An Introduction to the Geology of Verde Valley, A Different Perspective

Van Andel Creation Research Center Field Study Note

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Abstract

The geology of Verde Valley in central Arizona near the Van Andel Creation Research Center is introduced. Characteristics of the Verde Formation are discussed along with the possibilities that it may have been deposited either from water being ponded by a lava dam blocking water flow out of the valley or from water being ponded in a closed graben. The development of the Mogollon Rim and the various gravel beds near or on the Rim are presented from the aspect of Flood geology. A monoclinal fold feature within the valley is examined. The many volcanic formations within the valley need to be studied to determine if they were deposited either subaqueously or subaerially. Suggestions are offered for possible creationist field work in Verde Valley.

Introduction

The Verde Valley of central Arizona is in the transition zone (formerly called the "mountain or central highlands region") between the Colorado Plateau and Basin and Range physiographic provinces (Figure 1). It is 20 miles wide and 30 miles long. The valley has as its boundaries, the Mogollon (muh-ge-own) Rim to the northeast, and the Black Hills to the southwest (Figure 2). The Black Hills separate Verde Valley from Chino Valley where the Van Andel Creation Research Center is located. As you drive from Chino Valley along U. S. Highway 89A, the first views of Verde Valley are from Mingus Mountain in the Black Hills (Figure 3).

The Valley has been inhabited by man for probably over 1000 years. An adequate water supply, particularly along the Verde River, which drains the valley, encouraged human habitation. The first white man entered the valley in 1583. Mining activity in Jerome was considerable from the late 1800's until 1953. Jerome, once a ghost town, is mainly a tourist attraction today with the Jerome State Historical Park Museum recalling the mining era. Camp Verde, Clarkdale and Cottonwood (Figure 4) are main towns in the valley. Sedona, in the beautiful red rock country just below the Mogollon Rim, is a center of the New Age movement and an artist's community catering to tourists.

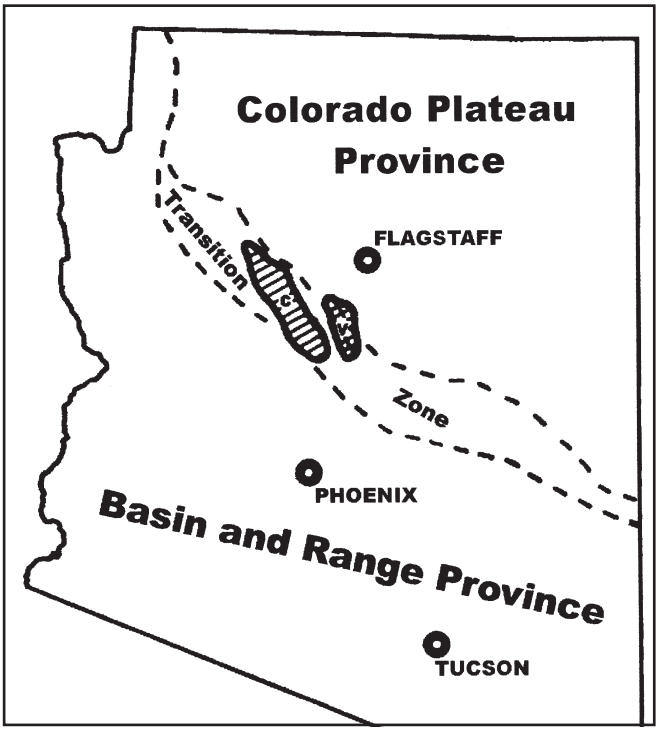

Figure 1. The locations of Verde Valley and Chino Valley within the Transition Zone physiographic province in Arizona (after Nations, Hevly, Blinn and Landye, 1981, p. 134). C: Chino Valley; V: Verde Valley.

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Received 15 March 1999; revised 19 April 1999

Figure 2. The Black Hills (in the background) as seen from Chino Valley, looking east on a cold March morning. Verde Valley is on the opposite side of the Black Hills.

