Instrumental Equipment
of the Institute of Geology of the CAS, v. v. i.

This text is a fragment of a more comprehensive document titled "***Introduction to the Institute of Geology"***, which is presented elsewhere on this webpage (see link Institute/Introduction to the Institute).

The text below presents basic information about the instrumental equipment of the Institute of Geology. For more detailed information please consult staff of particular departments and laboratories.

CONTENT

Current analytical equipment is in good condition, expired equipment has been refurbished. The new instruments enable the introduction of new methods. Laboratories of the IG are frequently used by partners from other institutes of the CAS, universities, museums and from the private sector. Laboratory of Physical Properties of Rocks provides the best technical equipment in the CR for all basic tests in rock mechanics, including the world-unique apparatus for the determination of high-pressure rock elastic anisotropy using P- and S-waves in spherical samples.

In the coming years, our instrumental equipment will be modernized. Along with the introduction of new methods, modernization will result in maintaining scientific competitiveness and strengthening the position of the Institute of Geology as a solid research partner for the Czech as well as foreign research institutions. Some of the most important innovation of the instrumental facilities are:

Upgrade of the CAMECA SX-100 microprobe including an installation of a new energy-dispersive spectrometer and complete control and analytical software upgrade. The CAMECA SX-100 is an essential instrument supporting research of teams across the Institute and also providing external projects.

Upgrade of equipment in the grinding shop (polishing, grinding and lapping machines) should be either refurbished or replaced in several consecutive steps.

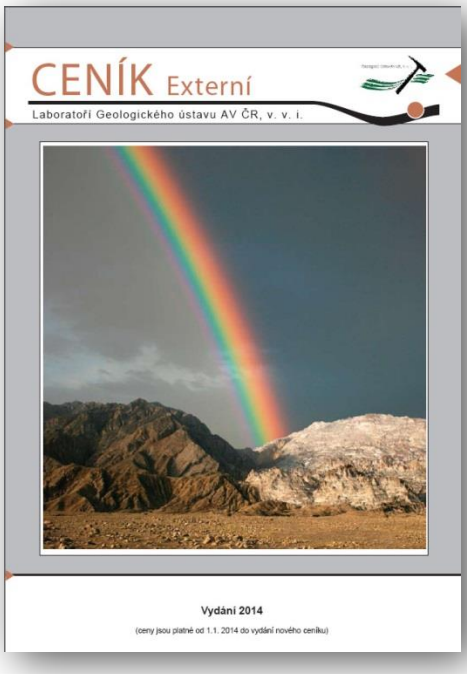
Purchase of a Raman micro-spectrometer allowing 3D confocal spectral mapping with micron-scale spatial resolution; equipped with two lasers to cover visible and near-infrared excitation wavelengths, and a CCD detector to record Raman spectra. The system should provide a quick and detailed tool to identify minerals.

The acquisition of a new excimer laser for laser ablation for the Element 2 high-resolution mass spectrometer coupled with a 213-nm NdYAG UP-213 laser ablation system. The proposed acquisition and implementation of the latest innovations in the laser ablation field (e.g., CA-chemical abrasion of zircon, small spot-size due to the laser efficiency, new calculation routines) should guarantee the best performance of the U-Pb technique with high accuracy and precision comparable to, e.g., double-focusing magnetic sector SIMS.

The Department of Paleomagnetism plans to modernize its essential equipment via purchasing motor and valve assembly of SRM (2017) for the 2G Enterprises Superconducting Rock Magnetometer, which is used to determine the intensity and direction of remanent magnetization of magnetically weak samples. Also, the compressor adsorber unit has to be replaced. To start hydrostatic pressure experiments on various magnetic properties, a new non-magnetic pressure cell is planned to be designed and built. Other paleomagnetic and rock-magnetic instruments (e.g., MFK-1 – new holder for magnetic anisotropy) as well as tools for preparation of samples should also be partly refurnished.

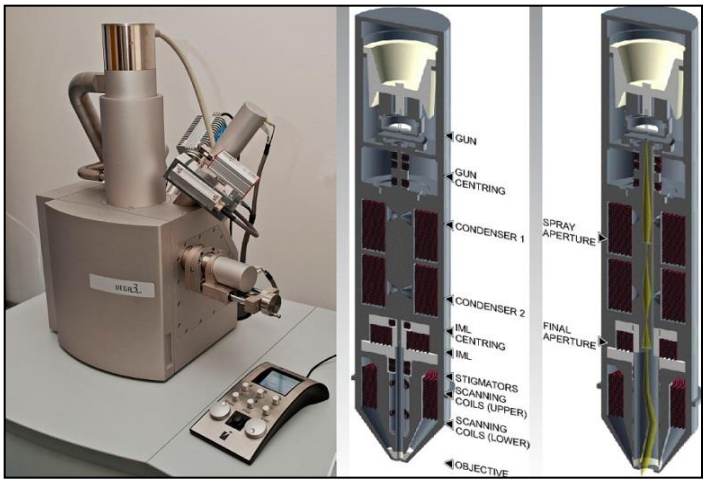
On the next pages you find a list of the most important instruments, laboratory equipment and other facilities with brief explanations and comments. For other relevant information see the price list of the Institute.

Price list for services of the Institute.



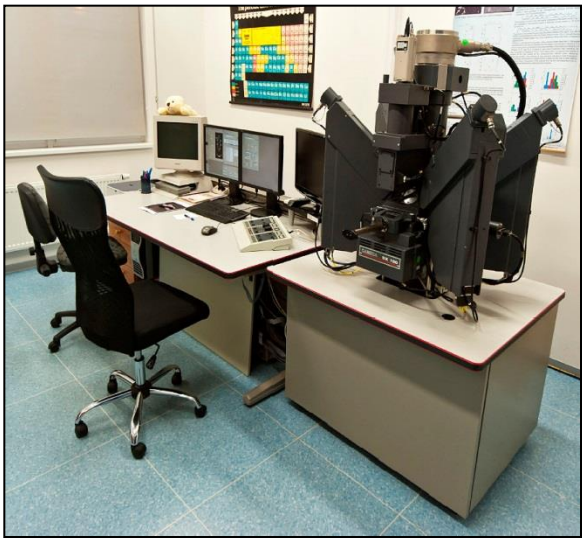
Most of facilities of Department of Analytical Methods are situated in the main research center. The staff here provides a service for the needs of the other professional units, however, they also pursue their own high-quality research focused especially on the application of instrumental methods to geological sciences.

