EROSION OF THE GRAND CANYON OF THE COLORADO RIVER PART II— Review of River Capture, Piping and Ancestral River Hypotheses and the Possible Formation of Vast Lakes

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Received 10 April 1991; Revised 8 September 1991

Abstract

The importance of the Muddy Creek Formation in the western terminus of the Grand Canyon, implying no through-flowing river at the time of deposition of the formation, is discussed. Piping, river capture and "ancestral" river path hypotheses are reviewed. When possible, suggestions based on the Flood model or after-effects of the Flood are offered.

Introduction

The antecedent Colorado River hypothesis in relation to the formation of the Grand Canyon was presented in Part I (Williams, Meyer and Wolfrom, 1991, pp. 92-98). Also the postulation was offered that the major cause in the formation of the Canyon was the erosive work of large quantities of rapidly-moving water laden with abrasive matter in a relatively short time span.

This part discusses evidence in the western Grand Canyon at the Pierce Ferry area that negates the antecedent river hypothesis. Piping, river capture and proposed "ancestral" river paths in relation to the formation of the Canyon are reviewed briefly. Whenever possible, remarks are offered within a Flood model construct. In mentioning time estimates, the authors are quoting the opinions of the various workers involved. We do not subscribe to the geologic timetable.

The Muddy Creek Formation and the Hualapai Limestone

Collier (1980, p. 34) explained that Powell's view of an already established Colorado River before the erosion of the Grand Canyon

> . . . doesn't mesh with facts found just west of the Grand Wash Cliffs. There the Muddy Creek Formation contains rocks that had to be deposited before the Colorado River flowed along its present course through the Grand Wash Cliffs. The top of the Muddy Creek Formation is radiometrically dated at about six million years. Thus a through-flowing Colorado River must be younger than six million years old and could not . . . have been established before the Kaibab Plateau rose during the Laramide Orogeny.

Likewise Hamblin (1976, p. 167) stated:

> The Colorado River attained its present course across the Uinkaret and Shivwits plateaus sometime after the Muddy Creek Formation was deposited 10.6 m.y.B.P.* against the receding Grand Wash Cliffs.

*million years before present

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Nations and Stump (1981, p. 90) noted:

> These deposits (the Muddy Creek Formation) and the absence of Laramide age sediments suggest that the Colorado River was not flowing there until after the uplift occurred.

Consider these remarks by Lucchitta (1988, p. 16):

> Toward the interior of the plateau (Colorado Plateau), the gravels north of the Grand Canyon are overlain directly by six million-year-old basalt. indicating that the Western Grand Canyon did not exist even that recently. (Parenthesis ours)

Dunbar (1965, p. 375) claimed that the Colorado River either did not exist or did not have its present course in Miocene times because of the interior drainage deposits containing salt and gypsum over which the River flows near the Grand Wash Cliffs. Then in a note on page 385 he stated that since Miocene vertebrate fossils have been found in the Muddy Creek Formation, it proved that the river may have originated during that Epoch. See the comments by Foster, 1973, p. 606; Schuchert and Dunbar, 1946, pp. 134-136; Blackwelder, 1934, pp. 551, 553; Lucchitta, 1972, pp. 1933-1947; Longwell, 1946. pp. 817-835.

Muddy Creek rocks were defined by Longwell when he located the type section in Muddy Valley, Nevada and he extended the name to the area along the Grand Wash Cliffs. The rocks are considered to be classic, continental, interior basin deposits (exposed in the Pierce Ferry area) which consist of conglomerates, breccias, sandstones, siltstones and crystalline precipitates (Billingsley, 1978, p. 19; Lucchitta and Young, 1986, pp. 170-171). No Colorado River gravel is present (Hunt, 1976, p. 129). Lucchitta and Young (1986, p. 171) suggested that the Muddy Creek Formation was deposited in quiet water, indicated by even bedding and the presence of tuff, gypsum and carbonates. Hualapai Limestone, considered a lake deposit, is found over the Muddy Creek rocks in places. For an idealized section of the Formation in the Grapevine Wash—Pierce Ferry areas, see Figure 1. Also note Figures 2 and 3. The formation is over 2,700 feet thick along the Grand Wash Cliffs (Billingsley, 1978, p. 19). Because of the presence of this formation, the Willow Springs deposit (Figure 4) in the Peach Springs-Truxton

*For a description of the Bidahochi formation, see Repenning and Irwin. 1954.

