37th Annual New Mexico Mineral Symposium

November 12 & 13, 2016

Annual New Mexico Mineral Symposium

Mineral photos by
Jeff Scovil

Featured speaker: John Cornish
Upside down and in the future,
mining Tasmania's Adelaide Mine

Program and Abstracts

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

Socorro 2016

Welcome to

The Thirty-Seventh Annual New Mexico Mineral Symposium

November 12 & 13, 2016

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
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Grant County Rolling Stones
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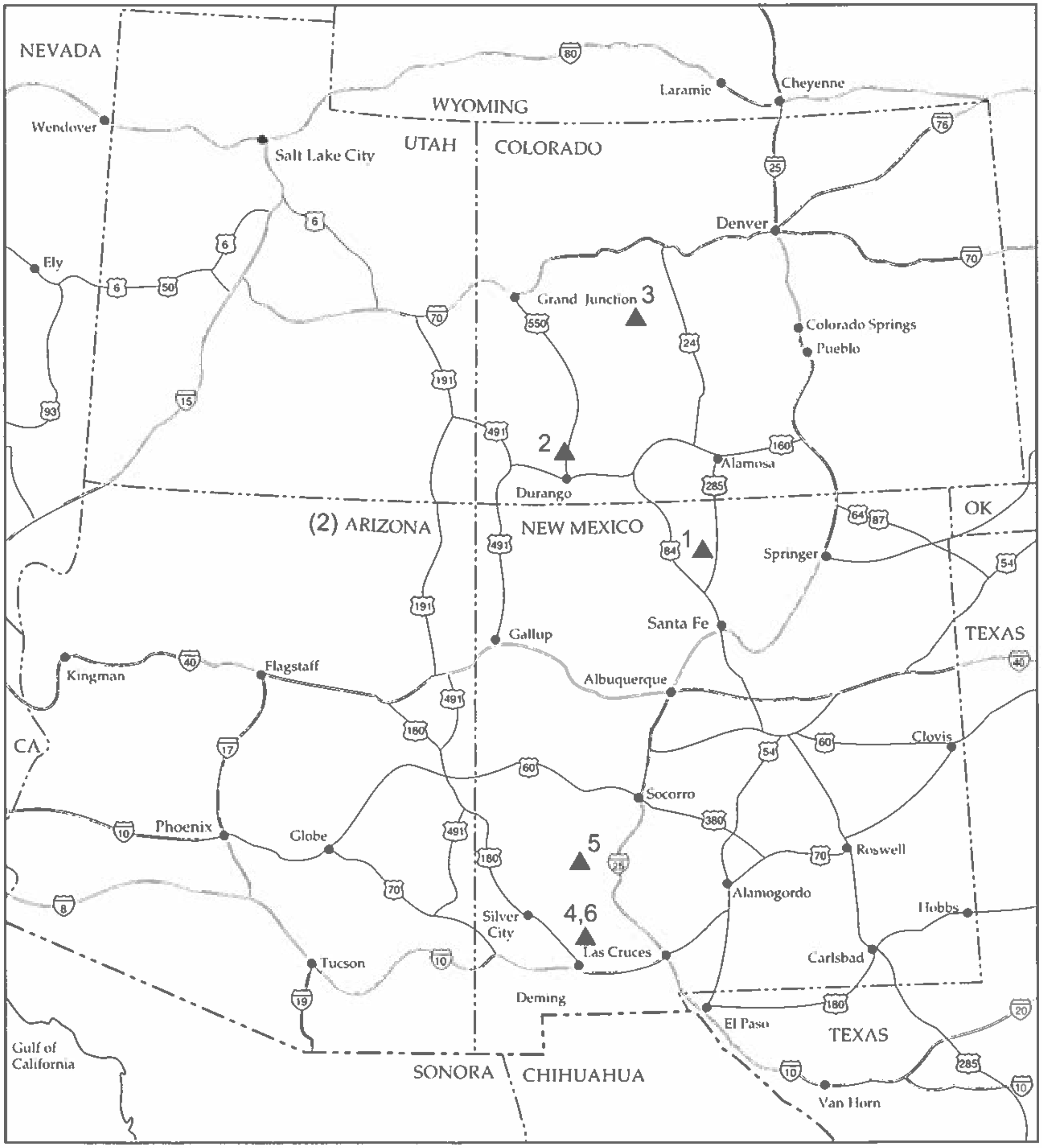
White Mountain Gem and Mineral Club
Friends of Minerology-Colorado Chapter
City of Socorro

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 mineral photos on the cover by Jeff Scovil.



Geographic Index Map
37th New Mexico Mineral Symposium

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12 &13 November 2016

SCHEDULE

Friday, November 11, 2016

8:00–5:00	Field Trip to Copper Flat, Sierra County, N.M. – Virginia T. McLemore, trip leader
5:00–7:00 pm	Friends of the Museum Reception – Headen Center (Bureau of Geology) atrium Appetizers and Cash Bar
7:00 pm	Informal motel tailgating and social hour, individual rooms, Comfort Inn & Suites **(# 1 on map)** and other venues — FREE

Saturday, November 12, 2016

8:00 am	Registration, Macey Center; continental breakfast
8:50	*Opening remarks,* main auditorium
9:00	*Fluorite localities of Arizona* — Barbara Muntyan
9:30	*All that glitters* — Larry Havens and Jack Thompson
10:00	**Coffee and Burrito break**
11:00	*The Petaca District, New Mexico: New findings from an old district* — Michael N. Spilde, Steve Dubyk, William P. Moats, and Brian Salem **(1)**
11:30	*Collecting the San Juans II* — Tom Rosemeyer **(2)**
12:00 pm	**Lunch & Museum Tour**
1:30	*What ever happened to the mineral specimens from Captain Jack's Black Queen Mine?* — Jane Bardal **(3)**
2:00	*Cultural aspects of mineral collecting in China* — Mark Jacobson
2:30	*An unknown mineralogist* — Herwig Pelckmans
3:00	**Coffee break**
3:30	*There once was a goat named Kåre: Over a millennium of mining from Falu Gruve, Sweden* — Nathalie Brandes and Paul Brandes
4:00	*Upside down and in the future, mining Tasmania's Adelaide Mine* — John Cornish (Featured Speaker)
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 13, 2016

8:00 am	**Morning social, coffee and donuts**
8:50	*Welcome to the second day of the symposium and follow-up remarks*
9:00	*The Evolution of uranium mineralogy in New Mexico* — Virgil W. Lueth and Kelsey McNamara
9:30	*Fabulous fluorites and other minerals from Cooke's Peak: Following in the footsteps of legends* — Philip Simmons and Michael Sanders **(4)**
10:00	**Coffee break**
10:30	*Quartz from Arizona* — Les Presmyk
11:00	*New red beryl find in Paramount Canyon shows promise* – Michael C. Michayluk **(5)**
11:30	*A New Mexico occurrence of sidwillite and other molybdenum secondary minerals.* — Ramon DeMark and Virgil W. Lueth **(6)**
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)**

What ever happened to the mineral specimens from Captain Jack's Black Queen Mine? A historical tour through the 1893 Chicago World's Fair and the Pueblo Mineral Palace

Jane Bardal

Captain Ellen Jack owned the Black Queen Mine in the 1880s. Located near Crystal, Colorado, it produced noteworthy specimens of wire silver. Once the Black Queen began shipping ore on a regular basis, several people tried to wrest the mine from Captain Jack and her co-owners. In 1889, she sold her half–interest in the mine to the Crystal River Mining Company.

