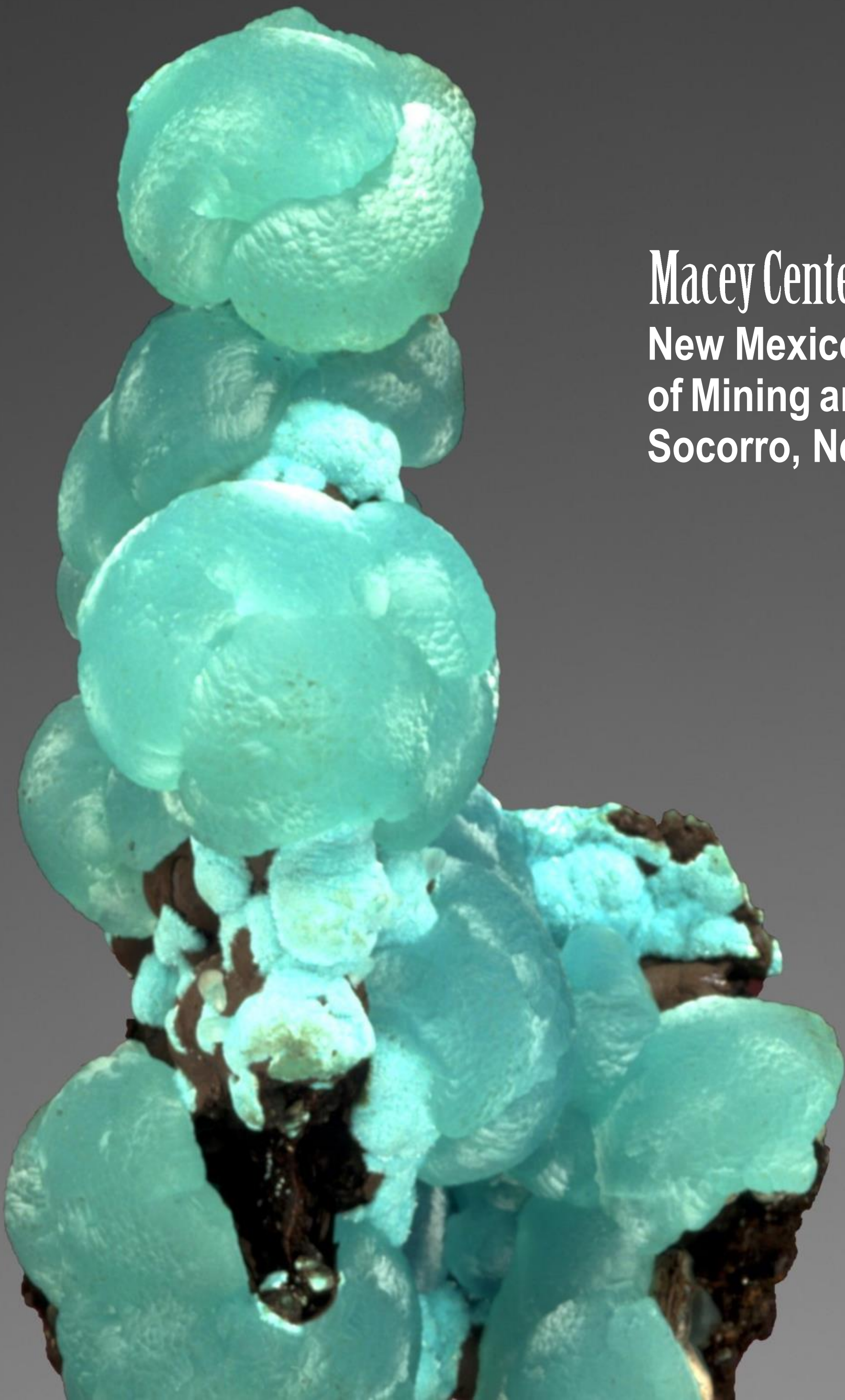
44th NEW MEXICO MINERAL SYMPOSIUM

Program and Abstracts

November 1 – 3, 2024

The King of Kashmir: Unearthing the World's Greatest Mineral Specimen

Daniel Trinchillo, Featured Speaker



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

WELCOME

to the

44th NEW MEXICO MINERAL SYMPOSIUM

November 1 – 3, 2024

Macey Center

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

Socorro, New Mexico 2024

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
Los Alamos Geological Society
Friends of Mineralogy Colorado Chapter
Sierra County Rock and Gem Society
John & Maryanne Fender
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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 photo is Smithsonite from the Kelly Mine, Magdalena District, Socorro County, New Mexico. Mineral Museum no. 16315. Gift of Roy & Pam Johnson. Photo by Jeff Scovil

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Sunday	**November 3, 2024**
8:00 am	Morning social, coffee, and donuts—Macey Center
8:50 am	Welcome to the second day of the symposium and follow-up remarks
9:00 am to 1:00 pm	Silent auction sponsored by the Albuquerque Gem and Mineral Club for the benefit of the Mineral Museum (free and open to the public)
9:00 am	*Bernalite from New Mexico*—Patrick E. Haynes (pg.27)
9:30 am	*The Mineralogy, Origin, and Economic Potential of Arsenide Five Element Veins Deposits: Examples from the Black Hawk District, New Mexico and Worldwide* —Virginia T. McLemore, Evan Owen, Robert Cook, Nicole C. Hurtig, Don Musser, Zohreh Kazemi Motlagh, Jakob Newcomer, and William X. Chavez, (pg.29)
10:00 am	**Coffee break**
10:30 am	*Two Donations of Historical New Mexico Mining Equipment to the NMBGMR*—Paul R. Secord (pg.32)
11:00 am	*Pre-Cambrian Banded Iron Formation (BIF) near Jerome, Arizona*—David Stoudt, Wes Yeager, and Susan Hoffman (pg.34)
11:30 am	*Thunder Eggs from the Little Florida Mountains, New Mexico*—Lori Coleman (pg.36)
1:00	Albuquerque Club silent auction checkout (pay for winning bids) - Macey Center

Symposium Keynote Speakers 1979–2024

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"
2020		Cancelled due to Covid-19
2021	41	Jeffrey Post, "The Smithsonian Gem Collection—Unearthed: Surprising Stories Behind the Jewels"
2022	42	John Jaszczak, "120 Years of the A.E. Seaman Mineral Museum of Michigan Tech"

Symposium Keynote Speakers 1979–2023

Year	#	Keynote speakers and Abstract
2023	43	EloïseGaillou, “History of collecting at the Mineralogy Museum of l’École des Mines de Paris”
2024	44	Daniel Trinchillo, “The King of Kashmir: Unearthing the World's Greatest Mineral Specimen”

History of Silver Mining in New Mexico

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Background

Silver, like gold and platinum, was born from cataclysmic events in the heavens. Researchers theorize that the majority of heavy elements (silver, gold, and platinum) in our solar system likely originated from a single neutron-star merger that occurred about 80 million years before the birth of our solar system (5.4 billion years ago).

Silver, Silver City Manganese Mine, Grant County, New Mexico. 3.5 cm. NMBGMR#10023. Jeff Scovil photo.

As the Earth formed, heavy elements such as iron, silver, and gold sank toward the planet's core. If no other events had occurred, there would be very little silver or gold in the Earth's crust but around 4 billion years ago, the Earth was bombarded by asteroids. These impacts stirred the deeper layers of the planet and forced some silver and gold into the upper mantle. Plate tectonics and volcanism play an important role in transporting heavy elements from the mantle to the crust. Silver is transported in mineral rich water and is concentrated in veins and alteration zones.

Mindat lists 212 mineral species containing silver. This includes: 7 element species; 193 sulfides and sulfosalts species; 7 halide species; one oxide species; one sulfate species; and three phosphate, arsenate, and vanadate species.

New Mexico

New Mexico has a wonderful endowment of silver (and other minerals like copper and gold) because of its geologic history. Important geologic events creating this endowment include the marginal extension of the base domain, the Laramide Orogeny caused by the subduction of the Farallon Plate, and the subsequent crustal extension and Rio Grande Rift and its associated volcanism.

Silver has been found in 163 mining districts and other geographic locations in New Mexico. More than 118.7 million oz. of silver have been produced in New Mexico from 1848 through 2014. Silver is currently extracted only as a byproduct of copper mining. Production from most districts has been small; however, 14 districts have produced more than 3,000,000 oz. of silver, and together they account for approximately 80% of the total silver production in New Mexico. (V. T. McLemore, 2017)

Silver is found in 14 distinct types of deposits that range in age from Proterozoic through Holocene. Five deposit types have produced significant gold and/or silver as the primary product: placer, volcanic-epithermal, Great Plains margin (alkaline-related), carbonate-hosted silver-manganese replacement, and Laramide vein. Four deposit types have produced significant silver and gold as byproducts of base-metal production: carbonate-hosted lead-zinc replacement, Laramide skarn, porphyry copper, and Proterozoic massive-sulfide. The five remaining deposit types with minor silver and/or gold production are: copper-silver (±uranium) vein, Rio Grande rift, Mississippi Valley-type, sedimentary-copper, and vein and replacement in Proterozoic rocks. (V. T. McLemore, 2017)

Silver, Acanthite, Ni-Skutterudite, Ankerite, Alhambra Mine, Black Hawk Mining District, Big Burro Mountains, Grant County, New Mexico. 18 cm across. NMBGMR#19016.