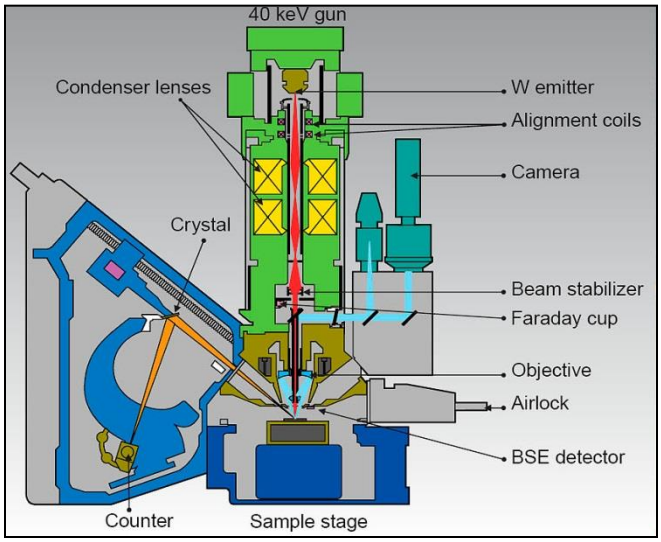
Reliable quantitative local chemical analysis and/or acquisition of element distribution maps using electron microprobe analyses and scanning electron microscopy (EPMA/SEM) require planar polished conductive surfaces. Such prerequisites are fulfilled when bulky solid samples are sectioned, polished and coated. For that purpose a suite of **cutting**, **grinding**, **lapping** and **polishing machines** to prepare polished sections or thin sections is available at this laboratory. To make the specimens conductive for EPMA/SEM chemical analyses, a coating by carbon is used. For imaging of rough surfaces using secondary electrons in high vacuum, samples are sputtered with gold to prevent their charging. The laboratory owns also all necessary instruments to **carbon-coat** or **gold-sputter** the specimens.



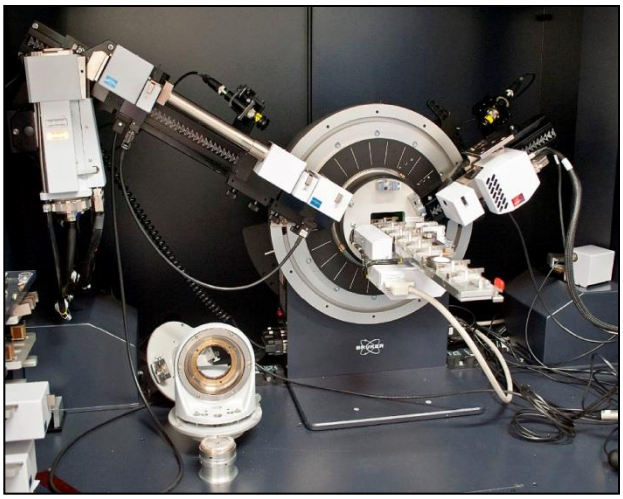
TESCAN VEGA3XMU scanning electron microscope (SEM) is an SEM of a variable pressure construction and allows observation and analysis of not only carbon-coated or gold-sputtered materials but also of uncoated specimens including biological materials. It is equipped with detectors of secondary and back-scatted electrons as well as energy-dispersive spectrometer (EDS) **Bruker QUANTAX 200**, which collects the entire spectrum allowing data acquisition typically within a minute. The spot which the analytical data are collected from may be on the order of 1 um in diameter. Element contents reliably measured with the device are as low as 0.X-X wt.%. Also available are low vacuum secondary electron (LVSTD) and color **cathodoluminescence** (CL) (detection range 350-850 nm) detectors. The source of electrons is a tungsten heated cathode. Under the optimum conditions the magnification of the SEM may reach up to 150,000× which translates to a resolution of 10 nm. The minimum magnification is 1.5× that means that objects as large as 127 mm across can be observed at once. 3D surface metrology is also possible.

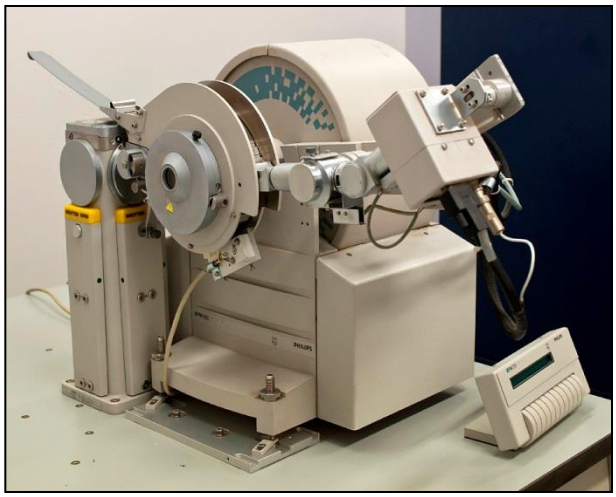
Typical application of the SEM instruments are: observation and imaging of surface characteristics of both coated and uncoated 3D specimens (various objects in paleontology, mineralogy, material science, etc.); observation and imaging of samples (polished (thin)sections) by BSE detector to reveal compositional differences; mapping of element distribution; local standard-less or standard-based chemical analyses.





CAMECA SX-100 electron probe microanalyzer (EPMA) is used mainly for non-destructive quantitative analysis of solid-state materials on the micrometer scale from selected spots down to a few microns across. The instrument is equipped with four wave-dispersive crystal spectrometers. Two of them carry 4 individual standard crystals each (LIF; PET; TAP; PC0 and PC1, respectively), two other house two so-called large crystals each (i.e., crystals with lower detection limits; LLIF; LTAP; LPET; LPC2). Instrument allows analysis of specimens for elements from B to U. The method is strictly standard-based, i.e., solid-state standards of known composition for all elements to be analyzed must be provided. A selection of correction procedures applied to calculate element concentrations include ϕρZ, PAP, and Merlet. Element contents can be reliably measured down to tens ppm. Chemical composition can be measured exclusively from planar polished surfaces. All the measurements and imaging are carried out in high vacuum. Though the probe is used usually for local chemical analysis, it occasionally serves also for imaging or collection of element distribution maps.





