EXPLORING THE LAVA TUBES OF THE 1881 FLOW
HAWAI'I

FLAG 134 EXPEDITION REPORT

April 15, 2017
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PREAMBLE: This project was conducted under a permit issued by the DLNR of the State of Alaska. The permit has publication restrictions related to cave conservation, rare and endangered species and cultural heritage associated with these and other underground sites in the Hawai‘ian Islands. Accordingly our maps are generalized and entrances cannot be located from the photographs. In order to comply with the permit conditions we respectfully request this flag report is neither published nor made available to the general public. This situation may change as the project matures.

1. Project Overview

The Big Island of Hawai‘i contains the largest lava tube systems in the world - in fact 7 of the world's ten longest lava tube systems are located in the Hawaiian Islands. Currently the world record for length is held by Kazumura Cave at 65.5 km. Kazumura is located on the eastern flank of the Kilauea volcano, and it is the deepest cave system in the USA at 1101.5 m.

On the nearby Mauna Loa volcano there is a similar and partially explored system within the 1881 flow (Figures 1 and 2). This system contains the 20.7 km long and 436.8 m deep Emesine Cave - fourth longest lava tube in the world - and the related but as yet unconnected 2.2 km long Kaumana Cave near Hilo, some 18.8 km downslope.

Exploration and mapping in the 1881 system ceased in 2002 given the rough terrain and difficulties of accessing the downslope (eastern) end of Emesine. That year work began in an easier and larger tube system located on private land near Ocean View, and efforts shifted to this location.

The March 2017 project is a renewed, multi-year effort to explore the 1881 flow between Emesine and Kaumana caves, and find a route into the downslope continuation of the Emesine system.

2. Project Explanation

In order to understand the extent and genesis of cave systems and allow for scientific research, accurate cave maps are essential. Dr. Pat Kambesis is a recognized cave mapping expert, and she was involved in the original exploration and mapping of the caves of the 1881 flow. After a 15 year hiatus she suggested a renewed exploration effort in what is almost certainly an extensive, deep, and world-class lava tube system. Using an existing State permit in 2016, an initial effort was made to find a surface route into the middle of the "gap" between Emesine and Kaumana. In March 2017 a second effort (and the subject of this Flag Report) was made under State permit with a small team using a more systematic approach. They were successful locating new entrances and getting underground.
3. **Project Objectives**

A. To locate windows (e.g. collapses in lava tube roofs) in the 18 km gap between the downslope end of Emesine Cave, and the upslope end of Kaumana cave, in the 1881 flow, and

B. To explore and map these lava tubes, and

C. To evaluate the feasibility of further expeditions with the long term goal of extending and connecting these world-class lava tube systems.

4. **Personnel:**

Dr. Pat Kambesis / Principle Investigator / Kentucky / Cave Research Foundation and Instructor at Western Kentucky University

John Pollack / Co-PI / British Columbia / Cave Research Foundation

K. David Sawatzky MD / Nova Scotia / Cave Research Foundation

Judy Robertson / Nova Scotia

Maike Buchemuelle/Ruhr Universitat Bochum

Ivonne Fleischauer//Ruhr Universitat Bochum

5. **Project Methods**

A. **Permit Acquisition:** The State of Hawai‘i has comprehensive cave protection act (2002) requiring land-owner permission before entering any cave. Given the study area lies on State property (Mauna Loa Forest Reserve and Waiakea Forest Reserve), Dr. Kambesis sought and obtained a DLNR permit for this project. The permit allowed for exploration of the 1881 flow on state lands, but it does not allow for general interest publications about the project, nor does it allow publication of any maps or images that may help a casual reader relocate the sites. These limitations are based on accepted principles of cave conservation, and the need to protect cultural and burial sites held sacred by native Hawai‘ians.

B. **Remote Sensing:** Prior to landing in Hawai‘i the study area was examined using Google Earth Pro upon which we superimposed .kml files of known caves in the 1881 flow - specifically Emesine and Kaumana Caves. UTM coordinates were obtained for a number of potential but unconfirmed entrances.

C. **Field Location:** Using the UTM coordinates obtained in B. above and Garmin 64ST hand-held GPS units, a team navigated to each potential entrance and then did a grid search for the feature. If found the entrance was given a unique alpha-numeric code.

