

Deep seismic survey off Yamagata, Japan Sea, using ocean bottom seismographs and airgun array

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The relationship between crustal structure and earthquakes along the Japan Sea has been recently investigated via seismic surveys as part of the research project "Integrated Research Project on Seismic and Tsunami Hazards around the Sea of Japan", conducted by the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT). As a part of this project, we have performed seismic surveys in the Japan Sea since 2013. As the last data acquisition in this project, a deep seismic survey was conducted off Yamagata Prefecture in FY2019. This survey line is located near the aftershock area of the M6.7 earthquake offshore Yamagata Prefecture, which occurred on June 18, 2019. The aftershock of this earthquake occurred on the continental shelf, in which water depth is shallower than 100 m. Therefore, obtaining the whole crustal structure imaging of the land-sea boundary area is important for studying the crustal structure in relation to formation of the earthquake source fault off the coast of Yamagata Prefecture. However, due to fishing activities around the survey area, the seismic survey line was set approximately 20 km north of the aftershock area. We conducted the seismic survey using the JAMSTEC R/V *KAIREI* in August 2019. The survey area extends from the continental shelf off Sakata, Mogami Trough, Sado Ridge, Yamato Basin, and Yamato Bank. Along the survey line, 39 ocean bottom seismographs (OBSs) were deployed at approximately 2 km from the continental shelf to the Mogami Trough, approximately 8 km from the trough to the eastern Yamato Basin, and approximately 16 km from the basin to Yamato Bank. We shot an airgun array with a spacing of 200 m along the survey line. The airgun 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. All deployed OBSs were recovered during the cruise. A multi-channel seismic reflection survey was also planned during the cruise, but it was canceled due to typhoons. In order to obtain the P-wave velocity structure under the survey lines, the data analysis was carried out by tomographic inversion (Fujie et al., 2013, GRL) based on the first arrival phases and the PmP phases (reflections from the Moho) recorded by OBSs. Based on the preliminary result of data analysis, the P-wave velocity in the Yamato Basin tends to correspond to the thick ocean crust, and the Sado Ridge and the Yamato Bank have the P-wave velocity structure corresponding to the continental crust. These features are generally consistent with recent studies on crustal structure in and around the Yamato Basin (Sato et al., 2014, JGR; Sato et al., 2018, Tectonophysics.). We present an outline of the data acquisition and the preliminary result on the P-wave velocity structure of the survey line.

Keywords: Japan Sea, Ocean Bottom Seismograph, Deep seismic survey, Yamato Basin, Earthquake Offshore Yamagata Prefecture on June 18, 2019