DEPARTMENT OF NEOTECTONICS AND THERMOCHRONOLOGY

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

THEMATIC RESEARCH FOCUS

- NEOTECTONIC AND LONG-TERM LANDSCAPE EVOLUTION
- QUATERNARY TECTONIC ACTIVITY AND PALEOSEISMICITY
- FAULT ARCHITECTURE AND KINEMATICS
- FIELD MAPPING OF BRITTLE STRUCTURES
- 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 Plio-Quaternary sediments exposed on the trench wall at Kopanina site in West Bohemia. Photo P. Štěpančíková.

MAIN RESEARCH SUBJECTS

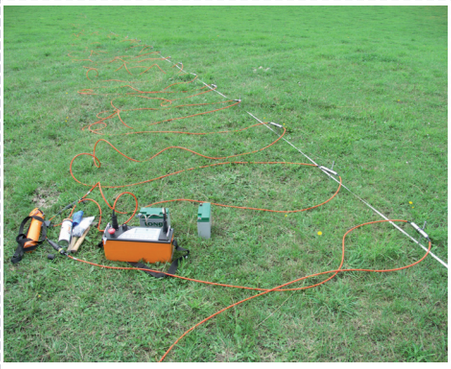
- Study of Quaternary tectonic activity and paleoseismicity in various geological regions by means of mapping, geophysical surveying, trenching, and dating
- Investigation of long-term morphotectonic evolution of studied areas as well as their thermal history
- Investigation of fault characteristics,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

KEY RESEARCH EQUIPMENT

- Automatic resistivity system ARES (GF Instruments, CZ)
- Geode 24-channel Seismograph (Geometrics)
- Conductivity measurement device CMD Explorer (in collaboration with Charles University in Prague)
- Ground penetrating radar Malå Ramac X3M system (in collaboration with Charles University in Prague)
- Alphachron™ automated helium thermochronology instrument
- Gravity separation table Wilfley
- Jaw crusher BB50 Retsch
- Autosieve system Fritsch
- Mechanical dilatometer TM71

Autosieve system Fritsch (vibratory sieve shaker) used for grain size analysis of soil samples.

Alphachron™ automated helium thermochronology instrument is a turn-key system for the automated extraction and measurement of radiogenic helium from mineral samples.



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

Seismic system Geode used for examining of structure and elastic properties of rocks. Photo P. Tábořík

Measurements of conductivity by CMD Explorer serve as a powerful tool for determination of areal extent of sedimentary features (e. g. alluvial fans, colluvial deposits etc.). Photo J. Šreinová

Displacement monitoring on the Superstition Hills Fault, California, by mechanical dilatometer TM71 with automated data recording. Photo P. Štěpančíková

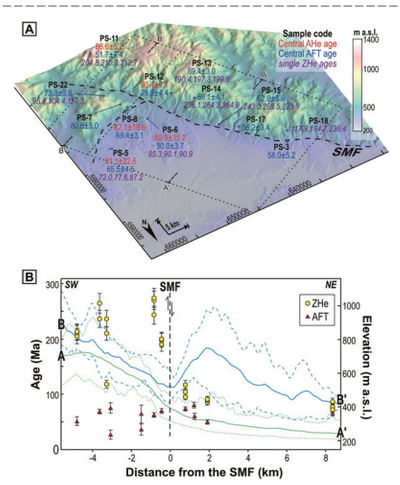
Malå Ramac system (100 MHz antenna)- ground penetrating radar is used for determination of sedimentary layers or extent of alluvial fans. Photo P. Štěpančíková

ACHIEVEMENTS

Long-term landscape evolution

Štěpančíková P., Stemberk J., Vilímek, V., Košťák B.(2008): *Neotectonic development of drainage networks in the East Sudeten Mountains and monitoring of recent fault displacements (Czech Republic).* Special Issue on: Impact of active tectonics and uplift on fluvial landscapes and river valley development, Geomorphology. 102 (1), 68-80

Danišík, M., P. Štěpančíková, and N. Evans (2012), *Constraining long-term denudation and faulting history in intraplate regions by multi-system thermochronology - an example of the Sudetic Marginal Fault (Bohemian Massif, Central Europe)*, Tectonics, Vol. 31, Tc2003, 19pp



a) Thermochronological results plotted on a DEM of Rychlebské hory Mts (b) Bedrock ZHe and AFT ages along the two swath profiles plotted as a function of distance from the Sudetic Marginal Fault.

