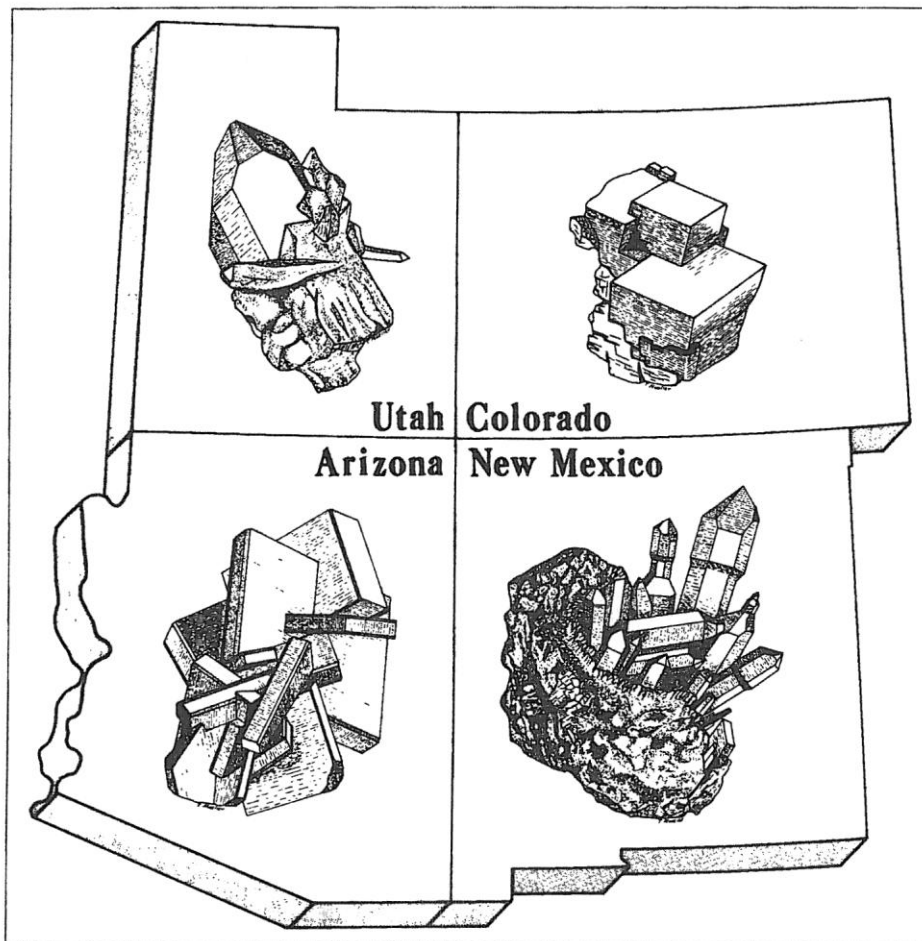




NEW MEXICO MINERAL SYMPOSIUM

November 9 & 10, 1996



NMIMT Campus, Socorro, New Mexico

Welcome to
THE SEVENTEENTH ANNUAL
NEW MEXICO MINERAL SYMPOSIUM

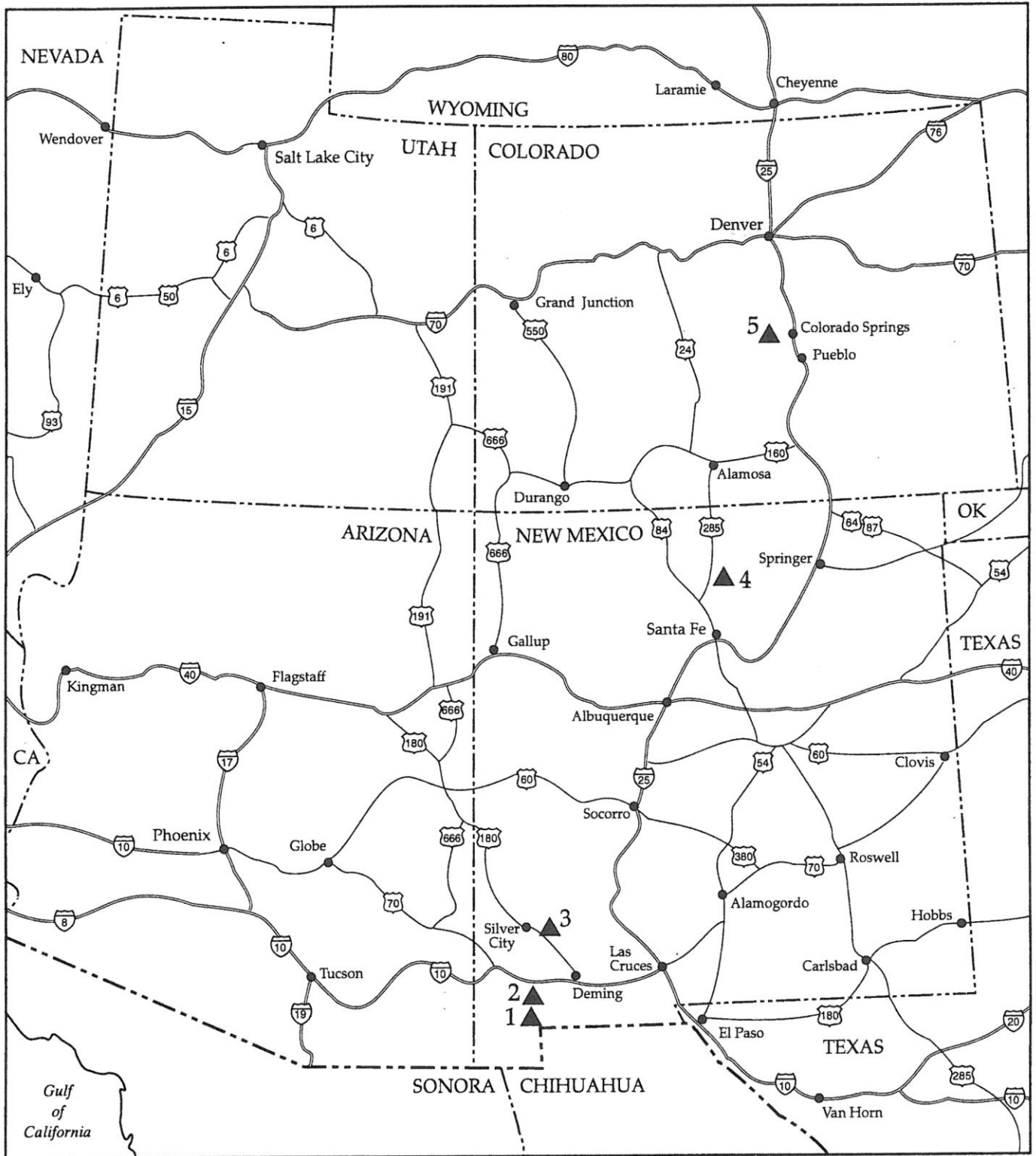
November 9 and 10, 1996

Macey Center Auditorium
New Mexico Institute of Mining and Technology
Socorro, New Mexico

sponsored by
New Mexico Bureau of Mines and Mineral Resources
Albuquerque Gem and Mineral Club
Los Alamos Geological Society
New Mexico Geological Society
Chaparral Rockhounds

The purpose of the New Mexico Mineral Symposium is to bring together for an exchange of ideas both professionals and amateurs interested in mineralogy. The sponsors hope that the Seventeenth New Mexico Mineral Symposium will give both groups a forum to present their cumulative knowledge of mineral occurrences in the state. In addition to the formal papers, informal discussions among mineralogists, geologists, and hobbyists should benefit all.

Cover—MINERALS OF THE FOUR-CORNERS STATES. Scepter quartz from Kingston, New Mexico; rhodochrosite from Silverton, Colorado; topaz from the Thomas Mountains, Utah; and barite from Superior, Arizona represent the four-corners states in the cover design by Teresa Mueller.



Geographic Index Map
 17th New Mexico Mineral Symposium

SCHEDULE

Numbers in parentheses refer to geographic location on map.

Friday, November 8

6:00 pm Informal tailgating and social hour,
individual rooms, Super 8 Motel

4:00-4:45 *Gemstones of Russia*—Robert W. Jones, featured speaker

Saturday, November 9

8:30 am Registration, Macey Center;
continental breakfast

5:30 Sarsaparilla and suds: cocktail hour,
cash bar

9:20 *Opening remarks*, main auditorium

6:30 Dinner followed by a brief
presentation by Robert W. Jones and
an auction to benefit the New
Mexico Mineral Symposium.

9:30 (1) *Secondary bismuth minerals from
the Apache mine, Hidalgo County,
New Mexico*—Virgil W. Lueth

Sunday, November 10

10:00 *Minerals in disguise: Arizona
pseudomorphs*—Anna Domitrovic

8:15 am Morning social, coffee and donuts

10:30 Coffee break

9:00 Welcome to the second day of the
symposium and follow-up remarks

11:00 (2) *A second New Mexico carminite
locality, Victorio Mountains, Luna
County, New Mexico*—Joan Beyer

