A Mineralographic Report of the Ore Minerals of the Silver Standard Mine, British Columbia

by

George Fulford

Department of Geology, University of British Columbia

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4073 W. 18th Ave.,
Vancouver, B.C.
April 15, 1954.

Dr. R.M. Thompson,
Department of Geology,
University of British Columbia.

Dear Sir:

I hereby submit a Mineralographic Report on the Ore Minerals of the Silver Standard Mine, British Columbia, in partial fulfilment of the requirements of the course in Geology 409.

Yours truly,

George Fulford.

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LIST OF ILLUSTRATIONS

ACKNOWLEDGMENTS

The preparatory work for this report was done in the Geology Laboratory at the University of British Columbia.

The writer wishes to express his appreciation to Dr. R. M. Thompson and to Mr. W. C. Jones for their valuable assistance.

SILVER STANDARD MINE

Location and History of the Mine

The Silver Standard Mine, a silver-lead-zinc property, is located in the Omineca Mining Division of British Columbia, six miles northwest of the New Hazelton railway station. Its holdings include twenty-one Crown-granted claims and thirty-two located claims. Most of the ore is obtained from six of the fourteen known veins. Crude ore was shipped from 1913-1917. After the installation of a 50 ton mill in 1917, the ore was concentrated and shipped until operations were suspended in 1922. The property was under active development by Canadian Cadillac Gold Mines, Limited, of Montreal, during 1938, but operations were suspended early in 1939, owing to lack of funds.

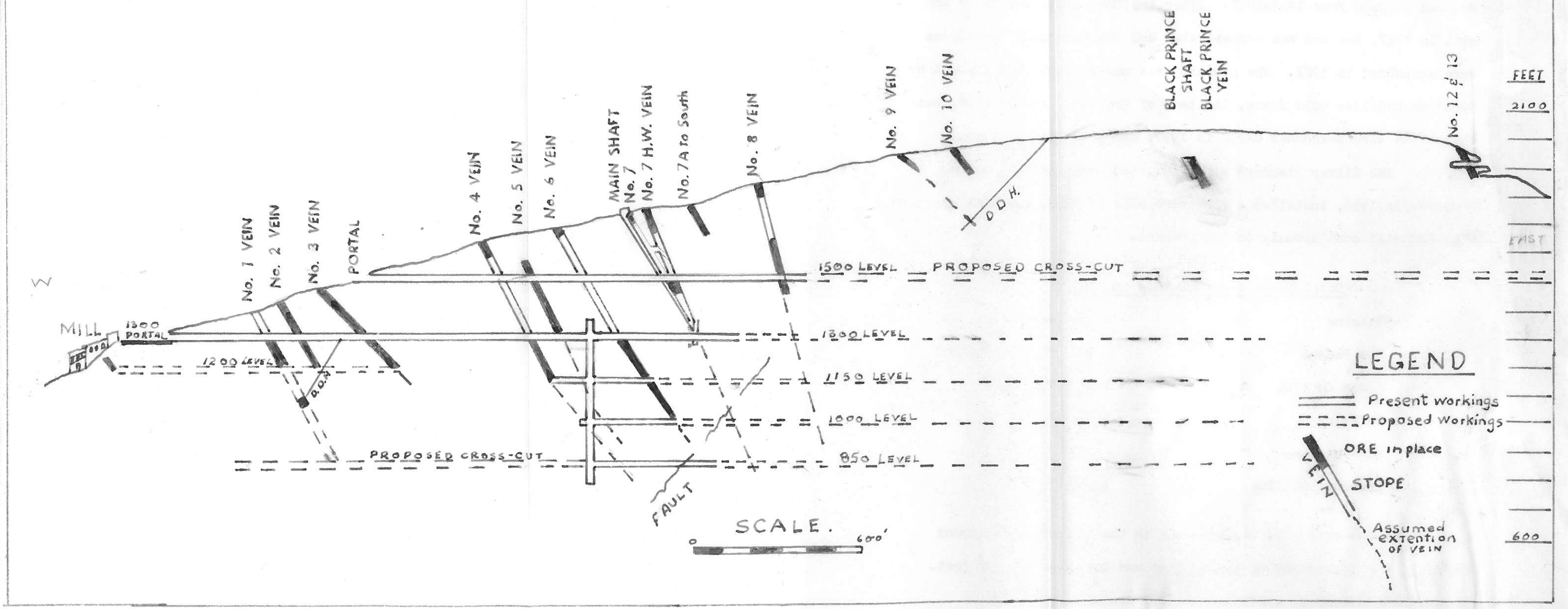
The Silver Standard Mine Ltd., took over control of the property in 1946, installed a flotation mill in 1948, and have operated mine and mill continuously to the present.

