A LABORATORY INVESTIGATION OF THE ORES OF THE ST. PAUL GROUP OF MINERAL CLAIMS, OSOYOOS DISTRICT, BRITISH COLUMBIA

A report submitted in fulfillment of the requirements
of Geology 9, part of the course in Geological
Engineering leading to the degree of
Bachelor of Applied Science at
the University of British
Columbia

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ACKNOWLEDGMENTS

Previous Work

Dr. C. E. Cairnes[1] visited the St. Paul Mineral Group in 1930 and the writer has had to rely largely on his report concerning the Geology of the property. Dr. Cairnes also studied the ores microscopically and stated that the sulphides are principally arsenopyrite, antimonial sulphides, pyrite, and pyrrhotite with small amounts of galena, sphalerite, and chalcopyrite. The antimonial sulphides being Jamesonite, Tetrahedrite and probably Stibnite. No free gold was observed but native silver was found to occur in microscopic specks.

Present Work

The writer wishes to thank Dr. O. Van Etter of New Westminster, B. C. for the information regarding the history of the property which he gladly supplied. The writer is also indebted to Dr. H. V. Warren under whose direction the investigation was carried on.

Thanks are also due to Mssrs. J. L. DeLeen and J. Donnon who gave valuable instruction in laboratory routine and in the preparation of polished sections.

1. Cairnes, C. E., St. Paul Group of Mineral Claims, Osoyoos District, B. C., Summary Report, 1930, Part A, Pp. 116 - 121.

A LABORATORY INVESTIGATION OF THE ORES OF THE ST. PAUL GROUP OF MINERAL CLAIMS OSOYOOS DISTRICT BRITISH COLUMBIA

INTRODUCTION

General Statement

The purpose of the investigation was to:

1. determine the minerals present,
2. study the relationship between the different minerals and determine their paragenesis,
3. determine and account for the distribution of the gold and silver values of the ore,
4. attempt to find some evidence that would indicate whether or not the gold and silver values will persist with depth in the deposit,
5. obtain photographs showing the contact relationship of

of the minerals present,

6. note in particular any special feature of the mineral jamesonite.

The Property

Location and Accessibility.

The St. Paul mineral group, comprising the Toughnut, Zilpah, Minerva, and Black Bess Crown-granted claims occupies part of the summit and northwestern slope of Monasheee mountain, Vernon mining division, Osoyoos district, British Columbia.

The property may be reached by a branch road one mile long, that leads off from the Vernon-Edgewood highway, about 42 miles east of Vernon. This branch road is continued by a trail which leads to an old camp and 2 - stamp mill. The trail climbs rather steeply up the northerly slope of the mountain passing the lower St. Paul mine workings on the Toughnut claim and reaching the higher old Morgan workings on the Minerva claim. The trail than passes over the summit and continues down the easterly slope of the mountain to connect again with the Edgewood-Vernon highway.

History.

The property was first discovered and staked by a trapper by the name of Morgan. In 1913 Rembler Paul and his associates acquired the property, and erected a 2-stamp mill which they moved from the old Monashee mine to Seward Creek. The property had a varied history until 1926, when it was taken over by the present owners, Dr. O. Van Etter of New Westminster, B. C., and Messrs. O. M. Sheppard and Rube Brown of Bellingham, Washington, who formed a syndicate called the St. Paul Mines, Limited with headquarters now at New Westminster, B. C. Since then development has been entirely concentrated on the lowermost St. Paul workings on the Toughnut claim. Work on the property was interrupted as a result of the war but development is expected to be resumed this spring.

In 1927, 11 tons of ore shipped to Trail produced:

Gold	----------------	6 ozs.
Silver	--------------	1572 ozs.
Lead	---------------	2525 lbs.
Zinc	---------------	1930 lbs.

In all, production from Monashee and St. Paul workings has been 2729 tons of ore which produced 503 oz. of gold and some silver.

Topography

This area 30 to 50 miles east of Vernon includes the drainage basin of Cherry Creek, and headwaters of the Kettle River and of several streams flowing into Upper Arrow Lake. It is a mountainous region traversed by the Vernon-Edgewood Highway the average relief being about 3000'.

General Geology.

The area has not been completely mapped geologically.

In general it is underlain by sedimentary and volcanic rocks of various sorts, with argillite and greenstone the commonest. Alteration of these rocks has been relatively intense. Crystalline schists, gneisses and intrusive rocks of the Shuswap series are relatively abundant.

Detailed Geology.

