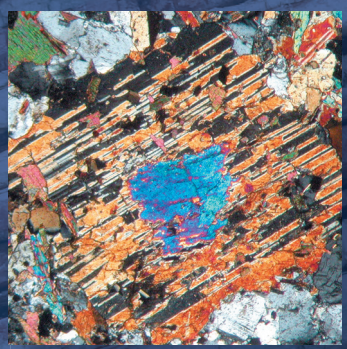
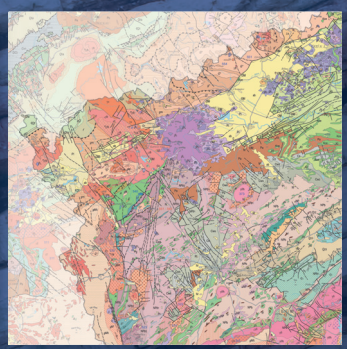
CZECH GEOLOGICAL SURVEY





Annual Report **2007**

The Czech Geological Survey is a highly respected state organization which specializes in creating, collecting, and provision of impartial expert geological information for the purposes of the state administration, private sector and broad public.

The key feature of the Czech Geological Survey is an inseparable interconnection of the society-oriented services with the top-ranking research in geology, natural resources, geological hazards and environmental protection.

The Czech Geological Survey is an internationally recognized scientific institution responding to the requirements of sustainable development of society and playing significant role in geology popularization and education.

Mission

- Regional researching and geological mapping of the territory of the Czech Republic
- Basic and applied research in geological hazards, mineral resources, ground water sources, rock environment and environmental protection
- State geological survey administration in accordance with Act No. 62/1988 Coll. (on geological works)
- Acquisition, collection and assessment of data on the geological composition, mineral resources, and geohazards on the territory of the Czech Republic
- Provision of geoscientific data and expert support of decision-making in the state and public issues
- International cooperation and foreign development aid
- Education in geosciences and environmental protection

Main fields of activity

- Geological research and mapping
- Rock environment and its protection
- Mineral resources and mining environmental impact
- Geological hazards, prevention and impact mitigation
- Geinformation management and delivery

The Czech Geological Survey is established by the Ministry of the Environment.

Ministerstvo životního prostředí
České republiky

Contents

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RNDr. Jan Pašava, CSc.

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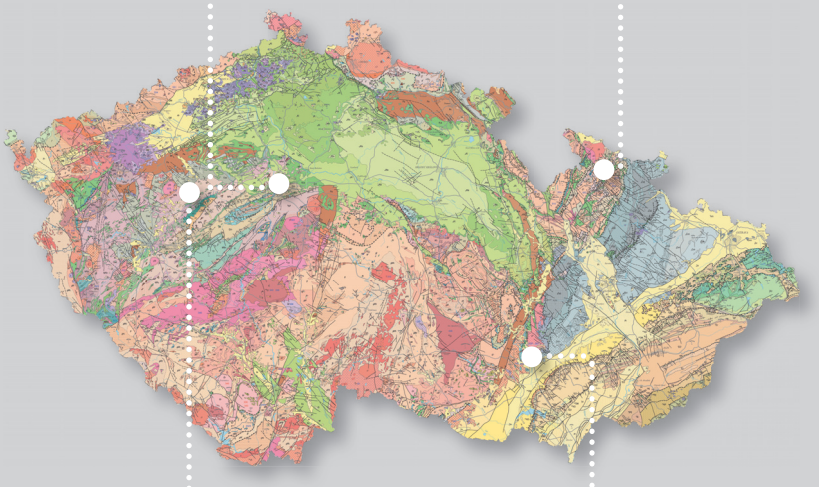

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- Approval Board
- Approbation Committee
- Editorial Board
- CGS Portal Board

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2007

The year of publication of a new Synoptic Geological Map of the Czech Republic and a strengthened role for the National Geological Survey

Zdeněk Venera
Director of Czech Geological Survey

In 2006, we successfully opposed the ill-conceived transformation of the Czech Geological Survey (CGS) into a public research institution. This would have meant that the CGS would have become a purely academic organization detached from the role for which it was originally founded, namely to provide an expert geological service to the Czech Government and the public administration. As a consequence, an principal precedent for the dual function of the geological survey was established. Using the existing resources of the Survey, expert advice and consultancy will be provided to the community at large, with continued provision of statutory scientific services to the government and public administration.

Despite the exceptionally low budget allocated by the Ministry of the Environment to the CGS for the year 2007, protracted discussions led to agreement on a working procedure for financing the activities of the CGS. Separate lines of funding were established, one to support statutory research activities and another to provide income through contracted services and consultancy. This laid the foundation for a new transparent system of accounting, in which specific deliverables will be paid for by the customers to whom they are provided. The results of such contracted work cannot be obtained free-of-charge from the CGS as a mere by-product of its scientific activities.

In the quest for a balanced budget in 2007, which also included a deficit in the budget carried over from the previous year, we were successful in winning seven major projects in the Research and Development Program administered by the Ministry of the Environment. As a new stipulation, the budgets for these projects now cover the cost of labour. Consequently, this income contributes to the annual average pay raise in the CGS.

In 2007, we negotiated and concluded a contract with the Geological Survey of Iran for geological mapping at a scale of 1 : 25,000, including methodical training of the Iranian staff. This project marks a breakthrough in CGS activities, being the first overseas transaction fully paid by the customer. The high level of scientific co-operation with our Iranian counterparts has proven a welcome stimulus for the Czech team. This project reflects the trend in activities of other national geological surveys worldwide, in which the resources and expertise used to provide the services required by their respective countries are exported to encourage international scientific co-operation and enhance economic benefits.

In 2007, preparations for the International Year of Planet Earth (IYPE) were in full swing. The CGS played a leading role in the national activities devoted to this global event coordinated under the auspices of the UN, and allocated its own human and financial resources to assure maximum outreach. One of key initiatives related to the IYPE is the OneGeology project. This multinational project aims at making web-accessible the best available geological map data worldwide at a scale of 1 : 1 million. The CGS became a major player in OneGeology Europe, a project approved by the European Commission to produce European Union coverage for the OneGeology initiative. In relation to Europe, I should also mention our role the EuroGeoSurveys – the association of the geological surveys of Europe. Our representatives were active especially in the Outreach Committee and INSPIRE (Infrastructure for Spatial Information in Europe) Working Group and it was an honour for me personally to serve as the elected President of EuroGeoSurveys in 2007.

The year 2007 is particularly noteworthy because a new edition of the 1 : 500,000 geological map of the Czech Republic was published. Forty years have elapsed since the last edition. The present map is the result of many years of painstaking observation and interpretation by our leading geologists, to provide a reliable depiction of the geological structures we walk over daily. The high quality and precision of the map are the result of digital compilation of geological observations and all the relevant data collected during a program of geological mapping covering the whole of the Czech Republic at a scale of 1 : 50,000, which has taken several decades to complete.

The last year has been marked by important changes in the senior management of the Survey. Dr. Jan Pašava, the new Deputy Director of Research, and Ing. Zdeněk Cilc, the new Deputy Director of Finance, have had a significant influence on the achievements of the CGS during 2007. Ultimately, however, our success must be ascribed to the joint endeavour, creativity, expertise and dedication of all our staff. I owe them my heartfelt thanks for the contributions they have made in sustaining the professional standards of the CGS. Having overcome the difficulties we faced last year, I am sure we will rise to any future challenges we may encounter in implementing our vision of a modern geological survey that provides high quality information and scientific input to support the knowledge-based society that we aspire to create.

Geological and thematic maps

Jaroslava Pertoldová
Head of Department of Crystalline Complexes

Geological mapping substantially contributes to understanding the processes of rock interaction with the bio- or hydrosphere affecting our environment, such as water percolation, weathering or erosion. Geological information establishes a framework for applied geoscientific topics, such as assessment of geohazards, resources, strategic planning, and land development. The maps serve as a basis for further geological research.
A project of detailed geological mapping at a scale of 1 : 25,000 continued in the Bohemian Massif and Western Carpathians. In addition to the Czech Republic, the Czech Geological Survey has created geological maps in cooperation with foreign geological institutions in several countries.

Objectives and outputs of geological mapping

Geological mapping has been one of the main tasks of the CGS since its foundation. The mapping includes compilation of geological and thematic maps on various scales and collecting, assessing, and providing of data and material documentation. The outputs represent important contributions to analytical and synthetic knowledge on the Earth, i.e. the rock, soil, and water environments. The results provide new, modern information on the geological structure and tectonometamorphic evolution, the occurrences and extent of rock types, the development of soils, the dynamics of landscape formation and the transport of surface materials within the geological time-scale. A set of maps distinguishing different types of surface relief at a scale of 1 : 10,000 is an example of such a detailed study of the mutual interactions between geology and geomorphology.
Recently, the CGS has conducted detailed geological and thematic mapping and digitizing of the maps at a scale of 1 : 25,000. The selection of the mapped areas reflects the priorities of the state and local authorities related to environmental or developmental issues. New map sheets have been completed and mapping currently continues in the areas of the Šumava Mts, Krkonoše Mts, NW Bohemia, Jeseníky Mts, Žďárské vrchy Mts, Vsetín area, Maleník-Poodří area, Křivoklát protected area, Plzeň, Kladno, Kutná Hora, Labe regions, and Doupov Mts.

Application of new methods in mapping

The mapping in the Žďárské Vrchy protected region acted as a testing project for implementation of digital data collection directly in the field. The data were subsequently processed exclusively using GIS software to produce the final maps without using traditional manual methods. The successful test resulted in the formulation of a new mapping methodology for the CGS. This approach enhanced the creation of geological and applied outputs derived from the rough data.

New general geological map of the Czech Republic after 40 years, scale 1 : 500,000

The detailed maps were compiled to form a synoptic 1 : 500,000 geological map of the Czech Republic, which was printed in 2007. Among other features, the map depicts nappe tectonics of the crystalline and flysch units. The CGS continues in multipurpose geological mapping of Šumava and Krkonoše Mts protected

landscape areas, Křivoklát UNESCO Biospheric Reserve, and of the Quaternary sediments in the Czech Republic. In addition to the traditional field and analytical methods, remote sensing inputs have growing importance for final processing of general maps. Our institution collaborates on the "One Geology" project, the aim of which is to create a geological map of the Earth at a scale of 1 : 1,000,000. For this output, the CGS prepares a related principal geological division of the Czech Republic, complemented by geological profiles.

3D modelling of buried crystalline complexes in northern Bohemia

Reconstruction of the basement geology and palaeorelief of sedimentary basins is based on re-evaluation of drill hole data and their digitizing (approx. 23,000 well logs were processed). Combined analysis of seismic and gravity data leading to gravimetric modelling along selected seismic profiles and examination of digital topographical models enabled the visualization of hidden regional structural features. A digital elevation model of the crystalline basement and the Upper Palaeozoic surface strata resulted in a new view of the geological structures of the Bohemian Cretaceous Basin area. The series of these research projects provides advanced information on the hidden geological structure and morphology of the Quaternary cover of northern and eastern Bohemia. This knowledge enables more fundamental approaches to the future mapping of the examined areas, e.g., in the Cheb and Sokolov basins or within the framework of a proposed mapping project of the Bohemian Paradise UNESCO European Geopark.

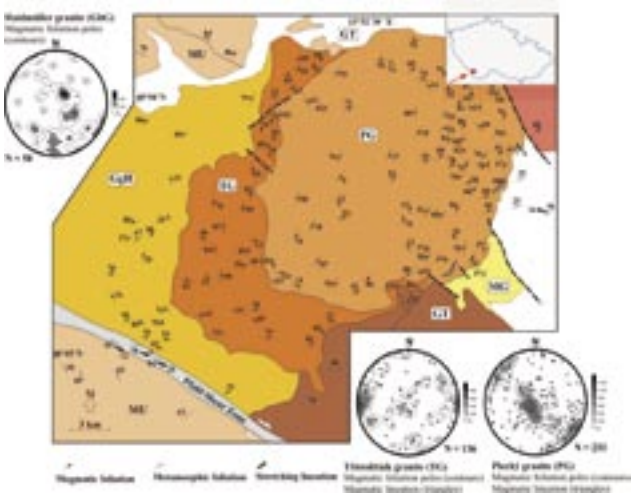
Mapping activities on other continents

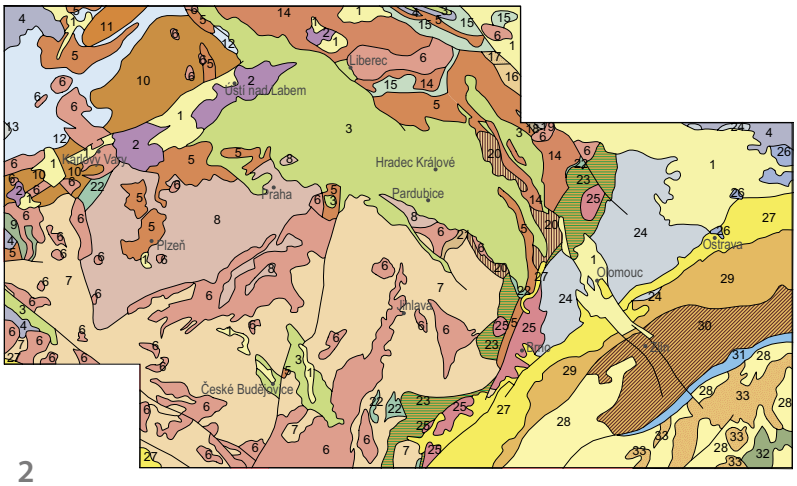
Pioneering geological research and mapping of the Antarctic Peninsula and James Ross Island proceeded in another summer field campaign. In Latin America, the mapping fieldworks were focused on the Santa Lucia Caldera in the central part of Nicaragua and on the Miramar region in Costa Rica. The results obtained from the field mapping season in 2007 comprise radiometry, analysis of regional vulnerability and detailed examination of volcanic formations. Landslide susceptibility analysis of the northern part of El Salvador was validated with an inventory map of 363 landslides and proved to be reliable. The susceptibility map serves as a basis to assist in slope management and land-use planing. A four-year-long geological mapping project was finished in the Mongolian Altay, and the Mongolian partner obtained 88 maps at a scale of 1 : 50,000, 400 pages of the final report, the coherent georeferenced database, and other supplementary materials.

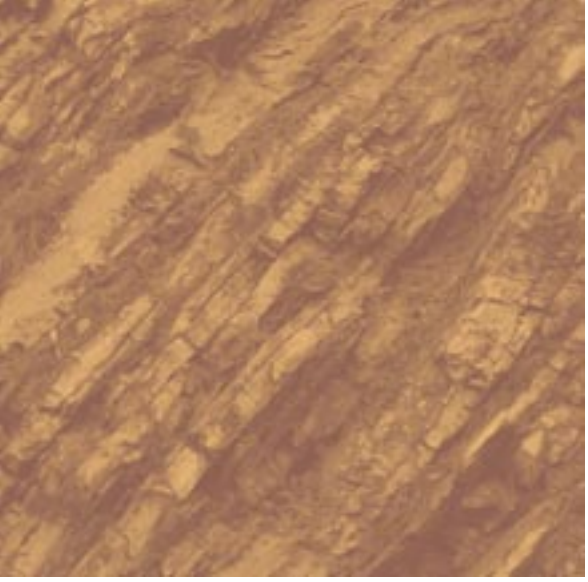
1) Study of magmatic fabrics inside granitoid plutons, example from the Plechý pluton in southern Bohemia
2) Generalized tectonic scheme of the Bohemian Massif

Geological mapping during 2005–2006

In this period, harmonization and digitization of the 1 : 50,000 geological and thematic maps covering the entire Czech Republic were finished and complemented by detailed mapping. Geodynamic modeling of the contact between the Bohemian Massif and Western Carpathians was concerned with the geological potential for oil and gas accumulations in this area. The Stožec geological open-air museum was created in the Šumava Mts and was opened to the public. International projects focused on natural hazards, resources, and land planning in Peru, Mongolia, Zambia, and Burkina Faso were finished, while activities in Nicaragua, Costa Rica and Salvador continued.







