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Delayed response of cosmogenic-derived denudation in the eastern Himalaya

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The Tsangpo/Siang/Brahmaputra River flows from the high and arid Tibetan Plateau through the dissected Himalayan range and further over a flat and humid floodplain to the Bay of Bengal. Intense fluvial incision and erosion along the Brahmaputra in the eastern Himalaya syntaxis has been suggested by some to drive high uplift rates in the region through lithospheric unloading [e.g. 1]. Despite being a potential key region to better understand the couplings between erosion, tectonics and climate, modern denudation in the Brahmaputra watershed is still poorly quantified.

To address these questions, we measured cosmogenic 10Be in river sediments along the entire length of the river, from the Tsangpo in Tibet to the Brahmaputra in Bangladesh including the main tributaries, to retrieve modern erosion rates and sediment fluxes. These measurements suggest low denudation rates on the Tibetan Plateau (< 0.1 mm/a) that increase locally to 2 to 3 mm/a in the region of the eastern syntaxis of the Himalayan range. While sediment samples from the Tibetan plateau show stable 10Be concentrations, samples from the syntaxis all the way downstream to Bangladesh show a higher variability depending on sampling season or grain size.

The river reach through the eastern Himalayan range coincides with a sharp decrease in the mainstream sediment 10Be concentrations that fingerprints the addition of sediments from intensely eroding areas. However, this erosive signal is only recorded by the cosmogenic nuclide signal 100 km or more downstream of the reach where steep river gradients, high uplift rates and landslide frequencies have been observed and measured [1,2]. Similar effects have been observed elsewhere in the Himalayan range [3] and these need to be understood in order to further use detrital cosmogenic nuclides as denudation tracers in tectonically active regions. We explore possible causes of this downstream shift in the denudation signal that may be caused, amongst other, by temporary transience in sediment supply or downstream abrasion processes of the material eroded in the syntaxis.

[1] Finnegan et al., 2008 – GSA Bulletin vol.120 pp. 142-155
[2] Larsen & Montgomery, 2012 – Nat. Geosciences vol.5 pp. 468-473
[3] Olen et al., 2015 – JGR 120 pp. 2080-2102