95 ANNIVERSARY

CZECH GEOLOGICAL SURVEY

Annual Report **2013**

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From the left: **Vít Štrupl** – Head of the Geofond Division, **Dana Čápová** – Deputy Director for Informatics, **Oldřich Krejčí** – Director of the Brno Branch, **Zdeněk Venera** – Director of the Czech Geological Survey, **Jan Pašava** – Deputy Director for Research and Head of the Geochemical Division and Central Laboratories, **Petr Mixa** – Deputy Director for Geology, **Zdeněk Cilc** – Deputy Director for Economics.

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.

Director's Introduction

In 2014, just when you are getting this Annual Report on hand, the Czech Geological Survey has been celebrating the 95th anniversary of its establishment. Then, in 1919, it came into being under the name *State Geological Institute of the Czechoslovak Republic*. The importance ascribed to it by its founders is best revealed by the fact that it originated shortly after the birth of the Czechoslovak state as one of the first governmental and scientific bodies. The mission it was entrusted with is still carried on. It derives from the experience of all civilized nations that acknowledge the necessity of a systematic study of geological setting of their territory as well as the need for a state-founded institution that will publish impartial professional reports and expert advice assessments related to the environmental matters and industrial development.

At present, the Czech Geological Survey has been established following a decree of its superseding agency, which is the Ministry of the Environment (MoE), and fulfils two fundamental missions: as one of the MoE´s institutions provides a geological service for the government and public administration, private sector and general public. The concurrent mission is geoscientific research, with a perspective that the synergy of those two spheres warrants a high level professional support for the state and public sector, thus distinguishing the state geological survey from the academia. The CGS provides core geoscientific information for the Czech state, facilitating decision-making in the matters of natural resources, geohazards and sustainable development and strives to strengthen its position as a leading geoscientific research institution of the Czech Republic.

In the course of the 21st century, geosciences have developed into a real interdisciplinary field taking advantage of cooperating with other scientific branches including biology, material science, information and social science. Complex information processing and an effective advice service in the matters of geosciences continue to contribute to the solution of crucial and indeed life-important questions of our society.

After the successful completion of the Operational Programme MZP0002579801 *Geoscience for the 21st century society: From the regional-based investigations through the geohazards all the way to the global changes*, carried out from 2005 through 2010 (extended to 2011) and in relation to the changing national and global priorities, the Czech Geological Survey has adapted and upgraded strategic trends of its development which resulted in the approval of the Strategic Research Plan for 2012–2015.

The following priority topics are being dealt within this Plan:

1. Complex regional and deep investigation of the lithosphere.
2. Research into global changes in the geological past and the development of biodiversity.
3. Analysis of vulnerability of the landscape to natural and anthropogenic processes.
4. Research and evaluation of state of groundwater resources (amounts, limits, quality).
5. Research on mineral resources and the influence of mining and processing on the environment.
6. Research on environmental and geo-energetic technologies.
7. Building of an integrated geoscience information system.

The Czech Geological Survey is increasingly productive in the field of scientific research. According to the last evaluation conducted by the Research, Development and Innovation Council, the CGS is the most successful scientific body among the MoE´s institutions, and ranks 22nd among all the evaluated Czech scientific bodies, ahead of a number of Academy of Science CR institutes as well as universities.

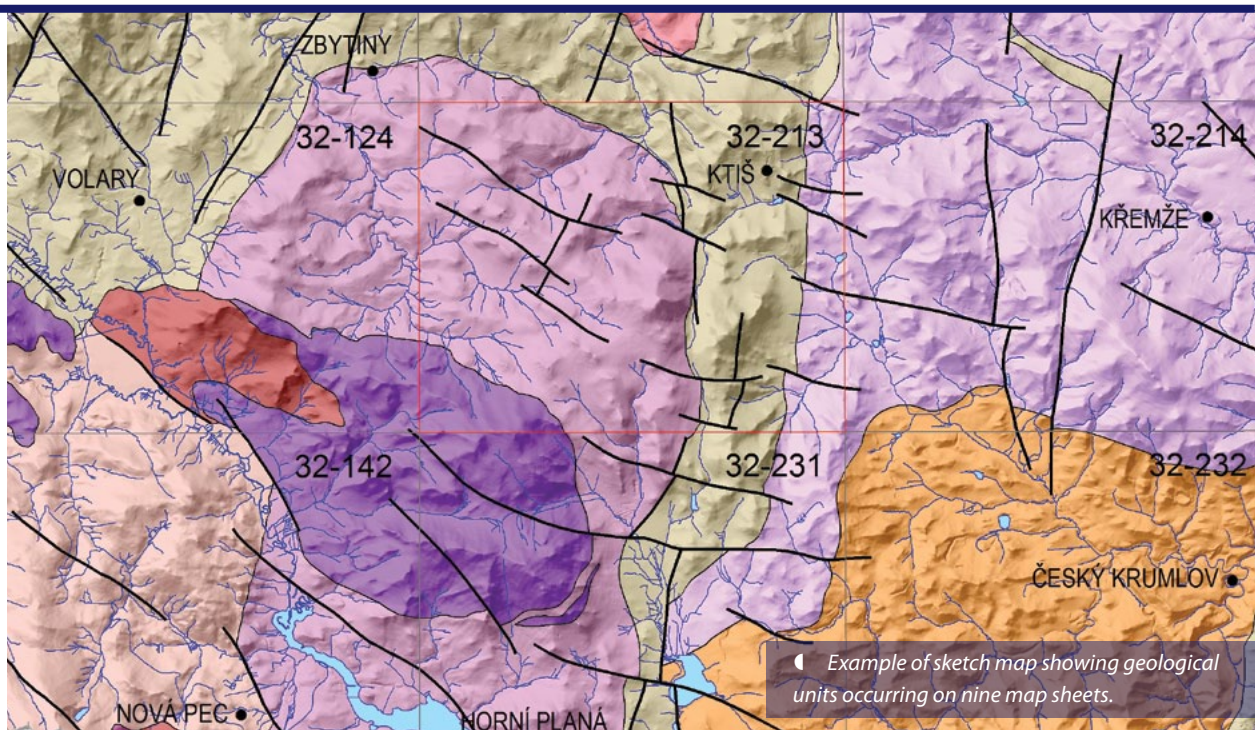
In addition to research results, the number of expert reports produced by staff of the Regional Geological Administration of the CGS has been growing steadily. They tackle the requirements of the public and local sector administration for advice in applied geology. The CGS played an important role in managing the landslides triggered by torrential rains at the turn of May–June 2013. The most notable event from this period was the large landslide at Dobkovičky in the České středohoří Mts that damaged the unfinished D8-Highway connecting Prague with Germany. The cost of stabilizing the landslide and rebuilding the damaged highway has been estimated to be hundreds of millions of CZK. The CGS provided a professional advice report for the Czech Government on that landslide and as a result, the Government has issued decree No. 640/2013 entrusting the Czech Geological Survey with an expert supervision over exploration, monitoring and stabilizing works, together with the selection of suitable methods and overseeing of the operation. This example clearly shows that a rational management of public matters requires decision-making to be supported at all levels by an impartial and professionally well-qualified expertise, which the Czech Geological Survey is able to provide.

Zdeněk Venera

Jaroslava Pertoldová

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

Geological and Thematic Maps



Example of sketch map showing geological units occurring on nine map sheets.

Geological maps provide comprehensive information on the geological structure of the territory of the Czech Republic. They are used in environmental protection, assessment of geohazards including the impacts of floods, mineral deposit exploration, evaluation of groundwater resources and strategic or land-use planning.

Geological mapping

The year 2013 saw a significant enhancement in the mapping techniques thanks to an advanced methodology in data processing and presentation. Mapping has been one of the principal activities of the CGS since its foundation and the advancement in research methodology has brought about a significant progress in the output quality. Considerable improvements have been made in the storage of rock, soil and water samples as well as in the archiving of all new data. The information is stored in an upgraded system of databases that permits their verification and future use. Map sheets are compiled and published according to a unified and progressively updated regional legend which enables smooth harmonization between adjacent map sheets.

Contribution to the economy and environment

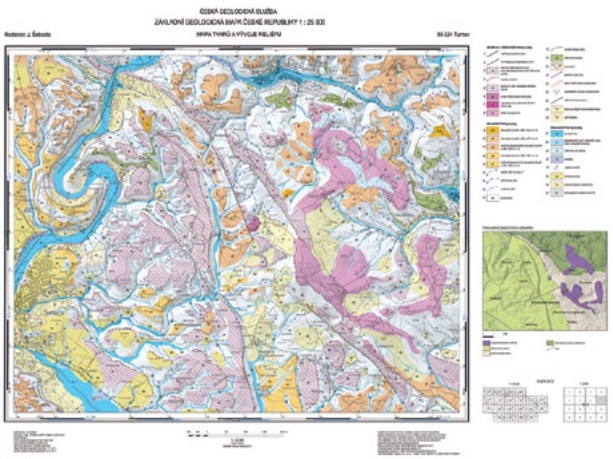
Each map and the accompanying explanatory notes serve as a primary data source for local and national government bodies and include a comprehensive chapter dedicated to environmental geofactors. One of the top priorities is the adjustment of land-use planning requirements to the conventional and newly identified geofactors. These include groundwater resources, soil evolution, influence of bedrock on the chemistry of the environment, anthropogenic contamination extent and possible conflicts of interest.

The new geological maps also provide background data for assessing the potential of the rock environment for CO_2 storage, dangerous waste disposal and geothermal energy exploitation.

They are therefore of primary interest to both private and governmental sector.

Detailed maps at 1:25,000 scale

Detailed geological maps of the Czech Republic at a scale of 1:25,000 are compiled in accordance with a new procedure and consist of three main parts. The fundamental components are geological map together with a legend and separate graphic appendices. They are accompanied by explanatory notes comprehensively describing the individual items in the legend and special chapters dedicated to geoscientific aspects. Linked to these two parts is the third part, which is a database and relevant thematic maps, both accessible online. During mapping, information on the rock environment is entered into the National Geological Mapping Database and the local open server *www.geology.cz* is continuously upgraded.



Example of a thematic layer associated with a geological map (exodynamic map – sheet Turnov).

Mapped areas

In 2013, mapping was carried out in eight areas: Krkonoše Mts, the Šumava Mts National Park and Protected Area, Brno Region, Moravian Karst Protected Area, Doupovské hory Mts, Čistá-Jesenice Massif, Křivoklát Protected Area and the Central Moldanubian Batholith. In addition to geological maps with explanatory notes and associated data layers, other map types have been produced. They include maps of mineral deposits, maps of environmental geofactors and geomorphological maps. Completed sets of map sheets Horní Planá and Ktiš na Šumavě, Valeč and Bochov in the Doupovské hory Mts, or Hejnice and Jizerka in the Krkonoše-Jizera area may serve as examples.

Derived maps

In 2013, the successful project *Maps of decorative stones of the Czech Republic* continued with focus on the South Bohemian section. All the geological maps covering the area of the Czech Republic at 1:50,000 and 1:200,000 scales have been harmonized and completed and are now freely available on our map server at *www.geology.cz/extranet/mapy*. Maps at 1:50,000 and 1:25,000 scales form part of an integrated geoinformatic system with special database applications, such as the database of important geological localities, slope failures, decorative stones or radon risk maps.

Follow up research and presentation of results

Cooperation with the newly established Železné hory National Geopark has largely contributed to the CGS database extension and to the increase of scientific potential of the geopark. Based on the cooperation, a new project for regional geological mapping of that area has been prepared. New findings have been published, describing, for instance, hitherto unknown hyperalkaline granite body on the Kleť Ridge in the Blanský les Massif, contrasting metamorphic development of the mafic and felsic granulites in the Blanský les, hornfelsed graphitic gneiss in the Knížecí durbachite pluton domain and occurrence of a petalite-spodumen pegmatite near Rožmberk nad Vltavou. New information on the extent and geological structure of the Žatec part of the Kladno-Rakovník Basin has been acquired. New economic geological indications and occurrence of kaolin clays and bentonite have been discovered shortly before the end of the field survey in the 11-241 Bochov sheet area. The *Guide to the Geology of the Šumava Mountains*, an English version of the *Průvodce geologií Šumavy*, has been published. Results of mapping of the Doupovské hory Mts have been included into the scientific publication of *Nature and Landscape of the Doupovské Hory Mts* in press. In 2013, five map sheets with explanatory notes and exodynamic maps describing the relief character from the Bohemian Paradise UNESCO Geopark (map sheets Turnov, Semily, Kněžmost, Rovensko pod Troskami and Lomnice nad Popelkou) were printed within the Geological Base Map of the Czech Republic edition.

Lilian Švábenická
Head of the Department of Sedimentary Formations

Jaroslava Pertoldová
Head of the Department of Regional Geology of Crystalline Complexes

Regional Geological Research

Pustý zámek, view from the south – remains of eroded caldera of the main volcano of the Doupovské hory Mts (photo by P. Maděra).

During 2013, geological investigations of the basement of the Bohemian Massif and Western Carpathians encompassed geotectonics, petrology, geochronology, sedimentology and basin analysis, litho- and biostratigraphy and volcanology. Attention was given to correlating the evidence for significant global changes in geological processes during the history of the Earth. Applied geology also formed an important aspect of regional studies, in particular the mechanics and rheology of the rock environment and their changes under different regimes of stress and thermal loading. Significant advances in regional research and in the understanding of the geological evolution of Central Europe have stemmed from the knowledge obtained through fieldwork, especially by basic and detailed geological mapping.

Metamorphic rocks

Structural mapping in the area of the Šumava Mts and of medium-sized granitic bodies in the SE part of the Bohemian Massif involved collection of petrological, geochemical and geochronological samples in order to date the pre-Variscan and Variscan events in the geological evolution of the massif using laser ablation ICP-MS analysis.

A new hyperpotassic granulite body on the Kleť Ridge and the main phases of the metamorphic development of granulites in the Blanský les Massif have also recently been described. In 2013, structural investigations aimed at the compilation of an integrated tectonic map of the Šumava area were carried out and the English version of the *Guide to the Geology of the Šumava Mountains* was published. The petrological and geochronological factors governing the formation of the Běstvina granulite were studied. The results were interpreted in terms of a model of subduction and exhumation of the lower continental crust between 360 and 340 Ma. A study of detrital zircons from

the metasediments of the Monotonous and Varied units of the Moldanubian Zone provided new evidence for the pre-collision evolution of the Bohemian Massif. A petrological study of granulites enabled evaluation of the influence of rheology on the final microstructure of the rock. During the investigation of the upper crustal composition in the area of the Doupovské hory Mts and East Bohemia, two independent *in situ* geophysical methods were applied: field gamma spectrometry and magnetometry. By this means, the position of the NE boundary of the Mariánské Lázně Complex was successfully defined and, in addition, new information about the geological structure of the Žatec part of the Kladno-Rakovník Basin was acquired. The results of mapping in the Doupovské hory Mts were summarized in a popular scientific book *Příroda a krajina Doupovských hor* (*Nature and Landscape of the Doupovské Hory Mts*) published jointly by the Regional Museum in Karlovy Vary and the CGS. During their study of pyrometamorphic rocks of the Most Basin, Žáček *et al*. (2013a) described a new type of Ca-rich graftonite $(Fe^{2+},Mn,Ca)_3(PO_4)_2$ discovered in olivine buchite.

Igneous rocks

In terms of their volume, igneous rocks form an important part of the geological composition of the Czech Republic. Their abundance and variability are remarkable in comparison with most other parts of Europe. An essential theme in investigations of the geotectonic evolution of large crustal blocks involves interpretation of the factors governing the emplacement and structural evolution of magmatic complexes, batholiths and individual intrusions. During 2013, research was focused on the Krkonoše-Jizera Pluton, the geodynamic evolution of the eastern part of the Moldanubian Batholith based on detailed AMS and gravimetric analysis, and on the petrology and geochronology of the Klenov Pluton. Detailed geological mapping of a number of bodies of the Fojtka granodiorite in the western part of the Krkonoše-Jizera Massif was completed. A further stage of structural analysis in selected Variscan granitic bodies of the Teplá-Barrandian Unit, Brno Massif and Moldanubian Unit was carried out in order to define orientation and character of their internal structure, the mechanisms governing their emplacement and the wider implications of their geodynamic evolution.

Volcanic rocks

The Czech Geological Survey, in cooperation with the Institute of Rock Structure and Mechanics of the AS CR, v.v.i., and the Highland University of New Mexico, undertook a study of the mechanism of ascent of basanite magma into Cenozoic supracrustal volcanic rocks, particularly under the very shallow conditions in the environment of a pyroclastic cone. Zebín near Jičín was chosen as the model locality. The geochemical evolution of magmas in the series trachybasalt-basaltic trachyandesite-trachyandesite-phonolite on the southern flank of the Doupovské hory Mts was also studied.

Sedimentary formations

In order to determine the geometry and stratigraphy of the volcanosedimentary fill of the Permo-Carboniferous Krkonoše Piedmont Basin, a 3D model of the basement and of the surface of the Permo-Carboniferous sequence underlying the Cretaceous sequence was created using all the available information from boreholes and geophysical survey. In cooperation with the Institute of Geophysics of the AS CR, v.v.i., a full investigation of the reference borehole Bch-1 Běchary in the Bohemian Cretaceous Basin has been completed. This borehole reached a depth of 403 m and penetrated the clayey sediments of the basin. Identification of inoceramid macrofauna and calcareous nannofossils in the borehole provided stratigraphic markers for the interpretations of marine deposits in the interval from the Upper Cenomanian to the Middle Coniacian. The results of the macro- and micro-palaeontological investigation were correlated with geophysical data, chemostratigraphy, lithofacies and biofacies. By means of this multidisciplinary approach, it was possible to compare the stratigraphy of the Bch-1 borehole with clastic sequences in the delta system of the Bohemian Paradise and then with other selected sections of the Turonian-Coniacian sequence in Europe (e.g. the Salzgitter-Salder stratotype in Lower Saxony). The unique correlation between macrobiostratigraphy/event stratigraphy and sequence stratigraphy has been achieved. It enabled determination of the Turonian-Coniacian boundary in sand bodies of the delta system and more precise isotopic dating of events from complete sedimentary sequences in other sections in Western Europe. Palynological analysis of the sediments of a former man-made lake situated in the area of Bochov, Western Bohemia, was completed in 2013. This enhances stratigraphic interpretation of the Quaternary cover and contributed to reconstruction of the changes in the palaeoclimate and landscape since the 17th century.

Modelling of geosystems

Under the terms of the project *Research on thermally loaded rocks – prospects for underground storage of thermal energy* (2011–2014, MPO/FR) for the Ministry of Industry and Trade, 3D structural-geological mapping in the Josef Gallery near Mokrsko is continuing. In 2013, the Czech Geological Survey, in cooperation with four other contracted institutions, carried out laboratory measurements and experiments, geotechnical investigations and fieldwork at Mokrsko. The fieldwork involved monitoring conditions at the experimental site, maintenance and minor adjustments of the instrumentation, research at the surface reference locality, water pressure tests, measurements of geomechanical, thermodynamic and hydrodynamic parameters and of the hydrogeological conditions on the site. The development of a material which would enable maximum transfer of heat into the rock massif and its subsequent recovery continued. An application for a patent on the optimum composition was submitted in 2013. This material consists of a geopolymer modified by the addition of substances with high thermal conductivity.

Based on the assessment of a refined network of wells in the Cenomanian, the basement of the A aquifer in the Děčín area was modelled for the purpose of the *Review of Groundwater Resources* project. During gravity measurements in the east Bohemian Cretaceous, a gravity profile through the SE part of the Bohemian Cretaceous Basin was interpreted.

Jiří Frýda

Coordinator of the strategic plan for research into global changes

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 the marine or terrestrial ecosystem. Using palaeontological, sedimentological and geochemical methods, the team of scientists from the CGS analyses the changes in selected abiotic characteristics of the palaeoenvironment and parameters describing the evolution of palaeodiversity before, during and after global crises. In conclusion, the analysis of evolution of palaeodiversity comprises time-consuming taxonomical, palaeoecological and palaeobiogeographical research.

In 2013, the team of scientists studying global changes in the Earth's history consisted of 12 researchers, 7 Ph.D. students and one technical assistant with the total work capacity of 9 full-time jobs per year. The team members are as follows: Eva Břízová, Petr Budil, Pavel Čáp, Jana Drábková, Juraj Farkaš, Lenka Ferrová, Jiří Frýda, Tomáš Hroch, Jiří Kříž, Richard Lojka, Štěpán Manda, Daniel Nývlt, Marika Polechová, Zbyněk Šimůnek, Tomáš Štor, Alena Tichá, Petra Tonarová, Radek Vodrážka, Stanislava Vodrážková and Zuzana Tasáryová.

Publications

These scientists published a total of 34 papers in journals with an IF, 6 chapters in foreign scientific books and 4 peer-reviewed publications without an IF.

Jiří Frýda and Štěpán Manda, members of our team, led the international scientific journal *Bulletin of Geosciences* in 2013. This year, 50 papers of 914 pages in total were published in it. In 2013, the *Bulletin of Geosciences* was cited 345 times in the Web of Science

database, which ranks this journal with the IF 1.495 as the 16th most important international journal in its field of expertise (see more in the chapter Publications Issued by the CGS).

Overview of main results

Marine Palaeozoic

In 2013, study of early Palaeozoic sedimentary sequences continued with focus on the response of biosphere to global changes and changes in the structure of associations affected by a crisis. The following main results of this research have been published:

- A new model of the basal Choteč Event (Vodrážková *et al.* 2013).
- Results of the study of the Lau Event focused on the global carbon cycle (Frýda & Manda 2013).
- A new study on the Devonian-Carboniferous boundary (Kumpán *et al*. 2013).
- A new model of formation of bituminous shale deposits in North Africa and Arabia based on the study of biological crises during the Silurian (Loydell *et al.* 2013).
- A new sedimentological study on the isotopic Lau Event (Gocke *et al.* 2013).
- A paper on the Middle Ordovician bivalves from the Prague Basin based on a dissertation focused on Ordovician bivalves (Polechová 2013). This paper not only brings a systematic review of bivalves, but also addresses palaeoecology and palaeobiogeography of Middle Ordovician bivalves.
- A chapter in a book on palaeobiogeography of early Palaeozoic (Ebbestad *et al.* 2013).
- A chapter in a book on the class Gastropoda (Frýda *et al.* 2013).
- A new method of separation of microfossils (Jarochowska *et al.* 2013).
- Ontogenesis of Devonian conodonts *Polygnathus serotinus* and *P. bultyncki* (Klapper & Vodrážková 2013).
- A review of the family Palaeozygopleuridae, describing the influence of Devonian bioevents on its phylogenesis (Frýda *et al.* 2013)
- A study on development of Upper Devonian sediments in NW China (Suttner *et al.* 2013).
- A study on the evolution of palaeodiversity of the Lower Devonian ecosystem of Morocco (Frey *et al.* 2013).
- A new study focused on the ontogenesis of phacopid trilobites (Budil *et al.* 2013a).
- A study focused on the oldest dalmanitid trilobite in the Prague Basin (Budil *et al.* 2013b).
- A new study describing unique finds of digestive system of trilobites (Fatka *et al.* 2013a).
- Analysis of the palaeogeographic position of the Prague Basin in Silurian (Kletetschka *et al.* 2013).
- A study describing more unique finds of trilobite bowels from Lower Ordovician (Fatka *et al.* 2013b, c).
- A study on the relationship between volcanism and evolution of Silurian faunas – in press (Tasáryová *et al.* 2013).
- A study on Silurian chemostratigraphy – in press (Loydell *et al.* 2013).
- A study on integrated stratigraphy of the Silurian – in press (Slavík *et al.* 2013).
- A study on the evolution of Silurian species palaeoassociations – in press (Manda & Frýda 2013).
- A review of Silurian carcinosomatid eurypterids – in press (Budil *et al.* 2013).
- A study on the behaviour of harpetid trilobites – in press (Fatka *et al.* 2013).
- Studies on the evolution of biomineralization (Frýda *et al.* 2013, Frýdová *et al.* 2013 and Hrabánková *et al.* 2013).

