

## Field Moment

# Hidden wonder

## The discovery and survey of Leandras Cave, Grand Canyon National Park

By Steve Rice

**WHILE HIKING A REMOTE SECTION OF** the South Rim in Grand Canyon National Park in 2006, longtime cave researcher Jason Ballensky noticed what appeared to be a large cave entrance across the canyon on a cliff below the North Rim. Hiking out to this area on a later trip, Ballensky confirmed that this entrance led to a large cave, later named Athenas Cave, with an 1,800-foot- (550 m) long passageway. For Grand Canyon this was an exciting find, as the cave was relatively large compared with most others in the park. Intrigued by this discovery, Ballensky subsequently surveyed the Redwall Limestone in search of additional cave entrances. Tucked into a side canyon along a 600-foot- (180 m) tall cliff face was a massive black entrance, and they returned a few weeks later eager to explore. What they discovered was beyond imagination.

Access to most caves in Grand Canyon is a strenuous endeavor, and Leandras Cave is no different. An off-trail bushwhack route drops off the rim precipitously, descending roughly 2,500 ft (760 m) over only 1 mi (1.6 km), including several tricky climbing sections and one short rappel. All water must be hiked in. The camp is roughly 4 mi (6 km) from the nearest road, and the cave

is another mile from camp along a loose slope above a 600 ft (180 m) cliff of Redwall Limestone. To top it off, entry to the cave requires a 120 ft (36 m) free-hanging rappel off the edge of this cliff (fig. 1).

The cave began as a single borehole that led to an intersection where massive passages departed in different directions (fig. 2). Knowing that they had an immense discovery on their hands, the team left the cave with only a small amount of survey conducted and began planning for a return trip with a larger team. In 2007 they returned and surveyed 1.25 mi (2 km) of passage in just two days. But the scale of this cave continued to amaze. Large borehole passages often 100 ft high and 80 ft wide (30 m × 24 m) had so many perpendicular offshoot passages of a diameter that accommodated walking that they were difficult to map (fig. 3). Thus in 2008, surveyors divided into two teams and were able to increase the length of the explored portion of the cave to nearly 5 mi (8 km). The final survey was conducted in 2009 and brought the total length of the cave to 42,329 ft, or just over 8 mi (12.8 km). Leandras Cave is the longest in Arizona and likely one of the most voluminous in the western United States,



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**Figure 1.** The rappel into Leandras Cave is seen here from the large cave entrance room with the North Rim in the background. The rappel starts along the wall of the Redwall Limestone, and then becomes a 120-foot free-hanging drop to the base of the entrance.

with an average passageway diameter of 37 ft (11.3 m).

The scale of Leandras Cave is only part of the story, however. Unique biological and mineralogical finds add to the intrigue of this amazing discovery (figs 4 and 5). An ever present, often puzzling, and sometimes disconcerting detail about Leandras Cave is the sheer number of mummified bats found within (fig. 6). Thousands of impeccably preserved specimens line the walls and floors of the cave in certain areas, with very little evidence of current bat use. In 2009 these remains were investigated more thoroughly, and at least nine species were identified: pallid, Townsend's big-eared, big brown, Allen's lappet-browed, silver-haired, hoary, western small-footed myotis, long-eared myotis, fringed myotis, and, potentially, canyon bat. From a mineralogical perspective, many of the passages are densely decorated with incredible gypsum formations, some exceeding 4 ft (1.2 m) in



**Figure 2.** Extended exposure photography is necessary to fully illuminate the huge passages in Leandras Cave. Lights shine on different areas for short periods of time and the entire passage is shown in the final image.



**Figure 3.** Cave passage shape and substrate vary throughout, but the impressive dimensions are nearly constant. Situating the light behind the caver in this photo allows for a long-exposure shot to illuminate the full passage without washing out the photo, and provides a good reference scale for the size of the cave.



**Figure 4.** Delicate gypsum grass (needles) overlies gypsum flowers (white and brown curls) and gypsum crust (white material, bottom left) in Leandras Cave. Profuse gypsum decoration is found throughout the cave.



**Figure 5.** This feature was named the "cheeseburger" not only for its resemblance to the real thing but also for the cavers' hunger for non-freeze-dried food at the end of survey trips.



**Figure 6.** Thick gypsum flowers (white curls) support a mummified bat (hanging upside-down). Leandras Cave has preserved thousands of bats, which often look as if they are still alive today. Nine species have been identified to date, and future studies are necessary to determine the age of these bats.

length and likely the longest specimens of this type in the world. Additionally, many of the walls were coated in thick mammillary deposits. These deposits form just below the water table. Similar deposits from other caves in Grand Canyon have been dated to help identify when rock strata were incised to form the Grand Canyon itself.

