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Evaluating the use of Petrography, zircon U–Pb ages and Sr–Nd isotopes in tracking provenance: A case study from Tsangpo-Siang-Brahmaputra Basin

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The occurrence of catastrophic events i.e. floods has proven to play a key role in the rapid sediment delivery from the source area to depocenters and in understanding the focused erosion zones in highland areas. Tracking the provenance of these catastrophic flood sediments provides an insight into the linkage between climate-tectonic coupling and earth surface processes. In general, information on sediment sources has been derived through petrographic and mineralogical investigations on distinct grain-sized sediment or on a grain-by-grain basis, zircon U–Pb geochronology. However, information from fractionated sediment investigations has made it impossible to distinguish source areas using different methods. Sr-Nd isotopes on bulk sediment on the other hand, are still uncommon in tracing the sediment provenance. All three methods discuss the provenance based on the geology of the catchment area, cycles of erosion, mineral maturity. The petrographic and mineralogical investigations respond to short-term sedimentary processes, U-Pb zircon chronology responds to long-term sedimentary processes, however, Sr-Nd responds to both the processes. Therefore, it is crucial to critically examine all these methodologies in tracking the origin of sediment. This research gives an integrated mineralogical–geochemical database on sediments carried by the extreme events in the Tsangpo-Siang-Brahmaputra river system. We attempted to compare the above-mentioned fingerprint approaches and determine the optimal strategy by comparing them on the same samples to determine the relative relevance of various sources. The petrographic analysis was done using Gazzi-Dickinsion method and implied that most of the samples were eroded from Higher Himalaya with a minute amount sourced from Tibet Plateau. This was a bit mystifying as the floods were sourced by the bleaching of glacial dammed lakes from the Tibetan Plateau (Panda et al., 2020). In normal conditions, some studies using the zircon U–Pb geochronology have also suggested Higher Himalaya (Namche Barwa massif) as an erosional hotspot in North-Eastern Syntaxis but in case of extreme events, such study are yet to be done. While the Sr-Nd analysis was done and shows the dominancy of sediments derived from the Tibetan Plateau. Thus, the provenance fingerprinting using the two proxies gives dissimilar results. However, the robustness of Sr-Nd systematics allows us to suggest that the megafloods in the Siang River carried a large amount of sediments that were eroded from Tethyan sequences before entering into the George area, adding additional sediment from crystalline material of the higher Himalaya.

Keywords- Paleofloods, Provenance fingerprinting, sediment petrography, U–Pb zircon chronology, Sr-Nd isotopes.