Silver mining occurred under Spanish and Mexican rule in what would become New Mexico, but records are sparse and inconsistent. The discovery of the Comstock Lode (NV) in 1858 inaugurated large-scale silver mining in the western United States. The Comstock was the first important silver-mining district in the United States, and its discovery stimulated a great deal of prospecting for silver across the western United States. New Mexico's first major silver discovery (as a Territory) was in 1863 in the North Magdalena district (Pueblo Springs area).

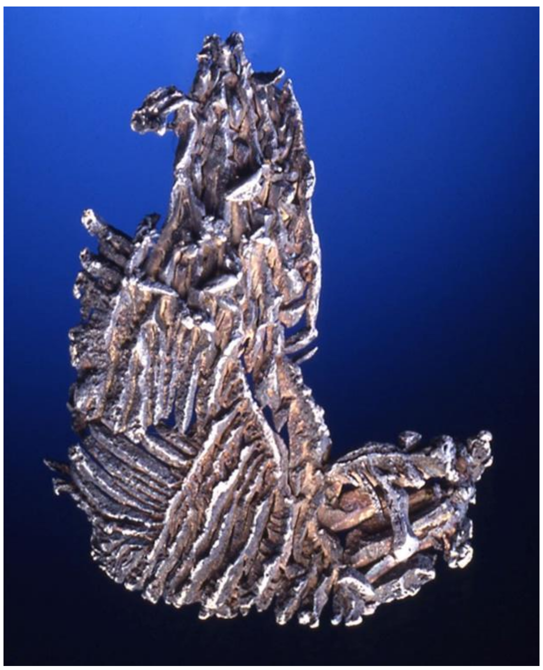
The mining districts of New Mexico that produced the largest amounts of silver were the Mogollon in Catron County (with >20M oz.); Burro Mountains in Grant County (with >10M oz.); Willow Creek in San Miguel County (with 6.2M oz.); Lordsburg in Hidalgo County (with 6.2M oz.); Kingston in Sierra County (with 6M oz.); Lake Valley in Sierra County (with 5.8M oz.); Fierro-Hanover in Grants County (with >5M oz.); Steeple Rock in Grant County (with 4.5M oz.); and Magdalena in Socorro County (with 4M oz.). (R. M. North and V. T. McLemore, V. T., 1986)

We will look at a select number of mines from the districts that produced significant amounts of silver as well as the silver species that made up the production. Because of its rarity, we will spend some time discussing the unusual arsenide five-element-vein deposits of the Black Hawk district in the Burro Mountains, Grant County, New Mexico. We will also discuss some historically significant mines like the Bridal Chamber located in the Lake Valley district, Sierra County, New Mexico that produced copious amounts of silver from a couple of halide silver species.

Chlorargyrite, Bridal Chamber Stope, Sierra Grande Mine, Lake Valley District, Sierra

County, New Mexico. 8 cm. NMBGMR#15606. John Rakovan photo.

The story of silver mining in New Mexico is not just about the production records and the geologic settings; it includes the story of the men and women that toiled in the sweltering New Mexico heat of summer and the freezing temperatures of winter; endured harsh mining conditions; weathered the turbulent economic policies of the mid 1800s through the early 1900s; and suffered through influenza pandemics, fires and floods, and the Apache Wars.



Silver, Silver City Mining District, Grant County, New Mexico. 5 cm. NMBGMR#16799. Jeff Scovil photo.

Between 1879 and 1882 all of the major railroads within the state were completed and stage line established. This significantly improved the movement of labor, equipment, and ore. During this same time practically all precious and base metal producing districts in NM were discovered and developed. (J. Simmons, 1990)

In 1893 mines and smelters began to shut down, banks closed their doors, and real estate values plummeted when Congress repealed the Sherman Silver Purchase Act causing the price of silver to drop to $0.62 per ounce.

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From the Dark Forest to the Ore Mountains, the Geology and History of the Erzgebirge

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From 1156 to 1162, Markgraf Otto von Meißen had areas of the Mircwidu (Dark Forest) cleared in order to establish the Altzelle Monastery and several farming villages. According to legend, not long after this, members of a trading caravan noticed a shiny rock had been turned over by one of their wagon wheels. When this proved to be silver, the news spread quickly and a rush of people flooded the region in what is known as the First Berggeschrey (or Berggeschrei), roughly translated as “mining shout” or “mining clamor”. Silver proved to be one of the many important minerals mined from what would become known as the Erzgebirge, or Ore Mountains.

Wire silver, calcite, and acanthite, Freiberg, Saxony, Erzgebirgskreis, Germany. 9.4 cm tall. Irv Brown specimen. Jeff Scovil photo.

The Erzgebirge stretch for about 150 km along the border between Germany and the Czech Republic, where they are called Krušné hory. Covering a total area of around 5400 km^2, they rise to their highest point of 1244 m at Keilberg. Prior to deforestation due to the growth of the mining industry, the mountains were covered by a dense forest of Fir, Beech, and Pine. Today, after reforestation efforts, stands of spruce trees dot the mountains.

Fluorapatite (FAP), fluorite and quartz, Sauberg Mine, Ehrenfriedersdorf, Erzgebirgskreis, Saxony, Germany. 11.3 cm. Type locality for FAP. John Rakovan specimen. Jeff Scovil photo.

The basement rocks of the Erzgebirge were formed in the Neoproterozoic during the Cadomian Orogeny along the margin of Gondwana. There is still debate concerning how long the orogeny continued, but by the early Paleozoic, localized basins and bimodal volcanics indicate rifting had begun in the region. Rifting continued through the Ordovician as passive margin sedimentary rocks were deposited, which are overlain by Silurian to Devonian pelagic sedimentary rocks. During the Carboniferous, the Variscan Orogeny affected the region as Pangaea assembled. Eclogite, coesite, and microdiamond inclusions indicate the rocks of the Erzgebirge were subducted to very high pressures. Additionally, compressional tectonics thrust rocks overtop one another to create a complicated stack of units with different metamorphic grades. Peak metamorphism occurred between 350 and 340 Ma, followed by rapid uplift. During the Late Carboniferous into the Permian, extensional tectonics once again affected the region, and several granite intrusions were emplaced. The Altenberg-Teplice Caldera, approximately 35 km long and 10 km wide with a ring dyke of microgranite, erupted around 312 Ma.

Fluorite (FL), Jáchymov, Karlovy Vary Region, Erzgebirgskreis, Czech Republic. 12 cm. Type locality for FL. J.Soukup specimen Bohuslav Bures photo.

Mesozoic rocks are rare in the Erzgebirge with only localized outcroppings of Cretaceous-aged sedimentary rock layers. During the Tertiary, tectonic stresses related to the Alpine Orogeny and the opening of the Atlantic Ocean caused block-faulting and the development of the Erzgebirge Block that tilts to the northwest. Some sedimentary and volcanic rocks from the early to mid-Cenozoic are found in parts of the Erzgebirge.

Rocks in the Erzgebirge host several different types of ore deposits. Tin and tungsten-bearing minerals are found in the greisen of the Late Carboniferous and Permian granitic intrusions. Topaz, commonly wine-yellow, is also associated with granites. Polymetallic silver-bearing veins were deposited during the Variscan Orogeny and throughout the Mesozoic. Veins rich in uranium minerals are likely derived from uranium-rich granites.

During the Early to Middle Bronze Age (approximately 2000 to 1300 B.C.), mining and processing of cassiterite for tin occurred in the Erzgebirge, but was later forgotten as other tin-producing areas like Cornwall rose to prominence. No significant mining occurred during the Early Middle Ages, and few settlements were found in the inhospitable Mircwidu. The Berggeshrey of 1168 changed that dramatically. Markgraf Otto von Meißen decreed that anyone could dig for silver on his lands for a fee, and then sell it to his mint. These miners were not serfs and enjoyed personal freedom as well as other privileges. Thus Christiansdorf, where the mining rush began, became Freiberg in reference to the rights of the free miners.

The Erzgebirge experienced several boom and bust cycles following the first mining rush. After a decline in mining in the late 1300s, new silver discoveries set off the Second

Berggeschrey around 1470. Old mines were reopened and new ones established, including one in famed locations like Joachimsthal, Schneeberg, and Annaberg. It was during this time that the mountains became known as the Erzgebirge. The Thirty Years War, from 1618-1648, left much of the region devastated, but industry returned around 1650 with the establishment of a blue dye works that used cobalt to create smalt, a vibrant blue pigment. The third mining cycle boomed in the latter part of the 1700s with the advent of new mining technologies. By the end of the 1850s, however, mining was once again in decline, with the exception of uranium, which was used to color glass at the time. Uranium mining continued until the fall of the Soviet Union in 1990.

