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A MINERALOGRAPHIC EXAMINATION OF THE ORE OF THE MORRIS MINE, TATLAYOKO LAKE, BRITISH COLUMBIA

Submitted in partial fulfilment of requirements
in the Department of Geology, Fourth Year,
at the University of British Columbia

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

552 Tennis Crescent,
University Hill,
Vancouver, B. C.,
April 9th, 1948

Dr. H. V. Warren,
Professor of Mineralogy,
Department of Geology,
University of British Columbia.

Dear Sir:

I have the honour to submit herewith the report: "A Mineralographic Examination of the Ore of the Morris Mine, Tatlayoka Lake, British Columbia", as required for the second term work in the course Geology 409 of the Department of Geology at the University of British Columbia.

Sincerely yours,

Richard B. Campbell.

Richard B. Campbell

ABSTRACT

This report deals with the mineralography of the ore of the Morris Mine near Tatlayoke Lake, B. C. The mineralization has occurred in two periods, in the first of which arsenopyrite, sphalerite, tetrahedrite, pyrite, galena, gold, and an unidentified mineral were deposited, and in the second of which stibnite was deposited in large amounts. Gold occurs in grains as large as 0.2mm within any of the first group of minerals, and frequently as free gold in quartz; it was not observed associated with stibnite. Tetrahedrite is probably argentiferous, producing the silver values; and, as it does not occur closely associated with stibnite, it is the one sulphide unique to that part of the ore containing the precious metals.

A MINERALOGRAPHIC EXAMINATION OF THE ORE OF THE MORRIS MINE, TATLAYOKO LAKE, BRITISH COLUMBIA

INTRODUCTION

Purpose

A description of the minerals, their interrelations and paragenesis, as they occur in the ore of the Morris Mine, is the purpose of this report. This description is based on both macroscopic and microscopic examination of selected samples. Special emphasis will be laid on those minerals closely related to, hence indicative of the presence of the precious metals, gold and silver.

Location

The Morris Mine is situated about six miles from the South end of Tatlayoko Lake, south of the head of Matthew Creek, a branch of the Homathko River, British Columbia. The showings on the property are at elevations between 6000' and 6500' feet.

Access to the area is by motor road,

169 miles West from Williams Lake to the north end of Tatlayoko Lake, by boat or pack trail to the south end of the lake, and thence 3½ miles southeasterly by a narrow road to the Morris base camp at elevation 2850'. The main camp is connected by about three miles of pack trail to the mine camp at an elevation of 6050'feet.

Acknowledgments

The writer is particularly indebted to Dr. H. V. Warren and Dr. R. M. Thompson for their guidance and help in the many problems arising in the microscopic examination of polished sections of the ore. He is also grateful to Mr. J. Donnan for assistance in the mounting and polishing of the sections used in this work. It may also be stated here that all the information concerning the location and geology of the Morris Mine, and, unless otherwise stated, the assays referred to, are derived from a part of the Annual Report of the Minister of Mines of the Province of British Columbia, 1935, by B. T. O'Grady (O'Grady 1935).

Rather than make continual reference in the matter of etch tests and microchemical tests used in the identification of the ore minerals, it is acknowledged here that all information required for such identification was derived from the United States Geological Survey Bulletin 914, 1940, entitled "Microscopic Determination of the Ore Minerals", by M. N. Short (Short 1940).

Geology

The geology of the area will be but briefly stated in this work. The veins cut Triassic argillites and sandstones, and a quartz-diorite stock. This stock is probably related to the Coast Range batholith, the edge of which is a few miles to the South. The veins are apparently closely related to the stock, for if they do not cut it they have not been observed more than 400' from its nearest exposure. Dykes, ranging in composition from diorite to basalt, are all apparently younger than the veins, either cutting them or intersecting other dykes which cut them. Many of the veins not in the intrusive are in argillites and are often followed closely by dykes. The attitude of the sediments was not determined, and the fractures, occupied by dykes and veins, follow no well defined system.

The main Morris vein has been traced on the surface for 850 feet, through a vertical range of 450 feet, and followed underground for 280 feet from the lowest outcrop. The average width of the vein in the 280 foot adit is 2.7 feet. The assays over this length and breadth of vein were found to be 0.25 ounces of gold per ton, and 3.1 ounces of silver.

MINERALOGY

Macroscopic Examination

The ore occurs generally in clean walled veins, and in part exhibits a banding or crustification. Some parts of the mineralization occur in brecciated and crushed silicified zones. This seems especially true of the stibnite rich facies.

The outstanding feature of the ore examined macroscopically is the presence of the two distinct types of mineralization. The principal type is that in which the sulphides are chiefly arsenopyrite, and sphalerite with small amounts of tetrahedrite. The existence of other sulphides is suggested, but identification by macroscopic methods is difficult. These metallic minerals are enclosed in quartz, which is mostly a milky white colour, but some of which tends to a smoky grey, suggesting two generations. The arsenopyrite occurs as long lathe-like euhedral crystals up to 5mm long, and also in masses of anhedral grains. These two types of arsenopyrite occur in zones, parallel to one another and parallel to the walls of the veins. The masses of irregular grains have the appearance of zones subject to some fracturing, and indeed generally occur along and about a striking linear fracture parallel to the walls. Sphalerite occurs in irregular to rounded blebs up to 1cm in diameter. The more general size is about 5mm.

The outstanding feature of the arsenopyrite, sphalerite type of mineralization is the obvious space filling character of the ore. Many lathes of arsenopyrite lie perpendicular to the walls of the vein, separated by elongate grains of quartz also perpendicular to the walls. This comb structure typifies open space deposition at shallow depths, typical of epithermal deposits.

