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Channel Profiles Around Himalayan River Anticlines: Constraints on their Formation?

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Recent studies on erosion and uplift along major south draining Himalyan rivers show that the current morphology is rather reflecting the feedback between active tectonics, climate and erosion, than it is inherited from past tectonics (Pliocene reactivation of the MCT). This is based on an about 50 km to 80 km wide orogen parallel zone at the front of the High Himalayan Range that is characterised by very rapid erosion rates, high uplift rates and young cooling ages. Here we present a comparison between measured and numerically modeled channel profiles of rivers in two important drainage basins of Central Nepal: the Kali-Gandaki and the Arun drainage basins. Modeled channel profiles are based on a simple stream power approach using best-fit exponents defining the non-linearities in the relative contributions of local channel gradient and water flux to erosion rate. Our analysis on the stream power of the whole river network shows in some detail the spatial extension of a 50 km to 80 km wide zone, in front of the High Himalayan range that is characterized by a stream power elevated by more than one order of magnitude. Tributaries draining parallel and entirely within that zone show increasing stream power and increasing channel gradients from the spring to the confluence point. From the analysis of the stream power and the channel gradients of the entire network of the Kali Gandaki and the Arun drainage basins we can localise regions of maximum uplift exactly within the channels of large Himalayan rivers and found evidence that the uplift decreases with increasing distance to the main channels. Therefore we assume that a significant amount of uplift within this corridor is driven by river incision and tectonic response. We suggest a model where the uplift of this zone is driven by erosion and tectonic response, so that centres of maximum uplift are located within the main channels of the north - south drain-

ing rivers and that the rate of uplift slows down with increasing distance to the main channels. Such a spatial distribution of the uplift leads ultimately to the formation of river anticlines as observed along all major Himalayan rivers. We propose that the formation of river anticlines along south draining Himalayan rivers is accelerated by a sudden increase of the drainage area and discharge as a consequence of capture of orogen-parallel drainages on the north side of the range following successive headward cutting into the Tibetan Plateau. The model is confirmed by differences between main channels and east - west running tributaries. Time dependent numerical models predict that capture events cause strongly elevated erosion rates in the main channel and that an orogen parallel corridor with elevated uplift is required to maintain the linear steep front of the range over time.