Seismic velocity model of Minami-Tori Shima and its belonging seamount chain

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Minami-Tori Shima is the only Japanese island on the Pacific plate and no other island is located within distance of less than 800 km from the Japanese territorial islands. However, under the sea, many seamounts are scattered around Minami-Tori Shima and form a seamount chain, called Marcus-Wake Seamount chain (seamount group). According to the result of radiogenic isotope study, they were formed predominantly by the Cretaceous volcanic activity without clear formation age progression, in spite of their widespread distribution. Many formation models of the seamount groups on the Western Pacific Basin have been proposed, and they are still controversial. To constrain formation models from the approach of the seismic velocity structure, the Japan Coast Guard conducted a wide-angle and reflection seismic experiment at Marcus-Wake Seamount chain.

The survey line named MTr3 is cutting across the seamount chain from northeast to southwest. Its length is set to approximately 480 km, long enough to clarify the velocity structure of the uppermost mantle under the seamount chain. Ninety ocean bottom seismographs (OBS) in total were deployed at a 5 km spacing around the seamount chain and a 7.5 km spacing on the flat seafloor. A 6,000 inch3 (1500 inch $*$4) airgun array was used as the seismic source. The shot spacing was set to 200 m.

The OBS data show high S/N. In the record sections of many OBSs data, P-wave first arrivals can be identified clearly to an offset 150 km. Some record sections show strong signals at an offset distance farther than 300 km. These signals would be reflected waves at a reflector seated in the mantle. In order to construct a structure model, the two-dimensional forward modeling based on a graph theory (Kubota et al., 2005) and two-dimensional tomographic inversion using first arrivals were (Koenaga et al., 2003) applied. To certify the constructed model, the 2D elastic finite-difference wave propagations (Laresen and Shultz, 1995) on the model were calculated.

In the final structure model, Moho depth at the flat oceanic seafloor is approximately 13 km and at the Takuyo Daigo Seamount is about 19 km. Although Mianmi-Tori Shima is the highest (sea) mountain around the survey area, the Moho depth at it is obtained to be ˜14 km, close to the mean Moho depth at the flat seafloor. The velocity structure of the uppermost mantle at the flat seafloor, the Takuyo Seamount and Minami-Tori Shima is 8.1, 7.6 and 7.9 km/s respectively. One of the possibility of the structural difference between the Takuyo Daigo Seamount and Minami-Tori Shima could be a diffrence amount of magma supply.

Based on assumption that these seismic waves are reflected P-waves at a reflector seated in the mantle and seismic velocity in the upper mantle is 8.3 km/s, locations of the deep reflector is estimated as ˜70 km in depth.