

Imaging the subducting slabs and mantle plumes with high-resolution global tomography

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Global seismic tomography has been used to determine the 3-D whole-mantle structure, which has provided important information on the deep structures of the subducting slabs and mantle plumes as well as deep Earth dynamics. Tomographic images under the hotspot volcanoes such as Hawaii, Iceland and Tahiti exhibit low-velocity anomalies, which may reflect hot mantle plumes (e.g., Zhao, 2004, 2009). Zhao et al. (2009) investigated the upper-mantle structures under the intraplate volcanoes in China (Mt. Changbai and Mt. Wudalianchi). Their results suggest that these intraplate volcanoes are related to the big mantle wedge above the stagnant Pacific slab under East Asia. In this work, we have tried to determine a more detailed 3-D mantle structure by using global tomography. In Zhao (2004, 2009), the thickness of the subducting Pacific slab was imaged to be 200-250 km due to the lower resolution. While high-resolution local and regional tomography under the Japan Islands shows the slab thickness to be 85-90 km (Zhao et al., 2009, 2011; Huang et al., 2011). To obtain a high-resolution whole-mantle tomography, we have tried to adopt a much denser flexible-grid with a grid interval of 50 km in depth and 100-200 km in lateral direction. We used five kinds of ISC P-wave data (P, pP, PP, PcP and P-diff phases), and adopted a flexible-grid model parameterization (Zhao, 2009; Yamamoto and Zhao, 2010). The 1-D iasp91 Earth model was adopted to be the starting model for the tomographic inversion. In this work we have used about 1.7 million P-wave arrival times from about 13000 earthquakes. By using many kinds of seismic phases, the spatial resolution of the tomographic images has been much improved for the upper mantle under the oceanic regions. The preliminary results show a similar pattern of whole-mantle tomography as the previous models, but both the subducting slabs and mantle plumes exhibit sharper images than those revealed by the previous studies.