Water Gaps in the Alaska Range

Michael J. Oard*

Abstract

Two of the six water gaps through the Alaska Range will be briefly described. These water gaps fit in with a worldwide pattern of well over one thousand water gaps. Water gaps are a major mystery to uniformitarian geology. The three main uniformitarian hypotheses for the origin of water gaps will be analyzed and found wanting. There does not appear to be any evidence for either of the two hypotheses suggested for the origin of the Alaska Range water gaps. However, the Flood paradigm successfully explains these water gaps, as well as practically all others, and even wind gaps. Both wind and water gaps could have been rapidly carved during the Channelized Flow Phase of the Flood, when strong water currents were flowing perpendicular to mountains or ridges. An analog for a water and wind gap occurred during the gigantic Lake Missoula flood at the peak of the Ice Age.

Introduction

Water gaps are another of the many uniformitarian mysteries of geomorphology (Oard, 2008), which is the study of the features of the earth's surface. Present processes over millions of years are invoked to explain these water gaps, and several hypotheses have been invented. Not only is it difficult to prove them; there is also evidence against them. This paper will describe the Alaska Range water gaps, especially the more assessable Nenana and Delta water gaps, and relate them to water gaps found worldwide. It will be shown that the Genesis Flood provides a reasonable mechanism for their formation.

A water gap is: "A deep pass in a mountain ridge, through which a stream flows; esp. a narrow gorge or ravine cut through resistant rocks by an antecedent stream" (Bates and Jackson, 1984, p. 559). In other words, a water gap is a perpendicular cut through a mountain range, ridge or other structural barrier. This definition of a water gap unfortunately includes the mechanism of an "antecedent stream," which is: "A stream that was established before local uplift began and incised its channel at the same rate the land was rising; a stream that existed prior to the present topography" (Bates and Jackson, 1984, p. 22). This is the case of a hypothesis intruding on observations: the definition presupposes that water gaps are created by streams that eroded down precisely at the same rate as tectonic uplift. A definition of a geological feature should be purely descriptive *without* speculation concerning its origin. Furthermore, a search of the literature demonstrates that uniformitarian scientists claim *five* possible mechanisms for the formation of water gaps, only one of which is an antecedent stream or river.

Wind gaps are related to water gaps, but are not eroded deeply enough to sustain present day water flow (Figure 1). A wind gap is: "A shallow notch in the crest or upper part of a mountain ridge, usually at a higher level than a water gap" (Bates and Jackson, 1984, p. 559). The notch in a ridge has to be an *erosional* notch, not a notch caused by faulting or some other mechanism. In other words, the entire ridge was once near the same altitude, until a notch

---

* Michael J. Oard, 34 W. Clara Court, Bozeman, MT 59718,
mikeoard@bridgeband.com

Accepted for publication: May 7, 2007

Figure 1. Cumberland Wind Gap in the Appalachian Mountains along the Virginia/ Kentucky border near Middlesboro, Kentucky (view northwest from highway 58). This notch has been eroded down nearly 1,000 feet (300 m), as measured on the northeast side (Rich, 1933).

was eroded across its top. A wind gap is considered an ancient or incipient water gap, thought to have formed either when the sediments were thicker in the surrounding valleys or before the ridge had uplifted, if the ridge is a fault block. Uniformitarian geologists believe that wind gaps were initially cut by a stream or river. Then following either valley erosion or mountain uplift, the stream flowing through the ancient water gap was diverted and its course through the ridge abandoned. So, the wind gap was left at a higher altitude than the adjacent valley, which is why no stream or river flows through it today. Only wind passes through the gap now, which is why it is called a *wind* gap.

The Alaska Range Water Gaps

The Alaska Range (Figure 2) is an arc-shaped, generally east-west mountain range 600 miles (965 km) long in southern Alaska. It merges with the Wrangell and St. Elias Mountains on the east and the Aleutian Range on the west (Wahrhaftig, 1958). The highest mountain in North America, Denali (formerly Mount McKinley) at 20,135 ft (6,194 m), lies within the western Alaska Range. Most mountains are much lower with the crest of most of the range averaging between 7,000 and 9,000 ft (2,135 and 2,745 m) high. The lowlands north and south of the range are at low altitudes. The Tanana Basin to the north is a broad, swampy lowland with average elevation between 395 to 820 ft (120 and 250 m) asl (Bemis, 2004).

Six rivers rise in the lowlands *south* of the range and flow northward across the range in water gaps to empty into the Yukon or Tanana River (Thornbury, 1965). These rivers are located at semi-regular intervals of 25 to 100 miles (40 to 160 km) apart (Wahrhaftig, 1965), and from west to east they are the Nenana, Delta, Nabesna, Chusana, Beaver, and White Rivers. The northwest foothills are a series of parallel east-west ridges, caused by folding and thrusting, and separated by long narrow valleys (Bemis, 2004). Just as mysterious, the drainage

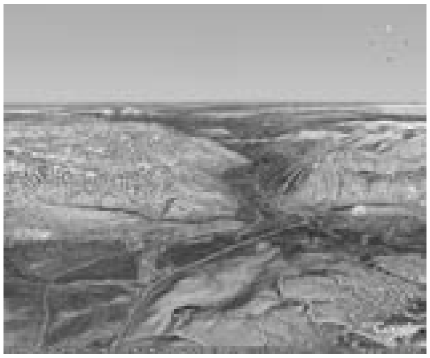
Figure 2. Shaded relief map of Alaska. The Alaska Range (arrow) is the arc-shaped mountain range that extends from southwest Cook inlet to near the Alaska-Canadian border. (From U. S. Geological Survey.)

is even perpendicular to these ridges and valleys:

> Strangely enough, the drainage does not follow these valleys but has a dendritic pattern roughly at right angles thereto, the rivers cutting directly across ridges and valleys alike (Wahrhaftig, 1958, p. 52).

In fact, the drainage of the rivers and tributaries is remarkably straight and parallel through these ridges (Wahrhaftig and Black, 1958). The origin of this drainage pattern is a puzzle.

The Nenana River is the first water gap to the west (Figure 3 and 4). The main highway (George Parks Highway or Highway 3) from Anchorage to Fairbanks passes through this water gap, which is only 2,363 ft (720 m) asl. The next water gap to the east is the water gap of the Delta River in which the Richardson Highway (Highway 4) and the Trans-Alaska pipeline pass through (Figures 5 and 6). Both water gaps pass through a generally low area in the Alaska Range. How did such water gaps form?



