Cave Inventory

with the Carlsbad Cavern National Park Cave Inventory Form

Contents

Dedication

Dedicated to the troglophile in all of us.

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Introduction

Introduction to cave inventory

A **cave inventory** is a description of resources associated with a cave or caves. They are of benefit to the land manager in deciding how best to protect, study and manage the caves.

There are two basic flavors of cave inventories: a general cave inventory and a detailed resource inventory.

General cave inventory

A general cave inventory is usually performed on behalf of a land manager to describe the general features of the caves being managed. There is usually one inventory description for each cave with a list of the specific resources to be found therein.

A general cave inventory would probably list for each cave or karst feature information such as: location including GPS coordinates, step logs or whatever location information is available; the general form of the cave such as solutional, erosional, lava tube, etc.; the significant flora and fauna within the cave such as bat hibernacula or mammal dens, or rare species, etc.; significant speleological resources such as large gypsum formations or long stalactites, boxwork, rimstone, aragonite, etc.; the hydrological nature of the cave; the general pattern and size of the cave such as multilevel maze, angular network, branchwork, etc.; any significant paleontological resources; anthropogenic resources such as skeletons, bones, etc.; historic artifacts and historic graffiti markings such as signatures; any historic uses of the cave and anything that would make the cave significant.

A general cave inventory provides a quick view of the significant nature of a cave and an overview of the significance of an area populated with caves.

A general cave inventory should list the presence or absence of a gate or other protections and what type of lock (if any) is used to secure the gate. It should list the location of any geological markers (sometimes called *cave medallions*). It should also include a description of the recreational significance and any monitoring programs in effect. If ropes or ladders or other specialized equipment or skills are needed to access the cave, they should be listed.

A general cave inventory should also detail the availability of maps, papers and other documentation related to the cave itself. Also any artifacts which have been removed from the cave should be listed with their current location.

Finally, if applicable, a statement as to whether or not the cave should be deemed "significant" according to the Federal Cave Resources Protection Act should be provided.

This is not a comprehensive list and a general cave inventory should include whatever information the land manager deems as important for the proper protection and management of the cave and karst resources.

Cave resource inventory

A cave resource inventory is a more detailed map of the inventory items within a single cave or a section of a cave. Cave resource inventories are normally done alongside a survey (map) and provide more detailed layers to augment the map.

Cave resource inventories are usually collected in the cave at the same time as survey work to draw the map. For each survey station, the inventory lists the resources (significant or not) associated with that station. From this, the information is normally put into ArcGIS (see ArcGIS on Wikipedia [1]) form to provide layers of information for the map. This information can be of great value for the scientist, researcher or the cave manager.

Most cave resource inventories are collected in a form provided by the land manager and specialized for the information they want. For example, the *Carlsbad Cavern National Park Cave Inventory Form* is on water proof paper and is sized to fit in a standard survey notebook. It lists such general categories as: formations, geology, biology, cultural and miscellaneous. Under these, specific entries exist for things like: dripping water, floor material, obstacles such as pits and climbs, flowstone, stalagmite, boxwork, rimstone,

gypsum flowers or needles, hydromagnesites such as moonmilk or balloons, clays such as endellite, fossils, sulfur, beetles, crickets, bones, artifacts and graffiti.

From this detailed inventory information, map layers can be drawn and coordinated with surface features or other areas of the cave to produce a detailed map of the location of various types of things within the cave.

A good cave resource inventory should also list the degree and form of human impact on or around each station so that an impact map can be produced. To go along with this, the location of any human impacts which might benefit from restoration or protection measures should be noted. Information about the difficulties to be encountered should a rescue need to be performed may also be important.

Producing a good cave resource inventory is painstaking work. It involves a detailed analysis of the floor, walls and ceiling at each station with everything found being recorded in the inventory form. A detailed scan should be done of everything around each station and this takes time. Often the inventory is the slowest portion of a survey with the sketcher not far behind.

The purpose of the resource inventory is to be as accurate and thorough as possible so it helps greatly to have knowledgeable individuals perform the inventory function. Also, photographs of any extremely unusual find or unidentified item can help make for an accurate and thorough inventory.

Further reading

- Matthew, Reese (2001); *The Use of Cave Inventory System as a Cave Management Tool* from the 15th National Cave and Karst Management Symposium, Tucson, AZ, October 16-19, 2001

External links

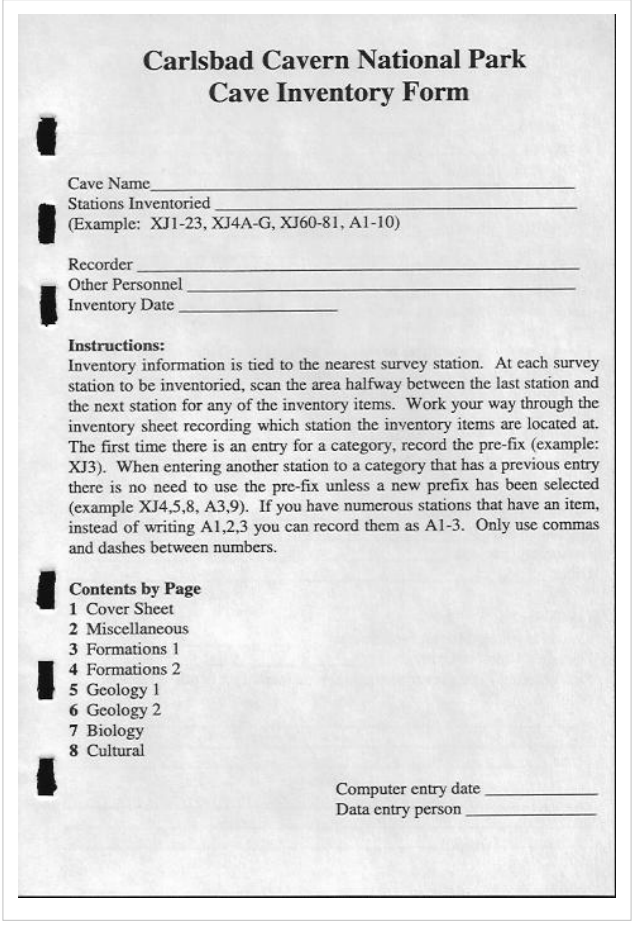
- A paper by Johanna Kovarik and Pat Kambesis titled *Cave resource inventories: why they are important?* [2]
- The Virtual Cave [3] an online reference by Dave Bunnell of cave resources which might be included in an inventory

References

[1] http://en.wikipedia.org/wiki/Arc_gis
[2] http://www.nckms.org/2005/pdf/Papers/kovarikKambesis.pdf
[3] http://www.goodearthgraphics.com/virtcave

Carlsbad Cavern National Park Cave Inventory Form

Cover Sheet



Carlsbad Cavern National Park
Cave Inventory Form

Cave Name_____
Stations Inventoried _____
(Example: XJ1-23, XJ4A-G, XJ60-81, A1-10)

Recorder _____
Other Personnel _____
Inventory Date _____

Instructions:
Inventory information is tied to the nearest survey station. At each survey station to be inventoried, scan the area halfway between the last station and the next station for any of the inventory items. Work your way through the inventory sheet recording which station the inventory items are located at. The first time there is an entry for a category, record the pre-fix (example: XJ3). When entering another station to a category that has a previous entry there is no need to use the pre-fix unless a new prefix has been selected (example XJ4,5,8, A3,9). If you have numerous stations that have an item, instead of writing A1,2,3 you can record them as A1-3. Only use commas and dashes between numbers.

Contents by Page
1 Cover Sheet
2 Miscellaneous
3 Formations 1
4 Formations 2
5 Geology 1
6 Geology 2
7 Biology
8 Cultural

Computer entry date _____
Data entry person _____

The **cover sheet** of the *CCNP Cave Inventory Form* has several fields used to identify the inventory and some instructions. All of these fields should be filled out completely.

Fields and instructions

- Cave Name
- Stations Inventoried
- Recorder
- Other Personnel
- Inventory Date
- Instructions

Cover sheet

Cave Name

The **Cave Name** field of the inventory form should be completed as unambiguously as possible to aid in identifying the form later.

Example

Cave Name: Carlsbad Caverns, New Section

Stations Inventoried

The **Stations Inventoried** field should list all stations which were inventoried on the form. Dashes are often appropriate here as this field is usually filled out outside of the cave. If you do this, remember to complete the field.

Example

Stations Inventoried: FA127-145,GA113

Recorder

The **Recorder** field is used to list the name of the person who is recording the inventory information in the form. Nicknames are usually not appropriate.

Example

Recorder: William Tucker

Other Personnel

The **Other Personnel** field should list the complete names of others who helped gather the inventory information. Often this field includes the names of everyone on the survey team since most often everyone helps with inventory to one degree or another.

Example

Other Personnel: Tammy Tucker, William Tucker, Tim Kohtz

Inventory Date

The **Inventory Date** field should be completed with the date that the inventory was performed. Use spelled month names to avoid confusion where some use MM/DD/YY format and others use DD/MM/YY format. Is "2/12/95" February 12 or December 2?

Example

Inventory Date: February 19, 2011

Instructions

The following quote is the **instructions** from the *CCNP Cave Inventory Form*. Clarification and comments follow.

> "Inventory information is tied to the nearest survey station. At each survey station to be inventoried, scan the area halfway between the last station and the next station for any of the inventory items. Work your way through the inventory sheet recording which station the inventory items are located at. The first time there is an entry for a category, record the pre-fix (example: XJ3). When entering another station to a category that has a previous entry there is no need to use the pre-fix unless a new prefix has been selected (example: XJ4,5,8,A3,9). If you have numerous stations that have an item, instead of writing A1,2,3 you can record them as A1-3. Only use commas and dashes between numbers."

Comments

Dashes

In the form, it is difficult and error prone to use dashes (except for Stations Inventoried). Using a dash requires predicting the future. For example, if you are at G37 and find an inventory item to record for it and expect to encounter it again at the next few stations, it is dangerous to enter "G37-". The danger lies in what happens when you don't encounter the expected. Do you erase the dash? Did you remember to erase the dash or is your inventory inaccurate because of an oversite? My advice is to never use the dash or at least be extremely judicious and careful with its use.

Abbreviations

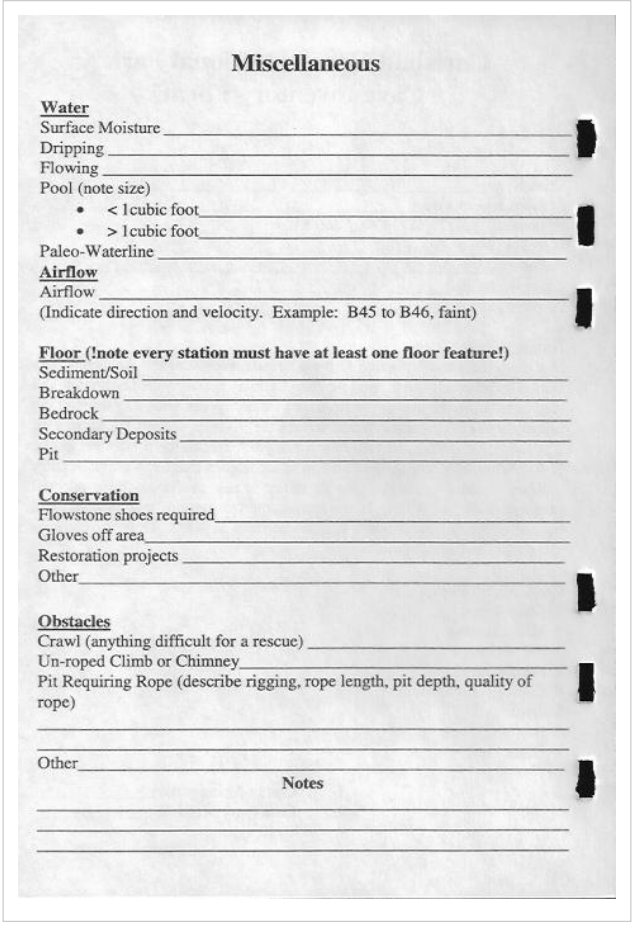
Leaving off the prefix (the letter part) of the survey stations for the second and subsequent encounters of an inventory item is good practice. Some of the spaces for recording stations are small and you may find them too restrictive after a long day of survey. Abbreviating the stations helps here; but, do not abbreviate anything except the letter part of the survey designation. For example, do not record an inventory item encountered at FA223, FA224 and FA225 as "FA223,4,5". This is ambiguous and difficult for the data entry person, who uses your form later, to decipher. Instead, record this situation as "FA223,224,225".

Which Stations to Inventory

Unless you have been specifically instructed otherwise, only inventory the new stations you are setting. Do not take inventory for existing stations that you tie into.

Page 2

Miscellaneous



Miscellaneous

Water
Surface Moisture _____
Dripping _____
Flowing _____
Pool (note size)
- < 1cubic foot_____
- > 1cubic foot_____

Paleo-Waterline _____

Airflow
Airflow _____
(Indicate direction and velocity. Example: B45 to B46, faint)

Floor (!note every station must have at least one floor feature!)
Sediment/Soil _____
Breakdown _____
Bedrock _____
Secondary Deposits _____
Pit _____

Conservation
Flowstone shoes required_____
Gloves off area_____
Restoration projects _____
Other_____

Obstacles
Crawl (anything difficult for a rescue) _____
Un-roped Climb or Chimney_____
Pit Requiring Rope (describe rigging, rope length, pit depth, quality of rope)
_____
_____
Other_____

Notes
_____
_____
_____

The **Miscellaneous** page is page 2 of the *Carlsbad Cavern National Park Cave Inventory Form* and includes sections for water, airflow, floor, conservation and obstacles. Every station should be listed somewhere under floor.

Sections

- Water
- Airflow
- Floor
- Conservation
- Obstacles

Water

Water

The **Water** section of the *CCNP Cave Inventory Form* is used to record stations where a visible sign of water or paleo-water is observed. It is divided into several fields and one subsection related to the indication of water observed.

Fields and subsections

- Surface Moisture
- Dripping
- Flowing
- Pool
- Paleo-Waterline

Surface Moisture, Water

The **Surface Moisture** field of the Water section is used to record any station which has visible signs of moisture that is not dripping, flowing or pooled. Visible signs of moisture may include: wet flowstone; mud; moist bedrock; damp formations and others.

Dripping, Water

Dripping stalactite

The **Dripping** field of the Water section of the *CCNP Cave Inventory Form* should be used to list stations where dripping water is observed.

When observing drips by sound alone, make certain that the sound is coming from this station and not some nearby station. If the drips have accumulated enough to form a pool, the station should be recorded there as well.

Water, Dripping

Splashes from dripping water

Flowing, Water

The **Flowing** field of the Water section of the *CCNP Cave Inventory Form* should be used to list stations where flowing water is observed. Flowing water must exhibit movement and not be merely dripping or pooled. If the flow has formed a pool, or is coming from a pool, the station should be recorded there as well.

Pool, Water

Large pool

The **Pool** subsection of the Water section of the *CCNP Cave Inventory Form* is used to list stations where a pool of water is observed. Pools are categorized according to their estimated volume: less than one cubic foot and those of greater than one cubic foot. A cubic foot is approximately 7.5 gallons.

< 1 cubic foot

The **< 1 cubic foot** field should be used to record stations which possess a pool of water with an estimated volume of less than one cubic foot.

> 1 cubic foot

The **> 1 cubic foot** field should be used to record stations which possess a pool of water with an estimated volume of greater than one cubic foot.

Water, Pool

Pool

Paleo-Waterline, Water

Paleo-Waterline

The **Paleo-Waterline** field of the Water section should be used to record stations where an indication of a past waterline is evident. Shelfstone is one indication of such a waterline. A horizontal line with a change in color above and below is another indication.

Paleo-Waterline, Water

Paleo-Waterline visible as a stain on a stalactite

Paleo-Waterline

Airflow

Airflow

The **Airflow** section has only one field and it is used to list stations with noticeable airflow.

Fields

- Airflow

Airflow

Formation indicating airflow

The **Airflow** field should list stations with noticeable airflow. Indicate the direction and velocity next to the station. Velocities are not expected to be precise, just descriptive like "faint", "breeze", "strong", "breathing", "blowing", etc.

Example

Airflow: B45 to B46 (faint)

Floor

Floor

The **Floor** section should be used to record the type of floor detail. Note that every station must have at least one floor feature indicated. Each station should be listed under each type of floor feature observed.

Fields

- Sediment/Soil
- Breakdown
- Bedrock
- Secondary Deposits
- Pit

Sediment/Soil, Floor

Sediment

The **Sediment/Soil** field should be used to record stations where sediments or soils can be observed as floor detail.

If sediments are observed and they appear to be fluffed up, it may be an indication that Rhadine beetles are in the area.

Breakdown, Floor

Breakdown

The **Breakdown** field of the Floor section should be used to list stations where breakdown is identified as one of the floor features.

Breakdown is collapsed cave ceilings or walls. The size can vary from small chips and flakes to much larger blocks, slabs and boulders. The size of a breakdown block is limited only by the size of the passage in which it fell.

Most breakdown fell as the water table dropped during the transition from phreatic to vadose. So, any feature which is a natural part of the bedrock (such as fossils) and those that formed during the phreatic phase (such as spar) may be found in breakdown. Breakdown may have fallen onto features (such as clays and massive gypsum) and secondary formations can form in, under, around and over breakdown and some secondary deposits may have formed on the underside before it fell. Examine the breakdown itself and the spaces around it for other inventory items.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 161-163 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* pp 2-3

Bedrock, Floor

The **Bedrock** field of the Floor section should be used to record stations where bedrock appears as one of the floor details.

Secondary Deposits, Floor

A variety of secondary deposits on the floor

The **Secondary Deposits** field of the Floor section is used to record stations where secondary deposits are one of the floor details.

Secondary deposits can include a number of things but are most often calcite or gypsum. Flowstone, stalagmites, rimstone dams, crusts and coatings are all secondary deposits that might appear as floor detail, among others. There is no need to identify the type of secondary deposit in this field, just that it appears. Be aware that gypsum can be either a secondary deposit or bedrock. In order to be a secondary deposit, it must have been deposited after the void of the cave formed and not an original part of the bedrock.

Pit, Floor

The **Pit** field is one of the floor detail fields and should list any stations where the floor area includes a pit.

Conservation

Conservation

The **Conservation** section is used to record stations where some type of conservation issue is indicated. The station is listed under the type of conservation item observed.

Fields

- Flowstone
- Gloves off area
- Restoration projects
- Other

Flowstone, Conservation

This flowstone has been stained by dirty, marring boots. This should be inventoried as conservation flowstone, a restoration project and, of course, calcite flowstone.

The **Flowstone** conservation inventory field should be used to list stations with flowstone where changing to clean aqua sox is required. Not all flowstone will be inventoried as a conservation item (see also Flowstone) such as flowstone on the wall.

Wearing marking soles can cause black marks on flowstone, and dirty boots can track mud, sediment and other items onto clean flowstone. Any flowstone which is easily marred or damaged from not changing to aqua sox should be inventoried as a conservation flowstone item.

Gloves off area, Conservation

The **Gloves off area** of the Conservation section should be used to list stations where removing dirty gloves is advised to prevent marring pristine surfaces.

In some situations, it is adviseable to remove gloves after passing through a dirty section such as corrosion residue, mud, dirt or guano before proceeding to a cleaner area such as flowstone. An extra pair of clean gloves or powder-free surgical gloves should be worn temporarily. These situations are usually encountered in crawls but could be in walking passage where the hands are needed for stability or climbing. Should one of these situations be encountered, it is best to flag the location with a "gloves off" sign to warn future travelers.

Restoration projects, Conservation

This stalagmite has been stained with mud from being touched with soiled gloves. This is a good example of a restoration project.

The **Restoration projects** conservation field should be used to list any stations that have human impacts which could benefit from work to restore. The human impacts could be accidental or purposeful, it doesn't matter. Muddy flowstone is one of the easiest to recognize but other useful restoration projects should be listed including broken formations and other impacts that can be restored.

Other, Conservation

The **Other** field of the Conservation section should be used to list stations which have some other conservation issue other than aqua sox, gloves off, or restoration projects. A brief description of the issue noted should be included next to the station.

Examples might include:

- extremely fragile areas which should be avoided
- damaged or impacted areas which cannot be restored
- special instructions for moving through an area in order to conserve it
- others

Example

- Conservation, Other: G77 (extremely fragile gypsum hairs, move slowly)

Obstacles

Obstacles

The **Obstacles** section is used to record stations where there is some obstruction or difficulty for normal travel through the cave. The goal is to record impediments for rescue situations. The station should be listed in the field according to the type of obstacle observed.

Fields

- Crawl
- Unroped climb or chimney
- Pit
- Other

Crawl, Obstacles

An example of a place where rescue could be difficult

The **Crawl** Obstacles inventory field is used to list stations which need to be noted as a potential issue for rescue. If the crawl is less than 12 inches or so, it may require additional consideration as feet and noses may scrape the ceiling in normal sked configuration. Any station which would present difficulty for a rescue litter or sked should be listed, not necessarily just true crawls. Narrow passages; quick turns; and squeezes of any kind should be listed. Pits and unroped climbs or chimneys have their own fields as do other obstacles.

Unroped climb or chimney, Obstacles

The **Unroped climb or chimney** field in the Obstacles section is used to record stations where some exposure (potential for a fall) is found but no rope is needed.

Some climbs or chimneys may not be much of an obstacle for normal travel through the cave; but, they could be a serious impediment to rescue. If such an exposure is found at a station which would affect rescue efforts, it should be recorded.

Example

- Unroped climb or chimney: FA17 (chimney up through crack to FA18 and beyond)

Pit, Obstacles

The **Pit** obstacle field should be used to record any climb requiring rope.

Any pit, climb or any situation requiring rope should be recorded especially for rescues. Describe the rigging, rope length, pit depth, and quality of rope. These details should be recorded next to the station.

Example

Pit: AA77(currently unrigged, 160 ft. drop, rig around stalagmite, 180 ft. rope needed)

Other, Obstacles

The **Other** field of the Obstacles section should be used to record any obstacle which is not a crawl, unroped climb or chimney, or pit.

This field is a kind of catch-all field for any type of obstacle which does not already have its own field. Some examples of obstacles that might be listed here include: crossing a pool by means of a narrow ledge; a steep, slippery slope; a very delicate area which could be damaged; or others that might hamper or impede a rescue. It a good practice to describe the type of obstacle next to the station.

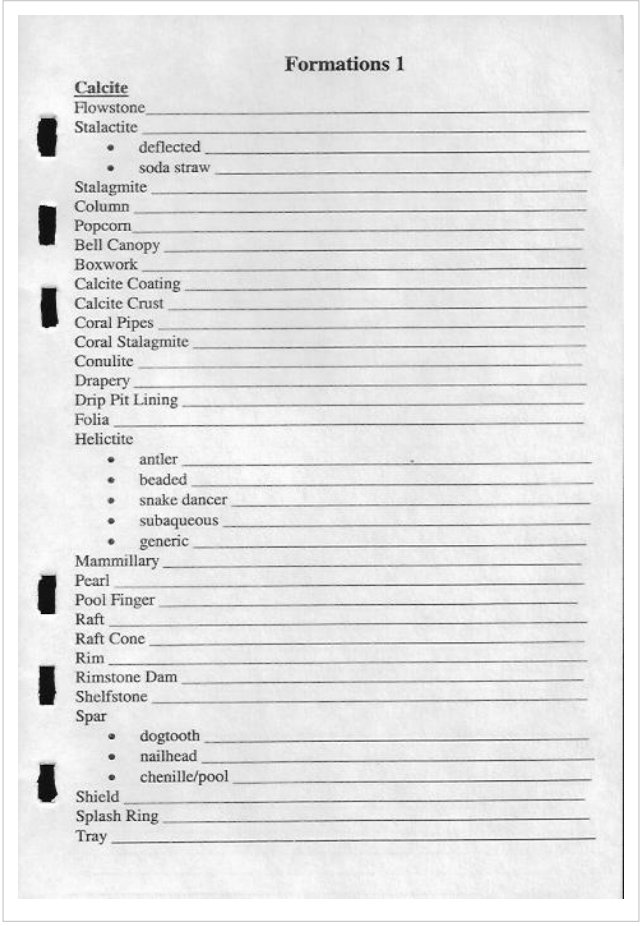
Example

Obstacles

Other: G37 (handline advised on steep slope)

Page 3

Formations 1



Formations 1

Calcite

Flowstone
Stalactite
- deflected
- soda straw

Stalagmite
Column
Popcorn
Bell Canopy
Boxwork
Calcite Coating
Calcite Crust
Coral Pipes
Coral Stalagmite
Conulite
Drapery
Drip Pit Lining
Folia
Helictite
- antler
- beaded
- snake dancer
- subaqueous
- generic

Mammillary
Pearl
Pool Finger
Raft
Raft Cone
Rim
Rimstone Dam
Shelfstone
Spar
- dogtooth
- nailhead
- chenille/pool

Shield
Splash Ring
Tray

The **Formations 1** page is page 3 of the *Carlsbad Cavern National Park Cave Inventory Form* and could be thought of as the "Calcite" page since that is the only section it contains.

