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Large Spatial and Temporal Variations in Himalayan Denudation

R. Thiede (1) and T. Ehlers (2)

(1) Inst. f. Erd- und Umweltwissenschaften, University of Potsdam, Germany (thiede@geo.uni-potsdam.de), (2) Inst. f. Geowissenschaften, University of Tuebingen, Germany (todd.ehlers@uni-tuebingen.de)

Over the last 30 years numerous studies have been presenting thermochrononemeter data collected across the Indian, Nepalese, and Bhutanese Himalaya. A compilation of these data provide now sufficient sample coverage across the Himalaya to quantify spatial and temporal variations in denudation along several broad segments of the orogen. We use these data to evaluate recent controversies surrounding the tectonic and climate controls of the erosional flux and to evaluate lateral variation in exhumation along strike of the Himalaya. More specifically, recent studies of the Himalaya show that enhanced precipitation correlates with regions of high denudation, leading to the suggestion of a long-term co-evolution of climate and denudation. We integrate 1070 published bedrock mineral cooling ages with a Monte-Carlo inverse-model to quantify the orogen-wide denudation history. Results indicate large variations in denudation that can only partially be explained by modern and paleo precipitation. Across $>$1000 km of the southern Greater Himalaya (Lesser Himalayan Crystalline) denudation rates were highest ($\sim$1.5-3 mm/yr) between $\sim$10-2 Ma and lower (0.5-2.6 mm/yr) over the last 2 My. In constrast to this, across the $\sim$2500 km length of the northern Greater Himalaya (Higher Himalayan Crystalline) denudation rates vary over lengthscales of $\sim$300-1700 km. Slower denudation ($<$1 mm/yr) occurred between 10-4 Ma followed by a large increase (1.2-2.6 mm/yr) in the last $\sim$4 Ma. We find that only the southern Greater Himalayan Sequence supports a co-evolution of climate and denudation whereas for the higher elevation northern Greater Himalaya, we speculate, if denudation history reflects variations in tectonic shortening and/or glacial enhanced erosion.