

Shallow crustal structure at the northern Okinawa Trough based on seismic reflection survey

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The Okinawa Trough, a backarc basin of the Ryukyu (Nansei-Shoto) island arc-trench system to the southwest of Kyushu, Japan, is considered to be in the stage of continental rifting caused by the subduction of the Philippine Sea plate. The crustal extension beneath the trough is in progress and its degree varies from north to south. We, Japan Coast Guard (JCG), conducted several geological and geophysical investigations including seismic refraction surveys with ocean bottom seismographs (OBSs) and seismic reflection surveys to obtain fine seismic structural images related to the rifting process in the Okinawa Trough.

In this report, we will show a multi-channel seismic reflection (MCS) profile in the northern Okinawa Trough. The seismic line is N-S trending along the trough strike and its length is 563 km: the line starts from the continental shelf to the east of Goto Islands at the northernmost, through the Danjo Basin, to the west of Yokogan-Sone bank, intersects the volcanic front to the north of Ito-Torishima Island, and ends to the northwest of Okinoerabu Island at the southernmost line. Except for about 200 m depth at the northern end of the survey line, the water depth gradually becomes deeper from 700 m at the north to 1,200 m at the south. We employed a trigun cluster with a total capacity of 1,050 (350×3) inch³ and 3,000 m multi-channel hydrophone streamer with 240 channels to record the seismic signals from airgun shots. Totally 11,363 shots were fired at every 50 m on the survey line. The acquired MCS data were processed through a band-pass filter, deconvolution, normal move out correction and CMP stacking. We divided the seismic line into three parts based on the characteristics of the seafloor topography and the MCS records, and described them from north to south. The northern part corresponds to the area from the continental shelf to the Danjo Basin. The water depth abruptly changes from 200 m at the shelf to 800 m at the center of the basin. The MCS profile shows a thick sedimentary layer with the maximum thickness of around 4,000 m beneath the Danjo Basin. We interpreted the structure as a “syn-rift” accumulating sediments while the ongoing crustal extension.

In the middle part, from the south of the Danjo Basin to 90 km west of the volcanic front, the water depth varies from 700 to 1,000 m southwardly. There are some NE-SW trending bathymetric highs with heights of 200-300 m on the seismic line. The seafloor topography between the knolls is rather flat and the MCS records show there are sedimentary layers below the flat seafloor. However, we can see lots of normal faults in the sedimentary layer and these faults don't reach up to the seafloor.

The southern part of the line is characterized by lineaments of the seafloor topography with strikes of NE-SW or ENE-WSW. The NE-SW orientation is parallel to the volcanic front in this region. There are many seafloor undulations and knolls with heights of 300-500 m. The MCS records reveal a number of igneous intrusions and normal faults which deform the sedimentary layer and the seafloor.

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