CZECH GEOLOGICAL SURVEY

Annual Report **2023**

Content

Photo by P. Neubert.

Director's Introduction

Over the past year, the Czech Geological Survey (CGS) has achieved notable success in the performance of the state geological survey, in scientific research and in foreign activities.

In 2023, CGS once again achieved an excellent rating in research and development. This was acknowledged by both the founder, the Ministry of the Environment (MoE), and an expert committee established by the government's Council for Research, Development and Innovation. The committee compared scientific publications and applied results of Czech research organizations for the period 2018–2022. In terms of the quality of applied research in Earth sciences, CGS was the top-ranked research organization in this field. As far as applied research within the state geological survey is concerned, I would like to highlight a few of our most important activities. First of all, the cooperation of CGS under the leadership of the Deputy Director for Geology Petr Mixa with SÚRAO (Radioactive Waste Repository Authority) on detailed research and mapping of four candidate sites for the location of a future nuclear waste repository. These are currently being investigated using methods that do not involve any disturbance to the landscape or land. Once the Ministry of the Environment has established the exploration areas for the so-called special intervention in the Earth's crust, i.e. installation of the underground repository, it will be possible to start a drilling survey, which is necessary for a more detailed understanding of the geological structure.

One of the most important activities in the past year was the evaluation of the geological conditions of the Krušné hory Mountains and the České středohoří Mountains in terms of delineating a corridor for

the construction of a high-speed railway (HSR) from Prague to Dresden for the needs of the Czech Railway Administration. The municipalities concerned with building of the HSR have reservations about this construction, but the role of the CGS is only to objectively evaluate geological conditions of various alternatives. The optimal route from the geological point of view will be recommended to the investor, who will then consider other aspects of the projected construction and decide on the final design of the corridor.

The use of geothermal energy, a long-term goal of CGS, saw a renewed focus in 2023. At the end of the year, the Minister of the Environment, Petr Hladík, assigned the Climate Protection Section, MoE, in collaboration with CGS, to devise a plan for the advancement of geothermal energy in the Czech Republic. It is anticipated that the government will approve this proposal during 2024, paving the way for further research projects and new geothermal installations. Furthermore, the preparation of a major Czech geothermal project SYNERGYS, which will be implemented in Litoměřice and financed by the Just Transition Fund, has been completed. CGS is itself at the forefront of this trend. Zdeněk Cilc, the Deputy Director for Economics, was instrumental in securing a subsidy from the State Environmental Fund for a comprehensive energy reconstruction of the CGS headquarters in a listed historic building in Prague's Klárov district. Fifteen boreholes were drilled to a depth of 200 m in the adjacent courtyard. This will enable the building to use geothermal energy through heat pumps to replace decades-old electric boilers. The return on this investment is calculated at 8 to 10 years according to current parameters. In addition, the old windows have been replaced with replicas approved by the National Heritage Institute, which also meet demanding thermal insulation parameters.

The year 2023 saw the preparation of new European legislation (Critical Raw Materials Act) to secure critical minerals for EU member states. In Czechia, this includes lithium, fluorite, barite, graphite, tungsten, feldspar and manganese. The European Commission approved the legislation and referred it to the European Parliament for adoption. For CGS, as for the other European geological surveys, this signifies a new focus in researching and mapping domestic sources of these raw materials, which are essential for solar and wind energy technologies, while reducing the EU's dependence on imports of the raw materials from non-democratic countries. At CGS, we have been conducting this research since 2014 within the framework of the Technology Agency of CR and Ministry of Industry and Trade projects and we have reviewed all available information on the domestic sources of these raw materials. Further advancement of our knowledge will require expensive geophysical and geochemical studies, followed by drilling. It is clear that our capacity in this respect will need to be strengthened in the future.

Our projects in Ethiopia, led by Kryštof Verner and funded by the Czech Development Agency and focused on (1) the production of a geological map of the entire country at a scale of 1:1 million and (2) the assessment of geological and hydrogeological aspects in the Sidama region and the Gamo and Gofa zones in terms of agricultural development, are nearing completion. The results of these projects were highly commended by the Czech Prime Minister Petr Fiala during his visit to the Ministry of Water and Energy in Addis Ababa in November 2023.

Another development cooperation project was initiated last year in Bosnia and Herzegovina under the direction of Dana Čápová. The objective is to establish a new geological information system, which will be implemented concurrently in the Geological Survey of the Federation of Bosnia and Herzegovina and the Geological Survey of the Republic of Srpska by 2026.

The launch of the new website represents a significant milestone in the presentation of the CGS's work to the public. The website was prepared over a two-year period and became operational at the end of last year. In addition to a more attractive design, the new website has a clearer structure and allows visitors to navigate more easily through the extensive content that the CGS makes available to the public. Furthermore, it incorporates open datasets, accessible to users in accordance with the revised requirements set forth in Act No. 261/2021 Coll.

Finally, I wish all readers of this annual report an interesting read. I would also like to express my gratitude to my colleagues at CGS for their enthusiasm and hard work.

Zdeněk Venera

Organizational structure of the Czech Geological Survey

Situation as of 31 December, 2023

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Project Management
Management and Administration
of the Brno Branch

Human Resources Section
Internal Audit

Advisory bodies

Review Board
CGS Map Approbation Committee

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Photo by P. Neubert.

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

Management

Czech Geological Survey

The Czech Geological Survey is a highly respected state organization that compiles, stores, interprets and provides objective expert geological information for the state administration, the private sector and the public. It is a state-funded body, the departmental research institute of the Ministry of the Environment responsible for functioning as the state geological survey in the Czech Republic. It is the only institution tasked with the systematic investigation of the geological structure of the entire Czech Republic.

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

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

Main fields of activity

- Geological research and mapping
- Rock environment and its protection
- Mineral resources and environmental impacts of mining
- Geohazards, prevention and mitigation of their impact
- Geoinformation management and delivery

Mission

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

Vision

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

Photo by P. Neubert.

Jan Pašava
Deputy Director for Research

Long-Term Conceptual Development of Research Organization (LCDRO)

CGS is the leading research organization in the Czech Republic in the field of Earth sciences. For the next five-year period, the CGS has prepared a new strategic document – the Long-Term Conceptual Development of a Research Organization (LCDRO/DKRVO), which includes the Strategic Research Plan for 2023–2027.

This document was prepared in accordance with the Updated Research, Development and Innovation Concept of the Ministry of Environment for the years 2016 to 2035 with a view to 2050. Through the peer review assessment of the MoE Expert Advisory Body, this concept received an excellent, top rating. It also serves as the basis for the MoE's decision to provide institutional support. Following the approved document, the research activities of the CGS are focused on the following research tasks:

>> LCDRO << Structure and dynamics of the Earth
D. Buriánek, P. Hasalová, V. Janoušek

>> LCDRO << Research of global changes, the biosphere and the sedimentary record
J. Frýda, S. Vodrážková

>> LCDRO << Minerals for sustainable economic development
M. Poňavič, B. Kříbek

>> LCDRO << Groundwater research and evaluation
L. Rukavičková, J. Řihošek

>> LCDRO << Geoenergy research
J. Holeček, D. Štěpánský

>> LCDRO << Engineering geology and geohazards
M. Aue, O. Krejčí

>> LCDRO << Landscape biogeochemistry in the era of climate change
M. Novák, J. Hruška

>> LCDRO << Professional support and organization development
M. Vajskebrová, J. Procházková

All activities within the priority areas, including basic and applied research, are in accordance with the CGS foundation charter and enable the performance of the state geological survey at a high professional level. CGS research is also carried out in close connection with the priority needs of the MoE with the aim of continuing to produce the highest quality geoscientific results both at national and international level. An important part of this new strategic document is the popularization and development of digital technologies in geology as well as research and development of modern analytical and imaging methods, which is very important for the successful implementation of all areas of research.

The year 2023 was the first year of the new LCDRO and the CGS staff produced a total of 260 outputs of the Register of Information on Results (RIV) categories in this period. They include 117 articles in professional journals (110 of them in impacted journals), 17 professional books, 3 chapters in a professional book, 12 contributions in proceedings, 5 patents, 1 methodology, 72 specialized maps with professional content including 3D models, 5 outputs in the audiovisual category, 2 outputs in the software category, 8 organized conference/workshop/exhibition events, 11 research reports and others. In the category of articles in impact factor journals, it should be highlighted that 80% of the articles were published in journals ranked in the 1st and 2nd quartiles of the field (Q1 and Q2).

The peer review assessment of selected excellent results of science and research of the Czech Geological Survey and the bibliometric analysis for the 2018–2022 collections, published by the Government Research, Development and Innovation Council (RDIC), shows that in addition to significant publishing activity in the dominant field of Earth and related environmental sciences (results well above the national and global median (https://hodnoceni.rvvi.cz/hodnoceni2022/biblio), the CGS is also a significant producer of applied research results. In terms of the proportion of research organizations' ratings of Grade 1, 2 and 3 results over a five-year period (Rating 18 – Rating 22) in the field of Earth and related environmental sciences, CGS is the most significant producer of the highest quality selected results evaluated in terms of societal relevance/contribution to knowledge of all research organizations in the country (https://hodnoceni.rvvi.cz/hodnoceni2022/nebiblio).

Based on the discussion of the results of the Evaluation 22 according to the 2017+ Methodology in a tripartite meeting in November 2023 (with the participation of representatives of the institutional support provider – MoE, RDIC, and RDIC expert panels), it was emphasized that research organizations under the MoE are an excellent proof that departmental institutions can be excellent research subjects. The Czech Geological Survey has traditionally been presented on various platforms alongside universities and institutes of the Czech Academy of Sciences (CAS), to which it is a strong competitor in its field and at the same time fulfils the needs of the state.

David Buriánek
Coordinator for Earth structure
and dynamics

We study the processes involved in the evolution of the Earth's mantle and crust. Regionally, the research focuses not only on the geological structure of the Czech Republic, but also on the Variscides of Europe and Africa, the Central Asian Orogenic Belt and the Pan-African orogens. Geological maps are an integral part of this part of the research and provide comprehensive information on the geological structure of the Czech Republic. They are used for environmental protection, geohazard assessment, mineral exploration, and for land-use planning.

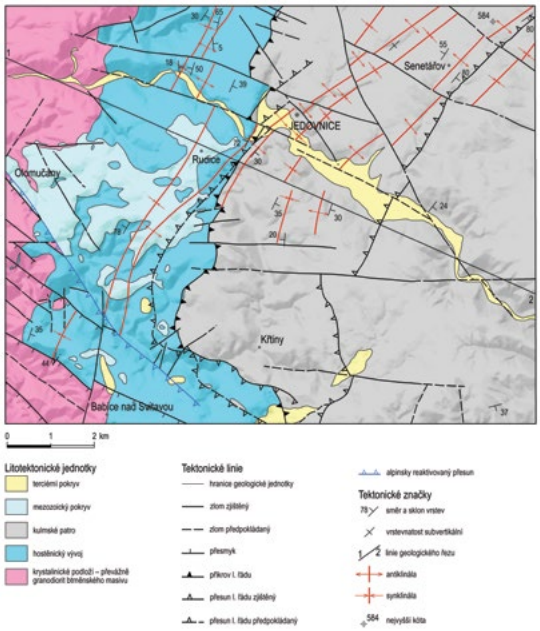
>> LCDRO <<

Structure and dynamics of the Earth

Photo by P. Neubert.

Geological mapping and regional geological research

Geological mapping is one of the main tasks of the state geological survey. Geological mapping involves the creation of geological and thematic maps at various scales and collecting, processing and providing of accompanying data files and material samples. Field data are stored in a unified database, where they are subdivided thematically (geology, hydrogeology, pedology). The research activities of the Czech Geological Survey focus primarily on mapping at a scale of 1:25,000. However, the Czech Geological Survey has been involved in long-term foreign projects as well. The geological mapping project at a scale of 1:25,000 includes the creation of geological maps. The explanatory notes to these maps contain information on the mapped areas with regard to petrography, geophysics, hydrogeology, engineering geology, structural geology, economic geology, geochemistry, pedology, and environmental geology. Three previously completed 1:25,000 scale maps with explanatory notes were published in print. In addition, a thematic geological map of Jizerka in the Jizera Mountains and two maps of decorative stones for the Ústí nad Labem Region and the Vysočina Region were published. Within the framework of foreign development cooperation, mapping is being carried out in selected areas of Ethiopia at a scale of 1:100,000.



Schematic structural map of the Jedovnice map sheet (24-411).

Within the framework of the OG MoE project "Update of the 1:50,000 scale soil map edition", two updated soil maps have been newly produced. A number of publications have been produced in connection with the geological mapping, for example, new structural and petrological data have been compiled to interpret the Variscan polyphase tectono-metamorphic evolution

A study of brittle faulting of granodiorites of the Brunovistulicum on the eastern margin of the Bohemian Massif. Photo by D. Buriánek.

A challenging field geological survey in the heart of Ethiopian Highlands. Photo by D. Buriánek.

in the south-western Moldanubian Zone, or the origin of the green illite/smectite in the Boskovice furrow has been interpreted.

Understanding endogenous processes in the past and present

As part of the study of the geodynamic evolution of the Asian accretionary and collisional orogens (EXPRO project), research has been carried out in Mongolia, northern China, and the Siberian region. In 2023, 12 papers were published from different parts of the Central Asian Orogen. Work was also carried out in northern and sub-Saharan Africa, Namibia, Madagascar, and the European Alps as part of the study of the amalgamation and disintegration of the Gondwana supercontinent using Africa and the European Alps as examples. The results of these works show the mechanism of Gondwana breakup in the Carboniferous and synorogenic magmatism in the Permian. A number of papers have been produced as part of the study of the geodynamic evolution of the Variscan subduction-collision system in Europe. Investigations have been carried out mainly in the Bohemian Massif in the Czech Republic, Poland, the French Massif Central, and in the Variscan massifs of the western Alps. The porous melt flow in the continental crust was characterized by numerical modelling. Research on the Si isotopic composition of deep-sea and shallow-water siliceous schists of the Teplá-Barrandian Unit was completed, pointing to the great importance of the coupling of geochemical cycles of silicon, iron and carbon in the Proterozoic oceans. The source of magmatic rocks of the Aleutian volcanic arc was investigated using Mo isotopic composition, and boron concentrations. Furthermore, the possible mechanism of surface eruption of Ca-carbonatites from the Kaiserstuhl area was refined. The GCDkit.Mineral software has been released for the recalculation of mineral data from electron microprobe. As part of the study of crust-shell interactions, P–T evolution conditions were calculated by thermobarometric procedures and thermodynamic modelling, and an experimental study of diamond graphitization was carried out.

Lithospheric research for radioactive waste disposal

Work continued on the geological and hydrogeological mapping of selected sites considered for a deep repository for radioactive waste. The planning of follow-up technical work, structural, morphological and geomorphological analysis and remote sensing methods complemented these investigations. In the second half of the year, sites were identified for deep borehole locations and for planned geophysical work. The subject of the interdisciplinary project was the study of the rock environment at the Bukov Underground Research Facility. Safety analyses are being prepared for the periodic safety assessment of operating radioactive waste repositories. The monitoring of the temperature of the rock mass at the Bukov Underground Research Facility and the Rožná I mine is continuing in the form of measurements in eight boreholes fitted with temperature sensors.

Jiří Frýda
Coordinator of research on global changes in the past

Stanislava Vodrážková
Coordinator of research on global changes in the past

We focus on global environmental changes affecting the biodiversity of fossil, sub-recent and recent marine and terrestrial ecosystems. We also study the impact of volcanic activity on fossil and recent ecosystems and perform palaeoenvironmental reconstructions in areas of extinct volcanism. We focus on palaeoenvironmental and geochronological analyses of key periods in the Quaternary when fundamental changes in the formation of the landscape and biological communities occurred.

>> LCDRO <<

Research of global changes, the biosphere and the sedimentary record

Photo by P. Neubert.

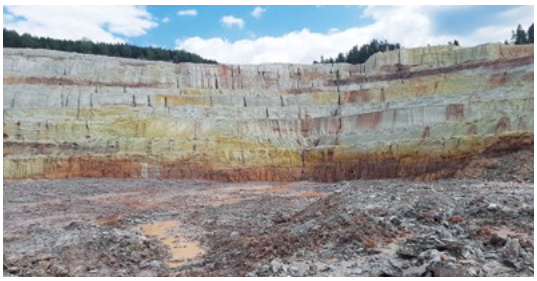
Research on global change and the evolution of marine ecosystems

In 2023, a study testing the uranium isotope-based hypothesis of the role of anoxia in the global extinction event and the subsequent isotope anomaly in the Silurian Lau/Kozlowskii event, during which marine ecosystems were fundamentally reorganized, yielded major findings. The palaeobiological aspect is applied in the study published in *Nature* describing a uniquely preserved trilobite specimen in which, for the first time in the world, gut filling with food remains has been documented, making it possible to reconstruct its diet and food intake. Another study focused on microfossils and environmental reconstruction during the Ordovician Hirnantian glaciation associated with mass extinction. Activities within the subcommissions of the International Commission on Stratigraphy have also been key areas of research. In this context, for example, a study was published that reconstructed palaeoenvironmental conditions at the Jurassic/Cretaceous boundary. In 2023, 19 Jimp outputs were published (or are in press).

Three-dimensional reconstruction of the trilobite *Bohemolichas incola* viewed from below (ventral view), with the carapace in beige and the contents of the digestive tract distinguished by colour. Source: *Nature*. Photo by V. Vaškaninová, CC BY 4.

Research on global change and the evolution of terrestrial ecosystems

The subject of the research was the evolution of the flora during the significant global climatic changes of the Early Palaeozoic. A study was published based on the unique discovery of an exceptionally well-preserved cordaite branch, including leaves and pollen-producing organs, which allowed a complete reconstruction of this plant. Furthermore, pollen organs of medullary pteridosperms from the Upper Silesian Basin were processed. This resulted in the identification of five new species for this basin. According to these associations, the affiliation of the pollen organs to pteridosperm foliage was indicated. There was also a unique opportunity to construct



View of the quarry wall of the kaolin quarry in Kaznějov – Nýřany Member, Carboniferous, Westphalian D. Photo by Z. Šimůnek.

Detail of sedimentary texture with a fossil plant on the upper surface. Photo by Z. Šimůnek.

a 3D model of the fill of the excavated part of the quarry near Kaznějov and to reconstruct the river system in the Carboniferous period. The first impressions of the flora in the Jihlava furrow, *Sigillaria* sp., in the Prachovice borehole in the Železné hory Mountains were found, which together with palynology refined the Early Palaeozoic age to the Upper Carboniferous. A taxonomic and palaeoecological study of a new genus of herbaceous lycophyte *Thomasites* was also published. In 2023, 4 Jimp outputs were published (or accepted for publication).

The relationship between volcanism, sedimentary environments and the biosphere

Research has focused on the mechanisms by which volcanic activity interacts with the surrounding environment. These include changes in topography and thus hydrological conditions, as well as the contribution of mineralized solutions to the sedimentary environment. This resulted, for example, in the formation of sedimentary limestones with mantle isotopic signatures. In contrast, eruptions in lacustrine environments lead to higher explosivity. This also applies to the growth of pyroclastic cones within maar craters. A special chapter of research is the study of the mineralization of biogenic material, especially fossil wood buried by volcanic processes.

Fragments of volcanic cinders and mineralized wood in a pyroclastic flow deposit at the foot of the Miocene Milá volcano. Photo by V. Rapprich.

The wide variability in the chemical composition of volcanoclastic deposits, but especially in the processes of their emplacement, is then reflected in the different mineral associations observed in these mineralized woods. Investigation of isotopic systems in mineralized woods revealed the source of mineralizing fluids and conditions of mineralization. An unusual group is represented by zeolitized woods. Our research has documented that the REE contents of these woods reflect the temperature of the lahars burying the studied woods. The team published 4 papers in the Jimp category in 2023, with more in press and to be published in 2024.

The evolution of the Quaternary environment and the study of exogenic geological processes

The research focused on the reconstruction of the environment during key periods of the Quaternary. A palaeoecological analysis was published that demonstrated changes in the population dynamics of cold-adapted plant species in relation to Quaternary environmental changes. Another study assessed the geomorphological evolution of Europe based on a digital elevation model and aerial photographs, focusing on periglacial and glacial processes. Another study provided a new perspective on the forest cover of the Last Glacial of Central Europe based on modern analogues from Yakutia. A study was also published discussing the use of stone glaciers as indicators of palaeopermafrost distribution based on ^{10}Be exposure ages. A (geo)archaeological project focusing on prehistoric cultural adaptation in the expanding desert region of Sudan was presented. Research focusing on the geomorphology and temporal evolution of the formation of aeolian dunes and thermokarst structures in the Moravian Sahara region and the evolution of the deglaciation of the James Ross Archipelago in Antarctica was also conducted. In 2023, 9 Jimp outputs were published (or are in press).

Other activities

Some staff are involved in work related to the publication of the international WOS-indexed journal *Bulletin of Geosciences*, which received an IF of 1.9 in 2023, placing it on the borderline of the 1st and 2nd quartile of palaeontological journals worldwide. Members of the team are also involved in teaching and training of students at Charles University, Czech University of Life Sciences and MUNI and in popularization activities, presenting research results to the wider public.