The rocks exposed in the vicinity of the St. Paul Mineral Group are largely greenish volcanics with intercalated sediments. These have a general east strike and for the most part a southerly dip. They lie in an area mapped by Dawson as occupied by the Cache Creek series regarded by him as being Upper Palaeozoic[1].

The St. Paul mine workings have exposed an intrusive body of diorite, which may be supposed to be related to the Mesozoic batholithic intrusion so extensively represented a few miles south of Monashee Mountain. It is medium grained and carries disseminated pyrite, in places being quite heavily mineralized by this iron sulphide.

Mineralization occurs chiefly in the form of quartz veins lying within or close to the southern contact of the diorite body. This contact is marked underground by strong faulting or shearing. The veins range from 1 to 4 feet and generally dip gently southward.

1. Dawson, G. M., Geol. Surv., Canada, Shuswap Sheet.

LABORATORY INVESTIGATION

General Statement

The ore samples were first examined megascopically. Polished sections of picked ore samples were examined microscopically to determine the minerals present and their paragenesis. In order to determine the destribution of silver, which was ~~the eluvial~~ believed to be related to the antimonial sulphides, a sample of what was thought to be nearly pure jamesonite was assayed. The various groups of minerals were separated by superpanning and the products assayed for gold and silver. Polished sections of superpanner products were also examined microscopically.

Megascopic Examination

The samples consisted of about 15 pounds of ore from the stock pile of the St. Paul mine. Eight representative samples were chosen.

Sulphides comprise about 80% of the minerals, the most abundant of these being jamesonite.

This steel grey mineral occurs as fibrous massive, the acicular crystals having a strong tendency to being parallel. The fibres readily cleave at right angles to their elongation so that the mineral crumbles easily. Under the hand lens quartz and pyrite crystals are found to occur in the jamesonite.

Jamesonite also occurs in quartz as patches or occupying small fractures in the quartz. It is more abundant where it occurs in conjunction with pyrite or arsenopyrite.

Arsenopyrite is the second most abundant sulphide. It is dense fine grained, the largest crystals being about 0.5 mm.

It occurs disseminated throughout the jamesonite but is much more abundant in the quartz. Wherever it is abundant needles of jamesonite are dispersed throughout it.

Pyrite occurs in minor quantities disseminated throughout the quartz and the arsenopyrite. It seems to be more plentiful however, at the borders between the quartz and the arsenopyrite. It is fine grained, some of it being typically cubic, the largest cubes being 1 mm.

Small amounts of a dull grey sulfide occurs, usually associated with the jamesonite. A thin blue irridescent film on the mineral suggests the presence of copper. It was tentatively identified as tetrahedrite.

No other metallic mineral could be observed in the hand specimens.

The gangue consists of white crystalline quartz moderately fractured and cut here and there by veinlets of jamesonite.

Microscopic Examination

Eight polished sections were made from the specimens and studied. The minerals present were identified using etch reactions and microchemical methods.

The gangue minerals, quartz and calcite, were easily identified as well as the metallic minerals arsenopyrite, pyrite, jamesonite, tetrahedrite and chalcopyrite. Sphalerite and pyrrhotite presented some difficulty however, being present in such small amounts.

Jamesonite was a special problem as this mineral appeared to be intimately associated with another mineral. The writer at one stage believed this to be due to the orientation of the crystal grains of jamesonite resulting in slight color and hardness variation from grain to grain. As a result of a chemical analyses it is now thought the jamesonite is in reality two minerals. (Ref. Fig. 1 & 2, See Page 19).

However since this mineral resembling jamesonite has not been positively identified, it will not be referred to seperately in this report but will be understood to be included with "jamesonite."

The minerals identified therefore, in order of decreasing abundance, are:

Gangue: ----------	Quartz
	Calcite
Metallics: --------	Jamesonite
	Arsenopyrite
	Tetrahedrite
	Pyrite
	Chalcopyrite
	Sphalerite
	Pyrrhotite

Polished Sections of the Ore

Section No. 1

Metallics occupy 85% of the section.

Minerals present in order of decreasing abundance:

Gangue: ------- Quartz

Metallics: ----- Arsenopyrite
Jamesonite
Pyrite

Texture:- Nearly all the mineral crystals are anhedral.

Arsenopyrite forms the groundmass but is highly fractured, the fractures filled mostly with quartz. Subhedral quartz crystals are scattered throughout the section and often include small triangular arsenopyrite crystals.

The jamesonite occurs as long narrow crystals or large irregular patches and in places is sufficiently abundant to form the groundmass. Scattered throughout it are arsenopyrite crystal remnants which are obviously being replaced by the guest mineral, jamesonite. A few of the jamesonite crystals exhibit the characteristic cleavage at right angles to the elongation of the crystals. (Ref. Fig. 3)

A few small rounded crystals of pyrite occur as islands in the jamesonite.

