Using clast geometries to establish paleoriver discharges: Testing records for aggradation and incision from the upper Indus River, Ladakh Himalaya

River Terraces are ubiquitous in mountains that nourish and help sustain past, present and future human societies. These terraces are part of valley wide aggradations where that have been studied extensively in Himalaya to understand the processes driving such periodic river valley aggradation and incision resulting. When climatic forcing is considered, the debate continues on whether wetter climate intervals with increased rainfall and glacial melting promote river aggradation through increased discharge and enhanced sediment load, or instead, it is during drier conditions when aggradation occurs through increased sediment to water ratio. This study, for the first time, constrains the discharge during periods of established river aggradation and incision of the Indus River, Ladakh Himalaya over late Quaternary. Here, geometric data from imbricated gravels (see the figure) of channel fills are used to calculate paleodischarges during net river aggradation at 47–23 ka, and preserved slack water deposits (SWDs) at 14–10 ka are used to constrain paleodischarges that occurred during net river incision. Catchment scale discharge derived from these valley fill sequences ranges from 834±47 to 4457±253 cumecs. Syn-incision discharge estimates yielded discharge values ranges from 19030 to 47954 cumecs are considerably higher than discharges estimated from periods of aggradation. An important observation emerges that the aggradation in the Himalayan rivers occurred in glacial-interglacial transient warm climatic conditions (33–21 ka and 17–14 ka), when the sediment budget in the rivers increased just after the glacial events. Thus, aggradation took place in the Indus River, when sediment to water ratio was higher during MIS-3 and incision initiated when sediment to water ratio reduced during post-glacial climatically wet phase (early Holocene).

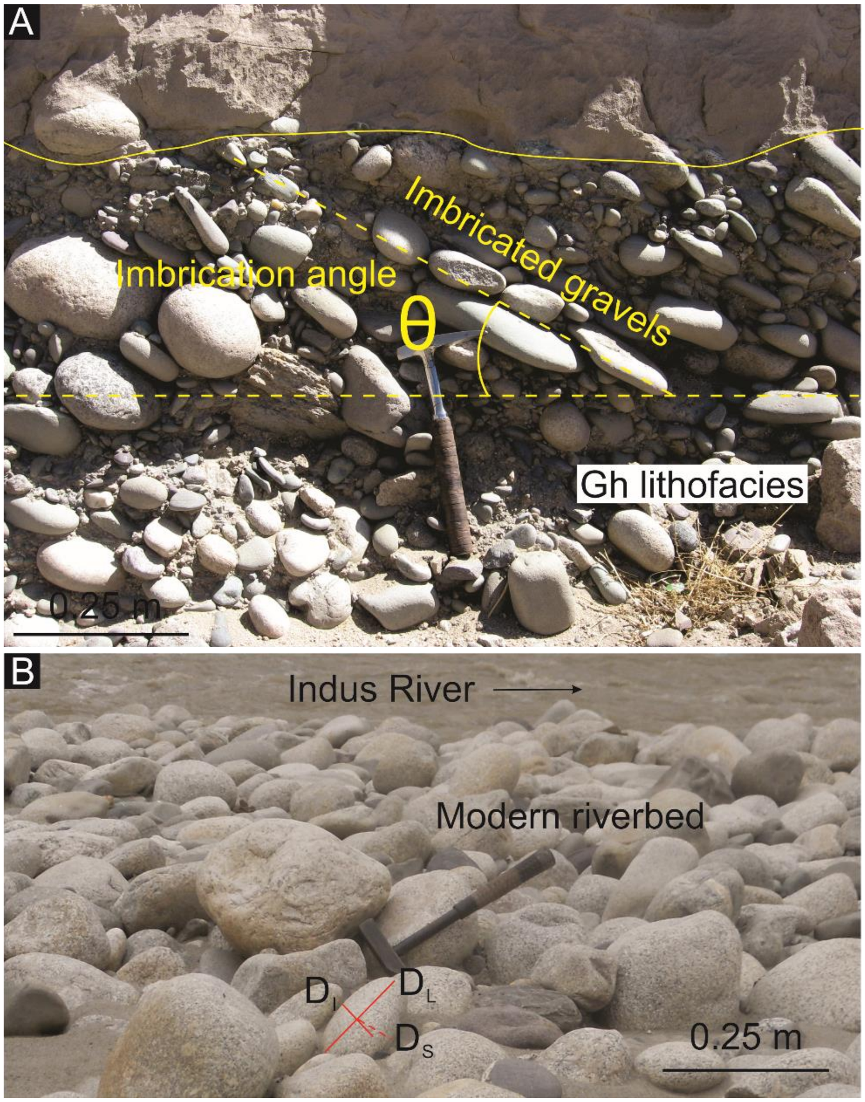

Figure (A) Clast-supported gravels (Gh facies) showing imbrication angle (θ). (B) Photograph showing clast data: longest (D_L), intermediate (D_I) and shortest (D_S) diameters, imbrication angle (Θ) and litho-type.

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