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Geochemical proxies for weathering and provenance of Late Quaternary alluvial core-sediments from NW India

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The Indo–Gangetic alluvial plains are formed by sediment deposition in the foreland basin as a result of upliftment and subsequent erosion of the Himalaya. Earlier study (Sinha et al., 2013) has shown the subsurface existence of buried channel bodies beneath the Ghaggar plains in NW Indo–Gangetic plains. The mapped sand bodies follow trace of a paleochannel that begins at the mountain front near the exit of river Sutlej and extends to the northern margin of the Thar desert, suggesting existence of a large Himalayan–sourced river (Singh et al., 2011) in the past. The buried sand bodies hold potential records of erosion history over the Himalaya that could be used to assess climate–controlled erosion over the Himalaya. Geochemical variations in the sediments from two (∼45m long) cores drilled below the trace of the paleochannel (upstream) near Sirhind, Punjab and two cores (GS–10 & 11) from downstream near Kalibangan, Rajasthan, are used in this study to understand the erosional pattern over the Himalaya during Late Quaternary. Down–core variations in chemical index of alteration (CIA=51–79) along with K2O/Na2O and $Al2O_3$/(CaO+Na2O) ratios are consistent with the trends of SW summer monsoonal fluctuations during the Glacial–Interglacial periods indicating climate controlled weathering at the source; higher values during Interglacial and lower during Glacial periods with maximum value during the Holocene. Sr–Nd isotopic compositions of drill–cores sediments, 87Sr/86Sr (0.7314–0.7946), εNd (–23.2 to –14) are within the range of silicate rocks from the Higher and Lesser Himalaya. Significant down–core variations in 87Sr/86Sr and εNd are observed that reflect the mixing of varying proportions of the Higher and Lesser Himalayan sediments, the two dominant sources to the core sites. Sediments deposited during MIS–2 and MIS–4, cold and dry Glacial periods, show high 87Sr/86Sr and low εNd suggesting an enhanced contribution from the Lesser Himalayan rocks that are characterized by more radiogenic Sr and less radiogenic Nd. Whereas those deposited during MIS–1 and MIS–3, warm and humid Interglacial periods, are distinctly less radiogenic in Sr and more radiogenic in Nd (Higher Himalayan signature) suggesting increased contribution from the Higher Himalayan rocks. These variations can be attributed to decreased contribution from the Higher Himalaya during Glacial periods due to increased glacial cover over the Higher Himalaya which in turn are caused by lower solar insolation and vice versa. The findings of this study, consistent with those from the Ganga–Yamuna interfluve sediments (Rahaman et al., 2009), indicate a dominant control of climate on sediment provenance and source weathering.

References:
Sinha et al. (2013), Quaternary International, 308–309, 66–75.
Singh et al. (2011), AGU Fall Meeting 5–9 December 2011.
Rahaman et al. (2009), Geology, 37, 559–526.