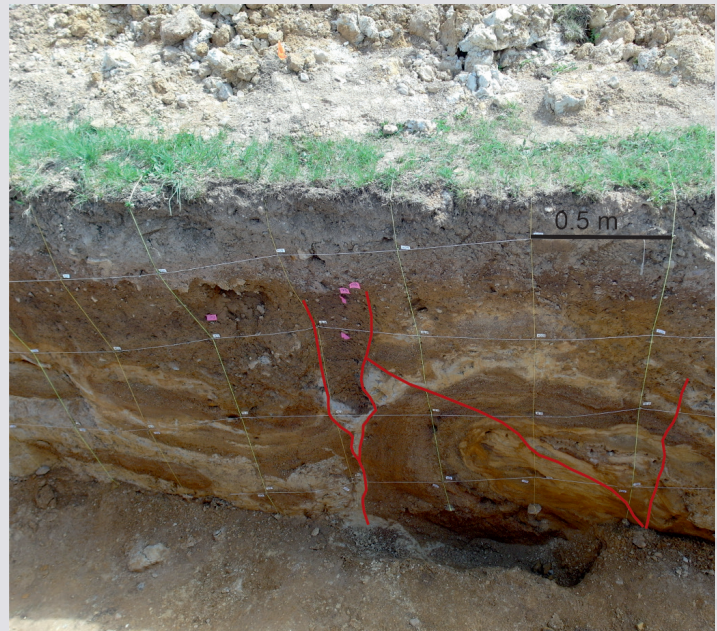




# DEPARTMENT OF NEOTECTONICS AND THERMOCHRONOLOGY

## 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

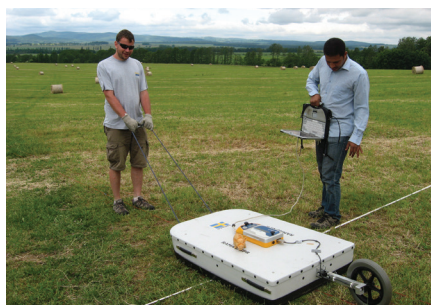
- Study of Quaternary tectonic activity and paleoseismicity in various geological regions by means of mapping, trenching, dating, and geophysical surveying.
- Investigation of long-term morphotectonic evolution of the studied areas as well as their thermal history.
- Investigation of fault characteristics, kinematics, and reactivation processes during geological history including fault rocks studies, their dating, and related 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 (e.g. fault detection, internal structure of landslides).
- Long-term development of slope deformations with regard to structural conditions (based on integrated 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).
- Use of low temperature thermochronology for dating the exhumation process of Alpine-Himalayan orogenic belt.
- Application of low temperature thermochronology to understand the exhumation and preservation of porphyry copper deposits in the Tethyan metallogenic belt.

## KEY RESEARCH EQUIPMENT

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



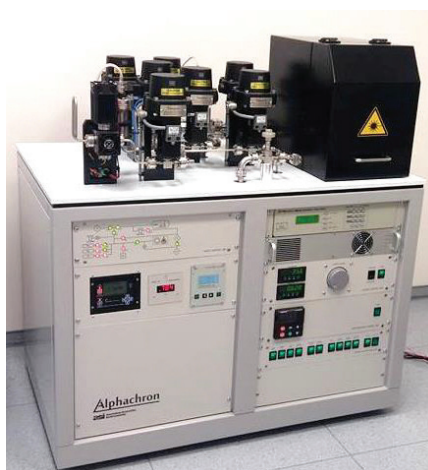
Monitoring of displacements along the Superstition Hills Fault (see the fissure) carried out by extensometer TM71 with automated .data recording.



