19th
annual

# NEW MEXICO
# MINERAL SYMPOSIUM

November 7 & 8, 1998

NMIMT Campus, Socorro, New Mexico

Welcome to

# THE NINETEENTH ANNUAL

# NEW MEXICO MINERAL SYMPOSIUM

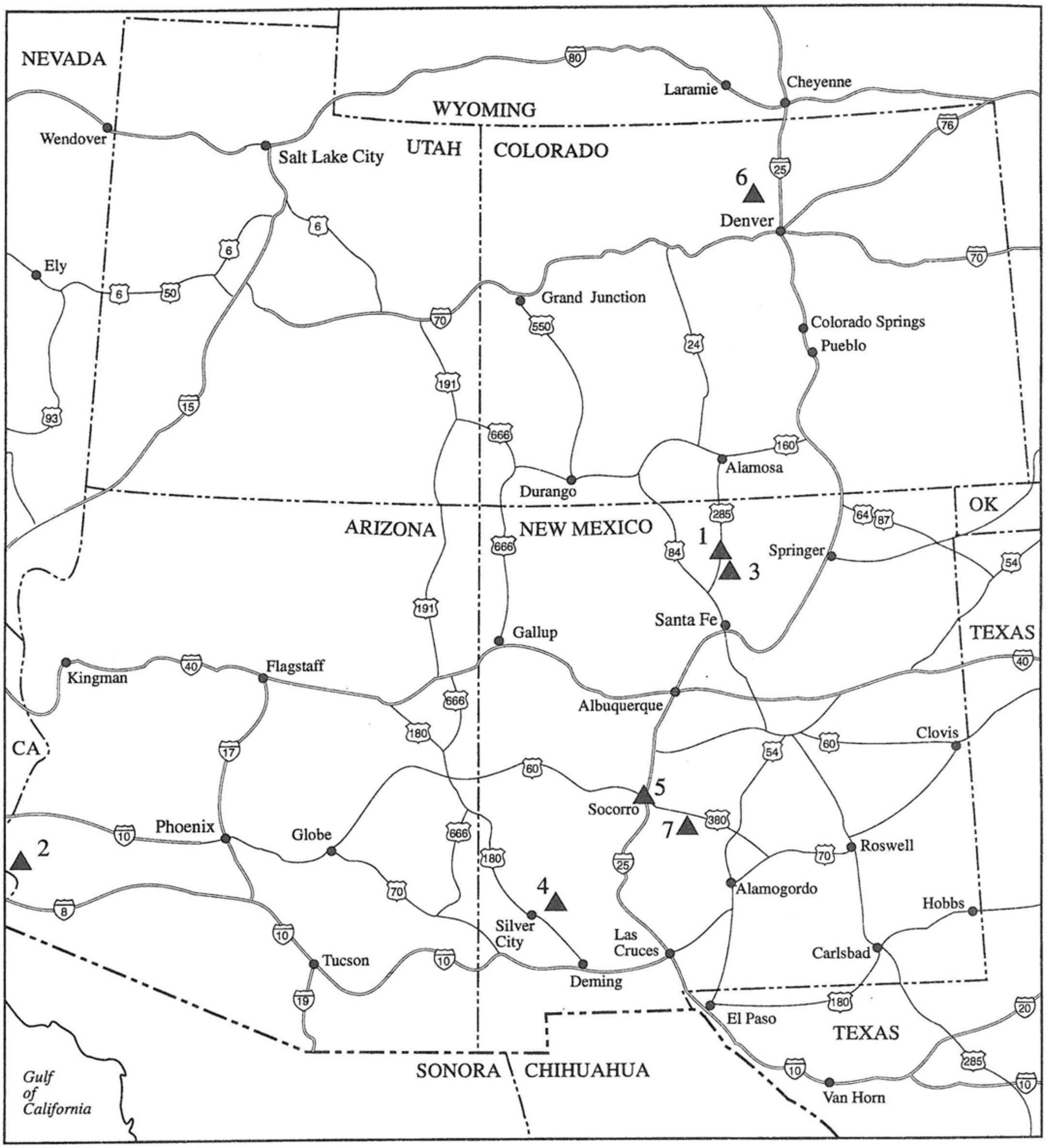
NOVEMBER 7 AND 8, 1998

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 Nineteenth 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
19th New Mexico Mineral Symposium

## SCHEDULE

Numbers in parentheses refer to geographic location on index map.

### Friday, November 6

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

### Saturday, November 7

| | |
|---|---|
| 8:30 am | Registration, Macey Center; continental breakfast |
| 9:20 | ***Opening remarks,*** main auditorium |
| 9:30 | ***New Mexico wulfenite*** —Ramon S. DeMark |
| 10:00 | **(1)** ***Schorl-dravite tourmaline in metamorphic rocks from the Pilar cliffs, Taos County, New Mexico***—Peter J. Modreski and Jesse M. Kline |
| 10:30 | Coffee break |
| 11:00 | **(2)** ***The Red Cloud mine—an update***—Les Presmyk |
| 11:30 | **(3)** ***Bismuth minerals from the Harding mine: more than just yellow-green grunge***—Mike Spilde |
| 12:00 pm | Lunch |
| 1:00 | Museum tours |
| 2:00 | **(4)** ***Magnetite crystals from the Republic pit, Hanover, Grant County, New Mexico***—Ron Gibbs |
| 2:30 | ***Scottish rainbows—the agate***—Dale G. Wheeler |
| 3:00 | Coffee break |
| 3:30 | **(5)** ***Famous minerals specimens we have known and some of the questionable characters who have stumbled across them OR half-truths that should live for eternity***—Robert W. Eveleth and Virgil W. Lueth |
| 4:00 | ***Collectible minerals of the Midwestern United States***<br>—Terry Huizing, featured speaker |
| 5:30 | Sarsaparilla and suds: cocktail hour, cash bar |
| 6:30 | Dinner followed by an auction to benefit the New Mexico Mineral Symposium and a brief presentation<br>***Colorful calcites*** by Terry Huizing |

### Sunday, November 8

| | |
|---|---|
| 8:15 am | Morning social, coffee and donuts |
| 9:00 | Welcome to the second day of the symposium and follow-up remarks |
| 9:10 | **(6)** ***Telluride minerals of the Phil Sheridan Lode, Boulder, Colorado***—Harry Covey |
| 9:40 | **(7)** ***Mines, men and minerals—an update on mineral collecting in the Hansonburg District***—Michael R. Sanders and Thomas M. Massis |
| 10:10 | Coffee break |
| 10:40 | ***Causes of color in minerals and gemstones***—Paul F. Hlava |
| 11:10 | ***Open forum on minerals and collecting in the four-corners states*** |
| 12:00 pm | Lunch |
| 1:15-3:00 | Silent auction, upper lobby, Macey Center, sponsored by the Albuquerque Gem and Mineral Club |

# New Mexico wulfenite

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Although New Mexico is not known for spectacular wulfenite, the state nevertheless has produced some noteworthy specimens, and this attractive mineral is more widespread than is commonly realized. A search of the literature and personal knowledge of documented specimens reveals 55 specific mines or districts that have produced wulfenite (list enclosed) in New Mexico. Most of these occurrences have been cited in the last 33 years. Schilling (1965) reports only 17 wulfenite occurrences in New Mexico.