Section 2A

Metallics occupy 30% of the slide.

Minerals present in order of decreasing abundance:

Gangue:	---------	Quartz
		Calcite
Metallics:	-------	Arsenopyrite
		Jamesonite
		Pyrite

Texture: The quartz and calcite occur in about equal amounts and are intimately associated. Small anhedral crystals of arsenopyrite and pyrite and disseminated throughout the gangue in minor amounts. A band of pure quartz lying in the calcite-quartz gangue is liberally sprinkled with tiny arsenopyrite crystals.

Most of the metallics occupy one side of the section. Arsenopyrite forms the main groundmass. It is fractured and partly replaced by blebs and stringers of jamesonite. The quartz occuring in the arsenopyrite is free from calcite.

Section 2B

Metallics occupy nearly all of the section.

Minerals present in order of decreasing abundance:

Gangue:	---------	Calcite
		Quartz
Metallics:	--------	Jamesonite
		Arsenopyrite

(Conti.) Metallics	--------	Pyrite
		Chalcopyrite

Texture: A small calcite vein cuts across one corner of the section. In it are found small patches of jamesonite. (Ref. Fig. 4)

The jamesonite forms the groundmass and the arsenopyrite and pyrite form numerous small closely spaced islands in the antimonial sulfide. Quartz is present in minor quantities and one small bleb of chalcopyrite occurs in the jamesonite.

Section 3A

Metallics occupy about half of the section.

Minerals present in order of decreasing abundance:

Gangue:	-------	Quartz
		Calcite
Metallics:	------	Tetrahedrite
		Arsenopyrite
		Pyrite
		Chalcopyrite
		Sphalerite

Texture: Quartz makes up nearly all of the gangue but a few calcite veinlets are present both in the quartz and in the tetrahedrite. About a third of the slide is solid quartz except for a few tiny arsenopyrite crystals in it. Elsewhere the host minerals quartz, arsenopyrite and pyrite form islands in the tetrahedrite.

The calcite veinlets contain small blebs of chalcopyrite in them and often terminate into a thin chalcopyrite stringer in the tetrahedrite. The copper pyrites also occur as blebs in the tetrahedrite and usually at the contacts between the grey copper and some other mineral. Small patches of sphalerite in the tetrahedrite. There is an intimate relationship between the tetrahedrite, sphalerite and chalcopyrite. (Ref.Fig.5)

Section 3B

Metallics occupy 50% of the section.

Minerals present in order of decreasing abundance:

Gangue:	--------	Quartz
		Calcite
Metallics:	------	Tetrahedrite
		Jamesonite
		Arsenopyrite
		Chalcopyrite
		Pyrite
		Sphalerite

Texture: Calcite veins cut through the other minerals. In places a curious spotty effect caused by tiny blebs of jamesonite in calcite was observed. Arsenopyrite and rare crystals of pyrite are dispersed in the quartz, grey copper and jamesonite. Chalcopyrite stringers, usually occupying tiny fractures in the tetrahedrite are fairly abundant. A few very small pieces of sphalerite were noted. The jamesonite sometimes tends to have a lamellary curved effect ressembling curved plates.

Section 4

Metallics occupy 80% of the section.

Minerals present in order of decreasing abundance:

Gangue:	-------	Quartz
		Calcite
Metallics:	------	Jamesonite.

Texture: The relationships of the minerals present is similar to that of the previous sections. The pyrite crystals are rarely found in the jamesonite being usually present in the quartz or in close association with the arsenopyrite.

The arsenopyrite crystals in the jamesonite always have ragged edges.

Section 5

Metallics occupy 55% of the section.

Minerals present in order of decreasing abundance:

Gangue:	-------	Quartz
		Calcite
Metallics:	------	Arsenopyrite
		Jamesonite
		Pyrite

Texture: Quartz which forms the groundmass of this section is liberally sprinkled with fairly large arsenopyrite and pyrite crystals and is cut by a poorly defined jamesonite vein. Part of the section is intensely fractured arsenopyrite containing blebs and veinlets of jamesonite and quartz. In some instances small quartz veinlets cut through both the arsenopyrite and jamesonite. (Ref. Fig. 6 and 7)

Section 6

Metallics occupy nearly all the section.

Minerals present in order of decreasing abundance:

Gangue:	------	Quartz
Metallics	------	Jamesonite
		Arsenopyrite
		Pyrrhotite

Texture: Jamesonite comprises about 90% of the section. Scattered throughout it are small rounded crystals of quartz and jamesonite. A few tiny crystals of pyrrhotite are also present.

