# Shallow very-low-frequency earthquake activity in the Hyuga-nada region revealed by long-term ocean bottom seismological observation

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The Nankai Trough is one of the most active areas of slow earthquakes. In particular, the western part of the area, which is called as Hyuga-nada, is characterized by high activity of the shallow slow earthquake and weak interplate coupling. In 2013, an ocean bottom observation illustrated the detail of shallow low-frequency tremor activity associated with the very-low-frequency earthquake (VLFE) for the first time in this region. The shallow slow earthquake should be a key to understand the occurrence of the megathrust earthquake and tsunami adjacent trench region such as the 2011 Tohoku earthquake.

To understand the characteristics of the activity in more detail, we started long-term ocean bottom broad-band observation just above the focal area of the shallow slow earthquake from 2014. During observation, we observed the two types shallow tremor activity: ambient tremor activity in 2014, 2015, 2017, and triggered tremor activity in 2016. The observation shows that the shallow tremor repeatedly occurs in the almost same area, but their activities were quite in variety. These tremor activities were also usually associated with VLEF in spatial and temporal. A predominate frequency of the VLFE recorded by ocean bottom seismometer was approximately 0.05 to 0.1 Hz and an apparent propagation velocity is 0.75~1.0 km/s, which is interpreted as the Airy phase of ocean-acoustic-mode dominant Rayleigh waves [Sugioka *et al.*, 2012].

For more quantitative evaluation of shallow VLFE, we performed the moment tensor inversion under the point source approximation adopted by modeling seismic wave propagation in an inhomogeneous medium using a finite-difference code [OpenSWPC; Maeda *et al.*, 2017]. We used a 2.5-D velocity structure model inferred from an active-source seismic survey in the Hyuga-nada region [Nakanishi *et al.*, in press]. Although the observation was mainly short-period seismometer of dominant frequency with 1 Hz (Lennartz LE-3Dlite), the signal of VLFE can be recognized clearly after deconvolution of instrumental response. Preliminary results show an excellent fit between observed and synthetic waveforms at frequency band of 0.05-0.1 Hz, and moment tensor solutions show a reverse-faulting mechanism located near depths of plate boundary. The duration of moment rate function was at least 10 s that is longer than the ordinary earthquake comparing with approximately same magnitude.

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