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Seismic tomography and anisotropy of the Helan-Liupan tectonic belt: Insight into lower crustal flow and seismotectonics



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We applied the tomographic methods of Zhao et al. [1, 2] and Wang and Zhao [3] to our data set to study the detailed 3-D P- and S-wave velocity (V_p , V_s) and Poisson's ratio (σ) images as well as P-wave azimuthal anisotropy in the crust and uppermost mantle beneath the Helan-Liupan tectonic belt (HLT) and adjacent regions. The data set used in this study consists of 38,880 P-wave and 35,117 S-wave arrival times from 5,028 local earthquakes recorded by 66 seismic stations in the study area during 1980 to 2014.

Obvious low- V_p and low- σ anomalies are revealed in the lower crust beneath the Qilian Orogenic Belt and Western Qinling, which we interpret as a weakened zone mainly caused by water and capable of ductile flow on a geological timescale. Our P-wave anisotropy results suggest that the flow direction in the lower crust is nearly parallel to the direction of the geodetic crustal motion and that of the upper mantle flow beneath the study region. Most of the 26 large earthquakes (1125-1954) in the study region occurred in the boundary zones where V_p , V_s and σ change drastically over a short distance. Beneath the source areas of the large historical earthquakes, fluid-related low-velocity zones exist widely in the lower crust. The fluids (water) result from dehydration of hydrous minerals in the deeper crust and uppermost mantle beneath the northeastern Tibetan Plateau. When the fluids migrate upward to the active faults, the fault-zone friction is reduced and so large crustal earthquakes can be triggered. Our present results shed new light on the seismogenesis and geodynamics of the northeastern Tibetan Plateau and adjacent areas.

References:

[1] Zhao D et al. (1992) Journal of Geophysical Research 97: 19909-19928

[2] Zhao D et al. (2016) Gondwana Research <http://dx.doi.org/10.1016/j.jgr.2015.05.008>

[3] Wang J and Zhao D (2013) *Geophysical Journal International* 193: 1166-1181