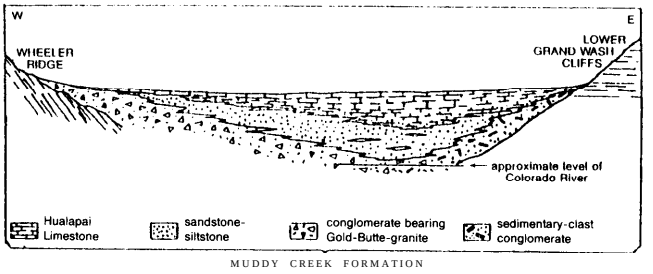

Figure 1. Idealized east-west section of the Muddy Creek Formation in the Grapevine Wash—Pierce Ferry areas (not to scale). The Colorado River has cut about 2000 ft. below the original basin-fill surface (after Lucchitta and Young, 1980). Drawing by Martha Smith.

area (see Lucchita, 1972, p. 1943) and the lower member of the Bidahochi formation* (Figure 5) in northeastern Arizona, McKee et al. (1967, pp. 56-58) concluded that no through-flowing drainage in these areas was possible during a period of ponding or lake development. Therefore it was concluded that the Colorado River did not flow through the western Grand Canyon until possibly during the Pliocene Epoch.

The problems caused by the Muddy Creek Formation and the overlain Hualapai Limestone (Figure 6) were noted by Hunt (1976, pp. 129, 131).

> Moreover, unconformably overlying the Muddy Creek Formation is the Hualapai Limestone, an embankment deposit of freshwater limestone recording a lake about a 1000 feet deep—a body of water vastly deeper and more extensive than Lake Mead. The limestone centers about the mouth of Grand Canyon, the Lower Granite Gorge, yet includes no elastic delta.

Hunt (p. 138) also revealed that the presence of halite and anhydrite deposits associated with lacustrine deposits in the western Grand Canyon area

> . . . poses the same kind of problems as does the Hualapai Limestone—no apparent source for the water; and a puzzling absence of interbedded elastic sediments.

Here is where Flood geologists can offer solutions, though probably not acceptable to uniformitarian geologists. Could the Muddy Creek Formation, Hualapai Limestone and the vast salt deposits have resulted from drying Flood waters or after-effects of the Flood where vast lakes were trapped by tectonic movements? Considering a possibly different climate after the Flood in the Grand Canyon area, extensive post-Flood rains could have maintained abundant water in the region. This possibility needs to be explored. See Blackwelder, 1934, pp. 559, 560 for a discussion of climate change.

Since the evidence indicates vast lake deposits in the western Grand Canyon area, geologists began to suggest different mechanisms for the formation of the Grand Canyon other than the antecedent river hypothesis.

Piping

Wishing to retain an older age for certain sections of the Colorado River and to satisfy the geologic evidences in the western Grand Canyon areas, Charles Hunt (1969, p. 116: 1976, p. 137) proposed that the waters of the Colorado River were ponded by the Muddy Creek Formation as well as by uplift in the Peach Springs region. This reservoir would have been in porous Paleozoic limestone. The impounded water leaked through the limestone and was discharged through springs depositing the Hualapai Limestone and filling the lake in which that limestone was formed.

As Hunt (1976, p. 137) noted:

> This is piping on a vast scale and many regard it an outrageous scale. At least the hypothesis has the merit of explaining the Hualapai Limestone, its lake and the absence of a elastic delta. When my editor first read the interpretation, he wrote, 'It made me feel flushed.'

As Hunt stated, "We have inferred that the Colorado River reached the Lake Mead area by underground drainage when the Hualapai Limestone was deposited" (pp. 138-139).

Moore (1958, pp. 493-494), in his historical geology textbook, posed the following question [1d] at the end of chapter 18:

> Indians of the lower canyon country (Havasupai) hand down a story that the river in the canyon formerly was swallowed whole by the earth. Is this a geologic possibility, and if so, explain?

