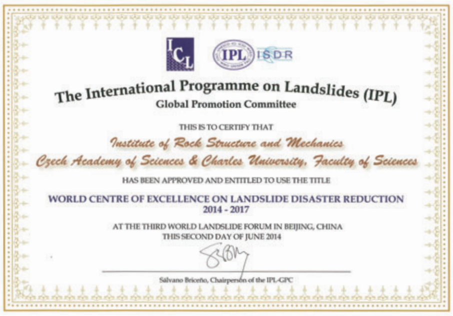
DEPARTMENT OF ENGINEERING GEOLOGY

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

THEMATIC RESEARCH FOCUS

- **NATURAL HAZARDS AND RISKS**
- **LANDSLIDES AND SLOPE DEFORMATIONS**
- **CURRENT FAULT MOVEMENTS**
- **ROCK WEATHERING**



The International Programme on Landslides (IPL)
Global Promotion Committee

THIS IS TO CERTIFY THAT

Institute of Rock Structure and Mechanics
Czech Academy of Sciences & Charles University, Faculty of Sciences

HAS BEEN APPROVED AND ENTITLED TO USE THE TITLE

WORLD CENTRE OF EXCELLENCE ON LANDSLIDE DISASTER REDUCTION
2014 - 2017

AT THE THIRD WORLD LANDSLIDE FORUM IN BEIJING, CHINA
THIS SECOND DAY OF JUNE 2014

Sálvano Briceño, Chairperson of the IPL-GPC

Landslide scarp in Hluboče, Bíle Karpaty, Czechia. Landslide was triggered in spring 2006 after snow thawing. Photo J. Klimeš

WORLD CENTRE OF EXCELLENCE ON LANDSLIDE DISASTER REDUCTION

"Landslide Risk Assessment and Development Guidelines for Effective Risk Reduction" 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 the Charles University in Prague, Faculty of Science.

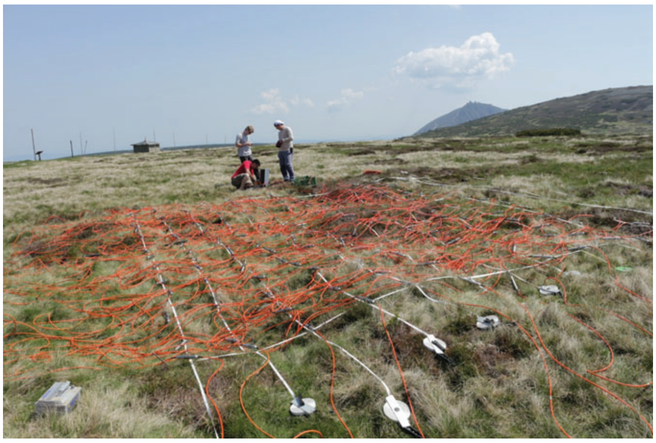
MAIN RESEARCH SUBJECTS

- Observation, assessment and modelling of various natural hazards (slope processes, floods, subsidence etc.)
- Development of methods for precise modelling, visualisation and long-term monitoring of the landscape and geological environment
- High mountains hazards analysis including glacial lakes outburst floods and slope development dynamics analysis after deglaciation in high-Arctic
- Analyses of fault displacements along with other geodynamic phenomena (earthquakes, stress fields, gas flux etc.)
- Modelling of landslide susceptibility, vulnerability, hazard and risks
- Multidisciplinary studies of evolution and dynamics of all types of slope deformations
- Sedimentary rocks weathering processes, karst and pseudokarst phenomena formation and development

KEY RESEARCH EQUIPMENT

- TM-71 crack gauge
- Geoelectric apparatus ARES
- Terrestrial laser scanner ILRIS 3D
- HVS 125 drilling rig
- CTC 256 Memmert climatic test chamber
- Quanta 450 (SEM) scanning electron microscope
- Portable dilatometer HOLLE
- Crackmeter Gefran with GEKO datalogger
- DJI Phantom UAV with GoPro camera

TM-71 crack gauge installed on fault in the forefront of the Hans Glacier in Hornsund, Svalbard. Photo F. Hartvich.