Regional geological research

Geological research is based particularly on detailed geological mapping of the Bohemian Massif and Western Carpathians. It covers the basic research projects, including the International Geological Correlation Programme, in cooperation with other Czech or foreign scientific institutions. These projects allow for construction of interpretations of tectonics, magmatic geology, metamorphism, volcanology and sedimentology, especially in combination with other specialized methods. The scientific results are presented at international conferences and published in reviewed journals and monographies.

Jaroslava Pertoldová
Head of Department of Crystalline Complexes

Detailed geological study of the Czech Republic is focused on the following topics

- definition of regional geological units, their evolution and main tectonic structures
- the deep structure of the Bohemian Massif
- petrological, geochemical, geochronological and mineralogical investigations of crystalline formations
- genesis and emplacement of magmatic bodies
- the architecture of sedimentary and volcanic formations and their thermal histories
- lithostratigraphic and biostratigraphic correlations.

The geological research at CGS is connected with Czech- and EU-funded research projects involving international cooperation. An integral part of our activities consists in a comprehensive presentation of geological knowledge in Geoparks or other public displays and exhibitions.

Research in the crystalline basement

NW Bohemia: Structural and metamorphic study focuses on a Palaeozoic suture between the Teplá-Barrandian and Saxothuringian continental blocks. New 3D geological models, based on archive drilling data and reprocessed geophysical data, comprise the following layers: the relief of the crystalline basement, a roof of the Permian and Carboniferous deposits, and the base of the Quaternary.

The Šumava Mts: A study of the relationships between three distinct orogenic structural systems was performed using geometric measurement of structural elements, comparison of rheology of granitoids, and the modes of emplacement of durbachites of the Knížecí Stolec pluton and the granitoids of the Plechý and Strážný plutons.

The Krkonoše and Jizera Mts: Special studies related to geological mapping were combined with geophysical (first with Gamma X-ray), metamorphic and structural methods. Calibration of the geothermometers for medium-tempered chloritic rocks was employed for estimation of the metamorphic pathway of phyllites and slates from the Železný Brod area.

Western Bohemia: The thrust-related geological structure in the region was demonstrated by comparative study of orthogneisses and newly identified eclogites, serpentinites and granulites from the crystalline units buried below the Cretaceous and Tertiary clastics and volcanics.

The eastern part of the Bohemian Massif: New geological data collected and processed between 2004–2007 were compiled into a new tectonic evolution scenario for the NE margin of the Moldanubian domain (Kutná Hora, Polička and Svratka crystalline units and the Strážek Moldanubicum) including geochronology of magmatic events, a sequence of major stages of thrusting and faulting accompanied by exhumation of upper mantle and lower crustal rocks, and determination of their sources. An experimental study of melting of felsitic rocks and granulites was completed in cooperation with the universities of Innsbruck and Bayreuth.

Lilian Švábenická
Head of Department of Sedimentary Formations

Research in sedimentary and volcanic formations

The Bohemian Massif

Neoproterozoic: Barrandian low-grade metamorphosed rocks have been distinguished and a new volcanological conception of the Cambrian Křivoklát-Rokycany volcanic complex was established. Microbiota (filaments, colonial organisms, algae) have been found in Neoproterozoic siliceous rocks in the Křivoklát area.

Palaeozoic: In the Prague Basin, research was concentrated on the environment and palaeocommunities in the Ludlow, Silurian. A new superorder Nepiomorphia has been described and systematic studies of Bivalvia in the peri-Gondwana region were performed. High-resolution record of the Mšec Lake, Stephanian B enabled reconstruction of changes linked with climate oscillation in the eastern equatorial Pangea. A monograph described cuticles of new cordaitean species from the Bohemian Massif. Prepollen and cuticles were isolated from Carboniferous *Whittleseya* and *Aulacotheca synangi* from the Intrasudetic Basin. Deposits of phreatomagmatic and strombolian eruptions have been discovered among lavas in the Krkonoše Piedmont Basin.

Mesozoic: Bohemian Cretaceous Basin: The stratigraphic architecture and biostratigraphy of the Cenomanian and Turonian hemipelagic and deltaic sequences were interpreted. Research in NW Bohemia associated with hydrothermal aquifers, and petrological analyses of silicified sediments were performed. Interbasinal correlation with the Lower Saxony Basin and Gosau was conducted.

Tertiary: Research was performed on tectonosedimentary evolution of the Most Basin within the Eger Graben, especially evolution of the basin geometry and interaction between fluvial and deltaic depositional systems, tectonics, and peat compaction. The source area, sedimentary processes, extent of lahar deposits and debris avalanches have been defined in the E of the Doupovské hory Volcanic Complex.

Quaternary: A correlation has been established between the terrace systems of the eastern Polabí and the Vltava-Labe confluence. The evolution of the modern drainage pattern in the Bohemian Massif is being dated. The continental glaciation was reviewed and paleoenvironmental reconstructions have been completed. Palynology and micromorphology have contributed to interpretations of past environments at archaeological sites and to protection of nature parks and protected landscape areas.

Western Carpathians

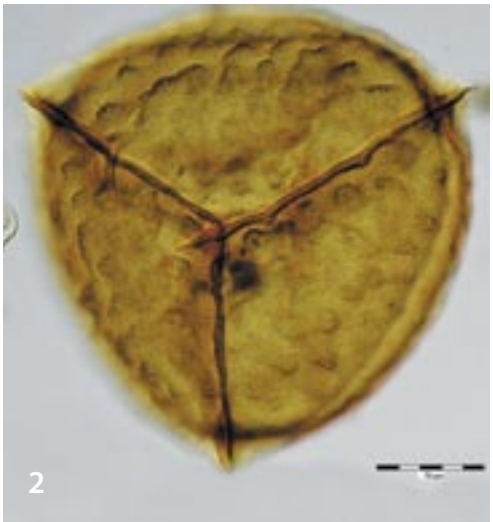
The Outer Western Carpathians: Research of paleobiota of the Cretaceous oceanic red beds enabled correlation through flysch facies zones. Biostratigraphic research of the Krosno lithofacies has demonstrated its diachronism and highlighted Oligocene-Miocene tectonic processes using AMS and provenance analysis of garnets.

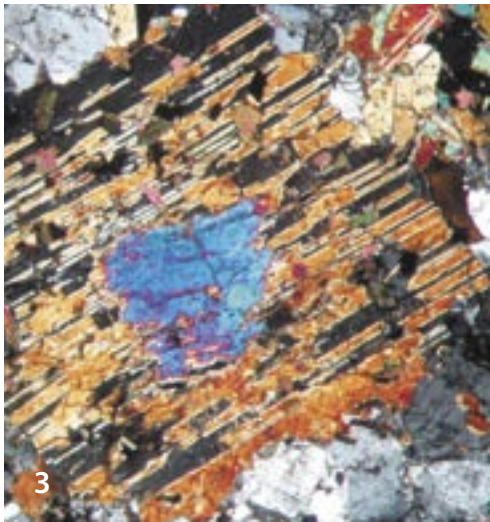
Carpathian Foredeep: Biostratigraphic, petrographic and geophysical study of the Middle Miocene provided a new insight into the sedimentary history of the SW part of the area.

Regional geological research during 2005–2006

CGS has created a digital elevation model of the crystalline basement and the Upper Paleozoic surface strata buried below the sedimentary and volcanic units of the Cheb and Sokolov Tertiary basins. Numerous petrological and structural research projects were carried out in the Krušné Hory Mts, Ohře suture zone, Krkonoše and Šumava Mts, Žďárské Vrchy and other areas. Several successful Ph.D. theses were supervised by the specialists of CGS. Among the topics of applied geology, a database of decorative stone in the Czech Republic was created and installed on the server www.geology.cz.

1) Glass sandstones, Upper Turonian-Coniacian, Bohemain Cretaceous Basin, Střeleč Quarry
2) Megaspore of quillwort (*Isoëtes*), Quaternary, Šumava, Stará jímka Mire
3) Pyroxene enclosed in a amphibole crystal from the Knížecí Stolec durbachite pluton





Research on global changes

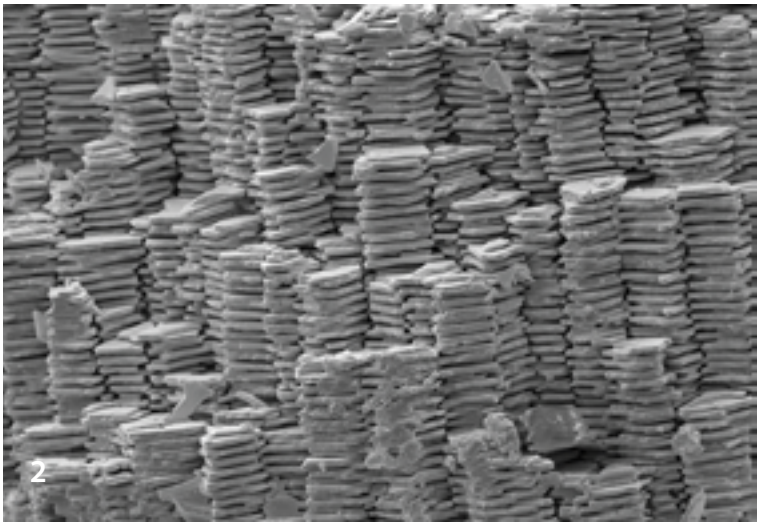
Jiří Frýda
Head of Department of Rock Geochemistry
Editor of Bulletin of Geosciences

Global changes that occurred throughout the history of the Earth are among the most important topics in modern geology and palaeobiology. Research workers at the Czech Geological Survey focused predominantly on a detailed analysis of global critical events in the Palaeozoic marine and terrestrial ecosystems. The results obtained facilitate interpretation of the causal relationships between biotic and abiotic elements of the palaeoenvironment and improve our understanding of reactions of the biota during global crises and subsequent ecosystem recoveries. Papers summarizing these findings were published in international scientific periodicals or were presented at various scientific conferences.

The interpretation of global changes that took place during the geological history of the Earth is based on a complex approach that involves palaeontological, sedimentological, and geochemical methods. Some of the work, published in 2007, that is a product of detailed studies of critical events in Palaeozoic marine and terrestrial ecosystems includes:

- monitoring changes of the carbon isotope ratio in the marine ecosystem during the Silurian LAU event
- a detailed study of the transgressive-regressive cycles during the Silurian LAU event and their relation to the evolution of Silurian faunas
- the establishment of a dramatic decrease in sea water temperature in temperate latitudes during the Silurian LAU event
- the first evidence of failed predation in Palaeozoic plankton
- chemostratigraphic definition of the Silurian-Devonian boundary based on changes in the isotopic composition of sea water

1



2

- the development of a new phylogenetic model for Palaeozoic Bivalvia
- a new classification of the Class Gastropoda based on joint efforts of an international team of palaeontologists and zoologists
- analysis of the origin of planktotrophy in gastropods
- analysis of the transgresive-regressive cycles and global sea water changes during the basal Choteč bioevent (Devonian) based on the isotopic composition of oxygen in apatite of conodont elements
- the carbon cycle in Early Silurian sediments
- stability in time of biomineralizing processes that took place during global crises of sea ecosystems as reflected in Palaeozoic and Mesozoic cephalopods
- palaeogeographic analysis of North American gastropod faunas
- a review of lycophyte parent plants of the genera *Polysporia*, *Selaginela* and *Spencerites* from the Pennsylvanian (Bolsovian-Stephanian B) continental basins of the Bohemian Massif based on their spores *in situ* and on prepollen of the genera *Florinites* and *Monoletes* isolated from male reproductive organs of pteridosperms and cordaitaleans
- a study of the palynological record at Mšec Lake, the largest reservoir among Bohemian Upper Palaeozoic basins of Stephanian B age.

A list of the Czech Geological Survey's researchers who participate in the study of global changes reflected in the Earth's geological record:
Stanislava Berkyová, Eva Břízová, Petr Budil, Jana Drábková, Lenka Ferrová, Jiří Frýda, Milan Geršl, Tomáš Hroch, Jiří Kříž, Richard Lojka, Štěpán Manda, Karel Martínek, Marika Steinová, Zbyněk Šimůnek, Petra Tonarová, Radek Vodrážka

1) New species of Silurian gastropod, *Spinicharybdis krizi*, named in honor of Jiří Kříž, Czech Geological Survey
2) Shell structure of Late Cretaceous *Sensuitrochus ferreri* (Cirridae, Gastropoda)
3) Extensive accumulations of Eocene fossil shells (*Cucullaea*) in the marine sediments on the Seymour Island, Antarctica
4) Detail of megaspore *Zonalesporites superbus* isolated from the sub-arborescent lycopsid *Omphalophloios feistmantelii* from Lubná near Rakovník (Radnice Member, Bolsovian)

Summary

In 2007, a study of global changes recorded in the history of the Earth was based on research activities performed in 2005 and 2006. The 2007 research results have been reported at several international scientific conferences and were or are being finalized for publication in impacted scientific periodicals. The study of marine ecosystems was aimed primarily at monitoring the biodiversity during global crises and the ecosystem recoveries that followed. Special attention was paid to the collection of data related to carbon and oxygen cycles and associated changes in ocean temperatures. Specifically, the information about ancient ocean water temperatures provides a key to meaningful palaeoclimatological reconstruction of changes in the ice-cap volumes and related changes in ocean level and water circulation. The data collected could be used to interpret short-term (within 1–5 million years) ocean level fluctuations. However, the mechanism of these short-term fluctuations during periods designated as "greenhouse" (period of no ice caps) is still not fully understood and remains a challenge for modern geology and palaeoclimatology.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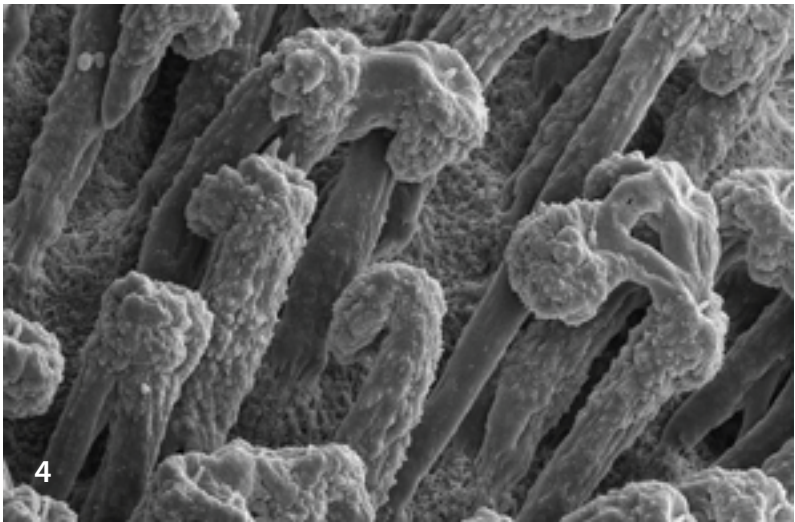
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Environmental geochemistry and biogeochemistry

Martin Novák
Head of Department of Environmental Geochemistry and Biochemistry

Damaged ecosystems throughout the Czech Republic are a legacy of high industrial emission rates in the late 20th century. Geochemical, hydrochemical, and isotope tools were used to trace the dispersion pathways of pollutants through the environment, and to evaluate fluxes, pool sizes and turnover times for environmentally relevant compounds in upland catchments. A number of integrated national and international projects focused on nutrient cycling and biogeochemical processes occurring in forest soils, wetlands, lakes, and freshwaters. The broadening scope of interdisciplinary projects is mirrored in publications in prestigious journals.

