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Seismic structure survey in the Australian-Antarctic Discordance (AAD)

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1.Introduction

The AAD (Australian-Antarctic Discordance) is a part of the Southeast Indian Ridge (120 degree East-128 degree East). The AAD is an anomalously deep and chaotic zone. In spite of its spreading rate (74 mm/yr), the AAD has rift valleys, which is a feature of slow spreading rate zones. This characteristic is considered to be caused by a low temperature mantle beneath the AAD. Although the AAD is the one of the important area for understanding formation of oceanic crust, it is difficult to carry out a marine seismic survey since the AAD area is within the storm zone. The AAD is divided into five segments, B-1 to B-5 from east to west. The areas of between B3 east and B5 have anomalous seafloors.

2.Observation

A seismic survey for crust structure in AAD had been carried out only in the B5 segment before our seismic experiment. From 26 January to 12 February 2002, we carried out seismic experiments with large capacity airguns, Ocean Bottom Seismometer (OBS) and hydrophone streamer in the B4 segment to reveal the structure of the uppermost mantle and crust by using the R/V Hakuho-maru, the University of Tokyo. Two airguns, one had a 17-liter chamber and another had a 20-liter chamber were used as controlled sources. Five OBSs were deployed at spacing of 20km on a line perpendicular to the ridge axis. The airguns were shot every 60 seconds on the main line which ran over the five OBSs and were shot every 20 seconds on the other six lines. The main line is 100 km long. A multi-channel hydrophone streamer was towed during airgun shooting to record reflection waves.

3. Analysis and result

Airgun-shooting positions were determined by GPS (Global Positioning Systems) data, and OBS positions were estimated by travel times of direct water waves from airguns. Then, recorded sections in distance-time domain were plotted. Apparent velocities of first arrivals vary with offset distances corresponding to complicated geographical feature. The velocity structure beneath the profile parallel to the ridge axis is derived, because the sea floor topography under the profile is relatively smooth. A seismic velocity model is obtained from using a tau-p method from OBS records. The velocity structure was confirmed by using the ray tracing method. The first layer has a P-wave velocity of about 2.5 km/s. Below the first layer, layers with P-wave velocities of 5 km/s and 6 km/s exist. At the depth of about 3 km from the sea floor, P-wave velocity reaches 7.9 km/s.