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He, Sr, Nd and U isotopic variations in post-shield lavas from the Big Island of Hawaii -- insight into magma production and the chemical structure of the Hawaiian plume

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He, Sr, Nd, and U isotopic variations in post-shield lavas from the Big Island of Hawaii – insight into magma production and the chemical structure of the Hawaiian plume

We present new isotopic and trace element data on post-shield alkalic lavas from the Hualalai, Mauna Kea, and Kohala. These small-volume eruptions, which presumably correspond to small-volume source regions in the mantle, serve as high resolution probes of geochemical heterogeneity to complement data available from shield-stage tholeiites that originate in the primary melting region. The post-shield isotopic ratios average over mantle volumes as much as 100 times smaller than those of the shield stage lavas. The post-shield volcanic vents are spread over an area of about 2500 km² on the island of Hawaii. The locations extend about 35km on either side of the axis of the Hawaiian ridge and 60 to 110 km northwest of the centroid of the main melting anomaly (located between Kilauea and Loihi). Helium isotopic ratios were measured on olivine separates and, where present, pyroxene separates from the same samples. The Sr, Nd, and U-series isotopes were done on whole rock powders of the same samples. He isotopes range from 6-11 R/Ra, ⁸⁷Sr/⁸⁶Sr varies from 0.70345-0.70374, and epsilon-Nd from +5.3 to +7.4. The total range of Sr and Nd isotopic variations in these lavas is about twice that observed in the 2.84 km section of Mauna Kea drilled by HSDP, and similar to the range encompassed by Mauna Loa and Mauna Kea tholeiites excluding those erupted from ML since 30 Ka. For He the range is much smaller in the post-shield lavas than in the shield lavas. There is general SW – NE asymmetry for all three isotope systems that could be viewed either as the Loa-Kea dichotomy or a reflection of the overall radial zoning of the plume. The amplitude of Sr and Nd heterogeneities is not markedly larger than in the shield sections of the volcanoes, which indicates that if there are larger amplitude variations in the plume, they are substantially smaller than the source regions of the post shield lavas. There is no evidence that the post-shield lavas are affected substantially by lithospheric interaction or that they are melted from isotopically anomalous material associated with pyroxene-rich domains.