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



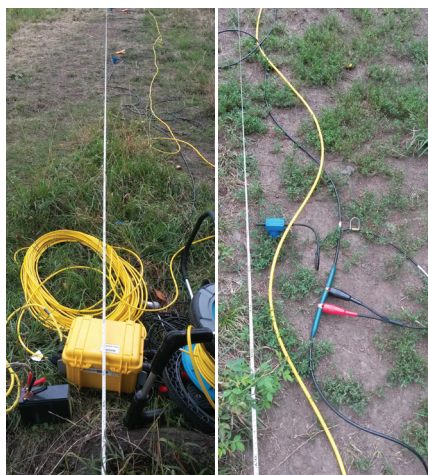
Electric resistivity measurements using ARES resistivity system. Searching for the Superstition Hills fault, southern California.



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.



Seismic system Geode used for examining of 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

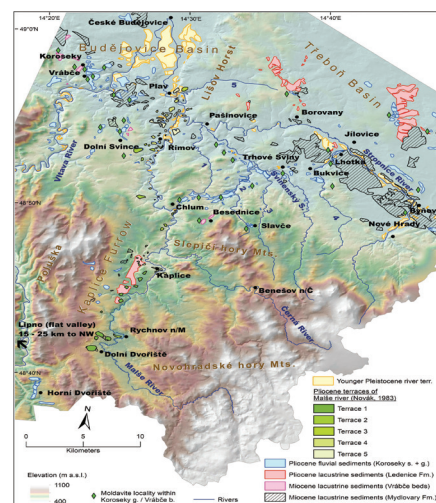
### ● Neotectonic and long-term landscape evolution

Özkaptan M., Gülyüz E., Kaymakçı N., Langereis C. (2021): Neogene restoration of geometry of the Neotethyan suture zone in Central Anatolia (Turkey). *International Geology Review* 64 (21), 2985-3004. ISSN 0020-6814. E-ISSN 1938-2839.

Özkaptan, M., Gülyüz, E., Uzel, B., Özacar, A.A., Langereis, C.G., Kaymakçı, N., (2021): Deformation in SW Anatolia (Turkey) Documented by Anisotropy of Magnetic Susceptibility (AMS) Data. *Tectonics*, 40, e2021TC006882.

Flašar J., Štěpančíková P. (2022): Geomorphological evidence of tectonic activity of the Mariánské Lázně Fault (Czech Republic) and its influence on stream network evolution. *Acta Geodyn. Geomater.* 19/1 (204).

Flašar J., Štěpančíková P. (2022): Plio-Pleistocene paleodrainage reconstruction using moldavite-bearing and morphostratigraphically related deposits (Southern Bohemia, Czech Republic). *Palaeogeography, Palaeoclimatology, Palaeoecology*. Volume 586, 110783, ISSN 0031-0182.

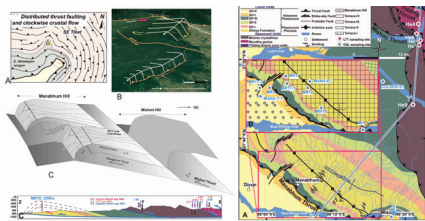


Late Cenozoic sediments in the area of Novohradské hory Mts. showing the hydrogeographical paleogeographical evolution.

Goswami Chakrabarti C., Narzary B., Weber J. C., Jana P., Bhattacharjee S., Jaiswal M. (2022): Preliminary Study of the Manabhum Anticline: A Possible Key to Better Understanding the Quaternary Tectonics of the Eastern Himalayan Syntaxial Zone. In Bhattacharya H. N., Bhattacharya S., Das B. C., Islam A. (eds.): *Neotectonic Movements and Channel*. Society of Earth Scientists Series. pp 239–260. Springer Nature.

Flašar J., Martínek K., Verner K., Kalinová R. (2023): Neogene-Quaternary response of the Novohradské hory Mts. (Czech Republic) fluvial systems to tectonics – Analyses of morphotectonics, stream-length index and structural geology, *Quaternary International* 656, 1-15. ISSN 1040-6182.

