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Commentary

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Rapid Deposition of Coarse Sediment: Alluvial Fan

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Description

Alluvial fans are cone shaped accumulations of coarse sediment deposited at the transition from confined flow during a canyon to unconfined flow during a basin. This also corresponds to a break in slope. As the slope shallows and therefore the flows opened up, the flows hamper and deposit much of the sediment that they were ready to transport within the canyon. Fan geometry is decided by the speed of deposition. At the canyon mouth, it's steep (up to 15°) thanks to rapid deposition of coarse sediment. It shallows to about 5° over the most a part of the fan and shallows even more too 1°-2° at the toe. Only suspended sediments are transported beyond the toe, alongside dissolved ions. If the water can pond, the fine grains settle out and the water evaporates forming minerals like gypsum and halite, and creating playa lake deposits.

Alluvial fans usually form where a confined feeder channel exits a mountain front or a glacier margin. As the flow exits the feeder channel onto the fan surface, it's ready to open up into wide, shallow channels or to infiltrate the surface. This reduces the carrying power of the flow and results in deposition of sediments flow in the proximal fan, where the slope is steepest, is usually confined to a single channel which may be up to 30 meters (98 ft) deep. This channel is subject to blockage by accumulated sediments which causes flow to periodically escape of its old channel (nodal avulsion) and shift to a neighborhood of the fan with a steeper gradient, where deposition resumes. As a result, normally only a part of the fan is active at any particular time, and therefore the bypassed areas may undergo soil formation or erosion.

Alluvial fans can be debris-flow-dominated or stream-flow-dominated. Which kind of fan is made is controlled by climate, tectonics, and therefore the bedrock lithology within the area feeding the flow onto the fan.

Debris flows are slurries of mud, rock debris, and only enough water to form the sediment into a viscous flow. Due to the high viscosity, the flow is laminar, sort of a glacier, and sort of a glacier, there's no significant sorting of grain sizes. Debris flows can transport very large blocks and still move until the interior friction of the flow thanks to viscosity exceeds the flow's momentum when it freezes into place. This can occur thanks to either the loss of water or lower slope. The resulting deposits show little sorting and would be classified as a mud supported breccia or a diamictite. Diamictites are defined as very poorly sorted sedimentary rocks with no grain size sorting within them.

Stream flow processes happen on all alluvial fans but are the most process for sediment transport on stream-flow-dominated alluvial fans. Stream-flow-dominated alluvial fans occur where there's perennial, seasonal, or ephemeral stream flow that feeds a system of distributary channels on the fan. In arid or semiarid climates, deposition is dominated by infrequent but intense rainfall that produces flash floods within the feeder channel. This leads to sheetfloods on the alluvial cone, where sediment-laden water leaves its channel confines and spreads across the fan surface. These may include hyper concentrated flows containing 20% to 45% sediments. As the flood recedes, it often leaves a lag of gravel deposits that have the looks of a network of braided streams.

Alluvial fans are often found in desert areas often subjected to periodic flash floods from nearby thunderstorms in local hills. The typical watercourse in an arid climate features a large, funnel-shaped basin at the highest, resulting in a narrow defile, which opens out into an alluvial cone at rock bottom. Multiple braided streams are usually present and active during water flows. Phreatophytes (plants with long tap roots capable of reaching a trouble table) characteristically form fan-toe phreatophyte strips. The phreatophytes may form sinuous lines radiating from the fan toe. These trace buried channels of coarse sediments from the fan that have interfingered with impermeable playa sediments.

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