



# the Getchell Mine

## Humboldt County



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**The Getchell mine, located in north-central Nevada, has for many years been the world's leading producer of fine crystallized realgar. In addition, crystals of orpiment and rare sulfosalts including galkhaite, laffittite and getchellite (type locality) occur in the arsenic orebody.**

### INTRODUCTION

The Getchell gold mine is located approximately 42 km north of Golconda, Humboldt County, Nevada. The mine is situated on the eastern flank of the Osgood Mountains along the Getchell fault and is within the Potosi mining district. Gold bullion was produced intermittently between 1938 and 1967. This deposit is one of several disseminated-type gold deposits in the western United States, including Carlin, Cortez, Gold Acres, Jerrett Canyon and Mercur, in addition to numerous smaller deposits (Roberts *et al.*, 1971).

### HISTORY

The history of the Potosi mining district dates back before 1918 when considerable mining activity centered around the tungsten deposits in the area. Hotz and Willden (1964) have summarized the mining history of the Getchell mine.

The deposit was discovered in the fall of 1934 by two prospectors, Ed Knight and Emmett Chase, who believed they had discovered a large low grade gold deposit. Within a year they had sold their mine to Nobel Getchell and his partner, George Wingfield. The mine was named after Nobel Getchell and, after just five years of production, it had achieved the distinction of being the largest gold producer in Nevada. It was not until 1954 that production of by-product gold from the Ruth mine at Ely, Nevada, exceeded Getchell's output.

The Getchell mine had the good fortune of mining an arsenic-bearing orebody at the beginning of World War II, when the federal government closed all non-essential gold mines. Due to the need for this strategic metal, Getchell was permitted to mine gold along with the arsenic. Production continued until 1951 when the easily mined gold ores were exhausted and mining of tungsten ore started along the major fault zone.

The production of tungsten ceased in 1957, when additional reserves of gold ore were discovered. The Getchell mine produced gold until 1968, when it became unprofitable to continue operations, and the mine closed. Since then, many mining companies have explored the possibility of reopening the mine for gold but, to date, none have found adequate reserves to warrant renewed mining operations.

### GEOLOGY

The geology of the Getchell mine and surrounding Osgood Mountains has been mapped and studied by a number of authors including Hobbs (1948), Hotz and Willden (1964), Silberman and McKee (1971), Erickson and Marsh (1974), Joralemon (1951), Berger and Taylor (1974) and Berger (1980).

The rocks in the vicinity of the Getchell mine are lower Paleozoic sediments which have been intruded by a granodiorite stock of Cretaceous age. The oldest rocks consist of Middle and Upper Cambrian carbonaceous shale and thin-bedded limestone called the

Preble formation. This formation is unconformably overlain by a sequence of intercalated dolomitic limestone and chert, shale, siltstone and mafic volcanic rocks assigned to the Comus formation of Early and Middle Ordovician age. The Getchell fault system, a connecting group of high-angle, dip-slip faults, cuts the thrust faults along the eastern margin of the Osgood Mountains. Berger and Taylor (1974) have re-evaluated field evidence and concluded that the displacement of the fault has been predominantly vertical, and that the fault system controlled the emplacement of the granodiorite stock and related dikes. The fault system has remained active right up to the present, as shown by displacement of Quaternary (?) alluvium in the mine area.

copper, cesium, thallium and gold. Except for gold, these elements have combined with either arsenic or sulfur to form a number of sulfide and sulfarsenide minerals which have resulted from late-stage hydrothermal activity along the Getchell fault. Berger (1980) suggests that this hydrothermal activity has altered the limestone by decarbonatization accompanied by silicification. Early low-temperature hydrothermal action, which preceded the sulfide mineralization, deposited gold, the principal ore mineral, along the fault zone and replaced the limestone with quartz. The minor ore minerals include cinnabar, stibnite, chalcocopyrite and sphalerite. Molybdenite and scheelite are unrelated to the sulfide mineralization but are more closely associated with the

