Sources and structures of arc volcanism in the Sunda Arc, east Java, Indonesia (Ref IAP2-18-118)

Durham University, Earth Sciences
In partnership with Glasgow University

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Key Words

Overview

Subduction produces some of the world’s most influential volcanoes, responsible for many natural hazards that complicate life on subduction zones but provide mineral and geothermal resources, in addition to valuable and fertile land. Therefore, understanding the sources of magma and their pathways through the crust are of major scientific and social importance.

Alignment of edifices into volcanic arcs is strong evidence that petrogenetic and/or structural control are important controls upon locations of subduction magmatism at a regional scale (Fig. 1). Recent work (Pacey et al., 2013) has shown that the overriding plate exerts a strong structural control upon volcano distribution in the Sunda Arc, Indonesia. To investigate these controls further this project will:

1. Explore local-scale control at Lamongan volcano; and,

2. Integrate spatial and geochemical records to develop a detailed picture of magma storage and sources in east Java.

Lamongan is an unusual and valuable volcano because its multiple, discrete cinder cones, maars and lava flows map out the strong, local structural controls operating at this edifice (Carn & Pyle, 2001). The project will use geochemical tools to extend understanding of this distribution into the sub-surface. Analyses will also be undertaken of the neighbouring Ijang-Argopuro stratovolcano to provide a link to other, east Java volcanoes (Handley et al., 2014).

Figure 1: Alignment of volcanoes along the Sunda Arc

The student will receive opportunities to develop skills in understanding geochemical and structural aspects of volcanism. These will be employed to understand the sources of subduction zone magmas, the transport of magma through the crust, the construction of individual volcanoes, and the development of a volcanic arc. The project will also feed into on-going work to understand the distribution of volcanoes in other arc systems around the globe, which are revealing similar structural controls to those found at Sunda (Pacey et al., 2013).

Methodology

Fieldwork:
The project will benefit from access to a detailed collection of samples from Lamongan (Carn et al., 2001). This will be used to provide training in geochemical techniques and in relating chemistry to location. The student will visit east Java to collect field data for Lamongan and collect new samples from its neighbouring stratovolcano, Ijang-Argopura, to determine relationships between the two.

**Petrological:**
Microscopy and scanning electron microscopy (SEM) at Durham will characterise the textures and broad geochemical record of the rocks and their crystals. The student will obtain quantitative analyses of crystals by electron microprobe at an external institute. If funds allow, in situ analyses of crystals will be conducted by laser-ablation ICP-MS at Durham.

**Geochemical:**
Major and trace element analyses will be conducted on the samples collected during fieldwork. Radiogenic isotope analyses at Durham will be used to investigate the sources of material involved in the generation of both centres.

**Spatial Distribution:**
Locations of volcanic edifices will be analysed using tools developed in Durham. Lamongan provides an exciting opportunity to develop this approach from the regional to the local scale i.e. of a single volcanic centre.

**Interpretation and Application:**
The team of supervisors will provide training in how to interpret and use the data. This will be augmented by involvement in Durham Earth Science and IAPETUS training to develop communication and presentation skills. The project will also involve collaboration with Prof. David Pyle (Oxford) who was involved in collection of the Lamongan sample suite.

**Timeline**
Y2. Fieldwork to collect further samples. Isotopic analyses. Training to relate geochemical and spatial datasets.
Y3. Continue laboratory work, fully integrate geochemical and spatial datasets, manuscript writing and international conference presentation.
Y3.5. Focus on completion of thesis write-up and manuscript development.

**Training & Skills**
The student will be trained in a range of petrological and geochemical techniques at Durham, including scanning electron microscopy, and element abundance and isotopic measurements of volcanic rocks. There will also be training in the application of petrogenetic modelling techniques, such as MELTS, and analysis of spatial distribution using MatLab. The student will be embedded in the Durham Volcanology Group, a vibrant collaborative group of 9 staff and around 20 postdoctoral and postgraduate researchers. IAPETUS and NERC also offer opportunities to develop specific research skills, which will be considered throughout the course of the project.

**References & Further Reading**

**Further Information**
Please direct further questions to colin.macpherson@durham.ac.uk.