CZECH GEOLOGICAL SURVEY

Annual Report **2011**

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Advisory bodies

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International Section
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Zdeněk Venera
Director
zdenek.venera@geology.cz

Secretariat
Human Resources Section
Internal Audit

Advisory bodies

Editorial Board of the Bulletin of Geosciences
CGS Portal Board
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Geochemical Division and Central Laboratories

Jan Pašava
Head of Division & Deputy Director for Research
jan.pasava@geology.cz

Central Laboratory Prague

Věra Zoulková
Head of Department
vera.zoulkova@geology.cz

Environmental Geochemistry and Biogeochemistry

Martin Novák
Head of Department
martin.novak@geology.cz

Rock Geochemistry

Jiří Frýda
Head of Department
jiri.fryda@geology.cz

Applied Geochemistry and Testing Laboratory Brno

Juraj Franců
Head of Department
juraj.francu@geology.cz

Economic Division

Zdeněk Cilc
Head of Division & Deputy Director for Economics
zdenek.cilc@geology.cz

General Economics

Jana Kuklová
Head of Department
jana.kuklova@geology.cz

Economics and Administration

Mirko Vaněček
Head of Department
mirko.vanecek@geology.cz

Geological Division

Petr Mixa
Head of Division & Deputy Director for Geology
petr.mixa@geology.cz

Regional Geology of Crystalline Complexes

Jaroslava Pertoldová
Head of Department
jaroslava.pertoldova@geology.cz

Regional Geology of Sedimentary Formations

Lilian Švábenická
Head of Department
lilian.svabenicka@geology.cz

Applied Geology

Jan Čurda
Head of Department
jan.curda@geology.cz

Regional Geology of Moravia

Jiří Otava
Head of Department
jiri.otava@geology.cz

Geology of Environment and Geophysics

Jan Šikula
Head of Department
jan.sikula@geology.cz

Geofond Division

Vít Štrupl
Head of Division
vit.strupl@geology.cz

Geological Documentation

Milada Hrdlovicsová
Head of Department
milada.hrdlovicsova@geology.cz

Mineral Raw Materials

Jaromír Starý
Head of Department
jaromir.stary@geology.cz

Geological Exploration and Mining Impacts

Jaroslav Novák
Head of Department
jaroslav.novak@geology.cz

Division of Informatics

Dana Čápová
Head of Division & Deputy Director for Informatics
dana.capova@geology.cz

Publishing House CGS

Patrik Fiferna
Head of Department
patrik.fiferna@geology.cz

Information Services

Hana Breiterová
Head of Department
hana.breiterova@geology.cz

Information Systems

Zuzana Krejčí
Head of Department
zuzana.krejci@geology.cz

Situation as of January 1, 2012

MANAGEMENT

Zdeněk Venera
Director

Petr Mixa
Deputy Director for Geology and Head of the Geological Division

Dana Čápová
Deputy Director for Informatics and Head of the Division of Informatics

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

Vít Štrupl
Head of Geofond Division

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

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 service 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 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 Service 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.

Introduction

Tomáš Chalupa
Minister of the Environment

Zdeněk Venera
Director of the Czech Geological Survey

Dear friends and colleagues,

You now have in front of you the Annual Report of the Czech Geological Survey for the year 2011. The CGS has been a research institute of the Ministry of the Environment since 1990. Beginning last year there has been a restructuring of the organizations under the authority of the Ministry of the Environment. As part of this process, the ministry disbanded the government department CGS – Geofond as of 31.12.2011 and its work has now been transferred to the CGS. It is my pleasure to state that, according to the nationwide assessment of 477 Czech research institutions by the Research, Development and Innovation Council of the Government of the Czech Republic in 2011, the CGS was rated one of the most scientifically successful institutions within the resort of the Ministry of the Environment. The CGS was ranked in twenty-second place. The Council placed the CGS thirteenth out of the twenty top rese arch institutions in terms of its scientific performance over the past five years. Both the focus and quality of its research were judged comparable with that carried out in the leading geological surveys in Europe and around the world.

One of the most important and largest long-term projects in which the CGS became involved last year is the Review of Groundwater Resources in the Czech Republic, the purpose of which is to reassess the most important groundwater resources in the area of our republic. This five-year project is funded from the Operational Programme Environment and by the Ministry of the Environment and the State Environmental Fund. This, as well as many other research projects in which the most recent advances in scientific knowledge and technology are being applied to problems of profound practical importance, contributes to the sustainable development of human society and to the protection of the environment.

It is greatly to its credit that, over the past twenty years of its existence as an organization under the authority of the Ministry of the Environment, the Czech Geological Survey has achieved and maintained a national and international reputation for the quality of its scientific research and the high professional standard of the geological service that it delivers.

Sincerely
Tomáš Chalupa

The year 2011 has become one of the landmarks in the development of the state geological service in the Czech Republic. In 1975, Geofond of the Czech Republic was separated from the Central Geological Institute and this resulted in an anomalous arrangement whereby the tasks of the state geological service had been carried out by two separate institutions. Since 1998, when I became the Director of the Department of Geology at the Ministry of the Environment, I have been striving to reunify the functions of the state geological survey within a single institution. As in other developed countries, our national geological survey is expected to possess expertise covering a wide field of the Earth Sciences, and concurrently, it must also be able to fulfil its statutory duty by providing practical support and expert scientific advice to the state administration on issues relating to the environment, mineral resources, groundwaters and geological hazards. The act of unification was, in fact, prescribed by an amendment to the Geological Law issued in 2000, but it was not fulfilled until the 1st January 2012. After many years of effort and discussions, the Czech Geological Survey was re-established as a single organization following a decree by the Minister of the Environment, Tomáš Chalupa, with the support of Deputy Ministers Tomáš Tesař and Tomáš Vrbík. All the functions of the state geological service are now performed by the CGS that has assumed responsibility for the tasks undertaken by the former CGS – Geofond. The CGS recognizes the outstanding reputation of Geofond as an archive and provider of geological information. It is now our collective responsibility to maintain this resource and to make the best use of current advances in technology so that information continues to be accessible to all interested persons. The future of the united CGS, however, will not be easy. Being a government organization, it is impacted by the economy measures now being implemented. In the face of these difficulties, it is vital to remember that the professional capabilities and scientific reputation of the CGS depend on the enthusiasm and expertise of the staff that is its most valuable asset. This is the main reason why I do not view reduction of employees due to decreasing financial support from the state budget as a way forward. Our task is to maintain the human potential of this respected Survey while generating projects funded from other sources.

Zdeněk Venera

Geological and thematic maps

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

Geological maps provide comprehensive information about the geological composition of the territory of the Czech Republic. They are used especially for environmental protection, assessment of geohazards, mineral deposit exploration, evaluation of groundwater reserves and strategic or land-use planning. Explanatory texts supplied with each map give details of particular geological aspects of the mapped area, such as petrology, structure, hydrogeology etc., and all the essential information acquired during mapping of the ares is summarized.

Geological mapping

Geological mapping has been one of the key tasks of the Czech Geological Survey since its foundation. The CGS is the only institution in the Czech Republic with the statutory responsibility to compile and publish geological maps for the state. Mapping involves not only compilation of geological and thematic maps at various scales, but also the collection, processing and provision of the accompanying data (chemical analyses, descriptions of rock thin sections, various structural measurements etc.) and samples of rock, water and soil. All these observations are stored in the National Geological Mapping Database which is designed so that different layers of informations can be compiled and displayed in a digital format

Contributions to economy and environment

The selection of areas to be mapped is governed by the environmental policies and planning priorites of the state and local goverments. During the geological survey for a map sheet, the evolution of the soils must also be studied to provide information essential for environmental analysis. New informations about deposits of minerals and industrial raw materials and resources of coal or geothermal energy are of direct economic value, and assessments and proposals for protective measures must be made. The identification of potential sites for the underground storage of gas and hazardous waste is also important.

Detailed maps at 1:25,000 scale

The core mapping project being undertaken by the CGS is the detailed mapping of selected areas of the Czech Republic at a scale 1:25,000. Each of these detailed maps consists of three parts. The map itself is accompanied by separate explanatory notes and all the information gathered during mapping is also compiled in a digital information system.

An extract from the exodynamic map sheet 03-324 Turnov, showing the characteristics of the relief along the Lužice Fault Zone. The relief to the south-west of Železný Brod is the result of erosion by the Jizera River and its tributaries.

Mapped areas

During the current cycle of work, geological mapping of nine areas is in progress. These are as follows: the Krkonoše Mts, the Šumava Mts National Park and Protected Area, the Brno Region and the Moravian Karst Protected Area, the Beskydy Mts, the Jeseníky Mts Protected Area, the Doupov Mts with the Čistá-Jesenice Massif, the Křivoklát Protected Area, the Central Moldanubian Batholith and the Bohemian Paradise. Under the terms of the new Directive for Geological Mapping of the Czech Republic at the Scale of 1:25,000, fourteen map sheets were completed in 2011: 03-142 Hejnice, 03-231 Jizerka, 03-423 Svoboda nad Úpou, 03-424 Trutnov, 24-324 Brno-sever, 24-341 Oslavany, 12-321 Panoší Újezd, 23-314 Deštná, 03-341 Kněžmost, 03-324 Turnov, 03-342 Rovensko pod Troskami, 03-431 Lomnice nad Popelkou, 03-413 Semily and 03-422 Žacléř. Mapping continued on a further 17 map sheets.

Derived maps

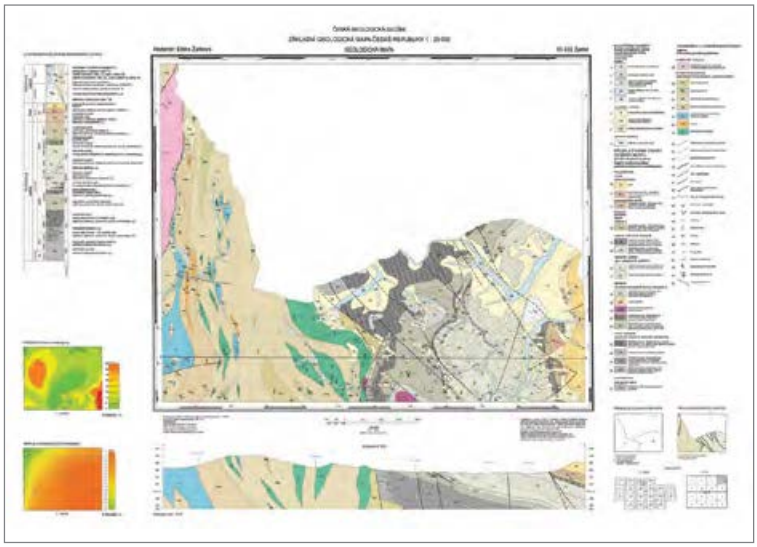
The CGS compiles geological maps of the border areas of the Czech Republic and in other countries in cooperation with foreign geological institutions. In addition, the CGS is collaborating in *OneGeology*, the aim of which is to create a geological map of the Earth at a scale of 1:1,000,000. Geological maps at 1:50,000 and 1:200,000 scale, which already cover the entire territory of the Czech Republic, are available free on the Map Server (*mapy.geology.cz*).

During 2011, an analysis of the exodynamic processes responsible for the relief in the area of the European Geopark Bohemian Paradise was carried out. This information was used to compile maps at 1:25,000 scale classifying the landforms and other geological features in terms of their exogene (erosional or depositional) and endogene origins. The maps also show areas prone to geohazards, particularly to flooding and landslides.

Further research and presentation of results

Compilation of the information gathered during geological mapping form the basis for scientific papers that are published regularly in high-impact international journals. It is natural that regional geological research depends closely on geological mapping. In our research, emphasis is placed on interpreting the structural and geological evolution of the Bohemian Massif and the Western Carpathians. Annual field courses on geological mapping are organized in cooperation with the faculties of science. The results of geological mapping are also presented regularly at seminars and workshops for geoscientific and mining companies.

Field trip by the participants of the international conference in Monínec, which was organized by the Czech Geological Society in cooperation with the CGS. It is the type locality for durbachite of the Čertovo břemeno type, which is the most basic rock in the Central Bohemian Pluton (photo by V. Žáček).



One of the recently printed map sheets 03-422 Žacléř (editor E. Žáčková). The general layout of the map, the colour code used to depict different types of rock, and the names and indices used to describe rock-types follow the standards given in the Directive for Geological Mapping at the Scale of 1:25,000 (compiled by a team of authors led by P. Hanžl).

Staff from the CGS took an active part in the international conference *Challenges and threats of ecotourism and geotourism to the protection of biodiversity and geodiversity* held in Telč in October 2011. The data acquired during geological research and mapping in the area of Bohemian Paradise have been published regularly in international impact journals. The book *Geopark Bohemian Paradise* was published in both Czech and English editions. This publication describes a wide range of geological phenomena in a style that will appeal to the general public as well as to specialists.

Regional geological research

Jaroslava Pertoldová
Lilian Švábenická

Head of the Department of Regional Geology of Crystalline Complexes / Sedimentary Formations

Basic geological research on the Bohemian Massif and the Outer Western Carpathians is closely related to geological mapping and is carried out in cooperation with other geological institutions, both in the Czech Republic and abroad. The rocks exposed in different parts of the Czech Republic range in age from 2,100 Ma to recent. The scope of regional research reflects this diversity. Important themes are the tectonometamorphic evolution of the basement and the emplacement and composition of associated intrusions and volcanics, and the tectonosedimentary evolution, litho- and biostratigraphy of the overlying sediments, including palaeoenvironmental interpretation. The results of this research are presented at international conferences and published in reviewed journals and monographs.

Metamorphic rocks

In 2011 emphasis was placed on the investigation of areas of the Moldanubian Zone, the Krkonoše-Jizera Crystalline Complex, the Moravicum and partly on the area of the Doupovské hory Mts. The work ranged from practical tasks to more theoretically oriented investigations, e.g. the petrological interpretation and experimental work on the granulites of Kutná Hora carried out in relation to basic geological mapping, and modern structural geological investigations, mostly related to plutonic rocks of the southern and central parts of the Bohemian Massif. Petrological and structural studies of this unit have led to a better understanding of the lithotectonic correlation between separate domains of the Moldanubian Zone and their geodynamic and rheological behavior during the Variscan orogeny in the later Palaeozoic.

Field observations, combined with data from existing literature, were used to compile expert reports for the Radioactive Waste Repository Authority of the Czech Republic. The aim is to identify a site suitable for the construction of a deep geological repository for spent nuclear fuel.

An outcrop of migmatized paragneiss near Masákova Lhota in the Šumava Mts. Selective weathering has picked out the compositional variations in the foliated structure and this has been emphasised by the growth of vegetation, in this case houseleeks (photo by V. Žáček).

Magmatic rocks

Magmatism in the Czech Republic has led to the formation of granitic plutons that are remarkable in scale compared with the other parts of Europe. Modern structural-geological and petrological analysis of magmatic complexes was carried out throughout the whole republic, but mostly in the Šumava Region of the Moldanubian Complex and the Central Moldanubian Pluton. Emphasis was placed on understanding the mechanisms of intrusion, and the evolution of the composition of intrusive bodies in the north-eastern part of the Bohemian Massif, the reconstruction of the Cambro-Ordovician geodynamic event in the west and on the synthesis of the geodynamic evolution of the Moldanubian Plutonic Complex situated in the south.

Currently, practical research on magmatic rocks is concerned with continuous monitoring of the water-supply tunnels near Bedřichov in the Jizera Mts. This work is being carried out in cooperation

Examining sand derived from the Eocene rocks in the quarry near Ježov in south Moravia. The suspended material contains rare nummulites, large planktonic foraminifera from the Tertiary seas, together with fragments of oyster shells and spines of sea urchins (photo by P. Maděra).

with the Technical University in Liberec. This research is focused on acquiring quantitative information about the long-term stability of the Jizera granite massif for use in modelling the evolution of the rock environment. One application of this research will be the identification of structures suitable for use as underground repositories for storage of nuclear waste or gas. *In-situ* experiments designed to measure the response of crystalline rocks to thermal loading were begun in the Josef Adit near Mokrsko. This experimental work is funded by the Ministry of Industry and Trade of the Czech Republic. The objective is to measure the changes of physical and chemical properties of crystalline granular rocks as a result of thermal loading up to 100 °C. The safety and the efficiency of heat storage in the rock environment are being assessed.

Volcanic rocks

During 2011, research on volcanic rocks was focused on the comprehensive investigation of monogenetic volcanoes and sub-volcanic intrusions of Permian and Tertiary age in the Krkonoše Piedmont Basin and those of Cambrian age in the Křivoklát Area. Attention was given to interpreting the various styles of volcanic eruption and to the geometry and scale of subsurface volcanic intrusions. Individual eruptions were also dated. Exploration boreholes drilled in the area near Lomnice nad Popelkou, together with archive data from the CGS – Geofond, helped to answer some of the questions concerning the stratigraphy and geometry of the eruptive sequences. Volcanic activity had a significant effect on the sedimentary environment and on the rocks deposited at key-stages of the geological evolution of the Czech region. By combining the results of volcanological and sedimentological studies it has been possible to reconstruct the palaeoenvironment in individual areas.

Reconstruction of the landscape in the Krkonoše Piedmont Basin at the time of the deposition of the lacustrine Kalná Horizon (author: J. Svoboda).

Sedimentary formations

Stratigraphic, sedimentological, and palaeoclimatological studies of Permian and Carboniferous sediments in the area of the UNESCO European Geopark Bohemian Paradise were completed. Information obtained from the core of a recently completed drill hole near Smita village contributed significant results to the sedimentological investigation. Sediments of colluvial origin and sediments deposited in rivers, lakes and river deltas were identified in the sequence of red-brown mudstones, siltstones, sandstones and conglomerates. It was possible to place these in stratigraphic context and classify and interpret the lithofacies. Particular use was made of fossiliferous horizons preserved in lake sediments, namely the Ploužnice, Rudná and Kalná horizons. The flora found in these rocks enabled the stratigraphic age of the Carboniferous sediments to be determined accurately and it was also possible to determine the climatic conditions under which they were deposited. It also enabled palaeoenvironmental reconstructions. Absence of xerophilous conifers and the scarcity of hydrophilous Lycopodiophyta and ferns in the Carboniferous proved that the climate was warm with marked seasonal variations in precipitation. Under these conditions it was not possible for hydrophilous species to survive through the dry seasons. Palaeobotanical evidence from the Permian rocks indicated that the climate was by that time more arid.

Global changes in the past

Zbyněk Šimůnek
Research team leader

Study of global changes in the environment and climate in the geological past help us to understand the climate changes occuring in the present and to forecast their possible impact in the future. We have created models which show the response of flora and fauna to changes in climate and ecology, when these changes took place, and what caused them. Each significant global change that led to mass extinction and the appearance of new species generally defines a boundary between two stratigraphic units. The approach to studying these problems is different in marine and continental environments. The results of our research are regularly published in peer-reviewed, impact journals.

Effects of global changes on the marine environment

The focus of research into global changes in the marine domain is placed on the response of marine fauna to changes in climate and changes in the salinity and the concentration of oxygen in the oceans at different stages during geological history.

Early Palaeozoic

During 2011, research on two topics continued from the previous year: These are concerned with changes in the composition of the marine fauna (conodonts, gastropods, cephalopods, brachiopods, tentaculites, bivalves, scolecodonts etc.) and the way in which the diversity of the faunal communities changed in relationship to changes in the palaeoenvironment (microfacies, volcanism) during the Palaeozoic in the areas of the present Czech Republic, the USA and the Silurian and Devonian of Gotland in Sweden. Emphasis was also placed on questions of international correlation using biostratigraphy and chemostratigraphy.

Ordovician

Palaeontological studies of trilobite and bivalve species were made during 2011. The results of palaeontological investigations carried out at Červený vrch in Prague, together with a study on the pyritized fauna from the Motol Formation in the Kosov Quarry near the town of Beroun were published.

Silurian

During 2011 emphasis was placed on investigating the bivalve fauna of peri-Gondwana and scolecodonts from the Prague Basin. Particular attention was given to the response of polychaetes to important events in geological history. The development of the cephalopod biofacies was the main evolutionary event during the Silurian. The bivalves of the Nepiomorphia group were associated with this biofaces. Approximately 100 genera of Palaeozoic bivalves were included in the study.

Devonian

The emphasis in research on Devonian fossils was placed on the conodont faunas of Nevada (USA). Four new species were described. Another investigation in progress is concerned with the early ontogenetic stages of phacopid trilobites from the Prague Basin.

An outcrop of Permian sediments of the Veverská Bítýška Formation in the Boskovice Furrow. The exposed beds are mostly green to grey siltstones of the Chudčice Horizon that crop out near the northern edge of Veverská Bítýška. The photograph shows Helena Gilíková making observations at this locality during field mapping.

Mesozoic

| Cretaceous

A new species of sponge from the Upper Cretaceous rocks of James Ross Island in the Antarctic has been described. This sponge, *Laocoetis piserai*, is exceptionally important from the palaeobiogeographical point of view and is also the first fossil sponge to be found in Antarctica. The discovery of this unique fossil was an outcome of the detailed palaeontological and sedimentological field studies carried out by a team from the CGS on the Upper Cretaceous rocks exposed on James Ross Island in the Antarctic Peninsula.

Cenozoic

| Neogene

In the northern part of James Ross Island (Antarctica), which is not covered by ice, a new formation of Upper Miocene age has been defined. This is named the Mendel Formation and consists of glaciterrestrial, glacimarine and marine sediments. The age of these rocks has been determined as 5.9 to 5.4 Ma by dating the underlying basalts and using the shells of the scallop *Zygochlamys andersonni*. The changes in the sequence of sediments reflect the cyclicity of climate and the changes of sea level that took place during the Upper Miocene on the terrestrial margin of Antarctica. The whole formation provides a unique palaeoclimatic record for this period of geological history.

Changes in the terrestrial environment

The focus of this research is to record and interpret the response of flora to climate changes. By reconstructing the composition of fossil plant communities it is possible to deduce the character of the terrestrial vegetation and its relationship to the climate prevailing at that time.

Late Palaeozoic

| Carboniferous

During 2011, neuropterid fronds of Westphalian pteridosperms from the Carboniferous basins in Central Bohemia were investigated. Using the structure of their cuticles, a new genus, *Havlenaea*, was described. Recently, coal samples have been macerated so that the cuticles and palynomorphs contained in the coal can be separated for detailed study. This procedure will enable the identification and interpretation of plant assemblages using two independent methods: cuticular analysis and palynological analysis. Up to now, it has only been possible to assess the floristic composition of coal by using palynological analysis. Analysis of pollen and spores in the river sediments of Westphalian age from the coal basins in central and western Bohemia enabled the composition of the vegetation growing in the coastal areas to be identified. The seasonal pattern of rhythmic lamination in lake sediments of the Malesice Member (Stephanian B) has been studied in detail.

| Permian

During the field mapping carried out during 2011, a new locality with xerophilous Walchia flora was discovered near the village of Veverské Knínice in the Boskovice Furrow.

Macerated part of a frond of the pteridosperm Alethopteris subdavreuxii *Sterzel with well-preserved venation, which was found in Carboniferous sediments of Asturian age in Zwickau (Germany). This plant has only a limited distribution but is morphologically very similar to the Czech species* Callipteridium rubescens. *Detailed study of their cuticles, however, has shown that these are two different species.*

Cenozoic

| Quaternary

Palaeoecological investigations based on palynological analysis, malacozoology and radiocarbon dating have been carried out in the flood plain of the Labe River in the eastern Labe lowlands. The flood plain of the now non-existent Dudváh River preserved in a palaeomeander on Žitný Island, is another site where palynological analysis is being combined with studies of macro-remains, malacozoology and radiocarbon dating. Sedimentation here took place approximately 2500–3000 years ago. A palaeomeander in the Dunaj River preserved at Vrakúň on the same island is about the same age. Here, macro-remains were collected and prepared for palynological analysis and radiocarbon dating.

In 2011, for the first time, the Czech Geological Survey was granted a patent by the Industrial Property Office in Prague (Vodrážka 2011). The patent relates to a new method for the chemical separation of calcareous and pyritized fossils from calcareous rocks using 38% sulphuric acid.

Environmental geochemistry and biogeochemistry

Martin Novák
Head of the Department of Environmental Geochemistry and Biogeochemistry

Ecosystem studies

In 2011, the staff of our Department published numerous papers about the condition of ecosystems in the Czech Republic. Topics under investigation include weathering processes, atmospheric deposition, airborne dust, emissions of greenhouse gases, forest soils, wetlands and the hydrochemistry of both small and large river catchments. Mathematical modelling of biochemical processes was successfully used for predicting the response of the landscape to climate change. Development of methods for using non-traditional isotope systems continued in 2011 placing emphasis on nutrients, especially magnesium.

Soil observatories

During 2011, rapid progress was made on the integrated research programme in the small catchment of Lysina in the Slavkovský les Mts. This catchment, together with several satellite sites in the Czech Republic, has been designated one of four European soil observatories. The project *Soil Trec* is being carried out under the auspices of the 7th Framework Programme of the EU by a consortium of 15 national teams. The intention of the project is to create the nucleus for a worldwide network of soil observatories for the 21st century.

Monitoring of atmospheric pollution

In 2011, a three-year programme monitoring the chemical composition of horizontal and vertical atmospheric precipitation was completed. Compositions were monitored at the newly established CGS network of sampling sites located on 10 mountain tops near the borders of the Czech Republic. It was discovered that pollution of the mountains by heavy metals is now very low compared to the situation in the past. Public attention was drawn to this positive news by a leading article in Hospodářské noviny (Economic News) and interest continued for the whole ski season.

21st International Goldschmidt Conference

In August 2011, our team also took part in organizing the scientific programme of the 21st International Goldschmidt Conference in Prague. More than 3300 delegates from all around the world registered for this most prestigious annual meeting of geochemists. Scientists from the CGS gave 20 presentations at the conference.

The predicted influence of climate change and decrease in acidification on the biochemistry of forest ecosystems

The current trend in climate change is marked by increasing mean annual temperatures and changes in the seasonal pattern of precipitation. This will lead to changes in the discharge from river catchments. Based on the predictions of the BROOK90 model for the small river catchments of the GEOMON system in the Slavkovský les Mts, there will be a decrease in the total runoff of surface waters by the year 2070. The pattern of runoff will also change so that the period of the greatest runoff will take place in the winter months during which there will be more rain and less snow. The runoff in the summer months will decrease significantly as a result of rising temperatures.

This change will also have an impact on the chemical composition of surface waters, as predicted by the MAGIC model. The concentrations of anions of strong acids will rise slightly, but the concentrations of cations will also increase. No significant change in the acid/base balance is expected to occur, so climate change will consequently not have any radical impact on the recovery of acidified forest ecosystems.

The decline in acidification has had a significant impact on the carbon content of forest soils. The observations made over two decades in the forest area of Načetín in the Krušné hory Mts showed that the carbon contents of organic soil horizons have decreased by 47% since the 1990s and the nitrogen contents have decreased by 42% during the same period. This was due to the decrease in acid precipitation, followed by the revival of microbial communities in the soils.

Sampling of horizontal atmospheric precipitation (rime) at the Velký Polom site in the Moravskoslezské Beskydy Mts (photo by K. Hrdličková).

Their biological activity was previously inhibited by acidification. The heterotrophic microbes use the accumulated humus for their metabolism and transform it mainly to CO_2. Paradoxically, the decrease in acidification of soils has therefore led to release of CO_2 into the atmosphere.

Chemical composition of surface waters

In 2011, the second survey of the chemical composition of surface waters in the whole Czech Republic (2007–2010) was completed and interpreted. Compared to the situation when the first survey was carried out during the decade from 1980–1990, the situation has improved significantly, especially as regards acidification. In the case of nitrates, the situation has not improved much because over 23% of the area of the Czech Republic, the pollution of surface waters by nitrogen still exceeds the acceptable limits. Surface waters are also extensively contaminated by phosphorus. The maximum acceptable environmental limits for phosphorus and/or nitrogen are exceeded over 29% of the area of the Czech Republic. On the other hand, contamination of waters by heavy metals (As, Be, Cd, Cu, and Pb) is comparatively low. The maximum acceptable limits for some of the heavy metals are exceeded over only 1,6% of the area of the Czech Republic.

