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REPLACEMENT PHENOMENA IN THE SILVER-GOLD VEINS AT RAWHIDE NEVADA

By Eugene Grutt

Rawhide, Nevada is located in north-central Mineral County about six miles from the Churchill County line, and about 50 miles south-east of Fallon, Nevada.

Although the first mineral locations were made in 1906, it was not until the "boom" of 1908 that mining was started. According to the U.S. Bureau of Mines records Rawhide has produced in excess of $1,500,000 from lode and placer mines.

Rocks and Mineralization

The country rocks, for the most part, are tertiary rhyolites, andesites, and rhyolite-breccias and tuffs. Most of the rocks originated as flows.

The mineralization is of the epithermal type as is clearly shown by the mineral veins. The veins show symmetrical colloform bending, vugs, comb structure and replacement, all of which are epithermal characteristics. According to Lindgren[1] the temperatures attending this type of mineralization are generally less than 200° C, and the pressures are usually under 100 atmospheres.

Events Leading To Ore Formation

In the formation of mineral veins of the type found in Rawhide, there are definite stages in the formation that can be traced. The first step is the intrusion of a magma into the earth's crust. The intrusion is generally closely followed by a period of fracturing or faulting around the intrusion, which fracturing may produce structures favorable for the later deposition or ore. The ore itself is deposited from solutions ascending through these structures, forced upward by some means not clearly understood. The solutions are composed of magmatic and ground waters containing products of magmatic differentiation, and when the physico-chemical conditions are favorable, these rising thermal solutions deposit their load of gangue and ore-making elements in the form of various minerals.

The hydrothermal solutions change in acid and base content through the period of activity. There is also a change from high temperatures at the beginning of hydrothermal activity to lower temperatures in the last stages.

As to the exact character of the solutions in which the minerals are transported there is considerable disagreement. Lindgren[2] holds that the solutions, which are acid in nature at their source, are rapidly neutralized by the wall rocks through which they pass until finally they become alkaline, and that the hydrotherm veins are formed from alkaline solutions. Bowen[3] says that most ores are likely deposited from acid solution, and that their transportation is no problem in these solutions. Frondell[4] thinks that native gold can be carried in either alkaline or acid solution, but in the alkaline solutions he shows that the action of colloids plays an important part.

In any event, as the rising solutions change in composition, they give rise to a rather definite paragenesis. Replacement is caused by this hydrothermal change. Minerals stable under one condition may become unstable as the solutions change in character or composition, and the early minerals may be completely replaced by later ones. These replacement phenomena are exellently shown in two quartz veins at Rawhide.

Burn's Hill Quartz Vein

In a vein on Burn's Hill unusual pseudomorphs of quartz after calcite have been developed.

The paragenesis of this vein is as follows:

1--Banded chalcedony

2--Vein quartz containing small amount of pyrite and arsenopyrite.

3--Calcite

4--Replacement of calcite by quartz

5--Alunite

This vein averages about twelve inches in width, between rhyolite walls, and fully two-thirds of the vein consists of banded chalcedony and massive quartz. Pyrite and some arsenopyrite occur as small crystals disseminated through the massive vein quartz. The calcite was deposited on the quartz in crystals of the aregentine variety, which is a calcite developed parallel to the basal plane in the form of thin hexagonal plates (Fig. 1). The crystals arranged from one-half inch to three inches in diameter. They were arranged in various positions and in general only about one half of the crystal plate was developed. They were intimately intergrown and formed a cellular lacy structure. Later quartz completely replaced the calcite with the development of thousands of minute quartz crystals on both sides of the original calcite plate (Fig. 1). Each crystal developed perpendicular to the plane of the plate growing with the utmost economy of space. These quartz crystals are about .1 mm. in diameter and .5 mm. long. The pseudomorph plates average about 2 mm. in thickness which is probably considerably thicker than the original calcite plate.

The replacement of the calcite was due to its becoming unstalbe under changing conditions. Graton thinks that the replacement of carbonates in epithermal veins indicates a change from alkaline to acid solutions. Calcite would be readily dissolved in acid solutions.

There are two possible modes of origin of the alunite. It could have been formed by ascending acid solutions or by reaction between ascending alkaline solutions and descending ~~aicd~~ acid solutions. Either mode of origin is possible in this vein.

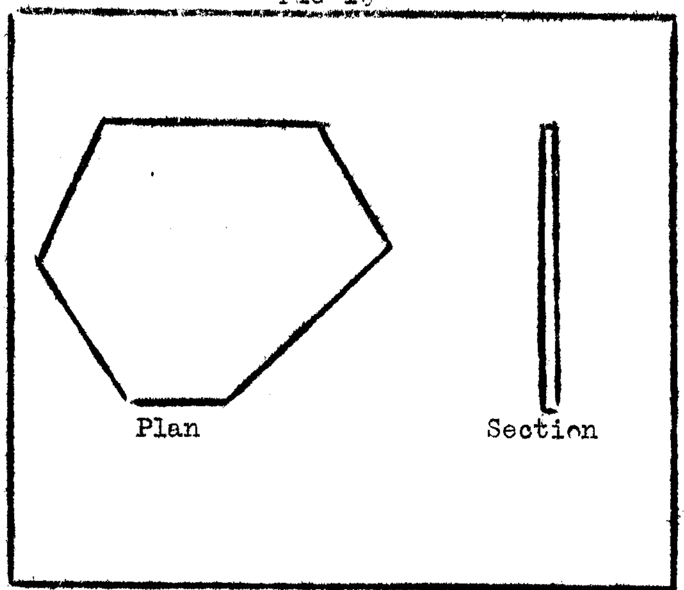
There was no gold or silver mineralization in this vein.

