# Institute of Rock Structure and Mechanics
# Czech Academy of Sciences

Company ID No.: 67985891
Registered office: V Holešovičkách 94/41, 182 09 Prague 8

# Annual Report on Activities and Financial Management for the year 2025

Compiled: 24 April 2026

Discussed by the Institute Board on: 1 June 2026

Approved by the Supervisory Board on: 10 June 2026

Prague, 15 June 2026

*This english translation serves for informative purposes only, legally binding is the Czech version*

# Contents

## I. Information on the Composition and Activities of the IRSM Governing Bodies

### Composition of the Institute's Governing Bodies

| | |
|---|---|
| Director: | RNDr. Filip Hartvich, PhD. |
| Institute Board: | |
| Chair: | RNDr. Josef Stemberk, CSc. |
| Deputy Chair: | Mgr. Martina Havelcová, PhD. |
| Internal members: | Ing. Olga Bičáková, PhD.<br>Mgr. Jan Blahůt, PhD.<br>RNDr. Jiří Málek, PhD.<br>doc. Ing. Tomáš Suchý, PhD.<br>RNDr. Petra Štěpančíková, PhD. |
| External members: | Mgr. Jiří Adamovič, CSc. (Institute of Geology of the Czech Academy of Sciences),<br>Prof. RNDr. Tomáš Fischer, PhD. (Faculty of Science, Charles University)<br>doc. Ing. Jaroslav Kloužek, CSc. (University of Chemistry and Technology, Prague)<br>Ing. Pavel Kriegsman (KM, s.r.o.), |
| Secretary: | doc. RNDr. Pavel Straka, DrSc. |
| Supervisory Board: | |
| Chair: | Ing. Ilona Müllerová, DrSc. (Council of the Czech Academy of Sciences) |
| Deputy Chair: | Mgr. Lucia Fojtíková, PhD. (Institute of Rock Structure and Mechanics of the Czech Academy of Sciences) |
| Members: | doc. Ing. Jakub Kostelecký, PhD. (Faculty of Civil Engineering, Czech Technical University)<br>prof. RNDr. Jakub Langhammer, PhD. (Faculty of Science, Charles University)<br>doc. Ing. Radek Sedláček, PhD. (Faculty of Mechanical Engineering) |
| Secretary: | RNDr. Jakub Stemberk, PhD. |

## Activities of the Institute's Governing Bodies

### Director:

– successfully guided the Institute through its regular international evaluation. The first phase of the evaluation (collection of publications) took place from February to June 2025, and the second phase, including a visit by the evaluation panel, from July to October;

– attended all four meetings of the Institute Board and reported on the Institute's research, administrative and management activities;

– attended both meetings of the IRSM Supervisory Board and reported on the Institute's financial, administrative and research matters.

In addition:
– A total of six organisational notices were issued by the Director during 2025. Five meetings were also held between the Institute's senior management and department heads.

– In November 2025, the Director evaluated the publication activity of research staff through a publication competition. The results were announced and recognised with financial awards.

– Institute employees received bonuses from institutional funds at mid-year and at the end of the year.

– As part of its commercial activities, the Institute prepared several dozen expert statements, assessments and reports, including for ČEZ, a.s., Sklopísek Střeleč, a.s., the Vyšehrad National Cultural Monument and others.

– The Institute actively participated in four programmes under the Strategy AV21 framework, carrying out research as well as science communication and public outreach activities.

– Dr. Aislin Reynolds from the United States joined the Department of Applied Rock Mechanics as a postdoctoral researcher; Associate Professor Adam Emmer joined the Department of Engineering Geology as a research scientist; and Professor Nuretdin Kaymakci joined the Department of Neotectonics and Thermochronology as a research scientist.

– The Institute took an active part in the Science Fair in Letňany (5–7 June 2025), where it presented an exhibition of its scientific activities for the general public. It also participated in the Czech Academy of Sciences Week by organising a tour of the premises and presenting its research activities to the public, particularly to students.

– The photovoltaic power plant project progressed to a tender for the contractor; however, the procedure was subsequently cancelled because funding from the Czech Academy of Sciences for capital construction projects was unavailable. Funding was pledged for 2026.

– Agreements and memoranda were concluded with the Czech Technical University in Prague, the Faculty of Mathematics and Physics of Charles University, and the Faculty of Science of Charles University on the joint supervision of doctoral students and the applicable conditions under the 2025 amendment to the Higher Education Act. Agreements with additional universities are in preparation.

– A joint research agreement was concluded with the Istituto Nazionale di Geofisica e Vulcanologia (Italy).

– Agreements were concluded for participation in three Czech Science Foundation projects as a partner institution and in one project as the principal investigator's institution, and work on these new projects commenced.

**Institute Board:**

During 2025, the Institute Board held four ordinary meetings:
27 May, 23 September, 3 November and 17 December.

– **27 May**. The Institute's Annual Report for 2024 and the draft budget for 2025 were discussed. Both documents were submitted to the Supervisory Board for its opinion. The Board took note of the allocation of institutional and service tasks for 2025 and the issue of the building permit for the photovoltaic power plant. The first phase of the Institute's international evaluation had been completed successfully. The Board approved 22 Czech Science Foundation grant proposals for submission.

– **23 September**. An itinerary was prepared for the visit of the international evaluation panel. The Board took note of Act No. 264/2025 Coll. on cybersecurity, effective from 1 November 2025, and the obligations arising from it. It also discussed the impact of the amendment to the Higher Education Act, which introduces significant changes to the funding of doctoral students.

– **3 November**. The Board discussed the results of the Institute's international evaluation following the evaluation panel's on-site visit on 6 October 2025. The Institute's activities in 2020–2024 were assessed positively: its research has a clear practical impact, and its results are published in prestigious international journals and receive a favourable response. However, the Institute should strengthen cooperation between departments and student participation in research activities.

In addition, the existing rules governing commercial contracts and the internal organisational guidelines need to be updated. The Institute will acquire ownership of a former infantry bunker, which will be used as a field research station.

– **17 December**. The Board took note of (a) the favourable final report of the international evaluation panel, (b) the change in the allocation of salary support for postdoctoral researchers, (c) the status of agreements between universities and the Czech Academy of Sciences on the co-funding of doctoral students, (d) implementation of the Institute's 2025 budget, and (e) the Institute's cybersecurity self-identification.

The Board discussed a new guideline on commercial contracts, the draft IRSM Internal Organisational Guideline, and an overview of salary-scale ranges in connection with the change in the minimum wage.

The Director's substantiated request to transfer CZK 608,646.35 from the Reserve Fund to the Asset Replacement Fund was approved.

**Supervisory Board:**

In accordance with its Rules of Procedure, the IRSM Supervisory Board met twice in 2025 and considered three matters by *per rollam* procedure. The Supervisory Board had access to the Institute's financial results and Annual Report for 2024 and its budget for 2025.

The Supervisory Board's first meeting of 2025 was held on 11 July 2025. At the meeting, the Board verified and approved the minutes of its previous meeting, No. 2/2024; discussed the final implementation of the IRSM budget for 2024; and discussed and approved the final budget for 2025. It also discussed and took note of the auditor's report and the 2024 financial statements. As a further agenda item, the Board discussed and approved the Report on the Activities of the IRSM Supervisory Board for 2024 and the final IRSM Annual Report for 2024. Ms Hessová, Head of the IRSM Finance Department, then briefed the members on the Institute's interim financial results and the selection of a new audit firm for 2026. Of the five audit firms that submitted bids, Interexpert CZ, s.r.o., Prague, was selected and approved. The Institute's Director, Dr Hartvich, subsequently briefed the members on IRSM's research activities and other activities of the Institute's management, including preparations for the photovoltaic power plant and support for research and laboratory operations through small institutional projects. The proposed evaluation of the IRSM Director's managerial performance was discussed and approved. The results of *per rollam* votes Nos 1/2025 and 2/2025 (see below) were also verified, and two residential lease agreements for Dr Štěpančíková and Dr Ertepinar were approved.

At its second meeting, held on 15 December 2025, the Supervisory Board verified and approved the minutes of meeting No. 1/2025 and *per rollam* vote No. 3/2025 (see below). It also took note of the interim implementation of the 2025 budget and the outlook for 2026. Dr Hartvich, the Director, briefed the Board members on the progress of and difficulties with the tender procedure for constructing a photovoltaic power plant on the roofs of the IRSM buildings, as well as on developments at the Institute. The Supervisory Board recommended that the Director use the Asset Replacement Fund actively but prudently in 2026.

During 2025, the Supervisory Board considered and approved three draft resolutions by *per rollam* procedure:

1) Approval of the IRSM Annual Report for 2024.
2) Evaluation of the IRSM Director's managerial performance for 2024.
3) Free-of-charge transfer of a former military infantry bunker into the ownership of IRSM.

## II. Information on Amendments to the Deed of Foundation

No amendments were made to the Deed of Foundation during 2025.

## III. Evaluation of the Institute's Main Activities

### 1. Research Results

The Institute's research activities were carried out under Long-Term Conceptual Development Project No. RVO 67985891 and focused both on research in selected geoscience fields and on societally relevant research in materials science and engineering.

- **Research in the geosciences**:

Rock research focused on the conditions giving rise to natural and induced geodynamic processes and activity in the upper layer of the Earth's crust, specifically:
– processes threatening the stability of the Earth's surface and mitigation of their adverse impacts;
– monitoring and investigation of seismic-wave propagation through different rock environments;

– monitoring and analysis of slope and tectonic movements;
– investigation of palaeostress conditions in the Bohemian Massif;
– investigation of neotectonic phenomena in the United States and Türkiye;
– monitoring and analysis of the physical and mechanical properties of rock masses in relation to rock composition, precipitation and temperature.

- **Research in materials science and engineering**:

Study of raw materials and organic and inorganic materials, with emphasis on their properties and applications in medicine and the food industry, as well as in glassmaking, construction and environmental technologies, specifically:
– preparation and investigation of collagen-based materials for use in medicine and the food industry;
– modelling of melting processes, development of new melting equipment, and vitrification of radioactive waste;
– preparation, characterisation and application of special infrared-transparent glasses;
– development of special composite materials for practical applications;
– preparation of new geopolymer composites and investigation of their properties and applications;
– development of new technologies for the thermochemical processing of biomass and waste plastics.

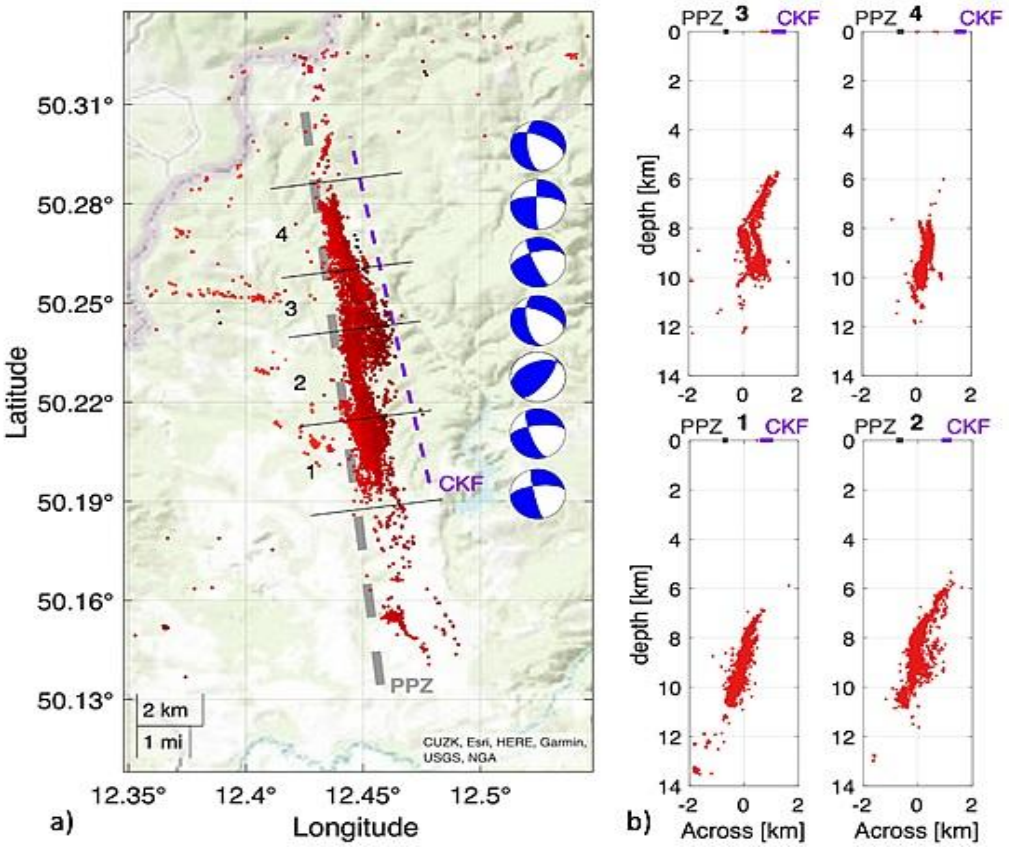
The Institute achieved a number of significant results in both basic and applied research through international cooperation with foreign research and educational institutions, collaboration with domestic research institutes, including institutes of the Czech Academy of Sciences, universities, and cooperation with industrial and public-sector organisations such as the Road and Motorway Directorate of the Czech Republic, ČEZ, a.s., Energoprojekt Praha, Sklopísek Střeleč, a.s., Energoprůzkum s.r.o., and others. Three significant results are presented below by way of illustration.

**1) In collaboration with Charles University—Faculty of Science, Institute of Hydrogeology, Engineering Geology and Applied Geophysics—a significant discovery was made of the Čirá–Kopanina Fault, which is the surface continuation of the Nový Kostel focal zone in the earthquake-swarm region of western Bohemia**.

**Abstract:**
This study of western Bohemia, an area known for frequent earthquake swarms, provides the first compelling evidence of a surface expression of the Čirá–Kopanina Fault, which is responsible for seismic activity in the Nový Kostel area. A combination of geomorphological, geophysical and seismological methods demonstrates the continuity and character of the fault zone from depth to the surface. The results indicate recent tectonic activity. The discovery of the Čirá–Kopanina Fault is particularly significant for assessing regional seismic hazard.

**Publication**:
Štěpančíková P., Stemberk J., Tábořík P., Fischer T., Findžová L., Valenta J. Discovering the Čirá-Kopanina Fault: Bridging the Gap between Surface Evidence and Seismic Activity. *Lithosphere* 2025, 2024(15), 192.
doi.org/10.2113/2024/lithosphere_2024_192

**Illustration for Result 1**:




*Distribution of earthquake hypocentres compared with the position of the Počátky–Plesná Fault Zone and the newly discovered Čirá–Kopanina Fault. The figure shows relocated earthquake hypocentres in the Nový Kostel area from 1991 to 2021. The map depicts the distribution of epicentres in relation to the Počátky–Plesná Zone (PPZ) and the newly identified Čirá–Kopanina Fault (CKF), including focal mechanisms of the stronger earthquakes. Depth sections from south to north document the steeply dipping fault zone and its continuity from depth to the surface expressions of both fault structures.*

**2) Another significant result was achieved through international cooperation, specifically with Idaho National Laboratory (USA), Pacific Northwest National Laboratory (USA), and the U.S. Department of Energy. The result is a characterisation of the dynamic and static corrosion of chromium–alumina refractories in glass melt intended for the disposal of radioactive waste by vitrification**.

