

CAVE MINERALS

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CAVE AVENUE

USA

1957; Northrop, 1959).

ORIGIN: Probably formed as a mineral in a vadose cave clay (Good, 1957).

REFERENCE: Good (1957), Northrop (1959).

OTHER SILICATES

CRISTOBOLITE (Opal)

Cristobolite (SiO_2) occurs in caves in a very finely crystalline form commonly called opal. Cristobolite (opal) speleothems are small and comparatively rare.

OPAL IN LAVA TUBES

DESCRIPTION: Opal forms in lava tubes as stalactites, stalagmites, flowstone, helictites and coralloids.

Coralloids—Dendritic opal speleothems resembling coral have been noted with stems (2 cm in length, 5 mm in diameter) protruding from lava-tube walls. Branches radiate from the end of each stem. Some of the branches are short and bulbous, some are long and slender, many are covered with short acicular spines. Nodular opal popcorn may form as botryoidal layers on lava stalactitic cores or basalt spines and globules (Swartzlow and Keller, 1937).

Flowstone—Coatings of white to gray opal cover

some lava-tube floors. Also, walls and fissures may be covered with white banded opal (Anderson, 1930; Lindsley, 1966).

Helictites—Some nongravimorphic opal forms branch from the main stem and in one cave recurve upward to the ceiling (Swartzlow and Keller, 1937).

Stalactites—Opal stalactites have been reported, 2 to 3 in in length, porous, and white to pale gray or yellow in color. Some are pure opal and others are interbanded with chalcedony. Some stalactites are hard throughout; some of the more hydrated opal stalactites have a soft core (Anderson, 1930). The pure opal stalactites have a small hollow central tube similar to calcite stalactites.

Stalagmites—Opal stalagmites occur as botryoidal mounds 2 to 3 in in diameter. Some are hard throughout and some have soft interiors (Anderson, 1930).

ORIGIN: Lava tube opal stalactites, stalagmites, and flowstone are deposited by silica-bearing cavern waters. The source of the silica in solution (up to 200 ppm SiO_2) is volcanic glass (George Moore, personal communication). Helictites and popcorn are probably deposited by capillary action and slow seepage of water through the porous lava.

OPAL IN LIMESTONE CAVES

DESCRIPTION: Layers of opal have been reported alternating with calcite in stalactites, flowstone, popcorn and with gypsum and calcite in cave

Fig. 66. Boxwork with scintillites. Scintillites are the chert-cored helictite forms covered with sparkling quartz crystals.

