Evidence for a Mid-Holocene Buried Himalayan River beneath the Ghaggar Plains, NW India: A Geochemical Provenance Study

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Existence of a glacier-fed major paleo-river channel (the lost Sarasvati), during the mid-Holocene, has always been theorised along the present day ephemeral Ghaggar–Hakra river of north-western Indian sub-continent [1]. Furthermore, the mysterious collapse of the Bronze Age Harappan civilisation (3300-1300 BCE) has often been correlated with the demise of this paleo-river. In the present study, we sampled sub-surface sand bodies, appear to have been deposited by a paleo channel, present beneath the modern Ghaggar-alluvium along a 120 km trail and studied their trace element and Sr-Nd isotopic characteristics to constrain provenance. These coarse, micaceous, grey, sub-surface channel sand deposits occur at a depth of 7-12 m and are visibly distinguishable from the immediately overlying brown alluvial silty-mud. Their depositional ages were determined by radiocarbon (of molluscs) and OSL dating (of quartz) methods, which suggest that the paleochannle was active more than ~6000 years BP. Geochemical results reveal that the trace element patterns of these sand deposits overlap with the modern fluvial sediments of the rivers of Punjab. Their $^{87}Sr/^{86}Sr$ (0.759 to 0.770) and ε_{Nd} (-16.9 to -18.9) are akin to those of the sediment carried by higher Himalayan born Sutlej River and very different from the Siwalik derived Ghaggar sediments ($^{87}Sr/^{86}Sr$: 0.733 to 0.747 and ε_{Nd}: -14.4 to -15.1). Moreover, the $^{87}Sr/^{86}Sr$ ratios of the in-situ mollusc shells from these sand bodies are 0.7187±0.0003 and resemble that of the water of the Sutlej (0.7166 – 0.7218 [2,3]). We therefore infer that the Sutlej was flowing into the paleo-Ghaggar during the mid-Holocene (≥6 ka), before it was captured by the Ravi.

[1] Valdiya (2013) *Curr. Sci.* **104,** 42-54. [2] Pande *et al.* (1994) *Chem Geol* **116**, 245-259. [3] Karim and Veizer (2000) *Chem Geol* **170**, 153-177.