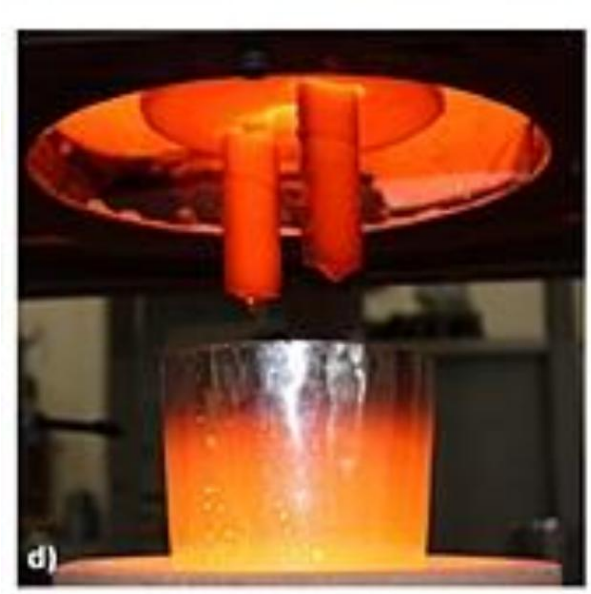
**Abstract:**
Chromium–alumina refractory is used in glass furnaces for nuclear-waste disposal because of its high resistance. Nevertheless, the aggressive conditions cause corrosion, which limits furnace service life. Subsurface and glass-line corrosion of this refractory was therefore investigated under static and dynamic conditions. Subsurface corrosion was found to increase by 10% for each 1 mm/s increase in melt velocity, whereas glass-line corrosion remained unaffected. The dependence of the corrosion rate on temperature is therefore inversely proportional to melt viscosity. Glass composition also affects both corrosion modes in a similar manner, according to the contents of $Cr_2O_3$, $Al_2O_3$, and alkalis. The experimental data also enabled the diffusion

coefficients of the principal dissolving species to be determined; these were found to be consistent between the glass-line and subsurface corrosion models.

**Publication:**

Pezl R., Kloužek J., Vernerová M., Cincibusová P., Msallamová Š., Jin T., Ferkl P., Hrma P., Guillen D., Kruger A., Pokorný R. Dynamic and static corrosion of chromium-alumina refractory in simulated nuclear waste glass. *Ceramics International* 2025, 51(29), 60583–60591. 10.1016/j.ceramint.2025.10.255

**Illustration for Result 2:**




*Experimental setup for the dynamic corrosion test: a Pt/Rh crucible containing glass melt (shown in the lower part of the figure) and the corroded refractory specimens cooling after removal (upper part of the figure) prior to further evaluation.*

**3) A further significant result achieved in collaboration with the Czech Technical University in Prague and the Institute of Physics of the Czech Academy of Sciences was the invention of a surface-treatment method for magnesium-based materials and magnesium alloys.**

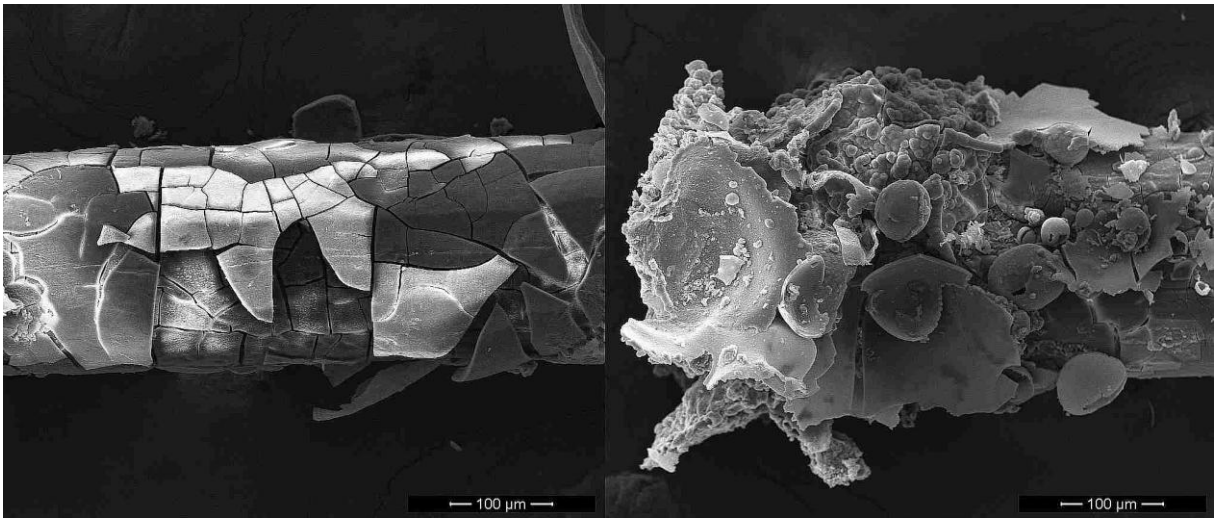
**Abstract:**

The invention provides a method for the surface treatment of materials used in the manufacture of magnesium alloys, medical devices and implants, based on chemically etching the material's surface layer with a nitric-acid-based etchant. Materials treated in this way can be used for biodegradable, resorbable and absorbable implants, cerclage devices (i.e. the surgical constriction of a ring-shaped anatomical structure using a special band), sutures, suture materials and bone-fixation implants. The invention is intended primarily for medical applications; however, because the surface treatment of alloys is also an important step in adding value to foundry products, the invention is beneficial in this field as well.

**Publication:**

Karel Tesař, Karel Balík. Method for the Surface Treatment of Magnesium-Alloy-Based Material. Czech Patent CZ 310 283, Industrial Property Office, 2025.

**Illustration for Result 3:**




*Comparison of etched (left) and unetched (right) magnesium wire. Images of pure magnesium wires after etching (left) and without etching (right), following two months in Eagle's Minimum Essential Medium. The image on the left, showing the etched wire, reveals only limited surface damage caused by corrosion. Both general and localised corrosion lead to a substantial deterioration in mechanical properties.*

## 2. Activities of the Research Departments and Significant Outputs of Their Work

The Institute conducted research in seven departments, five of which focused on geoscience disciplines and two on materials science disciplines:

Geoscience disciplines were pursued in the Department of Applied Rock Mechanics, Department of Engineering Geology, Department of Neotectonics and Thermochronology, Department of Seismotectonics, and Department of Geochemistry.

Materials science disciplines were pursued in the Department of Composite and Carbon Materials and the Department of Material Structure and Properties.

Joint workplaces with universities are a permanent part of the Institute's research departments. Within the Department of Geochemistry, the Laboratory of Sorption and Porosimetric Analysis operates as a joint workplace of the Institute and the Faculty of Science, Charles University. Similarly, the Laboratory of Inorganic Materials forms a permanent part of the Department of Material Structure and Properties and operates as a joint workplace of the Institute and the University of Chemistry and Technology, Prague.

In total, the Institute's research departments carried out 22 major research projects, including six projects involving international cooperation. In 2025, they participated in Strategy AV21 research programmes, collaborated with universities and research centres in the Czech Republic and abroad, and undertook commissioned work for external clients. Institute staff served on major international scientific commissions, organised a scientific conference and numerous seminars, contributed to science communication, and supported the education of secondary-school students and the general public. The Institute was granted one patent.

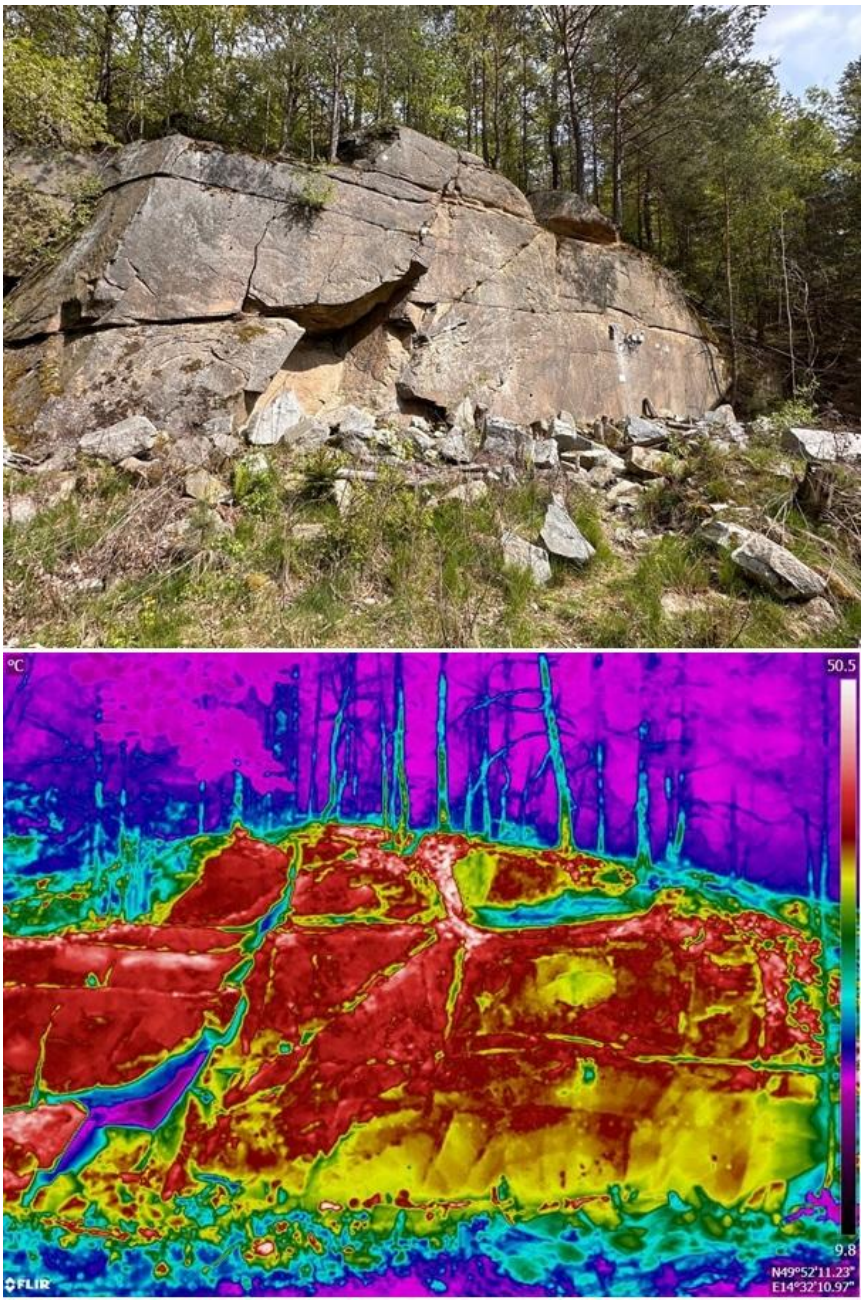
In 2025, staff of the research departments also held numerous teaching appointments at universities, not only at Czech universities, but also at an institution abroad, the University of New York.

The Institute cooperated closely with industry and public-sector organisations (Section III, point 5), for example by testing rock samples from borehole cores for the Dukovany Nuclear Power Plant and determining the properties of the bedrock on which the new Dukovany II nuclear power units will be built. The results will provide a basis for the precise positioning of structures with regard to bedrock stability and maximum load capacity. Another example is the monitoring of the stability of rock structures and underground spaces at national cultural monuments.


*Illustrative photograph: Sample used to test the bedrock of the Dukovany II Nuclear Power Plant.*

**Department of Applied Rock Mechanics** focused on the physical and mechanical properties of rock formations and rocks, and on their short- and long-term changes in response to endogenous and exogenous factors. This primarily involved determining bulk density, porosity, permeability and strength (uniaxial compression tests, indirect tensile tests—so-called Brazilian tests), determining fracture toughness (a material characteristic expressing resistance to crack propagation and brittle fracture), triaxial testing and shear strength. The static and dynamic moduli of rocks were also determined, and rock anisotropy was measured under varying confining pressures.

Particular emphasis was placed on monitoring and analysing rock masses in relation to rock composition, precipitation and temperature. Special attention was given to the effects of climate change and high temperatures, for example during fires, on rock properties. Non-destructive methods for monitoring rock properties were also developed. Another research topic was rock anisotropy investigated by means of acoustic emission.




*Experimental measurements of rock properties under natural conditions are conducted at the field laboratory in the former Požáry granodiorite quarry near Prosečnice in Central Bohemia. The monitored variables include climatic parameters, incident and reflected radiation, fracture movements, surface stress, rock moisture and temperature, and apparent electrical resistivity within the rock mass.*

The Department's work was supported not only by a fully equipped rock-mechanics laboratory, but also by a network of rock-mass monitoring sites in Czechia, Italy, the United States and Svalbard (Spitsbergen). Funding for the research topics was secured from the Technology Agency of the Czech Republic's Environment for Life programme (SS07010216: Effects of Fires and High Temperatures on Rock-Mass Stability) and from a bilateral Mobility Plus project with Türkiye (TÜBİTAK-24-01: Changes in Rock-Mass Properties after Forest Fires). The Department's research and technical staff also participated in an OP JAK project (CZ.02.01.01/00/22_008/0004605: Natural and Anthropogenic Geohazards) and another Environment for Life project of the Technology Agency of the Czech Republic

(SS02030023: Rock Environment and Mineral Resources). Since 2025, Department staff have also worked on a Czech Science Foundation project (25-17664S: Patterns and Trends of Rock-Slope Instability Explained by Thermal Effects in a Temperate Climate).

**Significant outputs:**

Caleca F, Lombardo L, Steger S, Tanyas H, Raspini F, Dahal A, Nefros C, Mărgărint M, Drouin V, Jemec-Auflič M, Novellino A, Tonini M, Loche M, Casagli N, Tofani V (2025). Pan-European landslide risk: from theory to practice. *Reviews in Geophysics* 63(1): 2023RG000825. https://doi.org/10.1029/2023RG000825

Dhakal OP, Loche M, Kumar Dahal R, Scaringi G (2025). Influence of temperature on the residual shear strength of landslide soil: role of the clay fraction. *Bulletin of Engineering Geology and the Environment* 84, 394. https://doi.org/10.1007/s10064-025-04405-w

Le TM, Nguyen XX, Hu TB, Dong JJ (2025). The Influence of Matedness, Roughness, and Surface Configuration of Smooth to Slightly Rough Joints on Stress-dependent Apertures. *International Journal of Rock Mechanics and Mining Sciences*, 193, 106159. https://doi.org/10.1016/j.ijrmms.2025.106159

Loche M, Scaringi G (2025). Assessing the Influence of Temperature on Slope Stability in a Temperate Climate: A Nationwide Spatial Probability Analysis in Italy. *Environmental Modelling and Software* 183: 106217 https://doi.org/10.1016/j.envsoft.2024.106217

Marmoni GM, Blahůt J, Martino S, Bakun-Mazor D (2025). Editorial: Environmental processes driving to slope failures: investigations, monitoring, and modelling through natural field laboratories. *Frontiers in Earth Science*. https://doi.org/10.3389/feart.2025.1556839

Nguyen XX, Truong MH, Nguyen DT, Nguyen TMT, Bui TTL (2025). Collapse Behavior and Geotechnical Properties of Sandy Loess-like Deposit in Southern Vietnam. *Geotechnical and Geological Engineering* 43, 326. https://doi.org/10.1007/s10706-025-03288-8

Nguyen XX, Yeh CW, Le TM, Dong JJ, Liu CH, Pan CP (2025). Estimating the Permeability–Depth Relation of Slate Formation for Geothermal Project. *Rock Mechanics and Rock Engineering* 1–16. https://doi.org/10.1007/s00603-025-04590-w

Šilhán K, Balek J, Klimeš J, Blahůt J, Hartvich F, Raška P, Riezner P, Šťastný M (2025). Complete historical chronology of complex landslide movements? Improving the tree-ring based results using multidisciplinary approaches. *Catena* 252: 108877. https://doi.org/10.1016/j.catena.2025.108877

Lokajíček T, Přikryl R, Racek M, Řimnáčová D, Natherová V, Petružálek M, Aminzadeh A (2025). Influence of Thermal Loading on Microcrack Evolution and Elastic Anisotropy in Westerly Granite. *Rock Mechanics and Rock Engineering*, 1-25. https://doi.org/10.1007/s00603-025-04939-1

Vavryčuk V, Petružálek M, Lokajíček T (2025). Anisotropic properties of fracture zone in sandstone inferred from seismic moment tensors of acoustic emissions. *Ultrasonics*, 107832. https://doi.org/10.1016/j.ultras.2025.107832

**Department of Engineering Geology** focused on the analysis and interpretation of hazardous geodynamic phenomena associated with exogenous processes, particularly slope deformation and weathering, as well as endogenous processes such as fault movements. Particular attention was paid to developing reliable and accurate monitoring methods for slope and tectonic phenomena, especially landslides, and for predicting their occurrence and development. The research was conducted in close international cooperation, particularly with European geoscience institutions. The Department also participated in international research using **monitoring networks**:

- Network name: **Landslides, rockfalls and debris flows reported in the media since 2011.**

Monitoring target: initiation and reactivation of slope deformations in Czechia.
Operator: IRSM (NASA programme (USA).
Scope: identifying the location and timing of landslides and the damage they cause.

