7-8

600412

THE MINERALOGRAPHY OF THE RUTH-HOPE AND SILVERSMITH MINES OF THE SANDON DISTRICT, BRITISH COLUMBIA

K. E. NORTHCOTE

April 15 1953.

CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

THE MINERALOGRAPHY OF THE RUTH-HOPE AND SILVERSMITH MINES OF THE SANDON DISTRICT, BRITISH COLUMBIA

I. Introduction

The Ruth-Hope and Silversmith mines lie immediately to the south of the town of Sandon which is situated in the Selkirk mountains six miles east of Slocan Lake and nine miles by road from New Denver. The properties consist of the Slocan Star, Rabbit Paw, Silversmith, Ruth, Hope, Stewart and Ruth #2 ore zones. The area is well served by mining roads, however, some are in poor repair and are passable only with difficulty.

This report will deal only with the ore zones which have had representative samples taken from them, namely; the Silversmith, Slocan Star, Ruth and Hope ore zones. Figure 1 shows the distribution of the specimens. Polished sections were made only from specimens which showed the greater mineral assemblage or some extraordinary structural characteristic. The value of this report is therefore very limited but will demonstrate the relationships between the minerals.

Acknowledgments

The writer is very grateful for the assistance and suggestions given by Dr. R.M. Thompson, both during the scheduled laboratory periods and at any other time advice was needed. The assistance and suggestions given by Mr. J.A. Donnan are also gratefully acknowledged; likewise the assistance of Mr. Earl Dodson, who also collected the specimens, is greatly appreciated.

II History and Production

The original claims of the Ruth-Hope and Silversmith mines were staked in 1892; since then the Slocan camp has experienced periods of booms and relative inactivity reflecting the price of lead and zinc, milling difficulties and periods between the location of new ore bodies. At the present time the properties are operated by Carnegie Mines Ltd., of Montreal.

The Ruth Lode

During the years 1896 to 1898 about 12,500 tons of ore were shipped which constituted most of the Ruth Lode. This ore contained 1,000,000 oz. silver and 10,800,000 lbs. of lead. Zinc production was not general until 1925. The Ruth levels have changed very little since 1905.

Hope Lode

The Hope Lode did not produce until 1906; from that time until 1911 most of the ore mined was of shipping grade. In the years

1928 to 1929 a yearly production of over 13,000 tons of ore was reached. Since then the property has been worked only from 1930 to 1940 and again in 1949 and 1950. Figures for production from the Hope lode are not available.

Silversmith and Slocan Star Lode

The Slocan Star ore shoot was located in 1891 and the first ore was produced in 1893. Ore production from 1894-1905 was valued at $2,675,430.00. The property was closed until 1911 and then operated until 1917 when financial difficulties again closed the property. The company was reorganized in 1918 when the Silversmith ore body was discovered. The Silversmith ore body was mined up to the year 1927 then mining was curtailed until 1936. The mine has been inactive since 1940. The Silversmith Slocan Star is credited with a production of 344,600 tons of ore and concentrates which includes 1,129 oz. gold, 7,393,000 oz. silver, 76,587,000 lbs. of lead and 16,390,000 lbs. of zinc. The Ruth, Hope, Stewart and Silversmith lodes ~~have~~ produced to the end of 1949 approximately 65,000 tons of ore containing in ore and concentrates, 240 oz. Au, 3,000,000 oz. silver, 27,650,000 lbs. of lead and 3,100,000 lbs. of zinc.

III General Geology

The Sandon area lies two miles north of the northern boundary of the Nelson batholith and is underlain by sediments of the Slocan series which are intruded by dykes and small stocks. The rock types include tuff, argillites, quartzites, limestones, and mixtures of these types. Silicification is widespread, affecting the limestones the most by converting them to a rock resembling quartzite. Silicification is not related to lodes but rather to the general process of intrusion. The sediments are in the form of one large recumbent fold containing smaller folds of various sizes and complexity. The major fold has little or no dip or plunge, strikes northwest and is concave to the southwest. Tangential and cross cutting faults are widespread throughout the area. The tangential faults are parallel in strike to the formation and commonly are bedded while the cross cutting faults cross the regional strike at large angles. All faults seem to be normal but show lateral as well as normal components of movement. The lodes seem to be controlled by the cross cutting faults, and are generally in zones of fracture rather than shear. The fracture zones represent places of decreased confining pressure. M.S. Hedley states that ore deposition is structural and that temperature and load pressure due to depth are of minor importance.

