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Micro-seismicity in incoming Philippine Sea Plate off Kii Peninsula based on ocean-bottom seismographic observation

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From 2005 to 2008, we repeated ocean-bottom seismograph (OBS) observation to investigate micro-seismicity around the axis of the Nankai Trough off Kii Peninsula, southwest Japan (Yamazaki et al., 2011, Tech.Rep.MRI). This micro-seismicity is not recorded well with 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). Obana et al. also reported that composite focal mechanisms of the shallower microearthquakes showed extensional stress in the direction nearly normal to the trough axis and those of the deeper 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 to build up and how it develops?

To investigate this problem, we deployed 24 OBSs, with 8 n.m. (˜15 km) of the spatial interval between every OBS, to the south from the trough axis in 2009. Following the previous two reports last year (Hirata et al., 2012a, JpGU meeting; 2012b, SSJ meeting), we discuss the depth range and focal mechanism of these microearthquakes.

Figure shows hypocenters, located in this study, for the observation period of about three months (left panel of figure). We chose only hypocenters within and nearby the OBS network to plot those in the figure. Shaded circles and closed inversed triangles indicate hypocenters and OBSs, respectively. The events are smaller than M2, and most of them are limited less than M1.5. Almost all of those occur less than 20 km in depth, and thus are confirmed to occur within the oceanic crust and the uppermost mantle. In the southern region of the OBS network, half of the events seems to occur within the oceanic crust and the other half in the uppermost mantle. This feature in the southern region is robust in the examination of various hypocenter determination using six different 1D velocity structures. These events are not recorded on JMA land-based seismic network (right panel). It is difficult to consider the events occur only within this temporary OBS network that was arbitrarily positioned by us. So we guess that similar microearthquakes perhaps occur in wider area outside of the OBS network. Figure also shows composite plots of the P-wave first motion polarity (lower hemisphere projections) for microearthquakes occurring in the northern and southern regions of the OBS network. Open and closed circles indicate downward and upward P-wave first motion, respectively. The composite plots suggest that trough-normal extensional stress is predominant in both the northern and southern regions; in the northern region (near the trough axis), the microearthquakes can be explained by normal faults having trough-normal extensional stress. In the southern region, however, those are seemed to be strike-slip faults. The trough-normal extensional stress is perhaps produced by bending of the incoming Philippine Sea Plate.