- Network name: **SlopeNet**

Monitoring target: slope deformations, landslides and rockfalls.
Operator: IRSM (RENS programme).
Scope: geophysical and geotechnical monitoring of slope deformations, active participation in international research, and shared responsibility for monitoring operations.

In addition to their research, Department staff organised educational events for the public. In cooperation with the Museum of the Moravian Wallachia Region, they organised the exhibition *Landslides Not Only in Wallachia* and a field excursion to a landslide near Vsetín. Together with Academia Film Olomouc, they held a discussion on documentary films about ground movements and other phenomena. In cooperation with the Municipal Library of Prague, they also organised a lecture entitled *Czech Footprints in the Arctic*; and, together with the Federación de Municipios Libres del Perú, a lecture entitled *Foreign Scientists and Peruvian Communities: Practical Experience and Specific Opportunities for Cooperation in Relation to Hazardous Slope Processes*.
Department staff participated in organising the major international event “2025 Advanced Institute on Landslide Risks in the Mountains of Northern Mainland Southeast Asia”, led by the International Centre of Excellence Taipei – Integrated Research on Disaster Risk. The event took place in Thái Nguyên, Vietnam, from 24 to 28 March 2025.

**Significant output:**
A contactless laser positioning system for tracking the three-dimensional kinematic behaviour of rock-slope fractures and active faults, tested on a large rockslide in the Western Alps.

**Abstract:**
This technical innovation is a contactless laser positioning system that uses a triangulation approach to generate near-real-time three-dimensional records of fault behaviour. The positioning system comprises a sensing unit—a pair of laser modules, a digital camera and a customised target—a control unit, and a processing unit hosted

on a remote server. Images of the target are acquired at regular intervals and transmitted to the server, where a semi-automated image-processing protocol transforms the beam patterns into precise three-dimensional measurements. Its precision is characterised by a maximum standard deviation of 0.04 mm in uniaxial measurement, while its accuracy is estimated to be better than 0.02 mm. Two such devices were tested on a large rock slope on the eastern flanks of the Aiguilles Rouges in south-eastern France. The laser positioning system proved capable of detecting complex fault kinematics, opening the way for its integration into more comprehensive landslide-monitoring programmes.

**Publication:**

Baroň I., Trčka T., Čejka J., Škarvada P., Dolejška D., Vassallo R., Metral L., Rowberry M., Balek J., Hartvich F. (2025). Contactless laser positioning system for tracking three-dimensional kinematic behaviour of rock slope fractures and active faults tested on a large rockslide in the Western Alps. *Landslides*. https://doi.org/10.1007/s10346-025-02648-y

**Other outputs:**

Šilhán K, Balek J, Klimeš J, Blahůt J, Hartvich F, Raška P, Riezner J, Šťastný M (2025). Complete historical chronology of complex landslide movements? Improving the tree-ring based results using multidisciplinary approaches. CATENA 252, 108877. https://doi.org/10.1016/j.catena.2025.108877

Koppensteiner S.J., Bauer H., Grasemann B., Plan L., Baroň I. (2025). Fault mirrors in the process zone of a seismogenic fault (Karawanks, Eastern Alps). *Austrian Journal of Earth Sciences* 118, No.1–Sciendo, 115–132. https://doi.org/10.17738/ajes.2025.0006

Hartvich F., Duszyński F., Tábořík P., Jancewicz K., Adamovič A., Bartz W. (2025). Rockfall in orthogonally jointed sandstone: a multi-instrumental study of a pillar collapse. *Bull Eng Geol Environ* 84, 513. https://doi.org/10.1007/s10064-025-04526-2

Šilhán K, Balek J, Klimeš J, Blahůt J, Hartvich F, Raška P, Riezner P, Šťastný M (2025). Complete historical chronology of complex landslide movements? Improving the tree-ring based results using multidisciplinary approaches. CATENA 252, 108877. https://doi.org/10.1016/j.catena.2025.108877

Mikluš V., Trčka T., Rowberry M., Rogerson M. (2025). Searching for muons in caves. *Cave Radio and Electronics Group Journal* 129, 22–24.

Rowberry M., Baroň I., Trčka T., 2025. Could caves hold the key to earthquake prediction? *Cave Radio and Electronics Group Journal* 131, 21–24.

Létal A, Klimeš J, Şandric I (2025). Chapter 13 – Building landslide inventory with LiDAR data and deep learning. *In:* I. Sandric, V. Ilinca, Z. Chitu (Eds.), Earth Observation Applications to Landslide Mapping, Monitoring and Modeling, 297–311. https://doi.org/10.1016/B978-0-12-823868-4.00014-3

**Department of Neotectonics and Thermochronology** continued in 2025 to investigate palaeostress conditions in the Bohemian Massif and examined selected fault structures, including the Krušné Hory, Mariánské Lázně and Lusatian faults. International activities included tectonic and geophysical investigations in California's San Andreas Fault Zone. Fieldwork and sampling were also carried out in Türkiye, focusing on the thermochronological evolution of regions at lithospheric plate boundaries. Fieldwork also took place in the north-eastern Himalayas in India. In cooperation with other geoscience institutions, the Department also contributed to research on slope deformations and the structural and tectonic evolution of sandstone landscapes in Czechia and Poland, including the use of geophysical methods in interdisciplinary studies.

Department staff are involved in expert-witness activities in the field of geology.

In 2025, the Department participated in international research on slope deformations and tectonic structures using **monitoring networks**:

- Network name: **SlopeNet**

Monitoring target: slope deformations, landslides and rockfalls.
Operator: IRSM (RENS programme).
Scope: geophysical and geotechnical monitoring of slope deformations, active participation in international research, and shared responsibility for monitoring operations.

- Network name: **EU TecNet**

Monitoring target: three-dimensional monitoring of tectonic structures in the EU.
Operator: IRSM (CzechGeo programme).
Scope: active participation in monitoring, instrument readings and maintenance.

Alongside their research activities, Department staff contributed to secondary-school education through the *Geology of the Blanský Forest* event organised by the Czech-English Grammar School in České Budějovice, where they delivered a thematic lecture combined with a guided field excursion. The Department is listed in the registers of experts in geology, geomechanics, geodynamics and engineering geology and also conducts demanding expert assessments abroad (see below). The Head of the Department, Dr Petra Štěpančíková, is Vice-President of the Commission on Terrestrial Processes, Deposits & History (TERPRO), one of the principal commissions of the International Union for Quaternary Research (INQUA). A significant practical result was the Department's contribution to site characterisation for a new nuclear facility in Czechia, carried out as part of research on the Krušné Hory Fault to assess the suitability of sites for small modular reactors (see point 5 below).

**Significant outputs:**

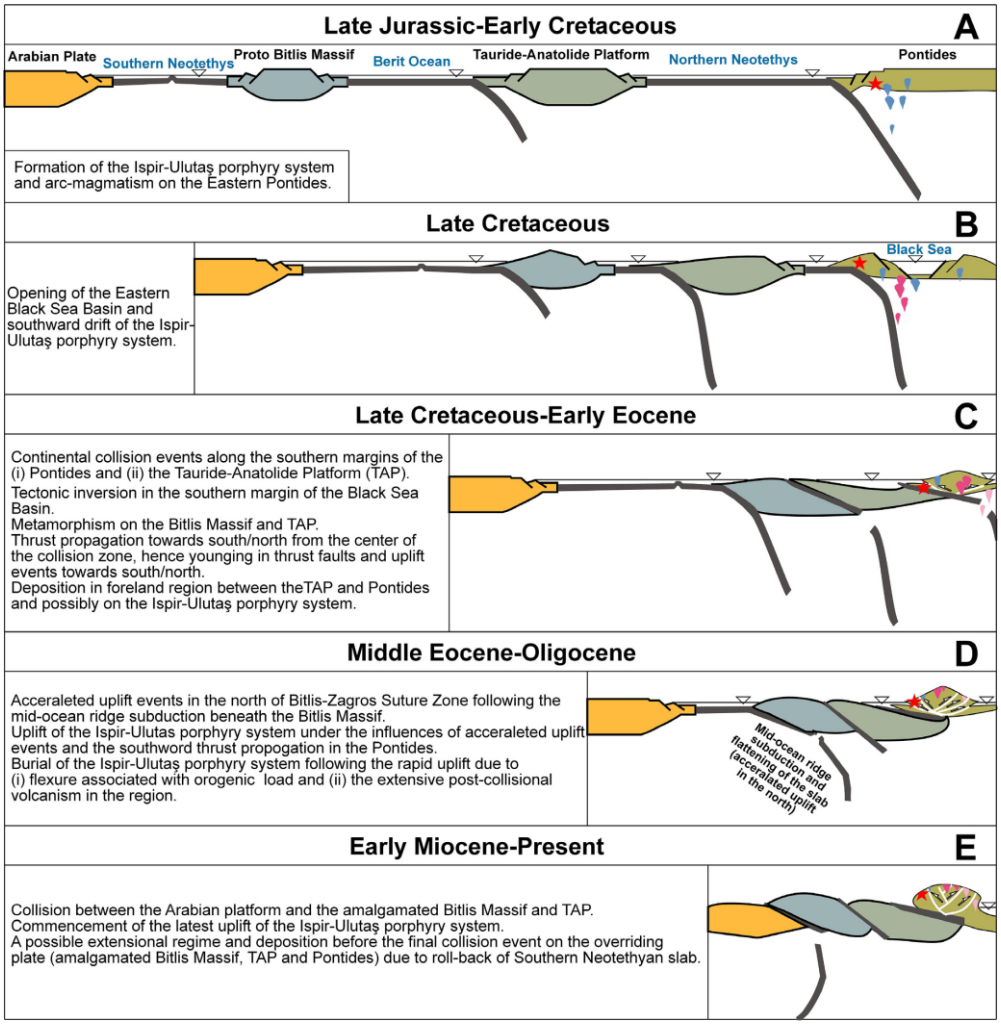
**1) Discovery of the Čirá–Kopanina Fault, the surface continuation of the Nový Kostel focal zone in the earthquake-swarm region of western Bohemia; see pp. 7–8.**

**2) Thermal–tectonic history of the İspir–Ulutaş porphyry Cu–Mo deposit, Eastern Pontides: implications for regional tectonics and exploration of porphyry systems**

**Abstract:**
Low-temperature thermochronology (AFT, AHe and ZHe) was used to reconstruct the evolution of the İspir–Ulutaş porphyry Cu–Mo deposit in the Eastern Pontides. The results indicate deep burial (>5 km), multi-stage exhumation, Eocene burial, and renewed uplift from the Miocene to the present. This explains the preservation of the deposit and has considerable significance for regional exploration.

**Publication:**
Gülyüz N. (2025). Thermal-tectonic history of the İspir-Ulutaş porphyry Cu-Mo deposit, Eastern Pontides: Implications for regional tectonics and exploration of porphyry systems. *Ore Geology Reviews* 179, 106532.
https://doi.org/10.1016/j.oregeorev.2025.106532

**Illustration for the output:**



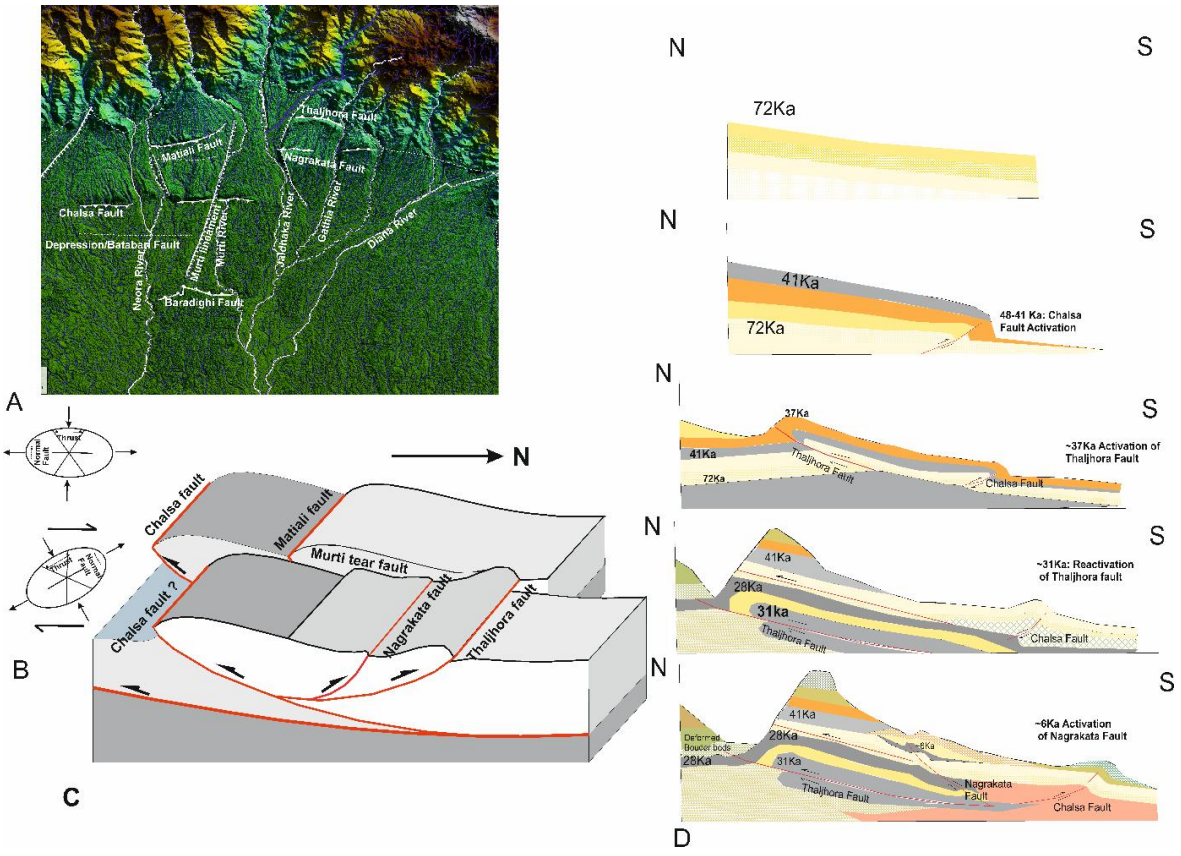

*Schematic representation of the regional geodynamic evolution and tectono-thermal development of the İspir–Ulutaş porphyry system. The principal geodynamic phases from the Late Jurassic to the present (Early Miocene–Present) are shown, including subduction of the northern branch of the Neotethys, opening of the eastern Black Sea basin, continental collisions, and post-collisional development in the Eastern Pontides. The illustration depicts the tectono-thermal evolution of the İspir–Ulutaş porphyry system and its relationship to regional uplift, exhumation, burial and preservation of the deposit.*

### 3) Fault dynamics and palaeoseismic evidence of earthquakes in the Darjeeling–Sikkim Himalayan foothills: a study of fault-controlled landscapes

**Abstract:**
The dynamic interaction of regional thrusts, backthrusts and transverse faults that accommodate deformation was quantitatively explained for the first time on the basis of palaeoseismological and geomorphological studies along the foothills of the Bhutan Himalaya. Radiocarbon and OSL data confirm significant uplift along backthrusts approximately between ~31,000 and ~28,000 cal BP, around ~21,000 cal BP, and approximately ~9,000 cal BP. The studies also confirm seismic activity in the Late Pleistocene, with at least two major earthquakes (Mw 6–7) affecting both fault movements and landscape evolution.