Terrestrial Permo-Carboniferous

In 2013, attention was given especially to studying the effect of global changes on the evolution of Permo-Carboniferous flora, analysis of climate change and palaeobiogeography. The main achievements are listed below:

- Publishing a study on climatic and biotic changes on the Carboniferous-Permian boundary (Opluštil *et al.* 2013).
- Cuticles of the genus *Sphenophyllum* were acquired from Ukraine (Šimůnek & Bureš 2013).
- Cuticles (especially the upper cuticle) of aphlebias (cyclopterids) from the pteridosperm *Laveineopteris bohemica* from Westphalian C of Central Bohemia were obtained. They differ from cyklopterids of other species of laveineopterids. Unlike other species', their upper cuticle does not have stomata (Šimůnek & Cleal 2013).
- Dispersive cuticles of *Cordaites* from the Polish part of Upper Silesian Basin were described (Šimůnek & Florjan 2013).

Marine Cretaceous

Taxonomic, taphonomic, biostratigraphic and palaeogeographic assessment of the Cretaceous and Eocene of the James Ross Island continued in 2013. As a result, a study on polychaetes from the Bohemian Cretaceous Basin was published (Žítt & Vodrážka 2013).

Quaternary

Research that continued in 2013 was focused on the human influence on the evolution of Quaternary flora, analysis of isotopic composition of magnesium in sedimentary carbonates and theoretical modelling of global magnesium (Mg) and calcium (Ca) cycle during the geological evolution of the Earth. The following main results of this research have been published:

- A chapter in a book on the behaviour of Ca and Mg isotopes in sediments (Farkaš *et al.* 2013).
- A chapter in a book on the chemism of marine water and sediments (Kump *et al.* 2013).
- A chapter in a book on the landscape evolution in the James Ross Island (Davies *et al.* 2013).
- A study on freshwater lakes in the James Ross Island (Nedbalová *et al.* 2013).
- A study on freshwater diatoms from the James Ross Island (Kopalová *et al.* 2013).
- A study on Gravettian of Moravia (Vlačiky *et al.* 2013).

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Head of the Department of Environmental Geochemistry and Biogeochemistry

Landscape Vulnerability Analysis

Peat-core sampling for isotope study of nitrogen deposition from Blatenská slať highmoor in the Bohemian Forest (photo by M. Štěpánová).

The long-term, sometimes scarcely discernible effects of anthropogenic activities on the landscape ecosystem can ultimately turn with unexpected speed against the chief perpetrator – man. Our research therefore concentrates on the processes controlling the flowpaths of environmentally critical elements in the ecosystem. Comprehensive, interdisciplinary studies are designed to identify and quantify the risks to forests, soil, surface waters and groundwaters. The investigation of environmental vulnerability also involves monitoring of geohazards (landslides, radon risk), and the compilation of registers and map applications to assist decision-making by government authorities and to raise public awareness of important environmental issues.

Zinc concentrations in atmospheric deposition

During 2013, an analysis of the isotopic composition of zinc deposited from the atmosphere on the peaks of six mountains in the Czech Republic was completed. Zinc deposition was the highest in the Beskydy Mts and lowest in the Bohemian Forest. Up to 95% of Zn deposited was found to be in the soluble fraction, whereas the percentage of zinc bound in silt-size particles was surprisingly small. The concentration of Zn in atmospheric icing was roughly 4 times higher than that in snow itself. The Zn isotope composition showed contrasting trends in the western and eastern halves of the Czech territory. In the west, the isotopic composition of the zinc in the

ice was heavier than that in the snow. In the east, the trend was the opposite. Our objective is to use the pattern of Zn isotope distribution to determine the provenance of the pollution.

GEOMON

The hydrological year 2013 marked the compilation of the globally unique twentieth anniversary dataset on the nutrient cycle and the balance of ecologically important compounds in a network of fourteen small forest basins GEOMON, coordinated by the Czech Geological Survey. The dataset contains analyses of precipitation, throughfall and outflow, including the results of hydrological measurements. These are collected using standardized sampling and analytical procedures so that they can be used for hydrological and biogeochemical modelling.

Geochemical modelling – SoilTrEC

Since 2010, three spruce-dominated catchments with different bedrock – Lysina (on granite), Pluhův bor (on serpentinite) and Na Zeleném (on amphibolite) – have formed the Slavkovský les critical zone observatory belonging to the European SoilTrEC project. This is one of the four major areas of Europe selected for a long-term investigation of changes in the soil and for testing newly developed geochemical models. The results are published in a series of papers in high IF journals .

Carbon and nitrogen cycles

The influence of forest soil acidification and eutrophication on the carbon and nitrogen cycles was studied using long-term monitoring, experimental trials and biogeochemical modelling. Last year, an investigation was carried out into the synergistic effects of acidification and the natural disturbance of forest ecosystems on the major element cycle in the glacial lake catchments of the Protected Landscape Area Český les ("Bohemian Forest"). This work has only been possible because of the continuous monitoring of conditions in these ecosystems since 1984. A controlled experimental acidification-fertilisation trial test was carried out in the Načetín area (FP7 project – SLAvONIC). The results were used to create optimum biogeochemical models for simulating the evolution of the chemical composition of soils and surface waters. All this work was conducted in close cooperation with foreign partners.

Critical load evaluation

In 2013, the ForSoil project involved critical load evaluation of eight forest areas subject to II-level monitoring. This evaluation is based almost exclusively on the data collected in the experiment trial areas. Critical loads of sulphur CLmax(S) show a wide range of values from 186 eq $ha^{-1}year^{-1}$ (Všeteč) to 2,524 eq $ha^{-1}year^{-1}$ (Lazy). From 2005 to 2010, the atmospheric sulphur deposition exceeded the critical loads in four areas (Mísečky, Všeteč, Lásenice and Luisino údolí). In addition, nitrogen has also contributed to environmental acidification in the Mísečky and Lásenice areas. The largest excess in nutrition nitrogen values was detected in the Luisino údolí area.

Slope failures

A comprehensive Register of Slope Failures in the Czech Republic (RSN ČR) has been prepared and is accessible online to professionals and the general public through the portal (*www.geology.cz/svahovenestability*). The entries summarize information on individual slope failures and include maps with descriptions of those failures, relevant photos and archive materials. The Register enables processing and updating of new data on failures including details of their location that can be used immediately by the Slope Failure Response Centre of the Ministry of the Environment, and by other government agencies, the legislature and environmental protection agencies. The Register is systematically updated by field surveys, detailed mapping and expert technical reports. Field observations and documents relating to the landslides that occurred during the extreme flood events in 2006 through 2010 together with a synoptic review of all landslides in Moravia were compiled on regional basis.

Radon risk

An interactive map application of the Geological Survey and the National Office for Nuclear Safety *Comprehensive radon-risk information for national administrative units* has been prepared and placed on the map server of the CGS. The application summarizes in a user-friendly manner all available data on radon in the bedrock, in buildings and on dose rates affecting communities and their neighbourhoods. A special detector that can measure the vertical radon distribution in areas of extremely thin soil cover has been constructed and field tests have been completed. Special procedures have been developed for radon index determination in this type of geological setting.

Environmental mapping

Surveys of the geofactors, soil geochemistry, mapping of the engineering geology stability conditions and of exodynamic phenomena at scales of 1:25,000 and 1:10,000 in selected regions have provided up-to-date information on landscape vulnerability. This work has been underpinned by field and laboratory investigations. The results are intended for use by government authorities in decision-making as well as for public information. In total, 19 map sets were completed in 2013.

Lenka Rukavičková
Coordinator for the strategic plan for research in hydrogeology

Groundwater Research

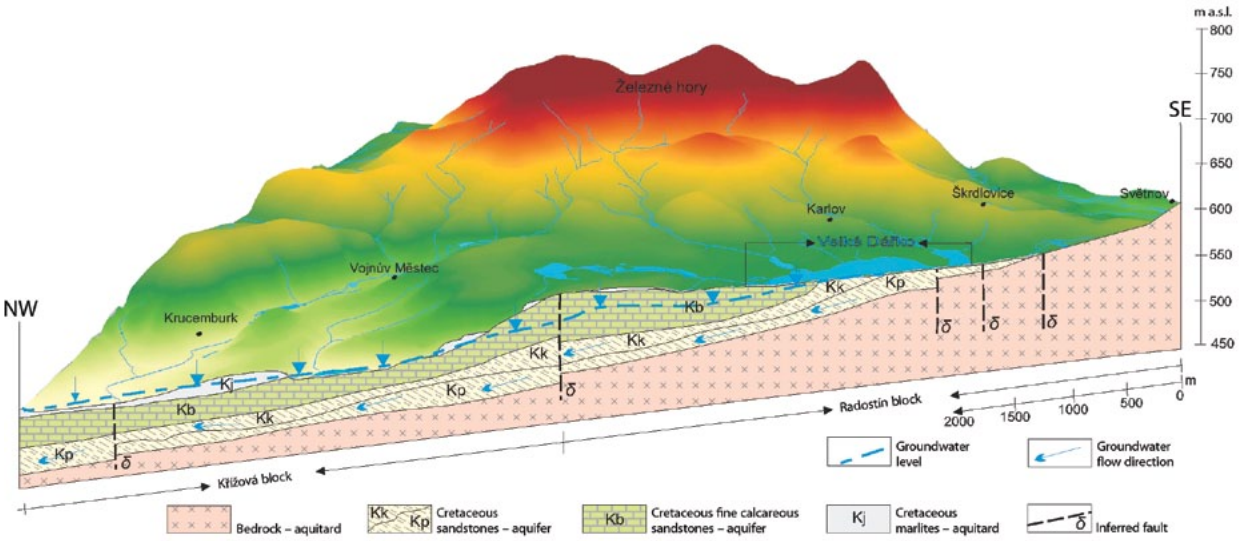
Groundwater sampling and field measurements in the Josef underground laboratory at Mokrsko.

During 2013, attention was given to collecting more precise data on the spatial distribution of aquifers and aquitards in the Bohemian Cretaceous Basin and on the assessment of groundwater residence time in the basin. An applied groundwater science programme was specifically concerned with hydrogeological problems related to the disposal of hazardous waste and energy storage in the rock environment.

Groundwater research in the Bohemian Cretaceous Basin

The major research activities carried out in the Bohemian Cretaceous Basin formed a part of the project *Review of Groundwater Resources*. The main objective of this project is the quantitative assessment of the natural groundwater resources within 56 selected hydrogeological zones and the determination of usable resources. The research has been carried out in the Cretaceous, Tertiary and Quaternary hydrogeological structures, which contain around 80% of the overall groundwater supply in the Czech Republic.

In 2013, the groundwater science programme was concerned with the creation of conceptual models of Cretaceous groundwater-bearing structures. Detailed characterization of the physical properties of aquifers was extended to the northwestern and eastern parts of the Bohemian Cretaceous



Hydrogeological model of groundwater flow at the south-eastern closure of the Dlouhá mez Cretaceous structure.

Basin. Studies have been carried out on the aquifers A, AB, B, BC, C, C1, C2 and on the D aquifer hosted by the Teplice, Březno and Merboltice formations. Creating models of the geological structure of the aquifers also involved identification of significant tectonic zones and volcanic dykes that have a marked influence on the regional flow of groundwater.
At the same time, transmissivity evaluation was also carried out for all the aquifers mentioned above.
The geological and conceptual hydrogeological models that have been created incorporate the results of surface geophysical measurements using electrical, gravity and seismic techniques, as well as gamma-spectrometry. Chemical analyses of groundwater and the assessment of groundwater residence times based on natural tracers also formed an important part of this study.
The re-interpretation of hydrogeological well logs and information from the borehole archive have provided valuable constraints on the final models.
Dating of groundwater using modern isotopic methods has been carried out simultaneously. This dating involves the measurement of ^{3}H, ^{3}He, ^{4}He, ^{85}Kr, ^{39}Ar and ^{14}C isotopes. The age of groundwater in the Cenomanian aquifer has been found to increase from several hundred years in the north to up to 20,000 years in the south. Measurements using ^{14}C and ^{39}Ar isotopes date the age of its recharge to the last Ice Age. In contrast, the groundwater in the Turonian aquifer is a much younger mixture. Groundwater older than 50 years has mingled with that infiltrated from the surface. The full results of these investigations have been published in the *Applied Geochemistry* journal.

Hydrogeological mapping

Hydrogeological mapping at a scale of 1:25,000 was carried out in selected areas of the Czech Republic. This mapping has provided a new insight into the quantity, quality and flow regime of groundwater in various types of rock environment. Compilation of the data required for sustainable planning of groundwater development, management and environmental protection was an intrinsic part of the mapping.

Applied hydrogeology

Surveying rock environments suitable for disposal of hazardous waste and for the use as repositories of raw materials and energy has continued. The investigations were focused on the evaluation of various parameters of the rock environment that govern its permeability. The properties and permeability of fracture networks developed on the macroscopic scale (the bulk rock) and on the microscopic scale (rock matrix) have been studied systematically. It has been found that these networks show features that are specific for each locality and type of rock.
The experience gained over a long period of field-based studies of the hydraulic properties of low permeability rocks carried out by the Czech Geological Survey has been summarized in a publication focused on the methods used for testing.
Variation of natural flow regime and the chemical composition of the groundwater is being investigated within the frame of the project dealing with the stability of bentonite in a rock environment at the temperature of 95 °C and another project focused on the potential for underground thermal energy storage.
Applied research also involved development of equipment for sampling deep groundwater from small diameter boreholes. This equipment has been awarded a utility model certificate by the Industrial Property Office of the Czech Republic.
Work has also started on the introduction of innovative farming systems on Quaternary sediments in water resource protection zones. These developments are being carried out in cooperation with the Research Institute for Agriculture. Medical geography conducted by the Czech Geological Survey is focused on the relationship between the geological setting, drinking water quality, nuclear radiation and other environmental factors and the function of the thyroid gland in children. Geographic Information System (GIS) techniques were used for integration and spatial analysis of data and their subsequent visualization.

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

Mineral Resources

Extraction of sand and gravel from water at the non-reserved deposit in Dolany near Pardubice (photo by P. Rambousek).

Research on mineral resources in the Czech Republic continued in the work of previous years by more active pursue for knowledge of the national natural resource base and by monitoring the latest technical and economic trends in usage of natural resources both in the Czech Republic and abroad. To support decision-making processes and land-use planning, background materials on natural resources have been acquired and updated. Experts from the CGS have actively participated in development of the European Raw Materials Initiative by preparing the supporting research projects and legislative recommendations.
As a wider spectrum of basic and applied research of natural resources needs to be carried out in the national as well as European context, a new department within the organizational structure of the CGS has been established: the Department of Mineral Resources Research and Policy.
The Czech Geological Survey also continuously provides the state geological survey, as required by the Law, which has involved numerous activities to ensure collection, processing and providing information on mineral resources and their protection and usage.
Special attention has been given to mineralogical and geochemical assessment of mineral resources and the research of possibilities of the usage of mining waste. Assessment of the impact of mining on the environment and the study of history of mining in the area of the Czech Republic should be pointed out as well.
Exploration geologists have joined many European and overseas projects focused on the study of mineral potential of the countries and on the assessment of the environmental impact of mining.

Extending the knowledge of possibilities of usage of the mineral resource base of the Czech Republic

The talk *Mineral resources in the CR and in the context of the European Union* was given for the Committee on Economic Affairs of the Chamber of Deputies of the Parliament of the Czech Republic under the terms of seminars given by the AS CR *Scientific information – base for a better, competitive society.* This talk outlined the resource potential of the CR with special regard to critical resources and possibilities of their usage based on up-to-date scientific knowledge.

As a part of a consortium led by the TU-VŠB Ostrava, the CGS joined a long-term project of the Competence Centre for Effective and Ecological Mining of Mineral Resources (CEEMIR), funded by the Technology Agency of the CR. The project aims to assess the potential of usage of selected critical raw materials in the Czech Republic. Preparation of the work for the Road and Motorway Directorate of the CR, entitled *Technical and economical inspection of natural construction aggregate quarries,* was initiated. The contract is due to be signed in 2014, with the intended duration until 2015. A total of 115 key quarries and sand pits, which supply the construction of road structures in the Czech Republic, will be thoroughly investigated. Currently exploited and processed mineral products will be inventoried, including their technological quality certificates for the particular construction purpose. All possibly present pollutants shall be declared and the state of the art of mining and processing will be reported.

Compilation of maps of mineral resources

A part of our research is also compiling maps of mineral deposits and maps of environmental geofactors of the Czech Republic at the scale of 1:25,000. In 2013, maps of mineral deposits for the following 12 map sheets were completed: Jedovnice, Šlapanice, Horní Planá, Ktiš, Rokytnice nad Jizerou, Jesenice, Bochov, Valeč, Stráž nad Ohří, Kadaň, Kyselka, and Nepomyšl. Experts in natural resources were directly involved in compiling maps of environmental geofactors at the scale of 1:25,000 for 8 completed map sheets.

Assessment of the possibility of gas extraction from coal seams and bituminous shales

As requested by the Czech Government Decree No. 115 issued on the 20th of February 2013, which addressed the matter of shale gas, a study named *Potential impacts of exploration and production of unconventional resources of natural gas (combustible natural gas extracted from gas-bearing shales, SG – 'Shale Gas' and combustible natural gas obtained by underground coal gasification 'UCG') based on experience from abroad* was published. The report summarized the wide spectrum of available scientific, technological and legislative material and experience with risk assessment and the real or potential impact of exploration and exploitation of unconventional gas on the environment in the USA, countries of the European Union, especially Poland and the UK, and some other countries. Another project, funded by the Department of Geology of the Ministry of the Environment (DG MoE), was devoted to comparing and contrasting geological and geochemical parameters of Devonian and Carboniferous mudstones in the Appalachian Basin, Pennsylvania, USA, and in the units of the eastern margin

Sampling of dark grey to green-grey biotite-amphibolic gneisses and amphibolites on the second level of the non-reserved deposit of building stone in Polnička (photo by J. Godány).

of the Bohemian Massif. The project continues until 2014 with comparing the gas source potential of selected units in the CR and the USA. Partial results and some information obtained during a study visit overseas were presented for the scientific community in the CGS in Prague at a seminar *Technology of exploration and production of gas from shales and state supervision over its environmental impacts – experience from Pennsylvania, USA.*

In addition, a project was prepared for the DG MoE: *Methods for assessment of unconventional hydrocarbon resources under the conditions of the geological structure and legislation of the Czech Republic.* The project shall propose the development of procedures for assessment of environmental impact of hydraulic fracking of shales used abroad, such as the effects on hydrogeology – mainly on the quality of drinking water resources. Other methodological proposals for risk assessment include evaluation of geological conditions that can act as hazardous factors in the areas where exploration and production could potentially take place in the future.

Mineralogical and geochemical research of mineral deposits

Research on the "five element formation" (Ag-Co-Ni-Bi-As) in the Krušné hory Mts was carried out on a number of locations: Měděnec, Mědník, Orpus, "Jan v poušti" ("John in a desert") Mine in Nové Zvolání, Přísečnice, Vykmanov, Hora Svaté Kateřiny, Mikulov-Hrob.

Preliminary results of the study of isotopic composition $^{18}O/^{16}O$ and $^{13}C/^{12}C$ of the carbonate veins on these localities reflect mixing of waters of deep and meteoric origin during the formation of the mineralization. Vertical zonality of hydrothermal veins was discovered in the Měděnec deposit, where Co-Ni mineralization is predominant in the upper parts and Ag mineralization is typical for lower parts of the ore bodies. Ore-forming fluids from the Měděnec deposit and the Mědník skarn body probably originate from the same deep source. Detailed mineralogical study of the Hora Svaté Kateřiny locality with a detected Ti-rich cassiterite and galena proves transitional type of ore mineralization between greisenization and other hydrothermal mineralization. A new detailed mineralogical research at the Mikulov-Hrob locality has shown typologically identical overlay of the "five-element formation" as in the western part of the Krušné hory Mts.

Mineral Resources

Conference of the ArchaeoMontan *project in Dippoldiswalde (photo by P. Bohdálek).*

Methodologically important geochronological research of the Re/Os mafic and ultramafic rocks and segregation type of the Cu-Ni ores from the Jezírka deposit in the Ransko Massif has shown their Variscan age – 341.5 ± 7.9 Ma.
Research on the isotope composition of Cr of mantle chromites representing different types of deposits of different age and geotectonics position revealed that its composition remains steady during the geological history ($\delta^{53}/^{52}Cr = -0.08 \pm 0.10‰$).
Analyses of flotation sands from Horní Benešov and Kutná Hora made during the research of the content and forms of distribution of industrially interesting elements in flotation waste after modification of polymetallic ores has shown interesting residual content of Ag (0.3–20 g/t). An analysis of archived preserved samples of concentrates from the Kaňk Mine confirmed increased content of In (346 and 439 ppm), Cd (1443 and 1650 ppm) in correlation with increased contents of Zn; correlations with increased contents of Cu, Pb and Ag are also positive.

Research in the field of historical mining and metallurgy study

Czech-Saxon cooperation on the *ArchaeoMontan* project, which is focused on the Krušné hory Mts, has brought a number of new results. Marked geomagnetic anomalies at the Kremsiger locality indicated the presence of historic ore processing plants with increased content of magnetite in the soil horizon on the floor of these objects. Intensively limonitized skarns were detected and technolites – small fragments of fayalite cinder with no chemical admixture of base and precious metals – were found sporadically.
A findings of ceramics with a crust with a high content of Pb and low content of Ag is greatly valued. The first finds in residential objects gives evidence of test smelting, which indicates that there was interest in prospection for Ag ores at the Kremsiger locality.
On the Černý potok Hill, it was discovered that the spread of skarn lentils and their mining had been much more extensive than originally anticipated. Some new veins and metasomatic structures with fluorite and sulphides (sphalerite, galena) have been found and presence of scheelite has been detected locally.
Very important findings were three microns large grains of pure silver and argentite (acanthite) in form of a powder in limonite with aggregates of hisingerite, psilomelane and phases of Cu-Si, Cu-U-P, which can be interpreted as fragments of a vein system with Ag ore mineralization.
Research of anthropogenic geochemical footprint in the environment after mining and smelting of Ag, Cu and Fe ores in the wider environs of Přísečnice and Vejprty has also been initiated under the terms of the *ArchaeoMontan* project. Preliminary results indicate that there were at least three, or more likely even four historical periods when the local deposits were exploited, these periods reaching to the Middle Ages.
Besides the Krušné hory Mts area, a unique conservation archaeological research was supervised in Suchá Rudná (Hrubý Jeseník), which excavated medieval relics after mining and panning of gold dated between years 1225 and 1232. The results were presented at conferences in Kutná Hora, Kadaň and Jihlava.
Securing and stabilizing of old mine workings in Horní Město were monitored.

Research at the historic mine working in Dippoldiswalde, Saxony (photo by P. Bohdálek).

An excursion and a presentation *Historic mineral resources in the area of Železné hory* were organized for the Protected Landscape Area Železné hory Administration and the Boii civic society. The focus was given to the possible historic usage of the previous Celtic settlement. Limonite iron ores from Litošice and Nasavrky have been provided for experimental archaeological melting. The talk *Zlaté hory ore mining district – its past and presence* was given at the Faculty of Science of the Charles University in Prague to students of economic geology.

International cooperation and foreign expertises

In the consortium of European geological surveys – EuroGeoSurveys (EGS), the CGS continued in the mutual projects preparing the European resource-efficient initiative. The consortium, led by the British Geological Survey (BGS), initiated its work on the *MinInventory* project aiming to catalogue information systems on mineral resources in European countries. The CGS began to work on the compilation of a European Minerals Yearbook, unified information system and prognosis studies within the large-scale *Minerals4EU* coordination project, financed from the EU funds for science and research and the 7th Framework Programme in the consortium led by the Finish Geological Survey (GTK).
Scientists from the CGS worked in the expert groups of the EGS on raw materials, energy resources, geochemistry and international cooperation. Completion of the European atlas *GEMAS – Geochemical Atlas of Agricultural Soils* and continuation in the geochemical study of hazardous elements in suburbs of cities (*Urban Geochemistry*) were a great success. The analytical methods that were developed are also significant for refining the methods of geochemical prospecting.