***above*: Figure 3. The Nenana water gap through the Alaska Range, view north, which is the same direction the river flows (permission from Google Earth™ mapping service).**

***right*: Figure 4. Nenana water gap (view north) from Denali Highway just southwest of Cantwell, Alaska.**

Water Gaps Worldwide

One would think that such transverse drainage through a mountain range would be rare, but it is not. Water gaps are found worldwide. For instance, there are numerous water gaps, small and large in the western United States.

> In numerous places, especially in the Southern and Middle Rockies, rivers cut across uplifts cored by resistant rocks in preference to what appear to be more logical courses on softer rocks around the uplifts (Madole et al., 1987, p. 213).

Figure 5. Delta River water gap through the Alaska Range, view north northwest, which is the direction of river flow (permission from Google Earth™ mapping service).

The Grand Canyon is a one-mile-deep (1.6 km) water gap. The Colorado River flows through several plateaus, the highest of which is the Kaibab Plateau, more than 9,000 ft (2,745 m) high. The origin of this water gap has been an enigma for a long time. Both uniformitarians and creationists have struggled to explain its origin (Young and Spamer, 2001). The uniformitarian hypotheses seem hopelessly muddled.

There are 300 water gaps in the Zagros Mountains of western Iran alone, creating gorges up to 8,000 ft (2,440 m) deep (Oberlander, 1965). These mountains rise up to 15,000 ft (4,575 m) above sea level, and are 1,000 miles (1,600 km) long and about 150 miles (240 km) wide. The Zagros Mountains are "very young" geologically (Pliocene) and little modified by erosion, which means that the water gaps are even "younger." The lower walls of some water gaps are near vertical, sometimes overhanging. The most impressive aspect of the Zagros drainage is that the streams and rivers appear to *shun valleys* and prefer to *transect mountains*—numerous times.

Figure 6. Delta River water gap (view north from Black Rapid Viewpoint).

> The Zagros drainage pattern is distinctive by virtue of its disregard of major geological obstructions, both on a general scale and in detail…Certain streams ignore structure completely; some appear to "seek" obstacles to transect; others are deflected by barriers only to breach them at some point near their termini. Many streams cut in and out of anticlines without transecting them completely, and a few cross the same barrier more than once in reverse direction (Oberlander, 1965, pp. 1, 89, quotes his).

There are probably well over 1,000 water gaps across the earth.

> Since these early studies [in the late 19th century] transverse drainage has [sic] been identified from most major mountain belt regions around the world… (Stokes and Mather, 2003, p. 61).

So, the Alaska Range water gaps are not unusual, but part of a common worldwide pattern.

Water Gaps—A Major Mystery of Uniformitarian Geology

The origin of water gaps is mysterious within the uniformitarian paradigm (Oard, 2001; 2007; 2008). Crickmay (1974) noted that rivers seem to cut water gaps as if there were no mountain barrier.

> Admittedly a fascinating picture, a river runs over low, open plains directly towards seemingly impassable mountains but, undiverted by their presence, passes through them by way of a narrow defile, or water gap, to a lower region beyond. (p. 154.)

How could this have happened? Summerfield (1991) states that such discordant drainage is especially common in fold mountains.

> One of the most perplexing problems of drainage development to unravel is that provided by **transverse drainage**. Such a drainage pattern, which is also known as **discordant drainage**, occurs when river channels cut across geological structures … Such drainage, which is common in fold mountain belts, is often regarded as anomalous, although this is not really an appropriate description. (p. 411, emphasis in original.)

Why should a river or stream flow through a barrier and not pass around it? Like canyons, uniformitarians assume a river erosion origin simply because a river is presently flowing through the gap. They ignore the possibility that some other mechanism could have cut the gap first and then the river simply followed the easiest route afterwards. Their reasoning is compromised by their commitment to uniformitarianism (or actualism), and their ideas, though plentiful, are poorly supported by observation, as will be shown below.

It is important to realize that not all water gaps are mysterious. Water gaps are only a puzzle when the river or stream could have more easily flowed around the ridge or mountain, but instead ended up cutting through the barrier. For example, the Columbia River Gorge between Oregon and Washington is a major water gap through the Cascade Mountains, but it runs through one of the lowest paths through the Cascade Mountains. Presumably when the mountains were lower and/or the rocks in eastern Washington and Oregon higher, the drainage would have already been established.

Despite Hypotheses, Origin of Water Gaps Unknown

Although there are five hypotheses for the origin of water gaps, only three are considered significant: 1) the antecedent stream model, 2) the superimposed stream model, and 3) stream piracy (Austin, 1994; Stokes and Mather, 2003; Williams et al., 1991; 1992).

The Antecedent Stream Hypothesis

The antecedent stream hypothesis requires a river to be flowing in a set course prior to uplift of a landscape of low relief. Then a barrier, such as a mountain range, is uplifted in the path of the stream, but the process is sufficiently "slow" so that the stream or river maintains its course by eroding the landscape as it rises (Figure 7). The antecedent stream hypothesis was probably the first hypothesis invoked to explain transverse drainage. John Wesley Powell assumed that antecedent streams had cut the Green River and Grand Canyon water gaps. Most geologists accepted Powell's hypothesis for many years.

This theory applies mainly to large rivers because only they have enough erosive power to keep up with uplift (Ahnert, 1998). However, some investigators believe that any river erosion would be too slow relative to mountain building to cut valleys, and do not accept the model. Although Twidale (1976) disagreed with that assessment, he did admit that antecedent rivers or streams are rare.

In many cases, the antecedent stream hypothesis can be ruled out for a number of reasons. For instance, the water gaps in Wales are cut through "old" mountains (Small, 1978). The rivers would have to be even older, which seems impossible. So, the Wales water gaps are assumed to have originated by superimposition, since there is no other viable hypothesis.

