Hypocenter determination of low-frequency earthquakes in the western Shikoku region by Source-Scanning Algorithm

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Nonvolcanic tremors are found in many different subduction zones, including southwest Japan and Cascadia. The tremor epicenters are distributed in a belt-like zone along the strike of a subducted plate. In southwest Japan, the source depths of well-located tremors are concentrated at a depth of about 30 km, with relatively large uncertainties (Obara, 2002). Among them, the so-called low frequency earthquakes (LFE), which are thought to comprise at least a portion of tremors and have relatively clear P- and S-wave arrivals, are located on the plate interface (Shelly et al., 2006). In northern Cascadia, however, the tremors are distributed in a wide depth range between 10 and 40 km (Kao et al., 2005).

Since the previous studies have been done with different data sets and by different methods, it is difficult to understand what the common features of tremors are and what causes the difference in the estimated depth ranges. The determination of precise source locations are crucially important to discuss the generation mechanism of tremors.

To answer the above questions, we have applied the two methods: (1) Envelope Cross-correlation Method (ECM; Obara, 2002); and (2) Source-Scanning Algorithm (SSA; Kao and Shan, 2004); to the two different data sets recorded in southwestern Japan and northern Cascadia. In this paper, we report the results of the application of SSA to the southwestern Japan data set. In particular, we focus on the application to LFEs.

The tremor data we used in this study are those which was recorded at NIED Hi-net stations in the Shikoku region. The vertical components which contain LFE records are collected based on the JMA earthquake catalog. The records are bandpass filtered and resampled to 10 Hz data. The amplitude of the waveform record is normalized by the standard deviation. SSA is applied to this pre-processed data. Brightness values are calculated at every grid points with 0.1 s interval in time and 1 km in space. Our preliminary result shows that both of JMA LFE solutions and SSE solutions are consistent. We have showed that SSA has a preferable waveform that consists of a distinct wave packet with a large amplitude and short duration. These characteristics in SSA may fit the feature of LFE waveforms which have relatively clear P and S phases.