The greatest volume of international activities regarding mineral resources and impacts of mining was targeted on African countries. The research in West Africa carried out under the terms of the AMIRA-WAXI project that is focused on the processes of distribution of gold and accompanying elements in soils and laterites. As a result, criteria were set for mineral prospection in regions affected by various stages of tropical weathering.
The environmental impacts of ore mining and processing was studied under the terms of a project funded by the Czech Science Foundation (GACR) in Zambia and Namibia. The Czech Geological Survey is the leader of the UNESCO-IGCP-SIDA 594 project named *Environmental and health impacts of mining in Africa*. The results of this project were presented at the international congress *Earth sciences: Solution to African development and challenges (CAG24)*, which took place in Addis Ababa, Ethiopia, in January 2013. The final workshop of this project is going to be held in Prague in May 2014. Iron ores were studied in Brazil at the Carajas deposit, Amantaytau gold deposit was studied in Uzbekistan, and a Ni-Mo-PGE ore deposit in black shales was studied in South China.
Under the terms of the International Development Assistance programme, extensive mapping at the scale of 1:50,000 supplemented by mineralogical and geochemical exploration were carried out in the West Altay, Mongolia.

Providing the state geological survey

The departments of mineral resources compiled a number of expert reports as requested by the Ministry of the Environment for decision-making support according to the Geological Law No. 62/1988 Coll. with all amendments. The most important of these reports were expert studies on the new development areas stated in the land-use plans, especially on the construction works in marginal parts of the North Bohemian Lignite Basin with some remaining reserves of lignite in the Mineral Resource Protection Areas, and analyses for the determination of exploration leases in the surroundings of Kašperské Hory. A detailed expertise was compiled for the Ministry of Industry and Trade on the update of the National Resource Policy and the National Energy Concept regarding the potentially utilizable coal deposits.
To support the operation of the state geological survey, the project named *Specification of the registry and the state-of-the-art of usage of non-reserved minerals in the Czech Republic in relation to the statement on statistical mining, technical and operational information from the Hor (MPO) 1-01 in order to update the Mineral Information System (SurIS)* was run in cooperation with the Czech Mining Office and the relevant regional mining offices and was supported by the Ministry of the Environment. Entries in this registry and their positioning in the map cover the South Bohemian, Central Bohemian, Hradec Králové, Olomouc, Pardubice and Liberec regions and specify the registry in the SurIS to comply with § 13 of the Law No. 2/1988 Coll. The outputs of this project are needed for compilation of land-use planning documentation, for state and regional administration bodies and especially for compilation of background information for regional analysis.
In 2013, 185 deposits of unreserved minerals were examined and supplemented with written and graphical documentation.

Vít Štrupl
Head and Deputy Director of Geofond Division

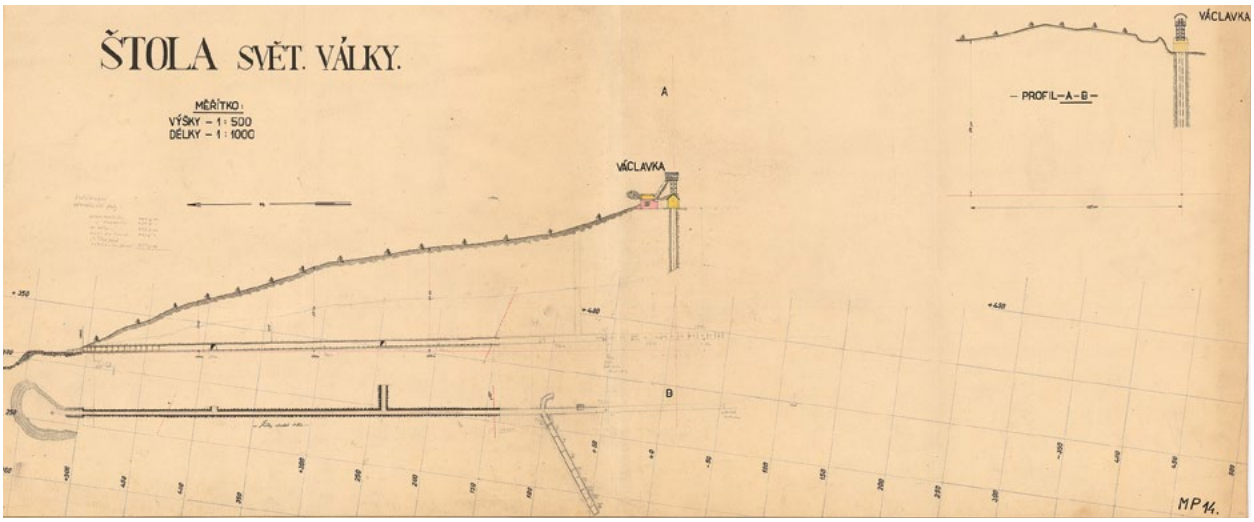
Mine Workings and Mining Waste

Exposure of mine waste on the west slope of the Emanuel Mine spoil heap at Milešov (Příbram district).

Under the authority of the Ministry of the Environment, 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.

Mine Workings Impacts Database

As part of its statutory duties in the Czech Republic, and under the authority of the Ministry of the Environment, the Czech Geological Survey carries out field assessment of sites where occurrence of old mine workings and their impact is reported. According to the Mining Act, the term "old mine working" refers to an abandoned underground mine, the original operator of which, or its legal successor, does not exist or is unknown. Since 2002, the open pits abandoned after the extraction of reserved minerals have also been placed in that category. Most frequently, the mine workings are indicated at the surface by subsided ground, collapsed soil or simply by open adits and shafts. Should they be found, the law entails the duty of reporting and keeping records of such phenomena. During the site assessment, expert teams photograph, locate and describe the old workings. These technical data are used to compile expert reports for the Ministry of the Environment. Other important sources of information for expert reviews are published and unpublished reports, various editions of maps and other databases of the CGS Information System. They encompass, for instance, abandoned nine lands database (as of the 31st December, 2013, this contained data on 5,603 sites), inventory of underground mines (as of the 31st December, 2013, this contained data on 26,360 sites and 22,845 digital photographs) and a database of mining maps which, by the 31st December, 2013, contained 12,604 maps and their photographic scans. The Mine Workings Impacts Database



Detail of a mining map showing the position of the World War Adit (Weltkriegsstollen, Barbora). Roudný-Laby, Benešov district, author unknown, 1942, CGS – Geofond Kutná Hora.

contains records of each of the reported cases accompanied by all related documentation. The information compiled in this inventory is stored in the Mine Workings Impacts Database. By the 31st December, 2013, the Database of Mine Workings Impacts contained 2,658 case reports from a total of 2,199 sites. Information on the present condition and location of the reported old mine workings is permanently accessible to the public through the map GISViewer applications on the CGS website.

Inventory of Hazardous Waste Facilities

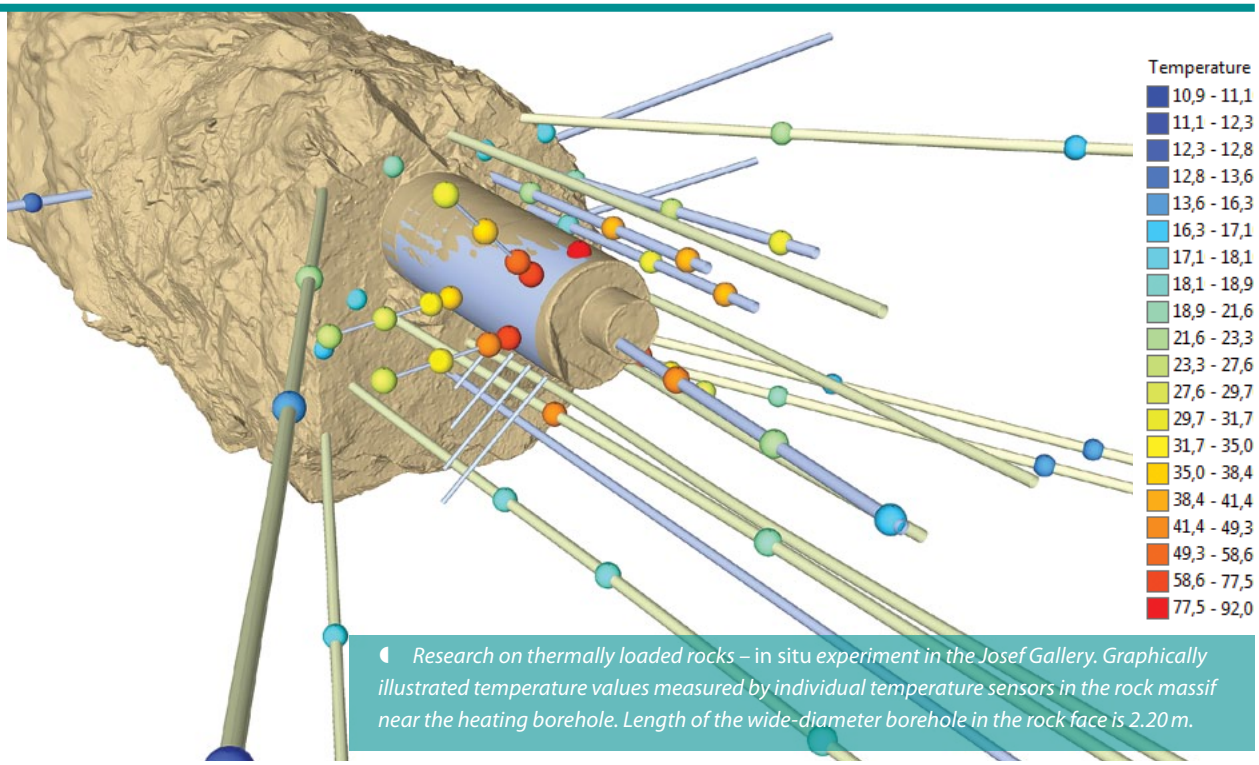
The environmental impacts caused by mining are still observable in the landscape: spoil heaps, tailling ponds, overburden and abandoned placers. In some cases, they have become significant features of the landscape marked by the occurrence of unique flora and fauna, but elsewhere they may pose a serious environmental hazard or endanger human health. The tailings and waste remaining after mining and processing of ores contain a wide spectrum of toxic elements which, when released through weathering processes, contaminate the surrounding soil and the surface and groundwaters. In some waste facility sites, there are unstable slopes and local landslides can occur here. In 2001, the Czech Geological Survey established the database of dumps, expanding it significantly in 2006 by the addition of data acquired from the government-owned DIAMO company. The Mining Waste Treatment Act came into force in 2009 and stipulates the creation of a new inventory of mine waste sites in the Czech Republic. Under the terms of the Operational Programme Environment, the CGS has carried out the project *Identification and classification of closed and abandoned mining waste facilities posing serious environmental or health hazards*, which was completed in 2012. The result was the creation of a new Inventory of Waste Facilities that now forms a part of the CGS Information System. It contains more than 7,000 objects and it is updated on a daily basis. Analyses of samples collected from 300 selected sites have led to 11 of these being filed in the Inventory of Hazardous Waste Facilities. The Inventory

Outflow of ferriferous water from collapsed entrance of the World War Adit driven underneath the Roudný Gold Mine (Benešov district).

was launched on the 5th May, 2012 as an independent public web application and it exists in Czech and English versions. In addition to giving details of the exact location, it also provides essential information on the type and ranking of risk for each site.

Vít Hladík
Coordinator for research into environmental and geo-energy technologies

Environmental Technologies



Research on thermally loaded rocks – in situ *experiment in the Josef Gallery. Graphically illustrated temperature values measured by individual temperature sensors in the rock massif near the heating borehole. Length of the wide-diameter borehole in the rock face is 2.20 m.*

In 2013, the environmental and geo-energy technology-related research focused on the issues of energy storage in the rock environment, on radioactive waste repositories, on geothermal energy and on geological storage of CO_2. Another activity is the engagement in the social dialogue about the role of science and research in transition to a low-carbon future.

Energy storage in the rock environment

Energy storage in the rock environment is a major research topic in the Czech Geological Survey, which gains in importance in the context of the development of intermittent renewable energy sources such as wind farms and solar power stations. Energy storage is one of the principal methods of curbing negative impacts of energy-supply fluctuations from these sources on network stability and general security of energy supply to the users in future.

In 2013, work on the project *Research on thermally loaded rocks – prospects for underground storage of thermal energy* continued. A key part of this project consists of an *in situ* experiment in the Josef Gallery near Mokrsko, in the environment of granitic rocks at the depth of approximately 120 m. The research is focused on a detailed analysis of influence of cyclic heating on the rock environment and the reversal of the flow of thermal energy, aiming at industrial use of the subsurface for the purposes of energy storage.

Within the project *Reversible storage of energy in the rock massif*, the CGS participates in experiments aimed at identifying rock types with parameters that would potentially enable building underground thermal energy reservoirs in the Czech Republic. In 2013, laboratory testing of rock samples was completed and based on the previous research results, a functional model of a thermal reservoir with 0.5 m^3 in volume was set up.

Radioactive waste disposal

During 2013, the Czech Geological Survey continued in cooperation on a project focused on bentonite – a material suitable for seal barriers at deep radioactive waste repositories. Bentonite stability under *in situ* conditions at temperatures of up to 95 °C and its interaction with the surrounding rock enviroment and ground water are investigated. The main *in situ* experiment is situated in the Josef Gallery near Mokrsko; the primary purpose of the project is to develop methodologies and best practices usable for building a deep radioactive waste repository in the future.

Research on alternative ways of the geological storage of the spent nuclear fuel in 5 km deep boreholes is under preparation, in cooperation with American specialists.

The monograph *Far Field of Geological Repository in the Bohemian Massif* was published. It summarizes the results of a three-year research on a far-field rock environment of a storage of spent nuclear fuel and high-level radioactive waste in an abandoned mine in granites at the depth of 500 m. The monograph highlights possible long-term risks related to this way of hazardous waste storage.

Geothermal energy

The sudden boom of various types of revewable-energy sources and the rising social requirements for development of low-carbon energy sources have increased expectations of further developments in harvesting of the Earth's internal heat within energy production and the related demand for applied research in this area. A new research team has been set up in the Czech Geological Survey to deal systematically with the geothermal-energy issues. Creation of a database with geothermal data from the Czech territory, a legislation survey of issues related to geothermal resources and engagement of the Czech Geological Survey in international research activities represent the first steps in this direction.

Geological storage of carbon dioxide and the CO_2 Capture and Storage (CCS) technology

In 2013, the Czech Geological Survey completed its activities within the *CGS Europe* European coordination initiative, which had an objective to create a stable pan-European expert body in the area of geological storage of CO_2. That objective has been reached in the form of enlargement of the existing West-European CO_2GeoNet Network of Excellence by new members. The Czech Geological Survey has been one of these new members since September 2013. Activities of the Czech Geological Survey in the *CGS Europe* project involved work in the Management Board, with the rensponsibility for knowledge dissemination, coorganizing of international workshops in Espoo (Finland) and in Sofia (Bulgaria) as well as carrying out a series of lecturing and publishing activities and for presenting the CCS achievements in the media.

The year 2013 saw completing of the cooperation with ÚJV Řež on the project *Research and development of methods and technologies for capture of CO_2 from fossil-fuelled power plants and CO_2 storage in geological formations in the Czech Republic*. The project focused on the methodology of permeability measurements on rock samples for super-critical CO_2,

Participants of the workshop on CO_2 geological storage in Espoo (Finland). The event was held within the European CGS Europe *project and the Czech Geological Survey was its coorganizer.*

which will be used in assessment and licensing of future CO_2 storage sites.

Another CCS-related project involving the CGS is titled *Development and optimization of methodologies for research on safety barriers for CO_2 storage as one of the key ways for decreasing the GHG content in the atmosphere*. The project investigates potential CO_2 leakage pathways from the storage sites. Particular attention is given to a possible leakage along boreholes and through the sealing caprock of the storage.

Social dialogue on the role of science and research in transition to the low-carbon future

The Czech Geological Survey participates in the European *R&Dialogue* project aimed at stirring up and organizing a dialogue between the Research and Development Organizations on one side and Civil Society Organizations on the other on the topic of transition to low-carbon society, including the development of renewable energy resources, CO_2 capture and storage and other technologies. In 2013, forty-one methodologically consistent interviews were made with the representatives of the main stakeholders – institutions, companies and NGOs. Analysis of these interviews will help identify activities leading to the improvement of social dialogue and related knowledge sharing. The National Low-Carbon Council has been established, composed of representatives of invited institutions and organizations, to coordinate the individual activities of the national dialogue, which will start in 2014.

Jan Čurda
Head of Regional Geological Administration

Regional Geological Administration

On 7th June 2013 landslide at Dobkovičky village buried the half-built D8-Highway leading from Prague to Dresden.

In addition to carrying out research, publishing maps and scientific papers, promoting geological education, and other related activities, the Czech Geological Survey provides a geological service for the state, in accordance with its legal framework. The regional geologists and specialists in mineral deposits, hydrogeology and engineering geology from the CGS provide professional assessments of geological matters across the whole Czech Republic and compile reports that enable the state and local administration to take appropriate decisions in the public interest. This statutory duty of the Czech Geological Survey is embodied in the Law on Geological Work. The organization and procedures used to carry out this service are the responsibility of the Regional Geological Administration within the CGS.

Report writing

The most frequent task carried out by the regional geologists at the CGS is the compilation of professional reports. These reports are concerned with a wide range of topics including hazardous geofactors, conflicts of interest, land-use planning, impacts of construction and technology on the environment, management of construction sites, remediation of old ecological burdens, proposals for nature conservation etc.

Continuous acquisition, storage and processing of scientific data on the geological composition and structure of the country, on the protection and use of natural resources and on geological hazards and necessary preventive measures guarantee that the

Landslide-disrupted regional railway track No. 097 (Lovosice–Teplice) at the section between railway stations Dobkovičky and Radejčín.

information essential for making political, economic, judicial and ecological decisions affecting land use is available.

Activities undertaken, contracting authorities and working teams

In 2013, a team of three members of the Regional Geological Administration coordinated 717 tasks carried out for state and local administrative bodies, courts, universities, museums, non-profit making and non-governmental organizations and other customers. Partial teams of specialists were also subcontracted to carry out these activities. Specialists were chosen from a total of 38 regional geologists, 14 regional specialists in mineral deposits and 6 specialists in hydrogeology, cooperating as required with 3–5 engineering geologists working across the whole Czech Republic. Within the frame of the "Floods 2013" action, the teams of regional specialists compiled 121 expert assessments for the needs of flood emergency committees. The main problem caused by the floods, being solved by the CGS specialist in engineering geology, is a large landslide in D8-Highway near Dobkovičky.

Expert opinions on projects submitted to the Operational Programme the Environment (OPE)

In accordance with the *Consolidated version of the Directive of the Ministry of the Environment No. 3/2011, under the terms of Appendix 1, on submitting an application for financial support for projects from the Operational Programme the Environment, including co-finance from the State Environmental Fund of the Czech Republic and from the state budget of the Czech Republic – chapter 315 (the environment)*, regional specialists from the CGS compiled 3 expert assessments concerning individual projects within the OPE, *Priority axis 6 – Improving the state of nature and the landscape, Area of Intervention 6.6 – The prevention of landslides and rock avalanches, the monitoring of geofactors and the impacts of mining and extractive activities, and the assessment of non-renewable natural resources, including groundwater resources*.

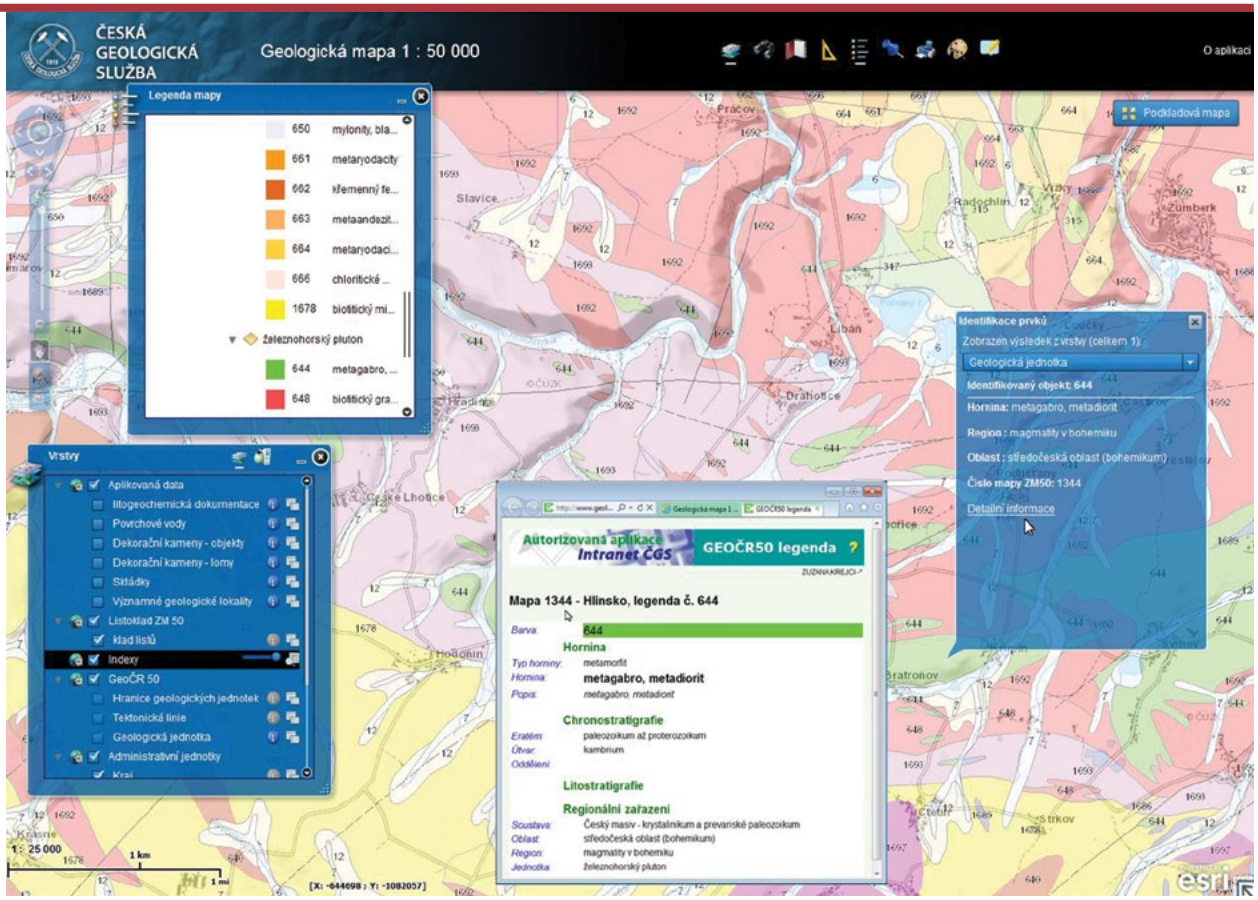
Material damage was also recorded in a quarry higher up. Buildings and equipment situated on landslide edge in quarry rear were also damaged, including weighing machine and aggregate dump.

The June landslide has blocked the half-built motorway from Prague to Dresden, including the drainage network and channels. The firemen repumped gradually the dammed water pond above the landslide body down to the "V Ječkách" stream valley.

Zuzana Krejčí
Head of the Department of Information Systems

Lucie Kondrová
Deputy Head of the Department of Information Systems

Geological Information System



Collection of data created by activities of the Czech Geological Survey, their administration and their provision is one of the key factors influencing the function of the state geological survey in the Czech Republic. Building of the geological information system is essential for securing information for the administrative bodies, wider scientific community and corporate organizations. The concept of the system is compatible with the Czech and EU legislation governing access to information. The use of international standards secures interoperability of data sources and integration into the national and European spatial data infrastructure, which is currently being formed.

INSPIRE and the interoperability of geodata

The INSPIRE Directive issued by the European Commission (EC) aims at setting up a European legislative framework necessary for generating a European infrastructure of spatial information on the environment. The CGS has been tasked with providing current information on data (metadata) and preparing for publication of the data referring to geology, soils, raw materials, energy sources and geohazards. The CGS staff are actively engaged

in formulating the INSPIRE implementation rules in the Czech Republic, in particular as members of the technical working groups KOVIN, and take part in testing and commenting on the proposed INSPIRE documents. During 2013, they commented on the Czech translation of the Regulation on interoperability of spatial data sets for INSPIRE Annexes II and III. In cooperation with the other specialists, work on the creation and testing of standardized web services (WMS, WFS) is in progress.

Geological Information System

The *Geological Information System* (*GeoIS*) was designed by the CGS to be compatible with the national and international directives (JISŽP and INSPIRE). The core of the GeoIS is the *Central Data Storage* (*CDS*), which contains over 50 thematic databases (*www.geology.cz/geodata*). It contains graphical data (maps, geological cross-sections, and map related schemes) and descriptive data (code lists, results of analyses, archival data, operational databases, etc.). The GeoIS contains several large thematic subsystems: geological maps – the *National Geologic Map Database* (*NGMD*), geohazards – the subsystem mainly relating to slope failures and radon risk, mineral resources – *Mineral Information System* (*SurIS*), mining waste – *Inventory of Hazardous Waste Facilities*, a subsystem for hydrogeology etc.

