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Climatic controls on arid continental basin margin systems

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Alluvial fans are both dominant and long-lived within continental basin margin systems. As a result, they commonly interact with a variety of depositional systems that exist at different times in the distal extent of the basin as the basin evolves. The deposits of the distal basin often cycle between those with the potential to act as good aquifers and those with the potential to act as good aquitards. The interactions between the distal deposits and the basin margin fans can have a significant impact upon basin-scale fluid flow. The fans themselves are commonly considered as relatively homogeneous, but their sedimentology is controlled by a variety of factors, including: 1) differing depositional mechanisms; 2) localised autocyclic controls; 3) geometrical and temporal interactions with deposits of the basin centre; and, 4) long-term allocyclic climatic variations.

This work examines the basin margin systems of the Cutler Group sediments of the Paradox Basin, western U.S.A and presents generalised facies models for the Cutler Group alluvial fans as well as for the zone of interaction between these fans and the contemporaneous environments in the basin centre, at a variety of scales. Small-scale controls on deposition include climate, tectonics, base level and sediment supply. It has been ascertained that long-term climatic alterations were the main control on these depositional systems. Models have been constructed to highlight how both long-term and short-term alterations in the climatic regime can affect the sedimentation in the basin. These models can be applied to better understand similar, but poorly exposed, alluvial fan deposits.

The alluvial fans of the Brockram Facies, northern England form part of a once-proposed site for low-level nuclear waste decommissioning. As such, it is important to understand the sedimentology, three-dimensional geometry, and the proposed connectivity of the deposits from the perspective of basin-scale fluid flow.

The developed models suggest that the deposits of the Brockram alluvial fans have the potential to contain numerous preferential flow zones. Where these flow zones are adjacent to the unique deposits of the zone of interaction it affects basin-scale fluid flow by: 1) interconnecting decent reservoirs in the distal extent of the basin; 2) creating flow pathways away from these reservoirs; 3) introducing secondary baffles into the system; and, 4) creating a bypass to charge these distal reservoirs.