Natural Tunnel, Virginia: Origin Speculations

Emmett L. Williams*

Abstract

A model for the development of Natural Tunnel, Virginia within a young-earth framework is presented. A brief review of conjectures offered to date on the origin of the tunnel is given. The creationist model employs the action of retreating Floodwater on carbonate strata to form the tunnel.

Introduction

Previously I discussed how a karst feature (Natural Bridge) in the Commonwealth of Virginia could have formed assuming a young earth-Flood model (Williams, 2002). This treatise covers the origin of another karst feature in Virginia—Natural Tunnel. It is located in Scott County near the towns of Clinchport and Duffield in the southwestern corner of Virginia (Figure 1). The tunnel is a part of Natural Tunnel State Park, a short distance east of U. S. Highway 23.

History of Natural Tunnel

Daniel Boone may have been one of the first explorers to see the tunnel. Likely it was well-known to local Indians and hunters prior to that time (Natural Tunnel State Park Trail Guide). The arch was named Natural Tunnel by Lt. Col. Stephen H. Long when he explored the site in 1831 (Virginia Department of Conservation and Recreation). In 1880 an engineer, J. H. McCue, found the tunnel while surveying a route for the South Atlantic and Ohio Railroad (Waltham, 1988, p. 11). Around that time William Jennings Bryan, the famous orator and statesman, declared the tunnel to be the eighth wonder of the world (Natural Tunnel State Park Trail Guide). The South Atlantic and Ohio laid tracks through the tunnel in 1890. Later the Southern Railroad acquired the tracks and started passenger service calling it the Natural Tunnel Line.

When large coal deposits were discovered in the region, trains began hauling the mineral through the tunnel and these operations continue today even though passenger service was discontinued (Virginia Department of Conservation and Recreation).

> The Commonwealth of Virginia acquired the tunnel and 100 surrounding acres in 1967 from the Natural Tunnel Chasm and Caverns Corp. to establish Natural Tunnel State Park. Approximately 750 acres were later acquired, and the Park opened in 1971. (Virginia Dept. of Conservation and Recreation).

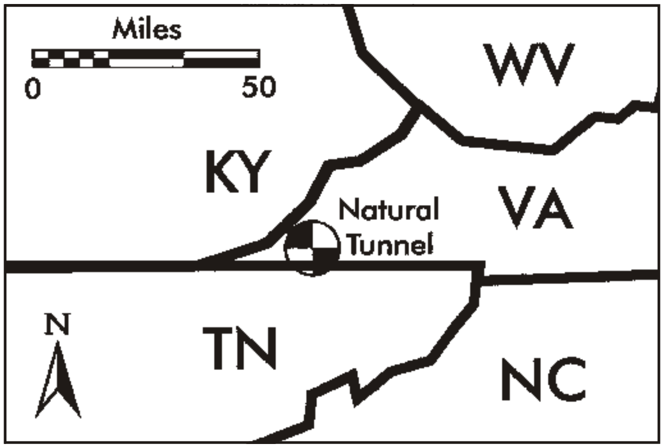

Figure 1. The location of Natural Tunnel in Scott County, Virginia.

Geologic Setting of the Natural Tunnel Region

Natural Tunnel is located in the Appalachian Valley (the portion of which in Virginia is often called the Great Valley of Virginia). "The Appalachian Valley is a subdivision of a larger region called the Appalachian Highlands..." (Butts, 1973, p. 5). Natural Tunnel (Figures 2 and 3) lies in the Valley and Ridge Physiographic Province, "...a region characterized by long, parallel ridges separated by narrow, deep valleys" (Milici, 1990, p. 17). The tunnel is a large solution arch cut into the Cambrian-Ordovician Knox Group dolostones and limestones (Brent, 1963, p. 18; Cooper, 1945, pp. 189–191; Milici, 1990, p. 19). Natural Tunnel is incised into Purchase Ridge (Figure 4), a major topographic feature composed of synclinal dolomite escarpments "oriented NE-SW in line with the Appalachian structural trend" (Waltham, 1988, p. 11).

