Sequatchie Valley Tennessee and Alabama: A Different Approach

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Abstract

The origin of Sequatchie Valley is viewed from a uniformitarian approach. In contrast, the origin of the valley is proposed from a young earth-Flood perspective. Also considered are the Tennessee River water gap in Walden Ridge, Tennessee, the Mississippian-Pennsylvanian boundary problem in the region and evidences of high-energy deposition on Walden Ridge and Sand Mountain, Alabama.

Introduction

Sequatchie Valley is a long, relatively narrow valley in Tennessee and Alabama and in places it is quite picturesque. Geological studies have been conducted on the many features as well as the structure of the Valley. These studies will be reviewed and an origin of the Valley from a Flood-young earth perspective will be postulated.

Miller (1974, p. 4) noted that Sequatchie Valley "...is one of the largest and most spectacular anticlinal valleys in the world." See Figure 1. The valley extends approximately 200 miles from east-central Tennessee almost in a straight line into northeastern Alabama (Mills, 2002; Smith, 2000, p. 4; Martin 1940, p. 15). See Figure 2. Harris and Milici (1977, p. 24) also commented on the beauty of the valley. "Breached by erosion along most of its length the Sequatchie anticline forms one of the most scenic valleys in east Tennessee."The extension of the valley into Alabama is sometimes called Browns Valley which is less prominent than the section in Tennessee. The damming of the Tennessee River forming Guntersville Lake also covers much of the valley in Alabama.

The valley is located within the Cumberland Plateau and is bounded on the southeastern side in Tennessee by an escarpment, Walden Ridge, which in Alabama is called Sand Mountain. The Tennessee River separates the two heights by a water gap cut into the ridge. The Cumberland Plateau forms the boundary on the northwestern side of the valley in Tennessee and Alabama. The valley is within the Appalachian Plateaus physiographic province (Mills, 2002; Raymond, et al., 1988, pp. 1, 2; Milici, 1960, p. 79). It is considered by some investigators to be one of the most perfect or classic examples of an anticlinal valley in the world (Crawford, 1989, p. 1; Martin, 1940, p. 16).

Figure 1. A portion of Sequatchie Valley near Dunlap, Tennessee. The Cumberland Plateau escarpment can be seen in the background.

Topography of the Valley

Milici (1960, p. 3) described the topography of the valley in Tennessee as:

> ...the relief and pronounced linearity of the valley, and the consistently rugged valley walls, are the most striking topographic features of the structure. Maximum eleva-

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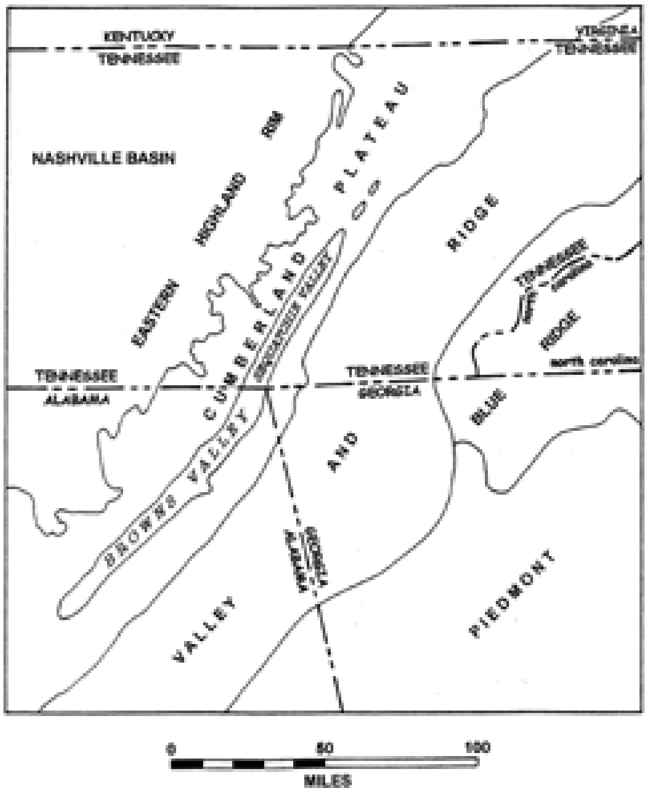

Figure 2. The location of Sequatchie Valley in Tennessee and Browns Valley in Alabama (after Milici, 1963, p. 816). Drawing by Mary Elizabeth Akridge.

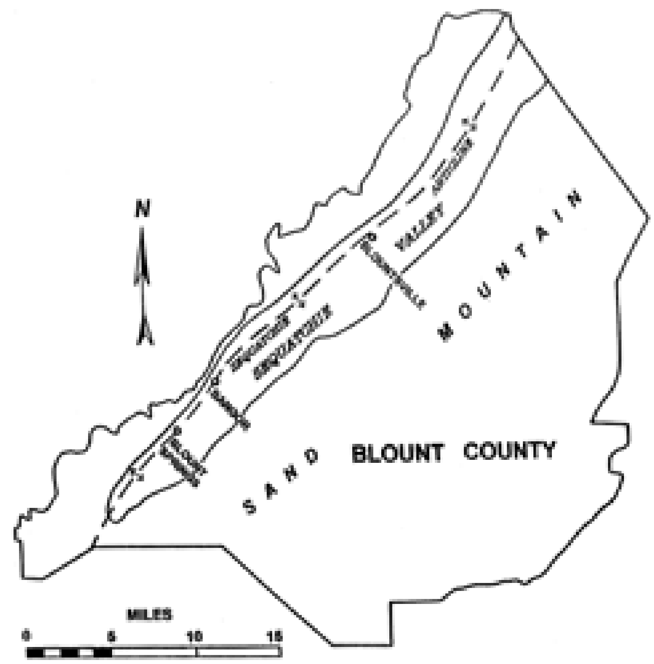

Figure 3. The terminus of Sequatchie Valley in Blount County, Alabama. Note that the modern terminology is Sequatchie Valley in Alabama (after Faust, 1984, p. 2). Drawing by Mary Elizabeth Akridge.