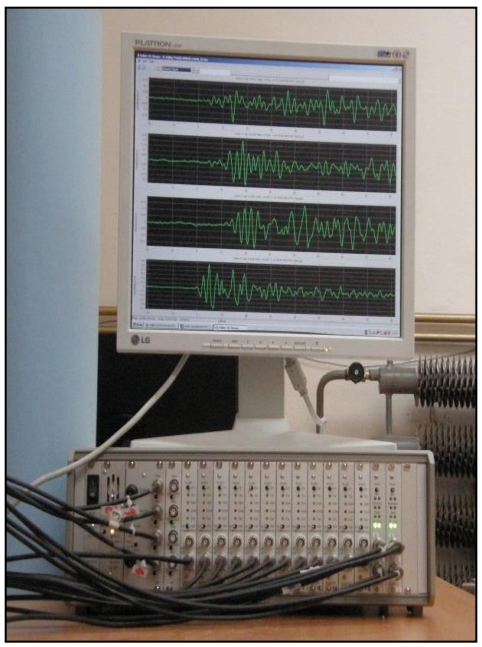
Bruker D-8 DISCOVER X-ray powder diffractometer is a multi-purpose powder X-ray diffraction instrument with a variable measuring radius designed to study powder samples or solid polycrystalline blocks (polished (thin)sections, rock chips etc.). Diffractometer is of the design θ-2θ and allows studying materials in both reflection and transmission (either foil or capillary) geometry. Optional focusing primary asymmetric monochromator of Johansson type produces spectrally pure K 1 radiation. Diffracted radiation is collected with a position-sensitive 1D silicon strip detector LynxEye. In the microdiffraction setup used for bulk samples, the primary monochromator is replaced by polycapillary optics and beam limited with a collimator and a sample is placed on a special motorized xyz-stage.

Philips X'Pert X-ray powder diffractometer is a compact powder X-ray diffraction unit for routine analytical work. Typical applications of this instrument are: phase identification and (semi)quantitative phase analysis; extraction of information on unit-cell size, peak intensities and peak shape parameters; crystal structure refinement, etc.

Department of Analytical Methods (Reseacrh Centre at Puškinovo náměstí)

This workplace focuses on research of the physical properties of rocks. The staff there is mainly focused to basic research of rock physical properties, nevertheless unique measuring systems are used to supply experimental data to the other professional units and to private sphere.

Uniaxial load frame MTS is a computer-controlled servo-hydraulic loading system specifically adjusted for long-term testing. This system allows testing of rocks in regime of controlled force or controlled deformation. Together with triaxial cell, this equipment allows simulation of pressure-temperature conditions and permeability measurements.



High pressure chamber - a unique device developed to study elastic anisotropy of rocks under high hydrostatic pressure on spherical samples. We are able to simulate pressures acting in 15 – 20 km depth. Because of spherical shape of studied samples we can describe properties of rock in 3D what is unique in the world. From the experiment we can tell reliable information about orientation of basic rock structures as microcrack systems or alignment of mineral grains. Measuring of shear waves gives us the ability to determine a complete set of elastic parameters and better describe qualities of rock under examination. Experiments done at several pressure levels provide information about process of closing of microcrack systems.

Vallen System AMSY-5 is a sixteen-channel transient recorder which allows us to monitor process of cracking during the uniaxial loading of rock sample. A net of 16 sensors detects every single crack in rock above the limit set. Recorded data are used to localize each crack and map the process of their propagation in time. This helps us to understand better the behavior of the rock failure process.

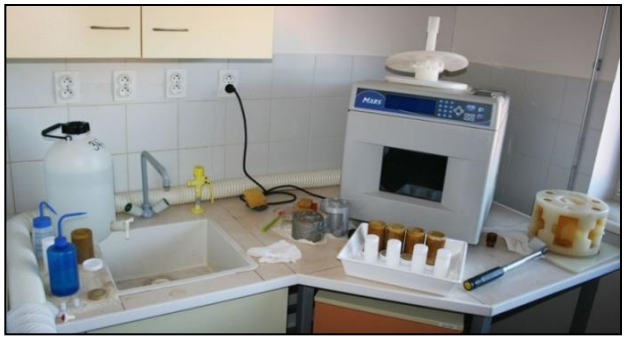
This department flexibly conforms to the needs of study of natural changes of the Earth system, especially the understanding of climatic oscillations and paleoenvironmental changes in the youngest geological history, and influence of the human impacts on the environment. Multi-disciplinary orientation of the staff, necessary for the solution of environmental problems, is comparable to those of foreign teams. Research activities of the staff of the laboratory cover such scientific fields as mineralogy, geochemistry, sedimentology, pedology, climatology, geomorphology, ecology, etc. Significant activities of the laboratory have been focused on the biogeodynamics of chemical elements in the environment. Changes and long-term trends in element budgets caused by human activities and climatic oscillations have been monitored in experimental areas for the last 20 years.

Collection of an environmental sample: **Pasive collector** for collection of rain water.

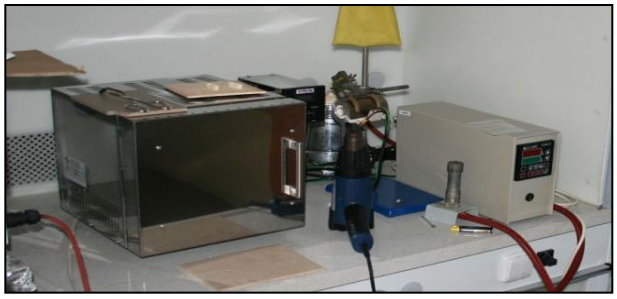
A set of **iceboxes** is used for storage of environmental samples.

We operate with several preparatory laboratories that serve for prime preparation of samples for the following analyses.

Before analysis, majority of solid samples are prepared by decomposition in acids. In the **HPA-S Anton Paar high pressure asher**, samples are dissolved at temperatures up to 300 °C and pressures up to 100 atm.



