Seismic studies on asperities along the Sagami trough and the purpose of the Kanto asperity project

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Subduction-zone earthquakes along the Sagami trough, where the Philippine Sea slab is subducting, have repeatedly occurred. The 1703 Genroku and 1923 (Taisho) Kanto earthquakes are known as this type earthquake, and cause severe damages in the metropolitan area. The recurrence periods of Taisho- and Genroku-type earthquakes inferred from crustal deformation are bout 200 and 2000 years, respectively (e.g., Earthquake Research Committee, 2004).

In the case of subduction-zone earthquakes, regions of large slip during earthquake are called asperity, which does not change. Inter-seismic coupling is strong in asperity, and is weak in non-asperity region (e.g., Coordination Committee for Earthquake Prediction Research in Universities, 2006).

This framework can be applied to the subduction zone along the Sagami trough. The difference between the Sagami and Nankai troughs, where the Philippine Sea slab is also subducting, is that slow slip events occur at the same depths as the asperity.

Many studies on the asperity along the Sagami trough have been carried out. Slip distribution of the 1923 Kanto earthquake is inferred from geodetic, seismic waveform, seismic intensity, and tsunami waveform data, and that of the 1703 Genroku earthquake from seismic intensity, crustal deformation, and tsunami data. These results are roughly consistent each other. Two asperities of the 1923 Kanto earthquake are located around the western part of Kanagawa prefecture (the base of the Izu peninsula) and around the Miura peninsula. An additional asperity of the 1703 Genroku earthquake is located the southern part of the Boso Peninsula.

Seismicity during these five years is very low in these asperities (Kobayashi and Koketsu, 2005). This suggests strong seismic coupling, which is also inferred from the geodetic study of the slip deficit distribution (Sagiya, 2005)

Around the asperities, small repeating earthquakes are observed as well as slow slip events. Kimura (2005) shows that the small repeating earthquakes occurred during the slow slip events.

It is important for asperity studies to determine the shape of the plate boundary, which can be the fault plane. Different fault plane can cause different asperity (Sato et al. 2005). Many models of the upper surface of the Philippine Sea slab have been presented (e.g., Ishida, 1992). Deep seismic profiling was carried out as a part of the Special Project for Earthquake Disaster Mitigation in Urban areas (DaiDaiToku) between 2002 and 2006. This profiling successfully presents a new image of the upper surface of the Philippine Sea slab (Sato et al. 2005), which is shallower than the previous models. This profiling also presents that amplitudes of reflections are different between in the asperity and non-asperity regions, suggesting the different characteristics on the plate boundaries in these regions. Recently, many studies related to the DaiDaiToku project have shown results on the Philippine Sea slab.

Seismic monitoring in the Sagami Bay and off Boso region will be carried out as a part of the Kanto Asperity Project. Ten borehole sites and inland ones can cover the asperity and non-asperity regions. Good coverage and very low noise in boreholes can catch smaller earthquakes, improve hypocenter and focal mechanism determinations. If seismic surveys with OBS are performed, we can obtain shallow structures of the Philippine Sea slab and knowledge on the relation between amplitude of reflection and asperity. In future, we can get a chance of deep drilling reaching the plate boundary in the asperity region, which cannot be included in this project, if we successfully show good results.