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Complex deformation of the eastern Tibetan Plateau inferred from ambient-noise Rayleigh-wave tomography

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The continental collision between India and Eurasia in the Cenozoic has resulted in the rise and growth of the vast Tibetan Plateau (TP). Popular models, such as rigid-block extrusion, continuous deformation, and the mid-lower crustal flow, have been proposed to describe the growth and expansion of eastern Tibet. Low-velocity zones (LVZs) in the Tibetan crust, together with high conductivity and high heat flow, have been widely used to support the crustal flow model. We performed Rayleigh-wave anisotropic tomography using ambient-noise data from permanent and temporary stations to place constraints on the crustal deformation fabrics of the eastern TP. Azimuthally anisotropic phase-velocity maps were constructed at periods from 8 to 45 s, which were then inverted for anisotropic shear-velocity structure to a depth of 80 km. The fast directions of azimuthal anisotropy in the upper crust show a systematic transition from E-W in the Lhasa Terrane to NW-SE in the eastern and northeastern part of the plateau and to N-S in the southeastern margin of the plateau. The pattern is generally consistent with the trends of main strike-slip faults, major crustal boundaries and the fast polarization directions of SKS waves, indicating that the Tibetan orogenesis could have caused the same deformation fabrics down to sub-continental mantle. The intensities of azimuthal anisotropy in the mid-lower crust are significantly lower beneath the plateau proper than at the eastern and northern margins of the plateau, suggesting that flow in the Tibetan lower crust, if happened, likely occurs on smaller scale than previously proposed.