Figure 3. Looking northeast into Verde Valley from Mingus Mountain in the Black Hills. The Mogollon Rim can be seen on the horizon forming the northeastern boundary of the valley.

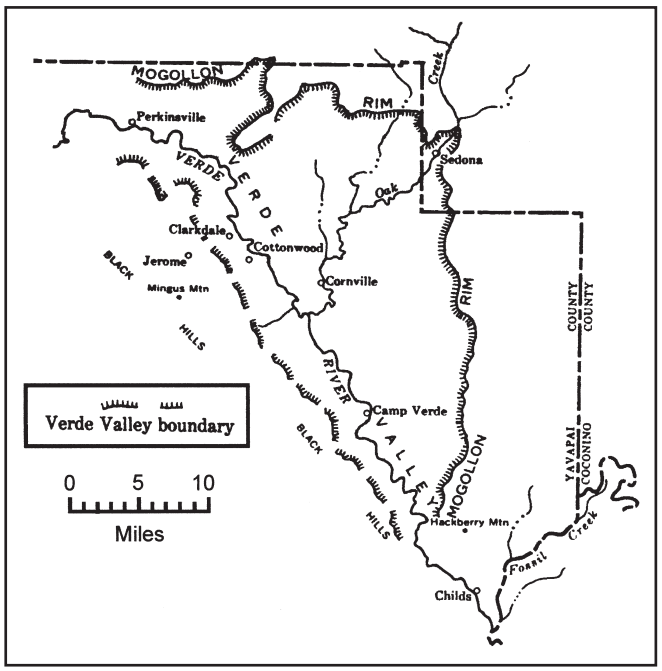

Figure 4. A map of Verde Valley in Yavapai and Coconino Counties, Arizona (after Twenter and Metzgar, 1963, p. 6).

Figure 5. Looking northeast into Verde Valley from the town of Jerome which was built along the trace of the Verde Fault. The vertical displacement along this fault is about 6000 feet (Ranney, 1989, pp. 7, 28; also see Lehner, 1958, pp. 572-573). The Mogollon Rim can be seen on the horizon.

Verde Valley has been downfaulted (Figure 5) from the surrounding landscape (Nations, Hevly, Blinn and Landye, 1981, p. 133; Chronic, 1983, p. xiii; Lindberg, 1986, p. 136) which suggests that the entire valley and the Black Hills were once part of the Colorado Plateau (Lindberg, 1986, p. 138). However Peirce and Nations (1986, p. 112) postulated that the southern margin of the Colorado Plateau (Mogollon Rim) may have developed by erosion in Oligocene time and not by later Miocene faulting. (Also see Peirce, Damon and Shafiqullah, 1979.) A discussion of these concerns will be presented later.

A reconnaissance was conducted to investigate the geology of Verde Valley. Creationist interpretations are needed for the origin of several interesting geological features in the region. Introductory comments are presented to acquaint creationists with field work opportunities near the Van Andel Research Center. It would be helpful in the future to perform an in-depth examination of the valley.

Verde Formation

Olaf Jenkins (1923, pp. 65–81) named and described the characteristics of the Verde Formation. This formation is unique to Verde Valley and covers an area of about 300

Figure 6. An outcrop of the Verde Formation along Highway 30 in Yavapai County where the highway crosses the Verde River near the town of Cornville.

