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How atypical is Kaua‘i's Loa-Kea geochemical trend?

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Shield-stage lavas from Kaua'i show a seemingly atypical range and distribution of Pb isotopic compositions compared to other Hawaiian volcanoes. Western Kaua'i lavas are Kea-like in composition and are distinct from eastern lavas, which are Loa-like[1]. These compositions are geographically flipped relative to those of the younger Hawaiian volcanoes, which typically erupt lavas of Loa composition along the southwestern Hawaiian trend and lavas of Kea composition along the northeastern trend[2]. We present major element, trace element, and Sr-Nd-Hf isotopic compositions as well as ages for shield samples from Kaua'i. Isotopic compositions correlate with age from west to east, implying that shield-stage lavas underwent a change in their mantle source between 4.7 and 4.4 Ma, transitioning from Kea to Loa compositions over about 300 ka. Comparing Kaua'i isotopic trends and those from other Hawaiian volcanoes indicates that a change in isotopic compositions during the shield-stage of individual volcanoes is not necessarily unique to Kaua'i. For example, the magnitude of isotopic and age changes on Kaua'i is comparable to those of West Moloka'i[3] and Mauna Loa[4] shield-stage lavas. West Moloka'i lavas show a change in Pb-Sr-Nd-Hf compositions that also crosses the Loa-Kea compositional boundary. Mauna Loa lava isotopic compositions are within the Loa field, although they change over time (e.g., from lower to higher $^{87}Sr/^{86}Sr$). Kaua'i basalt compositions change both across the Loa-Kea boundary and with time, with the addition of a flipped Loa-Kea geography. Volcanoes that show compositional changes within their respective Loa or Kea fields may be explained by smaller-scale heterogeneities present on either side of the Hawaiian plume. Volcanoes that show compositional changes across the Loa-Kea boundary, such as West Moloka'i and Kaua'i, are relatively uncommon and may occur because the trend of the compositional boundary in the plume is at an angle to the direction of Pacific plate motion[1,2,3].

[1] Williamson *et al.* (2019) *Geochem. Geophys. Geosys.* 20, 4354-4369. [2] Abouchami *et al.* (2005) *Nature* 434, 851-856. [3] Xu *et al.* (2014) *Geochem. Geophys. Geosys.* 8, Q08G21. [4] Rhodes (2015) *Geophys. Mono.* 208, 59-78.