The added value of interdisciplinary studies

Research projects in the environmental sciences are increasingly concerned with soil as a valuable natural resource, whose sustainable management is vital for our survival. The interplay of geological, biological, hydrological and atmospheric forces has led to the development of various soil types. Using state-of-the-art biogeochemical techniques, we have documented that Czech soils are rarely in a steady state condition. Ecosystem health, unthinkable without a balanced soil environment, is the topic of two books published in 2007 by Springer and Elsevier, and guest-edited by geochemists at the CGS. A delay in the decrease in acidification of waters and soils following rapidly decreasing air pollution is one of the highlights of these books. Original, peer-reviewed work was published in the fields of nutrient cycling, mass balances in small catchments, predictive ecological modelling, atmogeochemistry, stable isotopes, trace metals and metaloids, and practical applications of low-temperature geochemistry.

Nutrient cycling

The Šumava National Park is recovering from a massive windstorm in January 2007. The impact of tree felling and depressed net primary production on nutrient supply is a matter of concern in these nutrient-deficient ecosystems. Monitoring of the consequences of both the natural disaster and the controversial long-term forest management practices has been commissioned by the Administration of the National Park.
Our experts joined the "Nitrogen Retention Across Europe and North America" international project in 2007. Nutrient dynamics were studied at the Načetín research plot in the Krušné hory Mts to obtain insights into the effects of liming on organic matter decomposition rates and ecosystem functioning.
Relatively pristine forest ecosystems were investigated in the Ukrainian Carpathians. Contemporary cycling of Ca, Mg, K and N will be compared with rare historical data for the same sites from the 1930s.

Mass balances in small catchments

Monthly monitoring of hydrogeochemical fluxes in the GEOMON network of 14 forested catchments has been under way since 1994. The time series of input/output mass balances of major and trace elements is unique in the Central European context in terms of duration (14 years) and methodological consistency. Hydrochemical mass balances respond to climatic changes, i.e. long dry periods combined with extreme precipitation events. The role of forests in retaining water and adaptive measures for landscape preservation were the subject of spin-off studies. Annual evaluation of critical loads in the Czech Republic is used in revising the CLRTAP Protocol.

Predictive ecological modeling

The MAGIC and SAFE biogeochemical models were applied

to mountain ecosystems. Regeneration of the topsoil and continuing acidification of mineral soil was modelled at Lysina. Complete recovery from past acid rain will take decades. Spruce monocultures appeared to have a negative effect on leaching of basic cations from the soils. One third of the loss of Ca, Mg, Na and K occurs via tree harvesting. MAGIC modelling showed that, for the next approx. 30 years, fish are not likely to return to Bohemian lakes, due to persevering acidity. A study of the relationship between acidity and export of dissolved organic carbon continued in upland and wetland areas.

Atmogeochemistry

A unique comparison was performed between the arsenic deposition rates in the Orlické hory Mts in the mid-1980s and today. Whereas horizontal deposition of As decreased 16-fold, vertical deposition of As decreased only 8-fold, indicating different distances of pollution sources for these two types of deposition.

Stable isotopes

Isotope data were collected from several research plots to elucidate the pathways of C, N and S mineralization in soils. Recharge areas for drinking water near Hradec Králové and Mělník were investigated using H_2O-O isotopes.

The behavior of metals and metaloids

At two previously heavily polluted Czech catchments, arsenic export via surface runoff was shown to exceed present-day atmospheric inputs. Similar observations have not been reported from any other sites. As desorption in soils increases with increasing pH of the water.

Experimental work using Al-rich samples from the Klínovec stream indicated that secondary Al phases readily adsorb sulfate anions upon passage from neutral to acidic pH. This finding can help to explain how abiotic factors influence the trophic status of oligotrophic waters.

Practical applications of low-temperature geochemistry

The toxic waste repository Pozďátky near Třebíč was investigated using traditional and non-traditional isotopes (S, Pb, Fe). Isotopic tracers made it possible to monitor the movement of a contaminated groundwater plume in the vicinity of human settlements.

Regional hydrogeochemical survey

Re-sampling and analysis of surface waters in the Czech Republic 20 years after maximum industrial pollution (1987), project started in April 2007. Over 1800 river water samples were processed. Lower-elevation areas appeared to experience slower rates of recovery from acidification.

Environmental projects in Africa

Environmental impact of large-scale mining and smelting was evaluated in Zambia and Namibia.

The period of 2005 and 2006

Two international meetings were hosted in Prague by the Czech Geological Survey in 2005 and 2006. The Acid Rain Symposium was attended by nearly 700 research workers. AIG-7, a symposium on applied isotope geochemistry, attracted 200 participants. Our team co-organized the 5th International Symposium on Ecosystem Behavior at the University of California at Santa Cruz (USA). This series of meetings was launched by our institute as early as 1987. Our environmental geochemists have acted as reviewers for a dozen high-ranking international journals. Members of the Department of Environmental Geochemistry and Biogeochemistry of the CGS have served as Associate Editors of Geochimica et Cosmochimica Acta, Applied Geochemistry and Environmental Pollution.

1) U dvou louček (Photo L. Erbanová)
2) Research sampling of peat monoliths. Stor Amyran, Sweden (Photo P. Pacherová)
3) Velké Dářko Bog, Žďárské vrchy Mts (Photo L. Zemanová)

Minerals and environmental impacts of mining

Zdeňka Petáková
Head of Department of Mineral Resources

Minerals in the Czech Republic as well as abroad, suggestions concerning their optimal use, and reduction of the environmental impacts of mining in accordance with the principles of sustainable development constitute the main focus of the work of economic geologists at the Czech Geological Survey. Current knowledge of mineral resources is being expanded and made available to the public through district specialists – economic geologists. Educational and popularising activities regarding minerals and the environmental impacts of mining aim to provide professionals as well as non-professionals with objective information.

Report on activities in 2007

A long list of viewpoints and suggestions regarding mineral extraction and remediation of mining impacts has been prepared for the state administration and local authorities.
The status of liquidated and secured old mining works was monitored in the territory of the Czech Republic in 2005–2007. 1,236 inspections and documentation of the current safety status in 826 old mining sites have been performed. This pilot project represented one of the most important activities of the economic geologists of the CGS in terms of capacity. Its output serves as an important basis for the Ministry of the Environment to provide for the general safety of the population and as a methodical basis for permanent periodical revision of the sites.

The environmental impact of mining

A study has been performed of the environmental impact of mining, processing and manufacturing of minerals, focused mainly on environmental contamination from mining waste. Old burdens from mineral mining were thoroughly evaluated by mapping the critical impacts of pyrite mining in Lukavice near Chrudim.
Work on the project "Investigation of possibilities for long-term elimination of post-ore mining hazards in the ore district of Horní Benešov and Horní Město", funded by the Czech Grant Agency (in cooperation with VŠB – Technical University of Ostrava) was commenced by sampling the tailing pond in Horní Benešov and a search in the historical literature.

Mapping and mineral resources

The occurrence and importance of minerals in the area mapped geologically by the CGS in 2005–2007 have been evaluated in the explanatory notes of the 1 : 25,000 maps.
Inferred mineral resources of building stone in a total volume of 41 mill m^3 have been estimated for the Vysočina region.
Work progressed on the literature search for the study "Distribution of selected minerals suitable for environmental application in the territory of the Czech Republic, possibilities for their use and proposed legislative protection of prospective deposits".
The knowledge has been systematically collected on mineral exploitation in the territory of the Czech Republic since the Paleolith up to the present time. Trends have been followed in mineral exploitation in the territory of Europe and worldwide in order to provide a comprehensive professional standpoint for decisions regarding the state mineral policy and its updating and to provide objective information for the public.

Foreign expertise

The mineral potential of areas studied in Afghanistan (raw

materials for cement production, dimension stone) has been evaluated within the framework of foreign developmental assistance of the Czech Republic (project holder GET, s.r.o.).
Basic mineral prospecting has been carried out during mapping work in Mongolia and Iran. Simultaneously, prospecting and reconnaissance work was accompanied by methodical education of Iranian geologists by CGS experts.

Research and international cooperation

The CGS participated in work on the Bioshale project (Search for a sustainable method of exploiting black shale ores using biotechnologies), financed by the 6th Framework Programme of the EU, coordinated by the BRGM.
Bilateral cooperation in economic geology progressed with the following partner countries:
France (Ministry of Education, Youth and Sports – MŠMT – Barrande Programme: Biophosphatisation and sulphidisation of organic matter in black shales and associated remobilisation and fractionation of metals), Russia (MŠMT – Kontakt Program: Fractionation of platinoids in various types of geological environment on samples from selected ore deposits in the Polar Urals) and Uzbekistan (MŠMT – Kontakt Program: Resources, transport, and fractionation of platinoids in selected extensive gold and copper deposits in Uzbekistan). Collaboration within the framework of the international geoscientific IGCP/UNESCO Program continued on the following topics of economic geology: No. 479, involving the study of platinum metal distribution in the area of the Svitavy magnetic and gravimetric anomaly, No. 486, focused on an experimental study of tellurides, especially platinum metals (a new mineral has been described), and No. 502, encompassing the study of platinoid distribution in volcanogenic massive sulphides (main deposit types in the Iberian pyrite belt area) and in the recent hydrotherms of the "black smoker" type (area of mid-ocean ridge) aiming to explain patterns of genesis of these ore accumulations.
The CGS is actively participating in the activities of the SGA, SEG and IAGOD international scientific organizations.

Significant activities in 2005–2006

Regional mineral resource studies for the Zlín and Olomouc regions, studies of variant possibilities of brown coal reserves of the Velkolom ČSA quarry exploitation, and the study "Degree of impact on and renewal of basic functions of the rock environment of the Sokolov–Karlovy Vary agglomeration" were updated to serve as a basis for urban planning.
Our workers participated in expert committees compiling data for the assembly of important European documents – Directive 2006/21/ EC on the management of waste from extractive industries and amending Directive 2004/35/EC.
The study "Application of economic instruments of the international classification of mineral resources in the Czech Mining Law system" has been prepared for the Ministry of Industry and Trade. Approximately 500 inferred mineral resources have been re-evaluated. Gold resources in post-indigenous mining waste in Burkina Faso were evaluated and geochemical mapping was conducted in Zambia and Namibia within the framework of foreign developmental assistance. The traditional Geochim international postgraduate geochemical course was organized. A monograph on the Rožná uranium deposit represented the most important outcome of the theoretical study of mineral deposits.

1) Example of a map depicting categories of accessibility and exploitability of the mineral deposits in the vicinity of Hulín, Zlín region
2) Economic geology mapping in northern Iran (Photo P. Rambousek)


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Applied geology and natural hazards

Oldřich Krejčí
Director of Brno Branch

This section summarizes the activities and achievements of several specialized fields of applied geology. In particular, the survey encompasses hydrogeological research and mapping, study and documentation of slope deformation, and an outline of the potential use of sorbed methane associated with coal seams. In addition, the findings of the research on the distribution of radiocesium ^{137}Cs in the soils of a number of regions are presented. A survey evaluated the impact of selected units on CO_2 storage and geological barriers and distant interactions were studied to assess the potential of geological bodies for storage of radioactive materials.

Hydrogeological research and mapping

The CGS Hydrogeology Group is a multidisciplinary group of hydrogeologists with a wide range of experience and skills in regional groundwater research in the Czech Republic. The main fields of expertise include:

- regional hydrogeological mapping, the compilation of different types of hydrogeological maps and complementary explanatory notes and hydrogeological studies
- study of groundwater resident time in different rocks to estimate modern water proportions
- research on groundwater quality and hydrochemical processes, implementation of the EU groundwater protection policies and directives (hydrogeological zones, study of nitrate contamination in groundwater in areas with extensive agriculture exploitation)
- estimate of regional groundwater dynamics and borehole hydraulics
- assessment of urban, industrial, and agricultural groundwater pollution
- estimation of the aquifer properties of regional hydraulic parameters, assessment of water quality, mineral water analysis
- research on groundwater quality and hydrogeochemical processes, the implementation of the EU groundwater protection policies and directives
- groundwater protection strategies (hydroecological mapping, different kinds of vulnerability maps).

Geological hazards

Project documentation and mapping of slope deformation in the Czech Republic

The subject of mapping of areas with landslides triggered by various processes comprises a major part of the activities of CGS engineering geologists. Their research resulted in the recommendation of mitigation measures after the flooding in the Czech Republic in 1997 and later in the spring of 2006, when a flood caused thousands of landslides and other slope instabilities. The work of CGS is based on the study of geological and anthropogenic conditions of slope instabilities, their mapping, documentation, categorization and possible trend prediction. Special engineering-geological maps of landslide areas at a scale of 1 : 10,000 provide the primary basis for producing simple graphical prediction maps (in three different categories recognized by signal bright colours and digitized using the ZABAGED 2 grid based at a scale of 1 : 10,000) of landslide susceptibilities (landslide hazard map). This map contains areas with characterization based on stability conditions and with specific conditions for various kinds of construction work. This special research project strives to summarize and evaluate as much information as possible on the physiographic settings and mechanism of landslide phenomena in the areas of Mladá Boleslav, Vsetín, Zlín (started back in 1997); Frýdek-Místek, Uherské Hradiště, the eastern part of the České středohoří Mts (Česká Lípa region), the western part of the České

středohoří Mts (Teplice and Most regions) in 2005–2007. The social demand for these projects is significant in terms of the effectiveness of their funding. The maps designed for the state authorities provide a basis for prohibition of construction work in critical areas and define areas of extreme natural hazards. During the first months of 2006, a major snow thaw caused many problems and large slope instabilities, confirming the need for this type of project. Some landslides with a specific size and the affected area have been designated as disaster areas (the landslide areas of Brumov-Bylnice and Hluboče, as well as the tunnel portal of the first-class road in Hřebeč near Moravská Třebová). The CGS documented and issued a recommendation for stability precautions and monitoring of the Vír area duct tunnel portal near Běleč, which has been closed since September 2005. This disturbance was recognized as a serious problem caused, among other things, by slope movements. During the 2004–2007 period, the total damage caused by active slope instabilities reached several million CZK. The total extent of the damage since 1997 has corresponded to approx. 80 million EUR, but only half of this damage has been remedied to the present time. The main goal of the programme in 2007 was the prevention of damage caused mainly by extreme geodynamic processes in the Czech Republic. A slope instability map at a scale of 1 : 10,000 for district purposes, relating to the danger of slope movements, using a relief digital model and some other satellite data (Landsat, ASTER, Radarsat), was created for morphological analysis and mapping of slope movements in the mountain areas of the Frýdek-Místek, Uherské Hradiště and České středohoří Mts districts. In addition, work progressed on a complex map of geohazards, with some quantitative formulations, such as the particular critical features in the Vsetín area and near the Šance dam on the Ostravica River. In total, 160 maps, with the location and description of 5,222 landslides, were completed during the course of the project. During the 1998–2007 period, the Czech Geological Survey compiled 248 maps with 9,811 slope instability locations, complementing some earlier projects in the Děčín–Ústí nad Labem District and the central part of the České středohoří Mts. Altogether, 12,000 slope instabilities are recorded in the CGS database.

