

Seismological evidence for growing and re-melting continental crust in the Izu-Bonin arc

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Seismological studies for revealing growth processes of continental crust under intra-oceanic arcs have been increased since a 6km/s-layer indicating an andestic continental crust had been found in the northern Izu arc. Structural image from those studies suggested significant crustal variations from an arc to arc, in which the Izu arc and the Aleutian arc are considered as the two end members, i.e., the 6km/s-layer is imaged in the Izu arc, while no seismological evidence for the 6 km/s-layer is obtained in the Aleutian arc. A bimodal volcanism observed in the Izu arc may also suggest a variation of crustal growth process even in a single arc system. In this study, we examine structural variation along the Izu-Bonin arc by means of active source seismic imaging, and integrating the structural image and petrological studies proposes a possible scenario of a growth of a continental crust under an intra-oceanic arc. The wide-angle seismic data used were acquired in 2004 and 2005 from the Sagami-bay to the north of the Iow-jima, over 1000 km long, along the volcanic front. An overall structure along the entire profile shows a drastic structural change at the Sofugan tectonic line; e.g., a thick crust (more than 30 km thick in the thickest part) including a well-developed 6km/s-layer at the north and a thin crust (less than 20 km thick) with poorly developed 6km/s-layer at the south. Detailed seismic image in the northern part (from the Sagami-bay to Tori-shima) shows an along arc structural fluctuation with 70-100 km wave-length, which correspond to the bimodal volcanism in the Izu arc; i.e., low average crustal seismic velocities of the crust at the basaltic volcanoes (e.g., O-shima, Miyake-jima, Hachjo-jima, Aoga-shima), while high average velocity at the rhyolite volcanoes (e.g., Nii-jima, Kurose, South-Hachjo caldera, Myoji knoll and South Sumisu caldera). In addition, the variation of the average velocity shows a good anti-correlation with volumes of the andestic middle crust. We conclude from those observations that the continental crust grows beneath the basalt volcanoes in the Izu arc, while rhyolite volcanism is attributed by re-melting the pre-existing continental crust. A geochemical modeling for a formation of a crust in an intra-oceanic arc also supports our conclusion.