

Eastward extrusion and northward expansion of the Tibetan plateau—discussions for the deep processes of the plateau uplift

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Weak material beneath the Tibetan plateau escaped and extruded eastward from beneath the thickened, elevated central plateau during continuous convergence between India and Eurasia. Here we present a fine image of the crustal and uppermost mantle structure across the Tibet-Qinling transition zone that was generated from a dense linear seismic array. Based on the seismic image and combined with previous geological and geophysical studies, we shall discuss the material extrusion of the Tibetan plateau, unveiling the depth extent to which the Qinling Belt (which could serve as a flow channel) may accommodate the extrusion of ductile material beneath the Tibetan plateau, and how these dynamic processes might accommodate plateau uplift and expansion at the eastern margin of the Tibetan plateau; furthermore, we compare the mechanisms of crustal deformation/thickening and the behavioral patterns of the lithospheric mantle between the eastern and northern margins of the Tibetan plateau. Our study results reveal that (1) middle to lower crustal flow accompanied by regional fault-related strike-slip/thrusts may occur beneath the eastern margin of the Tibetan plateau and may be a significant deep seismogenic mechanism of the large earthquakes occurring on the eastern margin of the plateau, but it has not vastly extruded farther beyond the Tibet-Qinling boundary into the lower crust of the Qinling Belt; (2) The hot asthenospheric mantle material beneath the Tibetan plateau may escape eastwards by convergence/squeezing between the India-Eurasia continents and flow to the Qinling Belt, accelerating the delamination or thermal erosion at the base of the lithosphere beneath the Tibet-Qinling/Sichuan boundary area. A combination of the preceding two mechanisms, i.e., the extrusion of ductile middle to lower crustal material, accompanied by regional fault-related tectonics and isostatic buoyancy resulting from lithospheric detachment (triggered by asthenospheric flow), may have jointly facilitated plateau uplift and expansion in the Tibet-Qinling and Tibet-Sichuan transition zones. The deep process of material extrusion on the eastern margin of the Tibet Plateau is distinguishable from the deep mechanism responsible for the northward expansion within the Tibet-Alxa transition zone at the northern margin of the plateau.