

Seismic array observations for study of nonvolcanic tremor activity and underground structure in western Shikoku

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Nonvolcanic tremor is a seismic phenomena associated with the short-term slow slip event on the transition zone between the downdip stable sliding zone and updip seismogenic zone along the subducting plate interface. In southwest Japan, the tremor is distributed within a belt-like zone with a length of about 600 km and a width of 20 to 50 km. The tremor activity style is gradually changed according to the depth even in the narrow width. In the shallow updip side, major tremor episodes associated with the crustal deformation caused by the slow slip event occur episodically at an interval of several months; however, in the deep downdip side, minor tremor episodes frequently occur. This depth dependence of tremor recurrence is also observed in Cascadia. Therefore, this might reflect the gradual change in the frictional property along the plate interface according to the depth and temperature. One of the possible reason for the depth dependent activity is reduction of normal stress due to increase of pore pressure. If the volume of fluid changes within the tremor zone, we expect to detect any change in the seismic structure along the plate interface. According to the purpose to detect spatial change of seismic structure and spatiotemporal detail distribution of tremor activity, we deployed dense array composed of high-sensitivity seismometers in western part of Shikoku Island because the width of the tremor belt-like zone is widest in this region.

The seismic array is mainly divided into two types: linear array and separated dense array. The linear array is composed of 70 three-component velocity seismometer with a natural frequency of 1 Hz. This array is placed along the Sadamisaki peninsula and coast line of the Bungo channel with a length of about 100 km at the space of 1~2 km. In order to detect the spatial variation in the seismic structure associated with the tremor activity change, the linear array was planned to include the updip and downdip edges of tremor zone. The separated dense array includes one large array composed of 30 seismometers at the spacing of 200 m and five small arrays composed of 9 seismometers. This array system is used to detect the tremor migration by beam forming method (Takeda et al., 2012). The observation period is 1.5 years from September 2011 to March 2013. During this observation period, we detected three major tremor episodes from December 2011 to January 2012, from May to June 2012, and from November to December 2012. Moreover we detected temporal tremor activity triggered by passing of the surface wave from Mw8.6 Sumatra earthquake on 11 April, 2012 (Enescu et al., 2012). This triggered tremor occurred at an interval of about 30 seconds at first, then the recurrence interval became to be about 20 seconds according to the dispersion of the surface wave. The relative arrival time of tremor envelope and amplitude pattern observed between these stations also changed in time. This suggests that the source and/or mechanism of the tremor might slightly change.

Keywords: non-volcanic tremor, slow earthquake, subduction zone, plate interface