Microwave oven is not only useful in a house kitchen, but with a special teflon PTFE pressure bombs it is useful for decomposition of samples as well. Of course, the microwave power inserted on sample is far more higher than in the kitchen models.



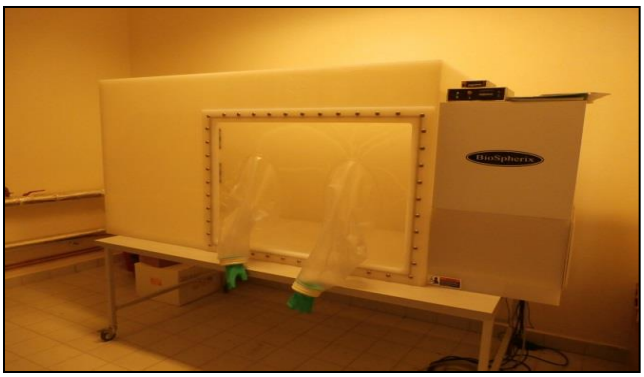
Another approach to decomposition of minerals is based on melting in resistance oven upon regulated temperature up to 1,300 °C in platinum, silver or quartz crucibles.

SPECIAL EQUIPMENT AND TECHNIQUES FOR WORKUP, PREPARATION AND STUDY SAMPLES

Some samples collected in geochemical study sites are air sensitive, prone to decomposition, lost of target analytes or sensitive to contamination. For these samples, special workup procedures are required.

The freeze-drying apparatus is frequently used in biochemical and biological applications for careful drying of sensitive samples. Samples are frozen before drying *in vacuo*, water is removed from the sample by sublimation.

Diluted liquid samples can be preconcentrated before analysis on the **vacuum rotatory evaporator**. Samples are delivered in the plastic bottles, transferred into an evaporation flask and evaporated *in vacuo*. Concentrated sample resulting is present in a small flask connected to the apparatus.



Glove-box where inside the closed space, argon atmosphere is maintained to protect the sample from air influence and contamination from atmospheric dust. Samples are inserted by the port to the right site and handled by gloves connected to long plastic sleeves.

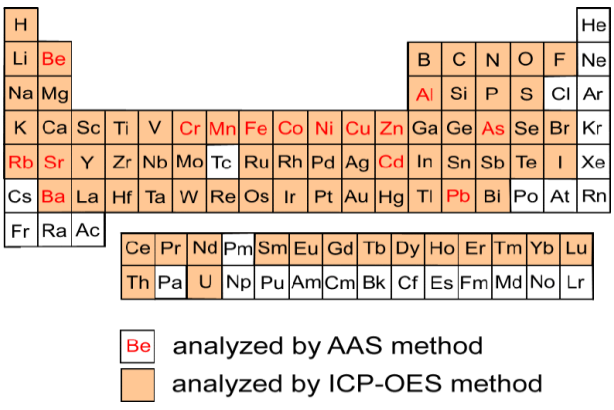
Quantification of inorganic carbon (carbonate) and organic carbon in natural liquid or solid samples is performed on **TOC analyser equipped with autosampler** for liquid samples introduction.

The presence and amount of nitrates, chlorides, sulfates and other anionic component is analysed on the **HPLC liquid analyser** by chromatography on anion exchanging chromatography with conductivity detection.

Majority of chemical elements can be analysed in the Geochemical labs by ICP techniques.

Samples of various origin are studied. Besides minerals and rocks which are the main materials of interest of geology and geochemistry, the soils, rain, precipitation, water and fog are study subjects of geochemistry. Biogeochemistry concerns on various biomaterials (wood, leaves, pines, organic soil horizons etc.).

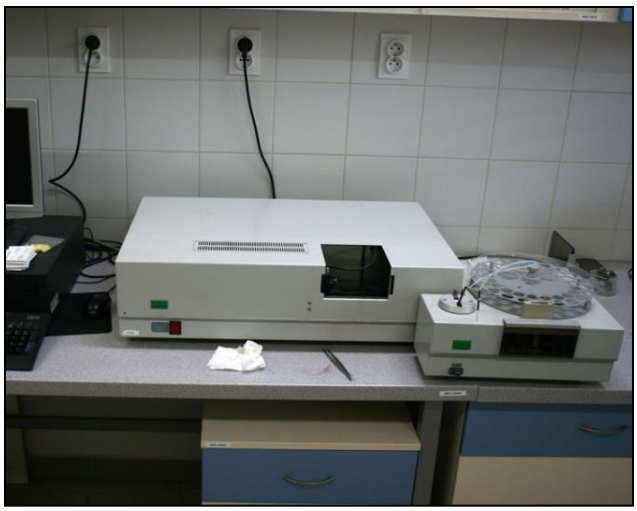
Chemical composition of samples is studied on universal multielement spectrometers in an argon plasma discharge (**ICP EOS instrument**). At temperatures about 10,000 K, chemical elements present in the sample emit visible or UV radiation, which is collected and processed. As a result, certain element is identified together with its content in the sample.



Geochemical laboratory is also equipped with other standard instruments: **AAS analysers**, **microwave** and **UV digestion instruments**, **UV spectrometer** equipped with **CV-AFS** and **CV-AAS analysers**, **UV digestion** and of coarse **ICP-MS ELEMENT 2** with a laser ablation system shared with the Laboratory of *Geological Processes*.

SPECIALITY OF RESEARCH IN GEOCHEMICAL DEPARTMENT OF GEOCHEMISTRY: UTLTRA-TRACE MERCURY ANALYSIS

Mercury is a highly toxic element, dangerous for the environment and humans even in minute amounts. The analysis of mercury in ultra-trace amounts, especially in environmentally related samples, is demanding task and extraordinary sensitive machines are needed. In the mercury lab at GLI we are working on two such instruments. Detection limits up to 0.1 ng/l of mercury can be reached.

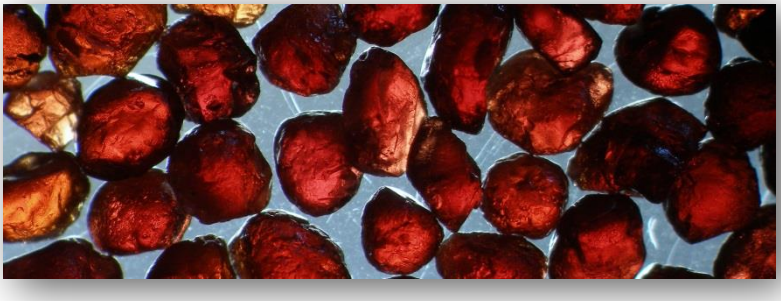


Advanced mercury analyser used for analysis of mercury content in solid samples. Extraordinary sensitivity (up to fractions of nanogram Hg) is reached.

