The University of Oxford Department of Earth Sciences

EARTHSCIENCES

UNIVERSITY OF OXFORD

The Earthquake Ruptures of Iran and Central Asia

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Key Words	**Earthquakes, Fieldwork, Remote-sensing, Seismology, Palaeoseismology, Asia**

Overview

We accept students within our program of mapping and analysing earthquake ruptures across central Asia, with sufficient spatial extent and time-range to address earthquake rupture variability in inner Asia, and continental interiors in general. We will use our insights to investigate and understand the potential for large magnitude earthquakes, clustering in time and space in particular regions, and the completeness of the historic record in continental interiors.

The PhD student will undertake a detailed analysis of the active faults and earthquake ruptures within a defined part of our broader study region, and to use knowledge of the faulting to investigate the regional active tectonics. It is likely that the project will involve fieldwork in one or several of the central Asian countries.

Photograph showing surface ruptures from the 1889 M_w 8 Chilik earthquake in the Kazakh Tien Shan. Displacement was about 10 m (see people for scale) and the ruptures extend for over 100 km. Careful survey and mapping of the ruptures help us understand the source of the earthquake, a repeat of which would cause widespread damage.

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 GPS 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).

Earthquakes of the early to mid-20th century form an important bridge between the modern and historical eras as they allow direct comparison of early instrumental seismic data, historical documentary data, and the source parameters gleaned from study of the preserved surface ruptures. A number of important Iranian and central Asian earthquakes occurred within the early 20th century, and many are

still poorly understood. The project may involve collecting, digitizing, and modelling archive paper seismograms to yield estimates of the source parameters. These estimates will be combined with independent measurements from fieldwork and historical records of shaking.

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 summer (~9 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 would receive training in:

(a) Field methods relating to the project (i.e. tectonic geomorphology, field surveying using drones, palaeoseismic trenching, sampling for a range of Quaternary dating techniques.

(b) 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.

(c) Potential use of archive material such as paper seismogram records and/or photographic aerial survey for estimation of earthquake source parameters and reconstruction of ground displacements.

(d) 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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