The 21st Goldschmidt International Geological Conference

co-organized by the Czech Geological Survey

In late August 2011, Prague became the meeting place for the leading geochemists from across the world. Since its modest beginnings 20 years ago, when the tradition of an annual geochemical conference was started by 200 enthusiasts, the Goldschmidt Conference has steadily grown larger. On August 18 2011, we had the opportunity to welcome a record-breaking 3315 delegates from 37 countries on 5 continents to the Hall of the Congress Centre in Prague. The 3700 registered abstracts were also a record number. The Czech coordinator of the scientific programme was Martin Novák.

The Goldschmidt Conference is organized in Europe every odd year by the European Association of Geochemistry (EAG) and overseas every even year by the Geochemical Society. The host city is selected in Europe, America, Asia or Australia. An attractive destination, however, is not the only condition necessary for hosting the Goldschmidt Conference. The steering committee also takes into consideration whether there is a geochemical research community with an international reputation in the host country. This condition was fulfilled by teams from the geochemical departments of three Prague institutions: the CGS, the Faculty of Science at Charles University and the Czech University of Life Sciences. Each of these teams publishes dozens of original research papers in prestigious international journals every year.

Preparation of the scientific programme for the 21st Goldschmidt Conference was carried out in cooperation with the Czech Geological Survey, and took 5 years to complete. The logistics were provided by the British company *Cambridge Publications*. The team that organized the programme was led by three scientists from France (Bernard Marty, Bernard Bourdon and Eric Oelkers), one from the U.K. (Chris Ballentine)

The conference took place in 18 halls at the Congress Centre and over 3000 delegates attended.

The Congress Centre is one of the outstanding buildings in Prague, with beautiful views across the city.

and one from the Czech Republic (Martin Novák of the Czech Geological Survey). Sue Trumbore and Jon Chorover from the USA, together with Martin Novák, were responsible for the biochemical sessions. The scientific committee identified 135 themes and scientists from the geochemical community proposed a further 102. After combining some of the proposed topics, the organizing committee arrived at the final number of 182 sessions.

The sessions were held simultaneously in 18 lecture halls. One keynote lecture was given every day in the Congress Hall with associated ceremonies for the presentation of various awards and honours. The talks covered a wide range of subjects concerned with both pure and applied research. Among the most fascinating, as always, were contributions concerning cosmogeochemistry, the accretion of the Earth, petrogenesis, the onset and present state of plate tectonics, and processes in the Earth's mantle. Over the years, number of biochemical contributions presented at the Goldschmidt Conference has been steadily increasing. In 2011 half of the papers presented had biochemical themes. Some of the hottest topics were climate change, nanoparticles and the role of microorganisms in regulating global geochemical cycles. Papers with traditional geochemical themes related to mineralogy, pollution and new analytical methods were also well represented. Many of these papers were concerned with the use of isotopic methods, in particular the fast-developing field of non-traditional isotopes (Cr, Ca, Mg, Fe, Mo, Se, Ni, Cd, Hg, etc.).

A rich social and cultural programme was also organized for Goldschmidt Conference participants. This included tours of Prague, evening concerts in Prague churches, a banquet in the Municipal House and in Břevnov Cloister and three-day scientific excursions across the whole country. The successful organization of the cultural programme and the efficient management of the simultaneous sessions in 18 different halls would not have been possible without the assistance of the team of 50 local English-speaking students who provided information, and served as guides. Just recently, we have learnt that our new bid to organize another Goldschmidt Conference was successful. Even though 9 cities made bids to host the conference in 2015, Prague was chosen. The CGS will once again take a leading part in the organization of the scientific programme and, no doubt, the student community will also rise to the occasion.

Poster advertising the next Goldschmidt Conference in 2015. This was designed, by the Publishing House of the CGS. Watercolour by O. Savicky.

Mineral resources and the environmental impact of mining

Zdeňka Petáková
Head of the Department of Mineral Resources

Economic geologists from the Czech Geological Survey carry out surveys and environmental studies of mineral resources in the Czech Republic, as well as in countries abroad. The primary aim of this work, based on the principles of sustainable development and the current needs of society, is to ensure optimal use of resources and minimise the impact of mining on the environment. We advise government and provide objective information to the public.

Scientific support for decision-making at state and local levels

The CGS served as an adviser on issues relating to mineral resources and the environmental impact of mining during the compilation of the *National Research, Development and Innovation Policy of the Czech Republic*. The CGS also provided expert advice and reviewed the text for the *National Mineral Policy of the Czech Republic*. During 2011, we compiled a number of expert reports for the state and local administration. These were concerned with mining, mitigating the impacts of mining and the relationship between mineral deposits and land-use planning. Collaboration continued with the members of the former Independent Expert Commission for Assessment of the Energy Needs of the Czech Republic.

Meeting of the working group on the project Assessment of the potential of mineral resources on the Saxon-Czech border – cross-border register of mineral resources, that was held in Jáchymov in 2011 (photo by M. Hellmich).

Mineral resources

During 2011, trends in the supply of strategic, high technology and "critical resources" (as defined by the EU), were monitored.

Maps of mineral resources were compiled for the areas of Bohemian Paradise, Křivoklát, Krkonoše Mts, Šumava Mts, Jeseníky Mts, Beskydy Mts and the Czech-Moravian Highlands, in all a total of 12 map sheets at 1:25,000 scale. Legends, and summaries of information on mineral resources and their use were compiled for each sheet. Five detailed geological sections at a scale of 1:25,000, together with legends, were compiled within the frame of the project *Geological factors affecting the environment of the southern foothills of the Krkonoše Mts*. Emphasis was placed on surveying and depicting the impacts of mining, such as mining subsidence and contamination.

Members of the Mineral Resources Department helped to collect samples for a geopark and for schools and museums in the Svitavy area. A significant contribution was made to the content of the descriptive brochure *Geology of the Protected Landscape Areas and National Parks in the Czech Republic – Třeboňsko Protected Landscape Area*.

Following the CGS tradition, information about mineral resources was also provided to archaeologists. Lectures and fieldtrips for the Administration of the Protected Landscape Area Železné hory and the non-governmental organization Boii were also arranged. Emphasis was placed on the history of extraction and use of local mineral resources at the time of the Celtic settlements. During 2011, members of the Department also contributed to the professional activities of the Czech Association of Economic Geologists.

Updating the Regional Mineral Policy for the Liberec Region (URMP LR)

The *Regional Mineral Policy for the Liberec Region* was updated by the GCS in accord with the still incompleted *National Mineral Policy of the Czech Republic* and the *National Energy Policy of the Czech Republic*.

The final public discussion on the *Update of The Regional Mineral Policy for the Liberec Region* (ARSP LK) was held in the Regional Council of Liberec in coordination with the Ministry of the Environment of the Czech Republic. The results of the evaluation of the SEA – Strategic Environmental Impact Assessment were discussed. This was carried out under the terms of Act No. 100/2011 Coll., as amended (SEA).

The final version of the URMP LR was ratified at the 9th meeting of the Regional Council of Liberec Region (resolution No. 386/11/ZK), after all the objections and comments had been taken into account. This document is the outcome of a thorough analysis by a team of scientists, officers and representatives of both local and regional administrations and the general public. It sets out the principles that will govern the utilization of the mineral resources of the area until 2020. This is a strategic document that will be used by the local administration and individual departments of the Regional Council of Liberec to guide planning decisions about the exploitation of mineral resources and land-use.

The impact of mining on the environment

The third and final phase of the project *Review of the current state of safety of abandoned mine workings* was completed for the Ministry of the Environment of the Czech Republic. A field survey of the current state of safety of 571 abandoned mine workings (AMW) was carried out. Conditions were found to be inadequate and unsafe in 29 cases. Recommendations for certain repairs to technical safety measures were made in further 64 AMW.

As part of the *European Resource Initiative* and under the terms of the *EO-MINERS* project, the CGS Mineral Resources Department collaborated with Sokolovská Uhelná Inc. in the development and application of remote sensing techniques for monitoring areas of the Sokolov Basin affected by coal mining.

The risk of mine subsidence in the area of Lukavice village near Rychnov nad Kněžnou was also assessed.

Some results from an ongoing study of dust in Czech conurbations were presented at the meeting of the Geochemistry Expert Group of EuroGeoSurveys, held in Finland in 2011.

International cooperation and work abroad

An overall assessment of the future resource potential of 8 mineral deposits on the Saxon-Czech border was completed as part of the project *Assessment of the potential of mineral resources on the Saxon-Czech border – cross-border register of mineral resources*. This project was carried out in cooperation with Saxon partners from Geokompetenzzentrum Freiberg e.V.

View of the open pit at the Černý Důl deposit in the Krkonoše Mts. This mine is shown on the 1:25,000 scale Map of Mineral Resources, Sheet Svoboda nad Úpou (photo by R. Rambousek).

A mineral resource assessment of an area in Iran, which was carried out under the terms of a geological mapping contract with the Geological Survey of Iran was completed with the approval of the geological and special-purpose exploration-geological maps.

Members of the Mineral Resources section took part in compiling the *European Resource Initiative* and *European Innovation Platform* under the terms of the association of European geological surveys EuroGeoSurveys (EGS). Preparations for a project to create an information system for energy resources in Europe were begun with funds provided under the terms of the GeoEnergy Expert Group of EGS.

Members of the section also participated in the international project *GEMAS (Geochemical Mapping of Agricultural Soils)* of the Geochemistry Expert Group of EGS. Preliminary results of this project were presented at the international conference Pedometrics 2011.

Throughout 2011, economic geologists from the CGS continued to participate in the scientific activities of the international organizations SGA, SEG and IAGOD.

Geofond

Vít Štrupl
Head of Geofond Division

On the 1st January 2012, a new division, No. 600, was created in the organizational structure of the Czech Geological Survey. This department carries out most of the tasks of the former state organ named Czech Geological Survey – Geofond. The 60 years of development of this organization, disbanded on December 31, 2011 by Act No. 3/11 of the Ministry of the Environment, is summarized below.

History

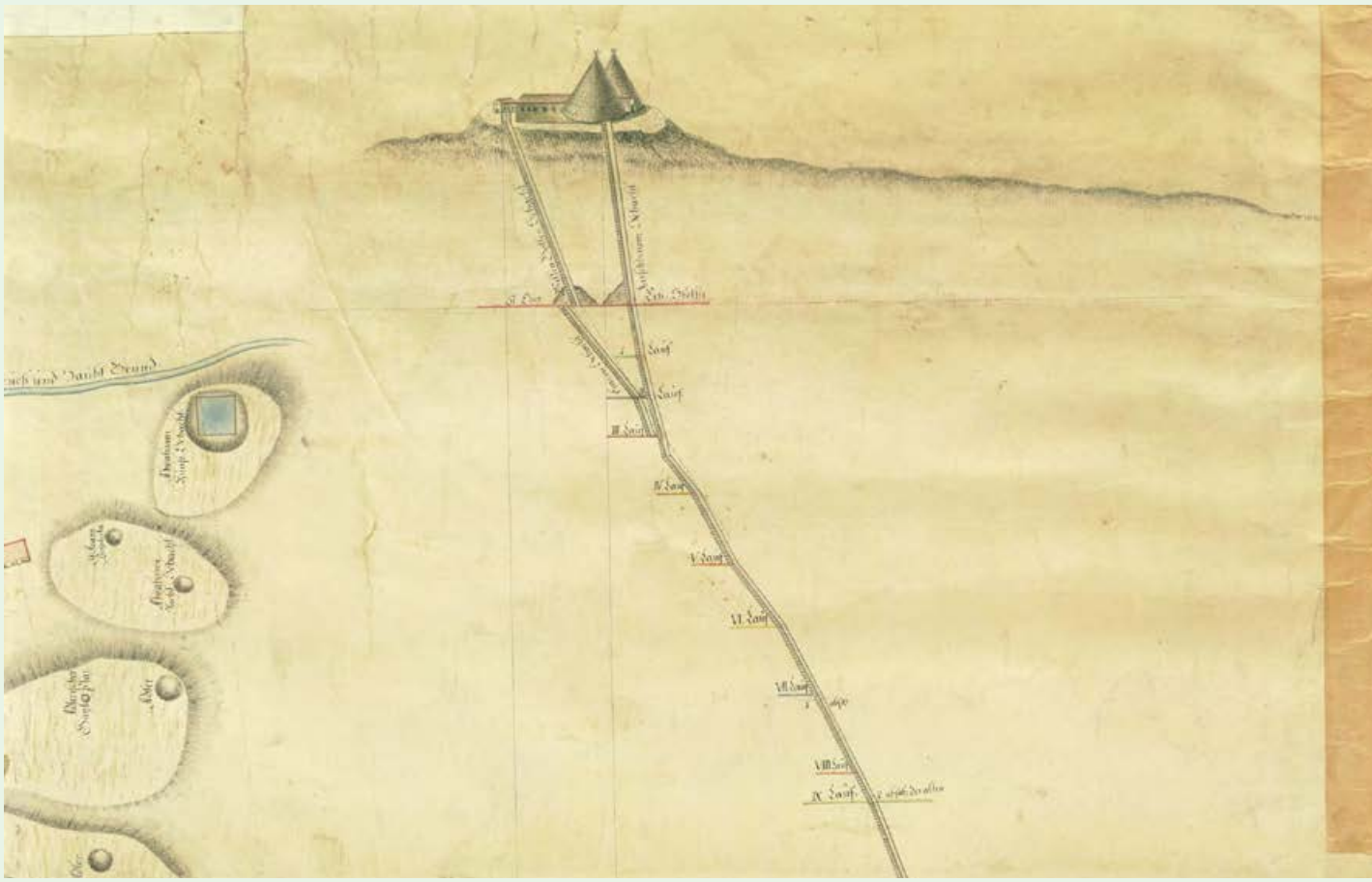
Geofond was established by a Government Resolution of 17th June 1952 as a "**Geological Fund**", the designated archive of the **Central Geological Institute (CGI)**. In this fund, "the summaries and results of all geological projects carried out by ministries, companies and other institutions, as well as all literature on geology (including maps) published in Czechoslovakia" were to be archived. State Planning Office Decree No. 298 regarding the **forwarding of documents to the Geological Fund** was issued on 14th October 1952 and stipulated that "institutions conducting geoscientific and exploration activities should forward the required documents to the Geological Fund. The documents included project proposals, plans and reports with results in the appropriate format and, upon request, geological samples and overviews of mine production".

The most decisive moment for the subsequent development of Geofond was 1st January 1975, when Measure No. 1 of the president of the Czech Geological Authority (CGA) was issued. By this measure, the Geological Fund was separated from the Central Geological Institute and merged with Geoinvesta (a specialized semi-commercial arm of CGU), as the state-funded organization designated "**Geofond**, Specialized Organization of the Czech Geological Authority in Prague". This measure was also the charter of foundation of Geofond itself and, for the first time, the official name **Geofond** was used. Until then, the term **Geological Fund** was used in all official documents and Geofond served only as a legislative abbreviation. In 1977, **Geofond** moved to the newly reconstructed premises at 26 Kostelní St., where the laboratories of the Central Geological Institute had formerly been located.

After the CGA was dissolved on 1st July 1990, the responsibility for funding Geofond, a state-funded organization, passed to the Ministry of the Environment of the Czech Republic (MoE). Around the beginning of 1991, based on Act No. 575/1990 Coll., on measures for the central administration of state agencies in the Czech Republic, the duties of geological exploration and mineral extraction were transferred to the Ministry of Economic Policy and Development (later the Ministry of Economy of the Czech Republic). Consequently, 20 staff members, responsible for the registers of mineral deposits and for the registration of geological work, were transferred to the state-funded organization ÚVTEI and, on 1st July 1991, to the successor organization NIS CR – Centre Geofond (National Information Centre of the Czech Republic) as an independent unit to undertake tasks relating to national minerals policy.

Based on Decision No. 8/91 of the Minister of the Environment on 24th May 1991, the name of the organization was changed to **Geofond of the Czech Republic** and its primary purpose and tasks were modified to serve as **an archival, documentation, information and study centre of the state geological service of the Czech Republic.** Along with the Czech Geological Survey, it was **authorized to function as the state geological service**. After the Ministry of Economic Policy and Development was disbanded, its geological research duties passed to the MoE, and its duties relating to minerals policy and the exploitation of mineral deposits passed to the Ministry of Industry and Trade (MoIaT). Consequently, NIS CR – Centre Geofond was incorporated into Geofond CR in 1997. An **agreement on the use of Geofond CR services** was entered into by the MoE and MoIaT, ensuring that Geofond carried out certain of the duties of MoIaT. At the same time Geofond assumed administrative responsibility for the Office of Gold Deposit Documentation, located at the Jílové u Prahy Regional Museum.

In 2001, the **legal status** of Geofond CR changed to that of **a government department**. On 1st April 2002, the **name was changed to Czech Geological Survey – Geofond**. In September



A section of a historical mining map dating from the 18th century, housed in the CGS workplace at Kutná Hora.

2003, the Geofyzika, plc, Company located in Brno was disbanded and administration of the archive of geophysical exploration work funded from the state budget, as well as the creation and administration of geophysical databases, were transferred to Geofond.

A modern information centre

The establishment of Geofond as a **separate state-funded organization** in 1975 had a decisive impact on its subsequent development and activities. The equipment of Geofond with modern computer technology capable of storing and delivering information from digital databases was given priority by the new administration so that reliable storage of all data, administration of the databases and the provision of various outputs from them became possible. **The central task of Geofond became the systematic maintenance, updating and operation of a functional information system**, based on the in-house application of computer technology. Progressively, over a number of years, Geofond grew from a geological archive into a modern geological information centre.

The development of Geofond was also positively influenced by the reincorporation of the department of NIS CR – Centre Geofond. This led to a significant extension in the activities of Geofond and, thanks to the transfer of the fund of geological work from the Ministry of Industry and Trade to the MoE, it became possible to finance projects concerned with the information from this archive. At the same time, the agenda arising from current legislation and the duties assigned at the foundation of Geofond were becoming more important. Geofond thus became the organization effectively responsible for some of the statutory tasks forming part of the state geological service. Activities that should be mentioned in particular are as follows: keeping records of geological works carried out in the Czech Republic, keeping records of mineral resources contained in mineral deposits, keeping records of protected areas of mineral deposits and prognostic resources for exploration areas, keeping records of unexploited state-owned mineral deposits, calculating the reserves of state-owned deposits, keeping records of abandoned mine workings and remediation works carried out on them, inventory and assessment of dumping sites for mining waste, providing background information for

A secured entrance to a registered abandoned mine working.

regional analysis and the compilation of maps of protection of mineral deposits and areas of mining subsidence.

Archive collections

Over the years, many separate archive funds were established in Geofond: **Archive of reports** – approximately 205,000 **unpublished** reports; **Archive of mineral reserves** – approximately 3,900 reports containing approved calculations of the reserves of mineral deposits, including calculations of groundwater resources; **Archive of travels abroad** – approximately 10,500 reports concerning working travels abroad; **Archive of paper documents of the register of deposits of mineral resources** – maps at 1:25,000 scale depicting the boundaries of deposits of mineral resources (blocks of reserves), obtained from the processed reports, registration forms, certificates of mineral deposits, State Statistical Statements Geo V3-01, rulings on assessments of reserves from the Commission for Rating of Reserves, rulings on approval of reserves, authorizations for Geofond to protect and register a deposit, decisions on the establishment, changes to and cancellations of protected areas of mineral deposits, decisions on the establishment, changes to and cancellations of designated mining leases; **Geophysical archive** – approximately 4,000 unpublished reports on geophysical exploration. This archive is located in Brno; **Archives of maps** – approximately 13,000 geological maps, approximately 16,000 maps of soil fertility and approximately 10,000 historical mining maps stored in the workplace at Kutná Hora; **Archive of geological samples** – approximately 36,000 metres of drill core from 1,745 important drill holes. This archive is located in stores in Kamenná and Chotěboř.

Information system

The character of Geofond – a state-funded organization and later a government department –enabled the creation and operation of a geological information system based on the data held in the state archives. Creation of the bibliographical **ASGI database** (Automatized System of Geological Information) was initiated first. This database functions as a digital card index and as of 31st December 2011 it contained 220,984 records (in 2011, 3,050 entries were added to the database).

In 1976, the creation of a **drill hole database** was initiated. This database contains not only basic information about the location, azimuth, inclination and depth of drill holes but also drill hole log descriptions. Since 1991, when the final transfer of all useful drill hole logs from reports deposited in Geofond was completed, new entries in the database have mainly been drill hole logs from recent reports. In 2011, the number of entries increased by 1,987 so that, as of the 31st December 2011, it contained 676,439 objects.

Between 1991 and 1993, hydrogeological properties were also transferred to the database using information from a card index, updated regularly since 1966. Because in these cases the documented objects were often not drill holes, but wells, springs and other water sources, the label "drill hole" was replaced by the label "geologically documented objects". As of the 31st December 2011 the database of **hydrogeological objects** contained 87,926 entries (in 2011, 2,877 entries were added to the database).

In 1996, the database of **geological specimens** was integrated within the **drill hole database**. As of the 31st December 2011 this part of the database contained information about geological specimens from 1,530 drill holes. The specimens are housed in stores at Kamenná and Chotěboř. In 2011, information about 100 objects was added to this database.

In 1999, the creation of a database of **geophysical logs** was initiated. The compilation continued during subsequent years with funding under the terms of projects for geological works. As of the 31st December 2011 the database contained geophysical logs from

5,334 drill holes and inclinometric measurements from 2,844 drill holes. In 2011, logs from 78 drill holes were added to the database.

In 1976, the creation of the **landslide** database was initiated. This was based on a traditional inventory of landslides, compiled during 1961–1963 as part of a nationwide programme to monitor these phenomena, initiated by decision of the government of Czechoslovakia. The database was continuously updated until 2010, when it was transferred to the Czech Geological Survey. As of the 31st December 2010 the database contained information about 9,323 landslides.

At that time, the first versions of the database of deposits of mineral resources were created. The database was based on reports about exploration geology and on a traditional inventory of deposits of mineral resources, started in 1961. The database took its present form in the 1990s as part of the **Information System on Mineral Resources (SurIS)** compiled by NIS CR – Centre Geofond. As of the 31st December 2011 the database contained the following registers (the numbers of entries added, updated and deleted in 2011 are given in brackets): **mineral resources** – information about 9,824 objects (44; 1,841), of which there are 1,490 state-owned deposits with calculated reserves (B), 829 registered non-reserved mineral deposits (D), 821 other unregistered mineral deposits and resources (N), 222 approved prognostic resources (P, R), 1,081 other registered prognostic resources (Q), 1,414 non-economic mineral occurrences and negative exploration results (V), 3,945 cancelled sites of mineral deposits or resources (Z, U) and 22 geological structures serving as gas reservoirs or underground repositories (K); **protected areas of mineral deposits (CHLÚ)** – information about 1,517 objects (26; 32); **mining leases (DP)** – information about 1,340 objects (8; 201); **mining leases pending (PS DP)** – information about 813 objects (3; 15); **exploration areas (PÚ)** – information about 644 objects (16; 8); **graphical data (GO)** – coordinates of 16,476 objects from the above-mentioned registers – polygons, points and also coordinates of the boundaries of all administrative districts in the Czech Republic (70; 111; 15); **organizations (companies)** –information about 3,126 organizations (including those no longer in existence) undertaking geological work, exploration for mineral resources and mining (47; 188); **decisions governing approval and depreciation of reserves** – 4,404 approvals or depreciations of resources (93); **economic data** – statistics on global and domestic prices of major mineral commodities and on volumes of foreign trade in minerals.

In 1985, creation of the database of **areas of mining subsidence** was initiated. As of the 31st December 2011 the database contained 5,574 objects (in 2011, 32 entries were added to the database).

In 1986, the **database of regional hydrogeological surveys** was created from the basic information held by Geofond and the Czech Hydrometeorological Institute. It was last updated in 2004. After that, the database held information about 670 regional hydrogeological projects, including 164 calculations of groundwater reserves.

In 1988, the **database of abandoned mine workings (SDD)** was created under the terms of **§35** of Czech National Council Act No. 44/1988 Coll., On the protection and use of mineral resources (Mining Act), as amended, and sections 1 and 2 of the Ministry of Environment Decree No. 363/1992 Coll., On detecting and recording the impacts of mine workings. As of the 31st December 2011 the database contained 2,593 reported objects in total, of which 2,272 are abandoned mine workings (in 2011, 68 new objects were reported) and 9 multiple-event reports that contain information about 2,862 impacts of mine workings without further details. The database is relationally linked to the **database of underground mine workings (HDD)**, the creation of which was initiated in 1999 at the joint request of the Czech Mining Bureau, MoE and MoIaT. As of the 31st December 2011 the database contained information about 26,156 objects with 20,530 graphical appendices (in 2011, 122 objects were added to the database).

In 1990, the **database of historical mining maps** was created from information about the historical mining maps housed in the workplace at Kutná Hora. As of the 31st December 2011, the database contained records pertaining to 12,547 old mining maps (new entries for 730 maps were added in 2011).

Since 1992, information about scientific books, journals and other documents concerning geological sciences, mining and history have been incorporated into the **database** *Catalogue of Historical Mining Publications*. As of the 31st December 2011, the database contained records of 7,161 publications in total.

From 1991 to 1994, the **database of radiometric anomalies** was created under the terms of a project funded by the MoE. The database comprises three sub-databases that have not been changed significantly since they were created. These are: radiometric anomalies – 16,203 anomalies discovered during field prospecting; radiometrically anomalous areas – 3,420 groups of radiometrically anomalous objects, and radiometric exploration – 466 areas where surveys of radioactive material have been carried out.

Each years since 1999, the latest information about **areas affected by exploitation of mineral resources** is obtained from annual state statistical report Hor(MPO)1-01 and then stored in a database with the same name. In 2011, data relating to 823 mining claims and 233 registered non-exclusive mineral deposits were listed.

In 2001, the creation of the **database of waste dumps** was initiated. The database incorporates information supplied by external organizations under the terms of projects funded by the MoE. As of the 31st December 2011, the database contained information about 7,106 objects including 21,430 photographs (in 2011, information about 970 new objects was added).

In 1997, Geofond was appointed to supervise the compilation of specialized databases. The compilation, carried out by selected organizations under contract, was funded from the state budget. Consequently, following the disbanding of Geofyzika Inc. Brno in 2003, Geofond became responsible for creating and operating databases containing the results of geophysical measurements and surveys (geophysical surveys, airborne geophysics, gravimetry, petrophysics, geoelectric measurements and the records of seismic data). In 2004, Geofond also acquired a database created by Geomin Co-op. Jihlava that contained the results of geochemical analysis of 1,072,362 samples.

Since 2004, the **digital archive** has been under construction. At first, priority was given to scanning geological reports from the 1950s, because deterioration of the original paper documents in storage was making them illegible. Scanning of reports has been carried out at Geofond since 2006. New reports were scanned using modern equipment and procedures. Selected reports (mostly category "FZ") requested by external and internal users were also scanned. As of the 31st December 2011, the digital archive contained in total 2,296,019 pages from 27,639 reports, comprising approximately 11% of the estimated total of pages and reports deposited in the archive (in 2011, 283,036 pages from 3,690 reports were added to the digital archive).

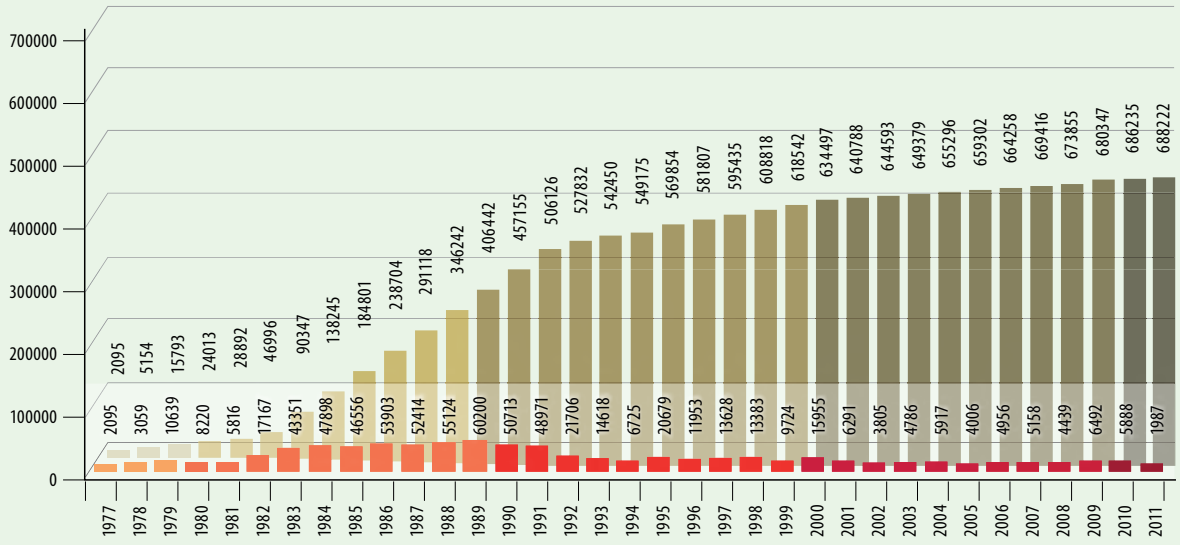
Important features of all these databases are their nationwide coverage, the **systematic updating of databases by entry of information from recent documents**, the verification of the data and also the locations of the features or phenomena described (bibliographic databases excepted). These are given in the S-JTSK coordinate system that enables their presentation to the general public through online map applications.

