

ANNUAL NEW MEXICO MINERAL SYMPOSIUM

35th Annual
New Mexico
Mineral Symposium

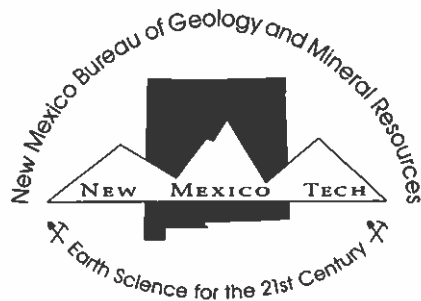
November 8 & 9, 2014



PROGRAM &
ABSTRACTS

35th Annual
New Mexico
Mineral Symposium

November 8 & 9, 2014



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

Socorro 2014

Welcome to

The Thirty-Fifth Annual New Mexico Mineral Symposium

November 8 and 9, 2014

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

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

Additional sponsors this year include:

Albuquerque Gem and Mineral Club
Chaparral Rockhounds
Los Alamos Geological Society
New Mexico Geological Society Foundation
Grant County Rolling Stones
Friends of Mineralogy
City of Socorro



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.

35th Annual New Mexico Mineral Symposium

7–9 November 2014

SCHEDULE

Friday, November 7, 2014

6:00 pm Informal motel tailgating and social hour, individual rooms, Comfort Inn & Suites (# 1 on map) and other venues—FREE

Saturday, November 8, 2014

8:00 am **Registration, Macey Center; continental breakfast**
8:50 *Opening remarks, main auditorium*
9:00 *The minerals from the pegmatites of the Crystal Mountain district, Larimer County, Colorado – Mark Jacobson (1)*
9:30 *Lesser known mines and minerals in the Magdalena mining district, Socorro County, New Mexico—Ray DeMark and Tom Katonek (2)*
10:00 **Coffee and Burrito break**
11:00 *Crystallized mineral deposits of the San Pedro River Basin – Barbara Muntyan (3)*
11:30 *Tales from the Crypt(omelane) – Virgil W. Lueth (4)*
12:00 pm **Lunch & Museum Tour**
1:30 *Zeolites of Chili, Rio Arriba County, New Mexico – Patrick Haynes (5)*
2:00 *The California Blue Mine: Aquamarine discovery, specimen recovery, and geochemistry in the Mojave Desert – Ian Merkel*
2:30 *New Finds from the Michigan Copper Country – Tom Rosemeyer*
3:00 **Coffee break**
3:30 *The Lesser known minerals of the Pikes Peak Batholit—Peter Modreski and Jack Thompson (6)*
4:00 *The Past, Present, and Future of the new New Mexico Bureau of Geology & Mineral Resources – Mineral Museum – Virgil W. Lueth (7)*
(featured event with a tour of the new facility)
5:30 *Sarsaparilla and suds: cocktail hour, cash bar – Fidel Center Ballrooms*
6:30 *Silent Auction and Dinner followed by a voice auction to benefit the New Mexico Mineral Symposium – Fidel Center Ballrooms*

Sunday, November 9, 2014

8:00 am **Morning social, coffee and donuts**
8:50 *Welcome to the second day of the symposium and follow-up remarks*
9:00 *20 Years After: A Brief Update on the Study of Telluride Minerals & Deposits – Bruce Geller*
9:30 *Trout Creek Pegmatite district, Chaffee County, Colorado – Will Moates and Mel Stairs (8)*
10:00 **Coffee break**
10:30 *Collecting in the Hansonberg District in the 1950s and 1960s (MexTex and Blanchard Mines) – Sherman Marsh (9)*
11:00 *Mine Reclamation and Mineral Specimen Recovery Operation in July 2013 at the Blanchard Mine, Socorro County, New Mexico – Michael R. Sanders and Ramon S. Demark (10)*
11:30 *Mining in the Ancient World – An Introduction to Methods and Technology – Nathalie N. Brandes*
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)*

Minerals from the Pegmatites of the Crystal Mountain District, Larimer County, Colorado

Mark Ivan Jacobson
Denver, Colorado

Blue apatite crystals, purpurite-heterosite, spodumene, chrysoberyl, tantalite and beryl are some of the minerals specimens available for collecting in the Crystal Mountain district. This is one of the few pegmatite districts in Colorado where neither all the pegmatites have been found, studied, mapped nor all the minerals described. Because the minerals specimens found in this district are not in the \$1,000 price range, field collecting is still possible.

The Crystal Mountain District is geographically centered around Crystal Mountain in section 26, T7N R72W, about thirteen miles west of Fort Collins and Loveland, Colorado. Most of the district's pegmatites are found north of Drake in the Big Thompson Canyon and south of Buckhorn Canyon. This area can be located on the Crystal Mountain, Buckhorn Mountain, Drake and Glen Haven 7.5 minute topographic quadrangle maps. Although private property is scattered throughout the area, access via National Forest Service roads is usually possible. Certainly, the pegmatites can be legally accessed by foot.

The Crystal Mountain pegmatites occur within 1.7 billion year old Proterozoic high-grade metamorphic phyllites, schists, and gneisses, which are mostly between the andalusite (first appearance) and staurolite (last presence) metamorphic mineral zones. These rocks have been historically called the Idaho Springs Formation, although this name has fallen from favor and has not been replaced. The Longs Peak-St. Vrain batholith and its variant, the Mt. Olympus pluton, is composed of granite and quartz monzonite. This batholith has been aged dated as 1.42 by +/- 30 my, and is part of the Berthoud Plutonic suite in Colorado. The pegmatites are interpreted but are not proved to have been formed from the Longs Peak batholith and of the same age as the granite.

Most of the pegmatites in this district are clustered in a thermal synclinal trough that plunges to the southeast, as indicated by metamorphic mineral zones. In general those pegmatites closest to the Longs Peak-St. Vrain granite are most simple with few accessory minerals whereas those furthest away are more strongly zoned with more abundant lithium, beryllium and phosphate accessory minerals. The pegmatites in this district are the most phosphate and beryl rich in Colorado but are poor in rare-earth and radioactive elements, thus suggesting that they are members of the LCT class of complex rare-metal pegmatites.

Approximately forty-three minerals have been found in the district. These are:

albite	fluorite	thorite
allanite	garnet (almandine?)	triphylite-lithiophilite
alluaudite series minerals	graftonite-beusite	topaz
amblygonite-montebrazite	heterosite-purpurite	torbernite- metatorbernite
autunite	lepidolite	triplite
bertrandite	magnetite	uraninite
beryl	microcline	uranophane
bismuthinite	monazite	vandendriesscheite
bismutite	muscovite and Li-muscovite	vivanite
chrysoberyl	phosphuranylite	zircon variety cyrtolite
columbite-tantalite	schorl	
ferrosicklerite-sicklerite	scheelite	
fluorapatite	spodumene	

Massive phosphate minerals are common at the Hyatt, Storm Mt., Big Boulder, Crystal Snow, Double Opening, Black Beauty Beryl pegmatites and a few others. Where either iron or manganese end members of heterosite-purpurite are found, ferrisicklerite-sickerite and triphylite-lithiophilite could be found. Metasomatic alteration of these phosphates results in members of the alluaudite series. Primary graffonite-beusite is frequently intergrown along parallel exsolution lamellae with triphylite-lithiophilite but is usually found as heterosite-purpurite and graffonite intergrowths on the surface. Triplite is a primary mineral and is found alone or in association with other phosphates. Vivianite forms bluish coating on fracture surfaces of triphylite or other phosphates. Purple phosphosiderite, massive fine-grained apatite and possibly grungy mitridatite as crusts have been reported from the Big Boulder pegmatite and may be present in the other phosphate rich pegmatites.

Although Thurston (1955) bragged about how rare columbite-tantalite minerals are in these pegmatites, thin blades of these species are numerous enough that its presence should be expected in any pegmatite with albite variety cleavelandite – a variety known from the Bull Elk Beryl Crystal, Big Boulder, Tantalum, Sherwood Place, and Buckhorn pegmatites.

Chrysoberyl tends to be present in beryl-rich pegmatites that were emplaced well within the sillimanite metamorphic zones. The Wisdom Ranch and Bull Elk Beryl Crystal contain the most chrysoberyl in the district but the mineral should be expected in many other district pegmatites, especially the thinner ones.

Beryl is abundant in many pegmatites as euhedral opaque crystals that vary from white to green, and rarely bluish. Although gem quality beryl crystals have been reported in the literature, their provenance is suspect. In fact, any crystals except for micro blue apatites that show evidence of crystallization in a vug should be suspected of having an origin outside of this district.

