



What controls the growth and shape of the Himalayan foreland fold-and-thrust belt?

Djordje Grujic, John Hirschmiller, and Deirdre Mallyon

Dalhousie University, Department of Earth Sciences, Halifax, Canada (dgrujic@dal.ca, 902 494 6889)

We provide empirical evidence for the impact of surface processes on the structure and geometry of the present-day foreland fold-and-thrust belt (FTB) of the Himalaya. We have reconstructed and analysed ten balanced cross sections distributed along the entire length of the Himalayan arc. Here, we focus on the Siwalik Group, which represents the deformed part of the foreland basin and consists of synorogenic middle Miocene to Pleistocene sediments that form the youngest and frontal part of the Himalayan orogen. Within the active foreland fold-and-thrust belt of the Himalaya, extension, strain rate, and belt morphology vary systematically from west to east. Strain rates correlate well with west-to east increases in convergence rates according to both long-term plate velocity data and GPS data, suggesting that Pliocene to Holocene shortening is externally imposed and related to plate convergence rates. Conversely, the eastward decrease in belt width corresponds to an eastward increase in rainfall rates and specific stream power. Although mass accretion rates have not been well constrained, we argue that they remain relatively constant along the FTB. We suggest that the morphology of the Himalayan FTB is controlled primarily by erosion, in accordance with the critical taper model. Surface material removal is mainly controlled through rainfall and runoff and can be expressed as specific stream power. Thus, we propose that climatically induced erosion is the principal control on Himalayan foreland fold-and-thrust belt morphology. We test this hypothesis through a series of 1D numerical models. Among the parameters controlling the form of a wedge, lithology, erodibility, and rock mechanical properties are relatively homogeneous throughout the belt. Hence, within the range of observed values in the Himalaya, we investigate the sensitivity of the shape of the Himalayan fold-and-thrust belt to the sole-out depth of the basal décollement, flux of tectonically added material, and the erosional constant.