The two mineral effect given by jamesonite is clearly evident in this section. (Ref. Fig. 1)

Small irregular areas of grey appear in the jamesonite but these disappear after polishing anew and new areas appear. They are probably due to quartz crystals just underneath the jamesonite surface.

PARAGENESIS

The genetic history of the minerals present in general was fairly easy to work out. However, it has not been always possible to determine the amount of overlapping which occurs between some of the minerals.

Pyrrhotite was found only as small blebs in the jamesonite and is therefore earlier than jamesonite. The scarcity of pyrrhotite suggests however, that it was either:

(a) introduced very early and has been almost completely replaced by later minerals, or

(b) was pre-jamesonite but present in only very small quantity.

The evidence seems to support (b), although a combination of (a) and (b) is possible. No pyrrhotite was found in the pyrite or arsenopyrite. It is quite possible that it was deposited contemporaneously with these two minerals, occupying fissures or fractures and later solutions, following these same fractures replaced the pyrrhotite first.

Arsenopyrite and pyrite were the first minerals to be emplaced in this mineral deposit. The close association between the two indicates that they are at least in part simultaneous. In some cases however, pyrite crystals are cut through by the arsenopyrite so that some of the arsenopyrite is later than the pyrite.

The pyrite and arsenopyrite were apparently intensely fractured after crystallization had been complete, followed by the introduction of siliceous bearing solutions so that the quartz filled fractures form a reticulated network of veinlets throughout the arsenopyrite. Typical triangular arsenopyrite crystals are often found in the quartz, as well as rare large crystals of pyrite. It would appear that this was a case in which the gangue mineral replaced the sulphides. This may have been so to a certain extent but from the contacts between quartz and the sulphides one gets the impression that the sulphide fragments and crystals together with the siliceous solutions formed a sort of "mush" and that this mush forced its way into larger fractures, thus forming the sulphide bearing quartz veins.

The close association of calcite with quartz in one slide indicates that a minor amount of calcite was formed at this stage.

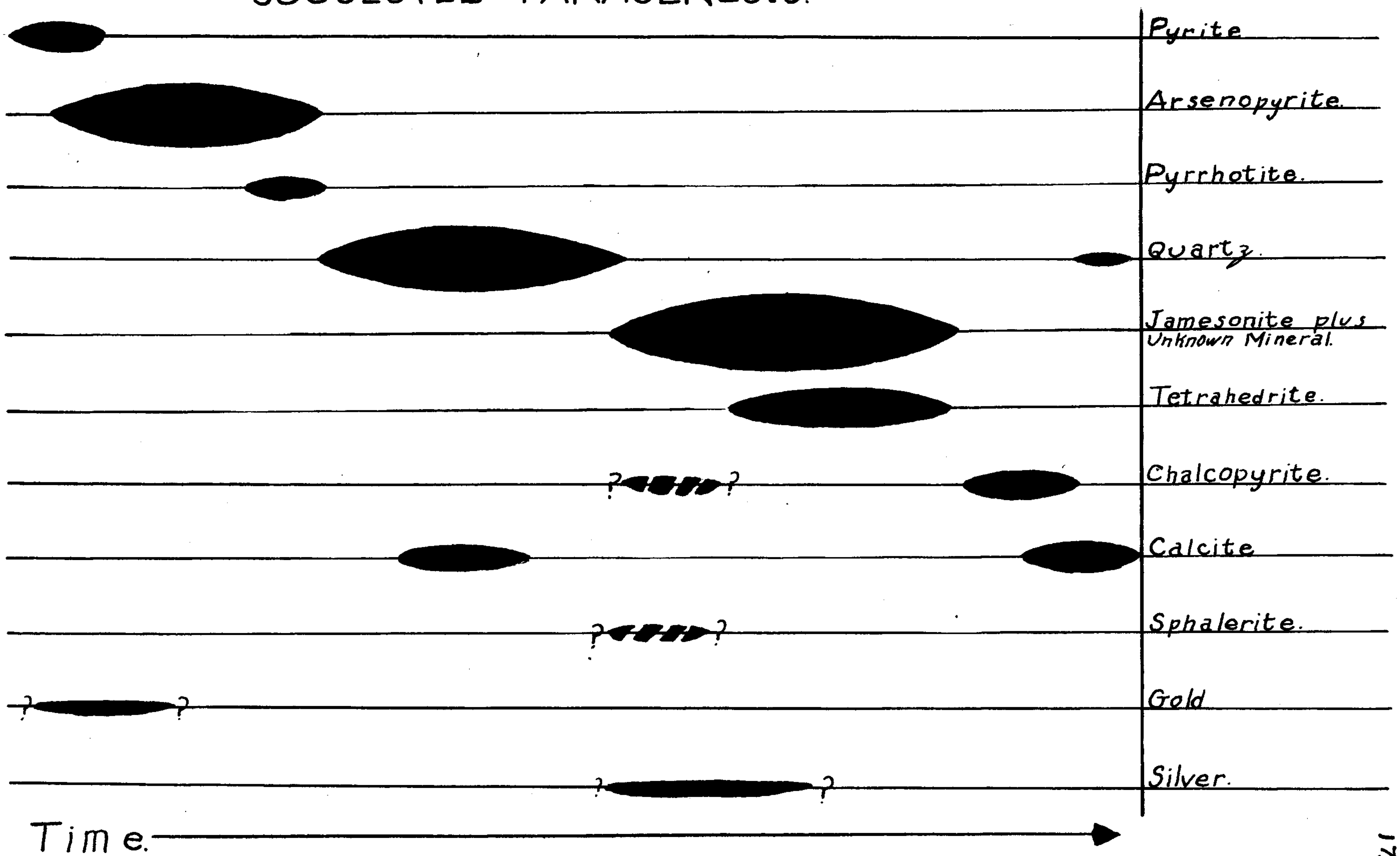
The minor amount of tetrahedrite present is simultaneous with the jamesonite, both being later than the quartz. The contacts between these two minerals is a sinuous line and they often form embayments of one mineral into the other. Blebs of tetrahedrite are also found in the jamesonite and vice versa. Islands of the host minerals are found in them. Where jamesonite has not completely replaced the host minerals it is particularly abundant at the contacts between the quartz and arsenopyrite.

