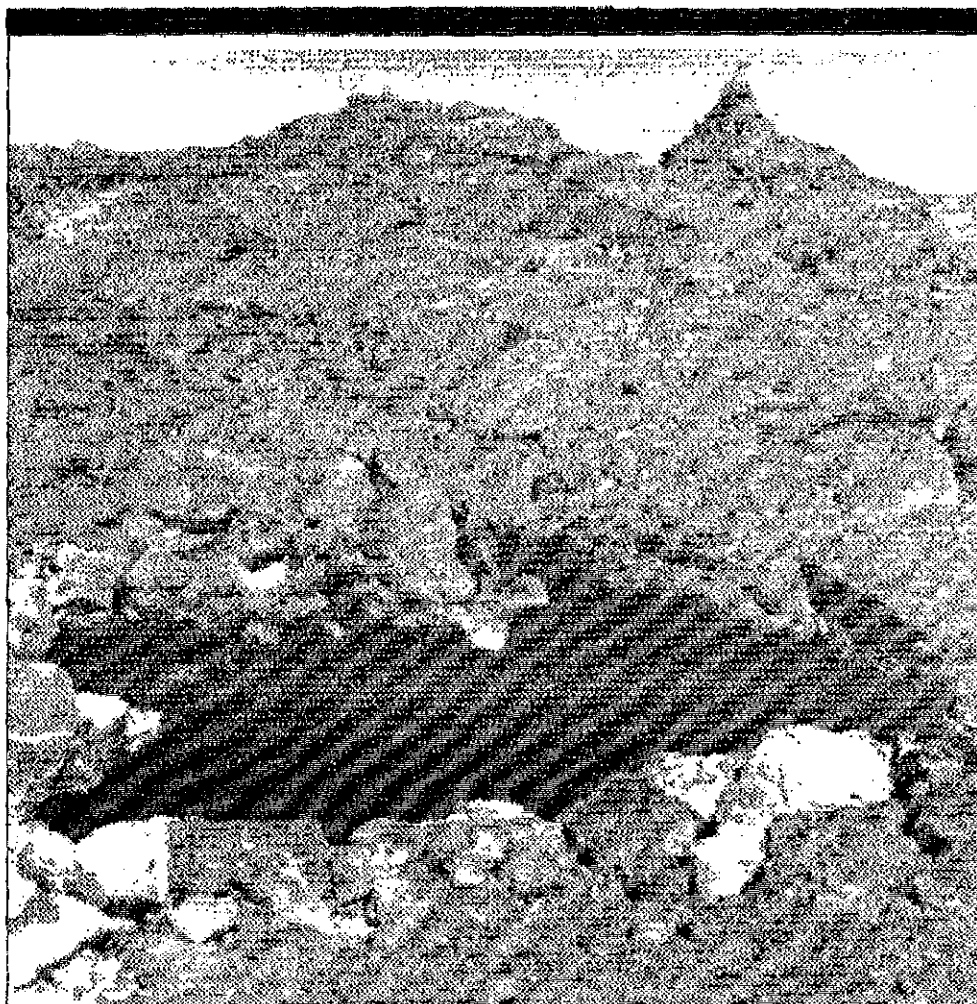

Craters of the Moon **CAVE RESEARCH** **GUIDE**



Prepared by Scott C. Jex

Publication Number 1 of the Craters of the Moon Project - July 1988



The Craters of the Moon Project

Craters of the Moon Cave Research Guide

The Craters of the Moon Project

Publication Number 1

July 1988

Page 1

Introduction

Caves at Craters of the Moon National Monument, Idaho, have been a topic of interest for the explorer and scientist since the early 1920's. From exploration and mapping to the study of bats and cave beetles, cave research is becoming an important part of the monument's resource management system.

This publication has been prepared to assist park managers with a standard format for the documentation of new cave discoveries as they occur. Researchers involved in cave documentation are urged to follow the standards defined in this publication to make inclusion of your material in the park database as consistent as possible.

Cave Conservation

Preservation of all features within the park are critical to the resource management system. Of particular concern is maintaining new cave discoveries as wilderness features.

Craters of the Moon Cave Research Guide

The Craters of the Moon Project

Publication Number 1

July 1988

Page 2

Volcanic Cave Structures

Caves, as generally accepted, are hollow places inside the earth. At Craters of the Moon virtually all caves of significant length are hollow areas which formed within lava flows, and are technically known as lava tubes.

