Durham University

MSc by Research (Volcanology)

Lithium enrichment and extraction from granite

Supervisors: Dr Madeleine Humphreys; Dr Catriona Menzies; Prof Jon Gluyas; Dr Alex Iveson

Background:

The UK's transition from hydrocarbon to renewable energy resources relies on developing secure domestic pathways to source critical metals, including lithium as a key component of rechargeable batteries. Some low-enthalpy (warm) geothermal fluids), which are already being used to generate renewable heat, also contain high dissolved metal contents, including lithium. These fluids are associated with areas of high heat flow, and are underlain by large plutonic granite bodies, including in northeast England and in Cornwall.

The potential to exploit both heat and the metals found in these waters makes them an important exploration target. However, the source of metal enrichment into the fluids is not well understood. This means that the sustainability/ longevity of metal supply in geothermal fluids is hard to predict.

The village of Rookhope and location of the granite borehole

Project Aims and Methods:

This MSc project aims to evaluate the potential of granites to release critical metals into hydrothermal waters circulating in fracture systems within the granites. This will be a direct test of whether the lithium present in geothermal fluids could have been derived from reaction with the granite, or from external sedimentary formation waters (e.g. Sanjuan et al. 2016; Edmunds et al. 1985).

The student will undertake high temperature/ pressure experiments using ambient and high-temperature experimental methods to evaluate the reactivity of host rocks in different fluids, and the rates of trace metal enrichment in the fluid. Elements of interest will include lithium as well as niobium, rubidium, caesium and tin. Geochemical composition of experimental fluids and the mineralogy and geochemistry of residual solid starting materials will be analysed in order to quantify metal extraction into circulating fluids.

Using these datasets, together with existing structural models and published data on fluid compositions, the student will evaluate the potential of the granites to supply metals into the geothermal system, and consider the implications for potential longevity or sustainability of supply.

Training and skills development:

The student will be part of the vibrant, active Durham Earth Sciences volcanology research group. The student will also be part Durham Energy Institute (DEI) and will benefit from interaction with ongoing projects on geothermal energy and other renewable resources. Technical training will include:

- High-temperature experimental methods
- Sample preparation techniques
- Scanning electron microscopy
- Inductively coupled plasma mass spectrometry and ion chromatography methods
- Geochemical reaction modelling
- Writing and presentation skills *via* weekly volcanology group meetings

Pre-requisites:

The successful candidate will be highly motivated and have:

- Strong interests in geochemistry, renewable energy and igneous petrology
- Good attention to detail and an interest in hands-on experimentation
- Excellent writing skills

Previous experience of working with geochemical datasets would be an advantage, but is not essential.

Research costs:

Research costs associated with this project will be met by the supervisor. For an outstanding student, a reduction in MScR tuition fees may be possible – please contact the supervisor to discuss.

References and further reading

Sanjuan et al. (2016)

Edmunds et al. (1985)

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