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西太平洋地域のマントル構造とダイナミクス

Seismic structure and mantle dynamics in the Western Pacific region

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We used regional and global seismic tomography to determine high-resolution 3-D mantle structure under Western Pacific to East Asia (Zhao, 2004, 2009; Huang and Zhao, 2006; Zhao et al., 2009). Our results show prominent low-velocity anomalies from the surface down to 410 km depth beneath the intraplate volcanoes and a broad high-velocity anomaly in the mantle transition zone under East Asia. Focal-mechanism solutions of deep earthquakes indicate that the subducting Pacific slab under the Japan Sea and the East Asia margin is subject to compressive stress regime. These results suggest that the Pacific slab meets strong resistance at the 660-km discontinuity and so it becomes stagnant in the mantle transition zone under East Asia. The Philippine Sea slab has also subducted down to the mantle transition zone under western Japan and the Ryukyu back-arc region. The western edge of the stagnant slab is generally parallel with the Japan Trench and the Ryukyu Trench and roughly coincides with a prominent surface topography and gravity boundary in East China, which is located approximately 1800 km west of the trenches. The upper mantle under East Asia has formed a big mantle wedge (BMW) above the stagnant slab. The BMW exhibits low seismic-velocity and high electrical-conductivity, which is hot and wet because of the deep dehydration reactions of the stagnant slab and the convective circulation process in the BMW. These processes lead to the upwelling of hot and wet asthenospheric materials and thinning and fracturing of the continental lithosphere, leading to the formation of the active intraplate volcanoes in East Asia (such as the Changbai and Wudalianchi volcanoes in NE China). Our results also show that the active Tengchong volcano in SW China is related to the deep subduction of the Burma microplate down to the mantle transition zone and a BMW above the Burma slab.

References

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