The second type of mineralization is characterized by the preponderance of stibnite over the other sulphides. Sphalerite and minor arsenopyrite are discernable in this part of the ore. Here there are rather irregular vein walls and within the vein are fragments of the wall rock. In the vein, stibnite occurs in veinlets through the quartz, and also in irregular masses containing needle-like crystals up to 5mm long. The veinlets, while not clearly defined, reach a width of 3 to 5mm. The wall rock is, in places, veined irregularly by stibnite.

The mineralization has apparently occurred in two periods, in the first of which the arsenide arsenopyrite is the dominant mineral, accompanied by sphalerite and tetrahedrite, with some pyrite. The second period seems to be one in which stibnite has been deposited in large amounts by a later influx of antimony-rich solutions.

Microscopic Examination

General Description

The ore occurs in veins composed of quartz, sulphides, and, in places, carbonate. Gold occurs in very erratic mineralization, usually accompanying the heavy polysulphide zones. The sulphides are pyrite, arsenopyrite, sphalerite, tetrahedrite, galena, a metallic grey mineral so far unidentified, and which will be referred to as "X," and stibnite. The gangue minerals are quartz and minor amounts of carbonate.

There appears to have been two periods of mineralization, each one depositing quartz, and the last stibnite and carbonate. The ore is outstanding for the fact that each period has its typical mineralization which tends to occur in zones not intimately mixed. Stibnite was not observed to occur where there is heavy tetrahedrite mineralization, which latter is closely associated with the observed gold. It may be stated, however, that with the stibnite there are minor amounts of other sulphides, especially arsenopyrite and lesser amounts of sphalerite. This does not necessarily imply that these higher temperature minerals are products of the same period of mineralization as the stibnite; rather they are remnants of the first period, veined, and to some extent replaced by second generation quartz and late stibnite.

The descriptions of individual minerals will be given in the order of their age rather than of their abundance. It is to be noted, however, that of the two types of mineralization, the sequence in which the minerals are described corresponds roughly to that in which they occur in most abundance. In the ore of the first period type arsenopyrite is by far the most abundant mineral. Next in order of amount are sphalerite, tetrahedrite or pyrite, "X", galena, and gold. Because there is such diversity in the intensity of sulphide mineralization, no attempt has been made to estimate overall percentages.

In the ore dominated by stibnite, that mineral has been reported as comprising 16 percent of the total vein, and is accompanied by minor arsenopyrite, sphalerite and "X."

It is felt that a description of the minerals in the order in which they were deposited will lend continuity to the following work.

Descriptions of Individual Minerals

Quartz

Quartz, as previously stated, occurs in two generations. The truth of this statement may not be entirely proven; for, while there is very good evidence of post pyrite, arsenopyrite, sphalerite, tetrahedrite, quartz, there is little definite proof of a quartz existing prior to these minerals. The argument in favour of the early quartz is based mainly on the fact that grains of arsenopyrite, which is considered one of the first sulphides, occur in many places in fractures in the quartz. That is, euhedral to subhedral grains begin and end in a fracture. (See figure 4)

Further strength is added to this argument by the fact that quartz is often an early mineral.

That there is quartz succeeding the deposition of arsenopyrite, sphalerite, tetrahedrite and galena is clearly shown in almost every section. It clearly cuts the arsenopyrite, and in many places, as in Sections III and IV, occupies veinlets in sphalerite, and often has a corroded contact with it, exhibiting caries bitten into the sphalerite. It often has a similar contact with tetrahedrite. Further evidence that some quartz is later than tetrahedrite is shown by its behaviour in veinlets in sphalerite. In many places tetrahedrite veinlets in sphalerite are interrupted by quartz, and often in these places the quartz has widened the veinlets considerably and irregularly into the sphalerite. Also in these veinlets quartz may occur nearer the edge of the sphalerite grain than does the tetrahedrite, having the appearance of working into the veinlet preferentially replacing the latter mineral.

Small veinlets and grains of quartz occur in the galena in a manner similar to its relation with sphalerite, and is likely later than both that mineral and "X."

Pyrite

There is little pyrite in the ore; it was observed in any amount only in a few sections. Where it does occur, it is typically in corroded euhedral grains being replaced and veined partly by quartz and partly by arsenopyrite.

Pyrite was identified by its hardness, yellowish colour and negative reaction to etch reagents.

Arsenopyrite

Arsenopyrite is one of the most prevalent minerals in the ore. It occurs in large crystals up to 5mm in length down to minute particles. The large grains are dominantly euhedral, whereas the small ones are both euhedral and very irregularly anhedral.

It is, with the probable exception of pyrite, the earliest sulphide. It has been cut or engulfed by sphalerite, tetrahedrite, "X," and quartz. The best examples of its relations with sphalerite and tetrahedrite are to be found in Section III and with "X" and quartz in Section II.

Examples of sphalerite actually cutting arsenopyrite are rare. It does occur in Section IV, but sphalerite does in many cases apparently engulf or partially engulf the other mineral. Tetrahedrite, which veins sphalerite, also veins and engulfs grains of arsenopyrite. The tetrahedrite-arsenopyrite contact is, in places, very regular, but in others it is heavily caried, the corrosion apparently being that of arsenopyrite by tetrahedrite.

In two large grains of arsenopyrite in Section II, the relations of arsenopyrite and "X" (see figure 5) and arsenopyrite and quartz (see figure 3) are clearly shown. In one case, in the middle of a euhedral crystal of arsenopyrite is a bleb of "X," and from each side of this bleb is a fracture running to the periphery of the grain. The fracture passes through X as well as the arsenopyrite. In the other grain one pointed end of a typical diamond shaped ~~grain~~ crystal of arsenopyrite has been moved out about 0.2mm and is slightly out of line. The interspace is filled with quartz. On the side of this same grain are fragments of arsenopyrite removed from a notch which is filled with quartz.

