# MINERALS OF ARIZONA

## Nineteenth Annual Symposium

Sponsored By
Flagg Mineral Foundation &
Arizona-Sonora Desert Museum

Saturday March 26, 2011

Co-Chairpersons
Anna Domitrovic - Curator Emerata, Arizona-Sonora Desert Musuem
Ray Grant - Chair, Flagg Mineral Foundation

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**Sponsored by the Flagg Mineral Foundation, and Arizona-Sonora Desert Museum**

## Saturday March 26, 2011
## 8 AM. to 5 PM.

## Arizona-Sonora Desert Museum
## Tucson, Arizona

**Co-chairpersons:**
**Anna Domitrovic – Curator Emerata, Arizona-Sonora Desert Museum**
**Ray Grant – Chair, Flagg Mineral Foundation**

**Cover Design by Harvey Jong**

**Photo Credits for Cover Artwork**

**Upper left photo**
**Rongibbsite**
**Evening Star mine, Bighorn Mountains, Maricopa County, AZ**
**Ron Gibbs specimen & photo**

**Upper right photo**
**Markascherite**
**Childs Aldwinkle mine, Bunker Hill District, Copper Creek, Pinal County, AZ**
**Mark Ascher specimen/Sugar White photo**
**Height of large crystal: 1.1 mm**

**Lower left photo**
**Azurite**
**Rosemont, Rosemont-Helvetia District, Santa Rita Mountains, Pima County, AZ**
**Harvey Jong specimen & photo**
**Field of view: ~2.5mm**

**Lower right photo**
**Vanadinite**
**Old Yuma mine, Saguaro National Park, Amole District, Tucson Mountains, Pinal Co., AZ**
**Bill Hunt photo**

## Symposium Program

| | |
|---|---|
| 8:00 - 9:00 - | Coffee Hour |
| 9:00 - 9:10 - | Welcoming Remarks and Introductions |
| 9:10 – 9:40– | Minerals of the Mission Complex – Bill Williams |
| 9:40 – 10:10 - | Oracle Granite Tourmaline - Barbara Muntyan |
| 10:10 – 10:50 - | Break, Mineral Silent Auction |
| 10:50 – 11:20 - | The Forgotten Silver District – Peck Mining District - Brian Beck |
| 11:20 – 11:50 - | Arizona Mineral Treasures – Tony Potucek |
| 11:50 – 1:30 - | Lunch, Mineral Silent Auction<br>Visit Museum's mineral exhibits, limited tour for the Museum's mineral vault. |
| 1:30 – 2:00 – | Rosemont Copper project, Coronado National Forest - Beverley Everson |
| 2:00 – 2:30 - | Mines and Minerals of the Amole District, Tucson Mountains, Pima County - Anna Domitrovic |
| 2:30 – 3:00 - | Break, Mineral Silent Auction |
| 3:00 – 3:30 - | Microminerals of the Evening Star mine –Ron Gibbs |
| 3:30 – 4:00 - | What's New in Arizona Minerals – Marcus Origlieri, Harvey Jong and Ray Grant |
| 4:00 - | Visit Museum's mineral exhibits, limited tour for the Museum's mineral vault. |

# Minerals of the Mission Complex Pima Mining District

Bill Williams

The Pima Mining District is located 20 miles south of downtown Tucson. The Mission Mine Complex now owns and/or leases virtually all of the property that now comprises this district. Through a series of purchases made in the 1980's, Asarco consolidated its Mission, San Xavier North and San Xavier South mines with the open pit mines of Pima and Eisenhower (a joint venture between Anamax and Asarco) and the Mineral Hill property which contained the Daisy, Mineral Hill, Plumed Knight, and former Eagle-Picher San Xavier underground mines. In addition, Asarco has a mining lease on the Tohono O'odum Indian Reservation directly north of the mine. In total, Asarco controls over 15,000 acres of property in this district.

In 1872, the first recorded claim in the U.S. Land Office in Arizona Territory was the San Xavier claim which is located in the Pima Mining District. All recorded production for the period of 1882 through 1957 was from the underground mines of the district, which operated intermittently due to silver and copper prices. The development of the open pits started with the Pima Mine which started mill production in 1957. The mill to process the ores from the adjacent Mission Mine began in 1961. Asarco treated oxide ores from the San Xavier North and San Xavier South Mines during the period of 1973 to 1978. Total production from these pits has been approximately 791,000,000 tons of ore grading 0.602 percent copper, equivalent to nearly 9.5 billion pound of copper in the ore. Waste moved is approximately 2.5 billion tons, which equates to a stripping ratio of 3.23 tons of waste per 1 ton of ore. In terms of mineral specimens, the oxide period generated the largest number of specimens seen today from this district. An interesting point to consider is the fact that the pits of this district are "youngsters" when compared to those of Morenci, Ray, and Ajo, yet the district has had known mineralization for nearly 140 years.

The author will use a power point presentation which will briefly show an overview of the Mission Complex, the properties making up its ownership, a brief history, and some of the major known collectable crystalline minerals found in this district. The following tables provide the mineral name and known mine localities in the district where the mineral was found. These lists represent specimens known to the author through 30 years of collecting in the district and from other collectors specimens, but should by no means be considered the only known specimen types that could be from here.

| Copper Oxide Minerals | Known Mine Occurrences |
|---|---|
| Azurite | San Xavier North & South pits, Daisy, Mineral Hill |
| Brochantite | San Xavier North pit |
| Chalcotrichite (var. of cuprite) | San Xavier North & South pits, Daisy |
| Chrysocolla | San Xavier North & South pits, Daisy |
| Cuprite | San Xavier North pit, Daisy |
| Malachite | San Xavier North & South pits, Daisy, Mineral Hill |
| Tenorite | San Xavier North & South pits |

| Other Minerals | Known Mine Occurrences |
|---|---|
| Aragonite | Mission underground |
| Barite | Mission pit, San Xavier South pit |
| Calcite | Mission pit, San Xavier North & South pits |
| Copper (Native) | Mission pit, Eisenhower pit, San Xavier North & South pits, Daisy |
| Dolomite | Mission pit |
| Fluorite | Mission pit |
| Garnet | Mission pit |
| Quartz | Mission pit, San Xavier North pit |
| Pyrite | Mission pit |
| Scheelite | Mission pit |
| Gypsum | Mission pit, Eisenhower pit |
| Wulfenite | Pima pit, Daisy |

# ORACLE GRANITE TOURMALINE

Barbara L. Muntyan
Tucson, Arizona

Mineral collectors in southern Arizona have long known about pseudomorphs of biotite mica after schorl tourmaline, some up to nearly twelve inches long, found in outcrops of pegmatite within the Oracle Granite. This rock unit is found widely distributed in the Santa Catalina Mountains and in the foothill zone around the town of Oracle, just north of Tucson.