9:10 *The ugly ores of silver*—Andrew J.
Regis

11:30 *Quartz from southeastern
Oklahoma*—Joe Lobell

9:40 (4) *Gahnite, margarita, and other
minerals from Taos County, New
Mexico*—Ramon DeMark & Jesse
Kline

12:00 pm Lunch

10:10 Coffee break

1:00 Museum Tours

10:40 (5) *"Onegite" from the Pikes Peak
batholith, Colorado*—Peter Modreski

2:00 (3) *A mineralogical tour of Grant
County, New Mexico*—Ronald B.
Gibbs

11:10 *Open forum on minerals and
collecting in the four-corners states*

2:30 *Arizona vanadinite*—Jeffrey Scovil

12:00 pm Lunch

3:00 ; Coffee break

1:15-3:00 Silent auction, upper lobby, Macey
Center, sponsored by the
Albuquerque Gem and Mineral Club

3:30 *Colorado fluorite*—Barbara Muntyan

Secondary bismuth minerals from the Apache mine, Hidalgo County, New Mexico

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The Apache mine is in the bootheel region of southwest New Mexico. Deposits in the area were first worked by Mexican miners who shipped silver ore back to Chihuahua City, Mexico. The Apache No. 2 mining district (also known as the Anderson district) was located by Bob Anderson in 1878. Mining was continuous from 1878 to 1929, at which time the main stope collapsed at the Apache mine. The district is credited with the production of about 100,000 tons of silver-copper and silver-lead ore. Interest in the district continues to the present day with recent claims (May 1996) posted at the mine.

Two types of ore deposits are known in the district. Copper skarns are found at the contact zone between a 27 Ma monzonite porphyry and Cretaceous limestones (Peterson, 1976). Mineralogy of these deposits is typical for a copper skarn and consists of garnet, diopside pyroxene, epidote, quartz, and calcite with sulfide minerals of chalcopyrite and pyrite. Much of the ore is oxidized to malachite and chrysocolla. Vein replacement deposits represent the second type of mineralization in the district. These veins are associated with the McKinley fault zone. Calcite is the dominant vein material, containing pods or blebs of oxidized ore minerals. Geology of the fault zone is complex with many subsidiary faults juxtaposing limestone, shale, and skarn units. The dominant ore minerals are malachite and chrysocolla with minor amounts of secondary bismuth minerals.

