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Kanto Asperity Project

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The Kanto region (Tokyo and the surrounding area) is one of the most densely populated urban areas in the world and has been devastated by repeated great earthquakes. Seismotectonics in this region is very unique. Complicated plate configurations are due to T-T-T type triple junction, island arc-island arc collision zone, and very shallow angle between trench axis of the Sagami trough and subducting direction.
Great earthquakes along the Sagami trough have repeatedly occurred. The 1703 Genroku and 19 23 (Taisho) Kanto earthquakes caused severe damages in the metropolitan area. The recurrence periods of Taisho- and Genroku-type earthquakes are about 200-400 and 2000 years, respectively (e.g., Earthquake Research Committee, 2004).

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 Nankai and Cascadia, slow slip events occur at deeper levels than the asperities, 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 (materials, fluid, or surface roughness) to those (temperature and pressure) encountered at Nankai and Cascadia.

Proposals of the Kanto Asperity Project (KAP) have been submitted to the Integrated Ocean Drilling Program (IODP) to know the shape of the asperities and slow slip region, their physical properties, and tectonics along the Sagami trough, which are considered to control the occurrence of the great earthquakes and slow slips.

The KAP consists of three research components. The first component is shallow drilling, coring, and logging at several sites for tectonics and paleoseismology. The second is long-term monitoring with wide area network, focusing on understanding slow slip and earthquake cycle. The third is coring and logging plate boundaries in asperity to measure physical properties.

We discussed a new concept on scientific goals in the last year. We focusing on the different behavior in three patches, two asperities of the Kanto and Genroku earthquakes, and a region of slow slip events.
-Taisho (1923) asperity: recurrence time is 200-400 years. Coupling rate is 80-100 %.
-Genroku (1703) asperity: recurrence time is about 2000 years. Coupling rate is about 10-30 %. This asperity may always move with the Taisho asperity.
-Slow slip asperity: recurrence time is 5-7 years. Coupling rate is 70-100 %.
The three patches raise two key questions.
1) Why these different asperities exist under the same depth, this means the same pressure and temperature conditions.
2) What is the slow slip? Can the slow slip events be used for assessing earthquake generation models?

We have prepared new three proposals to answer these questions.

We will propose downhole monitoring during 15-20 years, which will record 3-4 cycles of slow slip events. The distribution of the proposed sites cover the slow slip event region. We can construct and verify the physical model of the slow slip cycle. The coupling rate between plates in slow slip region is about 100 percent, and is comparable with those of most of great earthquakes. If we assume that the differences the slow slip events and normal earthquakes are dynamic rupture process of the earthquake generation models, and that frictional properties control the differences, we may apply the earthquake generation models to the slow slip events through tuning frictional properties. Since recurrence periods of great earthquakes are ~100 years or ~1000 years, the observation of slow slip events several times has a great advantage to the observation of great earthquakes to construct earthquake generation cycle model.

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