> tions of the eastern valley wall, which ranges in altitude from 2000 feet in the southern part of the area mapped to 3000 feet at the head of the valley, are generally 100 to 400 feet greater than those at the western side of the valley. The relief from the top of the Cumberland Plateau to the floor of the valley is consistently greater than 1000 feet throughout the length of the Sequatchie Valley from the Tennessee-Alabama state line to the head of the valley.

The width of the valley in Tennessee varies from 4 to 5 miles (Miller, 1974, p. 4).

Sand Mountain in northeast Alabama has an altitude of 1400 to 1500 feet and is 1000 feet above the valley floor (Wilson, 1975, p. 20) which is approximately four miles in width at Stevenson, Jackson County (approximately 8 miles directly south of the Tennessee-Alabama state line). Further southwest, the valley floor widens in places to about five miles. (It is difficult to determine the width of the valley floor where Guntersville Lake is ponded.) Then in Blount County the floor width begins to decrease as the valley ends below Blount Springs (Figure 3). The height of Sand Mountain decreases to approximately 1000 feet, whereas Blount Springs has an altitude of 500 feet above sea level near the termination of the valley. "Sequatchie Valley [in Alabama] is characterized by the presence of sandstone ridges and moderate relief"(Raymond et al., 1988, p. 1) [Brackets added].

Sequatchie Anticline

Milici (1967, p. 179) stated that the:

> Sequatchie anticline is an isolated Valley and Ridge-type structure situated in gently dipping and only locally deformed rocks of the Cumberland Plateau of Tennessee and Alabama...The structure...parallels the regional trend of the Appalachians...

Also see Crawford (1989, p. 1; 1981, p. 18).

The anticline (Figure 4) is reflected along most of its length by Sequatchie Valley, however on the northeastern end of the valley, the anticline formed Crab Orchard Mountains which consist of massive unbreached sandstone. "The anticline dies out to the northeast and disappears at Emory River fault zone" (Gaydos et al., 1982, p. 8) [Figure 5]. Southwestward, the surface effects of the anticline end in western Blount County, Alabama (Figure 3), where as Thomas (1972, p. 7) described "...Mississippian rocks plunge beneath the Pennsylvanian." The anticline has been traced subsurface across western Jefferson County, Alabama where it apparently ends (Figure 6).

Figure 4. An outcrop of St. Louis Limestone in the gently-dipping southeastern limb of the Sequatchie anticline along Tennessee Highway 30 near Pikeville. The valley is to the left of the photograph indicating the convex upward nature of the fold.

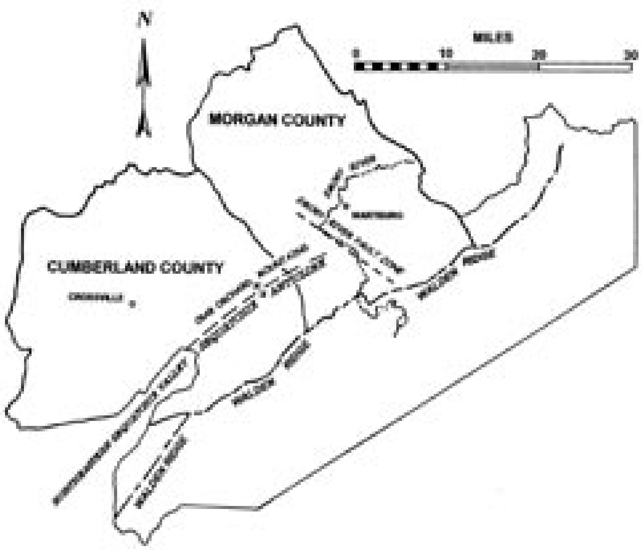

Figure 5. The northeastern termination of Sequatchie anticline at the Emory River fault zone in Morgan County, Tennessee (after Gaydos et al., 1982). Drawing by Mary Elizabeth Akridge.

Miller (1974, p. 42) commented that generally the axis of the anticline in Sequatchie Valley, Tennessee is parallel to that of the valley. Earlier, Martin (1940, pp. 101–102) suggested that the axis of the anticline is well over toward the northwestern flank of the fold and cannot be definitely placed. Rogers (1950, p. 674) was impressed by the isolation of the anticline since the feature is related to the folds of the Appalachian Valley and Ridge province yet it is the

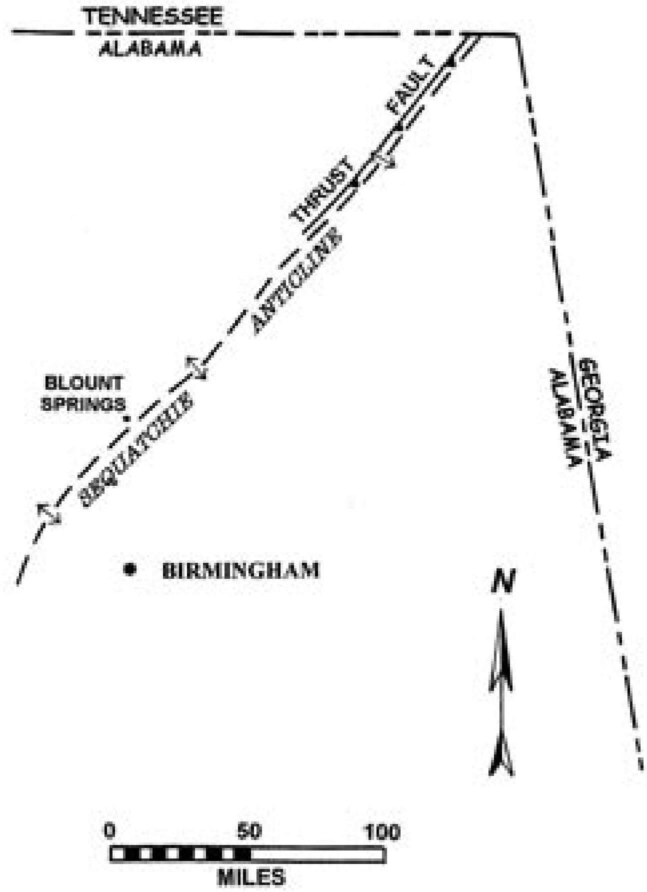

Figure 6. Trace of the Sequatchie anticline in Alabama (after Thomas and Neathery, 1980, p. 473). Drawing by Mary Elizabeth Akridge.

most northwestern of such folds separated from the others by Walden Ridge and Sand Mountain which are at least seven miles wide and are underlain by undisturbed, flat Pennsylvanian rocks.

