



CZECH
GEOLOGICAL
SURVEY

Annual Report **2024**



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Director's Foreword

Dear readers,

As we reflect on the past year, I want to highlight several of our most significant achievements and milestones. In 2024, the Czech Geological Survey marked its 105th anniversary. We celebrated this historic milestone together with the Minister of the Environment, Petr Hladík, and our former directors, Vladimír Sattran and Miloš Růžička. On this special occasion, we honored our colleagues Karel Schulmann and Martin Novák with the Cyril Purkyně Medal for their lifelong contributions to geological science and their merit in building a worldwide reputation of the Czech Geological Survey (p. 4).

Professor Karel Schulmann also concluded his exceptionally successful project, *Principal mechanisms of peripheral continental growth during the supercontinental cycle*, funded by the Czech Science Foundation (CSF). Completed last year, the project was evaluated by the CSF as a remarkable success, yielding 43 articles in high-impact journals (p. 67).

Under the leadership of Kryštof Verner, our team completed a landmark project supported by the Czech Development Agency: the *Geological and Hydrogeological Map of Ethiopia at a scale of 1:1,200,000* (p. 63). This flagship masterpiece, essential in any national geological map collection, is the result of four years of dedicated work by Czech and Ethiopian geologists. It is accompanied by a comprehensive book on geological and hydrogeological setting of Ethiopia, as well as an interactive web application that makes the maps accessible to all.

After several years of preparation, we were thrilled to finally launch the SYNERGYS project in Litoměřice. Led by the Faculty of Science, Charles University and funded by the Just Transition Operational Programme, this project includes the construction of a deep geothermal energy source. As a part of near-zero-emission energy production, this pioneering experiment in the Czech Republic will involve injecting water into a 3–4 km deep borehole to be heated by the Earth and then pumped back to the surface for local heating.

Building on our expertise in geothermal energy, we also completed the energy renovation of our Klárov headquarters. Thanks to a grant from the State Environmental Fund, we



Foto P. Neubert.

replaced outdated 1970s electric boilers with modern heat pumps that draw energy from 15 boreholes, each 200 m deep. This exemplary achievement was made possible due to our Deputy Director for Economics, Zdeněk Cilc, who initiated and managed this project. He also deserves immense credit for launching the preparation of another, even larger project: complete energy and architectural reconstruction of our laboratory building in Barrandov, which includes adding a new floor. Construction is planned for 2026, and we intend to power this modern, ecological building with both geothermal and solar energy.

In 2024, the European Parliament adopted the Critical Raw Materials Act (CRMA). This regulation aims to strengthen the EU's self-sufficiency and reduce its critical dependence on imported raw and processed materials, primarily from China. The Act requires member states to implement national exploration plans. In response, we collaborated with DIAMO, state mining enterprise, to develop a plan focusing on resources with potential in the Czech Republic, such as graphite, tungsten, lithium, fluorite, barite, niobium, tantalum, rare earth elements, and feldspars. The plan was approved by the Government and future activities over the next six years will generate an unprecedented amount of new geological data.

Finally, 2024 also marked the 100th anniversary of our geological library. In addition to 220,000 printed titles, it provides the most extensive access to digital resources among all organizations under the Ministry of the Environment (p. 76). This public service is complemented by our Geofond archive, where all geological reports are stored, with the most significant documents digitized and available online.

In closing, I want to extend my heartfelt thanks to all CGS employees. Their enthusiasm and dedication were instrumental in overcoming the challenges of the past year. They continue to be a pillar of support for the state in the geological sciences, and for that, I am deeply grateful.


Zdeněk Venera

Organizational structure of the Czech Geological Survey

Situation as of 31 December, 2024

Advisory bodies	Directorate		Advisory bodies
Jan Pašava Deputy Director for Research jan.pasava@geology.cz Editorial Boards of the Bulletin of Geosciences and Geoscience Research Reports	Zdeněk Venera Director zdenek.venera@geology.cz Management Project Management Management and Administration of the Brno Branch	Human Resources Section Internal Audit	Review Board CGS Map Approval Committee
Geochemical Division and Central Laboratories Anna Vymazalová Head of Division & Deputy Director for Research anna.vymazalova@geology.cz	Economic Division Zdeněk Cilc Head of Division & Deputy Director for Economics zdenek.cilc@geology.cz	Geological Division Petr Mixa Head of Division & Deputy Director for Geology, Deputy Director of the CGS petr.mixa@geology.cz	Division of Information Systems Vít Štrupl Head of Division & Deputy Director for Informatics vit.strupl@geology.cz
Environmental Geochemistry and Biogeochemistry Martin Novák Head of Department martin.novak@geology.cz	General Economics Jana Kuklová Head of Department jana.kuklova@geology.cz	Regional Geology of Crystalline Complexes Jan Jelínek Head of Department jan.jelinek@geology.cz	Informatics Richard Binko Head of Department richard.binko@geology.cz
Rock Geochemistry František Laufek Head of Department frantisek.laufek@geology.cz	Economics and Administration Blanka Štolbová Head of Department blanka.stolbova@geology.cz	Regional Geology of Sedimentary Formations Zuzana Tasáryová Head of Department zuzana.tasaryova@geology.cz	Geofond Milada Hrdlovicsová Head of Department milada.hrdlovicsova@geology.cz
Mineral Resources Research and Policy Michal Poňavič Head of Department michal.ponavic@geology.cz	Department of Assets and Public Procurement Radek Mixa Head of Department radek.mixa@geology.cz	Applied Geology Petr Kycl Head of Department petr.kycl@geology.cz	Mineral Raw Materials Jaromír Starý Head of Department jaromir.stary@geology.cz
Central Laboratory Tereza Grabmüllerová Head of Department tereza.grabmullerova@geology.cz		Regional Geology of Moravia Jan Vít Head of Department jan.vit@geology.cz	Mining Impacts Jolana Skřivánková Head of Department jolana.skrivankova@geology.cz
		Centre for Lithospheric Research Karel Schulmann Head of Department karel.schulmann@geology.cz	Geological Exploration Zdeňka Petáková Head of Department zdenka.petakova@geology.cz
			Information Services Hana Breiterová Head of Department hana.breiterova@geology.cz
			CGS Publishing House Patrik Fiferna Head of Department patrik.fiferna@geology.cz

Management

Czech Geological Survey

The Czech Geological Survey is a respected, state-funded organization and a departmental research institute of the Ministry of the Environment. It is responsible for compiling, storing, interpreting, and providing objective geological information to government agencies, the private sector, and the public. In its capacity as the official state geological survey, it is the only institution tasked with the systematic investigation of the geological structure of the entire Czech Republic.

The Survey's well-established reputation is built on an effective balance of public service and top-tier research in geological science, natural resources, geohazards, and environmental protection. As an internationally respected scientific institution, it supports society's goals for sustainable development and plays a vital role in education and in promoting public understanding 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 impacts
- Geoinformation management and delivery

Mission

- Performance of the state geological survey in accordance with Act No. 62/1988 Coll. (on Geological Works).
- Regional research, geological mapping, and the creation of geological 3D models of the territory of the Czech Republic.
- Basic and applied research in the fields of geohazards, mineral resources, groundwater resources, protection of the rock environment, and environmental protection.
- Acquisition, collection, and evaluation of information on the geological composition of the territory, mineral resources, and geohazards within the Czech Republic.
- Provision of geoscience information and expert support for decision-making in matters of state and public interest.
- International cooperation and foreign development aid.
- Education in geosciences and in the field of environmental protection.



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

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.

Zdeněk Venera
Director of the CGS



Photo by P. Neubert.

Petr Hladík
Minister of the Environment

105 successful years

In 2024, the Czech Geological Survey celebrated a significant anniversary – 105 years since its foundation. A good opportunity to commemorate its activities, history, successes, and plans for the future!

The history of the Czech Geological Survey began as early as 1919, shortly after the establishment of the independent Czechoslovak Republic, although under a different institutional name at the time. While the names continued to change over the years, the core of its activities was set: the systematic geological survey of the state's territory, the publication of corresponding geological maps, as well as independent expert assessment and publishing activities, the collection and archiving of professional written materials, and collection-building, educational, and last but not least, popularization activities. In principle, nothing has changed in this regard to this day.

The CGS still bases its activities on the connection between services for society and research. Over the years, it has developed into a modern research institution in the field of Earth sciences, capable of responding quickly to the needs of sustainable societal development. It has also long been involved in solving international projects around the world and has earned the status of an internationally recognized scientific institution. It also plays a significant role in the educational sphere and in the promotion of geology.

From all this, it is clear there was much to celebrate. And the Czech Geological Survey celebrated its significant anniversary with true dignity: in the beautiful setting of the Baroque Liechtenstein Palace, where on November 6, 2024, not only its past and present employees and collaborators gathered, but also its supporters and friends.

To open the event, CGS Director Zdeněk Venera and Minister of the Environment Petr Hladík delivered inspiring speeches. They emphasized not only the importance of the institution and the successes it has achieved during its 105 years of existence, but also the crucial tasks that lie ahead, especially those concerning the strengthening of Europe's raw material self-sufficiency.

The official program also featured the ceremonial presentation of the Cyril Purkyně Medal, an award honouring the institute's first director. RNDr. Martin Novák, CSc., and Prof. RNDr. Karel Schulmann, CSc., were recognized for their lifelong achievements in science and their dedication to enhancing the prestige of the Czech Geological Survey.

During the event, guests had the opportunity to view an exhibition that engagingly presented the key activities, major projects, and outstanding research results of the Czech Geological Survey. This exhibition highlighted the scientific achievements of the CGS and brought the importance of geology for contemporary society closer to the public.

The gathering also provided a platform for informal conversations, enabling collegial and friendly meetings, thereby strengthening the already strong ties within the geological community and opening space for new collaborations and initiatives for the future.

Text by Klára Froňková, photo by Petr Neubert.



Martin Novák was awarded the Cyril Purkyně Medal.



Presenting the medal to Karel Schulmann.



A relaxed atmosphere filled the hall.



The meeting allowed for collegial and friendly encounters.



Musical accompaniment was present.



Photo by P. Neubert.

Jan Pašava
Deputy Director for Research



Long-Term Conceptual Development of Research Organization (LCDRO)

The CGS is the leading research organization in the Czech Republic in the field of Earth sciences. Since 2023, it has been implementing a new *Long-Term Conceptual Development of 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 (MoE) 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:



Structure and dynamics of the Earth

(D. Buriánek, P. Hasalová, V. Janoušek)



Research of global changes, the biosphere and the sedimentary record

(J. Frýda, S. Vodrážková)



Minerals for sustainable economic development

(M. Poňavič, B. Kříbek)



Groundwater research and evaluation

(L. Rukavičková, J. Řihošek)



Geoenergy research

(J. Holeček, D. Štěpánský)



Engineering geology and geohazards

(M. Aue, O. Krejčí)



Landscape biogeochemistry in the era of climate change

(M. Novák, J. Hruška)



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 2024 marked the second year of implementing the new LCDRO. During this period, Czech Geological Survey (CGS) staff produced a total of 209 RIV (*Register of Information on Results*) category outputs.

Of this total, outputs included: 108 articles in peer-reviewed journals, 2 monographs, 3 chapters in monographs, 1 patent, 43 specialized maps with professional content, including 3D models, 10 comprehensive research reports, 4 outputs in the audiovisual production category, 14 organized events such as conferences, workshops, or exhibitions.

Within the category of articles in professional periodicals, it is important to highlight that 75 articles were published in international impacted journals ranked in the 1st (48 articles) and 2nd (27 articles) quartiles of their respective fields (Q1, Q2).

A peer review assessment of selected excellent scientific and research results of the Czech Geological Survey, along with a bibliometric analysis for the collection period of 2018–2022, published by the Research, Development and Innovation Council (RVVI), demonstrates that in addition to significant publication activity in the dominant field of Earth sciences and related environmental sciences (with results significantly above both the national and global median, as shown at <https://hodnoceni.rvvi.cz/hodnoceni2023/biblio-vo>), the CGS is also a significant producer of applied research results.

In terms of the share of research organizations assessed with grades 1, 2, and 3 for results over a five-year period (Assessment 19–Assessment 23) in the field of Earth sciences and related environmental sciences, the CGS remains the most significant producer of the highest quality selected results among all research organizations in the Czech Republic. These results are assessed in terms of their societal relevance and contribution to knowledge (<https://hodnoceni.rvvi.cz/hodnoceni2023/nebiblio>).

The CGS produces a large number of high-quality results, fully comparable with purely research-oriented institutions in the Czech Republic.

Exploring Earth: For understanding and benefit

Structure and dynamics of the Earth

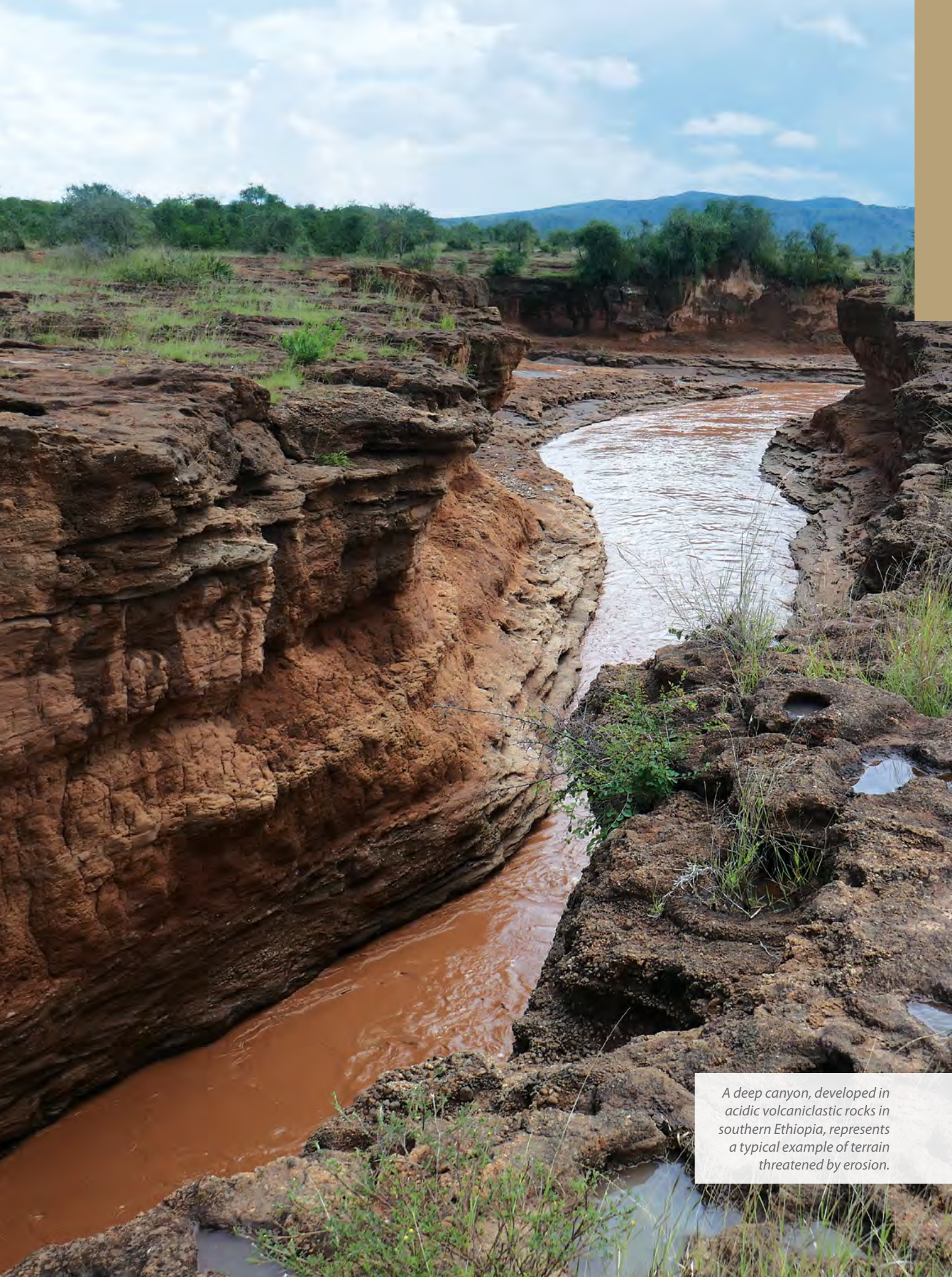


David Buriánek
Coordinator for Earth Structure
and Dynamics

Our goal is to contribute to understanding how processes within our planet function. We focus not only on the geological structure of the Czech Republic but also on interpreting the origin and evolution of orogenic belts in Europe, Africa, and Asia.

For over a hundred years, we have been creating geological maps, which are an integral part of our research. They provide comprehensive information about the geological structure of the areas we study.

Our studies and maps are instrumental in environmental protection, assessing geological risks, prospecting for mineral resources, identifying sites for radioactive waste disposal, and supporting land-use planning.



A deep canyon, developed in acidic volcaniclastic rocks in southern Ethiopia, represents a typical example of terrain threatened by erosion.

Geological mapping and regional geological research

Geological mapping involves the creation of geological and thematic maps at various scales, as well as the collection, 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). In 2024, we continued developing internal databases for fieldwork documentation. We also released applications for the general public, including a web service for the digital terrain model of the Czech Republic (based on State Administration of Land Surveying and Cadastre / Digital Terrain Model data) and a new version of the *Important Geological Localities* web application.

For geological mapping at a 1:25,000 scale, we completed two maps in the Šumava region. We also published a Czech-Polish cross-border map, the *Orlické and Bystřické hory Mts geological map for tourists* at 1:50,000, and the 1:25,000 map with explanations for sheet 24-233 *Ostrov u Macochy*. As part of our international development cooperation, we finalized the 1:1,200,000 geological and hydrogeological map of Ethiopia.

The Czech Geological Survey also collaborated on a field mapping course organized by the Faculty of Science of Masaryk University in the Zlaté Hory area.

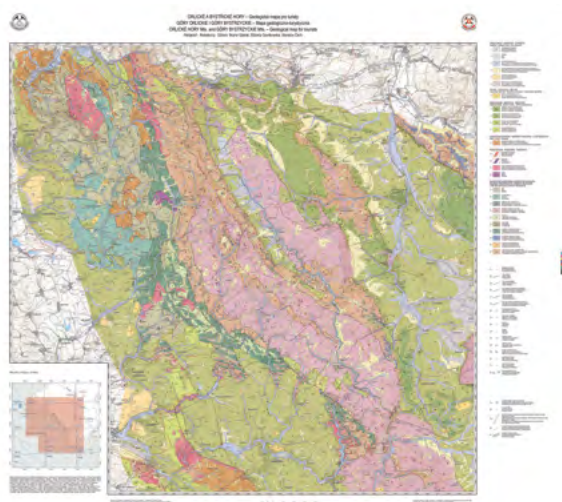
Following our geological mapping efforts, we produced numerous publications that expand on information gathered from field research. For instance, in 2024, we published a study explaining changes in spinelide chemical composition during the crystallization of polzenite magma. We provided

a detailed description of the Cenozoic volcanic activity in the Mertolmaria-Abamineos area of northwestern Ethiopia. We also documented a new occurrence of the gersdorffite-cobaltite series mineral from the Dřínová quarry near Tišnov.

Furthermore, we conducted detailed research on the mineralization of two 1950s uranium exploration shafts near Soseň and Kosobody in the Rakovník district. Based on petrography and mineralogy, we identified the source of metabasite artifacts from a Neolithic settlement in Brno-Holásky. We described the corrosion mechanism of calcite speleothems in epigene caves of the Moravian Karst and studied seasonal oscillations in carbon dioxide levels within karst caves in the Moravian Karst area. Finally, we contributed to interpreting the genesis of the fluvial-lacustrine Vrábče and Koroseky formations in South Bohemia.

Endogenous processes: Past and present understanding

In 2024, research continued on the geodynamic evolution of Asian accretionary and collisional orogens, the Variscan subduction-collision system in Europe, and the study of the amalgamation and breakup of the Gondwana supercontinent, exemplified by Africa and the European Alps. A unique and comprehensive overview of the crustal structure of central Mongolia was established using gravimetric modeling. A comprehensive petrological and geochronological study from the Mongolian Altai revealed a surprising Carboniferous to Permian age for metamorphic sequences in this critical region. With the help of a set of geochemical and geochron-



Geological map of the Orlické and Bystřické hory Mts for tourists at a scale of 1:50,000.



Field camp during geological survey in Mongolia.



Geological field survey of outcrops in the area considered for the construction of a radioactive waste repository (Horka locality in the Třebíč region).

ological data, the existence of an active Ediacaran continental arc was demonstrated. A completely new perspective on the mechanism and timing of the collision of Mongolian microcontinents and units with the Siberian craton emerged. Extensive geological studies were carried out in Namibia, Algeria, Madagascar, Ethiopia, and the European Alps. A comprehensive dataset of magnetic geophysical data from Antarctica was compiled. Numerical modelling was used to simulate the formation of the Zagros Mountains in Iran. Field research continued in Bohemia, Austria, the Sowie Mountains in Poland, the Massif Central in France, the Serre Batholith in Calabria, the Spanish Pyrenees, Algeria, and England. Among other things, research clarifying the origin of stromatolitic cherts in the Teplá-Barrandian unit was completed, pointing to the primary biogenic origin of stromatolites.

Last year, a number of publications focused on the genesis and origin of carbonatite magmas. This involved studying the isotopic composition of Ca in carbonatites and associated silicate rocks from two bodies in southern India. New significant data for understanding changes in the redox behaviour of the upper mantle were provided by a study of the Ti isotopic systematics in carbonatites, from the oldest (3 billion years) to the present day. A comprehensive study was carried out focusing on the global systematics of platinum group metals and the Re–Os isotopic composition in various types of carbonatites, as well as a study focused on carbonate-silicate melt inclusions in garnets of Saxothuringian peridotites.

Results of a study on the age and Hf isotopes of detrital zircons from volcanosedimentary rocks of the Western Carpathians were published. The Li isotopic systematics in rocks obtained from a deep borehole near the Icelandic

Krafla volcano show an ambiguous relationship between rhyolite magmas and underlying felsic lenses. Re–Os isotopic systematics of mantle xenoliths from the westernmost part of the Ohře Rift indicate a significant role of recycled oceanic crust and partial melting of the subcontinental mantle beneath the Bohemian Massif. Various mechanisms of lithospheric mantle metasomatism in the Moldanubian Zone were demonstrated due to the penetration of basaltic melts, from which garnet pyroxenites crystallized. A study also emerged documenting the metasomatic interaction of mantle xenoliths with surrounding felsic rocks in the Moldanubian region. A comparative study of the Li isotopic composition of granites across the Krušné hory Mts demonstrated the influence of degassing on Li systematics.