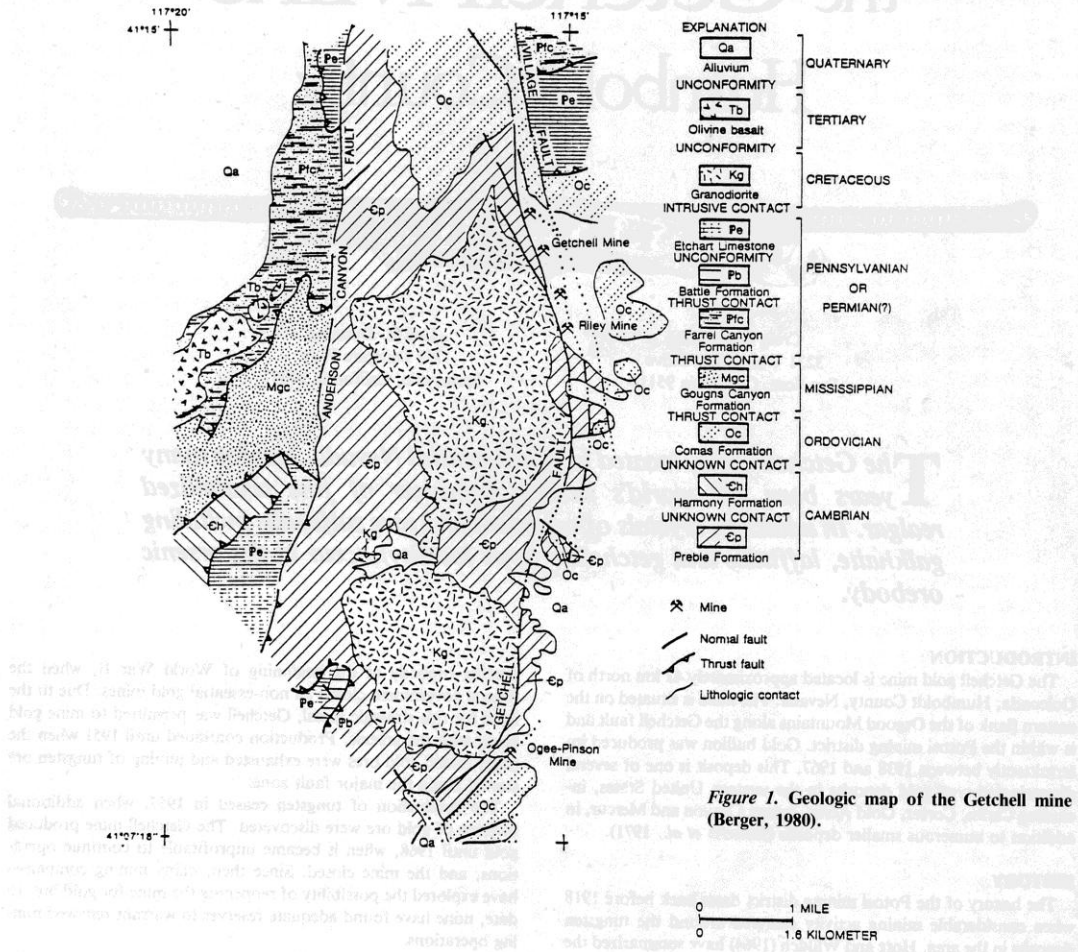


Figure 1. Geologic map of the Getchell mine (Berger, 1980).

Gold mineralization was controlled by three segments of the Getchell fault system which provided channels for the ascending epithermal solutions and resulted in silicification of the Preble formation limestone and carbonaceous shale beds.

**MINERALOGY**

Aside from the rock-forming minerals, the mineralogy of the Getchell mine is dominated by massive arsenic sulfide mineralization containing minor amounts of mercury, silver, antimony, zinc,

granodiorite rocks adjacent to the fault zone, especially in the South pit. Realgar and orpiment constitute the major arsenic sulfide minerals, which resulted from late-stage hydrothermal activity along the fault zone and rock fractures. The rare sulfosalts getchellite, galkhaite and laffittite occur in minor amount in the sulfide orebody and are usually found as small, granular crystals associated with realgar and orpiment.