In discussing the Cumberland Plateau, Rogers (1970, p.23) explained that:

> ...the Plateau is split lengthwise by Sequatchie Valley... where the straight Sequatchie anticline...has lifted up the resistant Carboniferous...sandstone layers and exposed the less resistant strata beneath.

At the crest of the anticline, resistant Pennsylvanian sandstones were breached by erosion. The underlying Mississippian and Ordovician limestones which then occupied a structurally higher position than normal in the core of the anticline core were more extensively eroded (Mies, 1999, p. 3).

An excellent overview of the anticline is given by Thomas and Bearce (1969, p. 26):

> The Sequatchie anticline is the most northwesterly structure of the southern Appalachians. It is an elongate

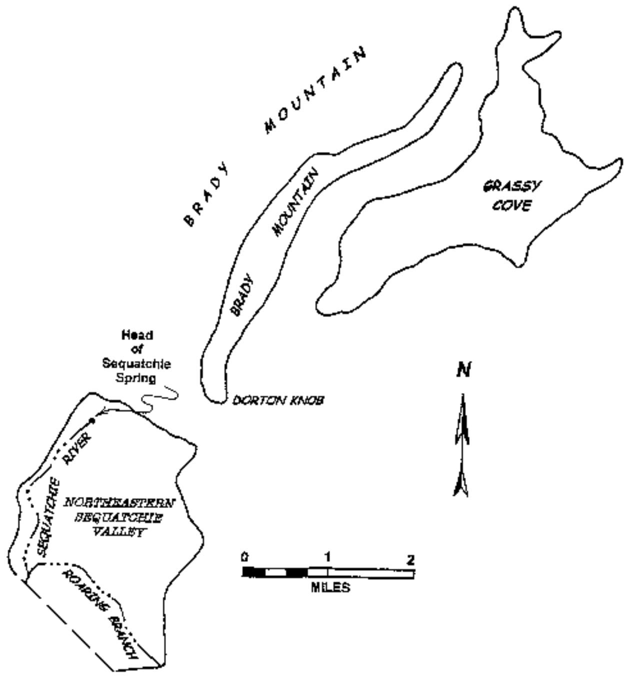

Figure 7. Location of Grassy Cove in relation to Sequatchie Valley. Only the uppermost heights of Brady Mountain are shown. Outlines are only approximate (after Crawford, 1989). Drawing by Mary Elizabeth Akridge.

> asymmetric anticline that extends 250 miles from Morgan County, Tennessee, to Jefferson County, Alabama... [This distance includes the known subsurface trace of the anticline]. The northwest limb of the anticline is steep along its entire length; and, a thrust fault extends along the northwest flank of the anticline from near its northeastern end 150 miles southwestward... The anticline is essentially non-plunging except within a few miles of each exposed end. It maintains uniform structural relief relative to the beds in the Cumberland Plateau ...South of Grassy Cove, Tennessee, [Figure 7] the anticline rises to its maximum structural relief which is maintained for more than 150 miles southward beyond Guntersville, Alabama... [Brackets added].

Figure 8 illustrates the asymmetric nature of the Sequatchie anticline.

Sequatchie Thrust Fault

The Sequatchie anticline was formed by thrust faulting (Milici, 1967, p. 191). "The western flank of the anticline is broken along most of its length by a generally southwestward-dipping overthrust" (Milici, 1963, p. 819). The overthrust has been traced on the surface from Devilstep

Figure 8a. Steeply-dipping Pottsville strata on northwestern limb of the asymmetric Sequatchie anticline.

Figure 8b. Gently-dipping Bangor Limestone over a tongue of clay shale on the gently-dipping southeastern limb of the asymmetric Sequatchie anticline. These photographs were taken along Interstate 65 in Blount County, Alabama, near exit 287.

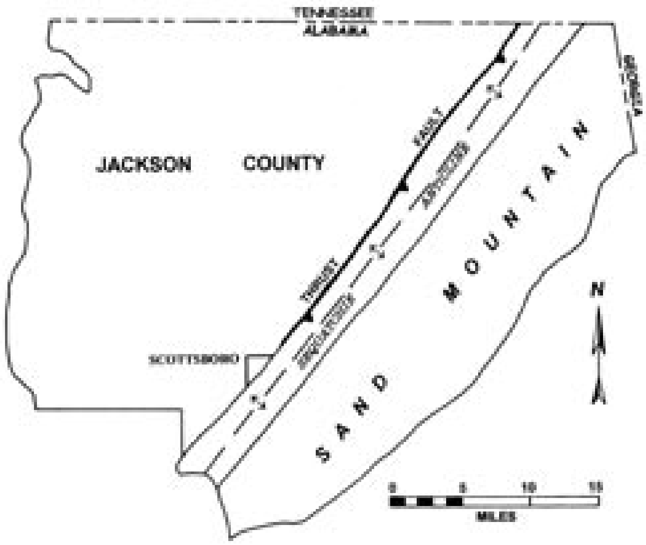

Figure 9. Trace of the Sequatchie thrust fault as it apparently ends north of Scottsboro, Alabama (after Thomas, 1972). Drawing by Mary Elizabeth Akridge.

