

## Silver Haloid Salts, Wonder, Nevada

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\*The halogen salts of silver at Tonopah show the chloride, bromo-chloride, and iodide occupying fairly well-marked horizons; their respective positions being downward in the order named. This sequence is explained as corresponding to the order of their deposition from percolating surface waters charged with haloid alkaline salts. It is interesting to find that the arrangement of these secondary silver minerals at Wonder corresponds to that at Tonopah, and bears out the theory advanced to explain the order of deposition at that place.

Wonder is situated in Churchill county, Nevada, about 120 miles east of Reno. The country is a complex of tertiary eruptives, including rhyolite, dacite, andesite, and basalt. Of these the Wonder rhyolite is the oldest. It is a basic type of rhyolite, which, from its mineralogical and chemical composition, might well be called a quartz latite; but it has been commonly known as the Wonder rhyolite. The ore-bearing veins of the district occur in this 'rhyolite,' usually near small intrusive masses of a more acid rhyolite. They are composed chiefly of quartz and a white potash-feldspar. There are many of these veins in the district, most of which contain small deposits of silver-gold ore; but none, except the Nevada Wonder vein, has produced sufficient ore to pay for mining. The Nevada Wonder vein outcrops at the surface. It lies partly on the contact between the 'rhyolite' and an intrusive body of dacite, but toward the north the vein leaves the contact and lies entirely within the 'rhyolite.' The strike is N. 25° W., and the dip 75° E. The ore consists of quartz rudely banded with feldspar. Oxidation extends to the 1300-ft. level. The oxidized part of the vein forms the cleanest silver-gold ore, from a mining and milling point of view, that I have ever seen. The gangue is composed of quartz, feldspar with its usual decomposition products, and occasional small quantities of fluorite. It is stained yellowish brown with limonite, although some of the ore is white. The silver is in the form of argentite and halogen salts, and the gold is both native and combined with the argentite. Oxide of manganese occurs only in small dendritic forms, except in unimportant local concentrations. Copper and lead occur only in traces. No zinc was found above the 1300-ft. level, and there is practically no arsenic or antimony.

The silver haloids found were embolite, iodobromite, and iodyrite, which are respectively the bromo-chloride, iodo-bromo-chloride, and iodide of silver. No cerargyrite was seen. As at Tonopah, the percolating waters contained the alkaline salts of chlorine, bromine, and iodine,

which caused the selective precipitation of corresponding secondary silver minerals in separate horizons. There was this difference, however, that while at Tonopah the silver took the form of chloride, bromo-chloride, and iodide, at Wonder it took the form of bromo-chloride, iodo-bromo-chloride, and iodide, the order being downward as named. The best example of this was in what is known as the Extension ore-shoot where embolite was found to a depth of 950 ft. and iodobromite from that depth to the 1300-ft. level. Iodyrite was found in limited quantity and in collectible amount only in one locality on the 1000-ft. level, where, in a hanging-wall branch of the vein, there was an unusually rich deposit of silver sulphide which had been shattered and partly oxidized. Iodobromite occurred in films and crystallized coatings throughout this mass, among which were some pretty specimens. At the lower limits of this enrichment, a small pocket of loose iodyrite crystals was found lying immediately under rich fragments of ore. As at Tonopah, jarosite, the hydrous sulphate of iron, was prominent among the decomposition products associated with the iodyrite. It will be observed that, although this iodyrite was not found at the lower limit of the iodobromite zone, it was in a channel separated from the main body of the ore. In this position the rich ore had the effect of intensifying the precipitation of the chlorine and bromine and reducing their concentrations, until the solution was sufficiently weak in these elements to permit the precipitation of the iodide. In the main vein, however, the iodobromite zone extended to the lower limits of oxidation at the 1300-ft. level. While the iodide was uniformly precipitated separately from the chloride and bromide at Tonopah, it was, with the trifling exception noted, precipitated in combination with them at Wonder. The reason for this is apparently that the percolating solutions in the two places contained different concentrations of the chlorides, bromides, and iodides. Emmons says:<sup>1</sup> "If, in a solution containing the three halogens, chlorides are vastly in excess, silver chloride will be precipitated first, even if bromides and iodides are present, for, in a mixed solution, the least soluble salts are not precipitated first, if a more soluble salt is present in sufficiently great concentration."

Evidently the concentration of chlorine was less in proportion to that of bromine and iodine at Wonder than it was at Tonopah. The minerals associated with these halides were the quartz and feldspar of the vein with their usual decomposition products, limonite in com-

\*Abstract: 'Economic Geology', Oct.-Nov. 1917.