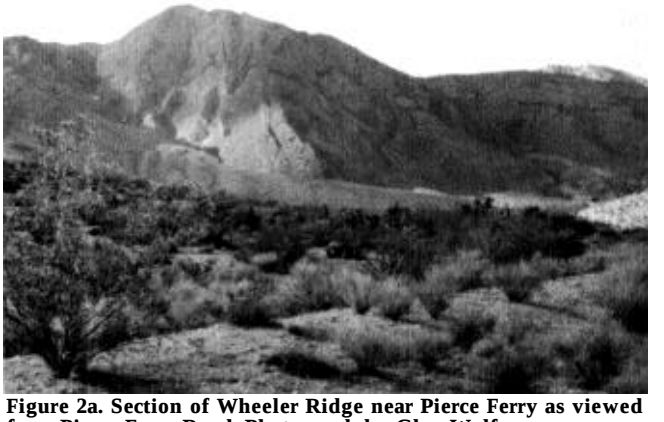

Figure 2a. Section of Wheeler Ridge near Pierce Ferry as viewed from Pierce Ferry Road. Photograph by Glen Wolfrom.

b. Wheeler Ridge as viewed from Grapevine Mesa. Photograph by Emmett Williams.

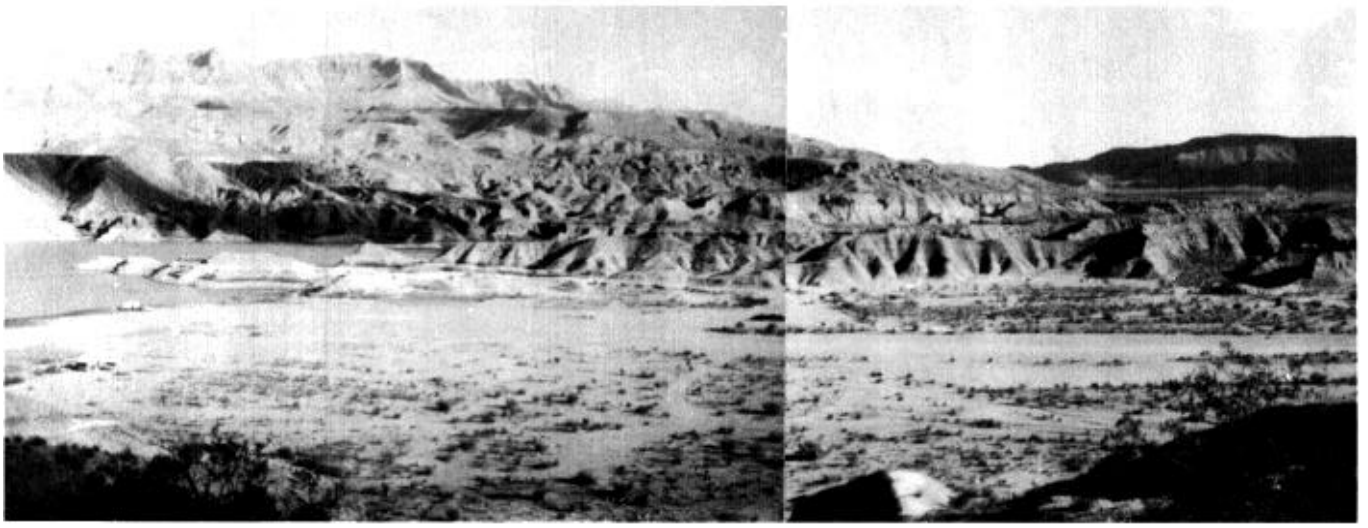

Figure 3. Panoramic view of Pierce Ferry area—the "end" of the Grand Canyon and the "beginning" of Lake Mead. Lower part of Grand Wash Cliffs can be seen in center of picture. Photograph by Glen Wolfrom.

One wonders if Hunt knew about the Havasupai legend when he postulated his piping hypothesis.

Such a view avoided the quandary of the lack of a through-flowing river in the western Grand Canyon area as well as allowing geologists to assume that the river system was older in the eastern Canyon region (Hunt, 1976, p. 129). Lucchitta and Young (1986, p. 172) pointed out the weaknesses in Hunt's proposal, stating that "interior-basin deposits of Miocene time are ubiquitous in the lower Colorado River region" and that there is no evidence for the springs postulated by Hunt. They contended that separate basins might have been involved in the formation of the Hualapai Limestone. Collier (1980, pp. 34-36) also claimed that Hunt's proposal was unsatisfactory because the segment of the Colorado River that defines the Arizona border with California and Nevada could not have existed as early as Hunt thought.

Interestingly, Nations and Stump (1981, pp. 90-91) conjectured that since there are marine deposits along the Arizona-California border. (Figure 7):

> . . . the Gulf of California extended as far north as the Lake Mead area in middle Tertiary (Miocene) time, and it certainly extended north to Needles as late as Pliocene time.

Figure 4. Gravels of Willow Springs deposit exposed in road cut along Route 66. Location is 2.9 miles west of entrance to Grand Canyon Caverns. Photograph by Emmett Williams.

