Geophysical Research Abstracts, Vol. 7, 05743, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05743

Long transient response times of rivers in eastern Tibet to regional plateau uplift: The affect of mega-landslides.

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The eastern margin of the Tibetan plateau is an actively evolving landscape adjusting to regional and localized surface uplift, climate changes, and large-scale river reorganization through river capture. Regional topography is characterized by deep river gorges cutting into an uplifted, low-relief relict landscape. Major rivers in the region typically drain off this gentle, relict landscape preserved at higher elevations on the plateau and run southeast to where they have deeply dissected the topography. Measured concentrations of 10Be in quartz extracted from stream sediments indicate that the high elevation, relict landscape is eroding slowly, between 15 and 22 m/MY, while the low elevation, dissected landscape is eroding much faster, between 140 and 800 m/MY.

Thermo-chronological studies show that rates of rock cooling in the region increased dramatically between 9 and 13 million years ago, suggesting that regional uplift and major river incision began at that time (Clark, 2005). The persistence of slow erosion rates and patches of high elevation, relict landscape despite rapid incision and intense fluvial dissection by trunk streams at lower elevations for at least the last 8–10 million years suggests a slow response of the rivers in eastern Tibet to regional plateau uplift.

Field work along the Yalong and Dadu Rivers, two major tributaries of the Yangtze River that dissect the eastern margin of the Tibetan Plateau, indicates that a high frequency of large, deep-seated landslide events, both modern and ancient, have led to extensive and prolonged river damming of these deep river gorges. These observations

suggest that a strong feedback between hillslope processes, channel morphology, and incision rate is prevalent throughout this landscape. River channels steepen and narrow because landslide debris armors channel bottoms. In addition, profile knickpoints form as the result of steep rapids that persist while rivers incise landslide deposits and upstream aggradation initiated by river damming.

River incision sets the pace of landscape lowering, but in eastern Tibet, landslides appear to significantly inhibit river incision. Preliminary data indicates that landslide deposits can linger within the fluvial system, inhibiting bedrock incision, for $>$40,000 years. By prohibiting bedrock incision, landslides slow the rivers' transient response to plateau uplift, and have thus far prevented the development of distinct, steady profile forms in the major rivers of eastern Tibet even though they have been adjusting for at least 8-10 million years.

References:

Clark, M. K., House, M. A., Royden, L. H., Whipple, K., Burchfiel, B.C., Zhang, X., and Tang, W., Late Cenozoic uplift of southeastern Tibet, Geology, ***In Press***, 2005