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Upper mantle structure beneath the central North China from surface wave tomography

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The North China craton (NCC), part of the Sino-Korean craton (SKC), is an important natural laboratory for studying the temporal and spatial evolution of lithosphere. The NCC experienced widespread reactivations during the Late Mesozoic and Cenozoic. In the eastern NCC, lithospheric thinning and destruction occurred and the cratonic lithospheric mantle is replaced by young and fertile mantle. And the western NCC remains relatively stable and may have a thick cratonic lithosphere. Beneath the central NCC (the Trans-North China Orogen) located in the transitional zone, the lithosphere is characterized by the significant lateral variation. Recent geochemical studies also suggest that lithospheric thinning may have taken place in the central NCC during the Cenozoic. The tectonic activities in the southern and northern in the central NCC are obviously different. The Basaltic volcanism is widespread in the northern, and however is rare in the southern during the Cenozoic. Deep structures and dynamic mechanisms are still unclear and little is known about the Cenozoic lithospheric evolution in the central NCC.

In order to obtain the upper-mantle structures beneath the central NCC, we measured phase velocities at 13 periods from 20 s to 143 s using Rayleigh-wave data recorded at about 170 broadband seismic stations in 2008-2018 in the area and obtained phase velocities using the method of two-plane-wave tomography. And then we inverted the shear-wave velocity structure of the crust and upper mantle from phase velocities. Our results show the lateral variation of velocity structures of the crust and upper mantle beneath the central North China. There are obvious differences of velocity structures beneath the northern and southern area bounded by about N37.5°. In the mid-low crust, low-velocity anomalies widely distribute beneath the northern area. In the upper mantle, two strong low-velocity anomalies separately appear in the asthenosphere beneath the northern and southern Shanxi rift. The minimum shear-wave velocity is about 4.2km/s in the low-velocity anomalies zone. The asthenosphere upwelling and lithospheric thinning may appear beneath the northern Shanxi rift. The evolutions of lithosphere and basalt volcanism are related to the extension induced by the Pacific subduction and Indian-Eurasian collision. Beneath the area near N37.5°, the lithosphere may still be thick. Beneath the southern area, thin lithosphere with the thickness of about 130 km locally appears above the low-velocity asthenosphere beneath Linfen, Yuncheng and Weihe rift basin. The lithosphere is still characterized by high velocity and there is no asthenosphere upwelling in these areas. A low-velocity body appears in the lithosphere beneath the Lingbao basin and its eastern region. We suggest that the low-velocity body is related to the collision of the North China block and Yangzi block.