Chapter 43

Australian Planation Surfaces

Planation surfaces are more common and much easier to recognize in Africa and Australia than on the other continents.[1] Australia represents one huge planation surface that has been modified by uplift, further erosion, dissection, and local volcanism. Lester King summarizes:

> The primary datum of Australian geomorphology is the early-Cainozoic [Cenozoic], "Great Australian" planation…, that reduced the continent almost everywhere to an extremity of low relief.[2]

Twidale and Campbell exclaim: "… Australia is, as Dorothea Mackellar said, 'a land of sweeping plains'. Plains of remarkable flatness occupy huge areas of the interior."[3]

I will briefly summarize some of the main planation surfaces in Australia. They are similar to those of Africa (see Chapter 42), in that they are often capped with a resistant duricrust.[4]

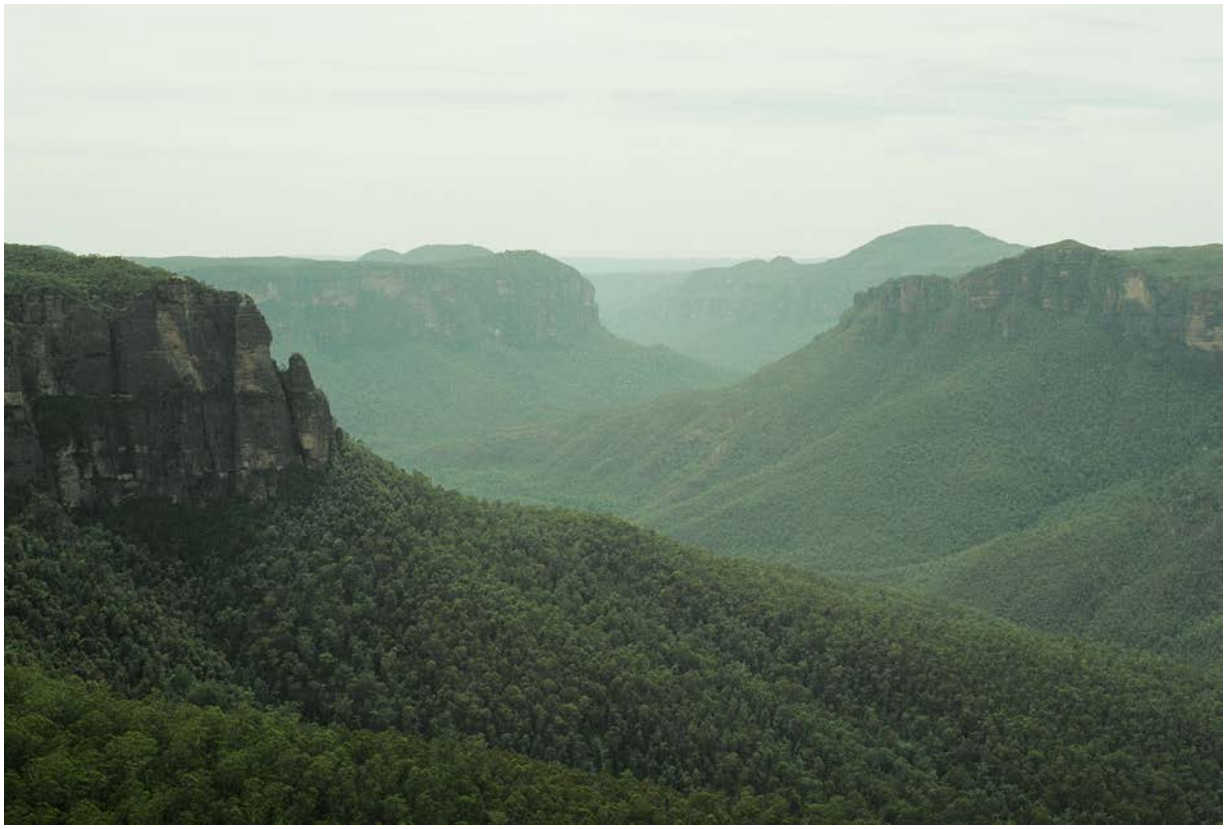

Figure 43.1. The dissected planation surface of the Tableland of eastern Australia.

