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El Malpais National Monument

LAVA TUBE SYSTEM  
RESOURCE INVENTORY  
REPORT

Prepared for:

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## Bandera Lava Tube System

### ZUNI CAVE AREA

#### General Description

The Zuni Cave Area of the Bandera Lava Tube System begins at Bandera Crater (T9N; R12W; Section 22, the NE corner) and extends south along the east half of Section 22, the southwest corner of Section 23, and finally into the west half of Section 26. Curiously, although this area possesses (at least) two major ice caves, the Zuni Cave Area is not outstanding from a cave resource standpoint. Of course, it is possible that further inventory will alter this assessment. However, if so, new discoveries are likely to be ice caves rather than large lava tubes such as occur in the East of Rendija, Apache, and Outlaw Trail areas.

This is not to say the Zuni Cave Area is not a rich, exciting, beautiful portion of the Bandera tube system. Bandera Crater is one of America's most dramatic examples of an extinct volcano, and while the incredible stark beginnings of the Bandera Tube System are not rich in big caves one is never likely to forget the lava tube collapse and associated surface features of this landscape.

Zuni Cave is usually referred to as the "Commercial Ice Cave". The name change was suggested by Elston and Wophletz (1987) and the consultant recommends its formal adoption. A second major ice cave located one-quarter mile South of Zuni Ice Cave -- but one that should not be open to the public except on a guided tour basis -- is also recommended for a name change from its informal "Frozen Bat" appellation to "Acoma Cave". The reason for the recommended name change is that the consultant is recommending that all but one of the study area's major ice caves be named for the Indian tribes that surrounded El Malpais circa 1850. One of these caves had to be named for the Acomas and Frozen Bat is an appropriately significant ice cave.

The Zuni Cave Area of El Malpais is believed to have the highest potential for ice cave formation because it possesses the highest elevations of any lava tube area in the National Monument; also because of its proximity to the Zuni Mountains. The average elevation of this portion of the tube system is 7,800 feet.

When he began the lava tube system inventory, the consultant fully expected to discover a number of spectacular and previously unknown ice caves in this area. Although Acoma (Frozen Bat) was identified, few other enterable ice caves were encountered. However, the consultant believes the dearth of enterable ice caves arises not from a lack of ice in the caves but rather from too much ice in too many caves.

That is, the consultant believes that most of the ice caves of the Zuni Cave Area cannot be entered because they are choked closed by ice. This may seem like a radical conclusion in the face of strong evidence that the ice formations of Zuni Cave and Lichen Cave are known to have dramatically receded within the recent past. However, it appears an inescapable conclusion when cave lead after cave lead cannot be entered because they are choked closed by ice formations.

The consultant believes that the upper Bandera lava tube system may display the hydrological phenomenon of an "ice table". That is, that a substantial quantity of frozen water may be perched in the fractures, fissures, cavities, and caves of the tube system. The dynamics of ice formation would remain a function of cold air drainage into small and large air spaces in the tube system. The only difference being proposed here is that the tube system may possess far more ice than has been previously suspected.

The above theory differs from that proposed by other researchers in that it does not seek to explain the formation of ice in one cave -- namely Zuni -- but rather attempts to explain the presence of the fifty or more ice caves in this area and the many hundreds present on the Bandera tube system as a whole. Ice is far too frequent in the Bandera tube system caves to be explainable, for example, in terms of that proposed by Harrington (1940) and Elston and Wohletz (1987) for Zuni Cave. As Dr. Alton Lindsey (1951) pointed out regarding Harrington's explanation: it simply does not fit all El Malpais caves. Indeed, the consultant would go farther still: Harrington's explanation does not even fit most caves.

The Zuni Cave Area, in addition to Bandera Crater and two major ice caves, possesses a beautiful double lava bridge, several exquisite lava sinks, a double window cave, an ice water spring in an ice cave, and more. Further, the likelihood that new features will be found in this area -- especially ice caves -- is high.

Map/Photo Code: ZC

ZC-1 (4)      The crater of Bandera is over 700 feet deep. This is the source of the Bandera Lava Tube System, which is likely the longest and the most "big cave" intensive lava tube system on the North American continent. The crater is impressive.

- ZC-2 (2) This is the "Shoulder of the Breach", or what remains of the breach in the crater's South wall that resulted in the formation of the Bandera lava tube system. Initial bearing of the tube averages 220 degrees.
- ZC-3 (1) Many small, short length caves are present just below the Shoulder of the Breach. These are consistently very cold (34 to 38 degrees) and choked with either ice, rubble, or both. Did not locate any caves of consequence but could not thoroughly explore the possibilities either. To do so between the Shoulder of the Breach and Zuni Cave would require an estimated 100 hours of field time for a minimum of two persons. Access code is frequently #4. The photo is of a typical (and inconspicuous) cave entrance in this portion of the tube system, which tend to be on the tube system flanks rather than in the tube itself.
- ZC-4 (1) A walled structure is present immediately South of the Shoulder of the Breach on the West side of the tube system. Note how the floor of the structure differs from the surrounding rocky ground.
- ZC-5 (3) The beginnings of the Bandera Tube System are not spectacular but it is stark. Note small cave leads in Photo A; these are typical.
- ZC-6 (4) This series of photos displays a "fern garden" niche on the West side of the Bandera Tube. The B photo displays another small (cold) cave lead. Air temperature in cave entrance on 6-26-88 was 37 degrees F. Note yellow lichen (Acarospora evoluta) indicator on photo A; when this lichen is encountered in profusion, a cold cave, fracture, or fissure should be looked for diligently in the immediate area. Fern and moss species were not identified. Sensitivity code is #1.
- ZC-7 (2) Huge fracture high on the rim of the tube system and running parallel to it. Photo A is looking up out of the fracture from the bottom

(height: 35 feet; width 3 to 6 feet). Photo B is the floor of the fracture with small cave lead to an ice choke. This is a typical scenario for those fractures entered.

- ZC-8 (1) The floor of the Bandera Tube; note advanced soil development.
- ZC-9 (1) Climbing the wall of the tube.
- ZC-10 (2) Aspen grove and mixed conifers growing in tube floor in the turn of the tube from south to west. A curious feature of this aspen grove is the growth of moss around the base of the aspen trunks; this has not been observed elsewhere (no photo).
- ZC-11 (1) Aspen and mixed conifer on the shoulder of the tube and just below the trail.
- ZC-12 (1) East side of collapsed tube; note person standing on edge of precipitous tube face.
- ZC-13 (1) The Bandera lava tube at the beginning of its big turn to the east. Depth of tube exceeds 70 feet here.
- ZC-14 (2) A small habitation cave on the west side of the tube wall. Photo B is from the cave interior. Ceiling height is 10 feet; cave width is up to 20 feet. Cave floor drops 20 feet from entrance to rear of cave. Much bone is present in the cave. Also lithic material and charred wood. Floor is fill. Evidence of minor digging. Cave air temperature 55 degrees F on 6-26-88. Entrance bearing looking out is 110 degrees. Recommend archeologist consider site. Access code is #1.
- ZC-15 (1) On the west lip of the tube system.
- ZC-16 (2) Note the huge fracture running parallel to the tube. When this feature occurs, the likelihood of major cave occurrence decreases dramatically. The parallel fracture zones

appear to be strongly associated with the subsidence of the tube roof rather than with 1) the outright vertical sheering of the tube roof; or 2) the keying together of the tube roof to form a cave.

- ZC-17 (1) Looking up the lava tube from south to north. Note aspen grove high on tube floor.
- ZC-18 (2) Small cave in the fracture zone on west side of tube.
- ZC-19 (1) View of the tube looking south.
- ZC-20 (6) Ice Water Spring Collapse Structure (CS). Depth is up to 40 feet; length 100 feet; width 50 feet. Note ice water spring in Photos C and D. Water temperature on June 27 was 35 degrees F. Ice is visible under the water. Emerald green algae is believed to be a Stichococcus-Sphaerella bloom. Pool faces 290 degrees. Access code is #2. Sensitivity code is #4. Photo F is looking to west from Ice Water Spring C.S.; note unbroken pahoehoe lava.
- ZC-21 (3) Archeological site located in a small subsidiary lava tube (WNW). Note screen in entrance in Photo B and pottery sherds in C.
- ZC-22 (1) Crevice 30 feet in depth with snow in bottom on June 27, 1988. Many earth fractures nearby, some exceeding 60 feet in depth.
- ZC-23 (5) Dome Collapse Structure (CS) is immediately south of Ice Water Spring CS. Note the dome-like shape of CS in Photo A and the surface features associated with it in B. CS leads into a shallow cave. Bearing in is 60 degrees T. Cave is choked with ice. Length of cave 30 feet; ceiling up to 25 feet; width to 30 feet; depth below rim of CS is 60 feet. Access code is #3.
- ZC-24 (3) Views of subsidence collapse of tube in area where the Bandera system makes its big turn to the east.

- ZC-25 (1) Earth fracture running parallel to Bandera system; fractures remain common on both sides of the tube in this area; caves are rare and small when present.
- ZC-26 (3) Earth fracture with a depth of 25 feet; differs from most in that ecological succession has created a micro-habitat for moss, ferns, and lichens. Access code is #2. Sensitivity code is #1.
- ZC-27 (1) Walled structure archeological site; appears to be quite old.
- ZC-28 (2) Shallow ice cave. Note distinct crust of the pahoehoe lava roof. Cave ceiling up to 10 feet high but averages 3 to 4 feet. Length 30 feet. Ash deposits and wood in cave; also tin cans and glass sherds. Cave is ice choked at terminus by ice pond 3 by 10 feet. Much rubble and breakdown. Access code is #3. Not spectacular.
- ZC-29 (1) On lip of lava tube system where it widens and makes its southernmost turn to the east (Note: the tube system turns east in two places: 1) immediately west of Zuni Cave CS; and 2) immediately west of Triangle Cave CS). This photo was taken in the area of the second turn.
- ZC-30 (1) A lava wall on the Bandera System; height of wall 60 feet or more. Cave at base is shallow. Choked with ice. Note stark beauty of lava surface.
- ZC-31 (1) Earth fracture running parallel to the Bandera tube system.
- ZC-32 (1) An example of the jumbled and torn rock land lying between the tube's big turn to the east and Lichen Cave.
- ZC-33 (1) The fractured earth lying on the south margin of the Bandera tube.

- ZC-34 (1) Example of classic pahoehoe lava.
- ZC-35 (1) A ground surface lava tube lying immediately north of David Candelaria's old motor tour trail. Cave ceiling height is 3 to 5 feet; width is of similar dimensions. Length of both tube segments is 50 feet. Access code is #3.
- ZC-36 (1) A second ground surface lava tube lying immediately south of the motor tour trail. Note the classic pahoehoe crust which forms the cave's roof. Dimensions are similar to ZC-35 above except length is 100 feet.
- ZC-37 (9) Lichen Cave was, during the summer of 1988, an ice water spring. Like the small pool of water at Ice Water Spring CS, Lichen Cave's pool is transformed into emerald green by what is believed to be a bloom of *Stichococcus-Sphaerella* algae (see photo H). Lindsey (1951) named and described Lichen Cave in his ecological monograph paper as a major ice cave. Lichen Cave can no longer be described as such. Indeed, although ice underlies the pool of water and is in evidence in small leads very close to the surface, ice is not readily apparent at Lichen Cave. This means that the level of ice in the cave has substantially declined in the past 37 years. What is perhaps even more significant, Lindsey reported a "high water" mark exists (or existed) at this cave 121 inches above the ice floor. If Lindsey's interpretation is correct, it would appear that El Malpais' ice formations have been in decline for many decades and that the decline has not yet reached its nadir.

Note the spectacular yellow lichen formations of Acarospora evoluta on the cave wall and the rich carpet of moss on the breakdown boulders above the cave floor in Photos A and B. Lindsey reports Arctic Alpine moss, Homomallium incurvatum, from this cave. Photos C and D are close-ups of the moss carpet covering much of the cave's breakdown.

Photo E is the yellow lichen growing on a dark rock background that creates a startling mosaic of rich color.

Photo F is looking straight up at the rock overhang of Lichen Cave. Lichen Cave faces 350 degrees (almost due north). Water temperature of the pool on 6-28-88 was 34 degrees F. The water level in the pool was 1 foot in depth on the above date. The pool is 12 feet in length and up to 4 feet in width.

The Lichen Cave CS is 200 feet in length and 100 feet in width. Depth from the lip of the overhang to the pool is 60 feet.

Lichen Cave is suitable for intensive visitor use so long as visitors are not permitted to walk on the moss and lichen carpet, which is highly sensitive to trampling (sensitivity code #1). Access code is #2.

- ZC-38 (3) A six (6) room concentration of archeological sites is located immediately north and east of Lichen Cave and are probably associated with it.
- ZC-39 (1) Entrance to a small ice cave beside David Candelaria's trail to Zuni Ice Cave. Access code is #3. Ice is in the form of a small pond that chokes the cave closed.
- ZC-40 (7) Trail Sink is 30 feet in diameter and up to 25 feet deep. Access Code is #3, but it is a tricky #3. Three cave leads are present in Trail Sink, all choked by ice very close to the surface. The bearings looking out of the three entrances are 120 degrees, 100 degrees, and 325 degrees. The 120 degree ice cave (ice choke) had free standing water atop ice (see Photo D). Water temperature on 6-29-88 was 34 degrees. The 325 degree cave on this date had snow in its entrance (see Photo E). Moss, lichens, and ferns are prolific on the north facing floor of the sink (see Photo F). Sensitivity code is #1.

ZC-41 (8)

Zuni (Commercial) Cave is believed well suited to intensive visitor use so long as visitors remain suspended above the ice and near the cave entrance where body heat will rise and tend to be carried out of the cave.

However, despite the intensive visitor use suitability assessment for this cave, it appears that the cave's ice levels have receded dramatically since 1926 when the vertical to overhanging, semi-circular wall of ice was measured as fourteen (14) feet high (Lee). In 1951, Lindsey recorded an ice wall only nine (9) feet high. In 1988, ice wall height is only only seven (7) feet. If Zuni Cave were the only ice cave to be experiencing receding ice, the suspected cause would be intensive visitor use. However, falling ice levels have also been recorded for Lichen Cave and Alton Lindsey (La Manchia) Cave, both of which receive little or no visitor use. Indeed, Alton Lindsey Cave was completely choked by ice until circa 1953, when a small hole in the ice was enlarged to permit entry. Inside were artifacts, bighorn sheep bones, and large ash deposits.

The cause of the receding ice levels in El Malpais' ice caves is most likely due to normal climatic wet-dry cycling. This is suggested by the closing of Alton Lindsey Cave by ice buildup and its reopening by ice melt in circa 1953. However, a monitoring program should be instituted in Zuni Cave (as well as in other major ice caves) as soon as is feasible to assess the impact of intensive (or backcountry) visitor use on the cave resource. Under no circumstance should the general public have access to the floor and ice formations of Zuni Cave. Interestingly, Zuni Cave faces 155 degrees, or south/southeast. Thus, in winter, the sun shines directly onto the ice floor. This is unexpected, but not unprecedented. At least two other ice caves on the Bandera System -- one of them major -- are directly exposed to the sun for at least a portion of the year.

Air temperature at the ice wall was 31 degrees Fahrenheit on 6-29-88.

Cave ceiling height is up to 35 feet; width is up to 40 feet; the length of the ice chamber is 60 feet. In addition, a rubble lead continues at a bearing of 345 degrees until choked closed by breakdown at a distance of 70 feet. This lead is interesting, however, because the fracture that figures in Harrington's (1940) theory of ice cave formation is located in it.

PLEASE NOTE: Zuni Ice Cave will be nominated for designation as a National Natural Landmark in December, 1988; selected portions of this nomination and photographs will be included in this report at that time.

- ZC-42 (2)      Zuni CS length is 300 feet and width is 50 feet. Maximum depth of CS from rim to rubble floor is 30 feet. Access code is #2.
- ZC-43 (2)      A small ice cave is present at the south end of the Zuni CS. The cave entrance is small, 2 by 3 feet, and drops a vertical 6 feet to the cave floor. A small ice pond chokes the cave closed. Access code is a tricky #3. Note: cave ceiling is composed of loose rubble.
- ZC-44 (1)      Archeological site near the lip of Trail CS.
- ZC-45 (3)      A three-room complex of archeological sites just north of the lip of Zuni Cave, one of which (Photo A) is situated in a shallow cave.
- ZC-46 (3)      Hidden Sink is located 100 yards east and slightly south of Zuni CS. Note thin crust that overhangs the sink in Photo A. Depth of the sink is up to 25 feet and diameter is 30 feet. Access code is #4. Sensitivity code is #1.
- ZC-47 (2)      Bridge-Window CS length is 400 feet, width is 50 feet, and depth of CS from rim to rubble floor is 40 feet. Note bridge window at south end of CS in Photo ZC-47A.
- ZC-48 (1)      Archeological site in the east wall of Bridge-Window CS.

ZC-49 (3) Small ice cave on north end of Bridge-Window CS. Ice in form of pond on west side of cave. Cave length is only 15 feet but width is 40 feet. Entrance is small, only 3 by 3 feet. Ceiling height is a maximum of 12 feet.

Note pottery sherds in Photo B; they are located just inside entrance (Photo A) against the wall. Photo C is of cave interior. Access code is #3.

ZC-50 (8) Picture Window Sink. Access is through the lava bridge at the south end of Bridge-Window CS. As photo A suggests, this is a beautiful sink. The picture window opens to a bearing of 350 degrees and a view of Bandera Crater (Photo B). Two ice cave (really ice chokes) are present in Picture Window CS. Entrances are depicted in Photos E and F.

The sink is up to 30 feet deep, 40 feet in length, and 20 feet in width. Length of the lava bridge entrance is 40 feet, ceiling height 20 feet, and width 30 feet. Access code is #3. See Photo B for surface view of bridge and Photo H for same of Picture Window Sink. Sensitivity code is #1.

ZC-51 (2) Acoma CS. This is not a conspicuous CS. Depth is 20 feet, length 175 feet, and width up to 40 feet. View in Photo A is looking north to Bandera Crater. An ice choked cave lead is located on the south end of the CS; see Photo B.

ZC-52 (11) On the north end is located Acoma (formerly termed Frozen Bat) Cave. This is a major ice cave.

An archeological site is situated atop the entrance to the cave (Photo A).

Photo B is of the entrance to Acoma Cave; it is quite constricted, measuring only 2 by 2 feet. Access code is #5.

Photo C is of the spectacular orange lichen (probably Gasparrina elegans var. brachyloba) colony at the entrance to Acoma Cave.

Acoma Cave faces 165 degrees. Although the entrance is very tight, the rock is stable and danger level low (provided a person is sufficiently slender to negotiate the tight passage). The ice of Acoma Cave is close to the surface -- only 12 inches below the floor of the CS. The dimensions of the ice chamber are: ceiling up to 12 feet with 8 foot average; width up to 25 feet; length up to 35 feet.

The ice of this cave is massive primarily in the form of a floor deposit. However, three ice pedestals are present in the cave (see Photos D, E, and F) and on June 30, an exquisite crystal-like sword of ice hung from the ceiling (see Photo G).

The air temperature 3 feet above the floor of the cave on 6-30-88 was 39 degrees F. The consultant cannot explain this temperature. It appears 8 degrees F. too high. However, the thermometer was functioning properly (a temperature taken on the floor registered 31 degrees F). On returning to the cave in early September, the air temperature taken at the same station (3 feet above the floor) was 32 degrees F.

Wood is present in the ice and the proximity of the archeological site above the cave entrance suggests that Acoma Cave was utilized as a water source by Native Americans.

ZC-53 (1)

Bandera tube system 150 yards south of Acoma Cave.

ZC-54 (3)

Triangle CS is located at a sharp turn in the direction of the tube system from 167 degrees to 90 degrees. CS length is 300 feet; width is 125 feet; and depth is up to 30 feet. Access code is #2. Photo E is of a rock overhang on the West side of ;the CS. This CS has a rich mixed conifer forest growing in its floor composed of large Douglas fir, Ponderosa pine, and Rocky Mountain Juniper (see Photo A). Sensitivity code is #1.

- ZC-55 (2) An ice cave is present on the northwest corner of Triangle CS (see Photos A and B for external view of entrance). Bearing into cave is 315 degrees T. Once inside, cave height increases to a maximum of 12 feet, with a maximum width of 20 feet and a length of 100 feet. At the end of a tight lava chute (2 feet by 5 feet), the 15 by 10 by 5 chamber with an ice pond choke that measures 12 feet in length and 1 to 4 feet in width. Air temperature on 6-30-88 was 32 degrees F. Access code is #5.
- ZC-56 An archeological site is present in a small subsidiary tube on the north rim of Triangle CS (note rock wall behind person).
- ZC-57 (2) A subsidiary tube is present on the east end of Triangle CS. Length is 40 feet, height 7 feet (max), and width 3 to 5 feet. The name of the CS was assigned from the unusual shape of this small tube. Photo A is an external view whereas Photo B is internal.
- ZC-58 (1) Classic pahoehoe lava on the rim of Triangle C.S.
- ZC-59 (3) Little Rattler CS. This is that portion of the Bandera Tube System that is in the most advanced state of ecological succession of any other. Presumably, favorable effective moisture conditions resulted in the rapid production of organic matter which in turn succeeded to what we find today: a thriving mixed conifer forest dominated by huge Douglas firs (over 4 feet in diameter) but also including aspen, Ponderosa pine, and Rocky Mountain Juniper. This condition is depicted in Photo A.
- The name "Little Rattler" was assigned because this was the only site on the tube system where a rattlesnake was encountered. Size was 18 inches. Species could not be determined without collecting the reptile. Since the consultant had no permission to collect vertebrates, the rattler was left to live out lava days.