The alteration of uraninite found within or adjacent to phosphate nodules is responsible for the reports of the other uranium minerals of uranophane, phosphuranylite, vandendriesscheite, autunite, and torbernite in the district. Such minerals have been reported from the Storm Mountain, Buckhorn, Hyatt, and Double Opening pegmatites and may be present in other pegmatites.

The most collectable minerals in the district are beryl, schorl, and chrysoberyl. Hard work is still required for attractive specimens but the area to search is large. Since high monetary value specimens are not known from this district, field collectors still have the opportunity to collect interesting species without the distraction of treasure hunters.

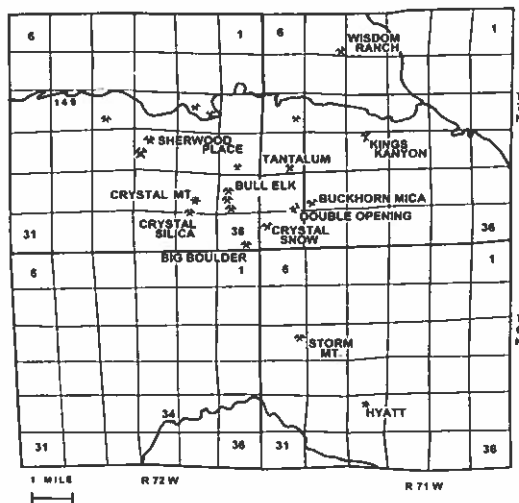


Figure 1—Index map showing the major pegmatites within the Crystal Mountain district.

Lesser-known Mines and Minerals of the Magdalena District, Socorro County, New Mexico

Ray DeMark and Tom Katonak, Albuquerque, New Mexico

Mention the Magdalena district in Socorro County New Mexico to mineral collectors and, most likely, the Kelly mine with its beautiful aqua botryoidal smithsonite will come to mind. There were, however, more than forty additional mines in the district that produced a wide variety of minerals—many of which are rare and significant in their own right. The presentation, although not all-inclusive, will feature many of the lesser-known mines and minerals of the district.

The mining district got its start in 1877 when Col. J. S. Hutchinson (“Old Hutch”) first discovered oxidized lead (primarily cerussite) ores in the area. It was smelted in an adobe furnace and the product was hauled to Kansas City by ox teams (Lasky, 1932). Gustav Billing erected a smelter near Socorro in 1881 to handle the ores from the district. It operated until 1893 when it was closed due to the decline of the silver market. The Graphic smelter was erected in 1896 to handle the oxidized lead ores from the district (the three most important mines were the Kelly, Graphic and Juanita). This smelter operated until 1902 when cerussite was largely exhausted, thus ending the lead carbonate period of the district. The district was revitalized in 1903 with the discovery of zinc carbonate (smithsonite) ore and was especially active during the First World War, reaching its peak in 1916 (Loughlin and Koschmann, 1942). Intermittent mining continued for decades after, but the district never again achieved the production levels of its lead and zinc boom days (Gibbs, 1989).

Mineral collectors visiting the area have generally concentrated on the “big three”: The Kelly, Graphic and Juanita mines. While smithsonite has been the biggest draw, fine specimens of azurite, barite and aurichalcite have also been recovered. Exploration by intrepid collectors of other mines in the district has revealed a surprisingly wide variety of minerals, some of which are new to the district and to the state. Also, looking closely at the “big three” mines has revealed previously ignored or missed minerals of interest. Several of these will be featured in the presentation. We describe these minerals starting from the north end of the district and working to the south.

Anchor mine: This mine consists of a 170-foot decline with three levels. On the second level, wire silver associated with acanthite and galena has been found. The wires were up to one centimeter in length. At the bottom of the decline (adit level) wulfenite and cerussite crystals were recovered. The wulfenite crystals were up to 6mm and the largest cerussite crystal was 3cm (DeMark, 2003).

Hardscrabble mine: A strenuous hike reaches the mine, high on a ridge south of the Anchor mine. In June 2008, Rex Nelson and Jim Van Loan collected a blue aqua mineral encrusting rocks in one of the mine’s “glory holes”. XRD analysis confirmed the mineral to be chalcocalumite, a hydrated copper aluminum sulfate (Lueth, personal communication, 2014). This was the first confirmed occurrence of this mineral in the district and state. Smithsonite, hemimorphite and rosasite can be found on the dumps.

Graphic mine: Aurichalcite specimens are particularly noteworthy as well as azurite. In the 1970’s, many single crystals of azurite up to 2cm were screened from the dumps. Brian Huntsman collected cuprite crystals pseudomorphed by malachite in 1979. Other

minerals of note include rosasite spheres on white smithsonite, green "rice-grain" smithsonite crystals and sprays of malachite crystals. Anhydrous ilvaite with hedenbergite was found on the dumps in July 1992.

Kelly mine: While much more could be written about the fabulous smithsonite specimens from the Kelly mine, we shall resist! An unusual occurrence in the early 1970's of a botryoidal aqua colored mineral resembling smithsonite was determined to be a compact variety of aurichalcite. However, the attractive specimens, some sprinkled with small rice-grain smithsonite, were limited in number. In 1987, Chris Cowan found small yellow-green dipyrnid crystals of wulfenite on azurite on the 6th level. This was the first recorded occurrence of wulfenite in the district.

Germany mine: The main adit to the mine is now flooded, but reputedly, thin, tabular crystals of white to pink barite were common.

Juanita mine: Exceptional crystals of golden-brown barite up to 10cm occurred in large pockets in the upper levels. Plattnerite has been found on some of these crystals (first report from this district). Some of the smithsonite has a distinctive yellow-green color. Marvelous micro crystals have been collected from the dumps, including dundasite, azurite, cuprite, malachite after cuprite, and fraipontite. Allophane specimens, colored blue by copper, were once common on the dumps, and can still occasionally be found.

South Juanita mine: Adit level entry to the mine is no longer possible due to collapse and burial of the portal, however the vertical shaft is still open. Mark Massis discovered wonderful specimens of acicular cerussite on drusy azurite in a seam/pocket on the second level of the mine. Only a few specimens were recovered, but a large number of loose crystals up to 2cm were collected. Crinoid stems replaced by smithsonite have also been found.

Black Cloud mine: Recent investigations of this mine, which is accessed by several adits, has not revealed any minerals of interest to the collector. Rosasite has been collected from the Helen Cross group, adjacent to the Black Cloud mine.

Mistletoe mine: In May 1993, dipyrnid and tabular crystals of orange colored wulfenite to 4mm were collected from the mine that is located south and below the Black Cloud mine. Cerussite and jarosite crystals have also been found here.

Enterprise mine: The underground workings of the Enterprise are no longer accessible, but in November 1991, Will Moats collected white rice-grain smithsonite, and Mike Sanders collected finely crystallized aurichalcite from this location. Today, gray smithsonite, jarosite, azurite, aurichalcite coated by calcite, galena and sphalerite can be found on the dumps.

Young America mine: Further south and below the Enterprise mine, the Young America mine is accessible through an adit. Barite crystals line a large pocket (about five feet wide by six feet deep and two feet high). The crystals are thin, tabular, white and have a dull luster. Some occur on drusy quartz. Drusy azurite with malachite is found in another large pocket and Mike Sanders collected some fine specimens of clear rice-grain smithsonite on hematite-covered quartz back in 1998.

Linchburg mine: This mine was extensively explored by Chris DeWitt and one of the authors (RSD) in 1993 prior to its use as a test facility for storing munitions in underground mines. This was a joint venture between the U.S. Corps of Engineers and the Republic of Korea. The

development plan called for up to 32 blasts with the largest explosion using 2.5 tons of dynamite (Defensor Chiefton, June 29 & 30, 1993). Entry to the mine following these tests has not been possible to the authors' knowledge.

Two mineral species not previously reported / confirmed from New Mexico were found in the spring of 1993. Both these minerals, ktenasite and serpierite, are hydrated copper zinc sulfates. An additional unknown hydrated zinc carbonate sulfate remains to be identified. Quartz pseudomorphs after calcite and fluorite are noteworthy as is the occurrence of wulfenite (one of only three other locations in the district). An unusual sheave-type habit of ferruginous calcite is unique. Exceptional crystals of pyramidal cerussite were found on the dump in July, 1973 along with the district's first reported occurrence of ilvaite in October, 1980.

Iron Mask mine: A visit to the mine in July 2014 by the authors revealed only the stone foundations of structures, minor dumps and vertical shafts. Some minor barite was found on the dumps. According to the Albuquerque Journal, Sept 2, 2009, "A Magdalena man was found dead at the bottom of a 65-foot mine shaft (Iron Mask mine) in Patterson canyon..." We do not recommend rappelling down this shaft!