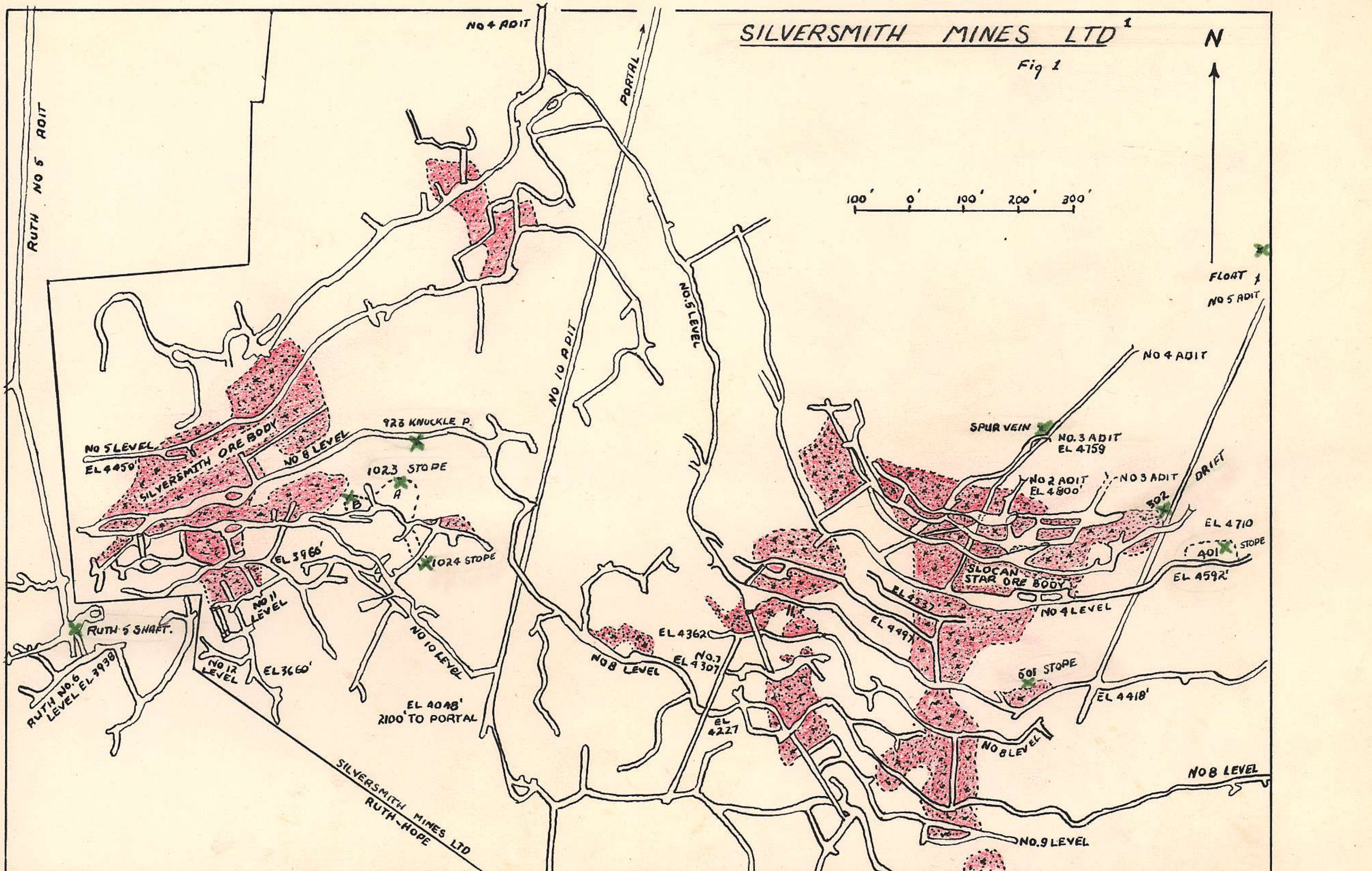
IV Geology of the Properties

The Ruth Lode consists of a very weak fissure with a few feet of displacement on the hanging wall which is down and to the east. The attitude is N75°E/V above #3 level and flattens to dip of 70°SE below that level. From east to west the lode is continuous for 700' and has a vertical range of 1400'. The lode is bounded on the west by a zone of interbed adjustment beyond which is the Stewart zone. On the east it is bounded by the Ruth-Silversmith fault. The explored part of the lode is in the axial region of a recumbent fold convex to the west. Mineralization seemed to favor the upper half of the recumbent fold where the down and eastward movement on the lode fissure was opposed to the westward dipping planes. Mineralization also favoured situations where the fractures crossed the beds at high angles. The quartz and quartz feldspar porphyry and dykes which intruded the thin bedded argillites and quartzite country rock seem to have had no effect on the mineralization. A general reversal in dip of bedding in the form of a second recumbent fold convex to the east, takes place a short distance below #5 level which may favor a second lower ore zone.

The Hope lode strikes east and dips 25-40° S. The steeper parts of the lode are usually more clearly defined. The Hope lode is believed to be the westerly continuation of the Silversmith lode beyond the Ruth-Silversmith fault. This being the case, then it is probable that there is an intervening block of potentially favourable ground. The Hope lode more closely resembles a production zone than a fissure as it has a width of 40 feet in some places. The lode has a maximum length of 550 feet and pitches to the east. Ore shoots are irregular, they pinch and swell and often terminate at their greatest width against a cross fissure. The thickness of the ore shoots varies from a fraction of an inch to $2\frac{1}{2}$ feet, with an average length of 100 feet.

The Silversmith lode strikes N75°E and has an average dip of 45° S. It is probably sill-like in cross section due to the influence of folded structures. The lode is a major cross cutting zone of fracturing and shearing up to 50 feet or more wide. The lode is interrupted by several southwest dipping faults which offset the lode by about 1,000 feet to the right. Regionally the lode is in the crest zone of the major Slocan fold but locally it is in a zone of recumbent folding which involves three or more main reversals in dip. The Silversmith ore zone consists of two sub-parallel ore shoots in branches steeper than the main lode fissure; both are zones of slippage and shearing. The Silversmith ore zone is continuous into Ruth-Hope ground where it is terminated by the Ruth-Silversmith fault zone. No reason is known for its eastern termination.

The Slocan Star lode meets the footwall split of the Silversmith lode. It is over 750 feet long and has a vertical range of 800' on a 45° slope. Its width is not known. The lode is widest at the surface and funnels down to the #5 level. The lode structure is complicated by folding, faulting, slipping and shearing. The country rock consists of sediments from the Slocan series which are cut by numerous dykes and one small stock. The lode has a curving strike in a westerly direction and is widest in the more marked bends of the strike. These parts have formed channels for abundant mineralization and ore deposition. The lode also widens where its attitude conforms more closely with that of the strata and/is more sharply defined and narrower where it cuts the strata at a high angle.



1 Hedley M.S *Geology and Ore Deposits of the Slocan Mining Camp* Fig 13.

× Specimen taken.

V Method of Preparation of Polished Sections

The suite consists of 24 specimens. Polished sections were made from eight specimens showing greater mineral assemblage or some outstanding structural feature. In some cases more than one specimen was made from the same hand specimen. The specimen was selected, the section of the specimen to be mounted was cut away with the diamond saw and then rough ground with #240 carborundum. The section was then mounted in paraffin in a rectangular brass frame and again rough ground. The section was then successively ground with #90 and #50 abrasive and polished with #27 lakeside polish and soap.

