



Geochemical characteristics of the earliest volcanism in the Izu-Bonin forearc

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Record of the earliest volcanism in the Izu-Bonin arc is exposed on the Ogasawara Islands. New $^{40}\text{Ar}/^{39}\text{Ar}$ dating results imply that the boninitic volcanism recorded on Chichijima Island had been active in a shorter period than previously thought, i.e., 46-48 Ma. Tholeiitic andesite from Hahajima Island appears to be 2-3 m.y. younger than the Chichijima boninites. The isotopic compositions of the Chichijima boninites are distinct from the Hahajima tholeiites (Taylor et al., 2003). Combined with the age data, significant change of arc magma source at ca. 45 Ma is implied.

Hoping to acquire information on the even earlier stage of arc volcanism, diving was conducted on the western escarpment of the Bonin Ridge (BRE, hereafter). During four SHINKAI 6500 submersible dives, fresh andesitic clasts were recovered from the northern segment of the ridge, and boninitic lava blocks as well as Nummulitic limestone of middle Eocene age were recovered from the escarpment northwest of Chichijima (southernmost diving site).

The andesites from the northern segment of the BRE are tholeiitic and are similar to those from Hahajima Island in petrography and major element composition. However they show enrichment in LILE and LREE that is not observed in the Hahajima tholeiites. Boninitic lavas from the BRE are different from the Chichijima boninites in major element composition by having lower MgO and higher TiO_2 , and overlap the composition of boninites from ODP site 793. Overall chemical characteristics including trace

elements are similar to high-Ca boninitic rocks from the Izu-Bonin arc.

The isotopic characteristics of the lavas from the BRE are distinct from the subaerial lavas. The tholeiitic andesites from the BRE have more radiogenic Pb and Nd, and comparable Sr isotopic composition to the Hahajima tholeiites. They form a similar isotopic trend to other Eocene lavas from the Izu-Bonin-Mariana arc, i.e., a trend pointing to low or negative $\Delta 7/4$ and $\Delta 8/4$ with higher $^{206}\text{Pb}/^{204}\text{Pb}$ (i.e., HIMU-like). The boninitic samples from the escarpment show compositions intermediate between the tholeiitic andesite from the BRE and the Chichijima Boninites, which form a trend extending to high $\Delta 7/4$ and $\Delta 8/4$. In Sr-Pb and Pb-Nd isotopic plots, boninitic lavas from the BRE plot between the Bonin Ridge tholeiite and the Chichijima boninite with slightly lower $^{143}\text{Nd}/^{144}\text{Nd}$ and $^{206}\text{Pb}/^{204}\text{Pb}$ and higher $^{87}\text{Sr}/^{86}\text{Sr}$ relative to the tholeiites from BRE, confirming the transitional isotopic characteristics of the boninitic rocks.

$^{40}\text{Ar}/^{39}\text{Ar}$ dating of a boninitic and a tholeiitic andesite from the BRE returned well-defined plateau ages of 42.86 and 41.84 Ma, respectively. These ages indicate that the samples from the BRE postdate the subaerial lavas that constitute the basement of the Bonin islands. The observed sections could be debris from the younger section which had been eroded away in the subaerial part of the Bonin Ridge or represent the earliest stage of volcanism related to the back-arc rifting of the Ogasawara Trough., which is the oldest rifting of the Izu-Bonin arc.

The new geochemical results from the BRE imply that tholeiitic and boninitic volcanic activity was contemporaneous on the Bonin Ridge. At that same time, the compositions of the subarc mantle and/or a slab-derived component in the arc magma source seem to have changed in both time and space during the first 6 m.y. of the Izu-Bonin arc.