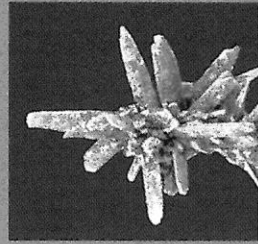
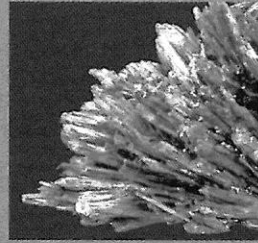


ANNUAL NEW MEXICO MINERAL SYMPOSIUM

26th Annual
New Mexico
Mineral Symposium

November 12 & 13, 2005



PROGRAM &
ABSTRACTS

26th Annual
New Mexico
Mineral Symposium

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New Mexico Bureau of Geology and Mineral Resources
A Division of New Mexico Institute of Mining and Technology

Socorro 2005

Welcome to

THE TWENTY—SIXTH ANNUAL

NEW MEXICO MINERAL SYMPOSIUM

November 12 and 13, 2005

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

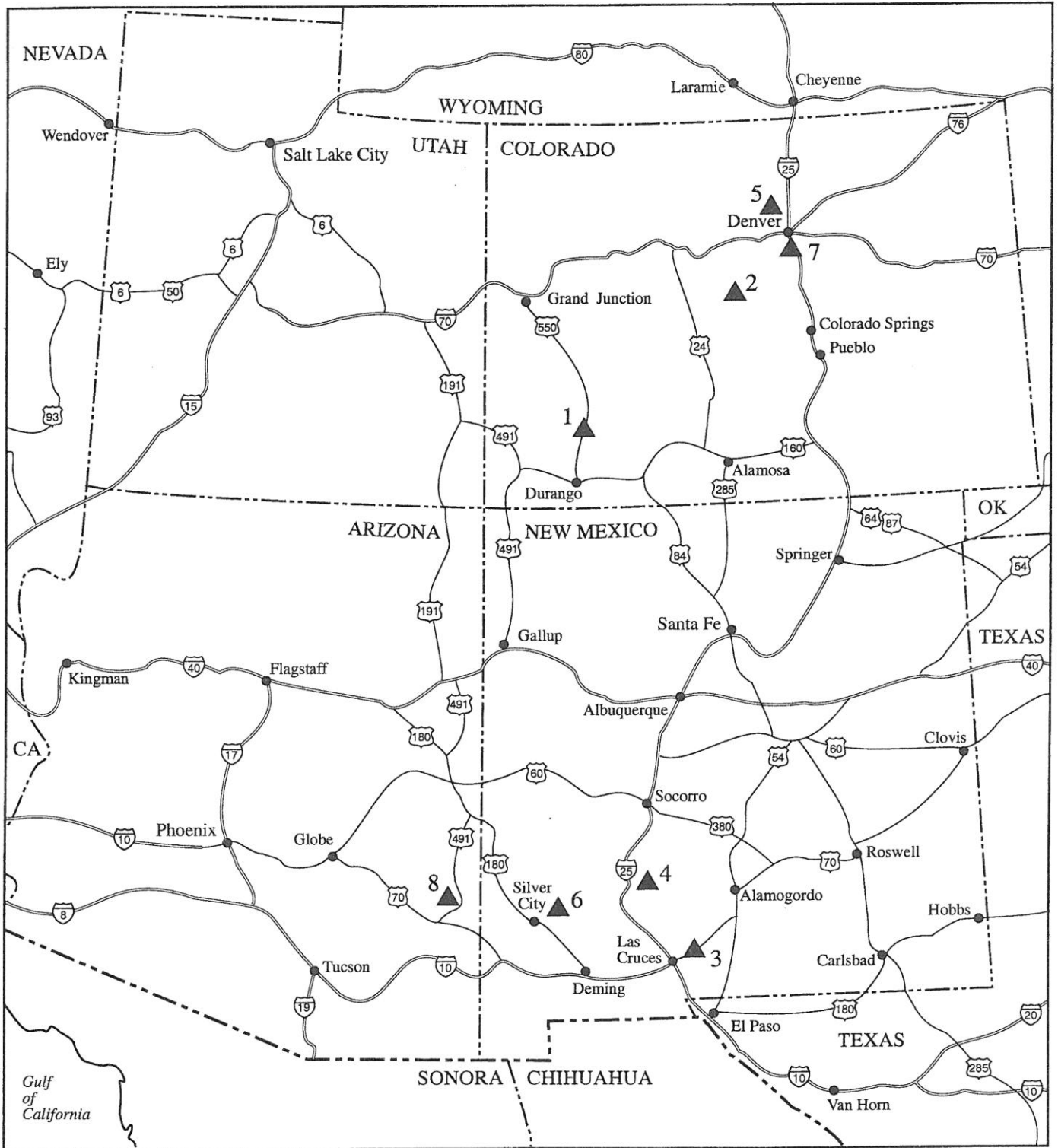
The Mineral Symposium is organized each year by the Mineral Museum
at the New Mexico Bureau of Geology and Mineral Resources.