The CGS Metainformation System (see *micka. geology.cz*) serves as a core information basis on CGS data sources and is fully compatible with the INSPIRE implementing rules. It contains standardized information on datasets, map services and web applications. Through harvesting, the updated metadata on CGS data sources are also available on the day-to-day basis on the National INSPIRE Geoportal (*geoportal.gov.cz*). In 2013, a metadata profile for the description of geoscience data, services and applications created by the CGS, was extended. Thus, metadata of the CGS data sources, which are administered in Czech and English versions, can be utilized effectively. The profile extension included definition of the thesaurus of geoscience themes, code lists, rules for filling in metadata to be used on the CGS information portal, etc.

Development of the technology and content of data sources

In 2013, a process of an overall transition to the 10.2 version with all the Esri compounds was initiated in CGS, associated with the upgrade and unification of the used central database system for the ArcSDE geodatabases. Data structures were specifically fitted for rapid information visualization via a map server and for the need of newly arising applications. Changes in the procedures were targeted at constraining relation links and at formation of database views. The following activities were carried out in the Central Data Storage (CDS) in 2013:

1. A feasibility study of upgrade of the SurIS (preparation of upgrade of the whole system from VisualFoxPro into SDE geodatabase);
2. A new data model for a new mining works application – it will be part of the central data repository which will entail interconnection with the other CGS databases;
3. A thematically harmonized PMČR50 layer (Soil maps at 1:50,000 scale – 2013 as of writing) was deposited into the CDS.

View of opening window of the map application for accessing soil maps at the scale of 1:50,000.

Geographical Information System (GIS)

The *Geographical Information System* (*GIS*) has been progressively developed by the CGS as a tool used by the whole organization to process, utilize and access spatial data. A major step leading to further development of the corporate GIS in the Czech Geological Survey is the Enterprise License Agreement signed with the Esri company in the middle of 2013. The agreement enables a stepwise implementation of a newly conceived upgrade of the corporate GIS or combining field observations with the use of GIS and the information collected by remote sensing. These methods of applying 3D modelling and digital cartography tools are routinely used for work on major projects in the Czech Republic (*Geological mapping at 1:25,000 scale*, *Review of Groundwater Resources*, *Research on thermally loaded rocks*) or abroad (Iran, Ethiopia). In relation to the collection, administration and provision of data by means of Esri SW, the Czech Geological Survey was awarded **a prestigious prize for a complex deployment of GIS in the information system of the state geological survey** during the 22nd GIS Esri conference held in the Czech Republic in November 2013.

The Director of the CGS Zdeněk Venera receiving the prize for a complex deployment of GIS in the information system of the state geological survey during the GIS Esri conference held in the CR.

Geological Information System

Providing access to geoscience data and information

The *Information Portal of the CGS* (*IP CGS*) is an integrated platform for information from GeoIS containing more than 100 thematic applications (more on the subject see chapter Web of the Czech Geological Survey).

The **Map Server** by means of which spatial data stored in the archives of the CGS and NGMD can be accessed free of charge, is one of the most visited parts of IP CGS. In 2013, revision of map applications continued. In comparison with older versions, the latest map applications are equipped with many new functions enabled by using the ArcGIS Server technology and ArcGIS Viewer for Flex technologies (new application for Geological map at 1:50,000 scale following up with an older application GEOINFO, Geoscience maps 1:500,000, Comprehensive radon-risk information). For English versions of the map applications, all parts of the application were translated into English. This required extension of the code itself for bilingual captions. Along with the map applications, the inherent map services had to be put into English. The progress in map services based on the new ArcGIS server versions required a new concept of authentication of users taking advantage of authorized map services through the GISViewer (e.g. in applications for Mining maps and Mining impacts). The authentication system routinely used on the CGS Portal was chosen as the most suitable one. It is based on the LDAP standard and run by means of the Oracle Internet Directory. Part of the distribution module was set up and integrated with the new versions of the eEarth/eWater distribution applications.

Information and communication technologies

Development of the GeoIS infrastructure continued in 2013 and concentrated on expanding of virtualization on the well-tried VMware platform that enables hosting the MS Windows- and Linux-run virtual servers. Owing to virtualization it was possible to take advantage of almost limitless HW options for planning a suitable conception of upgrading the Esri technology to 10.2 version. A successful tendering and purchase of a large-capacity data repository was a crucial moment for the infrastructure development in 2013. This is the first project of this type in the existence of ICT in the CGS. Project's objective is to build up a data repository with geographically separated nodes (utility hubs) out of which each one will have 40 TB of net capacity, protected by the RAID technology with dual parity. Between the nodes, an effective replication by combination of several technologies will be secured, such as snapshots, deduplications or compression. On top of it, Prague-Klárov workplace will host an EISPACK (banded) library with a capacity of 66 TB, tasked mainly with the geographically separated back-up of the existing repository at Prague-Kostelní workplace, which hosts file data in the form of scanned documents and maps. Large-capacity repository implementation activities are planned for 2014.

International cooperation

In 2013, the CGS coordinated work within the **OneGeology-Europe Plus** initiative that follows up with the 1G-E project the objective of which is to complete the coverage of Europe by harmonized 1:1,000,000 scale geological maps of countries that had not been involved in the original project. The staff of the Informatics Division organized a workshop on this subject in Ljubljana and throughout the year 2013, they provided technical support for translations of the OneGeology-Europe web interface, for the Metadata catalogue, for the creation and editing of metadata and for setting up the Esri technology-aided map service. The **Minerals4EU** project – Minerals Intelligence Network for Europe (FP7) aims at designing a Paneuropean infrastructure providing relevant topical data on raw materials, a regularly updated yearbook and a prognosis study on the web portal. Informatics-wise, the CGS has reached an important position as author, administrator and future operator of the metadata system and co-founder of the Minerals4EU Knowledge data platform. The staff of the Department of Information Systems participate in the bespoke project of the EGS **Geoscientific Knowledge and Skills in African Geological Surveys**, being in particular involved in analysing the current situation in African Geological Surveys in the field of processing and providing geoscience data, mainly those linked with geological and specialist mapping.

During the international workshop in Ljubljana, the CGS staff, together with the other participants, presented results of the OneGeology-Europe *project as well as the process of incorporation of new states to the built-up infrastructure.*

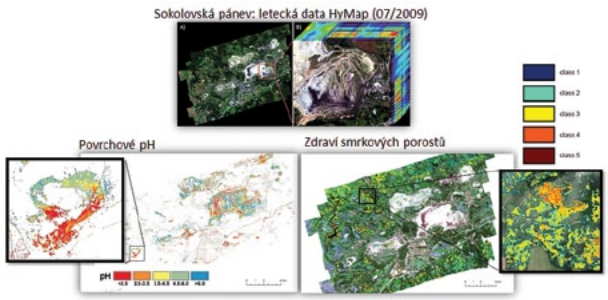
Veronika Kopačková
Head of the Remote Sensing Centre

Remote Sensing

Remote sensing is nowadays the most widespread method of acquisition of spatial data regarding the Earth's surface and objects. The data not only provide a synoptic view of the studied area, but also enable to combine spatial and thematic information and also temporary details. In accordance with persistent upgrading of the data parameters (e.g. spectral resolution, range, spatial resolution), their analysis moves from qualitative to quantitative.

Activities of the Remote Sensing Centre

The Remote Sensing Centre (RSC, *www. remotesensinggeology.ic.cz*) specialises in the application of image spectroscopy (IS) techniques using optical and thermal hyperspectral (HS) data (0.45–13.00 μm) for geological purposes. Within the frame of several research projects (GACR 205/09/1989-HYPSO: *www.geology.cz/ project619100*, FP7 EOMINERS: *www.eo-miners.eu*, EUFAR-DeMinTIR: *www.remotesensing geology.ic.cz/projects/demintir.html*), the HS data from HyMap, CASI and AHS sensors were obtained for the test site in the Sokolov Basin. The acquired data were used for further investigation of the relationship between the chemical composition of the soil substrate and the health of vegetation growing on it, by using quantitative methods of IS. In 2013, the RSC team focused on the analysis of HS data acquired at multiple time-intervals and on the evaluation of their temporal changes. Within the HyperAlgo project (MŠMT, KONTAKT II, Czech-Israeli cooperation), the research activities are focused on the automation and upgrading of statistical modelling (linear and non-linear models) and on creation of tools in IDL (Interactive Data Language) for the quantitative analysis and HS data classification. The INMON project (MŠMT, KONTAKT II, Czech-American cooperation) enabled acquiring hyperspectral image data of the new sensor APEX (Airborne Prism EXperiment) for a selected site in the Krušné hory Mts. The data will be used both for the evaluation of present-day physiological conditions of spruce-dominated woodlands and for evaluation of health conditions of those woodlands in 1998–2013.
The results of the RSC have been published continuously in international peer-reviewed scientific journals with an IF.



Modelling of selected parameters on the basis of aerial hyperspectral data.

Models for determining the gradient of pH and the content of selected heavy metals across an area and for assessing the physiological conditions and general health of forest cover are among the main outputs from these research activities.
In addition to the HS technologies described above, the RSC is engaged in other research activities. New procedures for classifying topographical features and interpreting their subsequent geomorphological development have been created, as well as a new method enabling updating of information on tectonic and hydrogeological features using ALOS PALSAR satellite radar data. Within the frame of the project PanGeo (FP7: *www.pangeoproject.eu*), tens of new polygons with potential risk of vertical movements were detected for Prague and Ostrava, on the basis of radar interferometry results.
New procedures for the thermal anomalies and moist soils detection are being developed in the course of mapping activities in Ethiopia.

Remote sensing research at the CGS is carried out in cooperation with the following partners

- Faculty of Sciences, Charles University in Prague
- CzechGlobe, Academy of Sciences of the Czech Republic
- German Aerospace Centre (Deutsches Zentrum für Luft und Raumfahrt, DLR)
- Tel Aviv University
- French Geological Survey (Bureau de Recherches Géologiques et Minières, BRGM)
- VITO (Flemish Institute for Technological Research)
- NASA – Goddard Space Flight Center

Petr Štěpánek
Head of the Project Management Section

International Activities and Cooperation

Geology field camp in the Namib desert on the Skeleton Coast north-western Namibia (photo by S.L. Kitt).

International activities mainly involve participation in projects under the Czech International Development Cooperation programme in Mongolia and Ethiopia, projects funded by the Czech Science Foundation with international participation, international Research and Development programmes such as KONTAKT II, INGO II, MOBILITY and NÁVRAT, projects of the 7th Framework Programme of the European Union and Cross-Border Cooperation with Poland and the Free State of Saxony. Last but not least, international cooperation also takes place in geoscientific programmes of UNESCO or is held under foreign contracts.

CZECH INTERNATIONAL DEVELOPMENT COOPERATION

Capacity building in environmental geology – Mapping of geohazards including hydrogeological conditions in Dila and Hosaina areas, Ethiopia

The activities of Czech geologists in Ethiopia are focused on prevention of consequences of natural disasters. In this project, Czech experts train their Ethiopian colleagues in methods of research and assessment of hazardous geological factors such as volcanic and seismic activity, erosion, landslides and contamination of water resources with fluorine. The work takes place in the area of the central Ethiopian Rift in southern Ethiopia.

In 2013, systematic research in the area of the 1:250,000 map sheet Hosaina and a detailed study in the surroundings of Hawasa and Shashemene towns were completed. Styles of past volcanic eruptions and the spread of their fallout were studied all around the area of interest, as well as the tectonic network. Areas prone to sheet erosion and landslides were mapped and factors influencing the accessibility and usability of groundwater resources were interpreted from the geological structure.

Geological mapping at 1:50,000 scale and evaluating the economic potential of a selected area in Western Mongolia

The first stage of this three-year project was carried out in 2013. This project follows a number of past successful Czechoslovak and

Czech projects in Mongolia. The area of interest covers over 1,770 km^2 and is situated in the north-western part of the Mongolian Altay belonging to the Chovd Aimag. From the geological point of view, the area is formed of crystalline rocks and flysch of the Early Palaeozoic age, with a number of granitic plutons and very marked tectonics. The aim of this project is to compile 5 geological maps at the scale 1:50,000 with location of mineralogical anomalies in terms of ores and industrial resources, followed by compiling maps of mineral deposits and their indications and a proposal for next detailed exploration stages. During the three-month expedition in 2013, geological mapping was carried out over approximately 60% of the area.
In addition, four Mongolian students and two young geologists were trained in field methods.

Improving the quality of tertiary education in Earth sciences focused especially on applied disciplines related to mitigating geohazards

The high abundance of hazardous geological factors in Ethiopia requires their intensive research that would result in more efficient protection of inhabitants from the consequences of natural disasters. In addition to providing additional knowledge to already active Ethiopian geologists, the Czech Geological Survey commenced a project, which aims to send Czech experts in geological hazards and related topics to Ethiopian universities. Hydrogeology is taught at Addis Ababa University. Other geological disciplines have been transferred to Arba Minch University, a regional university in the South of Ethiopia, which is closer to hazardous geological phenomena also (but not only) by its location.

PROJECTS FUNDED BY THE CZECH SCIENCE FOUNDATION

Deciphering the pre-convergence history of crustal domains in deeply eroded orogenic belts from detrital zircon populations

Two field campaigns took place in 2013 under the terms of this project. Work on the Dom Feliciano Belt in **Uruguay** focused on sampling of rocks that had been a part of the volcano-sedimentary cover of the rift domain of the collapsing supercontinent of Rodinia during the pre-collisional stage of evolution. Fieldwork in **Namibia** involved more sampling of the metasedimentary rock from the least metamorphosed part of the Kaoko Belt with the aim to date the populations of detrital zircons. Samples were taken with regard to the presence of several horizons of glacigenic sediments, which enable a relatively accurate estimate of the absolute age of sedimentation. The project was completed by publishing a paper in the *Gondwana Research* journal. This paper describes the provenience and age of the Neo-Proterozoic cover of the Congo Craton in the Kaoko Belt in Namibia. Another paper resulting from this project was published in the *Journal of the Geological Society of London* and presented last year's results of dating of detrital zircons from metasedimentary rocks of the Moldanubian Unit of the Bohemian Massif.

Impact of mining and processing of ore on the environment in Namibia: Modelling migration of pollutants in soils, plants and groundwaters

In 2013, the effect of ore mining and processing was studied at the Rosh Pinah and Tsumeb mineral deposits in Namibia. The results of the study of vegetation and soil contamination were compared with numerical models of dust fallout. It was revealed that the actual extent of contamination in soils and vegetation is larger than in the model due to long-term deposition of the contaminants in soils and resuspension of dust particles. By studying the isotope composition of copper, the migration of this element to deeper parts of the soil profile was monitored in the area of the abandoned mineral deposit in Kombat, Namibia.

Crustal growth and construction of continental crust: the example of the Central Asian Orogenic Belt

Key results in the interpretation of the contact between the Trans-Altay Oceanic Domain and the continental domain of South Gobi were achieved in this project. The results were published in the *Gondwana Research* journal. In addition, palaeomagnetic research was completed in Southern Mongolia. It has shown that the whole area rotated anticlockwise during the Permian and Early Triassic. These results are compatible with the results of the structural analysis of this area and comply with the latest model of orocline folding of the Central Asian Belt in Mongolia. Geophysical data from Southern Mongolia were processed and a new model of distribution of terranes in the studied area was presented. Gravity modelling shows that felsic crust of probably Ordovician age flows under the entire area. Thermodynamic modelling and thermochronology (U-Pb zircon, monazite and Ar-Ar amphibole and biotite) were carried out in Mongolian and Chinese Altay. These works helped to characterize the extremely high-temperature character of lower crust and the exhumation connected with extrusion of viscous lower crust and heat advection due to repeated intrusions of diorite and gabbro magmas of the magmatic arc.

INTERNATIONAL RESEARCH AND DEVELOPMENT

INMON: Innovative methods for monitoring the state of health of the common spruce in the Krušné hory Mts using hyperspectral data

INMON, the Czech-American cooperation project, is focused on monitoring the health of the common spruce (*Picea abies*) forest ecosystems in the area of the "black triangle" in Central Europe using the modern methods of image spectroscopy. The health of spruce stands is assessed based on biochemical and biophysical parameters (leaf pigments, lignin, LAI: Leaf Area Index) and modelling their surface gradients on images obtained from hyperspectral data. The current project follows on from research carried out from 1998 to 2004 by the Faculty of Science of the Charles University in Prague in cooperation with the

International Activities and Cooperation

Intensive sheet erosion in the Bilate River floodplain, south Ethiopia (photo by V. Rapprich).

NASA Goddard Space Flight Centre (GSFC). During this research, airborne hyperspectral image data were acquired by the ASAS sensor. A new airborne imaging took place in 2013 and this time, hyperspectral data were acquired using the APEX sensor (Belgian VITO agency). This provided a unique opportunity to compare the changes in the state of health of the spruce stands that took place between the airborne imaging carried out in 1998 and 2013.

Development of algorithms and computing techniques for data mining of spectral based information for ecological and soil mapping

Two teams, the Czech (*Remote Sensing Centre, CGS*) and the Israeli (*Remote Sensing and GIS Laboratory, University of Tel Aviv*), cooperated on this research project focused on introducing new approaches to quantitative analysis and classification of hyperspectral data. The concept of this project targets two fields of development: (i) testing and validation of known linear and non-linear statistical methods using the PARACUDA system (SW/HW platform for automated data processing being developed by the Israeli partner), (ii) creation of new algorithms and scripts in IDL (programming language of the ENVI SW). The new approaches are tested on hyperspectral data acquired during previous common projects, on which both teams cooperated (EO-MINERS, DeMinTIR, HypSo).

The role of Palaeozoic accretionary and collisional orogens in the formation and growth of continental crust (ROPAKO)

Geophysical data from both the European and Asian parts of the Trans-Eurasian Orogen were interpreted during this project. A major part of the results is currently being reviewed for publication in the *Journal of Geophysical Research*. In addition, a new model of the European part of the orogen has been introduced and is in print in the prestigious *Geology* journal. The previously planned comparison of geology from the western part of the European Variscan Belt was carried out during work in the Vosges, the French Massif Central, the Pyrenees and the Moroccan Meseta. Both the numerical and analogue models of relamination of the lower crust are roughly completed and a part has been presented. Magmatic and geochronological evolution of the Trans-Eurasian Orogenic Belt was studied especially on the examples from the Vosges, Bohemian Massif and the Pyrenees. Great attention was given to geochemistry, age and genesis of the Devonian arc developed on the western margin of Brunia. The studies of Mg-K magmatism were supplemented by data from central Vosges and further reviewed using data from the Bohemian Massif. This resulted in creation of a new geodynamic model of eastern Variscides.

Presentation and interpretation of whole-rock geochemical data from igneous rocks – bringing the power of R language to a wider community

The aim of our cooperation with our French colleagues from the University of Jean Monnet in Saint-Etienne (Prof. Jean-François Moyen and Dr Oscar Laurent) was to prepare the monograph titled *Geochemical Modelling of Igneous Processes – Principles and Recipes in R Language* to be published by Springer. In addition to that, the relevant modules were programmed in the R language and the GCDkit system. Geochemical modelling of the petrogenesis of igneous rocks in the R language was the subject of a workshop that took place at the National Geophysical Research Institute in Hyderabad (India).

Projects of the KONTAKT II and INGO II programmes have been run under the terms of the International Research and Development:

- Representation of the CR in the steering bodies of SGA (Society for Geology Applied to Mineral Deposits)
- Representation of the CR in the steering bodies of AAPG (American Association of Petroleum Geologists)
- Membership in the Scientific Committee on Antarctic Research (SCAR) and in the Council of Managers of National Antarctic Programmes COMNAP
- Experimental investigation of ternary systems: silver – metal of the Pt-group – chalcogen

7TH FRAMEWORK PROGRAMME OF THE EUROPEAN UNION

SoilTrEC: Soil Transformations in European Catchments

Three brook catchment areas in the Slavkov Forest with geochemically different bedrocks (granite, serpentinite and amphibolite) form a critical zone observatory of the network for the European project SoilTrEC. The project is aimed at investigation of the zone between the unweathered rock and the treetops. The work involves monitoring of the cycle of water and chemical compounds including Ca, Mg, S, Pb, Cr and Be isotopes, weathering processes and the condition of the soil biota. In 2013, detailed sampling of drill cores and soils and their chemical and mineralogical analyses were carried out. Sampling of atmospheric precipitation, canopy throughfall, soil water at five different depths and surface waters has been ongoing. Data acquired are used for testing of newly developed biogeochemical models (CAST, TEM, PIHM). According to the results of models of climate change, the investigated rivers and catchments will be threatened by evaporation during the next decades, especially on the turn of summer to autumn. Other problems will include exhaustion of nutrients from the soil (shortage of Mg), toxic metals (especially Al) contaminating water on granite catchments and on the other hand, shortage of some other nutrients (K and P) on serpentinite catchments.

Czech-Mongolian expedition team in the basecamp near Somon Munchairchan in the Western Mongolian Altay (photo by V. Žáček)

EO-Miners: Earth observation for monitoring and observing environmental and societal impacts of mineral resources exploration and exploitation

This international project funded from the European Commission (the 7th Framework Programme – FP7) is aimed at monitoring of environmental and social impacts of mining with use of remote sensing. In addition to the Sokolov Basin, which had been chosen as the European testing site, investigations were carried out at the Witbank coal mining area in South Africa and the Makmal gold mine in Kyrgyzstan. On the basis of field trials, parameters indicative of erosional processes and pollution of air, water and soil that could be studied by remote sensing were selected. Maps and information layers based on the results of this research coming from a wide range of satellite (ASTER, WorldView, Quickbird) and airborne hyperspectral data (HyMap, AHS, CASI) are available for the wide public on the official website of the project (*www.eo-miners.eu*).

PanGeo: GMES – Copernicus System for accessing geological information

The international project *PanGeo*, running under the Copernicus (former GMES) and the 7th Framework Programme of the EC, is concerned with the monitoring of hazards caused by vertical movements of the terrain (uplift and subsidence) in the vicinity of large urban agglomerations using radar interferometric methods. The highlight of this project has been an online catalogue of these geohazards for the 52 biggest cities within the EU countries that is available for the public. Two cities from each country have been selected; in the Czech Republic, these were Prague and Ostrava. Using this innovative method (radar interferometry), tens of new polygons with potentially hazardous vertical movements have been identified. The information is available for the wide public on the web portal and map services (*www.pangeoproject.eu*). The Czech team, consisting of the experts from the Remote Sensing Centre, was awarded the 1st prize for presenting the results of this project at the national GIS Esri conference in the Czech Republic in 2013.

SLAvONIC: Effects of soil alteration on nitrogen and carbon cycling

Despite being regarded as some of the most natural ecosystems, forests of Central Europe are facing a marked oppression from the human kind. Some of the most significant changes in the forest function are connected with man-induced acidification of forest soils (acid rains in the 20th century), eutrophization (accumulation of nitrogen from atmospheric deposition) and long-term economic management (change in the natural species composition of woody plants). Simultaneously, forests are perceived as ecosystems capable of capturing carbon from the atmosphere and thus helping mitigation of impacts of climate change. The mission of the SLAvONIC project is to study the carbon and nitrogen cycles in forest soils (dissolved and gas phase) in a spruce and beech forest in dependence on experimentally modified conditions. Modifications in the chemical composition of soils include (1) acidification – increasing deposition of sulphur, (2) eutrophization – increasing the

International Activities and Cooperation

Obří skály ("Giant rocks", 1,081 m a.s.l.) in Hrubý Jeseník Mts, one of the sites on the Sudetes Georoute (photo by J. Večeřa).

deposition of N and (3) combined effect of acidification and eutrophization. The main aim of the project is to assess the ability of forest soils to capture carbon and nitrogen and to simulate key processes influencing the transformation of the soil organic mass using biogeochemical models.

