

Cause of Significant scattering of teleseismic P-wave near Japan Trench as Inferred by Large-Scale Numerical Simulation

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We found a significant scattered wave train in Japan after the arrival of near-vertical incidence of P-wave of the Off West Coast, New Zealand Earthquake (Mw7.6) in 2009 by using a dense, high-sensitive seismograph network (Hi-net) operated by NIED. The scattered wave train is dominant in the vertical component at period band of 20-50 s with a propagation velocity of 3.5 km/s. It propagates cylindrically to west from Kanto area, central Japan. This signal contains only low-frequency components and no local earthquakes were reported at that time. All of these facts suggest that the observed wave train is a scattered wave originated nearfield by incoming P wave from distant earthquake.

To locate the conversion point of the scattered waves, we first separated scattered wave train from large-amplitude direct waves. Firstly, we stacked seismic traces along the wavefront of the direct waves to cancel out the scattered wave propagating from different direction to each station to make a clear direct wave packet. Then, the stacked trace is subtracted from the raw seismogram to enhance scattered waves. By analyzing the subtracted traces based on an array data processing technique, we located the scatterer at around the Boso triple junction of three plates, southeast of Kanto area.

To clarify what kind of structure develops such large scattered waves, we conducted a finite difference method simulation of seismic wave propagation using high-resolution subsurface structure model with topography and bathymetry. Simulation results revealed that strong scattered waves are generated along the Japan Trench, and are guided to the direction normal to the trench axis due to the reverberation between seafloor and the Pacific plate boundary. In addition, the reverberation of scattered waves in thick (~9000 m) seawater column above the Boso triple junction enhance and elongate the scattered waves significantly, which explains observed feature of scattered waves.

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