Undoubtedly there are other unusual mineral species still hidden in the many smaller mines, workings and prospects of the district. Decades of plant growth, erosion, deterioration of the old roads and mine workings, and steep rugged terrain make future mineral collecting both challenging and rewarding.

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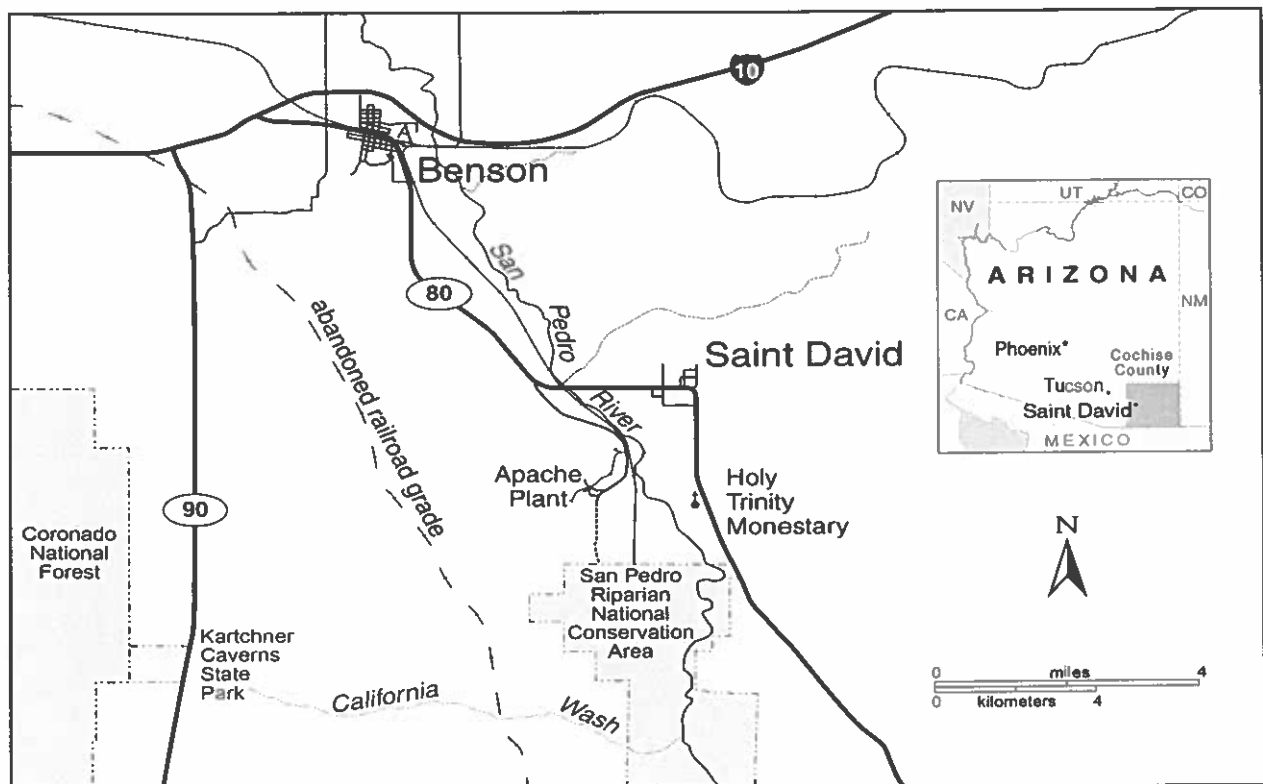
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Crystallized Mineral Deposits of the San Pedro River Basin, Arizona

Barbara L. Muntyan

The gypsum (selenite) deposits near the hamlet of St. David in Cochise County, Arizona, have been known to mineral collectors for more than fifty years. The collecting areas are located on the west side of the San Pedro river valley. This valley is a graben: a fault-block downed dropped valley, possibly associated with Basin and Range faulting. The river itself flows north out of Mexico and is one of the last free-flowing rivers in Arizona. Although it is a quiet stream for most of the year, the San Pedro can turn into a roaring torrent during the summer monsoons. The landscape in the collecting areas is high chaparral: sparse grasses, a few prickly pears, creosote bushes and occasional mesquite trees.

Pleistocene Ice Age erosion is found on many of the benches; some of them contain vertebrate fossils. The gypsum deposits cover a wide area. Although most collectors only know the area near St. David, crystals can be found in an area approximately 200 square miles.



Map by W. W. Besse

Gypsum is hydrated Calcium Sulfate: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. A monoclinic mineral, it is soft (only 2 on the Mohs Scale), and has a highly developed cleavage parallel to the C axis of the crystals. Gypsum crystals result from evaporation of saline waters. It is also soluble in water, which means that material exposed on the surface is etched, dull, and broken along cleavage planes.

Most field guides and most collectors are familiar only with small desert roses perhaps a half inch to 1 inch in diameter, and indeed there are literally thousands—probably millions—of them found on the surface or near-surface throughout the collecting areas. Most of the area is Arizona State Trust Land. Access to the familiar collecting sites is from the Apache Powder Road; a former dynamite manufacturing operation to supply dynamite to the mines in Bisbee, the plant's ten-story tower is a prominent landmark visible from much of the collecting spots.

The best crystals are found *in situ* in a number of washes that run down to the San Pedro River to the east. On the correct horizons in some of these washes, roses can reach 8 inches in diameter. In addition, depending on the wash, fine monoclinic crystals up to 6 inches in length, fishtail twins, hopped crystals, and crystals with movable bubbles have been found. Crystal color can be tan, red-brown, white, cream or clear, transparent selenite crystals.

Because of the potential for flash flooding during the summer monsoons, many of the washes are scoured or change channels. In addition, the ground is rock-hard bentonite and other clays, which are softened by the monsoons. Thus, optimum-collecting time is after the rains, but only after the trails dry out a bit to allow motor travel. Four-wheel drive and high clearance is definitely required.

Tales from the Crypt(omelane)

Virgil W. Lueth

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Manganese oxide mineralization is commonly associated with hydro- and geothermal systems throughout the western United States and Mexico. A number of manganese oxide phases are potassium-bearing and are amenable to age dating using $^{40}\text{Ar}/^{39}\text{Ar}$ techniques. This presentation will highlight the trials and tribulations of a series of studies on manganese oxide age dating along the Rio Grande rift of New Mexico. The results of these studies allow us to understand the complex interactions between basin and surface water waters, structures, lithology, and igneous activity as well as establish the duration of these geothermal systems.

Meet Manganese: Manganese, the 10th most abundant element in the earth's crust, forms over 250 different species. The large number potential valence states and coordination geometries is responsible for plethora of manganese minerals that comprises up to 6% of all known minerals. The weathering and hydrothermal environments contain the greatest diversity of manganese minerals.

What's Up with Wad? Wad is old miner's term for manganese oxide ore and significant amounts were mined from just south of Socorro in the Luis Lopez Manganese District. Mineralization was thought to be caused by a hydrothermal circulation cell centered about a buried intrusion. However, the direct dating of the manganese ores revealed that the mineralization is much younger than originally thought and the source was from elsewhere. The high precision of the dating demonstrates the potential for dating hydrothermal ore deposits.

The Perils of Pyrolusite: Taking the success of the Luis Lopez dating study and applying it to other manganese occurrences up and down the rift resulted in more questions than answers. Manganese oxide mineralization has been considered a pathfinder to sulfide ores for over 100 years. In mining districts where we have significant sulfide mineralization (e.g. Magdalena and Lake Valley); there are also manganese oxide ores nearby. The dating of the manganese minerals revealed them to be much younger than the sulfide ores and thus unrelated to each other.

The Trials of Mice and Man(ganite): A detailed study of the Argentiferous Manganese Oxide Mineralization (AMOM) at Santa Eulalia, Mexico was also attempted with the intent to prove the usefulness of manganese mineralization as a pathfinder to sulfide ore. Detailed geochronology was employed to date the sulfide mineralization at 26.6 Ma. Dating of the AMOM resulted in ages between 10 and 2 Ma. The anecdotal relationship of manganese mineralization to sulfide ore does not appear to hold at this location and other models of formation and timing have to be considered.

Making Sense of Psilomelane: The age and duration of geothermal systems along the Rio Grande rift was part of a recent research study sponsored by the Department of Energy. Manganese deposits in proximity to modern geothermal systems were studied in order to better ascertain the presence blind exploration targets. In all deposits studied, independent age constraints were present at all deposits that allowed for independent verification of manganese oxide geochronology. In all geothermal areas considered, manganese age dating provided accurate ages for determining the age and estimating the duration of the geothermal systems. Accordingly, geothermal exploration in areas of manganese mineralization appears justified if the age of the deposit is less than 10 million years.

