond Kutná Hora workplace.

Mine Workings Impacts Database

According to the Mining Act, the designation “old mine working” refers to an abandoned underground mine and whose original operator or its legal successor do not exist or are unknown. The abandoned open pits left after reserved-mineral extraction also belong to that group. Mine workings are indicated on the surface mostly as collapsed or sunken soil or they occur as simple open adits and shafts. In case of finding such mine impacts, the Mining Act imposes the duty of reporting, registering and solving these phenomena.

The Czech Geological Survey is charged with administration of the reported old mine workings impacts. A new web application called Report of an old mine working or its surface impacts was designed and made public in 2016. The application enables an on-line reporting of hazardous manifestations of old mine workings which are subsequently filed in the register. The CGS then carries out a first-hand site assessment and regular inspections of their security, an activity which is financed by the Ministry of the Environment. During the site assessment the expert teams make

photographs, locate and describe the sites. These data are then filed in the Register and supplied to the Ministry of the Environment. In 2016, around 1940 mine workings and their impact sites were visited. The information from unpublished reports, from publications, map funds and other databases of the CGS Information System was an outstanding source. It is represented above all by the abandoned mine lands database keeping records of mining-influence areas and deep underground mines, and as of December 31, 2016, it involved data about 5,667 sites. The mine



Re-built mouth of a locked adit near Knížkovice, Beroun district (2016).

workings database includes an integral complete inventory of underground mines, and as of December 31, 2016, it contained data about 27,709 sites and about 24,000 digital charts and photographs. It also safekeeps a database of mining maps (as of December 31, 2016 it contained data about 14,861 maps and their scanning photos). The old mine working impacts inventory consists of single reported cases and all related documents. The data are stored in the Mine Workings Impacts Database. As of December 31, 2016, that Database contained 2,773 case reports for 2,225 sites in total. Information on their current condition and location are permanently available for the public via the map applications on the CGS website.

Inventory of Hazardous Waste Facilities

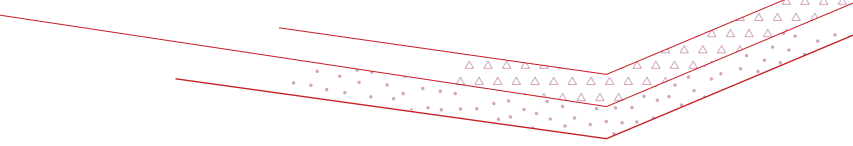
The environmental mining-related impacts are still visible in the landscape as spoil heaps, tailing ponds, dumps and abandoned placers. In some cases they

have become significant land-forming factors marked by the occurrence of unique flora and fauna on the other hand they may play a role of secondarily utilized raw material sources or pose a grave danger for the environment and human health. The tailings left after mining and ore dressing contain a wide spectrum of toxic elements which, when released by the weathering processes, contaminate the surrounding soil and the groundwater and surface water. Many ancient mining sites are also affected by landslips or in-breaks. In 2001, the Czech Geological Survey established a database of dumps gradually expanding it by new sites. The Mining Waste Treatment Act that came into force in 2009 stipulates formation of a complex inventory of mining disposal sites in the Czech Republic. Within the framework of the operational program Environment, the CGS prepared the project “Identification of closed and abandoned mining waste disposal facilities posing serious environmental or health hazards” that was run between 2009

and 2012. New database – Inventory of Waste Facilities has become part of the CGS Information System. As of December 31, 2016 it contained data on 7,081 sites and is constantly updated. Detailed data, including location, are available to the public as a map application on the CGS websites. Based on the evaluation of analyses from samples collected at 300 selected sites, 18 of them were filed in the Inventory of Hazardous Waste Facilities. This Inventory was launched on May 1, 2012 as an independent presentation web application and it exists in a Czech and an English version. In addition to an exact location, it also contains basic data about the type and risk rank.



Vít Štrupl
Head and Deputy Director
of Geofond Division



Geological Information System

The Czech Geological Survey gathers data about geological setting of the state territory. Their processing, administration and distribution are the chief prerequisites for exerting the duty of the state geological survey in the Czech Republic. Building of the geological information system is essential for providing information for the national administrative bodies and for research and other professional activities of the Czech Geological Survey. The concept of the system is compatible with the Czech and EU legislation governing access to information. The use of international standards safeguards interoperability of data sources and their integration into the national and European spatial data infrastructure.

Geological Information System

The *Geological Information System (GeoIS)* is designed by the CGS to be compatible with national and international directives (JISŽP, INSPIRE). Consolidation of the information system, its harmonization and the conceptual upgrade of the technological basis continued in 2016. The core of the GeoIS is the *Central Data Store (CDS)*, which contains 61 thematic databases (www.geology.cz/geodata). The CDS stores both graphical data (maps, geological cross sections, inventories of hazardous waste disposal sites, slope instabilities, etc.) as well as descriptive data (code lists, results of analyses, the digital Geofond archive, etc.). The GeoIS shows a wide variety of thematic subsystems: geological maps – *National Geological Map Database (NGMD)*; mineral resources – *Mineral Information System (SurIS)*; mining waste – disposal site inventory; a subsystem for geologically documented objects (boreholes, test pits, etc.); geohazards (an inventory of slope instabilities and comprehensive radon information) as well as hydrogeology, geophysics, soil, etc.

The *CGS Metadata Information System (MIS)*; see micka.geology.cz) serves for orientation in CGS datasets as well as in services or applications. The MIS is fully compatible with the current INSPIRE Implementing Rules and serves as a source of up-to-date information for the national (geoportal.gov.cz) and European geoportal INSPIRE as well as for the CGS information portal that generates a the-

matic list of web mapping services WMS (wms.geology.cz), a thematic list of and a guidepost to public web applications (aplikace.geology.cz), and a guidepost to map applications (mapy.geology.cz), all of which are in Czech and English.

INSPIRE and interoperability of geodata

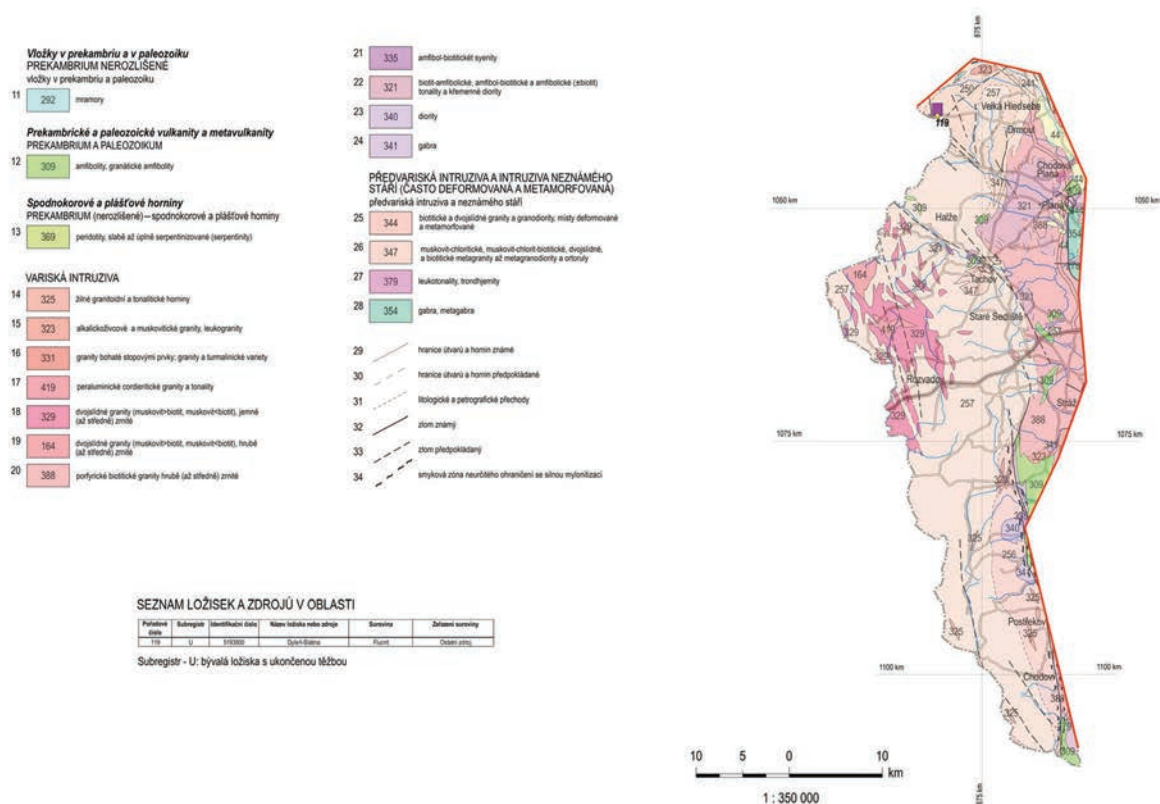
The INSPIRE Directive of the European Commission and the Council requires the CGS to provide up-to-date metadata and to publish data related to geology, soil, mineral resources, energy resources and natural risk zones. As part of its work on the European Geological Data Infrastructure (EGDI), an updated geological map layer at 1: 500,000 scale (formerly provided for the OneGeology-Europe portal) was prepared. It was converted to the GeoSciML-Portrayal 4.0 structure, with new links as required by INSPIRE, and launched as a view and download service for the INSPIRE Geology theme. As part of the CzechGeo/EPOS project, CGS geophysical data and their potential accessibility according to INSPIRE requirements were analyzed. The data will be made available not only to the CzechGeo consortium but also to the general public. At the end of 2016, the CGS also published three other download services in the ATOM format: a Slope Instabilities Inventory, a 1:50,000 radon risk map, and a 1:1,000,000 soil map. All datasets made available through the download services and licensing con-

ditions for their use (under the public license CC BY 4.0) are currently described on a new extranet site on the CGS portal: www.geology.cz/extranet/mapy/mapy-online/stahovaci-sluzby.

Development of the technology and content of data sources

The consolidation of existing data sources continued in 2016. The *Mine Workings Information System (ISDD)* was made operational for internal agendas. The ISDD is designed to record mine workings and to collect, manage and provide information on these mine workings and their impacts. The ISDD also comprises the Mine Working Impacts Database, which was established in 1988 based on the Mining Act (§ 35 of Act No. 44/1988 Coll., on the Protection and Use of Mineral Resources), and contains all incoming notifications pursuant to this Act and Decree No. 363/1992 Coll.

Development of the CGS Central Data Store, which comprises an operational (SDEDBo1) and test (SDEDBo2) database, continued in 2016. Datasets from other repositories were systematically transferred to this structure to create a single CGS data store. It currently contains consolidated spatial datasets from SurIS and data on slope instabilities, mining maps, mine workings, radon maps, mining waste disposal sites, interesting geosites, and other gradually accumulating data.



Project Competence Centre for Effective and Ecological Mining of Mineral Resources – Map section of Area 4a at 1:350,000 scale. The 1:500,000 Geological Map served as a geological base map. The scripts that were used to generate the legend are based on tools for the legend of 1:25,000 maps.

Development of an ArcGIS for Desktop tool for generating diagram indicating the orientation of tectonic structures from measured data, obtained from geological mapping, began in 2016. The data serve as a source of further interpretation, and analysis of their orientation can lead to understanding the geological structure (tectonics) of the territory.

Geographic Information System (GIS)

The GIS continued to be used by the entire CGS as a tool for processing, utilizing and accessing spatial data. Thanks to an Enterprise License Agreement with Esri, GIS methods for spatial data analysis, 3D modelling, and digital cartography could be routinely used, without limitations on the number of licenses, by CGS staff for research projects in the Czech Republic (geological mapping at 1:25,000 scale, CEEMIR, Review of Groundwater Re-

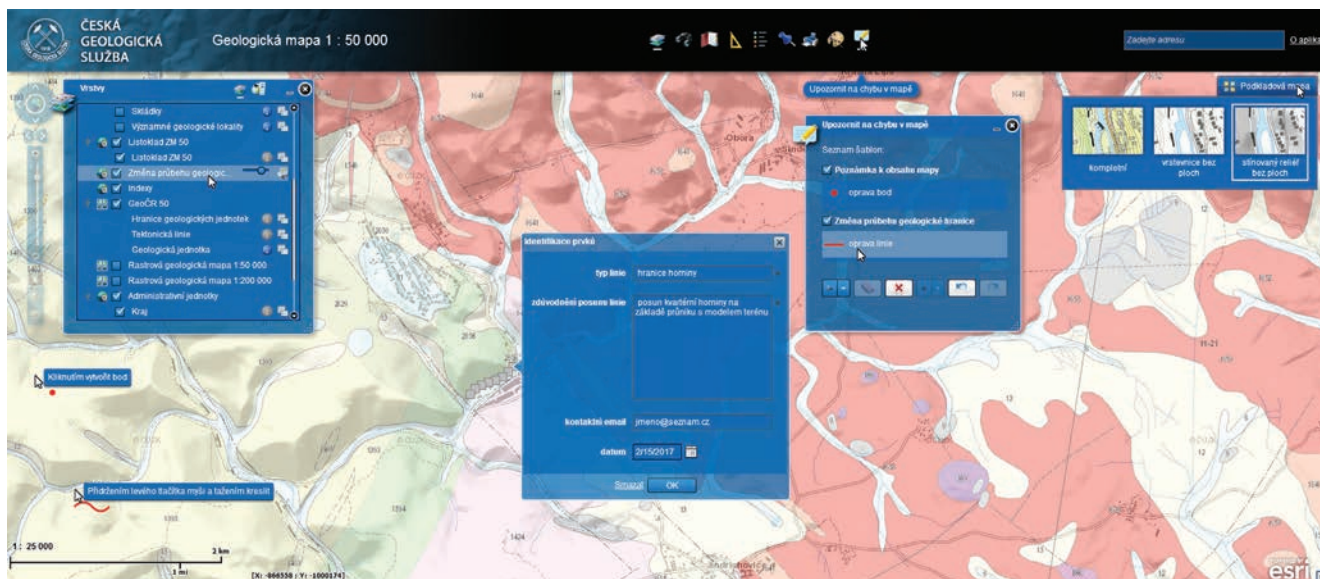
sources, Research on thermally loaded rocks, REPP-CO₂) and abroad (Ethiopia, Mongolia).

Activities in 2016 again focused on the development and maintenance of the NGMD. They mainly involved some settings in the geodatabase, modification of attribute columns, or testing of conversion scripts from the test database to the CDS. The vectorization of the 1:200,000 Geological Map (GEOČR200), containing 23 map sheets, was completed in 2016. The legends of the GEOČR200, GEOČR50 and GEOČR500 maps were converted into a unified data structure so that they may be edited or constructed using the same tools as in the case of the legend of GEOČR25 (script GM legend 0.3a) – see figure above.

New forms of transfer from the ArcGIS Desktop to SW for prepress preparation (Illustrator version 12) were tested in 2016 as well.

Providing access to geoscience data and information

The CGS Information Portal (IP CGS) is a GeoIS integration platform containing 69 thematic applications (for more details, see the chapter Website of the Czech Geological Survey). The CGS IP also includes the CGS Map Server (MS) that provides free access to spatial data deposited in the CGS archive, the NGMD, the SurIS or elsewhere, and it is one of the most visited sites of the IP. The development of the MS in 2016 included the launch of the application Territory Data – spatial data issuing, where state authorities (municipalities with extended competence, regional and other authorities) can download current data for land-use planning, including a generated inventory of these data according to current legislation (mapy.geology.cz/vydej). The entire system is fully automated, which significantly increases work efficiency.



The map application Geological Map 1:50,000, which provides users with the tool – Map Change Notification. Users can add information to individual points or lines, point out incorrect map content, or change a boundary. The CGS evaluates the data and modifies the map if necessary.

In addition, a new Seismic Profiles map application was developed and expanded the wide range of applications, with which the CGS currently presents its findings and data. An application for reporting mine working impacts was launched as well. Using a wizard, the public can provide information about an existing, thus far unrecorded mine working (www.geology.cz/app/dud_ozn). A new type of JavaScript-based applications is concurrently being developed. New map components (dynamic legend, advanced printing, appearance customization, object identification, search, and result table) are being developed in the WebApp Builder environment, and their functionality defines a new application model that will replace applications developed in ArcGIS Viewer for Flex 3.5 and GIS Viewer 1.2. These applications will not be supported over the long term given the current development of web browsers. The map services of the MS are utilized not only in map server applications but also in mobile applications (user CGSmobile, www.arcgis.com/features) and in map attachments of the so-called database applications (www.geology.cz/extranet/sluzby/aplikace). Web map services were developed as a standard for sharing GIS data over the In-

ternet. The CGS currently provides WMS services (wms.geology.cz) and INSPIRE download services. Four new download services were added in 2016 (see chapter INSPIRE and interoperability of geodata. An extensive development of the minerals information system continued during 2016 as the core of the system was transferred to the production environment and made available to relevant personnel from the Department of Geology of the MoE (Ministry of the Environment). The system significantly improved the possibility of sharing current technical data between the CGS and MoE. The applications Geological Localities and Geological Encyclopedia were linked to a new photo archive in 2016 as well.

