

INSTITUTE OF ROCK STRUCTURE AND MECHANICS OF THE CAS



INSTITUTE OF ROCK STRUCTURE AND MECHANICS
of the Czech Academy of Sciences

The Institute of Rock Structure and Mechanics of the Czech Academy of Sciences (IRSM) is one of the five institutes belonging to the Earth Sciences section.

Since 2007, the IRSM is a legally constituted public research institution (abbreviated as v. v. i.).



IRSM of the CAS (archive of the IRSM)

MAIN ACTIVITIES

The Institute of Rock Structure and Mechanics of the Czech Academy of Sciences is concerned in studies of structure and properties of rock medium, rocks, derived materials and special composite materials. The subjects of investigation are natural and induced phenomena and processes affecting behavior, development and stability of rocks in their natural location in earth crust, as well as inorganic and organic materials found in-situ or developed in laboratories. Advanced monitoring and laboratory methods are applied to constitute general findings and to set up conditions for their practical exploitation.

The main objectives of research and educational activities of the IRSM include:

- Acquisition, analyses and dissemination of scientific findings through publishing the results in monographs, scientific journals and conference proceedings
- Cooperation with universities and other scientific and research institutions as well as with business companies
- Education and formation of new generations of scientists by teaching and tutoring of students at universities
- Participation on doctoral study programs
- Contributing to raising the scientific knowledge and to development of practical applications of research findings
- Involvement in the international co-operation in research, education and dissemination of scientific knowledge
- Management, maintenance and improvement of research infrastructures
- Organization of scientific meetings, conferences and seminars both at national and international level

A BRIEF HISTORY OF IRSM

● 1927

The Institute was founded under the name „**Institute for Scientific Research of Coal**“. The research was mainly related to the chemistry of coal and chemical processing of solid fuels. Its founder and first director, Dr. Hans Tropsch, was a co-discoverer of the well known **Fischer-Tropsch synthesis** of liquid fuels from coal.

● 1948

The Institute was renamed „**The State Institute of Fuels**“.

● 1958

The Mining Institute of the Czechoslovak Academy of Sciences was founded in 1958 as a basic research centre for mining sciences. The staff, equipment and research programmes were taken over from previous institutions with already thirty years of research tradition. The Mining Institute developed montane and mining sciences and reached the world excellency, namely in personalities like **František Špetl**, an internationally renowned expert in the field of coal and mineral processing.

● 1967

Scientific journal „**Reports of the Mining Institute**“ was founded, later (1970) renamed „**Acta Montana**“.

● 1970

The Mining Institute was significantly reorganized. Gradually, individual departments were established, aiming at various aspects of research in geomechanics, geotechnics, mineral processing, coal and coke refining, groundwater hydraulics, etc.

● 1978

After a series of mining accidents in Ostrava coal mines, a branch of the Mining Institute was established in Ostrava. This branch later became today's **Institute of Geonics, ASCR v.v.i.**

● 1979

The Mining Institute and the Geological Institute of the Czechoslovak Academy of Sciences were merged under the new name: **The Institute of Geology and Geotechnics of the CS AS**.