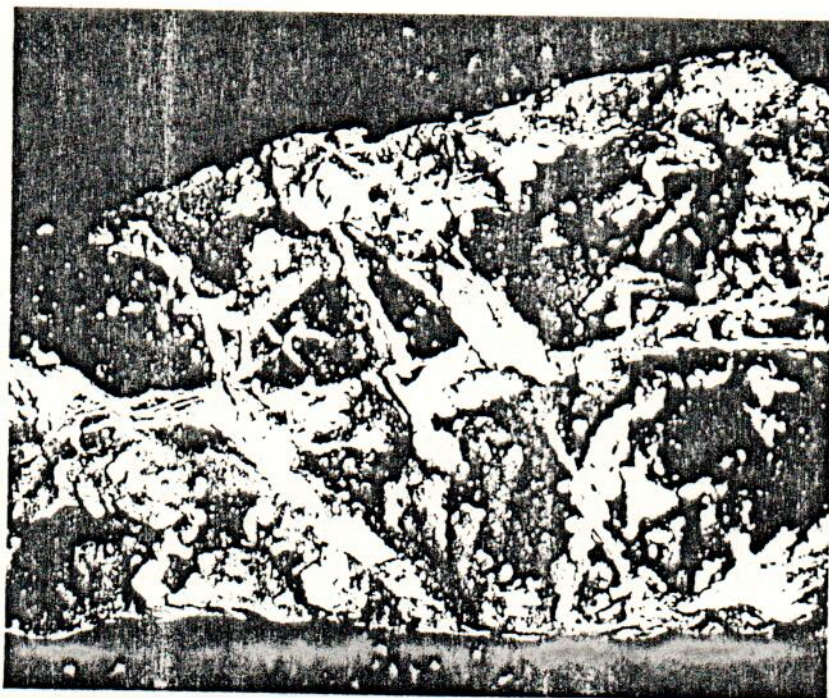
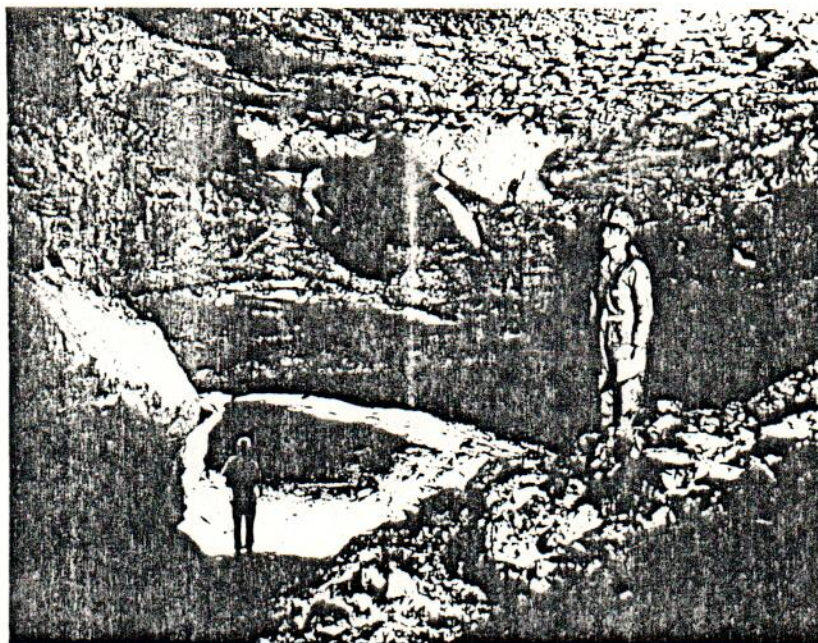


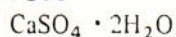
Fig. 70. Gypsum causing bedrock breakdown in Upper Turner Ave., Flint Mammoth Cave system. Note the gypsum flowers on the ceiling, the bedrock hanging from the ceiling and the breakdown on the floor underneath the gypsum flowers.



Luster: silky to earthy

Habit: fibrous to hair-like; fiber axis is the c-axis; coarsely crystalline

GYPSUM



Insoluble in cold dilute HCl; slightly soluble in water. Becomes dehydrated and powdery upon heating with a close flame.

No taste

Transparent to translucent

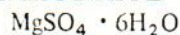
Color: selenite crystals are colorless; fibrous gypsum is white and silky; impurities produce browns, grays, or tans

Luster: vitreous, pearly, silky

Hardness: 2

Habit: *needles* twinned on the 100 plane; also tabular and fibrous

HEXAHYDRITE



Very soluble in water

Taste: bitter, salty

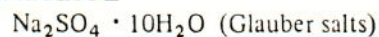
Transparent to opaque

Color: colorless to white

Luster: pearly to vitreous

Habit: fibrous

MIRABILITE



Very soluble in water; dissolves readily in the mouth; effloresces very rapidly; melts when slightly warmed; decomposition takes place in matter of seconds to minutes when removed from the stable cavern environment (White and others, 1970).

