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Seismic anisotropy in the mantle wedge estimated by numerical simulations

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Understanding the detailed structure of the mantle wedge is difficult, because there are a variety of factors, such as water and melt, which should be taken into account. As a first step to constrain the structure in this region, it is a good way to focus on a simple model, and estimate observable output. In this presentation, we consider the small-scale convection (SSC) in the mantle wedge as an example of the models which may explain the spatial and temporal distribution of volcanoes on the NE Japan and see its effects on seismic anisotropy, that is, the observations which has a close relationship with the mantle flow.

The mantle flow is calculated with composite rheology (i.e., a combination of linear and non-linear rheology) and by using the obtained flow, we estimate P-wave anisotropy based on a theory of LPO development.

Results in the horizontal cross-sections show that the fast direction of P-wave propagation is almost the same as the direction of plate motion. This implies that the large-scale mantle flow associated with subducting slab is still dominant even in the presence of SSC. Results in the vertical cross-sections show that the fast direction of P-wave propagation tends to tilt vertically particularly near the downwellings of SSC. However, the present studies of P-wave azimuthal anisotropy determine the fast direction of P-wave propagation only in the horizontal cross-sections. Therefore, the seismological technique to determine the P-wave anisotropy including the vertical direction (or in 3D) gives us the essential information to know the mantle movement of any kind in the mantle wedge. We also discuss the observation with surface waves which show large V_{SH}/V_{SV} in the mantle wedge and its implications based on our modeling results.

Keywords: mantle wedge, small-scale convection, seismic anisotropy