Development and Work Done in 1953

Raising	1,134 feet
Ore Passes	342 "
Cross Cutting	1,208 "
Drifting	1,606 "
Sub-drifting	115 "
Diamond Drilling	3,564 "

A new vein, No. 7A, adjacent to the present underground workings, was discovered on the surface and stripped for 700 feet. It contains economical grade lead-silver ore in sections.

CROSS SECTION OF
SILVER STANDARD MINE
SHOWING PRESENT WORKINGS AND PROPOSED DEVELOPMENT



Development was concentrated in the shaft area. The shaft-sinking programme was completed and an ore pass system added. On No. 6 vein, the 1,150 ft. - 1,300 ft. level block was prepared for mining; the 1,000 ft. - 1,150 ft. block partially completed; and, on the 850 ft. the crosscut to No. 6 vein was advanced and, due to a large post mineral fault, is thought to be some three hundred feet short of its objective. A diamond drill hole from the cross cut has located the downward extension of No. 6 vein below the 1,000 ft. level with a narrow intersection assaying 0.15 oz. Au, 80.3 oz. Ag. On No. 4 vein at 1,150 ft. level, several hundred feet of drifting disclosed a strong, well-mineralized vein, but only patches of commercial ore. Diamond drilling successfully located an ore area above the top level on No. 6 vein where an intersection 1.9 feet wide graded 0.18 oz. Au, 248.7 oz. Ag, 13.9% Pb and 28.6% Zn.

General Geology

The principal veins and mine workings are on the western side of Glen mountain, between elevations 850 feet and 2,200 feet. The area is underlain by a thick series of gently folded rocks of the Hazelton group of Upper Jurrasic or Lower Cretaceous age, and range from course, gray, impure limestone and graywacke to finely laminated, grey to green argillites. The sandstone contains rounded fragments of lava and grade into beds of tuff. The sediments in the mine area form a low anticline with the limbs of the fold dipping east and west and the axial plane striking north. West of the main adit, the dip is 35° West; east of it, 5° to 15°, East, striking North. The west limb of the anticline is intruded by two small granodiorite bodies, the diameter of the larger being approximately five hundred feet. These granitic bodies appear to be of the same age or are a little younger than the Hazelton group. Numerous faults are exposed in the mine workings but displacement is only from a few inches to a few feet.

The thirteen veins on the property all strike northeast and dip from 50° to 70° southeast. They occur along strong fault fissures in the folded sedimentary rocks. No. 3 vein extends into the granodiorite. The veins range in length from 100 feet to 1,500 feet and in width, from a few inches to 10 feet. They occur within a width of 4,500 feet from west to east across the mountain and are numbered consecutively from west to east.

Ore Reserves

Estimates of Ore Reserves as of March 31, 1953

Place	Tons Proven	Tons Probable	Total
Old Tailings	2,169	-	2,169
No. 1 Vein	1,197	2,625	3,822
No. 4 Vein	2,751	2,467	4,218
No. 6 Vein	28,444	7,565	36,009
No. 7 Vein	2,942	262	3,204
No. 8 Vein	477	955	1,432
No. 12 Vein	197	-	197
Broken	5,745	-	5,745

Grade:- 0.116 oz. Au., 41.5 oz. Ag., 4.4% Pb, 8.2% Zn., 0.115% Cd.

The ore is trucked six miles to the railroad at New Hazelton and taken by rail to Trail, British Columbia. Copper was recovered for the first time in 1953 due to new smelter arrangements providing for payment for copper content in lead concentrates.