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[1] Ollier, C., 1981. *Tectonics and Landforms*, Longman, New York, NY, p. 306.
[2] King, L.C., *The Morphology of the Earth—A Study and Synthesis of World Scenery*, Hafner Publishing Company, New York, NY, 1967, p. 341.
[3] Twidale, C.R. and E.M. Campbell, 2005. *Australian Landforms: Understanding a Low, Flat, Arid and Old Landscape*, Rosenberg Publishing Pty Ltd, New South Wales, Australia, pp. 9, 12.
[4] Young, R.W. and I. McDougall, 1982. Basalts and silcretes on the coast near Ulladulla, southern New South Wales. *Journal of the Geological Society of Australia* 29:425–430.

Eastern Australia

The Great Escarpment has eroded inland from the coast of eastern Australia (see Appendix 5). Eastern Australia's highest elevation is just west of the Great Escarpment. It is a rolling planation surface (technically an erosion surface) that runs north-south for about 1,500 miles (2,400 km) (Figure 43.1) that is often referred to as the Tableland. It sometimes is carved on horizontal sedimentary rocks (Figure 43.2), but more often it bevels dipping sedimentary rocks. Figure 43.3 shows the planation surface has truncated vertically dipping strata on the New England Tableland at Wollomombi Falls. The vertical strata represent one limb of an uplift of sedimentary rock that formed a fold or anticline, which was subsequently sheared off (Figure 43.4). Like other planation surfaces across the earth, erosional remnants of the once overlying strata were left on the surface (Figure 43.5). They are generally called inselbergs or monadnocks, which will be discussed in Part XI.

Figure 43.2. The Three Sisters along the Great Escarpment west of Sidney, Australia. Note that the layers are horizontal.

Because of the dates given for basalt lava flows, the Tableland is considered to have experienced very little erosion for around 50 million years:

> Eocene – mid-Oligocene basaltic lavas preserved on the highland surfaces and along the present valleys have made it possible to state that the present landscape above the coastal

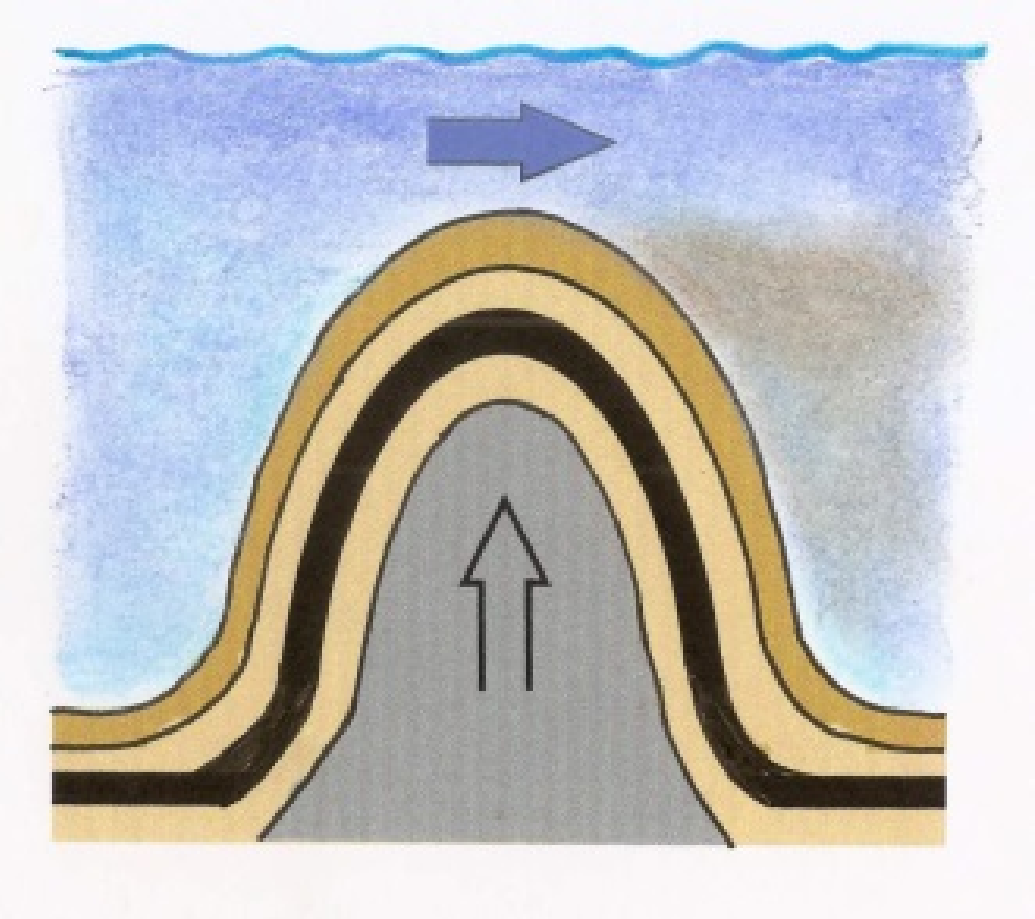
escarpment has not changed to any considerable degree since the Early Cenozoic [about 50 million years ago]…[5]