**Publication:**
Goswami Chakrabarti C., Štěpančíková P., Singh A., Jaiswal M.K., Jana P. (2025). Fault dynamics and paleoseismic evidence in the Darjeeling-Sikkim Himalayan foothills: A study of fault-controlled landscapes. *Geomorphology* 482, 109802. https://doi.org/10.1016/j.geomorph.2025.109802

**Illustration for the output:**




*The figure illustrates the direction of strain accommodation and the formation of different fault types over time. It shows the fault network in the study area and a block diagram illustrating the direction of deformation accommodation and the development of different fault types.*
*A. Study area with the fault network displayed on a digital elevation model.*
*B. Strain ellipsoid illustrating the stress configuration.*
*C. Block diagram illustrating the formation of different fault types in the study area.*
*D. Sequence of events in the study area derived from interpretation of the data.*

**Other outputs:**

Aksu B., Uzel B., Kaymakci N. (2025). 3D structural controls of a high-enthalpy geothermal field in an extensional setting: the Kizildere geothermal field (Western Türkiye). *Geothermal Energy* 13(1), 28. https://doi.org/10.1186/s40517-025-00361-6

Dessacka A.K., Fotso-Nguemo T.C., Tall M., Yepdo Z.D., Chouto S., Dikwa B.D., Komelo C.K., Nonki R.M., Diallo I., Diedhiou A., Monkam D., Sana H. (2025). Potential Impact of Increased Global Warming on the Hydroclimatology of Central Africa during the twenty-first Century. *Earth Systems and Environment* 9, 3665–3681. https://doi.org/10.1007/s41748-025-00710-2

Hartvich F., Duszyński F., Tábořík P., Jancewicz K., Adamovič J., Bartz W. (2025). Rockfall in orthogonally jointed sandstone: a multi-instrumental study of a pillar collapse. *Bulletin of Engineering Geology and the Environment* 84, 513. https://doi.org/10.1007/s10064-025-04526-2

Kaiser K., Kasprzak M., Adameková K., Błaś M., de Boer A.-M., Derner K., Duma P., Kočár P., Latocha-Wites A., Opała-Owczarek M., Owczarek P., Petr L., Petřík J., Tábořík P., van der Maaten E., van der Maaten-Theunissen M. (2025). Deciphering Sudetic landscape history by using alluvial geoarchives: Holocene environmental changes at Hala Izerska, SW Poland. CATENA 254, 108943. https://doi.org/10.1016/j.catena.2025.108943

Kašing M., Jirásek J., Matýsek D., Valenta J., Rapprich V., Tábořík P., Pek T. (2025). Almost eroded but still there: Oldest diatreme volcanoes of pre-Quaternary age in the eastern Bohemian Massif, Czechia. *Geomorphology* 475, 109668. https://doi.org/10.1016/j.geomorph.2025.109668

Stercz M., Grega D., Petro L., Hók J., Németh Z., Bednarik M., Stemberk J. jr. (2025). 3D long-term monitoring of recent tectonic activity in the Branisko Tunnel (Eastern Slovakia). *Geologica Carpathica* 76 (1), p.55-67. https://doi.org/10.31577/GeolCarp.2025.04

Štěpančíková P., Stemberk J., Tábořík P., Fischer T., Findžová L., Valenta J. (2025). Discovering the Čirá-Kopanina Fault: Bridging the Gap Between Surface Evidence and Seismic Activity. *Litosphere 2024* (Special 15), 192, 24. https://doi.org/10.2113/2024/lithosphere_2024_192

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**Department of Seismotectonics** focused on the study of earthquakes in relation to the dynamics and tectonic evolution of structures in the Earth's crust, particularly its upper part. At the same time, it continued to develop new methods for evaluating seismic and other geophysical measurements, including the design and use of specialised instruments. The Department participated in seismic experiments focused on major seismically active regions, including the Vrancea region in Romania, the Reykjanes Peninsula in Iceland, and the East African Rift in Ethiopia. Seismic phenomena were also investigated through national and international projects based on monitoring networks. Monitoring systems operated in several countries and were integrated into international seismic networks, including REYKJANET, MKNET, the Czech Regional Seismic Network, EBAR, SEN, ELISE and AdriaArray. The Department also contributed to research on seismic phenomena on Mars and

assessed opportunities for the use of geothermal energy. Particular attention was paid to determining seismic hazard in Czechia, with a focus on the sites of existing and planned nuclear power plants. The Department participated in international research on seismic phenomena through the following **monitoring networks**:

– Network name: **REYKJANET**
Monitoring target: earthquakes in Iceland. Operators: Institute of Geophysics of the Czech Academy of Sciences, public research institution, and IRSM (CzechGeo/EPOS programme).
Scope: detailed long-term international research in a seismically active region of Iceland.

– Network name: **MKNET**
Monitoring target: earthquakes in the Little Carpathians. Operators: IRSM; Earth Science Institute of the Slovak Academy of Sciences; Centre for Science and Research, s.r.o. (CzechGeo/EPOS programme). Scope: detailed investigation of a seismically active region, with continuous data recording and evaluation.

– Network name: **Czech Regional Seismic Network**
Monitoring target: earthquakes in Czechia and worldwide. Operators: Institute of Geophysics of the Czech Academy of Sciences; IRSM; Institute of Geonics of the Czech Academy of Sciences; Faculty of Mathematics and Physics, Charles University; and Masaryk University in Brno (CzechGeo/EPOS programme).
Scope: the Department of Seismotectonics operates four seismic stations. The network serves as core scientific infrastructure for extensive earthquake research.

– Network name: **EBAR Monitoring Network**
Monitoring target: earthquakes in eastern Bohemia.
Operator: IRSM.
Scope: detailed long-term research in a seismically active region that represents a significant source of seismic hazard in eastern Bohemia.

**Significant outputs:**

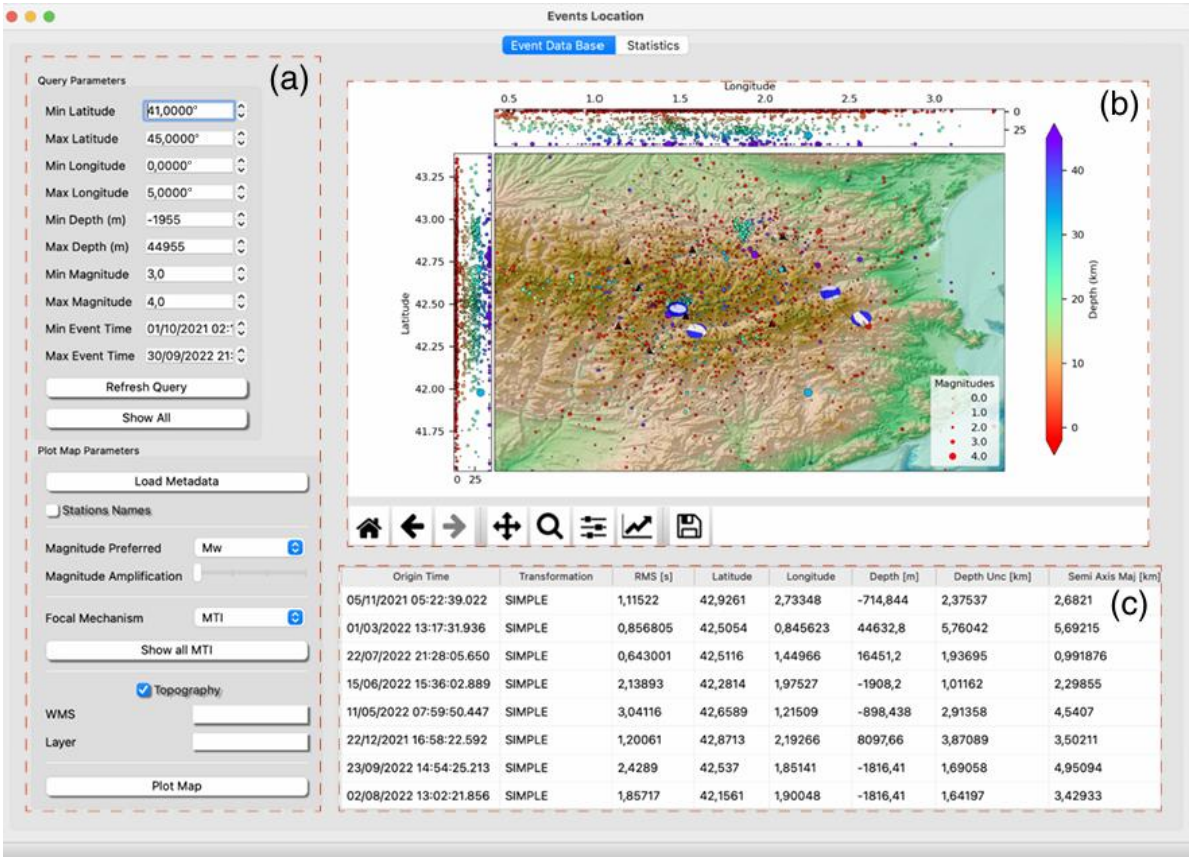
**1) A new Python toolbox for seismic-source analysis**

**Abstract:**
To improve the efficiency of estimating seismic-source parameters, a new software package, surfQuake, was developed. Its comprehensive toolkit automates the picking of seismic-wave arrival times, event association and location, moment magnitude determination from P-wave or S-wave displacement spectra, and moment-tensor inversion within a Bayesian framework, for which the Department of Seismotectonics was responsible. surfQuake is programmed in Python 3 and offers users three levels of programming for flexibility and customisation.

**Publication:**
R. Cabieces, T. C. Junqueira, K. Harris, J. Relinque, C. Satriano, J. Vackář (2025). surfQuake: A new Python toolbox for the workflow process of seismic sources. *Seismol. Res. Letters* 96(4). https://doi.org/10.1785/0220240186

**Illustration for the output:**





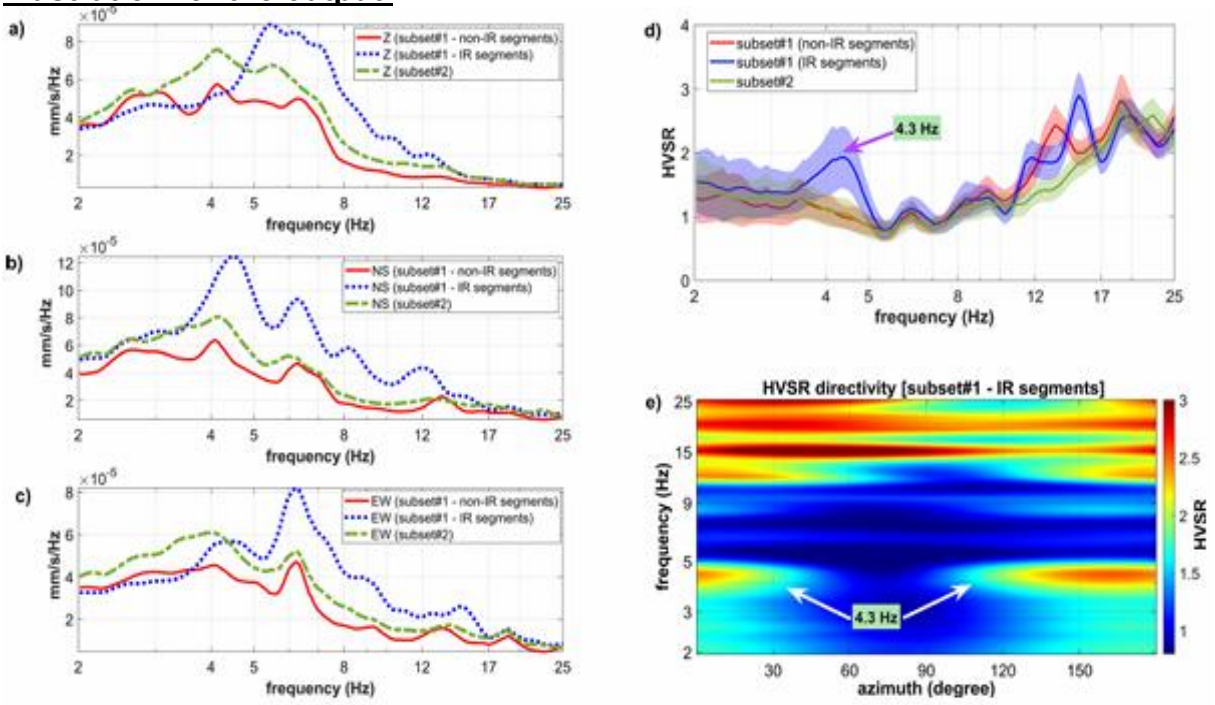

*Example of the surfQuake software. Database system: (a) query parameterisation and database mapping; (b) database map showing the hypocentre in close-up view, seismic stations and web map services (WMS) as available layers. Focal mechanisms can also be plotted in this widget; (c) phase-information table showing the hypocentre source parameters and their associated uncertainties.*

## 2) Possible effects of industrial components on miniature-array analysis of microtremors and the horizontal-to-vertical spectral ratio

**Abstract:**
Surface-wave analysis can be performed using various techniques selected according to site conditions and research objectives. Miniature Array Analysis of Microtremors (MAAM) derives Rayleigh-wave dispersion from passive vertical-component data over a broad frequency range, but is sensitive to industrial noise. Comparison with ESAC and time-lapse analyses shows that non-monochromatic industrial noise can significantly distort both MAAM dispersion curves and HVSR, highlighting the need for coherence and noise assessment during processing.

