

Nascent along arc magmatism is consistently hydrous as revealed by H concentrations in orthopyroxene phenocrysts: A study of boninites from the Izu-Bonin-Mariana Intraoceanic Arc

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The Izu-Bonin-Mariana intraoceanic arc system was generated following subduction initiation along the proto-Philippine Plate - Pacific Plate boundary beginning c. 52 Ma. During the subsequent 2 Myr, abundant crust was generated at a suprasubduction zone ridge, a majority of which is preserved in the modern forearc as forearc basalt-boninite extrusives. Boninite volcanism persisted along this boundary until at least c. 45 Ma and constitutes the proto-arc phase of magmatism.

We observe that primitive boninite products sampled by on-land surveys, oceanic dredging/diving, and ODP/IODP drilling are broadly similar; dominated by pyroxene minerals (\pm olivine) set in a glassy matrix with neither hydrous nor aluminous phases present. These rocks were derived from a shallow magmatic system that formed in the 2 Myr following subduction initiation and persisted throughout the c. 7 Myr proto-arc period.

Samples studied here were recovered from the Mariana fore-arc (Guam), Ani-jima (Muko-jima Island Group), the submarine portion of the Bonin Ridge and the nearby trench slope (sampled by Shinkai 6500 diving and IODP Expedition 352, respectively), and the Izu fore-arc (sampled during ODP Leg 125). Orthopyroxene phenocrysts were manually separated from whole rocks and prepared for ion microprobe analysis. Their H concentrations are similar, ranging from 83-151 $\mu\text{g/g}$ H_2O with core analyses having lower concentrations than rim analyses. Inferred crystallization temperatures are broadly similar using Ca-in-orthopyroxene thermometry.

Based on these data, orthopyroxene crystallized from shallow (crustal) water under-saturated melts. Melt H_2O concentrations inferred for each reservoir were estimated using partitioning data recovered from Chichi-jima orthopyroxene-melt inclusion pairs and range from c. 2.4-4.2 wt.% in the Mariana fore-arc, c. 3.2-4.3 wt.% for the Muko-jima Island Group, c. 3.1-4.3 wt.% for samples recovered from the submarine Bonin Ridge, and c. 2.9-3.7 wt.% in the Izu fore-arc, demonstrating along-arc similarity in magmatic H_2O concentrations and stable magmatic conditions