In order to demonstrate antecedence, one must usually prove that the river in question predates uplift—a very difficult task (Twidale, 1976). Then, uplift must be slow enough not to deflect the river's course (Ranney, 2005). This special conjunction of time and erosion would be unusual, especially over a long period of time. If the river is flowing through an

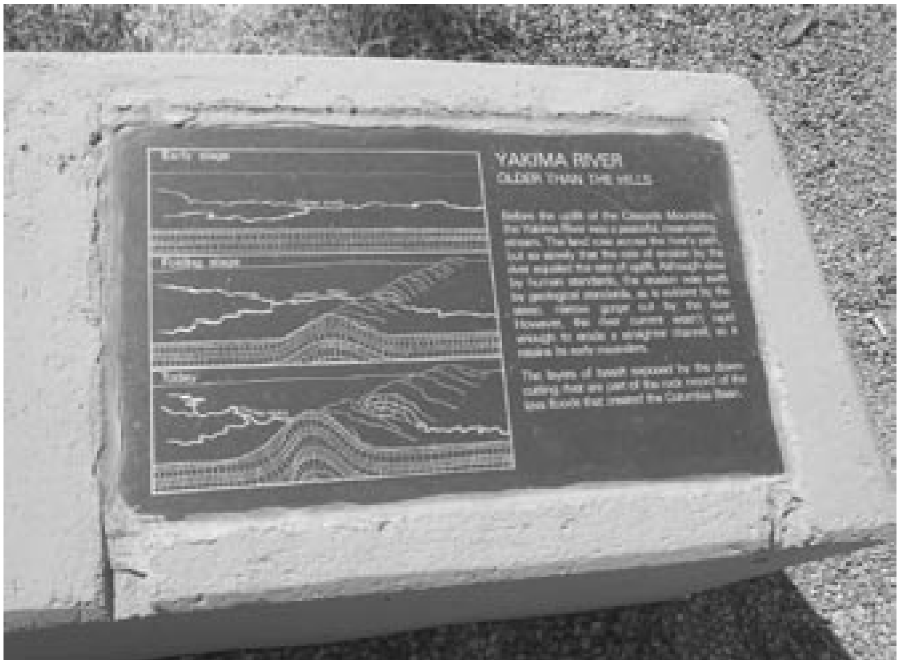


Figure 7. Block diagram showing the antecedent stream hypothesis. The stream is first established. Then the ridge slowly uplifts while the stream is able to erode through the barrier.

enclosed basin and the mountains rise too fast, a lake should form upstream of the barrier, but lake deposits are rarely if ever found. The chance of creating one water gap is low; creating multiple aligned gaps seems astronomical. The antecedent stream hypothesis appears to be a very simplistic explanation with little or no evidence. Sometimes, this idea is put forward simply because any other alternative is even more improbable (Small, 1978).

Geologists have recognized this, and many "antecedent stream" water gaps have been "reinterpreted," suggesting that there was little or no evidence for antecedence in the first place. For instance, the water gaps on the Laramie, Arkansas, North Platte, and South Platte Rivers in the east central Rockies, once attributed to antecedent streams, are now considered products of superimposed streams (Short and Blair, 1986). Twidale (2004, p. 193) noted the difficulty of demonstrating the possibility of the antecedence hypothesis.

> It is fair to state that though many rivers of tectonically active regions are probably of such an origin [antecedence], but like warping in relation to river capture, it is difficult to prove. The ages of the river and of the implied tectonism have to be established, and this is rarely possible.

Thus, the antecedent stream hypothesis faces these difficulties:

- It is now considered a minor contributor to water gaps
- Streams must predate uplift
- Geologists must prove that the mountains were uplifted, instead as a result of erosion
- Uplift must have been slow enough not to deflect the stream's original course
- General absence of expected upstream lake deposits
- Hypothesis has been rejected in many cases upon further study
- Aligned water gaps cannot be explained

The Superimposed Stream Hypothesis

Problems in the antecedent stream model led to the superimposed (sometimes referred to as *superposed*) stream hypothesis. But, this model seems to have just as many problems. A superimposed stream or river is defined as: "A stream that was established on a new surface and that maintained its course despite different lithologies and structures encountered as it eroded downward into the underlying rock" (Bates and Jackson, 1984). In this hypothesis, a landscape is buried by renewed sedimentation, usually caused by marine transgression. Then, a stream or river is established on the generally flat cover of sediments or sedimentary rock, called the "covermass." As erosion takes place over millions of years, the stream erodes downward, maintaining its course even upon encountering harder rock beneath the covermass. So, after millions of years the stream ends up flowing through the older structural barriers. At the same time, the rest of the cover mass is eroded, leaving behind a river flowing through ridges or mountains (Figure 8). Apparently, any evidence of a prior "covermass" is enough to convince geomorphologists of this hypothesis (Twidale, 2004).

Although geologists at first believed that the Rocky Mountain water gaps were caused by antecedent streams, they later embraced the superimposed stream hypothesis. But Hunt (1967) was skeptical:

> However, the stream courses across the various ranges in the Rocky Mountains probably are not superimposed. Too much fill would have been required to bury the several mountain ranges, and too much erosion would have been required to remove that fill. (p. 272.)

There is rarely any evidence for such a thick covermass or its deposition by a prior transgression.

A major problem with superimposition is that the river must maintain the same course to cut into resistant formations, while at the same time meander enough to erode the covermass, leaving only the more resistant rocks at higher elevations (Crickmay, 1974, p. 155). Even if there was any evidence, the concept defies logic. Consequently, there is

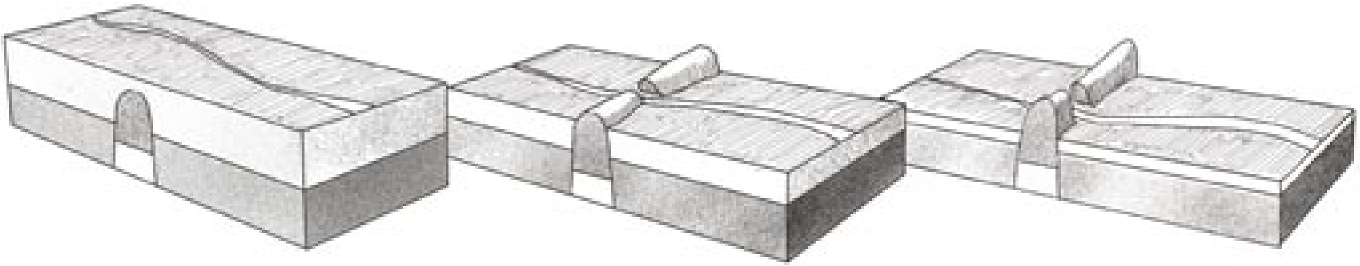


Figure 8. Block diagram of the superimposed stream hypothesis. The stream maintains its same course as most of the covermass (top layer) is eroded. (Illustration drawn by Bryan Miller.)

rarely any evidence that water and wind gaps formed from superposed streams:

> Although a plausible mechanism, superimposition is extremely difficult to verify except in the case of very young orogens [uplifted linear, folded, and deformed mountain belts] where vestiges of the original sedimentary cover remain. In ancient mountain belts, denudation will have removed all the evidence of any pre-existing sedimentary cover (Summerfield, 1991, p. 411, brackets added).

Even when erosional remnants of sediments are found, they do not automatically imply continuous coverage above the existing terrain. Since most of the strata have been eroded, it is in fact an argument from a lack of evidence, and therefore weak.