The centuries of mining led to numerous scientific advances. Georgius Agricola, often recognized as the Father of Mineralogy, lived in Joachimsthal in the 1500s and wrote numerous ground-breaking scientific texts concerning minerals, mining, metallurgy, and geology based on his observations from the mines. The oldest mining school in the world, the Bergakademie at Freiberg, was established in 1765. Principles of forest sustainability were outlined by Carl von Carlowitz in 1713 in response to a timber shortage and in 1811 the world's first school of forestry, the Königliche-Sächsische Forestakademie, was established. René Just Haüy, a pioneer of crystallography, used topaz from the Erzgebirge for his studies. Lastly, several elements were discovered from ore and mining waste, including wolfram (in 1783), rubidium (in 1861), indium (in 1863), germanium (in 1886), polonium (in 1898), and radium (in 1898).

Because of its rich history, the Erzgebirge was declared a World Heritage Site in 2019.

Physical map of the Erzgebirgskreis. Wikipedia (https://en.wikipedia.org/wiki/Ore_Mountains#/media/File: Erzgebirge_phys_map_de.png Creative Commons "CC-BY-SA 2.0" licensed)

New Mexico Fluorite Locations – Found and Lost

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Fluorite in New Mexico is abundant and widespread. Northrop and LaBruzza (1996) cited locations in twenty of New Mexico's thirty-three counties. Mindat lists over 600 sites, prospects, and mines in New Mexico! An article by Simmons (2020) with photographs, is the most comprehensive and current coverage of New Mexico fluorite occurrences, while Bulletin 21 by Rothrock, et. al. (1946) documents the extensive fluorite locations, county-by-county, known at that time. This abstract will be limited to some of the more significant fluorite occurrences that have taken place in the last forty years. Due to the constraints of time and space, only a small portion of New Mexico fluorite locations are provided.

Fluorite, Bohrnstedt Fluorite mine, White Sands Missile Range. 15.2 X 11.5 cm. NMBGMR #16600 Phil Simmons photo.

Possibly the most significant New Mexico fluorite occurrences and specimen recovery event took place in the spring/summer of 2023 at the Blanchard mine in the Hansonburg district near Bingham. Two itinerant mining entrepreneurs (Michael Eagleton & Bradley Culebro) were authorized to collect specimens at the Blanchard mine in March 2023. They subsequently opened a pocket in what had previously been dubbed the 'Eagles Nest'. Two large specimens (over 30 pounds) of stepped, intergrown, green fluorite cubes up to three inches were recovered. Shortly thereafter, the miners showed a third similar specimen to the mine owners (Mike Sanders and Ray DeMark). Shortly thereafter, an agreement was reached between the owners and the miners to excavate specimens from the pocket which was named the 'Ice Cream Igloo Pocket'. Mining started in April and continued into the summer. A large number of specimens were recovered (some were exceptionally large – over 100 pounds). The last depositional stage, less than 1mm, was purple over the dominant crystal color green. The dig was terminated on 22 June with the final recovery of 'The Beast', a specimen weighing approximately 1,100 pounds!

Fluorite, Pine Canyon Dist. 9.0 X 7.9 cm. Mike Sanders specimen. Phil Simmons photo.

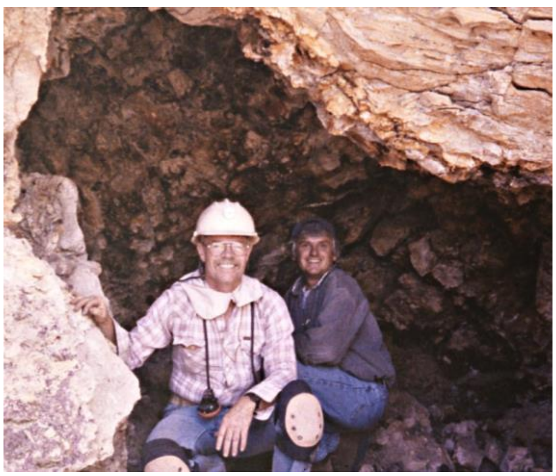
Purple octahedral fluorite labeled Catron County, New Mexico, first appeared on the market in the early 1970's. Dick Jones of Casa Grande, Arizona was the primary seller. Following his death in 1982, Robert North and one of the authors (RSD) made a search to locate this occurrence. An additional search of Catron County fluorite locations was also unsuccessful. Doubting the Catron County provenance, North and DeMark searched Dick Jones's claim records at the Bureau of Land Management (BLM) and suggested a possible location in the Burro Mountains southwest of Silver City in Grant County. Upon investigation of the site by Robert Dickie and one of the authors (RSD), they found this was indeed the location of the elusive 'Catron County' fluorite. Claims on the property had lapsed, so in 1983 they filed a new claim and named it 'Judith Lynn'. A subsequent mechanized (track-hoe) dig at the site in 1994 produced a large volume of fluorite specimens. In 2019, another mechanical dig at the site was completely unproductive, and the area was reclaimed in accordance with U.S. Forest Service directives. Future specimen recovery from the Judith Lynn claim is doubtful.

Fluorite on Quartz, Cabresto Creek deposit, Questa Dist. 11.4 X 7.8 cm. Fred Ortega specimen. Phil Simmons photo.

The Tijeras Canyon District, southeast of Albuquerque contains numerous mines rich in fluorite. Access to the mines is restricted due to their location at the north end of the Isleta Pueblo and on Kirtland Air Force Base (AFB). The Galena King mine (a patented claim) is surrounded on three sides by Isleta Pueblo and on the north side of Kirtland Air Force Base (AFB). Collectors in the 1960s and 1970s recovered a large number of specimens from the underground workings. Stepped blue and purple octahedral and cubic fluorite were recovered from veins and seams in Precambrian gneiss. The last stage of deposition on much of the cubic fluorite was an unattractive iron oxide included fluorite layer that detracted from some of the specimens. In 2014, a self-proclaimed group (friends of the Galena King mine), in coordination with Kirtland AFB and Isleta Pueblo, took on the task of closing the two portals to the mine, which remain closed. Other mines in the district include the Highland Mary (aka Frustration) mine and the Lucky Bill (aka Octoroon) mine. The fluorite from these mines is similar to specimens from the Galena King mine.

Fluorite, Mex Tex Mine, Hansonburg Dist. 11.2 X 8.0 cm. Ray DeMark specimen, Phil Simmons photo.

Cookes Peak in Luna County was not well known for specimens prior to the 1950s. A pocket opened in the Surprise mine by Mark Massis in 1989 yielded many excellent specimens (purple octahedrons up to two inches with a blue cubic core). Subsequent collectors have brought out blue-gray cubic crystals with edges modified by the dodecahedron. The property is currently under claim by Phil Simmons, Erin Delventhal, and others. Recent efforts (2014) by Simmons, Chris Cowan, and Mike Sanders have been very productive, and an exceptional specimen dubbed "The Camel" was recovered. It now resides at the NMBMMR Museum.



Mike Sanders and Virgil Lueth, Bornstadt Fluorite Mine, 1999.

The Gila Fluorspar District, in the ruggedly beautiful country of southwest New Mexico, is the home to the first fluorite mine in the state (Foster mine – Rothrock et al., 1946). Fluorite crystals from the Last Chance mine are mostly green octahedrons from 2.0 to 5.0 cm. Unfortunately, most specimens have a final depositional layer of colorless fluorite which detracts from their appearance, but this can be mechanically removed to reveal the saturated green color underneath. Other mines in the district include the Foster, Blue Spar, Watson Mountain, and Turkey Creek. Purple octahedrons are dominant in some of these mines. Jay Rosenbauer and the Hales family have collected extensively in the area and recovered excellent specimens. Mike Sanders pulled out an excellent plate of crystals from "The Cleft" which is above the Last Chance mine. It is now in the NMBMMR museum in Socorro.

The Zuni Mountain District in Cibola County was the largest fluorite producer in the state. Production was primarily in the 1940s and early in the 1950s. (Simmons, 2020). Crystals are generally cubic ranging from 1.0 – 3.0 cm. Purple to blue colors dominate, and the luster is rather dull, although in high luster, smaller crystals infrequently occur. Specimen recovery is mostly from dumps and outcrops in trenches and pits. Mines in the district include the Section 21 and 27, Prospector's, Ponderosa, Mirabal, Bonnekay, and numerous others. Rex Nelson has collected extensively in the district and acquired a comprehensive collection from many of the mines.

Cabresto Creek lies northeast of Questa in Taos County. Fred Ortega was alerted to the area in 2012 by an individual unfamiliar with minerals. Investigation by Fred revealed excellent purple octahedral stepped fluorite crystals averaging 1.5 to 2.5 cm. The crystals are mostly translucent to opaque. The outcrop is above a steep talus slope overlooking the creek. Collecting in the cliff outcrop is not for the faint of heart! Fred and Phil Simmons recovered many specimens on a drusy quartz matrix. Most of the worthwhile specimens are now gone, and further production is doubtful.

The Small Fry deposit/prospect in Rio Arriba County first came to the attention of collectors in the late 1990s. Bingler, E.C. (1968) described the property and was the first to mention the occurrence of fluorite. Pale to moderately dark purple, botryoidal, finely crystalline fluorite often associated with baryte occurs in veins/seams in fine-grained volcanic rocks.