Lithosphere research for radioactive waste disposal

In 2024, within the framework of the *SÚRAO – CGS Horizontal Cooperation project*, work continued on geological and hydrogeological mapping at a scale of 1:25,000 for selected sites considered for the placement of a deep geological repository for radioactive waste. The collection and analysis of remote sensing data for morphostructural and geomorphological analysis of the areas, including the identification of aquifer regions based on remote sensing analyses, also progressed.

Under the *Geological and Geotechnical Characterization of the Bukov II Underground Research Facility (URF) Rock Environment project*, work continued to characterize the rock environment in newly excavated laboratory tunnels for the purpose of placing SÚRAO research experiments. The interdisciplinary *Bukov URF Interaction Experiments project* involved *in-situ* mock-up type physical models (IE) placed in the rock environment at the Bukov Underground Research Facility (URF Bukov). Two reports were produced, assessing the geological conditions of sites considered for the placement of a small modular reactor.

The multidisciplinary project, *Preparation of Safety Analyses for Periodic Safety Assessment of Operational Radioactive Waste Repositories*, began in March 2021 in collaboration with several other domestic companies (JCE, AFRY, SÚRAO, and Progeo). In 2024, the Czech Geological Survey presented the results of research and modelling work for a week-long ARTEMIS mission from the International Atomic Energy Agency, which came to verify the methodological correctness of these safety analyses using the examples of the Bratrství and Richard sites.

**From the past,
we draw knowledge for the future**

Research on global changes, the biosphere and the sedimentary record

Jiří Frýda

Stanislava Vodrážková

Coordinators for Research
on Global Changes

Our research focuses on studying global environmental changes across a broad stratigraphic range, from the Paleozoic era to the present day.

We utilize paleobiological, paleoecological, sedimentological, and geochemical methods, as well as integrated stratigraphy, to analyze the evolution of marine and terrestrial ecosystems.

We investigate the interactions between volcanism and sedimentary environments and its influence on the development of the biosphere. In the field of Quaternary research, we concentrate on paleoenvironmental reconstructions and the study of exogenous geological processes that have shaped the current landscape.



Oncoidal limestones of the Tofta Formation (Silurian, Gotland). The carbonate sequences on Gotland Island are exceptional due to the excellent preservation of fossil biota and a detailed record of Silurian environmental changes. Photo by Michal Kubajko.

Research on global changes and the evolution of marine ecosystems

In 2024, our scientific team published 18 articles in prestigious scientific journals. This interdisciplinary research covered a broad stratigraphic range, from the Paleozoic to the Cenozoic eras.

Among the key outputs were studies on the expansion of anoxic and euxinic waters during the Silurian Lau/Kozłowski Event, which was linked to a dramatic extinction event. Also notable was an extensive chapter in the prestigious book *Treatise on Geochemistry*, focusing on the study of alkalinity and element cycles in oceans, both present-day and throughout geological history.

Significant research also explored the diversification of Silurian terrestrial plants, which surprisingly occurred in temperate and cold climatic zones. Considerable attention was given to the paleoecology, paleobiology, and stratigraphy of benthic, nektonic, and planktonic communities. This included organisms crucial for determining the relative age of rocks, such as graptolites and conodonts.

In the field of stratigraphy, several important milestones were achieved. The International Commission on Stratigraphy (ICS) ratified a proposal to establish a new stratotype (GSSP) for the base of the Telychian Stage (Silurian) in southern Spain. Additionally, a proposal was submitted to divide the Silurian Přídolí Series into two stages. Intense multidisciplinary research also focused on the study of the Jurassic-Cretaceous boundary.

*Crinoidal limestones and stromatoporoid reef limestones of the Sundre Formation, Silurian, Gotland.
Photo by M. Kubajko.*



Research on global changes and the evolution of terrestrial ecosystems

Our research team focused on studying the Late Paleozoic, primarily the Permo-Carboniferous basins of the Bohemian Massif. Attention was given to analyzing the development of terrestrial flora during significant global climatic changes.

A monograph on the cuticles of Stephanian and Permian cordaites was published. An integrated approach to studying the Radnice Member of the Kladno-Rakovník Basin allowed for an evaluation of environmental and climate changes during the deposition of this coal seam.

Research in the Upper Silesian Basin concentrated on cyclothems and cyclostratigraphy. This resulted in a new sequence-stratigraphic model with a precise definition



Carbonized wood fragments found within a Miocene pyroclastic flow deposit, located at the base of the Milá volcano in the České středohoří Mts (Koutecký et al. 2024).



Geoarcheological research in the Eastern Sahel (central Sudan) offers valuable insights into the region's climate evolution over the past 30,000 years. Photo by J. Hošek.

of Milankovitch cycles. The identified sequences are interpreted as a reflection of the interplay between relative sea-level changes and variations in clastic material input. These are likely controlled globally by the intensity of Gondwanan glaciation, associated glacioeustasy, and climatic seasonality.

Furthermore, the succession of transtensional and extensional tectonic processes was presented, based on the correlation of sedimentary records from basins on the Lusatian Fault and in the Elbe Zone. A significant achievement was also the organization of an excursion as part of the International Palaeobotanical and Palynological Congress.

Interactions of volcanism with sedimentary environments and the biosphere

Research in this area has contributed to a better understanding of the role of volcanism in the development of sedimentary basins and life on Earth. A total of six articles were published in prestigious scientific journals.

As part of the study reconstructing the growth of volcanic cones, an article was published on the origin of unusual apatite rocks cutting through a pyroclastic cone within the explosive Bažina crater. Another significant study focused on the potential role of the physical instability of alkaline volcanoes as a trigger for carbonatite eruptions, presenting a new model for the development of the Miocene Kaiserstuhl volcano in the Rhine Rift.

The influence of seawater on volcanic activity was studied in Mesozoic alkaline volcanics in northern Moravia and Silurian volcanics of the Prague Basin. Here, the secondary origin of aegirines, formed due to the interaction of alkaline lavas with seawater, was documented. Research on the Bídnice maar-diatreme volcano provided insights into its unusual geomorphological position.

A significant discovery was made at the Valeč locality, where one of the world's oldest predecessors of felines was documented in a volcanosedimentary sequence. When studying the role of volcanism in the burial and permineralization of organisms, fossilized wood from the Milá stratovolcano and an Oligocene forest buried by an eruption near Kadaň were examined. A notable achievement was also the organization of the international conference Volcandpark 2024.

Evolution of the Quaternary environment and the study of exogenous geological processes

In 2024, research into the evolution of the Quaternary environment and exogenous geological processes yielded significant results across several sub-fields. This work led to seven articles published in prestigious scientific journals.

For example, a deglaciation chronology for the James Ross Archipelago near the Antarctic Peninsula was developed. Meanwhile, paleolimnological research documented event sedimentation related to deglaciation in Lake Monolith.

Significant findings also emerged from the study of hydroclimatic and environmental changes in the Eastern Sahel over the last 30,000 years, as well as the discovery of a glacial refugium for thermophilic vegetation in South Moravia. Important insights were also gained from research into resedimented loess on glacialfluvial substrata in the southern part of the European loess belt, and the mapping of thermokarst structures in the northern vicinity of Hodonín.

OSL dating of aeolian dunes significantly contributed to a deeper understanding of the formation of the Moravian Sahara dune field from the Last Glacial Maximum to the Late Glacial period.

No development without resources: We discover, protect, plan

Minerals for sustainable economic development



Michal Poňavič

Coordinator for Minerals
for Sustainable Economic
Development

Last year, economic geologists participated in significant international and domestic projects focused on the research of critical mineral, construction, and energy raw materials.

Their work also included legislative support for state authorities, not only in elaborating the Czech Republic's raw material policy for individual regions but also in addressing the issues of protection and extraction of mineral resources within the framework of spatial planning.

Attention was also paid to studying the impacts of raw material extraction and processing on the environment and public health.



Laterite sampling, Křemže.
Photo by Z. Gabriel.

Research of critical raw materials

In the past year, research into critical raw materials was fully funded by external sources. Among the most significant projects undertaken by the Czech Geological Survey (CGS) were, for example, task SS02030023: *Rock Environment and Mineral Resources (RENS)* (supported by TACR), a contract for DIAMO state enterprise *Strategic Raw Materials in the context of Government Resolution 866/2021*, and the *SEMACRET project (HORIZON EU)*.

In 2024, as part of the deposit-related component of the RENS project, four structural boreholes (totalling 400 linear meters) were subcontracted and drilled at the Mochov and Horní Staňkov localities in the Plzeň Region. These inclined core drills successfully passed through structural zones and provided valuable drill cores. The project also continued the study of critical raw materials in the areas of Nové Město pod Smrkem, Šluknov, Havlíčkův Brod, and historical gold (Au) mining districts in the Moldanubian Zone.

Technological tests for processing graphite raw materials from South Bohemia and Moravia successfully continued (CGS obtained another patent focused on graphite raw material processing), as did the study of germanium (Ge) extraction from lignite and hard coal. In the area of obtaining strategic raw material concentrates, a wide range of tests were conducted, focusing on, for example, Au, indium (In), tungsten (W), Ge, rare earth elements (REE), etc.

Within the sub-topics of the *Strategic Raw Materials in the context of Government Resolution 866/2021* task, last year saw both deposit and technological research of leucocratic, weakly mineralized granites in the central Moldanubian Plutonic Complex. The study of mineralization in erlans and skarns in the Krušné hory Mts also continued. In the Čistá-Jesenice Massif area, research focused on the distribution of REE in the various petrological rock types encountered.

On the international *SEMACRET project* at the Staré Ransko Ni-Cu-(Co, PGE) ore district, laboratory and field work continued. CGS staff successfully organized an international geophysical workshop, where data obtained from modern airborne geophysical surveys were evaluated and interpreted.

At the beginning of 2024, work commenced on the international *SuMREE project (Sustainable Mining of REE in Europe, ERA-MIN program, TH88020001)*. The goal of this project is to clarify the distribution and origin of REE, scandium (Sc), nickel (Ni), cobalt (Co), and PGE in selected lateritic deposits (Křemže, Bojanovice) associated with ultrabasic complexes. The first phase of work focused on systematic sampling of individual ore fields of lateritic weathering products around Křemže. In the autumn, CGS staff organized the project's kick-off meeting, attended by representatives from all international project partners.

Another international project, *DeepBEAT (Deep exploration Boosted by Advanced exploration Technologies, Horizon EU project)*, began in the autumn with a kick-off meeting in Freiberg. This project is focused on researching the mineralization of rare earth elements and zirconium in metasomatites of the Čistá-Jesenice Massif.

Environmental impacts of raw material extraction and processing

At the Tschudi copper deposit in Namibia, *copper and cobalt ore leaching processes were monitored using Cu isotopes*. Significant changes in the isotopic composition of copper were observed during leaching. The pH of the leaching solutions ranged between 1 and 1.3, indicating a *considerable burden on the aquatic biosphere* in the studied area.

In 2024, the impact of *copper and cobalt ore mining and processing on the contamination of the Kafue River in Zambia*

Kick-off meeting for the SuMREE Project, including a field excursion to the Bližná-Černá building stone deposit in Pošumaví region. Photo by M. Poňavič.



was studied, from the Copperbelt region all the way to its confluence with the Zambezi River. The results suggest that the *primary source of contamination is the leaching of potentially harmful elements from extensive tailings ponds.*

Expert support for state authorities

Last year, the geological work task *“Assessment and evaluation of the North Bohemian Lignite Basin deposit area regarding its potential release for further utilization”* was successfully completed for the Ministry of the Environment (MoE). One of the key outcomes is the *“Methodology for assessing the relationship between deposit objects and their protection in relation to spatial planning”*, which was used to evaluate selected brown coal registered deposits without designated protection in the North Bohemian Lignite Basin. This project provided exceptionally important expert documentation, as required by *Government Resolution No. 552/23*, which will serve the MoE and the Ministry of Industry and Trade in the coming years for evaluating the Strategic Raw Material (North Bohemian Lignite Basin) areas regarding their potential release for the development of affected municipalities and cities.

In collaboration with the *Mining Union and the Association for Road Construction*, research was conducted on the availability of construction material sources for planned transportation infrastructure development projects, in connection with *Act No. 465/2023 Coll. (the Linear Act)*. The conclusions were formulated in the conceptual document *“Study on the security and availability of construction material sources for planned transportation infrastructure development projects (HSR, railway constructions, highway and road constructions, etc.) – Stage II in connection with Act No. 465/2023 Coll.”*

Furthermore, the study *“Evaluation of the impact of protecting problematic localities with mineral deposit accumulations on the territorial development of the Karlovy Vary agglomeration”* was completed. This study focused on deposits and mineral resource sources included in the Regional Raw Material Policy of the Karlovy Vary Region. The purpose of the study was an expert evaluation of the significance of mineral deposits and sources (especially kaolins and clays) and the selection of problematic localities within the Karlovy Vary agglomeration.

Last year, work was also completed on the textual parts of the *Update to the Regional Raw Material Policy for the Zlín Region*. Concurrently, there was expert collaboration with the *Regional Authority of the Central Bohemian Region* on



Bulk sampling of scheelite ore, Kristýna adit. Photo by V. Žáček.

evaluating the environmental impacts of the concept for the *Update to the Regional Raw Material Policy for the Central Bohemian Region and the Capital City of Prague* through the SEA process (Strategic Environmental Assessment, according to *Act No. 100/2001 Coll.*, as amended).

A significant activity was the work of the *regional mineral resource specialists*, appointed as part of the state geological survey's responsibilities. As in previous years, they provided *expert assessment, consulting, and service activities* for central government bodies, as well as regional and local self-governments in the area of mineral resources. Among the most important assessments were, for example:

- *Expert assessment of the application from LB MINERALS, s.r.o., Tovární 431, 330 12 Horní Bříza (ID 27994929), in accordance with Section 4a, paragraph 2 of Act No. 62/1988 Coll., on geological works, as amended, for the establishment of the Soběškury exploration area for the exploration of the Dnešice-Plzeňsko-jih bentonite exclusive deposit (B 3123500).*
- *CGS opinion on the deepening of the Zahrádka quarry at the Zahrádka building stone deposit (441_0047_2024) for the Regional Authority of the Plzeň Region.*
- *Expert assessment of aggregate deposits in the municipality of Kozárovce in the context of the need for further utilization of existing and, especially, reserve aggregate deposits, and an evaluation of the current state of utilization, lifespan of reserves, and prospective aggregate needs in the Příbram district.*
- *CGS recommendations regarding submitted applications for the establishment of exploration areas for the exploration of exclusive minerals in the municipality of Lhenice in the South Bohemian Region.*

We investigate groundwater: for life today and tomorrow

Groundwater research and evaluation



Lenka Rukavičková

Coordinator for Groundwater
Research and Evaluation

In 2024, groundwater research focused on investigating the impact of climate change, long-lasting drought, and mining activities on natural groundwater resources.

The research also included an assessment of the sustainability of groundwater resource utilization and possibilities for their protection. The research covered specific conditions for water protection in karst structures, in areas with mineral waters, and with crystalline rocks.

The issue of identifying suitable environments for underground repositories and reservoirs was also addressed.



*Modification of the measuring
profile at the outflow from
the Krásno Peatland.
Photo by I. Kůrková.*

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

The PERUN project addresses the evaluation of the impact of climate change and drought on groundwater resources. In 2024, a methodology for assessing the balance of Quaternary hydrogeological regions was developed.

The project *Defining and evaluating areas crucial for the recharge of strategic groundwater resources with regard to their protection and stabilization* focuses on optimizing activities in water resource protection zones. The hydrogeological area 4232 Ústí syncline, a key source of drinking water for the Brno agglomeration, is being processed as a model area. Emphasis is placed on monitoring the impact of agriculture on groundwater quality, especially on nitrate and pesticide levels in the water.



Documentation of a spring at the Březový potok locality. Photo by I. Kůrková.

Within the *RENS: Rock Environment and Mineral Resources project*, we are addressing the impacts of *anthropogenic activity and climate change on karst areas*. In 2024, data compilation focused on localizing contamination in karst environments and identifying its sources.

A methodology for evaluating the geological conditions of *spa resource protection zones* was also developed. The goal of this work is to assess the effectiveness of existing protection zones for natural medicinal mineral water sources across the Czech Republic. In 2024, a study of the Hodonín locality was completed.

Research on *mineral waters in the Slavkovský les Protected Landscape Area (PLA)* aims to gather data for establishing (and revising) protection zones for various hydrogeological



The Malý Bublák mineral spring in Slavkovský les with high concentrations of dissolved metals. Photo by J. Holeček.



Hydrometric measurements of the Jedovnický potok Stream at the Rudice Sinkhole. Photo by R. Hadacz.

phenomena. This data will be used to prepare a new management plan for the Slavkovský les PLA.

Work continued on studying the impacts of the Turów mine's operations on groundwater and surface water in the Czech Republic's border area. In 2024, the specialized groundwater monitoring network was expanded with 10 new monitoring wells. The goal of this work is to verify whether the underground wall is a sufficient measure to limit the decline of groundwater levels in the adjacent border area in Czech territory.

Groundwater recharge processes in various hydrogeological structures

The project *Groundwater in Crystalline Rocks* addresses groundwater issues in selected hydrogeological regions made up of crystalline massifs. In 2024, geophysical surveys were conducted to identify suitable locations for hydrogeological drilling. Specialized geological data is



Measuring flows with a magnetic-inductive flowmeter on the Loma River in Ethiopia. Photo by J. Jelínek.

being progressively compiled for selected hydrogeological districts.

The project *System for continuous vadose water monitoring in deep aquifers* uses existing measuring infrastructure at the Uhelná locality, supplemented with new boreholes, to develop a tool for predicting groundwater levels. The research aims to clarify significant declines in groundwater levels within the Bohemian Cretaceous Basin.

Hydrogeological maps for selected map sheets in the Czech Republic were compiled and revised. In 2024, two hydrogeological maps of the Novohradské hory region were completed. Work continued on compiling the *Hydrogeological Map of Ethiopia*.

Work also continued on the follow-up to the *Review of Groundwater Resources* project. This involves publishing project results in the form of scientific books and monitoring 52 hydrogeological boreholes. The monitoring results allow for evaluating water level trends and the function of individual hydrogeological structures.

As part of international cooperation, specialists from the Czech Geological Survey are participating in the *Geological Service for Europe (Horizon)* project. The topic addresses the assessment, protection, and sustainable use of groundwater resources in Europe.

Hydrogeological aspects of deep repository construction and geothermal energy utilization

Specialists in *hydrogeology* and *hydrochemistry* have been involved in several applied projects focusing on the issue of *deep disposal of high-level radioactive waste*.

Research projects are underway at the underground research facilities *Bukov I* and *Bukov II* in the Rožná mine and at the *Josef Underground Laboratory* in Mokrsko. This research investigates the *interaction of groundwater with a model simulating a disposal unit* and involves *hydrogeological documentation of inflows* into the mine workings.

For the second year, *hydrogeological mapping* continued around four selected sites with potential for locating a *deep geological repository for radioactive waste* in the Czech Republic.

Hydrogeological research is an integral part of applied research into *geoenergy utilization*. As part of research tasks on the *SYNERGYS* and *PUSH-IT* projects, a *hydrogeological monitoring network* was established at the Litoměřice locality. The data collected will serve as input for the hydrogeological model of the area of interest.

Paving the way for sustainable energy

Geoenergy research



Jan Holeček
Coordinator
for Geoenergy Research

In 2024, the CGS researchers solved nine projects focusing on various aspects of geoenergy utilization and storage. These projects were medium to large in scale, considering the volume of work, allocated financial resources, and the number of involved researchers, making them significant at both national and international levels.

The projects extended across individual research goals and areas, simultaneously addressing geoeconomic, geological, hydrogeological, and storage aspects of subsurface utilization.

A developing research area, and one of current societal relevance, is the utilization and storage of hydrogen fuels.



Drilling of a new, 500-meter-deep geological borehole at the Litoměřice site. This borehole is used to characterize the rock environment at the location of a future BTES (Borehole Thermal Energy Storage) facility. Photo by J. Holeček.



Cleaning of drilling fluid in hydrogeological well LTH-1. This well will be used as hydrogeological monitoring borehole in the BTES field at the Litoměřice locality. Photo by J. Holeček.

In 2024, the final phase of the Czech-Norwegian project *CO₂-SPICER* concluded in the area of geological CO₂ storage. This pilot project focused on CO₂ storage in a depleted carbonate natural gas reservoir. The main objective was to prepare the Zar-3 hydrocarbon deposit in Southeast Moravia for conversion into a pilot CO₂ storage facility. Project results were summarized in a comprehensive technical and final report. Furthermore, a 3D static model of the storage complex was prepared, along with a 3D dynamic model simulating the historical exploitation of the deposit and forecasting the storage of supercritical CO₂ into the reservoir rocks.

The European geological services project *GSEU* (*Geological Service for Europe, 2022–2027*) addresses the creation and harmonization of a unified geoscientific dataset model across Europe. The CGS participates in geoenergy research through tasks associated with *Work Package 3 – Geothermal energy and underground storage inventory*. This work package focuses on creating an updated pan-European atlas of CO₂ storage potential, geothermal potential maps, and an atlas of potential energy storage sites, especially for hydrogen and heat. The project builds upon the results of previous European initiatives and aims to ensure a pan-European approach to geoenergy management, resource classification, and the integration of various outputs into the open European Geological Data Infrastructure (EGDI).

Early in 2024, the European project *COREu* (*CO₂ routes across Europe*) was launched. The project's goal is to enable the industrial application of *Carbon Capture and Storage* (CCS) by developing several regional CO₂ transport and storage concepts for Central and Eastern Europe. Within this project, the CGS is involved in preparing a storage concept for the southeastern part of the Czech Republic. The project will include the creation of static and dynamic models of selected geological structures, geological and geochemical analyses, and a proposal for infrastructure to transport CO₂ captured in the region. Further attention will be paid to the sustainability of the chosen concept based on the social consensus of all participants, especially the communities that will be affected by the project in its various stages.