Little Rattler CS is nearly 600 feet in length. Width is up to 150 feet but 50 feet is more typical of much of the tube segment. Much of the floor is park-like (see Photo B). Many small cave openings and earth fractures. Not explored. Note classic CS subsidence features in Photo C. Tube bearing is 162 degrees True. Access code is #1. Suitable for interpretation. Access code is #1. Sensitivity code is 1.

ZC-60 (1) Small CS lying immediately south of Little Rattler CS; three small ice cave (ice choke) leads. These are rubble caves; rock unstable. Ice is near surface.

ZC-61 (1) Roof of the tube system is not collapsed in portions of this area. However, no entrances to big caves were located; three leads into ice chokes encountered.

ZC-62 (7) Hanging Fern Cave. This cave occurs in a spectacular sink only 20 by 30 feet in width and length but which is up to 80 feet in depth (see Photos A and B). Access code is #2. The cave entrance looks much like a forested Lichen Cave. Bearing into cave is 210 degrees (Note that the tube system is beginning a lazy turn to the southwest at Hanging Fern Cave).

The name "Hanging Fern" was assigned because the ferns present on the cave's north facing wall hang from the wall of the CS (see Photo C). In Photo D and E, this hanging phenomenon is continued; note the "moss" soil the ferns are growing in.

The entrance to Hanging Fern Cave is 20 feet in height and 30 feet in width (see Photo F). However, the cave opens to 50 feet in width with a 35 foot ceiling once inside. Cave length is only 125 feet: Hanging Fern ends in an ice choke on two leads (cave dimensions are much reduced at the two chokes).

Photo G depicts the south rim of the sink in which Hanging Fern Cave is situated.

- ZC-63 (1) The roof of the tube has conspicuously subsided in a sag along much of this portion of the Bandera System. Many small cave leads. Few entered; those that were tended to be choked with ice.
- ZC-64 (1) Exquisite Cone. This is a striking spatter-cone on the edge of the tube system. Height is 40 feet and diameter 100 feet. Beautiful lava surface features. View from summit of cone dramatic.
- ZC-65 (1) Indian Water CS is a significant CS. Length is 300 feet; width 50 feet; and depth up to 25 feet. The cave in the distance in Photo A is Indian Water Cave.
- ZC-66 (7) Indian Water Cave is significant not so much because it is an ice cave -- ice caves are the most common cave on this portion of the Bandera Tube System -- rather because this cave is an effective ice (melt) spring during the summer months. That this water was formerly utilized is apparent from the placement of two (2) log ladders from the west wall and down into an ice spring chamber (see Photos A, B, and C for views of one of the ladders and the ice spring entrance).
- The ice spring chamber is only 5 feet in height and 3 to 6 feet in width, but is a sinuous 20 feet in length. Ice water depth on 7-16-88 was 12 inches. The ice formation appears to be massive.
- The ice spring in Indian Water Cave is only a portion of this cave's features. The main entrance is 20 feet in height, 30 feet in width, and cave length is 250 feet in 3 leads. Access code for Indian Water Cave is #3. This is the case because huge boulder breakdown rubble must be repeatedly climbed and descended. Ice is found in numerous pools at the base of the boulders. Indian Water Cave is very cold for a large cave this close to the surface. Cave air temperature is 31 degrees, which suggests why the ice fan formations depicted in Photos D, E, and F were present on 7-16-88. Photo G depicts a curious mammillary gland-like ice formation.

Bearing into the cave is 65 degrees True.

Sensitivity code is #1.

ZC-67 (1) Indian Water CS has numerous (at least 5) ice choke leads. Photo depicts one of these, with an ice pond in view from the surface. On the south side is a cave lead 100 feet long that ends in an ice choke. Ceiling height is up to 20 feet and width 50 feet. Access code is 5 because entrance is a crawl.

ZC-68 (3) Bubble Windows Sink is a dome-like CS that only partially collapsed, leaving a bridge across a portion of the sink. Sink diameter is 20 feet and depth is 20 feet. Access code is #3 through the east window. Sink has a very tight entry cave (1 by 2 feet) on the north side. Length explored was 200 feet; did not continue because consultant was alone and cave access was becoming increasingly tricky. Lead needs to be checked out when caver backup is available.

The Bubble Windows Sink marks the south terminus of the Zuni Cave area of the Bandera lava tube system.

ZC-69 (1) Circle C.S. is a shallow subsidence feature that collapsed in the configuration of an almost perfect circle. Depth is 15 feet and diameter 100 feet.

## Bandera Lava Tube System

### EAST OF RENDIJA AREA

#### General Description

The East of Rendiya Area of the Bandera Lava Tube System begins in T9N, R12W, Section 27 on the Eastern edge at Bubble Windows Sink. Thence the area bisects Section 27 west and then south, extending into the northwest corner of Section 34 and the eastern half of Section 33. The Township shifts from T9N to T8N (the Range remains 12 W) as the tube system moves south into the east half of Section 4, the west half of Section 9, and the southwest corner of the northwest corner of Section 10.

The total length of the East of Rendiya Area is four (4) air miles. Of this length, however, over one-half is largely barren of lava tube resources. On the other hand, those portions of East of Rendiya in Sections 4, 9, and 10 are may be unparalleled on the North American continent for the size and grandeur of its lava caves, lava bridges, and cave windows. East of Rendiya is, in a very real sense, the heart of El Malpais.

#### Map/Photo Code: ER

- ER-1 (1)      The first two (2) miles of East of Rendiya is a confused lava landscape that is largely devoid of conspicuous collapse structures (CS) such as occur in the southern half of East of Rendiya. Intact tubes (caves) are not prevalent and when encountered tend to be small.
  
- ER-2 (1)      Shallow subsidence CS where the Bandera Tube System turns west on its long, sinuous course that eventually takes it 15 or more miles south and east.
  
- ER-3 (1)      This portion of the Bandera Tube is much like the Twin Craters system in that whereas the tube more often than not appears to be intact, entrances into the caves cannot be located. Note roof sag.
  
- ER-4 (1)      Much of this portion of the Bandera Tube System is flanked by massive aa flows. In places, these flows have covered the Bandera tube system.
  
- ER-5 (3)      Hoya de Infierno is a huge subsidence pit (which was named by Hatheway and Herring (1970). Subsidence pits are sites of local widening and deepening of a given lava tube.

Two such pits occur on the Bandera Tube System. Depth is to 100 feet, width to 500 feet, and length 1,200 feet. This is a large pit. Access code is #2.

- ER-6 (1) No caves of consequence were located in the vicinity of Hoya de Infierno. However, enormous earth fractures in the pahoehoe are present, especially on the northwest corner of the pit. Note the tree growing out of the fracture.
- ER-7 (1) On the west edge of the pit looking north with Bandera Crater and Cerro Bandero in distance.
- ER-8 (1) In the bottom of Hoya de Infierno looking to the north; this is an enormous subsidence pit.
- ER-9 (1) Similar to Photo ER-5 except view includes pahoehoe margin of the subsidence pit. Spectacular pahoehoe surface features occur along the entire margin of Hoya de Infierno.
- ER-10 (1) Subsidence collapse of the Bandera tube. Note that width and depth are quite unspectacular relative to other portions of the Bandera system. Width is not more than 30 feet and depth here is no more than 20 feet. This is typical in this northern section of East of Rendija. Access code is #2.
- ER-11 (5) Overhang Ice Cave (see Photo A) is of importance only because it may have been utilized by Native Americans as a water source. Occurs on the north side of a loose crawl cave on the Bandera tube which is almost impassably filled with boulder size rubble (Access Code is #3 rather than #5). Cave length is 100 feet; ceiling height 3 to 20 feet, and width up to 30 feet (see Photo B to view of south entrance).

The side passage in which the ice is situated is depicted in Photo C. It is located on the west side of the north entrance. The passage falls a near vertical 25 feet to an ice choke pond. Charred wood is present on the site. Also four inches of free water on 9-4-88. Pond is 9 feet in length and up to 5 feet in width. Further ice is present in second tight crawl immediately to west and under the massive ceiling breakdown that nearly chokes the upper part of the cave closed.

Photo D is of the South entrance.

ER-12 (1) A subsidence collapse section of the Bandera tube with dimensions and characteristics similar to ER-10. Note subsidence of pahoehoe at CS margin. Beautiful pahoehoe here.

ER-13 (1) An unspectacular lava bridge where the orientation of the Bandera Tube shifts from due south (180 degrees) to a southwesterly direction. Length is 60 feet, widths up to 30 feet, and ceiling up to 25 feet. Access code is #2.

ER-14 (1) Subsidence collapse of the tube remains the rule in the northern portion of East of Rendija. Depth is to 25 feet and width up to 50 feet here. Note the spectacular parallel fractures created when the tube roof subsided.

ER-15 (2) Arch Ice Cave is situated on the south side of a small CS. It would hardly be worthy of mention except for the fact that its water appears to have been utilized by Native Americans. Also there is an archeological site in a lava tube nearby that is unusual.

Arch Ice Cave is not spectacular. Its ceiling is up to 15 feet in height, 25 feet in width, with a length of only 35 feet. Ice is in pond that chokes the cave closed. Photo B is close-up of entrance into ice chamber. Access code is #2.

ER-16 (3) An inconspicuous archeological site is located 15 feet to the south of Arch Ice Cave. It is situated in a small surface tube and is unusual in that the tube has been divided into three (3) rooms by rock walls (see Photo A. Note that person is holding one large utility ware pottery sherd).

Photos B and C are of the easily overlooked entrance to the archeological site in tube.

This cave is not large, having a ceiling that averages only 4 feet in height, widths of 4 to 12 feet, and a total length of 30 feet (also see schematic drawing).

- ER-17 (2) View from the summit of a spatter cone overlooking a massive aa-blocky lava flow lying west of Lost Woman and east of the Bandera tube system (Photo A); Photo B is view to south. Access code is #2.
- ER-18 (1) The Bandera Tube enters another decidedly amorphous segment south of Arch Ice Cave and remains so for nearly one-half of its length.
- ER-19 (13) Indian Trail CS. This is the East of Rendija Area's first major CS. Access code is #3. Length is 350 feet, width up to 100 feet, and depth up to 60 feet. Two (2) ice caves are present; they are located on the north and south ends of the CS (see Photos A and B for the north end cave and Photos C, D, and E for the south end cave).

Bearing into the south end cave is 210 degrees. Much moss in the entrance (see Photos G and H). Cave is large, with a ceiling height of 40 feet and an entrance width of 60 feet. Cave length is only 100 feet (however, this cave should be far more thoroughly searched than was possible during this inventory). Air temperature just inside cave is 50 degrees. Water up to 12 inches deep is present in the cave's floor. Water temperature was 34 degrees on 9-2-88; the water was underlain by ice on this date (see Photo I for view of boulder strewn floor where ice spring is situated). Photo is of consultant and was taken remotely using a tripod for scale).

Photo F is of a small chamber in the Southeast wall of this cave that appears to have previously been walled up.

Photo J is a view from inside the cave looking out; note that the west rim of the CS gives the cave the appearance of possessing a rectangular entrance.

The north end cave is essentially an overhang; however, the ice formations are larger and in the form of an ice pond plug (10 feet by 4 feet). The ice is rather difficult to reach, requiring a 30 foot descent in the form of a combination crawl and scramble through huge boulders to the ice plug. Note the impressive

cliff-like rim of the CS above the north end cave (ice choke) in Photos K and M. Finally, a view of the north end cave's impressive overhang is provided in Photo M.

Sensitivity code is #1.

ER-20 (4) A complex of six walled structures is situated immediately south of Indian Trail CS. This location, like so many others, is no accident. Nor is what appears to be a very old cairn trail leading specifically to this site from the west (see ER-21). Although the consultant has not located walled structures at every ice cave suitable for use as a fresh water source, he has not diligently searched for them either. Instead, he strove to abide by his voluntary inclusion of archeological sites in this inventory as an "incidental" resource. Even so, he located walled structures at most ice caves that could be utilized as a water source.

Note in ER-20 D the rocks that have been turned over on site adjacent to Indian Water CS and archeological sites; activity was recent as evidenced by the presence of uprooted cactus that was still green.

ER-21 (1) An old cairn trail leads across the lava from the west. The trail is believed to be old because the cairns are inconspicuous and lichen covered. Evidence that this trail has been used more recently is provided by the blaze on the large Ponderosa pine in Photo.

ER-22 (1) Another walled structure but 100 yards further south and near the rim of Spattercone CS.

ER-23 (2) Spattercone CS is 200 feet wide and nearly 500 feet in length (Note the appearance CS has to a valley in Photos A and B). Depth is up to 25 feet. The CS is interesting because it is an example of a CS breached by a later aa flow. There is much evidence that aa flows engulfed many CS's in many parts of El Malpais; Spattercone CS is one of the few, however, in which the aa initiated but did NOT complete the engulfment. This is a subsidence collapse of the tube.

CS was named for the remains of a spattercone located 100 yards east of the CS.

A half-filled plastic water jug was found at this CS, indicating that someone had recently been in the area (Note also overturned rocks found at site ER-20). Access code is #1

ER-24 (2)

Lost Window is present on the east side of Spattercone CS (see Photos A and B). Note the incredible thin pahoehoe cave roof, especially in Photo A. The window was not entered because this could not be done without technical assist (ropes and at least one backup person).

The window is 15 feet in diameter. Log ladder in window.

Cave depth is up to 35 feet; height and width are up to 35 feet and 40 feet respectively. Cave appears to terminate rapidly on both ends. Bearings of the two leads are 225 degrees and 40 degrees. Window is beautiful. Access code is #4.

ER-25 (3)

Sunlight Ice Cave. This is not a large nor a conspicuous ice cave. It is believed significant for two reasons: 1) it is useable as a water source; and 2) sunlight on 9-6-88 shone directly into the cave entrance.

The cave is in a subsidiary tube that runs nearly parallel (140 degrees) to the Bandera Tube System (115 degrees). The entrance is in the south wall of the cave and was opened by the sheer-walled collapse of the main tube. Bearing out is 230 degrees, but entrance faces an arch open to the sky from 175 degrees to 270 degrees.

Cave ceiling is up to 12 feet in height; width is to 35 feet; and depth is 30 feet. The ice choke is located on the west (main tube) side of the cave. Access code is #2.

ER-26 (1)

This is a view of Sinuous CS in which Sunlight Ice Cave is located. Note that the east wall of the collapse is sheer whereas the west wall has subsided. Depth of the CS is up to 30 feet, width to 100 feet, and length is 400 feet. Access code is #2.

ER-27 (4) The lengthiest segments of an unbroken Bandera tube system collapse structure (CS) occur in East of Rendija. This northern subsidence C.S., while not as spectacular as those that occur further south, is the lengthiest CS of the area at 2,000 feet. Because of its conspicuous twists and turns, it has been named Sinuous CS. Like ER-26, which is part of Sinuous CS, this collapse structure combines the features of both subsidence and sheer-walled tube collapses. However, cave density is typical of subsidence collapse rather than sheer-walled areas (caves are shallow or absent) and subsidence features predominate (but note the combination of subsidence and sheer walled collapse features evident in Photos A through C). Photo D is the south end of Sinuous CS. Access Code is #1-#2.

A number of small ice cave leads were located but these were Access Code #5.

ER-28 (1) A view of that portion of Sinuous CS in which Four-Window Cave exits into the Bandera Tube.

ER-29 (1) The roof of Giant Ice Cave (see ER-30 below).

ER-30 (1) Giant CS is 600 feet long, sheer walled, and impressive. CS depth is up to 50 feet and width is to 100 feet.

ER-31 (9). Giant Ice Cave does not have the appearance of an ice cave. Ice cave entrances tend not to be big cave entrances, but Giant is certainly a big cave (relative to lava tubes). Air temperature 50 feet into the entrance was 50 degrees on 9-6-88.

Bearing into cave is 35 degrees T.

Note pahoe-hoe overhang at cave entrance. Ceiling height is up to 50 feet, width is to 40 feet, and length to 300 feet. 200 feet in, cave turns from 35 degrees to 90 degrees and terminates in a boulder choke. However, on the left side of the choke is an ice choke. Air temperature 10 feet above the ice on 9-6-88 was 40 degrees.

Photo F is a view of the interior of the cave; note unusually high ceiling.

Photo G is a view looking out of the cave from atop the rubble pile near the cave terminus. Access code is #2.

- ER-32 (3) An ice cave is situated on the east side of the Giant CS in an ice pool choke only 10 feet below the floor of the CS. A log in the cave entrance appears to have been purposely placed in the position indicated in Photo B. Cave is a useable water source. Sensitivity Code is #1. Access code is #3.
- ER-33 (3) Arched Bridge is the first of six (6) lava bridges that occur within the next 3,000 feet of the Bandera Tube System. Arched Bridge is slightly arched (see Photo A). The height of bridge ceiling above the floor is up to 50 feet; bridge width is 50 feet; bridge length is up to 50 feet. Photo C is a view of the bridge from the CS.
- ER-34 (8) Skylight Cave. There are two "window" caves in the East of Rendija area that can be legitimately described as representing the essence of El Malpais' caves. Skylight Cave is one of these caves, as is suggested in Photo A. The big window is an almost perfect circular roof collapse 30 feet in diameter. Ceiling height within the window portion is up to 50 feet; width is up to 60 feet. As Photo B also suggests, the cave's big window imparts to the cave a magnificent quality that probably is equalled only at neighboring Four-Window Cave.
- Photo C is shot vertically from the floor through the window.
- Photo D is a view of the cave through the window from the surface; note thinness of the pahoehoe roof.
- Photo E is of late-day sunlight shining through the window and illuminating the East wall of the cave.
- Photo F is of this cave's conspicuous falling lava level striations on the cave's east wall immediately south of the window. These formations are the finest of this type present in El Malpais. Note smooth texture of the wall in Photo G. Such smooth textures are most frequently found in cave turns such as this one.

The location of the big window immediately north of a major turn in the cave is typical of cave windows and of many collapse structures (CS). Cave windows tend to be located in turns or near them, which suggests that the turn in the lava tube places considerable stress on the cave roof.

Skylight Cave is 600 feet in length, which includes a branching of the cave at its southern end. Bearing into the cave is 140 degrees. The cave makes two sinuous turns 300 feet in to a main tube bearing of 160 degrees.

ER-35 (1) The roof of Skylight Cave; note smoothness of pahoehoe surface.

ER-36 (4) Twin Bridges is El Malpais' most spectacular natural arch feature, as is suggested in Photo A.

The dimensions of the North Bridge are 100 feet in length, up to 40 feet in height from floor to ceiling, and 70 feet in width. An interior view of the North Bridge is provided in Photo B. Bearing looking through bridge from north is 125 degrees. A view of South Bridge from North Bridge is provided in Photo C.

South Bridge is 60 feet in length and otherwise very similar to North Bridge. Photos D and E are views of South Bridge taken from the lip of the CS on the southeast. Bearing looking through bridge from north is 120 degrees.

The floors of North and South Bridges are broken and strewn with huge boulders. Access code is a tough #2.

ER-37 (3) This view of East of Rendija C.S. is believed to be El Malpais' finest example of a sheer walled collapse structure. Note vertical sheering of the roof and walls of the tube into a near box canyon like configuration. CS depth averages 40 feet, width is to 100 feet, and the length of the CS to Sunken Bridge is 400 feet. Note view of South Bridge in Photo B and view from east rim of CS in Photo C. Access code is a tough #2. Many small ice caves/chokes as well as dry caves are present along the flanks of the sheer walled collapses characteristic of the south half of the East of Rendija Area.

- ER-38 (3) Sunken Bridge is what appears to be the lower tier of a stacked tube. Bridge length is 70 feet and width is 60 feet. Depth to the roof of Sunken Bridge is 25 feet. Access code is #3.
- ER-39 (2) Walled structure archeological site on the west side of CS located 100 feet north of Long Bridge; note windowlike feature in structure.
- ER-40 (7) Long Bridge is the lengthiest of any of East of Rendija's bridges at 200 feet. A person is standing at the far end of Long Bridge in Photo A. Photo C is striking because it provides a view of a typical bridge (and cave) floor in the East of Rendija area. Note huge size of the boulders from the ceiling breakdown.
- Photo D provides another interior view of the floor of Long Bridge. Photo E is view from surface of north entrance. Photo F is a view of climbing through the bridge. Photo G is a view of the north entrance from the floor of the CS.
- Bridge height and widths are up to 40 feet and 60 feet respectively.
- Access code remains a tough #2.
- ER-41 (3) Hidden Bridge is the last of East of Rendija's six natural bridges. It is far less conspicuous than are the others; bridge length is 50 feet, width to 60 feet, and ceiling height to 35 feet. View of bridge is from interior. Access code is tough #2.
- ER-42 (2) An old trail appears to lead from the east rim to the floor of the CS near the north entrance to Long Bridge.
- ER-43 (1) A walled structure sits atop the west edge of the roof of the entrance to Long Bridge.

- ER-44 (8) Various views of one of El Malpais' largest concentrations of walled structures. Note how elaborately walls were constructed relative to the more common type as represented in ER-43. View in Photo E is of shovel left on the site by persons unknown.
- ER-45 (4) Views of walled structures situated 300 feet north of ER-44.
- ER-46 (3) End Cave is the final segment of East of Rendija's big caves/bridges that began at Giant Ice Cave. This is an impressive cave with a length of nearly 500 feet and interior dimensions that are every bit as impressive as Skylight Cave (excepting its lack of a window open to the sky). Bearing into cave is 180 degrees True. This cave, like all of the big caves and bridges East of Rendija, has beautiful lava rock features such as falling lava level striations, smooth walls, and dripping lava formations. Note size of cave in Photo C. Access code is a tough #2.
- ER-47 (4) Hoya de Diablo is the Bandera System's second subsidence pit. Although smaller than Hoya de Infierno, Diablo is an impressive 800 feet in length, 250 feet in width, and up to 60 feet in depth. Like Hoya de Infierno, Diablo is characterized by enormous fractures on the east-west flanks of the pit. Caves investigated were shallow but area was not intensively worked. Spectacular surface features are present on the rim and flanks of Hoya de Diablo (Photos D and E). Access Code is #2.
- ER-48 (2) Northeast of Hoya de Cibola lie a number of shallow subsidence collapse structures (15 feet deep, 25 feet wide, 50 feet in length). Photo B is a wide view with cave ER-49 in the distance.
- ER-49 (2) Classic surface lava tube which is also much larger than is typical of such structures. Note person standing atop tube. Ceiling height up to 15 feet, width 25 feet, and length 30 feet (choked closed by rubble). Moss adjacent to rubble choke and cold air suggest that ice is close to tube terminus. Access code is #2. Sensitivity code is #1.
- ER-50 (2) The East of Rendija area south of Giant Cave possesses some of the most dramatic pahoehoe lava features in the National Monument.

