Episodic Lithospheric Deformation in Eastern Tibet Inferred from Seismic Anisotropy

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Mechanisms for uplift and deformation of the Tibetan Plateau remain vigorously debated; hypotheses include stepwise growth, distributed thickening and crustal channel flow, each with a distinct anisotropic signature. We have developed a new azimuthally anisotropic shear-velocity model for the lithosphere beneath eastern Tibet, based on ambient-noise tomography from 643 seismic stations. In our model, the Tibetan upper crust is characterized by strong anisotropy with fast axes that correlate with surface geology and mantle anisotropy, suggesting the occurrence of coherent deformation. However, a much different picture emerges in the middle and lower crust, where anisotropy is disordered and weaker beneath the plateau than along its margins, inconsistent with the prediction of large-scale eastward crust flow in eastern Tibet. We propose a new deformation model for the plateau, in which early heterogeneous crustal thickening was a primary driver for plateau uplift and later disordered crust flow smoothed previous irregular structural relief and reset the mid-lower crustal anisotropy. Compatible with this model, we suggest that the southeastern plateau margin was raised likely by asthenospheric upwelling.