Thus, the superimposed stream hypothesis faces these difficulties:

- Absence of evidence for hypothetical transgressions and resulting covermass
- Rivers erode downward to cut structure, but covermass is eroded laterally
- Absence of evidence
- Erosional remnants do not prove original covermass
- Geometry demands incredibly large covermass in some cases
- Stream should be deflected and eroded downward from hard sediments into underlying and adjacent soft rock

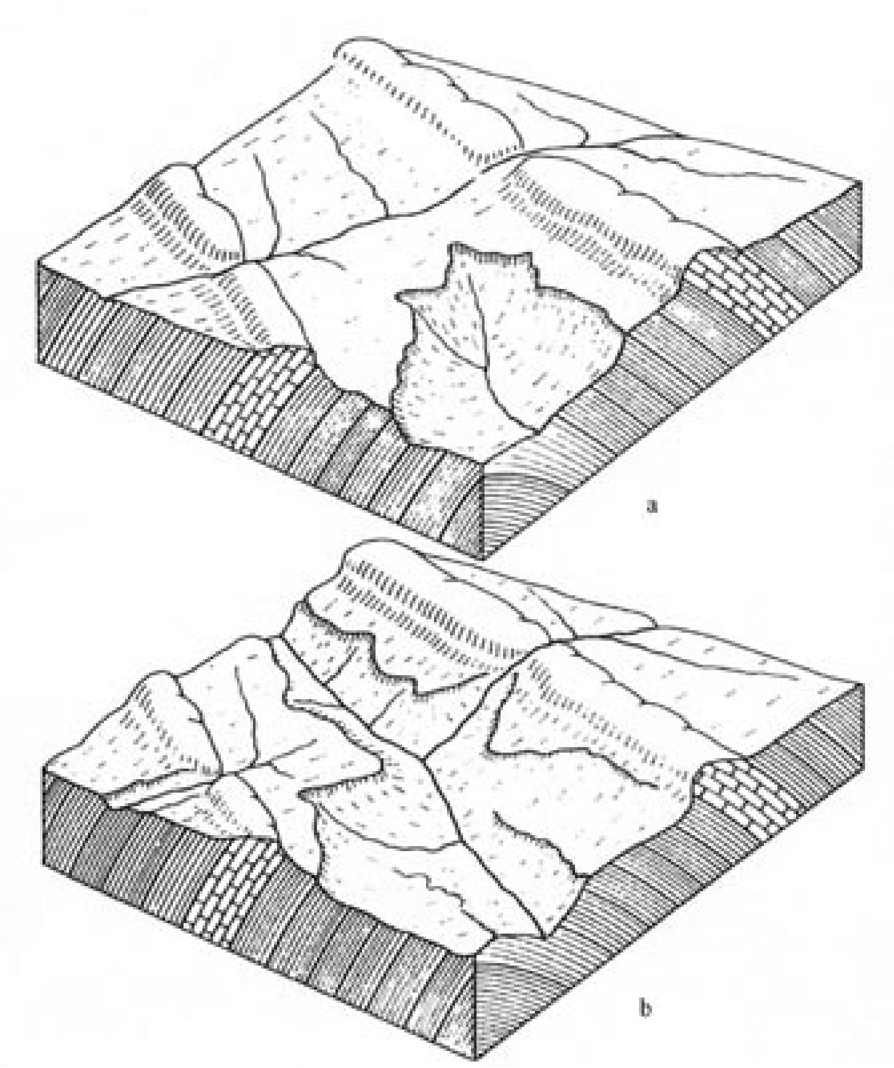


Figure 9. Block diagram of two stages of stream capture. (a) The stream on the lower right is rapidly eroding headward and captures the right portion of the other stream in (b). Modified from Summerfield (1991, p. 411).

The Stream Piracy Hypothesis

The third major hypothesis is called *stream piracy* or *stream capture* (Figure 9). Summerfield (1991, p. 410) explained: “River capture occurs when one stream erodes more aggressively than an adjacent stream and captures its discharge by intersecting its channel.” The higher rate of erosion by the capturing stream can be attributed to: (1) a steeper gradient, (2) greater discharge, (3) less resistant rocks, and (4) higher precipitation.

Several lines of evidence are offered for this model (Small, 1978). One is the “elbow of capture,” which is a sharp change in channel direction on the order of 90° or more. Another is a “misfit” stream—one which carries too much water or too little for its channel. Underfit streams, where flow is too small, are common. Overfit streams are those where flow is too large for the channel. Captured streams are underfit below the point of capture, and the “pirate” stream becomes overfit past that point. Wind gaps, or “cols,” are thought to be the abandoned portion of a stream captured long ago, especially when they contain exotic gravels.

The model is also supported by sudden gradient increases in river profiles, known as “knickpoints.” A waterfall is an extreme example of a knickpoint. Geologists attribute the sudden change in slope to stream capture.

At first glance, these phenomena

seem to support the model. But an "elbow of capture" may be caused by geological factors such as faulting or changes in lithology. Not all sharp changes, even those in front of water gaps, are always attributed to capture, such as the Yar River on the Isle of Wight (Small, 1978). Likewise, misfit streams have other explanations. First, there is little or no evidence for overfit streams, which should be observed at any recent capture event. Dury (1964) demonstrated that virtually *all* streams in an area, whether presumed captured or not, are underfit. He considered this strong evidence against the capture hypothesis. Cols can also form in other ways (Small, 1978). The best evidence for flow through cols is the presence of exotic water-worn gravels. But these gravels cannot show whether a stream was captured, diverted, or simply dried up. Finally, knickpoints are also equivocal unless accompanied by other evidence because they can be caused by renewed regional uplift or a "young" stream that is still eroding headward.

The model seems simple enough given millions of years of denudation, yet reality is more complex. Many supposed examples have ignited disputes among geomorphologists (Small, 1978). If nothing else, the mechanism has been applied too liberally (Small, 1978). The origin of the transverse drainage of the Zambezi River in Africa was assumed to have been caused by river capture (Thomas and Shaw, 1992), but it has since been proposed that this instance of river capture was caused by a catastrophic flood from a breached paleolake.

In order to demonstrate stream piracy, it must be shown that the pirating stream was incised to a significantly lower level than its victim. But past erosional levels are often erased by ongoing active erosion.

Small (1978) stated that there rarely is direct evidence for stream piracy; it is an inference from general features: "It must be apparent from this discussion that the phenomenon of river capture cannot be 'taken on trust' " (p. 229). It seems impossible for stream piracy to account for aligned water gaps observed in some areas. Given the "bandwagon effect," there may be many incorrect applications of the model.