Also in Section II is a band of fine grained anhedral arsenopyrite distributed around a straight fracture passing across the section and along which part of the section is broken. Some of the unknown mineral "X" and some quartz has filled the spaces in this mylonite-like material. Apparently a period of active fracturing, involving minor movement, occurred after the deposition of arsenopyrite, and prior to the deposition of X.

The distinctive rhomb shaped sections of arsenopyrite crystals, with its white colour, high hardness, and anisotropism, was considered satisfactory evidence for identification. This was borne out by the fact that the only etch reaction was a slight stain ~~with HNO_3~~ and fume tarnish by HNO_3.

Sphalerite

Sphalerite was determined by its very dark grey colour and distinctive internal reflection under inclined light. It has easily determined relations to the other minerals. That it is later than arsenopyrite has been shown above, and the fact that it precedes tetrahedrite (see figure 8) and quartz has also been described. It has been veined in places by "X," and by second generation quartz, apparently cut by carbonate; and appears, in its relation to stibnite, to have been replaced to some extent by that mineral.

Galena, which occurs in unsupported grains in the sphalerite, does to some extent vein it, and generally has the appearance of replacing and fracture filling in the sphalerite and is probably younger.

Sphalerite occurs from very small grains to large blebs one cm. in diameter. The average size of grains of this mineral is approximately 5mm.

A notable fact of this occurrence of sphalerite is the complete absence of chalcopyrite.

Tetrahedrite

The relationship of tetrahedrite to its associated minerals is not as simple as that of sphalerite, beyond the fact that it clearly veins sphalerite in veinlets with matched walls and is younger than that mineral.

"X" seems to have replaced tetrahedrite, for in several places in Section III small, deeply caried unsupported nuclei of tetrahedrite occur in the middle of a grain of "X." This would indicate replacement of tetrahedrite from the borders of a grain, and this is likely the case, for in several other places "X" occurs along the margin of and somewhat incising tetrahedrite.

The second generation quartz, although not found actually cutting tetrahedrite, does appear, by the nature of its contact, to have been deposited later than that mineral. The relation of quartz in the veinlets in sphalerite also indicates that tetrahedrite is earlier.

Also tending to date the tetrahedrite is its association with sphalerite. Despite the fact that it is younger, its many mutual boundaries and intimate association with that mineral indicate a close relationship in time of deposition.

Tetrahedrite was identified by the brownish tinge to its grey colour, by the fact that it reacts only slightly with HNO_3 and is negative to all other reagents, its hardness, and its isotropism. It was definitely determined by microchemical tests giving copper, antimony and some iron.

It occurs in narrow veins in sphalerite, usually about 0.5mm wide, and in grains averaging 0.3mm in diameter. The largest grain observed was about 4mm wide.

Galena

Only in Section IX was galena observed. Here it occurs in a few grains, ranging in size from 0.2 to 0.5mm, and is invariably intimately associated with "X," and enclosed by larger bodies of sphalerite. It was identified by its white colour, well developed triangular pits, and softness; standard etch tests conclusively proved it as galena. The anisotropism of "X," plus subtle differences in colour, distinguished that mineral from galena, with which it is intermixed in a patchwork of small grains, especially along the edges of the larger grains of galena. "X" is slightly darker grey. The relations of galena and sphalerite appears to be one of replacement of the latter mineral by the first; for, as stated, the galena occurs in irregular blebs within the sphalerite. The possibility of some fissure filling is not precluded, for the galena does to some extent vein the sphalerite in small fingers. This, plus the fact that galena is normally later than sphalerite, has been taken as proof that it is a later mineral.

Tetrahedrite was not observed in contact with galena, but the close association of galena and "X" has been interpreted as evidence suggesting it to be later than tetrahedrite, and to be contemporaneous with, or more probably earlier than "X."

The galena contains blebs and small stringers of quartz that is correlated with quartz of similar relations to the sphalerite. Thus galena has been placed before the second generation quartz.

"X"(Unidentified)

The time of deposition of "X" is difficult to establish. That it is probably younger than tetrahedrite is shown above, but its relations to the second quartz and to stibnite are not so clear.

As is clearly shown in Section II, it is deposited in quartz, where it occurs along fractures, and where minute fibrous needles penetrate the quartz. Hence it is younger than quartz, but which quartz? It is associated intimately with tetrahedrite and galena, and occurs in a less close association with stibnite. Tetrahedrite and stibnite never, so far as is known, occur in a close association. As stated above, it is deposited in fractures in quartz, but in some cases, especially where closely associated with tetrahedrite, it seems to have the characteristics of the last mineral of earlier deposition than second generation quartz. On the other hand, it occurs with quartz in filling the interspaces in fragmented arsenopyrite, (Sections II and VI) and, further, is in some degree associated with stibnite.

Since its relations to stibnite could be similar to that of sphalerite or arsenopyrite, and since it could have replaced and cut arsenopyrite before the second quartz, it is probable, in view of its rather close association with tetrahedrite and galena, that "X" was deposited previous to the second generation quartz.

"X" was distinguished from galena and tetrahedrite only with difficulty. It is slightly darker grey than the former and slightly lighter than the latter, and when it occurs, as it often does, intimately associated with one or the other, it is very difficult to distinguish, because in these cases one of the minerals is usually in very small grains. This mineral has etch reactions placing it in the jamesonite-boulangerite group. It etches black with HNO_3. After remaining negative for awhile, the etch sweeps over the grain in a wave, suggestive of meneghinite. It stains brown with KOH, suggesting jamesonite, and is virtually negative to all the other standard reagents. Great difficulty was experienced in obtaining microchemical reactions, the most conclusive being that for antimony. Exact identification by X-ray powder photograph should soon be made. The hardness of "X" is between B and C.

