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Presentation rather confusing. Careful microscopic work.

# MINERALOGRAPHY OF THE 1250 ZINC OREBODY BRITANNIA MINES B.C.



A report submitted during the fourth year of Geological Engineering at the University of British Columbia.

Thomas E. Rowbottom

March 26, 1951.

## PREFACE

Material for this report was obtained through microscopic study at the University of British Columbia during the author's fourth year in Geological Engineering.

Acknowledgements are made to the faculty at the university, Dr. Thompson, Dr. Warren, J.Gower and Dr. White for their many helpful suggestions and co-operation. Acknowledgements are also given to Dr.Dolar-Mantuani and to Dr. McTaggert for their kind assistance during the study of the thin sections. Thanks are given to J. Donnan for the preparation of the thin sections and for his supervision during the preparation of the polished sections. To the Geological staff at Britannia Mines acknowledgements are given for their many helpful suggestions and co-operation. Thanks are given to Mr.C.Roper, the manager at Britannia, for permission to publish this report.

Box 73 Little Mountain Camp
Vancouver, B.C.
March 26, 1951.

Geology Department
University of British Columbia
Vancouver, B.C.

Dear Sirs:

It gives me pleasure to submit the following report," Mineralography of the 1250 Zinc Orebody, Britannia Mines B.C." This is in partial fulfillment of the requirements of the course Geology 409 at the University of British Columbia.

Yours truly,
T.E. Rowbottom.
T.E.Rowbottom.

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# ABSTRACT

The 1250 Zinc orebody at Britannia Mines is situated in the Fairview section of the Britannia shear zone.

The orebody maybe divided into two types of mineralization;these are a barite-sphalerite ore and a siliceous copper ore. The barite-sphalerite mineralization consists of sphalerite,chalcopyrite,tetrahedrite,galena and minor amounts of gold,in a gangue of barite,pyrite and very minor amounts of quartz. The siliceous copper ore consists of chalcopyrite,sphalerite and galena,in a gangue of quartz,pyrite and barite.

The barite-sphalerite ore is believed to be the result of the earliest period of mineralization and the siliceous copper ore is a transition ore,in which quartz and sulphides,mainly chalcopyrite,were introduced and replaced barite and the remaining host rock.

The even distribution of the sphalerite, the twinning of sphalerite,which is the result of deformation, and similar percentages of iron in the sphalerite,indicate that the sphalerite of the siliceous copper ore and the sphalerite of the barite-sphalerite ore were deposited during the same mineralization period. The above evidence is used to suggest that the sphalerite of the much deepar No.8 orebody,also was deposited at the same time.

# MINERALOGRAPHY OF THE 1250 ZINC OREBODY

# BRITANNIA MINES B.C.

## INTRODUCTION

Britannia Mines is situated on the east side of Howe Sound about 30 miles north of Vancouver. The ore deposits occur on the west side of the Coast Range Batholith in what has been termed by Dr. Schofield and other geologists as "the Pacific Copper Belt". The orebodies occur in a roof pendant of volcanic and sedimentary rocks of Mesozoic age. The rocks of the pendant are known as the Britannia Group. The Britannia Group is divided into the Goat Mountain Formation and the Britannia Formation. The Britannia Formation contains the host rock of the Britannia orebodies.

The host rock of the Britannia orebodies is called locally the green mottled schist, which is a sheared phase of one member of the Britannia Formation which was originally a volcanic and could be called a 'greenstone'. During the intrusion of the Coast Range Batholith, the Britannia Formation was faulted and folded, the rocks were fractured and brecciated and in this manner became a suitable host rock for the deposition of ore minerals. Ore solutions from the deep seated igneous source ascended the fault plane and deposited ore minerals in the suitable host rock of the Britannia Formation.

The source of the mineralization solutions is the Coast Range Batholith. The deposits of the shear zone are zoned with respect to the Batholith; the higher temperature group is found closest to the batholith and the lower temperature group is found further away from the granitic mass. The deposits of the Britannia shear zone are all mesothermal however, the barite sphalerite mineralization is believed to be a lower temperature type than the siliceous copper type. In some sections of the Britannia shear zone H.T.James has stated that reversals of zoning are apparent because the lower temperature barite-sphalerite mineralization is partly replaced by the higher temperature siliceous copper ore.