Taste: *cool, then feeble saline and bitter*

Transparent

Colorless

Luster: vitreous

Habit: fibrous and massive; fiber axis is the c-axis, coarsely crystalline

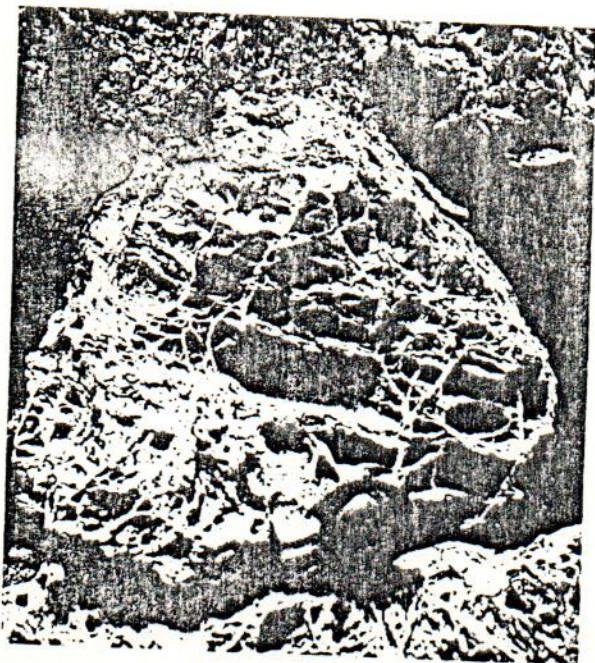
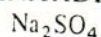


Fig. 71. Gypsum boxwork.

THENARDITE



Very soluble in water

Taste: faintly salty

Transparent to translucent

Color: colorless when pure

Luster: vitreous, inclining toward resinous

Habit: powdery crusts and efflorescences

SULFATE SPELEOTHEMS

BOXWORK, GYPSUM

DESCRIPTION: Fins of selenite boxwork occur in gypsum caves (Fig. 71). The depth of individual fins has been observed to reach up to 20 cm from the wall. Boxwork in one southwestern cave averages approximately 30 cm on a side. In another southwestern cave it is about 3 cm long on a side. Some of the southwestern cave boxwork is corroded on the edges and some is covered with a clay coating (John J. Corcoran, personal communication).

ORIGIN: Gypsum boxwork originates when

cracks or fractures in gypsum bedrock are filled with less soluble selenite. This material is left in relief when the gypsum bedrock is dissolved.

REFERENCE: Carpenter and Schluter (1961).

CRUSTS, SULFATE

DESCRIPTION: Sulfate crusts are deposits that coat cave ceilings and walls, grow in bedrock seams and cracks, or, more rarely, grow on the floor from cave silt. Gypsum crusts (Fig. 72) may consist of crystals with a granular equant or fibrous texture, or they may be composed of curved or tabular crystals (Deal, 1962; White, 1968). Gypsum crust has been observed up to 10 cm in thickness. A blistered crust is crust that forms in hemispherical bulges. White epsomite occurs on cave walls and in floor deposits as crusts or fibrous efflorescences (Berry and Mason, 1959; White, 1970). Mirabilite crusts and coatings occur on cave walls and floors as thin, fibrous, feathery crystal overgrowths (White and others, 1970; White, 1970). An old report from Mammoth Caves states: "...the whole floor was so thickly powdered with small crystals of glauber salt, that it resembled a hoar frost and rendered walking very unpleasant and slippery..." (Blane, 1824). Bloedite cave crusts have been reported in Lee Cave, Kentucky (White, 1971). Gypsum, mirabilite (Fig. 73), and thenardite crusts have also been reported from lava caves (Lindsley, 1966).

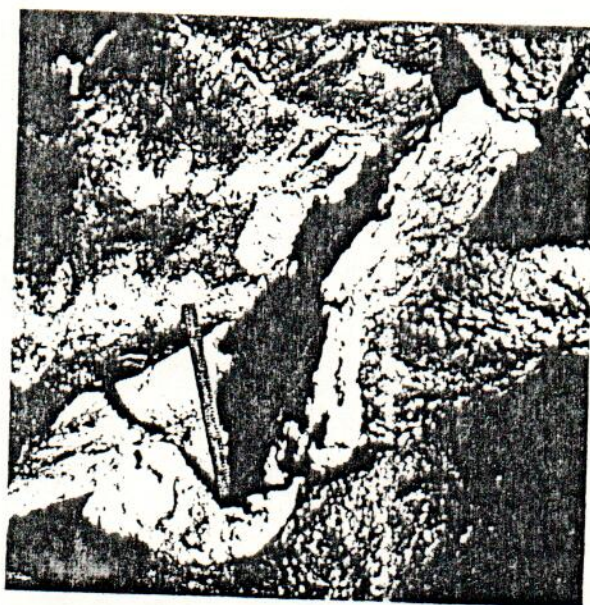


Fig. 72. Gypsum cave crust. Crust has peeled away from wallrock. Scale is 6 in long.

solutions and was later oxidized to hematite.

