The stratigraphy and emplacement of the Antrim lavas (SEAL)

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Abstract: The Antrim lavas were erupted during continental rifting that led to the opening of the North Atlantic ca. 56 Ma and now form a basalt plateau in NE Ireland including the iconic UNESCO World Heritage site the Giant's Causeway. Much work to date has focused on the petrology and geochemistry of the basalt, resulting in a sophisticated understanding of the genesis and evolution of the basalt magma; however, relatively little is known about the internal stratigraphy of the lava sequence. This project aims to determine the stratigraphy of the Antrim Lavas from a series of cores drilled across the plateau that penetrate the basalt sequence, complemented by field sampling. In addition to stratigraphic analysis of cores and outcrop data using basalt petrology, the project will use magnetic analyses to aid stratigraphic interpretation, including anisotropy of magnetic susceptibility (AMS), which can provide fabric data that can help to interpret flow direction. This will enable us to develop the most detailed model for the stratigraphy and emplacement of the Antrim lavas to date, developing our understanding of the volcanism that accompanied the rifting of the N. Atlantic.

Aim: To develop a comprehensive and detailed model of the internal stratigraphy and emplacement of the Antrim Lava sequence from cores and outcrop data

Objectives: 1) Stratigraphic analysis of cores including establishing basalt facies to to correlate between cores, magnetostratigraphy and petrological analyses; 2) Determine the structure from fabric analyses achieved through AMS measurements of split cores and oriented outcrop samples; 3) generate a 3D model of the internal stratigraphy using correlated facies to establish facies architecture and structure using geological modelling software Move™; 4) interpret the emplacement of the lavas from fabric analyses.

Project specific training: Volcanic stratigraphy and facies analysis involves identifying and interpreting different types of lava flow and volcanic deposit. From cores this will be done through detailed description of the texture and petrology including quantitative petrology techniques such as crystal size distribution analysis. Additional data and samples may be collected from outcrop. Rock magnetic analyses can contribute to facies analyses through varying magnetic parameters such as magnetisation, polarisation, susceptibility and fabrics. Key rock magnetic analysis will be susceptibility and AMS used for fabric analysis. As well as laboratory rock magnetic analysis, the project will involve field sampling of oriented samples using block sampling and field drilling.

Project management and logistics: The principal supervisor will be Dr Carl Stevenson who is a specialist in rock magnetic analysis. Dr Sebastian Watt will co-supervise the project providing expertise from a volcanological perspective. Dr Rob Raine, based in Belfast, is the external supervisor providing a link with the BGS and access to core material at the GSNI and mineral company core stores in Antrim and Belfast, and contributes stratigraphic analyses expertise with industry experience in core description, geochemistry and correlation. The project will require regular visits to the core store and several periods of field work in NI. Rock magnetic analyses, 3D modelling and petrology will be carried out at Birmingham.

Selected references:

Walker, G.P.L., 1959, Some Observations on the Antrim Basalts and Associated Dolerite Intrusions: Proceedings of the Geologists' Association, v. 70, p. 179-205.

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Ellam, R.M., and Stuart, F.M., 2000, The Sub-lithospheric Source of North Atlantic Basalts: Evidence for, and Significance of, a Common End-member: Journal of Petrology, v. 41, p. 919-932.

Lyle, P., 2000, The eruption environment of multi-tiered columnar basalt lava flows: Journal of the Geological Society, v. 157, p. 715-722.

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