Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SCG62-P05 Room:Convention Hall Time:May 27 18:15-19:30

2014 Bungo channel slow slip event inferred from deep low-frequency tremor activity

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Episodic tremor and slip is a stick-slip phenomenon in the transition zone between locked and stable sliding zones on the plate interface in Southwest Japan. The tremor burst with duration of several days spontaneously occurs at interval of several months in each segment. On the other hand, in the Bungo channel region, the long-term slow slip event (SSE) occurs at every 6~7 years at the updip side from the tremor zone. During the long-term SSE, continuous tremor activity was observed for a few months in 2003 and 2010 at the updip part of the tremor zone which is neighbor to the source area of the long-term SSE. We expected the next long-term SSE in 2016; however, tiny long-term SSE was inferred from tremor activity in early 2014, then The Geospatial Information Authority of Japan reported the occurrence of the SSE (GSI, 2014). In this paper, we discuss the relationship between Bungo channel long-term SSE and triggered tremor.

Tremor activity seems to be quite different at its updip and downdip parts in the Bungo channel region. Tremor activity at the updip part is well correlated with the crustal displacement caused by the long-term SSE; however, tremor activity at the downdip part is constant with time irrespective to the occurrence of the long-term SSEs. The rate of the tremor number density which is the number of tremor per 1 km square is nearly the same in both parts except during the long-term SSE. This indicates that the standard rate of the tremor number density is independent from the depth. Because the triggered tremor by the long-term SSE is added on the standard tremor rate at only the updip part, anomalous increase of the updip tremor may indicate a proxy for SSE. Tremor activity at the updip part of the tremor zone in the Bungo channel seems to increase a little bit from the beginning of 2014. Then, small change in the crustal deformation was recognized from the middle of 2014 at southwestern Shikoku by using GSI GEONET GNSS data. Similar small change in both tremor and GNSS data had been observed in the late 2006 and the beginning of 2009. The 2006 small episode lasted for a few months. This is interpreted as the occurrence of very small long-term SSE. On the other hand, the 2009 small episode was identified by tiny increase of tremor activity, then gradually appeared in GNSS data, and finally evolved to the long-term SSE associated with significant slip and tremor activity from the beginning of 2010. According to these previous examples, we expect that the small change observed by tremor and GNSS data in 2014 might have stopped or will evolve to a regular long-term SSE before long.

After SSEs in 2003 and 2010, tremor activity seems to slightly increase in the inland region within 50 km from the triggered tremor region in the Bungo channel. Such 7-year period variation in tremor activity is observed at only the updip side of the tremor zone. Moreover, pattern of the long-term variation seems to slightly migrate from the Bungo channel to east during a few years. We might interpret that a tiny transient slip after the long-term SSE slowly propagates between the tremor zone and megathrust seismogenic zone.

Keywords: non-volcanic tremor, slow slip event, slow earthquake, interaction, subduction zone