"X" occurs in blebs of very diverse sizes, ranging from minute to 1.5mm. The average would probably be approximately 0.3mm. It also occurs in small stringers in sphalerite and arsenopyrite.

NOTE

An Appendix

The unidentified mineral "X" has been identified from X-ray powder photograph by Dr. R.M. Thompson and proved to be jamesonite, the mineral most strongly indicated by the etch reactions.

Gold

The precious metal was identified by its bright yellow colour, sectility, isotropism and immunity to all etch reagents, with the exception of acqua regia.

The dating of the deposition of the gold, which only occurs, at least in large amounts, in association with arsenopyrite, sphalerite, and tetrahedrite, depends entirely on dating the quartz in which it is largely contained. Here is a problem that is apparently impossible of solution. All that can be said of it is that gold is later than quartz--again, which quartz? It does occur in some cases within sphalerite, tetrahedrite, arsenopyrite, and X; along the boundaries of sphalerite and quartz, tetrahedrite and quartz, and in fractures in arsenopyrite, which places it later than these minerals. Gold was not found in any relationship to stibnite or carbonate. The assay values of samples of the veins were exceedingly erratic, indicating a definite tie-up with some particular type of mineralization. Because gold was found in rather spectacular amounts in Section III, that is, with the first period of mineralization, characterized by tetrahedrite and large amounts of sphalerite, it has been placed with that group. It is placed as the last mineral of the first period of mineralization, preceding the deposition of second generation quartz, and following the deposition of X.

As previously stated, most of the gold occurs as free metal in quartz. Of the observed grains, at least 75 percent have this occurrence. It is always associated with fractures, often with mineral contacts, regardless of the host mineral, and was probably emplaced largely through the mechanism of open space deposition, with replacement playing a minor role.

The largest grains of gold observed are 0.2mm in diameter, the average size being approximately 0.1mm. in diameter, Very small grains are discernable, and gold probably occurs in submicroscopic particles. (See figures 6,7,8,9).

Stibnite

The stibnite in the ore is related closely to few minerals, with the exception of quartz and sphalerite. It typically occurs along fractures in quartz, pinching and swelling in a very irregular manner in blebs up to 5mm long. In places "islands" of quartz have been engulfed and many irregular "peninsulas" of quartz project into the stibnite. Its deposition was apparently accomplished by both fracture filling and replacement. In places it surrounds and apparently replaces some sphalerite. Stibnite was not observed to be cut by any other mineral.

From the above facts, and from the nature of the mineral itself, stibnite has been placed in the second period of mineralization. A major argument in favour of this is the fact that nowhere is stibnite found closely related to tetrahedrite; although, should it have been, it might still have occurred in a later period. That the second generation quartz was not observed to cut it, and that gold was deposited prior to this quartz and is not associated with stibnite, is also suggestive that stibnite is the product of a late period of mineralization. This mineral was recognized by its grey colour, softness, and exceedingly diagnostic etch with KOH. Except for the etch, and rather strong anisotropism, it is very similar to "X" in general appearance.

Carbonate

Carbonate in this ore cuts or is otherwise related to most of the other minerals in a manner suggesting it is the youngest mineral, or perhaps contemporaneous with stibnite. It engulfs and replaces pyrite and arsenopyrite, cuts through and apparently replaces sphalerite, as it leaves stringers of tetrahedrite cutting it; otherwise only known to occur in sphalerite in veinlet form. It decidedly veins quartz, and in one case engulfs part of a grain of stibnite.

CONCLUSIONS

Mineralogy

The metallic minerals identified in the ore of the Morris Mine are arsenopyrite, sphalerite, tetrahedrite, pyrite, an unidentified mineral referred to as "X," galena and gold, which occur in what has been termed the first period of mineralization. Stibnite is the metallic constituent of the second period. The gangue minerals are quartz and carbonate, probably calcite.

Gold is not consistently associated with a particular mineral, but occurs with arsenopyrite, sphalerite, tetrahedrite and X, and most often as free gold in quartz. In those parts of the ore rich in stibnite, gold was not observed, and assays of such parts have shown only a trace of gold and silver.

Silver minerals were not seen, and it is altogether likely that tetrahedrite is argentiferous. This mineral is also uniquely associated with high gold values.

Assays

The reported assays present a discrepancy with conditions noted in the ore that was examined. High values in gold and silver are given as occurring with arsenopyrite and stibnite rich facies. This may be because the ore assayed and that here reported on are not from the same veins.

Assays of mineralization showing "heavy sulphide consisting chiefly of stibnite and arsenopyrite" gave one ounce of gold per ton, and 22 ounces of silver. "A sample containing 16.7 percent stibnite" assayed only a trace of gold and silver.

Process of Mineralization

The process whereby the minerals in the ore were deposited was dominantly that of open space filling. This is exemplified by a tendency to crustification, the well developed comb structure of the quartz and arsenopyrite, and the mineralization, chiefly by stibnite, of breccia zones, leaving clean-cut fragments of wall rock in the sulphide. Microscopic examination shows that replacement has, to a minor extent, been active, usually of one vein mineral by another.

Classification of the Deposit

The temperature of formation of the ore apparently varied considerably between the time of deposition of the relatively high temperature arsenopyrite and the low temperature stibnite. The fact that open spaces, allowing the formation of rather continuous veins and the development of comb structures, crustification, and breccia zones were an important feature in the vein formation, indicates a low pressure of formation. There is little, with the exception of the arsenopyrite, to indicate this is other than an epithermal type of deposit. It is possible that the arsenopyrite was deposited in the early stages before the rapid loss of temperature culminating in the low temperature late stage deposition of stibnite.