Research on Coal Bed Methane in the Czech Republic

Altogether 24 scout boreholes were drilled during 1993–2000, covering an area of ca 800 km^2, mainly in the Upper Silesian Basin (USB). The exploration and particularly the exploitation of the CBM in the Czech Republic were of interest for four companies in 1992 (EUROGAS Kladno, Inc., OKD, DPB Paskov, Inc., UNIGEO Ostrava, Inc., and MCBM Ostrava, Ltd.). Between 1994 and 1998, these companies were authorized to carry out CBM-oriented projects. The expenses connected with the implementation of these projects were mostly covered by the state. The achieved results for the individual boreholes were summarized (with the participation of CGS specialists) in the corresponding final reports, approved by the review board of the Czech Ministry of the Environment. Estimates of the volume of CBM within the Czech part of the USB are sufficiently satisfactory, but the technology for extraction will have to be improved. On the other hand, it became clear that, within the Czech Republic, the USB is an area suitable for further exploration of CBM. In addition to the geological structure and the existence of extensive coal beds within the Ostrava and Karviná formations, the tectonic evolution governing migration of gas and fluids throughout the area during the recent stages of its geological development seems to be a very favourable factor. As a follow-up of the research and exploration works, all the important results were published in the Czech-English book entitled "Coal Bed Methane in the Upper Silesian Basin", published in the CGS.

Applied geochemistry

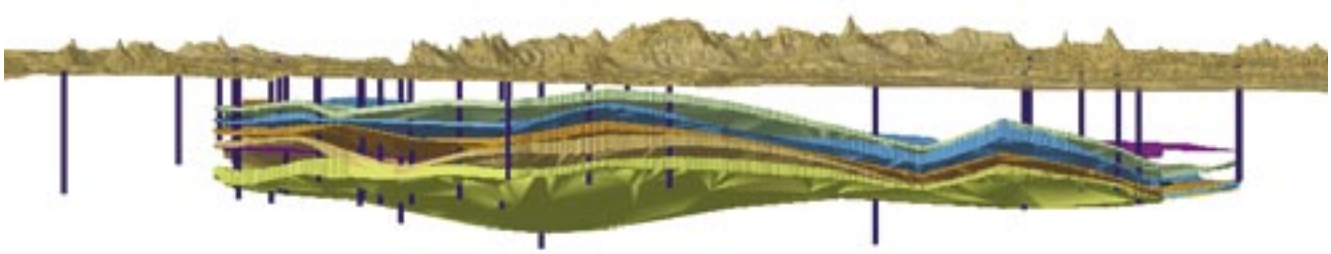
Research on ^{137}Cs marker horizons

The survey aimed to determine the extent, the level and the vertical distribution of selected contaminants in the soils of various cultivation areas (forests, pastures, fields) in the Moravian-Silesian Beskydy area (earlier the districts of the Jeseníky Mts and Králický Sněžník Mt. were evaluated). The research was focused namely on radiogenic ^{137}Cs (half-life of 30.1 years), U, Th, K, and several other selected elements (heavy metals). The connection between the contents of these contaminants and the granularity, the clay fraction and the organic matter in soils will be investigated. In addition, the possible ecological impacts of contamination of the soil in relation to the potential entry of the anthropogenic compounds into the food chain have been analysed.

Be anomalies in the Králický Sněžník Mts

Geological mapping in the Šumperk district revealed some higher contents of Be (up to 18.3 ppm) in the stream sediment samples

Mšeno-Roudnice Basin – potential storage structure for CO_2 – 3D (R. Lojka – L. Kondrová)



collected in the vicinity of the Králický Sněžník Mt. area. These anomalies were detected particularly in the Sněžník Unit of the Orlice-Kladsko Crystalline Complex. Based on interpretation of the whole data set, it is possible to assume that identification of the main or single Be-bearing minerals in the Králický Sněžník Mt. area is not easy, if feasible at all. The indicated Be anomalies do not reflect a high concentration of Be in the primary source rocks or local occurrence of Be minerals (beryl, bavenite), but are undoubtedly connected with the rock chemistry of the wider basement area. Evidently, they are related to changes in the chemical water characteristics (Eh, pH) that lead to transport of even very low contents of flowing Be. The main source consists in the minerals of metagranites and migmatites (graywakes). In the natural water, Be adsorbs on hydrate Fe oxides under some specific conditions and can reach very significant concentrations.

Sources and interactions of methane and CO_2 in the subsurface (SIMCA R&D project)

The project is focused on generation of the above greenhouse gases and associated volatile compounds and their alteration before they reach the atmosphere. Soil and deep gases are collected in cooperation with mining, oil and gas producing and gas-storage companies and characterized by detailed chemical and isotopic methods. The results of regional surveys contribute to better understanding of the critical controls of the subsurface processes producing and consuming different types of greenhouse compounds; these results are being summarized to improve the national greenhouse gas inventory in the Czech Republic. This topic is further dealt with from the prospective of gas sorption and desorption on and from coals in the DFG-GAČR. The high-pressure and high-temperature measurements are performed at RWTH University in Aachen, Germany, and simulate the behaviour of gases and coal seams at real geological depths.

Model of transport of sediments, suspended particulate matter, and contaminants in the Dyje River Basin

The project is concerned with the sub-recent spatial evolution of fluvial and lacustrine sediment bodies in the catchment area of the Dyje River with respect to changes of surface water flow, transport and distribution of selected contaminants in different streams and overbank sediments. Special attention is devoted to hydraulic and morphologic changes in river channels and flood plains as a product of both natural evolution and anthropogenic activity. The fine and very fine fractions of the suspended particulate matter and river sediments, as the principal transport media of pollutants, is characterized by the mineralogical and organic petrological composition and by the surface properties. The model integrates regional to nano-scale processes and provides a tool to estimate the transportation distance and lifetime until full or apparent disappearance. The results will contribute to better understanding of the role of key elements of the sedimentary system and provide criteria for environmental pollution risk assessment.

Applied geophysics

CGS participates in building the Czech National Geophysical Database. Its main development in 2007 was focused on integration of Czech data resources into the GEOMIND international geophysical Internet information system. These activities were performed within the GEOMIND international project co-financed by the EU as part of its eCONTENTplus programme. The system will be implemented in 2008 and will provide unique multilingual access to the information on European geophysical data. Methodology development in geophysical data interpretation for geological mapping purposes and structural geological research represents another important activity in the area of applied geophysics. In 2007, the main attention was aimed at interpretation procedures in gravity and reflection seismics connected with 1 : 25,000 scale mapping of various areas of the Czech Republic.

Capture and geological storage of CO_2

CGS carried out intensive research in the area of underground storage of CO_2. Within EU GeoCapacity – an international project funded by the EU within its 6th Framework Programme – the inventory of potential geological CO_2 storage sites in the territory of the Czech Republic was finalised. The theoretical storage capacities of the structures were calculated and the data were included in the pan-European "CO_2-GIS". Work was commenced on three more detailed case studies, each representing a different geological setting. The case studies concentrate on deep saline aquifers of the Central Bohemian Permian-Carboniferous basins, the Hrušky semi-depleted oil and gas field in the Vienna Basin and unmineable coal seems of the Upper Silesian Basin. In addition, an assessment of the country potential for enhanced hydrocarbon (oil and coal-bed methane) recovery is underway, using the software tools and know-how of other project partners. CGS is the coordinator of CO2NET EAST, an EU-funded coordination project (6th Framework Programme) focused on transfer of knowledge on CO_2 capture and storage, networking extension and awareness-raising in new EU Member States and Associated Candidate Countries.

High level waste deposition

CGS and its applied geology department have participated in projects financed by the Czech Radioactive Waste Repository Authority (RAWRA). During this year, project 54 80 02 "Study of the granitoid joints system dynamics in the Bedřichov waterworks tunnel in the Jizerské hory Mts" will be finalized and project 54 80 01 "Study of far-field interaction processes of a deep waste repository and the high level waste" (ends in 2009) will continue in its second stage. Currently, project work is prepared both financially and professionally for the study "Interpretation of geological and other work at the Melechov massif testing locality" which is expected to commence next year (2009–2014).

Radon risk research

Radon originating in bedrock is considered a major precursor of radon in dwellings. After completing the maps of the radon index from bedrock at a scale 1 : 50,000, further research is focused on statistical evaluation of radon in particular rock types and its link to indoor radon, the comparison of soil gas radon and indoor radon data for administrative units and testing of various geostatistical methods for constructing the European Radon Map – part of the Natural Radiation Atlas of Europe. Broad cooperation with the National Radiation Protection Institute enables reduction of the exposure of inhabitants to natural radionuclides.

Research Centre Task 528001 "Research into the processes of the field of distant interactions of the deep repository of spent nuclear fuel and highly radioactive waste"

The CGS is a leader of the "G-Bariera" Consortium established in 2007 to develop a scientific and engineering base for the evaluation of the main functions of far-field interactions in natural barriers for final disposal of highly radioactive wastes in granitic rocks in the territory of the Czech Republic. The other members of the Consortium are the Institute of Nuclear Research, Rez a.s., the Technical University in Liberec and Stavební geologie-Geotechnika, a.s. Other institutions, including the institutes of the Academy of Sciences of the Czech Republic, also participate in the research. The Consortium uses geological, hydrogeological, geophysical, geochemical and geotechnical data from three granitic bodies in the Nejdek-Eibenstock pluton, the Melechov Massif and the Jizerský Massif and from the underground reservoir of gas at the Příbram granite massive to characterize the properties and behaviour of a potential rock environment as a hypothetical deep repository for spent nuclear fuel. The data are used as an input in computer models of groundwater flow, water-rock interaction and migration of radionuclides in fractured granite.

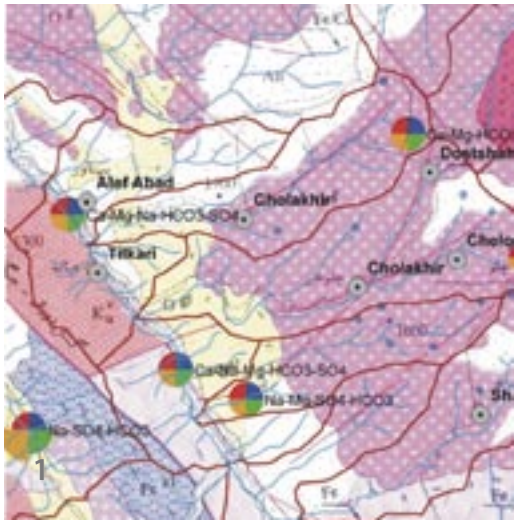
Task 690100 "Advanced Remedial Technologies and Processes"

The CGS is one of the key partners in the Advanced Remedial Technologies and Processes Research Centre headed by the Technical University of Liberec and financed by the Ministry of Education, Youth and Sports of the Czech Republic. The role of the Survey lies in development and application of advanced methods of geological, hydrogeological, geochemical, and geophysical data retrieval as a basis for modelling the processes and technologies to meet the strict requirements on groundwater quality and environmental safety. The research is directed towards the development of field methods to obtain the data required for safety evaluation and behaviour modelling of the geological repository of spent nuclear fuel and high-level radioactive wastes. Additional topics include a field study of natural purification processes at the "Pozďátky" toxic wastes dump in Třebíč, modelling of geological structures buried under sedimentary basins of the Bohemian Massif and modelling of metamorphic processes in the bedrock of the basins. Within the Centre, the survey contributes to the education of young experts in accredited Ph.D. programmes.

The 2005 and 2006 period

More than 160 maps of slope instabilities at a scale of 1 : 10,000 including 5,200 slides have been produced in recent years. The regional research on ^{137}Cs distribution in soils has been completed in the Moravskoslezské Beskydy, Jeseníky, Králický Sněžník, and Orlické hory Mts Protected Landscape Areas. Work progressed on the evaluation of the measurement of the radon risk and production of radon index maps at a scale of 1 : 50,000. The research centre successfully prepared an assessment of potential hazards for the rock environment resulting from the storage of radioactive fuel (modelling of distant interaction processes).

1) Groundwater type and content of Ca^{2+}, Na^{-}, SO_4^{2-} and HCO_3^{-} in the examined springs
2) Sampling of groundwater from several sections of a drill hole in granite of the Eibenstock-Nejdek Massif
3) Water pressure test at a drill hole to evaluate the permeability of granite



State Geological Survey Administration

Darja Skácelová
Project Secretary & Quality Manager

The Czech Geological Survey undertakes geological surveying on the territory of the Czech Republic in accordance with the current wording of the foundation deed. The CGS is also recorded in the list of institutions qualified for expert activities. The keystone, enabling expert geological support for decision-making on subjects of state and public interests, lies in the expert activity of district geologists and specialists in sediment geology and hydrogeology, complemented with advisory activities responding to the requirements and needs of the state and public administrative authorities throughout the entire territory of the Czech Republic. The aim of this activity consists in the continuous acquisition, collection, preservation, and especially professional processing and provision of data concerning the territory geological composition of the state, protection of mineral resources and groundwater sources and information on geological hazards. The data serve for subsequent political, economic, judicial and environmental decision-making employed, for example, in land-use planning, environmental protection, landscape and natural resource protection, as well as determination of the environmental stability of the territory.

The Administration of District Geologists, a three-member administrative unit pursuing the 3500 project entitled "Geological construction as a conditioning factor of the use and development of the territory of the Czech Republic", performed a total of 365 different service acts for the state and autonomous authorities, courts, universities, non-governmental and non-profit organizations, and other bodies in the course of 2007 within the System of Quality Assurance in accordance with ČSN EN ISO 9001 (1999) Standard. Work on these activities was performed, on an asymmetric basis, by individual working teams composed of a total of 38 district geologists, 14 district deposit geology specialists and 6 district hydrogeology specialists with cooperation, where required, from 5 non-localized engineering geologists. For the effective management of such a large and highly heterogeneous team and in view of the personnel changes within the CGS, it was essential to update CGS Director's Regulation No. 2/2004 for the advisory and service activities of district geologists and district specialists, in effect from July 1, 2004, through Amendment No. 6 (2007). In 2007, complete documentation of written and graphic records of all activities concerning the 3500 project was archived on the intranet. The entire record agenda of the Administration of District Geologists was fully controlled on-line by the CGS Portal and the entire record was continually updated in close cooperation with the CGS IT section. This was related mainly to the compatibility of the system with the Register of documents and records, becoming the leading regulation controlling distribution of all the CGS documents.