**Publication:**
Dal Moro, G. (2025). Possible Effects of Industrial Components on the Miniature Array Analysis of Microtremors and Horizontal-to-Vertical Spectral Ratio (with Some Notes on Their Joint Inversion). *Pure and Applied Geophysics* 182, 3569–3590. https://doi.org/10.1007/s00024-025-03736-9

**Illustration for the output**:



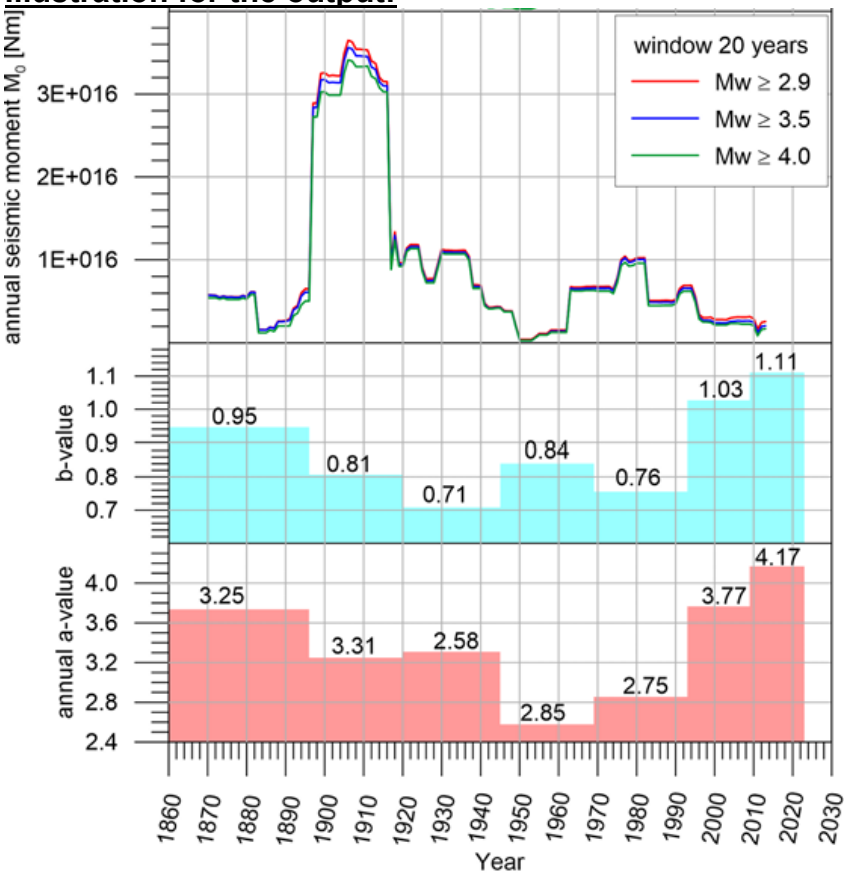

*Example of a case study involving microtremor measurement and analysis: (a) amplitude spectra for the vertical (Z) component; (b) amplitude spectra for the NS component; (c) amplitude spectra for the EW component; (d) HVSR curves (mean curve with standard deviations); (e) HVSR directionality for an industrial-noise segment.*

### 3) Increased seismicity in the early twentieth century in Czechia and neighbouring areas of Central Europe

**Abstract:**
Although Czechia shows only moderate seismic activity, reliable seismic-risk assessment is essential because of its dense settlement and critical infrastructure. Analysis of a new earthquake catalogue for 1860–2023 shows a marked increase in seismic activity between 1896 and 1910, after which no similarly strong events occurred. This finding has important implications for seismic-hazard assessment methods. Changes in seismicity and in the catalogue b-value between 1860 and 2023 were evaluated and clearly illustrated graphically (see illustration for the output). The graphs convincingly show that, between 1896 and 1919, the seismicity rate in the intraplate region of Czechia and neighbouring areas of Central Europe was significantly higher than in other decades.

**Publication**:
Lukešová, R., Fojtíková, L., Vackář, J. and J. Málek (2025). Increased seismicity at the beginning of the twentieth century in the intraplate region of Czechia and neighboring areas in Central Europe. *Environmental Earth Sciences* 84:102, https://doi.org/10.1007/s12665-025-12091-w

**Illustration for the output:**




*Changes in seismicity and in the catalogue b-value between 1860 and 2023. The graphs demonstrate that, between 1896 and 1919, the seismicity rate in the intraplate region of Czechia and neighbouring areas of Central Europe was significantly higher than in other decades.*

**Other outputs:**

F. Borleanu, L. Petrescu, C. Neagoe, H. Kampfová Exnerová, M. Diaconescu, R. Lukešová, Chr. Schiffer, H. Silvennoinen, L. Vecsey, C. Ionescu, L. Fojtíková, T. Vuorinen, O. Jianu, J. Plomerová, T. Nagel, T. Tiira, M. Mihalache, P. Jedlička, M. Anghel, D. Ionescu, M. Toanca, J. Kotek, A. Dragomir, P. Kolínský, the AdriaArray Seismology Group (2025). The AdriaArray Temporary Broadband Network in Romania: Enhancing Seismic Monitoring and Data Quality. *Annals of Geopysics* 68, https://doi:10.4401/ag-9318

Saadalla, H., Qaysi, S., Mohamed, A., Fojtikova, L., Abu-Nadr, E., Adly, A., Ezzalarab, M. (2025). Low stress drop and strike-slip detachment faulting: insights from a new earthquake sequence in the El-Nuqra Region, Southeastern Desert, Egypt. *Model. Earth Syst. Environ.* 11, 73. https://doi.org/10.1007/s40808-024-02255-1

P. Filip, M. Revallo, L. Fojtíková (2025). Vorticity-induced magnetization of paramagnetic fluids in Taylor–Couette flow, *Journal of Magnetism and Magnetic Materials* 627, 173062. https://doi.org/10.1016/j.jmmm.2025.173062

M. Kašing, J. Jirásek, D. Matýsek, J. Valenta, V. Rapprich, P. Tábořík, T. Pech (2025). Almost eroded but still there: Oldest diatreme volcanoes of pre-Quaternary age in the eastern Bohemian Massif, Czechia. *Geomorphology* 475, 109668, https://doi.org/10.1016/j.geomorph.2025.109668

Malytskyy D., Fojtikova L., Malek J., Astashkina O., Gnyp A., Dobushovskyy M., Pak R., Melnyk M., Nikulins V. & Ignatyshyn V. (2025). Seismic moment tensor and focal mechanism for earthquake of February 22, 2024 in eastern Slovakia (12:54:15 UTC, 21.75E°E, 49.03°N, depth 9 km, ML3.0). *Geofizicheskiy Zhurnal* 47(2), 110–115. https://doi.org/10.24028/gj.v47i2.322470

Málek, J., J. Brokešová (2025). Patent No. CZ 310515 B6, Measuring Device for the Simultaneous Measurement of Rotational and Translational Movements of a Body. Industrial Property Office, 2025.

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**Department of Geochemistry** focused on the study of organically rich materials, including systematic characterisation of fossil samples, identification of significant biological sources, reconstruction of accumulation conditions, coalification, maturation and weathering in sedimentary environments. Geochemical approaches are also used by the Department in the study of non-geological problems, namely in long-term research into the relationship between resins of modern and fossil conifers.

The properties of waste materials as sorbents, the properties of natural and synthesised carbonaceous materials as filters, and contaminants associated with coal mining were also investigated. Following on from research in previous years, granitic rocks, tektites, pumice and amphiboles were studied.

In addition to teaching at Charles University, Department staff contributed to secondary-school education, practical activities (see point 5), international cooperation with Kyushu University and the University of Strathclyde, and work within the International Committee for Coal and Organic Petrology. They also engaged in science communication during the Open Days event held as part of the Czech Academy of Sciences Week.

**Significant outputs:**

**1) Acetone adsorption on hierarchically porous carbon foams: the effect of nitrogen doping and oxygen functional groups**

**Abstract:**

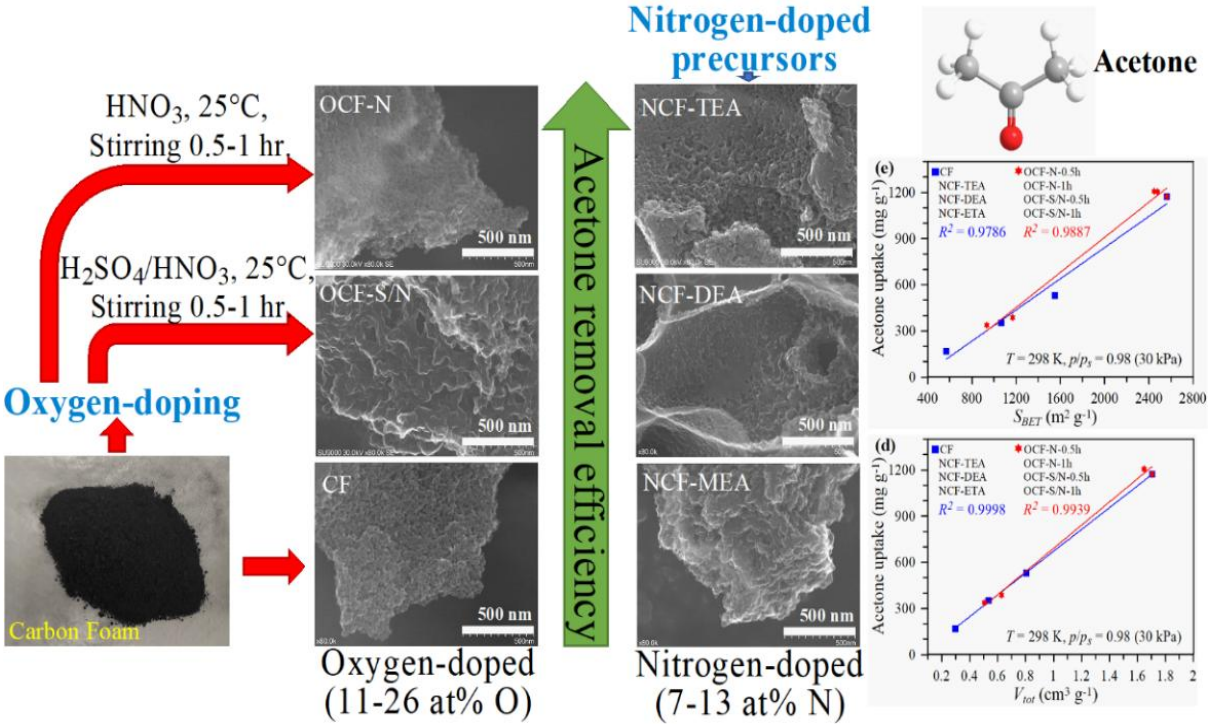
Carbon foams with an exceptionally high specific surface area and tunable nitrogen and oxygen surface functional groups were synthesised for efficient acetone-vapour adsorption. Mild oxygen doping was found to preserve microporosity, resulting in exceptional acetone sorption capacity, higher $N_2$/acetone selectivity and excellent regeneration stability compared with undoped carbon foam. By contrast, aggressive oxidation and high nitrogen doping substantially reduced both porosity and acetone adsorption capacity.

**Publication:**

M. Vorokhta, M.I.M. Kusdhany, M. Vorochta, M. Švábová, M. Nishihara, K. Sasaki, S.M. Lyth (2025). Acetone adsorption on hierarchically porous carbon foams: Effect of

nitrogen doping and oxygen functional groups. *Chemical Engineering Journal* 521, 166784. https://doi.org/10.1016/j.cej.2025.166784

**Illustration for the output:**




*Carbon foams doped with oxygen and nitrogen units for enhanced acetone-vapour adsorption. The figure shows how the morphology of the carbon foam changes when doped with oxygen and nitrogen units, and how these structural modifications affect its porosity and subsequent adsorption of acetone vapour.*

**2) Thermally induced degradation of Westerly granite microstructure documented by dynamic elastic properties and pore space and damage characteristics.**

**Abstract:**

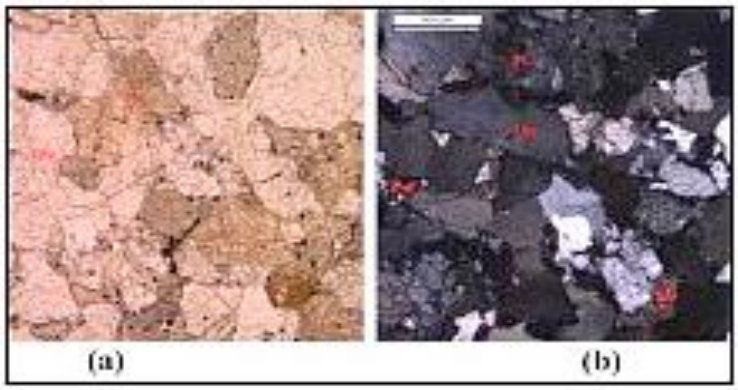
Rock damage was assessed using 52 samples of Westerly granite heated to 100–800 °C. Ultrasonic tests, petrographic observations and petrological assessments were carried out, together with porosimetric measurements. It was found that, under thermal loading, the dynamic elastic properties of the samples decreased markedly, while porosity increased exponentially, especially above the quartz phase transition. Microscopic observations also revealed crushed minerals in microcracks at temperatures of 650–800 °C, which substantially affected porosity. The microscopic observations and the above measurements showed that, when assessing rock damage, it is necessary to combine several methods and compare the results.

**Publication:**

D. Řimnáčová, V. Natherová, T. Lokajíček, M. Metružálek, A. Aminzadeh, M. Racek, R. Přikryl (2025). Thermally induced degradation of Westerly granite microstructure

documented by dynamic elastic properties and pore space and damage characteristics. *Bulletin of Engineering Geology and the Environment* 83 (12), 518. https://doi.org/10.1007/s10064-024-04011-2

**Illustration for the output:**




*Evolution of rock damage and degradation of its micromechanical properties as a result of thermal loading.*

**Other outputs:**

Strunga, V. Havránek, J. Lorinčík, K. Sihelská, P. Krist, Martina Havelcová, B. Čejková, J. Mizera (2025). Radiation-enhanced fluid diffusion and alteration around uraniferous inclusions in Cenomanian resinite from North Bohemia. *Chemical Geology* 673, 122554. https://doi.org/10.1016/j.chemgeo.2024.122554

V. Suchý, K. Pachnerová Brabcová, J. Zachariáš, I. Světlík, Q. Luo, J. Wu, L. Borecká (2025). Bridging the gap: Anatomy of recently growing calcareous crusts in the Bohemian Karst (Czech Republic). *Sedimentary Geology* 477, 106821. https://doi.org/10.1016/j.sedgeo.2025.106821

A. Malhocká, M. Švábová, T. Suchý (2025). Chemotaxonomy according to leaf terpenes of eight cypress species growing in the Czech Republic in the light of modern phylogenetic classification. *Biochemical Systematics and Ecology* 120, 104980. https://doi.org/10.1016/j.bse.2025.104980

Švábová, M., Šváb, M., Vorokhta, M., Pohořelý, M. (2025). Evaluation of micropollutant removal from artificially recharged water using activated carbon. *J. Hazard. Mater.* 494, 138504. https://doi.org/10.1016/j.jhazmat.2025.138504

J. Mizera, O. Bakhmachuk, V. Strunga, V. Procházka (2025). Clues on the Australasian impact crater site inferred from detailed mineralogical study of a monazite inclusion in a Muong Nong tektite. *Geology* 53, e582. https://doi.org/10.1130/G53049C.1

Nádaskay, R., Opluštil, S., Martínek, K., Šimůnek, Z., Zajíc, J., Drábková, J., Podzimková, P., Sýkorová, I. (2025). Climatically-driven cessation of coal formation in tropical Pangea around the Pennsylvanian-Permian boundary; an example from alluvial-lacustrine succession of the Líně Formation (Czechia). *International Journal of Coal Geology* 300, 1–31. https://doi.org/10.1016/j.coal.2025.104694

Issa M., Andrejkovičová S., Zribi M., Daniela Řimnáčová, Oliveira M. S. A., Pálková H., Rocha F., Baklouti S. (2025). Development of Compacted Alkali Activated Materials based on Phosphate Waste Washing Sludge and Natural Clay. *Construction and Building Materials* 494, 143403. https://doi.org/10.1016/j.conbuildmat.2025.143403

