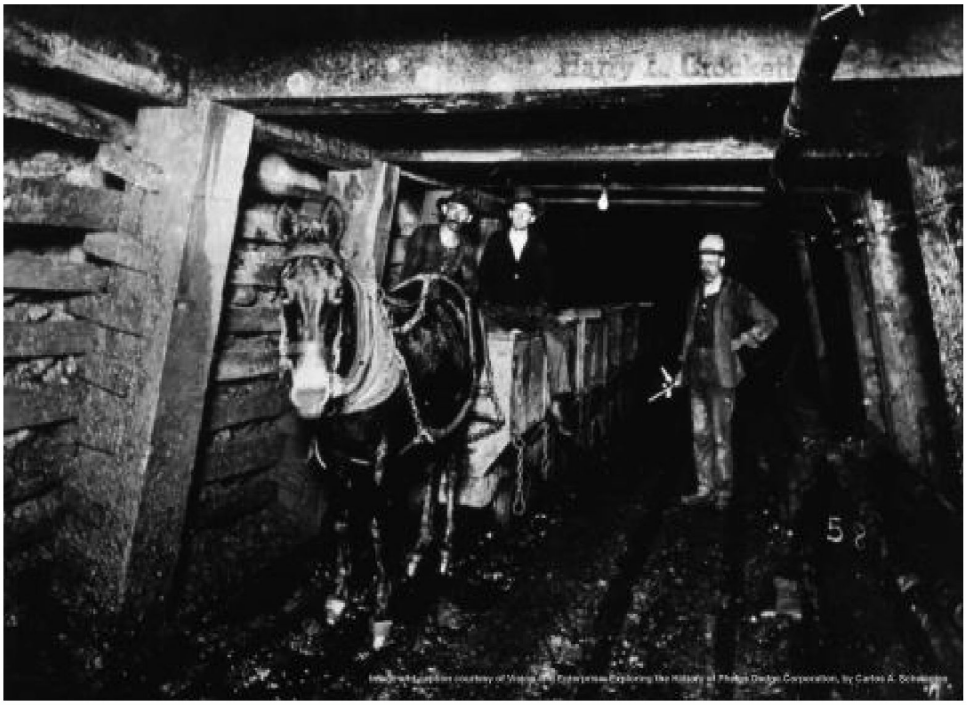

COPPER QUEEN MINE 1897

Bisbee, Arizona Copper

BY DR. SHANNON GRAEWIN

Complex Geology and Wild West History Made Bisbee a Favorite with Mineral Collectors and a Classic American Locality for Copper and its Secondaries

By Shannon Graewin

Since its founding in 1877 until it closed in 1975, the area of Bisbee Arizona had produced more than 3.6 million tons of copper as well as more than 3 million kilograms of silver and 84,000 kilograms of gold. It also commercially produced zinc and lead and is known to more than 320 distinct mineral species and thousands of collectible specimens. Bisbee is located in Cochise County in the south eastern corner of Arizona in the Mule Mountains just south of Tombstone, AZ.

History

The beginnings of Bisbee are truly straight out of a John Wayne movie. It all began as prospectors from Texas moved westward in search of mineral outcrops and water sources. Because the area was known to be inhabited by Apache Indian tribes as well as Mexican Bandits, often the US Calvary helped civilians and explorers in these efforts. One such government scout was John Dunn from Fort Bowie, Texas who found a piece of cerussite in Mule Gulch (the main valley of the Mule Mountains) as he was searching for water. Because cerussite can be an indicator for silver ore deposits, he traced it back to a large hematite outcropping, later named the Iron Monster. He was working with J. A. Rucker and filed the first mineral claim on August 2, 1877- the Rucker claim. As the party returned to Fort Bowie, and being thusly encouraged, Dunn enlisted the help of George Warren. Warren seemed to be a perfect fit for a follow up expedition as he himself had spent 2 years as a child with an Apache tribe after being wounded and captured after his father was killed. Warren was a prisoner of the Apaches until he was purchased for 15 lbs. of sugar by earlier prospectors from which he learned his trade. Warren was to explore the Mule Mountain area and stake claims on behalf of himself, Dunn, and Rucker on any hopeful