International cooperation

Work on the development of a functional prototype of the European Geological Data Infrastructure Portal (EGDI) within the CzechGeo/EPOS (EraNET) project was carried out in 2016. The CGS created the pilot metadata catalogue for EGDI in 2016 (egdi.geology.cz). The experience gained while developing the EGDI metadata catalogue was applied in updating the metadata catalogue of the ProSUM project (Horizon 2020), which will be filled in 2017 with the metadata of harmonized databases and services involving

secondary sources of minerals, including mining waste within Europe.

In June 2016, CGS staff took part in the third workshop “European Meeting on 3D Geological Modelling” organized by the German geological surveys, BGS and TNO in Wiesbaden, Germany. The workshop was attended by approximately 100 participants from nearly 50 organizations. The current state of work and plans for the near future were summarized, and the problems of standardizing 3D data, the quality of produced models, etc., were discussed as well.

In 2016, the CGS also participated in four workshops of the international network within the COST TU1206 SUB-URBAN action – “A European network to improve understanding and use of the ground beneath our cities”. This COST action mainly provides for the exchange of experience among European geological surveys and other organizations involved in the modelling of the subsurface (with emphasis on the subsurface of city conurbations).



Zuzana Krejčí
Head of the Department
of Information Systems

Remote sensing

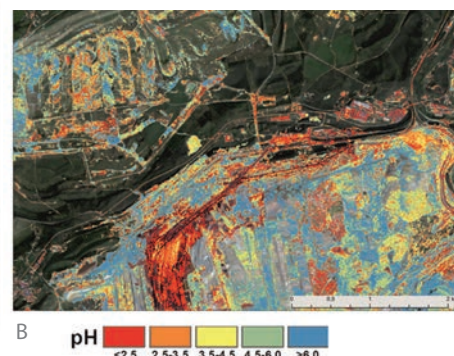
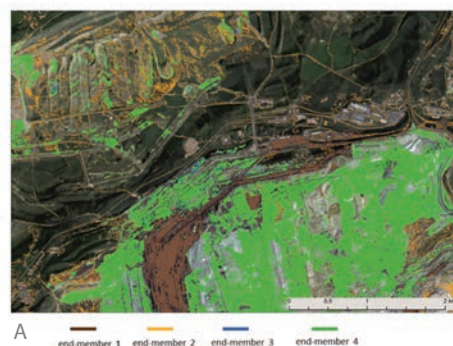
Remote sensing is nowadays thanks to new space programs and fast developing technologies the most widespread method of acquisition of spatial data regarding the Earth's surface and objects. In accordance with persistent upgrading of the long distance data parameters (for instance spectral resolution, range, spatial resolution), their analysis moves from qualitative to quantitative level.

Activities of the Remote Sensing Centre

The Remote Sensing Centre (RSC) concentrates in a long range on the application of quantitative image spectroscopy methods by using optical and thermal hyperspectral (HS) data (0.45–13.00 μm). The RSC team uses the quantitative spectroscopic methods as a modern tool for monitoring all environmental constituents (rock – vegetation – water) and in order to study their interactions.

Within the frame of national and international long-range research projects models were set up for the surface pH gradient determination in exposed substrates or for contaminated surface mine waters. Another model focuses on assessment of the overall state of health of spruce-dominated forest stands not exhibiting any visible damage symptoms yet. As a matter of fact, those image spectroscopy applications have a great potential in the field of environmental monitoring, since they enable identifying acid substrates and their relation to the so called “Acid Mine Drainage” (AMD) or to the quality of the surrounding surface waters and vegetation.

At present, the team has been focusing in particular on designing new approaches and algorithms in the field of quantitative analysis and hyperspectral data classification. Conceptually, these activities target three areas of development: (1) testing



Modelling of the surface pH of exposed substrates represented an indirect task, which initially required the definition of a conceptual geochemical model describing the relationship between pH and the occurrence of the so-called indicative minerals. These indicative minerals were detected and relatively quantified using HS image data (A), after which a statistical model estimating the pH (B) was finally created.

and validation of linear and non-linear statistical approaches, (2) creation of new algorithms/models combining optical and thermal HS data and (3) creation of models using new-generation satellite data (for instance Sentinel-1-3, EnMAP).

In addition to HS technologies, the Remote Sensing Centre has been engaged in other fields of remote sensing. Procedures have been developed for the classification of morphometric features and their ensuing geomorphological interpretation and a new method has been devised enabling updating tectonic and hydrogeological elements based on ALOS PALSAR satellite radar data. Possibilities of applying radar interferometry (SBAS-DInSAR) method for detecting vertical movements and deformations are being tested within a project run by the MoE of the Czech Republic. The results are then used for landslide movement prediction in České středohoří Mts or for interpreting post-seismic phenomena including neo-tectonics in the East African Rift System.

In addition to using remote sensing methods, RSC staff creates 3D models of underground mines. The necessary software equipment has been substantially upgraded by purchasing the MOVE software. The currently used 3D geological model of the locality Bukov has been transferred into this environment. Concurrently, advanced modelling of underground mine works is

under-way, and fulfilling of the other underground-planning and exploration-related tasks, be it for the Radioactive Waste Repository Authority or other agencies, are carried out.

The results of RSC's activity in the above mentioned fields are continuously published in IF-indexed, international peer-reviewed professional journals.

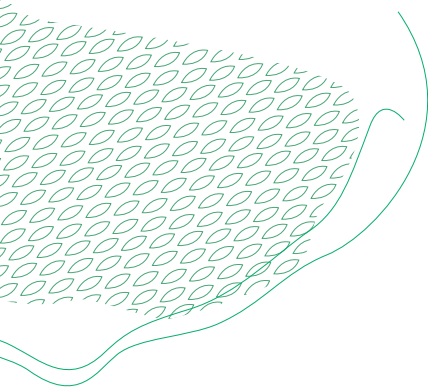
Scientific cooperation:

- Faculty of Science, Charles University in Prague
- CzechGlobe, Academy of Sciences of the Czech Republic
- Deutsches Geoforschungs Zentrum (GFZ)
- Tel Aviv University
- French Geological Survey (Bureau de Recherches Géologiques et Minières, BRGM)
- VITO (Flemish Institute for Technological Research) Vlaamse Instelling voor Technologisch Onderzoek
- NASA – Goddard Space Flight Center
- EuroGeoSurveys: Earth Observation and Geohazards Expert Group (EOEG)



Veronika Kopačková
Head of the Remote Sensing
Centre

International activities and cooperation



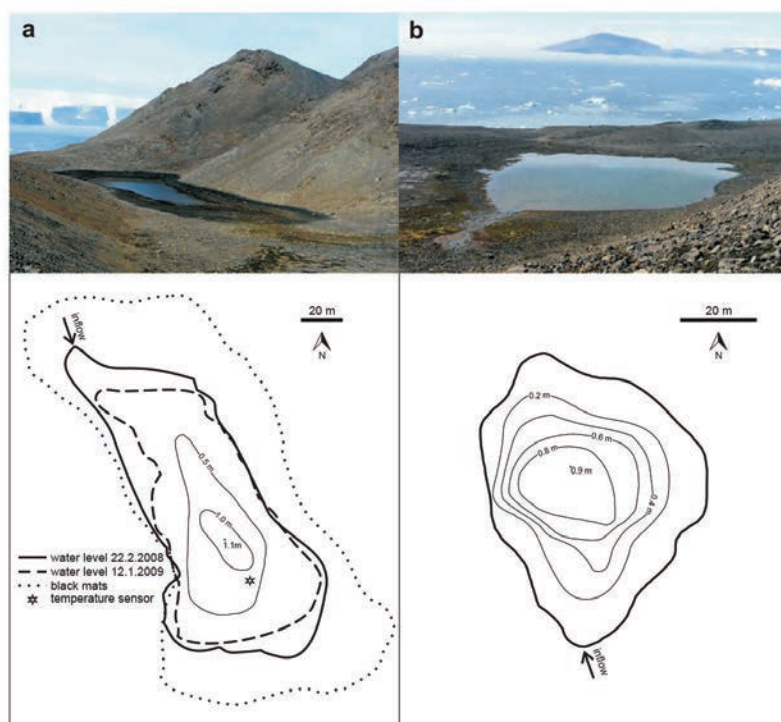
The Czech Geological Survey carries out a wide variety of activities, including the cooperation with international partners. The international development cooperation projects are focused on the elimination of poverty, promotion of the economic and social development, and on the assistance in environmental protection issues in developing countries. Another significant area of activities is the science and research projects implemented in international consortia. These are for instance the Framework Programmes of the European Union, of the financial mechanisms of the EEA and the Norway Grants or bilateral cooperation projects financed both from national or international sources. Further projects run by the CGS, for example the operational program ones, are also co-financed by the Structural Funds of the EU. Within the national grant programs, CGS experts also carry out research of geological phenomena in overseas localities, as for example in Antarctica, Africa or Asia. The Czech Geological Survey is an active member of a number of important international associations.

Projects of the Czech Science Foundation

Sponges in Cretaceous marine ecosystems and their importance for environmental changes assessments: insights from Bohemia and Antarctica

An article describing late Cretaceous plant fossils from Antarctica was published, including bio-stratigraphic and paleo-ecological implications (Kvaček and Vodrážka 2016). Late Cretaceous fauna from the Hidden Lake Formation (Coniacian) was described. The fossilization took place in a deep marine environment, as exemplified by the sedimentology and paleontology of fossiliferous outcrops in the vicinity of the Czech polar station (northern portion of the James Ross Island, Antarctic Peninsula area, James Ross Basin).

A multidisciplinary study by Elster et al. (2016) was published in prestigious journal *Biogeosciences*. This study is based



Lakes in the northern part of James Ross Island (area of the Antarctic Peninsula), from which calcified organosedimentary structures were newly described (Elster et al. 2016).



The Skorpion open pit mine of non-sulphide zinc ore in southern Namibia.



A stay in a camp during fieldwork near Purros, northwest Namibia.

on biology, geology and climate field studies conducted in the northern part of the James Ross Island in 2008–2012. Even though this work is not describing fossils, but sub-fossil or recent organisms, nevertheless, geochemical, sedimentological and petrographic approach was applied in solving fundamental questions related to the organic-sedimentary structures, reminding of fossil stromatolites in many aspects.

The Rodinia break-up record (~ 800–750 Ma) in orogenic belts of southwestern Africa and southeastern South America

The project investigates the pre-collisional geological evolution and the tectonic position of geological units that had formed the so-called Kaoko-Gariep-Dom Feliciano Orogenic Belt during the Neoproterozoic convergence and are now exposed in the coastal areas of the southern Atlantic Ocean.

In 2016, an article was published, describing for the first time a very good spatial correlation of the coeval magmatic rocks both sides of the Atlantic and defines more precisely the relative position of the South American and African continents before being separated during the Mesozoic. The year 2016 also saw the comple-

tion of a study of the age and provenance of the sedimentary mantle of the Congo craton in northwest Namibia. The study provided inside knowledge of the timing of the first tectonic events that gave rise to a mountain belt whose erosion subsequently generates flysch sediments transported eastwards, into the foreland of the nascent orogenic area.

The project will be terminated in the next year with a study describing formation of an intra-continental rift, whose closure gave rise to the Kaoko-Gariep-Dom Feliciano Orogenic Belt.

Mining and processing of Cu, Pb, Zn and Co ores in Sub-Saharan Africa – a natural geochemical laboratory for pollutant behavior study

The impact of mining on the environment was studied within the Czech Science Foundation project in Namibia. The study of isotopic composition of copper in the soil around the Tsumeb smelter enabled delimiting the contaminated area. Isotopic composition of copper in the grass has shown the main source of contamination being the dust from local setting-ponds, and scoria depositories. The influence of dust fallout from the smelter is of minor importance.

Environment monitoring around the active Skorpion deposit in southern Namibia has indicated an extensive soil contamination by arsenic, zinc and cadmium in the vicinity of the ore-dressing plant. Eco-toxicity of the flotation-plant waste was studied on the Rosh Pinah deposit.

International Research and Development Programs – National Programs

The role of Palaeozoic accretion and collisional orogens in the formation and growth of continental crust

The year 2016 saw termination of the NÁVRAT – ROPAKO project that had four main targets: 1) *Identifying mechanisms of continental construction*. This part of project involved a new model of collisional orogen formation involving both the European Variscan belt and Tibet utilizing numeric methods.

2) *Assessment of the actual growth of the crust versus its recycling*. A new model of transformation of the accretionary wedge sediments into a stratified stable-continent crust has been put forward for Central Asia. 3) *Geophysical characteristics and visualization of the present-day deep structure of collisional and accretion orogens*. This part of the project involves modeling and vi-



Sokolov (Czech Republic): field survey and ground-based spectrometer measurement.



Mongolian Altai (southwestern Mongolia): teaching structural geology and tectonics to Mongolian students.

sualization of MOHO and 3D structure of accretion orogens in Central Asia. 4) *Creation of a conceptual geodynamical evolution model of the Eurasian orogenic belt.* In this part of the project a new model of transformation of thinned margin of the Rheic Ocean into a collisional orogenic area was drafted. At the same time, generic continental crust subduction models in the Chinese Tien Shan and in the Saxothuringicum were drafted, highlighting a shallow delamination depth of the subducted plate.

A new approach to soil-degradation modeling using superspectral data

Project of the Czech-Israeli scientific cooperation (co-partnered by the Tel Aviv University) initiated in the middle of 2016, specializes in implementing quantitative methods of imaging spectroscopy. Currently, two methods of imaging spectroscopy are being used with the hyperspectral scanner (HS) data acquired mostly by airborne imaging, nevertheless, optimizing them for the new generation satellite data parameters – the so-called super-spectral satellite data (Sentinel-2 and WorldView-3), seems to be of utmost importance now. At present, these methods belong to the world-wide fastest developing ones and repre-

sent therefore a vast future potential for monitoring all environmental issues, including the monitoring of soil, its contamination or degradation. The mainstay of the new project is applying and adapting the quantitative soil-parameter modeling for the spatial and spectral dimension of the super-spectral sensors. The areas affected by anthropogenic pollution both in the Czech Republic (Sokolov Basin: brown-coal extraction, detection of heavy-metal contamination), and in Israel (Evrona Playa – a valuable oil spill-struck nature reserve in 2014), serve as testing sites. The project is run in the Remote Sensing Centre between 2016 and 2018.

Cooperation with the Free State of Saxony 2014–2020

ArchaeoMontan 2018

ArchaeoMontan 2018 is an international project dedicated to the study of medieval mining in the Saxon and Czech part of the Krušné hory Mts. It is part of “The Operational Program of cross-border cooperation between the Czech Republic and the Free State of Saxony 2014–2020” financed by the European Union from the European Regional Development Fund. In 2016, study of the

newly discovered well-preserved underground medieval mine systems in the Dippoldiswalde site in Saxony and other ones in Berggießhübel and Scharfenberg (Meissen Region) continued. Large subsurface areas lying immediately underneath the very core of the Dippoldiswalde town were documented and investigated by modern methods including the 3D space scanning. The investigated mining sites represent an important mining ground with an incipient exploitation dated to AD 1160. The dating has been corroborated on the basis of the state of conservation and volume of identified wooden artefacts in the mining area. In the Czech Republic, archaeological research is underway in the area of an abandoned medieval mining settlement dated to 14th century at Kremsiger near the town of Přísečnice and in the area of the Krupka and Jáchymov towns verified by revision field work. The discovered and archaeologically substantiated medieval mining in the above mentioned areas will markedly modify the theses about the age of mineral resources extraction in the Krušné hory Mts, in the Czech Republic as well as in Central Europe.



Gobi Desert (southwestern Mongolia): preparation and sorting of samples before transport to laboratories in Ulaanbaatar.

Horizon 2020

Brachiopods As Sensitive tracers of global marine Environment: Insights from alkaline, alkaline Earth metal, and metalloid trace element ratios and isotope systems (BASE-LiNE Earth)

The European Union-sponsored project focuses on isotopic composition of selected elements (Li, Mg, etc.) in the brachiopod shells in the global ocean since the Paleozoic until now, which is ca 540 million years. The new data can furnish a lot of information about the chemical evolution of sea water (temperature, salinity, pH and other data), about the paleoclimate conditions and their changes or about the weathering process intensity in the ancient continents. Lithium isotope ratios in a selected suite of recent brachiopod shells from different localities were measured during 2016. These measurements have corroborated the determined differences in $^7\text{Li}/^6\text{Li}$ ratios between the solutions and calcite

from the brachiopod shells. Tiny differences in Li concentrations, but not in $^7\text{Li}/^6\text{Li}$ ratios, have been recorded on the species to species base, which reflects the inner structure of the brachiopods. Several selected samples were used for vital effects determination, but they were not proved. These pilot measurements have thus proved robustness of the brachiopods as a potential isotope paleo-ocean evolution archive. The brachiopod analyses were coupled by Li-isotope measurements in several ocean-water samples.