Megascopic Description

The suite of specimens studied were collected by Mr. D.R. West. The minerals ~~visited~~ occurring in the hand specimens, in approximate order of their abundance are: galena, sphalerite, tetrahedrite, chalcopyrite and pyrite.

The main gangue minerals are quartz and minor amounts of siderite, chlorite, and probably some carbonate.

The medium-grained galena shows characteristically well-developed cleavage. Sphalerite is orange-brown and massive; tetrahedrite, mouse-gray and massive. Chalcopyrite is sparsely and erratically distributed throughout the specimens. No evidence of any oxidized ore was found but in two polished sections possible evidence of Limonite was observed.

The individual specimens are described in the appendix.

Identification of Minerals

Nine polished sections of the ore were made. Determination of the minerals was made from their physical properties (colour, hardness, texture and anisotropism), their etch tests, using the standard reagents, $HgCl_2$, KOH, KCN, HCl 1:1, Fe Cl_3 and HNO_3 1:1, and by microchemical procedures.

Arsenopyrite: Fe As S

Arsenopyrite occurs in grains up to 0.4 m.m. in diameter. The mineral exhibits a number of euhedral crystals with characteristic rhombic cross-section whose borders show no corrosion. The Arsenopyrite is associated with sphalerite and galena (see figure 3) in which it occurs as euhedral crystals. It is possible to say only that the Arsenopyrite formed earlier than the sphalerite. The Arsenopyrite was identified by its "galena"-white colour, hardness F , and polarization colours greenish yellow, violet.

Bournonite: 2 PbS. Cu2S. $Sb2S_3$

Bournonite was found in only one section in which it occurred as rims around tetrahedrite and in some places completely replacing it. The bournonite separates tetrahedrite from meneghinite (Fig. 10). It replaces tetrahedrite and seems to send projections into the meneghinite. It is, therefore, believed to be younger than the meneghinite. Identification was by its gray colour, greenish-gray to purple polarization colours and its hardness C.

Chalcopyrite: Cu Fe S_2

Veins and masses of Chalcopyrite are present in most of the sections. It appears that the Chalcopyrite has been deposited continuously throughout the period of mineralization. It is associated with pyrrhotite, veining sphalerite (Fig. 7) and replacing galena. It was identified by its yellow colour, hardness C, and its isotropism.

Galena: PbS.

Galena is the most common mineral in the sections. Small blebs of pyrargyrite, sphalerite, chalcopyrite, and tetrahedrite are scattered throughout it. It also exhibits the typical triangular cleavage pits. Silver has been reported to be present in the galena in solid solution, but no spectrographic determinations were made to confirm this. Galena was identified by its "galena"-white colour, hardness B, and its isotropism.

Pyrite: $Fe S_2$

Pyrite was identified by its pale, brass-yellow colour, hardness F, and isotropism. Deposition of pyrite will be discussed in the paragenesis (p. 16).

Pyrrhotite: Fe S.

Pyrrhotite occurs only in one section, possibly replacing pyrite. It was identified by its pinkish-cream colour, hardness D, and light grey to brown polarization colours.

Sphalerite: ZnS.

Massive sphalerite is a common mineral in the sections, exhibiting strong, resinous internal reflection, grey colour, and hardness C. Sphalerite is veined by chalcopyrite and displays smooth boundaries with tetrahedrite. The tetrahedrite appears to intrude the Sphalerite, indicating it is later than the Sphalerite.

Marcasite: $Fe\ S_2$

Marcasite forms irregular but characteristic lamellae in pyrrhotite (fig. 4). It was identified by its pale, brass-yellow colour, hardness E , and yellow-green polarization colours. The marcasite occurs in one section only.

Pyrargyrite: $3\ Ag_2\ S.\ Sb_2\ S_3$

Pyrargyrite, the only silver mineral found in the sections, is associated with sphalerite and galena, appearing to replace the galena and tetrahedrite (fig. 8). When associated with galena, it has a distinctive greenish tinge. Chalcopyrite, occurring in it, gives it a mottled texture.