As a secondary mineral usually derived from the oxidation of galena, wulfenite is most commonly found in arid regions. This is true in New Mexico where almost all occurrences are in the most southern, arid counties. The exceptions are two sites each in Bernalillo and Santa Fe Counties and a questionable report from a volcanic plug near El Rito in Rio Arriba County (Northrup and LaBruzza, 1996).

Before World War I, wulfenite was the most important ore mineral for molybdenum (Schilling, 1965). In that regard, the Stephenson–Bennett mine in Doña Ana County and mines in the Hillsboro and Palomas Gap (Caballo Mountains) districts of Sierra County shipped small amounts of wulfenite molybdenum ore (Schilling, 1965). Additionally, wulfenite was an important ore mineral for lead at the Stephenson–Bennett mine (Dunham, 1935). Mineral collectors today cringe at this thought.

The Stephenson–Bennett mine in Doña Ana County has arguably produced the finest and largest volume of wulfenite specimens from New Mexico. The orebody was discovered in 1847 (Dunham, 1935) with silver and lead ore production continuing well into this century. Many outstanding specimens were recovered by collectors long after the mining era was over. A fatal accident by "exploring" high-school students in the 1980s has resulted in total closure of the mine. Stephenson–Bennett wulfenite is noteworthy because of the wide variety of color and habits exhibited.

Wulfenite from the Denver shaft in the Central mining district of Grant County rivals the best of the Stephenson–Bennett specimens in quality if not quantity. Denver shaft wulfenite was discovered by Robert Eveleth and Bill Worthington during a mine evaluation in 1975. Superb yellow-orange, lustrous crystals up to 2.5 cm were found in a wet, compact fault gouge at the end of a short drift off the first level. Six fuzed rounds of dynamite were found still loaded in drill holes adjacent to the occurrence. Unfortunately, shortly after this discovery, the head frame was removed, and the poor rock dump was bulldozed over the decline. Another stellar New Mexico mineral location lost, perhaps forever.

Historically, mines such as the Ground Hog and Lucky Bill in the Central district of Grant County yielded excellent specimens. Today, however, specimens from these mines are rare to nonexistent. A sad fact is that specimens were not a priority during New Mexico's early mining history.

Many of New Mexico's current locations bring forward specimens that are best viewed with magnification, i.e., microcrystals. No less interesting or beautiful than hand-sized specimens, these microcrystals come in many habits, colors, and associations. Finding these crystals in previously unreported locations and contexts adds to the mineralogical knowledge of orebodies and should be reported or published when discovered. Perhaps with the 100th anniversary of New Mexico statehood in 2012, we will have 100 New Mexico wulfenite locations—a noble goal.

## REFERENCES

Dunham, K. C., 1935, The geology of the Organ Mountains, with an account of the geology and mineral resources of Doña Ana County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 11.

Northrop, S. A., and LaBruzza, F. A., 1996, Minerals of New Mexico: University of New Mexico Press, third edition.

Schilling, J. H., 1965, Molybdenum resources of New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 76.

## NEW MEXICO WULFENITE LOCATIONS

**Bernalillo County**
- Galena King mine
- Octoroon mine

**Doria Ana County**
- Bear Canyon district
- Organ district
  - Stephenson—Bennett mine
  - Memphis mine

**Eddy County**
- Red Lake prospects

**Grant County**
- Burro Mountains district
  - Tyrone pit
- Central district
  - Bullfrog mine
  - Denver shaft
  - Ground Hog mine
  - Lucky Bill mine
- Fierro-Hanover district
  - Mason tunnel
- Georgetown district
  - Commercial mine
- White Signal district
  - Uncle Sam mine

**Hidalgo County**
- San Simon district
  - Granite Gap mines
- Lordsburg district
  - Anita mine

**Lincoln County**
- Gallinas Mountains district
  - Buckhorn mine
  - Red Cloud copper mine
  - Rio Tinto mine

**Luna County**
- Cooke's Peak district
- Jose district
  - Faywood mine
- Tres Hermanas district
  - Comfort claim
- Victorio district
  - Irish Rose mine

**Otero County** Orogrande district

**Rio Arriba County**
- Near El Rito (?)

**Santa Fe County**
- Cerrillos district
  - Mina del Tiro
- New Placers district
  - Carnahan mine

**Sierra County**
- Caballo Mountains district
  - Cox mine
  - Dewey mine
  - Gladys claim
  - Napolean mine
  - White Swan mine
- Cuchillo Negro district
  - Confidence mine
  - Dictator mine
- Hermosa district
- Hillsboro district
  - S. J. Macy
  - Petroglyph (Miner's Dream) mine
  - Virginia lode
- Iron Mountain No. 2 district
  - Goat Canyon area
- Lake Valley district
  - Caroline mine
- Macho district

**Socorro County**
- Cat Mountain district
- Hansonburg district
  - Blanchard mine
- Mex—Tex mine
  - Hickey #1 mine
  - Ora tunnel
  - Rattlesnake pit
- Lemitar Mountains district
- Magdalena district
  - Kelly mine
  - Linchburg mine
  - Mistletoe mine
- Socorro Peak district
  - Blue Canyon mine
  - Dewey lode
  - May Flower mine
  - Silver Bar mines

## Schorl-dravite tourmaline in metamorphic rocks from the Pilar cliffs, Taos County, New Mexico

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(Location 1 on index map)

Tourmaline is a distinctive mineral of the metamorphic rocks exposed in the rugged Pilar cliffs at the west edge of the Picuris Range, southwest Taos County. The Cliffs, along the east bank of the Rio Grande south of the town of Pilar, extend from approximately 6,000 ft elevation at river level to a plateau at approximately 7,500 ft. From north to south, these Precambrian metamorphic rocks include quartz-muscovite-feldspar "quartz-eye" schist of the Glenwoody Formation that is structurally overlain by massive quartzite of the Ortega Formation (Hondo Group) and staurolite-, garnet-, and biotite-bearing schist and quartzite of the Rinconada Formation (Hondo Group). The Glenwoody and Ortega Formations are separated by the south-dipping Pilar shear zone, and it has been debated which is actually the younger sequence of rocks. The Glenwoody Formation, believed to be metamorphosed rhyolite, perhaps an ash-flow tuff, has a reported age of about 1,700 Ma (Early Proterozoic) and has been tentatively correlated with the Vadito Group exposed farther southeast in the Picuris Range (Bauer and Helper, 1994; see also Bauer, 1984, 1987, 1993; Gresens and Stensrud, 1974; Manley, 1984; Montgomery, 1953). Manganese-rich layers near the top of the Glenwoody Formation are distinctive in containing the red manganese-bearing epidote mineral, piemontite, and Grambling (1984) has described the bright green, ferric iron and manganese-bearing andalusite (viridine) found at the Glenwoody—Ortega contact.