Another impressive statistic of Leandras Cave is the number of volunteer hours associated with the survey. Several teams of highly skilled and dedicated cavers spent

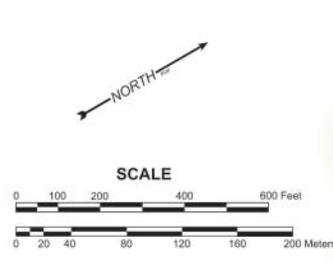
a combined 700 hours on cave survey, not counting the strenuous hikes to and from the cave and the travel time for many who came from other parts of the country to participate. One volunteer compiled the survey data, reviewed the sketch maps, and produced a beautiful, functional map, which accounted for an additional 500 hours of volunteer time.

The details of Leandras Cave were kept secret until the project could be completed. Compiled by volunteer Bob Richards,

the map was unveiled at the 2011 National Speleological Society annual conference and was awarded "Best in Show" in the cartography competition (fig. 7, next page). A presentation on the discovery and survey was very well received and resulted in numerous inquiries by individuals and groups interested in conducting cave-related research at Grand Canyon National Park. Park staff will be updating the cave and karst resources page of the Grand Canyon National Park Web site ([nps.gov/grca/naturescience](http://nps.gov/grca/naturescience)) later this summer with much of this information.

All caves in Grand Canyon National Park are closed to visitation for safety and resource preservation concerns. Access is granted to some caves via a cave entry permit. Other caves and more substantial cave work (e.g., surveys) require a research permit. Cave exploration in Grand Canyon continues, and with hundreds of remote side canyons and thousands of miles of exposed cliff faces, the next big discovery is waiting to be made.

—Steve Rice, hydrologist and cave resources manager, Grand Canyon National Park, [Steven\\_E\\_Rice@nps.gov](mailto:Steven_E_Rice@nps.gov).



**Legend - Cave Symbols**

|                                 |                                    |
|---------------------------------|------------------------------------|
| — Passage Walls                 | — Entrance shafts                  |
| — Underlying Passage            | — Depth Below Datum (ft/m)         |
| — Upper Level (surveyed)        | — Flowstone                        |
| — Not Surveyed                  | — Stalactites                      |
| — Small Breakdown               | — Stalagmites                      |
| — Medium Breakdown              | — Opium Crystals, Flowers or Curls |
| — Large Breakdown Blocks        | — Dogtooth Spar                    |
| — Bedrock Floor                 | — Mummified Bats or Bones          |
| — Dirt or Sand Floor            | — Too tight to continue            |
| — Drop or ledge (down on right) | — Lead                             |
| — Slope (left)                  | — Sheds near entrance              |
| — Drop Height (feet)            | — Closer on floor                  |
| — Drop, rope needed             | — Pool of Water                    |
| — Ceiling Height (feet)         | — Opium cover floor                |
| — Ceiling Drop (lower on left)  | — Register                         |
| — Dome                          | — Key Survey Point / Station       |