With the explosive growth of suburban bedroom communities, especially north of Tucson, exposures of the Oracle Granite are becoming somewhat more difficult to access. However, north of State Highway 77 in the vicinity of the town of Oracle, there is a wide area of ranch land and/or public land running all the way to the Mammoth area. There are a number of exposures of Oracle Granite pegmatite in this area and many of them contain small to large schorl tourmaline crystals, up to 10 or 12 inches in length, pseudomorphs of biotite mica replacing tourmaline, large books of biotite mica, well-developed tan feldspar crystals, and occasional pseudomorphs of pyrite cubes replaced by limonite or hissingerite. These all occur in huge, white, massive quartz dikes which generally erupt several feet above the surrounding terrain. Most of these dikes, some of which run for 80 to 100 feet, trend north-northeast by south-southwest. They are actually visible on satellite images on Google Earth. There are also reports of beryl in these pegmatites. Both the author and Evan Jones own specimens of dull-green beryl crystals, both from the same dealer, reported to have been found in the Oracle Granite, but the author has found none of her own so far.

The area that contains the pegmatite outcrops is composed of low, rolling hills cut by small and large arroyos. Vegetation consists of open grassland, with yucca, prickly pear cactus, barrel cactus, cholla, thorny schrub and a few mesquite trees. Access to the pegmatite exposures can be obtained by driving north from State Highway 77 on the Willow Springs Road. The pegmatites begin west of the Willow Springs Ranch and extend all the way to Fortified Peak and beyond. There are several moderately-maintained dirt roads branching off of the Willow Springs Road, and several will bring one near to the quartz dikes. Some hiking is required.

In many places the ground is littered with broken sections of tourmaline crystals ranging in size from perhaps a half inch to 2 inches in length. Most are not terminated, but many show little weathering and have good luster. In addition, there are places where biotite mica is weathering out in sheets up to 2 inches across. Some very nice books of biotite, sometimes attached to either white massive quartz

or pale-tan feldspar can be obtained with minimal effort. They make nice locality specimens for the collector.

On a trip to collect mica specimens for children's grab bag giveaways in 2008, my collecting buddy Sheila Powell and I returned to a zone we had previously collected. We knew it had copious amounts of loose mica books which would be perfect for the grab bags. We had not been there for a couple of years and were astounded to see most of the mica and nearly all the tourmaline fragments had been seemingly "vacuumed" up, possibly by some field trip group with low standards.

Since we knew where the mica had been concentrated, we started digging down, prying apart large sections of massive quartz and large feldspar cleavages. We began to find fresh mica books on matrix about one foot down. These continued on downward for a couple of feet A pit about four feet by five feet and perhaps three feet deep was ultimately dug out.

As we continued to expand our pit, we began to find unaltered tourmaline crystals to about 6 inches by 1½ inches, on a matrix consisting of mica, quartz, and feldspar. This seemed quite exciting to me, because all the specimens from this area which I had heretofore seen were almost entirely single crystals without any matrix. Sheila likes big specimens, and she pulled out several pieces at least a foot across. Some of the schorls which we excavated did shatter and crumble, and there were none with the low pyramidal terminations of early specimens, but some did have the pinacoid (flat) termination. When all the digging was done in that pocket, we had several flats of matrix tourmaline specimens, some quite nice.

Pseudomorphs of limonite or hissingerite after pyrite cubes have also been reported from outcrops in the Oracle Granite. On one of our scouting trips, we came upon an area with several machine-generated prospect pits, which appeared to be for manganese or iron. Near one such pit, we found a small exposure with very sharp crystals of pseudomorphed pyrite cubes to 1 inch on edge. Smaller examples of pyrite pseudomorphs are not uncommon throughout the area. Small red to orange garnets, up to about ¼ inch are also found, often frozen within massive feldspar.

This collecting area has been known for many years, and a number of Arizona collectors have nice specimens, including Les Presmyk and Evan Jones. However, since Arizona collectors primarily love red, yellow, blue or green minerals, this area has heretofore been under-appreciated. It deserves more recognition.

N of CK
1850 - 1870 silver
Curtain / Black Warrior SP

# THE FORGOTTEN SILVER DISTRICT - PECK MINING DISTRICT

YAVAPAI COUNTY, ARIZONA by Brian A. Beck, PG

The first written report of the Peck Mining District was published in 1877 by Hiram C. Hodge (*Arizona As It Is; and The Coming Country*) :

> "The Peck is one of the leading mines of the Territory. Discovered in 1875, it was worked successfully till 1878, when the owners became involved in a lawsuit which has not yet ended. The mine produced during that short period $1,200,000. Ore worth from $5,000 to $20,000 per ton was frequently met with. Pending the settlement of lawsuits, one of the finest properties in the Territory is lying idle. The rich vein is about 18 inches wide, composed mainly of chlorides and carbonates..... The Peck is a strong vein, with prominent quartzite croppings traceable across the country for several miles. .....The vein is a strong and well-defined one, the richer ore bodies occurring in chambers or bunches. .....It shows a vein from 2 to 3 feet wide, composed of sulphurets, galena, native and antimonial silver, assaying on an average, $200 per ton.....
>
> The geological character of the country both east and west, a half mile from the mine, is granite, but between the granite formation, for a half mile to one mile in width, are numerous dykes of quartzites, slate, and porphyry, intermixed with granite, forming a splendid gangue for a rich and extensive mineral deposit. At a depth of two hundred and thirty feet the ore body is five feet wide, carrying a wonderful strata of almost solid chloride of silver, from eight to fourteen inches wide, which yields from $1,000 to $3,000 per ton in refined silver bullion. .....The ore from this mine is transported by pack trains over twenty miles to their mill, which is quite expensive. "

The production history of the Peck for the 3 years of known operation, a reported 1.1 million ounces of silver was produced. The one smelter report also indicates that some of the materials shipped had recoverable antimony to 24% of the total weight. The reported depth of the Peck Mine was 400 feet with most of the production from one ore pod/saddle reef. As far as we have been able to determine, this property has not been drilled or mapped. The five adits and shafts we were able to access, did have silver and antimony mineralization.

