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Segmentation of the Himalayan megathrust on different spatial and temporal scales: a view from geomorphology and thermochronology

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Lateral variations in the topography, geological structure, exhumation and precipitation patterns of the Himalaya correlate strongly, sparking numerous studies on the processes controlling these links. It has been argued that strong exhumation at the topographic front of the high range is focused by climatic forcing, through orographic precipitation, and that this focused exhumation may have driven recent out-of-sequence thrusting in the mountain belt. However, thermo-kinematic models predict that tectonic factors, in particular the geometry of the Main Himalayan detachment along which India under-thrusts the Himalaya and Tibet, controls these spatial patterns in topography and exhumation. A quantitative comparison of patterns of topography, fluvial incision power and exhumation along transects where the detachment geometry is independently predicted to vary, corroborates this model. These results imply that along-strike climatic variations in the Himalaya respond to tectonics rather than driving it. The presence or absence of a mid-crustal ramp may be due to inherited structures on the under-thrusting Indian Plate or, alternatively, may reflect transient behaviour of the accreting Lesser Himalayan thrust stack, which may oscillate between frontal accretion (without a ramp) and basal accretion in the presence of a ramp. The links between such segmentation of the Himalayan megathrust on geological timescales and the nature and distribution of seismicity along the range have only recently started to appear and provide challenging but promising avenues for future research.