Thus, the stream piracy model faces these difficulties:

- Other explanations exist for the "elbow of capture," wind gaps, and knickpoints
- Overfit streams are nearly nonexistent
- Most streams are underfit
- It is hard to demonstrate historically deeper erosion by the pirating stream
- Aligned water gaps cannot be explained
- Evidence is often missing

Little, If Any, Evidence for Uniformitarian Hypotheses

In summary, there rarely is evidence for *any* of these uniformitarian hypotheses. One of them is simply invoked to provide some explanation for wind or water gaps. Any of them is preferable to no hypothesis at all. However, investigators rarely present compelling evidence. It is easy to understand how the different hypotheses come and go for a particular area.

Thomas Oberlander probably has studied water gaps more rigorously than anyone else. He has many sobering thoughts on past and present research. For instance, Oberlander (1965) noted the conjectural nature of explanations.

> The question of the origin of geological discordant drainage has almost always been attacked *deductively*, leading toward conclusions that remain largely within the realm of *conjecture*. Accordingly, the anomalous stream courses are attributed to previous tectonic environment [antecedence], to superposition from *hypothetical* erosion surfaces or covermasses, or to headward extension under largely *unspecified* controls [stream piracy]. (p. 1, emphasis and brackets added.)

Twenty years later, Oberlander (1985) expressed the same opinion.

> Large streams transverse to deformational structures are conspicuous geomorphic elements in orogens [mountains] of *all ages*. Each such stream and each breached structure presents a geomorphic problem. However, the *apparent absence of empirical evidence* for the origin of such drainage generally limits comment upon it.… Transverse streams in areas of Cenozoic deformation are routinely attributed to stream antecedence to structure; where older structures are involved the choice includes antecedence, stream superposition from an *unidentified* covermass, or headward stream extension in some *unspecified* manner [piracy]. Whatever the choice, we are *rarely* provided with conclusive supporting arguments. (pp. 155–156, brackets and emphasis added.)

Given that all uniformitarian hypotheses are insufficient, we should wonder if the problem lies with the parent paradigm of uniformitarianism.

The Hypotheses Applied to the Alaska Range Water Gaps

Some have suggested that the water gaps through the Alaska Range and the northern foothills formed by antecedent drainage—the Alaska Range was uplifted through existing rivers which maintained their courses (Thornbury, 1965). The late Cenozoic uplift of the Alaska Range, about 5 to 6 million years ago within the uniformitarian timescale (Fitzgerald et al., 1995), could be considered evidence in favor of antecedence. But, geologists believe the drainage was established after the uplift. Without antecedence (stream piracy was not considered), Wahrhaftig and Black (1958) defaulted to superimposed streams. In their model, the folds and thrusts for at least the northern foothills first formed ridges, then the whole area was covered with a flat "covermass," and finally a drainage superimposed on this covermass carved downward into the ridges. Finally, the valleys were eroded. However, the streams and rivers are unexpectedly parallel, which is surprising since they would have had to meander extensively to erode the valleys (Wahrhaftig and Black, 1958; Wahrhaftig, 1965).

The water gaps of the Alaska Range are just as mysterious as the many other water gaps across the Earth. None of the uniformitarian models fit the evidence. Perhaps the answer is to explore outside the uniformitarian paradigm.

The Late Flood Origin of Water Gaps

Uniformitarian hypotheses for the formation of water and wind gaps are essentially speculative guesses with little, if any, supporting evidence. There are numerous problems with all three major hypotheses. A better explanation can be found by shifting paradigms and examining how catastrophic erosion during the late Flood can explain these features.

Did Water Gaps Form after the Flood?

Some creationists have suggested that some water and wind gaps were cut by post-Flood erosion during local catastrophic events, such as the dam-breach hypothesis for the origin of Grand Canyon (Austin, 1994; Brown, 2001). However, I believe that the evidence supports a late-Flood origin for these features.

Erosion from a catastrophic dam breach could create water and wind gaps. This has been suggested as the cause of anomalous drainage on the Zambezi River (Thomas and Shaw, 1992). The dam could have been rock or unconsolidated debris. In either case, it evidently gave way, much like the failure at Red Rock Pass and catastrophic flooding down the Snake River from Ice Age Lake Bonneville in the Salt Lake basin in Utah (Oard, 2004a). The Bonneville flood is believed to have discharged 1,150 mi^3 (4,750 km^3) of water in eight weeks, dropping Lake Bonneville 354 ft (108 m) [O'Connor, 1993]. However, this flood did not appear to produce any water or wind gaps.

The Ice Age would have produced lakes dammed by ice sheets in North America, Europe, and Asia. Several of these show evidence of breaching by overtopping a bounding ridge, cutting a canyon and reversing the drainage of a river. Glacial Lake Agassiz in south-central Canada spilled over ridges at many locations (Oard, 2004a) that may have become water or wind gaps.

One of the largest ice age lakes was glacial Lake Missoula (Oard, 2004a). After this lake deepened to 2,000 ft (610 m) at the ice dam in northern Idaho, the ice burst, producing one of the largest floods since that of Genesis. Glacial Lake Missoula contained 540 mi^3 (2,210 km^3) of water and emptied in two days, sending a wall of water around 400 ft (120 m) deep across the Pacific Northwest, from Spokane, Washington to Portland, Oregon. It did produce one impressive water and wind gap, illustrating a mechanism for these features more plausible than any uniformitarian model.

Stream capture is also feasible after the Flood, especially by small streams and in areas where very little erosion would suffice to trigger capture. However, given the relative difference in erosion rates during and since the Flood, one would not expect significant stream piracy in the approximately 4,500 years since the Flood. During the post-Flood period, stream piracy should be rare, and any water gaps would be small.

A Flood Mechanism for Cutting Gaps

If few water or wind gaps have formed since the Flood, then they must have formed during the Flood. Since these gaps appear to be among the final features formed in the geologic sequence of events, they must have been cut late in the Retreating Stage of the Flood. Uniformitarians recognize this relative timing and attribute water and wind gaps predominantly to the late Cenozoic. For instance, the 300 water gaps in the Zagros Mountains are believed to have been excavated during the late Cenozoic (Oberlander, 1965).

The Recessive Stage of the Flood can be divided into an early Sheet Flow Phase and a later Channelized Flow Phase (Walker, 1994). It is unlikely that any water gaps formed during the Sheet Flow Phase, because the widths of water gaps are much narrower than the sheetflow currents, which were probably very wide. But it is possible that notches could have been initiated in a mountain barrier or ridge by local variations in the sheetflow currents or by structural or lithological zones of weakness. These would have been subsequently enlarged during channelized flow. Regardless of when the initial notch developed, the large majority of water gaps, as well as wind gaps, probably formed during the Channelized Flow Phase.