● 1990

The Institute of Geology and Geotechnics was again divided into two

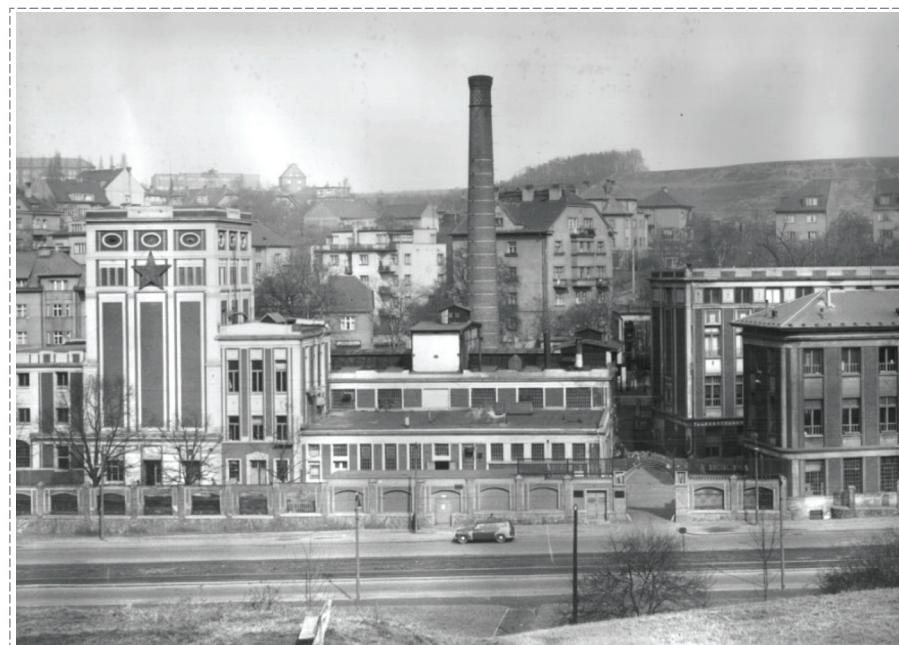
independent institutes: **The Institute of Geotechnics and the Geological Institute**.

● 1992

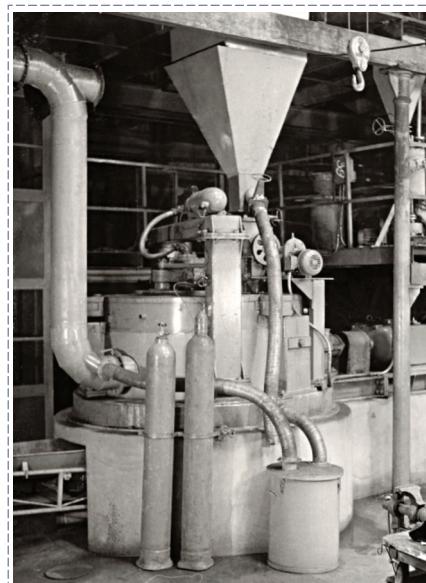
After the formation of the Academy of Sciences of the Czech Republic, the Geotechnical Institute changed its name to current „**Institute of Rock Structure and Mechanics ASCR**“.



Measuring the parameters of the thermal decomposition of coal
(archive of the IRSM)



Mining Institute of the Czechoslovak Academy of Sciences (archive of the IRSM)



Annular horizontal press for research of briquette formation from hard coal
(archive of the IRSM)

HIGHLIGHTS AND ACCOMPLISHMENTS THROUGH THE HISTORY 1958 - 1989

- Evaluation of the stability of underground engineering constructions, especially mines
- Development of physical methods for treatments of coal, ores and loose materials, some were patented
- Petrographical composition, physical properties and the chemistry of coal were used in the development of an international classification system describing the formation of coal deposits, their weathering and thermal processes
- Organisation of a major international conference on the research of coal under the name „Coal Science, Prague 1968“ and establishing of a tradition of regular international conferences „Coal Science“, which still continues
- New methods were developed for studying porous structures and formulation of a worldwide recognized, new theory on microporous structure of solids

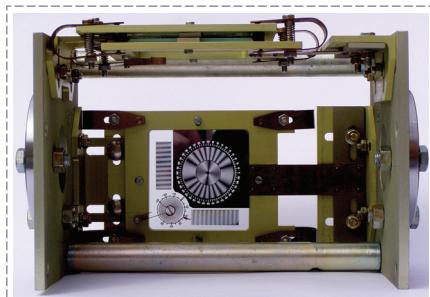


Fig. 1: Dilatometer TM-71, a high-precision 3D microdisplacement measuring device (archive of the IRSM)

- Construction of a measuring device for monitoring microdisplacements and rotations of blocks of rock or engineering construction segments (Fig. 1)
- Development of methods for seismic and seismo-acoustic measuring of underground pressure in mountain regions
- Development of the petrology of black and brown coal using reactivity and optical properties of macerals in the production of coke and briquettes
- Development and application of modelling methods for solving geotechnical problems, such as stability of slopes, predicting of slope deformation at the bottom of quarries, etc. The methods combine physical modelling using equivalent materials and numerical analyses

