INSTITUTE OF ROCK STRUCTURE AND MECHANICS
The Czech Academy of Sciences

DEPARTMENT OF NEOTECTONICS AND THERMOCHRONOLOGY

THEMATIC RESEARCH FOCUS

- **NEOTECTONIC AND LONG-TERM LANDSCAPE EVOLUTION**
- **ACTIVE TECTONICS AND PALEOSEISMICITY**
- **FAULT ARCHITECTURE, KINEMATICS AND STRESS FIELD DYNAMICS**
- **DYNAMICS AND LONG-TERM EVOLUTION OF SLOPE DEFORMATIONS**
- **THERMOCHRONOLOGICAL DATING OF LOW-TEMPERATURE GEOLOGICAL PROCESSES BY U-Th/He**

Mariánské Lázně Fault zone cutting and deforming Pliocene and Quaternary sediments exposed in the trench at the Kopanina site in West Bohemia

MAIN SCOPE OF RESEARCH

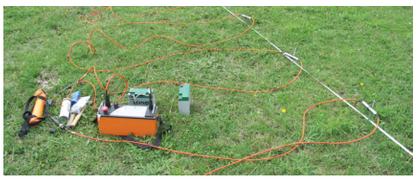
- Study of Quaternary tectonic activity and paleoseismicity in various geological regions by means of mapping, trenching, dating, and geophysical surveying.
- Investigation of long-term morphotectonic evolution of studied areas as well as their thermal history.
- Investigation of fault characteristics, kinematics, and reactivation processes during geological history including fault rocks studies and their dating, and alteration processes.
- Regional geodynamic evolution based on a multidisciplinary approach comparing tectonic processes, volcanism, sedimentation, denudation, and geomorphological development.
- Acquisition of data on geological conditions for hazard assessment.
- Analyses of post-Cretaceous tectonics on dated volcanic rocks.
- Application and testing of various geophysical methods for the identification of subsurface structures (fault detection, landslide internal structure, etc.).
- Long-term development of slope deformations with regard to structural conditions (using complex geomorphological, geotechnical, and geophysical surveys).
- Monitoring of fault displacements on active faults within plate boundaries (California) as well as in the intraplate Bohemian Massif (Czech Republic).

KEY RESEARCH EQUIPMENT

- ARES I and ARES II automatic resistivity systems (GF Instruments, CZ)
- Geode 24-channel seismograph (Geometrics)
- CMD Explorer conductivity meter (GF Instruments)
- Ramac X3M ground penetrating radar system (Malå GeoScience) – (in collaboration with Charles University, Prague)
- The Alphachron™ automated helium thermochronology instrument
- Wilfley gravity separation table
- BB50 Retsch jaw crusher
- Fritsch autosieve system
- TM71 optical-mechanical dilatometer

Displacement monitoring on the Superstition Hills Fault, California, using a TM71 mechanical dilatometer with automated data recording

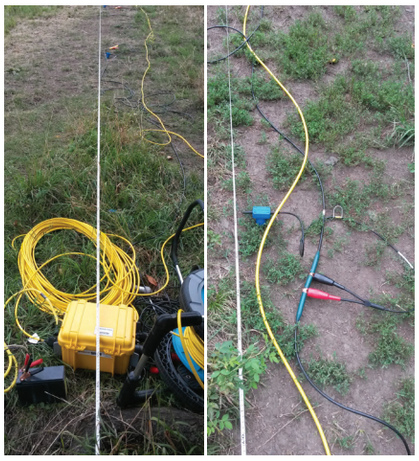
Malå Ramac system (100 MHz antenna) - ground penetrang radar is used for determination of sedimentary layers or extent of alluvial fans



ERT measurements using the ARES resistivity system. Searching for the Sudec Marginal Fault - its location and trace at Bílá Voda site

The Alphachron™ automated helium thermochronology instrument is a turnkey system for the automated extraction and measurement of radiogenic helium from mineral samples

Wilfley shaking table is used for gravity mineral separation from suspension



Geode seismic system used to examine the structure and elastic properties of rocks

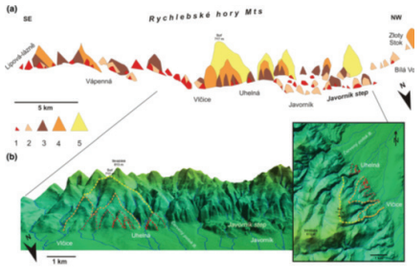
Conductivity measurements using the CMD Explorer serve as a powerful tool for determining the areal extent of sedimentary features (e.g. alluvial fans, colluvial deposits, etc.)