Effects of soil alteration on nitrogen and carbon cycling (SLAvONIC)

The SLAvONIC project aims at studying the carbon and nitrogen circulation in forest soils (dissolved and gaseous phase) in a spruce-dominated and beech-dominated forest in relation to experiment-modified conditions. The interference into the soil chemistry includes (1) acidification of soils – increase in sulfur deposition,

(2) soil eutrophication – increase in N deposition, and (3) combined influence of acidification and eutrophication (www.geology.cz/slavonic). Current results show the increased soil acidity inducing a decrease of forest top-soil decomposition and decrease in washing off the dissolved organic carbon from the forest soils. The soils acidification slows down the circulation of carbon in them and the latter can accumulate for a long time here. Any influence of soil eutrophication on the carbon cycle has not been proved so far. Out of the net primary production (NPP) of the spruce-dominated and beech-dominated forest in the Načetín locality ($9.37 \text{ t C ha}^{-1} \text{ year}^{-1}$ and $7.98 \text{ t C ha}^{-1} \text{ year}^{-1}$), 57% are represented by NPP surface biomass and 43% are represented by NPP underground biomass (roots, exudates, mycorrhizae) in the spruce-dominated forest and 68% by NPP surface biomass and 32% are represented by NPP underground biomass in the beech-dominated forest.



Measurement of soil respiration (CO₂) at a site.



Mongolian Altai (southwestern Mongolia): regularly alternating layers of limestones and siltstones typical for the Devonian carbonate flysch development.

Measuring, monitoring, mitigating and managing the environmental impact of shale gas (M4ShaleGas) extraction

Project's acronym M4ShaleGas derives from four priority research activities "Measuring, monitoring, mitigating and managing the environmental impact of shale gas (M4ShaleGas) extraction" in the European geological and social milieu. The majority of European countries are engaged in the project consisting of 22 sub-chapters. The CGS participates in the investigation of "Simulation of the potential composition and mobility of materials in the technological waters from the shale gas boreholes", carried out by the "GeoForschungsZentrum Potsdam" (German Research Centre for Geosciences). In laboratory conditions, rocks with an increased content of organic matter undergo the influence of technological waters at temperatures and pressures similar to natural geologic setting. The results shall show mineral and organic substances formed in this process and how to go about them during their exploration and extraction. The gathered data will be integrated

into the 3D models of selected geological units. The years 2015 and 2016 saw completion of a survey in the Mikulov Formation located on the southeastern margin of the Bohemian Massif.

International development and cooperation and the follow-up research

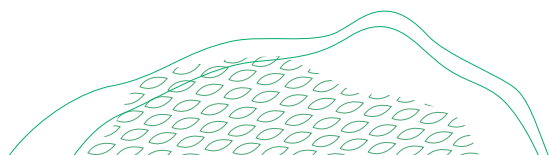
Geological mapping at 1:50,000 scale and assessment of selected area's economic potential in Western Mongolia

Project of international development cooperation "Geological mapping at 1:50,000 scale and assessment of selected area's economic potential in Western Mongolia" was successfully terminated and submitted in Ulaanbaatar, Mongolia in September 2016. The project was carried out between 2013 and 2016 and was authored by 32 specialists from four countries. It involved also educational activities with 19 young Mongolian geologists being trained in the field work. The project was situated in the rugged terrain of the western Mongolian Altai mountain belt of the Khovd Aymag in the area of the Munkhairkhan, Mankhan and Zereg districts (somens). It involved

five regional geological and 50 specialist maps and interpretation maps of geochemical and mineral prospecting, covering in total 1,770 km² of area. The results of the project, which also include 43 new geochronological data, are within the detailed final report (Žáček et al. 2016) and have officially been submitted to the Mongolian partner organization MRAM. Several of the results have been already published.

Landslide susceptibility assessment in rugged terrains of Georgia using examples of endangered settlements, international road and powerlines in the Dusheti municipality

The year 2016 was project's third year. Installation of monitoring instruments at three localities was accomplished. They were selected on the risk ranking basis related to slope instability character. Those instruments will be coupled with the early warning system. A course for our Georgian young colleagues was organized teaching them susceptibility assessment using statistical methods in GIS environment and other procedures applied by the Czech Geological Survey





Training in geological mapping techniques.

in dealing with major slope instability problems, including on-site examples. Last but not least, slope instability database in the Czech, Georgian and English versions has been set up and the data gathered during mapping fed into it. The WATRAD and ISATech companies are cooperating on the project. The Georgian partner institution NEA (National Environment Agency) asked for project's extension until the end of 2017. Thus, the project's scope will involve geophysical measurement at Bazaleti locality and mathematical stability modeling of local landslide paralleled with on-job training of Georgian colleagues.

Stratigraphy, sedimentology and provenance study of the Zuun Nuruu, Tsetseg and Sagsai flysch formations (Hovd Zone, Western Mongolia) – in-house project

The study of Ordovician, Silurian and Devonian volcano-sedimentary formations (Zuun Nuruu, Tsetseg and Sagsai) has brought new information about their development, age, origin of their clastic material and the carbonate rock depositional environment.

Sedimentological, geochronological and

geochemical data are being studied in detail and macro- and micro-paleontological material evaluated. This detailed stratigraphic-sedimentological research of the flysch formations follows up on a completed project of geological mapping and assessment of the economic potential of Western Mongolia.

International membership

EuroGeoSurveys – gathering of 32 European geological surveys

ICOGS – International Consortium of Geological Surveys

Central European Initiative – gathering of Central European geological surveys: Czech, Slovak, Austrian, Hungarian, Polish and Slovenian

ENeRG – European Network for Research in Geo-Energy (member of the steering committee and website editor V. Hladík)

SGA – Society for Geology Applied to Mineral Deposits (executive secretary J. Pašava, student representative A. Vymazalová) – a scientific society gathering over 1000 specialists in the field of geology and mineral deposits from over 80 countries around the world

AAPG – American Association of Petroleum Geologists

INQUA – International Union for Quaternary Research

ProGEO – European Association for the Protection of Geological Heritage

KBGA – Carpatho-Balkan Geological Association

CO₂NET – Carbon Dioxide Knowledge Sharing Network (V. Hladík – member of the steering committee)

EAGE – European Association of Geoscientists and Engineers; affiliated member is the Czech Association of Applied Geophysicists (member of the steering committee D. Čáková)

CGMW – Commission for the Geological Map of the World

GIC – Geoscience Information Consortium – a consortium gathering the managers of informatics of 26 geological surveys around the world

IAGOD – International Association on the Genesis of Ore Deposits (leader of the Czech team B. Kříbek)

SEG – Society of Exploration Geologists (member of the steering committee J. Pašava)

SRG – The Society of Resource Geology (Japan)

CETEG – Central European Tectonic Groups

COMNAP – Council of Managers of National Antarctic Programs

SCAR – The Scientific Committee on Antarctic Research

Jana Rumanová
Project manager

Laboratories

Central Laboratory Prague

The Central Laboratory is located in Barrandov, Prague. It is responsible for the chemical analysis of minerals, rocks and sediments as well as the biogeochemical analysis of organic materials such as conifer needles, wood, and peat. Analysis of water is also carried out here. The laboratory has been accredited since 1993 and regular national and international interlaboratory tests of analytical quality have been consistently giving good results.

Analyses of solid samples

Silicate analysis is the main service requested by the CGS and other clients. The analysis of major elements provides fundamental information on the stoichiometry of minerals and the chemical composition of rocks. In addition, the contents of trace elements are determined using a variety of instrumental methods (ICP-MS, FAAS, HGAAS and RFA). Special procedures are also available for fire assay of gold and platinum group metals (PGM).

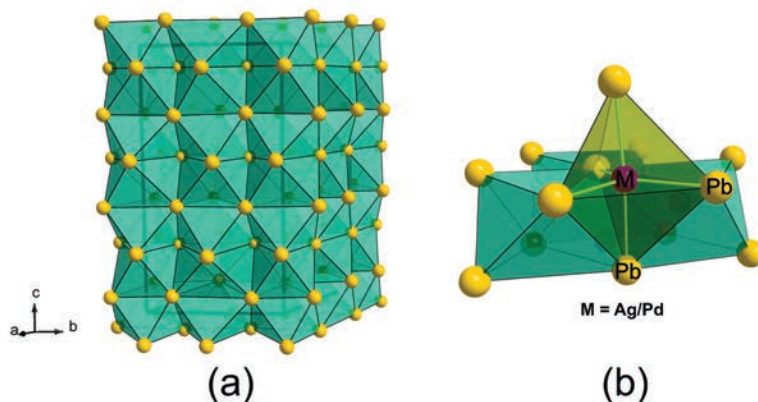
Water analyses

The analysis of groundwater and precipitation is an important duty of the laboratory at Barrandov. The contents of metals and anions, and total carbon and nitrogen dissolved in water are important environmental indicators. Aquifers and surface waters must be monitored regularly. Analysis of trace elements is carried out using ETAAS and ICP-MS.



Věra Zoulková

Head of the Central Laboratory
in Prague



Crystal structure of the new mineral norilskite, $(\text{Ag,Pd})_{7-x}\text{Pb}_4$, (a) structure featuring $[\text{MPb}_6]$ coordination polyhedra, (b) detailed view showing the site occupancy in a single layer.

Central Laboratory Brno

Central Laboratory Brno has been accredited since 1993 and focuses on the organic and gas geochemistry.

Rocks and crude oils

Contents of the organic and mineral carbon and of total sulphur are determined in the sedimentary rocks and soils. Selected samples of rocks and crude oil are subjected to analyses of molecular composition of extractable compounds, especially biomarkers indicating biological origin of organic matter, for instance from deciduous or coniferous trees or algae. Reflected and fluorescence light microscopy helps characterize organic petrographic constituents such as pollen grains, cuticles, plant tissues or fossils. Vitrinite reflectance is utilized in reconstructing the thermal history of sedimentary basins, the depth of burial or erosion.

Ecology

Persistent organic pollutants (POPs) are analysed in soils and in fly ash. A detailed examination of their composition indicates whether they come from a natural background or from contamination.

The total content of polycyclic aromatic hydrocarbons or their mutual ratios are utilized in compilation of environmental load maps.

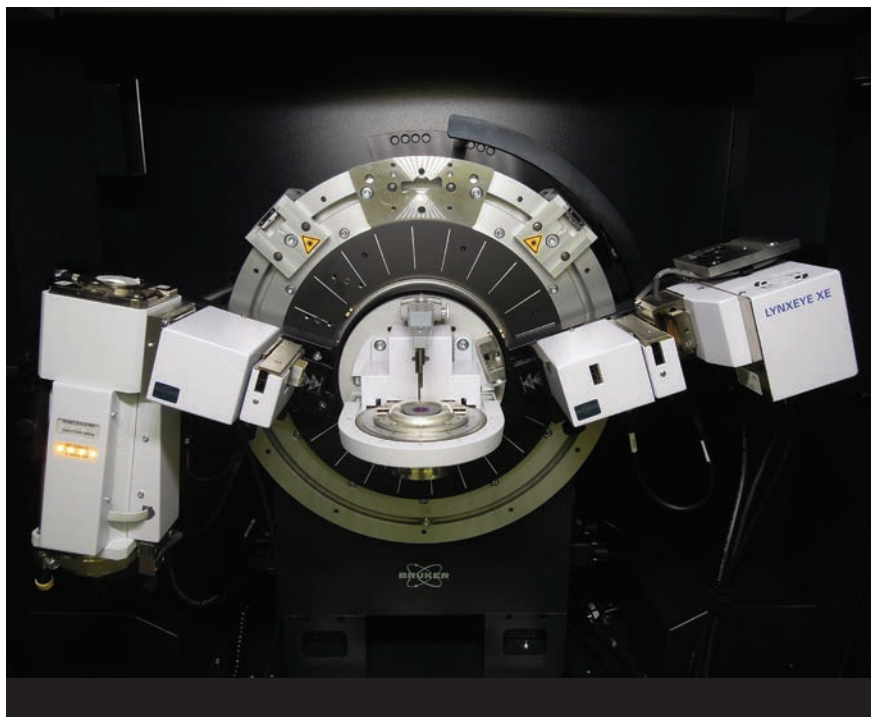
Gases

Field measurements of gases are carried out using Ecoprobe 5 and Draeger portable instruments. Detailed accredited chromatographic quantitative analysis determines 20 compounds including helium and argon. These measurements along with the analyses of isotopic composition of carbon in methane and in higher hydrocarbons help determine the origin of the gases, be it for instance from collieries, microbial activities or from oil deposits.



Juraj Franců

Head of the Central Laboratory
Brno



Detailed view of the new RTG Bruker D8 Advance powder diffractometer.



A swarm of mafic magmatic enclaves in a light granitoid (Skeleton Coast National Park, northwestern Namibia).



Special Laboratories

Special Laboratories represent the core of the Department of Rock Geochemistry and they provide a variety of applications. X-ray diffraction analysis is an indispensable method for determining the lattice structure of crystalline solid materials and for phase analysis of geological samples. Particular attention is given to the study of new minerals and synthetic phases of platinum-group elements (PGE), investigation of their crystal structure and selected physico-chemical properties. Chemical composition and zoning of single mineral grains are the subject of studies using the scanning electron microscope (SEM); rock microstructures are visualized by using the electron backscattered diffraction (EBSD) system.

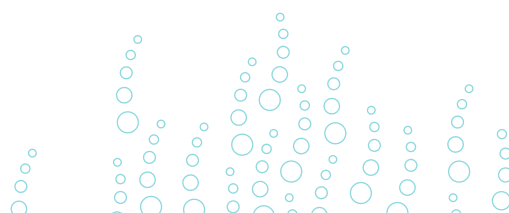
The P-V-T-X conditions of the genesis and composition of hydrothermal solutions are studied in our Fluid Inclusions Facility.

The Experimental Mineralogical Laboratory focuses on phase relation study within the S, Te, Se and PGE-bearing systems. The thermal ionization mass spectrometer (TIMS) and multicollector inductively coupled plasma-mass spectrometer (MC ICP MS) are capable of measuring the isotopic composition of elements and are important in petrogenetic and geochronological applications (for instance Sr, Nd, Pb, Li, Cr, Mg...). The influence of global palaeoenvironmental changes on the marine and terrestrial communities is the subject of research in the Laboratory of Ecostratigraphy and Palaeobiology.

The staff members of the Special Laboratories are not only responsible for providing primary data, but are also often renowned scientists, taking an active part in multi-disciplinary projects, regularly publishing their results and are involved in teaching activities.




Vojtěch Janoušek
Deputy Head of the Department
of Rock Geochemistry





Library and Collections

The services of the Library and Collections are used not only by experts from the Czech Geological Survey or other scientific institutions but also by students, private researchers and other interested members of the public. Researchers may use the study rooms in Klarov, Prague and in the Brno office located at Leitnerova 22, where study materials from the library and collections are provided. Mining literature may be studied at the Kutná Hora office.



Library

The CGS Library provides the largest collection of geoscience literature in the Czech Republic. Since 2013, it also holds a specialized archive from the former library of the Ministry of the Environment (MoE). As the only library in the Czech Republic, we also offer literature dealing with waste and waste management. All registered readers may use nine proprietary databases as well as globally recognized full text databases (Science Direct, SpringerLink, Willey Interscience, Blackwell, GeoscienceWorld) and bibliographic databases (Web of Knowledge, Scopus, Georef and Geobase, Environment Complete). Of all the libraries administered by the MoE, the CGS Library provides the widest range of online information sources.

In 2016, we focused on processing a collection of mining literature, which is stored at the Kutná Hora office. It is a specialized collection of monographs and periodicals. The CGS Library provided methodological assistance, training in cataloging and work with the library system. First, we focused on the processing of the monographs, which will be followed by the recording of the periodicals. The processed publications may be found in a common catalogue and are available to readers at the Kutná Hora office.

Other activities of the Library

Beside standard activities related to the services of the Library, its staff participate in the processing data and their transfer to the R&D Information System. The geological bibliography is being updated by the processing of current and backlogged annual reports. The articles processed in this manner are an integral part of the National Geoscience Bibliography GeoLib. In addition, the environment-related bibliography is being updated with articles from all the printed sources available in the CGS Library. An important and unique part are articles involving waste management, which no other library deals with. These articles are mainly used by MoE staff.