Bismuth minerals are restricted to the upper parts of the ore deposit. Bismutite, $\text{Bi}_2(\text{CO}_3)_0_2$, is the most common bismuth mineral, reported to be a pseudomorph of bismuthinite. Yellow rims surrounding bismutite surrounded by calcite have been identified as kettnerite, $\text{CaBi}(\text{CO}_3)\text{OF}$, by x-ray diffraction. The paragenetic relationship of bismutite, calcite, and kettnerite indicates the calcite post-dates oxidation of primary bismuth ore minerals and probably represents cavern filling. Other bismuth minerals, tentatively identified by optical examination and crystallographic habit include: perite, PbBiO_2Cl ; bismite, Bi_2O_3 ; and bismoclite, BiOC1 . These minerals were observed only in material that was devoid of calcite from above the 200 level. The calcite-free material, no longer available, was collected at the mine by Mahlon T. Everhart in the 1930s and later donated to the NMBMMR Mineral Museum in 1990. Chiorargyrite, AgCl , is fairly abundant in the calcite-free material and represents the major silver-bearing phase in the deposit. The abundant copper, silver, and bismuth secondary minerals suggest that the primary bismuth sulfide was not bismuthinite, but was possibly a silver-copper-bismuth sulfosalt of the pavonite group.

Reference

Peterson, S. L., 1976, Geology of the Apache No. 2 mining district, Hidalgo County, New Mexico: Unpublished MS thesis, University of New Mexico, 86 pp.

Minerals in disguise: Arizona pseudomorphs

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Minerals form when specific temperatures and pressures are applied to chemical solutions in a particular geologic environment, whether it be sedimentary, igneous, or metamorphic. Pseudomorphs result when the presumably stable environment of formation becomes unstable, altering the conditions, thus resulting in a new environment. Different conditions can cause instability, which produce pseudomorphs by various means. The manners in which pseudomorphs occur include replacement or substitution; chemical alteration; and encrustation, dissolution, and resulting casts. The end result of each situation is the retention of the form of the original mineral with a partial or complete chemical alteration.

The introduction of highly silicious solutions and subsequent replacement of a fallen tree alters the original nature of the tree resulting in petrified wood, typical of Petrified Forest in northeastern Arizona. Thus, quartz is a pseudomorph after wood by replacement or substitution of the latter by the former. Quartz, in fact, is a common pseudomorphic replacement of many minerals including anhydrite, calcite, and hemimorphite, all of which occur in Arizona. The replacement is complete so that none of the original material remains.

Chemical alteration may not be so complete, as many times a core of the original minerals remains. It involves a partial addition or subtraction of elements or compounds in the original mineral but still produces what can be called a pseudomorph. Add carbon, oxygen, and hydrogen to cuprite, Cu_2O , and what results is a malachite, $\text{Cu}_2^{+2}\text{CO}_3(\text{OH})_2$, pseudomorph after cuprite. Take away copper, carbon, and oxygen from azurite, $\text{Cu}_3^{+2}(\text{CO}_3)_2(\text{OH})_2$, and there is still a malachite pseudomorph, this time after azurite.

The third possibility is an encrustation of one mineral over another. Although some may call simple coatings a pseudomorph, the purist would require the complete removal of the mineral after the encrustation, leaving behind only a cast of the original.

There are examples of each of these types of pseudomorphs within the boundaries of the state of Arizona. Some of the classic and unmistakable pseudomorph occurrences include malachite pseudomorphs after azurite from Ajo and Bisbee; and Camp Verde calcite pseudomorphs after glauconite, some of which have been penetrated by post-mining chrysocolla and malachite. Other easily recognized pseudomorphs are the Bloody Basin and Inspiration malachite pseudomorphs after azurite with drusy quartz coatings. There are also Arizona localities that have produced a variety of pseudomorphs including Tiger (malachite after azurite, sauconite after cerussite), the 79 Mine (chrysocolla after hemimorphite and wulfenite), and the Flux Mine (anglesite after cerussite and cerussite after anglesite).

Pseudomorphs by replacement

QUARTZ var. JASPER SiO_2
after
WOOD

COPPER Cu
after
WOOD

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
WOOD

CALCITE CaCO_3
after
SAYS PHOEBE (BIRD) NEST

QUARTZ SiO_2
after
ANHYDRITE CaSO_4

QUARTZ SiO_2
after
CALCITE CaCO_3

CALCITE CaCO_3
after
HEMIMORPHITE $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$

MUSCOVITE $\text{KAl}_2(\text{Si}_3\text{Al})_0\text{H}_2(\text{OH},\text{F})_2$
after
SCHORL $\text{NaFe}_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_4$

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
after
CERUSSITE PbCO_3

Casts as pseudomorphs

VANADINITE $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$
cast of
FLUORITE CaF_2

QUARTZ SiO_2
cast of
CALCITE CaCO_3

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
cast of
CERUSSITE PbCO_3
after (by replacement)
LINARITE $\text{PbCu}(\text{SO}_4)(\text{OH})_2$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

Pseudomorphs by alteration

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

QUARTZ SiO_2
after
HEMIMORPHITE $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_{4-n}\text{H}_2\text{O}$
after
HEMIMORPHITE $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$

PYROLUSITE MnO_2
after
MANGANITE $\text{MnO}(\text{OH})$

ANGLESITE PbSO_4
after
CERUSSITE PbCO_3

CERUSSITE PbCO_3
after
ANGLESITE PbSO_4

DESCLOIZITE $\text{PbZn}(\text{VO}_4)(\text{OH})$
after
WULFENITE PbMoO_4

GRAEMITE $\text{CuTeO}_3 \cdot \text{H}_2\text{O}$
after
TEINEITE $\text{CuTeO}_3 \cdot 2\text{H}_2\text{O}$