ACHIEVEMENTS

- **Neotectonic and long-term landscape evolution**

Štěpančíková P., Stemberk J. jr (2016): *Region of the Rychlebské hory Mountains – tectonically controlled landforms and unique landscape of granite inselbergs (Sudetic Mountains).* In: Pánek T., Hradecký J. (Eds.): Landscapes and Landforms of the Czech Republic, Series World Geomorphological Landscapes. Springer, 2016, 263–276.

Stemberk J., Štěpančíková P., Tábořík P., Coubal M. (2017). *Valley evolution of the Biala Lądecka drainage network during late Cenozoic, Lower Silesia, Poland. Proceedings of the 8th International INQUA Meeting on Paleoseismology, Active Tectonics and Archeoseismology. Handbook and Programme. 13–16 November 2017.* Lower Hutt: GNS Science, 2017, 374–377. GNS Science miscellaneous, 110.



Perspective drawing of staircase-like arranged faceted spurs along the Czech portion of the Sudetic Marginal fault (a) and 3D view of digital elevation model with facets around Uhelná village (b)

Špaček P., Bábek O., Štěpančíková P., Švancara J., Pazdírková J., Sedláček J. (2015): *The Nysa-Morava Zone: an active tectonic domain with Late Cenozoic sedimentary grabens in the Western Carpathians' foreland (NE Bohemian Massif).* International Journal of Earth Sciences 104 (4), 963–990.

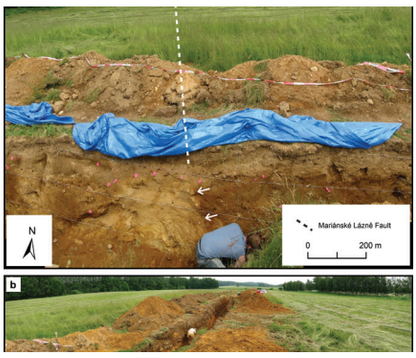
Balatka B., Kalvoda J., Steklá T., Štěpančíková P. (2019): *Morphostratigraphy of river terraces in the Eger valley (Czechia) focused on the Smrčiny Mountains, the Chebská pánev Basin and the Sokolovská pánev Basin.* AUC GEOGRAPHICA 54 (2), 240–259.

- **Paleoseismology**

Štěpančíková P., Fischer T., Stemberk J. jr., Nováková L., Hartvich F., Figueiredo P.M. (2019): *Active tectonics in the Cheb Basin: youngest documented Holocene surface faulting in Central Europe?* Geomorphology 327, 472–488.

Masana E., Moreno X., Gràcia E., Pallàs R., Ortuño M., López R., Gómez-Novell O., Ruano

P., Perea H., Štěpančíková P., Khazaradze G., (2018): *First evidence of paleoearthquakes along the Carboneras Fault Zone (SE Iberian Peninsula): Los Trances site.* Geologica Acta 16 (4), 461–476.



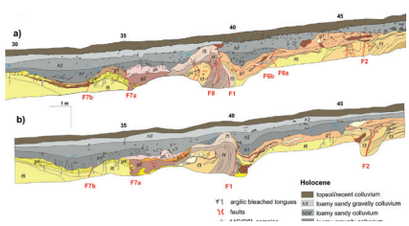
The Kopanina trenching site at the Mariánské Lázně fault where Holocene faulting was proven.

Ortuño M., Corominas O., Villamor P., Zúñiga R.F., Lacan P., Aguirre-Díaz G., Perea H., Štěpančíková P., Ramírez-Herrera M.T. (2019): *Evidence of recent ruptures in the central faults of the Acambay graben (Central Mexico).* Geomorphology 326, 17–37.

Rockwell T.K., Masana E., Sharp W.D., Štěpančíková P., Ferrater M., Mertz-Kraus R. (2019): *Late Quaternary slip-rates for the southern Elsinore fault in the Coyote Mountains, southern California from analysis of alluvial fan landforms, clast provenance, soils, and U-series dating of pedogenic carbonate.* Geomorphology 326, 68–89.

Rockwell T.K., Fletcher J.M., Teran O.J., Hernandez A.P., Mueller K.J., Salisbury J.B., Akciz S.O., Štěpančíková P. (2015): *Reassessment of the 1892 Laguna Salada Earthquake: Fault Kinematics and Rupture Patterns.* Bulletin of the Seismological Society of America 105 (6), 2885–2893.

Bábek O., Briestenský M., Přecechtělová G., Štěpančíková P., Hellstrom J.C., Drysdale R. N. (2015): *Pleistocene speleothem fracturing in the foreland of the Western Carpathians: a case study from the seismically active eastern margin of the Bohemian Massif.* Geological Quaterly 59 (3), 491–506.



Trench log of the Kopanina site with offset and deformed Holocene sediments along the Mariánské Lázně fault.