3D measuring of polygonal soils together with colleagues from the Charles University in Prague using an ERT system ARES at Modre Sedlo. In the background Mt. Sněžka (1602 m a.s.l.)

HVS 125 drilling and taking samples from a fault zone in Bílá Voda, Czechia. Photo F. Hartvich.

Jan Blahůt is surveying fault area in Hornsund, Svalbard with ILRIS3D terrestrial laser scanner. Photo M. Hladká.

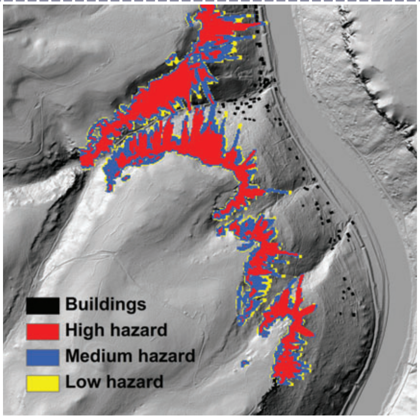
ACHIEVEMENTS

● Landslide susceptibility, hazard and risk

Quan Luna B., Blahůt J., Camera C., van Westen C., Apuani T., Jetten V., Sterlacchini S., 2014. *Physically based dynamic run-out modelling for quantitative debris flow risk assessment: a case study in Tresenda, northern Italy.* Environmental Earth Sciences. 72(3), 645-661. doi: 10.1007/s12665-013-2986-7

Blahůt J., Glade T., Sterlacchini S., 2014. *Debris flows risk analysis and direct loss estimation: the case study of Valtellina di Tirano, Italy.* Journal of Mountain Science, 11(2), 288-307. doi: 10.1007/s11629-013-2806-2

Blahůt J., Klimeš J., Vařilová Z., 2013. *Quantitative rockfall hazard and risk analysis in selected municipalities of the České Švýcarsko national park, Northwestern Czechia.* Geografie, 118(3), 205-220.



Rockfall hazard modelling for part of the Dolní Žleb municipality, Northern Czechia.

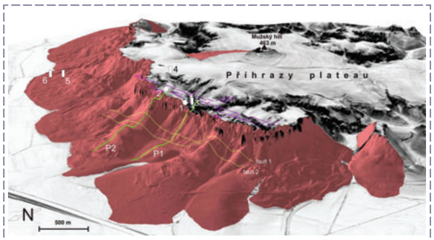
Klimeš J., Blahůt J., 2012. *Landslide risk analysis and its application in regional planning: an example from the highlands of the Outer Western Carpathians, Czech Republic.* Natural Hazards, 64(2), 1779-1803. doi: 10.1007/s11069-012-0339-6

● Multidisciplinary studies of slope deformations

Smolíková J., Blahůt J., Vilímek V., 2015. *Analysis of rainfall preceding debris flows on the Smědavská hora Mt., Jizerské hory Mts., Czech Republic.* Landslides. doi: 10.1007/s10346-015-0601-6

Pánek T., Hartvich F., Jankovská V., Klimeš J., Tábořík P., Bubík M., Smolková V., Hradecký J., 2014. *Large Late Pleistocene landslides from the marginal slope of the Flysch Carpathians.* Landslides, 11(6), 981-992. doi: 10.1007/s10346-013-0463-8

Burda J., Hartvich F., Valenta J., Smítka V., Rybář J., 2013. *Climate-induced landslide reactivation at the edge of the Most Basin (Czech Republic) – progress towards better landslide prediction.* Natural Hazards and Earth System Sciences, 13, 361-374. doi: 10.5194/nhess-13-361-2013



3D view of the NW rim of the Příhrazy Plateau with the studied Mužský Hill deep-seated gravitational slope deformation, Český ráj, Czechia. P1 and P2: ERT profiles; 1 and 2: monitoring sites; 3, 4, 5 and 6: boreholes. Dotted lines - approximate position of faults, observed on ERT profiles.