In addition to quartz and calcite, the gangue minerals include marcasite, pyrite, arsenopyrite, magnetite, barite, fluorite and chabazite. Secondary minerals resulting from local weathering of

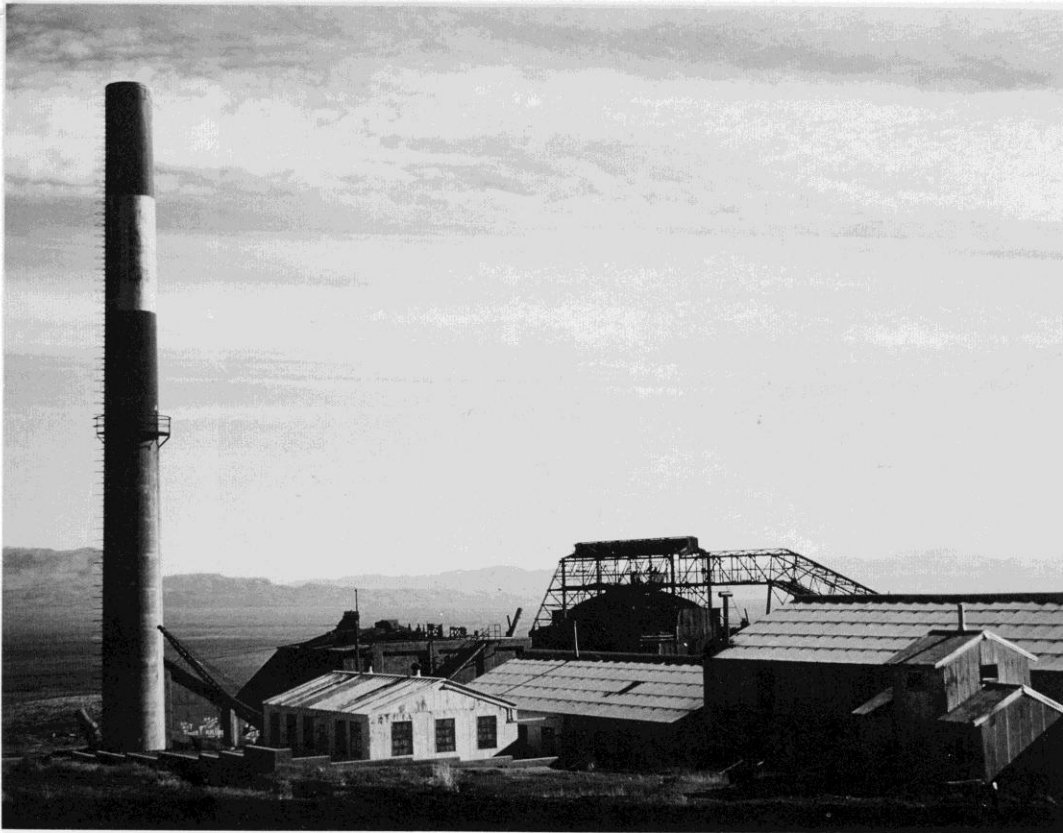


Figure 2. Getchell mine in 1975; Stolburg photo.

the ore minerals include gypsum, picropharmacolite and ilsemanite.

**Cinnabar** HgS

High mercury concentrations in the gold ore have been attributed to cinnabar in association with stibnite. The South pit ores show about five times the mercury concentration as do the ores of the North pit. Cinnabar occurs in very minor amounts in the Getchell orebody and it is usually found as very small (less than 1 mm), dark red, pseudocubic rhombohedral crystals associated with quartz, realgar and stibnite. The crystals are single or complex intergrowths attached to either quartz or realgar crystals. Most crystals are quite complex and twinned. Pyrite crystals and grains are in intimate association with cinnabar and are usually found nucleated on the faces of cinnabar crystals.

**Fluorite** CaF<sub>2</sub>

Fluorite is one of the common accessory minerals found in the Getchell deposit. It typically occurs as simple cubes, often showing color zoning from clear to violet, in the carbonaceous quartz rock associated with orpiment and realgar. Late-stage calcite has covered much of the fluorite; this can be removed by mild acid etching. In the North pit area fluorite is associated with stibnite, orpiment, realgar and galkhaite. Crystals up to 1 cm on an edge are common.