Sections

- Calcite

Calcite

Calcite

Most speleothems in Guadalupe caves are composed of **calcite** or aragonite, $CaCO_3$. These two carbonate minerals form the majority of all speleothems and a wide variety of speleothem types, most of which appear in the calcite section of the inventory form.

References

- New Mexico Bureau of Mines & Mineral Resources Bulletin 117; Geology of Carlsbad Cavern and other caves in the Guadalupe Mountains, New Mexico and Texas; PART II: MINERALOGY; CARBONATES http://www.nps.gov/history/history/online_books/geology/publications/state/nm/1987-117/sec1-2.htm

Fields and subsections

- Flowstone
- Stalactite
- Stalagmite
- Column
- Popcorn
- Bell Canopy
- Boxwork
- Calcite Coating
- Calcite Crust
- Coral Pipes
- Coral Stalagmite
- Conulite
- Drapery
- Drip Pit Lining
- Folia
- Helictite
- Mammillary
- Pearl
- Pool Finger
- Raft
- Raft Cone
- Rim
- Rimstone Dam
- Shelfstone
- Spar
- Shield
- Splash Ring
- Tray

Flowstone, Calcite

Flowstone

The **Flowstone** field of the Calcite section should record any observation of flowstone that is not some other more specific speleothem.

Flowstone is one of the most common of speleothem types and exhibits as cascading sheets of calcite flowing over obstructions like a frozen waterfall. It is deposited when water flows in thin films.

Flowstone can vary in both size and color. The color varieties can be great and can be in complex, multicolored combinations. Color combinations can include: white, cream, yellow, orange, red, carmel and even black. Flowstone can exhibit a velvetine texture or be very smooth. It may be dry or moist. It may exhibit on the walls, cascading out of high leads or on the floor. Often other speleothem types exhibit where flowstone is found.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 70-72 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 280-281 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Flowstone, Calcite

Black flowstone

Velvetine textured flowstone

Flowstone on a wall

Flowstone

Stalactite, Calcite

Stalactites

The **Stalactite** field of the Calcite section should list stations where stalactites are observed.

Stalactites are ceiling formations that hang downward like icicles. Stalactites may appear individually or in groups, sometimes tremendous groups, with other speleothem types associated such as stalagmites and draperies. They may be any of a number of colors and can vary in size from tiny to massive.

When a stalactite joins with a stalagmite or reaches the floor, a column is formed.

Two specific subtypes of stalactite have their own fields on the form. These are deflected stalactites and soda straws. These subtypes should be recorded in the respective subfields. Only calcite stalactites that are not deflected and are not straws should be recorded in this field.

Look for stalactites on the ceiling and overhanging ledges.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 281-282 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 104-108 ISBN: 1-879961-07-5

Fields

- deflected
- soda straw

Stalactite, Calcite

Gallery

Stalactites

Stalactites

Stalactites

Stalactites

deflected, Stalactite, Calcite

Deflected stalactite

The **deflected** subfield of the Stalactite field should record stations where a deflected stalactite can be found.

Deflected stalactites are stalactites which show some noticeable slant from the vertical. They grow this way primarily by air movement causing more minerals to be deposited on one side from evaporation or deposition. They can occur singularly or in clusters. If a deflected stalactite is found, they can often be found at other nearby stations where conditions may be similar. The airflow which caused the deflection may still be present or conditions could have changed such that airflow is no longer evident.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 107-108 ISBN: 1-879961-07-5

soda straw, Stalactite, Calcite

Soda straws

The **soda straw** subfield of the Stalactite field should record stations where soda straws are observed.

Soda straws are thin-walled tubes of calcite or aragonite which hang from the ceiling but may be found broken on the floor. They have a constant diameter of about the width of a drop of water and may be any length from a few centimeters to multiple meters long. They may also exhibit active dripping or hanging drops of water but can also be found dry and, at least temporarily, inactive. They can appear singularly or in clusters, sometimes great clusters. Examine the ceiling especially along cracks or where other stalactites are formed to find soda straws. And don't forget to look at the floor. Broken straws can also be found cemented into flowstone.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 281-282 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

soda straw, Stalactite, Calcite

Closeup of a soda straw

Soda straws

Stalagmite, Calcite

Stalagmites

The **Stalagmite** field of the Calcite section should list stations where calcite stalagmites are observed. Gypsum stalagmites and aragonite stalagmites have their own fields on the form.

Stalagmites are secondary floor deposits usually of calcite. They are one of the most commonly encountered formations and exhibit as pillars built up by water dripping from the ceiling. The drip source often exhibits a stalactite but not always. Stalagmites are usually larger in diameter than any corresponding stalactite with rounded tops instead of pointed. Stalagmites can vary greatly in size and shape from small to massive formations; from tall, thin poles to wide, fat mounds and anything in between. Stalagmites can be smooth; popcorn covered; layered like piles of plates; fluted; or covered with various other deposits including bell canopies. A stalagmite which has joined with its corresponding stalctite is known as a column.

A calcite stalagmite of any size or shape should be recorded in this field.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 108-112 ISBN: 1-879961-07-5

Column, Calcite

Columns

The **Column** field of the Calcite section should record any stations that exhibit columns.

Columns form when a stalactite joins a stalagmite making a continuous formation from ceiling to floor.

Columns can vary greatly in both thickness and height. Columns can be massive floor to ceiling formations with great thickness or smaller formations that reach from ceiling to floor in an alcove. A column could be as simple as a single soda straw which has managed to reach the floor; but, these would normally be inventoried as straws and not columns. However, if a straw is the connection between two more substantial formations, a column is the more appropriate inventory category.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 56-57 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 283 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Popcorn, Calcite

Popcorn

The **Popcorn** field of the Calcite section should be used to record stations where cave popcorn is found.

Cave popcorn are small balls of calcite, aragonite and more rarely gypsum which project from surfaces such as bedrock and other speleothems. They usually appear in clusters but can rarely occur singularly. Dense growths of popcorn that terminate downwardly are known as trays. Popcorn can form almost anywhere and comes in a few varieties including button popcorn which has flattened nodules. Any observation of popcorn no matter its composition should be recorded here. Popcorn nodules may be smooth like flowstone or chalky and round like edible popcorn. They may be decorated with frostwork and may appear only on one side of speleothems, usually the windward side. The clusters may terminate abruptly in a stratographic layer in either an upward or downward direction. The size of each individual nodule can vary from tiny to small but usually does not grow much bigger than an inch or so. The color is usually white but various other colors are possible, too.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 288 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 59-61 ISBN: 1-879961-07-5

Popcorn, Calcite

Button popcorn

Singularly unusual popcorn nodule

Bell Canopy, Calcite

Bell canopies

The **Bell Canopy** field of the Calcite section should list stations that exhibit a bell canopy.

Bell canopies are sheets of flowstone that flare outward as they descend. They terminate before reaching the floor so as to form hood or bell shapes. Bell canopies can form hoods over older formations or be suspended from the ceiling, walls or other speleothems. They form by weathered material that flows as a paste and hardens, or by water that evaporates before dripping off of the edge.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 283-284 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Bell Canopy, Calcite

Bell canopy

Bell canopy

Dripping bell canopy

Boxwork, Calcite

Boxwork. Other formations visible include popcorn and dogtooth spar.

The **Boxwork** Calcite inventory field should be used to list stations which exhibit boxwork.

Boxwork is not technically a speleothem but a speleogen. That is, it is not a formation but a residual of dissolution. Boxwork forms when cracks in the bedrock are filled with a mineral which is harder to dissolve than the bedrock itself. When the bedrock dissolves, it leaves the mineral which used to fill the cracks exposed. It often appears on the ceiling but may be present anywhere bedrock is exposed. It may be obscured by secondary formations. Boxwork can appear as small examples or large areas. It often takes on polygonal shapes (usually rectangular) but may be almost any shape. It need not project far from the rock to be considered boxwork. Often it is a different color than the bedrock (usually darker). Alternative explanations for boxwork exist which involve cracks in the bedrock being filled with minerals after the cave formed.

Although the field appears in the calcite section of the *CCNP Cave Inventory Form*, any boxwork no matter its specific mineral content (which may be difficult to identify anyway and may not be calcite) should be listed.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 343-344 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 52-54 ISBN: 1-879961-07-5

Boxwork, Calcite

Boxwork

Boxwork

Boxwork with a calcite coating

A singular boxwork fin protruding from the wall

Calcite Coating, Calcite

Calcite coating on bedrock. The arrow identifies a sponge.

The **Calcite Coating** inventory field should be used to list stations where a coating of calcite is found.

A calcite coating is a thin layer or layers of calcite usually over bedrock or breakdown. It is much thinner than a calcite crust and more tightly adhered to the underlying structure.

It is sometimes difficult to differentiate between a calcite coating, an aragonite coating, a gypsum coating, and even moonmilk. The distinctions between a calcite coating and a calcite crust may also be subtle.

Calcite tends to have square-ish crystals. Gypsum sometimes makes starbursts. Aragonite and moonmilk are both bright white. Aragonite coatings are not an inventory item on the *CCNP Cave Inventory Form* and should be inventoried as a calcite coating, so there is no need to distinguish between these two. Calcite coatings can have a wide variety of colors. Calcite coatings can also be entirely clear. Coatings may build up in layers, coating upon coating, to form thicker coatings.

Sometimes it is difficult to positively differentiate between different coatings in the field without destructive testing.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 55-56, 145 ISBN: 1-879961-07-5

Calcite Crust, Calcite

Calcite crust

The **Calcite Crust** inventory field should be used to list stations where a crust of calcite is found.

A calcite crust is a layer of calcite that is thicker and less firmly adhered to the substructure than a calcite coating. Calcite crusts can form over almost any other material. They can be thin or thick. Often, they are fragile and easily broken, especially on floor sediments, if stepped on or touched so great care should be taken not to damage them.

The distinctions between a calcite coating and a calcite crust may be subtle.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 62-63 ISBN: 1-879961-07-5

Calcite Crust, Calcite

Calcite crust on floor sediments

Coral Pipes, Calcite

Coral pipes

Coral Pipes, also known as "calcified silt pillars", are clusters of vertically oriented speleothems that form by calcite encrusting a mud or silt interior.

Coral pipes form in clusters only a few centimeters apart. Each tower-like formation is usually less than 10 cm in height. Coral pipes are taller than they are wide. In cross section, they are concentric layers of calcite (or other mineral) over a soft silt or mud internal core. Coral pipes form on steeply sloping floors or walls.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 62 ISBN: 1-879961-07-5

Coral Stalagmite, Calcite

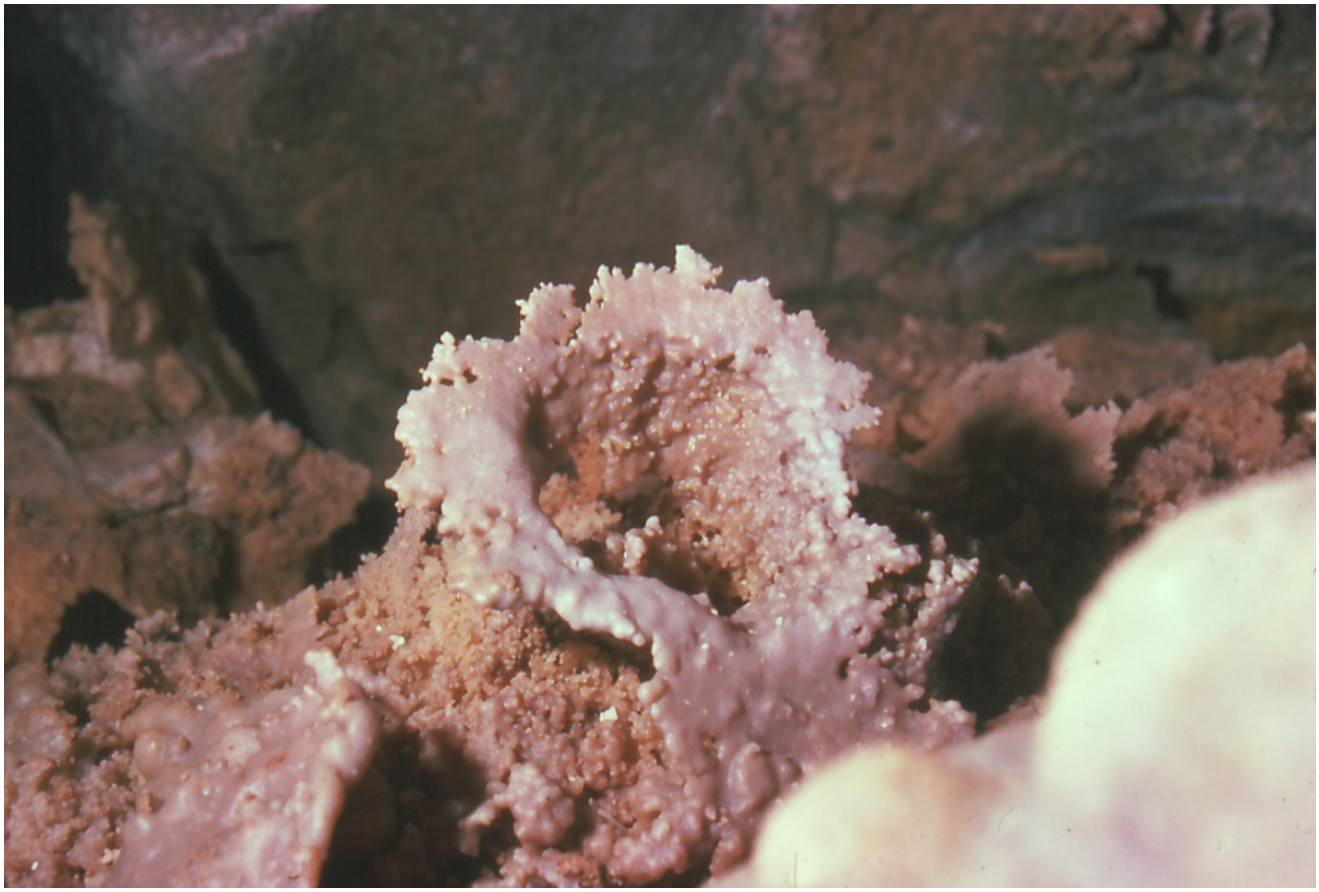
Coral stalagmite

The **Coral Stalagmite** field of the Calcite section should list stations where coral stalagmites are observed. Gypsum stalagmites and aragonite stalagmites have their own fields on the form.

Coral Stalagmites are important indicators of sulfuric acid speleogenisis. They appear as stalagmite-like formations, often hollow, covered in popcorn and/or aragonite. They may be difficult to distinguish from aragonite stalagmites. The primary distinguishing factor is that the later is covered mostly in aragonite while the former is covered mostly in popcorn.

Coral Stalagmites are important, but not definitive, indicators of sulfuric acid speleogenesis. They are believed to form inside drip tubes within massive gypsum blocks. The gypsum is later dissolved leaving the standing stalagmite behind. Massive gypsum may still be present in the area or may not.

Conulite, Calcite



Conulite

The **Conulite** field of the Calcite section should be used to record any observation of conulites.

Conulites are drip pit linings that have been exposed by removal of the substrate. They are cone shaped calcite deposits that form in drip pits. When the material in which the drip pit formed is washed away, dissolved or removed by some means, what is left is a thin calcite cone or tube that once lined the inside of the drip pit.

Conulites can form in a variety of materials including guano, sediments like mud or gravel, moonmilk or even massive gypsum. All of these materials are soft or easily eroded and thus subject to drip pit formation and later removal which may leave a conulite.

Conulites are usually small, about 15 cm in depth with thin walls up to 1 cm thick. In massive gypsum, they may be more tubular than conical as massive gypsum forms tubular drip pits. If filled with water, they may resemble a bird bath and may sometimes resemble a fan. They may have a flared and fluted edge which once extended over the surface of the substrate material.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 57-59 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 284 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Conulite, Calcite

Moonmilk conulite. Note the bat mummy near the base.

Conulite

Drapery, Calcite

Drapery

The **Drapery** field of the Calcite section is used to record stations that have a drapery.

Draperies are flowstone, dripstone formations which appear on the ceiling or walls. They are formed by a ribbon of water leaving a trail of calcite. The result is a sheet of hanging flowstone. They curve in graceful lines much like a hanging piece of cloth. Draperies come in all sizes from very small to enormous. Draperies may extend all the way to the floor; but, if not, almost always have a noticeable slant along their lower edge and may terminate in a stalactite. The lower edge may be smooth or decorated with regularly spaced beads or teeth like a saw blade. The color can vary greatly; and, due to changes in mineral content of the water over time, colorful horizontal stripes or bands can form within the drapery. These striped draperies are sometimes known affectionately as "cave bacon".

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 282 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Drapery, Calcite

Beaded draperies

Draperies

Draperies from below

Draperies

Drip Pit Lining, Calcite

Drip pit lining

The **Drip Pit Lining** field of the Calcite section should be used to record observations of calcite drip pit linings.

A calcite drip pit lining is a drip pit which has been lined with a thin coating of calcite. The pit itself could be in any material including bedrock, gypsum, sediments like mud or gravel and moonmilk or even guano.

Folia, Calcite

Folia

The **Folia** field of the Calcite section should be used to record any observation of folia.

Folia are horizontal growths of calcite usually occurring on overhanging walls. They appear much like inverted rimstone dams.

Folia are concentrated around pool surfaces and more specifically, near the top of the water table. They are often associated with calcite rafts and mammillaries. They are believed to form when CO_2 bubbles strike the ceiling or an overhanging wall and cause calcite to precipitate from the water. They may also form from frequent changes in water level leaving behind horizontal deposits.

Folia ribs project from the wall between 1 and 5 cm with a thickness of each rib about 0.5-1 cm. Each rib is usually spaced between 1 and 5 cm apart.

Folia have also been observed in mud.

Look for folia on the walls or ceiling in places that once overhung a pool especially if calcite rafts or mammillaries are in the area.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 73-74 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 277 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Folia, Calcite

Folia

Helictite, Calcite

Various helictites on a single formation

The **Helictite** subsection of the Calcite section is used to record stations where helictites are observed. Helictites are classified as to their specific form in the corresponding field.

Helictites are formed of calcite or aragonite and grow in erratic, twisting projections that seem to defy gravity. They form by hydrostatic water pressure and wicking caused by evaporation. Helictites are classified on the *Carlsbad Cavern National Park Cave Inventory Form* as to their shape and form and as to whether ot not they formed under water due to the common-ion effect.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 285-286 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 76-81 ISBN: 1-879961-07-5

Fields

- antler
- beaded
- snake dancer
- subaqueous
- other

antler, Helictite, Calcite

Antler helictites

The **antler** field of the Calcite Helictite section should record stations that exhibit antler helictites.

Like the arms of a deer antler, or the twigs of a branch, antler helictites exhibit straight stems with antler-like tips. The arms of antler helictites are thicker than other helictites (up to 15 cm). The growth is less eccentric in direction than other helictite types. They may or may not be branched. They are usually found on the walls, growing outward, or the floor, growing upward. They may be mixed with various other speleothems including other helictites and anthodites.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 77 ISBN: 1-879961-07-5

Antler, Helictite, Calcite

Antler helictites

beaded, Helictite, Calcite

Beaded helictites

The **beaded** field of the Calcite Helictite section should record stations that exhibit beaded helictites.

Like rosary beads on a string, beaded helictites are distinguished from other helictites by small (0.5 to 2mm) diameter beads or bumps on the branches.

Beaded helictites usually appear as fine, branching helictites, white in color. The beads may appear on only a few or all of the branches. These beads are believed to be caused by periodic changes in growth rate. Even though beaded helictites appear in the calcite section of the *CCNP Cave Inventory Form* they are usually composed of aragonite but can be a mixture of minerals even on the same branch. The branches may be coated with later deposits of calcite making the beads appear less like beads and more like bumps.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 76-77, 145-146 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 285 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Beaded, Helictite, Calcite

Beaded helictites

Beaded helictite

snake dancer, Helictite, Calcite

Snake dancer helictites

The **snake dancer** field of the Calcite Helictite section should record stations that exhibit snake dancer helictites.

Like a snake rising from a charmer's basket, snake dancer helictites grow in a primarily upward direction. They are usually found on the walls or ledges or could grow from other speleothems. The defining characteristic that distinguishes them from other helictities is the upward growth.

Snake dancer helictites are sometimes called heligmites because of their upward growth; but, this name is considered to be inappropriate. Snake dancer helictites often grow from sediments on the floor and in these cases may be the result of water wicking upwardly.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 285-286 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

subaqueous, Helictite, Calcite

Subaqueous helictites

The **subaqueous** field of the Helictite subsection of the Calcite section should be used to record any observation of subaqueous helictites.

Subaqueous helictites are helictites which form under water. They are formed much like other helictites, but they do not bifurcate or split. They appear as erratic tubes associated with a pool or former pool. They can be observed attached to the rim or walls of the pool and angling downward. They are usually located a couple of meters (3 to 6 feet) downslope from a large gypsum deposit or formation.

Look for subaqueous helictites on the rims and walls of pools or former pools especially if gypsum is nearby.

References

- Pate, Dale. *Canyons & Caves; Issue No. 10; Fall 1998*; HELICTITES AND SUBAQUEOUS HELICTITES: http://www.nps.gov/cave/planyourvisit/upload/c&c10.pdf
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 80 ISBN: 1-879961-07-5

other, Helictite, Calcite

Other helictites

The **other** field of the Calcite Helictite section should record stations that exhibit helictites which are not antler, beaded, snake dancer or subaqueous. Any other type of helictite should be recorded here.

Most helictites found will be inventoried as "other" since they do not have the proper characteristics for more specific categorization. Any helictite which is not thick (antler), growing upwardly (snake dancer), beaded or subaqueous (under water) should be listed in this field.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 285-286 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 76-81 ISBN: 1-879961-07-5

Other, Helictite, Calcite

Small helictites

Mammillary, Calcite

Mammillaries

The **Mammillary** field should be used to record any observation of a mammillary crust.

Mammillaries are a type of calcite crust that forms on the ceiling and overhanging walls of submerged bedrock. More specifically, it tends to occur in shallow phreatic conditions near the top of the water table.

When bedrock is covered by the water table, calcite can precipitate and coat the bedrock forming bulbous, cloud-like formations. Similar conditions can form folia, rafts and raft cones so these are often associated with each other.

Mammillaries are rounded knobs of calcite that appear on the ceiling and walls. They can be any of a number of colors depending upon the mineral content of the water. Whites and yellows seem to be common.

Look for mammillaries anywhere you may be inventorying near what once was below a water table and look for the associated speleothem types such as folia and rafts, too.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 56 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 275 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Mammillary, Calcite

Mammillaries

Mammillaries - note the Paleo-Waterline

Pearl, Calcite

Typical nest of cave pearls

Cave **pearls** are small balls of calcite or aragonite that usually form on the floor in shallow pools or depressions. They are formed from constant, steady dripping action causing agitation of a small seed crystal building up layers of calcite. They can occur singularly in depressions in the bedrock but are usually found in nests. Some of the pearls may become cemented into the floor. Cave pearls need not always be round. Sometimes they can have a cylindrical shape. The size varies from very small but rarely gets much larger than a golf ball or small egg. Most are pea to marble sized. Nests of pearls can easily be obscured by mud or silt. Great care should be taken not to disturb them during a survey.

Cave pearls are not to be confused with pisolites.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 280 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Pearl, Calcite

Cylindrical cave pearls

Pool Finger, Calcite

Pool fingers

Pool fingers are finger-like calcite formations that appear in pools and former pools usually under shelfstone. Many pool fingers resemble soda straws but are more lumpy, have no internal canal and sometimes form loops. They look like calcite coated strings or filaments and are believed to have a biological origin that is just that: mineral coated microbial filaments.

Most pool fingers are less than 1/2 mm wide and extend downward into the pool or former pool from under shelfstone. They may be associated with other pool formations such as chenille and pool spar and even subaqueous helictites.

Look for pool fingers in pools or anywhere a former pool may have existed especially under shelfstone.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 296-297 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 86-87 ISBN: 1-879961-07-5

Pool Finger, Calcite

Pool fingers

U loop pool finger

Raft, Calcite

Calcite rafts on a small pool

The **Raft** field of the Calcite section is used to record stations where calcite cave rafts are observed.

Cave rafts are thin accumulations of calcite or aragonite or more rarely gypsum that form on the surface of cave pools. Only calcite or aragonite cave rafts should be recorded in this field. Gypsum rafts have their own field.

Cave rafts form as extremely thin accumulations of crystals floating on the surface of a pool only because of surface tension. They form on still water. As they grow, they grow downward becoming thicker until they are too massive to float or are disturbed in which case they sink to the bottom of the pool. If sinking cave rafts accumulate in the same place (because of dripping water, for example), they may pile up into what is known as a raft cone.