A minor amount of fracturing followed this later period of replacement permitting the introduction of small quantities of the later hydrothermal solutions. Calcite and quartz filled the fractures. Several calcite veinlets end with a chalcopyrite stringer, and chalcopyrite crystals are sometimes found in the thicker portions of the veinlets so that apparently chalcopyrite and possibly sphalerite belong to this period.

Some chalcopyrite and perhaps all of the sphalerite no doubt were simultaneous with the jamesonite.

In this discussion the two minerals spoken of as jamesonite only, as already explained, have the same age relationships.

SUGGESTED PARAGENESIS.



PLANNING AND ASSAYING

In order to determine the occurrence of gold in the ore some of the ore samples were crushed,screened and super-panned in an attempt to seperate the arsenopyrite from the antimonial sulfides. The arsenopyrite tip thus obtained was sent to the assayer but at the time of writing this report of the assay results has not yet been received.

A sample of what was thought to be pure jamesonite was also sent away for analysis. The purpose of this was to confirm the mineral jamesonite and determine whether or not silver was associated with it.

The results are discussed in the following pages.

JAMESONITE

A polished section of the pure fibrous mineral thought to be all jamesonite showed the probability of two very similar minerals being present besides remnants of arsenopyrite crystals. However, because of their close physical properties this "two mineral effect" was thought to be due to different grain orientation.

For simplification we will call one mineral J and the other Z.

Careful etch tests gave the following results:

"J" - HNO_3 = Slight effervescense, tarnishes iridescent and sometimes blackens.

- HCl = Fumes tarnish all around drop mineral under drop negative.
- KCN = Neg.
- $FeCl_3$ = Neg.
- KOH = Slowly stains iridescent.
- $HgCl_2$ = Neg.

"Z" - HNO_3 = Slight effervescence and blackens.

- HCl = Fumes tarnish slightly all around drop. Mineral under drop neg.
- KCN = Neg.
- $FeCl_3$ = Neg.
- KOH = Stains iridescent. Action slower than with "J".

"Z" - $HgCl_2$ - Neg.

"Z" was found to be slightly harder than "J".

Under polarized light both minerals seemed to give the same polarization colors.

Specific gravity tests carried on three ore samples gave the following results: 1. - 5.23

2. - 5.59

3. - 5.59

(SPecific gravity tests by Dr. H. V. Warren gave a result of 5.58 - Theoretical S.G. of jamesonite is 5.63).

It is not surprising therefore that only one mineral, namely jamesonite, was thought to be present. The assay results however did not support this viewpoint. Dr. Warren and D.D. Campbell, who is also working on ore from this property, had samples analysed too and their results are given below, along with the theoretical composition of jamesonite, for comparison.

