EARTHSCIENCES

Earthquake and related hazards of the South Caucasus

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Key words:	Geohazards, earthquake, landslide, fieldwork, remote-sensing, seismology, paleoseismology, South Caucasus
Research theme(s):	Geodesy, Tectonics, Volcanology and related hazards
Eligible courses for this project:	• DPhil in Earth Sciences • Environmental Research (NERC DTP)

Overview

The South Caucasus (Armenia, Azerbaijan, Georgia, Turkiye) is a region prone to earthquake and related hazards, with an abundant record of earthquakes (e.g. 1903 Shemakhi in Azerbaijan, 1988 Spitak in Armenia, 1998 Racha in Georgia, and several very destructive earthquakes of the large decade in eastern Turkiye). There are large population centres and rapidly growing infrastructure networks across the region, providing an urgent need to understand the hazard from earthquakes, and from related hazards such as land sliding. We will work with colleagues in national institutes in all partner countries, building on existing long-term collaborations.

Paleoseismic trench excavated by the team in collaboration with the Republican Seismic Survey of Azerbaijan.

The student will join our program of mapping and analysing earthquake ruptures, active faults, landslide distributions, and regional tectonic deformation across Asia, giving opportunity to be involved in efforts in central Asia, as well as the core focus in the South Caucasus. There is sufficient spatial extent and time-range to address earthquake rupture variability in the South Caucasus, and continental interiors in general. The PhD student will undertake a detailed analysis of the active faults and earthquake ruptures across the broad region of our study, using the knowledge to investigate the regional active tectonics, the mechanics of faulting, and the detailed history of rupture in large earthquakes. The project will involve fieldwork in one or several of the countries of the South Caucasus, as well as bringing together a range of remote-sensing, seismological, and geodetic constraints on the regional deformation.

We will use our insights to investigate and understand the potential for large magnitude earthquakes and the completeness of the historic record in continental interiors. We will feed these advances into improved appreciation of earthquake hazard and risk.

Methodology

The student will use a combination of satellite image and terrain analysis and fieldwork to locate active faults through careful analysis of the landscape. Particular focus will be given to faults that display evidence of surface rupture in individual earthquakes, which can be retained in the landscape for more than 1,000 years, or for faults that are suspected of having caused major historical seismic events. Forensic field investigation of historic and prehistoric earthquake ruptures will incorporate detailed survey of the ruptures and of the wider geomorphology using satellite imagery and aerial survey using drones. Analysis of these survey data will enable us to reconstruct the magnitude and other parameters of the source**.** We will bracket the ages of the earthquakes using palaeoseismic trenching, and by applying state-of-the-art developments in Quaternary dating methods.

The palaeoseismic investigation of historic and prehistoric ruptures will be combined with region-wide studies of recent seismicity and GNSS measurements of crustal strain. The focal mechanisms and depths of recent earthquakes of moderate size provide vital information about the types of faulting that might be expected in particular regions, and also the potential magnitude of an earthquake on a fault of given length (as the magnitude scales with fault area).

Many of our recent fieldtrips and outputs are described on our website, and give an idea of the range of scientific problems we address, and methods we apply. Blog – Earthquakes in Central Asia

Timeline

Year 1: The first year will introduce the irst stages of the project, and develop core skills and background knowledge of active tectonics in continental regions. A laboratory-based project will be selected to allow the student to learn the methods of satellite image analysis and digital topographic model (DEM) creation and analysis. We anticipate the first field work in the early summer (~6 months into the project).

Years 2 and 3: Years two and three will consist of remote-sensing analysis, fieldwork, and the preparation and analysis of samples for Quaternary dating.

Year 4: Data integration, thesis completion, papers for international journals/conference presentation.

Training & Skills

The student will receive training in:

- Field methods relating to the project (i.e. tectonic geomorphology, field surveying using drones, palaeoseismic trenching, sampling for a range of Quaternary dating techniques.
- Analysis of satellite imagery and digital topographic models to map and measure earthquake displacements. Construction of digital topographic datasets from stereo satellite imagery and from aerial photographs collected by drone survey.

- The student would interact with the wider 'COMET' community of students and researchers, enabling wider training and sharing of knowledge

References & Further Reading

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Further Information

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