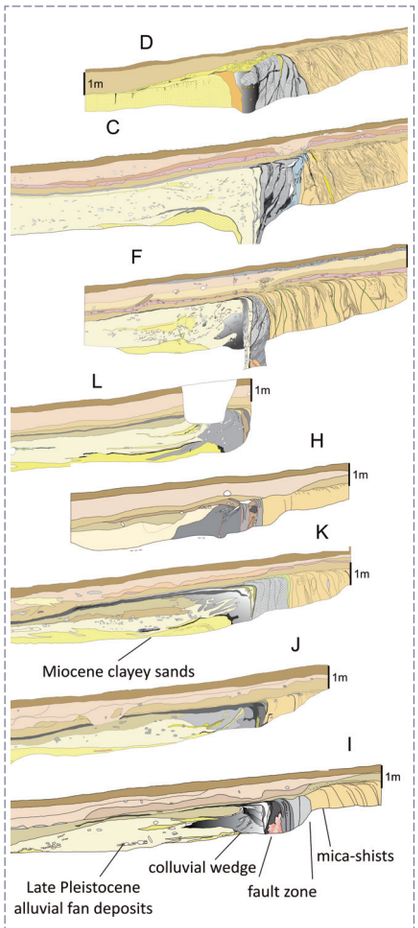
Paleoseismology

Štěpančíková P., Hók J., Nývlt D., Dohnal J., Sýkorová I., Stemberk J. (2010): *Active tectonics research using trenching technique on the south-eastern section of the Sudetic Marginal Fault (NE Bohemian Massif, central Europe)*. Tectonophysics, Vol. 485, 1-4, 269–282

Paleoseismological 3D trenching across the Sudetic Marginal Fault at Bílá Voda site. Photo P. Štěpančíková

Ortuño M., Masana E., García-Meléndez E., Martínez-Díaz J., Štěpančíková P., Canora C., P. Cunha P., Sohbati R., Buylaert JP, Murray A. S. (2012): *An exceptionally long paleoseismic record of a slow-moving fault: The Alhama de Murcia fault (Eastern Betic shear zone, Spain)*. Geological Society of America Bulletin, Vol. 124; no. 9/10; p. 1474–1494

Wechsler N., Rockwell T.K., Klinger Y., Štěpančíková P., Kanari M., Marco S., Agnon A. (2014): *A Paleoseismic Record of Earthquakes for the Dead Sea Transform Fault between the First and Seventh Centuries C.E.: Nonperiodic Behavior of a Plate Boundary Fault*. Bulletin of the Seismological Society of America, Vol. 104, 3, pp. 1329-1347



Geological logs of trenches across the Sudetic Marginal Fault at Bílá Voda site.

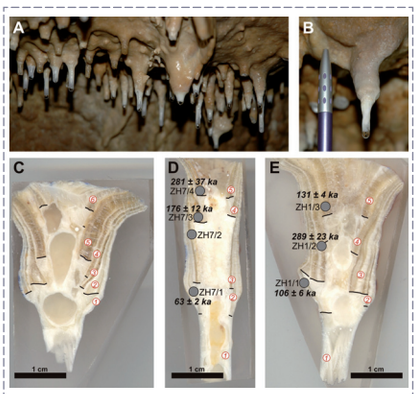
Štěpančíková P., Rockwell T., Hartvich F., Tábořík P., Stemberk Jakub, Ortuño M., Wechsler N. (2013): *Late Quaternary Activity of the Sudetic Marginal Fault in the Czech Republic: A signal of Ice Loading? Seismic Hazard, Critical Facilities and Slow Active Faults (C. Grutzner, A. Rudersdorf, R. Peréz-Lopéz, K. Reicherter, eds.)* 4th International INQUA Meeting on Paleoseismology, Active tectonics and Archeoseismology, Aachen, Germany, 259-262

Neotectonics and tectonic geomorphology

Štěpančíková, P., Stemberk J. jr (2015): *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

Špaček P., Bábek O., Štěpančíková P., Švancara J., Pazdírková J., Sedláček J. (2014): *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: Vol. 104, 4 (2015), 963-990

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

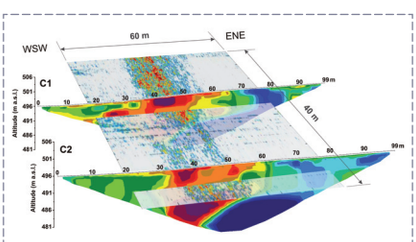


Stalactites deformation and their U/Th dating from the Za Hájovnou Cave.