Tourmaline occurs throughout the Glenwoody Formation and in about the lowest 100 m of the Ortega Formation. The tourmaline ranges from brown to reddish brown to black, and it varies from fine needles to lustrous prisms up to several centimeters in length and 5 mm or more in diameter. The tourmaline ranges from dravite (magnesium-rich) to schorl (iron-rich). Rocks hosting tourmaline include mica schist, fine-grained quartz-feldsparmica schist, quartz pods and augen, and simple pegmatites. One —50-m-thick dark layer in the Ortega is rich in tourmaline and almandine garnet largely pseudomorphed to the hydrous iron silicate mineral, hisingerite. Other minerals associated with the tourmaline include quartz; white, pinkish-purple to coppery-red, and green (fuchsite) varieties of muscovite; piemontite, epidote, clinozoisite, zoisite, and pink zoisite (thulite); tremolite; green andalusite (viridine), sillimanite, and kyanite; and rare accessory minerals including allanite and stibiotantalite (several of these mineral identifications have been made by Paul F. Hlava, Sandia National Laboratories, and Virgil E. Lueth, New Mexico Bureau of Mines and Mineral Resources). The red micas are not known to be lithium-bearing and are colored mainly by ferric iron, rahter than manganese. The piemontite, purple muscovite and fuchsite, thulite, plus blue idocrase (cyprine) and gahnite from the Pilar area have been described by DeMark and Hlava (1987) and DeMark and Kline (1997).

## REFERENCES

Bauer, P. W., 1984, Stratigraphic summary and structural problems of Precamrian rocks, Picuris Range, New Mexico; *in* Baldridge, W. S., Dickerson, P. W., Riecker, R. E., and Zidek, J. (eds.), Rio Grande rift: northern New Mexico: New Mexico Geological Society, Guidebook 35, pp. 199-204.

Bauer, P. W., 1987, Precambrian geology of the Picuris Range, north-central New Mexico: Unpublished PhD dissertation, New Mexico Institute of Mining and Technology, Socorro, New Mexico; New Mexico Bureau of Mines and Mineral Resources, Open-file Rept. 325, 280 pp.

Bauer, P. W., 1993, Proterozoic tectonic evolution of the Picuris Mountains, northern New Mexico: Journal of Geology, v. 101, pp. 483-500.

Bauer, P. W., and Helper, M. A., 1994, Geology of Trampas quadrangle, Picuris Mountains, Taos and Rio Arriba Counties, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Geologic Map 71, scale: 1:24,000.

DeMark, R. S., and Hlava, P. F., 1987, A new occurrence of cyprine (blue idocrase) in New Mexico: New Mexico Geology, v. 9, pp. 21-22.

DeMark, R. S., and Kline, J. M., 1997, Gahnite, margarite, and other new mineral occurrences from Taos County, New Mexico: New Mexico Geology, v. 19, pp. 28.

Grambling, J. A., 1984, The Precambrian rocks near Pilar; *in* Baldridge, W. S., Dickerson, P. W., Riecker, R. E., and Zidek, J. (eds.), Rio Grande rift: northern New Mexico: New Mexico Geological Society, Guidebook 35, pp. 305-306.

Gresens, R. L., and Stensrud, H. L., 1974, Recognition of more metarhyolite occurrences in northern New Mexico and a possible Precambrian stratigraphy: The Mountain Geologist, v. 11, pp. 109-124.

Manley, Kim, 1984, First-day road log, from Taos to Embudo, Dixon, Penasco, Vadito, Tres Ritos, Holman Hill, and back to Taos via U.S. Hill and Talpa; *in* Baldridge, W. S., Dickerson, P. W., Riecker, R. E., and Zidek, J. (eds.), Rio Grande rift: northern New Mexico: New Mexico Geological Society, Guidebook 35, pp. 303-319.

Montgomery, Arthur, 1953, Pre-Cambrian geology of the Picuris Range, north-central New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 30, 89 pp.

## The Red Cloud mine—an update

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(Location 2 on index map)

### Mining history

The Red Cloud mine is approximately 42 mi north of Yuma, Arizona in La Paz County. It was located in 1862 and the claim was patented in 1877. The only period of profitable mining took place from 1878 to 1885. Approximately $500,000 to $1,000,000 in silver was recovered from the mine. By 1890 all mining efforts had ceased.

Several attempts to drill, explore, and mine the Red Cloud have occurred over the next 90 years, with little or no success. The last effort took place from 1979 to 1984, when the price of silver jumped to more than $50 per ounce. The mine was emptied of broken rock and a mill was constructed. With the subsequent drop in the silver price, this attempt also failed.

### Collecting history

Wulfenite specimens were recovered during the earliest mining period. The 1899 Territorial Governor's report to Congress even mentioned the wulfenite from Red Cloud mine. Specimens found their way into eastern collections, including those at Harvard and Michigan Tech.

As a result of seeing these specimens, Arthur Montgomery persuaded Ed Over to visit the mine in 1938. He spent 45 days at the Red Cloud and collected specimens from what is considered by many to be the best pocket ever found. The crystals became the standard by which all future pockets were compared.

From the early 1960s through 1979, the Red Cloud became a favorite destination for collectors, primarily from Arizona and California. Although none of the pockets rivaled Over's discovery, many fine specimens were found. After the mining company left in 1984, a feverish period of collecting took place until the early 1990s when all of the stopes were once again filled with broken rock.

### Current operations

In 1994, the Red Cloud mine was purchased by a group of collectors headed by Wayne Thompson. All necessary arrangements fell into place by late 1995 and mining began in January 1996. An open-pit operation was determined to be the safest and most economic way to mine. This should be true for at least the first 50 to 60 ft downdip on the vein.

The first cut removed a layer of overburden 30 ft wide, 250 ft long, and 10-15 ft deep. The exposed vein was then mined using hand methods, from screwdrivers to jackhammers. A small pocket was hit at the end of January and was offered for sale at the Tucson Show. Mining continued through the end of March with little to show for the effort. One pocket containing five specimens was discovered in the middle of March. This was somewhat noteworthy because the matrix was coated with drusy quartz crystals. Late in March, a crack was opened up near the north incline that had crystals as large as 5/8". This was encouraging but it was forgotten four days later when the big pocket was hit at the south end of the trench.