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A Legacy Revived: New Treasures from the Eagle's Nest Mine

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The Eagle's Nest gold mine, nestled in the heart of the Sierra Nevada foothills in California, is a legendary site that traces its origins back to the great American Gold Rush—a defining chapter in our nation's history. While all gold is crystallized at the atomic level, Eagle's Nest is renowned as one of the primary sources of crystallized gold that can reach individual crystals over an inch. Its specimens have a remarkable degree of purity and geometric perfection, all at extraordinary proportions. Their intricate and beautiful crystal forms, richness and quality are a testament to the particular geologic environment of the locality.

Gold and quartz, Eagle's Nest Mine, Placer County, California. 16.8 cm. Fine Minerals International # 23643, James Elliott photo.

The mine was originally claimed by three Swiss settlers who held ownership through the generations. Although always known for its crystallized examples, its most prolific period was between 1970-2004 when it produced more crystallized gold than any other California specimen mine. (Leicht, 2004) Afterwards, it lay dormant for decades, and was considered a "sleeping giant" of the Gold Rush era. Through the years, it remained in one way or another with its original families until it was acquired by Daniel Trinchillo in 2019. Employing a new mine manager, Keith Wentz, and lead geologist, Ian Merkel, along with the latest technology and methods available, Trinchillo and his team initiated a new era of mining.

Gold, Eagle's Nest Mine, Placer County, California. 7 cm. Fine Minerals International #23621, James Elliott photo.

After years of inactivity, Eagle's Nest had a very special gift (and on Valentine's Day of 2024, at that). A pocket of breathtaking gold specimens was discovered, the likes of which had not been seen in over a decade. With a number of complex, large, three-dimensional, "new" pieces, Valentine's pocket specimens mark an exciting next generation of specimens for the historic mine. As the Eagle's Nest mine reawakens, it continues to contribute to our understanding of the geology of the Sierra Nevada and asserts its place in the rich legacy of American gold mining.

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The Cobalt Area Silver-Arsenide Deposits

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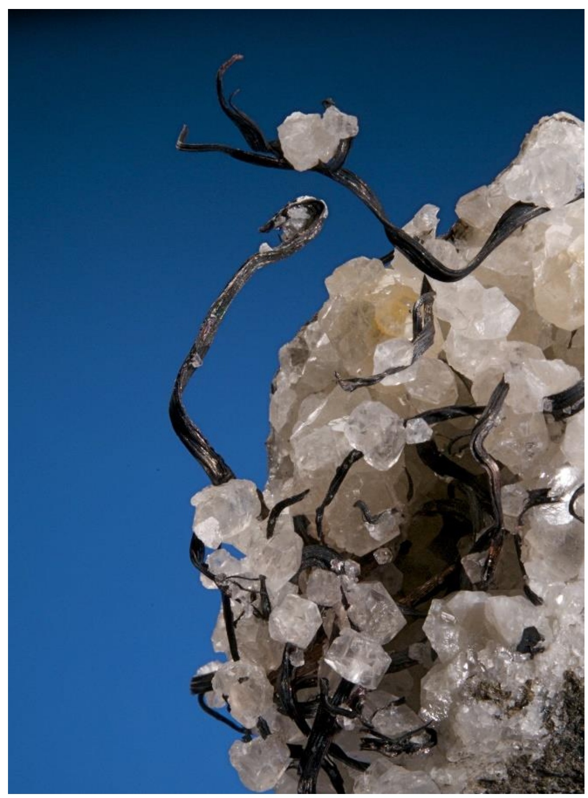
The Cobalt silver mining area, in northern Ontario, Canada, was discovered in 1903 by workers of the Timiskaming and Northern Ontario Railway and is renowned as the source of 600 million troy ounces of silver, mostly mined as native silver in association with Co-Ni-Fe-Sb sulpharsenide and sulphosalt minerals in carbonate veins. The near-vertical veins were emplaced in fault-controlled fractures in various rock types, all within a few hundred meters of the Nipissing Diabase Sill. The sill intruded local rocks 2.162 billion years ago and deposition of the silver veins occurred after that. According to fluid inclusion studies, the minerals in the veins were precipitated from hypersaline aqueous solutions into fault-controlled fractures at pressures of 600 -1360 bars (60-136Mpa) over the temperature range of 300-350 degrees Celsius.

Silver, acanthite, calcite, Keeley Mine, South Lorraine Township, Ontario, Canada. 5 cm tall.

Royal Ontario Museum Collection Ray McDougall Photo.

The source of the vein minerals has never been definitively determined but theories share the commonality that the heat from the 333m thick diabase and, perhaps, its parent magma body caused metals to be concentrated from a local source(s) and moved by the saline solutions to eventual emplacement in fractures, in all surrounding rock types, including the Nipissing diabase sill. The elemental makeup of the veins has resulted in a unique and interesting suite of minerals and mineralogical textures, including nine type-locality minerals, which will be covered in detail in this presentation.



Silver, Calcite, Keeley Mine, South Lorraine Township, Ontario, Canada. 4 cm. Royal

Ontario Museum Collection Ray McDougall Photo.

Lollingite-coated silver crystals, Langis Mine, Casey Township, Ontario, Canada. 6.0cm across. David Joyce photo.

Safflorite, Beaver Mine, Cobalt, Ontario, Canada. 8.5cm across. David Joyce photo.

Nickeline, Rusty Lake Mine, Leith Township, Ontario, Canada. 2.5cm tall. David Joyce photo.

Crystallized Microminerals of the Lake Superior Native Copper District

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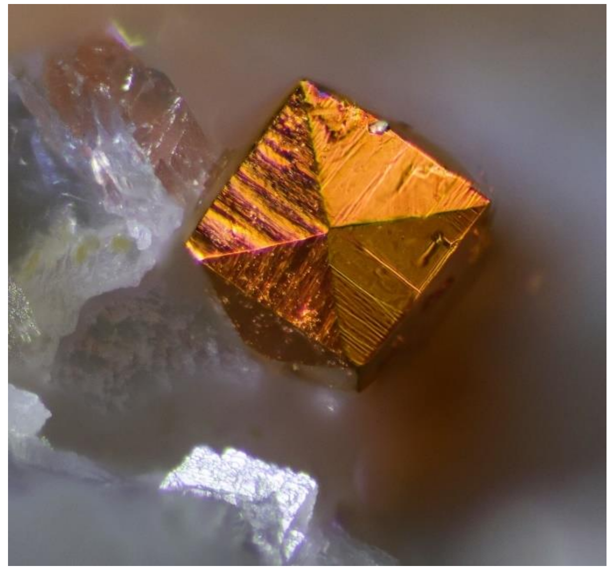
This year my rambling dissertation will be on the micro-crystallized minerals that occur in the Lake Superior Native Copper District. The two areas that will be discussed are the historic Michigan Copper District in the Keweenaw and new finds along the Knife River and Big Sucker Creek in St Louis County, Minnesota. Both localities in Minnesota are just upstream from the mouth of the waterways, where they empty into Lake Superior.

New finds continue to be made in the Keweenaw of Michigan by collectors working the remaining mine dumps. Although collecting has been on the decline in recent years quality specimens can still be found. Some discussed will be sprays of micro copper crystals on prehnite from the Connecticut mine and beautiful manganite crystals from the Central mine with both localities in Keweenaw County.

Also discussed will be significant finds in the last few years. The most exciting finds have been made in Minnesota by Frank Karasti, who is a third-generation retired iron miner who lives in Gilbert, Minnesota. Frank has been concentrating on the boulder-strewn Knife River and Big Sucker Creek. Both localities have produced micro copper specimens that equal or surpass the material found in the Michigan Copper. Associated minerals include microspheres of malachite and beautiful small groups and crystallized incrustations of volborthite on prehnite.

Hope to see you in the Michigan Copper Country to enjoy a Cornish pasty and a whitefish dinner.



Copper (tetrahexahedral crystal) and prehnite, Big Sucker Creek, St. Louis County, Minnesota. FOV 0.8 mm. Frank Karasti specimen and photo.

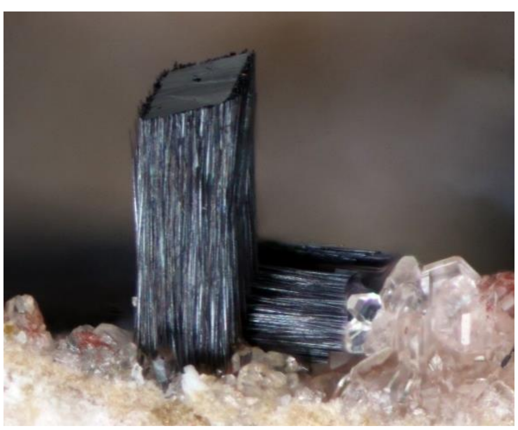
Volborthite, malachite, and prehnite, Knife River, St. Louis County, Minnesota. FOV 1 mm. Frank Karasti specimen and photo.

Cuprite, Calumet & Hecla mine, 1.3 mm crystal. John Jaszczak photo.