As the currents became more laterally restricted, mountains and plateaus would have been rising above the retreating Floodwater. Currents would have been diverted into low areas or notches formed earlier. For a time, current velocities would have remained high enough to form water and wind gaps, and even large canyons

Rapid Cutting of Water and Wind Gaps

Water and wind gaps, up to the size of valleys and canyons would have been rapidly cut during the Channelized Flow Phase. Because the base level for the recession of the Flood was the newly created ocean basins, currents would have often flowed perpendicular to mountains and hills, cutting through them instead of going around, forming

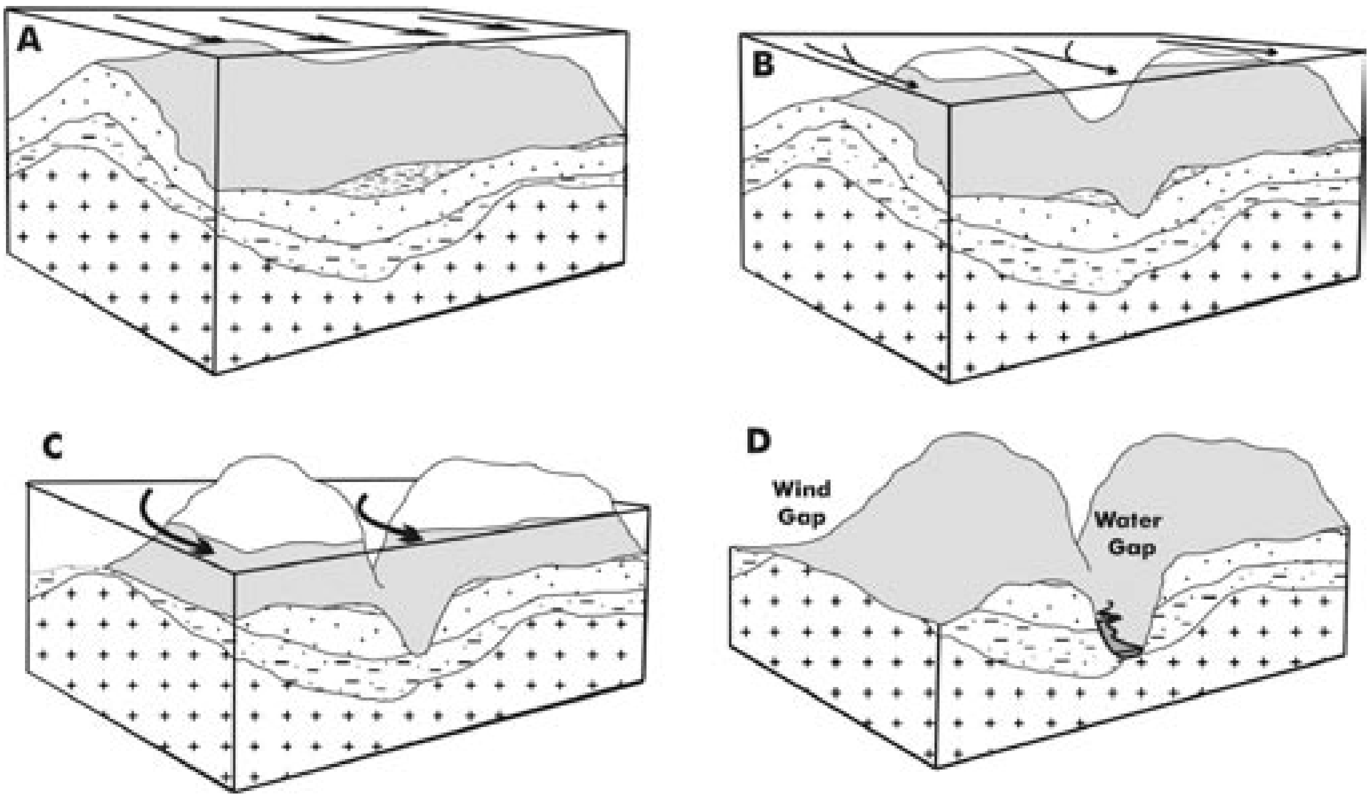


Figure 10. Series of schematics on the formation of water and wind gaps (drawn by Peter Klevberg). (A) Water flowing perpendicular to a transverse ridge forms shallow notches on the ridge. (B) Notches are eroded further as the water level drops below the top of the ridge. (C) Floodwaters continue to drain as notches deepen. (D) Floodwaters are completely drained with a river running through the lowest notch, the water gap. Insufficient erosion in the other notch left a wind gap.

valleys, canyons, and pediments (Oard, 2004b; 2007) [Figure 10a]. The high current velocity would have cut gaps directly through elevated topography. In many cases, overlying sediments would have been eroded too, like an accelerated version of the superimposed stream hypothesis.

Because these landscapes were created by a rapid hydraulic event, it is important to consider current variations, even during the sheetflow runoff (Schumm and Ethridge, 1994). These variations might have initiated notches at higher elevations. Lithological or structural weaknesses could also have been involved, although few water gaps are associated with faults. A fourth possibility is that the channelized flow cut gaps from notch to completion. Regardless, once formed, the currents would have sped up through the notch relative to the surrounding flow (Figure 10b). Therefore, erosion would have accelerated with the current velocity. Abrasive sediment in the water would also have contributed to rapid erosion of the gaps (Figure 10). We can see the same phenomena today when a dam breaches. Once the water finds the point of failure, it rapidly cuts down, although parts of the dam may survive intact.

Wind gaps are found at higher elevations than the local drainage. They might be high because they were not cut to sufficient depth, either from a drop in water level or decrease in erosional energy. They may also have been uplifted too high. At any rate, they transport only wind today (Figure 10c,d).

Dynamic Flood processes could also account for some of the evidence attributed to stream capture, such as the elbow of capture; rounded, exotic gravels in wind gaps; and underfit streams. For example, an elbow of capture might have formed by shifts in a channelized current as it cut into a valley first in one direction, then another.

Another advantage of the Flood hypothesis is that it explains multiple, aligned gaps—a singular point of failure for the uniformitarian theories. A high-velocity Flood current would be flowing on a regional to megaregional scale. Thus, its momentum would easily carry it though multiple barriers, and the large size of the current would create aligned water or wind gaps in a series of perpendicular ridges, such as those observed in the Appalachian Mountains of the eastern United States and the MacDonnell Ranges in central Australia.

