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Mt. Chambers Creek alluvial fan – a recorder for Late Quaternary flow regime changes along the eastern Flinders Ranges (South Australia)

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Climate is a primary control on Late Quaternary alluvial fan evolution and past hydrological changes should be sensitively recorded in alluvial fan stratigraphy. The Flinders Ranges (S Australia) are situated between tropical and extra-tropical (e.g. westerlies) elements of the atmospheric circulation. Numerous alluvial fans constitute the transition between the Flinders Ranges and the large salt lake system of Lake Frome to the east.

Along the arid eastern margin of the Flinders Ranges, geomorphology and stratigraphy were investigated at Mt. Chambers Creek alluvial fan (31°S). The fan is connected to a ~380 km2 catchment via the Mt. Chambers gorge, which has incised into the uplifted range front. Upstream of the gorge, manifold exposures along valley fills provide evidence for a generally fining-upward sequence of fluvial gravels and (eolian?) silts, which are topped by thick layers of tufa that have subsequently incised. Downstream of the apex, the alluvial fan surface is characterized by relatively low slopes (~0.5° – 1.5°) and a complex pattern of desert pavements, overlain by several inactive feeder channels and/or floodouts. The modern channel drains into an active floodout approximately 13 km downstream of the fan apex, showing that significant quantities of coarse-grained sediment load do not currently reach the baselevel at Lake Frome. Mt. Chambers Creek has incised several meters into the fan body, exposing extensive outcrops of alluvial fan sediments and paleosols. Generally, the fan stratigraphy can be divided into six different units, each of them bounded by laterally continuous and mostly carbonaceous paleosol horizons. The lowermost four units are dominated by matrix- and clast supported gravels, indicating high-energy events such as hyperconcentrated and debris flows. Along the distal fan, the thickness of these units and grain size generally decreases, locally exposing a sequence of well-developed and buried desert pavements. In combination, these observations imply environmental conditions favourable of increased frequency and/or magnitude during the deposition of units 1-4 under wetter climatic conditions. In contrast, unit 5 consists of silts and carbonatic gravel deposits, containing numerous fragments of well-rounded carbonate nodules, likely indicating the onset of upstream erosion leading to reworking of paleosols and tufa deposits. The uppermost unit 6 is composed of mainly fluvial sands and pebbles and seems to be limited to the distal fan, where it corresponds to the currently observed floodout dynamics.

In combination with new radiocarbon and OSL dates (currently in progress), the correlation of downstream alluvial fan stratigraphy and upstream catchment dynamics provides the base for a much more reliable reconstruction of alluvial fan history and flow regime changes over the Late Quaternary. Thereby, our results will provide an important link between existing regional paleoclimatic records from Lake Frome (lake level variations) and the Flinders Ranges (loessic valley fills), eventually helping to decipher the relative roles of the southern westerlies vs. tropical moisture sources over the Late Quaternary.