**Galkhaite** (Cs,Tl)(Hg,Cu,Zn)<sub>6</sub>(As,Sb)<sub>4</sub>S<sub>12</sub>

The rare sulfosalt galkhaite was first described by Gruzdev *et al.* (1972) from the Gal-Khaya deposit, Yakutia, and the Khaidaikan deposit, Kirgizia, U.S.S.R., as idiomorphic crystals up to 1 cm, crystal aggregates, and granular aggregates in mercury deposits (see also Jungles, 1974). Associated minerals in the Soviet deposits include pyrite, stibnite, cinnabar, metacinnabar, aktashite, wakabayashilite, orpiment, realgar, getchellite, calcite, fluorite and quartz. It has been replaced in many places by cinnabar and metacinnabar.

Galkhaite has since been discovered at the Getchell mine by Botinelly *et al.* (1973) and at the Carlin, Nevada, gold deposits by Dickson and Radtke (1978). A recent re-examination of galkhaite from Getchell by Chen and Szymanski (1981) has shown that cesium is an important element in the structure; cesium is rarely associated with thallium.

At Getchell, galkhaite is principally found on the dark gray, limy, carbonaceous quartz rocks in the North pit area. Here it is associated with pyrite, fluorite, realgar, stibnite and orpiment. Galkhaite occurs as simple cubes or as multiple intergrowths of cubes and is steel-gray to brownish black with a metallic luster. The color is probably due to included or surficial graphite. Where the crystals have been protected by calcite they are brilliantly deep red in color with deep red internal reflections. All crystals show the



Figure 3. Realgar from the Getchell mine. The crystal at upper left measures 1.4 cm. Barbara Cureton collection.

Figure 4. Realgar from the Getchell mine, showing crystals to 1.4 cm which have been partially freed from enclosing calcite. Barbara Cureton collection.



common  $a\{100\}$  form. However, the forms  $d\{110\}$  and  $o\{111\}$  occur occasionally.

In the South pit galkhaite typically occurs in association with getchellite and cinnabar. The crystals are usually black, intergrown, simple cubes in cavities of massive getchellite, with realgar and orpiment.

**Getchellite**  $\text{AsSb}_3$

Getchellite was first described by Weissberg (1965) as a new mineral from the Getchell mine; it is intimately associated with abundant orpiment and realgar and lesser amounts of quartz, stib-

nite, cinnabar, galkhaite and laffittite. Other occurrences of getchellite include the Carlin, Nevada, gold deposit (Radtke *et al.*, 1977), the Zarehchauran orpiment mine in northeastern Iran (Bariand *et al.*, 1965, 1968) and the Gal-Khaya deposit, U.S.S.R. (Gruzdev *et al.*, 1972).

At Getchell, getchellite was first discovered in the arsenic sulfide ores of the South pit extension where it has formed thin lenses and pods in the massive orpiment-realgar arsenic ore along the fault zone. Weissberg (1965) suggests that getchellite was one of the first hydrothermal minerals deposited after quartz.

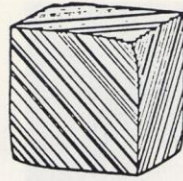
Getchellite occurs both as anhedral grains molded by realgar and

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**Figure 6.** Deep red galkhaite crystals to 2 mm from the Getchell mine. Barbara Cureton collection.



**Figure 5.** Crystal sketch of galkhaite (Jungles, 1974).

orpiment and as rare euhedral crystals included in orpiment (Weissberg, 1965). Free-standing crystals are very rare and occasionally have been found in small cavities in the massive material. Both stibnite and galkhaite crystals have been observed partially filling small cavities in massive getchellite.

Aside from its darker red color and orange-red streak, getchellite closely resembles orpiment in physical properties. Crystals of both getchellite and orpiment are commonly bent or otherwise deformed by movements subsequent to ore deposition. Masses of getchellite up to 5 cm or larger are not uncommon in the veins. These masses, when broken, reveal the mineral's perfect basal cleavage and these multiple basal cleavages, surrounded by yellow orpiment, make very attractive specimens.

