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Alluvial flash-flood stratigraphy of a large dryland river: the Luni River, Thar Desert, Western India

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Detailed descriptions of the fluvial architecture of large dryland rivers are few, which hinders the understanding of stratigraphic development in aggradational settings. The aim of this study was to obtain new generic insight of the fluvial dynamics and resultant stratigraphy of such a river. The novelty of this investigation is that an unusually extensive and deep section across a major active dryland river was logged and the dated stratigraphy related to the behaviour of the discharge regimen. The results should help improve understanding of the stratigraphic development in modern dryland rivers and in characterizing oil, gas and groundwater reservoirs in the dryland geological record more generally. The Luni River is the largest river in the Thar desert, India, but yet details of the channel stratigraphy are sparse. Discharges can reach 14,000 m3s-1 but the bed is dry most of the year. GPS positioning and mm-resolution surveys within a 700m long, 5m deep trench enabled logging and photography of the strata associations, dated using optically-stimulated luminescence (OSL). The deposits consist of planar, sandy, upper-stage plane bed lamination and low-angle stratification, sandwiching less-frequent dune trough cross-sets. Mud clasts are abundant at any elevation. Water-ripple cross-sets or silt-clay layers occur rarely, usually near the top of sections. Aeolian dune cross-sets also appear sparsely at higher elevations. Consequently, the majority of preserved strata are due to supercritical flows. Localized deep scour causes massive collapse and soft-sediment deformation. Scour holes are infilled by rapidly-deposited massive sands adjacent to older bedded-deposits. Within bedform phase diagrams, estimated hydraulic parameters indicate a dominance of the upper-stage plane bed state, but the presence of dune cross-sets is also related to the flood hydrograph. Repeated deep scour results in units of deposition of different OSL ages (50 to 500 years BP) found at similar shallow depths (2-3m). Older dates (1-2 ka) occur in lower strata (4-5 m) at which depths younger scour-fill units also are occasionally preserved.