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Authors

Brown, Shaun T.
Yogodzinski, Gene M.
Vervoort, Jeffery D.
[et al.](#)

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Hafnium in Aleutian lavas: Isotopic and trace element evidence for slab melting

Brown, S.T.^{1,2} Yagodinski, G.M.¹ Vervoort, J.D.³, Gersen, M.G.³

1 Dept of Geological Sciences, University of South Carolina Columbia, SC 29208

2 Center for Isotope Geochemistry, Lawrence Berkeley National Laboratory, Berkeley, CA 94720

3 Department of Geology Washington State University, Pullman, WA 99164

New isotopic and trace element analyses of 65 Aleutian lavas are used to investigate the sources of Hf in arc magmas and the origin of high Nd/Hf and Sm/Hf in island arc lavas compared to global MORB (i.e. HFSE depletion). A well-characterized subducting sediment composition and relatively simple subduction system make the Aleutian arc an ideal natural laboratory to study the nature of source components in island arc lavas.

Aleutian basalts are commonly characterized by high Nd/Hf (5-8) and Sm/Hf (1.45-2.25) compared to similarly evolved MORB (Nd/Hf = 4, Sm/Hf=1.35). The Nd/Hf ratios in Aleutian lavas are not correlated with the observed westward (along-arc) increases in both ϵ_{Hf} and ϵ_{Nd} , which have been related to the composition and quantity of sediment being subducted beneath the Aleutians. Sample suites from Korovin, Little Sitkin and other volcanic centers show that Nd/Hf evolves to lower values with increasing SiO₂. Thus high Nd/Hf appears to be both a primary magma characteristic and, to a first order, unrelated to the Nd and Hf isotopic variation.

Two-component mixtures of bulk subducting sediment (Nd/Hf =6) and depleted mantle (Nd/Hf = 3-4) cannot create mixtures with both the isotopic and trace element characteristics of the least evolved Aleutian lavas. Moreover, since high Nd/Hf lavas

occur over the whole range of measured ϵ_{Hf} , there appears to be no two-component mixture that can adequately explain both the trace element and isotopic characteristics of the least evolved Aleutian lavas. We suggest that a third component with high Nd/Hf is required, that contributes Hf to the source of Aleutian lavas.

Recent experimental studies (e.g. Green and Adam, 2003, *Eur. Journ. of Min.*) indicate that MORB-derived fluids probably have low Nd/Hf (<4), and are unlikely mixing end members for Aleutian lavas with Nd/Hf=5-8. In contrast, magnesian andesites from the western Aleutians, inferred to be melts of the subducting oceanic crust (Kay, 1978 JVGR), have Nd/Hf = 9-10, the highest ratios observed in Aleutian lavas. Thus, coupled Nd-Hf isotopic systematics and the presence of high Nd/Hf in the least evolved Aleutian lavas appear to require a 'slab melt' component in magmas throughout the arc.