Chapter 11

Coastal Great Escarpments

Another piece of evidence the continents eroded quickly comes from the existence of high cliffs. I have mentioned some of these already, such as the Grand Staircase and the Roan/Book Cliffs of the Colorado Plateau (see Chapters 8 and 9). Other high cliffs are found near the coasts of some continents. They are called coastal Great Escarpments. They can be about as high the Colorado Plateau escarpments.

General Features of Coastal Great Escarpments

Coastal Great Escarpments are often found along what are called Atlantic-type or passive continental margins (see Chapter 30). Those margins are not associated with an offshore trench. They are different from those off of the Pacific Coast of Central and South America. Coastal Great Escarpments are usually very long, often a few thousand miles—a very unusual geomorphological feature. They are often over 3,000 feet (1,000 m) high![1] They tend to run parallel to the coast and are not the result of faults but have *eroded inland* from the coast 10 miles to over 100 miles (16 to over 160 km). Coastal Great Escarpments separate a high plateau (an erosional or planation surface planed to low relief) from a coastal plain of moderate relief. (See Volume II of this book on the subject of planation surfaces). It is not an exaggeration to say that coastal Great Escarpments represent one of the most significant topographical features on earth.[2]

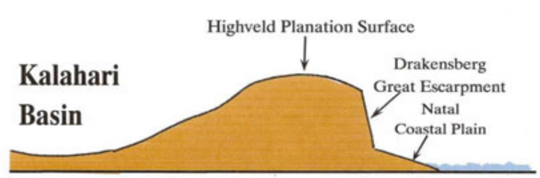

Figure 11.1. Cross section from the Kalahari Basin to the ocean off southeast South Africa showing the seaward facing Drakensberg Great Escarpment that is about 10,000 feet (3,000 m) high (drawn by Mrs. Melanie Richard).

The best examples of coastal Great Escarpments are found around southern Africa, eastern Australia, eastern Brazil, and the western peninsula of India. (Figure11.1) The Drakensberg Great Escarpment inland from the southeast African coast is 10,000 feet (3,000 m) high! This escarpment is so impressive that it is the subject of the next chapter. Almost the entire width of eastern Australia has an inland Great Escarpment. Figure 11.2 shows part of this continental scale escarpment in the Grose Valley west of Sydney, eastern Australia. The Blue Ridge Escarpment in the eastern United States is a smaller version of a Great Escarpment. Appendix 5 provides the details of all these other coastal Great Escarpments except for the one in Southeast Africa.

[1] Ollier, C.D., 1985. Morphotectonics of passive continental margins: Introduction. *Zeitschrift für Geomorphologie* N. F. 54:1–9.

[2] Van der Wateren, F.M. and T.J. Dunai, 2001. Late Neogene passive margin denudation history—cosmogenic isotope measurements from the central Namib Desert. Global and Planetary Change 30:271–307.

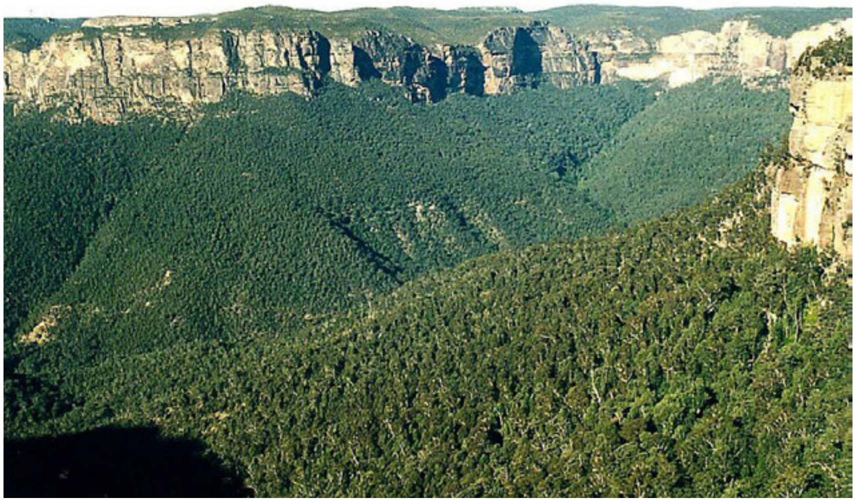

Figure 11.2. Australian Great Escarpment in the Grose Valley west of Sydney, Australia, from Govett's Leap (courtesy of Tas Walker).

