Crustal structure of the island arc-ocean transition between the Kyushu-Palau Ridge and Shikoku/Parece Vela Basin

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Seismic velocity structure of the continent/island arc-ocean transition provides crucial information of rifting tectonics. The Kyushu-Palau Ridge (KPR) is a remnant of a proto Izu-Ogasawara-Mariana island arc separated by the backarc spreading of the Shikoku and Parece Vela backarc basins. For the purpose of elucidation of the intra-arc rifting, we conducted 13 wide-angle seismic profiles across the KPR at 15-30 N in 2004-2006 under the Japanese Continental Shelf Survey Project. Then, we could obtain 13 P-wave velocity structural models at the remnant island arc-ocean transition zone.

The seafloor topography at the boundary of the KPR and Shikoku and Parece Vela backarc basins is characterized by sharp and steep scarps supposed to be formed by the initial rifting, breakup and early separation of the proto-arc. On the basis of the bathymetric data, the island arc/ocean boundary apparently corresponds to the position of the escarpments. The seismic structure, however, does not simply support the position of the boundary.

The crustal models beneath the KPR roughly consist of two layers. The KPR crusts comprise the upper crust with P-wave velocities less than 6.8 km/s and large velocity gradient, and lower crust with 6.8-7.2 km/s and small velocity gradient. The crustal thicknesses beneath the KPR vary from 8 to 20 km according to the profiles and are significantly thicker than those of the both sides of each profile, that is, the oceanic crusts of the West Philippine Basin to the west and of the Shikoku Basin and Parece Vela Basin to the east. The thicker crust beneath the KPR is mainly due to a thickening of the lower crust.

The positions where the thick KPR crusts thin to the same thickness of oceanic basins are not necessary located at the just below the submarine escarpments. Several profiles show that the crusts become thinnest to the east of the escarpments. The position corresponds to the east end of the sediment pond related to the rifting, identified by the multi-channel seismic profiles. The minimum crustal thickness is less than 4 km, which is thinner than that of normal oceanic crusts prevailing in the further eastern part of the basins. Very thin oceanic layer 3 characterizes the thinnest crust. The Pn values just below the thinning crust east of the KPR suggest slightly higher ones.