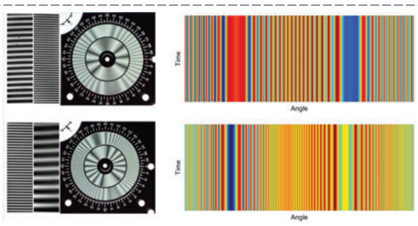
Klimeš J., Vilímek V., 2011. *A catastrophic landslide near Rampac Grande in the Cordillera Negra, northern Peru.* Landslides, 8(3), 309-320.

● Landslide monitoring

Martí X., Rowberry M.D., Blahůt J., 2013. *A MATLAB® code for counting the moiré fringe patterns recorded on the optical-mechanical crack gauge TM-71.* Computers and Geosciences, 52, 164-167. doi: 10.1016/j.cageo.2012.09.029

Klimeš J., Rowberry M.D., Blahůt J., Briestenský M., Hartvich F., Košťák B., Rybář J., Stemberk J., Štěpančíková P., 2012. *The monitoring of slow moving landslides and assessment of stabilisation measures using an optical-mechanical crackgauge.* Landslides, 9, 407-415. doi: 10.1007/s10346-011-0306-4.

Hartvich F., Mentlík P., 2010. *Slope development reconstruction at two sites in the Bohemian Forest Mountains.* Earth Surface Processes and Landforms, 35, 373-389. doi: 10.1002/esp.1932



Real-time monitoring with automated data processing of TM-71 crack gauge measurements is currently under development.

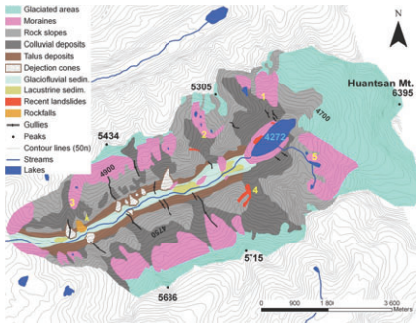
● High mountain hazards

Emmer A., Loarte E. C., Klimeš J., Vilímek V., 2015. *Recent evolution and degradation of the bent Jatunraju glacier (Cordillera Blanca, Peru).* Geomorphology, 228, 345-355. doi: 10.1016/j.geomorph.2014.09.018

Vilímek V., Klimeš J., Emmer A., Benešová M., 2015. *Geomorphologic impacts of the glacial lake outburst flood from Lake No. 513 (Peru).* Environmental Earth Sciences, 73(9), 5233-5244. doi: 10.1007/s12665-014-3768-6

Klimeš J., Benešová M., Vilímek V., Bouška P., Rapre A. C., 2014. *The reconstruction of a glacial lake outburst flood using HEC-RAS and its significance for future hazard assessments: an example from Lake 513 in the Cordillera Blanca, Peru.* Natural Hazards, 71, 1617-1638, doi: 10.1007/s11069-013-0968-4

Novotný J., Klimeš J., 2014. *Grain size distribution of soils within the Cordillera Blanca, Peru: an indicator of basic mechanical properties for slope stability evaluation.* Journal of Mountain Science, 11, 563-577. doi: 10.1007/s11629-013-2836-9



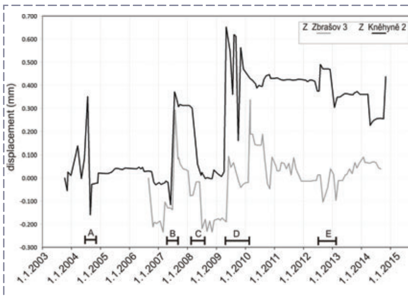
Geomorphological map of glacial valley in Cordillera Blanca in Peru shows variety of processes forming the valley.