A lava tube is an underground cavity in which lava once flowed and drained out leaving a hollow tube of hardened lava. In addition to lava tubes, there are other types of hollow structures which exist in the monument. Natural bridges, spatter cones, hornitos, pressure ridges, fissures, lava trees, and hollow mounds may also fall within the broad category of caves.

Lava Tubes

Of all caves within the monument, the lava tube is the most significant in terms of length and structure. Lava tubes are formed when the surface of a molten lava flow cools and hardens, forming a solid crust under which liquid lava continues to flow. If conditions permit, the lava can flow out from under the crust leaving a hollow passage—the lava tube. Typically, the escape of molten lava seals the ends of the tube tube shut, making it inaccessible and invisible from the surface. Over time many of the tubes develop cracks and portions of the ceiling collapse—revealing the tubes and allowing human access.

Natural Bridges

A natural bridge is a section of cave ceiling which remains intact after a roof collapse, usually stretching across the collapse perpendicular to the main direction of the tube. The span of a natural bridge is limited only by the stability of the rock which originally formed the tube ceiling, the shape of the bridge and time itself. For more information on the identification and classification of natural bridges see xxx.

Spatter Cones

At Craters of the Moon, spatter cones

were formed when lava erupted from fissure vents in the earth. When spewing out, the molten lava cooled in the air and fell back around the vent, piling up as the eruption continued. In most cases the insulated interior of the spatter pile continued to plumb lava to the surface until the vent sealed itself off. However, a hollow cavity can form within the interior if the lava suddenly subsides inside the cone. Subsiding can occur if the liquid lava retreats back down the vent or breaks through a weak area at the base of the cone.

Hornitos

Hornitos are formed when "plastic" lava is pushed up by hot gasses and hardens in a low oven-shaped mound. In most cases holes form in the mound to allow the gasses to escape and reveal the hollow interior. Hornito interiors observed at Craters of the Moon are generally not large enough to allow human access.

Pressure Ridges

A pressure ridge is an elastic expanse of lava flow crust which buckles up and pulls away from the molten lava below. If conditions permit, a hollow passage may form on the underside of this buckle creating a cave. Usually pressure ridge caves are short in length, and contain lava stalactites on the ceiling formed when the crust pulled away from the flow.

Fissure and Rift Caves

Fissures are cracks in the earth's crust. At Craters of the Moon fissures vary in length, width and depth. While not truly defined as caves, hollow areas occur in many of the cracks in the monument. Fissure caves usually contain ice and water, and may have passages that run parallel to the crack. Access to fissure or "rift caves" often requires the use of ropes.

Lava Trees & Tree Molds

Although not generally considered caves, lava trees are hollow lava formations created when airborne liquid lava pelted

Craters of the Moon Cave Research Guide

The Craters of the Moon Project

Publication Number 1

July 1988

Page 3

down on live trees and piled up around their trunks. The tree trunks burned away and left a hollow vertical shaft inside the cooled lava pile. Shafts within lava trees can reach a depth of ten feet or more, but depth can be hard to determine if rocks have been dropped into the interior by early explorers. Diameter of the interior varies, but is rarely large enough to allow human access.

A similar formation, tree molds, are also found in the monument. Tree molds generally appear as an open horizontal depression on the surface of the lava crust caused when trees fell over into the molten lava and formed an imprint before burning away. Tree molds are also formed when a molten flow surrounds standing trees.

The primary difference between lava trees and tree molds is elevation above the surrounding surface. Lava trees rise above the surface in a mound shape. Tree molds are generally on or below the surface of a flow.

Hollow Mounds

Extremely thin-crust small lava tubes are considered hollow mounds. Basically a flow feature, the mounds usually cover a large area of a given flow surface. They are normally too small for exploration and their ceilings, less than 12 inches thick, generally cannot withstand the weight of a human. Length of the mounds will vary, but weak ceilings limit any significant expanses over 10 feet.

Pits and Sinks

Pits are readily identified as lava tubes in which the ceiling is totally collapsed and no subterranean passage can be found. Pits may contain hollow areas between "breakdown" on the floor and the walls of the pit—but these would not be considered caves unless they allow human access.

Sinks are similar in appearance to pits. The primary difference is that the formation of the sink is not due to ceiling collapse. Sinks form when molten lava escapes from beneath a "plastic" top crust—allowing the crust to sink into the area vacated by the lava. The floor of a sink is smooth in comparison to the breakdown filling the interior of a pit.

