

Plume-ridge interaction revised: the case of Reykjanes ridge and Iceland

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Anomalies in seafloor elevation, crustal production and MORB geochemistry locally characterize mid-ocean ridges in the vicinity of mantle plumes. These characteristics are considered evidence for the interaction of the upper mantle with an upwelling plume that is hotter and chemically more fertile. In this contribution, we question this model presenting petrological and geochemical data on peridotites and MORB from the Charlie Gibbs Transform Zone (53°N), which is located at the southern end of the Reykjanes ridge south-west of Iceland. With exception of rare mantle xenoliths in some OIB-derived lavas, these rocks potentially represent a unique direct samples of mantle peridotites from the upwelling Iceland plume, that is diverted, and channelled along the Mid Atlantic ridge south of Iceland [1]. Studied peridotites are heterogeneous in composition and range from residual harzburgites to refertilized lherzolites. The clinopyroxenes (cpx) in harzburgites have MORB-like Nd-Hf isotope ratios ($\epsilon_{\text{Hf}}=14-32$ and $\epsilon_{\text{Nd}}=10-16$) indicating a residual character generated by <10% partial melting of a DM-like peridotite. In contrast, the lherzolite cpx have extremely high Hf isotope ratios (up to 463), but low ϵ_{Nd} (6.8) associated with very low M-REE but high LREE. These features require ancient (>1.5 Ga) melt-depletion followed by recent interaction with incompatible element enriched melts. These observations suggest that the lherzolites formed through reaction of melts with peridotite that characterized by high degrees of melt depletion dating back >1.5 Ga before its emplacement in the present-day North Atlantic asthenosphere, and reaction with migrating melts during recent melting [2]. Based on seismic tomography, gravity models and the chemistry of associated MORB, we suggest that a large part of the Iceland plume consists of such ancient, ultra-depleted peridotites that may compensate for the excess density of recycled crust and cause its positive thermochemical buoyancy [3]. The shallow bathymetry, anomalous MORB chemistry, and the extensive melt production of some plume-influenced ridges can also be caused by high proportions of ancient melt-depleted peridotites in the upwelling sub-ridge mantle.