Suggested Method of Treatment of the Ore

This superficial examination of the ore

hardly justifies a recommendation for the method of milling. It would appear, however, that a gravity type of concentrating the free gold from material ground to pass 100 mesh would be a good method of original concentration. This might be accomplished with a jig. The jig tails could be ground to 200 mesh, the stibnite removed by flotation, and the flotation tails ground finer for a cyanidation process.

LIST OF SECTIONS

Section I:	Stibnite Arsenopyrite Sphalerite "X" (unidentified)	
Section II:	Arsenopyrite Sphalerite Pyrite "X" (unidentified) Tetrahedrite	
Section III:	Arsenopyrite Sphalerite Pyrite Tetrahedrite "X" (unidentified) Gold	
Section IV:	Arsenopyrite Sphalerite Pyrite Tetrahedrite "X" (unidentified)	
Section V:	Stibnite Arsenopyrite Sphalerite Pyrite	
Section VI:	Arsenopyrite "X" (unidentified)	
Section VII:	Stibnite Sphalerite Arsenopyrite	
Section VIII: (in two zones)	(1) Arsenopyrite Pyrite Sphalerite Tetrahedrite "X" (unidentified)	(2) Stibnite "X" (unidentified) Arsenopyrite Sphalerite
Section IX: (superpolished)	Arsenopyrite Sphalerite Tetrahedrite "X" (unidentified) Galena Gold	

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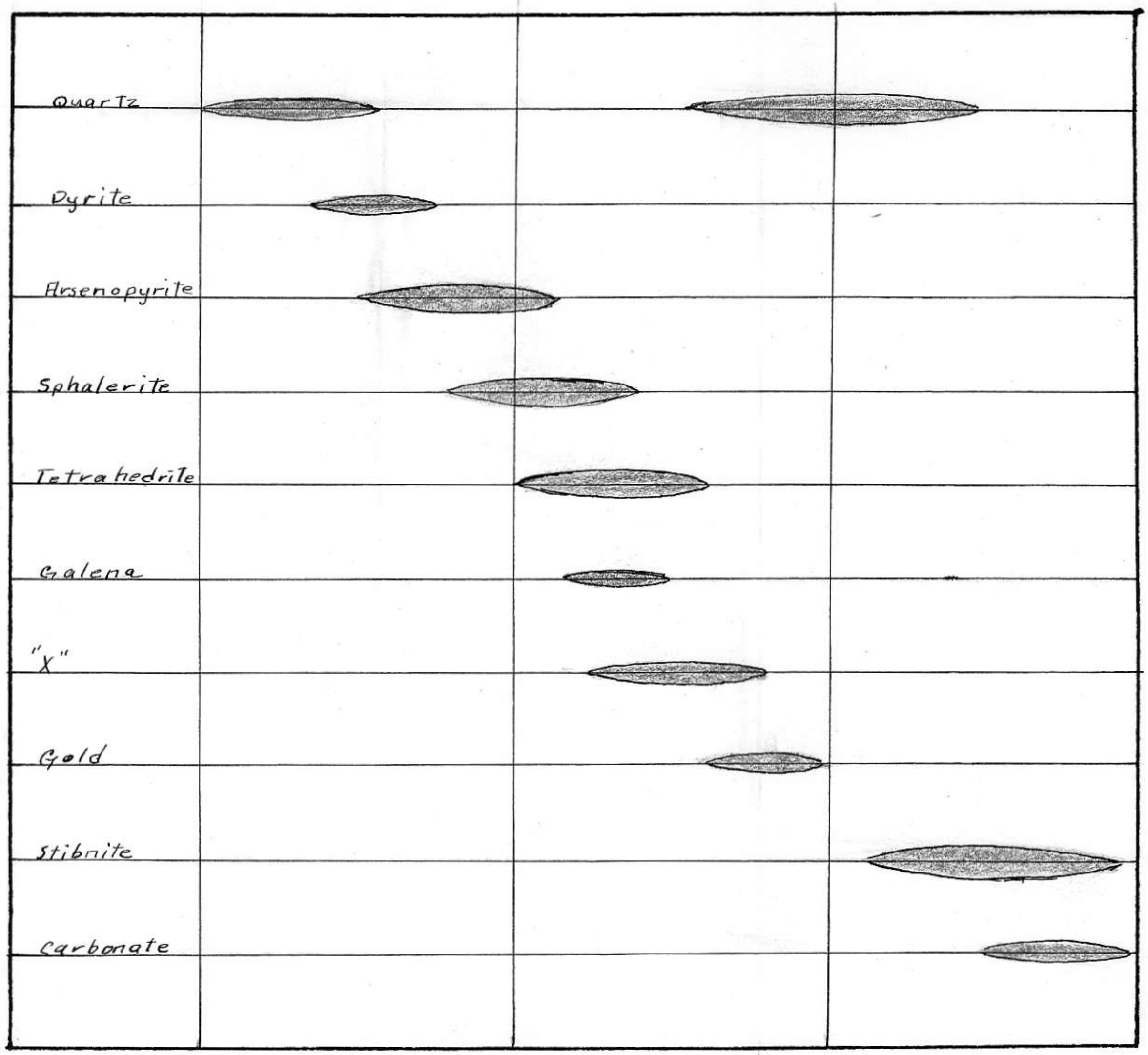


Figure 1

Paragenesis Diagram.