The orebodies at Britannia comprises what are eight separate orebodies. These are from west to east the No 8 orebody, the Jane orebody, the Bluff orebody, the Fairview orebody, the No.5 orebody, the Empress orebody and the Victoria orebody. The ore of all these deposits is the pyritic replacement type and therefore the deposits of the Britannia shear zone may be classified as pyritic mesothermal replacement deposits. The vertical extent of the orebodies is over 5000 feet and has shown no mineralogical change which would indicate a termination of mineralization. The I250 Zinc orebody is considered a part of the Fairview section of the mine which contains both the barite- sphalerite mineralization and the siliceous copper mineralization

The ore minerals of the Britannia shear zone deposits are mainly sphalerite and chalcopyrite. Gold, silver and cadmium are extracted from the ore.

Britannia, until the last few years was considered primarily a copper producing mine, However, with the opening up of the No.8 orebody, the I250 Zinc orebody and other zinc orebodies, the production of zinc has increased so that at the present time the production of zinc exceeds the production of copper.

Production for the year 1950 are listed below:

Copper...........I5,000,000 pounds

Zinc.............22,000,000 pounds

Gold..............I2,000 ounces

The above production of copper, zinc and gold was recovered from the mining of 900,000 tons of ore.

## EARLY HISTORY

Copper was found at Britannia in 1888 by John Forbes but it was not until 1898 that Oliver Furry staked five claims. In 1900 the Britannia Copper Syndicate was formed and mining was started on the five Furry claims. In, 1908, through the efforts of Grant B. Schley, the Britannia Mining and Smelting Company was formed as a subsidiary of the Howe Sound Company of New York. Since then the mine has been in continuous production.

## EARLY WRITERS

In 1907 LeRoy visited the area as geologist for the Geological Survey of Canada. His report' a Portion of the Main Coast of British Columbia', describes the rocks of the area and the orebodies that occur in them. In 1913 R.G.McConnel wrote a brief account of the orebodies. The first complete examination of the rocks was through the efforts of Dr. Schofield. H.T.James examined the property in 1929 as geologist for the Geological Survey of Canada and later as geologist for the Howe Sound Company. Later papers by Britannia geologists F.Ebbutt and W.T.Irvine have contributed much towards the knowledge of the Britannia orebodies and the regional geology.

## ORE SPECIMENS

Specimens of the ore from the I250 Zinc orebody were received from Britannia Mines in September and in December of I950. All specimens were collected by D. Markland, a Geological Engineer at Britannia and were accompanied by a map showing the location from where each specimen was taken. The map accompanies this report.

## METHODS OF STUDY

Polished sections were made of the specimens of the I250 Zinc orebody, using the equipment of the University of British Columbia.

Microscopic study was conducted, using A.B. Edwards,'Texture of the Ore Minerals' as a guide for paragenesis and texture. Etch tests and microchemical tests as outlined in M.N.Shorts 'Microscopic Determination of the Ore Minerals', were used and unless otherwise stated the determinations of the minerals were carried out by these methods. The description of the tests for the individual minerals will be omitted from the report. The reader is referred to the above two references for information as to the exact nature of the microscopic tests.

Several thin sections were made by J.Donnan, for the author. The thin sections were necessary to observe the relationships of the gangue minerals.

## STRUCTURAL GEOLOGY AS RELATED TO ORE DEPOSITION

The Coast Range Batholith is believed to be the source of the mineral deposits of the Britannia shear zone. During the intrusion of the Coast Range Batholith, the rocks of the Britannia Formation were stressed in such a manner that thrust faulting occured. Thrust faulting was accompanied by the formation of westerly plunging drag folds and a shear zone of large dimensions. During this orogeny the rocks of the Britannia Formation were fractured and brecciated and were rendered suitable to the deposition of ore minerals. The ore solutions ascended the fault plane which served as a channel-way into the suitable host rocks of the Britannia Formation.

The orebodies of the Britannia shear zone are situated in the drag folds and in the fractured zone adjacent to the drag folds. The orebodies all lie in the hanging-wall of the Britannia thrust fault and are formed by the replacement of a suitable host rock or they are the the result of fracture filling in the shear zone.

The host rock of most of the orebodies of the Britannia shear zone is locally called the green mottled schist. The green mottled schist is a sheared phase of one of the members of the Britannia Formation and was originally a volcanic rock. The host rock of the No.8 orebody according to W.T.Irvine is a sheared member of the Britannia Formation which was a medium fragmental and tuff series.

