Recent and episodic addition to the Hawaiian plume activity

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The Hawaiian magmatic activity during the last few million years has occurred along two parallel concurrently active volcano trends – referred to as the Kea and Loa. Significant differences in the radiogenic isotope of lavas between the two volcano trends must reflect similar differences in the underlying mantle, and offer a unique opportunity to model the structure of the plume and provide an insight into the variation observed in individual volcanoes. We analyzed Hf isotopic compositions of lavas from Koolau volcano including the Nuuanu submarine landslide deposit derived from the interior part of the Koolau shield [1]. Detailed interpretation of the available and new Hf data with the Sr-Nd-Pb isotopic data has allowed us to delineate the temporal geochemical evolution of the Loa-trend magmatism.

The Kea plume trend was most probably active throughout its 85 Myr history, whereas the Loa-trend activity appeared only 3 Myr ago. The new Hf isotope data is critical in deciphering the temporal isotopic trend of Loa-trend lavas into a loop-like excursion from Koolau main shield stage toward an extreme composition in Lanai lava and then back to a Loihi composition while the Kea-trend lavas remained nearly unchanged isotopically. These systematic isotopic trends reveal that horizontally, the Hawaiian plume in the past 3 Ma spread in two divergent paths with Koolau as the pivot. Thus, the geochemical trend does not simply form parallel Kea and Loa lineaments as has been widely believed. The time dependent isotopic variation in the Loa trend can be used for reconstructing vertical zonation of the plume, and suggests the episodic involvement of zoned component including recycled materials in the Hawaiian plume beneath the Loa-trend trajectory. In the entire history of the Hawaiian-Emperor chain magmatism, the extremely large magma flux anomaly in the past 5 Myr indicates a pulse of episodic thermal increase of the Hawaiian plume during this period. In addition, larger magma flux in Kea-trend volcanics over the Loa-trend volcanics in the past 3 Myr reveals that the thermal centre of the plume has been dominated by the Kea component. Entrainment of the recycled materials into the Hawaiian mantle plume on the other hand is attributed to the recent enhancement of plume activity.

References

[1] Tanaka R., Nakamura E., and Takahashi E. (2002) *AGU Geophs. Monogr.* **128,** 311-332.