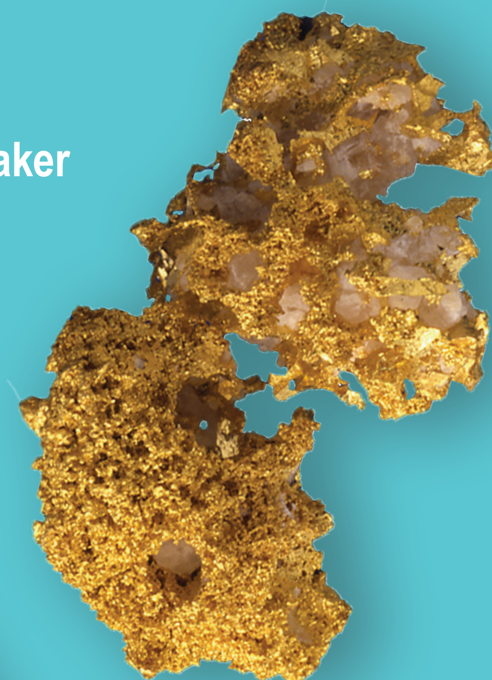
40th ANNUAL NEW MEXICO MINERAL SYMPOSIUM

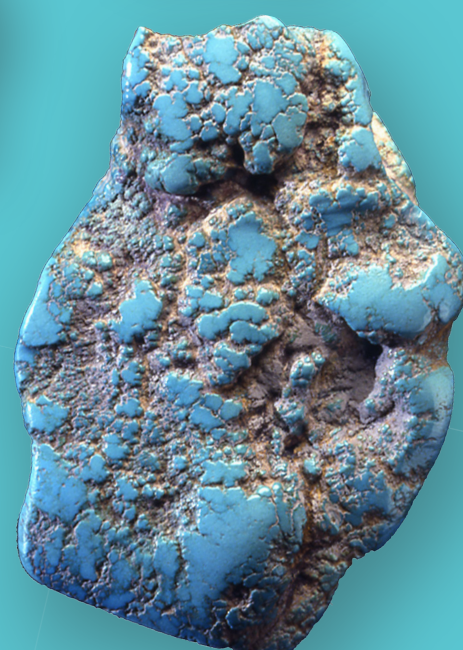
Program and Abstracts

November 9 & 10, 2019

An overview of the agates of northern Mexico and southern New Mexico

Brad L. Cross, Featured Speaker





Mineral photos by Jeff Scovil

Macey Center

New Mexico Institute of Mining and Technology
Socorro, New Mexico

WELCOME

to the

40th ANNUAL NEW MEXICO MINERAL SYMPOSIUM

November 9 & 10, 2019

Macey Center

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

Socorro 2019

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

Sponsors:
Albuquerque Gem and Mineral Club
Chaparral Rockhounds
Los Alamos Geological Society
New Mexico Geological Society Foundation
Friends of Mineralogy
Grant County Rolling Stones
Friends of Mineralogy—Colorado Chapter
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 encourages intimate discussions among all interested in mineralogy and associated fields.

The cover photos are silver (Silver City, NM), gold (San Pedro, NM), and turquoise (Orogrande, NM).

Contents

PROGRAM

Friday — November 8, 2019

5:00–7:00 p.m.	Friends of the Museum reception—Headen Center (Bureau of Geology) atrium. Appetizers and cash bar
7:00 p.m. to ?	Informal motel tailgating and social hour, individual rooms, Comfort Inn & Suites (# 1 on map and other venues—FREE)

Saturday — November 9, 2019

8:00 a.m.	*Registration,* Macey Center, continental breakfast
8:50	*Opening remarks,* main auditorium
9:00	*The New Mexico Mineral Symposium, a Forty-year Journey*—Peter Modreski
9:30	*Arthur Montgomery*—Raymond Grant
10:00	**Coffee and burrito break**
11:00	*New Mexico pseudomorphs*—Philip Simmons and Erin Delventhal
11:30	*The New Cornelia mine, Ajo, Arizona*—History and Minerals—Les Presmyk
12:00 p.m.	**Lunch**
1:00	*Chalcopyrite disease and other incurable ore textures*—John L. Lufkin and Paul Barton
1:30	*Prehnite in Arizona: A significant new find*—Barbara Muntyan
2:00	*The Cresson mine: The untold stories*—Steven Veatch and Ben Elick
2:30	*Mineral adventures in the Keeweenaw*—Tom Rosemeyer
3:00	**Coffee break**
3:30	*Goldfield Nevada: Short but sweet*—Nathalie N. Brandes and Paul T. Brandes
4:00	*An overview of the agates of northern Mexico and southern New Mexico*—Brad Cross (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 10, 2019

8:00 a.m.	Morning social, coffee, and donuts
8:50	*Welcome to the second day of the symposium and follow-up remarks*
9:00	*Fluorescent Calcite of Southwest New Mexico: Ultraviolet colors to rival Franklin, New Jersey*—Bruce Cox
9:30	*Columbian emeralds and their "oily" heritage*—David L. Stoudt
10:00	**Coffee break**
10:30	*New Mexico microminerals: Obscure, rare, and aesthetic species*—Ray DeMark, Michael Michayluk, and Tom Katonak
11:00	*The Blanchard Mine: The Little Mine that Couldn't Ore*—Erin Delventhal
11:30	*Aldridgeite and Kellynoids from the Kelly Mine*—Klaus Fuhrberger
12:00 p.m.	**Lunch**
9:00 a.m. to 1:00 p.m.	Silent auction, lower lobby, Macey Center, sponsored by the Albuquerque Gem and Mineral Club for the benefit of the Mineral Museum (FREE)

The New Mexico Mineral Symposium, a Forty-year Journey

—Peter J. Modreski
U.S. Geological Survey, Mail Stop 150, Box 25046 Federal Center, Denver CO 80225, pmodreski@usgs.gov, pmodreski@aol.com

When I proposed to give a talk this year about the 40-year history of the symposium, I knew I had given a retrospective talk about it before, but in honesty I was quite amazed to realize that this talk had already been 20 years ago—how time goes by! The symposium has grown greatly in attendance, moved its location around for the talks, banquet, and motel tailgating sessions, and the Mineral Museum itself has moved twice, ultimately to its present superb new building in 2015. Since most of our present attendees will be least familiar with the early years of the symposium, the bulk of this abstract will be a repetition of the text of my 1999 20-year summary (Modreski, 1999). Which follows!

The New Mexico Mineral Symposium was organized in 1979 to provide an opportunity for amateurs and professionals interested in the mineralogy of New Mexico to meet and exchange information about minerals and their occurrence in the State. The first symposium was held in Northrop Hall of the University of New Mexico (UNM) on Sept. 29-30, 1979. The co-chairmen were Ramon S. DeMark, Rodney C. Ewing of UNM, and Peter J. Modreski, and the symposium was identified as being cosponsored by the Albuquerque Gem and Mineral Club, UNM Geology Department, and Friends of Mineralogy. It was Ray and I who basically conceived the idea of a symposium and started organizing it. This first symposium consisted of 10 talks held on Saturday, and a field trip Sunday to the Blanchard mine, Bingham NM. This was in the "old days", when a visit to the Blanchard mine with its well known and well crystallized fluorite, barite, and galena was a special event that required permission from the company, Hansonburg Mines, Inc., that was then working the property.

The second and all subsequent symposia were held on the New Mexico Institute of Mining and Technology (NMIMT) campus in Socorro, NM, under the sponsorship of the New Mexico Bureau of Mines and Mineral Resources. Cosponsors over the years have included the Albuquerque Gem and Mineral Club, New Mexico Tech Mineralogical Society, Los Alamos Geological Society, New Mexico Geological Society, Chaparral Rockhounds, UNM Department of Geology, New Mexico Museum of Natural History, NMIMT Geology Department, and New Mexico Tech Cooney Mining Club.

After the second symposium in 1980, there was a gap of a year when no symposium was held. It seems to have been the feeling at the time that perhaps there was only enough interest to support a biennial symposium. However, enthusiasm appeared high after the 1982 symposium, and it has been an annual event on the NMIMT campus ever since, held from 1980-84 usually in Weir Hall and from 1985 onward in the Macey Center auditorium. New Mexico Bureau of Mines and Mineral Resources staff organized and chaired the symposia; Robert M. North was the chair from 198087, Marc L. Wilson from 1989–91, and Virgil W. Lueth from 1994 to the present, with Robert W. Eveleth regularly assisting and doing the job in during the intervening years.

Beginning in 1983, keynote speakers were invited to give a special presentation (or two), beginning with the Bureau's own Bob Eveleth. Bob's talk and slide show, presented in a somewhat impromptu setting in the back of the El Matador Lounge at the El Camino restaurant, was a particularly enjoyable and memorable one for its treatment of the tall tales and shifty characters in New Mexico's mining history. His talk may also qualify for the longest title of a presentation at the symposium (see below).

A Saturday evening banquet became a regular feature of the symposium starting in 1984; these were held in the Macey Center except for 1989–92 when the banquet was in the quaint and historic (but acoustically challenged) Garcia Opera House. Collectors who wished to sell or swap specimens began setting up mineral displays in their rooms at the El Camino Motel, starting on Friday evening, and this became an "officially" publicized feature beginning with the 6th (1985) symposium. In 1993 the "tailgating" was moved to the Super 8 Motel, which then became the principal conference motel.

The first three symposia included field trips held on Sunday. As noted above the first year's trip was to the Blanchard mine, the second trip was to the Magdalena district (Graphic-Waldo and Lynchburg mine dumps), and the third was to the Orogrande district, Otero County. In 1984 and thereafter no formal field trip was held, and the symposium talks were expanded to 1½ days, with a silent auction held on Sunday afternoon. In lieu of a field trip, field guides for self-guided trips to various mineral localities in the state were prepared by the Bureau and made available at the symposium.

Looking back at past topics presented at the symposium, the first symposium included papers on several areas then relatively little known but now considered "classic" New Mexico mineral localities:

the Red Cloud fluorite-copper-rare earth deposit in the Gallinas Mountains, and the red beryl and pseudobrookite occurrence near Paramount Canyon in the Black Range, as well as papers on the Harding pegmatite, the Blanchard mine (Hansonburg district), and others. The 3rd (1982) symposium saw the first paper, by Ray DeMark, on the unusual minerals of the Point of Rocks phonolite sill, a locality that provided subject matter for a number of subsequent talks. The first presentation about minerals from the schists in the Picuris Range near Pilar was made in 1986, also by DeMark who described cyprine (blue vesuvianite), piemontite, thulite (pink zoisite), and associated minerals. Talks at the first three symposia were confined to localities in New Mexico, but beginning in 1983 with a talk by Richard Graeme on Bisbee, Arizona, talks on neighboring states, Mexico, and occasionally beyond have been included. Beginning in 1982, abstracts of those papers dealing with New Mexico were reprinted in New Mexico Geology in addition to being printed in the abstracts booklet distributed at the symposium.

Invited keynote speakers from the first twenty symposia are listed below; the titles of their presentations are approximate (given in parentheses) when these were not printed in the symposium program. A table giving additional details about each symposium and the featured speakers was included in the article by Eveleth and Lueth (1997) about the history of the Mineral Museum.

Now (I'm writing back in the present now, 2019), abstracts of the talks from all the past symposia are available in a searchable database on the Museum website. Some things about the symposium don't change: Ray DeMark remains the one speaker who has presented a talk at every symposium throughout its whole history! We all look forward to many more years of rewarding symposia, continuing to expand our knowledge of New Mexico mineral occurrences and our camaraderie with fellow collectors!

References

Eveleth, R.W., and Lueth, V.W., 1997, A rocky history—the first 100 years of the Mineral Museum in Socorro, New Mexico, USA: New Mexico Geology, v. 19, no. 3, p. 65-75.