The instrument is designed for mercury analyzes in liquid samples and for speciation studies.

OLYMPUS SZX 16 Optical binocular microscope with the **CANON digital photocamera** and specialized **QuickPHOTO Micro software** and a **Deep Focus module** is used for the documentation of samples, separation of sub-samples for other methods and, of coarse, for imaging of samples and details for publications.

OLYMPUS BX50 Optical polarizing microscope with the **digital camera DP 70** and specialized **QuickPHOTO software** and a **Deep Focus module** is used for a detailed study of thin (for transmitted light) and polished (for reflected light) sections. Software enables documentation, image preparation and image analysis. The microscope is equipped also with a fluorescent source of different wavelengths.



Examples of photos from the above characterized microscopes.

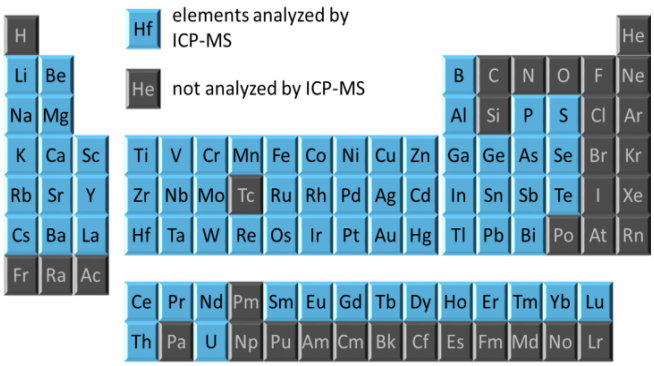
The Department of Geological Processes conducts a complex research in the field of processes, past and present, acting within the lithosphere – the Earth crust and the upper part of the Earth mantle. The analysis of material, physical and biological record preserved in the available rocks permits us to describe the dynamics of large lithospheric blocks in the past, to reconstruct temperature and pressure histories of large rock complexes including the evolution of sedimentary basins from the Early Paleozoic to the present. Good knowledge of these processes in the geological history of Central Europe together with extensive research activities at a global scale enable us to present results of general validity and universal use in the realm of Earth sciences.

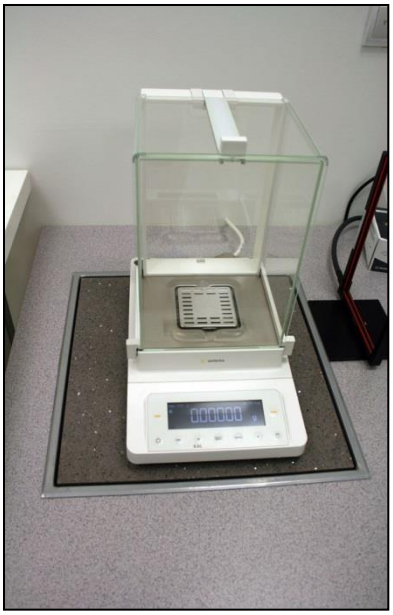
Element 2 (Thermo Fisher) inductively coupled plasma mass spectrometer (ICP-MS) is used for trace and ultra-trace element analysis (down to a sub-ppm level) and for the determination of isotope ratios (with a precision of up to 0.1% relative standard deviation). Both solution and solid-state analyses are available. The instrument is equipped with a double focusing magnetic sector field mass analyzer based on a reverse Nier-Johnson geometry, which allows high-speed multielement analysis. A high mass resolution mode of operation enables the elimination of polyatomic interferences. Typical applications include multi-element analysis of digested inorganic and organic materials, ultra-trace analysis of natural waters, determination of $^{206}Pb/^{207}Pb$ and $^{208}Pb/^{206}Pb$ isotope ratios in environmetal samples. Preparation of samples is carried out in a specialized clean laboratory (see next page).

The ICP-MS is equipped with optional sample introduction systems:

- **Aridus II** desolvating nebulizer for the elimination of oxide interferences in solution analyses. It can be also used for simultaneous aspiration of a tracer solution during laser ablation analyses.
- **Hydride generator** provides sub-ppb detection limits for hydride-forming elements such as As, Se, Sb.

Laser ablation unit (New Wave Research, UP213) in connection with the ICP-MS is used for sampling of solid-state materials. It employs a Nd:YAG medium to produce laser light at 213 nm. The main applications are space-resolved quantitative analysis of trace and elements in mineral grains in silicates (pyroxenes, quartz, etc.) or sulphides (molybdenite, chalcopyrites, etc), such as elemental profiling and mapping, and U-Pb dating of zircons. The spatial resolution of the laser beam is in the range of tens micrometers. Planar polished surface and compact structure of a sample is necessary for any analysis using LA-ICP-MS.



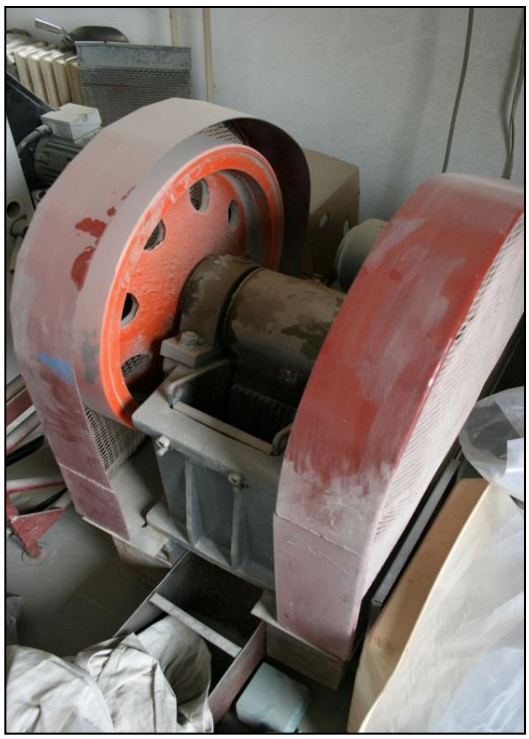


Lab digital analytical balance scale is used for precise sample weighing.

