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Waveform effects of the thinning or tearing of the subducting Pacific plate beneath Japan
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We studied the detailed distorted structure of the subducting Pacific plate near Honshu in the Kanto district by the use of waveforms from deep earthquakes recorded at fore-arc Hi-net and F-net stations in Japan. Such waveforms confirm most of the earlier observations like dominance of low-frequency onset and following high-frequency energy due to the stochastic waveguide effect of the subducting plate, proposed earlier by Furumura and Kennett (2005). However, new observations for most of the source-receiver paths show the distortion of body waves, when signals traverse the Pacific slab at depths more than 350 km. They include the loss of high frequency energy in P-coda, loss of low-frequency precursor and presence of converted phases in P-coda. Such complexities in the observed waveforms are difficult to explain by existing slab model, indicating sudden lateral change in the wave guiding properties of the subducting slab such as caused by the thinning or tearing of the slab in deeper part.

To explain the observations, we employ two-dimensional finite-difference method (FDM) simulations of complete high-frequency P-SV wave propagation taking thinning of Pacific slab into account. We expect that the observed guided wave energy must decouple from waveguide where the slab is deformed or thin. Low frequency energy leaks out of the slab and travels to the receivers along paths in the low velocity mantle surrounding the slab. Taking into account the tomographic evidence of weak velocity anomaly of the Pacific slab beneath Honshu and the observations of slab tear in the Pacific plate (Obayashi et al., 2009; Kennet and Furumura, 2010), we expect a local velocity anomaly or thinning in the oceanic lithosphere along the Izu-Bonin arc that would be compatible with the observations. The preliminary results, which suggest that the Pacific slab is strongly deformed beneath Honsu, is the cause of the complicated waves from deep events with strong source location dependencies. These effects need to be tested further with a 3-D FDM simulation employing high-performance computers with a variety of possible slab geometries.

キーワード: slab tears, subducting plate, waveguide, wave propagation
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