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Characterizing and interpreting the morphology of fan-shaped depositional landforms along the Madison Range front, SW Montana

Diverse fan-shaped depositional landforms exist at outlets of major drainages along the western Madison Range, southwest Montana. Field documentation and Google Earth image analysis allow for morphological characterization of eight landforms and their drainage basins using slope, area, bedrock geology, and surface topography as criteria. Based on morphology, landforms were interpreted as large sheetflood alluvial fans (Cedar Creek, Indian Creek), large debris-flow alluvial fans (Tolman Creek, Mill Creek), small debris-flow alluvial fans (Shell Creek, S of Deer Creek) and glacially-derived terminal and ground moraines (S Fork of Indian Creek, Wolf Creek). Sheetflood, mass wasting, and glacial processes were identified to explain fan formation. Fan slope and size directly correlate with drainage basin slope and size. Drainages with tilted sedimentary rock layers preferentially form debris-flow fans instead of sheetflood fans. Moraine morphology is tied to glacial processes. Climatic factors (glaciation) caused large scale fan deposition in the Pleistocene, while tectonic factors (down-dropping of the Madison Valley) influenced Holocene fan and moraine entrenchment. Implications include contributing to the understanding of past topographic and tectonic patterns' relation to ancient fan sequences, and demonstrating that cryogenic processes should be considered when interpreting coarse-grain facies deposited in high latitude continental extensional basins during icehouse periods.