Meaning and prospect for science of slow earthquakes

*Kazushige Obara[1]

1. Earthquake Research Institute, The University of Tokyo

Slow earthquake is a general term for low-speed fault slip phenomena compared to the ones of ordinary earthquakes. Since around the end of the 20th century, slow earthquakes with wide range of characteristic times have been discovered by densely distributed seismic and GNSS observation networks in Japan then detected in many subduction zones along the circum-Pacific. They are distributed around the seismogenic zone. Because different types of slow earthquakes occurring simultaneously at the same or neighboring regions indicate strong interaction, we expect that frequent occurrence of slow earthquakes might gradually change the physical conditions of the surrounding region, potentially connected to the occurrence of ordinary earthquakes. During the last two decades we have recognized that the slow earthquakes were not special events at each region but common phenomena. Deep low frequency tremor and short-term slow slip event (SSE) were independently discovered at Nankai and Cascadia subduction zones, respectively, after that the coupling phenomena of episodic tremor and slip (ETS) were detected in both regions. Deep very-low frequency (VLF) earthquake associated with ETS was firstly detected in Nankai, after a while also detected in Cascadia. Based on recent marine temporal observation at the western Nankai trough region, shallow tremor has been discovered in association with already-known shallow VLF event like as deep ETS. Therefore, one of our next research targets is to find shallow SSE which is expected to host shallow tremor and VLF. Detailed comparison between shallow and deep slow earthquakes will bring new geological and physical constraints for the similar frictional property at the different thermal and pressure regimes. In future, understanding activity mode, environment, and mechanism of slow earthquakes will contribute to development of Earth science in the following three viewpoints. One is to reconstruct the new comparative subductology based on quantitative comparison study of slow earthquakes at different subduction zones. Second is to reconstruct the approach of earthquake science based on a unified understanding of slow deformations and fast slips. Third is to contribute to advanced evaluation for the occurrence of megathrust earthquake based on understanding mutual interaction between slow and huge earthquakes.

Keywords: Slow earthquake, subduction zone, Nankai trough