VI Macromineralogy

Sections 1 and 2 were made from the same specimen taken from #1024 stope of the Silversmith mine. The specimen measures 4x4x2½, all of its surfaces are fresh. The metallic minerals appear to be medium "grained" and equigranular. The country rock or ground mass was probably an argillite which has been partly carbonized by stress and shearing. The gangue consists of an ankeritic carbonate and quartz. The metallic minerals are chiefly pyrite and galena.

Section 3 was made from a specimen exhibiting a slickensides face and was taken from #1024 stope. The specimen measures approximately 5x2½x2½ inches. One side of the specimen shows the concave slickenside face which was probably taken from a section of mullion. The specimen shows the gradation from steel galena at the fault face to a rather medium grained gneissic crystalline galena at the other end of the specimen. The other metallic minerals in the hand specimen include pyrite and some sphalerite. Gangue minerals are relatively scarce in this specimen, however, some quartz and a very little ankeritic siderite are present.

Sections 4 and 5 were taken from another specimen taken from #1024 stope. The specimen measures 2½x2½x1½ inches. One surface exhibits slickensides and is carbonized showing carbon and finely divided sulphides. The other surfaces are relatively fresh. The boundary between the impure quartzitic country rock and the metallic minerals is very irregular suggesting partial replacement. The metallic minerals are chiefly galena, pyrite, chalcopyrite, sphalerite and some tetrahedrite. The gangue mineral is chiefly quartz.

Sections 6 and 7 were made from the same specimen which was again taken from #1024 stope. The specimen is approximately 4x2½x2 inches in size and consists of medium grained and fine grained metallic sulphides in a quartz gangue. The metallic minerals present include galena, pyrite, chalcopyrite, tetrahedrite which is a dull grey color and finely crystalline and a ruby silver which gives a bright red streak.

Section 8 was made from a specimen taken from #1023 B stope of the Silversmith mine. The size of this specimen is approximately 4x3½x2½ inches. The country rock looks like a very dirty limestone but is rather hard, gives no reaction with acid and was found to be typical of the argillites of the district. The metallic minerals in this specimen are chiefly sphalerite and pyrite. Sphalerite makes up most of the specimen.

Section 9 was made from a hand specimen which was taken from the Ruth #5 level. The size of this specimen is approximately $5\frac{1}{2}x5\frac{1}{2}x2\frac{1}{2}$ inches. No really fresh surfaces appear on this specimen. Fault faces are present which are coated with carbon. A white coating which is probably hydrozincite covers part of the specimen and appears to have been deposited as a result of the evaporation of water which has trickled over it. Microchemical tests give a very definite zinc test for this mineral and under ultra violet light the mineral fluoresces blue. The metallic mineral present is chiefly galena, the major gangue mineral is quartz.

Section 10 was made from a specimen taken from the spur vein of the Slocan Star mine. The specimen measures approximately $4x4x2\frac{1}{2}$ inches. No fresh surfaces are present. The specimen is coated with limonite; smithsonite occurs in an open space in sphalerite. The metallic minerals present are chiefly sphalerite and chalcopyrite. The gangue mineral is chiefly quartz.

Section 11 was made from a specimen which shows a tight drag fold structure. The specimen was taken from the Ruth #5 level adjacent to a fault face. The specimen is approximately $3\frac{1}{2}x2\frac{1}{2}x2$ inches. One end of the specimen shows a complete fold structure which has a tendency to be thicker in its apex than on its limbs, indicating a slight amount of flow of less competent members. One face of the specimen is a fault face which shows a coating of limonite. The limbs of the fold are carbonized which was probably caused during the distortion of the impure country rock.

No polished sections were made from the remaining specimens of the suite, However, the specimens which show some interesting features will be discussed briefly.

A specimen taken from #302 drift of the Slocan Star ore body consists of angular fragments or brecciated sphalerite with comb structure quartz stringers which passes between the fragments. This is evidence of deposition of quartz later than sphalerite.

A specimen of gneissic galena was taken from 1023 stope A. which contains chalcopyrite, ankcritic gangue and fragments of country rock.

VII. Micro Mineralogy

Table of Minerals Present and Abundance

Section #	1	2	3	4	5	6	7	8	9	10	11
Sphalerite	E(+)	C	X(+)	C	E(-)	E	E	A	D	A	E
Chalcopyrite	X	E	-	X	-	X	X	E(-)	X	E(+)	X
Pyrite	C	D	-	D	X	E	X	X	E	X	C
Arsenopyrite	E	X	-	X	-	X	-	-	X	X	E
Tetrahedrite	-	X	X(+)	E	E	E	D	-	-	-	-
Galena	D	C	A	A	A	A	A	X	C	-	C
Pyrargyrite	-	-	-	-	X	-	X	-	-	-	-
Native Ag.	-	-	-	X	X	X	X	-	-	-	-
(Marcasite)	X	X	-	X	X	-	-	(X)	X	-	X

<u>Key</u>

(-)	not detected
X	5%
E	5%-10%
D	10%-25%
C	25%-50%
A	50%

Silversmith	Sections	1 to 7	1024 Stope
	Section	8	1025 B stope
Ruth	Section	9	Ruth 5 level
	Section	11	
Slocan Star	Section	10	Spur Vein

Gangue Minerals

Ankeritic Carbonate
Quartz
Carbon
Hydrozincite (#8 level, Ruth 5 level)
Smithsonite (Slocan Star spur)
Limonite

Table of Etch Reactions

	$HgCl_2$	KOH	KCN	$FeCl_3$	HNO_3	HCl	Aqua regia
Sphalerite	(-)	(-)	(-)	(-)	(+)$^{\pm}$	(+)*	(+)
Chalcopyrite	(-)	(-)	(-)	(-)	(+)*	(-)	(+)
Pyrite	(-)	(-)	(-)	(-)	(+)	(-)	(+)
Arsenopyrite	(-)	(-)	(-)	(-)	(+)	(-)	
Tetrahedrite	(-)	(-)	(+)*	(-)	(+)	(-)	(+)
Galena	(-)	(-)	(-)	(+)	(+)	(+)	
Pyrargyrite	(+)	(+)	(+)	(-)	(+)*	(+)	(+)
Native Silver	(+)	(-)	(+)	(+)	(+)	(+)*	
Marcasite	(-)	(-)	(-)	(±)	(+)	(-)	

(+)* etching does not always take place

Minerals Present in the Sections

Sphalerite ZnS.