Modreski, P.J., 1999, Reminiscences on 20 years of the New Mexico Mineral Symposium: 20th Annual New Mexico Mineral Symposium, NMIMT campus, Socorro, NM, p. 4-5.

Symposium Keynote Speakers 1979–2019

Year	#	Keynote speakers and Abstract
1979–1982	1–3	
1983	4	Robert W. Eveleth, “Of Bridal Chambers, jewelry shops, and crystal caverns—a glimpse at New Mexico’s mining camps, characters, and their mineral treasures”
1984	5	Laurence H. Lattman, President, New Mexico Institute of Mining & Technology; “High-tech materials for modern society”
1985	6	Peter Bancroft, “Gem and crystal treasures”
1986	7	Vandall T. King. “Pegmatite petrology through phosphate mineralogy”
1987	8	Robert W. Jones, “Copper throughout history”
1988	9	Peter Bancroft, “Gem and mineral treasures II”
1989	10	Philip C. Goodell and Kathryn Evans Goodell, “Adventures in the Sierra Madre, Batopilas, Chihuahua”
1990	11	Peter K.M. Megaw, “Mineralogy of the rhodochrosite-bearing “silicate” ore-bodies of the Potosi mine, Santa Eulalia mining district, Chihuahua, Mexico”
1991	12	Gilbert Gauthier, “Mineral classics of Shaba, Zaire”
1992	13	Stanley J. Dyl, II, “Mining history and specimen mineralogy of the Lake Superior copper district”
1993	14	Bernard Kozykowski, “Franklin—its mines and minerals;” and, “The Sterling mine—a precious hillside preserve”
1994	15	Fred Ward, “The ‘precious’ gems: where they occur, how they are mined;” and, “Jade”
1995	16	Dr. Miguel Romero Sanchez, “The Romero Mineral Museum”
1996	17	Robert W. Jones, “Gemstones of Russia”
1997	18	Carl A. Francis, “A fourth world occurrence of foitite at Copper Mountain, Taos County, New Mexico”
1998	19	Terry Huizing, “Collectible minerals of the Midwestern United States”, and, “Colorful calcites”
1999	20	Rodney Ewing, “Mineralogy, applications to nuclear waste”
2000	21	Richard Houck, “Sterling Hill: Yesterday, Today and Tomorrow”
2001	22	Jeff Scovil, “Sampling the Finest”
2002	23	Robert Barron, “Recovery of A 17 Ton Copper Boulder from Lake Superior”
2003	24	John Rakovan, “The Cause of Color in Fluorite with special reference to the Hansonburg District, NM”
2004	25	Harrison H. Schmidt, “Lunar Geology and Mineralogy”
2005	26	Terry Wallace, “Silver of the American West”
2006	27	Ed Raines, “The Leadville Silver Deposits”
2007	28	John Rakovan, “Mineralogical Meanderings in Japan”
2008	29	John Medici, “Some highlights of 45 years of Medici Family field collecting”
2009	30	Ray DeMark, “Thirty Years of symposium presentations: a retrospective”
2010	31	R. Peter Richards “Geology and Mineralogy of Mont Saint-Hilaire, Quebec, Canada”
2011	32	Dr. Anthony Kampf, “Solving Mineral Mysteries”
2012	33	Jean DeMouthe, “Ancient and modern uses of gems & minerals: talismans, tools & medicine”
2013	34	Allan Young, “Collecting Thumbnail Minerals”
2014	35	Virgil W. Lueth, “The Past, Present, and Future of the New Mexico Bureau of Geology & Mineral Resources—Mineral Museum”
2015	36	Robert Cook, “An Overview of five great American Gold Specimen Locations”
2016	37	John Cornish, “Upside down and in the future, mining Tasmania’s Adelaide Mine”
2017	38	Bob Jones, “The History of the Bristol Connecticut Copper Mine”
2018	39	Peter K.M. Megaw, “The Santa Eulalia Mining District, Chihuahua, Mexico”
2019	40	Brad Cross, “An overview of the agates of northern Mexico and southern New Mexico”

Arthur Montgomery

—Raymond Grant

Arthur Montgomery was born in December 1909 in New York City and grew up there. He was interested in science and by the time he started college he had decided to study geology and in 1927 he entered Princeton University. He graduated with a BS in Geology in 1931. After graduating he went to Europe and in the summer of 1931 he visited the Island of Seiland in far north Norway to collect minerals. During 1932 he worked at Ward's Natural Science under George English to learn more about the mineral business. In June of 1933 he made his first collecting trip to the west with R. C. Vance of the American Museum They collected topaz in the Thomas Range of Utah and opal at Virgin Valley in Nevada.

He next partnered with Ed Over and together they did some serious collecting. In 1934 they collected in the Thomas Range and then at Devil's Head, Colorado. In 1935 they mined for tourmaline at Mesa Grande in southern California; in 1936 with Ed Henderson they worked for three months at Prince of Wales Island, Alaska and then in September opened up the Little Green Monster Mine for variscite near Fairfield Utah, in 1937 they returned to Fairfield and in 1938 they worked at Mount Antero in Colorado. When World War Two started Montgomery and Over switched to a search for strategic mineral deposits for TAMCO (Titanium Alloy Manufacturing Company) from 1939 to 1941.

In 1942, Montgomery made his first trip to the Harding Mine in New Mexico. This was the beginning of his love of New Mexico. TAMCO turned down the property so Montgomery started working there and purchased the mine. He worked mining tantalum until 1947, when he started graduate school at Harvard. He did his Ph.D. thesis on the "Pre-Cambrian Geology of the Picuris Range, north-central New Mexico" which kept him coming back to New Mexico. He received his Ph.D. in 1951 and his thesis was published as New Mexico Bureau of Mines Bulletin 30 in 1953. In 1951 he started teaching geology at Lafayette College in Easton, Pennsylvania, where I was his student, and retired in 1975 as full professor. During all these years he returned to New Mexico every summer. Mining continued at the Harding for beryl from 1949 to 1959. During some of those years it was the leading beryl producer in the United States. He continued his fieldwork and was co-author of "Geology of Part of the Southern Sangre de Cristo Mountains, New Mexico" and "Trail Guide to the Geology of the Upper Pecos." In 1978 he donated the Harding Mine to the University of New Mexico. From 1978 until his death he devoted himself to his religion, first as a volunteer at a nursing home in Trinidad, Colorado until 1993 and then living with a group from the religion in Albuquerque.

He said this about New Mexico: "Living in this place, in such scenery and close to such simple earth-loving people, has been the finest experience I have ever had. I'll never be the same again, and I've been very lucky." He died in December 1999 in Albuquerque, New Mexico.

References

Matrix, a Journal of the History of Minerals, 2000, The Life and Times of Arthur Montgomery: vo. 8, no. 2, 112p.

Miller, J.P., Montgomery, A., and Sutherland, P.K., 1963, Geology of Part of the Southern Sangre de Cristo Mountains, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Memoir 11, 106p.

Montgomery, Arthur, 1934, Digging for Opal in Virgin Valley: Rocks and Minerals, v.9, no.10, p.141-145.

Montgomery, Arthur, 1935, Minerals of the Thomas Range, Utah: Rocks and Minerals, v.10, no.11, p.161-168.

Montgomery, Arthur, 1937, The Epidote Localities of Prince of Wales Island: Rocks and Minerals, v.12, no.7, p.195-208.

Montgomery, Arthur, 1938, Storm over Antero: Rocks and Minerals, v.13, no.12, p.355-367.

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

Montgomery, Arthur, 1997, Reminiscences of a Mineralogist: Matrix Publishing Company, Dillsburg, PA, 82p.

Sutherland, P.K., and Montgomery, A, 1960, Trail Guide to the Geology of the Upper Pecos: New Mexico Bureau of Mines and Mineral Resources, Scenic Trips to the Geologic Past, No. 6, 83p.

Pseudomorphs of New Mexico
What is a pseudomorph?
What pseudomorphs are found in New Mexico?

—Philip Simmons and Erin Delventhal

The first question has been the subject of much debate over the course of the past two hundred years. Even today, the definition of what is and isn't a pseudomorph is not agreed upon by the mineral community. The term comes from the combination of pseudo (false) and morph (form), and is generally applied to crystalline or aggregate mineral materials showing the recognizable form of a different pre-existing crystalline mineral (Delventhal, 2019). The first mention of this term was used for fossil replacements by Renè Just Haüy in 1801 (Delventhal, 2019), but has developed over time to include mineral replacements.

Figure 1. Copper ps. Azurite (alteration), Copper Rose Mine, San Lorenzo, Georgetown District, Grant County, New Mexico, USA. 3.3cm x 2.2cm. Collection of Lou Conti, photograph by Erin Delventhal.

Through extensive research and many talks with other collectors, the following definitions will be used. Alteration pseudomorphs consist of a chemical interaction between the two stages of mineral replacement such as copper ps. azurite and iron oxides/hydroxides ps. pyrite. Minerals can also be partially altered, and the dividing line between pseudomorphs and surficial alteration is a grey area. Encrustation pseudomorphs include minerals that have coated a previous crystalline material while still preserving the original form (epimorphs, perimorphs), such as quartz after calcite. Cast pseudomorphs involve minerals that have filled hollow voids left by a previous mineral, a well-known example being sylvite ps. langbeinite. Fossil pseudomorphs are also prevalent in certain areas, and can be just as interesting as mineral replacements. The Kelly mine has produced a wide variety of these including smithsonite ps. crinoid and horn coral. Pseudomorphs where the elemental chemistry remains constant, but the crystalline structure changes as a result of P-T conditions (paramorphs) are a special case. The most common examples of paramorphs are calcite ps. aragonite and acanthite ps. argentite.

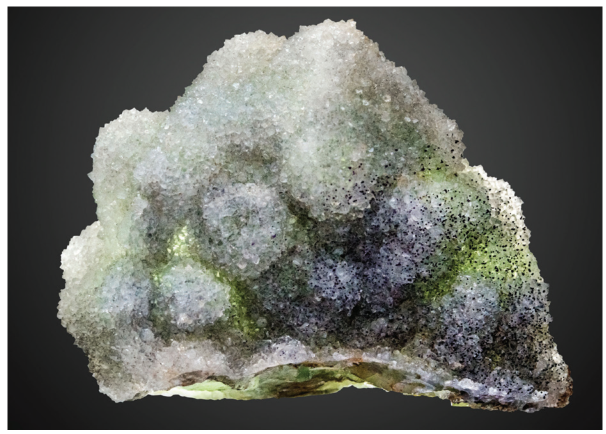


Figure 2. Quartz ps. fluorite (perimorph), Cookes Peak District, Luna County, New Mexico. 4.6cm x 3.4cm. Collection of and photograph by Erin Delventhal.

New Mexico has a vast variety of pseudomorphs, related to the wide geologic diversity within the state and the amount of oxidation that has altered deposit mineralization over the course of time. These deposits not only include the typical base and precious metal ore deposits found in the central, south-central and southwestern parts of the state, but also more uncommon deposits such as pegmatites, evaporites and mafic systems. Many of the most recognized New Mexico pseudomorphs will be discussed along with newer discoveries and oddball occurrences.

