Historical Misunderstandings About Lava Tube Systems and Lava Tube Caves of Lava Beds National Monument, California.

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Abstract

Until quite recently the relationship between caves, lava tubes, lava tube systems, and tube-fed lava flows of Lava Beds National Monument, California, has been poorly understood. How this could be in an age of vulcanospeleological enlightenment is endemic and perpetuated by the monument's geographic, demographic, and political isolation. The only monument-wide geologic study – which addressed the fundamental relationship of lava tubes to lava flows – and a few other brief but valuable geologic appraisals, were never published and therefor escaped reconciliation with contemporary understanding of lava tubes. As a consequence, local misconceptions flourished by default until recently, when the Federal Cave Resource Protection Act required that caves be delimited.

Lava Beds National Monument

Lava Beds National Monument lies on the northern slope of the huge Medicine Lake Volcano, a shield volcano of enormous bulk. The monument is roughly rectangular in shape, enclosing 72 square miles, at an elevation of about 5,200 feet at the south end and 4,100 feet at the old shoreline of Tule Lake which forms the northern boundary. Virtually the entire monument is covered with volcanic rock, of which about two-thirds is Basalt of Mammoth Crater, a late-Pleistocene basaltic lava. From several different vents, but principally Mammoth Crater, it was distributed by lava tube systems, leaving numerous flows with terrace-like borders ranging up to 30 feet high, separated by valley-like depressions in between. Most of the caves are in this basalt.

Nearly all of the individual caves are lava tube caves that are segments of several extensive lava tube systems. The caves range in length from a few yards to the longest, Catacombs Cave, with about 6,900 feet of surveyed passage. Some are complex horizontally, having many interconnected branches. Others are vertically complex, having several levels. Depths range from surface tubes to 150 feet below the surface in the lower levels of some of the master tubes.

The lava tube systems are extensively collapsed, but many of the segments – the individual caves – have suffered little collapse and exhibit an abundance of flow features, such as lava flowstone and the many forms that result from it. Benches, linings, stalactites, ribbed walls, shelves, lava falls, and all kinds of flow lines are abundant. As a rule, speleothems (secondary mineralization) are seldom well developed in lava tubes, and Lava Beds is no exception. Ice, technically a speleothem, is plentiful in caves having a suitable shape.

Monument is Isolated

Lava Beds National Monument probably encloses the heaviest concentration of lava tubes and lava tube caves in the continental U.S.* However, despite the presence of so much tube-fed lava so close to home, the Monument has escaped the intense scrutiny that vulcanospeleologists have devoted to other areas. There are some obvious reasons for this, and some obscure reasons.

First, the monument is isolated geographically and demographically. It is 60 miles from the nearest city, Klamath Falls, which is not large enough to support a caving organization. It is about 50 miles from the nearest interstate highway and, until recently, visiting there entailed driving on

*There may be heavier concentrations at Craters of the Moon National Monument and elsewhere in Idaho – time will tell.

some gravel roads. It is 300 and 350 miles from large population centers, Portland and San Francisco respectively. There are no accommodations in the park except a small campground; few accommodations in the usual sense nearer than Klamath Falls, 60 miles to the north; and no services whatsoever within 25 miles of park headquarters. The weather is reliably unpredictable and, at an elevation of 4,500 feet, often very cold in the winter and spring.

For its own reasons, and perhaps because of local pressure, the Park Service has not seen fit to expand facilities to accommodate more overnight visitors. In short, there are more attractive places where lava tubes may be studied; for example, all around other flanks of the Medicine Lake Volcano, Mount St. Helens National Volcanic Monument, and near Trout Lake, Washington.

Left Out of Vulcanospeleology

Lava Beds missed out on the rapid expansion of vulcanospeleology that began in the mid 1960s. They have a fine library for use by researchers and authors, but until recently it contained little about lava tubes, *per se*. In 1936, and occasionally thereafter, respectable studies of the lava tubes and systems in the monument were completed. These works, which are in the monument library, would have contributed greatly to early vulcanospeleology, but were distributed only internally, and never published (Fisher, 1934; Glaeser, 1936; Hatheway, 1969; Lewis and Anderson, 1936; and Peck, 1976). As a consequence, the theories and terms they contained were never reconciled with the observations of others. One of these [Lewis and Anderson contained by far the largest block of terms and descriptions for lava tube features up to that time. For most part, they were based solely on local observations and conclusions. Predictably, they contained fundamental misunderstandings and embodied much local convention. For example, the term "chimney" was applied to hornitos as well as spatter cones, cinder cones became "buttes," and these names hang on to this day. Until recently, because there was little else to refer to, local convention dominated by default.]

