UGRLS Project Proposal: BOOM! Exploring the plumbing of explosive volcanism using radiogenic isotopes

1. Research Project Leader:
   Dan Morgan

2. Scholarship Project Supervisor:
   Jason Harvey

3. Working title of Scholarship Project: Magmatic timescales of Southern volcanic zone eruptions in the Chilean Andes

4. Period of Scholarship Project Work:
   Summer 2017 and summer 2018

5. Summary of the research to which the Scholar will contribute:
   A central topic in volcanism concerns the interplay between crustal stresses (including deformation processes) and magma transport across the lithosphere. Particular to the Southern Volcanic Zone of the Andes there is a major (~1,000 km long) structure, the Liquiñe-Ofqui Fault Zone (LOFZ) controlling the tectonics of the volcanic arc, and in particular the volcanoes of Osorno, Calbuco and La Vígueria. A tectonic-volcanic model based on focal mechanisms of shallow crustal earthquakes and supported by whole-rock geochemistry suggests that depending on the tectonic setting, the magmas are associated with longer/shorter crustal residence times and hence possess evolved/primitive magmatic compositions, i.e. some magmas come straight from the mantle whereas others stall within the crust prior to eruption. There is, at this time, no quantitative data for crustal residence times in the different tectonic settings of the SVZ. By making high precision Sr-Nd-Pb isotope measurements of the eruptive products of Cabuco, Osorno and La Vígueria, the scholarship holder will test existing hypotheses of residence times of magma within the Andean crust prior to its eruption at the surface.

6. Summary of the work to be undertaken by the Scholar:
   (i) Detailed isotopic analysis (Sr-Nd-Pb) of the composition of explosive volcanic samples recovered from the Chilean volcanoes Osorno, Calbuco and La Vígueria (chemistry and mass spectrometry)

   (ii) Assisting in the interpretation of the data obtained (i.e. figuring out what it means)

   (iii) Presentation of work in progress to the high temperature geochemistry group at Leeds, and the wider UK geochemical community (telling everyone how awesome your data is and what this means for volcanic plumbing in the Andes)

7. Detail of the work to be undertaken by the Scholar:
   All of the analytical work will be conducted in the Thermal Ionization Mass Spectrometry Laboratory (and its associated clean laboratories) in the School of Earth and Environment at the University of Leeds. This will take place exclusively in the summer breaks of 2017 and 2018. The work comprises the decomposition of silicate rocks using mineral acids, chemical separation of Sr, Nd and Pb through a series of ion exchange / chromatographic columns, and high precision isotopic analysis using our state of the art thermal ionization mass spectrometer. The scholarship holder will be trained in all of these aspects of sample preparation and analysis and will gain a valuable set of analytical skills. Once data has been obtained, it will need to be interpreted within the wider context of the Chilean Andes. Research skills, such as literature searches and data analysis will also form a significant component of the training that the scholarship holder could expect to receive. Finally, the results of the study will be presented, both internally to the high temperature geochemistry research group at Leeds and
also at a high profile national ± international conference, for which presentation and networking skills will be practiced.

8. **Detail of the Leadership development to be undertaken as part of the project:**
   The scholarship holder will have the opportunity to plan and execute an analytical campaign on a suite of explosively erupted volcanic products from the Chilean Andes. In addition, the scholarship holder will gain experience in a number of analytical techniques which will allow the Sr-Nd-Pb isotope signature of these unique samples to be determined. Finally, the scholarship holder learn data interpretation skills and present their findings at the annual Geochemistry Group research in progress meeting, a national meeting run by the Geological Society of London and the Mineralogical Society of Great Britain and Ireland hence gaining valuable presentation skills experience. In essence, this is an entire research project in miniature, the outcome of which will be publishable and will guide further investigations of these rocks.

9. **Outputs expected of the Scholar including the final report:**
   The scholarship holder will establish the geochemical signature of the volcanic products of Osorno, Calbuco and La Vígueria. This will allow them to distinguish whether magma transits direct from a mantle source or ponds at shallow levels where it interacts with the crust, prior to eruption. The results of this study will be published in a high quality peer-reviewed journal (such as Geochimica et Cosmochimica Acta, Chemical Geology, or Lithos) and would be presented at a national geochemistry conference, for example the Research in Progress meeting of the Geochemistry Group (a special interest group of the Geological Society of London and the Mineralogical Society of Great Britain and Ireland).

10. **Details of supervision arrangements:**
    All project supervision will be undertaken by Jason Harvey. There will be opportunities to discuss the project, as it evolves, with Dan Morgan and Eduardo Morgado Bravo (PhD student joint supervised by Harvey and Morgan). Both Dan and Jason will be available throughout the period of research. Jason will train the scholarship holder in all of the required preparatory and analytical procedures in addition to a tour of the facilities and complete health and safety briefing relevant to the research. The scholarship holder will be introduced to the other members of the high temperature geochemistry group and will work as a member of that team during the placement.