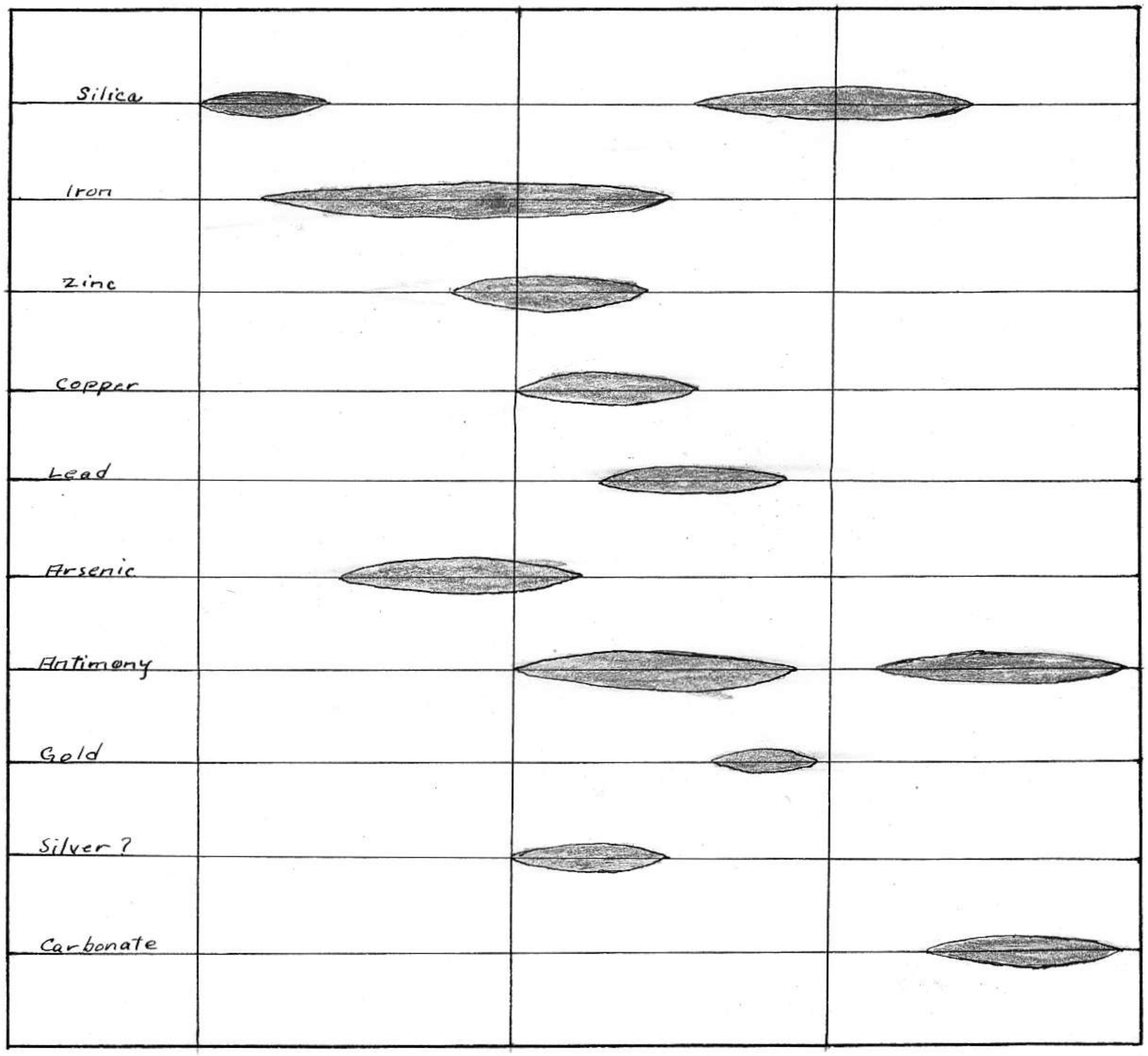


Figure 2

Diagram of Introduction

of Elements.

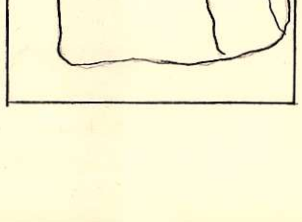
Figure 3

Sketch of Quartz Filling

Fractures in Arsenopyrite

X 50

Location in Section II



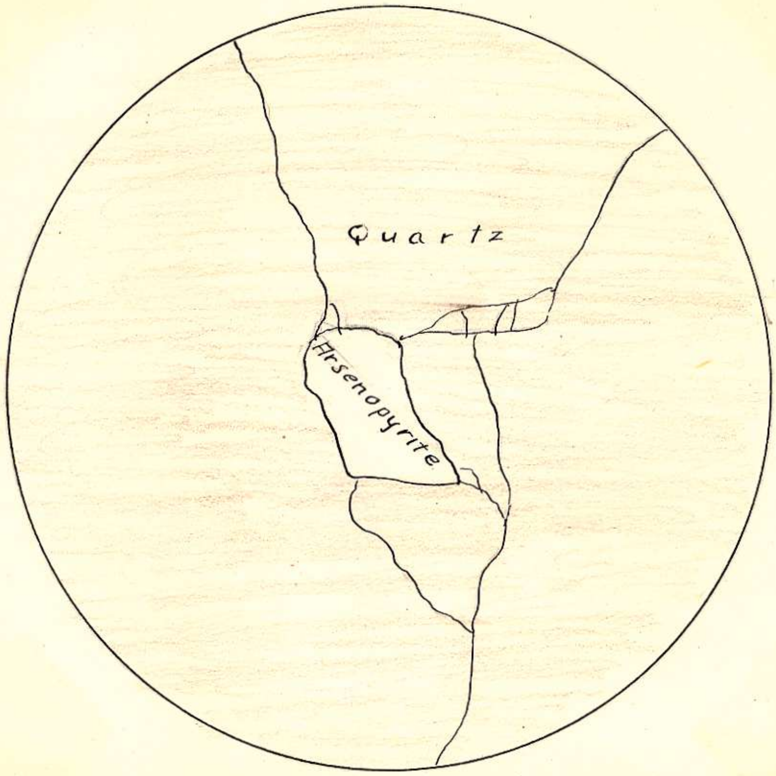


Figure 4

Sketch of Arsenopyrite Crystal in

Fractures in Quartz.

