Part III

Catastrophic Erosion of the Continents

Differential vertical tectonics occurred at both the small and large scale to drain the Floodwater. The water would have flowed, sometimes at high velocity, off the continents. Such currents would likely be over 100 mph (160 kph) at times, and be tremendously erosive, especially in areas where the top layers were not cemented. It can be shown that indeed the continents have been greatly eroded.

This part will focus on the amount of rock removed from the continents. Characteristics of this erosion will also show that the erosion was rapid, contrary to uniformitarianism, but just as expected during the Retreating Stage of the Flood.

Chapter 8

Up to 20,000 Feet of Erosion from the Continents

Have you ever wondered when you dig down through the soil, why you often hit hard rock at a shallow depth? Hard rock is sometimes exposed with little or no soil or loose debris (Figure 8.1). It is only in special areas, such as river valleys, landslide areas, glaciated areas, etc. that show any significant depth of soil or debris.

One would have expected that if the landscape were many millions of years old, soils and weathered rock would be very deep, but they are not. The reason the bedrock is so close to the surface is because the surface of the continents is not that old. It is also consistent with being recently scoured by water.

Figure 8.1. Thin layer of debris over hard rock, Hallett's Cove, South Australia. Scratched bedrock supposedly made by the "Permian glaciation" (photo by Tas Walker, who provides the scale).

The hard rock at or near the surface would not have cemented this close to the surface. It requires a fair amount of sediment above it to add weight and to allow groundwater under pressure to transport the cementing chemicals into the sediment. So, the surface hard rock is evidence of heavy erosion in the recent past.

The Flood would be the ideal environment for the rapid cementation of rocks because of the rapid deposition of thousands of feet of sediments saturated with chemically-charged water. The water would become increasingly pressurized because of the increasing weight of sediment above. This would move the cementing chemicals through the pores creating sedimentary rocks. Some sedimentary rocks have over 30% cement between the grains. The amount of overlaying sediment needed for cementation is unknown, but it is probably at least several thousand feet. So, hard rocks found at or near the surface indicate a fair amount of erosion had to have occurred over most areas of the continents.

I will summarize some of the research on continental erosion, mainly over the United States, with which I am most familiar. I will briefly mention erosional results from other con-tinents without much analysis, in order to show that all the continents have been eroded thousands of feet. The amount of erosion in an area can be deduced by several methods, which are presented in the in-depth section at the end of the chapter.

