Teleseismic upper-mantle tomography of the Tanlu fault zone in East China

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The Tanlu fault zone, NNE-SSW oriented with strike-slip motions, is the most significant active fault in East China. The great 1668 Tancheng earthquake (Ms 8.5) occurred on this fault zone, which is located above the stagnant Pacific slab in the mantle transition zone (MTZ). To the east of the Tancheng earthquake epicenter and under the southernmost Korean Peninsula to westernmost Japan, the subducting Pacific slab exhibits a sharp change in its geometry. However, the relationship between the Pacific slab and the great earthquake on the Tanlu fault is unclear. To address this issue, we conduct teleseismic P-wave tomography using 44,715 relative arrival times. These data are collected from high-quality seismograms of 838 teleseismic events (M > 5.5; epicenter distances of 30-90 degrees) recorded at 126 provincial seismic stations around the Tanlu fault zone in East China. Our results show that at depths < 150 km, high velocity (high-V) anomalies appear to the west of the Tanlu fault, whereas some low velocity (low-V) anomalies are visible to the east of the fault zone. Strong lateral heterogeneities are revealed along the fault zone. At depths of 230-470 km, to the northwest of the Tanlu fault, there are obvious low-V anomalies which may reflect hot and wet mantle upwelling, whereas to the east, some high-V anomalies are visible, which may reflect the detached Eurasian lithosphere. In the MTZ, both high-V and low-V anomalies are visible, and the widespread high-V anomalies may reflect the stagnant Pacific slab. Beneath the hypocenter of the 1668 Tancheng earthquake, a prominent low-V anomaly is revealed in the upper mantle down the MTZ depth, which may reflect upwelling flow of hot and wet materials. Fluids from the upwelling mantle flow may have played a key role in the generation of the Tancheng earthquake. Integrating with previous findings, our present results suggest that the Tancheng earthquake could be related to the sharp change in the Pacific slab geometry, the eastward retreat of the Pacific slab, as well as some slab-materials collapsing down to the lower mantle resulted from the gravity effect and/or phase transition, which may cause the low-V anomaly in the MTZ.
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