## Part IX

# A Survey of Planation Surfaces on Other Continents

This part will continue the survey of planation surfaces but on other continents. I have only visited eastern Australia to observe the planation surface on the Tableland above the erosional escarpment (see Appendix 5) and southern England. Therefore, this part will have few photographs. Readers from these other continents are encouraged to examine planation surfaces for yourself. Planation surfaces can be seen at many locations, but remember that what is observed is just a remnant of a once larger area of planation.

## Chapter 42

# The African Surface

There is no doubt that planation surfaces are common to Africa, which has had a long history of analysis. There has always been debate over the number of planation surfaces and their uniformitarian "age." This same debate continues over other continents as well. The ideas of South African geomorphologist, Lester King, held sway for many years, although he changed his mind more than once on the number of planation surfaces. Recent thinking suggests there is only one large, warped planation surface on Africa. This is not likely to end the debate.[1]

### Lester King's Analysis of Multiple Planation Surfaces

Lester King analyzed erosion and planation surfaces from all over the world.[2] He published his results in several books and many journal articles. Since King was from the University of Natal in southeast Africa, he focused primarily on the remarkable planation surface or surfaces of Africa. He recognized that about 60% of Africa's ground surface consists of planation surfaces of different altitudes! In fact, Africa has more erosion and planation surfaces than any other continent. Just south of the Sahara Desert is a planation surface believed to stretch 5,000 km east-west and 500 km north-south.[3] Partridge called this continent-wide erosion surface the "African Surface."[4] Some of the African planation surfaces are perfectly flat, almost as level as the sea.[5] Many of us have seen pictures of numerous animals walking freely over the Serengeti Plain of east Africa (Figure 42.1). How many have noticed the extreme flatness of the terrain? Interestingly, the rocks beneath the Serengeti are deformed igneous and metamorphic rocks. The elevation is about 0.9 miles (1.5 km) above msl in Tanzania. Yet, on the Serengeti or African surface, the rocks have eroded into a flat planation surface. Intuitively, it would take a very strong current of water to accomplish such a feat. Time could not accomplish this, since time will cause a flat surface to become eroded and dissected.

During his career, King had different ideas on the number and age of erosion and planation surfaces as did many other geologists during and after his time. As a result, there is a complicated, diverse, and abundant literature on Africa's planation surfaces.[4,6,7,8,9,10,11,12,13]

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[1] Oard, M.J., 2011. The remarkable African planation surface. *Journal of Creation* 25(1):111–122.
[2] King, L.C., *The Morphology of the Earth—A Study and Synthesis of World Scenery*, Hafner Publishing Company, New York, NY, 1967.
[3] Chorley, R.J., S.A. Schumm, and D.E. Sugden, 1984. *Geomorphology,* Methuen, London, UK, p. 491.
[4] Partridge, T.C., 1998. Of diamonds, dinosaurs and diastrophism: 150 million years of landscape evolution in Southern Africa, *African Journal of Geology* 101(13):167–184.
[5] King,L.c., 1956. A geomorphological comparison between Eastern Brazil and Africa (Central and Southern). *The Quarterly Journal of the Geological Society of London* 112:460.
[6] Coltorti, M., F. Dramis, F. and C.D. Ollier, 2007. Planation surfaces in northern Ethiopia, *Geomorphology* 89:287–296.
[7] De Swardt, A.M.J., 1964. Lateritisation and landscape development in parts of equatorial Africa, *Zeitschrift für Geomorpholgie* 8:313–333.
[8] De Swardt, A.M.J. and G. Bennet, 1974. Structure and physiographic development of Natal since the late Jurassic, *Transactions of the Geological Society of South Africa* 77:309–322.
[9] Dixey, F., 1946. Erosion and tectonics in the East African rift system, *The Quarterly Journal of the Geological Society of London* 102:339–387.

Ollier and Marker[14] reanalyzed King's African Surface at its most important site in South Africa, and instead of seeing five or six planation surfaces, they concluded there were only two, a high upper "paleoplain" at about 0.9 miles (1.5 km) msl and a coastal erosion surface, separated by the Great Escarpment that rings southern Africa about 160 miles (100 km) inland from the coast (see Chapter 12).

*Figure 42.1. The flat planation surface of the Serengeti Plain in East Africa, which truncates deformed igneous and metamorphic rocks in the subsurface (Wikipedia).*

King generally settled on three planation surfaces in Africa, as well as on other continents of the world. C.R. Twidale, a well-known geomorphologist from Australia, accepted King's general scheme.[15,16,17] The planation surfaces often found at high elevations[18] and are remarkably flat. In referring to one of his three levels, King exclaimed: "A planation of extraordinary smoothness developed over enormous areas in all the continents."[19]

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[10] Doornkamp, J.C., 1968. The nature, correlation, and ages of the erosion surfaces of southern Uganda, *Geografiska Annaler* 50A:151–162.
[11] King, L.C., 1982. *The Natal Monocline*, second revised edition, University of Natal Press, Pietermaritzburg, South Africa.
[12] Partridge, T.C. and R.R. Maud, 1987. Geomorphic evolution of southern Africa since the Mesozoic, *South African Journal of Geology* 90(2):179–208.
[13] Trendall, A.F., 1962. The formation of 'apparent peneplains' by a process of combined lateritisation and surface wash, *Zeitschrift für Geomorpholgie* 6:183–197.
[14] Ollier, C.D. and M.E. Marker, M.E., 1985. The Great Escarpment of Southern Africa, *Zeitschrift für Geomorphologie N. F. Suppl.-Bd.* 54:37–56.
[15] Twidale, C.R., 1992. King of the plains: Lester King's contribution to geomorphology, *Geomorphology* 5:491–509.
[16] Twidale, C.R., 1998. Antiquity of landforms: an 'extremely unlikely' concept vindicated, *Australian Journal of Earth Sciences* 45:657–668.
[17] Twidale, C.R., 2003. Canons revisited and reviewed: Lester King's views of landscape evolution considered 50 years later, *GSA Bulletin* 115:1,155–1,172.
[18] Twidale, Ref. 16, p. 660.
[19] King, Ref. 2, p. 188.