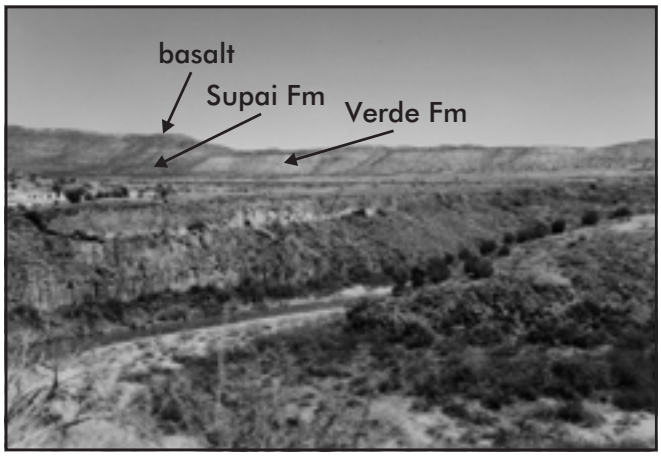

Figure 7a. A view from the Verde Canyon Railroad across Duff Flat which is underlain by lava flows. The Verde River has incised a steep wall gorge in the flows. Likely more water flowed in the Verde River in the past to form this box canyon. On the horizon, the limy beds of the Verde formation (on the right) uncomformably overlie the Supai Formation. A basalt layer caps the Supai. (Jenkins, 1923, p. 68; Mahard, 1949, p. 108, plate 4).

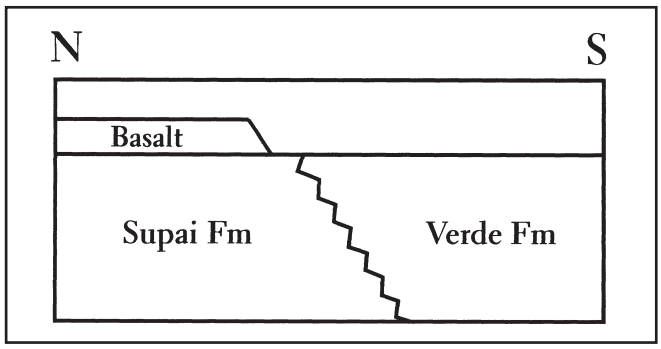

Figure 7b. Generalized stratigraphic relationship of the Supai and Verde formation contact in Figure 7a.

square miles. Jenkins (p. 69) noted that the formation consisted "...of white limestones, gravels, clays and saline materials." He claimed that the deposits developed:

> ...as the result of sedimentation, produced both mechanically and chemically, from a body of inland water, a lake of varying briny content, which was formed through the damming of the Verde River by surface lava flows (p. 69).

Mahard (1949, p. 104) measured two incomplete sections of the Verde formation and observed that it:

> ...is not composed of beds of material which were spread uniformly over wide areas but instead is built up of thin lenses of material of varying composition, the lenses overlapping and interfingering with one another.

Mahard identified limestones which he suggested "... were deposited in a series of playa lakes as marls" (p. 106). He found sandstones, siltstones, and claystones cemented by calcium carbonate within the formation. He speculated that salt bed deposition occurred by evaporation in an arid climate possibly in separate playas (p.107) and he also found lava flows interbedded with members of the Verde Formation.

Lehner, in his study of the Clarkdale Quadrangle (1958, pp.557, 559), noted that the Verde Formation is a thick limy lacustrine deposit consisting of fine-grained carbonate rocks including limestone, calcareous sandstone, limy siltstone and marl. He explained that gravel beds and basalt flows are marginal to and intertonguing with the carbonate rocks. Ranney (1989, p. 29) stated that the Verde Formation is composed of white limestone, brown mudstone, salt and other evaporites. He claimed that the formation is over 3000 ft. thick in the central portion of the Verde Basin. Nations, Hevly, Blinn and Landye (1981, p. 134) described the formation as "... a sequence of interbedded limestones, mudstones, sandstones, conglomerates, evaporites and volcanic rocks..." They discussed the types of fossils found within the formation (pp. 139–146). Anderson and Creasy (1958, p. 59) claimed that the Verde formation is lithologically diverse and its beds are lenticular or as Twenter and Metzger (1963, p. 49) so aptly commented that the formation "...is a complex assemblage of rocks having a variety of lithologic characteristics." Figures 6 and 7 show some outcrops of the Verde Formation. Concerning the postulated dam that supposedly ponded the water within the Verde basin, Mahard (1949, p. 104) explained:

> Jenkins' (1923) original hypothesis regarding the origin of Lake Verde required blocking of the Verde River by a basalt and pyroclastic dam 7 to 15 miles south of Camp Verde. No detailed study of the dam was attempted.... but a reconnaissance of the area reveals a series of flows and tuff deposits now deeply trenched by the Verde River, which are judged to be

Figure 8. Looking north and upstream along the Verde River from Childs, Arizona where a lava deposit could possibly have blocked any water flow from exiting Verde Valley in the past.

more than adequate to effectively impound the river waters.

