Fingerprinting the mantle during subduction initiation using Re-Os isotopic systematics of Izu-Bonin-Mariana forearc boninites

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The birth of a subduction zone is a process that cannot presently be observed. However, the early volcanic products created during subduction initiation can be used to investigate the ancient geodynamics responsible for creating the new tectonic regime. IODP Expedition 352 sampled the earliest boninitic lavas produced near the Ogasawara Islands during the initiation of the Izu-Bonin-Mariana subduction zone. The boninite lavas can be subdivided into low-silica boninites (LSB), high-silica boninites (HSB), and boninitic basalts (BB) on the basis of major element chemistry [1]. Shervais et al. [2] suggest that the HSB originated from a mantle source distinct from both the LSB and BB; the compositional difference could be due contributions from the subducting slab.

In order to investigate the nature of the mantle contributing to boninite production, Re and Os isotopes were measured on 30 boninite lavas. The measured $^{187}Re/^{188}Os$ vs. $^{187}Os/^{188}Os$ values correlate well with a 50.1 Ma age reference line, consistent with approximate age of boninite formation in this region. Age-corrected $^{187}Os/^{188}Os$ ratios extend from anciently depleted mantle to mildly radiogenic values (0.1224-0.1484) and contain 8-567ppt Os. There is no distinguishable Os isotopic difference between LSB, HSB, and BB. Likewise, there are no strong correlations between decreasing Os abundance, increasing Re abundance, and increasing $^{187}Os/^{188}Os$ values. Therefore, the processes responsible for generating different types of boninite lavas do not influence Os isotope systematics. Instead, the isotopic variations recorded by boninite lavas may reflect ancient heterogeneities in the mantle prior to subduction initiation.

[1] Reagan et al. (2017) Internat. Geol Rev. [2] Shervais et al. (2017) EGU General Assembly.