

GEOLOGY 409

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"MINERALOGRAPHY OF THE ERICKSON-ASHBY PROSPECT"

TAKU RIVER - MAP AREA

by

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March 1949

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Good job  
RNT

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### ABSTRACT

This report is a result of a microscopic examination of polished sections prepared from samples of high grade ore from the Erickson-Ashby property in the Taku River district. These examinations were carried out in the mineralography laboratory at the University of British Columbia during the spring term of the 1948-49 session. The following metallic minerals were determined:- arsenopyrite, pyrite, pyrrhotite, sphalerite, chalcopyrite, tetrahedrite, and boulangerite.

### ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. R. M. Thompson of the Department of Geology, for his helpful instructions and criticisms during the examination of the polished sections, also for his confirmation by X-Ray of tetrahedrite and boulangerite. He also thanks the other members of the mineralogy staff and J. Donnan, technical instructor, for his help with polished sections.

## MINERALOGRAPHY OF THE ERICKSON-ASHBY PROSPECT

### INTRODUCTION

Polished sections were prepared from a suite of ores from the Erickson-Ashby property. Five selected samples were cut, mounted in demar, ground and polished for examination under the reflecting microscope. To determine the minerals the sections were examined under polarized light, etch tests and micro chemical methods of mineral determination were used. The possible genetic relationships of the minerals were worked out and are offered in this report.

#### Location

The property is located in the Taku River Map Area in the Atlin Mining division. The claims are situated about three and one-half miles from Tulsequah on the north end of Erickson Mountain. The showings range from near river level to heights of 5000 feet.

Tulsequah is the nearest settlement and is situated on the Taku River at the junction of four main routes of water travel.

#### General Geology

The group of claims are located on the north end of Mt. Erickson. They were staked by Erickson and Ashby in September, 1929, and considerable work was done during the

three succeeding years.

Mt. Erickson is a narrow ridge with very steep sides and above 2000 feet, exposure is most continuous except for patches of talus. The rocks are pre Permian sandy argillites and quartzites overlain by the Stikine group of volcanic rocks. Between the two is a sheet only a few feet thick of Permian limestone. This sheet of limestone which may have been continuous before deformation now forms numerous discontinuous patches of very irregular shape.

Mineralizing solutions appear to be of two definite types:- (I) Limestone replacment between the pre Permian and Mesozoic rocks, forming discontinuous blanket like bodies.

(2) Shear zone replacements in the volcanic rocks.

## MINERALOGY

### Megascopic Analysis

Pyrite is fairly abundant in the ore and the most common sulfide observed. It occurs in massive form or in very fine grains which have been somewhat crystallised into very small cubes not exceeding 1 m.m. in grain size.

A silvery grey fibrous mineral having a hardness of 2.5 and prismatic cleavage is present disseminated through the quartz gangue, however, does not occur in the higher grade ores where quartz is a minor constituent.

Sphalerite is present in the massive form and as fairly well developed dodecahedral crystals. It is easily recognized by its brown color and streak, its hardness of 4, and adamantine luster. It is associated with pyrite and the silvery grey sulfide mentioned below.

A massive silvery grey sulfide having galena like properties occurs in the specimens where the quartz gangue is nearly absent. It is associated with pyrite and sphalerite and of equal importance. It may be the massive variety of the fibrous mineral.

Blue, green and irridescent stains suggest the presence of primary copper.

The iron sulfides have been weathered and leave a rust brown coating on the exposed surfaces.

Quartz is the most common gangue mineral but calcite occurs in minor amounts. The quartz is massive in several specimens in which it is the chief mineral but in others well developed elongate hexagonal crystals were found, e.g. spec. E. A. 3. Sulfides appear to fill the open spaces between the quartz crystals. This criteria suggests open space filling and is very suggestive of replacement textures.

#### Microscopic Analysis

The following minerals were determined by microscopic methods:- arsenopyrite, pyrite, pyrrhotite, quartz, sphalerite,

chalcopyrite, tetrahedrite, boulangerite, and calcite.

#### Minerals Present and How Determined

Pyrite FeS

Pyrite is the most common sulfide in the ore occurring in massive form and less commonly cubic crystal form. It is easily recognized by its brass yellow color, pitted surface due to its resistance to polish, negative etch reactions, isotropism and resistance to scratching. The massive pyrite is well fractured and the fractures have been healed by quartz and later sulfides. The crystalline pyrite has been ~~highly~~ corroded due to later solutions and the crystals present though not perfect are very suggestive of pyrite cubes. It is associated with all the other minerals present except fibrous boulangerite, calcite and tetrahedrite.