Figure 1 Bisbee Location

land, but neglected to included Dunn and Rucker when he filed the paperwork. Although the areas he claimed became wildly lucrative in the upcoming century, Warren did not share in these profits. Legend has it that he gambled away his share of the claims (including the area of the Copper Queen Mine) and sold himself into peonage in Mexico. (He was purchased back by Judge Berry and went on to custodial services in the Bisbee area- all the while watching his former claims become wildly successful). Ultimately, the area was named the Warren Mining District which really was his sole consolation.

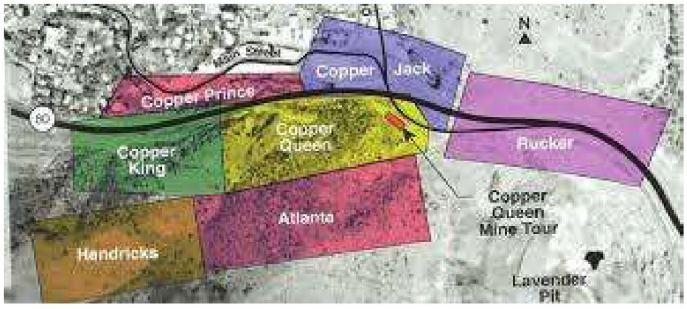

Figure 2 Layout of Mine Claims

Early mining in Mule Gulch was difficult. The original cerussite deposit was small and was not associated with silver. The Hendricks claim was larger, but was not profitable. In 1880, Edward Riley optioned the Copper Queen Mine and sold half of the stake to Martin and Ballard. Together, they became the Copper Queen Mining Company. The Copper queen had very rich ores, but the ore needed to be hauled to the West Coast by mule trains and was shipped to Wales for smelting. This drained much of the profits. A local smelter was clearly needed and DeWitt Bisbee from San Francisco became the investor that allowed the construction of the on-site smelter.

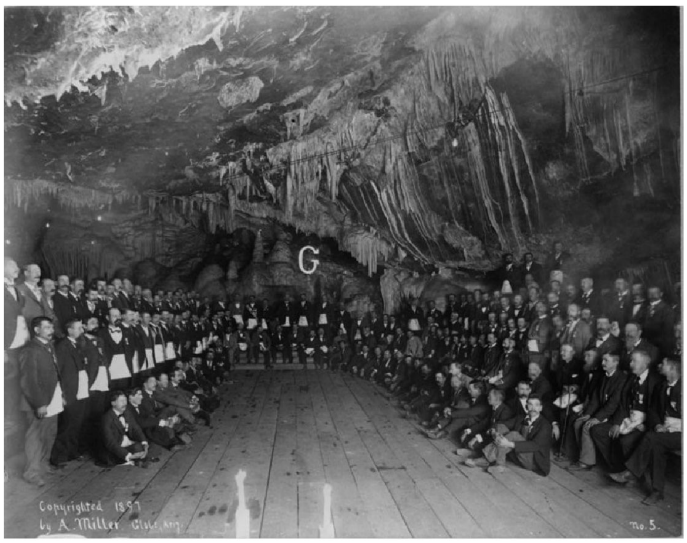

Figure 3 Bisbee Lodge Members in a 1897 Meeting Underground

Figure 4 Hammering in the Mine

Profitable for many years, the ore ran out in 1884. The Copper Queen Mining Company began to search for new ore sources, and at about the same time, a mercantile firm from the East Coast named Phelps, Dodge, and Co purchased the Atlanta claim adjacent to the Rucker claim. They had lean times, but finally found a big ore body at 60 meters down in the shaft. The Copper Queen Mining Company simultaneously found a different area of the same giant ore body. In a spirit of cooperation, both agreed to a merger and they became the Copper Queen Consolidated Mining Co. For 18 years, they had successful and profitable production. There were smaller producers also in the area, including the Calumet and Arizona Mining Co, Shattuck and Arizona Mining, and Dunn and Arizona Mining ventures. Most of these consolidated under the Phelps Dodge name in 1931. Work continued with plentiful ore and healthy profits until 1975 when copper prices fell due to influx of cheaper, foreign copper. Costs of production were also rising and the ore quality was also decreasing. The Bisbee Mines closed for good in 1975, although the town still exists and there is a small amount of mine tourism in the area.