Examples of activities carried out by district geologists and specialists in 2007

- Views of the land-use planning documents (Area Development Principles) of large land district units of Olomouc, Ústí nad Labem, and Zlín
- Views of slope instabilities on the entire territory of the Czech Republic

- Natural Monument Protection Status exemption (e.g. the Barrand Rock)
- Reconnaissance of temporary hydrogeological phenomena in connection with an anthropogenic use of the North Bohemian Basin (settling pits, spoil dumps etc.)
- Assessment of geothermal energy use projects
- Views on preservation of brown coal land-environmental mining limits
- Assessment of various mineral resource mining projects in the entire area of the Czech Republic
- Expert verification of the current state of anthropogenic impact at the site of the former cleaning plant of the Jáchymov mines

Reconnaissance and proposals for the safety of old mining works over the entire area of the Czech Republic

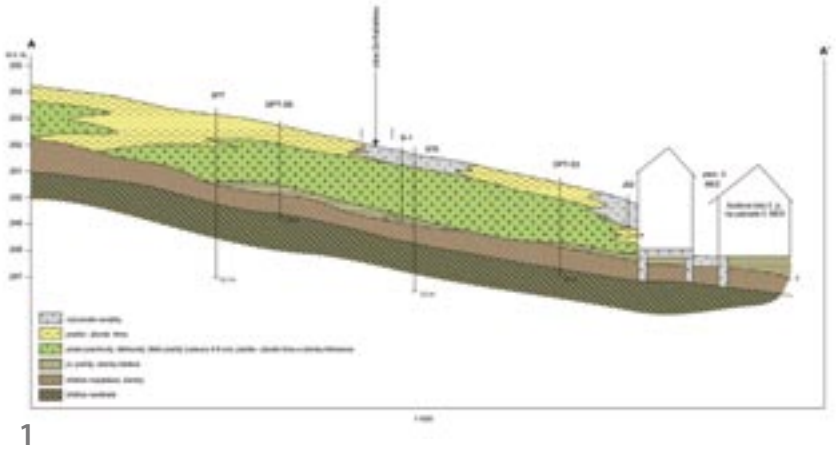
- Territorial-analytical documentation analysis in accordance with Act No. 183 Coll., as amended, according to district resource policies
- Opinions concerning new allotment specification
- Views on selected mineral resource exploitation in relation to the state energy policy
- Expert opinions for the district, municipal, and regional courts
- Opinions on the impact of hydrogeological phenomena on the rock environment (e.g. Lednice Lakes, Sedm Dvorů, Neveklov, Pečky, Tmaň etc.)

The Czech Geological Survey undertakes the state geological survey of the Czech Republic within the framework of its research and development activities, as formulated in the founding deed and in accordance with Section 17 of Act No. 62/1988 Coll., as amended. The system of district geologists and associated specialists assists in the acquisition of background data and in providing expert information in accordance with the requirements of all levels of the governmental authorities of the Czech Republic. These expert opinions are employed in various political, economic, and ecological decision-making concerning land-use planning, natural environment protection, natural resource management and protection, remedial activities for old environmental hazards and other important environmental issues. More than 365 such expert opinions were issued in 2007, some of them on important matters such as new building sites, remediation of old mine works, regional or local groundwater pollution or land-use planning documents in various districts of the Czech Republic.

The 2005 and 2006 period

Similarly, 327 activities were performed in 2005, while in 2006 the number increased to 348 activities. In both years, expert opinions for different types of the land-use planning documentation, ranging from large territorial units and regional urban agglomerations to individual towns and villages predominated among the activities performed. The year 2006 was, atypically, marked by an increase in demand for the analysis of slope instabilities, constituting approximately one quarter of all the recorded activities. An increased number of operations concerning the exploitation of minerals, especially nonmetalliferous, resources, was characteristic for 2005.

1) Schematic geological section of a location in Prague-Hostivař (R. Kadlecová – P. Kycl)
2) An overall view of the rock formation at Vyhlídka, Nový Kramolín near Domažlice, composed of quartz phyllonites. Both the parts of the outcrop are highlighted, as well the main structure planes of several systems and different inclinations (Photo J. Zvelebil)



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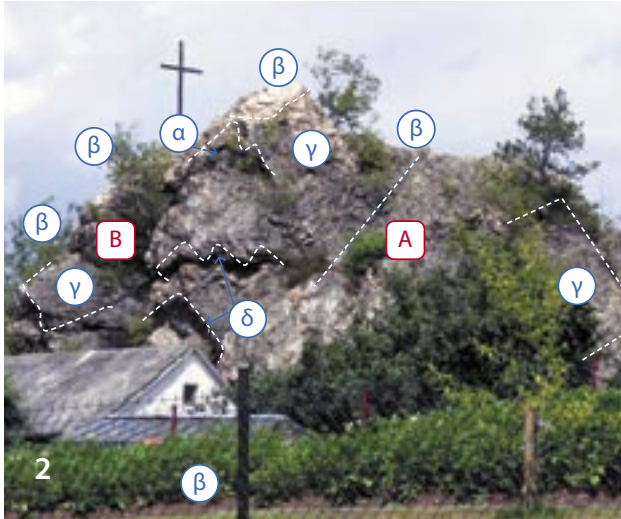

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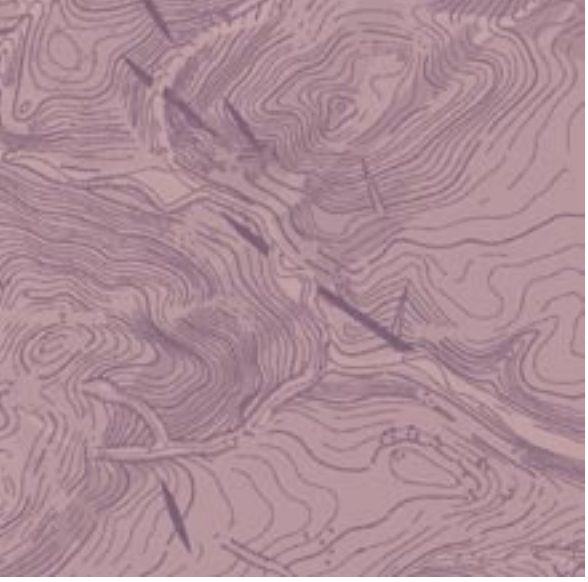


Management and delivery of geodata

Zuzana Krejčí
Head of Department of Information Systems

The Czech Geological Survey is responsible for the collection, preservation, analysis, and provision of geoscience data and information. Thus, the creation of a structured and continually updated national geological information system (GeoIS) representing an essential source of information for the state geological service performance, as well as support for decision-making at all levels of the state administration, is an activity of strategic importance. Furthermore, GeoIS is used as a tool in CGS research activities and popularization of geology among the general public. The GeoIS concept and development, moreover, comply with the legislative requirements of the Czech Republic and the EU concerning access to information, interoperability of data sources and integration into the national and European spatial information infrastructure (European Commission INSPIRE Directive).

National Geological Map Database (NGMD)

Since 2005, the development of GeoIS has been bound particularly with the implementation of the NGMD concept. This long-term programme has been designed as a complex knowledge and information system integrating individual geodatabases of vectorized geological maps at various scales into the extensive database of digitized geoscientific maps and related documentation deposited in the CGS Archive. Creation of the NGMD has three main objectives:

- **Data Integration** – NGMD provides a unified environment for the integration of existing data and information obtained from geological mapping.
- **Research & Development** – deploys modern techniques, technologies, and application facilities enhancing effectiveness of CGS activities, as well as data relevance and quality.
- **Data dissemination** – ensures the presentation and effective evaluation of geoscientific data and information.

The implementation of the NGMD project reflects the current state of the national geological map databases abroad and draws upon a detailed analysis of the present-day development of individual geographic information systems at different scales: GEOCR25, GEOCR50, GEOCR 500, DigArchive.

The following general principles are employed in the formation of the NGMD:

- the use of uniform procedures for gathering, storing, and provision of data and information
- standardization of geoscientific terminology (creation and maintenance of geoscience lexicons)
- integration of geoscientific mapping services in the emerging national (global) spatial information infrastructure in accordance with the requirements of the European Commission INSPIRE Directive, e-government programmes, GMES, GEOSS, focusing mainly on technological and content interoperability (e.g. OGC, ISO standards).

Digital Geological Field Logbook

The Digital Geological Field Logbook serves as a central repository application for NGMD data. It constitutes an extensive database for creation and administration of complete geological map documentation, as well as documentation arising from mapping for the purposes of engineering geology, hydrogeology etc. at various scales. The application provides, among other things, the tools for:

- storage and management of descriptive data and a whole range of other measurements

- localization of documentation in a selectable base map
- document upload (photos, texts, graphs, coordinate files from GPS)
- conversion of coordinates (S-JTSK, WGS84, S-42)
- database administration (monitoring of the capacity and current changes in the database, etc.)
- data upload to the offline version of the application for use in field.

Geographic Information Systems (GIS)

The GIS development as a corporate tool for spatial data processing and use is an integral part of the formation of NGMD. Geographic Information Systems are currently used in all the processes related to map production, including the methods of geological mapping (digital data collection, tools for the derived map construction etc.) In research both in the Czech Republic (1 : 25,000 geological mapping) and abroad (e.g. 1 : 50,000 mapping of the Mongolian Altay), modern GIS techniques are used routinely in the area of spatial data analysis (derived or applied map creation) or 3D geological modelling.

Central Data Storage (CDS)

The database of NGMD is based in the Central Data Storage launched within RDBMS Oracle. Also, CDS is formed by a range of other data sources representing the results of CGS projects. In total, CDS includes as many as 52 thematic databases based on a uniform platform and utilizing unified lexicons. The CDS development also involves the advancement of the environment, enabling access to data and information by means of the applications integrated in the CGS Information Portal.

Metadata Information System (MIS)

The increasing amount of data stored and administered in GeoIS and the requirements for the accessibility of information on data sources and services has led to the content and technological upgrading of the CGS Metadata Information System. The present-day geological MIS, based on the standardized geological profile for metadata (ISO 19115, 19119, 19139), is an organic part of the metainformation system of the Ministry of the Environment, and is fully compatible with the EC INSPIRE directive. The system encompasses structured information on services, ways and purposes of data creation, their quality, accessibility, and serviceability etc.

Provision of geoscientific data and information

CGS Information Portal

The CGS Information Portal represents an integration platform for the CGS Information System. In 2006, the overall technological upgrade of the system was carried out, which involved, in particular, improvements in the information search, support for CGS activities and increased security – personal data protection, email integration or user-friendly tools for self-publishing. Moreover, a new Czech and English version of the extranet comprising 65 thematic applications was launched in 2007. The development of the CGS Information System has been supported by two extensive projects, facilitating a new approach to publishing geodata: "Information Portal of Geohazards in the Czech Republic" (2005–2007) and "Portal of the State Geological Survey" (2005–2007).

Portal of Geohazards in the Czech Republic

The development of the portal directly reflects an increase in demand for the interpreted geoscientific information. The systems of Internet applications (web services) along with the GeoReports reporting application allow non-professionals to access on-line applied data (subsoil radon, terrain instabilities, groundwater vulnerability) in the areas selected by the users. The reports are always supplemented by professional recommendations for land use with regard to the occurrence and intensity of the geohazard or rock subsoil vulnerability. Also, the portal features the Catalogue of Geohazards (a structured description of all potential hazardous geofactors in the Czech Republic).

SGS Portal

SGS portal (www.geologickasluzba.cz) is a distributed www system, enabling virtual interconnection of CGS, CGS-Geofond, and CENIA

Geological map of the Czech Republic 1 : 500,000 – a new solid geology map received a prestigious award "The Map of the Year 2007" in the competition organized annually by the Czech Cartographic Society

One of the digital cartography products of the information system of the project ZAMTYN NURUU 50 – Hydrogeological map

through sharing data sources and map services. The resulting applications facilitate, for instance, interconnection of the GEOCR 50 database with the database of boreholes or access to the geological documentation archives (both maps and reports) of both organizations. The joint geological MIS (EN ISO 19115 and 19139) is part of the SGS portal.

WWW Map Server

The server is integrated in the CGS Information Portal (e.g. joint authorized access to applications). Via the map server, CGS ensures free provision of spatial data. The map services are used in the following types of applications:

- access to information about maps and documents deposited in the CGS Archive
- access to NGMD data
- thematic applications aiming at particular issues and research solutions
- on-line shop.

Digital documentation diary

CGS has taken advantage of sharing the map services with other organizations (Ministry of the Environment, CENIA, ANCLP CR) on a long-term basis. This also implies the transfer of the CGS map services from the platform of ArcIMS to the standard platform of OGC – WMS, WFS mapping services.

Digital cartography

A new methodology of digital mapping based on ESRI technologies has been successfully employed. Two finalized large-format maps have received prominent cartographic awards:

- Geological Map of the Czech Republic 1 : 500,000 – 1st prize in the Map of the Year competition organized annually by the Czech Cartographic Society – "Individual Mapping Project" category.
- Map of the Nicaraguan Volcanic Chain 1 : 200,000 – 3rd prize in the international Map Gallery competition within the 26th Annual ESRI User Conference, San Diego, USA – "Cartographic Design" category.

Furthermore, the new system of digital mapping is also used in processing the outcomes of geological and thematic 1 : 25,000 mapping (113 map sheets) and within international projects.

Receiving of the award for the poster "Geological and thematic maps as a product of the information system of the project ZAMTYN NURUU 50" at the 16th GIS ESRI Conference in Prague (Photo: Archive of the Geobusiness journal)

Information and Communication Technologies

High quality ICT technology development represents the backbone of a modern geological survey. The technological development of ICT at CGS currently focuses on two fundamental goals: increasing the computer network security, and central administration of the network components and processes. These aims have been achieved through the following activities:

- management of authorized access to network components (PC, printer, network unit) – MS Active Directory implementation
- gradual implementation of a new antivirus system, i.e. extended e-mail and web control, bi-directional firewall, and antispyware and anti-rootkit protection
- new Mail Server System based on the Linux platform and applying the central authorization protocol.

Currently, the HW platform of the CGS internal network is created by 13 servers (OS Linux) and 367 PCs (OS MS Windows).

International cooperation

The achievements and conceptual approach to data management and provision of geoscientific data and information are of such a high level that some specialists have become welcome partners for work on international projects and initiatives. In addition to the numerous examples of bilateral cooperation, these consist in the following international projects:

- OneGeology Europe – EC e-ContentPlus project (WP leader)
- GEOMIND – Geophysical Multilingual Internet-Driven Information Service (a contribution to the EC e-ContentPlus programme)
- AEGOS – African-European Georesources Observation System – FP7 project (WP leader)
- EarthSemantics - Ontology-based Multilingual Interoperable Service for Earth Sciences – project proposal (4/2008) FP7-ICT Digital libraries and technology-enhanced learning (WP leader).

The period of 2005 and 2006

The development of informatics focused mainly on the formation of modern geological infrastructure, development of GIS methods and information services in geology for efficient dissemination of data and information among the professional and non-professional public. The NGMD concept proposal was outlined and it is being gradually implemented as a complex information system of geological mapping data. The expert harmonization of regional-geological units, the national GEOCR50 – Version 3, continued. In accordance with the European Commission INSPIRE directive, the core of MIS (ISO 19115 and 19139) was created. A new version of the CGS web was launched, which completed the technological upgrade of the CGS Information Portal. While creating the CGS Information Portal, the projects "Portal of State Geological Survey" and "Portal of Geohazards in the Czech Republic" were dealt with. Participation in the projects of applied and regional geology in the Czech Republic and abroad: Landscape Atlas of the Czech Republic, radon risk mapping, 1 : 500,000 geological map of the Czech Republic, projects of international development aid – Peru, El Salvador, Nicaragua, Mongolia etc.

