

PROJECT TITLE: Insights into the Frictional Properties of Earthquake-Generating Faults

University of Bristol Theme: Climate and Environment Research Challenge Area

Research Group(s): Geophysics

Lead Supervisor: Dr Sam Wimpenny, University of Bristol, School of Earth Sciences

Co-Supervisor: Dr James Verdon, University of Bristol, School of Earth Sciences

Co-Supervisor: Prof. Alex Copley, University of Cambridge, Department of Earth Sciences

Project enquiries: s.wimpenny@bristol.ac.uk

Project keywords: Tectonics, Earthquakes, Seismology

Funder: University of Bristol Scholarship

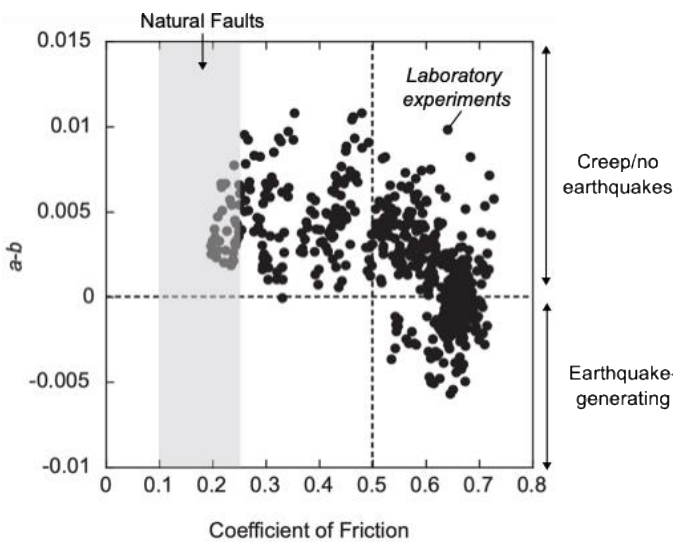


Figure 1: Lab faults with similar friction to natural earthquake-generating faults slip via stable creep and not earthquake-generating slip [Ikari et al., 2011].

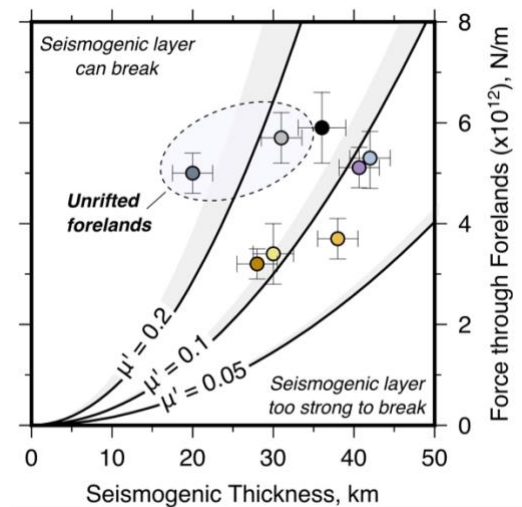


Figure 2: Estimates of the friction on faults (μ') needed to explain the distribution of large earthquake depths in the Andes foreland.

Project Background

The frictional strength of faults influences a huge range of geological processes, from the size and shape of rifts and mountain belts to the generation of earthquakes in response to anthropogenic activity such as geothermal energy production and carbon-capture and storage. Laboratory experiments predict that faults within crystalline basement rocks should require stresses of hundreds of megapascals to break in earthquakes, but geophysical studies indicate that these large earthquake-generating faults are about an order of magnitude weaker. Curiously, some of the mechanisms invoked to explain these weak faults should also cause faults to creep, not break in earthquakes, whilst others are scale-dependent and would suggest that small faults are, on average, stronger than large faults.

Project Aims and Methods

Your aim will be to develop new insights into the frictional resistance to slip on faults across a range of geological settings and spatial scales. The methodologies and techniques you choose will depend on your skillset, and you will be encouraged to shape the project based on your interests.

Some potential lines of inquiry are: (1) using long-period seismology, satellite remote-sensing and fieldwork to study the locations, size and distribution of large earthquakes within the continents where the forces that generate these earthquakes can be estimated; (2) using the locations and size distributions of small earthquakes generated in response to known natural or anthropogenic stress

changes to determine the distribution of fault stress relative to fault strength across a range of geological settings and fault sizes; (3) studying the geological structure of exposed fault zones that hosted earthquakes in the past to determine the geological habitat of earthquake generation, and to investigate the mechanisms that might create weak faults; and (4) to develop a framework for testing whether the short-term weakening of faults during earthquake slip influences the long-term tectonics of rifts and mountain belts over many millions of years.

Candidate

The candidate should have a background in Geophysics and/or Geology.

Training

You will receive training in all of the methods needed to perform the analyses from the supervisory team, through at the University of Bristol, and through our partner organisations (including the Centre for the Observation and Modelling of Earthquakes, Volcanoes and Tectonics – COMET).

Background reading and references

Ikari et al., (2011), *On the relation between fault strength and frictional stability*, Geology.

Wimpenny, (2022), *Weak, seismogenic faults inherited from Mesozoic rifts control mountain building in the Andean forelands*, Geophysics, Geochemistry and Geosystems.

Copley, (2017), *The strength of earthquake-generating faults*, Journal of the Geological Society.

Useful links

<http://www.bristol.ac.uk/earthsciences/courses/postgraduate/>

Eligibility

UK and International students are eligible for a University of Bristol Scholarship. UoB Scholarships are fully funded for 4 years and cover university fees, living expenses at the UKRI standard rate, and an allowance of £2100 per year towards research expenses.

Application deadline: **Monday 20th January, 2025 , 23.59 GMT**
(Interviews are expected to take place in mid/late February)

How to apply

Applications are online only at: <http://www.bristol.ac.uk/study/postgraduate/apply/>

Please select “**PhD in Geology**” as the programme in the online application system.

Please specify the **project title and supervisors** for the project that you are applying for.

To ensure your application is considered under the University of Bristol Scholarship funding scheme you must complete the **Funding** page in your online PhD application as follows:

1. For “*What is your likely source of funding?*” select **Studentship**
2. For the free text field “*Please give the name of your scholarship or studentship*” enter **University of Bristol Scholarship**.
3. Set “*Percentage from this source*” to **100%**
4. Set “*Is this funding already secured?*” to **No**