Figure 8 shows a view in the lower Verde Valley where the river has cut through lava deposits. Nations et al. (1981, p. 133) noted that tectonism coupled with volcanic activity dammed the Verde Valley to allow accumulation of the sediments that comprise the Verde Formation. Ranney (1989, pp. 28–29) offered a different interpretation of how the waters became entrapped in the Verde basin. After the Verde Fault was active, causing the downdropping of 6000 ft. of rock to generate the Verde Valley,

Continued and rapid subsidence of the valley floor caused the Verde River to become sluggish and, eventually, impounded. (Initially geologists believed that lava from the Hackberry Mountain volcano, near Childs, had caused the river channel to become dammed, but recent studies on the age of these lavas suggests that they are too old) [p. 29].

Deposition of the Verde Formation — Young Earth Perspective

How did the water, from which the Verde Formation was deposited, become ponded in Verde Valley? Creationists (Austin 1996; Austin and Snelling, 1998; Snelling 1999a, b) have shown that potassium-argon and argon-argon dating of volcanic rocks often is unreliable. Thus the radiometric age of the lava that could have dammed water in Verde Valley is likely subject to the same errors. Therefore a volcanic rock dam in the valley cannot be ruled out as being too old to be involved in the ponding of water.

There is certainly a possibility that a lava dam upstream from Childs, Arizona (Figure 8) may have temporarily prevented water flow away from Verde Valley. Also downfaulting of the valley could have trapped water in the graben. Possibly after more field work, the following issues may be addressed.

- Was it a lava flow that dammed water in Verde Valley or did downfaulting accomplish the task or did both contribute?
- Was the water that was ponded in the valley, trapped Flood water?
- If it was trapped Flood water, was it enriched by precipitation during the post-Flood ice age?
- Did Flood water escape or evaporate either before the formation of a dam or before continued downfaulting closed the graben? Did a later lake form because of considerable ice age precipitation in the closed basin resulting in the deposition of the Verde Formation.
- How deep was the postulated lake or lakes? The Verde Formation is over 3000 feet thick at the center of the valley (Ranney, 1989, p. 29). The uniformitarian postulate of many playa lakes evaporating over thousands of years could cause the accumulation of 3000 feet or more of sediment. However from a young earth viewpoint, the evaporation of one sediment-laden deep lake in a brief period of time could account for thousands of feet of deposit.
- Was water being fed into a ponded lake from higher elevations on the Colorado Plateau during the period of deposition of the Verde Formation? Was this an occasional or a continual early post-Flood drainage?
- When did the trapped water in the valley finally breach or overtop any possible geographic obstacle initiating the flow of the ancestral Verde River? The Verde has incised lava flows (Figures 7 and 8) along its path and it appears that considerably greater volumes of water must have flowed along its course in the past because the present river is underfit.
- Was there any erosion of the Verde Formation as the newly-developed flow drained the valley?
- Possibly during a post-Flood drying period did a drop in the regional base-level and ground flow discharge cause a reduction in the flow volume of the Verde River? For a similar proposal, see Froede, 1996b.

The Mogollon Rim and "Rim Gravels"

The term, Mogollon Rim or Escarpment, (Figures 3 and 5) has been used to identify the southern topographic boundary of the Colorado Plateau province in Arizona. It has been suggested that the Rim is actually the southern terminus of the Permian cliff formers (Coconino, Toroweap and Kaibab formations) in central Arizona (Peirce and Nations, 1986; Peirce, Damon and Shafiquallah, 1979). Peirce (1984, p. 8) noted that:

> The Mogollon... Escarpment of central Arizona is one of the State's spectacular natural attractions, especially when viewed from the rim of its precipitate cliffs. The name "Mogollon" was apparently derived from Juan Iguacio Flores Mogollon, a former Governor of New Mexico during the period 1712–1715…

In the past the Rim frequently was called the Verde Breaks in the Verde Valley region (Mahard, 1949, p. 103).