Remote Sensing

Veronika Kopačková
Head of Group

Earth observation or Remote Sensing plays an important role in the monitoring of global, regional and local geological, morphological and environmental aspects. In accordance with the latest trends, a new Remote Sensing Centre (RSC) was established in the CGS in 2006, in order to provide geological activities with expert interpretation of Earth observation data. Although the RSC is a part of the Department of Crystalline Complexes, remote sensing specialists are involved in a wide range of geological projects across the CGS. The group is also involved in training activities and either organizes or cooperates on various teaching courses.

In 2007, the team focused on two major themes:

- the mineral spectroscopy method applied to the open-mine environment
- slope instability modelling for highly hazardous terrains.

A collaboration between the RSC (in the framework of the project "Environmental Impact of Mining", 2007–2009, funded by the Ministry of the Environment) and BRGM (in the framework of its self-funded RTD projects) commenced in 2007 for the Sokolov lignite mine, focusing on mining impact assessment using high-altitude and ground-based spectroradiometry. A first preliminary field reconnaissance was organized during the first two weeks of September, 2007. Field spectroradiometric measurements under natural lighting conditions, together with laboratory measurement under artificial lighting conditions (ASD Fieldspec 3 spectroradiometer), allowed building of spectral libraries for representative samples of jarosite, goethite, hematite and clay mineral groups and creation of the very first spectral mineral maps based on classification of ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) images.

In 2007, the Remote Sensing Centre finished a detailed study dealing with evaluation of landslide-prone zones in the northern part of El Salvador using multivariate statistical methods while integrating diverse digital data sets, including various derivatives of digital elevation models (DEMs) as well as Landsat-based information, such as micro-lineament density and landcover; seismic database, geological, and morphological maps. As a result, a landslide susceptibility map integrating morphological, lithological and hydrological information was computed. Delineated hazard zones were validated with a landslide inventory map and both the model and terrain mapping showed a good agreement.

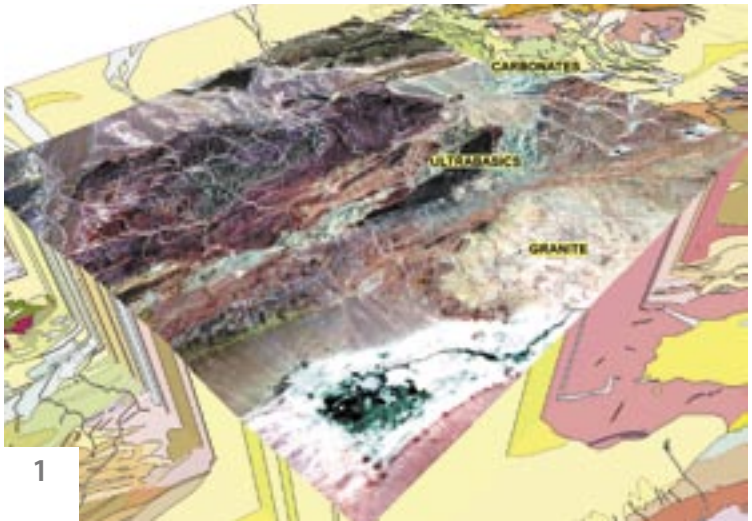
International cooperation

- Monitoring of mining impacts based on optical and thermal spectroscopy – Observation des effets d´exploitation à ciel ouvert fondé sur la spectroscopie optique et thermique – Joint bilateral collaboration (The Ministry of the Environment and BRGM, since 2007).
- Grupo Latinoamericano de Investigación de Deslizamientos – Latin-American group on landslide hazards (since 2008, in a cooperation with CSUCA – ASDI/SAREC).

The period of 2006

Since its foundation in 2006, the RSC has been engaged in practically all the aspects of modern geographical data handling, integrating remote sensing data with GIS and other simulation and modelling techniques. As remote sensing is an ideal tool for continuous surveying and inventories of natural resources, these techniques have become integral components of numerous Earth resource applications in the CGS, including geological mapping, structural analysis, mineral exploration, geomorphologic interpretation, geohazard mapping, etc. The specific and extreme natural conditions in Mongolia, Iran or Peru, namely lack of vegetation and exposure of rocks, enhance the utilization of such advanced methods.

1) Mongolia – ASTER Image
False colour composite ASTER image of Gobi Altay draped over a digital elevation model along with the geological map
2) Landslide susceptibility map – El Salvador study
The final hazard map classified into five categories of landslide susceptibility: very low, low, moderate, high and very high



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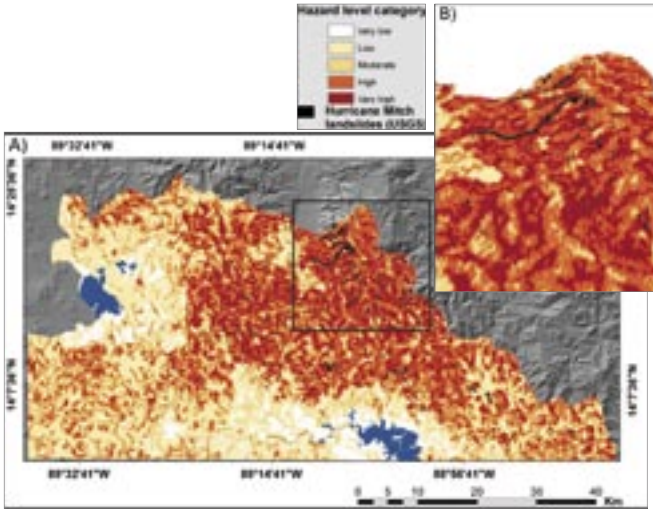

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International activities and cooperation

Lenka Hradecká
Head of Section of International Cooperation

International activities and cooperation of the Czech Geological Survey involve various kinds of projects, such as Foreign Development Aid, broad bilateral cooperation, International scientific programmes, geological research in Antarctica and the Geochim UNESCO courses. All these activities are an integral part of the CGS 2005–2010 Research Plan. CGS is active member of many international organizations. In 2007, director of CGS Zdeněk Venera, acted as a president of the EuroGeoSurveys organization. CGS also intensively supports activities within International Year of Planet Earth and its participation in the OneGeology initiative.

Foreign Development Aid

Within the Czech Governmental Development Assistance Programme and under the garancy of the Ministry of the Environment of Czech Republic, the CGS has carried out projects in Central America and Peru. The project of geological mapping in Mongolia was completed and the results were delivered to the Mongolian partners. The Central American project entitled "Regional geological survey for definition and prediction of natural hazards in parts of Central America" methodically continued the work on previous projects performed in Nicaragua, El Salvador and Costa Rica. The main aims of the Central American project can be specified as follows:

- study of the vulnerability of various geologically and geomorphologically defined areas geological mapping (mostly completely new) including full documentation
- evaluation of geological, geomorphological, meteorological, hydrological and other processes and their potential negative relationships to natural disasters
- establishment of permanent cooperation with the partners of government organizations in developing countries; this can contribute outstandingly to competition with other cooperating institutions such as those of the USA, Germany, Japan, Spain etc.

The project in Peru is concerned with the research and examination of geomorphological and hydrogeological conditions in the catchment of the Piura River in terms of reduction of environmental factors, restrictive for social and economical development of the region. The geological map at a scale of 1 : 200,000, covering the entire Pacific volcanic chain of Nicaragua, was published in 2007. Geological and geomorphological information constitute a synthesis of 5-year studies by Czech and Nicaraguan teams.Orogenic processes were studied in the Kaoko belt in Namibia. Here, the structural, petrological, and geochronological results define the contemporaneous evolution of two neighbouring crustal segments exhumed from different depths. The geochemistry and petrogenesis

of subduction-related magmatic activity were examined in granitoids of the Californian Sierra Nevada Range.

Bilateral cooperation

CGS has signed a bilateral protocol on scientific cooperation with the Geological Surveys of Slovakia, Poland, Austria, Germany, Hungary, and Slovenia and Geological Institutions in Nicaragua, Costa Rica, Chile, Iran, Mongolia, Uzbekistan and Russia. The cooperation is based on joint mapping, long-term activities of geological and paleontological specialists, exchange of geological experience, scientific literature and information on conferences and workshops. Together with the geological surveys of Slovakia, Austria, Germany, and Poland, we concentrate on cross-border regional geological research, mapping and correlation of geological units, their facies and stratigraphy. In 2007 this work was performed in the Orlica-Bystřice Mts and Opava Mts. The EU project "Geostrada Sudetska" (INTERREG III A Czech Republic – Poland) has been initiated and started in the NE of the Czech Republic.

International scientific projects

Geologists, geochemists, paleontologists, and other specialists from CGS participate in several international research projects financed by Czech and foreign grant agencies, the European Union, projects of the Ministry of Education of the Czech Republic (KONTAKT, BARRANDE, INGO). Within the Research Plan of CGS, the following projects are being pursued:

- EUROLIMPACS – Evaluating the Impacts of Global Change on European Freshwater Ecosystems – 6FP project of the EU
- BIOSHALE – Black Shale Ores using Biotechnologies – 6FP project of the EU
- Activities within the Society for Geology Applied to Mineral Deposits – project INGO (Inter Non-Governmental Organization)
- GeoCapacity – Assessing European Capacity for Geological Storage of Carbon Dioxide – 6FP project of the EU
- Assessment of Potential for Geological Deposition of CO_2 in Greece and the Czech Republic – KONTAKT project
- Abiotic System of Oligotrophic Waters – KONTAKT project
- GEOMIND – Geophysical Multilingual Internet-Driven Information Service – project of the EU
- CO2NET EAST – CO_2 Capture and Storage Networking Extension to New Member States – project of the EU
- Biophosphatization and sulphidization of organic matter in black shales and remobilization and fractionation of metals – BARRANDE project
- Fractionation platinoids in different types of geological environment for examples of selected metalliferous deposits of Polar Urals – KONTAKT project
- Sources, transport and fractionation of platinoids from selected gigantic/extensive deposits of gold and copper in Uzbekistan – project KONTAKT
- Evaluation of effects of Göteborg Protocol for acidic waters and soils – project of Norway
- Soil Crit Zone – research on the Critical Zone – 6FP project of the EU

Cooperation within IGCP (International Geological Correlation Program) Projects:

IGCP 503 – Ordovician Palaeogeography and Palaeoclimate
IGCP 497 – The Rheic Ocean – its Origin, Evolution, and Correlatives
IGCP 502 – Global Comparison of Volcanic-hosted Massive Sulphide Districts
IGCP 479 – Sustainable Use of the Platinum-Group Elements in the 21st Century: Risks and Opportunities
IGCP 486 – Au-Ag-telluride-selenide deposits
IGCP 499 – Evolution of Ecosystems and Climate in the Devonian
IGCP 469 – Late Variscan Terrestrial Biotas and Palaeoenvironments

1) CGS membership in international organizations
2) Joint Czech and Slovak quaternary excursion within bilateral cooperation
3) Block of coarse agglomerates of debris-flow, outer part of Santa Lucia Caldera, Boaco, Nicaragua (Photo P. Hradecký)


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Geological research in Antarctica

Geological research in Antarctica has continued within the VaV/660/1/03 project, currently being finalized, and the newly established VaV SPII 1a9/23/07 project. Research is concentrated on basic geological mapping in the northern deglaciated part of James Ross Island in the David Dome, Monolith Lake, San José Pass and St. Martha Cove areas. Volcanological studies, research on glacial/interglacial cyclicity of Neogene glacigenous and glacimarine sediments, as well as a study of clast provenance and temperature/metamorphic history of Triassic, Cretaceous and Terciary flysch sediments were performed in the James Ross basin (analogous rocks were studied in Dosolacion Island in southern Patagonia).

Geological research in Iran

The title of the Iranian project is: "Capacity Building of the Geological Survey of Iranian staff in Geological Mapping at a scale of 1 : 25,000 for selected map sheets in the Eastern Azerbaijan Province of Iran". In total, 4 map sheets should be completed in 2008 (Avan, Eshtobin, Ahar and Ghalandar). Geological mapping, economic geological prospection and environmental mapping are the three main aims in the northern, extremely mountainous part in the Lesser Caucasus. Economic geological prospection works and geohazard data sampling are envisaged in the southern region surrounding of the Ahar city. In addition to geological mapping in different informative layers of geological disciplines, workshops are held, supervised by our experts in different branches. Three workshops have been organized in both Tehran and Tabriz. For the first time in the history of the Geological Survey of Iran, a direct online television connection was installed during the third workshop in Tabriz.

Activities within International Year of Planet Earth (IYPE)

During 2007, the active web page www.rokplanetyzeme.cz served the purposes of IYPE. It provides all the information on IYPE-Cz events and promotions. Regular series of documents and debates are prepared for the Czech TV24 and the Czech Radio Leonardo. An animated 40´´ TV spot for IYPE is funded by the Czech Ministry of the Environment. Many popular geological books have been published under the IYPE logo. Fifty Czech UNESCO schools accepted IYPE as a leading program for 2008. One of the most popular events of 2007 was an art competition for school children entitled "My Piece of Earth" inspired by the Planet Earth/Gaia.

The national round of the student 2007 IYPE competition was organized by the IYPE-CZ national committee. Two student winners took part in the Paris IYPE GLE, and made a student video documentary of the Paris event. The coordinator of the IYPE CZ, V. Stedra, took part in the IYPE NC meetings in London and Vienna (2007), and in the GLE in Paris.

International memberships

CGS is member of EuroGeoSurveys, International Union for Quaternary Research, European Association for the Conservation of the Geological Heritage (ProGEO), Central European Initiative (CEI), International Association on the genesis of Ore Deposits (IAGOD), Carpathian-Balkan Geological Association (CBGA), World Goldpanning Association, Commission for the Geological Map of the World (CGMW), European Network for Research in Geo-Energy (EneRG), Association of European Geological Societies (AEGS), Society for Geology Applied to Mineral Deposits (SGA),

4) Geologists from the CGS with their colleagues from Costa Rica in the field at Puerto Calderas, Costa Rica (Photo V. Žáček)

5) Members of the Czech-Iranian mapping expedition in the summer of 2007 (Photo J. Otava)

Carbon Dioxide Knowledge Transfer Network (CO2NET), and Europamines. The CGS organizes the annual meeting of the latter organization and a week-long excursion programme.