Collections

The Department of Geological Collections stores and provides access to fossils, mineral and rock samples, drill cores, thin sections and other geology-related items collected by researchers of the CGS or other institutions, as well as by private collectors during field work. The most valuable samples from a science perspective are located in geological, mineralogical and palaeontological collections. This select collections of a museum character is stored, made accessible and recorded in the CES national register by virtue of Act No. 122/2000 Coll.,

as amended, and of amended Decree 275/2000 Coll. The storage, access and loan of these items is subject to strict conditions defined by the above-mentioned and subsequent legal regulations. The documented material (geological and palaeontological samples from geological mapping, thin sections and drill cores from boreholes) is kept in accordance with Act No. 62/1988 Coll., as amended by Act No. 66/2001 Coll.

Significant additions to the collections

One of the most significant acquisition to the collections in 2016 was the rediscovery of a unique graptolite material from Hlinsko, which was obtained in the field in the 1950s by Dr. Radvan Horný, a former CGS employee and then an important employee of the National Museum in Prague. He stored this important material as a standard mapping document in the repository at Lužná. The material, which contains many type and figured specimens, was rediscovered during discarding work within the in-house CGS project No. 344500 “Fulfilling the sub-targets of the ‘Draft concept of a further development of the stores of material and written documentation of the CGS’ – re-discarding and re-deposition of palaeontological documentation material related to the localities and conservation of the J. Sekyra collection at Lužná near Rakovník – Phase II”. Be-



Holotype specimen of trilobite *Chotecops auspex* Chlupáč 1971, cephalon ICh 3419, figured by Chlupáč (1971) in Tab. 3, Figures 1–3, subsequently figured by Chlupáč (1977) at Tab. XIX, Figures 1–3, lateral view. Choteč Formation, Choteč Limestone facies, Middle Devonian, Eifelian Stage, U Jezírka Quarry, Prague-Hlubočepy. I. Chlupáč Collection.

sides this material, the smaller yet valuable acquisitions of the collections of V. Vokáč, H. Eliášová, Z. Šimůnek, O. Zicha and others should be mentioned as well. This material and other new collections of a museum character were entered into a central inventory of collections of the Ministry of Culture of the Czech Republic. Project No. 344500 involved mainly the processing of the extensive collection of J. Sekyra and its preparation for entry into the CES, and also the re-discarding of other material (mainly the collections of Chlupáč, Bouček, Plas, Soukup, Fejfar, Hokr and Čtyrský). The care of the collections (300,000 pieces in total) was accompanied by intensive publishing activity.

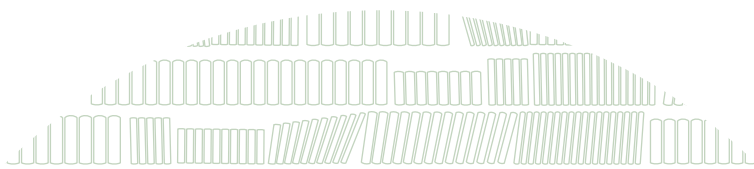


Hana Breiterová

Head of the Department of
Information Services and Head of
the Geological Library



Two incomplete individuals and two negatives of the cephalon of the trilobite *Dalmanitina socialis* (Barrande, 1846) from the Upper Ordovician Letná Formation, Prague-Letná, Belveder, from the CGS collections, item number XB 159. Photo by M. Frouz.





Geological documentation

Within the frame of the administration of state geological survey, the staff of Geofond secures collection, long-term storage and maintenance, evaluation and access to geological documentation and to results of the Earth Science investigations deposited by both natural persons and corporate bodies in accordance with the Act No. 62/1988 Coll., on geological work. These data are managed and made available in professional records of the Geoscience Information System.



Archives

The **Archive of Geological Reports** is a specialized archive that holds the largest collection of unpublished geoscience documents in the Czech Republic. It comprises more than 250,000 written reports and graph supplements, which represent 3,500 m of documentation. In 2016, the Geofond Division of the CGS received over 4,000 final reports from newly conducted geological surveys. In addition, reports containing the results from CGS research activities and documents from older sources were added to the collection as well. All the new additions to the archive were processed, integrated into the ASGI archive database and made available for browsing. Selected data from the reports obtained are being processed thematically in specialized datasets and databases.

The **Map Archive** collects map outputs from CGS activities as well as other geoscience maps from other sources. A total of 320 maps from the Czech Republic and other countries were added to the collection in 2016. An independent part of the Map Archive comprises an extensive dataset of mining maps, which is gradually being supplemented by copies of selected historical maps from the hold-

ings of the National Archives. Map documents may be searched for and browsed online in the “Map Archive” application.

Archive services are provided to state and local authorities as well as to the public, schools and academia. In 2016, the study room staff provided visitors with 10,000 archival documents and other material in digital form as well.

Systematic digitization of archival holdings has been underway since 2004. Its main purpose is to permanently preserve the oldest documents and to make the most sought-after and important works readily available. More than 40,000 archive reports, representing three million pages of text and graphic attachments, are currently being digitized. Nearly all the Map Archive holdings are also available in digital form.

Borehole logs material documentation (Geofond Division)

The repositories of the CGS Geofond Division hold a continuously updated set of over 34,000 m of material samples, which are available upon request, in a special filing system of sample containers. These are rock samples or continuous drill cores from structural and other important boreholes in the

Czech Republic. In 2016, approximately 10,000 m of borehole samples were successfully moved from the warehouse in Chotěboř to the repository in Stratov.

Borehole logs, hydrogeological database, geophysical records and archives

Information on geological exploration activities carried out in the Czech Republic is stored in individual specialized datasets based on point-diagram and planar-diagram systems. Characteristic features of the datasets are their national scope, systematic updating and well-defined territorial locations. Basic data are available in the web map application GISViewer. Simple data outputs are provided within the eEarth and eWater online dispensing systems. Comprehensive outputs involving the interaction of individual datasets are provided upon request.

In 2016, cooperation continued on the “Review of Groundwater Resources” project. New objects were incorporated into the GDO and GEO datasets, and processing work began for their inclusion in the HYD dataset.

The **Geologically Documented Objects Dataset – GDO** contains basic information on geological exploration work. It is the most comprehensive dataset with



Archival holdings and study room of the Geofond Division.



Moving of borehole samples from the Chotěboř warehouse to the Stratov repository.

more than 690,400 objects. A total of 3,398 objects were added to the dataset in 2016.

The Borehole, Shaft and Well Record Dataset – GEO specifies the basic GDO data with more comprehensive information, detailed object data, and petrographic descriptions of the rocks encountered. A total of 2,195 objects were added in 2016, and the dataset now contains information on nearly 620,000 objects. Part of the data was obtained from various organizations in digital form only, so that there are object descriptions that lack primary archive documents.

The Hydrogeological Database – HYD contains hydrogeological data including measurements, analyses and tests. The data

are continually updated, and 2,448 objects were added in 2016. It currently holds information on nearly 99,700 objects.

The Technical Parameters of Well Drilling Dataset – TECH contains information on well construction and casing parameters for nearly 3,500 boreholes.

The Drill Logging Dataset – KAR contains digitized drill-logging data from more than 5,500 borehole and directional log data from more than 2,900 objects.

The Groundwater Data and Information Dataset contains data on groundwater reserve estimation polygons and data on regional hydrogeological resource evaluation polygons.

The Geophysical Exploration Dataset includes the locations of significant geophysical surveys (gravimetric, magnetometric, airborne geophysical, VES measurements, seismic, petrophysical) contained in archival reports.



Milada Hrdlovicová
Head of the Department
of Geological Documentation

Publishing House and promotional activities

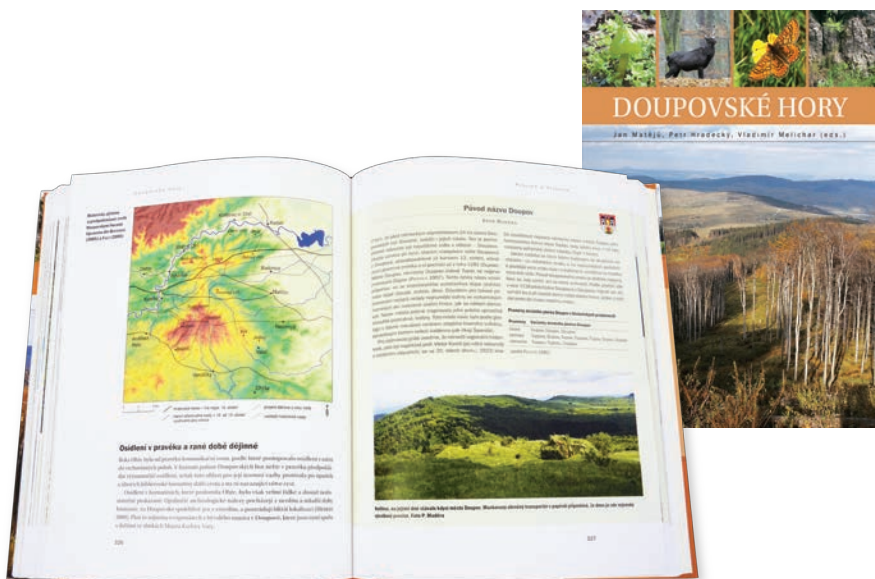
The Publishing House of the Czech Geological Survey is the largest publisher of geological literature in the Czech Republic. It focuses on professional publications dedicated to geoscience, geological and thematic maps at various scales, and on popular science and educational literature. A wide variety of publications provide information on domestic research results as well as on the findings of geology specialists from various projects throughout the world. The Publishing House also provides promotional activities and popularizes the research of CGS experts. The information is presented in a comprehensible and engaging manner to all interested professionals and lay people, and to students, tourists and children as well.

In 2016, the Czech Geological Survey's work on various projects, and publishing and commercial activities included the released 20 titles. The most popular books, as reflected in sales figures, were *Doupovské hory* ("Doupovské hory Mts") edited by Jan Matějů, Petr Hradecký and

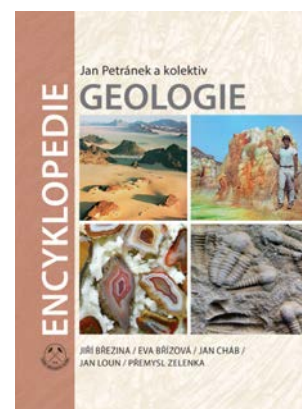
Vladimír Melichar, and Jan Petránek's *Encyklopedie geologie* ("Encyclopedia of Geology"). Likewise, Václav Rybařík's book *Kamenná katedrála* ("Stone Cathedral") pleased many experts and geological enthusiasts as well. Traditionally published professional publications are

of interest to specialists from many fields of science and serve as a source of information for students or state administration representatives.

A newly launched series called *Journeys into the Geological Past* will include popular science brochures presenting the



In cooperation with the Karlovy Vary Museum, the Czech Geological Survey published the book *Doupovské hory* ("Doupovské hory Mts") edited by Jan Matějů, Petr Hradecký and Vladimír Melichar. This is the first comprehensive monograph that summarizes the latest findings on the nature, landscape as well as the history of the Doupovské hory Mts. It took a team of forty authors, specialists in geology, zoology, botany and other fields, several years of work. In view of the work's significance and number of co-authors involved, the book launch ceremony was held twice, first at the Ostrov Chateau on 30 November 2016 and subsequently at the CGS Geological Bookstore on 13 December 2016.



The latest edition of Prof. Jan Petránek's geological encyclopedia is a supplemented and updated version of his original book, which was published twenty years ago and which is now unavailable. It contains over 2,600 entries explaining basic geoscience concepts. The explanations are comprehensible and accessible to a wide range of interested parties while maintaining an appropriate professional level. The text is accompanied by understandable tables and includes many colour illustrations and photographs. The book launch was held at the CGS Geological Bookstore on 9 February 2016.



The Czech Geological Survey is a traditional partner of the Science and Technology Week (TVT), organized by the Czech Academy of Sciences. During the TVT 2016 week, Doors Open Days were organized by the CGS (at the Klárov and Barrandov offices) in November, and the opening of the photography exhibition *Ázerbájdžán* ("Azerbaijan") of CGS specialist Pavel Hanžl was held for CGS visitors. The photos were taken during the author's work-related visits to this area.



Together with other leading institutions from all over the Czech Republic, the Czech Geological Survey was engaged in the preparation of the *Geology of the Jizerské hory Mts and Liberec Region* exhibit, organized by the North Bohemian Museum in Liberec from 24 February to 8 May 2016. The latest regional geology research results were presented, and the exhibit included samples of rocks and minerals. A catalogue of the same title, which remains a valuable source of information, was published in conjunction with the exhibition.

current scientific knowledge on the origin and evolution of selected localities with augmented reality photos, which readers may view after downloading the Geology AR app from Google Play. The first brochure of this series is a dedicated to Trosky Hill located in the Bohemian Paradise.

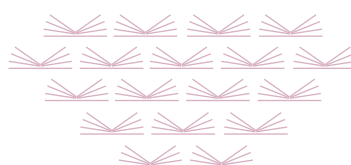
Due to increased interest in the Czech Geological Survey's publications and maps, the online bookstore had to be improved in order to provide more modern graphics, including a more user-friendly and responsive user interface. The new, easier-to-use online store, with the same internet address (<http://obchod.geology.cz>), has been in operation since June and offers a wider range of product groups.

Book fairs and exhibitions

The Czech Geological Survey presented its popular science and education publications at the Autumn Book Fair in Havlíčkův Brod in October. Together with other leading institutions from all over the Czech Republic, it helped organize the "Geology of the Jizerské hory Mts and Liberec Region" exhibit at the North Bohemian Museum in Liberec. The exhibit was on display in the grand hall from 24 February to 8 May 2016. The CGS was also engaged in successfully organizing the Czech Republic's largest science festival, the Science and Technology Week, which included, for instance, Doors Open Days at the Survey's two Prague offices – Klárov and Barrandov.

Throughout the year, visitors were

able to view several photography exhibitions held at the CGS Geological Bookstore. Oleg Man's exhibition *60 let s fotografií* ("60 Years of Photography") commenced in February and, on the same occasion, the author also launched his book *Sebrané fotografie* ("Collected Photos"). Ivana Frolíková's photo exhibition *Za světlý severu (Lofoty a Vesterály)* ("Beyond the Northern Lights (Lofoten and Vesterálen Islands)") that was on display from April, was followed in September by *Potulky svetom* ("Global Wanderings") – original photos of our Slovak colleague Štefan Káčer. The photo exhibition *Ázerbájdžán* ("Azerbaijan") of geologist Pavel Hanžl was launched during a Doors Open Day in November.

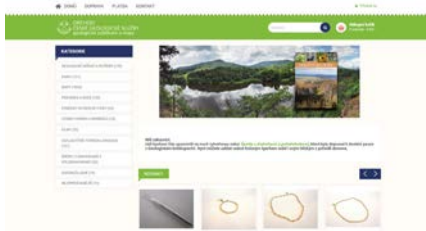




Documentary films on the research of leading Czech Geological Survey specialists involved in various CGS activities were released on DVD after becoming popular with YouTube channel viewers. In an engaging manner, the films present key issues dealt with by specialists from various geoscience disciplines, and they are also very popular as natural science teaching aids at primary and secondary schools.



A groundbreaking novelty is the release of the Trosky Hill Brochure illustrated with augmented reality photos, which readers view after downloading the Geology AR app from Google Play. They will acquaint themselves with the latest scientific perspective on the geological evolution of this iconic rock formation in the Bohemian Paradise, which is the result of volcanic activity. Other brochures that explain the geological origin and evolution of selected localities using modern technologies are planned for release as part of the *Journeys into the Geological Past* series.



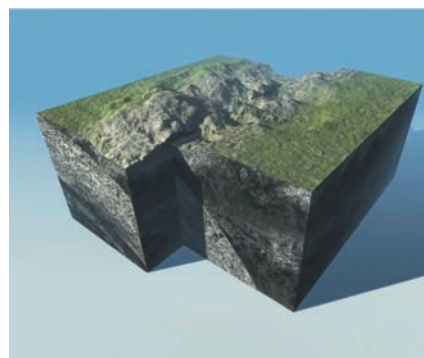
The Czech Geological Survey launched a new online bookstore (<http://obchod.geology.cz/>), which provides more modern graphics and a more user-friendly and responsive user interface. The product groups in which particular goods of the online store are included were modified as well – the structure was simplified and clearly arranged. “Precious and semiprecious gemstone jewelry” and “Films” are newly created product groups.



The Publishing House staff was responsible for key *Publicity and Dissemination* activities for the **REPP-CO2** project. Staff members collaborated on the preparation of graphic and educational materials and helped update the website. They were also engaged in the organization of the final conference, which took place on 7–8 November 2016 with the participation of leading Czech and foreign experts specializing in the geological storage of CO₂.

GEOLOGICKÁ OLYMPIÁDA

The Czech Geological Survey helps organize the national Geology Olympiad (<http://www.geologicka-olympiada.cz/>). The competition in geoscience knowledge is designed for primary and secondary school students. Its aim is to help educate about inanimate nature, and to seek talented pupils by systematically supporting and developing their professional growth.



