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Three-dimensional seismic attenuation structure beneath northeastern Japan

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We estimated three-dimensional seismic attenuation structure beneath northeastern Japan, using the methods of Eberhart-Phillips and Chadwick (2002) and Hayami et al. (2009). Waveforms from local earthquakes were used to determine t* values, which represent whole ray path attenuation terms. At first, we used a time window of 1.28 s and 2.56 s from the onsets of P- and S-wave arrivals for earthquakes with depths shallower and greater than 25 km, respectively, and velocity spectra for each P and S phase was calculated. Then we simultaneously determined a value of t*, corner frequency, and amplitude level for the calculated spectra. Finally, the t* values were inverted for 3-D attenuation structure.
The study region is 37-42N, 138-143E, and a depth range of 0-200 km. The number of stations used in this study is 234. We obtained 7727 P-wave and 7087 S-wave spectrum from 262 events (M>2.5) that occurred in the period from October 2006 to December 2008. Horizontal and vertical grid nodes were set with a spacing of 0.25 degree and 15 km, respectively. Checkerboard resolution tests are used to evaluate the reliability of obtained results. The checkerboard pattern is well recovered beneath the land area down to a depth of 100 km.
Obtained results show that the mantle wedge shows a high Q (low attenuation) in the fore arc and a low Q (high attenuation) in the back arc. The low-Q zone in the back-arc mantle is distributed sub-parallel to the down-dip direction of the Pacific slab, and the inclination of the low-Q zone is similar to that of a low-velocity zone (Nakajima et al., 2001). A prominent low-Q zone is imaged along the volcanic front at a depth of 40 km, which corresponds to a low-V and high-Vp/Vs zone revealed by travel-time tomography. High-resolution imaging of 3D attenuation structure as well as 3D velocity structure can deepen our understanding of fluid circulation and arc magmatism in the mantle wedge of NE Japan.