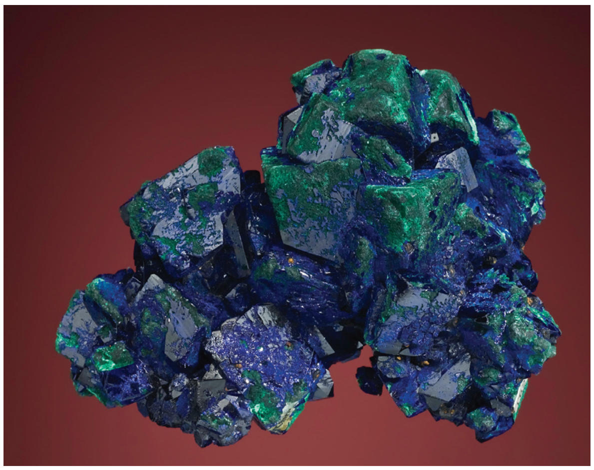
References

Delventhal, Erin (2019). Pseudomorphs: the Mimics of the Mineral World. https://www.facebook.com/notes/enchanted-minerals-llc/pseudomorphs-the-mimics-of-the-mineral-world/469266880271104.

The New Cornelia Mine, Ajo, Pima County, Arizona

—Les Presmyk

The New Cornelia mine at Ajo, Arizona has a long and storied history. Most of it good and a bit of it infamous and notorious. Not like Tombstone and Bisbee with hangings and bank robberies resulting in multiple deaths but there were more than a few investors and miners who lost substantial sums of money due to deceit and fraud. Copper, at least not in Arizona, just does not seem to inspire events like silver and gold has done.



Azurite, Ajo

In the early 1850s, disappointed gold seekers began returning from California to head back east and recover their lives and finances. A few stopped in what was then still part of Sonora, Mexico, searching for gold in the normally dry river beds. In 1853 this all changed with the Gadsden Purchase, which added land south of the Gila River and established the border between Arizona, New Mexico, and Mexico. Once this southern border was established the territories of Arizona and New Mexico were configured but they looked a bit different than today. President Lincoln established the two territories and current boundaries in 1862.

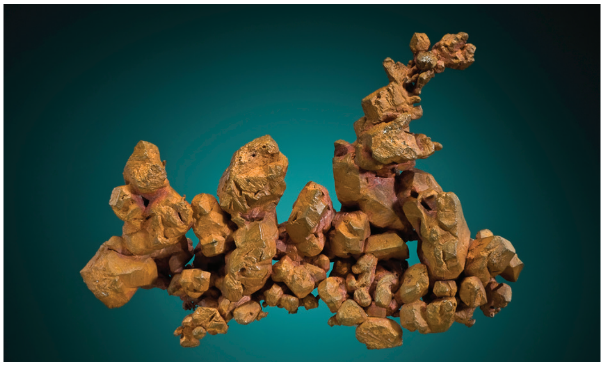
The mineral deposits at Ajo, supposedly named for wild garlic in the area but probably more appropriately named by the natives in the area for vivid blue and green minerals they used in face paint colors, attracted some of the earliest interest by American explorers and prospectors. The greens and blues of the copper oxides stood out in stark contrast to the dark iron-rich rock. Unfortunately, the precious metal values from gold and silver found in most of the other copper deposits around Arizona were more elusive here. Although these deposits were the earliest lodes sampled, productive mining remained elusive for over 60 years.

From the 1850s to the early 1900s the deposits at Ajo went through a series of claims, financial pratfalls and bankruptcies with claims being sold and resold and consolidated. For its first 60 years, Ajo produced more schemes than real mines. The ores were relatively low grade compared to other copper districts in Arizona. For example, the early carbonate ores of Bisbee and Morenci were rich enough (10% to 20%+) to be sent directly to the smelter. Ajo's carbonate rocks were more in the order of less than 5%. So, besides technology not being available to refine this material, water was a constant issue and of course, high transportation costs. The first shipment of 11 tons of hand sorted, high-grade material had to be hauled by 20 mule teams (one ton per wagon) to Yuma, placed on a ship to San Francisco and then shipped to Swansea, Wales for processing. While this ore was worth $400 per ton it was not sustainable and the mining shut down.

When the New Cornelia mine shut down in 1984, it was notable because it was the oldest and longest continually mined open pit copper mine in Arizona. Since that time both the Morenci and Ray mines can now lay claim to that title but the New Cornelia was the first and the longest lived open pit mine, having started in 1916.

The real production phase of Ajo started around 1910 following the success of mining and milling large volumes to reduce the per pound cost of producing copper from lower grade deposits at Bingham Canyon, Utah. Three companies started work at Ajo but it was ultimately John C. Greenway, the general manager of the Calumet and Arizona Mining Company in Bisbee, who decided to start drilling in 1911 to delineate the potential orebody. While this work continued and various claims were acquired, the other issue, not the least important by any means, was how to treat the carbonate and oxide copper ores. This was the first successful and legitimate oxide leach process developed for treating this lower grade material. Greenway and Dr. Louis Ricketts developed this process, starting with a 1 ton plant, ramping it up to 40 tons per day for the next year and with this success, built a 5,000 ton capacity plant to treat these ores.

From 1912 to 1916 a lot was happening in the Ajo area. The railroad was completed from Gila Bend, the town was built, the open pit mine was begun, the leach plant and electrolytic refinery was constructed and just as important, a water source about seven miles away along with a pumping facility and pipeline was installed. May 1, 1917 was a momentous day in Ajo. The leach plant was completed but it was not until June 18 that the first copper cathodes were



Copper, Ajo

shipped out of town. This plant operated until 1930 and processed 17 millions tons of ore averaging 1.3% copper. By 1923, enough sulfide mineralization had been delineated that the construction of a concentrating mill was justified and went into operation in January 1924. With the consolidation of the Phelps-Dodge Corporation and the Calumet and Arizona Mining Company in 1931, Ajo became the New Cornelia Branch of the Phelps-Dodge Corporation.

Minerals and Collecting History

Thomas and Gibbs list 40 species of rock-forming, hypogene and alteration minerals in their 1983 Mineralogical Record article on Ajo. They also list 55 secondary minerals. From this list copper, azurite, malachite (and malachite pseudomorphs), shattuckite, ajoite, papagoite, calcite and cuprite are the most notable.

While there were certainly azurite and malachite specimens uncovered during the first forty years mining, and especially the carbonate and oxide ores, virtually no verifiable specimens exist before the mid to late 1950s. In this time period, expansion of the open pit to reach deeper sulfide ores encountered areas rich in both azurite and malachite specimens, large native copper crystals, masses of crystallized shattuckite and two new copper silicate minerals, ajoite and papagoite. During the late 1950s and early 1960s specimen production from Ajo hit its heyday.

The native copper specimens were unlike anything seen in Arizona because they most resembled Michigan style crystals. Crystals over 2" and masses weighing several hundred pounds were encountered. There was a second style, also very distinctive for Arizona, of parallel growths of herringbone-like crystals. The azurites from this period are also distinctive because they are pseudo-cubic in appearance and of course, the malachite pseudomorphs are just as distinctive.

Cuprite was found as crystals up to ½" on rock matrix and in a few pockets on native copper. Some of the most vibrant cuprite in calcite specimens from Arizona came from Ajo. The chalcotrichite form of cuprite was also abundant during a few short periods.

Shattuckite was found in chunks and masses up to three inches thick and over a foot across. Tufts of radiating crystals were discovered in vugs within these masses. Much of this massive material was cut and polished into cabochons.

During this time two new copper silicate minerals were discovered and named. Both have distinctive colors and occurred as vugs of crystals as well as massive enough chunks to be cut and polished. Ajoite is an almost turquoise blue while papagoite is a medium blue and not as dark as shattuckite.

Calcite specimens, besides those included with cuprite, were found occasionally. The most notable specimens were found while digging the underground water shafts.

The next and final period of specimen production occurred in the 1970s when Wayne Thompson and Southwest Mineral Associates acquired the collecting contract and started work at the mine. The first pocket consisted of two rocks, each with one face covered with malachite after azurite crystals and the occasional unaltered azurite crystal. The two faces were sawn off the larger rocks and then trimmed into smaller specimens. These have become classic Ajo specimens, both for the association and the generally ½" to 5/8" thick matrix obviously sawn back. Additional pockets of azurite and malachite after azurite specimens were recovered at this time. Since the late 1970s no additional specimen recovery has occurred at the mine.

Malachiteaf after Azurite, Ajo

Origin of “Chalcopyrite Disease” and Other Incurable Sphalerite Textures

—John L. Lufkin and Paul Barton

It has been over 45 years since I first heard my co-author speak at the Short Course on Sulfide Mineralogy at the GSA Meetings in Miami, Florida, when he said “it is certain that ore textures present much information, but it is equally certain that there are few areas of scientific endeavor that are more subject to misinterpretation of ore textures. The interpretation of ore textures is the most maligned, most difficult, and the most important aspects of these (sulfide) rocks.” (Barton, 1973, p. B-3) This is still true today, unfortunately. Our task today, however, is to focus on the latest, and perhaps the most challenging texture yet. It received its name one day by the well-known petrologist and microscopist, Jim Craig, Geology Professor at VPI, when he exclaimed, “this is not a texture, it is a disease!”, and doggone it, the name stuck. More accurately, the texture should be described as disseminations or inclusions of dust to very fine-grained chalcopyrite in sphalerite.

Since the time of Paul Ramdohr, the “father of ore microscopy”, it has been learned that ore textures are developed primarily a) as open-spaced fillings, and as processes of b) replacement, c) exsolution, and more recently d) coprecipitation.

Regarding “chalcopyrite disease,” several papers have concluded that chalcopyrite has replaced the host sphalerite. Nakano (1937) was the first to suggest that chalcopyrite blebs in Kuroko ore were formed by replacement of zinc sulfide. All investigators of the disease, including Barton, 1978; Eldridge et al., 1983; Barton and Bethke, 1987; Eldridge et al., 1988, have suggested that copper was added to form the chalcopyrite in inclusions accompanied by loss of zinc and conservation of iron.

In a more recent paper by Bortnikov, et al, Econ. Geol, 1991, their microprobe data on the iron contents in sphalerite from at least one of their Russian deposits was nearly identical, both in zones without chalcopyrite blebs and in zones that are rich in chalcopyrite inclusions. This suggests to the authors that the texture resulted from coprecipitation, rather than by replacement.

We are reminded of Ramdohr’s comment made almost 30 years ago, “...that many textures can be formed in a variety of ways and that even where at present only one mode of formation is known the possibility of several modes of formation exits” (Ramdohr, 1980, p. 195). During this presentation numerous photomicrographs will be shown featuring examples of ore textures produced by replacement, exsolution, and coprecipitation, as well as some unknowns, including the vermicular or “wormy” texture.

Arizona Prehnite: A New Find

—Barbara L. Muntyan

Prehnite, hydrated calcium aluminosilicate, is not a common species in Arizona. Indeed, Mindat (as of August, 2019), lists only six locations, and all but one of these are for massive veinlets of the species. Recently, a newly-reported Arizona find of this mineral has produced attractive, pale green- to cream-color prehnite in well-crystallized specimens up to 15 cm across. The story of the discovery makes an intriguing addition to Arizona collecting history.

I first saw examples of these prehnite specimens at a small gathering of Arizona collectors at our monthly luncheon in Phoenix several years ago. One of the group, Dick Morris (then a Phoenix resident, now living in Pinetop, AZ) had brought in a couple of pieces for "Show-and-Tell." He had acquired them at the Copper City Rock Shop in Globe, Arizona. While these first specimens were modest, it nevertheless aroused my interest as a specialist in Arizona minerals. Within a short time, I took a trip from Tucson to Globe to find out more.

I have known the proprietor of the Copper Rock Shop for many years, and always have found John Mediz to be knowledgeable and willing to share locality information. When I asked about the prehnite find, he told me it was found by two brothers from Globe, and he put me in touch with them. Their story of the prehnite find is most interesting.

John and Roy Trobaugh, who have the deposit under claim, have lived and worked in Globe for most of their lives. Both love the outdoors and spent many hours in the Tonto National Forest, hiking, picnicking with family and friends, and looking for mineral specimens. They were not avid field collectors, but they had knowledge of many species, particularly material from the Globe area suitable for slabbing and polishing.