Sphalerite generally takes a pitted but somewhat smooth polish and often shows cleavage. It is a blue grey color and has a hardness of E ($3\frac{1}{2}$). When scratched with a needle it gives a brownish yellow streak; under crossed nicols the powder appears creamy white. Possibly its most distinctive characteristic is a reddish yellow internal reflection. Sphalerite is isotropic and non pleochroic. Etch reactions are positive for HNO_3 which gives a tarnish or slight stain. Aqua regia gives effervescence and stains the mineral dark brown. $HgCl_2$, KOH, KCN, $FeCl_3$ and HCl give (-) results. The mineral is most closely associated with chalcopyrite galena and siderite gangue.

Where sphalerite is in contact with galena the boundaries are sometimes smooth but in most cases there are numerous apophyses of one mineral in the other. Galena, in many cases, occurs as stringers running through the sphalerite and in some cases is so highly developed that the sphalerite becomes rounded and takes on a granule texture as in section 4. The sphalerite is extremely variable in size ranging from 0.1mm up to the size of complete specimens composed almost entirely of sphalerite. The larger masses almost invariably show exsolution of chalcopyrite which forms a crystallographic texture along certain crystal faces or cleavage of sphalerite. In some cases this texture approaches a semigraphic texture but as a rule is too highly controlled by the sphalerite cleavage to allow a graphic texture to form.

Chalcopyrite $Cu_2s.\ Fe_2'S_3$

Chalcopyrite takes a very smooth polish, has a brass yellow color, hardness of D(3) and gives a black streak which distinguishes it from gold. The mineral is very weakly anisotropic, non-pleochroic and (Sometimes) is not twinned. Microchemistry gives a test for copper. Etch reactions give (+)-reactions for HNO_3 as a reddish colored stain. Aqua regia is (+) and gives a brown stain. HCl, KCN, $FeCl_3$, KOH and $HgCl_2$ give negative reactions. The chalcopyrite is in most cases a result of exsolution from sphalerite but it is not necessarily the case that all of the chalcopyrite is the result of exsolution. The size ranges from .03mm x 1.5mm stringers in chalcopyrite to blebs 1.5mm x 5mm. which are loosely associated with gangue.

Pyrite FeS_2

Pyrite may form enhedral to subhedral crystals or in some cases very large irregular masses. It does not appear to be closely related to any of the metallic minerals unless it could be considered associated with arsenopyrite. Pyrite takes a very pitted polish, it is a brass yellow color and has a hardness of F (6). HNO_3 and Aqua regia both give (+) reaction as a tarnish and slow effervescence. $HgCl_2$, KCN, KOH, $FeCl_3$ and HCl all give (-) results. The size ranges from very minute particles to very large masses, the average size is about .45mm x .25mm.

Arsenopyrite FeAsS

Arsenopyrite seems to have a tendency to partly rim the crystals of pyrite. It is very doubtful that the resulting texture could be called a reaction rim texture. Arsenopyrite is a silver white color and has a tendency to take a very pitted polish but on the whole is smoother than pyrite. The mineral is anisotropic from a grey to a yellow brown to bluish. Its most distinctive characteristic is perhaps its tendency to form rhomb shaped crystals. HNO_3 stains the mineral irridescent and sometimes effervesces slowly. HCl, $HgCl_2$, $FeCl_3$, KOH, KCN, $HgCl_2$, give negative results.

Tetrahedrite $5Cu_2S\ 2(Cu,Fe)S\ 2Sb_2\ S_3$

Tetrahedrite takes a smooth polish, has a brownish grey color and a hardness of D ($3\frac{1}{2}$). The mineral gives a black to reddish black streak and the bottom of the groove of a scratch sometimes appears reddish black. The mineral is non pleochroic, isotropic and gives no really apparent internal reflection. Aqua regia gives a positive etch reaction; HNO_3 sometimes tarnishes the mineral. $HgCl_2$, KOH, KCN, $FeCl_3$ and HCl give negative reactions. Tetrahedrite seems to develop several textures. It sometimes occurs in rounded blebs in galena giving a mutual boundary or caries texture. At several places in the sections tetrahedrite developed an atoll texture in galena. A cocade texture was frequently observed which was formed by tetrahedrite surrounding grains of sphalerite in a galena ground mass. At other places in the sections tetrahedrite is somewhat restricted in its form by the cleavage of galena which it possibly replaces to some extent, forming a semi-graphic to cuspate texture.

Galena PbS

Galena takes a smooth polish but has many triangular pits in its surface which are caused by cleavage. The mineral is white, has a hardness of B ($2\frac{1}{2}$) and gives a black streak although it is slightly sectile. Galena is non pleochroic, isotropic and has no internal reflection. $FeCl_3$ gives a (+) etch reaction producing irridescence, HNO_3 produces a black stain and $FeCl_3$ stains irridescent. $HgCl_2$, KOH, KCN, give negative reactions. HCl is (+) ~~which~~ and gives an irridescent tarnish. Galena forms large irregular masses which have a tendency to become cuspate. Inclusions of galena in tetrahedrite are generally rounded. The size of the galena masses is extremely variable ranging from $<.1$mm to entire specimens composed of galena.

Pyrargyrite $3Ag_2S.Sb_2S_3$

Pyrargyrite was first identified in section #5 from 1024 stope where it occurred as a small bleb inclosed by tetrahedrite. Larger amounts of pyargyrite occur in polished section #7 from 1024 stope in the form of stringers which average .4mm x .15mm wide. Pyrargyrite polishes very smoothly, has a definite blue grey color and a hardness of B+ (2½). It is anisotropic but the anisotropism colors are masked by its blood red to ruby red internal reflection colors, which are most noticeable in rougher areas. Pyrargyrite gives a red streak which appears blood red under crossed nicols. HNO_3 stains the mineral brown but does not give a definite etch. HCl tarnishes the mineral, KCN stains it black and leaves a pitted appearance. KOH stains irridescent and $HgCl_2$ leaves a brown stain. $FeCl_3$ gives a negative reaction. Pyrargyrite is closely associated with tetrahedrite in which it forms a semi crystallographic to cuspate texture. Microchemical tests give a very definite test for antimony which distinguishes it from proustite.