- ER-51 (2) The edge of "7610" aa flow which lies immediately East of the Bandera Tube System. The flow is named "7610 for the elevation of the spattercone source of the lava. Photo B is an attempt to record how the broken ground surface appears to one walking through this storm-tossed sea of rock.
- ER-52 (1) The East of Rendija area of the Bandera tube system as viewed from an aa lava wall immediately to the east.
- ER-53 (4) Breached CS is last CS on a subsidiary tube system to Bandera that has been named Olla. Breached CS is much reduced in size relative to the main Bandera system but is nonetheless of considerable interest. CS length is 80 feet, width is 60 feet and depth is up to 30 feet. Access code is #2.

Photo A is a view of the entrance to West Cave. Photo B is of the cave from its interior; note the steep rubble descent into the cave (25 feet). Cave width at the entrance is 30 feet and ceiling height is up to 20 feet. Bearing into cave is 285 degrees. Floor at the entrance is rubble strewn to smooth, but shifts to jagged aa as one moves into the cave. Ceiling and walls constrict, but showy lava stalagmites are encountered. Cave length is 200 feet until constriction closes tube. Air temperature in cave entrance on 6-6-88 was 42 degrees.

The entrance to East Cave is similar to a subway tunnel. It is also more open and larger than West Cave (see Photo E). Cave width is up to 40 feet and height up to 30 feet. Ceiling and wall constriction rapidly close the cave, however, to half these dimensions. Bearing into cave is 100 degrees. A branching occurs 175 feet inside, one tube to the north (at 15 degrees), and one tube to the east-southeast (at 120 degrees). Both rapidly terminate in lava chokes. Showy lava stalagmites are present in the cave and air temperature on 6-6-88 was 39 degrees. Showy silver (water droplet-mineral) formations present. Bone and much burned wood in entrance. Photo C is of East Cave entrance from rim of CS.

Sensitivity Code is for East Cave of Breached C.S.

Photo D is of a shallow cave on the northeast corner of the CS that once constituted a third tube entrance (or exit). Choked closed with rubble.

- ER-54 (1)      Walled structure in a lava tube with pottery sherds.
- ER-55 (1)      One of El Malpais' most confused pahoehoe flows lies north of Breached CS on the Olla Tube Subsystem.
- ER-56 (2)      An ice cave entrance on the Olla Subsystem. CS size is 60 feet by 20 feet and 20 feet deep. Cave falls a rapid 30 feet to an ice choke in a chamber 12 feet in height, 20 feet in width, and 40 feet long. Bearing in is 220 degrees. Ice choked cave on north side of CS also. Access code is #2.
- ER-57 (1)      Short Bridge Cave. Length is only 30 feet; width is 20 feet and height to 20 feet. Cave is heavily boulder strewn. Lead on southwest side opens into showy chamber 15 by 50 by 8. On northeast side is small chamber with ice pond at bottom of boulder pile (size of pond is 2 by 5 feet). Access code is #3.
- ER-58 (4)      Yeso Chico Ice Cave is on the south end of a small CS 50 feet in length, 30 feet in width, and 35 feet deep (see Photo A). Average ceiling height is 15 feet. Ice is visible in cave from floor of CS. Ash and burned wood in cave. Ice forms a choke across an arch 20 feet long and up to 5 feet deep (see Photos B and C). Yeso Chico Cave, because the ice is so close to the surface, is believed to be a much larger ice cave than it appears. Access code is #2.

Photo D is a view of a small lead on the east side of the cave that opens into a 5 by 8 foot ice pond. Access code is #3.

Bearing looking into Yeso Chico Cave is 215 degrees.

Sensitivity code is #1.

A small walled structure site is located on the West rim of the CS of this cave and immediately adjacent to the cave (no photo).

- ER-59 (18)      Four Window Cave. This cave has been described as the "Old Faithful" of El Malpais; the view provided by Photos A through C suggests why. Ceiling height is up to 50 feet and width to 50 feet. Photo D includes the moss carpet below the bridge window. Bearing into cave is 360 degrees. Sensitivity code is #1. Access code is #2.
- Photo E is a view of the entrance from the rubble pile beneath the fourth window. Note appearance of stacked tube (appearance only).
- Photo F is a view of three of the cave's four windows.
- Four Window Cave splits into two branches 250 feet into the cave. The left branch chokes off within 50 feet. The right branch is more productive. Although it constricts down to a ceiling height of 20 to 30 feet and to a similar width, the walls and floor smooth into a subway tunnel like configuration that winds and twists for 400 feet (see Photos G through I). Average bearing into cave is 345 degrees.
- 900 feet into the cave, Four Window assumes a stacked tube configuration (see Photo J). The lower tube deadends. The upper continues north and west and exits through a narrow passage into the bottom of the Bandera tube system (see Photo K). Access code for exit is #3.
- Total length is 1,000 feet.
- ER-60 (1)      Buzz Hummel Cave. Technical assist access only (code #4). 40 foot vertical drop into cave. Length 150 feet. Width to 40 feet. Choked on both ends. Bearing is 55 degrees (parallels main Bandera tube system).
- ER-61 (1)      Walled structure situated 150 yards north and west of Four Window Cave.
- ER-62 (1)      Walled structure situated 100 yards north and west of Four Window Cave.
- ER-63 (1)      Curious rectangular structure situated immediately East of Bridge Window of Four Window Cave. A circular structure is also present beside window on east side.
- ER-64 (1)      A walled structure located immediately east of Skylight Cave.

## Bandera Lava Tube System

### ANASAZI CAVE AREA

#### General Description

The Anasazi Cave Area of the Bandera Lava tube system begins at that poing in T8N, R12W, Section 9, the southeast corner of the southeast corner where the Bandera system turns from a bearing of 205 degrees (SSW) to one of 100 degrees (ESE) and continues to the northeast corner of the southwest corner of Section 14. The above constitutes an air mile distance of two (2) miles. In that distance occur several of the most important caves in the National Monument.

The significance of the Anasazi Cave segment of the Bandera Tube System is high because the area possesses:

1) one of the most significant ice caves in El Malpais (Apache Ice Cave), and 2) the third longest "big" cave in the National Monument. In addition, the consultant located a complete bighorn sheep skull in this portion of the tube system as well as a single horn. These findings provided proof conclusive that the Anasazi Cave Area was once habitat for this regionally extirpated species.

Finally, the Apache Ice Cave is an effective (warm weather) spring that has provided water in a dry land to wildlife (such as bighorn sheep) and to both historic and prehistoric humans for many centuries. The area appears to the consultant to hold value in that it may well possess, more than any other single region, the concentration of keys necessary for our coming to understand El Malpais' past.

Map/Photo Code: AC

- AC-1 (1)            The beginning of the trail into the Anasazi Cave Area from the North edge of Little Hole in the Wall. Note the two rock cairns the man is approaching and will pass between.
- AC-2 (1)            The foot trail across aa lava marked by low lichen covered cairns; note cairns on either side of the person.
- AC-3 (1)            The foot trail proceeds north; note cairns to the left and right of the walking person.
- AC-4 (1)            Note cairn beside person.
- AC-5                omit
- AC-6 (1)            This portion of foot trail is constructed in the sense that large rocks were piled on the trail margins; note cairn atop hill on East in distance.

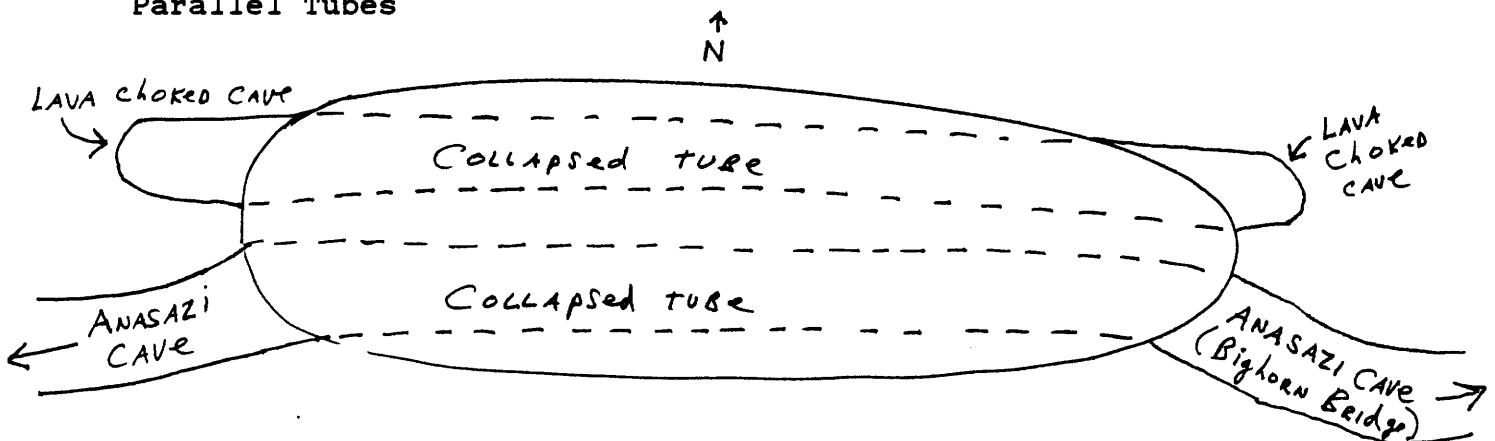
- AC-7 (2) Note cairn atop hill and the forbidding aspect of the land.
- AC-8 (1) The forest in the distance is the edge of the pahoehoe lava and only 100 yards south of the Bandera tube system.
- AC-9 (1) The cairn trail leads directly to the Bandera tube system. The cairns through the forest are of special interest: many of them are no longer obviously visible because trees have grown up in front of them. This suggests to the consultant that the trail has been in place for a considerable period of time.
- AC-10 (1) The two large vertical walled collapse structures that are the entrance to Anasazi Cave have but one non-technical entry point on the north side of East CS. Photo is from rim looking down onto the boulder choked floor of this sheer walled CS. Access code is #3.
- AC-11 (2) East CS is 200 feet in length, up to 100 feet in width, and as much as 40 feet in depth. Photo B is taken on the floor of the CS looking East toward Bighorn Bridge.
- AC-12 (2) The east entrance to the Bighorn Bridge segment of Anasazi Cave from the rim of East CS (Photo A) and from the floor of the CS (Photo B). Access code remains #3.
- AC-13 (3) The interior of Bighorn Bridge; note beauty of cave ceiling (film is Ektachrome 800/1600 @ 1600). Note person silhouetted at the West entrance to the Bighorn Bridge.
- AC-14 (4) The name "Bighorn" was assigned to this lava bridge because the consultant discovered a complete bighorn sheep skull under the bridge on 7-7-88. Bridge length is 180 feet; ceiling height is up to 40 feet; width up to 60 feet. Bearing into bridge from East is 295 degrees; 100 feet in, the bridge turns to 325 degrees and thence exits into West CS. Film is again Ektachrome 800/1600 @ 1600. Access code is #3.
- AC-15 (1) West CS from the lip of Bighorn Bridge. Note the twin cave entrances at the West end of the CS. The south cave is Bighorn Corral segment

of Anasazi Cave; the north cave is short and choked with lava. West CS is 200 feet in length, up to 100 feet in width, and as much as 40 feet in depth. Access code is #3.

AC-16 (1)

Another view of AC-9. This one better reveals that the Bighorn Bridge (East) side of West CS also has two (2) cave entrances. The south entrance is to the Bighorn Bridge segment of Anasazi Cave while the north is a short lava choked overhang. What is interesting about this fact is that the tube system appears to have consisted of two parallel tubes.

Schematic Drawing of West Collapse Structure and Hypothetical Parallel Tubes



The above configuration is not unprecedented in El Malpais. Furniture Cave on the Hoya System is an example of this configuration. El Malpais' longest cave, Outlaw, lies immediately south of an adjacent (and mostly collapsed) portion of the Bandera tube system. Further, Navajo Ice Cave may (?) display this characteristic. Finally, other portions of Anasazi Cave also display a parallel tube configuration.

AC-17 (9)

Bighorn Sheep Trap. This segment of Anasazi Cave has what the consultant believes may be a bighorn sheep trap constructed by Native Americans and/or by early settlers. The trap is constructed totally from poles of native and readily available tree species; no evidence of wire was found (Note Photo B).

Photo E is from the interior of the cave looking out toward the trap.

In Photo F, note the down segments of the trap.

The bighorn sheep horn in Photo G was discovered by Matthew Carlton on 6-30-88. Note the trap in the background.

Photo AC-17 H -- another view of the trap construction.

Photo AC-17 I -- from interior of cave looking out to the trap (note two persons).

Access code is #3.

- AC-18 (1) This is the entrance to the short cave segment lying immediately north of Bighorn Sheep Trap. Cave drops 30 feet and is very wet. Air temperature on 6-30-88 was 37 degrees. No visible ice. Length is only 40 feet. Ceiling height 30 feet and width 30 feet. Sensitivity code is #1.
- AC-19 (1) Fern hanging ten (10) feet above the entrance to the Bighorn Sheep Trap segment of Anasazi Cave.
- AC-20 (7) The Bighorn Sheep Trap lies at the entrance to a 700 foot segment of Anasazi Cave that is broken roughly in the middle by this beautiful window. Note log ladder in Photos A and B. Cave bearing to 250 feet in is 295 degrees. Cave then turns to 315 degrees for 400 feet.

Photo C is of the window from west.

Photo D is the west entrance to Anasazi Cave. Sensitivity code is #1.

A small bat colony (200 individuals) was encountered on the west end of Anasazi Cave on 6-30-88. Air temperature in this portion of the cave was 62 degrees F. Species of bat could not be determined.

- AC-21 (15) Apache Ice Cave lies at the west end of Anasazi Cave. Photo A is a view from the interior looking out. Note that cave floor is ice. This large ice cave is located on the west side of a CS 40 feet wide, 60 feet long, and up to 60 feet in depth (see Photo B and C).

The CS is unusual in that the cave is accessible not only from the east through Anasazi Cave but also from the east through a hole in the lava (see Photo D of hole in lava wall). A trail descends through the wall to the floor of Apache Ice Cave (see Photos E and F). The trail into Apache Ice Cave is constructed to a relatively high standard. A piece of a very old (circa 1920) rubber inner tube was discovered in a crevice beneath the trail which may suggest that the existing trail was upgraded from a more primitive trail early in this century. Note the "historic" debris in Photo G.

That Apache Cave was utilized by prehistoric peoples is apparent from the numerous pottery sherds to be found on the east margin of the ice (see Photos H and I). Also from the deep ashes located on the cave's south wall (see Photo J).

Photo K -- another view entrance to Apache Ice Cave. Note low ceiling height relative to that of adjacent Anasazi Cave.

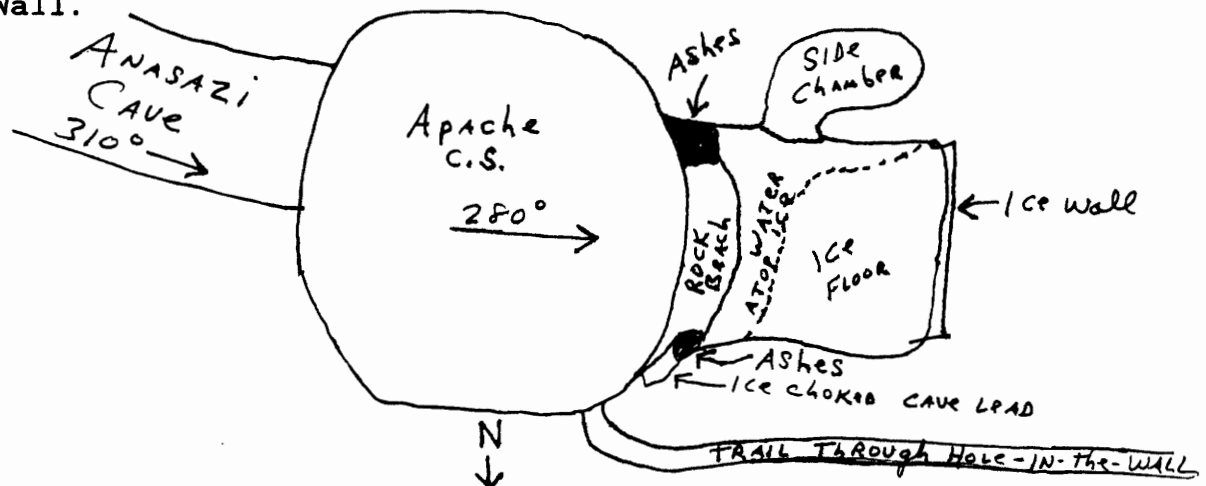
Photo L is of a ledge directly above the ice cave (note ice chamber at bottom of photo).

Photos M and N and wide views of the ice floor; Photo O is a close-up.

Photo P is of the surface entrance to the hole in the wall, Apache Ice Cave, and Anasazi Cave (West entrance).

Access code to Apache Ice Cave via trail is #1.  
Access code via Anasazi cave is #3.

Schematic Drawing of Apache Ice Cave, Collapse Structure, and Hole in the Wall.



Apache Ice Cave dimensions are: ceiling height up to 12 feet; width 25 feet (ice and water) to 35 feet (rock); length to a massive ice choke 40 feet. When one considers that the bearing looking out of the cave is 120 degrees and that this bearing allows sun to shine directly onto the margin of the ice in September, it becomes apparent that the mass of ice supporting the cave must indeed be massive. There are very conspicuous air bubbles in the ice that forms the floor of this cave. A metal rod 6 feet in length is now frozen into the floor of the cave; was it used to try to force an entry through the ice choke?

The sunlight falling into Apache Ice Cave during warm weather (for a small portion of the day) creates a pool of water up to 18 inches in depth from mid-spring through at least early fall. That this water was utilized historically and prehistorically by humans and by bighorn sheep is obvious.

Air temperature in the cave 3 feet above water/ice level was 37 degrees on 7-9-88. The name "Apache" was chosen for this particular ice cave in keeping with the consultant's practice of naming a major ice cave for each of the four major tribes found in the region of El Malpais when New Mexico became part of the United States in 1848. The Apache war chief Victorio is known to have led his people to El Malpais at least as late as the 1870's. Although the area of El Malpais where Victorio secluded his band, which included women and children, is not known, the area of this cave is a better possibility than are most alternatives.

The consultant further speculates as to whether Apache Ice Cave is not the original source of the "Hole in the Wall". The trail down into the cave certainly fits the description better than any site the consultant has seen in El Malpais. Apache Ice Cave is known as "Rusty Barrel" Cave by Sandia Grotto. This name was assigned because the remnants of an old 35 gallon metal barrel are present on the site.

Sensitivity code is #1, #3, and #4.

- AC-22 (1) View looking out of Hole in the Wall entrance to Apache Ice Cave. Note pole and marker
- AC-23 (1) A circular walled structure archeological site lying immediately adjacent to Apache Ice Cave.
- AC-24 (6) A complex of six (6) walled structures lying 400 feet West of Apache Ice Cave. Note trees growing in some of the structures.
- AC-25 (1) Cairn and tree blaze on edge of a flow West of Apache Ice Cave.
- AC-26 (6) Walled archeological site inside a lava tube subsidiary to the Bandera System. Note pottery sherds in Photos B and C and notice placed with them in D. Photos E are of a surface site adjacent to the cave site.
- AC-27 (1) Subsidence collapse of the Bandera tube; many cold small, cold cave leads, many with ice, but no major caves in this area.
- AC-28 (1) Much of the Bandera Tube west of Apache Ice Cave has not collapsed or subsided but appears to be intact.
- AC-29 (1) Segment of subsidence collapse of Bandera tube 1,200 feet west of AC-27.
- AC-30 (1) Roof of the tube; appears to be intact.
- AC-31 (1) Note classic pahoehoe lava on roof of tube.
- AC-32 (1) The turn of the Bandera Tube from a bearing of 205 degrees to 100 degrees occurs at this CS.
- AC-33 (1) This is believed to be a bearing tree -- that is, a tree bent when young to point in a specified direction.
- AC-34 (19) Anasazi Cave (East Entrance). The consultant has adhered to the identical method he used with Outlaw Cave by assigning a single name to a series of caves and bridges that: 1) are unquestionably all an integral part of an identical lava tube system; and 2) are unbroken by lava plugs or ceiling breakdown and therefore, are continuously negotiable for the distance indicated in the cave length. A collapse structure up to 200 feet in length was included in Outlaw Cave. With Anasazi Cave, two 200 foot open CS segments are included as part of the cave system.

Photo A is of the East entrance to Anasazi Cave. This cave was named "Classic Cave" by Sandia Grotto. The "Anasazi" name is suggested here because this name has obvious linkages to El Malpais' past. The consultant did not name an ice cave after the Anasazi because water is a prerequisite of life and the Anasazi are no longer a living people. Although it can be argued that the Anasazi differentiated into the Acomas, Zunis, and others, these living peoples each have had a major ice cave named for them or during the inventory.

Anasazi Cave is impressive by any standard of lava cave measure. Although ceiling heights average 30 to 40 feet in the cave, in places they are as high as 50 feet. Cave widths average 40 feet but in places approach 60 feet. And although this is not an ice cave, it is a very cold cave indeed. On 7-2-88, cave air temperature averaged 39 degrees F and at its terminus measured 36 degrees F.