They call this area of deposition the ancestral Gulf of California. Could these have been Flood-deposited materials which remained as the Flood waters receded and the arid climate developed?

River Capture Hypothesis

McKee (1985, p. 34) conjectured that during the early Pliocene Epoch:

> As the last great seaway withdrew from the Grand Canyon region toward the Gulf of Mexico near the conclusion of Chapter IV (Mesozoic Era), local stream drainage followed it eastward. Apparently drainage continued to move in that direction for a long time.

Figure 5. Section of Bidahochi Formation near Greasewood, AZ, view looking east from Navajo Route 15. Photograph by Emmett Williams.

Maxwell (1968, pp. 15, 16) showed what he considered to be the extent of the "Mesozoic Sea" in North America (Figure 8). Interestingly there should be similar formations in both the Grand Canyon and the Big Bend areas as well as similar fauna and flora if this vast area, particularly in Arizona and West Texas, became arid after the regression of the waters. This has been found to be true in two cases. The Petrified Forest Member of the Chinle Formation in Arizona

Figure 6. Hualapai limestone cap along top of Grapevine Mesa, view looking southwest. Photograph by Emmett Williams.

(Figures 9 and 10) is similar in appearance to the Gulfian Series of Formations in west Texas (Also see Williams, Howe and White, 1991). Flood geologists might speculate that the "Mesozoic Sea" shown in Figure 8 was evidence of remnant Flood waters.

McKee also discussed the major uplift of the Grand Canyon region and noted (1985, p. 34):

> As the region came up, westward-flowing streams cut deeper and headward until eventually they connected with or "captured" the Colorado River as it flowed south from Colorado and Wyoming.

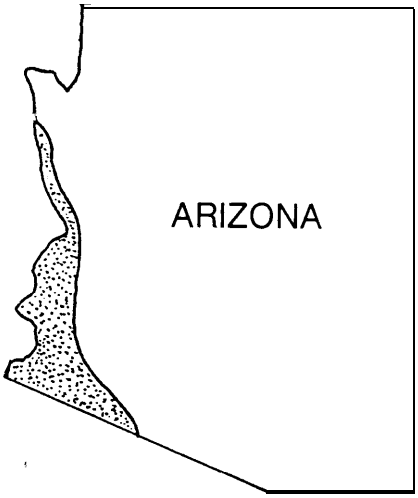

Figure 7. Shaded area represents distribution of Miocene-Pliocene marine deposits within the boundaries of Arizona (after Nations and Stump, 1981). Drawing by Martha Smith.

When consulting the eighth edition of McKee's book (1945) no mention was made of a capture of the Colorado River. What happened in the intervening time between the 1945 and 1985 publications that caused the introduction of the river capture hypothesis? Edwin McKee hosted a conclave of outstanding geologists at the Museum of Northern Arizona in August 1964 to develop a hypothesis on the evolution of the Colorado River. They determined:

> . . . that the ancestral Colorado River had indeed flowed down through Marble Canyon, but it then turned up the Little Colorado River to eventually spill into the Gulf of Mexico. Meanwhile, small tributary creeks on either side of the Kaibab Plateau were supposed to be carving toward one another by the processes of headward erosion. When they met, the westerly flowing stream captured the drainage of the easterly flowing stream. At this point, the Colorado River began to flow to the west . . . through the Kaibab Plateau (Collier, 1980, p. 36).

