Seismic structure of West Philippine Basin and Kyusyu-Palau Ridge by seafloor borehole seismometer, OBS and airgun experiment

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The western Pacific area including the Philippine Sea Plate is characterized by many island-arc-trench systems and back-arc basins, which are estimated to correspond to subduction of oceanic plates. The Philippine Sea Plate is divided into two regions by the Kyushu-Palau Ridge running from north to south. There are the Shikoku Basin and the Parece-Vela Basin in the eastern part, and the West Philippine Basin exists in the western part. Because the West Philippine Basin is the oldest in the Philippine Sea Plate, the structure of this basin is reflected in the formation process of the Philippine Sea Plate. It is important to study a seismic structure of the West Philippine Basin and the Kyushu-Palau Ridge to consider the formation process of the Philippine Sea Plate and to estimate the development process of an island-arc-trench system. In addition, the borehole broadband seismic station (WP-1) was installed in the easternmost part of the West Philippine Basin in 2001 and is in operation. To obtain the seismic structure is also important for analyses of data retrieved from the WP-1.

Three seismic surveys using airguns, borehole broadband seismometer installed at the WP-1 and ocean bottom seismometers were conducted around the WP-1 from 2002 to 2003. The length of the profile parallel to the Kyushu-Palau Ridge is about 120km and perpendicular to the ridge is about 150 km. The line perpendicular to the Ridge covered the region from the WP-1 site to Kyushu-Palau Ridge. Total number of used OBSs is twelve. Seismic velocity structures for shallow structure are derived from using a tau-p method of individual OBS records. A deep structure beneath the profile is estimated by a forward modeling using a two-dimensional ray tracing method.

In the West Philippine Basin, the uppermost layer of the crust consists of sediments, whose P-wave velocity is 2.6km/s. The thickness of the sedimentary layer is about 520m. The P-wave velocity at the top of the second layer (Layer 2) is 4.8 km/s and the thickness is 1.0-1.2km. The top of third layer (Layer 3) has a P-wave velocity of 6.2 km/sec beneath the N-S profile and 6.7 km/s beneath the E-W profile, and is approximately 2.3 km thick. The P-wave velocity of the uppermost mantle is approximately 8.0km/s. The total thickness of the igneous crust is estimated to be 3.3-3.8 km. The crust is about 3-4 km thinner compared to typical oceanic crusts. The thin curst may correspond to lower melt supply at the formation of the crust. Beneath the Kyushu-Palau Ridge, the sedimentary layer becomes thin toward a summit, and there are areas without sediments at the top of the ridge. A layer with P-wave velocities of 4.7-5.7km exists beneath the sedimentary layer. The thickness of the 4.7-km/s layer is 3.5-4.0km. Beneath the 4.7-km/s layer, there is the layer with P-wave velocity of about 6 km/s, which is a typical layer of island-arc crusts. The 6-km/s layer is estimated to have thickness of about 2-3km. The P-wave velocities of the lower crust is 6.7-7.1km, and thickness is thicker than 4.0km. A resolution of the deep region beneath the Ridge is not high due to inadequate ray coverage. The P-wave velocity of the uppermost mantle is approximately 8.0km/s. The 6-km/s layer is thinner than those in the northern Kyushu-Palau Ridge and in the northern Izu-Ogasawara island arc.