Questionable pseudomorphs, casts, and coatings

GRAEMITE $\text{CuTeO}_3 \cdot \text{H}_2\text{O}$
after
TEINEITE $\text{CuTeO}_3 \cdot 2\text{H}_2\text{O}$

GOETHITE $\text{FeO}(\text{OH})$
cast of
VANADINITE $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$

QUARTZ SiO_2
coating/after
WULFENITE PbMoO_4

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
coating/after
WULFENITE PbMoO_4

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_{4-n}\text{H}_2\text{O}$
penetrating
CERUSSITE PbCO_3

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
penetrating
CALCITE CaCO_3
after
GLAUBERITE $\text{Na}_2\text{Ca}(\text{SO}_4)_2$

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
coating
CERUSSITE PbCO_3
after
LINARITE $\text{PbCu}(\text{SO}_4)(\text{OH})_2$

ROSASITE $(\text{Cu},\text{Zn})_2(\text{CO}_3)(\text{OH})_2$
coating
MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}(\text{CO}_3)_2(\text{OH})_2$

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
coating
GOETHITE $\text{FeO}(\text{OH})$
after
ANHYDRITE CaSO_4

QUARTZ SiO_2
over
MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}(\text{CO}_3)_2(\text{OH})_2$

Localities

BISBEE

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}(\text{CO}_3)_2(\text{OH})_2$

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after

CUPRITE Cu_2O

79 MINE

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
AFTER
HEMIMORPHITE $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$ after
WULFENITE PbMoO_4

AURICHALCITE $(\text{Zn},\text{Cu})_5(\text{CO}_3)_2(\text{OH})_6$
after
WULFENITE PbMoO_4

INSPIRATION

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

CHRYSOCOLLA $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

TIGER

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

SAUCONITE $\text{Na}_{10}\text{Zn}_3(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$
after
CERUSSITE PbCO_3

CAMP VERDE

CALCITE CaCO_3
after
GLAUBERITE $\text{Na}_2\text{Ca}(\text{SO}_4)_2$

AJO

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

BLOODY BASIN

MALACHITE $\text{Cu}_2\text{CO}_3(\text{OH})_2$
after
AZURITE $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

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**A second New Mexico carminite locality:
Victorio Mountains, Luna County**

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The arsenate mineral carminite was first reported in New Mexico from Granite Gap, Hidalgo County (DeMark, 1996). A new carminite occurrence has recently been discovered at Mine Hill in the Victorio Mountains, Luna County. Beudantite and adamite are also reported here for the first time from Mine Hill.

The Victorio Mountains are 18 mi west of Deming and easily accessible by leaving I—10 at the Gage exit and driving about 3.5 mi south.

Mine Hill, at the southeast corner of the Victorio group, is composed mainly of faulted Silurian dolomite; the orebodies are deeply oxidized lead-zinc veins. It was the site of lead, zinc, silver, and gold mining from 1880 to the late 1950s. Total production for the entire period was less than two million dollars, over half of which was recovered during the first 25 years. Major producers were the Chance and Jessie claims; other important properties were the Rover, Rambler, Excess, and Helen claims. Ore minerals were listed by Griswold (1961) as cerussite, anglesite, silver halides, and native gold, with minor smithsonite and secondary copper minerals in a gangue of quartz, calcite, and various iron oxides. Lindgren, Graton, and Gordon (1910) observed that all the ores contained some arsenic.

Although Mine Hill has never been noted for mineral specimens, collectors have long known that microcrystals of secondary lead, zinc, and copper minerals occur there. The Helen yields cream, yellow, and orange mimetite and/or vanadinite; yellow to orange wulfenite; and occasionally square, orange to amber descloizite plates. Similar mimetite/vanadinite, as well as aurichalcite, malachite, conichalcite, and sparse willemite have been found at the Rambler and the Excess. Cerussite and anglesite are uncommon except at the Rover, but they seldom form attractive crystals.

The newly discovered arsenates were all found on the Chance and Jessie dumps. Adamite occurs in fractures in pinkish-gray dolomite, associated with conichalcite and hemimorphite. Adamite forms sharp, lustrous, wedge-shaped microcrystals and rounded crystal aggregates that are colorless, pale blue, or bright turquoise blue. One sample of elongate, sea-green crystals was found. Adamite is nowhere abundant, most of the blue and green minerals on the dumps being aurichalcite and conichalcite. Conichalcite occurs as sprays of pale mint-green crystals, and as translucent apple-green to grass-green balls of dolomite and hematite.

Carminite and beudantite are usually found together, often accompanied by opaque white mimetite and occasionally by cerussite, in a quartz or hematite matrix. Beudantite forms yellow-green pods and streaks in the matrix, and tiny yellow crystalline masses. Carminite occurs as minute (<0.5 mm), lustrous, brilliant red, translucent crystals in single laths, radiating and bowtie sprays, and rounded clusters. In a single sample, abundant gray-green, amorphous bromargyrite is associated with carminite, mimetite, and beudantite. Late-stage calcite frequently permeates these rocks, partially filling pores and veinlets. Treatment with dilute HCl has produced mixed results.

One interesting sample from the Chance dumps displays quartz crystals associated with small rust-colored masses that are covered by a velvety reddish-brown outer layer, with carminite sprays and beudantite grains sprinkled over all. Preliminary microprobe analysis indicates that both the rust-colored material and the velvety material are calcium iron arsenates, tentatively identified as kolfanite $[\text{Ca}_2\text{Fe}_3^{+3}\text{O}_2(\text{AsO}_4)_3 \cdot 2\text{H}_2\text{O}]$, and arseniosiderite $[\text{CaFe}_3^{+3}(\text{AsO}_4)_3 \cdot 3\text{H}_2\text{O}]$. If x-ray analysis confirms these identifications, two more arsenates will be added to the list of New Mexico minerals.