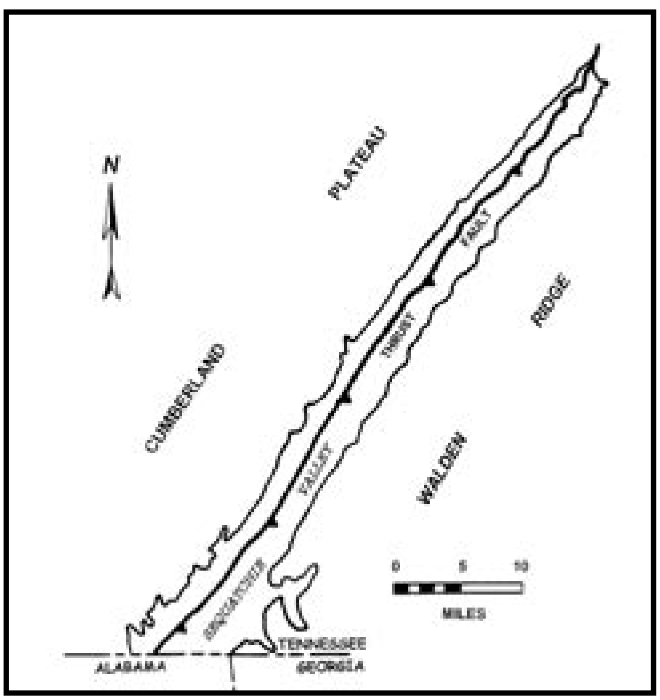

Figure 10. Trace of Sequatchie thrust fault in Tennessee (after Milici, 1960, p. 55). Drawing by Mary Elizabeth Akridge.

Hollow (Vandever and Grassy Cove Quadrangles) at the southwestern base of Brady Mountain in Tennessee (Figure 7) into northeastern Alabama where it ends just north of Scottsboro (Figure 9) [Thomas, 1972, plate 8; Thomas

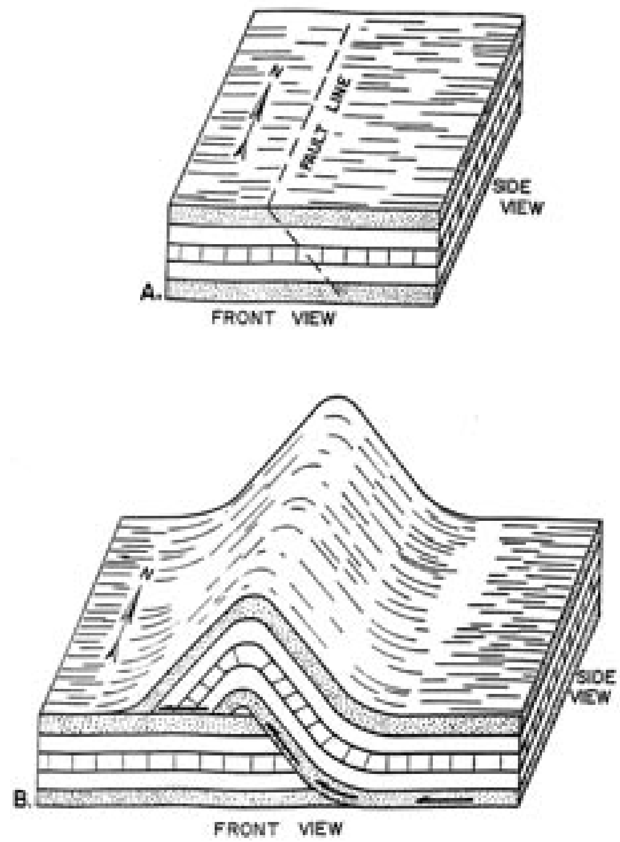

Figure 11. Block diagrams illustrating possible mechanism of formation for Sequatchie anticline; A. Trace of fault before thrusting; B. Resultant anticline after thrusting. Erosion of the anticline would expose older formations in valley floor (after Churnet, 1997, pp. 48, 49). Drawing by Mary Elizabeth Akridge.

and Neathery, 1980, p. 473]. The fault has been found subsurface in an oil test well near Crab Orchard, Tennessee about 10 miles southeast of Crossville.

> Stratigraphic displacement along the fault increases from a few hundred feet in the northern portion of Sequatchie Valley to approximately 2500 feet near Dunlap, Sequatchie County, Tennessee. This displacement persists southwestward to the Tennessee-Alabama line. In Alabama the displacement decreases from approximately 2200 feet near Stevenson, Jackson County, to nil at the southwestern terminus of the fault (Milici, 1963, p. 820).

A trace of the thrust fault in Tennessee is seen in Figure 10. A suggested sequence for the development of the anticline by thrust faulting is illustrated using block diagrams (Figure 11).

The relationship of the Sequatchie overthrust to the Cumberland Plateau has been discussed by geologists. Wilson and Stearns (1958, p. 1286) noted that: "The thin

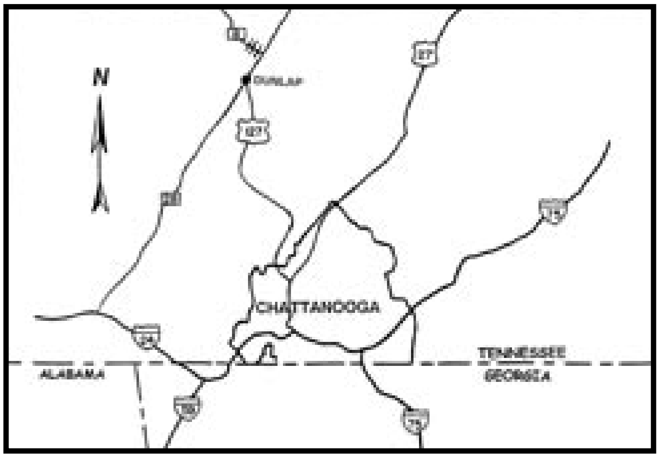

Figure 12. Location (dashed lines) of decollement zone in Cumberland Plateau adjacent to Sequatchie Valley. Drawing by Mary Elizabeth Akridge.

Cumberland Plateau overthrust sheet is interrupted by the deeper-seated prominent Sequatchie Valley anticline." Milici (1963, p. 824; 1960, p. 72) felt that the two overthrusts are the same structure. Wilson and Wojtal (1986, p. 143) consider that:

> ...the Cumberland Plateau is split by the Sequatchie Valley. This valley over 1600 ft...deep for most of its length, has also breached the Cumberland Plateau sheet and divides it into two parts. The trailing edge of the western part of the Cumberland Plateau sheet, the Cumberland Plateau thrust, is exposed along the west wall of the Sequatchie Valley. The leading edge of the eastern part of the Cumberland Plateau sheet, the Sequatchie Valley thrust, crops out along the west side of the valley floor... The two faults join at the north end of the Sequatchie Valley indicating that the Cumberland Plateau thrust is an upper glide horizon associated with the steeply dipping Sequatchie Valley thrust...