Animation of the Blanice Graben

Popular science animations that illustrate the origin and evolution of geological localities are becoming increasingly popular and desirable ways of presenting the latest scientific knowledge. Some of them also promote collaboration between institutions – for instance, the Ministry of the Environment, the Czech Union for Nature Conservation Vlašim, and the national geopark Region of the Knights of Blaník collaborated on the animation of the Blanice Graben. The animations are then shared with the public via the CGS YouTube channel (www.youtube.com/user/Geologycz).

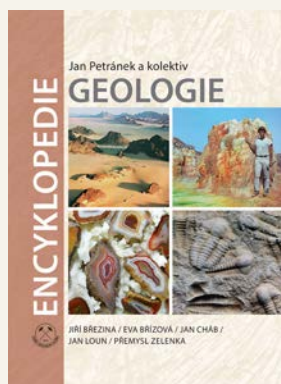


Patrik Fiferina
Head of the Publishing House
of the CGS

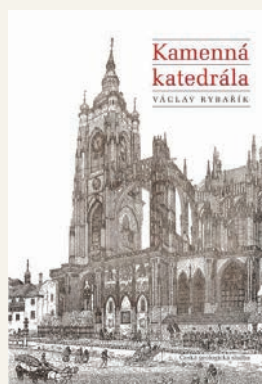


Selected publications issued by the CGS

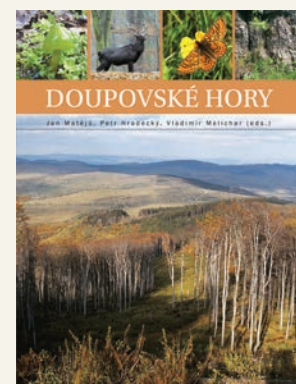
Books and periodicals



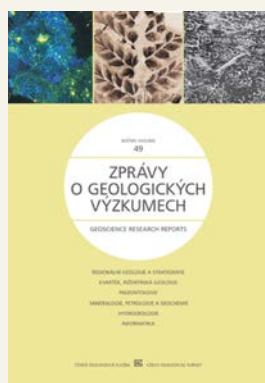
J. Petránek
Encyclopedia of Geology



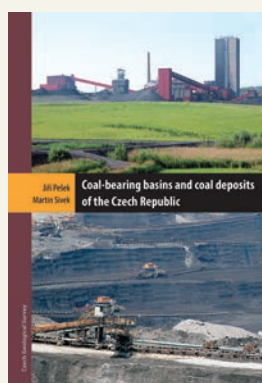
V. Rybářik
Stone Cathedral



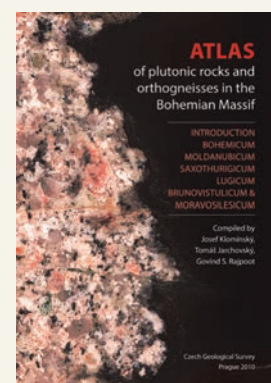
J. Matějů, P. Hradecký,
V. Melichar (eds)
Doupovské hory Mts



V. Čechová (ed.)
Geoscience Research Reports in 2015



J. Pešek, M. Sivek
Coal-bearing basins and coal deposits of the Czech Republic



J. Klonínský, T. Jarchovský,
G. S. Rajpoot
Atlas of plutonic rocks and orthogneisses in the Bohemian Massif



J. Starý
Review of Reserved Mineral Deposit Reserves of the CR, Parts I and II



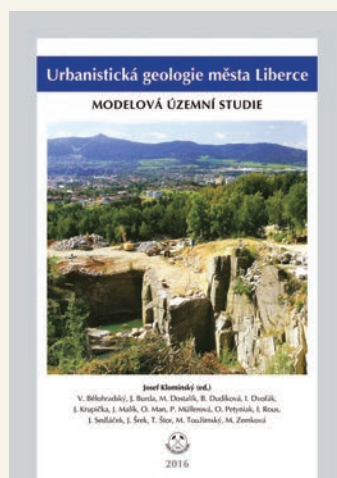
J. Starý
Register of Mineral Deposit Reserves of the CR



J. Starý
Changes in Reserves of Reserved Mineral Deposits in 2006–2015



Maps



J. Klomínský (ed.)
**Urban geology of the city of
Liberec with 1:13,000 map**



J. Otava et al.
**Geological map of the Czech
Republic 1:25,000 with explanatory
notes, 25-141 Kč**

Brochures with augmented reality photos

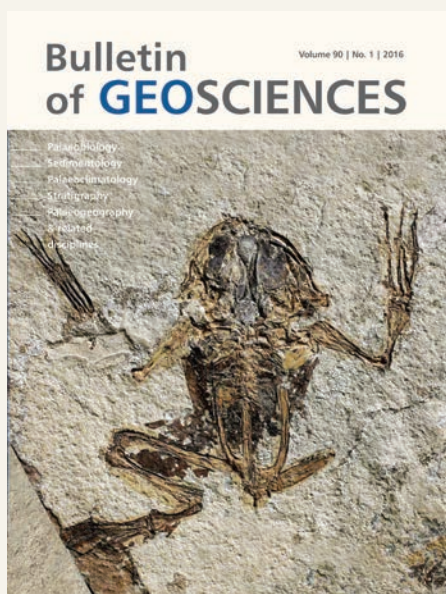


M. S. Petronis, V. Rappich, A. Tauchman
Journeys into the Geological Past – Trosky



P. Závada, V. Rappich, K. Mach
Journeys into the Geological Past – Bořeň

Periodicals



The *Bulletin of Geosciences* (www.geology.cz/bulletin) is the most significant scientific journal published by the Czech Geological Survey. This journal – formerly called “*Věstník*” – was founded on request of the scientists from the State Geological Institute of the Czechoslovak Republic. The first volume was issued in 1925. Since then, thousands of scientific papers have been published in the journal and it now constitutes an archive of the most important scientific research on geology of the Bohemian Massif. In 2006, the Editorial Board set the focus of the journal on *palaeoenvironmental research and the evolution of life on Earth*. In 2007, the *Bulletin of Geosciences* was included with other international scientific journals in the most prestigious scientific databases. In 2010, on the basis of the high quality of its scientific content, the prestigious American company Thomson Reuters awarded the journal an impact factor. Thanks to the long-term efforts of the current Editorial Board, the *Bulletin of Geosciences* is one of the top 10 most important scientific journals published in the Czech Republic and it has the highest *impact factor* of all geo-scientific journals. Its impact factor value for 2015 is 1.7.



The Czech Geological Survey is a co-publisher of the *Journal of Geosciences* (<http://www.jgeosci.org>), released by the Czech Geological Society with the grant support of the Council for Scientific Societies of the Czech Republic and the Czech Literary Fund Foundation. Being a periodical with a long tradition (62nd volume), it takes up with its predecessors *Časopis pro mineralogii a geologii* and *Journal of the Czech Geological Society*. Since 2006, it has been focusing on process-oriented studies dealing mainly with mineralogy, structural geology, petrology and geochemistry of igneous and metamorphic rocks. In addition to regular volumes, special monothematic issues are also published. Two issues were released last year, the first describing geology of the Mongolian part of the Central Asian Orogenic Belt and the second dealing with magmatism in the Bohemian Massif, in honour of the deceased associate professor František Holub. The *Journal of Geosciences* maintains a high standard and is indexed in a number of database services, including the prestigious Web of Science, Scopus and GeoRef. In 2011, thanks to this fact, it was awarded by the Thomson Reuters company an impact factor whose value for 2015 is 1.326.

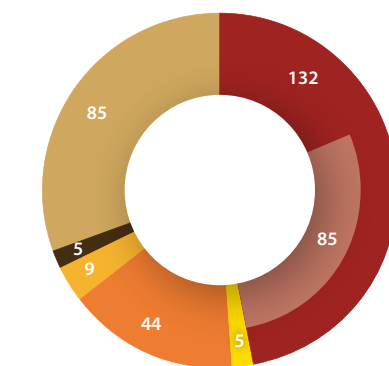
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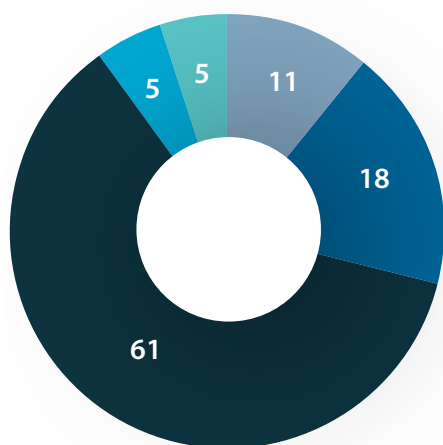


CGS publishing activity in 2016

- Papers in journals
- of this: in journals with impact factor
- Papers in reviewed proceedings
- Papers in unreviewed proceedings
- Scientific book
- Chapter in a book
- Maps

Financial review

In 2016, the Czech Geological Survey reached a positive financial balance of CZK 801,818, out of which CZK 413,160 represent primary activities and CZK 388,658 secondary activities.



Percentage distribution of expenditure in various categories for 2016

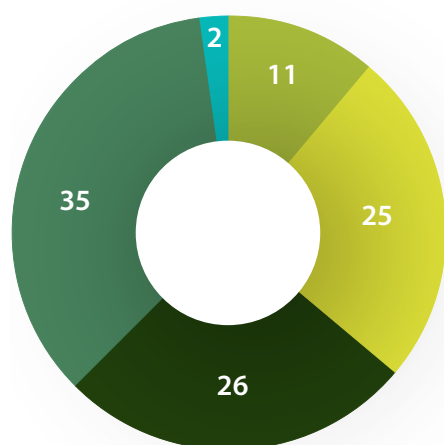
- Material and power consumption
- Services
- Total costs of personnel
- Depreciation of tangible and intangible assets
- Other expenses

Total expenditure of the organization

| Total expenditure of the organization (CZK) | 302,095,000 |
|--|-------------|
| Material and power consumption | 31,974,000 |
| Services | 55,121,000 |
| Total costs of personnel | 185,406,000 |
| Depreciation of tangible and intangible assets | 15,951,000 |
| Other expenses | 13,643,000 |

Fulfilment of the main aims and priorities

- Successful project implementation in exertion of duties of the state geological survey according to the aims and priorities of the parent organization and the extraordinary requirements of the national and local administration and as well as citizens of the Czech Republic.
- Maintaining the top rating of the Survey and of the individual staff members in scientific research and securing the necessary financial means for the expansion of its research activities.
- Securing additional own income sources from newly acquired projects and service orders.
- Securing corresponding funds for financing own investment in maintaining competitive abilities and highly qualified professional status (technical equipment, ICT, intangible assets).



Percentage distribution of income in various categories for 2016

- Revenues and other own income
- Allocation for activities of the organization
- Institutional funding for research organization
- Funds for projects and service orders
- Income from transfers

Total income of the organization

| Total income (CZK) | 302,897,000 |
|---|-------------|
| Revenues and other own income | 34,568,000 |
| Allocation for activities of the organization | 77,055,000 |
| Institutional funding for research organization | 78,087,000 |
| Funds for projects and service orders | 106,471,000 |
| Income from transfers | 6,716,000 |

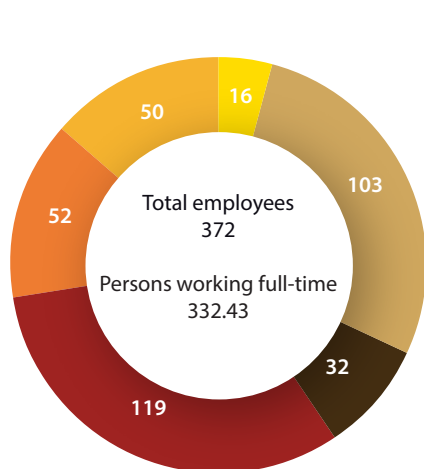


Zdeněk Čilc
Head of the Economic Division
and Deputy Director for
Economics

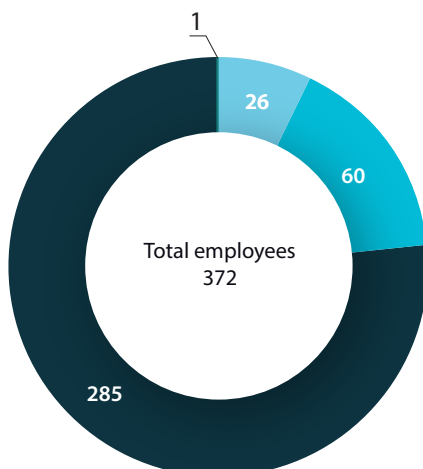
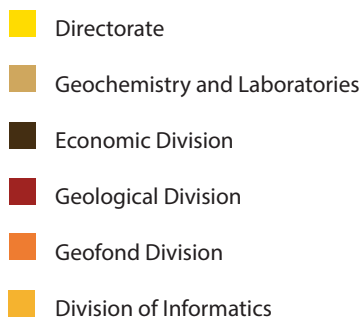
Human resources

In 2016, the Czech Geological Survey had a total of 372 employees, the equivalent of 332.43 persons working full-time.

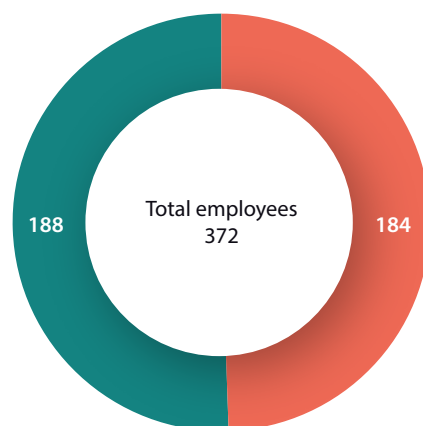
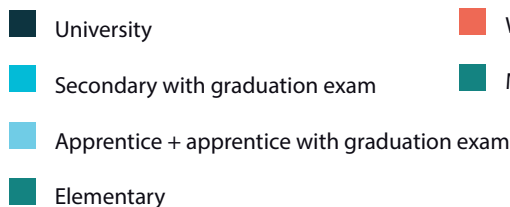
The CGS observes the principles of equal employment opportunity for all age groups, women and men alike and covers a wide range of labour relations. This is corroborated by the fact that employees returning from the maternity or parental leaves are offered the opportunity of working part time and the same applies to the senior-staff people who wish to continue their employment after reaching the retirement age. Part-time status may also be granted to staff members taking university studies or Ph.D. studies.



Graph showing the CGS subject fields



Graph showing the educational qualification of the CGS staff



Graph showing the gender ratio of the CGS staff

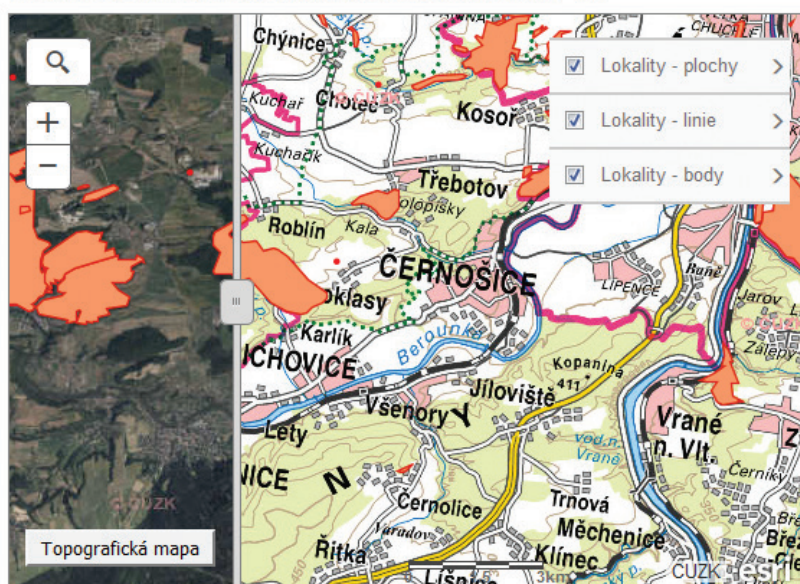


Helena Žemličková
Head of the Human Resources
Section

Website of the Czech Geological Survey

The Czech Geological Survey publicizes the results of its activity through dozens of its web presentations. Their content and their technical background are being constantly updated and upgraded.

Přehled významných geologických lokalit na mapě ČR



A new e-shop of the Czech Geological Survey was launched towards the end of June 2016. In addition to a more modern graphic design, it brought to the users a handier responsive user interface. Based on the marketability analysis of the individual commercial items, a complete change of products sections within which the goods of the on-line trading are distributed was made, thus making the structure of the sections simpler and easy to take in.

Based on the experience with development of the map application “Interesting Geosites”, a script making use of the ESRI Javascript API was designed, enabling a simple embedding of inter-active maps onto the websites. Examples of such maps can be seen on “Geological Localities” page (<http://www.geology.cz/localities>) or “Decorative Stones” page (<http://www.geology.cz/decorative-stones>). The functionality of any map can be expanded by another script, which was used in practice in a new application designed for reporting old mine workings <http://www.geology.cz/app/dud ozn>. In order to meet the requirements of the REPP-CO₂ project (Preparation of a research pilot project on CO₂ geological storage in the Czech Republic) web pages of the “Czech National Information Portal” have been created (<http://www.geology.cz/ccs>) for this purpose.