Arsenopyrite FeAsS

The occurrence of this mineral is minor probably due to its replacement by later pyrite. Its diamond shape, pinkish white color, inferior hardness -F, positive etch to HNO<sub>3</sub> and strong anisotropism is very distinctive. It also occurs as tiny rugged residuals in pyrite which have almost completely replaced it.

Pyrrhotite FeS

This mineral occurs in two generations and is thought to be later than pyrite, possibly replacing it. Skeleton cubic and dodecahedral outlines suggest pseudomorphs after pyrite.

In section E.A. 2, where quartz is the chief mineral present pyrrhotite is directly associated with arsenopyrite and pyrite is practically absent. Most of the pyrrhotite is massive, is very badly corroded and irregular and its borders appear to be remnants of pyrite. The mineral is recognized by its moderate anisotropism, magnetic properties, smooth polish, hardness D, orangy tan color, negative etch tests and micro chem tests for iron.

Pyrrhotite is also present in the form of laths and elongate blebs as exsolved bodies in sphalerite where chalcopyrite also occurs in solid solution. Its occurrence in this form however is minor.

Quartz      SiO<sub>2</sub>

Two varieties of quartz are present described as follows:- (1) Dark gray quartz

(2) Watery light gray quartz

The two varieties appear to be contemporaneous but the dark gray variety is the more common, occurs as healing fractures in pyrite and filling open spaces in corroded arsenopyrite and pyrrhotite. This variety also appears as well developed euhedral hexagonal cross sections and elongate laths. The open spaces between the crystals have been filled by later sulfides.

Sphalerite      ZnS

Sphalerite along with boulangarite is <sup>the</sup> second most



common sulfide in the ores. It occurs almost invariably with exsolved intergrowths of chalcopyrite in the sphalerite along with minor intergrowths of pyrrhotite. Sphalerite is found healing fractures in the early sulfides and filling open spaces in the crystallized quartz. Its resinous internal reflection is very characteristic and along with micro chem tests for zinc, its mouse gray color and negative etch reactions it is easily recognized.

Chalcopyrite       $\text{CuFeS}$

This mineral occurs as exsolved intergrowths in sphalerite. These intergrowths are lath like elongate stringers<sup>1</sup> which appear to follow crystal boundaries, but in most cases occur as minute blebs in somewhat parallel orientation, and are seen only under high magnification. Chalcopyrite is recognized by its brass yellow color, isotropism, easily scratched with needle having a hardness of C, micro chem tests for copper and iron and its negative etch reactions.

Tetrahedrite       $5\text{Cu}_2\text{S} \cdot 2(\text{Cu}, \text{Fe})\text{S} \cdot 2\text{Sb}_2\text{S}_3$

Tetrahedrite is a very minor constituent in the ores and occurs only in direct association with fibrous boulangerite and calcite. It is found in sections E.A. 1 and E. A. 2 where quartz gangue is prominent but does not occur with the other massive sulfides. The mineral is light gray in color with a slight suspicion of pink, is isotropic, has a hardness of C- gave negative etch tests and positive tests for copper and antimony. An X-Ray nowever was required and its presence was

confirmed.

Boulangerite  $5\text{PbS}\cdot\text{Sb}_2\text{S}_3$

Boulangerite is a very common sulfide and occurs in two distinct forms:- (1) A fibrous variety associated with tetrahedrite and disseminated through quartz and later calcite. It is found only in sections E.A. 1 and 2 where quartz is the main mineral.

(2) The massive variety is very common and occurs healing fractures in pyrite and replacing other sulfides as well as quartz.

A distinctive characteristic of boulangerite is its pleochroism which gives the appearance of two minerals being present, one impression is galena white with a slight suspicion of pink while the other appears slightly gray with a greenish suggestion. Triangular pits due to the prismatic cleavage are fairly common. The mineral is galena white in color; is anisotropic with colors changing from light gray to medium gray to a bluish gray; hardness of B; positive etch tests to HCl, HNO<sub>3</sub> and negative to KOH which distinguished from other lead antimony sulfides. Micro chem tests yielded lead and antimony. X-Ray patterns taken of the powder proved the mineral to be boulangerite.

