

Seismicity in the trench-outer rise region off Fukushima and Ibaraki, southern Japan Trench

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After the 2011 Tohoku-oki earthquake, seismicity within the incoming Pacific plate is active in the trench-outer rise region along the Japan Trench. These earthquakes were characterized by normal-faulting focal mechanisms and could provide information about potential source faults of large outer-rise normal-faulting earthquakes. We have conducted earthquake observations in the southern part of the Japan Trench, off Fukushima and Ibaraki region (36°–38° N) by using ocean bottom seismographs (OBSs). The observations were conducted from March to July, 2017. We have deployed 35 OBSs including 14 ultra-deep type OBSs, which can be deployed in the trench-axis area where the maximum water depth was about 7800 m. Earthquakes were detected from continuous OBS records and phase arrival times were picked manually. Then, we relocated earthquakes by using double-difference tomography technique. In the tomography analysis, we used the initial velocity model based on an active seismic study conducted in the study area. Finally, we have obtained hypocenter location of about 1400 earthquakes. We also estimated focal mechanisms by using P-wave first-motion polarities in vertical component seismograms. The results show several linear earthquake clusters in the trench-outer rise region extended in roughly N-S and NNE-SSW directions. Pre-dominance of the normal-faulting focal mechanisms indicate that the earthquakes in the trench-outer rise region were explained by bending-related normal-faulting. The earthquake cluster oriented N-S direction was almost parallel to the strike of the northern Japan Trench, whereas NNE-SSW oriented linear clusters were almost parallel to the strike of the southern Japan Trench. Although the strike of the Japan trench changes from N-S in the north to NNE-SSW in the south at around 38° N, linear clusters parallel to both directions suggest existence of the complicated fault system in the trench-outer rise region in this area. Previous OBS observations along the Japan Trench showed that there was almost no seismicity along the plate boundary and within the overriding plate closed to the trench axis. The trench landward seismicity close to the trench axis observed only within the subducting Pacific plate. However, shallow earthquakes, which could occur along the plate boundary or within the overriding plate, close to the trench axis were observed landward slope of the Japan Trench south of 36.7° N. Seafloor geodetic studies indicated that seaward motion in the landward slope along the southern part of the Japan Trench, while landward motion were observed along the central part of the Japan trench. The characteristic shallow seismicity beneath the landward slope close to the trench axis might relate to the different displacement of the trench landward slope in the southern part of the Japan Trench.

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