Crustal structure and opening process on the back-arc basin in the southwestern margin of the Japan Sea

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The Japan Sea is one of very well studied back-arc basins in the northwestern Pacific. Based on geophysical, geological, and petrological results, it is suggested that the back-arc opening of the Japan Sea was taken from the Early Oligocene to the Middle Miocene (e.g., Tamaki et al., 1992). From 3.5 Ma, in the eastern and southwestern margins, the crustal shortening by a strong compression occurred (e.g., Sato, 1994, Itoh et al., 1997). The deformation such as active faults and folds has developed in these margins because of these opening and shortening (e.g., Okamura et al., 2007). Recently, in the eastern margin of the Japan Sea, it was found from the result that the deformation zone affected by the shortening and back-arc opening is distributed on the rifted island arc crust, and on a structural boundary between this arc crust and the thicker oceanic crust in the northern part only by the seismic survey (No et al., 2014, Sato et al., 2014). This result shows that the back-arc opening process and the crustal structure formed by this opening may have connection with this deformation process. Although the southwestern margin of the Japan Sea seems to have the region of the complex formation process, we have little information about the crustal structure formed by back-arc opening, and the detailed opening process in this margin. To obtain this information, the active-source seismic survey using ocean bottom seismographs (OBSs), and multi-channel streamer system (MCS) was undertaken from the arc to the back-arc basin of the southwestern margin of the Japan Sea off Echizen-misaki cape, Fukui Prefecture in 2015.
This seismic survey using 54 OBSs and a tuned air-gun array (7,800 cu. inch) was conducted from the continental shelf off Echizen-misaki cape, Fukui Prefcture, Oki Trough, Oki Ridge, Yamato Basin to the Kita-Oki Bank, in the southwestern margin of the Japan Sea. This survey line has about 270 km length. In record sections of several OBSs and land stations, not only the first arrived phases but also later phases reflected from interfaces in the crust and uppermost mantle are visible.
The Oki Ridge has about 20 km of the crustal thickness. The upper part of the crust with P-wave velocity of 5.4-6.2 km/s corresponding to the continental upper crust has about 10 km. This shows that the Oki Ridge may have the character of the continental crust. On the other hand, the crust in the Yamato Basin and Oki Trough has 13 and 15 km thick, respectively. These are thinner than that the Oki Ridge. The Yamato Basin and Oki Trough do not have the character of the typical continental crust. The upper part of the crust in the continental shelf area has 10 km with a lateral variation. This crust may have the continental crustal type because the P-wave velocity distribution is similar to that of the continental upper crust in Korean Peninsula (Cho et al., 2006). And, this variation may correspond to the distribution of the deformation. This crustal structure in the southwestern margin of the Japan Sea off Fukui differs from that in the northern part of the eastern margin (No et al., 2006). This might show that the southwestern margin off Fukui is different from the northern one on the back-arc opening process.

Keywords: Japan Sea, back-arc basin, crustal structure, opening process