In 2011, 299 outputs containing information about 9,396 drill holes and 83,559 records of borehole sections, were supplied from the **borehole database**. Of these, 1 request was from the CGS, 4 from the Academy of Sciences, 39 from various schools and 255 from private organizations and individuals. Outputs provided through application e-Earth are not included in these numbers because the application does not track the numbers of visitors consulting boreholes and borehole profiles. Despite this, there were 242 users of the application in 2011 (82 more than in 2010) who paid 465,600 CZK in total (114,600 CZK more than in 2010).

A total of 87 graphical outputs, containing information about 26,113 objects, were supplied to users from the **database of hydrogeological data**. Of these, 3 requests were from the CGS, 2 from various schools, 2 from local authorities, 2 from regional councils, 1 from a ministry and 77 from private organizations and individuals. 18 separate drill hole logs were supplied from the **database of geophysical logs** in response to one request from a private organization. Data about one area were provided from the **database of regional hydrogeological surveys** in response to one request from a private organization. A total of 8 outputs, containing information about 729 objects, were provided from the **database of areas of mining subsidence** (the CGS – 1, private organizations and individuals – 7). Information about objects located on 36 1:50,000 scale maps were provided from the **database of radiometric anomalies and radiometrically anomalous areas** in response to 8 requests from state administrative bodies. Information about 11,877 objects was provided from the **database of underground mine workings** in response to 4 requests from private organizations and informaion about 3,530 objects was provided from the **database of waste dumps** in response to 4 requests (schools – 1, the CGS – 1, private organizations and individuals – 2). 44 outputs, containing information about 11,239 mineral deposits, 48 mining leases, 86 protected mineral deposits and 50 registered potential resources, were provided from **SurIS** (the CGS – 5, MoE – 1, MoIaT – 1, regional councils – 1, private organizations and individuals – 36).

13 requests for information from the **geophysical subsystem** were received from private organizations. These requests were mainly for gravimetric data (grid 250 × 250 m), and also for information about physical properties of rock samples from drill hole cores and about surface and secondary seismic post-stack data.

Based on the official price list, the total value of the services supplied in 2011 amounted to 1,349,187 CZK, although the actual amount received was 682,417 CZK. The difference between the revenue calculated according to the price list and the invoiced price was 666,770 CZK. This difference was mainly because of data transfer agreements (395,000 CZK for the Czech Office for Surveying, Mapping and Cadastre), discounts for employees of the CGS (approx. 150,000 CZK) and also because of special terms for supplying information to schools. There were 40 requests from schools with a nominal value of 62,530 CZK, but only 4,393 CZK was paid in fees. Outputs from databases are provided free for educational purposes and for use in student diplomas and theses.



Numbers of drill holes archived (1977–2011). Number of drill holes archived each year Total number of drill holes archived

Tasks fulfilled by Geofond under the terms of current legislation and its charter of foundation

- Gathering, storing, expert processing and providing access to geological documentation and the results of geological projects: as of the 31st December 2011 the archive contained approximately 223,000 unpublished geological reports, of which 3,148 were added in 2011 (**§12** of **Act No. 62/1988 Coll.**, On geological work, as amended and **§§ 12 to 16** of the **Act** and Ministry of the Environment **Decree No. 368/2004 Coll.**, On geological documentation);
- Creation, development, management and continuous updating of the comprehensive **information system of the state geological survey** (**§ 2** letter d) of **Act No. 365/2000 Coll.**, On public administration information systems);
- Providing selected **information about specific areas of the Czech Republic** to local planning authorities for regional planning and background analysis (**§ 27**, section 3 of **Act No. 183/2006 Coll.**, On town and country planning and building code /Building Act/);
- **Registration** of new geological works and maintaining the register of these works, issuing certificates and providing access to summary information about registered geological works. In 2011, 2,900 works were registered (**§ 7** of **Act No. 62/1988 Coll.**);
- Fulfilling its duties according to **§ 10**, section 2 of **Act No. 44/1988 Coll.** and **providing protection and registration** of 366 unexploited **reserved mineral deposits** as authorized by **§ 8** of **Act No. 44/1988 Coll.;**
- Providing access to **background information** required for the issue of binding decisions based on **§19** (Siting of buildings and facilities within a protected deposit area) of **Act No. 44/1988 Coll.**, particularly in cases of reserved mineral deposits, records of which Geofond is authorized to keep. In 2011 there were requests for 1,648 expert opinions and 106 reports, opinions and compilations of literature summaries regarding hazardous geofactors (assessment of areas affected by mining activity);
- Observing and recording the **impacts of abandoned mine workings** (SDD – as of the 31st December 2011 there were 2,172 records in the database), including the database of underground mine workings (HDD – as of the 31st December 2011 there were 25,915 records in the database), the database of areas of mining subsidence (as of the 31st December 2011 there were 5,567 records in the database) and the database of historical mining maps (as of the 31st December 2011 there were details of 11,766 maps entered in the database). The database SDD is based on reports about abandoned mine workings. Geofond also cooperates with the MoE and MoIaT in dealing with the issue of reported mine workings (**§ 35** section 3 of **Act No. 44/1988 Coll.** and **§§1, 2** of Ministry of Environment **Decree No. 363/1992 Coll.**);
- Maintaining a register of reserves contained in reserved mineral deposits under **§ 29** of **Act No. 44/1988 Coll.** and **§ 4** of **Decree No. 497/1992 Coll.**, On the register of reserves of reserved mineral deposits;
- Compilation of the Geo(MoE)V3-01 resort statistical reports as authorized by the MoE, by virtue of **Act No. 89/1995 Coll.**, On the state statistical service, as amended. These reports are required as summary records of reserves contained in reserved mineral deposit. On the basis of this information, the *Review of Reserved Mineral Deposit Reserves of the Czech Republic as of 1st January* is compiled annually in accordance

with **§ 29** of **Act No. 44/1988 Coll.** and **§ 5** of **Decree No. 497/1992 Coll.**;

- Annual compilation of the *Summary of Mineral Reserves in Mining Leases and Other Exploited Deposits of Non-Reserved Minerals* and of the *Register of Reserves in Reserved Mineral Deposits of the Czech Republic as of the 1st January each year*. The compilations are based on **Hor(MPO)1-01 statistical reports**, as authorized by the MoIaT (**Act No. 89/1995 Coll.**);
- Compilation of background information for **records of protected mineral deposits** (CHLÚ) and for **records of protected areas with specific underground facilities** (CHÚZZ) as well as for their national database (**§ 29**, section 2 of **Act No. 44/1988 Coll.**, and the **Decree** of the MoE **No. 497/1992 Coll.**, On protected deposit areas);
- Maintaining **archives** of rulings on **CHLÚ**, issued in accordance with **§ 17** of **Act No. 44/1988 Coll.**;
- Maintaining **archives** containing assessments by the former Mineral Reserves Evaluation Committee and rulings of the Ministry of Economy (Ministry of Economic Policy and Development) and the MoE on reserves of mineral deposits in accordance with **§ 14**, section 3 of **Act No. 44/1988 Coll.**;
- Maintaining the register of **permits for prospecting and exploring deposits and resources of reserved minerals** and providing expert opinions for new rulings issued by the MoE in accordance with **§ 4** of **Act No. 62/1988 Coll.** Geofond also maintains the register of **mining leases pending** and provides expert opinions for new rulings issued by the MoE in accordance with **§ 24** of **Act No. 44/1988 Coll.**;
- Maintaining the archive of **non-reserved deposits** of non-reserved minerals (construction materials);
- Maintaining the **register of underground mine workings** as a basis for dealing with the issue of underground mine workings in accordance with **§ 35** of **Act No. 44/1988 Coll.** and **Decree No. 363/1992 Coll.**;
- Maintaining the **archive of prognostic resources** (**§ 13**, section 4 of **Act No. 62/1988 Coll.**);
- Operating the database of **areas of mining subsidence** in accordance with **§ 35**, section 3 **Act No. 44/1988 Coll.**;
- Maintaining the **database of areas affected by the exploitation of mineral resources,** areas where reclamation and remediation is in progress and where it is already completed. This database is kept in order to fulfil the responsibility of the MoE to protect the rock environment and to undertake ecological supervision of mining activities (**§ 19** of the **Act No. 2/1969 Coll.**, On establishment of ministries and other institutions of the central government of the Czech Republic and **§ 1**, section 5), point 5 of **Act No. 272/1996 Coll.**, according to which certain duties of the agencies of the central state administration of the Czech Republic are carried out);
- Identification and classification of **closed and abandoned mining waste disposal sites** posing serious environmental or health hazards (post exploitation dumping sites) and maintaining a register of these (**§ 17**, section 4, letter a) of **Act No. 157/2009 Coll.**, On mining waste management and amendments to certain acts, which implement the provisions of **Directive 2006/21/EC** on the management of waste from extractive industries and of **Directive 2004/35/EC**.

Other activities of Geofond

- Annual edition and publication of *Mineral Commodity Summaries of the Czech Republic* and of the Czech version *Surovinové zdroje České republiky*;
- Annual edition and publication of the study *Pohyb zásob na výhradních ložiscích nerostných surovin* (Changes in Reserves of Reserved Mineral Deposits), covering the previous 10 years and including comments on individual mineral resources;
- Editing and publication of **maps of protected mineral deposits** and of **areas of mining subsidence** (the recent editions also include the locations of **mine workings)**, for the authorities responsible for land use planning (every 3 months a map of one region is published). These maps are edited to fulfil the regulation **§ 13,** section 3 of **Act No. 62/1988 Coll.**, On areas with specific geological structures;
- Operation, development and updating of online **map applications** – old mining maps, geophysical surveys, reported mine workings, landslides, information system on mineral resources SurIS, territorial data, mining impacts (SDD, HDD, dumping sites, abandoned mine workings), drill hole surveys and eEarth – an application providing digital access to drill hole profiles in 6 of the EU countries in 7 European languages (a fee is charged for access to this application);
- Operation, updating and development of **other applications** – digital catalogue of unpublished reports (ASGI), multilingual specialized geological and hydrogeological dictionaries eEarth and eWater (each providing translations in 12 languages), Geological specimens (samples) – application enabling searches for drill holes with archived drill hole core samples, and old mining maps – a digital catalogue of mining maps, including thumbnails of scanned maps.

Publishing schedule for maps at 1:50,000 scale of protected mineral deposits and areas of mining subsidence.

Projects

In 2011, 14 projects were carried out by Geofond and of these 13 were completed that year. The projects financed from funds for geological works, for old mine workings and for research and development (R&D). Of these, 13 projects were managed and carried out by Geofond while the R&D project was undertaken by Geofond in cooperation with other partners. The projects were as follows:

- *Economic Register of the SurIS IV* (2010–2011)
- *Optimizing the System for Processing Primary Documentation – phase II* (2009–2011)
- *Revision of geologically documented objects and their supplementation by geological and hydrogeological data* (2010–2011)
- *Digitization of the geophysical archive in the Brno workplace and its incorporation into the information system of the CGS – Geofond* (2010–2012)
- *Acquisition of the archive of geological specimens housed in the compound of the Litvínovská Uhelná Company, plc, and transfer of the core from drill hole DP 333-09 to the archive of geological specimens of the CGS – Geofond as a stratotype* (2011)
- *Kovanice Storage Facility – Updating of the Archive of duplicates* (2011)
- *Review of the current state of safety of abandoned mine workings* (2008–2011)
- *Digitization of selected collections from the Moravian Regional Archive in Brno* (2009–2011)
- *Digitization of documents from the register of abandoned mine workings* (2011)
- *Database of mine workings: first background information for investigation of reported abandoned mine workings* (2009–2011)
- *Creation of the web portal for the information system of mine workings* (2010–2011)
- *Digitization of selected maps from the Jílové u Prahy Regional Museum* (2011)
- *Introduction of the database of mine workings into the production web portal*
- *R&D: SP/2e1/153/07 Principles of interaction in the "water/rock/landscape" system and their application to groundwater protection in the Czech Republic* – this project was led by the CGS while Geofond was one of the participants.

Apart from these projects, Geofond also carried out a project within the Operational Programme Environment *Identification and classification of closed and abandoned mining waste disposal sites posing serious environmental or health hazards.* A grant for this work was received from the EU.

Conclusion

For nearly 60 years, the unpublished results of geological work carried out in the area of the Czech Republic have been systematically gathered and securely stored. In comparison with other countries in Europe and elsewhere, the scale and detail of the information available is unique. The processing of this data into a comprehensive information system, and the use of the most up-to date technology to provide access to it, have added immensely to the value of this national resource. To meet the social and economic imperatives of protecting the environment and developing sustainable strategies for the use of natural resources, access to up-to-date information of the highest quality is essential. In short, the efficiency of government and the future health and welfare of the nation depends on sustained investment in the gathering, management and presentation of information. In this, the CGS – Geofond has played a leading role and, under the auspices of the unified Czech Geological Survey, it will continue to do so.

Applied geology

Oldřich Krejčí
Director of the Brno Branch

Work in hydrogeology has been concerned with identifying geological structures important for water management and also with ensuring the protection of the infiltration and transmission systems in those zones that are promising from the point of view of water resource engineering.

Research in exploration geology has been focused on improving the present state of knowledge about ways that the mineral resource base of the Czech Republic can be utilized in response to macroeconomic circumstances, international relations, and the technological demands of industry, taking into account the information gathered systematically by the CGS about the impact of mining and processing of resources on the environment, both in the Czech Republic and abroad.

A qualitative change in the procedures for collating research on dynamic ground movements and especially on slope failures was successfully carried out as a result of which, the National Information Centre for Slope Instabilities (NICSN) was established. For the first time this will ensure that all the data obtained from existing projects concerned with the investigation of slope failures throughout the Czech Republic will be compiled and evaluated using the same procedures.

A survey of the radon index in Quaternary fluvial sediments was carried out and its relation to the radon index of the underlying basement rocks and to radon in buildings was investigated. Emphasis has also been placed on interpretation of this work for the European Commission IES Ispra (compilation of the European Geogenic Radon Potential Map).

The systematic monitoring of organic pollutants and heavy metals in recent soils and sediments in rivers and reservoirs with various levels of anthropogenic burden is ongoing. This monitoring is based on detailed analysis of saturated and aromatic hydrocarbons. Research into geological storage of CO_2 continued according to plan, together with the investigation of geological structures in the Czech Republic identified as suitable for the storage of CO_2. Exchange of information within the international knowledge sharing networks ENeRG and CO2NET was incresed, and CGS became a partner in the coordination action CGS Europe.

Hydrogeological investigations

As a part of the long-term programme of investigation of geological structures important for water management, emphasis was placed particularly on the assessment of different areas of the Czech Republic to determine the sizes and properties of prospective hydrogeological objects. Part of this research was concerned with the demarcation of the infiltration areas of deeper aquifers in the different hydrogeological regions with reference to their potential to supply drinking water. Protection of the infiltration and transmission systems of these hydrogeological objects was an important aspect of this research. Attention was also given to the investigation of mineral water resources. The hydrogeological team of CGS were also involved in assessing the problem of potential water contamination arising from underground TNT charges remaining after previous seismic exploration near the village of Halenkovice.

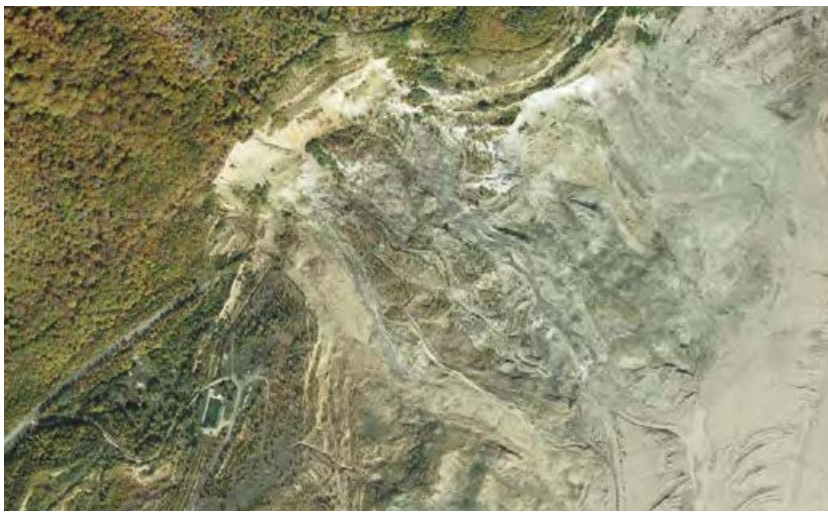
Specialists from the CGS made a significant contribution to the compilation of hydrogeological maps and plans and also to writing the hydrogeological

chapters for the explanatory notes to accompany the edition of maps at 1:25,000 scale covering selected areas of the Czech Republic (the Brno Area, Křivoklát Area, Krkonoše Piedmont Area, Beskydy Mts Area and the Šumava Mts Area). Hydrogeological data were also supplied for compilation of the map of environmental geofactors and relevant explanatory notes.

Geohazards and engineering geology

Recent slope failures in part of the area of the Brno conurbation covered by the four map sheets at 1:25,000 scale (24-324 Brno-North, 24-342 Brno-South, 24-413 Mokrá-Horákov and 24-431 Šlapanice), were mapped and investigated. The properties of the Neogene clays and the relationship between their geotechnical parameters and susceptibility to sliding was studied in detail. A map of slope failures and selected risk factors was compiled for each map sheet. On these maps, the slope failures in the cuttings and on the embankments of important roads and in the areas of former extractive operations (quarries, sand quarries and brick clay quarries) are also plotted. Former excavations that have already been completely backfilled and built-up and that might still be dangerous in the future were also plotted. All the records concerning mining and extractive operations since the first mapping, undertaken during the Austro-Hungarian era (the 1st Military Mapping Survey in 1836–1852), have been collected and analysed. This was used to create the new database of slope failures in the Neogene basins of the Brno conurbation. Before the recent mapping was carried out, only 7 landslides were recorded in the register of landslides and other slope failures on the 4 map sheets listed above. After the new mapping was completed, a total of 91 slope failures had been identified. Most of the new data was obtained from recent mapping or taken from archive materials. New mineralogical and geotechnical analyses of clay sediments were also made. In the type areas (e.g. Brno – Medlánky) the following activities were carried out in order to assess and mitigate the problems of slope stability:

- Analysis of the factors governing the initiation and growth of slope failures (their origin, onset mechanisms, their dynamics and history), including the study of historic maps, photographs and archive materials, as well as old newspapers;
- Measurement of mineralogical, petrological, structural geological, petrophysical and geotechnical properties of both individual landslides and regions with regard to their incipient instability;
- Interpretation of the gravity field (and some other geophysical parameters) to assess the extent and thickness of Neogene sediments;
- Provision of expert advice to the civil authorities and defining and supplementing the information about the engineering geological characteristics of the geological environment to assist local planning. In addition, the impact of both existing and potential new slope failures was assessed;
- Adding to and updating the information about hazardous geodynamic phenomena in the Czech Republic in the comprehensive information system to assist decision-making by the state and local administration;
- Extending the classification of regions onto quasi-homogenous units based on geology and physical geography.



Aerial photo of the highest part of the scarp of the landslide area above the ČSA surface mine near Horní Jiřetín. A counterweight fill (mine dump) at the toe of the landslide can be seen near the right side of the picture. Picture taken from www.seznam.mapy/cz – GEODIS Brno.

The results of the above research on slope failures were presented at the conference *Svahové deformace a pseudokras 2011 (Slope deformations and pseudokarst 2011)*, which was held from 25th to 27th of May 2011 in the Institute of Geotechnics at the Faculty of Civil Engineering, Brno University of Technology.

Work was carried out on the write-off procedure for property on the stabilized landslides of 1997 based on resolution ČR No. 1063/1999 of the Government of the Czech Republic, as requested by the Office for Government Representation in Property Affairs. The new project *National Information Centre for Slope Instabilities in the Czech Republic* was put forward as a part of the technical support for Priority Axis 6.6. of the Operational Programme Environment, *The prevention of landslides and rock avalanches, the monitoring of geofactors and the impact of mining and extractive activities, and the assessment of non-renewable natural resources, including groundwater resources.*

Work on the project *Development of the interactive map of risks to slope stability in the Czech Republic* was completed. Transfer of the database of the Register of Slope Failures from CGS – Geofond to the CGS continued.

A view of the eastern part of the scarp below Jezeří Castle (photo by O. Krejčí).

CGS has been responsible for compiling, maintaining and publishing the database since 1st January 2011. The archiving of final reports and completed projects concerned with slope failures in the Register of Slope Failures continues.

As part of their professional duties, specialists from the CGS also compiled reports on many significant slope failures. One of the areas where serious failures occur are the slopes of the Krušné hory Mts above the ČSA open pit mine near the Jezeří castle. This slope has been monitored by various organizations for tens of years. Even though the extent of the landslides at this locality are unique in the Czech Republic, at present they pose only a low risk. Recent surveys show that they do not pose a threat to the Jezeří castle or to the nearby villages of Černice and Horní Jiřetín, nor do they pose a significant threat to the extractive operations in the ČSA open pit mine. The risk of further movement of these landslides is reduced by the preservation of the protective pillar of the arboretum, by ongoing work to stabilize the south-western slopes of the ČSA open pit mine and by planned dumping of mining waste on the inner side of the affected slopes. Local activation of the heads of the landslides and further spreading in the order of a few tens of meters is very likely, nevertheless movements on a scale that would affect Jezeří castle and its access roads are considered very unlikely.

The roadcutting near Lysůvky, part of the re-routing of the R48 highway from Rychlatice to Frýdek-Místek, is an important construction that was documented by experts from the CGS for the Road and Motorway Directorate of the Czech Republic. The Frýdek Formation, part of the Subsilesian Unit, was exposed along all the roadcutting. This formation consists predominantly of grey and grey-brown calcareous silty mudstones, locally containing thin lenses of calcareous sandstone. The clays and mudstones of the Frýdek Formation to the east of the tunnel structure (overpass to Lysůvky) are of Lower to Middle Palaeocene age. The Frýdek Formation to the west of the tunnel is of Upper Maastrichtian age. Rock of Maastritian age also occurs in tectonic lenses between Zelinkovice and Rychaltice. Sandy glacial till of Middle Pleistocene age (Saalian glaciation) and a thin layer of loess and loessic loam is also found on the surface. Quaternary sediments range in thickness from less than one to three meters and locally they are missing completely.

The mudstones of the Frýdek Formation are strongly disturbed and have very poor cohesion. These sediments are located near the thrust plane of the Silesian nappe. The hills north of the road form a tectonic outlier of the Silesian nappe that consists of the Těšín-Hradiště Formation, the Palkovice Formation and the Baška Formation. Sediments of the Silesian nappe overlie the disturbed mudstones of the Frýdek Formation and push them against the northern wall of the road cut. The pressure of the rock overburden should therefore also had to be taken into account in the analysis of the stability of the diaphragm wall, because the difference in relief between the summits of the hills (310 m and 366 m above sea level) reaches 50–60 m. Even though the road was not cut through existing older landslides, unloading of the toe of the slope in a nearly cohesionless rock leads to activation of landslides on the slopes of the roadcutting and can cause tilting of the diagraphm wall.

One previously unknown older landslide was discovered during the field reconnaissance. This was intersected at the eastern end of the cutting near Frýdek-Místek. Because the toe of the landslide has been affected by construction of the roadcutting, appropriate drainage in the landslide was recommended in order to stabilize it.

Applied geophysics

Radon Programme

Radon measurements in the bedrock of selected areas were completed, namely in the Neoproterozoic olistostromes in the area around Plzeň and the Precambrian mica schists in the areas around Tábor and Kutná Hora. The results of these measurements, together with specified polygons of transient radon index, were incorporated into updated 1:50,000 scale maps of the radon index. A new set of updated polygon maps of the radon index was created in the GIS environment and given to the staff of the IT department for incorporation into the Map Server. At the same time, 620 new entries from the period between 2005–2011 were added to the radon database of the CGS and made available for presentation on the Map Server. Notes on the Map Server containing background information were also updated under the terms of a Ministry of the Environment project. Currently, a report compiled for the State Office of Nuclear Safety (SÚJB) concerning the maximum radon values to be used in the revised classification of the radon index of land is the subject of peer review. Background files, characterizing the level of the radon risk in countries participating in the *OneGeology* initiative were compiled for use in creating the European Geogenic Radon Potential Map and were later sent to the coordination centre at JRC Ispra. A workshop on this topic was organized in CGS at the end of November 2011. A number of professional papers, maps and reports have been produced as a result of the research on radon carried out during 2011.

Storage of carbon dioxide

Research into the problems of geological storage of CO_2 continued during 2011. As a partner in the Pan European coordination action CGS Europe, information was regularly exchanged with other members of the international knowledge-sharing networks ENeRG and CO2NET. The Czech Geological Survey also co-organized the international workshop *CO_2 Capture and Storage – Response to Climate Change*, which was held on 13th and 14th of April in Vilnius.

The national information portal for CO_2 capture and storage technologies (*http://www.geology.cz/co2net-east*) is in operation and being continuously updated. The results of previous Czech-Norwegian research on potential CO_2 storages in the Permian-Carboniferous aquifers and oil deposits of eastern Moravia in the Czech Republic have been prepared for publication.

Applied geochemistry

In 2011, a map of the content of polycyclic aromatic hydrocarbons (PAH) in the area of Rosice – Oslavany was created. Recent mobilization, transport and fixation of substances released during black coal mining were investigated. Detail analysis of the abundances of various PAH showed that samples of coal are enriched in phenanthrene while typical petrogenetic PAH such as fluoranthene, pyrene, benz(a) anthracene and chrysene are the most common in river sediments. The patern of distribution of PAH in river sediments shows that the concentration of monitored compounds is already higher before the river enters the former mining area. Based on these findings, it can be concluded that the river system is currently not affected by the materials remaining in the mining area. The sorption properties of river sediments and suspended matter were also studied. The cation-exchange capacity of the suspended matter in the rivers investigated reaches equilibrium values. The cation-exchange capacity of the samples have intermediate values of, i.e. 30–90 meq/g.10^3. Calcium (Ca^{2+}) and magnesium (Mg^{2+}) were mostly released to solution, whereas the amount of sodium (Na^{+}) and potassium (K^{+}) released was minimal. Aluminium, chromium and, in large part, arsenic, nickel and vanadium can be considered as elements held by strong bonds in stable minerals. Cadmium, lead and zinc are potentially hazardous. However, the actual contents of cadmium in the conditions that prevail in the Czech Republic are very low.

As far as regional research is concerned, investigation of sediment contamination in the lower reaches of the rivers Dyje and Morava was completed. Emphasis was also placed on compilation of data from the geochemical investigation of "post-Chernobyl" contamination of sediments by radiocesium ^{137}Cs in selected areas of the Czech Republic (Moravskoslezské Beskydy Mts, Jeseníky Mts, Orlické hory Mts, the area of Králický Sněžník, central and southern Bohemia). The final goal is to incorporate the results of these special investigations into the web Portal of Geohazard, now under development.

A view of a roadcut on the R48 highway seen from the footbridge near Lysůvky looking towards Frýdek-Místek. A landslide area is located along the right bank slopes of the roadcut.

