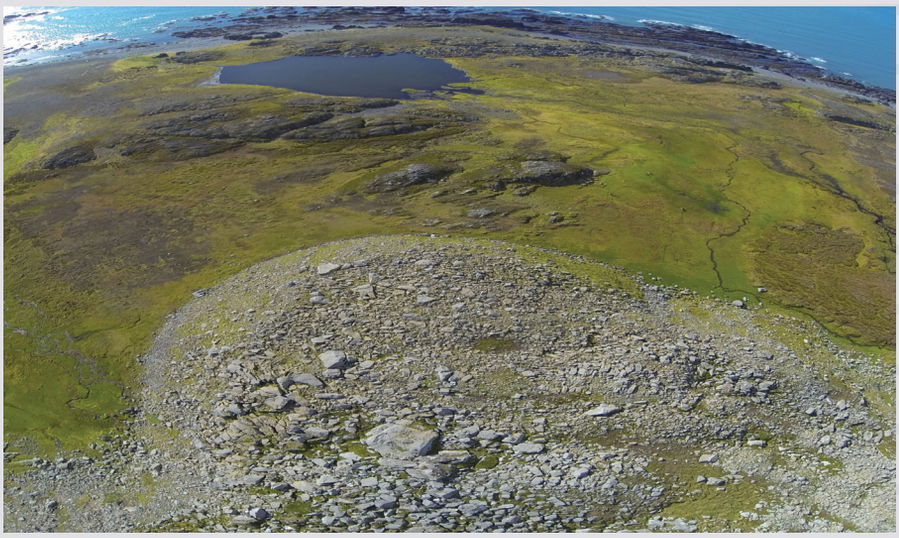
INSTITUTE OF ROCK STRUCTURE AND MECHANICS
The Czech Academy of Sciences

DEPARTMENT OF ENGINEERING GEOLOGY

THEMATIC RESEARCH FOCUS

- **NATURAL HAZARDS AND RISKS**
- **LANDSLIDES AND OTHER SLOPE DEFORMATIONS**
- **PRESENT-DAY TECTONICS AND FAULT MOVEMENTS**
- **GEODYNAMICS OF ARCTIC AND VOLCANIC REGIONS**



Wide-angle photo of rock glacier and coastal plain at Hornsund, Svalbard (NO)

WORLD CENTRE OF EXCELLENCE ON LANDSLIDE DISASTER REDUCTION

The "community-centered landslide disaster risk reduction in changing climate" World Centre of Excellence has been identified by the International Programme on Landslides. It is a joint research centre of the Department of Engineering Geology of the IRSM CAS and the Department of Physical Geography and Geoecology of Charles University in Prague, Faculty of Science.

MAIN RESEARCH INTERESTS

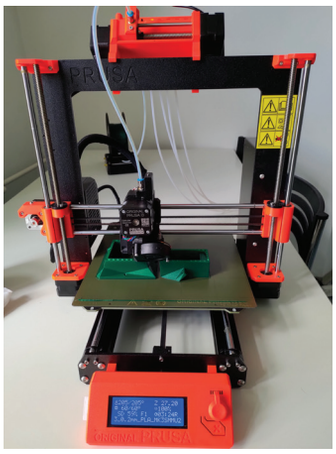
- Multidisciplinary studies of slope deformations using cutting-edge equipment
- Long-term monitoring and assessment of tectonic fault activity
- Geodynamic activity vs. thermal, climatic, seismic and fluid flow phenomena
- Sedimentary rock weathering and erosion, karst phenomena formation
- Slope and tectonic processes in recently deglaciated high Arctic and high Mountains
- Giant landslides on volcanic islands and related phenomena
- Application of advanced technologies in geosciences
- Landslide susceptibility, hazard and risk assessment in societal contexts