Cave rafts may be observed: on the surface of pools; under water on the bottom of a pool; or lying along the bottom of a former pool. Cave rafts on the surface of a pool may be very thin looking like a film of powder or dust on the water. Cave rafts are usually white, yellowish or brown in color and look like ice or very thin lily pads. They may be touching the edge of a pool or floating freely but are incapable of supporting their own weight should the pool drop, unlike shelfstone. The top sides of cave rafts are flat and may be smooth or glossy. The bottom sides are rough. The shape may be very irregular and may even have holes in it like lace.

Rafts usually do not exceed 15 cm in diameter and 1 mm in thickness (about the thickness of a piece of paper). If the rafts are in a dried pool, they may have become cemented to the floor or could still be loose.

Look for cave rafts in every pool encountered no matter its size. Also look for them on the bottom of pools or former pools.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 278-279 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 88 ISBN: 1-879961-07-5

Raft, Calcite

Calcite rafts in a dry pool

Raft in an unusual place

Loose pile of rafts

Raft Cone, Calcite

Raft cones with drip pits

The **Raft Cone** field of the Calcite section is used to record stations where raft cones are observed.

Raft cones are piles of rafts. Dripping water can cause rafts to sink in the same location. They can pile up in flaky mounds that look like stalagmites. They may be cemented together, especially if exposed because the pool has dropped or may still be a loose pile of rafts. There is no separate field for gypsum raft cones even though there is a separate field for gypsum rafts; so, any observation of a raft cone should be recorded here no matter its composition. Raft cones may exhibit a hole in the top like a volcano where water has dissolved or eroded into the cone. Exposed raft cones can be obscured by secondary formations.

Look for raft cones in pools and former pools and anywhere rafts are observed.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 279 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 88-91 ISBN: 1-879961-07-5

Raft Cone, Calcite

Large raft cone with secondary formations on top

Raft cones

Rim, Calcite

Calcite rim. Note the cricket and the evidence of a spider, too.

The **Rim** field of the Calcite section should be used to record stations that exhibit rims of calcite. Other mineral rims have their own field in their respective sections.

Calcite rims (also sometimes known as vents) are wind formed features of calcite. They form usually around constrictions where consistent airflow is present. They are smooth on the inside but rough on the outside with features such as popcorn lining the outside surface. Rims form as a shell or projection extending on the upwind side of a constriction where moisture laden air consistently escapes. As such, they tend to require a pool or water source somewhere on the downwind side in order to provide the moist, warm air.

Rims can be any of a number of shapes from round tubes or eggs to more irregular shells or ears. They tend to conform somewhat to the shape of the constriction but may be biased in only one direction by the airflow. They can be found on the floor, walls or ceiling; anywhere air is or was escaping.

Rims can form from various mineral materials and several of them have fields on the inventory form. The appropriate field based on the mineral content of the rim feature should be used. Only calcite rims are recorded in this field.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 331-333 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 91-92 ISBN: 1-879961-07-5

Rimstone Dam, Calcite

Rimstone dams

The **Rimstone Dam** field of the Calcite section should be used to record any observation of rimstone dams.

Rimstone dams are calcite deposits that form at the edges of water to make terraces or walls over which the water spills. Unlike shelfstone, they are not flat and horizontal, but are sloped and have height. Each terrace is stair-stepped from its neighbor. They form at the edges of pools or along sloping water paths when the water spills and loses some of its CO_2.

Rimstone dams can occur singularly or in large, cascading terraces of dams. The spaces behind each dam will usually be lined with pool spar. They can vary greatly in both height and width from small ripples to large walls. Smaller rimstone dams are also known as gours.

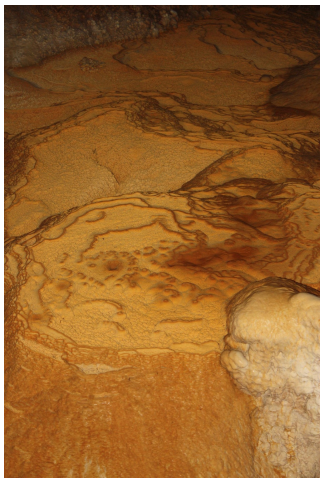
Look for them on the floor where water may have once flowed and take care during survey not to damage them as the walls can be very thin and fragile.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 92-94 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 277-278 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Rimstone Dam, Calcite

A large group of rimstone dams



Gours or small rimstone dams

Rimstone dam. Other items visible include: shelfstone, popcorn, and a crust over floor sediments.

Shelfstone, Calcite

Shelfstone around a pool. Note the guano; it and the pool should be inventoried separately.

The **Shelfstone** field of the Calcite section should be used to record any observation of shelfstone.

Shelfstone is a flat ledge of calcite that grew at the edge of a pool. It extends inwardly creating a ledge above the water. They can also form around other speleothems such as columns and stalagmites to form tables and lily pads.

Shelfstone forms at the pool surface and if the pool level changes over time, multiple levels of shelfstone can form. Shelfstone can be left high and dry when a former pool has dropped or disappeared. Its presence indicates a former pool level or paleo-waterline. Shelfstone is usually only a few centimeters thick but its width can vary greatly even up to several meters. Chenille/Pool spar, pool fingers and subaqueous helictites can be found under shelfstone so be sure to examine it for these speleothem types. Shelfstone may not be thick enough nor strong enough to support weight without breaking so take great care when crossing shelfstone and keep your weight on the more substantial surfaces.

Look for shelfstone at the edges of any pool or former pool.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 97-98 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 278 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Shelfstone, Calcite

Shelfstone tables

Very large shelfstone table

Shelfstone from below

Spar, Calcite

The **Spar** subsection of the Calcite section records stations where some type of spar is observed.

Spar crystals are classified on the *CCNP Cave Inventory Form* as to their shape and location. Spar crystals that form in pools of water above the water table are known as pool spar. Those that form under the water table are classified as either dogtooth or nailhead according to the shape of the individual crystals.

All three of the spar types are calcite though other minerals can form spar.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 101 ISBN: 1-879961-07-5

Fields

- dogtooth
- nailhead
- chenille/pool

dogtooth, Spar, Calcite

Dogtooth spar

The **dogtooth** field should be used to list stations which exhibit dogtooth spar crystals.

Dogtooth spar is a crystaline speleothem usually of calcite. The shape is scalenohedral -- triangular facets -- with pointed ends. The size can vary from barely discernable to quite large. The color can vary too. Often only one end of the scalenohedron may be visible giving each crystal a pyramid-like shape. Sometimes, both ends of the crystal can be seen forming a kind of faceted football shape. They can occur singularly or in clusters. They can often be found lining the insides of vugs or cavities and cracks but can also occur on the ceiling or walls directly. Since they formed when the cave was phreatic, they can be obscured by other formations such as flowstone, popcorn, crusts or staining. When looking for dogtooth spar, take the time to look into cracks and vugs in the walls, floor and ceiling. And don't forget to examine breakdown -- it may possess a vug containing dogtooth spar. Often when dogtooth spar is found, it can be found at nearby stations, too.

If the shape of each crystal does not seem to be scalenohedral but is more complex, you may be seeing nailhead spar.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 101 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 275 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

dogtooth, Spar, Calcite

Larger dogtooth spar crystals partially obscured by flowstone, popcorn and staining

Dogtooth spar in a vug

Dogtooth spar

nailhead, Spar, Calcite

Nailhead spar

The **nailhead** field should be used to list stations which exhibit nailhead spar.

Nailhead spar typically is "flatter" or more "cubic" than dogtooth spar with blunt ends. The shape is a combination of a rhombohedron where each facet is a rhombus, and a scalenohedron where each facet is a triangle. This is basically a combination of the two primary crystaline shapes of calcite in a single crystal. Pure rhombohedral calcite (rhomb spar) has no specific field on the form and should be inventoried as nailhead. Except for the shape of each crystal, nailhead spar has characteristics very similar to dogtooth spar and can be found in similar locations.

Nailhead spar can occur singularly; but are usually found in clusters. They can be found lining the insides of vugs or cavities and cracks but can also occur on the ceiling or walls directly. They formed when the cave was phreatic so individual crystals can grow to be quite large; but, are usually small. They can be obscured by other formations such as flowstone, popcorn, crusts or staining. When looking for nailhead spar, take the time to look into cracks and vugs in the walls, floor and ceiling. And don't forget to examine breakdown -- it may possess a vug containing nailhead spar.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 101 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 275 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

nailhead, Spar, Calcite

Nailhead spar

Nailhead spar

chenille/pool, Spar, Calcite

Pool spar closeup

The **chenille/pool** field should be used to list stations which have pool spar crystals.

Pool spar are well-defined crystals that grow under the surface of pools of water. They may be found lining the floor, sides and under shelfstone of pools and dry pools. Chenille spar are a subset of pool spar. Individual pool spar crystals are rarely large and most often small but the clusters of crystals can line the entire underwater surfaces of a pool.

Chenille spar are long drapery-like crystaline formations which form just below the water surface. They are closely related to pool fingers -- both have the same origin, calcite crystals growing on microbial filaments. The primary difference between pool fingers and chenille spar is that chenille looks more like a drapery while pool fingers are more finger-like. Chenille spar rarely gets more than a meter in length and individual crystals are usually so small as to make the formation look velvety.

Look for pool spar and the chenille variety of pool spar anywhere pools have formed or may have once been. Be sure to examine under shelfstone and ledges that may be covering the pool and hiding the spar. It doesn't take much of a pool to form pool spar. Pool spar can even form between the gours in a series of rimstone dams.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 297 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 101 ISBN: 1-879961-07-5

chenille/pool, Spar, Calcite

Pool spar and chenille spar. The shelfstone may be listed as a restoration project.

Chenille pool spar ceiling

Shield, Calcite

Shield

The **Shield** field of the Calcite section should be used to record stations where a shield is found.

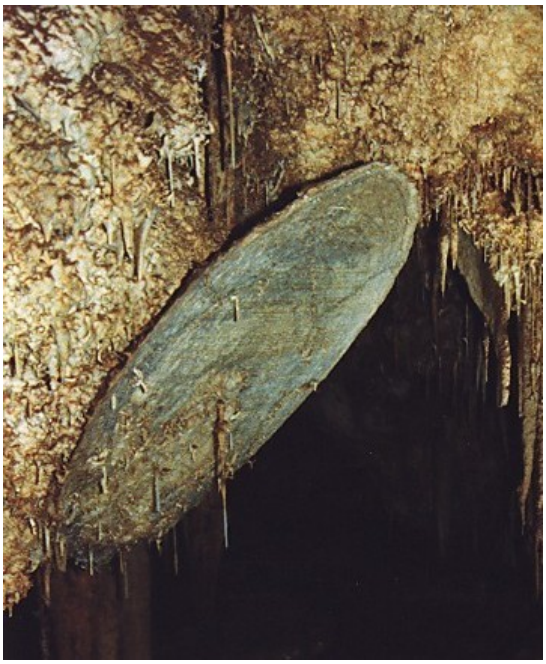
A shield appears as two parallel plates of calcite separated by a thin crack. The crack may not be visible at the edges because it is too thin or obscured. Shields are usually flat on top and usually oval in shape. They grow outward at their edges and can be attached to bedrock or other speleothems (usually columns). They are rarely parallel to the floor and most often have a noticeable slant. They are often decorated underneath with other formations such as stalactites. These could reach the floor forming a column between the shield and the floor. Shields may also be decorated on top by secondary speleothems such as stalagmites. True shields are rare and occasionally other features such as a flat rock or welts from a crack in a column are mistakenly identified as shields.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 286-287 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 98 ISBN: 1-879961-07-5

Shield, Calcite

Shield



Shield

Shield

Shield

Splash Ring, Calcite

Splash Ring on Guano. Note the drip pit.

The **Splash Ring** field is used to record stations where cave rings appear.

Splash rings (also known as cave rings) are noticeable rings of calcite usually around a central splash point. There are two primary, identified mechanisms for splash ring development. There is no need to note the mechanism on the form; but, it can usually be identified by the diameter of the ring and the presence or absense of a central, hollow stalagmite.

The first and most common mechanism is when drips of water strike a soft floor surface such as sediment or guano. If there is sufficient height, the drips may form a depression and splash outward, depositing their minerals in a circle around the splash point. A central stalagmite may form at the same time. This type of splash ring is almost always between 0.8 and 2 meters in diameter.

The second mechanism is experimentally demonstrated to be when droplets fall and separate into smaller droplets on their way to the floor. This mechanism forms much smaller rings and may not have a central splash point; but, a small mound or stalagmite in the center.

Another, more rare type of splash ring has been observed in the Guads in gypsum. Splash rings can also form when splashes strike hard floor surfaces and wash off softer materials such as sediments or hydromagnesite.

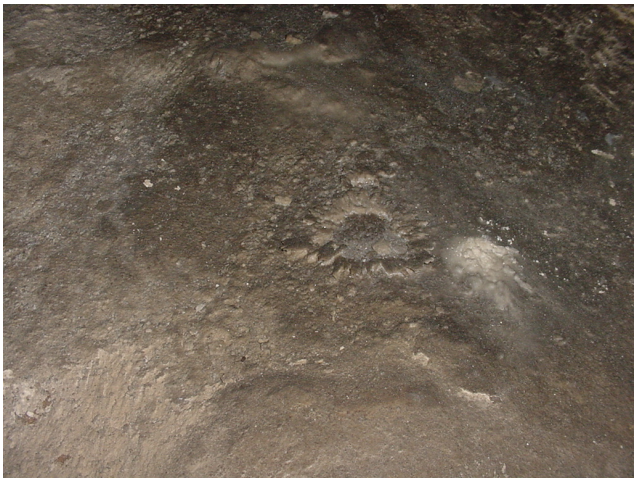
Splash rings are very round when the floor is flat. If the floor has a slope, they will take on an eliptical shape. The ring could be partially obstructed and thus may not form a complete circle.

Look for splash rings on the floor especially when the floor material is soft.

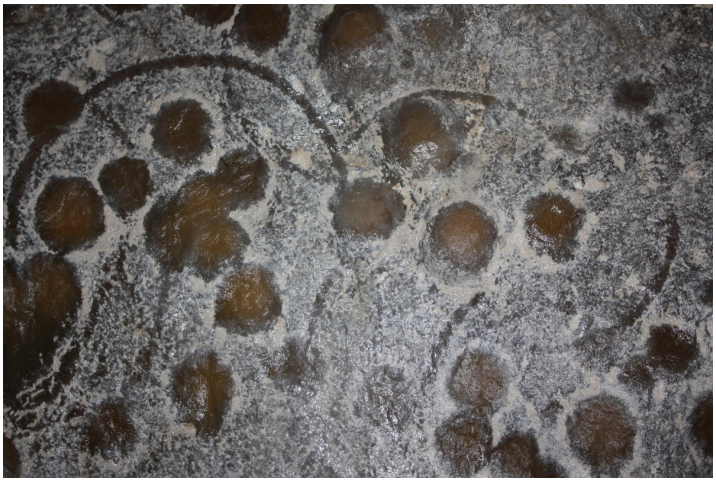
References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 94-95 ISBN: 1-879961-07-5

Splash Ring, Calcite



Splash Ring on Calcite



Overlapping splash rings visible through a thin hydromagnesite layer on flowstone

Splash Ring on flowstone floor by sediment removal

Splash rings

Tray, Calcite

Trays

The **Tray** field of the Calcite section should record stations which exhibit cave trays.

Trays hang down from the ceiling or on overhangs from the walls but end abruptly on the bottom creating a noticeably flat underside. They usually form under bedrock ceiling pendants but may form under stalactites. In the Guadalupe Mountains, they are usually calcite and heavily encrusted with popcorn and aragonite frostwork. Trays can form next to each other at different levels. Hollow stalagmites can sometimes be found directly below the trays and may exhibit as a splash ring.

References

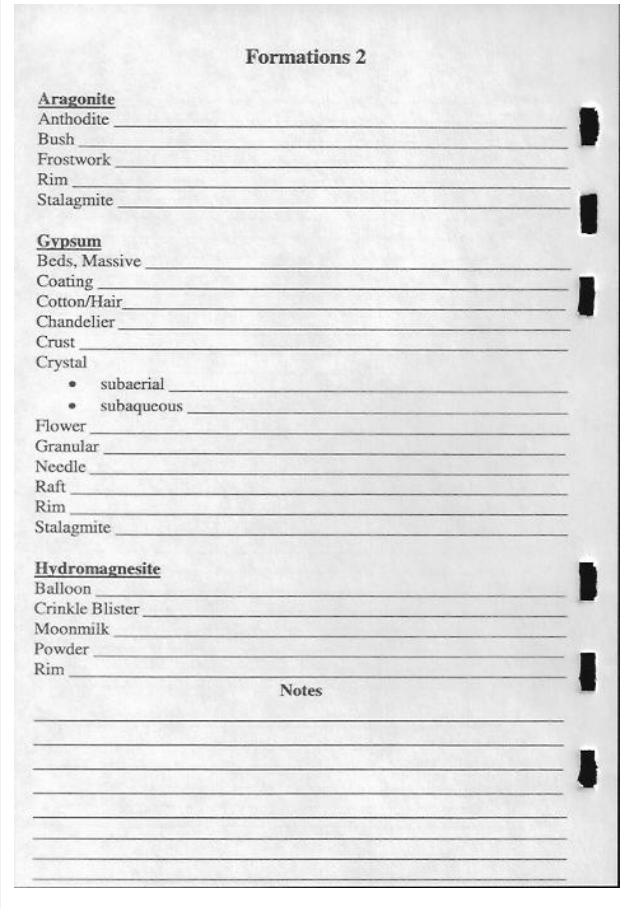
- Allison, Stan. *Canyons & Caves; Issue No. 19; Winter 2000 - 2001; CAVE TRAYS*: http://www.nps.gov/cave/planyourvisit/upload/c&c19.pdf
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p288 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Tray, Calcite

Trays with nailhead spar

Page 4

Formations 2



Formations 2

Aragonite
Anthodite
Bush
Frostwork
Rim
Stalagmite

Gypsum
Beds, Massive
Coating
Cotton/Hair
Chandelier
Crust
Crystal
- subaerial
- subaqueous

Flower
Granular
Needle
Raft
Rim
Stalagmite

Hydromagnesite
Balloon
Crinkle Blister
Moonmilk
Powder
Rim

Notes

The **Formations 2** page of the *Carlsbad Cavern National Park Cave Inventory Form* is the page 4 and includes sections for aragonite, gypsum and hydromagnesite.

Sections

- Aragonite
- Gypsum
- Hydromagnesite

Aragonite

Aragonite

The **Aragonite** section should be used to record stations where aragonite is observed. Specific types of aragonite formations are recorded in the fields.

Fields

- Anthodite
- Aragonite Bush
- Frostwork
- Rim
- Stalagmite

Anthodite, Aragonite

Anthodite

Anthodites are clusters of quill-like sprays radiating from a central location.

Anthodites are usually white and resemble a sea urchin. Though in the aragonite section of the inventory form, they are usually composed of calcite but may have aragonite mixed in. Anthodites are hard to classify because they may resemble other speleothems such as antler helictites.

Antler helictites form by capillary or wicking of solutions through a tiny central canal. Anthodites form from thin solutions along the outer surface.

The differences between anthodites, frostwork and helictites, especially antler helictites, are transitional in nature. One may transform into the other and they are often found associated and even mixed together in the same formation. The differences are often subtle and distinctions are sometimes arbitrary. Deciding how to classify one of these types on the inventory form is sometimes subjective and inexact.

In general:

- Anthodites are spiky, like quills, and radiate from a central point.
- Frostwork is fine, needle-like and looks like ice crystals.
- Antler Helictites are more like a deer antler.

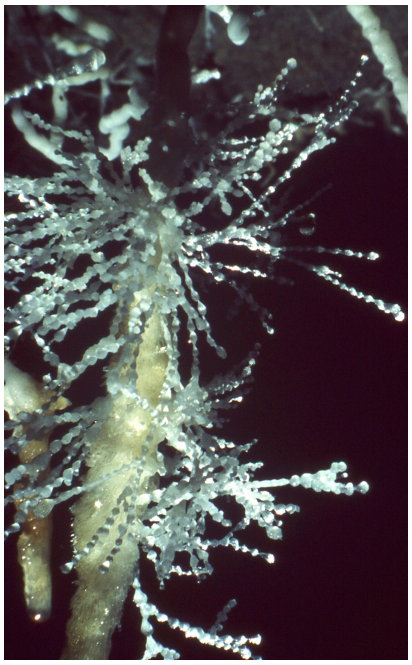
A single formation could show qualities of each and it would not be improper to classify it under more than one category, if so.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 45-47 ISBN: 1-879961-07-5

Anthodite, Aragonite

Anthodite



Beaded Anthodite

Aragonite Bush, Aragonite

Aragonite bush

The **Aragonite bush** field of the Aragonite section should record any observation of the bush form of aragonite.

Aragonite bushes are dense clusters of aragonite in the form of bushes or Christmas trees. They often exhibit frostwork, fine, white, needle-like growths of crystals that individually look very much like ice crystals. Aragonite bushes can vary in size from small to large. If the bush contains frostwork, that should also be recorded in the frostwork field.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 74-75 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 289 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Aragonite Bush, Aragonite

Aragonite Bush

Frostwork, Aragonite

Frostwork

The **Frostwork** field of the Aragonite section should record any observation of frostwork.

Frostwork is fine, white, needle-like growths of aragonite crystals that look very much like ice crystals. Frostwork can appear in aragonite bushes which should also be recorded in the aragonite bushes field. Frostwork can also appear separate from bushes on popcorn nodules or growing from calcite crusts and coatings.

Frostwork crystals are usually short but can be many millimeters long in some situations. They often radiate outward.

Examine all popcorn carefully for signs of frostwork growing within it and examine any aragonite bushes for frostwork which may be present at the tips.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 74-75 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 289 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Rim, Aragonite

The **Rim** field of the Aragonite section should be used to record stations that exhibit rims of aragonite. Other mineral rims have their own field in their respective sections.

Aragonite rims (also sometimes known as vents) are wind formed features of aragonite. They form usually around constrictions where consistent airflow is present. They are smooth on the inside but rough on the outside with features such as popcorn or frostwork lining the outside surface. Rims form as a shell or projection extending on the upwind side of a constriction where moisture laden air consistently escapes. As such, they tend to require a pool or water source somewhere on the downwind side in order to provide the moist, warm air.

Rims can be any of a number of shapes from round tubes or eggs to more irregular shells or ears. They tend to conform somewhat to the shape of the constriction but may be biased in only one direction by the airflow. They can be found on the floor, walls or ceiling; anywhere air is or was escaping.

Rims can form from various mineral materials and several of them have fields on the inventory form. The appropriate field based on the mineral content of the rim feature should be used. Only gypsum rims are recorded in this field.

Stalagmite, Aragonite

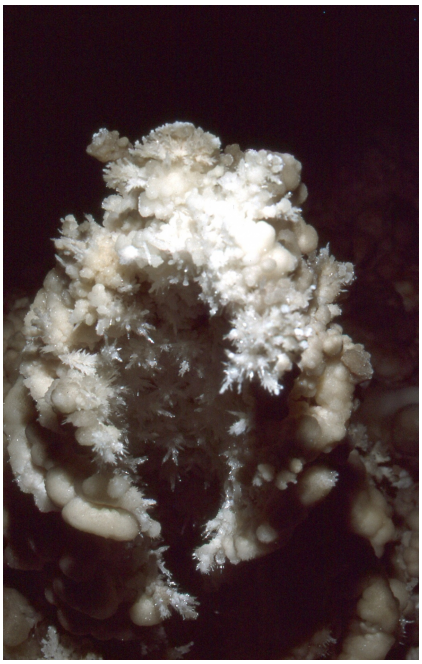
Aragonite stalagmite

The **Stalagmite** field of the Aragonite section should list stations where stalagmites of aragonite are observed. Gypsum stalagmites and calcite stalagmites have their own fields on the form.

Aragonite Stalagmites are secondary floor deposits of aragonite and are similar to calcite stalagmites but are not smooth. They are covered with jagged aragonite nodules. These nodules are often brittle and easily broken if touched. It may be difficult to distinguish aragonite stalagmites from calcite coral stalagmites.

An aragonite stalagmite of any size or shape should be recorded in this field.

Stalagmite, Aragonite



Aragonite stalagmite

Gypsum

Gypsum

The **Gypsum** section is used to record stations where some form of gypsum appears. Record the station next to the type of gypsum formation.

Fields

- Beds, Massive
- Coating
- Cotton/Hair
- Chandelier
- Crust
- Crystal
- Flower
- Granular
- Needle
- Raft
- Rim
- Stalagmite

Beds, Massive, Gypsum

Massive gypsum

The **Beds, Massive** field of the Gypsum section should be used to record stations where massive gypsum is found.