● Long-term monitoring of fault movements

Briestenský M., Stemberk J., Rowberry M. D., 2014. *The use of damaged speleothems and in situ fault displacement monitoring to characterise active tectonic structures: an example from Západní Cave, Czech Republic.* Acta Carsologica, 43(1), 129-138. doi: 10.3986/ac.v43i1.626

Košťák B., Mrlina J., Stemberk J., Chán B., 2011. *Tectonic movements monitored in the Bohemian Massif.* Journal of Geodynamics, 52(1), 34-44. doi: 10.1016/j.jog.2010.11.007

Stemberk J., Košťák B., Cacoń S., 2010. *A tectonic pressure pulse and increased geodynamic activity recorded from the long-term monitoring of faults in Europe.* Tectonophysics, 487(1-4), 1-12. doi: 10.1016/j.tecto.2010.03.001



Results of TM-71 crack gauge monitoring site Kněhyně 2 at bottom of the Kněhyně cave (depth 57.5 m under surface) and site No. 3 in the Zbrašov Aragonite Cave. Both curves show Z-axis, i.e. relative uplift and sinking of the blocks. A, B, C, D, E - periods of reported transient fault slips.

Analyses of fault displacements and comparison with other geodynamic phenomenaa

Stemberk J., Briestenský M. , Cacoń S., 2015. The recognition of transient compressional fault slow–slip along the northern shore of Hornsund Fjord, Sw Spitsbergen, Svalbard Polish Polar Research, 36(2), 109-123. doi: 10.1515/popore-2015-0007

Briestenský M., Thinová L., Praksová R., Stemberk J., Rowberry M.D., Knejflová Z., 2014. *Radon, carbon dioxide and fault displacements in Central Europe related to the Tohoku earthquake.* Radiation Protection Dosimetry, 160, 78-82. doi: 10.1093/rpd/ncu090

Hartvich F., Valenta J., 2013. *Tracing an intramontane fault: an interdisciplinary approach.* Surveys in Geophysics, 34 (3), 317-347. doi: 10.1007/s10712-012-9216-9

Briestenský M., Thinová L. Stemberk J., Rowberry M. D., 2011. *The use of caves as observatories for recent geodynamic activity and radon gas concentrations in the Western Carpathians and Bohemian Massif.* Radiation Protection Dosimetry, 145(2-3), 166-172. doi: 10.1093/rpd/ncr080

MAIN COLLABORATING PARTNERS

- Charles University in Prague, Faculty of Science (Prague, CZ)
- Ostrava University, Faculty of Science (Ostrava, CZ)
- University of Jan Evangelista Purkyně, Faculty of Science (Ústí nad Labem, CZ)
- SÚRAO (Prague, CZ)
- Polish Academy of Sciences (Poland)
- Comenius University in Bratislava, Faculty of Science (Slovakia)
- Slovak Geological Survey - GÚDŠ (Slovakia)
- Polish Polar Station Hornsund (Svalbard)
- Wroclaw University of Environmental and Life Sciences (Poland)
- Museum of Natural History (Vienna, Austria)
- Karslruhe Institute of Technology (Germany)
- TU Darmstadt (Germany)
- Geophysical Institute of Peru (Peru)
- National Water Authority (Peru)
- University of Zurich (Switzerland)
- University of Bern (Switzerland)
- NAGRA (Switzerland)
- Karst Research Institute (Slovenia)
- Geological Institute of the BAS (Bulgary)
- University of Strathclyde (Scotland, UK)

Josef Stemberk, Filip Hartvich and Jan Blahůt installing GNSS measuring place in Hornsund fjord, Svalbard. GNSS measurement campaigns are used to monitor regional tectonic movements and isostatic uplift of the Hornsund fjord area. Photo M. Hladká.