Clean laboratory of the Institute consists of two independent labs with different degree of air quality. The **first lab** (picture upper left) with a HEPA-filtered air of class D is using for sample decomposition in acid-resistant fume hood and acid purification (HNO_3, HCl, HF using Savillex Distillation Unit). The **second lab** (upper right and bottom pictures) with HEPA-filtered air of class C is devoted to low-blank chemistry, which includes sample decomposition and separation of the elements (e.g., Os, Re, Pb, Lu, Hf) from the matrix for subsequent isotopic analyses. This room is equipped with 2 custom-designed laminar flow hoods with HEPA-filtered air of class A, system for preparation of ultraclean Milli-Q water Millipore Element and high precision weighting device Sartorius Cubis.

Currently, the clean lab is mainly used for research projects dealing with highly siderophile element, Re-Os and Lu-Hf isotopic analyses and molybdenite Re-Os geochronology.

A certain kind of mineral concentrate is needed for the study of minerals and their properties. This is obtained by separation of minerals from the rocks. First, the rock is crushed in **jaw crusher** into smaller fragments, then in **crusher roller mills** to obtain small grains. Sieving of samples to various fractions is a following procedure needed for the other process. Using a **floating table** and **magnetic separator** the grains are divided into light/heavy weight fraction and on the magnetic and non-magnetic minerals. Finally, the mineral grains are separated in heavy liquids based on their density.



Jaw rock crusher

Crusher roller mill

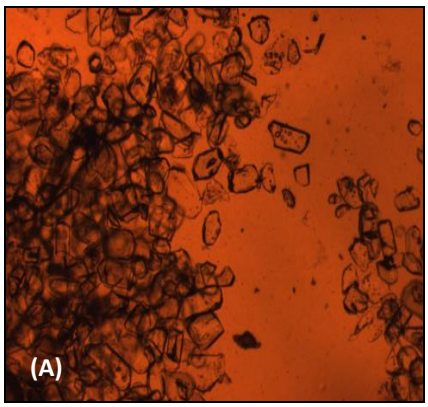
Magnetic separator

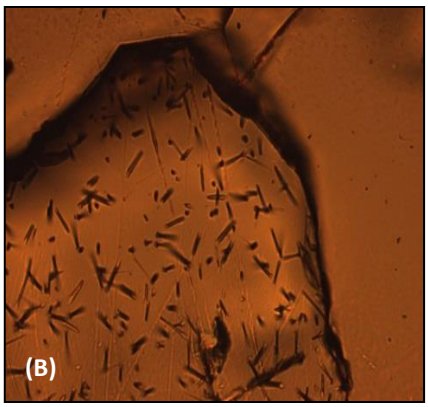
Floating table

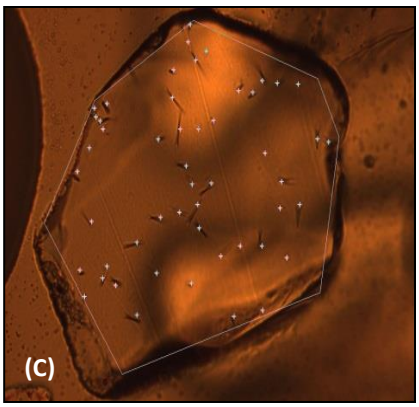
Laboratory of heavy liquid separation

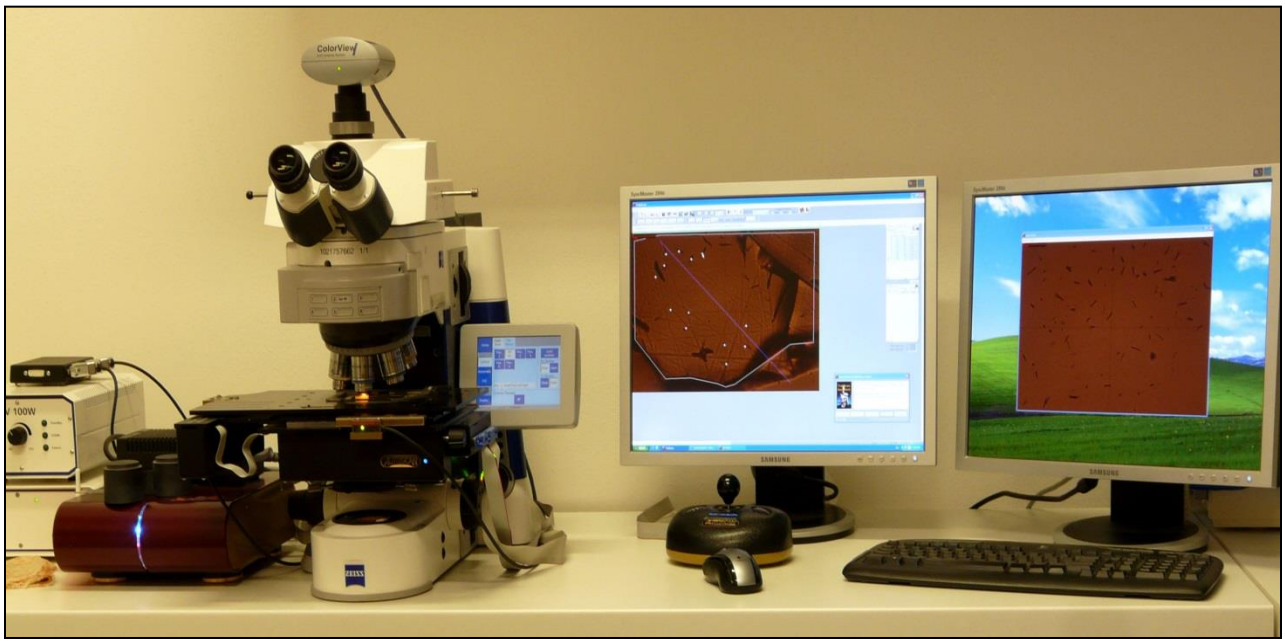
Fission track analysis is a radiometric dating method based on the analysis of radiation damage trails ("fission tracks") within U-bearing minerals (such as apatite, zircon, titanite,…). This method allows to determine simultaneously time and temperature evolution of rocks by counting fission tracks in individual grains and length-measuring of the confined tracks. This results in time-temperature curves for each sample and reconstruction of the uplift/burial history in areas such as tectonic active fault zones, sedimentary basins and their source areas.

