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Rifting crustal structure in the Okinawa Trough

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We have conducted seismic exploration to elucidate the backarc basin-island arc-trench system in the Nansei Shoto (Ryukyu) Arc, southwestern part of Japan. This region is characterized by a rifting stage at the Okinawa Trough as a backarc basin. The exploration consists of several wide-angle seismic and multi-channel seismic reflection lines of which directions are perpendicular to and along the trough axis. In the experiments, we used a non-tuned airgun array with a total volume of 98.4 liter (6,000 inch³) as a controlled seismic source at an interval of 200 m (90 s) for refraction lines and a 3-gun cluster airgun, 17.1 liter (1,050 inch³) in a total volume, at an interval of 50 m for reflection lines. Ocean bottom seismographs (OBS) deployed at every 5 km interval and a 3000-m-long, 240-channel hydrophone streamer were used as receivers.

The P-wave velocity model along the trough axis shows very large variation. The crustal thickness generally decreases from 23 km in the north to around 10 km beneath the Miyako and Yaeyama Submarine Grabens in the southern end of the Okinawa Trough. The crust beneath the trough is composed of three layers, upper crust with a P velocity less than 6 km/s, middle crust with $V_p = 6.0-6.5$ km/s, and lower crust with $V_p = 6.5-7$ km/s. The decrease in the total crustal thickness may be due to the thinning of lower crusts.

The preliminary crustal models obtained in the lines across the trough axis also indicate the existence of the mid crust throughout the lines, which may characterize the island arc crustal structure of the Nansei Shoto Arc. The largest variation in the velocity models along the perpendicular lines is positioned around the transition zone between the Okinawa Trough and East China Sea rather than the center of the trough. The thinnest lower crusts along the lines do not necessarily correspond to the center position of the trough deduced from the seafloor topography.

Keywords: Okinawa Trough, crustal structure, rifting