Evidence of tectonic activity along the Cumberland Plateau thrust can be seen in a decollement zone at Dunlap, Tennessee along Tennessee Highway 8 from the intersection of U.S. Highway 127 for approximately two miles (Figures 12 and 13). Differences in opinion exist concerning the folding and faulting in the region of the Sequatchie anticline and Cumberland thrust sheet which are beyond the scope of this paper (Hawkins, n.d.; Wilson and Wojtal, 1986).

It has been conjectured that during the massive Appalachian faulting and folding, Walden Ridge and Sand Mountain were transported westward closer to the main Cumberland Plateau (Rogers, 1950, p. 677). Churnet et al., (1985, p. 34) claim that: "Walden Ridge is an allochthonous block which moved to the west on the Sequatchie thrust fault. The westward movement was accompanied by folding."

Uniformitarian Model for the Development of Sequatchie Valley

It is assumed that forces associated with the Allegheny orogeny during the late Paleozoic Era extended as far west as the present location of Sequatchie Valley. The Sequatchie anticline was formed by thrust faulting during this orogeny. Sequatchie Valley in Tennessee is believed to have developed during a period of Mesozoic erosion which reduced the anticlinal structure to a valley (Miller, 1974, pp. 42–44). Miller's model is illustrated in Figure 14 using block diagrams.

Milici (1967, p. 179) believed that: "Sequatchie Valley drainage is tributary to the Tennessee River, which flows through part of the valley, and is intimately related to the development of that river." He suggested that "The Tennessee River probably eroded headward across the Sequatchie anticline during the Mesozoic and initiated formation of the Sequatchie Valley"(Milici, 1967, p. 180). Thus considering Figure 14 with Milici's postulation that the Tennessee River captured the Sequatchie Valley drainage, this sequence of events started the northeastward advance of the valley into east Tennessee by headward erosion.

The process of headward erosion occurred in the following manner "...Pennsylvania formations were breached and the Pennington shales were exposed along the crest of the structure [Sequatchie anticline]..." (Milici, 1967, p. 183) [Brackets added]. Once the resistant Pennsylvanian mate-

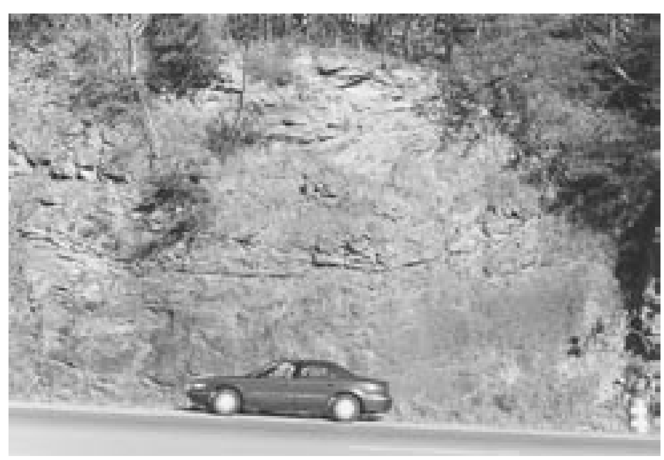

Figure 13. Folding caused by faulting in decollement zone in the Lower Gizzard Group along Tennessee Highway 8 (automobile for scale).

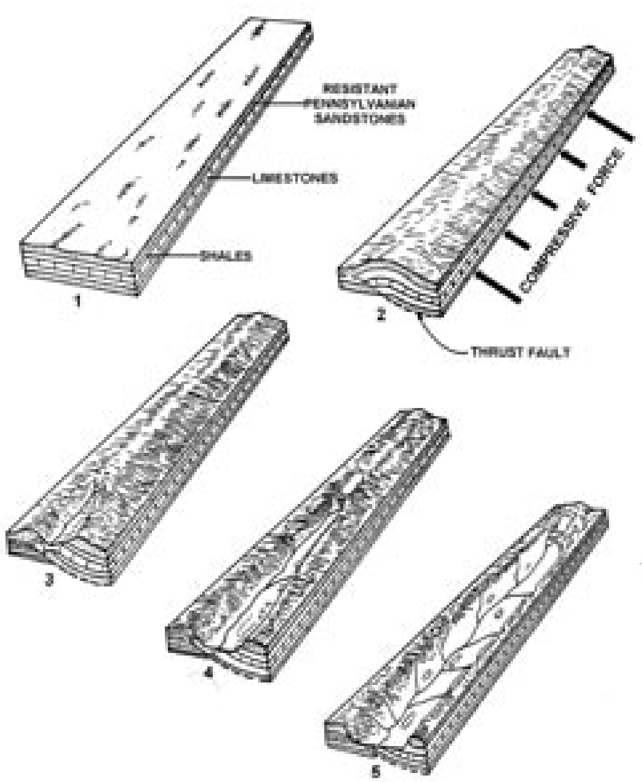

Figure 14. Uniformitarian model for the development of Sequatchie Valley using block diagrams (after Miller 1974, p. 33). Drawing by Mary Elizabeth Akridge.
1. Flat-lying sediments prior to Allegheny Orogeny.
2. Anticline formed by thrust faulting during orogeny.
3. Tennessee River begins to erode headward after capturing drainage from ancestral Sequatchie River on crest of anticline.
4. Resistant sandstones have been removed in lower valley as sinkholes form at head of valley as headward erosion continued.
5. Present headward erosion continued up the valley by the same means as 4. Present valley configuration showing karst valleys (coves) at head of valley.

Figure 15. Grassy Cove, Tennessee.

Figure 16. Head of Sequatchie Spring or McWhorter Spring at northeastern head of Sequatchie Valley. This spring is on private property.

rial has been penetrated, the underlying less resistant shales and limestones were easily eroded or dissolved, continuing the advance of the valley toward the northeast. Once water entered the structurally elevated limestones along the anticline, underground solution of these rocks undermined overlying strata as the valley advanced headward.