There has been considerable discussion in the geologic literature whether the rim has resulted primarily from the process of either erosion or faulting. Now, however, it is considered that erosion was the major actor in producing the rim with faulting playing a lesser role (Hunt, 1956; Lehner, 1958, p. 516; McKee and McKee, 1972; Peirce, Damon and Shafiquallah, 1979; Nations et al., 1981, p. 133; Peirce and Nations, 1986; Ranney, 1989, pp. 24–28; 1990, pp. 52–57). And it is thought that continual erosion has caused the ancestral rim to retreat about 4 to 5 miles to its present position (Ranney, 1990, p. 53), leaving isolated buttes and mesas as remnants of the Plateau cliff formers in Verde Valley (Mahard, 1949, p. 103: Lehner, 1958, p. 516; Beus, 1999). A generalized stratigraphic column of the valley is shown in Figure 9.

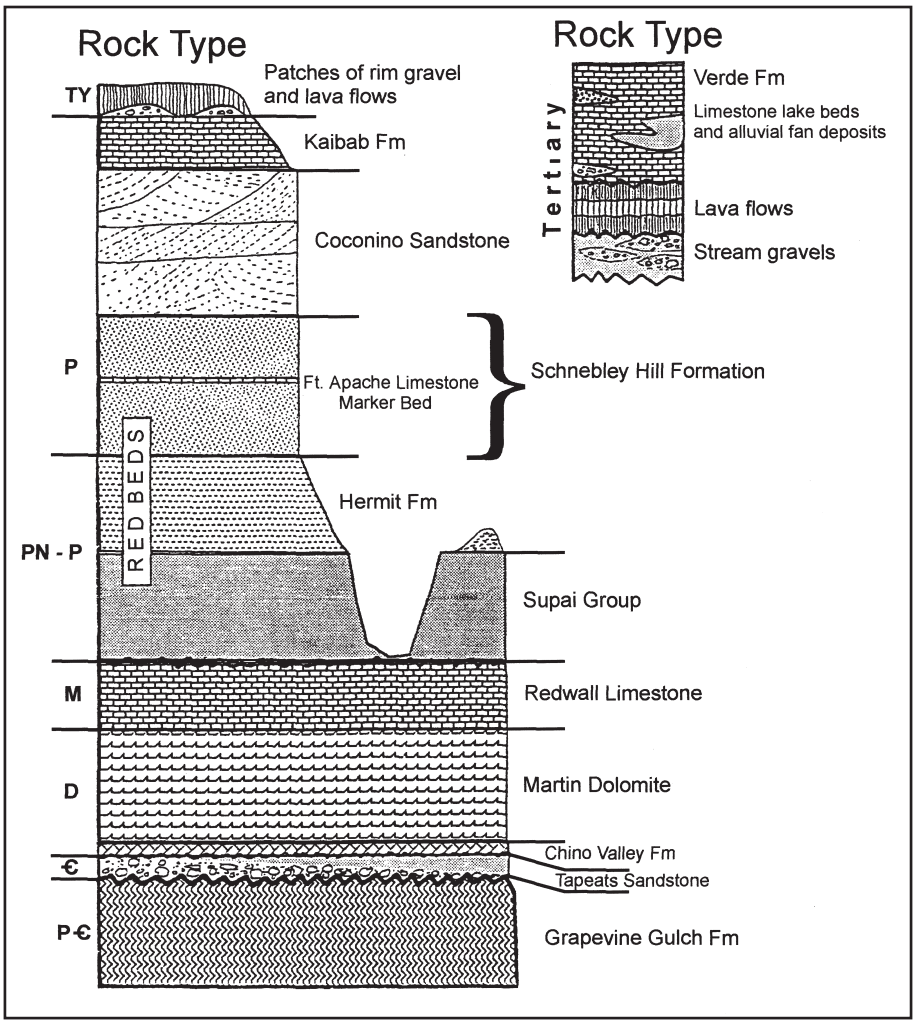

Figure 9. Stratigraphic column of Verde Valley (after Beus, 1999)
PC: Precambrian M: Mississippian TY: Tertiary
C: Cambrian PN-P: Pennsylvanian-Permian
D: Devonian P: Permian