Review of Groundwater Resources in the Czech Republic

Renáta Kadlecová
Petr Mixa
Scientific leader /
Manager of the Review
of Groundwater Resources project

In 2011 work continued on this project, which is being carried out between 2010 and 2015. The chief aim of the investigation is to review the groundwater resources of approximately one third of the area of the Czech Republic. Models will be developed and the data acquired will be used to enable optimum exploitation and protection of groundwater contained in the major aquifers. During 2011, mostly archive data and background data required for further work were compiled and evaluated. Sub-contractors and partners for future cooperation were also chosen.

Gathering the background data

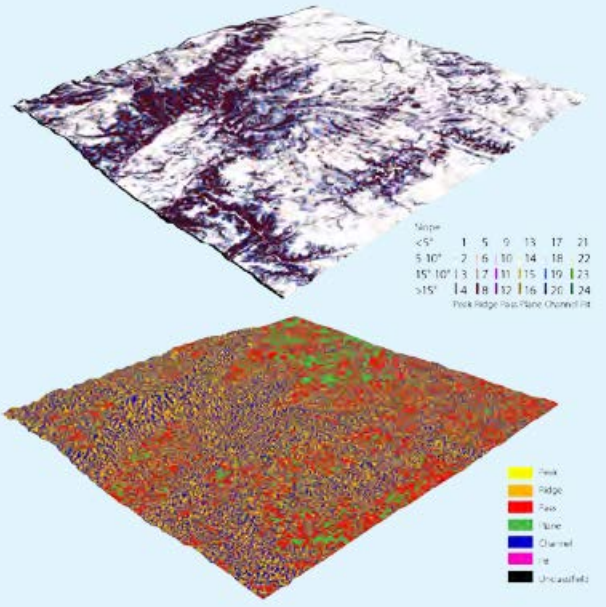
Specialists from the CGS worked on the gathering and compilation of background data mostly keeping to the schedule approved for 2011. The first requirement was to screen the inventory of data to ensure that the background information is reliable. A literature search was carried out to assemble the best available information about the geology of different hydrogeological districts. This search was based on an analysis of relevant archive drill hole data, maps, geological cross-sections and various reports. The aquifers and their near-surface zones in the various hydrogeological districts were defined. Following the definition of the aquifers, appropriate hydrological parameters were determined for them according to pre-set attributes.

Analysis of archive data and supplementary information

Comparative studies of information about sources of groundwater used in the first River Basin Management Plans have been made. Archive information was supplemented by recent data acquired using new remote sensing methods, geophysical methods and field surveys. Two key projects to model exploration drill holes RB-1 and RB-2, located in the area of Cretaceous sediments in Eastern Bohemia, were carried out using archive data. Information from well-logging measurements and hydrodynamic tests were also incorporated in the models.

Monitoring

The first stage in determining the residence time of water in the rock environment was to select some important hydrogeological objects from some of the thoroughly assessed hydrogeological districts. Near the end of 2010, i.e. at the beginning of the hydrogeological year, regular sampling of these objects at monthly intervals was begun.



A morphometric map (lower layer) and a derived map of morphometric features, based on the classification of the angles of slopes (upper layer). Author V. Kopačková.

This sampling programme lasted for about 6 months. The main purpose was to establish the relationship between precipitation, surface water and groundwater. As a result, it will be possible to assess the outflow of subsurface water through watercourses more precisely and to evaluate the rate of recharge of aquifers in relation to precipitation and drainage.

Information system

To enable the compilation of different categories of data in the same spatial framework, an information system has been created in which layers of descriptive, numerical and graphic information can be combined. The GIS system used by the CGS is based on the technology supplied by the ESRI Company that has been engaged for a long time in developing systems for compiling, maintaining, editing and presenting spatial data. Mainly the ArcGIS Desktop applications (ArcView, ArcEditor, ArcInfo, 3D Analyst and others) are being used in the project. The information is held in the central data storage of the CGS that incorporates the ArcSDE system enabling multi-user access to the GIS data. ArcGIS applications are used for preparing and printing background data, processing spatial data, carrying out spatial analysis and also, in combination with other software, for 3D modelling. Applications providing access to data are based both on Oracle Portal and on ArcGIS Desktop.

Cooperation

The contracts for hydrological and hydrogeological exploration work, specialist geophysical surveys (seismics, gravimetry and drill hole logging), exploration drilling and the creation of hydraulic models are being awarded to external contractors selected by the CGS. The CGS, however, will manage the programme of work and take responsibility for the interpretation of the scientific results.

Publicity

During the first phase, a website for the project was created. Basic information about the project was published on this website, followed by details of individual hydrogeological districts and some of the results of ongoing investigations. The English version of the website and a special web page for young people were launched later during the year. Two information boards were installed in the premises of the CGS. The formats of these were designed in accordance with the graphic manual of the State Environmental Fund of the Czech Republic. Next, a press release was issued and a press conference was organized. The discussion focused primarily on the current problems of water management in the Czech Republic and the ways in which the project will help to solve them. The press release, together with other regular information bulletins, has provided a basis for tens of articles in the press and on the web, as well as for programmes broadcast on radio and television. Members of the CGS have already published 6 articles concerning the ongoing review of groundwater resources in the Czech Republic.

Measurement of the conductivity and temperature of water in a spring emerging from open fissures in sandstones of the Bohemian Cretaceous Basin (photo by P. Fiferna).

Presentations

The aims of the project and its strategic importance, together with some of the first results have been presented at several scientific meetings. The first of these titled *Regional research on groundwaters and its utilization in state administration* was given at a seminar of the Scientific and Technical Water-management Society of Prague. Other presentation took place at the Ministry of the Environment, at the 31st ESRI International User Conference in San Diego, California, USA, and at the Congress of the Czech and Slovak Geological Society in Monínec. A seminar on the progress achieved during the first phase of the project was held in November 2011 at the headquarters of the GCS in Prague, Czech Republic.

Regional Geological Administration

Jan Čurda
Head of Regional Geological Administration

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. 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 Works. The organization and procedures used to deliver 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 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 information essential for making political, economic, judicial and ecological decisions affecting land use is available.

Drill hole to investigate the B aquifer in the Ústí nad Orlicí syncline near Mikuleč.

Activities undertaken, contracting authorities and working teams

In 2011, a team of three members of the Regional Geological Administration coordinated 600 tasks carried out for state and local administrative bodies, courts, universities, nonprofit making and non-governmental organizations and other customers. Specific teams of 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.

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)* (No. 3405/M/11, 55257/ENV/11 of July 22, 2011), regional specialists from the CGS compiled 255 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.*

Outcrop of coal seam buried by detritus from the Petřkovice Member, Ostrava Formation in the Landek NNM.

Geological information system

Zuzana Krejčí
Head of the Department
of Information Systems

The collection, administration, and provision of geoscientific information is one of the key functions of the Czech Geological Survey. The statutory duties of the Survey entail the interpretation and compilation of this information in the form of databases, maps, and reports, as well as scientific papers, so that it can be delivered to the State Administrative Bodies, local planning authorities, the wider scientific community and the public. This is achieved by means of a comprehensive purpose-designed geological information system. The system used by the CGS is compatible with Czech and EU legislation governing access to information and embodies international standards that enable interoperability of data. The CGS is now helping to create the national and European infrastructure of spatial information.

INSPIRE in the Czech Geological Survey

The purpose of the INSPIRE Directive (2007/2/EC) of the European Parliament and of the Council of 14 March 2007 was to establish an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment. The rules (IR) for implementing the infrastructure are Commission Decisions, binding in their entirety, designed to ensure compatibility of spatial data across the 27 Member States of the EU. The CGS, as the statutory provider of geoscientific information (geology, hydrogeology, soils, geohazards) for the Czech state is required to follow this directive. It is obliged to supply metadata describing the information held in the CGS system in the agreed format and, subsequently, the data itself will also be made available. The staff of CGS are involved in creating the rules for implementation of INSPIRE in the Czech Republic under the terms of the working group KOVIN (metadata, data specifications, net services etc.), as well as actively participating in testing and commenting on the INSPIRE documents.

The geological information system of CGS

The *Geological Information System (GeoIS)* was designed by the CGS to be compatible with the national and international directives, JISŽP and INSPIRE.

The heart of GeoIS is the *Central Data Storage (CDS)*. This contains over 50 thematic databases (*www.geology.cz/geodata*), in the form of graphical information (maps, geological sections and diagrams) and descriptions (map legends and keys, code lists, results of chemical analyses, archive data, operational databases etc.). The GeoIS contains several large thematic subsystems: geological maps – *National Geological Map Database (NGMD)*, geohazards – the subsystem concerning mainly slope failures and radon risk, the subsystem for hydrogeology etc.

Through the *CGS metainformation system (MIS)* (*micka.geology.cz*), users have access to information about the type, quality, and availability of data held in the CDS. The CGS system forms part of the larger Information System (MIS) of the Ministry of the Environment and is based on the international standards EN ISO 19115, 19119 and 19139 that ensure compatibility with the INSPIRE Directive. Moreover, it contains standardized information about map services and www applications.

Development of technology and content of data resources

During 2011, emphasis was placed on the data structures and their extensions in order to meet the needs of current projects, and on the interconnectivity of the separate parts of the CDS.

The adjustment and the extension of the data structure involved mainly the *National Geological Map Database (NGMD)*, the *Register of Slope Failures* (within the frame of the R&D project *Development of the interactive map of risks to slope stability in the Czech Republic*, transfer of the *Register of Slope Failures* from the authority of the CGS Geofond to the authority of the CGS), hydrogeological data (the R&D projects *Principles of interaction in the "water/rock/landscape" system and their application to groundwater protection in the Czech Republic* and *Review of Groundwater Resources*), collections, archive (Archive of Slope Failures), and other sources of data, such as significant geological localities, decorative stones and the operational database of the books and papers published by the staff of CGS (*Geopub*).

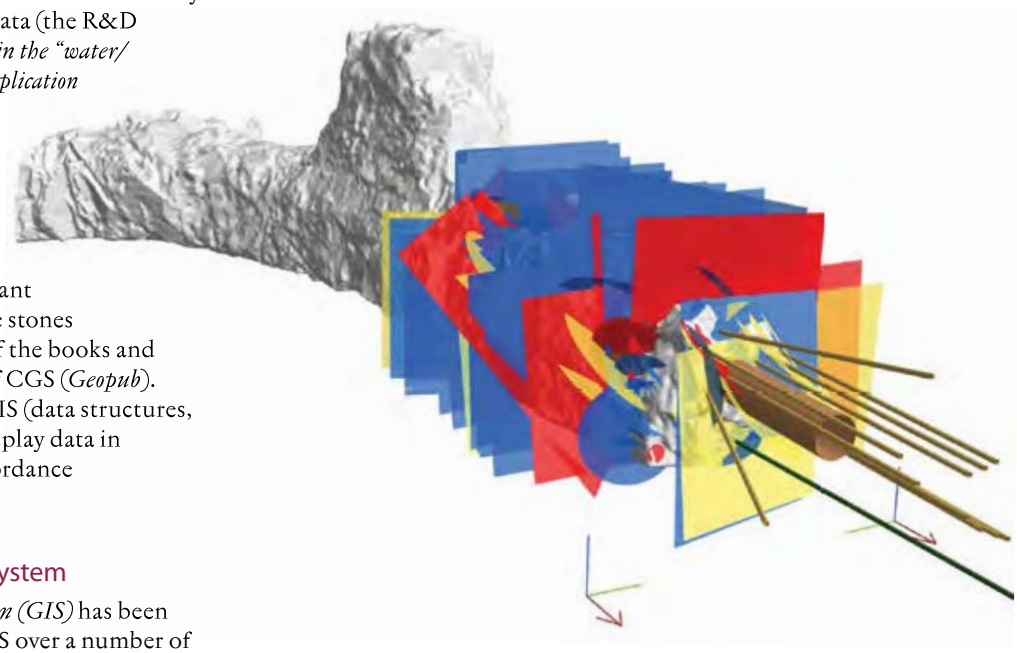
In 2011, a section of the GeoIS (data structures, map services) was created to display data in an interoperable format in accordance with the INSPIRE Directive.

Geographical Information System

A *Geographical Information System (GIS)* has been progressively developed by CGS over a number of years. It is the tool used by the whole organization to access, compile and process spatial data. In 2011, extensions were added to the tools used by field geologists to access the NGMD and process data used for compiling geological maps (tools for analysis of structural measurements, creation of the graphic format of the map legend based on the data stored in the NGMD, batch processing of routine checks and analyses etc.). It is now easier to combine field observations and digital photographs with information gathered by remote sensing and use GIS to produce 3D models. These methods are routinely used by geologists mapping at 1:25,000 scale and/or within the context of the project *Review of Groundwater Resources in the Czech Republic*, and on projects in Iran, Nicaragua and Ethiopia.

Providing access to geoscientific data and information

The *CGS Information Portal* (*IP CGS*) is the integrated information platform for the CGS. It contains 65 thematic applications. In 2011, major modifications of the structure and design of the public part of the portal (*www.geology.cz/extranet*) were completed. As a result of several projects, new applications displaying slope failures and the CGS collections (*muzeum.geology.cz*) were made available to the public on the IP CGS. Within the non-public part of the portal, new modules for recording field observations on hydrogeology in the NGMD were added to the application Digital Documentation Diary, and the Geopub application was modified.



Use of GIS for planning drill holes in the Josef Underground Laboratory near Mokrsko (120 m below surface). A detailed map of brittle tectonic features (faults and joints) has been created in the ArcGIS environment by integrating the results of 3D laser scanning of the walls of side tunnels. Using this procedure, the technical difficulty of planning drilling projects in structurally complex environments can be minimized.

Through the *Map Server – mapy.geology.cz* – the CGS provides free access to spatial data stored in its archive and the NGMD. In 2011, a series of applications based on the ArcGIS Server/ArcGIS Viewer for Flex technology were created and added.

The *Portal of the State Geological Survey* (*www.geologickasluzba.cz*) provides a virtual link between the data held by CGS, CGS – Geofond and CENIA so that information and map services can be shared. *The Portal of Geohazards in the Czech Republic – www.geology.cz.geohazardy* – provides open access to information about radon in bedrock, slope failures, vulnerability of groundwater and other hazardous geological phenomena (GeoReports, Catalogue of geohazards).

Interoperability of geoscientific data

The CGS is involved in a long-term project for integrating geoscientific information within the national information infrastructure under the terms of the INSPIRE Directive, e-Government programmes, GMES, and GEOSS.

In 2011, access to the Register of Ground instabilities, supplemented by engineering-geological maps at 1:50,000 scale and 1:500,000 scale and the Map of Risks to Slope Stability (a), was published through the web application http://maps.geology.cz/svahove_nestability. The set of new applications designed to provide information about these phenomena has also been supplemented by an application that makes documents (reports and maps) from the Archive of Ground instabilities (b) available -http://sesuvy.geology.cz/archiv.

Emphasis is placed on technical procedures for integrating data from CGS, the Ministry of the Environment, CENIA, AOPK and other sources, and ensuring both technological and content interoperability.

Work on the implementation of the INSPIRE Directive in the Czech Republic continued during 2011. WMS and WFS map services based on EN, ISO and OGC standards were created and tested. A range of WMS services displaying the data sources was broadened (*wms.geology.cz*). In 2011, the CGS also participated in the review and testing of the first public proposal for data specifications given in Annexes II and III of the INSPIRE Directive. The testing was organized by the Joint Research Centre (JRC) of the European Commission in liaison with the European community of geologists coordinated by EuroGeosurveys (EGS). Comments on specifications required for interoperability of data in the fields of geology, hydrogeology, geohazards, soils and exploration geology have been compiled. These specifications will have a decisive influence on the structure of published data and also define the way in which access to the data resources of the CGS will develop in the future.

Information and communication technologies

Information and communication technologies (*ICT*) govern the efficiency with which a modern geological survey can carry out its work. By the end of 2011, the total equipment of the CGS intranet consisted of 32 servers (OS Linux and MS Windows) and 554 PC's and laptops (OS MS Windows).

During 2011, the CGS has made plans to introduce virtual servers and procedures for central management of network components and increase the security of the network by the end of 2011, anticipating the takeover of the ICT from the CGS – Geofond.

International cooperation

During 2011, the CGS remained an active member of the Geoscience Information Consortium (GIC) and EuroGeoSurveys and also contributed to the worldwide project *OneGeology Global*. In addition, work continued on two other major international projects *OneGeology-Europe* (EU eContentPlus) and *AEGOS – African-European Georesources Observation System* (EU FP 7). Since 2011, the CGS has assumed responsibility for managing and maintaining a multilingual metadata catalogue (*one.geology.cz*) that was created under the terms of the project *OneGeology-Europe*. The 1st phase of the international project *AEGOS – African-European Georesources Observation System* (Support Action Programme FP7) was successfully completed in 2011. The CGS led an international team that designed the specifications for the technical infrastructure that will guarantee effective access to geoscientific information across Africa during the next stages of the project. The strategy and technical procedures proposed for the implementation of the AEGOS data infrastructure rely on a distributed system that will provide multilingual online access to metadata, data and user-friendly products through the use of standardized interoperable online services.

Remote sensing

Veronika Kopačková
Head of the Remote Sensing Centre

Thanks to new space programmes and rapidly developing technologies, remote sensing of the Earth is, today, the most widespread method for obtaining spatial data about the Earth´s surface and specific objects on it. In addition to the fact that satellite data provide a synoptic overview of areas under investigation, the main advantage is that it is possible to combine spatial information with thematic data (qualitative information about the objects under investigation) and temporal data (systematic sampling of archived data that enables a time series of the images to be evaluated).

Activities of the Remote Sensing Centre

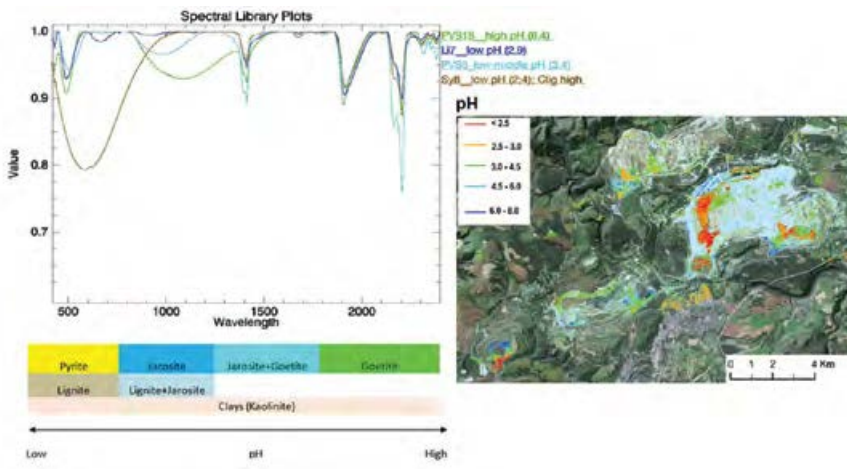
The Remote Sensing Centre (*http://www.remotesensing-geology.ic.cz/*) specialises in the application of spectrometric imaging techniques using optical hyperspectral (0.45–2.50 µm) (HS) data for geological purposes. The CGS is pioneering the application of these techniques in the Czech Republic. During 2011, investigations were also extended to the use of thermal remote sensing (8–13 µm).

The central theme of investigation is the interpretation of the relationship between the chemical composition of the soil substrate and the health of vegetation growing on it, by using quantitative spectrometric imaging. Most of the data analysed is obtained using the HyMap aerial hyperspectral sensor and, more recently, also thermal infrared data from the AHS sensor. This research is currently financed from both national (GACR 205/09/1989-HYPSO: *http://www.geology.cz/project619100/*), and international sources (FP7-EO-MINERS: *http://www.eo-miners.eu/*, EUFAR-DeMinTIR: *http://www.remotesensing-geology.ic.cz/projects/demintir.html*). Mathematical 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 work described above, the Remote Sensing Centre is engaged in other research. New procedures for classifying topographical features and interpreting their subsequent geomorphological development have been created, as well as a new method enabling updating of tectonic and hydrogeological features using ALOS PALSAR satellite radar data.

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

- Faculty of Natural Sciences, Charles University in Prague
- CzechGlobe, Academy of Sciences of the Czech Republic
- German Aerospace Centre (Deutsches Zentrum für Luft und Raumfahrt, DLR)
- Martin-Luther-University Halle-Wittenberg
- French Geological Survey (Bureau de Recherches Géologiques et Minières, BRGM)



Example of the application of hyperspectral mapping. The geochemical properties and mineralogical composition of the substrate are characterized by using their hyperspectral signatures. Using this information a model of the variation of the pH of the substrate without the vegetation cover can be created.

International activities and cooperation

During 2011, as in previous years, the CGS took part in a number of international projects. Among these activities there was mapping and research that continued on James Ross Island in Antarctica, assessment of the resource potential, groundwater supplies and environmental hazards in Africa and, of course, scientific cooperation with partners in Europe. The contributions made by scientists from the CGS to the UNESCO International Geological Correlation Programmes were also important.

Tectonic evolution and prediction of the mineral potential of West Africa

In 2011, the Czech Geological Survey took part in the geological assessment of the mineral potential of West Africa under the terms of the AMIRA-WAXI West Africa Exploration Initiative. Work on the project was concerned with the study of geochemical dispersion haloes around ore deposits and yielded new information about the factors governing the patterns of distribution of indicator elements in the weathering profile.

It was discovered that gold in the regolith and weathering profile shows a strong correlation with a number of other chemical elements, in particular arsenic, copper, antimony, tungsten, tellurium and selenium. The geochemical fingerprint that distinguishes each type of gold mineralization is determined primarily by the geochemical composition of the mineral association in which the gold occurs. In addition to determining the dispersion of elements in the weathering profile, emphasis was also placed on testing the viability of biochemical methods for prospecting. A pilot study demonstrated that the amounts of zinc, copper and gold in the foliage and bark of trees are markedly higher where they are found growing in soils over mineralization.

Research in the northern part of the Antarctic Peninsula and adjacent James Ross Island

This 5-year project, VaV 222101 (2007–2011), financed by a grant from the Ministry of the Environment, came to an end. Topographical, geological and geomorphological maps of the northern, de-glaciated part of James Ross Island at a scale of 1:25,000 were compiled. Special geological investigations were also carried out on the following topics: the reconstruction of changes in the pattern of glaciation in relation to changes in climate during the recent geological past; a study of the volcanic activity on James Ross Island; monitoring of bird and mammal populations and their behaviour, and a study of organic pollutants transported to Antarctica by wind and precipitation.

Study of the provenance of metamorphosed sedimentary rocks

In 2010, the Czech Science Foundation approved funding for the research project *Deciphering the pre-convergence history of crustal domains in deeply eroded orogenic belts from detrital zircon populations*. The project will be carried out between 2011 and 2013 in the Bohemian Massif and the Kaoko Belt in south-western Namibia. The purpose of the project is to test methods of dating detrital zircons for use in interpreting the tectonic history of different highly metamorphosed clastic sedimentary units. Work in the Bohemian Massif is focused on determining the provenance of migmatitized sediments within the Moldanubian Unit and their relationship to the (meta)sediments of the Teplá-Barrandian Unit and the Brunovistulian Unit. The study in the Kaoko Belt in Namibia is designed to identify the provenance of the clastic material in highly metamorphosed sediments in the cover of the Congo Craton and in the back-arc basin in collision with it.

Influence of mining on the environment and public health in Zambia

The project UNESCO/IGCP/SIDA 594 in Zambia has been coordinated by the CGS. Under the terms of this project, a study of the environmental impact caused by mining and processing of copper and cobalt ores in the Zambian part of the Copperbelt has been carried out. The results of this study were presented at the preliminary meeting on the project held at Kitwe in Zambia

Geologists use Zodiac RIBs to reach distant parts of the coast of James Ross Island in Antarctica.

on 17–18th of October 2011. Forty-six experts from nine European and African countries took part in the meeting. The proceedings of the meeting and the main outputs from the project, including the work of the Czech group, are available at the web address *www.geology.cz/igcp594*.

Glacial retreat in the northern part of James Ross Island

This project was scheduled for the period 2009–2012. The aim is to investigate changes in the volume and the area covered by small glaciers in the northern, mostly deglaciated, part of James Ross Island. A survey is being carried out using remote sensing methods and glaciological field measurements. It has been found that glaciers in this part of the island are retreating as a result of an increase in temperature that is several times higher here that in other parts of our planet. The project is financed by the Czech Science Foundation.

Assessment of mining-related impacts based on the application of a hyperspectral sensor

The aim of this project, which is being undertaken from 2009 to 2012, is to study the relationship between the geochemical composition of soils and substrates and the health of vegetation growing on them, placing emphasis on the effects of heavy metals. Hyperspectral (HS) aerial images acquired using a HyMap aerial sensor are being analyzed. The geochemical parameters of exposed substrates can be measured by quantitative spectroscopy, and the aim is to define spectral criteria that indicate how the geochemical properties of the soil affect the biochemical behaviour of the vegetation growing on it. Once the relationship between the geochemistry of the substrate and the biochemical stresses in the vegetation have been defined, the patterns of stress in the vegetation can be correlated with the geochemistry of the substrate and mapped remotely using hyperspectral technology. The preliminary results of the project show that it is possible to model the pH gradient and the concentration of selected

heavy metals across an area and also to model the physical state and general health of forests. This project is financed by the Czech Science Foundation.

Disparity and ontogenesis in trilobites: characterization of morphological changes

During the first year of the project MOBILITY MEB 021122, several visits by CGS scientists to the Université de Lille took place, as well as visits by French collaborators to the collections of the CGS and of the Natural History Museum in Prague. As a result of the first year of work on the project, joint papers on juvenile phacoid trilobites from Devonian sediments of the Prague Basin, and on a unique discovery of a dalmanitid trilobite with hypostome *in-situ* will shortly be published. L. Laibl, a student working on a master's programme, was successfully trained in the procedures used for morphometric analysis of the early ontogenetic stages of trilobites. This methodology was developed by Dr C. Crônier, one of the French partners in the project, and has been used with great success by L. Laibl in his master's studies.

Training of the staff of the Moravian branches of the CGS in best practices in leadership and management of research and development

This project is being carried out under the terms of the Education for Competitiveness Operational Programme. The programme started in 2009 and will end in August 2012. A programme for the continuing education of scientific staff was created and three pilot training sessions have been organized. A team of instructors was recruited from the employees of the CGS and systematically trained in education. The themes of the training are: modern methods of geological exploration, project management, presentation and dissemination of results and effective communication and cooperation within teams. Training in leadership and management of science and research is also carried out. All the ongoing training and activities are carried out by the staff of the CGS, in cooperation with external lecturers, both from the Czech Republic and abroad.

This project reflects the long-felt need for systematic training of staff in the CGS branches in best scientific practice and project management. The training is also offered to Ph.D. students working with the CGS, some of whom will join the permanent staff of the CGS in future. This training is especially important because of the need for effective engagement in international networks and research projects.

International scientific projects

Soil TrEC – contribution to the creation of a worldwide network of soil observatories that will monitor biogeochemical processes in the era of global climate change (large integrated project under the terms of the 7th Framework Programme of the EU).

Poster for the workshop Mining and the Environment in Africa held under the auspices IGCP 594.

AEGOS – preparatory stage in the creation of an African-European system for monitoring geological resources – especially mineral resources, groundwater and energy resources (supporting programme of the 7th Framework Programme of the EU).

CGS Europe – Coordinated European project focused on the geological storage of CO_2 (coordinated programme on the terms of the 7th Framework Programme of the EU).

Assessment of the impact of the Gothenburg protocol on acidified and eutrophied soils and waters (supported by a grant from Iceland, Lichtenstein and Norway under the terms of the EHP Financial Mechanism and the Norwegian Financial Mechanism).

Monitoring cross-border transport of pollutants and identification of sources of dust particles using isotopes (supported by a grant from Norway through the Norwegian Financial Mechanism).

PANGEO is a project designed to identify and monitor hazards caused by variations in topography across large conurbations. The aim is to compile comprehensive information about the hazards affecting 52 large European cities. Under the terms of this project, a survey of geohazards in two cities in the Czech Republic, Prague and Ostrava, will be carried out. This is a cooperative project within the 7th Framework Programme of the EU).

Middle Palaeozoic climate and sea-level changes and their influence on marine community evolution: a comparison of models from the Perunica microcontinent and the Laurasian continent (project of Czech-American bilateral scientific and technological cooperation).

Assessment of the potential of mineral resources on the Saxon-Czech border – cross-border register of mineral resources (project under the terms of the Ziel 3 Programme that supports cross-border cooperation between the Czech Republic and the Free State of Saxony 2007–2013).