In 1994 the Abandoned Mine Land Bureau covered or backfilled all the Mine Hill shafts and adits, destroying the Helen, Rambler, and Excess dumps. Collecting is still possible on a few small ore piles near the Helen headframe and on the extensive, mostly undisturbed, Chance and Jessie dumps.

Acknowledgments—Special thanks to Arnold Hampson for color photomicrographs, to Paul Hlava for microprobe analysis and mineral identification, and to Mark Cunningham and the New Mexico State University SEM Laboratory for SEM photomicrographs.

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Quartz from southeastern Oklahoma

Joe Lobell

A mineralogical tour of Grant County

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Grant County has one of the most diverse and rich mining and mineral heritage of any area in New Mexico. This tour will highlight some of the famous and well-known localities and some of the lesser-known ones as well. Minerals from the Alhambra, Commercial, Tyrone, Chino, and Cleveland mines, the Gila River area, and other well-known localities will be featured. New species and additions to the mineralogical record for Grant County and New Mexico will be highlighted.

Vanadinite occurrences in Arizona

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Vanadinite, the mineral

Vanadinite is a lead chloro vanadate $Pb_5(VO_4)_3Cl$. A partial series exists toward the arsenate mimetite, and the phosphate pyromorphite. Arsenic-rich vanadinite is generally known as endlichite.

Vanadinite crystallizes in the hexagonal system, usually as simple short to long prisms terminated by the pinacoid. Crystals are often cavernous, and sometimes barrel-shaped. It has a hardness of 3, and a density of 6.88. The color is usually red, also brown, orange, yellow, and rarely green. The streak is white to yellowish, and the luster is subresinous.

Occurrence—Vanadinite is a secondary mineral found in the oxide zone of lead and vanadium bearing deposits. Associated minerals include pyromorphite, wulfenite, cerussite, anglesite, descloizite and mottramite. Vanadinite alters to descloizite and sometimes replaces wulfenite.

Uses—Vanadinite is a minor ore of the metal vanadium that is alloyed with steel to toughen it.

Vanadinite in Arizona

Arizona has the most vanadinite localities of any state in the Union (Anthony et al., 1995, list 63). The majority are in the southern Basin and Range province. In most of these deposits it is a minor secondary mineral thought to be derived from large associated bodies of granitic and monzonitic rocks. Most mining of vanadium has occurred in the north part of the state on the Colorado Plateau. These deposits are the so called Plateau-type deposits, occurring in sandstones. Uranium is the other major and far more economically important component of these deposits. Unfortunately, the minerals of these deposits rarely crystallize and therefore are of little interest to mineral collectors.

Several Arizona localities are world-famous for both the quality and quantity of their vanadinite as well as the associated minerals. The best known are the Apache, Old Yuma, and the Mammoth-St. Anthony mines. Recent additions to Arizona's list of classics include the J. C. Holmes claim, Puzzler mine, North Geronimo (Pure Potential) mine, and the Hamburg mine.

References

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Fluorite occurrences in the San Juan Mountains of southwest Colorado

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Fluorite is a common gangue mineral in many of the mines located in the San Juan Mountains of southwest Colorado, often forming large euhedral crystals associated with quartz, rhodochrosite, calcite, pyrite, sphalerite, galena, and other minerals. Encrustation pseudomorphs of quartz after fluorite are also relatively common in quartz outcrops throughout the San Juans. Although fluorite is relatively common in the mines of the San Juans, it has not been widely exploited commercially, possibly because it rarely forms massive veins that could be mined at a profit. An exception was the Thistledown mine, along the Camp Bird road, about a mile southwest of the town of Ouray, where mining was specifically for fluorite. This overview is intended to provide a survey of the mines that have produced a significant amount of well-formed crystallized fluorite.

Some of the finest crystallized fluorite specimens come from the Sunnyside mine, located in San Juan County, about 5 mi northwest of Silverton along Cement Creek at the old site of Gladstone. Specimens are composed of octahedra or cubes of fluorite to as much as 4 inches on edge, typically on a matrix of drusy white quartz, often associated with rhodochrosite, pyrite, and other sulfides. Color includes pale green, emerald green, pale lavender, and grayish green. At the mouth of Arrastra Gulch, about 2 mi north of Silverton, is a prospect known as the Genoa claim. It has produced fine groups of encrustation pseudomorphs of quartz after octahedra of emerald-green fluorite to 2 inches on edge, in plates to as much as 10 inches across. Occasional encrustation pseudomorphs of quartz after barite are also found interspersed with the fluorite at this locale. The Ransom mine, just above the town site of Eureka, has yielded some beautiful gemmy, pale-green complex cuboctahedra of fluorite to nearly 2 inches on edge, implanted on large, milky-white barrel-shaped quartz clusters. In and near Hematite Gulch, west of the Animas River and opposite the mouth of Cunningham Gulch, several mines and prospects contain pale-green octahedra of fluorite, sometimes coated with a thin crust of drusy quartz.

In the Red Mountain mining district, between Silverton and Ouray, the Longfellow mine contains occasional cubes of lavender or white fluorite cubes to 1.5 inch on edge on plates of bright enargite crystals. The Idarado mine, which runs from Red Mountain Pass on the east all the way to the Telluride side on the west, contains occasional vugs with pale-lavender cubes and octahedra to 1 inch in association with quartz, minor sulfides, and other less-common species. At the north end of the Red Mountain district on the west edge of Ironton Park is a small prospect, the Gertrude claim. This claim contains large (to 2 inches on edge) bright-green fluorite octahedra coated with a druse of quartz and associated with scalenohedral calcite crystals to 0.5 inches.

