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Stress regime in the Philippine Sea slab and the asperity of the Kanto earthquake

Junichi Nakajima[1*], Akira Hasegawa[1], Fuyuki Hirose[2]

[1]Tohoku University, [2]Meteorological Research Institute

Two oceanic plates, the Philippine Sea and Pacific slabs, are subducting beneath Kanto, and seismogenesis are discussed in terms of dual subduction and resultant interaction (e.g., Wu et al., GRL, 2007; Uchida et al., EPSL, 2009; Nakajima et al., JGR, 2009; Nakajima and Hasegawa, JGR, 2010). However, stress regime in the Philippine Sea slab is poorly understood because of diverse seismicity as well as complex geometries of the two slabs. Here we determine focal mechanisms of small earthquakes in the Philippine Sea slab, and discuss stress regime with implications for the location of the Kanto asperity.

We determined focal mechanisms of 245 earthquakes occurring in the Philippine Sea slab from 2003 to 2010, and combined them with those determined by JMA. The obtained solutions indicate that stress regime is quite different between the northeast and southwest of the Tokyo bay. In the northeast, earthquakes nearby the slab surface occur under down-dip compressional stress regime, while those far from the slab surface have focal mechanisms with T axis in the down-dip direction. Earthquakes in the southwest have, however, T axis with a higher dip angle than the slab dip. Notably, such earthquakes occur only beneath the Kanto asperity.

Results of stres-tensor inversion show that sigma1 or sigma3 is parallel to the relative plate motion of the Philippine Sea slab, suggesting that stress regime in the slab is controlled mainly by the plate motion, not by local slab geometry. We further calculate the effect of a plate coupling along the Kanto asperity on intraslab stress regime. The obtained results suggest that stress regime generated by the plate coupling can explain the occurrence of the earthquakes with T axis with a higher dip angle. This spatial relation implies that the down-dip extension of the Kanto asperity is not locked at present and hence a large interplate earthquake would not occur there.