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Focused modern denudation of the Longmen Shan margin of the eastern Tibetan plateau

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We use river sediment load data to map the pattern of modern denudation across the Longmen Shan margin of the Tibetan plateau. Suspended sediment load, with corrections of bed load and solute load contributions, is used to calculate watershed-averaged denudation rates. Decadal erosion is spatially heterogeneous, and seasonally modulated by monsoon-flows, which account for 80-90% of the sediment load. Enhanced denudation occurs in a $\sim$ 50 km-wide band on the hanging wall of the Longmen Shan and Huya fault zones, reaching 0.5 – 0.8 mm/yr. These rates are similar to kyr-scale rates deduced from cosmogenic 10Be and to Myr-scale rates from low-temperature thermochronology. The sediment flux-derived erosion rates decrease with increasing distance plateau-ward, to less than 0.05 mm/yr at a distance $\sim$200 km northwest of the foot of the Longmen Shan. The gradient in precipitation across this margin alone cannot explain this one-order-of-magnitude spatial difference in erosion. Rather, the river sediment load data delineates a zone of relatively rapid denudation around active faults that carry the Longmen Shan in their hanging wall. From the similarity of denudation rates measured over Myr, kyr, and decadal time scales, we propose that erosion of the Longmen Shan margin has approached a flux steady state. The erosional efflux is balanced by advection of rock toward the Longmen margin above the $\sim$20° NW-dipping ramp of the margin-bounding fault. Our results suggest that high amounts of landslide material mobilized by earthquakes such as the Mw 7.9 2008 Wenchuan event are gradually removed by rivers, smoothing sediment flux over time. Our results also suggest that caution should be exercised when interpreting young cooling ages as evidence of the initiation of plateau uplift. Advection of an already high plateau into the belt of higher erosion rate at the Longmen Shan could also give rise to an abrupt cooling history.