Deep Long-Period Earthquakes in Eastern Shimane

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Deep long-period earthquakes (DLPs) are deep (~10–45 km) earthquakes that radiate long-period (~2–8Hz) seismic waves despite their small magnitude (M<2). As well as low-frequency earthquakes on plate interface (tectonic LFEs), DLPs widely observed in volcanic regions (volcanic DLPs) are potentially essential to understand the slow deformation processes in various tectonic settings. While tectonic LFEs are recognized as slip events, the physical mechanism of volcanic DLPs has not been well understood. Specifically, at least some volcanic DLPs have significant non-double-couple components [Nakamichi et al., 2003; Aso and Ide, 2014; Oikawa et al., 2019].
Volcanic DLPs occur around the Moho not only beneath worldwide volcanoes but also far from active volcanoes [Aso et al., 2011, 2013; Vidale et al., 2014]. Many of these events are located in shear zones [e.g., Nishimura and Takada, 2017], where large inland earthquakes occur. As a candidate mechanism that could explain both DLPs on volcanic front and back-arc DLPs without recent surface volcanic activity, thermal strains produced by a cooling magma body are suggested as a driving force [Aso and Tsai, 2014]. Secondary triggered resonant oscillation may produce harmonic waveforms, which commonly characterize volcanic DLPs.
The seismic source process is fundamentally essential for understanding their genesis. For this purpose, we reanalyze the DLPs in eastern Shimane, where high signal-to-noise (S/N) records are available. We use Hi-net stations, which meet the high S/N standard. We first correct P-wave arrivals based on the waveform similarity among stations. Then, we apply moment tensor inversion for the P-wave windows. We confirm the oscillating source process reported by Aso and Ide (2014). While the middle and the latter part of the P-wave determine the oscillating pattern robustly, the polarity of the oscillation is sensitive to the initial part of the P-wave, which is not constrained well. Therefore we carry out the campaign observation to investigate the very early part of the DLP events.

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