TESTING THE CORE-MANTLE-BOUNDARY & LARGE IGNEOUS PROVINCE HYPOTHESIS: A FULL-VECTOTR PALAEOMAGNETIC STUDY OF THE NORTH ATLANTIC IGNEOUS PROVINCE.

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Fig 1. Left: A photograph from 2016 of NAIP at Fingal's Cave, Staffa, Scotland. Right: a map showing the NAIP with an arrow highlighting the position of the Faroe Isles.

Background: Large Igneous Provinces (LIPs) are large areas of volcanism that erupt over millions of years. It has been suggested that LIPs are delayed expressions of energy release from the Earth's Core; hot plumes from the Core-Mantle Boundary (CMB) rise over a period of ~50 Myr to form hotspots. When a hotspot first breaks through the Earth's crust a LIP forms. Before the energy release at the CMB, it is very likely that the Earth's Core was hotter than usual. It is predicted that increases in temperature, will increase fluid-flow rates in the outer Core, increasing the efficiency of the geodynamo, leading to higher geomagnetic field intensities than usual (Biggin, et al., 2012). However, these ideas have not been rigorously tested.

The Columbia River Basalts, north west USA, is a 'small' LIP that occurred ~17-14 Ma and is associated with the Yellowstone hotspot, and the North Atlantic Igneous Province (NAIP) is a LIP that erupted ~64 to 54 Ma centred on the Icelandic hotspot. The NAIP was broken up during the formation of the Atlantic Ocean and now extends from eastern Greenland, the Faroe Islands, Northern Ireland and Scotland (Fig. 1). If the hypothesis of Biggin et al. (2012) is correct, then there should be a low in the intensity recorded by the NAIP LIP basalts due to the initial formation of the plume that forms the Yellowstone hotspot. However, modern ancient absolute geomagnetic field intensity (palaeointensity) estimates recovered from NAIP rocks are very limited (e.g., Riisager, et al. 2002). There are older estimates, especially from Scotland (e.g., Smith, 1967), however, these no longer meet modern quality criteria.

Project: The aim of the project is to test the CMB & LIP hypothesis of Biggin et al. (2012), by collecting samples from both the Faroe Isles and the western coast of the British Isles. A modern full-vector palaeomagnetic study of these samples will be conducted to test the hypothesis described above.

Student Profile: This project is a combined field and laboratory project, and would suit a candidate with strong interest field-based Earth Sciences. Candidates should have a degree in Earth Science or Physics. Fieldwork will involve wild camping in remote areas in potentially cold and wet environments. Good laboratory skills also desirable.

*Biggin, A.J., Steinberger, B., Aubert, J., Suttie, N., Holme, R., Torsvik, T.H., van der Meer, D.G. & van Hinsbergen, D.J.J., 2012. Possible links between long-term geomagnetic variations and whole-mantle convection processes, Nature Geosci., **5**, 526-533, doi: 10.1038/ngeo1521.*

Riisager, P., Riisager, J., Abrahamsen, N. & Waagstein, R., 2002. Thellier palaeointensity experiments on Faroes flood basalts: technical aspects and geomagnetic implications, Phys. Earth Planet. Inter., 131, 91-100.

Smith, P.J., 1967. The Intensity of the Tertiary Geomagnetic Field, Geophys. J. Royal Astron. Soc., 12, 239-258.

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