REPORT ON BOULANGERITE

IN SULLIVAN ORE

Geology 9

J. P. McCulloch

Met. Eng. '43

BOULANGERITE IN ORE
FROM
THE SULLIVAN MINE

Purpose of the Investigations

The singular character of the occurrences of boulangerite in the Sullivan Mine has aroused some degree of interest. Its mode of occurrence is quite varied, ranging from fine disseminations in galena to fair-sized lumps of the pure mineral. These occurrences are found in the upper levels of the mine; a well-known authority has told the writer of seeing remarkable concentrations of it on one part of the 4200 level.

The study of the micro-structure of the ore, carried on by the writer, was not for the purpose of solving a metallurgical problem. The mineral, along with its close relative, jamesonite, which is qualitatively similar, floats with the galena and is shipped to Trail in the lead concentrates. There the antimony content is recovered from the lead anode slimes by pyrometallurgical treatment. However, some knowledge of the occurrence and associations of this hitherto unstudied mineral has been considered desirable.

Properties of Boulangerite

Boulangerite is a lead-antimony sulfide belonging to the Jamesonite group of sulfo-salts. Its formula is given as $5PbS.2Sb_2S_3$; the formula of jamesonite is $2PbS.Sb_2S_3$. It belongs to the orthorhombic system and occurs in Sullivan ore as prismatic crystals. This crystalline form is very friable and great difficulty was experienced in cutting the specimens in preparation for mounting them. Boulangerite has the same hardness as galena.

The antimony content of the pure mineral is 25.7%. An assay run on an apparently pure sample from the Sullivan assayed at 16.4%. Because of the great difficulty in assaying for lead in the presence of antimony and because of the lack of available time no assays were run for the lead content.

Paragenesis

The minerals found were, in order of abundance, galena, sphalerite, pyrrhotite, pyrite or boulangerite, and arsenopyrite. The order of deposition was as follows: pyrite, arsenopyrite, pyrrhotite preceding and contemporaneous with sphalerite, sphalerite, galena and boulangerite.

There appears to have been a period of cooling

after the deposition of the pyrite and arsenopyrite followed by a general movement. The pyrite and arsenopyrite show considerable fracturing. The pyrrhotite appeared to have deposited next closely followed by the sphalerite. These were deposited together for a period with the sphalerite replacing and veining the pyrrhotite to a certain extent. The last period saw the deposition of the galena and the precipitation out of solution of the boulangerite. There is considerable replacement and veining of the sphalerite and pyrrhotite by galena. In addition the entire area of sphalerite is spotted with fine inclusions of carbonate gangue.

It may be noteworthy that there were a considerable number of galena inclusions in the other minerals while there were no inclusions of boulangerite. Also in the smaller galena veins in the sphalerite and pyrrhotite there was no deposition of the boulangerite. Whether or not this has any significance the writer does not feel well enough informed to state.

The boulangerite usually takes the form of angular blebs of about 100 microns diameter in the galena matrix. One exception to this is found in Section No. 2 where a definite veinlet of boulangerite is to be seen traversing the galena.

Discussion of the Polished Sections

No 1.

In this section no pyrite was found and the arsenopyrite could only be found under higher magnifications. Boulangerite is to be found as inclusions and blebs in constant proportions in all parts of the galena.

No. 2.

This is mostly a large area of galena. As mentioned previously there is a definite vein of boulangerite running across one side of the section. Small inclusions of pyrrhotite and a large partially-replaced crystal of pyrite are the remaining features of this specimen. No sphalerite can be found.

No. 3.

In this section all of the minerals were found. It was the only one in which pyrite and arsenopyrite were found together. The general characteristics of this section were the same as those of No. 1.

Differentiation of the Minerals

Galena

No difficulty was experienced in identifying the galena. The hardness, color, and the characteristic triangular pits were considered sufficient evidence to name it.

Boulangerite

This mineral gave considerable trouble at first in newly-polished sections. The color was so very similar to that of galena that it was only after a period of conditioning of the eye that boulangerite could be recognized. However, an indication of it was given in areas where the characteristic galena pits were not to be seen. Once an area had been etched an etch-cleavage of parallel lines showed on those occurrences of boulangerite whose orientations were favorable and this persisted even after considerable buffing.