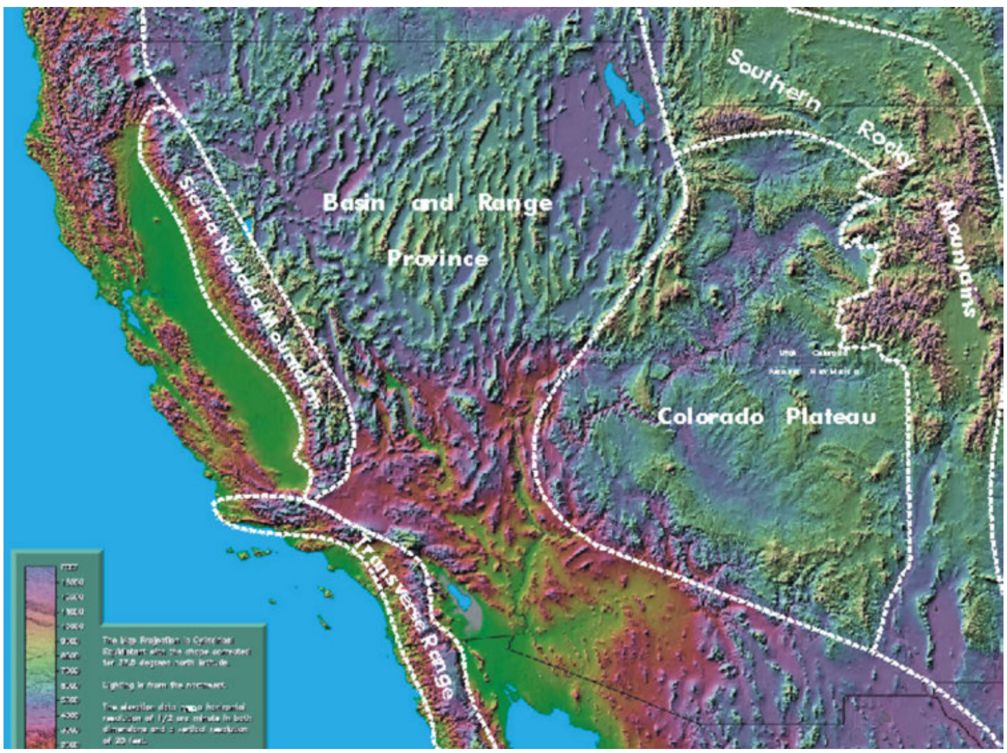

Figure 8.2. The Southwest United States showing the Colorado Plateau (color-coded elevation map background provided by Ray Sterner and drawn by Peter Klevberg).

Huge Erosion Colorado Plateau

It is difficult to estimate the amount of erosion over the Rocky Mountains and the Great Basin because of faulting, but a rough estimate for the area can be made from the Colorado Plateau (Figure 8.2), which lies between them in the Southwest United States. The sedimentary rocks of the Colorado Plateau are generally mildly deformed into domes and basins (anticlines and synclines). The domes have been heavily eroded. With trigonometry, an estimate of the amount of erosion of the dome can be made (see in-depth section at the end of the chapter).

Figure 8.3. The Grand Staircase as viewed from the North Kaibab Plateau just north of Grand Canyon. The sedimentary rocks dip gently to the north and represent about 10,000 feet (3,000 m) of strata. Zion Canyon is carved in the White Cliff and Bryce Canyon in the top Pink Cliff.

The Grand Staircase is part of the western Colorado Plateau (Figure 8.3). It represents the eroded north limb of a huge east-west dome that was centered almost over Grand Canyon. Part of this doming could be caused by isostatic uplift after erosion of the Grand Canyon. The sedimentary rocks that form cliffs in the Grand Staircase are about 10,000 feet (3,000 m) thick. They represent erosional remnants of sedimentary rocks that once extended far south. So, in projecting the layers of the Grand Staircase south over the Grand Canyon, with no change in the thickness, would result in a maximum estimate because the layers may have thinned on the dome. But the layers likely did not thin much since the thickness of 1,000-foot (300 m) erosional remnants in the Grand Canyon area (see Chapter 9) show that the lower strata were not thinned much. To be very conservative we can assume that the layers could have thinned 40%. Based on this estimate of sedi-mentary rock thinning, the amount of erosion would be a minimum of 6,000 feet (1,830 m). Furthermore, there is 2,000 feet (610 m) of volcanic rocks on top of the Grand Stair-case out of view to the north in Figure 8.3. This volcanic rock may have extended over the top of the strata in the Grand Canyon area, but I will not include this rock to be even more conservative. So, 6,000 to 10,000 feet (1,830 to 3,000 m) of sedimentary rock was eroded from the whole Grand Canyon area—before the canyon was formed! The erosion left behind a planation surface (planation surfaces will be exp lored in Volume II).

The San Rafael Swell lies in the northwest portion of the Colorado Plateau. It is 75 miles (121 km) long and about 40 mi (64 km) wide.[1] The sedimentary rocks of the north limb of the San Rafael Swell, north of Price, Utah, make up the Roan and Book Cliffs and dip about 8° down toward the north to northeast. Peter Klevberg and I calculated the

[1] Huuse, M., S.J. Shoulders, D.I. Netoff, and J. Cartwright, 2005. Giant sandstone pipes record basin-scale liquefaction of buried dune sands in the Middle Jurassic of SE Utah. *Terra Nova* 17:81.