Proof offered for this erosive and solutional action is the continuing slow process of valley advance. At the northeastern head of the valley (Figures 5 and 7), the Sequatchie River begins at the Head of Sequatchie Spring [Vandever Quadrangle] (Figure 7) and other springs which are fed by underground movement of water from coves northeast of the valley head. These coves, the largest of which is Grassy Cove, (Figure 15) are karst valleys or large sinkholes floored by Mississippian carbonates. Milici (1967), Miller (1974) and Lane (1957) predict that these karst valleys will eventually become part of Sequatchie Valley as the solutional cavities increase in size, eventually undermining the overlying sediments in a continuing headward growth of the valley.

In a recent field study centering on Grassy Cove [which Crawford (1989, p. 1) thinks is the largest karst depression in North America], it was noted that the cove is drained by Cove Creek into Mill Cave with the water flowing underground below Brady Mountain [Grassy Cove Quadrangle] (Figure 7) and resurfacing at Head of Sequatchie Spring (Figure 16) in the Sequatchie Valley. Crawford (p. ix) claimed that:

> ...conduit caves form by subterranean invasion of aggressive caprock streams as they breach the clastic Pennsylvanian caprock of the Cumberland Plateau and invade the underlying Mississippian carbonates. If the gradient of a caprock stream is less than the dip of a structural high (such as an anticline), it will eventually cut through the caprock into the underlying limestone. As the water of the caprock stream which is aggressive to calcium carbonate, begins to flow through the joints and bedding planes of the underlying limestone to a resurgence near the base of the Cumberland Plateau Escarpment, corrosion and corrasion will enlarge the most efficient route, thus creating a conduit cave. Slope retreat by the sapping of underlying limestones from under the sandstone caprock will proceed in all directions...resulting in a karst valley...

Continuing this line of reasoning, Crawford (p. ix) concluded:

> Along the Sequatchie anticline, subterranean stream invasion, conduit cavern development, and the growth of karst valleys have played and continue to play a major role in changing anticlinal mountain into anticlinal valley, The anticlinal mountain is first reduced to karst valleys as surface-flowing streams are diverted underground, and finally the karst valleys are assimilated into the Sequatchie Valley itself as it advances headward up the Sequatchie Anticline.

Sapping of the Pennsylvanian strata along the Cumberland Plateau escarpment can occur with subsequent collapse of large blocks of Pennsylvanian rocks onto the valley floor (Figure 17). Over 60 years ago Martin (1940, p. 125) found an oval-shaped sink west of Grassy Cove that was 75 ft. by 300 ft. where portions of Pennington and Gizzard material had collapsed into a large cave in the underlying Bangor Limestone indicating the recent occurrence of the sapping phenomena. Also solution cavities (Figure 18) were seen along the limestone outcrop mentioned earlier (Figure 4). Such solution tubes would likely become enlarged with continued water flow through them.

If the present is the key to the past, all that is necessary for such a process to form Sequatchie Valley is enough time—approximately 65–230 million years would have elapsed to reduce the anticline to the present valley and the headward erosion continues slowly in the present.

Consider the southwestward development of Sequatchie Valley in Alabama. Assuming that the intense Mesozoic erosion breached the anticline in northeast Alabama, the flow of the Tennessee River may have been trapped in the breached anticline (Milici, 1968, p. 477) and its flow would continue the headward erosion process downstream. However about 60 miles downstream near present-day Guntersville, crustal movements possibly blocked the southwest flow and caused the river to change course to a northwest direction. Weathering continued to erode the valley in a southwest direction until the resistant Pennsylvanian Pottsville was not breached where the valley ends in Blount County (Figure 3). Another factor that would inhibit further valley extension is that the anticline plunges at the southwestern end of the valley (Thomas and Bearce, 1969, p. 26) just as it plunges at the northeastern end of the valley.

Tentative Flood—Young Earth Speculations: Sequatchie Valley

Sediments in the Sequatchie Valley region were deposited during the Flood. The clastic sandstones were derived possibly from eroded antediluvian mountains (Whitcomb and Morris, 1963, p. 215) or from erosion of the recently-uplifted

Figure 17. Cumberland Plateau escarpment. Sections of the face likely removed by cliff sapping are seen in foreground.

Figure 18. Solution cavity in St. Louis Limestone at outcrop along Tennessee Highway 30.

Appalachians (Froede, 1998, p. 70). During the recessional stage of the Flood, as the level of water dropped, the crust of the earth likely would rebound. This effect could have caused mountains such as the Appalachians to be uplifted. Subsequently, the Sequatchie Valley anticline may have developed in the latter period of the Appalachian thrusting and folding event.

During this time frame the recently deposited sediments were water-laden and probably quite plastic as overthrusting produced the structural height (anticline). If such a process did occur, there possibly would have been cracking or faulting along the anticlinal crest (see Oard, 2001, p. 86) as a result of the considerable strain placed on the crest by the upward movement.

As Floodwater continued to recede, the rapidly moving fluid containing abrasive particulate material would carve a channel along the crest of the anticline. This erosive action would deepen the channel into a valley. The almost straight line of Sequatchie Valley may be testimony to this action. Once the anticline plunged where massive sandstone deposits were formed (at each end of the valley), little erosion occurred and the headward advance of the valley was terminated. In the lower reaches of the valley in Alabama beyond where the Sequatchie thrust died out, channelized Flood currents would carve a depression not as spectacular as the valley is along the thrust fault since the thrusting caused the elevation of easily-erodible shales and carbonates closer to the anticlinal crest.

During the warm, wet post-Flood ice age (Oard, 1990), the coves above the northeastern terminus of the valley started forming. The consolidated, dewatered resistant sandstone caprock may have been breached in places. The less resistant shales and carbonates below the surface strata would act as ideal channels for water entering the breached sections to form solution cavities. Sinkholes also formed and subterranean water-flow would enlarge existing cavities into caves. Eventually the aggressive water would emerge at the head of Sequatchie Valley. In many places the sandstone surface cover would collapse into sinkholes or suffer cliff sapping after being undercut. Thus the coves expanded and Sequatchie Valley continued forming headward. This process likely slowed after the ice age to the present rate of valley headward erosion.