The large pocket was remarkable for several reasons. First, it was a crack that was as much as 8 inches across, 4 ft high, and about 30 ft long. A typical pocket at the Red Cloud is the size of a softball, and a large pocket might have a crack that opened to as much as 2 inches across. Second, because of the decision to mine by open-pit methods, large specimens were extracted, the best of which was 12 inches across. Quality specimens larger than 2 inches by 2 inches were virtually unheard of from this mine. In one lucky circumstance, this pocket actually produced more fine cabinet specimens than thumbnail specimens

Mining continued through the middle of May 1996 and then was shut down for the summer. Overburden stripping continued throughout the summer in preparation for the second phase. This waste layer was approximately 20 ft thick, 60 ft wide, and 300 ft long. This exposed 20 ft of vein which was mined in two 10-ft-high cuts. This worked started back up in November 1996 and continued through April 1997. Not a single good wulfenite specimen was collected in the first cut. A few nice cerussite crystals were collected but that makes them very valuable specimens, at least from a cost standpoint.

While mining the lower 10 ft cut, a small pocket was hit on March 13, 1997. One fine specimen was recovered and several flats of saleable material were also collected. Hope was renewed but, in typical Red Cloud fashion, was quickly dashed. That was the only good pocket for the 1996/1997 mining season. We have almost used up the good fortune from the first year to pay for the mining costs of the second year.

No further mining has taken place since operations were completed in April 1997. Once funding becomes available, the third phase will get under way. This time the overburden that must be removed to expose 20 ft of vein will be between 6 and 7 times the amount for the first cut. However, hope springs eternal with all miners, whether they are looking for copper, gold, or wulfenite. The next big pocket is just a few feet deeper than we have already dug.

Local and not so local clubs have been invited to take field trips to the Red Cloud to collect in the pits and the dump. This started with the Los Angeles Museum of Natural History Gem & Mineral Guild and has included the Mineralogical Society of Arizona, the Arizona Mineral & Mining Museum Foundation, and the Tucson Gem & Mineral Society. Other clubs can be accommodated on an invitation basis only.

## RED CLOUD MINERALOGY

| COLLECTABLE SPECIES | MICROMOUNT | ORE/GANGUE |
|---|---|---|
| Wulfenite | Willemite | Galena |
| Cerussite | Fluorite | Chlorargyrite |
| | Plattnerite | Calcite |
| | Caledonite | Barite |
| | Hemimorphite | Quartz |
| | Anglesite | Aragonite |
| | Stetefeldtite | Gypsum |
| | Mimetite | Minium |
| | Linarite | Massicot |
| | Vanadinite | |

# Bismuth minerals from the Harding mine—more than just yellow-green grunge

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(Location 3 on index map)

Bismuth minerals are relatively uncommon and are usually associated with vein-type or hydrothermal deposits, particularly gold and silver ore deposits. Bismuth sulfide is the primary mineral and is often associated with other sulfides of arsenic and antimony. Bismuth also occurs in telluride-type deposits where it may be present in complex suites of Ag, Au, Pb, Cu, Sb, and Hg sulfosalt and telluride minerals. However, primary and secondary bismuth minerals can also be found in pegmatites, although it is rare in these deposits.

Bismuth has been noted in the pegmatites of San Diego County (California) and also in a few pegmatites in New England, Black Hills (South Dakota), Colorado, and New Mexico. The most famous, and probably most abundant, pegmatite occurrence in New Mexico is at the Harding mine although these minerals have also been reported in other New Mexico pegmatites such as the Petaca, Ojo Caliente, El Porvenir, and Rociada districts. Of the 20 reported bismuth occurrences in New Mexico (Lueth, 1996; Northrop, 1996), seven are found at the Harding and two are found only there.

The Harding deposit, located in the Picuris Range 30 km south of Taos and 10 km east of Dixon, is a rare-element pegmatite. The pegmatite was mined more than 50 years: before World War II for the lithium minerals lepidolite, lithium muscovite, and spodumene; during the war for tantalum in the form of microlite and columbite/tantalite; and in the 1950s for beryl as an ore of beryllium. The bismuth minerals were never commercially produced and as a result can be picked up on the mine dumps with some careful searching (and maybe some luck). A scan of the Harding mine collection at UNM yielded 18 samples of bismuth minerals and 4 more containing unidentified minerals that are possibly Bi-bearing minerals.

Bismuth minerals have been identified from three lithologic units in the pegmatite: the beryl zone (quartz+albite+muscovite±perthite), the quartz+albite+muscovite unit and the quartz+lath spodumene unit. Nearly all the samples contain a suite of colorful bismuth minerals, interstitial and surface coatings on coarse-grained quartz, albite, spodumene, and perthite. Bismutite $[Bi_2(CO_3)0_2]$ appears to be the most common mineral and occurs as blue-green crystals or as green to yellow-green, waxy masses and coatings. Beyerite $[(Ca,Pb)Bi_2(CO_3)_20_2]$ occurs intergrown with bismutite in various shades of yellow and yellow green. The oxide bismite occurs as grayish-green to yellowish powdery coatings and masses. The rare Bi-vanadate pucherite occurs as yellow-orange to orange-brown coatings and microcrystals on spodumene, quartz, and muscovite. In addition to the colorful yellow-green and yellow of the secondary bismuth minerals, some specimens host brilliant-green mottramite $[PbCu(VO_4)0H]$ and malachite $[Cu_2(CO_3)(OH)_2]$ (Hlava, 1986). The primary bismuth minerals from which these secondary minerals have altered are probably bismuthinite ($Bi_2S_3$), native bismuth, and bismutotantalite $[BiTaO_4]$ that have all been reported as residual grains within secondary bismuth minerals (Hlava, 1986; Jahns and Ewing, 1976). In addition, bismuth occurs in minor amounts in primary microlite $[(Ca,Na)_2Ta_2O_6\ (O,OH,F)]$ from the quartz+lath spodumene unit of the pegmatite.

A note on collecting at the Harding mine: the property is owned by the University of New Mexico and is one of the few mine properties where collectors are actively welcomed. Some restrictions apply, mainly that collecting is limited to personal use and that a signed release form is given to the mine caretaker. Release forms and information about the mine may be obtained from the Department of Earth and Planetary Science or at http://eps.unm.edu/harding/harding.htm.

## REFERENCES

Hlava, P. F., 1986, Unusual minerals from the Harding pegmatite; *in* Colorado pegmatites: Colorado Pegmatite Symposium, May 30-June 2, 1986, pp. 55-57.

Jahns, R. H., and Ewing, R. C., 1976, The Harding mine, Taos County, New Mexico; *in* Ewing, R. C., and Kues, B. S. (eds.), Vermejo Park: New Mexico Geological Society, Guidebook 27, pp. 263-276.

