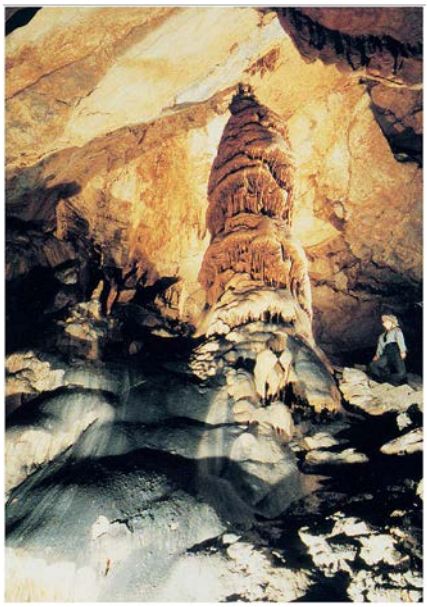
Cumberland Gap National Historical Park



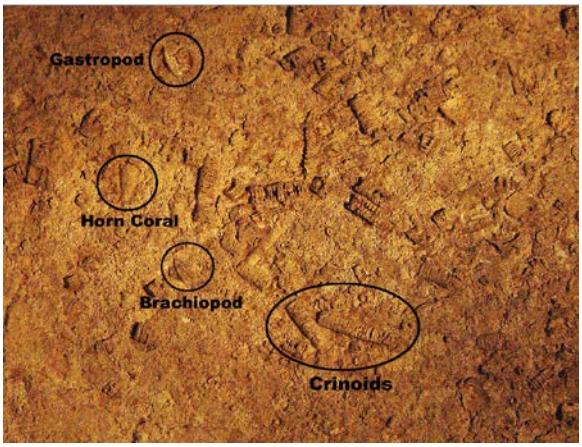
Gap Cave – A Primer

A "cave" is defined as an opening in the earth large enough to hold a person. When more than one cave is connected, they are sometimes collectively referred to as a "cavern." In common usage, however, cave and cavern are often used interchangeably.

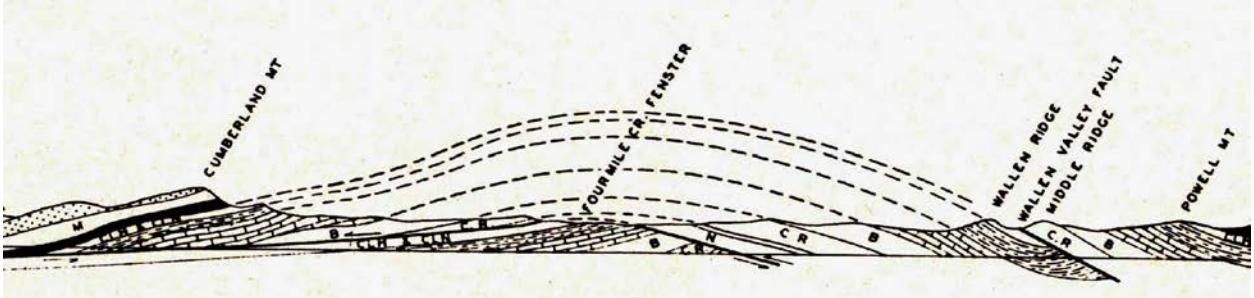
There are several types of caves. The three most common types are: Lava tubes, created when lava flows cool from the outside in and then empty of remaining molten rock; tectonic caves, created by earth movements such as rock slides or earthquakes; and karst caves, created by the action of water, either flowing up from below or descending from the earth's surface. Karst caves created by descending water are, by far, the most common. They exist in formations of sandstone, gypsum, dolomite and, as here in southern Kentucky, limestone. Most major karst caves are found in limestone.

Geologic History

About 350 million years ago, the surface of what is now southeastern Kentucky was covered by a warm, shallow, equatorial sea. Brachiopods, crinoids, bi-valves and other sea creatures with external skeletons composed of calcium and carbon lived in this sea. As these animals died over the millennia, layer upon layer of their skeletal remains littered the seafloor and were eventually compressed into limestone. Gap Cave lies in a 500-foot thick layer of limestone known as the Newman formation, topped by the Pennington and Lee sandstone formations, also deposited in the ancient sea.

