Double subduction of the Philippine Sea plate in its northern end region

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The Philippine Sea slab beneath Kanto is characterized by its thickness. It is more than 60km in the metropolitan area. Why does such a thick slab exist beneath Kato?

Another notable feature of the seismic slab beneath the Kanto area is the multi plane structure of the hypocentral distribution. For example, two seismic planes, both deepen to north in parallel, are seen in the north-south cross section taken at around the longitude 139.5E. The upper one is supposed to be related to the occurrence of the 1923 Kanto earthquake and the lower one seems to subduct from the sea region to the south of the axis of Sagami Trough. Eguchi and Hori (2006) called the feature a bookshelf structure and considered either one of them represents a slab that subducted in the past.

On the other hand, a clear seismic plane that inclines toward east is recognized in the east-west cross section in the region to the south of the middle of the Boso Peninsula. Nakamura and Shimazaki (1981) once considered that it represents the shape of the Philippine Sea slab in the time when it subducted beneath Kanto more northward.

We look for the origin of the above-described enigmatic structure of the seismic slab standing on the following three principles.

1. A seismic plane represents existence of a slab. Here, a slab means a subducted oceanic plate or a part of it.
2. Direction of the inclination of the seismic plane does not necessarily represent direction of the subduction.
3. An oceanic plate has a tendency to subduct in a way not to be resisted as much as possible.

Based on the three principles (postulates) we propose a hypothesis that two Philippine Sea slabs are subducting toward NNW beneath Kanto. The upper one is the Kanto slab that is responsible for the occurrence of the Kanto earthquakes. The lower one that inclines toward east seems to subduct from the region to the south of the Boso Peninsula. The 1703 Genroku earthquake might be an interplate earthquake that occurred on the upper boundary of the lower slab or on its splay fault. We think that the zone where the lower slab begins to subduct possibly continues to the southern boundary of the Izu micro-plate. We further think that the detachment of the crust of the Izu Peninsula postulated by Seno (1995) to have occurred at the time of the 2000 northern Izu islands event and the crustal deformation observed after the event in the sea region around the Izu islands (Kobayashi and Yoshida, 2007) were manifestations of deformations of the Philippine Sea plate which might be related to the double subduction of the slab in the Kanto region. We discuss various tectonic features in the Kanto, Izu and Tokai regions from these viewpoints.