		0. Jamesonite Theoretical	1. Dr. Warren	2. D.D.Campbell	3. L.O.Gouin
Pb.	-	40.16	38.90	38.74	29.61
Sb.	-	35.39	34.46	33.32	30.57
S.	-	21.74	21.50	21.97	21.66
Fe.	-	2.71	3.42	3.74	10.77
Ag.	-	-	0.30	.25	.11
Cu.	-	-	0.15	.47	.04
As.	-	-	0.38	.39	6.23
In.	-	-	0.88	1.10	1.00
		100.00	99.99	99.98	99.99

3.55 5.59

The Pb : Sb ratio in (1) and (2) is almost exactly the same as in (0). Furthermore if we assume the Arsenic as all in Arsenopyrite and the Copper as all in Tetrahechite (both minerals are known to occur in this ore) then enough iron and sulfur is removed to make the Pb : Sb : S : Fe ratio in (1) and (2) nearly the same as in (0). This therefore seems to confirm the presence of jamesonite in the ore.

Sample (3) is not so readily explained. There is an excess of Fe and As, and Pb and Sb are present in nearly equal amounts. If we assumed the presence of Berthierite ($FeSb_2S_4$) or Gudmundite (FesBS) we might rectify the Pb :Sb : Fe ratio, but arsenic would remain unexplained and too much sulphur would be removed.

On the basis of etch reactions, three minerals closely ressemble jamesonite; they are, plagionite, semseyite and zinkenite.

Their theoretical compositions are given below:

	Plagionite $5PbS.4Sb_2S_3$	Semseyite $9PbS.4Sb_2S_3$	Zinkenite $PbS.Sb_2S_3$
Pb. -	40.55	53.10	32.60
Sb. -	38.12	27.73	44.70
S. -	21.33	19.17	22.70
	100.00	100.00	100.00

Plagionite and semseyite have a higher lead to antimony ratio and hence are not helpful. Zinkenite however has a higher per cent of antimony than lead. If it is assumed that 9% of the lead in (3) occurs in zinkenite and the rest as jamesonite, and that the arsenic occurs all in arsenopyrite, the following results are obtained.

		Jamesonite	Zinkenite	Arsenopyrite	
Pb	-	20.61	9.	-	= 29.61
Sb	-	18.25	12.35	-	= 30.60
S	-	11.20	6.27	2.66	= 20.13
Fe	-	1.39	-	4.65	= 6.04
As	-	-	-	6.23	= 6.23
		51.45	27.62	13.54	92.61

Sulphur and iron are not completely taken care of and the writer is at a loss how to explain them. However zinkenite occurs in vein deposits formed at low to moderate temperatures associated with sulpho-salts, sphalerite, galena, pyrite, carbonates and quartz.[1] In physical and microchemical properties it closely ressembles jamesonite. Hence the possibility of its presence here cannot be ignored.

1. The System of Mineralogy, James D. Dana and Edward S. Dana, Seventh Edition, P.477.

CONCLUSIONS

The mineral assemblage in this ore deposit clearly indicate that it is of hypogene origin. The minerals present are also, in general, characteristic of mesothermal deposit. The hydrothermal solutions were probably derived from the diorite body mentioned at the beginning, fissures and fractures permitting them to ascend and form quartz veins as well as partly replace the wall rock.

The absence of galena, the lack of much sphalerite and chalcopyrite and the presence of some pyrrhotite leads to the belief that mineralization occured under conditions represented by the lower part of the mesothermal zone.

The gold present, which is apparently too fine-grained to be seen even microscopically, is thought to be associated with the arsenopyrite and pyrite. The writer believes that it is of the Hedley variety[1], that is, gold in native form that is disseminated in extremely small grains without regard to grain size, fractures or grain boundaries.

The silver on the other hand seems to be definitely tied up with the jamesonite. The analyses of sample (1) and (2) which are nearly pure jamesonite show a much higher silver content than sample (3) which is not all jamesonite. Hence whenever the jamesonite has extensively replaced the pyrite and arsenopyrite the silver-gold ratio of the ore might be

1. H.V.Warren and J.M.Cummings: Textural Relations in Gold Ores of British Columbia, AIME., Technical Publication No. 777, 1937

expected to increase.

It is not possible to predict any changes in gold values with depth. It is not known how much of the deposit has been already removed by erosion. However such minerals as arsenopyrite and pyrite have an extensive vertical range and might be expected to carry their values to considerable depth.

Since no combination of the minerals known to occur in this deposit can satisfactorily explain analyses No. 3 it is apparent that a heretofore unsuspected mineral is present.