The flagship CGS project in area of the geothermal energy research is *SYNERGYS* (2024–2030). It focuses on the innovative combination of heat energy capture and seasonal storage into the rock environment at depths ranging from 100 to 500 meters. This thermal storage system is interconnected with the utilization of a geothermal heat source from greater depths, specifically 2.5–3.5 km. The project also includes the integration of other renewable technologies, such as photovoltaic systems, green hydrogen production, and waste heat storage. For the first time in the Czech Republic, such a comprehensive set of technologies will be installed and thoroughly tested, enabling efficient production of clean energy (heat, cold, electricity) and simultaneously accumulating thermal energy in underground borehole thermal energy storage (BTES) systems.



Drill core from the newly constructed 500-meter deep geological borehole at the Litoměřice locality. The section of the drill core from 186–189 meters shows the transition from light Cretaceous sediments to red Permian claystones. Photo by J. Holeček.

Another European project, *PUSH-IT*, is also dedicated to using the rock environment for energy storage. As a member of an international research consortium, the CGS is involved in the *Horizon PUSH-IT* project, which focuses on storing heat within the rock environment. The project aims for a practical demonstration of high-temperature heat storage (up to 90 °C) using geothermal reservoirs with three different technologies and storage environments – aquifers, boreholes, and mines – across six European sites. In the Czech Republic, research is focused on the Litoměřice locality, where *BTES* (*Borehole Thermal Energy Storage*) technology for heat storage is being tested.

The energy potential and use of geothermal energy in district heating and cooling systems were addressed in the international project *Geothermal-DHC* (COST program), which prioritized strengthening international cooperation. This project focused on integrating geothermal energy into decarbonized heating and cooling systems, examining the technological approach from the rock environment all the way to specific technological solutions. This project was completed in 2024, achieving all its planned objectives.

Conversely, a new project, *FindHeat* (2024–2028, *Horizon Europe*), was launched at the end of 2024. It will focus on researching innovative approaches to geothermal resource exploration, including the use of existing older data and their reprocessing and reinterpretation using newly



Cleaning of drilling fluid in hydrogeological well LTH-1. Photo by J. Holeček.

developed or innovatively applied new methods and software tools. The goal is to reduce risks stemming from insufficient knowledge of the geological environment, thus lowering investment costs for geothermal projects.

In the field of *underground hydrogen storage research*, work began on a project titled *Potential for hydrogen storage in geological structures within the Czech Republic* under the TACR Theta 2 program. The use of geological structures for hydrogen storage is an increasingly discussed topic as the Czech Republic moves toward fulfilling its hydrogen strategy as part of the transition to a zero-emission economy. The Czech Republic has many years of experience operating underground natural gas storage facilities, but research evaluating the geological environment's potential for hydrogen storage has not yet received sufficient attention.

In May 2024, the project *Controlled deep biogas* (2024–2028) received support in the TACR Theta 2 competition. This project addresses the issue of *controlled methanogenesis in areas with terminated coal mining*. Microbial methane and active methanogenic archaea bacteria have been found in a number of black coal mines in the Ostrava and Karviná sub-basins. The project aims to verify whether microbial methanogenesis can be intensified in closed mine spaces by adding supportive media. In the initial stage, gas, water, and coal samples were taken from boreholes for chemical, isotopic, and microbiological analyses.

We understand the risks: we protect the landscape and people

Engineering geology and geohazards



Milan Aue
Coordinator
for Engineering Geology
and Geohazards

In 2024, focusing on the state's priority needs in *geological risk research*, the CGS concentrated on providing expert documentation. This documentation was based on applied research findings for the protection and utilization of the *rock environment, soil, groundwater, and mineral resources*, aiming to reduce their burden from anthropogenic factors in the landscape.

Furthermore, the CGS contributed to developing tools and technologies necessary for the *identification, monitoring, prediction, prevention, and reduction of risks from natural crises*. Examples include the catastrophic floods in North Moravia in September 2024. The CGS also monitored their impacts to ensure a safe society.



Documentation of the source area of frequent devastating flash floods on the Kuro River above the town of Stepantsminda, in the foothills of Georgia's dominant peak, Kazbek. Photo by J. Novotný, 2021.

CGS activities in the 2024 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.

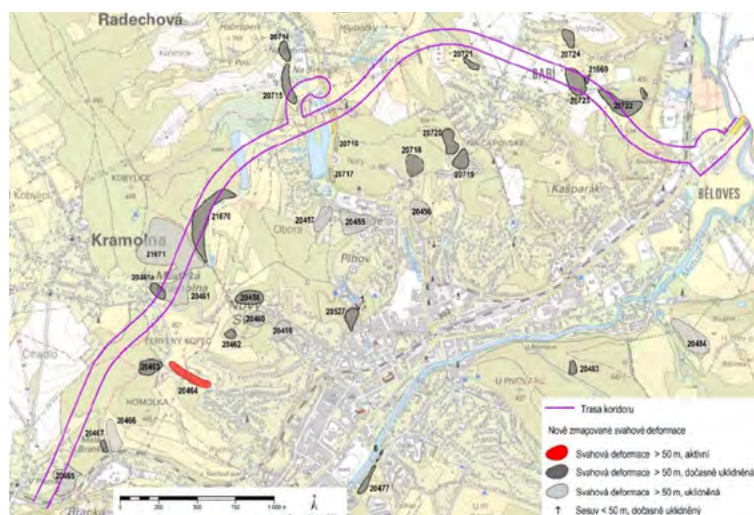
In recent years, there has been a growing demand for information on landslides that threaten specific structures or sets of structures. For this purpose, thematic catalogues of slope deformations with the identification of the most vulnerable locations or sections of linear constructions should be continuously prepared. In 2024, this work was primarily conducted on the road and motorway construction sites of the Road and Motorway Directorate of the Czech Republic. We are also successfully developing our

collaboration with ČEPS, a.s., continuously analyzing and monitoring the entire network of extra-high voltage pylons in the Czech Republic for potential threats from slope instabilities and other geological risks.

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.

From our international activities, we can mention the ongoing research into *slope deformations in Peru*. Specifically, we are assessing landslide risk in the rural community of *Rampac Grande in the Peruvian Andes*, where unexpectedly fast-moving landslides claimed many lives in 2009. The study area presents a challenging social, cultural, and geological environment, which limits the applicable technical solutions for landslide risk reduction and requires a high level of participation from local communities in all natural risk reduction steps.

We can also mention the successful completion of research work within the development project in Georgia. This project focuses on eliminating dangers associated with very frequent catastrophic slope movements, known



Updated records of slope deformations in the corridor of the planned route for the future I/33 Náchod bypass.



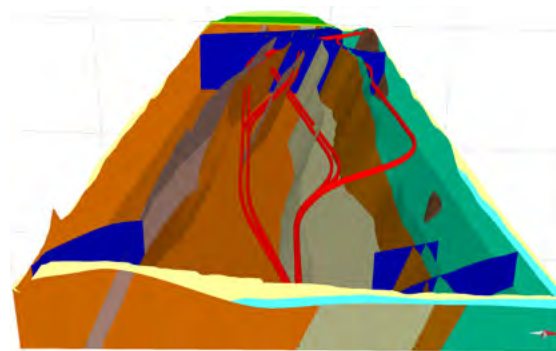
Region Pirikita Khevsureti in Georgia, affected by numerous slope deformations. Photo by M. Dostalík.

as flash floods, which cause serious socio-economic damage and loss of life, especially in the mountainous regions of Georgia. The field mapping campaign targeted the Pirikita Khevsureti region. The project aims to supplement information on geological hazards in this region, which is also a priority geographical area for the Czech Republic's foreign development cooperation program. This mountainous region is highly active and dynamic in terms of landslide risk but is very difficult to access, which is why detailed information on geological risks has been lacking there until now. Geological hazard mapping mainly concentrated on the area along the main access road. Additionally, the functionality of the newly developed analytical tool, Landslider, was verified in real-world conditions. During this, Georgian colleagues received training in landslide mapping. Through this project, NEA, as the organization responsible for mapping natural risks in Georgia, will gain a new analytical toolset and know-how to streamline spatial planning and infrastructure development.

Radon risk from geological bedrock is a significant geological hazard with a direct impact on public health. The radioactive decay of radon produces metallic daughter isotopes, which settle on the lung lining and, through internal radiation, can increase the incidence of lung cancer. The CGS's task is to identify rock types with elevated radon concentrations, which can penetrate buildings constructed on them and negatively affect residents' health during long-term exposure. In 2024, research focused on moni-

toring radon concentration and dose rate values in local lithological rock types with anticipated elevated levels of these parameters. In connection with the fulfilment of the national radon action plan, extensive research was carried out in the Horažďovice – Blatná area, specifically targeting radiometrically detectable presumed contacts of differing lithotypes that might show contrasting differences in measured radiometric values (R_n – radon concentration and H – dose equivalent rate).

The CGS's research activities in the field of strategic building construction primarily involved the geological assessment of the stability of road I/2 in relation to mining in the Zdechovice – Strážník quarry, and within the corridor of the planned route for the future I/33 Náchod bypass. Also noteworthy are the CGS's engineering-geological research works on the planned corridors for new railway connections. This includes, in particular, the CGS's expert activities in preparing for the construction of railway tunnels as part of the VRT Prague–Dresden high-speed rail line, the Beroun tunnel as part of the express connection towards Pilsen, and the tunnel between Prague-Dejvice and Prague-Velešlavín railway stations as part of the express connection via Václav Havel International Airport towards Kladno.



Comparison of variants for the new tunnel connection between Prague-Dejvice and Prague-Velešlavín railway stations in a 3D geological model, showing potential risk areas (marked in blue).

A changing Earth: Studying transformations for sustainability

Landscape biogeochemistry in the era of climate change



Martin Novák

Coordinator for Landscape Biogeochemistry in the Era of Climate Change

In 2024, the study of environmentally relevant elements continued for the 31st year within the GEOMON network of small forest catchments.

Other key topics included carbon sequestration in the landscape, changes in the nitrogen cycle within forest ecosystems, response of wetlands to climate change, and air quality in the industrial regions of Bohemia and Silesia, with a focus on toxic trace elements.

In January 2024, the 11th BIOGEOMON symposium was held in Puerto Rico. The Czech Geological Survey co-organized this event.



*The studied peat bog
Jelení hora in the Krušné hory
Mts. Photo by E. Přečková.*

Cycling of carbon and other selected elements in ecosystems under environmental change

In 2024, we investigated the *impact of air pollution on the growth increments* of three European tree species (beech, fir, spruce) across five regions of the Czech Republic. The analysis reveals a highly complex interaction between *air pollution, climate change, and changing nutrient availability*.

A long-term study measuring *mercury content in spruce forest litter* in the Krušné hory Mts (Načetín) shows the *highest recorded mercury deposition flux in Europe* ($51 \mu\text{g m}^{-2} \text{year}^{-2}$).

Time series data of *Pb, Cd, and Pb concentrations in surface waters* from the ICP Integrated Monitoring Network, including the Lysina and Anenské catchments, have been processed and published.

Since 2019, results from the *GEOMON network catchments, Načetín research plot, and Šumava lakes* have been used to *monitor the effects of the EU's National Emission Ceiling Directive* and are regularly uploaded to a European database.

In soils and rock cores from deep boreholes at the *Žarošice deposit in the Carpathian Flysch Belt*, aliphatic and aromatic hydrocarbons were monitored to understand *palaeoecological changes from 160 to 25 million years ago*. This research emphasized *the balance between carbon sources and sinks* in the sedimentary environment.



Winter sampling of soil water, U dvou louček catchment, Orlické Mts. Photo by J. Čuřík.



Soil sampling in the Žofínský prales National Nature Reserve. Photo by F. Oulehle.

Modelling biogeochemical processes in the landscape

In 2024, the *impact of historical atmospheric nitrogen deposition on changes in temperate forest vegetation* was assessed. Data from repeated phytocoenological surveys conducted since the 1950s and again since the 1990s were used.

Work continued on evaluating the *nutrient balance of forest soils within the GEOMON catchments*. We also updated input parameters (atmospheric deposition of base cations, sulphur, and nitrogen) for the *critical loads database* and refined their calculations.

Climate data from the *Aladin Climate/CZ model* were prepared to simulate the future hydrological regime in the GEOMON network catchments in the years 2021–2100.

Long-term monitoring of *spring discharge* allows for a better understanding of *groundwater dynamics* resulting from climate change. We observed a significant decrease in the occurrence of annual maximum spring discharge in April and May, and an increase in March. The highest proportion of springs with decreasing annual discharge rates was found in lowlands (< 300 m a.s.l.), and spring discharge in crystalline and flysch areas declined with increasing temperature more than in Cretaceous regions.

Bark beetle outbreaks significantly impact forest ecosystems and biogeochemical cycles. Long-term monitoring of the *Polomka catchment in the Bohemian-Moravian Highlands* showed that, after bark beetle infestation and partial

removal of the spruce stand, water runoff increased, and simultaneously, *nitrate concentrations in the runoff nearly doubled* (from 4.4 to 7.7 mg L⁻¹).

Isotopes as a diagnostic tool in biogeochemistry

Sampling of gasoline and diesel in the Czech Republic, Poland, Saxony, Bavaria, and Austria for Pb isotope fingerprinting has been completed. Simultaneously, *ratios of radiogenic Pb isotopes in aerosols* within the Ostrava agglomeration were evaluated along five sites of a 35 km long SW–NE transect. Current data indicate a surprisingly high *homogenization of air masses*, even in close proximity to large point sources of industrial atmospheric pollution. The *isotopic composition of magnesium, calcium, and strontium* was studied in the GEOMON network's mountain catchments. Isotopes were used for a qualified estimation of the *origin of these essential nutrients in runoff*. Similarly, the proportion of these elements originating from *rock weathering and atmospheric deposition* was evaluated in individual soil horizons. Current results indicate that, in mixing models, the geogenic input of Mg, Ca, or Sr into the ecosystem often cannot be replaced by the isotopic composition of the bulk rock, as individual minerals differ in both their isotopic composition and weathering rates. Dating vertical peat profiles using ²¹⁰Pb is part of an ongoing study of *biological nitrogen fixation in Sphagnum-dominated bogs*. Residual activities of atmospheric ²¹⁰Pb at



Sphagnum sampling. Photo by I. Jačková.

various depths of waterlogged organic soils were determined by a spectrometry in collaboration with the Nuclear Research Institute Řež. Vertical profiles of active peatlands and in historically mined peat deposits were studied.

Carbon sources in particulate matter were monitored in the Ostrava region. Currently we use isotopic methods to study the *oxidation processes of SO₂ and NO_x emissions*.

Our research also focused on *industrial processing of electronic waste*, which generates a large amount of dust with extreme concentrations of hazardous elements (Ag, As, Ba, Cd, Co, Cr, Cu, Ni, Pb, Sb, Sn, Sr, and Zn), as well as a significant amount of organic matter in the form of plastic particles.



Peat core sampling at the Hora Svatého Šebestiána Bog in the Krušné hory Mts. Photo by M. Štěpánová.

Advancing science, connecting experts

Professional support and organization development



Markéta Vajskebrová
Coordinator
for Professional Support
and Organization Development

In response to evolving global and national priorities, the Czech Geological Survey is adapting and developing its strategic directions.

The LCDRO vision focuses on, among other things, the effective support of expert and applied activities and the overall development of the organization. It emphasizes the development of new analytical and imaging laboratory methods, as well as the use of digital technologies. It also includes the publication and interpretation of the CGS achieved results and activities, as well as the popularization of geological sciences for the broader public.

A crucial aspect of scientific organization development is strengthening human resources and enhancing the competencies of all employees.



*The Minister of the Environment,
Petr Hladík, also supported the
Geology Day with his presence.
Photo by O. Man.*

Research and development of analytical and imaging laboratory methods

In 2024, 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 CGS plays an integral role as a principal investigator or key co-investigator.

At the CGS Laboratory of Radiogenic Isotopes, a *new methodology for the separation and measurement of Nd isotopic composition in soil water samples* has been implemented. The laboratory is now capable of separating both *Sr and Nd from the same sample*. The methodology for separating and measuring the isotopic composition of Sr and Nd was tested using a set of graphite samples, and sample preparation procedures were refined. A methodology for the *separation and determination of Sr isotopic composition in gold samples* was also introduced, and the development of *Fe separation and Fe isotopic composition determination in rock matrices using MC-ICPMS* was completed. As part of application of radiogenic isotope surveys in archaeological research, new methods for preparing medieval horse bone, tooth, and hoof samples for Sr isotopic composition measurements were tested.

Work continued on characterizing the *Sr isotopic composition of Moravian wines*. A set of new reference materials (UQAC-4, 5, 6; PTC-1b; OREAS-683) for *determining platinum group element concentrations* were characterized using LA-ICPMS. Research continued on *mineralogical and geochemical changes in BCV bentonites* after short-term and long-term thermal loading under dry conditions at 200 °C.

In collaboration with the *Centre for Experimental Geotechnics at the Czech Technical University*, a mock-up experiment was concluded in the Josef adit. Here, BCV bentonite was heated to 200 °C for 5 years under rock-environment conditions, simulating conditions in a planned deep geological repository for spent nuclear fuel. The effect of increased temperature was studied using a full range of analytical techniques, including the determination of *cation exchange capacity (CEC)*, *XRD*, *FTIR*, *thermal analysis*, and *a new methodology for determining smectite charge* based on smectite saturation with a Cu-triene solution. The laboratory is also investigating the *kinetics of rehydration* for thermally loaded samples exposed to varying humidity. Processes leading to changes in cation exchange capacity of BCV bentonite samples (fixation and release of Ca^{2+} and Mg^{2+} ions in the interlayer, smectite dissolution, etc.) were studied.

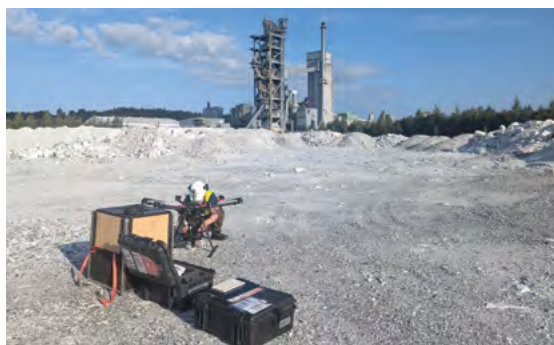
Development of digital technologies in geology

The CGS actively implements and develops *modern digital technologies*. Among its most significant achievements are globally recognized results in the field of *modelling geological processes*, *creating 3D models of geological structures*, and *utilizing remote sensing (RS) methods*. The foundation of these successes lies in extensive, interconnected databases that are continuously updated during various geological investigations. The use of advanced digital technologies combined with high-quality data allows for the creation of highly accurate and expertly substantiated models.

In the area of *computer modelling of geological processes*, software tools for researching *porous melt flow in the continental crust* have been particularly developed.



Laboratory of Mass Spectrometry uses the modern Triton Plus instrument for highly precise determinations of strontium and neodymium isotopic composition. Photo by T. Magna.



AV campaign at the Nordkalk Oy Ab quarry (Lappeenranta, Finland) – MultiMiner project. Photo by J. Jelének.



Comprehensive model of the Kaňk polymetallic ore deposit, featuring a 3D mineralization model, a Landscape model of development, a 3D model of mine workings, and a 3D model of undermining impacts. Author: J. Jelínek.

A simplified description of felsic rock melting as a function of pressure, temperature, and water content was created. This description was combined with software for calculating melt propagation through rock. Realistic scenarios were simulated, such as melt distribution in ductile shear zones under various pressure and temperature conditions. Two experiments on the formation of migmatite domes were conducted using *computed tomography (CT scanner)* at the University of Bern.

The CGS continuously develops cooperation with both state and private institutions in the field of creating *3D models of the geological environment*. The most significant projects fall under long-term cooperation with SÚRAO, SÚRO, and ČVUT, focused on research, exploration, and evaluation

of potential sites for a *deep geological repository for high-level radioactive waste*. A significant milestone is also the newly established cooperation with ČEZ, within which geological models are being prepared for the planned *small modular reactor (SMR)* and a new nuclear source (NJZ) at the Temelín site. Simultaneously, intensive work is underway in cooperation with the Railway Administration on *geological surveys for the planned Prague–Dresden high-speed rail line*, especially in the area of the planned Krušné hory Mts and Central Bohemian Uplands tunnels, as well as for the *Střešovice railway tunnel project in Prague*. All these projects require the creation of accurate and detailed geological models, which are crucial for the safe and efficient realization of these strategically important constructions.

Within the *RENS project (Rock Environment and Mineral Resources)*, research focused on creating a *comprehensive 3D model of the Kaňk ore deposit*. For this location, a set of interconnected models was developed, including a *geological model of the area*, a *model of historical mining works*, and a *landscape model*. These detailed models collectively form the necessary basis for assembling a final 3D model that will enable the analysis of the impact of historical mining activities on the current terrain surface.

Concurrently with this research, specialized software was developed for creating a 3D model that accounts for the *degree of uncertainty in structural-geological models*. This innovative tool significantly contributes to a more precise evaluation and interpretation of geological structures.



Field geophysical measurement using Electrical Resistivity Tomography (ERT) method. Photo by V. Žáček.



Czech Geological Survey stand at educational events in Prague. Photo by O. Man, M. Polechová.

In the field of *remote sensing (RS)*, a comprehensive approach combines various methods: from optical data analysis and radar interferometry to image spectroscopy and elevation data analysis. These methods are applied to data captured by all available platforms, including *unmanned aerial vehicles (UAV)*, *aircraft*, and *satellites*. This modern approach has found significant application, particularly in *monitoring geohazards* and in the development of *environmental monitoring methodologies around mining activities*. Within these activities, research focuses especially on evaluating *surface water quality*, *dust occurrence*, and *mapping minerals in mine dumps*. For these purposes, specialized sensors installed on UAVs and the latest satellite systems, especially *hyperspectral sensors*, are utilized, enabling detailed analysis of the areas under investigation.

Outreach and popularization

The most significant event of the year was the traditional *Geology Day with the CGS*, held at our Klárov headquarters in Prague. A diverse program of interactive stations introduced visitors to various geological topics that our staff specialize in. A special program with tasks was prepared for school groups, and the activities and information offered also captivated visitors of all ages from the general public. CGS staff once again actively participated in organizing the regional and national rounds of the *Geology Olympiad*, and as co-organizers, they won the prestigious award from the Czech Association of Geomorphologists for their work in popularization.

The CGS also took part in numerous other outreach events, including the *Science Festival at Gutovka*, *Brno Libraries Day*, *Healthy Earth Day*, *Open House Prague*, and the opening of the SÚRAO information center in Jáchymov.