**Gold Au**

In the orebody gold occurs as micron to submicron-sized particles closely associated with carbonaceous quartz and shales, within the sulfide minerals, and as fine particles within and between

**Figure 7.** Orpiment crystals, 1.2 cm crystal on a 5.0 x 6.3 cm matrix; Stolburg specimen.



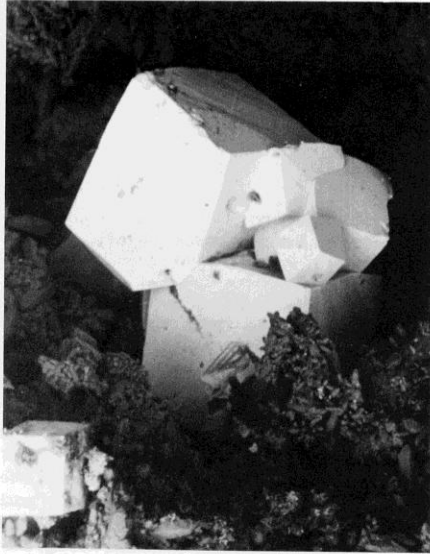


Figure 8. Intergrown galkhaite crystals, 0.4 mm across, showing diagonal striations normal to {111} on {100}; Dunning SEM photo and specimen.

quartz and clay grains. Although it is the principal ore mineral of the mine, no specimen quality samples of gold have been found. It is only by examining polished sections of ore that gold can be seen, although some isolated grains have been reported visible under low magnification.

**Graphite** C

Graphite, amorphous carbon and organic complexes occur in the silicified zones of the orebody and account for the dark gray color of the ore. The graphite is very fine grained and occasionally coats crystals of the ore minerals.

**Gypsum**  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Gypsum occurs as delicate radiating groups of clear acicular crystals in cavities and along fracture planes of the gray carbonaceous quartz-realgar ore of the North pit. The crystals show striations and typical terminations.

**Ilsemanite**  $\text{Mo}_3\text{O}_8 \cdot n\text{H}_2\text{O}$  (?)

Local groundwater alteration of molybdenite in the North pit area has resulted in dark blue coatings of ilsemanite along fractures in the gray carbonaceous shales.

**Laffittite**  $\text{AgHgAsS}_3$

The rare sulfosalts laffittite was first described from the Jas Roux mine, Hautes Alpes, France, by Johan *et al.* (1974). At this mine it occurs as small grains up to 0.2 mm associated with smithite, stibnite, pierrotite, realgar, sphalerite, pyrite and two thallium antimony minerals in dolomitic rocks. Laffittite has also been identified from the mines at Iquique, Chile.

Recently Nakai and Appleman (1983) discovered laffittite on a Smithsonian Institution specimen (#134796) labeled getchellite from the Getchell mine, Humboldt County, Nevada. In this specimen laffittite occurs as anhedral grains about 1 mm in maximum length which are generally surrounded by either getchellite or orpiment. This discovery prompted a thorough examination of the authors' getchellite-containing specimens. Laffittite was subsequently found in about 75% of the hand specimens examined.



Figure 9. Deep red, transparent crystals of laffittite, 0.2 x 0.6 mm, embedded in quartz with orpiment. Visible faces show fine striations. Dunning SEM photo and specimen.

Laffittite is most easily recognized when it occurs in massive, fine grained orpiment rather than in the darker red getchellite or realgar. Although very rare, monoclinic crystals of laffittite do occur in specimens containing veins of crystallized quartz and orpiment. Single or multiple contact crystals have formed in quartz cavities associated with acicular realgar crystals and foliated masses of orpiment. Laffittite crystals are deep red in color, resembling cinnabar, although slightly darker than getchellite. The developed faces are very brilliant and are striated. Both the crystals and anhedral grains show no cleavage when broken. They also are quite brittle, which accounts for the rarity of visible crystals when the rock is broken. Occasionally, small imperfect crystals are found in massive orpiment and, after weathering of the orpiment, stand out in relief.