Rock Shelters

As the name implies, rock shelters are hollow areas within piled rock. Most rock shelters are constructed by humans for protection from the elements. Usually constructed on the surface, rarely would a rock shelter be considered a cave. However, caves may be found with rocks piled at the entrance to achieve the effect of a shelter.

Teepee circles, rocks laid in a circular shape on the surface, are not considered rock shelters. It is theorized that these rocks anchored teepee or hunting blind structures used by native inhabitants.

Waterholes

The presence of a waterhole does not automatically warrant the assignment of cave status, however most caves do contain water in some form during the winter months. Standing water is an important resource and should be documented when found.

In caves, the source of standing water is rain and melted snow that drips through cracks in the walls and ceiling. In winter, this water freezes on the floor of the cave—sealing the cracks on the floor and preventing water from escaping. During summer months the ice usually melts and allows the water to drip through the floor. There are no documented occurrences of percolating groundwater in any of the caves within the monument.

Waterholes can also be located at the bottom of pits and sinks. The standing water is usually located under rocks that shade the ice beneath the water from direct sunlight.

Under no circumstances should the water found in waterholes be consumed by humans or pack animals. Animal excrement in the water breeds disease which is tolerable only to resident animals.

Craters of the Moon Cave Research Guide

The Craters of the Moon Project

Publication Number 1

July 1988

Page 4

When is a Structure a Cave?

When documenting caves in the monument the researcher should first consider if the structure is, in fact, a cave. For the purpose of this guide we will assume that a "cave" is a hollow place which will allow human access. Whether or not the structure requires artificial light for exploration is not significant in the determination of cave status.

Does this structure require cave status? The purpose for identifying a structure as a cave is to place it in the parks "inventory" of geographic features. All newly discovered caves within the monument are given "wilderness" status—thereby protecting the feature from human alteration and abuse. The criteria for assigning cave status can be any of the following:

- **Geologic Formation**

While all known caves in the monument start and end in basalt lava flows, the type of lava, i.e. pahoehoe, aa, etc., should be noted. A cave structure found in an area other than basalt would be a significant occurrence.

- **Number of Levels**

Any cave with more than a single level is considered unique within the monument and should be documented as such.

- **Passage Length**

Any cave with an internal passage length in excess of 100 feet should be considered important and added to inventory.

- **Water Content**

The occurrence of standing water in any cave during dry conditions would justify cave classification.

- **Hazards Present**

Any cave with confusing passageways, vertical drops, loose rocks subject to cave-in, and water levels presenting a

drowning hazard requires cave status.

- **Significant Contents**

Caves containing artifacts, organisms, fossils, speleothems (mineral deposits), or unusual or fragile structural, hydrological, or genetic geological features will warrant cave status.

- **Proximity to Public Access**

Any cave found within 400 yards (1/4 mile) of a public trail should be assigned cave status. Caves close to existing trails can be hazardous to ill-equipped visitors, and cataloguing of these caves can expedite search or rescue efforts in an emergency.

- **Aesthetic or Historical Value**

Any cave structure having aesthetic or historical appeal can be added to inventory with documentation explaining the feature.

Craters of the Moon Cave Research Guide

The Craters of the Moon Project
Publication Number 1
July 1988

Page 5

Naming the Cave

Most features within the monument were named years ago during various geological surveys and explorations. Caves, however, are being named as they are discovered, a continual process since they can be found at any time.

Naming of new caves found within the monument should be performed by the person or persons documenting the discovery. Before using a new cave name in documentation, research should be performed by park personnel to determine that the cave has not been previously documented and named, and that the chosen name is not a duplication of an existing name. The RENAMING of existing caves is to be performed by authorized park managers only.

The naming of new caves within the monument shall be based on the following criteria whenever possible (in order of preference):

1. Geographic proximity to known feature

Monument → Example: A cave located at the base of Big Cinder Butte could be called "Big Cinder Butte Cave," or "Big Cinder Tunnel." However, a cave located near Beauty Cave should NOT be called "Beauty Cave II" or "Beauty Cave Connection," etc.

2. Characteristic-related name

Example: A cave with a red cinder floor might be called "Red Floor Cave." A cave with twisting passages could be called "Spiral Cave." However, a cave with sensitive mineral deposits should NOT be called something exciting like "Quartz Cave."

The logic behind characteristic naming is to relate the name to a special cave feature—but not to entice a visitor to the cave who might damage or remove a feature. The same concept applies to characteristic naming based on wildlife present in or near the cave. The name "Grasshopper Cave" could be acceptable if a grasshopper was seen near the entrance, but under no circumstances use

a name like "Golden Eagle Pit" for a cave that contains nesting Eagles in the entrance. DO NOT name caves after fragile or protected features.