Many years ago, the brothers attended a mineral show in Phoenix and saw so-called "Desert Roses" for sale. These were not typical desert roses, which are normally either gypsum or chalcedony. These specimens came from the Tonto Forest north of Globe, and were eventually identified as being prehnite. The brothers were intrigued, but did not pursue the find for several years.

Eventually, the Trobaugh brothers and two friends decided to go camping and mineral collecting in the area where the prehnite desert roses had been found. They made camp near a huge tree. One cowboy friend, the late Samuel R. Ellison (nicknamed "Slim," because he was seriously overweight!) was in charge of the cooking, while the other three men reconnoitered the surrounding hills. They found the prehnite seam up on the ridge above the camp and picked up several samples, but did not purse extensive collecting at that time.

Time passed before the brothers decided to reexamine the prehnite deposit. Roy Troubaugh says that a number of Globe residents also knew about the odd "desert roses" and that it was considered merely an interesting deposit (personal communication, March, 2019). The brothers set out to revisit the area where the prehnite was found, looking for the huge tree where they had camped with the two cowboy friends years earlier. They could not find it, and thus spent the next dozen years periodically revisiting the general area and trying to find the exact spot. It became a mild obsession. Finally, in 2013, the brothers took yet another foray to seek the prehnite deposit. This time they found the landmark tree and the prehnite at the top of the ridge. And this time, the brothers filed lode claims on the outcrop.

Prehnite is a secondary or hydrothermal mineral, forming in veins and cavities in mafic volcanic rocks and less-commonly in granitic gneiss. The mountains of the Tonto Forest north of Globe are rugged and sparsely populated. Mountain peaks rise above 6,000 ft., with deep canyons between. The area bordering the Salt River to the north is wilderness area; the San Carlos Apache reservation lies east of the area. A few large ranches run cattle on grazing leases in the area and there are a few Forest Service roads. There are no towns between Globe and Show Low.

The prehnite deposit extends approximately 1,200 ft. along a contact between mid-Proterzoic mafic rock and later Protoerzoic basaltic rock. On the margins of the intrusion, prehnite formed in veins ranging from 2.5 cm to 30 cm which pinch and swell. The prehnite generally forms pale-green massive material, but in the wider pods, has had enough room to form specimens which are found loose in decomposed vugs. Color ranges from off-white to pale sea-green to a medium sea green. Specimens have formed fan-like groups found in clusters looking like roses or perhaps pale green “brains.” A second habit forms tighter fans looking a bit like rice grains.

While researching prehnite, I came across the sole image on Mindat of a crystallized prehnite from Arizona. It had the famous Rock Currier brass bar at the bottom and, indeed, the specimen was his. The notes said the specimen was from the “Cooledge Dam, Stanley Butte mining district” and that the specimen was obtained from Les Presmyk, noted Phoenix mineral collector and dealer. When I contacted Les for more information, he told me he had two specimens and both were obtained from Fred and Sammy Jones of Globe. They had gotten them from Harold Maryott. Doing some further research, it turned out that the Jones were lifelong residents of Globe. Harold Maryott had been the Chief Mine Engineer at Miami Copper from 1939 to 1946, and also a longtime resident of the Globe-Miami area.

My interest in the Currier prehnite specimen and the people surrounding it was due to the fact that the pale-green prehnite shown on Mindat was identical to the specimens which come from the Tonto Forest north of Globe. Subsequently, I have examined Les Presmyk’s remaining specimen. And the similarity to my specimens is remarkable. It has been my experience as a field collector that specimens from two different places are almost never identical. Moreover, Mr. Maryott and the Jones were all from Globe, and (according to Roy Trobaugh) the Jones family leases were located next to the lease where the “Desert Roses” occurred. It is quite possible that either Maryott or the Jones suggested the Cooledge Dam locality in an effort to keep other collectors off their neighbors’ land. Perhaps we will never know for certain.

John Alvin Trobaugh, 1941–2015

References

Anderson, J. L. (1989) "Protoerozic Anorogenic Granites of the Southwestern United States," in Jenney, J.P. and Reynolds, S. J., editors. Geologic Evolution of Arizona. Tucson, Arizona Geological Society Digest 17, 211-218.

Anthony, J. W., Bideaux, R. A., Bladh, K. W. and Nichols, M. C. (1995) "Prehnite" in Handbook of Mineralology, vol. 2. Pt. 2, p. 660.

Anthony, J. W., Williams, S. A., Bideaux, R. A., and Grant, R.W. (1977) Mineralogy of Arizona. Tucson, AZ, University of Arizona Press, First edition, p. 156.

Anthony, J. W., Williams, S. A., Bideaux, R. A., and Grant, R.W. (1995) Mineralogy of Arizona. Tucson, AZ, University of Arizona Press, Third edition, pp. 334-335.

Darton, N. H. (1915) A Resume' of Arizona Geology. Tucson, AZ, University of Arizona Press,pp. 228-232.

Galbraith, F. W. and Brennan, D. J. (1959) Mineralogy of Arizona. Tucson, AZ, University of Arizona Press, p. 115.

Gastil, G. (1962) "A Working Hypothesis for Arizona's Older Precambrian History," in Guidebook of the Mogollon Rim Region, East-Central Arizona. New Mexico Geological Society #13, pp. 52-54.

Goldschmidt, Victor. (1986) "Prehnite" in Der Altas der Crystallformen. Rochester Mineralogical Symposium. Facsimile reprint in 9 volumes.

Liou, J. G. (1971) "Synthesis and Stability Relations of Prehnite, Ca2Al2Si3O10(OH)2," in American Mineralogist, v. 56, 507-531.

Livingston, D. F. "Older Precambrian Rocks Near the Salt River Canyon, Central Gila County, Arizona," in Guidebook of the Mogollon Rim Region, East-Central Arizona. New Mexico Geological Society #13, pp. 55-57.

Shride, Andrew F. (1967) Younger Precambrian Geology in Southern Arizona. U. S. GeologicalSurvey Professional Paper 566.

Smith, Douglas (1970) "Mineralogy and Petrology of the Diabasic Rocks in a Differentiated Olivine Sill Complex, Sierra Ancha, Arizona," in Contribution to Mineralology and Petrology, v. 27, 95-113.

Wrucke, Chester T. (1989) "Middle Protoerozic Apache Group, Troy Quartzite, and Associated Diabase of Southern Arizona," in Jenny, J.P. and Reynolds, S. J. Geologic Evolution of Arizona. Tucson, Arizona Geological Digest 17, 239-258.

The Cresson Mine: The Untold Stories

—Benjamin Hayden Elick and Steven Wade Veatch

The Cresson mine (figure 1)—situated between Cripple Creek and Victor, Colorado—was established in 1894 (MacKell, 2003). No one is certain who started the mine, but records show that two brothers, insurance agents J.R. and Eugene Harbeck from Chicago, were early owners. After a hard night of drinking, they sobered up the next day and learned of their new acquisition (MacKell, 2003). The Cresson Mining and Milling Company was organized a year later, in 1895, to raise capital and operate the mine (Patton and Wolf, 1915). The mine continued operating through several leases with low but steady proceeds.

The Cresson mine became profitable when Richard Roelofs, a known mining innovator, was hired by the Harbecks as mine manager in 1895. Roelofs wrote on an undated letterhead: "I was a prospector, a leaser, a miner, an assayer and chemist, an underground shift boss, foreman, superintendent and then general manager of one to the greatest of Colorado's mines" (Roelofs, n.d.).

Roelofs (figure 2) was a newcomer to Colorado, as many were when the Cripple Creek gold rush ignited in 1891. He moved to Cripple Creek in 1893 with his wife Mabel. They had one child, Richard Jr., who was born on August 19, 1894 in Cripple Creek.

Roelofs introduced new technology and mining techniques at the Cresson mine, including an aerial tramway he designed that transported ore to a railway at the bottom of the large hill on which the Cresson sat. The tramway reduced the costs of transporting ore (Sprague, 1953). Roelofs deepened the shaft and enlarged the mined-out voids, or stopes. The Cresson's stopes were the largest in the district, at almost 100 m in width and hundreds of meters high. It is estimated that several houses could fit inside the stopes of the Cresson (Jensen, 2003; Sprague, 1953). Roelofs's work allowed the Cresson mine to be debt free by 1911, and it earned $150,000 annually between 1912-1913.

Miners discovered the famous Cresson vug by accident on November 25, 1914 (Smith Jr., Feitz, and

Figure1. Early view of the Cresson mine, Cripple Creek, Colorado. Photograph date circa 1914, courtesy of the Cripple Creek District Museum.

Raines, 1985). While following large ore shoots on the 12th level, miners broke into the large chamber, or "vug," which was in the shape of a pear (Patton and Wolf, 1915). The vug was approximately 12 m tall, 7 m long, and 4 m wide. The walls were lined with delicate, sparkling crystals of gold tellurides; however, many had fallen to the floor—disturbed by nearby blasting (Jensen, 2003).

The ore minerals in the vug were mostly the gold tellurides sylvanite and calaverite. Sylvanite is comprised of gold, silver, and tellurium, while calaverite contains only gold and tellurium. The tellurides within the Cresson vug occurred as crystals, varying in length from 1 to 3 mm. On some crystals of calaverite, pure gold was found, suggesting chemical alteration (Patton and Wolf, 1915). These ore minerals penetrated beyond the surface of the vug into the surrounding rock to depths of up to 1.5 m (Mehls and Mehls, 2001).

The gold camp was soon buzzing with conversation about the vug, and word of the discovery spread across the nation. National newspapers said the vug "staggers the imagination," and another paper declared it "the most important strike ever made in the Cripple Creek District" (Various period newspapers: Cripple Creek District Museum, n.d.). This astonishing discovery supported Cripple Creek's claim that it was the "World's Greatest Gold Camp."

The vug, and a considerable amount of Cresson ore, was a part of the Cresson pipe, or blowout. The Cresson pipe is an elliptical cylinder of lamprophyric material (mafic rocks) 100 to 150 m in diameter (Jensen, 2003). The lamprophyric matrix graded into a lighter colored carbonate matrix (Jensen, 2003). The entire blowout is encased inside a diatreme, a carrot-shaped volcanic complex, emplaced in the Oligocene (~ 30 Ma) that reached deep into the crust (Jensen, 2003). The perimeter of the pipe produced 2,000,000 ounces of gold, indicating major deposits of gold-bearing solutions along the contact between the Cresson pipe and the diatreme (Jensen, 2003).

The gold ore from the vug was so valuable that Roelofs quickly took measures to prevent theft or high grading. He ordered a storehouse built underground (on the same level as the Cresson vug) into an old drift and secured it with solid steel doors. Bags of gold ore were stacked by hand and securely locked inside. A newspaper article described the magnitude of ore as "they had stacked between 80 to 100 tons of the phenomenally rich ore at the time of my visit, and from all indications, will continue stacking this ore for some time" (Various period newspapers: Cripple Creek District Museum, n.d.). At times, up to $500,000 (1914 value, or $36,250,000 in today's dollars) worth of gold ore was stored there.

The Cresson vug's valuable gold ore also needed special handling. Roelofs hired guards to protect the vug and ore. The guards watched over the ore on every part of its journey through mining, transportation, and processing—keeping it safe from thieves. Two to three armed guards worked each shift underground, providing constant protection to the ore and vug. To prevent high grading, Roelofs allowed only two of the most trusted and senior miners to work the vug at a time, and always under close supervision.

Figure 2. Richard Roelofs, manager of the Cresson mine. Photograph date 1914, courtesy of the Cripple Creek District Museum.

The Cresson mine took precautions to secure the ore while it traveled on the railways to smelters. These measures included locked box cars and guards carrying sawed-off shotguns and rifles, who rode inside and on the top of the cars (Newton, 1928).