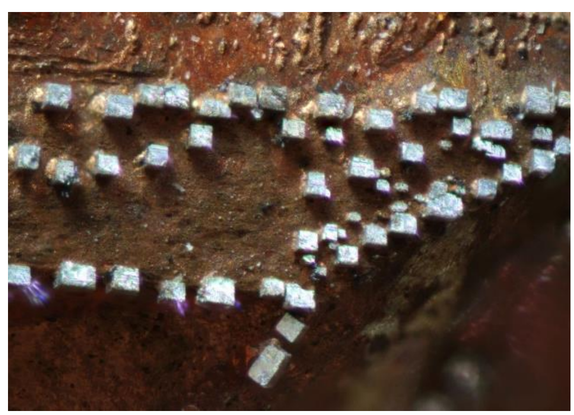
Silver, #5 shaft, Franklin mine, Hancock. 1.9 mm twin. John Jaszczak photo.

Datolite, Iroquois Mine, 0.83mm FOV. John Jaszczak photo.

Copper & prehnite, Avery shaft, Cliff mine. 2.4 mm vug. John Jaszczak photo.



Manganite, Tamarack Jr. No. 1 mine, 2.8-mm tall. John Jaszczak photo.



Silver epitaxic on Copper Caledonia mine. 1.44 mm FOV. John Jaszczak photo.

The Jáchymov Ore District, Karlovy Vary Region, Czech Republic: The World's Most Historic Five-Element Vein Deposit

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Situated in the scenic Erzgebirge or "ore mountains" near the border with Germany, the ancient mining town of Jáchymov or (Sankt) Joachimsthal has arguably played a more important role in the development of mineralogy and mining engineering than any other locality in Europe and perhaps the world. A classic example of the 5-element (Ag-Co-Ni-Bi-U) vein type deposit, mineralization at Jáchymov is related to hydrothermal fluids and igneous intrusions of the Hercynian orogeny in late Paleozoic time. Silver mining, which began in the 15th century, led to Jáchymov being the second-most populous town in the Kingdom of Bohemia by 1534, with over 613 mines operating in the district. The word "dollar" has its derivation in the silver "Joachimsthaler" coins minted there beginning in the 16th century. Between 1527 and 1531, a famous Renaissance man and perhaps the world's first "mining engineer," Georgius Agricola, worked in Jáchymov as a town physician. During the most productive period of silver mining at Jáchymov (1516-1600) approximately 350 tons of Ag were mined, an incredible feat considering the primitive mining methods employed and the physical labor required to mine even an ounce of this precious metal. In addition to its rich human history, Jáchymov was and still is a "mineralogical rainforest", with 437 minerals known (Mindat.org, accessed 8-27-2024), and an impressive 55 of those being type locality species. Indeed, even extremely common minerals such as fluorite (!) were first formally described at Jáchymov, a testament to its central place in the development of the science of mineralogy in the 16th, 17th and 18th centuries. Considered a strategic and highly secretive state resource by the Soviet-aligned Czech government after WWII, due to its large uranium resource, today Jáchymov is a tourist destination and quiet village of under 4000 people, a far cry from the days when kings and queens fought over this jewel of the Erzgebirge, and "Joachimsthalers" fueled the rise of modern European civilization.

Radium Palace Hotel, Joachimsthal (Jáchymov), Bohemia. Process print. Source: Wellcome Collection.)

Svornost mine shaft building in the center of the town of Jáchymov. Vintage real photo postcard, publisher unknown, ca. 1930. G. Grundmann collection. From Mindat.org.

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The King of Kashmir: Unearthing the World's Greatest Mineral Specimen

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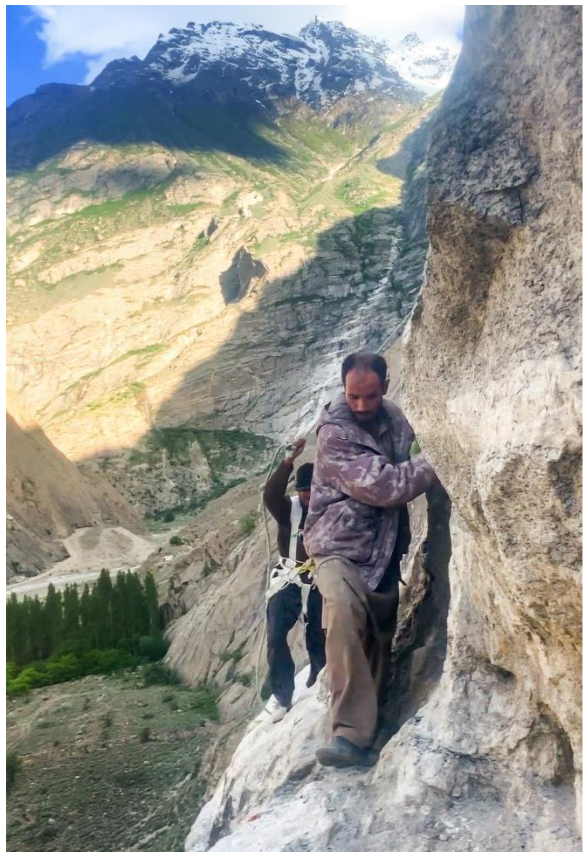
Aquamarine has been widely known and collected for millennia, yet, the most iconic and defining examples of its species have largely been discovered in the last 50 years, with each benchmark piece moving the needle towards new standards for mineralogy and crystallography. These discoveries are not just thanks to an accepted trend towards the preservation of fine specimens but indicate a shift in technology and modernization. The "King of Kashmir," a breathtaking aquamarine discovered in 2019, has widely been hailed as the greatest specimen of the modern age—if not all time. It is celebrated not just for its spectacular beauty, size, and quality but also for what it represents: a modern phase of mining increased global cooperation, and the next level of mineral collecting, all unlike anything seen before.

Miner with King of Kashmir in situ

The Shigar Valley, home to many of the world's most beautiful aquamarine specimens, is located in the remote and rugged terrain of the Karakoram Mountain range. Notoriously difficult to surmount, its steep, rocky landscape and high altitudes have long presented a formidable challenge to miners. Although arduous, the promise of specimens draws the local tribes to the steep rock face from year to year.



Braldu Valley climbing the wall up to the mine

Despite generations of mining, nothing could prepare the miners for what they would find—the "King of Kashmir" surpassed all expectations. It consisted of over a dozen stunning aquamarine crystals dispersed along the ceiling of a pocket. Its density of perfect crystals was unlike anything ever before found. Given its massive size and obvious quality, the miners understood that they were ill-equipped to attempt its extraction alone. Calling upon mineral dealer, Daniel Trinchillo, they sought help in its recovery, and a fair price worthy of the piece. Trinchillo, working in partnership with Marco Amabili negotiated with the owners. Once the deal was finalized, they brought in trusted friends and mining experts Marco Lorenzoni, and Dr. Federico Pezzotta to begin the recovery process. Not without its own trials and tribulations, the mining team worked onsite for over a month, diligently removing the single piece, all at nearly 300 meters up on a sheer cliff face and 30 meters straight into the mountain. Eventually, the King of Kashmir was finally unearthed. It was then wrapped in blankets and brought down the mountain on ropes like a cable car. It was then sent to the MCP lab in Milan for inspection and professional cleaning.

Daniel Trinchillo with the King of Kashmir

Weighing approximately 140 kilograms and measuring 80 centimeters in length, the preservation of the King of Kashmir is not just a stroke of luck but the result of a convergence of factors that could only occur at this point in history. Such a perfect and large-scale specimen could only exist at a time when mining knowledge and technology have reached their current heights, allowing for precision extraction and preservation. For collectors and mineral enthusiasts, this specimen is not just a remarkable piece—it is a symbol that mineral discovery and recovery have reached a new age.

Bernalite from New Mexico

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The Victorio mining district lies within the Victorio Mountains, about 19 miles West of Deming, New Mexico, on the Gage Quadrangle, 7.5 minute series. Skarns are located within the "middle hills" in Township 24 S, Range 12 W, section 29, and are south of Interstate 10. The skarns, "tactites", or metamorphic alteration zones, lie within the Ordovician Montoya dolostones or limestones (Griswald). The alteration areas are approximately 35 million years old (Donahue).

Bernalite crystals, Ogre Bogle Claim, Victorio mining district, Luna Co., NM. FOV 0.5 mm. Pat Haynes specimen. Scott Brayley photo.

In 1984 I was chasing skarn minerals in the Victorio mining district. I was specifically looking for tetrahedrons of microscopic yellow to brown helvite. The Ogre Bogle claim had a lot of potential. Grossular and quartz were the most dominant minerals. However, calcite fills most of the vugs in the rocks, so acid baths are used to expose the microscopic minerals within the vugs. Other common species are helvite, beryl, scheelite, actinolite, tremolite, muscovite, and titanite. Mindat.org lists 22 species (December 2022) occurring at the Ogre Bogle claim. One of the acid baths had several rocks with a very tiny, green cubic-looking mineral. An initial electron microprobe analysis revealed only iron and oxygen. The green cubes were unique!