Lueth, V. W., 1996, Secondary bismuth minerals from the Apache mine, Hidalgo County, New Mexico: 17th Annual New Mexico Mineral Symposium, abstracts, p. 4; New Mexico Geology, 1997, v. 19, p. 26.

Northrop, S. A., and LaBnizza, F. A., 1996, Minerals of New Mexico: University of New Mexico Press, 3rd edition.

## Primary and secondary bismuth minerals from the Harding mine

| Bi-mineral | Compound name/ formula | Color/appearance/ habit |
|---|---|---|
| Beyerite | Calcium-lead, bismuth carbonate<br>$(Ca,Pb)Bi_2(CO_3)_2O_2$ | White, yellowish white to bright yellow, gray-green/<br>Vitreous, massive, earthy/<br>Thin tabular crystals to earthy masses |
| Bismite | Bismuth oxide<br>$Bi_20_3$ | Yellowish, gray-green/<br>Massive, earthy, powdery/<br>Powdery crusts, stains |
| Bismuth | Native element<br>$Bi$ | Silver-white w/ pink tint/<br>Metallic/<br>Usually massive or indistinct crystals, granular |
| Bismuthinite | Bismuth sulfide<br>$Bi_2S_3$ | Lead gray to tin white, iridescent or yellow tarnish/<br>Metallic/<br>Usually massive or fibrous, crystals prismatic to acicular, with vertical striations |
| Bismutite | Bismuth carbonate<br>$Bi_2(CO_3)0_2$ | Yellow, white, brownish, greenish or gray/<br>Massive, earthy/<br>Fibrous, lamellar aggregates, scaly crusts |
| Bismutotantalite | Bismuth, tantalum oxide<br>$Bi(Ta,Nb)0_4$ | Brown to black/<br>Submetallic/<br>Prismatic crystals |
| Microlite | Calcium-sodium, tantalum oxide hydrate<br>$(Ca,Na)_2Ta_2O_5(O,OH,F)$ | Brown, yellow, black/<br>Resinous/<br>Octahedral crystals, granular |
| Pucherite | Bismuth vanadate<br>$BiVO_4$ | Yellowish to yellow-brown coatings/<br>Resinous, powdery/<br>Crystalline, scaly crusts |

# Magnetite crystals from the Republic pit
# Hanover, Grant County, New Mexico

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(Location 4 on index map)

Well-formed crystals of magnetite have been found in the Republic pit and several other mines in the Hanover-Fierro district of Grant County, New Mexico. The crystals occur in skarns along the margin of a Tertiary granodiorite porphyry intrusive where it invaded Silurian and Ordovician dolomite. Although massive magnetite is common, the skarns occasionally contain areas with well-formed magnetite crystals that have grown in coarse crystalline calcite. The crystals usually occur as simple, sharp, equant octahedrons and can be as large as 3 or 4 inches on edge. Fine specimens have been obtained by dissolving the calcite from chunks of the magnetite-calcite skarn displaying sharp crystal outlines.

The Republic pit is a part of a group of mines operated by the Hanover Bessemer Iron Ore Association in 1894. Other properties included the Union Hill, the Anson S., and the Jim Fair pit. The mines were worked by a variety of owners over the years until 1931 when they closed for good. The property then passed through several hands and is now owned by Cobre Mining Company, a subsidiary of Phelps Dodge Mining Company. In 1997 the Republic pit was covered with a waste stockpile and collecting opportunities ceased. Other deposits in the area contain similar mineralization although in lesser quantities.

## Scottish rainbows—the agate

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Among the worldwide localities for agate that are listed in most mineral books (Brazil, Mexico, United States), Scotland is rarely mentioned. Its agates, however, have some very unusual colors and banding that are found only in Scotland. Many of the agates, especially those collected along the beaches, are only pea size, but even in those small sizes are found superior colors and banding. Large agates are found in areas where no other mineralization is found. A superb exhibit of rough and cut Scottish agates can be found in the Royal Scottish Museum, Chambers Street, Edinburgh. A paperback book published within the last 10 years by Harry MacPherson, former mineral curator at the RSM, beautifully details the collection and the mineral formation. My program highlights a number of both personally collected Scottish agates as well as those that were given to me by an estate. U.S. collectors can perhaps recognize in locally collected (New Mexico) agates the same forming features.

Credit for mentioning the Scottish agate book is given to Pete Modreski who mentioned it to me last year at the symposium. Thanks to Alan & Margaret Houghton of Bedale, N. YORK who introduced me to Scottish agate collecting and to Mrs. Ivy Stevens of Glasgow, Scotland who gave me agates from her late husband's collection.

# Famous mineral specimens we have known
# and some of the questionable characters who have stumbled across them
# OR half-truths that should live for eternity!

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New Mexico Bureau of Mines and Mineral Resources
Socorro, NM 87801

(Location 5 on index map)

A photograph is said to be worth a thousand words but a prized mineral specimen is another matter entirely: any old prospector worth his "salt" can talk for hours about the circumstances surrounding the discovery of his favorite chunk of "highgrade." These speakers have known some really talented geezers, some of whom you'll meet, who could ramble on for days (present company excluded, of course). We'll spare your ears, however, and relate but a few brief, and it is hoped, humorous anecdotes regarding the rigors of the quest and regale you with tales of individual collectors and their hard-won treasures—treasures that in some cases have suffered long-term identity crises, been misused for public rituals, or even survived a rough trip down the mountain only to serve ignominiously as the family doorstop. If nothing else, this presentation will serve to prove that truth is stranger than publicity. Names and dates have occasionally been changed to protect the guilty!