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*Emmett L. Williams, Ph. D., P. O. Box 2006, Alpharetta, GA 30023

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Figure 2. The south portal of Natural Tunnel. The Norfolk-Southern Railroad tracks are seen to the right. Stock Creek is to the left of the tracks. The trace of the Glenita fault is in the lower left of the tunnel. (Photograph taken in 1989)

Underfit Stock Creek and the Norfolk-Southern Railroad (Figures 2 and 3) pass through the tunnel. The dimensions of the tunnel are: length of 900 ft., width of 130 ft., and height of 75 ft. above Stock Creek which is in the Clinch River system. The thickness of the arch is 200 ft. with one large circular dome in the roof (Dietrich, 1990, p. 112; Webb, 1988, p. 23). Beyond the south portal of the tunnel is a spectacular amphitheater (Figures 5 and 6) at the head of a gorge that is approximately 700 ft. deep (Woodward, 1936, p. 611; Webb, 1988, p. 23).

Speculations on the Formation of Natural Tunnel

Woodward (1936) postulated that in the past a higher altitude tributary of the North Fork of the Clinch River flowed somewhat parallel to the Clinch River (Figure 7a). An active smaller tributary of the Clinch began to erode headward toward the higher level stream (Figure 7b). About the same time, a sink developed in the upper stream diverting some of the flow into an underground channel which eventually joined the headward growing tributary (Figure 7c). The sink continued to enlarge, capturing all of the flow from the upper reaches of the high-level tributary forming Stock Creek. The water flowing in the phreatic tube eroded and dissolved the walls until the roof of the underground passage collapsed except at Natural Tunnel (Figure 7d). The roof remains at the tunnel because it is situated near the axis of a broad shallow syncline where the dolomite and limestone strata are nearly horizonal resisting dissolution and erosion. (These horizonal layers being massive and less jointed have greater structural integrity than those layers located farther from the axis of the syncline.)

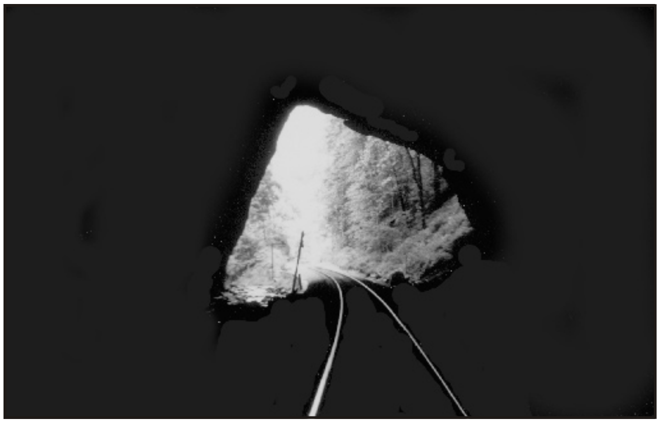

Figure 3. The north portal as viewed from the inside of Natural Tunnel. Stock Creek is seen on the left. This photograph was taken in 1989. Presently no visitors are allowed in the tunnel.

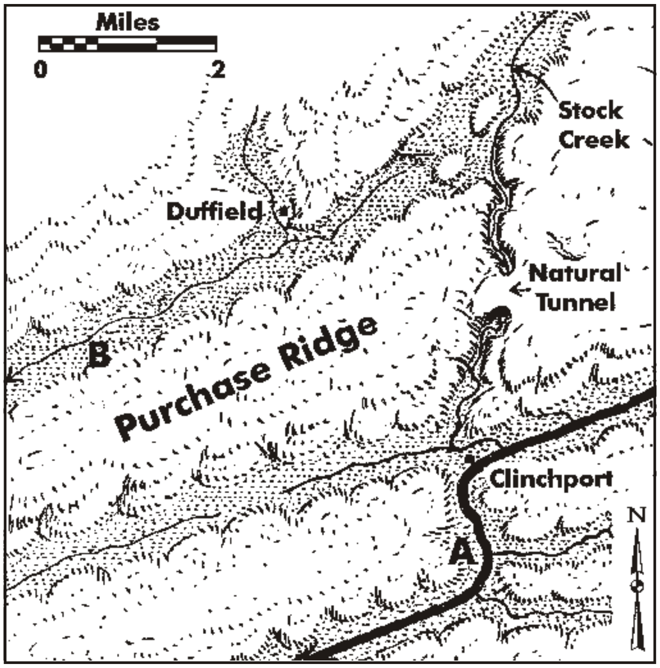

Figure 4. Diagram of Purchase Ridge/Stock Creek/ Clinch River (after Woodward, 1936) A: Clinch River; B: North Fork.