Appendix I

Lithology of Certain Formations in Sequatchie Valley Region

Brief lithogies of the geologic formations discussed in this paper are given by state and in descending order from youngest to oldest.

ALABAMA

System	Formation	Lithology
Pennsylvanian	Pottsville	sandstone, shale, siltstone containing coal beds (a)
Mississippian	Pennington	succession of shale, dolostone and limestone (b)
Mississippian	Bangor Limestone	bioclastic and oolitic limestone (c)

TENNESSEE

System	Group	Formation	Lithology
Pennsylvanian	Gizzard	Signal Point Shale	shale, siltstone, sandstone, coal beds (d)
Pennsylvanian	Gizzard	Warren Point Sandstone	sandstone containing quartz pebbles, shale, coal beds (d)
Pennsylvanian	Gizzard	Raccoon Mountain	shale, siltstone, sandstone, coal (d)
Mississippian		Pennington	dolomite, limestone, shale, sandstone, conglomeratic sandstone (e)
Mississippian		St. Louis Limestone	gray limestone with lenses or nodules of gray chert (f)

(a) Smith, 1979, p. I26; (b) Thomas, 1979, p. 113; (c) Thomas, 1979, pp. I9, I10; (d) Milici et al., 1979, pp. G19-G21; (e) Milici et al., 1979, p. G18; (f) Milici and Finlayson, 1967.

Appendix II

Tennessee River Water Gap in Walden Ridge

The course of the Tennessee River has interested geologists for over 100 years. Milici (1968) and Mills and Kaye (2001) have reviewed the various ideas of whether the ancestral Tennessee River was an antecedent or consequent stream or was originally the postulated "Appalachian River." Arguments over the reason why the river goes through Walden Ridge instead of continuing southward also were discussed. This latter "problem"is the subject of this Appendix.

We approach the formation of the water gap from a Flood viewpoint employing the model devised by Oard (2001, pp. 82–84). After considerable sheet erosion occurred during the early stages of Flood retreat, eventually the water level decreased below the tops of various mountains and ridges. The flowing water may have cut into weaker sections of these heights and the retreating water was channeled into these gaps. As the water level decreased further, the channelized flow would continue to cut the gap to lower levels forming a "water gap."In this model the "ancestral" Tennessee River would have developed as the volume of the channelized flow became smaller and the regional strata more consolidated by providing a "path" for the river as it was trapped into flowing through the gap.

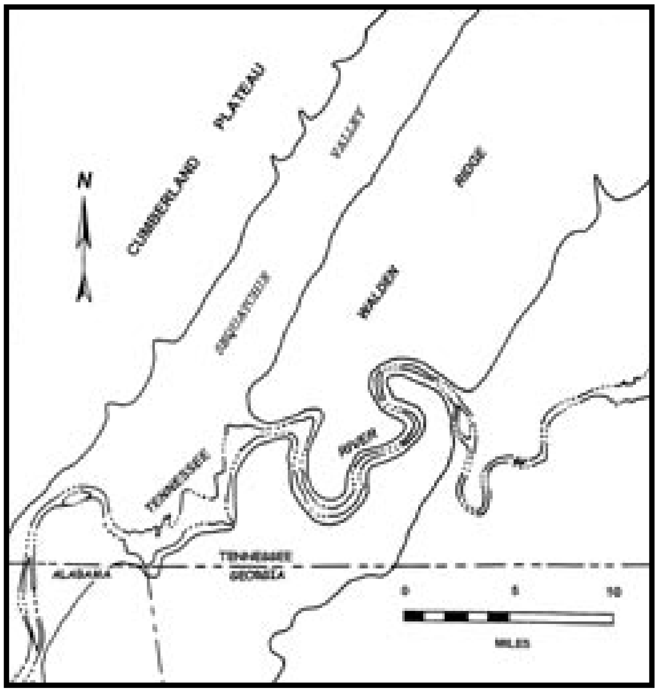

Figure 19. Meanders in Tennessee River as it winds its way through Walden Ridge. Drawing by Mary Elizabeth Akridge.

What about the meanders (Figure 19) in the present course of the river as it winds through Walden Ridge? Milici (1968, p. 477) using an uniformitarian approach noted that:

> The winding pattern in and near Walden Ridge gorge ignores major structural features and may be traced westward from Chattanooga over formations of contrasting topograph expression,....

He reaches the conclusion that "... the river probably developed its meandering course over largely unconsolidated Pennsylvanian sands and muds of the Mesozoic Coastal Plain..." (p. 477). We agree that the meanders developed by water flowing over soft, water-laden strata. Morris and Wiggert (1972, pp. 502–523), in discussing entrenched meanders claimed:

> ...it would seem necessary to postulate much greater volumes of water in the streams than now present, together with much less resistant walls than the rocks of which they now consist (p. 523).

In explaining the consecutive meanders in Kanab Canyon in Arizona and Utah, Williams et al. (1997, pp. 162, 164–165) adopted the same view.

Appendix III

The Mississippian-Pennsylvanian Boundary Problem

After doing field work on the northern part of Sand Mountain, Wilson (1975, pp. 23, 24) observed:

> On Sand Mountain the position of the boundary between Mississippian and Pennsylvanian rocks is difficult to determine with any degree of assurance. There is no evidence of large-scale erosion at the contact; rather, the beds appear to be entirely gradational. The transition from sandy, light brown to gray shales of the Pennsylvanian System to the maroon, brown and greenish-gray shales of the underlying Mississippian Pennington Formation can be detected in the field only in a few selected localities. Ideal sites for observation of the systemic boundary are commonly found along highway road cuts. In areas where the exposures are poor, the top of the Mississippian is placed arbitrarily at the highest appearance of maroon and green shales (p. 23).

Thus, the Pennington Formation is actually considered a transitional formation where Pennsylvanian shales grade into Mississippian shales. The boundary between the Mississippian and Pennsylvanian is based on arbitrary lithologic characteristics. "The absence of adequate faunal occurrences makes this task [at northern Sand Mountain] very difficult in a given exposure" (Wilson , p. 24) [Brackets added]. Milici et al. (1979, p. G1) noted that the Pennington Formation is a transitional unit, "...composed of many lithologies". The Pennington is discussed later in detail (p. G18). Thomas (1979, pp. I15–I17) discussed the problem of the Mississippian-Pennsylvanian boundary also stating, "However available biostratigraphic data do not precisely define the Mississippian-Pennsylvanian boundary" (pp. I15, I16). Thomas hoped that future studies of outcrops in Alabama would shed light on this problem (p. I17).