CGS experts made significant contributions to the creation of the permanent geological exhibition in the *Czech Karst House of Nature* and a geological exhibition at the headquarters of the *Blaník Knights Region national geopark*, prepared for its 10th anniversary.

The CGS exhibition activities continued with three photographic exhibitions at the Geological Bookstore and collaboration on an exhibition at the *Sokolov Museum* (Mountains Spitting Fire, or Volcanoes of Our Region). Outreach activities also included lectures by CGS experts on various scientific topics held outside CGS buildings, as well as seminars conducted at CGS workplaces. In 2024, five seminars took place at Barrandov and twelve at Klárov.

The CGS participated in organizing the international scientific conference *Volcandpark 2024 in Jičín* and also in publishing the abstract volume for this conference. CGS geologists prepared the text for an excursion guide and were involved in organizing and leading the *Czech Geological Society's excursion echoes of Krkonoše mining and living water in Malá Úpa*.

In cooperation with the *Bohemian Switzerland National Park*, an animation about the geological formation of Pravčická Brána was completed, and work is currently underway to make the animation and a short video about CGS activities in Ethiopia accessible to the public.

News and interesting facts from the CGS are published on *Facebook and Instagram*. The Geological Library also regularly posts interesting insights from scientific literature on Instagram.

Work continued on supplementing, maintaining, and updating *popularization databases* ("Important Geological Localities", "Photoarchive", "Building and Decorative Stones"). A new *presentation application* was launched

for the database of important geological localities in the Czech Republic, and a new layer offering animations of geological site development was added to the “Interesting Geosites” map application. In conjunction with the new CGS website, an English version was published at <https://cgs.gov.cz/en>, and several project pages were created.

The CGS has newly decided to offer thousands of its *historical and current geological photographs* from its photo archive for non-commercial use under the Creative Commons BY-NC-ND 4.0 license.

In printed literature, a volume dedicated to Ferry Fediuk was published in the *Personalities of Czech Geology* series, along with the book *Women in Geology – How to Become a Geologist* by Z. Petáková. Four issues of the *World of Geology* newsletter were released in both print and electronic form, covering the most significant events and information about CGS activities from the past period. With CGS support, two issues of *Reports on Geological Research* and a double issue of *Geological Research in Moravia and Silesia* were published. Two popular *memory card games* were released – “Geological Localities of the Czech Republic” and “Volcanoes of the Czech Republic” (in Czech and English).

Human resources support

Mentoring activities continued to strengthen staff competencies in both scientific topics and “soft skills”. Preparation of the next generation of employees and the transfer of knowledge from more experienced to less experienced colleagues also progressed. In 2024, *seven mentor-mentee pairs* collaborated. These activities primarily focused on knowledge transfer and gaining practical experience with methodologies and fieldwork in geological and geomor-

phological mapping, geological exploration, the use of analytical methods, and the preparation of scientific publications for international journals.

The CGS systematically and long-term supports the *upgrading of qualifications and strengthening of professional competencies* among its younger staff. The composition of the project team changes annually as existing staff complete their studies and new ones begin. The outcome is not only the successful completion of studies and defense of final theses by staff but, in some cases, also the publication of their own results at conferences or in scientific journals. In 2024, *eight CGS staff members received this support*.

All employees are further *individually supported in continuing education* according to their own preferences. Regular *language courses* in English, Spanish, and French are held at all branches. In 2024, a seminar on the *Amendment to the Building Act and its Connection to Water Law Legislation* was organized, along with a seminar on *How to Build Resilience to Stress*, and *Krav Maga self-defense courses*. A *Gender Equality Course* was designated for managers, stemming from the Gender Equality Plan (GEP) that the CGS is committed to fulfilling.

The e-training content included six modules:

1. *Horizon Europe* framework programme
2. Gender audit in the institution
3. Quality standards for building internal capacities
4. Thematic areas of the gender equality plan: balancing personal and work life
5. Thematic areas of the gender equality plan: gender dimension in research content
6. Thematic areas of the gender equality plan: sexual harassment and gender-based violence



Cover page of the CGS newsletter *World of Geology*.



The CGS creates animations of geological formation origins, which can also be viewed on mobile devices. Photo by P. Neubert.



Photo by O. Man.

Vít Štrupl
Head of Information Systems Division,
Deputy Director



CGS and the state geological survey

The Czech Geological Survey is a state-funded organization established by the Ministry of the Environment to provide state geological survey in the Czech Republic.

According to § 17 of Act No. 62/1988 Coll., on Geological Works, as amended (the Geological Act), the activities of the state geological survey include the collection, processing, storage, and provision of data on the geological composition of the territory, the protection and utilization of natural mineral resources, groundwater resources, and geological risks.

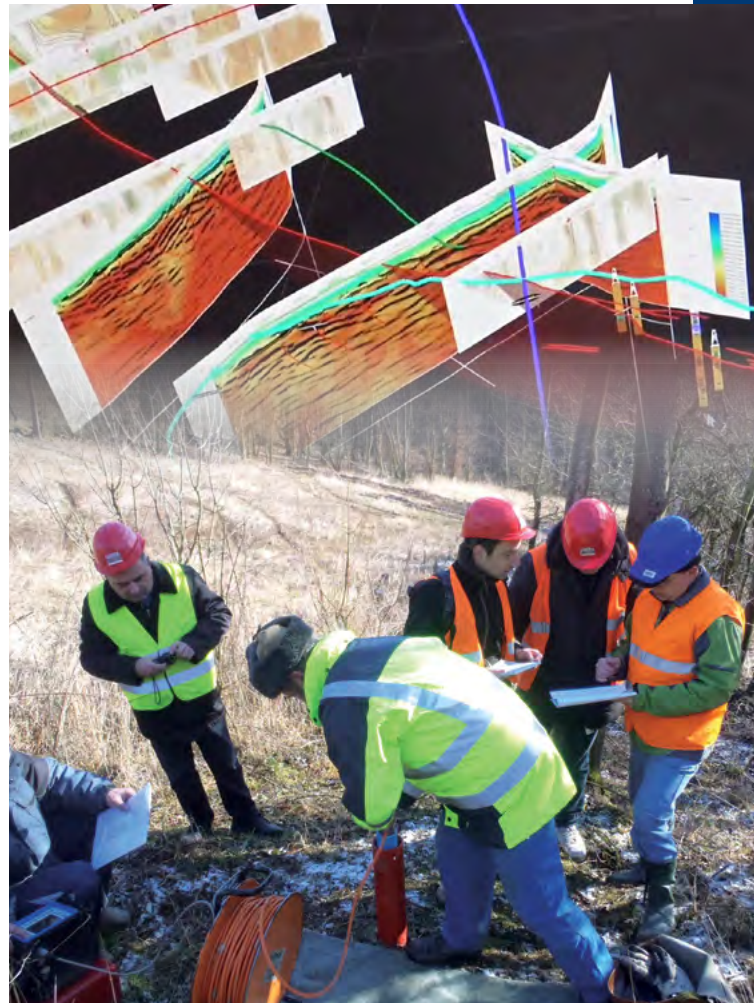


Overview of main activities

The state geological survey is carried out through a number of specialized agendas, whose purpose and focus are regulated by more detailed legislative provisions. These include:

- Maintaining inventory of geological projects performed in the Czech Republic.
- Collecting, processing (recording, scanning), archiving, and providing access to geological documentation both in the form of written, unpublished reports and of material documentation (mostly drill cores and samples).
- Managing geological exploration databases (drilling, hydrogeological, geophysical, geochemical, and radiometric).
- Registering and maintaining the slope deformations (landslides, rockfalls, etc.).
- Registering and maintaining the mineral deposits and prognostic mineral resources.
- Registering of underground mines, abandoned mine lands, impacts of mine workings and mining maps.
- Maintaining the sites with mining waste.
- Preparing expert opinions, professional statements, and providing data for spatial urban planning.
- Geological mapping and creation of geological models.

A complete list of all CGS activities is provided in the organization's foundation charter.



Digitalization and professional development

The Czech Geological Survey continuously focuses on the use of modern technologies for data collection, processing, and provision. Individual agendas are digitized to varying degrees, allowing for more efficient data management and easier accessibility for users. This approach is also linked to increasing demands on technological security and data infrastructure management, as well as on the professional qualifications of employees and the need for their continuous professional education.

Making results accessible and communicating with the public

The results of the state geological survey activities and other professional results are primarily made accessible through:

- Web services and specialized applications.
- Expert consultations and opinions.
- Data sets in open data format.
- Specialized publications and electronic outputs.

Records of geological works and geological documentation

As part of its state geological survey duties, the Czech Geological Survey maintains records of geological works and the organizations that carry them out. It also ensures the collection, permanent storage, professional processing, evaluation, and accessibility of geological documentation and the results of geological works performed by both individuals and legal entities within the Czech Republic. The goal is to enable the use of geological documentation to professionally support public authorities, specialized activities of organizations and companies, and for scientific purposes.



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Head of Geological
Exploration Department



Milada Hrdlovicsová
Head of Geofond
Department



Alan Donát
Head of Document
Intake and Processing
Section



Jolana Skřivánková
Head of Mining
Impacts Department



Records of geological works

Organizations performing geological work in the Czech Republic submit documentation for these projects to the Czech Geological Survey, which registers them in accordance with § 7 of the Geological Works Act and the relevant decree. The Ministry of the Environment has entrusted the Czech Geological Survey with maintaining these records. In 2024, 267 *economic entities* registered geological works, which is 3 more than in 2023. The number of registering economic entities shows a consistent, constant trend.

A total of 5,125 *registration forms* for geological works were recorded, a slight decrease from the previous year when 5,158 forms were registered. The number of registration forms shows a consistent, constant trend, as seen in the figure "Records of geological works – number of registration forms in 2015–2024".

The majority of registered works continue to be in *hydrogeology and engineering geology*, while the number of records concerning mineral resources, the use of geothermal energy, and geological research is increasing.

The database also includes information on *cancelled geological works*, with a total of 12 reported in 2024.

Written and digital geological documentation

Receipt of geological documentation and geological project results

In 2024, a total of 5,522 *reports and assessments* with the results of geological works were submitted to the Geofond archive. Thematic focus showed a predominance of hydrogeological and engineering-geological surveys. All documents were processed as annotated records and are



*Example of geological documentation being processed.
Photo by M. Hlubučková.*

available for parametric searching in the ASGI archive application: <https://app.geology.cz/asgi/>.

Archival holdings and services

The Geofond archive permanently stores and makes accessible over 293,000 *reports and assessments* in its holdings. In 2024, more than 1,000 *researchers* visited the archive's study room. A service for tracing and online sending of scans of selected parts of documentation is also provided; 547 *orders* were processed this way. Larger orders are handled centrally within data services.

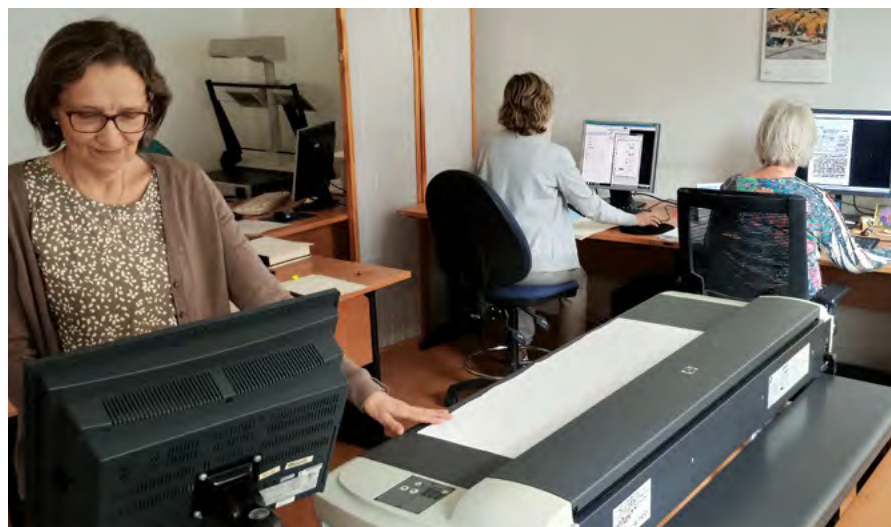
Digitalization of the archival fund and remote access

The digitalization of the archival fund is continuously underway at our offices in Prague and Brno. Over 57,000 *archival documents* are available to researchers in the online viewer. In 2024, documents submitted to the archive in



Records of geological works – number of registration forms in 2015–2024.

Digitization workplace at the CGS branch in Brno. Photo by M. Hrdlovicsová.



both printed and electronic forms were successfully integrated into the viewer.

Map archive

The map archive primarily collects cartographic works created as part of CGS research tasks, but it also contains other geoscientific map documents from both the Czech Republic and abroad, including historical maps. In 2024, over 600 maps were added to the fund, often including accompanying texts and explanations. The vast majority are available digitally in the application app.geology.cz/mapovy_archiv.

Geological sample collection

Within the Geofond department, the staff is responsible for the ongoing supplementation, meticulous management,

and, by request, the provision of a substantial collection. This collection contains more than 39,500 meters of continuous drill cores and rock samples, derived from key structural and other significant boreholes located across the Czech Republic. The material documentation repositories situated in Kamenná, Stratov, and Lužná currently hold over 16,300 sample containers. These store materials from 3,189 unique geological sources – primarily boreholes – within a specialized storage system.

In 2024, the CGS archives received a significant addition when a unique collection compiled by Dr. B. Mlčoch during his tenure at CGS was deposited for permanent storage at the Kamenná repository. This collection comprises over 1,500 geological samples from 524 boreholes drilled throughout the Czech Republic.



Storage of geological documentation in the Geofond archive (Kostelní 26, Prague 7). Photo by M. Hlubečková.



Providing drill core material documentation for study. Photo by J. Bezák.

Additionally, new materials were archived at the Lužná facility (Hall No. 3). These include:

- Core samples from borehole D-83/11, transferred from the Karviná-Lazy Mine (OKD).
- Drill cores from two monitoring boreholes of the Turów Mine.
- The 314-meter core from borehole PD-3 in Roztoky. This sample is particularly notable for its recently confirmed Rare Earth Element (REE) mineralization, identified in research by Dr. V. Rapprich.

In 2024, specialized storage equipment for drilling materials was acquired through public procurement,



Drill core from borehole D83-11, OKD, Karviná-Lazy Mine. Photo by J. Bezák.



Receipt of new sample containers for storing drill core material documentation at the CGS Lužná storage facility. Photo by J. Bezák.

with funding from the Ministry of the Environment's ISPROFIN program. The acquisition included 800 sample containers and 3,000 pull-out trays, which are essential for the long-term storage and accessibility of geological documentation managed by the CGS.

Mining-Historical Department in Kutná Hora

The Department of Mining History in Kutná Hora houses a specialized library of geological literature, a collection of mining maps, and part of the signature series of the Resource Reports Collection from the CGS archive. The department is also responsible for maintaining the database of undermined areas. Basic information about undermined areas is publicly accessible through the "Mining Impacts" application.

The science library is fully catalogued in the Clavius library system and is part of the CGS science library. Basic information about the mining maps in the local collection, including previews, is publicly accessible through the "Mining Maps" application.

The reports from the Resource Reports Collection, which are stored in the local depositories, 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. These reports have been progressively digitized for several years, and their digital versions are accessible through the CGS web portal. The Kutná Hora department also participates in several projects and contracts.



Title page of the journal Hornický věstník from 1919.



Excerpt from a 1762 map, showing mining works in the vicinity of Kašperské Hory.

Drilling and geophysical exploration

The Czech Geological Survey manages specialized databases for exploration data. These include geologically documented objects with geological profiles, hydrogeological and well-logging data, and links to physical documentation like drill cores in CGS archives.

CGS also maintains geophysical databases (radiometry, gravimetry, seismic data), a digitized paper archive, and provides a map application to view geophysical data.



Roman Kujal
Information Systems
Management
Department



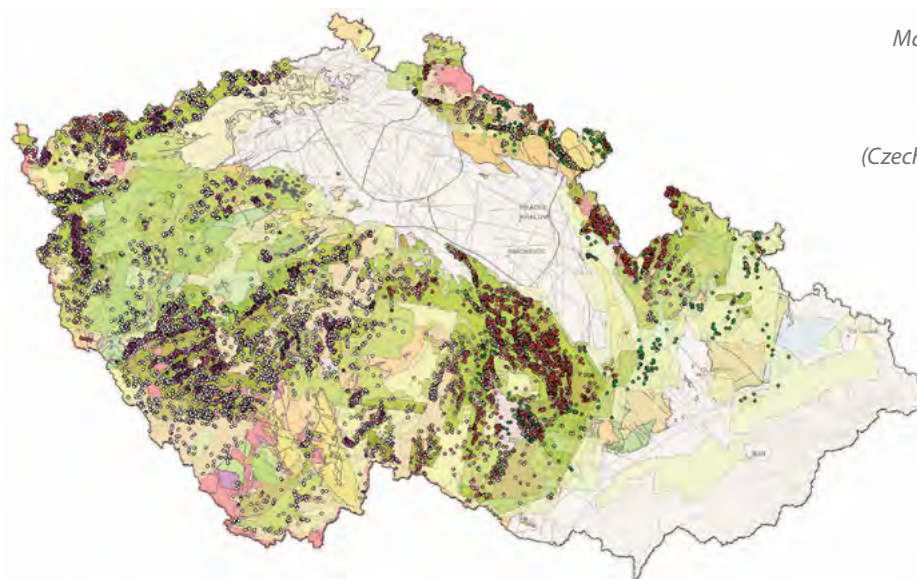
Václav Zikán
Head of Drilling
and Hydrogeological
Exploration Section

Geophysical data

Geophysical data at the CGS fall into two main categories: *well-logging data* (geophysical measurements in boreholes) and *data from the former Geofyzika Brno company*. These are distinct datasets managed under their own systems.

Well-logging data are stored in the KAR database sub-register in the form of numerically expressed well-logging curves from individual measurements. An overview of boreholes with well-logging data is available through the *Drilling Exploration map application*, where the existence of this data is indicated in the attributes.

Data from the former Geofyzika include radiometry, magnetometry (both airborne geophysics), gravimetry, seismic



Map application "Radiometric anomalies and exploration status based on data from the former ČSÚP" (Czechoslovak Uranium Industry).



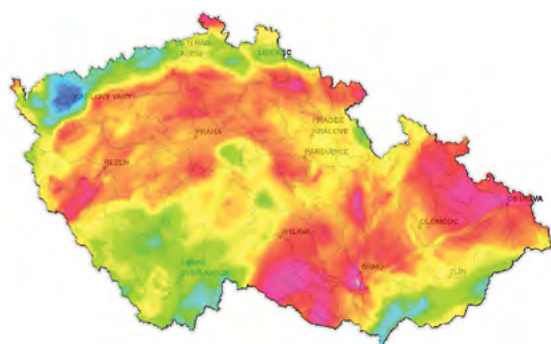
Vibroseis – seismic wave source, with a cable and geophone in the foreground.

data, physical rock properties, and more. Depending on their nature, they are stored either in a database or a file system. In addition to its own data, CGS also archives the

digitized paper archive of Geofyzika Brno. The Geophysical Measurements map application displays the location of both geophysical data and archival materials.



Example of objects from the GDO database displayed in the publicly available web map application "Drilling Exploration".



Map application "Geophysical Measurements" – map of complete Bouguer anomalies.

Drilling and hydrogeological exploration

The CGS maintains the *database of geologically documented objects (GDO)* within the Czech Republic, which also includes sub-databases for geological (GEO) and hydrogeological (HYD) data. Several changes occurred in 2024.

The team was reduced by almost half, and a new work method was adopted. This method moves away from storing complete geological profiles for selected objects, focusing instead on storing most new objects with basic data. Full profiles are now only saved based on CGS projects. A new application for entering data into the GDO was introduced in March 2024. In 2024, the application operated in a limited mode for HYD.

As of December 31, 2024, the *GDO database contained 729,112 objects*. The annual increase was 7,892 objects. Of these, 7,617 were added to GEO and 2,359 to HYD.

Separately, and not linked to the GDO, there is a *regional hydrogeological exploration database*. It collects data on polygons of regional hydrogeological exploration and information on polygons with groundwater reserve calculations. As of December 31, 2024, the database contained 979 polygons (an annual increase of 14 polygons).

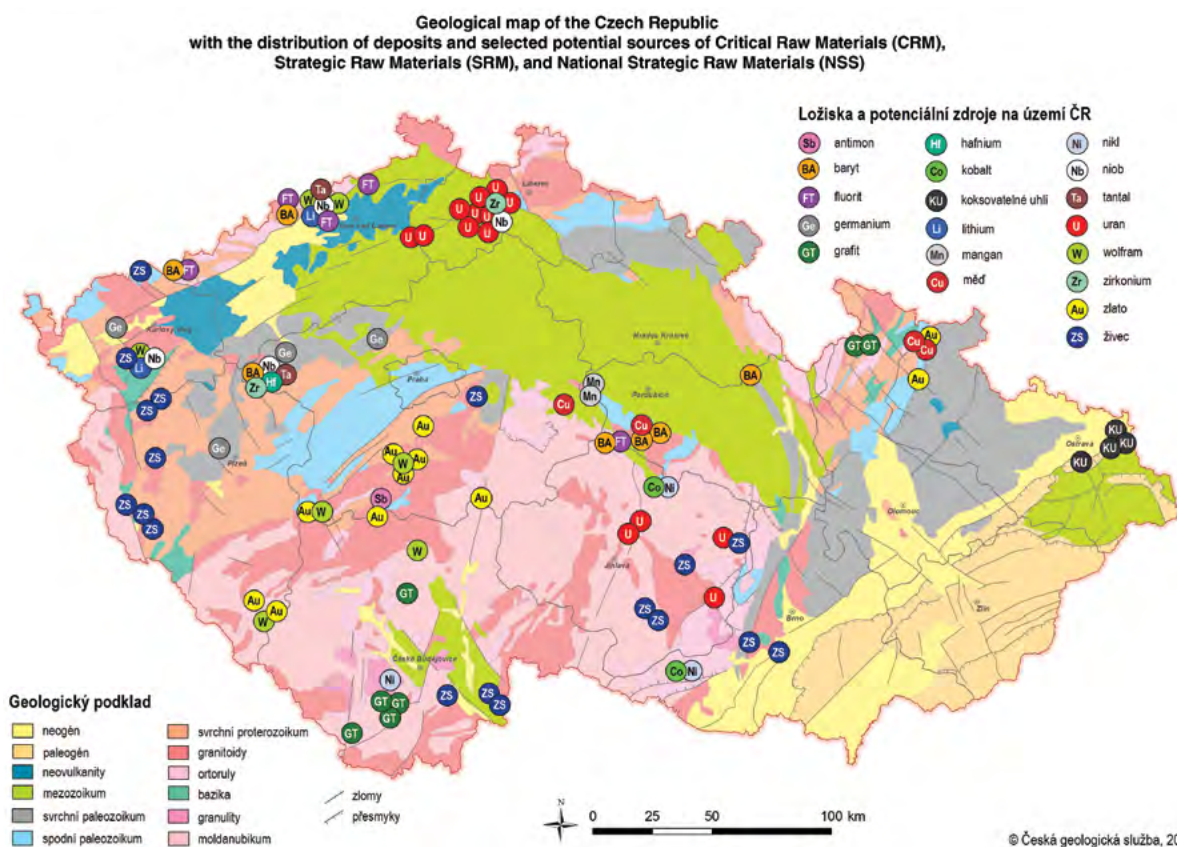
Mineral resources



Jaromír Starý
Head of the Mineral
Information System
Department

The Czech Geological Survey, as part of its state geological survey, manages several agendas related to mineral resources. Some activities are performed directly under the authority of the *Ministry of the Environment (MoE)*, while others stem from an agreement between the CGS, MoE, and the *Ministry of Industry and Trade (MIT)*, or from other legislative provisions.