Native Silver Ag

Native Silver was first observed in section 5 from 1024 stope. It occurred as a very small bleb in pyrargyrite. Native silver was more abundant in section 6 from 1024 stope and very abundant with respect to pyrargyrite in section 7 which was made from the same hand specimen as section 6. Native silver was observed in both tetrahedrite and galena. In both cases it may occur as irregular blebs but the tendency is towards a crystallographic texture. Native silver veinlets in the tetrahedrite seem to prefer at least two directions. It is probably the result of replacement but may be partially by exsolution. In

also be the result of exsolution

galena, native silver seems to follow the cleavage traces of galena. This texture may have been caused by replacement of galena. Native silver takes a very smooth polish, has a brilliant white to creamy white color but tarnishes readily. The mineral has a hardness of B($2\frac{1}{2}$) is isotropic and shows no internal reflection. $HgCl_2$ stains the mineral brown, KCN tarnishes indistinctly grey to brown, $FeCl_3$ produces an irridescent stain and HNO_3 causes effervescence and leaves a white coating. KOH causes no etching of the mineral. The size varies from very minute blebs .25mm x .15mm to .08 x .05mm.

(Possible Marcasite) FeS_2

Marcasite has similar properties to pyrite but is anisotropic from yellowish brown to a bluish color. Pyrite in some cases is also slightly anisotropic. It is therefore probable that some of the mineral identified as marcasite is actually pyrite. Pyrite is sometimes anisotropic

Gangue Minerals

Hydrozincite 2 Zn CO_3 .3Zn $(OH)_2$

Hydrozincite occurs as an earthy encrustation which appears to have been deposited by evaporation from water which has trickled over the specimen. The mineral is white in color and gives a blue fluorescence under ultra violet light. Microchemical tests give a definite zinc test and negative results for other metallic elements. Hydrozincite occurs on the specimen from the Ruth #5 level and another specimen taken from Silversmith #8 level.

Smithsonite Zn CO_3

Smithsonite occurs as a very friable encrustation in a pocket in sphalerite on a specimen taken from the spur vein of the Slocan Star ore body. The mineral is in an olive green colored, powder-like form. Micro-chemical tests gave a definite test for zinc. A faint iron test was noticed, probably the result of limonite which covers much of the specimen. The mineral gave no apparent test for arsenic which distinguishes it from scorodite. (Hydrous Fe Arsenate).

Limonite

Limonite is formed on many of the hand specimens but will not be discussed. ~~in detail~~.

Graphite

Graphite is present in many of the specimens and is probably the result of pressure and shearing stresses on the impure country rock. In some cases the graphite is mixed with finely divided sulphides.

Ankeritic Carbonate

The carbonate present in the specimens sometimes effervesced with HCl. The carbonate was treated with a copper nitrate solution but gave negative results for calcite. The carbonate gave a positive test for iron and magnesium. Since the relative proportions of iron and magnesium ~~are~~ were not known the carbonate was classed as an ankcritic carbonate.

Quartz

Quartz is present in most of the specimens either in the massive form, in veinlets or veins showing comb structure. There is evidence for at least two periods of quartz deposition.

VIII Paragenesis

A hand specimen taken from (1023B) stope shows some quartz veinlets cutting the country rock but not later minerals. A layer of ankeritic carbonate gangue is then deposited on the country rock followed by sphalerite which perhaps partly replaces the ~~sideritic~~ ankeritic gangue. Stringers of pyrite and quartz then cut the country rock, the ankeritic gangue and the sphalerite which indicates deposition of pyrite and quartz later than sphalerite. Another hand specimen taken from 302 drift shows brecciated sphalerite with stringers of quartz about 1/2-3/4 of an inch wide showing comb structure which passes between the angular sphalerite fragments.

Plate 1 shows exsolution of chalcopyrite from sphalerite which produces a crystallographic texture. Other occurrences of chalcopyrite in galena appear to be restricted in form by the cleavage of galena. However no conclusive evidence was found which proved deposition of chalcopyrite later than galena.

Pyrite has had at least two possible major periods of deposition. In the hand specimens some of the pyrite is closely associated with the early gangue minerals and not with the later sulphides. The hand specimen taken from #1023B stope shows pyrite stringers deposited later than sphalerite.

Arseno pyrite seems to be more closely related to pyrite, which it partly rims, than any of the other sulphides. Deposition of early pyrite and arsenopyrite is considered to be contemporaneous as no conclusive evidence was found which proved pyrite to be older.

Galena stringers cut sphalerite and partly replace it. This process is carried on until the sphalerite assumes a granule texture as in Plate 2. Galena also cuts euhedral crystals of pyrite.

Tetrahedrite has a tendency to form cusps which appear to follow the cleavage traces of galena as in Plate 3. In another part of the same section two blebs of tetrahedrite occurred which were joined by an even sided straight stringer of tetrahedrite in galena suggesting deposition and partial replacement of galena by tetrahedrite.

Pyrargyrite traverses tetrahedrite in irregular veinlets. In some cases pyrargyrite stringers prefer certain directions but on the whole the veinlets and inclusions are rather irregular which suggests replacement of tetrahedrite by pyrargyrite. The relationship of pyrargyrite and tetrahedrite is shown in plate 4.

Native silver produces a somewhat crystallographic texture in tetrahedrite which is probably produced by replacement and perhaps partly by exsolution. The relationship of tetrahedrite and native silver is evident in plate 4. Plate 5 shows pyrargyrite being cut by a minute veinlet of native silver, as seen by using #8 objective, 1/10 A ocular lens and oil immersion. Native silver also has the tendency to form cusps in galena and also forms a crystallographic texture in galena as in Plate 6. When the polished section was reground and repolished the same structure was evident. However, the structure contained tetrahedrite as well as native silver. On the basis of this evidence it is thought that the sequence of deposition is; galena, tetrahedrite, pyrargyrite and then native silver.