## MINERALOGRAPHY OF THE 1250 ZINC OREBODY

### TYPES OF MINERALIZATION

Two types of mineralization are found in the 1250 Zinc orebody. The two types are a siliceous copper mineralization and a barite-sphalerite mineralization. The two types are in contact with one another in various parts of the 1250 Zinc orebody.

The siliceous copper mineralization consists of chalcopyrite and sphalerite as the ore minerals and quartz pyrite and barite as the gangue minerals. Galena is present but in lesser amounts than is found in the barite-sphalerite type of ore. The presence of barite and the absence of tetrahedrite suggests that the siliceous ore is actually a transition of the barite-sphalerite mineralization.

The barite-sphalerite mineralization consists of sphalerite and chalcopyrite as the ore minerals. Galena, and tetrahedrite occur in minor but important amounts. The gangue minerals are barite, pyrite and small amounts of quartz. Quartz is lacking in some of the polished sections but in all thin sections of barite-sphalerite ore examined quartz in very small amounts is present.

The two types of mineralization of the I250 Zinc orebody indicate that after the mineralization period the orebodies were stressed and deformed by forces which may have developed during faulting, folding ar other oregenic movements. The evidence of deformation is readily visáble because of the twinning of the sphalerite, the striations on chalcopyrite and the irregular triangular cleavage pits of the galena.

## DEFORMATION OF THE ORE MINERALS

M.J.Buerger(I), has shown that ore minerals when stressed fail by translation or by twinning. The stresses which produce such deformation are the result of faulting, folding or other oregenic movements.

Deposits such as the Coeur d'Alene, show evidence of the deformation by the twinning of sphalerite, the striations of chalcopyrite and the irregular cleavage pits of galena. The schistose appearance of the hand specimen is also evidence of deformation. M.J.Bueger when describing the above occurance states;

"In deposits of this sort, the evidence of ore deformation is so clear that no reasonable doubt exists

(I) M.J.Buerger,The plastic deformation of ore minerals. Am.Mineralogist,I3,pp.35-5I.

as to the sequence of events which gave rise to the characture of the present ore. The ore minerals were first deposited by filling and replacement and subsequently were subjected to enormous forces which distorted the original crystals. The evidence shows that the softer minerals were deformed through flowage; while the harder minerals such as pyrite and quartz were broken or crushed."

A brief summary of the conclusions of M.J.Bueger will be given; for further information the reader is referred to the paper by M.J.Buerger.

The Beformation of Sphalerite

Sphalerite deforms by gliding on{III} planes and the movement is by twinning. Within the unit cell of sphalerite there are seven octahedral planes, that completely define the secondary twinning of the unit sphalerite cell.

The twinning of sphalerite is readily visáble microscopically,if,after polishing the specimen is etched with a dilute solution of potassium permanganate which has been acidified with sulphuric acid. The twinning stands out as well defined dark bands. The dark bands intersect at an angle of I20 degrees.(Fig.I) Etching with potassium permanganate proves the presenceof twinning because if twinning has occurred the crystalline directions will differ from those of undeformed portions, and etching will reveal the presence of twin bands.


Figure No 1. X-150 By. Dr. Thompson.

Buerger states that a pure crystal would be expected to deform by translation, while an impure crystal having distorted planes upon which extensive slip would be attended by great friction, would be expected to deform by secondary twinning. Sphalerite contains from one to I8 (25) percent of iron in solid solution and therefore would be expected to deform by secondary twinning. In this case however the ZnS is virtually Fe free.

The Deformation of Chalcopyrite

Chalcopyrite has a similar crystal lattice to sphalerite. Chalcopyrite is a relatively pure mineral and therefore should deform by translation.

Etching with potassium permanganate reveals no etch bands because the crystalline directions are the same in the altered and unaltered specimen.

### The Deformation of Galena

Galena when stressed deforms by translation in (IIO) directions. The evidence of deformation is apparent by observing irregular cleavage pits.

In summary, sphalerite deforms by twinning, whereas galena and chalcopyrite deform by translation. The purity of a mineral is an important factor in determining whether translation or twinning will occur. Impure minerals such as sphalerite, which contains iron in exsolution will deform by twinning, whereas galena and chalcopyrite, which are usually pure minerals would deform by translation. Twinning, if present, is good evidence that deformation of an ore-body has occurred.