MONITORING NETWORKS

- TecNet – world-wide monitoring network using TM-71 on tectonic faults
- SlopeNet – slope deformation activity monitoring network using various devices
- Rocktherm – network monitoring thermal conditions inside the rock together with block movements and environmental parameters
- Geonas – GNSS permanent monitoring network (CR, Svalbard)

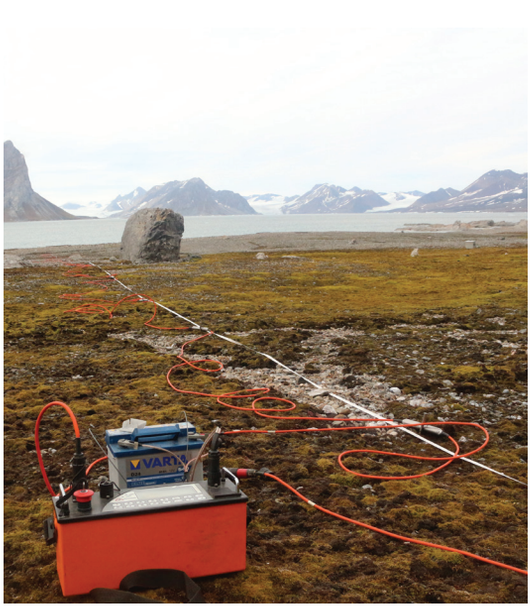
KEY RESEARCH EQUIPMENT

- **Monitoring**
  - TM-71 crack gauges with automatic reading and connection unit
  - HOLLE portable dilatometers
  - Gefran crackmeters with Tertium dataloggers
  - Trimble GNSS permanent stations
  - Fiedler automatic climatic stations
  - DMS multiparametric inclinometer by CSG
- **Field measurements and sampling**
  - HVS 125 drilling rig
  - ARES and ARES II ERT devices
  - Flir E95 IR camera
- **Lab equipment**
  - CTC 256 Memmert climatic test chamber
  - Quanta 450 (SEM) scanning electron microscope
  - Průša 3MK and Felix 3.1 3D printers
- **Surveying and geodesy**
  - DJI Phantom UAV with RGB camera
  - DJI Inspire UAV with RGB and IR cameras
  - Polaris (long-range) and ILRIS 3D terrestrial laser scanners
  - Sokkia and Topcon total stations
  - Topcon HiPer DGNSS



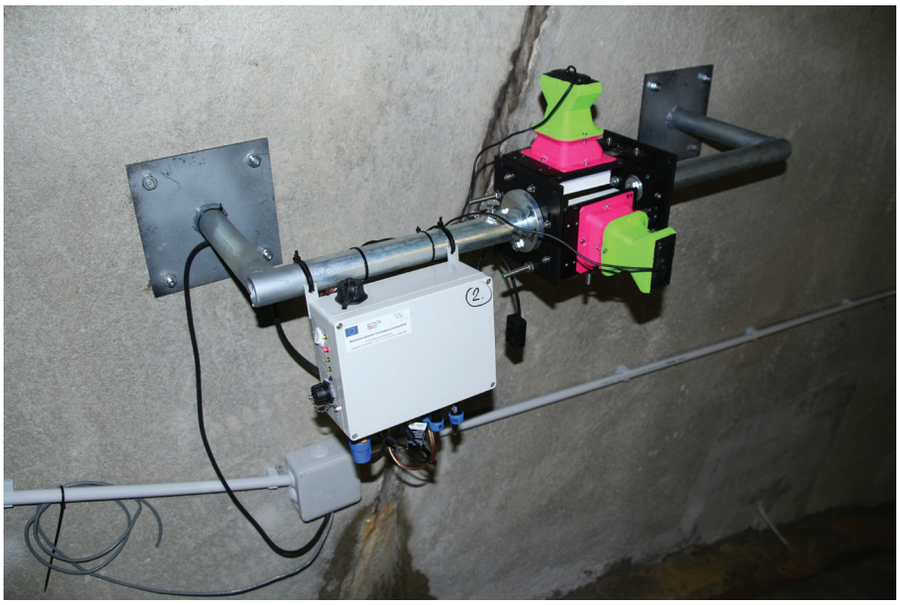
Printing of parts of automatic reading unit for TM-71 dilatometers on a 3D printer

