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Seismic structure of northern segment of the N-S tectonic belt in North-Central China and its geological implications

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We study high-resolution three-dimensional P-wave velocity tomography and anisotropic structure of the crust and uppermost mantle under the Helan–Liupan–Ordos western margin tectonic belt in North-Central China using 13,506 high-quality P-wave arrival times from 2666 local earthquakes recorded by 87 seismic stations during 1980–2014. Our results show that prominent low-velocity anomalies exist widely in the lower crust beneath the study region and the low-V zones extend to the uppermost mantle in some local areas, suggesting that the lower crust contains higher-temperature materials and/or fluids. The major fault zones, especially the large boundary faults between major tectonic units, are located at the edge portion of the low-V anomalies or transition zones between the low-V and high-V anomalies in the upper crust, whereas low-V anomalies are revealed in the lower crust under most of the faults. Most of large historical earthquakes are located in the boundary zones where P-wave velocity changes drastically in a short distance. Beneath the source zones of most of the large historical earthquakes, prominent low-V anomalies are visible in the lower crust. Significant P-wave azimuthal anisotropy is revealed in the study region, and the pattern of anisotropy in the upper crust is consistent with the surface geologic features. In the lower crust and uppermost mantle, the predominant fast velocity direction (FVD) is NNE-SSW under the Yinchuan Graben and NWW-SEE or NW-SE beneath the Corridor transitional zone, Qilian Orogenic Belt and Western Qinling Orogenic Belt, and the FVD is NE-SW under the eastern Qilian Orogenic Belt. The anisotropy in the lower crust may be caused by the lattice preferred orientation of minerals, which may reflect the lower-crustal ductile flow with varied directions. The present results shed new light on the seismotectonics and geodynamic processes of the Qinghai-Tibetan Plateau and its northeastern margin.

References:

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