A further evidence of rapid, abrupt formation of gaps is the youthful appearance of such features. They show little signs of later erosion. Crickmay (1933) stated that wind gaps have been modified little by weathering since they first formed. This is entirely consistent with the Flood explanation—the Channelized Flow Phase was the *last* event of the Flood and occurred only a few thousand years ago. This "youthfulness" is also an argument against the uniformitarian model; we would have to accept that wind gaps have remained untouched by erosion for millions of years.

The Example of the Lake Missoula Flood

Geomorphological evidence for the Recessive Stage of the Flood is strong (Oard, in press). Whereas uniformitarian geologists have to invent speculative secondary hypotheses to salvage their paradigm in the light of conflicting evidence, the Flood paradigm does not need to invent secondary hypotheses, because the evidence is consistent with the paradigm. Furthermore, the Lake Missoula flood offers the Flood paradigm an example of how a well-substantiated catastrophic flood at the peak of the Ice Age (Oard, 2004a) created a water and wind gap. The Lake Missoula flood (also called the Spokane or the Bretz flood) demonstrates that the catastrophic model works much better than any low-energy solution.

Despite its width of up to 100 miles (160 km), the Lake Missoula Flood possessed a current velocity of up to 65 mph (100 kph). There likely was only one major flood and possibly a few minor floods afterwards (Oard, 2003; 2004a)]. One major pathway was the Cheney-Palouse scabland tract in the eastern part of the flood path. The southern portion of this tract includes the upper portion of Washtucna Coulee. Prior to the flood, the Palouse River rising from the mountains of northern Idaho flowed westward through this coulee and then into the Columbia River. The Snake River flows parallel to the Washtucna Coulee about 10 miles (16 km) south. There is a basalt ridge covered by about 100 ft (30 m) of the Palouse silt between the Snake River and Washtucna Coulee. This ridge is about 500 ft (150 m) above the Snake River.

The Lake Missoula flood rushed southward into the head of Washtucna Coulee. It overtopped the ridge between Washtucna Coulee and the Snake River at two locations, forming a water and wind gap (Figure 11). To the east, the width was initially around 8 miles (13 km), but the flow eventually formed a narrow, vertically walled canyon 500 ft (150 m) deep—down to the level of the Snake River. The narrow erosion likely was manifested as a "retreating waterfall." After the flood, the Palouse River, instead of continuing its flow westward down Washtucna Coulee as before, took a 90° left-hand turn and flowed through what is now called Palouse Canyon and into the Snake River. Palouse Canyon is therefore a water gap formed during the Lake Missoula flood. Palouse Falls (Figure 12) would then represent a "knickpoint."

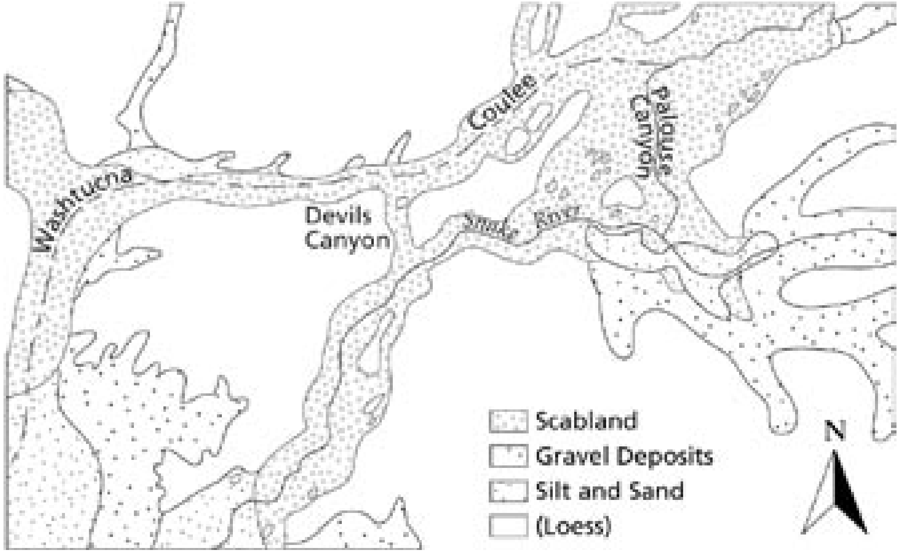


Figure 11. Map of ridge between Washtucna Coulee and the Snake River showing Palouse and Devils Canyons cut from the Lake Missoula flood. Modified from Bretz (1928, p. 205). (Drawing by Mark Wolfe.)

The Lake Missoula flood also breached the ridge between Washtucna Coulee and the Snake River 15 miles (24 km) west of Palouse Canyon. A narrow notch called Devils Coulee, 500 ft (150 m) deep was eroded through the ridge. However, the Lake Missoula flood did not erode this coulee deep enough at its entrance from Washtucna Coulee. The entrance to Devils Coulee is approximately 100 ft (30 m) above Washtucna Coulee, and no stream was diverted down Devils Coulee. So Devils Coulee remains a wind gap. Palouse Canyon and Devils Coulee, therefore, are examples of how large volumes of energetic floodwaters can rapidly excavate water and wind gaps in hard rock (Oard, 2003).

Figure 12. Palouse Falls on the Palouse River between Washtucna Coulee and the Snake River.

Summary

Six water gaps cut through the Alaska Range, as well as foothills north of the range. These features are similar to well over 1,000 water gaps across the earth, 300 alone in the Zagros Mountains of Iran. How a river could cut through a mountain range or ridge presents a seemingly insurmountable challenge to uniformitarian geologists. It does not seem that an appeal to actualism would help. Of course, many hypotheses have been invented over the years—all with apparently fatal problems. Water and wind gaps can rapidly be cut during the Channelized Flow Phase of the Flood by currents flowing perpendicular to mountains and ridges. An example of the cutting of a water and wind gap in a few days is provided by the Lake Missoula flood. Worldwide water and wind gaps, like other global geomorphological mysteries, point to a *global* Flood.

Acknowledgments

I thank Hank Giesecke for accompanying me during this trip to view the Nenana and Delta River water gaps in the Alaska Range. I also thank North Star Bible Camp of Willow, Alaska, for their generous hospitality in providing housing, meals and wheels for this study. I appreciate John Reed fine-tuning several of the figures. Finally, I thank Bryan Miller of Master Books for drawing Figure 8.

This research was supported by a research grant from the Creation Research Society.

References

CRSQ: *Creation Research Society Quarterly*

Ahnert, F. 1998. *Introduction to Geomorphology*. Arnold, London, UK.

Austin, S.A. 1994. How was Grand Canyon eroded? In Austin, S.A. (editor). *Grand Canyon: Monument to Catastrophe*, pp. 83–110. Institute for Creation Research, Santee, CA.