The fundamental and key element is the *Mineral Information System (SurlS)*, which is part of the *Geological Information System (GeolS)*. This system continuously and comprehensively collects all available data on the mineral resource potential in the Czech Republic. The data and information from SurlS serve state administration and self-government bodies for qualified decision-making that supports the development of the state and its administrative units.





The Mineral Information System (SurlS) is part of the Geological Information System (GeoS).

SurlS – Mineral Information System

The *Mineral Information System (SurlS)* is a component of the *Geological Information System (GeoS)* of the Czech Geological Survey. It collects and provides all available data on the mineral resource potential of the Czech Republic. Its foundation is a *database of mineral deposits and resources in the Czech Republic*, which is linked to several sub-databases: *companies (organizations)*, *mining lease areas (DP)*, *protected deposit areas (CHLÚ)*, *preliminary consents for establishing DP (PSDP)*, *exploration areas (PÚ)*, *decisions on reserve approval*, and *graphic objects*.

SurlS is continuously updated based on mandatory geological documentation submissions, results of geological work, departmental forms Geo (MoE) V 3-01 and Hor – MIT. The basic data in SurlS is accessible via a map application (<https://mapy.geology.cz/suris/>).

The new *Information System for Protected Deposit Areas and Special Interventions in the Earth's Crust (ISCHLÚ)* also draws from SurlS data. Since 2019, ISCHLÚ has been registered as a *Public Administration Information System (ISVS)* with the Ministry of the Interior of the Czech Republic.

Departmental data collection

As part of the comprehensive inventory of reserves in exclusive deposits, the CGS, on behalf of the MoE, processes data and outputs from the *Annual Reports on the Movement and Status of Reserves in Exclusive Mineral Deposits Geo (MoE) V3-01*. These reports are part of departmental data collection as per § 29 of Act No. 44/1988 Coll., on the Protection and Use of Mineral Resources (Mining Act), as amended.

Furthermore, within the framework of mining and technical records, CGS processes data and outputs from the *Form for Providing Data to Mining and Technical Records (Hor – MIT)*, which are also part of depart-



Monograph Balance of Reserves: Part I – Ores and Trace Elements
Part II – Mineral Fuels and Energy Minerals.



Monograph Balance of Reserves: Part III – Exclusive Deposits of Industrial and Building Minerals.



Monograph Deposits of Non-Exclusive Minerals.



Yearbook Mineral Commodity Summaries of the Czech Republic 2025.

mental data collection as per § 29a of Act No. 44/1988 Coll., on the Protection and Use of Mineral Resources (Mining Act), as amended.

Professional outputs and publications

From the SurlS data, several monographs have been prepared: *Balance of Exclusive Mineral Reserves of the Czech Republic as of January 1, 2025*; *Inventory of Mineral Deposits in the Czech Republic as of January 1, 2025*; a study on *Mineral Reserve Movement in Exclusive Mineral Deposits in the Years 2015–2024*; *Overview of Mineral Reserves in Mining Lease Areas and Other Mined Deposits of Non-Exclusive Minerals as of January 1, 2025*; and the yearbook *Mineral Commodity Summaries of the Czech Republic 2025 (statistical data to 2024)*. This publication has been issued since 1992 with the aim of providing information on mineral resources in the Czech Republic and abroad. The preparation of the publication utilized a range of domestic and international source materials from journals, professional literature, and the latest available editions of various international statistical overviews.

Mine workings, undermined areas, and mining waste



Jolana Skřivánková
Head of the Mining
Impacts Department



Pavel Šír
Mine Workings
Registration Section

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*.

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.



*Collapse of an old shaft on
silver-bearing veins in Dobrá
Voda near Telč, Jihlava District.
Addressed within the Mine
Working Impacts Inventory.*

The field investigations are based on a long-established method.

In 2024, CGS employees inspected 2,000 mine working sites and documented their impacts.

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.

Undermined areas

The Czech Geological Survey maintains a database of undermined areas in the Czech Republic. In this context, undermined areas are defined as polygons encompassing the known or presumed occurrence of deep underground mine workings, created for the purpose of mineral extraction or exploration. This definition therefore excludes structures like tunnels, cellars, sewers, underground storage facilities, shelters, etc. Data on undermining are continuously updated and refined, serving as a basis for spatial planning. Currently, over 5,600 undermined areas are registered. Information regarding the situation, extent, and descriptions of individual undermined areas is presented in a map application (along with mine workings) on the CGS website.

The primary sources of information for creating the database of undermined areas are written materials stored in the geological documentation archives of Geofond in Prague, Kutná Hora, and Jílové u Prahy. Documents from

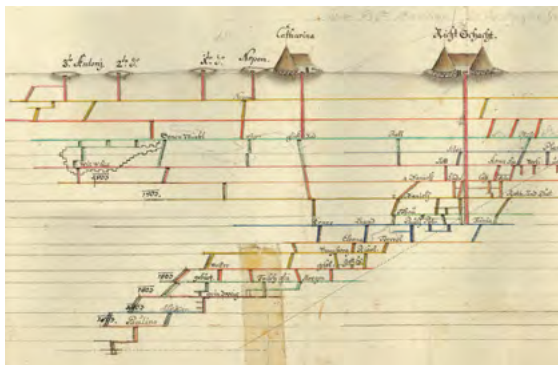
state archives and archives of specialized organizations are also utilized. The facility in Kutná Hora also houses an extensive specialized library of geological and mining literature, as well as collections of mining maps, comprising nearly 14,000 items.

For each undermined area, basic data are recorded, such as the mined raw material, period of mining, surface manifestations, data accuracy, level of documentation, and so forth. An important component includes references to relevant reports pertaining to the specific undermined area.

Inventory of Mining 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.

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.



Excerpt from a mining map from 1799, showing the situation of mine workings on silver-bearing veins near Stará Vožice, Tábor District.



Part of the specialized library at the Mining History Department in Kutná Hora.

Slope deformations



Oldřich Krejčí
Engineering
Geology Section

Among the activities of the Czech Geological Survey in performing its state geological survey related to *landslides and slope deformations* are fieldwork and engineering-geological mapping, the record of specialized technical reports and assessments, and their processing into graphic and text databases within the CGS Information System. This also includes publicly accessible map applications that present areas affected by slope deformations.

The operation of the Inventory of Slope Deformations was fully transferred to the CGS on January 1, 2011. In its current data set, the CGS has been continuously building a detailed Inventory of Slope Deformations *in the Czech Republic* with a precision of 1:10,000. This inventory contains data and information from the activities of various organizations from 1962 to the present. As of December 31, 2024, 25,779 records of landslide objects were registered.

Active slope deformations are considered more significant sources of risk. Activity is always recorded at the time of mapping the slope deformation. To ensure effective use, the Inventory is continuously supplemented, updated, and verified through field revisions (mapping, assessment activities).

In 2024, a total of 2,021 *landslide objects* were newly mapped or revised, including 230 *active*, 1,280 *temporarily stabilized*, and 511 *stabilized* ones.



*Extensive collapse of loess blocks into the Olšava riverbed.
Photo by J. Nečas.*



Washed-away accumulation part of the landslide in Vrbno pod Pradědem after the floods in September 2024. Photo by O. Krejčí.

As part of Regional Geological Administration assessment activities, 148 slope deformations were evaluated. A total of 26 original author's map sheets at a scale of 1:10,000 were processed.

Information on slope deformations is available online on the internet portal at https://mapy.geology.cz/svahove_deformace/. Data on this portal are continuously updated and supplemented. In 2024, the map application was updated 12 times. In 2024, CGS was tasked with recording landslides with flood damage from the period of high precipitation on September 14–15, 2025. A total of 64 slope deformation objects were reported, including 42 objects of danger category III, requiring stabilization work. Additionally, 17 more slope deformations from this period were recorded through the CGS's own mapping efforts.

From a methodological perspective, modern *remote sensing (RS) methods* are extensively used for mapping slope deformations, such as the analysis of the 5th generation digital relief model (DMR 5G) and imaging with CGS's own unmanned aerial vehicles.



Complicated detachment scarp of a slope deformation on the slopes of Stolová hora in the Pavlov Hills. Photo by J. Nečas.

Key projects ensuring funding for slope deformation research in 2024 were: *TACR Environment for Life – Natural and Anthropogenic Georisks and Risk Geofactors (MŠMT)*.

Contractual cooperation in 2024 was based on collaboration with the following organizations:

- Road and Motorway Directorate of the Czech Republic, s. p.
- Česká přenosová soustava ČEPS, a. s. (Czech Transmission System)
- Správa železnic, státní organizace (Railway Administration, state organization)

Research results were utilized by cities, municipalities, and the State Environmental Fund for evaluating applications for grants from European funds under the *Operational Program Environment 2021–2027*, in accordance with valid program documents.

CGS staff participated in mapping damage and risks resulting from the *fire in Bohemian Switzerland*. Research work also included innovations in methods for monitoring sloped terrains, innovations in methodologies for determining warning states, and the development of warning systems based on pilot localities.

Continuous data transfer on slope instabilities was carried out for requests for current data on landslide areas in accordance with §28 of Act No. 183/2006 Coll., on *Spatial Planning and Building Code – Update of Spatial Analytical Documents*. Currently, this activity takes place within the *Spatial Information Output Module of Planning Analytical Materials*.

Expert assessments and spatial planning



Jan Čurda
Head of the Regional
Geologists Administration



Zdeňka Petáková
Head of the Department
of Geological Exploration

The Czech Geological Survey, as part of its state geological survey, prepares *expert assessments and expertise*. This activity is coordinated by the internal body, the *Regional Geologists Administration (RGA)*, and is carried out by regional geologists, hydrogeologists, deposit geologists, and engineering geologists.

Furthermore, upon request from public authorities and other authorized entities, the CGS provides *expert statements on investment construction plans*. The CGS also provides public authorities with *data sets for the purpose of preparing spatial analytical documents* (so-called territorial data according to § 64 of the *Building Act*).

Regional Geologists Administration

The CGS expert assessment activities, carried out as part of its state geological survey under § 17 of Act No. 62/1988 Coll., on *Geological Works*, as amended, are primarily focused on the continuous performance of state geological survey in daily practice. The essence of this work lies in providing expert responses to requests from public authorities, which turn to the CGS in accordance with relevant legislative regulations.

The expert activities of regional geologists, as well as regional specialists for deposit geology, hydrogeology, and engineering geology, combined with assessment activities, cover the entire territory of the Czech Republic on a territorial basis, as required by Act No. 62/1988 Coll., on *Geological Works*, as amended. In 2024, which marked the twenty-seventh year of continuous operation for the CGS Regional Geologists Administration, this work was conducted exclusively in digital form through the *RGA Protocol application* on the CGS internet portal. The system used for managing the agenda continued to be improved to meet the ever-increasing quantitative and qualitative demands on assessment activities in the future, which the CGS Regional Geologists Administration strives to reflect.

Of the total of 1,003 actions administered in 2024, more than a third consisted of assessments focused on *hydrogeological issues*. The continuously growing number of hydrogeological assessments for several years running reflects the fact that many first-instance administrative authorities, as substantively competent bodies under § 104, par. 2, letter c) and § 106, par. 1 of Act No. 254/2001 Coll., on *Waters and on Amendments to Certain Acts (Water Act)*, as amended, and as special building authorities under § 15, par. 1 of Act No. 183/2006 Coll., on *Spatial Planning and Building Code (Building Act)*, as effective until December 31, 2023, in accordance with § 334a, par. 3 of Act No. 283/2021 Coll., the *Building Act*, as amended, are increasingly declaring that they lack the necessary expert knowledge to issue relevant decisions. Therefore, they turn to the CGS with requests for assessments of an *arbitrary or explanatory nature* under § 56 of Act No. 500/2004 Coll., the *Administrative Procedure Code*, as amended. Unfortunately, many such proceedings are intentionally complicated by the obstructive stance of some participants, or the issued decisions are challenged by third parties.

The second most numerous group of outputs was *statements on spatial planning documentation and comprehensive land adjustments*.

Actions related to addressing *slope deformation issues*, with 153 outputs, ranked third in frequency. Crucial for this group of expert outputs were the *extreme rainfall totals in September 2024*, which in some regions of the Czech Republic led to the formation of a significant number (62) of new slope deformations. CGS specialists were often able to promptly document these within the first few hours of their reporting to the CGS crisis hotline.

Expert statements

The Information Systems Division provides statements on investment construction and spatial planning documentation regarding areas with special geological conditions, as defined by § 13 of the Geological Act and § 18 and § 19 of the Mining Act.

In 2024, 1,471 requests for statements were administered concerning the protection of mineral deposits and the existence of undermined areas. A total of 896 statements were provided to spatial planning authorities and citizens in accordance with § 15, par. 1 of the Mining Act. The issuance of mining-historical statements was discontinued in 2024 as it is not a legally mandated activity.

The number of statements shows a continuous increase, as visible in the figure "Number of processed items in the statement agenda from 2015 to 2024". Compared to 2023, the number of administered statements increased by 228 items, representing an 18% rise. The administration of these statements was carried out in close cooperation with the assessment activities of the CGS Regional Geologists Administration.



Number of processed items in the statements agenda from 2015 to 2024.



Schematic situation of the unstable slope at property No. 23 on the bank of the Myslíkovský stream in the cadastral area of Myslík, with a view to the west on the background of an aerial photograph taken by the CGS on September 19, 2024. Photo by J. Malík, September 2024.

The red polygon delimits the active manifestations of the slope deformation JAMA_0692a. The turquoise blue broken line follows the channel of the rill, the fortified part of which is clogged within the extent of the landslide (dashed turquoise blue line). The turquoise blue wavy line indicates the surface inflow into the landslide's scarp area from the forest road and concentrated inflows from the north from the surrounding roofs of building No. 185. The yellow winding lines highlight the cracks in the slope heading towards building No. 185 and connecting to the scarp area. The dark blue point with an arrow indicates the underground water spring in the landslide's scarp wall.

Geological Information System



Richard Binko
Head of the Informatics
Department

The Geological Information System (GeolS) is a key tool for standardizing data collection, processing, and provision on the rock environment of the Czech Republic. The Czech Geological Survey has long managed GeolS to serve state administration bodies, the public, and its own professional and research activities. Its concept meets Czech and EU legislative requirements for information access and security.

Updated website: Important Geological Localities of the Czech Republic

In 2024, the web application for Important Geological Localities, one of the most visited resources of the CGS, was fully redesigned. It contains detailed information on more than 3,300 geological sites.

The new design is responsive, adapting to various screen sizes like tablets and mobile phones. It also utilizes a device's GPS to identify nearby localities for users in the field. The application provides multiple ways to find information: a multi-criteria search, a map view with all localities plotted, and pre-compiled lists based on themes (e.g., protected stratotypes, youngest volcanoes, and historical gold panning sites). Photographic documentation from the CGS archive is included for approximately 66% of the sites.

The application is intended for a broad audience, including the public, specialists, and for educational use. It is available at <https://lokality.geology.cz> and includes an English-language version for international visitors.

Precise elevation service for internal CGS use

A web service, available at <https://app.geology.cz/dmr/>, has been developed to provide elevation data in meters for any location within the Czech Republic. The service utilizes data from the DMR 4G (© ČÚZK, 2018) digital elevation model.

Its architecture is designed to minimize the load on the CGS database infrastructure. To achieve this, the data is stored efficiently in binary files outside the database, enabling direct, high-performance access to the required

Example of the responsive display mode of the updated localities website.

Vrkoč

Všeobecná charakteristika

Kraj: Ústecký kraj
Okres: Ústí nad Labem
Obec: Ústí nad Labem
Katastrální území: Varhovy
Mapové listy: 02-41, Ústí nad Labem, 02-413 Varhovy
Lokalita: Státní výchoz ze trati na levém břehu říčky v S. části městské části Ústí nad Labem - Varhovy.
Přístup k lokalitě: bez omezení - autem příjezd bez zábradlí vjezdu (v dosahu 250 m)

Geologie

Geologická charakteristika: Lokalita Vrkoč představuje intruzivní těleso nefelického bazaltu žilného tvaru, vyseparovaný erozí řeky Labe z pískovcové morfolofické soustavy a povrchových produktů efuzivní aktivity spodního subkomplexu. Výjimečná je zde výjimečně uspořádaná sloupová odlučnost. Pokud by se jednalo o běžnou pravou žilu, sloupová odlučnost by byla subhorizontální, kolmá ke kontaktům. Zde však uspořádání sloupů indikuje ještě třetí plochu ochlazení situovanou vodorovně, v místě nad současným tělesem. Tuto plochu by mohl být povrch předpokládání povrchového výlevu produkovaného právě touto žilou. Pak by těleso Vrkoče představovalo lineární přírodní dráhu, což je v souladu s představou řířového vulkanismu této oblasti. Vodorovně na Podlešínském potoce (Varhovský vodorovný), cca 500 západně od NPP Vrkoč, se vytvořili díky nevýrovnané spádové klíve na stupni tvoření odolnější horninou - lávovým výlevu bazaltu. Je vysoký 12 m a je nejvyšší v Českém středohoří.

Regionální členění: Český masiv > terciér Českého masivu > podtrutnovské pánev a přilehlé vulkanické hornatiny > středohorský vulkanický komplex

Stratigrafie: terciér

Téma: geomorfologie, vulkanologie

Jevy: žila, intruze, kamenné varhany (sloupovitá odlučnost), vodorovný, selektivní eroze

Původ geologických jevů (geneze): vulkanická

Hornina: bazalt

Ochrana a střety zájmů

Stupeň ochrany: Národní přírodní památka (NPP) v CHKO



Žilná intruze bazaltu. Výjimečně uspořádaná sloupová odlučnost...



values. The service has been successfully validated against test datasets with known elevations.

It is currently used by internal CGS applications to verify or supplement positional data with accurate elevations.

Tool for preparing custom topographic base maps

With the launch of the new national map series as open data, the Czech Office for Surveying, Mapping and Cadastre (ČÚZK) stopped offering customisation services to other organizations. In response, the Informatics Department has developed a tool for ArcGIS Pro to automate this process. The tool downloads vector data from the national topographic map of the Czech Republic for a user-defined area and scale. It then merges the relevant map sheets and adjusts the symbology, labels, and elevation data to generate a partially transparent topographic base map, which is prepared for overlaying thematic geoscientific data.

Publication of selected datasets in HVD Mode

In 2024, additional datasets were opened according to the CGS publication plan and newly valid obligations for publishing HVD (High-Value Data) data. The CGS opened the "Slope Instabilities" dataset and all national datasets harmonized with the INSPIRE directive: Geological Map at a scale of 1:500,000, Borehole Surveys, Geophysical Surveys, Seismic Profiles and Geoelectrics – VES, Radon Index Map 1:50,000, Landslides, Mineral Resources, Soil Maps 1:50,000. In 2024, the CGS provides a total of 17 open datasets in the HVD category through its local open data catalog. All are published in the National Open Data Catalog (NKOD) of the Czech Republic – <https://data.gov.cz/>



The resulting topographic base map modified using the new tool.



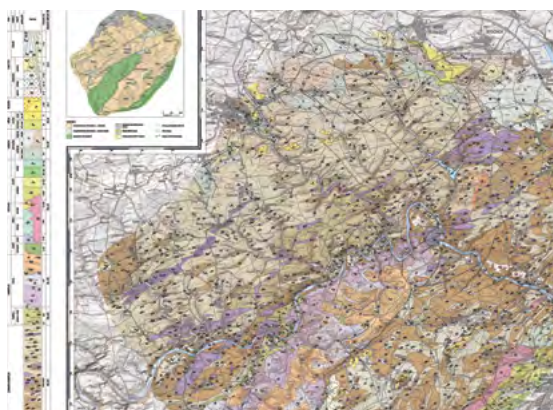
Presentation of the Field Maps mobile application implementation process at the GIS Esri conference in the Czech Republic (Photo © ARCDATA PRAHA).

Field Maps application

The Field Maps application continues to be developed; it was successfully introduced into the process of collecting documentation points in the previous year. Emphasis was placed on adapting it to user needs and the possibilities brought by newer versions. In addition, the entire Field Maps implementation process was presented with positive feedback at the GIS Esri conference in the Czech Republic.

Print outputs

As part of the pre-press preparation, a total of 8 maps were completed. These underwent processing, review, and final adjustments to meet all cartographic requirements for accuracy, legibility, and print quality. Among them are, for example: Geological map of Ethiopia 1:1,200,000, Hydrogeological map of Ethiopia 1:1,200,000, Orlické and Bystřické hory Mts – geological map for tourists, and Geological map of the Křivoklátsko Protected Landscape Area.



Detail from the geological map of the Křivoklátsko Protected Landscape Area, completely digitally processed in a geographic information system.



Photo by O. Man.

Petr Mixa
Head of the Department of Geology,
Deputy Director



International activities and cooperation in 2024

International activities are an important part of the professional work of the specialists at the Czech Geological Survey. The institution's management systematically works to secure international cooperation of a research projects, as well as development or commercial contracts.