Minerals4EU: Minerals Intelligence Network for Europe

The CGS is one of the cooperating partners in a consortium which brings together 31 partner organizations (mostly geological surveys) from 24 European countries. Between 1st September 2013 and 15th August 2015, it will attempt, along with its other partners, to overcome Europe's major disadvantage – the lack of knowledge of the amount, kind and location of raw material resources that are at diposal on its territory. The identical problem is encountered with the secondary resources, which, besides the raw materials, will also be targeted by the project. The project shall, therefore, draft the raw materials data collection pattern, the method of processing those data, including the follow-up forecast studies, prepare a web portal for data publication and a European minerals year-book.
Between the 16th and 17th September 2013, our representatives (see photo) participated in a project kick-off meeting that took place in the headquarters of the chief coordinator, Finnish GTK, in Espoo near Helsinki. Further project-related meetings focused in partilular on information collection and evaluation, were held with an active participation of the CGS representatives on the 26th–27th November 2013 at BRGM in Paris and on the 5th December 2013 at BGS in Keyworth near Nottingham.

PROJECTS RUNNING UNDER THE OPERATIONAL PROGRAMME OF CROSS-BORDER COOPERATION

Sudetes Georoute – geological tourist guidebook, cooperation with Poland

The project was commenced in July in 2010 under the terms of the Operational Programme Cross-Border Cooperation CR-PR

2007–2013 in the field of Support of Development of Business Environment and Tourism and was completed in July 2013. One of the main aims of the project was to introduce touristically interesting geological objects along the Czech-Polish border. Over 600 km long Georoute runs along the mountain ridges of the Sudetes from Bogatynia in the west to Opava in the east, alternately on the Czech and Polish side of the border. During this project, 21 bilingual Czech-Polish information boards were created and installed along the trail; of these, 11 were on the Czech and 10 on the Polish side. Other achievements were publishing 42 brochures (21 in Czech and 21 in Polish) and the geological-tourist guidebook in 3 different language versions (Czech, Polish and English). These illustrate approximately 300 geotouristic sites on both sides of the Czech-Polish border. Finally, the project's official website *www.geostrada.eu* was launched.

ArchaeoMontan, cooperation with the Free State of Saxony

In 2013, work followed on the previous stages of the *ArchaeoMontan* project. The principal activity was the detailed investigation of the Kremsiger locality together with archaeologists, and field geological and mineralogical research of other localities in the environs of Černý Potok, as well as on other localities in the studied area (Horní Halže, Měděnec, Kovářská). Data from the LIDAR airborne imaging enabled us to find other, from the greater part aplanated old workings. The highlight of this year was a workshop organized by the CGS in Jáchymov along with a field excursion to the Kremsiger locality (near Černý Potok). The most significant scientific event, besides the fieldwork, however, was the conference titled *Krušná krajina* ("Harsh Landscapes" – derived from the Czech name for the Ore Mountains, Krušné hory, which in literal translation means "Harsh Mountains", translator's note) held in Kadaň on the 26th–28th September 2013.

INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMMES OF UNESCO (INTERNATIONAL GEOSCIENCES PROGRAMME – IGCP)

Geologists from the CGS continued in participation on several IGCP projects in 2013. These were focused on demanding programmes for correlation of geological phenomena throughout all continents.

IGCP Project 575 – THE PENNSYLVANIAN TERRESTRIAL HABITATS AND BIOTAS IN SOUTHEASTERN EUROPE AND NORTHERN ASIA MINOR AND THEIR RELATION TO TECTONICS AND CLIMATE.
IGCP Project 580 – APPLICATION OF MAGNETIC SUSCEPTIBILITY ON PALEOZOIC SEDIMENTARY ROCKS.
IGCP/SIDA Project 594 – IMPACT OF MINING ON THE ENVIRONMENT IN AFRICA.
IGCP Project 591 – THE EARLY TO MIDDLE PALAEOZOIC REVOLUTION.
IGCP Project 596 – CLIMATE CHANGE AND BIODIVERSITY PATTERNS IN THE MID-PALEOZOIC.
IGCP Project 624 – ONE GEOLOGY.

INTERNATIONAL CONTRACTS

The AMIRA-WAXI project: Mineral potential of Western Africa. Requested by IRD Toulouse, France

In 2013, the project targeted 3D modelling of distribution of gold and accompanying elements in regolith and fresh rock. These models showed that the distribution of metals in regolith was determined mainly by the geochemical character of primary mineralization. Due to the sorption of metals and semimetals on iron hydroxides and manganese in tropical soils, elements do not migrate dramatically in regolith, with the exception of zinc and silver. Isotopic composition of copper, zinc and lead in a gossan was studied in the Perkoa lead and zinc ore mine in Burkina Faso.

INTERNATIONAL MEMBERSHIP

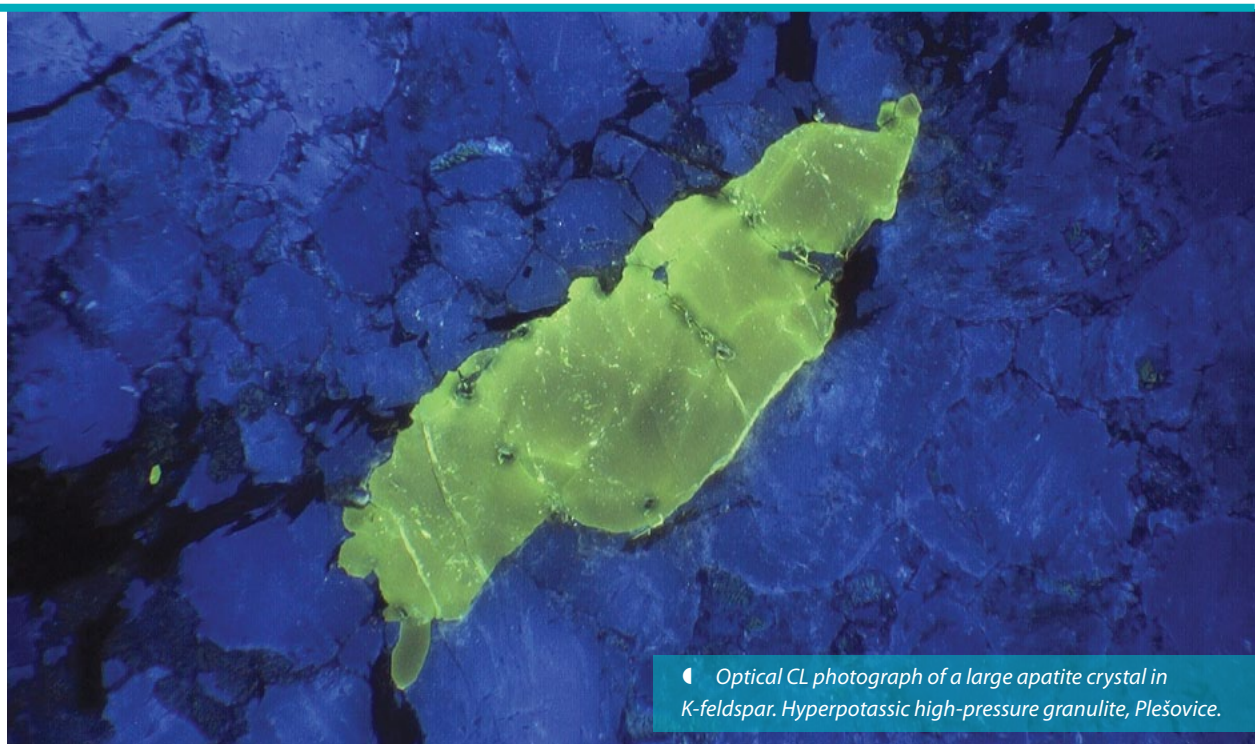
EuroGeoSurveys – gathering of 32 European geological surveys
ICOGS – International Consorcium of Geological Surveys
Central European Initiative – gathering of Central European geological surveys: Czech, Slovak, Austrian, Hungarian, Polish and Slovenian
ENeRG – European Network for Research in Geo-Energy (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 (President of the European Region V. Dvořáková).
INQUA – International Union for Quaternary Research
ProGEO – European Association for the Protection of Geological Heritage
KBGA – Carpatho-Balkan Geological Association
EAGE – European Association of Geoscientists and Engineers; affiliated member is the Czech Association of Applied Geophysicists (member of the steering committee D. Čápová)
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

Věra Zoulková
Head of the Central Laboratory in Prague

Juraj Franců
Head of the Central Laboratory Brno

Vojtěch Janoušek
Deputy Head of the Department of Rock Geochemistry

Laboratories



Optical CL photograph of a large apatite crystal in K-feldspar. Hyperpotassic high-pressure granulite, Plešovice.

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.

CENTRAL LABORATORY BRNO

The Central Laboratory Brno focuses on organic and gas geochemistry and has been accredited since 2013.

Rocks and crude oils

The rocks and soils are best described by means of the organic and mineral carbon and total sulphur analyses. Selected samples of rocks and crude oil are subjected to analysis of the molecular composition of extractable compounds, especially biomarkers indicating biological origin of organic matter from deciduous

and coniferous trees or algae. Reflected and fluorescence light microscopy provides characteristics of organic petrographic constituents, such as pollens, cuticles, plant tissues and their remains left after forest wildfires. Vitrinite reflectance is measured and used in models of thermal history of sedimentary basins, burial depth and 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 ratio are presented in the form of environmental load maps.

Gases

Field measurements of gas composition are carried out using Ecoprobe 5 and Draeger portable instruments. Detailed accredited chromatographic quantitative analysis determines 20 compounds including helium and argon. These measurements are combined with the analysis of isotopic composition of carbon in the methane and higher hydrocarbons (see laboratory at Barrandov workplace).

Projects

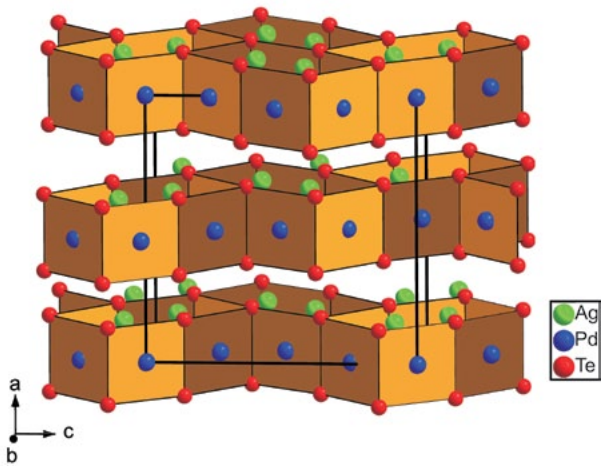
The organic matter investigations in the sedimentary units of the Bohemian Massif, the Carpathians or the Moesian Platform in Romania are utilised to interpret the changes in the palaeoenvironment and the palaeoclimate recorded in the geological archives of those sedimentary units. The hydrocarbon systems in the Czech Republic and abroad are investigated from the viewpoint of oil and gas source rock potential, thermal history and correlation of liquid and gaseous fluids with rock bitumens.

Methane and CO_2 containing gases are sampled and analysed within projects sponsored by Green Gas DPB, RWE and Nafta Co. and interpretations are made concerning their origin, geochemical affinity, mixing and degradation. Based on the geochemical correlation of the gases, gas-tightness is checked in the underground gas storage reservoirs and monitoring of gas leakage from soil into the atmosphere is carried out in cooperation with the sponsors.

Cooperation with MU-RECETOX resulted in two publications on the mineralogical characteristics of fly-ash nanoparticles in IF journals. These particles act as organic pollutants (POPs) and heavy metal sorption agents which penetrate through imperfect filtration systems into organisms, thus augmenting toxic effects.

SPECIAL LABORATORIES

Special Laboratories represent the core of the Department of Rock Geochemistry providing a wide variety of analytical facilities. X-ray diffraction (XRD) is an indispensable method for determining the lattice structure of crystalline solid materials and for phase analysis of geologic 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 select physico-chemical properties.



Crystal structure of the mineral sopcheite, $Ag_4Pd_3Te_4$.

Sample collection and field documentation in the Mt. Reece area (Antarctic Peninsula, Graham Land).

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 backscatter diffraction (EBSD) attachment.

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 multiple collector inductively coupled plasma-mass spectrometer (MC ICP-MS) are capable of measuring the isotopic composition of relatively heavy elements applicable to petrogenetic and geochronological studies. 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 of the Special Laboratories are not only responsible for providing primary data, but also they are often renowned scientists, taking an active part in multidisciplinary projects, regularly publishing their results and involved in teaching activities. In 2013, they published 8 articles in geological journals with an IF and were co-authors of 16 other, which represents 35% of the overall annual production of the Czech Geological Survey.

Hana Breiterová

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

Library and Collections

The services of the Library and Collections are utilized not only by specialists from the Czech Geological Survey and other scientific institutions, but also by students, private researchers, and the general public. Researchers can use two well-equipped, modern study rooms to consult and examine materials from the holdings of the Library and Collections of the CGS.

LIBRARY

The CGS Library is the largest geological library in the Czech Republic. In addition to running its own databases, it provides access for all registered readers to the worldwide fulltext (Science Direct, SpringerLink, Willey Interscience, Blackwell, Geoscience World) and bibliographic databases (Web of Knowledge, Scopus, Georef and Geobase, Environment Complete). The resources of electronic information held by the CGS Library are the most extensive of all the libraries administered by the Ministry of the Environment.

Other activities of the Library

Besides standard activities related to Library services, its staff participates in data processing and submission to the Register of Information of the R&D&I Council. The geological bibliography of the current and retrospective annual reports is in progress.

The year 2013 saw a partial transfer of holdings from the shut down library of the Ministry of the Environment (MoE) to the premises of the CGS. The first step was identifying books and documents to be taken over by the CGS Library. These were bagged and incorporated in the catalogue and prepared for the transfer. The conversion of the catalogue to the library system used by the CGS was achieved in April 2013 by creating a separate database indexed as ENVI, after a thorough preparatory work. The index rows have been preserved and prefixed with ZP signage. The remaining part of the MoE holdings has been offered to other libraries administered by the MoE. Basic reference literature and the current volumes of environment-related, not lent-out periodicals, have been made

accessible to "reference" studies in the CGS study room. The periodicals are a basic source for bibliography compilation from the environment-related scientific subjects. Internet access has enabled an easy search for any item from the library holdings. In order to accommodate the holdings comprising around 200 thousand items, it was necessary to equip the shelves with a new storage system. This was accomplished towards the end of 2013. To set up a well-organized access service to publications of the former MoE library, it will be necessary to refit all the repositories. A logistic support has been prepared for the holdings transfer into new stacks which is to take place in January 2014.

COLLECTIONS

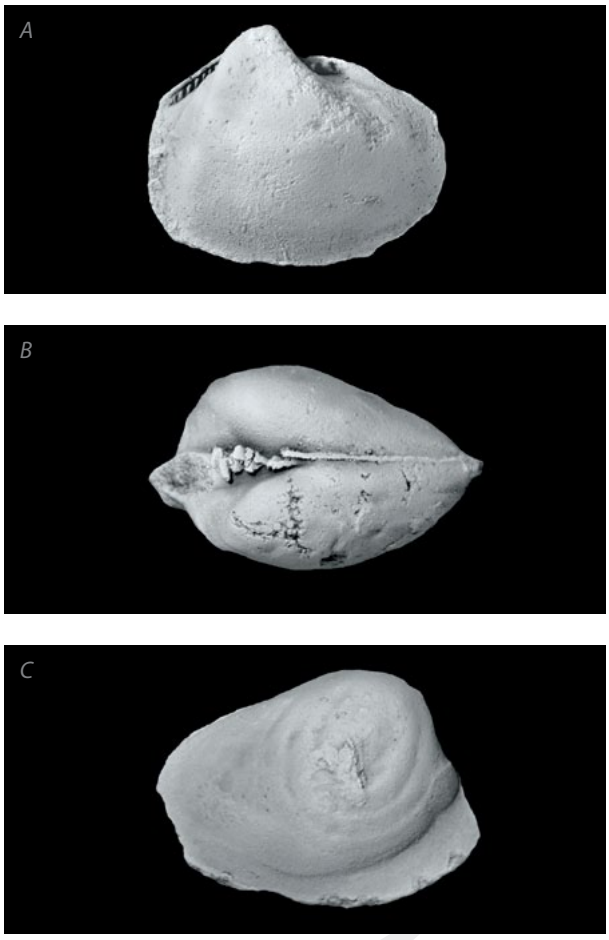
The Department of Geological Collections stores and provides access to fossils, samples of minerals and rocks, drill cores, thin sections and other geological documentation collected by researchers from the CGS, from other institutions and by private collectors during field work. The most valuable specimens from the scientific point of view are located in the geological, mineralogical, and palaeontological collections. Selected material from the collections is stored, made accessible and registered in the CES national register under the terms of Act No. 122/2000 Coll. and Decree No. 275/2000 Coll. These specimens are stored, made accessible and lent under strict conditions defined by the regulations quoted above. Material documentation (geological and palaeontological samples from geological mapping, drill cores and thin sections) is stored under the terms of Act No. 62/1988 Coll., amended by Act No. 66/2001 Coll.

Significant new acquisitions to the CGS Collections

The handing over of Silurian and Devonian bivalves from the collection of Dr Kříž to the CGS continued during 2013 and is now nearly complete. This collection of over 16,000 Palaeozoic bivalves is one of the largest and the most scientifically important in the world. The Czech Geological Survey is honoured to have acquired this collection and to be responsible for making it accessible to the wider community of palaeontologists as well as the scientific staff of the CGS. It is necessary to mention the phytopalaeontological material of Permo-Carboniferous age from the Czech Republic and Portugal donated by Dr Šimůnek and a series of smaller, nevertheless, very important donations from various collectors (V. Kozák, M. Polechová, M. Szabad, A. Hanák, R. Šach and Z. Tasáryová). The work on the CGS project No. 335400 involved continuous evaluation of an important fossil material from Antarctica. This material, together with other acquisitions, have been filed in the Central Register of Collections of the Ministry of Culture of the Czech Republic. The curatorial work containing a total of approximately 300,000 items was accompanied by an intensive publication activity.

Towards the end of 2013, an extensive study titled *Draft concept of a further development of the stores of material and written documentation of the CGS* (Štrupl *et al.* 2013) was prepared. The study sets goals of a mid-term storage of documentary material in the depositories of the CGS. It also proposes solution of problems related to rather unsatisfying conditions of samples storage in the Lužná u Rakovníka site.

Explanations to photograph:
Accumulation of trilobites Dalmanitina socialis *(Barrande, 1846). Vráž u Berouna, Upper Ordovician, Sandbian, Letná Formation. The 19th century quarry-men cemented more complete trilobites onto such accumulations in order to hike their price. Even though a portion of these trilobites is cemented, they are probably original specimens, their broken pieces or fragments, possibly with exception of the right upper corner of the sample. The specimen comes from former collections of the Czech Technical University (former Deutsche Technische Hochschule), donated to the Czech Geological Survey in the 1960s. The specimen is catalogued under No. p 4943.*



Bivalves (molluscs) from the CGS Collections.
A – Praenucula bohemica *(Barrande, 1881), CW1, internal mould of the right valve with preserved hinge, Osek, Middle Ordovician, Šárka Formation.*
B – Pseudocyrtodonta obtusa *(Barrande, 1881), JK14834e, internal mould with preserved hinge, dorsal view, Praha-Spořilov, Upper Ordovician, Zahořany Formation.*
C – Pseudocyrtodonta obtusa *(Barrande, 1881), JK14834e, internal mould of the right valve with preserved anterior muscle scar, Praha-Spořilov, Upper Ordovician, Zahořany Formation.*

Milada Hrdlovicsová
Head of the Department of Geological Documentation

Geological Documentation

Map Archive.

The staff of Geofond, which is the Czech national geoscience data centre, 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 on geological work and geological documentation. These data are managed and made available in professional records of the Geoscience Information System.

ARCHIVES

In 2013, research report and expert advice report holdings of the originally independent professional archive of the Czech Geological Survey and that of Geofond, merged. This has resulted in the centralization of the professional archive service. Besides relocating a part of the holdings and facilitating document lending, a data conversion was carried out. Over 16 thousand records were upgraded and transferred under the uniform ASGI system, which was paralleled by sorting out mutually duplicate documents.

Geofond Archive is a specialized body that archives and provides access to 240 thousand pieces of geoscience documents, redistributed according to subject themes. In 2013, under the terms of the Public Records Act, approximately 3,000 new records and bespoke expert advice records were deposited in the archive. In addition, the holdings have been expanded by depositing over 1,500 documents from revised archival sources. The results of the CGS research activities are deposited in an independent index. After being professionally evaluated, the information on the documents is made available for parametric browsing in the ASGI application.

Map Archive collects in-house produced geological maps and also manages geological map documents acquired from other sources. The available geoscientific map datasets have been continuously updated and range from the core Czech geological data to overseas geoscientific map products. An extensive dataset

of mining maps is an independent part of the Map Archive and is gradually complemented with selected thematic maps from the National Archives holdings. All map datasets are searchable online.

Archive service and digitization of archives holdings

The archive holdings are utilized as an information support for the needs of government bodies, for the professional and general public, schools and academia. In 2013, more than 10,000 documents were provided by request to readers in the study room, and a sizeable set of documents could be studied in digital form. A systematic digitizing of archival holdings has been underway at specialized work places in Prague and Brno. The main goal is, in particular, the storage and securing future use of relatively old and unique geological manuscripts. Approximately 2.6 million pages of research and expert advice reports have been digitized until now. Over 80 thousand map documents are also available in digital form.

MATERIALS COLLECTIONS GEOFOND

In a special filing system of sample containers, the CGS repositories hold a continuously complemented set of over 30 thousand meters of collected geological materials available on demand. It is an extraordinarily valuable complex of rock samples in the form of cuttings or coherent drill-cores from structural and other important boreholes.

BOREHOLE LOGS, HYDROGEOLOGICAL DATABASE, GEOPHYSICAL RECORDS AND ARCHIVES

Information on geological exploration activities in the Czech Republic are stored in individual professional datasets based on point-diagram or planary-diagram systems. The fundamental data are available in the web map service application GISViewer, simple data outputs are provided within pre-paid eEarth and eWater online services. Complex outputs involving interaction of individual datasets are provided on demand.

Geologically documented objects dataset – GDO contains basic information on geological exploration works. It is the most comprehensive dataset with more than 684,000 objects.

Borehole, shaft and well record dataset – GEO contains lithological descriptions with depth and thickness data. In 2013, data on more than 3,500 objects were added into the dataset.

Hydrogeological database – HYD contains more detailed hyrogeological data including information on hydrogeological measurements, analyses and tests. The data are being continually upgraded, almost 93,000 objects are deposited here at present.

Technical parameters of well drilling dataset – TECH involves information on well construction and casing parameters for nearly 3,500 boreholes.

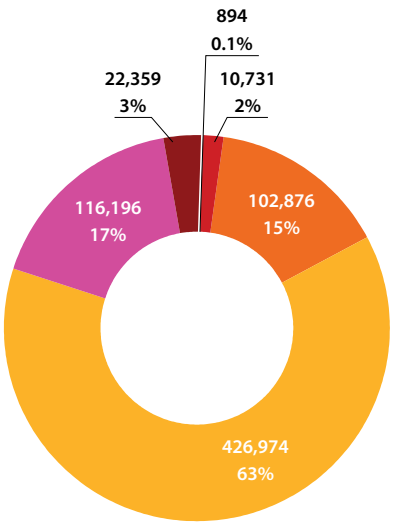
Drill logging dataset – KAR contains digitized drill-logging data from more than 5,300 boreholes and directional log data from more than 2,800 objects.

Groundwater data and information dataset contains data on the groundwater reserve estimation polygons and data on the regional hydrogeological resource evaluation polygons.

Geophysical exploration dataset contains information on the gravity, seismic, petrophysical and other geophysical measurements carried out on the Czech territory since 1950.

Drill core library.

Geologically documented objects (GDO) according to their purpose



Patrik Fiferna
Head of the Publishing House of the CGS

Publishing House and the Promotion of Geology

The Czech Geological Survey actively participated in the Czech Nature fair, within the frame of the year-round campaign of the same name, organized by the Ministry of the Environment. The fair took place between 19th and 20th April 2013 in the Nations House in Vinohrady, Prague. The people who attended the CGS exhibition stand were captivated mainly by exclusive samples of rocks and minerals.

Publishing scientific books, journals and maps has been an essential activity of the Czech Geological Survey since its foundation. During the past twenty years, over a thousand publications have been published. Nowadays, a wide range of educational and promotional activities take place alongside publishing. The public is informed and addressed by means of geoscientific exhibitions, fairs, conferences and popular educational competitions. Information is accessible at the Information Portal of the Czech Geological Survey, which is being improved and becoming more and more attractive and is visited annually by over 70 thousand unique users.