## BARITE-SPHALERITE MINERALIZATION

### Megascopic Examination

Megascopically the only minerals which can be determined are chalcopyrite and pyrite. The hand specimens are noticeably fine grained and the specific gravity is above normal.

## Microscopic Examination

### Pyrite

Pyrite is abundant in all polished sections examined and appears to represent three periods of deposition.

Large grains of pyrite have been fractured and mineralized with sphalerite, chalcopyrite and galena. This generation of pyrite is pre ore. Rounded corroded grains of pyrite are very abundant and are also probably pre ore. Many small euhedral grains of pyrite are present and these represent the last deposition of pyrite. Pyrite appears in excessive amounts wherever the barite-sphalerite ore merges with the siliceous copper ore.

### Sphalerite

Sphalerite is the most abundant ore mineral of the barite-sphalerite type of mineralization and is evenly distributed throughout the polished sections. The most noticeable microscopic property of the sphalerite is the presence of twinning. The twinning stands out as well defined bands which intersect at angles of 120 degrees. The twinning, after etching with potassium permanganate which had been acidified with sulphuric acid, remained as well defined dark bands. Therefore, in accordance with the experiments of Buerger the presence of twinning is confirmed and deformation of the orebody is indicated.

Sphalerite is the oldest ore mineral found in the barite-sphalerite type of mineralization and contains numerous exsolution intergrowths of chalcopyrite. The chalcopyrite is therefore contemporaneous with the sphalerite.

The sphalerite of the I250 Zinc orebody contains on the average 0.34 percent of iron in solid solution(I). and would indicate a low mesothermal temperature of deposition.

Chalcopyrite

Chalcopyrite is abundant in the polished sections examined and represents at least one period of deposition. Chalcopyrite appears as seriate exsolution intergrowths in the sphalerite. The grain size of the exsolution intergrowths varies from 5 to I0 microns and in some of the sections examined the intergrowths are numerous. Large particles of chalcopyrite are also present and are apparently later than the sphalerite.

Is this not due to twinning See Short P. 75

Striations are visable microscopically on well polished specimens of chalcopyrite. Etching with potassium permanganate which had been acidified with sulphuric acid resulted in a uniform etch and no twin bands were visable. The above tests indicates that the chalcopyrite deformed by translation rather than by twinning when stressed by orogenic forces.

Blebs of chalcopyrite often contain,tear shaped particles of tetrahedrite and rounded particles of galena.

(1) P. Kavanagh, "Minor Elements in Sphalerite of the Britannia Mines".

These particles resemble intergrowths,However no conclusive evidence was observed.

Tetrahedrite

Tetrahedrite is fairly abundant in the polished sections of barite-sphalerite ore and is only found in this type of ore.

Microchemical tests for silver are negative, However since the test is very sensitive the absence of silver in the tetrahedrite is not positive. Microchemical tests for antimony and copper were obtained and etch tests are indicative of tetrahedrite. Since, the composition of the silver bearing tetrahedrite,'freibergite' and the etch tests are similar to tetrahedrite, the presence or absence of freibergite was not determined.

Twinning was not observed on the tetrahedrite when the mineral was etched or on the unetched specimen.