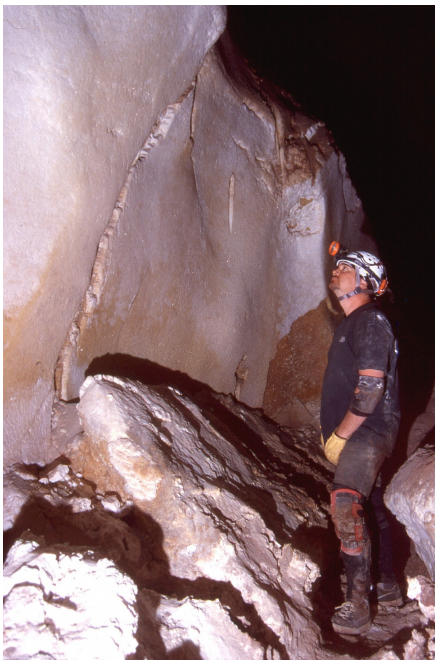
In sulfuric acid caves, gypsum can accumulate in large, massive deposits. These deposits can appear as blocks on the cave floor. They are white in color but can be discolored and obscured by sediments, guano and other things.

Drip pits and rillenkarren can be associated with these massive gypsum beds.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 215-225, especially 220 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Beds, Massive, Gypsum



Massive gypsum

Coating, Gypsum

Gypsum coating in the form of stars on bedrock.

The **Coating** field of the Gypsum section should be used to list stations where a coating of gypsum is found.

A gypsum coating is a thin layer or layers of gypsum usually over bedrock or breakdown. It sometimes appears in star-like patterns but can take on many shapes. It can form on soils or even guano but is usually on rock. It is much thinner than a gypsum crust and more tightly adhered to the underlying structure. The distinctions between a gypsum coating and a gypsum crust may be subtle.

Gypsum sometimes makes starbursts while calcite tends to have squarish crystals. Aragonite and moonmilk are both bright white. Coatings may build up in layers, coating upon coating, to form thicker coatings.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 55-56, 145 ISBN: 1-879961-07-5

Cotton/Hair, Gypsum

Gypsum hair

The **Cotton/Hair** field of the Gypsum section should be used to record any observation of fibrous forms of gypsum.

Fibrous forms of gypsum are known by several descriptive names depending upon the appearance. These include: cotton, hair, beards, ropes, wool and others. All of the fibrous forms are closely related and should be inventoried in this field. Needles and flowers have their own fields.

The fibrous forms of gypsum are among the most delicate of speleothems. They appear as fine threads of gypsum, sometimes individually and sometimes in clusters or even coils like ropes. They can be found hanging from ceiling, growing from the walls, on ledges or on the floor especially in damp mud.

Fibrous gypsum is very fragile and even disturbance of the air from a passing caver or breath can damage them.

Look for the fibrous forms of gypsum anywhere gypsum may be present. Be sure to look under breakdown especially if the floor sediments are moist. Take great care not to damage them.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 66-68 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 290-291 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Cotton/Hair, Gypsum

Gypsum cotton

Gypsum hairs

Chandelier, Gypsum

Gypsum chandelier

The **Chandelier** field should be used to record stations that exhibit gypsum chandeliers.

Chandeliers are easily the most impressive of gypsum formations. They hang downward from the ceiling or outward from the wall in cascading, branching arrays of white gypsum. The arms may branch in various directions but tend downward. The arms are usually more massive at the base and thin as each branch occurs often terminating in selenite needles. If still active, drops of water may be visible at the tips. If inactive, it may be coated with a fine, white gypsum powder. The arms are often described as being claw-like or dagger-like. Chandeliers can vary in size and can be quite large. Large epsomite formations can sometimes be confused with gypsum chandeliers.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 291-292 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Chandelier, Gypsum

Gypsum chandelier

Crust, Gypsum

Gypsum crust

The **Crust** field of the Gypsum section should be used to list stations where a crust of gypsum is observed.

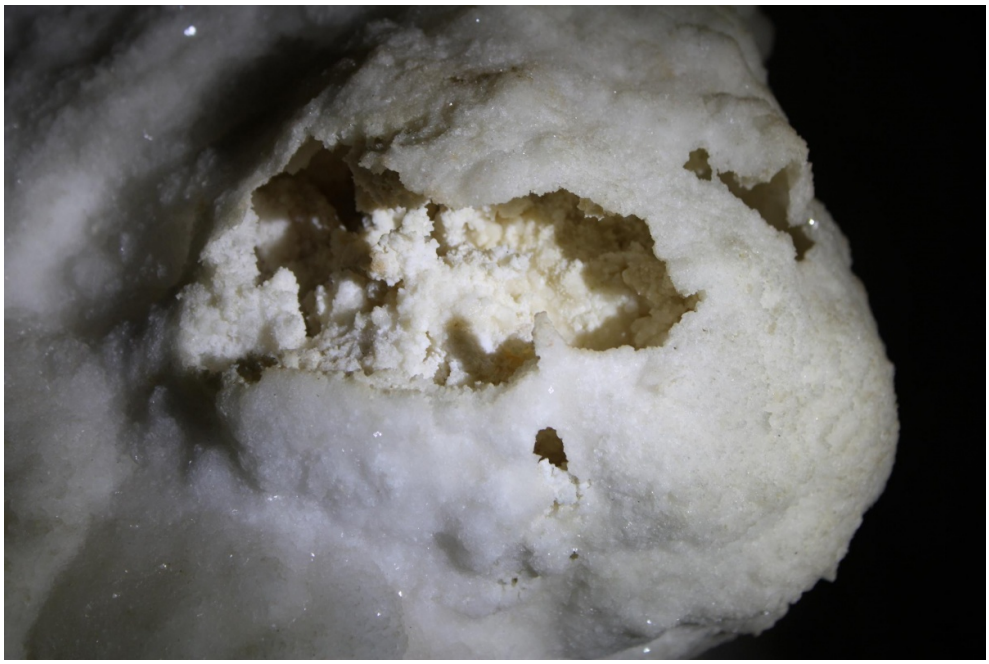
A gypsum crust is a poorly adhered layer of gypsum usually over bedrock or breakdown. Often there will be noticeable space between the crust and the structure that it covers. It usually appears as white, crystaline layer but may be discolored by dirt, dust or any number of other stains. Gypsum crusts can vary in thickness from a millimeter up to a half meter thick and can have the appearance of snow packed against the bedrock.

Gypsum crusts are often very fragile, brittle and easily broken if touched and though they sometimes appear substantial, they are not. The primary distinction between a gypsum crust and a gypsum coating is that a crust is less firmly adhered to the substructure.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 289-290 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Crust, Gypsum



Gypsum crust

Crystal, Gypsum

The **Crystal** subsection of the Gypsum section is used to record appearances of crystal gypsum. Specific types should be recorded in the appropriate field.

Fields

- subaerial
- subaqueous

subaerial, Gypsum

Subaerial gypsum crystals

subaqueous, Gypsum

Subaqueous gypsum crystals

subaqueous, Crystal, Gypsum

Selenite crystal

Selenite crystals

Flower, Gypsum

Gypsum flower

The **Flower** field is used to record stations where gypsum flowers are found.

Gypsum flowers form when pyrite oxidizes just below the surface of exposed bedrock. They grow outward in curving fronds that appear to have been squeezed out of the rock like toothpaste. They form fronds which curl and separate, spreading to make something that resembles a flower. They are usually dry and white in color but can be stained, particularly with rust colors. Gypsum flowers are usually tiny to small but they can grow to be large with fronds of several feet. The diameter of each frond can vary from tiny to several inches on larger flowers. Gypsum flowers sometimes appear as single fronds, so the flower-like shape is not a requirement. Look for gypsum flowers with careful and close examination of all surfaces, especially exposed bedrock, breakdown and soils which might be just a thin layer over bedrock. Also look for them among gypsum crusts as they often occur together.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 291 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 63 ISBN: 1-879961-07-5

Flower, Gypsum

Various gypsum flowers. Pen for scale.

A variety of gypsum flowers.

Granular, Gypsum

Granular gypsum

The **Granular** field of the Gypsum section should be used to list stations where granular gypsum appears.

Gypsum can appear in granular form which can vary from fine powder to course granules. If present, t is usually found on the floor or a shelf where other gypsum is present.

Needle, Gypsum

Gypsum needle

The **Needle** field of the Gypsum section should be used to record any stations that exhibit gypsum needles.

Gypsum needles (also known as selenite needles) are thin blades of gypsum that look like needles. They are straight and can vary in length from a few milimeters to several meters in length in rare cases. The color is usually clear but shorter varieties can grow in mud and be stained by the mud itself. Gypsum needles are closely related to gypsum cotton and hair and often occur in proximity.

Gypsum needles seem to grow upward from floor sediments and soils seeming to push aside the individual grains of soil as they grow. However, they can also be found on bedrock in the floor, on walls or even on the ceiling and growing from other speleothems where they often lie flat and radiate in clusters.

Examine closely to notice these delicate speleothems especially where other gypsum formations are found and floor sediments are present.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 103-104 ISBN: 1-879961-07-5
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 290-291 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Needle, Gypsum

Gypsum needles. These are fine enough that they could be inventoried as Gypsum Cotton/Hair.

Raft, Gypsum

The **Raft** field of the Gypsum section is used to record stations where gypsum cave rafts are observed.

Gypsum rafts are similar to calcite rafts. They are thin accumulations of gypsum that form on the surface of cave pools. Only gypsum rafts should be recorded in this field.

Cave rafts form as extremely thin accumulations of crystals floating on the surface of a pool only because of surface tension. They form on still water. As they grow, they grow downward becoming thicker until they are too massive to float or are disturbed in which case they sink to the bottom of the pool.

Cave rafts may be observed: on the surface of pools; under water on the bottom of a pool; or lying along the bottom of a former pool. Cave rafts on the surface of a pool may be very thin looking like a film of powder or dust on the water. Cave rafts are usually white, yellowish or brown in color and look like ice or very thin lily pads. They may be touching the edge of a pool or floating freely but are incapable of supporting their own weight should the pool drop. The top sides of cave rafts are flat and may be smooth or glossy. The bottom sides are rough. The shape may be very irregular and may even have holes in it like lace.

Rafts usually do not exceed 15 cm in diameter and 1 mm in thickness (about the thickness of a piece of paper). If the rafts are in a dried pool, they may have become cemented to the floor or could still be loose.

Look for cave rafts in every pool encountered no matter its size. Also look for them on the bottom of pools or former pools.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 278-279 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 88 ISBN: 1-879961-07-5

Rim, Gypsum

Gypsum rim

The **Rim** field of the Gypsum section should be used to record stations that exhibit rims of gypsum. Other mineral rims have their own field in their respective sections.

Gypsum rims (also sometimes known as vents) are wind formed features of gypsum. They form usually around constrictions where consistent airflow is present. Rims form as a shell or projection extending on the upwind side of a constriction where moisture laden air consistently escapes. As such, they tend to require a pool or water source somewhere on the downwind side in order to provide the moist, warm air.

Rims can be any of a number of shapes from round tubes or eggs to more irregular shells or ears. They tend to conform somewhat to the shape of the constriction but may be biased in only one direction by the airflow. They can be found on the floor, walls or ceiling; anywhere air is or was escaping.

Rims can form from various mineral materials and several of them have fields on the inventory form. The appropriate field based on the mineral content of the rim feature should be used. Only gypsum rims are recorded in this field.

Rim, Gypsum

Gypsum rim vents

Stalagmite, Gypsum

Gypsum stalagmite

Hydromagnesite

Hydromagnesite

The **Hydromagnesite** section contains fields which should be used to record appearances of hydromagnesite.

Fields

- Balloon
- Crinkle Blister
- Moonmilk
- Powder
- Rim

Balloon, Hydromagnesite

Hydromagnesite balloons

The **Balloon** field of the Hydromagnesite section should be used to list stations that have a Hydromagnesite Balloon.

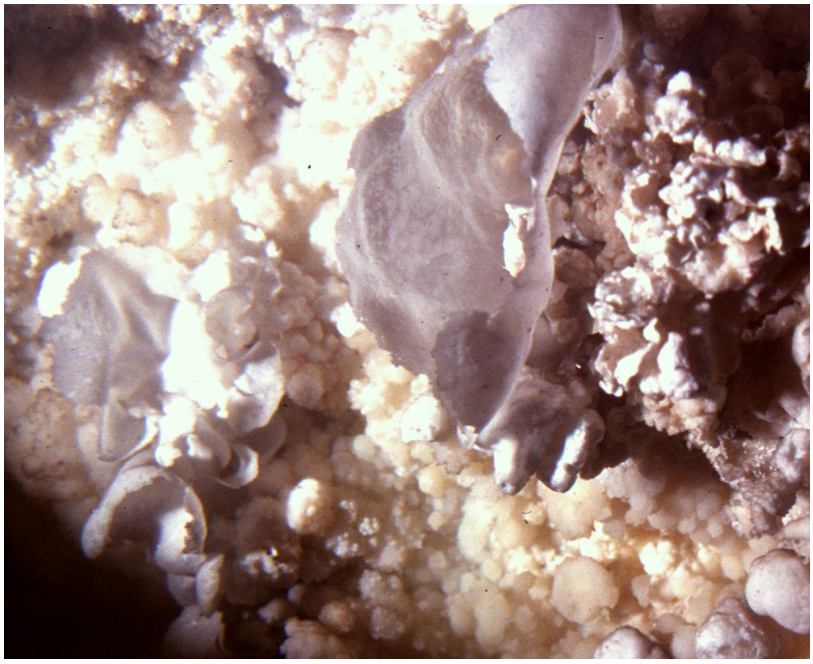
Hydromagnesite Balloons are thin hollow shells of hydromagnesite. They often look like they have been inflated and then maybe partially deflated. They are usually white in color and may have a pearly texture. They are mainly found on bedrock but sometimes on other speleothems. They are also most commonly found on the cave walls. Balloons are rare and there are no known situations where they are actively forming. If you happen to find one which appears to be forming (it may appear to be wet and pliable), that would be a good time for a note on the inventory form and a photograph.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 292-293 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 4

Balloon, Hydromagnesite

Hydromagnesite balloon



Closeup of a balloon

Crinkle Blister, Hydromagnesite

Crinkle blisters

The **Crinkle Blister** field of the Hydromagnesite section should be used to record stations which exhibit cave blisters.

Crinkle Blisters are thin, hollow balls that form on cave walls and other speleothems. Even though this field appears under the hydromagnesite section of the *CCNP Cave Inventory Form*, most blisters are made of calcite or gypsum. Any blisters found should be recorded here no matter their composition which may be difficult to determine, anyway. Most crinkle blisters are rarely more than a few centimeters in diameter. They can sometimes appear as curling flakes. The thickness of the walls can range from half a millimeter to almost one centimeter. They are formed from pasty minerals which have dried. They sometimes appear in blobs like shaving cream.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 293 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Crinkle Blister, Hydromagnesite

Crinkle blisters

Crinkle blisters in the form of curling flakes

Crinkle blisters

Moonmilk, Hydromagnesite

Moonmilk on soda straw

The **Moonmilk** field of the Hydromagnesite section should be used to record any observation of moonmilk no matter its mineral content which may be hard to determine in the field anyway.

Moonmilk is a soft, white, pasty deposit. The texture is often described as having the consistency of cottage cheese. Small particles in the deposit account for the smooth texture. It can range from liquid to a dry powder depending upon the environment. The powder form is inventoried in a different field.

The mineral content of moonmilk can be hydromagnesite, dolomite, huntite, calcite, aragonite, or a variety of other minerals. It is most commonly found near the intersection of the massive reef with either the forereef or backreef. Moonmilk deposits can appear anywhere and on anything including other formations.

References

- Burgess, Harry. *Canyons & Caves; Issue No. 3; Fall 1996*; Moonmilk: http://www.nps.gov/cave/planyourvisit/upload/c&c3.pdf

Moonmilk, Hydromagnesite

Moonmilk stalagmite

Moonmilk flowstone, hand for scale

Powder, Hydromagnesite

Hydromagnesite powder

The **Powder** field of the Hydromagnesite section should record any observation of the powdery form of moonmilk.

The powdery form of moonmilk can be any of a number of minerals including hydromagnesite, dolomite, huntite, calcite, aragonite, and others. The powdery form is usually white and looks like talcum powder. It is basically dehydrated moonmilk or corroded calcite. Any observation of powdery moonmilk should be recorded in this field as it is difficult to determine the specific mineral content without testing. The powdery form of moonmilk is usually found on the floor or shelves as it does not adhere well.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 298 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society p 143 ISBN: 1-879961-07-5

Rim, Hydromagnesite

Hydromegnesite rim

The **Rim** field of the Hydromagnesite section should be used to record stations that exhibit rims of hydromagnesite. Other mineral rims have their own field in their respective sections.

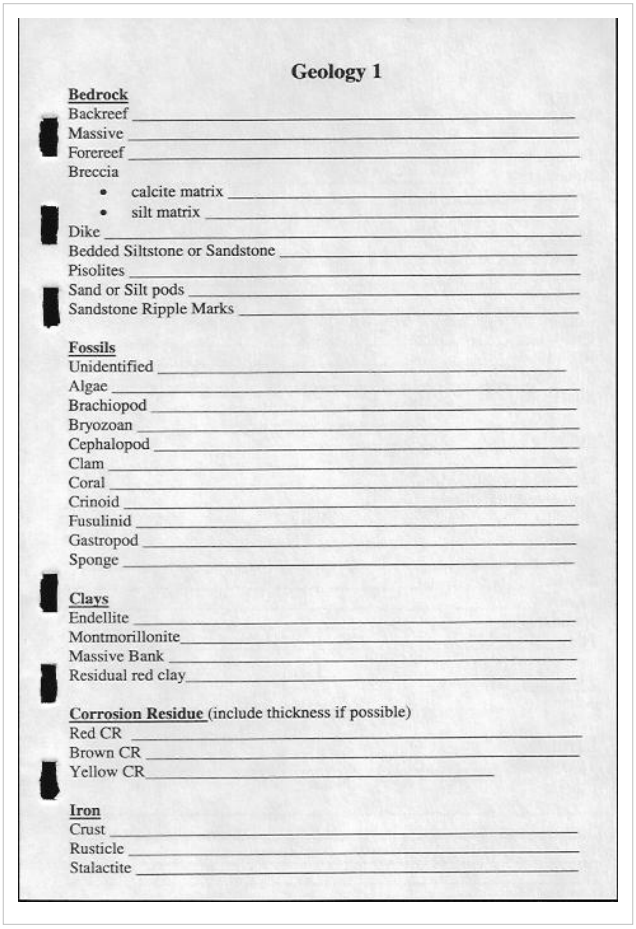
Hydromagnesite rims (also sometimes known as vents) are wind formed features of hydromagnesite. They form usually around constrictions where consistent airflow is present. Rims form as a shell or projection extending on the upwind side of a constriction where moisture laden air consistently escapes. As such, they tend to require a pool or water source somewhere on the downwind side in order to provide the moist, warm air.

Rims can be any of a number of shapes from round tubes or eggs to more irregular shells or ears. They tend to conform somewhat to the shape of the constriction but may be biased in only one direction by the airflow. They can be found on the floor, walls or ceiling; anywhere air is or was escaping.

Rims can form from various mineral materials and several of them have fields on the inventory form. The appropriate field based on the mineral content of the rim feature should be used. Only hydromagnesite rims are recorded in this field.

Page 5

Geology 1



Geology 1

Bedrock
Backreef _____
Massive _____
Forereef _____
Breccia
- calcite matrix _____
- silt matrix _____

Dike _____
Bedded Siltstone or Sandstone _____
Pisolites _____
Sand or Silt pods _____
Sandstone Ripple Marks _____

Fossils
Unidentified _____
Algae _____
Brachiopod _____
Bryozoan _____
Cephalopod _____
Clam _____
Coral _____
Crinoid _____
Fusulinid _____
Gastropod _____
Sponge _____

Clays
Endellite _____
Montmorillonite _____
Massive Bank _____
Residual red clay _____

Corrosion Residue (include thickness if possible)
Red CR _____
Brown CR _____
Yellow CR _____

Iron
Crust _____
Rusticle _____
Stalactite _____

The **Geology 1** page of the *Carlsbad Cavern National Park Cave Inventory Form* is page 5 and includes sections for bedrock, fossils, clays, corrosion residue and iron.

Sections

- Bedrock
- Fossils
- Clays
- Corrosion residue
- Iron

Bedrock

Bedrock

The **Bedrock** section should be used to record stations where the bedrock can be observed or determined. Record the station in the field indicating the type of bedrock.

Fields and subsections

- Backreef
- Massive
- Forereef
- Breccia
- Dike
- Bedded Siltstone or Sandstone
- Pisolites
- Sand or Silt pods
- Sandstone Ripple Marks

Backreef, Bedrock

The **Backreef** field of the Bedrock section is used to list stations where backreef bedrock is observed.

Backreef is indicated by horizontal limestone and dolomite strata. The strata are usually thin and bedded with sandstone and dolomites. It is lightly colored and sometimes has large gastropods. Pisolites are a characteristic of backreef bedrock.

References

- Various (June 2004) *Core Values* Carlsbad Caverns National Park; as published by Bob Hoff: http://carlsbadcavernshistory.blogspot.com/2011/05/carlsbad-caverns-national-park-core.html
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 4

Massive, Bedrock

Massive reef

The **Massive** field of the Bedrock section is used to list stations where massive reef bedrock is observed.

The massive reef is indicated by unstratified limestone. It is poor in fossils (usually only algae and sponge). It is fine grained, light gray to cream colored and may contain many vugs.

References

- Various (June 2004) *Core Values* Carlsbad Caverns National Park; as published by Bob Hoff: http://carlsbadcavernshistory.blogspot.com/2011/05/carlsbad-caverns-national-park-core.html
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 4

Forereef, Bedrock

The **Forereef** field of the Bedrock section is used to list stations where forereef bedrock is observed.

Forereef is indicated by sloping, brecciated limestone strata. The color is light buff to pink. It often contains good fossils such as brachiopods, bryozoans, crinoids and sponges.

References

- Various (June 2004) *Core Values* Carlsbad Caverns National Park; as published by Bob Hoff: http://carlsbadcavernshistory.blogspot.com/2011/05/carlsbad-caverns-national-park-core.html
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 4

Breccia, Bedrock

The fields of the **Breccia** subsection of the Bedrock section are used to further classify breccia as to the binding agent in the matrix.

Breccia is composed of fragments of other rock cemented together by some kind of matrix. For purposes of the Carlsbad Cavern National Park Cave Inventory Form, the two possible matrices are calcite and silt.

Fields

- calcite matrix
- silt matrix

calcite matrix, Breccia, Bedrock

calcite matrix breccia

The **calcite matrix** field of the bedrock breccia section should be used to list stations which exhibit breccia that is bound by a calcite matrix.

Breccia is composed of fragments of other rock cemented together by some kind of matrix. Breccia to be listed in this field is cemented by calcite.

Bedded Siltstone or Sandstone, Bedrock

Bedded siltstone.

The **Bedded Siltstone or Sandstone** field should be used to list stations that exhibit bedrock with siltstone or sandstone that is clearly bedded. Siltstone or Sandstone that appears as pods should be inventoried as Sand or Silt pods.

Bedded siltstone or sandstone may be found anywhere that bedrock is visible. It is an indicator of backreef.

Pisolites, Bedrock

Pisolites. Rarely are they as pronounced and distinguished as this.

The **Pisolites** field should be used to list stations that exhibit bedrock with pisolites.

Pisolites are not a formation. They are an exposed characteristic of the original bedrock and exhibit as round nodules (sometimes with layers). They rarely appear singularly but instead most often appear in clusters or layers in the bedrock. The size can vary from pea-sized to larger. Very small varieties are often distinguished by being called "oolites" but for purposes of the *CCNP Cave Inventory Form*, all pisolites and oolites no matter their size should be inventoried in this field.

Pisolitic limestone (that is, bedrock limestone that contains pisolites) can be obscured by any type of secondary formation. They can also be found in breakdown -- anywhere that bedrock is exposed. They are a characteristic of backreef and are an indicator of backreef bedrock.

