A finer structure of the Hawaiian mantle plume

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Hawaiian volcanoes form two chains, the Loa and Kea trends, which are geographically and geochemically distinct [1,2]. We explore the isotopic characteristics (high-precision Pb-Nd-Sr-Hf) of two "Kea"-trend volcanoes (Kohala and Haleakala) with transitional isotopic signatures at their shield-building stage to assess the degree of independence between the two trends of the Hawaiian mantle plume (HMP). In all isotopic systems, these samples are intermediate between Loa and Kea compositions and cross-over the Pb-Pb boundary [3]. They extend the Pb-Pb trend of W. Maui and E. Molokai, with distinctly lower $^{208}Pb/^{204}Pb$ for a given $^{206}Pb/^{204}Pb$. Statistical analysis of the MC-ICP-MS or triple-spike shield tholeiite data (n>600) and the existence of three Pb-Pb trends originating from average Loa composition indicate that Loa is the dominant mantle source composition on the archipelago. Isotopically, four geochemical groups are identified, in order of increasing $^{208}Pb^{*}/^{206}Pb^{*}$, $^{87}Sr/^{86}Sr$ and decreasing ε_{Hf}, ε_{Nd}: transitional Kea (E. Molokai, W. Maui, Haleakala, Kohala), Kea (Mauna Kea, Kilauea), average Loa (Mauna Loa, Hualalai, Kauai, Waianae, W. Molokai, Loihi), and enriched Loa (Koolau Makapuu, Lanai, Kahoolawe).

The implications are: 1) the HMP is bilaterally zoned, perpendicular to the edge of Pacific LLSVP, with an overal gradation in $^{208}Pb^{*}/^{206}Pb^{*}$ [4], ε_{Hf}, ε_{Nd}; 2) HMP source components refresh and grade into and out of existence on a smaller timescale than previously thought; 3) the Loa component dominates volumetrically the islands and could account for the large increase in volume flux over the last 5 Myr [5]; 4) the Kea trend source is heterogeneous but to a smaller extent than the Loa trend source; and 5) vertical heterogeneity of the plume is important on a regional scale and at the scale of individual volcanoes.

[1] Jackson et al. (1972) *GSA Bull.* **83**, 1-17. [2] Weis et al. (2011) *Nat. Geosci.* **4**, 831-8. [3] Abouchami et al. (2005) *Nature* **434**, 851-6. [4] Farnetani et al. (2012) *EPSL* **359-60**, 240-7. [5] Wessel (2016) *Geoph. J. Int.* **204,** 932-47.