The 1893 Chicago World's Fair, also known as the Columbian Exposition, commemorated the 400-year anniversary of Columbus' voyage to the new world. The Fair showcased many aspects of American prosperity and advancement, such as technology and mining. Colorado exhibited minerals from the many mining districts around the state. A specimen of wire silver from the Black Queen Mine won a prize at the fair. Many of the specimens from the Fair ended up in the Field Museum in Chicago, but the Black Queen specimen is not among them.

Also in the 1890s, the Mineral Palace in Pueblo, Colorado opened to great fanfare. It housed a world-class mineral collection, including specimens from the Black Queen Mine. By the 1930s, the Mineral Palace had fallen into disrepair and was closed. The specimens had been pilfered for many years, and the remaining specimens ended up in many different places.

In this presentation I will describe the results of my search for mineral specimens from this mine.

This research has been funded in part by a grant from the Charles Redd Center, Brigham Young University, 2016.

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There once was a goat named Kåre—over a millenium of mining at Falu Gruve, Sweden

Nathalie Brandes and Paul Brandes

According to legend, Kopparberget, Sweden's Great Copper Mountain, was discovered by a goat named Kåre. Today known as Falun, the mine has a long and colorful history. Its rich ore helped Sweden become a European power in the mid-1500s and the mine still has an impact on Swedish culture today.

Rocks at Falun are dominated by 1.8 to 1.9 Ga Palaeoproterozoic metavolcanics known as leptites that are interpreted to be felsic pyroclastics and rhyolitic ash deposited in a submarine environment. There are also some mafic and intermediate metavolcanics as well as metasediments interpreted as mudstone, turbidite, and greywacke in addition to some carbonate units. Plutonic rocks of various compositions intrude these rocks. The tectonic setting of these rocks was an extensional back-arc environment. Deformation metamorphism affected the region during the 1.8–1.9 Ga Svecokarelian Orogeny.

The ore deposit at Falun is hosted in the Leptite Formation. Most of these rocks are quartz and mica rich and traditionally called "ore quartzites" and "mica schists." Both calcite and dolomite marble as well as skarn are also found at Falun Mine. All these rocks have been folded into a large, steeply plunging isoclinal syncline.

Seven types of ore are recognized at the mine:

1. Hard ore: veins and disseminated sulphides hosted in quartzite.
2. Compact pyrite ore (soft ore): massive sulphides with quartz and carbonate gangue minerals.
3. Sköl: altered rock related to fault zones that occasionally contain sulphides.
4. Native gold: found in quartz veins and lenses that post-date the sulphides.
5. Galena veins.
6. Compact ball ore: massive sulphide containing spherical inclusions of host rock.
7. Skarns.

The main ore deposit is a pyritic Zn-Pb-Cu-(Au-Ag) sulphide formed as a stratabound volcanic associated limestone-skarn (SVALS) deposit caused by exhalation in a submarine environment.

There is much debate over the early history of Falun. The legend of its discovery by Kåre the billygoat is deeply lodged in the folklore of the region, but archaeological evidence concerning the origins of mining is equivocal. Studies have yielded dates ranging from AD 589±97 to circa AD 1245. The earliest written record of mining operations at Falun is a document from 1288 that outlines the exchange of an estate for a share of the mine.

Prior to the mid-1700s, mine workers were employed by "Master Miners," who were shareholders. The Master Miners arranged their own labor force and the processing of ore. The actual miners were peasants who were granted special rights. In the mid-1700s, employment shifted to the model of a more modern company, with miners employed by the mine, not a Master Miner.

Originally an open cast mine, miners soon worked underground in search of the richest ore. Firesetting was originally used to break rock. Black powder was first adopted for surface use in the late 1600s, but by 1710 it was used in both surface and underground applications. Dewatering was accomplished by hand or horsepower until the 1550s, when the first waterwheel was installed for this purpose. Waterwheels eventually provided the power for pumps, hoisting engines, and bellows.

Following extraction, ore was crushed and roasted in open fires. The roasted ore was then smelted, and lastly refined. Originally, copper was sent for refining to Germany and Holland. After 1619, refining was completed in Säter, Sweden. In the 1800s, processing of ore moved from open roasting to other techniques and by the early 1900s new plants were constructed for various wet separation methods.

Sweden was a major European power from the mid-1500s to the early 1700s. This was in part due to the rich ore of Falun Mine providing wealth to the kingdom. Peak production occurred in the mid-1600s, when it is estimated the mine produced half the world's supply of copper.

Massive amounts of SO_2 were released into the atmosphere during ore roasting. The pungent scent of sulphur could be smelled up the 80 km away. Thick smoke caused twilight conditions at midday and the overpowering fumes made breathing difficult and caused problematic coughs and nosebleeds. The sulphurous air, however, did have some benefits. There were no mosquitoes, fewer reports of contagious diseases, and when plague spread throughout Sweden in 1710, the disease did not strike Falun.

By the late 1600s, an inspection by the Board of Mines concluded measures were necessary to secure the mine. Thus, it came as no surprise when the Great Collapse occurred in 1687. A massive amount of rock separating two galleries fell and produced a pit 100 m deep with rubble filling the collapse up to 350 m below the surface. This large area became known as Stora Stöten, the Great Pit. Fortunately, the collapse occurred on Midsummer Day when no one was working in the mine, thus there were no casualties. Soon after the collapse copper production began to decline, but the production of other metals, including zinc, gold, and silver, increased.

In 1888, the old shareholding system that had existed at the mine since the Middle Ages was modernized into a joint-stock company. This company expanded mining operations as well as diversifying into other industries. Falun Mine continued to operate until December 8, 1992. After over a millennium of mining, the economic ore had finally run out. The joint-stock company (STORA) is still in business, specializing in forestry and paper products.

Over the life of the mine, it is estimated that 30 million tons of ore were extracted, producing around 400,000 tons of copper. In addition to the metal riches that shaped Sweden's history, the ore at Falun also impacted countryside and culture of the nation. Waste rock is used to create a unique paint known as Falun Red, which is very popular throughout Sweden. Artists, authors, and poets have used the Falun Red painted farmstead as a symbol of Swedish heritage.

Falun Mine was declared a World Heritage Site in 2001. Guided tours are offered to underground workings. Visitors can also walk around the surface mining complex and visit a museum on site.

