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Imaging continental break-up magmatism in the upper and lower crust beneath the Faroe Islands, North Atlantic, using passive seismic data

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The Faroes margin is one of the northern North Atlantic volcanic rifted continental margins, where breakup was accompanied by massive volcanism. The crustal structure of the continental block on which the Faroe Islands sits is poorly understood, mainly due to the presence of thick (>2.5 km) basalt sequences that erupted as part of the continental breakup of the northern North Atlantic at c. 55 Ma. In particular, the thickness of the basalt sequences, the presence of sub-basalt sedimentary rocks, the properties of the crystalline basement and continental crust, Moho depth and the characteristics of a possible magmatically-intruded lower crustal layer are all largely unconstrained beneath the Faroe Islands landmass.

The Faroe Islands Passive Seismic Experiment (FIPSE) has collected global teleseismic earthquake data from 12 temporary broadband seismometer stations to image variations in crustal layer thickness and velocity beneath the Faroe Islands. This work will present results achieved using the receiver function method that: i) image the uppermost $\sim$10 km of the crust to constrain the flood basalt thickness and depth to crystalline basement; ii) image the Moho discontinuity to provide three-dimensional variations in crustal thickness and bulk crustal velocity; and iii) identification and classification of high-velocity lower crustal layers.

Our Faroese crustal thickness estimates of 23-31 km from receiver function H-κ stacking analysis are consistent with Moho depth estimates from previous offshore seismic refraction/wide angle reflection experiments of 21-35 km adjacent to the Faroe Islands. We find evidence for a high-velocity lower crustal layer beneath the Faroe Islands, but with variable thickness and seismic characteristics. These findings provide information about the extrusive and intruded igneous volume in this part of the North Atlantic Igneous Province and aid the understanding the paleogeographic development around the time of continental break-up, as well as the present day elevation of the region. Furthermore, we present the first direct evidence for sedimentary rocks between the thick basaltic sequences and crystalline basement beneath the Faroe Islands, which is of particular interest to the hydrocarbon industry.