Like Outlaw and Chantry Caves, Anasazi is likely one of the finest examples of a lava cave on this planet.

Photo B is a second photo of the cave entrance; note the pahoehoe surface that forms the roof of the cave.

Photo C is a view of the east entrance which measures 30 feet by 40 feet.

Photo D is looking through a cave segment to a collapse structure 600 feet in the distance at a bearing of 105 degrees. Note broken, rubble floor which is decidedly characteristic of most of this cave (though there are "smooth floor" exceptions in this cave).

In Photos F and G, the boulder strewn floor is again illuminated.

The cave segment ends at a distance of 600 feet at a CS visible in the distance in Photo H. Note classic lava tube symmetry of cave walls and ceiling depicted in photo (person in photo is shining cave light from the waist).

The first CS on the east side of Anasazi Cave was named "Gunsight" because of the perfectly straight tree growing precisely in the middle of the CS (as can be viewed on Photos I and J). CS is 40 feet in diameter and up to 40 feet in depth.

Gunsight CS supports a beautiful moss carpet atop its otherwise jagged surface (see Photo K).

A short bridge-like segment 60 feet in length at a bearing of 100 degrees leads to a second CS. The view in Photo L is looking down into the cave from the top of Gunsight CS. Note boulder strewn floor.

Immediately north (50 feet) of Photo L is a second and parallel tube segment from which the cave can be exited.

The most spectacular lava stalagmites located during the inventory are present in a short passage on the north side of the cave, which can be viewed in Photo N. Height of the tall stalagmite is approximately two (2) feet.

Additional stalagmites are present in a second nearby chamber (see Photos O and P). Lava formations such as these proved maddeningly difficult to photograph. However, they tend to be very common, although not of the size seen in Photo N.

AC-35 (7)

Snow White Skull C.S. is the second CS on the east entrance of Anasazi Cave. It is 50 feet in length and 30 feet in width. Photos A and B are views of the CS from inside the east side of the cave (note person standing on CS breakdown in A). The B photo is taken from further in the cave. An unidentified large vertebrate skull (antelope, domestic goat?) was encountered just inside the cave from CS AC-35. It can be viewed in Photo C.

Note tent shape of cave ceiling in Photo D.

Silver formations (composed of water droplets and calcium carbonate) are superb in Anasazi (see Photo E).

AC-36 (5) A beautiful window is next encountered. Size is 10 by 15 feet (Photos A and B).

Anasazi Cave splits into two tube branches just east of the above window. Cave size does not decrease in the branch tubes, a fact that lends credence to the idea that the Bandera tube system, at least in places, formed side by side (parallel) tubes.

Note the wall texture of the tube in Photo C, which is in a big turn.

The floor of Anasazi Cave is typically shattered and broken by huge boulders as can be viewed in Photo D.

Cave length is estimated at 3,700 feet. This length would place it third longest on the Bandera tube system. Sensitivity code is #1.

PLEASE NOTE: this cave has been surveyed; a map will be available in December, 1988; this report will be amended to reflect the survey by January 31, 1988.

AC-37 (1) Large pottery sherds found on or near the roof of Anasazi Cave.

AC-38 (1) Subsidence collapse of Bandera tube system has many small cave leads and typically exhibits parallel fractures on the tube margins. Depth of the C.S. is up to 50 feet and width exceeds 100 feet. Access code is #2.

AC-39 (1) Note the park-like floor of the subsided tube which is up to 50 feet in depth and 100 feet in width. Access code is #2.

AC-40 (1) The subsidence collapse portion of the tube ends in this photo and is replaced by an intact portion of the tube.

- AC-41 (1) This is Brewer's Pit, a spectacular window in the roof of a cave with a depth of 50 feet. Cave links with the west end of Grand Junction C.S. Length of Brewer's Pit cave is reported by Sandia Grotto to be 600 feet with up to 400 feet of subsidiary tube length. Cave ceiling height and width are as large as any on the Bandera tube system. Access code is #4.
- AC-42 (3) Lava Junction CS. is incredible because it has four large tubes entering it, including two parallel tubes on the east (see Photo A). Photo B is of single tube entering from the west (this is AC-41 or Brewer's Pit Cave). Note pahoehoe crust of spectacular overhang in Photo AC-42D. Tube also enters from the north. Total length of all big tube segments was reported as 1,000 feet. Cave dimensions similar to Brewer's Pit Cave.
- Lava Junction CS was not entered. Access code is #4. Sensitivity code is #1.
- Note person on rim of CS in photos B and C. Depth of CS is 40 feet; width is 100 feet; and length 70 feet. If one C.S. were to be chosen as El Malpais' most impressive, this would be the consultant's choice.
- AC-43 (2) Eden Cave is on a small subsidiary tube of Bandera. A portion of the roof of the cave has collapsed to form a window 8 feet by 15 feet which is situated 20 feet above the floor. On the north facing wall of the cave, a beautiful colony of ferns (probably Pteridium aquilinum) was growing on 9-14-88. The intense green in the photograph is not exaggerated.
- AC-44 (1) The tube breaks up in a subsidence collapse that is a tangled mass of broken lava 400 feet southeast of Lava Junction CS.
- AC-45 (1) A view of the most southerly CS in the Apache Cave Area of the Bandera Tube System.
- AC-46 (1) A view of what can happen to the seat of pants when inventorying El Malpais caves.

## Bandera Lava Tube System

### NAVAJO CAVE AREA

#### General Description

The Navajo Cave area of the Bandera Lava tube system begins in T8N, R12W, Section 14, the southeast corner of the southwest corner, and extends south-southeast through the northeast corner of Section 23 into and through the mid-section of Section 24 to its eastern edge. This constitutes a distance of nearly two (2) air miles. Located within this portion of the Bandera Tube System is Navajo Cave, one of El Malpais' most spectacular and significant ice caves.

The remainder of the area has numerous ice caves but most are either small, choked with ice, or both. A subsidiary tube system is located south and east of Navajo Cave. It is of special interest, as is a spectacular collapse structure (CS) that has been named Hole-in-the-Roof CS. However, overall, the Navajo Cave area (at least so far as is known at this time) must be ranked far behind the Outlaw Trail, Anasazi, and East of Rendija portions of the Bandera Lava Tube System in cave resources. The reason for this fact appears to be the preponderance of subsidence collapse features as opposed to sheer wall and intact tube features. A second reason is the presence of El Malpais' most spectacular aa lava flow directly atop much of the Bandera tube in the Navajo Cave area.

#### Map/Photo Code: NC

- NC-1 (1)            A subsidence collapse tube, the most common lava tube feature encountered in the Navajo Cave Area. Note the extremely large block of subsided but intact pahoehoe lava in photo.
- NC-2 (1)            Subsidence collapse of the Bandera tube.
- NC-3 (6)            Deadend Cave lies immediately west of Navajo Cave (see Photo A). The entrance is large (up to 40 feet in height and 50 feet in width) but only 150 feet long (see Photo B). The cave is interesting because it is in a stacked tube configuration with the lengthiest segment in the lower tube. The upper tube is short in length (30 feet). A large overhanging ledge is also present on the north and west sides of the cave entrance (see Photo E). Deadend is a surprisingly dramatic cave if one takes the time to explore it. For example, note the small tube within a large tube in Photo D, keeping in mind that the large tube is the lower tube of a stacked tube configuration. This is a dramatic cave.

NC-4 (16)

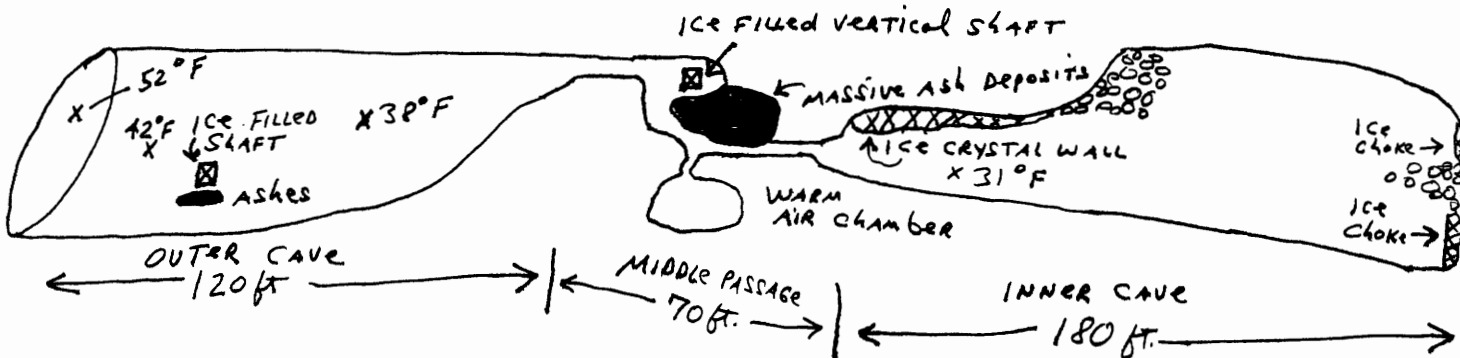
Navajo Cave entrance faces 342 degrees T ((nearly due North). Air temperature at cave entrance (one foot from the sunlight of an 86 degree day) was 53 degrees at 12:30 PM on 7-11-88.

Ceiling height at cave entrance is 16 feet; cave width at entrance is 40 feet.

Total cave length is 370 feet. However, Navajo Cave consists of four distinct parts: the Outer Cave (120 feet in length); Middle Passage ( 70 feet in length); the Inner Cave (180 feet in length); and the East Room (which adds no substantial length to the cave).

The maximum height of the inner ceiling is 30 feet; maximum width is 50 feet (the maximum width includes the East Room, which may be the remnant of a side by side tube such as occurs at Furniture Cave on the Hoya system and elsewhere.

Schematic Drawing of Navajo Cave



Navajo Cave is one of El Malpais' most dramatic and significant ice caves. It is also, after Zuni Ice Cave (Candelaria's commercial cave), the most known and visited ice cave in the new National Monument. The cave's existence has been known for centuries, as is evident from the cave's massive ash deposits, especially in Middle Passage. Navajo Cave has been utilized as a water source both historically and prehistorically. Pottery sherds are present in the cave.

This cave has received increased visitation in recent years because of an obvious rock cairn trail to the cave from a parking area only

one-third (1/3) mile to the southwest. A rock cairn trail is also now present IN the cave and ashes have even been scattered on the ice floor of the Inner Cave to prevent visitors from slipping. Resource damage to the cave includes: 50 to 100 years of pot hunting; the scooping out of ice from the Inner Cave's ice crystal wall within the past three years; the breaking off of a wooden ladder (50 plus years in age) that until 1985 protruded out of an ice choked vertical shaft; the driving of a steel rod into this vertical shaft apparently by vandals attempting to gain access to the lower cave (if it exists); the heating of the cave by visitors utilizing Coleman lanterns for lights; and associated littering.

Management Recommendations: 1) include most of the 4X4 vehicle access road in the El Malpais Wilderness; 2) remove the rock cairn trail that extends from the existing parking area to the cave; 3) strongly encourage the use of an NPS or NPS approved guide for visitors accessing Navajo Cave (see also the consultant's "Cave Management Recommendations Report"); and 4) remove the steel rod that has been driven into the ice choked vertical shaft in Middle Passage (see Photo in N-1 series).

Research Recommendation: The consultant feel a reasonable possibility exists that Navajo Cave comprises the middle tier of a triple stack of lava tubes.

The above schematic suggests that the ice choked vertical shaft in Middle Passage (which until 1985 had a wooden ladder protruding out of it) may be the entrance to a lower level of the cave. Although it is rumored that this vertical shaft was drilled by a miner some time in this century, the absence of tailings from a drilling operation suggests to the consultant that the rumor is false. Further suggestions that the rectangular shaped vertical shaft is not man-made is the presence of a similar ice choked vertical shaft-like structure only sixty (60) feet from this cave's entrance (see Photo B) and another rectangular structure in the floor of at least one other cave on the Bandera tube system (this one free of ice).

If a non-damaging research project can be designed to determine the depth of the ice choked vertical shaft and an associated means to determine if rock or ice lies below the Middle Passage of Navajo Cave, such research should be pursued.

Access code for Navajo Cave is #2.

Photo A is looking out of Navajo Cave at the entrance; note person. Photo B is of the ice filled shaft near the cave's entrance. Photos C and D are of the moss covered rocks in the cave's entrance. Sensitivity code is #1, #3, and #4.

Photo E is the floor of the subsidence collapse that forms part of the roof of Navajo Cave; this means that Navajo appears to be the lower tier of a stacked tube.

Photos F (4) are of Navajo Cave's Middle Passage ice crystal formations.

Photo G is of damage to the ice crystal wall by vandals scooping ice out of the cave.

Photo NC-4 H, I, and J are of the ice crystal wall in 1980. Ice wall appears to have receded.

Photo K is a 1988 photo of the ice wall; note that a recession appears to be in progress.

Photo L is of the ice plug that terminates cave access.

Photo M is a common melanistic lizard taken at the entrance to Navajo Cave. This lizard is common throughout El Malpais.

NC-5 (1) Subsidence collapse of the Bandera tube lies immediately east of Navajo Cave; numerous fractures of considerable size on both the north and south sides of the tube (depth to over 40 feet0; some have trees growing out of them).

NC-6 (1) Subsidence collapse east of Navajo Cave; note sagging pahoehoe that formed the roof of the tube.

- NC-7 (2)      Subsidence CS with dimensions 150 feet in width by 200 feet in length; depth is up to 30 feet with a gradual descent; three ice cave leads in CS (small and ice choked) as well as four small (dry) caves. Access code is #1.
- NC-8 (5)      Hole-in-the-Roof CS. Vertical walled CS 70 feet in width, 100 feet in length, and up to 40 feet in depth. Large caves on both the west and east ends (40 foot ceilings; 40 foot widths) can be safely accessed only with technical assist. Access code is #4.
- CS should be entered as soon as possible; cave on east end could be 400 to 500 feet in length or more. Vegetation in floor of CS does not suggest an ice cave; anticipate large lava tube structure such as is found East of Rendija, Anasazi, and Outlaw Trail areas.
- Two (2) small ice caves lie immediately north of Hole-in-the-Roof CS. Caves are ice choked, short in length, and are crawls. Access code is #5. See photo C for view of typical entrance.
- NC-9 (1)      Surfacially channelized (sagging) portion of the Bandera tube; shallow channel results from subsidence of tube while rock was still plastic; a cave may or may not be present beneath the channel.
- Nc-10 (1)      Small (15 feet) cave choked by ice; note yellow lichens at tight squeeze entrance.
- NC-11 (2)      Subsidence collapse of Bandera tube -- similar to NC-5 above.
- NC-12 (1)      Subsidence collapse of Bandera Tube -- similar to NC-5 above.
- NC-13 (1)      Walled structure archeological site near edge of aa lava and cairn trail approach to Navajo Cave; note tree growing in site.
- NC-14 (1)      Walled structure archeological site immediately south of Navajo Cave.
- NC-15 (1)      Complex of walled structures immediately south and east of Navajo Cave in a subsidiary tube system.
- NC-16 (2)      An archeological site in a small lava tube; note wall at entrance and 15 feet into cave in Photo A. Photo B is an external view of site. Access code is #3.

- NC-17 (1) Floor (or roof) of a lava tube subsidiary to the Bandera tube; tube here is 10 to 15 feet deep and up to 50 feet wide. Note flat pahoehoe floor of tube that could also be the roof of a cave. Name of subsidiary tube: Gus Rainey. Subsidiary system length is believed to be 2,000 feet. System is rich in cultural sites at north end. Access code is #1.
- Subsidiary cave size is considerably reduced from that of the main Bandera system; cave widths are typically 20 feet and heights are 8 to 12 feet. Cave lengths are up to 200 feet; bridges are present on the system; the subsidiary tube system is both interesting and beautiful. System was not intensively invenoried.
- NC-18 (2) A sheer-walled CS on the Rainey tube subsystem. Note pahoehoe overhang in Photo A. Depth is up to 20 feet; length 40 feet, and width 20 feet. Access code is #3.
- NC-19 (1) Another sheer walled CS on the Rainey subsystem; note Rocky Mountain Juniper growing in the CS. Depth is to 20 feet, width to 20 feet, and length to 30 feet. Access code is #3.
- NC-20 (3) Ash Chamber Cave is an ice cave situated beneath a large overhang (40 feet wide and up to 12 feet in height) of pahoehoe lava (Photo A). Cave length is negligibile (30 feet), most of it being choked by massive breakdown. However, on the east side of the overhang and under a large boulder is a chamber (3 by 10 by 4) full of ash that appears to have been frequently utilized to melt the ice in its floor for water use. Access code is #3.
- NC-21 Subsidence collapse of Bandera tube.
- NC-22 Shallow subsidence sagging of Bandera Tube System; note that floor of subsidence could be roof of cave.
- NC-23 Subsidence collapse of Bandera Tube System.
- NC-24 Deep fracture on the south flank of the tube system; depth 30 feet and width up to 10 feet. Access code is #3.
- NC-25 The Bandera tube system flattens out and seemingly disappears in places as it moves east; system is here flanked on both the north and south by a massive aa flow.

- NC-26            A view of the Desolation aa Flow, which is believed to be the most formidable in El Malpais.
- NC-27            The floor of the Bandera Tube.
- NC-28            The Desolation aa flow surrounds and in places has overrun the Bandera Tube System. This aa flow is an incredible expanse of sharp, jagged, tortuous landscape.

## Bandera Tube System

### OUTLAW TRAIL AREA

#### General Description

This portion of the Bandera Tube System begins in T.8 N., R. 11 W., on the western edge of Section 19 and extends through the southwest corner of this section, the north half of Section 30, through the middle of Section 29, to (at least) the western edge of Section 28 of T8N, R11W. In terms of air distance, the above equates with not quite three (3) air miles. Within this short distance is located, and by many magnitudes, the greatest concentration of major caves within the National Monument. Further, until this inventory, the existence of these caves was not even a rumor. However, this does not mean that no one knew of the caves. Virtually every cave in the area has been littered with tin cans or marked with painted arrows. Further, water caches were found. The caves were known. But like most of El Malpais, only to a very few persons.

The caves of the Outlaw Trail Area are decidedly unusual in that in most of the area it is more common to encounter intact lava tubes than it is to find collapsed tubes. An analogous situation exists -- but on a dramatically reduced scale -- for the north and east wings of the El Cauldron lava tube system.

The caves of the Outlaw Trail are not the largest in terms of height and width. That distinction belongs to the East of Rendija and Apache Cave regions of the Bandera tube system and the Lava Crater tube system. However, the Outlaw Trail Area caves approach to within 20 percent of the maximum on ceiling height and within 10 percent of the maximum tube widths.

Where the Outlaw Trail caves distinguish themselves as world class lava caves is in terms of intact lava tube length. Outlaw Cave possesses a total length of nearly 7,000 feet, including all passages, bridges, and collapse structure interruptions (e.g., windows, skylights). There are few, if any, lava tubes on the North American continent that can equal this cave length. Closely associated with Outlaw Cave are nearby cave segments that, if added together, would exceed two (2) miles in length. The most spectacular of these is Chantry Cave, which is 4,000 feet in length, is broken by only two collapse structures and one small window.

Further, under no circumstances did the consultant thoroughly inventory the caves of the Outlaw Trail Area. Much more is believed to remain to be discovered in this intriguing corner of El Malpais National Monument. And for good reason: this is one of the most remote and difficult portions of the National Monument to access. Access is a difficult problem here. But most of all, navigating in the sea of trees that characterizes the area presents the most challenging orienteering situation encountered by the consultant in El Malpais.

Map/Photo Code: OT

- OT-1 (2) Typical view of the country that must be crossed to reach the Bandera Tube System in the Outlaw Trail Area. Note lack of landmarks available.
- OT-2 (1) Aspen occurs only on the fringe of the lava in this portion of the flow, apparently as a result of increased water availability due to edge effect. Curiously, the largest aspens the consultant encountered in El Malpais were on the northern approach to the Outlaw Trail area.
- OT-3 (1) The Outlaw Trail Area shows considerable evidence of a high frequency of fire in past years. Note the base of this snag. Management recommendation: a series of fire-killed snags should be dated to determine frequency of past fires and date fire control became effective.
- OT-4 (1) As remote as the Outlaw Trail area is, signs of the former presence of people are disturbingly frequent.
- OT-5 (2) Walled archeological site in cave; pot sherds present.
- OT-6 (1) Thin slivers of sandstone located near small caves on the edge of the lava.
- OT-7 (5) Treasure Hunter Mine. It is reported by Mr. Pete Arrosa that several families worked three (3) years trying to locate a reported gold treasure on this site. Rock was blasted with dynamite and apparently removed by hand. The site is interesting in that it includes such amenities as a cable slide and constructed rock benches under trees. According to the consultant's records, the site is located on private land.
- OT-8 (1) Trash dump of Treasure Hunter Mine and adjacent private cabins.
- OT-9 (2) The consultant had considerable trouble locating the Outlaw Trail and had given up when he encountered this "bearing " tree, which pointed precisely in the right direction to exit the lava at the southern extremity of Cerritos de Jaspe.
- OT-10 (1) Near the bearing tree, the consultant located an old blaze on a Ponderosa pine.

