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西太平洋と東アジア地域のマントルトモグラフィーとダイナミクス
Seismic tomography and mantle dynamics of the Western-Pacific and East Asia regions

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We have used multiscale seismic tomography to determine the detailed 3-D seismic velocity structure of the crust and mantle under the Western-Pacific subduction zones and the East Asian continental regions. The subducting Pacific and Philippine Sea (PHS) slabs are imaged clearly from their entering the mantle at the oceanic trenches to their reaching the mantle transition zone and finally to the core-mantle boundary (CMB). High-resolution local tomography of Northeast Japan has imaged the shallow portion of the slab from the Japan Trench down to about 200 km depth under Japan Sea. The 3-D Vp and Vs structures of the forearc region under the Pacific Ocean are constrained by locating suboceanic events precisely with sP depth phases. Strong structural heterogeneity is revealed in the megathrust zone under the forearc region, and there is a good correlation between the heterogeneity and the distribution of large thrust earthquakes including the great 2011 Tohoku-oki earthquake (Mw 9.0). A joint inversion of local and teleseismic data imaged the subducting Pacific slab down to 670 km depth under the Japan Islands and the Japan Sea. The PHS slab is detected down to 500 km depth under SW Japan. A mantle upwelling is found under SW Japan that rises from about 400 km depth right above the Pacific slab up to the PHS slab. Regional and global tomography revealed the Pacific slab that is stagnant in the mantle transition zone under Eastern China. A big mantle wedge (BMW) has formed in the upper mantle above the stagnant slab. Convective circulations in the BMW and deep dehydration of the stagnant slab may have caused the intraplate volcanoes in NE Asia, such as the Changbai and Wudalianchi volcanoes. The active Tengchong volcanism in SW China is caused by a similar process in the BMW above the subducting Burma (or Indian) slab. Global tomography shows pieces of fast anomalies in the middle and lower mantle as well as in the D ” layer above the CMB, suggesting that the stagnant slab finally collapses down to the lower mantle and CMB as a result of very large gravitational instability from phase transitions. Prominent slow anomalies are also revealed in the mantle under the subducting slabs, which may represent either mantle plumes or upwelling flows associated with the deep subduction of the slabs.

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