

Average slip rate at the transition zone on the plate interface estimated from non-volcanic deep low-frequency tremors

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Non-volcanic deep low-frequency (DLF) tremors [e.g. Obara, 2002] and short-term slow slip events (SSE) [e.g. Hirose and Obara et al., 2005] occur in the transition zone between seismogenic and stable slip zones on the plate interface in southwest Japan. There are the relationship between the size of S-SSE and the size of tremor activity [Hiramatsu et al., 2008]. Because the detection of the DLF tremors is easier than that of SSE, the tremor activity is a useful indicator of SSE.

Interpretation of the monitoring of the slip in the transition zone on the plate interface is important to understand the subduction process of oceanic plate, because the slip such as SSEs occurs at deeper extension of the seismogenic zone of large earthquakes on the interface. In this study, we estimate slip rate at the transition zone in the plate interface using the DLF tremors in Shikoku, Kii, and Tokai region, Japan.

We use the catalogs of tremor determined by the envelope correlation method [Obara, 2002] and assume that the envelope of the reduced displacement provides an apparent moment rate function [Hiramatsu et al., 2008]. We estimate the seismic moment of a short-term SSE from the total size of DLF tremors of an episode based on a proportional relationship between the seismic moment of the short-term SSE observed geodetically and the total size the DLF tremors of the corresponding episode.

We can find step-like changes in the temporal variation in the cumulative seismic moment. Some changes correspond to the occurrence of short-term SSEs observed geodetically [e.g. Hirose and Obara, 2005]. Assuming fault areas based on the tremor activity, the average slip rate at the transition zone estimated from the temporal variation in the cumulative seismic moment of SSEs is 4.1cm/yr, 3.5cm/yr, 2.5cm/yr in the western Shikoku, the northwest Kii and Tokai, respectively. These values compensate the difference between the convergence rate at the trench and the slip rate at the transition zone of the subducting Philippine Sea plate. In the other words, the slip rate estimated from the DLF tremors provides a constraint of the slip deficit rate at the transition zone on the plate interface.

Keywords: non-volcanic deep low-frequency tremors, short-term slow slip events, slip deficit rate