- OT-11 (1) Immediately to the west, he located a much more recent and conspicuous blaze placed above an old blaze. The consultant had found the Outlaw Trail. The authenticity of the trail was further confirmed by the fact that it could be used by horses (with a minimum of clearing work) and an ancient horseshoe was found in the trail.
- OT-12 (1) The trail is most difficult to follow; for someone without experience, a full day might be required to figure out its meanderings and for the return to the starting point.
- OT-13 (1) Outlaw Trail; note the utter lack of landmarks.
- OT-14 (1) Sometimes the blazes are creative -- such as this rock placed in the branched fork of a tree.
- OT-15 (5) This small cave and subsidiary tube system of Bandera lies immediately south of the Outlaw Trail. Cave is actually a bridge 45 feet in length. Entrances average 5 feet in height and 15 feet in width. Once in the cave, the ceiling increases to a maximum of 10 feet and the width to 20 feet. Bearing looking in from west is 135 degrees T. Wood present in cave; otherwise, no sign of habitation. Room located on south side; ceiling very low. Access code is #1.
- OT-16 (1) One of the few walled structures found in the Outlaw Trail Area.
- OT-17 (1) One knows he has reached the Bandera tube system when Flint's Hideout Cave is encountered on the west side of the trail. Note the thinness of the roof. Floor to ceiling height is 30 feet; cave width is 35 feet. Entrance is technical assist (Access Code #4). Not entered. Based on the characteristics of nearby caves and their location, this Bandera system cave could prove up to 1,000 feet in length. Bearing into cave from west rim of CS is 150 degrees; bearing looking into cave from east rim of CS is 340 degrees.
- OT-18 (2) Ice Cave Bird Window is near the terminus of a 1,000 foot Bandera tube cave. Note thinness of lava ceiling. Floor to ceiling height is 40 feet plus; width is 50 plus feet. This is a large cave. Window is 8 feet by 20 feet. Note: the caves of

this area are littered with cans -- one or two in cave entrance or thrown through window or onto floor of cave or CS. Seems to be a method of marking the caves.

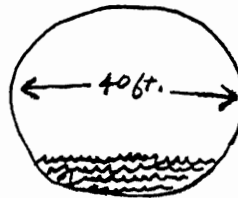
Window name was assigned because the ice cave bird (Hammond's flycatcher) was observed at this window in early August.

- OT-19 (1) Outlaw base camp.
- OT-20 (2) Subsidence collapse of Bandera tube. Bearing looking from east to west is 280 degrees. CS length is 175 feet and width is 100 feet.
- OT-21 (1) Cave lies on east end of OT-20 CS. Note painted X on rock at cave entrance.
- OT-22 (1) Cave entrance from another angle. Entrance is 20 feet wide and up to 15 feet in height. Access code is #2.
- OT-23 (2) Cave floor is rubble-strewn; ceiling is up to 30 feet high and width is up to 35 feet. Total cave length is 200 feet. Looking into cave, bearing is 125 degrees. Air temperature in cave near entrance is 52 degrees. Access code is #2.
- OT-24 (1) Note sinuous turn in tube from 125 degrees T to 95 degrees T; note falling lava levels on cave wall.
- OT-25 (6) North Turn CS. Named for the conspicuous turn to the north that the tube system makes in this CS. CS length is 250 feet; width is up to 100 feet; depth is as much as 35 feet. Entrance to North Turn Cave lies on east side of CS.
- OT-26 (7) Views of entrance to North Turn Cave. Note doming of lava tube.
- OT-27 (4) North Turn Cave -- it could be a subway tunnel except for the rubble on the floor. Note the beautiful mottled coloration of lava walls. This is characteristic of many ( but certainly not all) cave walls in the Outlaw Trail area (see Photo B, C, and D). Access code is #2. Sensitivity code is #1.

Pack rat midden is located on south near entrance. Air temperature of cave near entrance is 59 degrees F. Air temperature in direct sun at 9:10 AM on

8-11-88 was 73 degrees F. At entrance, ceiling height is 25 feet and cave width is up to 40 feet. However, the maximum width is achieved not at the floor level of the cave but approximately 10 feet up the sides.

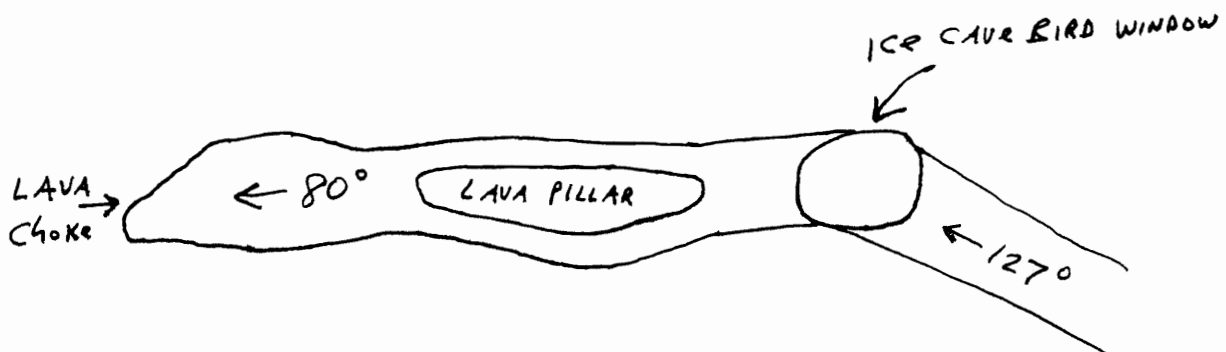
Schematic drawing of classic tunnel shape of North Turn Cave:



A spam can is present in entrance as well as some type of marking tape. Bearing looking into cave is 145 degrees T. 150 feet into cave, turns from 145 degrees to 100 degrees T. 400 feet into cave, turns from 100 degrees to 60 degrees T. 500 feet in, cave turns from 60 degrees to 127 degrees T. 780 feet into cave, is Window OT-18. At window, cave turns to 80 degrees T and proceeds to 880 feet.

At 880 feet, cave splits into two (2) branches divided by a central pillar:

Schematic Drawing of North Turn Cave:



Pillar separates cave into two branches but ends in 100 feet. Air temperature in cave is 50 degrees F. In Y section of cave, ceiling height falls to as little as 7 feet and width to 20 feet.

Bearing from pillar to cave terminus is 90 degrees T, and total distance from entrance to lava plug is 1,000 feet. Much water vapor from pillar to cave terminus; cloud-like formations present in the cave, and dripping water.

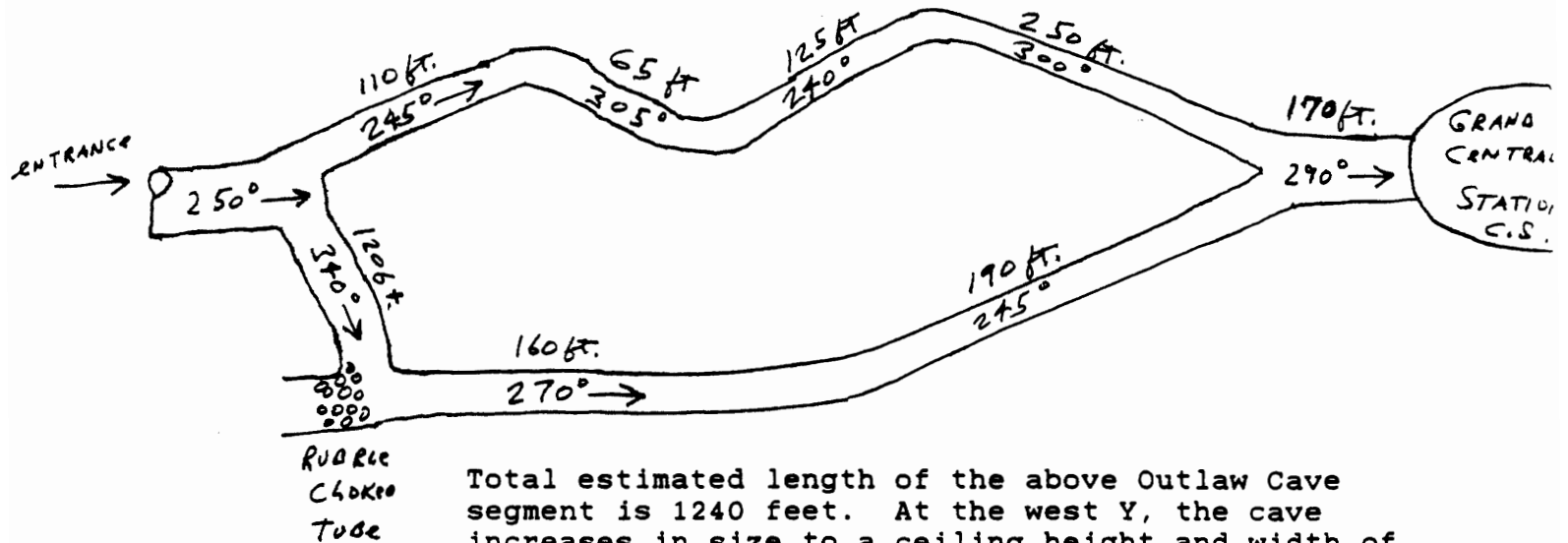
- OT-28 (7) Ice Cave Bird Window (OT-18) at 780 feet into North Turn Cave.
- OT-29 (2) Floor of North Turn Cave at the entrance to the cave.
- OT-30 (1) Ponderosa pine seedling clinging to life on bare rock.
- OT-31 (8) Ridge Runner Cave. The name was derived from the raised floor which conspicuously drops off 2-3 feet on both sides to form distinct ridges. This is quite an impressive lava tube feature. Feature is believed to originate from falling lava levels which formed the equivalent of levies within the lava tube. Bearing looking into cave is 259 degrees. Cave has very small window -- size 1 foot by 1 foot. Access code is #2. Sensitivity code is #1.
- OT-32 (1) Ridge Runner Cave walls in places look like an abstract painting.
- OT-33 (1) Ridge Runner Cave's ceiling is up to 25 feet high and width is up to 40 feet. Floor is flat except for ceiling rock fall seen in this photo.
- OT-34 (1) Bone wedged in between rocks near cave terminus at a distance of 250 feet. Appears owner of bone was rock fall victim (?). Other bones at cave terminus. Temperature 42 degrees. Cave terminus may have been used for meat storage. Silver formations present at rear of cave. Last 150 feet of cave is much reduced in size over entrance portion of cave: ceiling here is 3 feet to 8 feet in height and width is down to 20 feet and less. Aluminum cans in cave.  
  
Dripping lava and lava stagtites formations at rear of cave are beautiful.
- OT-35 (3) The entrance to Feeding Trough Cave is located on the east side of a very small CS located on the south side of a blocky lava flow. Cave width is 35 feet; ceiling height is 10 to 20 feet; length is 250 feet. Note beautiful moss growth at entrance. Cave is wide but not high. Floor is relatively flat but

covered with small, sharp aa rocks that would make a fall painful. Roof collapse present. Cave bearing looking in is 135 degrees T. Access code is #2. Sensitivity code is #2.

- OT-36 (5) Cave Name -- Feeding Trough -- derived from the distinctive feeding trough-like lava formations on both walls. Origination of these formations must be similar to the raised floor phenomena in Ridge Runner Cave --a receding flow of lava.
- OT-37 (1) Note the relative smoothness of portions of the walls of Feeding Trough Cave. The Outlaw Trail area caves are characterized by considerable variation in cave wall texture, color, and appearance. Lava cycles in cave are dramatic.
- OT-38 (1) Feeding Trough Cave is spectacular; view is from breakdown to ceiling with entrance and moss carpet in background. Air temperature at cave entrance was 44 degrees; at cave terminus was 40 degrees at 3:42 PM on 8-11-88.
- OT-39 (1) Moss covered rocks in entrance of Feeding Trough Cave. Note lichen covered snag at top of photo.
- OT-40 (1) The entrance to Outlaw Law -- the longest (known) cave in El Malpais and believed to be one of the longest lava tubes on the planet. Outlaw begins inconspicuously. Its beginning CS (which it shares with Feeding Trough Cave) is small (40 feet in length; 25 feet in width; and 20 feet in depth), inconspicuous, and easily missed. The cave entrance is similarly innocuous: 7 feet in width and 3 feet in height. The cave had a strong current of cold air blowing out (temperature 43 degrees) and a colony of orange lichens (Gasparrinia elegans var. brachyloba), the presence of which is often a predictor of an ice cave. Access code for entrance is #3. Sensitivity code is #1.

The consultant was anticipating an ice cave of relatively short length when he entered Outlaw Cave. This is not what he encountered. Cave ceiling height is only 10 feet, and width 20 feet at entrance. However, the cave Y's into two branches. The cave ceiling height and cave width of both branches averages 20 feet.

Schematic Drawing of Entrance Section of Outlaw Cave:

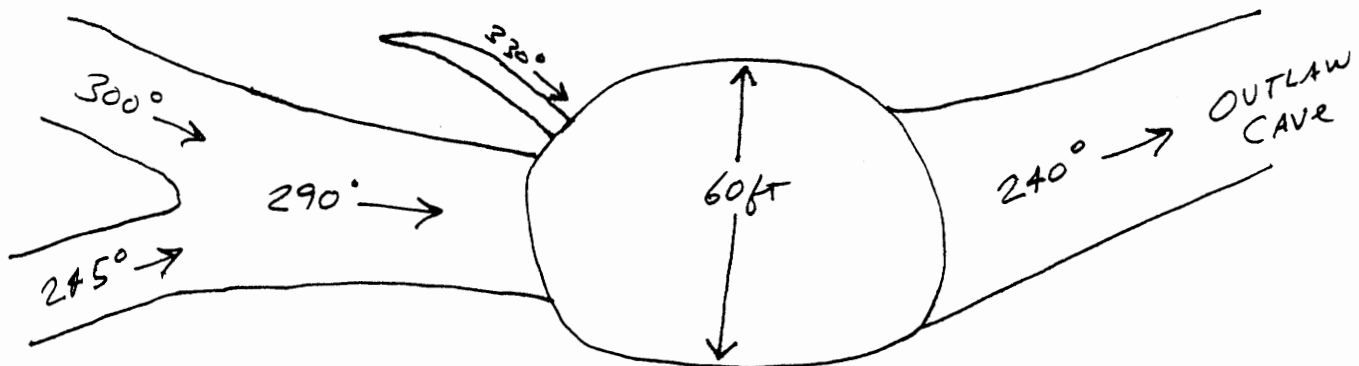


Total estimated length of the above Outlaw Cave segment is 1240 feet. At the west Y, the cave increases in size to a ceiling height and width of 30 feet. Note: took sample in south branch of entrance to Outlaw of snow white and bitter tasting material.

OT-41 (2) Outlaw Cave exit into Grand Central Station CS.

OT-42 (2) Grand Central Station CS -- Outlaw Cave's first CS is accessible only with technical assistance (Access code #4). CS length is 60 feet in diameter and 40 feet in depth. Name Grand Central Station was assigned to CS because 4 caves junction at or near this CS:

Schematic Drawing of Grand Central Station CS:



- OT-43 (1) View of Grand Central Station CS from the surface.
- OT-44 (2) The North wall of Grand Central Station. Note falling lava flow level lines on wall.
- OT-45 (2) Small subway tunnel-like lava tube on southeast side of CS; note smooth floor and beautiful mottling of rock walls. Length is only 75 feet. Ceiling height is up to 10 feet and width is 20 feet near entrance but chokes down to become impassable very rapidly.
- OT-46 (2) Continuation of Outlaw Cave -- bearing in is 320 degrees. Ceiling height is 20 feet and width is 30 feet. Walls at entrance are smooth like subway tunnel but floor is covered with rubble. Cave turns from 320 degrees to 280 degrees 120 feet in. Cave continues at 280 degrees for 180 feet. Cave turns from 280 degrees to 345 degrees and continues for 200 feet. Total length of this segment is 500 feet.
- OT-47 (1) Encountered more lava troughs in this Outlaw Cave segment. Origination of the troughs is believed due to reduced lava flow. The outer margins of the lava solidified into low walls within the tube and inside this flow channel within a cave the lava flowed downhill and out of the lava conduit.
- OT-48 (1) Exit of Outlaw Cave into Silver Arrow CS (name comes from the presence of painted silver arrow on the South rim of CS). Approximately 200 feet east of the entrance is a bat colony estimated at 100 to 200 individuals. Could not identify. Air temperature in this segment is 66 degrees F. Total Outlaw Cave length to Silver Arrow CS -- 1,800 feet. Coors cans at exit from this segment into Silver Arrow CS.
- OT-49 (4) Silver Arrow CS. This is the largest CS on the Outlaw Cave System. It measures 200 feet in length, 100 feet in width, and up to 35 feet in depth. Access code from surface is #3; from cave, Access code is #2.
- OT-50 (3) The roof of Outlaw Cave above OT-48.
- OT-51 (1) The entrance to the west tunnel of Outlaw Cave from Silver Arrow CS. Note mottled coloration of walls, ceiling, and even floor. Bearing into cave is 245 degrees. Entrance is 40 feet wide and up to 40 feet in height. Rubble pile from CS into cave is 60 degrees steep and drops 30 feet. Access code is #2.

- OT-52 (1) Old tin cans in cave with light from window shining 360 feet in the distance.
- OT-53 (4) 240 feet into the cave from Silver Arrow CS, Outlaw Cave turns from 245 degrees to 270 degrees and continues for another 120 feet to an oblong shaped window (shape appears circular from certain perspectives). Diameter of window is 20 feet. Maximum cave dimensions have not changed (40 feet by 40 feet). Cave length from Silver Arrow to window is 360 feet. Total length of Outlaw Cave to this point --2,360 feet. Note Indian ladder in window.
- OT-54 (2) Bearing into next segment of Outlaw Cave is 250 degrees. Many bones present; appear to be deer but some are too large.
- Rock cairns present in cave (see Photo B).
- Air temperature in cave was 66 degrees on 8/14/88.
- Distance to next CS is 400 feet for a total cave distance of 2,760 feet.
- OT-55 (2) View looking back toward window OT-53. Cave width here is 50 feet, very wide for any El Malpais Cave. Ceiling remains at 30 feet. Note cairn in photo with wall in foreground.
- OT-56 (3) Giant's Window CS lies an estimated 2,760 feet into Outlaw Cave. Window measures 40 feet by 40 feet. Many deer (?) bones are present in the cave fringes of the window. Note in the C photo how the edge shape of the collapsed portion of the tube almost perfectly conforms to the edge shape of the intact portion.
- OT-57 (1) Note the firebrand at the cave fringe of Giant's Window.
- OT-58 (1) The south wall of Outlaw Cave at edge of Giant's Window.
- OT-59 (1) Looking east back into Outlaw Cave from the Giant's Window.
- OT-60 (1) Giant's Window from the surface.
- OT-61 (1) Located top portion of skull (domestic goat?)

- OT-62 (2) Outlaw Cave continues at a bearing of 285 degrees for a distance of 340 feet. The cave then turns to a bearing of four (4) degrees for a distance of 200 feet and opens into Grand Central Station #2 CS. The length of this segment of Outlaw Cave is 540 feet for a total cave length of 3,300 feet.
- OT-63 (2) A view of Grand Central Station CS #2 and Outlaw Cave from the surface. CS is 100 feet in diameter and up to 40 feet deep. Note person in photo A. Access code is #3. Sensitivity code remains #1.
- OT-64 (2) Subsidence CS lying immediately west and north of Grand Central Station #2 CS that is a second branch of the Bandera Tube System.
- OT-65 (1) Shallow cave is present on the East side of the subsidence CS. Cave is 25 feet in length with 8 foot ceiling and 15 foot maximum width. Opening is 4 by 15 feet.
- OT-66 (1) Other small openings in subsidence CS -- not explored.
- OT-67 (1) Outlaw Cave continues from Grand Central Station #2 CS at a bearing of 270 degrees for 370 feet, then turns to 350 degrees for 180 feet and finally to 315 degrees for 170 feet to Bighorn CS. This segment's length is 720 feet, which raises the total cave length to 4,020 feet. Cave dimensions have not changed. Access code remains #3.
- OT-68 (1) Bighorn CS is 100 feet in length and up to 30 feet in width. Note the flat crust of pahoehoe, which is more generally typical of this portion of El Malpais than any other, and is the type of lava flow characteristic one would anticipate in a cave rich area.
- OT-69 (2) Outlaw Cave continues at a bearing of 280 degrees. The cave ceiling height falls to 20 feet and width to 25 feet. However, the mottled coloration of the cave increases in intensity to create a startling rock mosaic.
- OT-70 (2) Located animal skull deep in a crevice 170 feet into cave. Depth was 5 feet. Very difficult to remove but finally succeeded. Believe skull is that of a female Bighorn Sheep. If so, this finding means the

consultant has located two Bighorn skulls spaced nearly four miles apart. Unlike the site of the first skull, which was located near an ice cave that was an effective spring in warm weather, this area has no known water availability.

- OT-71 (1) Cave enters Skull CS. This one is 100 feet in length and 40 feet in width. Cave segment length was 330 feet for a total cave length to this point of 4,450 feet (including CS length). Again, notice square-like configuration of the lava tube.
- OT-72 (2) Bearing into cave is 265 degrees. Ceiling at entrance is only 10 feet high, but quickly increases to 25 feet. Width of cave is typical 40 feet. 200 feet into cave, bearing turns to 320 degrees. Nearby is this small (1 by 2 feet) but beautiful window and its light.
- OT-73 (1) Outlaw Cave's ceiling height increases from 25 to 35 feet. Note person in cave.
- OT-74 (1) The surrealistic mottling of Outlaw Cave's ceiling and walls is an outstanding characteristic of this cave. Note window in distance.
- OT-75 (1) Outlaw Cave turns to 335 degrees 450 feet into this cave segment. Photo was taken 650 feet into the cave with Bridge CS as a light in the distance. Note variation in cave ceiling and wall coloration and texture.
- OT-76 (1) Note smooth texture of the tube wall at this site.
- OT-77 (9) This is Bridge CS. The name is derived from the fact the CS is a double window with a 30 foot wide lava bridge separating the two. Note person in photo. The first window is 30 feet and the second 20 feet in diameter. The cave segment leading to Bridge CS is 960 feet in length for a total cave length of 5,310 feet.
- OT-78 (1) Views of Double Bridge from the surface.
- OT-79 (1) Bearing into the cave from Bridge CS is 280 degrees. 90 feet into the cave, bearing turns to 310 degrees. It is here that Outlaw assumes one of its most stunning guises. Note smooth floor and ceiling breakdown at turn in distance.