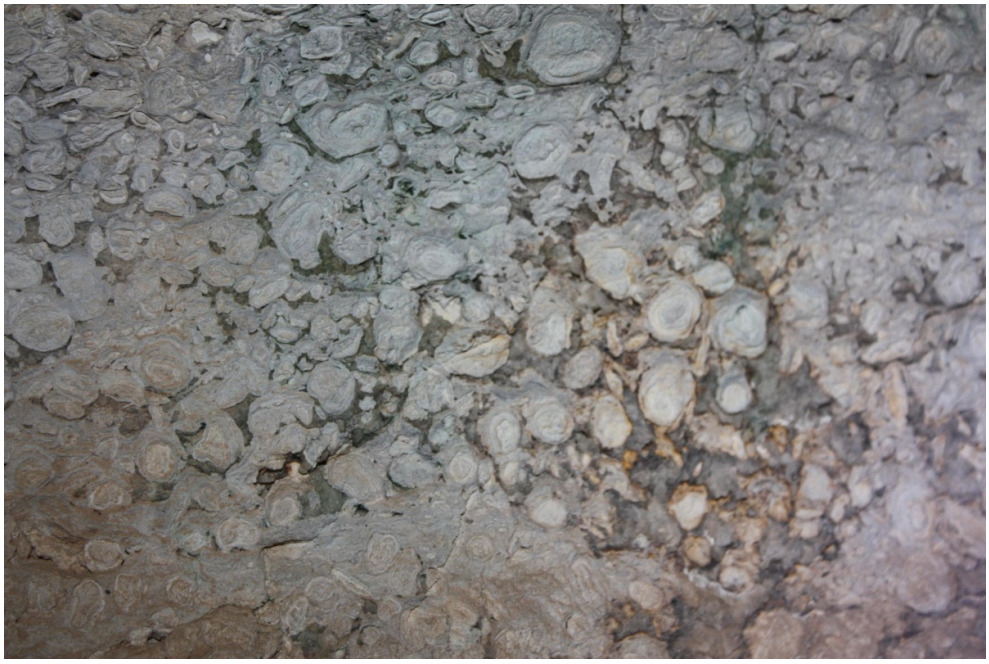
Pisolites are not to be confused with cave pearls.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 67 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Pisolites, Bedrock

Pisolites



Pisolites

Sandstone Ripple Marks, Bedrock

Sandstone Ripple Marks

The **Sandstone Ripple Marks** field should be used to list stations that exhibit bedrock with sandstone that shows ripple marks. Siltstone or Sandstone that appears as pods should be inventoried as Sand or Silt pods and bedded sandstone should be inventoried as Bedded Siltstone or Sandstone.

Sandstone ripple marks may be found anywhere that bedrock is visible; but, it is usually found on the wall or in breakdown. It is an indicator of backreef.

Fossils

Fossils

The fields of the **Fossils** section are used to record stations with observable fossils.

Fields

- Unidentified
- Algae
- Brachiopod
- Bryozoan
- Cephalopod
- Clam
- Coral
- Crinoid
- Fusulinid
- Gastropod
- Sponge

Unidentified, Fossils

Sea urchin spine with unidentified fossil on left.

The **unidentified** field is used to record stations where a fossil is clearly seen, but cannot be identified by the inventory team. Fossils which can be identified but for which there is no specific field on the form may also be inventoried here with a note. There is no "other" field in the fossils section.

The sea urchin spine seen at the same station in this photo should be inventoried here with a note as there is not a pre-set category for it on the form. The same with the echinoid fossil in the photo below.

Photos should be taken of unidentified fossils whenever possible to be used to help identify it with outside assistance.

Example

Fossils

Unidentified: GG39 (photo JF-#1036 & Sea Urchin Spine)

Unidentified, Fossils

Echinoid spine and base

Algae, Fossils

The **Algae** field of the Fossils section should be used to record any observation of fossil algae.

There are about a dozen different types of algae that have been identified in the Guadalupes through fossil impressions. They appear as thin, multiple uniform layers. They may be straight, tightly curved, or stacked. They can be found in the massive reef or forereef.

References

- Coleman, Mary Carol and Cameron Coleman (2010) *Fossils of Guadalupe Mountains National Park* Carlsbad Caverns Guadalupe Mountains Association pp 10-12, http://www.ccgma.org

Brachiopod, Fossils

Brachiopod

The **Brachiopod** field of the Fossils section should be used to record any observation of fossil brachiopods.

Brachiopods are marine animals with a hinged, two-part shell on the top and bottom as opposed to the left and right arrangement of clams. They are, therefore, a bivalve but are not really related to other bivalve mollusks. Brachiopods also have a coiled, rigid cartilaginous internal structure called a lophophore, which sometimes appears in fossils.

Brachiopods and clams are sometimes difficult to distinguish as fossils. If the impression is bilaterally symmetrical, it is probably a brachiopod. If asymmetrical, it is probably a clam.

Brachiopod impressions can occur in large clusters.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York p 89 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3
- Coleman, Mary Carol and Cameron Coleman (2010) *Fossils of Guadalupe Mountains National Park* Carlsbad Caverns Guadalupe Mountains Association pp 23-26, http://www.ccgma.org

Bryozoan, Fossils

Bryozoan fan

The **Bryozoan** field of the Fossils section should be used to record stations where a bryozoan fossil is found.

Bryozoan fossils have a diverse variety of appearances. Some look like pieces of broken twigs with possible branches. Others appear as mesh like patterns and textures. Others appear as a screw-like spiral shape.

Dendrite, Manganese

Bryozoan

Cephalopod, Fossils

Vertical cross section of a nautiloid, a type of cephalopod

The **Cephalopod** field should be used to list stations which exhibit cephalopod fossils.

Cephalopod fossils are characterized by a chambered shell. They are coiled in one plane or straight and tapered with internal chambers. They are usually found in exposed bedrock or breakdown and may be obscured in various ways. They could be covered partially or completely by secondary formations and they could be exposed in any direction or in any cross section.

There are two major groups of cephalopods, ammonoids and nautiloids. There is no reason to distinguish these on the inventory form, they are both cephalopods.

Ammonoids have a spiral shell, coiled in one plane with internal chambers that may be wavy or complicated. In vertical cross section, the chambers may appear like a spiral of progressively smaller circular voids. They are uncommon but can be found in various places.

Nautiloids have a spiral shell, coiled in one plane with curved internal chambers. These are commonly referred to as a *chambered nautilus* or *chambered nautiloid*. The interior chambers are smoothly curved.

Cephalopods can also have a straight, tapered, not coiled, shell.

If a shell impression is found (not a clam or brachiopod) with internal chambers, it is probably a cephalopod. If there are no internal chambers, it is probably a gastropod. If the interior of the shell cannot be seen, a shell with logorithmically spaced indications of internal chambers is probably a cephalopod. A shell with a smooth exterior or fine, more evenly spaced growth rings is probably a gastropod. If the shell is straight, tapered, and not coiled, it is probably a cephalopod. If the shell is coiled but not in one plane, it is probably a gastropod.

The size of cephalopod fossil impressions can vary greatly.

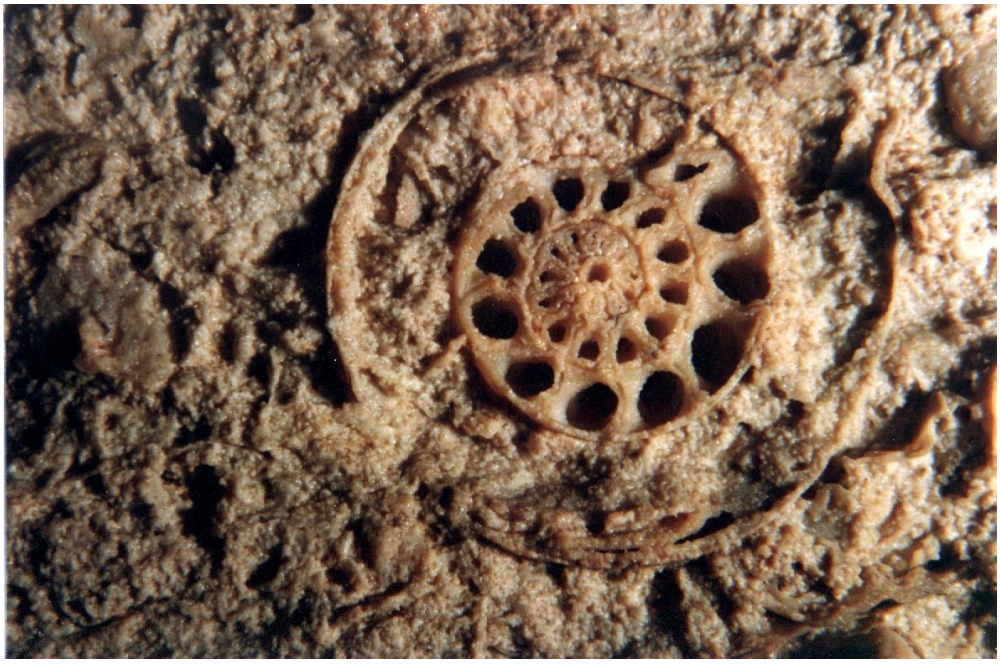
Cephalopods can leave fossil impressions with no shell. Tentacles like a squid or octopus are the clue to look for. These shell-less impressions are usually hard to recognize and identify, especially in bedrock exposed by dissolution or erosion.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 71-72 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Coleman, Mary Carol and Cameron Coleman (2010) *Fossils of Guadalupe Mountains National Park* Carlsbad Caverns Guadalupe Mountains Association pp 13-19, http://www.ccgma.org

Cephalopod, Fossils

Horizontal cross section of a cephalopod



Vertical cross section of an ammonoid, a type of cephalopod

Clam, Fossils

The **Clam** field of the Fossils section should be used to record any observation of a fossil clam. For purposes of the *CCNP Cave Inventory Form*, a clam refers to any bivalve mollusk (not a brachiopod).

Clams and brachiopods are superficially similar. They both have a hinged shell consisting of two valves. In brachiopods, the two valves are on the dorsal and ventral surfaces of the body and are symmetrical, while in clams, they are on the left and right sides and are asymmetrical. Other than their superficial similarities, they are not really related.

Clams and brachiopods are sometimes difficult to distinguish. The primary distinguishing characteristic is symmetry in the shell. Clams have an asymmetrical shell while brachiopods have a symmetrical shell. Clams are also known as pelecypods.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York pp 89-90 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3
- Coleman, Mary Carol and Cameron Coleman (2010) *Fossils of Guadalupe Mountains National Park* Carlsbad Caverns Guadalupe Mountains Association pp 27-28, http://www.ccgma.org

Crinoid, Fossils

An exceptional example of a crinoid. Most are much more difficult to recognize.

The **Crinoid** field should be used to record stations where crinoid fossils are found.

Crinoids are a marine animal which may be preserved in the bedrock as fossils. These fossils may then be exposed.

A complete crinoid looks like a lily with what appear to be roots, a stem and a flower; but, they are not plants but animals. Any portion may be exposed as a fossil; but, usually, the fossils are a cross section of the long stem and it appears like a stack of buttons.

Crinoids may be difficult to recognize and obscured by other formations. Look for them anywhere bedrock is exposed including breakdown.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 72 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Crinoid, Fossils

Crinoid stem

Fusulinid, Fossils

An exceptional example of fusulinids. Brown spots are corrosion residue.

The **Fusilinid** field of the Fossils section should be used to list stations which possess fusulinids.

Fusulinids are the largest of single celled fossils and are typically described as looking like grains of rice.

References

- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 5

Fusulinid, Fossils

Fusulinids altered to crystals

Gastropod, Fossils

Gastropod

The **Gastropod** field of the Fossils section should be used to record any observation of a fossil gastropod.

Gastropod fossils are characterized by a tapered spiral shell with no internal chambers. Snails are gastropods. They are usually found in exposed bedrock or breakdown and may be obscured in various ways. They could be covered partially or completely by secondary formations and they could be exposed in any direction or in any cross section. They can be flat or more elongated but are always spiraled and tapered somewhat. The spiral is usually in more than one plane.

If a spiral shell impression is found (not a clam or brachiopod) with no internal chambers, it is probably a gastropod. If there are internal chambers, it is probably a cephalopod. If the interior of the shell cannot be seen, a shell with no growth rings or fine, evenly spaced growth rings is probably a gastropod. A shell impression which is spiraled in more than one plane is probably a gastropod.

The size of gastropod fossil impressions can vary.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 71-72 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Coleman, Mary Carol and Cameron Coleman (2010) *Fossils of Guadalupe Mountains National Park* Carlsbad Caverns Guadalupe Mountains Association pp 20-22, http://www.ccgma.org

Sponge, Fossils

Sponge fossil

Clays

Clays

The **Clays** section is used to record appearances of some type of clay. The specific fields indicate the type of clay found.

Fields

- Endellite
- Montmorillonite
- Massive Bank
- Residual red clay

Endellite, Clays

Endellite

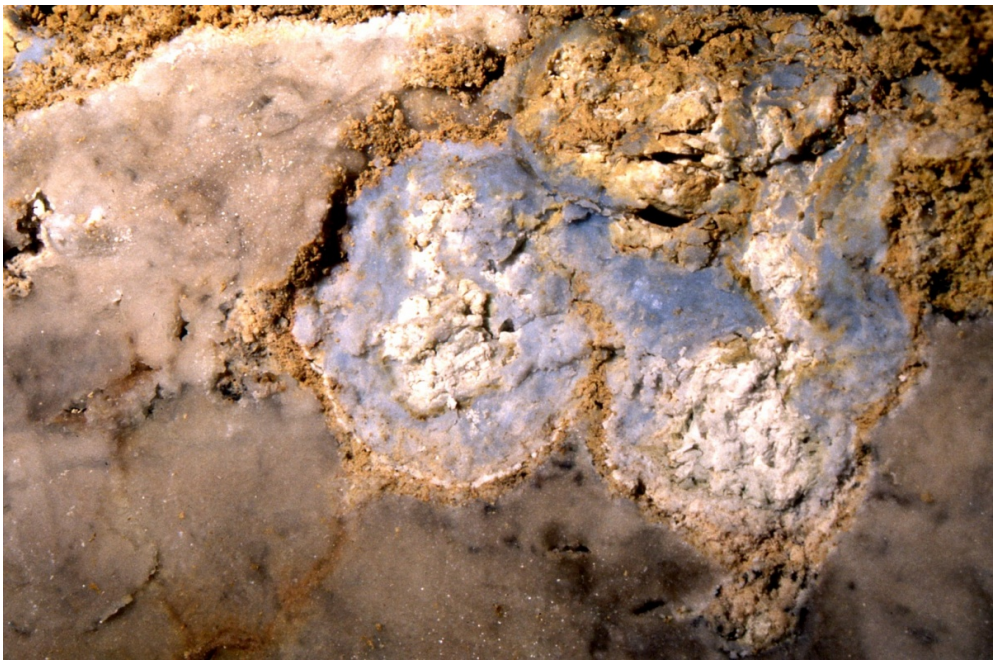
The **Endellite** field of the Clays section should list stations where endellite is found.

Endellite is an aluminosilicate clay mineral which has been transformed by sulphuric acid from montmorillonite. Geologists usually know it as "hydrated halloysite"; but, speleologists still use the term "endellite". It is often found associated with montmorillonite. It is usually bluish in color but the color can range from white to deep blue or green. It is waxy and looks something like candle wax or soap. It can appear under breakdown or scattered in sediments. Look for it anywhere clays may accumulate.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 119 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 177, 181-182 ISBN: 1-879961-07-5

Endellite, Clays



Endellite in the wall

Endellite

Massive Bank, Clays

Graffiti sculpture in massive clay bank

The **Massive Bank** field of the Clays section should be used to record stations that exhibit a massive amount of clay in a single location.

In the Guadalupes, such massive banks of clay are usually red in color; but, they could be a variety of colors. Massive clay banks differ from corrosion residues. Where corrosion residues were concentrated when the limestone was dissolved and left them behind, massive clay banks are original concentrations in the bedrock. Similarly [[Clays (Inventory)/Residual red Clay|residual red clays are concentrated from dissolution and not original masses. This distinction may be difficult to discern accurately.

Massive clay banks are most often found associated with the backreef.

Residual red clay, Clays

The **Residual red clay** field of the Clays section should be used to record stations that exhibit residual red clay.

Red clay is probably the most common clay found in the Guadalupes. It can appear as both a massive bank or a residue. This field should be used to record occurances of the residual variety.

Residual red clays are similar to corrosion residues. They both form by residues left behind from dissolution of the original bedrock. The residual red clays are made up of clay particles where the corrosion residues are usually somewhat larger particles. This distinction may be difficult to discern accurately in the cave.

Residual red clays are most often found associated with the backreef.

Corrosion residue

Corrosion residue

Corrosion residues are relatively insoluable minerals which were once part of the bedrock. They were left behind and concentrated when the bedrock was dissolved. They are the waste products from bacterial processes which utilize manganese and iron in the rock for energy.

On the *CCNP Cave Inventory Form*, the recorder is asked only to distinguish them by color. There are three color categories on the form: red, brown and yellow. They can usually be found on the floor as fluffy, colored soils (speleosols) but could appear in cracks or vugs or on shelves and ledges. They could even appear as a type of crust or coating. Several colors could be present at a single location. Many caves in the Guadalupes have exceptional examples of corrosion residue. The individual grains of a corrosion residue accumulation are often arranged in tiny fractal patterns indicating a biological origin.

The *CCNP Cave Inventory Form* asks the recorder to include the thickness if possible. An estimate of how thick the accumulation is should be included next to the station.

Fields

- Red CR
- Brown CR
- Yellow CR

Example

Corrosion Residue

Red CR: GG39 (thin film)

Brown CR: GG40 (4 inches)

Yellow CR: GG37 (3 cm), 38 (2.5 cm)

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 337-338 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5
- Various (June 2004) *Core Values* Carlsbad Caverns National Park; as published by Bob Hoff: http://carlsbadcavernshistory.blogspot.com/2011/05/carlsbad-caverns-national-park-core.html

Red CR, Corrosion residue

Red corrosion residue

The **Red CR** field is used to record stations where red corrosion residue is found. The red is usually a rusty red color. The color often comes from iron oxides and may be altered by iron-oxidizing bacteria.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 338 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Brown CR, Corrosion residue

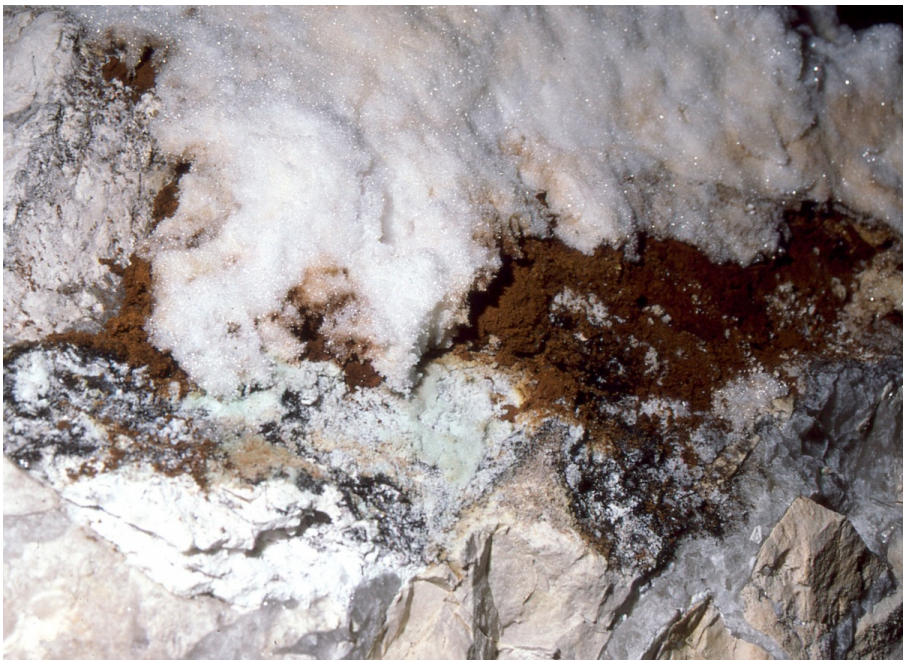
Brown corrosion residue

The **Brown CR** field is used to record stations where brown corrosion residue is found. The brown is usually a dark brown or even black. Manganese oxides often contribute these dark colors.

References

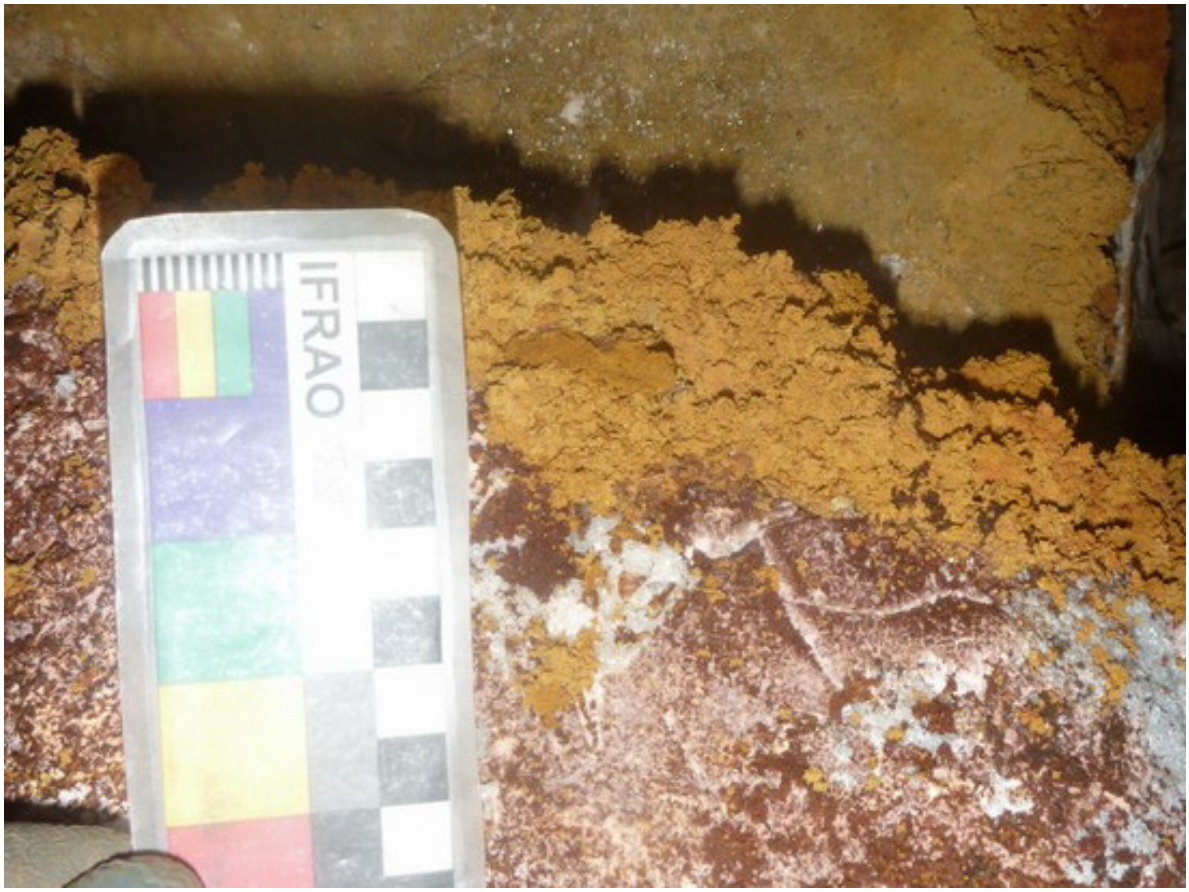
- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 338 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Brown CR, Corrosion residue



Brown corrosion residue under a gypsum crust

Yellow CR, Corrosion residue



Corrosion residues. Most of the corrosion residue in this photo is yellow. The darker residue is red.

The **Yellow CR** field is used to record stations where yellow corrosion residue is found. The yellow is usually a kind of dirty yellow color.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 338 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Iron

Iron

The **Iron** section is used to record any appearances of iron. Indicate the type of iron found by recording the station in the appropriate field.