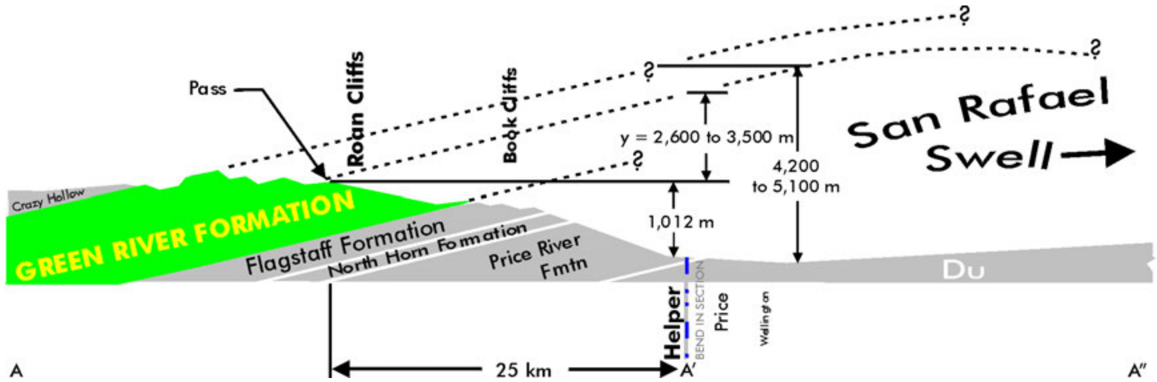

Figure 8.4. The eroded north limb of the San Rafael Swell showing 14,000 to 17,000 feet (4,300 to 5,100 m) of erosion over Price, Utah. The dashed lines with question marks represent the extrapolation of the sedimentary rock over the San Rafael Swell assuming no change in thickness.

amount of sedimentary rock eroded from above Price, Utah, where the sedimentary rocks start to flatten out.[2] Based on trigonometry and being conservative, we also used an angle of dip as low as 6°. We calculated the amount of erosion as 12,000 (3,660 m) to 15,000 feet (4,575 m) over Price, Utah. Looking north from a high pass, a cliff in the top formation was eroded about 2,000 feet (600 m) indicating that this amount of sedimentary rock needed to be added to the calculation. So, the total erosion (a minimum) over Price, Utah, and probably the whole San Rafael Swell, is 14,000 (4,200 m) to 17,000 feet (5,100 m), as shown in Figure 8.4!

Based on geological clues such as the Grand Staircase and the Roan and Book Cliffs, an average of 8,000 to 16,000 feet (2,500 to 5,000 m) of erosion has occurred over the entire Colorado Plateau! [3] Since the Colorado Plateau represents an area of about 132,000 mi2 (337,000 km2), the amount of erosion for the entire Colorado Plateau is 205,000 to 410,000 mi3 (842,000 to 1,700,000 km3). The sediments have been swept off the continent, indicating a rapid watery mechanism consistent with the Retreating Stage of the Flood.

Erosion from Other Areas of Western North America

Other areas of the North American continent also demonstrate massive erosion, of which only a few estimates from the literature will be mentioned. Erosional remnants in the western United States demonstrate that at least a few thousand feet of sedimentary rocks have been eroded. Possibly as much as several thousand feet of rock has been removed from the inland areas of the northwestern states.[4] More than a mile of rock has

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[2] Oard, M.J. and P. Klevberg, 2008. The Green River Formation very likely did not form in a postdiluvial lake, *Answers Research Journal* 1:99–108.

[3] Schmidt, K.-H., 1989. The significance of scarp retreat for Cenozoic landform evolution on the Colorado Plateau, U.S.A. *Earth Surface Processes and Landforms* 14:93–105.

