A RECIPE FOR MEGAFANS

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Abstract

Large fan-shaped sediment distributary systems (10^3 – 10^5 km^2), typically referred to as fluvial megafans, are found proximal to topographic barriers within terrestrial basins. Concepts regarding their formation have been focused on water-dominated processes associated with monsoonal climates, high sediment bedload, and flow rate. But are there other processes behind the erratic avulsive channel behavior of some of the largest fans on the planet? This study presents remotely mapped geomorphic observations from megafans including playa lakes, dunes, vegetation patterns, and basin elevation profiles of fans. Corroborating these concepts are field observations drawn from the Chaco Plain of Argentina. Active tectonics set the stage for multiple monsoon-affected eastward-flowing fluvial systems to interact with the northerly prevailing winds from the South American lower-level jet. The Chaco megafans exhibit low overall slope and limited drainage integration creating playas in both abandoned channels within the active fluvial belt and small depressions on the loess-covered floodplains. Chaco forebulge stratigraphy shows that distal from the main fluvial belt multiple loess-paleosol sequences are present up to four meters below the surface. This suggests that where subsidence outpaces fluvial avulsion rates, fine-grain wind-blown detritus aggrades in packages defined by soil profiles. Loessic paleosols are also located proximal to the orographic front, where the development of uplands relative to modern/recent fluvial incision protects the eolian sediments from erosion. Varying temporal cyclicity in aridity and seasonality of precipitation determines the climatic regime that the megafan sediments experience, resulting in megafans covered in complex fabrics of slope-oriented fluvial/pluvial features superimposed on wind-oriented eolian features and vice versa. The interaction of these depositional environments in the Chaco foreland basin highlights the smoothing effect of eolian transport and deposition, which may allow for high-avulsion rates that enhance megafan development. These geomorphic features can be observed on other globally notable megafan basin systems, highlighting the complexity of sediment transport pathways within a terrestrial realm.

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