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Focal Mechanisms of Semi-Volcanic Deep Low-Frequency Earthquakes in Eastern Shimane

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<Backgrounds>

Many deep low-frequency earthquakes (LFEs) occur near the island arc Mohorovicic discontinuities and far from both active volcanoes and plate boundaries. They are quite similar to volcanic LFEs beneath active volcanoes, which infers some fluid movement in the source region, and regarded as "semi-volcanic" LFEs [*Aso et al.*, 2011; 2012 (this meeting)]. Several previous studies determined the focal mechanisms of volcanic and semi-volcanic LFEs using only a small portion of information of the waveforms. Although the estimated focal mechanisms are various, they may not necessary support the variety of the actual physical process, owing to the large determination error [e.g., *Nishidomi and Takeo*, 1996; *Ohmi and Obara*, 2002; *Nakamichi et al.*, 2003]. Here we determine the reliable focal mechanisms by waveform inversion for LFEs in eastern Shimane, where many large LFEs occurred in a quiet region. The locations are also close to the fault plane of the 2000 western Tottori earthquake of M_w 6.6, and right beneath Yokota volcano, which is a Quaternary volcanic cluster.

<Data and methods>

We estimated the focal mechanisms of semi-volcanic LFEs in eastern Shimane by moment tensor inversion. The data are velocity seismograms at five stations of Hi-net near the epicenters. For each seismogram, we extracted a 2.5-second time window beginning from 0.2 seconds before the arrivals of either P-wave in a vertical component or S-wave in a horizontal component. The synthetic waveforms were calculated using the discrete wavenumber integration method developed by *Takeo* [1985] for a horizontally layered structure. For 60 LFEs larger than $M1$ and recorded at all five stations, the focal mechanisms and moment rate functions were estimated by grid search and linear inversion, respectively. We also tested the stability of solutions.

<Result and discussions>

The moment rate functions of the semi-volcanic LFEs oscillate between positive and negative values unlike those of regular earthquakes. The focal mechanisms are dominated by isotropic and CLVD components for most of the LFEs, and the breaking of symmetry might yield a minor double-couple component. Although the sign combination of the isotropic and deviatoric components is consistent with that of a tensile crack, the ratio of them is better explained by a linear dipole. This result is equivalent to the combination of the single force solution estimated by *Ohmi and Obara* [2002] from S/P amplitude ratios and its reaction force. The principal symmetry axis of the focal mechanism is parallel not only to the lineation of hypocenters obtained by *Aso et al.* [2012 (this meeting)], but also to the T-axis of the focal mechanism of the western Tottori earthquake and the minimum principal axis of a regional stress field in southwestern Japan, which suggests the existence of a scale-independent orientation. These focal mechanisms may represent some fluid movement in a crack-like structure aligned in the lineation direction.

Keywords: Low-Frequency Earthquake, Semi-Volcanic LFE, Eastern Shimane