A New Mexico occurrence of Sidwillite and other molybdenum minerals

Ramon S. DeMark and Virgil W. Lueth

Cooke's Peak is a prominent feature of the landscape in southwestern New Mexico. It is predominantly a granodiorite intrusive that has pushed up through the Paleozoic sedimentary rocks. Hydrothermal solutions from the intrusion produced the ore bodies localized in suitable limestone units and the accompanying silicification (jasperoid formation). The district was developed for its lead, zinc, and silver deposits although it is most famous to mineral collectors for the exceptional purple and green octahedral fluorite crystals.

The Summit group of mines, in the Cooke's Peak district, consists of a number of adits, shafts, pits, and trenches many of which are rich in fluorite. While investigating one of the adits, along with Chris Cowan, on the 19th of February, 2016, one of the authors (RSD) found two pieces of rock approximately 6" x 8" which were coated with lustrous, green microcrystals. A second trip by the authors, accompanied by Philip Simmons, recovered only one additional piece.

The specimens were brought to the New Mexico Bureau of Geology and Mineral Resources for examination and analysis. X-ray diffraction analysis of the green crystals resulted in an x-ray diffractogram that matched the mineral sidwillite ($MoO_3 \cdot 2H_2O$). Previous investigations of the Cooke's Peak district (Griswold 1961; Jicha 1954; Schilling 1965) specifically do not mention the occurrence of molybdenum minerals. Additional examination of the material led to the identification of molybdite (MoO_3) by x-ray diffraction. Visual identification of ilsemannite ($(Mo_2{}^{6}+ Mo^{4}+)O_8 \cdot H_2O$?) and jordisite ($MoS_2$) were also inferred. The amorphous nature of these two minerals makes confirmation of these species by XRD impossible. Ilsemannite is characterized by blue color (subject to change once exposed and waxy texture. Jordisite was identified by its shiny black, grainy to earthy texture. A few grains, resembling ferrimolybdite ($Fe_2{}^{3}+(Mo^{6+}O_4)_3 \cdot 7\text{-}8H_2O$) were also observed on some samples.

All that glitters . . .

Larry Havens and Jack Thompson

David Rickard's recent book Pyrite: A natural history of fool's gold (Oxford University Press, 2015) has given us an enthusiastic recasting of pyrite, not as common-as-dirt fool's gold and metaphor for false values, but as a "super-hero" mineral that influenced human evolution and culture, science and industry, and ancient, modern and future Earth environments.

In a style as effusive as Carl Sagan's in his Cosmos, Rickard's paean to pyrite serves to reawaken interest in a mineral so often taken for granted. Commonplace they may be yet pyrite crystals work a siren call that lures us in despite our best efforts to resist. This bright, shiny mineral enthralls people of all ages, cultures and backgrounds. Budding collectors gravitate to pyrite right out of the gate thanks to its allure, abundance and affordability; it's our gateway "drug." Therefore, revisiting an old, comfortable friend of the mineral world, and refreshing what we know of its history and nature, is a worthwhile pursuit.

The Usual Basics

Name: pyrite (early – py-ri-tes, iron pyrites) from the Greek pyr for "fire" because it sparks when struck with stone or iron, and, hence, a useful fire starter.

The metallic sulfide FeS_2 occurs in virtually all geologic formations: sedimentary deposits, hydrothermal veins and metamorphic settings; and is commonly massive, granular, radiating, reniform, discoid, globular and crystalline in the isometric system – usually in cubes, irregular pentagonal dodecahedrons called "pyritohedrons," octahedrons and rarely diploids. Pyrite displays a great variety of crystal forms for a common mineral. It and calcite go head to head in Goldschmidt's Atlas of crystal drawings for the most sketches. The intriguing grooves in the faces of many pyrite crystals are the result of changing conditions that cause a crystal to change back and forth many times between a pyritohedron and a cube. Very rarely, in low-temperature, hydrothermal veins, pyrite will form minute, threadlike (filiform) crystals with right angle bends or coils. A "screw dislocation mechanism" is suggested for this phenomenon (Henderson and Francis 1969).

With its pale, brassy-yellow color and metallic luster, pyrite bears a close enough resemblance to gold to dupe the gullible and early on earned the label "fool's gold." It further helped spawn the familiar phrase "All that glitters is not gold." Shakespeare uses it verbatim in The Merchant of Venice. The phrase was considered proverbial by the 16th century.

Of course, in reality, pyrite's physical characteristics are far from gold-like. Pyrite fails the density test with gold—5 grams/cm^3 to 19 grams/cm^3. Pyrite is twice as hard as gold; its color is off; and it certainly is not malleable with its conchoidal fracture and brittle tenacity.

Historical and Modern Uses

Pyrite has proved to be a utilitarian mineral for mankind, serving him in many an imaginative way, increasing in sophistication as he developed his arsenal of scientific tools. Probably the earliest application of pyrite was as a fire-starter. No smart, early human would go anywhere without his kit of pyrite and tinder. Striking rocks were everywhere.

A logical adaptation of the "pyrite makes sparks" technology to the human tendency to apply benign processes to the tools of war is seen in the evolution of firearms. In the 1500s the clumsy matchlock firearm gave way to the "wheel lock" mechanism. In simple terms, a piece of pyrite was levered against a spinning, grooved wheel that shot sparks into a pan of powder that, in turn, touched off the main charge. Finally, a weapon that could be concealed under clothing. This leap forward in firearm design led to the first gun control laws. Fear of assassination among the nobles

Cultural aspects of mineral collecting in China

Mark Ivan Jacobson, 1714 S. Clarkson Street, Denver, CO 80210

Minerals from China are widely available for purchase and commonly seen at mineral shows across the US. In China, mineral specimens, which are almost exclusively from China, are seen in a variety of settings: geology museums, private collections, retail mineral-rock businesses, and traditional viewing rock (奇石) exhibitions. Between July 2008 and April 2013, I lived in Chengdu, Sichuan Province and had the opportunity to see Chinese minerals in these settings, do some field collecting and overcome the hurdles of assembling a library on Chinese minerals and pegmatites.

During the 1800–1900s, China advanced its tradition of natural found art–these are rocks, and sometimes minerals, that either have interesting artistic geometric shapes and colors or have shapes that resemble either man-made objects or living things–people, animals or plants. There are Chinese guidebooks on the naming, classification and valuation of viewing stones (the literal translation of 奇石, Qíshí, is strange stones).

Polishing, carving, and faceting of minerals has also continued, especially within their historic tradition of carved and polished jades. A word of caution: the Chinese word that is translated to jade, 玉 (yù), is also used for any rock or mineral that will form attractive masses after polishing. For example, a polished fine-grained purple lepidolite is referred to in translation as purple jade.

The collecting of crystals as art or minerals as scientific, intellectual curiosities started after Mao Zedong death in 1976 and the rise of Deng Xiaoping in 1978. Deng with the Eight Elders introduced the "reform and opening up" of China. As the governmental changes increased, travel to and within China has become both politically and physically easier, allowing for the development of domestic mineral dealers.

Chinese collectors prefer giant to large crystals or crystal groups. Value depends more on size than authenticity or quality. There is no negative value assigned to material that is polished, enhanced, fabricated, dyed, or repaired. Oiling of minerals or selling the minerals water-wet is a common practice. Color and form is everything. There is either little interest in knowing a specimen's locality or provenance or else this information is concealed to protect the seller's perceived business advantage.

