Chapter 33

Planation Surfaces Once Much Larger

Planation surfaces are easily identified and there is evidence they were once much larger and were modified either later in the Flood or in the post-Food period.

Modification of Planation Surfaces

Planation surfaces were formed primarily during the Sheet Flow Phase of the Flood (see Chapter 57). Later in the flood, during the Channelized Flow Phase, planation surfaces were sometimes severely eroded and dissected. Tectonic processes then tilted and broke up many of them.[1] In some cases erosional remnants are all that is left of what was once a vast planation surface. Occasionally, channelized Floodwaters formed multiple planation surfaces through repeated scouring and erosion as with the High Plains of Montana and adjacent Canada which have four levels of planation surfaces (see Chapter 36).

Figure 33.1. A small stream is now cutting into a once-continuous planation surface (pediment) east of the Little Rocky Mountains, north central Montana.

[1] Twidale, C.R., 1976. *Analysis of Landforms*, John Wiley & Sons Australasia Pty Ltd, New York, NY, p. 415.

Modification of planation surfaces continued after the Flood. Landsliding and mass wasting at the edge of the surface or within valleys sometimes dissected the planation surface (see Figure 15.1). Streams and rivers flowing over the planation surface form rills, coulees, and canyons (Figure 33.1). Later, in deserts, rainfall can be heavy and erosive.[2] In speaking of torrential rainfall on a nearly flat surface, Savigear states:

> When rain falls on a nearly flat surface initially it is absorbed. Subsequently a sheet of water develops extending from puddles to small lakes. At this stage there may be a slight movement of the water but if the surface slope is gentle this is slow and non-turbulent. As the water deepens, or on steeper slopes, runnels [small channels] develop in which there is transportation and corrosion [erosion]. The development of runnels appears inevitable since all surfaces are irregular because of the occurrence [sic] of larger waste fragments or tufts of vegetation.[3]

Therefore, running water, even in deserts, is seen to either incise or add sediments to planation surfaces, but *not* form them.[4]

Many other post-Flood processes can modify a planation surface. Surficial weathering and mass wasting can transform a planation surface into a rolling erosion surface with time. Glaciation itself can modify or even destroy a planation surface. Melt water from the glacier can erode soil and rock and form canyons or valleys (see Chapter 36). If a glacier or ice sheet has little erosive power, it could deposit a veneer of hummocky till on top, disguising it (see Figure 36.4).

After a planation surface is formed, lava or air fall ash (tuff) has been known to cover and obscure it. In southwest Montana the Challis volcanics flowed over a planation surface.[5] Although lava may obscure a planation surface, it will also protect it or a gravel cap on the planation surface from further erosion. Planation surfaces that are below surficial lava flows will mostly be considered as surficial for the purposes of this study. Table 33.1 lists all the process that modify a planation surface after it formed.

1. Eroded to a small remnant
2. Dissected into smaller remnants
3. Tectonic break up
4. Tectonic tilting
5. Post-Flood erosion or dissection by rivers and streams
6. Land sliding and mass wasting along the edge or in valleys on planation surface
7. Surficial weathering
8. Glacial erosion and dissection
9. Deposition of hummocky till on the surface
10. Covered by volcanic lava or air fall ash

Table 33.1. Processes that modify a planation surface after it forms.

[2] Wilkinson, M.J., 1988. Arid landscapes. In, Moon B.P. and G.F. Dardis (editors), *The Geomorphology of Southern Africa*, Southern Book Publishers Ltd, Johannesburg, South Africa, p. 159.
[3] Savigear, R.A.G., 1960. Slopes and hills in West Africa. *Zeitschrift für Geomorpholgie* 1:159.
[4] Garner, H.F., 1974. *The Origin of Landscapes: A Synthesis of Geomorphology*, Oxford University Press, New York, NY, p. 344.
[5] M'Gonigle, J.W. and G.B. Dalrymple, 1996. $^{40}Ar/^{39}Ar$ ages of some Challis Volcanic Group rocks and the initiation of Tertiary sedimentary basins in Southwestern Montana. *U. S. Geological Survey Bulletin 2132*, Washington, D.C.

