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Toward imaging fault zones of outer rise earthquakes succeeding a large megathrust earthquake in the Japan Trench

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There has been long-standing debate concerning how and where an intra-plate large normal fault earthquake occurred in the oceanic plate seaward of the trench (i.e. outer rise) following a shallow large megathrust earthquake. In the Japan Trench region, the 1933 Showa-Sanriku earthquake are believed to be an outer rise event succeeding the 1896 Meiji-Sanriku megathrust earthquake. Based on those observations, many seismologists have warned a large normal fault earthquake in the Pacific plate seaward of the rupture zone of the 2011 Tohoku-oki earthquake, because no magnitude-8 class outer rise normal fault earthquake has occurred since the 2011 earthquake. Most problematic issue to understand an outer rise earthquake in the Japan Trench region is that there are little information of size and distribution of fault zones of those events. Recent results of active-source seismic studies as well as earthquake monitoring, however, show a possible approach to image fault zone of outer rise normal fault events. We observed, from wide-angle seismic data, P-wave velocity reduction in the uppermost mantle from the outer rise to the trench axis. This may implie mantle serpentinization due to water penetration to the mantle through a bend-related normal fault system (Fujie et al. 2013). Seismic reflection data also show gaps between clearly imaged the Moho reflections (Nakamura et al. 2014). Moreover, aftershock observation of the 2011 Tohoku-oki earthquake in the outer rise shows that normal fault earthquakes are distributed from the crust to ˜40 km deep in the mantle. This suggests that the oceanic lithosphere became under extension stress filed down to 40 km deep after the 2011 event (Obana et al., 2012). Comparing the seismic reflection image and the aftershocks distribution likely indicates that a cluster of the normal fault aftershocks seem to be located in the area where we observe gaps of the Moho reflection. This suggest that the gaps of the Moho reflection can be a structural factor to identify the fault zones of the outer rise normal fault event. In this presentation, we summarize the results of our previous studies and introduce a future plan of the integrated seismic study in the outer rise region.

キーワード: Outer rise earthquake, Japan Trench, Fault, Seismic image, Earthquake monitoring, Megathrust
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