Failure to recognize the fundamental relationship between lava tubes and the emplacement of lava many miles from its source hampered understanding of lava tubes at Lava Beds for many years. Lava tubes were something that occurred in lava flows when the top, and later the sides, hardened. The vital role of lava tubes in spreading lava so thinly, over great areas, was virtually ignored. Even as recently as 1990, in a long-awaited U.S. Geological Survey publication (Walters, 1990) there is little enlightenment beyond: "Lava tubes typically form in the interior of thick lava flows." Lava tubes were seen as places where the lava drained away, but never as the place where it came from, a far more important distinction. A few researchers, up to snuff vulcanospeleologically, have examined and written about specific lava tubes and systems in the monument during the past two decades. The only comprehensive, monument-wide study of the lava tube systems – which enumerates only selected, developed caves – was completed by Lewis and Anderson in 1936.

How Many Caves?

No one can say, with reasonable certainty, how many individual caves there are in the Monument. Many surveys have been initiated, but none have been completed. Over 400 cave names appear in the literature, probably 200 of those have been located and explored to some extent, but only about 75 have been described well enough to be positively identified.

In 1934, Fisher wrote that 293 caves had been discovered, about 130 had been explored, and about 50 had been named and developed to some extent. The number 293 became legendary, appearing in writings through 1985. Some accounts rounded the number off to 300 caves, and indeed, a 1934 map bore 303 individual cave symbols. In 1936, Glaeser (1936) documented about 130 additional caves, but clearly some of these overlap the legendary 293.

Segmentation

The numbers above are not especially meaningful, however, because until 1990 no systematic protocol for distinguishing individual caves was needed or acknowledged. Whether one will be employed remains to be seen. As a result, many distortions of reality thrive. For example, in 1928 the entire cave loop section (about five miles worth of frequently segmented lava tubes) of the Headquarters System was included in Labyrinth Cave. By the mid-1980s, Labyrinth Cave had deflated to a more plausible, respectably competitive, but oddly precise length of 15,666 feet. (Presumably this length varied a little with seasonal temperature.) Applying the rule of segmentation recommended by the

International Union of Speleology (UIS) – that collapses wider than they are deep, segment a lava tube – Labyrinth Cave actually has about 3,800 feet of passage. However, its true nature is still not completely resolved. Along its course are several relatively small openings in the roof, that are skylights by any known definition. Two of these openings have stairways and are designated entrances – not to Labyrinth Cave – but to Thunderbolt Cave and Lava Brook Cave.

Stewart Peck (1976), while a summer employee at the monument, completed a survey of caves in the Cave Loop area. He was quite aware that the Labyrinth Branch was extensively segmented, and listed a total length of 12,845 feet, of which he noted that 1,310 feet was collapse trench. He also (correctly) noted that the longest tube ". . .not intersected or broken by a collapse. . ." was probably Catacombs Cave, at 6,562 feet. Catacombs has since been inflated to 7,475.00 feet (decimal added) and re-surveyed (by one of the most respected cave surveyors in the northwest) to 6,900 feet. Even though Peck's article was published, and is in the monument library (Peck, 1976), a prominent 1990 publication about some Lava Beds caves asserts that Golden Dome, Labyrinth, Hopkins Chocolate . . . and Blue Grotto caves [are] "several interconnected but separately named caves."(Waters *et al.*, 1990) In fact, the above caves are all separated from each other by one or more segmenting collapses. For example, the nearest points between Golden Dome and Blue Grotto are separated by four collapses – two of which are two or more times longer than they are deep – and two other short caves. The caves named above are segments of the Labyrinth Branch (of the Headquarters System) but are not interconnected in any real sense.