A gradational contact between two formations could be explained by rapid deposition within a matter of hours or days, not millions of years (Williams, 1994). A rapid sequence of deposition would account for the lack of an erosion surface. If the deposition of strata were separated by a long period of time, probable erosion during these intervals would clearly delineate individual formations.

Froede (in press) claims "The purported passage of millions of years of Earth history should be represented by more than color or lithologic change." Are the postulated millions of years between these depositional sequences real or imaginary?

Appendix IV

Sand Mountain and Walden Ridge: Possible Flood Evidences

Young earth Flood proponents are constrained by a short interval of time in which considerable geologic activity must occur. The Flood and its aftereffects provide the basis for most of this envisioned activity. Thus those who accept the tenets of a young earth and dynamic Flood usually propose very high-energy geologic processes for that period of time. We will employ some of these processes as possibilities for the origin of formations and features on Sand Mountain and Walden Ridge.

Cross-bedding is considered to form in a high-energy situation involving either water or air currents. We found examples of cross-bedding near the crest of Sand Mountain (Figure 20) in the Pottsville Formation and in Warren Point Sandstone at the southern town limits of Signal Mountain, Tennessee on Walden Ridge. [Mies (1999, p. 4) referred to the latter as spectacular cross-beds.] Since both of the above-mentioned formations are sandstone, we discuss a mechanism for the development of cross-beds in sandstone from a Flood perspective. Austin (1994, pp. 33–36) proposed that in the depths of the Floodwater, currents flowing over sand deposits generated cross-bedding. After uplift and with the decreasing base level of the water, the sand containing cementing agents such as iron oxides, silica, and various carbonates, would be exposed and later lithify as sandstone. Wilson, a uniformitarian geologist, suggested (1975, p. 21) that, "The Pennsylvanian strata on Sand Mountain are an erosional remnant of formerly more extensive coal-bearing rocks which covered a large part of the Eastern United States."[This would also apply to Walden Ridge.] Dynamic currents in deep Floodwater probably formed huge sand waves that exhibited cross-bedding and were interspersed with lenses of plant material, clay (mud) and silt. Upon lithifaction and induration, sandstone, shale and siltstone containing coal layers would be found over a considerable land mass.

Several outcrops of Pennsylvanian rock on Walden Ridge were examined by Churnet et al., 1985; Churnet and Bergenback, 1986. Most of the sections contained upward-fining sequences or graded bedding (decrease in the coarseness of grains from the base to the upper surface of a layer of sediment). Graded bedding can be emplaced by high-energy turbidity currents (Nevins, 1970, pp. 6–8; Froede, 1998, pp. 63–71). During the Flood as sand waves were forming to considerable heights, water movement could have generated many turbidity currents producing upward-fining sequences of sedimentary materials.

An outcrop of Sewanee Conglomerate containing rounded, milky quartz pebbles in sandstone was observed near the top of Walden Ridge. Milici (1979, p. G22) stated that the formation"... is the most persistent stratigraphic unit in Tennessee coal measures."The conglomerate can contain a large number of pebbles per unit volume at a given location and very few at another. The rock is massively-bedded at Cumberland Falls, Kentucky (Wanless, 1942, p. 4) compared to the loosely-cemented material at Walden Ridge. The formation is found from Kentucky to Georgia. Rivers transport sand and pebbles, but they do not generally deposit pebbles and sand at the same location as well as over such a wide area. Could highly-turbulent Flood currents deposit pebbles and sand grains together over great distances? All of the mechanisms presented from the Flood viewpoint in this appendix are tentative speculations.

Figure 20. Cross-bedding in Pottsville Formation on Sand Mountain near Geraldine, Alabama.

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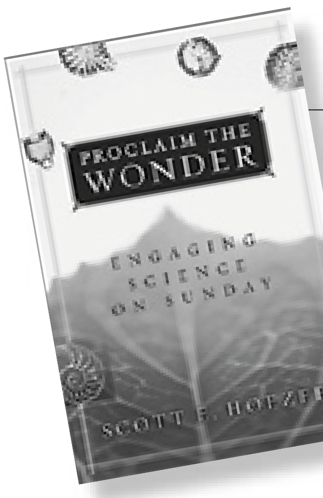

Book Review

Proclaim the Wonder by Scott E. Hoezee
Baker Books, Grand Rapids. 2003, 238 pages, $17.00.

Author Scott, a graduate of Calvin College and Seminary, pastors a Christian Reformed Church in Grand Rapids. The book is directed toward pastors and encourages the insertion of science topics into sermons. Hoezee rightly identifies the twin themes of creation and redemption throughout Scripture with creation often ignored or diminished. The suggestions for pastors are several: Take up an aspect of nature as a hobby, clip science articles, and walk in the woods now and then.

The intelligent Design movement is emphasized. A wonderful "poker game" quote comes from philosopher Alvin Plantinga regarding the attempt to explain apparent design as a result of multiple universes, "Waal, shore, Tex, I *know* it's a leetle mite suspicious that every time I deal I git four aces and a wild card, but have you considered the following? Possibly there is an infinite succession of universes, so that for any possible distribution of possible poker hands, there is a universe in which that possibility is realized; we just happen to find ourselves in one where someone like me always deals himself only aces and wild cards without ever cheating. So put up that shootin' arn and set down 'n shut yore yap, ya dumb galoot" (p. 127).

Unfortunately when author Hoezee gives examples of sermon science illustrations, weaknesses abound. He assumes the big bang (p. 123), shows sarcasm toward a young earth, and totally confuses carbon-14 dating (p. 82), nuclear fission/fusion (p. 110), and light years (p. 196). A "modified process theology" view is suggested. That is, God does not foresee all future events, but he has the power to intervene in history when he so desires. The author is correct that "science on Sunday" can help generate effective Bible study and worship. This book is helpful after its weaknesses are filtered out.

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