MICROSCOPIC EXAMINATION

OF THE

J. AND L. ORE

600377

by

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THE J. AND L. ORE.

Introduction.

The J. and L. group of claims is located between the south and east forks of Carnes creek, approximately 30 miles north of Revelstoke, B.C. The claims lie on the shoulder of Goat Mountain about 8 miles by trail from the Columbia River road.

The deposit was discovered in 1898 and since that time has been optioned to numerous individuals and companies. The preliminary geological investigations which have been carried out show that the deposit contains at least 800,000 tons of a good grade of lead-zinc ore carrying gold and silver values. Development work on the deposit has been held back in view of the difficulties encountered in producing a marketable concentrate and the fact that the ore is of a refractory type.

General Geology.[1]

The rocks in the vicinity of the J. and L. group are chiefly schist and limestone with occasional bands of quartzite. The vein or mineralized zone occurs at or near a schist-limestone contact that strikes 65 to 75 degrees west (magnetic) and dips 30 to 55 degrees to the north east (into Goat Mountain). This contact has been traced for several thousand feet up the hillside. The mineralized zone is not continuous throughout this distance. In places it reaches

(1) H. C. Gunning, G.S.C. Summary Report, 1928.

a width of six to eight feet. The hanging wall consists of schist and the footwall of limestone. Gouge is present in many places. The sulphides occur as veinlets, lenses, or bunches. The vein matter has been extensively altered and decomposed.

The schist on the hanging wall of the vein is an altered quartzite sheared to sericite schist. Under the microscope it is seen to consist of quartz, pyrite in cubes, sercite, and a little talc. The ore lies along a well defined shear zone, on the contact of marble and schist and has been formed in part by filling of the shear zone, and in part by replacement, particularly of the footwall marble.

General Mineralogy.

The mineralogy of the deposit is complex in its associations and character. The minerals present, although relatively common, are so fine grained that the determination of their relative abundance, Paragenesis, and genetic relationships is very difficult.

Megascopic examination of the ore resulted in the identification of arsenopyrite, pyrite, quartz, calcite, sphalerite, and a small amount of chalcopyrite. Pyrrhotite was also noted in the hand specimens. No other minerals could be identified in the hand specimens because of the extremely fine grained nature of the ore. It was noted in several of the specimens that the ore takes on a banded appearance; the individual bands having either gangue or one of the more abundant sulphides as their main component.

One polished section was prepared from each of four specimens which had been selected at random from a quantity of the ore. The following minerals were identified in the polished sections:

Ore Minerals.	Gangue Minerals.
Pyrite	Quartz
Arsenopyrite	Calcite
Sphalerite	
Galena	
Chalcopyrite	
Anglesite	
Tetrahedrite	
Bournonite	

Pyrite and arsenopyrite are the two most abundant minerals present in the sections examined. Sphalerite is next in abundance followed by galena, chalcopyrite, and anglesite. Tetrahedrite and bournonite are the two least abundant minerals in the sections. Quartz and calcite are the gangue minerals and form about 10 per cent of the sections.

An analysis of the ore was carried out by the Mines Branch, Department of Mines, Ottawa, and the following results were obtained:

Gold........	0.52	oz. per ton
Silver......	3.50	"
Zinc........	4.57	per cent
Arsenic.....	11.90	"
Copper......	0.15	"
Lead........	6.0	"
Iron........	21.8	"
Antimony....	0.22	"
Insoluble...	16.38	"

Detail Mineralogy.

Pyrite.- In the sections examined pyrite appears to be one of the most abundant minerals. It occurs as rounded, crushed grains with a few grains showing the typical cubic crystal form. The average grain size is approximately 500 microns with a few grains reaching a maximum of 2000 microns. The borders between the pyrite and its associates are usually irregular; the irregularities being caused by the fractured and pitted condition of the grains. The fractured appearance of the pyrite grains suggests early deposition followed by movement in the vein. The pyrite is replaced and cut by quartz and calcite both of which were introduced after the fracturing of the pyrite. The pyrite has been replaced but it is nowhere seen replacing other minerals.

Arsenopyrite.- The arsenopyrite is present in the sections in quantities approximately equal that of the pyrite. Many of the grains have been crushed and appear as a finely disseminated mass of crystal fragments. Other grains show the typical diamond-shaped form. The size of the grains averages 350-400 microns with a few reaching a maximum of 1500 microns. The borders between the arsenopyrite grains and the other minerals is commonly irregular. Like the pyrite, arsenopyrite has been cut and replaced by gangue, sphalerite and later minerals. The fractured appearance of the arsenopyrite with replacement by gangue suggests that it was deposited contemporaneously with the pyrite. The arseno-pyrite is nowhere seen to cut or replace pyrite or any other minerals. The bands of the ore which contain the highest percentage of arsenopyrite have galena, sphalerite and gangue as the main associates and only minor amounts of pyrite and the sulpho-salts, and little or no chalcopyrite.