- OT-80 (2)      The south branch of the cave hits another window 580 feet into the cave. Total cave length at this point is 5,930 feet.
- OT-81 (2)      Much animal bone was encountered at this window, apparently the result of accidental falls from the surface into the cave.
- OT-82 (3)      Bearing into Outlaw Cave from Bone Window is 300 degrees True. Cave turns from this bearing to 360 degrees True 280 feet into the cave. At 560 feet, Arrowhead Window is encountered. Window is 25 feet in length and up to 15 feet in width. An enormous pack rat midden up to 15 feet in diameter is located at this window. Note beautiful moss carpet below window. Sensitivity code is #1.
- Outlaw Cave appears to end 110 feet west of Arrowhead Window. The length of this segment is 670 feet, for a total Outlaw Cave length of 6,600 feet.
- OT-83 (1)      Roof of Outlaw Cave.
- OT-84 (2)      Collapsed portion of the Bandera tube immediately north (100 yards) of the terminus of Outlaw Cave. Name assigned is Overhang C.S. Width of CS is 285 feet and length is 200 feet. Photo A is looking east; Photo B is looking west. Note classic pahoe-hoe formation of photo B. Caves are located on both ends of the CS.
- OT-85 (4)      The east end cave has two leads. The north side lead is 60 feet in length and choked with lava. The south side lead was named Black Silver Cave. Cave is not large. It is situated 40 feet below the floor of the CS. Surface air temperature on 8-20-88 was 86 degrees in shade. Cave temperature, in contrast, was 37 degrees. Ice is near! Note Black Silver Cave's beautiful mosaic of lichens, moss, lava stalagmites, and silver (water droplet-calcium carbonate) formations in Photo A.
- Cave ceiling height rapidly diminishes from 15 feet to 0 at the cave terminus (see Photo B). Cave width varies from 20 feet to 2 feet. Cave length is 120 feet at a bearing of 150 degrees looking into cave. Access code is #2. Sensitivity code is #1. Lava stalactites and dripping lava formations are unusually beautiful in this cave.

OT-86 (2) Spectacular lava stalagmite formations are present in Black Silver Cave (note: such formations are extremely difficult to photograph).

OT-87 (2) Black Silver Cave is overhung by an impressive 20 foot wide lip of lava that appears more like sandstone than the olivine basalt of which it is composed.

OT-88 (4) The west side cave is very different from Black Silver. The tube is domed and a single large cave is present. Name assigned is J. Frank Dobie Cave, after the author J. Frank Dobie who visited and wrote of El Malpais in the 1920's.

OT-89 (2) From the floor of the CS, the breakdown drops a precipitous 40 feet into J. Frank Dobie Cave (note person entering cave on breakdown). Access Code is #3.

This is a very wide cave at 60 feet -- as wide, in fact, as the largest caves in El Malpais (note: width increases inside the cave over that depicted in the photo). Cave ceiling height ranges up to 35 feet.

Cave's moss on south wall is spectacular. Sensitivity code is #1.

(CONTINUED)

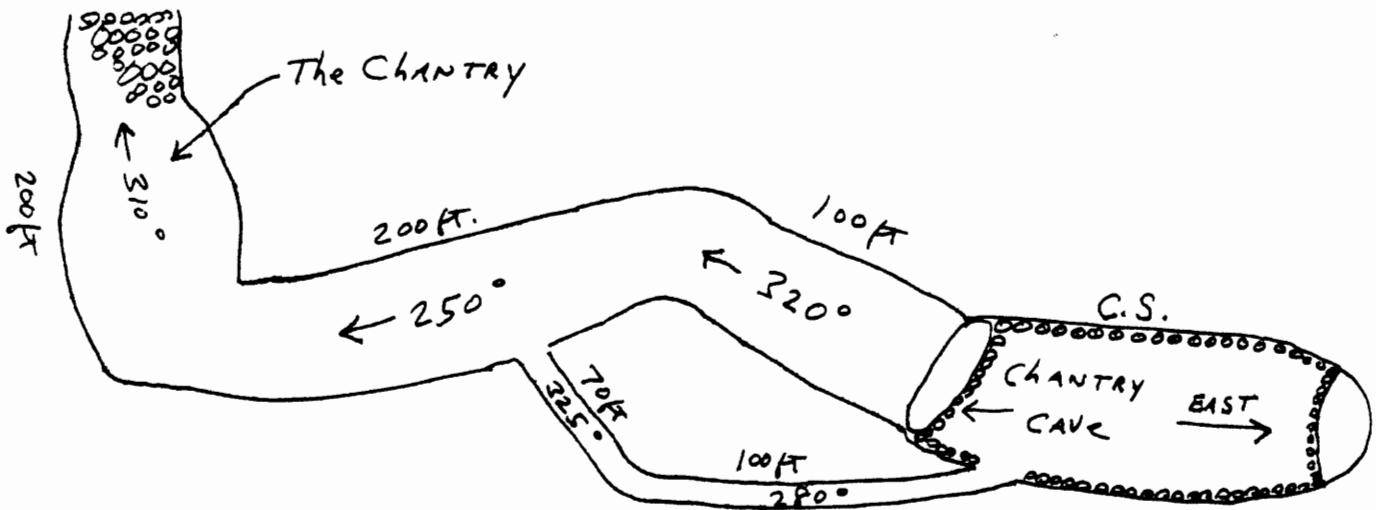
- OT-90 (2) This cave runs only 300 feet before a boulder choke is encountered. However, the portion of the cave that is enterable is exquisitely beautiful. Note the combination of mottled and lava black coloration of the cave. This is unusual. Also, the boulder plug in the far distance.
- OT-91 (1) Bandera tube subsidence collapse. Note extreme width (up to 200 feet). Depth is up to 30 feet.
- OT-92 (3) First archeological site located on Bandera tube system in Outlaw Trail Area. Note that snag has fallen across structure.
- OT-93 (1) Cave immediately adjacent to walled structure on west end of C.S. (not entered).
- OT-94 (1) Cave at east end of above CS. Not entered.
- OT-95 (1) Rock cairn markers are situated all over the Outlaw Trail Cave area, but especially at or near cave entrances, windows, and collapse structures (CS).
- OT-96 (2) The next CS east on the main Bandera tube system. It is a subsidence collapse; length is 300 feet and width up to 100 feet. CS depth is up to 40 feet.
- OT-97 (2) The next CS east on the Bandera system. Depth of CS here is to 30 feet. Length is 200 feet and width is up to 70 feet.
- OT-98 (1) CS on Main Bandera tube lying East and South of OT-97. Cave not entered. Note conspicuous roof sag.
- OT-99 (1) omit
- OT-100 (2) Several more examples of the numerous rock cairns in the Outlaw Trail area.
- OT-101 (3) View of one of the most spectacular examples of "classic" pahoehoe lava encountered during the inventory is provided in Photo A. Photos B and C were taken nearby.

- OT-102 (3) Ancient and gnarled junipers like this one are rare in the Outlaw Trail area. Area is typically an unbroken expanse of Ponderosa pine.
- OT-103 (1) Huge pressure ridge type fracture south of Bandera tube system.
- OT-104 (3) Three examples of the roof of Outlaw Cave.
- OT-105 (1) An example of the roof of Outlaw Cave.
- OT-106 (2) A twisted and burned Ponderosa pine such as the consultant has never previously encountered.
- OT-107 (1) Water thermos was located hanging in a tree near the entrance to Chantry Cave.
- OT-108 (1) Entrance to the West side of Chantry Cave. Collapse Structure is 60 feet in diameter. Bearing into cave is 320 degrees for a distance of 100 feet. Cave height is up to 35 feet and width up to 50 feet. Floor is covered with heavy breakdown. Access code is #3.
- OT-109 (1) Chantry Cave turns from 320 degrees True to 250 degrees True 150 feet inside. At a distance of 225 feet, a branch tube enters from the east (please see OT-111 for schematic drawing). Photo OT-109 is taken at this junction. Note beautiful coloration of cave walls and ceiling.
- OT-110 (3) Chantry (West) Cave turns to 320 degrees 300 feet in and proceeds at this bearing for another 200 feet before choking off in a small rubble chamber. Immediately prior to choking off, the cave's floor smooths and a huge vertically tilted and arrow shaped slab of pahoehoe lava is encountered that points almost precisely to a small (1 by 1) window in the side of the cave's ceiling. The cave's name "Chantry" was given because of the resemblance of this portion of the cave to a cathedral. The two photos are of this feature; however, the photos do not do the beauty of the site proper justice. Ceiling height in the chantry is up to 50 feet and width exceeds 50 feet.

OT-111 (3)

This is Chantry Cave's branch, which was mentioned in OT-109 above.

Schematic Drawing of the west portion of Chantry Cave:



The branch tube is of "classic" lava tube configuration in that it has an almost perfectly circular shape. Ceiling height averages 10 feet but is as high as 20 feet prior to its junction with the main cave. Width averages 15 feet. The floor is extremely smooth and, for this reason, is atypical of most El Malpais' cave floors. Total estimated cave length is 4,000 feet.

Access code is #2 for the branch tube and #3 for the main cave. Sensitivity code is #1.

OT-112 (3)

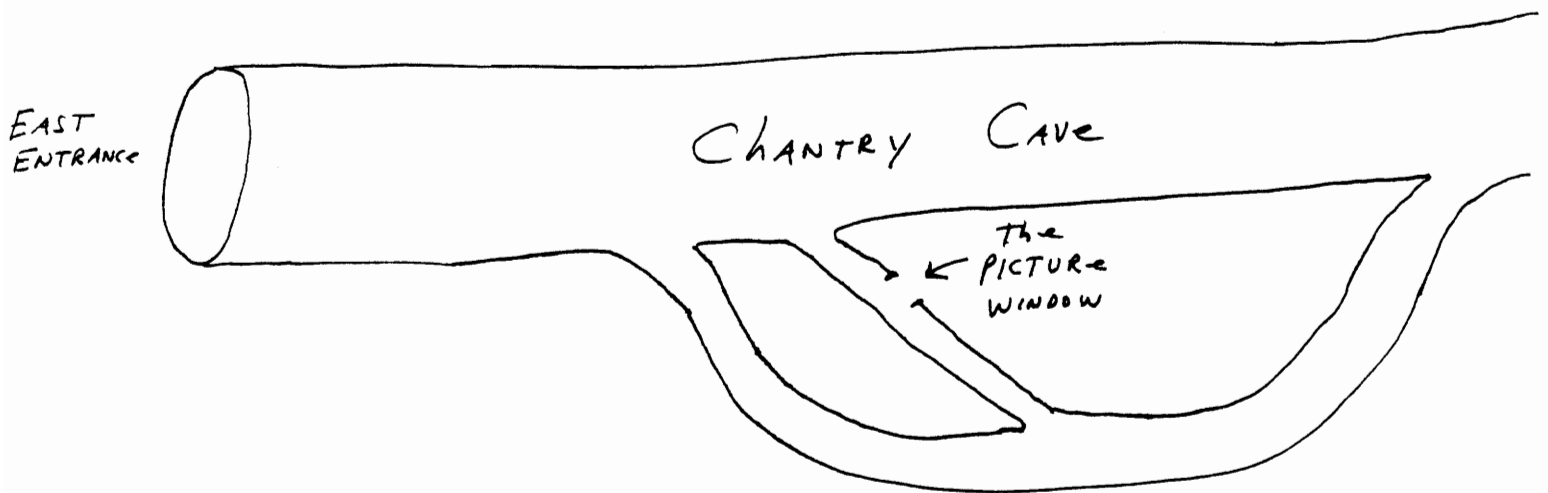
This is the entrance to the east side of Chantry Cave. Note, on the interior photos, the moss carpet just inside the cave, especially in 112-B. Sensitivity code is #1.

Cave dimensions are big cave "typical" for the Outlaw Trail area: ceiling up to 30 feet; width up to 40 feet. Access code is #2. Air temperature of cave was 53 degrees on 8-21-88.

OT-113 (8)

Chantry Cave gets interesting very rapidly in that the cave branches into three (3) tunnels. The left two (2) are far smaller than the main cave, with ceilings of 3 to 20 feet and widths of 10 to 25 feet.

Schematic Drawing of the east branches of Chantry Cave:



The OT-113 series of photos are all taken in the branch tubes on the south. Photo A is of the rectangular hole in the wall of the middle tube that has been named the "picture window". Photos B and C demonstrate the "classic" shape of this cave's branch tubes and its striking coloration. The D photo is taken at the junction of five branch tubes; again, note striking coloration and exquisite symmetry of the tube. The E photo is a view of the lowest portion of the cave's ceiling.

OT-114 (2)

These striking photographs were taken in the main cave 2,400 feet further east of the OT-113 series photos. Note the clouds in the cave! Chantry Cave maintains a classic lava tube symmetry throughout its longest passage (3,000+ feet of unbroken cave).

OT-115 (2)

Note that although the floor of the cave is level it is anything but flat. This view is representative of much of Chantry Cave's long dark passage. Light in distance is far east exit (entrance) of the 3,560 foot cave segment.

- OT-116 (1) Caver moving through underground clouds near the far east entrance.
- OT-117 (6) The far east entrance (exit) to the Long Dark Passage segment of Chantry Cave. Note that caver stands in entrance in Photo A.
- Note underground clouds in B and D; also the clearing of the underground atmosphere to allow viewing of the green moss growing in the entrance in Photo D.
- OT-118 (1) The Far East entrance to (or exit from) Chantry Cave's Long Dark Passage segment (3,000+ feet).
- OT-119 East End CS is 200 feet in length and 70 feet in width. Chantry Cave's entrance (exit) to the Long Dark Passage is in the distance.
- OT-120 (1) Note rock cairn on edge of East End CS; also fractured pahoehoe.
- OT-121 (2) The exterior entrance to the final segment of Chantry Cave.
- OT-122 (2) The interior entrance to the final segment of Chantry Cave. Note the high lava ridges adjacent to both cave walls and the spectacular green carpet of moss which extends far back into the cave. Cave ceiling heights and widths are similar to those for the more westerly segments of Chantry Cave. Sensitivity code here is #2.
- OT-123 (2) Photo A is of moss on a lava ridge adjacent to the north wall. Lava ridges in caves are formed when the flow level of the lava falls and creates an interior channel within the lava tunnel.
- Photo B is a view of a lava ridge deeper in the cave. Note smoothness of wall and configuration.
- OT-124 (1) The spectacular terminus of Chantry Cave. Silver formation covering ceiling and walls is due to water droplets forming on calcium carbonate. This final segment of Chantry Cave is 410 feet in length. The total length of Chantry Cave, therefore, is estimated to be 4,200 feet.

OT-125 (1)

This was Outlaw Base Camp during two weeks in the month of August. Inventorying the Outlaw Trail area of El Malpais National Monument was difficult because of the formidable access and navigation requirements. Backpacking in and setting up a base camp was imperative. Further difficulties arose due to battery charging demands (both for cave lights and electric flash). And then the summer thunderstorm season did not help matters: getting drenched by rain and even pounded by hail was not infrequent. On several occasions during the night, it seemed likely that the wind would pick up the tent and reposition it in Albuquerque or beyond. And then there were the yellowjackets, mosquitoes, and gnats. Finally, the consultant worked over half the Outlaw Trail Area's caves alone with all the hazards, real and imagined, that caving without backup entails. In short, inventorying the Outlaw Trail caves was extremely demanding and time-consuming. However, the lava cave resource concentration in the Outlaw Trail Area is unparalleled in El Malpais. The consultant inventoried and mapped nearly three (3) miles of caves in this area, two of which account for 11,140 feet of passage. The consultant believes that the Outlaw Trail area's lava caves are of international significance. Further, he is certain that he did not exhaust the area's cave potential.

## **CERRO CANDELARIA**

### **General Description**

The lava flows of Cerro Candelaria, Lava Crater, and Twin Crater, according to Charles M. Maxwell, are "difficult or impractical" to differentiate one from another. Thus, although Hatheway and Herring (1970) identify Cerro Candelaria as the source of the "Candelaria Tube" system, this identification is at best uncertain. The conclusion becomes suspect when one considers that for this crater to be the flow source would have required the lava to have made a 125 degree turn immediately on exit from Cerro Candelaria's nearly due South (170 degree) breach in the crater wall. This seems unlikely to the consultant, especially since he could find no evidence of lava tube structure on the east side of Cerro Candelaria and given the fact that existing topography suggests a southerly course direction for the Cerro Candelaria flow. Therefore, and until better evidence can be developed to the contrary, the lava tube system identified by Hatheway and Herring as "Candelaria" is being renamed and reassociated with the "Lava Crater Lava Tube System" (also see the General Description for Lava Crater).

LAVA CRATER  
LAVA TUBE SYSTEM

General Description

Lava Crater is identified as "La Tetera" by Hatheway and Herring (1970), Causey (1971), and Maxwell (1986). However, the crater is named Lava Crater on the Ice Caves U.S. Geological Survey topographic quadrangle. The consultant has chosen to retain the U.S.G.S. name for the purposes of this report.

Lava Crater is an appropriate appellation for this lava tube source: the crater's walls are composed of layers of lava and welded spatter, whereas the lava crater's visual configuration is both classic and exquisitely beautiful.

On a map, Lava Crater appears overshadowed by its nearly 300 foot taller and far more massive cinder cone neighbor on the immediate east, Cerro Candelaria (crater diameter 1,400 feet as opposed to Lava Crater's 600 feet). However, when one visits Lava Crater on the ground, it is by far the more dramatic crater.

Lava Crater rises a maximum of 200 feet above the surrounding landscape and crater depth is 200 feet. Significantly for this consultant, Lava Crater is breached on the north northeast and immediately initiates one of El Malpais' richest lava cave segments. This tube trends north and north northwest prior to being covered by a more recent Bandera associated aa flow. The consultant hypothesizes (please see Map #2) that the tube turns northeast and east under this aa flow to link with the collapsed tube/open channel system previously identified as "Candelaria". This is, of course, a hypothesis; however, it is believed that it fits the "ground" situation more appropriately than does a Cerro Candelaria source. However, it is important to keep in mind that, and as Causey flatly states, "whether these craters (Cerro Candelaria and Lava Crater) were responsible for the flows (Candelaria tube system) is impossible to ascertain."

Map/Photo Code: LC

- |      |     |                                                                             |
|------|-----|-----------------------------------------------------------------------------|
| LC-1 | (1) | Lava Crater from the north rim. Note aspen and Douglas fir in crater floor. |
| LC-2 | (1) | View of west side of crater rim.                                            |
| LC-3 | (1) | West side of crater and landscape to southwest.                             |
| LC-4 | (1) | View from south rim.                                                        |

- LC-5 (1) On the South rim moving East.
- LC-6 (2) Views into crater from south with landscape in distance.
- LC-7 (1) East rim of crater; note persons on rim.
- LC-8 (1) Initial collapse depression of Lava Crater system.
- LC-9/10 (2) Collapse structures (depressions) in advanced stages of ecological succession.
- LC-11 (3) Shallow but large cave on north end of collapse structure (CS). Cave ceiling height is to 30 feet, width is to 40 feet, and length is 150 feet. Cave displays ice stalagmites in Spring of some years as photo shows. Access code is #1. Sensitivity code is #1.
- LC-12 (1) This CS contains Alton Lindsey Cave. CS is 150 feet by 100 feet and up to 50 feet in depth. Alton Lindsey Cave is situated on the West side of the CS.
- LC-13 (1) The entrance to Alton Lindsey Cave supports a rich colony of moss and liverworts, some of which are extremely rare and may be endangered. Sensitivity codes for this cave are #2 and #3.
- LC-14 (2) The nest and eggs of songbird nicknamed "the ice cave bird" because of its being found only in association with large ice or cold (less than 40 degrees) caves. It is believed this bird is Empidonax hammondi or Hammond's Flycatcher (please see "Reconnaissance of Biota" in this report.
- A massive ice chute lies immediately below nest and air temperature at nest was recorded at 42 degrees on 7-3-88.
- LC-15 (6) A massive ice chute 35 feet in length initially slopes into Alton Lindsey Cave at a maximum angle of 60 degrees (see Photos A, B, and C) . The cave entrance height is 3 feet or less but entrance width is 15 feet. At the terminus of the ice chute, the

cave floor rises 4 feet into a chamber with a ceiling 30 feet in height, 40 feet in length, and 50 feet in length. This chamber at times in the spring of the year serves as host to ice stalagmites of considerable beauty and startling size (see Photo D and E). Ice stalagmites up to 10 feet in height with widths of up to one foot have been observed. This phenomena is apparently restricted (?) to late winter and spring, and cannot be counted on to occur in any given year.

A second chamber is present to the left at a bearing of 140 degrees that is nearly as large as the first chamber. Total cave length is 130 feet.

Massive ash deposits with pottery sherds in them are present on the left side of the cave entrance (please see Cave Management Recommendations for more information on Alton Lindsey Cave). Cave access code is #4.

- LC-16 (1) Ice stalagmite in Alton Lindsey Cave.
- LC-17 (1) Broken Rock CS with Broken Rock Cave on north side.
- LC-18 (1) Entrance to Broken Rock Cave. Cave chokes down to a boulder-strewn squeeze that requires climbing large rocks. Length is 100 feet. Cave leads to Dripping Lava C.S.
- LC-19 (1) Archeological site in LC-17.
- LC-20 (1) Dripping Lava Cave CS.
- LC-21 (2) Trail into Dripping Lava Cave.
- LC-22 (5) Entrance to Dripping Lava Cave, which requires climbing 6 feet down a log ladder. Access code is #3.
- LC-23 (17) Dripping Lava Ice Cave is one of El Malpais' best examples of a large lava tube. Although access is constricted by large boulders and requires a ladder to negotiate a 6 foot boulder drop, the first 500 feet of the cave is as large as any lava tube in El Malpais with heights up to 70 feet from

floor to ceiling and widths of up to 50 feet. The 70 foot height is achieved by an impressive lava dome in the ceiling of the cave and approximately 100 feet north of the cave entrance.