3. Hazard-related name

Example. A cave with rattlesnakes near the entrance might be called "Rattlesnake Cave," but use of such natural hazard names is subject to change and may conflict with the concept of protected features above. A name like "Snake Bite Cave" might be more appropriate. Structural hazards can be simpler to deal with, such as a cave with loose ceiling rocks being called "Roof Collapse Cave." Hazard-related names are difficult to implement and have questionable value as a warning.

4. Intangible names

Disrespectful or impertinent naming of caves will not be allowed within the monument. Names like Butt Buster Cave, Suzy's Hole, Elephant Pit, Queens Cavern, etc., are examples of non-descriptive naming which serves no purpose in park management efforts.

5. Use of personal names

The use of generally acknowledged first or last personal names will not be accepted as cave names. Names like George's Cave or Johnson's Pit are examples of unacceptable personal name use. The right to name or rename features with personal names for ceremonial or dedication purposes lies solely with park management.

Suitable Name Suffixes

They ~~The~~ ^{the} ~~name~~ ^{names} of cave structures ~~should~~ ^{may} carry an appropriate suffix whenever possible based on the following criteria:

• Lava Tubes

A lava tube can be identified as a cave, cavern, tunnel, tube, hole, den or grotto.

• Natural Bridges

Natural bridge structures should be identified as natural bridge, bridge or arch.

Craters of the Moon Cave Research Guide

The Craters of the Moon Project

Publication Number 1

July 1988

Page 6

- **Spatter Cones**
Spatter cones can carry the suffix spatter cone, cone, vent, or shaft.
- **Hornitos**
Hornitos are called hornitos.
- **Fissure and Rift Caves**
Fissure caves should have a suffix such as fissure, rift, crack, crevice, or split.
- **Lava Trees and Tree Molds**
Lava trees must be called lava trees, and tree molds should be called tree molds.
- **Hollow Mounds**
Hollow mounds should be called mounds.
- **Pits and Sinks**
Pits should carry the suffix of pit, and sinks the suffix of sink.
- **Waterholes**
This designation should be restricted to sink, pit or rift waterholes. Caves containing standing water are not considered waterholes.

Craters of the Moon Cave Research Guide

The Craters of the Moon Project
Publication Number 1
July 1988

Page 7

Documenting Cave Locations

To include a new cave in park inventory proper documentation must be prepared and submitted to park management. Preparation of a "Cave Coding Worksheet" (see forms chapter) is considered minimum documentation and should be accompanied by photographs or slides of the cave entrance and significant features. The worksheet is available from park managers for use in the field.

Determining the Cave Location

The first step in identifying the location of a cave is to take compass readings at the cave entrance. The "Cave Location Field Log" (see forms chapter) is a convenient way to record compass readings at the site.

Field Equipment

Documenting the location of a cave requires the use of a current topographic map of the area and an instrument to take compass readings. An altimeter to measure entrance elevation and a clinometer for calculating vertical angles may be used, but are not required.

Readings may be taken with a theodolite, transit or compass. Since cave locations are rarely listed more accurately than within 300 feet, the use of a quality sighting compass or pocket transit is sufficient. A compass graduated from 0 to 360 degrees (with north being the starting and ending point) will simplify readings. However, a compass graduated in quadrants (0 to 90 degrees in NW, SE, SW and NE quadrants) will yield the same results, but readings must be listed as "bearings" stating the quadrant and degrees.

Compass Sightings

Whenever possible, the readings should be taken from a station positioned directly above the cave entrance on the surface, or atop a cairn marking the location.

Sightings from the station should begin in the north and progress in a clockwise

direction (north, east, south and west). The readings taken in this manner are called "azimuth from north" when recording the readings. Sightings should be made to visible points on the horizon which are also printed on a topographic map of the area. Sight on points that are at least 90 degrees apart whenever possible. On rare occasions, you may be able to sight on USGS survey monuments, but usually these markers are too low on the surface to see from a distance.

Record your sightings to each point in azimuths from 0 to 360 degrees (or bearings if using a quadrant graduated compass) making certain to note the name of the point as shown on the topographic map. If your compass is corrected for declination, be certain to note the correction used and the year (i.e. 1983 16-1/2 degrees), otherwise recordings will be assumed as magnetic readings. Declination angles are shown on USGS topographic maps. Full degree (°) readings are usually sufficient, however if the graduation of your compass shows minutes (') or seconds (") of arc you may wish to further refine your recordings, i.e. 92°, 30', 15".