Hand drilling of aeolian sediments in the Moravian Sahara region to distinguish generations of aeolian sediments and sampling for optical luminescence dating. Photo by D. Nývlt.

Michal Poňavič
Coordinator for minerals for sustainable
economic development

The research was focused not only on deposits and resources of critical raw materials but also on construction and energy minerals. An essential part of the work activities also included legislative support for state authorities, specifically in preparing the Czech Republic's raw materials policy on a regional level as well as in dealing with mineral extraction issues involving land-use planning. Particular attention was also paid to studying the impacts that mining and processing of raw materials has on the environment and human health, to the development of new research methods concerning mineral deposits, and to mining heritage research.

Minerals for sustainable economic development

Photo by P. Neubert.

Sampling of mineralized water from the Ervěnice-ČSA coal quarry. Photo by J. Godány.

Within the framework of the CGS Strategic Research Plan for 2023–2027, projects focused on the study of critical raw materials (CRM) were addressed in relation to national and EU strategic documents. The research was fully funded from external sources, the most important projects carried out by the CGS include the task "SS02030023: Rock Environment and Mineral Resources RENS" (supported by TAČR), the contract for DIAMO state enterprise "Strategic raw materials in the context of Government Resolution 866/2021" or the project "SEMACRET" (HORIZON EU). In 2023, we successfully drilled the Or-1 structural well in the central part of the Krušné hory Mts as part of the RENS project. The borehole with a profile length of 300 m intersected Přísečnice Varied Group and intersected reddened positions of lime silicate rocks and skarns with polymetallic mineralization. The project also continued to study CRM in the Nové Město pod Smrkem, Šluknov area, Havlíčkův Brod area and historic Au deposits in Moldanubian Zone.

Not only the technological tests of graphite raw material processing from South Bohemia and Moravia, but also the study of Ge extraction from brown and black coal continued successfully. A wide range of tests were carried out on the extraction of concentrates of strategic raw materials, e.g. on Au, In, W, Ge, REE, etc.

Within the sub-topics of the task "Strategic raw materials in the context of Government Resolution 866/2021", the deposit and technological research of weakly mineralized Sn-Nb(Ta) granites in the central Moldanubian Plutonic Complex continued. Research work on tungsten mineralization was concentrated mainly in the area of the Kovářská exploration area (defined for DIAMO state enterprise). Technological research of the raw material focused on its complex processing and the balance of individual utility components (feldspars, REE concentrate, $ZrSiO_4$ concentrate with Nb minerals) was continued in the area of the Čistá-Jesenice massif.

As a result of technological research in 2023, CGS received four new patents aimed at obtaining lithium mica concentrates and improving their qualitative properties and one patent for obtaining concentrates of rare earth elements, niobium-tantalite, zircon and active substances.

In 2023, laboratory and field work (including airborne geophysics) on Ni-Cu-(Co, PGE) in the Staré Ransko ore district continued on the international SEMACRET project. The BrineRIS project (study of brines containing Li and their geothermal potential), funded by EU EIT funds, continued. Samples were sent to GTK technology laboratories in Finland, Utrecht University in the Netherlands and TU Wroclaw.

SEMACRET project, airborne geophysics: the FTMG detector is used to search for mineralized structures. Photo by V. Wertich.

Within the framework of the EU HORIZON-funded EuroGeoSurveys GSEU joint project, work continued on the completion and construction of the EGDI database for mapping CRM potential in Europe. An important part of the solution was the development of methodologies for the assessment of mineral reserves according to UNFC 3D. In cooperation with GTK Finland, a methodology workshop on UNFC classification was held in Prague in May 2023.

The Czech Geological Survey in cooperation with GET, s.r.o., Prague, continued the project TITSMPO026 "Research on the raw material potential of strategic minerals in brines of the Bohemian Massif", supported by TA CR.

In 2023, the solution of the geological work task Geology Department of the Ministry of Environment "Assessment and evaluation of the lignite-bearing area of the North Bohemian Lignite Basin in terms of the possibility of its release for further exploitation" was started. The result of the project will be the creation of "Methodology for the assessment of the relationship between the deposit objects and their protection in relation to spatial planning", which will be used in the following years in the assessment of all lignite deposits without mining lease in the North Bohemian Lignite Basin. In 2023, an economic geology resource assessment was conducted to estimate the content of elements of interest in the waste from alkaline leaching of uranium ores deposited in the K-1 tailings from the Rožná deposit.

Collection of sludge after alkaline leaching of uranium ores deposited at K-1 from the Rožná deposit. Photo by B. Kříbek.

Drilling exploration of gold-bearing and polymetallic ores, Mír Zlaté Hory adit. Photo by J. Godány.

The application of stable and non-traditional isotopes as indicators of soil and river network contamination by mining was verified at the Tschudi Cu ore deposit in Namibia. In Botswana, the bioavailability of toxic metals in smelter dust was assessed. The areal extent of soil contamination by smelter fallout in the Luanshya region of Zambia was also assessed. At the Skorpion Zn ore deposit in southern Namibia, the bioavailability of potentially toxic metals in emissions from hydrometallurgical and electrochemical operations was studied. Cooperation with Iranian (Bu Alin Sina University in Hamedan), Russian (RAS Novosibirsk) and Chinese (Peking University) colleagues focused on geological, geochemical and isotopic studies of a new epithermal Au deposit (Atash-Anbar).

Last year, work began on the preparation of the "Update of the Regional Raw Materials Policy of the Zlín Region". The contract for the Liberec Region "Update of the Raw Materials Database of the Regional Raw Materials Policy of the Liberec Region" was continued. In cooperation with the regional authorities of the Central Bohemia, Karlovy Vary and South Bohemia regions, we organized a series of expert seminars for the regional councils and awareness-raising lectures for the general public. Within the framework of montane research, the RENS project continued to create 3D complex models on the examples of the Kaňk ore deposit and the Mariánské Radčice lignite deposit.

A significant activity was the activity of regional deposit specialists appointed within the framework of the state geological survey. As in other years, they carried out assessment, consultation and service activities for state administration bodies as well as regional and local authorities in the field of mineral resources.

Lenka Rukavičková
Hydrogeological
research coordinator

Groundwater is an important component of the environment and an irreplaceable source of drinking water. Due to declining groundwater reserves and due to the need for their protection, this field of CGS research is becoming increasingly important. The research focuses on evaluating the impact of climate change, long-lasting drought and mining activities on natural groundwater sources, as well as on specific conditions of their protection in karst areas, in places with mineral water occurrence and crystalline rocks areas. The aspects of finding a suitable environment for situating underground repositories were also addressed.

>> LCDRO <<

Groundwater research and evaluation

Photo by P. Neubert.

Impact of climate change and other anthropogenic impacts on natural groundwater resources

The PERUN project deals with the assessment of the status of natural groundwater resources, prediction of their development and research on the sensitivity of selected natural systems to drought and climate change in the Czech Republic.

The project "Defining and evaluating the areas decisive for subsidizing strategic groundwater resources with regard to their protection and stabilization" has been launched. The aim of the project is to prepare documents on the basis of which it will be possible to propose the optimization of activities in the outer groundwater source protection zones.

The aim of the topic "Groundwater in the Karst System" is to determine the impacts of anthropogenic activities and climate change on the hydrogeological structures of karst areas and on their infiltration areas. A set of thematic hydrogeological maps was prepared for the Moravian, Mladeč-Javoříčko, Hranice and Chýnov Karst.

Attention was also paid to the protection of natural mineral water resources. In general terms, the research focused on the methodology for assessing the geological conditions of the protection zones of spa resources. The "Revision of mineral springs in the Slavkovský les Protected Landscape Area" was initiated. The aim of the project is to collect data for the determination (revision) of protection zones of mineral springs and peloid deposits.

In 2023, work continued on the study of the effects of the mining activities in the Turów lignite mine in Poland on the groundwater and surface water in the border area of the Czech Republic. The research included evaluation of the effectiveness of the underground grout curtain at the site of the extracted fault.

The foothill spring in the Slavkovský les Protected Landscape Area. Photo by I. Šupíková.

During 2023, a research on drought issues in the Czech Republic was completed. The main output is the map application "Vulnerability of groundwater resource quantity to drought" (https://mapy.geology.cz/ hydro_rajony/).

Study of formation of groundwater reserves in various hydrogeological structures

In 2023, the project "Groundwater in Crystalline Rocks" continued. The aim of the project is to identify suitable areas for new groundwater resources in three hydrogeological districts, consisting of metamorphic and igneous rocks, to define the areas most affected by hydrogeological drought, to obtain evidence for water retention in the landscape and to develop a methodology for assessing groundwater reserves.

The aim of the project "System for continuous vadose zone monitoring and prediction of water level in deep

Water sampling from the drip meter, Pršavý komín, Býčí skála, Moravian Karst. Photo by R. Hadacz.

Datalogger check in the hydrogeological borehole Martínkov, Groundwater in Crystalline Rocks project. Photo by R. Hadacz.

aquifers" is to use the existing extensive measuring infrastructure at the Uhelná site to develop a tool for predicting the development of groundwater levels applicable in the longer term to other locations in the Czech Republic.

Hydrogeological maps were compiled and revised for selected map sheets in the Czech Republic. Work continued on the compilation of the Hydrogeological Map of Ethiopia at a scale of 1:1,000 000 in cooperation with AQUATEST a. s. and the Geological Survey of Ethiopia.

The results of hydrogeological research in the vicinity of Beroun were published in a popular scientific form in the monograph "Nature of Beroun between the Bohemian Karst and Křivoklátsko" (Žák et al., 2023) and in the form of a scientific article (Holeček and Holečková, 2023). The results of the assessment of groundwater reserves in five hydrogeological regions have been published in the form of scientific books (e.g. Burda ed., 2023; Kryštofová et al., 2023).

Within the framework of international cooperation, experts from CGS are involved in the project "A Geological Service for Europe" (Horizon). The addressed topic is assessment, protection and sustainable use of groundwater resources in Europe.

Hydrogeological aspects of underground repository and geothermal energy development

Specialists in hydrogeology and hydrochemistry have been involved in a number of applied projects focused on the issue of underground repository of high-level waste. The projects take place at the Bukov I and Bukov II underground research sites at the Rožná mine and at the Josef underground laboratory in Mokrsko. In 2023, hydrogeological research was initiated at four sites prospective for the location of a deep underground radioactive waste repository in the Czech Republic. The work included hydrogeological mapping and expert support to Czech Radioactive Waste Repository Authority in planning hydrogeological research and monitoring.

Hydrogeological research is an essential and integral part of applied research on geoenergy exploitation. Two geothermal projects, PUSH-it and SYNERGYS, were initiated in 2023. The gained knowledge will be used for the conception, design, hydraulic stimulation and subsequent efficient operation of the underground thermal energy storage.

Flow measurements on the Loma River in Ethiopia to compile a hydrologic balance of the area. Photo by J. Jelínek.

Jan Holeček
Geoenergy research
coordinator

In 2023, there were eight projects focusing on geoenergy research. These projects have overlap between both research objectives and research areas, with geological, geoenergy, hydrogeological and storage aspects being addressed simultaneously. The research team has prepared new project applications for 2023, thus ensuring continuity of geoenergy research at the CGS in the following years. Attention is also paid to the current social topic of hydrogen fuel use and storage.

>> LCDRO <<

Geoenergy research

Photo by P. Neubert.

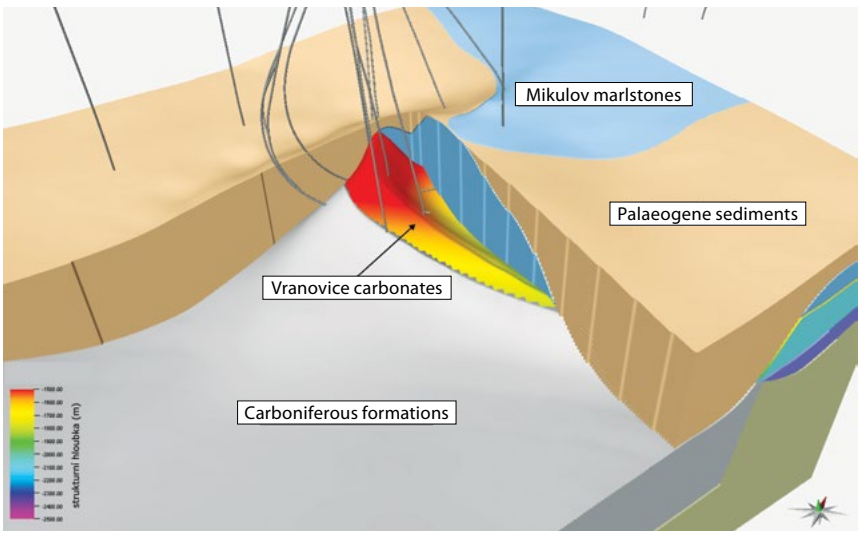
In the field of geological CO_2 storage, the Czech-Norwegian CO2-SPICER project (2021–2024) has been finalized. The aim was to prepare the Zar-3 hydrocarbon deposit in southeast Moravia for conversion into a pilot carbon dioxide storage site. In 2023, 3D geological models of the storage complex were created and the properties of the rocks and fluids in and around the storage site were assessed. On the basis of the experience gained, the compilation of the "Zar-3 repository monitoring plan and scenarios for its further development" was initiated.

A new GSEU (Geological Service for Europe, 2022–2027) project aimed at creating and harmonising a single data model for geoscience datasets from across Europe. Methodological preparation for the creation of a new European atlas of CO_2 storage potential, new pan-European maps of geothermal potential and an atlas of potential energy storage, especially in the form of hydrogen and heat, is underway with significant input from the CGS.

A new project, COREu (CO_2 Routes across Europe), has been submitted by the research team. Negotiations on the project documentation have been ongoing during 2023 and this four-year project will start in January 2024. The CGS will participate in the preparation and conception of a cluster for CO_2 storage in the Central European area. This will include geological and geochemical analyses, the creation of static and dynamic models of selected geological structures and the design of infrastructure for transporting the CO_2 captured in the region.

Two parallel and thematically related projects, SYNERGYS and PUSH-IT, focus on the use of the rock environment as an energy storage. The five-year SYNERGYS project (Synergy Energy Systems, 2023–2028) has been launched, with the main objective of combining the capture and storage of energy from the rock environment at shallow and medium depths (ca. 100–500 m) with the use of geothermal resources from great depths (ca. 2.5–3.5 km). The project simultaneously integrates photovoltaic sources and green hydrogen production with the aim of exploiting other renewable sources. For the first time in the Czech Republic, a set of technologies that comprehensively addresses clean energy production (heat, cold, electricity) and thermal energy storage in Borehole Thermal Energy Storage (BTES) will be installed and tested. During 2023, the project application and feasibility study were being finalized and initial research work commenced.

In parallel with the SYNERGYS project, the European PUSH-IT project was launched at the Litoměřice site in 2023, focusing on heat storage in rock environments at temperatures of up to 90 °C. This four-year project (2023–2027) was supported by the HORIZON-CL5-2022-D3-01-04 call and involves 19 European partners from both academia and the commercial sector. The main objective of the PUSH-IT project is to demonstrate full-scale thermal storage technology at six different European sites with different geological conditions in the Czech Republic, Germany, the Netherlands and the UK. PUSH-IT implements, develops and tests the potential of heat storage technologies in mines,



A 3D geological model of Zar-3 structure in Vranovice carbonates of the Jurassic age. This structure is a planned site for the construction of a CCS repository. Author: M. Pereszlényi.

Drilling of a 500 m deep borehole at Litoměřice. This is the first exploratory borehole of the prospective BTES repository. Photo by J. Holeček.

boreholes and aquifers (MTES, BTES, and ATES). Work started in 2023 and preparations for drilling two pilot wells are underway for drilling immediately in early 2024.

The energy potential and the use of geothermal energy in district heating and cooling systems is addressed in the international project Geothermal-DHC (COST programme), whose priority is to strengthen international cooperation. In 2023, CGS researchers continued international networking and knowledge exchange in shallow and deep geothermal energy research and exploitation. The project addresses the integration of geothermal energy into decarbonized heating and cooling systems, following a technology-led approach from the rock environment to technological solutions. This project is at an advanced stage and will be completed in 2024.

Technology Agency of the Czech Republic supported project "Variant technical solutions for deep underground storage of radioactive waste" addresses the repository issue of spent nuclear fuel storage. The subject of this two-year project (2/2023–2/2025) is the analysis of options for technical solutions for the deep storage of radioactive waste (RAW) and spent nuclear fuel (SNF) and the applicability of the proposed solutions in practice in the territory of the Czech Republic with regard to the legislation in force. Although this project is primarily focused on the topic of spent nuclear fuel storage, it has a significant overlap with the field of geothermal energy in terms of determining the geothermal parameters of the rock environment, which subsequently affect the repository itself.

In the area of underground hydrogen storage research, CGS has completed work under the European HyStorIES project (2021–2023), which is aimed at evaluating the potential for geological storage of hydrogen in the porous environment of produced gas and aquifers in 19 European countries. The CGS participated in the preparation of data from the territory of the Czech Republic for the European database of potentially suitable areas and sub-geological objects, which was finalized in 2023.

Milan Aue
Coordinator for engineering geology
and geohazards

With regard to the priority needs of the state, in 2023 CGS focused on providing expert documents based on the results of applied research for the protection and use of the rock environment, soil, groundwater and mineral resources and reducing their burden due to anthropogenic factors in the landscape. It has also contributed to the development of tools and technologies to identify, monitor, predict, prevent and reduce the risk of emergencies (disasters) of natural origin and to monitor their impact in order to ensure a safe society.

Engineering geology and geohazards

Photo by P. Neubert.

CGS activities in the 2023 research task focused on the following key topics:

- Mapping, documentation and research of geological risks (geohazards), including their categorization at regional and local levels, addressing the issue of negative anthropogenic impacts on the quality of environmental components (old burdens after mining, contamination of the rock environment and possible health risks).
- Development of a geological survey portal and provision of data on geological risks for the professional and lay public.
- Creation of specialized landslide susceptibility maps for individual geomorphological and geological units and selected urban agglomerations. This work is conducted annually in conjunction with the implementation of the INSPIRE Directive within the CGS.
- Implementation of activities designed to enhance public awareness of radon-related issues. One of the most significant geological risks directly affecting the population's radiation exposure is the radon risk associated with the geological bedrock. The significance of addressing the issue of radon in geological bedrock is further enhanced by the interdisciplinary link to monitoring radon concentrations in drinking water and building materials. The findings of the project contribute to a comprehensive assessment of natural radioactivity as a risk factor in geology.
- Identification of the main geological factors with a potential negative impact on the construction of strategic buildings in order to understand the characteristics of the rock environment in interaction with the building and its surroundings. In addition, the delineation of engineering geological regions based on specific features relevant to engineering geology and geotechnics in relation to the foundation of structures is also closely related to this activity.

In recent years, there has been a growing demand for information on landslides that threaten specific structures or sets of structures. For this purpose, thematic catalogues of slope deformations with the identification of the most vulnerable locations or sections of linear constructions should be continuously prepared. In 2023, this work was primarily conducted on the road and motorway construction sites of the Road and Motorway Directorate of the Czech Republic. A collaborative relationship has been established with ČEPS, plc., which oversees the continuous analysis and monitoring of the entire network of extra-high voltage pylons in the Czech Republic with regard to the potential for slope instabilities.

Engineering geology research in the field of slope deformation represents a core area of geohazard studies, as it identifies and addresses the interaction of the rock environment with geohazards (landslides) and structures. Related to this is the delineation of engineering geological regions based on the similarity or homogeneity of those features that are important specifically for engineering geology and geotechnics. This has led to the development of specialized landslide susceptibility maps for individual geomorphological-geological units, selected urban agglomerations and important linear constructions.

International activities include intensive research work on slope stability issues in the Cordillera Blanca in Peru,

The newly built Dariali run-of-river hydroelectric power plant at the confluence of the Kuro and Terek rivers in the Kazbegi region of Georgia destroyed by a torrential current. Photo by M. Dostalík.

Lake Safuna Baja (further on) and Safuna Alta (closer) with an 80 m high moraine, the inner slope of which has been eroded by a shock wave created by a rockfall. Photo by Jan Novotný.

both in moraines and in rock slopes. The research work is being carried out under the direction of Prof. Vilímek from the Faculty of Science of Charles University, and the author team is international.

Furthermore, the launch of a development project in Georgia is worthy of mention. Its objective is to eliminate the danger associated with very frequent catastrophic slope movements, which are technically called torrential flows. These cause serious socio-economic damage, including loss of human life, especially in the mountainous regions of Georgia. The principal outputs of the project will be geological risk maps of the Khevsureti area, a geological risk assessment methodology, and analytical tools that will be compiled in an accessible toolbox. The project will provide the NEA, the organization responsible for natural risk mapping in Georgia, with a new analytical toolbox and know-how to streamline land use planning and infrastructure development. The development project in Georgia represents a logical continuation of the existing cooperation initiated by the project "Landslide susceptibility assessment in the mountainous part of Georgia..." (Mccheta-Mtianeti 2014–2016), which was implemented under the auspices of the Czech Development Agency. The fruitful collaboration was subsequently extended through the project "Methodology for the assessment of the territory with regard to the risk of torrential flows using innovative technologies", which was implemented through the Czech-UNDP Partnership Challenge Fund 2020.