EO-MINERS – project focused on monitoring and evaluation of environmental and socio-economic impacts of the mining industry at local and regional levels (medium scale project based on cooperation within the 7th Framework Programme of the EU).

Sudetian Geotrail, geological tourist guide (project under the terms of the Operational Programme Crossborder cooperation Czech Republic – Poland 2007–2013).

UNESCO International Geological Correlation Programmes (IGCP)

Scientists from the CGS participated in the following IGCP projects during 2011:

IGCP 540 – Gold-bearing hydrothermal fluids in orogenic deposits.

IGCP 575 – Pennsylvanian terrestrial habitats and biotas in southeastern Europe and northern Asia Minor and their relation to tectonics and climate.

IGCP 580 – Application of magnetic susceptibility as a palaeoclimatological indicator in Palaeozoic sedimentary rocks and characterization of the magnetic signature.

IGCP 591 – The Early to Middle Palaeozoic revolution (Š. Manda – national representative).

IGCP 594 – Environmental and health impacts of mining in Africa (B. Kříbek – international leader).

IGCP 596 – Climate change and biodiversity patterns in the Mid-Palaeozoic (S. Vodrážková – national representative).

The scientists from CGS also participated in the management of the Czech National Committee for UNESCO International Geoscientific Programmes (IGCP) (J. Pašava – chair, A. Vymazalová – secretary).

Membership of international organizations

EuroGeoSurveys – association of the 32 European geological surveys

ICOGS – International Consortium of Geological Surveys

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

ENeRG – European Network for Research in Geoenergy (V. Hladík – member of the steering committee and editor of the newsletter)

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

AAPG – American Association of Petroleum Geologists (V. Dvořáková – president of the European Region)

INQUA – International Union for Quaternary Research

ProGEO – European Association for the Protection of Geological Heritage

KBGA – Carpatho-Balkan Geological Association

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

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

CGMW – Commission for the Geological Map of the World

GIC – Geoscience Information Consortium (R. Tomas – chairman) – a consortium gathering the managers of informatics of 26 geological surveys around the world

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

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

SRG – The Society of Resource Geology (Japan)

CETEG – Central European Tectonic Groups

Laboratories

Věra Zoulková
Head of the Central Laboratory

Central Laboratory

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. The laboratory has been accredited since 1993 and regular national and international interlaboratory tests of analytical quality have consistently given 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 about 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, 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.

Milan Geršl
Head of the Department of Applied Geochemistry and the Brno Testing Laboratory

Brno Testing Laboratory

In addition to providing commercial analytical services, the Brno Laboratory of Organic Geochemistry carries out research on biomarkers, environmental geochemistry and the geochemistry of gases. A renovation of the facilities for gas analysis was completed during 2011, and new methods of gas analysis were introduced, including the field measurement of surface emissions of carbon dioxide and methane.

Work on projects

The project *Model of sediment and organic pollutant transport bound to suspended particulate matter in the Dyje River catchment area* (2007–2011, MZP/SP), led by M. Geršl and E. Geršlová, was successfully completed and the final report accepted. Under the terms of the project, geochemical analysis of both river and reservoir sediments and soils from the vicinity of rivers was carried out with the aim of studying the distribution of organic pollutants and toxic metals. The adsorbtion and transport of pollutants by river sediments was studied. The record of sedimentation in a number of reservoirs

was also studied so that the history of pollution from the adjacent river catchment could be determined. Using this information it has been possible to suggest strategies for treating reservoir sediments for the purpose of revitalizing the reservoirs.

Work on the project *Regional geochemistry of the rock environment in Western Bohemia* (MŽP OOHPP-40/10/GP) was completed in 2011. The project, led by M. Geršl and E. Geršlová, involved detailed geochemical surveys of the areas covered by the 1:25,000 scale map sheets Krupka and Teplice. An environmental-geochemical survey of both inorganic and organic components over the areas of the 1:25,000 scale map sheets Valašské Meziříčí, Rožnov pod Radhoštěm and Jablunka was also carried out.

A unique collection of rock samples potentially suitable for CO_2 storage is currently being created under the terms of work 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* (Č.Fr-TI1/379). The rock samples are now being tested under high-pressure in the presence of reservoir fluids and CO_2 in a supercritical state. Part of the work on this project is concerned with the possible problems of leakage of CO_2 and methods for monitoring this.

Vojtěch Janoušek
Deputy head of the Department of Rock Geochemistry

Special Laboratories

The range of analytical facilities provided by the Special Laboratories forms the backbone of the Department of Rock Geochemistry. X-ray diffraction (XRD) is used to determine the lattice structure that defines the morphology and other properties of crystalline minerals. The chemical composition and zoning of minerals are studied using the scanning electron microscope (SEM); microstructures can be visualized by using the electron backscatter diffraction (EBSD) attachment. The P-V-T-X conditions of hydrothermal fluids are studied in our Fluid Inclusions Facility. Phase relations within the S, Te, Se and PGE-bearing systems are the subject of research in the Experimental Mineralogical Laboratory. The thermal ionization mass spectrometer (TIMS) is capable of measuring the isotopic ratios of several elements applicable to petrogenetic and geochronological studies (Sr, Nd, Ca and Os). The influence of global palaeoenvironmental changes on the evolution of marine and terrestrial communities is the subject of research in the Laboratory of Ecostratigraphy and Palaeobiology.

The workers in the Special Laboratories are not only responsible for providing primary geochemical data, but are often also established scientists, taking an active part in multidisciplinary projects, regularly publishing their results and being involved in teaching.

Milan Geršl investigating the transport of suspended matter in the Dyje and Svratka river catchments. Geochemical analysis of river and reservoir sediments and soils from the vicinity of rivers is being carried out to determine the distribution of selected organic pollutants and toxic metals.

Library, Archive and Collections

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

The integrated services of the Library, Archive and Collections are used not only by specialists from the Czech Geological Survey and other scientific institutions, but also by students, amateur naturalists and the general public. Researchers can use two well-equipped modern private rooms with collections of documents available from the depositories of the Library, Archive and Collections of the CGS.

Library

The Library of the CGS is the largest geological library in the Czech Republic. It manages a unique collection of geological literature from around the world. The study rooms offer not only printed materials, but also electronic resources. Also referencing, interlibrary and search services are provided in both standard and electronic forms.

The Library provides access to the databases of the CGS as well as to worldwide fulltext (Science Direct, SpringerLink, Wiley Interscience, Blackwell, GeoscienceWorld) and bibliographic databases (Web of Knowledge, Scopus, GeoRef and GeoBase, Environment Complete). These sources are available to all registered readers. The CGS Library provides the widest collection of electronic information resources of all the libraries within the Ministry of the Environment.

Other activities of the Library

The staff of the geological library also played a significant part in activities other than those involved in providing the library services described above. One of these was processing and delivering data for the Register of Information about Results for the R&D&I Council. Cooperation with the reference libraries of other organizations under the jurisdiction of the Czech Ministry of the Environment continued. An Aggregate Catalogue, SOKAT, combining the databases of these different libraries and information centres has been created as the result of this cooperation. In 2011, a prototype of the SOKAT catalogue was launched. The National geoscientific bibliography, also the result of cooperation between geological libraries within the Czech reference network, was already completed by 2011 and is now being progressively updated. The geological bibliography from earlier annual reports is being processed retrospectively. The bibliographical information going back to 1985 has so far been incorporated. Training courses for individuals, as well as lectures and presentations for groups of users, are held regularly.

The web page of the National Geoscience Bibliography. This application links two previously separate databases related to Earth Sciences. It is now possible for users to obtain information from both databases using a single interface.

Archive

The main priority of the Archive is to provide bibliographic information and raster thumbnail displays of most of the geoscientific maps, not only on the web pages of the CGS (*http://www.geology.cz/extranet/mapy/archiv*), but also in the study room. The resources of the Archive are regularly supplemented by the addition of documents and reports from international projects, the Grant Agency of the Czech Republic and old documents from bequests, as well as various scientific reports written by the staff of the CGS.

Description of the brown coal mine in the archbishopric estate of Světec

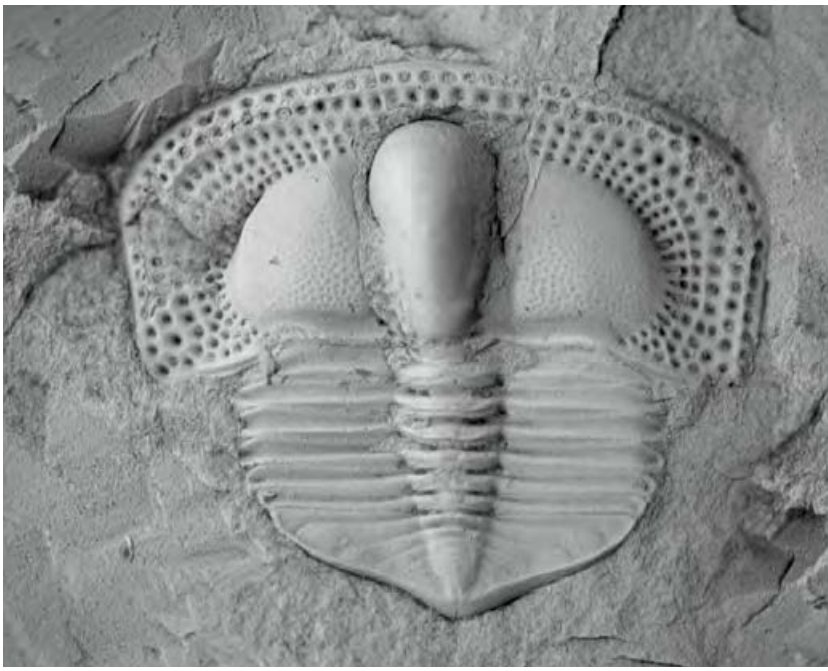
In 1766, the clerk J.P. Habel from Postoloprty manor wrote a unique report with the title *Description of the brown coal mine in the archbishopric estate of Světec.* It describes the observations he made on a visit to the Mine at Světec. The manuscript was written in Old German cursive script (Kurrentschrift). It describes the beginnings of brown coal mining in the area around Bílina, and contains many fascinating historical details of techniques used for underground mining at that time and the problems encountered. The manuscript describes the organization of the mine and the location and use of various buildings and shafts and how both coal and ash were stored and sold. It also gives descriptions of how a brew kettle was modified so that beer could be brewed using brown coal, together with sketches of a kibble and other details of practical interest. In 2011, in recognition of its historical importance, the CGS reprinted this report in facsimile with a Czech translation, together with a historical commentary on the mining of brown coal in North Bohemia and a collection of photographs. It is hoped that this re-published report will find its way to the shelves of libraries in the Czech Republic and abroad, and will be read by all those interested in the history of mining and commerce in Bohemia.

Renovation of the CGS Archive databases

This internal project is designed to solve the problem of processing, preservation and effective access to scientific documents created by the CGS and deposited in the CGS Archive. In accord with new legislation on access to information, it is necessary create a unified system for electronic management of records. Progress on the transfer of the database of the map archive to the CDS, as well as modernization of the Photo Archive, will continue.

Collections

The Department of Material Documentation and Collections stores and provides access to fossils,



One of the new acquisitions to the CGS Collections, a trilobite Marrolithus ornatus *(Sternberg, 1833), from a temporary outcrop in Prague-Vysočany, Zahořany Formation, Upper Ordovician, Sandbian.*

samples of minerals and rocks, drill cores, thin sections and other material documentation acquired by researchers from CGS and other organizations.

Significant new acquisitions to the CGS Collections

The donation and transfer of Silurian and Devonian bivalves collected by Dr Kříž to the CGS continued during 2011. This collection of over 18,000 Palaeozoic bivalves is the largest in the world. Purchase of a third collection from V. Frank was also important. Both type and original specimens gathered by Dr Manda, as well as trilobites collected by Dr Budil and MSc. Rak, were deposited into the collections of the CGS. The material of the museum character was registered in the central register of collections of the Ministry of Culture of the Czech Republic.

Maintenance of the CGS Collections

In addition to the care of approximately 300,000 stored items, intensive publication activity supplemented the museological duties and work on three grant projects was carried out. Work on the project *Building the Information System of the Czech Geological Survey – revision and palaeontological investigation of selected older funds from the CGS collections* (VaV DE08P04OMG002) was of particular importance. The catalogue of palaeontological type specimens and the originals held in the collections of the CGS and an extensive on-line catalogue of the collections, supplemented by numerous photographs and descriptive notes (Virtual Museum II., *http://muzeum.geology.cz/*) were created and published under the terms of this project. A fourth grant project, KONTAKT, will continue in 2012. The aim of this project is the exchange of palaeontological information between the Université de Lille 1, the CGS and Charles University.

Publishing House and the promotion of geology

Patrik Fiferna
Head of the Publishing House of the CGS

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 engaged and informed 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 made more and more attractive. It is visited annually by over 70 thousand users.

Publishing activity

During 2011, the main emphasis remained on the publication of individual sheets of the *Geological Base Map of the Czech Republic at 1:25,000 scale*, with the accompanying explanatory texts. The following sheets were published: 14-343 Svitavy, 13-322 Kolín, 13-324 Kutná Hora and 24-122 Brněnec. Among other significant scientific publications during 2011, the following should be mentioned: *Geoscience Research Reports for 2010*; J. Tyráček, *Journal of Geological Sciences – Anthropozoic*, and P. Hanžl, *Explanatory notes to the Geological Base Map of the Czech Republic at 1 : 25 000 scale*. In total, 21 publications were issued.

Za nerosty čtyřmi světadíly aneb Zážitky českého mineraloga

(In Pursuit of Minerals across Four Continents – Experiences of a Czech mineralogist)

Kolik je Guayan? – Do zapomenutých končin Jižní Ameriky

(How Many Guyanas Are There? – Into forgotten parts of South America)

In these popular scientific books, Jan Hus Bernard and Jiří Jiránek, former employees of the CGS, describe some of their unusual experiences and observations, gathered during their long periods of work abroad.

Za tajemstvím kamenů – příručka pro mladé sběratele hornin, minerálů a zkamenělin

(About the Mystery of Stones – a guide for young collectors of rocks, minerals and fossils)

This book for children, written by Prof. Jan Petránek, a doyen of Czech geology, is intended for all boys and girls who want to experience the fascinating world of geology through the adventure of collecting.

Geoscience Research Reports for 2010

A new layout was designed for this journal to make the text and graphics more attractive to its readership. A total of 56 papers by 112 authors from across the whole Czech Republic were published in 2010.

The Publishing House of the CGS promoted its activities and presented publications at several scientific events in the Czech Republic (the 2nd Open Congress of the Czech Geological Society and the Slovak Geological Society, the international conference Challenges and threats of ecotourism and geotourism to the protection of biodiversity and geodiversity, and the 21st Autumn Book Fair in Havlíčkův Brod).

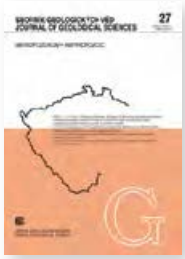
Popularization of geology

During 2011, the Czech Geological Survey once again acted as coordinator of the *Week of Science and Technology* – the biggest scientific festival in the Czech Republic. The CGS prepared many activities for the festival. In addition to the Open Doors Day, which took place at three workplaces (Klárov, Barrandov and Brno), the CGS organized several interesting lectures and exhibitions. Among them was an exhibition *Planeta Země mocná i zranitelná* (Planet Earth Mighty and Vulnerable). On the *Day of the Ministry of the Environment,* geological walks led by members of the CGS staff were organized to raise awareness of the work carried out by the survey as one of the resort organizations of the ministry. The 5th year of the children's painting contest *My Piece of Earth* was also a success. The GCS also organized presentation stands, exhibitions and launches of books, with the aim of increasing public awareness of the importance of geology to society and the services undertaken in this context by the CGS. An integral part of this campaign is to encourage the circulation and use of geoscientific publications and maps, and to raise awareness of geoscientific issues through the web portal of the CGS.

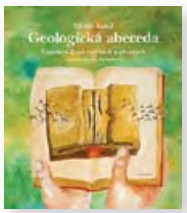
The range of products for sale in the CGS bookshop at Klárov was increased by adding geological publications from other publishing houses, as well as geological equipment. At present, the bookshop offers more than 2750 geoscientific publications and maps for sale.

The geological bookshop served as a gallery for 5 exhibitions (J. Haasová – Landscapes Born of Fire; M. Machek – The Colourful World of Rocks under the Microscope, I. Frolíková – On the Waves of Peru; R. Vodrážka, B. Mlčoch – Fossilized Secrets of Antarctica, L. Kondrová, P. Gürtlerová, R. Gürtler – Through the Magical Landscapes of Chile) and for 3 book launches [J. Petránek – Za tajemstvím kamenů – příručka pro mladé sběratele hornin, minerálů a zkamenělin (About the Mystery of Stones – a guide for young collectors of rocks, minerals and fossils), Z. Kukal et al. – Hrady Čech a Moravy (Castles of Bohemia and Moravia), Z. Kukal, H. Neubertová – Geologická abeceda (A Geological Alphabet)].

PUBLICATIONS ISSUED BY THE CZECH GEOLOGICAL SURVEY

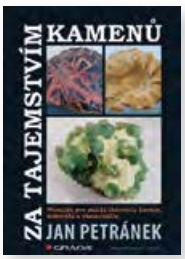


Jaroslav Tyráček,
Daniel Nývlt
and co-authors
Anthropozoic, Volume 27



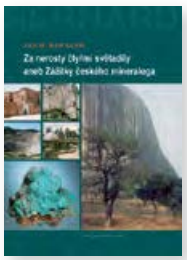
Zdeněk Kukal,
Helena Neubertová
A Geological Alphabet – Secrets
of the Earth in rhymes and pictures

Geoscience Research
Reports for 2010



Jan Petránek
About the Mystery of Stones –
a guide for young collectors
of rocks, minerals and fossils

Petr Budil,
Marika Steinová
Current catalogue of figured
types and specimens in the
palaeontological collections of the
Czech Geological Survey

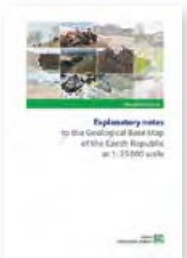


Jan H. Bernard
In Pursuit of Minerals
across Four Continents –
Experiences of a Czech
mineralogist

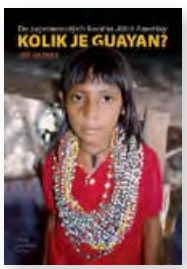
Johann Philipp Habel,
Roman Jírů
Description of
the brown coal mine
in the archbishopric
estate of Světec

Vít Hladík
What exactly is
geological storage
of CO_2?

Ondrej Lexa
9th International
Eclogite Conference

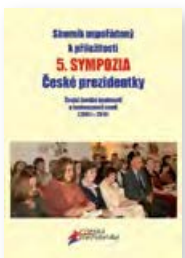


Pavel Hanžl and co-authors
Explanatory notes to
the Geological Base Map of the
Czech Republic at 1 : 25 000 scale



Jiří Jiránek
How Many Guyanas
Are There? – Into
forgotten parts
of South America

Jan Cháb
The Stony Face
of the Czech Republic



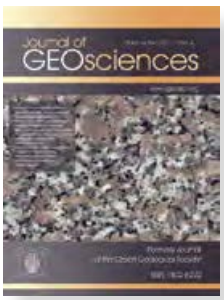
Zdeňka Petáková
Czech Female Presidents

Lucie Kondrová
The Fascinating Landscape
of Chile through the eyes
of Lucie Kondrová

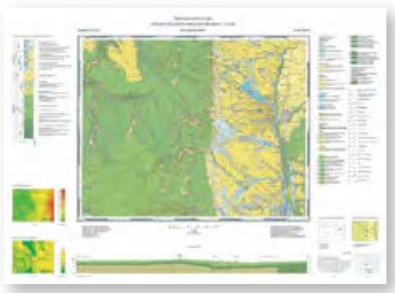
Bohdan Kříbek
Mining and the Environment
in Africa (CD-ROM)

The Bulletin of Geosciences is an international scientific journal with a history nearly 90 years long, published by the Czech Geological Survey (also, since 2011, in cooperation with the West Bohemia Museum in Pilsen). This journal is one of the top 10 most important scientific journals published in the Czech Republic and is included in all prestigious scientific databases.

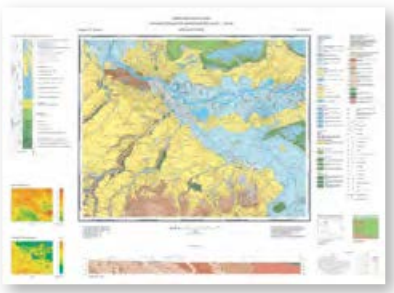
In 2006, the editorial board set the focus of the journal on research into the palaeoenvironment and the evolution of life on Earth. In 2010, thanks to its high scientific quality, the journal was awarded an impact factor, which is now 1.10.



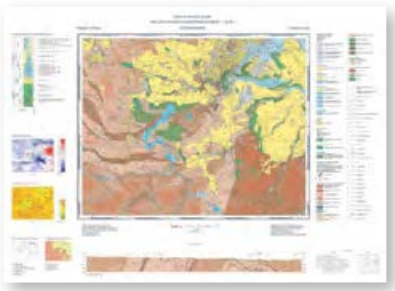
The Czech Geological Survey is also co-editor of the Journal of Geosciences. This journal publishes papers mainly concerned with mineralogy, structural geology, petrology and the geochemistry of igneous and metamorphic rocks. In addition to regular volumes, special thematic issues are also published. The journal maintains a high scientific standard and is indexed by a number of databases, including the prestigious Web of Science and Scopus. In 2011, the journal was awarded an impact factor, which is now 1.28.



Stanislav Čech *et al.*
Geological Base Map of the Czech Republic at a scale of 1:25,000 and its integral parts, sheet 14-343
Svitavy



Přemysl Zelenka *et al.*
Geological Base Map of the Czech Republic at a scale of 1:25,000 and its integral parts, sheet 13-322
Kolín



Veronika Štědrá *et al.*
Geological Base Map of the Czech Republic at a scale of 1:25,000 and its integral parts, sheet 13-324
Kutná Hora

Stanislav Čech *et al.*
Geological Base Map of the Czech Republic at a scale of 1:25,000 and its integral parts, sheet 24-122
Brněnec

SELECTED SCIENTIFIC PAPERS

Scientists from the Czech Geological Survey or authors and co-authors of all of these papers that have been published in impact journals.

Bačík, P., Ozdín, D., Miglierini, M., Kardošová, P., Pentrák, M. & Haloda, J., 2011, "Crystallochemical effects of heat treatment on Fe-dominant tourmalines from Dolní Bory (Czech Republic) and Vlachovo (Slovakia)", ***Physics and Chemistry of Minerals,*** vol. 38, no. 8, pp. 599–611.

Baratoux, L., Metelka, V., Naba, S., Jessell, M.W., Grégoire, M. & Ganne, J., 2011, "Juvenile Paleoproterozoic crust evolution during the Eburnean orogeny (~2.2–2.0 Ga), western Burkina Faso", ***Precambrian Research,*** vol. 191, no. 1–2, pp. 18–45.

Barnet, I. & Pacherová, P., 2011, "Impact of the deeper geological basement on soil gas and indoor radon concentrations in areas of Quaternary fluvial sediments (Bohemian Massif, Czech Republic)", ***Environmental Earth Sciences,*** vol. 63, no. 3, pp. 551–557.

Baroň, I., Řehánek, T., Vošmik, J., Musel, V. & Kondrová, L., 2011, "Report on a recent deep-seated landslide at Gírová Mt., Czech Republic, triggered by a heavy rainfall: The Gírová Mt., Outer West Carpathians; Czech Republic", ***Landslides,*** vol. 8, no. 3, pp. 355–361.

Bashforth, A.R., Drábková, J., Opluštil, S., Gibling, M.R. & Falcon-Lang, H.J., 2011, "Landscape gradients and patchiness in riparian vegetation on a Middle Pennsylvanian braided-river plain prone to flood disturbance (Nýřany Member, Central and Western Bohemian Basin, Czech Republic)", ***Review of Palaeobotany and Palynology,*** vol. 163, no. 3–4, pp. 153–189.

Benčoková, A., Hruška, J. & Krám, P., 2011, "Modeling anticipated climate change impact on biogeochemical cycles of an acidified headwater catchment", ***Applied Geochemistry,*** vol. 26, no. SUPPL., pp. S6–S8.

Benčoková, A., Krám, P. & Hruška, J., 2011, "Future climate and changes in flow patterns in Czech headwater catchments", ***Climate Research,*** vol. 49, no. 1, pp. 1–15.

Břízová, E. & Juřičková, L., 2011, "Could canopy forests survive agricultural colonization in the Polabí lowland (Czech Republic)", ***Bulletin of Geosciences,*** vol. 86, no. 2, pp. 283–300.

Budil, P., Fatka, O., Kolář, P. & David, M., 2011, "*Arthrorhachis* Hawle & Corda, 1847 (Agnostida) in the Prague Basin (Barrandian area, Czech Republic) revisited", ***Bulletin of Geosciences,*** vol. 86, no. 4, pp. 707–724.

Buriánek, D. & Dolníček, Z., 2011, "Metamorphic evolution of the contact aureole of the Dipilto Batholith, Eastern Chortis Terrane, Nicaragua", ***Journal of Geosciences,*** vol. 56, no. 1, pp. 9–26.

Buriánek, D., Hanžl, P. & Hrdličková, K., 2011, "Pegmatite dykes and quartz veins with tourmaline: An example of partial melting in the contact aureole of the Chandman Massif intrusion, SW Mongolia", ***Journal of Geosciences,*** vol. 56, no. 2, pp. 201–213.

Buriánek, D. & Hradecký, P., 2011, "The volcano-tectonic evolution of the Miocene Santa Lucía Volcano, Boaco district, Nicaragua", ***Journal of Geosciences,*** vol. 56, no. 1, pp. 27–41.

Bussien, D., Bussy, F., Magna, T. & Masson, H., 2011, "Timing of Palaeozoic magmatism in the Maggia and Sambuco nappes and paleogeographic implications (Central Lepontine Alps)", ***Swiss Journal of Geosciences,*** vol. 104, no. 1, pp. 1–29.

Cabral, A.R., Moore, J.M., Mapani, B.S., Koubová, M. & Sattler, C., 2011, "Geochemical and mineralogical constraints on the genesis of the Otjosondu ferromanganese deposit, Namibia: Hydrothermal exhalative versus hydrogenetic (including snowball-Earth) origins", ***South African Journal of Geology,*** vol. 114, no. 1, pp. 57–76.

Corcho Alvarado, J.A., Leuenberger, M., Kipfer, R., Pačes, T. & Purtschert, R., 2011, "Reconstruction of past climate conditions over central Europe from groundwater data", ***Quaternary Science Reviews,*** vol. 30, no. 23–24, pp. 3423–3429.

Cuda, J., Kohout, T., Tuček, J., Haloda, J., Filip, J., Prucek, R. & Zbořil, R., 2011, "Low-temperature magnetic transition in troilite: A simple marker for highly stoichi-ometric FeS systems", ***Journal of Geophysical Research B: Solid Earth,*** vol. 116, no. 11.

Čopjaková, R., Novák, M. & Franců, E., 2011, "Formation of authigenic monazite-(Ce) to monazite-(Nd) from Upper Carboniferous graywackes of the Drahany Upland: Roles of the chemical composition of host rock and burial temperature", ***Lithos,*** vol. 127, no. 1–2, pp. 373–385.

Ernst, A., Manda, Š. & Zágoršek, K., 2011, "Cryptostome bryozoan Stictoporella simplex (POČTA, 1894) from the Silurian of Bohemia", ***Neues Jahrbuch für Geologie und Palaontologie – Abhandlungen,*** vol. 260, no. 1, pp. 79–85.

Ettler, V., Mihaljevič, M., Kříbek, B., Majer, V. & Šebek, O., 2011, "Tracing the spatial distribution and mobility of metal/metalloid contaminants in oxisols in the vicinity of the Nkana copper smelter, Copperbelt province, Zambia", ***Geoderma,*** vol. 164, no. 1–2, pp. 73–84.