[4] Oard, M.J., 1996. Where is the Flood/post-Flood boundary in the rock record? *Journal of Creation* 10 (2):258–278.

been eroded from southern Arizona.[5] Well more than 1.25 miles (2 km) of strata has disappeared from the Rocky Mountains and foothills of southern Canada.[6]

Possibly 20,000 Feet of Erosion Appalachians

We have all heard that the Appalachians in the eastern United States are old and worn down by erosion. This is really a uniformitarian statement, assuming it takes hundreds of millions of years to round and erode mountains. It is also known that the Retreating Stage of the Flood can accomplish this much erosion in a very short time by powerful currents flowing over and off the rising Appalachians into the deepening ocean basins.[7] Nevertheless, the rounded appearance of the Appalachians do give the appearance that the mountains are well eroded (Figure 8.5 and 8.6). Two main methods of estimating the amount of erosion (see in-depth section at the end of the chapter) show that the uniformitarian estimate in this case is reasonable.

Figure 8.5. The Blue Ridge Mountains, showing an eroded, rounded appearance (view southeast from exit 55 on Interstate 64 Virginia).

Figure 8.6. The Great Smokey Mountains of the southern Blue Ridge Mountains, showing an eroded, rounded appearance (view southeast from Sevierville, Tennessee).

One method used to estimate the depth of erosion in the Appalachians is the rank of coal. Coal is commonly found in the sedimentary rocks just west of the Blue Ridge Mountains. This coal is mostly high-rank anthracite and medium-rank bituminous coal with the rank of the coal generally higher toward the southeast.[8] Friedman and Sanders believe that the anthracite coal in the Catskill Mountains of New York indicate that about 21,000 feet (6.4 km) of erosion has occurred over these mountains,

[5] Oard, M.J. and P. Klevberg, 2005. Deposits remaining from the Genesis Flood: Rim Gravels in Arizona. *Creation Research Society Quarterly* 42(1):1–17.

[6] Osborn, G., G. Stockmal, and R. Haspel, 2006. Emergence of the Canadian Rockies and adjacent plains: a comparison of physiography between end-of-Laramide time and the present day. *Geomorphology* 75:450–477.

[7] Oard, M.J., 2011. Origin of Appalachian Geomorphology Part I: erosion by retreating Floodwater. *Creation Research Society Quarterly* 48(1):33–48.

[8] Hower, J.C. and S.M. Rimmer, 1991. Coal rank trends in the Central Appalachian coalfield: Virginia, West Virginia, and Kentucky. *Organic Geochemistry* 17(2):161–173.

assuming the current temperature change with depth.[9] The same argument would apply for the sedimentary rock west of the Blue Ridge Mountains, where anthracite is also near the surface in places. However, if the change in temperature with depth were higher than normal when the coal formed, less overburden sedimentary rocks would have been needed to change the plant material to coal.[8] Since bituminous coal has a lower rank than anthracite, the overburden would have been substantially less in those areas. So, 13,000 to 21,000 feet (4 to 6.4 km) of erosion is probably a reasonable estimate for the amount of erosion based on the rank of both types of coal and assuming a change in temperature with depth as observed today.

Pazzaglia and Gardner reinforced this estimate of erosion by stating that over four miles (7 km) of rock has probably been eroded from the Appalachian Mountains! [10] This amount of erosion can also be roughly inferred by the amount of sediment and sedimentary rocks eroded off the Appalachians and deposited along the continental margin (see Appendix 4).

A few Erosion Estimates from Other Continents

Similar erosion has scoured the other continents, especially mountainous areas. [11,12] There are probably many estimates of continental erosion in the geological literature, but a few will suffice to show that what happened on North America is typical of what occurred on other continents.

Analysis of geological features on Australia show that this continent is also heavily-eroded.[13] For example, 3.8 miles (6 km) of rock probably was removed from the Flinders Range in South Australia![14,15]

Two miles (3 km) of rock has been eroded from the Welch Mountains of the United Kingdom.[16] Almost a mile (1.6 km) of sedimentary rock has been removed from southeast England (see Figure 2.1).[17]

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[9] Friedman, G.M. and J.E. Sanders, 1982. Time-temperature-burial significance of Devonian anthracite implies former great (~6.5 km) depth of burial of Catskill Mountains, New York. *Geology* 10:93–96.