Sponsors this year include:

Albuquerque Gem and Mineral Club
Chaparral Rockhounds
Los Alamos Geological Society
New Mexico Geological Society

The New Mexico Mineral Symposium provides a forum for both professionals and amateurs interested in mineralogy. The meeting allows all to share their cumulative knowledge of mineral occurrences and provides stimulus for mineralogical studies and new mineral discoveries. In addition, the informal atmosphere allows for intimate discussions among all interested in mineralogy and associated fields.

New Mexico minerals on the cover: top left - pyrolusite, top right - halite, bottom left - malachite pseudomorph of linarite, and bottom right - magnetite.



Geographic Index Map
26th New Mexico Mineral Symposium

SCHEDULE

Friday, November 11, 2005

Numbers in parentheses refer to geographic location on the index map.

6:00 pm Informal tailgating and social hour, individual rooms, Super 8 Motel (#1 on map) **FREE**

Saturday, November 12, 2005

8:30 am Registration, Macey Center; continental breakfast
920 *Opening remarks, main auditorium*
930 *A review of New Mexico's great mineral specimen locations that are now lost, closed, abandoned, or otherwise extinct—Ray DeMark*
1000 *The fluorescence of agate and related minerals from New Mexico and the world—Peter Modreski*
1030 Coffee break
11:00 *The Camp Bird mine-20 years after I first opened my mouth—Tom Rosemeyer (1)*
11:30 *Reconnaissance of new wulfenite occurrences in southwestern New Mexico—Robert Walstrom*
12:00 pm Lunch
100 Museum tours
200 *Topaz—Treasure of the Redskin Granite: Jewel of the Tarryalls—Steven Veatch and Rich Fetterd (2)*
230 *Minerals of the Organ Mountains—Fred Hurd (3)*
300 Coffee break
330 *Herkimer-style quartz from the Jornada del Muerto Basin—Dylan Canales and Robert Sanders (4)*
4:00 *Silver of the American West—Dr. Terry Wallace, featured speaker*
5:30 Sarsaparilla and suds: cocktail hour, cash bar
630 Dinner followed by an auction to benefit the New Mexico Mineral Symposium

Sunday, November 13, 2005

8:15 am Morning social: coffee and donuts
915 *Welcome to the second day of the symposium and follow-up remarks*
925 *Anatomy of a telluride vein—Harry Covey (5)*
955 *The mines and minerals of Georgetown, New Mexico—Ron Gibbs (6)*
1025 Coffee break
1055 *Diamonds of the Paul Seel micromount and the Denver Museum collections—Jim Hurbut and Jack Thompson (7)*
1125 *Minerals of the Copper Mountain, Arizona Jay Rosenbauer (8)*
12:00 pm Lunch
1:15-3:00 Silent auction, upper lobby, Macey Center, sponsored by the Albuquerque Gem and Mineral Club for the benefit of the Mineral Museum (**FREE**)

A review of New Mexico's great mineral specimen locations that are now lost, closed, abandoned, or otherwise extinct

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Private collections and museums throughout the world contain superb mineral specimens from New Mexico. Fabulous specimens of lustrous blue and green smithsonite from the Kelly mine in the Magdalena district are instantly recognizable in collections from London to Tokyo. Many other New Mexico minerals evoke recognition and appreciation for their unique qualities, aesthetics, or rarity. Unfortunately, one factor that sets these outstanding specimens apart from others is that they can no longer be collected, for a variety of reasons. Mine closings, exhaustion of deposits, reclamation, legal restrictions, and other limitations have all contributed to the loss of classic New Mexico mineral specimen locations. Of course, one positive aspect of this situation is that the value of specimens from these locations has markedly increased due to their scarcity.

Appreciation of minerals as specimens by New Mexicans seems to have been negligible during the very active mining era from 1880 to 1910. Consequently, much of the noteworthy material that was produced during that era went to dealers, collectors, and museums in the eastern United States and Europe. Adding to the loss of classic New Mexico minerals was a devastating fire in 1928 that burned down the Old Main building on the campus of the New Mexico School of Mines in Socorro (Eveleth 1997). This had been the home of a substantial mineral collection that had been assembled, starting at least as early as 1899. No catalog remains, thus no record exists of the specimens in that early collection.

Before 1900 many of the foremost eastern mineral dealers, including George L. English, A. E. Foote, Otto Kuntze, Lazard Cahn, and others, were acquiring and promoting the "fantastic" minerals of New Mexico. Early advertisements in *The Mineral Collector*, published from 1894 to 1907 in New York, hyped smithsonite from the Kelly mine, wulfenite and cerussite from the Organ Mountains (Stephenson—Bennett mine), vanadinite and descloizite from Lake Valley, "endlichite" from Hillsboro, descloizite from the Mimbres (Commercial mine), copper pseudomorphs after azurite from Georgetown (Rose mine), and rare minerals such as melanotekite from Hillsboro and altaite from the Organ Mountains (Hilltop mine).

