Seismic exploration to reveal structure of deep low-frequency tremor area

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We perform a seismic exploration by using controlled sources to reveal the seismic velocity profile and the geometry of the subducting Philippine Sea plate around the source region of low-frequency tremors (LFTs) at western Shikoku in March 2008.

LFT, first found by Obara (2002) at southwestern Japan, is a seismic phenomenon that P- and S-wave onset cannot be clearly recognized. Although source region of LFT is widespread along the strike of subducting Philippine Sea plate from Tokai to Shikoku region, their activity is not uniform along the strike. LFT also occurs periodically associated with the occurrence of the short-term slow slip event. For example, major activities of LFTs occur at the intervals of approximately six months. The LFT sometimes includes earthquakes with S-wave onsets we can recognize. Such an earthquake is located as a low frequency earthquake (LFE) by measuring the S-wave onsets. Shelly et al. (2006) reveals that LFEs occur on the plate boundary by relocating LFEs using waveform cross correlation with seismic wave tomography. They also report that there is high-Vp/Vs region below the source region of LFE, which suggests that the characteristic condition which set-ups the occurrence of the LFEs. For more detailed discussion on the LFT/LFE occurrence, we need finer-scale crustal structure model and plate geometry than what we can obtain from tomographic and/or receiver function studies using natural earthquakes. Especially, at western Shikoku, a careful discussion should be required since the plate boundary estimated by Shiomi et al. (2004) bends. Continuous geometry along the dip of the plate also should be important for considering the tremor generation mechanism.

To archieve these purpose, seismic exploration with controlled sources are one of the most powerful tools in seismology; therefore we design the exploration with the following specs. There are two profiles EW and NS direction with 75km and 85km length respectively. The 360 seismometers with the natural frequency of 2Hz (L-22D) which consists of 200 vertical and 160 three-component seismographs will be installed with the average separations of 500m and 333m for EW and NS profiles, respectively. Three-component seismographs are installed with 1km average separation. By using S-waves, we will be able to discuss the S-wave velocity structure of the source region. Six 500kg dynamite sources will be used. We expect that these huge sources as a controlled source exploration enables us to detect the reflected wave from the plate boundary of Philippine Sea plate at around 30 km depth. The crossing NS and EW profiles will be used for evaluating variation of the geometry of the Philippine Sea Plate and inhomogeneous velocity structure along the dip and strike, which could be related to the occurrence of LFT/LFE.