**New Analysis Says Only One!**

In 2008, two geomorophologists presented the idea of only one planation surface on Africa, which they called the African Surface.[20] Because of the controversy over the number and age of the planation surfaces, some scientists have dismissed the entire concept of planation surfaces on the continents,[21] but there is no doubt that the African Surface, however it is defined, exists:

> By 1985, although nobody denied the reality of the African Surface, controversy thus persisted over its extent, distribution, age, and characteristics even in the historic type area of African geomorphology that was South Africa.[22]

Elsewhere Burke and Gunnell state: "In summary, the evolution of terminology over the past 50 years reveals … an unwavering acceptance of the African Surface as a geomorphic reality."[23] Burke and Gunnell decided to stick with a winner and refer to their one planation surface as the African Surface.

Burke and Gunnell attempted to relate the African surface to plate tectonics and other major uniformitarian geological events, such as east African rifting and the mid and late Cenozoic deformation of the crust. This deformation consists of bulging upward swells and subsidence of strata into basins. The African Surface covers *most* of Africa. Previous investigators, including King, had correlated planation surfaces mainly by altitude. So, applying plate tectonics, Burke and Gunnell claim Africa split from the Pangea supercontinent about 180 million years ago, and since then the continent has essentially been "stable," until 30 million years ago. They assume planation surfaces formed in a stable environment, although this has never been demonstrated. Accordingly, the erosion that formed the flat African Erosion Surface planed down mountains, rift flank uplifts, and volcanoes during a stable period.[21] During this approximately 150 million years of stability, there were occasional, regional marine inundations, "terrestrial" sedimentation, and volcanism in spots, complicating matters. All of these events, as well as the age of the African Surface itself, are imprecise within the uniformitarian dating system, although the planation of the surface supposedly culminated about 30 million years ago in the mid Tertiary.

Then, 30 million years ago, the African Surface flexed up or down and the east African rift opened up. Africa is mostly composed of a series of large domes with depressions in between. So, the nearly continent wide African Surface flexing up or down is their explanation for why the surface currently lies at different altitudes.

The upward flexing of large domes caused erosion on the oceanward-side creating the spectacular Great Escarpment that rings southern Africa (see Chapter 12).[24] The Great Escarpment along southeast Africa, also called the Drakensberg, up to about 10,000 feet (3,000 m) high. The timing of the uplift that supposedly began 30 million years ago makes these great escarpments young. Burke and Gunnell will probably get an argument over their idea, since

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[20] Burke, K. and Y. Gunnell, Y., 2008. *The African Erosion Surface: A Continental-Scale Synthesis of Geomorphology, Tectonics, and Environmental Change over the Past 180 Million Years*. Geological Society of America Memoir 201, Boulder, CO.

[21] Burke and Gunnell, Ref. 20, p. 6.

[22] Burke and Gunnell, Ref. 20, p. 15.

[23] Burke and Gunnell, Ref. 20, p. 19.

[24] Oard, M.J., 2008. *Flood by Design: Retreating Water Shapes the Earth's Surface*, Master Books, Green Forest, AR, pp. 53–54.

many assume it would take much longer than 30 million years to erode. Other researchers think the flexing is much older.[25]

Burke and Gunnell expect challenges to their synthesis, although they seem to be fairly close to the deductions of other geomorphologists:

> Although the term "African Surface" has been used in many ways in southern Africa, increasing similarities in the use of the term, if not as yet a consensus, are emerging from the work of recent years.[23]

*Figure 42.2. The Drakensburg escarpment in southeast Africa (Wikipedia).*

## Planation Surfaces Capped by Duricrusts

One enigmatic feature of the African Erosion Surface is that it is usually capped by a duricrust, which is defined as a hard crust generally found in a semiarid climate.[26] There are generally four types of duricrusts: (1) ferricrete, an iron oxide crust; (2) silcrete, a silicon dioxide crust; (3) calcrete, a calcium oxide crusts; and (4) bauxite, an aluminum oxide crust. The term laterite is often used for a crust that has oxides of iron or aluminum or both.[27] Duricrusts are considered chemical sediments. Many geologists think they developed within ancient soils.[7]

The duricrusts that commonly cover the African Surface are mostly composed of bauxite and laterite.[20,28] A fair percentage of them are silcrete.[4] A duricrust can be fairly thick. The laterite cap on the African Surface in Uganda is up to 100 feet (30 m) thick.[7] The hardness of the cap has

[25] Moore, A.E., 1999. A reappraisal of epeirogenic flexure axes in southern Africa, *South African Journal of Geology* 102(4):363–376.
[26] Neuendorf, K.K.E., J.P. Mehl, Jr., and J.A. Jackson, 2005. *Glossary of Geology*, Fifth Edition. American Geological Institute, Alexandria, VA, p. 197.
[27] Neuendorf *et al*., Ref. 26, p. 363.
[28] Chardon, D., V. Chevillotte, A. Beauvais, G. Grandin, and B. Boulangé, 2006. Planation, bauxites and epeirogeny: one or two palaeosurfaces on the West African margin? *Geomorphology* 82:273–282.

been somewhat responsible for the preservation of African Surface remnants during subsequent erosion. The origin of duricrusts will be examined in Chapter 57.