The status of some of these classic mineral specimen locations today is as follows:

- Kelly and Graphic mines (smithsonite, aurichalcite). Inaccessible due to caving and unsafe underground conditions.
- Stephenson—Bennett mine (wulfenite and cerussite). Closed to access by Abandoned Mines Program.
- Rose mine (copper pseudomorphs). Remediated in 1992 with access prohibited by Phelps Dodge Corporation.
- S. J. Macy (Percha) mine ("endlichite"). Unsafe underground workings and exhausted specimen occurrences.
- Lake Valley mines (vanadinite and descloizite). Underground workings inaccessible and minerals exhausted.
- Commercial mine (descloizite and vanadinite). Inaccessible due to collapse of decline.

Mining and collector activity in more recent years opened up other "classic" New Mexico locations that have also been obliterated or otherwise lost for various reasons. Some of these more recent classics include:

- Denver shaft (wulfenite). Shaft covered up and site obliterated in 1979.
- Alhambra mine (silver and Ni-skutterudite). Shaft filled in and stock piles obliterated.
- Ground Hog mine (chalcopyrite). Shaft closed and mine flooded in 1981.

- **Mina Tiro Estrella** (Japan law quartz). Under private claim. Site exhausted.
- **Hanover #2 mine** (azurite). Adit filled in and closed with metal door.
- **Cunningham Hill mine** (scheelite). Mine closed and pit flooded.
- **Pine Canyon prospect** (fluorite). Site reclaimed in 1994.
- **Sierra Blanca** (smoky quartz). Wilderness area, collecting prohibited.
- **Poison Canyon** (uranophane, tyuyamunite). Mines closed, area remediated.

On the positive side, there still remain noteworthy New Mexico locations that are today producing classic mineral specimens. Some of these sites are the:

- **Hansonburg district** (Blanchard, Mex-Tex, and Royal Flush mines producing fluorite, linarite, spangolite, and other minerals). Open with permission of claim owners.
- **San Pedro mine** (chalcopyrite, gold, scheelite). Open with permission of owner.
- **Bosque Draw** (pyrite). Under claim but open with permission of claim owners.
- **Mule Creek** (amethystine quartz). Various claims but access possible with permission.

There are, of course, many other locations in New Mexico producing or capable of producing outstanding mineral specimens. If history is an example, however, many of these specimens will be underappreciated in our home state and will find their home outside of the area. Isn't it time we give recognition to the marvelous mineral patrimony of New Mexico?

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Fluorescence of agate and related minerals from New Mexico and the world

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Agate, chalcedony, and opal from many localities in New Mexico, as well as worldwide, often have a characteristic green or yellow-green fluorescence under shortwave ultraviolet light.

The green fluorescence is known to be caused by uranium, present as its oxidized, hexavalent form, U^{6+} , and more specifically as the hydrated uranyl molecular ion, $(UO_2 \cdot nH_2O)^{2+}$ (see Gorobets et al. 1977). The fluorescence is strongest under shortwave ultraviolet light (wavelength about 254 nm), and is much weaker under the lower energy longwave ultraviolet light (about 360 nm) produced by less expensive

"black lights." The fluorescence has a distinctive, recognizable spectrum of multiple bands due to vibrational structure of the triatomic UO_2^{2+} molecular ion, which makes it easy to distinguish from other activators that may produce green fluorescence, such as the green fluorescence of Mn^{2+} seen in the zinc silicate, willemite.

The most outstanding occurrences of brightly fluorescent agate and chalcedony are in nodules and geodes formed in volcanic rocks. The Apache Creek area, Catron County, is known for agate and for flattened, sometimes faintly pink colored chalcedony "roses" that weather out of rhyolite, and that can be strongly fluorescent. One is pictured as Fig. 14 of Modreski (1987). Agate that occurs in basalt in this same general area is variably fluorescent, with bands ranging from very weak to moderately fluorescent. Similar occurrences of fluorescent agate are present throughout the Mogollon—Datil volcanic field, as well as adjacent parts of Arizona and Mexico. Chalcedony (grayish-white to faintly pink) lining the interiors of gas cavities in rhyolite lava in the Peloncillo Mountains near Geronimo Pass, Hidalgo County, New Mexico, often fluoresces bright green (Modreski 1996). Some of the agate and chalcedony found in the Deming area, including Rockhound State Park, is similarly fluorescent; Colburn (1999) and Dunbar and McLemore (2000) discuss the origin of these spherulitic agatized nodules.

Agate and chalcedony in petrified wood also commonly show green fluorescence; the latest-formed chalcedony in veins and fractures within the wood often appears to have the highest uranium concentration and the brightest green fluorescence. Agate, chalcedony, and silicified wood in terrace gravels in the Los Lunas, New Mexico, area often show this green fluorescence, though usually not exceptionally bright.

Small blebs, layers, and coatings of chalcedony or hyalite opal occur in many localities throughout New Mexico and elsewhere, so that such green-fluorescing mineral material is a common sight both in sedimentary and igneous rocks and in ore deposits. Green-fluorescent patches of hyalite opal can be seen on fractures and in gas cavities in the phonolite sill at Point of Rocks, New Mexico, a well-known locality for microminerals. Minerals such as calcite, aragonite, and gypsum often appear to fluoresce green, but the fluorescence is often, or perhaps always, not actually in the host mineral, but from inclusions or thin coatings of opal; such material has been observed at, for example, the Stevenson—Bennett and Kelly mines (see Figs.