OUTSTANDING RECENT ACHIEVEMENTS 2000 - 2009

- Preparation of additives and definition of modifications in reaction conditions to reduce emissions of sulphur compounds and toxic elements in the pulverized combustion of brown coal
- Preparation of glass with new properties, such as resistance to oxidation at high temperatures during pyrolysis
- Processing of brown coal fly ash for the production of ceramic and building materials (Fig. 2)



Fig. 2: Architectural ornament: voluta made of a geopolymmer (archive of the IRSM)

- Treatment and recycling of the waste polyethylene from municipal dumps
- Designing of composite materials and their preparation for the use in orthopaedics as a bone substitute and filling (Fig. 3)

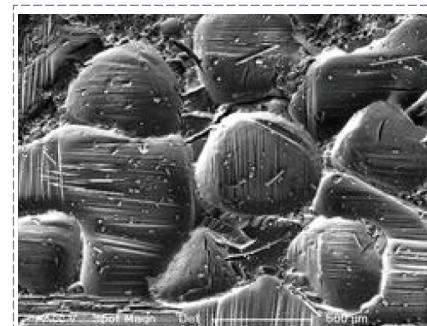


Fig. 3: Surface of a glass-based composite (pore size 400-600 microns) (archive of the IRSM)

- Designing and verification of a technology for processing of waste rubber (in co-operation with Sokolovská coal company, a. s., and UVP Bechovice, a. s.)
- Development of new seismic methods for processing of shallow structures measuring
- Development of geopolymers applicable as a new sound-insulating material, as a replacement for epoxy resins

- Earthquake hazard map of the Czech Republic, Poland and Slovakia, showing a 90% probability of non-exceeding given degree macroseismic intensity in the next 50 years (Fig. 4)

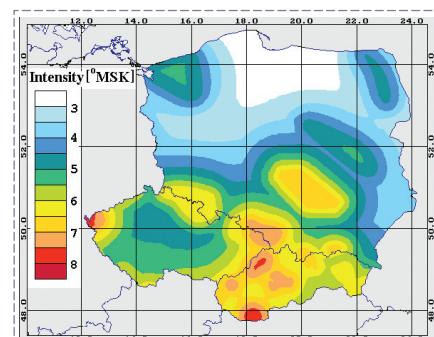


Fig. 4: A seismic hazard map (archive of the IRSM)

- Industrial filter-cleaning materials designed from neodymium magnets. The magnetic field has a magnetic induction value approximately 3,4x higher than when ferrite magnets are used (Fig. 5)



Fig. 5: Industrial filter (archive of the IRSM)

- Organisation of the First European Conference on Landslides
- Creation and development of the EU TecNet: a network for direct observation and measurement of microdisplacements on tectonic faults
- Monography „Coal Atlas of the Czech part of the Upper Silesian Coal basin“ (in cooperation with Mining University in Ostrava)
- Discovery of new minerals: telluronevskit and fosfowalpurgin (in cooperation with the National Museum and the Museum of Bohemian Paradise in Turnov) (Fig. 6)

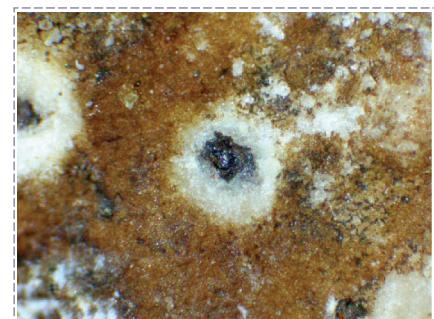


Fig. 6: Microphotograph of telluronevskit (newly discovered mineral) (archive of the IRSM)