Tetrahedrite: $3\ Cu_2\ S.\ Sb_2\ S_3$

Tetrahedrite is a common mineral in most of the sections studied. It was identified by its grey colour, hardness D, and its etch reaction. Microchemical tests revealed Silver. Tetrahedrite is associated mainly with galena which is replacing the Tetrahedrite (fig. 9). Bournonite is also replacing it (fig. 10)

Unknown "A"

This mineral occurred only in polished section No. 2, as an exsolution product with the chalcopyrite. It appeared as a light yellow lath in the chalcopyrite. Its hardness was C-D and it was isotropic. The mineral was negative to all etch tests except HNO_3 and KOH which produced a brown etch. When the section was repolished, the mineral disappeared and it was impossible to identify it from the data accumulated.

Distribution of Minerals in the Polished Sections

	1	2	3	4	5	6	7	8	9
Arsenopyrite							C		P
Pyrite		A				P.			
Chalcopyrite		C	P	P		P	P	P	P
Galena	A	C	A	A	A	A	A	A	
Sphalerite	A	A	A	P		P	A	A	C
Pyrrhotite		A							
Marcasite		C							
Tetrahedrite	A	P	C	A		A	A	P	A
Meneghinite				P					A
Bournonite									A
Pyrargyrite		C			P				

A - abundant

C - common

P - present

Metallic	Gangue
Galena	quartz
Sphalerite	siderite
Tetrahedrite	chlorite
Pyrite	limonite
Pyrrhotite	carbonate
Marcasite	

