Geophysical Research Abstracts
Vol. 18, EGU2016-6149, 2016
EGU General Assembly 2016

New interpretation of the deep mantle structure beneath eastern China

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Recent study of high resolution seismic tomography presents a large mass of high velocity abnormality beneath eastern China near the phase change depth, expanding more than 1600km-wide in East-west cross-section across the North China plate. This structure high is generally believed to be the subducted slab of Pacific plate beneath the Eurasia continent, while its origin and dynamic effect on the Cenozoic tectonic evolution of eastern China remain to be controversial. We developed a subduction-driven geodynamic mantle convection model that honors a set of global plate reconstruction data since 230Ma to help understand the formation and evolution of mantle structure beneath eastern China. The assimilation of plate kinematics, continuous evolving plate margin, asymmetric subduction zone, and paleo seafloor age data enables the spatial and temporal consistency between the geologic data and the mantle convection model, and guarantees the conservation of the buoyancy flux across the lithosphere and subducted slabs. Our model achieved a first order approximation between predictions and the observed data. Interestingly, the model suggests that the slab material stagnated above discontinuity didn't form until 15Ma, much later than previous expected, and the fast abnormality in the mid-mantle further west in the tomographic image is interpreted to be the remnants of the Mesozoic Izanagi subduction. Moreover, detailed analysis suggests that the accelerated subduction of Philippine Sea plate beneath Eurasia plate along the Ryukyu Trench and Nankai Trough since 15Ma may largely contribute to extending feature above 670km discontinuity. The long distance expansion of the slab material in the East-west direction may be an illusion caused by the approximate spatial perpendicularity between the cross-section and the subduction direction of the Philippine Sea plate. Our model emphasizes the necessity of the re-examination on the geophysical observation and its tectonic and geodynamic implication in eastern China.