<u>Sphalerite</u>.- Sphalerite ranks third in abundance as an ore mineral in the sections. It is present as variously shaped patches and blebs ranging in size from 20 microns to 5-6 mm. in diameter. The mineral also occurs as veinlets and elongated patches, the latter imparting a banded appearance to the ore. The borders of the sphalerite are irregular where the mineral contacts arsenopyrite and pyrite, and becomes more regular where it is replaced by the later sulphides and sulpho-salts. Sphalerite is found cutting across and replacing gangue, pyrite, and arsenopyrite. Tiny blebs of chalcopyrite were noted within the sphalerite in one section. The sulpho-salts are usually associated with the sphalerite and are seen to replace it. Galena occurs as the latest replacement of the sphalerite.

It was noted that in the hand specimens the sphalerite has a decided blue tinge to its colour. The blue colour is also noticeable in the polished sections and the sphalerite resembles chalcocite in appearance. This blue stain is caused by the presence of manganese in the sphalerite.

<u>Galena</u>.- Galena ranks approximately fourth in abundance in the sections. It occurs as veinlets and small blebs. The veinlets are not usually continuous nor are they very uniform in width. The grains or blebs of the mineral average

60-70 microns in diameter. Where the galena contacts or replaces gangue and the sulpho-salts, the borders of the grains are quite regular. In most other cases however, the borders tend to be irregular with tongues of galena extending into the earlier sulphides. Galena is the latest metallic mineral to be introduced and it is seen to cut across and replace gangue, arsenopyrite, pyrite, sphalerite, and chalcopyrite. It also appears to replace tetrahedrite and bournonite, with which it is frequently associated. The most common associate of the galena is sphalerite.

<u>Chalcopyrite</u>.- Chalcopyrite ranks below galena in abundance in the ore. It shows a definite "spotty" occurrence in the sections and in the hand specimens. Three of the four sections examined showed little or no chalcopyrite; that which did occur being only tiny blebs averaging 10-15 microns in diameter. The fourth section examined showed a considerable amount of chalcopyrite occurring as veinlets cutting across the pyrite grains. Chalcopyrite seems to favour the presence of pyrite for its deposition. The veinlets of chalcopyrite were more uniform and continuous than the veinlets of galena. These veinlets average 300 microns in width. The borders of the chalcopyrite blebs are smooth, whereas the borders of the veinlets tend to be rather irregular in detail. Chalcopyrite shows replacement by galena and is itself seen to be replacing sphalerite, pyrite, arsenopyrite, and gangue.

Anglesite.- Anglesite is present as an aleration product of galena. The contact between the anglesite and the galena is irregular. Small inclusions of galena are present within the anglesite.

Tetrahedrite.- Tetrahedrite occurs as scattered grains and minute inclusions in a relatively small quantity. The grain size averages 40 microns with a few grains up to 200 microns in size. The boundaries of the grains are generally smooth and rounded. The grains are often irregular in shape. Tetrahedrite is associated with sphalerite, bournonite, and usually with galena. It sometimes occurs as tiny blebs in the galena. There is no evidence as to whether it was deposited at the same time as the chalcopyrite or after the chalcopyrite.

Bournonite.- Minor quantities of this mineral were identified in the section. It shows up as the only anisotropic metallic mineral in the sections and in one instance showed twinning. The largest grains observed had a maximum diameter of 200 microns while the average grain size was approximately 35 microns. The grains are often irregular in shape but have smooth boundaries. Bournonite was almost invariably associated with tetrahedrite and often with galena and sphalerite. It was probably introduced at the same time as the tetrahedrite.

