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Cenozoic Landscape evolution of the South-African Plateau around the Orange Valley: tectonic and climate coupling

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The plateaus form the key geomorphic element of the African relief with the occurrence of the South African (or Kalahari) Plateau, extending from South Africa to southern Congo (Fig. 1). The origin and evolution of this large relief with a mean elevation ranging 1 to 2 kilometres were largely debated. This work discussed the landscape growth of the South African plateau on both sides of the Orange valley in term of planation process, incision, deformation and climate change.

This work is mainly based on a geomorphic analysis done from DEM and field data. First, we proposed a new typology of planation surfaces based on their genetic process (weathering versus erosion), and not depending the elevation, as previously. Five types of planation surfaces were retained: etchplain, peneplain, pediplain, top-weathering surface and wav-cut platform.

Using this approach to determine the evolution of Orange valley, we recognised three planation surfaces of which origin is not controlled by the lithology: a top weathering surface recorded the end of Eocene weathering period, a first etchplain-to-pediplain formed during the Oligocene and finally a pediplain initiated after a deformation event during the Miocene. This event reorganised completely the drainage network and the catchment of the Orange River that became similar to the current one. It corresponds to a regional tilting of the southern part of the plateau with a elevation of 200 m at least. Afterwards, global eustatic variations driven the landscape evolution because the Orange River gained the current stream connected to the sea level. Thus the landscape growth of the South African plateau results in a change in planation processes driven by a first climate change occurring during a slow uplift, then a regional tilting and at least by eustasy. Thus, an accurate and detail geomorphic analysis allows discriminating the tectonic to climatic processes causing the current landscape.