X 50

Location in Section II

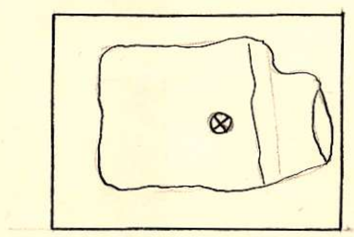


Figure 5

Micro-Photograph of Arsenopyrite

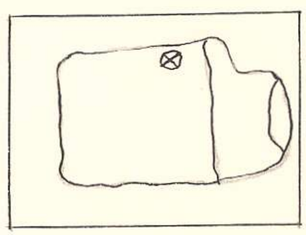
Replaced by "X"

X 75

Microscope Leitz No. 337061
Ocular 8X
Objective No. 3

Photograph Exposure 3/10secs.
Camera Busch Pressman
By R.Steiner

Location in Section II



NOTE

"X" has been identified as jamesonite.

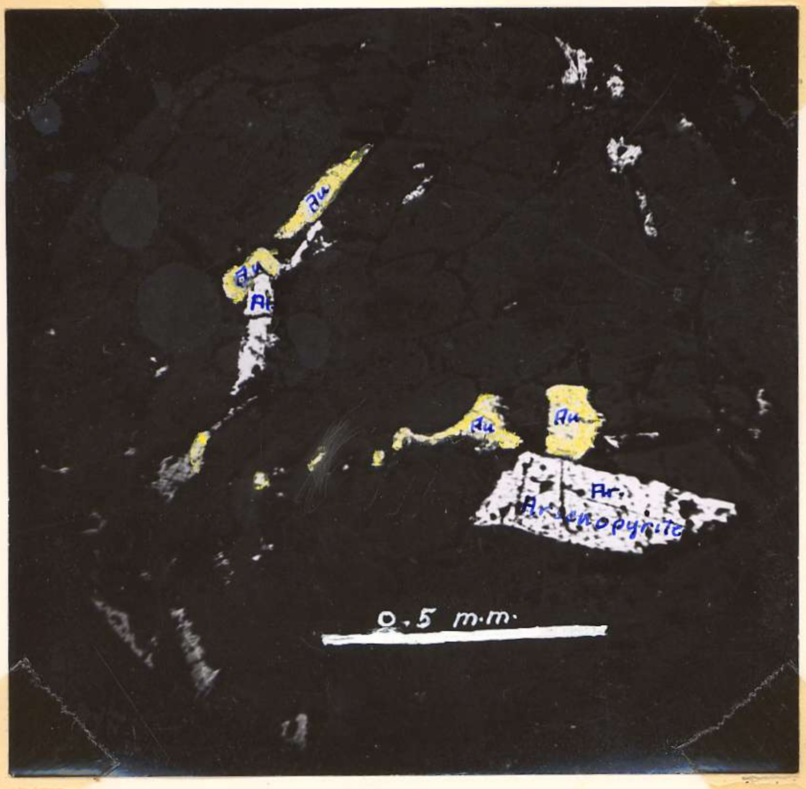


Figure 6

Micro-Photograph of Heavy

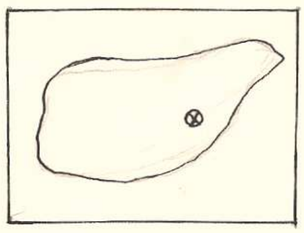
Gold Mineralization in Quartz

X 75

Microscope Leitz No. 537061
Ocular 8 X
Objective No. 3

Photograph Exposure 3/10secs.
Camera Busch Pressman
By R.Steiner

Location in Section III



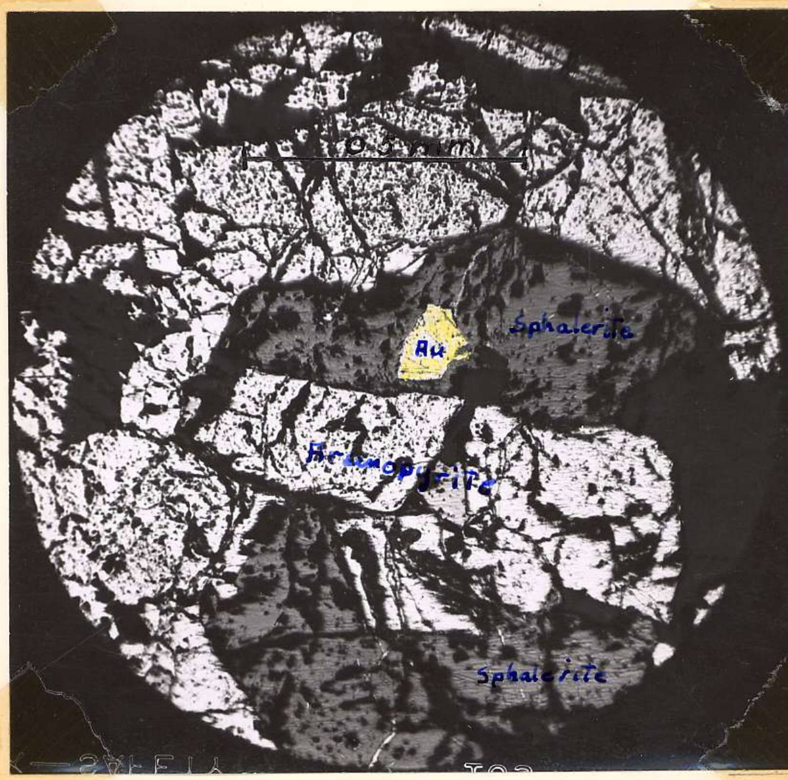


Figure 7

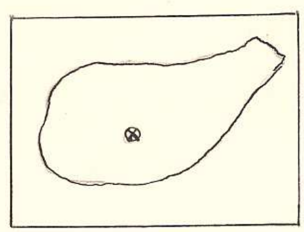
