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Stable Ce isotopic compositions of oceanic island basalts from the Madeira Archpelago

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Ocean Island Basalts (OIB) are crucial for understanding Earth's mantle dynamics and crust-mantle recycling. Originating from deep mantle plumes, they carry unique geochemical signatures that reflect mantle composition, heterogeneity, and thermal conditions. Their isotopic and elemental characteristics will shed light on mantle-crust interactions, plume-lithosphere processes, and deep material cycling.

Cerium (Ce) is a unique element due to its variable valence states (+3 and +4). Therefore, Ce exhibits distinct behavior compared to other REEs, especially under redox conditions. In oxidizing environments, Ce^{3+} can be oxidized to Ce^{4+}, leading to fractionation of Ce isotopes and the potential for Ce anomalies. As subducted materials (such as oceanic sediments and crust) are dragged into the mantle, they release fluids and melts that can interact with the mantle, which could modify the redox conditions of the mantle source.

In this study, we present the first systematic stable Ce isotope data for a well-characterized suite of OIB from the Madeira Archipelago. The Madeira Archipelago is an ideal location for studying the recycling of subducted material in ocean island basalt (OIB) lavas due to its unique mantle source, which is believed to contain a complete package of recycled oceanic lithosphere. This makes it a natural laboratory for investigating the processes of mantle heterogeneity and the contribution of subducted oceanic crust to OIB magmatism. The archipelago's lavas exhibit a range of geochemical signatures that reflect the involvement of both upper and lower oceanic crust in their mantle source. Our results show that $\delta^{142}Ce$ [$\delta^{142}Ce = (^{142}Ce/^{140}Ce)_{sample}/ (^{142}Ce/^{140}Ce)_{NIST\ SRM3110} - 1) \times 1000$ ‰] of samples showed limited variation ranging from -0.025 to +0.034 ‰ with an average of 0.006± 0.039‰ (2SD, N=17). The homogeneity of stable Ce isotopes in OIBs may reflect the uniformity of the Ce isotopic composition in the Madeira mantle plume source, or limited contributions from subducted components.