5 and 15 in Modreski 1987) and in the Luis Lopez manganese district, Socorro County.

The intrinsic fluorescence of uranium minerals such as autunite has the same distinctive spectrum and color as that of the uranyl-bearing silica minerals. Some uranyl minerals, such as carnotite, tyuyamunite, and torbernite, are not fluorescent at all. Many, such as autunite and zippeite, have a fluorescence that appears visually as the same yellow-green color as uraniferous agate and opal. Others, such as andersonite and liebigite, have a fluorescence spectrum that is shifted slightly to higher energies (shorter wavelengths) and visually appear blue-green rather than yellow-green.

Worldwide, probably the most brightly fluorescent silica mineral known is hyalite opal from Spruce Pine, North Carolina, which is reported to contain as much as 3,000 ppm (= 0.3 weight percent) uranium (deNeufville et al. 1981). Other examples of chalcedony or opal that fluoresce with moderate brightness (such as "common" opal from Virgin Valley, Nevada) contain several hundred ppm U, and more weakly fluorescent examples typically contain less than 100 ppm. Published analyses were cited and summarized by Modreski (2005); the symposium volume containing that abstract contains many other papers on the occurrence, genesis, and characteristics of silica minerals worldwide. Other general sources of information

about the occurrence of fluorescent minerals and quartz minerals from New Mexico include Modreski (1987), Wilbur and Lueth (2000), and Northrop (1959, 1996).

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The Camp Bird mine—twenty years after I first opened my mouth...

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The Camp Bird mine, located 6 miles southwest of Ouray, Colorado, was discovered by Thomas F. Walsh in 1896. Under Walsh's management, the Camp Bird mine was developed into one of the most profitable and famous mines in Colorado and made Walsh a millionaire many times over.

Rocks in the Camp Bird mine area consist of Paleozoic and Mesozoic sediments that have been partially eroded. The Tertiary Telluride Conglomerate was deposited on the peneplained surface and is the host rock for the Pb-Cu-Zn replacement orebodies. Later volcanic eruptions from a series of central-vent volcanoes deposited rhyodacitic ash and lava flows on the Telluride Conglomerate and formed the Tertiary San Juan Tuff and Silverton volcanic series.

All of the gold production of the Camp Bird mine has come from the Camp Bird vein, which strikes east-west and dips 70° south. Early-day production was mainly Au-Ag-Cu ores, but as mining progressed deeper, the gold values diminished and changed to Ag-Pb-Cu-Zn ores.

Three stages of mineralization make up the compound Camp Bird vein. The first stage of vein formation was the quartz-sulfide component, which consists of quartz, galena, chalcopyrite, sphalerite, and rarely tetrahedrite. Accessory minerals include pyrite, calcite, chlorite, rhodonite, rhodochrosite, fluorite, ankerite, and scheelite. The second stage of vein formation was the gold-quartz breccia component, which consists of quartz, gold, minor petzite, and locally, small amounts of sulfides. In the deeper levels of the mine, appreciable specularite hematite is associated with the gold stage. The third and last stage of vein formation was the bull quartz stage, which is barren of ore minerals and usually forms massive veins, which sometimes show cockscomb structure. Vugs are numerous and contain milky white quartz crystals up to 4 inches long.

During the 1970s most of the ore mined was from Pb-Cu-Zn replacement orebodies along the Orphan and Gordon veins at the base of the Telluride Conglomerate. Galena, chalcopyrite, and sphalerite were the primary ore minerals and replaced the matrix, pebbles, and cobbles that made up the conglomerate. Accessory minerals include quartz, epidote, calcite, pyrite, barite, fluorite, and rhodochrosite.

Over the years, the Camp Bird mine has produced hundreds of fine mineral specimens. Exceptional specimens of native gold and quartz crystal groups have come from the Camp Bird vein, whereas exceptional crystal groups of galena, sphalerite, and chalcopyrite associated with quartz, epidote, and calcite have been recovered from the replacement orebodies. In June 1987 a vug was discovered in the Camp Bird vein that produced the finest scheelite crystals ever found in Colorado.

**Reconnaissance of new wulfenite occurrences
in southwestern New Mexico**

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The three contiguous counties, Luna, Grant, and Hidalgo, in the extreme southwest portion of New Mexico have experienced their share of periodic mining activity over the years. Abundant evidence of this activity can be seen in the form of many small prospects, mines, and several open pit operations scattered over the mountain ranges. Several of the larger copper mines are still in production. Although copper, fluorite, manganese, gold, and other minerals have been successfully mined in the area, lead-silver-zinc occurrences have also had considerable production activity. Some of these latter localities were field examined over the last several collecting seasons and as a result revealed some interesting micromineral potential. Following is a list of unpublished wulfenite occurrences from those localities:

