Geophysical Research Abstracts, Vol. 7, 04767, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04767

Erosion or channel flow? What controls the development of the Himalayan fold-and-thrust belt

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Despite model predictions and isolated field observations the nature of coupling between focused erosion and tectonics the Himalayan orogen remains controversial. These geological field data and models suggest a mid-crustal channel flow that is responsible for transporting formerly subducted and metamorphic Indian crust toward the southern front of the orogen where it has been partially exhumed since the Miocene. Is the observed focusing of erosion influencing the location, style and magnitude of the deformation or alternatively has the presently observed structural configuration been driven by continuous extrusion of a mid-crustal channel? To shed some light on this important issue in the orogen evolution we conducted structural field observations coupled with thermochoronologic studies in the sector of the orogen, which is located in the surface window of the channel flow region.

We report new ^{40}Ar/^{39}Ar white mica and apatite fission track (AFT) ages which constrain exhumation paths along an approximately 120-km-wide NE-SW transect spanning the greater Sutlej region of the northwest-Himalaya, India. The ^{40}Ar/^{39}Ar data indicates that High Himalayan Crystalline units were exhumed between about $\sim$19-15 Ma. In turn southward propagating Lesser Himalayan Crystalline nappes to the south were rapidly exhumed between 7 and 4 Ma, thus indicating progressive southward migration of thrust sheets and accompanying tectonically controlled exhumation. The AFT data, in contrast, document synchronous exhumation irrespective of these structures. Less than 2-m.-yr.-old cooling ages define an elliptically shaped, NE-SW-oriented $\sim$80 x 40 km region, spanning both crystalline nappes. This locus of pronounced exhumation defined by the AFT data correlates with a region of high relief, intense monsoonal precipitation, discharge, and sediment flux rates during the

Holocene. We infer that these conditions have influenced this part of the Himalayan orogen since the onset of monsoonal precipitation patterns and the establishment of an orographic barrier in Miocene time. If correct, the correlation between high relief, precipitation and exhumation suggests that, while tectonic processes such as the mid-crustal channel flow may have exerted the dominant control on the pattern of denudation before and until the middle Miocene, surface processes have been the most important factor controlling both pattern of denudation and deformation since the Pliocene time.