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Characterizing slab inputs in the earliest stages of subduction: Preliminary evidence from fluid-mobile element systematics for IODP Expedition 352 recovered volcanic samples

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IODP Expedition 352 recovered ~1.22 km of boninitic and basaltic volcanic rocks from four sites in the Izu-Bonin forearc to examine the volcanic phenomena associated with subduction initiation. While the recovered forearc basalts give little indication for the involvement of slab-derived volatiles, the extensive sequences of boninite series lavas recovered up-section show physical evidence for extensive fluid involvement (heavy vesicularity, explosive eruptive style), along with chemistries indicative of fluid-addition melting of depleted mantle sources. We are attempting to assay the makeup and likely slab provenance of these fluids via their fluid-mobile element (B, As, Cs, Sb, Pb, Li) systematics.

Boron abundances measured thus far in fresh boninitic glasses recovered from Holes U1439C and U1442A range from 3-12 ppm, with B/Be and B/La ranging from 7.5-106 and 2-18.5, respectively. While the highest values are comparable to those observed in the most B-enriched Izu-bonin arc rocks, most of the data are at the low end of this range. Cs/Th and Pb/Ce ratios encompass the range of values encountered in IBM boninites in the literature, and are comparable to values for Izu arc lavas, while As/Sm ratios appear to be lower than in arc suites. Li concentrations are elevated relative to basaltic lavas, at 7-17 ppm, and Li/Yb ratios range from 8-22, a factor of four higher than the range encountered in volcanic arc suites. While fluid-mobile element systematics of Izu-Bonin volcanic arc lavas show evidence for inputs of two unique slab components with markedly different fluid-mobile element enrichments, the Izu-Bonin boninites can best be explained as simple mixtures of very depleted mantle and a single slab phase with high abundances of fluid-mobile species, along with elevated K, Ba, and other common subduction indicator species.

Volcanic arc lavas globally show evidence for a fluid-mobile element enriched component that appears to be similar to serpentinite. Serpentinites generally show marked enrichments in B, As, and Cs, but lesser enrichments in Pb, Li and other alkaline species (e.g., Savov et al 2005; 2007; Deschamps et al 2011). The pattern of relative fluid-mobile species enrichment in the Exp. 352 boninites differs from that of IBM forearc serpentinites, indicating that either serpentinites are not be the source for the enriching fluids, or if they are that the serpentinites are of shallower or deeper origins than those recovered by ODP drilling, which can result in different elemental enrichment patterns (e.g., Mottl et al 2003; Hattori and Guillot 2007).