Zeolites from Chili, Rio Arriba County, New Mexico

Patrick E. Haynes

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Nearly 30 years ago I collected some chabazite from a basalt road-cut south of Chili, New Mexico. I was not impressed with what I had found, rhombohedrons about 1 mm in size.

About 2 years ago a friend showed me a label and a specimen, an "apophyllite" from North of Española, New Mexico. One day, when we were on our way to the Harding Mine, we made a detour to Chili. We ended up finding much more than just "apophyllite."

The locality is about 1 mile SE of Chili on NM Highway 84 (milepost not noted), and West of the Rio Chama. On the East side of the road the outcrop is about 200 ft long, while on the higher West side it is about 250 ft long. There is only a little room for parking and vehicles on the roadway tend to speed, creating dangerous situations. When collecting on the higher West side, about 15 ft high, one has to be careful to not drop rocks onto the roadway. While working, a "spotter" is helpful for keeping loose rocks from the roadway. Caution is needed.

It is the author's experience that when calcite occurs with zeolites, as it does at Chili, the zeolites are usually Ca-dominant. Testing and identifications on the minerals was performed using Virgil Lueth's x-ray diffractometer. The x-ray diffractometer determines structure, not chemistry, so sometimes it may not give species-definitive results. With few exceptions the XRD results for zeolites were Ca-dominant. "Chabazite" and "phillipsite" had mixed results. There was 1 identification of chabazite-Na, which may be erroneous. Phillipsite had results of "phillipsite-Ca," "phillipsite-K," and "phillipsite-Na."

The basalt is approximately 9.8 myo (potassium/argon dating, verbal communication with Maureen Wilkes) and is a member of the middle to upper Miocene Lobato Formation (Koning, 2005). The mineralogy is similar on both sides of the roadway. The following minerals were identified:

- **Analcime** ($\text{NaAlSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$) is a very common zeolite, but at Chili very few were found. The crystals are tiny, < 1 mm, colorless, transparent trapezohedrons, and it was visually identified.
- **Apophyllite** species undetermined/untested, was found in perhaps just 1 specimen. It is a tetragonal-appearing, colorless, transparent prism about 0.7 mm in size.
- **Baryte** (BaSO_4) as opaque white crystals and aggregates to 1 mm in size. Less commonly colorless transparent crystals are observed.
- **Calcite** (CaCO_3) is common as rhombohedrons (to 3 mm), flat wafers (to 8 mm), scalenohedrons (to 5 mm that sometimes encase green nontronite spheres), and very tiny crystals/aggregates that resemble erionite, a usually fine-grained zeolite. Coarse calcite was visually identified, while the fine-grained material and rhombohedrons effervesced in HCl. Gemmy individual rhombohedrons resemble chabazite and need to be verified with HCl. These rhombohedrons can be elongated on one axis, which is not seen in chabazite-Ca rhombohedrons.
- **Chabazite-(Ca)**, $\text{Ca}_2(\text{Al}_4\text{Si}_8\text{O}_{24}) \cdot 13\text{H}_2\text{O}$, is the most common mineral, forming colorless transparent to translucent rhombohedrons to 5 mm, but usually much smaller. Simple penetration twins are common. Not often seen were crystals attaching to each other to form tiny, gemmy, irregular bridges across vug interiors. On the East side a few specimens of variety "phacolite" were found. The phacolite crystals are stubby flat hexagonally-shaped trillings that were generally opaque, and up to 4 mm in size.
- **Covellite** (CuS) was visually identified on just 3 specimens. They are thin wafers to < 1 mm with crude hexagonal outlines and were oxidized with green "halos" of a secondary mineral at their bases, hence the guess of "covellite."

- **Erionite-Ca**, $\text{Ca}_4\text{K}_2(\text{Al}_{10}\text{Si}_{26}\text{O}_{72})\cdot 30\text{H}_2\text{O}$, was verified in a specimen in association with lévyne-Ca. From other localities it is not uncommon for erionite to coat the outside of lévyne crystals, forming thin "sandwiches". Apparently this is no different, and it explains the layering seen in some of the Chili lévyne crystals. No erionite was identified that was in free-standing crystals. Specimens with particularly tiny crystals turned out to be calcite. I expect testing of more specimens to reveal otherwise. Erionite-Ca is very tiny, has a silky luster and grows perpendicular to the surface of the lévyne-Ca crystals.
- **Goethite**, $\alpha\text{-Fe}^{3+}\text{O}(\text{OH})$, was visually identified. It forms branching dendrites that can sometimes protrude from the crystal surface they are grow upon.
- **Harmotome**, $\text{Ba}_2(\text{NaKCa}_{0.5})(\text{Al}_5\text{Si}_{11}\text{O}_{32})\cdot 12\text{H}_2\text{O}$, forms blocky prisms to 3 or 4 mm that can be colorless to white, with the larger crystals tending to be white and more opaque. The larger crystals are sometimes etched. The etching causes thin plates to remain, which reveals differences in crystallization or, perhaps, chemistry. Harmotome and phillipsite are always twinned. What appears to be single crystals are actually twins composed of 4 crystals. These are called Morvenite twins. Harmotome from Chili can also form Marburg twins, which are composed of 2 Morvenite twins. These can be easily confused with Perier twins, but the striations are different. Some of the harmotome crystals can have "side panels", which are probably polysynthetic twinning. Harmotome aggregates in parallel growth can result in curved 001 / top faces, similar to what is seen with stellerite and stilbite.
- **Hematite**, $\alpha\text{-Fe}_2\text{O}_3$, is found as small metallic red aggregates to 1.5 mm. It was visually identified.
- **Lévyne-Ca** $\text{Ca}_3(\text{Si}_{12}\text{Al}_6)\text{O}_{36}\cdot 18\text{H}_2\text{O}$, forms attractive, transparent to opaque, hexagonal plates to 2.5 mm that can be layered. This layering is generally due to a coating of erionite-Ca, which is a common association, and varies in opacity and color. Lévyne-Ca is not common at Chili. Colorless, transparent crystals, without erionite-Ca, tend to be very brittle. The erionite-Ca coating makes the lévyne-Ca crystals more resistant to shock, weathering, etc.
- **Nontronite** $\text{Na}_{0.3}\text{Fe}_2^{3+}(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2\cdot n\text{H}_2\text{O}$, is found as tiny green spheres encased in calcite. This is a visual identification. Nontronite from Sugar Grove, West Virginia displays an interesting characteristic: when exposed to air the green nontronite starts losing water or oxidizing, and its color darkens, to gray or black. This change occurs within a few hours. Once exposed, even quickly placing nontronite into water will not stop the dehydration, or oxidation, process. At Chili the clay minerals, nontronite and saponite, can form ropey structures, vug coatings and spheres. These are usually brown-colored, representing a mixture of saponite and nontronite. Less commonly these ropey structures are dark gray-black nontronite.
- **Phillipsite-Ca?** $(\text{Ca}_{0.5}\text{Na},\text{K})_9\{\text{Al}_9\text{Si}_{27}\text{O}_{72}\}\cdot 24\text{H}_2\text{O}$, is common as white to colorless prisms. They are smaller than the harmotome crystals, and are composed of Morvenite twins that can very rarely combine to form Stemple twins. Only 3 damaged Stemple twins have been observed. They are rare. The XRD results were variable, suggesting Ca, K and Na phillipsites. It is doubtful that all occur here. The author's best guess is for "phillipsite-Ca".
- **Pyroxene**, species undetermined, is rarely found as euhedral crystals. Crystals are opaque, greenish-brown prisms that are frequently coated with calcite or other minerals.
- **Saponite**, $(\text{Ca},\text{Na})_{0.3}(\text{Mg},\text{Fe}^{2+})_3(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2\cdot 4\text{H}_2\text{O}$, forms common masses of white clay. Relatively long ropey "worms" are common, but are usually mixed with nontronite, giving them a brown color. Saponite can be the last mineral to form. Both are nontronite and saponite are smectite group minerals.

- **Thomsonite-Ca**, $\text{Ca}_2\text{Na}[\text{Al}_5\text{Si}_5\text{O}_{20}]6\text{H}_2\text{O}$, is common. It forms spheres and botryoidal coatings in cavities. Spheres can reach at least 4 mm. Under high magnification one can rarely see tiny individual laths. These crystals tend to stack against each other on the 001 face. It is one of the last minerals to form, so it can coat other minerals. It is interesting when thomsonite-Ca coats elongated calcite scalenohedrons and is subsequently broken, which reveals crystals radiating about a hexagonal calcite core.