Goswami (Chakrabarti) C., Gulyuz, E., Gulyuz, N., Narzary, B., Jaiswal, M.K., Karaoglan, F., (2024): Geomorphological and Geo/Thermo-chronological responses of Indian Plate's deformation during Neogene-Quaternary time along the Eastern Himalayan Syntaxis: Formation of Manabhum Anticline. *Journal of Asian Earth Science*, (260) 105967.

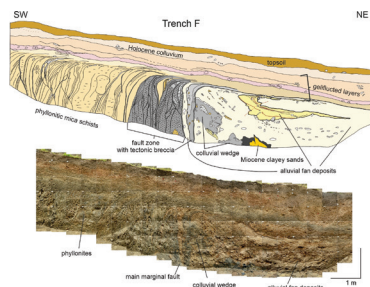


*Interpretative model showing the uplift of Indian plate along the Eastern Himalayan Syntaxis during Cenozoic time and formation of new fold and thrust giving rise to Quaternary hills. The uplift rate is significant in the Quaternary Period, which is ~3.2 mm/year compared to the Neogene uplift rate of ~2.3mm/year.*

Shivsager, V., Basumatary, D., Goswami Chakrabarti, C., Rawat, M. Singh, S., Jaiswal, M.K. (2024): An assessment of oxbow lakes and their potential in reconstructing past river discharge: Implication to reconstruct past climate in Southern West Bengal. *Geochronometria*. Vol. 51 (1), 192455. ISSN 1897-1695. E-ISSN 1897-1695

● **Paleoseismology**

Štěpančíková P., Rockwell T.K., Stemberk J., Rhodes E. J., Hartvich F., Luttrell K., Myers M., Tábořík P., Rood D. H., Wechsler N., Nývlt D., Ortuño M., Hók J. (2022): Acceleration of Late Pleistocene activity of a Central European fault driven by ice loading. *Earth and Planetary Science Letters* 591, 117596.



*Log and photomosaic of a trench wall documenting the fault zone of Sudetic Marginal Fault and deformed layers of Late Pleistocene aluvial fan deposits.*

León-Loya R., Lacan P., Ortuño M., Zúñiga F. R., Štěpančíková P., Stemberk J., Hernández Flores A. P., Carrera Hernández J. J., Sunyé-Puchol I., Aguirre-Díaz G., Audin L. (2023): Paleoseismology of a Major Crustal Seismogenic Source near Mexico City: The Southern Border of the Acambay Graben. *Tectonics* 42, e2022TC007610.

Radulov A., Dilov T., Rockwell T., Štěpančíková P., Yaneva M., Donkova Y., Stemberk J., Sana H., Nikolov N. (2023): First paleoseismic data from the Balkan Range. *Tectonophysics* 863, 230009.

McCalpin J., Ferrario F., Figueiredo P., Livio F., Grützner C., Pisarska-Jamroży M., Quigley M., Reicherter K., Rockwell T., Štěpančíková P., Tábořík P. (2023): New developments in onshore paleoseismic methods, and their impact on Quaternary tectonic studies. *Quaternary International* 664, 59-76.

Radulov A., Rockwell T.K., Yaneva M., Donkova Y., Kiselinov H., Nikolov N. (2024). Variable slip mode in the past 3300 years on the fault ruptured in the 2012 M 5.6 Pernik slow earthquake in Bulgaria. *Natural Hazards*, 120: 5309–5331.

● **Seismic hazard**

Sana H. (2020): Chapter 1. - Synthetic ground motions of the 2005 Kashmir M7.6 earthquake at the bedrock and at surface using stochastic dynamic finite fault modelling with a dynamic corner. In Samui P., Dixon B., Bui D.T. (eds.): *Basics of Computational Geophysics*, 1st Edition. Elsevier, Dec 1st 2020, 432 p. ISBN: 9780128205136.

Sana H. (2020): Chapter 10. - Liquefaction as a seismic hazard: scales, examples and analysis. In Samui P., Dixon B., Bui D.T. (eds.): *Basics of Computational Geophysics*, 1st Edition. Elsevier, Dec 1st 2020, 432 p. ISBN: 9780128205136.

