Seismic imaging of East Asian orogens and subduction zones

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In the past a few years, significant advances have been made on seismic imaging of East Asian orogens and subduction zones (*Zhao et al*., 2017a). High-resolution images of seismic tomography and receiver functions of the East Asian region are obtained, revealing significant lateral heterogeneities in the crust and upper mantle, which are caused by active plate subductions and continental orogeny. A significant advance in the seismic imaging is tomographic inversions for three-dimensional distribution of seismic anisotropy in the crust and mantle, which provides important new information on the lithospheric deformation and mantle convection associated with the continental orogeny and plate subductions (*Zhao et al*., 2016). The intraplate volcanism in Northeast Asia is caused by hot and wet upwelling flows in the big mantle wedge above the stagnant Pacific slab in the mantle transition zone (MTZ). The age distribution of the subducting Pacific slab beneath East Asia is estimated, shedding new light on the evolution of the Pacific slab, as well as the East Asian tectonics during the Late Mesozoic to the Cenozoic (*Liu et al*., 2017). The nucleation of great earthquakes, such as the 2008 Wenchuan earthquake (M 8.0), the 2011 Tohoku-oki earthquake (M 9.0) and the 2015 Nepal earthquake (M 7.9), is controlled by structural heterogeneities in and around the seismogenic fault zones. It is considered that fluids are involved in the nucleation and rupture processes of all types of earthquakes (*Zhao et al*., 2018). The cause of deep earthquakes is still not very clear, though transformational faulting triggered by metastable olivine transforming to spinel in the cold, stressed core of the subducting slab is a viable mechanism, and a metastable olivine wedge is revealed within the western Pacific subducting slab at the MTZ depths. The 2015 Bonin deep earthquake (M 7.9, ~670 km depth) occurred at the MTZ bottom within the vertical Pacific slab which is penetrating into the lower mantle. This very unusual deep event was caused by joint effects of several factors, including the slab's fast deep subduction, slab tearing and thermal variation, stress changes and phase transformations in the slab, and complex interactions between the slab and the ambient mantle (*Zhao et al*., 2017b).

References

Liu, X., D. Zhao, S. Li, W. Wei (2017) Age of the subducting Pacific slab beneath East Asia and its geodynamic implications. *Earth Planet. Sci. Lett*. 464, 166-174.
Zhao, D., S. Yu, X. Liu (2016) Seismic anisotropy tomography: New insight into subduction dynamics. *Gondwana Res.* 33, 24-43.
Zhao, D., Y. Isozaki, S. Maruyama (2017a) Seismic imaging of the Asian orogens and subduction zones. *J. Asian Earth Sci.* 145, 349-367.
Zhao, D., M. Fujisawa, G. Toyokuni (2017b) Tomography of the subducting Pacific slab and the 2015 Bonin deepest earthquake (Mw 7.9). *Scientific Reports* 7, 44487, doi:10.1038/srep44487.
Zhao, D., X. Liu, Y. Hua (2018) Tottori earthquakes and Daisen volcano: Effects of fluids, slab melting and hot mantle upwelling. *Earth Planet. Sci. Lett.* 485, 121-129.

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