

CASP Research Award for Geological Fieldwork- 2018 Award Winner

Applicant: Jessica Pugsley, University of Aberdeen.
Project Title: Three-dimensional modelling of lava accumulations of the British Palaeogene Volcanic Province
Award: £2,050.

Scientific Question and Rationale:

Predicting three-dimensional geometry of lava fields in outcrop and in the subsurface is highly complex, though commercially critical along the North Atlantic Margin, one of the last remaining frontier regions of hydrocarbon exploration within the UK Continental Shelf. Thick, heterogeneous volcanic sequences in this region pose considerable problems both for seismic imaging and drilling efficiency. This project will utilize the excellent exposure of volcanic sequences on the Isle of Mull, part of the British Palaeogene Volcanic Province (BPVP), to generate a surface geometry of internal packages, which can then be applied to subsurface geometries.

Specific Objectives and Deliverables:

The cliff sections of Mull represent unparalleled exposure and accessibility of volcanic outcrop within the BPVP, mirroring the complexity of volcanic sequences encountered offshore. Extensive field mapping combined with 3D modelling obtained from a drone will provide a means of generating detailed information on the 3D architecture and formation of these ancient volcanic deposits. Ultimately the aim, through forward modelling, is to produce synthetic seismic of the Mull lava pile and its intra-volcanic sedimentary intervals, in addition to gaining further insight into the Mull Lava Piles stratigraphy. An understanding of the lateral continuity and acoustic impedance of different volcanic units will facilitate more accurate subsurface predictions, including: (1) the presence of low permeability fluid barriers, and (2) the depth to base volcanics, critical in a pre-drill scenario when estimating the cost and duration of drilling each section of the overburden.

Current 3D models produced during the first year of this PhD have successfully displayed the extensive level of minor and major faulting on Mull, and the compartmentalisation this may cause in the subsurface, as well as the heterogeneous nature of the lava pile itself. Considerable numbers of tree fossils have also been observed during field work in season 1 illustrating extensive hiatus in volcanism in which intra-volcanic sedimentary intervals formed. Geologically mapping the lava morphologies illustrates the complexities of the area, which are significantly oversimplified on the current BGS geological map of the area.

Proposed Work Plan:

Fieldwork during season 2 (2018) will be carried out in two blocks firstly a week in April to generate additional drone imagery and then 8 weeks summer field season June – August.

April droning acquisition: Further of 3km of further coastline to add to the current 3.8km – droning will be conducted partially over an area mapped in field season 1 where extensive normal faulting occurs offsetting the geology, this data will then be used to reconstruct the faults on Mull and help fully understand the facie stratigraphy of the area. The second section of droning will be carried out over part of the area that will be mapped in field season two where the 30m high cliffs are inaccessible from the base – then further around this coastline where further faulting dissects the area.

Summer field season June – August: Extensive geological mapping, logging and sampling will be conducted over the area south of the 12km² area covered in field season 1. The data derived aims to provide insight into the heterogeneous nature of the lava pile and give a better understanding of its stratigraphy.

Proposed Expenditure including details of any other sources of funding:

- *Accommodation:* £1,300 for 8 weeks summer field season, £500 droning week.
- *Transport:* £250 Petrol and Ferry for the year.
- **Total: £2,050.**

Funding: Currently no other sources of funding external to the University of Aberdeen have been secured; the project is funded through the Elphinstone Scholarship (fees only), therefore only partially funded, though I am extremely motivated and financially secure external to the project.