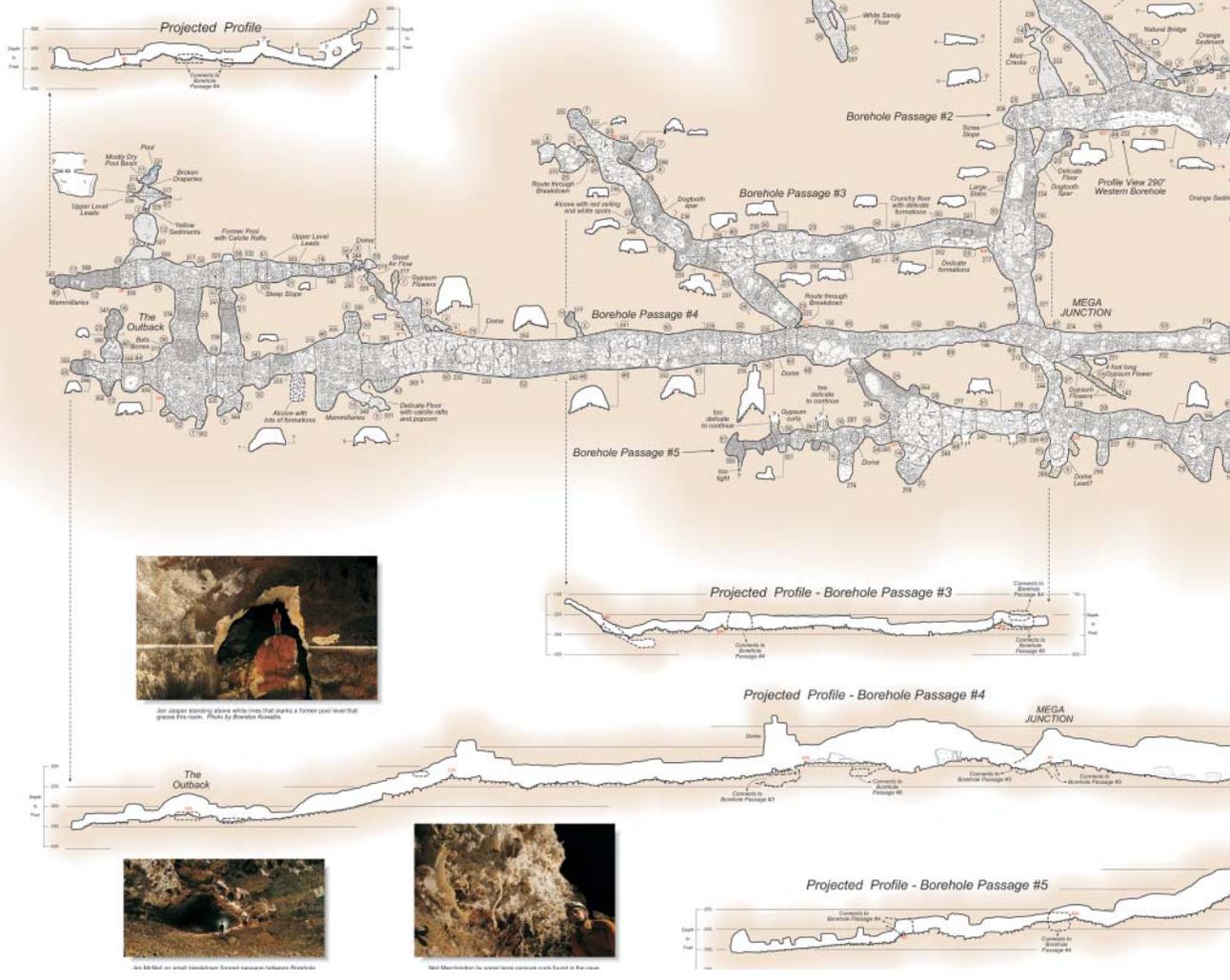
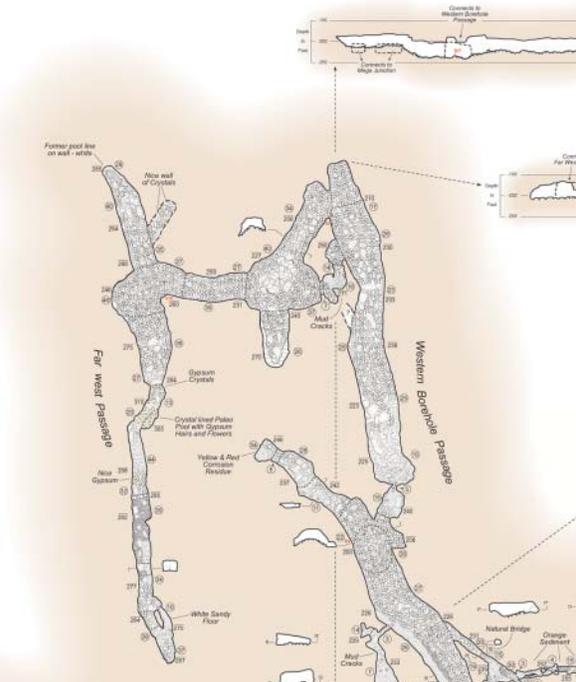


Figure 7. Poster and map developed for the 2011 National Speleological Society annual conference at which Leandras Cave was publicized.