OneGeology Europe

It is the aim of OneGeology to create dynamic, digital, geological map data at a scale of approx. 1 : 1 million for the world and to make it web-accessible. This is an international initiative of the geological surveys of the world and represents a geological survey contribution to the International Year of Planet Earth. The CGS is among 79 nations now participating in this project. Since 2007, CGS has been an active member and, since 2008, among 21 geological surveys, also the leader of one working package of the OneGeology Europe – EC e-ContentPlus project.
http://onegeology.org

GIC

CGS is one of 26 members of the Geoscience Information Consortium (GIC). Its main objective is to support the exchange of information among Geological Surveys Organizations related to the use and management of geoscience information systems in support of the earth sciences internationally. From the year 2007, the CGS Head of Division and Deputy for Informatics, Mr. Robert Tomas, performs the duties of executive secretary of GIC.
http://www.geology.cz/gic

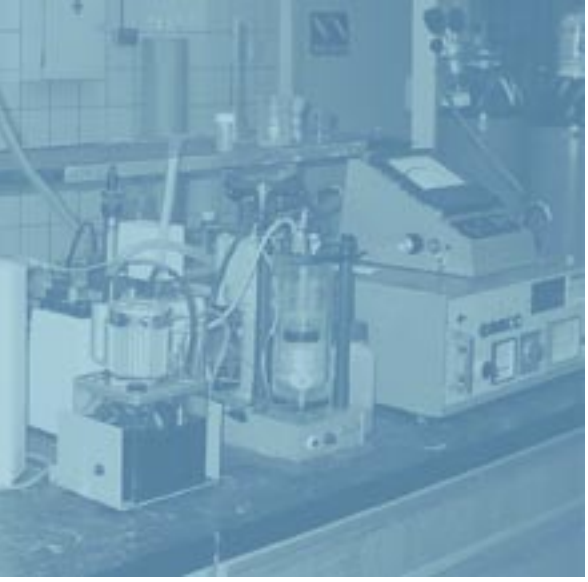
International activities in 2005 and 2006

Projects of the Czech Development Assistance Program:

- Assessment of the impact of mining and processing of copper ores on the environment of the Copperbelt, Zambia
- Assessment of the impact of mining and processing of ores on the environment in the mining district of Namibia
- Geological survey of selected areas of Mongolia at a scale of 1 : 50,000
- GEOCHIM course coorganized by the UNESCO
- Evaluation of gold sources in waste material after artisanal exploitation in Burkina Faso and possibilities for their further economic use
- Geological study of natural hazards, province of Santa Ana, NW El Salvador Geological study of vulnerability and hazards, area of Ocotal-Dipilto, Northern Nicaragua
- Reconnaissance geological study of the area of Miramar, Dept. Guanacaste, Costa Rica
- Geological study of natural hazards, Estelí area, Nicaragua
- Reconnaissance geomorphologic study of the area of San Salvador Assessment of the natural hazards in the central and upper parts of catchment of the Chira and Piura rivers in north-western Peru, investigation of the possibility of prediction of natural disasters and reduction of consequent damage.

6) Extraction of gold by washing crushed ore in sluice boxes at Pousghin, Ganzourgou region, Central Burkina Faso (Photo J. Pašava)

7) Cap Lachman – the northernmost promontory of James Ross Island during low tide. Erratic blocks originated from the Antarctic peninsula (Photo B. Mlčoch)



CGS Laboratories

Laboratories are an integral part of the Czech Geological Survey and are concerned with the following areas: The CGS Central Laboratory in Prague, performs inorganic analyses of various materials. The Testing Laboratory in Brno, provides chemical analyses of organic compounds in various materials. The system also includes the laboratories of the Rock Environment Geochemistry Department, as well as the laboratories of the Environmental Geochemistry and Biogeochemistry Department. The former predominantly provide services for clients; the latter are more of a research character. In 2007, a new ultra-trace laboratory for preparation of samples for further analyses was opened.

Věra Zoulková
Head of Prague Laboratory

CGS Central Laboratory

The CGS Central laboratory has profited from its prolonged experience in the analysis of rock materials, sediments, the air and surface waters. It is also concerned with inorganic analyses of non-specific materials (conifer needles, peat, wood, etc.) In the sphere of solid samples, the greatest customer demand is for silicate analysis. Complete tests of various surface or atmospheric waters are performed in the water analysis department. In addition, the laboratory carries out trace element specification, various types of tests and other special determinations (Au specification, docimastic analysis to determine Pt-metals). The following instrumentation is used for these analyses:

- Retsch jaw crusher, Retsch SK-1 hammer mill, TS 100A vibrating mill, Siebtechnik – sample preparation
- Elmer Analyst 100 and 3100 Perkin atomic absorption spectrometer for main component and trace element measurement
- Emission spectrometer equipped with Iris Advantage Thermo Jarrell Ash induction-fixed plasma unit for rare soil element and water cation measurement
- Elmer 4000 Perkin atomic absorption spectrometer – equipped with hybrid generation – As, Sb, Bi specification
- 9400 Advant XP ARL wave-dispersive X-ray spectrometer – trace element assessment
- AMA 254 Altec mercurometer – Hg determination Eltra CS 500 analyser – C, S, CO_2 determination
- Perkin Elmer Hitachi 200 or Perkin Elmer Lambda 10 spectrometers for Fe, P, and ammonium ion measurement Shimadzu LC-6A or Alltech 650 chromatographs – anion determination
- Perkin Elmer 4100 atomic absorption spectrometer equipped with electro-thermal atomisation – trace element specification Radelkis pH-meter PX-meter, conductometers
- Tekmar – Dohrmann Apollo 9000 complete carbon and nitrogen analyser.

Laboratories of the geochemistry departments

The research activities of these departments encompass a wide spectrum within the earth sciences, from mineralogy and petrochemistry to the geochemistry of the atmosphere, hydrosphere, and terrasphere, and even interdisciplinary environmental sciences, such as biogeochemistry, plant and soil ecology, and global changes. The Laboratory of Mineralogy and Special Methods consists of a number of units: the Mineral Separation Facility, Thin Section Facility, Optical Microscope Facility, and Fluid Inclusion Facility. The X-ray Diffraction Facility, equipped with a Philips X'pert System powder diffractometer, has participated in mineralogical, geochemical, and environmental projects. Its work has included qualitative and quantitative phase analysis, crystal structure refinement, description of new natural phases. The X-ray Microanalysis Facility (LAREM) is equipped with two independent analytical systems: a LINK ISIS 300 energy-dispersion (ED) system with an ultra-thin window, and a

Microspec wave-dispersive system. The laboratory has performed over 100,000 quantitative chemical analyses. The Laboratory of Experimental Petrology studies phase relationships and synthesizes mineral phases. The Micropaleontological Facility prepares microfossils for examination under the CS 3200 scanning electron microscope. The Laboratory of Stable Isotopes is equipped with two mass spectrometers, a Finnigan MAT 251 and a Geo 20-20 instrument. Routinely available analyses include: the determination of 13C, and 18O in carbonates; 2H and 18O in waters; 13C in solid, liquid and gaseous organic materials; 15N in organic materials and solutions; 18O in sulphates; and 34S in sulphides and sulphates. The laboratory has participated in several international calibration tests (sulphur and carbon standards). The Laboratory of Radiogenic Isotopes (LARIZ) studies the distribution of radiogenic isotopes, principally of Sr and Nd, in natural environments. The chemical separations are carried out by ion-exchange techniques in the Ultra Clean Lab. LARIZ is equipped with a Finnigan MAT 262 thermal ionisation mass spectrometer (TIMS).

Eva Franců
Head of Brno Laboratory

Organic Geochemistry Laboratory

The Organic Geochemistry Laboratory, CGS Branch Brno, provides geochemical analysis of organic matter in sedimentary rocks, crude oils and gases to characterize the biological source, depositional environment, thermal maturity, oil-oil and oil-source rock correlation. The results are used in studies of sedimentary basin evolution, paleo-ecology, paleo-climatology, and thermal history. Analysis of organic contaminants in river and lake sediments, soils, water, and waste materials provide data used in for-target and non-target screening of environmental pollution focused on discrimination between anthropogenic pollutants and the natural background. Analytical methods and instrumentation:

- elemental analysis of organic and inorganic carbon and sulfur (TOC, TIC, TS) by Eltra 1000CS
- elemental analysis of organic-bound halogens in water (AOX, EOX) by Stroehlein 7020Cl and ThermoEuroglas (TOC 1200)
- analysis of gases, hydrocarbons, and organic pollutants in sediment/rock extract or oils using Agilent Technologies (AT) 7890A, 6890 and 5890 gas chromatographs with FID, ECD, and TCD detectors
- analysis of volatile organic compounds in sediments, soils and water using a HT7050 Tekmar Dohrmann headspace analyser with a high-temperature (300 °C) module
- analysis of biomarkers in source rocks, oils and organic pollutants in environmental samples using an Agilent AT 6890 GC / AT 5973 MSD gas chromatography-mass spectrometry instrument
- analysis of polycyclic aromatic compounds (PAHs) and pigments by high-performance liquid chromatography with UV/VIS and fluorescence detection, Agilent AT 1100
- organic petrology of coal, kerogen in sedimentary rocks, and suspended particulate matter using a Leitz MPV-2 microscope photometer in translucent, reflected, and fluorescent light.

The CGS Central Laboratory, Prague and the Laboratory of Organic Geochemistry, Brno are certified testing laboratories in accordance with the EN ISO/IEC 17025 standard; Certificate of Accreditation issued by the Czech Accreditation Institute.

The 2005 and 2006 period

Within their accreditation, the chemical laboratories located in Prague as well as in Brno regularly and successfully take part in inter-laboratory comparative tests, not only in the Czech Republic, but also at an international level. Both laboratories have continuously extended the range of laboratory methods to include other determinations to accommodate the demands of their clients.

1) ZL BRNO: Gas chromatography in the Laboratory of Geochemistry of the CGS
2) Determination of fluorides in solid samples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Library, Archive and Collections

Hana Breiterová
Head of Department of Information Services

The Department of Information Services serves as an information centre for both the general public and the scientific community. Scientists from the Czech Geological Survey, as well as from another institutions, students and amateur private researcher workers benefit from its modern, mainly on-line services. Integration of the Archive and Library services contributed to more efficient geoinformation access and utilization of services. Research workers can also use two study rooms with modern equipment, where study materials from the CGS Library, Archive and Collections funds are available. Since 2007, the CGS Library has led a new R&D project entitled "National Geoscience Bibliography", aiming at the creation of a new national information infrastructure in the Earth sciences.

CGS Library

The CGS Library is the largest geological library in the Czech Republic. Its fund contains a unique collection of geological literature from all over the world and it currently includes 163,000 volumes. The study room of the CGS Library provides the scientific community with on-line access to its own databases, as well as to a wide range of globally respected full-text databases (Science Direct, SpringerLink, Willey Interscience) and reference databases (Web of Knowledge, Scopus, Georef a Geobase). Retrospective digitalisation of library funds has been carried out continuously. Bibliographic researches are provided at the request of readers. The complex "GeoPub" application was developed during work on the internal project entitled "Methodology of collection, management and distribution of data on the publication activities of CGS researcher workers". The database contains data back to the year 1999, inclusive, and constitutes a basis for various outputs utilizing many search tools. The complete management of the database is performed by CGS librarians.

In 2007, an R&D project entitled "National Geoscience Bibliography", directed towards the creation of a new infrastructure in the Earth sciences, was submitted and accepted. The project is based on cooperation and data sharing with other Czech geological libraries of research and educational institutions under the Academy of Sciences, Charles University and Masaryk University.

CGS Archive

Maintenance and editing of the system has been performed continuously since the digitisation of all the geoscientific maps and related documentation stored in the CGS Archive and after launching the set of on-line applications for user access in 2005. A new CGS Archive and Library Study Room were created and are continuously maintained. Work has progressed on the digitization of annual map acquisitions and their incorporation into the system. At the same time, the database of unpublished geological reports and professional opinions was edited and completed and included in the website application.

Since 2006, the CGS Archive has also participated in the "Portal of the State Geological Survey" project (as a basis for the Portal of Geology in the Czech Republic)". In cooperation with CGS-Geofond, it participated in development of an application for on-line integration of the archive data from both institutions, providing users with the ability to access it from a single website (www. geologickasluzba.cz).

Within its other activities in 2007, the Archive continued cooperating with the Czech Cartographic Society on the creation of

a website devoted to promotion of land surveying, cartography and mapping. In the framework of international cooperation, the head of the CGS Archive has continued to participate in INHIGEO: the IUGS International Commission (participation in the conferences at Eichstädt – Germany and Bánská Štiavnica – Slovakia).

CGS Collections

In 2007, the workers of the CGS Collections predominantly focused on physical care for the paleontological and mineralogical collections, material and drill documentation, and on the creation of their databases and technical support for the researcher workers. Numerous collection acquisitions (particularly the collections of J. Kříž and J. Sekyra) were processed and work progressed on the gradual digitization and revision of the old fund. Furthermore, new and older revised material (mainly the collections of R. Mikuláš, M. Procházka, J. Valíček, and H. Eliášová) was submitted to the Central Register of Collections of the Czech Ministry of the Culture. In addition, significant advances were made in the revision of foreign documentation material as well as in processing of the archived section material and its registration within the on-line databases. The content of the CGS Virtual Museum (www.geology.cz/muzeum) was expanded and the promotional exhibition at Klárov was substantially transformed. In the course of the year, the R&D project of the Ministry of Culture MK0DERDE08P04OMG002 entitled "Computerization of funds and revision of the material deposited in the paleontological collections of the Czech Geological Survey" was submitted and approved, aiming at the complete physical revision, cataloguing and paleontological study of exceptionally valuable author's funds of the CGS paleontological collections. The data acquired will be incorporated in the CGS Information System in an upgraded structure.

Survey of the grant projects in which the staff of the CGS Collections acted as research workers, co-research workers, or contributors in 2007

2004–2006: SFCR 205-04-P026 "A revision of the lower Devonian dalmanitid ("odontochilid") trilobites of the of Prague Basin. " Research worker: P. Budil. Evaluation – completed.
2005–2008: SFCR 205-06-0395 "Palaeoecology and trophic structure of selected Cambrian and Ordovician fossil assemblages in the Barrandian area ." Head research worker: O. Fatka, CGS co-research worker: P. Budil, grant in progress.
2005–2008: GAAV: IAA304130601 "Biodiversity dynamics in the Šárka Formation (Ordovician of the Prague Basin): faunal analysis, paleoecological, biogeographic and stratigraphic aspects." Head research workers: J. Kraft – P. Kraft, CGS co-research worker: P. Budil, grant in progress.
In 2004–2007, the workers of the Collections participated in the project of international developmental aid entitled "Geological Mapping of Mongolian Altay", supervised by P. Hanžl.

The period of 2005 and 2006

2005 – establishing of a common study room of the Library and CGS Archive, moving the funds.
2005 – preparation of the 2006 wall calendar – Geological Maps 1829–1922.
2005–2006 – project entitled "Digitization of Mining Maps Deposited in the CGS Deposit Fund – Kutná Hora GeoFund" in progress.
2006 – performance of the internal project entitled "Methodology of collection and distribution of data on the publication activities of CGS staff and external geoscience organizations and their utilization for a geological bibliography of the Czech Republic", new data deliveries designed for the geology bibliography supplementation contracted.
2006 – a new application for recording the publication activities of CGS staff was launched (outcomes transferred to RIV and other activities of CGS workers).

1) Trilobite *Deanaspis senftenbergi* (Hawle et Corda, 1847) from the CGS Collections
2) Petrographic map of the Zbiroh, Točník, Králův Dvůr, Mirošov and Osek state domains at a scale of 1 : 97,200 (Johann Jirasek, 1786)

Publishing House and promotion of geology

Patrik Fiferna
Head of Publishing Department

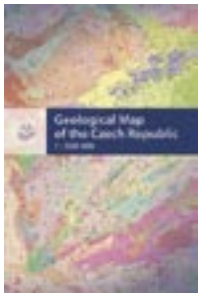
Throughout the past years, the CGS Publishing House has undergone a considerable transformation based on the current needs of a modern state geological survey. In addition to the traditional production of geological maps and publications, an increasing amount of attention has been devoted to on-line publications, promotion of CGS activities and popularization of geology. Moreover, the department has recently been equipped with a new reprographic centre for small-run printing (print on demand).