Planation surfaces that once covered a much larger area were greatly reduced by the many modifying processes. The planation surface shown in Figure 32.1 was significantly larger and covered much of the central and northern Bighorn Basin, until the edges eroded away, leaving only a series of low-altitude plateaus. Small planation surface remnants can easily go unnoticed by the untrained eye since they can be camouflaged by beautiful mountains, fast-flowing rivers, and greenery. Perhaps Ollier and Pain are correct that the Earth's surface was once composed of mostly planation surfaces before major uplift and erosion destroyed or whittled down most of them.[6]

Figure 33.2. The high, pointed Teton Mountains of western Wyoming (view west). Two of the mountains in the northern Teton Mountains (not in picture) are flat-topped erosion surfaces capped by scattered well-rounded quartzites from central Idaho.

Topographic Locations of Planation Surfaces

Planation surfaces are found in many topographic circumstances: 1) valley bottoms, 2) hill slopes, 3) pediments, 4) mountaintops, and 5) plains or plateaus. The last three are readily noticed, but the first two are more deceptive.

Planation Surfaces Sometimes on Flat-Bottomed Valleys

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

A flat valley bottom may be a planation surface covered with a veneer of sediment and gravel, but subsurface data are required to distinguish it from the many valleys that have accumulated sediments. Flat bottomed valleys that were once a planation surface had to have been planed by a current that filled the entire valley. If not, we would expect to find the valley bottom dissected, having both terraces and mesas, or cut and fill structures, as we find in some river valleys today.

Figure 33.3. Table Mountain in the Highland Mountains, just south of Butte, Montana.

Erosion Surfaces Can Even Be Along Hills

Crickmay considers hill slopes that bevel the rock at an angle as a non-horizontal erosion surface, sort of like a slip-off slope on the inside of a river bend, but on a gigantic scale.[7] Some of these hill slope erosion surfaces are covered with a veneer of rounded gravel, similar to near horizontal planation surfaces, indicating the presence of running water as the probable erosional agent along the valley side. Such hill slope erosion surfaces imply formation by a current that fills the valley. It subsides evenly as it erodes the sides. Hill slope erosion surfaces are not all that distinctive, so they will not be discussed further.

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[7] Crickmay, C.H., 1974. *The Work of the River: A Critical Study of the Central Aspects of Geomorphology*, American Elsevier Publishing Co., New York, NY, pp. 217–227.

Pediments Easily Observed

A pediment is: "A broad sloping rock-floored erosion surface or plain of low relief, typically developed by subaerial agents (including running water), in an arid or semiarid region at the base of an abrupt and receding mountain front or plateau escarpment…"[8] In other words, a pediment is a planation surface at the base of a mountain, mountain range, hill, or ridge. Pediments are common worldwide, easily identified and extensively written about. (see Figures 1.4 and 1.5). The formation of pediments is mysterious in its own right and is the subject of Part XIV in Volume III.

Figure 33.4. The Wind River Mountains showing the flat topped mountains (view west from northern Green River Basin).

Mountaintop Planation Surfaces

Many mountains are pointed and jagged, like the Teton Mountains of northwestern Wyoming (Figure 33.2). But some mountains are flat topped and are sometimes called "table mountains." The mountain with a planation surface at it stop in the Highland Mountains, just south of Butte, Montana, is actually called Table Mountain (Figure 33.3). It seems paradoxical that we find planation surfaces on the *tops* of mountains, and that they are common in some mountain ranges,

[8] Neuendorf, K.K.E., J.P. Mehl, Jr., and J.A. Jackson, 2005. *Glossary of Geology*, Fifth Edition. American Geological Institute, Alexandria, VA, p. 477.

like the Beartooth Mountains of south-central Montana and north-central Wyoming (see Figure 6.4) and the northwest Wind River Mountains of west-central Wyoming (Figure 33.4). It is likely sedimentary rocks once covered the planation surfaces of the Beartooth Mountains, Wind River Mountains, and other mountain ranges before they were uplifted. Most of this sedimentary rock was eroded, once again exposing the planation surface. Sedimentary erosional remnants dot the surface of the mountains, providing evidence that the planation surface on these ranges are an exhumed surface[9] (see Appendix 15 on exhumed planation surfaces).

Figure 33.5. Planation surface on Gypsum Mountain, northwest Wind River Mountains of west central Wyoming. The mountain is composed of carbonate rocks with beds dipping west about 40° to the right.