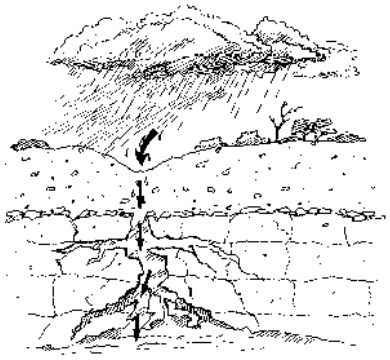


About 250 million years ago, the Atlantic oceanic plate carrying the Newman Limestone formation began moving slowly northwest, eventually colliding with the American plate. As these two tectonic plates crunched into each other, rock formations were folded into a pleated chain of mountains, extending from Newfoundland to Alabama. The Appalachian Mountains are the vastly eroded remnants of this ancient mountain range. The following illustrations reflect the millions of years of erosion and tectonic movement leading to the current landscape. Cumberland Mountain, with its band of sandstone topped Newman limestone rises at the left.



Formation of Gap Cave

Most karst caves form as the result of a process called "chemical weathering" or chemical erosion. As rainwater falls through the atmosphere, it collects carbon dioxide (CO_2). Additionally, as the rain passes through organic layers of the earth's surface, it absorbs even more CO_2. This CO_2-saturated water becomes carbonic acid (H_2CO_3)—or "carbonated water" if you are in the soft drink industry. (The carbonated water in your soft drink is hundreds of times more acidic than the carbonic acid which creates karst caves.)



As the rainwater works its way down in the soil, it seeps into minute cracks in the limestone. Because carbonic acid dissolves calcium carbonate ($CaCO_3$), the primary ingredient of limestone, the water slowly dissolves the limestone formation along these cracks, molecule by molecule. As the cracks expand over time, more and more water flows through them, accelerating the dissolution process. Eventually, if surface or subterranean water resources are sufficient, streams or rivers begin to flow through these openings in the limestone, adding abrasion as an additional cause of limestone removal. This is known as physical weathering or physical erosion.

Rivers once flowed through the upper chambers of Gap Cave--and Gap Creek still flows through the lowest level of the cavern. Water flowing from the cavern was used to power several mills and the machinery at the Cumberland Iron Furnace in the 19th century. The creek was dammed inside the cave in the 1800's to create a reservoir that still supplies the towns of Cumberland Gap and Harrogate, Tennessee with drinking water. (Lincoln Memorial University retained rights to the cave water when transferring ownership of the cavern to the National Park Service.) Additionally, Gap Creek flows with sufficient volume to provide about 2-million gallons of Cumberland Gap Mountain Spring Water, bottled by the Coca-Cola Bottling plant in Middlesboro.

The formation of a karst cave occurs over thousands upon thousands of years. Gap Cave is estimated to be 3-5 million years old—and is still forming. The several levels of Gap Cave—five have been explored—are typical of a karst cave and reflect the various levels at which water flowed as the cavern was being formed. The highest level in a cavern is its oldest and subsequent levels are a reflection of gradually falling water