During the 1880s, a law suit shut down the Peck Mine. In the late 1880s, the main shaft of the Peck Mine was dynamited by one of the owners to keep the other owners out of the mine. The main shaft was never reopened.

The first description of the vein and ore deposits was provided by the USGS in 1905 in the Bradshaw Mountains Folio # 126, by Jaggar and Palache. The classification of the deposits for the region were classified according to the dominant value of their contents: gold, silver, and copper. The classification was tied to the main production of an individual deposit, but they recognized the division is not distinct, since the ore minerals occur together and vary extremely.

"Silver deposits - The typical silver veins of the district are narrow veins carrying argentiferous galena, argentite, pyrargyrite, and probably other antimonial silver minerals in their deeper portions, and cerargyrite and sulphate and carbonate of lead at the surface. The gangue is largely siderite with more or less quartz and calcite. Several very rich veins of this character were found in the quadrangle, but they have long been exhausted and abandoned, so that in the field at present little can be seen of their character. Silver is also present in varying amounts in the veins classed as gold veins, and in ores rich in galena frequently exceeds the gold value."

Internal Structural Control

The main structural control for these Veins are faults. These faults do not show any lateral (strike slip) movement past a few tens of feet, but appear to have dip slip movements of several hundred feet at least. No studies have been conducted to determine the amount of dip slip movement.

The mineralizing solutions were deposited along the fault surfaces, but in an apparent, distinct manner. The style of these deposits can be termed "saddle reef" or lenticular, where a flexture in the fault surface separated sufficiently to allow mineralization to occur. From the cross-sections, descriptions of the mines and veins, and from field observations, numerous features appear to be present in all of the published materials on these ore deposits and be observed in the field (Photograph Section):

A. The lateral width of the saddle reefs within the faults is 50 to 250 feet.

B. The thickness of these saddle reefs from a few inches to no more than 18 feet, with the average thickness being 2 feet.

C. The depth of these saddle reefs ranges from 200 to more than 400 feet (deepest known shaft in the Curtin).

D. These ore deposits typically have a 10 to 25 degrees rake to the north in this area.

E. These deposits have a dip of 60 to 80 degrees from the vertical with a dip to the west.

F. The strike of these deposits varies but generally northeast to the southwest.

G. The known saddle reefs tend to occur in groups, up to 8, along the vein structures and are separated by less than 200 feet, laterally.

The mineralogy identified within the Peck District is provide in the tables.

**Curtin/Black Warrior Group Mineral Descriptions**

| LOCATION | MINERAL | Elements | HOST ROCK | Grain Size Range | Color | Luster | Comment |
|---|---|---|---|---|---|---|---|
| CURTIN | Silver Minerals | | | | | | |
| SILVER PRINCE | Acanthite | Ag S | Qtz Vein | 0.25 to 2 mm | lead gray/black | metallic | thorn shaped crystals on quartz |
| BLACK WARRIOR | Allargentum | Ag Sb S | Qtz Vein | 0.1 to 2 mm | silver to lead gray | metallic | usually found with Stibnite |
| | Argentiferous Galena | Pb Ag S | Qtz Vein | 1 to 9 mm | lead gray | metallic | isolated grains in qtz and calcite |
| | Bromargyrite | Ag Br | Vugs in Veins | 0.1 to 3 mm | yellow-green | resinous to waxy | massive replacement to isometric crystals |
| | Chlorargyrite | Ag Cl | Vugs in Veins | 0.1 to 3 mm | yellow-green | resinous to waxy | massive replacement to isometric crystals |
| | Iodargyrite | Ag I | Vugs in Veins | 0.1 to 1 mm | pale gray to black | resinous to waxy | massive replacement to coatings on fractures surfaces |
| | Miargyrite | Ag Sb S | Vugs in Veins | <1 mm | black | metallic to waxy | velvet coatings on Mn and Fe Minerals |
| | Silver - Native | Ag | Vugs in Veins | 1 to 2 mm | silver | metallic | in vugs with Acanthite |
| | Tenantite | Ca Fe Ag Zn Sb S | Vugs in Veins | 0.1 to 2 mm | black | metallic | coatings on fractures and filling Vugs |
| | Dyscrasite | Ag Sb | | | silver white | metallic | possible association with Stibnite and Miargyrite |
| | Proustite | Ag As S | | | vermilion/red | admantine | possible crusts in vugs with Acanthite |
| | Pyrargyrite | Ag Sb S | | | red/red-gray | admantine | possible crusts with In Miargyrite and Allargentum |
| | Stephanite | Ag Sb S | | | lead gray/black | metallic | possible xals with Miargyrite |
| | Antimony Minerals | | | | | | |
| | Stibnite | Sb S | Vugs in Veins | <2mm | lead-gray | metallic | common mineral in altered vein materials |
| | Boulangerite | Pb Sb S | | | Lead gray | metallic | xals near Galena occurrances |
| | Paakkonenite | Sb As S | | | lead gray | metallic | possbile crust with Miargyrite and Stibnite |
| | Other Minerals | | | | | | |
| | Bixbyite | Fe Mn O | Vugs in Veins | 1 to 2 mm | black to brown | waxy | vug filling |
| | Braunite | Ca Mg Mn Fe Si O | Vugs in Veins | 1 to 2 mm | black to brown | waxy | vug filling |
| | Calcite | Ca C O | Qtz Veins | 1 to 18 mm | Brown to White | waxy | massive fillings in veins and secondary xals on fractures |
| | Coronadite | Pb Mn O | Vugs in Veins | 1 to 2 mm | black to brown | waxy | vug filling |
| | Cuprite | Cu O | Vugs in Veins | 1 to 2 mm | black to brown | metallic | vug filling |
| | Galena | Pb S | Qtz Veins | 1 to 25 mm | lead gray | metallic | isolated grains in qtz and calcite |
| | Goethite | Fe O | Qtz Veins | 1 to 9 mm | brownish gray | waxy | coatings on fractures and filling Vugs |
| | Hematite | Fe O | Qtz Veins | 1 to 9 mm | black/reddish | metallic | fracture fillings |
| | Hetaerolite | Zn Mn O | Vugs in Veins | 1 to 3 mm | black to brown | waxy | vug filling |
| | Jamesonite | Pb Fe Sb S | Vugs in Veins | 1 to 3 mm | Lead gray | metallic | vug filling |
| | Magnetite | Fe O | Copper Vein | fracture fillings | black | metallic | fracture fillings |
| | Psilomelane | Mn Fe O | Coatings on fractures | 1 to 5 mm | black to brown | waxy | coatings on fractures and filling Vugs |
| | Pyrite | Fe S | Quartzsite | 1 to 3 mm | Brassy | metallic | isolated grains in quartzsite |
| | Pyrolusite | Mn O | Coatings on fractures | 1 to 12 mm | black to gray | waxy | common mineral in and primary and secondary fractures |
| | Quartz | Si O | Qtz Veins, coatings | 1 to 30 mm | clear to mildy | resinous to waxy | massive to vug filling xals |
| | Romanechite | Ba Mn O | Vugs in Veins | 1 to 2 mm | black to brown | waxy | vug filling |
| | Siderite | Fe C O | Coatings on fractures | 1 to 12 mm | brown | waxy | common mineral in and primary and secondary fractures |
| | Sphalerite | Zn Fe S | | | black to brown | waxy | isolated grains in qtz and calcite, 2nd vein system |
| | | | | | | | |
| CURTIN | Copper Minerals | | | | | | |
| Copper Vein | Azurite | Cu C O | Copper Vein | crusts on fracture | blue | waxy | crusts on fractures |
| | Cuprite | Cu O | Copper Vein | fracture fillings | black/reddish | metallic | fracture fillings |
| | Malachite | Cu C O | Copper Vein | crusts on fracture | green | waxy | crusts on fractures |