Within the limits of present laboratory investigations this mineral has properties comparable with jamesonite as follows. In polished sections it is slightly darker and harder than jamesonite. The etch reactions are practically identical except that with nitric acid this mineral tends to blacken more readily. In all probability it has a lower specific gravity (5.23) than jamesonite.

The mineral is tentatively identified as closely resembling zinkenite but further investigation will be necessary before the mineral is positively identified.

PHOTOMICROGRAPHS

Q	-	Quartz
Jam	-	Jamesonite
Asp	-	Arsenopyrite
Sp	-	Sphalerite
Ch	-	Chalcopyrite
Tetr	-	Tetrahedrite
Cal	-	Calcite

FIGURE 1

Plate No. 5

Mag. X165

Note dark patch in middle of photograph and slight difference in shades emphasized by broken pencil line.

FIGURE 2

Plate No. 6

Mag. X165

Same as Fig. 1 but with crossed nicols.
Broken pencil line is now grain boundary.
Note remnant arsenopyrite crystals.

Figure 3

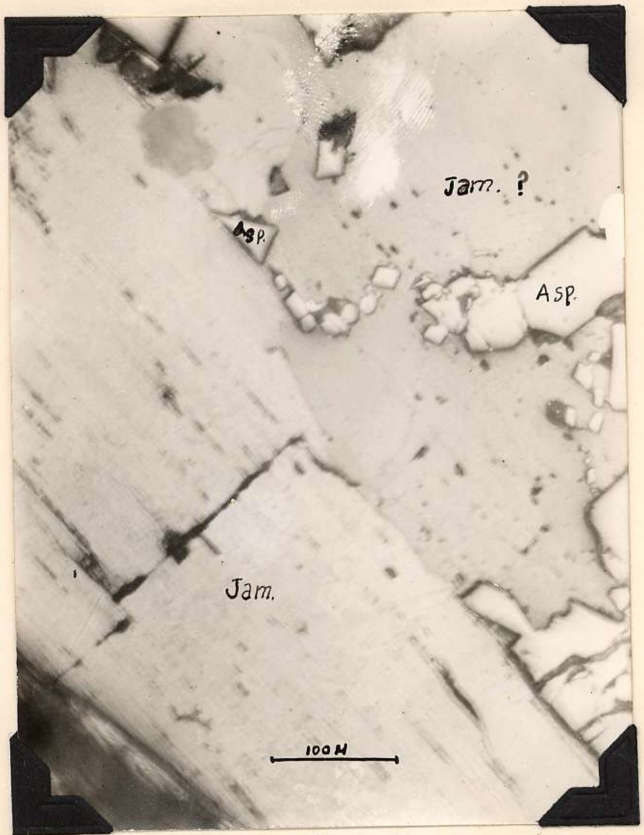


Plate No. 2

Mag.X165

Cleavage at right angles to elongation of crystal grain in jamesonite.

FIGURE 4

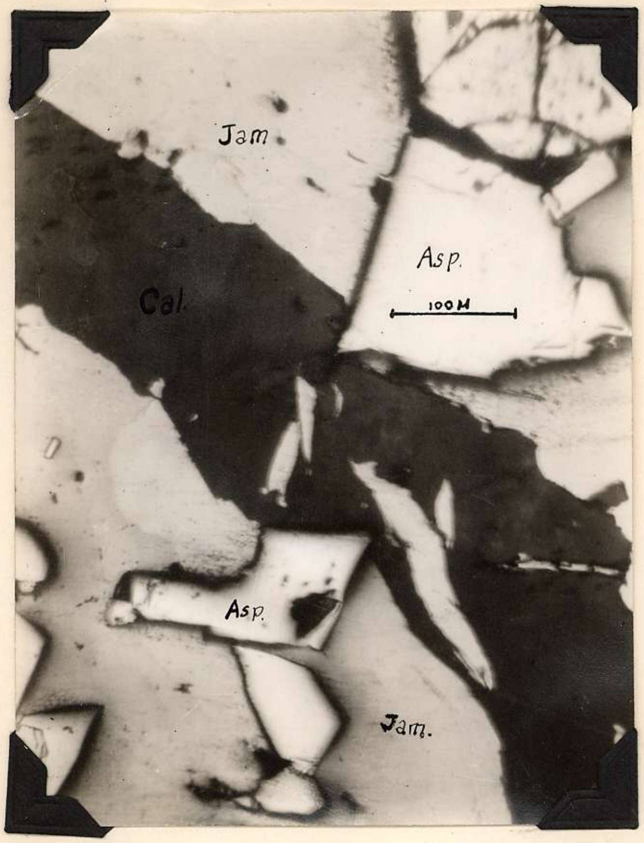


Plate No. 7

Mag. X165

Calcite vein cutting through jamesonite. Note projection of arsenopyrite crystals into vein and irregular jamesonite walls. Calcite introduced perhaps under oxidizing conditions and jamesonite partly replaced by gangue.