The origin of the geomorphology of the eastern highlands is not well understood by uniformitarian geologists,[6] but is consistent with the Retreating Stage of the Flood (see Part XII).

Figure 43.3. Near-vertical sedimentary rocks have been beveled to form an erosion surface on the New England Tableland, Australia. Later more channelized erosion carved the gorge, now home to the Wollomombi Falls.

[5] Lidmar-Bergström, K., C.D. Ollier, and J.R. Sulebak, 2000. Landforms and uplift history of southern Norway. *Global and Planetary Change* 24:227.

[6] Ollier C. and C. Pain, 2000. *The Origin of Mountains*, Routledge, London, U.K., pp. 199–202



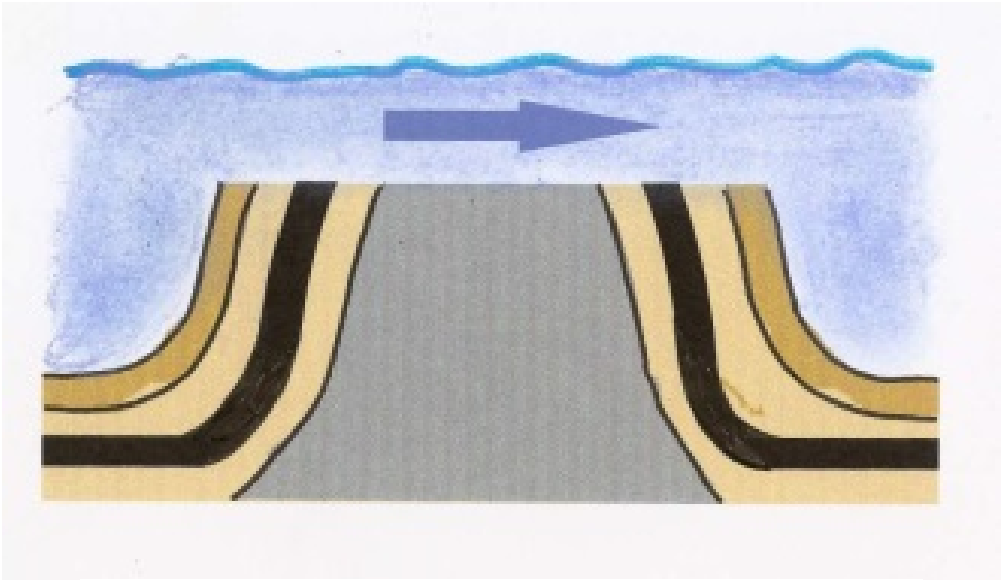


Figure 43.4. Schematic of how planation surfaces are carved on vertical strata. In a), a dome or anticline is uplifted, while in b) the top is sheared off by the Floodwater (drawn by Mrs. Melanie Richard)

Figure 43.5. An erosional remnant on top of Tableland, eastern Australia.