The Grizzly Bear mine, in Ouray County, about 1 mile south of Ouray, has numerous vugs that contain fluorite crystals from 1-inch cubes of lavender to roughly 0.75-inch cuboctahedra of pale-green perched on plates of milky quartz crystals and associated with small rhodochrosite crystals. The Camp Bird mine, about 5 mi southwest of Ouray, also has numerous vugs containing fluorite crystals. Large encrustation pseudomorphs of quartz over emerald-green cubes of fluorite were found on the 14

Level of the East Camp Bird, whereas small, gemmy clusters of fluorite were found with cream-color doubly terminated calcite crystals on the 21 Level. Other vugs have produced colorless to pale-green fluorite in various parts of the mine. The Thistledown mine, which was mined for a short time around the First World War for fluorite, has yielded some of the largest emerald-green octahedra of fluorite crystals ever found in Ouray County. One crystal measures more than 3 inches on edge and is found on a plate of etched, white quartz crystals.

Although fluorite has no significant economic value in the mines of the San Juans, it forms fine large euhedral crystals and attractive crystal specimens in a range of color and habit and deserves its reputation as one of the most desirable collectible species from this area.

Gemstones of Russia (A Collector's Guide)

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Two trips to Russia in 1996 have given the speaker many opportunities to visit museums, view collections, and experience the adventure of visiting Russia.

This slide talk will describe some of the events surrounding these visits while visiting such famous museums as the Hermitage, the Fersmann Museum, the Diamond Fund, the Winter Palace, and more. Emphasis will be placed on the impressive use made by Russian artisans of the colorful massive gem materials available from the Ural Mountains and Siberia. Comments on the discovery of charoite and the gem now called Siberian emerald (chrome diopside) will be made along with comments on the well-known gems: emerald, amethyst, and the like.

The ugly ores of silver

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Unlike gold, silver occurs in more than 100 silver-bearing minerals. However, only 12 are common enough to be found in the true silver-only deposits in the western United States. Most collectors have well-crystallized specimens of many of the silver minerals in their collections, probably from the classic European localities or from Central and South America. Most likely the dominant silver mineral represented is native silver. But how many collectors have the "bonanza" silver minerals from the classic silver deposits of the western United States, especially from the localities listed in this paper? Don't feel bad, most state museums don't have them either. If they do, they are buried in the basement listed as "study" or "research" specimens and are probably the massive, noncrystallized "ugly ores" taken from these deposits after the main production years have long since passed.

The twelve silver minerals, which made up the bonanza deposits of silver in the western United States, are:

Acanthite (Argentite)	Ag_2S	86 - 87% Ag
Chlorargyrite (Cerargyrite)	AgCl	73 - 76% Ag
Bromargyrite (Embolite)	AgBr	73 - 76% Ag
Miargyrite	AgSbS_2	34 - 37% Ag
Naumannite	Ag_2Se	73 - 76% Ag
Pearceite	$(\text{AgCu})_{16}\text{As}_3\text{S}_{11}$	60 - 77% Ag
Polybasite	$(\text{AgCu})_{16}\text{Sb}_2\text{S}_{11}$	68 - 74% Ag
Proustite	Ag_3AsS_3	64 - 65% Ag
Pyrargyrite	Ag_3SbS_3	59 - 60% Ag
Stephanite	Ag_5SbS_4	68% Ag
Sternbergite	AgFe_2S_3	33 - 35% Ag

These minerals occur as the only ores of silver in the following silver deposits:

New Mexico

Silver City - Chloride Flats - argentite, chlorargyrite

Lake Valley - Bridal Chamber - chlorargyrite, bromargyrite

Utah

Silver Reef district - argentite, chlorargyrite

Colorado

Gold Brick district - Courtland mine - argentite, stephanite, pyrargyrite

Aspen - Mollie Gibson, Smuggler - argentite, polybasite, pearceite, pyrargyrite

Arizona

Chloride district - Distaff mine - argentite, chlorargyrite, proustite, pearceite

Tombstone district - Santa Ana mine - chlorargyrite, bromargyrite

Nevada

Comstock - argentite, stephanite, pyrargyrite, chlorargyrite, sternbergite

Tonopah - chlorargyrite, bromargyrite, argentite, stephanite, pyrargyrite, polybasite

Idaho

Silver City - naumannite, chlorargyrite, pyrargyrite, proustite, polybasite, miargyrite, argentite

Delamar - argentite, chlorargyrite, miargyrite, polybasite, pyrargyrite

California

Calico district - chlorargyrite, bromargyrite

A review of the literature written when these deposits were being mined at their peak production revealed that these minerals often occurred as well-developed crystals and clusters. Unfortunately, very few, if any, of these well-crystallized specimens ever found their way into a collection, private or public.

The most attractive group of silver minerals are the ruby silvers: proustite, pyrargyrite, and miargyrite. Even so, most of these are either massive or are poorly formed crystals. In fact, you have to look hard to detect any ruby-red color. This is probably because the ruby silvers, like the silver haloids, are light sensitive and darken with exposure to light. Yes, most of the important ore minerals of silver you see today from the United States are black, poorly crystallized, and ugly. But it wasn't always that way.

A few of the silver deposits deserve some discussion:

Lake Valley, NM—The Bridal Chamber was one of the few true bonanza occurrences of silver in the United States. In a space of 20 ft high by 70 ft wide, 2.5 million ounces of silver were extracted. Most of this came from a 4-ft-thick seam of nearly pure chlorargyrite, much of it well crystallized.

