

Collision between the Pacific and Philippine Sea slabs and seismotectonics beneath Kanto, central Japan

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The Philippine Sea and Pacific slabs are subducting beneath the Kanto district. Consequently, seismicity beneath Kanto can be grouped into 5 groups: (1) in the overriding plate, (2) along the upper interface of the Philippine Sea slab, (3) in the Philippine Sea slab, (4) along the boundary between the bottom of the Philippine Sea slab and upper interface of the Pacific slab, and (5) in the Pacific slab. In particular, megathrust earthquakes such as the 1923 Kanto earthquake have occurred along the plate interface of the Philippine Sea slab and caused severe damages to Tokyo metropolitan area. In order to understand where megathrust earthquakes possibly occur and to develop better models of seismotectonics in Kanto, precise configurations of the upper interface of the two subducting slabs are very important. Here we propose a new model of seismotectonics beneath Kanto on the basis of results of high-resolution travel-time tomography, distribution of seismicity, and focal mechanism of microearthquakes.

It is very important to know whether or not the Philippine Sea slab is subducting toward the north of the Izu peninsula without disruption, since the Philippine Sea slab can be deformed due to the convergence with the Pacific slab if it is continuous there. Results of travel-time tomography performed in a wider region including the north of the Izu peninsula clearly show that the Philippine Sea slab is continuous at the north of the Izu peninsula and is subducting at least at a depth of 140 km.

The upper interface of the Pacific slab is determined based on velocity structures and focal mechanism solutions of microearthquakes around the plate interface. The obtained configuration shows the Pacific slab is dented at the east to southeast of the Boso peninsula, where the Pacific slab is in contact with the Philippine Sea slab. Interaction of the two slabs can deform both slabs and result in a unique tectonics beneath Kanto region.

We classify earthquakes beneath Kanto into 5 groups described above and compare them with the seismic velocity structures. New findings are as follows: (1) interplate earthquakes on both the upper plate boundaries of the Philippine Sea and Pacific slabs occur at exceptionally deeper depths compared to other regions, (2) the region with interplate earthquakes corresponds well to the contact zone between the Pacific and Philippine Sea slabs, (3) the down-dip limit of the asperity of the 1923 Kanto earthquake might not be controlled by the serpentinized mantle wedge at least at the east of the Tokyo bay, and (4) the eastward extent of the asperity of the 1923 earthquake and the occurrence of slow-slip events around the Boso peninsula could be affected by the dent of the Pacific slab immediately below.