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High resolution He isotopes from Reykjanes Ridge MORB support pulsing Iceland plume

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The upwelling mantle plume beneath Iceland flows south down the Reykjanes Ridge (RR). Several prominent V-shaped ridges (VSRs) that extend obliquely from RR are believed to result from pulses of hotter mantle in the upwelling mantle (Jones et al., 2014). Although the along-ridge variation in inferred mantle temperature correlates with basalt trace element composition, whether this is due to variation in the temperature of the mantle plume or a consequence of crustal accretion processes with a series of rift propagation cycles remains unclear.

$^{3}He/^{4}He$ from 41 MORB glasses from southernmost Iceland to 55°N on Reykjanes Ridge range from 10.7 to 16.5 R_A. There is no systematic correlation with He concentration implying that pre-eruptive degassing is not responsible for the $^{3}He/^{4}He$ variation. The running mean of $^{3}He/^{4}He$ shows a broad peak of ~16.0 R_A centred around 60°N. This coincides with the topographic high associated with VSR-1. South of the 60°N $^{3}He/^{4}He$ decreases and becomes more variable. A less-distinct peak at 56°N (13 R_A) coincides with the topographic high associated with VSR-2. The variation in $^{3}He/^{4}He$ at 56°N is consistent with the strong variation in free-air gravity field anomalies beneath the ridge that indicates heterogeneity in mantle temperature beneath the ridge. The size of the He isotope anomalies at VSR-1 and VSR-2 scales with excess temperature. The coincidence of high $^{3}He/^{4}He$ with the topographic expression of the VSRs implies that the melt temperature variation along the Reykjanes Ridge is due to the increased proportion of deep mantle in the upwelling plume.