Activity of deep low frequancy tremor triggered by teleseismic earthquakes.

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Deep low frequency tremor in subduction zone is sometimes triggered by surface waves from teleseismic earthquakes. This type of tremor is called as triggered tremor. Amplitude of triggered tremor seems to be modulated by each phase of surface wave trace of teleseismic earthquake. Such triggered tremor has been observed in the ambient tremor zone where short-term slow slip events episodically occur. However, triggered tremor is not distributed in the entire source area of ambient tremor, but is rather concentrated in several spots. In this study, we investigated finer spatiotemporal characteristics of triggered tremor in order to reveal its activity.

We applied matched filter technique (Shelly et al., 2007) to detection of triggered tremor episodes in northern Kii and western Shikoku area, where triggered tremor episodes were observed at many times. The data obtained at NIED Hi-net stations were used in this analysis. We used waveforms of low frequency earthquake based on the JMA hypocenter catalog as templates of tremor. We analyzed continuous waveform data for one hour from the origin times of 67 teleseismic events with magnitude larger than 7.5 which occurred after Dec. 26, 2004.

Triggered tremor episodes were detected at 9 teleseismic events in northern Kii and at 15 teleseismic events in western Shikoku. Triggered tremor episodes were detected in one spot at northern Kii, and in two spots at western Shikoku. The areas where triggered tremor episodes occurred are not same at some teleseismic events. Along-dip migrations of triggered tremor were observed in both areas. Migration speed of triggered tremor is 5–20 km/h in northern Kii and about 40—100 km/h in western Shikoku. In northern Kii, the directions of migrations are same in all cases. In western Shikoku, both up-dip and down-dip migrations were observed.

Although migration speed of our result is much faster than that of episodic tremor and slip, about 10 km/day, tremor episodes having migration speed similar to our result has been reported during non-triggered tremor in previous studies. In northern Kii, migration of triggered tremor is similar to rapid tremor reversal (RTR) and rapid tremor forward (RTF) (Houston et al., 2011). Then, migration of triggered tremor may correspond to RTR and RTF. In western Shikoku, migration of triggered tremor is similar to rapid streak (Ghosh et al., 2010).

Ghosh et al. (2010) proposed two models about rapid streak. The first one is the apparent velocity model. The second model is effect of fluid. If we try to explain the observed migration in western Shikoku by the apparent velocity model with an assumption of actual migration velocity of 20 km/h obtained on northern Kii, the initiation of the background slip must be located at longer than 20 km away from the streak because apparent velocity at tremor streak would be about 60 km/h. However, the triggered tremor is excited at the same time as the arrival of the surface wave. Therefore, the apparent velocity model is not suitable for migration of triggered tremor and the fluid model might remain as one of reasonable models. However, another model may be reasonable for migration of triggered tremor. This is tremor asperity model, which predicts occurrence of real high-speed rupture due to existence of strong tremor asperities.

Keywords: Deep low frequency tremor, triggered tremor