Bates, R.L. and J.A. Jackson (editors). 1984. *Dictionary of Geological Terms*, 3rd edition, Anchor Press/Doubleday, Garden City, NY.

Bemis, S.P. 2004. *Neotectonic Framework of the North-Central Alaska Range Foothills*. M.S. thesis, University of Alaska Fairbanks, Fairbanks, AK.

Bretz, J.H., 1928. Alternative hypotheses for Channeled Scabland. I. *Journal of Geology* 36:193–223.

Brown, W. 2001. *In the Beginning: Compelling Evidence for Creation and the Flood*, 7th edition. Center for Scientific Creation, Phoenix, AZ.

Crickmay, C.H. 1933. The later stages of the cycle of erosion: some weaknesses in the theory of the cycle of erosion. *Geological Magazine* 70:337–347.

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.

Dury, G.H. 1964. Principles of Underfit Streams—General Theory of Meandering Valleys. *U. S. Geological Survey Professional Paper* 452-A, Washington, D.C.

Fitzgerald, P.G., R.B. Sorkhabi, T.F. Redfield, and E. Strump, 1995. Uplift and denudation of the central Alaska Range: a case study in the use of apatite fission track thermochronology to determine absolute uplift parameters. *Journal of Geophysical Research* 100(B10):20,175–20,191.

Hunt, C.B. 1967. *Physiography of the United States*. W.H. Freeman and Company, San Francisco, CA.

Madole, R.F., W.C. Bradley, D.S. Loewenherz, D.F. Ritter, N.W. Rutter, and C.E. Thorn. 1987. In Graf, W.L. (editors), 1987. *Geomorphic Systems of North America*, Geological Society of America Centennial Special Volume 2, pp. 211–257.Boulder, CO.

Oard, M.J. 2001. Vertical tectonics and the drainage of Floodwater: a model for the middle and late diluvian period—Part II. *CRSQ* 38(2):82–83.

Oard, M.J. 2003. Evidence for Only One Gigantic Lake Missoula Flood. In Ivey, R.L. (editor). *The Fifth International Conference on Creationism*, technical symposium sessions, pp. 219–231. Creation Science Fellowship, Pittsburgh, PA.

Oard, M.J. 2004a. *The Missoula Flood Controversy and the Genesis Flood*. Creation Research Society Monograph No. 13, Chino Valley, AZ.

Oard, M.J. 2004b. Pediments Formed by the Flood: Evidence for the Flood/post-Flood Boundary in the Late Cenozoic. *TJ* 18(2):15–27.

Oard, M.J. 2007. Do Rivers Erode Through Mountains? Water Gaps are Strong Evidence for the Genesis Flood. *Creation* 29(3):18–23.

Oard, M.J. 2008. *Flood by Design: The Earth's Surface—Shaped by Receding Water*. Master Books, Green Forest, AR (in press).

Oberlander, T.M. 1965. *The Zagros Streams: A New Interpretation of Transverse Drainage in an Orogenic Zone*. Syracuse Geographical Series No. 1, Syracuse, NY.

Oberlander, T.M. 1985. Origin of Drainage Transverse to Structures in Orogens. In Morisawa, M. and J.T. Hack (editors). *Tectonic Geomorphology*, pp. 155–182. Allen and Unwin, Boston, MA.

O'Connor, J.E. 1993. *Hydrology, Hydraulics, and Geomorphology of the Bonneville Flood*. Geological Society of America Special Paper 274, Boulder, CO.

Ranney, W. 2005. *Carving Grand Canyon: Evidence, Theories, and Mystery*. Grand Canyon Association, Grand Canyon, AZ.

Rich, J.L. 1933. Physiography and Structure at Cumberland Gap. *GSA Bulletin* 44:1,219–1,236.

Schumm, S. and F.G. Ethridge. 1994. Origin, Evolution and Morphology of Fluvial Valleys. In Dalrymple, R.W., R. Boyd, and B.A. Zaitlin (editors). *Incised-Valley Systems: Origins and Sedimentary Sequences*, pp. 11–27. SEPM Special Publication No. 51, Tulsa, OK.

Short, N.M. and R.W. Blair, Jr. (editors). 1986. *Geomorphology from Space: A Global Overview of Regional Landforms*. NASA, Washington, D.C.

Small, R.J. 1978. *The Study of Landforms: A Textbook of Geomorphology*, second edition. Cambridge University Press, London.

Stokes, M. and A.E. Mather. 2003. Tectonic origin and evolution of a transverse drainage: the Río Almanzora, Betic Cordillera, Southeast Spain. *Geomorphology* 50:61.

Summerfield, M.A. 1991. *Global Geomorphology*. Longman Scientific & Technical, New York, NY.

Thomas, D.S.G. and P.A. Shaw. 1992. The Zambezi River: tectonics, climatic change and drainage evolution—is there really evidence for a catastrophic flood? A discussion. *Palaeogeography, Palaeoclimatology, Palaeoecology* 91:175–178.

Thornbury, W.D. 1965. *Regional Geomorphology of the United States*. John Wiley & Sons, New York, NY.

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

Twidale, C.R. 2004. River patterns and their meaning. *Earth-Science Reviews* 67:159–218.

Wahrhaftig, C. 1958. The Alaska Range. In Williams H. (editor). *Landscapes of Alaska: Their Geological Evolution*. University of California Press, Los Angeles, CA.

Wahrhaftig, C. 1965. Physiographic divisions of Alaska. *U.S. Geological Survey Professional Paper* 482, Washington D.C.

Wahrhaftig, C. and R.F. Black. 1958. Quaternary and engineering geology in the central part of the Alaska Range. *U.S. Geological Survey Professional Paper* 293, Washington D.C.

Walker, T. 1994. A Biblical geological model. In Walsh, R.E. (editor). *Proceedings of the Third International Conference on Creationism*, technical symposium sessions. Creation Science Fellowship, pp. 581–592. Pittsburgh, PA.

Williams, E.L., J.R. Meyer, and G.W. Wolfrom, 1991. Erosion of Grand Canyon Part I—Review of antecedent river hypothesis and the postulation of large quantities of rapidly flowing water as the primary agent of erosion. *CRSQ* 28:92–98.

Williams, E.L., J.R. Meyer, and G.W. Wolfrom. 1992. Erosion of Grand Canyon Part II—Review of river capture, piping and ancestral river hypotheses and the possible formation of vast lakes. *CRSQ* 28:138–145.

Young, R.A. and E.E. Spamer (editors). 2001. *Colorado River Origin and Evolution: Proceedings of a Symposium held at Grand Canyon National Park in June, 2000*. Grand Canyon Association, Grand Canyon, AZ.