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Model for bedrock-core bar evolution in dryland rivers

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Bedrock-alluvial channels in dryland rivers are thought to evolve through a cycle of alluvial building events during low flow periods, punctuated by stripping events in response to rare high magnitude flows. There has been little testing of this model however, due to the limited acquisition of pre- and post- morphological survey data following extreme events. We were interested in identifying 1) the mechanisms behind bedform development in transitional bedrock-alluvial systems, 2) how bedrock-core bars were initiated, and 3) the role of topographic lows in the development of bedrock core bars. We focus on the Sabie river, Kruger National Park, South Africa, and interrogate channel evolution using a 30 year historic aerial photograph record, conduct aerial LiDAR-derived sediment depth analysis over bedrock-core bar units stripped during an extreme event in 2012, ran morphodynamic simulations of sediment deposition patterns and hydraulics over an exposed bedrock anastomosed pavement, and interrogated sediment logs to investigate sediment structure; sampled 2003 and 2012. Examination of the sedimentary units associated with the bedrock anastomosed reaches revealed a repeating sequence of coarse sand/fine gravel grading through to silt representing successive flood related depositional units. Sediment depths were found to be greater over bedrock lows suggesting these are key loci for bedrock-core bar initiation. However, 2-D modelling indicates mid-range, rather than low, velocities during peak flows for these areas. It is likely that topographic lows are preferential routing areas for fine sediment, and material stalls in these areas on the falling limb of the hydrograph. Subsequent vegetation establishment and succession on sediment deposits in the topographic lows plays a key role in the development of bedrock-core bars, through increasing strength of alluvial units and capturing new sediments. With these results in mind we present a conceptual model for the development of bedrock-core bars and discuss it's significance for reach-scale evolution of bedrock-alluvial anastomosed channels in dryland rivers.