The tilted sedimentary rocks that drape the western Wind River Mountains (Figure 33.5) were planed during mountain uplift. The planation surfaces are at about the same altitude as those on the granite, so it appears this mountaintop planation surface was formed during the runoff phase of the Flood. Planation surfaces on the surrounding sedimentary rocks have caused some geologists to think the mountain top planation surface formed as the same time as the mountains uplifted.[10] Eliot Blackwelder earlier deduced:

> The age of the Wind River summit peneplain [planation surface] is debatable, but, by a process of finessing, it may be worked out with some degree of assurance. It will be admitted by all that, since it trunkates [sic] the structures produced by the folding at the close of the Cretaceous, it must be of Cenozoic age.[11]

Remnant planation surfaces are sometimes found among jagged peaks (Figures 33.4 and 33.6). Two mountain peaks in the northern Teton Mountains of Wyoming, Red Mountain and Mount Moran are flat-topped planation surfaces.[12] Figures 33.6 shows the top of Mount Moran, which is most likely an exhumed planation surface because an approximately 50 foot (15m)

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[9] Oard, M.J., 2014. The meaning of the Great Unconformity and Sauk megasequence. *Journal of Creation* 28(1):12–15.

[10] Steidtmann, J.R., L.T. Middleton, and M.W. Shuster, 1989. Post-Laramide (Oligocene) uplift in the Wind River Range, Wyoming. *Geology* 17:38–41.

[11] Blackwelder, E., 1915. Cenozoic history of the mountains of central Wyoming. *Journal of Geology* 23:202.

[12] Blackwelder, E., 1915. Post-Cretaceous history of the mountains of central western Wyoming. *The Journal of Geology* 23:193–217.

erosional remnant of Flathead Sandstone lies on top of the flat granite and gneiss surface (Figure 33.7).

Figure 33.6. Flat-topped Mount Moran, northern Teton Mountains, Wyoming (from Hergenrather et al., 2012, Your Guide to Yellowstone and Grand Teton National Parks: A Different Perspective, Master books, Green Forest, AR).

The thick mass of Absoroka Volcanics east of Yellowstone Park has a planation surface on the top of its southern portion. Lava covered the area probably in the middle of the Flood, and it underwent planning after all the volcanics were laid down.

In summary, there must have been *two* planning events in the area. The first happened early in the Flood, forming a planation surface on the granite and gneiss of the upper crust of the Earth. It was then covered by sediments that became sedimentary rocks. This planning event corresponds to the Great Unconformity below the horizontal sedimentary rocks and on top of the igneous and metamorphic rocks of the Grand Canyon.[9] A second planning happened late in the Flood during mountain uplift. As the sedimentary rocks were eroded off the first planation surface, a second planation surface was formed on the tilted sedimentary rocks at the edge of the western Wind River Mountains and on the Absaroka Volcanics.

Figure 33.7. Flathead Sandstone on top of Mount Moran (arrow) (from Hergenrather et al., 2012, Your Guide to Yellowstone and Grand Teton National Parks: A Different Perspective, Master books, Green Forest, AR). The vertical black rock is a dike of diabase, a basalt-like rock.

Mountaintop planation surfaces are found worldwide. Some of the mountains projecting from the Antarctica Ice Sheet have flat tops.[13,14] Some are granite. No known process planes granite to a flat surface other than a global Flood. Planation surfaces developed extensively over Japan in the late Cenozoic toward the end of the Flood and are now found on the tops of mountain

[13] Trail, D.S., 1964. The glacial geology of the Prince Charles Mountains. In, Adie, R.J. (editor), *Antarctic Geology*, Elsevier, New York, NY, pp. 143–151.
[14] Kerr, A., D.E. Sugden, and M.A. Summerfield, 2000. Linking tectonics and landscape development in a passive margin setting: The Transantarctic Mountains. In, Summerfield, M.A. (editor), *Geomorphology and Global Tectonics*, John Wiley & Sons, New York, NY, pp. 303–319.

ridges.[15] The tops of some of the mountains in western and central China are flat-topped planation surfaces.[16,17] Planation surfaces are found on the mountaintops of northern Tibet above 16,400 feet (5,000 m).[18] Mountaintop planation surfaces are also found in the Andes of South America and the Southern Alps of New Zealand.[19]

Sometimes mountaintop planation surfaces are capped with patchy or continuous exotic gravel. The gravel can be up to boulder size and very well rounded. Red Mountain in the northern Teton Mountains is capped with patchy exotic quartzites that are up to about 20 inches (50 cm) long (see Figure 17.3) and have percussion marks (see Figure 17.4) indicating a very turbulent fast flow. Their nearest source is central Idaho about 200 miles (320 km) to the west or northwest.[20]

Geomorphologists, Cliff Ollier and Colin Pain believe that after a period of folding much of the earth was planed. Then, very late in geological time, the planation surfaces uplifted and eroded into mountains[6,21] as illustrated in Figure A1.1. Erosion was so extensive in some areas that the planation surface was totally destroyed while it formed rugged mountains. In other cases, erosion was not strong enough to erase all remnants of the planation surfaces and left behind flat-topped mountains. I believe Ollier and Pain are close to being correct in their beliefs. Their ideas fit well with the Retreating Stage of the Flood, as will be discussed in Chapter 57.