No evidence for time of deposition of marcasite was apparent. However, marcasite is generally formed under near surface conditions by deposition from acidic solutions and in most cases is supergene.

The Type of Deposit

The ore bodies are chiefly mesothermal type deposits. The temperature of the ore body must have exceeded 350°C to 400°C which is the temperature for unmixing of chalcopyrite from sphalerite. No pyrrhotite was observed in the polished sections which, if in quantity, would indicate a high temperature type of deposit. The native silver appears to be homogeneous indicating deposition at temperatures of

200^oC or more, which suggests an upper epithermal to lower mesothermal type of deposit. Pyrargyrite is a low temperature mineral which is deposited at temperatures below 250 C. The ore deposit must range from an epithermal to a mesothermal type.

IX Conclusions

It was expected that polybasite would be found accompanying the other silver minerals. The fact that it was not observed in the polished sections does not indicate that it is not present in the ore. More polished sections of the specimens richer in silver should be made to check this possibility.

The occurrence of the silver minerals appears to be very spotty.* In the case of section #6 and section #7 which were both made from the same specimen taken from 1024 stope, the amount of silver present in section #7 is much greater than that in #6. The silver minerals are generally closely associated with tetrahedrite in galena, However, some sections exhibit an abundance of silver minerals but show no free silver minerals.*

In order to find some relationship between ore bodies, it would be necessary to follow a very systematic plan of specimen sampling, the study of a large number of polished sections and a meticulous study of the structural geology in the mines.

Galena is capable of carrying 0.1% silver minerals in solid solution. Anything over this amount would unmix and appear as blebs of tetrahedrite, native silver or pyrargyrite. Textures caused by exsolution can be duplicated by replacement textures, It would therefore be necessary to assay the galena for silver to determine whether the native silver is the result of replacement or exsolution. If the native silver is the result of exsolution the silver values of the ore would be higher than they appear to be from ~~the~~ examination of the polished sections.

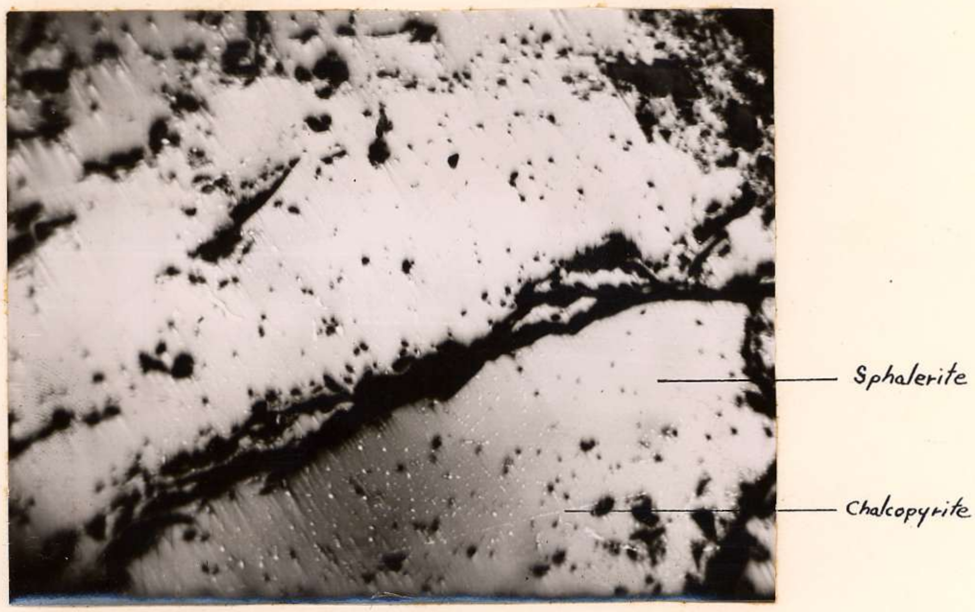


Plate 1 Section #8 1023B stope

Plate 1 exhibits a crystallographic texture caused by exsolution of chalcopyrite from sphalerite. Chalcopyrite appears as continuous lines of blebs parallel to the cleavage or crystal faces of sphalerite. Exsolution of chalcopyrite from sphalerite takes place at temperatures from 350°C to 400°C.

Plate 2 Section #4 1024 stope

Plate 2 shows a progressive semi-granuole texture caused by veinlets of galena cutting and partly replacing sphalerite. The outer margin of the original sphalerite mass is dissected and shows well rounded globules. In the centre of the sphalerite mass the veinlets of galena are much more irregular, smaller and fewer in number.

