ALLUVIAL FAN ARCHIVES – UNLOCKING DEEPER TIME PERSPECTIVES IN FLUVIAL LANDSCAPES

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Alluvial fans are but one landform element that comprises part of an alluvial fan landform system within fluvial landscapes. Unlocking the information contained within these underused fluvial archives will substantially benefit our understanding of fluvial landscape development. The net-depositional, distributive fluvial landform element of the fan system (the actual fan) is the element most likely to be preserved over Quaternary time-scales and beyond (i.e. deeper time, Fig. 1) and is the dominant landscape portion (>80%) of modern depositional basins observable on the Earth surface [1].

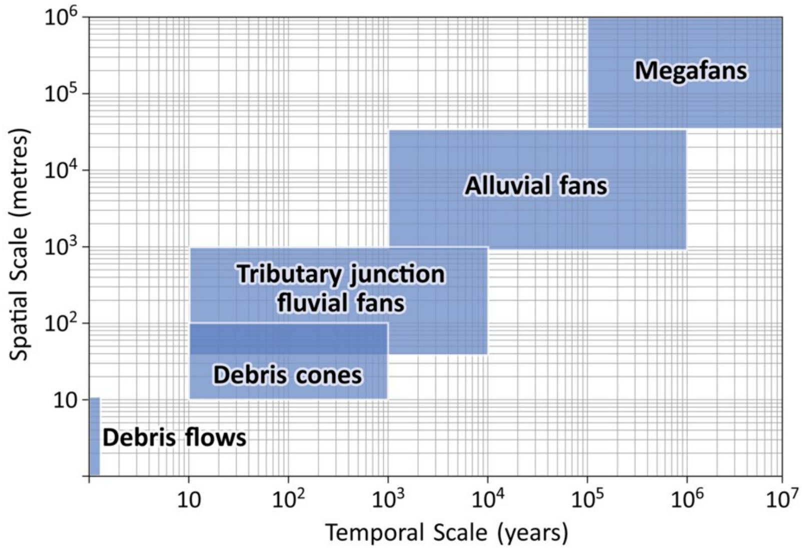

Fig. 1 Distributive fluvial system landform elements – typical spatial and temporal scales covered [2]

In contrast the net-erosional, contributive fluvial landform element of the system (the catchment area that supplies the water and sediment to the fan) dominates the adjacent upland mountain landscape areas, but has minimal preservation potential over these longer time-scales. As a result geomorphological studies focusing on landscape development have mainly concentrated on what we can learn from the morphology of both catchment and fan elements [3], whilst geological studies have focused largely on the sedimentology and stratigraphic architecture of the fan [1,2]. To add complication to these often disparate views on 'fan systems' the fan and the catchment may be additionally linked by a third landscape element – a transportation dominated zone (an incised river system) where alluvial fan systems bridge growing tectonic structures [4] and 'telescope' out, for example along a mountain front where the orogen is actively growing and thus widening (Fig. 2).