Farkaš, J., Déjeant, A., Novák, M. & Jacobsen, S.B., 2011, "Calcium isotope constraints on the uptake and sources of Ca^{2+} in a base-poor forest: A new concept of combining stable ($\delta^{44/42}Ca$) and radiogenic ($_{\varepsilon}Ca$) signals", ***Geochimica et Cosmochimica Acta,*** vol. 75, no. 22, pp. 7031–7046.

Fatka, O., Micka, V., Szabad, M., Vokáč, V. & Vorel, T., 2011, "Nomenclature of Cambrian lithostratigraphy of the Skryje-Týřovice Basin", ***Bulletin of Geosciences,*** vol. 86, no. 4, pp. 841–858.

Filippi, M., Bruthans, J., Palatinus, L., Zare, M. & Asadi, N., 2011, "Secondary halite deposits in the Iranian salt karst: General description and origin", ***International Journal of Speleology,*** vol. 40, no. 2, pp. 141–162.

Fojtíková, I., Barnet, I. & Marusiaková, M., 2011, "Radon index of a local administrative unit", ***Radiation Protection Dosimetry,*** vol. 145, no. 2–3, pp. 107–109.

Franěk, J., Schulmann, K., Lexa, O., Tomek, C. & Edel, J., 2011, "Model of syn-convergent

extrusion of orogenic lower crust in the core of the Variscan belt: Implications for exhumation of high-pressure rocks in large hot orogens", ***Journal of Metamorphic Geology,*** vol. 29, no. 1, pp. 53–78.

Franěk, J., Schulmann, K., Lexa, O., Ulrich, S., Štípská, P., Haloda, J. & Týcová, P., 2011, "Origin of felsic granulite microstructure by heterogeneous decomposition of alkali feldspar and extreme weakening of orogenic lower crust during the Variscan orogeny", ***Journal of Metamorphic Geology,*** vol. 29, no. 1, pp. 103–130.

Frouz, J., Cajthaml, T., Kříbek, B., Schaeffer, P., Bartuška, M., Galertová, R., Rojík, P. & Krištůfek, V., 2011, "Deep, subsurface microflora after excavation respiration and biomass and its potential role in degradation of fossil organic matter", ***Folia Microbiologica,*** vol. 56, no. 5, pp. 389–396.

Frýda, J. & Ferrová, L., 2011, "The oldest evidence of non-coaxial shell heterostrophy in the Class Gastropoda", ***Bulletin of Geosciences,*** vol. 86, no. 4, pp. 765–776.

Guy, A., Edel, J., Schulmann, K., Tomek, C. & Lexa, O., 2011, "A geophysical model of the Variscan orogenic root (Bohemian Massif): Implications for modern collisional orogens", ***Lithos,*** vol. 124, no. 1–2, pp. 144–157.

Hajná, J., Žák, J. & Kachlík, V., 2011, "Structure and stratigraphy of the Teplá-Barrandian Neoproterozoic, Bohemian Massif: A new plate-tectonic reinterpretation", ***Gondwana Research,*** vol. 19, no. 2, pp. 495–508.

Hatzignatiou, D.G., Riis, F., Berenblyum, R., Hladik, V., Lojka, R. & Franců, J., 2011, "Screening and evaluation of a saline aquifer for CO_2 storage: Central Bohemian Basin, Czech Republic", ***International Journal of Greenhouse Gas Control,*** vol. 5, no. 6, pp. 1429–1442.

Hojdová, M., Navrátil, T., Rohovec, J., Žák, K., Vaněk, A., Chrastný, V., Bače, R. & Svoboda, M., 2011, "Changes in mercury deposition in a mining and smelting region as recorded in tree rings", ***Water, Air, and Soil Pollution,*** vol. 216, no. 1–4, pp. 73–82.

Kotková, J., O'Brien, P.J. & Ziemann, M.A., 2011, "Diamond and coesite discovered in Saxony-type granulite: Solution to the Variscan garnet peridotite enigma", ***Geology,*** vol. 39, no. 7, pp. 667–670.

Krmíček, L., Cempírek, J., Havlín, A., Přichystal, A., Houzar, S., Krmíčková, M. & Gadas, P., 2011, "Mineralogy and petrogenesis of a Ba-Ti-Zr-rich peralkaline dyke from Šebkovice (Czech Republic): Recognition of the most lamproitic Variscan intrusion", ***Lithos,*** vol. 121, no. 1–4, pp. 74–86.

Kříbek, B., Mihaljevič, M., Šráček, O., Knésl, I., Ettler, V. & Nyambe, I., 2011, "The extent of arsenic and of metal uptake by aboveground tissues of Pteris vittata and Cyperus involucratus growing in copper- and cobalt-rich tailings of the Zambian Copperbelt", ***Archives of Environmental Contamination and Toxicology,*** vol. 61, no. 2, pp. 228–242.

Kříž, J., 2011, "Silurian *Tetinka* Barrande, 1881 (Bivalvia, Spanilidae) from Bohemia (Prague Basin) and Germany (Elbersreuth, Frankenwald)", ***Bulletin of Geosciences,*** vol. 86, no. 1, pp. 29–48.

Laufek, F. & Návrátil, J., 2011, "Synthesis and Rietveld refinement of the ternary skutterudite $RuSb_2Te$", ***Powder Diffraction,*** vol. 26, no. 4, pp. 331–334.

Laufek, F., Vymazalová, A., Chareev, D.A., Kristavchuk, A.V., Lin, Q., Drahokoupil, J. & Vasilchikova, T.M., 2011, "Crystal and electronic structure study of $AgPd_3Se$", ***Journal of Solid State Chemistry,*** vol. 184, no. 10, pp. 2794–2798.

Lejček, P., Gärtnerová, V., Jäger, A., Vaníčková, J., Děd, J. & Haloda, J., 2011, "Crystallographic aspects of intergranular failure of archaeological silver artefacts", ***Surface and Interface Analysis,*** vol. 43, no. 8, pp. 1128–1133.

Lexa, J., Šebesta, J., Chavez, J.A., Hernández, W. & Pécskay, Z., 2011, "Geology and volcanic evolution in the southern part of the San Salvador Metropolitan Area", ***Journal of Geosciences,*** vol. 56, no. 1, pp. 105–140.

Lexa, O., Schulmann, K., Janoušek, V., Štípská, P., Guy, A. & Racek, M., 2011, "Heat sources and trigger mechanisms of exhumation of HP granulites in Variscan orogenic root", ***Journal of Metamorphic Geology,*** vol. 29, no. 1, pp. 79–102.

Loydell, D.K. & Frýda, J., 2011, "At what stratigraphical level is the mid Ludfordian (Ludlow, Silurian) positive carbon isotope excursion in the type Ludlow area, Shropshire, England?", ***Bulletin of Geosciences,*** vol. 86, no. 2, pp. 197–208.

Machado, G., Franců, E., Vavrdová, M., Flores, D., Fonseca, P.E., Rocha, F., Pereira, L.C.G., Gomes, A., Fonseca, M. & Chaminé, H.I., 2011, "Stratigraphy, palynology and organic geochemistry of the Devonian-Mississippian metasedimentary Albergaria-a-Velha Unit (Porto-Tomar shear zone, W Portugal)", ***Geological Quarterly,*** vol. 55, no. 2, pp. 139–164.

Magna, T., Deutsch, A., Mezger, K., Skála, R., Seitz, H., Mizera, J., Řanda, Z. & Adolph, L., 2011, "Lithium in tektites and impact glasses: Implications for sources, histories and large impacts", ***Geochimica et Cosmochimica Acta,*** vol. 75, no. 8, pp. 2137–2158.

Magna, T., Wiechert, U., Stuart, F.M., Halliday, A.N. & Harrison, D., 2011, "Combined Li-He isotopes in Iceland and Jan Mayen basalts and constraints on the nature of the North Atlantic mantle", ***Geochimica et Cosmochimica Acta,*** vol. 75, no. 3, pp. 922–936.

Marton, E., Tokarski, A.K., Krejčí, O., Rauch, M., Olszewska, B., Tomanová Petrová, P. & Wójcik, A., 2011, "'Non-European' palaeomagnetic directions from the Carpathian Foredeep at the southern margin of the European plate", ***Terra Nova,*** vol. 23, no. 2, pp. 134–144.

Meinhold, G., Arslan, A., Lehnert, O. & Stampfli, G.M., 2011, "Global mass wasting during the Middle Ordovician: Meteoritic trigger or plate-tectonic environment?", ***Gondwana Research,*** vol. 19, no. 2, pp. 535–541.

Melegy, A., Slaninka, I., Pačes, T. & Rapant, S., 2011, "Weathering fluxes of arsenic from a small catchment in Slovak Republic", ***Environmental Earth Sciences,*** vol. 64, no. 2, pp. 549–555.

Metelka, V., Baratoux, L., Naba, S. & Jessell, M.W. 2011, "A geophysically constrained litho-structural analysis of the Eburnean greenstone belts and associated granitoid

domains, Burkina Faso, West Africa", ***Precambrian Research,*** vol. 190, no. 1–4, pp. 48–69.

Mihaljevič, M., Ettler, V., Šebek, O., Šráček, O., Kříbek, B., Kyncl, T., Majer, V. & Veselovský, F., 2011, "Lead isotopic and metallic pollution record in tree rings from the Copperbelt mining-smelting area, Zambia", ***Water, Air, and Soil Pollution,*** vol. 216, no. 1–4, pp. 657–668.

Mixa, P., Dobeš, P., Žáček, V., Lukeš, P. & Quintanilla, E.M., 2011, "Epithermal gold mineralization in Costa Rica, Cordillera de Tilarán – exploration geochemistry and genesis of gold deposits", ***Journal of Geosciences,*** vol. 56, no. 1, pp. 81–104.

Mrázová, Š. & Gadas, P., 2011, "Obsidian balls (marekanite) from Cerro Tijerina, central Nicaragua: Petrographic investigations", ***Journal of Geosciences,*** vol. 56, no. 1, pp. 43–49.

Nahodilová, R., Faryad, S.W., Dolejš, D., Tropper, P. & Konzett, J., 2011, "High-pressure partial melting and melt loss in felsic granulites in the Kutná Hora complex, Bohemian Massif (Czech Republic)", ***Lithos,*** vol. 125, no. 1–2, pp. 641–658.

Nehyba, S., Nývlt, D., Schkade, U., Kirchner, G. & Franců, E., 2011, "Depositional rates and dating techniques of modern deposits in the Brno reservoir (Czech Republic) during the last 70 years", ***Journal of Paleolimnology,*** vol. 45, no. 1, pp. 41–55.

Novák, M., Erbanová, L., Fottová, D., Cudlín, P. & Kuběna, A., 2011, "Behaviour of arsenic in forested catchments following a high-pollution period", ***Environmental Pollution,*** vol. 159, no. 1, pp. 204–211.

Novák, M., Zemanová, L., Voldřichová, P., Štěpánová, M., Adamová, M., Pacherová, P., Komárek, A., Krachler, M. & Přechová, E., 2011, "Experimental evidence for mobility/immobility of metals in peat", ***Environmental Science and Technology,*** vol. 45, no. 17, pp. 7180–7187.

Nývlt, D., Košler, J., Mlčoch, B., Mixa, P., Lisá, L., Bubík, M. & Hendriks, B.W.H., 2011, "The Mendel Formation: Evidence for Late Miocene climatic cyclicity at the northern tip of the Antarctic Peninsula", ***Palaeogeography, Palaeoclimatology, Palaeoecology,*** vol. 299, no. 1–2, pp. 363–384.

Oulehle, F., Evans, C.D., Hofmeister, J., Krejčí, R., Tahovská, K., Persson, T., Cudlín, P. & Hruška, J., 2011, "Major changes in forest carbon and nitrogen cycling caused by declining sulphur deposition", ***Global Change Biology,*** vol. 17, no. 10, pp. 3115–3129.

Pašava, J., Knésl, I., Vymazalová, A., Vavřín, I., Gurskaya, L.I. & Kolbantsev, L.R., 2011, "Geochemistry and mineralogy of platinum-group elements (PGE) in chromites from Centralnoye I, Polar Urals, Russia", ***Geoscience Frontiers,*** vol. 2, no. 1, pp. 81–85.

Sedlák, J., Gnojek, I., Verner, K., Franěk, J., Zabadal, S., Motschka, K. & Slovák, J., 2011, "Geophysical and structural pattern of the knížecí stolec pluton and its host rocks in the south-western part of the Moldanubian zone, Bohemian Massif", ***Journal of Geosciences,*** vol. 56, no. 2, pp. 143–162.

Sejkora, J., Ozdín, D., Laufek, F., Plášil, J. & Litochleb, J., 2011, "Marrucciite, a rare Hg-sulfosalt from the Gelnica ore deposit (Slovak Republic), and its comparison with the type occurrence at Buca della Vena mine (Italy)", ***Journal of Geosciences,*** vol. 56, no. 4, pp. 399–408.

Sejkora, J., Plášil, J., Císařová, I., Škoda, R., Hloušek, J., Veselovský, F. & Jebavá, I., 2011, "Interesting supergene Pb-rich mineral association from the Rovnost mining field, Jáchymov (St. Joachimsthal), Czech Republic", ***Journal of Geosciences,*** vol. 56, no. 3, pp. 257–271.

Sejkora, J., Plášil, J., Veselovský, F., Císařová, I. & Hloušek, J., 2011, "Ondrušite, $CaCu_4(AsO_4)_2(AsO_3OH)_2{\cdot}10H_2O$, a new mineral species from the Jáchymov ore district, Czech Republic: Description and crystal-structure determination", ***Canadian Mineralogist,*** vol. 49, no. 3, pp. 885–897.

Šimůnek, Z. & Cleal, C.J., 2011, "Imparipinnate neuropteroid foliage (Medullosales) from the middle Westphalian of the West and Central Bohemia Coal Basin, Czech Republic", ***Review of Palaeobotany and Palynology,*** vol. 166, no. 3–4, pp. 163–201.

Skácelová, Z., Mlčoch, B. & Tasáryová, Z., 2011, "Digital model of the crystalline basement and Permo-Carboniferous volcano-sedimentary strata in the Mnichovo Hradiště Basin and correlation with the geophysical fields (Czech Republic, Northern Bohemia)", ***Acta Geodynamica et Geomaterialia,*** vol. 8, no. 3, pp. 225–235.

Skála, R., Ondruš, P., Veselovský, F., Císařová, I. & Hloušek, J., 2011, "Agricolaite, a new mineral of uranium from Jáchymov, Czech Republic", ***Mineralogy and Petrology,*** vol. 103, no. 1–4, pp. 169–175.

Skrzypek, E., Schulmann, K., Štípská, P., Chopin, F., Lehmann, J., Lexa, O. & Haloda, J., 2011, "Tectono-metamorphic history recorded in garnet porphyroblasts: Insights from thermodynamic modelling and electron backscatter diffraction analysis of inclusion trails", ***Journal of Metamorphic Geology,*** vol. 29, no. 4, pp. 473–496.

Skrzypek, E., Štípská, P., Schulmann, K., Lexa, O. & Lexová, M., 2011, "Prograde and retrograde metamorphic fabrics – a key for understanding burial and exhumation in orogens (Bohemian Massif)", ***Journal of Metamorphic Geology,*** vol. 29, no. 4, pp. 451–472.

Smrčok, L., Rieder, M., Kolesnikov, A.I. & Granroth, G.E., 2011, "Combined inelastic neutron scattering and solid-state density functional theory study of dynamics of hydrogen atoms in muscovite 2M1", ***American Mineralogist,*** vol. 96, no. 2–3, pp. 301–307.

Stárková, M., Rapprich, V. & Breitkreuz, C., 2011, "Variable eruptive styles in an ancient monogenetic volcanic field: Examples from the Permian Levín Volcanic Field (Krkonoše Piedmont Basin, Bohemian Massif)", ***Journal of Geosciences,*** vol. 56, no. 2, pp. 163–180.

Svobodová, M., Švábenická, L., Skupien, P. & Hradecká, L., 2011, "Biostratigraphy and paleoecology of the Lower Cretaceous sediments in the Outer Western Carpathians (Silesian Unit, Czech Republic)", ***Geologica Carpathica,*** vol. 62, no. 4, pp. 309–332.

Šebesta, J., Šamonil, P., Lacina, J., Oulehle, F., Houška, J. & Buček, A., 2011, "Acidification of primeval forests in the Ukraine Carpathians: Vegetation and soil changes over six decades", ***Forest Ecology and Management,*** vol. 262, no. 7, pp. 1265–1279.

Šráček, O., Filip, J., Mihaljevič, M., Kříbek, B., Majer, V. & Veselovský, F., 2011, "Attenuation of dissolved metals in neutral mine drainage in the Zambian Copperbelt", ***Environmental Monitoring and Assessment,*** vol. 172, no. 1–4, pp. 287–299.

Tajčmanová, L., Abart, R., Neusser, G. & Rhede, D., 2011, "Growth of plagioclase rims around metastable kyanite during decompression of high-pressure felsic granulites (Bohemian Massif)", ***Journal of Metamorphic Geology,*** vol. 29, no. 9, pp. 1003–1018.

Turek, V. & Manda, S., 2011, "Colour pattern polymorphism in Silurian nautiloid *Phragmoceras* Broderip, 1839", ***Bulletin of Geosciences,*** vol. 86, no. 1, pp. 91–105.

Ulrich, S., Konopásek, J., Jeřábek, P. & Tajčmanová, L., 2011, "Transposition of structures in the Neoproterozoic Kaoko Belt (NW Namibia) and their absolute timing", ***International Journal of Earth Sciences,*** vol. 100, no. 2, pp. 415–429.

Valenta, J., Brož, M., Málek, J., Mlčoch, B., Rapprich, V. & Skácelová, Z., 2011, "Seismic model and geological interpretation of the basement beneath the Doupovské Hory Volcanic Complex (NW Czech Republic)", ***Acta Geophysica,*** vol. 59, no. 3, pp. 597–617.

Vaněk, A., Chrastný, V., Teper, L., Cabala, J., Penížek, V. & Komárek, M., 2011, "Distribution of thallium and accompanying metals in tree rings of Scots pine (*Pinus sylvestris* L.) from a smelter-affected area", ***Journal of Geochemical Exploration,*** vol. 108, no. 1, pp. 73–80.

Vaněk, A., Komárek, M., Vokurková, P., Mihaljevič, M., Šebek, O., Panušková, G., Chrastný, V. & Drábek, O., 2011, "Effect of illite and birnessite on thallium retention and bioavailability in contaminated soils", ***Journal of Hazardous Materials,*** vol. 191, no. 1–3, pp. 170–176.

Verner, K., Žák, J., Pertoldová, J., Trubač, J. & Týcová, P., 2011, "Reply to the comments on ´Magmatic history and geophysical signature of a post-collisional intrusive center emplaced near a crustal-scale shear zone: The Plechý granite pluton (Moldanubian batholith, Bohemian Massif)´ ", ***International Journal of Earth Sciences,*** vol. 100, no. 4, pp. 893–894.

Villagómez, D., Spikings, R., Magna, T., Kammer, A., Winkler, W. & Beltrán, A., 2011, "Geochronology, geochemistry and tectonic evolution of the Western and Central Cordilleras of Colombia", ***Lithos,*** vol. 125, no. 3–4, pp. 875–896.

Vítková, M., Ettler, V., Hyks, J., Astrup, T. & Kříbek, B., 2011, "Leaching of metals from copper smelter flue dust (Mufulira, Zambian Copperbelt)", ***Applied Geochemistry,*** vol. 26, no. SUPPL., pp. S263–S266.

Vodrážka, R. & Crame, J.A., 2011, "First fossil sponge from Antarctica and its paleobiogeographical significance", ***Journal of Paleontology,*** vol. 85, no. 1, pp. 48–57.

Vodrážková, S., Klapper, G. & Murphy, M.A., 2011, "Early Middle Devonian conodont faunas (Eifelian, *costatus-kockelianus* zones) from the Roberts Mountains and adjacent areas in Central Nevada", ***Bulletin of Geosciences,*** vol. 86, no. 4, pp. 737–764.

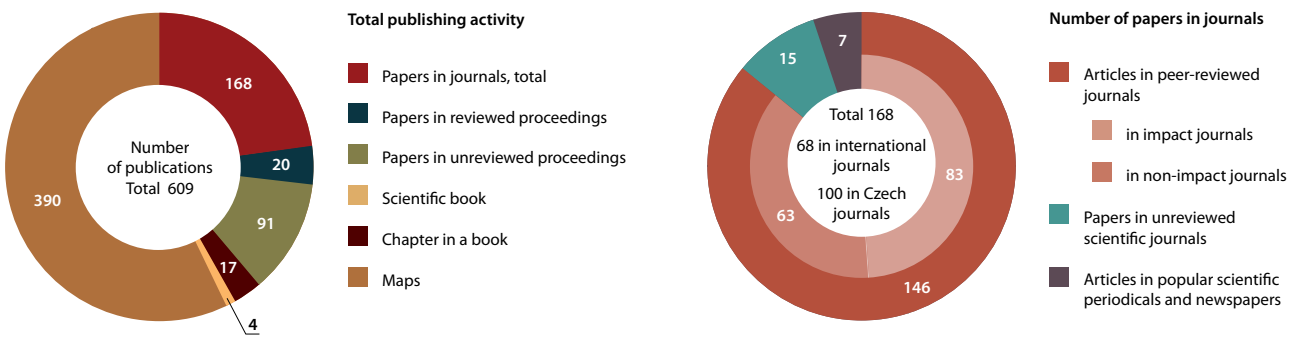
Vondrovic, L., Verner, K., Buriánek, D., Halodová, P., Kachlík, V. & Míková, J., 2011, "Emplacement, structural and P-T evolution of the ~346 Ma Miřetín Pluton (eastern Teplá – Barrandian zone, Bohemian Massif): Implications for regional transpressional tectonics", ***Journal of Geosciences,*** vol. 56, no. 4, pp. 343–357.

Vrána, S., 2011, "Manganese-rich garnet-quartz rocks and gneisses in the Bohemian part of the Moldanubian zone: Lithostratigraphic markers", ***Journal of Geosciences,*** vol. 56, no. 4, pp. 359–374.

Žáček, V., Janoušek, V., Ulloa, A., Košler, J., Huapaya, S., Mixa, P., Vondrovicová, L. & Alvarado, G.E., 2011, "The late Miocene Guacimal Pluton in the Cordillera de Tilarán, Costa Rica: Its nature, age and petrogenesis", ***Journal of Geosciences,*** vol. 56, no. 1, pp. 51–79.

Žák, J., Kratinová, Z., Trubač, J., Janoušek,V., Sláma, J. & Mrlina, J., 2011, "Structure, emplacement, and tectonic setting of Late Devonian granitoid plutons in the Teplá-Barrandian unit, Bohemian Massif", ***International Journal of Earth Sciences,*** vol. 100, no. 7, pp. 1477–1495.

Žák, J., Verner, K., Finger, F., Faryad, S.W., Chlupáčová, M. & Veselovský, F., 2011, "The generation of voluminous S-type granites in the Moldanubian unit, Bohemian Massif, by rapid isothermal exhumation of the metapelitic middle crust", ***Lithos,*** vol. 121, no. 1–4, pp. 25–40.



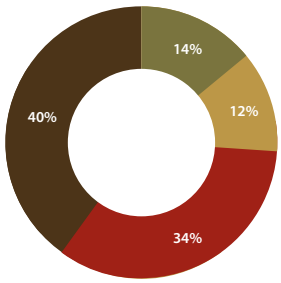
Financial review

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

In 2011, the Czech Geological Survey continued on its mission to increase the efficiency of its operations and seek new sources of funding to support them. The success of this strategy was based on the following choice of priorities:

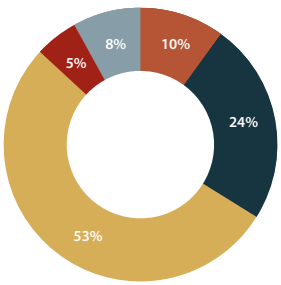
- To guarantee professional fulfilment of the duties of the national geological survey, despite the shortfall in funding from the Ministry of the Environment.
- To compensate for the decrease in government funding by work on national and international projects with high added value, that is, with a budget adequate to pay staff salaries.
- To support the development of the organization through earnings obtained from scientific activities.

The Czech Geological Survey finished the fiscal year 2011 with a positive balance of payments, amounting to 9.043 million Czech Crowns (before tax). A positive economic balance, serving as a reserve for the next fiscal year, was generated by supplementing the funding allocated by the MoE from other sources. A significant contribution to salaries and overhead expenses was obtained from income generated through external projects; additional income was also earned from our scientific activities.



Percentage distribution of income in various categories for 2010

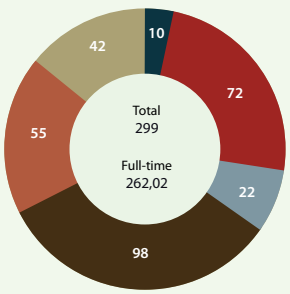
- Revenue generated from own resources
- Allocations for activities of the organization
- Institutional Research and Development
- Projects



Percentage distribution of expenditure in various categories for 2010

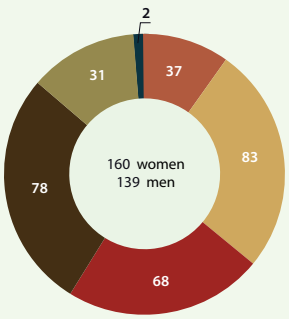
- Materials and power consumption
- Services
- Total costs of personnel
- Depreciation of tangible and intangible assets
- Other expenses

Human resources



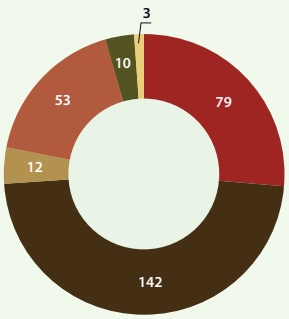
Number of employees in each division

- Directorate
- Geochemistry and laboratories
- Economic Division
- Division of Geology
- Brno Branch
- Division of Informatics



Age structure

Up to 30 years	37
31–40 years	83
41–50 years	68
51–60 years	78
61–70 years	31
Over 71 years	2



Education

- Ph.D.
- University education (Master)
- Bachelor
- Complete secondary education
- Skilled
- Elementary

Overview of main indicators of performance (in thousands CZK)

Year	2011	2010	2009	2008	2007
INCOME GENERATED BY CGS ACTIVITIES	**40 535**	**43 623**	**48 034**	**52 259**	**48 403**
of this: revenue from sale of own products and services	13 618	14 257	13 945	17 434	19 101
revenue from sale of property and material	499	562	38	0	10
activation of internal services	8 854	10 621	18 715	18 305	18 136
change in inventory	1 098	493	521	546	1 611
clearing account for funds	11 446	3 878	4	987	388
other income	5 020	13 812	14 811	14 987	9 157
OPERATIONAL GRANT	**243 247**	**210 081**	**208 493**	**189 849**	**180 574**
of this: **1) from the Ministry of the Environment**	194 651	181 934	177 853	162 588	154 917
of this: allocation for activities of the organization	35 457	36 982	40 113	36 893	29 324
for institutional Research and Development	97 083	76 011	78 204	84 395	84 545
special R&D projects	16 346	26 328	23 118	20 447	16 341
ISPROFIN	30 736	20 207	1 725	3 116	5 000
other (geological activities)	4 036	6 884	9 996	9 625	13 707
other NAR + Norway (lim)	9 064	9 386	22 448	0	0
from other sources (Norway + OP)	1 928	6 136	2 249	8 113	6 000
2) from other sources (from Slovakia)	25 033	11 085	14 097	17 339	17 768
of this: for R&D	22 971	11 085	14 097	17 339	17 768
3) income from specific grants to individual researchers	20 006	13 580	9 401	5 574	2 478
of this: for R&D	20 069	13 580	9 401	5 574	2 478
4) foreign funding	3 557	3 482	7 142	4 348	5 411
TOTAL INCOME	**283 782**	**253 704**	**256 527**	**242 107**	**228 977**
ECONOMIC OUTCOME	**9 043**	**91**	**2 773**	**59**	**4 056**
TOTAL EXPENDITURE	**274 739**	**253 613**	**253 754**	**242 048**	**224 921**
of this: material and power consumption	26 769	23 922	22 431	23 112	21 310
services	66 543	70 147	83 677	86 043	81 331
total costs of personnel	144 239	127 327	129 451	125 951	116 986
depreciation of tangible and intangible assets	15 011	12 190	12 563	2 497	1 566
taxes and fees	254	193	319	307	294
other expenses	21 923	19 834	5 313	4 137	3 434
INVESTMENTS	**20 508**	**20 249**	**59 410**	**20 785**	**26 322**
of this: construction work	7 338	3 162	40 071	13 864	17 855
other expenditure: tangible assets	10 340	16 562	18 938	6 107	6 315
other expenditure: intangible assets	2 829	525	401	815	2 152
FINANCING INVESTMENTS	**20 508**	**20 249**	**59 410**	**20 785**	**26 322**
1) grant from the Ministry of the Environment	12 620	17 751	55 461	16 114	21 873
2) from own resources	7 888	2 498	3 949	4 672	4 449

Interview
with Prof. Jan Petránek

photo by J. Petránek junior

Professor Kettner gave me a hammer, a small one so that "a boy can carry it"

Professor, your last book is a book for young people – the first guide for young collectors of rocks, fossils and minerals in the Czech Republic. Do you remember what interested you as a child and what, in the end, brought you to the study of geology?