Sana H., Štěpančíková P., Szameitat A., Stemberk J. (2021): Macroscopic Intensity Re-Evaluation of the 11 June 1895 Mid-Silesia, Poland, Earthquake. *Seismological Research Letters*, 92(2A), 1159-1167.

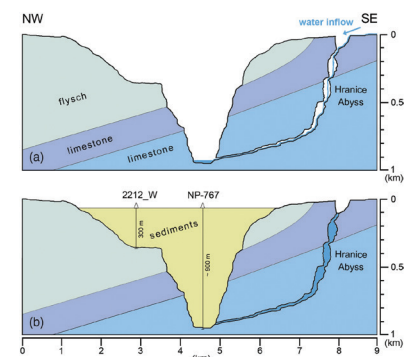


*The house showing damage caused by the 11 June 1895 Mid-Silesia, Poland earthquake. a) Repaired fissure in the stone gable with bricks. b) Wall anchor with reported 1 cm cracks. c) Damaged chimney. d) Ceiling cracks. e) f) g) Window corner cracks in the stable, with dropped keystones in window arches (f, g). h) Adjacent farm building with broken stones (i, j) and chipped corners (k, l).*

● **Geophysical survey in Earth science studies**

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), pp. 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.*

Sana H., Taborik P., Valenta J., Bhat F. A., Flasar J., Stepancikova P., Khwaja N. A. (2021): Detecting active faults in intramountain basins using electrical resistivity tomography: A focus on Kashmir Basin, NW Himalaya. *Journal of Applied Geophysics* 192, Article no. 104395.

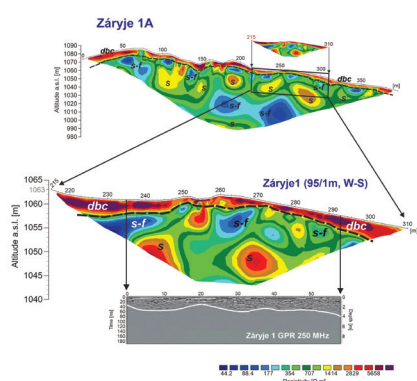
Majewski R.S., Valenta J., Tábořík P., Weger J., Kučera A., Patočka Z., Čermák J. (2022): Geophysical imaging of tree root absorption and conduction zones under field conditions: a comparison of common geoelectrical methods. *Plant and Soil*. Volume 481, 447–473.

● **Slope evolution and deformations**

Břežný M., Pánek T., Braucher R., Šilhán K., Chalupa V., Lenart J., Tábořík P., Aster Team (2021): Old but still active: >18 ka history of rock slope failures affecting a flysch anticline. *Landslides* 18 (1), 89–104.

Klimeš J., Novotný J., Rapre A.C., Balek J., Zahradníček P., Strozzini T., Sana H., Frey H., René M., Štěpánek P., Meitner J. (2021): Paraglacial rock slope stability under changing environmental conditions, Safuna Lakes, Cordillera Blanca Peru. *Frontiers in Earth Science* 9, Article no. 607277.

Duffek V., Tábořík P., Stacke V., Mentlík P. (2023): Origin of block accumulations based on the near-surface geophysics. *Open Geosciences* 15(1), 20220468.



Geophysical survey at Skalka (Bohemian Forest Mts.): (a) block accumulation types; (b) subsurface resistivity model with refraction boundary; (c) seismic velocity model with boundary and isolines (d) ground penetration radar section; (e) detailed GPR segment; (f) apparent resistivity curves.

Sana H., Ullah R., Zinke R., Fielding E. (2023): Torkham Rockslide of April 18, 2023, in Pakistan: an interplay of geomorphology, geology, slope cutting, and climate. *Landslides*.

Šilhán K., Fabiánová A., Klimeš J., Tábořík P., Hartvich F., Blahůt J. (2024): The effect of tree growth disturbances inertia on dendrogeomorphic spatio-temporal analysis of landslides: A case study. *Catena* 235, 107678.