REFERENCES: Deal (1962), White and Dieke (1962).

JAROSITE

DESCRIPTION: $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$. Jarosite occurs with tiniticite and limonite as a plaster-type coating on the lower cave walls and floor of Tintic Cave, Utah. The coating ranges in thickness from a few inches to a foot or more (Stringham, 1946). Jarosite has also been found in lava caves (Lindsley, 1966).

ORIGIN: Pyrite in the limestone seemingly supplied the iron and the sulfate for the jarosite coatings. The jarosite evidently formed after the tiniticite; the iron phosphate formed until all the phosphate was used up and then the iron sulfate formed. The jarosite in lava caves results from ground water percolating through porous basalt.

REFERENCES: Stringham (1946), Lindsley (1966), Broughton (1971).

LECONTITE

DESCRIPTION: $\text{NaNH}_4\text{SO}_4 \cdot 2\text{H}_2\text{O}$. Clear, colorless crystals of lecontite that taste saline and rather bitter occur imbedded in decomposed bat guano in Piedras Cave, Honduras.

ORIGIN: The NH_4 comes directly from the bat guano. The source of the sodium and the sulfate is unknown. Lecontite forms early in the breakdown of bat guano.

REFERENCES: Taylor (1858), Broughton (1971).

SCHOLZITE

DESCRIPTION: $\text{Ca}_3\text{Zn}(\text{PO}_4)_2(\text{OH})_2 \cdot \text{H}_2\text{O}$. Scholzite is reported from a cave in Virginia (Dietrich, 1960).

ORIGIN: Unknown.

REFERENCE: Dietrich (1960).

SIDERITE

DESCRIPTION: FeCO_3 . Siderite occurs as an

amber-brown core inside stalactites and dogtooth spar. In the dogtooth spar, the siderite and calcite are oriented exactly the same; cleavages pass directly through both crystals. Also reported are siderite solution deposits with a reddish-brown, varnish-like appearance (Foster, 1952).

ORIGIN: Unknown.

REFERENCES: Ziegler (1914), Johnson (1919), Foster (1952), Deal (1962), White and Dieke (1962).

SULFUR

DESCRIPTION: S. Rhombic and massive sulfur occur as seams embedded in thicker veins of gypsum blocks (Donald G. Davis, personal communication). Sulfur stalactites are also known from the Shor-su caves near Kokanda, Uzbek, U.S.S.R.

ORIGIN: Origin is speculative, but is probably secondary. Sulfur bacteria may separate the sulfur from the gypsum as part of their life processes.

REFERENCES: Ivanov (1968), Jennings (1971).

RELATED FORMS

LAVA

DESCRIPTION: A lava cave is defined as a natural mansize cavity or chamber in lava (Lindsley, 1966). Lava tubes are a type of elongated lava cave formed in lava flows when the surface material cools and solidifies while the interior remains partially fluid and continues to flow in a conduit. During the final stages of solidification lava drains partially or completely from the conduits, creating the lava tube caves. Many lava features morphologically resemble speleothems. These are formed by dripping, splashing, or flowing molten lava and are therefore not true speleothems according to the secondary-origin definition. However some investigators do consider lava forms to be speleothems (Lange, 1960a; Halliday, 1962). Lava forms include stalactites, ribbon-shaped draperies, stalagmites (Fig. 97), columns, flowstone, helictites (Fig. 98), and coralloids. Some of these are highly vesicular, with vesicles often elongated vertically. A glaze is sometimes preserved on the exterior of lava features. Lava forms are comparatively small, ranging only up to a foot or two in length. Lava caves can also contain secondary deposits of



Fig. 97. Lava stalagmites.

calcite, aragonite, gypsum, halite, quartz, cristobolite (opal), mirabilite (Fig. 73), thenardite, jarosite, and zeolites resulting from ground water percolation through the basalt (Rimbach, 1963; Lindsley, 1966; Harter, 1973).