Calcite  $\text{CaCO}_3$

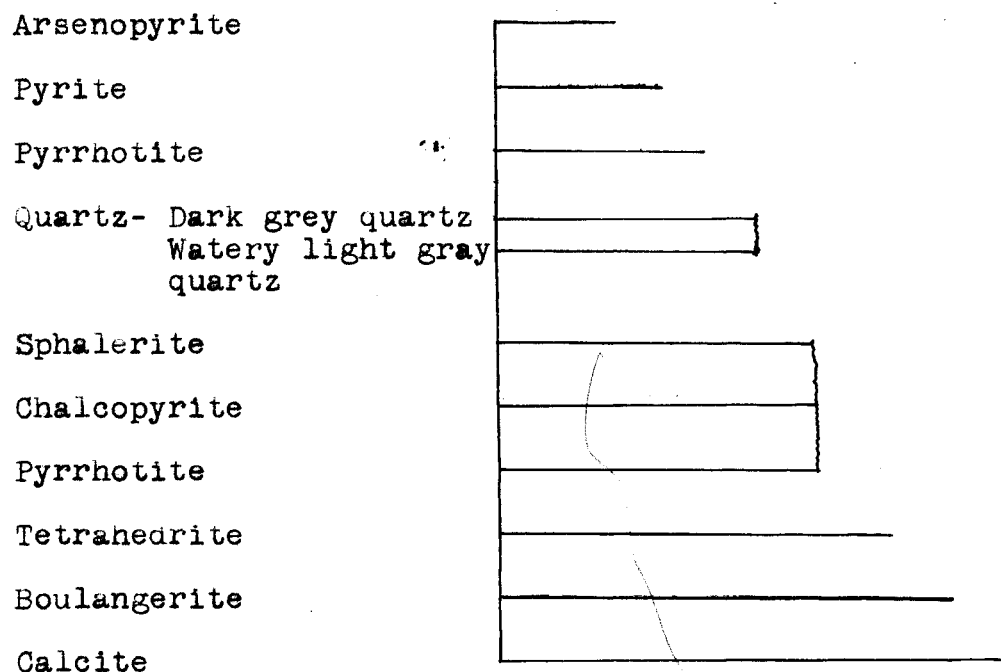
Calcite is the latest mineral to be deposited in the depositional sequence and is seen replacing fibrous boulangerite and tetrahedrite. It occurs only in small amounts in specimens E. A. 1 and E. A. 2.

List of Sections and Minerals Present

Section	Minerals Present
E.A. 1	<p>Pyrite is the most common sulfide; arsenopyrite is minor and is present in diamond shaped crystals; sphalerite, chalcopyrite, tetrahedrite and massive boulangerite are very minor; fibrous boulangerite fairly common.</p> <p>Quartz is the most common gangue and comprises about 70% of the section. Both varieties, dark gray and watery light gray quartz are present. Calcite is present in small amounts.</p>
E.A.2(A-B)	<p>As above with the exception of pyrite which is almost absent and pyrrhotite is the most common iron sulfide. Tetrahedrite and fibrous boulangerite are both fairly common in this section.</p>
E.A. 5	<p>Pyrite is dominant; arsenopyrite minor; sphalerite very common with chalcopyrite and a few laths of pyrrhotite in exsolution.</p> <p>Massive boulangerite is very common. Both varieties of quartz are present with the dark gray quartz crystallising in well defined hexagonal outlines.</p>
E.A. 6	<p>Massive pyrite and a few cubic crystals are present; arsenopyrite present as diamond</p>

Pyrite, pyrrhotite, arsenopyrite, sphalerite, tetrahedrite and boulangerite all occur in massive form and their grain sizes are too approximate to be worthy of mention.

### Paragenesis



Arsenopyrite appears to be the first mineral that was deposited. It appears in many cases to be contemporaneous with pyrite as they form mutual border relations and in other cases they seem to grade into each other, however, sufficient evidence was found where arsenopyrite which was badly corroded remained as residual remnants in pyrite indicating its replacement by pyrite (Plate I). Pyrite replaced the arsenopyrite as explained above, it was followed by a period of fracturing leaving openings for later hydrothermal solutions.

Pyrrhotite is believe to follow pyrite in genetic

sequence. In section E.A.2 vague cubic and dodecahedral outlines of pyrrhotite suggest pseudomorphs after pyrite. Massive pyrrhotite appears to be filling vacancies of former pyrite which has been dissolved and carried away leaving outer rims of pyrite. It appears that hydrothermal solutions have altered the pyrite to pyrrhotite except the small rims that are in contact with quartz. This evidence though very suggestive is not very conclusive.

The arsenopyrite, pyrite, and pyrrhotite were badly corroded and in addition the pyrite was highly fractured. These have been healed by quartz and replaced by later sulfides. Two distinct varieties of quartz were then deposited, dark gray quartz which has crystallized in part and watery light gray quartz. Both appear to be contemporaneous in depositional sequence. Many euhedral hexagonal crystals of dark grey quartz are present which were later filled with incoming sulfides suggest a loose crystalline structure which permitted the influx of these sulfides. In addition quartz has been fractured and replaced by later sulfides.