[10] Pazzaglia, F.J. and T.W. Gardner, 2000. Late Cenozoic landscape evolution of the US Atlantic passive margin: insights into a North American Great Escarpment. In Summerfield, M. A. (editor), *Geomorphology and Global Tectonics*, John Wiley & Sons, New York, NY, p. 287.

[11] King, L.C., 1983. *Wandering Continents and Spreading Sea Floors on an Expanding Earth*, John Wiley and Sons, New York, NY, pp. 197–214.

[12] Pazzaglia, F.J. and T.W. Gardner, 2000. Late Cenozoic landscape evolution of the US Atlantic passive margin: insights into a North American Great Escarpment. In, Summerfield, M. A. (editor), *Geomorphology and Global Tectonics*, John Wiley & Sons, New York, NY, pp. 283–302.

[13] Galloway, R.W., 1978. Introduction. In, Davies, J.L. and M.A.J. Williams (editors), *Landform Evolution in Australasia*, Australian National University Press, Canberra, Australia, pp. 1–4.

[14] Chorley, R.J., S.A. Schumm, and D.E. Sugden, 1984. *Geomorphology*, Methuen, London, U.K., p. 165.

[15] Twidale, C.R. and E.M. Campbell, 2005. *Australian Landforms: Understanding a Low, Flat, Arid and Old Landscape*, Rosenberg Publishing PTY Ltd, Dural Delivery Centre, New South Wales, p. 195.

[16] Small, R.J., 1978. *The Study of Landforms: A Textbook of Geomorphology*, second edition, Cambridge University Press, London, U.K., p. 266.

[17] Jones, D.K.C., 1999. On the uplift and denudation of the Weald. In, Smith, B.J., W.B. Whalley, and P.A. Warke (editors), *Uplift, Erosion and Stability: Perspectives on Long-Term Landscape Development*, Geological Society of London Special Publication No. 162, The Geological Society, London, U.K., p. 32.

Partridge believes more than one half to 2 miles (1-3 km) of rock has been removed from southern Africa since the Cretaceous period in the uniformitarian timescale.[18] Five to 6.9 miles (8 to 11 km) of sedimentary rocks are believed to have been removed from above the Vredefort impact crater, South Africa, and 3.1 miles (5 km) from above the Sudbury impact crater in southern Ontario.[19]

These are just a few of the estimates in the literature indicating that there has been massive erosion of the continents.

Summary

Based on geological indicators, the continents have indeed been greatly eroded. The fact that only a little soil has accumulated in many areas shows that the erosion ended recently. Massive erosion is exactly what would be expected during the Retreating Stage of the Flood. The eroded sediments are not found nearby. This supports a world-wide flood, not slow erosion over millions of years. On North America sediments have been swept off the continent with the exception of deposits in the lower Mississippi River Valley and basins and rifts near the coast. The sediments form the thick, continental margin sedimentary apron (see Part VI). Erosion sweeping sediments off the continents implies very strong, wide currents, as expected when the continents first uplifted and the ocean basins sank many thousands of feet during Flood runoff.

Besides the great volume of continental erosion, there are other indications that the erosion of the continents was rapid, based on the pattern of erosion, which will be taken up in the next four chapters.

Methods for Estimating the Amount of Erosion (in-depth section)

There are several methods for estimating the amount of erosion in a region. Some of them are indirect, such as chemical methods that rely on radiometric dating, which are based on many uniformitarian assumptions. I will not use these. I will stick to direct, more scientific methods.

One of these methods is based on the height of erosional remnants. This gives a minimum estimate because we do not know how thick the sediments originally were above the top of the erosional remnant. Since erosional remnants are often sedimentary rocks and the rock is hard at the top, we can safely add a few thousand feet of sedimentary rocks above the top of the erosional remnant.