The main benefits of these activities are considered to be the professional and personal development of CGS employees, the study of new geological fields and phenomena, and the development of language, cultural, and personal skills. An important benefit is the enhancement of the Czech Geological Survey's credit among European and global geological institutions. The financial volume of foreign projects represents approximately 5–7% of the CGS annual budget.

International activities are focused both on the European Union region and on other continents – especially Africa, as well as Asia and America. Scientific and development projects cover a whole range of geoscientific disciplines, representing the broad professional competence of the Czech Geological Survey.

Membership in selected international organizations

- AGU Advancing Earth and Space Science
- CETEG Central European Tectonic Groups
- EGS EuroGeoSurveys
- EGU European Geosciences Union
- IAEA International Atomic Energy Agency
- IAEG International Association for Engineering Geology and the Environment
- International Association of Sedimentologists
- SEG Society of Economic Geologists
- SGA Society for Geology Applied to Mineral Deposits



Partner countries in 2024:

- **Germany**
(cross-border geological maps)
- **Austria**
(critical mineral resources)
- **Slovakia**
(Quaternary geology, geochronology)
- **Spain**
(isotope geochemistry, volcanology)
- **Norway**
(environmental geochemistry)
- **Slovenia + Croatia**
(deep geological repository for nuclear waste)
- **Finland**
(critical mineral resources)
- **Italy**
(geology, mineralogy)
- **Greece**
(remote sensing, critical mineral resources)
- **Bosnia and Herzegovina**
(geological information systems)
- **Georgia**
(geohazards)
- **Albania**
(karst geology, speleology)
- **USA**
(structural geology, geological mapping)
- **Costa Rica**
(geological mapping, Quaternary geology, geohazards)
- **Peru**
(geohazards)
- **Ethiopia**
(geological mapping, hydrogeology, volcanology, geochronology)
- **Algeria**
- **Namibia**
- **Mongolia**
- **China**
(geology, tectonics, geochronology, geochemistry)
- **Uganda and Zambia**
(critical mineral resources)
- **Madagascar**
(geology, mineralogy)
- **Mauritania, Oman**
(Quaternary geology, archaeology)

Activities within EuroGeoSurveys



Within the European Union, the CGS is an active member of the association of European geological surveys, EuroGeoSurveys (EGS), through which CGS experts participate in a number of research projects and expert group activities via joint research. The most significant of these is the *Geological Service for Europe* project, in which the CGS is involved in topics such as *Critical raw materials*, *Geothermal energy & underground storage inventory*, *Improved appraisal, protection & sustainable use of European groundwater resources*, *Geological framework for the European geological data & information system*, and *European geological data infrastructure – EGDI*. European atlases of geothermal potential, groundwater, and CO₂ storage sites are also being created. On the EGS platform, a discussion has also been initiated among member states about establishing a European Geological Survey, the aim of which would be, among other things, to acquire strategic projects from the European Commission, focused especially on critical mineral resources.

Banana and coffee plants are the main economic crops of central Ethiopia.
Photo by P. Mixa.



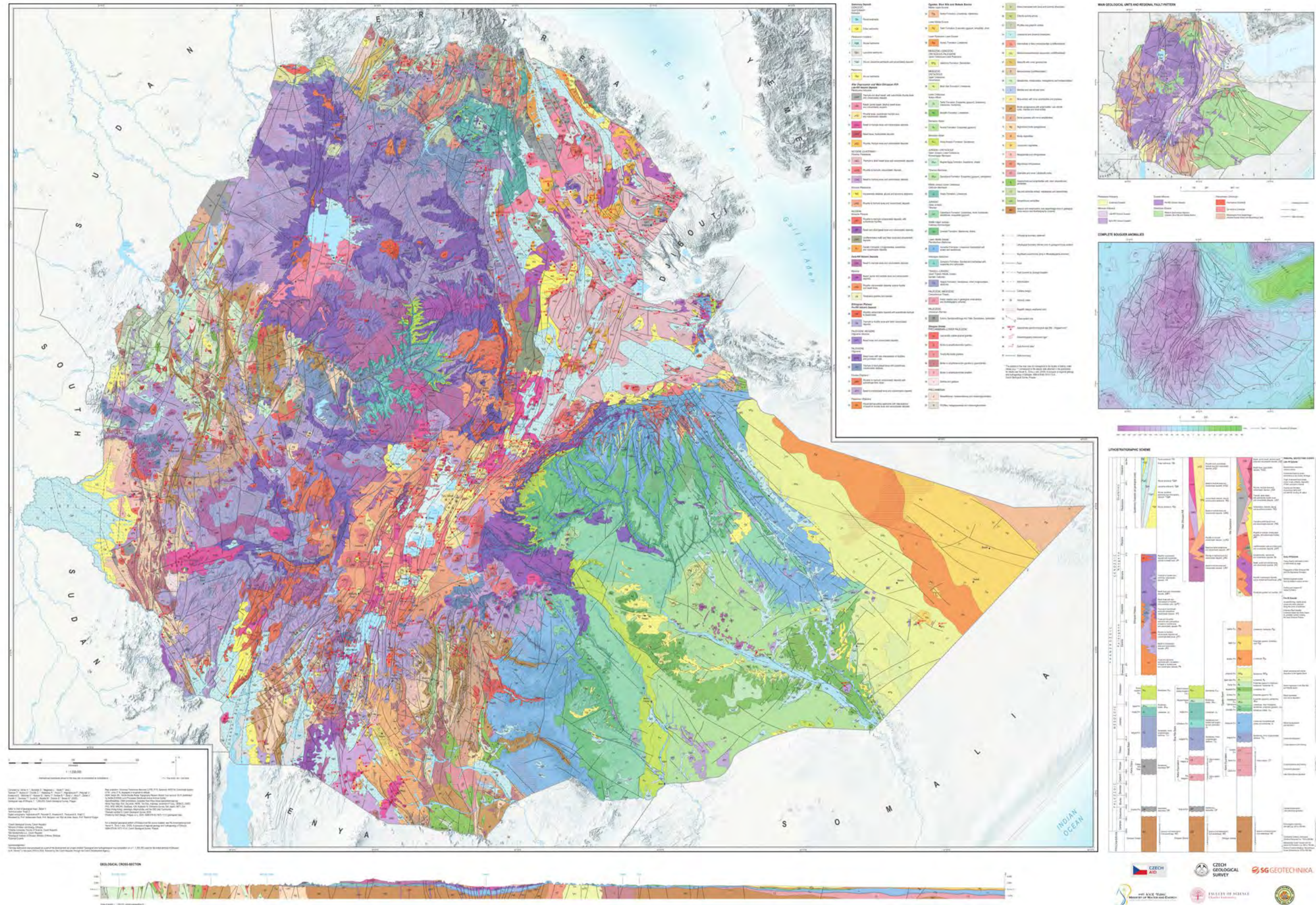
PanAfGeo and PanAfGeo+ country windows, Africa

In 2024, the second three-year program of the international *PanAfGeo* project concluded, in which the Czech Geological Survey trained colleagues from African countries in the skills of geological mapping and Earth remote sensing. This program ended in 2024 with courses in Uganda. The *PanAfGeo* program is succeeded by a third phase, *PanAfGeo+*, in which the CGS will again guarantee training in geological mapping and remote sensing under the leadership of Dr. Veronika Štědrá. The aim of the parallel project, *PanAfGeo+ country windows*, is to contribute to the sustainable management of Africa's raw material resources, to address adaptation to and mitigation of climate change, and to support the partnership between the EU and Africa in the field of geosciences, particularly critical raw materials. In 2024, the Czech Geological Survey began participation in mineral deposit projects in Zambia and Uganda; negotiations are underway for CGS participation in projects in Namibia, South Africa, and Rwanda.



GEOLOGICAL MAP OF ETHIOPIA

Compiled by: Kyrilof Verner, David Buriánek, Leta Megerssa, František Vacek (editors) with co-authors



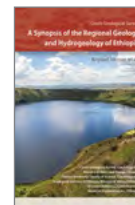
Geological map of Ethiopia at a scale of 1:1,200,000, compiled under the editorial supervision of K. Verner, D. Buriánek, L. Megerssa, and F. Vacek.

Ethiopia

One of the most significant achievements of the Czech Geological Survey's foreign development projects in recent years is the successful completion of the four-year project *Compilation of a national geological and hydrogeological map at a scale of 1:2,000,000 for the entire territory of Ethiopia*, financed by the Czech Development Agency and led for the CGS by Prof. Kryštof Verner, Ph.D.

An extensive research program was conducted, involving geological and hydrogeological mapping, literature reviews, and new field studies across Ethiopia.

This work resulted in the compilation of a nationwide geological and hydrogeological map at a 1:1,200,000 scale and the publication of the book, *A Synopsis of the Regional Geology and Hydrogeology of Ethiopia*.



In addition to the outputs mentioned, the project also focused on increasing the professional capacities of the collaborating Ethiopian experts and state officials in the field of geology and on the creation of related applications.



Lava dome above the magma chamber of the active volcano Erta Ale. Photo by K. Verner.



Gravitationally folded coal seam in a horizon of ash tuffs, Gamo zone. Photo by K. Verner.



Freshly solidified rope lava of the Erta Ale volcano from an eruption 4 months ago. Photo by K. Verner.

Norway

The long-term cooperation between the Czech Geological Survey and Norwegian colleagues continued with the *CatchCaN* project, focused on issues of environmental geochemistry. Within the framework of the Norway Grants project, CGS staff collected and analyzed soil samples from small Norwegian catchments. The joint project with the Norwegian Water Research Institute aimed to develop a new generation of the biogeochemical modeling platform MOBIUS, which simulates the carbon cycle in forest catchments.



Transport of equipment for soil sampling to the Norwegian research catchment Langtjern. Photo by J. Čuřík.



Vegetation on the border of the boreal zone and the subarctic taiga in the Norwegian research catchment Langtjern. Photo by J. Čuřík.



Sampling from quantitative soil probes in the Norwegian research catchment. Photo by J. Čuřík.



Measuring weir for flow measurement in the outlet section of the Birkenes research catchment in Norway. Photo by J. Čuřík.

Mongolia, China

In 2024, the significant four-year scientific project of the Czech Science Foundation (GACR, EXPRO), *Principal mechanisms of peripheral continental growth during the super-continent cycle*, was completed. The Czech Geological Survey's project, under the leadership of Prof. Karel Schulmann, was carried out in cooperation with colleagues from the Faculty of Science at Charles University, as well as with French, German, Swiss, British, Polish, Chinese, Mongolian, and American institutions. The main goal of the project was to study orogenic mechanisms and their records in the

Paleotethyan cycle and to decipher the developmental collage of the main Mongolian tectonostratigraphic units.

The results of the geological studies contributed to clarifying the closure of the Rheic Ocean, the amalgamation of the supercontinent Pangea, and the history of the Alleghanian-Variscan orogeny in this part of our planet.

During the project, 43 papers were published in the most prestigious international geological journals (*Tectonics*, *Journal of Metamorphic Geology*, *Gondwana Research*, *Lithos*, and others), and 6 master's theses and 4 doctoral dissertations were completed.



Participants of the post-conference excursion held at the conclusion of the project. Photo by P. Hanžl.



The yurt is still a traditional dwelling in Mongolia today. Photo by P. Mixa.



Fords are the most common way to cross a river in Mongolia today. Photo by P. Hanžl.

Speleological surveys in Greece / Albania

In October 2024, the Czech Geological Survey, represented by Mgr. Vít Baldík, Mgr. Eva Kryštofová, and Ing. Jiří Nečas, participated in an international scientific expedition of the Neuron Foundation to the hypogenic karst area in the Vromonero gorge, located on the border of southern Albania and Greece. The Vromonero hydrothermal area lies in the valley of the Sarandaporo River, near the tectonic contact of two regional geological units – the inner and outer Albanides. The main goal of the expedition, besides exploring the geological structure, was to obtain geodetic data to calculate the internal cave spaces and the area and volume of the lake in the Atmos abyss, which is filled with 26 °C warm sulfidic mineral water. The lake, named Neuron after the expedition, was determined to be the largest underground thermal lake in the world following the evaluation of bathymetric data.



*The Vromonero gorge with mineral water springs.
Photo by J. Nečas.*



*E. Kryštofová preparing the sonar for bathymetry.
Photo by V. Baldík.*



*Descent to the lake in Breshkë cave.
Photo by E. Kryštofová.*



*The water in Neuron Lake has a temperature of 26 °C.
View from the north. Photo by M. Audy.*

Nuclear repository in Slovenia / Croatia

Slovenia and Croatia jointly own and operate the Krško Nuclear Power Plant, which has an output of 700 MW and is located in Slovenia approximately 20 km from the Croatian border. Both countries have initiated a project to jointly build a deep geological repository for nuclear waste in crystalline rocks, with a repository design similar to the Czech variant. In light of the Czech Geological Survey's

extensive experience with this issue, the CGS was offered membership in the project consortium with the aim of defining the basic parameters of the repository. This primarily involved the phased approach to surveying suitable sites, as well as the time and financial demands of the work. Thus, under the leadership of Dr. Kristýna Hrdličková, the CGS team contributed to this initial phase of planning the exploratory work for siting the repository.



Slovenian-Croatian Krško Nuclear Power Plant. Photo by GEN Group.

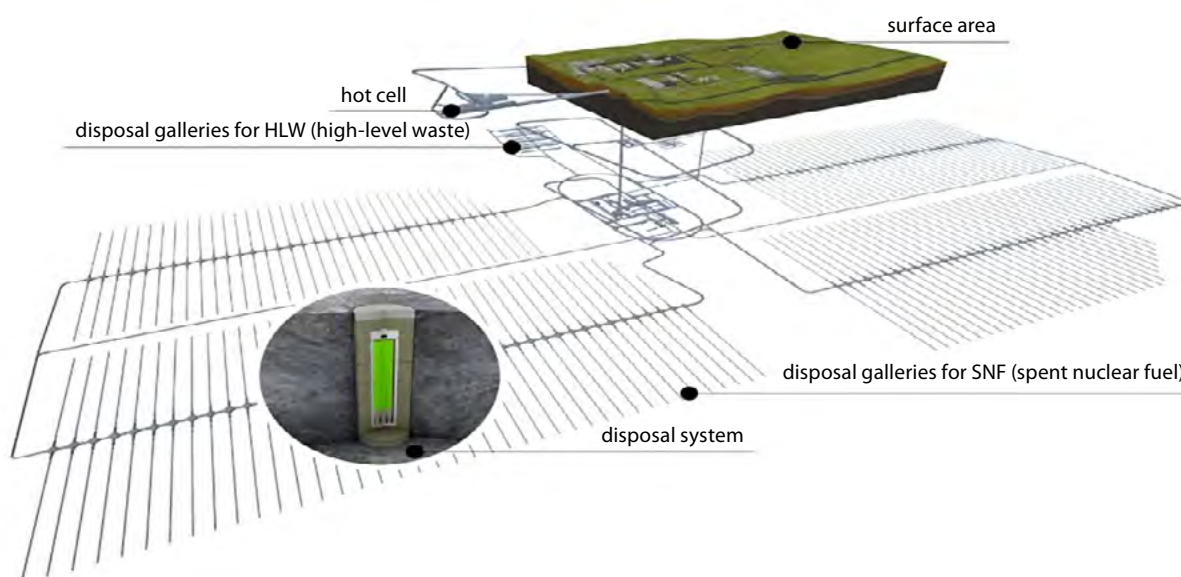


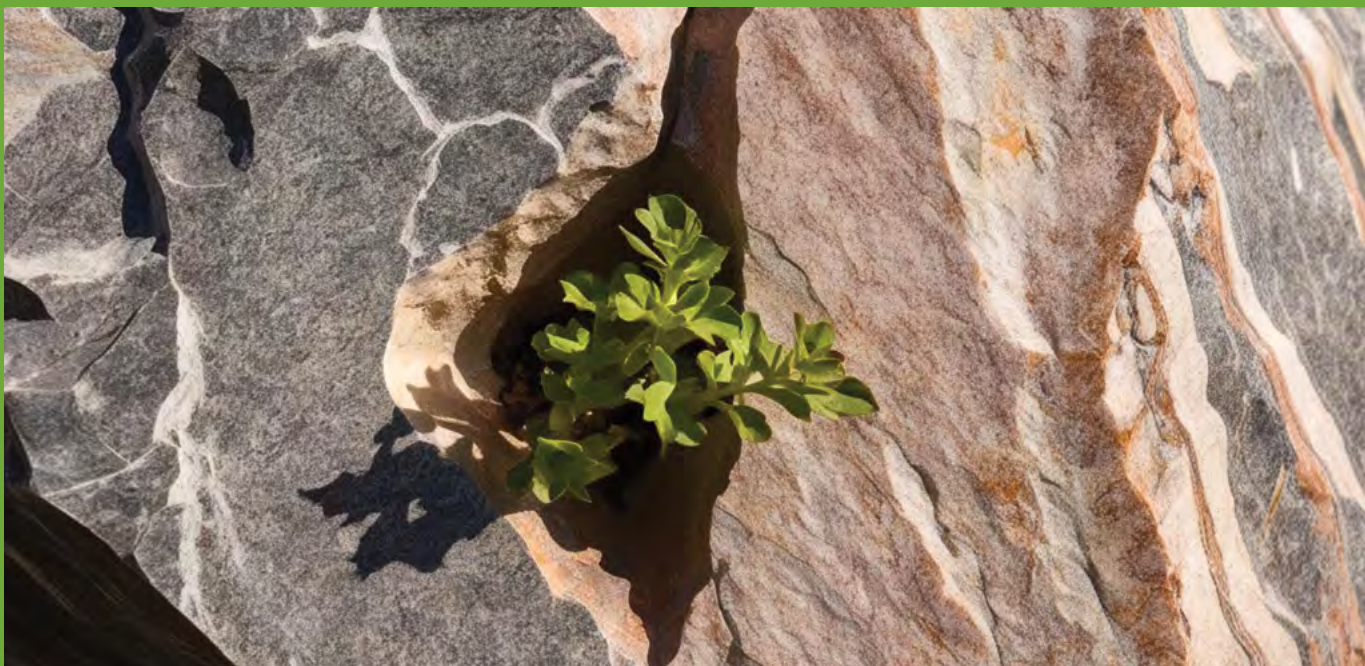
Diagram of the construction of a deep underground repository for radioactive waste in crystalline rocks.



2024 activities and institutional performance

In 2024, the activities of the Czech Geological Survey included a wide range of scientific, research, and publishing efforts, alongside the comprehensive operational management of the institution.

The following chapters of this Annual Report provide an overview of these key activities, which collectively fulfil the CGS's long-term professional and societal mission.



These sections summarize the key areas that characterized the year-round work of the CGS:

- **Laboratories**

Infrastructure, capabilities, and services of specialized analytical laboratories

- **Library and collections**

Curation and management of specialized archives and holdings

- **Publishing House**

Publishing activities, including the management of professional publications, scientific periodicals, and digital media

- **Selected scientific articles**

Key published achievements and scientific contributions

- **Financial review**

An overview of the organization's financial stability and performance

- **Human resources**

Staffing, professional development, and employee well-being

- **Projects**

A comprehensive review of all research grants and initiatives managed in 2024



Central and specialized laboratories

Central and specialized laboratories are indispensable for basic and applied research and for geoscience practice at national and international levels. The development of exact approaches for describing natural systems and quantifying material flows demands advanced instrumental equipment.

Applying standardized (accredited) methods to geomaterial samples is highly important. Equally fundamental are the expert interpretation of results, active exploration of new analytical possibilities, and the implementation of new analytical procedures.



Ondřej Šebek
Head of the
Multicollector Mass
Spectrometry Unit



František Laufek
Head of the X-ray
Diffraction Laboratory

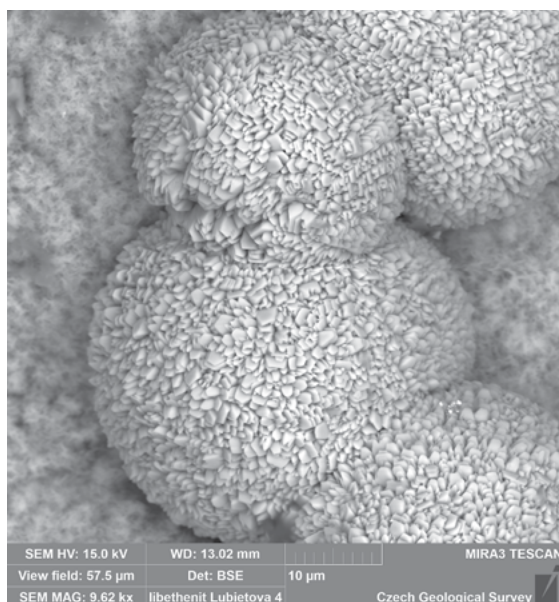


Tereza Grabmüllerová
Head of the Central
Laboratories

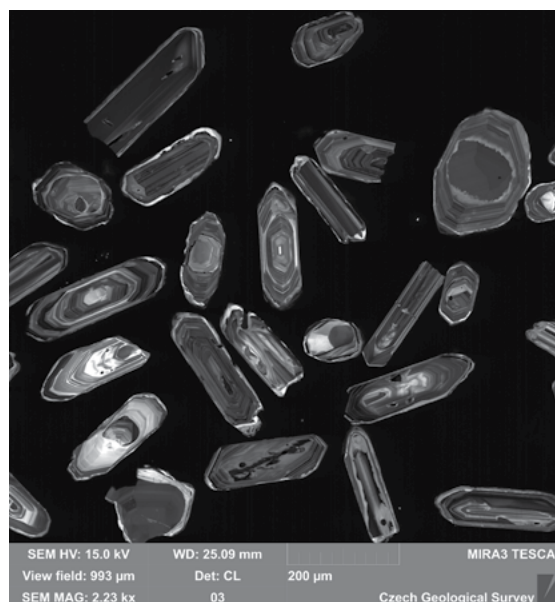


Daniela Ocásková
Head of the Gas
Chromatography
Section





Photograph of libethenite from Ľubietová in backscattered electrons; field of view is 152 µm. Photo by F. Laufek.



Zircon grains in cathodoluminescence. Photo by F. Laufek.

Central Laboratory

The Central Laboratory (CL) – with facilities in Prague and Brno – is a key pillar of the Czech Geological Survey's basic and applied research, supporting the fulfilment of its long-term conceptual development plan (LCDRO) and the execution of its duties as the state geological survey. The CL has been accredited by the Czech Accreditation Institute (CAI) since 1993. The CL's Brno facility specializes in the analysis of hydrocarbons, gases, and semi-volatile and volatile organic compounds. The results from accredited procedures are valid in all European Union countries. Compliance with the quality system is regularly audited by CAI staff.