Notes:

| | |
|---|---|
| confirmed | Confirmed identifcation through x-ray, microprobe or microscopic examination |
| suspected | Microscopic examination found mineral materials that were similar the to mineral described |
| Elements | Major element presented without full formula for the mineral species |

**Peck Group Mineral Descriptions**

| LOCATION | MINERAL | Elements | HOST ROCK | Grain Size Range | Color | Luster | Comment |
|---|---|---|---|---|---|---|---|
| PECK | **Silver Minerals** | | | | | | |
| | **Argentiferous Galena** | **Pb Ag S** | **Qtz Vein** | **1 to 4 mm** | **lead gray** | **metallic** | **isolated grains in qtz and calcite** |
| | **Miargyrite** | **Ag Sb S** | **Vugs in Veins** | **<1 mm** | **black** | **metallic to waxy** | **velvet coatings on Mn and Fe Minerals** |
| | **Tenantite** | **Ca Fe Ag Zn Sb S** | **Vugs in Veins** | **0.1 to 2 mm** | **black** | **metallic** | **coatings on fractures and filling Vugs** |
| | Acanthite | Ag S | | | lead gray/black | metallic | thorn shaped crystals on quartz |
| | Allargentum | Ag Sb S | | | silver to lead gray | metallic | usually found with Stibnite |
| | Bromargyrite | Ag Br | | | yellow-green | resinous to waxy | massive replacement to isometric crystals |
| | Chlorargyrite | Ag Cl | | | yellow-green | resinous to waxy | massive replacement to isometric crystals |
| | Iodargyrite | Ag I | | | pale gray to black | resinous to waxy | massive replacement to coatings on fractures surfaces |
| | Dyscrasite | Ag Sb | | | silver white | metallic | possible association with Stibnite and Miargyrite |
| | Proustite | Ag As S | | | vermilion/red | admantine | possible crusts in vugs with Acanthite |
| | Pyrargyrite | Ag Sb S | | | red/red-gray | admantine | possible crusts with in Miargyrite and Allargentum |
| | Silver Native | Ag | | | silver | metallic | possible crusts in vugs with Acanthite |
| | Stephanite | Ag Sb S | | | lead gray/black | metallic | possible xals with Miargyrite |
| | **Antimony Minerals** | | | | | | |
| | **Stibnite** | **Sb S** | **Vugs in Veins** | **<2mm** | **lead-gray** | **metallic** | **common mineral in altered vein materials** |
| | Boulangerite | Pb Sb S | | | Lead gray | metallic | possible xals near Galena occurrances |
| | Paakkonenite | Sb As S | | | lead gray | metallic | possbile crust with Miargyrite and Stibnite |
| | **Other Minerals** | | | | | | |
| | **Andalusite** | **Al Si O** | **Xals in Schist** | **2 to 6 mm** | **White to Gray** | **Waxy** | **isolated xals in boundary schist** |
| | **Arseniosiderite** | **Ca Fe As O** | **Coatings on fractures** | **Coatings** | **black to gray** | **metallic** | **common mineral in primary and secondary fractures** |
| | **Calcite** | **Ca C O** | **Qtz Veins** | **1 to 18 mm** | **Brown to White** | **waxy** | **massive fillings in veins and secondary xals on fractures** |
| | **Galena** | **Pb S** | **Qtz Veins** | **1 to 25 mm** | **lead gray** | **metallic** | **isolated grains in qtz and calcite** |
| | **Goethite** | **Fe O** | **Qtz Veins** | **1 to 9 mm** | **brownish gray** | **waxy** | **coatings on fractures and filling Vugs** |
| | **Hematite** | **Fe O** | **Qtz Veins** | **1 to 9 mm** | **black/reddish** | **metallic** | **fracture fillings** |
| | **Psilomelane** | **Mn Fe O** | **Coatings on fractures** | **1 to 5 mm** | **Black** | **waxy** | **coatings on fractures and filling Vugs** |
| | **Pyrite** | **Fe S** | **Quartzsite** | **1 to 3 mm** | **Brassy** | **metallic** | **isolated grains in quartzsite** |
| | **Pyrolusite** | **Mn O** | **Coatings on fractures** | **1 to 12 mm** | **black to gray** | **waxy** | **common mineral in primary and secondary fractures** |
| | **Quartz** | **Si O** | **Qtz Veins, coatings** | **1 to 30 mm** | **clear to milky** | **resinous to waxy** | **massive to vug filling xals** |
| | **Romanechite** | **Ba Mn O** | **Vugs in Veins** | **1 to 2 mm** | **black to brown** | **waxy** | **vug filling** |
| | **Siderite** | **Fe C O** | **Coatings on fractures** | **1 to 12 mm** | **brown** | **waxy** | **common mineral in primary and secondary fractures** |
| | **Sphalerite** | **Zn Fe S** | **Qtz Veins** | **2 to 12 mm** | **black to brown** | **waxy** | **isolated grains in qtz and calcite, 2nd vein system** |
| | **Vanadinite** | **Pb Cl V 0** | **Coatings on fractures** | **1 to 4 mm** | **brown** | **waxy** | **small xals on schist adjacent to qtz vein, 2nd vein system** |
| | Bixbyite | Fe Mn O | | | black to brown | waxy | massive fillings in veins and secondary xals on fractures |
| | Braunite | Ca Mg Mn Fe Si O | | | black to brown | waxy | massive fillings in veins and secondary xals on fractures |
| | Coronadite | Pb Mn O | | | black to brown | waxy | massive fillings in veins and secondary xals on fractures |
| | Cuprite | Cu O | | | black to brown | waxy | massive fillings in veins and secondary xals on fractures |
| | Hetaerolite | Zn Mn O | | | black to brown | waxy | massive fillings in veins and secondary xals on fractures |
| | Romanechite | Ba Mn O | | | black to brown | waxy | massive fillings in veins and secondary xals on fractures |
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Notes:

