PROJECT TITLE: CONTROLS ON CRITICAL METAL ENRICHMENT IN GRANITIC SYSTEMS

University of Bristol Research Theme: Climate/Environment

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Project keywords: pegmatites, Cornwall, metamorphism, anatexis, lithium

Figure 1. a) Exposed roof of the Land’s End Granite (lighter rocks in foreground) intruded into darker slates and metabasalt at Porthmeor Cove. b) Centimetre wide xenoliths of Mylor Slate country rock being digested in granitic melt from the Tregonning granite at Megiliggar Rocks. Note the surrounding ‘pegmatitic’ texture.

Project Background:

Critical metals are essential for the green energy revolution. A particularly important metal in this regard is lithium, which is a key constituent of rechargeable batteries. Lithium is relatively abundant in Earth’s crust, but must be enriched by many orders of magnitude before it becomes economically viable. Despite lithium’s fundamental role in the energy transition, the crustal processes by which lithium is enriched remains poorly constrained.

In the UK, the largest reserves of lithium are associated with the Cornish granites. Li and other critical metals such as Ta and Nb are often enriched up to economic grade in late stage pegmatites that permeate the roofs of granite plutons and surrounding country rocks. While granite plutons have a wide range of Li contents, even Li-rich granites seem able to produce pegmatites that can be Li-rich or barren. The reasons for this are unknown.

One key observation is that Li-rich granites are associated with high B and F, suggesting a genetic link between these volatile elements. Several authors have suggested that the concentrations of these elements in the intrusive magmas are linked to the extent of interaction with country rocks, but the direction of flux and the mechanisms of enrichment or depletion remain poorly understood (see London and Manning, 1995, Williamson et al., 2010, and Breiter et al., 2018).

Project Aims and Methods:

This study will use a mixture of fieldwork, petrology and experiments to further our understanding of the movement of Li, B and F in and out of granite rocks from the deep source of melting to the shallow late stage products such as pegmatites.
The student will study field relationships between Li-rich and barren pegmatite bodies, associated finer-grained granites and surrounding country rocks. They will collect and analyse samples to constrain the geological histories of these bodies and the mechanisms of critical metal enrichment.

The student will also design and run a series of low pressure experiments designed to investigate reactions between granitic bodies and the surrounding country rocks. This experimental campaign will constrain the exchange of elements such as Li and B between solid phases, melts and hydrous fluids. The student will develop complementary thermodynamic models in order to extrapolate the experimental results to a diverse, global set of natural pegmatites.

**Candidate requirements:**

The successful candidate should have an undergraduate degree in geology or a related subject. They will have extensive geological field experience, and should also have a keen interest in igneous and metamorphic petrology. They will be able to confidently interpret metamorphic and igneous rock textures in thin sections and hand specimens.

No experience with experimental or analytical techniques, or with thermodynamics software is required, although experience with one or more of these techniques would be a bonus. The student will be fully trained after their arrival in Bristol.

**Project partners:**

Ben Williamson (Camborne School of Mines) and Barbara Kunz (Open University).

**Training:**

Experimental petrology (cold seal, piston cylinder)
Analytical techniques (EMPA, ion probe, LA-ICPMS)
Thermodynamic modelling using THERMOCALC / Perple_X.

**Background reading and references:**

[http://elementsmagazine.org/past-issues/lithium-less-is-more/](http://elementsmagazine.org/past-issues/lithium-less-is-more/)

**Useful links**

[http://www.bristol.ac.uk/earthsciences/courses/postgraduate/](http://www.bristol.ac.uk/earthsciences/courses/postgraduate/)
[http://www.bristol.ac.uk/earthsciences/research/petrology/](http://www.bristol.ac.uk/earthsciences/research/petrology/)
[https://www.greenpeg.eu/](https://www.greenpeg.eu/)

**How to apply to the University of Bristol:**

[http://www.bristol.ac.uk/study/postgraduate/apply/](http://www.bristol.ac.uk/study/postgraduate/apply/)

The application deadline is Monday 14 February, 2022 at 2359 GMT. Interviews will take place during the period 10 March – 18 March 2022.

**General Enquiries:**

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