In presenting another model of tunnel formation, Waltham (1988, pp. 13–14) observed that the Clinch River and its North Fork flow in the Valley and Ridge Province generally parallel to the ridges (parallel to structural controls). He conjectured that the headwaters of ancestral Stock Creek drained into the North Fork. A tributary of the Clinch River eroded headward into Purchase Ridge and captured the head of the North Fork to form Stock Creek. The original route of Stock Creek was slightly west of the present location of Natural Tunnel. A sink developed along the route of Stock Creek causing the underground capture of this flow. The water then leaking through the opening of Natural Tunnel developed a phreatic loop.

The original sink into this phreatic loop was very close to the present northern entrance of Natural

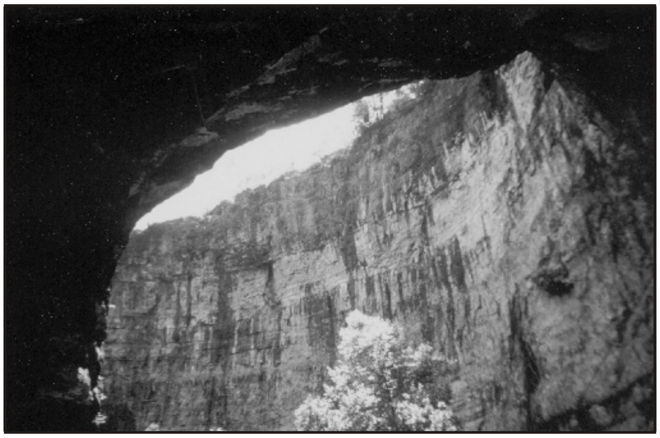

Figure 5. South portal amphitheater as seen from inside of Natural Tunnel. (Photograph taken in 1989)

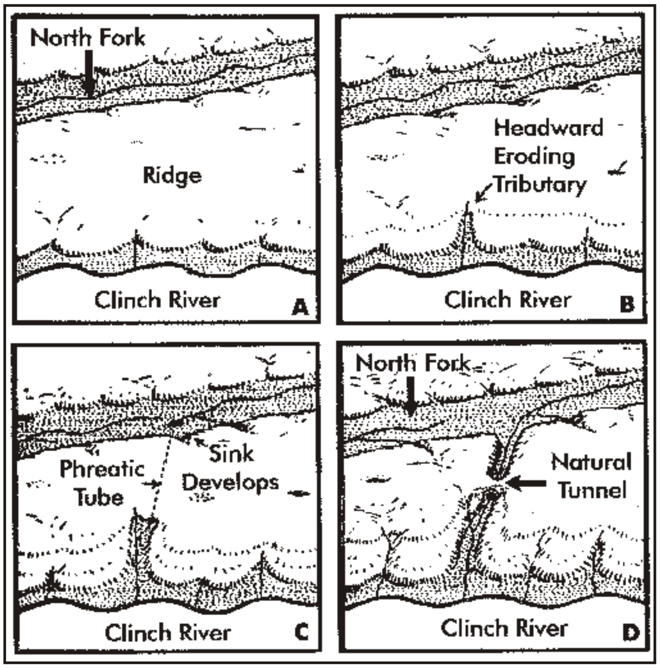

Figure 7. Stages of the Woodward (1936) model for the formation of Natural Tunnel.

> Tunnel. The original resurgence was a vauclusian rising (artesian spring) with a phreatic lift of close to 40m (about 131 ft.) ...and appears to have been some short way downstream of the present cave exit (Waltham, 1988 pp. 13, 14; Parenthesis added).