There are other types of escarpments that are not erosional, like along western South America and western Australia, that are mainly due to faulting as the continents uplifted. Although their height is impressive, it is the erosional escarpments (erosion of the cliffs or steep slopes) that tell us much more about the cause and timing of continental erosion.

Uniformitarian Difficulties

It is difficult for uniformitarian scientists to understand the origin of Great Escarpments along Atlantic-type passive margins:

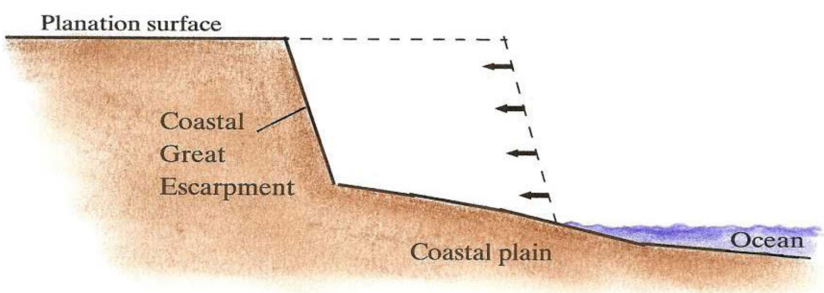

Figure 11.3. The gradual erosion of an escarpment toward the left over millions of years with little erosion on the planation surface above the escarpment (drawn by Mrs. Melanie Richard).

> Passive margin escarpments are extensively studied around the world, and understanding their evolution continues to present one of the more compelling interdisciplinary challenges tackled by earth scientists today.[3]

[3] Heimsath, A.M., J. Chappell, R.C. Finkel, K. Fifield, and A. Alimanovic, 2006. Escarpment erosion and landscape evolution in southeastern Australia. In, Willett, S.D., N. Hovius, M.T. Brandon, and D.M. Fisher (editors), *Tectonics, Climate, and landscape Evolution*, Geological Society of America Special Paper 398, Boulder, CO, p. 173.

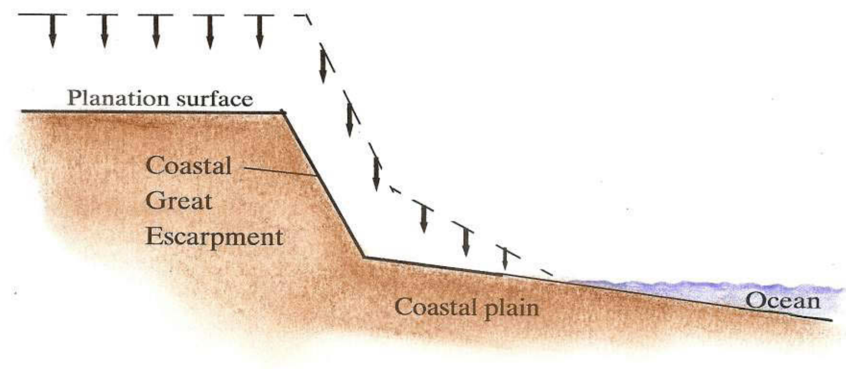

Figure 11.4. The downwearing hypothesis in which the land surface simply lowers over millions of years with little change in the location of the escarpment (drawn by Mrs. Melanie Richard).

Two uniformitarian hypotheses to explain the erosion of coastal escarpments have been suggested: (1) the gradual retreat of the escarpments inland by slow erosion with little or no erosion of the inland planation surface (Figure 11.3), and (2) the downwearing of an original escarpment located generally where we observe it today (Figure 11.4). Both of these hypotheses have severe difficulties, shown in the in-depth section at the end of the chapter. The slow retreat of the cliffs is the most likely model, but it defies uniformitarian erosional estimates.

Great Escarpments Formed during Retreating Floodwater

Field evidence suggests that escarpment erosion was very rapid for even the uniformitarian timescale. It appears some escarpments eroded horizontally inland from the coast up to 100 miles (160 km)! This much erosion should be termed *catastrophic*, within the uniformitarian scheme. A summary of their problems suggests four main difficulties. First, erosion should have been greater at higher elevations, and it is not.

