# High-frequency radiation prior to semi-volcanic low-frequency earthquake in Eastern Shimane, SW Japan, illuminated by “0.1 manten” Hyper Dense Seismic Observation

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Semi-volcanic deep low-frequency earthquake (LFE) that occurs distant from active volcanoes has been investigated by previous several studies [Ohmi and Obara, 2002; Aso et al., 2013]. In eastern Shimane of SW Japan, there is a spot hosting frequent semi-volcanic LFE activity for over 20 years. Above this source area, we installed a thousand of seismic stations from March 2017 to March 2018, which covers an entire aftershock zone of the 2000 Western-Tottori earthquake (Mw 6.7). The spatial interval of each seismic station ranges from 1 to 2 km.

We found out clear arrivals of high-frequency waveforms prior to arrivals of low-frequency signals by a hundred of the dense seismic stations. The differential arrival times between the high- and low-frequency waveforms are approximately 1.5 s. The high-frequency radiation has the strongest amplitude at 28 Hz and 16 Hz and is characterized by stronger P-wave amplitude than faint S-wave. In contrast, the low-frequency component is predominant from 1 to 6 Hz and shows variation of the ratio of P-wave to S-wave with epicentral distance. This observation clarifies that different excitation mechanisms are needed to explain bimodal radiations at the high- and low-frequency bands.

We relocated the high- and low-radiation sources by both visually picked arrival times and Source Scanning Algorithm. Then, each radiation source is located within a cloud of LEFs determined by the JMA. The depth of the high- and low-frequency sources are imaged around the depth of 30 km, namely around Moho discontinuity. But, the high-frequency radiation is slightly deeper than that of the low-frequency with a few km horizontal offset. The origin time of the high-frequency radiation is by 1.5 ~ 2 seconds earlier than that of the low-frequency. This slight spatial gap indicates that the two sources appear to be not collocated, while the spatial separation between the two sources is not so large in terms of the hypocenter accuracy. The present study first shows that the high- and low-frequency radiation sources are close to each other around Moho discontinuity.

Combined with these observations, we interpret that the early high-frequency radiation is derived from brittle breakage of low-permeability seal may arise from hydrothermal cementation. Infiltration of high-pressurized fluids into the bottom of lower crust may trigger slow shear slip or resonance of crustal fluids along a pre-existing fracture.

 