Deposits of gravel have been found on the Colorado Plateau near the Mogollon Rim as well as just below it. The deposits on the rim are referred to as "Rim gravels", which likely were transported from the south to their present position. A different deposit of gravel, located at the foot of the rim is the Beavertail gravels. They consist of two types of gravel, the lower deposit contains angular cobbles from the Kaibab and Coconino formations. The upper gravel deposit of rounded pebbles are considered to be Paleozoic and Precambrian in the uniformitarian scheme. The lower layer of gravels is thought to be talus debris from the ancestral Mogollon Rim and the upper layer likely was transported from the south as the "Rim gravels" were. Another recognized deposit—Slide Rock gravel—probably was derived from the north and transported southward. For discussions and locations of these deposits, see Ranney, 1989, pp. 24–28; Peirce and Nations, 1986.

All of the gravel beds have been employed to suggest a uniformitarian history of the region including the location of the ancestral Mogollon Rim. These deposits need to be interpreted within a Flood framework as Klevberg (1998) did with the Big Sky Paving gravel in Montana. For instance, the Arizona gravel deposits discussed above are considered to be fluvial in origin. However some of the gravels may have been deposited by late-stage Flood currents, eroding recently deposited sediments and moving the debris northward. Other gravel beds may have been left by retreating Flood water.

Both the development of the Mogollon Rim and the placement of the gravel deposits need to be cast into a creationist framework and time table.

Figure 10a. The railroad bend structure. a monocline. along the Verde River approximately seven miles north of Clarkdale, Arizona.

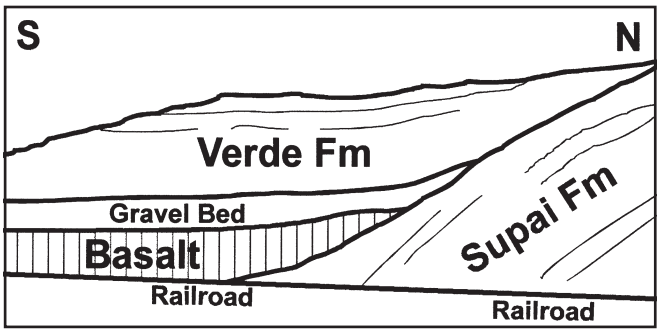

Figure 10b. A schematic diagram illustrating the relationship of the geologic formations in the railroad bend structure (after Mahard, 1949, plate, 9).

Railroad Bend Structure

About seven miles north of the Verde Canyon Railway depot at Clarkdale is a railroad cut along the Verde River where the river enters the box canyon shown in Figure 7. Along the cut is a unique geological feature (Figure 10a) which Mahard (1949, pp. 122–123) called the railroad bend structure. This feature, where the Verde Formation is in contact with the Supai Formation, was described by Jenkins (1923, p. 70). The Verde overlies a gravel bed which rests on a basalt layer (Figure 10b). Jenkins identified a fault between the Supai, the basalt and the lake deposits of the Verde Formation.

However Mahard identified the feature as a monoclinal fold. He did not find a fault between the lava and the Supai, but he detected some evidence of baking at the contact. The gravel layer consists mainly of Supai cobbles. It maybe of interest to carefully examine this fold and interpret the timing of the events that led to the development of this feature in the context of the Flood and its aftereffects.

Volcanics and Mineral Deposition

Verde Valley contains many volcanic rocks in the form of basalt, rhyolite (Figure 11), tuff and gabbro. Thus any creationist speculation concerning the geologic history of the valley must account for this volcanic activity. Particularly it would be helpful to identify which lava flows possibly formed under either subaqueous or subaerial conditions.