By The Way- the "apophyllite" that started the investigation is chabazite.

Acknowledgements

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The California Blue Mine: Aquamarine discovery, specimen recovery and geochemistry in the Mojave Desert

Ian Merkel

The California Blue mine is a recently discovered beryllium-fluorine miarolitic pegmatitic granite intrusion located in the Mojave Desert, California. The claim is located in San Bernardino County near Yucca Valley. The dike is fairly simple, being composed predominantly of quartz, perthite and albite. There is minor light and dark mica, especially associated with the cavities. The beryl crystals occur in close association with the cavities, similar to the micas. Gem aquamarine is found within the cavities growing from their walls, perched on terminated quartz or feldspar crystals or as euhedral "floater" crystals. Replacement gem crystals are also found outside of the cavities as irregular etched looking crystals after earlier heavily included crystals.

The miarolitic cavities occur centrally within the intrusion as two general types: quartz, perthite and albite and quartz, 2 feldspar, white mica, aquamarine +/- topaz. The bimodal nature of pockets is favored by the morphology of the dike, which is a tabular body with meter scale sub-verticle apophyses. Cavity formed aquamarine occurs within the tabular portion of the dike only. The apophyses contain cavities with quartz, microcline and albite, but no aquamarine.

The claim was discovered in 2006 and mined by hand until 2010 when a partnership was formed to mine for aquamarine using large machinery. Currently the claim is being worked intermittently in an open pit style mining and continued specimen production is expected.

New Finds from the Michigan Copper Country

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Mineral collecting in the Michigan Copper Country continues but at a slower pace than a few years ago. New, small finds are still being made but the slower pace is due to a number of reasons. The main reason is that the digging of mine dumps (poor rock piles) for specimens by younger people, that I called "mineral seekers," has almost come to a stand still. This is due to the fact that they could not collect enough specimens for resale to keep the bill collectors at bay. On the uphill side is that many of the mine dumps that were once a landmark in the Copper Country are slowly disappearing. This is due to increased road construction and repair along with new haul roads for an expanded logging industry. The good side is that many specimens are recovered during the crushing of their mine dump, but on the down side, once the dump is crushed it is gone for good.

But it is not that gloomy yet, there were a number of isolated finds from micro to cabinet size copper and silver specimens. A number of beautiful datolite nodules have also been found in the last few years. One of the most exciting finds has been the recovery of exotic and rare micro crystals of manganese silicates from the long-abandoned Manganese mine Near Copper Harbor. Beautiful micro crystals of macfallite (type locality), orientite, and tangeite along with the common manganese oxides were recovered from logging when the mine dump was used for logging road repair.

Da Copper Country is home to the Yoopers and is a place where you can come and leave your cell phone and computer behind and enjoy like in another world.

The Lesser-Known Minerals of the Pikes Peak Batholith

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The best known minerals of the Pikes Peak batholith are, of course, those that occur in the miarolitic pegmatites—pegmatites with open cavities “pockets”, which may contain free-growing, near-euhedral crystals. The major minerals include microcline (and its variety, amazonite), quartz (especially smoky quartz), and albite (often as the lamellar variety, cleavelandite); with relatively common accessory minerals that include biotite, fluorite, goethite, hematite, topaz, zinnwaldite, and zircon. But a wide variety of other minerals also occur; some well-known, some not; some sporadically distributed throughout the entire batholith, and some localized to one or a few districts within it.

The Pikes Peak batholith covers about 1,200 mi² (3,100 km²) of Colorado—about 1.15% of the total area of the state—and is just over 1 billion years old (1.08 Ga). Structures within the Pikes Peak Granite forming the main mass of the batholith show evidence of three main intrusive centers, from north to south the Buffalo Park, Lost Park, and Pikes Peak centers. Within and around the edges of the batholith, smaller, late stage plutons occur and can be divided into either sodic or potassic types; it is in or around these late plutons that most of the pegmatites occur. The igneous rocks of these late intrusive centers are not limited to granite but include more mafic and quartz-poor rock types such as syenite, monzonite, granodiorite, diorite, and gabbro. The mineral-bearing localities in the batholith can be grouped into several genetic and geographic types:

Miarolitic pegmatites: These are concentrated around the late intrusive centers that include Lake George, West Creek, Sugarloaf Peak, Mount Rosa, Redskin Stock, Tarryall, a large unnamed body in the Rampart Range, and a number of late-stage intrusions around Pikes Peak itself. The best-known pegmatite localities—hunted mainly for their smoky quartz, amazonite, and topaz—include those around Lake George/Crystal Peak, Tarryall Mountains/Pilot Peak, Harris Park, Wigwam Creek, Devils Head, Stove Mountain, Sentinel Rock and Specimen Rock, Cameron Cone/Crystal Park, and Glen Cove. Some of the more notable, unusual minerals—many of which contain barium, beryllium, and the rare earth elements—found in these pegmatites include barite, barylite (BaBe₂Si₂O₇), bastnäsite, bertrandite, beryl, cassiterite, columbite, genthelvite (Zn₈Be₆Si₆O₂₄S₂), milarite (KCa₂AlBe₂Si₁₂O₃₀·0.5H₂O), and phenakite. Carbonate minerals (calcite, rhodochrosite, siderite) also occur, mostly pseudomorphed by goethite or hematite; it is usually impossible to tell what the original rhombohedral mineral was.

Mount Rosa–St. Peters Dome–Stove Mountain area: This area contains pegmatites in and around several bodies of alkali- and fluorine-rich granites, including the Mount Rosa Granite, Windy Point Granite, and a fayalite granite. Just west of Colorado Springs, the area is usually accessed via the Gold Camp Road. Distinctive minerals from this area include an abundance of the black, sodic amphibole, riebeckite; the golden-brown, mica-like chain silicate mineral, astrophyllite; zircon, pyrochlore, and rare-earth minerals including bastnäsite-(Ce) and fluocerite-(Ce). Fayalite, the iron end-member of the olivine mineral group, is said to have been found both here and at Crystal Park, sometimes as remarkably large cleavage masses “to 10 pounds”, containing inclusions of a related olivine-group mineral, laihunite. Concentrations of uncommon fluoride minerals, including cryolite, elpasolite, gearksutite, pachnolite, prosopite, ralstonite, thomsenolite, and weberite, are found near the “Eureka Tunnel”, mined for cryolite and also a source of sometimes-gemmy zircon crystals. Fluorite-quartz vein deposits also occur in the St. Peters Dome area, and were once mined for fluorite. Classic papers on the Mount Rosa area are those by Gross and Heinrich (1965, 1966a,b), and a recent excellent paper is that by Zito and Hanson (2014) about Stove Mountain. As Zito and Hanson point out, two distinct types of

pegmatites occur in the area; miarolitic cavity-type pegmatites, similar to those in the rest of the Pikes Peak area, and sodic, Mount Rosa-type pegmatites, typically containing riebeckite. Galena plus several of its alteration products, including wulfenite, have been reported from the pegmatites here.

Badger Flats—Boomer mine—Lake George beryllium area: This district is unique within the batholith as it consists of greisen-type mineralization, a type of fluorine- and beryllium-rich hydrothermal alteration associated with the margins and tops of igneous intrusions. Beryllium minerals here include beryl, bertrandite, euclase, and phenakite, associated with fluorite, topaz, cassiterite, scheelite, and wolframite. Metal sulfides also occur, including arsenopyrite, chalcopyrite, galena, molybdenite, and sphalerite. These deposits, northwest of Lake George, are at the edge of the Pikes Peak batholith, along the margin of the Redskin Stock, both within the stock and in the older metamorphic country rock (Hawley 1963, 1969).

South Platte pegmatite district: This district includes a number of large pegmatite bodies in the form of cylindrical, vertical pipes typically between about 50 to 200 ft in diameter within the host Pikes Peak Granite. The largest, the Oregon No. 3, is 600 x 280 ft in horizontal cross-section. Quite different from the amazonite-smoky quartz miarolitic pegmatites, they generally lack any open cavities, are concentrically zoned with core, intermediate, and wall or border zones, and often contain zones of secondary hydrothermal alteration. They tend to be rich in rare earth and uranium-thorium minerals and fluorite, and are classic examples of the NYF (niobium-yttrium-fluorine) type of pegmatite. Much of the fluorite is unusually rich in yttrium and the other rare-earth elements, is opaque rather than transparent, and has distinctive fluorescence colors.

Simmons and Heinrich (1980) provide an excellent description of the district; the book describes and shows internal maps of 32 of the largest of the pegmatites, but at least 50 total are known.

