

Subduction initiation and ophiolites: isotopic links?

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Ophiolites are considered fragments of ocean crust preserved on land. This makes them invaluable for study, as one can walk along their crustal stratigraphy without the inconvenient impediment of kilometers of ocean and rock. However, the type of crust ophiolites represent and how they are emplaced is debated. A common (yet initially very controversial) proposal is that ophiolites are formed in supra-subduction zone settings [1]. This theory offers the tantalizing prospect of linking ophiolite crust to subduction initiation [2], a scenario for which there is no modern analogue on Earth. The chemical and dynamic conditions driving subduction initiation are largely unknown, as is the point in Earth's history at which subduction and thus modern plate tectonics were established.



Figure: Mafic lavas recovered by Expedition 352

During August and September 2014, Integrated Ocean Discovery Program (IODP) Expedition 352 set off to drill *in situ* forearc crust outboard the Bonin islands in the Pacific Ocean [3]. The recovered material allows the first comparison to be drawn between a complete *in situ* crustal chemical stratigraphy and ophiolites. In particular, there are several chemically and petrographically exotic rock types that appear to characterize forearc crust and some ophiolitic sequences. Two examples are *boninites* and *forearc basalts (FAB)* [4]. The unusual chemistry of these rocks presumably reflects the unusual conditions of their petrogenesis. Thus they are vital to understand when considering the formation of the forearc crust and its possible links to subduction initiation. This focuses on the stable isotope composition of vanadium, iron and zinc to investigate the forearc crust and its possible on land ophiolitic analogues. Although the study of some of these systems is in its infancy [5, 6], a combined approach has great promise to elucidate and distinguish the effects of variables such as mantle chemical depletion, oxidation state, and magmatic evolution.

Project Aims

Using the unique Expedition 352 lavas and a sample suite from the Troodos ophiolite in Cyprus, this project aims to (a) isotopically probe the genetic relationship of ophiolites to the forearc crust and b) determine the role and evolution of oxidation state during subduction initiation.

Methodology

The project focuses on samples from IODP Exp. 352 and a preliminary suite from the Troodos massif in Cyprus. There is opportunity to collect additional samples from

Troodos if deemed necessary. Samples will be analysed for stable isotope compositions of Fe-V-Zn at Imperial College London in the state of the art MAGIC labs (<http://www3.imperial.ac.uk/earthscienceandengineering/research/magic>).

Student Profile and Imperial Research Environment

This project is lab-based in nature and would suit a candidate with strong interest in cutting edge analytical isotope geochemistry and possessing excellent organizational and time management skills. Candidates should have a degree in Earth Science or Chemistry and a good background in both laboratory-based and field-based petrology. Previous chemical laboratory and/or isotope geochemistry experience is not required but is highly advantageous.

The successful candidate will join the vibrant MAGIC research group, which comprises PhD and MSci students in addition to postdoctoral researchers, fellows and four academic members of staff working on a diverse range of applications in isotope geochemistry:

<http://www3.imperial.ac.uk/earthscienceandengineering/research/magic/people>

The student will also interact with the Geodynamics Group:

<http://www3.imperial.ac.uk/earthscienceandengineering/research/geodynamics>

and benefit from established collaborative links to petrologists at the Natural History Museum: <http://www.nhm.ac.uk/research-curation/earth-sciences/mineral-planetary-sciences/volcanology-petrology/index.html>



Mass Spectrometry and Isotope Geochemistry at Imperial College London

Please do not hesitate to contact me for further information and informal enquiries:

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