Figure 5 Mine Shaft late 1800's

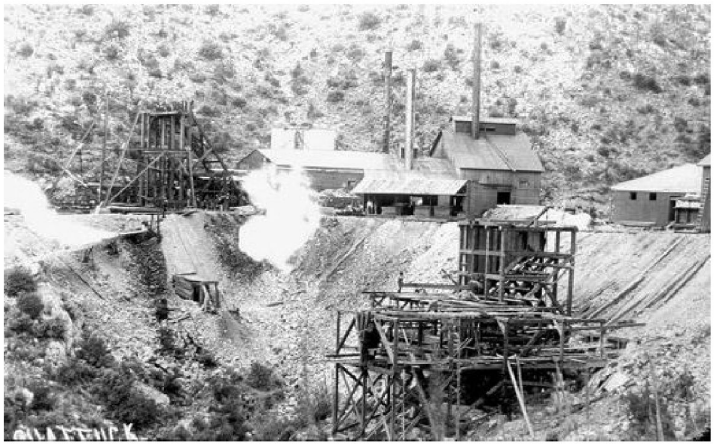

Figure 6 Shattuck Mine

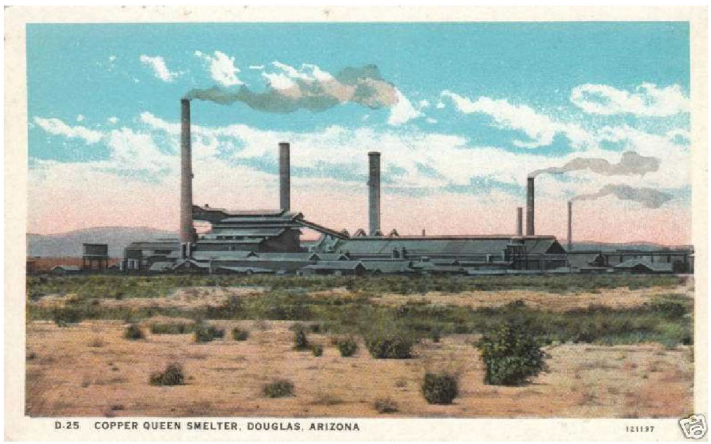

Figure 7 Postcard Depicting Bisbee Smelter

Figure 8 Lavender Pit Open Pit Mine.

Geology

A complex and active geology combined to make the rich ores and fantastic specimens which have made Bisbee famous. The basement rock is a quartz sericite (a fibrous mica that results from hydrothermally altered feldspar) schist from the Precambrian era (dated about 1.7 billion years old).

Figure 9 Sericite and Pyrite

Calcareous sediments (high in calcite from marine animal shell deposits) from the Paleozoic Era (250-500 million years ago) covered the sericite schist. During the Jurassic Era (145-200 million years ago) magma from the mantle penetrated these rocks forming stocks, dikes, and sill intrusion bodies. Faulting served as a conduit and > 450 million tons of pyrite (FeS_2) were deposited as either replacement deposits in the host rock or as disseminated pyrite in the intrusive areas.

