

Isotopic variation in tholeiite lavas from submarine Hualalai ridge, Hawaii

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The volcanoes of the Hawaiian Islands are distributed in two parallel trends (i.e., the 'Loa' and 'Kea' trends), whose rocks are characterized by general geochemical differences. It is broadly accepted that Hawaiian plume is composed of several components, but the chemical structure of Hawaiian plume remains a matter of considerable debate. Hualalai volcano, located on the Loa trend, has been in the post-shield alkalic stage for over 100 ky, and most of its surface is covered by alkalic basalts. Only a few isotopic studies have been previously conducted on shield tholeiitic basalts of this volcano. To identify source materials involved in Hualalai ridge volcanism can provide important information about the isotopic evolution of 'Loa' trend volcanoes.

We analyzed Hf, Pb, Sr, Nd isotopic compositions and trace element contents of 16 lava samples from the submarine ridges of Hualalai. The tholeiite samples were collected from North Kona region at 2700 - 3500 m water depth by 2001 Kaiko dive (K219) and at 2100 m - 4500 m depth by 2002 Shinkai 6500 dives (S690, S692). It is considered that these samples were erupted at the pre-shield or shield stage of this volcano based on the stratigraphy and lithology. Isotopic compositions of the lavas have $^{87}\text{Sr}/^{86}\text{Sr}$ ratios ranging from 0.703642 to 0.703801, $^{143}\text{Nd}/^{144}\text{Nd}$ from 0.512847 to 0.512934, $^{176}\text{Hf}/^{177}\text{Hf}$ from 0.283056 to 0.283124, $^{206}\text{Pb}/^{204}\text{Pb}$ from 18.0964 to 18.3294, $^{207}\text{Pb}/^{204}\text{Pb}$ from 15.4470 to 15.5039, and $^{208}\text{Pb}/^{204}\text{Pb}$ from 37.8541 to 38.1719. Hf, Nd, Sr isotopic compositions of the North Kona lavas are plotted within the data field previously reported for shield stage tholeiite from Mauna Loa, and define a clear mixing line showing that the mantle source consists of at least two components. Some of new Pb isotopic data have higher $^{207}\text{Pb}/^{204}\text{Pb}$ and $^{208}\text{Pb}/^{204}\text{Pb}$, for a given $^{206}\text{Pb}/^{204}\text{Pb}$, than published data from Mauna Loa and Hualalai. The trend emerges towards to 'Kea'-like component. The results indicate that (1) the isotopic variations in Hualalai shield lavas appear dominated by a mixture of two components: a 'Koolau'-like enriched component and a 'Kea'-like depleted component, (2) the Hualalai shield lavas originated from a source that had a relatively higher proportion of the 'Kea'-like component than the Mauna Loa source.