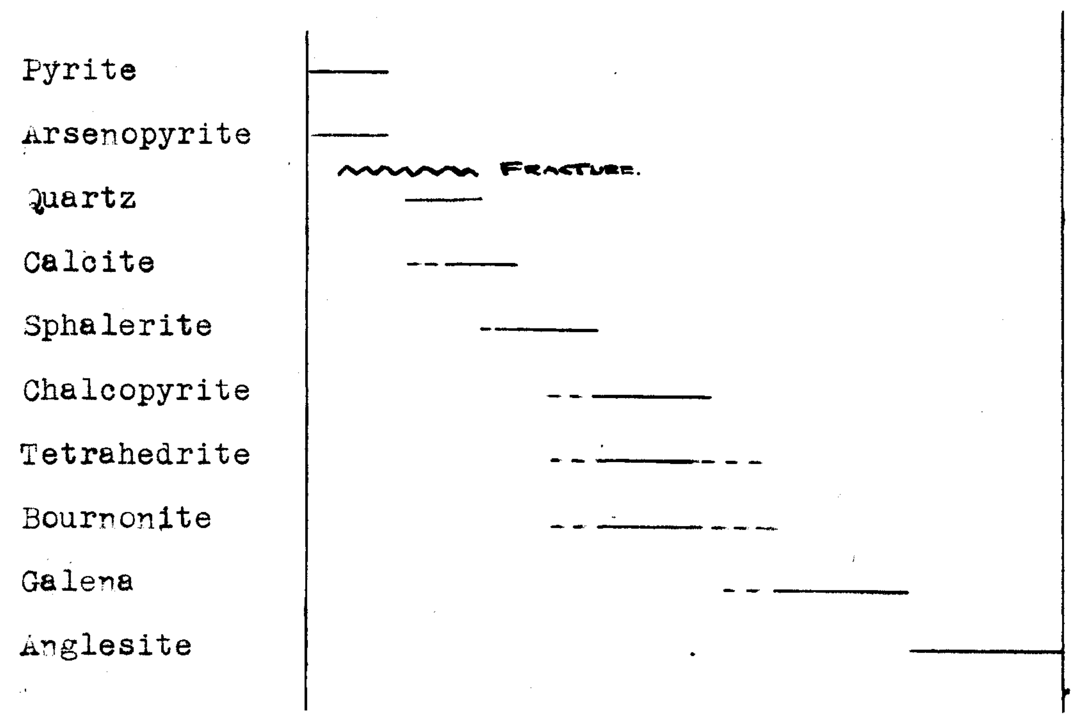
Gangue Minerals.- The gangue minerals are quartz and calcite. The ratio of quartz to calcite present varied in each section but in general the gangue is siliceous. The gangue minerals occur as stringers or bands containing little or no sulphides and also as replacement blebs and stringers intergrown with the sulphides. The bands of gangue have widths up to 4 mm. with the individual bands of quartz or calcite averaging 250-300 microns in width. Quartz and calcite "eyes" with diameters up to 5 mm. were noted in the hand specimens. The boundaries between the quarz and the calcite are usually smooth with only occasional irregularities. Where the gangue has replaced pyrite or arsenopyrite the borders are usually irregular. Boundaries between the gangue and sphalerite are commonly irregular while the boundaries between the gangue and later sulphides and sulpho-salts are smooth and well-defined.

The gangue replaces and cuts across the pyrite and arsenopyrite and has in places been replaced by sphalerite. Small blebs of chalcopyrite were note in the quartz in one of the sections. The calcite replaces the quartz in some places.

Paragenesis.

The fine grained texture of the ore makes it very difficult to determine accurately the sequence of deposition for the various minerals present. The fractured appearance of both the pyrite and the arsenopyrite, together with the fact that neither of the minerals are seen to replace any other mineral, suggests that these minerals were deposited first and contemporaneously. The deposition of the pyrite and arsenopyrite was followed by movement in the vein which caused the fracturing of the two minerals. The vein was then invaded by solutions which deposited quartz in the fractures of the sulphides and as stringers throughout the vein. The quartz deposition was closely followed by or accompanied by the deposition of calcite which in places has replaced the quartz and the early sulphides. The gangue and sulphides were then replaced in part by sphalerite. Chalcopyrite is seen replacing sphalerite and therefore may be considered to follow sphalerite in the sequence of deposition. Tetrahedrite and bournonite were probabley deposited together at the same time as the chalcopyrite although there is no evidence either for or against this statement. Galena is the latest mineral introduced and in places it has been altered to form anglesite.

The sequence stated above seems to be a satisfactory explanation of the conditions observed in the polished sections.



Type of Deposit.

The deposit is a fissure type of deposit in which replacement has been of major importance. The overall mineralization indicates a high temperature of formation and the fine grained texture suggests that it was formed at moderate depth. The deposit may therefore be classified as a xenothermal type of deposit.

Type of Mineralization.

The ore minerals present, with the exception of anglesite, are all hypogene minerals. Anglesite may be classified as an oxidized ore mineral.

Milling Character of the Ore.

The ore minerals are so very fine grained that it is necessary to grind the ore very finely to release the required minerals. The irregular grain boundaries of the main ore minerals and the presence of locked associations (as with arsenopyrite containing small blebs of sphalerite.) further complicates the milling problem.

