Geologic tour of Grand Caverns, Grottoes, Va

By

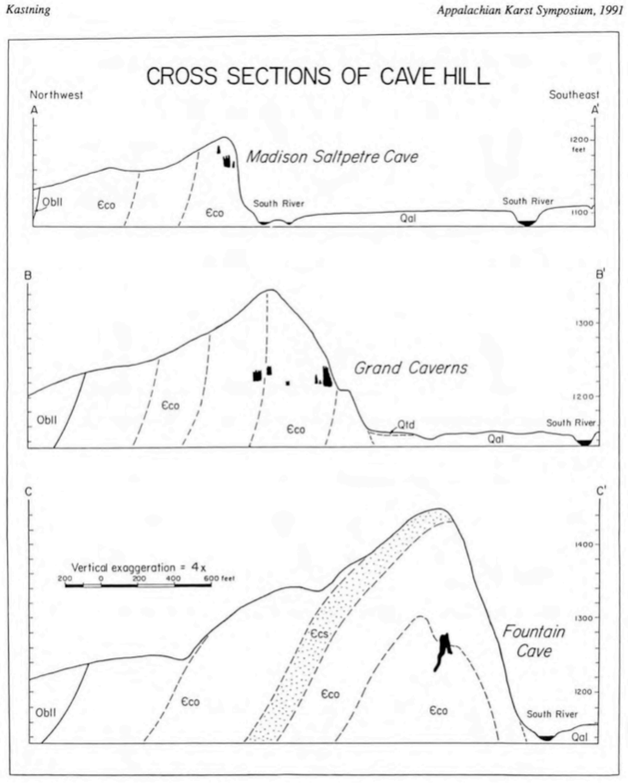
Dr. Ángel A. Garcia Jr
Department of Geology and Environmental Science

Geology Specialty Tour - Grand Caverns (01/1/23)

garci4aa@jmu.edu

JMU JAMES MADISON UNIVERSITY

(Left) Map with the Conococheague formation across VA. It ranges in thickness from about 2,200 feet in northern Virginia to 1,700 feet near Abingdon.



Kastning, E. H., & Kastning, K. M. (1991). Appalachian Karst: Proceedings of the Appalachian Karst Symposium, Radford Virginia, March 23-26, 1991. 247.

Overview

Karst phenomena happens when soluble rocks (e.g., limestones) are dissolved by natural waters. Karst process produce complex hydrological challenges, changes in the topography, and caves among other features. Caves are described simply as natural empty spaces big enough to allow human entrance into partial or total darkness. It is estimated that more than 15% of the ice-free surface of our planet it is karstified and that 17% of the global population inhabit karstified regions.

Conservation and preservation of caves it is common global priority because caves are commonly seen as a location that links diverse types of heritages like geological, ecological, cultural, archaeological, and geotourism among them, making caves a natural feature often protected by law.

Show caves (also known as tourist caves) are spaces in where visitors can explore caves by participating in guided tours in addition to enjoy other amenities such as maintained trails, and light fixtures with spotlighted features (e.g., archaeological artifacts, or speleothems).

Using caves (geologic feature) as the main attraction for building wealth initiated back in the 17th century southwestern Slovenia.

Historical relevance

Grand Caverns is the oldest show cave in the contiguous continental United States with continuous operations since 1806.

Early form of tours consisted in 4h expeditions to different sections using candlelight that participants held during the trip, leaded by a guide with a lantern mounted in a long post.

Grand Caverns will become a popular spot in the mid-19th century for tourist around the nation. Celebrations like the “Great Illumination and Ball” took place annually inside of the cave and consisted in installing ~2,000 candles in the walls and hosting square dancing in the Ball room.

By 1889, the Westinghouse Electric Company installed incandescent lighting in Grand Caverns, just 9 years after the invention of the electric bulb been patented.

Geology

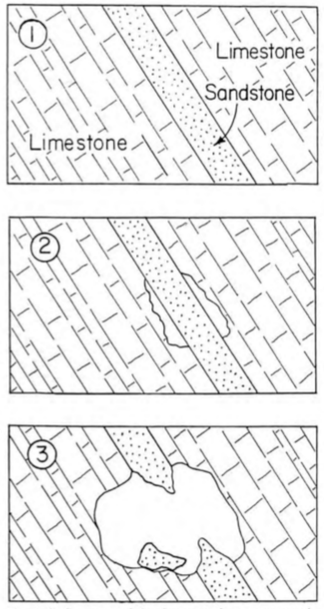
Grand Caverns is situated in Cave Hill in northern Augusta County in the Conococheague Formation with late Cambrian age.

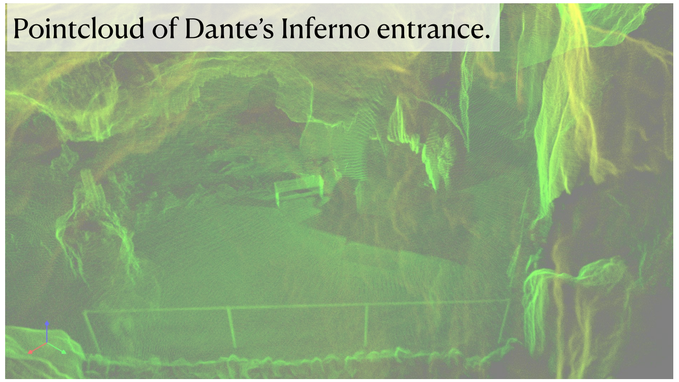
The Conococheage formation is characterized by fine-grained limestone with dark gray color, low porosity, and high crystalline purity.