Wulfenite Occurrences

Mine	District	Mountains	County	Mineral	Associated minerals	
Gladys	Cookes	Cookes	Luna	Wulfenite	Fluorite	Cerussite
Silver Cave	Florida	Florida	Luna	Wulfenite	Willemite	Malachite
Priser	Florida	Florida	Luna	Wulfenite	Fluorite	Willemite
Mahoney Park	Florida	Florida	Luna	Wulfenite	Hemimorphite	Cerussite
Dos Boca	Florida	Florida	Luna	Wulfenite	Cerussite	Galena
Lindy Ann	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Mimetite	Willemite
Marie	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Willemite	Aurichalcite
Cincinnati	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Cerussite	Aurichalcite
Hancock	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Mottramite	Gold
Section 9	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Willemite	Vanadinite
Black Hawk	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Bromargyrite	Mottramite
West Lime Hills	Tres Hermanas	Tres Hermanas	Luna	Wulfenite	Adamite	Conichalcite
Rambler	Victorio	Victorio	Luna	Wulfenite	Cacoxenite	Hemimorphite
Co-op	Gold Hill	Big Burro	Grant	Wulfenite	Silver	Cerussite
Lady Mary	Lordsburg	Pyramid	Hidalgo	Wulfenite	Mottramite	Vanadinite
Francis Kay	Lordsburg	Pyramid	Hidalgo	Wulfenite	Azurite	Cerussite
Owl	Lordsburg	Pyramid	Hidalgo	Wulfenite	Cerussite	Smithsonite
Polyanna	Lordsburg	Pyramid	Hidalgo	Wulfenite	Azurite	Malachite
Hillside	Lordsburg	Pyramid	Hidalgo	Wulfenite	Cerussite	Aurichalcite

A full 60% of the lead-silver-zinc occurrences examined produced wulfenite specimens. Most of the wulfenite was found in fissure veins or replacement deposits closely associated with granite pluton intrusions. By no means have all the lead-silver-zinc occurrences in this area been examined. Predictably, more wulfenite occurrences should be discovered as additional field-work is conducted.

Acknowledgments

Special thanks is given to Ron Gibbs for construction of the Power Point presentation and specimen photography and to area rancher Leedrue Hyatt for granting access to private property.

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Topaz—treasure of the Redskin Granite: Jewel of the Tarryalls

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Topaz, an aluminum fluorosilicate with the formula $Al_2SiO_5(F,OH)_2$, is found in a number of Colorado localities. The Tarryall area in Park County is known for the striking topaz specimens discovered there. Topaz, with a hardness of 8 on the Mohs scale, is a gem mineral harder than quartz. Topaz in the Tarryall Mountains forms in miarolitic cavities in pegmatites (coarse-grained granite). The China Wall, a granitic cupola in the Tarryall area, also yields topaz.

East of the China Wall, the Mutakat Road (Forest Road 211) winds its way near an area where a number of claims have been producing gem topaz for several years. The Hayman fire of 2002, the largest fire in Colorado's history, has been a major factor in the discovery of new topaz in the area. Frequent rain storms form newly eroded gullies that uncover topaz-bearing pegmatites. Mountain rains have also revealed many topaz and quartz crystals on the surface. Rich Fretterd, a member of the Lake George Gem and Mineral Club, staked the Petra placer in April 2004 after he discovered a number of fine topaz specimens at this locality. The name of the claim comes from the Latin *petra*, meaning rock or stone. The Petra placer is southeast of Pilot Peak (SW1/4 NE1/4 sec. 12 T11S R72W).

Fretterd is presently working on topaz-bearing pegmatites that are part of the Redskin Granite, a zoned, oval-shaped intrusion covering approximately 49 km². The Redskin Granite, a late stage variant of the Pikes Peak Granite, intrudes the western part of the Pikes Peak batholith. Pikes Peak Granite weathers pink, whereas the Redskin Granite weathers red because of the oxidation of iron-rich micas. The Redskin Granite is also known for its topaz-bearing pegmatites concentrated within and near the contact with Pikes Peak Granite.

The specimens from the Petra placer are remarkable for their size and clarity. Many specimens have a bluish tinge. The specimen shown in Figure 1 was found loose, just below the surface in an alluvial-colluvial deposit. The slightly abraded specimen had been transported a short



distance from the crystal-bearing pegmatite. This topaz specimen has a blocky, prismatic crystal habit with some of the prism faces slightly etched. The pale-blue crystal has a transparent interior and is terminated at one end—the other end is the cleavage plane.

New specimens continue to be found. Anhedral specimens are faceted into gems, whereas euhedral specimens make their way into museums or the mineral cabinets of rock hounds. The Petra placer is now a significant Colorado topaz locality.

FIGURE 1—Topaz specimen from the Petra placer. This prismatic crystal specimen terminates with a frosted pyramid on top. Rich Fretterd specimen, Steven Veatch photograph.

Minerals of the Organ Mountains

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A brief overview of the Organ Mountains, Doña Ana County, New Mexico, and the minerals collected from the mountains will be presented by a local collector. The current status of collecting in the Organ Mountains will be included. Emphasis will be given to the minerals field collected by the presenter and other New Mexico collectors.