Chloride Flat (Silver City), NM—This is another bonanza-type deposit in New Mexico. Over three million ounces of silver were taken from this area over a period of 5 yrs.

Silver City and Delamar, ID—These two districts produced over \$35 million in silver. When you consider that they are only 5 mi apart, this area becomes one of the major silver deposits in the United States. The chlorargyrite from both Delamar and Silver City occurred as fine-crystallized masses. Miargyrite was also an abundant ore mineral and occurred as excellent crystals in vugs. Naumannite, with properties similar to argentite, was the most common silver mineral in the district, commonly occurring as cubic and octahedral crystals. Most of the minerals previously identified as argentite were in reality naumannite. Proustite was also a very common ore mineral, especially in the Silver City district. A 500-pound mass of crystallized proustite from the Poorman mine was exhibited at the Paris Exposition in 1967. Two other silver minerals, polybasite and pyrargyrite, were also widely distributed in the ore from this area. Both occurred as well-developed crystals in vugs and on other minerals.

The most productive district was the Comstock Lode with a recorded production of \$150 million of silver. Tonopah, Nevada was second with a \$125 million silver output. Thus, Nevada's title as the "Silver State". Probably the silver district that produced the least attractive silver ores is the Silver Reef of Utah. Although more than seven million ounces of silver were produced from argentite and chlorargyrite ore, these silver minerals occurred disseminated in sandstone.

A modern (but mined out) silver deposit in Tombstone, Arizona deserves the final discussion. The Santa Ana mine consists of high-grade chlorargyrite and bromargyrite ore with native gold. I am

familiar with this mine as I was fortunate to do some work for the owners while it was still in the development state in 1963. An article in Newsweek, published in March 1964, described the mine as being so rich that "canvas was spread on the tunnel floor to catch almost pure silver dust". As mentioned before, the silver minerals were only the silver haloids, no native silver. I offered to sell and trade some of the higher-grade specimens with visible chlorargyrite and bromargyrite to collectors and clubs in Boston and New York City. The assays on these specimens were typically 1.5 ounces of Au and 1,500 ounces of Ag per ton. Guess what? — I still have all the specimens.

Gahnite, margarite, and other new mineral occurrences from Taos County, New Mexico

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Gahnite, the zinc spinet, has not been known from New Mexico in noteworthy specimens. Margarite, a brittle calcium mica has not been previously reported from New Mexico. One of the authors (JK) in 1995 located both of these minerals in the Harding mine (Picuris) district. The find was made in spite of the fact that this area has been one of the most extensively studied areas of the state. Although gahnite has been found in the Harding mine district (Jahns, 1953), euhedral crystals larger than 1-2 mm have been unknown. The new find was made on the dumps of a small unnamed pegmatite prospect pit about three-quarters of a mile north of the Harding mine. The dominant crystal form is the octahedron (111) modified by smaller dodecahedron (110) faces. The octahedral faces are marked by raised triangular growth patterns. Crystals are a dark grass green and lustrous. They average about 5 mm with the largest crystals about 1 cm in size. They are inmiarolitic cavities in a groundmass of albite, white muscovite, and anhedral spessartine garnet. Euhedral white beryl crystals and some small blue anhedral apatite crystals were also found on the dumps of the pit, and light-green-blue slender crystals of beryl up to 5 mm in length have been found at the margins of the prospect. Gahnite was not found in the exposed walls of the pit.

Margarite was found in a shear zone between amphibolite and schist about 1.5 mi northwest of the Harding mine. It occurs as loose spherical nodules and botryoidal masses up to 3.5 cm in contact with quartz veins. The nodules are very fine grained and buff to silver although most are stained darker by iron oxides. A nodule that was sawed in half was found to be margarite throughout (P. J. Modreski, personal communication). Identification was confirmed by x-ray diffraction (Bart Cannon) and by optical methods (P. J. Modreski). Corundum, often associated with margarite, has not been found at this location. Less than 200 m north of this area, pink zoisite (thulite) was found in exceptional euhedral crystals. Free-standing, gemmy, twinned crystals to 4 mm with an orange-pink color were found in a vuggy coarse-grained amphibolite. Larger translucent to sub-translucent crystals with prominent prism faces were also found along with sharp dodecahedral red-purple garnets.

The Pilar cliffs of the Glenwoody district lie adjacent to the Rio Grande just south of the village of Pilar. The upper portion of the Precambrian Vadito Group (Glenwoody Formation) exposed in the steep-walled cliffs have produced noteworthy specimens of piemontite, idocrase (cyprine), zoisite (thulite), and dravite. A new occurrence of the chromian muscovite, fuchsite, has recently been found high up the cliffs by one of the authors (JK). The fuchsite, which is light grass green, occurs in a seam about 10-12 cm thick that seems to extend laterally only a few meters. Exact dimensions are difficult to discern because of the steepness of the terrain. Small (less than 0.5 mm) brown octahedral gahnite crystals are found with the fuchsite. The gahnites are similar to those found in a fuchsite occurring at La Madera Mountain in Rio Arriba County. A dravite-bearing schist is exposed about 15 m south of the fuchsite location. Dark-brown dravite crystals, which commonly are 2 cm x 2 mm in size, are abundant in this area. A pegmatite with pink-purple muscovite occurs about 500 m south of the fuchsite location. Also high up on the cliff, the pegmatite is about 20 cm thick and dips steeply eastward. Specimens have a superficial resemblance to material from the Harding mine but upon closer examination, the muscovite has a distinct purple appearance unlike the Harding mine muscovite.

These recent mineral discoveries show that the persevering collector can expand the mineralogical knowledge of the Harding mine, Glenwoody and Picuris districts, by continued scrutiny of the less-accessible area of the region.

