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Migration properties of non-volcanic tremor

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Active burst of non-volcanic tremor detected in the Nankai and Cascadia subduction zone is usually associated with the short-term slow slip event, which is the stick slip in the deeper extension of the megathrust zone on the plate interface. The hypocenter of tremor and slip distribution of SSE are spatiotemporally synchronized each other. The duration time of the tremor episode is proportional to the moment of the SSE. Therefore, the tremor activity is considered as a sensitive sensor to monitor the interplate slip in the transition zone. The tremor activity is characterized by migration along the strike of the subducting plate at about 10 km/day. Moreover, the rapid migration at several 10 to 100 km/hour along the dip direction have been detected. The existence of the variation migration modes is important to resolve the fault slip process. Here we investigate some migration properties based on the new tremor catalog in southwest Japan.

In this study, we used the tremor catalog calculated every one minute by modified envelope cross correlation method (Maeda and Obara, 2009) and centroid tremor catalog calculated every one hour by the clustering process (Obara et al., 2010). The depth of the tremor is pinned on the plate interface given by the receiver function analysis. Based on the centroid tremor catalog, a depth dependent behavior of the tremor activity was clarified within the narrow tremor zone. At the shallower part, the major tremor episode with longer duration occurs at recurrence interval of a several months; however the short-duration minor tremor episode frequently occurs at the deeper part. The migration pattern also shows a systematic pattern in the dip direction. The major tremor activity usually starts from the deeper side and migrates updip at about 10 km/day. The updip migration is clearly observed on the tremor striation parallel to the slip direction. Based on the detail analysis of the space-time distribution by removing aftershock-like tremor activity, the tremor propagates radially from the initiation point and the migration front seems to be a circle. Therefore, the pre-known along-strike migration pattern may be interpreted as the radial migration within the narrow tremor belt. During the major tremor episode in northeastern Kii peninsula, we detected small-scale migration rapidly back along strike at velocity of 10 times faster than the slow-speed main migration. In this area, the tremor episode recurs every six months and migrates at 10-15 km/day. The tremor activity remains after passing through the migration front. During the aftershock-like period, the rapidly back migration at 5-20 km/hour occurred spanning 10-30 km in length. During the January 2006 episode propagating to the northeast direction, the rapid tremor reversal with a speed of 5 km/hour migrated southwestward; on the other hand, the rapid tremor reversal migrated northeastward on the same place during the June 2004 episode propagating to the southwest direction. Therefore, there exists at least three modes of tremor migration; along-strike migration at about 10 km/day over , along-strike reverse migration at about 100 km/day, and along-dip migration at about 1000 km/day.

Keywords: non-volcanic tremor, slow earthquakes, subduction zone, plate boundary, source migration