

Distribution of Intra-plate seismicity in trench-outer rise region along the Japan Trench based on ocean bottom seismograph observations

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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. In addition to this, near-trench seismicity has been observed off Sanriku, northern part of the Japan Trench, even before the 2011 earthquake. The near-trench seismicity off Sanriku considered as long-lasting aftershocks of the 1933 Showa-Sanriku large intra-plate normal-faulting earthquake. The intra-plate seismicity in the trench-outer rise region could provide information about potential source faults of outer-rise normal-faulting earthquakes. We have conducted seismicity observations along the Japan Trench repeatedly since 2011 by using ocean bottom seismographs. In these observations, we used ultra-deep type OBSs which can be deployed in the trench-axis area where the maximum water depth is more than 7000 m. Based on these observations, seismicity in the trench-outer rise region extended about 100-110 km seaward of the trench axis. Seaward extension of the seismicity is almost the same regardless of presence or absence of seamounts on the incoming Pacific plate. Shallow earthquakes located at depths corresponding to the oceanic crust and the uppermost part of the oceanic mantle show linear clusters not only parallel but also oblique to the trench axis. Most of the shallow clusters coincide with horst-and-graben structures formed by normal-faults cutting the oceanic crust. Although the seafloor bathymetry shows that the horst-and-graben structures were divided into small segments, the shallow linear clusters align with overall trends of the segmented structures. These observations suggest that that ruptures of large intra-plate normal-faulting earthquakes could be a compound rupture of multiple or segmented normal faults. Focal mechanisms obtained from the OBS observations show that normal-faulting earthquakes occurred down to a depth of about 40 km within the incoming Pacific plate. On the other hand, earthquakes at a depth of around 50 km has a reverse-faulting focal mechanism. Depth extent of the normal-faulting earthquakes did not change at least for 3 years after the 2011 Tohoku-oki earthquake. The results imply that source faults of large intra-plate normal-faulting earthquakes could extend down to a depth of about 40 km under the current stress regime.

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