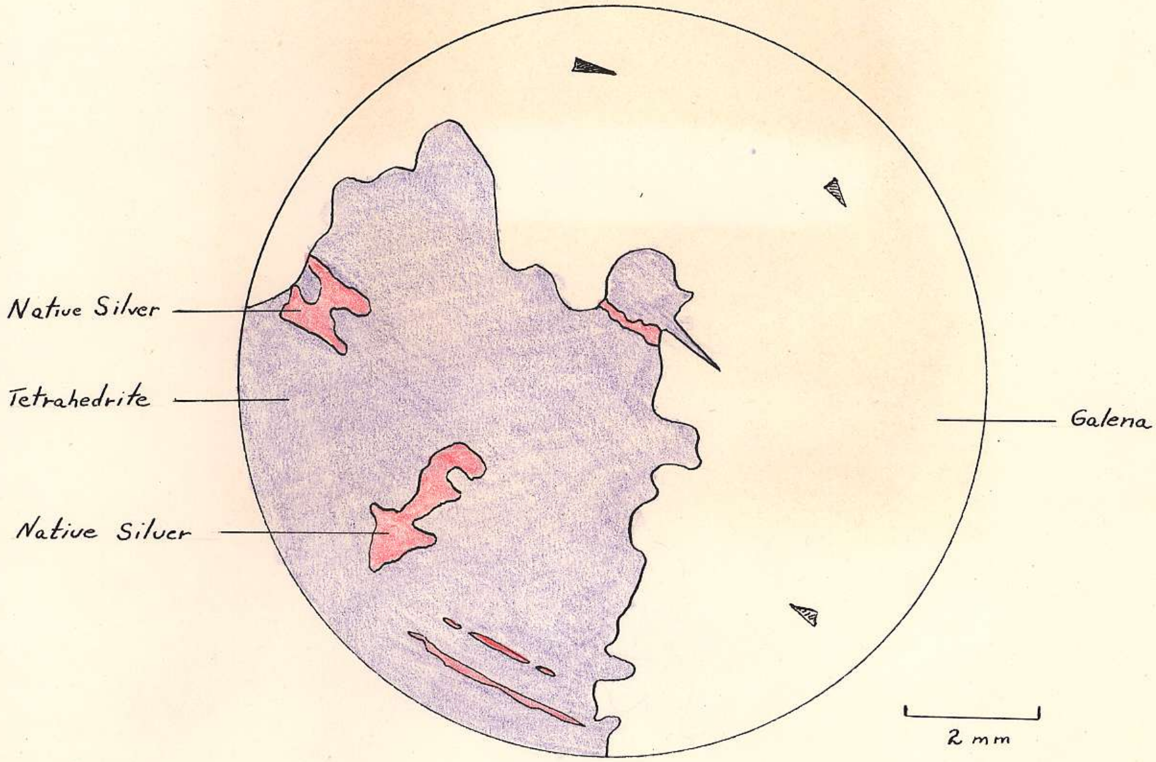


Plate 3 Section 7 1024 stope

A cusp of tetrahedrite projects into the galena and is probably bounded by cleavage faces of galena. Native silver forms veinlets which follow preferred directions in tetrahedrite, probably parallel to crystal faces. This feature could be caused either by exsolution or by replacement of tetrahedrite by native silver.

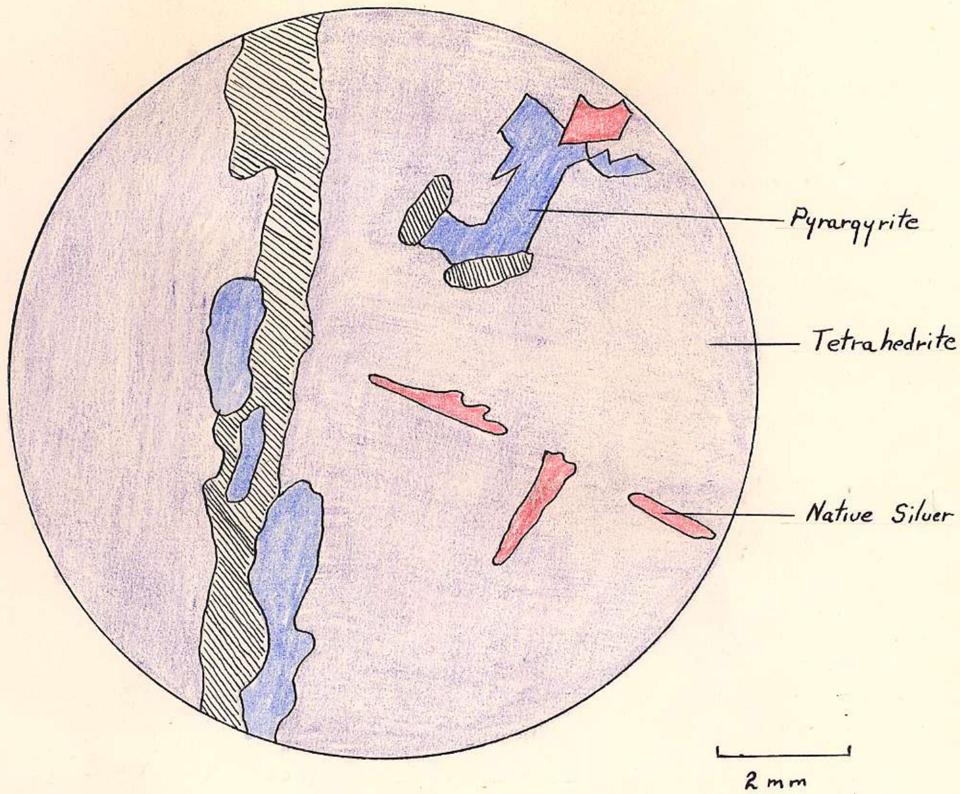
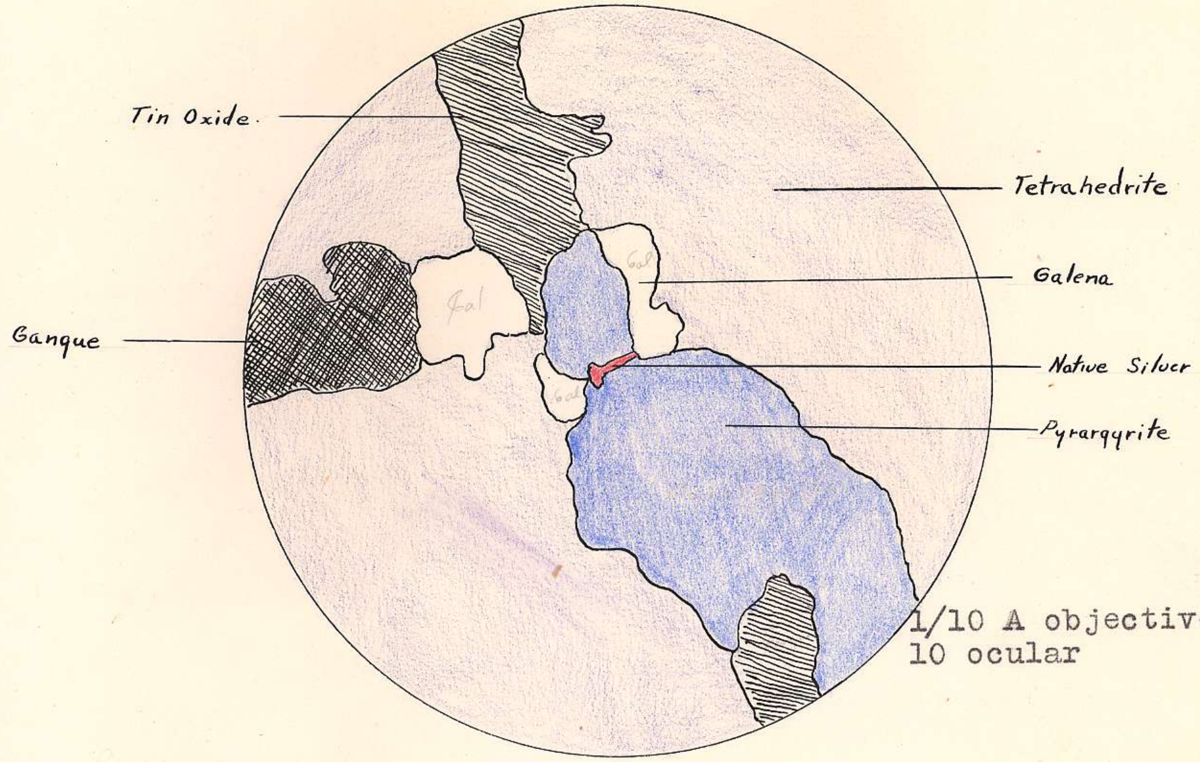