The original description of getchellite by Weissberg (1965) makes no reference to material which might be ascribed to laffittite. The only dark red mineral that he refers to is cinnabar. Considering the abundance of laffittite in some samples of getchellite-orpiment-realgar ore, together with its physical and chemical properties, it is surprising that it was not recognized earlier.

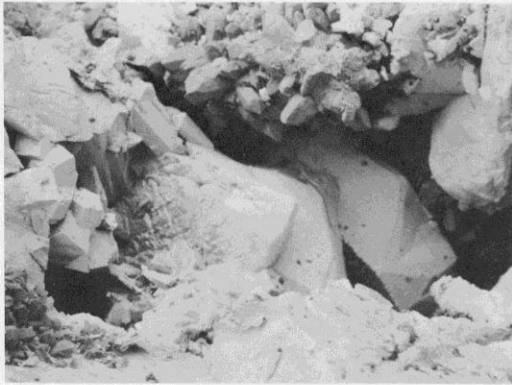
**Molybdenite**  $\text{MoS}_2$

**Scheelite**  $\text{CaWO}_4$

Disseminated molybdenite together with scheelite can be found in the granodiorite stock adjacent to skarn along the west vein and granodiorite dikes in the east wall of the South pit (Berger, 1980).

**Orpiment**  $\text{As}_2\text{S}_3$

Orpiment and realgar are the two most abundant arsenic sulfide minerals at Getchell. The major portion of orpiment occurs as veins of foliated, columnar or fibrous masses in the South pit extension, although it is distributed throughout the three main areas of mining. Where space permitted, crystals of orpiment formed in cavities along the quartz-rich fracture fillings. The crystals are generally small (1 cm or less), bright yellow-orange in color, and occur both as single and multiple intergrowths. The smaller crystals have a golden yellow color but, as the crystals become larger, the color deepens to a golden brown. The crystals are generally distorted, probably by remobilization of the ore following sulfide formation.



**Figure 10.** Euhedral crystals of getchellite in cavity, 0.2 x 0.5 mm, with black cubes of galkhaite at left center; Dunning SEM photo and specimen.



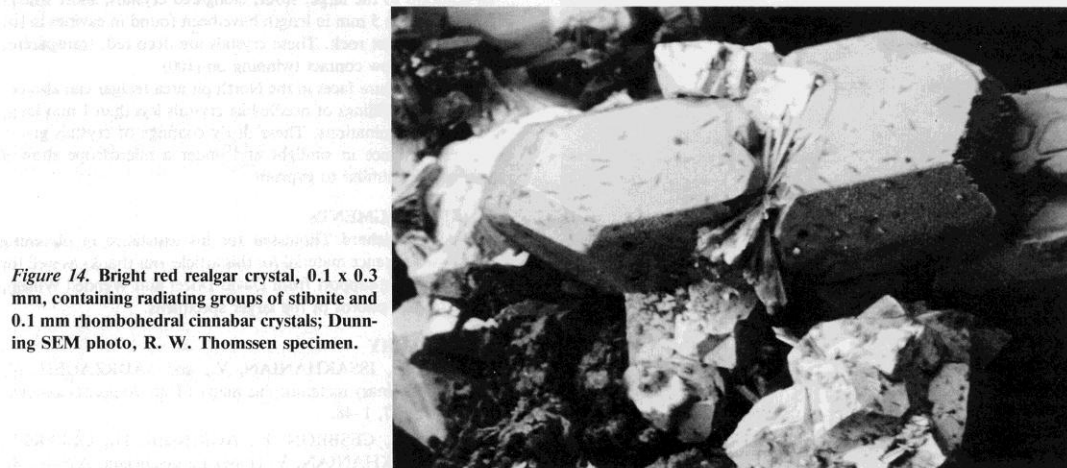
**Figure 11.** Dark red, pseudocubic rhombohedral cinnabar crystal, 0.2 mm wide, on quartz; Dunning SEM photo, R. W. Thomssen specimen.