ORIGIN: Lava features form by one of two processes: either by dripping lava or by gas heating (Lindsley, 1966). As molten lava drains out of a lava tube the subsiding fluid lava forms drip stalactites. The size of these forms depends on the viscosity and temperature of the molten lava; the more viscous the lava is, the more massive the stalactites (Knox, 1959). Stalactites formed in this way are mostly icicle-shaped (drip pendants). Ribbon-shaped cave draperies are another common product. Variations of the above process causes differences in form. Tubular stalactites grow when gravitomorphically controlled lava cools on the outside while the inside lava flows out, leaving a hollow tube. Sometimes the lava solidifies within the tubular stalactite. Teardrop or bulbous stalactites form when the lava is fluid enough to flow into a drip shape but solidifies in place instead of falling to the floor. "Sharks-teeth" or flattened icicle-shaped stalactites are thought to be formed by the elongation of comparatively viscous lava. Lava stalagmites are formed when lava drips from the ceiling onto the floor. Lava stalagmites are sometimes composed of mounds of hollow lava bubbles which at other times form "lava roses" (Harter, 1971). Halliday (1967c) has reported lava stalagmites

up to eight feet high. Lava helictites form when hot lava is forced out a small crack in the outside of a cooling stalactite. Other causes of lava helictites may be the release of dissolved gases from within molten lava or from wind currents (William R. Halliday, personal communication).

REFERENCES: Knox (1959), Halliday (1962; 1963a), Rimbach (1963), Stearns (1963), Lindsley (1966), Halliday (1967c), Harter (1971), Tubbs (1972), Harter (1973).

MUD

DESCRIPTION: Mud speleothem-like features are not true speleothems since they do not consist of secondary minerals, but are composed of detrital clay minerals plus impurities, such as organic material. Mud stalagmites are the most common of mud speleothem forms. Mud stalagmites, unlike other stalagmites, usually have a round hole or pit about 0.5 in in diameter that extends through the middle of the stalagmite from the top to the base, sometimes extending into the underlying cave soils. Mud stalagmites generally are internally structureless, but some may show concentric layering, particle-size stratification, or a color differentiation caused by a darker clay coating over a lighter colored calcareous or siliceous central core (Deal, 1966; Thayer, 1967).

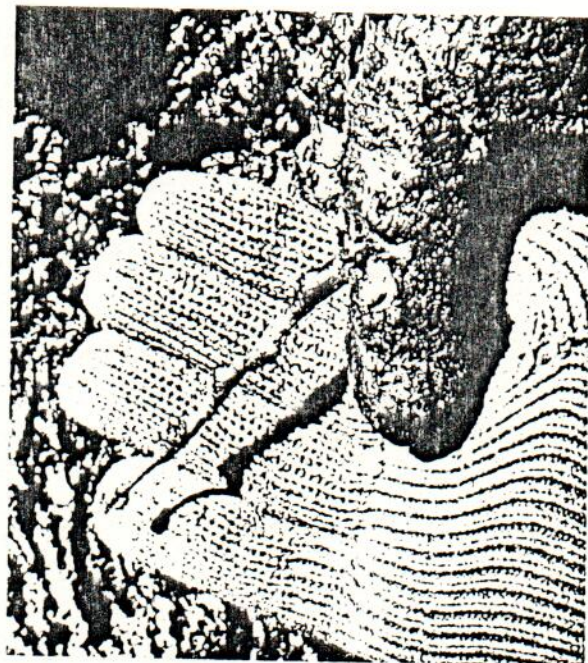


Fig. 98. A lava stalactite and a lava helictite.