Plate 4 Section 7 1024 stope

Tetrahedrite is veined by pyrargyrite which has irregular borders suggesting partial replacement of tetrahedrite by pyrargyrite. Plate 4 also shows elongated masses of native silver following preferred directions in tetrahedrite. The native silver could replace tetrahedrite or be the result of exsolution.



1/10 A objective
10 ocular

Plate 5 Section 7 1024 stope

The relationships of tetrahedrite, galena, pyrargyrite and native silver are evident in this section. Pyrargyrite cuts both galena and tetrahedrite. It is in turn cut by a fairly evensided veinlet of native silver.

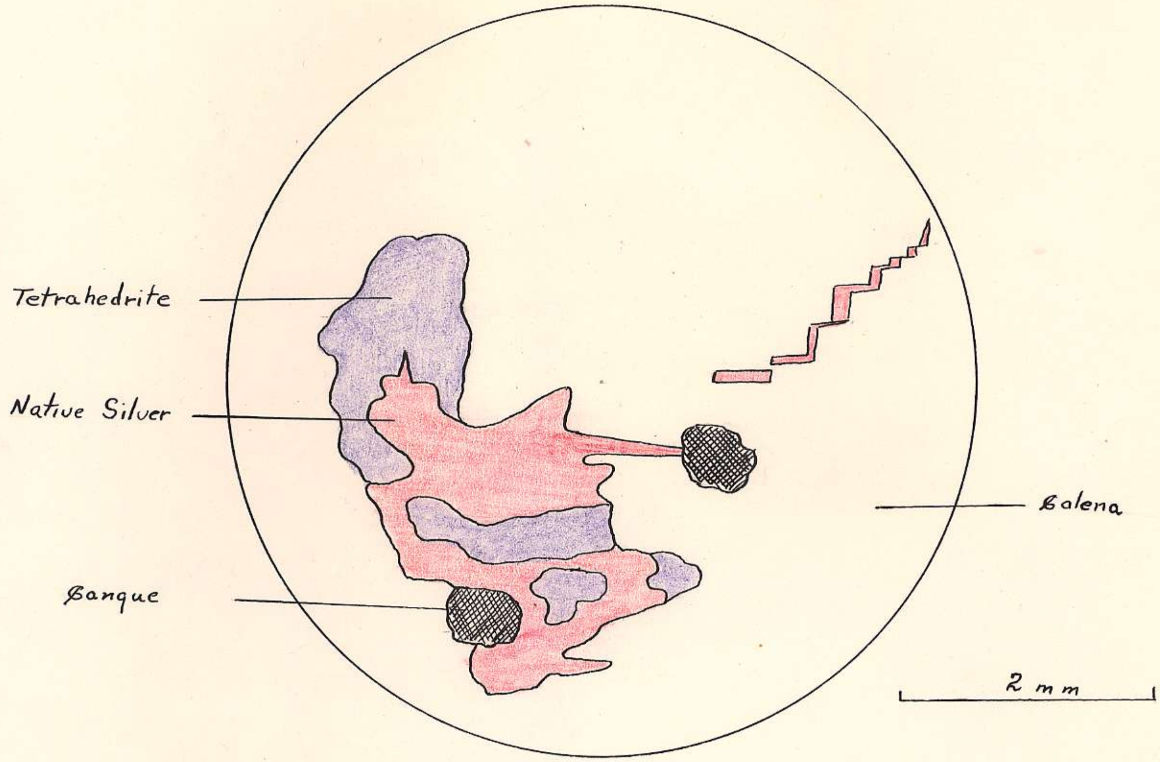


Plate 6 Section 7 1024 stope

Plate 6 exhibits the crystallographic texture of native silver in galena. This texture could be the result of exsolution of native silver from galena or the result of replacement which could duplicate this texture along crystal faces.

BIBLIOGRAPHY

Short, M.N., "Microscopic Determination of the Ore Minerals" United States Department of the Interior - Geological Survey Bulletin 914, 1940

Uytenbogaardt, W., Microscopic Identification of Ore Minerals Princeton University Press, Princeton, New Jersey, 1951

Edwards, A.B., Textures of the Ore Minerals, Australian Institute of Mining and Metallurgy, 1947

Hedley, M.S., Geology and Ore Deposits of the Sandon Area, Slocan Mining Camp, British Columbia, British Columbia Department of Mines Bulletin No. 29, 1952

Cairnes, C.E., Descriptions of properties, Slocan Mining Camp, British Columbia, Canada Department of Mines, Geological Survey Memoir #184, 1935

Peck, J.W., Minister of Mines Annual Report 1951