The Nullarbor Plain

One of the most perplexing planation surfaces in Australia is the Nullarbor Plain, a limestone plain in south-central Australia (Figure 43.6). It covers 78, 000 mi^2 (200,000 km^2) and is one of the flattest bedrock plains on earth.[7] The plain is so flat that the Transcontinental Railway stretches almost 310 miles (500 km) *without deviation*.[8] Earlier workers considered the plain an uplifted seafloor since the limestone is of marine origin, but upon closer examination it is now considered a terrestrial planation surface caused by erosion.[9,10] The origin of the Nullarbor Plain, therefore, is a great mystery for uniformitarian geomorphology:

> The flatness of the Nullarbor Plain … has long puzzled investigators … It is not a structural feature, 'a single exposed bedding plane', but what degradational process could produce such a feature? The surface, some 200,000 km^2 in extent, is eroded in flat-lying Miocene limestone, but at least 60 m of section have been removed near the southern or coastal margin of the plain.[11]

Twidale and Campbell are also mystified:

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[7] Twidale and Campbell, Ref. 3, p. 153.
[8] Twidale, C.R., 1976. *Analysis of Landforms*, John Wiley & Sons Australasia Pty Ltd, New York, NY, p. 19.
[9] Twidale, C.R., 1990. The origin and implications of some erosional landforms, *Journal of Geology* 98, p. 357.
[10] Lowry, C.C. and J.N.Jennings, 1974. The Nullarbor karst Australia. *Zeitschrift für Geomorphologie N. F.* 18(1):35–81.
[11] Twidale, C.R., 2002. The two-stage concept of landform and landscape development involving etching: origin, development and implications of an idea, *Earth-Science Reviews* 57, p. 59.

> Thus, the plain cuts across the structure of the bedrock, in this case the bedding, and the Nullarbor Plain is of erosional origin. But what sort of erosion could possibly result in a plain as flat as this?[12]

How could it remain flat despite being over 10 million years old? Adding to their problems is the limestone has a lack of cave and surface solution features.[13] Furthermore, at the present rate of erosion, all of Australia would be reduced to sea level in 10 million years (see Chapter 35).

Figure 43.6. The featureless Nullarbor planation surface (Wikipedia).

Western Australia

The dry plains of southwestern Australia represent one huge planation surface.[14] Ollier and Pain remark:

> The plains of Western Australia and Africa are about as flat as any erosional land surface can get... Very complex structures including folds, faults and highly sheared metamorphic zones underlie the plains…[15]

Even granite was planed flat. Interestingly, there are planation surfaces in northwest Australia that are considered very much older (see Chapter 35).

The Beveled Ridges of Isolated Mountain Ranges

Some isolated mountain ranges in Australia show flat-topped ridges that are angled or beveled against the dip of hard strata. One example is the Carr Boyd Ranges in northwest Australia (Figure 43.7).[16,17] Mountain ridge bevels are also seen on top of the Gawler Ranges of

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[12] Twidale and Campbell, Ref. 3, p. 156.
[13] Webb, J.A. and J.M. James, 2006. Karst evolution of the Nullarbor Plain, Australia. In, Harmon, R.S. and C. Wicks (editors), *Perspectives on Karst Geomorphology, Hydrology, and Geochemistry—A Tribute volume to Derek C. Ford and William B. White*, GSA Special Paper 404, Boulder, Co, pp. 65–78.
[14] King, ref. 2, p. 339
[15] Ollier and Pain, Ref. 6, p. 1.
[16] Ollier and Pain, Ref. 6, pp. 23–27.

south-central Australia, the Musgrove and MacDonnell Ranges of central Australia, and other ranges in Australia.[18] These beveled ridges are believed to have formed after a flat planation surface was uplifted and eroded further. The hard rocks remained resistant, while the softer rocks eroded to form broad valleys (Figure 43.8). A similar sequence was most likely responsible for forming the accordant ridges of the Appalachians but instead the flat bevel was entirely destroyed by erosion (see Chapter 40).