Other international activities include the 12th edition of the esteemed conference "Slope Deformations and Pseudocarst", which took place from 19 to 21 April 2023 in Banská Štiavnica, Slovakia. The event was attended by 10 experts from the Czech and Slovak Republics, and featured a total of 29 papers divided into following sections: "Research on slope deformations", "Linear structures and slope deformations", "Engineering geological and geotechnical research, stabilization measures" and "Monitoring and prevention of slope deformations". Additionally, the conference included a field trip to sites of significant slope deformation and stabilization in the vicinity of the city. The conference was organized by the Czech Geological Survey in collaboration with colleagues from the Faculty of Natural Sciences of Comenius University in Bratislava.

In 2023, within the framework of the National Radon Action Plan, measurements of radon concentration and dose equivalent power were carried out at selected contacts of mafic rocks and their dyke equivalents in the area between Sedlčany and Týn nad Vltavou. Measurements at 23 sites focused mainly on syenite porphyry and porphyritic bodies situated in the environment of amphibole-biotite granodiorites of the Vltava and technical type. The syenite porphyries and porphyrites were found to exhibit high to extremely high concentrations of Rn, exceeding values of over 240 kBq.m^{-3} in some areas. Dyke rocks situated in the Vltava-type granodiorites are characterized by more frequent values above 100 kBq.m^{-3} than in the technical-type granodiorites. This discrepancy is also reflected in the distribution of dose equivalent rates, with peaks above values exceeding 0.3 μSv.h^{-1} correlating with points of high Rn concentrations. The observed values confirm the classification of syenite porphyries and porphyrites in the high radon index category.

Martin Novák
Coordinators for landscape biogeochemistry
in the era of climate change

In 2023, we addressed several fundamental topics in biogeochemical and interdisciplinary research at the interface of geosciences, ecology and microbiology. Emphasis was placed on time-series interpretation in the context of hydrochemical monitoring of forest catchments, pedology and air quality. Biogeochemical cycles were studied using stable isotopes of nutrients and potentially toxic metals.

Landscape biogeochemistry in the era of climate change

Photo by P. Neubert.

Automatic sampler of surface runoff from the Polomka basin in the Železné hory Mts (GEOMON). Photo by O. Myška.

Cycling of carbon and other environmentally relevant elements

Analysis of concentration trends in dissolved organic carbon (DOC) in three GEOMON catchments in the Slavkov Forest monitored since 1993 revealed statistically significant increases in DOC concentrations, but, due to the decrease in runoff in dry and warm years 2015–2021, there was no increased DOC export in the Lysina granitic and Černý potok peaty catchments. Increased export was only recorded in the serpentinite Pluhův Bor catchment, where increase in DOC was the highest and where there was no reduction in runoff volume, probably due to partial deforestation of the catchment during the last decade.

Data on carbonaceous substances in aerosols of the Ostrava region were interpreted as part of a study of air pollution effects on ecosystems and human health. Based on the $\delta^{13}C$ isotopic composition of organic and elemental carbon in particles, emission sources were identified – steel production, local heating, transport, biological processes, and transboundary pollutant transport from Poland.

Organic pollutants including hydrocarbon gases were monitored in exploration and production wells. Degradation processes of aliphatic and polyaromatic compounds in oilfield formation waters by microbial communities were investigated by chemical methods (GCMS) and microbial metagenome sequencing. The result is a characterization of bacterial communities in deep-sea and near-surface conditions and their influence on the degradation of high-molecular-weight organic matter.

Modelling of biogeochemical processes

Data on forest soil microbiome along with N isotope mass balances were used to constrain N losses from forest catchments. Nitrogen losses in gaseous (N_2 and N_2O) and dissolved (NO^-_3) forms were correlated with the amount of the archaeal gene *amoA*.

King bolete (*Boletus edulis*) in its natural habitat – Jizerské hory Mts. Photo by A. Andronikov.

Collectors of horizontal deposition – Orlické hory Mts. Photo by J. Čuřík.

More than 1,700 tree rings of beech, spruce and fir were analysed isotopically to determine how trees regulate photosynthetic CO_2 uptake and to what extent this process is determined by water loss through respiration. The physiology of conifers (and fir in particular) was negatively affected by acid atmospheric deposition, whereas beech was able to maintain optimal physiological functioning even at times of peak acid deposition.

We initiated monitoring of the Suchá Bělá catchment in the Bohemian Switzerland National Park, where forests succumbed to fire in 2022. Very high nitrate concentrations – up to 21 mgL^{-1} – and very low pH of 4.7 were found in the runoff. This is the result of mineralization of humus by burning.

Palaeolacustrine records of sediments of the Cheb and Sokolov basins were investigated using stable isotopes of carbon and nitrogen. Variability of solute flux at the soil–regolith interface in the Ohře River basin was evaluated, offering an insight into the Miocene climatic optimum (16.9–14.7 Ma). This relatively high-CO_2 period is gaining increased attention due to its similarity to near-future climate scenarios.

Isotopes as a diagnostic tool in biogeochemistry

A study comparing isotopic composition of Mg, Ca and Sr in small forest catchments Na Lizu in the Šumava Mts (Moldanubian paragneiss) and Červík in the Moravian-Silesian Beskydy Mts (felsic turbidites of the Outer Carpathians) was continued. In the Na Lizu catchment, 7 main rock-forming and accessory minerals were mechanically separated and isotopically analysed. The results show that 80 to 90% of the potential geogenic sources of base cations for surface runoff are represented by a single mineral: biotite in the case of Mg, and plagioclase in the case of Ca and Sr. In collaboration with colleagues from ETH Zurich, an estimate of the depletion of Mg, Ca and Sr in forest soils compared to unweathered bedrock was made. The premise of the method is conservative behaviour of titanium and zirconium present in the rock.

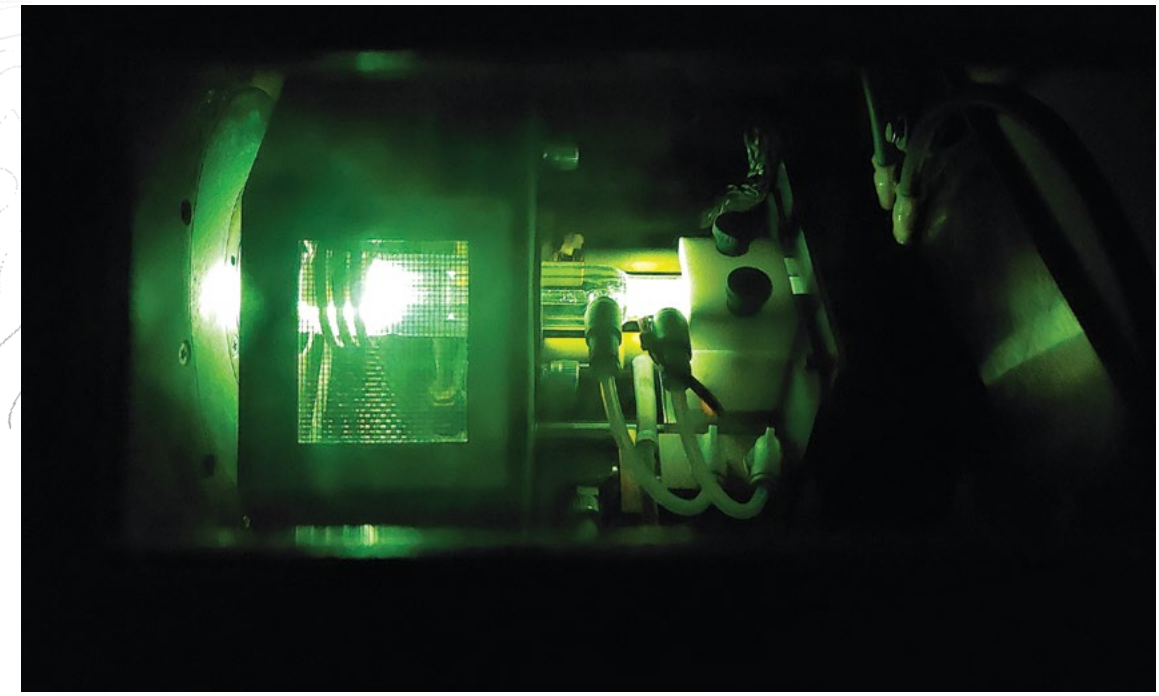
Elemental and isotopic analyses of fungi of the family *Boletaceae* growing on granite, amphibolite and serpentine showed that fungi can influence concentrations of Ag, Cd, K, Rb and some other elements in the substrate through their uptake.

Markéta Vajskebrová
Coordinator for professional support
and development

The vision of this part of LCDRO is to effectively support professional and applied activities and the development of the organization itself. It is primarily focused on developing new analytical methods and imaging techniques, and the use of digital technologies applied both in exploration and modelling of geological processes and objects. It also includes the publication and interpretation of the results and activities of the CGS and the popularization of geological disciplines towards the public in general. An important pillar of the development of the scientific organization is also the development of human resources in the form of strengthening the competences of all staff. This creates a multidisciplinary objective that links and deepens the cooperation between the different scientific teams.

Professional support and organization development

Photo by P. Neubert.



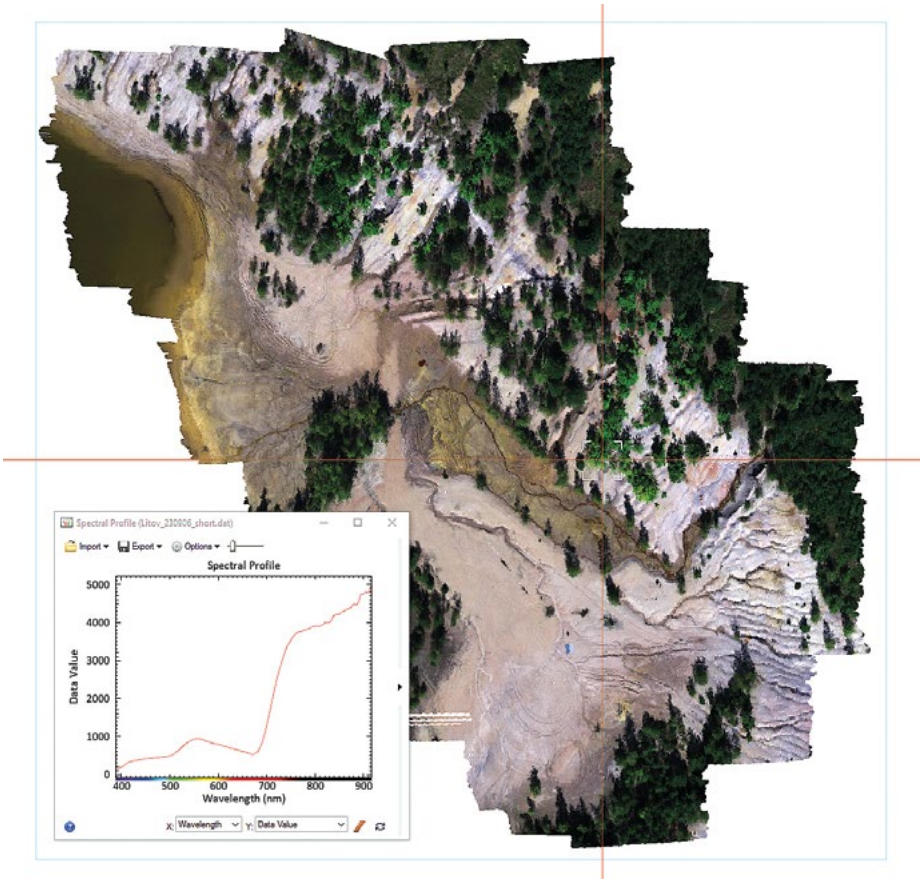
Plasma in Thermo Scientific Neptune mass spectrometer (MC ICP MS). Photo by F. Laufek.

Research and development of analytical and imaging laboratory methods

In 2023, the development of laboratory and instrumental methodologies for the scientific needs of the CGS staff continued so that the organization could be considered as self-sufficient as possible. This section of LCDRO offers a full analytical infrastructure for the growing number of international projects in which it plays an integral role as a principal investigator or key co-investigator.

An inter-laboratory study was carried out to compare the Sr isotopic composition of a suite of limestones and artificial cements as potential international reference materials with carbonate matrix. Within the EU-ITN H2020 project, elemental abundances and isotopic compositions of Li and B in a comprehensive set of international reference materials, including low--temperature silicate and carbonate matrices, have been determined following a wide range of processes typical of the Earth's surface (weathering, fluvial transport, sedimentation, etc.). Methodologies for the isolation and determination of Fe and Si isotopic compositions using MC-ICPMS have been developed and applied to natural samples within the frame of the MES Mobility programme. A new methodology for the separation of Pb from rock matrices was developed, successfully tested and applied to natural samples. The research on mineralogical and geochemical changes of BCV bentonites after short- and long-term thermal loading at 200 °C continued. The research was based on the determination of cation exchange capacity (CEC) and detailed study of powder X-ray diffraction records of the samples bentonite after Cu-triene saturation. The gas chromatography method was upgraded with mass selective GC/MS/MS detection. This allowed a better separation of organic polycyclics in rock and fluid samples, as well as a more detailed evaluation of the contribution of organic compounds of plant terrestrial

Department of Electron Microscopy and Microanalysis of the CGS in Prague, Barrandov. Photo by F. Laufek.



Hyperspectral orthomosaic of the Lítov spoil heap, created from UAV data, and a spectral curve showing the vegetation at that point.

or lake or marine origin. These methodologies are crucial in the study of palaeoenvironmental changes, including palaeoclimate, in the Earth's geological past. In the optical microscopy and separation laboratory, a new workflow has been developed for the separation of clinopyroxenes from peridotites.

Development of digital technologies in geology

Digital technologies in geology are constantly developing and new applications are being developed at CGS. Excellent results on a global scale have been achieved in modelling geological processes, 3D modelling of geological objects and in remote sensing. Such results cannot be achieved without high quality datasets that are interconnected in data systems and are continuously updated in other geological activities. Digital technology methods working with relevant data then increase the credibility of models of high professional and technical level of processing. In the field of geological process modelling, two-dimensional thermomechanical models have been developed to investigate the passage of melt through the continental crust. Last year, a prototype apparatus for monitoring melt migration during orogenic processes using computed tomography was completed in collaboration with the University of Bern and GFZ Potsdam.

In the field of DPZ, the emphasis is on the synchronous use of various methods (optical data analysis, radar interferometry, image spectroscopy, elevation data analysis) in combination with all available platforms (UAV, airborne, satellite) and with data from other geological disciplines. In the past year, the results of these approaches have been used to produce photogrammetric maps that help to monitor long-term changes in areas of interest (slope instabilities, tectonic phenomena and contaminant dispersion).

A 3D structural geological model of a potential deep--sea nuclear waste repository at the Hrádek site was published as part of a multi-year project of horizontal cooperation between CGS and Czech Radioactive Waste Repository Authority. At the same time, cooperation with the universities of TUL, CTU and Progeo was carried out in the preparation of documents for the creation of DFN models, which are necessary for modelling groundwater flow and contaminant dispersion.

cgs.gov.cz/en/laboratories cgs.gov.cz/en/maps-and-data/3d-models

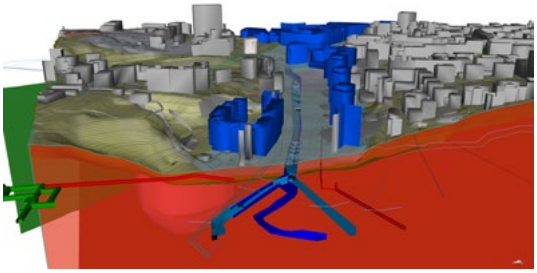
A set of partial 3D models of the Mariánské Radčice site has been completed for the Rock Environment and Mineral Resources (RENS) project, which are necessary for the creation of the final 3D model of the effects of undermining on the surface. Intensive work was carried out on the development of the software for the creation of the 3D structural geological uncertainty model and the compilation of the certified methodology. In the framework of cooperation with ČEZ, a. s., work continued on the development of the model for the planning of the completion of the Dukovany NPP and cooperation with the wider project team led by ÚJV Řež, a. s., on the periodic safety assessment of three operating radioactive waste repositories. In 2023, the project "Innovation of Geological Information Systems in Bosnia and Herzegovina" was launched to develop GIS in geological surveys in Bosnia and Herzegovina.

Popularization

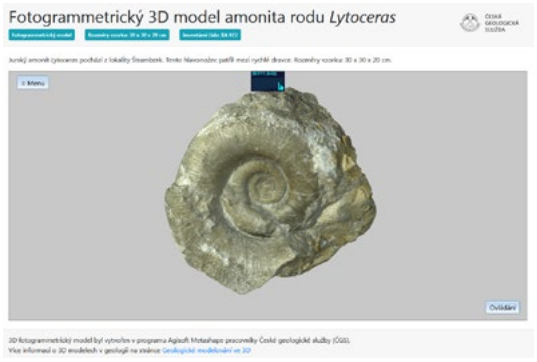
The most important popularization event is the Geological Day with CGS in Klárov. At the end of June 2023, several dozen interactive stations were prepared for all ages of the public and especially for school groups, presenting the main fields and activities of our organization. The event is free for all comers and enjoys growing interest year after year. In 2023, more than 1,000 visitors have already passed through the CGS gates! Similar popularization events on a smaller scale were




More than 1,000 visitors got acquainted with various scientific topics and professional activities at the Geology Day with CGS. Photo by O. Man.



Preview of the pilot GeoCIM model of Liberec city centre.



The 3D model of the Jurassic ammonite of the genus *Lytoceras* allows viewing the fossil from all sides. Photo by M. Vajskebrová.

also held, e.g. a one-day palaeontological programme for children with visual impairments, presentations at VědaFest ("ScienceFest") 2023, Vědobraní ("Science Gathering") at Dolní Břežany Primary School, Science Festival in the Gutovka Park in Prague 10 and KnihKvíz ("BookQuiz") in Brno, a lecture and workshop on the work of geologists at Beroun Primary School and a lecture on geothermal energy for the Sedlčansko Association of Municipalities. Guided tours of the entrance foyer, courtyard and St. Raphael's Chapel at the CGS headquarters in Klárov were held as part of the Open House Prague festival.

Map of building and decorative stones from the Vysočina Region.

Concerning popular publications, two thematic maps of decorative and building stones from the Ústí nad Labem Region and Vysočina Region were completed and printed, following on the successful edition of maps from other regions. The geological background shows the locations of rocks suitable for architectural or artistic use and is supplemented with information on the petrographic classification of these rocks and descriptions of the stone objects on which they were used.

Three 3D animations showing examples of fossils from the CGS collections have been published on the CGS website based on the newly developed methodology. Work continued on adding, maintaining and updating the popularization databases "Important geological localities", "Photoarchive" and "Building and decorative stones". The CGS also participated in the activities of the National Geoparks Council, an advisory body to the Ministry of Environment, which recommends certification of national geoparks, supports their long--term sustainability and is an important part of the common geoparks platform. In the direction of national geoparks, CGS is involved in mentoring, consulting and evaluation activities.

Support for human resources

An essential condition for the success and continuous development of a scientific institution is the significant support for the training of its own experts and the improvement of their competences. Such activities have long been a focus of attention at the CGS. The integration into scientific work and the transfer of experience from senior colleagues is supported by the mentoring project. The personal and career development of staff is carried out on an ad hoc basis in the form of courses according to the needs of specific employees. Through material, technical and financial support, CGS also supports the concurrent studies of its employees. This contributes not only to the successful completion of relevant pre- and postgraduate theses, but also to an increased number of professional publications and presentations at conferences.

Photo on the right: Boundary of Cretaceous (light Cenomanian glauconitic sandstones) and Permian (red siltstones and arkose sandstones). Photo by P. Gürtlerová, CGS Photo Archive.

