2004 Fall Meeting
Search Results

Cite abstracts as **Author(s) (2004), Title, *Eos Trans. AGU, 85*(47), Fall Meet. Suppl., Abstract xxxxx-xx**

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HR: 17:30h
AN: **T34B-07 INVITED**
TI: Self-organized balance between rapid erosion and uplift in the eastern Himalayan syntaxis.

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AB: Spectacular knickpoints on all the major rivers crossing the Himalaya are enigmatic because they are expected to be among the most dynamic elements of the landscape and yet appear essentially stationary. According to a simple but robust model of fluvial incision, knickpoints would retreat $\sim$100 km in 1 million years where fluvial incision of bedrock is rapid (up to $\sim$10 mm/a), in the absence of localized tectonic uplift. Knickpoint retreat slows markedly with modest tectonically induced antiformal uplift. With increasing, but still modest tectonic rock uplift (up to 2 mm/a) as well as crustal rebound due to

erosional unloading, knickpoint retreat stops. If antiformal rock uplift locally outpaces fluvial incision, the knickpoint will tend to shift downstream and sediments will accumulate upstream of the uplift. To illustrate that knickpoints are sensitive indicators of the balance between erosion and crustal uplift, we present diverse data from the Yarlung Tsangpo/Brahmaputra where the river plummets $\sim$2000 m over the largest knickpoint in the range. In this region, which includes the Namche Barwa-Gyala Peri massif as well as the Yarlung Tsangpo gorge, exceptionally young zircon fission-track dates (0.2 Ma), biotite ^{40}Ar/^{39}Ar ages (1.0 Ma), [(U-Th)/He] cooling ages (0.3 Ma) for zircons, and U-Pb ages of anatexis from bedrock samples define distinct regions where extremely rapid exhumation has been sustained for at least 3 Ma. Because these independently determined regions of rapid exhumation closely coincide spatially with one another, as well as with the region where calculated current fluvial incision rates reach their peak, the locus of rapid erosion has not migrated significantly relative to the underlying crust. As the rapid exhumation is clearly associated with the knickpoint, sustaining rapid erosion in this region requires the knickpoint to be essentially stationary. Our simple model 1) suggests that rock uplift must be within 1.5% of the incision rate for the knickpoint retreat not to exceed 20 km, consistent with the geochronological data, and 2) shows that localized uplift naturally accounts for the sediment ponding and alluvial reach upstream of the knickpoint that is characteristic of the Yarlung Tsangpo and other major rivers traversing the range. We suggest that major knickpoints on other large rivers in the Himalaya are also essentially stationary, and hence, reflect a near-perfect balance between erosion and rock uplift. This balance is not coincidental; it must arise from direct mechanisms, involving strong feedbacks that bring erosion and rock uplift locally into mutual alignment. This erosion/uplift balance may be of broad interest, because where it occurs, insight into the spatial variation in the rates of tectonic, structural, and metamorphic development could be obtained readily as they should mimic the spatial variation in rates of erosion, which can be estimated for broad areas with relative ease using remotely sensed data. Rapid erosion and uplift tend to be highly localized, hence even in steady state landscapes rates of erosion and uplift tend to vary spatially, and fluvial evacuation of crustal material can be highly localized.

DE: 8102 Continental contractional orogenic belts
DE: 1744 Tectonophysics
DE: 1824 Geomorphology (1625)
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