Around fourteen specimens of the green mineral were found. Perhaps, all of them originated from a single boulder or a very localized spot on a pit wall. I gave up all but three of the specimens for testing. After some time had passed, I inquired about the specimens. The researcher stated that he had lost the specimens!

This left me with just three existing specimens, and there was not enough material to perform a powder X-ray diffraction. Being frustrated about the status of the lost specimens, I pessimistically cataloged them into my collection as "unknown".

Decades passed, but in 2015, my curiosity finally prompted me to send one of the remaining three samples to Tony Kampf, who had equipment that could identify tiny crystals. Tony confirmed the green crystals to be bernalite, a rare mineral that had been found in Australia. Bernalite is $Fe(OH)_3 \cdot nH_2O$ (n = 0.0 to 0.25) (Birch). It is bottle-green, orthorhombic, and pseudo-cubic.

Bernalite had a slow start. In the early 1920's two specimens of it were found in the oxidized zone of the Proprietary Mine, Broken Hill Mine, NSW, Australia. The specimens have dark olive-green octahedral crystals up to 3 mm. The mineral was originally misidentified as scorodite. After sitting around for about 65 years, somebody questioned its identification. It was investigated and published as a new mineral in 1992.

In August 2024 Mindat.org lists 13 localities for bernalite, scattered over nine countries. It is rare, however many specimens of it have been found in the Clara Mine in Germany, with all of Mindat's bernalite images being specimens from that mine. The Clara Mine probably has some pretty good bernalite, but the New Mexican material is arguably better, probably world-class! It is unfortunate that the New Mexican material wasn't thoroughly investigated in the 1980's. New Mexico missed having a new type locality mineral.

Acknowledgments

I thank John Rakovan and Nancy Attaway for their helpful editing suggestions. I thank Tony Kampf for identifying the bernalite. I thank Scott Brayley for his photomicrography. One of his images is attached.

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The Mineralogy, Origin, and Economic Potential of Arsenide Five-Element Vein Deposits: Examples from the Black Hawk District, New Mexico and Worldwide

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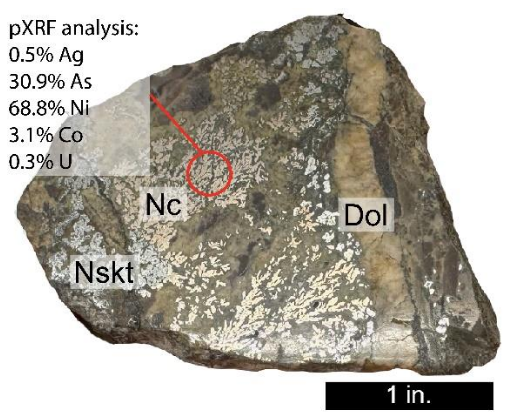
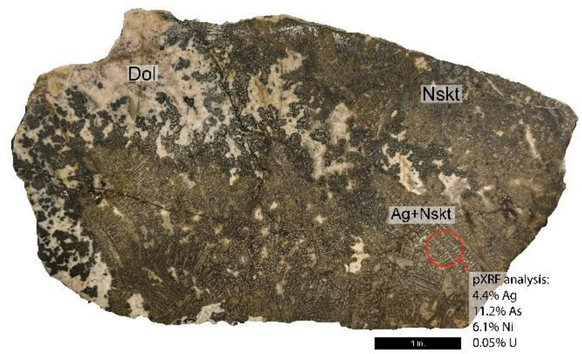
Arsenide five-element vein deposits are mineralogically and texturally complex, low- to moderate-temperature, hydrothermal, structurally-controlled Ag-Co-Ni-Bi-As bearing carbonate vein systems with local minor to trace elements such as U, Cu, Pb, Zn, Sb, Hg and others. There are many subtypes or variations of this deposit type, since some elements do not occur at all localities. They also have been called five element association, Ni-Co-native Ag ore type, Bi-Co-Ni-As-U-Ag-formation, Ag-Co-Ni-As-Bi type, and polymetallic veins. They contain high-grade silver (1000s g/t Ag), but are low tonnage (<1 Mt) and low in Au and Cu. Ag, Bi, and As are commonly found as native elements, whereas Co and Ni are found as arsenides and/or sulfides.



Polished slab of dendritic nickelskutterudite & nickeline, in carbonate vein, Alhambra mine, Black Hawk District.

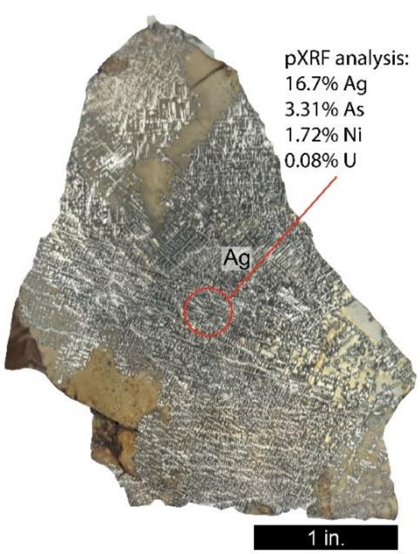
The five-element veins possibly represent segments of potentially larger mineral systems, the end members of which may be significantly different in composition and mineralogy. Nonetheless, five-element districts are being re-evaluated in many districts worldwide due to the significant quantities of critical minerals that these deposits host, especially Co and Ni, which are important components in batteries.



Polished slab of silver & nickelskutterudite in carbonate vein, Alhambra mine, Black Hawk District.

The elements (i.e., Ag, Co, Ni, Bi, As) forming most five-element vein systems have different chemical properties and are not normally found together in other deposit types, which highlights the need for specific hydrothermal processes leading to the formation of this particular element association. In other deposit types, such as epithermal Au-Ag deposits or polymetallic vein deposits; Ag is typically found with Cu and Au in sulfide- and sulfosalt-rich assemblages, both of which are rare in the five-element vein deposits. Bi is rare in low- to moderate-temperature vein deposits and is typically found in very high-temperature veins, skarns, and VMS deposits, however, the association with major Ni and Co mineralization is absent in these deposits. Common gangue (non-economic) minerals in five-element veins comprise of carbonates, such as calcite, siderite, ankerite, and dolomite with minor locally present barite, quartz, and fluorite.

Textures of five-element veins are not usual for open-space filling veins and include thin wires, fern-shaped dendrites of native metals (Ag, As, and Bi), herringbone Ag, and botryoidal masses. The dendritic textures common to most five-element veins are thought to have formed very quickly. Other minerals grow slowly and form euhedral crystals or massive aggregates. Many five-element vein deposits have erratic shapes and grades of ore bodies, but most are open-space fillings with little replacement of wall rock. Typically, these deposits are small, narrow (<2 m) and discontinuous, making exploration for new ore shoots challenging. Host rock composition, high-salinity fluids, rheology of veins and host rock, and intersections with former hydrothermal systems seem to play a critical role in the formation of five-element veins. Host rocks may act as sources of elements. Shale is locally attributed as a source of elements, but other five-element vein systems, such as the Black Hawk district (New Mexico) are hosted by Proterozoic rocks with no shale. World-wide examples include: Schneeberg (Germany), Jachymov (Czech Republic), Cobalt, (Ontario, Canada), Port Radium/Great Bear Lake (Northwest Territories, Canada), and Bou Azzer (Morocco).



Polished slab of silver in carbonate vein, Alhambra mine, Black Hawk District.

The Black Hawk district is east of Bullard Peak in the Burro Mountains in southwestern New Mexico and is one of the few localities of five-element veins in the U.S. In 1881, Cherokee Jim Bowman discovered rich silver float in a wash. John Black and his partner, Sloan, located the source of the float, near the Alhambra (formerly Blue Bell) mine. By 1881, claims were staked and a town developed. Although production records are lost, it is estimated that over $1,000,000 was produced from the district from1883 to 1893, when silver prices dropped due to the silver panic of 1893. Solid Silver Mining Co. produced $600,000 from the Black Hawk mine; one car load contained $28,000 worth of silver! An estimated $400,000 of high-grade silver was produced from the Alhambra, $100,000 from the Rose, $40,000 from the Hobson, and $10,000 from the Good Hope mines. From 1880 to 1890 the price of silver dropped from $1.15/oz to $0.95/oz, and by 1898 was $0.565/oz. The mines operated sporadically because of lack of capital, water issues, difficulty in finding ore shoots, and theft. The district is a favorite for mineral collectors and even during early production in 1883-1893, theft of high-grade silver samples was a problem. Guards had to be hired to make sure some ore actually made it to the mill!

Recent mapping, geochemistry, and petrography in the Black Hawk district have shown epithermal textures such as bladed quartz after calcite (indicative of boiling) and brecciation are common in the higher levels of the system. General paragenesis includes 1) early barren hydrothermal calcite-quartz stage with minor sulfides (pyrite, sphalerite), 2) Ni-Co-As-Ag arsenides and sulfarsenides hosted by carbonates with native Ag, 3) uraninite stage, 4) sulfide stage, 5) late calcite-dolomite-quartz veins, and 6) late dissolution and reprecipitation (supergene). Brecciation occurs throughout the middle to later stages. Mineralized samples contain up to 9970 ppm Ag, 8540 ppm As, 5690 ppm Co, 72,400 ppm Ni, 57 ppm Bi, 165 ppm Sb, and 32,600 ppm U.