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"Onegite" (amethyst with goethite inclusions) from the Pikes Peak batholith, Colorado

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"*Onegite*" is a now-little-used varietal term that refers to amethyst containing abundant, acicular inclusions of goethite. It was first used in 1802 by C. C. Andre (see Clark, 1993) to describe material from Wolf Island, Lake Onega, western Russia. The term was formerly used as a varietal name for goethite, and in fact, its use predates the name goethite itself, not coined until 1806 by J. G. Lenz (see Dana, 1892). "Onegite" can be considered to be a type of sagenitic quartz (Dake et al., 1938), though "sagenite" is also used in a more restrictive sense to refer only to rutilated quartz or reticulated, acicular rutile (Clark, 1993).

Mineral intergrowths fitting the description of onegite are one of the distinctive but somewhat uncommon mineral associations found in the miarolitic pegmatite cavities of the Pikes Peak batholith, Colorado. Onegite has been known from the Lake George intrusive center (Florissant-Lake George-Crystal Peak area) of the Pikes Peak batholith since the late 19th century and is still found by field collectors today. It is also reported from other areas in the batholith, including Wigwam Creek and Stove Mountain. The Pikes Peak batholith, a 1.06-1.09-billion-year-old anorogenic granite batholith covering some 3,000 km² in central Colorado (see Hutchinson, 1976; Wobus and Hutchinson, 1988; Foord, 1995; Unruh et al., 1995), is known for its pegmatites, which commonly contain smoky quartz, microcline (amazonite), albite, fluorite, topaz, and numerous other minerals. The mineralogy of pegmatite "pockets" in the Pikes Peak Granite has been described by Odiorne (1978), Foord and Martin (1979), and Muntyan and Muntyan (1985). The batholith was intruded to a relatively shallow level in the crust, as evidenced by the common occurrence of what were initially fluid-filled pockets (now miarolitic cavities) in parts of the batholith; one phase of granite in the batholith (fayalite granite) has been estimated to have crystallized at about 700°C and at a pressure of about 1.5 kb, = 5 km depth (Barker and others, 1975; Wobus, 1986).

Goethite is a common accessory mineral in the pegmatite "pockets", occurring as late-stage growth of dark-brown to golden-brown, bladed to acicular crystalline masses, typically attached to and surrounding crystals of smoky quartz. Amethyst, however, is relatively uncommon and is locally observed as small (<1 cm, rarely to 2.5 cm) crystals, characteristically associated and sometimes heavily included with goethite blades and needles. Swindle (1982) described goethite and "onegite" occurrences in the pegmatites, as did Berry (1994) in an as yet unpublished manuscript. The color of the goethite-included quartz crystals ranges from brown to near black in densely included crystals, to nearly inclusion-free, medium-purple amethyst. Sector zoning of the amethyst color is common. Habit of the goethite-included amethyst ranges from short prismatic, often flattened, to pseudo-bipyramidal; some crystals are pagoda-shaped, skeletal, or in radiating, pineapple-shaped clusters attached to larger smoky quartz crystals. This represents essentially the only mode of occurrence of amethyst in rocks of the Pikes Peak batholith (see Michalski, 1984, for a description of other amethyst occurrences in Colorado). R. R. Berry provided specimens, which have been examined in the present study, from pegmatites associated with aplitic granite near the outer margin of the Lake George ring complex about 0.5 mi northeast of Lake George.

The amethyst appears to be restricted to pegmatite cavities in which there was a somewhat unusual, late stage of quartz growth, contemporaneous with and post-dating the goethite. A typically observed paragenetic sequence of minerals is (1) near-colorless or pale smoky quartz surrounded by white or tan microcline in massive or graphic-textured pegmatite; (2) euhedral smoky quartz, \pm microcline (some amazonite), albite, fluorite, etc.; (3) goethite, alone or included in colorless to amethystine or smoky quartz; and (4) inclusion-free amethyst. Late overgrowths of colorless or milky quartz sometimes coat smoky quartz crystals, and in at least one case were observed to form a mold around a quartz-goethite crystal group (Berry, 1994). In most pegmatite cavities in the Pikes Peak Granite, the sequence only extends to (2) or (3) with goethite alone as the latest-stage mineral. Those cavities in which both goethite and quartz continued to grow, produced the "onegite" association. Amethyst is known to owe its color to ferric iron in the quartz; thus, the restricted occurrence to an intimate association with goethite is not surprising. Specifically, the purple amethyst color has been related to quartz in which the content of Fe^{3+} exceeds Fe^{2+} , and in which exposure to ionizing radiation further oxidizes Fe^{2+} ions to Fe^{3+} (Cohen, 1985, 1989). Quartz with $Fe^{3+} > Fe^{2+}$ is reported to be characteristic of shallow-depth environments; hence, amethyst is normally found in mineral veins and cavities that formed at relatively shallow depth (Cohen, 1985).

Few studies have been made of the temperatures of crystallization of quartz and associated minerals in miarolitic-cavity-bearing pegmatites of the Pikes Peak type, so only general estimates can be made based on published studies of other granite and pegmatite systems. Of the mineral associations found in the miarolitic-cavity pegmatites, only stage (1) above probably represents true magmatic pegmatite (water-saturated silicate melt coexisting with supercritical aqueous fluid), formed at temperatures on the order of 650-600°C. Stage (2), euhedral smoky quartz associated with amazonite and other well-crystallized "pocket" minerals, almost certainly formed in the hydrothermal regime, at temperatures from perhaps 550° downward to a few hundred (200?)°C. Goethite and the latest-stage amethystine quartz most likely formed at quite low temperatures, perhaps as low as 200-100°C(?). Fluid inclusion geothermometry studies of Pikes Peak pegmatite minerals would be a stimulating avenue of research and should produce some interesting results!

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