K and Sr isotope variations in boninite-series lavas from the Izu-Bonin forearc

CHRISTOPHER A. PARENDO[1*], STEIN B. JACOBSEN[1], KATSUYUKI YAMASHITA[2], OSAMU OKANO[2]

[1]Department of Earth & Planetary Sciences, Harvard University, Cambridge, MA, United States (*correspondence: cparendo@fas.harvard.edu)

[2]Graduate School of Natural Science and Technology, Okayama University, Okayama, Japan

Lavas that make up Chichijima, an island that is part of the Izu-Bonin forearc, are understood to have resulted from the following processes: (1) melting of a very depleted mantle in response to fluxing by slab-derived aqueous solutions enriched in fluid-mobile elements, and (2) fractional crystallizational, yielding a spectrum of compositions from the most primitive (boninites) to more evolved (dacites, rhyolites). A primary goal of this study is to assess the relative importance of these two broadly-defined processes in explaining the diversity of lava compositions on the island.

Here we report K and Sr isotope analyses for a range of rock types, including boninites, andesites, dacites, and quartz dacites. K isotope analyses were made using an Isoprobe-P MC-ICPMS and, subsequently, a Nu Sapphire MC-ICPMS. For both instruments, a hexapole collision and reaction cell is utilized to eliminate Ar-related interferences. Analytical precision is typically around 0.05 ‰ (2σ).

The lavas exhibit a range in $\delta^{41/39}$K (normalized to an estimate of Bulk Silicate Earth) from +0.44 to -1.40 ‰ (n = 13). $\delta^{41/39}$K and the K content of the samples are negatively correlated. ^{87}Sr/^{86}Sr ranges from ~ 0.7035 to 0.7055 after age correction (n = 10), consistent with data from previous studies. ^{87}Sr/^{86}Sr and 1/[Sr] are positively correlated.

Two hypotheses are being explored, in order to explain the exceptional range (almost 2 ‰) in $\delta^{41/39}$K values in this igneous suite. First, the variations might reflect preferential incorporation of ^{41}K into cumulates during fractional crystallization. A correlation between $\delta^{41/39}$K and Eu/Eu* indicates a possible role for plagioclase. Alternatively, the variations might result from preferential mobilization of ^{39}K during transport of K from the slab into, and through, the mantle wedge. In this case, the relationships involving $\delta^{41/39}$K and Ce/Ce* (as well as Eu/Eu*) might be attributed to derivation of material from slab sediments, which have negative Eu and Ce anomalies.