I have always been interested in nature and my long-term participation in the Scouting organization helped to strengthen that interest. As a boy, I collected all kinds of things – butterflies and beetles, I also had a herbarium and, of course, I was collecting rocks and minerals. My dad had his own collection of minerals and once he even went with us to Kozákov for several days to look for agates. In the second grade at school, I was taught by Prof. J. Kunský who later became the Professor of Geomorphology in the university, and also my dear lifelong friend. As a high school student I used to visit him occasionally in his flat. Once, when I visited him in the faculty, he took me to see Prof. R. Kettner, who gave me a hammer, a small one (so that "a boy can carry it", he said). He also immediately became my mentor and, to a large extent, started to direct my geological activities and learning.

How did it work?

In 1940, during my holidays after finishing the seventh grade of high school, Professor Kettner took me with him to the Blansko trough where he taught me the basics of geological mapping. During the following years, together with his other students, I took part in mapping the Moravian Karst. Despite his bulky constitution, the professor was physically fit and during the mapping he often ran around the steep and rocky slopes of the Moravian Karst and he even coped with the climb from the bottoms of the deep valleys of Pustý žleb and Suchý žleb. After several days of mapping I started to pray for rain, so that Professor Kettner would start to compile his geological maps and we, the younger ones, would finally be able to have a rest. On Sundays and bank holidays, I often used to go on field trips to the areas around Prague, sometimes together with other novices in geology. Sometimes, Professor of Engineering Geology, Quido Záruba, also participated. At that time, Professor Kettner was writing his classic, multi-volume textbook of general geology and when he had finished a volume, he would give it to me to read. After some time I would come and be examined by Prof. Kettner about what I had read, and he would gave me a provisional mark for my studies. It wasn't until the war ended that he wrote the results in my student record book.

But during the war you also worked as a chemist…

Yes, the war years were also years of chemistry for me. Because the Germans closed our universities, I took a two-year course in chemistry at technical school after my A-levels and then took a job as chemist in the "Českomoravská-Kolben-Daněk" (ČKD) Research Institute in Vysočany (my dad worked there as a chief constructor for automobile Praga). Geology was my greatest interest, but I still liked chemistry very much. When one of my father's friends, a chemical engineer, asked "what will your boy do?" he replied "He is just full of geology." The answer was definite: "He needs to be whipped, that would bring him to his senses!" My dad didn't whip me, so I became a geologist.

After some time, when a special analytical laboratory was established in Vysočany, I became its head. By the end of the war, a German director ordered (against the will of our director) to take on one engineer, a collaborator of Russian origin. He was placed in my laboratory and I still clearly remember his name: Vasilij Kasjanov. He was 20–25 years older than me and my four, only partly educated, chemists. I used to give him work and check the results, but he never talked to us. Actually he did, once, when he accused me of whistling the communist "Internationale" (which I didn't know at all), but worse was to come. Analyses were carried out in the adjacent laboratory by a young woman. She had to begin work there because of the introduction of Totaleinsatz (total deployment) but before she started, she had had no idea whatever about chemistry. One important source of samples was a huge foundry. Every day samples from one batch of high-quality steel for tank turrets would arrive. It was shortly before the end of the war when one analysis showed that a batch of steel contained 0.24% of phosphorus, which was unacceptable. As a result, the whole batch was destroyed by pouring it out onto sand. The German director of the company sampled the steel again and sent it for a new analysis as sample "X". The repeat analysis showed that the steel was actually alright (0.16% P) and this led to suspicion of sabotage. If this had been confirmed, it would probably have meant the death sentence for the analyst. Soon after that, I was called to the director of the Institute. It was agreed that I would fake a certificate of analysis stating that the analysis made in my laboratory found the phosphorus content to be exactly in the middle between the other two analyses (0.2%). This would mean that the two values fell inside the acceptable limits of analytical error. Then the next shock came. When I returned to the laboratory after my meeting with the director, I was confronted by Kasjanov, who said to me: "Mr. Petránek, if you fake the results, it will turn out badly for you. You were the subject of discussion by the Gestapo yesterday!" We still faked the certificate. It was on Friday and the German director was supposed to receive the certificate by Monday. On Sunday around noon, a squadron of American B 22 "flying fortresses" bombed the foundry, as well as a large part of the factory in Libeň, where the completed tanks were assembled, razing them to the ground. No one cared about our investigation after that. Much later, when we knew more about the Gestapo, I realized how naive we were to think that the Gestapo wouldn't be able to investigate how the analyses were faked.

With Professor Radim Kettner during secondary school studies.

After you finished your studies in Prague, you undertook a one-year study visit to Princeton University in the USA. At that time, people such as Albert Einstein and T.S. Eliot were still working there. That sounds nearly like a dream to our contemporaries. Did you meet them?

After finishing my doctorate in the Faculty of Science at Charles University in Prague, I did my short military service and then, at the end of September 1948, I left for the United States to study geology for one year in the prestigious Princeton University. It was three days after I left, at about 10 p.m., when two men visited my parents and wanted to revoke my passport…

I travelled to America by ship. This ship had been used to transport American soldiers to Europe, it sometimes creaked, and when a huge storm struck in the middle of the voyage, most of us passengers discovered what seasickness is like. The atmosphere inside the ship was unbearable, especially in overcrowded dormitories, so I usually lay on a bench on the deck. There, on the fresh air, one could survive. We docked late in New York.

In the university I attended all the recommended lectures, took the exams and diligently participated in field trips. I learned about all sorts of things I hadn't known before, such as the study of heavy minerals. Later, I introduced this discipline in the Central Geological

Institute and today it has become an indispensable tool for the study of all kinds of rocks and especially in exploration of mineral deposits. The geology department at Princeton had four cars at that time. We took them during the Easter and drove thousands of kilometres as far as to Alabama near the Gulf of Mexico, and visited many deposits. We paid for food and accommodation from our own pockets and we really tried to save money. We used to sleep in motels, six in two-bed rooms and bargained about prices for a bed and for sleeping in a sleeping bag on the floor. The final highlight of my study visit was the Princeton transcontinental field trip for second graders, which took us to the western states – Colorado, Nevada, Arizona and elsewhere.

On the edge of Princeton is the Institute for Advanced Studies. It is essentially an institution where distinguished scientists, regardless of their nationality or field of expertise, live, often until they die.

Saying goodbye to his horse at the end of military service in 1948.

Albert Einstein spent his last years there as well. Apart from these long-term residents, younger scientists can be invited to live here as well, so that they can pursue their research in absolute calm, without any disturbance and free of the various duties involved in their current jobs. Even though I didn't see Einstein himself, I did see one old, white-haired man there. He was the German physicist and Nobel Laureate, Max von Laue, discoverer of X-ray diffraction. Once, when invited by my friend, a young Dutch physicist, we lunched in a small cafeteria. We sat around a small table and just next to us sat two men, one of whom was the English poet Thomas. S. Eliot, awarded the Nobel Prize for literature; the other was the American physicist Jacob R. Oppenheimer, the father of the atomic bomb. In our Graduate College, where mostly postgraduates lived, occasional lectures were held and Oppenheimer gave one of them. Despite being father of the atomic bomb, he campaigned against nuclear weapons because he was so aware of their destructive potential.

Once there was a concert, instead of the usual lecture. It was a concert given by Bohuslav Martinů, who was there at that time. When the concert ended, I went to see him and asked him whether he still spoke Czech, because he had lived away from home for such a long time. He spoke perfect Czech however, and invited me to visit him. He was then professor of music at Princeton University, so I visited him in his department. He was very courteous; we had a chat and he told me he was going to visit the Czech Embassy in New York, but immediately added that he wouldn't be returning to Czechoslovakia.

You taught at Charles University afterwards, but you had to leave twice. What was the reason?

In was in 1952 when Prof. R. Kettner, at that time the head of the Geological Institute of Charles University, nominated several people for the post of docent. They were Dr Z. Špinar (palaeontology), Dr Vl. Pokorný (palaeontology), Dr Z. Pouba (exploration geology), Dr J. Konta (petrography) and myself (general and historical geology). Konta, who was then secretary of the Institute, called us for a meeting and informed us that he agreed to the nominations with the exception of me. He stated that he and the party (the Communist Party) are "at one with each other" and this way he returned the verdict. The reason was probably that he saw me as a rival in the field of the sedimentary research. He was jealous about my study visit to the USA, which took place despite a denunciation by the faculty.

Where did you go?

After that I started to commute to Ostrava, where I worked in the Mining University (VŠB). I taught exploration geology and was responsible for geological mapping courses. During the second year I moved there and I was coming back to Prague once every two weeks to see my family. In was unbearable in the long term. We had two children at that time, lived in single large room and shared facilities with three other flats. We didn't succeed in changing the flat, despite making desperate efforts. VŠB, on the other hand, was constructing houses for its employees and if I had got a house, I would probably have been ended up at VŠB. But, in the middle of 1954, a miracle happened. As a result of a complicated three-sided exchange, we managed to acquire a small, two-room flat in Prague. After that I succeeded in ending my employment with VŠB and started to work at the Central Geological Institute (CGI) in Prague.

It seems that for you, as well as for many others, the Central Geological Institute (CGI), now the Czech Geological Survey (CGS) was one of the few havens of employment at a time when political conditions were unfavourable.

In the Central Geological Institute, I was really happy for many years. I established a department for the study of sediments and a laboratory for study of heavy minerals there. I also introduced specialized seminars at which I both taught my younger colleagues and learned from them and from the results of the research that they were carrying out. One day, however, I was informed that I could no longer continue as the head of the sedimentological department. This was because a regulation had been issued, according to which only members of the Communist Party could work as heads of departments in the "central" institutions. My salary was decreased, but I didn't mind. I had less administrative work and more time for actual science. But the general situation was getting even tougher. A fierce, political purge took place in all the central bureaux and institutions and a lot of innocent people were dismissed, though I wasn't. I had to have an interview with Director Kořán, but he didn't rebuke me for anything and simply recommended that I should participate in the activities of the ROH

On the edge of the Grand Canyon during the Princeton transcontinental field trip.

(*Revoluční odborové hnutí* – Revolutionary Union Movement).

At that time, I had already registered to attend a geological congress on coal that was going to be held in Holland. My lecture had been accepted and all the fees paid, but I didn't go anywhere. They concealed from me that it was stated in the results of my political screening that I was not allowed to travel abroad, even to other socialist states. About two months later an invitation to a conference on coal came from Moscow. I was invited as a guest of the Soviet Academy of Sciences, and all the expensed for a week visit would also be reimbursed. I had to give a lecture concerning my research in the region of Ostrava-Karviná mining district. The "comrades" put their heads together and finally allowed me to visit socialist countries, but not others!

The situation did not get better for you until the sixties, when they offered you the post of Director of the CGI. What part did you play in the organization of what was to be, at that time, the largest geological event ever held in the Republic – the International Geological Congress, and why did everything turn out to be different than expected?

In December 1964 I was in India attending the International Geological Congress and, as the Czech representative at the IGC organizing committee, I invited geologists from all around the world to attend the next congress in Prague, which was planned to take place in 1968. The invitation was accepted and our four years of preparation then started. I became the secretary for science and my main goal was to ensure the quality of the papers submitted for presentation. Dr Josef Svoboda, then the director of CGI, was the president of the congress. On Monday the 19th of August 1968, just before the opening, we met with Prime Minister Černík and some of the other ministers. At the opening ceremony, I gave a short speech of welcome in English to all the geologists present on behalf of the director, Dr J. Svoboda, and the welcome-addresses on behalf of the Prime Minister as well as of the Mayor of Prague. About 3500 people were registered for the Congress. Lectures at all the scientific sessions took place next day, as well as the field trips that had been planned. Then, during the night, the Soviet army of occupation arrived. As a consequence of clashes with citizens, accompanied by damage to property and public services, all public transport was suspended and delegates started to leave with their families in large numbers. The programme of the whole Congress was paralysed. At the final meeting, the leaders of delegations strongly criticized the Soviet occupation. Among these was even the most powerful figure in Czech geology, Dr J. Pravda, the Director of the CGI. At that time, without my knowledge or by any request, the board of the Faculty of Science of the Charles University voted unanimously for my rehabilitation and put forward a proposal to appoint me as Professor of Geology. At that time, I was Deputy to the Director, Dr Svoboda (this was equivalent to being Vice-Director as far as the actual work was concerned, but the appointment of Vice-Director had to be approved by the Central Committee of the Communist Party, whereas appointment of Deputies was within the jurisdiction of Directors themselves). Dr Svoboda was slowly preparing for his retirement and, bearing this in mind, he asked whether I would agree to be his successor. I declined the offer without hesitation; the idea of again being able to carry out scientific research in the faculty, after so many years of clerical work, was far too attractive. I conceded to the wishes of Professor J. Vachtl that I should begin work in the faculty as soon

The President of the previous International Geological Congress (on the left), held in India in 1964, hands over the presidency of the congress in Prague to Dr J. Svoboda; J. Petránek on the right.

as possible. Unfortunately, I disregarded the advice of my old friend Svoboda who said I should not do so until I was sure that I really had been appointed as Professor. I started work in the faculty. The new minister temporarily acceded to the Ministry was quickly replaced by Professor Hrbek, a dedicated party man, and strict "normalization" immediately followed. The proposal for my appointment as Professor was discarded. At that time, the Director of the Institute of Geology at the Czechoslovak Academy of Sciences (CSAS), Academician Vladimír Zoubek, was preparing for his retirement and made me an offer to join him at CSAS and later to succeed him as Director and I accepted.

How did the still ongoing International Geoscience Programme of UNESCO become established?

I was elected as Deputy Secretary General of the International Union of Geological Sciences (IUGS) in 1968 at the International Geological Congress in Prague. From this time on I participated in the long-term preparation of the International Geoscience Programme (IGCP) that had just begun. Nevertheless, it wasn't until February 1973, when I organized a meeting of the Board of the IUGS in Prague, that Dr Abelson, Dr van der Heide (respectively President and Secretary General of the IUGS) and Dr Ronner from UNESCO met. At this meeting, which took place in the evening at my apartment, it was agreed that UNESCO would provide all the financial support for the project and IUGS would be responsible for the selection and scientific guidance of the projects. After this agreement was given official recognition by UNESCO and IUGS, an intergovernmental conference was organized. The project was accepted and I then became a member of the Board of the IGCP. The Board selected the projects and determined the amount of financial support provided.

Later, I won the election for the position of Head of the Geological Department in succession to Dr Ronner. I could have done a lot for our geologists in that post. Academician Zoubek visited the Minister of Foreign Affairs to plead the case for my appointment, but regardless of that I didn't receive permission to accept the position. They said it would only have been possible if I had been a member of the party. Academician Zoubek was due to retire in a few years and was looking for a successor. He asked me whether I would join the Communist Party and I refused. Doc. Ing. V. Hejl, who was a dedicated party man, became the new Director. He had studied at the Institute of Chemical Technology and knew nothing about geology. That might have been the reason why he told me he expected I would include him as a co-author of my publications. He didn't allow me to take part in meetings of the Boards of the IGCP and of the IUGS when they were held abroad. In 1976, when the annual meeting of IUGS was held in Hungary, I took an official vacation and joined the meeting in Budapest. When the Director heard about it, I received an official reprimand. My eight-year long post with the IUGS was about to end that summer so I should have attended the International Geological Congress in Australia. I was not allowed to do so, even though all the expenses would have been covered by the IUGS. Instead, I was ordered to excuse myself on the grounds of illness and submit a copy of the letter to the Central Geological Authority (UGU), so that it could be sent to the ÚV KSČ.

Fortunately, congresses and board meetings have never been the most important aspect of your work. What was the main focus of your research activities?

I devoted myself to the study of sediments and at the beginning my range of interests was quite broad. Then came the period of research in the coal-bearing district of Ostrava-Karviná, followed by studies of oolitic iron ore deposits. I mostly investigated Czech deposits and published my findings both in our country and abroad. In addition, I was giving lectures abroad. In 1966, when the Prague Spring was already on the horizon and political control wasn't so tough, it was possible for a while. I even gained a Doctorate of Geological Sciences for research on iron ores. When the IGCP programme started, I became the leader of a four-year project on "Oolitic iron ores", the outcome of which was, among other things, a worldwide register of these deposits (description of the deposits, their geological age, the mineralogical and chemical composition of the ores and the conditions of their formation). This extensive study was published in English in cooperation with Prof. F. Van Houten from the USA.

In addition to various conferences, you occasionally stayed abroad for longer periods. Which countries did you visit?

First I was in Ethiopia, where I worked in the UN Economic Commission for Africa. I assessed both proposed and ongoing projects financed by the UN.

I also worked in the National Geological Institute in Iraq for two years and spent two teaching at universities in Tunisia. Because of my work I also made short visits to Syria and especially to Libya where I learned to love the desert.

You've got a beautiful collection of agates from all around the world and even now you are often seen at large mineralogical fairs both in the Czech Republic and abroad. When did you start to collect agates and how did it complement your scientific work?

When I was a boy, I had already started to collect minerals. My activity was very variable, for instance during my feverish studies at university after the end of the war I didn't do much collecting. Nevertheless, I've always taken the opportunity to search for things. When our children were 11–13 years old, we all went out with a tent to the area of Nová Paka to look for agates (not very successfully). Later, the situation got significantly better, but my most successful periods were when we were in Ethiopia and later in Iraq. With my wife, I collected a large number of beautiful agates of sedimentary origin in Iraq. They became not just the showpiece of my collection, but also valuable specimens for exchange. Recently, after I retired and only had limited opportunities for sedimentological research, I was able to devote more time to agates. I've travelled to Morocco twice to collect agates, I wrote articles about them and I also published more comprehensive papers in Germany, one about the conditions under which agates are formed and a second one about the formation of sedimentary agates.

Professor, this year you will celebrate your 90th birthday. When you look back, what period of your life did you enjoy the most and what are your fondest memories? What was important for you in your life, and which people?

I had quite a colourful life, so this question is difficult to answer. As a geologist, I am grateful most of all to my teachers, Prof. R. Kettner, Prof. J. Koutek, Prof. O. Kodym and Prof. J. Kunský and also to Prof. E. Sampson from the USA, who taught economic mineral deposits. I also owe a lot of thanks to my many geologist friends for cooperation of various kinds. Most of all, I thank my former student, a long-time friend and excellent sedimentologist, Doc. Zdeněk Kukal. I cannot overstate how much I owe to my wife, who devotedly cared for me during longer stays abroad. With gratitude I also recall my parents, who always supported me in "my geology".

And what memories I like the most? That's not easy to answer. It was Princeton, for instance, where I was free from any duties so that I could devote myself to geology and discover the geological beauties of the USA. Completely different, but also beautiful, was the stay with my wife and children in Kenya where we made a trip below Kilimanjaro. I also like to recall the visit to the scenic island of Bali in Indonesia and the diametrically different beauty of the rugged Libyan Desert.

You are still continuing to work on new publications- recently for instance on a new encyclopaedia of geology…

Yes, I am working on a new edition. It isn't anything big, but it will be extended mostly thanks to the cooperation of many collaborators with different fields of expertise. I would also like to finish some scientific papers so I hope I will stay healthy, at least for a while longer.

Interview by Petr Maděra

Travelling on a mule through virgin forest near Gambella in southwestern Ethiopia (1966).

Principal events in **2011**

JANUARY | The CGS became a partner in the new CGS Europe project

CGS Europe is a new three-year project focused on geological storage of CO_2. It is funded within the 7th Framework Programme of the EU. The project is based on the cooperation of 34 research institutions from 24 member states of the EU and 4 associated countries. All of the participating institutions have previous experience with CO_2 storage. The goal of the project is to create a credible, independent, representative Pan-European group with established scientific and technical expertise to cooperate in developing long-term strategies for the capture and storage of CO_2.

An information brochure in Czech with the title ***Co to vlastně je geologické ukládání CO_2*** (What exactly is geological storage of CO_2) was compiled by the CGS under the terms of the project. The brochure was published in November 2011. In it, the main principles of the geological storage of CO_2 are explained by means of questions and answers in which both positive and negative aspects of the process are considered. The brochure is also fully illustrated.

31st MARCH | Landscapes Born of Fire

An exhibition of the art of Jana Haasová, entitled ***Krajiny zrozené ohněm*** (Landscapes Born of Fire), was opened in the bookshop of the CGS. The artist has taken landscapes formed by volcanic activity as the theme for her pictures.

28th APRIL | Launch of the book "About the Mystery of Stones"

The launch of the book ***Za tajemstvím kamenů – příručka pro mladé sběratele hornin, minerálů a zkamenělin*** (About the Mystery of Stones – a guide for young collectors of rocks, minerals and fossils) by Prof. Jan Petránek, together with a signing of the book ***Hrady Čech a Moravy, z čeho jsou a na čem stojí*** (Castles of Bohemia and Moravia – what they are made of and what they are built on) by Dr Zdeněk Kukal took place at the headquarters of the CGS in Klárov. Both authors, together with representatives of Grada Publishing, plc, which participated in the publication of both books, were present at the event. The authors spoke about interesting experiences they had while writing the books and entertained those present with some humorous anecdotes.

5th MAY | My Piece of Earth 2011 and the new web for children

The 5th year of the children's painting contest *My Piece of Earth*, organized by the CGS, was initiated. The Natural History Museum, the Zoological Garden in Prague, the Mladá fronta Publishing House, the Nature Conservation Agency of the Czech Republic, the Centre for Modern Education, the iQpark Liberec, the Mendel Museum in Brno and Grada Publishing, plc, helped to sponsor and organize the event. Large numbers of individuals and groups from schools throughout the Czech Republic traditionally take part in this competition. Its main purpose is to emphasise the importance of the earth sciences and the protection of the environment. In 2011, the theme of the competition was water as the basis of all life on Earth and the necessity of protecting water supplies. New CGS web pages for children were also launched and are now continuously updated.

9th MAY | Latest results of research on the geological storage of CO_2: CO_2GeoNet Open Forum 2011

Scientists from the whole of Europe met during the 9th to 11th of May at the ***CO_2GeoNet Open Forum*** conference in Venice where the latest developments in the field of geological storage of CO_2 were presented and discussed. This is one of the key technologies for counteracting the burden of greenhouse gases emitted into the atmosphere. At the conference, various topics were discussed including European research initiatives and schemes for financing research in Europe, the status of field experiments and pilot projects for capture and storage of CO_2, large-scale demonstration projects carried out under the terms of the European EEPR and NER300 mechanisms and the situation regarding legislation at both European and national levels. The conference was organized by CO_2GeoNet (European Network of Excellence in the Geological Storage of CO_2) and CGS Europe (Pan-European coordinated action on CO_2 Geological Storage). Together these organizations represent 34 research institutions from 28 European countries involved in sharing expertise in the field of long-term geological storage of CO_2.

18th MAY | Launch of the book "A Geological Alphabet"

A ceremony took place in the bookshop at the CGS in Klárov to launch the book ***Geologická abeceda*** (A Geological Alphabet) written by Dr Zdeněk Kukal and illustrated by graphic artist Helena Neubertová. The author, Zdeněk Kukal, addressed the visitors in his inimitable style. Representatives from the Publishing House of the CGS and from the Mladá fronta Publishing House also gave speeches. In keeping with the occasion, one of the visiting children gave a short reading from the book.

30th MAY | Conference of the Geoscience Information Consortium (GIC) in Namibia

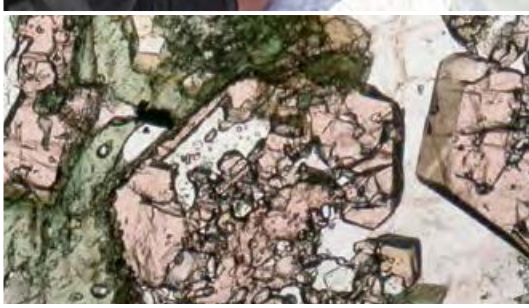
From 30th May to 4th June 2011, the annual conference of the Geoscience Information Consortium (GIC) took place in Africa for the first time at Windhoek (Namibia). The consortium gathers together the leaders and scientific personnel responsible for the management and development of informatics in geological surveys from around the world. The conference provided an opportunity to present and discuss problems of information technology and the advances in geoinformatic systems made by each country. Knowledge and experience with new products, technologies, policies and strategies was shared and ongoing and proposed projects and activities were discussed in a worldwide context.

22th JUNE | Updating the Regional Mineral Policy for the Liberec Region

Specialists from the CGS take part in formulating mineral policy at both local and national levels. In 2003, they developed the regional mineral policy for the Liberec Region. Based on a resolution by the Regional Council of Liberec, an updating of this document was carried out during 2010–2011. In the context of the still incomplete National Mineral Policy of the Czech Republic and the National Energy Policy of the Czech Republic, several aspects of the economic importance of the whole resource potential of the Liberec Region were thoroughly assessed. Specifically, these are the provision of adequate regional resources of construction material and the efficient use and protection of uranium resources of strategic national importance with regard to future impacts on the environment. The updated version of the Regional Mineral Policy for the Liberec Region has been based on the results of the inquiry initiated by the Ministry of the Environment taking into account the effects on the environment and public health under the terms of Act No. 100/2001 Coll., as amended. The specialists from the CGS provided expert advice at the many public discussions that were held and carried out the field investigation of all the registered deposits, as well as contributing to a programme of public lectures. A public discussion on the ***Update of The Regional Mineral Policy for the Liberec Region*** (ARSP LK) was held at the Regional Council of Liberec. The assessment of the effects of the policy on the environment and public health, carried out under the terms of Act No. 100/2011 Coll. (SEA), were discussed as well. After this discussion, the process of responding to comments and resolving objections began. On completion, the document will become a mandatory tool for decision making by both the government administration and the local authorities. It will provide a template for planning land use and regional development in the Liberec Region.

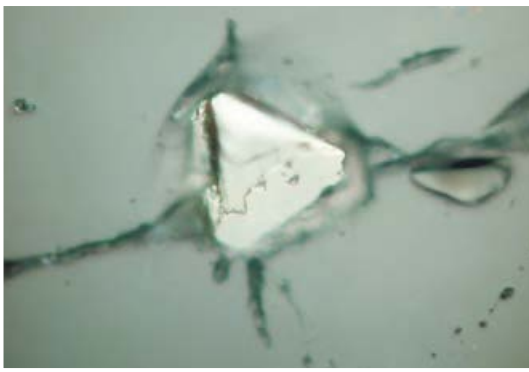
5th SEPTEMBER | The Colourful World of Rocks under the Microscope

An exhibition of micrographs of rocks and fossils made using optical and electron microscopes named ***Barevný svět hornin pod mikroskopem*** (The Colourful World of Rocks under the Microscope) was held between the 1st and the 30th of September 2011 in the bookshop at the CGS. It gave visitors some insights into one of the important methods used by Czech geologists and palaeontologists in their most recent geological research. The exhibition was organized in cooperation with the Institute of Geophysics of the Academy of Sciences of the Czech Republic (ASCR) and with the Centre of Administration and Operations of the ASCR.



16th SEPTEMBER | Czech diamonds – a new scientific success for the CGS

Recently, an important discovery was made by Dr Jana Kotková, CSc. (member of the Department of Rock Geochemistry of the CGS) in granulites from the north-western part of the Bohemian Massif where she found microdiamonds and coesite. These minerals can only be formed in geological environments that have experienced very high pressures. This discovery will have a significant impact on new models of the evolution of the Bohemian Massif. Dr Kotková, together with her German colleagues, published the details of their discovery in the prestigious scientific journal Geology. Reports about the discovery appeared immediately on various websites quoting the paper by Dr Kotková and it was promptly translated into Chinese. The newspaper MF DNES also reported the discovery on the 7th of October 2011 in the article ***Vědci našli v Česku diamanty*** (Scientists find diamonds in Bohemia).