FIGURE 5

Plate No. 1

Mag. X75

Probable contemporaneous deposition of sphalerite and tetrahedrite. Note rough matching of sphalerite walls where chalcopyrite veinlet cuts through it.

FIGURE 6

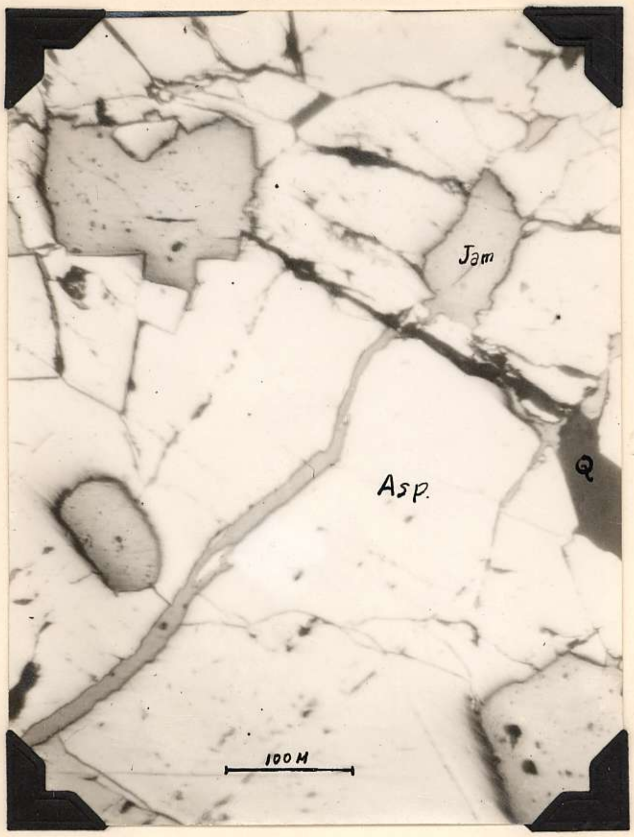


Plate No. 3

Mag. X165

Showing three age relationship.
Note arsenopyrite fragment in jamesonite veinlet.

FIGURE 7

Plate No. 4

Mag. X450

Part of Fig. 6 greatly magnified showing jamesonite vein cutting arsenopyrite ~~and~~ which is in turn cut by a quartz veinlet. This represents the second age of quartz.

PHOTOMICROGRAPHIC DATA.

Plate No	Mike No	Fig. in Report	Objective	Occular	Mag.	Filter	Illum.	Plate	Exposure in Seconds	Stage		Section No	Remarks.
										H	V		
1	Leitz No 337061	5	1.215 mm	6 X B	75	Blue	18 W	W-M	105	—	—	3	Exposure Good
2	Leitz Pan-Phot	3	3 B P	8 X	165	Blue	Arc	W-M	45	6.9	10.8	1	Exposure Good
3	Leitz Pan-phot	6	3 B P	8 X	165	Blue	Arc	W-M	43	1.5	6.1	5	Exposure Excellent
4	Leitz Pan-phot	7	6 A	8 X	450	Blue	Arc	W-M	43	1.5	6.1	5	Overexposed
5	Leitz Pan-phot	1	3 B P	8 X	165	Blue	Arc	W-M	45	15.4	10.4	6	High Relief on Section
6	Leitz Pan-phot	2	3 B P	8 X	165	None	Crossed Nicols Arc	W-M	1200	15.4	10.4	6	High Relief on Section Exposure Good
7	Leitz Pan Phot.	4	3 B P	8 X	165	Blue	Arc	W-M	43	15.0	9.8	2 B	High Relief on Section Exposure Good.

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Addenda

Silver - Gold Assays. (see P. 18)

	Gold $/ton	Silver $/ton	Arsenic %	Antimony %
Qtz Tails	0.275	7.50	11.24	1.90
+48	0.64	44.00	30.90	11.04
+65	0.70	33.00	33.04	7.04
+100	0.65	34.25	33.81	14.29
+150	0.83	32.8	32.28	13.93
+200	1.05	28.15	35.49	13.93

From the above we see that in the quartz tailings where the As and Sb are low the Au and Ag content are also low. The gold is therefore not in the quartz.