Cerium isotope constraints on Hawaiian mantle sources

P. BÉGUELIN[1], M. BIZIMIS[2], A. STRACKE[1], M. WILLIG[1]

[1]University of Münster, 48149 Münster, Germany
(*correspondence: beguelin@uni-muenster.de)
[2]SEOE, Univ. of South Carolina, Columbia, SC 29208, USA

Along with the widely-used Nd and Hf isotope ratios, Ce isotopes are tracers of the time-integrated rare-earth element signature of mantle sources. The sampling of depleted mantle source components generally results in overlapping trends in Nd–Hf isotope space[1]. However, the variable fractionation of La/Ce from Sm/Nd and Lu/Hf during mantle melting makes the presence of distinct time-integrated trace-element depleted source components in lavas appearent in Ce–Nd and Ce–Hf isotope space. Hence, combined Ce-Nd-Hf isotope studies are particularly well-suited for investigating the influence of variably depleted source components in Earth's mantle[2,3].

Here we present Ce isotope data for a set of well documented Hawaiian lavas from O'ahu, Kaua'i and Ni'ihau islands with the aim to investigate the importance of varaibly depleted source components on the isotopic variability in these Hawaiian lavas. The investigated lavas form stacked island-specific arrays in Ce–Nd and Ce–Hf isotope space. We show that lavas from O'ahu (Makapu'u series) cannot fit on a mixing cruve with Kaua'i and Ni'ihau lavas, requiring the presence of multiple isotopically depleted endmembers with varying $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ ratios for a given $^{138}Ce/^{136}Ce$.

A recycled mafic component in the upwelling plume with parent/daughter ratios akin to depleted MORB probably dominates the Ce–Nd–Hf istotope systematics of Makapu'u lavas. Kaua'i and Ni'ihau lavas from the post-erosional rejuvenated volcanic stage further require the existence of two distinct isotopically depleted sources components.

We show that when considered at the scale of a single hotspot, the Ce–Nd and Ce–Hf isotope systematics of mantle-derived lavas reveals multiple island-specific arrays. Explaining these arrays require the presence of several isotopically distinct depleted components in the upwelling plume, which are indistinct in Nd–Hf isotope space alone. Ce isotopes are thus a promising tracer of depleted mantle sources.

[1] Salters et al. (2011) *G³, 12(8).*
[2] Israel et al. (2020) *EPSL, 530, 115941.*
[3] Willig et al. (2020) *GCA, 272, 36-53.*