Chalcopyrite

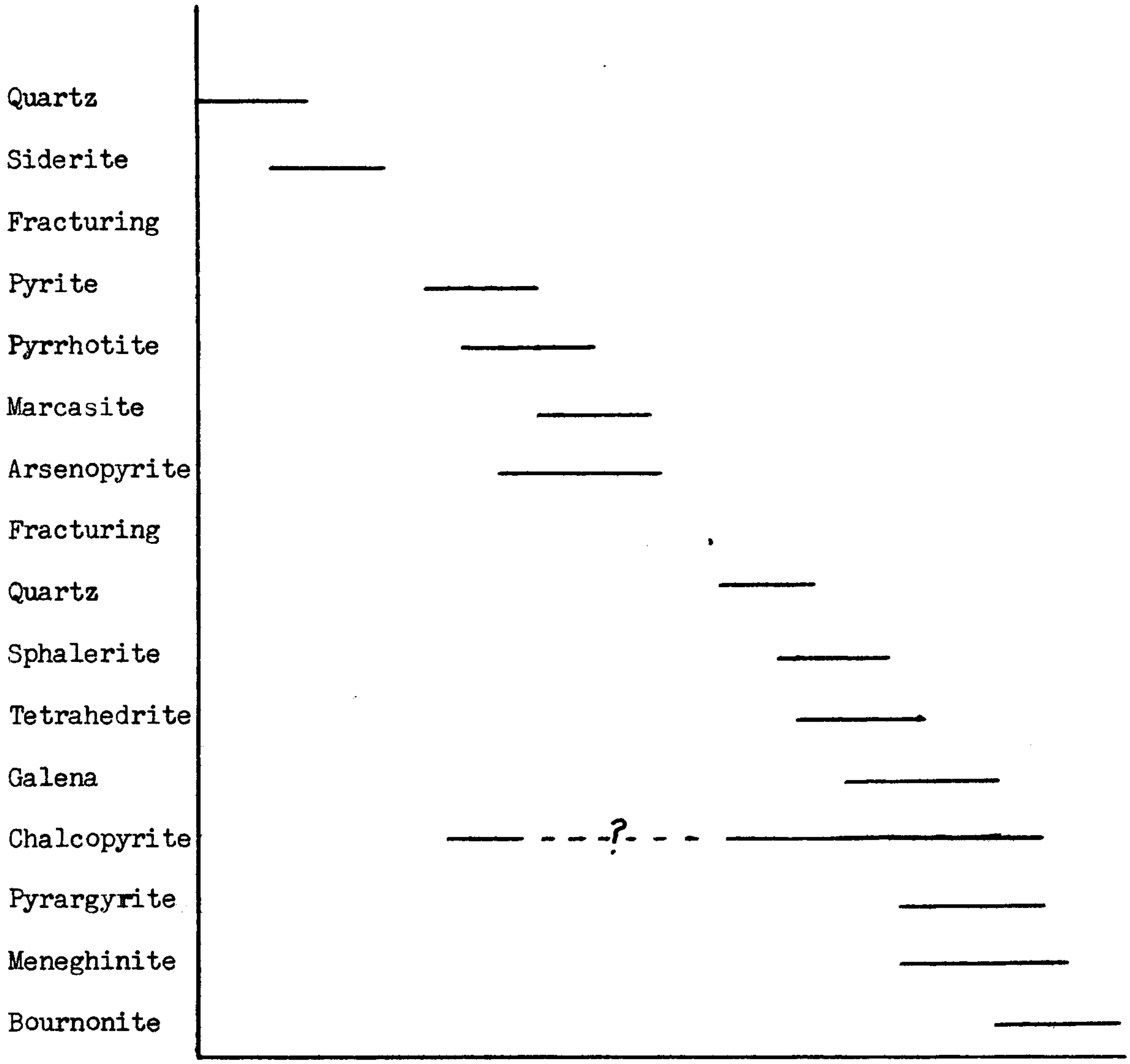
Arsenopyrite

Meneghinite

Bournonite

Pyrargyrite

Period of Deposition



Paragenesis

From the hand specimens, it was observed that quartz was deposited and then partially replaced by siderite which was fractured and later filled with sulphides. The relationship between the pyrite and pyrrhotite is difficult to establish. Almost perfect cubes of pyrite are scattered through the pyrrhotite. Partial euhedral crystals of pyrite occur throughout massive pyrite. This suggests that the pyrite was deposited first. Small masses of pyrrhotite are scattered throughout the pyrite. Marcasite, found as irregular, but characteristic, composite lamellae, is associated with pyrrhotite. Euhedral crystals of arsenopyrite occur scattered through the sphalerite and galena, indicating it is older. Chalcopyrite may have been deposited throughout the mineralizing period or in two stages of deposition since it is associated with pyrite and pyrrhotite and also the sulpho-salts. Further fracturing occurred and was succeeded by deposition of quartz and sulphides including, sphalerite, tetrahedrite, galena, pyrargyrite, meneghinite, and bournonite.

Discussion

Marcasite, formed from pyrrhotite by a change in the acidity and temperature of the residual mineralizing solutions, renders the pyrrhotite unstable so that it dissolves spontaneously. The iron and sulphur set free are reprecipitated almost immediately as marcasite, which is stable under the new conditions.*[1]

Sphalerite and argentiferous tetrahedrite are the most important minerals. Arsenopyrite is important since it apparently acted as the precipitant for gold.*[2] Free gold has been reported to occur in the ore but the author was not able to locate any in the polished sections examined. Some of the silver may occur in the galena, either in solid solution or in small amounts of ruby silver, but nearly all the high silver values are associated with tetrahedrite. The sphalerite concentrates contain an appreciable amount of cadmium but little silver. Two periods of mineralization are believed to have occurred as indicated by the two periods of deposition of quartz. The ore appears to be localized where small fissures join the main vein at a small angle.

The deposit appears to be typical of hydrothermal mineralization and probably would be classed as a mesothermal deposit. The pyrite and pyrrhotite would be deposited, probably, at the higher temperatures (400°C), while the sulpho-salts would probably be deposited at the lower temperature (200°C).

1. Edwards: page 100
2. Report of Minister of Mines (B.C.) Mem 223

Megascopic Examination

Specimen No. 1, from No. 8 vein, north drift, on 1,500 foot level, is approximately 3.5" x 2.5" x 1" in size. It contains coarsely crystalline galena and small amount of pyrargyrite. The galena and pyrargyrite occur in badly-fractured, milky-white quartz. The specimen is so badly fractured that fragments, $\frac{1}{4}$" x $\frac{1}{4}$" x $\frac{1}{4}$", are easily broken off by hand. A light tan coloured particle, $\frac{1}{2}$" x $\frac{1}{4}$", is visible as well as specks of chalcopyrite. Polished section No. 5 is from this specimen.

