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The late Mesozoic and Cenozoic development of southern Africa: geological and geomorphological evidence for widespread denudation and epeirogenic uplift

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Southern Africa represents one of the world's classic passive continental margins. Despite numerous endeavours, elucidating the age and origin of some its most conspicuous topographic features (e.g. the highly-elevated continental interior, the marginal bulge, and the erosional escarpment) remains among the most intractable and controversial problems within geomorphological research. Recent advances in apatite fission track analysis have better constrained the timing and magnitude of those denudational episodes to have affected the region following continental separation during the Mesozoic. Moreover, similar developments in terrestrial cosmogenic isotope analysis have afforded insight into denudation rates over the past several hundred thousand years. Whilst these studies have provided invaluable information with regard to the denudational history of the region, establishing the timing and magnitude of epeirogenic uplift is far more conjectural as the stratigraphic record is necessarily removed by denudation. This paper proposes a new morphostratigraphic model for southern Africa, based on the integration of offshore sedimentary sequences, records of post-emplacement alkaline volcanic pipe erosion, and detailed topographic analyses. The latter of these includes a reappraisal of some of the data previously cited in support of substantial late Cenozoic uplift within southeastern Africa, including a more systematic analysis of longitudinal stream profiles derived from rivers in KwaZulu-Natal and the Eastern Cape. It is shown that southern Africa must have been graded to sea-level prior to the late Cretaceous. Thereafter, widespread uplift occurred most probably during the Oligocene. This uplift initiated denudational unloading of the continental periphery as steep valley heads coalesced to form an increasingly prominent escarpment. Broadly coeval isostatic adjustment led to the reestablishment of a ubiquitous marginal bulge, which was likely to have previously existed at the time of continental separation. Furthermore, it is suggested that the atypically narrow continental shelf and adjacent highly elevated landmass of southeastern Africa may result from the presence of "broken" crust associated with the Agulhas Falkland Fracture Zone. The interpretation of the morphostratigraphy of southern Africa offered here represents a radical departure from many existing ideas.