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Back-ground seismicity within the Philippine Sea Plate off Shiono-misaki based on ocean-bottom seismographic observation

HIRATA, Kenji[1*], Hiroaki Tsushima[1], Akira Yamazaki[2], Hisatoshi Baba[3], Hiroshi Sarukawa[3], Akio Kobayashi[1], Hiroshi Ueno[1], Shigeki Aoki[1], Yasuhiro Yoshida[1], Akio Katsumata[1], Kenji Maeda[1], Takashi Yokota[1]

[1]Meteorological Reseach Institute, [2]Kakioka Magnetic Observatory, [3]Tokai University

From 2005 to 2008, we repeated short-term ocean-bottom seismic (OBS) observation four times to confirm ambient micro-seismicity at depths between about 10 km and 25 km beneath the axis of the Nankai Trough off Cape Shiono-misaki in Kii Peninsula, southwest Japan (Yamazaki et al., 2011, Tech. Rep. MRI). This micro-seismicity is poorly recorded by land seismic networks. Obana et al.(2005, JGR) distinguished them into two groups; shallow microearthquakes occurring within the oceanic crust of the incoming Philippine Sea Plate (PSP) (around 10 km in depth) and deep ones occurring in the uppermost mantle of PSP (about 15 km to 25 km in depth). They also reported that composite focal mechanisms of the shallow microearthquakes showed extensional stress in the direction nearly normal to the trough axis and those of the deep ones showed compressional stress in the direction normal to the trough axis, indicating "bending" of the incoming PHP. If so, how far south from the Nankai Trough axis the plate bending stress starts and how it develops?

To investigate this problem, we conducted OBS observations to the south from the trough axis between mid June 2009 and mid September 2009. The OBS network consisted of 24 short-term OBSs (4.5 Hz, 3-comp.) with a spacing of about 15 km (8 n.m.). We recovered 22 OBSs after a three-month long development. Deployment and recovery of the OBSs were done with R/V Ryofu-maru of JMA. After a linear correction of internal OBS time stamp, we picked arrival times of P-waves, S-waves and PS converted waves, which the picking of last phases is required for finding a set of initial station correction (i.e., sediment layer correction). Then we determined hypocenters assuming an appropriate one-dimensional velocity structure estimated based on a nearby seismic refraction experiment (Kodaira et al., 2000, Science). Next averaged differences between observed travel time and estimated travel times (O-C times) for each OBS were calculated. The averaged O-C times were then added to the previous station correction values, and the hypocenters were relocated. We repeated this procedure two times.

Figure shows preliminary hypocenters located in this study for the first 30 days of the observation period. Open circles and closed inversed triangles indicate hypocenters and OBSs, respectively. Hypocenters deeper than 30 km occur only outside the OBS network, indicating that their depths are not constrained. Within the OBS network, we find that the smallest earthquakes with magnitudes less than 1, which are defined as "ultra-microearthquakes(UMEs)", occur around 10 km in depth (upper panel of figure). JMA land-based seismic network does not detect the activity (lower panel). The OBS network was arbitrarily positioned and UMEs are probably a widespread feature of the seismicity in the incoming plate. So we propose that similar UMEs occur in wider area outside of the present OBS network. Among the two groups of microearthquakes reported by Obana et al., the deep microearthquake activity in the uppermost mantle within the present OBS network can be identified in the northern region of the OBS network (near the trough axis) but not in the southern region (toward the outer-rise). This suggests that microearthquakes in the uppermost mantle of PHP only occur near the trough axis and farther landward.