The significant events in 2007

- 36 publications including 12 maps in 2007.
- Geological Map of the Czech Republic 1 : 500,000 received a prestigious award "The Map of the Year 2007" in the competition organized annually by the Czech Cartographic Society (1)
- Change in focus and layout of the Bulletin of Geosciences. The journal has been accepted into the ISI database (Web of Science) (2)
- The Publisher has taken part in educational activities associated with the International Year of Planet Earth, particularly by organizing an art competition for children entitled My Piece of Earth, various educational workshops and through popularizing publications aimed mainly at young readers.
- The Publishing Department has set up a modern reprographic centre for "print on demand", enabling printing of a major part of the current production of the publisher and serving the needs of all the CGS staff (e.g. printing of research reports, brochures, posters, cards etc.).

Selected publications issued in 2007

- Tomášek, M.: The Soils of the Czech Republic (in Czech).
- Otava, J., Pošmourný, K.: Litovelské Pomoraví. Geology of the Protected Landscape Areas in the Czech Republic. (6)
- Geoscience Research Reports for 2006 (in Czech).
- Cháb, J., Stráník, Z., Eliáš, M.: Geological Map of the Czech Republic 1 : 500,000. (1)
- Geological thematic maps of the Czech Republic 1 : 25,000 with explanatory text: 12-443 Chotilsko, 22-212 Kamýk nad Vltavou, 22-221 Sedlčany, 34-224 Strážnice, 34-242 Mlýnky, 24-321 Tišnov, 24-224 Olomouc, 25-314 Otrokovice, 24-322 Blansko. (4)
- Večeřa, J.: Zlatý Chlum. Mining nature trail (in Czech). (7)
- Venera, Z. (ed.): CzechTec 07. 5th Meeting of the Central European Tectonic Studies Group (CETeG) & 12th Meeting of the Czech Tectonic Studies Group (ČTS), April 11–14, 2007, Teplá, Czech Republic.
- Kříbek, B., Majer, V., Nyambe, I.: Environmental-geochemical Atlas of the Central-northern Part of the Copperbelt Province of Zambia. (3)



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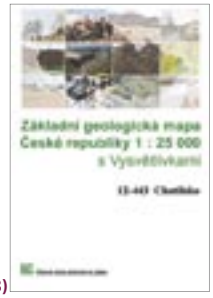


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Promotion of geology

It is increasingly obvious that, in addition to its fundamental activities, a modern organization of the CGS type must, pursue effective communication directed towards the public, develop its image in the media and elsewhere, inform the public of its activities in an interesting way and create awareness of the need for top-ranking geosciences in the Czech Republic.

Key activities

- An environment-oriented art exhibition for children entitled My Piece of Earth within the International Year of Planet Earth.
- Publication of postcards and a calendar featuring motifs of children's drawings submitted to the competition organizers.
- National workshop on the aspect of popularization of geology in the Czech Republic which was part of the 3rd congress of the Czech Geological Society.
- Presentation of the activities and achievements of CGS specialists, CGS Publishing House map and publication presentation at international conferences, book fairs, and exhibitions.
- Participation in other educational and popularizing activities associated with the International Year of Planet Earth and production of educational publications for young readers.
- Publication of a wall calendar entitled Czech Geological Survey working abroad, documenting the participation of CGS specialists in the projects of international development cooperation. (5)
- Regular distribution of an e-newsletter delivered to registered applicants interested in geology-related events and the CGS Publishing House production news. (8)
- Production of CGS promotional and advertising materials. Launch of an online shop offering a complete range of maps and publications.

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1) Presentation stands provide the visitors with information on activities of the CGS specialists including scientific as well as popularizing publications of the CGS Publishing House
2) Opening ceremony and award presentation highlighted the first year of the children's art exhibition My Piece of Earth
3) Opening ceremony of the Year of Planet Earth 2008 in the Czech Republic and inception of itinerant exhibition "Earth Mighty and Vulnerable"

The period of 2005 and 2006

- A total number of 68 publications including 18 maps were published in 2005–2006. Launch of an online shop offering a complete range of CGS Publishing House maps and publications.
- Publication of the 1 : 200,000 Map of the Nicaraguan Volcanic Chain winning the third prize in the Cartographic Design 2006 category of an international Map Gallery competition within the 26th Annual ESRI User Conference, San Diego.

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Selected scientific papers

2005

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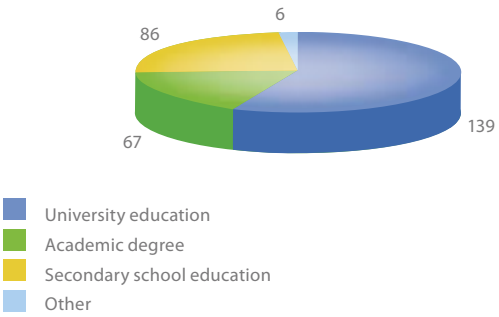
Human resources

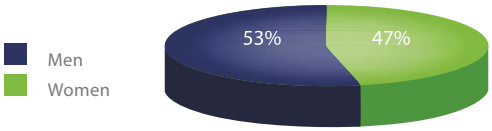
Jana Prudilová
Head of Human Resources Section

Since 2005, the total number of CGS staff has decreased from 315 to 298 (267 full time positions) at the present time. However, the overall decrease has not essentially affected the number of research workers. Their number decreased only from 207 to 206 in 2007. The average age of CGS employees is 46 years. The number of employees under the age of 30 has remained practically unchanged over the past three years. Nevertheless, there has been a clear increase in the number women employees within this age group. Simultaneously, there has been a decrease in the number of employees between 50 and 60 years of age. The current staff levels and age structure are displayed in the attached graphs.

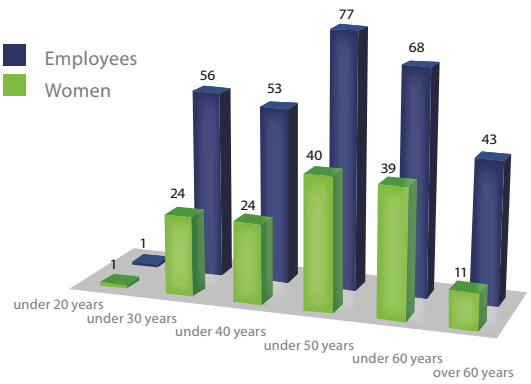
Education



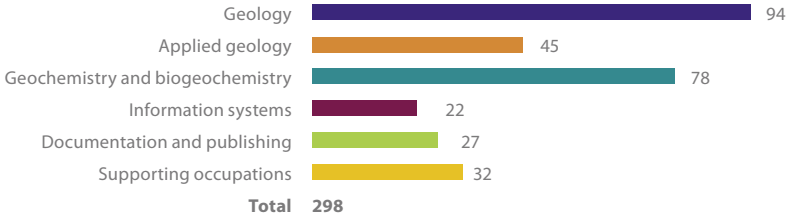
Gender ratio within the CGS employees



Age pyramid



CGS subject fields: 298 people (as of 31/12/2007)



Financial review

Ing. Zdeněk Cilc
Deputy for Economics

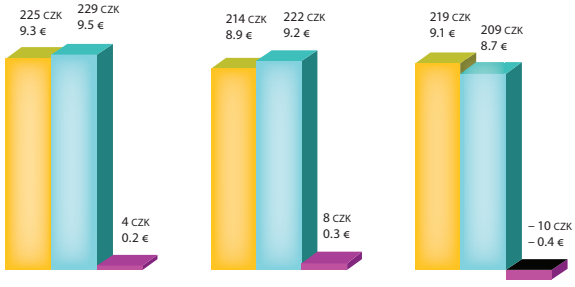
In the past period, the Czech Geological Survey concerned with restructuring of its internal activity funding on the basis of a thorough analysis of all costs. The Czech Geological Survey concluded the financial year of 2007 with the positive earnings before taxes amounting to 4,056 thousand CZK allowing to settle the loss of the past years of –3,326 thousand CZK.

The earnings achieved were significantly contributed to by the organization research and development results as well as the internal revenues of the organization on the basis of which it ranked among the most highly appreciated institutions of the Ministry of the Environment competence. The total budget is compased of various resources ilustrated in the following diagrams.

Number of research projects in CGS according funding resources

Ministry of Environment	63
Ministry of Education, Youth and Sports	8
Ministry of Agriculture	1
Grant Agencies	32
Others from the Czech Republic	3
European Union	9
Total	**116**

Revenues and expenses (mil.)

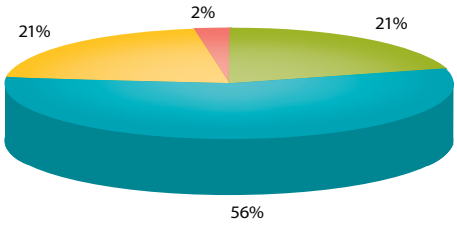


- total expenses
- total revenues
- earnings

Total revenues

229 mil. CZK

9.5 mil. €

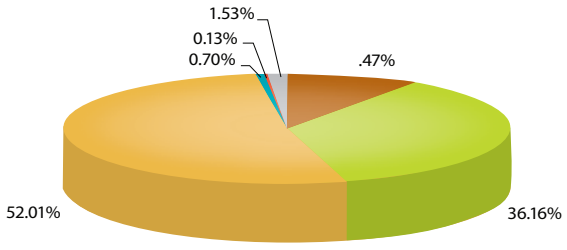


- revenues and other sources
- science and research
- geological activites
- foreign funding

Total expenses

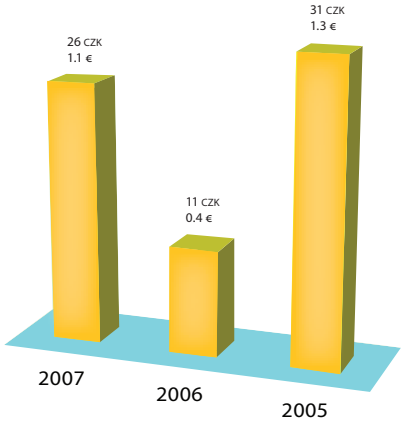
225 mil. CZK

9.3 mil. €



- material and energy costs
- services
- total personal costs
- tangible and intang property depreciation
- taxes and charges
- other costs

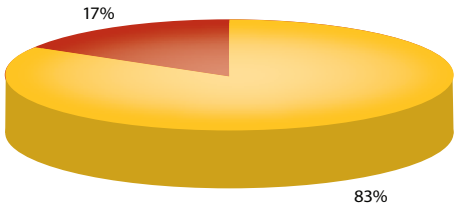
Investment works (mil.)



Resources of investement funding

26 mil. CZK

1.1 mil. €

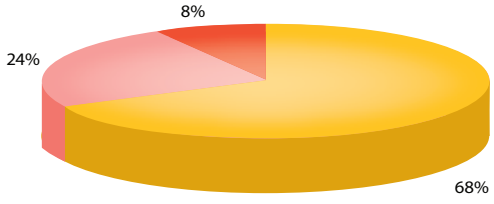


- grants
- internal financing

Investment works

26 mil. CZK

1.1 mil. €



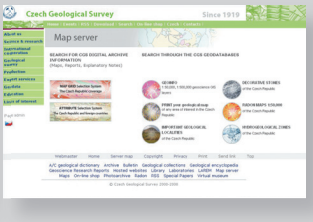
- construction works
- other tangible investments
- other intagible investments

Czech Geological Survey

information portal www.geology.cz

VISITS IN THE CGS PORTAL IN THE YEAR 2007
447,097

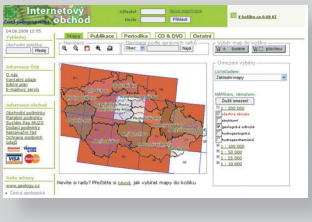
http://**www.geology.cz**
The opening page to the Information Portal of the Czech Geological Survey



http://www.geology.cz/**mapserver**
Free access to CGS maps and geoinformation

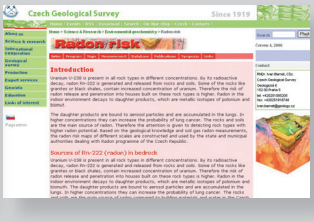
http://www.geology.cz/**antarktida**
CGS geological research activities in the Antarctica

http://www.geology.cz/**museum**
Virtual museum provides an on-line visit of the CGS collections

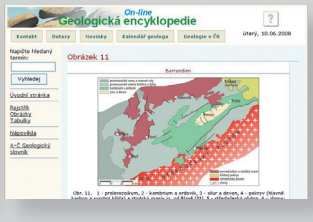


http://www.geology.cz/**obchod**
On-line map store offers geoscientific maps, books and other publications

http://www.geology.cz/**fotoarchiv**
Free access to the collection of ancient photographs with geological content

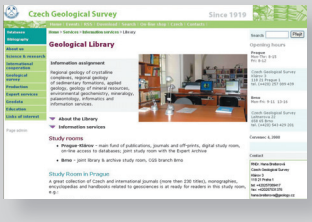


http://www.geology.cz/**radon**
Website devoted to radon risk in the Czech Republic

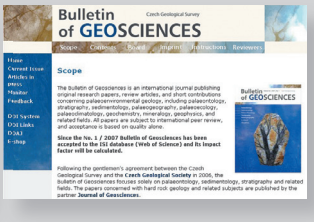


http://www.geology.cz/**encyklopedie**
Geological encyclopedia

Publication on-line



http://www.geology.cz/**library**
The CGS Geological Library



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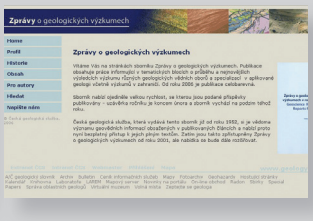
Bulletin of Geosciences

http://www.geology.cz/**spec-papers**
Special Papers

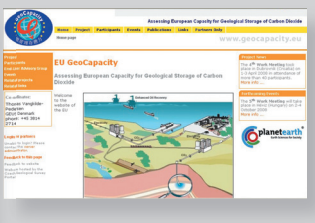


http://www.geology.cz/**zpravy**
Geoscience Research Reports

Selected hosted websites

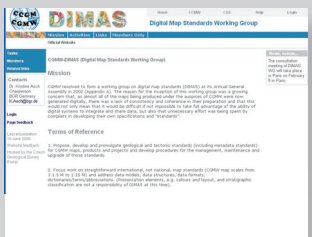
http://www.geology.cz/**gic**
Geoscience Information Consortium (GIC)

http://www.geology.cz/**mrpz**
International Year of Planet Earth (IYPE)



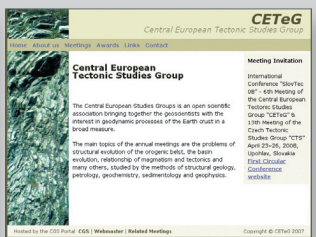
http://www.geology.cz/**geocapacity**
EU GeoCapacity – Assessing European Capacity for Geological Storage of Carbon Dioxide

http://www.geology.cz/**co2net-east**
CO2NET EAST – Portal for CO_2 capture and storage technologies



http://www.geology.cz/**dimas**
CGMW – Digital Map Standards Working Group

http://www.geology.cz/**iagod**
International Association on the Genesis of Ore Deposits



http://www.geology.cz/**ceteg**
The Central European Studies Groups

http://www.geologickasluzba.cz/
Portal of the State Geological Survey

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www.geology.cz

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