Books, magazines, and technical articles on minerals, viewing stones, and pegmatites are obtained from used and newly-published bookstores, internet book sellers similar to Ebay or Amazon, geology museum stores, mineral shops, internet scientific article distributors (7 cents a digital page) and photocopies from libraries. Even if you cannot read Mandarin, there is much to be gained—maps, specimens, chemical analyses and geologic cross sections can be understood with little to no language knowledge. The literature is extensive. Although small-scale (such as less than 1:100,000) topographic and geologic maps are still prohibited to the average Chinese citizen and all non-Chinese citizens, whereas road and city maps are easy to purchase in markets and bookstores.

Museums of earth science materials are usually found associated with universities that have significant earth science research, provincial geological survey offices, or more recently places to attract domestic tourists. With a population that in 2013 was economically 25% middle class or above, the number of people who have discretionary recreational time (and perhaps money) exceeds 330 million, which is greater than the total U.S. population.

Minerals and viewing stones are sold from clusters of small shops (an unofficial shopping plaza), private homes and apartments where a room might be dedicated just to selling minerals, or in curio and weekly markets laid out on a blanket or small table. Giant and small viewing stones, and cave speleothems (that may have come from immense limestone quarries for cement and aggregate) are sold sometimes associated with stone carving/ granite slabbing industrial centers.

This presentation will tour museums (the Geological Museum of China in Beijing, Chengdu University of Technology museum, Hubei Geologic Museum, and the Yifu Museum of China University of Geosciences), the Guilin mineral and viewing stone markets, curio-art markets (Chengdu and Beijing), the Pixian stone carving-granite slabbing center in Sichuan Province, and collecting localities along the eastern edge of the Qinghai-Xizang Plateau.

The easily available minerals to purchase in China are mostly the same as can be found in the major U.S.A. mineral shows—the supply-distribution routes from the mine to the market are the same. These include ore and gangue minerals from easily accessible mining areas from the coastal provinces such as calcites, fluorites, quartz, hematite, scheelite, pyrite, chalcopyrite and cinnabar, sedimentary minerals such as selenite, quartz and calcite, granite quarry minerals such as smoky quartz and some schist minerals such as dravite/schorl.

Minerals more likely to be seen in China than in the US include the topazes from Inner Mongolia, Yunnan and Hubei, beryls and tourmaline from Yunnan and Xinjiang and the less valuable pegmatite minerals from Hubei, Hunan, Sichuan and Xinjiang. Gem minerals that are common in certain areas of China—topaz, elbaite, beryl, and garnet will occasionally reach market areas. Scientific minerals such as pegmatite oxides, phosphates, and rare-earth/rare metal minerals, although common at the mine, do not have established distribution networks so that these materials are almost never seen for sale in China or outside its borders. Access to certain areas of China, such as Xinjiang, Qinghai, Inner Mongolia, Xizang (Tibet), and Heilongjiang may be exceedingly difficult for both Chinese and non-Chinese due to both physical and political challenges. Time, travel and professional-personal friendships with the appropriate people can resolve most of these issues. The future will eventually bring an increasing abundance of mineral specimens, more numerous mineral species, and mineral knowledge from China to the world.

Figure 1. Index map of the provinces of China with the areas to be discussed. Map courtesy of and copyright © Australian National University, College of Asia and the Pacific, CartoGIS CAP-027.

Figure 2. Gem quality "orthoclase" from the Boziquoer (REE-Nb-Ta-Zr) pegmatite field, Baicheng County, Akesu prefecture, northwest area of Xinjiang Province. Qinglang LUO specimen. Other crystal vug specimens from this pegmatite are associated with clear quartz and schorl.

The Evolution of Uranium mineralization in New Mexico

Virgil W. Lueth & Kelsey McNamara, New Mexico Bureau of Geology & Mineral Resources, NM Tech, 801 Leroy Place, Socorro, NM 87801

New Mexico is well known for its deposits of uranium and long famous for uranium minerals. Perhaps one of the earliest documented discoveries of uranium minerals west of the Mississippi was by Jones (1904), from the Lemitar Mountains district north of San Lorenzo Canyon in Socorro County (Eveleth et al., 2009). This was long before the famous 1950 discovery of Haystack Mountain by Paddy Martinez, near Grants, when the uranium boom was in full swing and New Mexico assumed its mantle as one of the top producers of uranium in the United States. Approximately 240 uranium minerals have been described from world-wide occurrences (Back, 2014) but only 43 have been reported from New Mexico (Northrup, 1996; Mindat.org). Undoubtedly, many more species are present within deposits scattered about the state awaiting discovery.

Scientists have long noted that particular minerals are more common in certain types of deposits and ages of rocks. Synthesizing these observations with geochemical principles, Hazen et al., (2008) defined 10 stages of "mineral evolution" that have operated on the earth over the last 4.5 billion years. The geochemistry of uranium is highly sensitive to some of these "evolutionary stages" and the resulting mineralogy can be used to identify four phases of uranium minerals (Hazen et al., 2009).

Six of the first 10 stages of mineral evolution (Hazen et al., 2008) occurred prior to the formation of New Mexico ca 1.8 Ga (Karlstrom et al., 2004). Accordingly, two of the four uranium mineral evolution phases occurred prior to the formation of the oldest rocks in the state. Vestiges of the first two stages may be recognizable in some New Mexico deposits. This presentation will present the mineralogy of uranium within the context of the four phases uranium mineral evolution of Hazen et al. (2009) that is encoded in the rocks of New Mexico.

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New Red Beryl find in Paramount Canyon

Michael C. Michayluk

New Red Beryl find in Paramount Canyon shows promise. The occurrence of red beryl in the Black Range of New Mexico has been known for several decades. One of the most well documented occurrences in the Black Range is that of Paramount Canyon, and several claims for beryl been filed here in the past. Perhaps the most productive claim was the Beryllium Virgin, claimed and worked extensively by Patrick Haynes in the 1980s. An estimated 50–80 crystals were collected on his claim with the largest measuring about 5 mm. A majority of these crystals were collected east of a hematite vein outcropping on the rim of the canyon. A new discovery of red beryl on the old Beryllium Virgin claim was made by Jerry Cone in the summer of 2015. Jerry discovered a rhyolite outcrop west of the exposed hematite vein which has since yielded several dozen red beryl crystals, with the largest measuring just over 5mm. Like previous beryl discoveries in the Black Range, the crystals occur in lithophysal cavities as tabular hexagonal prisms with the c-axis greatly shortened. Small hematite, quartz, opal, sanidine and clay-like minerals are associated with the red beryl at this particular outcrop. Bixbyite, cassiterite, chernovite- (Y), fluorite, gasparite- (Ce), ilmenite, pseudobrookite, rutile, and other minerals can also be found at Paramount Canyon, but seem to be absent at the beryl rich outcrop to the west.