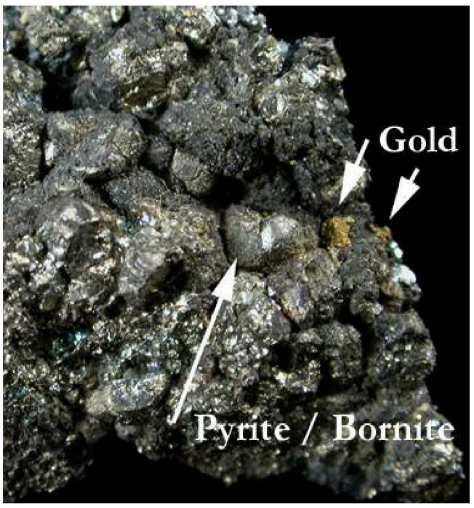

Figure 10 Bisbee Pyrite (FeS_2)

A second intrusion event occurred alongside the first event as an iron/ copper mineralization. This led to giant copper replacement deposits in the Sacramento stock complex

Figure 11 Sacramento Hill and Pit Mine

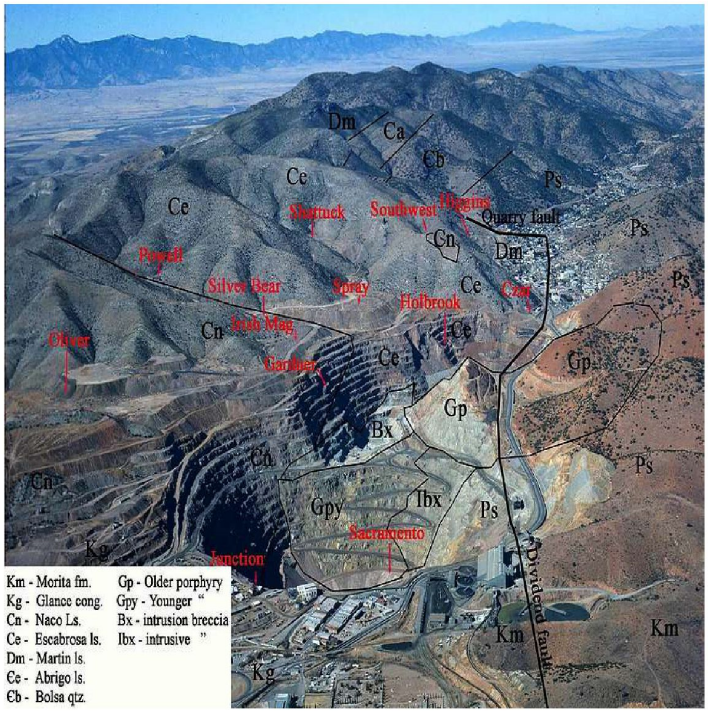

Figure 12 Geology and Mine Overlay

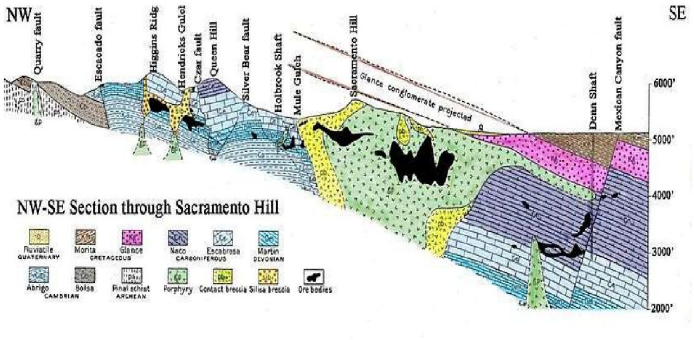

Figure 13 Sacrament Hill Geology

A third mineralization episode was a lead/ zinc phase and these ores were laid down adjacent to the preexisting pyrite and copper sulfite deposits. These ores were also mined commercially in Bisbee over the years.

The fourth and last mineralization phase was rich in precious minerals and was a smaller deposition overall than the previous ones. This led to the addition of tin, bismuth, vanadium, tungsten, arsenic, and tellurium.

Sometime before the Cretaceous period (65-175 million years ago), regional uplift occurred, and erosion carried off and large amount of the Paleozoic sediments and cut deep canyons in the limestone rocks. This allowed oxidation to occur of the intrusion ore bodies. Basically, erosion allowed oxygen to interact with the deeper minerals in the form of being exposed to air, or more commonly, through ground water percolating down through the rocks. Groundwater leaches metals and minerals from the more shallow rocks and carries them deeper, allowing transfer and possible interaction of new minerals together, and concentration of ore materials. The oxidation allows for formation of supergene minerals, which are chemical modifications by oxygen of the hypogene (original) products.

