The importance of melts of sediment and AOC in arc magma genesis: a Neodymium and Hafnium isotope perspective

Award: 03-25189 (July 2003), MARGINS-Related

D. Tollstrup[1], J. Gill[1]

[1]*University of California, Santa Cruz*

The nature (i.e., aqueous fluid vs. silicate melt) and sources (i.e., sediment vs. altered oceanic crust) of the slab flux added to the mantle wedge source of arc magmas have been investigated using isotopes of two of the least fluid-mobile slab tracers, Neodymium and Hafnium. • Volcanic front lavas from Izu, Mariana, Kurile, and Kamchatka arcs have less radiogenic Nd but only slightly less radiogenic Hf than the assumed mantle source for each arc, whereas rear-arc lavas are displaced toward much less radiogenic Hf and slightly less radiogenic Nd. This difference is shown in the figure by blue versus red symbols for Izu, and by CIP versus Kasuga Smts. for the Mariana arc. • Two component mixing of sediment and mantle can account for the average Nd and Hf isotope ratios of volcanic front lavas, but not the isotope variation observed within the arcs. • Mixing sediment and altered oceanic crust (AOC) with an assumed mantle can account for the Nd and Hf isotope ratios of both the volcanic front and rear-arc volcanoes. Nd-Hf and Pb isotope systematics are consistent with a slab flux to the mantle source of arc front and rear-arc volcanoes that is composed of > 90% AOC and < 10% sediment, with the proportion of sediment to AOC varying from arc to arc. • Although an aqueous fluid flux can explain the data for arc-front volcanoes, the relative fluid-immobility of both Nd and Hf requires the addition of a partial melt of both subducting sediment and AOC to the source of rear-arc volcanoes, leaving residual zircon in the slab.

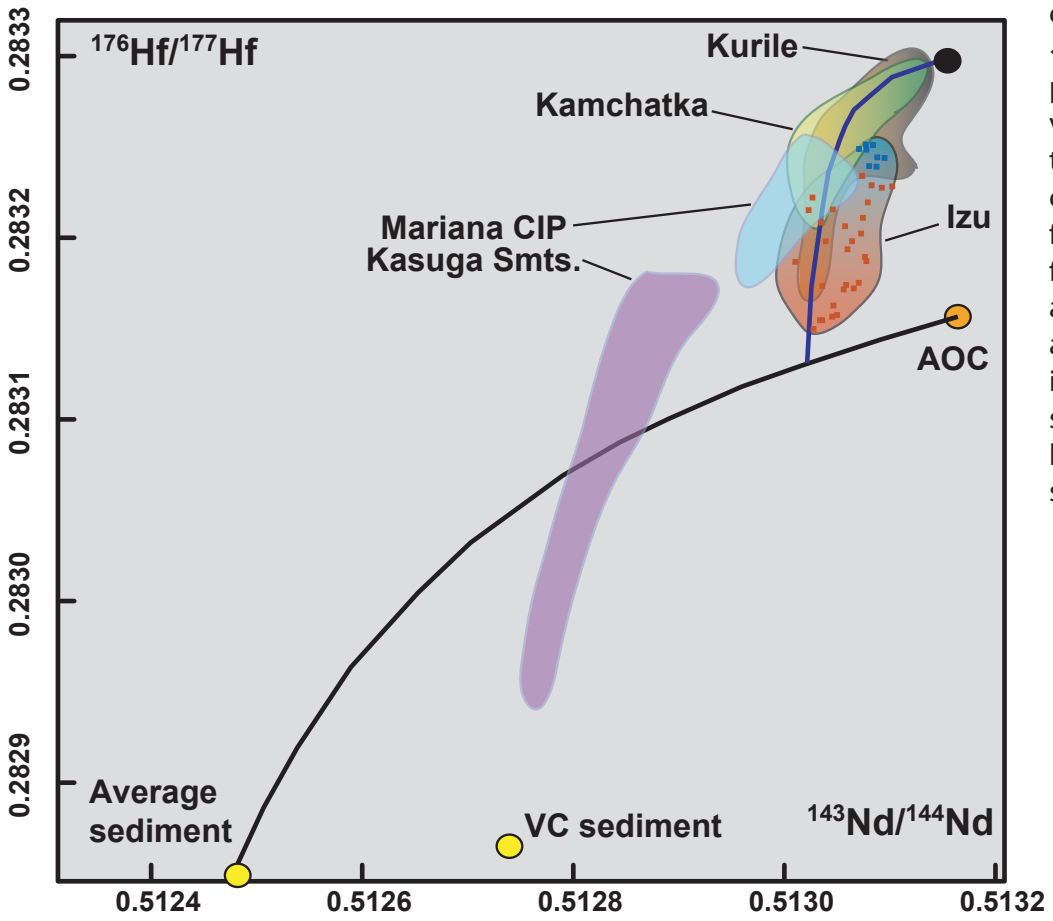

Figure: $^{176}Hf/^{177}Hf$ and $^{143}Nd/^{144}Nd$ systematics for Kamchatka, Kurile, Izu, and Mariana arcs. Each arc forms a mixing trend (blue line as an example for the Kurile arc) between an assumed mantle composition (black dot) and a slab component. The slab component is a mixture (black line) between AOC (orange dot) and sediment (yellow dot). AOC comprises > 90% of the slab component for most arcs. Data sources: Mariana CIP -Wade et al. (2005), Stern et al. (2007); Kasuga Smts. - Tollstrup and Gill (2005); Kamchatka - Munker et al. (2004); Kurile - Dreyer et al. (in prep.); Izu - Tollstrup et al. (in prep.); AOC - ODP Site 1149 (Hauff et al., 2006); Average and volcaniclastic (VC) sediment - ODP Site 801 (Plank et al., 2007).