

Formation and age of the Arran central ring complex

Supervisors:

Dr Andrew Kerr (School of Earth and Ocean Sciences, Cardiff University) – Main supervisor

Dr Kathryn Goodenough (British Geological Survey, Edinburgh)

Dr Davie Brown (School of Geographical and Earth Sciences, University of Glasgow)

Dr Iain McDonald (School of Earth and Ocean Sciences, Cardiff University)

Hosting institution: Cardiff University

Project description: Volcanological and petrogenetic research in the various eroded volcanic centres of the North Atlantic Palaeogene Igneous Province have greatly informed our understanding of processes in both caldera volcanoes and flood basalt magmatism (Bell & Williamson, 2002).

Arran is one of the UK's classic geological locations, yet, surprisingly, it has been the subject of very limited published research over the last 50 years. The 15km² Central Ring Complex of Arran is a Palaeogene volcanic centre containing evidence of explosive eruptions and caldera subsidence, followed by renewed volcanism on the caldera floor (King, 1955). The caldera includes a ~ 100 m thick sequence of basaltic to rhyolitic ignimbrites, indicating that major explosive eruptions took place in this caldera. The Arran Central Ring Complex is potentially unique in Britain because of its shallow level of exposure. This means that the relationships between the surface products, the caldera floor, the bounding faults and the sub-surface magma conduits can be directly observed. Given these unique circumstances, the project will entail a systematic and integrated volcanological, geochemical (major and trace elements and radiogenic isotopes) and geochronological approach to understanding both the petrogenesis and age of the complex and the processes, rates and timescales of caldera collapse.

The tuffs and breccias contain 'megablocks' of basalt and fossiliferous Jurassic-Cretaceous sedimentary rocks which were part of the original rock cover which shattered during caldera formation. It is however, possible that some of the sedimentary blocks are also early Palaeocene in age, which is highly significant given that most early Palaeocene sediments in western Britain were eroded prior to volcanism due to uplift caused by the arrival of the Icelandic mantle plume.

The project will involve detailed field mapping and sampling in Arran and major and trace element analysis at Cardiff, along with radiogenic isotope analysis (Sr, Nd, Pb & Hf) and radiometric dating (U-Pb and Ar-Ar) at the NERC Isotope Geoscience Laboratories, in Keyworth.

These data will aid caldera models in active basalt-rhyolite volcanic settings such as Yellowstone-Snake River Plain, Iceland and the Afar, and there will be an opportunity during the project to visit and compare modern Icelandic analogues with Arran.

Bell, B.R., Williamson, I.T. 2002. Tertiary Igneous Activity. In: The geology of Scotland. (Trewin, N.H. ed.) p.371-407.

King, B.C. 1955. The Ard Bheinn area of the Central Igneous Complex of Arran. *Quarterly Journal of the Geological Society of London*, 110, 323-356.

Training opportunities: The project will provide training in field geology, volcanology, petrology, geochemistry, geochronology and analytical techniques (ICP-MS & ICP-OES in Cardiff), together with isotope analyses and radiometric dating probably at the NERC Isotope Geosciences Laboratories and the Scottish Universities Environmental Research Centre. The student will be part of a cross-School

and group of staff, post-doctoral scientists and students working on global magmatic processes. The links with the BGS and Glasgow department will also enhance the student's training..