Red beryl is very rare and known only from a handful of localities worldwide, including the Thomas Range and Wah Wah Mountains of Utah, as well as the Black Range of New Mexico. Many rhyolite flows and domes, similar in composition to the beryl-bearing flows in the Black Range and Utah localities, occur across the western United States (Christiansen et al., 1986) All of these flows contain vapor-phase minerals such as bixbyite, hematite, pseudobrookite, and fluorite, but the occurrence of beryl is incredibly rare. In the Wah Wah Mountains, even within the rhyolite flow which hosts the red beryl, the productive open pits comprise only 0.02% of the surface area of the flow (Keith et al., 1994). The conditions that favor the formation of red beryl are apparently rarely achieved even within the premier beryl-bearing flow!

Detailed studies in Utah have better elucidated the nature of beryl deposition at specific localities. In the Wah Wah Mountains, all beryl crystals occur exclusively along shrinkage fractures in devitrified rhyolite, rather than in lithophysal pockets or in unfractured rock (Keith et al., 1994). Many studies have been conducted on the chemistry of the Taylor Creek Rhyolites, but all have been centered around tin deposition rather than beryl (Eggleston et al., 1986 and more). If a better understanding of the conditions of formation of Beryl in the Black Range could be achieved, then perhaps one could prospect for additional deposits at Paramount Canyon and other localities throughout the range.

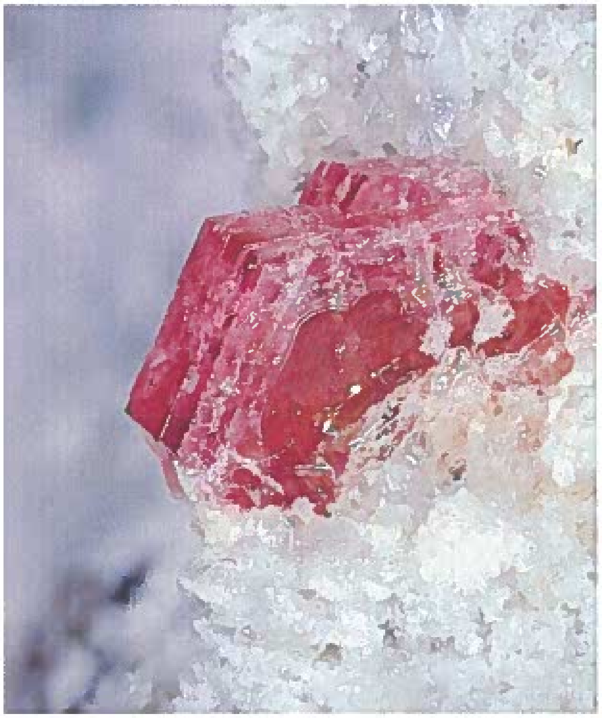

Figure 1. Field of view about 4.3 mm; crystal measures just over 3 mm. Specimen and photo by Michael C. Michayluk.

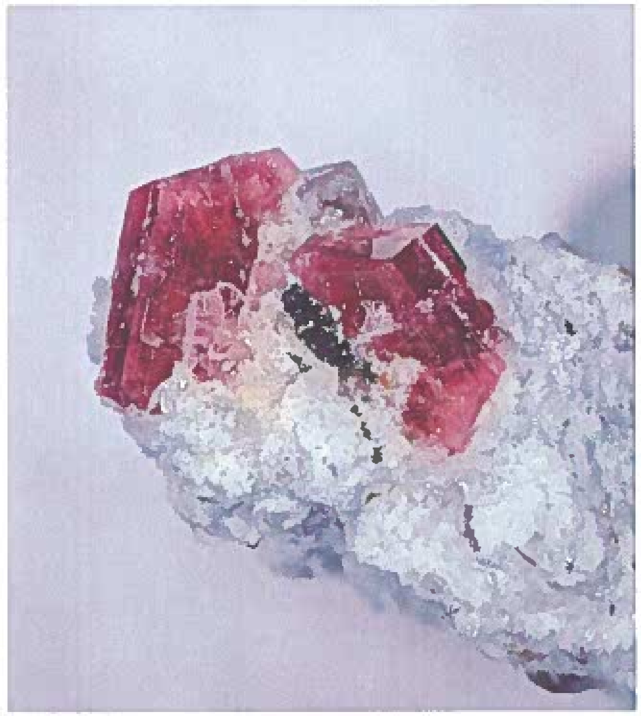

Figure 2. Field of view about 5.8 mm; largest single crystal about 3 mm wide. Specimen and photo by Michael C. Michayluk.

Figure 3. Field of view about 9.8 mm; crystal measures about 4 mm wide. Specimen and photo by Michael C. Michayluk.

Figure 4. Field of view about 12.6 mm; crystal measures about 5.2 mm wide. Specimen and photo by Michael C. Michayluk.

Flourite localities in Arizona

Barbara L. Muntyan, Tucson, Arizona

Fluorite is a widespread mineral in Arizona, occurring in at least 390 localities in twelve counties, according to MINDAT. Although perhaps less admired than specimens of Arizona wulfenite, azurite or malachite, fluorite can nevertheless be found in fine, euhedral crystals to 2" on edge, in hues of spruce green, pale green, lavender, dark purple, and bi-colored crystals. Associated minerals species include quartz, calcite, galena, cerussite and wulfenite.

The finest Arizona fluorite specimens have certainly come from the Oatman mining district, Mohave County in recent years, first from the Hardy mine and then later from the Homestake. Mined by Mark Hay and Dick Morris, these mines have provided a steady flow of octahedral fluorite, colored grass-green, spruce-green, or raspberry/green combos on white drusy quartz matrix, and with occasional rosettes of clear quartz on top. The specimens bear a striking resemblance to octahedral fluorite from the San Juan Mountains of Colorado, albeit without rhodochrosite.

The Santa Teresa wilderness area, Graham County, has recently produced fine octahedral purple fluorite on clusters of white to clear quartz crystals. The best fluorite crystals have been found up to 2" on edge and are usually grape-jelly purple, but may also be lavender or zoned shades of purple.

Another locale exploited commercially in the last few years is found at the eastern extent of the Tombstone Hills, Cochise County. Named "La Fluorite Dulcita" claim by the most recent claim holder, the deposit has been known for many years and has produced both pale green and dark purple octahedral fluorite on druzy quartz casts which have formed upon earlier depositions of yellow calcite in both scalenohedral and rhombohedral crystal forms.

A recent find near Deluge Wash toward the eastern side of the Huallapai Mountains has produced pale green fluorite crystals in complex cuboctahedra more than 2" across, perched on milk-white quartz crystals. This mining area has molybdenite and hiseringerite, as well as other contaminants, which make successful cleaning very challenging.

Other, older, localities for Arizona fluorite specimens include the mines of the Castle Dome area, including the Hull, where it has been found associated with galena, calcite and wulfenite. Other locales include the Heson mine in La Paz County, the Empire and Toughnut mines at Tombstone, Cochise County, the Neptune mine at the north end of the Sierrita Mountains in Pima County, the Prism (Rainbow) mine in Maricopa County, the Lucky and other mines in the Duncan area, the Ten Strike mine near Klondyke, and various locales in the Buckskin Mountains and Artillery Mountains.

