海底地震観測データにより推定した琉球海溝南部のプレート境界形状

Geometry of plate boundary beneath the southern Ryukyu Trench subduction zone deduced from passive seismic observation

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In the Ryukyu Trench subduction zone, many large earthquakes occurred historically. Recent seismic and geodetic studies indicate that the occurrence of very low frequency earthquake [Ando et al., 2012] and slow slip events [Heki and Kataoka, 2008; Nishimura, 2014] in the southern Ryukyu subduction zone. In addition, plausible seismogenic zone of the 1771 Yaeyama earthquake (Mw 8.0) is located near the trench [Nakamura, 2009]. These results suggest that the interplate coupling is not so weak and it is possible for the large interplate earthquake to occur in this region. However, the plane geometry is uncertain due to the sparse seismic observation network. To investigate the subducted plate geometry, we have conducted the passive seismic observation around the southern Ryukyu Trench using 6 land stations and 30 ocean bottom seismographs (OBSs) from Nov. 2013 to Mar. 2014, as a part of “Research project for compound disaster mitigation on the great earthquakes and tsunamis around the Nankai trough region”.

First, we conducted event detection from continuous seismic records and picked their first arrivals of P and S waves. We could detect microearthquakes about three times of Japan Meteorological Agency (JMA) catalogue during same periods. Second, we performed a seismic tomography to estimate the precious hypocenter locations. To improve the spatial resolution beneath the Island arc, we also used the first arrival data of JMA catalogue from 2013 to 2014. Then, we estimated the focal mechanisms of relocated earthquakes and searched the small repeating earthquakes according to the catalogue of Igarashi (2010). Finally, we estimated the depth variation of the subducted Philippine Sea plate beneath the Ryukyu arc by following assumptions: 1) low-angle thrust-type earthquakes and small repeating earthquakes occur along the plate boundary, 2) landward dipping high velocity layer indicates the slab mantle and the thickness of oceanic crust is about 7 km. The consistency of our plate geometry model and the result of active source survey [Arai et al., 2015] indicated the validity of above assumptions. In the western Ishigaki Island, we set our model as same as slab1.0 model [Hayes et al., 2012] because their model satisfied our assumptions.

Our plate model indicates local variation between Ishigaki to Miyako Islands, whereas plate geometry western Ishigaki seems to be smooth. In this area, plate boundary estimated shallower than slab1.0 model. Especially, plate boundary seems to have a convex structure beneath the Tarama Island. The difference in E-W direction also appeared in the seismicity pattern. Microearthquakes within oceanic crust in forearc region is active in only the eastern side, whereas the long-term slow slip located mainly western Ishigaki Island [Nishimura, 2014]. Besides, low-angle thrust-type earthquakes and small repeating earthquakes estimated in this study located the outside of the active area of long-term slow slip. Our tomographic result of P-wave velocity model also indicated that the landward mantle is strongly serpentinized, which might be corresponding to the occurrence of slow slip events.

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