Publishing activity

In 2013, the Czech Geological Survey released 56 titles in total as a result of its publishing activity, work on various projects and commercial activities. This is so far the highest number in its history. Owing to this, the Survey has recorded the highest revenue made by its Geological Bookshop.

Since April, the Publishing House of the Czech Geological Survey has been the chief coordinator of the project called *Discoveries are waiting for you* which is run within the Operational Programme – *Competitiveness through education*. It targets grammar-school and high-school students attending almost 35 natural history clubs all over the Czech Republic. In addition to field trips, workshops, e-learning and further geology-oriented project activities, the Publishing House prepares, at regular monthly intervals, educational, geosphere-related materials that serve the needs of children as well as teachers.

Publishing of individual sheets of the Geological Regional Map of the Czech Republic at 1:25,000 scale with explanatory notes continued in 2013. Map sheets 03-342 Rovensko pod Troskami, 03-324 Turnov, 03-413 Semily, 03-431 Lomnice nad Popelkou and 03-341 Kněžmost have been released.

Promotion of geology

The Czech Geological Survey actively attended the *Czech Nature* fair during the joint conference of the Czech Geological Society and the German Geological Society in Plzeň, the 1st conference of the National Geopark at Chodová Planá and the Autumn Book Fair at Havlíčkův Brod. As in previous years, we were coorganizing the Week of Science and Technology, the largest science festival in the Czech Republic, and acted as a partner institution of the Liberec GIS Days. The Geological Bookshop organized four exhibitions: *Palaeontology in philately, The Maya Calendar, A journey to Galicia* and *Through the desert and sand of the biblical landscape*. In addition, the Czech Geological Survey organized the seventh art-design competition called *My Piece of Earth*.

The visitors of the Geological Bookshop of the CGS are offered diverse maps and geoscientific publications, fieldwork equipment, as well as tools for sample processing. In addition, the CGS Bookshop became a respectable venue for various cultural events, such as launches of books and exhibitions of pictures, photographs or unique rocks and minerals.

In order to raise the awareness of the activities and mission of the Czech Geological Survey, a ten-minutes film has been shot and is available online on the CGS website.

The project Sudetes Georoute – geological tourist guidebook *involved publication of 3 books, 11 guidebooks with geologically interesting features and compilation of 21 bilingual information boards, placed along the Georoute.*

Within the project Discoveries are waiting for you, *an information portal called* World of Geology *has been created. It encompasses a variety of geoscientific information in an intelligible form, attractive for children as well as for teachers.*

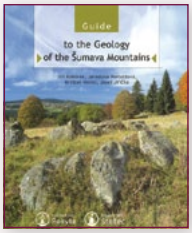
The Open Day and a tour of CGS workplaces are a suitable occasion for the general public and schoolchildren to be informed about the work of specialists active in various geoscientific disciplines.

Activities within the project Discoveries are waiting for you *such as the educational workshops at schools are widely attended. Geologists of the CGS make the children familiar with a variety of their activities and their experience. The workshops covered topics like volcanoes, geological studies conducted by the CGS in Antarctica, fossils or landslides.*

Publications Issued by the Czech Geological Survey

BOOKS AND PERIODICALS

Z. Petáková, A. Bauerová
Legacy of Emilie Strejčková



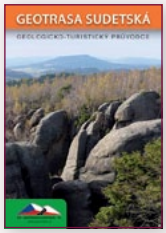
J. Babůrek, J. Pertoldová, K. Verner, J. Jiřička
Guide to the Geology of the Šumava Mountains

J. Buchner, V. Rapprich, O. Tietz
Basalt 2013, Cenozoic Magmatism in Central Europe – Abstracts & Excursion Guides

J. Starý, J. Novák, A. Horáková, J. Mojžíš, J. Novák ml.
Register of Mineral Deposit Reserves of the Czech Republic as of January 1st, 2013 – Non-Reserved Mineral Deposits

J. Marek, R. Šarič, P. Kácha
Joachim Barrande – Říkali mu jemnostpán, People called him gentle man, On l´appelait Monsieur Barrande

J. Starý, J. Novák, A. Horáková, J. Mojžíš, J. Novák ml, L. Richterová
Register of Mineral Deposit Reserves of the Czech Republic as of January 1st, 2013, Part I – Deposits of Ores, Trace Elements, Part II – Fuel and Energy Resources



Š. Mrázová, D. Skácelová, J. Otava, V. Pecina, M. Rejchrt, Z. Skácelová, J. Večeřa, A. Stachowiak, S. Cwojdziński, S. Ihnatowicz, J. Pacula
Sudetes Georoute – geological tourist guidebook

J. Starý, J. Novák, J. Mojžíš, J. Novák ml.
Register of Mineral Deposit Reserves of the Czech Republic as of January 1st, 2013, Part III – Reserved Nonmetallic Deposits

Sudetes Georoute – geologically interesting features

Š. Mrázová
1 Hejnice

Š. Mrázová
8 Horní Maršov

M. Rejchrt
9 Teplice nad Metují

V. Pecina
13 Staré Město

J. Večeřa
14 Branná

V. Pecina
15 Žulová

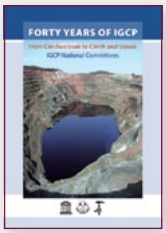
J. Večeřa
17 Zlaté Hory

J. Večeřa
18 Andělská Hora

Z. Skácelová
19 Bruntál

J. Otava
20 Budišov nad Budišovkou

J. Otava
21 Opava

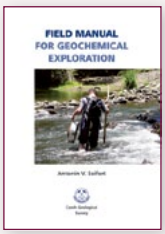


J. Pašava, A. Vymazalová
Forty years of IGCP – From Czechoslovak to Czech and Slovak IGCP National Committees

L. Rukavičková, J. Holeček, V. Bláha, T. Pačes
Methodology of water pressure tests in hard rock environment with low permeability

J. Starý, P. Kavina, I. Sitenský, T. Hodková
Changes in Reserves of Reserved Mineral Deposits 2003–2012

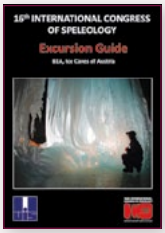
V. Čechová (ed.)
Geoscience Research Reports for 2012



A.V. Seifert
Field Manual for Geochemical Exploration

M. Opletal, K. Pošmourný, V. Pecina, J. Večeřa, J. Aichler
Geology of the Protected Landscape Areas in the Czech Republic – Jeseníky

16th International Congress of Speleology



D. Havlíček, I. Herglová, P. Vojtíšek
Excursion Guide, B1CZ, Show caves and UNESCO monuments in the Czech Republic

P. Polák
Excursion Guide, B2CZ , A2CZ, Caving in the Moravian Karst

J. Otava, R. Morávek
Excursion Guide, B3CZ, A3CZ, The most interesting karstological phenomena of Moravia

K. Žák, A. Komaško, V. Bláha, L. Falteisek
Excursion Guide, B5CZ, Bohemian Karst

L. Plan, K. Glitzner, T. Pfarr
Excursion Guide, B1A, Ice caves of Austria

S. Leel-Ossy, N. Fleck
Excursion Guide, B1H, Budapest hydrothermal caves

B. Vogel, J. Duckeck, A. Wolf
Excursion Guide, B2D, Caves and castles between Munich and Brno

M. Olenici, P. Lacobas
Excursion Guide, B1RO, Caves and karst in Apuseni Nature Park

M. Ferk, J. Tičar, A. Mihevc, M. Staut
Excursion Guide, B1SL, Speleological excursion to the Dinaric Karst of Slovenia

M. Ferk, J. Tičar, A. Mihevc, M. Staut
Excursion Guide, B2SL, Sport caving in the Caves of the Dinaric Karst of Slovenia

M. Piškula, J. Štětina
Excursion Guide, A7CZ, Cave diving Camp

P. Bella, Ľ. Gaál, P. Gažík, D. Haviarová, V. Papáč, Z. Višňovská, J. Zelinka
Excursion Guide, A1SK, Show caves in Slovakia

L. Vlček
Excursion Guide, A2SK, Karst, caves and caving in Slovakia

P. Holúbek, G. Lešinský
Excursion Guide, A3SK, Excavation in the caves of Slovakia

C. Egri, N. Fleck
Excursion Guide, A2H, Aggtelek Karst

V. Kompaniyets
Excursion Guide, A1UA, Gypsum karst in Podolie

J. Adamovič, P. Migoń, Z. Gołąb, J. Kopecký, O. Jenka, J. Mertlík, V. Peša, P. Havránek, J. Kukla, A. Komaško
Sandstone Caves and Rock Cities of Bohemia

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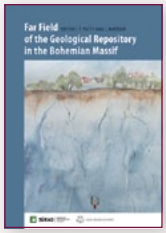

T. Pačes, J. Mikšová
Far Field of the Geological Repository in the Bohemian Massif

P. Gürtlerová
The sandstone rock towns in the Czech Republic

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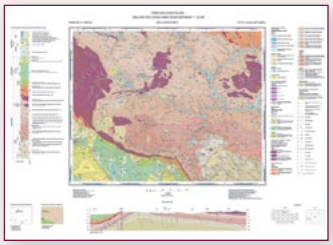
Issued both in Czech and French version.
Issued both in Czech and Polish version.

MAPS

Geological Base Map at 1:25,000 scale with explanatary notes

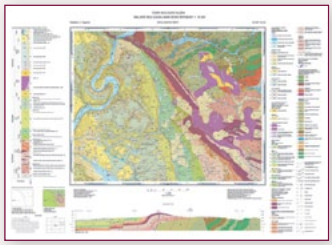
S. Čech *et al.*
03-342 Rovensko pod Troskami

MAP OF THE YEAR 2013



M. Stárková *et al.*
03-431 Lomnice nad Popelkou

MAP OF THE YEAR 2013

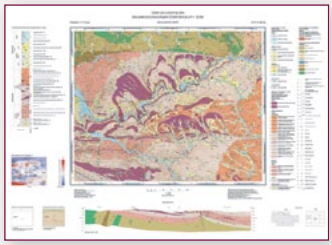


V. Rapprich *et al.*
03-324 Turnov

MAP OF THE YEAR 2013

J. Valečka *et al.*
03-341 Kněžmost

MAP OF THE YEAR 2013

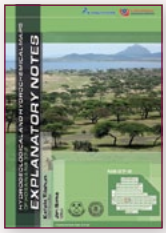


V. Prouza *et al.*
03-413 Semily

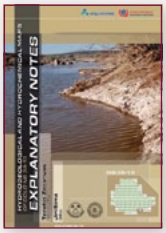
MAP OF THE YEAR 2013

In the 16th year of the prestigious cartographic competition, the series Geological Base Map of the CR at 1:25,000 – Bohemian Paradise UNESCO Geopark *(L. Švábenická* et al.*) gained the award "Map of the Year 2013" in the category "Atlases, Map Sets and Map Series".*

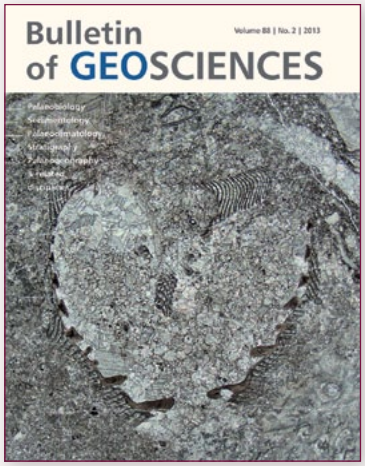
Explanatory notes



K. Tilahun, J. Sima
Hydrogeological and hydrochemical maps of Hosaina NB 37-2



T. Zecariyas, J. Sima
Hydrogeological and hydrochemical maps of Dolo NB 38-13



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.

Since 2001, the Bulletin has been publishing papers in English only. 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. During the past five years, 284 scientists from 37 countries published the results of their research in the Bulletin.

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 2013 is 1.495.

The Czech Geological Survey is a co-publisher of the Journal of Geosciences (*www.jgeosci.org*) released by the Czech Geological Society with the grant support of the Council of Scientific Societies of the Czech Republic and the Czech Literary Fund Foundation. Being a periodical with a long tradition (59th 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 thematic issues are also published. Two such issues were released in 2013, one dealing with the pegmatite mineralogy and geochemistry and the other one with the genesis of mineral deposits (on the occasion of prof. Pouba's unfulfilled 90th birthday). The journal maintains a high scientific standard and is indexed by a number of databases, including the prestigious Web of Science, Scopus and GeoRef. Thanks to this fact, the Thomson Reuters society awarded the journal an impact factor, reaching 0.804 in 2011.

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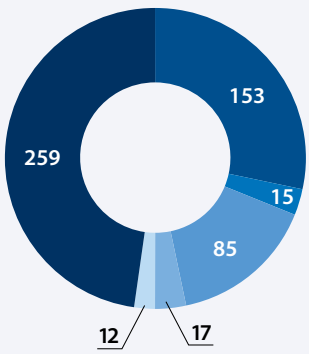
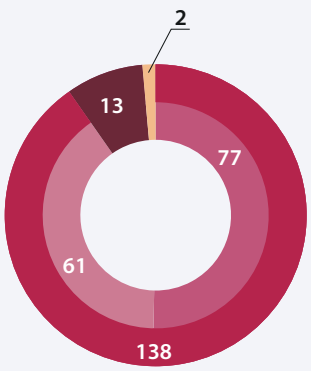


Total publishing activity

- Papers in journals, total
- Papers in reviewed proceedings
- Papers in unreviewed proceedings
- Scientific book
- Chapter in a book
- Maps



Number of papers in journals

- Articles in peer-reviewed journals
  - in journals with impact factor
  - in journals without impact factor
- Papers in unreviewed scientific journals
- Articles in popular scientific periodicals and newspapers

Zdeněk Cilc

Head of the Economic Division
and Deputy Director for Economics

Financial Review

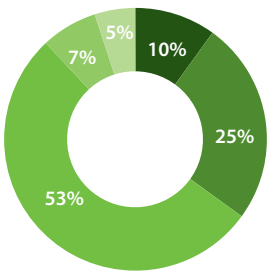
In 2013, the management and staff have been successful in fulfilling the main tasks and priorities of the Survey:

- The projects implemented as a part of the Survey's statutory duties were successfully completed.
- Top ratings were achieved in the assessment of the research activities carried out by the Survey and individual members of the scientific staff. Applications for research funds encountered a high level of success.
- Attention was given to maximizing the scientific output from the current projects and innovative proposals for new external projects and contracts were prepared to attract the funding required for the scientific activities and services of the CGS to continue and develop.
- A positive balance of income against expenditure was achieved in 2013.

Despite the success achieved, it remains a constant challenge to secure systematic funding of projects while fulfilling the duties of the state geological survey in cooperation with its parent organization, the Ministry of the Environment.

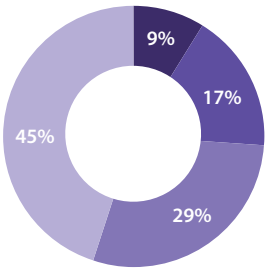
The top priority of the Czech Geological Survey at present is the completion of the project *Review of Groundwater Resources* by the end of the year 2015. This project is supported by a major grant from the State Environmental Fund.

The Czech Geological Survey, as a partly state-funded body, represents at present the optimal way of carrying out the duties of the state geological survey in the government administration. Except for the financial support for its operation and the funds allocated by its parent organization for maintenance and development of its assets, the Survey draws 70% of financial resources from carrying out its professional scientific activities.



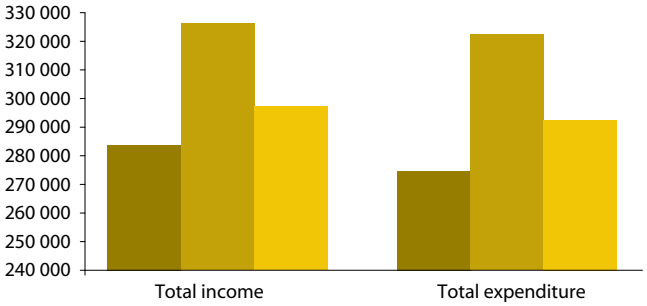
Percentage distribution of expenditure in various categories for 2013

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



Percentage distribution of income in various categories for 2013

- Revenue generated from own resources
- Allocations for activities of the organization
- Institutional Research and Development
- Projects



Total income and expenditure (in thousands CZK)

- 2011
- 2012
- 2013

The disproportion between 2013 and 2012 is caused by total drawing of grants and expenditure of external projects.

OVERVIEW OF MAIN INDICATORS OF PERFORMANCE (IN THOUSANDS CZK)

Year	2013	2012 *	2011	2010	2009
INCOME GENERATED BY CGS ACTIVITIES	27 698	28 859	40 535	43 623	48 034
of this: revenue from sale of own products and services	12 497	10 009	13 618	14 257	13 945
revenue from sale of property and material	581	84	499	562	38
activation of internal services	0	0	8 854	10 621	18 715
change in inventory	0	0	1 098	493	521
clearing account for funds	2 697	8 374	11 446	3 878	4
other income	11 923	10 392	5 020	13 812	14 811
OPERATIONAL GRANT	269 521	297 443	243 247	210 081	208 493
of this: 1) from the Ministry of the Environment	111 604	148 387	194 651	181 934	177 853
of this: allocation for activities of the organization	49 576	58 490	35 457	36 982	40 113
for institutional Research and Development	0	0	97 083	76 011	78 204
special R&D projects	0	1 137	16 346	26 328	23 118
ISPROFIN	24 669	41 817	30 736	20 207	1 725
other (geological activities)	14 318	14 019	4 036	6 884	9 996
other NAR + Norway (lim)	7 030	28 924	9 064	9 386	22 448
from other sources (Norway + OP)	16 011	4 000	1 928	6 136	2 249
2) from other sources (from state budget)	118 885	122 908	25 033	11 085	14 097
of this: for R&D	118 861	121 619	22 971	11 085	14 097
3) income from specific grants to individual researchers	9 258	9 617	20 006	13 580	9 401
of this: for R&D	9 258	8 787	20 069	13 580	9 401
4) foreign funding	10 208	11 355	3 557	3 482	7 142
5) income from SEF	525	2 060			
accrued items	19 041	3 116			
TOTAL INCOME	297 219	326 302	283 782	253 704	256 527
ECONOMIC OUTCOME	4 710	3 845	9 043	91	2 773
TOTAL EXPENDITURE	292 509	322 457	274 739	253 613	253 754
of this: material and power consumption	28 347	30 494	26 769	23 922	22 431
services	72 769	94 472	66 543	70 147	83 677
change in inventory	–379	–707			
total costs of personnel	157 116	164 183	144 239	127 327	129 451
depreciation of tangible and intangible assets	20 498	22 248	15 011	12 190	12 563
taxes and fees	339	283	254	193	319
other expenses	13 819	11 484	21 923	19 834	5 313
INVESTMENTS	22 826	18 799	20 508	20 249	59 410
of this: construction work	2 791	3 750	7 338	3 162	40 071
other expenditure: tangible assets	19 570	13 750	10 340	16 562	18 938
other expenditure: intangible assets	465	1 299	2 829	525	401
FINANCING INVESTMENTS	22 826	18 799	20 508	20 249	59 410
1) grant from the Ministry of the Environment	22 372	18 018	12 620	17 751	55 461
2) from own resources	454	781	7 888	2 498	3 949

* *in 2012 including former CGS – Geofond*

Helena Žemličková
Head of the Human Resources Section

Human Resources

In 2013, the Czech Geological Survey had a total of 346 employees, the equivalent of 307.41 persons working full-time (the employees taking parental leave or maternity leave are not included).

The Survey 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 oportunity 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.

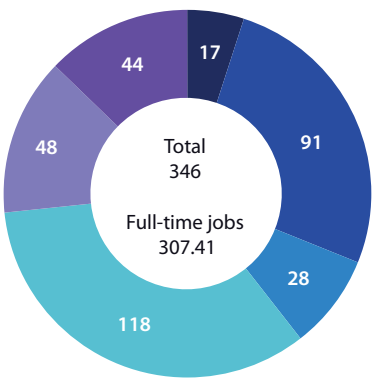
In October 2013, the Czech Geological Survey launched a project titled *Programme of further education for the CGS employees endangered on the labour market.* Its objective is to provide vocational education courses at Prague workplaces of the Czech Geological Survey. The fields covered include geology and other required skills. The training will accelerate the drive for improvement in professional, managerial and public relation abilities of the participants.

The further education project is targetting two groups:

1) employees under 30 and those on parental leave or shortly back at work;

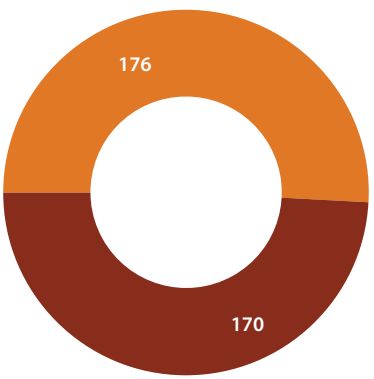
2) employees over 50.

The programme will involve not only separate training for the above defined groups, but also joint training of both groups.



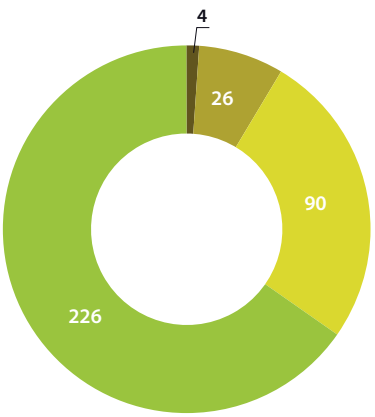
Graph showing the CGS subject fields

- Directorate
- Geochemistry and Laboratories
- Economic Division
- Geological Division
- Division of Geofond
- Division of Informatics



Graph showing the gender ratio of the CGS staff

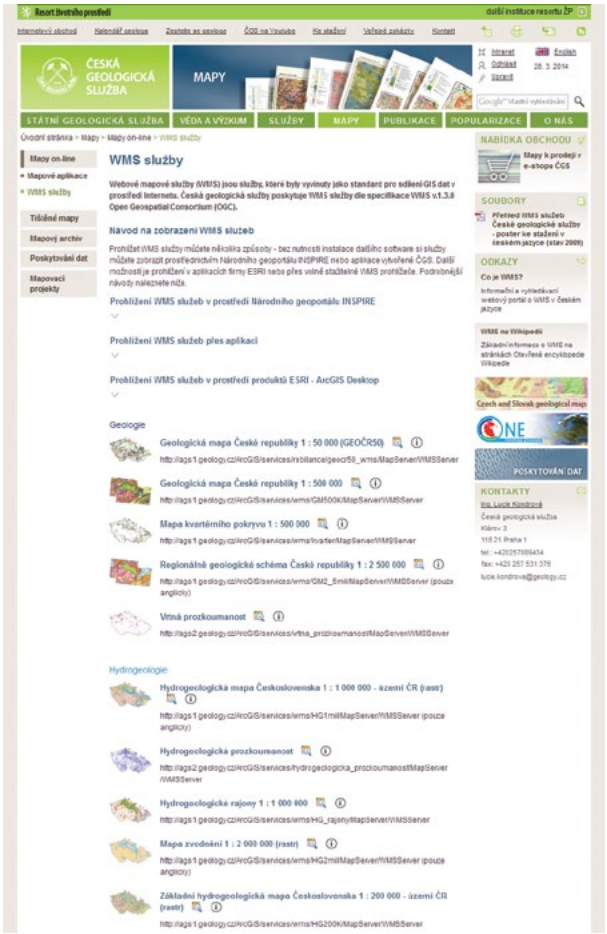
- Women
- Men



Graph showing the educational qualification of the CGS staff

- Elementary
- Apprentice + apprentice with graduation exam
- Secondary with graduation exam
- University

Website of the Czech Geological Survey



A list of WMS services on the CGS web portal, generated automatically from the Metadata catalogue.

A new English website of the Czech Geological Survey was lauched in January 2013 and has been progressively updated by the addition of pages for the laboratories, regional geology, groundwater and radon etc.
The portal of the disbanded organization CGS – Geofond was shut down in March 2013.

The page structure in the Services section on the Czech extranet has been redesigned to take account of the relocation of all archives to the Geofond building in Prague. This change is also reflected in the English extranet.