Galena

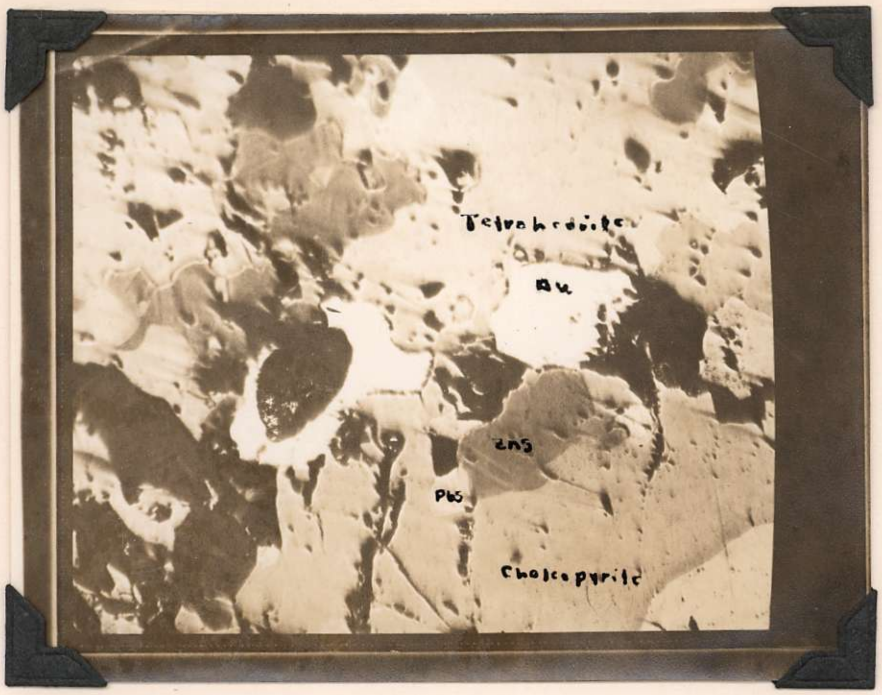
Galena is common in all the polished sections and appears to be the youngest sulphide present. Microscopically,cleavage pits in galena are scarce,However a few of the pits are deformed triangles which are indicative of deformation.

Polished section NO.6 (see map) consists of galena and sphalerite with minor amounts of chalcopyrite. Tetrahedrite is lacking from the polished section. Figure No.I (page IO) is a photograph of one of the microscopic views. In this section the absence of hard minerals encouraged the formation of twin bands. Careful study of this section is helpful to the study of paragenesis. The large particle of galena appears to truncate the twin bands of sphalerite, which are matched on both sides of the galena. Galena is therefore later than the sphalerite. In the central top portion of the picture, particles of galena and chalcopyrite appear to outline the twinning of the sphalerite. This may indicate that the chalcopyrite is also later than the sphalerite. Other examples are present such as the above which indicate that the galena and the chalcopyrite ~~is~~ are later than the sphalerite and appear to have been preferentially precipitated along the twin bands.

Gold

The barite-sphalerite mineralization contains gold in minor amounts. The largest particles of gold found in the polished sections ~~is~~ are pictured below. The actual size of the largest particle is 200 microns. Microscopic tests indicate the absence of silver in the gold.

The relative age of the gold in respect to the sulphides is not known; however the gold probably was deposited with the tetrahedrite, chalcopyrite and galena.




Barite - Sphalerite Ore. X-150 By. Dr. A. Thompson

Gangue Minerals

The gangue minerals of the barite-sphalerite mineralization are barite with minor amounts of quartz. Chlorite and sericite are also present. The barite is older than the quartz and the sulphides.

The gangue minerals of the barite-sphalerite ore and the gangue minerals of the siliceous ore will be discussed in a later paragraph.

Paragenesis

I. Barite

2. Pyrite

3. Sphalerite

4. Chalcopyrite and Tetrahedrite

5. Galena

6. Quartz

Chalcopyrite, tetrahedrite and galena may have been deposited at the same time. A second generation of chalcopyrite may also be present.

## SILICEOUS COPPER MINERALIZATION

### Megascopic Examination

Megascopically, the hand specimens are fine grained and have a higher than normal specific gravity. Chalcopyrite is more abundant or is present in larger particles than occurs in the barite-sphalerite ore.

### Microscopic Examination

#### Sphalerite

Sphalerite is abundant and evenly distributed in the siliceous copper mineralization. The sphalerite is twinned similarly to the sphalerite of the barite-sphalerite type and contains exsolution intergrowths of chalcopyrite. The sphalerite is later than the barite, pyrite and quartz.

#### Chalcopyrite

Chalcopyrite is the only copper mineral present and is probably later than the sphalerite. Chalcopyrite of the siliceous ore may represent two periods of deposition

The first period of deposition is probably contemporaneous with the chalcopyrite of the barite-sphalerite ore whereas the second period of the deposition of chalcopyrite maybe the result of a later mineralization period.

Galena

Galena occurs in minor amounts in the siliceous ore and is younger than bbe sphalerite and chalcopyrite. The triangular distorted cleavage pits are present.

The absence of tetrahedrite,whenever quartz appears in fairly large amounts suggests two mineralization periods. Quartz in lesser amounts in the siliceous ore as compared with the barite-sphalerite ore indicates that quartz has intruded the the barite-sphalerite mineralization and this is also suggestive of two periods of mineralization.