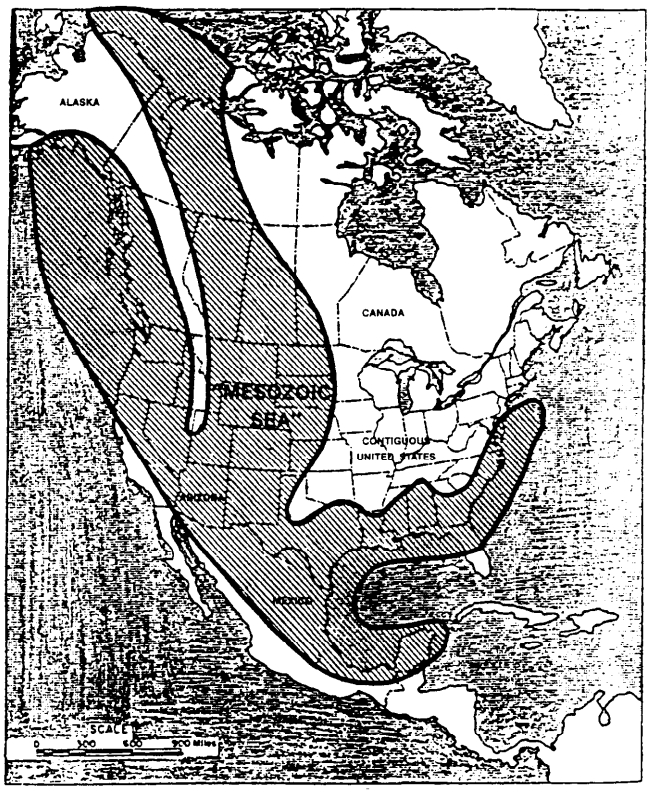

Figure 8. Map of North America showing extent of "Mesozoic Sea" (after Maxwell, 1968). Drawing by Martha Smith.

For complete details of the five stages of the evolution of the Colorado River proposed at the conference, see McKee, et al., 1967. Hunt (1976, p. 135) noted that

> The ancestral river that began cutting (the) Grand Canyon, and that eroded perhaps the first half of it, appears to have been the Little Colorado River, and this was back at a time when the river was vastly larger than it is now. (Parenthesis added)

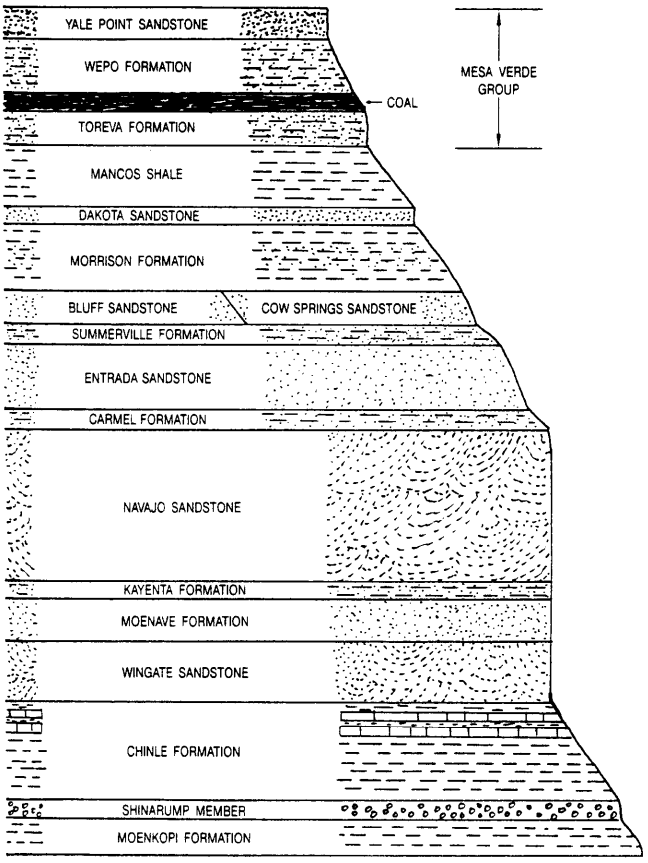

Figure 9. Idealized geologic cross section of Black Mesa in the Navajo Reservation to show position of Chinle Formation in relation to formations in the Grand Canyon and Petrified National Park areas (after Breed, 1975).

Again Lucchitta and Young (1986, p. 172) explained:

> The lower Colorado River worked its way onto the Colorado Plateau by headward erosion, and captured an older ancestral upper Colorado River, probably in the stretch between the Kaibab Plateau and the mouth of the Grand Canyon. In the process, the Canyon as we know it today was formed.

Lucchitta (1988, p. 10) in discussing the proposals of the 1964 conclave noted:

> . . . the ancestral Colorado followed its present course as far as the eastern end of the Grand Canyon, where it encountered the Kaibab Plateau. This Plateau prevented the river from flowing westward and deflected it southeastward along the course to the present Little Colorado and Rio Grande rivers into the Gulf of Mexico.

Lucchitta (p. 10) explained that by the process of headward erosion a youthful stream which emptied into a "newly opened" Gulf of California, captured the ancestral river somewhere in the eastern Grand Canyon. Nations and Stump (1981, pp. 88, 90) summarized the capture hypothesis by stating that it involved the following steps:

1. Uplift of Kaibab Plateau
2. Colorado River flowing west from the uplifted Plateau *gradually* cut the Grand Canyon into the uplift (headward erosion) until it captured the Little Colorado River that flowed south on the eastern side of the uplift. Evidence used: a. Flow direction of the Little Colorado River has been reversed from south to north flow since late Tertiary time; b. Large area of the Bidahochi Formation (late Tertiary lacustrine sediments) is considered to be the outlet for the ancestral Little Colorado River before the flow reversal.