In addition to the above cave location sightings, you also need to determine the direction of the cave entrance. Take this reading while facing the cave opening. Record this reading in azimuth from north, but it will need to be corrected for magnetic declination for the current year and listed as a bearing on the Cave Coding Worksheet.

If possible, one final reading should be noted; try to calculate the overall direction of the cave by recording a reading while standing inside a main passage.

Locating the Cave on a Topographic Map

Using a large, clear, 360 degree circular protractor is the simplest means of converting your readings to a cave location. Place the center of the protractor in the approximate area of the topographic map where you believe the cave entrance to be. With the 0° mark pointing toward the north, rotate the protractor until one of your sighting points lines up with its equivalent reading in degrees. Continue to shift and rotate the protractor until all sighting points line up with

Craters of the Moon Cave Research Guide

The Craters of the Moon Project

Publication Number 1

July 1988

Page 8

their corresponding protractor degrees. If you are using a small protractor, many of your sighting points may lie beyond its edges. If so, use a straightedge to align the sighting point and the protractor center mark and check your reading where the straightedge intersects the protractor edge.

After aligning all possible points place a mark on the map at the center of the protractor—which if properly aligned, will be the exact location of the cave entrance.

If altimeter readings were not taken at the cave entrance, you can extrapolate the altitude from the topographic map. Craters of the Moon topographic maps show variations in surface every 20 feet. Calculate the approximate altitude by checking the contour intervals on each side of the cave location.

Documenting the Cave Location With the Range and Township System

In addition to providing a map showing the location of the cave with documentation, the actual location must be stated on the "Cave Coding Worksheet." In the past, the minimum cave coordinates were listed by "Range," "Township," "Section" and "Quarter" as determined by a topographic map of the area. To increase precision of the coordinates to within a 500 foot square, the "Quarter" can be divided into quarters two more times. An example of these coordinates would be listed like this sample for Moonshine Cave:

S.E. 1/4, S.E. 1/4, N.E. 1/4,
Sec. 11, T. 1 N., R. 24 E.

The above sample shows that the cave entrance is located in the SE quarter of the SE quarter of the NE quarter of Section 11 in Township 1 North, Range 24 East.

Within the existing park boundaries there are a limited number of "Range" and "Township" designations as shown on topographic maps of the area, they are:

Range 24 East and 25 East

Township 2 North, 1 North and 1 South

Make certain when documenting cave coordinates that you list the proper Range and Township. Errors in these designations can lead to a location error of several miles.

Documenting the Cave Location With the UTM System

Recent topographic maps of the park include the 1000-meter Universal Transverse Mercator (UTM) grid. Use of this new system when listing cave location coordinates will enhance accuracy and eliminate erroneous Range and Township listings.

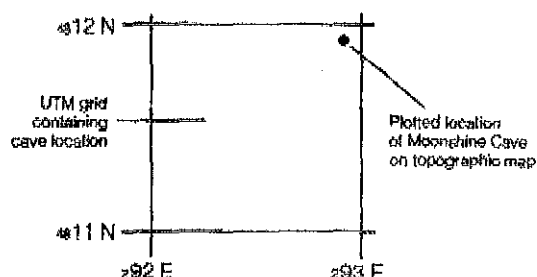
UTM grid lines are fine black lines which connect to UTM coordinates printed on the left and top edges of the map. UTM coordinates in the park are listed as "eastern" coordinates running vertically from west to east, and "northern" coordinates running horizontally from south to north. The "eastern" grid lines are shown as a 3 digit number, with the first number being inferior in size. The "northern" grid lines are shown as a 4 digit number with the first 2 numbers being inferior.

The number of UTM coordinates shown on topographic maps of the park are limited. Be certain that your coordinates fall within the following ranges:

284 East to 305 East

4785 North to 4820 North

To determine UTM coordinates, plot the cave entrance on a topographic map using compass readings and a protractor. Then, instead of subdividing and quartering a "Section," locate the UTM grid which contains the entrance:



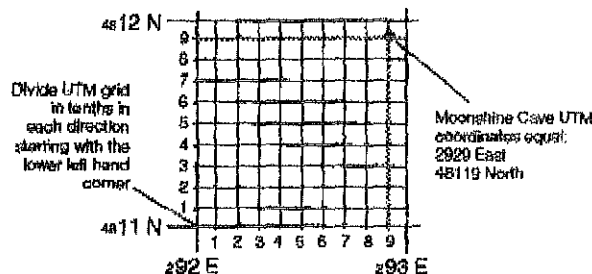
The UTM system allows for the pinpointing of features rather than the general grouping used in the Range and Township system. Subdivide the UTM grid in tenths beginning in the lower left hand corner. After dividing the grid you can identify a feature within a 100-meter square. This level of accuracy is sufficient for cave location documentation unless a close group of entrances must be

Craters of the Moon Cave Research Guide

The Craters of the Moon Project
Publication Number 1
July 1988

Page 9

distinguished. In such cases, the UTM grid can be divided into hundredths or thousandths.