Gangue Minerals of the I250 Zinc Orebody

Barite and quartz are the main gangue minerals chlorite and sericite are present in minor amounts. Sericite is more abundant than chlorite.

Some of the polished sections are lacking in quartz,however thin sections of these specimens reveal the presence of quartz in very minor amounts. The quartz observed in the thin sections veins the barite and since the cleavages of the barite are continuous on both sides of the quartz, the quartz is therefore later than the barite. Reentrant angles although not conclusive suggest that quartz is younger than the barite.

Quartz and barite are abundant in most of the polished sections examined of the siliceous type ore. However, this ore grades into a type of ore where barite occurs in minor amounts, or is lacking entirely and the gangue is mainly quartz. Whenever quartz appears in large amounts the absence of tetrahedrite is conspicuous. In sections examined where barite is missing the mineralization is widely dispersed. The dispersed mineralization consists of sphalerite, chalcopyrite and galena. The twinning on the sphalerite is poorly defined and is only observed on random particles.

The quartz of the polished and thin sections examined indicates that the quartz is younger than the barite and in places the evidence indicates that quartz is replacing barite.

Barite and quartz examined in several of the thin sections show shadowy extinction and therefore indicate that tha quartz and barite have been stressed.

Chlorite and sericite are present in the thin sections; sericite is more abundant than chlorite. In thin sections in which barite is lacking and the mineralization is dispersed both the chlorite and sericite are missing from the sections. Possibly, in these sections the chlorite and sericite have been completely replaced.

The chlorite and sericite may have been formed by hydrothermal alteration or they maybe the remnants of unreplaced host rock.

Quartz of the siliceous copper mineralization may represent two periods of deposition. The first generation of quartz deposited chalcopyrite in the ore zone and the second generation of quartz is responsible for the dispersed mineralization observered in some of the polished sections. The quartz may have replaced barite and any of the original host rock that remained after the proceeding mineralization periods.

Paragenesis of the Siliceous Copper Ore

I. Barite
2. Pyrite
3. Sphalerite and Chalcopyrite
4. Quartz
5. Chalcopyrite
6. Galena
7. Quartz

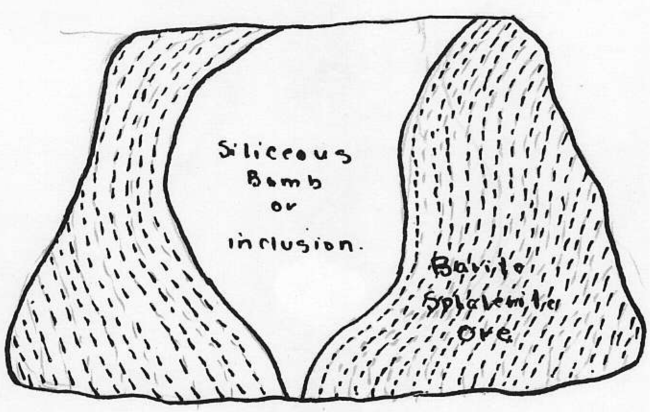
## THEORETICAL CONSIDERATIONS

Microscopic evidence indicates that the first period of mineralization in the 1250 Zinc Orebody was the deposition of the barite-sphalerite ore, and barite, pyrite sphalerite, chalcopyrite, galena and tetrahedrite were deposited in the favorable host rocks of the Britannia Formation. This period of mineralization was followed by a second period of mineralization when pyrite, chalcopyrite galena and quartz were deposited. The second period of mineralization may have replaced parts of the preceeding mineralization.

The sphalerite of the barite-sphalerite ore and and the sphalerite of the siliceous ore are twinned and as previously stated the twinning is a result of the deformation of the orebody. The above periods of mineralization were possibly followed by a third period of mineralization, and quartz, which may have carried minor amounts of sulphides, was deposited. The third mineralization period is represented by quartz with dispersed sulphides. The sphalerite is twinned and may have been deposited at the same time as the sphalerite of the siliceous copper ore was deposited. The author believes that a barren quartz period of mineralization represents the last period of deposition in the ore zone.

Since, the sphalerite of the siliceous copper ore and the sphalerite of the barite-sphalerite ore is twinned the deformation which caused the twinning was later than the deposition of the two types of ore; or at least later than the deposition of the sphalerite. of the two types.