Accounts claim that gold ore was scraped off the vug's walls and then shoveled into large canvas bags (figure 3). It took four weeks to mine the vug out (Cunningham, 2000).

There were two main grades of ore from the Cresson vug: the first grade included ore worth over $5,000 (1914 dollars) per ton and the second grade from $1,000 to $1,500 (1914 dollars) per ton ("$10,000,000 Strike in Cresson Mine Proves Again that Colorado is the Paradise for the Gold Hunter," 1914, p. 5). The higher-grade ore had 250-plus ounces of gold per ton, while the second grade of ore had 75-plus ounces per ton, based on the 1914 gold price of $20 per ounce (Historical Gold Prices, 2015).

Figure 3. Canvas bags of gold ore from the Cresson vug are brought to the surface. Men are getting the bags ready for shipment. Photograph date 1914, courtesy of the Cripple Creek District Museum.

In all, a whopping 60,000 ounces of gold was recovered from the vug (Hunter, 2002). The total value of the vug's ore in 1914 gold prices was $1,200,000 (Smith Jr., Feitz, and Raines, 1985). Based on today's gold values, the vug's rich ore would be worth over $87,000,000.

The discovery of the Cresson vug prompted other mines in the district to deepen their shafts, since the vug was found on a deep level of the Cresson. Mine owners also expanded exploration in their mines.

The Cresson mine was operated for 66 years, finally closing in 1961 (Munn, 1984). After finishing as one of the top producing mines in the district, its buildings were torn down and the head frame and its machinery were moved to a park in Victor.

In the early 1990s, exploration geologists discovered a 2.5 million-ounce gold deposit in the same area as the historic Cresson mine, called the Cresson deposit. The Cripple Creek and Victor Gold Mining Company submitted permit applications in 1994 for open pit mining of the Cresson deposit and surrounding areas. Mining started in December 1994, and by the end of 1995, 76,500 ounces of gold were produced. The Cripple Creek and Victor Gold Mining Company is still mining the area today under the ownership of Newmont Goldcorp with headquarters in Greenwood Village, Colorado.

The original Cresson mine shaft is long gone, and in its place is the Cresson open pit at 518 m deep (Poulson, personal communication, 2019). Newmont will deepen the pit another 91 m for an ultimate depth of 609 m. At this point, a portal for underground exploration is planned at the bottom of the pit. This project is planned in two phases. In phase one, a decline drift is planned with 762 m of easterly exploratory drifting underneath the Cresson pit. The intent is to establish drill bays at the end of the drift for core drilling below the historic Orpha May and Vindicator mines. The estimated cost of this phase is $26 million. Phase two includes 3,048 m of exploration drifting and positioning core drilling bays at an additional $100 million cost. The goal is to prove the potential for underground mining projects. If Newmont Goldcorp's investment council approves this plan, the project would start as early as the first quarter of 2020 (Poulson, personal communication, 2019).

The Cresson mine took its place among the important mines in Cripple Creek as a result of its early establishment in the district, an innovative mine manager, expansive underground workings, and the discovery of the rich Cresson vug. Mining continues at the Cresson today.

References

$10,000,000 Strike in Cresson Mine Proves Again that Colorado is the Paradise for the Gold Hunter. (1914, December 30). Denver Post, p. 5.

Cunningham, C. (2000). Cripple Creek Bonanza: From Gold to Gambling. Ridgway, CO: Wayfinder Press.

Historical Gold Prices. (2015). Retrieved from Only Gold: http://onlygold.com/Info/Historical-Gold-Prices.asp

Hunter, E. T. (2002). A Thumbnail Sketch of the Cripple Creek/Victor Mining District's History. Manuscript on Newmont Gold Corp website: https://www.newmontgoldcorp.com/wp-content/uploads/2019/04/ccv_history.pdf

Jensen, E. P. (2003). Magmatic and Hydrothermal Evolution of the Cripple Creek Gold Deposit, Colorado, and Comparisons with Regional and Global Magmatic-Hydrothermal Systems Associated with Alkaline Magmatism. PhD Thesis. Department of Geosciences, University of Arizona.

MacKell, J. (2003). Cripple Creek District: Last of Colorado's Gold Booms. Charleston: Arcadia Publishing.

Mehls, S. F., and Mehls, C. D. (2001). Goin' Up to Cripple Creek: A History of the Gold Belt Byway. Lafayette, CO: Western Historical Studies.

Munn, B. (1984). A Guide to the Mines of the Cripple Creek District. Colorado Springs: Century One Press.

Newton, H. J. (1928). Yellow Gold of Cripple Creek: Romances and Anecdotes of the Mines, Mining Men, and Mining Fortunes. Denver: Nelson Publishing Company.

Patton, H. B., and Wolf, H. J. (1915). Preliminary report on the Cresson gold strike at Cripple Creek, Colorado. Golden: Colorado School of Mines Quarterly. Vol 9, No. 4, p. 199-217.

Poulson, B. (2019, Febuary). Cripple Creek and Victor Gold Mine . (S. Veatch, Interviewer)

Roelofs, R. (n.d.). Undated letter, Cripple Creek District Musuem. Retrieved 2018

Smith Jr., A. E., Feitz, L., and Raines, E. (1985). The Cresson Vug Cripple Creek. The Mineralogical Record, Volume 16, p 231-238.

Sprague, M. (1953). Money Mountain: The Story of Cripple Creek Gold. Lincoln: University of Nebraska Press.

Various period newspapers: Cripple Creek District Museum, n.d. (n.d.).

Mineral Adventures in the Keweenaw

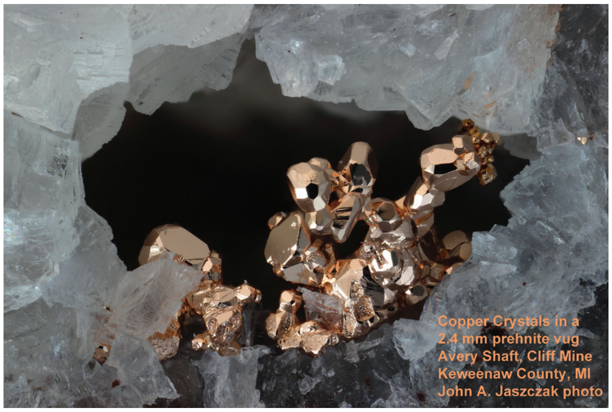
—*Tom Rosemeyer, 57647 Caledonia Street, Calumet, MI 49913, datolite@charter.net*

Two years have passed since I have given a talk on the Michigan Copper Country and I will update you on the collecting over that period of time. Most of the specimens recovered have been the result of mine dumps being crushed for construction purposes. Crushing has continued at a steady pace and will continue to do so in the future. The downside is that once the dumps are gone they are gone for good but on the upside specimens are being recovered. The contractors have been allowing collecting after working hours and on weekends. This has allowed the recovery of many copper and silver specimens along with associated minerals being saved from the jaws of the crusher. Every year it is a race against time to try and save specimens from a colorful bygone era of mining in the district. There has also been small but important discoveries made at remote mine sites that I will discuss in the talk.


Copper (1.3 cm wide)
Old Seneca Mine
Keweenaw County, MI
John A. Jaszczak photo


Copper Wire - 4 mm vug
Cliff Mine, No. 4 Shaft
Keeweenaw County, MI
John Jaszczak photo


Copper included quartz
2.4 mm crystals
Aztec Mine,
Ontonagon Co., MI
John Jaszczak photo


Copper Crystals in a
2.4 mm prehnite vug
Avery Shaft, Cliff Mine
Keweenaw County, MI
John A. Jaszczak photo

Goldfield—Short but Sweet!

—Nathalie N. Brandes and Paul T. Brandes

Discovered in 1902, Goldfield quickly grew into Nevada's largest city. Peak production from the rich but confusing epithermal ore occurred in 1910. By 1912, both the population and production were declining. In those few short years, Goldfield rose to prominence and faded into obscurity but remains a fascinating locality for those interested in geology and mining history.

Overview of Goldfield from 1908, just before the crash.

Goldfield is located in the Goldfield Hills about 45 km (28 mi) south of Tonopah, Nevada. The mining district sits at an elevation of ~1740 m (~5700 ft.), although the surrounding hills rise as high as 2100 m (6900 ft.). The climate is arid, resulting in little vegetation. US Highway 95 runs through Goldfield today, but early in the 20th Century three standard gauge railways also served the city.

The Goldfield Mining District sits at the western margin of a Tertiary volcanic center. Typical rocks of the district include volcanic breccia, rhyolite, quartz latite, trachyandesite, and rhyodacite overlying Ordovician metasediments and granitic rocks. The oldest of these volcanic rocks are Oligocene (30-31 Ma). During this eruptive episode, a caldera and associated ring fracture system formed. After a period of quiescence, volcanism resumed around 22 Ma with the eruption of trachyandesite and rhyodacite.

Goldfield is the largest known high sulphidation gold deposit in North America. These types of epithermal deposits tend to form adjacent to volcanic centers where magmatic volatiles, such as HCl and SO^2, rise and are absorbed by meteoric water, resulting in an acidic fluid that leaches rock. In the case of Goldfield, this mineralization occurred about 20-21 Ma with the shallow emplacement of a pluton. Ore fluids followed fractures and faults associated with the prior volcanic activity of the region, including the Oligocene ring facture system. Rock closest to the fractures was silicified whereas rock farther from the fractures was argillized. Supergene mineralization occurred between 9 and 12 Ma based on alunite formation.

The Goldfield Mining District occupies an area of about 39 km^2 (15 mi^2) of hydrothermally altered rock, however, the richest ores were concentrated in an area of only 1.3 km^2 (0.5 mi^2). Gold occurred within the silicified zones of the altered Tertiary volcanic rocks. Changes in grade, even within the silicified zone, were abrupt, often going from rich ore to barren rock within a meter (3.3 feet). Typically the highest grade ore occurred in brecciated parts of unoxidized ore zones. Often the brecciated pieces would be covered with quartz, pyrite, famatinite, tetrahedrite-tennantite, bismuthinite, goldfieldite, native gold, and sometimes tellurides and sphalerite. This ore commonly produced 440-580 oz./ton gold. The richest carload of ore, however, was extracted from the Mohawk Mine in 1906 and produced 609.6 oz./ton gold and 75.4 oz./ ton silver.

The first claims at Goldfield were staked on December 4, 1902 by Harry Stimler and William Marsh, a pair of prospectors who had been grubstaked by Jim Butler of Tonopah. The prospectors named their site "Grandpa." Soon more gold strikes were made, more claims were staked, and a rush to the new district began. By 1903, a town was organized

A modern (March, 2019) view of Florence Mine and its remaining headframe.

and given the name Goldfield. Mines in the district operated under a leasing system in which a company was granted a lease along a vein and paid the claim owner a percentage of the production after operating costs. This led to the development of many mining companies until most were consolidated by George Nixon and George Wingfield as the Goldfield Consolidated Mines Company.

Just five years after the initial discovery of ore, Goldfield became the largest city in Nevada with a population near 20,000. The glory days of rich ore in Goldfield were short-lived. Labor tensions rose with the arrival of the Western Federation of Miners union and strikes broke out in 1906 and 1907. Fearing violence, as had occurred in Leadville, Colorado and other mining towns, federal troops were dispatched to maintain order. The strike ended with no major episodes of violence and mining companies refusing to employ Western Federation of Miners members. Peak production from the mines occurred in 1910 with 539,000 oz. gold and 118,000 oz. silver produced. Following that year, large numbers of the population began leaving. By 1912, a local mining engineer reported to a friend that all who were able had left that spring. Mining continued for a few more years, but in 1919 the Goldfield Consolidated Mill shut down and with it, large-scale mining ended.