Installation of a DMS multiparametric inclinometer by CSG at the Čeřeniště landslide site (CZ)



ARES ERT device measuring on the rockfall accumulation in Hornsund, Svalbard (NO)

Installation of automatic climatic and environment monitoring station (CZ)



Newly installed current version of the TM-71 automatized 3D dilatometer inside the Horka lake dam (CZ)

ACHIEVEMENTS

● Multidisciplinary studies of slope deformations

Klimeš J., Novotný J., Novotná I., Jordán de Urries B., Vilímek V., Emmer A., Strozzi T., Kusák M., Rapre A.C., Hartvich F., Frey H. (2016): *Landslides in moraines as triggers of glacial lake outburst floods: example of the Palcacocha Lake (Cordillera Blanca, Peru).* Landslides 13, 1461–1477.

Chalupa V., Pánek T., Tábořík P., Klimeš J., Hartvich F., Grygar R. (2018): *Deep-seated gravitational slope deformations controlled by the structure of flysch nappe outlier: insights from large scale electrical resistivity tomography survey and LiDAR mapping.* Geomorphology 321, 174–187.

Pánek T, Klimeš J, (2016): *Temporal behavior of deep-seated gravitational slope deformations: A review.* Earth-Science Reviews 156, 14–38.

● Long-term monitoring of tectonic fault activity

Briestenský M., Rowberry M. D., Stemberk J., Stefanov P., Vozár J., Šebela S., Petro Ľ., Bella P., Gaal Ľ., Ormukov Ch. (2015): *Evidence of a plate-wide tectonic pressure pulse provided by extensometric monitoring in the Balkan Mountains (Bulgaria).* Geologica Carpathica 66 (5), 427–438.

Baroň I., Plan L., Sokol L., Grasemann B., Melichar R., Mitrovic I., Stemberk J. (2019): *Present-day kinematic behaviour of active faults in the Eastern Alps.* Tectonophysics 752, 1–23.

● Geodynamic activity vs. thermal, climatic, seismic and fluid flow phenomena

Blahůt J., Baroň I., Sokoľ L., Meletlidis S., Klimeš J., Rowberry M., Melichar R., García-Cañada L., Martí X. (2018): *Large landslide stress states calculated following extreme climatic and tectonic events on El Hierro, Canary Islands.* Landslides 15, 1801–1814.

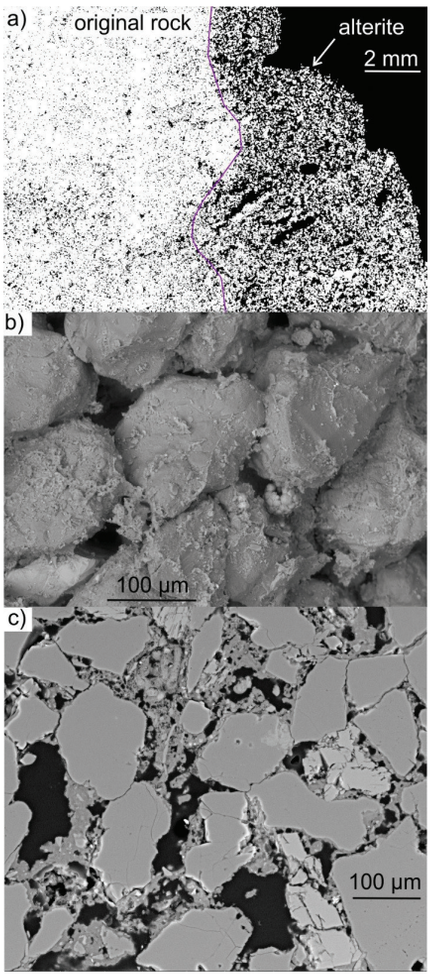
Baroň I., Sokol L., Melichar R., Plan L. (2019): *Gravitational and tectonic stress states within a deep-seated gravitational slope deformation near the seismogenic Periadriatic Line fault.* Engineering Geology 261 (11), 105284.

