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Megafans of the Gangetic plains: a review of decades of research

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A 'megafan' is defined as "a large (10^3 - 10^5 km²), fan-shaped mass of clastic sediment deposited by a *laterally mobile river system* that emanates from the outer point of a large mountainous drainage network." These are characterized by expansion of flow downstream of a drainage outlet through a branching distributary pattern of channels. Leier et al. (2005), based on data from 202 rivers across different continents, set out the following conditions for the formation of fluvial megafans: (a) aggrading river basins with high sediment flux, (b) moderate to extreme seasonal discharge fluctuations producing channel instability and fan-shaped sediment lobes, and (c) adequate spacing between river exits from mountains [1].

The Gangetic Plain is one of the largest alluvial plains in the world with a drainage area of 980,000 km². It is marked by several large axial river systems such as the Ganga and the Yamuna, and transverse drainages, such as the Kosi and Gandak flowing from the north, and the Sone flowing from the south. Most of the transverse drainages in the eastern part of the plains have formed megafans, some cone shaped and others elongate. Of these, the Sone megafan is the only one that is formed by a drainage flowing from the cratonic highlands to the south. Most of these fans have a clear geomorphic expression in terms of topography and landforms. Limited information about their sub-surface stratigraphy is available which suggests that these landforms have existed for at least 50 ka and some of them may be much older. In contrast, no rivers have formed a megafan in the western part of the Gangetic plains.

One of the important fluvial processes operating on these megafans is the dynamics of the river systems as exemplified best by the Kosi River. The topography of the Kosi megafan is convex-upward and the numerous paleochannels on its surface are the remnants of westward movements of the Kosi during the last 200 years. In contrast, the Gandak megafan is an elongate fan with limited channel migration. High sediment delivery and rapid channel bed aggradation have been cited as the main driving forces of channel instability and frequent migration. The Sone megafan covering ~12,000 km² has formed through sediment accumulation from sediments supplied by the cratons; and the distal parts of the fan have been dissected by the axial Ganga River.

Significant differences exist between the fans in terms of their stratigraphic thicknesses which are primarily controlled by variations in the hinterland settings and sediment supply during the Late Quaternary period. Depositional phases characterized by the aggradation of sediment packages are the outcome of multiple aggradational events related to autocyclic channel mobility. Proximal-to-distal trends in sediment facies of some of the fans show a backstepping of the gravel front through time, signifying a decrease in flow energy conditions. This paper will discuss the morphological and sedimentological attributes of the different fan systems across the Gangetic plains.

References:

[1] Leier AL, DeCelles PG and Pelletier JD (2005) *Geology* 33(4): 289-292.