Some of the "best known" include the Little Patsy, Luster group, Oregon group, Seerie, Snowflake, and White Cloud pegmatites. They are located mostly in the northern part of the batholith, east of Buffalo Creek, but outliers exist west of Wellington Lake (McGuire pegmatite) and near Divide (Black Cloud pegmatite) and Lake George (Teller pegmatite).

William B. "Skip" Simmons of the University of New Orleans and his graduate students and colleagues have produced a considerable series of research papers on the mineralogy and geochemistry of these pegmatites, which has included the discovery of the new mineral species, samarskite-(Yb). Characteristic minerals include fluorite, allanite-(Ce), bastnäsite-(Ce), euxenite-(Y), fergusonite-(Y), fluocerite-(Ce), gadolinite-(Ce), monazite-(Ce), samarskite-(Y), synchysite-(Y), thalenite-(Y), thorite, uraninite, xenotime-(Y), yttriotantalite-(Y), and zircon. Much of the zircon is the opaque, metamict, highly radioactive variety, "cyrtolite".

An exact and accurate count of the total number of minerals that occur within the entire Pikes Peak batholith is difficult to attain because of the number of unconfirmed or semi-confirmed older reports; the complexity of many of the mineral groups (including the micas and the rare-earth minerals) and changes in their nomenclature over the years; differences in the way individual species vs. families or groups of minerals have been referred to; and the number of separate localities and districts or subdistricts within the batholith, and whether some localities along the margins should be counted as part of the batholith. All told, there appear to be about 128 valid reported mineral species from the Pikes Peak batholith. These include 4 type minerals: elpasolite (St. Peters Dome), murataite-(Y) (St. Peters Dome), samarskite-(Yb) (Little Patsy pegmatite, South Platte district), and siderophyllite (from "Pikes Peak", collected by A.E. Foote circa 1880).

Detailed descriptions of the minerals of the batholith can be found in Muntyan and Muntyan (1985), Eckel (1997), and Raines (2010). Good accounts of the geology of the whole batholith include Smith et al. (1999), Wobus and Anderson (1978), and Wobus (2001).

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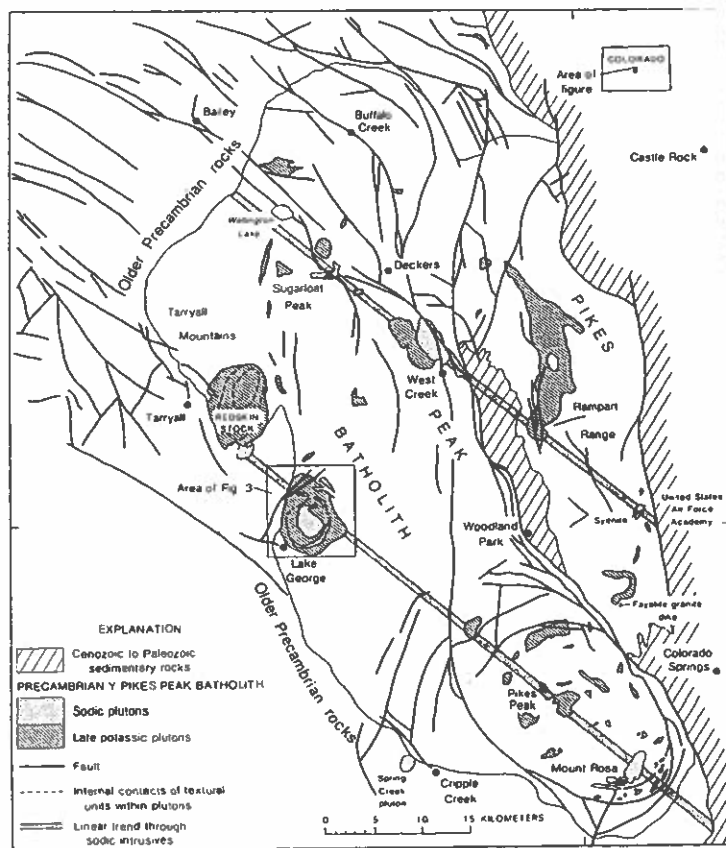
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Accompanying map: From Wobus and Anderson (1978), figure 1, p. 82, with acknowledgements to U.S. Geological Survey.



History of the New Mexico Bureau of Mines & Mineral Resources—Mineral Museum

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A little over 115 years ago the New Mexico Territorial Legislature established the New Mexico School of Mines (now New Mexico Institute of Mining and Technology). The charge to the school was to provide for higher education in the earth and related sciences. The school's board of trustees (now "Regents") was assigned the responsibility of prescribing the various courses of study, of equipping laboratories and classrooms in a manner appropriate for instruction, and of assembling (for educational purposes) a geological and mineralogical cabinet. President Fayette A. Jones carefully selected and acquired many specimens during his travels for the fledgling school and to him must go the credit for creating, in 1899, the first collection. With little or no fanfare, Socorro's first museum of any kind was born. Nurtured by dozens of earth scientists over the years, the collection has steadily evolved through prosperity and depression, fame and tragedy, to a superb assemblage of more than 10,000 pieces today. The museum is maintained by the New Mexico Bureau of Mines and Mineral Resources, and its staff routinely draws on this mineralogical legacy to participate in educational events and gem and mineral shows throughout New Mexico and the United States. In addition, the collection provides ongoing aesthetic, scientific, and research benefits for all of society.

In the early 2000s, the Bureau of Geology and New Mexico Tech began planning for a new building for the New Mexico Bureau of Geology & Mineral Resources. The wood frame building currently occupied was cobbled together over several years and has many roof leaks, inadequate bathroom facilities, and is not ADA compliant. We also have 85 years' worth of irreplaceable archival materials which are at risk. In addition, our staff, laboratories, and our world-class Mineral Museum are in five different buildings scattered across the New Mexico Tech campus.

A site for the new building was selected between MSEC, the building that houses the Earth and Environmental Science Department, and the Skeen Library. The new 53,000 square-foot LEED certified building will include new public spaces that will allow much easier access to our Mineral Museum, the Publications Office, the Geologic Information Center (which houses our library and archival materials), and our Subsurface Data Library (which houses our petroleum records). The building will also house our analytical laboratories. Funding for the new building will be provided, in part, from revenues generated by General Obligation Bond C for higher education capital improvement projects, which was approved by voters during the November 2012 election.

20 Years After: A Brief Update on the Study of Telluride Minerals & Deposits

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Much research has been conducted on telluride deposits (those containing the element Te), applying new tools and insights, in the twenty years since the completion of my doctoral studies (Geller, 1993). Te has become a more sought-after commodity, since its application in modern photovoltaic (PV) cells, thermoelectric devices (in military and medical applications), certain memory chips, and guided missiles (George, 2013a). Twenty years ago, Te was only employed in industrial applications, such as metal alloying, rubber vulcanization, and in glass/ceramic pigments, but continues to be used in these industries today (George, 2013b). It is likely that demand for Te will grow, as technology advances, catalyzing better understanding of telluride mineral distribution, exploration for more Te deposits, and improved methods of Te extraction. All Te produced until recently, came as a by-product from processing sulfide ores. Only one deposit in China has recently been mined specifically for its Te.

Although Te remains one of the rarest elements on earth, the IMA has approved 85 unoxidized telluride minerals (those lacking O in their formulae). These are found in diverse geologic environments, generally in the trigonal crystal system. Despite similar chemical behavior with Se, only about 9% of worldwide Te deposits have any reported Se species (Ralph, 2014). Literature reported correlations of tellurides with V minerals are also over-exaggerated and run only at about 6% (Ibid). Nineteen elements have been found to bond with Te in nature, the most common being Bi, S, and Ag. There is no known natural Cd telluride phase. Ralph (2014) reports that the six most typically occurring tellurides on earth (referred to in this talk as 'the big six') in order of occurrences are: hessite, tetradymite, altaite, petzite, sylvanite, and calaverite, which strongly corroborates data presented in my dissertation, but not entirely in that order.

Tellurides have been reported on six continents. From data in Ralph (2014), many countries now report tellurides that did not in 1993. China has seen the largest increase in the number of telluride deposits. In 1993, the Boulder Telluride Belt (BTB) in Colorado had the largest diversity of telluride minerals in the geologic literature. Today, eight districts on four continents eclipse the BTB in this distinction (Figure 1).

The countries with the most telluride occurrences as reported by Ralph (2014) are: the United States, China, Canada, and Russia, which correlates well with their overall land size. Colorado had the most telluride occurrences per square kilometer of any region in the U.S. in 1993 (Geller, 1993). Extrapolating from data presented by Ralph (2014), Colorado presently has the most telluride occurrences per square kilometer of any known region in the world, statistically.