<sup>1</sup>William Harvey Emmons, 'The Enrichment of Sulphide Ores,' Bulletin 529 U. S. G. S., 1913.



paratively small amount, manganese dioxide in small amount, and wulfenite. The last occurred in small amounts in the iodobromite zone, though there seems to be no obvious connection between the two. As previously mentioned, flaky jarosite occurred with the iodyrite, but not noticeably elsewhere. It is noteworthy that no pure bromide of silver was identified either at Tonopah or Wonder.

The source of the halogen salts of the alkalies appears to be in the salt lakes that formerly existed in this region. Alkali flats, and salt beds of commercial importance, lie within 25 miles of Wonder. As far as I have been able to ascertain, the accumulations of salt in the Great Basin have not been tested for iodine or bromine, but George Otis Smith has informed me that bromine was detected in the brines from Searles Lake, California. Doubtless, close analysis would show that they exist in practically all of these accumulations of salt.

Embolite,  $\text{Ag}(\text{BrCl})$ , occurs as grayish-green, waxy, translucent coatings and groupings of deformed crystals adhering to the ore. Where the mineral is abundant, it is sometimes found in the form of loose crystals, often of cubical form, lying in cracks and openings. It is often associated with wulfenite. It has a perceptible odor of bromine. It is sectile and has no cleavage. The symmetry is isometric.

Iodobromite,  $2\text{AgCl}$ ,  $2\text{AgBr}$ ,  $\text{AgI}$  (Dana), the iodobromo-chloride, occurs as light to dark olive-green, translucent, lustrous, crystalline coatings, and loose imperfect crystals. Crystal-surfaces have a brilliant lustre. The mineral has no cleavage and is sectile. It is associated with a small amount of wulfenite and an occasional loose crystal of iodyrite. The odor of bromine is apparent. The symmetry is isometric but perfect crystals are rare.

Iodyrite,  $\text{AgI}$ , the iodide, is found in pockets of loose sulphur-yellow crystals in cracks and cavities in the ore, and in occasional crystals associated with iodobromite. The symmetry is hexagonal hemimorphic. The mineral is sectile and has well-defined cleavage. It has a distinct odor slightly milder than that of iodobromite or embolite. The odor of these minerals, as a class, is one of their most distinctive characteristics, though I do not know that it has been mentioned before in print. It is best described as a drug-store or laboratory odor, reminding one strongly of the characteristic odors of those places, and is not as rank as the odor of chlorine or bromine gas. Of the specimens that I have at hand, embolite and iodobromite smell alike, though iodobromite is the stronger. The smell of iodyrite is milder and less penetrating than that of the other two. The odor of these minerals is sufficiently strong, so that on entering stopes where a deposit had been newly found, I have frequently been made aware of its presence through the sense of smell.

UNDER the recently enacted revision of the Texas mining law claims covering mineral deposits not occurring as lodes may consist of four sections, or about 2400 acres, on which the usual assessment work must be done, and a royalty must be paid to the State.

## Tariff Commission Asks for Data

The Tariff Commission is making an inquiry into the significant developments that have taken place in the chemical industries since the passage of the tariff act of 1913. Changes which seem likely to alter permanently the conditions of international competition or the course or volume of foreign trade are of special interest. All persons having direct knowledge of pertinent facts in regard to any particular industry or product are invited to submit a statement to the Tariff Commission. Among the matters on which the commission desires information are:

1. The manufacture within the United States of articles formerly unavailable or obtained exclusively by importation; for example, phosgene.

2. In the case of industries previously established in the United States, the erection of new plants or increase in capacity of existing plants; for example, the increase in capacity of existing plants for making caustic soda and chlorine.

3. The future of industries newly created, or in which productive capacity has been greatly increased to meet a direct war-demand. How can these plants be utilized when the war-demand disappears?

4. Any general or significant differences in the prevailing methods of manufacture here and abroad.

5. Differences in the organization of the industry here and abroad.

6. The development or invention in the United States or abroad of new or improved processes which are likely to influence the conditions of international competition; for example, the hydrogenation of fatty oils or the flotation process for concentrating ores.

7. Significant changes in the conditions of international competition caused by the recent law making patents owned by citizens of enemy countries available to American manufacturers.

8. Industries which have been seriously hampered in their normal operation or development by difficulty in securing materials or supplies formerly imported; for example, the lack of potash for fertilizer or glass. If these difficulties have been met by the introduction of substitutes, is it expected that there will be a return to the old materials and methods when foreign supplies again become available, or will the changes be permanent?

9. Developments or changes in other industries which have created a new or greatly increased demand for chemical products; for example, the manufacture of new varieties of glass.

10. The discovery of new uses of materials, creating a new demand or furnishing a market for materials formerly wasted; for example, the use of aniline as an accelerator in the vulcanization of rubber.

11. Any governmental hindrances in the United States or abroad, either in manufacture or commerce; such as the export duty on nitrate from Chile.

The commission will publish only general statements or summaries, which will not reveal the operation or plans of individual companies.