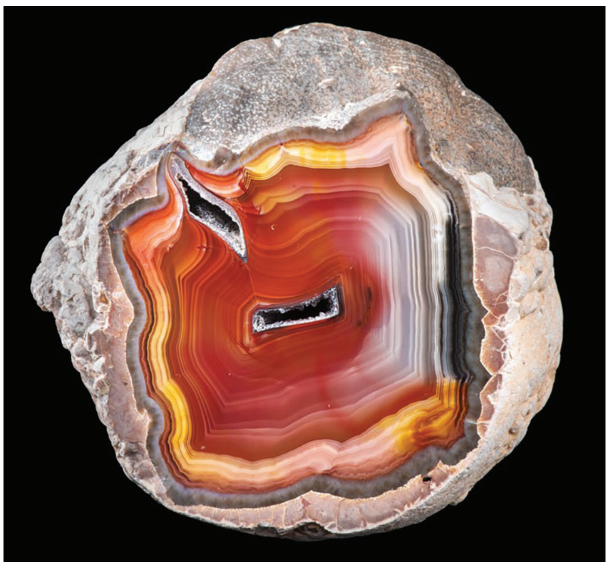
The town seen today is but a small part of what once existed. A major flash flood destroyed part of the town in 1913. Ten years later, a bootlegger's still ignited a fire that swept through many of the remaining buildings. If one visits Goldfield today, one can still see the hotel, the courthouse, the school, and of course, the headframes and tailings piles of a legendary mining locality.

A high grade gold specimen from the tailings pile of the Florence Mine. This photo is courtesy of Jon Aurich.

The Agates and Geodes of Northern Chihuahua and Southern New Mexico

—*Brad L. Cross, 810 East Olympic, Pflugerville, Texas 78660, Brad.Cross@WSP.com*

Since the 1940's, northern Chihuahua and southern New Mexico have gifted collectors with a wide variety of colorful, complex, and intriguing agates, geodes, and thundereggs. The occurrences are found as isolated deposits, most within Tertiary-age andesites, rhyolites, and ash flow tuffs. The rare exception is Crazy Lace Agate which occurs in Cretaceous-age limestone.



New Mexico Thunderegg, Luna County, New Mexico

Traveling south of El Paso, Texas along Mexican Highway 45, the first commercial quartz geode deposit is found near Villa Ahumada, Chih., approximately 83 miles south of the border. Intermittent deposits of colorful agate nodules and quartz geodes can be traced in a southerly direction into the state of Durango, a distance of at least 450 miles.

A vast majority of the more popular agates such as Laguna, Coyamito, Agua Nueva, and "Coconut" geodes are concentrated mid-way between El Paso and Chihuahua City in the Sierra Gallego region. A second trend of occurrences continues off to the northwest some 125 miles to the modern-day city of Nuevo Casas Grandes, then 100 miles north up to Palomas and Deming, New Mexico on the U.S.—Mexico border where Hermanas thundereggs, Big Diggins Agate, and a host of other banded, sagenite, and plume agates are found.

Each variety of agate is usually named after a nearby ranch or railroad station and all are found on private land, usually large cattle ranches. Although quality material could be easily collected from the land surface in the 1940's and 1950's, loose material quickly disappeared and hard rock mining was initiated.

Although there are many varieties of Mexican agate, each has a unique set of characteristics such as specific color ranges, fineness of banding, nodule size and shape, as well as external pitting and color that help provide clues in identifying the exact location.

Laguna Agate

This nodular agate is perhaps one of today's most popular varieties, recognized by its colorful, distinct, ornate, fluted, and holly leaf-like fortifications. The brighter color combinations are many times found in the central portion of the nodule where clear chalcedony tends to alternate with opaque bands. There are several colors found in Laguna that seem to be particularly typical. Raspberry red, shades of orchid, pleasing soft yellows, orange, and gray bands

Laguna Agate, near Estacion Ojo Laguna, Chih., Mexico

are especially common. The most prized specimens have contrasting combinations of color such as purple, red, and orange.

Nodules ranging in size from a hen egg up to a large cantaloupe are mined immediately east of Estación Ojo Laguna in the Sierra El Oso, located approximately 170 miles south of El Paso.

Coyamito Agate

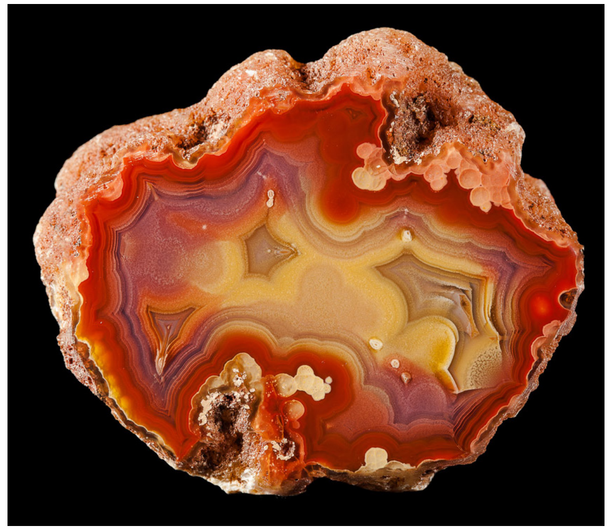
Rare color combinations of purple and yellow, rose and white, as well as various shades of red, orange and mustard are found in this Chihuahuan gem. Unlike the Laguna Agates, most of the brighter colors typically occur in the outer perimeter. The clash colors, coupled with ghostly pseudomorphs of evaporitic minerals, make this agate one of Chihuahua's most prized gems.

Found on Rancho Coyamito Norte, or about 30 miles north of the Laguna Agate deposit, two primary deposits are identified on the ranch. The Los Alamos area is the most southerly productive region on the ranch and characteristically contains muted or dark shades of lavender and yellow bands encasing both molds and casts of past mineralization. These agates are particularly large and can reach upwards of a foot in diameter.

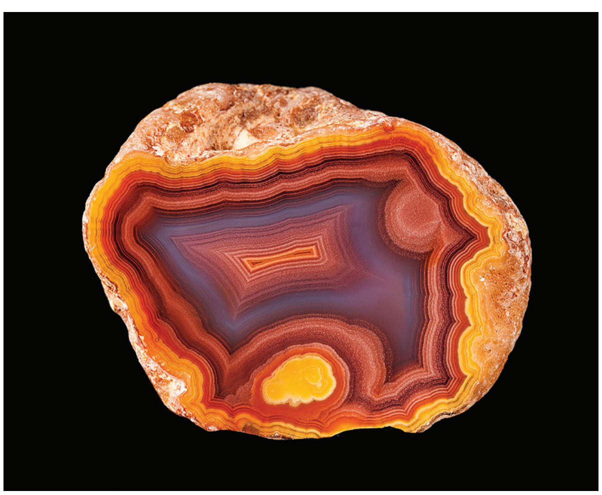
Some 500 yards to the north of Los Alamos is La Sonoreña, a grouping of small and isolated concentrations of agate. Here, various small pits are found on the slopes of the andesitic hills where each pit tends to produce a unique type of agate. Few agates offer the variety and appeal as those from this ranch.

Moctezuma Agate

Pastel shades of salmon, pink, yellow, tan, and white readily identify a Mexican agate locality as Rancho El Barreal. Found east of Estación Moctezuma, these nodules are located within the mining concession Laguna Verde. These nodules typically have a siliceous and sometimes chalky white banana peel-like rind. Chromatography, a separation of coloring agents by semi-permeable bands, are many times found in Moctezuma Agate and provide abrupt and dramatic color changes.



Coyamito Agate, Rancho Coyamito Norte, Chih., Mexico



Coyamito Agate, Rancho Coyamito Norte, Chih., Mexico

Apache Agate

Unlike the common fortification pattern found in other nodular agates, Apache agate has bright red, vivid orange, and dark yellow splashes of color seemingly suspended as draped folds and swirling veils in colorless to deep blue chalcedony. Located on Rancho La Viñata, most of the host andesite has succumbed to the attacks of mother nature, leaving the irregular-shaped nodules to prominently stand out in a beige clay-like soil.

Agua Nueva Agate

Occurring in both nodule and vein form, the trademark characteristic for Agua Nueva Agate are remarkable straw-like tubes. Vein agate, reaching over 14 inches in thickness, occurs on Rancho Los Nogales as a golden brown to red moss agate with individual pockets of purple, white, and pink tube agate. The individual tubes average three-quarters of an inch in diameter, many times being completely encased by euhedral quartz. Found within the same mining concession, Mi Sueño, nodular banded agates shaded in lavender, purple, gold, and yellow are also found.

A second area of the ranch, claimed under the name Agua Nueva, produces nodular agates with a flat base and somewhat domed top. These nodules characteristically contain an outer perimeter of dark yellow to light orange moss agate. The central portion of the nodules typically contains rosy violet hues contrasting with the occasional dark green, black, or white band.

Apache Agate, Rancho La Vinata, Chih., Mexico

Crazy Lace Agate

Towering above the desert floor to an elevation of 6,200 feet, the Sierra Santa Lucia hosts numerous agate mining concessions and diggings. Primarily occurring as a vein agate, irregular curved and twisted bands in shapes of zig-zags, scallops, bouquets, sunbursts, and eyes compose this agate. The peculiar structures are many times grouped together in a larger spherical complex. While individual bands of red, yellow, orange, or brown occur, the vast majority of the material is gray or white. However, widespread staining is primarily responsible for much of the color. Unlike all other Mexican agate, Crazy Lace Agate is mined from a highly siliceous, dark gray Cretaceous limestone.

"Coconut" Geodes

The popular Mexican "coconut" geodes occur within an ash-flow tuff at Las Choyas, a remote geographic point approximately 22 miles northeast of Ojo Laguna, Chih. These quartz geodes are mined from a two square-mile area and have constituted a multi-million dollar business. Geodes from this location are easily identified by their near-perfect spherical shape. They occur in a 44 million year old ash flow tuff and the geodes, when brought to the surface, appear white from the clinging fragments of the volcanic ash in which they were imbedded. Roughly three-foot diameter shafts are hand dug to depths of 100 feet or more through tenacious, welded ash flow tuff. Once the geode-producing unit is reached, tunnels are constructed in the highly altered tuff, following the pay zone.

Only 20 percent of the geodes are hollow and those that are, usually have an outer wall of variable thickness consisting of blue-gray banded agate while other walls are composed entirely of siderite. The walls grade inward into well-defined crystalline quartz of colorless, smoky, and amethystine varieties. Finally, there is a complex of late-stage sequence of minerals, including carbonates, manganese oxides, and iron oxides and hydroxides, in the centers of many of the geodes.

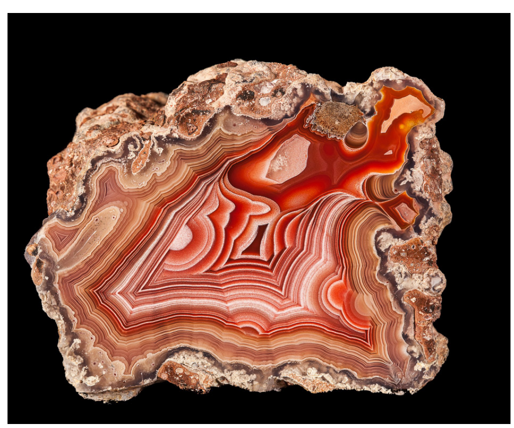
Hermanas Thundereggs

World class thundereggs can be found approximately 38 miles southwest of Deming, New Mexico. Multi-color banded agate, opal, and various varieties of quartz can be found within the round spheroidal nodules known as thundereggs. This section of land is currently under lease by Lori Lytle Coleman of the Spanish Stirrup Rock Shop. No digging or surface collecting is allowed except during scheduled times with clubs and Lori.

