Characteristic activities of deep low frequency tremor in Cascadia and southwest Japan based on energy information

*Kazushige Obara[1], Kenneth C. Creager[2]

1. Earthquake Research Institute, The University of Tokyo, 2. University of Washington

Episodic tremor and slip (ETS) composed of three types of slow earthquakes; deep low frequency tremor, deep very low frequency earthquake and short-term slow slip event actively occur at the downdip side of the seismogenic zone along the subducting plate interface in Cascadia and southwest Japan subduction zones. ETS indicates some characteristic activities including segmentation, periodicity, migration, triggering and so on, similar to those of regular earthquake activities. Among these phenomena, tremor may be able to considered to be a representative to illuminate detailed spatiotemporal slip behavior and interplate condition. At the beginning of discovery of tremor, the tremor catalog did not include energy information (e.g., Obara, 2002); however, recently constructed tremor catalogs including radiation energy of tremor (e.g., Annoura et al., 2016) is expected to evaluate inhomogeneous properties of tremor source (e.g., Kano et al., 2018). In Cascadia, Pacific Northwest Seismic Network (PNSN) has been producing the tremor catalog for many years based on the method developed by Wech and Creager (2008) and the system has been improved to include the radiation energy of tremor from 2018. In this paper, the tremor activity in Cascadia is reinvestigated from the point of view for radiation energy of tremor and compared to southwest Japan.

Tremor activity in Cascadia is mainly separated into three large segments as pointed by previous studies (e.g., Brudzinski and Allen, 2007); north (47N~), middle (44~47N), and south (~44N) segments. Among these segments, the radiation energy of tremor is the largest in the north segment although the number of tremor event is the largest in the south segment. The tremor activity is the lowest in the middle segment as for both of number and energy of tremor. On the other hand, the radiation energy per tremor event is almost the same in middle and south segments although it is the largest in the north segment. This suggests that the strength of each tremor patch is similar in the middle and south segments however the population of weak tremor patches is larger in the south segment.
By using energy information, spatiotemporal variation of tremor activity is well clarified. During major tremor episodes associated with migration and SSE, the number of tremor event seems to be constant with time; however, the radiation energy changes with time including rise and fall at every several days. Such long-period temporal variation of tremor energy might be correlated with rapid change in migration pattern of tremor. Radiation energy of tremor seems to large when the migration direction and/or velocity significantly change. This is well consistent with the relationship between energy and migration speed of tremor obtained in western Shikoku, Japan (Kano et al., 2018).

Keywords: Slow earthquake, Tremor, Episodic tremor and slip, Subduction zone