Fields

- Crust
- Rusticle
- Stalactite

Crust, Iron

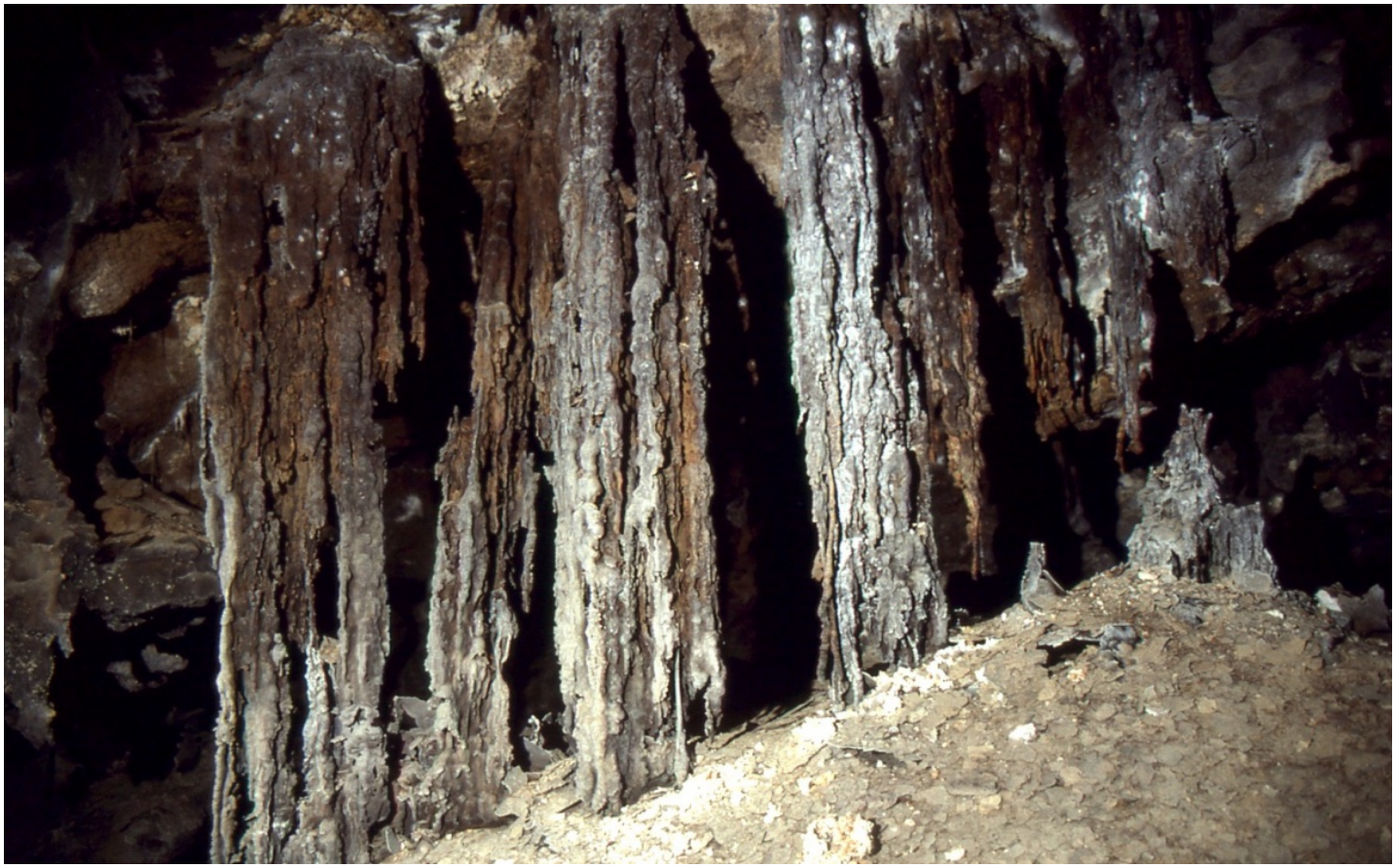
Iron crust on bedrock

The **Crust** field of the Iron section should be used to list stations which exhibit a crust of iron.

Iron crusts are secondary accumulations of iron usually on bedrock which are not an integral part of the underlying structure. Iron crusts vary in color from dark brown to rusty red and may exhibit a variety of colors in this range.

Iron crusts are rare and are usually found in backreef areas with plenty of sand and other minerals mixed into the limestone.

Rusticle, Iron



Rusticles

The **Rusticle** field of the Iron section should be used to record stations where rusticles are found.

Rusticles are unusual cave formations made primarily from or heavily influenced by iron or iron oxides. These iron formations can form unusual wire-like or very irregular shapes. They usually hang from the ceiling or an overhang in an outcrop but may grow from the wall or a breakdown boulder. The bedrock probably contains a concentration of iron which becomes the formation.

Rusticles and iron stalactites are similar and there is considerable confusion over the distinctions. Rusticles are usually thinner and more twisty, wirey or irregular while iron stalactites are basically more ordinary stalactites with an iron oxide coating or iron oxide incorporated in the formation. If the formation appears to be primarily made of iron or iron oxides, or is not a stalactite, it is best to inventory it as a rusticle. If it appears to be iron oxide over or in a more ordinary stalactite, it is better to inventory it as an iron stalactite.

References

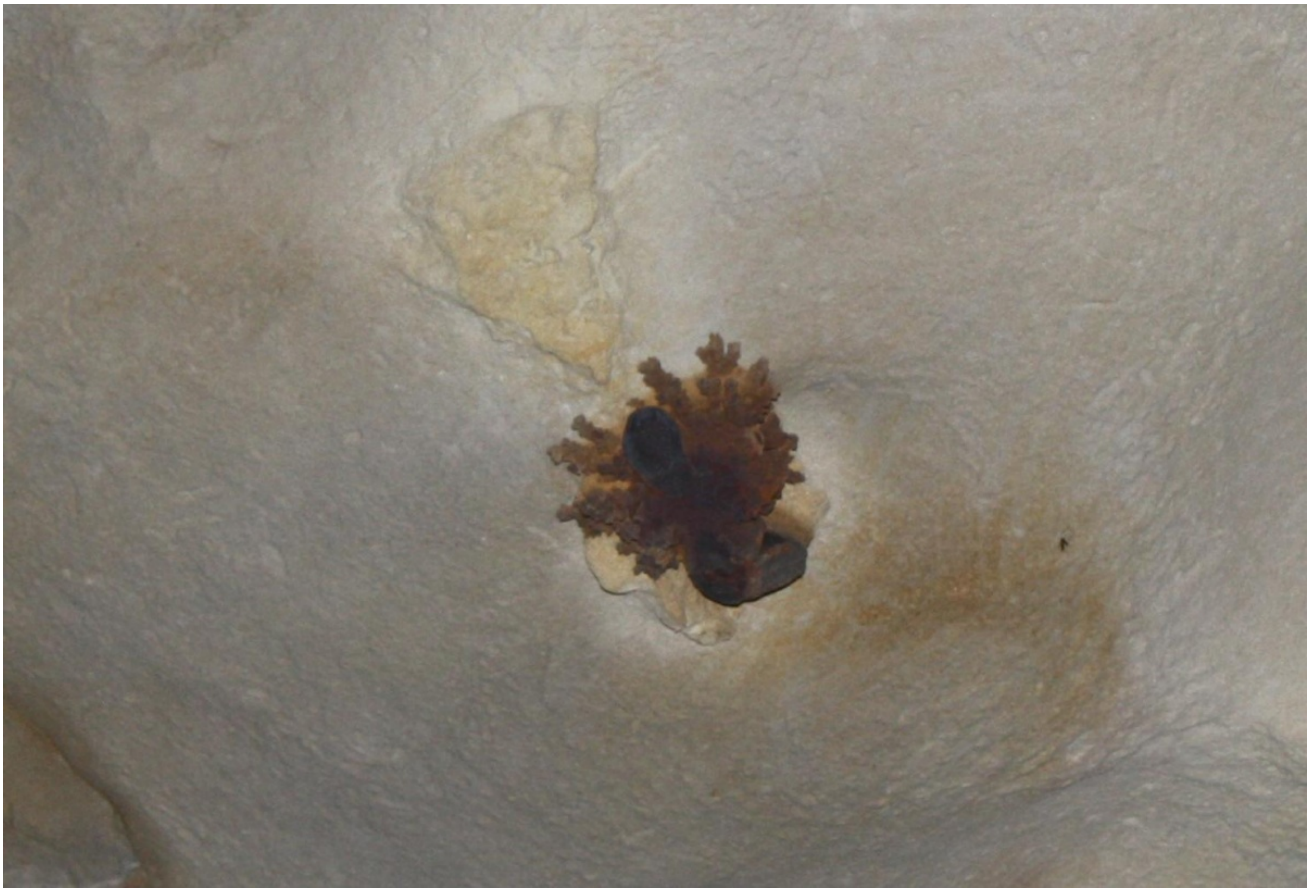
- Burger, Paul; description of the distinctions between rusticles and iron stalactites

Rusticle, Iron

Rusticles

Rusticles

Stalactite, Iron



Iron stalactite in the ceiling

The **Stalactite** field of the Iron section should be used to record stations where iron stalactites are found.

Iron stalactites are basically more ordinary stalactites with an iron oxide coating or iron oxides incorporated in the speleothem itself. The color will be dark and rusty.

Iron stalactites can be found anywhere stalactites can be found with the addition or a noticeable amount of iron.

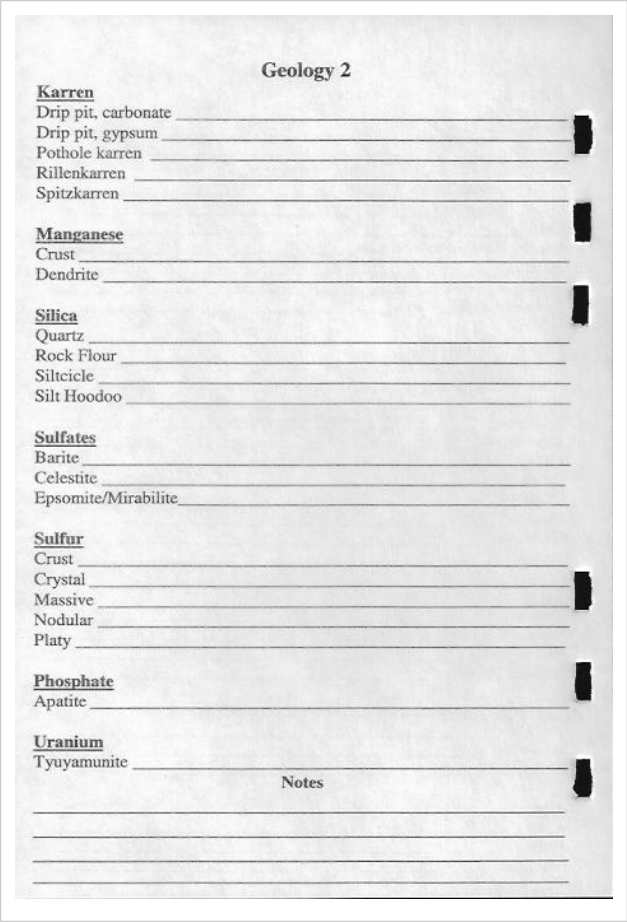
If the formation appears to be primarily made of iron or iron oxides, or is not a stalactite, it is best to inventory it as a rusticle. If it appears to be iron oxide over or in a more ordinary stalactite, it is better to inventory it as an iron stalactite.

References

- Burger, Paul; description of the distinctions between rusticles and iron stalactites

Page 6

Geology 2



Geology 2

Karren
Drip pit, carbonate
Drip pit, gypsum
Pothole karren
Rillenkarren
Spitzkarren

Manganese
Crust
Dendrite

Silica
Quartz
Rock Flour
Siltcicle
Silt Hoodoo

Sulfates
Barite
Celestite
Epsomite/Mirabilite

Sulfur
Crust
Crystal
Massive
Nodular
Platy

Phosphate
Apatite

Uranium
Tyuyamunite

Notes

The **Geology 2** page of the *Carlsbad Cavern National Park Cave Inventory Form* is page 6 and includes sections for karren, manganese, silica, sulfates, sulfur, phosphate and uranium.

Sections

- Karren
- Manganese
- Silica
- Sulfates
- Sulfur
- Phosphate
- Uranium

Karren

Karren

The **Karren** section should be used to record stations where some form of karren is found. The specific fields indicate the type of karren observed.

Fields

- Drip pit, carbonate
- Drip pit, gypsum
- Pothole karren
- Rillenkarren
- Spitzkarren

Drip pit, carbonate, Karren

Drip pit in a stalagmite

The **Drip pit, carbonate** field should be used to record any observation of a drip pit except for those in gypsum which has its own field.

A drip pit is a depression or hollow which is formed from dripping water. It can appear as a shallow depression in almost any floor material especially soft materials like guano, sediments like mud or gravel and moonmilk; but they can also form in harder carbonate materials like flowstone or stalagmites or directly in the bedrock.

Drip pits can vary in size from small depressions to deep, hollow, drill holes. Drip pits can be lined with calcite (see drip pit lining) which is one of the stages in forming a conulite. They may or may not be filled with water and can possess a cave pearl at the bottom.

Examine the floor and any shelves which may exhibit drip pits.

Drip pit, carbonate, Karren

Drip pit

Large drip pit

Drip pit, gypsum, Karren

Drip pit in gypsum

The **Drip pit, gypsum** field should be used to record any observation of a drip pit in gypsum. Drip pits in other material have their own field.

A drip pit is a depression or hollow which is formed from dripping water. It can appear as a shallow depression in almost any floor material. This field should be used only to record drip pits in gypsum.

Drip pits can vary in size from small depressions to deep, hollow, drill holes.

Examine the floor and any shelves made of gypsum which may exhibit drip pits.

Rillenkarren, Karren

Rillenkarren in gypsum

The **Rillenkarren** field is used to record stations that exhibit rillenkarren.

Rillenkarren are etched flutes or channels which are dissolved or eroded by dripping or flowing water. They usually exhibit as parallel channels or flutes. The hollows or "rills" may narrow and disappear with distance or, when dissolved by acid rich water like in the Guadalupes, may become deeper with distance. This latter type should probably be called "rinnenkarren" because of this characteristic but for purposes of the *Carlsbad Cavern National Park Cave Inventory Form*, they are inventoried in this field.

Rillenkarren may form on soft materials like guano or sediments. They can also form in harder materials like bedrock or massive gypsum. The defining characteristic is multiple channels separated by ribs of undissolved or uneroded material. The grooves are rounded troughs with sharp ridges.

References

- Klimchouk, Alexander B.; Ford, Derek C.; Palmer, Arthur N.; Dreybrodt, Wolfgang (2000) *Speleogensis; Evolution of Karst Aquifers* National Speleological Society, Huntsville, AL p 423 ISBN: 1-879961-09-1
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 2

Spitzkarren, Karren

Spitzkarren

The **Spitzkarren** field of the Karren section should be used to list stations which exhibit spitzkarren.

Spitzkarren are tower-like formations left by water dripping on dissolvable or erodable substrate like bedrock, breakdown, gypsum, sediment, guano, or even corrosion residue (speleosol). It could be considered the opposite of rillenkarren which form as rills or hollows. Spitzkarren exhibits as sharply spiked, angular and pointed.

References

- Klimchouk, Alexander B.; Ford, Derek C.; Palmer, Arthur N.; Dreybrodt, Wolfgang (2000) *Speleogensis; Evolution of Karst Aquifers* National Speleological Society, Huntsville, AL p 423 ISBN: 1-879961-09-1
- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* pp 2-3

Spitzkarren, Karren

Spitzkarren in gypsum

Gypsum spitzkarren

Manganese

Manganese

The fields of the **Manganese** section should be used to record stations which exhibit manganese.

Fields

- Crust
- Dendrite

Crust, Manganese

Manganese crust

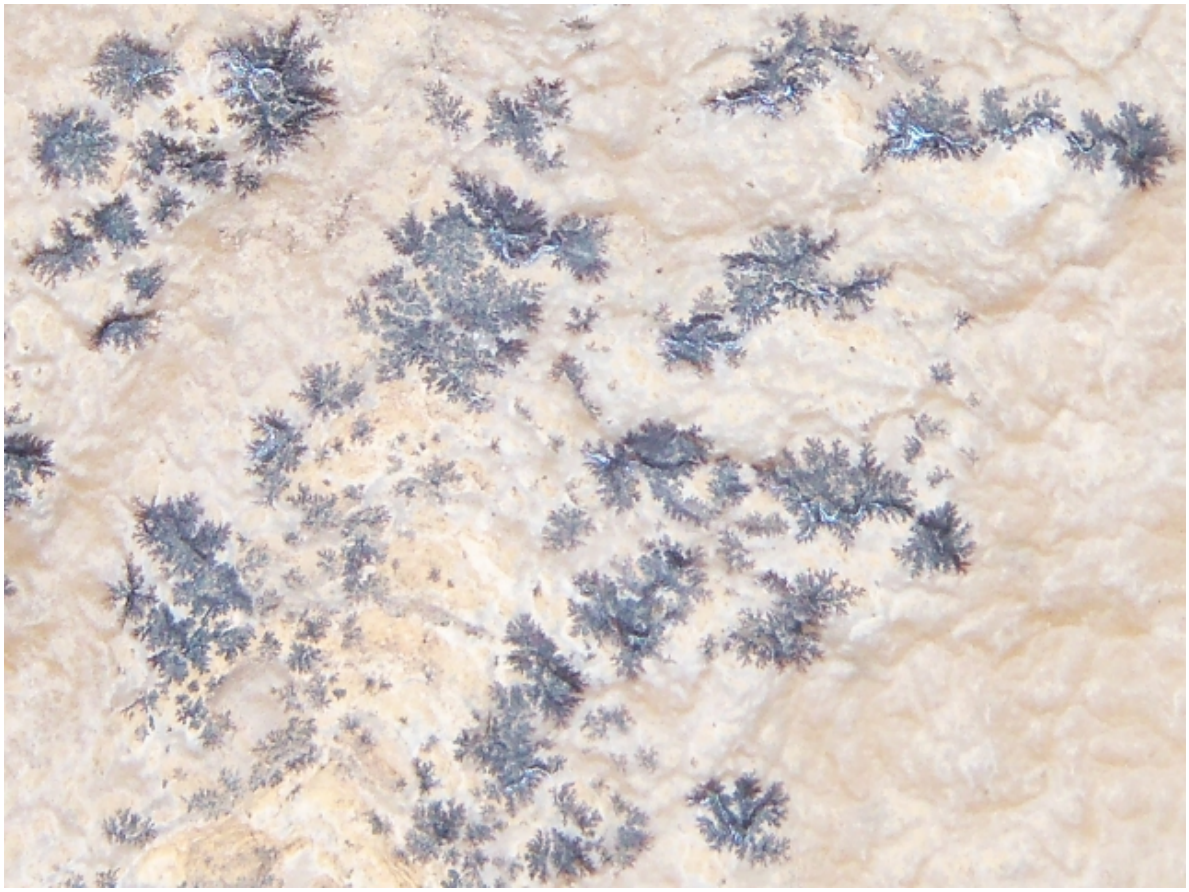
The **Crust** field of the Manganese section should list stations where a crust of manganese is found.

A manganese crust is a thin layer of manganese that is not firmly adhered to the substructure. It can be recognized by its dark, almost black coloring. It should not be confused with calcite that has been stained black by manganese. Moist manganese crusts often come off when touched so great care should be taken not to disturb them. They can be found on bedrock or clays.

Crust, Manganese

Manganese crust

Dendrite, Manganese



Manganese dendrites

The **Dendrite** field of the Manganese section should be used to record any appearance of manganese dendrites.

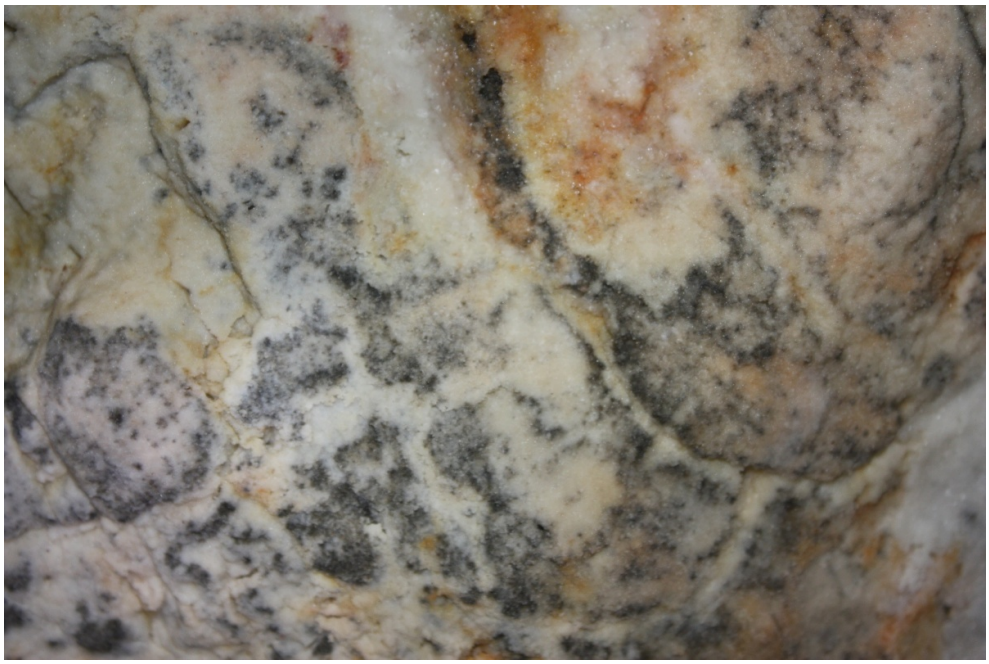
Manganese dendrites appear most often as tiny, scattered, black or dark purple dots on calcite or bedrock, and especially on calcite coatings over limestone bedrock. When more developed, they can appear as dark, fractal, fern-like shapes. The size can vary greatly from tiny specks to larger organized areas. Examine exposed bedrock and calcite, especially coatings on bedrock for the tell-tale dark dots which indicate manganese dendrites. A close examination is often required.

Manganese dendrites are actually a form of manganese oxide (and sometimes iron). The fractal shapes may be an indication of biological influence from iron and manganese oxidizing bacteria. Manganese dendrites could be mistaken for fossils because the branching pattern may look like leaves.

References

- Potter, Russell M. and Rossman, George R.. *Mineralogy of manganese dendrites and coatings*. American Mineralogist, Volume 64, pages 1219-1226, 1979: http://www.minsocam.org/ammin/AM64/AM64_1219.pdf
- *Pseudofossils; Dendrites*. Arkansas Geological Survey: http://www.geology.ar.gov/geology/pseudofossils.htm

Dendrite, Manganese



Manganese dendrites

Silica

Silica

The **Silica** section is used to record stations which exhibit some form of silica.

Fields

- Quartz
- Rock Flour
- Siltcicle
- Silt Hoodoo

Quartz, Silica

Quartz crystals

Siltcicle, Silica

Moonmilk siltcicle

Silt Hoodoo, Silica

Hoodoos in mud

The **Silt Hoodoo** field of the Silica section should be used to record any observations of hoodoos in silt or other granular media.

Hoodoos are formed in relatively soft rock or sediments topped by a harder, less easily eroded cap that partially protects each one. The softer material is partially eroded leaving behind a mound. The result is a tower or cone of the more easily eroded material capped by the protecting layer.

Sulfates

Sulfates

The **Sulfates** section is used to record stations where some form of sulfate mineral is found.

Fields

- Barite
- Celestite
- Epsomite/Mirabilite

Barite, Sulfates

The **Barite** field of the Sulfates section should list stations that exhibit some form of barite.

Barite (also known as *barium sulfate*) is a fragile, semi-hard mineral with perfect prismatic cleavage. Barite is not a metal, but is very heavy. It is white or bluegray in color and, if found, it usually indicates nearby ore deposits. It can be identified by its weight and color.

References

- Burgess, Harry. *Canyons & Caves; Issue No. 1; Spring 1996*. More on Lechuguillan Minerals: http://www.nps.gov/cave/planyourvisit/upload/c&c1.pdf

Celestite, Sulfates

The **Celestite** field of the Sulfates section should be used to record stations where celestite is found.

Celestite (also known as *strontium sulfate*) is colorless to sky-blue. It occurs in crusts and linings on the walls and is a precipitate and indicator of sulfuric-acid dissolution. The size of individual crystals can vary from 1 cm to 80 cm (about 2.5 ft).

References

- Burgess, Harry. *Canyons & Caves; Issue No. 1; Spring 1996*. More on Lechuguillan Minerals: http://www.nps.gov/cave/planyourvisit/upload/c&c1.pdf

Epsomite/Mirabilite, Sulfates

Epsomite

The **Epsomite/Mirabilite** field should be used to list stations where the sulfate minerals epsomite or mirabilite are observed.

Epsomite is soft and white or clear. It has a bitter taste though it is not appropriate to perform this test in the field. It may appear as needles, stalactites, stalagmites and other dripstone like formations. Mirabilite is clear and usually looks like ice. It has a slightly bitter or salty taste. Both are salts of different metals. Epsomite and mirabilite formations can change seasonally as they are influenced by humidity. They can also form over other speleothems. These formations are easily confused with similar gypsum formations such as chandeliers.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH p 293 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Epsomite/Mirabilite, Sulfates

Epsomite or Mirabilite on a calcite soda straw

Epsomite

Large epsomite stalagmite with mummified bats

Small epsomite stalagmite

Sulfur

Sulfur

The **Sulfur** section is used to record any occurrences of sulfur.

Most deposits of sulfur in Guadalupe Mountains caves are nearly pure, and pale yellow to canary yellow in color. They differ primarily in their shape, size and texture. Sulfur can appear as massive deposits, crystals, crusts, nodules and plates. Sulfur in Guadalupe caves is often associated with gypsum.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 119-120, 349 ISBN: 1-879961-07-5

Fields

- Crust
- Crystal
- Massive
- Nodular
- Platy

Crust, Sulfur

Sulfur crust

The **Crust** field of the Sulfur section is used to record any appearance of a sulfur crust.

Sulfur crusts tend to be strongly associated with gypsum and may overlay or be mixed with gypsum crusts. Sulfur crusts appear as yellow, crusty deposits that are not tightly adhered to the underlying substructure. The thickness and color can vary. These crusts may appear high in a passage, near the ceiling but could appear almost anywhere. Look for them if indications of gypsum are present or especially if other sulfur formations are found in the area.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 119-120, 349 ISBN: 1-879961-07-5

Crust, Sulfur

Sulfur crust on bedrock

Massive, Sulfur

Sulfur

The **Massive** field of the Sulfur section should be used to record stations where sulfur in massive form can be found.