In conclusion, although not valued as highly as Arizona's more famous species, fluorite forms in many places throughout Arizona and in attractive specimens which can grace many collector or museum collections.

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The Unknown Mineralogist

Herwig Pelckmans

Throughout history, many mineral species have been named after a person. Some of these individuals are hardly known to science, even today. On the other hand, the mineralogists who described new species are fairly well known in most cases.

One 20th Century mineralogist however, who described many new minerals, remained a complete mistery. Besides his name and the minerals he described, hardly anything else was known about him. No biography was ever written about him, no photos of him were ever published, and even his nationality was an open question.

In this talk you will be introduced to this intriguing scientist. You will learn more about him and the beautiful minerals he described, and you will even get to see, for the first time in history, some photos of the mineralogist in question.

Arizona Quartz – Not everything from Arizona is blue, green, red or yellow

Les Presmyk

Quartz has played a role in the various civilizations that have lived in Arizona over the millennia and has been more important than gold or silver. Starting with such utilitarian applications of agate and amethyst for arrowheads and other implements and quartz crystals for medicinal and ornamental purposes, the use of quartz is evident in prehistoric excavations. In the past 100 years or so, quartz and its various forms have been preserved for lapidary and specimen beauty. It is worth noting the significant agate, fire agate, jasper and petrified wood localities in the state but this paper will deal mainly with the crystallized quartz locales.

Although Arizona's copper and lead minerals generally overshadow everything else, Arizona possesses fine quartz localities and some of them are unique or nearly so. A few result from the mining for copper and other metals and many are surface localities, mainly discovered by rockhounds and mineral collectors. The Four Peaks amethyst mine produces world-class faceting amethyst and the locale is almost visible from all of Phoenix. This discussion will include Arizona's copper mines, smaller underground mines, and a number of the surface localities.

Although Ajo had lots of quartz and silica in the orebody and a suite of copper silicate minerals, including shattuckite, ajoite and papagoite, virtually no specimen quartz is known from there. The mines of Bisbee are much the same situation except for the occasional pocket of amethyst or amethystine quartz crystals, sometimes associated with white bladed calcite. All of the drusy quartz on malachite or chrysocolla specimens I have seen labeled from Bisbee are from the Live Oak mine in Miami.

Drusy quartz crystals covering chrysocolla are known from several Arizona copper mines, starting with the Old Dominion in Globe, the Live Oak in Miami, the Ray mine and Bagdad. As an aside, areas in and around the Bagdad mine have produced quartz crystal clusters and Japan-Law twins. A few specimens were recovered in Morenci in the 1990s but very few. The Twin Buttes mine south of Tucson and even the Mammoth-St. Anthony mine has produced some attractive quartz on chrysocolla specimens. There are also some small but important localities, including the Blue Angel prospect in western Arizona, that have produced good specimens. The material can make for attractive specimens as well as being used in jewelry.

Chrysocolla in quartz (chalcedony) or gem silica was first noted by Ransome at the Old Dominion but it is the material from the Live Oak mine, both underground and open-pit, which made Arizona world famous for this beautiful gem material. Gem silica has also come from the Ray mine and Bagdad. Some of the Ray material was quite attractive when it first came out of the ground but as it lost water, it became more opaque, some of the material turned more white than blue.

A thorough discussion of Arizona's quartz localities has to include the Holland Mine and the various surface deposits in and around Washington Camp and Duquesne. The Holland Mine has produced Japan-Law twins up to 10" on a side and individual doubly-terminated crystals to 14" long. Some of Arizona's best amethyst scepters have been found around the Santo Niño mine. Numerous pockets of normal quartz crystals and groups of Japan-Law twins have been encountered throughout the area. Most of the twins are frosted white but an occasional pocket has produced lustrous, clear heart-shaped twins.

Quartzsite, Arizona is named after its quartz locality at Crystal Hill, not the metamorphic rock. Years ago, Rock Currier decided to make up tee-shirts for sale at his booth at the Quartzsite show. They became gifts when it was pointed out to Rock his error in assuming the town was named after the rock, not the nearby quartz crystal locality. Crystal Hill has produced clear and lustrous quartz crystals up to 10" long and in clusters to 12" across. Some of the crystals have included chlorite and schorl, and a few have cut fine cats-eye gemstones. The locality is now a state park and only hand digging is allowed. South and slightly west of Quartzsite is the Crystal Gallery/Veta Grande/Big Bertha/Purple Cow Ledge claim. Since the 1950s it has produced high quality hematite crystals up to 3 inches across standing on white quartz and associated quartz crystals. The quartz crystals, with and without hematite, are also quite interesting. Some of the crystals exhibit curving of up to 30 degrees. Arizona's best faden quartz comes from this locality.

Date Creek Ranch, between Wickenburg and Kingman, has produced colorless, amethyst and smoky quartz crystals and clusters for decades. It is entirely a surface accessible locality although a few years ago collectors went in with a back-hoe and dug out a number of specimens.

The Fat Jack mine just outside of Crown King is also known for its colorless, amethyst and smoky quartz crystals and scepters. Stolzite crystals are also found here, with a few being very bright yellow and occurring on quartz crystals. Over the past 20 to 25 years, pockets have been sporadic and the claim has been owned by a half dozen different people. The claim is now held by members of the Mineralogical Society of Arizona.

The Huachuca Mountains south of Sierra Vista have several areas for collecting quartz. Starting with the Wakefield mine, which produced clusters of clear, lustrous crystals to various surface pits, rock crystal, amethyst and smoky quartz can still be collected here. There are a series of hiking trails throughout the mountains with lots of hummingbirds and other wildlife if one cannot find any of the quartz crystal locales. The Hamburg mine produced Japan-Law twins with associated malachite or yellow calcite.

For decades, deer hunters, rockhounds and people hiking the hills and lower slopes of the Mongollon Rim country from Payson to Tonto Village and Diamond Point have picked up the sparkly and clear "Payson or Arizona Diamonds." These crystals occur in vugs in limestone, similar similar to the famous Herkimer diamonds of New York. In the mid-1990s there was a lot of collecting activity in the area, which prompted the Forest Service to withdraw 7,000 acres from mineral entry and set it aside for recreational collecting. While most of the crystals found here appear to be colorless, a lot of the crystals actually exhibit a slight to noticeable amethyst color to them.