**Figure 12.** Dark red, intergrown, rhombohedral crystals of cinnabar, 0.5 mm long, and intergrown galkhaite cubes on quartz; Dunning SEM photo, R. W. Thomssen specimen.



**Figure 13.** Radiating groups of blue-black stibnite crystals, 0.2 mm long, on red realgar; Dunning SEM photo, R. W. Thomssen specimen.



**Figure 14.** Bright red realgar crystal, 0.1 x 0.3 mm, containing radiating groups of stibnite and 0.1 mm rhombohedral cinnabar crystals; Dunning SEM photo, R. W. Thomssen specimen.



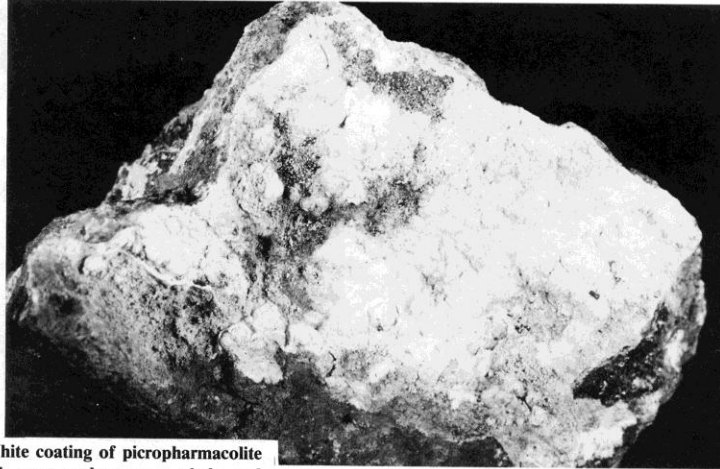


Figure 15. White coating of picroparmacolite covering dark gray carbonaceous shale and massive realgar specimen, 6 x 8 cm; Dunning SEM photo and specimen.

**Picroparmacolite**  $H_2Ca_4Mg(AsO_4)_4 \cdot 11H_2O$

Picroparmacolite occurs at the west end of the North pit as coatings along fracture surfaces in the realgar-rich carbonaceous shales and quartz. It generally forms dense white coatings less than 2 mm thick, or thicker botryoidal coatings showing a resemblance to cauliflower. Under the scanning electron microscope these coatings are seen to be composed of minute bladed crystals less



Figure 16. Groups of radiating transparent gypsum crystals on carbonaceous shale with realgar and orpiment. Specimen 4 x 6 cm; Dunning photo and specimen.

than 0.2 x 9 microns in size. The massive material generally shows a radiating to foliated appearance. Oxidation of both realgar and orpiment under acidic conditions has resulted in the formation of picroparmacolite. In addition, a number of unidentified calcium arsenates have been discovered in the partially oxidized realgar-orpiment veins. Owing to the complex nature of these secondary minerals and their dehydration products, further description will be delayed until their identification can be completed.

**Realgar** AsS

Realgar is one of the more spectacular sulfide minerals at Getchell. It was deposited, along with orpiment, as a late-stage product of local hydrothermal activity following the gold and quartz mineralization along veins and fractures of the Getchell fault system. In rocks with abundant carbonaceous material realgar and orpiment are found surrounded by dense masses of late-stage remobilized carbon (Berger, 1980).

The Getchell mine has been known for many years for its realgar crystal groups. Especially attractive groups of divergent crystals surrounded by calcite and attached to dark gray carbonaceous quartz have been recovered from the mine. After etching to remove most of the calcite, stout prismatic red crystals, commonly 10 cm or longer, form a colorful contrast against the white calcite and dark gray matrix rock.

In addition to the large, stout, elongated crystals, short stubby crystals less than 5 mm in length have been found in cavities in the quartz-calcite host rock. These crystals are deep red, transparent, and typically show contact twinning on (100).

Along the fracture faces in the North pit area realgar can also occur as thin vein fillings of needle-like crystals less than 1 mm long, with typical terminations. These drusy coatings of crystals give a deep red brilliance in sunlight and under a microscope show a radiating habit similar to gypsum.

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