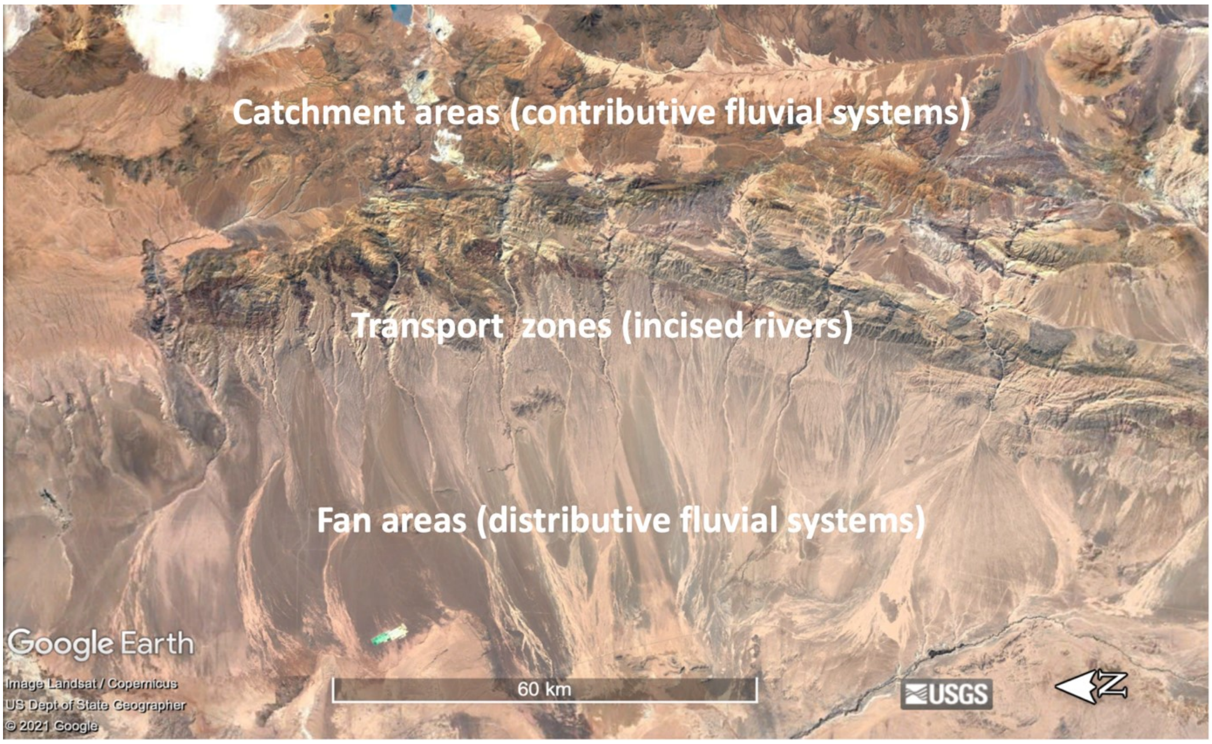

Fig 2. A Satellite view (courtesy of Google Earth, 2021) showing large fan systems comprising contributive elements (catchment areas), transport dominated zones (incising river systems) and distributive elements (fans). These fan systems have their catchments located within the Precordillera of the western central Andes. At this point the Precordillera is growing higher and wider, leading to the westward 'telescoping' of the fans and the development of net 'transport' zones between the catchment areas and the fans which form part of the regional Pacific Palaeo-surface of Peru/Chile - [4].

Alluvial fan systems in their entirety are therefore composed of both contributive and distributive fluvial elements that can be driven by 'top-down' (catchment area) and bottom-up (base-level) drivers (Fig. 3). These can occur over a variety of spatial and temporal scales within fluvial landscape contexts. Alluvial fan systems are consequently potentially invaluable records of longer-term landscape change and yet their full potential has yet to be realized within this context.

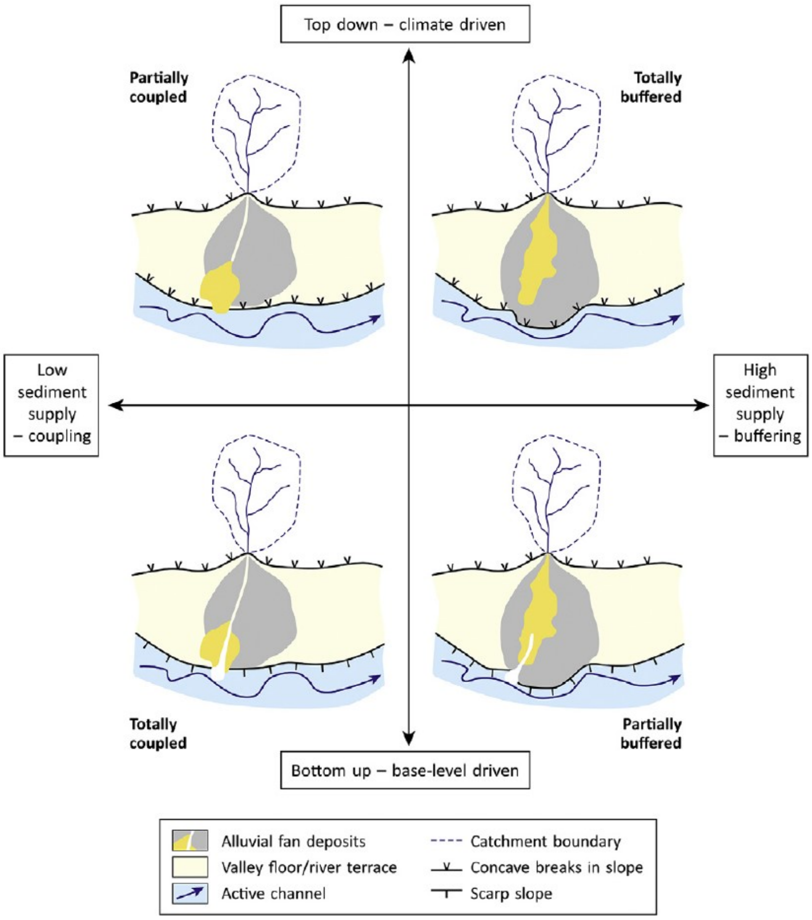

Fig. 3. *A conceptual model of tributary fan system interaction with adjacent fluvial systems and the key drivers of connectivity between the river and fan systems [2]*

This presentation aims to examine how we can develop the potential of alluvial fan archives by utilizing and integrating the lessons from geomorphological and geological based alluvial fan system research approaches. In so doing we will address how this knowledge can be used to further our understanding of fluvial landscape development over deeper time-scales. This will be achieved via a range of predominantly dryland case studies which apply novel approaches to alluvial fan system analysis combining both geological and geomorphological concepts. We will then use these data to address what the fan can tell us (qualitatively and quantitatively) about the fluvial landscape development e.g. river capture, geomaterials, landscape processes, palaeohydrology, vegetation and the likely external driving factors (climate, tectonics, base-level).

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