

Crustal structure of the mid Izu-Ogasawara Arc

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A wide-angle seismic experiment was conducted as a joint operation between the Hydrographic and Oceanographic Department, Japan Coast Guard (HODJ) and the Japan Marine Science and Technology Center (JAMSTEC) in April-May, 2002, to construct a crustal structure model of the Izu-Ogasawara (Bonin) arc, which can be a clue to clarify the evolution process of the intra-oceanic island arc. The Izu-Ogasawara arc is located on the eastern edge of the Philippine Sea plate along with the Izu-Ogasawara Trench, and shifts to the Mariana arc at its southern end. In this investigation, we deployed 25 ocean bottom seismographs (OBS) at 20-30 km of intervals along about 800 km track-line at 30-31N from the Pacific Basin at its eastern end, through the Shichito-Iwojima Ridge and Kinan Escarpment, to the center of the Shikoku Basin at its western end, except for the Izu-Ogasawara Trench area exceeding 6000 m depth. The deployment and retrieval of OBSs were carried out by S/V Shoyo, HODJ. The seismic source is an array of eight, 1500 in³ (24.6 liter) air guns (12000 in³ or 196.6 liter, total) provided by R/V Kairei belonging to JAMSTEC, firing every 90 seconds with an approximate 200 m spacing.

The data recorded by each OBS were of high quality, especially the OBS set on the arc could keep a record of clear signals of Pn and/or PmP with offsets of up to 200km. Travel time data were modeled by the two-dimensional ray tracing. The profile of multi-channel seismic reflection carried out almost the same situation (Park et al. 2002), was referred to estimate the thickness of upper sedimental layer.

The acquired crustal model along the track-line shows several structural features. One of those is a thick lower crust extending to ~50 km east from the Kinan Escarpment which forms a large vertical displacement of over 600 m in water depth on the Shikoku Basin. In this area, total thickness of the crust is about 2 km larger than that in the surrounding area. An average thickness of the Shikoku Basin is about 2 km smaller than that in the Pacific Basin, estimated from this crustal model.

The structural model also reveals that the thickness of the Izu-Ogasawara island arc crust is approximately 20 km and that there exists a 6.0-6.5 km/s layer with ~5 km thickness at the mid of the crust and a thick 7.0-7.2 km/s layer with thickness of over 5 km at the bottom of the crust. These structural characteristics highly resemble the result of the northern Izu-Ogasawara arc survey at 32N conducted by Suyehiro et al. (1996), though the water depth along the Izu-Ogasawara arc gradually becomes larger from north to south.