Modelling geochemical variations associated with rift relocations at Iceland.

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Rift relocations, where the onshore active spreading axes periodically jump eastwards relative to the offshore Reykjanes and Kolbeinsey ridges, to remain in alignment with the Iceland plume centre, have dominated the tectonic evolution of Iceland. During a rift relocation two adjacent spreading axes operate simultanaeously, and as a result there is a significant reduction in the spreading rate across an individual axis. Normal full spreading rates on Iceland are considered to be around 20mm/yr; this can decrease to around 10mm/yr across one of the spreading axes, during a rift jump [1]. It has been suggested that below a threshold of 20mm/yr, conductive cooling becomes a significant control on the extent of the melting region [2].

This study focusses on the Skagi region of Northern Iceland; the location of a palaeo-rift axis which died around 3Ma [1], when the transfer of extension to the presently active Northern Volcanic Zone (NVZ) was completed. There are 4 stages of the rift cycle represented at Iceland: birth (Eastern Volcanic Zone, EVZ), steady-state (NVZ), decline (Western Volcanic Zone, WVZ) and death (Skagi) of a spreading axis. New data shows that Skagi is geochemically distinct from the presently active NVZ and WVZ, but has similar characteristics to the EVZ; with high Fe-Ti and relative enrichment in the incompatible elements Nb, Zr and Y. Compositional variations are also associated with the current rift relocation from the WVZ to the EVZ.

A numerical model, based on simple 2-D corner flow beneath a spreading ridge, is used to define the steady-state thermal structure for upwelling and melting mantle; and model the composition of ridge products. Models for the composition at each of the different rift cycle stages are then compared to the observed geochemistry. Future expansion of the numerical model to allow time-dependent variations in spreading rate will help constrain the rates of transfer of extension during a rift jump, and allow tracking of the resulting geochemical variations and melt production rates. The overall aim is to account for the compositional differences observed at Skagi and ultimately understand the dynamics of rift relocations at Iceland.

References

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