Second, erosion should preferentially erode the softer rocks, but escarpment erosion affected both soft and hard rocks the *same*.[4] This is better explained by a large sheet of water rushing off the continent eroding both hard and soft rocks indiscriminately. Sheet erosion would have little concern for the hardness of the rocks.

Third, the escarpments still maintain steep slopes. If they were tens of millions years old they should have lost their steepness.[5]

Fourth, river valleys are generally perpendicular to the escarpments in the coastal sections. The river valleys have vertical walls and incomplete incision as though they have not yet adjusted to the uplift.[6] The vast erosion of the escarpment, therefore, had to be *rapid and recent*.

It is admitted by those who have studied coastal Great Escarpments of passive margins that the escarpment first formed by continental uplift while the ocean basins sank (see the in-depth section below for one example). The pattern fits well with enormous continental erosion that took place during the Retreating Stage of the Flood. It is the

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[4] Ollier, C.D. and M.E. Marker, 1985. The Great Escarpment of Southern Africa. *Zeitschrift für Geomorphologie* N. F. 54:37–56.

[5] King, L.C., 1953. Canons of landscape evolution. *GSA Bulletin* 64:721–751.

[6] King, L.C., 1982. *The Natal Monocline*, second revised edition. University of Natal Press, Pietermaritzburg, South Africa.

type of erosion one would predict during a retreating "waterfall" as water flowed off of the land toward the ocean. But this waterfall would be hundreds to possibly thousands of miles wide, which would place it during the Sheet Flow Phase (see Figure 3.3) of Noah's Flood.

Therefore, coastal Great Escarpments provide further evidence for the rapid runoff and erosion by the Floodwater from the continents as the ocean basins sank.

Uniformitarian Origin Hypotheses of Coastal Great Escarpments (in-depth section)

Uniformitarian geologists have two main hypotheses to account for coastal Great Escarpments. This section will elaborate on each one and show that the slow cliff retreat of an original coastal escarpment is much more likely, but it still defies uniformitarian erosion rates.

Gradual Retreat of the Escarpment Hypothesis

One hypothesis suggests the escarpment began at the coast during continental break-up during plate tectonics (Figure 11.3). The coastal section somehow uplifted thousands of feet forming a cliff or steep slope where the land split. Then, the escarpment eroded gradually inland over millions of years to where it is today. While the escarpment eroded inland, the planation surface above the escarpment lowered very little.

The problem with this hypothesis is that escarpment retreat is still much too fast and the downward lowering of the planation surface is much too slow to be consistent with uniformitarian reckoning. Tucker and Slingerland stated in regard to all such escarpments, the erosion of which they have not been able to understand:

> Erosional escarpments are common features of high-elevation rifted continents [Atlantic-type margins]. Fission track data suggest that these escarpments form by base level lowering [sea level falls] and/or marginal [continental] uplift during rifting, *followed by lateral retreat of an erosion front across tens to hundreds of kilometers* ... Yet at present there is only a rudimentary understanding of the geomorphic mechanisms capable of driving such prolonged escarpment retreat (emphasis and brackets mine).[7]

Notice that Tucker and Slingerland admit that the *land rose while the sea floor sank* during the formation and retreat of an escarpment, similar to the belief of Lester King and other geomorphologists (see Part II). This kind of tectonics and erosion is consistent with what the Bible states in Psalm 104:8 (see Chapter 4). However, it is difficult for uniformitarian geologists to envision how the escarpment could retreat inland for as much as 100 miles (160 km) through erosion by rivers and streams. It seems the escarpment would become less steep with time. This is what would be expected during the erosion of a cliff, since vertical faces erode faster than horizontal surfaces. These difficulties are probably the reason why a second hypothesis has been postulated.

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[7] Tucker, G.E. and R.L. Slingerland, 1994. Erosional dynamics, flexural isostasy, and long-lived escarpments: a numerical modeling study. *Journal of Geophysical Research* 99 (B6):12,229.

The Downwearing Hypothesis

The second idea suggests the escarpment began more or less where it is located today. The erosion was downward, both above and below the escarpment (Figure 11.4). This hypothesis is bolstered by computer models of erosion and the application of inaccurate radiometric dating methods. They are inaccurate because the models assume the temperature history of the subsurface area.