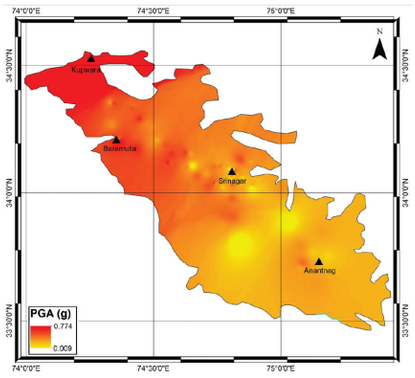
Špaček P., Valenta J., Tábořík P., Ambrož V., Urban M., Štěpančíková P. (2017): *Fault slip versus slope deformations: Experience from paleoseismic trenches in the region with low slip-rate faults and strong Pleistocene periglacial mass wasting (Bohemian Massif).* Quaternary International 451, 56–73.

● Seismic hazard

Sana H. (2018): *Seismic microzonation of Srinagar city, Jammu and Kashmir.* Soil Dynamics and Earthquake Engineering 115, 578–588.

Sana H. (2019): *A probabilistic approach to the seismic hazard in Kashmir basin, NW Himalaya.* Geoscience Letters 6, 5.

Sana H., Nath S.K., Gujral K.S. (2019): *Site response analysis of the Kashmir valley during the 8 October 2005 Kashmir earthquake (Mw 7.6) using a geotechnical dataset.* Bulletin of Engineering Geology and the Environment 78, 2551–2563.



Peak ground acceleration of the 8 October 2005 Kashmir earthquake

Zábranová E., Matyska C., Stemberk J. jr., Málek J. (2020): *Eigenoscillations and Stability of Rocking Stones: The Case Study of "The Hus Pulpit" in The Central Bohemian Pluton.* Pure and Applied Geophysics 177, 1907–1916.

● Applied geophysics

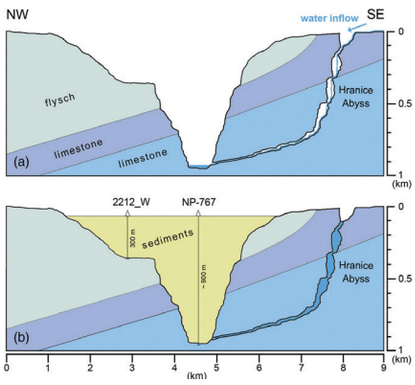
Blecha V., Fischer T., Tábořík P., Vilhelm J., Klanica R., Valenta J., Štěpančíková P. (2018): *Geophysical evidence of the Eastern Marginal Fault of the Cheb Basin (Czech Republic).* Studia Geophysica et Geodetica 62/4, 660–680.

Petronis M., Valenta J., Rapprich V., Lindline J., Heizler M., Van Wyk de Vries B., Shields S., Balek J., Fojtíková L., Tábořík P. (2018): *Emplacement History of the Miocene Zebín Tuff Cone (Czech Republic) revealed from Ground Geophysics, Anisotropy of Magnetic Susceptibility, Paleomagnetic, and 40Ar/39Ar Geochronology Data.* Geochemistry, Geophysics, Geosystems 19/10, 3764–3792.

Uxa T., Křížek M., Krause D., Hartvich F., Tábořík P., Kasprzak M. (2019): *Comment on "Geophysical approach to the study of a periglacial blockfield in a mountain area (Ztracené kameny, Eastern Sudetes, Czech Republic)" by Stan et al. (2017).* Geomorphology 328, 231–237.

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

Klanica R., Kadlec J., Tábořík P., Mrlina J., Valenta J., Kováčiková S., Hill G.J. (2020): *Hypogenic versus epigenic origin of deep underwater caves illustrated on the Hranice Abyss (Czech Republic) – the world's deepest freshwater cave.* Journal of Geophysical Research: Earth Surface 125 (9), e2020JF005663.



Conceptual geological cross-section through the Hranice Abyss and Carpathian Foredeep: (a) situation during the early Langhian, when the CF opened and the HA originated, (b) current state with boreholes.

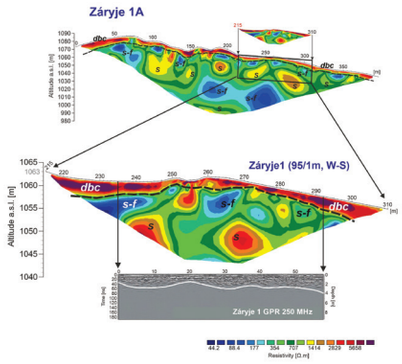
● Long-term development of slope deformations

Urban, J., Pánek, T., Hradecký, J., Tábořík, P. (2015): *Deep structures of slopes connected with sandstone crags in the upland area of the Świętokrzyskie (Holy Cross) Mountains, Central Poland.* Geomorphology 246, 519–530.