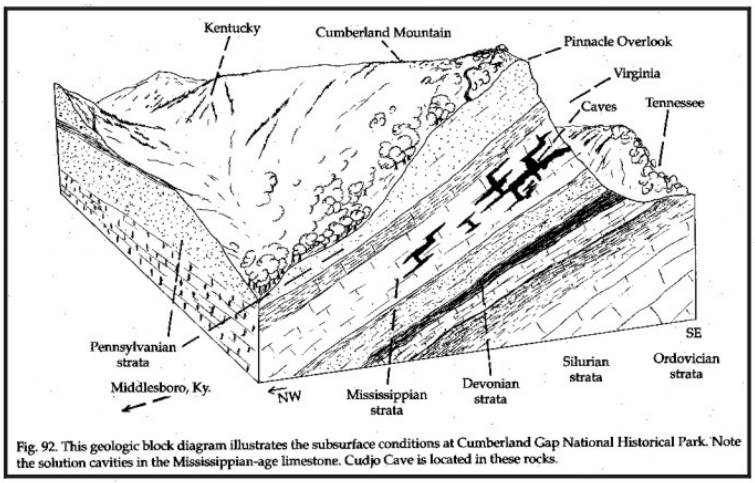


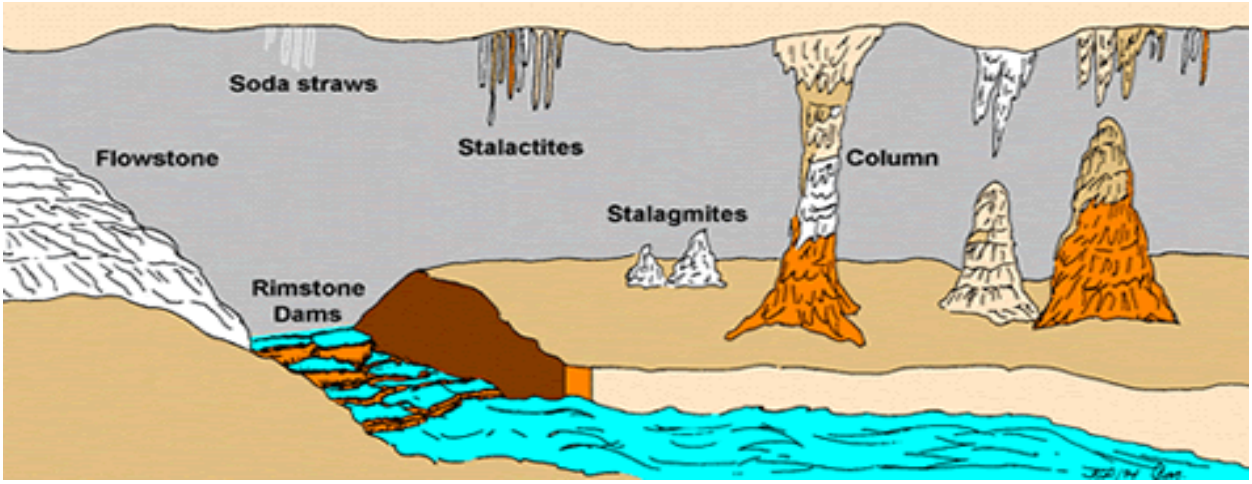
Fig. 92. This geologic block diagram illustrates the subsurface conditions at Cumberland Gap National Historical Park. Note the solution cavities in the Mississippian-age limestone. Cudjo Cave is located in these rocks.

As underground passages and rooms enlarge, they sometimes become too wide to support their ceilings and breakdown collapses occur. The potential for collapse increases as water drains from a passage and its buoyant force is not present to help support the ceiling. A breakdown room can be discerned by the presence of angular rocks on its floor, unshaped by the abrasion of flowing water. Most of the large rooms in Gap Cave are a direct result of this breakdown process.

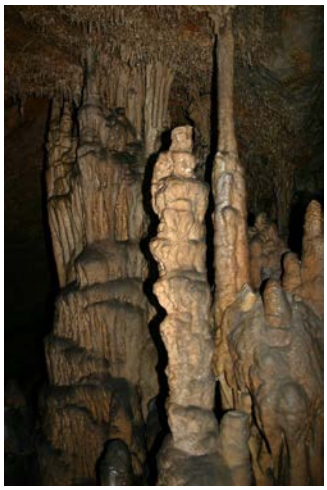
About 14 miles of cavern has been explored so far in Gap Cave. Only about 0.25-mile of the cavern and three levels are open to the public during Ranger-led tours.

Stalactites and other cave formations

Cave formations are collectively referred to as speleothems, from the Greek words for "cave" and "deposit." The speleothems most people are familiar with are stalactites, icicle-like formations attached to cave ceilings, stalagmites which rise from cave floors, and pillars or columns, formed when the two meet. Other forms of speleothems evident in Gap Cave are flowstones, cave ribbons or cave bacon, and soda straws.



Speleothems are formed by the reverse process of cavern formation. The limestone dissolved in seeping water takes the form of calcite, the most stable form of calcium carbonate. As the calcite-saturated water flows along cracks, over rocks or drips from the ceiling, it slowly releases some of its CO^2 into the air, thus allowing minute bits of calcite and other minerals to precipitate out from the solution. As countless drops of water precipitate their minerals, the calcite begins to accumulate into formations like flowstone, stalactites, stalagmites, etc.



