Changbai volcano: seismic tomography, origin and East-Asia tectonics

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Recent high-resolution seismic tomography revealed a prominent low-velocity anomaly from the surface down to 410 km depth beneath the Changbai volcano and a broad high-velocity anomaly in the mantle transition zone under East Asia (Zhao et al., 2004, 2009; Lei and Zhao, 2005). 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 (Zhao et al., 2009). 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 NE Asia. The upper mantle under NE Asia has formed a big mantle wedge (BMW) above the stagnant slab (Zhao et al., 2007, 2011; Zhao and Liu, 2010). The BMW exhibits low seismic-velocity and high electrical-conductivity, which is hot and also 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 as well as the formation of the active intraplate volcanoes in NE Asia. Therefore the active Changbai intraplate volcanism is not related to a deep mantle plume but is caused by the plate tectonic processes in the upper mantle and the mantle transition zone. A better understanding of these processes can be achieved by deploying a network of seismic stations on the Korea Peninsula and Japan Sea to determine higher-resolution mantle tomography under NE Asia in addition to conducting other geophysical and geochemical investigations of the region.

References

Zhao, D., J. Lei, R. Tang (2004) Origin of the Changbai intraplate volcanism in Northeast China: Evidence from seismic tomography. Chinese Sci. Bull. 49, 1401-1408.

Lei J., D. Zhao (2005) P-wave tomography and origin of the Changbai intraplate volcano in Northeast Asia. Tectonophysics 397, 281-295.

Zhao, D., S. Maruyama, S. Omori (2007) Mantle dynamics of western Pacific to East Asia: New insight from seismic tomography and mineral physics. Gondwana Res. 11, 120-131.

Zhao, D. et al. (2009) Seismic image and origin of the Changbai intraplate volcano in East Asia: Role of big mantle wedge above the stagnant Pacific slab. Phys. Earth Planet. Inter. 173, 197-206.

Zhao, D., L. Liu (2010) Deep structure and origin of active volcanoes in China. Geoscience Frontiers 1, 31-44.

Zhao, D., S. Yu, E. Ohtani (2011) East Asia: Seismotectonics, magmatism and mantle dynamics. J. Asian Earth Sci. 40, 689-709.