Crustal structure from the Wakasa Bay to the western Yamato Basin, Japan Sea, deduced from marine seismic survey

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We participated in the “Integrated Research Project on Seismic and Tsunami Hazards Around the Sea of Japan” conducted by the MEXT of Japan; in particular, we performed seismic surveys from the R/V KAIREI in the Japan Sea beginning in 2014. In August 2015, we conducted a marine seismic survey to study the crustal structure around the area from the Wakasa Bay to the western Yamato Basin. This survey area is located in a region where the focal mechanism transitions from a reverse fault to a strike-slip fault (e.g., Mikumo, 1990; Terakawa and Matsuura, 2010) and where several earthquakes with a magnitude of 6.5 or larger have occurred in the past 100 years. Furthermore, the primary active faults in this study area have been estimated to exist in the margin of the Oki trough and the marginal terrace (e.g., Okamura, 2013; the Committee for Technical Investigation on Large-scale Earthquake in Sea of Japan, 2014).

The formation of source faults in the Japan Sea is divided into at least two types. One type is formed when reverse faults have been reactivated by inversion tectonics (e.g., Okamura et al., 1995). The other type is formed by a reverse fault occurring in the boundary of the crustal structure (e.g., No et al., 2014). Therefore, revealing the relationship between the crustal structure and tectonic history is one of an important key in the research of the source faults in the Japan Sea. In particular, because the Yamato Basin is the only large basin in the Japan Sea that is capable of being fully investigated (as a result of the exclusive economic zone), research on the crustal structure of the Yamato Basin contributes to the discussion of the source faults that formed in the land-side margin of the Yamato Basin.

We conducted multichannel seismic reflection (MCS) surveys along nine lines. Some seismic lines were crooked to avoid the many fishing operations and equipment located in the survey area. To obtain high-quality MCS data, we shot an air gun array with 50 m spacing. The tuned air gun array had a maximum capacity of 7,800 cu in (approximately 130 L) and consisted of 32 air guns. The standard air pressure was 2,000 psi (approximately 14 MPa). The air gun array was kept 10 m below the sea surface throughout the experiment. During the air gun shooting, we towed a 444-channel hydrophone streamer cable. The group interval was 12.5 m, and the cable was approximately 6 km long. The towing depth of the streamer cable was maintained at 12 m below the sea surface by depth controllers. The sampling rate and record length were 2 ms and 16 s, respectively. Moreover, the air gun array with a shot spacing of 200 m in the seismic refraction/reflection survey conducted using 54 ocean bottom seismographs (OBSs). Moreover, the airgun array with a shot spacing of 200 m in the seismic refraction/reflection survey by 54 OBSs used almost the same configuration as the MCS survey. In addition, because onshore-offshore seismic profiles in the south extension were conducted by Ito et al. (2006), Nakanishi et al. (2008), and Earthquake Research Institute (2016), we are able to obtain the crustal structure imaging of the central Japan, ranging from the Nankai Trough to the Japan Sea.

We present an outline of the crustal structure obtained from preliminary results of MCS imaging and the P-wave velocity structure of the study area.

Keywords: Japan Sea, Yamato Basin, Crustal structure, MCS, OBS