Regional lowering of the base level eliminated the phreatic loop which left the roof of the cave above water level. The roof of the present tunnel was stable but at the site of the present amphitheater, the roof was unstable and collapsed. As Waltham (1988) noted:

> The rock amphitheater at the exit... almost certainly formed by collapse of the cave where it wrapped round an exceedingly sharp left bend... (p. 14).

Figure 6. Amphitheater at south portal of Natural Tunnel. Portal is on the right of photograph. (Photograph taken in 1989)

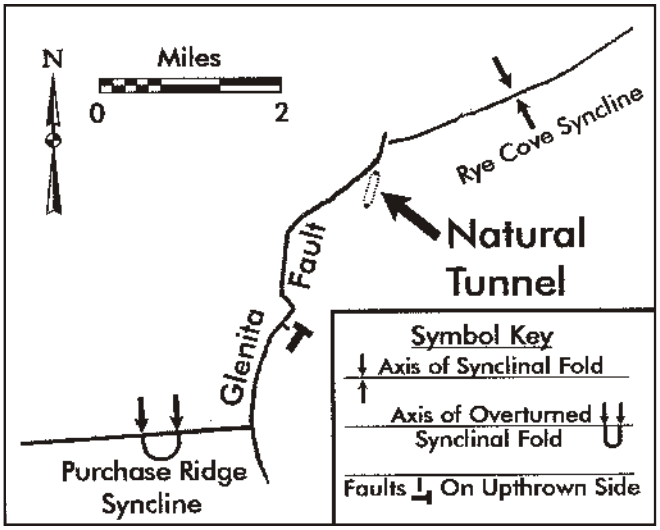

Figure 8. Location of Glenita fault in relation to Natural Tunnel (after Milici, 1990, p. 21).

Waltham surmized that failure of the cave roof occurred "a long time ago" and "Stock Creek has since removed the breakdown..." (p. 14) leaving the steep-walled amphitheater.

Milici (1990) utilized the faulting and folding that occurred in the vicinity of Natural Tunnel to help explain the origin of the feature. Previously, Brent had mentioned that... (1963, p. 1). "...the Rye Cove syncline ...contains many small folds and faults."

> Natural Tunnel ...and the creek that flows through it, Stock Creek, are aligned along a zone of structural weakness that occurs between the gently folded Rye Cove syncline (downfold) on the east and the more tightly folded Purchase Ridge syncline to the southwest (Milici, 1990, pp. 20, 22).

This zone, the Glenita Fault (Figure 8), passes beneath Natural Tunnel. Milici noted that: "Folded and faulted carbonate rock may be seen in both the south and north portals of the tunnel where the fault passes beneath it" (p. 22) and he stated that the tunnel was formed by the preferential solution of the dolomites and limestones along the fractured fault zone "... during the past million years or more" (p. 20).

Ancestral Stock Creek flowed over the region of Natural Tunnel State Park about 300 ft. above the level of the present creek that passes through the tunnel. A sink developed near which is today the north entrance of the tunnel capturing the water flow which subsequently formed a cavern by dissolution and erosion of the dolomites and limestones in its path. This cavern eventually became Natural Tunnel. The location of the present amphitheater may have been where Stock Creek formerly rose and emerged as a spring above the vicinity of the south portal. With progressive downcutting, Stock Creek incised a steep-sided valley below the tunnel whereas a broader valley developed above the north portal. The erosion process was aided by the presence of abrasive particulate matter in the flowing water. The south portal amphitheater developed as a steep-sided spring.

Why was the roof of the Natural Tunnel preserved during the erosional sequence of events? Milici relates that: "At the tunnel, most of the carbonate strata are subhorizontal or are only gently dipping, a requirement for the construction and maintenance of a large, long-standing arch" (p. 26).

Introductory Young Earth-Flood Model for Tunnel Formation

McQueen (1986) discussed the general development of the Southern Appalachians from a young-earth perspective. Chaffin (1990) examined the faulting in the Southwest Virginia region employing a catastrophic Flood viewpoint. Later Williams et al. (1994) presented a creationist model for the development of a canyon on the Appalachian Plateau. I will use the same approach in this study.