In the future, more tellurides will be discovered, from more worldwide occurrences, from type localities and occurrences with extremely diverse telluride mineralogy, but they will remain rare, occur in trace amounts, and probably possess similarities to "typical" telluride chemistry (the predominance of Bi, S, Ag, Pb, Pd, Cu, Au, etc.). The 'big six' will continue to dominate world occurrences. This study corroborates the value of mineral databases in mineral research.

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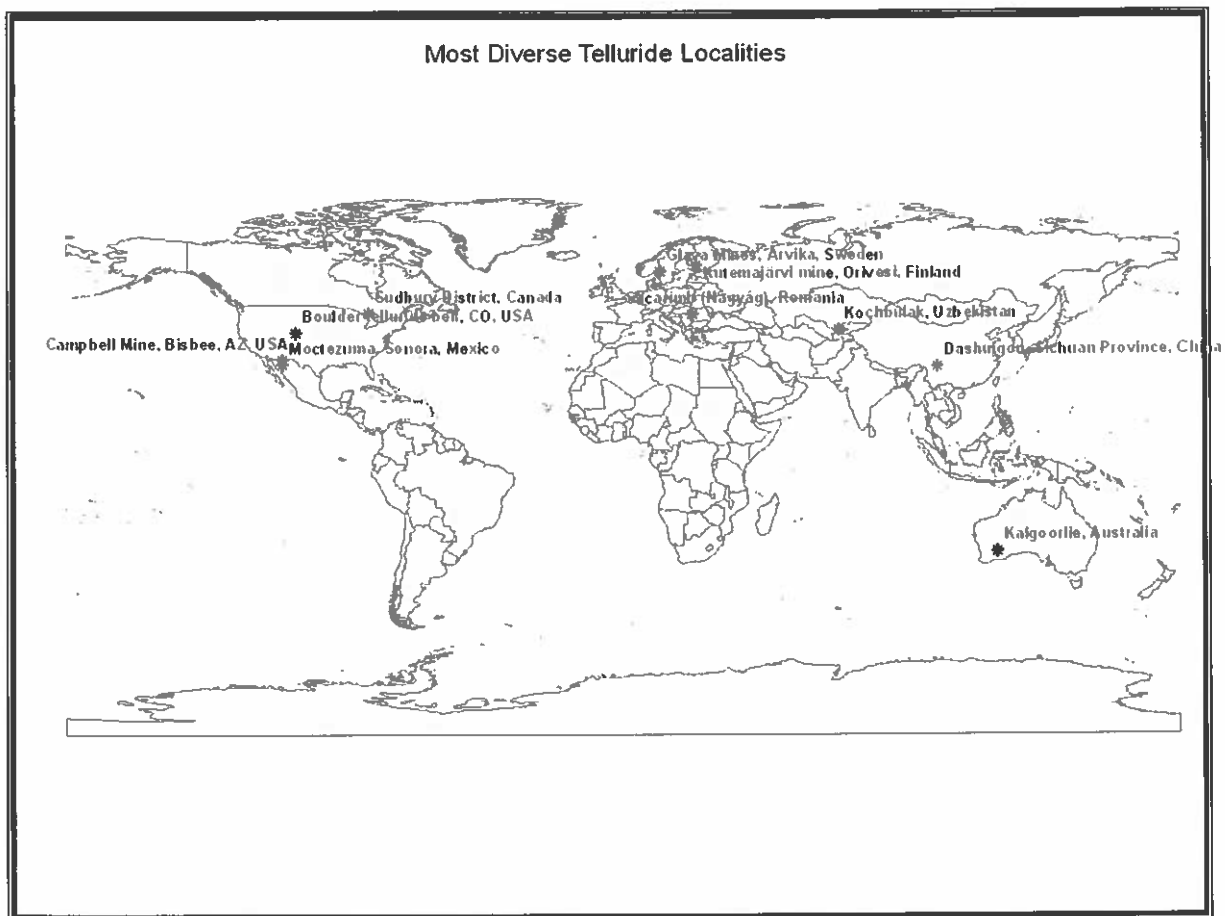


Figure 1—Worldwide telluride deposits with greatest telluride diversity, plus the world's only primary telluride producing district in China.

Trout Creek Pass Pegmatite District, Chaffee County, Colorado

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The Trout Creek Pass Pegmatite District consists of numerous, zoned granitic pegmatites that intrude the 1.7 Ga Denny Creek Granodiorite and which are located east and southeast of the town of Buena Vista, Chaffee County, Colorado. Although mined chiefly for feldspar, the pegmatites are enriched in niobium (Nb), tantalum (Ta), titanium (Ti), and rare earth elements (REE). This presentation will focus on four well-known deposits in the district that have been popular collecting sites: the Clora May, Yard, Crystal No. 8 (also known as the Luella), and the Tie Gulch pegmatites. The Clora May, Yard, and Crystal No. 8 are located on public land within the San Isabel National Forest; the Tie Gulch pegmatite appears to lie on private land north of, but not within, the Tie Gulch drainage. A high clearance vehicle is needed to reach the Yard. The other deposits are accessed via good, but unpaved roads.

Each of the four pegmatites exhibits a wall zone dominated by quartz and microcline, often in graphic intergrowth. Magnetite is also present in small amounts. Quartz and microcline comprise the core of each pegmatite as individual masses of giant crystal size, commonly 1-5 meters across. "Books" of biotite, 0.3 meters or more, occur along the core margins. Intermediate zones, or replacement zones, occur locally as small pods adjacent to the core and contain albite, \pm muscovite, and accessory minerals such as fluorite, allanite-Ce, bismutite, gadolinite-Y (very rare), xenotime-Y (very rare), monazite-Ce, polycrase-Y, and aeschynite-Y. Rose quartz of light pink color occurs at the Clora May and reportedly at the Crystal No. 8, and is present in trace amounts at the Tie Gulch pegmatite.

REE-Nb-Ta oxides are the main attraction for mineral collectors, however, chemical analysis is needed to identify specific mineral species, and even with modern methods, identification is difficult. In the past, most specimens from the Trout Creek Pegmatite District were labeled as "euxenite". Hanson and others (1992) report from microprobe analyses and recrystallization studies that specimens of black, metamict samples from the Yard and Crystal No. 8 pegmatites are most likely polycrase-Y, while visibly similar samples from the Clora May appear to be aeschynite-Y (they did not suggest an identity for REE-Nb-Ta oxides that occur at Tie Gulch). Most collectors label their specimens of REE-Nb-Ta oxides from these localities accordingly.

Although all four pegmatites have been popular collecting sites for decades, with the exception of the Crystal No. 8, recent visits by the authors have been productive. For example, a 10 cm crystal aggregate of polycrase-Y was recovered from the Yard, as well as smaller clusters and individual crystals and many broken pieces. Several years ago, a Colorado collector removed literally a wheelbarrow load of aeschynite-Y from the Clora May, which included many crystals and crystal groups, and perhaps the largest single, well formed aeschynite crystal ever recovered from a Colorado pegmatite. Additionally, dozens of 1-2 cm crystals of polycrase-Y(?) were screened from the dump at Tie Gulch by another Colorado collector. Even the Crystal No. 8 likely has something left if one is willing to dig into hard rock, as radioactive targets were noted this past summer, but not investigated.

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Collecting New Mexico in the 1950's and 1960's—MexTex and Blanchard Mines, Hansonburg Mining District

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Our introduction to the Hansonburg Mining District was in the late 1950s, when we were exploring near San Antonio south of Socorro. We noticed some large rocks near a railroad loading dock. Being curious, we checked them out and found they contained galena, barite and quartz. We then noticed more of these ore samples near the turn off from the main highway to the loading dock. Our interest was now piqued, so we decided to follow the trail of ore specimens to look for the source. This led us to the turnoff at Bingham on a dirt road heading south which eventually led us to the MexTex mine. This was the beginning of many trips to this mining district and many collecting adventures as well. At this time the MexTex mine consisted of a large underground stope opening on the west side of a cliff overlooking a flat area below where the mine buildings stood. The main road to the mine forked with one branch leading to the stope above and the other to the mine buildings below. There was a chain across the road to the stope. With some experimentation we found that if two people held up both sides of chain we could just barely drive under it, saving us a long walk. About 200 feet inside the stope was a pillar covered with linarite, malachite, fluorite, barite and quartz. Off to the right was a small area that contained quartz and fluorite covered with shiny, small black crystals. These later turned out to be murdochite ($\text{PbCu}_{62}\text{O}_{8-x}\text{Cl,Br}_2$).