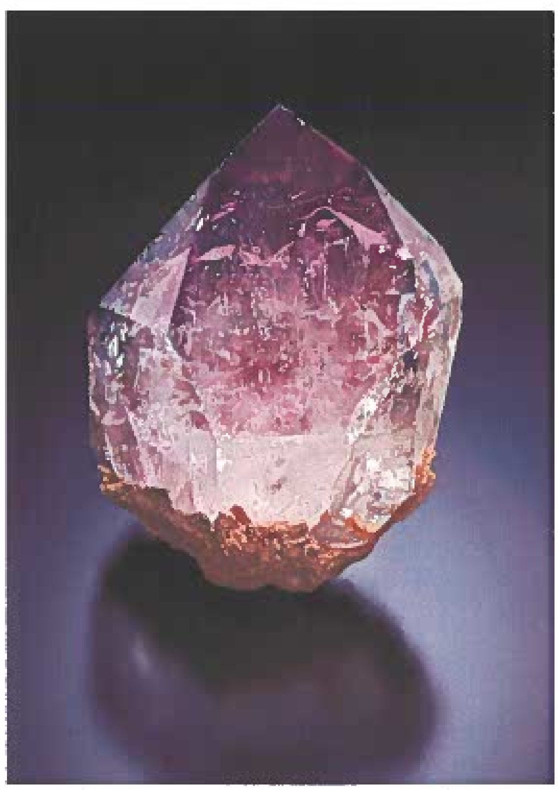
There are two notable quartz specimen areas in Graham County. The first is around Stanley Butte south of San Carlos Lake. This was part of the Mineral Strip area that was deeded back to the San Carlos Apache Tribe almost 50 years ago. From 1950 to 1980, the area was open to collectors and is probably best known for its andradite crystals. Quartz crystals up to 12" were collected in association with andradite and a number of pockets were excavated. Clear crystals with a tan chalcedony coating, amethyst and colorless crystals associated with andradite all come from this area. Probably the best include a pocket dug in 1984 with clear, slender quartz crystals on green andradite coated matrix. This region is no longer open to collecting.

The second area is the Santa Teresa Mountains in Graham County which is a locality discovered during World War II days to a more recent incarnation in the past 10 to 15 years. During World War II the northern end of the range was prospected for optical grade quartz crystals for the war effort. Fred Rhodes had a smoky quartz crystal with small epidote crystals scattered across the surface in his collection. This prompted Tony Potucek and others to explore the area 15 to 20 years ago. In the past 10 years several collectors have been hiking into the south end of the mountain range and collected a number of cavities in the granite, which have produced quartz, fluorite, hematite, beryl and ilmenite.

Because of its resistance to weathering it is one of the few minerals in Arizona that fine specimens can still be collected from near the surface. There is still plenty of quartz to be collected. It is just a matter of getting out and doing the exploration.

Quartz. Japan-Law Twin, Washington Camp, Arizona. *Jeff Scovil photograph.*

Quartz and andradite, Stanley Butte, Arizona. *Jeff Scovil photograph.*



Quartz, variety Amethyst, Diamond Point, Arizona. *Jeff Scovil photograph.*

Exploring the San Juans

Tom Rosemeyer

Last year, at the 36th Annual New Mexico Mineral Symposium, I regaled memories of the San Juan Mountains in the 1970s. This was a great decade of mineral specimen procurement with the Camp Bird, Idarado, and Sunnyside mines in full production and a number of smaller mines also operating. By the late 1970s almost all mining had come to an end in the San Juans and I asked myself what next! There was no way that I was going to stop mineral collecting so I told myself "Head to the Hills" (aka mountains).

In the 1970s I had collected easily accessible mine dumps but was wary of underground collecting by myself in long abandoned mines. I did try a few but they were small operations with limited underground workings. By this time I had quite a bit of underground experience in operating mines and knew what to expect in the subterranean but needed a collecting partner. This all changed in 1982 when a young man and his wife moved to Ouray, Colorado to open a gift shop in town called "The Sandman." This is when I met Robert and Grace Stoufer whom Benjy Kuehling had introduced me to and who was also a mineral collector. He told me for a living he poured different colored sand in small bottles to create birds and animal sculptures. At first I couldn't visualize what he meant but after he showed me his work I was amazed at the intricate designs he created and made a good living at it.

But this time I had built up a good reference library on the San Juan Region which included geology, mineralogy, and mining history publications (this was before personal computers and the internet). Robert Stoufer and I started to collect the mines in Ouray County both on the surface and underground if there was access to the workings. Robert adapted quickly to underground collecting and we made a great team. Research and careful collecting paid off and we started to recover many fine minerals specimens from large crystal groups to micro crystals. From the start I kept a detailed collecting log of our excursions that included a sketch of surface features of the mine site and a description of the minerals collected at the site. If we collected the underground workings a rough brunton compass survey and paced outline of the workings was drawn. This included a description of the vein and any crystal pockets that were discovered. The contents of the pocket were also notes as to minerals present and their size. This information along with surface and underground photos would prove invaluable for years to come especially when I started writing articles for the publication Rocks & Minerals. This was also a good permanent record, as in later years; many of the entrances to the workings were permanently sealed by the MLRD (Mined Land Reclamation Division of the Colorado Bureau of Mines) and EPA (Environmental Protection Agency) of the US Government to keep us safe.

Fabulous fluorites and other minerals from Cooke's Peak: following in the footsteps of a legend

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The Cooke's Peak district (CPD) and Jose mining districts are located on the northeast and northwest sides (respectively) of Cooke's Peak, a prominent geographical feature in southwestern New Mexico (NM) about 18 miles north of Deming, NM.

Geology

Cooke's Peak is an early Tertiary (39 million year ago [MYA]) granodiorite stock intruded into much older (about 400 MYA) Silurian and Devonian Fusselman dolomite and Percha shale sediments. The main ore bodies in both districts typically occur as isolated pod-like replacement deposits in the Fusselman below the impermeable Percha shale "dam." Ores consisted mainly of argentiferous galena, sphalerite, cerussite, minor smithsonite, with a gangue of fluorite, quartz, calcite and pyrite.

History

Initial mining claims in the districts were located from about 1876–1880. The bulk of mining activity occurred from 1880 to 1905, and by 1905 the richest ore deposits were exhausted. Early mining activity ended by 1911, and the districts were dormant until a second brief period of mining took place during a revival in the CPD from 1951 to 1953. Total production from these relatively small mining districts since 1953 has been about $1 million in lead and zinc values to date. There has been no reported commercial mining activity in the districts since 1953.

Mineral Collecting Activities

The primary focus of this talk will be mineral collecting adventures in the CPD, and also in the more obscure small Jose district. Although of no importance to the commercial miners, for mineral collectors fluorite is the mineral of choice to be found in the CPD. Very nice specimens of quartz epimorphs after calcite and vanadinite have also been recovered from a Jose district mine.
Those of us who have collected in this area have been fascinated by the fact that two very distinct varieties of fluorite can be found on individual specimens from the CPD. On individual specimens, fluorite occurs initially as blue-gray modified cubes to 2.5 centimeters that were then overgrown by dark purple octahedrons up to 7 centimeters on edge, with a core of bottle-green fluorite. The two generations of fluorite are always separated by a thin clay layer. These combination-type fluorite specimens are unique and immediately recognizable by those familiar with CPD material. Another recent significant discovery in the CPD consists of dark green octahedral fluorite specimens with individual crystals up to about 5 centimeters on edge. Very noteworthy large specimens of both the combination fluorite, and the recent dark green material from the CPD are on display in the new New Mexico Bureau of Geology and Mineral Resources mineral museum in Socorro, New Mexico.