The CGS Publishing House has asked for a design of a makeshift page dedicated to the “Geology Olympiad”, (see <http://www.geologicka-olympiada.cz/>).

Based on the experience gained with the creation of responsive web design pages, the websites of the Czech extranet (<http://www.geology.cz/extranet>) and the English extranet (<http://www.geology.cz/extranet-eng>) were adapted to the pattern more suitable for being displayed on mobile facilities. Work enabling an enhanced extranet accessibility on mobile mechanisms will go on in 2017.

The map application “Interesting Geosites” continued being further developed during 2016. Major novelty is that it runs as the first CGS map application via the secure https protocol on the address <https://mapy.geology.cz/zajimavosti>.

Pages for download services have been set up on both the Czech and English extranet (<http://www.geology.cz/extranet/mapy/mapy-online/stahovaci-sluzby>, <http://www.geology.cz/extranet-eng/maps/online/download-services>). They display an overview of services in the ATOM and WFS formats we provide for meeting the requirements of the INSPIRE directive.

In line with the SSL server certificate for HTTPS operation of the web service and in line with the termination of SHA-1 support by the certification authorities issuing credibility certificates, we were compelled to implement a reverse proxy into the Portal environment.

That proxy is based on the Linux operating system whose web service is able, besides the SHA-1 algorithm, of running newer algorithms standing between the user and the user’s authentication service. The key communication between the user and the reverse proxy is encrypted (currently TLS1.0).



Radek Svítal
Web administrator

Principal events in 2016

13 January

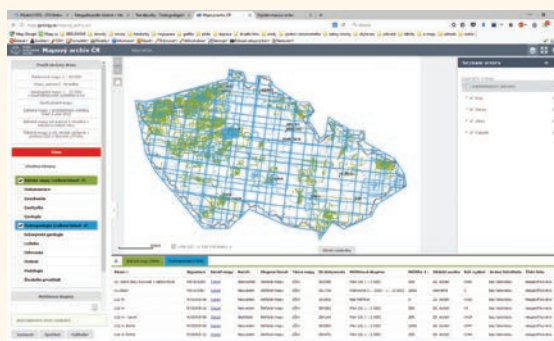
Lucie Kondrová successfully defended her doctoral thesis and received her Ph.D.

MSc. Lucie Kondrová, a member of the CGS Information Systems Department, successfully defended her dissertation on the “Data model for 3D modelling of the geological structure of the Czech Republic” during the Geodesy and Cartography study programme at the Department of Geomatics (Faculty of Civil Engineering, Czech Technical University in Prague). Her supervisor and opponents acknowledged the high level of her work, which pushes the possibilities of understanding the geological environment by proposing a National 3D Geological Database GEOČR3D. The database will serve as a data source for geological modelling of the territory of the Czech Republic, as a storage of 3D data and models, and as a source for their visualization. The topic will be further developed as part of the Strategic Research Plan of the CGS in 2016–2020.

19 January

New application Map Archive of the CR

The new application Map Archive of the Czech Republic has been added to the list of map applications. It enables users to search for and view localized map entries for the territory of the Czech Republic, which are stored in the CGS Archive. Search results provide bibliographic information and a link to previews of scanned maps.



20 January

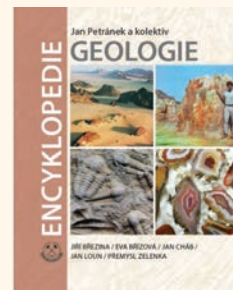
New CGS Library catalogue

A new online CGS Library catalogue was launched. It allows users to search all documents in the library holdings, to search for articles in databases, and enables online document ordering and reader account management.

9 February

Launch of the *Encyclopedia of Geology*

The launch ceremony of the book *Encyklopedie geologie* (“Encyclopedia of Geology”) by Prof. Jan Petránek et al. was held at the CGS Geological Bookstore at Klárov. Regrettably, the professor did not live to see the launch of the book.



23 February

Exhibition celebrating Oleg Man's 60th birthday

The opening of the artistic photography exhibition *60 let s fotografií* (“60 Years of Photography”) by Oleg Man, a long-time graphic designer of the CGS Publishing House, was held at the CGS Geological Bookstore at Klárov. The launch of his book *Sebrané fotografie* (“Collected Photos”) also took place on the same occasion.



24 February

Exhibition *Geology of the Jizerské hory Mts and Liberec Region*

The North Bohemian Museum in Liberec launched the exhibition *Geologie Jizerských hor a Liberecka* ("Geology of the Jizerské hory Mts and Liberec Region") in the grand hall. It was prepared by a number of experts from leading institutions from across the country, including the Czech Geological Survey. The exhibition displayed the latest regional geology research results, including rock and mineral samples.



4 April

Opening of the Czech Paradise House of Nature

Richard Brabec, the Minister of the Environment, officially opened the Czech Paradise House of Nature in Dolánky near Turnov, along with František Pelc, Director of the Nature Conservation Agency of the Czech Republic, Turnov Mayor Tomáš Hock and Radek Hromádka, Director of the Ecocentre Oldřichov v Hájích. This is already the eighth house of nature in the Czech Republic. The main attraction of the visitor centre in the tastefully renovated former school building is an interactive natural science exhibit showing the living and inanimate nature of the Bohemian Paradise Protected Landscape Area. The Czech Geological Survey was also engaged in providing the content of the exhibition.



3 May

New version of the "Interesting Geosites of the CR" map application

The promotional map application "Interesting Geosites of the Czech Republic" was upgraded to a new version with a number of innovations such as an improved search function, a separate layer of national geoparks or geological excursions, and animations on how the landscape formed. In order to gain an understanding of how our mineral wealth is used, the application also displays the "Decorative Stones" and "Mine Workings" layers with basic information on relevant sites.



6 May

New website of the Czech National Information Portal on CCS Technologies

The new Czech National Information Portal on CCS Technologies was launched on www.geology.cz/ccs. (The existing website at www.geology.cz/co2net-east is no longer up-to-date.) The capture and storage of CO₂ is one of the promising options for reducing greenhouse gas emissions into the atmosphere and, thus, for climate change mitigation. The aim of this portal is, among other things, to provide up-to-date CCS information to interested parties.

9 May

Presentation of the CGS Centre for Remote Sensing at the Living Planet Symposium 2016

The Living Planet Symposium, organized by the European Space Agency (ESA), was held in Prague on 9–13 May 2016. Thanks to nearly 3,000 participants, it became one of the largest Earth observation events under the ESA. The CGS Remote Sensing Centre contributed to the event on four occasions.



12 May

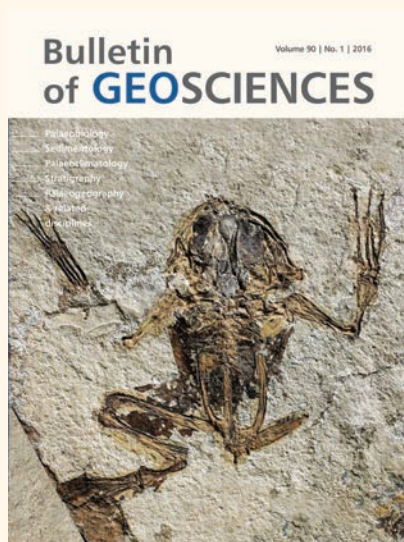
REPP-CO2 organized a workshop at the CO₂GeoNet Open Forum conference in Venice

As part of the REPP-CO2 project, a workshop titled “CO₂ Storage Pilot Projects in Europe” was held at the CO₂GeoNet Open Forum in Venice. The organized workshop received a very positive feedback, and over 45 members of the CO₂GeoNet association and other interested parties took part. During the first part of the workshop, representatives of the Czech Geological Survey presented the project REPP-CO2 (V. Hladík), J. Franců dealt in detail with the construction of a 3D geological model of the LBr-1 locality of interest, and Norwegian partner R. Berenblyum (IRIS) followed with a presentation on dynamic modelling and simulation of CO₂ injection at this site. Representatives of other partner projects on CO₂ storage in Spain (J.C. de Dios), Israel (A. Niemi) and the Netherlands (F. Neele) made their presentations during the second part. The conclusion involved an extensive discussion.

13 June

10th anniversary of the new Bulletin of Geosciences and new IF

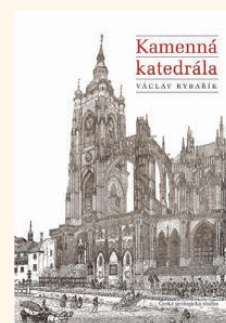
The new impact factor was announced for the Bulletin of Geosciences for 2015. It reached its highest value thus far – 1.70. A decade passed in 2016 since the new Editorial Board changed the focus of the Bulletin to paleontology research and the evolution of life on Earth. Over the past 10 years, more than 600 scientists from 43 countries have published their scientific research results, in more than 400 scientific articles, in the Bulletin. Thanks to the efforts of the current Editorial Board, the Bulletin of Geosciences is currently the third most important scientific journal published in the Czech Republic and one of the leading international paleontological journals.



14 June

Launch of the book *Stone Cathedral*

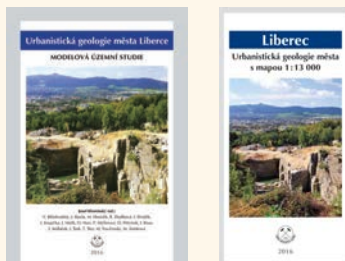
The launch of Václav Rybářik's book *Kamenná katedrála* (“Stone Cathedral”), introduced by Assoc. Prof. Zdeněk Kukal, was held at the CGS Geological Bookstore.



16 June

Geology of the Jizerské hory Mts and Liberec Region

The launch of the publication *Geologie Jizerských hor a Liberecka* ("Geology of the Jizerské hory Mts and Liberec Region"), issued by the North Bohemian Museum in Liberec in cooperation with the Czech Geological Survey, was held at the CGS Geological Bookstore.



20 June

Miloslav Cihelka passed away

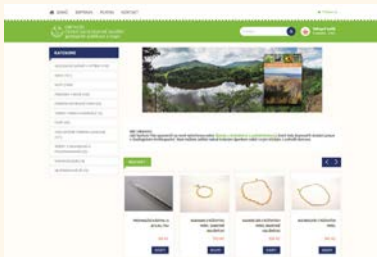
Miloslav Cihelka left us forever at the age of 81 on Monday, June 20th. He worked for the Czech Geological Survey (formerly the Central Geological Institute) continuously from 1947 and was granted the status of an emeritus staff member of the CGS in recognition of his lifetime's work. Miloslav Cihelka worked tirelessly until the very end.



27 June

New online store of the Czech Geological Survey

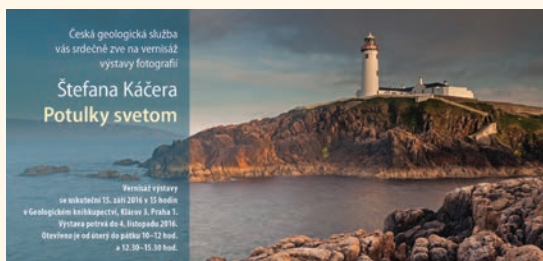
The Czech Geological Survey launched a new online store that offers a more user-friendly and faster service, including more modern graphics.



15 September

Photography Exhibition by Štefan Káčer

The opening of the photo exhibition *Potulky svetom* ("Global Wanderings") by Štefan Káčer, a colleague from the State Geological Institute of Dionýz Štúr (Slovakia), was held at the CGS Geological Bookstore.



22 September

Successful review of the development cooperation project in Mongolia

The Czech Republic's development cooperation project "Geological mapping at 1:50,000 scale and assessment of the economic potential of Western Mongolia (Mongol Altai 50)", conducted in cooperation with Mongolia, was successfully reviewed before the Mongolian Expert Commission at a meeting held at the Mineral Resources Authority of Mongolia in Ulaanbaatar. The project was carried out in 2013–2016 by 32 experts from four countries along with 40 other co-workers and technicians. The project involved the field training of 19 young Mongolian geologists. It also included the compilation of five geological maps at a scale of 1:50,000, edited by D. Buriánek, P. Čáp, I. Soejono, T. Vorel and V. Žáček, and 60 geochemical anomaly maps, including maps of the mineral potential of selected areas, under the direction of P. Bohdálék and V. Pecina. The review proceedings also included presentations by the project leader V. Žáček and by P. Bohdálék, head of the economic geology unit.



23 September

Professor O. Gerel awarded the Radim Kettner Medal

On the 20th anniversary of the founding of the Mongolian Geological Society, the Director of the Czech Geological Survey Z. Venera awarded the Radim Kettner Medal to Professor O. Gerel at a seminar held at the Mongolian University of Science and Technology in Ulaanbaatar in the presence of the Czech Ambassador to Mongolia Mrs. I. Grollová. She was awarded the medal by the Czech Geological Survey in recognition of her extraordinary merits in the development of Czech-Mongolian cooperation in geology. The seminar and preceding workshop also included lectures by K. Schulmann, A. Guy and P. Hanžl, summarizing the research and geological activities of the CGS in Mongolia.



12 October

Sailing the Caribbean Without a Yacht - Lesser Antilles

The launch of Jiří Jiránek's book *Karibikem bez jachty – Malé Antily* ("Sailing the Caribbean Without a Yacht – Lesser Antilles") was held at the CGS Geological Bookstore. The publication was launched by Professor of American Studies Josef Opatrný (Faculty of Arts at Charles University) and ethnographer and traveler Prof. Miloslav Stingl.



12 October

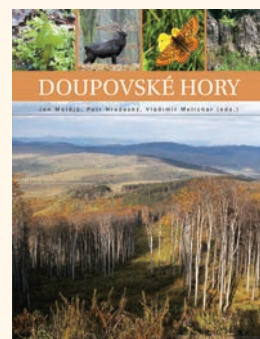
Czech-Norwegian seminar on cooperation in CCS research and development – Oslo

A Czech-Norwegian seminar on the cooperation in CCS research and development was held at the Scandic Solli Hotel in Oslo as an event associated with the *European CCS Forum* that is organized by the Global CCS Institute. The seminar was jointly conducted as a part of the *Czech-Norway Pilot CCS Study* and *REPP-CO2* projects under the *CCS Programme of the Norway Grants*. The latter project was coordinated by the Czech Geological Survey.

7 November

The first monograph on the nature and history of the Doupovské hory Mts was published

In cooperation with the Karlovy Vary Museum, the Czech Geological Survey released the book *Doupovské hory* ("Doupovské hory Mts"). This is the first comprehensive monograph that summarizes the latest findings on the nature, landscape as well as the history of Doupovské hory Mts. It took several years of work by a team of 40 authors and specialists in geology, zoology, botany and other fields.



7 November

CGS as a partner of the Science and Technology Week 2016

A Doors Open Day in Klárovo and Barrandov and a photography exhibition *Ázerbájdžán* ("Azerbaijan") by Pavel Hanžl were held during the Science and Technology Week 2016 organized by the Czech Academy of Sciences, in which the Czech Geological Survey has traditionally been involved.



7–8 November

Conference CO₂ Capture and Storage in the Conditions of the Czech Republic – Cooperation of the Czech Republic and Norway

The Czech-Norwegian conference CO₂ Capture and Storage in the Conditions of the Czech Republic was held at the Masaryk Dormitory in Prague. The conference was organized by the Nuclear Research Institute Řež Plc, the Czech Technical University in Prague, and the Czech Geological Survey. The main topic was the presentation of the results and conclusions of research projects implemented under the CZ08 programme of the Norway Grants, namely the “Study of CCS pilot technologies for coal fired power plants in the Czech Republic” and “Preparation of a research pilot project on geological CO₂ storage in the Czech Republic” (REPP-CO2).

14–16 November

Survey at the GIS Day event in Liberec

The traditional *GIS Day 2016* event was held at the Technical University in Liberec. This year the Czech Geological Survey was engaged in its organization with a demonstration titled “A Země se otevřela” (“And the Earth opened up”). Visitors were acquainted with the map application *Interesting Geosites of the Czech Republic*, and with the possibilities, tools and benefits of its use. For three days students, educators, interested members of the public, and other professionals visited our stand and tried out the application on an interactive whiteboard and found interesting places in their own neighbourhoods while testing various mapping tasks. Because many people expressed interest in more detailed geological information, we also examined the application *Significant geological localities of the Czech Republic* and map applications involving other geological topics offered on the CGS portal. Educators were acquainted with our range of information and materials suitable for teaching.