Herkimer-style quartz from the Jornada del Muerto Basin

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"Herkimer-style" quartz occurs in the Cretaceous Mesaverde Group in the Jornada del Muerto Basin, Sierra County, New Mexico. Quartz crystals up to four inches occur with calcite as fracture or fault fillings within sandstone and limestone units. Crystals on matrix grow on surfaces displaying near vertical slickenlines. Free, double-terminated crystals are suspended in calcite. Many low-temperature macroscopic inclusions of gas, liquid, petroleum, anthraxolite, and carbonate occur in various combinations within crystals. Crystals fluoresce blue, red, and orange under both longwave and shortwave UV light. The strike of the quartz-filled fractures varies between 205 and 260° with near vertical dips. Normal, rift-related faulting is dominant in the area. Basaltic dikes are common locally and are concordant with faults.

Silver of the American West

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Silver, not gold, is the metal that made the American West. Although the discovery of gold in the foothills of the Sierra Nevada in 1848 sparked the great rush to California, it was the tremendous silver deposits that provided the stable mineral economy that led to the rise of cities and states. The first great silver strike was the Comstock Lode (1859), followed by Park City (1869), Silverton (1874), Leadville (1875), Aspen (1879), Creede (1890), Tombstone (1877), and Coeur d'Alene (1885). These great camps produced more than 100,000 metric tonnes of silver (although even more silver was produced as a byproduct of copper mining). Despite this great tonnage of metal, only a modest number of exceptional silver mineral specimens survive to grace modern collections. Historical descriptions of specimens suggest that American silver specimens would rival the great European localities, but interest in specimens in the last quarter of the 19th century, remoteness of the camps, and mining methods conspired to send most of the material to the smelter. The mineralogy of the deposits is varied and rich, and there are a number of silver minerals that are unique (or nearly unique) to the western United States. These include aurorite ($[(\text{Mn},\text{Ag},\text{Ca})\text{Mn}_3\text{O}_7 \cdot 3\text{H}_2\text{O}]$), cameronite ($\text{AgCu}_7\text{Te}_{10}$), empressite (AgTe), benjaminite ($\text{Ag}_3\text{Bi}_7\text{S}_{12}$), ourayite ($\text{Pb}_4\text{Ag}_3\text{Bi}_5\text{S}_{13}$), owyheelite ($\text{Pb}_7\text{Ag}_2[\text{Sb},\text{Bi}]_8\text{S}_{20}$), billingsleyite ($\text{Ag}_7[\text{As},\text{Sb}]_6\text{S}_6$), henryite ($\text{Cu}_4\text{Ag}_3\text{Te}_4$), and treasurite ($\text{Ag}_7\text{Pb}_6\text{Bi}_{15}\text{S}_{32}$)•

The Comstock Lode produced more than 250 million dollars worth of silver between 1859 and 1890 and made the United States the world's largest silver producer until the 20th century. The silver ore was mainly disseminated, fine-grained complex veins that contained acanthite, polybasite, and polybasite. The surviving "great" specimens number in the hundreds. The mines of Colorado are largely based on epithermal vein systems associated with voluminous ash-flow eruptions 25-40 million years before the present. Some districts involved significant carbonate replacement (Leadville and Aspen), whereas others are nearly devoid of sediment host rock. The volcanic mineralizing fluids deposited sulphides (principally pyrite, marmatite, galena, and sphalerite), and the range of silver minerals are represented. The mines of the Coeur d'Alene exploit polymetallic veins, and the silver is largely bound in galena and other Pb minerals.

The mining history of the West is preserved in the minerals specimens. Although nearly all the mines are extinct, and the silver is long recycled in the economy, the wire silvers from Creede, acanthite cubes from Park City, and silver tellurides from the mountains of Colorado are a testament to the civilizing of the West.

Anatomy of a telluride vein

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The term "telluride vein" is descriptive with respect to the constituents of the minerals within the vein. Most, if not all, telluride veins are also sulfide veins, for they contain many of the base metal sulfide minerals, such as sphalerite, pyrite, galena, and markasite. The relationship of these minerals seems to depend on the preference of the metal anion to associate with either sulfur or tellurium. Because gold does not associate with sulfur, telluride minerals, i.e. calaverite, sylvanite, krennerite, and petzite, in the assemblage give the vein its unique and distinct identification—"telluride vein."

Nearly all the base metals have their telluride counterpart, i.e. Pb—galena—altaite, Fe—pyrite—frohbergite, Ag—argentite—hessite, Cu—chalcopyrite—rickardite, etc. There are no known Zn tellurides, and some metals do not form tellurides, such as cobalt, tin, molybdenum, etc.

Telluride veins form a very conspicuous gossan in the areas where the vein is protected from erosion. Any vein that has abundant pyrite will form the iron hat (gossan). It is in the gossan that we find the rare "rusty gold" and many of the secondary tellurium minerals, such as tellurates and tellurites. Rusty gold forms when ground water leaches away the tellurium from sylvanite leaving the gold molecules in place. These pseudomorphs of gold after sylvanite are the rarest form of gold there is. Few collections have samples of this rare mineral.

The telluride veins of the Gold Hill district in Colorado were given the term "pocket veins" because the miners did not understand the mode of occurrence of the rich cymoid structures that occur along the strike of the vein. They would mine through the structure and wonder why the values diminished on the other side, not realizing that they had to follow the cymoid structure to stay in paying ore. Many discoveries and prospects were abandoned because the ore values diminished with progress along a tunnel, whereas, if they had followed the cymoid structure they would have been in good ore for many hundreds of feet.

