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Catchment control in making the Indo-Gangetic plains: An isotopic (Sr and Nd) study

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The vast stretch of Indo-Gangetic Plains (IGP) has been studied so far for their sedimentological and geomorphic aspects to understand the architectural setup and depositional processes in the floodplains; little however is known of the role played by catchment area lithologies, dynamics and climate in building the floodplains. Isotopic systematics of floodplain sediments are quite useful in constraining the sources to the sediments just as they were for sediments of the Bengal Fan and Sub-Himalayas, because we do have the isotopic characteristics of various lithotectonic units of the Himalayas and the Indian Shield. Integrating our isotopic data from the Gangetic plains with those of the Indus, Brahmputra and tributaries of Ganges from Nepal, we find that the sediment chemistry gets modified in due course by mixing with tributaries. We note that the sediments of the Ganges system with higher $^{87}Sr/^{86}Sr$ (≈ 0.78) and lower $\varepsilon_{Nd}(0)$ (≈ -14) values do not show much isotopic variability; however, the Ghaggar and Thar desert sediments have isotopically distinct feature with lower $^{87}Sr/^{86}Sr$ (≈ 0.73) and higher $\varepsilon_{Nd}(0)$ (≈ -14) values. We suggest, on the basis of the presence of Subathu Formation ($^{87}Sr/^{86}Sr$≈ 0.712, $\varepsilon_{Nd}(0)$ ≈ -8) in the catchment of Ghaggar and manifestation of its chemistry to the Thar region sediments, that the erosion of the Sub-Himalayan Tertiaries plays an important role in making the floodplains. Interestingly, the Sub-Himalayan regions always get a higher rainfall than those of the Lesser/Higher Himalayas and the floodplains at least since the Quaternary. Ganges floodplains may not reveal such signatures because the Siwaliks of the Sub-Himalayas and High Himalayas are isotopically very similar. The Yamuna floodplain sediments at Kalpi further southeast show the influence of Shield components but to a limited extent only near the confluence of river Chambal. Therefore, the isotopic composition of the floodplains indicates that the proximal sources to these plains appear to be more important than that of the distal Himalayan sources in making the floodplains. It appears that the Quaternary IGP is an extension of Tertiary Sub-Himalayas.

Keywords: Indo-Gangetic Plains; Quaternary sediments; Isotope chemistry; Sr and Nd.