In one specimen from a barite-sphalerite zone (specimen No.I), quartz with dispersed sulphides appears to have intruded the barite-sphalerite mineralization. Tetrahedrite in noticeable amounts is present outside the quartz zone. Therefore the ore on the outside of the quartz is typical barite-sphalerite mineralization and the quartz represents the last deposition of quartz. The mineralization on the outside of the quartz zone shows a distinct banded structure and the rock megascopically is a schist. It appears: ① that the quartz has intruded the schist and either forced apart the walls or it has replaced the host rock; ② or that the barite-sphalerite ore flowed into position and isolated the quartz inclusion or bomb. The dispersed mineralization inside the quartz indicates that the quartz intruded the barite-sphalerite mineralization and replaced barite and host rock. The transition zone between the two is a zone of dense pyrite which grades into the barite-sphalerite mineralization. Quartz in very minor amounts is present in the barite-sphalerite ore. (see Diag. below)




x 1/2

The sphalerite of the barite-sphalerite ore and the sphalerite of the siliceous copper ore is twinned and this ore mineral is distributed uniformly throughout both types of ore. Microscopic evidence indicates that the sphalerite of the two types of ore could have been deposited at the same time and the siliceous ore is the result of a later mineralization period which intruded and replaced part of the barite-sphalerite mineralization. The presence of tetrahedrite in the barite-sphalerite ore indicates that at least two periods of mineralization are present; however differences in host rock could account for the absence or presence of the tetrahedrite.

A very interesting relationship between the iron contents of the two types of sphalerite was drawn to the attention of the author by P.Kavanagh(I) and with his kind permission some of the results will be listed below:

| LOCATION | Av. Iron in % |
|---|---|
| I250 Zinc Orebody | |
| Siliceous copper ore.................... | 0.34% |
| Barite-sphalerite ore.................. | 0.44% |
| No. 8 Orebody.......................... | 0.89% |

Several sections of the No.8 orebody were studied and the twinning of the sphalerite is present. The sections studied were from the 4I00 level and from the 4950 level.

The very regular gradient in the percentage of

(I) P.Kavanagh, Minor Elements in Sphalerite of the Britannia Mine.

iron in the ores of the No.8 orebody and the I250 Zinc orebody could indicate that the sphalerite of these two orebodies was deposited at the same time. The sphalerite of the upper orebody, the I250 Zinc orebody, since it was closer to the surface would be expected to be deposited at a lower temperature than the sphalerite of the much deeper No.8 orebody. The higher temperature of deposition is indicated by the greater percentage of iron in the sphalerite of the No. 8 orebody. (Some doubt exists as to the purity of the ZnS analysed from these various zones) & amount of FeS present.

The presence of twinned sphalerite in both these orebodies proves that the deformation of the orebodies took place after the deposition of the sphalerite. The twinning therefore suggests, as does the iron content, that the sphalerite of the No.8 orebody and the sphalerite of the siliceous copper ores of the I250 Zinc orebody, belong to the same mineralization period.

The sphalerite of the I250 Zinc, barite-sphalerite ore, indicates a lower temperature of deposition than the siliceous copper ore. The lower temperature of deposition maybe the result of the location of the orebody. The barite sphalerite orebody may have been further away from the magma source and therefore lower temperature minerals were deposited. The sphalerite of the I250 Zinc orebody may have been deposited at the same time; the even distribution of the sphalerite in both the siliceous copper ore and in the barite-sphalerite ore is suggestive, the close correlation of the iron in solid solution in the two sphalerites and the presence of twinning in the two types of sphalerite is also suggestive. If, the above assumptions are correct and there is every reason to believe that they are , the mineralization period that deposited sphalerite in the host rock of the No.8 orebody was also responsible for the deposition of sphalerite in the 1250 Zinc orebody.

Microscopic study indicates that a second period of mineralization deposited quartz and sulphides, mainly, chalcopyrite in the ore zone. The later quartz appears to have replaced barite. Whenever quartz is present in large amounts the copper mineral tetrahedrite is missing. Tetrahedrite may have been preferentially replaced by one of the later sulphides or it was never present in these parts of the orebody. Chalcopyrite is the only copper mineral present in the siliceous type ore and may have been deposited during a later period of mineralization than the sphalerite which contains chalcopyrite in solid solution. Chalcopyrite is more abundant when quartz is present.