Cave Hill is a miniature version of the ridges that are characteristic in the Appalachian Mountains because of the considerable structured deformation resulting from the Alleghanian Orogeny (300 Ma).

Grand Caverns has overturned bedding striking N-S and with dipping angles from 85° to 90° as a product of the regional structural deformation (figure above).

Research about structural control suggest that speleogenesis of the cave are controlled by porosity and purity of the mixed lithology (figure on the right).

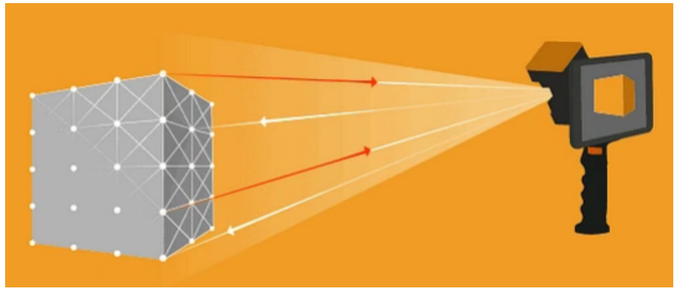


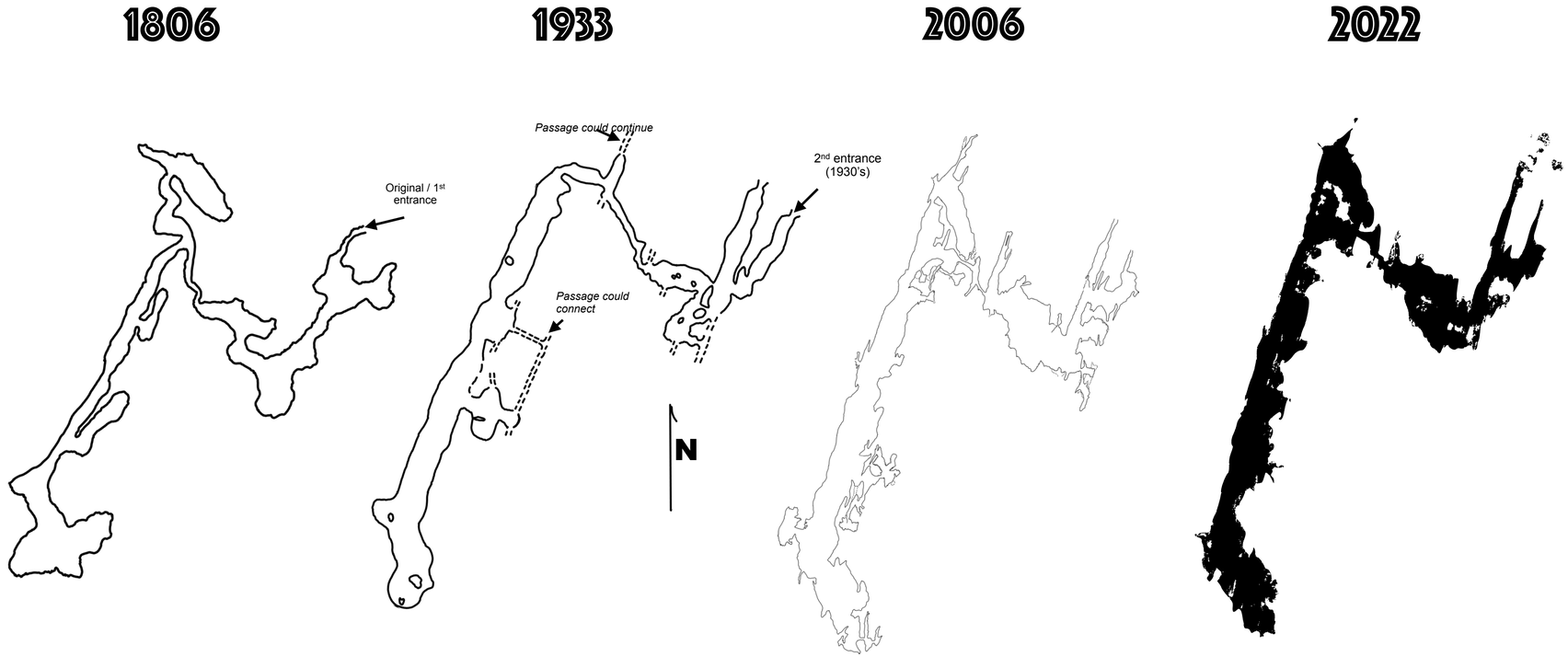


Intersection of different heritages at Grand Caverns

High-resolution pointcloud

- mobile lidar (Light Detection and Ranging)
- SLAM (simultaneous localization and mapping) technology
- ZEB Horizon-GeoSLAM scanner with a capacity of 300 x 10^3 pulses/s for the construction of high-resolution point cloud.





Mapping evolution of the upper level (commercial) of Grand Caverns. From left to right: Map of 1806 based on Jacob Peck survey, 1933 map modified from (McGill, 1933), 2006 map from Paul Gaskin, and the 2022 map constructed with LiDAR-SLAM.

Garcia, A. and Shank, A., Exploring the Intersection of Different Heritages in Grand Caverns, Grottoes, VA, manuscript in revision, Geological Society of London Special Volume: Great Geological Outcrops, Locales, and Geoheritage