### ● Thermochronology

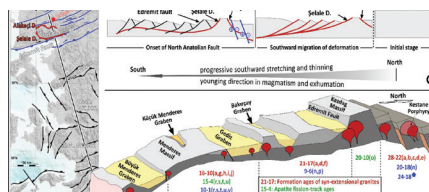
Karaođlan F., Karataş B., Özdemir Y., Gülyüz E., Vassilev O., Selbesođlu M. O., Gildir S. (2023): The geo/thermo-chronology of Dismal Island (Marguerite Bay, Antarctic Peninsula). *Turkish Journal of Earth Sciences*. 32(8):975-988

Gülyüz N., Gülyüz E., Karaođlan F., Kuşcu İ. (2024) Low temperature thermochronology reveals tilting of crystalline bodies, Halilaga porphyry Cu-Au deposit, NW Anatolia: Implications for exploration of porphyry copper deposits and interpretation of low-temperature thermochronology data for regional tectonics. *Ore Geology Reviews*, Volume 166, March 2024, 105958.

Gildir S., Karaođlan F., Gülyüz E. (2024). The Low-Temperature Thermochronology

Records the Convergence Between the Anatolid-Tauride Block and Arabian Platform Along the Southeast Anatolian Orogenic Belt. *Minerals*, 14, 614.

Gülyüz N., Kuşcu İ., Danişik M. (2024): Application of (U-Th)/He hematite geochronology to the Çaldağ lateritic Ni-Co deposit, Western Anatolia: Implications for multi-stage weathering events during interglacial periods/segments. *Ore Geology Reviews* 172, 106203.



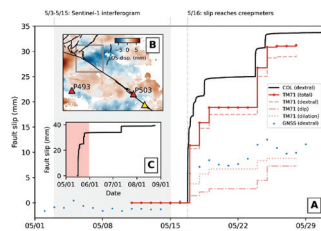
Major structures and basins of Western Anatolia (WA) (A). Evolution of extension in the WA due to interplay between extensional and strike-slip regime from the Oligocene to present(B). Halilaga deposit within WA, with granite formation and cooling ages (AFT and AHe) (C).

### ● Fault structure and behaviour

Share P.-E., Tábořík P., Štěpančíková P., Stemberk J. jr., Rockwell T.K., Wade A., Arrowsmith J.R., Donnellan A., 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 geological, topographic, seismic and resistivity data. *Geophysical Journal International* 222(2), 781-794.

Gülyüz N., Shipton Z. K., Kuşcu İ. (2023): Multiphase deformation, fluid flow and mineralization in epithermal systems: Inferences from structures, vein textures and breccias of the Kestanelik epithermal Au-Ag deposit, NW Turkey. *Turkish Journal of Earth Sciences*: Vol. 32: No. 1, Article 4.

Vavra E., Fialko Y., Rockwell T. K., Bilham R., Stepancikova P., Stemberk Jakob, Tábořík P., Stemberk Josef (2024): Characteristic Slow-Slip Events on the Superstition Hills Fault, Southern California. *Geophysical Research Letters*, 51, e2023GL107244.



(a) May 2023 fault slip on Superstition Hills Fault (SHF). Black: Dextral slip from COL creepmeter. Red: extensometer TM71 data, Blue dots: GNSS baseline change. (b) Sentinel-1 interferogram (3-15 May) showing initial slip on the northern SHF. (c) COL fault slip time series through August 2023.

## 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)
- Komenský University (Bratislava, Slovakia)
- University of Göttingen (Germany)
- Leipzig University (Germany)
- San Diego State University (California, USA)
- Oregon State University (Oregon, USA)
- 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)
- Inter University Acceleration Centre, New Delhi, (India)
- Indian Institute of Science Education and Research (IISER), Kolkata (India)
- Geological Institute "Strashimir Dimitrov" of the BAS (Sofia, Bulgaria)

