Deep seismic reflection profiling across the Oshima Peninsula, SW Hokkaido, Japan

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An onshore-offshore seismic data set was collected across the Oshima peninsula, SW Hokkaido to the Japan basin, off SW-Hokkaido to determine the geometry of seismogenic source faults and basic structure of backarc of NE Honshu arc (Sato, T. et al., 2019 JpGU; No et al., 2019, JpGU). Here, we present the result of deep seismic reflection profiling across the Oshima peninsula, high-reslolution seismic reflection survey across the western boundary fault of Hakodate plain and P-wave velocity structure obtained from onshore-offshore integrated seismic processing.

The deep seismic data set was collected across the Oshima peninsula in May, 2018. Vertical land seismometers (GSR) were deployed with a spacing 50 to 200 m along the 54-km-long seismic line using fixed 1119 channel. The seismic source was four to five vibroseis trucks with standard 150 m shot spacing. As high energy shot, 50 stationary sweep were carried out every 5 km along the seismic line. Sweep frequency was 6 to 60 Hz and sweep length was 16 to 20 sec. The obtained seismic data were processed according to a standard common-midpoint (CMP) stacking and a post stack time migration. We used refraction tomography to determine the P-wave velocity structure, that revealed down to 8 km in depth beneath the western part of the seismic line. Obtained P-wave velocity profile demonstrates the geometry of the top surface of pre-Tertiary rocks. The Kamiiso massif and Esashi range marked by high Vp (> 5 km/s) and 2 km of sediment cover are distributed in the Tate and Hakodate Basins. With a pattern of seismic reflection, main geologic structure is interpreted a series of westward dipping Miocene normal faults. The NS-trending Kamiiso massif is an uplifted zone bounded by a high-angle reverse fault, which formed as a normal fault. The high-resolution seismic reflection profiling was performed across the western boundary fault of the Hakodate plain. Seismic source was a viborseis truck and the seismic signal was recorded fixed 845 channel offline recorders (GSR). Shot and receiver intervals are 10 m. The 8-km-long seismic section portrays the geometry of active fault down to 2 km in depth. The fault dips 45 degrees westward in more than one km depth. Judging from the stratigraphy, it is interpreted as a reactivation of normal fault as reverse fault. On the contrary, the shallower part of active fault forms thin-skinned type of deformation associated with wedge-thrust, fault-related fold and flat-ramp structure. The obtained shallow structure is very concordant with the feature of tectonic geomorphology and frontal part of active thrust is presented as a blind thrust. The air-gun shots along the offshore of Oshima peninsula were recorded by fixed recorders on land and integrated P-wave velocity was obtained covering 310 km seismic line. The basic feature is very similar to the velocity model proposed by Sato, T. et al. (2019) JpGU. The velocity structure portrays the detailed structure produced by Miocene backarc extension and formation of the Sea of Japan crust. In spite of the later shortening deformation, basic structure has extensional tectonic features. There no evidence of the subduction of the Sea of Japan crust beneath the Hokkaido continental crust.

Keywords: Deep seismic reflection profiling, Seismic source fault, SW Hokkaido