Telluride veins are most often narrow fissures, and the size of the pay streak that carries the values is what determines the richness of the mines. Due to earth shifts, the veins of the Gold Hill district opened many times, causing a new implantation of minerals in many quartz stringers that may or may not be blessed with telluride values.

The mines and minerals of Georgetown, New Mexico

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The Georgetown district is located about 25 miles from Silver City, between the village of Mimbres and the former town of Santa Rita. It is reached by traveling north on Forest Road 73, which joins Highway 152, 2 miles east of Hanover. Today, old dumps and prospect pits are all that mark the site of the mines, and only a cemetery and an empty meadow exist where the town once stood.

The discovery of silver in the Georgetown area dates from the late 1860s. At that time, the area was still partially under the control of the Apache Indians who often raided outlying settlers and travelers. Little development of the silver deposit occurred until about 1873, and by 1875, the camp was booming. Several substantial underground mines were developed and operated by a number of companies, the largest of which was the Mimbres Consolidated Mining Company. Notable mines included the Naiad Queen, Commercial, McNulty, Satisfaction, and McGregor. Most of the ores were sent to mills and smelters 3 miles to the east on the Mimbres River where there is a reliable source of water. The decline of silver prices in 1892 was the beginning of the end for the mines, and production swiftly declined. At the turn of the century, F. A. Jones reported that production from the district amounted to \$3.5 million dollars, and subsequent writers have placed the total loss to \$10 million. Since then, several lessors continued to work the old stopes with limited success but never on a large scale. An attempt to recover silver from old dumps through heap leaching was made in the 1980s without success. Today, the recent leaching operation has been reclaimed, and all the major mine openings have caved or been closed to prevent entry.

The silver and lead ores of the district are found within the Ordovician Fusselman limestone that lies directly beneath the Devonian Percha Shale. The shale forms an impervious barrier to rising mineralized solutions. Granodiorite porphyry dikes are found in the mines that may be related to the intrusion of the adjacent Santa Rita stock. Orebodies were developed along fracture zones, as replacement of the limestone adjacent to the contact between the two formations and along the dikes. Miners explored for ore by drifting along the contact looking for mineralization often disclosed by the abundant deposits of bright orange descloizite along fractures. The original sulfide mineralization has been almost completely replaced by a colorful suite of oxide minerals.

The district has been of interest to mineral collectors for many years for the fine specimens of vanadanite and descloizite that occur in the mines. In April 1889 the noted mineral dealer George English visited the mines and was offering descloizite as "extra fine specimens, averaging 1x1 inches, for 10 to 25 cents; 2x3 inches, 50 cents to \$2.50; 3x4 inches, \$1.00 to \$3.50, shelf and museum specimens, \$3.50 to \$15.00" in his 1897 catalog.

The species list from the district is not large and is largely derived from the oxidation of primary ores dominated by galena. Most of these minerals can still be collected as micromineral specimens on the dumps by the patient and determined collector.

- argentite—reported
- aurichalcite—uncommon
- bromargyrite—sparse
- calcite—abundant
- cerussite—common
- chlorargyrite—reported
- descloizite—abundant
- galena—uncommon
- hemimorphite—common
- iodargyrite—reported
- malachite—rare
- plattnerite—rare
- "pyrolusite"—common
- quartz—common
- silver—reported
- vanadanite—common
- willemite—uncommon
- wulfenite—uncommon

Diamonds of the Paul Seel micromount and the Denver Museum collections

James Hurbut and Jack Thompson

Denver Museum of Natural History and Science

201 Colorado Blvd.

Denver, CO 80205

Paul Seel was an avid mineral collector, famous micromounter, and member of the Micromounters Hall of Fame.

A major emphasis in Paul's collection began in the late 1940s with a growing fascination in diamond crystals and their formation. He started to collect and study them as microcrystals, spending considerable time gathering information on their formation deep in the earth and the way they were transported to the surface.

His collection of mounted microdiamonds containing over 3,000 items shows most of the crystal forms, colors, and has some diamonds with inclusions. There also are 7,000 unmounted, sorted microcrystals in the collection as well as 100 macrocrystals. An interest in morphological crystallography led him to specialize in collecting diamond, topaz, and quartz crystals that display normal and unique forms. In the 1950s Paul started to collect synthetic diamonds from friends who worked at General Electric Company. These early synthetics that he obtained are only fractional millimeter in size. He also has dual mounts of diamonds where one was irradiated by neutrons showing a change in color.

One of the highlights of Paul's mineralogical experiences was his invitation to participate in the first kimberlite conference in South Africa in 1973, where he gave a talk and had a chance to collect and buy diamonds.

Paul made hand drawings of many of his micromounted diamonds. His drawings show the great details of the crystal forms that are difficult to see by someone not familiar with crystallography. By using two projectors it is possible to see Paul's drawing and the actual crystal at the same time.