Stemberk J., Hartvich F., Blahůt J., Rybář J., Krejčí O. (2017): *Tectonic strain changes affecting the development of deep seated gravitational slope deformations in the Bohemian Massif and Outer Western Carpathians.* Geomorphology 289, 3–17.

● Sedimentary rock weathering and erosion

Dubois C., Deceuster J., Kaufmann O., Rowberry M. (2015): *A new method to quantify carbonate rock weathering.* Mathematical Geosciences 47, 889–935.

Kůrková I., Bruthans J., Balák F., Slavík M., Schweigstillová J., Bruthansová J., Mikuš P., Vojtíšek J., Grundloch J. (2019): *Factors controlling evolution of karst conduits in sandy limestone and calcareous sandstone (Turnov area, Czech Republic).* Journal of Hydrology 574, 1062–1073.



Alterite and microcrystalline or amorphous silica in the Illusion Cave. a) Micro-CT section via original rock–alterite transition, b) Alterite in detail, c) Rims of microcrystalline or amorphous silica cementing sand grains in polished section

● Geodynamic processes in high Arctic and high mountains

Hartvich F., Blahůt J., Stemberk J. (2017): *Rock avalanche and rock glacier: A compound landform study from Hornsund, Svalbard.* Geomorphology 276 (1), 244–256.

Installation of vertical wind turbine for powering TM-71 automatic monitoring station in Svalbard (NO)

Klimeš J., Novotný J., Novotná I., Jordán de Urries B., Vilímek V., Emmer A., Strozzi T., Kusák M., Rapre A.C., Hartvich F., Frey H. (2016): *Landslides in moraines as triggers of glacial lake outburst floods: example of the Palcacocha Lake (Cordillera Blanca, Peru).* Landslides 13, 1461–1477.

● Giant landslides on volcanic islands

Blahůt J., Mitrovic-Woodell I., Baroň I., René M., Rowberry M., Blard P.-H., Hartvich F., Balek J., Meletlidis S. (2020): *Volcanic edifice slip events recorded on the fault plane of the San Andrés Landslide, El Hierro, Canary Islands.* Tectonophysics 776, 228317.

Maintenance and upgrading of TM-71 monitoring in a gallery at Hierro Is. (E)

Klimeš J., Yepes J., Becerril L., Kusák M., Galindo I., Blahůt J. (2016): *Development and recent activity of the San Andrés landslide on El Hierro, Canary Islands, Spain.* Geomorphology 261, 119–131.

Blahůt J., Balek J., Klimeš J., Rowberry M., Kusák M., Kalina J. (2019): *A comprehensive global database of giant landslides on volcanic islands.* Landslides 16 (10), 2045–2052.

● Application of advanced technologies in geosciences

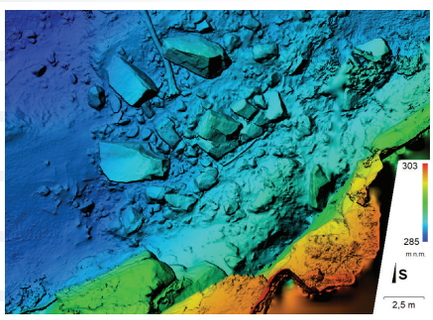
Hartvich F., Tábořík P., Šobr M., Janský B., Kliment Z., Langhammer J. (2020): *Landslide-dammed lake sediment volume calculation using waterborne ERT and SONAR profiling.* Earth Surf. Process. Landforms 45 (14), 3463–3474.

