Tomographic imaging of the upwelling flow and deep structure of arc volcanoes beneath Hokkaido

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Recent seismic tomography has revealed an inclined low-velocity zone in the mantle wedge of northeastern (NE) Japan. The zone is distributed sub-parallel to the down-dip direction of the slab and is considered to be an upwelling flow portion of the secondary convection that is mechanically induced by the slab subduction. This paper estimates three-dimensional (3D) seismic velocity structure to image the upwelling flow and to reveal its along-arc variation beneath Hokkaido.

The method by Zhao et al. [1992] was applied to arrival-time data recorded at 260 stations from ~8,600 earthquakes that occurred around Hokkaido. The total number of arrival-time data used in the inversion is about 170,000 for P wave and 140,000 for S wave. Grids were set up in the model space with intervals of 15-30 km in horizontal and 5-30 km in vertical directions.

Obtained results show a clear low-velocity zone in the mantle wedge, sub-parallel to the slab. The zone is distributed continuously from the east part of Hokkaido to the north part of Aomori prefecture crossing the junction between the Kuril and NE Japan arcs. Interestingly, the relationship between the distribution of volcanoes at the surface and the heterogeneous structure in the mantle wedge is seen even in Hokkaido, as is already revealed in NE Japan. The present observations provide important and essential constraints on the formation of arc volcanoes in subduction zones.