Jan Čurda
Head of the Regional
Geological Administration

Regional Geological Administration

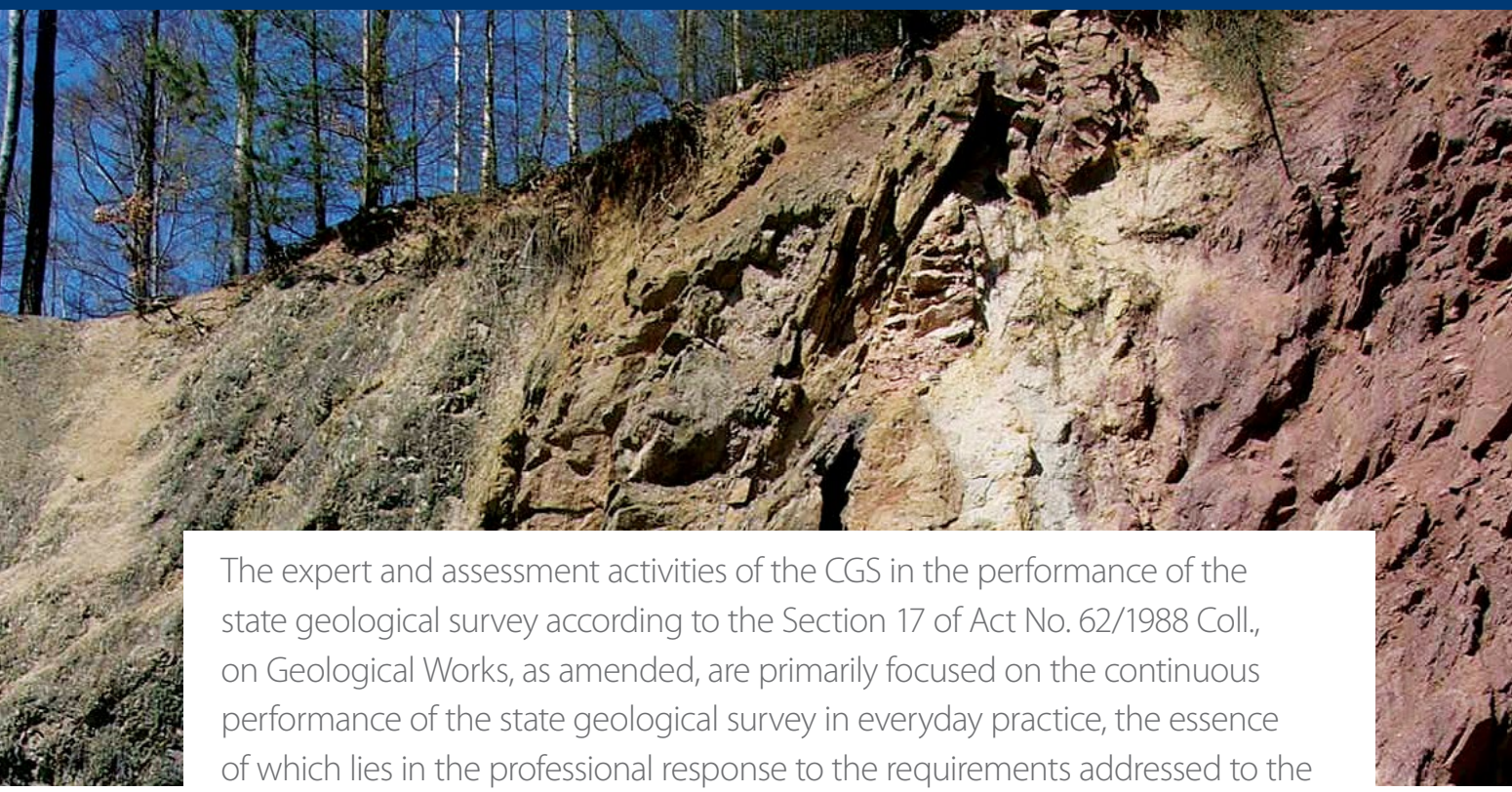
The expert activities of regional geologists, as well as regional specialists for economic geology, hydrogeology and engineering geology, combined with the assessment activities, cover the entire territory of the Czech Republic. In 2023, the twenty-sixth year of continuous activity of the CGS Regional Geological Administration (RGA), it was conducted exclusively in digital form via the RGA's agenda application on the CGS web portal. The system used to keep the agenda was further improved to meet the ever increasing quantitative and qualitative demands on the assessment activities in the future.

In 2023, within the project "Expertise and assessment activities of the Czech Geological Survey to ensure the operational requirements of the Department of Geology of the Ministry of the Environment of the Czech Republic, including support for landslides in the Operational Programme Environment, support for the processes arising from Decree No. 206/2001 Coll., updating of maps of opinions and statements on https://cgs.gov.cz/, operational primary field investigations, documentation, measurements...", the RGA of the Czech Geological Survey made available all its agenda back to 2003. This was done through the so-called interactive assessment map, which provides interested parties with an overview of the approximately 14,500 outputs stored in the database, as well as the

A former quarry in the orthogneiss of the Kutná Hora Crystalline Complex with two pocket-like fills of Cretaceous sediments. Photo by K. Motyčková.

959 actions administered in 2023, on a territorial basis for each cadastral area concerned. Among them, almost one-third were dominated by opinions focused on hydrogeological issues (287 actions), the second most numerous group of thematic outputs were opinions on land-use planning documents, and the third place was occupied by actions related to slope deformation with 85 outputs.

A more detailed analysis of the actions dealing with hydrogeological issues shows how administrative procedures for granting consent under the provisions of § 14(c) and individual provisions of Section 17 [paragraph 1(g) and (i)] of Act No. 254/2001 Coll., on Water and on Amendments to Certain Acts (the Water Act), as amended, and usually with a certain time lag, the



The expert and assessment activities of the CGS in the performance of the state geological survey according to the Section 17 of Act No. 62/1988 Coll., on Geological Works, as amended, are primarily focused on the continuous performance of the state geological survey in everyday practice, the essence of which lies in the professional response to the requirements addressed to the CGS by public authorities in accordance with the relevant legislative standards.

proceedings on the location of the construction of a waterworks, the permit for the management of groundwater – for its abstraction, and the proceedings for the issuance of a building permit for the establishment of a hydraulic structure. Many administrative authorities, as competent in accordance with the provisions of Section 104(2)(c) and Section 106(1) of the Water Act, and as special construction authorities under Section 15(1) of the Act No. 183/2006 Coll., on spatial planning and building regulations (Building Act), as amended until 31 December 2023, in accordance with the provisions of Section 334a(3) of Act No. 283/2021 Coll., the Building Act, as amended, declare in such situations that they do not have the necessary expertise to issue a decision, and so they turn to CGS with requests for the preparation of arbitration or explanatory opinions pursuant to the provisions of Section 56 of Act No. 500/2004 Coll., the Administrative Code, as amended. Unfortunately, it must be stated that many such proceedings are deliberately complicated by the obstructive or even bullying attitude of some parties.

Since approximately mid-2015, the CGS has been approached by requests from various entities (primarily professional design and consulting firms, then public authorities as well as individuals) to report/record landslide phenomena (including rockfall) in the CGS Inventory of Slope Instabilities and to classify/update their risk. These requirements reflected the progressively deepening awareness of the procedural documentation of the Operational Programme Environment 2014–2020, Priority Axis 1: "Improving water quality and reducing flood risk", Investment Priority 2 of Priority Axis 1: "Promoting climate change adaptation, risk prevention and risk management" by supporting investments aimed at addressing specific risks, ensuring disaster resilience and developing disaster management systems [according to Regulation of the European Parliament and of the Council of the EU No. 1300/2013, Article 4(B)(ii)]. Currently, the rules for applicants and beneficiaries in the OPE 2021–2027 are in force, so the recognition and classification of slope instabilities by the CGS specialist is based on the procedural mechanisms effective from 18 April 2023, based on the adopted OPE 2021–2027 Programme Document, current version number 2 (https://opzp.cz/dokument/2216).

Primary field investigations, documentation, measurements as well as other field tasks are carried out by CGS regional geologists and specialists depending on ad hoc needs of third parties from among public authorities, in order to fulfil the provisions of Section 17, paragraph 1 of Act No. 62/1988 Coll., on the collection of data on the geological composition of our state territory.

Photo on the right: The largest and most important deposit of feldspar raw material (albite granite and aplite granite) in the Czech Republic – the active open pit Krásno (Vysoký Kámen) located 1 km from the town of Krásno in the Karlovy Vary Region. Photo by J. Starý (2022).

Jaromír Starý
Head of the Mineral Information System Department

Zdeňka Petáková
Head of the Geological Exploration Department

Milada Hrdlovicsová
Head of the Geofond Department

Jolana Šanderová
Head of the Mining Impacts Department

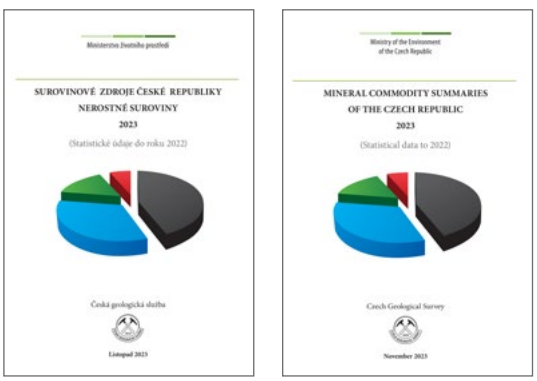
State geological survey agenda of the Information Systems Division

Inventory of geological projects

Organizations carrying out geological projects in the Czech Republic submit pertinent documents to the Czech Geological Survey (CGS), which inventorizes them according to § 7 of the act on geological work (Geological Act) and according to relevant decrees. The CGS was tasked by the Ministry of the Environment with the inventory's management. Geological projects of 264 organizations and 5,158 registration forms concerning geological activities were recorded in 2022.

Mineral resources

The Mineral Information System (SurIS) collects and provides all available data on the mineral potential of the Czech Republic. It is based on the database of mineral deposits and resources of the Czech Republic, with which other sub-databases are linked, such as companies, mining leases, protected deposit areas, preliminary mining lease approvals, exploration areas, approval of mineral reserves, and spatial features. SurIS is updated from compulsory geological documentation, results of geological works and Geo (MoE) V 3-01 and Hor–MIT forms. A map application (https://mapy.geology.cz/suris/) provides access to basic SurIS data.



Czech and English title pages of the *Mineral Commodity Summaries of the Czech Republic*.

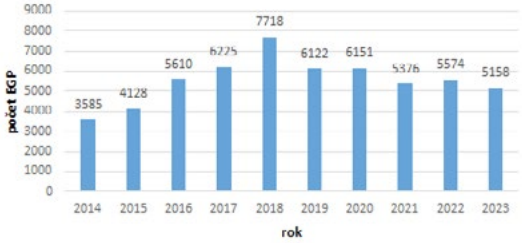
The following monographs were compiled based on SurIS data: *Balance of Reserved Mineral Deposit Reserves of the Czech Republic as of 1 January 2024*, *Inventory of Mineral Deposit Reserves of the Czech Republic as of 1 January 2024*, a yearbook *Mineral Commodity Summaries of the Czech Republic (Statistical Data 2023)*, and reviews *Movement and Changes in Reserves of Reserved Mineral*

The Information Systems Division performs the tasks of the state geological survey set forth in current laws and in the organization's foundation charter. These mainly include relevant provisions of the Geological Act (Act No. 62/1988 Coll., on geological work), the Mining Act (Act No. 44/1988 Coll., on the protection and use of mineral resources), the Mining Waste Act (Act No. 157/2009 Coll., on mining waste management), Act No. 61/1988 Coll., on mining activity, explosives and state mining administration and the Building Code (Act No. 183/2006 Coll.).

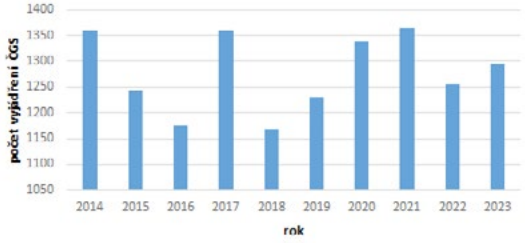
Deposits in 2014–2023 and *Summary of Mineral Reserves in Mining Leases and Other Exploited Deposits of Non-Reserved Minerals as of 1 January 2024*.

Expert assessment of land-use planning documents

The Information Systems Division provides comprehensive assessments of land development and land-use plans concerning areas with specific geological structures by virtue of § 13 of the Geological Act and § 18 and § 19 of the Mining Act. This involves cases of undermined areas and reserved deposits, which the CGS is authorized to safeguard and record. In 2023, 1,220 requests for assessments concerning mineral deposit safeguarding and 74 assessments of undermined areas were handled. The work was carried out in close cooperation with the assessment activities of the CGS Regional Geological Administration.



Inventory of geological projects – number of registration forms in 2014–2023.

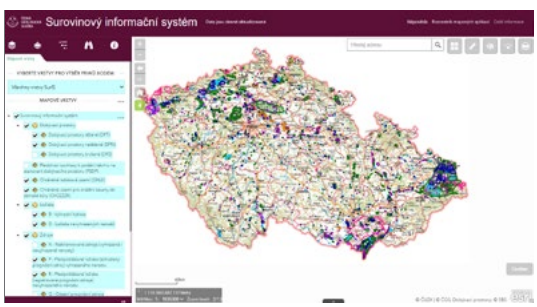


Number of processed expert assessments of land-use planning documents in 2014–2023.

Sample from the map fund of mining maps: a plan of the restoration of the Mrhal pond from 1771 by Rosentreitter. This pond was originally founded in 1555 as a source of water to power mining machines in the Rudolfov mining district.

Provision of territorial data for land-use analysis documents

In accordance with § 27 par. 3 of the Building Act, the following layers are provided free of charge to municipalities with extended scope and regions through the digital data output module for spatial analysis documents on the basis of the Standard for Monitored Phenomena: protected deposit areas, protected areas for special interventions into the Earth's crust, mineral deposits – reserved deposits, presumed deposits of reserved mineral, undermined areas, landslide areas and other geohazard areas, and mining impacts.



Display from the publicly available SurIS map application.

In addition to the municipalities with extended scope and regions, these data are also provided free of charge to the Ministry of the Environment, the Ministry of Regional Development and the State Land Office. In 2023, 37 municipalities with extended scope, 14 regions and the State Land Office downloaded data on reserved deposits (2,301 objects), prognostic resources (325 objects), protected deposit areas and protected areas for special interventions into the Earth's crust (1,550 objects), reported mine workings (3,348 objects), undermined areas (5,851 objects), landslides (17,704 objects), and closed and abandoned mining waste disposal sites (7,663 objects). The State Land Office was transferred 1,245 objects of the protected deposit areas.

Borehole surveys and hydrogeological database

The Czech Geological Survey maintains and manages the Geologically Documented Objects Database (GDO) in the territory of the Czech Republic. The GDO database contains basic information on spatially localized objects created during geological exploration

Display from the publicly available web mapping application Radiometric Anomalies and Exploration.

works. As of 31 December 2023, it contained 721,220 objects, mostly boreholes. Specialized databases are linked to the GDO database. Geological profiles for 1,007 objects were added to the GEO database in 2023. As of 31 December 2023, the database contained 625,217 objects with geological profiles. Hydrogeological data for 1,725 objects were added to the HYD database. As of 31 December 2023 it contained 113,534 objects. The Technical Parameters of Well Drilling Database, which is linked to the HYD database, contains information on well construction and casing parameters for nearly 3,500 wells. The Drill Logging Database contains digitized drill-logging data for 5,799 objects and directional log data for 3,011 objects. The Groundwater Data and Information Dataset collects data on groundwater reserve estimation polygons and data on regional hydrogeological resource evaluation polygons. As of 31 December 2023, the database contained 965 polygons.

Geophysical surveys

The easiest way for users to access geophysical data and information is through the application guide (https://cgs.gov.cz/mapy-a-data/aplikace). Through the online map application, the public is provided with key expert information subdivided into topics (web map services) involving Geophysical Surveys (with "Regional Surveys" and "Local Surveys" layers), Gravimetry (with "Overview of Gravimetric Map Scales", "Gravity Campaigns" and "Complete Bouguer Anomaly Map" layers), Seismics (with "Seismic Reflection Profiles" and "Well Shoots" layers) and Vertical Electrical Sounding. A radiometric survey of the former CSUP is also newly available, including information on radiometric anomalies. The data are also available from the web directory (https://cgs.gov.cz/mapy-a-data/webove-sluzby).

Mining impacts

Information on activities associated with mine workings, undermined areas and mining waste is provided in the chapter "Mine workings and mining waste".

Geological documentation

Information on the activities of the geological reports archive, map archive, archive services and on borehole core material documentation is provided in the chapter "Geological documentation".

Mining History Department of the Czech Geological Survey in Kutná Hora

The department houses a science library of geological literature, a collection of mining maps and a part of the signature series of the Resource Reports Collection from the CGS archive in a newly rebuilt depository. The department is also responsible for maintaining the database of undermined areas.

The science library is fully registered in the Clavius library system and is part of the CGS science library. Basic information on mining maps, including previews, is publicly available through the "Mining Maps" application. The reports of the Resource Reports Collection represent unique unpublished documents from economic geology surveys carried out in the territory of the Czech Republic in the second half of the 20th century. The reports are gradually being digitized. Basic information on undermined areas and mine workings is available to the public through the "Mining Impacts" application. The Kutná Hora office also issues statements concerning mining history and is involved in other contract work and projects of the CGS.

Vít Štrupl
Head of the Information Systems Division
and Deputy Director

Mine workings and mining waste

Mine Working Impacts Inventory

The Czech Geological Survey records reports of hazardous mine workings. The "Mining Impact Report" web application (https://app.geology.cz/dud_ozn/), accessible through the CGS website, is available online for reporting and recording all newly detected cases of mining impacts. The application allows anyone to report such phenomena, including attachment of photo documentation. Expert staff of CGS subsequently conduct initial on-site investigations and documentation. In case of mine workings, whose original operator or a legal successor does not exist or is unknown and abandoned exploratory mine workings, whose legal successor is the Czech state, regular inspections of safeguarding measures are conducted, funded by the MoE. The field investigations are based on a long-established method.

In 2023, CGS employees inspected 2,000 mine working sites and documented their impacts. Their activities are largely based on information contained in unpublished reports on geological project results, stored in the CGS Archive (Geofond), in publications, map collections and in other databases of the CGS Information System. These are mainly the abandoned mine lands database containing records on areas with underground mines, the mine workings database with a comprehensive inventory of underground mines, and the database of mining maps.

A sinkhole in a former kaolin mine in Orty near Hosín, České Budějovice district. Documented in the Mine Working Impacts Inventory.

The tasks of the state geological survey performed by the Czech Geological Survey include the maintenance of the Mine Working Impacts Inventory, initial on-site investigations of reported localities and regular inspections of taken safeguarding measures, as well as maintenance of Inventory of Hazardous Waste Facilities.

The Mining Impacts Inventory comprises files containing relevant documents for each reported case. Data are stored in the mining impacts database of the CGS Information System. Information on the status and location of reported mining impacts are also displayed by the "Mining Impacts" (https://mapy.geology.cz/dulni_dila_poddolovani/) and "Reported Mining Impacts (https://mapy.geology.cz/oznamena_dulni_dila/) map applications, which are permanently accessible to the public on the CGS website.

Inventory of Mining Waste Sites

Another state geological survey task performed by the Czech Geological Survey involves the maintenance of the Inventory of Hazardous Waste Facilities.

The Mining Waste Management Act that came into force in 2009 included a comprehensive inventory of mining waste disposal sites in the Czech Republic. The Czech Geological Survey created the Inventory of Mining Waste Facilities, which was included in the CGS Information System. It currently contains more than 7,000 objects and is continuously updated. Detailed data on the waste sites, including their location, are publicly available via the "Inventory of Mining Waste Facilities" map application on the CGS website.

Inventory of Hazardous Waste Facilities

The Inventory of Mining Waste Facilities also includes sites that have been classified as hazardous waste facilities. Above-threshold values for pollutants were detected at these sites and, in combination with other factors, they exceed hazard index (HI) 1. Each year, the Ministry of the Environment inspects and investigates six of the potentially most problematic sites. The Inventory of Hazardous Waste Facilities was launched in 2012 as a separate web application in Czech and English versions. So far, 24 facilities have been included in it.

A sinkhole in the lower adit under Dušno in the locality of Hradištko pod Medníkem, Prague-West district. Documented in the Mine Working Impacts Inventory.

Richard Binko
Head of the Informatics Department

Geological Information System

Geological Information System

The development of a geological information system (GeoIS) is key to the effective management and wide availability of geological data for the needs of government, academia and the public. GeoIS includes a number of broad thematic subsystems and is designed in accordance with national and international standards. A major project in 2023 was the rebuilding of the database of documentation points and the application software for database operation. Another important undertaking was the launch of the new CGS website. The necessary development of IT and GIS infrastructure was not neglected, and this year was particularly rich in map output.

