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The 3D crustal structure of Northeastern Tibetan area from seismic tomography

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The Northeastern Tibetan region is located in the border area of three sub-plates in China, i.e. the Tibetan plateau, North China block and Xinjiang block. Effected simultaneously by the extrusion driven by the India-Eurasia plat collision and the blockage of the Ordos basin, this area has complex geology, strong tectonics activities and suffered from several large historic earthquakes, such as the Haiyuan earthquake (M8.6) in 1920, the Gulang earthquake (M8.0) in 1927. To enhance our understanding of the crustal structure and the interaction between different tectonic blocks of this region, we conduct a three-dimensional (3D) tomographic study by using the arrival time date recorded by regional seismic network.

We used 101101 P and 103313 S wave arrival times from 11650 local earthquakes during 1970 to 2013 recorded by 154 permanent seismic stations of the local Seismic Network, installed over five provinces in China, i.e. Gansu, Ningxia, Qinghai, Shanxi, Neimenggu. We first established a 1D primary crustal model from LITHO1.0, an updated crust and lithospheric model of the Earth by weighted averaging. To better performer ray tracing, our inversion involved three discontinuities (including the Moho) with depth variation over the mantle derived from LITHO1.0. Detailed three-dimensional seismic velocity (Vp and Vs) structures of the crust of the Northeastern Tibetan are determined with a horizontal resolution of about 35 km and a depth resolution of 6-20 km. The Poisson's ratio (σ) structure was also estimated after obtained Vp and Vs structures.

We detected low-velocity anomalies in the lower crust and relative high-velocity anomalies in the upper crust beneath the Longmenshan faults zone, which are in good agreement with the results of most previous geophysical studies. Our results revealed clear different velocity variation beneath both sides of different tectonic blocks. In addition, we found the correlation between our tomographic result and previous geophysical studies. Moreover, we discussed the possible origination of low-velocity anomaly in the middle-low crust beneath the east part of Tibetan plateau with low-Poisson's ratio anomalies. The ray paths in our data set crisscross well in the study area, and the obtained tomographic images have a good resolution, indicating that the main features of our results are reliable.