21th SEPTEMBER | The 2nd Open Congress of the Czech Geological Society and the Slovak Geological Society

The 2nd Open Congress of the Czech Geological Society and the Slovak Geological Society was held between 21st and 25th of September in Monínec. An assembly of the Committee of the Czech Geological Society was also held at this Congress.

29th SEPTEMBER | End of the contest My Piece of Earth 2011

The children's painting competition My Piece of Earth, organized by the Czech Geological Survey, ended on 29th of September with a ceremony in the Eco-Technical Museum in Prague. The museum in the old waste water treatment plant in Bubeneč provided a marvellous opportunity to give the children who took part in the contest an idea about how waste water produced in cities is treated and how they themselves can contribute to the protection of our water sources. This venue was closely related to the theme of the contest that was to portray the Kingdom of the Water Fairy. Many children from kindergartens, elementary and high schools took part in the 5th year of the contest that has now become an established tradition across the whole Republic. Many hundreds of paintings and drawings were submitted to the judges.

5th OCTOBER | Conference on ecotourism and geotourism in Telč

The international conference ***Challenges and threats of ecotourism and geotourism to the protection of biodiversity and geodiversity*** was held in Telč on 5th and 6th of October 2011. The conference was organized by GEOPARK Vysočina, o.p.s. The CGS was one of the partners in the conference and its representatives; Dr Pertoldová and Dr Verner were also members of the scientific committee. On the first day, participants had an opportunity to hear several interesting lectures, including lectures by Dr Štědrá, Dr Pertoldová and Dr Verner from the CGS. On the second day a collective workshop followed by a fieldtrip to the site of the planned Vysočina geopark was organized. Dr Pertoldová and Dr Verner led the field trip and gave an explanation of the geological history of the area while Dr Břízová pointed out the details of the Quaternary sediments in the area of the future geopark.

10th OCTOBER | Announcement of the winner of the national Student GIS project competition

Mgr. Jan Mišurec of the Remote Sensing Centre was awarded the first prize in the national competition ***Student GIS projekt*** (Student GIS project), in which he achieved 1st place for the best master's thesis and 1st place for the best poster.

26th OCTOBER | Geological Survey at the Week of Science and Technology 2011

The CGS again cooperated in the organization of the largest scientific festival in the Czech Republic – the ***Week of Science and Technology*** (WST). As a contribution to the WST, specialists from the CGS presented lectures and open days were held at the CGS workplaces at Klárov and Barrandov in Prague and in Brno. A presentation ***Geological research in Antarctica – life of a geologist on an inhospitable continent*** by Radek Vodrážka, a member of several geological expeditions to Antarctica was given at the headquarters of the CGS at Klárov in Prague. At Barrandov, visitors heard a lecture by Stanislava Vodrážková ***Reconstruction of Palaeozoic sea temperatures – apatite from conodonts as an indicator of palaeoclimate***, and a lecture by Martin Novák and colleagues about ***Long-range transport of trace metals in Central Europe***. At the workplace in Brno M. Geršl gave a presentation about ***The use of organic chemistry to solve modern problems in geology***. In October, visitors to Klárov were also able to see the exhibitions ***Fossilized Secrets of Antarctica*** and ***Planet Earth Mighty and Vulnerable***.

20th NOVEMBER | Another major accolade for Czech palaeontology – international recognition of the work of Dr Stanislava Vodrážková

Recently, a decision by the Alexander von Humboldt Foundation concerning new sponsorships was announced. The palaeontological project undertaken by Dr Stanislava Vodrážková (née Berkyová) was highly rated by the international committee and she was awarded sponsorship from the Alexander von Humboldt Foundation. Dr Vodrážková has been elected to the elite Humboldt Club of scientists, the membership of which covers most areas of scientific research. This is a prestigious event and a great honour for Czech palaeontology and the CGS. It is notable that 44 holders of sponsorship from this organization have also been awarded a Nobel Prize.

13th DECEMBER | Through the Magical Landscapes of Chile

An exhibition of photographs titled ***Through the Magical Landscapes of Chile*** was opened in the bookshop of the CGS at Klárov. Lucie Kondrová and Pavla Gürtlerová who took the photographs were present. Both are members of the Czech Geological Survey.

List of projects

Regional geology and geological mapping

Contribution of the CR to stabilization of the state of the ozone layer of Earth and solar UV radiation in Antarctica, palaeoclimatological and palaeogeographical reconstruction of a selected part of Antarctica and related geological study and mapping, VaV SP II 1a 9/23/07, MŽP, 2007–2011	RNDr. Petr Mixa
Reversible storage of energy in the rock mass, cooperation with ISATech Ltd., TA01020348, TAČR, 2011–2013	Mgr. Jan Franěk, Ph.D.
Research on a thermally loaded rock – perspectives for underground thermal energy storage, FR–TI3/325, MPO, 2011–2014	Mgr. Jan Franěk, Ph.D.
Special studies, methods of research, Ph.D. theses and dissertations, ČGS, 2007–	RNDr. Eva Břízová, CSc.
Printing of geological and applied maps, ČGS, 2010–	RNDr. Pavel Hanžl, Dr.
Introduction of methods for separating Li from geological samples and measurement of the isotopic composition of Li using the Neptune MC-ICPMS, ČGS, 2010–2011	Dr.sc.nat. Tomáš Magna
Introduction of methods for separating Pb from geological samples and determination of the isotopic ratios of Pb, Sr and Nd using the Neptune MC – ICPMS, ČGS, 2010–2011	Mgr. Jitka Míková
Geochronological research on skarns from the Moldanubian and the Kutná Hora Crystalline Complex and their role in the geological evolution of the Bohemian Massif, ČGS, 2010–2011	RNDr. Jaroslava Pertoldová, CSc.
Mechanisms of transformation of the structure of minerals of the eclogite facies during deformation in conditions of the lower and middle crust: the example of HP metabasites from the central part of the Kutná Hora Crystalline Complex, ČGS, 2010–2011	Mgr. Veronika Štědrá, Ph.D.
Granitic orthogneisses within the Older Proterozoic Světlice orthogneiss, ČGS, 2010–2011	Mgr. Jakub Trubač
Genesis of wolfram ore mineralization in the North-East of the Saxothuringian, ČGS, 2010–2011	Mgr. Lukáš Vondrovic
Volcanic systems: origin and evolution of magma; fragmentation and sedimentation of volcanoclastic material, ČGS, 2010–2011	Mgr. Vladislav Rapprich
Development and application of the Re-Os method using the negative thermal ionization mass spectrometer (N-Tims) Finnigan MAT 262, ČGS, 2010–2012	Mgr. Lukáš Ackerman, Ph.D.
Completion of basic geological maps of Geopark Bohemian Paradise, ČGS, 2011–2012	RNDr. Lilian Švábenická, CSc.
Publication of the results of the International Development Cooperation project in Costa Rica, ČGS, 2011–2012	RNDr. Vladimír Žáček
Professional support for a supranational network of geoparks in the Czech Republic, ČGS, 2011–2012	Mgr. Veronika Štědrá, Ph.D.

Characteristics of microdiamonds and other UHP phases from high-pressure granulites of the Bohemian Massif, ČGS, 2011–2012	doc. RNDr. Jana Kotková, CSc.
Biostratigraphical correlation of pilot sections in the Jizera development of the Bohemian Cretaceous Basin based on the study of calcareous nanofossils, ČGS, 2011–2012	RNDr. Lilian Švábenická, CSc.
Systematics of the isotopes of Sr in rock, soil and waters of James Ross Island in Antarctica as an indicator of weathering processes and sources of alkaline cations	Mgr. Jitka Míková
Quantification and timing of uplift and erosion in the West Carpathians and adjacent Bohemian Massif in relationship to mass transfer to active basins, GAČR TOP/08/E014, 2008–2011	RNDr. Juraj Franců, CSc.
Biostratigraphical and palaeoenvironmental correlation of Upper Cretaceous sediments of the Bohemian Massif and Western Carpathians based on the study of nanofossils, GAČR P210/10/084, 2010–2012	RNDr. Lilian Švábenická, CSc.
Origin and metamorphic and structural record of lower crustal rocks – implications for the interpretation and timing of processes in orogenic roots, GAČR P210/10/P475, 2010–2012	Mgr. Martin Racek
Cordaitalean and pteridosperm cuticular analysis and their in situ prepollen, GAČR P210/10/0232, 2010–2014	RNDr. Zbyněk Šimůnek, CSc.
Granulitization of the Moldanubian lower crust: geochemical constraints on protoliths and metamorphic changes in the course of the Variscan orogenic cycle, GAČR P210/11/2358, 2011–2013	Mgr. Vojtěch Janoušek, Ph.D.
Deciphering the pre-convergence history of crustal domains in deeply eroded orogenic belts from detrital zircon populations, GAČR P210/11/1904, 2011–2013	Mgr. Jiří Konopásek, Ph.D.
Synthetic digital map of soil and soil parent materials at a scale 1:50,000 – analysis and methodology, OOHPP MŽP, 2011	Ing. Jana Janderková
Geological composition and geofactors in the environment in the Frenštát Area, OOHPP MŽP, 2011–2012	Mgr. Roman Novotný
Compilation of a map of soils and soil-forming substrates at 1:50,000 scale for the map sheets 11-21 Karlovy Vary and 22-13 Nepomuk, OOHPP MŽP, 2011	Ing. Jana Janderková
Digital processing of geological and special-purpose maps at 1:25,000 scale of the area of the Geopark Bohemian Paradise, OG MŽP, 2011	RNDr. Lilian Švábenická, CSc
Geological base mapping of CR at a scale of 1:25,000, ČGS, 2008–2014	RNDr. Jaroslava Pertoldová, CSc.
Krkonoše	Mgr. Jiří Konopásek, Ph.D.
Šumava	RNDr. Vladislav Žáček
Brněnsko	Mgr. David Buriánek, Ph.D.
Beskydy	Mgr. Roman Novotný
Jeseníky	RNDr. Vratislav Pecina

Doupovské hory	RNDr. Bedřich Mlčoch
Křivoklátsko	RNDr. Tomáš Vorel
Central pluton	RNDr. Kryštof Verner, Ph.D.
Preparation of methods for the Mapping Directive, ČGS, 2009–2012	RNDr. Pavel Hanžl, Dr.
Preparation of the journal Geological Research in Moravia and Silesia, ČGS, 2010–2012	Mgr. David Buriánek, Ph.D.
Editing of scientific publications, ČGS, 2010–	Mgr. Vojtěch Janoušek, Ph.D.
Editing and preparation of the printed and electronic versions of the Bulletin of Geosciences, ČGS, 2010–	prof. RNDr. Jiří Frýda, Dr.
Geological factors affecting the environment of the southern foothills of the Krkonoše Mts, OOHPP MŽP, 2008–2011	RNDr. Igor Jan Dvořák, Ph.D.
Geological composition and geofactors in the environment of the Beskydy Mountains, OOHPP MŽP, 2008–2011	Mgr. Roman Novotný
Recent deglaciation of the northern part of James Ross Island, Antarctica; in cooperation with MU, Brno, GAČR 205/09/1876, 2009–2012	Mgr. Daniel Nývlt, Ph.D.
Integrated late Silurian (Ludlow-Přídolí) stratigraphy of the Prague Synform; in cooperation with the Institute of Geology AV ČR, v.v.i., GAČR 205/09/0703, 2009–2013	RNDr. Štěpán Manda, Ph.D.
Feeding strategy from the Cambrian until the mid-Ordovician in the Teplá-Barrandien Unit; in cooperation with PřF UK Prague, GAČR 205/09/1521, 2009–2011	RNDr. Petr Budil, Ph.D.
Origin of topaz-bearing granites of the Krudum granite body; in cooperation with the ÚSMH AV ČR, v.v.i., GAČR 205/09/0540, 2009–2011	Mgr. Vojtěch Janoušek, Ph.D.
Pattern of occurrence and community composition of deep subsurface microflora in Miocene clay and claystones and their importance in situ and after extraction; in cooperation with the Biological Centre of AV ČR, v.v.i., GAČR 206/09/1642, 2009–2012	doc. RNDr. Bohdan Kříbek, DrSc.
Study of the chemical evolution of contrasting types of highly fractionated granitic melts using melt inclusions; in cooperation with the Institute of Geology AV ČR, v.v.i., IAA300130801, 2008–2011	RNDr. Milan Drábek, CSc.
Low-temperature magnetic properties of sulphides present in meteoritic material; in cooperation with the Institute of Geology AV ČR, v.v.i., KJB300130903, 2009–2011	Mgr. Patricie Týcová-Halodová
The origin of compositional and textural zoning in shallow-level granitoid plutons: a quantitative approach, GAČR P210/11/1168 (cooperation with the Faculty of Sciences of the Charles University), 2011–2013	Mgr. Vojtěch Janoušek, Ph.D.
Membership of the European Polar Board and European Polar Consortium (EPB, EPC) and fulfilling the duties of membership (programme of MŠMT, in cooperation with MU Brno), LA-09046, 2009–2012	Mgr. Zdeněk Venera, Ph.D.
Sudetian Geotrail, geological tourist guide (project under the terms of the Operational Programme Cross-border Cooperation), in cooperation with Poland, finances EU + 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
Geological mapping in Iran, 2006–2011	RNDr. Jiří Babůrek, Ph.D.

Applied geology

Principles of interaction in the "water/rock/landscape" system and their application to groundwater protection in the Czech Republic, R&D SP/2e1/153/07, MŽP, 2007–2011	RNDr. Renáta Kadlecová
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 MPO, Programme TIP), 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 ÚJV Řež (provider MPO, Programme TIP), FRTI1/379, 2009–2013	RNDr. Vladimír Kolejka
Database of decorative stones, ČGS, 2009–	RNDr. Barbora Dudíková Schulmannová
Research on radon hazards, ČGS, 2009–2011	RNDr. Ivan Barnet, CSc.
Legislation on water protection in the Czech Republic, ČGS, 2011–2012	Mgr. Alena Bartůňková
Register of Slope Failures, 2011–	Ing. Jan Šikula, Ph.D.
Selected platinum-group minerals and their experimental approach, GAČR P210/11/P744, 2011–2013	RNDr. Anna Vymazalová, Ph.D.
Assessment of mining related impacts based on the application of the ARES Airborne Hyperspectral Sensor, GAČR 205/09/1989, 2009–2012	Mgr. Veronika Kopačková
The National Centre for Effects – Commitment of the CR to an International Treaty on Distant Transport of Pollutants, OOO MŽP, 2006–2011	RNDr. Irena Skořepová, CSc.
Review of the current state of safety of abandoned mine workings, OOHPP MŽP, 2008–2011	RNDr. Michal Poňavič
Research and evaluation of the distribution of caesium and radionuclides in south Bohemia, OOHPP MŽP, 2009–2011	RNDr. Pavel Müller, CSc.
Regional documentation of hazardous geodynamic phenomena in the area of Džbán, Central Bohemia, and in the urban areas of Brno and around Zlín, OOHPP MŽP, 2009–2011	Ing. Petr Kycl
Regional geochemistry of the rock environment in West Bohemia, OOHPP MŽP, 2010–2011	Ing. Jan Malík
Documentation of the redistribution of ^{137}Cs and other selected radionuclides in near-surface rock layers in the area of Žulová, OOHPP MŽP, 2011–2012	doc. RNDr. Pavel Müller, CSc.

Updating of the radon index for further use in a unified map of the radon index of the Czech Republic at 1:50,000 scale, OOHPP MŽP, 2011	RNDr. Ivan Barnet, CSc.
Activities within the SGA; INGO programme, LA-09022, MŠMT, 2009–2012	RNDr. Jan Pašava, CSc.
Earth Observation for Monitoring and Observing Environmental and Societal Impacts of Mineral Resources Exploration and Exploitation, FP 7, 2010–2013	Mgr. Veronika Kopačková
Activities within the AAPG (American Association of Petroleum Geologists), LA 10025, MŠMT, 2010–2012	RNDr. Vlastimila Dvořáková
Review of Groundwater Resources in the Czech Republic (State Environmental Fund, under the terms of OPŽP, priority axis 6, financed by EU and ČR), 2010–2015	RNDr. Petr Mixa
Assessment of the potential of mineral resources on the Saxon-Czech border – cross-border register of mineral resources (Program to support cross-border cooperation between the Czech Republic and the Free State of Saxony 2007–2013, EU and ČR, partner Geokompetenzzentrum Freiberg e.V., No. of request 100020755), 2010–2011	Ing. Petr Bohdálek
Pan-European coordination action on Geological Storage of CO_2 (FP 7), 2010–2013	RNDr. Vít Hladík, MBA
Research Centre – Advanced Remediation Technologies and Processes (leader: TU Liberec), MŠMT, 2005–2011	prof. RNDr. Tomáš Pačes, DrSc.
Natural and synthetic minerals of the Pt group; their comprehensive characterization by innovative methods and clarification of their genesis in various geological conditions, MEB 061113, MŠMT, 2011–2012	RNDr. Anna Vymazalová, Ph.D.
Experimental study of ternary systems: Ag – PGE – (Se/Te/S), LH 11127, MŠMT, 2011–2014	RNDr. Anna Vymazalová, Ph.D.

Environmental geochemistry and biogeochemistry

Evaluation of the influence of climate changes on hydrological balance and the proposal of practical measures to mitigate their impacts, VaV SP/1a6/151/07, MŽP, 2007–2011	RNDr. Daniela Fottová
Model of sediment and organic pollutant transport bound to suspended particulate matter in the Dyje River catchment area, VaV SP/1b7/156/07, MŽP, 2007–2011	Mgr. Milan Geršl, Ph.D.
Anthropogenic pressures on the status of soils, water resources and water ecosystems in the Czech part of the international basin of the Elbe River, in cooperation with VÚV, v.v.i., VaV SP/2e7/229/07, MŽP, 2007–2011	Ing. František Bůzek, CSc.
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., VaV Q191C118, Mze, 2009–2013	Mgr. Magdaléna Koubová, Ph.D.
Chromium isotopes as an indicator of natural attenuation of water pollution: Introducing mass-spectrometry based technology, TA01021055, TAČR, 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.

Contribution to specific parts of the research plan of CGS by the Department of Geochemistry of the Rock Environment, ČGS, 2007–2012	Mgr. Jakub Haloda
Carbon balance in freshwater peat bogs – comparison of sites in middle latitudes with those in subarctic areas, ČGS, 2007–2011	Mgr. Leona Zemanová
Development of laboratory methods for separation of Ca from natural materials and analysis of Ca isotopes in the eluate obtained using the multicollector thermal ionization mass spectrometer (TIMS), ČGS, 2010–2012	Mgr. Lucie Erbanová
Isotope mass balance of lead in small catchment areas, ČGS, 2010–2012	Mgr. Markéta Štěpánová
Introducing new methods for the determination of the isotopic composition of copper using multicollector ICP mass spectrometry, ČGS, 2010–2011	Mgr. Jitka Míková
Release of the greenhouse gasses (CO_2 and CH_4) from various types of rock environment in the area covered by map sheets Jedovnice and Oslavany, ČGS, 2011–2012	Mgr. Milan Geršl, Ph.D.
Isotope thermometry of magnesium (Mg) and calcium (Ca) in carbonate minerals, ČGS, 2011–2012	Mgr. Juraj Farkaš, Ph.D.
Geochemical fossils in soils and lacustrine sediments as indicators of the biological origin of organic compounds, ČGS, 2011–2012	RNDr. Juraj Franců, CSc., Ing. Daniela Mácová
Soil acidification in less polluted natural forests: Evaluation of the present situation and prediction of future development (in cooperation with MLZU, Brno), GAČR 526/07/1187, 2007–2011	RNDr. Jakub Hruška, CSc.
The fate of legacy mercury in forest ecosystems in the area of the Black Triangle, Czech Republic, GAČR 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, GAČR 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.
Regional geochemistry of the rock environment in West Bohemia, OOHPP MŽP, 2010–2011	Mgr. Milan Geršl, Ph.D.
The influence of irrigation and precipitation on the mobility of arsenic in the soil profile (in cooperation with VŠCHT in Prague), GAČR P210/10/0938, 2010–2012	Ing. František Bůzek, CSc.
Assessment of impact of the Gothenburg protocol on acidified and eutrophied soils and waters in the Czech Republic – proposal for further investigations; Norwegian project, CZ0051; 2007–2011	RNDr. Jakub Hruška, CSc.
Monitoring of trans-boundary air pollution by isotope fingerprinting of sources; EU, 2008–2011	RNDr. Martin Novák, CSc.
Soil Transformations in European Catchments – Soil TrEC (FP7-ENV-2009-1, grant agreement number 244118), 2009–2014	RNDr. Martin Novák, CSc.

Global climate changes

Studying mechanisms of the reaction of the biosphere to global crisis events in the geological past II, ČGS, 2010–2011	prof. RNDr. Jiří Frýda, Dr.
Mineralogy and geochemistry of the Libkovické Beds: record of evolution of a lacustrine environment in the overburden of the Bílina Delta (Most Basin, Lower Miocene), ČGS, 2010–2011	Mgr. Richard Lojka
Biostratigraphy, analysis of stable isotopes and microfacial analysis of the "upper dark interval" of the Acanthopyge Limestone in the area around Koněprusy (Middle Devonian, Eifelian), ČGS, 2011–2012	Mgr. Stanislava Vodrážková, Ph.D.
Palaeoecological and climate changes at the end of the Carboniferous (Stephanian D) in the Krkonoše Piedmont Basin, ČGS, 2011–2012	RNDr. Marcela Stárková
The Silurian Sedgwickii Event: Carbon isotope excursion, graptolite mass extinction, sedimentary record; in cooperation with the Institute of Geology AV ČR, v.v.i., GAČR 205/09/0619, 2009–2011	prof. RNDr. Jiří Frýda, Dr.
Lacustrine and coal deposits of the Sokolov Basin as an archive of Miocene continental palaeoenvironments, palaeoclimate and tectonics; in cooperation with PřF UK, Prague – K. Martínek, GAČR 205/09/1162, 2009–2011	RNDr. Juraj Franců, CSc.
A new European reference profile for the study of Mid-Cretaceous changes in sea level, palaeoceanography and palaeoclimate: research borehole in the Bohemian Cretaceous Basin (in cooperation with the Geophysical Institute AV ČR, v.v.i.), GAČR P210/10/1991, 2010–2013	Mgr. Pavel Čech
Faunal dynamics in communities at the climactic stage of the Upper-Ordovician before the global crisis caused by climate changes: evidence from the Královdvor Formation in the Barrandien, in cooperation with the Institute of Geology AV ČR, v.v.i., IAA30111098, 2009–2011	RNDr. Petr Budil, Ph.D.
Climatic archives recorded in the Late Palaeozoic basins of the Bohemian Massif: proxies for reconstruction of climatic changes, GAČR P210/11/1431 (in cooperation for the Faculty of Sciences of the Charles University), 2011–2014	Mgr. Richard Lojka
Middle Palaeozoic climatic and sea-level changes and their influence on marine community evolution: a comparison of models from the Perunica microcontinent and the Laurasian continent, ME 08011, MŠMT, 2008–2012	prof. RNDr. Jiří Frýda, Dr.
Disparity and ontogeny in trilobites (Arthropoda): a characteristic of morphological changes, MEB 021122, MŠMT, 2011–2012	RNDr. Petr Budil, Ph.D.

Information systems

Development of the interactive map of risks to slope stability in the Czech Republic, VaV SP/1c5/157/07, MŽP, 2007–2011	RNDr. Zuzana Krejčí, CSc.
Building the Information System of the Czech Geological Survey – revision and palaeontological investigation of selected older funds from the CGS collections, VaV DE08P04OMG002, MK, 2008–2011	RNDr. Petr Budil, Ph.D.

Development of the www Information Portal of CGS, ČGS, 2009–2011	Ing. Radek Svítil
Data sources and metainformation system of the Czech Geological Survey, ČGS, 2007–2010	Ing. Jan Sedláček
System for protection of geological sites, ČGS, 2010–2012	RNDr. Pavla Gürtlerová
Maintenance and development of the digital archive of CGS, ČGS, 2010–2011	Ing. Jan Sedláček
Creation of an electronic data collection of rock and rock-forming minerals, ČGS, 2011–2012	RNDr. Radmila Nahodilová
Online geological encyclopaedia, ČGS, 2011	Ing. Jan Sedláček
Development and maintenance of the National Geologic Map Database of the Czech Republic, ČGS, 2011–	RNDr. Zuzana Krejčí, CSc., RNDr. Pavel Hanžl, Dr.
Application for the display of slope failures and its integration into the Portal of Geohazards, ČGS, 2011	RNDr. Zuzana Krejčí, CSc., Ing. Jan Šikula, Ph.D.
Testing of the INSPIRE Data Specification, ČGS, 2011	Ing. Lucie Kondrová
Evaluation of the significance of inorganic natural phenomena – analysis and processing of the register of important geological sites in nature reserves and natural heritage sites in the domain of "Moravia – North", Department of Highly Protected Natural Sites, MŽP, 2011	RNDr. Pavla Gürtlerová
African-European Georesources Observation System (AEGOS), EU, 2009–2011	RNDr. Dana Čápová
Educational project Brno, MŠMT, 2009–2012	RNDr. Vlastimila Dvořáková

Report writing and expert activities

Geological composition as a factor determining usage and development of the territory of CR: continuing investigations, ČGS, 1998–	RNDr. Jan Čurda

Abbreviations:

AV ČR – Academy of Sciences of the Czech Republic;
ČGS – Czech Geological Survey;
CR – the Czech Republic;
GAČR – Czech Science Foundation;
MK – Ministry of Culture;
MPO – Ministry of Industry and Trade;
MŠMT – Ministry of Education, Youth and Sports;
MU – Masaryk University;
Mze – Ministry of Agriculture;
MŽP – Ministry of the Environment;
PřF – Faculty of Sciences;
TU – Technical University;
UK – Charles University;
VaV – Research & Development Council

A new design for the website of the Czech Geological Survey

The new version of the information portal of the Czech Geological Survey was launched on the 3rd August 2011. Both the content and the design have been changed significantly. This enables easier navigation on the web and provides better access to information.

The most important change is the division of the website into seven sections, each of which has its own menu. This arrangement makes navigation on the web easier and clearer, because the CGS site contains nearly 250 pages. The web pages now have a consistent layout in three columns and the content is regularly revised and updated. Many topics have appeared on the CGS website for the very first time.

Supplementary information in the right column is always arranged in the same order, which makes navigation on the website easier. In this column, information about current events related to many of the topics is also given.

The *Custom Search Engine* from the Google Company is used for full text searching throughout the website.

Among the new web pages, for instance, the *Full list of projects carried out by the CGS* is given in the *Science & Research* section and there is a section named *Maps*, in which a wide range of geoscientific maps, produced or held by the CGS, is displayed. The section *Expert Services* has also been given a new structure so that information about a full range of laboratory and publishing services can be obtained easily.

Website Traffic

In 2011, there were 71,479 individual visits to the Czech-language version of the website of the CGS and a record-breaking 657,217 pages were consulted (the number of visitors decreased by 3% compared to 2010, but the number of pages displayed increased by 4%). The most visited specialized online resources were: Photo Archive – 110,917 visitors, Geological Encyclopaedia – 81,781 visitors and Map Server – 27,202 visitors (Source of statistics: Google Analytics).

New web pages

Research on thermally loaded rocks – perspectives on underground storage of thermal energy
www.geology.cz/mokrsko

Regional documentation of the hazardous geodynamic phenomena in the area of Džbán in Central Bohemia, in the Brno conurbation and in the Zlín Region
www.geology.cz/projekt639600

Geological factors affecting the environment of the southern foothills of the Krkonoše Mts
www.geology.cz/geofaktory-krkonose

Mining and the Environment in Africa
www.geology.cz/igcp594

National Geoparks Council
www.geology.cz/narodnigeoparky

New web pages

Web

Czech Geological Survey website
www.geology.cz

State Geological Survey *www.geology.cz/**sgs***

Science and Research
*www.geology.cz/extranet/**vav***

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Decorative Stones
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Other web presentations

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

The CGS channel on YouTube
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