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[18] 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.

[19] Senft, L.E. and S.T. Stewart, 2009. Dynamic fault weakening and the formation of large impact craters, *Earth and Planetary Science Letters* 287:471–482.

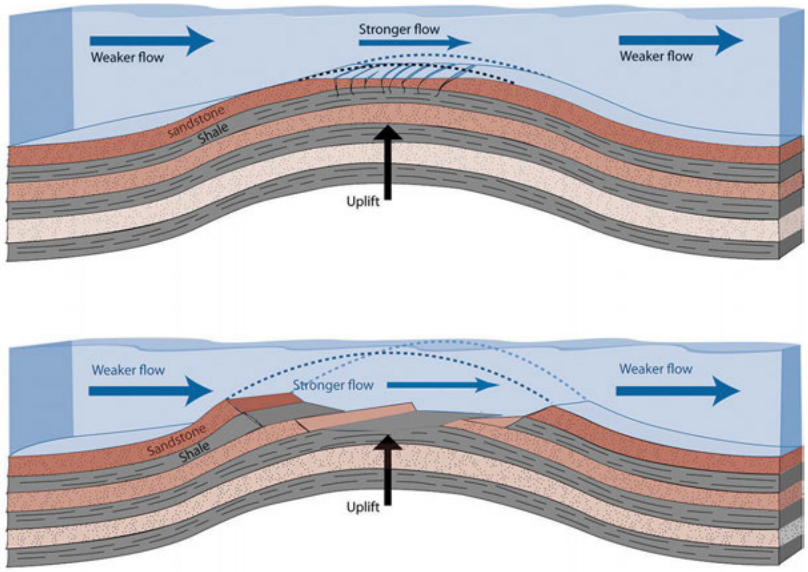

Figure 8.7. The erosion of the top of a dome (anticline).

A second method often employed is to measure the erosion from an eroded anticline or dome, which rose by the bowing up of sedimentary rocks. Figure 8.7 illustrates the uplift of an anticline and the erosion of the center. When anticlines uplift, the top is stretched and cracked. Thus, the center of the anticline will be much more vulnerable to erosion, especially with Floodwater moving at high velocity above it. So, the top of the anticline will be eroded, leaving the sides or limbs mostly intact.

Measuring the amount of erosion at the center of the anticline is relatively easy using trigonometry. One projects the dipping sedimentary rock found along the sides of the eroded anticline up toward the top of the anticline and then estimates the depth of the missing rock. This calculation assumes the thicknesses of the sedimentary layers were the same over the top of the anticline, but sometimes the layers thin. So, the amount of erosion may be overestimated.

This was the method used for estimating 14,000 (4,200 m) to 17,000 feet (5,100 m) of erosion over the San Rafael Swell (Figure 8.4) and for the estimate of 6,000 to 10,000 feet (1,830 to 3,000 m) of sedimentary rock eroded from the whole Grand Canyon area based on the dip of sedimentary rocks in the Grand Staircase to the north.

Figure 8.8. Bituminous Wyodak coal seam, Powder River Basin near Gillette, Wyoming.

A third method of estimating the amount of erosion is by the rank of coal found at or near the surface (Figure 8.8). The formation of coal from plant material is generally related to the temperature. Coal is made up of three ranks: lignite, bituminous, and anthracite, going from lowest to highest rank. The hotter the temperature the higher the rank. Thus, the rank of the coal is related to the depth of burial and the resultant heating. Therefore, coal near the surface indicates thousands to a few tens of thousands of feet of erosion of sedimentary rocks in the area. The amount erosion depends upon assumptions, such as possible heating from a nearby heat source, the change in temperature with depth, the existence of catalysts that can speed up the change, etc. So, coal rank estimates of erosion are educated guesses. The rank of coal gave an estimate of about 21,000 feet (6.4 km) of sedimentary rock eroded from the Valley and Ridge Province just west of the Blue Ridge Mountains.