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The origin of isotopic heterogeneity in MORBs: A case-study of incompatible element depleted basalts from the Bight Fracture Zone

STEPHANIE ANNE ANDERSON[1], MICHAEL BIZIMIS[1], BRAMLEY MURTON[2] AND JACQUELINE DIXON[3]

[1]University of South Carolina
[2]National Oceanography Centre
[3]University of South Florida

We present new isotope data on 31 basaltic glasses from the southern Reykjanes Ridge and the Mid-Atlantic Ridge (MAR) south of the Bight Fracture Zone (BFZ). Samples from 55.686°N to 59.830°N were selected from B. Murton's R/V Celtic Explorer (CE0806) and R.R.S. Charles Darwin (CD80) collections. The study area includes the BFZ, which is the first transform fault marking the termination of the Reykjanes Ridge at 56°47'N along the MAR. A large negative mantle Bouguer anomaly (MBA) bulls-eye gravity low is centered ~65 km south of the BFZ and is accompanied by increased volcanism in the form of numerous, small, off-ridge seamounts that appear to be unfaulted and hence young. Isotopic compositions of the basaltic glass samples from along the MAR become more depleted southward from the compositional discontinuity at ~60°N to the BFZ. We find a unique highly depleted component characterized by high εHf, εNd, and low $^{206}Pb/^{204}Pb$ at the vicinity of the BFZ, which is distinct from other depleted components identified in the Iceland plume and along the north MAR. In εHf-εNd space, these isotopic data have a slope of 2.55, which is one of the steepest seen in Atlantic MORBs. This εHf from εNd decoupling implies ancient mantle melting in the presence of garnet. South of the BFZ and along the MBA, εHf decreases sharply by ~4.0 εHf over a 25 km section, mimicked by a decrease in εNd, and increase in $^{206}Pb/^{204}Pb$. When compared to other data for the region, the component seen beneath the MBA and southwards to the Charlie Gibbs Fracture Zone (56.4-52°N) has similar εHf and εNd as seen north of the BFZ between 60°N and 62°N. We explore two alternatives for the source of this depleted basalt: a basin wide contamination of the North Atlantic upper mantle by old SCLM fragments, remnants of past collisions and openings in this hemisphere’s upper mantle or recycled melt-depleted peridotite from ancient oceanic crust generation.