Sandstone weathering

Bruthans J., Soukup J., Vaculíková J., Filippi M., Schweigstillová J., Mayo A.L., Mašín D., Kletetschka G., Řihošek J., 2014. *Sandstone landforms shaped by negative feedback between stress and erosion.* Nature Geoscience, 7(8), 597-601. doi: 10.1038/ngeo2209

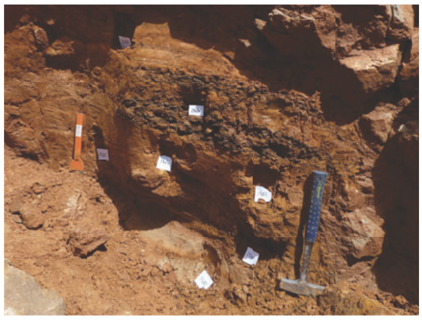
Bruthans J., Svetlik D., Soukup J., Schweigstillova J., Valek J., Sedláčková M., Mayo A., 2012. *Fast evolving conduits in clay-bonded sandstone: Characterization, erosion processes and significance for origin of sandstone landforms.* Geomorphology, 177, 178-193. doi: 10.1016/j.geomorph.2012.07.028

Limestone weathering and karstification

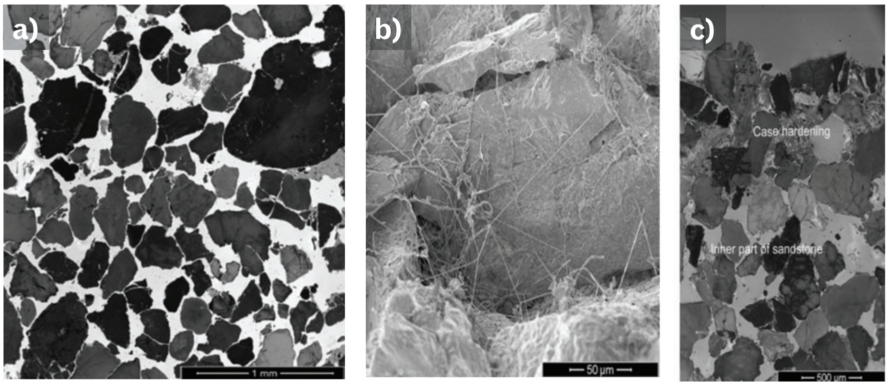
Dubois C., Deceuster J., Kaufmann O., Rowberry M.D., 2015. *A new method to quantify carbonate rock weathering.* Mathematical Geosciences, doi: 10.1007/s11004-014-9581-7.

Dubois C., Quinif Y., Baele J.-M., Barriquand L., Bini A., Bruxelles L., Dandurand G., Havron C., Kaufmann O., Lans B., Maire R., Martin J., Rodet J., Rowberry M.D., Tognini P., Vergari A., 2014. *The process of ghost-rock karstification and its role in the formation of caves.* Earth-Science Reviews, 131, 116-148. doi: 10.1016/j.earscirev.2014.01.006

Rowberry M.D., Battiau-Queney Y., Walsh P. T., Błażejowski B., Bout-Roumazeilles V., Trentesaux A., Křížová L., Griffiths H., 2014. *The weathered Carboniferous Limestone at Bullslaughter Bay, South Wales: the first example of ghost-rock recorded in the British Isles.* Geologica Belgica, 17, 33-42.



Samples of unweathered and weathered limestone are taken to the laboratory and subjected to a range of analytical techniques including calcimetry, granulometry, x-ray diffraction, exoscopy, and thin-section analyses. Photo M. D. Rowberry.



Photomicrographs of sandstone cross sections from the Střeleč quarry, Czechia: a) Sandstone with high porosity and low interlocking; b) Organic fibers (lichen hyphae) from the Střeleč sandstone surface. c) Case hardening on uneven, previously eroded surfaces of Střeleč sandstone; Photo J.Schweigstillová.

USMH

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