D. **Cave Mapping:** Cave survey utilized standard cave mapping techniques that involve station to station readings of distance, azimuth and inclination with Leica Disto-X or Suunto compass/clinometers and fiberglass tape (similar to surface surveys). Passage dimensions are also measured at each station. The survey data is recorded in a field book along with a diagrammatic sketch of the lava tube passage to
scale. Survey work is conducted by small teams (3-4 individuals) in order to minimize human impact to lava tube resources. In order to provide tie-in survey station should connections to other cave segments occur or in complicated junction areas, each survey station is marked by laying a piece of labeled flagging tape on the station. The survey tape is removed once the survey is complete.

Resource inventory consists of a feature inventory list that is compiled during the cave survey process and is associated with each survey station.

Field data and geographic information are entered into a data reduction/plotting software that produces a line plot for cartography. Lava tube features are photographed and referenced to each survey station. Photography also provides photogrammetric data for producing 3-D models of the lava tubes.

After the field work the data are converted to line plots using data reduction software (COMPASS) and exported as plot files to be utilized in the cartographic process. Digital cartography is conducted with a standard drawing program (ILLUSTRATOR) and all maps are produced in native format as well as in digital format (pdfs, tiffs, jpegs). Resource inventory data is compiled in spreadsheet format and photographs are referenced to each inventory point.

Finally a .kml file produced and then imported into Google Earth Pro.

6. Project Results

Two two-person teams spent 1 1/2 days visiting approximately 12 potential entrances located earlier on Google Earth Pro. The photo-interpretations were successful and on the first day, four "going" windows were located. Search tracks were recorded and each entrance was given a unique code.

The area's difficult reputation was well-deserved. The combination of lava covered with chest high ferns and grass, proved a formidable challenge. It took two hours to thrash through a single km of brush, and the bad footing meant falls were common even with hiking poles. The brush, uniform topography, and afternoon fog and rain, meant the team had to be competent with GPS. It was a great place to get badly lost with serious consequences.

Although the downslope end of Emesine Cave was only 4 km away from a track, the terrain was such that a hard, eight hours would be required to reach this area. It was too far removed for a day-trip. Fortunately we had four new entrances within 1 km of the track.

Beginning on the second day, a single mapping team was formed with Pat Kambesis handling the key job of sketching and data recording. John Pollack ran instruments, and rest of the team performed the various duties of scouting the route, locating and marking survey stations, and drawing cross-sections. In four days 1.2 km of new cave was mapped to CRF standards including plan, profile and cross-sectional views. Data was entered nightly onto the COMPASS cave mapping program, a .kml file produced and then imported into Google Earth Pro. A number of leads displayed good air flow, and when combined with the unchecked, surface leads, there isample justification for a larger return trip in 2018.
7. Project Implications

The remote sensing and mid-gap exploration strategies used in 2017 proved successful. Both new entrances and large lava tube were found on this trip despite the difficult surface terrain. There remains a 3 km gap between the upslope ends of the "mid-gap" caves and the lower end of Emesine Cave, however it is quite feasible to cover this distance over the next 2-3 years, which would yield the second deepest lava cave in the world. There are additional possibilities both upslope of Emesine, and farther downslope toward Kaumana, but for now, closing the 3 km gap is a feasible and realistic target.

We will continue this project in January 2018 with a larger team under State of Hawai‘i permit.

8. Selected Images:

Figure 1. Large Scale Map of Study Area. USGS Data Series 144.
Figure 2. Medium scale map of study area. P. Kambesis 2017.
Figure 3. 1881 flow. K.D. Sawatzky 2017.

Figure 4. Searching for entrances on the 1881 flow. J. Pollack 2017.
Figure 5. Rigging harness for cable ladder descent into a recently located tube window. K.D. Sawatzky 2017.

Figure 6. Large tube and entrance window. J. Pollack 2017.
Figure 7. Large tube and entrance window. Judy Robertson 2017.

Figure 8. There were crawls and low passage between the larger tubes. J. Pollack 2017.
Figure 9. Lava helectites. J. Pollack 2017.
Figure 10. Pat Kambesis recording data and sketching the passage. J. Pollack 2017.

Figure 11. Survey team in action. Judy Robertson 2017.
Figure 12. Typical example of passage sketch. K.D. Sawazky 2017.
Figure 13. Typical example of survey data. K.D. Sawatzky 2017.
Figure 14. The team with Flag No. 134 of The Explorers Club. L-R are K. David Sawatzky MD (FI'07), Judy Robertson, Maike Buchemuelle, Ivonne Fleischauer, Dr. Pat Kambesis (pending), and John Pollack (FI'06). J. Pollack 2017