Unfortunately, Collier (1980, p. 36) claimed:

> No one has ever found the ancestral river bed of the Colorado where it was supposed to flow east and south across Arizona, New Mexico and Texas.

Also Lucchitta (1988, p. 11) said that evidence collected since 1964 "argues against the Rio Grande connection." The evidence he (pp. 16-19) used is listed.

1. The presence of "Rim gravels" (Figures 11 and 12) along the southern and southwestern edge of the Colorado Plateau. These gravels which contain pebbles of granite and gneiss do not occur on the surface of the plateau but can be found to the south and southwest. Thus the drainage must have been from generally south to north in the past.*
2. The presence of volcanic material such as the Peach Springs tuff (Young and Brennan, 1974) in the western Grand Canyon area (Figure 13) indicates a northeast drainage pattern before the western portion

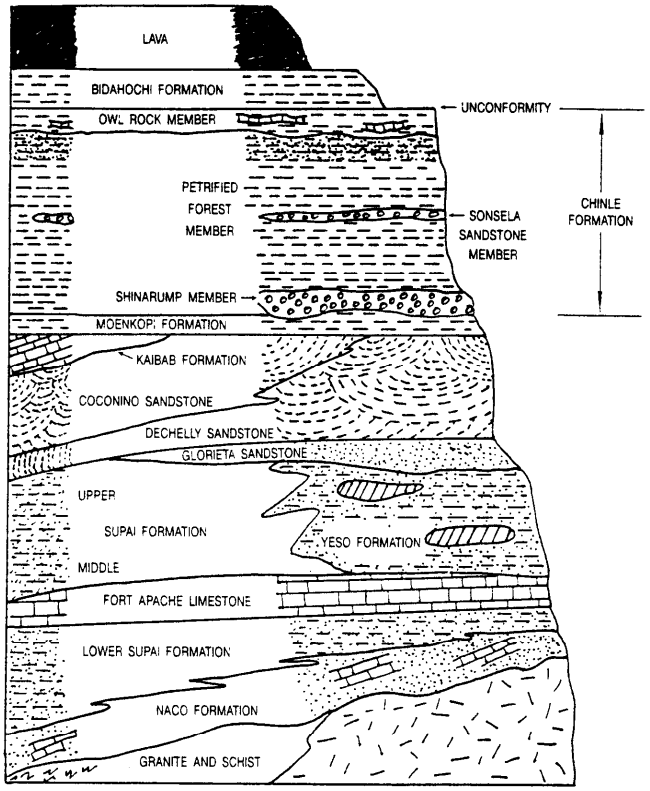

Figure 10. Idealized geologic cross section of Petrified Forest National Park, eastern Arizona to show position of Chinle Formation in relation to formations in the Grand Canyon and Black Mesa areas (after Billingsley and Breed, 1980). Unconformity includes Mesa Verde Group, Mancos Shale, Dakota Sandstone, Morrison Formation, Cow Springs Sandstone, Entrada Sandstone and Wingate Sandstone that are missing in the Park.

***For another discussion of rim gravel see Peirce, Damon and Shafiqullah, 1979, pp. 15-17.**

Figure 11. Rim gravel deposit about two miles south of Show Low, AZ along Highway 60. Photograph by Emmett Williams.

of the Canyon formed. [Also see Lucchitta (1972) and McKee and McKee (1972)].

3. If the Little Colorado River is a candidate for an ancestral Colorado River, present drainage pattern is to the northwest "parallel to the regional strike (trend) of beds" (Lucchitta, 1988, pp. 16, 18). Thus he concluded that this drainage pattern predates any canyon cutting and the basalts that flowed down the valleys in the area indicate the same drainage pattern. Of course these conclusions are not accepted by all geologists and the hypothesis is still in a state of flux.

Lucchitta (1988, p. 11) prefered another interpretation for the ancestral Colorado River.

> . . . the ancestral Colorado River did cross the Kaibab Plateau in the area of the present Grand Canyon, then continued northwestward along a so-called 'strike valley' at the foot of a cliff line similar to those still visible in the plateau country. The valley would have been somewhere in the area of the present Kanab, Uinkaret or Shivwits plateaus.