Micro-Photograph of Gold in Sphalerite

X 75

Microscope Leitz No. 337061
Ocular 8 X
Objective No. 3

Photograph Exposure 2/5 secs.
Camera Busch Pressman
By R. Steiner

Location in Section III



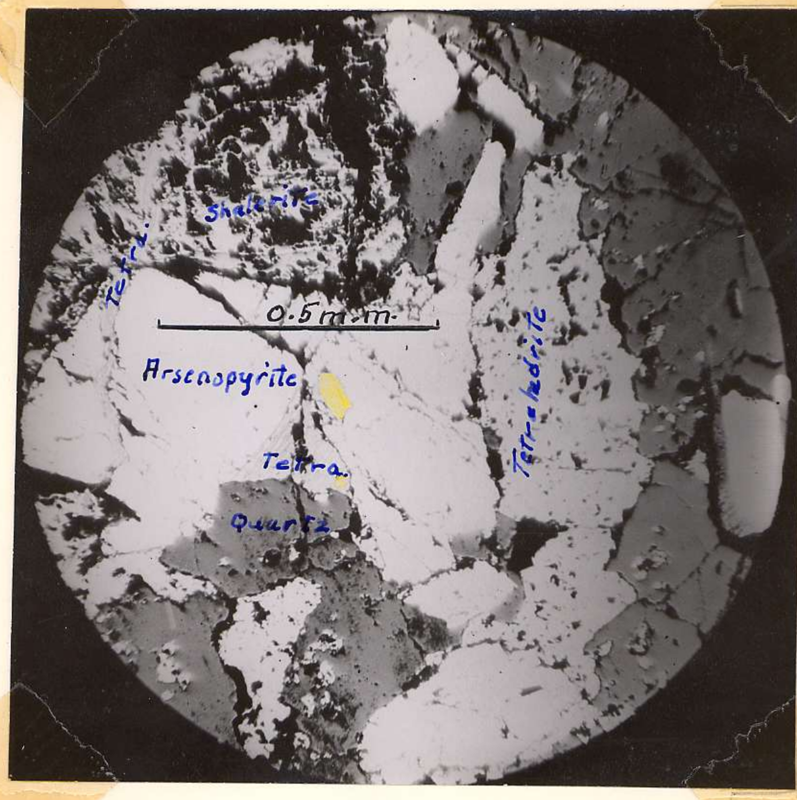


Figure 8

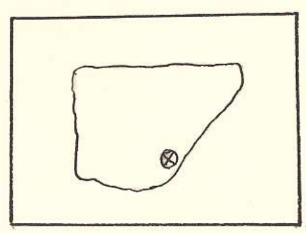
Micro-Photograph of Gold in Arsenopyrite, also showing Tetrahedrite Veining Sphalerite and Arsenopyrite.

X 75

Microscope Leitz No. 337061
Ocular 8 X
Objective No.3

Photograph Exposure 2/5secs.
Camera Busch Pressman
By R. Steiner

Location in Section IX



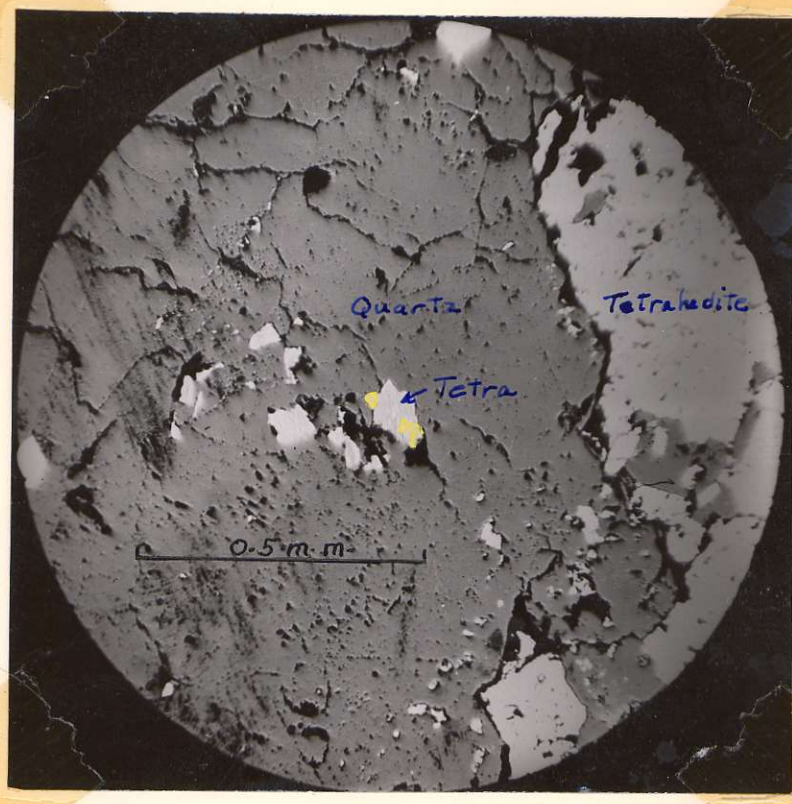


Figure 9

Micro-Photograph of Gold with Tetrahedrite

X 75

Microscope Leitz No. 337061
Ocular 8 X
Objective No. 3

Photograph Exposure 3/10 secs.
Camera Busch Pressman
By R.Steiner

Location in Section IX