



Spatial variations in fluvial incision across the eastern margin of Tibet reveal locus of thickening in the deep crust

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The manifestation of coupling among climate, erosion and tectonics along steep topographic margins of orogenic plateaus is strongly dependent on the processes driving crustal thickening. Along the eastern margin of the Tibetan Plateau, a long-standing and vigorous debate persists over whether mountain building occurred largely along upper-crustal faults or was the consequence of distributed thickening in the lower crust. Here we revisit this debate and show how surface deformation recorded by geomorphology over millennial timescales (10^4 - 10^5 yr) can yield insight into the role the deep crust along plateau margins.

In contrast to the intensively studied Longmen Shan, the topographic margin of the Tibetan Plateau north of the Sichuan Basin follows the north-south Min Shan and cuts orthogonally across the structural grain of the Mesozoic West Qinling orogen. The lack of a direct association of topography with upper crustal faults affords an opportunity to evaluate the patterns of differential rock uplift from geomorphology. First, we employ an empirical calibration of river profile steepness (channel gradient normalized for drainage basin area) and erosion rate from cosmogenic ^{10}Be concentrations in modern sediment. Application to the channels draining the plateau margin reveals a locus of high (300-500 m/Myr) erosion rate coincident with the Min Shan. Second, we present new results of surveying and dating of fluvial terraces developed along the Bailong Jiang, one of the major rivers draining across the plateau margin. A preliminary chronology of terrace tread deposits based on radiocarbon and OSL samples reveals systematic spatial gradients in fluvial incision, with highest incision rates (1000-2000 m/Myr) localized along the axis of the Min Shan and decreasing toward both the foreland and the plateau. This locus of incision has apparently been sustained through multiple generations of terrace formation and abandonment since ca. 80ka and thus is interpreted to reflect sustained differential rock uplift along this axis. The wavelength of the region of highest incision rates is ~ 80 km and requires either 1) a deeply buried tip of a blind fault, or 2) thickening in the deep crust. We argue that terrace deformation and associated rock uplift likely reflects flow and thickening of deep Tibetan crust against the foreland of the West Qinling.