The high content of arsenic and lead makes the ore a refractory type. The refractory nature of the ore makes it even more imperative that clean concentrates be produced.

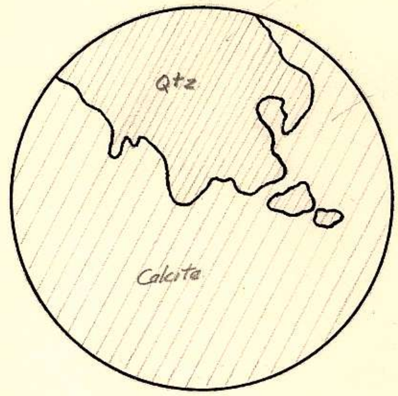
Conclusions.

The major problem concerned with this deposit seems to be of a metallurgical nature. The ore is a good grade of lead-zinc carrying gold and silver values. In spite of the excellent tenor of the ore the deposit is at present considered non-commercial because of the lack of a suitable method for the production of clean concentrates. The fine grained texture together with the irregular grain boundaries, prevents the separation of the main ore minerals.

The minerals present are almost all of the hypogene type. The complexity of the ore makes and accurate determination of the paragenesis very difficult.

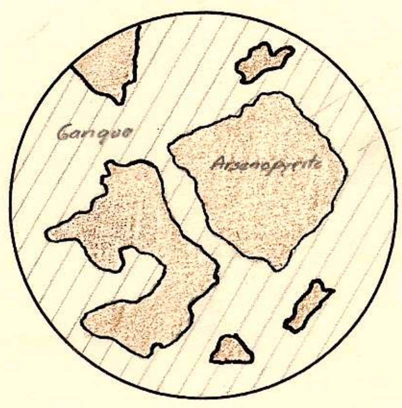
The quantity of tetrahedrite and bournonite found in the polished sections does not indicate the presence of antimony in commercial amounts. There is apparently not enough of these minerals present to seriously affect the selective flotation process.

Illustrations.



x 50

Fig.1.- Calcite replacing Quartz.



x 50

Fig.2.- Gangue cutting and replacing arsenopyrite.

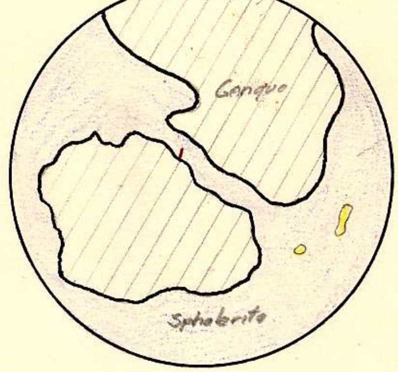


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Fig.3.- Sphalerite replacing gangue. Blebs of chalcopyrite in the Sphalerite.

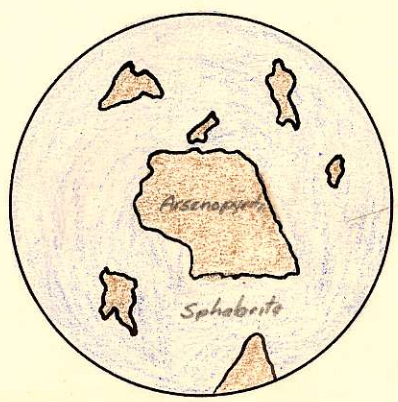

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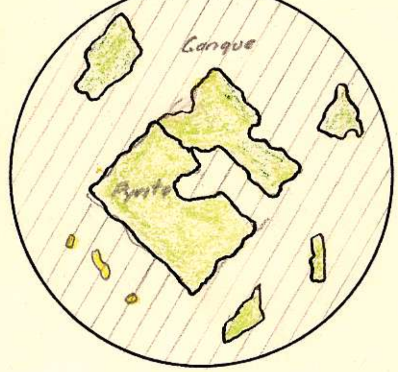
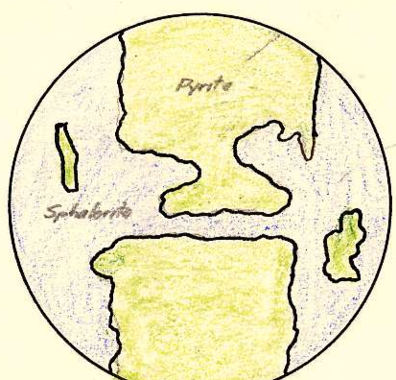
Fig.4.- Sphalerite replacing arsenopyrite.