Deming Agate (Big Diggins Agate)

Known for its beautiful banded agate in shades of reds, yellows, blues, and smoky blacks, lapidarists from around the world have cut and polished this classic agate for many years. There are currently 11 Bureau of Land Management claims in the Big Diggins area. Collecting is allowed only with permission from a claim holder.

Laguna Agate, near Estacion Ojo Laguna, Chih., Mexico



Laguna Agate, near Estacion Ojo Laguna, Chih., Mexico

Fluorescent Calcite Of Southwest New Mexico: Ultraviolet Colors to Rival Franklin New Jersey

—Bruce E. Cox, Geologist, Missoula, MT and T or C, NM

Abstract

The southwest quadrant of New Mexico hosts many localities yielding calcium carbonate minerals that fluoresce under short wave and long wave ultraviolet light. These localities correlate geographically with the mapped occurrence of manganese (Mn) deposits. Specimen fluorescent colors range from deep red, orange and pink (Mn activator?) to white, yellow and green (uranium and organic activators?). Samples were selected for a range of fluorescent color and intensity and submitted to a commercial lab for ICP analyses to determine potential UV activator elements. A comparison with other US fluorescent localities is presented.

Colombian Emeralds and Their “Oily“ Heritage

—David Stoudt, Santa Fe, New Mexico

Colombia has a rich cultural history, ethic diversity, biodiversity, and is rich in natural resources, including being the number one producer of fine emerald gemstones for jewelry and mineral specimen collectors in the world. The presentation will explore the Colombian emerald-countryside found in the Oriental (eastern) Cordillera Mountains and put forth a theory of emerald formation, not currently found in the voluminous, past and current literature.“ Esmeraldas de Colombia (1992), Emeralds of the World (English Lapis 2009), Colombian Emeralds (Mineralogical Record 2016) and Magnificent Green (GRE Swiss Lab, 2018) are all informative, but none have made the Emerald/Oil connection. When several Bogota Colombians learned that I was making this presentation, they exclaimed, “Do not tell consumers that emeralds and oil are tied together, we may
lose profits.”

The author in a 45 year career in domestic U.S. and International, oil and gas exploration/production has travelled to over 39 countries; lived and worked in several as an American expat. His focus for the past 11 years has been Colombia. This has given him significant and detailed exposure to geo-chemical oil/gas generation analyzes and analyzes of the produced oils; and that; together with numerous geo-field trips into the mountainous outcrops that host the emerald mines of Colombia and those outcrops are of interest in exploring for more of Colombia’s future oil fields. The same emerald-bearing, SURFACE geological units produce oil from the equivalent SUBSURFACE geological intervals in the oil basins to the west and east of the uplifted Cordillera holding the emerald mines. Geologcial coincidence, you may say?

Emeralds found around the world in 31 countries can be hosted in two types of deposits. First, the majority of emeralds are found in host rock of metamorphic/igneous origin. Second, Colombian emeralds are unique, in that, they are the only emeralds that are found in host rocks of sedimentary origin, such as marine shales and carbonates. A geological singularity, in itself.

Colombian emerald formations have three constants in their origin. First, the sedimentary host rocks are environmentally deep marine and Lower Cretaceous in age with high total organic content (TOC 3–19%). They were part of a worldwide geological event that saw biotic life eventually leading to Colombian oil generating source rock that contained increased amounts of Beryllium (Be), Chromium (Cr), and Vanadium (V). All of those three elements play critical parts in the formation of the intense, rich green emeralds of Colombia. The produced oils from the Middle Magdalena Basin (west of the Muzo emerald mines) and the produced oils from the Llanos Basin (east of the Chivor emerald mines) have abnormal amounts of Beryllium, Chromium, and Vanadium in their analyses. Coincidence?

The second constant and critical to the formation of emeralds is the under lying Evaporite (halite) beds that gave forth saline solutions which mobilized the critical elements for emerald formation. The evaporites are confined to the bottom of the Cretaceous age basin and form piercement salt domes found today on the surface, to the northeast of Bogota. Following the days of the Spanish conquest, salt mining found emeralds in the hardened sediment surrounding the salt domes.

The third constant for Colombia emerald formation and producing oil fields are the two periods of significant fault and tectonic deformation. The Pacific tectonic plate subduction under the Colombian landmass occurred in two easterly directed deformation pulses; occurring at 65 MM years ago for the eastern flank of the emerald belt (Chivor) and at 35 MM years ago for western emerald belt (Muzo). The deformation pulses produced high temperature and pressure events leading to the emerald crystal occurrences. Outcrops and oil wellbore cores contain evidence of numerous fracture types which are the pathways for emerald bearing fluid movement .

Colombian Emeralds are formed in the complex interplay of (1), elementally-enhanced, oil source rocks mixed with (2), the mineral rich fluids generated from the underlying evaporite/halite beds and (3) are then deeply buried under high temperature and pressure conditions. These emerald host rocks are then tectonically uplifted, faulted and folded into the present-day topography.

From field trips by helicopter and 4-wheel drive vehicles; numerous hot and humid hikes; to emerald mine visits; illustrated with specimen photos; to the streets of Bogota; this geological/mineralogical story will take you across the Colombia landscapes. The finest Colombian emeralds are some of the most coveted mineral specimens and fine Colombian emerald jewelry may command princely sums of money.

To bring the presentation home to New Mexico, there is brief discussion of New Mexico's emerald occurrence.

The author would to thank Virgil Lueth (Socorro) and Kelsey McNamara (Socorro) for accepting and aiding in the presentation. Remora Energy and La Luna Energy and their associated Houston and New York private equity financing partners for successful exploration/production efforts in Colombia over the last 11 years and permitted the author use of technical data. Dona Leicht of Kristalle (Calif) for use of some of her travel photos. Jesse Klein and Taos Rockers for insight into the emerald deposit of northern New Mexico. Susan Hoffman, my wife and travelling partner to some of Colombia's great cities.

New Mexico Micro Minerals – Obscure, Rare and Aesthetic Species

—Ramon S. DeMark, Michael Michayluk, and Thomas Katonak

A significant portion of New Mexico's mineralogical heritage can be attributed to micro minerals. Noteworthy occurrences are found in a variety of geological environments and regional areas. As with hand specimens, many of the locations for these minerals are no longer accessible, in existence—or even precisely known in some cases. This presentation focuses on a number of the micro minerals that are remarkable due to their rarity, obscurity and in some cases aesthetics. Such mineral examples are widely scattered over our state and include many mining districts and sub-districts. This table summarizes the locations where our specimens come from.

For a moment, let's also consider the "aesthetics" of these specimens. The exceptional beauty of our selection can only be revealed with the use of a microscope, and the capturing of the images through the techniques of photomicrography. Accordingly, many of the images in this presentation are just…stunning!

While the cognoscenti will know many of these minerals, other names will be unfamiliar to some collectors. The goal of this presentation is to make the remarkable breadth and diversity of New Mexico minerals known to the wider mineralogical community.

Baryte w/Uranophane

We can see that our special examples come from ten of New Mexico's 33 counties, where the southwestern counties Grant and Sierra tend to predominate. Also notice from the table that in many cases, it is unlikely that more specimens from these particular places will be recovered because of reclamation and loss of access.

Antlerite

Spangolite

Black Hawk district	Grant	Alhambra mine	Private claim
Point of Rocks	Colfax	Point of Rocks	Private ranch land
Georgetown district	Grant	Commercial mine	Reclaimed
Gallinas Mountains district	Lincoln	Buckhorn mine	Reclaimed
Red River district	Taos	Questa mine	Closed and in reclamation
Santa Rita district	Grant	Chino mine	Closed to collecting
Burro Mountains district	Grant	Tyrone mine	Closed to collecting
Central district	Grant	Denver Shaft	Reclaimed
Nacimiento Mountains dist.	Sandoval	Eureka mine	Private claims
Socorro Peak district	Socorro	May Flower mine	Access with permission
Grants Uranium district	McKinley	Poison Canyon, F-33 mine	Reclaimed
Red River district	Taos	Questa Mine	In reclamation

The Blanchard Mine: The Little Mine That Couldn't Ore

—Erin Delventhal

The Blanchard Mine, located in the Hansonburg District in the northern portion of the Oscura Mountains, Socorro County, New Mexico, has earned its place as a classic New Mexican locality through the production of widely available, high-quality mineral specimens - most notably the "Blanchard blue" fluorite (often associated with galena) as well as the discovery of some of the world's largest known linarite crystals. However, the rich mineralization at the Blanchard Mine produces a suite of other minerals that appeal to many varieties of collecting styles.

Fluorite - Ray DeMark: Fluorite on quartz • 21 cm x 10 cm x 8 cm • 5.4 cm edge on large crystal • Across from the ore bin • Ray Demark specimen • Erin Delventhal photograph

The history of the Blanchard Mine reaches into Indigenous Peoples and Spanish colonial history, but large-scale development began in the early 1900s. Numerous attempts were made to develop an economic source of lead at the Blanchard, but all were victim to the trials found in mining in a harsh and remote desert. Throughout the years, the Blanchard has been utilized as a "collector's dream," with visitors arriving from around the globe to be lead through the property by characters such as Ora Blanchard ("The Lady on the Mountain"), Sam "Rattlesnake" Jones, and, in present times, Ray DeMark, Mike Sanders, and Brian Huntsman.

Ora Blanchard at the rock shop in Bingham, circa 1967. Photograph by Vera Jones, courtesy of Vera Jones and the New Mexico Bureau of Geology and Mineral Resources, Historic Photograph Archives, Socorro, NM 87801.

The Sierra Oscura Mountains consist of basement Proterozoic granites and gneisses with overlying Pennsylvanian formations of marine limestone and shale with interbedded arkosic sandstone. Mineral deposits at the Blanchard Mine are concentrated as open-space fillings in fissures, fault breccia, and solution cavities that are primarily concentrated in the Council Springs limestone. The Blanchard Mine and the Hansonburg District have been the subject of numerous academic studies as one of the most prominent of the Rio Grande Rift deposits.

View of Western Mineral Product Co.'s mill looking north, circa 1916. Photograph courtesy of Wally Clark, St. Joe American Corp., Tucson AZ, New Mexico Bureau of Geology and Mineral Resources, Historic Photograph Archives, Socorro, NM 87801.

References

Allen, B. A., 1964, The Nature and Content of Certain Trace Elements in Selected Galenas (thesis): University of Arizona.

Basic Earth Science Systems, Inc, 1972, The Hansonburg Mining District, Socorro County, New Mexico.

Bohlke, J.K., Irwin, J.J., 1992, Brine history indicated by argon, krypton, chlorine, bromine, and iodine analysis of fluid inclusions from the Mississippi Valley type lead-fluorite-barite deposits at Hansonburg, New Mexico: Earth Planet. Sci. Lett.,v. 110, p. 51-66.

Clippinger, D. M., 1949, Barite of New Mexico: State School of Mines Mineral Resources Survey of New Mexico, Circular 21.

DeMark, R. S., 1987: Mining Development and Minerals of the Hansonburg Mining District, Socorro, New Mexico (abstract): 8th Annual New Mexico Mineral Symposium.

DeMark, R. S., 2003, Fluorite from the Blanchard Mine Group, Hansonburg Mining District, Socorro County, New Mexico: Rocks & Minerals, Vol. 78, No. 6.

Elstone, E. F., 1958, A Memorandum of Data and Observations on Lead-Barite-Fluorite Deposits, Hansonburg Mining District, Socorro County, New Mexico.

Elstone, E. F., 1959, Water Supply Problems Near the Bingham Project.

Elstone, E. F., 1961, Facts, Data, and Estimates - Bingham Project of Sunshine Mining Company, Socorro County, New Mexico.

Evans, D. L, 1957, An Appraisal: Portales Mining Company Tailings, San Antonio, Socorro County, New Mexico.

