Crust and upper mantle structure of the Tien Shan orogenic belt using full-wave ambient noise tomography.

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In order to understand the tectonic processes of the entire Tien Shan region, we construct a 3D shear wave velocity model of the crust and upper mantle using full-wave ambient noise tomographic method. High-quality empirical Green's functions at periods of 7-200 s are extracted from cross-correlation of vertical component of continuous seismic data at 108 stations during 2012 to 2014. Our shear velocity model reveals significant structural heterogeneities and deformation styles in the crust and upper mantle beneath the entire Tien Shan region. More specifically, our tomographic imaging shows distinct low shear velocity structures beneath the Tarim and Junggar basins in the upper and middle crust, and a general slow-to-fast velocity transition from middle crust to lower crust and upper mantle. Along the strike of the Tien Shan orogenic belt, we observe distinct high velocity features in the upper crust, with the highest velocity (>3.3 km/s) beneath the central Tien Shan segment. In the middle crust, western Tien Shan shows a clear arc-like shape of high velocity, and the highest velocity anomalies are imaged beneath eastern Tien Shan. In the lower crust and upper mantle, we image a prominent slow-to-fast velocity contrast from western and central Tian Shan (Vs < 3.5 km/s) to eastern Tien Shan (Vs > 4.4 km/s). We suggest that the low velocity zone in the lower crust beneath central Tien Shan may indicate partial melting due to the underthrusting of the Tarim Basin. The western Tien Shan low velocity anomalies in the upper mantle may be related to the Indian-Eurasia collision and the southward subduction of the Eurasia lithosphere. Our seismic model suggests that the underthrusting of the basins could play an important role in the formation and evolution of the eastern Tien Shan, providing new constrains for the underlying mantle dynamic processes.

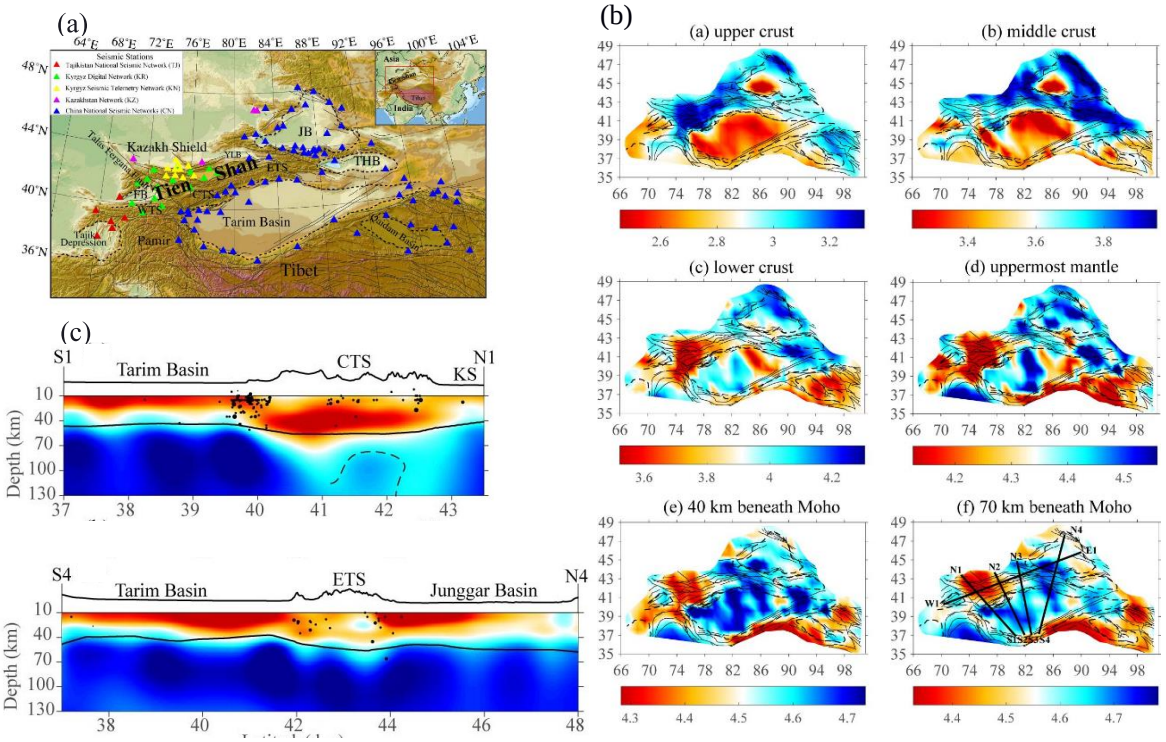

Figure (a) Sketch map of regional tectonics in the Tien Shan region. (b) Shear-wave velocity model at multiple depths. (c) Vertical cross-sections of shear wave velocity structures See Figure (b) for the profile locations.