**PROJECT TITLE:** Monitoring Injection-Induced Earthquakes in the UK

**DTP Research Theme(s):** Dynamic Earth

**Lead Institution:** University of Bristol

**Lead Supervisor:** Dr. James Verdon, School of Earth Sciences, University of Bristol

**Co-Supervisor:** Dr. Brian Baptie, British Geological Survey

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**Project keywords:** Induced seismicity, earthquakes, carbon capture and storage, geothermal, hydraulic fracturing

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**Map of microseismic events detected during hydraulic fracturing at the Preston New Road PNR-1z well in Lancashire.**

**Forecasting model used to predict induced earthquake magnitudes during the PNR-1z induced seismicity sequence.**

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**Project Background:** Understanding and managing injection-induced seismicity (IIS) – earthquakes caused by human activities in the subsurface – is a key challenge for a range of industrial activities, including: carbon capture and storage; geothermal energy; natural gas storage, hydraulic fracturing for shale gas; and disposal of oilfield waste fluids. Many of the aforementioned technologies are increasing in scale, and are being developed in new regions and countries. However, recent high-profile IIS incidents are changing levels of risk perception among both societies and regulators. Given these developments, there is a clear need to advance our scientific understanding of the causes of induced seismicity, the risks it poses, and potential mitigation methods. Furthermore, observation of induced seismicity could be used to investigate the mechanics of fault rupturing behaviour more generally.

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**Project Aims and Methods:**

The aim of this project is to investigate induced earthquakes using observational seismological methods. The student will analyse earthquake data recorded from a range of industrial sites, including the hydraulic fracturing at the Preston New Road site in Lancashire, UK\(^1\); the United Downs geothermal project in Cornwall\(^2\); and from other sites around the world including hydraulic fracturing, carbon capture and storage, and geothermal sites.

These investigations will serve to provide answers to important questions, including:

- What geological and geomechanical factors influence the occurrence and intensity of induced seismicity?
- Is it possible to make proactive forecasts of induced seismic hazard during operations?
- What steps can be taken to prevent or mitigate induced seismicity?

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\(^1\) [https://www.bbc.co.uk/news/uk-england-lancashire-49471321](https://www.bbc.co.uk/news/uk-england-lancashire-49471321)

From a purely scientific perspective, cases of induced seismicity provide a “natural laboratory” whereby known stimuli produce fault reactivation in a setting that is relatively well characterised. Therefore, observations of induced seismicity can be used to enhance our understanding of fault rupturing mechanics more generally.

Candidate requirements: This project requires a student with an undergraduate degree in geophysics, geology, physics, engineering, or a related discipline. Some experience in earthquake source characterisation methods would be beneficial but not essential. Some programming experience is also desirable. We welcome and encourage student applications from under-represented groups. We value a diverse research environment.

Collaborative partner: This project will be conducted in collaboration with the British Geological Survey. The BGS operates the UK’s national seismic monitoring network, as well as densified networks of seismometers around the Preston New Road and United Downs sites. As well as data recorded by these networks, they will also provide expertise in seismological analysis. The student will be based at the University of Bristol, but will make visits to the BGS in Edinburgh to collaborate with the co-supervisors.

Training: Training will be provided in earthquake seismology, with a focus on source characterisation and interpretation of microseismic data. This will include an understanding of the underlying theory, and its application via codes and analysis packages that are standard in the field. The student will also gain an understanding of the both the operational and regulatory issues surrounding subsurface injection and induced seismicity.

Background reading and references

Useful links
http://www.bristol.ac.uk/earthsciences/courses/postgraduate/

NERC GW4+ DTP Website:
For more information about the NERC GW4+ Doctoral Training Partnership please visit https://www.nercgw4plus.ac.uk.

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2022/doctoral/phd-great-western-four-dtp/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is Monday 10 January at 2359 GMT. Interviews will take place during the period 23 February – 9 March 2022.

General Enquiries:
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