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|---|---|
| confirmed | Confirmed identifcation through x-ray, microprobe or microscopic examination |
| suspected | Microscopic examination found mineral materials that were similar the to mineral described |
| Elements | Major element presented without full formula for the mineral species |

Arizona Mineral Treasures
by
Tony Potucek

Lithographie, LLC of Denver, Colorado for the 100th anniversary of Arizona statehood and the 2012 Tucson Gem and Mineral Show will publish a new book, Arizona Mineral Treasures. The book is a history of mineral collecting in Arizona. It has been divided into the following time periods:

1850-1875
1876-1900
1901-1930
1931-1955
1956-1975
1976-1995
1996-2012

And the following localities will be included in the book:

Apache County

1. Garnets, Northern Apache County

Cochise County

1. Bisbee mines, Warren district
2. Tombstone: Empire mine, Toughnut mine, and Gallagher mine
3. Hilltop mine, California district
4. Defiance mine, Turquoise district
5. Silver Bill mine, Turquoise district
6. Cohen mine, aka Comstock, Adams, Cowboy, Teviston district, Cowboy Canyon, Dos Cabezas Mountains
7. Huachuca Mountains
8. Maid of Sunshine mine, Turquoise district

Coconino County

1. Grandview mine (Last Chance), Grandview district

Gila County

1. Richmond Basin mines, Richmond Basin district
2. Stonewall Jackson mine, McMillan(ville), Globe Hills district
3. Old Dominion mine, Globe Hills district
4. Globe-Miami mines (including Blue Bird, Castle Dome, Inspiration, Miami Unit, Carlota, etc.) Miami-Inspiration district
5. Apache mine, Globe Hills district
6. Blue Ball mine, Summit district
7. Christmas mine, Banner district
8. 79 mine, Banner district
9. Finch mine (Barking Spider), Banner district
10. Joe Gundry Sidebar-Old Dominion mine, Globe Hills district
11. Diamond Point

Graham County

1. Grand Reef mine, Aravaipa district
2. Santa Teresa Mountains
3. Stanley Butte, Stanley Mining District
4. Iron Cap mine, Aravaipa Mining District

Greenlee County

1. Clifton-Morenci mines, Copper Mountain district

La Paz County

1. Red Cloud mine, Silver district
2. Pure Potential (North and South Geronimo mines, Silver district)
3. Veta Grande claim, Dome Rock Mountains, Quartzsite
4. Heson Mine, Mystery Hill mine group, Alamo district
5. Electric Meatball "mine", near Quartzsite
6. Ramsey mine, New Water district
7. Crystal Hill, Quartzsite

Maricopa County

1. Rowley mine, Painted Rock district
2. Mystic mine, Pike's Peak district
3. Four Peaks Amethyst deposit

Mohave County

1. Hardy mine, Homestake mine, Moss mine, etc., Oatman district aka San Francisco district
2. Antler mine, Hualapai district
3. Rawhide mine, Rawhide district
4. Western Union mine, Mineral Park and the Cerbat mines, Wallapai district
5. Portland mine, Pilgrim (Portland) district

Pima County

1. Heintzelman mine aka Cerro Colorado aka Silver Queen mine, Cerro Colorado district
2. Silver Bell mine, Silver Bell district
3. Old Yuma mine, Amole district
4. Ajo district
5. Gold Ledge claim aka Yuba mine, Greaterville district
6. Silver Hill mine, Waterman district
7. Helvetia mines (Omega, Isle Royal, etc, Helvetia district)
8. Weldon and Quijotoa mines, Quijotoa district
9. Indiana-Arizona mine, Silver Bell district

10. Twin Buttes-San Xavier North, Mission-Pima, Daisy mines, Pima district
11. Sierrita Mountains aquamarine, Pima district
12. Comobabi Mountains, Comobabi district

Pinal County

1. Silver King mine, Pioneer district
2. Magma mine, Pioneer district
3. Ray mines, Mineral Creek district
4. Ford mine, Old Hat district
5. Old Reliable mine, Copper Creek, Bunker Hill district
6. Mammoth-St. Anthony mines, Mammoth district
7. Ash Creek/Rattlesnake Canyon
8. Vekol mine, Vekol district
9. Grey Horse mine
10. San Manuel mine, San Manuel district

