Precise relocations of deep low-frequency earthquakes beneath NE-Japan and estimation of 3-D seismic velocity structure

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It is well known that deep low-frequency earthquakes (DLFEs) with dominant frequency around 2 Hz occur at depths from 20 to 40 km in volcanic areas beneath NE-Japan (Hasegawa and Yamamoto, 1994; Okada et al., 2000). In addition, it has been pointed out that the source mechanism of DLFEs consists of both DC and non-DC components by moment tensor inversions (Okada et al., 2000; Nakamichi et al., 2003). These observations suggest that the generation mechanism of DLFEs is closely related with fluids (or magma).

We precisely relocated the DLFEs occurring beneath NE Japan and determined the 3-D seismic velocity structure of the crust and uppermost mantle in the region surrounding them. We applied the DD tomography method (Zhang and Thurber, 2003) to data obtained by the seismic networks of Tohoku University, JMA and NIED. Note that we have included events within the subducting Pacific slab in the tomography inversion to increase the resolution of the lower crust structure. We used the 3D seismic velocity model of the whole NE-Japan by Nakajima et al. (2001) as the initial model.

We found that beneath the Shimokita peninsula, the DLFEs, which are distributed at depths from 15 to 25km, are located just above the P-wave low velocity zone. Nii et al. (2007) reported that most of DLFEs beneath Mt. Iwate and Mt. Naruko are also located just above the low Vs and high Vp/Vs areas in the crust, which probably correspond to regions of partial melting. It can be the common characteristic for DLFEs in NE Japan that they are located not in the P- and S-wave low velocity zone but just above the low velocity zone.