In summary,the sphalerite of the barite-sphalerite mineralization and the siliceous copper mineralization, may have been deposited at the same time. Tetrahedrite, chalcopyrite ,galena and small amounts of gold were also deposited at this time. The tetrahedrite was deposited in cooler parts of the host rock or in chemically suitable host rock.

A later period of mineralization with quartz and sulphides, mainly chalcopyrite, were deposited in the ore zone and quartz may have replaced barite and the sulphides may have preferentially replaced tetrahedrite, if the tetrahedrite was present. The quartz mineralization period was facilitated by deformation of the host rocks, which were fractured and brecciated and therefore formed channel-ways for later ascending solutions. The later mineral solutions are represented by quartz with chalcopyrite as the copper mineral. The deformation which formed channelways for later ore solutions also twinned the sphalerite and deformed the other ore minerals. A later period of quartz is evidenced, possibly, by the shadowy extinction of some of the quartz, which may have been stressed when openings were developed for the later ore solutions.

The siliceous copper ore studied is actually a transition type of the barite-sphalerite mineralization, which contains quartz with chalcopyrite as the copper mineral, in place of tetrahedrite which occurs in the barite-sphalerite mineralization. Since the siliceous copper ore consists of a higher temperature group of minerals than the barite sphalerite-ore and intrudes and partly replaces the barite-sphalerite mineralization the reversals of zoning mentioned by H.T.James in the Jane orebody are also present in the 1250 Zinc orebody. The higher temperature siliceous copper ore has replaced parts of the lower temperature barite-sphalerite ore and reverse zoning is apparent.

I250 ZINC MINERALIZATION SPECIMEN

(I) Siliceous Bomb in Barite-sphalerite ore.

(2) Barite-sphalerite type ore.

(3) From a vague Siliceous zone in Barite-sphalerite zone.

(4) Short discontinuous Chlorite Concent ration in form of a band.

(5) Not present.

(6) High Galena concentration in ore adjacent to green dyke.

(7) Barite-sphalerite type ore.

(8) Siliceous type ore.

(9) Barite-sphalerite type ore.

(IO) Siliceous type ore adjacent to a 1 foot band of Barite ore which is in turn adjacent to foot wall barren schist.

(II)-(I2)-(I3)-

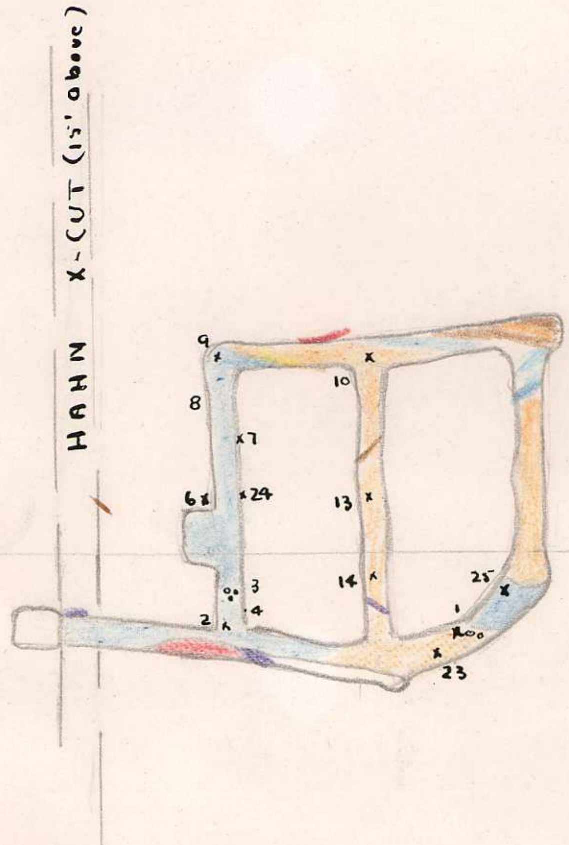
(I4) Siliceous type ore.

(I5) to (22)-

(23) Siliceous type ore.

(24) Siliceous Bomb.

(25) Siliceous Bomb (Quartzite?).




Siliceous Ore

Bornite - Sphalerite ore

Felsite Dykes.

Green Dykes.

Grey unsiliceous Schist.

FAIRVIEW

1025 Sublevel

11/46 Stope

Undercut Workings.

Scale 1" = 40'