EGU22-11457
https://doi.org/10.5194/egusphere-egu22-11457
EGU General Assembly 2022

Hyperconcentrated floods required to transport coarse bedload over the Gangetic Plains

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The gravel-sand transition is a distinct morphological boundary in continental foreland basins characterised by an abrupt downstream reduction in grainsize and lowering of channel gradients. Tectonic convergence between foreland basins and mountain fronts results in the progressive migration of the gravel-sand transition into the basin. As a result, the stratigraphy of the basin fill records a vertical coarsening with an abrupt transition from sandstones to conglomerates. Analysis of this stratigraphic boundary enables insight into the long-term stability of the gravel-sand transition, and records evidence of extreme flood events that were able to transport gravel far out into the basin. Floodwaters sourced from mountain ranges transport and re-suspend finer sediment commonly resulting in them becoming 'hyperconcentrated', further increasing the ability to mobilise coarse bedload; however, observations of sediment transport during such extreme flood events are limited. Here, we combine sedimentological analyses of Miocene deposits from the front of the Himalaya, with sediment entrainment calculations. We record the sedimentological transition between the Middle Siwalik sandstones and the Upper Siwalik conglomerates exposed across the Mohand anticline in North West India; this stratigraphic transition records the gravel to sand transition in the Miocene Gangetic Plains. Rather than this being an abrupt, single stratigraphic boundary, it shows a series of thick, coarse conglomeratic beds that punctuate the sandstones beneath the boundary. We focus on these beds as examples of major sediment transport events, and demonstrate the transport of cobble and gravel-rich bedload, facilitated by hyperconcentrated flow conditions, tens of kilometres beyond the gravel-sand transition. Such extreme flow conditions require intense monsoon precipitation, and enhanced suspended sediment concentrations, which in the modern system would represent a 1 in 500 to 1000 year flood event.