He postulated that the river then flowed into either Utah or Nevada and was later captured west of the Kaibab Plateau. He felt that this capture is verified in California's Salton trough by the presence of fossils found only in Cretaceous Mancos Shale of the Colorado Plateau. Thus large basins isolated from the sea existed in Utah or Nevada to receive the ancestral Colorado River.

Collier (1980, p. 37) claimed that

> The eastern Grand Canyon, with its steep walls and vigorous rapids, has a shaggy youthful appearance that belies the more dignified age that Lucchitta would assign it.

Collier also notes that the Utah basins needed to be studied more closely to determine if they could have accepted an ancestral river system and that:

> the western Grand Canyon would have had to cut to within a few hundred feet of its present depth in something like three million years—a blistering rate of erosion (p. 37).

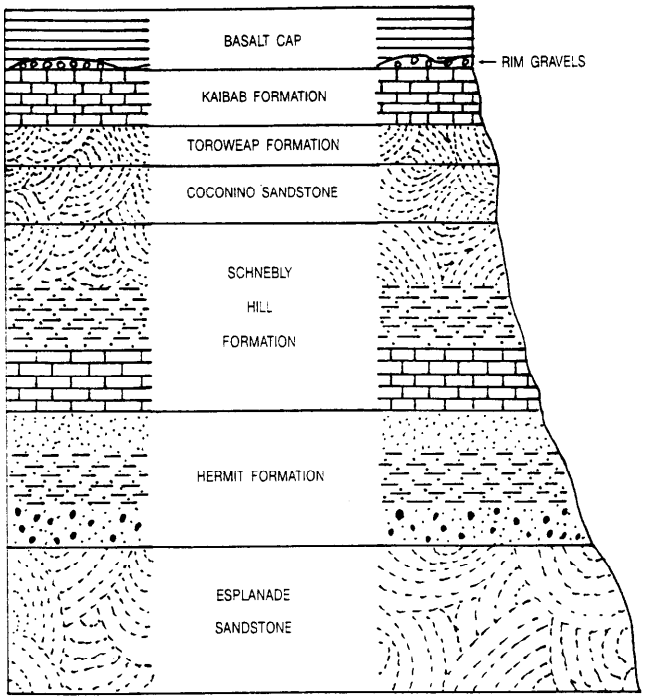

Figure 12. Idealized geologic cross section of Oak Creek Canyon. See Thiessen, 1986, p. 8 and Peirce, Damon and Shafiquallah, 1979, p. 16.

Figure 13. Peach Springs tuff and Willow Springs gravel exposed in road cut along Route 66. Location is 23.6 miles west of entrance to Grand Canyon Caverns. Photograph by Emmett Williams.

This blistering rate of erosion could have been "hotter" than Collier imagined if enough flowing water were present in the past.

Rice (1983, p. 291) pointed out that for the Colorado River to flow northwest into Utah, it would have had to travel up a rim higher than some of the proposed earlier channels in the area of Peach Springs. Hunt (1976, p. 133) stated that an antigravity waterfall would be required for the River to move out of the Grand Canyon as proposed by Lucchitta.

The "Ancestral" Colorado River Postulates

Besides offering his hypothesis of piping on a grand scale, Hunt (1969, p. 60) also proposed an outlet for the ancestral Colorado River.

> We cannot be sure how much of the Colorado River basin drained off the plateau via the canyon

at Peach Springs. Probably the Little Colorado River drainage was first to leave the plateau via that canyon. . . . By middle Miocene time the canyon at Peach Springs was blocked by uplift and by deposits of volcanic materials and related sediments.

