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Rapid grain size fining in modern and Pliocene Himalayan rivers

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Rapid grain size changes between two main units of a sedimentary megacycle in a foreland basin are commonly interpreted to result from changes in tectonic activity or climate in the adjacent mountain range. In central Nepal, the Cenozoic Siwaliks molasse deposits exposed in the frontal Himalayan folds are characterized by such a radical grain size transition. Locally gravel deposits completely replace sands in the upward sequence within about a hundred meters, the median grain size (D50) displaying a sharp increase by a factor of $\sim$100. Such a rapid gravel-sand transition is also observed in present-day river channels about 8-20 km downstream from the outlet of the frontal Himalaya. The passage from gravel-covered channel reaches (proximal alluvial fans) to sand-covered channel reaches (distal alluvial fans) occurs within a few kilometres on the Gangetic Plain in central Nepal, and the D50 ratio between the two types of channels equals $\sim$100. We propose that the dramatic and remarkably similar decrease in grain size observed in the Siwaliks series and along modern rivers in the Gangetic foreland basin, results from a similar hydrological process, i.e. a grain sorting process during the selective deposition of the sediment load. Such behaviour is quite well reproduce by simple grain-size-dependent sediment transport models if we account for the initial grain size distribution of the eroded sediments. By analogy with modern rivers behaviour, the sudden grain size decrease observed in the Cenozoic Siwaliks molasse deposits is interpreted as the crossing of this sorting transition during progressive southward migration of the depositional facies in response to continuous Himalayan orogen construction. This study demonstrates that an abrupt change in grain size does not necessarily relate to a change in tectonic or climatic forcing, but can simply arise from internal adjustment of the piedmont rivers to the deposition of coarse bedload and grain segregation processes.