東北地方下における太平洋スラブのP波減衰構造と地震活動
P-wave attenuation structure and seismicity in the Pacific slab beneath northeastern Japan

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Intermediate-depth earthquakes and arc magmatism in subduction zones are considered to be related to hydrous minerals and aqueous fluids dragged downward with a subducting oceanic plate (e.g., Kirby et al., 1996; Nakajima et al., 2013). The existence of fluid contributes to reduce seismic velocity reduction and enhance seismic attenuation (e.g., Karato, 2003). Therefore, the investigation of heterogeneous structures in the subducting oceanic plate is important to improve our understanding on genesis of intermediate-depth earthquakes.
In northeastern (NE) Japan, low P-wave velocities are observed in the subducting crust at a depths of 100 km (e.g., Shiina et al., 2013) and along the lower plane of the double-seismic zone (e.g., Zhan et al., 2004) at depths of 80-120 km, and they are interpreted as the existence of hydrous minerals and aqueous fluid. Although the fluids are likely to enhance seismic attenuation, detailed seismic attenuation structure of the Pacific slab have not yet been investigated because conventional methods are difficult to separate attenuation properties in the slab from that in the mantle wedge.
In this study, we adopted a spectral ratio technique for intraslab earthquakes beneath NE Japan to directly investigate seismic attenuation in the Pacific slab. By calculating a spectral ratio of velocity spectra for two earthquakes that are observed at common station and have identical ray paths from the shallower earthquake to the station, we obtained a spectrum that represents an intra-earthquakes average attenuation. We evaluated P-wave attenuation in the Pacific slab for 2,954 pairs from 1,135 earthquakes with assuming a source spectrum as w^2-model (Brune, 1970). Then, we estimated 3-D P-wave attenuation structure in the Pacific slab by the tomographic inversion method (Nakajima et al., 2013).
We obtained average P-wave attenuation (Q^{-1}) of 0.0016 in the Pacific slab beneath NE Japan, which is comparable to attenuation estimated in previous studies (e.g., Tsumura et al., 2000). The results show that P-wave attenuation is high near the subducting crust and in some areas beneath the coastline of the Pacific ocean. The high P-wave attenuation areas seems to be located at the upper plane seismic belt (Kita et al., 2006) and around source regions of large earthquakes, such as the 2003 Miyagi-oki intraslab earthquakes (M 7.1). As high attenuation in the subducting slab can be caused by the existence of fluid, these results suggest fluid-related embrittlement of intraslab earthquakes.

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