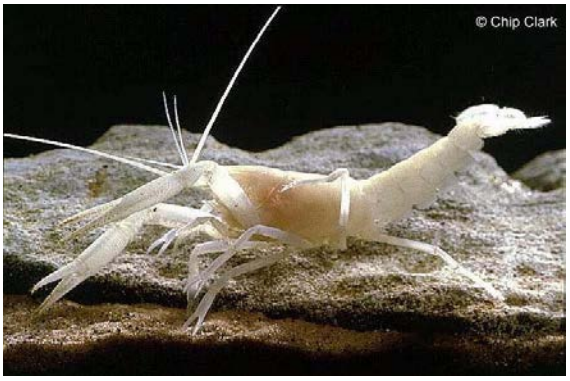
Acidity of cave water, water velocity and numerous other factors impact the rate of growth for cave formations. It is estimated that—on average—a stalactite or stalagmite will gain approximately one cubic inch every 100 years. Thus, a 12-inch conical stalactite that is 3-inches in diameter at its base represents about 2,800 years of growth.

The color of cave formations is determined by the combination of minerals present in the water as it evaporates. Although each of the formations will contain various minerals, all of them are mostly calcite. Black formations in Gap Cave are evidence of manganese in the water, while yellowish suggests sulfur and reddish formations suggest iron. The cream or ivory colored formations in Gap Cave are primarily pure calcite.

There are many reasons for not touching cave formations, but the most significant is the fact that oils, salt and acids on our skin can adversely impact the growth of formations. A single hand or fingerprint can add decades to the deposit of the next layer of calcite. Broken formations may never recover.

Cave Life

Caves have been the source of shelter for the world's creatures—and fascination for man—for eons. Humans carrying reed torches probably began to explore Gap Cave 2,000 – 4,000 years ago. Animals have utilized the cave even longer. The skeletal remains of a prehistoric Short-Faced Bear, dating back to approximately 15,000 years ago, were discovered about three miles into the cave. (Photographs of the remains are available at the desk in the Visitor Center.)



Cave Crayfish

As dark, deep and remote as caves may be, they are not devoid of life. In the absence of sunlight, highly specialized ecosystems and creatures have evolved. Some, known as troglobites, are adapted to living their entire lives in the low-energy, lightless underground, others are species that move in and out of the cave environment. Many of these animals have no color and are blind or have no eyes! They are dependent upon food which washes in with the water or is present in the cave. The animals that come and go are usually camouflaged and have functioning eyes in order to adapt in the outside world as well as the cave.

Gap Cave is no exception and the careful observer may see a limited, but diverse collection of creatures such as cave flies, cave crickets and other insects. Cave salamanders (*Eurycea lucifuga*, pictured) have been observed around the Cleopatra's Pool formation and other reptiles dwell near cave entrances. As it flows through the cave, Gap Creek is home to crayfish, amphipods, and other invertebrate species that have adapted to cave life.


Cave Salamander


Big Brown Bat

Bats are the most commonly observed mammals in the cavern, with Big Brown Bats, Little Brown Bats, the Northern Long-Eared Bat and the Eastern Pipistrelle bat frequently seen on tours. The endangered Indiana Bat and the Big-Eared Bat are also known to use this cave. Near cave entrances, one can also find evidence of the Eastern Wood Rat, often called a packrat because of its habit of collecting shiny objects.

Civil War use of Gap Cave

By the outbreak of the Civil War in 1861, Gap Cave was a well-known feature of Cumberland Pass. Thus, when Union and Confederate troops found themselves stationed here, it was a natural for idle soldiers to want to explore the caverns. Although Union and Confederate forces each controlled the Gap twice during the war, there were no major battles here only skirmishes. Thus, service at the Gap very much fit the definition of wartime service as interminable boredom pierced with moments of terror. A Park Ranger researching Civil War use of the cave has documented a soldier whose name and regiment was written on the wall of the cave the day after his regiment arrived at Cumberland Gap.

