Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SIT39-P05 Room:Poster Time:May 2 14:00-15:15

Whole-mantle P-wave radial anisotropy tomography

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1. Introduction

When studying seismic anisotropy, it is generally assumed that the medium under study has a hexagonal symmetry (i.e., transverse isotropy). In most cases, the axis of symmetry is assumed in the vertical direction (i.e., azimuthal anisotropy) or in the horizontal plane (i.e., radial anisotropy). Seismic anisotropy is induced mainly by the lattice-preferred orientation (LPO) of anisotropic minerals, especially for the olivine in the mantle (e.g., Zhang & Karato, 1995; Tommasi et al., 2000; Kaminski & Ribe, 2001). Studying seismic anisotropy is very important for understanding the structure and dynamics of the Earth's interior (e.g., Silver, 1996). Many previous studies have investigated P-wave azimuthal anisotropy tomography for several regions including the Japan Islands. Recently, Wang & Zhao (2013) studied P-wave radial anisotropy tomography of the Kyushu and Tohoku subduction zones. In this work, we have attempted to conduct global tomography to understand 3-D P-wave radial anisotropy in the whole mantle.

2. Data and method

In this study we used 12,657 earthquakes recorded by 6765 seismic stations which were selected from the ISC-EHB catalog by Yamamoto & Zhao, 2010. About 1.4 million arrival times of P, pP, PP, PcP and Pdiff waves are used in the tomographic inversion. The method of radial anisotropy tomography by Wang & Zhao (2013) is combined with the flexible-grid global tomography of Zhao et al. (2013) to conduct the whole-mantle tomographic inversion in this work.

3. Result

In comparison with the isotropic tomographic model, our anisotropic tomography model results in a smaller root-mean-square travel-time residual, suggesting that the anisotropic tomography model fits the data better. The isotropic component of this model is very consistent with the previous isotropic tomography. In upper mantle, low-velocity anomalies along the Pacific Rim, and high-velocity anomalies under the stable continents are visible. In addition, low-velocity anomalies exist from the surface down to the core-mantle boundary under South Pacific and East Africa, which represent two superplumes. The anisotropic results show that vertical velocity is greater than horizontal velocity under some regions such as South Pacific, which may reflect the mantle upwelling.

References

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Keywords: tomography, mantle, anisotropy tomography