New database and application solution for the collection of documentation points

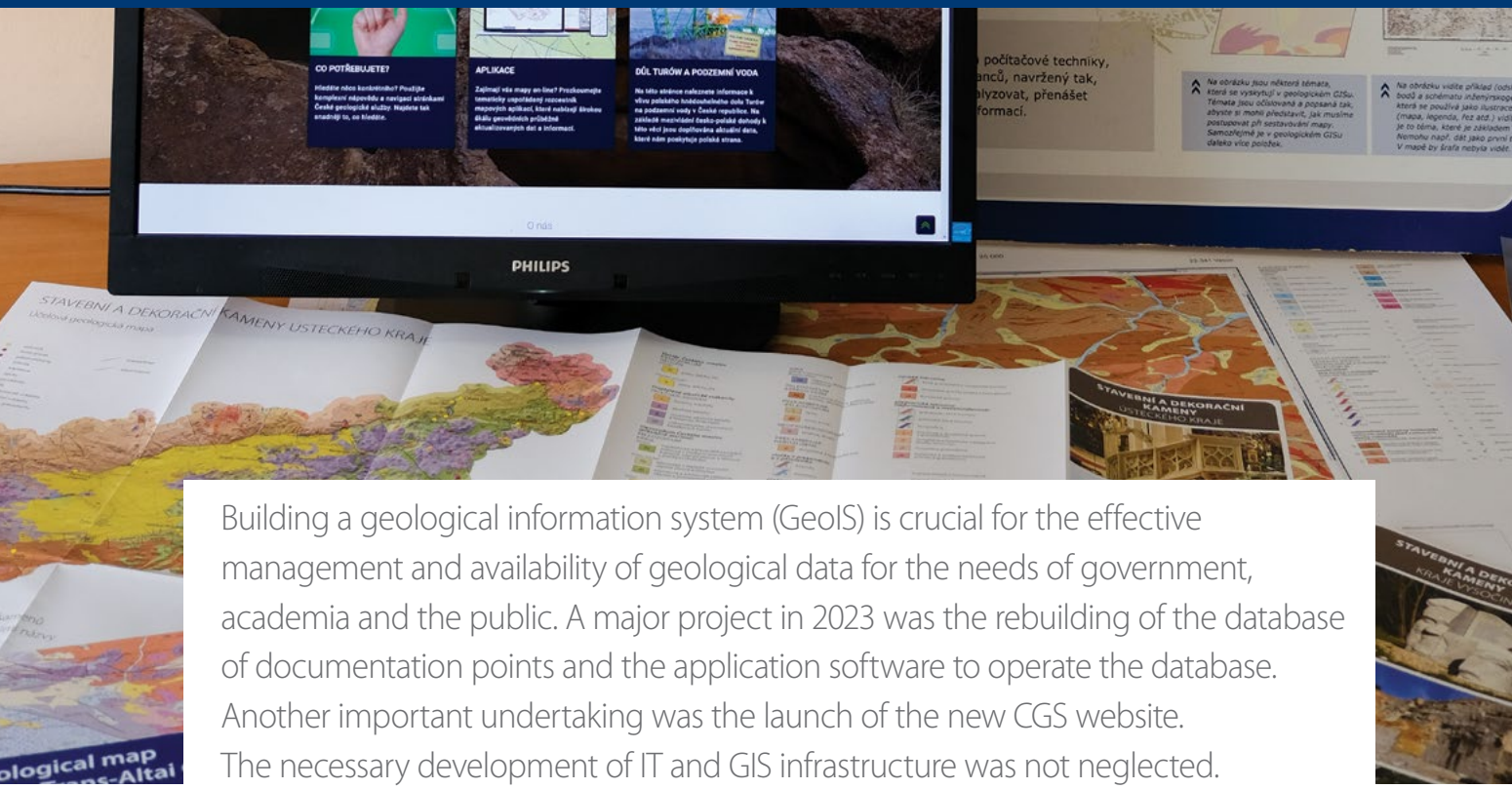
It is a system for storing and managing field documentation. Currently, the database includes over 120,000 records of geological documentation points. The new version of the engineering geology application has been deployed in connection with the development of a new methodology for describing slope deformations within the RENS task. The hydrogeological field application was launched in 2023 and is already working directly with spatial data. A new application for geological field documentation and pedological documentation is ready to be launched. The apps are now responsive and can be used on mobile devices.

For field data collection, ESRI's Field Maps mobile application has been deployed, allowing the user to easily record information and transfer it to a database of documentation points.

In order to facilitate data entry into the applications and at the same time to comply with the established terminology, the applications use categorical nomenclatures – **code lists** Nomenclatures contain a list of all regional geological units on the territory of the Czech Republic, with their relation to lithostratigraphic and chronostratigraphic classification.

New website of the Czech Geological Survey

At the end of November, the new CGS website was officially launched, bringing a fresh change in both content and graphic design. You can find it at the new address **cgs.gov.cz**. This website is built on a modern technological platform that is also used by other organizations under the Ministry of the Environment. It brings a clearer structure and more concise content, which guarantees easier access to information for users. In addition, the website is fully responsive. In a more attractive graphical form, the site features the widely used signposts for web applications, web services and datasets. Their content is already fully loaded from metadata.



Building a geological information system (GeoIS) is crucial for the effective management and availability of geological data for the needs of government, academia and the public. A major project in 2023 was the rebuilding of the database of documentation points and the application software to operate the database. Another important undertaking was the launch of the new CGS website. The necessary development of IT and GIS infrastructure was not neglected. The year 2023 was also particularly rich in map output.

GIS infrastructure upgrade

During 2023, the ArcGIS server infrastructure was significantly upgraded from version 10.6.1 to version 10.9.1. The central Oracle and PostgreSQL databases were upgraded; ArcGIS Pro version 3.1 and ArcGIS Desktop version 10.8.2 were deployed as the new enterprise-wide standard. To minimize potential problems, the entire new infrastructure was built from the ground up. The upgrade brought a number of benefits, most notably improved system security and performance, as well as enhanced capabilities for publishing map services and 3D scenes.

Access to drilling profiles in ArcGIS Pro

For GIS users, the much-requested tools for listing and exporting well profiles have been bundled into an installation package as a complement to ArcGIS Pro. Linking to the drilling database allows well locations to be linked to the description of the drilling profile. Boreholes selected on the map or entered using the GDO key are listed in a form from which they can be copied, e.g. to Excel.

Creating map outputs

In 2023, a total of 11 separate maps were produced for printing, significantly more than in previous years. This year, the CGS won the first prize in the 25th year of the prestigious Czech Cartographic Society Map of the Year competition in the category "Atlases, map sets and editions" for the map set "Geology, Soil Environment and Hydrogeology of the Sidama Region, Ethiopia". The award confirms the excellence of the CGS in the field of cartographic processing of map publications in the Czech Republic. The set of maps of the Sidama region represents the result of innovative methodology of mapping and interpretation of geoscientific data. They are an important result of the activities of the Czech Republic in Ethiopia in the field of development cooperation.

Project "Innovation of Geological Information Systems in Bosnia and Herzegovina"

The project "Innovation of Geological Information Systems in Bosnia and Herzegovina" was launched in 2023. The three-year cooperation between the CGS, the Geological Survey of Bosnia and Herzegovina (FZZG) and the Geological Survey of the Republic of Srpska (RZZGI) should result in an improved state of information technology in both Bosnian institutions. The first year of cooperation focused mainly on taking stock of the current state of the information system and then proposing strategies for its innovation.

Photo on the right by V. Žáček.

International activities and cooperation

Cooperation with European geological surveys

The Czech Geological Survey is an active member of EuroGeoSurveys (EGS) – a non-profit organization representing European national and regional geological surveys. Through joint research and activities of EGS expert groups, CGS specialists participate in providing European institutes, regulatory authorities, industries and the public with expert consultancy, harmonized geological maps and data infrastructure.

Geological Service for Europe project

The goal of the project is to establish a "Geological Service for Europe" as an entry point to a permanent collaborative network of European geological surveys and to provide European institutions, enterprises and citizens with up-to-date high-quality information, aggregated at the EU level. The specific goals of the project include, among other things, the development of several pan-European harmonized data and information services focused on primary raw materials and specifically on critical raw materials, as well as geothermal energy sources, CO_2 and energy storage, groundwater dynamics and quality, coastal zone issues, a methodology for collecting basic geological information, and development of 3D models and visualizations. An important part of the project also involves the development of an infrastructure linked to the existing EGDI (European Geological Data Infrastructure), which will provide access to data and information services developed during the project and elsewhere. The project consortium includes 48 partner organizations from 36 European countries (mainly national and regional geological surveys and associated partners). The project will run for five years and is largely funded by the European Commission through the Horizon Europe programme.

PanAfGeo project

The international project "PanAfGeo-2: Africa-EU Partnership – Support to Geological Sciences and Technology", which is co-funded by the European Union, focuses on quality improvement and technological advancement and, even in its second phase, is aimed particularly at African geological surveys personnel. The Czech Geological Survey is tasked with the coordination and implementation of a programme focused on practical geological field mapping in combination with remote sensing.

International projects are an integral part of the activities of the Czech Geological Survey. The CGS is involved in many projects in cooperation with other European geological surveys, other institutions and foreign partners in research, innovation and development projects. It is an active member of many international organizations.

Under the WP-A work package, two one-month field courses were completed in 2023, one in French in Tinghir and Agadir, Morocco, the other in English in Blantyre and Liwonde, southern Malawi. The last two courses are in preparation for the conclusion of the second phase of the PanAfGeo2 project in collaboration with resort partners in Uganda and Cameroon.

Development cooperation projects in Ethiopia

In the context of the major foreign development cooperation activities in Ethiopia, three projects are being undertaken in collaboration with international entities on (a) geoscientific mapping with implications for sustainable water resources management in the southern part of Ethiopia, (b) compilation of a national geological and hydrogeological map at a scale of 1:1,000,000 for the whole of Ethiopia, and (c) 3D hydrogeological modelling using AI tools. A comprehensive set of 1:100,000 scale geoscientific maps of the Gamo Zone, Ethiopia, entitled "Geology, Hydrogeology and Soil Environment of the Gamo Zone, Ethiopia", was completed and published in the past year 2023. In addition, landscape and land development plans for selected administrative units have been completed in close cooperation with local authorities, which will allow for more efficient management of vital natural resources such as land and water in the near future. Furthermore, the compilation of the national geological and hydrogeological map, including a new concept of regional geological zoning and stratigraphy, is underway and will be completed and published at the end of 2024. In connection with the initial phase of the creation of 3D hydrogeological models, a large data base is being compiled.

Joint photo of the Czech-Ethiopian mapping team at the end of the first expedition in the Gofa Zone, Protocol base, Sawla. Photo by K. Verner.

Innovation of geological information systems in Bosnia and Herzegovina

In 2023, a four-year Czech development cooperation project with Bosnia and Herzegovina "Innovation of Geological Information Systems in Bosnia and Herzegovina", funded by the Czech Development Agency, was launched. The project partners are the Geological Survey of the Federation of Bosnia and Herzegovina and the Geological Survey of the Republic of Srpska. The aim of the project is to support the two Bosnian institutions in the development of a geological information system, both in terms of technical infrastructure, data and information management and sharing, and the professional competence of staff to manage and operate the system.

International research projects

In 2023, the Czech Geological Survey cooperated with foreign partners on a number of research projects. For more information on activities within these projects in 2023, please visit the Czech Geological Survey website.

- Projects within UNESCO International Geoscience Programme (IGCP 637 Heritage Stone Designation project, IGCP 735 Rocks and the Rise of Ordovician Life)
- CO_2 Storage Pilot in a Carbonate Reservoir (CO2-SPICER)
- The Fate and Future of Carbon in Forests (CatchCaN)
- COST Geothermal-DHC: New geothermal resources for decarbonized heating grids
- HyStorIES – Hydrogen Storage in European Subsurface
- e-shape – Next generation satellite data and creation of innovative applications
- SEMACRET – Sustainable exploration of orthomagmatic (critical) raw materials in the EU: charting the road to the green energy transition
- BrineRIS – Brines of RIS countries as a source of CRM and energy supply
- Multi-Miner: Multi-source and Multi-scale Earth observation and Novel Machine Learning Methods for Mineral Exploration and Mine Site Monitoring
- PUSH-IT – Piloting Underground Storage of Heat In geoThermal reservoirs
- Revision of palaeontological material from the Barrandian area in Viennese institutions: a hitherto unappreciated resource for understanding the early phases of geological research in the Austro-Hungarian Empire
- Impact of climate changes on high-latitude (polar) marine benthic communities: what can we learn from the Ordovician?

Membership in international organizations

AAPG	American Association of Petroleum Geologists	J. Franců
AGU	American Geophysical Union	A. Andronikov, I. Andronikova, J. Hruška
CAAG	Czech Association of Geophysicists, a member of the Council of Scientific Societies of the Czech Republic (CSS), a member of the Union of Geological Associations (UGA), and an associated society of the European Association of Geoscientists and Engineers (EAGE)	D. Čápová, CAAG board member
CBGA	Carpathian-Balkan Geological Association	M. Bubík, national delegate
Central European Initiative	Association of the Central European geological surveys of the Czech Republic, Slovakia, Austria, Hungary, Croatia, Poland and Slovenia	Z. Venera, P. Mixa
CCGM	Commission for the Geological Map of the World	Z. Venera
CEP – ATS	Committee for Environmental Protection – Antarctic Treaty System	Z. Venera, D. Nývlt
CETEG	Central European Tectonics Group	Z. Venera, P. Mixa
CO2GeoNet	European Network of Excellence for Geological Storage of CO2	D. Štěpánský
Crossref	Crossref	Z. Tasáryová
DGGV	The German Geological Society, Deutsche Geologische Gesellschaft – Geologische Vereinigung e. V.	Z. Venera, R. Nádaskay
EAG	European Association of Geochemistry	V. Janoušek, A. Andronikov
EAGE	European Association of Geoscientists and Engineers	J. Franců
EAOG	European Association of Organic Geochemists	P. Jirman, D. Ocásková, J. Franců
EGS (EuroGeoSurveys)	Association of European Geological Surveys	Z. Venera, Board of Directors
EGS Geoenergy Expert Group	EGS Geoenergy Expert Group	D. Štěpánský

EGS Earth Observation and Geohazards Expert Group	EGS Earth Observation and Geohazards Expert Group	V. Strnadová
EGS Geochemistry Expert Group	EGS Geochemistry Expert Group	M. Poňavič
EGS Mineral Resources Expert Group	EGS Mineral Resources Expert Group	P. Rambousek, V. Wertich, Z. Gabriel
EGS Spatial Information Expert Group	EGS Spatial Information Expert Group	D. Čápová, chairwoman (since 2019), L. Kondrová
EGS Urban Geology Expert Group	EGS Urban Geology Expert Group	J. Jelének
EGS Geological Mapping & Modelling Expert Group	EGS Geological Mapping and Modelling Expert Group	Z. Bukovská
EGS Water Resources Expert Group	EGS Water Resources Expert Group	E. Kryštofová, O. Nol
EGU	The European Geosciences Union, Academia Europea	K. Schulmann, D. Petráš, P. Štípská
ENeRG	European Network for Research in Geo-Energy	D. Štěpánský
EPOS TCS GDM	EPOS Thematic Core Service, Geological Information and Modelling	D. Čápová, co-chair
GEO – GEO4MIN	Group on Earth Observation, Community Activity GEO4MIN on Earth Observation Data for Managing Mineral and Non-Renewable Energy Resources	V. Strnadová, co-chair (since 2018)
GIC	Geoscience Information Consortium, representing the managers of informatics of 35 geological surveys around the world	D. Čápová, steering committee member
GIC CE	A consortium representing the managers of informatics from the Central European geological surveys of the Czech Republic, Slovakia, Austria, Hungary, Croatia, Romania, Poland and Slovenia	D. Čápová, L. Kondrová, O. Petyniak
Geochemical Society	Geochemical Society	T. Magna
GSEU	Geological Service For Europe	O. Švagera
IAEA	International Atomic Energy Agency	O. Švagera
IAEG	The International Association for Engineering Geology and the Environment	J. Novotný, Secretary of the Czech IAEG National Group, O. Krejčí, member
IAGOD	International Association on the Genesis of Ore Deposits	J. Pašava, international committee member
IAS	International Association of Sedimentologists	D. Petráš, R. Nádaskay
ICL	International Consortium on Landslides	P. Kycl
International Organisation of Palaeobotany	International Organisation of Palaeobotany	Z. Šimůnek
ICS – ISOS	International Commission on Stratigraphy – International Subcommission on Ordovician Stratigraphy	P. Budil, member correspondent
ICS – SCCS	International Commission on Stratigraphy – I.U.G.S. International Subcommission on Carboniferous Stratigraphy	Z. Šimůnek
ICS – SDS	International Commission on Stratigraphy – International Subcommission on Devonian Stratigraphy	P. Budil, member correspondent
IGCP	Rocks and the Rise of Ordovician Life	P. Tonarová
INHIGEO	International Commission on the History of Geological Sciences	Z. Petáková
ISSS	International Subcommission on Silurian Stratigraphy	P. Tonarová
MSA	Mineralogical Society of America	T. Magna
ProGEO	European Association for the Conservation of Geological Heritage	P. Budil, chairman of the Czech national group
SEG	Society of Economic Geologists	J. Pašava, international committee member
SGA	Society for Geology Applied to Mineral Deposits – a scientific society representing over 1,300 experts on geology and mineral deposits from over 80 countries around the world; the SGA publishes the prestigious Mineralium Deposita journal	J. Pašava, executive secretary, A. Vymazalová, vicepresident for student affairs, B. Kříbek, M. Tuhý, J. Klepp, J. Kamenský, J. Mráček, K. Pertenová, Š. Dvořák, J. Bohadlo
SGS	Slovak Geological Society	P. Budil, honorary member
SOS	Subcommission on Ordovician Stratigraphy	P. Tonarová
SRG	The Society of Resource Geology (Japan)	J. Pašava

Photo on the right: The CGS Library has the largest collection of geoscientific literature in the Czech Republic.

Hana Breiterová
Head of the Information Services Department and Geological Library

Petr Budil
Head of the Collections and Material Documentation Department

Library and collections

CGS Library

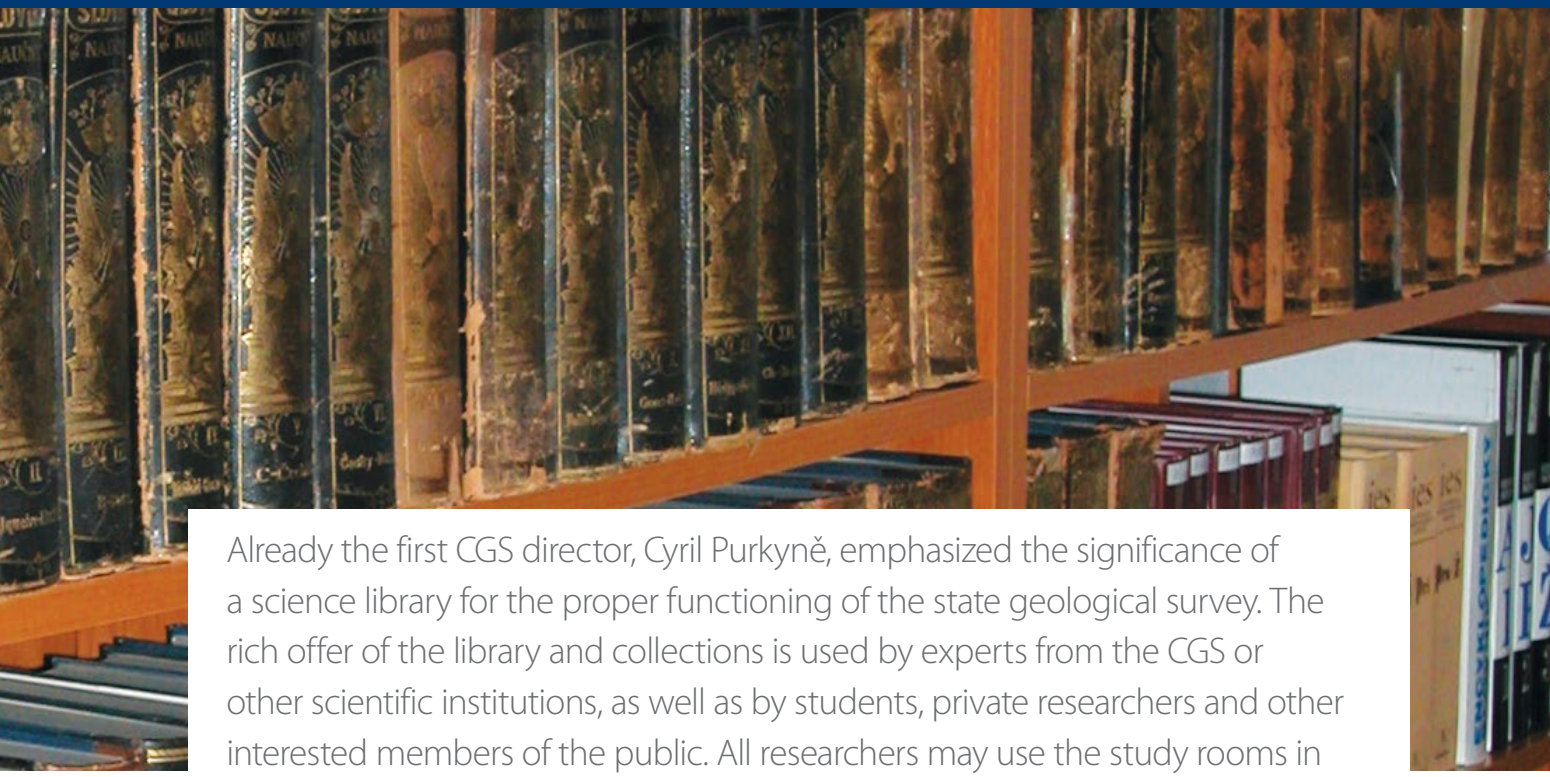
@KNIHOVNA_CGS

Access to the largest collection of geoscience literature in the Czech Republic is provided by the Czech Geological Survey Library, which since 2013 also includes a specialized archive from the former library of the Ministry of the Environment (MoE). The CGS Library is a public library, it has an online catalogue and everyone can search, order and borrow publications. Internationally recognized full-text databases (Science Direct, SpringerLink, Wiley Interscience, Blackwell, GeoscienceWorld) and bibliographic databases (Web of Knowledge, Scopus, Georef and Geobase) are accessible from a study room. Of all the libraries administered by the MoE, the CGS Library provides the widest range of online information sources. From 2023, the CGS Library has set up an Instagram to facilitate communication.