It is known that the massive sulfide (copper ore) deposits in the Jerome area were deposited subaqueously along with adjacent volcanic formations (Anderson and Nash, 1972; Lindberg, 1986; Ranney, 1989, pp. 2–8). The presence of pillow lava structures convinced geologists that these materials were deposited subaqueously. However pillow lava is not the sole indicator of subaqueous lava flows. It is now known that sheet flows of lava occur subaqueously without the formation of pillow lava (Fisher, 1984; Kennish and Lutz, 1998). Even welded tuff has been reported to be formed underwater (Kokelaar and Busby, 1992). These changing concepts may encourage creationists to view volcanic rocks in a different light to determine if they were deposited underwater during the Flood (Froede, 1996a; 1999; Williams, 1998; Williams, et al., 1998). Possibly some volcanic rocks once thought to have formed after the Flood may have been deposited during the Flood.

Conclusions

An introductory examination of the geology of Verde Valley from a creationist perspective has been completed. Possible young earth-Flood model applications have been suggested. The Van Andel Creation Research Cen-

Figure 11. Spires of Deception rhyolite in Deception Gulch southwest of Jerome, Arizona.

ter (VACRC) offers a location from which field studies of Verde Valley can easily be accomplished. Also John Meyer's knowledge of the region could facilitate any future field work. It is hoped that other field workers will examine this beautiful valley and present ideas on its origin in relation to the Flood.

Major items of study in the valley may include a careful delineation of the Verde Formation with the timing and conditions of deposition. It appears that 3000 feet or more of sediment may have accumulated from a deep body of water in the late stages of the Flood or soon thereafter. This body of water could have maintained considerable depth for sometime if continual or intermittent drainage from the Colorado Plateau supplied water into the closed graben. Also high amounts of post-Flood precipitation could have added water to the lake. A study of the development of the Mogollon Rim—whether by erosion or faulting— is encouraged. The relationship of the various gravel deposits around the rim to the Flood dynamics could be analyzed. The volcanic layers within the valley can be studied to determine if the formations developed subaqueously or subaerially which may yield evidence of the timing of the origin of the valley. These and other subjects would provide enjoyable research close to the VACRC.

Acknowledgments

The authors thank the many donors to the Creation Research Society Research Fund, interest from which financed a portion of these studies. We are grateful to Carl R. Froede, Jr. for his help and interest in this project and for doing the graphics for the figures.

Appendix

Prior Creationist Efforts on the Colorado Plateau and Transition Zone of Arizona

Creationists have done considerable field work on the Colorado Plateau. Much of this work has been summarized in Froede et al., 1997. References for the work of Steve Austin and Walter Brown on the plateau can be found in this article as well as previous studies sponsored by the Creation Research Society. Included are reference to canyon formation papers, Kaibab squirrel investigation, biological isolation study, Arizona meteor crater effort, strata interbedding work and ichnofossil speculations. This research was done by Jeremy Auldaney, Don DeYoung, George Howe, the late Walter Lammerts, John Meyer, Paul Rosnau, Bill Waisgerber, Emmett Williams, and Glen Wolfrom.

The geomorphology of Arizona was discussed in Froede et al., 1997. The Pikes Peak Iron Formation was the subject of Froede et al., 1998a. An early Flood setting was proposed for the origin of this banded iron material. Intrusive and extrusive volcanic rocks around VACRC were examined by Froede et al., 1998b who suggested that the intrusive volcanics were formed subaqueously, whereas the extrusive deposits formed after the Flood.

More ichnofossil work (Auldaney et al., 1997a, b) has been reported as well as a study on the origin of Kanab Canyon on the Colorado Plateau (Williams, Goette, Meyer, 1997).

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It is absurd for the Evolutionist to complain that it is unthinkable for an admittedly unthinkable God to make everything out of nothing, and then pretend that it is more thinkable that nothing should turn itself into anything.

Thomas Aquinas