Tracking subduction initiation via Re-Os isotopes and highly siderophile elements: A case study of Izu-Bonin-Mariana forearc lavas

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During subduction initiation and subsequent maturation, mantle melting begins in an extensional regime and progress to flux melting. This generates an evolution of volcanic products that progress from early MORB-like forearc basalts to boninites and eventually to arc lavas. Trace elements [1, 2] and Sr-Nd-Pb-Hf isotopes [3] demonstrate that the degree of melting and the source material change over time. Broadly, forearc basalts are derived from small melts of variable depleted mantle while boninites are generated by flux melting hightly depleted (harzburgitic) mantle.

When used in conjunction, Os isotopes and highly sidorphile elements are sensitve to both recent and long-term melt depletion events. We used these geochemical tools to understand the nature of the mantle and added components (i.e. subduction fluids, sediment, etc.) contributing to volcanism in the Izu-Bonin-Mariana forearc as subduction progressed from its initial extensional phase to convergence dominated by flux melting. Initial forearc basalts record low Os concentrations (15-100 ppt) and a range of initial $^{187}Os/^{188}Os$ (0.1184-0.1505), which are similar to radiogenic basalts from the Southwest Indian Ridge. Conversely, boninites record a range of Os concentrations (8-567ppt) and $^{187}Os/^{188}Os$ (0.1224-0.1484). A small subset of forearc basalt and boninite lavas show evidence for recent Re addition. Boninites can be subdivided geochemically based on major elements into low-silica boninites, high-silica boninites, and boninitic basalts. Isotopically, however, there is no difference between the $^{187}Os/^{188}Os$ signature in each suite. Instead, Os isotopes reflect ancient hetergeneities in the mantle while HSE abundances record a blend of ancient and recent processes. [1] Reagan et al. (2017) Internat. Geol Rev. [2] Shervais et al. (2019) G3. [3] Li et al. (in review) EPSL.