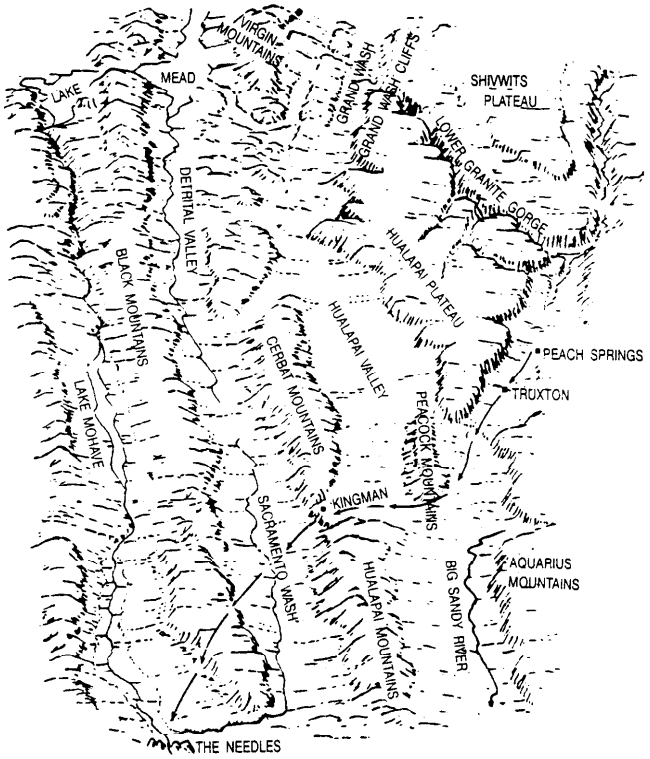

Figure 14. Possible ancestral path of the Colorado River in the basins and ranges west of the Grand Canyon as proposed by Hunt (after Hunt, 1969). Drawing by Martha Smith.

The problem with this view is that there was no outlet for the River after Peach Springs Canyon was blocked. Thus Hunt chose to offer the piping mechanism to remove the water flowing into the western Grand Canyon. Also Hunt (1969, p. 119) stated:

> The geology at the Peach Springs dry canyon indicates clearly that a sizable (sic) river was discharging there from the plateau more than 18 million years ago, and it had been discharging long enough before that to have eroded a canyon 1,000 feet deep.

Figure 15a. Peach Springs Canyon looking northeast from Peach Springs toward the Colorado River.

b. Peach Springs Canyon closer to the Colorado River.

c. The Colorado River looking west at the beginning of Peach Springs Canyon. Photographs by Emmett Williams.

The course of Hunt's ancestral Colorado River in the western Grand Canyon area is shown in Figure 14. Also see Figure 15. Thus three directions have been proposed recently for the exiting waters of a supposed ancestral Colorado River.

a. Southward up the Little Colorado River to the Rio Grande then into the Gulf of Mexico
b. Northwest into southern Utah
c. Southwest into Peach Springs Canyon across the Sacramento Wash to The Needles in California

Rice (1983) summarized the situation nicely and showed the possible suggested ancestral River paths. See Figure 16. Also see Corliss, 1988, pp. 215-217. Readers are urged to consult chapter 5 of the Institute for Creation Research guidebook on the Grand Canyon (Austin, et al., 1992, pp. 69-91). This book is an excel-

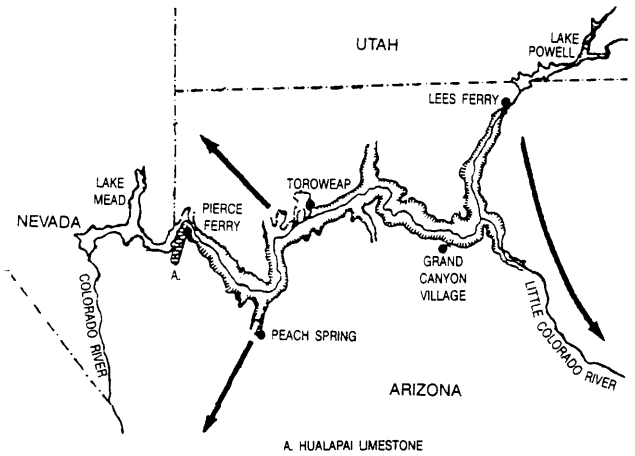

Figure 16. Proposed routes of the ancestral Colorado River in the Grand Canyon area indicated by arrows (after Rice, 1983). Drawing by Martha Smith.

lent scientific creationist study on all phases of the area's geology, biology, meteorology and archaeology.

The importance of basins and lakes on the Colorado Plateau, possible different climatic conditions and a discussion of possible mechanisms of rapid formation of the Grand Canyon will be presented in Part III.

Acknowledgement

The Research Committee of the Creation Research Society supplied funds for some of the field work involved in this research effort. This funding was made possible by donors to the Creation Research Society Laboratory Fund, interest from which was used. The authors appreciate this needed financial aid and thank everyone concerned.

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What does quantum physics reveal? That our world is more complex than most have ever dreamed. One scientist has noted that the universe seems "strangely overbuilt." Why is there such an intricate reality underlying a world that functions so ordinarily? He muses that it is as if God has created a beautiful, intricately-patterned golden chair and then overlaid it with common wood. The outside looks ordinary and functional, but within is a treasure waiting to be discovered and explored.

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