Santa Cruz County

1. Washington Camp district
2. Glove mine, Tyndall district
3. Flux mine, Harshaw district
4. JC Holmes claim
5. Hardshell mine, Harshaw district
6. Scepter Hill, Montana Peak
7. Santo Nino mine, Querces district

Yavapai County

1. Camp Verde
2. Jerome mines, Verde district
3. Piedmont mine, Copper Creek district, "Horse Thief Basin"
4. Yankee Boy mine, Humbug district, and other mines in Bradshaw Mountains
5. Bagdad, Eureka district
6. Old Dick-Bruce mines, Old Dick district
7. Fat Jack mine, Tiger district

8. Mistake mine, Box Canyon district
9. Quartz pseudomorphs after anhydrite, New River
10. Sunshine No. 8 claim, Castle Creek district

Yuma County

1. Castle Dome district

Rosemont Copper Project, Coronado National Forest
by
Beverley Everson

In July of 2007, Rosemont Copper Company submitted a mine plan of operations to the Coronado National Forest of Southeastern Arizona, for the mining and processing of 230 million pounds of copper, 5 million pounds of molybdenum and 3.5 million ounces of silver annually. The proposal calls for a 700 acre open pit, a 1200 acre tailings facility and a 1500 acre waste rock facility in the Santa Rita Mountains about 30 miles southeast of Tucson, AZ. The sulfide portion of the Rosemont deposit, occurs primarily in a Laramide skarn in Paleozoic carbonates and related sedimentary rocks. It is overlain by a small oxide deposit. The use of dry stack tailings is proposed for the operation, reducing process water volume to about one quarter the water use of similar local operations using conventional tailings methodology.

The environmental impact statement analysis for the proposed project began in March 2008, and resulted in over 11,000 public comments concerning impacts to visual resources, archeological sites, riparian vegetation, surface water, groundwater, and other surface resources. A preliminary groundwater model developed for the project indicates a 1' to 100' groundwater drawdown from pit dewatering extending as much as three miles from the pit center at the end of the 20 year mine life. Drawdown may result in the loss of springs and seeps in the project area and potential significant impact to riparian habitat. A draft environmental impact statement analyzing the effects of the proposed project is scheduled to be completed in December of 2010, guided by the General Mining Law of 1872, as amended, the Mining and Minerals Policy Act of 1970, the National Environmental Policy Act of 1970 and other pertinent statute, and Forest Service and Council of Environmental Quality regulation.

# THE MINES & MINERALS OF THE AMOLE MINING DISTRICT TUCSON MOUNTAINS, PIMA COUNTY, ARIZONA

**Anna M. Domitrovic**
**Curator *Emerata***
**Arizona-Sonora Desert Museum**
**Tucson, Arizona**

The Amole Mining District lies within the Tucson Mountains, a rugged, volcanic terrain bordering the western edge of the Tucson Basin, southern Pima County, Arizona. The mountain range is a series of volcanic and sedimentary rocks spanning geologic time from PreCambrian crystalline masses to Quaternary sediments and alluvium. The main body of the range consists of Mesozoic Jurassic and Cretaceous sedimentary rocks and Paleozoic limestone. Both intrusive and extrusive igneous rocks cut through the sedimentary ones. An extrusive rhyolite caps a series of silicified limestone and redbeds. Exotic limestone blocks of still questionable origin make up a rock layer called the Tucson Mountain Chaos. The mountain range has been repeatedly faulted, folded, intruded, uplifted and eroded; and varying episodes of intrusive and extrusive volcanic activity resulted in the Tucson Mountain range of present day.

Thus was the geologic setting for the mineralization that is the Amole Mining District. The Amole was one of the first ore deposits exploited and one of the first mining district with accompanying camps to be established in southern Arizona. Mineralization is related to Laramide uplift and Tertiary intrusions. Ore occurs as contact metamorphic and replacement deposits in limestone lenses within volcanic and erratic Paleozoic sedimentary rocks, mainly limestone. Deposits were later engulfed by additional volcanics and intrusions associated with a series of igneous dikes. Mineralized veins cut a complex series of altered and deformed (faulted and folded) Cretaceous volcanics.

Mineralization included small, irregular quartz fissures with scattered and partially oxidized base metal sulfides, which also contained silver and gold. Quartz-rich zones in volcanics contained some copper mineralization. Disseminated copper also occurred in fractured and altered Laramide intrusives and along volcanic boundaries.

Mining was accomplished through a series of shallow shafts and tunnels with some open cuts. During the course of mining operations through 1972, the district [produced approximately 35 thousand tins or ore which included 670 thousand pounds of lead (Pb), 529 thousand pounds of copper (Cu), 375 thousand pounds of zinc (Zn), more than 27,000 ounces of silver (Ag), and more than 1,000 ounces of gold (Au).

Major producers in the district included the mines surrounding Saginaw Hill, the first base metal operation in the district discovered in 1898; the Old Yuma Mine which produced Ag, Pb, Cu, and spotty Mo and V; and the Gould and Mile Wide mines in the southwest central part of the district near the Desert Museum produced mainly copper and silver which occurred in association with a series of Laramide quartz latite dikes, the Silver Lilly. Currently, Arizona Portland Cement's quarry and plant mines and processes

limestone for cement production at its Twin Peaks site at the north end of the district and the Tucson Mountains. Other quarry and pit operations within the district have produced basaltic building stone such as that utilized on the University of Arizona campus; decorative rock for building and ornamentation; clay, silica for flux, and sand and gravel.

Commodities as a result of mining and quarry operations in the Amole Mining District include clay, limestone, SAG and stone' silica flux and some asbestos; Cu, Ag, Au, Pb, Zn and spotty U, Mo, and V; Ca and Ba; and various copper carbonates, oxides, silicates and sulfides.

