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Fluvial system autogenesis in the Sneeuberg Mountains, South Africa: implications for reconstructing trajectories of landscape response.

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South-draining small upland catchments (< 5 km2) of the Sneeuberg Mountains, South Africa contain dendritic gully networks incised into deep deposits (up to 6 m) of colluvium and alluvium. Alluvial fans and flood-outs are common on upper slopes, while lower valley segments are occupied by wedges of alluvium and colluvium of varying depth and, in some instances, truncated laterally impinging fans where local hillslope-channel coupling is high. Several key sediment outcrops show a complex of cut and fill sequences, with subtle variations in soil overprinting pointing to a succession of phases of geomorphic instability and stability. Similar sequences also occur in main valleys and upstream of a nearby canyon. Gully cross sectional morphology changes significantly according to local valley morphology with loss of confinement upstream of headcuts through Permo-Triassic Beaufort Group sandstone/mudstones and intrusive dolerite dykes of the Drakensberg Group. These outcrops have acted as barriers to local sediment connectivity in the past, but many are now partially or completely incised.
Local geomorphic 'niches' relating to these changes in valley and channel morphology mean that autogenic processes predominate and thus significant leads and lags in the response of the landscape to climatic perturbations are highly probable. The palaeoenvironmental significance of these non-continuous clastic sedimentary archives can be evaluated, at least in part, via detailed analysis of modern analogues to interpret the depositional and pedogenic environments recorded in terrace fills, in tandem with the development of a new conceptual model detailing the likely trajectories of landscape response. Here we present results from two fieldwork campaigns in which detailed DGPS surveys of river long profiles, terrace height and delimitation of principal morphostratigraphic units in relation to barriers of different configuration and longevity were obtained. The resulting morphostratigraphic framework is then tested using mineral magnetic and geochemical (X-ray fluorescence) proxies as well as some limited dating results from OSL and radiocarbon techniques conducted on samples collected from principal sedimentary and pedological units within valley fills.
The stratigraphic evidence indicates a set of time-transgressive sedimentary units and palaeosols, the characteristics of which are determined by local base level, topography and groundwater. Phases of stability are represented by organic rich histosols and aridosols, where groundwater driven calcite has accumulated in topographically favourable locations. At least two phases of instability (cut and fill) are suggested across the study region with terraces that reflect a combination of autogenetically controlled backfilling and down-filling processes driven by fan morphodynamics and channel connectivity in relation to disruptive rock barriers. The research demonstrates that alluvial/colluvial depositories in these valleys contain limited, if any, extractable palaeoclimatic information, but are significant with respect to the determination and analysis of locally driven thresholds controlling phases of both local and regional geomorphic activity and their significance within the context of long term valley evolution.