

3-D shear-wave velocity structure of the Japan subduction zone from teleseismic tomography

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So far many researchers have used seismic tomography to investigate the 3-D seismic velocity structure beneath the Japan Islands. However, most of the previous tomographic studies used only the arrival-time data from local earthquakes that occurred in the crust and the subducting Pacific and Philippine Sea slabs under Japan, which could reveal the 3-D structure down to about 200 km depth including the crust and upper-mantle wedge, but could not determine the deeper 3-D structure for the entire subducting slabs and the mantle below the slabs. This problem was resolved by adding data from teleseismic events to conduct a joint inversion of local and teleseismic data (e.g., Zhao et al., 1994). However, so far only 3-D P-wave velocity structure has been studied under the Japan Islands (e.g., Abdelwahed and Zhao, 2007; Zhao et al., 2012), while high-resolution 3-D S-wave velocity (Vs) structure under Japan has not been investigated yet.

In this study, we have attempted to determine a detailed 3-D Vs model of the Japan subduction zone down to 700 km depth using both local and teleseismic data. We used ~101,200 S-wave arrival times from 1180 local earthquakes that occurred in and around Japan. We have also made great efforts to collect 17,167 S-wave arrival times from 25 teleseismic events (M 6.1 - 8.1) from the original 3-component seismograms recorded by the dense Hi-net seismic network deployed on the Japan Islands.

Main features of our 3-D Vs model are summarized as follows. (1) The subducting Pacific and Philippine Sea slabs are imaged clearly as high-velocity zones, and low-velocity anomalies are visible in the upper-mantle wedge above the slabs. The overall pattern of the 3-D Vs model is quite similar to that of the 3-D Vp model of Zhao et al. (2012). (2) The subducting Philippine Sea slab is well imaged as a high-velocity zone down to 400 km depth under west of Kyushu Island. (3) Beneath the Japan Sea off Shimane Peninsula in western Honshu (the Chugoku District), the Philippine Sea slab is found to subduct aseismically down to ~500 km depth. These new findings are considered to be very important for understanding the subduction history of the Philippine Sea plate as well as the dynamic evolution of the Japan subduction zone.

References

- Abdelwahed, M.F., D. Zhao (2007) Deep structure of the Japan subduction zone. *Phys. Earth Planet. Inter.* 162, 32-52.
Zhao, D., A. Hasegawa, H. Kanamori (1994) Deep structure of Japan subduction zone as derived from local, regional, and teleseismic events. *J. Geophys. Res.* 99, 22313 - 22329.
Zhao, D., T. Yanada, A. Hasegawa, N. Umino, W. Wei (2012) Imaging the subducting slabs and mantle upwelling under the Japan Islands. *Geophys. J. Int.* 190, 816-828.

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