It is assumed that the regional limestones and dolomites were deposited during the Flood. It is assumed also that these calcium-containing sedimentary strata would have set initially similar to the setting of portland cement (Williams and Herdklotz, 1977, pp. 197–198). Since the newly-deposited sediments would be water-laden, they would be semirigid. These strata would need time under subaerial conditions to dewater which would cause them to further harden.

As Floodwater began to retreat from the region, dissolution and erosion of the newly-deposited carbonates could have developed a sink particularly along a fault zone. As water entered the sink, it eventually formed a phreatic tube (Williams and Herdklotz, 1977, pp. 193, 197–198; 1978, p. 88). As more water entered the sink it would enlarge the opening and the underground route over time forming a cavern from which Natural Tunnel would develop. The downcutting by the water containing abrasive particulate matter would have produced an underground cavity beyond the present length of Natural Tunnel. During the same time period, the retreating water above the phreatic tube would dissolve and erode the roof of the cavern reducing its thickness such that the roof would collapse aiding in the formation of a gorge south of the present tunnel. As retreating Floodwater continued to pour through the developing tunnel, it could have exited the underground passage exerting considerable force on the strata at the south portal. With water being directed against the wall at the south portal and exerting pressure overhead from the water above ground level, the amphitheater likely would have formed by cliff sapping (Austin, 1994; Froede, 1996).

As the base level dropped, the carbonate sediments would dewater and harden with time stabilizing the tunnel and the gorge below leaving hardened strata on the steep-sided amphitheater. The area north of the tunnel would have suffered erosion in a more generalized manner being subjected to channelized flowing water in the narrow valley of the present Stock Creek between emerging ridges (cf., Oard, 2001) as the base level continued to decrease. This flow resulted in a somewhat broader valley north of Natural Tunnel.

Appendix: Geomorphic Models

The suggested model for tunnel, amphitheater and lower gorge development is one of many possibilities that could be presented. This model appeals to the karst features and local structural geology of the region. See Williams (2002) for a discussion of the formation of a natural bridge as well as references to the development of canyons in karst landscapes.

Acknowledgments

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Book Review

Excelsior: Memoir of a Forester by Laurence C. Walker

College of Forestry, Stephen F. Austin State University, USA. 1995, 490 pages, $20

Books on history and biography should be read in much greater quantities than works of fiction, just as, according to current dietary science, fruits, vegetables, and carbohydrates should be consumed in much greater quantities than meat, fatty foods, and sweets. A Christian should know and practice "You are what you eat " *and* "You are what you read." The memoir of Dr. Laurence C. Walker is both history and biography that challenges Christians to honor the Lord Jesus Christ as vocational mentors while actively engaged in the advance of the kingdom of God through Church participation.

Walker was Boy Scout and scoutmaster, forester and educator, soldier and civilian, and lay minister and ordained Presbyterian pastor during the last three quarters of the 20th century. Although his extensive travels all over the world were mainly related to his profession as a forester, he had an eye toward planting seeds of the gospel of Jesus Christ. For example, he carried copies of the Bible into China and gave his personal copy of C.S. Lewis' *Miracles* to a Chinese man. In the preface of his memoir, Walker makes his motive clear, "Who…would have the audacity to write about oneself? I write… because… my friends asked me to. They'd heard the tales over coffee conversations through the years." Early in the book Walker writes, "I trust, dear reader, that you've noted that this chapter, like others, is really about mentors." One such mentor for Walker, when he was a young boy growing up in Washington D.C. in an unchurched family noticeably devoid of a paternal influence, was his scoutmaster, a USDA botanist, who inspired his charges to "do our best to do our duty to God and country." It was through Walker's involvement in the boy scouts, which met in a Presbyterian church building, that he became acquainted with the pastor and subsequently responded to invitations to attend services and Bible study.

The context of the book is the career of a forester, without heavy technical jargon associated with the profession, yet the title reveals the foundation upon which Walker built his career, "Excelsior: the higher good." Walker