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## THE MINES OF THE AMOLE DISTRICT

Acme Group
Action SAG Pit
Amole Claim #1
Amole Group
Arizona
Arizona Consolidated
Arizona Mission Mn Group
Arizona Portland Cement Plant & Quarry
Arizona Tucson Mine & Property
Avra #1
Avra #1 (geothermal)
Bajo
Battle Axe
Bee Hive
Bonanza Park
Busterville #1
California Portland Cement
Carbonate
Contzen Pass area
Columbia
Copper Bell
Copper King
Cymberline
Dakota
De Vay Brick Company
Dutchess Claim
Gatlin
Gila Monster
Gold Hill
Gould
Grabe Brick
Haskins Property-Mexicana
Helpmate
Hequila
Homestake
Hope
Isabel
Ivy May
Josephine
La Plomosa
Lazy C quarries
Lead Flower Group
Lead Queen
Lillie Claim (Silver Lillie)
Lincoln Mines Group
Little Annie
Little Jimmy
Little Mary
Lucky Strike
Lucky Strike No 1
Mile Wide Group
Mirage
Nequilla
New Hope
Old Mission
Old Padre
Old Pueblo
Old Yuma (Yuma)
Oro Rock & Sand
Owl
Palo Alto Ranch No 3
Palo Verde
Palo Verde No 1 Claim
Pipage Queen
Park Hill
Pellegrin
Pima Rock & Sand Co Gravel Pit
Plant 26 & Sand Pit (Hudder)
Pure Gold
Quien Sabe
Rillito Limestone Nob
Rillito Mill & Quarry
Ruby Silver Group
Saginaw Hill
Saginaw
Sand & Gravel Plant
Sandy Crosby Clay
Santa Margarita
San Xavier
Sedimentary Hills Stock
Sibley
Silver Bell Claim
Silver Cup Group
Silver Flower
Silver Pass

**THE MINES OF THE AMOLE DISTRICT, con't**

Silver Roots Nos 1-5
Snyder Hill Limestone Deposit
Snyder Hill Prospect
Starr
Sweetwater
Tanner Rock & Sand
Teddy
Thunderbird
Tucson No 1 (geothermal)
Tucson Southwest No 2
Tucson Tufa Queen
Twin Hill Prospect
Twin Peaks Quarry
Twin Peaks Rock & Stone
Uncle Sam
Unnamed Prospects - numerous Cu, Cu-Fe, Cu-Mo-Pb, Cu-Pb, Cu-Pb-Zn, Cu-Zn, Pb & Pb-Mo
Valencia Pit

## THE MINERALS OF THE AMOLE DISTRICT

adamite
amphibole group
apophyllite
aragonite
atacamite
argentite
asbestos group
barite
beudantite
bindheimite
bornite
braunite
brezinaite
brochantite
calcite
carminite
cerargyrite
cerussite
chalcocite
chalcopyrite
chlorite
chrysocolla
cornetite
cuprite
descloizite
epidote
feldspar group
fluorite
fornacite
galena
garnet group
gibbsite
gypsum
hematite
hemimorphite
jasper
lechatelierite (fulgerite)
libethenite
limonite
maghemite
magnetite
malachite
manganese
mica group
mimetite
minium
mottramite
piemontite (piedmontite)
plattnerite
pseudomalachite
psilomelane
pyrite
pyrolucite
pyroxene group
quartz
romanechite
sericite
siderite
silver halides
smithsonite
sphalerite
stetefeldtite
tetrahedrite
thenardite
turquoise
vanadinite
vermiculite
vesuvianite
willemite
wulfenite

# Microminerals of the Evening Star Mine

Big Horn Mountains, Maricopa County, Arizona

Ron Gibbs

*2011 Arizona Mineral Symposium*

The Evening Star mine is a small polymetalic ore deposit that was prospected intermittently during the middle of the 20th century. Although listed as a Cu-Pb-Ag-Au-V-W deposit, very little if any ore was actually shipped. The wide assemblage of interesting, unusual, and rare minerals that occur there has been of interest to mineral collectors for many years.

Mindat lists 28 species occurring at the locality, however, careful study and analysis of specimens collected recently and in previous years by many collectors has enlarged the known minerals to at least 40 species. The ore bodies occur in a NW trending vein and have been intensely oxidized although relict masses of galena can still be found. The minerals can be divided into suites; those occurring in and with masses of galena, those occurring along the wholly oxidized portions of the vein and those in adjacent quartz veins.

Perhaps of most interest has been the suite of secondary lead minerals occurring in the galena pods and along their margins. These include cerussite, anglesite, leadhillite, caledonite, mattheddelite, alamosite, lanarkite, diaboleite and hydrocerussite. Most of these are very small and only a few specimens have been collected. A little further from the galena can be found fornacite, iranite, phoenicochroite and luddenite.

Some of the other species found in the well oxidized portion of the vein are especially beautiful and include creaseyite, mimetite, vanadanite, wickenburgite and calderonite.

**Minerals found at the Evening Star Mine**
**R. Gibbs, 3/19/2011**

alamosite
anglesite
bayldonite
bornite
brochantite
calcite
caledonite
calderonite
cerussite
chalcopyrite
chrysocolla
conichalcite
creaseyite
descloizite
diaboleite
fornacite
galena
goethite
gold
hematite
hydrocerussite
iranite
lanarkite
laumontite
lavendulan
leadhillite
luddenite
malachite
mattheddleite
mimetite
murdochite
phoenicochroite
plancheite
pyrite
quartz
scotlandite ?
sphalerite
stilbite
tangeite
vanadanite
wickenburgite
willemite

# What's New in Arizona Minerals

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The past year has been very productive with the discovery of three new type minerals and six new mineral occurrences for Arizona. In addition, several noteworthy finds of minerals new to known localities were made.

Total number of mineral species found in Arizona now stands at 886, while there are 83 type minerals.

The three new type minerals include:

1. **Georgerobinsonite** (IMA 2009-068)
Lead fluoride chloride chromate hydroxide, $Pb_4(CrO_4)_2(OH)_2FCl$. An extremely rare secondary mineral found only at the Mammoth-St. Anthony mine, Tiger, Mammoth District, Pinal County. The red-orange, orthorhombic crystals are less than 1 mm and are associated with diaboleite, matlockite, and an unknown white acicular mineral.

2. **Markascherite** (IMA 2010-051)
Copper molybdate hydroxide, $Cu_3MoO_4(OH)_4$. A very rare secondary mineral that occurs around the South Glory hole, Childs Aldwinkle mine, Bunker Hill District, Copper Creek, Pinal County. The green bladed, monoclinic crystals are 1.1 mm or less.