## Collectible minerals of the midwestern United States

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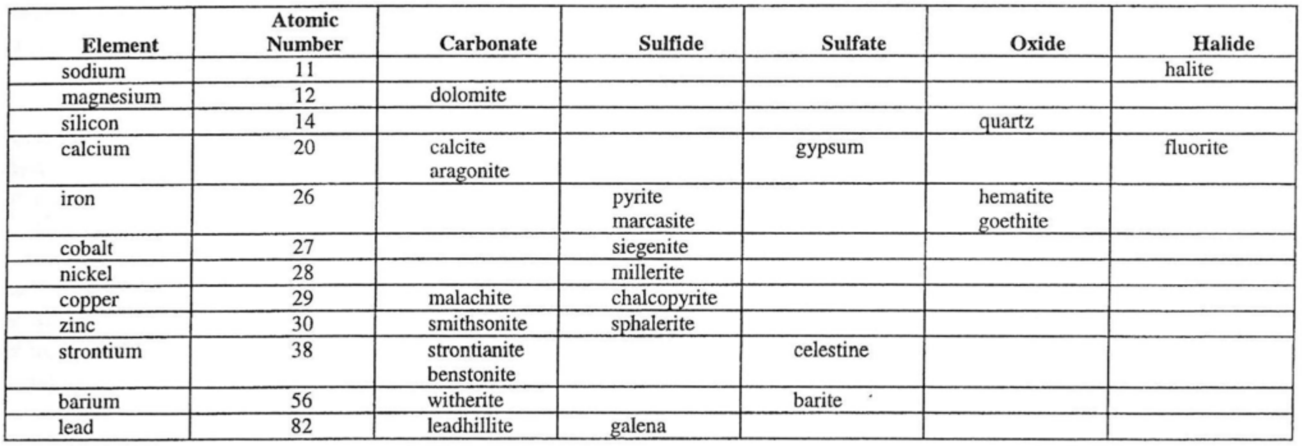
The midwestern states of Ohio, Indiana, Kentucky, Tennessee, Illinois, and Missouri share a simple suite of minerals that are found wherever dolomitized limestones crop out or are exposed by surface or underground mining. Of interest to collectors are approximately two dozen minerals that can occur as well-crystallized carbonates, sulfides, sulfates, oxides, or halides composed of eleven metals and silicon. The following table lists these minerals and the elements that form them.



| Element | Atomic Number | Carbonate | Sulfide | Sulfate | Oxide | Halide |
|---|---|---|---|---|---|---|
| sodium | 11 | | | | | halite |
| magnesium | 12 | dolomite | | | | |
| silicon | 14 | | | | quartz | |
| calcium | 20 | calcite<br>aragonite | | gypsum | | fluorite |
| iron | 26 | | pyrite<br>marcasite | | hematite<br>goethite | |
| cobalt | 27 | | siegenite | | | |
| nickel | 28 | | millerite | | | |
| copper | 29 | malachite | chalcopyrite | | | |
| zinc | 30 | smithsonite | sphalerite | | | |
| strontium | 38 | strontianite<br>benstonite | | celestine | | |
| barium | 56 | witherite | | barite | | |
| lead | 82 | leadhillite | galena | | | |

Metals present in the original sediments were mobilized by relatively low-temperature (100-200°C) fluids flowing upslope from the ancient basins and saline seas of the region and were concentrated. As these fluids reached an arch or a dome adjacent to the basins, minerals crystallized in open cavities within the host rock when the pressure and temperature were reduced. Other factors, such as the pH of the fluid, the presence of pyrobitumen, and the presence of fresh formation water influenced the timing and degree of crystallization.

Minerals found in the limestones of the Midwest are often well crystallized, beautiful, and abundant and occur in a wide range of habit, color, and association with other minerals.

## Telluride minerals of the Phil Sheridan lode, Boulder County, Colorado

Harry D. Covey
Owner of the Phil Sheridan Mine
Sunshine, CO

(Location 6 on index map)

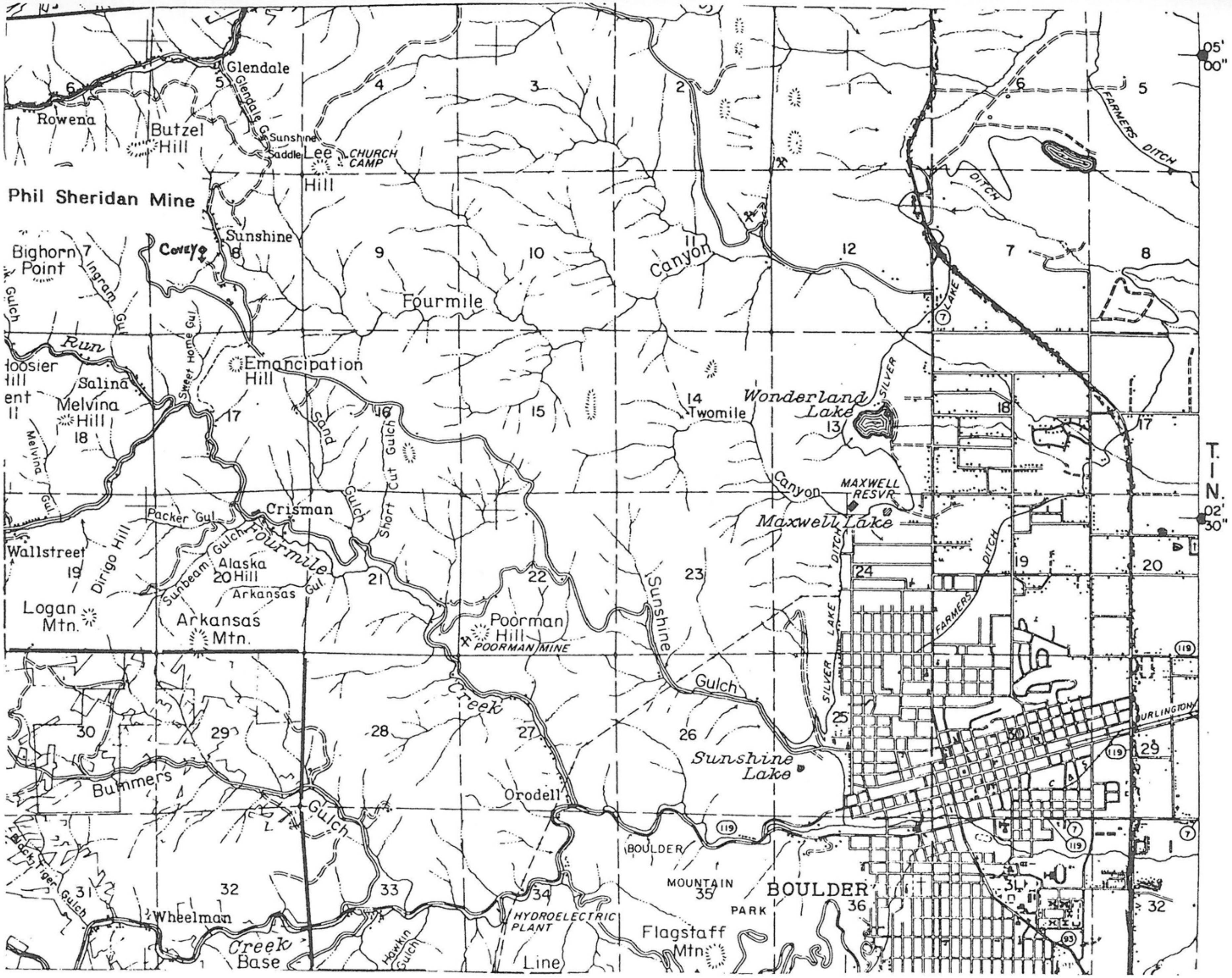
The mine known as the Phil Sheridan lode was discovered in the early days of prospecting, about 1860. The surface of the vein was worked for the very fine flour gold that resulted from decomposition of gold minerals: sylvanite, calaverite, and krennerite. Initially it was thought that this was all the gold that could be won from the veins. Trenches were dug along the veins following the strike of the vein. Several feet of overburden contained the fine flour gold they sought. The waste gravel was discarded downhill covering the exposed vein, and the telluride crystals were not recognized as containing gold.