Pages have been created for the following individual CGS projects:

- **OneGeology-Europe Plus**
  http://www.geology.cz/1geplus
- **Improving the standards of applied geology lectures at the Addis Ababa University**
  http://www.geology.cz/projekt681900
- **The Mongolian Altay project**
  http://www.geology.cz/mongolsky-altaj
- **SoilTrec**
  http://www.geology.cz/soiltrec
- **World of Geology**
  http://www.geology.cz/svet-geologie

In addition, the already designed pages of the Czech Commission on Stratigraphy have been made public this year (*http://www.geology.cz/stratigraphy*).
The CGS cooperated on the compilation of the text and the design of the artwork for the "Geostrada Sudecka – Geotrasa sudetská" website (*http://www.geostrada.eu*).
In order to speed up the creation of project-pages and simplify administration, a uniform CGS-style has been developed.

During 2013, while the CGS Metadata catalogue was being gradually interlinked with the portal, the automated generation of lists of WMS services was put into operation on both the Czech and English extranets. Until now, most of the lists of web applications have been generated automatically on the Czech extranet.

A new web image repository that will significantly accelerate the uploading of websites has been prepared and the transfer of images to this repository has begun. In addition, a whole range of activities now underway is due to be completed in 2014 (new applications and databases of photo archives and projects, another batch of lists of web applications uploaded from the Metadata catalogue, closing-down of the *geologickasluzba.cz* portal, etc.).

www.geology.cz

Principal Events in 2013

21ST FEBRUARY 2013

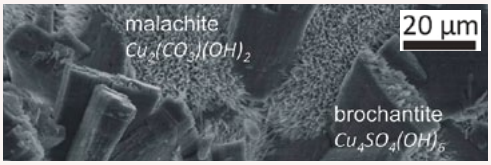
Website of the Czech Commission on Stratigraphy presents a new Geologic Time Scale

The website of the Czech Commission on Stratigraphy was established in 2010 in order to facilitate a more effective work of the Commission, easier communication between its members and up-to-date information for the public; it is a guest page on the portal of the Czech Geological Survey. Final impetus to publishing the page was the completion of the Czech chronostratigraphic table, the preparation of which has been in progress since 2010. The Time Scale substitutes the Czech Geologic Time Scale set up by Chlupáč (2000; *Bulletin of the CGS*, Vol. 75, No. 4). In light of the latest results in chronostratigraphy, it did not suffice in 2010 any more. At the beginning of the revision, possibility of adding the suffix -ian (-ien) to the stage names was considered, as is the case in English usage. In the end, the Czech tradition of using shorter names without any suffix was preserved, even though they are harder to handle, since the flexion of some names in the Czech language causes problems. It was necessary to create a table of morphemes which would explain the etymology of the name, suggest its spelling, mode of flexion and formation of adjectives. A similar table has never been published before and its goal is to make the usage of names of the chronostratigraphic units in Czech texts simpler. The preliminary version of the Czech Geologic Time Scale was presented at the Congress of the Czech and Slovak Geological Societies at Monínec in September 2011. Final layout was discussed and approved during Commission's session in February 2012. In the meantime, a new Geologic Time Scale was published by the International Commission on Stratigraphy (ICS), bringing a series of changes in numerical age of the boundaries as well as a new stage in the Cambrian. Updating of the Time Scale was completed towards the end of 2012 and it is finally at disposal to the public.

5TH MARCH 2013

Exhibition of photographs *Through the desert and sand of the biblical landscape*

Exhibition of photographs by Ivana Frolíková titled *Through the desert and sand of the biblical landscape* held in the Geological Bookshop in Klárov, Prague, started on the 13th March and was closed on the 30th April 2013.



22TH MARCH 2013

Geochemistry workshops of the CGS

The spring round of geochemistry workshops was held from the 22nd March until the 24th May 2013.

19TH APRIL 2013

My Piece of Earth 2013 competition started

On the occasion of the *Czech Nature* fair organized by the Ministry of the Environment on 19th–20th April in the Nations House in Vinohrady, Prague, the seventh visual art competition for children and young people called *My Piece of Earth* was started. The competition is organized by the Czech Geological Survey and the Ministry of the Environment and the last year's subject was various types of rocks and their utilization in the industry.

2ND MAY 2013

Palaeontology in philately

The exhibition of stamps collected by Radoslav Kovář, which show images of palaeontological material collected from various sites was on display on the CGS Publishing House premises from the 2nd May to the 18th June 2013.

17TH MAY 2013

Map of the Year 2012 award for the Czech Geological Survey

The book titled *Building and Decorative Stones of Prague and the Central Bohemian Region* by Barbora Dudíková Schulmannová and Jaroslav Valečka, released by the CGS Publishing House (graphic design by Stanislava Karbušická, edited by Petr Maděra, digitized-map edited by Zuzana Krejčí), won the prestigious "Map of the Year 2012" award in the category of Single Cartographic Product. The award is granted by the Cartographic Society of the Czech Republic. The 15th year of this competition was celebrated on the occasion of the Book World fair. The same award was granted in 2007 to the *Geological Map of the Czech Republic at 1:500,000 scale* by Jan Cháb, Zdeněk Stráník and Mojmír Eliáš.

7TH JUNE 2013

Emergency phone line of the CGS for the public: Landslips and rock falls

The Czech Geological Survey publicized emergency phone numbers for all who were affected by landslides and rock falls triggered by extreme rainfall. The public will be able to report these events and consult further preventive measures to be carried out.

10TH JUNE 2013

Director of the CGS Zdeněk Venera gave a talk on landslide hazards

The Director of the Czech Geological Survey, Mgr. Zdeněk Venera, Ph.D., was hosted by the Monday Studio 6 programme of the Czech Television, where he talked about the landslide hazards caused by long-lasting rainfall. Not only did he describe the landslide-related risks, but also informed which preventive measures to take, including the option of using the Emergency phone line of the Czech Geological Survey. He also shed light on the current conditions of the landslide in one of the sections of the D8-Highway.

Principal Events in 2013

19TH JUNE 2013

The Micropalaeontological Society of London in Prague

Conference of The Micropalaeotological Society (TMS), Foraminifera and Nannofossil Groups with the subject *Micropalaeontological record of global changes: from the epicontinental seas to the oceans* took place in Prague on 19th–22th June 2013. As a part of the programme, an excursion to Kutná Hora was organized (see the photo). This important event was organized by the Geological Institute of the Faculty of Science, Charles University, in cooperation with the Czech Geological Survey. New research results on the fossil and recent foraminifera and calcareous nannoplankton and their application in practice were presented at the joint meeting of marine biologists and palaeontologists. The study of microfossils provides important information for the regional geological investigations in marine sedimentary formations. Study of the existing oceans and their processes helps in understanding and interpreting the fossil record.

26TH JUNE 2013

A journey to Galicia

An exhibition of photographs titled *A journey to Galicia*, by Dr Jaroslava Pertoldová, CSc., a scientist from the Czech Geological Survey, was on display in the Geological Bookshop of the CGS from the 26th June to the 10th September 2013.

18TH JULY 2013

A major success of our fellow scientist Lucie Tajčmanová

Lucie Tajčmanová, staff member of the Department of Regional Geology of Crystalline Complexes, won a prestigious grant for junior scientists titled *Interplay between metamorphism and deformation in the Earth´s lithosphere: MADE-IN-EARTH* from the European Research Council – ERC. In fact, this is the first so-called "starting grant of the ERC" awarded to a Czech project applicant in the field of geology. The research project will be implemented at the ETH Zurich, its duration will be five years and its budget will be 1.5 million Euro. The European Research Council distributes the most prestigious European Union based science grants. These grants are awarded on the basis of scientific excellence of the researchers and their proposals for further studies they aim to pursue. The ERC is the scientists´ master league and its grants are meant for an exquisite segment of the best scientists. This success enables Lucie Tajčmanová to be appointed a Professor in metamorphic petrology at the ETH Zurich in September 2013.

24TH SEPTEMBER 2013

The German Geological Society appreciating Dr Stanislav Vrána's scientific work

The Leopold von Buch medal was awarded to Dr Stanislav Vrána, long-time staff member of the Czech Geological Survey, at the joint conference of the Czech Geological Society and the German Geological Society (DGG) in Pilsen. The DGG has thus appreciated his life-time excellent achievements in the fields of metamorphic petrology and mineralogy and his participation in international projects, most outstanding of which was the one focused on geological structure of West Bohemia in relation to the ultra-deep KTB borehole in Bavaria.

2ND OCTOBER 2013

Geochemical seminar of the Czech Geological Survey

Lecture given by Dr R.C. Scrivener, a consulting geologist from Wolf Minerals Ltd., the United Kingdom, dealing with the subject: *Metal mining in South-West England: Past production and future prospects – with special mention to the Hemerdon Tungsten Mine* was held at the Barrandov branch on the 2nd October 2013.

6TH NOVEMBER 2013

Completion of the project *Sudetes Georoute – geological tourist guidebook*

The project *Sudetes Georoute – geological tourist guidebook* was carried out within Poland-Czech Republic Cross-Border Operational Programme 2007–2013. It was finished with a public seminar held at the CGS headquarters. The objective of the project was to expand tourist activities in the Czech-Polish cross-border area and create a georoute leading along the mountain ranges of the Sudetes from Bogatynia in the west all the way to Opava in the east. The natural beauties and cultural richness of the region are highlighted by information boards, information leaflets written in Czech and Polish guidebooks (Czech, Polish and English versions) and project web pages *www.geostrada.eu*.

13TH NOVEMBER 2013

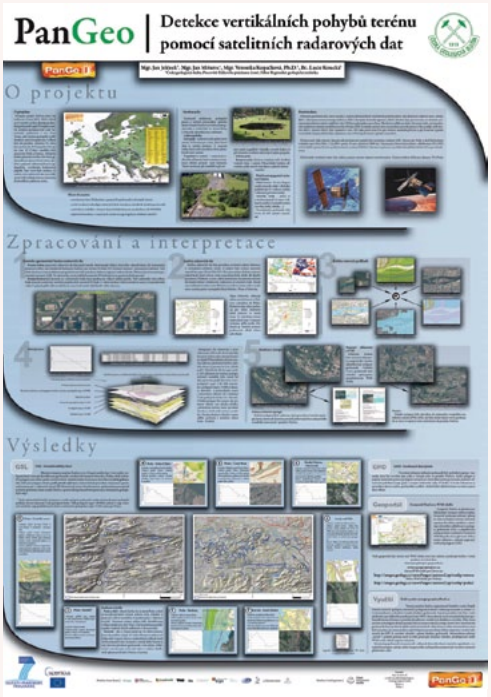
Veronika Kopačková and Marika Polechová have been awarded Dean's Prize for the best doctoral theses

On the 13th November 2013, Marika Polechová, Ph.D. and Veronika Kopačková, Ph.D., received the prestigious Prize of the Dean of the Faculty of Science, Charles University, prof. B. Gaš, for the best doctoral theses within the doctoral study programme for 2013.

The thesis of Marika Polechová is titled *Selected bivalves from the Ordovician of the Prague Basin* and it is, in fact, a detailed monograph. Dr Petr Kraft, CSc. (Institute of Geology and Palaeontology, Faculty of Science, Charles University) and Dr Jiří Kříž, CSc. (scientist emeritus at the CGS) were her supervisors. Dr Polechová is indeed a capable successor to the world-important research of early Palaeozoic bivalves carried out by Dr Jiří Kříž.

Veronika Kopačková wrote a dissertation titled *Hyperspectral Remote Sensing for Environmental Mapping and Monitoring*, which encompasses a collection of five scientific papers published by her in international peer-reviewed periodicals with an IF. Her dissertation deals with the application methods of imaging spectroscopy as a modern tool for environmental monitoring and pays a special attention to the modelling of selected geochemical and biochemical parameters. Her doctoral research involved new imaging spectroscopy-aided procedures enabling pH-modelling in the heterogeneous environment of open-cast mines or evaluating physiological condition of spruce-dominated woodlands and thus identify vegetation stress prior to the appearance of visible environmental damage symptoms.

Principal Events in 2013



13TH NOVEMBER 2013

Award for the Czech Geological Survey on the 22th GIS Esri conference

Between the 13th and 14th November, Prague Congress Centre was the venue for the 22nd GIS Esri conference in the Czech Republic, with more than 800 GIS supporters participating. At the conference, the Czech Geological Survey was awarded a prestigious prize for complex deployment of GIS in the state geological survey information system. The Director of the Czech Geological Survey, while receiving the prize, gave a brief presentation of the Survey´s activities to the conference participants.

Another success has been achieved by our Remote Sensing Centre.

A professional committee chaired by prof. Vít Voženílek awarded the first place to a poster by Jan Jelének, Jan Mišurec, Veronika Kopačková and Lucie Koucká with the title *PanGeo: Vertical ground movement detection by means of the satellite radar data*.

The Czech Geological Survey left a very distinct hallmark at the conference – one of the invited talks of the first block of the conference was prepared by our volcanologist Vladislav Rapprich and in addition, the Survey prepared one user presentation, 8 contest posters, a specimen of the map application *Geological map at 1:50,000 scale* and a large format map: *Geological map of the Czech Republic at a scale of 1:500,000*.

25TH NOVEMBER 2013

Launch of the *World of Geology* portal

The *World of Geology* – the geosphere portal, was launched on the web page *www.geology.cz/svet-geologie*. It provides information on the present state of knowledge in the earth science to both children and adults. The teachers may use the portal for curriculum preparation, since it provides not only broad theoretical background, but also practical experiments and tips for geoscience-related field trips. The *World of Geology* portal, which is still being designed to get a final layout, was created as a joint product of the *Discoveries are waiting for you* project co-financed by the European Social Fund and from the national budget of the Czech Republic.

28TH NOVEMBER 2013

The 17th Conference on late Tertiary

The traditional, already 17th Conference on late Tertiary took place in Brno on 28th–29th November 2013 at the Faculty of Science, Masaryk University.

13TH DECEMBER 2013

Geochemistry seminar of the Czech Geological Survey – EAG Distinguished Lecture Tour 2013

The seminar was held at CGS Barrandov. Within his EAG Distinguished Lecture Tour, Prof. Thomas Roeckmann from the Institute for Marine and Atmosperic research of the Utrecht University, the Netherlands, gave two lectures dealing with the stable isotope studies in the atmosphere.

17TH DECEMBER 2013

Geoscience-related satellite imagery exhibition

The Geological Bookshop of the CGS hosted a geoscience-related satellite imagery exhibition from selected international projects carried out by the CGS. The images have been created by Veronika Kopačková.
Presentation of another publication – *Geology of the Jeseníky Protected Landscape Area* from the successful series *Geology of the Protected Landscape Areas*, took place simultaneously.

Abbreviations:
AS CR – Academy of Sciences of the Czech Republic; **CDA** – Czech Development Agency; **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

Projects

Comprehensive regional and deep investigation of the lithosphere

Special studies, methods of research, Ph.D. theses and dissertations, CGS, 2007, continuing investigation	RNDr. Eva Břízová, CSc.
Print of geological and applied maps, CGS, 2010, continuing investigation	RNDr. Pavel Hanžl, Dr.
Preparation of methods for the Mapping Directive ZGM 25, CGS, 2009–2014	RNDr. Pavel Hanžl, Dr.
The database of decorative stones, CGS, continuing investigation	RNDr. Barbora Dudíková Schulmannová
Research on basalt volcanism and associated phenomena on James Ross Island, CGS, 2012–2013	Mgr. Vojtěch Erban
Genesis of the central alkaline belt of the Brno Massif, CGS, 2012–2013	RNDr. Pavel Hanžl, Dr.
Preparation of a guide to the most significant karst localities of Moravia and Silesia, CGS, 2012–2013	RNDr. Jiří Otava, CSc.
Volcanic systems II: origin and evolution of magma, fragmentation and sedimentation of volcaniclastic material, CGS, 2012–2014	Mgr. Vladislav Rapprich, Ph.D.
Pre-Variscan development of the units on the Eastern and Northern margins of the Moldanubian Zone: dating and structural-metamorphic analysis of schists and surrounding units, CGS, 2012–2014	Mgr. Igor Soejono
3D Modelling of the development of individual component formations, horizons and deposits of bituminous claystones in the Krkonoše Piedmont Basin, CGS, 2012–2013	RNDr. Marcela Stárková
Geological base mapping of CR at a scale of 1:25,000, CGS, 2008–2014, project´s preparatory phase in 2013, CGS, 2013	Mgr. David Buriánek, Ph.D.
Type localities of formations of the Sub-Silesian and Silesian units, CGS, 2013–2014	RNDr. Miroslav Bubík, CSc.
P-T development and characteristics of the mantle source of ultrabasic rocks in association with the ultra-high pressure North Bohemian granulites, CGS, 2013–2014	doc. RNDr. Jana Kotková, CSc.
Microstructural and chemical reappraisal of mineralogical inheritance in partially molten rocks: implication of AMS resetting in granitoids in central Vosges, CGS, 2013–2014	prof. RNDr. Karel Schulmann, CSc. Mgr. Pavlína Hasalová, Ph.D.
Annual TMS Foram/Nannofossil Group-preparation of a session and excursion, CGS, 2013	RNDr. Lilian Švábenická, CSc.
Drafting of the chapter on geology for the publication (in preparation) about Doupovské hory Mts, CGS, 2013	RNDr. Petr Hradecký
Protection of global stratotypes in the Barrandian area, CGS, 2013–2014	RNDr. Petr Budil, Ph.D.
Contribution to specific parts of the research plan of CGS by the Department of Geochemistry of the Rock Environment, CGS, 2013–2014	Mgr. Jakub Haloda, Ph.D.
Handbook of geochemical modeling of magmatic processes in R language, CGS, 2013–2014	doc. Mgr. Vojtěch Janoušek, Ph.D.
Geological composition and geofactors of the environment in Beskydy Mts, 23-233 Valašská Bystřice, CGS, 2012–2013	Mgr. Roman Novotný

Public dissemination of information about geological heritage held by the CGS: phase 1 – methodical, technical and professional support, CGS, 2012–2013	Mgr. Veronika Štědrá, Ph.D.
Preliminary editing and printing of geological maps, special maps of exodynamic phenomena and explanatory notes for the area of the Bohemian Paradise, CGS, 2012–2013	RNDr. Lilian Švábenická, CSc.
Stepwise upgrading and completion of the soil map series at 1:50,000 scale and compilation of map sheets Plzeň and Dobříš, CGS, 2013	Ing. Jana Janderková
Granulitization of the Moldanubian lower crust: geochemical constraints and metamorphic changes in the course of the Variscan orogenic cycle, Czech Science Foundation P210/11/2358, 2011–2013	doc. Mgr. Vojtěch Janoušek, Ph.D.
Deciphering the pre-convergence history of crustal domains in deeply eroded orogenic belts from detrital zircon populations, Czech Science Foundation P210/11/1904, 2011–2013	Mgr. Jiří Konopásek, Ph.D.
Crustal growth and construction of continental crust: the example of the Central Asian Orogenic Belt, Czech Science Foundation P210/12/2205, 2012–2015	prof. RNDr. Karel Schulmann, CSc.
Continental lithosphere as a source of differentiated alkaline lavas and the genetic role of basic magma determined through volcanism of the Ohře Graben, Czech Science Foundation P210/12/1990, 2012–2015	Dr. sc. nat. Tomáš Magna
Formation of phosphate minerals and their importance for dating of diagenesis and fluid activity in sedimentary rocks, Czech Science Foundation P210/12/2114, 2012–2014	doc. RNDr. Jan Košler, Ph.D.
The origin of compositional and textural zoning in shallow-level granitoid plutons: a quantitative approach, Czech Science Foundation P210/11/1168 (cooperation with the Faculty of Sciences, Charles University), 2011–2013	doc. Mgr. Vojtěch Janoušek, Ph.D.
North-Bohemian diamond- and coesite-bearing granulites: studying diamond genesis media in a deep subduction zone and consequences of geodynamic models, Czech Science Foundation 13-214505 (panel 210), 2013–2015	doc. RNDr. Jana Kotková, CSc.
Prograde metamorphism, crustal thickening and low-crust flow: a new concept of building a Variscan orogen root, Czech Science Foundation 13-163155 (panel 210), 2013–2016	Mgr. Pavla Štípská, Ph.D.
Use of non-traditional and traditional isotope systems in identifying source materials and the moldavite genesis process, Czech Science Foundation 13-223515 (panel 210), 2013–2016	Dr. sc. nat. Tomáš Magna
Geological base mapping of CR at a scale of 1:25,000, CGS, 2008–2014	RNDr. Jaroslava Pertoldová, CSc.
Krkonoše	Mgr. Karel Martínek, Ph.D.
Šumava	RNDr. Vladislav Žáček
Brněnsko	Mgr. David Buriánek, Ph.D.
Beskydy	Mgr. Roman Novotný
Doupovské hory	RNDr. Bedřich Mlčoch
Křivoklátsko	RNDr. Tomáš Vorel
Central pluton	RNDr. Kryštof Verner, Ph.D.
Preparation of the journal Geological Research in Moravia and Silesia, CGS, 2010–2012	Mgr. David Buriánek, Ph.D.
Editing of scientific publications, CGS, 2010, continuing investigation	doc. Mgr. Vojtěch Janoušek, Ph.D.
Editing and preparation of the printed and electronic versions of the Bulletin of Geosciences, CGS, 2010, continuing investigation	prof. RNDr. Jiří Frýda, Dr.
Sudetes Georoute – geological tourist guidebook (project under the terms of the Operational Programme Cross-Border Cooperation 2007–2013, in cooperation with the Republic of Poland, funded by EU and CR), 2010–2013	RNDr. Štěpánka Mrázová, Ph.D.
Enabling access to geological information in support of GMES, 7th Framework Programme of the EU, FP7-SPACE-2010-1, 2011–2014	Mgr. Veronika Kopačková

Projects

ArchaeoMontan, Operational Programme Cross-Border Cooperation 2007–2013 with the Free State of Saxony, funded by EU and CR, 2012–2014	RNDr. Vladimír Šrein, CSc.
The role of Palaeozoic accretion and collisional orogens in the formation and growth of continental crust (ROPAKO), MEYS – Programme NÁVRAT, LK11202, 2012–2016	prof. RNDr. Karel Schulmann, CSc.
Membership in the Scientific Committee on Antarctic Research (SCAR) and in the Council of Managers of National Antarctic Programmes (COMNAP), LG13013, MEYS, cooperation for MU Brno, 2013–2015	Mgr. Zdeněk Venera, Ph.D.
Presentation and interpretation of whole-rock geochemical data from igneous rocks – bringing the power of R to a wider community, 7AMB13FR026, 2013–2014	doc. Mgr. Vojtěch Janoušek, Ph.D.
Geological mapping at 1:50,000 scale and evaluating the economic potential of a selected area in Western Mongolia, MFA, 2013–2015	RNDr. Vladimír Žáček

Research into global changes in the geological past and the development of life

Research into Palaeozoic global changes and the development of biodiversity, CGS, 2012–2014	prof. RNDr. Jiří Frýda, Dr.
Palaeontology of the Antarctic Peninsula: physical processing and scientific assessment of material documentation held by the CGS, 2012–2014	Mgr. Radek Vodrážka, Ph.D.
Diagenetic changes in carbonate rocks in the Stephanian C in the Krkonoše Piedmont Basin, CGS, 2013	RNDr. Marcela Stárková
Development of the Carboniferous/Permian boundary interval in West Bohemia: treatment of field data from artificial outcrops of the Gazelle gas pipeline, CGS, 2013–2014	Mgr. Richard Lojka
Cordaitalean and pteridosperm cuticular analysis and their "in situ" prepollen, Czech Science Foundation, P210/10/0232, 2010–2014	RNDr. Zbyněk Šimůnek, CSc.
Multidisciplinary approach to assessment of the biotic crises of the Middle Palaeozoic – Devonian Daleje and Kačák bioevents (Prague Basin, Czech Republic), Czech Science Foundation, P210/12/2018,2012–2016	Mgr. Stanislava Vodrážková, Ph.D.
Magnesium isotope composition of Phanerozoic marine carbonates: Implications for chemical evolution of seawater and the formation of massive dolomites, Czech Science Foundation, P210/12/P631, 2012–2014	Mgr. Juraj Farkaš, Ph.D.
A new European reference section to study mid-Cretaceous sea-level changes, palaeoceanography and palaeoclimate: drilling the Bohemian Cretaceous Basin (in cooperation with the Geophysical Institute AS CR, v.v.i.), Czech Science Foundation P210/10/1991, 2010–2013	Mgr. Stanislav Čech
Climatic archives recorded in the Late Palaeozoic basins of the Bohemian Massif: proxies for reconstruction of climatic changes, Czech Science Foundation P210/11/1431 (in cooperation with the Faculty of Sciences, Charles University), 2011–2014	Mgr. Richard Lojka

Integrated stratigraphy of the Late Silurian (Ludlow–Přídolí) in the Prague Synform, in cooperation with the Institute of Geology AS CR, Czech Science Foundation v.v.i, 205/09/0703, 2009–2013	RNDr. Štěpán Manda, Ph.D.
Changes in the floristic record in the basins of the Bohemian Massif as a consequence of climate development during the Late Palaeozoic ice age, in cooperation with the Institute of Geology AS CR, Czech Science Foundation, P210/12/2053, 2012–2015	RNDr. Zbyněk Šimůnek, CSc.
Thermochronologic constraints on the evolution of the eastern Magallanes foreland basin sediments, cooperation for the Institute of Geology AS CR, v.v.i., 7AMB12AR024, institutional support of MEYS, 2012–2013	Mgr. Daniel Nývlt, Ph.D.