Sphalerite followed quartz during the deposition. It has filled and healed fractures in the earlier iron sulfides and quartz having also filled the openings between the quartz crystals. Chalcopyrite and pyrrhotite were formed contemporaneously with sphalerite in solid solution. Chalcopyrite seems to follow crystal boundaries in sphalerite and the blebs have aligned themselves in somewhat parallel orientation. The

pyrrhotite occurs as laths or elongate blebs and are very few in number. It may be regarded as second generation pyrrhotite since it was formed at a later date than the earlier massive variety. (Plate #2)

Tetrahedrite followed sphalerite in the genetic sequence. Although it was not found replacing any of the earlier minerals it has been replaced by later boulangerite. Plate #3 illustrates this replacement.

Fibrous and massive boulangerite replace the tetrahedrite and in most cases the fibrous variety has done the replacing. This may suggest that the fibrous variety was formed during the early crystallisation of boulangerite and the massive variety at a later stage. The massive form has also replaced sphalerite and other earlier minerals and in addition has filled in fractures in pyrite and quartz and filled the open spaces between the quartz crystals. (Plate #4)

Calcite was the last mineral to be deposited and it is seen replacing tetrahedrite and later boulangerite. (Plate #5)

#### Conclusions

1. The ores are apparently of hydrothermal intermediate temperature origin.
2. Replacement and open space filling have been the dominant processes in the formation of the sulfide ores.
3. The early formed minerals like arsenopyrite and pyrite were shattered and fractured and were invaded along the

fractures by younger minerals.

4. Quartz gangue healed the fractures without replacing them.

5. Quartz was fractured during a subsequent period with later minerals filling these fractures in the quartz and the earlier iron sulfides and replaced the fractured mineral.

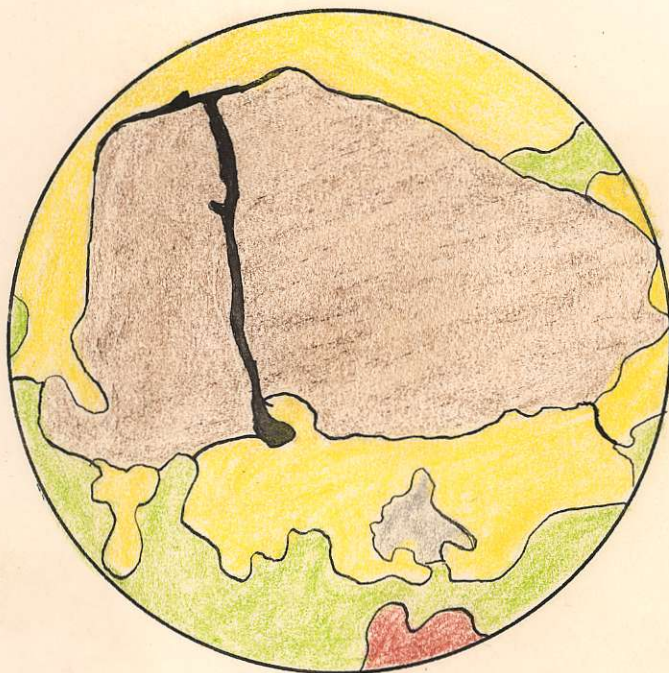
6. The later sulfides filled open spaces between the quartz crystals.

7. The minerals in the ore are fine to medium grained.







8. Pyrite, sphalerite, and boulangerite are the chief ore minerals present.

9. Quartz is the chief gangue mineral with minor amounts of calcite.

Plate #I  
Section E.A. 8



X 220

- |   |              |  |              |
|---|--------------|--|--------------|
|  | Arsenopyrite |  | Sphalerite   |
|  | Pyrite       |  | Boulangerite |
|  | Quartz       |  | Fractures    |

