PhD topic: Using Crystal Chemistry to Reconstruct Magma Storage Prior to Large Icelandic Eruptions

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Importance of the area of research

Large Icelandic eruptions have the capacity to cause substantial societal and economic disruption in Europe and North America, as exemplified by events such as the Laki Fires of 1783 CE. Accordingly, Icelandic eruptions feature in the 2023 UK National Risk Register. Our study of recent volcanic eruptions at Fagradalsfjall in SW Iceland (2021-23) has demonstrated the strong correspondence of timescales of monitored geophysical unrest with the results of petrological diffusion chronometry. We now have an excellent opportunity to establish the timescales of magmatic processes that take place before large eruptions, including not only pre-eruptive ascent but also longer-term assembly of magma storage zones. These results will then be used to improve the interpretation of monitoring data from Icelandic volcanic systems. The first focus of the project will be Laki itself.

Brief Summary

The crystal cargo of basalt lava flows provides a unique record of the physical conditions and processes that lead up to the onset of a volcanic eruption. It is well-established that compositional zonation in crystals can provide information about the timescales of magmatic processes. The novel part of the project lies in the combination of multiple elements from multiple phases to unpick the timescales associated both with magma storage and pre-eruptive transport – both crucial for building models of volcanic processes that inform the response to monitoring data. Our in-house analytical facilities allow high-precision determination of major and trace element compositions of minerals and mapping of their distributions. Combining data from our QEMSCAN system, new JEOL JXA-iHP200F electron probe and LA-ICP-MS provides an exceptional opportunity to disentangle pre-eruptive histories.

What's involved?

The student will collect and prepare samples from Icelandic eruptions. They will use samples in the supervisors' collection and new ones from fieldwork in Iceland. These samples will be prepared for petrographic and geochemical analysis and then subject to elemental mapping using the state-of-the-art micro-analytical suite in the Dept of Earth Sciences. The petrological and geochemical data will then be modelled using approaches that have been developed in Cambridge, in order to identify the storage conditions of the crystals, and the timescales between melt injection and eruption. Diffusion chronometry will rely on the DFENS approach3. The student will have flexibility to control the balance of fieldwork, microanalysis and modelling.

Equality Diversity & Inclusion

The project supervisors and the University of Cambridge actively support equality, diversity and inclusion and encourage applications from all sections of society. The University holds an institutional Athena-SWAN silver award and the Department of Earth Sciences is a bronze award holder.

How to Apply

You can find out about applying for this project on the Department of Earth Sciences page.

References

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