The results of etch and micro-chemical tests on neighboring areas of galena and boulangerite were as follows:

	Galena	Boulangerite
HNO_3	Black	Dark Brown
HCl	Brown	Neg.
KCN	Neg.	Neg.
$FeCl_3$	Slight Discoloration	Neg.
KOH	Neg.	Neg.
Presence of Sb	No	Yes

The results of these tests were judged sufficient to differentiate definitely the boulangerite from the galena. The KOH test proved that the mineral was not jamesonite.

Pyrrhotite

This mineral was recognized by its color, hardness and magnetic properties. No etch tests were run directly on the pyrrhotite but incidental etching resulting from the etching of neighboring minerals proved beyond all doubt that it was pyrrhotite.

Sphalerite

Sphalerite was usually identified by its color, hardness, and by the honey color of internally reflected

light. A check series of etch tests confirmed this.

Pyrite, Arsenopyrite

Pyrite was found in its usual form, - mostly irregular inclusions with pitted surfaces. The color was a very faint yellow in some inclusions but more usually was the more stronger shade of pale brass. The arsenopyrite occurred in small diamond-shaped crystals. Some doubt was expressed about the arsenopyrite in Section No. 1 because of pitted surfaces of the crystals obscuring the true color and causing it to ressemble pyrite. However, in Section No. 3 the pyrite and arsenopyrite occurred together and this made it easy to distinguish between them.

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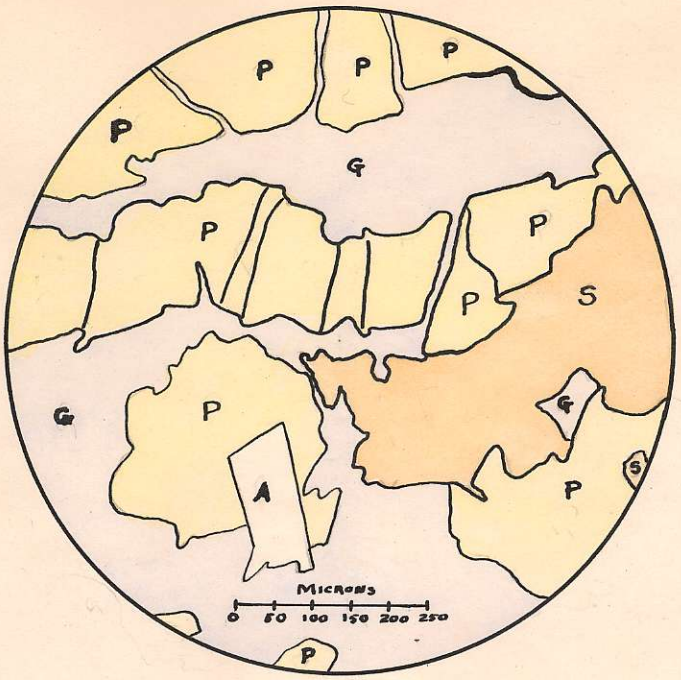
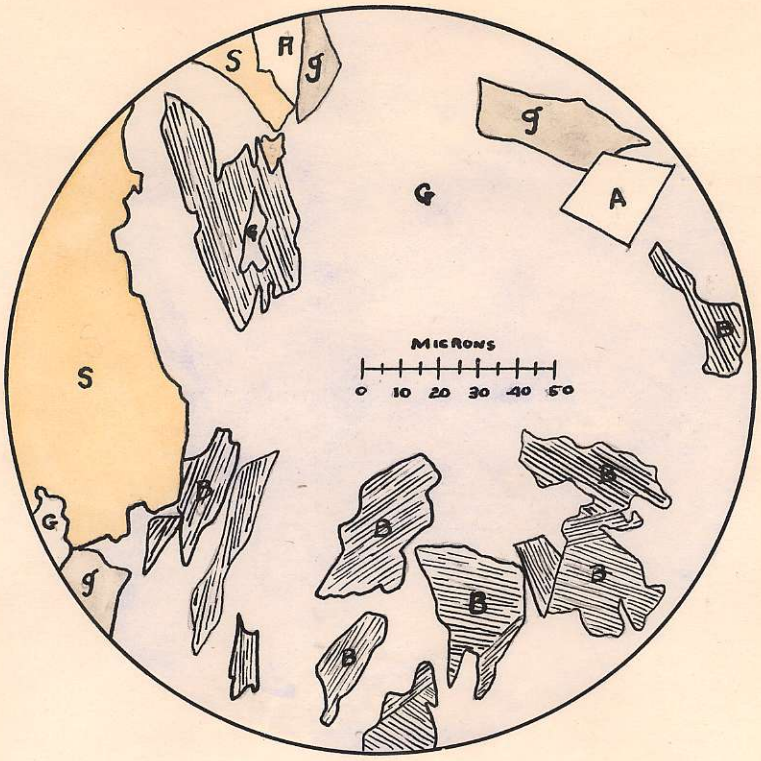