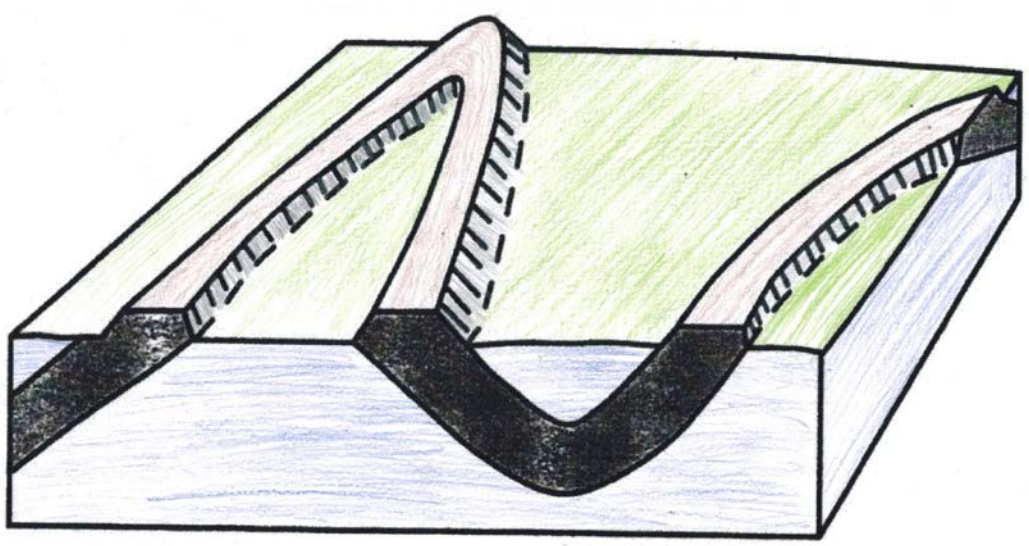

Figure 43.7. Diagram of planed ridges cut across folded rocks (from Ollier and Pain, 2000, p. 26).

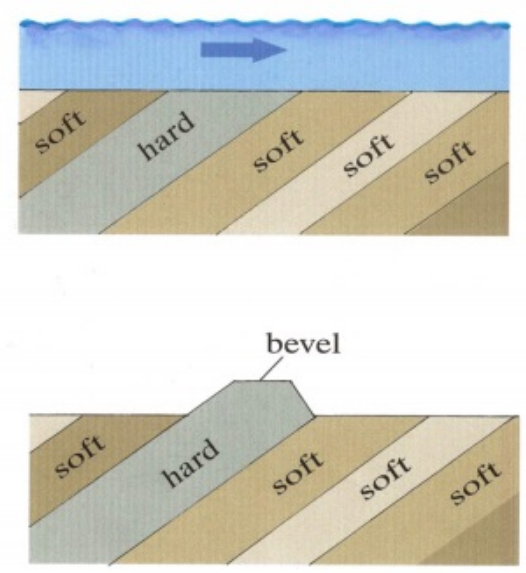

Figure 43.8. Origin of planed ridges in the Flood (adapted Ollier and Plain, 2000, p. 27 and redrawn by Mrs. Melanie Richard).

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[17] Ollier, C.D., 1988. The Kimberly Plateau, Western Australia: a Precambrian erosion surface. *Zeitschrift für Geomorphologie N. F.* 32:239–246.

[18] Twidale, C.R. and E.M. Campbell, 1992. Geomorphological development of the eastern margin of the Australian craton. *Earth Surface Processes and Landforms* 17:419–431.

Planation Surface around Ayers Rock

Ayers Rock is an erosional remnant of a folded layer of sandstone (see Figure 1.6). It is about 1,142 feet (348 m) high. The Ayers Rock sandstone is nearly vertical. It is surrounded by a planation surface,[19] that probably spans much of central Australia.

At first glance Ayers Rock appears to have been dropped into the middle of the desert of central Australia, perhaps by a giant iceberg. But further study proves it to be the top portion of a great mass of sandstone, the rest of which lies below the surface. The sandstone buckled and was subsequently eroded, as depicted in Figure 43.4, but with an inselberg (Ayers Rock) left behind in the process. What kind of forces would shear the buckled sandstone, leaving Ayers Rock exposed above a flatten surface all around for tens of miles?

[19] Ollier and Pain, Ref. 6, pp. 28–29.