After the first oxidation period, sometime in the Cretaceous Period, there was reactivation of the Dividend Fault, which dropped the southern end of the Bisbee area 500-700 meters relative to the northern fault area. The south end was covered by a shallow sea and more sediments were deposited. In the Pliocene Era, normal faulting occurred with uplift and tilting of the Mule Mountains. More erosion removed the sediments and allowed further supergene alteration as a second oxidation process. These features were present as mining commenced and are the modern features associated with Bisbee.

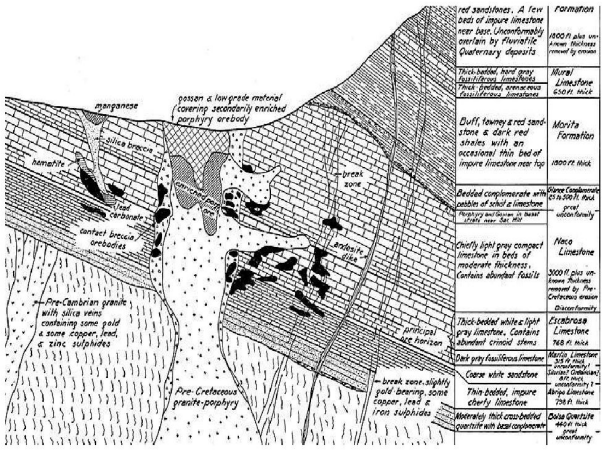

Figure 14 Generalized Geology Overview

Mineralogy

Bisbee is most famous for its copper secondary minerals—brilliant blue azurites and rich green malachites. It is also the type locality for seven species: spangolite, paramelaconite, shattuckite (1915), chalcoalumite, graemite, henryite, and kiddcreekite (Bisbeeite was discredited).

Figure 15 Left: Paramelaconite, Bisbee. Smithsonian Collection Right: Shattuckite, Bisbee. Dakota Matrix Mineral Photo

Bisbee is the best locality for many specimens, including anterite, aurichalcite, brochantite, chalcotrichite. It is also known for the best calcites included with malachite or cuprite, coloring them green or red.

Rare specimens of the locality are boxwork specimens, typically of malachite or goethite. They have open spaces amongst a scaffolding structure. They are formed when low grade sulfides (pyrite) are altered by acidic supergene solutions and cause corrosion along limestone fractures with siderite deposition. Continued corrosion preferentially dissolves the remaining limestone over the hardier siderite leaving behind isolated structures of the resistant siderite which is then slowly converted to goethite. Because copper sulfides are higher grade than pyrite, they are affected by acids more slowly. As they leech into solution as a later event, the goethite frameworks are a scaffolding for copper secondary formation.

Figure 16 Goethite Boxwork Specimen

Figure 17 Malachite Boxwork Specimen

Figure 18 Azurite and Malachite Boxwork Specimen. Smithsonian Collection

Copper at Bisbee

Bisbee produced many copper specimens, but they are not the largest specimens nor do they have the best crystallization compared to other world localities. The best Bisbee copper specimens are those with other mineral associations – many unique to Bisbee's complex geology.

Figure 19 Copper Specimen from the Queen Mine, approximately 6 cm

Figure 20 Fibrous Copper with Chalcocite on each side, Holbrook Mine. Collection of the Bisbee Mining and Historical Museum, photo by Nina Graeme

Figure 21 Copper. Smithsonian Collection. Dimensions not given, but it is huge

Figure 22 Cuprite on Copper. Smithsonian Collection

Figure 323 Cuprite and Copper on Calcite. Unknown Collection

Major Bisbee Collections

Les and Paula Presmyk

Evan Jones

Graeme Family Collection

Smithsonian

Freeport McMoRan Corporate Collection

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