Minerals in the Black Hawk district

Mineral Name	Mineral Formula	Mineral Name	Mineral Formula
Acanthite	Ag_2S	Nickeline	$NiAs$
Anglesite	$PbSO_4$	Nickelskutterudite	$(Ni,Co,Fe)As_3$
Ankerite	$Ca(Fe^{2+},Mg)(CO_3)_2$	Nimite	$(Ni,Mg,Al)_6((Si,Al)_4O_{10})(OH)_8$
Annabergite	$Ni_3(AsO_4)_2 \cdot 8H_2O$	Pearceite	$[Ag_6As_2S_7][Ag_9CuS_4]$
Aurichalcite	$(Zn,Cu)_5(CO_3)_2(OH)_6$	Polybasite	$[Ag_6Sb_2S_7][Ag_9CuS_4]$
Azurite	$Cu_3(CO_3)_2(OH)_2$	Proustite	Ag_3AsS_3
Barite	$BaSO_4$	Pyrargyrite	Ag_3SbS_3
Bismuthinite	Bi_2S_3	Pyrite	FeS_2
Bismutite	$(BiO)_2CO_3$	Pyrostilpnite	Ag_3SbS_3
Bornite	Cu_5FeS_4	Pyrrhotite	$Fe_{1-x}S$ $x = 0$ to 0.17
Chalcopyrite	$CuFeS_2$	Rammelsbergite	$NiAs_2$
Chlorargyrite	$AgCl$	Rhodochrosite	$MnCO_3$
Covellite	$Cu^{+}_4Cu^{2+}_2(S_2)_2S_2$	Safflorite	$(Co,Ni,Fe)As_2$
Cubanite	$CuFe_2S_3$	Scheelite	$Ca(WO_4)$
Digenite	Cu_9S_5	Siderite	$FeCO_3$
Erythrite	$Co_3(AsO_4)_2 \cdot 8H_2O$	Siegenite	$CoNi_2S_4$
Galena	PbS	Silver	Ag
Gersdorffite	$NiAsS$	Skutterudite	$CoAs_3$
Gold	Au	Sphalerite	ZnS
Hematite	Fe_2O_3	Stannite	Cu_2FeSnS_4
Jalpaite	Ag_3CuS_2	Stromeyerite	$AgCuS$
Manganite	$Mn^{3+}O(OH)$	Tennantite subgroup	$Cu_6(Cu_4\mathbf{C}^{2+}_2)As_4S_{12}S$
Marcasite	FeS_2	Tetrahedrite subgroup	$Cu_6(Cu_4\mathbf{C}^{2+}_2)Sb_4S_{12}S$
Mckinstreyite	$Ag_{5-x}Cu_{3+x}S_4$ $x \approx 0\text{-}0.28$	Uraninite	UO_2
Millerite	NiS	Zircon	$Zr(SiO_4)$
Molybdenite	MoS_2		

Two Donations of Historical New Mexico Mining Equipment to the NMBGMR

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The collection of the New Mexico Mineral Museum in the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) includes selected mining artifacts and memorabilia. Two important donations of well-documented mining artifacts were recently made to the Museum and Bureau. One, from longtime museum benefactor, Phil Bové of Santa Fe, includes many large pieces from the Cash Entry and other mines of the Cerrillos District, Santa Fe County, New Mexico. A highlight is a mine cage from the Cash Entry, Figure 1 (Kelsey McNamara and John Rakovan for scale). The second donation, from Desiri (Henderson) and Al Pielhau of Golden New Mexico, includes a hoist and 5-stamp stamp mill built in Golden to crush gold ore from the load deposits of the New Placers District, Santa Fe County, New Mexico. All of the larger artifacts from these donations will be permanently displayed in the west courtyard of the NMBGMR building, 801 Leroy Place, Socorro, New Mexico.

Museum staff in a mine cage! This piece was used at the Cash Entry Mine in the Cerrillos District, NM and was donated by Phil Bové.

Golden Stamp mill (built c 1885) behind the Henderson Store, Golden, NM. Donated by Desiri and Al Pielhau.

Mining historian Paul Secord has published a pamphlet on all of the pieces in the exhibit, ISBN:9798327979727, which is available in the NMBGMR bookstore and online through Amazon.

Mining Equipment Displayed

1. Golden Stamp Mill c.1885, "New Placers" - Henderson
2. English Iron Works Hoist, c.1910, San Pedro Mts. - Henderson

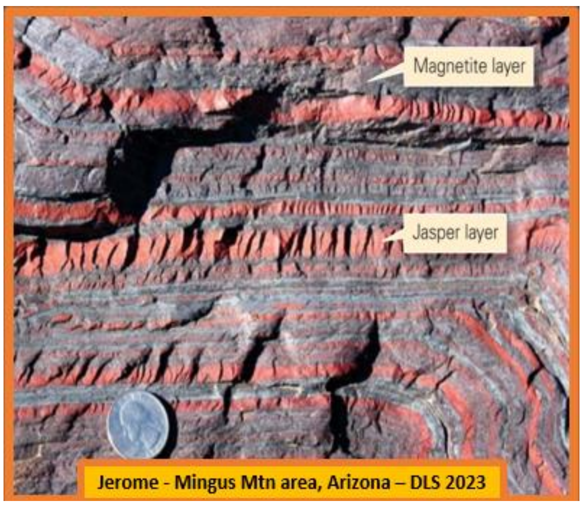
3. Hand operated rope winch for shaft and drift mining, 19th century, "New Placers" - Henderson
4. Air Compressor, Black Hornet Prospect, Cerrillos Hills - Bové
5. Mine Cage, Cash Entry Mine, Cerrillos Hills - Bové
6. Drive belt wheels connected to a diesel engine, Cerrillos Hills - Bové
7. Ore feeder, Cash Entry Mine, Cerrillos Hills - Bové
8. Head Frame Sheave, Cash Entry Mine, Cerrillos Hills – Bové
9. Ore Bucket, Willow Creek District, New Mexico - Bové
10. Ore Car, New Mexico? – Bové

Part of the mining artifact exhibit (north side) in the west courtyard of the NMBGMR building.

Pre-Cambrian BIF (Banded Iron Formation) near Jerome, Arizona: Worldwide Significance

DAVID STOUDT[1], WES YEAGER[2], SUSAN HOFFMAN[1]
[1]Santa Fe, NM, [2]Cottonwood, AZ

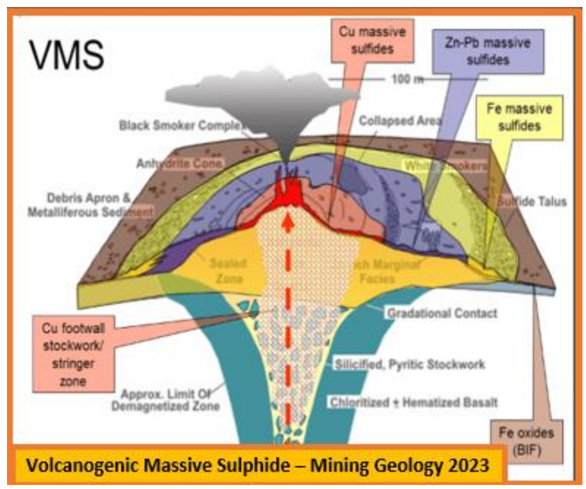
BIF (Banded Iron Formation) are layers of iron-rich sediment, either red or black, from the presence of hematite (Fe_2O_3) or magnetite (Fe_3O_4). BIF is the world's major supplier of iron ore for steel production. That market is valued at over $500 billion per year. The geologic age is Pre-Cambrian ranging from 3.5 Billion to 1.9 Billion years ago.



Jerome - Mingus Mtn area, Arizona – DLS 2023

Banded Iron Formations were deposited in ancient oceanic waters by dissolved iron (Fe) flowing in from continental rivers and combining with oxygen (O_2), released by photosynthesis of Cyanobacteria (commonly called blue-green algae). Photosynthesis is the process by which organisms use sunlight to produce food from carbon dioxide (CO_2) and water (H_2O). The combination resulted in the precipitation of black magnetite or red hematite. As atmospheric oxygen levels fell, the rocks deposited left red hematite-pigmented silica /chert layers. These red and black layers were repeated in repetitions thru 4 billion years.

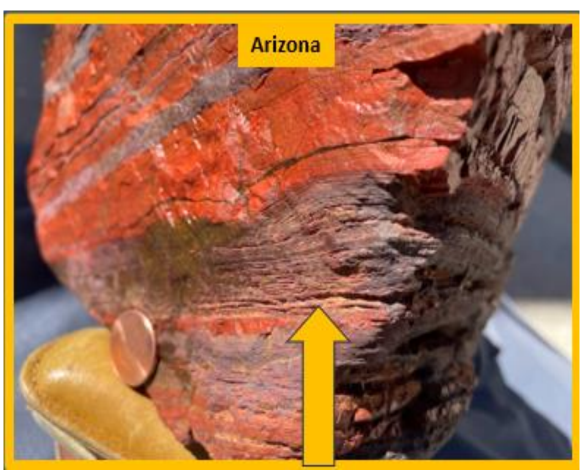
If the total geologic time column of 4.6 Billion years is normalized to a 24 hour day; the Pre-Cambrian portion amounts to 21.3 hours out of 24. The remainder of the geologic column is 2.7 hours. Human existence is equivalent to only a few minutes of geologic time. Banded iron formations, along with blue-green algae stromatolites are prominent throughout the Pre-Cambrian. Today, blue-green algae stromatolites have limited physical presence in nature.