Lokajíček T., Přikryl R., Racek; Daniela Řimnáčová, Petružálek M., Svitek T., Aminzadeh A. Natherova V. (2025). Influence of Thermal Loading on Microcrack Evolution and Elastic Anisotropy in Westerly Granite. *Rock Mechanics and Rock Engineering* 59(2), 2667–2691. https://doi:10.1007/s00603-025-04939-1

A. Malhocká, M. Švábová (2025). Inter and intraspecies variability of terpene profiles of four spruce species growing in the Czech Republic: a chemotaxonomic study. *Biochemical Systematics and Ecology* 123, 105095. https://doi.org/10.1016/j.bse.2025.105095

Daniela Řimnáčová, Perná I., Novotná M., Šupová M., Nováková M., Bičáková O. (2025). Activated Carbon–Geopolymer Composites: Influence of Particle Size and Content on CO2 Adsorption and Mechanical and Thermal Properties. *Crystals* 15, 892. https://doi.org/10.3390/cryst15100892

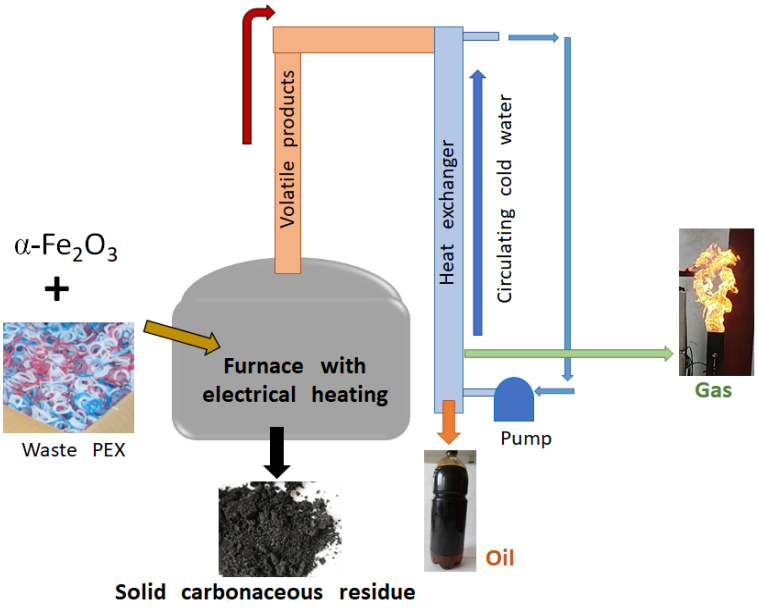
K. Holcová, M. Havelcová, S. Shaikh, M. Chroustová, K. Šarinová, F. Scheiner, P. Kraft, I. Sýkorová, R. Milovský (2025). Early Pleistocene fossil seagrass assemblages on Rhodes Island – a proof of allochthonous origin. *Continental Shelf Research* 105594. https://doi.org/10.1016/j.csr.2025.105594

René M. (2025). Introduction chapter: Ore Geology–Significant part of geosciences. – *In:* René M. (ed.) Ore Geology, IntechOpen, London, 1–6.

René M. (2025). Alteration of durbachites and U-Th mineralization in the durbachites of the Třebíč pluton, Czech Republic. *In:* René M. (ed.) Ore Geology, IntechOpen, London,115–129.

Materials and technological disciplines were pursued in **the Department of Composite and Carbon Materials and the Department of Material Structure and Properties**.

From the work of the materials- and technology-oriented departments (illustrative figure):




*Technological scheme for processing waste cross-linked polyethylene (PEX). The processing products are oils for further use, solid carbonaceous material for the production of sorbents, and energy gas for heating the processing unit.*

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**Department of Composite and Carbon Materials**: scientific activities focused primarily on studying the properties of collagen materials intended for use in medicine and the food industry, as well as on developing a biomimetic vascular graft for low-flow applications, developing an antibacterial barrier for human joint replacements, studying degradable magnesium materials, and characterising the climatic resistance and fire safety of composites with a partially pyrolysed polysiloxane matrix.

In 2025, particular attention was devoted to a project focused on developing a biomimetic vascular graft for low-flow applications that enables physiological pulse-wave transmission (AZV MZČR NW24-02-00206). The graft is a sandwich composite combining extruded collagen with a polyester knitted scaffold and respecting the structure of a native blood vessel. Our research activities focused on isolating collagen from fish skin (African sharptooth catfish), its detailed characterisation, and setting cross-linking conditions using a monoenergetic beam of accelerated electrons. We further studied the effects of this type of physical cross-linking within a study of the influence of different ionising-radiation parameters on the physicochemical properties of collagen gels at different concentrations. The results of this study were published in the prestigious International Journal of Biological Macromolecules. Further activities continued the development of technology for coating magnesium wires and degradable polymers used as surgical suture materials with degradable polymers and optimising their degradation time. Another area involved verifying the technology for processing collagen dispersion for impregnating the porous surfaces of implant anchoring parts, within the OP TAK project Antibacterial barrier for human joint replacements (CZ.01.01.01/01/22_002/0000934), as part of contract research with ProSpon s.r.o. Further activities in the field of biopolymers focused on the use of collagen in additive technologies, the influence of artificially induced osteoporosis on the physicochemical properties of collagen, and experimental investigation of the mechanical and structural properties of nanofibrous threads.

In the field of special composite materials, work focused primarily on the climatic resistance and fire safety of composites with a partially pyrolysed polysiloxane matrix reinforced with basalt fibres. This project evaluates frost resistance during long-term cyclic freezing, especially changes in mechanical properties. The study also included testing the flammability, or fire resistance, of the composites under development.

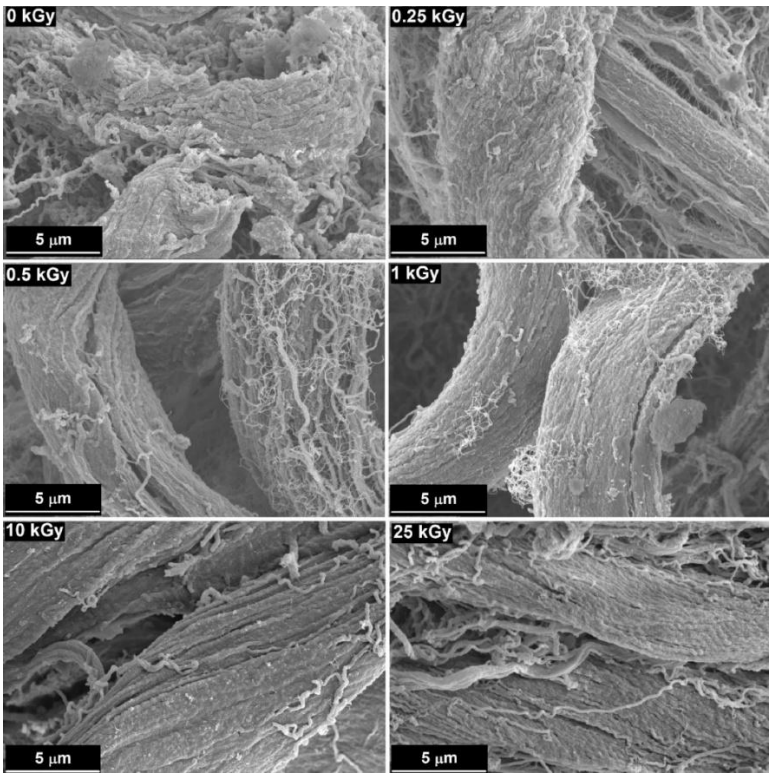
**Significant outputs:**

**1) Interaction of electron radiation with collagen gels: the role of dose and water content**

**Abstract:**
The study evaluated the effects of beta radiation (0.25–25 kGy) on bovine collagen hydrogels at a concentration of 3 wt.% and compared them with earlier results for gels with a higher concentration of 7 wt.%. The aim was to determine changes in collagen structure and their relationship to mechanical and rheological properties. Irradiation was found to induce both degradation and cross-linking of collagen, with the extent of both phenomena increasing with radiation dose. This was reflected in a reduction in the proportion of triple-helical structure and, conversely, an increase in cross-link density, which improved the material's mechanical parameters. However, the collagen structure was preserved even at a dose of 25 kGy. Collagen concentration significantly affects the resulting effect: 7 wt.% gels showed markedly higher cross-link density, whereas 3 wt.% gels were more susceptible to enzymatic degradation and swelling. At the level of higher-order structures, no significant differences were found between irradiated and non-irradiated samples. The study confirms that the high water content (97 wt.%) substantially affects the effect of electron radiation and makes it possible to observe changes even at low doses. The findings can be used to optimise sterilisation and modification procedures for collagen biomaterials.

**Publication:**
M. Šupová, T. Suchý, M. Vopálková, P. Novotná, M. Šulc, Z. Hrdlička, M. Houška (2025). The electron beam irradiation of type I bovine collagen gels: Insights into radiation dose and water content impacts on the composition and the structural, rheological, thermal and mechanical properties. *International Journal of Biological Macromolecules* 320, 146099. https://doi.org/10.1016/j.ijbiomac.2025.146099

**Illustration for the output:**



*SEM images of collagen gels before and after irradiation with doses of 0.25–25 kGy. Bundles of collagen* fibrils, typical of collagen isolates, are visible in all samples. The internal structure of the gels appears relatively heterogeneous. Compared with non-irradiated gels, no significant qualitative changes in fibril arrangement or configuration over longer distances were observed after irradiation. However, other analytical methods demonstrated substantial changes in collagen degradation and cross-linking induced by irradiation, which were strongly reflected in changes in the mechanical and rheological properties of the gels.

**2) A significant output was the patent: K. Tesař, K. Balík: Method for the Surface Treatment of Magnesium-Alloy-Based Material. Czech Patent CZ 310 283, Industrial Property Office, 2025. See p. 9.**

**Other outputs:**

J. Štípek, H. Rohm, T. Suchý, M. Šupová, R. Žitný, J. Skočilas, M. Žaloudková, M. Houška (2025). Characterization of structural properties and non-linear rheological behavior of collagen over a wide range of mass fractions under LAOS. *Polymer Engineering and Science* 65(6):3018–3028. https://doi.org/10.1002/pen.27195

L. Klecandová, A. Slíva, M. Šindler, M. Šupová, S. Kumar Sathish, J. Kupková, L. Hružík, K. Lafdi, K. Čech Barabaszová, G. Simha Martynková (2025). Effect of Processing on Structural and Morphological Changes of Hydroxyapatite-Based Materials. *ChemistrySelect* 10, e202405109, https://doi.org/10.1002/slct.202405109

Horný, L. Vištejnová, T. Suchý, E. Košťáková Kuželová, H. Chlup, J. Kronek, Z. Sobotka, Z. Petřivý, M. Žaloudková, K. Havlíčková, J. Moláček (2025). Degradation of the mechanical properties of poly-lactide-caprolactone-collagen composite for pulmonary artery banding after implantation into a rat's peritoneum. *Medical Engineering & Physics* 138, 104319. https://doi.org/10.1016/j.medengphy.2025.104319

Malhocká, M. Švábová, T. Suchý (2025). Chemotaxonomy according to leaf terpenes of eight cypress species growing in the Czech Republic in the light of modern phylogenetic classification. *Biochemical Systematics and Ecology* 120, 104980. https://doi.org/10.1016/j.bse.2025.104980

M. Šupová, Š. Rýglová, T. Suchý, M. Žaloudková, M. Braun (2025). The Impact of GAGs, Cross-Link Maturity and Telopeptides on the Formation of a Porcine Collagen-Based Hydrogel. *Gels* 11, 695. https://doi.org/10.3390/gels11090695

D. Řimnáčová, I. Perná, M. Novotná, M. Šupová, M. Nováková, O. Bičáková (2025). Activated Carbon–Geopolymer Composites: Influence of Particle Size and Content on $CO_2$ Adsorption and Mechanical and Thermal Properties. *Crystals* 15, 892. https://doi.org/10.3390/cryst15100892

M. Bujda, T. Suchý, V. Herynek, J. Dušková, M. Žaloudková, L. Šefc, K. Klíma, R. Plachý, R. Foltán (2025). In Vivo Degradation and Local Tissue Response of Experimental Carp Collagen Membranes: Micro-MRI and Histological Analysis. *Biopolymers* 116, e70045, https://doi.org/10.1002/bip.70045

**Department of Material Structure and Properties** focused, in the field of silicate chemistry and technology, both on technological issues of glass production, the disposal of radioactive waste by glass vitrification and the development of infrared-transparent glasses for technical applications, and on geopolymer materials. In the field of geopolymers, several years of cooperation with restorers on the repair of damaged tiles using specially developed geopolymer mixtures was successfully completed; these mixtures were applied in the Church of St John of Nepomuk at Zelená hora in Žďár nad Sázavou (a UNESCO World Heritage Site). Research, preparation and testing of the special mixtures, as well as their direct application, demonstrated the good practical usability of geopolymers.

The textural properties of biochars from different types of waste biomass and their use both as biofuels and as sorbents for pollutants were also studied, together with the conversion of organic waste materials by thermal processes. The technological feasibility of processing various types of waste lignocellulosic biomass under energy-saving conditions by slow catalysed pyrolysis was verified. Catalysed pyrolysis at atmospheric pressure followed by $CO_2$ sequestration produced synthesis gas with a variable $H_2$/CO ratio of 0.5–5, providing broad possibilities for applications in chemical production. The pyrolysis by-products, biochar and bio-oils, also have high utilisation potential. The effect of slow catalytic pyrolysis was also tested in the decomposition of waste cross-linked polyethylene, achieving a high yield of liquid hydrocarbons (up to 92 wt.%), suitable as lubricants, fuels or chemical raw materials. The method was tested on an industrial scale and is a promising solution for processing problematic waste.

**Significant outputs:**

**1) Increasing Tc retention during nuclear waste vitrification: effect of alumina source on the rate of rhenium incorporation into glass**

**Abstract:**
Technetium is a key and simulatable element for improving the efficiency of the vitrification process and minimising the long-term costs associated with nuclear-waste management. The use of boehmite—one of the Al sources, which forms nanocrystalline alumina polymorphs when heated—leads to up to 25% higher retention of the simulant element. Using X-ray diffraction and deionised-water leaching tests on heat-treated feed samples, we analysed the composition of the soluble oxyanion salt phase and the insoluble glass-forming phase as a function of temperature and evaluated the rate of incorporation of the element into the developing transient alkali alumino-borosilicate melt. Formation of nanocrystalline alumina in the boehmite-containing feed occurred at temperatures approximately 100 °C lower than in the gibbsite-containing feed, accelerating reactions between alumina, oxyanion salts and the borosilicate melt; this explains the increased retention of the simulant element, and thus technetium, in boehmite-containing feeds.

**Publication:**
Löwy L., Eret M., Kloužek J., Cincibusová P., Vernerová P., Kohoutková M., George J., Killmer M., Ferkl P., Hrma P., Kruger A.A., Pokorný R. (2025): Increasing Tc Retention during Nuclear Waste Vitrification: Effect of Alumina Source on the Rate of Rhenium Incorporation into Glass. *Journal of Nuclear Materials* 660, 155916. https://doi.org/10.1016/j.jnucmat.2025.155916

## 2) Thermo-rheological snapshot of melter-feed conversion to glass

**Abstract:**
The viscosity of high-level radioactive waste with a high alumina content was evaluated by thermomechanical analysis, a high-temperature viscometer and hot-stage microscopy, with viscosity estimates ranging from approximately $10^{7.5}$ Pa·s at 550 °C to approximately $10^{2.5}$ Pa·s at 1050 °C. As the temperature of the feed materials increased, their state changed from a rigid solid to a dilatant liquid, then to a pseudoplastic bubbly liquid containing dissolving solids, to fully developed foam and, finally, to a Newtonian glass melt.