Collections

The Collections and Material Documentation Department stores and provides access to fossils, mineral and rock samples, thin sections and other material collected by the Geological Survey's researchers and also access to the findings made by researchers from other institutions as well as by private collectors. The most valuable samples from a science perspective are located in geological-mineralogical and palaeontological collections. These museum-type collections are stored, made accessible and recorded in the CES national inventory by virtue of Act No. 122/2000 Coll., as amended, and Decree 275/2000 Coll. The management of these samples is subject to strict conditions defined by the above-mentioned and subsequent legal regulations. The documented samples – geological and palaeontological samples from geological mapping, and thin sections – are stored by the CGS in accordance with Act No. 62/1988 Coll., as amended by Act No. 66/2001 Coll.

The most significant acquisitions to the collections in 2023 were trilobites ex coll. V. Micka – representatives of the genus *Ptychoparioides* with remains of the digestive system, originals of the cirripede taxa from the work of Kočová-Veselská et al. (2020), phytopalaeontological material of Z. Šimůnek or fragments of rare arthropods from the Ordovician of the Barrandian area from the collection of O. Zicha. The department also continuously processes the rich collection of doc. Josef Sekyra originating from his research in Antarctica, deserts and the world's high mountains; the work continued in 2023. The collections of the CGS also provided distance services (photographing of specimens for the needs of researchers, making of latex casts, consultations, etc.).



Already the first CGS director, Cyril Purkyně, emphasized the significance of a science library for the proper functioning of the state geological survey. The rich offer of the library and collections is used by experts from the CGS or other scientific institutions, as well as by students, private researchers and other interested members of the public. All researchers may use the study rooms in Klárov, Prague, and at the Brno office.

The maintenance of the CGS collections in 2023, which comprise about 300,000 items in total, involved very intensive publishing activities by the staff of the Collections Department, in addition to their work as regional geological experts. In 2023, the staff of the Collections Department were again involved in teaching at the Faculty of Science of Charles University.

The year 2023 was filled with many events for the public, in which the Library and Collections staff participated in the provision of standardized public services under Section 10a of Act 122/2000 Coll:

- Day with the CGS

During this two-day event for the public, approximately 190 visitors visited the premises of the library and got acquainted not only with historical books, but also with other interesting publications. The visitors were especially interested in the demonstrations of Silurian fossils from the collections of the CGS, expert consultations and the opportunity to collect a Silurian fossil from a rock.

- Vědobraní – Dolní Břežany Science Fair

This important educational event took place on the premises of the school in Dolní Břežany near Prague and was attended by exhibitors from many scientific and technical institutions.

- Events for the Typhlotouristic (Blind Tourism) club

The CGS collections also provided an important event for visually impaired and blind children. During a visit to the collections' research room, children were able to haptically examine selected fossils, cast some specimens in plaster and try out a number of palaeontological techniques, including vibrating needle preparation.

Science festival.

- Science festival at Desítka 2023

The festival was traditionally held in the Gutovka area in Prague 10 with the participation of several thousand visitors. Twenty-five original scientific stands were presented at the event, including the "Silurian World", organized and presented by the staff of the CGS collections.

- KnihKvíz Brno

As part of the national Library Week, the KnihKvíz 2023 event took place in Brno on 3 October 2023 in the National Resistance Gardens. The first year of this event sought to introduce not only students, but also the general public to the diverse range of Brno libraries and their activities.

Photo on the right: Storage wall made of sample containers with pull-out troughs in the Kamenná archive of material documentation. Photo by J. Bezák.

Milada Hrdlovicsová
Head of the Geofond Division

Geological documentation

Receival of geological documents and geological project results

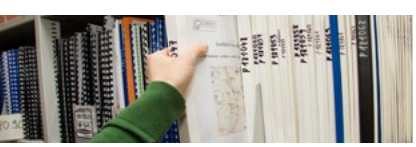
In 2023, 5,141 reports and assessments of geological project results were handed over to the CGS Archive pursuant to § 12 of Act No. 62/1988 Coll., by geological project owners or by organizations that carry out the projects. The thematic structure of these documents was dominated by hydrogeological and engineering geological surveys.

ASGI archive database

All documents submitted to the archive are continuously processed as search records with brief content annotations and with the use of indexing terms from a science thesaurus. This processing method enables a subsequent parametric search of all archived documents in the "ASGI" archive application at http://www.geology.cz/app/asgi.

Archive collections

The archive collections permanently hold and provide access to over 287,000 archive records of unpublished geoscience documents, divided into individual signature series. Within the framework of the archival care of the collections there is a continuous restoration and revitalization of selected oldest and most worn documents. Damaged documents are also prioritized for digitization.



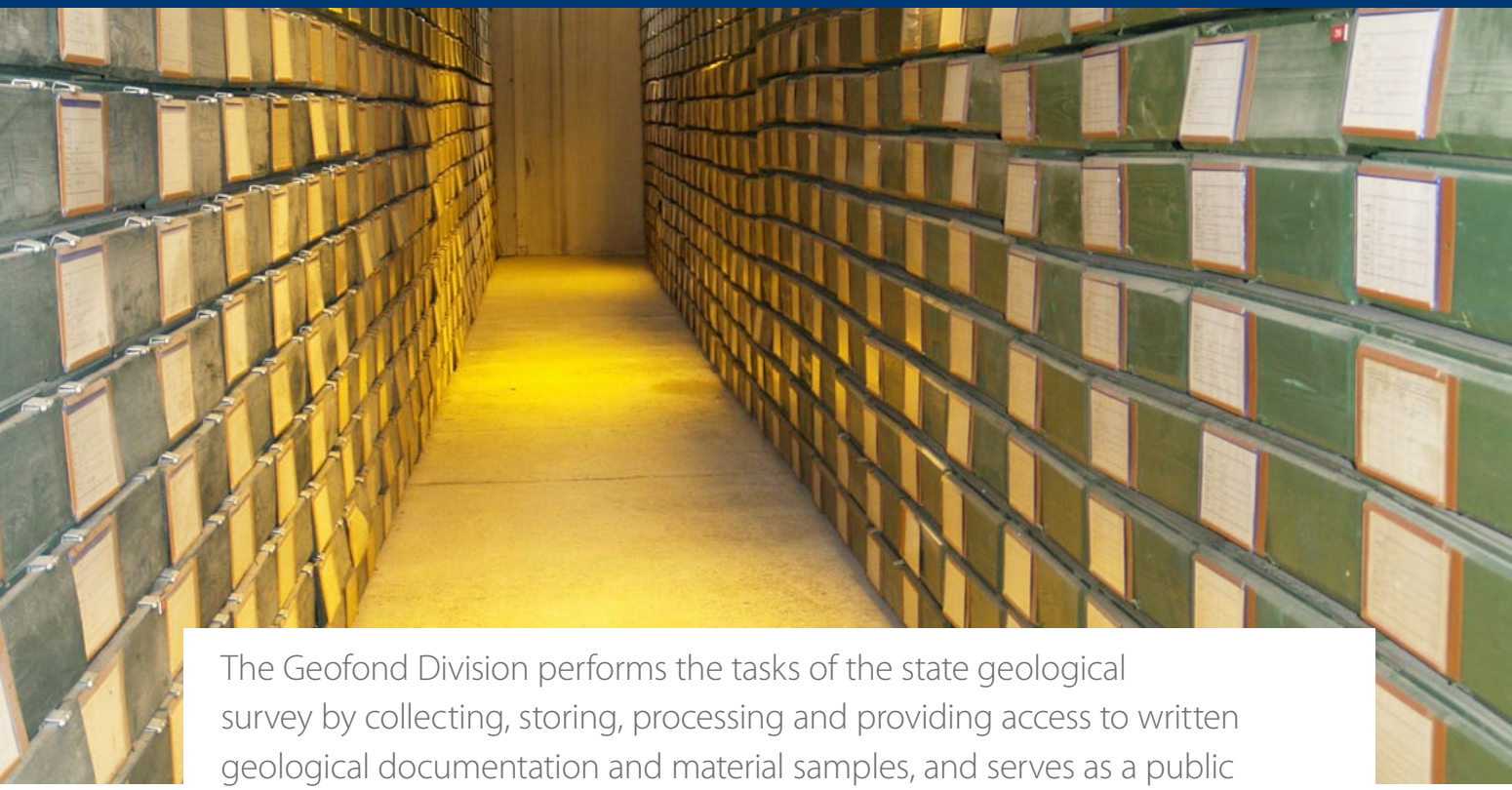
In 2023, 5,141 new additions of geological results were added to the archive. Photo by M. Hlubučková.

Archive services

A large community of professionals uses the archive services of the main study room located at Kostelní 26, in Prague 7. In 2023, the study room was visited by approximately a thousand researchers. There is increased interest in the use of remote services, which offer researchers the possibility of receiving scans of selected pages of archive documents online. The archive employees handled 445 of such requests. Large-scale digitization orders are handled centrally by data services.

Digitization of the archive collection

More than 52,000 digital archive documents, containing over 4.5 million image files, are now available. In 2023, economic geology reports from the Resource Reports Collection, documents necessary for the solution of CGS research tasks, external contracts and older or damaged reports were digitized to ensure their



The Geofond Division performs the tasks of the state geological survey by collecting, storing, processing and providing access to written geological documentation and material samples, and serves as a public study centre.

Digitization of map attachments from the Resource Reports Collection on a large format sheet-fed scanner. Photo by M. Hlubučková.

permanent preservation, and of the more recent additions, in particular selected reports with drilling profiles were digitized. The digitization process is carried out at the offices in Prague and Brno, which are equipped with modern scanning technology, including map and book scanners and a high-speed, high-capacity A3 loose-leaf scanner.

Map archive

A separate collection of the map archive collects CGS map outputs and also contains other geoscience maps from the Czech Republic as well as from foreign countries, including historical maps. In 2023, more than 500 new and older maps were added to the collection, often with accompanying texts and explanatory notes.

Remote access

Researchers use subscription online viewer linked to ASGI archive application http://www.geology.cz/app/asgi to study digitized reports and reviews. The bulk of the map archive collection is available in digital form in the map archive application http://www.geology.cz/extranet/mapy/archiv.

Borehole core material documentation

Based on requests, the staff of the Borehole Core Material Documentation Department provide access to a constantly growing set of more than 38 thousand metres of continuous drill cores or rock samples from structural and other important wells in the Czech Republic. Over 15,700 sample containers with 3,127 objects (mostly borehole cores) are stored in a special storage systems of sample containers with pull-out troughs in the Kamenná, Stratov and Lužná repositories. A clear search for stored borehole cores with material documentation is available in the map application https://mapy.geology.cz/vrtna_prozkoumanost/.

In total, approximately 1,667 m of borehole core material documentation from 318 objects (14 of which were continuous core boreholes) was stored in 2023.

Photo on the right: The national round of the Geology Olympiad took place on 25–28 April 2023 at the Centre for Environmental Education Kaprálův mlýn. Nine stations were prepared for the competitors – for example, knowledge tests, recognition of minerals, fossils, crystal systems or geological structures.

Patrik Fiferna
Head of the CGS
Publishing House

Publishing House

Books and maps

Each year, the Czech Geological Survey publishes scientific material devoted to individual geosciences, periodicals, monographs, geological and thematic maps of various scales as well as popular science titles, including those that use modern technologies such as augmented reality. The publishing, project and commercial activities included the release of 35 titles in 2023.

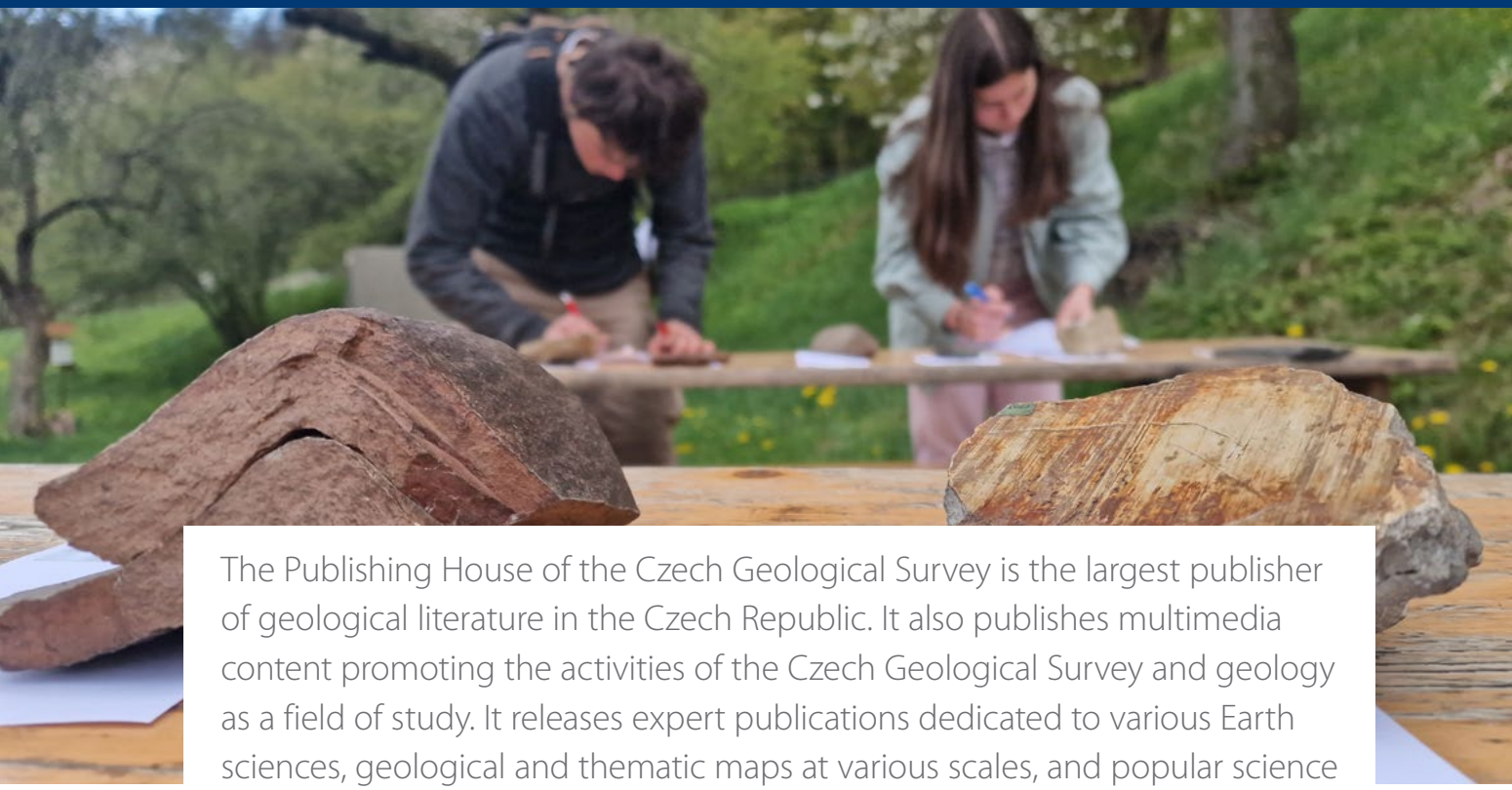
Promoting CGS activities and popularization of geology

In addition to maps and publications, the Czech Geological Survey also conducts promotional activities. It systematically acquaints the public with the research results of CGS specialists and promotes the popularization of geoscience in various forms – organizes exhibitions with geoscience themes, participates in the organization of the national Geology Olympiad, manages the World of Geology on Facebook (https://www.facebook.com/svetgeologie) and Geology TV on YouTube (https://www.youtube.com/user/Geologycz).

Last year, the CGS produced six new animations, which are available on YouTube: 'Kaiserstuhl', 'Kaiserstuhl – geological development', 'Šumná – geological development',

The opening of the exhibition of photographs by Martin Dostalík, *Landslides from a bird's eye view*, took place on 7 December 2023 in the Geological Bookstore. The opening also included the launch of the calendar for 2024.

On 29 November 2023, CGS organized a book signing and book launch of hydrogeologist Zbyněk Hrkal's books *Searching for Water on Three Continents* and *Europe Yesterday, Europe Today, Europe Tomorrow?*. Several well-known personalities accepted the invitation (from right: Egyptologist Miroslav Bárta, director and producer Steve Lichtag and actress Jitka Čvančarová).



The Publishing House of the Czech Geological Survey is the largest publisher of geological literature in the Czech Republic. It also publishes multimedia content promoting the activities of the Czech Geological Survey and geology as a field of study. It releases expert publications dedicated to various Earth sciences, geological and thematic maps at various scales, and popular science and education literature.

'Bažina – geological development', 'Rainwater management and impact on groundwater levels' and 'Thermal spring Vřídlo in Karlovy Vary'.

Another activity is the publication of the CGS *Svět geologie ("The World of Geology")* magazine, which is published quarterly and brings the most important events and information about the activities of the institution and interesting facts from the field of Earth Sciences. The magazine can be downloaded free of charge from the CGS website.

CGS also participated in the organization of VědaFest ("ScienceFest") 2023 in Prague, which prepares the most interesting from the world of natural, technical and social sciences for visitors.

The Geology Day with CGS is becoming a tradition, as evidenced by the number of visitors who came to the CGS headquarters on 23–24 June to see geologists at work in various geological fields. This event attracted more than a thousand people!

The Geology Day, which introduces the work of the CGS to the general public, is becoming increasingly popular. In 2023, it has expanded to 16 themes, covering not only classical disciplines such as mineralogy, field geology or palaeontology, but also palynology or the introduction of the Geological Library.

The CGS Geological Bookstore hosted four photographic exhibitions with geoscientific themes, namely Jiří Jiránek: *South America with a Geologist*, Ivana Frolíková: *Stone Ticino*, Pavel Hanžl: *Mongolia – The Land Where the Horizon Doesn't End*, and Kamila Šírová and Jiří Šír: *Amateur Cave*.

One of the biggest changes in communication with the public was the launch of the new CGS website. It is based on a modern technological solution and brings a significant change in content and graphic design.

Publishing and project activities

Norway grants | CO_2 SPICER | RE LNS Rock Environmental Natural Resources

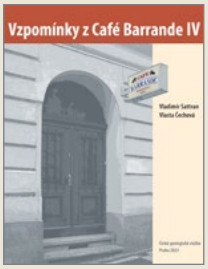
During 2023, the Publishing House was engaged in the projects 'CO2-SPICER – CO_2 Storage Pilot in a Carbonate Reservoir', and 'RENS – Rock Environment and Minerals'. The main task of the staff is to provide project publicity and promotional activities.

Selected publications issued by the CGS

BOOKS

Searching for Water on Three Continents

Zbyněk Hrkal



Memories from Café Barrande IV.

V. Sattran, V. Čechová (Eds)

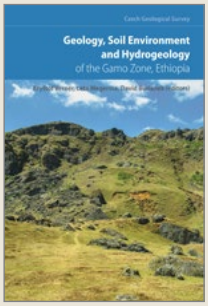
Czech and Slovak Geological Exiles

Jiří Jiránek

The Art of Stonemasonry in 19th Century Prague and Its Creators

Václav Rybařík

EXPLANATORY NOTES WITH MAP



Geology, Soil Environment and Hydrogeology of the Gamo Zone, Ethiopia

K. Verner, L. Megerssa, D. Buriánek (Eds)

Geological Map of the Gamo Zone at a scale 1:100,000

K. Verner, L. Megerssa, D. Buriánek

CALENDAR

Geology from a Bird's Eye View

Martin Dostalík

BOOKS

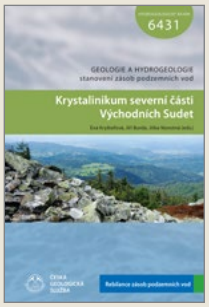
Review of Groundwater Resources

Cretaceous basal aquifer of the Benešov syncline (HG Zone 4730)

J. Burda (Ed.)

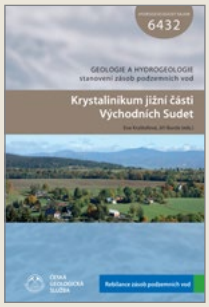
Cretaceous of the Obrtka and Ústěcký potok Streams (HG Zone 4523)

J. Burda, I. Kůrková (Eds)



Crystalline of the northern part of the Eastern Sudeten (HG Zone 6431)

E. Kryštofová, J. Burda, J. Novotná (Eds)



Crystalline of the southern part of the Eastern Sudeten (HG Zone 6432)

E. Kryštofová, J. Burda (Eds)

MAPS

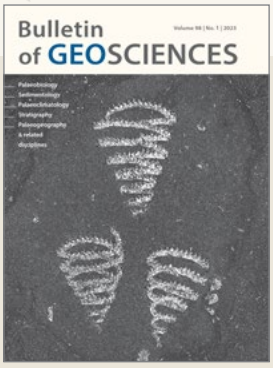
Building and Decorative Stones of the Ústí nad Labem Region

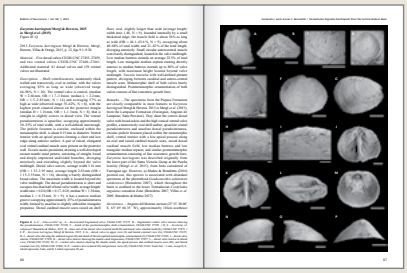
B. Dudíková, J. Mysliveček, V. Žáček, Z. Petáková

Building and Decorative Stones of the Vysočina Region

B. Dudíková, J. Pertoldová, D. Buriánek

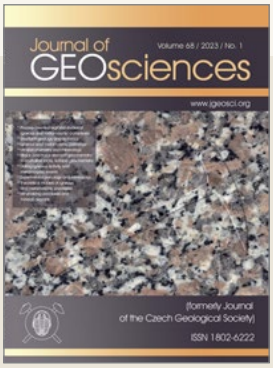
Periodicals

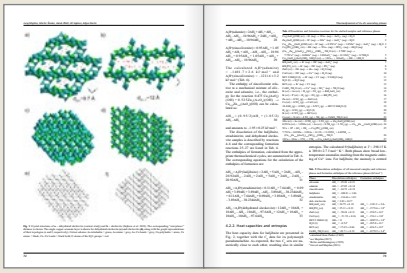




Bulletin of Geosciences

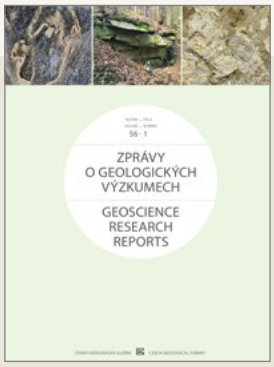
The *Bulletin of Geosciences* is the most important scientific journal published by the Czech Geological Survey. Its predecessor *Věstník Státního geologického ústavu Československé republiky* was founded at the request of the scientists of the State Geological Institute of the Czechoslovak Republic and the first volume was issued in 1925. Since then, thousands of scientific papers have been published and it now constitutes an archive of the most important scientific research on the geology of the Bohemian Massif. In 2006, a new editorial board set the focus of the journal on palaeoenvironmental research and on the evolution of life on Earth. In 2007, the *Bulletin of Geosciences* was included with other international scientific journals in the most prestigious scientific databases. In 2010, based on its high-quality scientific content, the journal received an impact factor from the prestigious American company Thomson Reuters.
Thanks to the long-term efforts of the current editorial board, the *Bulletin of Geosciences* is one of the top 10 most important scientific journals published in the Czech Republic.