3. **Rongibbsite** (IMA 2010-055)
Lead aluminum silicate hydroxide, $Pb_2(AlSi_4)O_{11}(OH)$. The mineral occurs as radiating, bladed to prismatic colorless crystals and is found at a prospect near the Evening Star mine, Bighorn Mountains, Maricopa County. Samples include monoclinic crystal clusters that are a couple millimeters in size.

The following six new species have been added to the Arizona mineral list:

1. **Arsendescloizite** $PbZn(AsO_4)(OH)$
2. **Arsentsumebite** $Pb_2Cu(AsO_4)(SO_4)(OH)$
3. **Ashburtonite** $Pb_4Cu_4(Si_4O_{12})(HCO_3)_4(OH)_3Cl \cdot H_2O$
4. **Herbertsmithite** $Cu_3Zn(OH)_6Cl_2$
5. **Lavendulan** $NaCaCu_5(AsO_4)_4Cl{\cdot}5H_2O$
6. **Scotlandite** $PbSO_3$

The first four minerals were found around the dumps at the Tonopah-Belmont mine, Tonopah, Osborn District, Bighorn Mountains, Maricopa County as sub-millimeter microcrystals. Lavendulan and Scotlandite have been identified at the Evening Star mine, Bighorn Mountains, Maricopa County. Scotlandite has also been found at the Grand Reef mine, Klondyke, Aravaipa District, Graham County.

The recent discoveries were made by a detailed microscopic search of materials collected from old localities and using new analytical tools. This suggests that additional new minerals may potentially be found by applying similar efforts to other locations with unusual mineralization.

**Table 1. Scorecard of Arizona Minerals**

| Date | Total Species | Type Minerals |
|---|---|---|
| 1995 (*Mineralogy of Arizona - third edition*) | 808 | 76 |
| 2007 (*Checklist of Arizona Minerals - second edition*) | 867 | 80<br>+ Bechererite<br>+ Calcioaravaipaite<br>+ Carmichaelite<br>+ Grandviewite<br>+ Shannonite<br>+ Wupatkiite<br>- Duhamelite<br>- Jeromite |
| 2008 | 872<br>+ Cumengeite<br>+ Mattheddleite<br>+ Milarite<br>+ Munakataite<br>+ Pharmacolite | 80 |
| 2009 | 876<br>+ Arthurite<br>+ Philipsbornite<br>+ Szenicsite | 81<br>+ IMA2009-068 |
| 2010 | 886<br>+ Arsendescloizite<br>+ Arsentsumebite<br>+ Ashburtonite<br>+ Herbertsmithite<br>+ Lavendulan<br>+ Scotlandite<br>+ Likasite*<br>+ Villimaninite* | 83<br>Georgerobinsonite (formerly IMA2009-068)<br>+ Markascherite<br>+ Rongibbsite |
| 2011 | | |

* Reported before 2010 but not included in the Arizona mineral list

## Table 2. New Minerals by Locality

Childs Aldwinkle mine, Bunker Hill District, Copper Creek, Pinal County
- Markascherite

Evening Star mine, Bighorn Mountains, Maricopa County
- Lavendulan
- Rongibbsite
- Scotlandite

Grand Reef mine, Klondyke, Aravaipa District, Graham County
- Scotlandite

Tonopah-Belmont mine, Tonopah, Osborn District, Bighorn Mountains, Maricopa County
- Arsendescloizite
- Arsentsumebite
- Ashburtonite
- Herbertsmithite

Mammoth-St. Anthony mine, Tiger, Pinal County
- Georgerobinsonite

## Table 3. New Minerals by Chemistry

Arsenates
- Arsendescloizite $PbZn(AsO_4)(OH)$
- Arsentsumebite $Pb_2Cu(AsO_4)(SO_4)(OH)$
- Lavendulan $NaCaCu_5(AsO_4)_4Cl \cdot 5H_2O$

Chromates
- Georgerobinsonite $Pb_4(CrO_4)_2(OH)_2FCl$

Halides
- Herbertsmithite $Cu_3Zn(OH)_6Cl_2$

Molybdates
- Markascherite $Cu_3MoO_4(OH)_4$

Silicates
- Ashburtonite $Pb_4Cu_4(Si_4O_{12})(HCO_3)_4(OH)_3Cl \bullet H_2O$
- Rongibbsite $Pb_2(AlSi_4)O_{11}(OH)$

Sulfates
- Scotlandite $PbSO_3$

## Mineral species added to the Arizona list since 1995

Abernathyite
Anilite
Annabergite
Arsendescloizite
Arsentsumebite
Arthurite
Ashburtonite
Bechererite*
Bonattite
Boothite
Brushite
Bustamite
Calcioaravaipaite*
Calderonite
Carmichaelite*
Clinoatacamite
Coloradoite
Crichtonite
Cumengeite
Cuprocopiapite
Eriochalcite
Ferrohexahydrite
Ferrohornblende
Ferroselite
Georgerobinsonite*
Glaucocerinite
Glaucodot
Glushinskite
Gordaite
Grandviewite*
Herbertsmithite
Hopeite
Hydroglauberite
Hydrohonessite
Jacobsite
Jokokuite
Kamitugaite
Kieserite
Kinoshitalite
Lansfordite
Lavendulan
Liroconite
Liskasite
Loveringite
Markascherite*
Mattheddleite
Mcguinnessite
Meionite
Milarite
Molybdite
Monohydrocalcite
Montanite
Montroydite
Munakataite
Namibite
Natrodufrenite
Nesquehonite
Nickel-Boussingaulite
Orthoserpierite
Paracoquimbite
Pentahydrite
Pharmacolite
Philipsbornite
Phosphohedyphane
Pyrochlore
Ramsbeckite
Rectorite
Reichenbachite
Rongibbsite*
Schmeiderite
Scotlandite
Shannonite*
Soddyite
Srilankite
Straczekite
Surite
Szenicsite
Uranopilite
Villimaninite
Wagnerite
Weddellite
Wupatkiite*
Zincocopiapite

* Type minerals