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CLIMATE- OR TECTONIC-DRIVEN EXHUMATION OF ROCKS IN THE NW.-HIMALAYA?

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Both syntaxes at the western and eastern margins of the Himalayan orogen show a clear correlation between active exhumation of metamorphic rocks and the incision of rivers, namely the Indus and the Tsangpo-Brahmaputra, cutting across the mountain range. This spatial and temporal correlation suggests that fluvial erosion can locally enhance tectonic uplift and exhumation, resulting in enhanced heat advection and weakening of the crust, which further creates a positive feedback mechanism enhancing deformation and exhumation (Zeitler et al., 2001).

The Sutlej river (NW India) also cross-cuts the whole Himalayan range but is spatially not correlated with a syntaxial position. In order to test the positive feedback model proposed for the syntaxial positions, the exhumation history of the rocks in the Sutlej Valley has been studied by petrological, structural and geochronological methods including geomorphological and sedimentological records (Vannay et al. 2004).

The Himalayan crystalline rocks exposed along the Sutlej Valley can be divided in two high-grade metamorphic gneiss wedges (Vannay and Grasemann, 2001), which both have a similar tectonometamorphic history but differ in the composition of source rocks and the age of exhumation:

The High Himalayan Crystalline Sequence (HHCS) is composed of amphibolite facies to migmatitic paragneisses, which are derived from the former Indian passive margin (equivalent to the low grade Tethyan Himalayas) and metamorphosed at temperatures up to 750°C at 30 km depth between Eocene and Early Miocene. During Early Miocene, combined thrusting along the Main Central Thrust (MCT) and extension along the Sangla Detachment induced the rapid exhumation and cooling of the HHCS, whereas exhumation was mainly controlled by erosion since Middle Miocene.

The Lesser Himalayan Crystalline Sequence (LHCS) is composed of amphibolite facies para- and orthogneisses with lithological affinity to the Indian Shield (Miller et al. 2000). The rocks metamorphosed at temperatures up to 700°C during underthrusting down to 30 km depth beneath the MCT. The LHCS cooled very rapidly since Late Miocene, as a consequence of exhumation controlled by thrusting along the Munsiari Thrust and extension along the Karcham normal fault in the MCT hanging wall. This renewed phase of tectonic extrusion at the Himalayan front is still active, as indicated by the present-day regional seismicity, and by hydrothermal circulation linked to elevated near-surface geothermal gradients in the LHCS. Active tectonics is furthermore supported by AMS ^{14}C ages of around 5500-3000 cal. B.C. (Draganits, E., Bookhagen B. pers. comm..) from tectonically deformed lake sediments above the Karcham normal fault.

We therefore conclude that active exhumation of amphibolite facies crustal rocks along the Sutlej Valley is spatially correlated with the high erosional potential of this major trans-Himalayan river, similar to processes reported from the Himalayan syntaxes. This correlation supports the idea of a positive feedback mechanism between crustal-scale deformation initialising the process, and climate controlled fluviatile erosion coupled with tectonothermal response, which furthermore enhances the exhumation process.

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