300 feet into the cave is a perennial ice pond with dimensions of 20 feet by 30 feet (see Photos A, B, and C).

The cave floor is generally very broken and visitors must frequently climb and descend ceiling breakdown, as Photos D and E attest. Note the visitors climbing the breakdown in E.

That Dripping Lava Ice Cave is large is driven home by Photo F; again, note the visitors climbing the breakdown. Also note beautiful coloration of cave ceiling; this is easy to miss when visiting the cave.

Dripping Lava Cave received its name from the formations in Photos G and H.

The cave constricts down to a 15 foot high ceiling (or less) and 20 foot wide widths toward its terminus at a length of 1,200 feet (see Photos I, J, and K; Photo K is of the cave's terminus).

A constricted crawl is present to the left of the rubble plug that forms the terminus. This is a rock rubble cave which is unstable and unsafe for exploration (Access code 6).. Buz Hummel, a caver with of all but unmatched experience, was trapped in this crawl when a rock fell on his helmet in 1981. The rock pinned down his head until it could be moved 15 minutes later. This crawl should be closed to the public.

Also, please see Cave Management Recommendations.

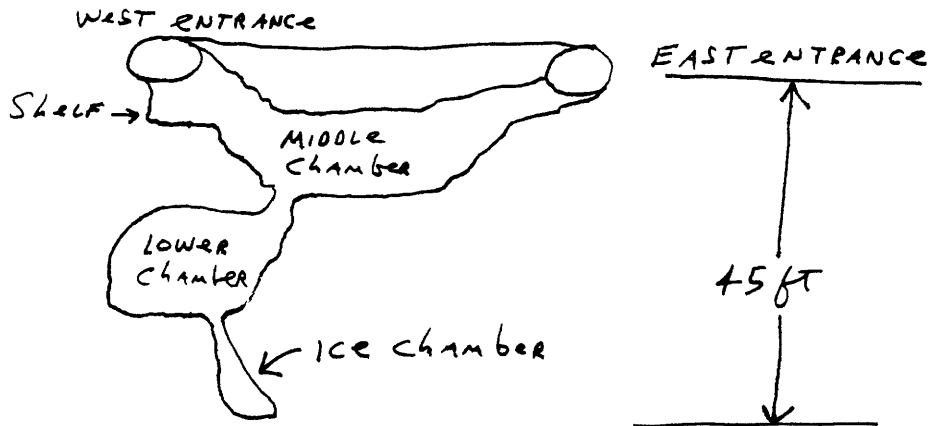
- LC-24 (1) Bandera associated aa lava flow that covered the lava crater tube (including part of Dripping Lava Cave).
- LC-25 (1) Roof of intact lava tube with projected source of Lava Crater.

- LC-26 (1) Subsidence Collapse of tube with aspens growing in bottom 2 1/2 miles north and east of Lava Crater.
- LC-27 (1) Aspens in floor of collapsed tube.
- LC-28 (1) Aspen on south rim of tube.
- LC-29 (1) Aspens and Ponderosa pine in floor of subsided tube.
- LC-30 (1) Subsidence collapse of tube; averages 30 feet in depth and 50 feet in width.
- LC-31 (1) Park-like floor of subsided tube; could also be roof of cave.
- LC-32 (1) Subsidence collapse of tube from north rim.
- LC-33 (1) Aspens in floor of collapsed tube.
- LC-34 (1) Collapsed tube from south rim.
- LC-35 (1) A cave-bridge is located on south side of the Lava Crater tube.
- LC-36 (2) Note that east side of cave has rock wall structure placed along entrance. Bearing looking into a through cave is 295 degrees T. Ceiling is up to 15 feet in height; width is up to 30 feet. Cave length is 100 feet. Much burned wood is present in the cave and rocks have been placed to create primitive walls in several places inside the cave. Access code is #1.
- LC-37 (1) West entrance (exit) to cave-bridge.
- LC-38 (1) A large Ponderosa pine growing in the floor of the lava tube. As with other tube systems, the presence of more mesic species and conspicuously larger individual specimens of area-typical species occur in direct association with the tube system. Douglas fir and Aspen are found in this area only in or on the tube system and large specimens of Ponderosa pine such as this one also occur only on the tube floor or along the rim.

- LC-39 (1) Collapsed lava tube.
- LC-40 (1) Ponderosa pine in floor of collapsed tube.
- LC-41 (1) The Lava Crater system displays a parallel tube configuration on at least one site on the system.
- LC-42 (1) Small caves on north side of collapsed tube. Entrance to larger cave is 4 by 8 feet. Cave is 25 feet in length and 35 feet in width. Ceiling is 10 feet. Undistinguished cave. Access code is #3.
- LC-43 (2) Short and undistinguished cave of similar dimension to above, except entrance is 3 by 3 feet. Access code is #3.
- LC-44 (1) Located large pottery sherds near LC-42 (utility ware). Relocated out of weather but within view.
- LC-45 (1) Floor of collapsed lava tube.
- LC-46 (1) View of entrance of Hidden Ice Cave across collapsed tube.
- LC-47 (1) Entrance to Hidden Ice Cave; the shelf person is standing on may be an archeological site. The entrance (from which the photo was taken) is 5 feet in height and 10 feet wide. Cave drops to 15 feet to shelf. A second level is present immediately east and 15 feet below the shelf. It has a 15 foot high ceiling and is 15 by 20 feet. A third level is reached by climbing down another 15 feet to the lowest cave level. The ceiling of the lower chamber is up to 25 feet in height. Width is 30 feet and length 40 feet. A side chamber is present on the south. Much recent debris in cave. Access code is #3.
- LC-48 (3) The south side chamber possesses ice and the presence of an ice ring around the walls of the chamber indicates the ice was once 3 to 4 feet deep (see photo of person kneeling beside ice ring and of ice on rock wall). Air temperature in chamber was 32 degrees on

8-29-88. Ice level of this cave has dramatically fallen in recent past. Burned wood and small lava rocks mixed in with ice. Chamber size is 20 feet in length, 10 feet in height, and 2 to 8 feet wide. Cave possesses small ice crystal formations.

Schematic drawing of Hidden Ice Cave.



- LC-49 (1) East entrance to Hidden Ice Cave.
- LC-50 (3) Collapsed lava tube.
- LC-51 (2) Chamber Cave has an extremely small entrance (1 1/2 by 2 feet). Access code is #3.
- LC-52 (2) Interior of Chamber Cave had an air temperature of 39 degrees F on 8-29-88. This is a rubble-filled chamber 40 feet in width, 20 feet in length, and with a ceiling of 15 feet. Old wood torch in cave. Silver formations present. Large bones present. Size is 20 feet in length by 30 feet in width with ceiling up to 10 feet in height. Located black on red pottery sherds in the cave.
- LC-53 (3) Collapsed tube displays meadow-like floor to the east of Hidden Ice Cave.
- LC-54 (3) Collapsed lava tube on eastern edge of Ice Caves Quadrangle.

El Caulderon  
Lava Tube System

General Description

The source of this system is El Caulderon, a cinder cone that rises 300 feet above the surrounding landscape. The crater of El Caulderon is up to 900 feet in diameter and 250 feet deep. The crater was breached on the east by lava (bearing 65 degrees T). The breach opens into a canyon-like open channel filled with rubble. Hatheway and Herring (1970) report that this portion of the tube system probably never formed a covered tube but rather conducted lava to three lava tubes lying lower down slope.

The open channel structures are up to 150 feet in width and up to 60 feet deep. There are at least two (2) open channels lying side by side both of which trend east and north. The north channel is the larger and it appears connected to the south channel by an interconnecting channel.

The open channels extend 1/4 mile to the east and north of the crater before progressing into a series of extremely sinuous collapse structures that branch north and east into three separate tube systems.

Those portions of the El Caulderon tube near the crater and the open channels tend to be collapsed (although intact portions are present). The much of the north branch tube has been covered by the Candelaria flow; however, two lengthy cave segments are present. The east branch tubes tend to be intact with impressively large sinks and (relatively) long cave sections.

Collapses on this system occurred in three forms: straight-sided open channels; shorter pits which are often oval in shape; and circular holes in the roofs of otherwise intact tubes. The literature does not mention the collapse structures and caves lying immediately east of Caulderon Bat Cave, and only Maxwell mentions those lying south of the bat cave.

The caves and sinks of El Caulderon are among the finest that occur in the National Monument outside of the Bandera Tube System. Given this fact and the system's proximity to State Highway 53, El Caulderon and its tubes are believed highly suitable for intensive use development (please see "Management Recommendation Report").

Map/Photo Code: EC

- EC-1     (1)     View into crater from the north rim.
- EC-2     (1)     View across northwest shoulder of crater toward Cerritos de Jaspe.

- EC-3 (1) View from southwest rim toward Cerritos de Jaspe.
- EC-4 (1) View from south rim.
- EC-5 (1) Looking toward the breach of El Caulderon Crater.
- EC-6 (4) The floor of the open channels that once drained lava from El Caulderon Crater.
- EC-7 (2) The open channel running east from El Caulderon.
- EC-8 (1) The open channel further down slope from El Caulderon.
- EC-9 (1) Close-up of open channel wall.
- EC-10 (2) Looking down the north channel from the east shoulder of El Caulderon.
- EC-11 (3) Looking down the South open channel.
- EC-12 (1) Interconnecting open channel that unites the north and south channels.
- EC-13 (9) Walled archeological site located in bottom of small collapse structure subsidiary to Big Park C.S. Note the unusually elaborate construction of this structure. Also the recent litter in Photos C.
- EC-14 (2) Wide park-like collapse structure in advanced state of ecological succession; name assigned is Big Park C.S.
- EC-15 (1) Looking east from rim of EC-14 collapse structure.
- EC-16 (1) Walled Structure C.S. is a subsidence collapse of El Caulderon tube. It lies north of Big Park CS. Note sinuous curves of C.S. on map. Access code is #2.
- EC-17 (1) Walled structure concentration lying on west shoulder of Walled Structure C.S.
- EC-18 (2) Possible collapsed entrance to ice cave; air temperature of wind exiting small hole 40 degrees on 8-25-88 at 11:10 AM on 88 degree day; much moss on collapse structure floor (sensitivity code #1).

- EC-19 (1) Trail Spring site. It is believed fed by melting ice water (water temperature in sun on 8-25-88 at 11:15 AM 42 degrees).
- EC-20 (3) Constructed trail leading from EC-17 walled structures to spring. Pottery sherds in trail. Also much historic debris. Access code is #1.
- EC-21 (1) View from rim of Walled Structure C.S.
- EC-22 (1) On rim of Walled Structure C.S. looking back on site of EC-17 walled structure.
- EC-23 (1) View from rim of Walled Structure C.S. where it makes its big turn to the west.
- EC-24 (2) Recently turned over rocks near site EC-25; rock cairns present also.
- EC-25 (1) Walled structure in floor of Walled Structure C.S.; small cave opening flowing cold air (45 degrees) on north side of structure.
- EC-26 omit
- EC-27 (1) Turquoise Cave is situated on the north rim of Walled Structure C.S.; cave is rubble-filled. Cairn present inside. Also animal bones. Air temperature was 46 degrees F (8/30/88) in lower section (used as refrigerator?) Depth to cave bottom 40 plus feet. Entrance is 2 feet by 2 feet. Ceiling is 3 feet to 15 feet. Cave width varies from 2 feet at entrance to 30 feet. Access code is #3. PLEASE NOTE: Small turquoise fragments are imbedded in the lava rock above the entrance to this cave.
- EC-28 (1) Looking down a Aspen C.S. from north.
- EC-29 (1) Aspen grove in floor of Aspen C.S. Site EC-30 (below) is located in this grove.
- EC-30 (3) Walled structure located 100 yards to north of EC-17 walled structure concentration.
- EC- 31 (1) View down Aspen C.S. from north.

- EC-32 (1) Rock choked ice cave with extremely tight entrance lies in this C.S. Air temperature in entrance on 8-26-88 (88 degree F day) was 35 degrees; with jacket on, became chilled trying to gain entry to cave. This is a rubble cave with much loose rock. No ice immediately visible but is very close to the surface. It is possible the cave could be opened. Free water is close also; mosquitoes active.
- EC-33 (1) Walled structure in floor of collapsed tube just north of rock choked ice cave EC-32. Much rock moving in this area; also sandstone on site. Amazing number of cans in this area.
- EC-34 (1) Second rock choked ice cave lies to north of EC-32. Air temperature is 38 degrees. Could not enter. Primitive walled structure EC-33 nearby.
- EC-35 (1) Looking down on site of EC-34 from vegetated bridge crossing collapsed tube.
- EC-36 (2) Constructed trail down north side of Sherd Spring C.S. to another ice water spring. Sherds in trail.
- EC-37 (2) Sherd Spring. Ice water spring with water temperature in sun of 40 degrees on 8-26-88 (air temperature 70 degrees at 8:50 AM on 8/26/88). Pottery sherds present. Much historic metal debris also. Rocks turned over recently. Temperature of rocks immediately east of spring 45 degrees. Ice very close to surface here.
- EC-38 (3) Four walled structures are present beside and above spring site. Sherds concentrated in two piles immediately west of spring. Signs of recent digging in floors of all structures. Sherds very plentiful; also sandstone. Believe this is an important site.
- EC-39 (4) Photos of sherds. Note sherd variety.
- EC-40 (1) Historic trash dump (30-50 years old).
- EC-41 (1) View of sites EC-36, 37, 38, 39 from north rim of Sherd Spring C.S.
- EC-42 (2) Large circular walled structure immediately to east of Sherd Spring.

- EC-43 (3) Smaller, more primitive walled structure with large tree growing in it located immediately to west of EC-42. Sherd found in wall -- utility ware and burned. Floor is covered with plant debris.
- EC-44 (2) Recent digging in bottom of small collapse structure; presumably vandal looking for hidden cave entrance.
- EC-45 (5) Guano Cave is present on north end of Dead Timber CS. Entrance height is maximum of 4 feet; entrance width is 20 feet. Bearing looking in is 110 degrees. Length is 270 feet. Ceiling up to 30 feet. Width up to 30 feet. Air temperature in cave is 66 degrees. Guano present but no bats in evidence. Animal scat present; also fine dust from shallow guano deposits. Beer cans in cave. Many overturned rocks and much digging. Large animal bones present. Sandstone (flagstones) present at entrance and in cave. Cave has distinctive odor; guano-like. Check to see if any bat species depart this section of NM prior to 8-27-88. Burned wood in cave. Access code is #3.
- EC-46 (1) View of Dead Timber C.S. from north to south.
- EC-47 (3) Dead Timber Cave present on south end of Dead Timber C.S. Entrance is rubble filled and 5 feet by 15 feet. Bearing in is 240 degrees. Cave length is 75 feet. Did not continue to cave terminus. Tight squeeze and alone. Burned wood in cave. Cave descends from lip of inner CS 20 feet, then rises 15 feet and falls again 10 feet. Cave temperature at entrance was 64 degrees but cooled rapidly to 41 degrees at back of cave. Cave ceiling height is up to 12 feet but more typically 6 feet. Width is up to 15 feet. Access code is #3.
- EC-48 (2) Walled structure (?) in next (shallow) CS down (north) of Dead Timber C.S. Filled in and old (?)
- EC-49 (3) Anasazi Sinks. Two impressive sinks lie immediately north of EC-48 site. Technical access only (Access code #4). Dimensions of south sink is 25 feet by 30 feet with a depth is up to 60 feet. A bridge connects this sink with a much larger one immediately to the north.

- EC-50 (3) Anasazi Sinks. Second sink lies 50 feet to the north of first. Access code is also #4. Diameter of this sink is much larger -- 90 feet. Depth is up to 60 feet. Sink is impressive. Consideration should be given to developing the site for intensive visitor use by installing a spiral ladder down to the floor of the first sink and a trail through the bridge to the second and larger sink. Would be quite impressive to enter these sinks.
- Old tire thrown into sink.
- Did not enter sinks. Caves are reported on north and south ends but both quickly choke off.
- Sensitivity code is #1.
- EC-51 (1) View from the north rim of the north sink to an adjacent C.S.
- EC-52 (6) Sandstone Cave is situated on the west end of Brushy C.S. Note lush vegetation on floor of CS; blocks sight of cave entrance. Cave located 30 feet below rim of CS. Length is 20 feet and width 30 feet. Ceiling slopes from 10 feet to 0 feet within the 20 foot length. Possible habitation site. Beer cans in cave. More non-indigenous (sandstone and other types) than ANY cave located during inventory. Bearing looking out of cave is 100 degrees. Access code is #2.
- EC-53 (1) View of Brushy CS from floor; Note rock.
- EC-54 (3) Views of Brushy CS; note moss growing in rocks in Photo C.
- EC-55 (3) Overturned rocks in CS and on adjacent site.
- EC-56 ( ) Junction Caves (which include adjacent EC-57) form one of the lengthiest lava tunnels on the El Caulderon System and one of the lengthiest in El Malpais. Total cave length (EC-56 and EC-57) is estimated at 3,000 feet. Bearing into EC-56 is 250 degrees. The cave tends to be of modest dimensions -- 15 foot ceilings and 20 foot widths. However, its location and proximity to Highway 53, the Anasazi Sinks, and Caulderon Bat Cave make it a prime candidate for intensive visitor use. Lithic

materials and pot sherds are present on the lip of the CS and at the entrance. Access Code is #1. Note: this El Caulderon Tube System is not connected to El Caulderon Crater in any discernable way. Causey (1971) suggests that either "the lava did not flow through a tube in the intervening area or that section of the tube was plugged."

EC-57 ( ) Junction Caves -- see EC-56 above. Bearing into EC-57 is 125 degrees.

EC-58 ( ) Caulderon Bat Cave. This cave serves as a warm weather site for a Mexican freetail bat (Tadarida brasiliensis mexicana) colony. Population is estimated at 50,000 or more. The bearing looking into Caulderon Bat Cave is 100 degrees. Cave dimensions are slightly larger than those of EC 56, 57. Ceiling height is up to 20 feet and widths up to to 25 feet. Guano lines remain on the walls of the cave. They suggest that prior to mining in the early '50's, this cave possessed guano deposits over 6 feet in depth. Cave length (together with EC-59 or Ghost Face Cave, below) is 2,600 feet (according to Causey). This is an impressive cave length for a lava tube. Air temperature in cave is warm for El Malpais -- 67 degrees on August 28.

Caulderon Bat Cave should be closed to the public.

Dr. Alton Lindsey reports this cave supported two to three million Tadarida prior to mining disturbance. Closure of the cave to the public possibly could restore the pre-disturbance population within the foreseeable future.

EC-59 ( ) Ghost Face Cave. Despite its close relationship to Caulderon Bat Cave, this is a colder cave by 21 degrees. Air temperature was 46 degrees on August 28. Cave dimensions are similar to Caulderon Bat Cave. The difference in air temperature is probably due to the presence of ice toward the western terminus of the cave. Ice caves and two ice water springs are known to exist on the El Caulderon tube system just west of the terminus of Ghost Face Cave. This cave has beautiful lava stalagmite and related formations.

If entry to Ghost Face Cave can be determined not to disturb the Tadarida colony in the adjacent Caulderon Bat Cave, this cave would be highly suitable for intensive use development. The cave is lengthy, of moderate size, and possesses outstanding lava formations.

## TWIN CRATERS

### Lava Tube System

#### General Description

Hatheway and Herring (1970) identify the Twin Craters lava flow as the oldest in their study area. Given the advanced state of ecological succession of the Twin Craters tube system, there can be little question but that the flow is not of recent origin. Indeed, although Hatheway and Herring indicate an exposed tube length of 7 kilometers (4.35 miles), most of this length is difficult to identify on the ground. The reason is the lack of collapse structures (CS) on the Twin Craters System. As Hatheway and Herring state, "Open collapse pits along the tube are rare, as most fractures are plastic, with a gradual surficial sag over the tube line." This translates into a tube system that is decidedly unspectacular -- at least when compared to a system such as Bandera or even El Cauldron. Caves -- so far as is known at this time -- are uncommon and those that do occur are less than dramatic.

The source of the tube system is Twin Craters, which is actually a cinder cone with three (rather than two) craters. The most prominent of these is the northernmost, which is 750 feet in width and nearly 200 feet in depth. The southern two craters are far less prominent with widths of 300 feet and depths of only 100 feet.

One final note on this tube system: although Hatheway and Herring map the tube system boldly from the craters south to and across the Bandera tube system, this mapping, in the judgment of the consultant, is hypothetical, especially immediately south of Twin Craters. Indeed, NPS aerial photographs suggest that this tube system could have originated from a source to the west and north of Twin Craters. That this tube system is not a cut and dried issue is supported by Maxwell's mapping of only those portions of the system that possess readily identifiable lava tube features. For this reason -- and because of inventory time constraints -- only those portions of the Twin Craters Tube System mapped by Maxwell were investigated on the ground.

