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日本沈み込み帯のＰ波異方性トモグラフィー
Mapping seismic anisotropy and heterogeneity of Japan subduction zone

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We determined P and S wave tomography and 3-D P-wave anisotropic structure under the Northeast Japan arc from the Japan Trench to the back-arc area under the Japan Sea using a large number of P and S wave arrival times from local shallow and deep earthquakes recorded by the dense local seismic networks. Arrival times from many suboceanic earthquakes relocated with sP depth phases enable us to determine the 3-D structures under the Pacific Ocean and Japan Sea, which expand the study region from the land area to the whole arc from the Japan Trench to the Japan Sea with a width of more than 500 km. Our results show strong heterogeneities on the top of the subducting Pacific slab under the Pacific Ocean and most large thrust earthquakes occurred in the high-velocity (high-V) areas where the Pacific slab and the overriding plate are strongly coupled. Low-velocity (low-V) zones are imaged in the mantle wedge with significant along-arc variations under the volcanic front. The mantle-wedge low-V zones extend westward under the Japan Sea and are connected with the subducting Pacific slab at depths of 150-200 km under the back-arc. The results indicate that the H2O and fluids brought downward by the subducting Pacific slab are released into the mantle wedge by dehydration and are subsequently transported to the surface by the upwelling flow in the mantle wedge. Significant P-wave anisotropic anomalies are revealed under the Honshu arc. The predominant fast-velocity direction (FVD) is E-W in the mantle wedge while it is N-S in the subducting Pacific slab. The anisotropy in the mantle wedge is the result of deformation caused by the subduction of the Pacific plate and the induced mantle wedge convection, while the special pattern in the middle of the mantle wedge argues for the 3-D mantle flow or the specific alignment of the olivine in partially molten mantle. The N-S (trench-parallel) FVD in the subducting Pacific slab represents either the original fossil anisotropy when the Pacific plate forms or the trench-parallel crystal and shaped preferred orientation in the subducting slab due to the slab bending.

We also performed a detailed 3-D P-wave anisotropic tomography of the crust and upper mantle beneath Southwest Japan using P-wave arrival times from local earthquakes. The Philippine Sea (PHS) slab is imaged clearly as a high-V anomaly which exhibits considerable lateral variations. Significant low-V anomalies are revealed above and below the PHS slab. The low-V anomalies above the PHS slab may reflect the upwelling flow in the mantle wedge and the PHS slab dehydration, and they form the source zone of the arc volcanoes in SW Japan. The low-V zones under the PHS slab may reflect the upwelling flow in the big mantle wedge above the Pacific slab. The anisotropy in the crust and upper mantle is complex. In Kyushu, the P-wave FVD is generally trench-normal in the mantle wedge under the back-arc, which is consistent with the corner flow driven by the PHS slab subduction. The FVD is trench-parallel in the subduting PHS slab under Kyushu.

References

Huang, Z., D. Zhao, L. Wang (2011) Seismic heterogeneity and anisotropy of the Honshu arc from the Japan Trench to the Japan Sea. Geophys. J. Int. 184, 1428-1444.

Huang, Z., D. Zhao, L. Wang (2011) Shear-wave anisotropy in the crust, mantle wedge and the subducting Pacific slab under Northeast Japan. Geochem. Geophys. Geosyst. 12, Q01002.

Wang, J., D. Zhao (2012) P wave anisotropic tomography of the Nankai subduction zone in Southwest Japan. Geochem. Geophys. Geosyst. 13, Q05017.

Zhao, D. (2012) Tomography and dynamics of Western-Pacific subduction zones. Monogr. Environ. Earth Planets 1, 1-70. (www.terrapub.co.jp/onlinemonographs/meep/list.html)

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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