The evidence suggests, however, that Gap Cave was used for more than idle time exploration. "Soldier's Cave", the second level area where tours exit the cave today, is believed to have been used as a hospital, as well as an ammunition dump, for soldiers stationed here. The hospital was probably used more for men felled by disease than for treatment of wounded soldiers, given the absence of major conflict in the Gap.

Additionally, it is probable that the cave was used to produce saltpeter, potassium nitrate (KNO_3). Saltpeter is mixed with sulfur and charcoal to produce black gunpowder, the only explosive used during the Civil War. The South had few gunpowder mills at the start of the war, however, and a total of only 30-tons of gunpowder on hand. With the Confederate artillery alone needing 87-tons, there was an urgent need to find new sources for gunpowder manufacture. Caves were natural resources tapped by the Southern states for this aspect of the war effort.

The nitrogen and potassium-rich bat guano accumulations on the floor of the cavern, along with a white crust of calcium nitrite naturally wicked up on undisturbed cave surfaces and easily converted to potassium nitrate, were mixed with water and leached into collection vats. The liquid was then boiled and evaporated to produce saltpeter, much as the pioneers produced salt from area salt licks.

Ownership and public tour history

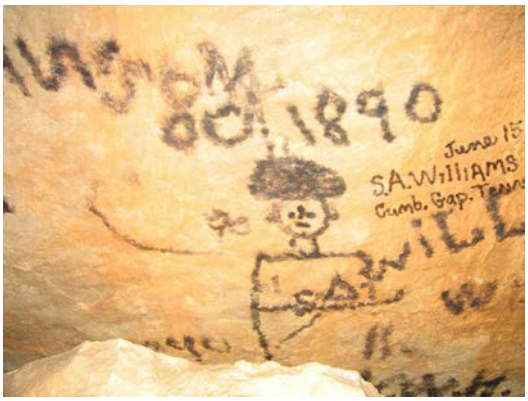
Initially described by Dr. Thomas Walker in his 1750 journey through the Gap, Gap Cave was soon well-known as a cavity in the face of Cumberland Mountain from which a constant stream of water and cold air issued. Further up the face of the Pinnacle, Soldier's Cave was discovered, gaining its name during the Civil War. Then, in 1888, land-owner Major Cockrill blasted an entry into the caverns, discovering the large chambers now visited on our tours. Major Cockrill claimed to have explored about 15 miles of cavern beneath the Pinnacle and named the caverns King Solomon's Cave, wiring many chambers with electric light by the turn of the Century and conducting the first commercial tours.

Old postcard showing the ticket office along Highway 25 E

In 1920, Lincoln Memorial University acquired ownership and renamed the caverns Cudjo's Cave, after the fictional slave whom novelist James T. Trowbridge had taking refuge in a Tennessee cave during the Civil War. LMU subsequently leased all but the lower level of the cave to two entrepreneurs in Cumberland Gap, who continued commercial tours of the cave. Electric lighting was installed in Soldiers Cave, in 1934, and shortly thereafter a tunnel was dug connecting Soldiers Cave to the lower Solomon's Cave sections, enhancing the tours. Concessionaires continued to operate tours of the cave until 1992 when it was acquired by the National Park Service, (except for the water rights retained by LMU).

Although commercial tour operators took steps to preserve and protect the cave, conservancy and respect for the natural resource aspects of the cave were not their highest priorities. It is reported that as many as 100 persons were permitted to tour the cave under the "supervision" of a single tour guide. Security of the cave, however, was often a problem and vandals frequently broke into the cavern, wracked havoc in terms of graffiti and broken formations.

"Cleaning" caves of graffiti and similar damage is highly discouraged by cave preservationists. The chemical and physical processes involved often create undesirable collateral damage—as well as obliterating prehistoric treasures such as pictograms or petroglyphs which are often hard to identify, even for experienced archeologists. Additionally, the federal Antiquities Preservation Act requires us to preserve items more than 50 years old, which would include much of the graffiti.



Today the exploration and mapping of Gap Cave is done by volunteers who are members of a group called the Cave Research Foundation (CRF). CRF is an organization of professional cavers and scientists who are dedicated to the exploration, mapping, and research of caves throughout the United States. They are active in many national parks and are an active partner with the staff at Cumberland Gap National Historical Park. Their continued efforts at Gap Cave are an essential part of management activities.