Eveleth, R. W., 2000, The Lady on the Mountain: My Personal Reminiscences of Ora W. Blanchard (draft).

Eveleth, R. W., Lueth, V. W., 2009, Old Hansonburg, one of New Mexico's forgotten mining camps: New Mexico Geological Society 60th Annual Fall Field Conference Guidebook: Geology of the Chupadera Mesa.

Eveleth, R. W., 2018, Chronology of the Hansonburg Mining District (working notes).

Johnston, W. D. Jr., 1928, Fluorspar in New Mexico: State School of Mines Mineral Resources Survey of New Mexico, Bulletin 4.

Jones, F. A., 1904, New Mexico Mines and Minerals - World's Fair Edition.

Jones, F. A. 1915, The Mineral Resources of New Mexico: State School of Mines Mineral Resources Survey of New Mexico, Bulletin 1.

Kottlowski, F. E., 1953, Geology and Ore Deposits of a Part of the Hansonburg Mining District, Socorro County, New Mexico: State School of Mines Mineral Resources Survey of New Mexico, Circular 23.

Kottlowski, F. E., Steensma, R. S., 1979, Barite-fluorite-lead mines of Hansonburg mining district in central New Mexico: New Mexico Geology Vol. 1, No. 2.

Lasky, S. G., 1932, The Ore Deposits of Socorro County, New Mexico: State School of Mines Mineral Resources Survey of New Mexico, Bulletin 8.

Lasky, S. G., Wootton, T. P., 1933, The Metal Resources of New Mexico and Their Economic Features: State School of Mines Mineral Resources Survey of New Mexico, Bulletin 7.

Lewchalermvong, C., 1973, Investigation and Evaluation of the Royal Flush and Mex-Tex Mines, and Adjacent Area, Hansonburg Mining District, Socorro county, New Mexico (thesis): New Mexico Institute of Mining and Technology.

Lindgren, W., Graton, L. C., Gordon, C. H., 1910, The Ore Deposits of New Mexico: United States Geological Survey Professional Paper 68.

Lueth, V. W., Rye, R. O., Peters, L., 2005, "Sour gas" hydrothermal jarosite: ancient to modern acid-sulfate mineralization in the souther Rio Grande Rift: US Geological Survey: Geochemistry of Sulfate Minerals: A Tribute to Robert O. Rye.

McCarthy, M. S., private report for the Western Mineral Products Company, undated (maps within dated 1918).

McLemore, V. T., Giorando, T. H., Lueth, V. W., Witcher, J. C., 1998: Origin of Barite-Fluorite-Galena Deposits in the Southern Rio Grande Rift, New Mexico: New Mexico Geological Society Guidebook, 49th Field Conference, Las Cruces Country II.

McMillan, N. J., Dickin, A. P., Haag, D., 2000, Evolution of Magma Source Regions in the rio Grande rift, southern New Mexico: GSA Bulletin, October 2000, v. 112, no. 10.

Norman, D. I., Ting, W., Putnam, B. R. III, Smith, R. W., 1985, Mineralization of the Hansonburg Mississippi-Valley-Type Deposit, New Mexico: Insight from Composition of Gases in Fluid Inclusions: Canadian Mineralogist, Vol. 23.

North, R. M., 1983, History and geology of the precious metal occurrences in Socorro County, New Mexico: New Mexico Geological Society 34th Annual Fall Field Conference Guidebook, Socorro Region II.

Ostrom, Gerry, 1983, untitled symposium notes.

Paddison, L. F., 1932, Notes on the McCarthy Mine.

Partey, F., Lev, S., Casey, R., Widom, E., Lueth, V. W., Rakovan, J., 2009, Source of Fluorine and Petrogenesis of the Rio Grande Rift-Type Barite-Fluorite-Galena Deposits: Society of Economic Geologists, Economic Geology vol, 104.

Peters, E. D., 1882, Notes on the Oscura Copper-Fields, and Other Mines in New Mexico: The Engineering and Mining Journal.

Putnam, B. R. III, Norman, D. I., Smith, R. W.: Mississippi Valley-type lead-fluorite-barite deposits of the Hansonburg mining district, New Mexico: New Mexico Geological Society 34th Annual Fall Field Conference Guidebook.

Rakovan, J., Partey, F., 2009, Mineralization of the Hansonburg Mining District, Bingham, New Mexico: New Mexico Geological Society 60th Annual Fall Field Conference Guidebook: Geology of the Chupadera Mesa.

Rocks and Minerals magazine, December 1936, Vol. 11, No. 11.

Roedder, E. Heyl, A. V., Creel, J. P., 1968: Environment of Ore Deposition at the Mex-Tex Deposits, Hansonburg District, New Mexico, from Studies of Fluid Inclusions: Economic Geology Vol. 63.

Rothrock, H. E., Johnson, C. H., Hahn, A. D., 1946, Fluorspar Resources of New Mexico, State School of Mines Mineral Resources Survey of New Mexico, Bulletin 21.

Smedley, J., 1961, Ora Blanchard's Mine: Rocks & Minerals 36:5-6, 254-269.

Smith, C. T., 1981, Feasibility Estimate for Hansonburg Mining District.

Stacey, J. S., Hedlund, D. C., 1983, Lead-isotopic compositions of diverse igneous rocks and ore deposits from southwestern New Mexico and their implications for early Proterozoic crustal evolution in the western United States.

Steensma, R. S., 1979, Feasibility of gravitational ore separation, Hansonburg mining district, central New Mexico: New Mexico Geology.

Stratton, P. A., 2001, untitled recollections.

Strong, M. F., 1964, The Blanchard Claims, Bingham, New Mexico: The Mineralogist Vol. 32, No. 3.

Sun, M., 1957, Minerals of the Hansonburg Mining District, Socorro County, New Mexico: Rocks and Minerals Magazine.

Taggart, J. E. Jr., Rosenzweig, A., Ford, E. E., 1989, The Hansonburg District, Bingham, New Mexico: Mineralogical Record, Vol. 20.

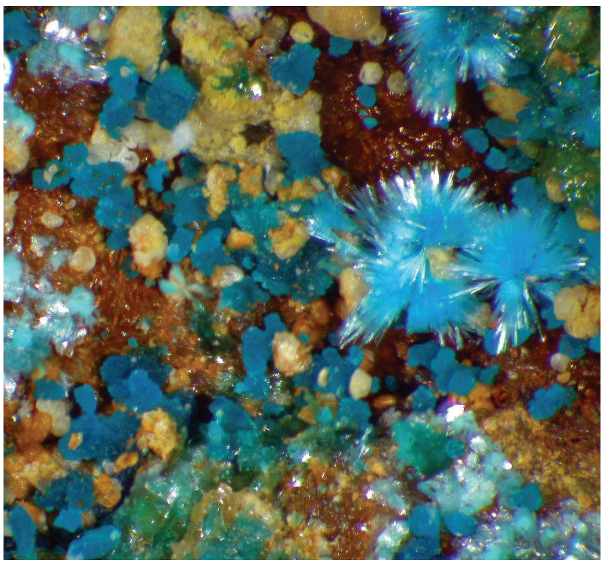
Talmage, S. B., Wootton, T. P., 1937, The Non-Metallic Mineral Resources of New Mexico and Their Economic Features: State School of Mines Mineral Resources Survey of New Mexico, Bulletin 12.

Aldrigeite und Kellynoids von das Grube Kelly (Aldrigeite and Kellynoids from the Kelly Mine)

—by Doktor Klaus Fuhrberger

Aldridgeite

A mineral assemblage was found in the Kelly Mine that had various secondary sulfate minerals. Most of the species were verified via xrd at the NMBG&MR. The identified minerals were aikinite (via eds, Travis Olds), chalcanthite, chlorite, covellite, galena, gypsum, ktenasite, neidermayrite, pyrite, acicular "serpierite", and sphalerite. There were two unknowns, which were checked by Tony Kampf with pxrd and eds. Some yellow transparent acicular crystals turned out to be gypsum. The other, blue hexagonal-shape pearly-lustered wafers, turned out to be aldridgeite.



Aldridgeite with 3 varieties (former "schulenbergesque" = wafers, former "serpierite" = prisms, and former "lazy serpierite" = spheres), with smithsonite and ktenasite (field of view = 6 mm).

The Kelly Mine aldrigeite, $(Cd,Ca)(Cu,Zn)_4(S0_4)_2(OH)_6.3H_2O$, is the second reported occurrence in the world. It is the cadmium analog of serpierite, $Ca(Cu^{2+},Zn)_4(SO_4)_2(OH)_6.3H_2O$. Both minerals are monoclinic.

However, Kelly Mine aldrigeite has two habits and might be forming in two different crystal systems (consider that analcime can crystallize in any system!). Tony Kampf's tests showed that the "serpierite" was also aldridgeite!

Aldridgeite was first published in 2015 and its xrd pattern was not in the NMBG&MR's database, so it was missed on the initial tests. Both habits of crystals can exist on the same specimen.

Kellynoids

The Kelly Mine is famous for its minerals, especially smithsonite. However, most of the ore in the mine lies within replaced Mississippian Kelly Limestone (323–354 myo), which can be fossiliferous, so it is not uncommon for Kelly Mine mineral specimens to have associated marine fossils. The most common being crinoid stem sections. Various brachiopods and horn corals have also been found associated with the minerals.

Additionally, the overlying Pennsylvanian Sandia Formation can be fossiliferous, with an even greater abundance and variety of fossils. However, if the sample originated in the mine, then it is more likely to be from the Kelly Limestone.

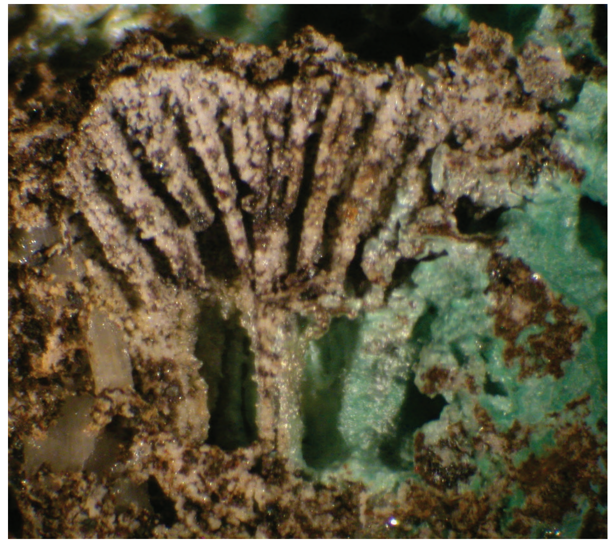
Whimsical names have been developed for some of the specimens. For instance, instead of labeling a specimen "smithsonite pseudomorph of a crinoid stem section", the term "smithsonoid" is shorter and its intent seems obvious. This "abreviating" can lead to many terms, such as smithsonoid, quartzinoid, calcinoid, hemimonoid, and crinophane. One also has to consider associated minerals attached to the fossils. Associations found so far include azursmithsonoid,

Quartzinoid (8 mm long) with Baryte, Juanita Mine, Kelly, Socorro Co., NM

hemimocalcinoid, brochantsmithsonoid, smithsoncrinocalyx, wulfensmithsonoid, and malachrosasmithsonoid. Other discoveries with different fossils are azursmithsonhorncoral, hemimocalcinhorncoral, smithsonquartzinbrachyspirifer, smithsonbrachyderbyia, smithsonquartzinbrach, and hemimocalcinbrach, etc.

Certainly, other combinations are out there.

Malachcerusgoethsmithsonhorncoral (6mm wide), Kelly Mine, Kelly, Socorro Co., NM



Azuresmithsonoid (11 mm diameter), Kelly Mine, Kelly, Socorro Co., NM

Notes