The MexTex Mine provided us with many specimens and inspired us to return many times. On one visit Bill Atkinson and I brought along our wives and two graduate students from Nepal, Biswa Man Pradhan and Yogendra Lal Singh. They were studying geology at UNM and were very interested to go with us as they had never gone mineral collecting before. We left after classes and arrived just before sunset. Upon arrival at the mine we posted my wife, Colleen, outside on the dump and told her to warn us if anybody came towards the mine. All went well until suddenly she came running in shouting that someone was coming! We immediately started grabbing our tools and packs and running towards our car. The Nepalese exchange students, not understanding what was going on, were understandably upset. As we emerged from the mine we looked down and saw lights from a car coming up the approach to the lower portion of the mine, where the buildings were. We threw our equipment into the trunk and climbed into the car. By this time it was totally dark and, not wanting to be seen or heard, we decided to make our way down with the engine and lights off. The two Nepalese students in the back seat were not only bewildered, but probably in fear of their lives. We probably had failed to mention this was a clandestine operation. We slipped under the chain and started out on the dirt access road. We were about a mile down the road when we saw the lights go on on the other car, which then started moving down their branch of the road. No time to be prudent, we accelerated as fast as we could go (the chase was on! -?). We sped past the fork in the road and raced for the main road. We made it to the pavement at least quarter of a mile ahead of the other car and floor-boarded the accelerator with the other vehicle behind us. We raced down the road as fast as we could, but the car behind us was gaining on us. We were debating what we should do and what they might do to do when they caught up with us. They drew closer and then passed us and disappeared down the road. Needless to say the Nepalese students were reluctant to go on any more collecting trips with us!

The other mine in the district that we visited was the Blanchard or Portales. Although it had mainly the same mineralogy as the MexTex, this mine also had a significant suite of other minerals. The most common was brochantite, occurring as fine light blue prismatic crystals filling vugs and fissures. At the time we were collecting this material was thought to be a new mineral, "blanchardite." Later studies proved it to be brochantite. One of the more interesting aspects of collecting at the Blanchard mine was dealing with Mrs. Blanchard. The Blanchard

family had owned the mine for many years (*For a detailed history and geology of the Hansonburg Mining District see Rakovan and Parley, 2009*). Mrs. Blanchard lived in a small cabin along the edge of the access road. We always stopped to chat with her and get permission to collect. Although she often greeted us carrying a shotgun she was always pleasant and allowed us to collect. The only drawback was that when we returned from collecting she would want to see what we had found. We would have to unpack our specimens to show her what we had found. We would have to unpack our specimens to show her and often she would pick out several that she particularly liked. These she would set aside next to her cabin. Unfortunately, she never tried to preserve these specimens and the next time we visited, there they would be, left out in the weather. Many times I took my wife with me and she often remained behind talking with Mrs. Blanchard while we collected. One time, while my wife was talking with her, a cat came around the corner of the house. The cat could barely hold its head up because it had a large cow-bell tied around its neck. My wife exclaimed, "Mrs. Blanchard, what happened to your cat?" Mrs. Blanchard replied, "Well, the cat was catching birds, so I had to 'bell the cat.' "

The 1950s and 1960s were magical times to be collecting. Mineral specimens were plentiful and we rarely saw other collectors on our trips. We only took what interested us for our own collections and rarely collected in quantity.

References

Rakovan, J. and Parley, F., 2009, *Mineralization of the Hansonburg Mining District, Bingham, New Mexico*, New Mexico Geological Society Guidebook, 60th Field Conference, Geology of the Chupadera Mesa Region, p. 387-398.

**Mine Reclamation and Mineral Specimen Recovery Operation,
July 2013, Blanchard Mine,
Socorro County, New Mexico**

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In July 2013, Blanchard mine claim owners Ray DeMark, Mike Sanders, and Brian Huntsman joined forces with Arizona-based mineral specimen miners and mineral dealers Mark Kielbaso and Bruce Barlow for a three week mine reclamation and mineral specimen recovery project at the Blanchard mine.

The Blanchard mine is located approximately 5 miles south of Bingham, in Socorro County, New Mexico. The mine is located on the west side of the Sierra Oscura mountain range and is surrounded on three sides by the White Sands Missile Range. The mine is located on Federal (U.S. Department of the Interior, Bureau of Land Management [BLM]) property. Therefore, prior to the start of operations mining permits were obtained both from the BLM, and from the State of New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD). MMD regulates provisions and requirements specified in the New Mexico Mining Act. Permit requirements included paying a permit application fee to MMD, posting a land reclamation bond to the BLM, and backfilling and restoring the project area to pre-mining conditions to the degree possible at the end of the operation.

The goal of this project was two-fold:

- 1) A Blanchard mine underground working known as the Portales tunnel was opened to the surface and was actively caving in. It was considered to be very hazardous, and posed a substantial safety and health threat to unauthorized persons who chose to enter the underground workings. It was therefore determined that the Portales tunnel portal needed to be sealed to prevent unauthorized entry into the underground workings.
- 2) Previous specimen mining work indicated that the potential for high-quality fluorite and galena on quartz mineral specimens existed in and around the Portales tunnel portal, but the formerly productive ground had become buried by the collapsed rock and sloughed material that had collected at the portal entrance. It was therefore concluded that this sloughed material and overburden would be temporarily removed to uncover potentially productive ground, mineral specimens if found would then be recovered, and finally the Portales tunnel portal would be backfilled and sealed with sloughed material and previously-mined waste rock in the immediate vicinity of the portal.

Operations commenced in early July 2013, and were completed approximately three weeks later. Equipment utilized for the operation included two track-mounted excavators (trackhoes), portable rock saws and drills, mining hand tools, specimen packaging materials, etc. One of the trackhoes was equipped with a bucket (hoe), and the second machine was equipped with a large hydraulic rock-breaking hammer, utilized for removing fractured rock and for breaking up large slabs, etc.

This was a successful and enjoyable operation. Mine closure and reclamation costs were recovered as part of the potential value of mineral specimens that were obtained. The three mining claim owners and the two Arizona mining partners also obtained multiple boxes of high-quality mineral specimens that were "highgraded" from the general specimen material produced during the operation. The Portales underground workings were also closed and backfilled which eliminated that hazard and potential liability at the property.

Equipment problems were minimal, and no accidents or injuries to project personnel occurred during the operation. Project participants were also treated to some spectacular July monsoon rainstorms that passed through the area during the project, and impromptu card games during the day and evening also helped pass the time!

The talk will focus on the various techniques and equipment utilized to extract mineral specimens, and complete the mine reclamation and land restoration work at the property. A representative sample of some of the high-quality mineral specimens recovered during the operation will also be shown.

Mining in the Ancient World—An Introduction to Methods and Technology

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Traditionally, the ages of ancient history are divided based upon the material used for tools and weapons resulting in the Stone Ages (Palaeolithic, Mesolithic, and Neolithic), Chalcolithic (Copper Age), Bronze Age, and Iron Age.

Even in the earliest of these time periods, the Palaeolithic, mining was actively undertaken. These early mines were often surface trenches or shallow bell pits used to extract chert for tools or minerals for making pigments. Mining tools used during this time were mostly hammerstones and horn picks, which were only effective in working softer sedimentary rocks. By the Neolithic, underground mines had grown in size, but were still shallow. Stone, bone, and antler tools were also still used. The Chalcolithic marks a major advancement in mining technology. Metals, especially copper, were extracted using firesetting to soften hard rocks. In addition, the development of smelting allowed people to separate metal from ore minerals such as copper carbonates and copper sulphides. Casting methods, including lost wax casting, were also developed at this time. Advances continued into the Bronze Age when in addition to firesetting, bronze tools were used, which allowed underground mines to become deeper and more expansive. The first documented use of iron and thus the beginning of the Iron Age was by the Hittites in present-day Turkey. Although iron is more difficult to smelt than other metals, this new technology spread across Europe.

The high point of the mining industry in the ancient world was with the Romans, who operated both open-cast and underground mines throughout the empire. Romans still used firesetting to weaken rock, but also used iron tools such as picks, gad bars, and battering rams. When geologic conditions were favorable for it, they employed a form of hydraulic mining. Roman mining resembled modern mining in several ways. The Romans began timbering their underground mines as well as using room and pillar methods. Ore was extracted from shafts using a windlass and basket or bucket. Illumination of underground mines was accomplished with oil lamps. These lamps were also used to test air quality and determine where dedicated ventilation shafts were needed. The Romans used several methods for dewatering deep mines, including French drains, bailing buckets, screw pumps, and waterwheels.

<http://geoinfo.nmt.edu/museum/minsymp/abstracts/submit/home.cfml?abs=08E054AE-0BAB-C557-1D264E9F520428F9>

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