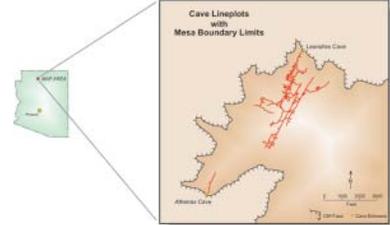
Projected Profile - Borehole Passage #2



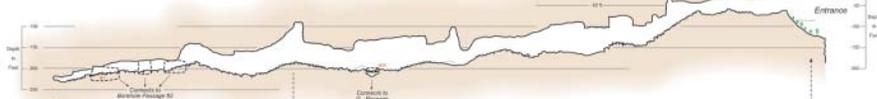
Profile View 290° - Western Borehole



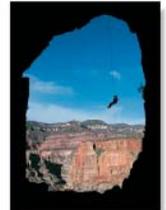
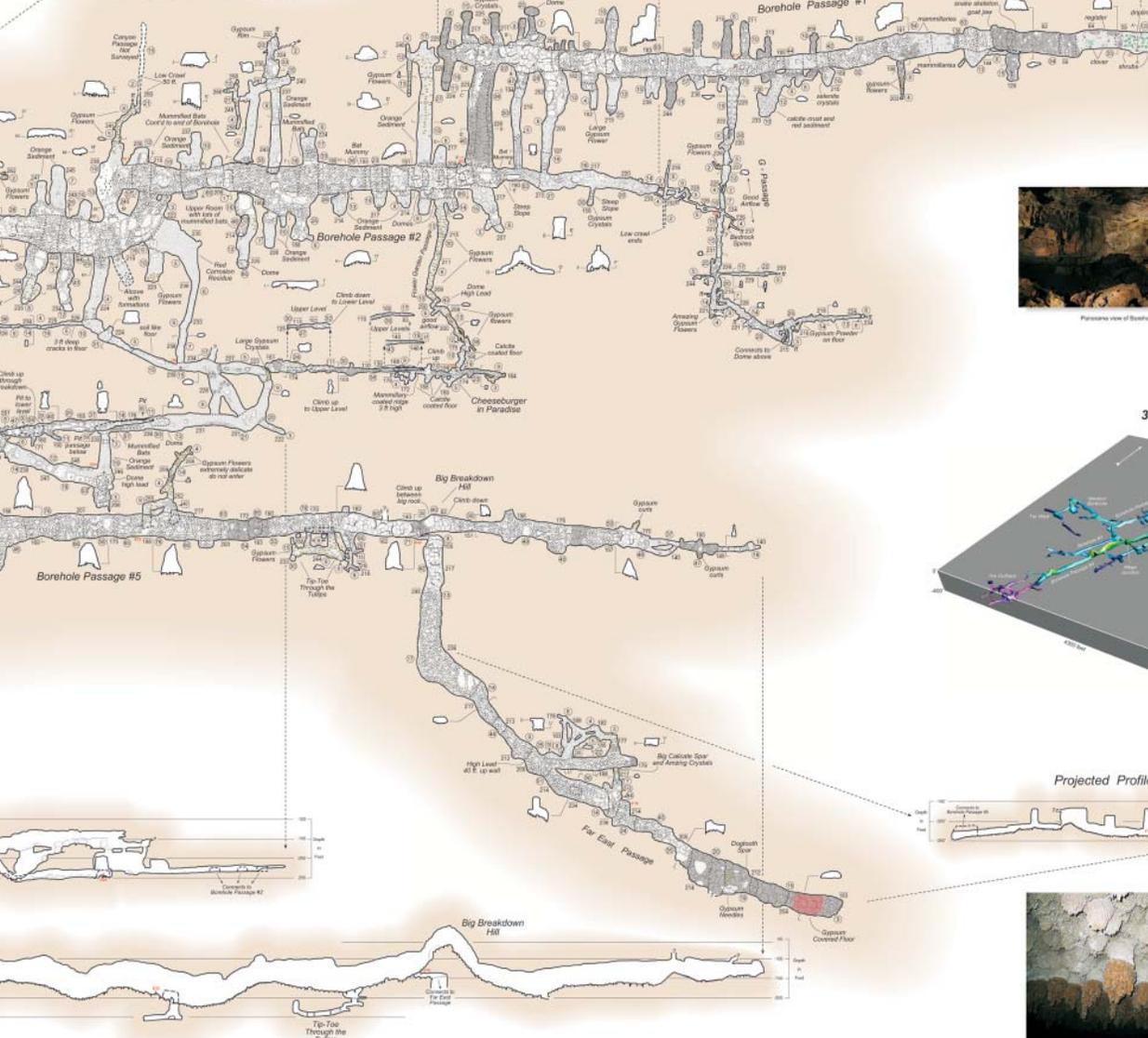
Heidi Oakes in Borehole Passage #1. Photo by Brandon Rowlett.



Projected Profile - Borehole Passage #1



Plan View

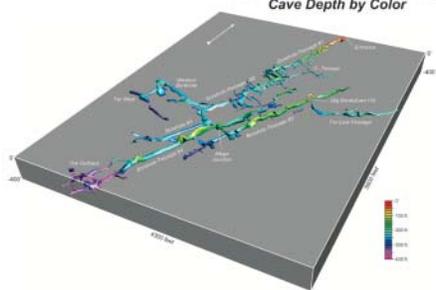


Looking out the large entrance to the cave system with cave on 120 foot upper. Photo by Jason Bahrerly.



Panoramic view of Borehole Passage #1, a breakdown filled passageway that also connects in this case. Photo by Brandon Rowlett.

3D Perspective model showing Cave Depth by Color



Projected Profile View - Far East Passage



Former gold miner from Idaho, Tombarrow, a chocolate color. Photo by Jason Bahrerly.