Core activities: Homogenization of solid samples, separation (wet, magnetic, heavy liquid), pebble analysis, granulometry (particle size analysis), elutriation, sieving, preparation of thin sections, polished thin sections, and polished sections, chemical analysis of water samples, chemical analysis of solid samples, and organic analysis of rocks, water, bitumen, and gases.

Key instrumentation: The CL is equipped with pH meters, conductometers, an HPLC Azura (Knauer), a deionized water preparation system, automatic titrators and a pX-meter (Radiometer), a TC and TN Torch analyzer (Teledyne Tekmar), spectrometers – including an Hg AMA 254 and a photometer 200 (Perkin-Elmer Hitachi) – a FAAS AAnalyst 200 (Perkin-Elmer) and PinAAcle 500 (Perkin-Elmer),

an ETA-AAS AAnalyst 700 (Perkin Elmer), an ICP-QMS 7900 (Agilent Technologies), a WD-XRF Primus IV (Rigaku), CS 500 and CS 580 analyzers (Eltra), a GC/MSD system AT 6890/5973N (Agilent Technologies), gas chromatographs including AT 6890 (Agilent Technologies), 7890A (Agilent Technologies), HP 5890 (Agilent Technologies), and ThermoEuroglas 1200 (Thermo Euroglas), a Leitz MPV-2 microscope photometer, an AT 1100 liquid chromatograph (Agilent Technologies) with FLD and DAD detection (used for the analysis of selected compounds in the extractable fraction), a 1000CS elemental analyzer (Eltra), a jaw crusher (Retsch), a ball mill (Retsch), milling equipment (IKA), a TurboVap analytical fraction concentrator (Zymark), and an ASE 100 extraction system (Dionex).

Specialized laboratories

Specialized laboratories provide expert services, generate primary data, and participate in their interpretation. They actively collaborate on national, international, and multidisciplinary projects. The results of their work are published in renowned journals and presented in international forums.

Isotope Geochemistry and Geochronology Laboratories

Main activities: Analysis of traditional radiogenic isotope systems (Sr, Nd, Os); analysis of non-traditional stable iso-



From left: multicollector inductively coupled plasma mass spectrometer (MC-ICP-MS), laser ablation (LA) system, and quadrupole inductively coupled plasma mass spectrometer (ICP-QMS). Photo by O. Šebek.

tope systems (Li, Mg, Fe, Cr, Cu, Zn, Cd, Mo, Pb, etc.); micromilling; sample preparation in a specialized ultraclean laboratory (USL) with controlled air purity; in-situ chemical and isotopic analysis using laser ablation (LA); U-Th-Pb geochronology in zircons; in-situ determination of Hf isotope ratios in zircons using LA coupled with MC-ICP-MS; data production for elemental contamination studies (determining sources, transport, and quantification of contaminants); data production for archaeology (e.g., determining material provenance); and data for economic geology (studying sedimentary, hydrothermal, or metamorphic processes).

Laboratory equipment: Triton Plus thermal ionization mass spectrometer (TIMS) and a Neptune multicollector inductively coupled plasma mass spectrometer (MC-ICP-MS) (Thermo Fisher Scientific); a Micromill (ESI) with a microbalance (Mettler-Toledo); an Analyte Excite 193 nm laser ablation system (Photon Machines) with a HelEx two-volume ablation cell; an Agilent 7900x ICP-MS (ICP-QMS) (Agilent); and a 5110 SVDV ICP-OES (Agilent).

Laboratory of Stable Isotopes (H, C, N, O, S)

Main activity: Determination of stable isotopes H, C, N, O, and S in natural materials.

Instrumentation: Delta V Advantage, Finnigan Mat 251, and Geo 20-20 mass spectrometers; a Fisons 1108; an EA Flash CNS. The laboratory operates a range of preparation lines to convert samples into gases suitable for isotopic measurements in classic dual-inlet mode. It is also equipped with a Liquid Water Isotope Analyzer 3000 (LGR Inc.).

X-ray Diffraction Laboratory

Main activities: Mineralogical analysis of a wide spectrum of geological materials; solving and refining the crystal structures of minerals and synthetic substances; mineralogical-geochemical study of clay minerals and their interactions in the natural environment.

Instrumentation: D8 Advance powder X-ray diffractometer (Bruker).

Electron Microscopy and Microanalysis Laboratory

Equipped with a high-resolution electron microscope and associated analyzers, the laboratory allows for the characterization of materials based on morphology and chemical composition, as well as the imaging of 3D objects.

Instrumentation: Tescan Mira 3GMU FEG-SEM (Field Emission Gun – Scanning Electron Microscope); analytical

systems including EDS, WDS, and EBSD (Oxford Instruments); and AzTec 6.1 acquisition software, which facilitates the characterization of materials in terms of chemical composition and crystallographic orientation at the microscale.

Fluid Inclusion Laboratory

The laboratory facilitates the study of inclusion homogenization temperatures (from $-180\text{ }^{\circ}\text{C}$ to $+600\text{ }^{\circ}\text{C}$) and the composition of aqueous and gaseous fluids in inclusions (up to 5 mm in size) from diverse geological environments. Instrumentation: Olympus BX53M polarizing microscope with a fluorescence illumination source and a LINKAM THMSG heating-freezing stage.

Experimental Mineralogy Laboratory

The research focuses primarily on the synthesis of chalcogenides, platinum-group metal (PGM) phases, and the study of phase relations.

Micropaleontology, Ecostratigraphy, and Chemostratigraphy Laboratory

The laboratory investigates the impact of global paleo-environmental changes on marine and terrestrial communities. Using paleontological, sedimentological, and geochemical methods, the laboratory's scientific team analyzes changes in selected abiotic paleoenvironmental characteristics and in parameters describing the evolution of paleodiversity during periods before, during, and after



*Chamber of the thermal ionization mass spectrometer (TIMS) with samples prepared for measurement.
Photo by F. Laufek.*

global crises. The analysis of paleodiversity evolution also includes taxonomic, paleoecological, and paleobiogeographical research.



*Goniometer of the Bruker D8 Advance X-ray diffractometer with an automatic sample changer.
Photo by F. Laufek.*

Library and collections



Hana Breiterová
Head of the Information
Services and Geological
Library Department



Petr Budil
Head of the Collections
Department

Even the first director, Cyril Purkyně, highlighted the importance of a specialized library for the proper functioning of the state geological survey. The rich offerings of the library and collections are utilized not only by experts from the Czech Geological Survey or other scientific organizations, but also by students, private researchers, and other interested members of the general public.

Study rooms in Prague at Klárov and at the Brno branch serve them all, where materials from library collections and archives are available for study. At the Kutná Hora office, it is possible to study mining literature.

Library in 2024

In 2024, the library celebrated its 100th anniversary since its establishment. At that time, it held 4,130 volumes; today, it has approximately 220,000. It boasts the *widest collection of geoscientific literature in the Czech Republic*, an extensive environmental collection, and the broadest collection of electronic information resources among the departmental organizations of the Ministry of the Environment. It acquires its collection through purchases, donations, and exchanges. During the existence of this service, it has collaborated with 606 institutions from 81 countries worldwide. 77,000 publications have been sent to partner institutions as part of this exchange, and 2,300 periodical titles along with many books and maps have been acquired. Today, publishing



Kids explore whether
dinosaurs had fleas.
Photo by H. Breiterová.



One of the schools visiting the study room.
Photo by H. Breiterová.

is shifting to the online environment, but we still maintain exchanges with 93 institutions from 29 countries.

An interesting form of exchange takes place with the Library of Congress in the United States. Based on the titles we send them, we gain volume credit, and with this credit, we subsequently “pay” for orders from their library, gaining access to a wide range of duplicate titles that are freely available. This “exchange e-shop” is very practical and allows convenient access to a selection of free professional books. In 2024, the library took over the collection of the significant paleontologist J. Kříž for processing and storage.

Collections

The Department of Collections and Material Documentation preserves and makes accessible *fossils, mineral and rock samples, thin sections, and other tangible geological evidence* acquired by geological survey staff, as well as finds from other organizations and private collectors. The most scientifically valuable samples are concentrated in the geological-mineralogical and paleontological collections. This material of a museum nature is preserved, made accessible, and registered by the department in the nationwide CES (Central Evidence of Collections) database in accordance with Act No. 122/2000 Coll., as amended, and the revised Decree 92/2023 Coll. A stricter regime, stipulated by these and subsequent legal regulations, applies to the management of these samples. Tangible documentation material – geological and paleontological samples for geological mapping, and thin sections – is preserved by the CGS in accordance with Act No. 62/1988 Coll., as amended by Act No. 66/2001 Coll.

Collections in 2024

The most significant additions to the collections in 2024 included *fossil samples from Antarctica* processed by R. Vo-drážka, *samples of the ichnogenus Rejkovicichnus* provided by R. Mikuláš, *Silurian graptolites* processed by P. Štorch

and Š. Manda, and *Silurian and Devonian trilobites* from F. Hartl. Among the additions to the geological-mineralogical subcollection, it is necessary to mention a valuable sample of *volcanic tuff with accretionary lapilli* donated by V. Rapprich, or a sample from layer No. 20 (Silurian-Devonian boundary) from the stratotype at Klonk near Sucho-masty provided by P. Lukeš. The Department of Collections and Material Documentation also continuously processes the rich collection of *Doc. Josef Sekyra* from his research in Antarctica, deserts, and the world’s high mountains; work continued in 2024.

The care of the CGS collection holdings, which total about 300,000 items, was accompanied in 2024 by intensive publication activity of collection staff, as well as their expert activity as regional geologists. Collection staff were also involved in teaching at the Faculty of Science, Charles University, in 2024.

The year 2024 was filled with numerous *public events* in which library and collection staff participated:

- CGS Day – a two-day event for the public; about 170 people visited the library premises. They became familiar with interesting historical journals, tried searching in the card catalogue, etc. The station on Cretaceous fossils – the *Cretaceous World* project – was besieged for the entire two days. Few wanted to miss the opportunity to pick out fossils from washes, especially since almost everyone succeeded.
- Science Festival at Gutovka – the *Cretaceous World* project was also presented here and met with extraordinary success at both events.
- Geology Olympiad – a popular competition with dozens of young participants attracted the attention of students from all schools.
- KnihKvíz (Book Quiz) Brno – on Tuesday, June 4, 2024, the second annual *Brno Libraries Day* event took place in Brno. The event helped spread awareness that even specialized libraries are accessible to the general public. The greatest interest was in books on geological topics intended for children and adolescents.
- Healthy Earth Day – the *Silurian World* project attracted the attention of many interested parties; the public was most interested in the opportunity to “extract” their own fossils from imported rocks.

Three invited lectures were presented for the Society of Friends of the National Museum, and one for the Université Claude Bernard Lyon 1.

Publishing House



Patrik Fiferka
Head of Publishing House

The CGS Publishing House is the largest publisher of geological literature in the Czech Republic and also publishes multimedia content promoting the institution's activities and geology as a field. It issues specialized publications dedicated to various branches of Earth sciences, geological and thematic maps of various scales, and popular science titles.

33 books and maps

In 2024, a successful publishing endeavour was, among others, the release of the book *Personalities of Czech Geology: Ferry Fediuk*. Among the maps published, the map with explanations *Ostrov u Macochy* at a scale of 1:25,000 received particular attention. In 2024, a total of 33 titles were published in connection with publishing activities, project work, and custom assignments.





Vladimír Žáček accompanied the opening of the Southwest Uganda exhibition with a very interesting narration about how the displayed photographs came to be.

3 photography exhibitions

The Geological Bookstore hosted three photography exhibitions with geoscientific themes: *Magic of New Zealand* by Lukáš Janků, *Southwest Uganda* by Vladimír Žáček, and *Tanzania – East African Rift Valley* by Jaroslav Kadlec.

3 social events

In September, the Geological Bookstore held a book launch for Zdeňka Petáková's *Women in Geology – How to Become a Geologist*. The CGS also once again participated in the 10th annual Open House Prague 2024 festival, which took place from May 13th to 19th, 2024. Guided tours



*The CGS hosted a book signing and launch event for Zdeňka Petáková's book, *Women in Geology – How to Become a Geologist*, featuring illustrations by Anne Dostálová. The event took place on September 19th at the Geological Bookstore.*

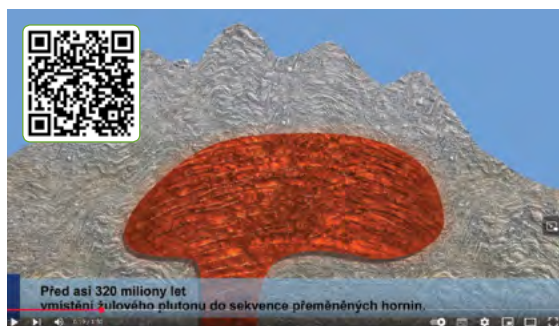
of St. Raphael's Chapel and the adjacent courtyard with the statue of St. Wenceslas were prepared for visitors. And in November, the social life of CGS geologists culminated in a celebration in the magnificent baroque spaces of the Liechtenstein Palace in Prague's Malá Strana.

3 animations on YouTube

Last year, the CGS created three new animations of geological phenomena and landscapes, which are available on YouTube: "Formation of Pravčická Brána", "The Thermal spring Vřídlo in Karlovy Vary", and "Geological development of the landscape near the village of Studenec in the Krkonoše foothills".



Geological development of the landscape near the village of Studenec in the Krkonoše foothills.



Thermal spring Vřídlo in Karlovy Vary.



A presentation event for the project Innovation of Geological Information Systems in Bosnia and Herzegovina took place near the city of Mostar in southern Bosnia and Herzegovina from September 10 to 12, 2024.

4 issues of the World of Geology newsletter



The Publishing House regularly prepares the CGS newsletter *World of Geology*, which is published quarterly and brings the most significant events and information about the institution's activities, as well as interesting facts from the field of Earth sciences. The magazine is freely available for download on the CGS website.



80 Facebook posts



The Publishing House manages the "Svět geologie" (World of Geology) accounts on Facebook (<https://www.facebook.com/svetgeologie>) and the CGS account on YouTube (<https://www.youtube.com/user/Geologycz>). These forms of promoting the CGS's work are very popular among fans of geology and natural sciences.

Project work



Innovation
of Geological Information Systems
in Bosnia and Herzegovina

Throughout 2024, the Publishing House participated in solving the projects *RENS – Rock Environment and Mineral Resources* and *Innovation of Geological Information Systems in Bosnia and Herzegovina*. The main task of the publishing staff is to ensure project publicity and associated promotional activities.

Geology Olympiad

The CGS co-organizes the nationwide *Geology Olympiad* (GO). On Monday, April 8, 2024, the regional round of the Geology Olympiad for the capital city of Prague took place on the premises of the Czech Geological Survey. The competition culminated in the central round, which was held from May 7 to 10 in Hořice, at the facilities

of the Secondary School of Applied Arts for Sculpture and Stonemasonry. The competition is organized by Masaryk University together with the Czech Geological Survey and the Association of Museums and Galleries of the Czech Republic. Representatives of these organizations ensured the traditionally high professional level of the event.



Participants in the regional round of the GO faced not only a theoretical test full of challenging questions but also a practical "identification" of geological samples, which tested their ability to identify and classify various minerals and rocks.



A total of 56 pupils and students competed in the central round of the GO, both in individual disciplines and in team competitions, which included field research in a nearby quarry and subsequent presentations of their findings. An excursion was also organized for the competition participants to localities where garnets are mined in Dolní Olešnice, and a tour of the Granát processing plant in Turnov, which specializes in the artistic processing of this rare stone.

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 paleoenvironmental 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, paleontology, 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.

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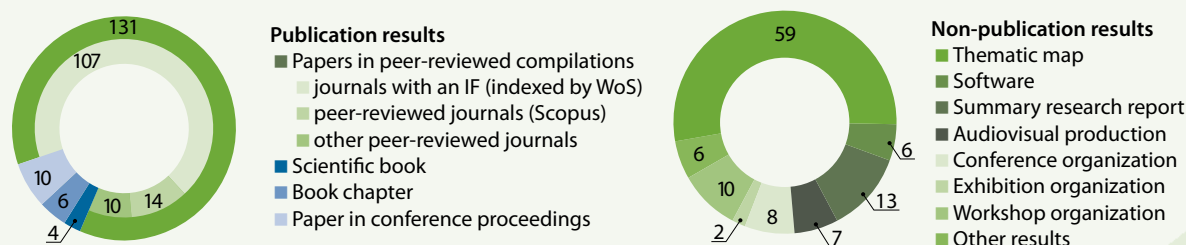
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Statistics on the results of CGS activities according to the current RVVI methodology



Financial review

In 2024, the Czech Geological Survey operated with total costs of CZK 531,187 thousand and total income of CZK 535,991 thousand. A positive financial result (profit) of CZK 4,804 thousand was achieved.

This profit was primarily achieved through revenues from the sale of services and other activities, totalling CZK 116,900 thousand. The largest items within this figure were revenues from services (mainly commercial activities) at CZK 61,350 thousand, and other operating income (mainly overheads from projects and contracts) at CZK 50,696 thousand. The organization's revenues from grants for projects, institutional funding for its long-term development concept, and the contribution from the founding ministry totalled CZK 405,519 thousand, accounting for 76% of total revenues.

The overall financial result ensured sufficient revenue to cover the costs of the Czech Geological Survey and to support its further development. Total personnel costs, amounting to CZK 302,290 thousand, were reduced by CZK 14,275 thousand year-on-year (primarily due to optimization



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

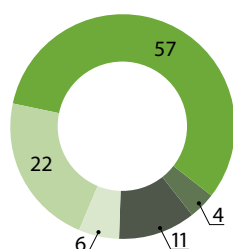
measures implemented at the end of 2023). In investments, a total of CZK 14,616 thousand was spent in 2024 on necessary equipment for the renewal and development of the Czech Geological Survey. Key investments in 2024 included the final phase of the Klárov building's reconstruction, featuring a new boiler room with heat pumps, and the implementation of an information system for tracking research outcomes.

With its science and research results in 2024, the Czech Geological Survey maintained its leading position within the Czech Republic's research evaluation system and secured funding for its development as a research organization, totalling CZK 121,385 thousand. Likewise, in 2024, the Czech Geological Survey successfully participated in numerous international projects (e.g., Horizon Europe, Norway Grants, OPST, TA CR, European Commission projects, etc.) and in international development assistance projects.

The financial results from 2024 and previous years provide a solid foundation for the organization's continued existence and development. They also ensure the fulfilment of its duties, both as the state geological survey and in the fields of science and research, as well as in providing services to other state and local government bodies and to the public.

Total expenses of the organization

Total expenses (CZK) 2024	531 187 127
Material and power consumption	30 352 091
Services	118 305 769
Total personnel costs	302 289 640
Depreciation of tangible and intangible assets	23 661 909
Other expenses	56 577 717

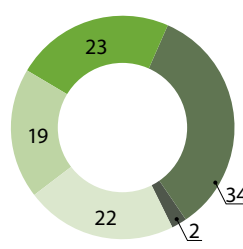


Expense breakdown, 2024 (%)

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

Total income of the organization

Total income (CZK) in 2024	535 991 065
Sales and other own-source revenue	120 936 138
Operating contribution from the founder	103 091 879
Institutional funding for development of research organization	121 384 803
Funds for projects	181 042 492
Amortization of deferred government grants	9 535 752



Income breakdown, 2024 (%)

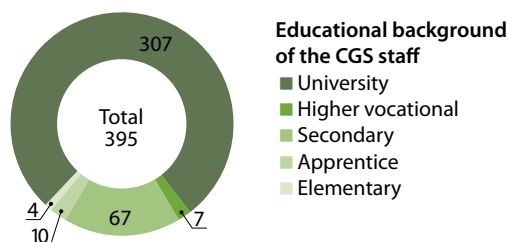
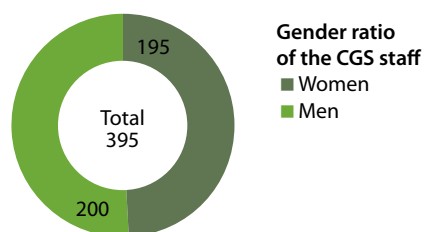
- Sales and other own-source revenue
- Operating contribution from the founder
- Institutional funding for development of research organization
- Funds for projects
- Amortization of deferred government grants

Human resources



Helena Žemličková
Head of the Human
Resources Department

The Czech Geological Survey employed a total of 395 people in 2024 (195 women and 200 men), including those on maternity and parental leave. This corresponds to a full-time equivalent of 339.60 employees.



The aforementioned metrics not only highlight our strong competitiveness in the labour market but also underscore the organization's economic growth and its prestige among research institutions in the Czech Republic.

The Czech Geological Survey actively promotes the professional development of its employees and is committed to enhancing their qualifications. It provides staff with training through a wide range of courses and seminars, such as in languages, law, and economics, and also organizes specialized professional training and workshops.

The organization is committed to upholding the principle of equal opportunities for all employees, regardless of age or gender, across all working conditions. This commitment is demonstrated by offering part-time work arrangements to employees returning from maternity and parental leave, as well as to working retirees and students pursuing higher education or doctoral degrees.

Equality and equal opportunity are core values shared throughout the Czech Geological Survey. This principle is actively promoted by our leadership and permeates all activities and operations carried out by the CGS.

On December 10, 2024, the Czech Geological Survey signed the *Charter against Domestic Violence*.

The *Charter against Domestic Violence* unites employers who are committed to combating domestic and gender-based violence and to helping its victims within their workplaces. Among other commitments, signatories pledge to educate all employees on the issue of domestic violence, create an environment where the topic can be discussed openly, and implement measures to assist victims in difficult life situations.