Plains and Plateau Planation Surfaces

The tops of flat plateaus, mesas, and buttes are the most obvious planation surfaces. Less obvious are large plains that are covered by sediment and gravel.[22] The High Plains of western North America are a good example. There are many extensive planation surfaces in Africa. The "African Surface" covers many hundreds of thousands of square miles (see Chapter 42).[23] Northern Cape Province, South Africa is a regional plain. It was eroded in granite, gneiss, and sandstone. The erosion left behind isolated inselbergs,[24] which will be discussed in more depth in Part XI. Twidale (1982b, p. 207; 1988, p. 206) suggests that these huge, extremely flat planation surfaces should be called *ultiplains*.[25,26]

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[15] Ohmori, H., 2000. Morphotectonic evolution of Japan. In, Summerfield, M.A. (editor), *Geomorphology and Global Tectonics*, John Wiley & Sons, New York, NY, pp. 154–155.
[16] Fothergill, P.A. and H. Ma, 1999. Preliminary observations on the geomorphic evolution of the Guide Basin, Qinghai Province, China: implications for the uplift of the northeast margin of the Tibetan Plateau. In, Smith, B.J, W.B. Whalley, and P.A. Warke (editors), *Uplift, Erosion and Stability: Perspectives on Long-Term Landscape Development*, Geological Society Special Publication No. 162, The Geological Society of London, The Geological Society, London, U.K., pp. 183–200.
[17] Li, J., S. Xie, and M. Kuang, 2001. Geomorphic evolution of the Yangtze Gorges and the time of their formation. *Geomorphology* 41:125–135.
[18] Benxing, Z., 1989. Controversy regarding the existence of a large ice sheet on the Qinghai-Xizang (Tibetan) Plateau during the Quaternary Period. *Quaternary Research* 32:121–123.
[19] King, L.C., 1983. *Wandering Continents and Spreading Sea Floors on an Expanding Earth*, John Wiley and Sons, New York, NY, p. 190.
[20] Oard, M.J., J. Hergenrather, and P. Klevberg, 2005. Flood transported quartzites—east of the Rocky Mountains. *Journal of Creation* 19(3):76–90.
[21] Oard, M.J., 2002. The mountains rose. *Journal of Creation* 16(3):40–43.
[22] Crickmay, Ref. 7, p. 207.
[23] Oard, M.J., 2011. The remarkable African planation surface. *Journal of Creation* 25(1):111–122.
[24] Twidale, C.R., 1982. *Granite Landforms*, Elsevier Scientific Publishing Company, New York, NY, p. 205.
[25] Twidale, Ref. 24, p. 207.
[26] Twidale, C.R., 1988. Granite landscapes. In, Moon, B.P. and G.F. Dardis (editors), *The Geomorphology of Southern Africa*, Southern Book Publishers, Johannesburg, South Africa, p. 206.

Sometimes the top of a plain, plateau, mesa, or butte is beveled at an angle to the dip of the sedimentary rocks, indicating that the surface was eroded by water and therefore an obvious planation surface (see Figure 32.1).

However, there are situations in which the tops of plateaus, mesas, and buttes lie parallel to the bedding below, as in the Grand Canyon area (see Figure 32.8). Other examples are east of the continental divide in Montana and Canada. The highest plain eroded down more than 2,500 feet (760 m) and formed a total of four levels of planation surfaces, all parallel to the sedimentary rocks.[27] These will be discussed in Chapters 36 and 37. The Appalachian Plateau is a dissected planation surface west of the Appalachian Mountains on generally flat sedimentary rocks (see Chapter 40).[28] These are still planation surfaces, since an erosional mechanism was needed to strip the sedimentary rocks that were above the planation surface and did not carve deep valleys or transport debris out of the area.[22] Just like the mountaintop planation surfaces, some of these surfaces are covered with well-traveled, rounded, coarse gravel.

[27] Alden, W.C. 1932. Physiography and glacial geology of eastern Montana and adjacent areas. *U. S. Geological Survey Professional Paper 174*, Washington, D.C.
[28] Wyckoff, J., 1999. *Reading the Earth—Landforms in the Making*. Adastra West Publishers, Mahwah, NJ, pp. 214–217.