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Three different types of events along the Sagami trough and objectives of the Kanto Asperity Project

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The Kanto region is one of the most densely populated urban areas in the world. Complicated plate configurations are due to T-T-T type triple junction, island arc-island arc collision zone, and very shallow angle between axis of the Sagami trough and subducting direction. Great earthquakes along the Sagami trough have repeatedly occurred. The 1703 Genroku and 1923 (Taisho) Kanto earthquakes caused severe damages in the Tokyo metropolitan area. Intriguingly slow slip events have also repeatedly occurred in an area adjacent to the asperities of the great earthquakes, off Boso peninsula (e.g., Ozawa et al 2007). In the cases of the Nankai and Cascadia subduction zones, slow slip events occur at deeper levels than the asperity, in a transition zone between the asperity and a region of steady slip. In contrast, slow slip events in the Kanto region have occurred at relatively shallow depths, at the same level as the asperity, raising the possibility of friction controlled by different conditions to those (temperature and pressure) encountered at Nankai and Cascadia.

We focus on three different types of seismic events occurring repeatedly at the almost same depth of the seismogenic zone along the Sagami trough (5-20 km)

(1) The 1923 M˜7.9 Taisho earthquake, located in Sagami Bay. Maximum slip is about 6 m, the recurrence interval is 200-400 yr, and the coupling rate is 80-100% (”coupling rates” = ”slip amounts during earthquakes or slow-slip events” / [”rate of motion of the Philippine Sea Plate” - ”recurrence interval”]) .

(2) The 1703 M˜8.2 Genroku earthquake, located in Sagami Bay, but also extending to the southern part of Boso Peninsula. Maximum slip is 15-20 m, the recurrence interval is ˜2000 yr, and the coupling rate at the southern part of the Boso Peninsula is 10-30%.

(3) Boso slow-slip events, located southeast of Boso Peninsula. Maximum slip is 15-20 cm over ˜10 days, the recurrence interval is 5-6 yr, and the coupling rate is 70-100%.

Proposals of the Kanto Asperity Project (KAP) have been submitted to the Integrated Ocean Drilling Program (IODP) to investigate the three patches. The scientific objectives are

Objective 1: To understand why the three different types of events occur side by side at almost same depth (in same P-T conditions), and

Objective 2: To establish realistic earthquake-generation models using data on each step of the process of natural earthquakes.

The KAP consists of three research programs for these objectives. In Program A we propose coring and logging plate boundaries in asperity to measure physical properties (particularly frictional parameters) and pore pressures to establish a realistic earthquake cycle model. In Program B, we propose long-term monitoring with wide area network to observe 2-3 cycles of slow slip events and to verify a model of earthquake generation cycle through model of slow slip event cycle. In Program C, we will propose shallow drilling, coring, and logging at several sites to get input materials on the Philippine sea plate.

Keywords: the 1923 Kanto earthquake, the 1703 Genroku earthquake, asperity, slow slip event