A simplified procedure for FTA using the ZEISS Imager M1m microscope: apatite grains in a sample at a magnification of 5x (A); part of the selected grain with fission tracks at a magnification of 50x (B); apatite grain with defined area and counted fission tracks for age determination (C); confined track for thermal-condition determination.









ZEISS Imager. M1m Microscope connected to two monitors of a computer for a fission track analysis (FTA).
The Microscope is equipped with an AUTOSCAN table moving in directions x, y, z. controlled by a computer and manual joystick; two light sources using reflected and transmitted light. Another part of the microscope is a digitizing equipment for measuring lengths of specific tracks parallel to the surface of the mineral grain (i.e. confined tracks).

RS-230 instrument is a portable radiation detector (Georadis Ltd., Brno, Czech Republic) with Bismuth Germanate detector (103 cm^3) with a high sensitivity (approximately 3 x higher in comparison to the same size NaI detector). Counts per seconds (cps) in selected energy windows are directly converted to the concentrations of potassium, K (%), uranium, U (ppm), thorium, Th (ppm) and total dose (nGy/h). The instrument offers an assay mode (provides sample concentrations of K, U and Th in selectable time intervals), scan mode (numeric display on front panel scanned to memory and audio response) and survey mode (cps at 1/sec rate display on front panel). It has bluetooth and USB data connections.

Gamma-ray spectrometry (GRS) can be used for direct detection of the concentrations of K, U and Th in geological mapping by detecting and delineating the lateral distribution of these elements in surface rocks and soils. Field GRS is very effective method – low-cost, fast, non-destructive and large data sets can be acquired. GRS in sediments is used as a principal tool for correlations in palaeoenvironmental studies and high-resolution stratigraphy. It can reveal information on the quality of impurities trapped in the sediments where Th and K concentrations usually reflect the presence of some minerals.

GR-320 Envispec Portable Gamma-ray Spectrometer (Exploranium, Canada and Geroadis, Czech Republic) is another portable gamma-ray spectrometer which can be used in the field. It has external detector, and the system utilizes 256/512 channel and a high-sensitivity 76x76 mm (3" x 3") Sodium-Iodide detector. Counts per seconds (cps) in selected energy windows are directly converted to the concentrations of potassium, K (%), uranium, U (ppm), thorium, Th (ppm) and total exposure or dose rate (nGy/h). It can be used for the same purposes as the RS-230 device.

Vacuum chamber connected with an air-pump is used for preparation of non-solid samples for thin sectioning in the geoarcheological laboratory. When the samples are cured enough, they are processed in thin sectioning lab (samples in dimension 3 x 4 cm).

The **CILAS 1190 LD laser granulometer** is used to provide a measurement of the grain size distribution in range from 0.04 to 2,500 µm. The measurement is based on a small amount of material and might be easily repeated. Using the different types of dispersion allows to get the picture about the primary or secondary given grain size distribution. Data can be reported in different fractions set by the user.

The aim of this department is focused on:

- reconstruction of biological evolution in selected fossil groups
- reflection of major changes and turnovers in biota - study of causations of important (often catastrophic) events in the Earth history
- high-resolution stratigraphy; precise dating and correlation of sedimentary strata
- paleogeographic reconstructions
- intersections with sedimentology, geochronology, ecology, archaeology, and other scientific disciplines
- popular science and education

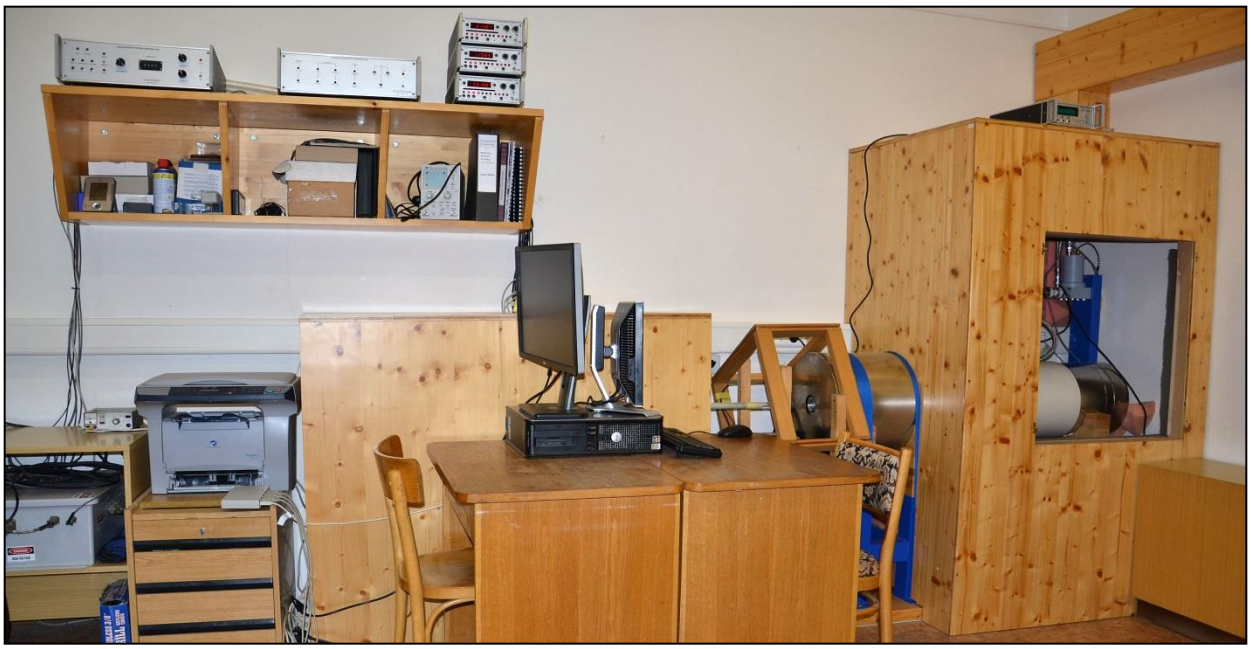
Research concentrates to the four principal directions: 1. the study of living conditions and biostratigraphy of invertebrate fossil groups (especially conodonts, graptolites, brachiopods, poriferans and echinoderms); 2. evolution of vertebrate groups (fishes, amphibians and mammals); 3. palynology of Carboniferous, Cretaceous and Cenozoic sediments; and 4; paleoichnology in a broad stratigraphic range from the Cambrian to the Recent.