The CPD and Jose districts are obscure small New Mexico mining districts about which very little has been published in the literature, and there is very little material from these localities available on the mineral specimen market. In addition, the New Mexico Mining and Minerals division (NMMD), Abandoned Mine Lands group in conjunction with the Federal Bureau of Land Management (BLM) are currently working to close the remaining accessible small workings in the CPD district, so recovery of specimens is somewhat of a race against time before closure activities are completed in this historic mining area.

Figure 1. CPD collecting trip, May 2015. Left to Right: Ray Demark, Hugo Brown, Fred Ortega, Chris Cowan, Ames Austin, Phil Simmons.

Figure 2. CPD combination fluorite specimen, 7.5 by 5 cm, collected 1969.

Figure 3. Modified cubic CPD fluorite, 12.5 by 7.5 cm, collected April 2014.

Figure 4. Jose district quartz epimorph after calcite, 7.5 by 7.5 cm, collected April 1997.

The Petaca District, New Mexico: new findings from an old district

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In 2011, we reported in this conference the initial results of a project to identify some of the complex rare earth element (REE) minerals from the Petaca District pegmatites (Spilde et al., 2011). Several of the important historical publications on this district, e.g. Jahns 1946, simply referred to the dark glassy minerals collected from these mines as samarskite. The rationale for our project was to use modern instrumentation to analyze and finally identify what we believed were misidentified specimens. At the time of our 2011 paper, we had sampled only a few of the pegmatites and had already identified several minerals new to the district or even to New Mexico. There are 88 mines and prospects at Petaca, and Jahns (1946) and his co-workers examined 76 during their fieldwork. Nearly all of these sites have now been visited by the authors, in addition to some not examined by Jahns. Most, but not all, locations yielded samples of complex REE minerals and/or monazite-Ce. Thus, with this paper, we present an update on this continued work.

The Petaca pegmatite district is located in north-central New Mexico in Rio Arriba County and lies within the Carson National Forest. The district forms a north trending belt about 7.2 kilometer wide by 24.1 kilometer long. Many of the individual pegmatites were mined for sheet and scrap mica from about 1870 through the end of World War II (1945), with perhaps one of the deposits mined as late as 1965. They are considered rare-element pegmatites, and with their Y- and Nb-bearing minerals, amazonitic potassium-feldspar, and common occurrence of fluorite as an accessory mineral, fall within the NYF (Niobium-Yttrium-Fluorine) category of pegmatites (London 2008).

In general, a border zone, wall zone, usually one or more intermediate zones, and a core zone usually comprise the pegmatites. The mineral composition is mainly microcline (perthite), quartz, albite, and muscovite, which occur as medium- to coarse-grained aggregates with granitoid textures in wall zones, and as large or giant anhedral to euhedral crystals in intermediate zones. Replacement bodies and fracture fillings of quartz, albite and muscovite are common. Accessory minerals include spessartine, fluorite, columbite-tantalite, monazite-(Ce), ilmenite, and less commonly, beryl, bismutite and various oxides that contain rare earth elements (REE), Y, Nb, Ta, and/or Ti. Some fluorite specimens from the Petaca district, particularly those from the Globe mine, exhibit extraordinary phosphorescence, glowing for 8 minutes or longer after short-wave ultraviolet light is removed. Several of the accessory minerals are radioactive due to essential uranium or thorium, or because they contain inclusions or fracture fillings of radioactive species. During our fieldwork in the district, radioactive minerals were collected using radiometric (scintillation) detectors.

To date, Y-REE-Nb-Ta-Ti oxides and other minerals have been collected from 32 individual pegmatites and analyzed by electron microprobe. Several new minerals were identified or confirmed for the district, including euxenite-(Y), samarskite-(Y), polycrase-(Y), xenotime-(Y), fergusonite-(Y), betafite, microlite (and variety uranmicrolite), tantalum-bearing rutile (variety strüverite), and pyrochlore. See Table 1 for formulas.

TABLE 1. Y-REE-Ta-Nb-Ti Minerals identified from the Petaca pegmatites.

Mineral Name	Ideal Formula
Aeschynite-(Y)	$(Y,Ca,Fe)(Ti,Nb)_2(O,OH)_6$
Betafite	$(Ca,U)_2(Ti,Nb,Ta)_2O_6(OH)$
Columbite-(Mn)	$(Mn,Fe)(Nb,Ta)_2O_6$
Euxenite-(Y)	$(Y,Ca,Ce)(Nb,Ta,Ti)_2O_6$
Fergusonite-(Y)	$(Y,Nd,La,Ce)NbO_4$
Microlite	$(Na,Ca)_2Ta_2O_6(O,OH,F)$
Monazite-(Ce)	$(Ce,La,Nd,Th)PO_4$
Polycrase-(Y)	$(Y,Ca,Ce,U,Th)(Ti,Nb,Ta)_2O_6$
Pyrochlore	$(Na,Ca)_2Nb_2O_6(OH,F)$
Samarskite-(Y)	$(Y,Fe^{3}+,U)(Nb,Ta)_5O_4$
Ta-Rutile (Strüverite)	$(Ti,Ta,Fe^{2+})O_2$
Uranmicrolite	$(U,Ca)_2(Ta,Nb)_2O_6(OH,F)$
Xenotime-(Y)	$(Y,REE)PO_4$

Monazite-(Ce) occurs as blocky masses and crystals weighing up to a half kilogram, and is the most abundant of the REE-bearing minerals in the Petaca district. Xenotime-(Y) was observed as vein-like alterations of and as inclusions in monazite-(Ce). Thorite, containing significant phosphate, was found at the Coats mine, and a sample likely to be thorite based on gamma spectroscopy was also found at the Apache mine. Thorite also occurs as minute inclusions in monazite-Ce at the Coats, Fridlund, La Paloma, and North Star deposits. Zircon was found at the La Paloma pegmatite as millimeter-sized crystals in quartz, associated with samarskite and bismutite. Uranmicrolite, associated with strüverite, occurs at the La Jarita pegmatite in cm-sized brownish-amber masses, and visually similar material of the same size was collected at the La Paloma. All specimens of columbite-tantalite analyzed in our study were found to be columbite-Mn.

The Y-REE-Ta-Nb-Ti oxide minerals examined in this study are highly complex. Differentiating between Y-REE-Ta-Nb-Ti oxide minerals is hampered not only by the complex chemistry of the minerals, but also because they are often metamict and display weak or no X-ray diffraction patterns. Furthermore, gross similarity between mineral formulae (e.g. samarskite vs. euxenite vs. fergusonite) adds to the confusion. The mineral composition reflects an evolving melt chemistry during crystallization, which was overprinted by late-stage igneous processes, and finally by hydrothermal alteration. Chemical analysis is required to classify many of these minerals, and even that requires statistical analysis methods to properly identify them. Nevertheless, the Petaca District is yielding a diverse array of rare and unusual minerals. Further exploration will undoubtedly uncover additional rare-element pegmatites and add new species to the growing list of minerals from this district.

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Notes