An integral and traditional part of our presentation was a geological map of the Liberec region with photographs of well-known geological localities and a collection of rocks, which allowed many visitors to test their knowledge of geology and local geography using matching exercises. Our demonstration also comprised a display of educational materials and selected geological or regional geology publications, including 1:25,000-scale geological maps. The highlight of our demonstration was a 3D view of the geological evolution of the well-known Trosky locality, which impressed all viewers by enlivening and enriching inanimate nature.

16 November

The first nationwide Geology Olympiad

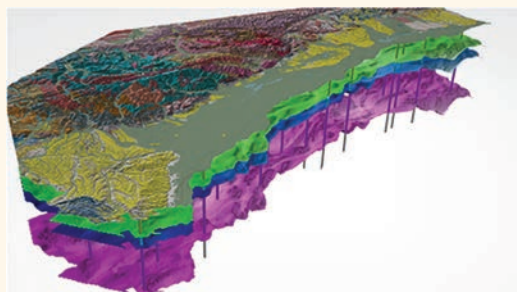
The Czech Geological Survey was engaged in the organization of the first nationwide Geology Olympiad (GO). The competition in geoscience knowledge is designed for primary and secondary school students. Its aim is to help educate about inanimate nature, to seek talented pupils, and to systematically promote and develop their professional growth. The Geology Olympiad is announced by the Masaryk University and coorganized by the Czech Geological Survey and Charles University. The general partner of the GO is Diamond Prague Museum, s.r.o.



16 November

Geology data model of France: new perspectives for geology

The event was held at Klárov, where Prof. Jean-Marc Lardeaux introduced the revolutionary BRGM programme “Le Référentiel géologique de la France (RGF)”.



27 November

Pavel Havlíček passed away

RNDr. Pavel Havlíček, CSc., an outstanding expert in Quaternary geology, reliable colleague and friend, left us forever on Sunday 27 November 2016. He worked at the institute from 1969. He was passionate about his work and his results were always flawless. He specialized in fluvial and aeolian sediments not only in the Czech Republic but also abroad, where he worked in places such as France, Central America, Libya and recently in Mongolia as well. In cooperation with the Geologische Bundesanstalt Wien, he contributed significantly to the geological research in the border areas of South Moravia and Lower Austria. He was involved in a wide range of professional activities. He worked with the Faculty of Science at Charles University, the Institute of Archeology of the Czech Academy of Sciences of the Czech Republic in Prague and Brno, as well as with regional organizations in his beloved Moravia. He was a member of the International Union for Quaternary Research INQUA and participated in several research projects of the International Geoscience Programme IGCP. The citation index on the



CGS Intranet lists his name under 245 works that he either authored or co-authored. In 2016 he completed a geological survey and mapping at the confluence of the Morava, Dyje and Kyjovka rivers and in the Bohemian Paradise.

12 December

Seminar “Minerals in the Liberec Region and their future use”

The seminar “Minerals in the Liberec Region and their future use” was held at the offices of the Liberec Regional Authority. It was organized by the Liberec Region in cooperation with the Czech Geological Survey. The main purpose of the seminar was to inform about the Liberec Region’s conceptual document regarding minerals and about its upcoming update in 2017. Other relevant topics were also presented, such as problematic mineral producing localities, the Turów Mine’s mining impact on the landscape in the Czech Republic, the use of abandoned mining sites, and educational projects of the Czech Geological Survey. The seminar was designed mainly for the representatives of the towns and municipalities in the Liberec Region, for relevant departments of ministries, for schools and the general public as well.



13 December

Launch of the book *Doupovské hory Mts*

Due to the work’s significance and number of co-authors involved (40), the Czech Geological Survey organized two launch ceremonies for the book *Doupovské hory* (“Doupovské hory Mts”), edited by Jan Matějů, Petr Hradecký and Vladimír Melichar. The first book launch was held in cooperation with the Karlovy Vary Museum at the Ostrov Chateau and attended by nearly three hundred people waiting in a long book signing queue. The book was also launched at the Geological Bookstore of the Czech Geological Survey.



Web

Czech Geological Survey website > www.geology.cz
State Geological Survey > www.geology.cz/extranet-eng/sgs
Science and Research > www.geology.cz/extranet-eng/science
Services > www.geology.cz/extranet-eng/services
Maps > www.geology.cz/extranet-eng/maps
Publishing activity > www.geology.cz/extranet-eng/publications
Promotion > www.geology.cz/extranet-eng/geology-for-all
About us > www.geology.cz/extranet-eng/about-us

Thematic portals

Portal of Geohazards > www.geology.cz/geohazardy
Photo Archive > fotoarchiv.geology.cz
Slope Failures > www.geology.cz/svahovenestability
World of Geology – portal dedicated to the geosphere > www.svet-geologie.cz

Journals

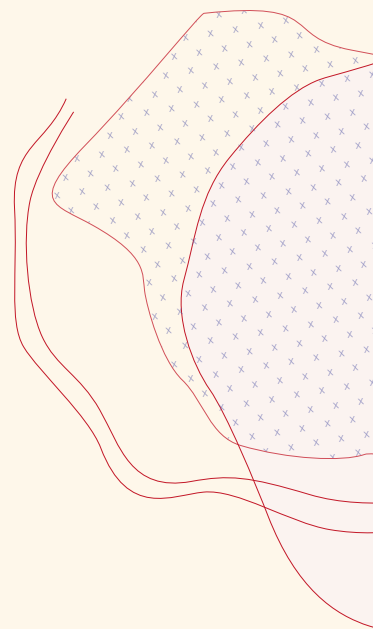
Bulletin of Geosciences > www.geology.cz/bulletin
Journal of Geological Sciences > www.geology.cz/sbornik
Special Papers > www.geology.cz/spec-papers
Geoscience Research Reports > www.geology.cz/zpravy

Web applications

Map Server > www.geology.cz/extranet-eng/maps
Geological Encyclopedia > www.geology.cz/encyklopedie
Dictionary of Geology E-C and C-E > www.geology.cz/slovník
Virtual Museum > muzeum.geology.cz
Geological Localities > lokalita.geology.cz
Interesting Geosites > mapy.geology.cz/geosites
Decorative Stones > dekoracni-kameny.geology.cz

Other web presentations

Online store > obchod.geology.cz
The CGS channel on YouTube > www.youtube.com/geologycz
Geology Olympiad > www.geologicka-olympiada.cz
Facebook – World of Geology > www.facebook.com/svetgeologie



Projects

Projects implemented in 2016

(as of 4th November 2016)

Abbreviations: **AS CR** – Academy of Sciences of the Czech Republic; **CDA** – Czech Development Agency; **MC** – Ministry of Culture; **MEYS** – Ministry of Education, Youth and Sports; **MFA** – Ministry of Foreign Affairs; **MIT** – Ministry of Industry and Trade; **MU** – Masaryk University; **MoA** – Ministry of Agriculture; **MoE** – Ministry of the Environment; **R&D** – Research & Development Council; **TACR** – Technology Agency of the Czech Republic

Other national programs

| | |
|--|--------------|
| • Innovation of farming systems in the Quaternary depositional setting, their control and application in the water resource management zones, QJ 1320213, cooperation with Crop Research Institute, v.v.i. (provider – Ministry of Agriculture), 2013–2017 | R. Kadlecová |
| • Competence Centre for Effective and Ecological Mining of Mineral Resources, TACR, 2014–2019 | M. Poňavič |
| • Investigation and risk assessment of slope instabilities along the lines of the main planned thoroughfares, TACR, ALFA Programme, TA04030824, 2014–2017 | J. Šikula |
| • Investigation of technological possibilities of rare element extraction in the Czech Republic with respect to minimizing environmental impacts and providing legislative background, TACR, BETA Programme, 1 st April 2015 – 30 th November 2016 | P. Rambousek |
| • Comparison criteria for classification of the reserved deposits of raw materials of the Czech Republic warranting compatibility with the internationally recognized standards "PERC and JORC", 1 st October 2015–31 st December 2016, a cooperation with GET, Co., provider TACR, Beta Programme | J. Godány |
| • Preparation of the book "Doupovské hory Mts." – special sponsorship by the town of Ostrov, 2016 | P. Fífera |
| • Preparation of the book "Doupovské hory Mts." – special sponsorship by the town of Klášterec n. Ohří, 2016 | P. Fífera |

Internal projects

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| • Projects drafting (time-sheet writing in all-type projects preparation) | not determined |
| • Corrections and amendments to project output after their termination, in course program (original number 320001) | not determined |
| • Decorative and building stones of the Czech Republic, in course program | B. Dudíková Schulmannová |
| • Special studies, methods of research, Ph.D. theses and dissertations, CGS, 2007, in course program | E. Břízová |
| • Printing of geological and applied maps | P. Hanžl |
| • Preparation of the journal Geological Research in Moravia and Silesia, CGS, in course program | D. Buriánek |
| • Editing of scientific publications, CGS, in course program | V. Janoušek |
| • Editing and preparation of the electronic version of the Bulletin of Geosciences, CGS, in course program | J. Frýda |
| • Editing and preparation of the printed version of the Bulletin of Geosciences, CGS, in course program | J. Frýda |
| • Register of Slope Failures, in course program | O. Krejčí |
| • Geological base mapping of CR at a scale of 1:25,000 for 2014–2018, CGS, (2013), 2014–2014 | D. Buriánek, J. Pertoldová |

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|---|-------------------------------------|
| • Železné hory Mts | S. Čech |
| • Novohradské hory Mts | B. Dudíková Schulmannová |
| • Šumava piedmont area | V. Žáček |
| • Bohemian Paradise II | L. Švábencová |
| • Brdy Mts | T. Vorel |
| • Central Moravia | P. Tomanová Petrová |
| • Methodology of isotopic composition measurement of light hydrocarbon inclusions in rocks, CGS, 2015–2016 | F. Bůžek |
| • Dating molybdenite from Trhové Sviny using Re-Os method with the aim of determining younger-age boundary of the Freistadt-type granodiorite, CGS, 2015–2016 | S. Vrána |
| • Moho depth model and lithospheric structures from GOCE gravity gradient data for the Central Asian Orogenic Belt, CGS, 2015–2016 | A. Guy |
| • High-pressure partial melting of lower-crust felsic rocks under the continental-subduction regime, CGS, 2015–2017 | P. Hasalová, R. Nahodilová |
| • Analog modeling of high-temperature orogens and of internal-structure development of folded sills in the collisional systems, CGS, 2015–2016 | P. Závada |
| • Volcanic systems III: genesis, evolution and rise of magma, fragmentation and sedimentation of volcanoclastic material, rift tectonics, CGS, 2015–2016 | V. Rappich |
| • Trace elements in quartz during the magmatic-hydrothermal development in the Krupka mining area in the Krušné Hory Mts, CGS, 2015–2016 | T. Jandová |
| • Geology of the Křivoklátsko Protected Landscape Area – a monographic description based on investigation conducted between 2002 and 2014, CGS, 2015–2016 | T. Vorel |
| • National Reference Center for Thematic Soil Research – cooperation with EEA (EIONET), CGS, 2016 | I. Dvořák |
| • Release of 1:50,000 soil maps – lay-out of digital maps produced by NCA CR according to the requirements for CGS map outputs, complemented by explanatory texts to maps and printing for the archive, CGS, 2016 | J. Janderková |
| • A complex investigation of geological environment in the Diamo Mines National Enterprise, Dolní Rožínka, CGS, 2015–2016 | J. Franěk, K. Verner |
| • Development of 3D geological models and related CGS databases production, CGS, 2016–2017 | J. Franěk, L. Kondrová |
| • Satellite imagery and aerial geophysical data based synoptic geological maps production and their utilization for crustal blocks interpretation in the Mongolian Altai area, CGS, 2016–2017 | P. Hanžl |
| • Research of Pleistocene lakes in the Třeboň area, CGS, 2016 | J. Hošek, M. Dostálík |
| • The character and origin of the Variscan orogenic peridotites in the Bohemian Massif, CGS, 2016 | V. Janoušek, V. Erban, J. Kočergina |
| • Examples of model areas in the East African Rift and in the Czech Republic, CGS, 2016 | J. Jelének |
| • Mineralogy, Geochemistry and Genesis of the Phosphate Mineralization in the Cenomanian–Turonian Sequence, Bohemian Cretaceous Basin, Czech Republic, CGS, 2016–2017 | Khalidoun S. Al-Bassam, P. Čech |
| • Crust- and- mantle interaction in a deep subduction zone environment, CGS, 2016–2017 | J. Kotková |
| • Preparation of professional publications from the Mongolian Altai area – making use of the so far unpublished data of the ZN-50 project and of the GACR grant No. P210/12/2205, CGS, 2016 | K. Schulmann |

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|---|-------------------|
| • Results of a seismic reflection profile in the East Bohemian Cretaceous | Z. Skácelová |
| • The position and tectonic evolution of the Bij Group unit (Hovd Zone, Mongolian Altai), CGS, 2016–2017 | I. Soejono |
| • Preparation of a monograph and map of the Krkonoše Piedmont Basin, CGS, 2016–2017 | M. Stárková |
| • Study of Carboniferous continental basins, CGS, 2016 | Z. Šimůnek |
| • Petrological investigation of new eclogite types from the northern margin of MLK using cool cathode-luminescence, CGS, 2016–2017 | V. Štědrá |
| • Stratigraphy, sedimentology and provenance study of the flysch Zuun Nuruu, Tsetseg and Sagsai formations (Hovd Zone, West Mongolia), CGS, 2016–2017 | P. Čáp |
| • Professional support of the national parks network of CR II, CGS, 2016–2017 | V. Štědrá |
| • Documenting hydrogeological phenomena and major water-supply sites at Tušimice Coal-mine (Libouš II – north quarry) and vicinity, CGS, completed 31 st December 2016 | P. Hrazdírka |
| • Characteristics of mineral paragenesis of the silver-bearing ore from Kongsberg deposit, Norway, and a comparison with the five-element formation in the Krušné hory Mts, CGS, 2015–2016 | J. Kotková |
| • Formation of corona-like and symplectic structures during eclogite metamorphism, CGS, 2015–2016 | T. Larikova |
| • Finalizing the outputs of the SoilTrEC project – isotopes, CGS, 2015–2016 | M. Novák |
| • Finalizing the outputs of the SoilTrEC project – monitoring/modeling, CGS, 2015–2016 | P. Krám |
| • Introduction of the isotopic dilution method of Sm and Nd for isotopic geochemistry purposes, CGS, 2015–2016 | J. Kočergina |
| • Determining zinc isotope ratio in selected small catchment areas of the GEOMON network, CGS, 2015–2016 | will be appointed |
| • Processing of data and finalizing of publications: (a) High-moors-based study of historic mining and ore dressing in the Krušné hory Mts, (b) Atmospheric deposition of cadmium in the Czech Republic: comparison of soluble and insoluble fractions in icings and in snow at changing pollution levels, CGS, 2015–2016 (INTERRUPTED) | L. Bohdálková |
| • Deleterious elements in soils of the Doupovské hory Mts, CGS, 2015–2016 | T. Sidorinová |
| • Study of mechanisms of global crises in the geological past, CGS, 2015–2016 | J. Frýda |
| • Palaeontology and sedimentology of the James Ross Basin, CGS, 2015–2016 | R. Vodrážka |
| • In-situ measurement of trace element concentrations and isotopic ratios of Sr and Nd by means of the (MC) ICP-MS laser ablation in apatite, CGS, 2015–2016 | J. Míková |
| • Review of Groundwater Resources – finalizing the project, CGS, 2015–2016 | P. Mixa |
| • Modelling of selected catchment areas of the GEOMON based on isotope analyses, creation of discharge and soil layer as a mineralization source, CGS, 2016–2017 | F. Bůzek |
| • Development of methods of phase analysis by means of X-ray powder diffraction (methodical project), CGS, 2016 | F. Laufek |
| • Development of a new type of heavy-mineral preparations and setting-up selected sedimentary formations standards for the Czech Republic, CGS, 2016–2017 | J. Otava |
| • Reinterpretation of properties and genesis of mineral waters and fossil salt brines of the Bohemian Massif and the Carpathian Foredeep using new isotope determination methods, CGS, 2016–2017 | T. Pačes |
| • Long-term monitoring of small forest catchment areas GEOMON | F. Oulehle |