ERT measurement of landslide-dammed lake sedimentary infill across Mladotice lake (CZ)

Langhammer J., Lendzioch T., Miřijovský J., Hartvich F. (2017): *UAV-Based Optical Granulometry as Tool for Detecting Changes in Structure of Flood Depositions.* Remote Sensing 9 (3), AN 240. DOI: 10.3390/rs9030240

● Landslide susceptibility, hazard and risk assessment in societal contexts

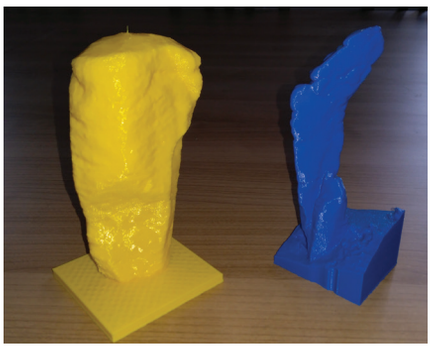
Klimeš J., Stemberk J., Blahůt J., Krejčí V., Krejčí O., Hartvich F., Kycl P. (2017): *Challenges for landslide hazard and risk management in 'low-risk' regions, Czech Republic – landslide occurrences and related costs (IPL project no. 197).* Landslides 14, 771–780.



Svitávka rockfall accumulation - hypsographic map placed over a 3D model created using UAV photogrammetry (CZ)

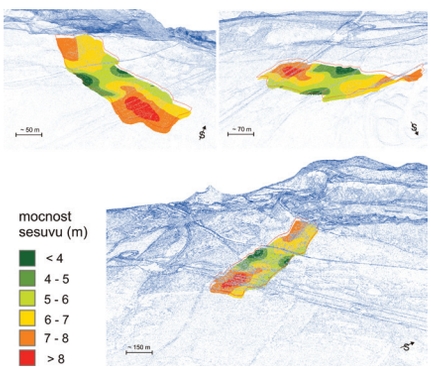
Klimeš J., Hartvich F., Tábořík P., Blahut J., Briestensky M., Stemberk J., Emmer A., Vargas R., Balek J. (2017): *Studies on selected landslides and their societal impacts: activity report of the Prague World Centre of Excellence, Czech Republic.* Landslides, 14, 1547–1553.

Poláky landslide: The scarp and damaged house at the village of Poláky landslide (2014, CZ)



3D models of rock towers "Cukrová homole" ("Sugar Cone", Adršpach rocks) and "Kobyla" ("Mare", Příhrazy) based on a 3D laser scan

Time-lapse monitoring of the rock surface temperature at Branická skála using an IR camera (Prague, CZ)



Modelled depth of the 2013 landslide during the D8 highway construction (Prackovice, CZ)

MAIN COLLABORATING PARTNERS

- Charles University in Prague (Prague, CZ)
- Ostrava University (Ostrava, CZ)
- University of Jan Evangelista Purkyně (Ústí nad Labem, CZ)
- Czech Technical University (Prague, CZ)
- SÚRAO (Prague, CZ)
- Museum of Natural History (Vienna, Austria)
- University of Liège (Belgium)
- Geological Institute of the BAS (Bulgaria)
- Johannes Guttenberg University (Germany)
- Karlsruhe Institute of Technology (Germany)
- TU Darmstadt (Germany)
- Polish Polar Station Hornsund (Svalbard, Norway)
- Institute of Geophysics, Polish Academy of Sciences (Warsaw, Poland)
- University of Environmental and Life Sciences (Wroclaw, Poland)
- Wroclaw University (Poland)
- National Research Institute of Glaciers and Mountain Ecosystems of Peru (Peru)
- National Archaeological Park of Machupicchu (Peru)
- Comenius University in Bratislava (Slovakia)
- Slovak Geological Survey – GÚDŠ (Slovakia)
- Karst Research Institute (Slovenia)
- University of Bern (Switzerland)
- NAGRA (Switzerland)
- Instituto Geográfico Nacional (Tenerife, Spain)
- University of Strathclyde (Scotland, UK)

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