**Publication:**
Younk S., George J., Luksic S., Marcial J., Cutforth D., Hrma P., Ferkl P., Kruger A., Pokorný R.: Thermo-rheological snapshot of melter feed conversion to glass. *Journal of the American Ceramic Society* 108, e20208 (2025).

**Other outputs:**

Podor R., Lautru J., Pokorný R., Nabyl Z., Schuller S. (2025). High Temperature Environmental Scanning Electron Microscopy Characterization of Transient Phase Formation During Conversion of Simulated Nuclear Waste Feed to Glass. *Materials Letters* 379, 137619. https://doi.org/10.1016/j.matlet.2024.137619

Sauvage E., Schuller S., Nabyl Z., Podor R., Lautru J., Benigni P., Kloužek J., Mure S., Benavent V. (2025). Liquid feed vitrification of high-level nuclear waste: Description and modeling of chemical reactions. *Journal of Nuclear Materials* 60, 155688. https://doi.org/10.1016/j.jnucmat.2025.155688

Pezl R., Kloužek J., Vernerová M., Cincibusová P., Msallamová Š., Jin T., Ferkl P., Hrma P., Guillen D., Kruger A., Pokorný R. (2025). Dynamic and static corrosion of chromium-alumina refraktory in simulated nuclear waste glass. Ceramics International 51, 60583–60591. https://doi.org/10.1016/j.ceramint.2025.10.255

Perná I., Novotná M., Hanzlíček T., Rafl J., Nováková M. (2025). The application of geopolymers in the renovation of the historical ceramic tiles in the pilgrimage church of St. John of Nepomuk (Czech Republic). *Case Studies in Construction Materials* 22, e04161. https://doi.org/10.1016/j.cscm.2024.e04161

Řimnáčová D., Perná I., Novotná M., Šupová M., Nováková M., Bičáková O. (2025). Activated Carbon–Geopolymer Composites: Influence of Particle Size and Content on $CO_2$ Adsorption and Mechanical and Thermal Properties. *Crystals* 15, 892. https://doi.org/10.3390/cryst15100892

Straka P., Cihlář J. (2025). Conversion of Biomass to Energy-Rich Gas by Catalyzed Pyrolysis in a Sealed Pressure Reactor. *Processes* 2025, 13(6), 1692. https://doi.org/10.3390/pr13061692

Straka P., Bičáková O., Cihlář J. (2025). Enhanced Recoverability and Recycling of Resistant Waste Crosslinked Polyethylene via $FeTiO_3$ Catalyst-Assisted Slow Pyrolysis. *Recycling* 10(6), 202. https://doi.org/10.3390/recycling10060202

Straka P., Cihlář J., Bičáková O. (2025): Production of Syngas and Hydrogen-Rich Gas from Lignocellulosic Biomass via $Ru/Al_2O_3$ Catalyst-Assisted Slow Pyrolysis. *Catalysts* 15(11), 1033. https://doi.org/10.3390/catal15111033

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All research departments promoted the results of their work through exhibitions, the Czech Academy of Sciences Week, the Science Fair, presentations and public lectures, educational events for secondary-school students, and meetings and cooperation with representatives of industrial organisations (see Section 7).

## 3. Major Research Projects Carried Out by the Research Departments in 2025

**Projects funded by the Czech Science Foundation (GAČR) and the Technology Agency of the Czech Republic (TAČR):**

- Comprehensive geophysical analysis of the ongoing volcanic eruption on the Reykjanes Peninsula, carried out in 2025–2030 (Czech Science Foundation).
- Tropical climate and vegetation response during the Late Palaeozoic Ice Age: an integrated study of spatial and temporal variability, carried out in 2025–2028 (Czech Science Foundation ).
- Patterns and trends of rock-slope instability explained by thermal effects in a temperate climate, carried out in 2025–2028 (Czech Science Foundation).
- Photoinduced phenomena in infrared-transparent glasses, carried out in 2025–2027 (Czech Science Foundation).
- Landslides in a changing climate: the effect of temperature on susceptibility and hazard in a temperate climate, carried out in 2024–2026 (Czech Science Foundation).
- Fossil submarine meadows — an overlooked Phanerozoic ecosystem: its contribution to shelf biodiversity and identification in the fossil record, carried out in 2023–2026 (Czech Science Foundation).
- Mapping seismic amplification in Czechia (MASAM), carried out in 2024–2026 (Technology Agency of the Czech Republic).
- Effects of fires and high temperatures on rock-mass stability, carried out in 2024–2026.
- Long-term reliable production of high-quality drinking water using activated carbon while respecting the circular-economy concept, carried out in 2024–2026 (Technology Agency of the Czech Republic).
- Rock environment and mineral resources, carried out in 2020–2026 (Technology Agency of the Czech Republic).

**Strategy AV21 projects**:

- Dynamic Planet Earth. Research programme: Cutting-edge research in the public interest. Carried out in 2023–2027.

- Circular economy in energy. Research programme: Sustainable energy. Carried out in 2022–2026.

**Projects funded by the Ministry of Education, Youth and Sports of the Czech Republic (MŠMT ČR) and the Ministry of Health of the Czech Republic (MZ ČR):**

- Experimental and mathematical analysis of primary glass-forming melt properties, gas evolution and their relation to primary foam production, carried out in 2023–2026 (Ministry of Education, Youth and Sports of the Czech Republic, Inter-Excellence II USA programme, No. LUAUS23062).
- Biomimetic vascular graft for low-flow applications enabling physiological pulse-wave transmission, carried out in 2024–2027 (Ministry of Health of the Czech Republic).
- Understanding prehistoric geological disasters in the Outer Western Carpathians using cosmogenic-radionuclide exposure dating, carried out in 2026–2027 (Ministry of Education, Youth and Sports of the Czech Republic).
- Natural and anthropogenic geohazards, carried out in 2024–2028 (Ministry of Education, Youth and Sports of the Czech Republic).

**Projects with foreign participation:**

- Looking into the past to understand the future: testing landslide-source-area morphometry as an indicator of coseismic origin, carried out in 2025–2027 in cooperation with the National Research Council of Italy.
- Understanding crustal evolution and active tectonics in interplate and intraplate settings: a comparative case study of the eastern Himalayas and western Bohemia, carried out in 2025–2026 in cooperation with the Council of Scientific and Industrial Research, India.
- Integration of 3D contactless positioning systems into a comprehensive geophysical monitoring network in Taiwan, carried out in 2025–2026 in cooperation with Academia Sinica, Taiwan.
- Monitoring and analysis of seismically active zones, focusing on the Hronov area in the Czech Republic and the Little Carpathians in Slovakia, carried out in 2025–2026 in cooperation with the Slovak Academy of Sciences.
- Searching for seismogenic-fault parameters using a combined methodology in slowly deforming terrains in Czechia and Bulgaria, carried out in 2025–2026 in cooperation with the Bulgarian Academy of Sciences.
- Changes in rock-mass properties after forest fires, carried out in 2024–2026 in cooperation with TÜBİTAK — the Scientific and Technological Research Council of Türkiye.

**International projects:**

See Section 6, International Cooperation, p. 37.

## 4. Cooperation with Universities

In delivering study programmes, IRSM staff taught 253 hours in bachelor's programmes and 186 hours in master's programmes in the summer semester; in the winter semester, they taught 293 hours in bachelor's programmes and 246 hours in master's programmes. Eight doctoral students were supervised at the Institute, including two from abroad. Institute staff taught in a number of study programmes and fields, particularly at Charles University (Faculty of Science, Faculty of Mathematics and Physics, and Faculty of Medicine in Plzeň), the Czech Technical University in Prague (Faculty of Mechanical Engineering and Faculty of Nuclear Sciences and Physical Engineering), the University of Chemistry and Technology, Prague (Faculty of Chemical Technology and Faculty of Environmental Technology), Masaryk University in Brno (Faculty of Science), Mendel University in Brno, the University of Ostrava (Faculty of Science), the University of South Bohemia in České Budějovice (Faculty of Education), and the University of New York.

The Institute has two joint workplaces with universities: one with the Faculty of Science of Charles University and one with the University of Chemistry and Technology, Prague. Institute staff served on five doctoral subject-area boards at the University of Chemistry and Technology, Prague, VSB – Technical University of Ostrava, and Charles University's Faculty of Science, and on two faculty scientific boards at the University of Chemistry and Technology, Prague.

The important Agreement on Mutual Cooperation in Implementing the Doctoral Study Programme Physics of the Earth and Planets, concluded with the Faculty of Mathematics and Physics of Charles University, continues to be implemented in both full-time and combined forms of study, as do the newly concluded agreements with the Faculty of Science of Charles University and the Faculty of Mechanical Engineering of the Czech Technical University in Prague.

## 5. Activities for Practice

**Contracts:**

1) Client: ÚJV Řež, a.s., Energoprojekt Praha division.

Contract: New nuclear source for SMRs in the Czech Republic, research on the Krušné Hory Fault, 2025.

Abstract: A partial report was prepared on the results of a joint survey by six research organisations, focused on evaluating the potential seismic activity of the Krušné Hory Fault and aimed at assessing the suitability of sites for small modular nuclear reactors (SMRs) by the ČEZ a.s. group.

Application: Assessment of site seismic safety.

2) Client: Anagold Madencilik Sanayı, mining company, Ticaret Anonim Şirketi, Madencilik, Türkiye.

Contract: Palaeoseismology of the Sabirli Fault (İliç, Erzincan Province, Eastern Anatolia, Türkiye).

Abstract: A final report was prepared presenting the results of a palaeoseismological survey of the Sabirli Fault, which passes through the Anagold gold mine near the town of İliç in the Erzincan region of Eastern Anatolia, Türkiye. The results are used to assess the fault's seismic potential and the recurrence interval of major earthquakes.

Application: Assessment of seismic hazard at the mining site.

3) Client: Sklopísek Střeleč, a.s.
Contract: Stability monitoring and assessment of the condition of the rock object in the village of Hrdoňovice – Újezd pod Troskami, Jičín District.
Abstract: Stability monitoring was carried out and the condition of the rock object in the village of Hrdoňovice was assessed. The results were submitted in the report by F. Hartvich et al.: Stability Monitoring and Assessment of the Condition of the Rock Object in the Village of Hrdoňovice, IRSM CAS, public research institution, Prague, 2025.
Application: Safety of rock objects.

4) Client: UJP Praha a.s.
Contract: Mercury porosimetry and wettability testing of surface layers of Zr alloys.
Abstract: Measurements of fuel-assembly cladding used in nuclear power plants were carried out using surface-chemistry methods. The measurements served to test the preservation and resistance of fuel-assembly cladding. In addition to a technical report, the results were also presented at the ČEZ Technical Seminar: D. Řimnáčová: Mercury Porosimetry and Wettability Testing of Surface Layers of Zr Alloys, ČEZ Technical Seminar, Prague, April 2025.
Application: Nuclear energy.

5) Client: Archaeological Institute of the Czech Academy of Sciences, public research institution.
Contract: Monitoring the stability of underground spaces beneath the Third Courtyard of the Prague Castle National Cultural Monument.
Abstract: Stability monitoring of underground spaces was carried out at Prague Castle. The results were presented to the client in the form of a technical report:
F. Hartvich: Monitoring the Stability of Underground Spaces at Prague Castle, IRSM CAS, public research institution, Prague, 2025.
Application: Safety of underground spaces.

6) Client: CTF Technology s.r.o., Plzeň.
Contract: Thermal processing of waste carbon composite and waste aircraft laminate.
Abstract: Waste composites were processed by slow low-temperature pyrolysis. The products obtained—pyrolysis gas and oil containing mainly phenols and liquid hydrocarbons—can be further utilised. The solid product retained its shape and can be reused in production.
Application: Recovery of difficult-to-process waste.

**Expert assessments:**

1) Client: Energoprůzkum s.r.o.
Scope: Monitoring movement activity on two selected dislocations in the Skalka adit in 2025. To assess the stability of the structure, two active fault structures in the adit were monitored with data recorded once per day and evaluated online. The results serve to formulate a strategy for adit stability.

2) Client: ČEZ a.s.
Scope: Consultation on preparations for the construction of the Dukovany II Nuclear Power Plant. Bids submitted by participants in the tender for construction of the Dukovany II Nuclear Power Plant were evaluated, and seismic-safety requirements were subsequently discussed with the tender winner.

3) Client: ČEZ Energetické produkty, s.r.o.
Scope: Determination of dynamic elastic moduli and estimation of borehole-core properties. P-wave and S-wave velocities were determined in borehole-core samples and dynamic elastic moduli were calculated. Mechanical direct-shear tests were also performed.

4) Client: Czech Geological Survey
Scope: Determination of the bulk density of gneiss. Bulk density was determined for 32 gneiss samples, and the results, together with an assessment, were submitted to the client.
5) Client: District Court in Ústí nad Labem
Scope: Determination of the extent of remediation measures and their usual cost as of 2 March 2021 for a rock mass located on land plots Nos 3688/2 and 148 in the cadastral area of Krupka. The expert opinion was submitted to the client.

Authorisation to perform expert-witness activities under Act No. 254/2019 Coll.

The workplace is registered in the list of experts for the expert field of GEOLOGY (Act No. 36/1967 Coll.).

## 6. International Cooperation

The Institute participated in four international projects and six projects with foreign participation, and cooperated under 11 bilateral scientific-cooperation agreements with foreign partners. It was intensively involved in scientific activities within international monitoring networks. Institute staff were active in eight international scientific organisations, in two cases holding official positions.

International projects:

- Mathematical Modeling and Experimental Evaluation of Melter Cold Cap for Nuclear Waste Vitrification. Battelle Energy Alliance, LLC, Idaho, USA, Contract No. 166789, 2016–2026.
- Radiolytical alteration of organic matter in coal and rocks enriched in radioactive minerals. International Committee for Coal and Organic Petrology, 2025.
- Natural Seismicity as a Prospecting and Monitoring Tool for Geothermal Energy Extraction. Iceland, Liechtenstein and Norway Grants (EEA Grants) and the Technology Agency of the Czech Republic, 2021–2025.
- European initiative AdriaArray: Understanding Active Deformation of the Adriatic Plate and its Margins, 2025.

Membership in international organisations with official positions:

1) Assoc. Prof. Ing. Jaroslav Kloužek, CSc.: International Commission on Glass, Technical Committee No. 18 – Glass melting. Vice-Chair, term of office: 2019–2025.

2) RNDr. Petra Štěpančíková, PhD: International Union for Quaternary Research, Commission on Terrestrial Processes, Deposits and History. Vice-President, term of office: 2023–2027.