Applied geophysics

Fischer, T., Štěpančíková, P., Karousová, M., Tábořík, P., Flechsig, C., Gaballah, M., 2012. *Imaging the Mariánské Lázně Fault (Czech Republic) by 3-D ground-penetrating radar and electric resistivity tomography.* Stud. Geophys. Geod. 56, Issue 4, pp. 1019-1036

Štěpančíková P., Dohnal J., Pánek T., Łój M., Smolková V., Šilhán K.: *The application of electrical resistivity tomography and gravimetric survey as useful tools in an active tectonics study of the Sudetic Marginal Fault (Bohemian Massif, central Europe)*. Journal of Applied Geophysics (2011), Vol. 74, 69-80



Visualisation of the Mariánské Lázně Fault zone by means of combined 3-D ERT/GPR measurements. Example of successful application of combined geophysical surveying.

MAIN COLLABORATING PARTNERS

- Charles University (Prague, CZ)
- Masaryk University (Brno, CZ)
- University of Ostrava (Ostrava, CZ)
- Palacký University (Olomouc, CZ)
- University of West Bohemia (Plzeň, CZ)
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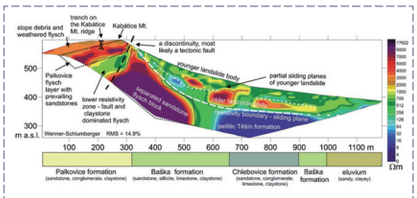
- Geophysical Institute AS CR, v.v.i. (Prague, CZ)
- Institute of Geonics AS CR, v.v.i. (Brno, CZ)
- Czech Gelogical Survey (Prague, Brno, CZ)
- GEOtest, a.s. (Ostrava)
- Barcelona University (Spain)
- Polish Geological Survey (Wroclaw, Poland)
- University of Wroclaw (Poland)
- Komenský University (Bratislava, Slovakia)
- University of Göttingen (Germany)
- Leipzig University (Germany)
- Ludwig Maximilians University Munich (Germany)
- San Diego State University (California, USA)
- Tel Aviv University (Tel Aviv, Izrael)
- UNAM (Querétaro, Mexico)
- Vienna University (Wien, Austria)
- Institut de Physique du Globe de Paris (France)
- University of Science and Technology(Krakow, Poland)
- Arba Minch University (Arba Minch, Ethiopia)
- University of Sheffield (United Kingdom)
- Imperial College London (United Kingdom)
- Curtin University (Perth, Australia)

Monitoring of active landslides

Prokešová, R., Kardoš, M., Tábořík, P., Medveďová, A., Stacke, V., Chudý, F. (2014): *Kinematic behaviour of a large earthflow defined by surface displacement monitoring, DEM differencing, and ERT imaging.* Geomorphology 224, 86-101

Prokešová R., Medveďová A., Tábořík P., Snopková Z., (2013): *Towards hydrological triggering mechanisms of large deep-seated landslides.* Landslides 10 (3), 239-254

Tábořík P., Pánek T., Lenart J., Prokešová R., Medveďová A., (2012): *Geoelectrical imaging of slope deformations – towards repeated measurements, effective electrode array and limitations.* Berichte Geol. B.-A., Vol. 93, 198-203



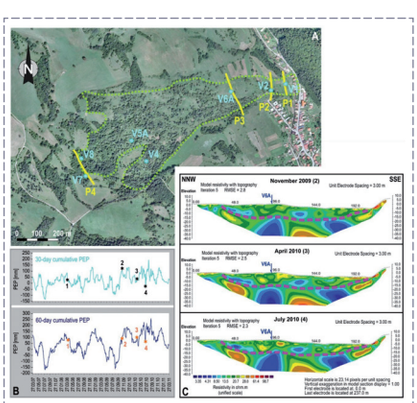
Geomorphic interpretation of the ERT section with emphasis on slope deformations: a detailed view of the main scarp of the Kabátice landslide.

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, Vol. 10(2), 159 – 174

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



Repeated ERT measurements on profile P-3 compared to 30- and 60-day cumulative precipitations landslide. Position of the P-3 profile indicated in the ortophotomap.

Fault architecture and kinematics

M. Coubal, J. Adamovič, J. Málek, V. Prouza, 2014. *Architecture of thrust faults with along-strike variations in fault-plane dip: anatomy of the Lusatian Fault, Bohemian Massif.* – Journal of Geosciences Vol. 59, 183-208

Slickensides with striae cutting sandstone of Triassic age, vincinity of the Hronov-Poříčí Fault. Photo M. Coubal.

Late Cenozoic paleostress history of Bohemian Massif

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 Vol. 87, 26-49

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

USMH

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