High-resolution 3-D crustal shear-wave velocity structure in the central Tanlu fault system and implications for its geodynamic settings

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The mid-Mesozoic intracontinental collision between the North and South China blocks resulted in the Tanlu fault system, which has generated a varying degree of seismicity, such as the M8.5 Tancheng great earthquake that occurred in 1668. While the suture between the two blocks in the region west of the Tanlu fault is clearly mapped to lie close to the northern margin of the Qinling-Dabie Orogenic Belt (QDOB), the exact location of its extension eastward remains an active subject of debate. To better understand the velocity structure and geodynamic implications in the middle segment of the Tanlu fault zone, we performed ambient noise tomography of the vertical component of ambient noise data recorded by 28 temporary seismic stations and 62 permanent stations deployed mainly in the northern Anhui and Jiangsu regions. Empirical Green's functions were retrieved from the cross-correlations functions, from which we extracted the Rayleigh wave group and phase velocity dispersion curves using an image analysis technique (Yao et al. 2006, 2011). After performing quality control on the dispersion data, we finally obtained a total number of 1504 group velocity and 1303 phase velocity dispersion curves at periods ranging from 2 s to 40 s, respectively. The direct surface wave inversion method of Fang et al. (2015) was adopted to jointly invert mix-path phase and group velocities and finally, we obtained the 3-D shear-wave velocity structure in the crust and uppermost mantle of the study region. Checkerboard resolution tests revealed that the tomographic results had a high lateral resolution of 0.75° × 0.75°. Our results show an upwelling in the uppermost mantle and the lower crust at the locations of the sutures in the west of Tanlu fault and northwards of Subei basin, which is characterized by a thick upper crust and gradual increasing low velocities from the surface to an approximate depth of 21 km. Apparent structural heterogeneities are observed at both sides of the Tanlu fault zone. Jiangsu Variations of velocity structures also appear along the strike direction of the fault zone. The obtained velocity anomalies reveal both lateral and vertical heterogeneities that are generally consistent with geologic features.