



Evidence for a crustal ramp below the northernmost part of the Bhutan Himalayas

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The Main Himalayan Thrust (MHT) marks the ca. 2500-km-long boundary between the India and Eurasia plates and accommodates most of the collision that produced the Himalayan Arc. It is the source of great historical and modern earthquakes that have been documented all along the front, except for Bhutan where data is scarce. A key parameter to better understand how tectonic loading accumulates and what magnitudes may be expected in the future is the geometry of the MHT at depth. Although 2D seismic images are now available for the western part of the range, lateral variations in geometry remain poorly constrained for the Bhutanese Himalayas. Here, using new and existing ^{10}Be cosmogenic exposure ages, tectonic geodesy and uplifted Holocene river terraces we assess both denudation rates and present-day kinematics of the MHT in western Bhutan. Our new dataset includes 32 catchment-averaged denudation rates ranging from 0.025 to 2.1 mm/yr. Their spatial pattern exhibits a strong northward denudation increase starting ca. 110 km north of the MFT. We interpret this major change as a mid-crustal flat-ramp transition in the MHT geometry. Compared to previous images showing in central Nepal and Sikkim a location of 80-100 km north of the MFT for this transition, we propose a longer extent of ca. 130 km for the horizontal décollement. This finding suggests a significant variation in the geometry of the MHT takes place over a very short distance (<50 km) between the Sikkim and western Bhutan.