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A detailed investigation of seismicity within the Philippine Sea slab: Upper-plane-seismic belt and stress regime

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Most of earthquakes that occurred within the subducted Philippine Sea slab beneath Tokai, Kinki and Shikoku have a T axis sub-parallel to the local strike of the slab, while earthquakes with a DE-type focal mechanism tend to occur beneath Kyushu. The fact that, despite the complex slab geometry along the Nankai trough, the direction of a T axis is largely parallel to the strike of the slab might indicate that the slab is a stress guide and the complex geometry is not related to the present stress regime (Wang et al., 2004). However, a detailed analysis of seismic activity within the subducted Philippine Sea slab beneath SW Japan taking into account a distance from the upper interface of the slab to each earthquake has not yet been performed.

We calculated a distance between the upper interface of the Philippine Sea slab determined by Hirose et al. (2007) and each hypocenter for earthquakes (~70,000) that occurred within the Philippine Sea slab and classified them relative to the distance. For earthquakes that occurred within the distance of 10 km from the slab interface in Kyushu, we found a seismic belt at depths of 50-70 km sub-parallel to the iso-depth contours of the Philippine Sea slab. This belt is similar to that detected within the Pacific slab beneath Hokkaido, Tohoku and Kanto (Kita et al., 2006; Hasegawa et al., 2007), which is interpreted to occur due to dehydration of hydrous minerals in the slab crust. In addition, earthquake clusters that align sub-parallel to the dip of the slab with a width of several to tens kilometers were detected beneath the Kii Peninsula and Tokai.

A careful investigation of focal mechanism solutions of intraslab earthquakes revealed that distribution of P axis varies with a distance from the upper interface of the slab beneath the Kii Peninsula and the southern part of Yamanashi Pref. Shallow events that occurred in the distance range of 0-4 km have P and T axis parallel and perpendicular to the local strike of the slab, respectively, while deeper ones have P and T axis perpendicular and parallel to it, respectively. These observations suggest that the shallower part of the slab is under slab-strike-parallel compressional stress but the deeper part is under slab-strike-parallel tensional stress, which is consistent with the stress field expected from the lateral bending of the slab, suggesting that the local geometry of the slab is related to the present stress regime.