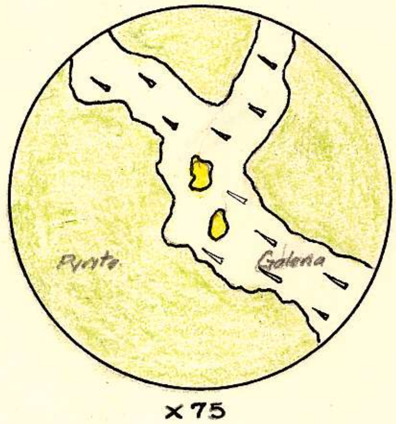
x 50

Fig.5.- Gangue replacing pyrite.



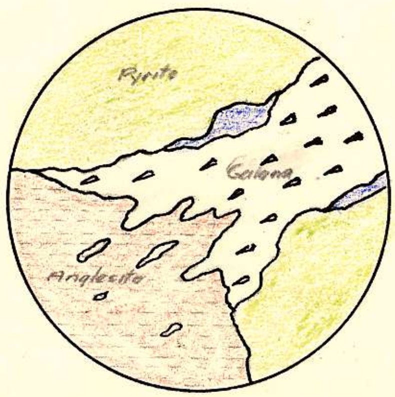
x 50

Fig.6.- Sphalerite replacing pyrite.



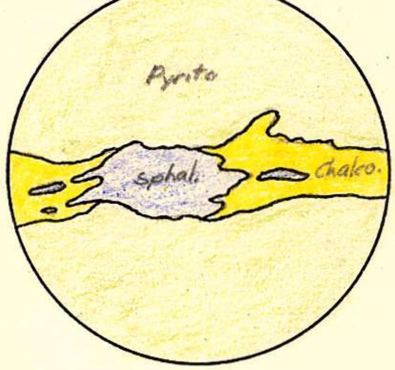
x 75

Fig.6.- Galena as veinlets in pyrite. Blebs of chalcopyrite within the galena.



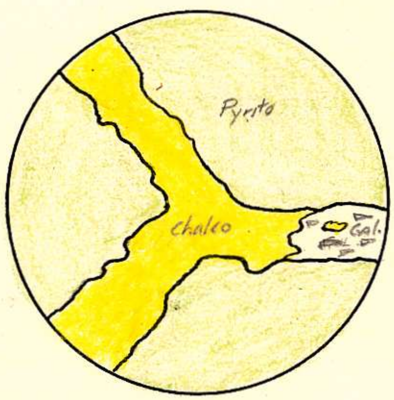
x 100

Fig.7.- Galena replacing pyrite and sphalerite. Galena being altered to anglesite.



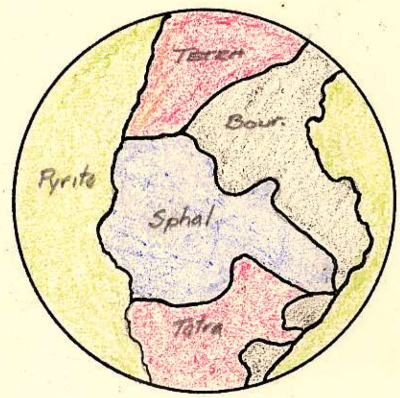
×75

Fig.9.- Chalcopyrite replacing sphalerite as a veinlet in pyrite.



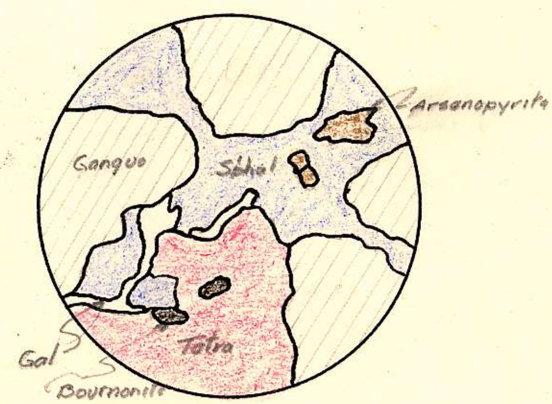
×75

Fig.10.- Galena replacing chalcopyrite as a veinlet in pyrite.



X 200

Fig.11.- Tetrahedrite and bournonite replacing sphalerite as a veinlet in pyrite.



X150

Fig.12.- Galena and tetrahedrite replacing sphalerite. Blebs of bournonite in the tetrahedrite. Fragments of arsenopyrite in the sphalerite. Galena is latest having been introduced along borders of tetrahedrite grains.

Acknowledgements.

The writer wishes to express his thanks to the British Columbia Research Council for the specimens of the ore used, and also to Dr. H. V. Warren and Dr. R. M. Thompson for their valuable assistance in the laboratory.