The computer models undergirding the second hypothesis are simple and arbitrary. In referring to these erosion models, Gunnell and Fleitout admit: "As in all models, simplifying assumptions and arbitrary conditions are introduced."[8] Cliff Ollier, a geomorphologist from Australia, has a modified downwearing hypothesis in that the escarpment of eastern Australia erodes and steepens in place over millions of years with little change in the planation surface above the escarpment.[9] In this case, there should still be more erosion on the planation surface to the west (the Tableland) than indicated and it is doubtful that the erosion should be focused mainly at the developing escarpment. Besides, normal erosion tends to smooth out a steep slope, not increase the slope with time.

Escarpment Retreat Model More Likely, But Not Slow

Obviously, the origin of coastal Great Escarpments is difficult to explain within the uniformitarian system. One problem with the second hypothesis is that the planation surface or plateau inland of the escarpment erodes downward while observations seem to indicate a *minimum of erosion*, which is anomalous since erosion should be faster at high altitude due to heavier precipitation and runoff than the lower coastal areas. Such observations would more favor the retreat of escarpment inland at the same time the planation surface above the escarpment erodes little (the first hypothesis above). How can this happen within uniformitarianism? It can't. Instead, the geomorphology favors rapid escarpment retreat, consistent with the Retreating Stage of the Flood.

In a recent analysis of the formation of a coastal escarpment in southern Sri Lanka, it was discovered that the escarpment retreated rapidly while at the same time the high altitude planation surface farther inland eroded downward little.[10] Thus, it appears that the downwearing hypothesis is wrong and the retreat of the escarpment is correct.

But there is still the problem of why the escarpment itself should erode long distances in such a short time within the uniformitarian timescale. The researchers on the Sri Lankan escarpment suggested that retreat was very rapid when the escarpment first formed near the coast and that it has slowed down to the lower erosion rates measured today.[10] This is rather convenient in that it puts the major erosion well into the past, where we cannot observe it. Even yet, there does not seem to be any basis for this hypothesis, except as a rescuing device for a contradiction to the uniformitarian principle. The idea of much greater erosion taking place in the past does not make sense in view of the very

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8 Gunnell, Y. and L. Fleitout, 2000. Morphotectonic evolution of the Western Ghats, India. In, Summerfield, M.A. (editor), *Geomorphology and Global Tectonics*, John Wiley & Sons, New York, NY, p. 331.

9 Ollier, C.D., 1982. The Great Escarpment of eastern Australia: tectonic and geomorphic significance. *Journal of the Geological Society of Australia* 29:19.

10 Vanacker, V., F. von Blanckenburg, T. Hewawasam, P.W. Kubik, 2007. Constraining landscape development of the Sri Lankan escarpment with cosmogenic nuclides in river sediments. *Earth and Planetary Science Letters* 253:402–414.

high rainfall in the vicinity of the escarpment. Present day rainfall is about 200 inches/year (5 m/yr) in the highlands. Rainfall is a major contributor to erosion. Such rainfall should cause more rapid erosion of the highland planation surface, decreasing the slope of the escarpment.

All of the coastal Great Escarpments are major landforms, but they have generally been overlooked by uniformitarian geologists.[11] Maybe they have been ignored because of the radical implications to their paradigm? Some investigators have even superficially claimed that the escarpments were formed by normal faulting, but there are no significant faults associated with these escarpments. Instead, the coastal Great Escarpments are *erosional* features:

> The escarpments are undoubtedly erosional, despite the tendency for writers on plate tectonics to draw cross-sections of passive [Atlantic-type] margins showing only normal faults downthrown on the ocean side. The mechanism of parallel [gradual] slope retreat, long championed by King, seems to be responsible. The *widespread* occurrence of Great Escarpments suggests that the mechanism occurs in a wide variety of settings, and is *not controlled* either by structure or climate (emphasis and brackets mine).[12]

We are talking about a major geomorphological feature that is widespread and not related to the hardness of the rocks or the climate. Uniformitarian scientists ignore the implications for catastrophism or invoke lame hypotheses to account for a feature that defies uniformitarianism.

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[11] Ollier, C.D., 1985. Morphotectonics of continental margins with great escarpments. In, Morisawa, M. and J.T. Hack (editors), *Tectonic Geomorphology*, Allen & Unwin, Boston, MA, pp. 3–25.

[12] Ollier, Ref. 1, p. 8.