The department has **rooms for maceration and processing of micropaleontological samples** equipped with levigation facility and fume hoods.

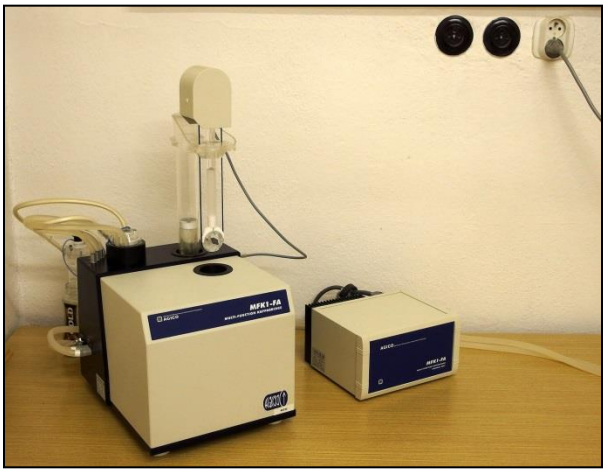
The MicroScribe® MX desktop 3D digitizer combined with the Skiron Kreon laser scanner serves for scanning of three-dimensional objects and uneven surfaces. The gained spatial data clouds are subsequently processed into graphic outputs by using 3D **Rhinoceros® NURBS** program with the rendering **Flamingo®** module. It is also possible to create a 3D animation with the help of the **BongoTM** module. 3D digitization offers the possibility of precise measurement, making of any non-destructive cross-sections or rotating visualizations for presentations or electronic publication supplements. Another option is measuring of the relative spatial relationships of the markers on the object. Scanning is particularly suitable for paleontological, ichnologic, and sedimentologic objects or surfaces.

The laboratory is situated in the magnetically quiet environment of the Průhonice Park. It was built using non-magnetic materials to guarantee strict requirements of paleomagnetic research. The team consists of highly experienced scientists with interests in paleomagnetism, magnetostratigraphy, rock and mineral magnetism, geology and planetology. The team is supported by mathematicians and programmers in order to develop new laboratory techniques. The scientific team members are involved in numerous national and international co-operations. The laboratory is equipped with modern instruments for paleomagnetic and rock magnetic studies, the most important are listed below.

Magnetic Vacuum Control System MAVACS with triaxial **Helmholz Induction Coil System HELICOS**, **Rotating Coil Magnetometer ROCOMA** and **Induction Coil Control Unit ICCON** is a self-contained automatic system creating a limited non-magnetic space (magnetic vacuum < ± 2nT; typical offset of the magnetic field sensor < ± 0.1nT) for paleomagnetic investigations, i.e. for thermal demagnetization of the remanent magnetization is conducted in the oven situated in the center of the MAVACS system. The operation of MAVACS is based on the feedback loop principle where the Earth's magnetic field is compensated by HELICOS and continually monitored by ROCOMA. The output of the ROCOMA controls the ICCON, which supplies the HELICOS generating the compensating magnetic field.



2G 755 4K Superconducting Rock Magnetometer (SRM) with a **2G800 Automatic Sample Handler System** and **Applied Physics Systems 581 DC SQUID System** is a very sensitive (magnetic moment < 10E-12 Am^2), liquid helium-free measurement system for determining the intensity and direction of natural remanent magnetization and for conducting alternating field demagnetization of the remanent magnetization. The SRM measures current induced in 3 sets of superconducting pickup coils placed at the center of the rock measurement region. The system permits remanent magnetization measurement in three axes and is designed to process discrete samples with a volume of up to 10 cm^3. Data are collected and displayed using the **2G Acquisition** software.



AGICO JR-6A Spinner Magnetometer is a sensitive (2.4 μA/m) laboratory instrument used for measurements of remanent magnetization. JR-6A is equipped with automatic specimen holders which enable automatic measuring of all components of the remanence vector. The magnetometer offers two rotation speeds, the higher (87.7 r,p,s) enabling the maximum sensitivity and the lower (16.7 r,p,s) to measure fragile specimens, soft specimens placed in perspex container and specimens with considerable deviations in size and shape. The JR-6A is fully controlled by an external computer and data are processed with REMA6W software.

AGICO MFK1-FA Kappabridge is the most sensitive (< 2x10-8 SI) laboratory instrument for measuring of magnetic susceptibility and its anisotropy. In conjunction with a CS4/CSL temperature control unit it is further used for measuring temperature dependence of magnetic susceptibility over a temperature range of -192 °C to 700 °C. MFK1-FA represents a fully automatic inductivity bridge which allows high precision measurements at three different frequencies (976 Hz, 3904 Hz, 15616 Hz) and in wide field range (2-700 A/m). The measurements are controlled by the SAFYR4W (magnetic susceptibility, anisotropy) and SUFYTE5W (temperature dependence) softwares.

Magnetic Measurements Pulse Magnetiser MMPM10 is a high field instrument for creating isothermal remnant magnetizations. The MMPM10 is equipped with 2 coils to generate accurate, short-duration (7 ms) high magnetic field pulse: the largest coil (max. field 3T) accommodates standard paleomagnetic samples in any orientation for IRM anisotropy studies. The smaller coil is 1.25 cm in diameter and generates pulsed field up to 9T. The magnetic field pulse is generated by discharging a bank of capacitors through the coil.

Magnetic Measurement Thermal Demagnetizer MMTD80A with **Eurotherm 3204 temperature controller** is a programmable thermal demagnetizer for up to 80 paleomagnetic samples up to 750 °C. The 4-layer closed Mu-metal shield guarantees a constant field <10nT during heating and cooling.

Thank you for your interest

Institute of Geology CAS, v.v.i.

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