Massive sulfur deposits usually appear as pale-yellow to canary-yellow deposits. They can vary in size but are often large with their own contained vugs. Any appearance of sulfur is strongly associated with the other forms so look for them, too. Also, sulfur in all forms is strongly associated with gypsum and unless it has been removed by some means, gypsum formations of various kinds are likely to be found nearby as well.

References

- Hill, Carol; Paolo Forti (1997) *Cave Minerals of the World (Second Edition ed.)* National Speleological Society pp 119-120, 349 ISBN: 1-879961-07-5

Massive, Sulfur

Massive sulfur

Phosphate

Phosphate

The **Phosphate** section is used to record any appearances of phosphate minerals. It has only one field.

Fields

- Apatite

Uranium

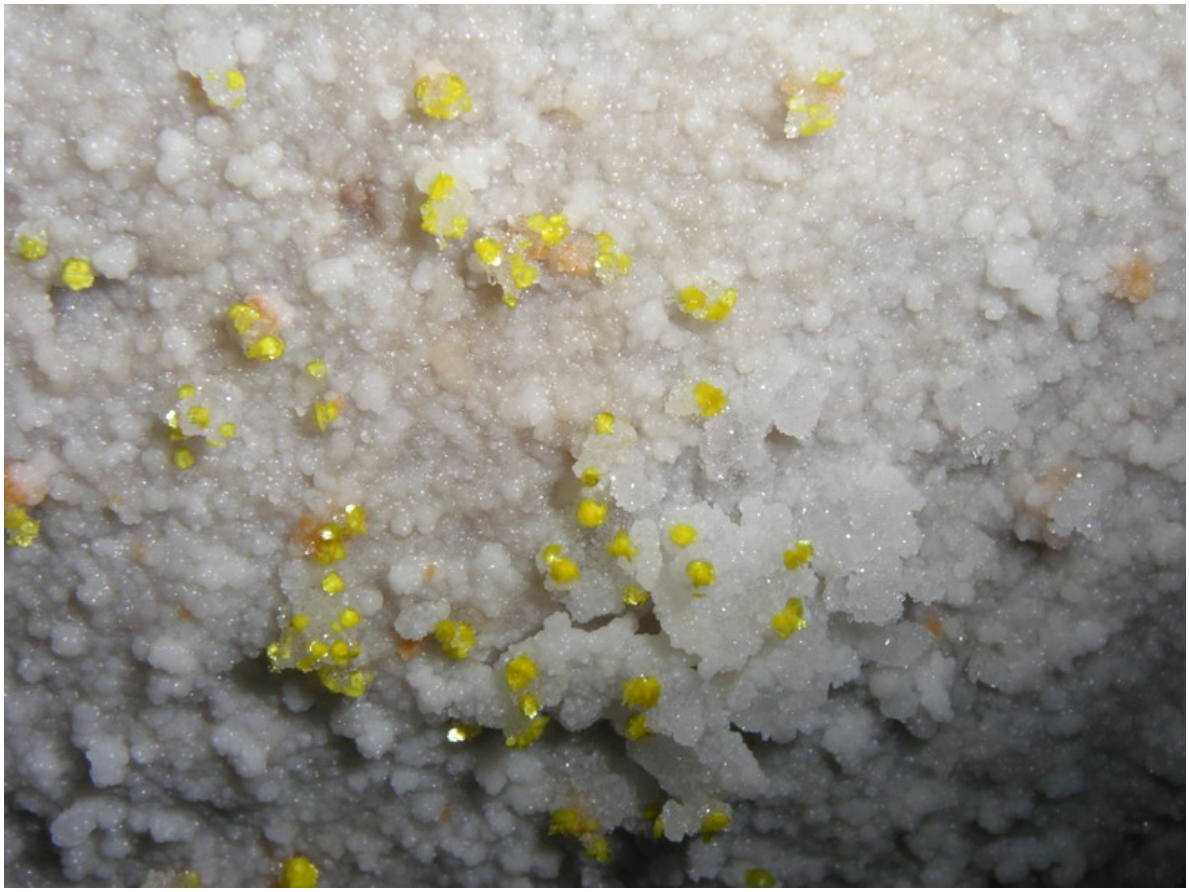
Uranium

The **Uranium** section is used to record any findings of uranium. It has only one field.

Fields

- Tyuyamunite

Tyuyamunite, Uranium



Tyuyamunite

The **Tyuyamunite** field should be used to list stations where the uranium mineral tyuyamunite is found.

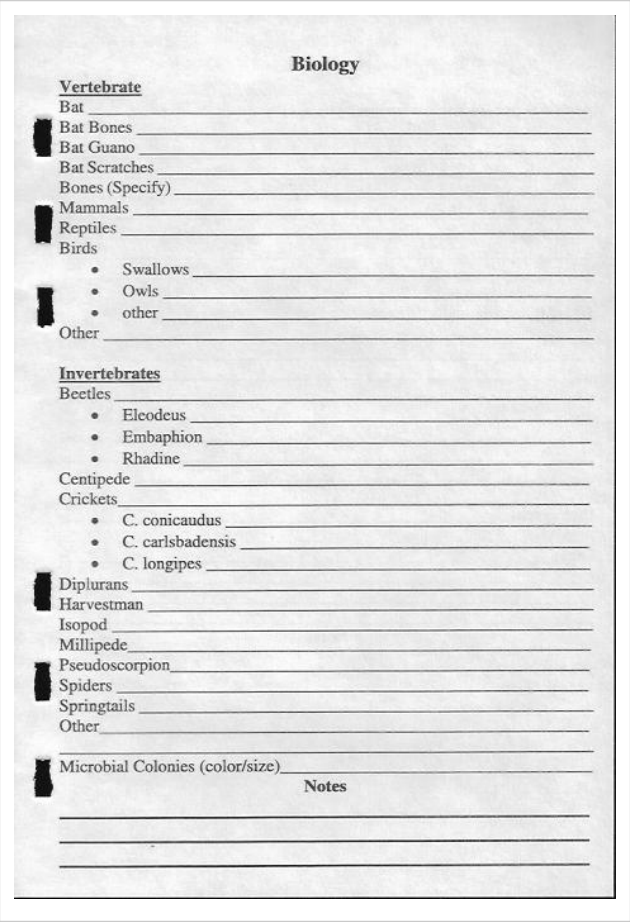
Tyuyamunite is rare, but has been found in the Guadalupes. It occurs as small, bright yellow crystals on evaporite crusts like gypsum. Tyuyamunite is usually associated with quartz and opal. It is slightly radioactive.

References

- Palmer, Arthur N. (2007) *Cave Geology* CAVE BOOKS, Dayton, OH pp 295, 404 ISBN-13: 978-0-939748-66-2, ISBN-10: 0-939748-66-5

Page 7

Biology



Biology

Vertebrate

Bat _____
Bat Bones _____
Bat Guano _____
Bat Scratches _____
Bones (Specify) _____
Mammals _____
Reptiles _____
Birds
- Swallows _____
- Owls _____
- other _____

Other _____

Invertebrates

Beetles _____
- Eleodeus _____
- Embaphion _____
- Rhadine _____

Centipede _____
Crickets _____
- C. conicaudus _____
- C. carlsbadensis _____
- C. longipes _____

Diplurans _____
Harvestman _____
Isopod _____
Millipede _____
Pseudoscorpion _____
Spiders _____
Springtails _____
Other _____

Microbial Colonies (color/size) _____

Notes

The **Biology** page of the *Carlsbad Cavern National Park Cave Inventory Form* is page 7 and classifies biology into two sections: vertebrate and invertebrates.

Sections

- Vertebrate
- Invertebrates

Vertebrate

Vertebrate

The **Vertebrate** section should be used to record stations where vertebrates are observed. Its fields and subsections should indicate the specific observation.

Fields and subsections

- Bat
- Bat Bones
- Bat Guano
- Bat Scratches
- Bones (Specify)
- Mammals
- Reptiles
- Birds
- other

Bat, Vertebrate

Bat (*corynorhinus townsendii*; CORTOW; Townsend's big-eared bat)

The **Bat** field of the Vertebrate section should be used to record any observation of living bats.

Some caves are habitats for bats. If present, they can be found almost anywhere in the cave from the entrance to deep within. Bats may occupy the cave seasonally (hibernation or maternity) or remain year round. Bats may be observed singly or in a group. They may be resting or flying. Indications that bats may be present include guano on the cave floor, in pools or on formations, and/or stains or scratches on the ceiling. It is highly unusual to find a bat on the floor and is an indication that something may be wrong. Do not disturb any bats observed.

Bat Bones, Vertebrate

Closeup of a bat skull. Note the gloved finger for scale.

The **Bat Bones** field should be used to record any observances of bat bones.

Bat bones can be found primarily on the floor. Bat bones are very fine, fragile, and, except for the skull, needle-like. They can accumulate or be scattered. They may be on the surface or mixed into sediments and soils. They can be found clinging in popcorn or other rough surfaces but they will mostly be found on the floor and usually near a wall. Often the skulls may not be present or be much harder to locate. The skulls are small, about the size of a marble and very delicate. Sometimes, a complete bat skeleton is found intact and may be partially encased and preserved in calcite. Care should be taken not to disturb or step on any bat bones found.

Look carefully along the floor, on shelves or ledges and especially near walls for the fine bones. Seeing them may require a hands-and-knees examination. If rough speleothems are in the area such as popcorn, be sure to examine it for bones which may have been caught by it. And, if a significant guano deposit is found, it is likely to contain bones so examine it. If there is any indication that bats were once in the area, it is likely that bones are around, look for them.

Bat Bones, Vertebrate

Bat skeleton

Bat bones scattered among Popcorn

Bat Guano, Vertebrate

Guano (disturbed)

The **Bat Guano** field should be used to record any stations which exhibit bat guano.

Bat guano is the excrement left behind by bats. It can be found on the cave floor, on formations, or in pools. It can be a sprinkling of small, dark pellets or, with the passage of time, be piles that are many feet deep. Guano may be old and historic or fresh and young. It could be dry and powdery or wet. Any recognized bat guano should be recorded.

It can be under, over or layered with flowstone and other secondary deposits.

If a significant accumulation is found, examine the ceiling above for bats and bat stains. Historic piles of guano often contain bat bones.

References

- unknown (1997) *Geology of Carlsbad Caverns Class - 1997 Memorial Day Expedition* p 2

Bat Guano, Vertebrate

Bat guano in and around a pool. Note the shelfstone.

Bat Scratches, Vertebrate

The **Bat Scratches** field should be used to record stations where noticeable scratch marks left by bats are found.

Claw and scratch marks may be observed indicating that a bat may have roosted or rested there. These marks are rare but may be found on soft materials like gypsum or corrosion residue. Look for them if there are any signs that bats may have been in the area such as guano or bones. If stains are observed (usually on the ceiling) these should be inventoried as other.

Bones, Vertebrate

Porcupine skeleton

The **Bones** field of the Vertebrate section should be used to record any stations which exhibit bones except bat bones.

Many types of bones of vertebrates can be found in caves from small animals such as salamanders, fish, birds, snakes and mice to larger animals such as Ring-tailed Cats, porcupines, and skunks to very large animals such as cows, goats and deer and even humans. It is not necessary to identify the type of animal which left the bones except to confirm that they are probably not bat bones which have their own inventory field.

Complete or almost complete skeletons are possible but bones are usually scattered and skeletons are often incomplete. Bones can be obscured by secondary formations such as calcite and sediments. Bones found in caves may be very old, even prehistoric or relatively young.

If any bones are found which appear to be human or prehistoric, that would be a good time for a photograph and a note on the inventory form.

Bones, Vertebrate

Human mandible

Bone fragment

Short-faced bear

Bones in breakdown

Small rodent skull

Unidentified small skeleton

Mammals, Vertebrate

Ringtail cat

The **Mammals** field of the Vertebrate section should be used to record any observation of mammals except bats.

Several types of mammals can be found in Guadalupe Mountains caves besides bats. Ringtail Cats; small rodents like mice or rats; porcupines; skunks; deer; goats; and others may be found in caves in the Guadalupes from time to time. Most often they will be observed near an entrance; but, ringtails can travel quite deeply into the cave. It is rare to see a mammal in a cave as they are usually elusive, so observe carefully.

Reptiles, Vertebrate

Bull Snake

The **Reptiles** field of the Vertebrate section should be used to record any observations of reptiles.

The most common reptiles in caves of the Guadalupes are snakes and occasionally lizards.

Amphibians such as frogs and salamanders should be recorded as "other".

Reptiles, Vertebrate

Whip Snake

Birds, Vertebrate

The **Birds** subsection of the Vertebrate section is used to record the observation of birds. The general classification is indicated in the specific field.

Fields

- Swallows
- Owls
- other

Swallows, Birds, Vertebrate

Swallows silhouetted against the light from a cave entrance

The **Swallows** subfield of the Vertebrate Birds section is used to record any observation of cave swallows.

Cave Swallows (*hirundo fulva*) usually nest just inside the entrance area of caves during the spring, summer and fall months. They rarely venture deeper than the twilight portion and are most active during the day. They prefer larger openings and high ceilings. Mud nests high on the walls and ceiling; feathers, twigs, grass and small broken egg shells on the floor; stains from droppings and noticeable chirping noises are all indications of swallows. When swallows are present, the signs are usually obvious and a musty smell or odor may be present. During the day, they can often be seen flying especially when silhouetted against the light from the entrance.

References

- Various (June 2004) *Core Values* Carlsbad Caverns National Park; as published by Bob Hoff: http://carlsbadcavernshistory.blogspot.com/2011/05/carlsbad-caverns-national-park-core.html

Swallows, Birds, Vertebrate

Swallow egg shell, droppings, feathers, etc.

Swallow on a mud nest

Owls, Birds, Vertebrate

Owl

The **Owls** subfield of the Vertebrate Birds section is used to record any observation of owls in the cave.

Owls, if found, will almost always be just inside the entrance area during the spring, summer and fall months. They rarely venture deeper than the twilight portion. They usually leave the cave at night and occupy it during the day. They may hide in small cracks or between the folds of a drapery. Small, egg shaped droppings on the floor are an indication of owls. Owls may hiss when disturbed.

other, Birds, Vertebrate

The **other** field of the Birds subsection should be used to record any observation of birds except swallows or owls.

Several types of birds can be found in Guadalupe Mountains caves besides swallows and owls. Turkey Vultures; Scaled Quail and other birds may occasionally be found from time to time. Most often they will be observed near an entrance; but, they could be lost or confused and might be found deeper in the cave. It is rare to see birds other than swallows in a cave; but, they do occasionally enter and may be observed.

other, Vertebrate

The **other** field of the Vertebrate section should be used to record any vertebrate items for which no other specific field exists on the form.

When listing a station in the other field, a description of the item should be included alongside the station.

Amphibians

Though reptiles have their own field on the form, amphibians do not and should be recorded as "other".

Salamanders

Salamanders are often found in caves but are rare in the Guadalupes and no true cave adapted species are known there, yet; but, there are a few caves where salamanders can be found in the Guads.

Tiger Salamander (notice the invertebrate in the upper left)

Frogs

Frogs found in caves are usually in damp locations and usually near an entrance of some kind with good access to food as they are not usually cave adapted.

Frog

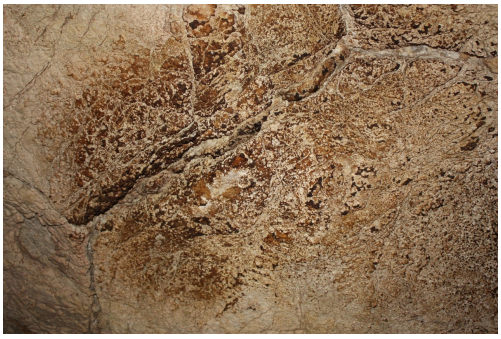
Bat mummies

Bat mummies are the dehydrated remains of bats with skin intact. There is no separate field on the form for bat mummies so they should be inventoried as other. Bat mummies can be found on the floor or even still clinging to a wall or speleothem. Bat mummies are sometimes found covered with a growth which is usually a greenish color but could be several other colors making them hard to identify as bats. The color from this growth may remain long after the mummy is dehydrated.

Bat mummy

Bat stains

A common sign left by bats are stains on the ceiling indicating that bats used that location for roosting. These stains are from the oils and dirt left by the bats. Claw marks on soft formations are more rarely observed and have their own inventory field. An accumulation of guano may be present below a location with bat stains.



Bat stains on the ceiling

Example

other: FF16 (Bat mummy)

Invertebrates

Invertebrates

The fields and subsections of the **Invertebrates** section are used to record the stations where invertebrates are observed.

Fields and subsections

- Beetles
- Centipede
- Crickets
- Diplurans
- Harvestman
- Isopod
- Millipede
- Pseudoscorpion
- Spiders
- Springtails
- Other
- Microbial Colonies

Beetles, Invertebrates

The **Beetles** field of the Invertebrates section and its subfields are used to record observations of any kind of beetle. Three specific genera of beetle are recorded in the subfields.

Two of three specific genera of beetles which have their own subfields (Eleodeus and Embaphion) are Darkling beetles and one is not (Rhadine). If a beetle can be identified as to one of these specific genera, it should be recorded in the corresponding field, if not, it should be recorded here.

Fields

- Eleodeus
- Embaphion
- Rhadine

Eleodeus, Beetles, Invertebrates

Eleodeus darkling beetle

The **Eleodeus** field of the Beetles subsection should be used to record any observation of darkling beetle in the genus *Eleodeus*.

Eleodeus beetles are black in color and strongly associated with guano. They have three noticeable body sections and are usually rounder and thinner than Embaphion.

Embaphion, Beetles, Invertebrates

Embaphion darkling beetle

The **Embaphion** field of the Beetles subsection should be used to record any observation of darkling beetle in the genus *Embaphion*.

Embaphion beetles are black in color and strongly associated with guano as they feed on it. The primary features of *Embaphion* which distinguish it from *Eleodeus* are that the shell of *Embaphion* curls upward at the edges and *Embaphion* have only two noticeable body segments. *Embaphion* is also flatter and wider than *Eleodeus*.

Rhadine, Beetles, Invertebrates

Rhadine beetle

The **Rhadine** field should be used to list stations where Rhadine beetles are observed.

Rhadine is a genus of ground beetle. Looking like a large red ant with a fat butt, they can often be seen running along the floor. One sign that Rhadine beetles may be in the area is fluffed up floor sediments. Care should be taken not to disturb these areas as it may injure the beetles. Rhadine beetles often live in the silt on the cave floor where they dig up and consume cricket eggs.

Rhadine, Beetles, Invertebrates

Rhadine beetle

Centipede, Invertebrates

Centipede

The **Centipede** field of the Invertebrates section should list stations where a centipede is found.

Centipedes have flat, multi-segmented bodies, with each segment having only one pair of legs. The total number of legs varies, but there are usually 20 or more. They are arthropods, not insects. Centipedes are predators and have 2 pincers just behind the head. Their bite is painful (like a bee sting), but not fatal. Some centipedes are known to prey on bats. They move very quickly and can be quite large and can climb well. The size can vary from small (an inch or less) to several inches in length and up to an inch in width. The color can vary from unpigmented to brown, dark brown or rust. Centipedes should not be confused with millipedes which have two pairs of legs per body segment.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York pp 106-107 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3

Centipede, Invertebrates

Centipede and harvestman on the ceiling

Centipede

Centipede

Crickets, Invertebrates

The **Crickets** field of the Invertebrates section and its subfields should be used to record any observation of a cricket. Three specific species of cricket are recorded in the subfields.

All three of the specific species of cricket which have their own subfield are camel crickets. If a cricket can be identified as to one of these three specific species, it should be recorded in the corresponding field. If the species cannot be identified or it is not one of these three specific species, it should be recorded here.

Fields

- C. conicaudus
- C. carlsbadensis
- C. longipes

C. conicaudus, Crickets, Invertebrates

ceuthophilus conicaudus

The **C. conicaudus** field should be used to record stations where the *ceuthophilus conicaudus* species of cave camel cricket is observed.

C. conicaudus can be identified by an interrupted pattern on the back and legs with distinct spikes. Some say it looks like they are wearing argyle stockings. *C. conicaudus* is less cave adapted than *c. longipes*; but, moreso than *c. carlsbadensis*.

They have been found in Spider Cave and a few in Left Hand Tunnel but they could be found anywhere.

They are usually slow moving and can be seen on the walls, floor or breakdown. Observe closely and carefully to see them as they can sometimes be found in small cracks or vugs.

References

- Pate, Dale. *Canyons & Caves; Issue No. 20; Spring 2001; Cave Crickets*: http://www.nps.gov/cave/planyourvisit/upload/c&c20.pdf

C. carlsbadensis, Crickets, Invertebrates

ceuthophilus carlsbadensis

The **C. carlsbadensis** field should be used to record stations where the *ceuthophilus carlsbadensis* species of cricket is observed.

Larger than *longipes* and darker in color, this cave camel cricket is reddish brown with a noticeably humped back. The antennae are not exceptionally long and they have two dark black eyes which appear as dots on the head. They are usually slow moving and can be seen on the walls, floor or breakdown. Observe closely and carefully to see them as they can sometimes be found in small cracks or vugs.

The least cave adapted of the three camel crickets on the *CCNP Cave Inventory Form*, *c. carlsbadensis* lives in food rich areas.

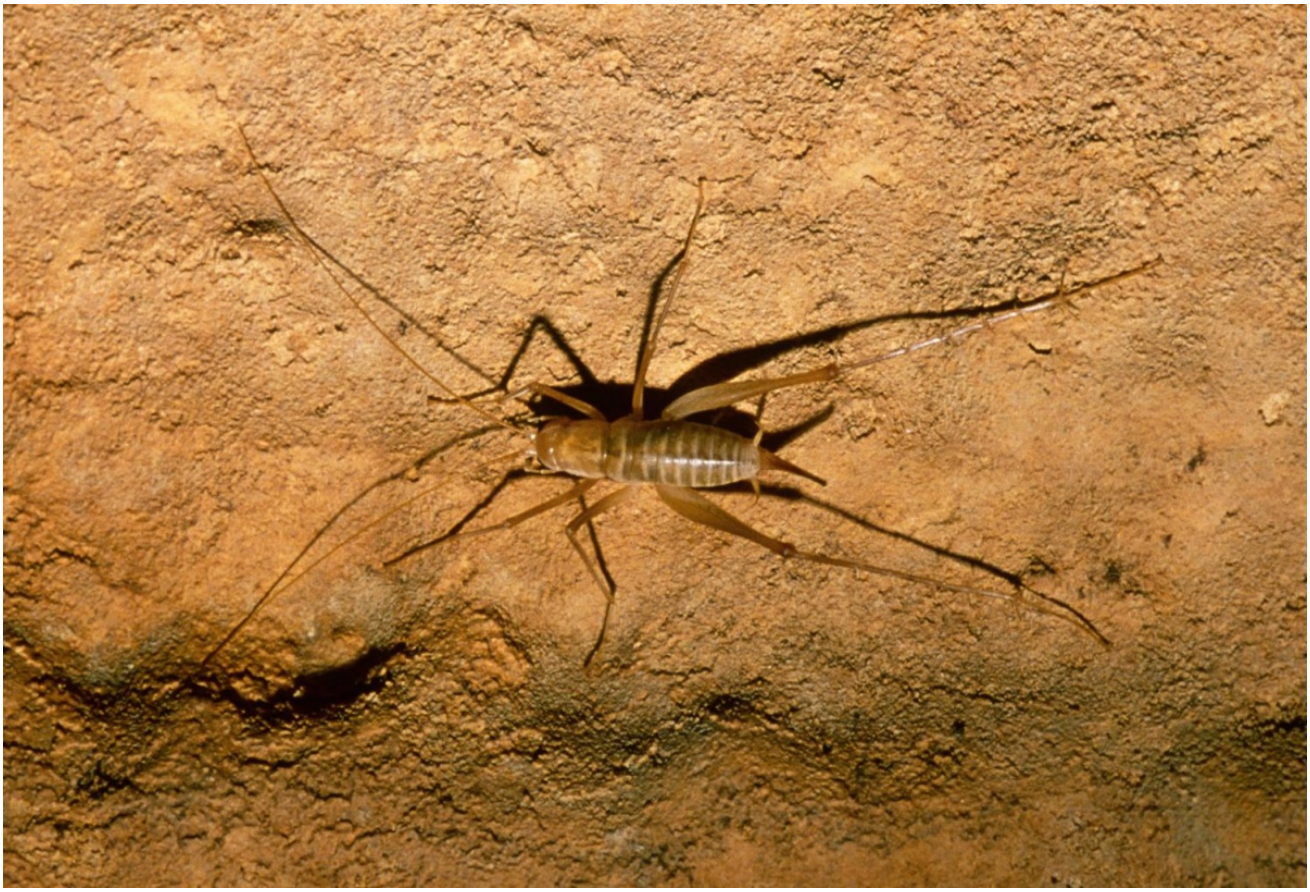
References

- Pate, Dale. *Canyons & Caves; Issue No. 20; Spring 2001; Cave Crickets*: http://www.nps.gov/cave/planyourvisit/upload/c&c20.pdf

C. carlsbadensis, Crickets, Invertebrates

c. carlsbadensis

C. longipes, Crickets, Invertebrates



ceuthophilus longipes

The **C. longipes** field should be used to record stations where the *ceuthophilus longipes* (pronounced lonjipees) species of cave camel cricket is observed.

