Reviewed research article

An Iceland hotspot saga

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Abstract — *Is Iceland a hotspot, with ridge-centered plume? In Iceland vigorous volcanism has built up a plateau 3.0 km higher than at a normal mid-ocean ridge with 3 to 4 times thicker crust than average oceanic crust. This volcanism can be associated with anomalous volcanism for 56–61 Ma in the form of aseismic ridges that stretch across the North Atlantic Ocean through Iceland, i.e. the Greenland-Iceland-Ridge (GIR) and the Faeroe-Iceland-Ridge (FIR). Iceland is a "meltspot" and an hotspot and the GIR and FIR may be hotspot trails. The trends or age progressions of the GIR and FIR are too uncertain to conclude if the Iceland hotspot can be a fixed reference point. There is a large seismic low-velocity anomaly (LVA) in the mantle under Iceland at least down to 400–450 km depth and with globally low velocities down to ∼200 km depth. The center of the LVA is at 64°40'N and 18°10'W between the glaciers Hofsjökull and Vatnajökull. The shape of the LVA is approximately that of a cylinder in the depth range 100–450 km, but at certain depths elongated in the north-south direction. The LVA extends at least up to 30–40 km depth beneath Central Iceland and the rift zones. The shallower part of the LVA (i.e. above ∼150 km depth) extends at least ∼700 km outside of Iceland to the southwest, along the Reykjanes Ridge. The LVA has been numerically modelled with geodynamic methods by several authors as a ridge-centered convecting plume. They try to fit crustal thickness of the Iceland hotspot and neighbouring ridge, and the magnitude and shape of the LVA. The latest of these models find a best fit: A plume 135–150°C hotter than background mantle, retaining in general 1% partial melt in a maximum ∼90 km thick melting zone, but reaching up to 2–3% partial melt in the shallowest mantle. The rest of produced melt goes into forming the crust. Considerable work has been carried out on various plume models to explain these and other observations in Iceland, but the models are still some way from reaching a mature state. As long as important observations are lacking and some key questions remain unanswered, alternatives to the plume model or more realistic variants of it in a larger tectonic framework, including heterogeneous mantle, should not be discouraged.*