#### Map/Photo Code: TW

- |      |     |                                                                                  |
|------|-----|----------------------------------------------------------------------------------|
| TW-1 | (1) | View of Twin Craters, the source of the Twin Craters lava tube system.           |
| TW-2 | (1) | A view of the "surficial sag" so common to much of the Twin Craters tube system. |

- TW-3 (5) Big Tree CS is a large CS for the Twin Crater System. It measures 150 feet in length, 75 feet in width, and 15 to 30 feet in depth. The age of this tube system is suggested by considerable organic litter buildup, soil development, and large trees encountered in Big Tree CS (see Photos D and E). Although the Bandera tube system possesses several CS's with similar conditions immediately south of Zuni Cave, in the case of Twin Craters the reason is believed to be system age rather than the site specific enhancement produced by the presence of ice close to the surface as with Bandera. Access code is #2. Sensitivity code is #1.
- TW-4 (4) Lonesome Bat Cave is present on the south end of Big Tree CS. Bearing in is 275 degrees. Ceiling height is up to 20 feet but 10 to 12 feet is more typical. Width is up to 30 feet. Cave is soon constricted by breakdown that reduces access to a crawl situation. Cave turns to 320 degrees then to 180 degrees. Length is 250 feet with most of this length a crawl through breakdown passages 3 by 4 feet in size with some as little as 1 by 2. Access code is #3 and #5.
- Photo D is of cave exit on south.
- TW-5 (2) The north end of Big Tree CS is choked closed. Note the upturned slabs of pahoehoe standing on end in Photos A and B; purpose is unknown. Also note the pressure ridge-like bulging of the floor, especially in Photo B.
- TW-6 (1) Two minor leads are present on the east side of Big Tree CS which terminate in chambers 20 by 15 by 6 feet and 8 by 15 by 6 feet respectively. Photo is of entrance to the first. Access code is #5.
- TW-7 (3) Open Sky Cave is a technical access cave is situated 150 feet east and south of Big Tree CS. Note pole ladders in cave. Cave was not entered; however roof collapse is 30 feet by 15 feet and depth is up to 35 feet. Cave width is up to 30 feet with ceiling height to 20 feet. Length was not determined.

TW-8 (2) Numerous tight leads and small caves are present immediately west of Open Sky Cave and south of Big Tree C.S. Many are cold (40 degrees). However, none proved of consequence.

TW-9 (3) Lava Arch. This natural bridge has a much thicker pahoehoe roof than do most bridges on the Bandera system. Bridge ceiling height is up to 20 feet but averages 15 feet; width is 50 feet (see Photos B).

The thickness of the roof of Lava Arch suggests why a shallow "surficial sag" may be so typical of this system: a tube collapse characterized by a roof no less thick than the height of the lava tube itself would not likely produce the spectacular collapse structures so characteristic of the Bandera System but would rather produce the minor subsidence of the ground surface so common to this system.

Access code is #2.

TW-10 (4) Lava Arch C.S. is bisected by Lava Arch. It is 300 feet in length and up to 100 feet in width. Depth is to 40 feet. Photo B is from the roof of the arch looking north; Photo C is from the roof of the arch looking south.

TW-11 (4) Boulder Plug Cave is a short cave with an inconspicuous entrance. It is located on the north end of Lava Arch C.S. (and north of Lava Arch) on the east wall. Entrance opens into a chamber with a domed ceiling up to 30 feet in height; width is up to 30 feet. Bearing in is 45 degrees. Cave turns south (160 degrees) and west, exiting into Lava Arch CS (south of the Arch). Must climb lava wall 12 feet high (see Photo B) in cave. Boulder Plug Cave is rubble filled from the high wall to its terminus and requires crawl to exit. Photo C is view of the boulder plug for which the cave is named. Cave length is 90 feet.

Access code is a #3.

TW-12 (4) Ice Pool Cave is located on the south end of Lava Arch CS. Entrance is small and inconspicuous (see Photos A and B). Opens into a chamber 10 feet in

height and 20 feet in width with ice and free water in bottom. Ice water pool is 2 by 2 feet; water temperature 34 degrees. Water is underlaid by ice. Burned wood in cave. Silver (water droplet-calcium-carbonate) formations in cave, especially near ice chamber (see Photo D).

Access code is #3. Sensitivity code is #1.

TW-13 (3) Shallow collapse structures such as this one are common south of Lava Arch and CS. Characterized by small cave leads, they are often cold and choked with rubble. Micro habitats characterized by moss carpets are common (Photo B).

Sensitivity code is #1.

TW-14 (1) The land surface is characterized by a subsidence sag (as opposed to a subsidence collapse) on much of the Twin Craters tube system.

TW-15 (1) The roof of the Twin Craters Tube is also frequently evident from an almost perfectly smooth but slightly sagging pahoehoe surface at ground level.

TW-16 (1) Surficial sagging of the ground surface; note that tree species here are Douglas Fir and Rocky Mountain Juniper. These species occur in this part of the Twin Crater flow only atop the tube system.

TW-17 (2) The surface of the Twin Craters pahoehoe flow surface, to a greater degree than any other flow, is almost perfectly smooth. Effect is to create park-like landscape.

TW-18 (1) Fawn found dead on 9-13-88. Encounter is mentioned because gunshots were heard coming from this general area two days previously. The fawn appeared to be two days dead.

TW-19 (2) Pot Hunter Turnpike Cave. The jeep trail access into the southern portion of the Twin Craters System (and much of the Bandera System as well) crosses over the Twin Crater tube system. Pot Hunter Turnpike Cave is actually an overhang 30 feet in depth, 25 feet in

width, and 15 feet in height. Note thickness of cave roof. Bearing into cave is 355 degrees. Access code is #2.

- TW-20 (2) The tube system south of Pot Hunter Turnpike Cave is characterized by subsidence collapse features. Note the parallel fracture in front of person (Photo A) and in the foreground (Photo B).
- TW-21 (1) Subsidence CS, which includes TW-20 above, is 800 feet in length, 50 to 100 feet in width, and 20 to 40 feet in depth.
- TW-22 (2) Note massive parallel fracturing of pahoehoe margins of this CS, especially in Photo B.
- TW-23 (2) The lava ledge in this view is believed to be the rim of the Twin Craters tube.
- TW-24 (1) The subsidence feature in this photo is one of the most spectacular in the National Monument.
- TW-25 (3) As the Twin Craters tube moves south, it again becomes amorphous.
- TW-26 (3) A small lava bridge is present on the west side of Subsidence CS. Length of bridge is 15 feet, height 7 feet, and width to 20 feet. Photo C provides a wide view.
- Access code is #1.
- TW-27 (2) Deer Bones Cave is a surface cave in a subsidiary tube (see Photo A) with a ceiling height of up to 12 feet, a width of 25 feet, and a length of 35 feet. The name is derived from a deer skeleton in the cave (see Photo B). Bearing into cave is 165 degrees True.
- Access code is #2.
- TW-28 (6) Lava Plug Cave is situated in a near surface portion of the Twin Craters tube. This cave is not conspicuous except for one reason: it possesses the finest example of a lava plug in El Malpais (at least the finest of which the consultant is aware). Bearing into cave is 40 degrees.

Cave ceiling height is up to 15 feet; width is up to 20 feet; length is 100 feet. Cave is not easy of access because of a tight scramble over breakdown. Access code is #3.

Name is derived from a tongue of lava that long ago sealed the cave closed (Photos B). This lava rock feature is spectacular.

- TW-29 (1) Numerous small cave leads, some very cold, are present on this portion of the Twin Craters tube system. Almost all are decidedly unlike Lava Plug Cave; they are undistinguished at best.
- TW-30 (1) The tube system is a tangle of jumbled rock to the north of Lava Plug Cave.
- TW-31 (2) Jumbled CS is shallow and inconspicuous. Length, however, is 800 feet and width up to 150 feet. Depth is 10 to 30 feet.

**RENDIJA**  
**Lava Tube System**

**General Description**

Cerro Rendija is a small shield volcano two miles in diameter that rises 500 feet above the surrounding landscape. Cerro Rendija is multi-cratered and, as is typical of shield volcanoes, erupted repeatedly. Hatheway and Herring (1970) believe the most recent eruption(s) produced the lava tube system lying to the east of the volcano and it is this system that was included in this inventory.

Hatheway and Herring mapped a single lava tube running from the northeast summit of Rendija south and east for a distance of approximately 4.5 miles. However, this inventory discovered an ice cave in a second Rendija tube system running nearly due east and under the western margin of the Bandera flow.

The Rendija tube systems are, so far as is known to date, not rich in caves. However, those that do occur are often either of considerable interest or among El Malpais' most significant lava tube features.

Map/Photo Code: R

R-1 (9) Rendija Ice Cave. The discovery of this cave was due to the presence of a half-moon shaped walled structure near its entrance. The consultant had long since learned that these archeological sites have a strong tendency to be associated with ice caves (and to a lesser degree with big, beautiful caves such as Four Window Cave). Although the small cave entrance was not on a lava tube system, he entered the cave to discover, if not a major ice cave, at least one that is significant.

The bearing into Rendija Ice Cave is 90 degrees T. The cave is broken into two sections: the outer chamber, a rubble strewn room 30 feet in length by 30 feet in width; and an inner room.

The inner room is 50 feet in length and 20 feet in width. Ceiling height varies from 5 feet to 0. Surprisingly, the floor is dirt fill -- and ice (see Photo A, B, and C). The ice deposits are situated on the north and

south margins of the floor in frozen ponds 15 feet long and 3 to 4 feet in width. It is entirely possible that the cave's floor is entirely composed of ice and that the dirt fill merely sits atop it in the middle (note how dirt fill mounds toward the center of the cave in Photo A.

That this cave was utilized as a water source is evident from the discovery of a mat woven from native plant materials (see Photos D, E, F, G, and H), part of which remains frozen in the ice.

Access code is #3. Sensitivity code is #3.

- R-2 (1) The inconspicuous walled structure responsible for the discovery of Rendija Ice Cave.
- R-3 (4) The Rendija Ice Cave is situated on the east end of the last CS on a small, inconspicuous tube system running east off of Cerro Rendija. That portion of this tube system which could be discerned from the aerial photographs was mapped on Map B.
- R-4 (1) Rendija Ice Cave and its tube system is flanked on the north by a massive wall of lava 60 to 70 vertical feet in height.
- R-5 (5) A complex of circular walled structures is situated 100 to 150 yards South of Rendija Ice Cave. Whether these archeological sites are associated with this ice cave or with a cave that has yet to be discovered is uncertain.
- R-6 (3) If an ice cave other than Rendija Ice is related to sites R-5 above, it is probably located on this fracture (fissure?) Although the fracture was investigated with negative results, the search was conducted with the haste necessary for this inventory. The fracture (fissure?) zone should be worked with considerable deliberation; the consultant feels certain an ice cave is present if it (or was; one which has subsequently been closed by rockfall or related debris). See Photos B and C especially; C is interior view looking out of fracture.

Access code is #3. Sensitivity code is #1.

- R-7 (1) Fracture Ice Cave. This is another fracture (fissure) believed to be associated with Cerro Rendija. Note imprint of fracture running east toward Cerro Rendija from cave opening. Cave entrance is 1 1/2 by 3 feet. Fracture depth is a near vertical 50 feet. At bottom is an ice pond that chokes the cave closed (Thanks to Paul Granone, Sandia Grotto for revealing this cave).
- R-8 (3) Cairn Cave is present immediately to the east of Fracture Ice Cave, this one 40 feet deep. (Thanks to Paul Granone, Sandia Grotto, for revealing this cave).
- R-9 (3) The summit of Cerro Rendija (Photo A and B) and a view from the summit (Photo C).
- R-10 (1) Ecological succession is far advanced in this Rendija CS, which now is little more than a small valley-like depression 400 feet in length, 200 feet in width and 30 feet in depth.
- R-11 (1) Another CS on the Rendija tube filled in and covered over by the process of ecological succession. Dimensions are 200 feet by 100 feet by 20 feet.
- R-12 (3) This CS remains immediately recognizable for what it is; however, caves were not located. Depth is 60 feet, length 400 feet and width 300 feet.
- R-13 (1) A 50 foot deep CS devoid of vegetation and caves. Length is 150 feet and width is 100 feet.
- R-14 (1) Park-like CS on the Rendija Tube System. Dimensions are 150 feet by 100 feet by 20 feet.
- R-15 (6) Fern Sink. This is El Malpais' most impressive circular sink. Diameter is 100 feet and depth is to 75 feet. Note in Photo A the dramatic roof overhang on the sink's northwest corner. Photo B is a view of Fern Sink from the north; note cave entrance.

Fern Sink is reported to have two ice caves, one on the north and one on the south. One of these caves is rumored to have been used as a water source by loggers when the Rendija area was logged in the 1940's. Whether this is true or not is uncertain; however, a close look at the foreground of Photo A will reveal the tip of a very stout tree pole in the foreground. The pole extends 4 feet over the edge of the sink and appears to have been utilized as a support for entering or exiting the sink.

Fern Sink was not entered during the inventory.

The collapsed roof of the cave on the north facing portion of the floor provides habitat for a moss carpet and bracken ferns two or more feet in height. Much ninebark on collapsed roof.

Access code is #4. Sensitivity code #1.

- R-16 (3) Roadside CS is a small collapse structure 250 feet north of the 4x4 road into Little Hole in the Wall. Length is 50 feet and width is 30 feet. Depth is up to 30 feet. View A is from the south; view B is from the north. A beautiful overhang is present on the north side (see Photo C).
- R-17 (2) Entrance Ice Cave is situated on the south side of Roadside CS. Bearing in is 165 degrees. Cave entrance is opening 8 feet in width and 5 feet in height. Cave opens into a chamber 20 feet in height, 20 feet in width, and 100 feet in length. Choked by rubble. Interestingly, this cave ice is not at or near the terminus; nor is it situated on the walls of the cave. The ice rather lies under the entrance in the breakdown pile. Visible ice mass is not large and is easily missed.
- R-18 (1) A small walled archeological site is present above Entrance Ice Cave on the West wall. Someone had dug in the floor of the site and exposed these pottery sherds; note also sandstone.
- R-19 (3) Lava Rim CS is conspicuously elevated above the surrounding ground level. The floor of the CS is filled with wind blown silt/sand and decaying organic matter, which creates a micro habitat for aspens in the north facing corner of the CS.
- R-20 (3) Lava Tube Ridge. This 40 foot high lava ridge is a curious feature in that it appears that only a single wall of the tube survived at the site.

**HOYA DE CIBOLA  
Lava Tube System**

**General description**

Hoya de Cibola is an extremely large subsidence pit that Hatheway and Herring (1970) believe is similar in origination to the Hoya de Infierno and Hoya de Diablo pits on the Bandera Lava Tube System. On the other hand, Causey (1971) believes Hoya de Cibola to be a large fissure. Because lava tubes radiate north, south, and east from Hoya de Cibola, Causey's explanation appears to hold considerable merit. However, if this structure is indeed a fissure, it was gargantuan in size.

Prior to this inventory, Hoya de Cibola was believed to be a minor lava tube system. This is no longer the assessment. Although this system cannot compare to the world class Bandera System, Hoya de Cibola's caves are often of surprising size and length as well as of exquisite beauty. Further, aerial photographs suggest that much additional work needs to be performed on this system. This assessment was confirmed when a Sandia Grotto member informed the consultant that Braided Cave -- a cave lying east of Furniture Cave -- may be 4,000 feet in length with a single 2,500 foot segment of dark cave.

Map/Photo Code: H

H-1 (20) Furniture Cave. This is a beautiful cave, also an unusual one. It has been stocked with furniture and utilized as a camp in recent years by persons unknown. The cave is located at the northeast end of a sheer walled CS that is 200 feet long, 50 feet wide, and up to 30 feet deep.

The bearing into the cave is 90 degrees T. Ceiling height ranges up to 20 feet and width to 25 feet. Length is 250 feet. Photo A is a view of the entrance.

Furniture Cave has two small skylight windows (size 1 by 2 feet and 4 by 8 feet) which can be viewed in Photos B and C respectively.

Much of Furniture Cave possesses smooth subway tunnel-like ceiling and walls (see Photo D).

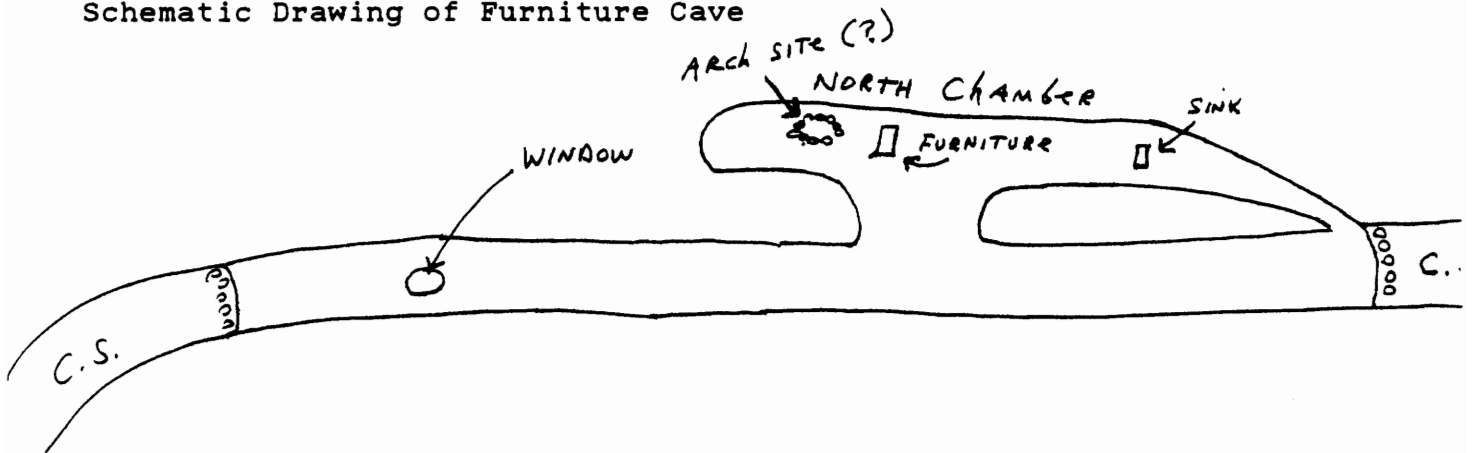
The name of the cave is derived from the furniture in the north chamber of the cave

(see Photos F through H). Apparently, Furniture Cave served as a hunting camp, pot hunter base camp, or both for some time. The presence of an open but not empty bottle of gin suggests the cave may still be in use. However, though the bed has sheets on it, it is filthy and would prove repulsive to any but most calloused sleeper.

A small walled structure is in place behind the couch-bed which may (or may not) be an archeological site (see Photo I).

The north chamber of Furniture Cave -- that is the portion the furniture is located in -- is actually a separate and parallel tube system to the portion of the cave through which the cave is accessed.

Schematic Drawing of Furniture Cave



It has become increasingly apparent that parallel tubes are a common feature of El Malpais lava tube systems.

Access code #2.

H-2 (5)

Joe Looney Cave. Located 150 feet west of Furniture Cave on the north side of CS. Inconspicuous entrance. Cave is a narrow 1 by

2 foot crawl for a distance of 50 feet. Leads to a lava chamber 4 feet in height, 30 feet in length, and 20 feet in width with exceptionally beautiful dripping lava formations. Access code is #5.

H-3 (1) Hoya Bridge-Cave. 50 feet in length, 30 feet in width, with a ceiling up to 20 feet high.

Access code is #2.

H-4 (5) Red Cave. This is a big cave for this tube system, with a ceiling up to 30 feet high and an average width of 50 feet. Air temperature was 42 degrees in the entrance. Bearing looking in is 295 degrees but makes turn to 190 degrees 50 feet in. Two passages meet again at 200 feet and continue for another 75 feet, terminating in rubble.

Name is derived from the strong red color of the lava rock in the rubble portion of this cave (see Photo D). Rubble portion of the cave requires crawl.

Access code is #2 and #5.

H-5 (1) Dome Cave is a rubble choked tube with a temperature of 35 degrees on 9-7-88. Note arched dome. Cave is 30 feet wide, 20 feet high, and 25 feet deep.

Access code is #1. Sensitivity code is #1.

H-6 (1) Typical Hoya CS. Width is up to 50 feet, depth to 30 feet and a length of 200 feet.

H-7 (9) Tube Dweller Cave is a stacked tube. Located in the upper tube is the lava tube equivalent of a cliff-dwelling. Hence the name Tube Dweller Cave. Note in Photo A the wall across the top tube with the curvature of the roof and the darkness of the lower cave showing at the bottom of the photo. This is perhaps El Malpais' most dramatic walled structure and one of its most impressive views of a lava tube.

The ceiling of the upper tube is 15 feet high and cave width is up to 30 feet. Most of the site is on the north side of the tube but the wall extends across entire front of cave. Bearing into cave is 245 degrees.

Site walls are 4 feet high, much rubble inside. Digging has occurred in site.

Access to Tube Dweller Cave is through two windows to the west of the walled structure. See Photo E.

- H-8 (2) The lower tube of Tube Dweller Cave is a large cave with a ceiling up to 25 feet in height and 50 feet in width. The cave narrows rapidly and chokes closed. Cave is likely an ice cave (temperature at entrance 44 degrees F on an 82 degree F day on 9-7-88); however, ice was not located during a brief search.

Bearing looking in is 280 degrees but at 50 feet turns to 235 degrees and continues for another 70 feet; total cave length 120 feet.

Access code is #2.

- H-9 (1) Amphitheater Cave lies on the east side of Tube Dweller CS. This is also a big cave with a domed ceiling 30 feet high and up to 50 feet wide. Cave length is 100 feet. Beautiful.

Access code is #2.

- H-10 (3) A typical view of a sheer-walled Hoya CS. Width is up to 70 feet and depth is to 30 feet.

- H-11 Lava Bomb Arch is a beautiful triangular shaped lava arch 75 feet in length. Ceiling is 20 feet high and width is 25 feet. A window is present in the roof of the bridge; size is 8 by 8 feet. What is most spectacular about this bridge is the lava bomb on its floor (see Photo B). It is entirely possible that the window in the bridge (see Photo A -- the window is the upper opening) was created by the lava bomb being ejected into the cave. A geologist should consider this site.

- H-12 Hoya de Cibola is one of El Malpais' most dramatic landforms. The structure is 2,000 feet in length, up to 650 feet in width, and over 100 feet deep. Causey (1971) believes this spectacular pit is in fact a huge fissure. Lava tubes are reported on the north and are definitely present on the east and south.

Mining has been conducted in Hoya de Cibola which has severely damaged portions of the the beautiful west wall.

Access code is #2.