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Crustal structure imaging around the rupture zone of the 1983 Nihonkai-Chubu earthquake by seismic reflection survey

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Large earthquakes have frequently occurred on the eastern margins of the Japan Sea (e.g., the 1983 Nihonkai-Chubu earthquake (M_J 7.7), the 1993 Hokkaido-Nansei-Oki earthquake (M_J 7.8)) causing very strong vibrations, large tsunamis, and serious damage across the coastline of the Japan Sea. The 1983 Nihonkai-Chubu Earthquake was triggered by an east-dipping reverse fault, according to the analyses of aftershock distribution and the focal mechanism of the epicentral area across the western margin of the Okushiri Ridge and Sado Ridge (e.g., Urabe et al., 1985; Sato, 1985). The fracture zone was divided into three regions. The starting point of the fracture is located near the southern end of the epicentral region, which is likely where the crustal structure changes abruptly (Ohtake et al., 2002). In August 2011, we conducted a marine seismic survey around the rupture zone of the 1983 Nihonkai-Chubu earthquake using the *R/V Kairei* of the Japan Agency for Marine-Earth Science and Technology. Within the aftershock area of this earthquake, there was an earthquake of M_J 6.4 in March 2011 following the 2011 off the Pacific Coast of Tohoku Earthquake. The western part of the survey area covered the transition zone of the Yamato Basin and Japan Basin. The seismic exploration data of this survey is important to help us understand the crustal structure of the Japan Sea, particularly its eastern margins. In addition, we carried out seismotectonic and growth structure studies off the coast of Akita and Yamagata.

The multichannel seismic reflection data was acquired along 11 lines with a total length of approximately 1,924 km. The survey lines were curved to avoid the many fishing operations and equipment in the survey area. We shot a tuned air gun array with a spacing of 50 m. This array has a total capacity of 7,800 cubic inches (about 130 l). The standard air pressure was 2,000 psi (approximately 14 MPa). During the shooting, we towed a 444-channel hydrophone streamer cable with a 5700-m maximum offset, and the group interval was 12.5 m. The towing depth of the streamer cable was maintained at 12 m below the sea surface using depth controllers. The sampling rate was 2 ms, and the recording length was 16 s.

We present an outline of the data acquisition and preliminary results of the data processing and interpretations in this study. Asymmetrical anticlines with east-dipping reverse faults are well developed near the rupture zone of the 1983 Nihonkai-Chubu earthquake. Imaging of the crust on the western side of the anticline showed low-frequency reflectors. Though the basement around the source region shows larger deformation in the seismic line on the southern side than the northern side, there is more deformation in the sedimentary layers on the northern side than on the southern side. In the continental shelf off the Oga Peninsula, the basement of the continental shelf off the southern coast of the peninsula becomes rapidly deeper near the eastern end of the survey line and forms a basin with a thickness of more than 4 s. Anticlines have developed in this basin, and the basement of the basin is unclear in the low-frequency image. In the continental shelf of the northern part from the Oga Peninsula, thickness of the deposited layer is about maximum 2 s, and deformation structures has been clearly grown as compared to the southern part, and is formed asymmetrical anticline related with west-dipping reverse fault. In the Japan Basin and Yamato Basin, reflectors of the Moho and the crust below the basement were identified more clearly in the Japan Basin than in the Yamato Basin.

Keywords: the eastern margin of the Japan Sea, strain concentration areas, seismic reflection survey, 1983 Nihonkai-Chubu Earthquake