



Międzynarodowa Środowiskowa Szkoła Doktorska
przy Centrum Studiów Polarnych
w Uniwersytecie Śląskim w Katowicach

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No. of PhD project: IEDS/2024/US/B

Title of PhD project: Enhancing paleoseismological record through multi-methods cave deformation analysis tested in diverse Hellenides tectonic regimes

The leading unit: University of Silesia in Katowice

Requirements:

1. Master's degree in geology, geophysics, earth sciences, or related fields;
2. experience in paleoseismology and/or tectonics and/or speleology;
3. very good communication skills in written and spoken English;
4. working with GIS and structural geology software such as QGIS or ArcGIS, TectonicsFP, Orient etc.;
5. mountaineering or caving skills are preferable but not essential if the candidate can show his willingness and the ability to work in difficult terrain.

Tasks description:

1. geomorphological and structural observations and related field sampling of deformed speleothems and fault-slip data measurements of cave passage offsets in three regions: Crete, Gulf of Corinth, and Macedonia;
2. sample processing of collected field data in the lab for U/Th dating
3. fault-slip data paleostress analysis and compilation of geochronological results, as well as spatial analysis;
4. work with the in-house research team and researchers from Greece and Austria
5. work at field locations in three different Greek locations (4-6 trips, each 1 -2 weeks).
6. publishing results in peer-reviewed international academic journals.
7. approximately 20% of the time will be dedicated to courses within the doctoral school program.

Summary of a doctoral project:

Caves uniquely preserve deformations shielded from surface erosion. Damaged speleothems help date deformations, while cave passage offsets enable kinematic reconstruction. Speleothem failure criteria provide seismological information, as tall speleothems can break if earthquakes exceed a critical horizontal ground acceleration. Despite this, long, thin speleothems exist in seismic regions, contrary to expectations. Holistic approach of the project



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integrating structural, geochronological, and geophysical analyses are emerging, but understanding seismic wave behavior in caves remains elusive. Recent Finite Element Method (FEM) applications predict speleothem failure but mainly in low-seismic regions. This research proposes to enhance seismic hazard assessment by integrative approach, combining extensive fieldwork and structural and geochronological analysis run by the Ph.D student with numerical models run by a dedicated postdoc and test sites with known tectonic settings, and aims to refine speleothem vulnerability understanding.

The Ph.D. study focuses on three regions: Crete (near the Hellenic Subduction Zone), Eastern Macedonia and Thrace (north of the Northern Anatolian Fault), and the Corinth Rift (rapid extension). Ph.D. student will date cave deformation to reveal detailed spatiotemporal stress field changes. Limited cave-based research in Greece offers potential for enhanced paleoseismic understanding, extending knowledge to over 0.5 Ma using Th/U and U-Pb dating. Fieldwork will be conducted on both mainland and islands, considering varying tectonic regimes. Methods employed in the Ph.D. project involve fault-slip data paleostress reconstruction, microstructural analysis, and dating damaged speleothems to provide timing insight, allowing the extension of the paleoseismic record and recognition of strong earthquake recurrence intervals.

Other information:

The work will be carried out under the supervision of:

Associate Professor Jacek Szczygieł, jacek.szczygiel@us.edu.pl, Institute of Earth Sciences, University of Silesia in Katowice

The Secretary of the IEDS Recruitment Committee: +48 32 3689 380, e-mail: polarknow@us.edu.pl

Information on the IEDS admissions: <https://www.mssd.us.edu.pl/en/admission-2024-2025>