Clumped isotope compositions of detrital carbonates in the Himalayan River system – 1) The modern Ganga basin

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The Ganges and Brahmaputra Rivers transport sediments from the Himalaya to the Bay of Bengal, where they are further distributed by turbidites to the Bengal Fan – this is the largest active sediment transport system on Earth. We measured carbonate clumped isotope temperatures ($T\Delta_{47}$) of detrital calcite in Ganges River suspended sediments and bedloads from several sites along the mainstem and its tributaries to investigate the carbonate budget (perhaps a proxy for weathering intensity) during river transport. $T\Delta_{47}$ values measured in detrital calcite from river sediments generally decrease with transport distance. In the upper reaches of Himalayan tributaries, $T\Delta_{47}$ ranges between 92-188°C. In contrast, detrital calcite in sediment samples collected from the mainstem of the Ganges, closer to the river-mouth, range between 10-60°C. We interpret this trend to reflect the mixing of two end-member components. The high-temperature endmember is consistent with Tethyan carbonate bedrocks derived from High-Himalaya outcrops. The low-temperature endmember may derive from one or more sources including soil-carbonates, biogenic calcite, and/or authigenic river carbonates.

Almost all samples have $T\Delta_{47}$ values well in excess of surface temperatures, consistent with river sediments being dominated by rock exhumed from 2 to >10 km depth in the Himalayas. Our results confirm that a significant volume of carbonate sediments are transported across thousands of kilometers from the Himalaya towards the Bay of Bengal, as solids, maintaining the clumped isotope signature of their Himalayan source. Carbonate export is controlled by bedrock erosion and runoff in each basin, and chemical weathering may be limited by the short residence time of sediments in the Ganges system.