# Bathymetry data analysis and multi-channel seismic reflection survey in the 1933 Sanriku earthquake (Mw 8.4) rupture region

*Tomoko Hanyu[1], Jin-Oh Park[1], Yukari Kido[2]

1. Atmosphere and Ocean Research Institute, The University of Tokyo, 2. Japan Agency for Marine-Earth Science and Technology

In the northern part of the Japan Trench, the 1933 Showa-Sanriku earthquake (Mw 8.4), a normal-faulting earthquake such as large tensional outer-rise earthquake, occurred 37 yr after the 1896 Meiji-Sanriku tsunami earthquake (Mw 8.0) that ruptured plate-interface. Both earthquakes generated tsunamis that caused serious damages along the Sanriku coast of northeast Japan. As such, similar large-scale outer-rise earthquake is predicted to occur after the 2011 Tohoku-Oki earthquake (Mw 9.0). However, evolution process of the outer-rise earthquake fault has been poorly understood so far. From seismological data, Kanamori (1971) indicated that the faulting, with the average slippage on the fault plane, dipping 45° towards N 90°W, amounts to 3.3 m, took place over the entire thickness of the lithosphere that caused the Showa-Sanriku earthquake. However, the large fault that penetrated from seafloor to upper mantle has not been identified yet. In order to obtain detailed images of the normal faults that cause the outer-rise earthquakes of the Japan Trench, we will carry out a multi-channel seismic reflection survey using R/V Shinsei-maru in April 2019. Before the survey, fine scale bathymetry data sets (90 meters grid), which were compiled and provided by JAMSTEC (after Kido et al., 2011), are used for the analysis of seafloor structure. In this study, we applied second-order differentiation to detect the horst-graben structures with slope at a steep angle.

The characteristics of horst-graben structures and inherited seafloor spreading fabric in our study are well concordant to those of Nakanishi (2011). In the region between 37.5°N–40°N, the horst-graben structures with trend of N20°E–N30°E are sometime broken continuity by the abyssal hills with trend of N50°E–N70°E and fault structures with trend of N20°W. In a part of this region, between 38°N–39°N, was considered that this region was formed as a result of the ridge propagation (Nakanishi, 2011). The structure boundary on the crustal surface and Moho is observed by the OBS survey (Fujie et al., 2016) that located at a fracture zone associated with the ridge propagation, although the length of the distorted crustal surface and Moho across the fracture zone is extended about 60 km. Note that, Nakanishi (2011) suggested that the fault structures with trend of N20°W are inherited seafloor spreading fabric and reactivated by the subduction. On the other hand, Kobayashi et al. (1998) interpreted that these faults are formed by the orientation change of the plate strength which is caused by the trend change of the trench axis from south to north along the Japan Trench. A few faults with slope angle of more than 50 degrees are recognized, but there is lack of continuity. Around the 39.5° N, continuous horst-graben structures with slope angle of about 30 degrees are confirmed. These continuous horst-graben structures have average vertical displacement of about 200 m. The longest horst-graben structure has length of about 250 km, and the northern portion of this fault reaches the hypocenter of Showa-Sanriku earthquake. It remains uncertain whether this structure is actually continuous or just apparently continuous. Because of the overlying sediment and lower resolution than that of seismic reflection data, the accurate slope angle and vertical displacement could not be obtained from only the bathymetry data. While, the large horst-graben structures could be detected by the bathymetry data and analysis of the bathymetric data is useful for planning the observation lines and pick-up the specific observation data set from the database. We will present the results of the bathymetry data analysis and preliminary results of the multi-channel seismic reflection survey in April 2019, and discuss the normal fault behavior associated with the outer-rise earthquakes.

 

Keywords: Japan Trench, Outer-rise, Normal fault associated with the outer-rise earthquakes, Bathymetry data, Multi-channel seismic reflection survey