SIGNIFICANT RECENT RESULTS

2010

- Development of a new quantitative determination of shear wave velocity for various geological units of the Bohemian Massif (Journal of Seismology, Vol. 15)
- Use of vertical static pendulums for earthquake prediction (Rock Stress and Earthquakes, Taylor & Francis Group, London, 2010)
- Identification of pulses caused by changes in stress in the Earth's crust (Tectonophysics, Vol. 487)
- Extension of research of geodynamic processes into High Arctic region (Fig. 1)



Fig. 1: Installation of a GPS point in Hornsund fjord, Southwestern Spitsbergen
(Photo: Jan Blahut)

2011

- Preparation of a new, fire resistant foam material from coal ashes combined with natural smectite and of a new, frost-resistant geopolymmer material based on metakaolinic quartz sand (Acta Geodynamica et Geomaterialia Vol. 8, Ceramics Silicate Vol. 55)
- Analysis of the composition of black layers on building materials at the Prague Castle (Science of the Total Environment, Vol. 409, 2011)

2012

- Development and testing of a Rotaphone, a new six-component seismograph (in cooperation with the Charles University in Prague, Review of Scientific Instruments, Vol. 83)
- Reconstruction of the formation of brown coal lithotypes from selected Miocene deposits, based on a systematic study of petrographic compositions and biomarkers. (Fuel, Vol. 99)

- Construction of a prototype of an improved, automated 3D dilatometer TM-71

2013

- Calculation and verification of the trajectory, structure and origin of the Chelyabinsk asteroid, in cooperation with the Astronomical Institute of the CAS (Nature, Vol. 503) (Fig. 2)



Fig. 2: Mosaic of a dust trace from the Chelyabinsk asteroid
(Photo: Alexander Važenin)

- Geophysical and geomorphological confirmation of the position and course of an important tectonic fault line the Posumavsky fault (Surveys in Geophysics, Vol. 34)

- Explanation of the principle of cementation and blackening of Holocene sands by humates from overlying peat (International Journal of Coal Geology, Vol. 114)

- A comprehensive biological assessment of composites used for replacement of the bone grafts for the treatment of degenerative or traumatic disc diseases. (Science of Advanced Materials, Vol. 5)

2014

- The Institute of Rock Structure and Mechanics of the CAS together with the

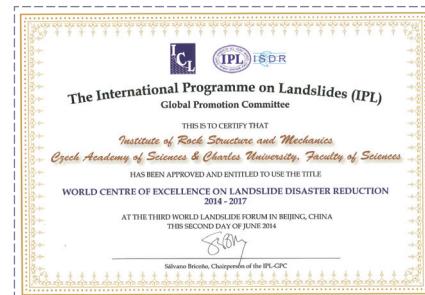


Fig. 3: Certificate of the World centre of excellence on landslide disaster reduction received in Beijing

Faculty of Natural Sciences, Charles University in Prague, have been awarded the status of „World centre of excellence on landslide disaster reduction. 2014-2017“ (Fig. 3)



Fig. 4: Result of experiments with Strelce sandstone - a perfect experimental gate, formed by repeated flooding of a loaded block with a rectangular opening.
(Photo: Jiří Bruthans)

- Novel explanation of the mechanism of typical sandstone rock relief formation in cooperation with the Charles University in Prague and the Geological Institute of the CAS, (Nature Geoscience, Vol. 7) (Fig. 4)

- Patent for a device for creating of strong magnetic fields using permanent NdFeB magnets (Fig. 5)



Fig. 5: A-tubes with sets of magnets, B - Air gap with strong magnetic field, C - devices to control the width of the air gaps, D - bolts to adjust the magnet sets
(archive of the IRSM)

2015

- Commissioning and construction of two laboratories with state-of-art equipment: „Centre for Texture Analysis“ and „Laboratory for Thermochemical Dating“

Journals published by the Institute

- Acta Geodynamica et Geomaterialia (AGG) (since 2004, formerly Acta Montana)
- Ceramics – Silicates (since 2012, together with CTU)
- Both journals are included in the databases WOS, Science Citation Index Expanded, Journal Citation Reports and Scopus



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