Boron isotopes in boninites record evolving input from a cooling slab during subduction initiation

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To initiate a subduction zone and produce arc lavas involves the starting and evolution of slab-to-mantle fluid and material exchanges, which can be studied through the compositions and isotopic signatures of early subduction-related magmatism. Boron is widely viewed as an endmember trace element in terms of its mobility in fluids, and many have contended that as both a trace element and an isotopic system it is an ideal tracer of the role and movement of fluids during subduction(1). However, very little data for boron, and even less data for B isotopes, exists for igneous rocks known to be associated with the earliest stages of subduction.

Boron and B isotope systematics for the two stratigraphic sections of boninite lavas recovered during IODP Expedition 352 in the Izu-Bonin forearc provide insights into how slab-mantle chemical exchanges start and evolve during subduction initiation. Boron concentrations are 3-4 times lower in early-erupted "low SiO_2" boninites (LSB) than in later-stage "high SiO_2" boninites (HSB)(2). $\delta^{11}B$ ranges from 0‰ to +8‰ in LSB, while HSB have a $\delta^{11}B$ of +1.5‰, ±1‰. Combined B isotope and Ba/Nb systematics point to high T° fluid and melt inputs from a mixed ocean crust/serpentinized lithospheric reservoir as the earliest slab inputs, producing the LSB via fluxed melting. Later, a transition to lower T° fluid inputs that reflect both sedimentary and ocean crust contributions lead to the formation of the late-stage HSB lavas. Our inferences from B isotopic systematics are consistent with the εHf and with the other radiogenic isotopic patterns of Exp. 352 forearc volcanic rocks in reflecting melt/fluid contributions from subducting ocean crust as the first slab-derived inputs to the IBM mantle wedge, with later inputs from subducting sediments as convergence proceeds and the slab cools. HSB magmatism also marks a transition early in the subduction process to slab sources and a magmatic geometry more consistent with that of the modern Izu-Bonin arc.

(1) De Hoog and Savov, (in Marschall, H: *Boron Isotopes*) 2018

(2) Reagan et al (*Int Geol. Rev.*) 2017