Projects implemented in 2024

Czech Science Foundation

CGS project manager

• Main mechanisms of peripheral continental growth during the supercontinental cycle	Schulmann Karel
• Multiphase solid inclusions in orogenic peridotites as tracers of metasomatization in collisional orogens	Kotková Jana
• Synthetic platinum-group minerals and their applications	Vymazalová Anna
• Interpreting geochemical data in igneous geochemistry: using the R language to develop new, and to integrate existing, free and open-source software	Janoušek Vojtěch
• Pervasive melt migration in continental crust: a micro-scale process with large-scale implications	Hasalová Pavlína
• Origin of the relaminant in the Bohemian Massif during the Variscan orogeny	Štípská Pavla
• Pre-Variscan oceanic basins of the Bohemian Massif – Integrating petrology, geochronology and non-traditional stable isotope systems	Magna Tomáš
• Does tree transpiration drive forest calcium biogeochemistry? Or the other way round?	Oulehle Filip
• Ancient jawed polychaetes: evolution and palaeogeography in the Lower Palaeozoic	Tonarová Petra
• Campaign-style geochronology of pre- to syn-collisional Devonian basins of the Variscan Orogenic Belt	Collett Stephen
• Tracing the environmental impact of electronic waste recycling using Cd, Pb, and Cu isotopes	Martinková Eva
• Nitrogen fixation in polluted Czech peat bogs: Reconciling high N accumulation rates based on ^{210}Pb dating with low $^{15}\text{N}_2$ uptake and low P availability	Novák Martin
• Petrogenesis and emplacement of deep-marine alkaline basaltoids: A case of Early Cretaceous magmatism in the northern Tethys region	Rapprich Vladislav
• Towards integrated stratigraphy of the Late Paleozoic in eastern equatorial Pangea	Šimůnek Zbyněk
• Generation, extent, and longevity of magma mush columns	Hasalová Pavlína
• Metals and their isotopes in active and abandoned mining areas of sub-Saharan Africa – towards understanding of their geochemistry and impacts	Kříbek Bohdan
• A global model of treethrow forms and the role of tree mortality in carbon storage	Oulehle Filip

Technology Agency of the Czech Republic

CGS project manager

• Engineered barrier 200C	Laufek František
• Rock environment and natural resources	Poňavič Michal
• Analytics 225000	Cilc Zdeněk
• Mineral resources SUBPROJECT 225000	Poňavič Michal
• Groundwater in the karst system SUBPROJECT 225000	Novotný Roman
• Geohazards SUBPROJECT 225000	Kýcl Petr
• Undermining SUBPROJECT 225000	Skřivánková Jolana
• Center for landscape and biodiversity	Oulehle Filip
• Integrated system for air quality research, assessment and monitoring	Novák Martin
• Prediction, evaluation and research for understanding national sensitivity and impacts of drought and climate change in Czechia	Nol Ondřej

• Study of variant technical solutions for deep disposal of radioactive waste	Nahodilová Radmila
• System for continuous vadose zone monitoring and prediction of water level in deep aquifers	Nol Ondřej
• Determination of protective zones of hydrogeological phenomena in the PLA Slavkovský les	Holeček Jan
• Defining and evaluating the areas decisive for subsidizing strategic groundwater resources with regard to their protection and stabilization	Novotná Jitka
• Natural and anthropogenic georisks	Kydl Petr
• The effects of forest fire on soil, hydrology, and the balance of ecologically significant elements in the context of the vegetation	Hruška Jakub
• Potential replacement vegetation modelling for nature conservation (NaPoVeg)	Chuman Tomáš
• The potential for hydrogen storage in geological structures within the Czech Republic	Štěpánský Dan
• Controlled deep biogas	Franců Juraj
• Sustainable mining of REE in Europe	Kubeš Martin
• Ecological methods for the pre-concentration of critical elements in natural rocks or waste from their processing and their connection to separation methods for the electrolytic extraction of these elements in a pure state	Ptíčen František

Internal projects funded by the MoE (Ministry of the Environment) under the Long-Term Conceptual Development of Research Organizations

CGS project manager

• Geology of the Křivoklátsko Protected Landscape Area – compilation of a monography based on research carried out in 2002–2018	Vorel Tomáš
• Continuous inventory of CGS samples in Brno	Bubík Miroslav
• Monograph of the Krkonoše Piedmont Basin and digitization of a 1:75,000 map	Stárková Marcela
• Geology of the Šumava National Park and Protected Landscape Area	Žáček Vladimír
• Mentoring	Hroch Tomáš
• Preparation and implementation of the Geology Day with CGS	Bukovská Zita
• 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	Soejono Igor
• Provenance analysis of sedimentary rocks from the internal domain of the Kaoko–Dom Feliciano–Garipe orogenic system (Namibia, Uruguay) – determination of age and Hf isotope ratios in detrital zircons	Konopásek Jiří
• Regional geological mapping of the Czech Republic at 1:25,000 scale, sheets 25-123 Hranice and 25-143 Bystřice pod Hostýnem	Tomanová Petrová Pavla
• Isotopic composition of Moldanubian granitoids: a new perspective on Variscan orogenic crustal variability and its implications for planned deep repository sites – horizontal cooperation	Janoušek Vojtěch
• Petrogenesis and geochemistry of the historic primitive lavas of La Palma	Magna Tomáš
• Testing of drones and virtual reality for research purposes	Koucká Lucie
• 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 – horizontal cooperation	Hasalová Pavlína
• Application of morphostratigraphic, thermochronometric and geochronological methods for reconstruction and prediction of relief evolution in the wider surroundings of candidate sites – horizontal cooperation	Hroch Tomáš
• A comprehensive study of the lacustrine carbonate factory in the Eger Rift Basin: geochemical insights into paleoenvironmental evolution	Petráš Daniel

• Volcanic systems VII	Stárková Marcela
• Implementation of the DKRVO – PART 2.1: Research on global changes and evolution of marine ecosystems – Palaeozoic	Frýda Jiří
• Sedimentological, palaeobotanical and palynological research of the Permo-Carboniferous basins of the Bohemian Massif	Šimůnek Zbyněk
• Selected taphocenoses of the Phanerozoic: palaeoecology, palaeobiogeography, stratigraphy and sedimentology	Vodrážka Radek
• Slope movements in the Peruvian Andes	Novotný Jan
• Cu, Zn and Cd isotope systematics at the substrate-to-mushroom interface in three polluted areas underlain by contrasting bedrock	Andronikov Alexandre
• Effect on elemental concentration and isotopic composition results of different sample preparation methods	Martinková Eva
• Interdisciplinary researches in CZO Slavkovský les	Krám Pavel
• Analysis of biomarkers in sedimentary rocks for palaeoenvironmental studies	Ocásková Daniela
• Evolution of changes in cation exchange capacity for bentonite heating	Koubová Magdaléna
• Conference preparation: 3 rd Virtual Annual IGCP 735 in Prague	Nohejlová Martina
• Preparation of all types of projects – capacity reporting	Mixa Petr
• Completion of projects (capacity reporting on technical completion of outputs – corrections after review process, for projects completed in the previous year)	Skácelová Darja
• Editorial plan and promotion plan, CGS Publishing House, 2020, ongoing	Fiferna Patrik
• Regional geological mapping of the Czech Republic at 1:25,000 scale	Buriánek David
• Regional geological mapping of the Czech Republic at 1:25,000 scale, Železné hory Mts	Čech Stanislav
• Regional geological mapping of the Czech Republic at 1:25,000 scale, Novohradské hory Mts	Dudíková Schulmannová Barbora
• Regional geological mapping of the Czech Republic at 1:25,000 scale, Pošumaví region	Žáček Vladimír
• Regional geological mapping of the Czech Republic at 1:25,000 scale, Bohemian Paradise II	Švábenická Lilian
• Regional geological mapping of the Czech Republic at 1:25,000 scale, Brdy Mts	Vorel Tomáš
• Regional geological mapping of the Czech Republic at 1:25,000 scale, Central Moravia	Tomanová Petrová Pavla
• Development of 3D geological models and related CGS databases	Franěk Jan
• Expert support for the National Geoparks Network of the Czech Republic II	Štědrá Veronika
• Geology of the Bohemian Cretaceous Basin	Čech Stanislav
• Decorative and building stones of the Czech Republic	Dudíková Schulmannová Barbora
• Study assistance for CGS employees	Žemličková Helena
• Editing of the <i>Geoscience Research Reports</i> journal	Sidorinová Tamara
• Printing of geological and applied maps	Žáček Vladimír
• Editing of the journal <i>Geological Research in Moravia and Silesia</i>	Buriánek David
• Editorial activities of scientific publications (capacity reporting), ongoing	Janoušek Vojtěch
• Editing and preparation of the electronic version of the <i>Bulletin of Geosciences</i>	Frýda Jiří
• Editing and printing of the <i>Bulletin of Geosciences</i>	Frýda Jiří
• Metamorphic evolution of the (U?)HP units of the Massif Central (France)	Dehoy Luc
• Potential field analyses and modelling of metamorphic terrains near radioactive waste repository site investigation – implications for deep crustal structures	Guy Alexandra
• When and at which conditions crystallized Plešovice zircon	Kotková Jana

• Valorization of the EXPRO project 19-27682X "Main mechanisms of peripheral continental growth during the supercontinent cycle" through publications and an international conference	Schulmann Karel
• Geochemical and mineralogical research of loess sediments from Hradisko u Kroměříže. Interdisciplinary use of data	Erbán Kočergina Julie
• Mineralization of biogenic material in a volcanic environment – III	Mysliveček Jakub
• Changes in the depositional environment, biological origin of sedimentary organic matter, and climate in the profile of the Menilite Formation at the Honětice locality (Žďánice Unit)	Jirman Petr
• Source areas and the weathering degree of material sedimented during the Late Glacial and Holocene in the Libuňka River basin in the Bohemian Paradise	Radoměšský Tomáš
• Topaz from the greisens of the Jizera Mountains and Cínovec as a potential abrasive for cutting and surface treatment of materials using AWJ (Abrasive Water Jet) technology	Veselovský František
• Rescue investigation of drill cores (Prague–Beroun tunnel)	Frýda Jiří
• Laser ablation methodology to study the platinum-group elements (PGE) in sulfides using a new set of the PGE reference materials	Andronikova Irina
• Tectonic evolution and thermochronology of the Moldanubian Unit in the Late Variscan and post-Variscan period	Verner Kryštof
• Development of the "Electronic Mountain Form" application and management of acquired data	Janoušek Michal
• World of Geology 2	Vajskebrová Markéta
• Harmonization of detailed geological maps of the ČGS and BGR, Phase I	Štědrá Veronika
• Integration of the ICT infrastructures of CGS and CGS – Geofond, ongoing	Binko Richard
• Important geological localities of the CR	Vajskebrová Markéta
• 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	Sedláček (Brno) Jan
• Expert opinion service of the regional geologists	Čurda Jan
• Executing tasks of the state geological survey apart from approved projects	Mixa Petr
• Executing tasks of the state geological survey apart from approved projects – Geofond Division, ongoing	Štrupl Vít
• Repair fund for laboratory instruments	Venera Zdeněk
• Activities of the coordinators of Long-Term Conceptual Development of Research Organizations/CGS	Pašava Jan
• Activities of the CGS Project-Review Board, ongoing	Mixa Petr

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	Horáková Anna
• Processing and evaluating final reports from the Resource Reports Collection at the Kutná Hora office as a basis for investigating mining impacts, 2022	Skřivánková Jolana
• 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	Šír Pavel
• Initial investigation of reported mitigated mining impacts in 2023	Štrupl Vít
• Mineral Commodity Summaries of the Czech Republic and Changes in Reserves of Reserved Mineral Deposits	Starý Jaromír

• RANAP, 2020, Contact of the Cretaceous and Permo-Carboniferous, web map update	Pacherová Petra
• 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.	Čurda Jan
• Restoration of selected parts of the geological documentation collection maintained by the CGS Geofond archives, 2022 phase	Hrdlovicsová Milada
• CGS repositories – retransfer of documented samples from old boreholes to the standard storage system of the CGS Geofond Division, 2022 phase	Donát Alan
• Monitoring of hydrogeological boreholes in 2021–2024 (Rebalance sustainability)	Vránek Tomáš
• Transfer of borehole logs from the archived reports of the FZ and P collections into the GDO and GEO systems, bentonite, 2022 phase	Petáková Zdeňka
• Wells with potential gas leakage in the Czech Republic, 2022	Franců Juraj
• Revision of prognosticated resources of industrial minerals and ores, category Q, in Central Bohemia	Mrázová Štěpánka
• Geological conditions in Spa Source Protection Zones – pre-project phase	Kryštofová Eva
• Post-fire activities of CGS geologists in the Bohemian Switzerland National Park	Malík Jan
• 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	Morysek Jiří

Projects for the MoE and other ministries

CGS project manager

• Turów 7/2016–2044	Kadlecová Renata
• Turów 7/2016–2044 – sub-project	Kadlecová Renata
• Institutional support for the long-term conceptual development of the research organization based on an evaluation of its achieved results	Pašava Jan
• Management of a network monitoring the status of ecosystems with regard to air pollution	Hruška Jakub
• ICP Waters conference 2024	Hruška Jakub
• ET-2019-019-RO-43040: Ensuring sustainable land management in selected areas of Ethiopia based on geoscience mapping	Verner Kryštof
• 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	Budil Petr
• Impact of climate changes on high-latitude (polar) marine benthic communities: What can we learn from the Ordovician?	Nohejlová Martina
• Czech-Austrian cooperation in the research of critical and strategic mineral resources in the southern part of the Bohemian Massif	Rambousek Petr
• Innovation of Geological Information Systems in Bosnia and Herzegovina	Čápková Dana
• Groundwater in crystalline rocks	Novotná Jitka
• Improving quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamo and Gofa zones, Ethiopia	Verner Kryštof

Horizon Europe and Horizon 2020

CGS project manager

• EU-COST Workshop: Offshore freshened groundwater: An unconventional water resource in coastal regions?	Petráš Daniel
• Prospecting and exploration of hidden deposits using modern technologies	Wertich Vojtěch
• FindHeat	Janků Lucie

• e-shape – Next-generation satellite data and creation of innovative applications	Strnadová Veronika
• SEMACRET – Sustainable exploration for orthomagmatic (critical) raw materials in the EU: Charting the road to the green energy transition	Wertich Vojtěch
• GSEU – A Geological Service for Europe	Čápková Dana
• A Geological Service for Europe – Critical Raw Materials, the International Centre of Excellence and United Nations Framework Classification	Gabriel Zbyněk
• A Geological Service for Europe – Geothermal energy & underground storage inventory	Janků Lukáš
• A Geological Service for Europe – Appraisal, protection & sustainable use of Europe's groundwater resources	Nol Ondřej
• A Geological Service for Europe – Geological framework for the European geological data & information system	Čápková Dana
• A Geological Service for Europe – European Geological Data Infrastructure, EGDl	Čápková Dana
• A Geological Service for Europe – Communication, Dissemination & Exploitation	Čápková Dana
• A Geological Service for Europe – Geological Surveys network and sustainable services for Europe	Čápková Dana
• Multi-Miner: Multi-source and multi-scale earth observation and novel machine learning methods for mineral exploration and mine site monitoring	Strnadová Veronika
• COREu (A European CO ₂ Transport and Storage Solution)	Štěpánský Dan
• MINEYE – Earth observation techniques for mine cycle monitoring using ML-based data fusion approach	Strnadová Veronika
• PUSH IT – Piloting Underground Storage of Heat In geoThermal reservoirs	Tym Antonín
• PUSH IT – sub-project WP 1	Tym Antonín
• PUSH IT – sub-project WP 2	Tym Antonín
• PUSH IT – sub-project WP 3	Tym Antonín
• PUSH IT – sub-project WP 4	Tym Antonín
• PUSH IT – sub-project WP 5	Tym Antonín

Other projects co-funded by foreign entities

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• SAPRECO ₂ – Salt precipitation during CO ₂ storage in carbonate rocks	Jirman Petr
• Methodology for generating coastal vulnerability maps in Costa Rica, considering sea-level rise as a result of climate change	Žáček Vladimír
• recomine SN-CZ-Plus 100704154	Mrázová Štěpánka
• CO ₂ Storage Pilot in a Carbonate Reservoir	Franců Juraj
• The fate and future of carbon in forests (CatchCaN)	Hruška Jakub
• BrineRIS – Brines of RIS countries as a source of CRM and energy supply	Rambousek Petr
• SYNERGYS	Tym Antonín
• SYNERGYS WP1	Tym Antonín
• SYNERGYS WP2	Tym Antonín
• SYNERGYS WP3	Tym Antonín
• SYNERGYS WP6	Tym Antonín
• Czech participation in envision mission – derisking of VenSpec-H development	Strnadová Veronika
• PanAfGeo-2: Africa-EU Partnership – Support to Geological Sciences and Technology	Štědrá Veronika

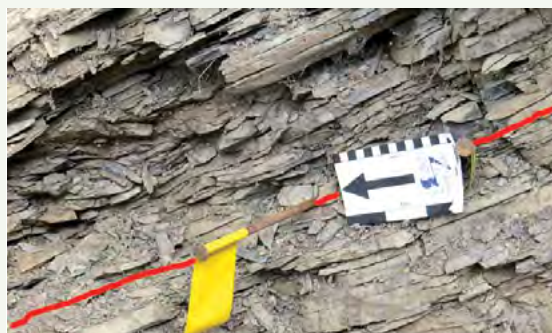
Significant events of 2024

New Global Stratotype (GSSP) in the Barrandian Paleozoic

The International Union of Geological Sciences (IUGS) approved a new Global Stratotype (GSSP) for the Aeronian Stage in the Lower Silurian of the Barrandian area near Hlásná Třebaň in the Beroun region. A stratotype is a geological locality where the standard for a specific historical geological period is defined. The base of the Aeronian Stage is now defined by the first appearance of the graptolite species *Demirastrites triangulatus* at this stratotype section near Hlásná Třebaň.

The stratotype proposal was submitted to the IUGS (based on detailed processing of the profile of the Želkovice Formation black shales near Hlásná Třebaň) by an international research team led by Petr Štorch (Institute of Geology of the Czech Academy of Sciences). Štěpán Manda, Zuzana Tasáryová, and Jiří Frýda from the Czech Geological Survey participated in the research. The international team's research lasted almost 10 years, and the three-stage approval process itself took almost a year. Practically, the research results can be used in geological surveys and documentation of large linear constructions, such as railway and road tunnels, as well as in the exploration of mineral deposits.

Zuzana Tasáryová



The boundary of the Rhuddanian and Aeronian stages ("golden spike") at the stratotype section near Hlásná Třebaň. Photo by Petr Štorch.



Demirastrites triangulatus. Photo by Petr Štorch.

Czech Geological Survey participates in opening ceremony of SÚRAO Information Centre in Jáchymov

The Czech Geological Survey, as an expert guarantor, supported the opening of the *SÚRAO Information Centre* in Jáchymov. The celebratory event was organized by the Radioactive Waste Repository Authority (SÚRAO) on Friday, October 11th, at the Jáchymov Town Hall, commemorating the 50th anniversary of the Bratrství repository near Jáchymov. Through close collaboration between the two institutions, CGS specialists conduct geological survey work and subsequently create 3D geological models of planned repositories.

CGS staff presented innovative 3D models illustrating the geological location of radioactive waste repositories, offering deeper insight into the complex issue of their disposal. These presentations captivated both morning school groups and afternoon visitors from the general public. Attendees also had the unique opportunity to touch and examine local rocks, both physically and through polarizing microscopes. The CGS presentation also included displays of specialist and popular science publications, which interested both children and adults. The event allowed our specialists to share their expertise with the public, contributing to a better understanding of the crucial topic of safe radioactive material disposal.

Jan Franěk, Patrik Fířerna



Czech Geological Survey successfully completes second series of PanAfGeo mapping courses in Uganda

The second phase of the international *PanAfGeo2* program (2021–2024) and its *Geoscientific Field Mapping* (WPA) section concluded on March 26, 2024, with its twelfth and final geological mapping course in Africa. This course was a collaboration between the Czech Geological Survey and the Department of Geological Survey of Uganda, taking place partly in Entebbe and partly in the mountainous south-western region of Uganda, around the city of Kabale.

Geological mapping in Africa is an exceptionally relevant topic for local geological surveys. Much of the territory is only broadly mapped, and the demand for detailed mapping work is steadily increasing, often without adequate capacity within the geological services to meet these needs. The month-long mapping courses are highly regarded by their African graduates for their multidisciplinary approach, extensive field practice, and effective transfer of knowledge and specific procedures crucial for mapping projects.

The course in Uganda marked the end of the second phase coordinated and led by the Czech Geological Survey. In addition to Czech experts, specialists from the French, Slovenian, and Portuguese geological surveys (BRGM, GeoZS, and LNEG), as well as African co-organizers from the host countries, participated. Beyond mapping, which is the most extensive and demanding part of the program, *PanAfGeo* also covers topics such as enhancing skills in geoscientific data processing, geo-hazards, geological heritage, prospecting and extraction of raw materials, their optimal primary processing, and an overall strategic approach to natural and mineral resources.

The closing ceremony of the mapping course in Uganda was held at the Lake Victoria Hotel in Entebbe, attended by Czech and Ugandan experts, the leadership of the Geological Survey of Uganda (DGS), and F. D. Mughyenyi from the project's advisory committee. Certificates for course graduates from 14 countries were personally presented by Minister Peter Lokeris and his deputy, Ms. Irene Bateebe, to significant attention from state media representatives.

Veronika Štědrá, Head of WPA PanAfGeo2



Prestigious recognition for CGS and GET: Technology Agency of the Czech Republic honours their joint project

On Thursday, November 7, 2024, the National Museum hosted the Innovation Gala, organized by the Technology Agency of the Czech Republic to mark its 15th anniversary. This prestigious evening was dedicated to recognizing the most significant applied research projects of 2023, across the categories of Partnership, Governance, Society, and Business.

The Czech Geological Survey and GET, s.r.o., triumphed in the Governance category. Their project, *Methodology and creation of standards for the development and periodic updating of regional raw material concepts, model solution for two selected regions*, secured the win in this category. This recognition highlights the importance and innovativeness of the project, which represents a crucial contribution to regional development.

Josef Godány from CGS and Petr Hanzlík from GET, s.r.o., accepted the award for this significant achievement. Josef Godány, as the principal investigator, led a team comprising leading specialists from both organizations, ensuring a high-quality and professional approach to tackling the project's complex tasks. This success is a testament to the excellent collaboration and expert competence of both institutions.



Michal Poňavič

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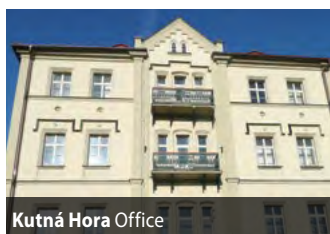
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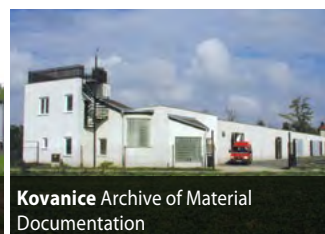
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