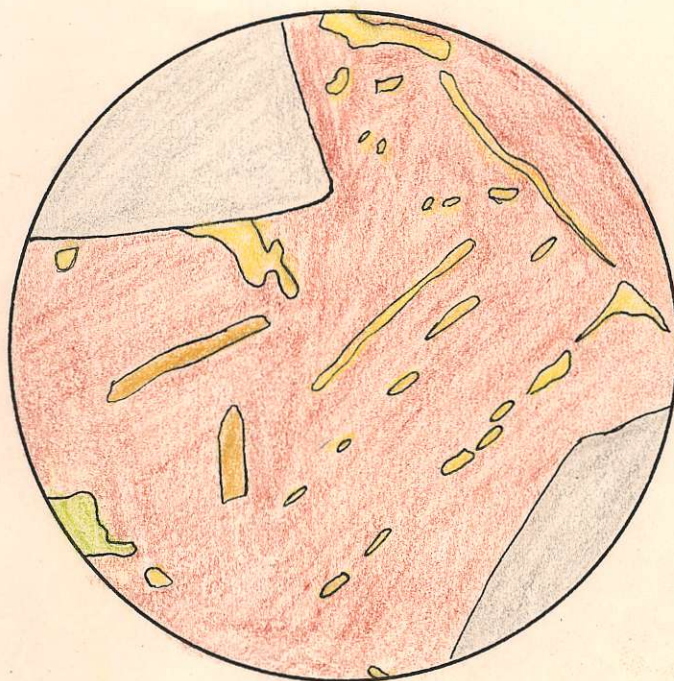
Remarks

Arsenopyrite is shown being replaced by pyrite, quartz has filled an open space in the corroded pyrite and boulangerite is replacing sphalerite and filling in fractures in the pyrite.



Plate #2.

Section E.A. 8



X 220



Sphalerite

Chalcopyrite

Pyrrhotite



Quartz

Boulangerite

Remarks

Sphalerite is seen filling in open spaces between the quartz crystals. Chalcopyrite and pyrrhotite are in exsolution with sphalerite, with the chalcopyrite following crystal boundaries of sphalerite. The blebs of chalcopyrite have aligned themselves in parallel orientation. Boulangerite is seen beginning to replace the sphalerite.

Plate # 3  
Section E.A. 2-B



X 220



Tetrahedrite



Quartz



Boulangerite

Remarks

Tetrahedrite in contact with quartz is being replaced by fibrous boulangerite.

Plate #4.

Section E.A. 5



X 220



Sphalerite



Pyrrhotite



Boulangerite



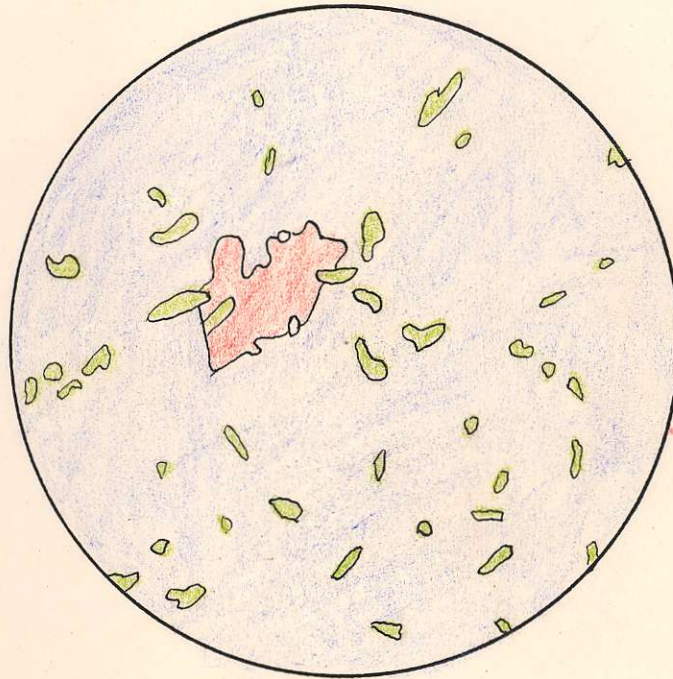
Pyrite

Remarks

Sphalerite is shown replacing pyrrhotite and pyrite,  
and boulangerite is replacing the sphalerite.

Plate #5.

Section E.A. 2-A



X 220



Tetrahedrite



Calcite



Boulangerite

Remarks

Boulangerite replacing tetrahedrite followed by their replacment by calcite gangue.

BIBLIOGRAPHY

1. Short M. N. "Microscopic Determination Of The Ore Minerals," United States Department of the Interior, Geological Survey Bulletin 914
2. Edwards A. B. "Texture Of The Ore Minerals."
3. Kerr F. A. Taku River Map Area, Canadian Geological Survey, Memoir 248
4. Mandy J. D. "Report on the Taku River Area, Atlin Mining Division, Northwestern Mineral Survey District British Columbia," Dept. of Mines, Bulletin I, 1936
5. Short M. N. "Criteria of Age Relations of Minerals," Econ. Geol., 26, 561-610 (p. 586) (1931)
6. Schouten C., "Structures and Textures....," 655-656, (1934) .
7. Gruner J. W., "Structural Reasons for Oriented Intergrowths in Some Minerals," Amer. Mineral., 14, 227 (1929)
8. Buerger N. W., "The unmixing of chalcopyrite from sphalerite," Amer. Mineral., 19, 528 (1934)