Cosmogenic evidence for profound landscape disequilibrium and pre-Pleistocene landscapes in South Africa

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Southernmost Africa is characterized extensive, gently-sloping uplands dissected by drainage systems flowing through deeply incised valleys. These uplands have been interpreted as ancient land surfaces and used in establishing denudation chronologies even though there are few geochronologic constraints on their age or the rate at which they are modified by surface processes.
Measurements of *in situ*-produced, cosmogenic ^{10}Be and ^{26}Al place quantitative, geochronologic constraints on the minimum surface exposure age and maximum erosion rate of land surfaces in south-central South Africa. Upland surfaces are little changed since the Pliocene; cobbles and outcrop samples collected from 5 silcrete-mantled surfaces have minimum limiting surface exposure ages of 0.2 to 2.7 My (median = 0.93 My) and maximum limiting erosion rates of 0.11 to 3.2 m/My (median = 0.54 m/My). Considering ^{26}Al analyses suggests that most samples have experienced only short periods of burial since initial exposure; two-isotope exposure/burial solutions extend minimum total histories of samples back to between 1.0 and 3.7 My and suggest that some of these surfaces have been stable near Earth's surface since at least the Pliocene.
The ^{10}Be content of 8 sand samples collected from rivers draining to the Southern Ocean indicates that the landscape as a whole is eroding much more quickly (about 5.4 m/My, area-weighted average) than the upland surfaces; thus, relief is increasing over time. Basin-scale erosion rates increase from west to east across southern Africa, suggesting the influence of the East African Rift and/or the African super swell on rates of surface processes.
Together, these data indicate a landscape of profound disequilibrium where ancient, gently-sloping land surfaces, their form inherited from millions of years ago, stand above incised channel networks which are eroding the overall landscape 10 to 25 times more quickly than erosion proceeds on the uplands.

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Robust lithologies preserve ancient alpine-like topography in southern Africa

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The Cape Mountains of southern Africa present an exception to the much-cited coupling of topography and tectonics. This relict postorogenic terrain is comparable to present-day active orogens in terms of hillslope and relief, yet returns some of the lowest ^{10}Be-based denudation rates in the world. Consequently, the Cape Mountains provide an outstanding demonstration that rugged topography alone is not sufficient to incite high denudation rates, and active tectonics need not be responsible for the maintenance of alpine-like topography. We attribute the suppression of denudation rates and maintenance of rugged topography within these mountains to the physically robust and chemically inert quartzites and metasediments that comprise the backbone of these mountains. The Cape Mountains thus provide a striking example of the strong role that lithology may play in long-term landscape evolution.