In 1990 – following passage of the Federal Cave Resources Protection Act, implementation of a cave management plan, and initiation of a cave inventory conducted by the Cave Research Foundation – it has become necessary to be more specific about which caves are which. The management at Lava Beds has never deliberately ignored or rejected increasing knowledge of lava tubes. The monument has specific needs in interpretation, and there never has been a need to accommodate other than the typical visitor, who could hardly care less about things like segmentation.

Underlying the determination of individual lava tube caves, of course, is the matter of segmentation. Indifference to it has contributed more to misunderstanding of Lava Beds caves than any other factor. The only consensus regarding it that exists (the UIS principle), holds that if a collapse sink's largest dimension measured horizontally exceeds its depth, the tube is segmented, resulting in multiple caves. This resolution is so simple, however, that it is vulnerable to artifices employed to join caves together for competitive purposes. I like it for its simplicity and because it provides something tangible to measure. Interestingly, initiatives aimed at broadening this consensus are seldom acknowledged, perhaps because to do so would acknowledge its existence. I look forward to the time when the need for a principle of segmentation is acknowledged and discourse may begin about specifics.

And Then . . . Bridges

Almost as frustrating as the lack of consensus about segmentation is the pervasive designation of segments of lava tubes as "natural bridges." Bridges at Lava Beds range widely in width. The longest is the 350-foot-long segment of the Headquarters Lava Tube System designated Heppe Bridge. (It was named by J. D. Howard, an early explorer who disdained caves without an area of total darkness.) The smallest is probably the "partial bridge" (whatever that is) described in Waters (1990). At Lava Beds, bridges are managed as caves, but the recently adopted cave managment plan further complicates the distinction with the following obfuscatory provision: "A bridge is any naturally occurring geologic feature that spans a space and whose span is wider than long."

Very little understanding of the relationship of tube-fed lava flows, lava tube systems, lava tubes, and lava tube caves is reflected in literature about Lava Beds. Even some of the most recent works infer that lava tubes are there because of the lava flow, when exactly the opposite is true. "System" has been applied to individual caves, to groups of caves, but only occasionally to entire systems. Even today, many who collect data have no clear idea of what a system is. Nearly 100 "systems" have been named. Many of these names are similar, to be sure, but there are only about nine alignments inside the monument that are arguably lava tube systems. Some "systems" have been judged and named on the basis of observations of a single segment, without apparent reference to the source of lava or its destination. At the same time, individual segments of systems are seldom recognized as parts of the whole.

Naming, re-naming, and re-identifying caves, without reference to or regard for the literature, has created difficulty. For example: (1) the two-level cave now known as Merrill Cave was known at various times as Bear Foot Ice, Bear Paw Ice, Bearpaw Ice, Ice Cave, Little Bear Paw, Lower Merrill, and Merrill Ice Cave. Bearpaw Cave, nearby, was known at differing times as Bear Foot, Bear Paw, Big Bear Paw, and Upper Merrill. (2) A short, two-level segment of the Headquarters System master tube, known appropriately as Compound Bridge since 1917, was recently re-named Natural Bridge, despite the existence of several dozen "Natural Bridges" in the monument. (3) Recently, a short, deep segment of the same master tube, shown on Forest Service, Park Service, and popular maps and in several pieces of literature, as Duffy's Well as far back as 1918, was arbitrarily renamed Old Still Well (Sowers *et al.*, 1990).

Natural Bridge Cave, a feature of the Cave Loop tour, is a two-level segment of the master tube of the Headquarters System with over 300 feet of passage. It was originally named Compound Bridge by J. D. Howard in 1917. Despite the presence of the name painted in large yellow letters on the edge of a large piece of floor crust just inside the upper entrance, and repeated confirmation in the literature, including "The origin of geographical, geological, and historical feature names in Lava Beds National Monument" (1965), not to mention a super-abundance of "natural bridges" in the monument already, a few years ago it was renamed Natural Bridge.

At least five cave numbering systems have been employed as a means of identifying Lava Beds caves, the first in 1936. A second series of numbers appeared in 1959, two more in 1989, and the latest in 1990. Fortunately, none of the numbering systems have anything in common. Otherwise there might be a lot more misunderstanding about Lava Beds caves than there already is.

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