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Crustal structural and anisotropy in northeastern Tibetan Plateau from receiver functions

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Abstract

Deformation in northern (NE) Tibet is essential for understanding the geodynamic processes of crustal thickening and outward growth associated with the Indo-Asian collision. We analyze receiver function data recorded by the regional seismic array of ChinArray-□ and permanent stations of the study region. The crustal thickness and Vp/Vs ratio are estimated using the H–κ grid searching technique (Zhu et al., 2000) . We also perform a joint analysis of Pms from radial and tangential receiver functions to measure fast polarization direction and splitting time (Liu et al., 2012). The harmonic analysis is adopted to obtain reliable crustal azimuthal anisotropy (Sun et al., 2012). Our result shows that the crust is significantly thickened (≥50 km) west of ~103°, while the Vp/Vs ratio is relatively low (~1.73) beneath the Qilian orogeny. We also found measurements of crustal azimuthal anisotropy beneath 71 stations in which the Pms arrivals with a dominant degree-2 back azimuth variations. The crustal anisotropy shows a north-south change across the Longshoushan fault. The measured splitting time in the region south of the Longshoushan fault is 0.22-1.02 s (with an average of 0.46 s). The fast direction mainly along the NW direction is roughly close to the fast polarization from XKS (Chang et al., 2021), which is parallel to the trending of the Qian orogenic belt, indicating a vertically coherent lithospheric deformation beneath the NE Tibet. To the north, the Alxa block exhibits a NNE-NE fast polarization with an average delay time of ~0.47s. Such observation differs from the fast-axis direction of mantle anisotropy, indicating that the crust and lithospheric mantle are decoupled. The north-south variation in crustal anisotropy of our study area may suggest that the growth front of the northeastern Tibetan Plateau may have extended to the Longshoushan fault.

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