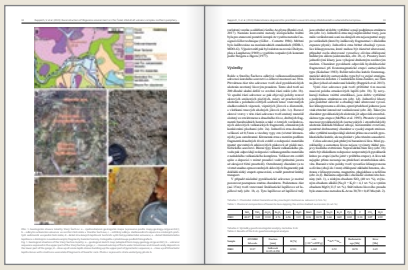




Journal of Geosciences

The Czech Geological Survey is a co-publisher of the *Journal of Geosciences* (http://www.jgeosci.org), released by the Czech Geological Society with the grant support of the Council of Scientific Societies of the Czech Republic and the Czech Literary Fund Foundation. Being a periodical with a long tradition (65th volume), it follows its predecessors *Časopis pro mineralogii a geologii* ("Journal of Mineralogy and Geology") and *Journal of the Czech Geological Society*. Since 2006, it has been focusing on process-oriented studies dealing mainly with mineralogy, structural geology, petrology, and with the geochemistry of igneous and metamorphic rocks. In addition to regular volumes, special monothematic issues are also published. The *Journal of Geosciences* maintains a high standard and is indexed in a number of database services, including the prestigious Web of Science, Scopus and GeoRef. Thanks to this fact, the journal received an impact factor from the Thomson Reuters company in 2011.





The Geoscience Research Reports

The *Geoscience Research Reports*, a compilation of reports, has been published as a periodical in printed form by the Czech Geological Survey since 1952. In recent years, free access has been provided to the full texts of published papers in electronic form as well. The reports have been available since 1991. The *Geoscience Research Reports* acquaint the general public with current knowledge from a wide range of geological fields. Readers are provided with the research findings of academia, state institutions and private companies, involving regional geology, stratigraphy, Quaternary research, engineering geology, palaeontology, mineralogy, petrology, geochemistry, hydrogeology, minerals, geophysics, geoinformatics and research abroad. The published papers have a high professional standard and are peer-reviewed. The multicolour publication with English summaries is included in the List of Reviewed Non-Impact Periodicals approved by the Czech government's Research, Development and Innovation Council. The CSAB (Content Selection and Advisory Board) has recommended the inclusion of this title in Scopus, for whose content Elsevier B.V. is responsible.

Svět geologie ("The World of Geology"), CGS Newsletter

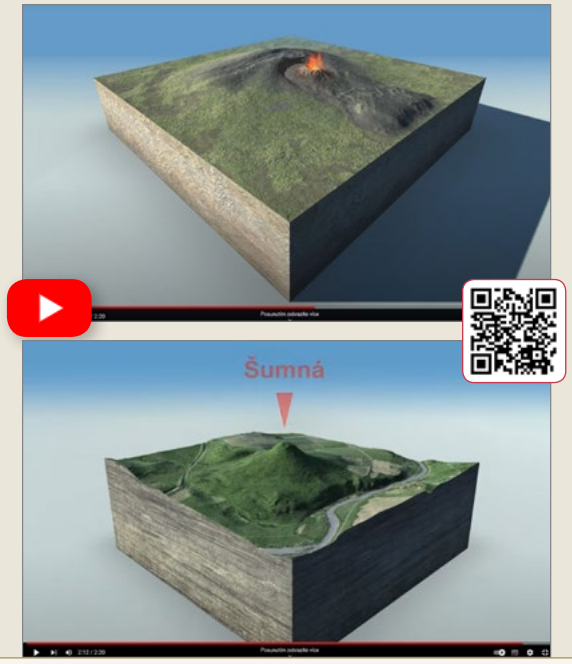
The Czech Geological Survey produces, stores and provides impartial expert geological information to the state administration, private sector and public. It regularly informs of news involving the organization's activities on its website and the CGS Annual Report. The *Svět geologie* quarterly also brings the most significant events and information involving the institute's activities as well as interesting geoscience facts. The magazine is free to download from the CGS website and is intended primarily for electronic distribution.

Selected posts on YouTube

Thermal spring Vřídlo in Karlovy Vary

The spa town of Karlovy Vary owes its origin and development to thermal mineral springs. The hottest of them, Vřídlo, reaches a temperature of 73 °C and gushes out 2,000 litres of hot water per minute. The origin of the thermal springs here is due to the geological structure. The Late Variscan granite pluton is cut by the Tertiary Ohře rift. The groundwater is therefore heated by a combination of radiogenic heat (from the decay of natural radionuclides in the granite) and deep circulation along the rift faults. CO_2 gas is also released along the rift-bounding fault zone from the south, which helps to drive the heated water to the surface and also contributes to the dissolution of mineral constituents from the rock environment.

Šumná – geological development

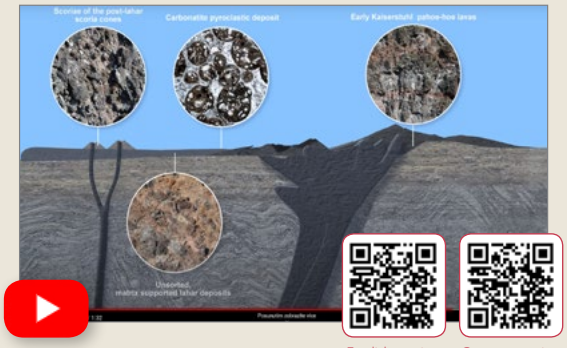


The youngest volcano of the Doupovské hory is Šumná, towering above Klášterec nad Ohří. This 20-million-year-old volcano is only minimally affected by erosion and its current shape has not changed much since it stopped erupting. The Šumná cinder cone cuts through and overlies a sequence of lahars – ancient massive landslides that tore out of the slopes of the Doupov volcano. In a Strombolian type eruption, fragments of volcanic slag were spewed into the air, gradually forming the cone itself, from which lava erupted at the end of the activity.

Bažina – geological development

Even at the beginning of the 21st century, a new volcano can be found in the Czech Republic from time to time. This is especially the case with maar volcanoes, which are explosive craters that do not create a striking topography. A pair of such maars was recently discovered in western Bohemia, near the village of Polná. While the first crater, known as Ztracený Rybník ('Lost Pond'), ended with an explosion that created a maar crater, second maar continued to be active. Thus, in the second crater, known as Bažina ('Swamp'), new portions of the protruding magma successively formed three overlapping small pyroclastic cones. This volcanologically very interesting evolution of a small volcano has been revealed thanks to a comprehensive geophysical survey of the site, but mainly thanks to the implementation of two exploratory boreholes excavated within the framework of the ICDP. The animation is in English.

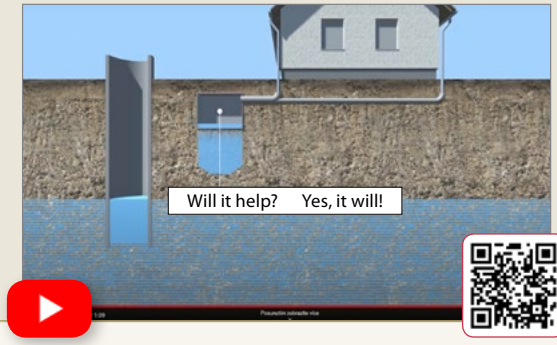
Kaiserstuhl – geological development



English version German version

The Kaiserstuhl is a small mountain range in south-west Germany, which is an erosional relic of an extinct Miocene volcano. The presence of carbonatites (magmatic carbonate rocks) makes this volcano very interesting indeed. Part of the volcano collapsed during its evolution, leading to the formation of debris avalanches and lahars. This collapse also exposed carbonatites within the volcano, leading to their explosive eruption and the deposition of carbonatite pyroclastics on the surface of the lahar fan at the base of the volcano. Kaiserstuhl volcano thus offers an alternative model of how carbonatite eruptions can be triggered.

Rainwater management and the impact on groundwater levels



This video answers the question of what to do when water is lost from a well. See what happens when you bring water to your well by tanker and how it all works.

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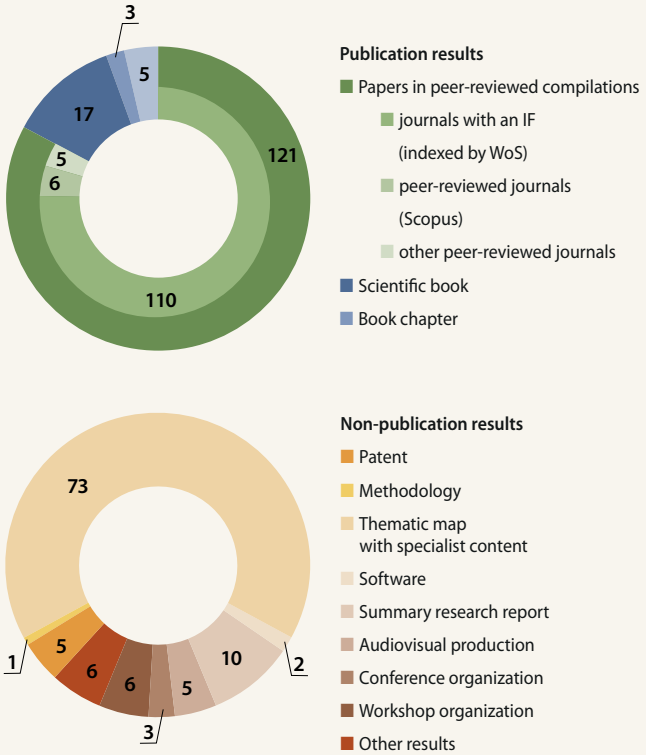
Statistics on the results of CGS activities according to the current RVVI methodology



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

Financial review

In 2022, the total expenditures and total income of the Czech Geological Survey amounted to CZK 513,111,000 and CZK 514,670,000, respectively.

In 2023, the CGS reached a positive financial balance of CZK 1,559,000.

The positive financial balance was achieved mainly due to income from the sale of services and other service-related activities amounting to a total of CZK 111,515,000, of which the largest portion of revenues came from the sale of services (mainly contracts) in the amount of CZK 53,472,000, and additional revenue from activities (mainly overhead costs from projects and contracts) in the amount of CZK 47,733,000.

The organization's total revenue, including subsidies for carrying out projects and tasks involving the long-term development concept for research organizations, obtained apart from contributions provided by the organization's founder, represent a total of CZK 410,775,000 and account for 80% of the total revenue.

The overall financial balance ensured sufficient revenue to cover the expenditures of the Czech Geological Survey and its continuing development. Total personnel cost in the amount of CZK 316,565,000 increased by CZK 27,207,000 year-on-year (mainly due to an increase in rates as of 1 September 2023), and investments in 2023 included the necessary purchase of upgraded equipment by the Czech Geological Survey amounting to a total of CZK 29,958,000. The most important investments in 2023 include the reconstruction of the Klárov building (replacement of windows, lighting, insulation of the attic and boreholes for heat pumps).

With its results in science and research in 2023, the Czech Geological Survey maintained its leading ranking in the science and research evaluation system in the Czech Republic, thus securing the necessary funding for the development of the research organization amounting to a total of CZK 118,724,000. Similarly, in 2023 the Czech Geological Survey successfully participated in international projects (such as Horizon 2020, Norwegian projects, projects of the EU's European Commission, and so forth) and foreign development projects as well.

The financial results from 2023 as well as from previous years form a solid basis for the organization's continuing existence and development for carrying out the state geological survey's tasks, science and research projects, and for providing services to various state authorities, local governments and the public.

Total expenditures of the organization

Total expenditures (CZK)	**513,111,167**
Material and power consumption	29,611,243
Services	88,046,701
Total personnel cost	316,565,015
Depreciation of tangible and intangible assets	23,996,452
Other expenses	54,891,756

Total income of the organization

Total income (CZK)	**514,669,770**
Sales and other own-source revenue	111,514,706
Allocation for activities of the organization	103,894,560
Institutional funding for development of research organizations	118,724,024
Funds for projects and commissioned services	169,670,709
Income from transfers	10,865,772

Helena Žemličková
Head of the Human
Resources Department

Human resources

In 2023, the Czech Geological Survey had 423 employees, including those on maternity and parental leave. The full-time equivalent amounted to 360.31, numbering 205 women and 218 men.

The indicators given above not only underline the high level of competitiveness in the labour market, but they also emphasize the organization's economic growth and prestige among research institutes in the Czech Republic.

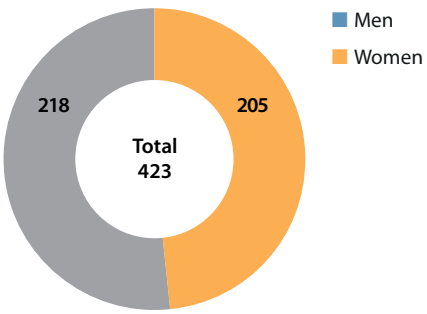
The Czech Geological Survey actively supports the professional development of its employees and takes an interest in enhancing their qualifications. It provides training for its employees through a wide range of language, legal and economic courses and seminars, expert training, specialized seminars and so forth. In 2023, courses such as "Safe Driving", "First Aid", "Law for Non-Lawyers" and "Survival" were held for employees.

The CGS observes the principles of equal employment opportunity for all age groups, women and men alike, covering a wide range of employment conditions. This is confirmed by the fact that employees returning from maternity or parental leave are offered the opportunity of working part-time as in the case of working seniors and staff members involved in university or PhD study programmes.

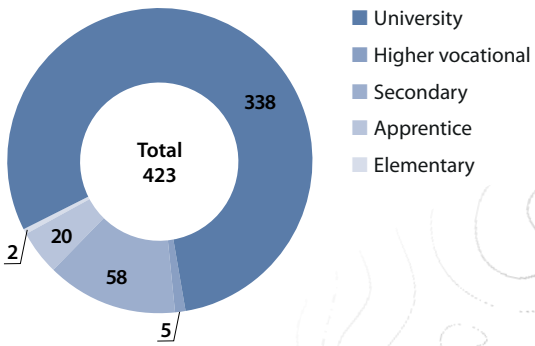
The theme of equality and equal opportunities is a core value in the Czech Geological Survey. It is purposefully promoted by the management and it affects all activities and activities carried out by the CGS. The ideas on which we are based are binding values within the European Community and are anchored in national legislation and at international level.

In 2023, the CGS established the position of gender ombudsman and ombudswoman. Female and male employees can turn to the ombudsman or ombudswoman in cases of sexual harassment, workplace violence, and other pertinent issues. The ombudsperson's role is to ensure legal compliance, individualized attention, confidentiality, security, and transparency.

Gender ratio of the CGS staff



Educational background of the CGS staff



Principal events in 2023

The 1st year of the scientific conference Karst, Caves and People took place

On 23–24 September 2022, the Czech Geological Survey in cooperation with the Czech Speleological Society, the Cave Administration of the Czech Republic and the AOPK – CHKO Moravský kras organized the 1st annual scientific conference on the issue of sustainable development in karst areas 'Karst, Caves and People'. The event was held under the auspices of the Union Internacionale de Spéléologie and with the support of the Ministry of the Environment in Češkovice near Blansko. Specialists from various scientific institutions presented their results in 18 lectures in four thematic blocks (Karst and Water, Karst and Caves, Karst and Nature Conservation, Karst and People): Representatives of the Czech Geological Survey, the Moravian Karst Protected Landscape Area, the Cave Administration of the Czech Republic, the Czech Speleological Society, the International Union of Speleology, the Moravian Museum, the Moravian Karst Nature House, the Brno University of Technology, the Faculty of Science, the Academy of Stciences of the Czech Republic and members of local governments. The second day of the conference included professional surface and underground excursions.

CGS measured the outflow of water at Turów mine

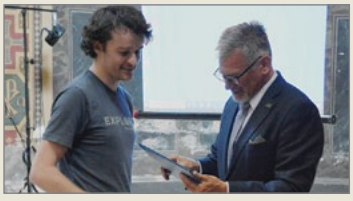
On 23 and 24 January, the Czech Geological Survey carried out its fourth inspection at the Turów mine, on the basis of the agreement between the Czech Republic and Poland on addressing the impacts of mining activities at this lignite mine on the territory of the Czech Republic. Specialists from the Czech Geological Survey examined the southern part of the Turów mine, where measurements of the amount of water run-off were subsequently carried out on three mine stages. Landsat 8 satellite images were also used to assess the progress of mining in the mine and to show that mining operations do not exceed the parameters set out in the agreement. A detailed description of the progress of the assessment mission, including the arrangements resulting from the final discussion between the Czech experts and representatives of the mine management and the Państwowy Instytut Geologiczny (State Geological Institute), is summarized in the attached report.

Geology Day with the Czech Geological Survey

After an unpleasant COVID hiatus, the Czech Geological Survey returned to organising promotional events for the public. The Earth Day, last held in 2019, was followed by the Geology Day with the CGS, which was repeated this year. And it was so successful that it is likely to become a tradition.

CGS Director's Awards for Young Scientists

On 25 May 2023, at the CGS headquarters in Klárov, Prague, the CGS Director's Awards for Young Scientists for significant publications published in the calendar year 2022 were officially presented by the Director of the institution, Mgr. Zdeněk Venera, Ph.D. Five high-quality publications were submitted to the competition. Following the evaluation of fifteen experts, the winner and the holder of the financial award in the amount of CZK 30,000 was Mgr. Martin Kubeš, Ph.D., for the article 'Highly evolved miaskitic syenites deciphering the origin and nature of enriched mantle source of ultrapotassic magmatism in the Variscan orogenic root (Bohemian Massif, Moldanubian Zone)', published in the journal *Lithos*. The second prize, accompanied by a financial bonus of 15,000 CZK, went to MGeol. Stephen Collett, Ph.D., for his paper 'Significance of a late Neoproterozoic – Early Cambrian southern Baltica active margin in late-stage Rodinian and early Gondwanan reconstructions', published in the journal *Precambrian Research*. The third-place winner and recipient of the 8,000 CZK prize was Mgr. Vojtěch Wertich, Ph.D., for his paper 'Trace element signatures of uraninite controlled by fluid-rock interactions: A case study from the Eastern Moldanubicum (Bohemian Massif)', published in the *Journal of Geochemical Exploration*.



Geology Olympiad 2023

The picturesque valley of the River Říčka in the Moravian Karst hides the sprawling building of Kaprálův mlýn (Kaprál's Mill), which houses the Centre for Environmental Education. It was here that 50 participants of the national round of the Geology Olympiad 2023 gathered on 25–28 April.

