Does sub-lithospheric topography control the extent of plume flow under Iceland?

CHRISTINA J MANNING[1]* AND MATTHEW THIRLWALL[1]

[1]Department of Earth Sciences, Royal Holloway University of London, Egham, Surrey TW20 0EX UK
(* correspondance: c.manning@es.rhul.ac.uk)

Iceland is the product of melt over-production on the North Atlantic Ridge, associated with the presence of the Iceland plume. Extensive analyses of Icelandic basalts have shown them to exhibit isotopic and trace element compositions consistent with their derivation from a mantle plume containing at least a portion of recycled material (enriched Sr-Nd-Pb isotopes, negative Δ^{207}Pb and K/Nb <270) [1,2]. In addition mixing trajectories in Pb-Pb and Nb/Y-Zr/Y space show no evidence of a role for North Atlantic Asthenosphere (NAA) in the genesis of Icelandic basalts [2,3]. This, along with 'Icelandic' geochemical signatures observed in basalts erupted at significant distance from Iceland along both Reykjanes and Kolbeinsey Ridges, suggests the influence of the plume extends far beyond the island itself [1]. This has been attributed to radial contamination of the surrounding asthenosphere by the Iceland plume head [5].

The island of Heimaey, located off South East Iceland, is the proposed tip of the propagating Eastern Rift Zone (ERZ) [4]. In contrast to other Icelandic basalts those from Heimaey exhibit significantly less 'Icelandic' compositions with less negative Δ^{207}Pb and K/Nb approaching mantle values, indicating a contribution from NAA. This suggests that at Heimaey, less than 200km from the proposed plume centre, there is a smaller contribution from plume material than seen 1000km along the Reykjanes Ridge. Given that the degree of melting at Heimaey is expected to be significantly smaller than that seen in the Reykjanes Ridge and that lower degree melts are expected to be enriched in lower Ts plume material, this difference in observed plume signature has to reflect actual variations in the proportion of plume material in the mantle underlying these areas. This suggests that either radial plume flow is significantly assymetric, or alternatively that plume flow patterns are controlled more by sub-lithospheric topography, associated with spreading and propagating rifts, than accounted for in the radial flow model.

[1] Thirlwall *et al* (2004), *GCA* **68**, 361-386 [2] Chauvel and Hemond (2000), *G*^{3} **1**, 1055-1085 [3] Fitton *et al* (1997) *EPSL* **153**, 197-208 [4] Mattsson and Oskarsson (2005) *JVGR* **147**, 245-267 [5] Ito (2001), *Nature* **411**, 681-4