Analysis of the vulnerability of the landscape to natural and anthropogenic processes

Reserves of soil potassium under conditions of permanent negative nutrient balance in grain production systems, in cooperation with the Crop Research Institute, v.v.i., R&D Q191C118, MoA, 2009–2013	Mgr. Magdaléna Koubová, Ph.D.
Chromium isotopes as an indicator of natural attenuation of water pollution: Introducing mass-spectrometry based technology, TA01021055, TACR, 2011–2014	RNDr. Martin Novák, CSc.
Forest soil conditions as a determining factor governing the state of health, biodiversity, wood-production and other functions of forests, in cooperation with the Forestry and Game Management Research Institute, v.v.i., QI 112A168, 2011–2014	RNDr. Irena Skořepová, CSc.
Register of Slope Failures, continuing investigation	Ing. Jan Šikula, Ph.D.
Vertical changes of radiometric parameters in areas with a thin cover of soil and earth – a basis for radon index evaluation in extreme geological conditions, CGS, 2012–2013	RNDr. Ivan Barnet, CSc.
Research on radon hazards in the environment of the CR, CGS, 2012–2013	RNDr. Ivan Barnet, CSc.
Evaluation of factors governing the chemistry of surface waters in the CR, CGS, 2012–2013	RNDr. Jakub Hruška, CSc.
Monitoring of mass elements fluxes in the GEOMON network of small catchments and its application, CGS, 2012–2013	RNDr. Daniela Fottová, Mgr. Filip Oulehle, Ph.D.
Feasibility study for restoring rock outcrops in the National Natural Monument at Landek CGS, 2013	Ing. Jan Malík
National soil reference centre – cooperation with EEA (EIONET), CGS, 2013	RNDr. Igor Dvořák, Ph.D.
Influence of acidity and soil-nutrient level on the organic-matter balance of soil in forest ecosystems, CGS, 2013–2014	Mgr. Filip Oulehle, Ph.D.
Highmoors-based study of historic mining and ore dressing in the Krušné hory Mts, CGS, 2013–2014	Mgr. Leona Bohdálková, Ph.D.
Trends in isotopic composition of atmospheric Pb during the past 10 thousand years: climate change and pollution research in the Velké Dářko peat bog, CGS, 2013–2014	Ing. Eva Čadková, Ph.D.
Development of efficient methods for determining cadmium-isotope composition, CGS, 2013	doc. RNDr. Vladislav Chrastný, Ph.D.
Isotopic analysis of archival samples of ice accretions and snows from 10 monitoring sites on mountain ranges of the Czech Republic, CGS, 2013–2014	Ing. Adéla Šípková
Geofactor-updating activities (particulary radon, slope failures, geochemistry of the rock environment and groundwaters) in databases and map documents, CGS, 2013	RNDr. Oldřich Krejčí, Ph.D.
Utilization of Lidar (DMR 5G) for an accurate identifying of slope failures, CGS, 2013	Ing. Petr Kycl

Projects

Geologic supervision of the Dobkovičky landslide remedying (D8), CGS, continuing investigation	Ing. Petr Kycl
Compliance of the CR with the International Convention on Distant Transport of Pollutants The National Centre for Pollution Effects, OOO MoE, 2012–2013	RNDr. Irena Skořepová, CSc.
Relationship between atmospheric N deposition and N accumulation in rain-fed peat bogs: Insights from a ^{210}Pb–^{15}N isotope study, Czech Science Foundation P504/12/1782, 2012–2014	RNDr. Martin Novák, CSc.
The fate of legacy mercury in forest ecosystems in the area of the Black Triangle, Czech Republic, Czech Science Foundation P210/11/1369 (in cooperation for the Institute of Geology AS CR, v.v.i.), 2011–2014	RNDr. Pavel Krám, Ph.D.
Influence of disturbance of the regime of a natural temperate forest on the variability of soils and pedogenesis on a rough spatial scale, Czech Science Foundation P504/11/2135 (in cooperation with the Silva Tarouca Research Institute for Landscape and Ornamental Gardening, v.v.i.), 2011–2013	RNDr. Jakub Hruška, CSc.
Soil Transformations in European Catchments – SoilTrEC (FP7-ENV-2009-1, grant agreement number 244118), 2009–2014	RNDr. Martin Novák, CSc.
Enabling access to geological information in support of GMES, 7th Framework Programme EU, FP7-SPACE-2010-1, 2011–2014	Mgr. Veronika Kopačková
Innovation of methods of monitoring the health conditions of the common spruce woodlands in the Krušné hory Mts using hyperspectral data, cooperation for the Faculty of Sciences, Charles University Prague, LH 12097, MEYS, 2012–2015	Mgr. Veronika Kopačková
A new approach to algorithmization and automation in the procedures of information gathering from hyperspectral data focused on the soil and environmental applications, LH13266, MEYS, 2013–2014	Mgr. Veronika Kopačková
SLAvONIC – Effects of soil alteration on nitrogen and carbon cycling, FP 7-PEOPLE-2013-CIG, 1st August 2013–31st July 2017	Mgr. Filip Oulehle, Ph.D.
Capability building in environmental geology – Mapping of geohazards including hydrogeological conditions in Dila and Hosaina areas, Ethiopia, MFA, 2012–2014	Mgr. Vladislav Rapprich, Ph.D.
Improving the quality of university education in the applied earth sciences focused mainly on geohazards and hydrogeology, MFA (CDA), 2013–2015	Mgr. Vladislav Rapprich, Ph.D.

Research and evaluation of state of groundwater resources (amounts, limits, quality)

Innovation of farming systems in the Quaternary depositional setting, their control and application in the water resource management zones, QJ 1320213, cooperation for the Crop Research Institute, v.v.i. (provider MoA), 2013–2017	RNDr. Renáta Kadlecová
Review of Groundwater Resources in the Czech Republic (State Environmental Fund, under the terms of OPŽP, priority axis 6, financed by EU and CR), 2010–2015	RNDr. Petr Mixa

Research on mineral resources and the influence of mining and processing on the environment

Risk factors in the exploration and mining of gas from shales under the conditions of geological structures of selected regions of the Czech Republic, CGS, 2012–2014	RNDr. Juraj Franců, CSc., RNDr. Vlastimila Dvořáková
Specification of an inventory and current state of utilization of non-reserved mineral deposits in the CR, based on the statement of mining- technical and operational data HOR (MIT) 1-01 for updating of the raw material information system (SurIS), CGS, 2012–2013	Ing. Karel Rýda Ing. Josef Godány
Abandoned basalt quarries in Česká Lípa territory and their educational value and the potential for the preservation of greater landscape geodiversity, CGS, 2012–2013	Mgr. Vladislav Rapprich, Ph.D., Ing. Josef Godány
Identification and documentation of selected abandoned historical mining waste sites, CGS, 2013	RNDr. Vít Štrupl
On-site investigations of reported remnants of old mine workings, CGS, 2013	RNDr. Vít Štrupl
Five-element formation in the Bohemian Krušné hory Mts – mineralogy, geochemistry of economic minerals and ore-forming processes, CGS, 2013–2014	RNDr. Vladimír Šrein, CSc.
Selected platinum-group minerals (PGM), experimental approach, Czech Science Foundation P210/11/P744, 2011–2013	RNDr. Anna Vymazalová, Ph.D.
Impact of mining and processing of ore on the environment in Namibia: Modelling migration of pollutants in soils, plants and groundwaters, Czech Science Foundation P210/12/1413, 2012–2014	doc. RNDr. Bohdan Kříbek, DrSc.
Re-Os geochronology of ore mineralizations in the Bohemian Massif and consequences for their metallogeny, Czech Science Foundation 13-15390S (panel 210), cooperation for the Geological Institute of AS CR, v.v.i., 2013–2016	RNDr. Jan Pašava, CSc.
Earth Observation for Monitoring and Observing Environmental and Societal Impacts of Mineral Resources Exploration and Exploitation, FP7, 2010–2013	Mgr. Veronika Kopačková
Experimental investigation of ternary systems: silver-PGM (platinum-group-metal)-chalcogen, LH11127, MEYS, 2011–2014	RNDr. Anna Vymazalová, Ph.D.
LG 13006: Representing Czech Republic in the steering bodies of SGA (Society for Geology Applied to Mineral Deposits), MEYS, 2013–2015	RNDr. Jan Pašava, CSc.
Minerals4EU – Minerals Intelligence Network for Europe, FP7-NMP-2013-CSA-7, 1st September 2013 – 31st August 2015	RNDr. Ivo Sitenský, CSc.

Research on environmental and geo-energetic technologies

Research on the influence of intergranular porosity on disposal into deep geological formations and the methodology for developing measuring apparatus, in cooperation with Stavební geologie-Geotechnika, a.s. (provider MIT, TIP Programme), FR-TI1/367, 2009–2013	Mgr. Lenka Rukavičková, Ph.D.
Research and development of methods and technologies for capture of CO_2 from fossil-fuelled power plants and CO_2 storage in geological formations in the Czech Republic, in cooperation with Nuclear Energy Research Institute Řež (provider MIT, TIP Programme), FR-TI1/379, 2009–2013	RNDr. Vladimír Kolejka
Reversible storage of energy in the rock massif, cooperation with ISATech Ltd., TA01020348, TACR, 2011–2013	Mgr. Jan Franěk, Ph.D.
Research on thermally loaded rocks – prospects for underground storage of thermal energy, FR-TI3/325, MIT, 2011–2014	Mgr. Jan Franěk, Ph.D.

Projects

In situ experimental investigation of bentonite stability during long-term heating up to 95 °C, in cooperation with WATRAD, s.r.o. (funded by the MIT, TIP Programme), FR-TI4/497, 2012–2015	Mgr. Jan Franěk, Ph.D.
Development and optimization of methodologies for research on safety barriers for CO_2 storage as one of the key ways for decreasing the GHG content in the atmosphere, TA03020405, cooperation for the Nuclear Energy Research Institute Řež, a.s., provider TAČR, 2013–2015	RNDr. Vladimír Kolejka
AHYMO + application of patent protection for the equipment fitted for collection of undisturbed water samples with precisely defined footage levels in undergauge boreholes in practice, CGS, 2013	Mgr. Jan Holeček
Geotermie 2013: Creation of a platform for solving the geothermal energy issues in the Czech Geological Survey, CGS, 2013	Mgr. Jan Holeček
An alternative method of geological storage of spent nuclear fuel, CGS, 2013	RNDr. Vít Hladík, MBA
Pan-European coordination action on CO_2 Geological Storage, 1st November 2010–31st October 2013 (FP_7)	prof. RNDr. Tomáš Pačes, DrSc.
R&Dialogue – Research and Civil Society Dialogue towards a low-carbon society, 7th Framework Programme of the EU, 1st June 2012–30th November 2015, accredited costs	RNDr. Vít Hladík, MBA

Building of an integrated geoscience information system

Building up the seismic profile database, primary and secondary data interconnection, CGS, 2013–2014	RNDr. Eva Hudečková
Development of the www Information Portal of the CGS, CGS continuing investigation	Ing. Radek Svítil
Data sources and metainformation system of the CGS, CGS, continuing investigation	Ing. Jan Sedláček
System for the inventory, protection and popularization of geological sites, CGS, 2010–2012	RNDr. Pavla Gürtlerová, RNDr. Jan Čurda
Maintenance and development of the digital archive of CGS, CGS, 2010–2011	Ing. Jan Sedláček
Integration of the CGS ICT infrastructures of the CGS, CGS, continuing investigation	Richard Binko
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Processing and evaluation of final reports from the Mineral Deposit Fund (FZ) at Kutná Hora workplace as a tool for old mine workings investigation, CGS, 2013	Mgr. Jolana Šanderová
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Zuzana Krejčí
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Profesional officer of the document management service

Landmark Data in the Czech Geology

Geofond archive in Malostranské Square, Prague, in 1964.

The Czech Geological Survey has been collecting data and information on the geological structure of the Czech Republic since 1919. The data were deposited in various ways – as written articles, as accompanying documents to maps, in tables and lately, in databases. Data are the most valuable component of every information system and the importance of their acquisition and management has to be emphasized.
The formation of this system started in 1952, when Geofond (i.e. Geological fund) was established in the then Central Geological Institute. Geofond was actually an archive, intended "to deposit an overview and results of all geological investigations carried out by ministries, firms, enterprises and other institutions". It was stipulated in the legislation that all institutions tasked with investigation and exploration within the field of geoscience should provide Geofond with the results of their geological activities accompanied by the necessary documentation and, if need be, with the exploitation overviews. A considerable amount of archival funds was generated in the Czech Geofond: Expert reports and unpublished reports fund; Reserves fund – reports with raw material and groundwater reserve calculations; International business trips fund – approximately 10,000 reports; Document archive of mineral deposit files – maps at 1:25,000 scale with charted deposit contours, sheet files, logs, statistical Geo V3-01 sheets, resolutions of the Reserve Classsification Commission on reserve assessment, resolutions on reserve approval, resolution on definition, changes and cancellations of protected mineral deposit areas or mining grounds; Geophysical archive – unpublished reports; Map funds – geological and historical mining maps; Material collection fund – approximately 35,000 m of rock samples from approximately 1750 major boreholes; Professional library at Kutná Hora – books and journals related to mining, geology and history.

Geofond 1975–2011

The establishment of Geofond as an independent publicly funded body in 1975 largely influenced its further orientation,

development and activity. Its principal and permanent task was the formation, systematic maintenance, upgrading and operation of an information system by means of own computer technology. Formation of the ASGI database that serves at present as a digital file was the prime step.
The year 1976 saw the creation of the borehole database (geologically documented objects), containing basic location data, in addition to well log descriptions.
In the 1990s, the database expanded by adding data on hydrogeological properties and was connected with the material collection files and well logging data. In 1979, the database of landslides and other hazardous slope deformations was formed.
In the 1990s, the Mineral Information System (SurIS) was formed. It consists of mineral deposit registers; registers of protected mineral deposit areas (CHLÚ); registers of mining grounds (DP); preliminary approvals of mining ground definition DP (PS DP); exploration areas; register of corporate bodies tasked with geological works, mining and related activities; resolution on approval and depreciation of reserves; economic register (ER) – data on major mineral commodities prices on the world and domestic markets and data on raw materials related foreign trade. Additional databases arose in the 1980s and 1990s: abandoned mine lands database, mine workings impacts database (SDD), inventory of underground mines (HDD), databases of mining maps, radiometric anomalies identified in surface prospecting, radiometric exploration, mining influence areas and dumps.
A database registering newly initiated geological works has been operated since 2001. In 2003, Geofond assumed administration of the Geofyzika Co. Brno geophysical exploration-related databases after the company had ceased to exist.
The characteristic feature of most of the databases is their nationwide extent, systematic complementation with new documents, data verification and accurate location of sites by coordinates. This fact enabled data presentation by means of map applications accessible to the general public via the Internet. The frequent utilization of the data is noteworthy.

CGS 1975–2011

After the separation of Geofond as the national geological database, the importance of primary data sources in the Czech Geological Survey decreased. Data and information were not deposited in uniform database structures and different kinds of software were used. At the beginning of the 1990s, over 40 databases of nationwide or local importance existed, focusing on geological documentation, on hydrogeology, geochemistry, library, collections (e.g. Protected geological sites in the CR, Inventory of construction material deposits, Database of reference points, Lithogeochemical database of the CGS, Waste dumps on Czech territory, Petroleum substances in waters and soils, Mineralogico-geological collection, Metainformation System etc.), but the data were hard to retrieve. This period is marked by a systematic database construction in the CGS and development of the Central Data Storage (CDS) linked to the Oracle database. The individual databases were relocated to

RNDr. Jaroslav Aichler, one of the main authors of the unified concept of the CGS information system.

the CDS and this was paralleled by vectorization of the 1:50,000 scale geological maps in the mid 1990s. Geographic Information System (Bentley/Intergraph/Oracle) was formed between 1994 and 1998 and the first database GEOČR50 related to vectorized 1:50,000 scale geological map production arose, along with the legend.
A unified concept of the CGS information system was drafted in 1999 (R. Tomas, J. Aichler, 1999), outlining the development of the infrastructure, the Central Data Storage, development of the GIS and the data and information presentation. This was a benchmark material that largely influenced further path for the Geological Information System of the CGS (GeoIS CGS). It also influenced projects that arose in 2000. The Digital Archive of the CGS was a fundamental project that involved digitization of 50,000 geoscience maps and accompanying documents – thus, the DigArchiv database was set up.
Then, with data processing in the CGS showing such a high level, the management decided to set up the Division of Informatics in 2001, which still exists today. It encompasses the Department of Information Systems, Department of Computer Administration, Department of Information Services (library, collections), Documentation Section (archives) and the Publishing House. In 2001, the activities of the Division of Informatics ushered in launching a unified information Portal of the CGS (RDBMS Oracle/Oracle 9IAS/Oracle Portal), which

Preparation of the documentation databases before the departure to the expedition in Nicaragua. The data acquired during the mapping process, as well as analytical data in connection with their reference points, are stored there.

Landmark Data in the Czech Geology

Geological Map of the Trans-Altay Gobi (P. Hanžl, Z. Krejčí, 2008) cut-out was used on promotion materials at the Esri International User Conference (San Diego, USA). In the photo from the left L. Kondrová, Z. Krejčí and L. Smyčková.

included the intranet, extranet and web pages promoting geology. The Portal continued to grow – the first integrated map server showing both the geomap coverage of the Czech Republic (in cooperation with data from the DigArchive) and the individual geologic maps (e.g. GEOČR50) was put in operation in 2003. During 2005–2006, the CGS Portal passed through a complete technological upgrade involving an application reprogramming and development of new publication instruments. The CGS Portal presented both the geological and the specialized maps (hydrogeological, mineral deposit maps, etc.) in the map server at vector and raster form, and also applications presenting collections (Virtual Museum), as well as a whole range of bibliography-related applications (e.g. national geoscience bibliography) and archive (Map Archive). Geological map related datasets with geological documetation and operational databases – for instance computer review lists, etc. – were published on the intranet.

In 2007, the Portal of the State Geological Survey was launched for the first time, and it encompassed data jointly published by the CGS and CGS – Geofond. It involved publication of maps GEOČR50 (CGS) and a borehole database (CGS – Geofond), the latter identifying the thickness of Quaternary cover and the first "solid" rock. The Portal also included the Portal of Geohazards presentation of interpreted information on the geological setting and selected hazardous geofactors (e.g. radon, groundwater chemistry and ground instability).

The Metainformation System had existed to facilitate orientation in the databases. In 2007, this system was substituted by a modern ISO standard-based metainformation system.

The latter includes a description of all operational databases (e.g. list of staff members), relation databases (raw materials, geohazards, geophysics, materials collections, library and archive, digitized geological notebooks) and map related geodatabases (GIS).

In addition to the GEOČR50 map database (see above), further map related geodatabases arose – GEOČR500 (1:500,000 scale maps) and GEOČR25 (1:25,000 scale maps) between 2000 and 2011. These databases include not only geological maps, but also the accompanying legends and specialized maps, e.g. the hydrogeological, mineral deposit, environmental geofactor maps, etc.

CGS 2012–2014

Geofond was disbanded as of the 31st December, 2011. The majority of the former staff of Geofond joined the organizational structure of the Czech Geological Survey, where a new division, 600 – Geofond, was established.

Since January 2012, creation of a unified GeoIS CGS has been underway. This system will integrate data of both organizations into the unified Central Data Storage and will enable their presentation (joining of the whole range of applications based on map services and information from relation databases). All the data are described in the Metainformation System devised between 2012 and 2013 (mainly the data model and metadata profile modifications were carried out). A new application for viewing and searching in metadata on the CGS sources has been put into operation (*micka.geology.cz*). All data sources have been subdivided into 13 categories. Their list is displayed on the CGS Portal in the CGS Data Sources section (*www.geology.cz/geodata*), including their way of presentation. This includes, for instance, the categories Geology (containing e.g. GEOČR25, 50 and 500), Raw Materials (containing e.g. SurIS, Revisions of abandoned mining sites), Mine Workings, Soils, Hydrogeology, Mine Wastes, etc.

The Czech Geological Survey, like its two former parent bodies, has been developing geoscience data sharing system along with other organizations (ME, CENIA, AOPK, etc.) on a long-term basis and is actively cooperating on being integrated into the national information data infrastructure in accordance with the requirements of the EC INSPIRE directive, the e-Government programs, the GMES or GEOSS. The CGS prepares its data presentations in accordance with the international standards (e.g. the WMS map service – Geological map of the Czech Republic at 1:500,000 scale, Map of radon risk 1:500,000 – *wms.geology.cz*, *mapy.geology.cz*).

New web pages

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***

Georeports *www.geology.cz/**georeporty***

Slope Failures
*www.geology.cz/**svahovenestability***

My Piece of Earth – webpage for children and young people ***mujkousekzeme**.geology.cz*

Geological Research on Antarctica
*www.geology.cz/**antarktida***

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/**slovnik***

Virtual Museum ***muzeum**.geology.cz*

Geological Localities ***lokality**.geology.cz*

Decorative Stones
***dekoracni-kameny**.geology.cz*

Other web presentations

On-line shop ***obchod**.geology.cz*

The CGS channel on YouTube
*www.youtube.com/**geologycz***

www.geology.cz

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Fax: +420251 818 748

Central Laboratory (inorganic geochemistry) | Geochemistry | Special Laboratories

Workplace **Jeseník**

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Regional Office | Archive of Geological Samples | Bookshop

Laboratory of Electron Microprobe and Microanalysis, Faculty of Science, MU **Brno**

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Joint Microprobe Laboratory of Masaryk University, Brno and the CGS

Archive of Material Documentation **Kamenná**

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Archive of Geological Samples

Archive of Material Documentation **Kovanice**

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Phone: +420 234 742 205

Archive of Written Documentation

Workplace **Kostelní**

Kostelní 26, 170 06 Praha 7,
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Fax: +420234 742 290

Geofond | Study Room | Video Archive | Part of the Documentary Archive | Specialized Offices

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Fax: +420 543 212 370

Regional and Applied Geology, Geophysics | Geochemistry | Testing Laboratory (organic geochemistry) | Library and Archive | Bookshop | GIS and DB

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Regional Museum and Centre for Documentation of Gold Deposits **Jílové**

Masarykovo nám. 16, 254 80
Jílové u Prahy,
Phone: +420 241 950 455

Archive of Material Documentation

Archive of Material Documentation **Lužná**

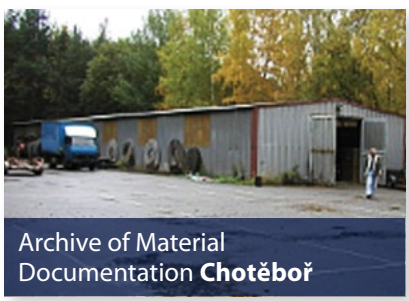
270 51 Lužná u Rakovníka, čp. 432,
Phone/Fax: +420 313 537 849

Archive of Geological Samples | Collections | Publications

Archive of Material Documentation **Stratov**

289 22 Stratov, čp. 184,
Phone: +420 234 742 205

Archive of Geological Samples and Written Documentation



Archive of Material Documentation **Chotěboř**

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Archive of Geological Samples

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