Stacke V., Tábořík P. (2015): *Interaction of the hillslopes and valley bottoms on the NW slope of the Lysá hora Mt., the highest peak of the Western Beskids.* Carpathian Journal of Earth and Environmental Sciences 10 (2), 159–174.

Klimeš J., Hartvich F., Tábořík P., Blahut J., Briestenský 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 (4), 1547–1553.

Tábořík P., Lenart J., Blecha V., Vilhelm J., Turský O. (2017): *Geophysical anatomy of counter-slope scarps in sedimentary flysch rocks (Outer Western Carpathians).* Geomorphology 276, 59–70.



GPR results compared to ERT pseudosections revealed the thickness of the colluvial mantle and surface of the underlying flysch bedrock at the Záryje site.

Lenart J., Kašing M., Tábořík P., Piotrowska N., Pawlyta J. (2018): *The Cyrilka Cave – the longest crevice-type cave in Czechia: structural controls, genesis, and age.* International Journal of Speleology 47 (3), 379–392.

Březný M., Pánek T., Lenart J., Grygar R., Tábořík P., McColl S.T. (2018): *Sackung and enigmatic mass movement folds on a structurally-controlled mountain ridge.* Geomorphology 322, 175–187.

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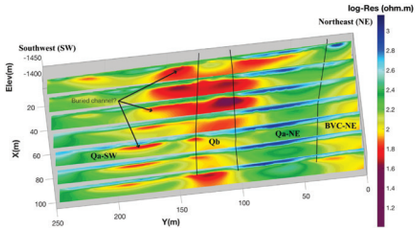
Březný M., Pánek T., Braucher R., Šilhán K., Chalupa V., Lenart J., Tábořík P., Aster Team (2020): *Old but still active: >18 ka history of rock slope failures affecting a flysch anticline.* Landslides 18, 89–104.

- **Fault architecture, kinematics and stress field dynamics**

Stemberk J. jr., Coubal M., Stemberk J., Štěpančíková P. (2019): *Stress analysis of fault slips data recorded within Dědičná štola Gallery in the Rychlebské hory Mts., NE part of the Bohemian massif.* Acta Geodynamica et Geomaterialia 16, No. 3 (195), 315–330.

Coubal M., Zelenka P., Stemberk J. jr. (2019): *Record of Alpine tectonic activity of the Železné hory Fault expressed by brittle deformation within its southeastern segment.* Geoscience Research Reports 52 (2), 141–146.

Share P.-E., Tábořík P., Štěpančíková P., Stemberk J., Rockwell T.K., Wade A., Arrowsmith J.R., Donnellan D., Vernon F.L., Ben-Zion Y. (2020): *Characterizing the uppermost 100 m structure of the San Jacinto fault zone southeast of Anza, California, through joint analysis of geologic, topographic, seismic and resistivity data.* Geophysical Journal International 222 (2), 781–794.



Resistivity inversion results showing the individual fault strands as continuous conductive features (warmer colours).

Coubal M., Málek J., Adamovič J., Štěpančíková P. (2015): *Late Cretaceous and Cenozoic dynamics of the Bohemian Massif inferred from the paleostress history of the Lusatian Fault Belt.* Journal of Geodynamics 87, 26–49.

Slickensides cutting basaltic lava flows of Pliocene age (5 Ma), the Kozákov Hill area

MAIN COLLABORATING PARTNERS

- Charles University (Prague, CZ)
- Masaryk University (Brno, CZ)
- University of Ostrava (Ostrava, CZ)
- Palacký University (Olomouc, CZ)
- University of West Bohemia (Pilsen, CZ)
- Geological Institute of the CAS (Prague, CZ)
- Geophysical Institute of the CAS (Prague, CZ)
- Institute of Geonics of the CAS (Brno, CZ)
- Czech Geological Survey (Prague, Brno, CZ)
- GEOtest, a.s. (Ostrava, CZ)
- G Impuls Praha (Prague, CZ)
- Barcelona University (Spain)
- Polish Geological Survey (Wroclaw, Poland)
- University of Wroclaw (Poland)
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- Leipzig University (Germany)
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- Tel Aviv University (Tel Aviv, Israel)
- UNAM (Querétaro, Mexico city, Mexico)
- Vienna University (Wien, Austria)
- Institut de Physique du Globe de Paris (France)
- University of Sheffield (United Kingdom)
- Imperial College London (United Kingdom)
- University of Calcutta (India)
- Department of Geology and Mining, Government of Jammu and Kashmir (Kashmir, India)
- Geological Institute "Strashimir Dimitrov" of the BAS (Sofia, Bulgaria)

V Holešovičkách 94/41,
182 09 Praha 8, Czech Republic
www.irsm.cas.cz

RNDr. Petra Štěpančíková, Ph.D..
Head of Department
Phone: +420 266 009 328; E-mail: stepancikova@irsm.cas.cz