Volcanogenic Massive Sulphide – Mining Geology 2023

Banded iron formations are found worldwide, with major deposits in the U.S. (Minnesota – Mesabi Range), Canada, Brazil, Russia, South Africa, and India. The most prominent are the Northwest Australia deposits in the Pilbara region. Some of the Australia banded iron deposits contain "Tiger Eye." The distinctive yellow bands are related to metamorphic asbestos. The Arizona region surrounding Jerome and Mingus Mountain of Yavapai County houses some BIF collecting areas, which are the focus of this presentation.

The Jerome and Mingus Mountain BIF occurred along an oceanic rift zone, quite similar to the Mid-Atlantic rift spreading center which crosses Iceland with active eruptions today. But in the case of Jerome/Mingus Mountain the volcanic eruptions were under several thousand feet of ocean water. The BIF formed on the periphery of the active eruption sites. Commercial minerals found at Jerome include copper, gold, silver, and chalcopyrite. All of these collectable minerals are included in the formation of VMS (Volcanic Massive Sulphides) along with the Banded Iron Formation magnetite and hematite colored silica/cherts.



The Jerome/Mingus Mountain BIF area of Yavapai County, Arizona, covers over 200,000 acres of aerial extent and is part of the Prescott National Forest. The rugged and heavily forested area is 4-wheel drive country. Happy collecting!

Thundereggs from the Florida Mountains -From Mine to Mantel

LORI LYTLE COLEMAN
148 Hill Country Rd., Alto, NM 88312, lorilytlecoleman@gmail.com

Introduction

Owner of the Spanish Stirrup Rock Shop, Lori Coleman has been mining thundereggs in the Little Florida Mountain in Luna County, NM fulltime since 2009. Her world-class deposit Lava Cap came onto the collector's scene at the Tucson Gem and Mineral Show in 2010. The first woman keynote speaker at the International Agate Expo in Austin, TX in 2019 she loves to tell her story and passion for mining New Mexico's incredible Thundereggs.

History

Mining in the Little Florida Mountain dates to the early 1900's. The remains of an old Manganese mine is still seen there today. An area known as South Canyon is part of an ancient Rhyolitic Lava Flow. Surface trace materials can be found of agate, thunderegg cores, flow banded rhyolite and common opal. Loris's first claim on BLM (Bureau of Land Management) was filed here. The deposit's name is Lava Cap. To manage the mining most efficiently Lori filed for permits through the NMMM. After securing bonds and writing a mining plan she was permitted to bring in equipment. The rest is history.

What is a Thunderegg

Similar to the well-known geode, a thunderegg has a shell that is rhyolite, making it impossible to simply pop open with a hammer like a geode. It must be cut open with a diamond-bladed rock saw. Thus exposing what makes New Mexico Thundereggs some of the best in the world. Lava Cap is known for its red shell, agate, common opal, quartz, and pseudomorphs after what is suspected calcite with manganese oxide pigments.

Two halves of a thunderegg in visible and ultraviolet light (showing green fluorescence)

Minerals and Fluorescents

Because of the presence of uranium salts in the fluids that precipitated the agate and quartz in these thundereggs, they react to ultraviolet light as pictured above. This makes the Lava Cap Thundereggs highly sought after by collectors of fluorescents.

The Everyday Person

While mining in 30-day stints, Loris's goal is 500-1000 lbs. a day. With this kind of volume, she quickly had to figure out how to market her materials to more than the small group of collectors worldwide. This led to building her world-class facility in Alto, NM where all the thundereggs are processed into decorative and useful objects.

The Facility

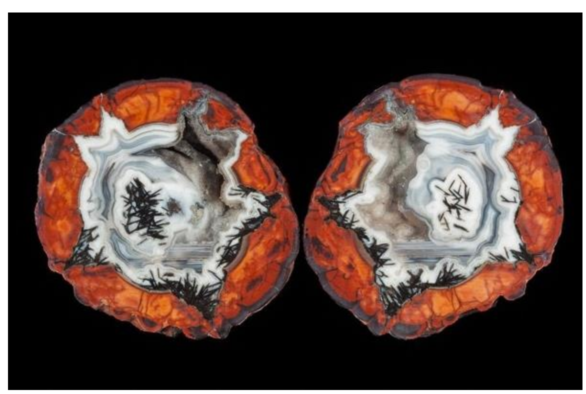
Loris's husband, Bruce, is a retired Engineer and designed a world-class processing facility. The first phase of the processing facility was built in 2018. Each area was designed for the equipment it would hold. There is a saw area, lap area, coring area, sphere area, tumbling area as well as ultrasonic drills and woodworking machines to make stands out of local wood.

Lori loves equipment almost as much as she loves rocks! The shop now measures 160’x50’ under one roof. They can produce all their own electric power with the solar panels on the roof. They also catch the rain off the roof to supply the water needed to keep the laps and tumblers going. The crusher allows them to take all the left-over cuttings and supply the tumblers. Thus using 100% of the material mined.

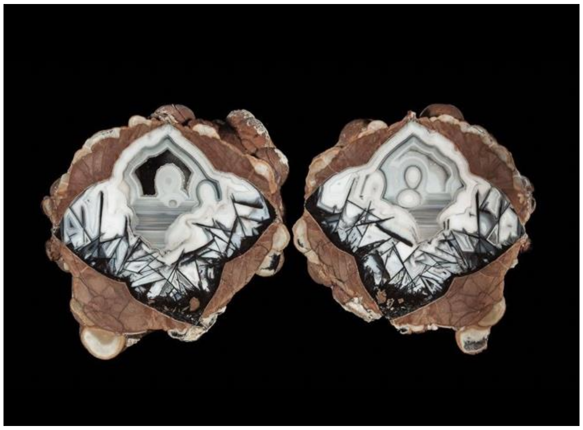
Up to the Mantel

Building a facility just outside of Ruidoso, NM a mountain town tourist mecca was the best business decision Lori & Bruce made. This allowed them to create all sorts of product lines to supply the tourists with all rock related décor for their homes in New Mexico, Texas, Arizona and beyond. From spheres to wine bottle holders, she’s got you covered. The rock is mined, processed, and sold here in NM. She is most certainly New Mexico True.

Lori with a particularly large thunderegg.

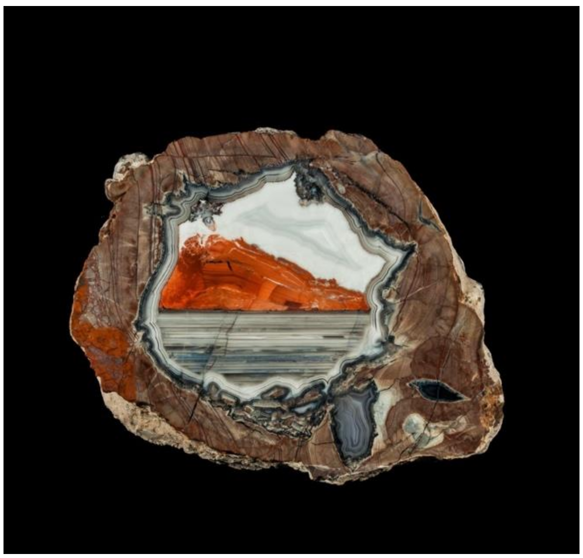


Lava Cap Thunderegg Pair



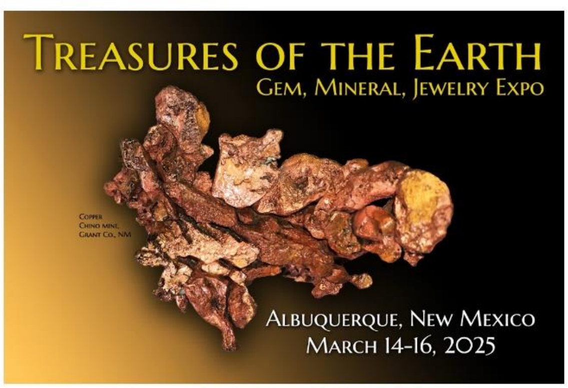
Lava Cap Thunderegg Pair with black, tabular pseudomorphs.

Lava Cap Thunderegg Pair with black, tabular pseudomorphs.



Lava Cap Thunderegg half with Tilt

Upcoming Events



March 14 - 16, 2025

Friday 10:00 AM to 6:00 PM
Saturday 10:00 AM to 6:00 PM
Sunday 10:00 AM to 5:00 PM

Creative Arts Center
Expo New Mexico
(State Fair Grounds)

Admission Cash Only
Fri $2, Sat & Sun $5