Then in 1872 it was learned that the silvery crystals in the horn quartz were sylvanite. A new gold rush and boom resulted, and most of the claims that exist today were initiated at that time—the Phil Sheridan lode was one of these. However, the work done in previous years had covered many of the rich sources of flour gold along the strike of the vein.

In 1965 the vein was uncovered when the owner of the Phil Sheridan claim gave the Boulder County road crew permission to use the gravel to widen the road into Sunshine. It was not immediately recognized, however, until the property was sold to the present owner who investigated the area with a keen interest in geology. A 1-inch-wide vein of nearly solid "rusty gold" was discovered at the present site of the mine. This vein was at the junction of the Washburn and Phil Sheridan veins, which run parallel south of this junction. Ore occurs sporadically in these veins, so it is not practical to mine the entire vein, only the cymoid structure that carries the richest ore.

The host rock of the Phil Sheridan and Washburn veins is the Boulder Creek granodiorite, which lends simplicity to the implantation of hydrothermal ore. The fissure stands out in good contrast to the surrounding wall rock. In the older workings, the altered wall rock is covered with secondary minerals, which delineate the vein. Mineralization caused hydrothermal alteration, which produced a sericitic envelope on both sides of the vein.

The major silver telluride in these veins is petzite along with minor hessite. The most abundant gold telluride is sylvanite along with some calaverite and minor krennerite. Associated minerals include coloradoite, nagyagite, altaite, melonite, and native tellurium. The associated minerals appear to have been deposited in their own suite and at different periods of vein opening. The base-metal sulfide minerals are very scarce; however pyrite or marcasite, each of which appears in its own suite, are quite commonly associated with the tellurides. Marcasite is much less common in the veins that contain abundant gold tellurides and often is auriferous.
The slides to be presented will clarify much of the information contained herein.


Glendale
Glendale G
Rowena
Butzel Hill
Sunshine Saddle
Lee Hill
CHURCH CAMP
Phil Sheridan Mine
Sunshine
Covey
Bighorn Point
Ingram Gul
Gulch
Run
Hoosier Hill
Salina
Melvina Hill
Melvina Gul
Sweet Home Gul
Emancipation Hill
Fourmile
Canyon
Sand Gulch
Short Cut Gulch
Crisman
Packer Gul
Wallstreet
Dirigo Hill
Sunbeam Gulch
Fourmile
Alaska Hill
Arkansas Gul
Logan Mtn.
Arkansas Mtn.
Poorman Hill
POORMAN MINE
Twomile
Wonderland Lake
SILVER LAKE
Canyon
MAXWELL RESVR
Maxwell Lake
SILVER LAKE DITCH
FARMERS DITCH
DITCH
Sunshine Gulch
Sunshine Lake
Creek
Orodell
Bummers Gulch
Black Tiger Gulch
Wheelman
Creek
Base
Hawkin Gulch
HYDROELECTRIC PLANT
Line
BOULDER
MOUNTAIN PARK
Flagstaff Mtn
BOULDER
BURLINGTON
T. 1 N.
05' 00"
02' 30"
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
7
119
93

# Mines, men, and minerals—an update on mineral collecting in the Hansonburg district

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(Location 7 on index map)

The Hansonburg mining district is on the west side of the Sierra Oscura Mountains in central New Mexico. It lies about 55 km southeast of Socorro at the northern boundaries of White Sands Missile Range. The district includes the Blanchard, Mex–Tex, Royal Flush, and Rose mines, and additional short tunnels and open-cut areas that lie 3-8 km south of NM-380 and the village of Bingham. Mining has occurred in the district since the 1880s, with the main ores of interest being fluorite, barite, and galena. Mineralization occurs as veins in steep, westerly dipping fault structures, and in highly fractured and silcified, sub-horizontal Pennsylvanian limestones immediately adjacent to the faults. Veins and adjacent mineralized rock often contain substantial open spaces and crystal-lined vugs that are exposed both in open cuts and trenches on the surface and in mine tunnels.

The Hansonburg district, and the Blanchard, Mex–Tex, and Royal Flush mines in particular, has become widely known as a source of fine crystal specimens for the past 40 years or so. However, commercial mining operations that were conducted prior to control of the claims by the current claimants were geared almost exclusively to production of ore, and surprisingly few specimens were salvaged from pre-1960s mining operations. We can only speculate about the quantity and quality of fine mineral specimens that were sacrificed to the crusher during the course of commercial mining in the district. However, we must conclude that the loss of irreplaceable material must have been substantial given the quality and quantity of specimens that are currently being produced from existing tunnels and excavations at these properties. All mineralized areas accessible to claiming are currently under the control of claimants whose sole interest is the production of mineral specimens. Some of the properties are accessible to the general public for collecting on a fee, or by-appointment basis.

We decided several years ago to increase the scale of specimen production at various locations in the district. Before this time, we had used only hand tools and occasional digging and blasting to produce material. We decided to try a somewhat-larger mechanized operation using a tracked Caterpillar 320L excavator in conjunction with hand-digging to recover specimens. This increase in scale has proved successful (some years we even made expenses!), and the machine has been used for the last 4 yrs to excavate mineralized areas exposed in existing open cuts on the surface. The operation has taken place around Memorial Day of each year and has lasted about 10 days each time. Limited specimen extraction with hand tools also has taken place in some of the underground workings at these properties.

Minerals have been produced from the Blanchard, Mex–Tex, and Rose mines. At the Mex–Tex mine, we have found high-quality, rare secondary minerals and more common species. The secondary minerals include brochantite, crandallite, creedite, cyanotrichite, libethenite, linarite, murdochite on smoky quartz, plumbogummite, pseudomalachite, spangolite, and tsumebite. The spangolite (up to 3 mm crystals) and cyanotrichite specimens are among the best ever found in New Mexico. Fine clusters and groups of both amethystine and smoky quartz (some liberally sprinkled with murdochite microcrystals) have also been produced from the Mex–Tex mine. From the Rose mine have come fine sky-blue fluorite crystal groups with barite blades. Also, a large pocket at the Royal Flush mine produced in excess of 4,000 lbs of specimens with small but gemmy fluorite cystals on matrix.