The primary distinguishing feature of *c. longipes* is long antennae and long legs. It is a small cricket whose color can range from translucent to brown. The size can vary from quite small (usually adolescent) to medium sized but (unless injured) will almost always have exceptionally long antennae. They have long, slender legs with fine leg spines. The females have a long ovipositor. They are usually slow moving and can be seen on the walls, floor or breakdown. Observe closely and carefully to see them as they can sometimes be found in small cracks or vugs.

C. longipes is smaller than *c. carlsbadensis* and lighter in color with longer antennae. They are the most cave adapted of the three species of crickets on the *CCNP Cave Inventory Form* and can live in areas of the cave that are poor in food.

References

- Pate, Dale. *Canyons & Caves; Issue No. 20; Spring 2001; Cave Crickets*: http://www.nps.gov/cave/planyourvisit/upload/c&c20.pdf

C. longipes, Crickets, Invertebrates

Tiny c. longipes

c. longipes

Diplurans, Invertebrates

Dipluran

The **Diplurans** field of the Invertebrates section is used to record any observation of diplurans.

Diplurans are insects. They are small, pure white and can move quickly though sporadically. They are easy to identify when you see them. They have an elongated body with a pair of appendages on each end making it hard to tell whether they are coming or going. The body length is usually less than 5 mm.

References

- Rick D. Houston Jr. *Canyons & Caves; Issue No. 2; Summer 1996*. Hey, What Kind of Bugs Live Here?: http://www.nps.gov/cave/planyourvisit/upload/c&c2.pdf

Diplurans, Invertebrates

Dipluran, flagging tape for scale

Dipluran on black flowstone

Harvestman, Invertebrates

Harvestmen

The **Harvestman** field of the Invertebrates section is used to record any observation of harvestmen.

Although superficially similar to spiders, harvestmen are a distinct order that is not closely related to spiders. Harvestmen are arachnids and can be easily distinguished from even long-legged spiders by a single body region and a single pair of eyes. Spiders have a separate abdomen and multiple pairs of eyes. Harvestmen usually have extremely long legs.

Harvestmen are colloquially known as "daddy longlegs" or "granddaddy longlegs". They can be found, usually near the twilight areas, in moist, dark locations, often under ledges, breakdown or on the ceiling. They may appear in groups, in large numbers and masses. They may react to light and vibration. Those near the entrance may not be troglodytic, leaving the cave at night to feed. Deeper in the cave, more cave adapted forms may be found that are blind. Cave adapted harvestmen are usually found in very wet locations, deep in the cave.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York pp 102-104 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3

Harvestman, Invertebrates

Harvestman (note the cricket, left)

A large group of Harvestmen

Isopod, Invertebrates

The **Isopod** field of the Invertebrates section should be used to record any observation of an isopod.

Isopods are an order of crustacean which includes familiar creatures such as woodlice and pill bugs. Isopods are small with seven pairs of legs. They are somewhat flat though there is variety in the order. Some isopods, those commonly known as pill bugs, have a tendency to roll into a ball when threatened. Color can vary from discolored to greys, browns and other earth tones. It is even possible for a single individual to exhibit more than one color on different body segments.

Isopods primarily feed on decaying matter and usually rely on food being brought into the cave environment by some means. Look for isopods on the floor especially among guano or leaf and wood accumulations especially if moist.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York p 95 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3

Millipede, Invertebrates

Millipedes

The **Millipede** field of the Invertebrates section should list stations where a millipede is found.

Millipedes are classified as arthropods, not insects. Millipedes can be identified by their long, cylindrical, multi-segmented bodies, with each segment having two pairs of legs (except for the first few behind the head). The total number of legs varies, but there are often many more than 20. They move slowly and can vary in size, color and shape. Some will coil into a tight spiral when threatened. Millipedes should not be confused with centipedes which have only one pair of legs per body segment.

Millipedes primarily feed on decaying matter so they usually depend on food resources that are brought into the cave like guano and wood or leaf material.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York pp 107-108 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3

Pseudoscorpion, Invertebrates

The **Pseudoscorpion** field of the Invertebrates section is used to record any observation of pseudoscorpion.

Pseudoscorpions are small arachnids, tiny even, that superficially resembled scorpions. They are rarely seen because of their size.

Spiders, Invertebrates

Extreme closeup of a spider in a cave. This one is tiny and very hard to notice among the popcorn and crystals.

The **Spiders** field should be used to list stations where spiders (not harvestmen) are observed. Look closely, they can be extremely small.

Spiders can be found anywhere in a cave. They are often more numerous near the entrance especially at a narrowing where webs would be more productive. Those near the entrance may not be truely cave adapted species therefore they may be darker in color, larger and easier to see. The cave adapted species usually found away from the entrance may be blind, decolored and smaller. They may not form webs and may move slowly -- they may be hard to find and see; but, they are there.

References

- Romero, Aldemaro (2009) *Cave Biology; Life in Darkness* Cambridge University Press, New York p 100 ISBN-Hardback: 978-0-521-82846-8, ISBN-Paperback: 978-0-521-53553-3

Spiders, Invertebrates

Spider

Springtails, Invertebrates

The **Springtails** field of the Invertebrates section records stations where springtails are observed.

Springtails are common in caves and can be found throughout the Guadalupe Mountains. They can usually be found in small pools or on wet flowstone. They are very small so a detailed observation is required to see them. They can be found floating, suspended by the surface tension of the water in pools of any size.

References

- Richards, Jason M.. *Canyons & Caves; Issue No. 9; Summer 1998*; WEIRD CAVE CREATURES; COLLEMBOLLANS: http://www.nps.gov/cave/planyourvisit/upload/c&c9.pdf

Other, Invertebrates

The **Other** field of the Invertebrates section should be used to list stations where invertebrates with no other specific field on the form are found.

Vinegaroons

Also known as whip scorpions, you may see one of these, near an entrance and probably in a moist area.

Vinegaroon

Streblid Fly pupae

You may find the "egg cases" for these flies on the walls in bat roosts. These flies live on bats and may be specific to Townsend's Big-eared bats.

External links

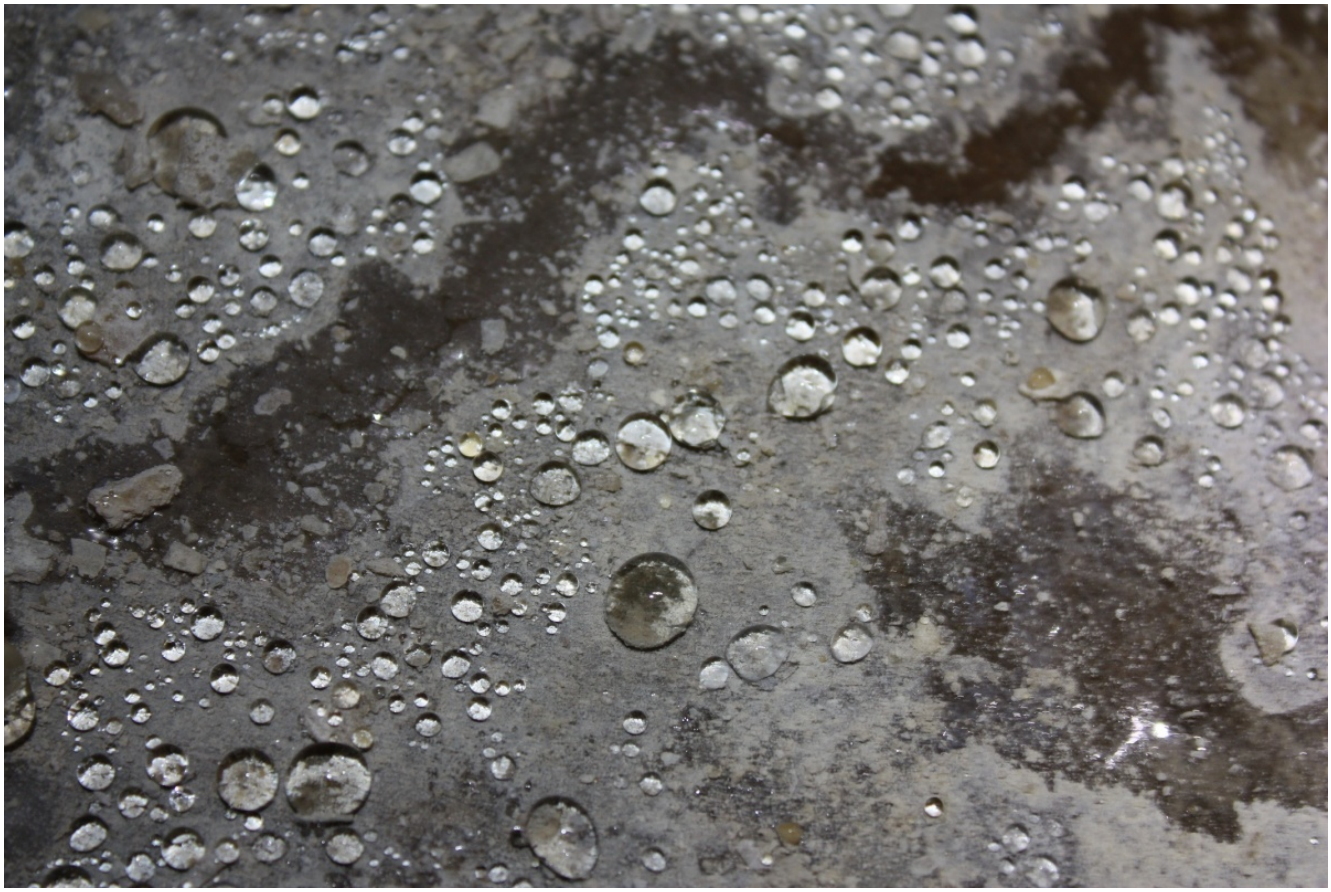
- Steblidae paper [1]
- Bat - bat fly coevolution (with pictures) [2]

Steblid Fly (bat fly) pupae.

References

[1] http://fm1.fieldmuseum.org/aa/Files/patterso/Dittmar_et_al_2009_J_Parasitol.pdf
[2] https://sites.google.com/a/fieldmuseum.org/bruce-pattersons-lab/Home/research-areas/bat---bat-fly-coevolution

Microbial Colonies, Invertebrates

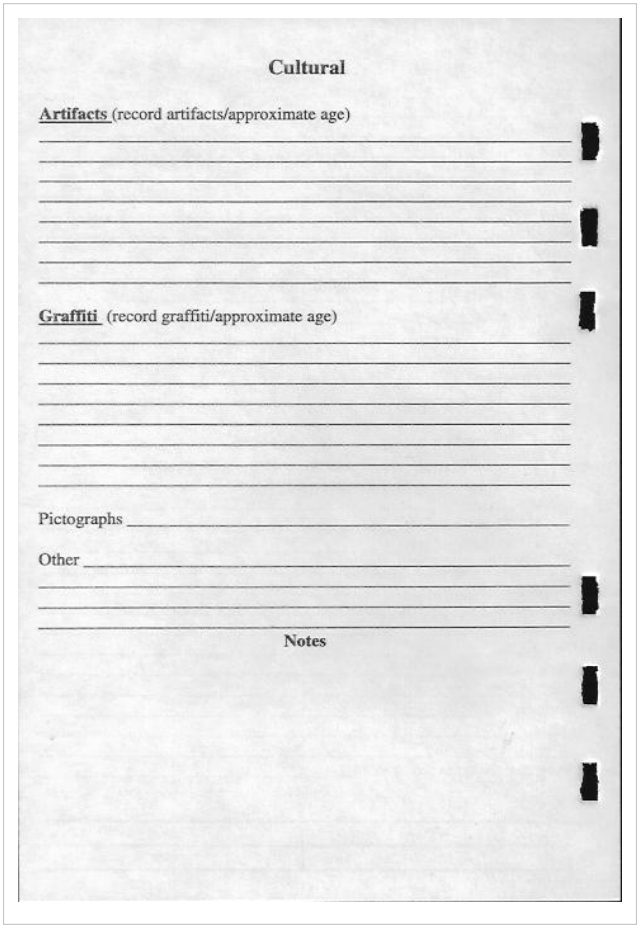


Actinomycetes

The **Microbial Colonies** field should be used to record stations where microbial colonies or signs of microbial colonies are observed.

Page 8

Cultural


Cultural

Artifacts (record artifacts/approximate age)

Graffiti (record graffiti/approximate age)

Pictographs

Other

Notes

The **Cultural** page is the last page (page 8) of the *Carlsbad Cavern National Park Cave Inventory Form* and includes sections for artifacts and graffiti.

Sections

- Artifacts
- Graffiti

Artifacts

Artifacts

Remains of a barrel

The **Artifacts** field is used to record stations where artifacts are found. Examples of artifacts might include: tobacco tins, glass jars, flash bulbs (broken or not), batteries, etc. They could also include very historic artifacts such as the remains of a sandal, pot shards or reed torch fragments.

Here is a list of a few of the things that I have actually recorded in this field to give you some idea of what should be recorded here.

- empty tobacco tin (1930s)
- pipe cleaning tool
- batteries (D-cell, 1950s)
- hair ribbon
- part of the sole of a boot
- rat trap (modern)
- flash bulb fragments
- burned paper chit
- electrical wiring
- remains of a boxed chicken dinner (see also bones)

The recorder is asked to include the approximate age of any artifacts found. This information should be included next to the station.

Example

Artifacts: G37 (kerosene lamp mantel, ~70 years)

Artifacts

An unusual artifact

Remains of a bucket

Graffiti

Graffiti

Historic graffiti in the form of pencil marks on a stalactite

The **Graffiti** field should be used to list stations which exhibit some type of intentional human made marking. Pictographs have their own field. The medium for these marks could be: pencil, pen, paint, carbide, scratches in calcite, mud or clay and any number of other media. Graffiti marks tend to be signatures or initials or some type of identifying mark and often include a date but not necessarily. The markings may be historic or not depending upon their age and significance. When looking for graffiti marks, pay particular attention around the deepest areas of the cave near dead ends especially if the area is large enough in which to sit or stand comfortably. These types of locations seem to attract graffiti. Pictographs are more often found in the twilight areas; but, graffiti is common there, too.

On the *CCNP Cave Inventory Form*, the recorder is asked to include a description and approximate age for all graffiti. Include this information next to the station. If the mark seems historic, recent or significant, a photograph could be helpful.

Example

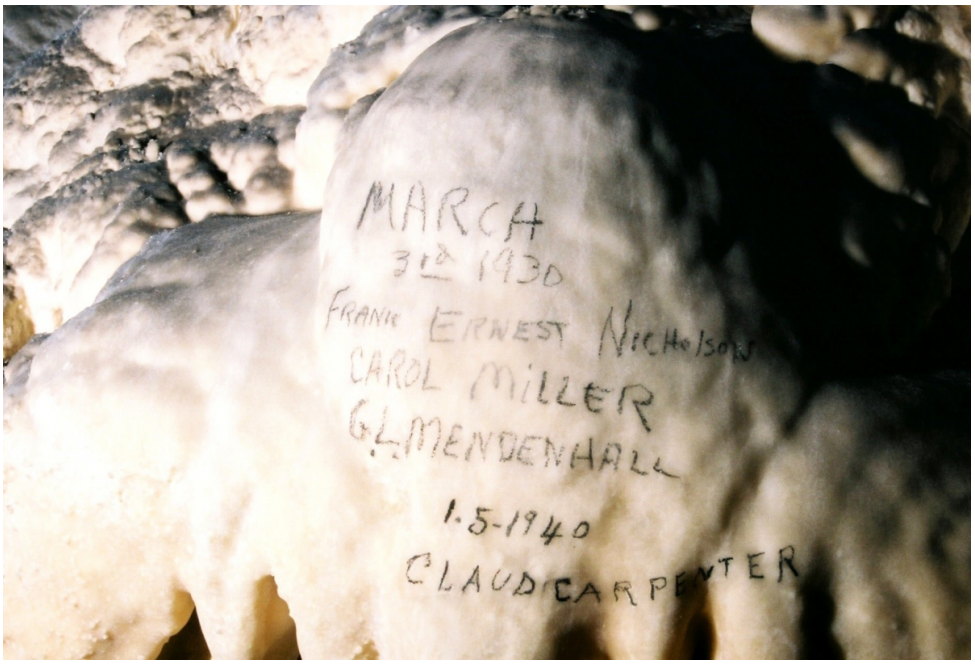
- Graffiti: FA79 (historic pencil signatures including "Robt Nymeyer" dated 1939)

References

- Hildreth-Werker, Val and Werker, Jim C. (2006) *Cave Conservation and Restoration* National Speleological Society, Huntsville, AL pp 110,333-334 ISBN: 1-879961-15-6

Graffiti

Graffiti in the form of scratches on calcite flowstone



Historic graffiti signatures

Fields

- Pictographs
- Other

Pictographs, Graffiti

Pictographs

The **Pictographs** field of the Graffiti section should be used to record stations where pictographs are observed.

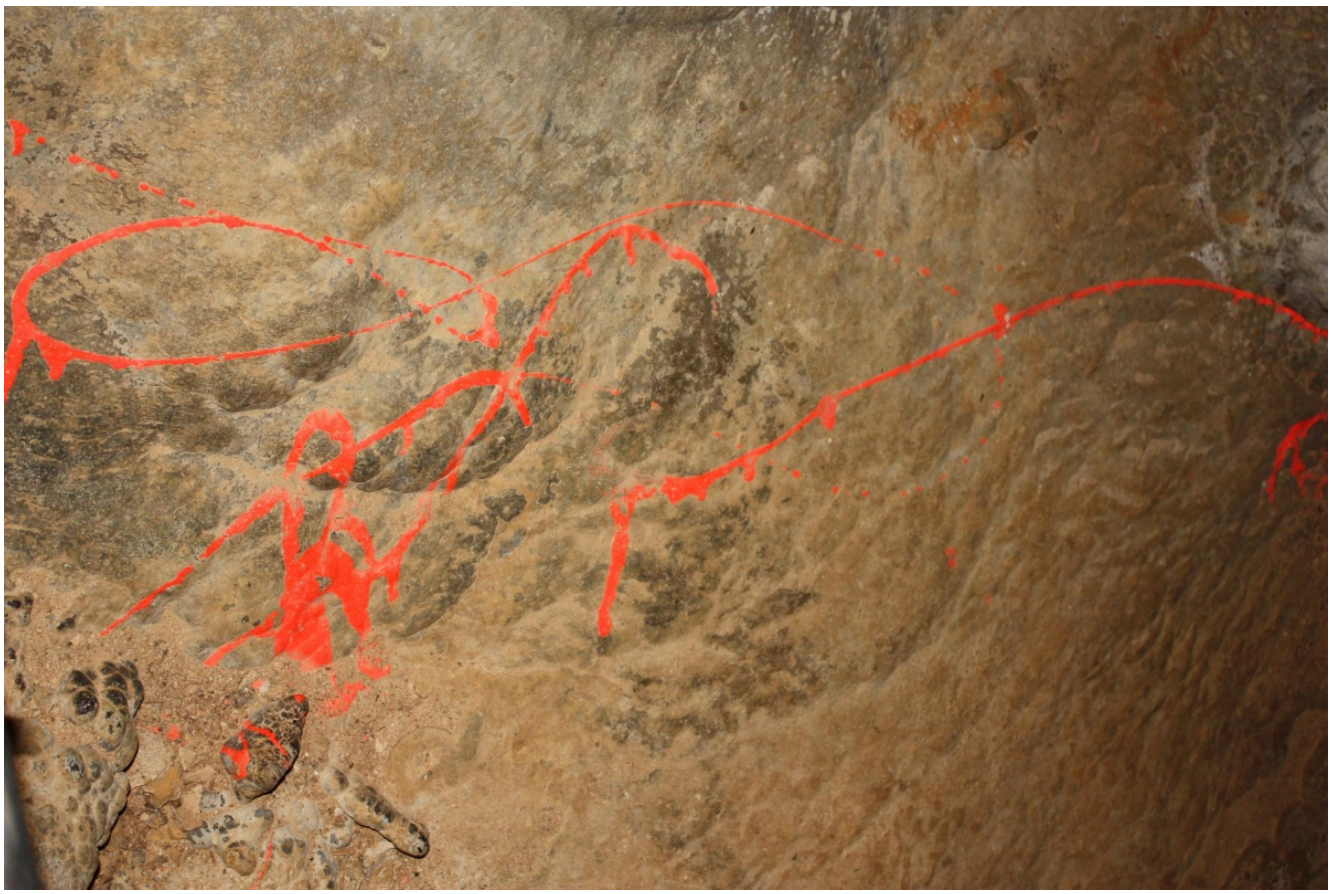
A pictograph is a prehistoric drawing or form of symbolic artwork and can be found within caves. True pictographs are of significant cultural and anthropological importance. Pictographs are most often found in the twilight portion of caves, near the entrance; but due to changes or other events, they could be found almost anywhere. The observation of something that appears to be a pictograph should not be discarded because of its location. The symbolic artwork may or may not be recognizable and because of age, it may even be very hard to identify. Red ochre, yellow ochre, charcoal black and white are common colors in pictographs. The pigments were often made of whatever colorful material could be collected. All that remains of a pictograph may be a faded, color blotch on a wall, so observe carefully especially near an entrance.

For purposes of cave inventory, the definition of pictograph should be broadly construed to include similar artwork such as petroglyphs. Basically, any kind of symbolic artform on the rock is inventoried in this field.

Pictographs, Graffiti

Pictographs

Other, Graffiti



Paint spilled or drizzled over bedrock and flowstone. This could be recorded as an other graffiti or as a possible restoration project or both.

The **Other** field of the Graffiti section should be used to list stations which exhibit some type of human made markings other than pictographs or graffiti. These may include things such as: paint marks, carbide marks (usually on the ceiling), scratches, pencil or pen marks, sculptures made of mud or clay, and other types of human made marks which are not of the pictograph or graffiti variety. Directional arrows in carbide, paint, and even lipstick or any other medium are examples.

On the *CCNP Cave Inventory Form*, the recorder is asked to include a description and approximate age for all graffiti. Include this information next to the station.

Example

- Graffiti, other: G23 (small clay sculpture with a university logo / 20 years)

References

- Hildreth-Werker, Val and Werker, Jim C. (2006) *Cave Conservation and Restoration* National Speleological Society, Huntsville, AL pp 110,333-334 ISBN: 1-879961-15-6

Glossary

Glossary

Aqua sox

Aqua sox are lightweight, slip-on shoes with non marring soles. The soles are usually white. They are usually sold for wearing when swimming and are often for sale seasonally. Aqua sox are used to cross easily marred surfaces such as flowstone where wearing heavy, soiled boots may mark the surface.

It is customary to change into aqua sox before crossing a delicate surface and change back to boots at the other side to avoid dirtying the aqua sox making them unuseable elsewhere without cleaning.

Fractal

Fractal refers to a network of branching shapes similar to a tree, bush or fern.

Phreatic

Phreatic refers to being below the water table.

Rescue litter

A **rescue litter** (sometimes called a stretcher) is a device designed to transport a patient in a rescue situation. Caves and other small spaces make transporting an incapacitated patient problematic. A rigid litter is preferred if the situation allows; but, it may be too large or unyielding. In such cases a sked may be used instead.

Rhombohedron

A **rhombohedron** is a 3-dimensional shape with flat faces and straight edges. Each of the faces is a rhomus -- that is, a four-sided figure with opposite sides parallel but not necessarily a square or rectangle as the angles need not be right angles.

Scalenohedral

A **scalenohedron** is a 3-dimensional shape with flat faces and straight edges. Each of the faces is a scalene triangle -- that is, all sides of the triangle are different lengths.

Sked

A **sked** is a type of portable, rescue litter or stretcher. It is basically a large piece of stiff plastic with webbing and other accessories making it suitable for confined space rescues. It is manufactured and marketed by Skedco [1] hence the name.

The sked rolls into a transportable form and when in use, the patient is packaged into it like a taco. It is not entirely rigid and the patient can often feel rocks and other irregularities under their back; but, the fact that it rolls up makes it able to be taken into spaces which would be impossible for a more rigid litter.

External links

- Photo of the basic sked after assembly [2]

Vadose

Vadose refers to being above the water table.

Vug

A **vug** is a cavity in the bedrock. The term usually refers to spaces that are small to medium size -- that is, too small to enter, otherwise, it would be a lead.

References

[1] http://www.skedco.com
[2] http://www.skedco.com/public/images/products_original/civ_SK-201-OR.jpg

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