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Crustal formation process and mass transfer in the Izu-Bonin subduction factory revealed by active - passive seismic studies

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JAMSTEC has conducted intensive seismic studies in the Izu-Bonin intra-oceanic arc where the Pacific plate is subducting beneath the Philippine Sea plate. A result of active seismic study along the present-day volcanic front provides new seismological constraints on crustal formation process: i.e., 1) crust of continental composition having Vp of 6 – 6.8 km/s has been predominantly generated beneath basaltic volcanic centers along the volcanic front, 2) the bulk compositions of the crust does not changed during evolution from the thin Bonin arc crust to the thick Izu arc crust, but represent more mafic (basaltic) than an average composition of typical continental crusts, 3) a process to return mafic to ultramafic lower crustal components to the mantle is required for an arc crust to evolve into a continental crust. A passive seismic study covered the Izu arc provides seismic velocity and random inhomogeneities images of the mantle wedge beneath the volcanic front. Both images show strong lateral variations (i.e., localized high Possion's ratio and highly scattered zones) which are likely correlated with the volcanoes, but they do not perfectly matched with the volcano locations. Those may suggest localized magmas in the mantle wedge and their branching toward the surface. In the rear-arc region, we discovered a seismological evidence of a paleo-Izu arc (presumably Oligocene arc). A variation pattern of crustal structure along the rear arc is similar to that we found in the present-day volcanic front; i.e., a volume of the 6-6.8 km/s crustal component (continental composition) shows 50-80 km scale variation, which corresponds to the distribution of the basalt volcanoes. A remarkable difference between the two arcs is, however, observed in the thinner parts of the 6-6.8

km/s crustal component. A volume ratio of a cruatal component having over 7 km/s (mafic to ultra-mafic composition) between the basalt volcanoes in the present-day arc (i.e., the thinner parts of the 6-6.8 km/s crustal component) shows significantly larger than that in the Oligocene arc. A process or mass transfer to predominantly increase such a high velocity crustal component between the basalt volcanoes may be required during the evolution process from the Oligocene arc to the present-day arc.