Bilateral cooperation with foreign partners:

1) Institute of Geophysics Polish Academy of Sciences (Instytut Geofizyki Polskiej Akademii Nauk)
   Topic of cooperation: Research into tectonic movements and slope deformations in the Svalbard archipelago.
2) University of Wrocław (Uniwersytet Wroclawski)
   Topic of cooperation: Research into structural-geological conditions and the structure of the Broumov Highlands / Góry Stołowe table mountains, Arctic research and permafrost research.
3) Natural History Museum Vienna (Naturhistorisches Museum Wien)
   Topic of cooperation: Research into active tectonics in caves of the Eastern Alps.
4) Johannes Gutenberg University Mainz (Johannes-Guttenberg Universität Mainz)
   Topic of cooperation: Radiometric dating of active tectonics in karst caves.
5) University of Memphis
   Topic of cooperation: Research into local seismicity.
6) University of Wrocław - Faculty of Earth Sciences and Environmental Management (Uniwersytet Wroclawski – Wydzial Nauk o Ziemi i Ksztaltowania Srodowiska).
   Agreement of co-operation: Joint research projects concerning research fields stated in the agreement; Exchange of academic staff and students; Joint publications and exchange of scientific and didactic materials; Organisation of joint scientific conferences and workshops.
7) Polish Geological Survey (Państwowy Instytut Geologiczny).
   Topic of cooperation: Monitoring tectonic movements in Niedźwiedzia Cave.
8) Chelungpu Fault Preservation Park (Zhushan), National Central University - NCU (Tayouan), Taiwan
   Topic of cooperation: 3D measurement of the microkinematics of the seismogenic Chelungpu Fault.
9) Agency of Rural Development and Soil and Water Conservation, MOA – ARDSWC (Nantou), Taiwan.
   Topic of cooperation: Monitoring deep-seated landslides triggered by extreme rainfall.
10) University of Savoie Mont Blanc, Institute of Earth Sciences (Université Savoie Mont Blanc, ISTerre, Le Bourget du Lac).
    Topic of cooperation: Monitoring deep-seated, structurally controlled, potentially catastrophic landslides in the Chamonix area.
11) US Geological Survey.
    Topic of cooperation: Thermal weathering of rocks and its effect on slope stability.

**International Advisory Board**

Chair:

**- Dr Rouwen Lehné**
Hessisches Landesamt für Umwelt und Geologie (HLNUG)
Dezernat G1 – Geologische Grundlagen
Rheingaustr. 186, 65203 Wiesbaden, Germany

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- **Prof. Vladimir Yudin**
Institute of macromolecular compounds RAS
199004 Saint-Petersburg, Bolshoy pr. 31,

- **Prof. Dr. Manfred Joswig**
Goethestr. 25, D-40237 Düsseldorf, Germany

- **Dr. Yann Klinger**
Tectonique – Bureau 208, Institut de Physique du Globe - CNRS UMR7154
Université de Paris
1, rue Jussieu, 75238 Paris cedex 05, France

- **Prof. Dr. Kimon Christanis**
Department of Geology
University of Patras, University Campus, GR-265.04 Rio-Patras, Greece

In 2025, the Board was informed in writing about the activities of the Institute and its individual departments and provided recommendations for further improving IRSM's activities.

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## 7. Science Popularisation and Public Education Activities

| Event title | Activity | Main organiser | Co-organiser | Place and date |
|---|---|---|---|---|
| **1.** Natural hazards in the western USA: the San Andreas Fault and its little brothers (California) & landslides that run all the way into the sea (Oregon) | Public seminar presenting research on natural hazards, such as earthquakes and landslides on the west coast of the USA, conducted by researchers at IRSM CAS. | Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution | | IRSM CAS, Prague, 11 June 2025 |
| **2.** Open Days as part of Czech Academy of Sciences Week | Lecture "Not all pores are the same", with demonstrations of laboratory measurements | Czech Academy of Sciences | Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, | IRSM CAS, Prague, 6–7 November 2025 |

| | | | | |
|---|---|---|---|---|
| | | | public research institution | |
| **3.** Presentation of the Laboratory of Thermal Processes | Presentation of the laboratory and its activities to representatives of the Association of the Chemical Industry of the Czech Republic. | Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution | | IRSM CAS, Prague, 8 January 2025 |
| **4.** Presentation of the equipment of the Laboratory of Thermal Processes for processing waste carbon composite materials | Presentation of the laboratory and equipment for processing waste carbon composites and preparation of a joint project with the University of West Bohemia in Plzeň and foreign partners. | Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution | | IRSM CAS, Prague, 25 March, 9 June, 19 June, 11 September and 9 December 2025 |
| **5.** Presentation of the Laboratory of Geopolymers | Presentation of the laboratory and its activities to architects from TaK Architects, s.r.o. | Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution | | IRSM CAS, Prague, 24 May 2025 |
| **6.** Czech Academy of Sciences Week | Presentation of technology-oriented research | Czech Academy of Sciences | Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution | IRSM CAS, Prague, 6–7 November 2025 |

## 8. Monitoring Networks

Monitoring 1
SlopeNet monitoring network:
Monitoring of slope deformations, landslides and rockfalls.
Operator: IRSM CAS, public research institution; RENS programme.
Scope: Geophysical and geotechnical monitoring of slope deformations; responsibility for monitoring operations.

Monitoring 2
EU TecNet monitoring network:
Three-dimensional monitoring of tectonic structures in the EU.
Operator: IRSM CAS, public research institution; Czech/Geo programme.
Scope: Instrument readings, maintenance and data evaluation.

Monitoring 3
Czech Regional Seismic Network:
Monitoring of earthquakes in Europe and worldwide.
Operators: Institute of Geophysics of the Czech Academy of Sciences, public research institution; IRSM CAS, public research institution; Institute of Geonics of the Czech Academy of Sciences, public research institution; Institute of Physics of the Earth, Masaryk University; Faculty of Mathematics and Physics, Charles University; Czech/Geo programme.
Scope: Core scientific infrastructure for earthquake research, especially long-term research into seismicity in Europe and worldwide.

Monitoring 4
MKNET monitoring network:
Monitoring of earthquakes in the Little Carpathians.
Operator: IRSM CAS, public research institution; Earth Science Institute of the Slovak Academy of Sciences; Centre for Science and Research, s.r.o.; Czech/Geo programme.
Scope: Continuous data recording and evaluation for detailed research into a selected seismically active area.

Monitoring 5
REYKJANET monitoring network:
Monitoring of earthquakes in Iceland.
Operators: Institute of Geophysics of the Czech Academy of Sciences, public research institution, and IRSM CAS, public research institution; Czech/Geo programme.
Scope: Detailed long-term international research in a seismically active area of Iceland.

Monitoring 6
Monitoring network Landslides, rockfalls and debris flows recorded by the media since 2011:
Initiation and reactivation of slope deformations in Czechia.
Operator: IRSM CAS, public research institution; NASA programme.
Scope: Identifying the location and timing of landslides and the damage they cause.

Monitoring 7
TecNet monitoring network:
Monitoring of slow movements on tectonic faults.
Operator: IRSM CAS, public research institution; Czech/Geo programme.
Scope: Monitoring aseismic tectonic movements on faults.

Monitoring 8
WEBNET monitoring network:
Monitoring of earthquakes in western Bohemia.
Operators: Institute of Geophysics of the Czech Academy of Sciences, public research institution, and IRSM CAS, public research institution; Czech/Geo programme.

Scope: Detailed long-term research into a selected seismically active area.

Monitoring 9
Geonas monitoring network:
Movements of fixed GNSS points.
Operator: IRSM CAS, public research institution; RI / OP RDE programme.
Scope: Monitoring tectonic movements.

Monitoring 10
EBAR monitoring network:
Monitoring of earthquakes in eastern Bohemia.
Operator: IRSM CAS, public research institution; Strategy AV21 programme.
Scope: Detailed long-term research into a seismically active area that represents a significant source of seismic hazard in eastern Bohemia.

Monitoring 11
SEN monitoring network:
Seismicity of the East African Rift.
Operators: IRSM CAS, public research institution, and Arba Minch University; Strategy AV21 programme.
Scope: Monitoring earthquakes in the seismically active East African Rift region.

Monitoring 12
AdriaArray monitoring network:
Seismicity of the Vrancea region, Romania.
Operator: IRSM CAS, public research institution; Strategy AV21 programme.
Scope: Research into intermediate-depth earthquakes in the Vrancea region, Romania.

Monitoring 13
ELISE monitoring network:
Seismicity of the Cheb region.
Operators: GFZ Potsdam, Institute of Geophysics of the Czech Academy of Sciences, public research institution, and IRSM CAS, public research institution; Strategy AV21 programme.
Scope: Research into seismicity in the Cheb region.

### 9. Published Periodicals

1) **Acta Geodynamica et Geomaterialia**, Vol. 22, Nos. 1–4, 2025, ISSN 1214-9705 (Print); 2336-4351 (Online). A quarterly peer-reviewed journal with an impact factor. Indexed in: Science Citation Index Expanded; Journal Citation Reports/Science Edition.

2) **Ceramics-Silikáty**, Vol. 69, Nos. 1–4, 2025, ISSN 0862-5468 (Print); ISSN 1804-5847 (Online). A quarterly peer-reviewed journal with an impact factor. Indexed in: Science Citation Index; Materials Science Citation Index; the Engineering Index (published by Engineering Information Inc.).

## IV. Evaluation of Additional and Other Activities

The Institute has no additional activities. For an evaluation of other activities, see Section III, point 5.

## V. Information on Measures to Remedy Deficiencies in Financial Management and a Report on the Implementation of Measures Imposed in the Previous Year

The Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution, had no deficiencies in financial management in 2025 or in the preceding year.

## VI. Financial Information on Matters Significant for Assessing the Institution's Financial Position and Which May Affect Its Development

See the annexes: the financial statements - Profit and loss statement 2025 and the auditor's report thereon.

## VII. Expected Development of the Institute's Activities

IRSM's research activities will continue to develop in line with global research trends in the respective disciplines, with emphasis on publication, teaching and science communication. Doctoral students in the relevant study programmes will continue to be recruited and trained to support and improve research. Research staff have undergone, and will continue to undergo, professional assessments designed to improve performance. Their performance will be closely linked to remuneration and, where appropriate, their working hours will be adjusted. Instrumentation will be continuously supplemented, upgraded and developed, and staff will be trained in its operation.

## VIII. Environmental Protection Activities

To meet societal needs, the Institute evaluates biofuels and alternative fuels and develops technological methods for processing plastic and municipal waste, treating and converting sewage-treatment sludge into fertilisers, and immobilising and disposing of radioactive waste by vitrification in glass. IRSM staff are provided with dedicated facilities for waste separation. Hazardous waste, as well as surplus materials that have already been used, is disposed of in an environmentally responsible manner by authorised companies. Pest control is carried out annually.

## IX. Employment Relations Activities

See Section I, subsection 'Activities of the Institute's Governing Bodies', and Section VII.

## X. Provision of Information under Act No. 106/1999 Coll., as amended, on Free Access to Information

In 2024, the Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, public research institution, provided information relating to its remit and activities through publication on its website and in specialist and science communication journals. Expert assessments were provided to ČEZ a.s., Energoprůzkum, s.r.o., the Czech Geological Survey and the District Court in Ústí nad Labem.

I. (a) number of requests for information submitted: 0;
number of decisions issued refusing a request: 0;

II. (b) number of appeals lodged against decisions: 0;

III. (c) number of court judgments reviewing the lawfulness of decisions refusing requests for information: 0;

IV. (d) list of exclusive licences granted: 0;

V. (e) number of complaints submitted under Section 16a of the Act: 0;

VI. (f) other information: 0.

(Published as at 1 March 2026)

## XI. Further sections of the Annual Report: Profit and Loss Statement 2025

**Institute of Rock Structure and Mechanics of the CAS, V Holešovičkách 94/41, 182 09 Prague 8, Czech republic**

# Profit and loss statement

| ID number 67985891 | **Balance as at 31. 12. 2025**<br>(in Czech Crowns, the comma separates two decimal places) | According to Decree No. 504/2002 Coll. |
|---|---|---|

| Item | | Row | Activities | | |
|---|---|---|---|---|---|
| Number | Designation | | Main activity | Supplementary activy | Total |
| ***A*** | ***A. Expenses*** | | | | |
| **A.I** | **I. Consumed purchases and purchased services** | **002** | **24 377 502, 63** | **1 426 950, 01** | **25 804 452, 64** |
| A.I.1 | 1.Consumption of material, energy and other non-inventory items | 003 | 9 690 325, 64 | 823 961, 15 | 10 514 286, 86 |
| A.I.3 | 3. Repairs and maintenance | 005 | 3 222 254, 25 | 239,99 | 3 222 494, 24 |
| A.I.4 | 4. Travel expenses | 006 | 2 354 472. 96 | 203 034, 66 | 2 557 507, 62 |
| A.I.5 | 5. Representation costs | 007 | 65 292, 71 | 6 120, 00 | 71 412, 71 |
| A.I.6 | 6. Other services | 008 | 9 045 157, 17 | 393 594, 21 | 9 438 751, 38 |
| **A.III** | **III. Total personnel expenses** | **013** | **75 532 501, 00** | **1 250 785, 00** | **76 813 286, 00** |
| A.III.10 | 10. Wages and salaries | 014 | 55 678 085, 00 | 931 759, 00 | 56 609 844, 00 |
| A.III.11 | 11. Statutory social insurance | 015 | 18 533 723, 00 | 309 860, 00 | 18 843 583, 00 |
| A.III.13 | 13. Statutory social expenses | 017 | 1 350 693, 00 | 9166, 00 | 1 359 859, 00 |
| **A.IV** | **IV. Total taxes and fees** | **019** | **126 133, 00** | | **126 133, 00** |
| **A.IV.15** | **15. Taxes and fees** | **020** | **126 133, 00** | | **126 133, 00** |
| **A.V** | **V. Total other expenses** | **021** | **1 154 185, 62** | **1 026 963, 00** | **2 181 148, 62** |
| A.V.19 | 19. Exchange rate losses | 025 | 48 460, 82 | | 48 460, 82 |
| A.V.22 | 22. Other expenses | 028 | 1 105 724, 80 | 1 026 963, 00 | 2 132 687, 80 |
| **A.VI** | **VI. Total depreciation expenses, sold assets, addition and utilization to reserves and adjustments** | **029** | **16 445 976, 61** | | **16 445 976, 61** |
| A.VI.23 | 23. Depreciation expenses of fixed assets | 030 | 16 445 976, 61 | - | 16 445 976, 61 |
| **A.VIII** | **VIII. Total income tax** | **037** | **180 600, 00** | | **180 600, 00** |
| A.VIII.29 | 29. Income tax | 038 | 180 600, 00 | | 180 600, 00 |
| | **Total expenses** | **039** | **117 846 898, 86** | **3 704 698, 01** | **121 551 596, 87** |
| ***B*** | ***B. Revenues*** | | | | |
| **B.I** | **I. Total operating grants** | **041** | **98 557 664, 81** | | **98 557 664, 81** |
| B.I.1 | 1. Operating grants | 042 | 98 557 664, 81 | | 98 557 664, 81 |
| **B.III** | **III. Revenues of own services and merchandise** | **047** | **412 647, 34** | **4 143 084, 68** | **4 555 732, 02** |
| **B.IV** | **IV. Total other revenues** | **048** | **20 240 782, 40** | **50 579, 35** | **20 291 361, 75** |
| B.IV.7 | 7. Interest income | 051 | 252 730, 80 | | 252 730, 80 |
| B.IV.8 | 8. Exchange rate gains | 052 | 5 948, 64 | | 5 948, 64 |
| B.IV.9 | 9. Settlement of funds | 053 | 772 116, 37 | | 772 116, 37 |
| B.IV.10 | 10. Other revenues | 054 | 19 209 986, 59 | 50 579, 35 | 19 260 565, 94 |
| | **Total revenues** | **061** | **119 211 094, 55** | **4 193 664, 03** | **123 404 758, 58** |
| **C** | **C. Profit / Loss before tax** | **062** | **1 544 795, 69** | **488 966, 02** | **2 033 761, 71** |
| **D** | **D. Profit / Loss after tax** | **063** | **1 364 195, 69** | **488 966, 02** | **1 853 161, 71** |