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| • Development of the CGS www information portal, in course program | R. Svítíl |
| • Data sources and the CGS meta-information system, in course program | J. Sedláček |
| • Administration and development of the digital archive of the CGS, CGS, in course program | J. Sedláček |
| • Development and administration of the National Geologic Map Database of the Czech Republic, CGS, in course program | Z. Krejčí |
| • Implementation of the European INSPIRE Directive in the CGS, in course program | L. Kondrová |
| • Enhancement of the ICT infrastructure of the CGS, CGS, in course program | R. Binko |
| • Facilitating access to collections and material documentation – Phase II | P. Čoupek |
| • Record-keeping system, protection and popularization of geological sites of CR, CGS, in course program | M. Vajskebrová |
| • Upgrade of the CGS Map Server, CGS, in course program | M. Paleček/ V. Pospíšil |
| • Administration, maintenance and development of the PMCR50 geo-database in relation with the compilation of new soil maps and their safekeeping, printing and presentation, CGS, in course program | J. Sedláček |
| • Finalizing implementation of data from the vertical geo-electric sounding to central databases from the new CGS measurements, CGS, 2016 | E. Hudečková |
| • Materials and documents depository – Jeseník, CGS, 2015–2016 | J. Večeřa |
| • Database of open-cast mining sites, CGS, 2015–2016 | J. Večeřa |
| • Completion of sub-tasks of the “Draft-concept of further development of materials collections of the CGS” – re-discard and redepositing of find-site palae-ontological collections and safekeeping of J. Sekyra's sample collections at Lužná u Rakovníka, phase II, CGS, 2016–2017 | P. Budil, E. Kadlecová, A. Čejchanová |
| • ArcGis Platform Online within the CGS, CGS, 2016 | R. Kujal |
| • Documents registry implementation in the CGS | H. Breiterová |
| • Activity of the CGS strategic research plan coordinators, in course program | J. Pašava |
| • Activity of the project-review board and the Geoscience Research Reports editorial board, in course program | P. Mixa |
| • Updating of the registry and the state-of-the-art of usage of non-reserved mineral, Hor (MIT) 1-01 for updating (3 rd part, 4 th part MIT, SURIS– modernization and implementation of upgraded data into the database application structure), i.e. the pilot s-meta-info Register, CGS, 2016 | K. Rýda |
| • Revision of mining-influence areas and of old mine-working charts based on new acquisitions of digital map documents as backgrounds for old mine workings investigation and for consolidation of data about abandoned exploratory mine workings, CGS, 2016 | A. Horáková |
| • Development of a technical, database-related and applicable infrastructure for efficient formation, easy access and safekeeping of information in the register of old mine workings and acquisition of data for old mine workings and documents investigation, CGS, 2016 | D. Čápková |
| • Processing and evaluation of final reports from the Mineral Deposit Fund (FZ) at Kutná Hora workplace as a tool for old mine workings investigation – phase III, CGS, 2016 | J. Šanderová |
| • Evaluation and processing of map documents deposited in national archives of the Czech Republic as a background for old workings investigation, phase 2016, CGS, 2016 | J. Šanderová |
| • Revision of safekeeping measures for old mine workings and abandoned exploratory mine workings, CGS, 2016 | P. Šír |

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| • The OUM registry – updating of data for selected abandoned depositories left after historical minerals mining – phase 2016, CGS, 2016 | V. Štrupl |
| • First-hand investigation of reported old mine-working manifestations in 2016, CGS, 2016 | V. Štrupl |
| • Mineral Commodity Summaries of the Czech Republic: Czech & English publication for 2015 (printed version plus CD), CGS, 2016 | J. Starý |
| • Spatial variations of radon and dosing input at tectonic structures, CGS, 2016 | I. Barnet |
| • Updating the 1:50,000 scale soil map production, compilation of map sheets of cross-border areas of Krušné hory Mts, CGS, 2016 | J. Janderková |
| • Activities related to updating of geo-factors knowledge in the databases and maps (phase 2016) from the following areas: slope instability prone areas – Frýšták, Frýdek-Místek and Třinec areas – (beginning of line constructions) – R. Novotný & J. Šíkula suffosion-affected area Vyškov, weathering, erosion – A. Petrová & J. Janderková upgrading the slope instabilities register, www.geology.cz – O. Krejčí | R. Novotný |
| • In-course geological documentation of important line constructions (R6, D3, D11), continuation of D4, Dubenec, D8-Řehlovice. Phase 2016, CGS, 2016 | V. Rapprich |
| • The Bohemian Paradise Geopark – finalizing the thematic maps for the Geo-park and completion of the geologic-setting reconnaissance in the southern–southwestern part of the Geopark at Příšovice, until 30 th November 2016, CGS, 2016 | L. Švábenická |
| • Mineral deposits information system (LIS) – ore-deposit files, files of exploration areas from the OG archives including written agenda and creation of information system, CGS, 2016 | J. Mojžíš |
| • Advisory and expert services provided for the geology department, CGS, 2016 | J. Čurda |
| • An inter-active map of OG reports in 2004–2014, CGS, 2016 | H. Skarková |
| • Development and application of a shallow multi-cable geophysical method for documenting landslides, cavities, thickness of the Quaternary and hidden geologic bodies, phase 2016 (Trosky, Moravian Karst), CGS, 2016 | M. Dostálík |
| • Delimiting and defining the Žerotín Graben in the Znojmo area, appraisal of its perspectives in terms of groundwater resources, and re-interpreting geophysical data, CGS, 2016 | O. Krejčí |
| • Geological map of the Brdy Protected Landscape Area – mapping at scale 1:25 000 – up-dating of the geological map of the CR at 1:50 000 scale) – applied maps, | T. Vorel |
| • Upgrading hydrogeological ground data for the Železné hory geopark, CGS, 2016 | S. Čech |
| • Support – Inventory of landslides from the OPZP (P01) and specific task SC1.3. Carrying out flood protection of urban area, activity A.1.3.4 – Stabilizing and remedying slope instabilities presenting danger to health, property and safety as stipulated in “The slope-instability inventory”), CGS, 2016 | J. Čurda |
| • Utilizing new-generation distance data in geological applications, CGS, 2016 | V. Kopačková |
| • Revitalization of selected parts of geological documentation in custody of the CGS Geofond archives, CGS, 2016 | M. Hrdlovicsová |
| • Kamenná II – re-locating sample materials from old boreholes into the standard storage system of the CGS Geofond Division, CGS, 2016 | A. Donát |
| • Incorporation of the professional-library fund at Kutná Hora workplace into the CLAVIUS filing system within the CGS, CGS, 2016 | J. Šanderová |
| • Detailed geological and geomorphological background data for the study of water retention in the landscape, CGS, 2016 | I. Dvořák |
| • A methodical approach-based new ranking and cataloguing of slope instabilities, principles of landslide-prone area treatment and determination of relative-stability degree of rock-built objects, CGS, 2016 | J. Malík |

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| • Interactive map of CGS advisory and expert-service reports of the Geofond (600) Division in 2000–2016, phase I | Z. Petáková |
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Projects – exerting the duty of national geological service

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|---|------------|
| • Geological setting as a factor determining land-use and development of the Czech Republic's territory (advisory and expert service), in course program | J. Čurda |
| • Geological supervision of remedying the Dobkovičky (D8) landslide, CGS, in course program | P. Kycl |
| • Assessment of the movement activity on the northeast slope of Pavlovské vrchy hills and a draft of effective measures for eliminating imminent danger in the environment of Dolní Věstonice | R. Novotný |
| • Exerting the duty of national geological service off the approved projects – Geological Division, in course program | P. Mixa |
| • Exerting the duty of national geological service off the approved projects – Geofond Division, in course program | V. Štrupl |
| • Laboratory instruments maintenance fund | Z. Venera |

The Czech Science Foundation (GACR)

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| • GACR P210/12/2018: Multidisciplinary approach to assessment of the biotic crises of the Middle Palaeozoic – Devonian Daleje and Kačák bioevents (Prague Basin, Czech Republic), 2012–2016 | S. Vodrážková |
| • GACR 13-163155 (Panel 210): Prograde metamorphism, crust thickening and low-crust flow: a new concept of building the Variscan orogen root, 2013–2016 | P. Štípská |
| • GACR 13-223515 (Panel 210): Use of non-traditional and traditional isotope systems in identifying source materials and the moldavite genesis process, 2013–2016 | T. Magna |
| • GACR 14-333115 (Panel P504): The balance of organic matter in soil and the nitrogen saturation concept – combined influence of the acidity and nutrient level in forest soils 2014–2016 | F. Oulehle |
| • GACR 14-259955 (panel P210): A new aspect of granite diversity with respect to the process of the melt migration between the source and the pluton, 2014–2016 | P. Hasalová |
| • GACR 14-31662P (Panel P210): Sponges in ancient marine ecosystems and their significance in the environmental change assessment: examples from the Cretaceous in the Czech Republic and Antarctica, 2014–2016 | R. Vodrážka |
| • GACR 14-21568P (Panel 210): Isotope-aided cadmium tracing in industry-polluted areas, Czech Science Foundation, 2014–2016 | E. Čadková |
| • GACR 15-213735 (Panel 503) 2014–2016 Isotopic mass balance of chrome-contaminated localities according to the $^{53}\text{Cr}/^{52}\text{Cr}$ frequency ratio of solid and liquid samples, 2015–2017 | M. Novák |
| • GACR 15-11674S (Panel 210): Mobilization model and geochemical cycles of potentially hazardous elements and organic materials in the burnt-up coal pit heaps, 2015–2017 | B. Kříbek |
| • GACR 15-05988S (Panel P210): The Rodinia break-up record (~ 800–750 Ma) in orogenic belts of southwestern Africa and southeastern South America, 2015–2017 | J. Konopásek |
| • GACR 15-08583S (Panel 210): The role of carbonatites for balancing HFSE HSE elements in the Earth Mantle – a combined approach by means of stable and radiogenic isotopes, 2015–2017 | T. Magna |

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| <ul style="list-style-type: none"> GACR 15-13525Y (Panel P210): Study of Lower Paleozoic polychaetes and the impact of environment changes on marine benthic ecosystems, 2015–2017 | P. Tonarová |
| <ul style="list-style-type: none"> GACR 16-18079S (Panel P504): Isotope evidence of microbial nitrogen fixing in the ombrotrophic wetlands, 1st January 2016–31st December 2018 | M. Novák |
| <ul style="list-style-type: none"> GACR 16-17457S (Panel P210): Melting of metagranitic rocks: an important, but little understood aspect of continental-crust evolution, 1st January 2016–31st December 2018 | P. Štípská |

Projects for the MoE and other Ministries

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|---|--------------|
| <ul style="list-style-type: none"> National centre for the effects – implementation of the Czech Republic's commitment to the international agreement on long-distance transport of contaminants, 000 MoE, 2006–2014 | I. Škořepová |
| <ul style="list-style-type: none"> Turów, MoE, 2016–2044 | R. Kadlecová |

Co-partnership in GACR projects

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|--|-----------|
| <ul style="list-style-type: none"> GACR 13-15390S (Panel P210): Re-Os geochronology of ore mineralizations in the Bohemian Massif and consequences for their metallogeny, cooperation for the Geological Institute of AS CR, v.v.i., 2013–2016 | J. Pašava |
| <ul style="list-style-type: none"> GACR 14-16124S: Updating the chronostratigraphy of the Lower Silurian: a proposal for new international stratotypes (GSSP) of the Aeronian and Homerian stages, cooperation with the Geological Institute of the AS CR, 2014–2016 | Š. Manda |
| <ul style="list-style-type: none"> GACR 15-13310S: Cr-isotope aided tracing of continental weathering in the Middle Paleozoic, cooperation with the Czech University of Life Sciences in Prague, 2015–2017 | J. Farkaš |
| <ul style="list-style-type: none"> GACR 16-11563S (Panel P210): The earliest Carboniferous greenhouse-icehouse climate oscillation – a multidisciplinary approach, cooperation with Masaryk University, Brno, 2016–2018 | J. Frýda |
| <ul style="list-style-type: none"> GACR 16-09979S (Panel P210): An integrated multidisciplinary study of the Jurassic-Cretaceous boundary in marine sequences: a contribution for the global boundary definition, cooperation with the Geological Institute of the AS CR, v.v.i., 2016–2018 | M. Bubík |
| <ul style="list-style-type: none"> GACR 16-13142S (Panel P210): Mining and processing of the Cu, Pb, Zn and Co ores in the Sub-Saharan Africa – a natural geochemical laboratory for the pollutant behavior study, cooperation with the Faculty of Science, Charles University Prague, 1st January–31st December 2018 | B. Kříbek |

International grants and MEYS

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| <ul style="list-style-type: none"> LK 11202: The role of Palaeozoic accretion and collisional orogens in the formation and growth of continental crust (ROPAKO), MEYS – Programme NÁVRAT, 2012–2016 | K. Schulmann |
| <ul style="list-style-type: none"> SLAvONIC – Effects of soil alteration on nitrogen and carbon cycling, FP 7-PEOPLE-2013-CIG, 1st August 2013–31st July 2017 | F. Oulehle |
| <ul style="list-style-type: none"> Horizon 2020: Base-Line Earth (Brachiopods As Sensitive tracers of gLobal marlNe Environment: Insights from alkaline, alkaline Earth metal, and metalloid trace element ratios and isotope systems), EU, 2015–2018 | T. Magna |
| <ul style="list-style-type: none"> Horizon 2020: ProSUM (Prospecting Secondary raw materials in the Urban mine and Mining waste), EU, 1st January 2015 – 31st December 2017 | D. Čápková |
| <ul style="list-style-type: none"> EHP-CZ02-OV-1-048-2014: Monitoring of small forested catchments GEOMON – effective research tool for strategic policy decisions in the environment issues, FM EHP. XII2014–IV/2016 | J. Hruška |

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| <ul style="list-style-type: none"> EHP-CZ02-0V-1-2014: The present-day degree of damage to forest and water ecosystems on territory of EVL Krkonoše and harmonizing the basic monitoring network for investigation of their evolution as a necessary background for management measures to enhance their stability and biodiversity, cooperation with the KRNAP (Krkonoše National Park), 2015–2016 | J. Hruška |
| <ul style="list-style-type: none"> Preparation of a research pilot project on CO₂ geological storage in the Czech Republic (REPP-CO2), Norwegian Funds 2009–2014, 23rd January 2015–30th April 2016 | V. Hladík |
| <ul style="list-style-type: none"> M4ShaleGas: Measuring, monitoring, mitigating managing the environmental impact of shale gas (M4ShaleGas), H2020 EC, 1st June 2015– 1st December 2017 | J. Franců |
| <ul style="list-style-type: none"> ArchaeoMontan 2018, cooperation with the Free State of Saxony 2014–2020, funded by EU and CR, 2015–2018 | P. Bohdálék |
| <ul style="list-style-type: none"> Research RINGEN, infrastructure, MEYS, 2016–2019 | J. Holeček |
| <ul style="list-style-type: none"> LM2015079: Distributed system of observational and field measurements of geophysical fields (CzechGeo/EPOS), 1st January – 31st December, MEYS (consortium Geophysical institute of the AS CR, v.v.i., Masaryk University Brno, Charles University Prague, Institute of Geonics AS CR, v.v.i., Institute of Rock Structure and Mechanics AS CR, v.v.i., Research Institute of Geodesy, Topography and Cartography, v.v.i.) | D. Čápková |
| <ul style="list-style-type: none"> LM 201575: National SoWa (Soil and Water) infrastructure for a complex monitoring of soil and water ecosystems in the context of a sustainable landscape use, 1st January 2016–31st December 2019, MEYS (consortium Biological centre of AS CR, v.v.i., University of South Bohemia in České Budějovice, Charles University, Prague, Czech Geological Survey) | J. Hruška |
| <ul style="list-style-type: none"> NF-CZ08-BFB-1-020-01-2016 – REPP-CO2 – intensifying cooperation, Norwegian funds, 14th April 2016–30th April 2017 | V. Hladík |
| <ul style="list-style-type: none"> 8G15004, Czech-Israeli cooperation, a novel approach for modeling soil degradation using super-spectral orbital data, 1st June 2016–31st May 2018 | V. Kopačková |
| <ul style="list-style-type: none"> Strategy for the use of shallow geothermal energy in Central Europe: planning, assessment and mapping, (Geoplasma), Interreg Central Europe, 1st July 2016–30th June 2019 | J. Holeček |
| <ul style="list-style-type: none"> Possibilities of land-based CO₂ storage in Europe, European Commission, Innovation and Networks Executive Agency, 653718 — ENOS — H2020-L-CE-2014-2015/H2020-LCE-2015-1, 1st September 2016 – 31st August 2020 | V. Hladík |
| <ul style="list-style-type: none"> RESIBIL – Water-Resources balancing in the eastern part of the Czech-Saxon border area and assessment of their sustainable use, Cooperation program between the Czech Republic and the Free State of Saxony 2014–2020, 13th January 2016–30th June 2019 | Š. Mrázová |

International development cooperation projects

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| <ul style="list-style-type: none"> Geological mapping at 1:50,000 scale and assessment of selected area's economic potential in Western Mongolia, MFA, 2013–2016 | V. Žáček |
| <ul style="list-style-type: none"> Landslide susceptibility assessment in rugged terrains of Georgia using examples of endangered settlements, international road and powerlines in the Dusheti municipality, MFA (CRA), 2014–2016 | A. Havlín |
| <ul style="list-style-type: none"> Study of natural phenomena deleterious to agricultural production in selected zones of the SNNPR (Southern Nations, Nationalities and People's region, Ethiopia, CRA, 2015–2017 | K. Verner |

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