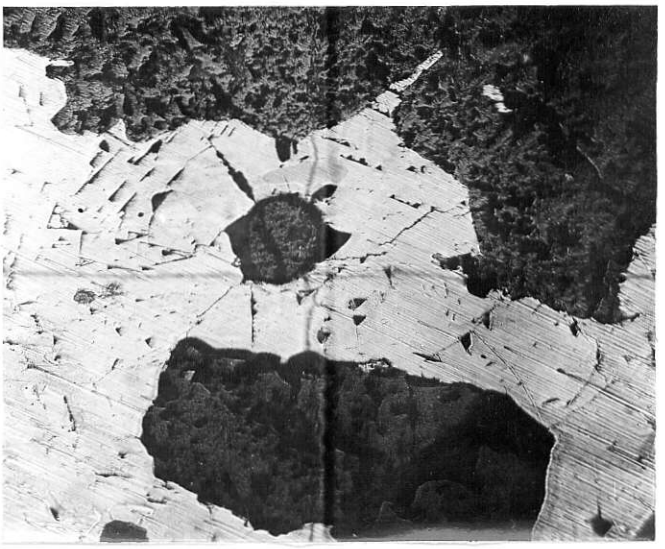
Section 3 - Showing fracturing of pyrite with replacement by sphalerite and galena
X 100

A	arsenopyrite
G	galena
P	pyrite
S	sphalerite

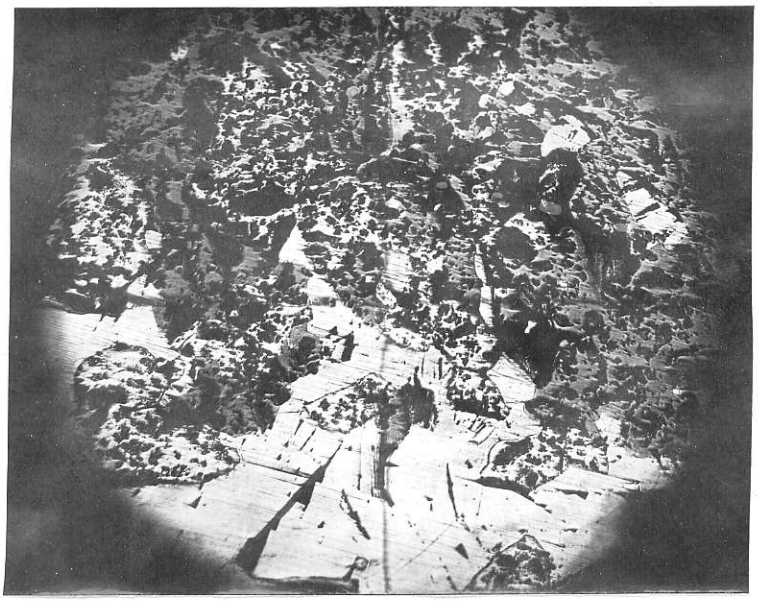


Section 1 - showing appearance of boulangerite after etching and buffing. - X 540

A	arsenopyrite
B	boulangerite
G	galena
S	sphalerite
g	gangue



Section 1 - sphalerite, galena, and boulangerite. This specimen of the boulangerite is oriented with the cleavage parallel to the surface. It can be seen in the lower left-hand quadrant; it is just a shade darker than the galena. X 84



Section 1 - Replacement of sphalerite and pyrrhotite by galena. X 38