Murray Hill Vein

The Murrary Hill Vein shows replacement phenomena similar to the Burn's Hill vein, but a more complete paragenesis is shown. The pseudomorphic nature of the ore is strikingly displayed in many specimens, and the relations can be easily detected. The vein varies from one foot to two feet in width.

The paragenesis is as follows:

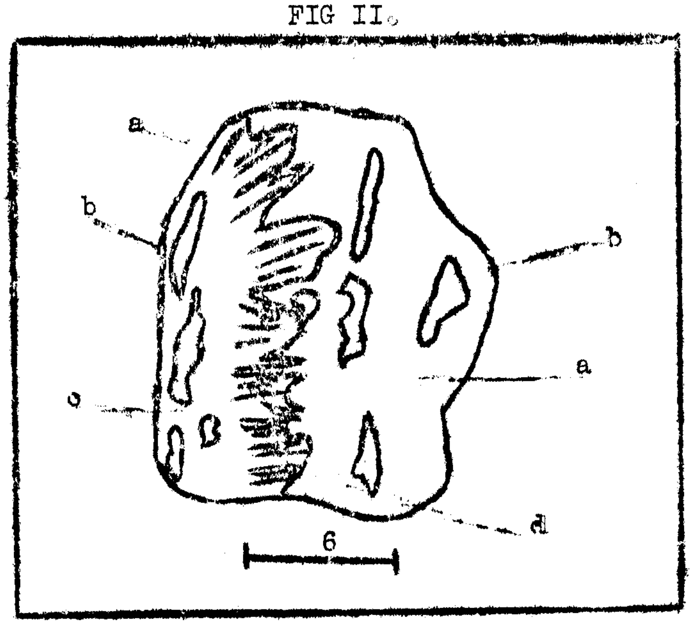
FIG I.



A pseudomorph plate from Burn's hill

(Actual Size)

FIG II.



A specimen Murray hill silver ore

a-- Vein quartz
b-- Vugs
c-- Quartz pseudomorphs
d-- Mineralized quartz

1--Barren vein quartz

2--Calcite

3--Replacement of calcite by quartz

4--Quartz containing pyrite and argentite along
with a little free gold

5--Barren vein quartz

The first stage, the introducing of massive vein quartz, was a prominent one, as approximately two-thirds of the vein is composed of it. This quartz is quite barren, and it shows vugs in many places.

The pseudomorphs of quartz after calcite show that the next mineral, calcite, was of the argentine variety. A close resemblance to the Burn's Hill pseudomorphs in shape is at once evident. On Murray Hill, however, the calcite did not grow in the open comb structure, common to all of the Burn's Hill material, instead sheaves of flat plates have been compactly developed. The traces of the individual blades are traceable for as far as four inches in places. The next step saw the formation of quartz pseudomorphs after calcite, with the calcite being completely removed. Simultaneous with the replacement of the calcite by quartz was the period of ore deposition. This mineralization is shown by a band of quartz containing dark patches of argentite and pyrite along with a small amount of free gold. The band of mineralized quartz varies from 1/8 inch to one-half inch in width, and is deposited in most cases directly next to and between the sheaves and individual plates of pseudomorphs (Fig. 2).

As evidenced by the narrow band of mineralized quartz the period of ore deposition was short. The last stage was the introduction of barren vein quartz.

Discussion

The Burn's Hill vein because of its unusual crystals is an interesting occurrence, but no conclusions about ore depositions can be reached. The Murray Hill vein, however, shows such definite boundaries of ore mineralization that one conclusion about this vein seems quite probable. The calcite appears to have controlled ore deposition.

The close relationship between the pseudomorphs and the mineralized quartz shows that the replacing and the ore bearing solutions were probably of the same state, and that some connection exists between the replacement of the calcite and the deposition or ore. The deposition of ore along the sheaves and between the calcite plates is too consistent to have been accidental.

If the replacement of the calcite is to be regarded as being done through the changing of solutions from alkaline to acid, and if replacing and mineralizing stages are to be regarded as the same, then the ore carrying solutions are probably of acid nature. The calcite exerted a neutralizing effect on the solutions as it was replaced by quartz. This action undoubtedly exerted strong control on the ore deposition.

REFERENCES

1--Lindgren, W.: Mineral Deposits, 4th ed., p 210

2--Lindgren, W.: Am. Inst. Min. Met. Eng., Tech. Pub. 713, p 360 ,1936

3--Bowen, N. L.: Ore Deposits of the Western States, p. 126, New York, 1933

4--Frondell, G.: Econ. Geol., Vol. 33, p. 16-17

5--Graton, L.C.: Ore Deposits of the Western States, p. 190, New York, 1933.