Minerals of Copper Mountain, Arizona

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History

In August of 1872 a prospecting party from Silver City, New Mexico, discovered the mines around Clifton, Arizona. The first mining district was organized under the name of the Copper Mountain district. At that time there were only 18-20 men in the district, including Stevens and Bob Metcalf. Among the first claims to be located were the Arizona Central, Copper Mountain, Montezuma, and the Yankie. Conditions were not encouraging at that time. The nearest railroad was 700 miles away in La Junta, Colorado, no roads had been built, and the Apaches made frequent raids until around 1885. The Lezinsky brothers of Las Cruces, New Mexico, acquired an interest in the mines from Bob Metcalf and soon after gained nearly full ownership of the group. In 1873 an adobe furnace was erected at the Longfellow mine with a 1-ton per day capacity. In 1874 the first water-jacket furnaces were built on the San Francisco River near Clifton. In 1879 the Lezinsky brothers built a baby gage (20-inch) railroad connecting Metcalf to Clifton. In 1881 the Southern Pacific Railroad was completed making larger operations possible and lowering the cost of operations.

About 1893 the great low-grade sulphide bodies of Copper Mountain were discovered. This led to larger concentrators and furnaces being built. By 1901 production reached 38 million pounds. The Detroit Copper Company was formed around 1875. They began smelting rich ore around 1882 at a smelter on the San Francisco River. In 1884 the smelter location was changed to Morenci. Around 1895 the holdings and plant were transferred to Dodge, Phelps and Company.

Mining was conducted with overhand stoping with square sets, the stopes being back filled as far as possible afterwards. Miners wages at the time were \$3.00 per day for Americans, \$2.50 for Mexicans, and \$1.00 to \$2.00 a day for common laborers. Timbering was the most expensive cost after labor. The timber was shipped in from California and Oregon. Mining costs varied from \$1.50 to \$2.00 per ton. The ore was rough sorted to smelting ore, 8% and above, and concentrating ore. Concentrating ore consisted of decomposed porphyry with finely disseminated pyrite and chalcocite. Oxide ore consisted of cuprite, malachite, and azurite. The West Yankie mine was the largest producer. The Manganese Blue mine produced large amounts of high-grade carbonate ore.

The Manganese Blue mine was the mainstay of the Detroit Copper Company for many years before the discovery of the great masses of chalcocite ore below Copper Mountain. It was developed through the Old Blue shaft to a depth of 400 feet. The collar elevation was at 4,853 feet and had four levels at 100, 175, 275, and 375 feet. The bulk of the ore was mined out before 1905. The old Manganese Blue workings are where the bulk of our mining for specimens took place.

Geology

The Copper Mountain fault runs along the center line of Copper Mountain and divides the sedimentary beds into two parts. The dip of the fault plane is 63° northeast or north-northeast. The vertical throw is about 225 feet, and the horizontal movement of the northeast block is about 70-90 feet. The rocks are greatly crushed near the fault, and often there are two or three parallel planes within a few feet. The northeast fault block is the Modoc Limestone, which has been altered to a heavy garnet skarn. The southwest side of the fault contains unaltered crystalline limestone. Rock exposed in the Old Blue shaft is as follows: 60 feet of limestone, 60 feet of garnet rock, 50 feet of limestone, and 25 feet of quartzite with more limestone below this.

The oxidization zone is from 400 to 600 feet. To this depth from the surface, the sulphate solutions descended, and along important fissures may have gone somewhat farther. The solutions not only followed fissures, but penetrated the porous, sericitized porphyry with considerable ease. The altered limestones and shales are very compact, non-porous, and

impervious. Oxidation through fissures and crack systems here reached 400 feet with no well-defined plane expressing the depth of oxidation.

Ore genesis

Intrusions of stocks and dikes of granite porphyry and quartz monzonite porphyry, which took place in Late Cretaceous or early Tertiary time, produced an important contact metamorphism in shales and limestones of Paleozoic age that happened to adjoin them. This metamorphism resulted in metasomatic development of garnet, epidote, diopside, and other silicates, accompanied by pyrite, magnetite, chalcopyrite, and sphalerite. The sulphides are not later introductions, but contemporaneous with the other contact minerals. The contact zone received substantial amounts of oxides of iron silica, sulfur, copper, and zinc, enough to form good-sized deposits of pure magnetite and low-grade deposits of chalcopyrite and sphalerite, all of which are unknown in the sedimentary series away from the porphyry.

Metamorphosed rocks are manifold and found under many varying conditions. There is only one common factor and that is the presence of the porphyry. It shows that the porphyry magma contained much water, which held in solution various salts, among which were salts of some of the heavy metals. Sodium chloride and ferric oxide probably predominated. It is believed that the magma contained all of the substances mentioned above, and that large quantities of this gaseous solution dissolved in the magma were suddenly released by diminution of pressure as the magma reached higher levels and forced its way through the adjoining sedimentary beds, the purest and coarsely granular limestones suffering the most far-reaching alteration and receiving the greatest additions of substance. It is thought that a direct transfer of material from cooling magma to adjacent sediments took place. The formation of garnet indicates large gains of ferric oxide and silica.

Collecting history

The geologic activity on Copper Mountain created a wonderful environment for the growth of mineral specimens. The Phelps Dodge Corporation has been kind enough to let us work with them in the extraction of these specimens. I have worked there off and on since 1996. In 2005 the last of Copper Mountain was covered with a leach dump, thus ending collecting on that great mountain.