The cave location plotted above for Moonshine Cave would be expressed by adding the number 9 to the east UTM number 292 E, becoming 2929 E; and adding 9 to the north UTM number 4811 N becoming 48119 N. When documenting cave locations show the east coordinate first:

Moonshine Cave 2929 E, 48119 N

Marking the Cave Entrance on Topographic Maps

When submitting your documentation to park managers, your report should include a plotted location of the cave on a map. A photocopy of the park topographic map is acceptable. Be careful to use the most recent USGS map of the area (available at the park visitor center). Outdated maps contain errors which can yield unusable results. *no UTM*

When placing entrances on maps, use the standard symbol for caves (Y). The long portion of the "Y" points in the direction of the cave entrance.

If documenting features other than caves, such as spatter cones, pits, natural bridges, lava trees, etc., use the target symbol (⊙).

If you travelled an established trail, or followed cairns to the location, indicate the trail on the map with a dotted line (---).

Cairns plotted on maps are drawn as a filled triangle (▲).

Accuracy is important when placing symbols on your sketch map. Your located features may be included on the next reprint of the USGS topographic map of the park, and erroneous placement can confuse other explorers using your coordinates.

Using Cairns as Field Markers

A cairn (locally pronounced kehr-in) is a heap of stones used as a marker on the lava flow surface. Cairns have been used through the years at the park to mark trails, and virtually every other ground feature of interest.

There are no standards for the placement of cairns, they are frequently built by geologists near USGS survey monuments, and by explorers near everything else.

INDICATE
MANAGEMENT

Craters of the Moon Cave Research Guide

The Craters of the Moon Project
Publication Number 1
July 1988

Page 10

Preparing a Cave Map

Preparing a map of the cave passage is not required, but is helpful to other researchers when deciding to travel long distances to the location. If the cave contains confusing passageways, it should be recommended that a cave survey be performed by an experienced survey team.

For the purposes of initial documentation, a sketch map is usually sufficient. Sketch maps are prepared by observation, rather than measurement. However, a map prepared in such a manner must contain the same title block information as a survey map.

Title Block Requirements

A title block (or equivalent text) must appear on all maps, regardless of the manner of preparation. The title block contains:

1. **Cave Name**
Use the approved cave name, as shown in the park inventory. If mapping a new cave discovery, insert your suggested cave name in parenthesis.
2. **Location**
It is assumed that any reported caves are within park boundaries, and lie within Butte County, Idaho. Any variations to the above must be noted.
3. **Exact Coordinates**
List the main entrance coordinates using the Range and Township System or the UTM System, noting which system used.
4. **Name and Address of Preparer**
Use full name and current residence address. Note group affiliation and member identification, if applicable (N.S.S. number, etc.)
5. **Date Map was Drawn**
Indicate the date map was drawn (not the date of discovery or survey).
6. **Type of Survey**
Indicate the method of survey and instruments used. If map was drawn

from observations only, state such. Otherwise, indicate tape and compass survey and indicate the instruments used (i.e. Brunton compass and steel tape, etc.). If a formal survey is made, it is highly recommended to submit the technical specifications and survey methods in written form.

7. Survey Date

Note the date(s) that the survey was performed.

8. Survey Party

List the full names and current residence addresses of survey party members, *incl.* Include phone numbers if possible.

9. Map Scale

Draw a graphic scale on the map in feet. Include a secondary scale for meters if possible. DO NOT use written scales, such as "one inch equals 100 feet."

10. North Orientation

Conspicuously show geographic north (corrected for current declination), and the year and degree of magnetic correction.

11. Graphic Symbols Used

The Map should be prepared using the standard cave symbols designated by the National Speleological Society: "Map Symbols: N.S.S. 1961 Std." (see appendix xxx). If other symbols are used, attach a copy of explanations, or document symbols directly on map.

the

the person drawing the map