Projects implemented in 2023

Czech Science Foundation	CGS project manager
19-27682X (EX1): Main mechanisms of peripheral continental growth during the supercontinental cycle	K. Schulmann
20-19471S: GeoMicLink: Microbial imprint in catchment-scale nutrient retention	F. Oulehle
20-20785J: Search for biological fingerprints and grain alteration patterns in Devonian and Carboniferous microbial facies – examples from the Bohemian Massif	S. Vodrážková
21-27420S: Controls of Mg, Ca and Sr isotope signals in catchment runoff: A multiple-site approach	M. Novák
22-33820S: Multiphase solid inclusions in orogenic peridotites as tracers of metasomatization in collisional orogens	J. Kotková
22-26485S: Synthetic platinum-group minerals and their applications	A. Vymazalová
22-34175S: Interpreting geochemical data in igneous geochemistry: using the R language to develop new, and to integrate existing, free and open-source software	V. Janoušek
23-0782S: Pervasive melt migration in continental crust: a micro-scale process with large-scale implications	P. Hasalová
23-08249S: Origin of the relaminant in the Bohemian Massif during the Variscan orogeny	P. Štípská
23-07625S: Pre-Variscan oceanic basins of the Bohemian Massif – Integrating petrology, geochronology and non-traditional stable isotope systems	T. Magna
23-07583S: Does tree transpiration drive forest calcium biogeochemistry? Or the other way round?	F. Oulehle
23-05944K: Ancient jawed polychaetes: evolution and palaeogeography in the Lower Palaeozoic	P. Tonarová
19-29124X: Evolution and post-emplacement history of carbonatites: Implications for the mobility and concentration of critical metals	T. Magna
20-13644S: Cherts and carbonates as geochemical proxies of paleoenvironmental conditions and Ocean Plate Stratigraphy	J. Pašava
20-23363S: Biostratigraphy and faunal dynamics of the Silurian pelagic biota of the Prague Basin in the context of major environmental changes and perturbations	Š. Manda
21-30043S: Petrogenesis and emplacement of deep-marine alkaline basaltoids: A case of Early Cretaceous magmatism in the northern Tethys region	V. Rapprich
22-11661K: Towards integrated stratigraphy of the Late Paleozoic in eastern equatorial Pangea	Z. Šimůnek
23-05577S: Generation, extent, and longevity of magma mush columns	P. Hasalová
23-05051S: Metals and their isotopes in active and abandoned mining areas of sub-Saharan Africa – towards understanding of their geochemistry and impacts	B. Kříbek

Technology Agency of the Czech Republic	CGS project manager
TK01030031: Engineered barrier 200C	F. Laufek
SS01010208: Targeted replenishment of groundwater as a tool to reduce drought impacts in the Czech Republic	R. Kadlecová
SS02030023: Rock environment and natural resources	M. Poňavič

• Analytics 225000	Z. Cilc
• Mineral resources SUBPROJECT 225000	M. Poňavič
• Groundwater in the karst system SUBPROJECT 225000	R. Novotný
• Geohazards SUBPROJECT 225000	P. Kycl
• Undermining SUBPROJECT 225000	J. Šanderová
• SS02030018: Center for landscape and biodiversity	F. Oulehle
• SS02030031: Integrated system for air quality research, assessment and monitoring	M. Novák
• SS02030040: Prediction, evaluation and research for understanding national sensitivity and impacts of drought and climate change in Czechia	O. Nol
• TITSMPO031: Research on promising mineral fillers and quartz raw materials in the Bohemian Massif, their treatment and use for progressive industrial applications	J. Godány
• TITSMPO026: Research on the raw material potential of strategic minerals in brines of the Bohemian Massif	J. Godány
• TK05010167: Study of variant technical solutions for deep disposal of radioactive waste	R. Nahodilová
• SS06010280: System for continuous vadose zone monitoring and prediction of water level in deep aquifers	O. Nol
• SS06010461: Determination of protective zones of hydrogeological phenomena in the PLA Slavkovský les	J. Holeček
• SS06010044: Defining and evaluating the areas decisive for subsidizing strategic groundwater resources with regard to their protection and stabilization	J. Novotná

Internal projects funded by the MoE (Ministry of the Environment) under the Long-Term Conceptual Development of Research Organizations	**CGS project manager**
• Wetlands and their importance in the landscape	E. Břízová
• Geology of the Křivoklátsko Protected Landscape Area – compilation of a monography based on research carried out in 2002–2018	T. Vorel
• Continuous inventory of CGS samples in Brno	M. Bubík
• Monograph of the Krkonoše Piedmont Basin and digitization of a 1:75,000 map	M. Stárková
• Development of methods for isotopic analysis of samples obtained by micromilling. 2020–2021	J. Hora
• Work in the steering committee of the ENeRG international research network	D. Štěpánský
• Soil maps 1:50,000 – lay-out of digital maps produced by the NCA CR according to the requirements for CGS map outputs, supplemented with explanatory notes to maps and printing for the archive	J. Janderková
• Interpretation and publication of significant results from site evaluation projects for the location of a deep radioactive waste repository	J. Pertoldová
• Geology of the Šumava National Park and Protected Landscape Area	V. Žáček
• Mentoring	Z. Bukovská
• Preparing to create a new popularising CGS website	J. Jelének
• Mineralization of biogenic material in a volcanic environment	J. Mysliveček
• Reconstructing pre-orogenic architecture of the Variscan suture zones of the Bohemian Massif	S. Collett
• Correlation of basement domains in covered parts of the Bohemian Massif and their metamorphic record	V. Peřestý
• Geochemistry and geochronology of an early-Variscan magmatic suite in the leptyno amphibolite complex of the Haut-Allier (French Massif Central)	de Hoym de Marien Luc
• The relaminant in the Bohemian Massif: what is the protolith age?	P. Štípská

Origin and evolution of high-grade metamorphic metasedimentary complexes in the central part of the Bohemian Massif	E. Žáčková
Animate and inanimate nature of the city of Beroun – publication plan support and personal research	J. Holeček
Correlation between concentrations of trace elements in precipitation and soil in the polluted area of Ostrava and the Polish part of Upper Silesia	T. Pačes
FLOW2020: New tools for geohazard risk assessment in high mountain regions	L. Koucká
Application of the LA-ICP-MS methodology to study trace elements in oxide minerals using multiple reference materials for calibration	I. Andronikova
Preparation of a new version of the virtual museum of the Czech Geological Survey	P. Budil
Preparation and implementation of the Geology Day with CGS	Z. Bukovská
Diamond graphitization in nature and experiment	J. Kotková
Pre-Variscan evolution of the central parts of the Bohemian Massif: a key to understanding the current geological structure of the candidate deep repository sites – horizontal cooperation	I. Soejono
Provenance analysis of sedimentary rocks from the internal domain of the Kaoko–Dom Feliciano–Gariep orogenic system (Namibia, Uruguay) – determination of age and Hf isotope ratios in detrital zircons	J. Konopásek
Regional geological mapping of the Czech Republic at 1:25,000 scale, sheets 25-123 Hranice and 25-143 Bystřice pod Hostýnem	P. Tomanová Petrová
Isotopic composition of Moldanubian granitoids: a new perspective on Variscan orogenic crustal variability and its implications for planned deep repository sites – horizontal cooperation	V. Janoušek
Petrogenesis and geochemistry of the historic primitive lavas of La Palma	T. Magna
Testing of drones and virtual reality for research purposes	L. Koucká
Melt migration in the continental crust and its role for granite formation – key to understanding the origin of granitoid bodies potentially hosting radioactive waste depositories	P. Hasalová
Application of morphostratigraphic, thermochronometric and geochronological methods for reconstruction and prediction of relief evolution in the wider surroundings of candidate sites – horizontal cooperation	T. Hroch
A comprehensive study of the lacustrine carbonate factory in the Eger Rift Basin: geochemical insights into paleoenvironmental evolution	D. Petráš
Comprehensive processing of the global auxiliary boundary stratotype of turon–coniac in the Czech Republic (Střeleč locality)	S. Čech
Volcanic systems VII.	M. Stárková
Implementation of the DKRVO – PART 2.1: Research on global changes and evolution of marine ecosystems – Palaeozoic	J. Frýda
Sedimentological, palaeobotanical and palynological research of the Permo-Carboniferous basins of the Bohemian Massif	Z. Šimůnek
Selected taphocenoses of the Phanerozoic: palaeoecology, palaeobiogeography, stratigraphy and sedimentology	R. Vodrážka
Slope movements in the Peruvian Andes	J. Novotný
Cu, Zn and Cd isotope systematics at the substrate-to-mushroom interface in three polluted areas underlain by contrasting bedrock	A. Andronikov
Effect on elemental concentration and isotopic composition results of different sample preparation methods	E. Martinková
Interdisciplinary researches in CZO Slavkovský les	P. Krám
Analysis of biomarkers in sedimentary rocks for palaeoenvironmental studies	D. Ocásková

Changes in soil aggregate stability, mineralogy and geochemistry under no-till and conventional tillage	M. Koubová
Evolution of changes in cation exchange capacity for bentonite heating	M. Koubová
Publication of two articles and preparation of chapters for a monograph	J. Hošek
Development of Electronic Mountain Form and Data Management applications	M. Janoušek
Conference preparation: 3rd Virtual Annual IGCP 735 in Prague	M. Nohejlová
Preparation of all types of projects – capacity reporting	P. Mixa
Completion of projects (capacity reporting on technical completion of outputs – corrections after review process, for projects completed in the previous year)	D. Skácelová
Editorial plan and promotion plan, CGS Publishing House, 2020, ongoing	P. Fiferna
Inventory of Slope Instabilities	O. Krejčí
Regional geological mapping of the Czech Republic at 1:25,000 scale	D. Buriánek
Regional geological mapping of the Czech Republic at 1:25,000 scale, Železné hory Mts	S. Čech
Regional geological mapping of the Czech Republic at 1:25,000 scale, Novohradské hory Mts	B. Dudíková Schulmannová
Regional geological mapping of the Czech Republic at 1:25,000 scale, Pošumaví region	V. Žáček
Regional geological mapping of the Czech Republic at 1:25,000 scale, Bohemian Paradise II	L. Švabenická
Regional geological mapping of the Czech Republic at 1:25,000 scale, Brdy Mts	T. Vorel
Regional geological mapping of the Czech Republic at 1:25,000 scale, Central Moravia	P. Tomanová Petrová
Development of 3D geological models and related CGS databases	J. Franěk
Expert support for the National Geoparks Network of the Czech Republic II	V. Štědrá
Geology of the Bohemian Cretaceous Basin	S. Čech
Decorative and building stones of the Czech Republic	B. Dudíková Schulmannová
Study assistance for CGS employees	A. Václavíková
Editing of the Geoscience Research Reports journal	T. Sidorinová
Printing of geological and applied maps	V. Žáček
Editing of the journal Geological Research in Moravia and Silesia	D. Buriánek
Editorial activities of scientific publications (capacity reporting), ongoing	V. Janoušek
Editing and preparation of the electronic version of the Bulletin of Geosciences	J. Frýda
Editing and printing of the Bulletin of Geosciences	J. Frýda
Integration of the ICT infrastructures of CGS and CGS – Geofond, ongoing	R. Binko
Important geological localities of the CR	M. Vajskebrová
Administration, maintenance and development of the PMČR50 geo-database related to the compilation of new soil maps and their safekeeping, printing and presentation, CGS, ongoing	J. Sedláček
Assessment services of regional geologists	J. Čurda
Executing tasks of the state geological survey apart from approved projects	P. Mixa
Executing tasks of the state geological survey apart from approved projects – Geofond Division, ongoing	V. Štrupl
Repair fund for laboratory instruments	Z. Venera
Activities of the coordinators of Long-Term Conceptual Development of Research Organizations/CGS	J. Pašava
Activities of the CGS Project-Review Board, ongoing	P. Mixa

Projects funded by the MoE for tasks of the state geological survey	CGS project manager
• Revision of mapped undermined areas and mine workings based on new acquisitions of digital map documents as a basis for investigating mining impacts and for consolidating data on abandoned exploratory mine workings, 2022	A. Horáková
• Processing and evaluating final reports from the Resource Reports Collection at the Kutná Hora office as a basis for investigating mining impacts, 2022	J. Šanderová
• Review of mitigated mining impacts and secured abandoned exploratory mine workings according to Czech Mining Authority Regulation No. 52/1997 Coll., on requirements for ensuring safety and occupational health and operational safety during the decommissioning of major mine workings, 2022	P. Šír
• Initial investigation of reported mitigated mining impacts in 2023	V. Štrupl
• Mineral Commodity Summaries of the Czech Republic and Changes in Reserves of Reserved Mineral Deposits	J. Starý
• RANAP, 2020, Contact of the Cretaceous and Permo-Carboniferous, web map update	P. Pacherová
• Update of soil maps at 1:50,000 scale	J. Janderková
• Advisory and expert services provided for the Geology Department of the MoE (including landslides for the Operational Programme Environment, updates of maps, assessments and opinions), NP321 (gas leakage measurement), etc.	J. Čurda
• Restoration of selected parts of the geological documentation collection maintained by the CGS Geofond archives, 2022 phase	M. Hrdlovicsová
• CGS repositories – retransfer of documented samples from old boreholes to the standard storage system of the CGS Geofond Division, 2022 phase	A. Donát
• Digitization of collections of the geophysical archive at the Geofond office in Brno, 2022 phase	E. Hudečková
• Monitoring of hydrogeological boreholes in 2021–2024 (Rebilance sustainability)	T. Vránek
• Transfer of borehole logs from the archived reports of the FZ and P collections into the GDO and GEO systems, feldspar, bentonite, 2022 phase	Z. Petáková
• Wells with potential gas leakage in the Czech Republic, 2022	J. Franců
• Revision of prognosticated resources of industrial minerals and ores, category Q, in Central Bohemia	Š. Mrázová
• Geological conditions in Spa Source Protection Zones – pre-project phase	E. Kryštofová
• Post-fire activities of CGS geologists in the Bohemian Switzerland National Park	J. Malík
• Consolidation and integration of the geochemistry dataset and its integration into the CGS information system	R. Kujal
• Methodology for the implementation of the UNFC system in the legislative framework of the Czech Republic	Z. Gabriel
• Assessment and evaluation of the lignite-bearing area of the North Bohemian Lignite Basin in terms of the possibility of its release for further exploitation	J. Morysek

Projects for the MoE and other ministries	CGS project manager
• Turów 7/2016–2044	R. Kadlecová
• Institutional support for the long-term conceptual development of the research organization based on an evaluation of its achieved results	J. Pašava
• Management of a network monitoring the status of ecosystems with regard to air pollution	J. Hruška
• ICP modelling a mapping conference 2023	T. Chuman
• ET-2019-019-RO-43040: Ensuring sustainable land management in selected areas of Ethiopia based on geoscience mapping	K. Verner
• ET-2020-077-RO-31140: Compilation of a national geological and hydrogeological map at a scale of 1:1,000,000 for the entire territory of Ethiopia	K. Verner

• Revision of palaeontological material from the Barrandian area in Viennese institutions: a hitherto unappreciated resource for understanding the early phases of geological research in the Austro-Hungarian Empire	P. Budil
• Impact of climate changes on high-latitude (polar) marine benthic communities: What can we learn from the Ordovician?	M. Nohejlová
• Improving quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamo and Gofa zones, Ethiopia	K. Verner
• CZ.02.2.69/0.0/0.0/18_053/0017379: International mobility of CGS researchers	A. Velímková
• Innovation of Geological Information Systems in Bosnia and Herzegovina	D. Čápová
• Groundwater in Crystalline Rocks	J. Novotná

Horizon Europe and Horizon 2020	CGS project manager
• COST Geothermal-DHC: New geothermal sources for carbon-free heating grids	A. Tym
• e-shape – Next-generation satellite data and creation of innovative applications	V. Strnadová
• SEMACRET – Sustainable exploration for orthomagmatic (critical) raw materials in the EU: Charting the road to the green energy transition	V. Wertich
• GSEU – A Geological Service for Europe	D. Čápová
• A Geological Service for Europe – Critical Raw Materials, the International Centre of Excellence and United Nations Framework Classification	Z. Gabriel
• A Geological Service for Europe – Geothermal energy & underground storage inventory	L. Janků
• A Geological Service for Europe – Appraisal, protection & sustainable use of Europe's groundwater resources	O. Nol
• A Geological Service for Europe – Geological framework for the European geological data & information system	D. Čápová
• A Geological Service for Europe – European Geological Data Infrastructure, EGDI	D. Čápová
• A Geological Service for Europe – Communication, Dissemination & Exploitation	D. Čápová
• A Geological Service for Europe – Geological Surveys network and sustainable services for Europe	D. Čápová
• Multi-Miner: Multi-source and multi-scale earth observation and novel machine learning methods for mineral exploration and mine site monitoring	V. Strnadová
• PUSH IT – Piloting Underground Storage of Heat In geoThermal reservoirs	A. Tym
• PUSH IT – sub-project WP 1	A. Tym
• PUSH IT – sub-project WP 2	A. Tym
• PUSH IT – sub-project WP 3	A. Tym
• PUSH IT – sub-project WP 4	A. Tym
• PUSH IT – sub-project WP 5	A. Tym

Other projects co-funded by foreign entities	CGS project manager
• TO01000112: CO_2 Storage Pilot in a Carbonate Reservoir	J. Franců
• TO01000220: The fate and future of carbon in forests (CatchCaN)	J. Hruška
• SYNERGYS – synergy energy systems – preparatory project	A. Tym
• BrineRIS – Brines of RIS countries as a source of CRM and energy supply	P. Rambousek
• SYNERGYS	A. Tym
• PanAfGeo-2: Africa-EU Partnership – Support to Geological Sciences and Technology	V. Štědrá

CGS website

The Czech Geological Survey launched a new website in 2023, which brought a significant change in content and graphic design. It is based on a modern technological solution, which is also used by other departmental organizations of the Ministry of the Environment and which will provide the CGS with a stable tool for presenting its activities and services for years to come.

We believe that users will be pleased with **the simplification of the structure and content of the website** and therefore **easier access to the required information**. The website is also fully responsive and therefore adapted for use on mobile phones and other devices.

For better and faster orientation on the website and in the institution's services, we have added a new menu called **"What do you need?"**, which is accessible from a header of every page of the website.

In a more attractive graphical form, the site features widely used **signposts** for web applications (including maps), web services and datasets.

The Czech Geological Survey has launched a website under the **gov.cz** domain, to which the websites of other state organizations are gradually being moved. Instead of www.geology.cz, you will now find us at **cgs.gov.cz**.

State geological survey
> https://cgs.gov.cz/en/state-geological-survey

Science and research
> https://cgs.gov.cz/en/science-and-research

Laboratories
> https://cgs.gov.cz/en/laboratories

Library, archive, collections
> https://cgs.gov.cz/en/library-archives-collections

Maps and data
> https://cgs.gov.cz/en/maps-and-data

Publications
> https://cgs.gov.cz/en/publications

About us
> https://cgs.gov.cz/en/about-us

Journals

Bulletin of Geosciences
> www.geology.cz/bulletin

Geoscience Research Reports
> https://app.geology.cz/zgv/en

Web applications

Guidepost to applications
> https://cgs.gov.cz/en/maps-and-data/applications

Dictionary of geology EN-CZ and CZ-EN
> http://www.geology.cz/aplikace/encyklopedie/gslov.pl?l=e

Virtual museum
> http://muzeum.geology.cz/?l=e

Interesting geosites
> https://mapy.geology.cz/geosites

Decorative stones
> http://decorative-stones.geology.cz/

Other web presentations

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

Principal offices of the Czech Geological Survey

Klárov Headquarters

Klárov 131/3,
118 00 Praha 1, Phone: 257 089 411

Directorate | Regional and Applied Geology | Specialized Library | Collections | IT systems and GIS | Publishing House | Bookstore | Reprographic Centre

Barrandov Laboratories

Geologická 577/6, Hlubočepy,
152 00 Praha 5, Phone: 251 085 111

Central Laboratory (inorganic geochemistry) | Rock and Environmental Geochemistry | Special Laboratories

Kostelní Office

Kostelní 364/26, Holešovice,
170 00 Praha 7, Phone: 234 742 111

Geofond Archive | Study Room | Scanner | Specialized offices for the performance of the state geological survey

Brno Branch

Leitnerova 204/22, Staré Brno,
602 00 Brno, Phone: 543 429 200

Regional and Applied Geology, Geophysics | Rock and Environmental Geochemistry | Testing Laboratory (organic geochemistry) | Library and Geophysical Archive | IT and GIS

Kutná Hora Office

Dačického náměstí 11/7,
Kutná Hora – Vnitřní Město,
284 01 Kutná Hora, Phone: 327 512 220

Mining History Department | Archive of Mining Maps | Archive of Resource Reports Collection | Specialized Library

Jeseník Office

Erbenova 348/1, Bukovice,
790 01 Jeseník, Phone: 584 412 081

Regional Office | Archive of Geological Samples | Bookshop

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

Kotlářská 267/2 , Veveří,
602 00 Brno, Phone: 541 129 496

Electron Microprobe and Microanalysis Laboratory

Jílové Regional Museum and Centre for Documentation of Gold Deposits

Masarykovo nám. 16,
254 01 Jílové u Prahy, Phone: 234 742 205

Archive of Written Documentation and Geological Samples of Au Deposits in CR

Lužná Archive of Material Documentation

Čsl. armády 432, 270 51 Lužná u Rakovníka

Archive of Geological Samples | Collections | Publications and Maps

Stratov Archive of Material Documentation

289 22 Stratov 20 a 21

Archive of Written Documentation and Geological Samples

Kamenná Archive of Material Documentation

Kamenná 42, 262 31 Milín

Archive of Geological Samples

Kovanice Archive of Material Documentation

288 02 Kovanice 184

Archive of Written Documentation

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