The operations at the Blanchard mine have also been productive and successful. Sky-blue, purple, and pale-green fluorite crystals up to 7 cm on edge, in mainly the cubic to modified cubic habit, but also in the hexoctahedral and dodecahedral habits, have been produced throughout the Blanchard mine area. Fluorite and barite specimens sprinkled with small (up to 2 mm) butterscotch-yellow wulfenite crystals were found near a large wooden ore bin on the property. A large crystallized cavity was discovered in one of the "Sunshine" tunnels in 1996, and much of the ceiling proved to be coated with dark-blue fluorite and highly altered galena crystals to 5 cm on an edge and barite. Fortunately, almost all the crystallized material was attached to a 15-cm-thick layer of silicified limestone that had either already gently slumped to the floor of the cavity or was partially detached and therefore easily removed. As a result, almost all crystal specimens were recovered with very little to no damage—a very unusual and fortuitous set of circumstances! The New Mexico Museum of Natural History and Science purchased most of the larger specimens from this cavity and plan to use this beautiful material for a crystal cavity reconstruction at the museum. We are gratified that this New Mexico treasure will remain in New Mexico. Water-clear, color-zoned fluorite cubes to 4 mm, with hexoctahedral modifications, were also found in this pocket.

Other minerals produced from the various Blanchard mine tunnels and surface workings include linarite and brochantite in association with fluorite, and beige-colored bubbly smithsonite. A very fine cabinet-sized specimen consisting of blue fluorite cubes to 5 cm nested within large lustrous cream barite crystals to 16 cm was, after much careful and skillful effort, recovered with very little damage from another Sunshine tunnel. This exceptional specimen passed through several mineral-dealer's hands. It was ultimately purchased by and is on display at the New Mexico Bureau of Mines and Mineral Resources Mineral Museum in Socorro.

Finally, one of us (Sanders) has been working on geologic mapping of the main tunnels at the Blanchard mine to determine how the mineralized zones exposed in each of the tunnels are connected to each other, both horizontally and vertically. The Sunshine Mining Company of Boise, Idaho conducted a large-scale exploration project at the Blanchard mine from 1958 to 1960 and excavated most tunnels at the property. As part of this study, Sunshine was contacted to determine if they still had maps, reports, and other information that was undoubtedly generated during this project, and if such information could be released to the current claimant if it still existed. Sunshine officials contacted about this project had no recollection of it, but they graciously allowed us to search through archived data stored in northern Idaho. Plan and cross-section maps produced during their project were found. The mining company again generously allowed copying of any information that was of interest. This historical Sunshine data will be used in conjunction with the ongoing geological study to help determine the amount of potentially productive mineralized ground that remains at the Blanchard mine. If reserves prove sufficient, if it appears that a sufficient quantity and quality of mineral specimens can be produced from those reserves to support an economically viable mining operation, and if the cost of other safety and logistical issues can be overcome, then underground specimen mining may at some point take place at the Blanchard mine.

# Causes of color in minerals and gemstones

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The colors that one sees when looking at a mineral or gemstone are due to the response of that person's eye to the energies of the light, the emission spectrum of the illumination, and, most importantly, physical phenomena in the material that cause some colors to be absorbed while others are undisturbed or enhanced. It is beyond the scope of this talk to do more than touch on the physiology of the eye that allows us to see colors. Likewise, we will not dwell on the emission spectra of various light sources. Rather, we will concentrate on the various ways in which materials, especially minerals and their heights of perfection, gemstones, produce color from white light.

Light is a form of energy (electromagnetic energy) and white light is a mixture of all of the visible energies (or wavelengths). In order for a mineral to cause color from white light it has to somehow perturb the balance of the light energies. Kurt Nassau[2'3] has separated the causes of color into 15 mechanisms based on five physical groupings. Although there are some color mechanisms that depend on direct emission of certain colors, most of the mechanisms we are interested in depend on the ability of minerals to preferentially absorb certain energies of light. When these energies are removed from the white light the mineral is colored by the complimentary color as demonstrated by the CIE* Chromaticity Diagram.

Light absorption by the electrons of transition-metal or rare-earth-element (REE) atoms, either as major parts of the mineral chemistry or impurities, is one of the most important and well-known of the coloring mechanisms[2'3'5]. Most common rock-forming elements have electronic structures that mitigate against causing colors. On the other hand, transition metals and REEs have electrons that can be excited to open, higher-energy levels. The electrons gain the necessary energy for the excitation by absorbing a particular energy (color) from white light, and thus cause the mineral to show the complementary color. Three prime examples of this mechanism are rubies, emeralds, and alexandrites, but there are many, many more.

Another important and common coloring mechanism is intervalence charge transfer. This occurs when a valence electron from one atom transfers to the structure of a nearby atom (often of a completely different element), again by absorbing just the amount of energy needed to make the transfer. Examples include sapphire, lapis lazuli, and amazonite.

Part 2 of this talk (next year) will discuss two more absorption-type mechanisms—color centers (fluorite, smoky quartz, amethyst) and band-gap colors (yellow and blue diamonds, cuprite, cinnabar). Then it will describe how colors are caused by physical phenomena such as scattering (cat's eyes, stars, opalescence), dispersion (fire in diamonds), interference (labradorite), and diffraction (play of colors in opal).

*Commission Internationale de l'Eclairage

ACKNOWLEDGMENT, REFERENCES, AND SUGGESTED READING

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2. Nassau, Kurt, 1983, The physics and chemistry of color: the fifteen causes of color: John Wiley & Sons, New York, 454 pp.

3. Nassau, Kurt, 1980, The causes of color: Scientific American, v. 243, no. 4, pp. 124-154. (Provides an excellent summary of the subject.)

4. Nassau, Kurt, 1981, Cubic zirconia: an update: Gems and Gemology, v 17, no. 1, pp. 9-19.

5. Fritsch, Emmanuel, and Rossman, G. R., 1987, An update on color in gems, part 1: introduction and colors caused by dispersed metal ions: Gems and Gemology, v. 23, no. 3, pp. 126-139.

6. Nassau, Kurt, and Valente, G. K., 1987, The seven types of yellow sapphire and their stability to light: Gems and Gemology, v. 23, no. 4, pp. 222-231.

7. Fritsch, Emmanuel, and Rossman, G. R., 1988, An update on color in gems, part 2: colors involving multiple atoms and color centers: Gems and Gemology, v. 24, no. 1, pp. 3-15.

8. Fritsch, Emmanuel, and Rossman, G. R. 1988, An update on color in gems, part 3: colors caused by band gaps and physical phenomena: Gems and Gemology, v. 24, no. 2, pp. 81-102. (Contains a table describing the causes of color for most gemstones.)

9. Fritsch, Emmanuel et al., Gem-quality cuprian-elbaite tourmalines from Sao Jose da Batalha, Paraiba, Brazil: Gems and Gemology, v. 26, no. 3, pp. 189-205.

*Gems and Gemology* contains numerous articles that include discussions of particular coloring mechanisms (such as ref. 9), too many to be enumerated here.