Specimen No. 2, is 2.5" x 1.5" x 1" and its source is not known. It consists entirely of massive galena with well-developed cleavage faces and mouse-grey tetrahedrite; about 40% of the specimen is galena and the remainder is tetrahedrite. Minor amounts of chalcopyrite are also present. Polished section No. 4 came from this specimen.

Specimen No. 3 was taken from 1,304 foot level, south drift and shows light tan-coloured, coarse grained siderite. The siderite is fractured and the veinlets are filled with later, milk-white quartz and mouse-gray tetrahedrite. Minor amounts of chalcopyrite and sphalerite are present. A soft, grey inclusion, about $\frac{1}{2}$" square, can be seen, bounded by quartz stringers. Meneghinite and bournonite were found in a polished section (No. 9), taken from this sample.

Specimen No. 4 is from No. 6 vein, 1,400 foot stope and is approximately 2.5" x 2.5" x 1.5" in size. It consists entirely of galena (80%) and sphalerite (20%). As the galena was seen to vein the sphalerite, it is considered to be younger than it. Polished section

No. 3, came from this specimen.

Specimen No. 5 came from the hanging wall of No. 4 vein, south drift, on the 1,300 foot level, about 75 feet south of the main cross cut. This specimen contains inclusions of the wall rock (probably an altered tuff or argillite) as well as a soft, white mineral, probably a carbonate. Small, isolated stringers of milky-white quartz occur. This quartz is fractured and filled with sulphides. Sulphides present are: orange-brown sphalerite, tetrahedrite, and chalcopyrite. Polished sections No. 7 and 8 are from this specimen.

Specimen No. 6 is a sample of the wall rock. It consists of a soft, grey-coloured rock, probably tuff or argillite. This rock is shot through with stringers of milky-white quartz and a green mineral identified as chlorite. The specimen exhibits clear, quartz crystals and drusy cavities in which chlorite occurs in sheaf-like bunches. The quartz crystals are rather unusual in shape. They are approximately 6 m.m. x 3 m.m. x 0.25 m.m. in size. The quartz is clear and shows well-developed terminations, but it is very flat, unlike ordinary quartz crystals that would be expected to form in vugs. I have arrived at no adequate explanation of this unusual shape. Isolated patches of milky-white quartz also occur throughout the specimen. Metallic minerals present are: sphalerite, pyrite, and chalcopyrite.

Key to Figures 1-9

ZnS	Sphalerite
PbS	Galena
PY	Pyrargyrite
Te	Tetrahedrite
[illegible]	Marcasite
Pr	Pyrrhotite
P	Pyrite
Ch	Chalcopyrite
Ga	Gangue
As	Arsenopyrite
Me	Meneghinite

Scale: fig. 1-9

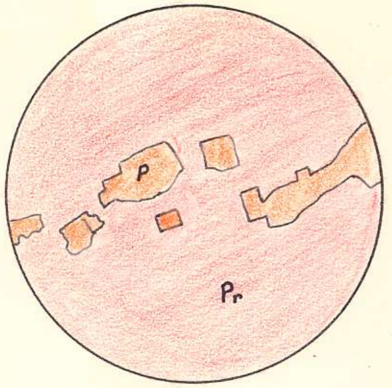


Fig. 1 - Euhedrial crystals and sub-euhedral crystals of pyrite occurring in Pyrrhotite.

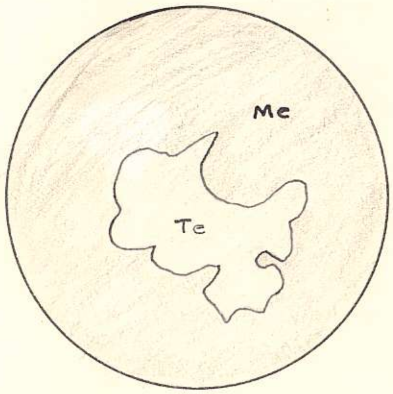


Fig. 2 - Meneginite replacing tetrahedrite.

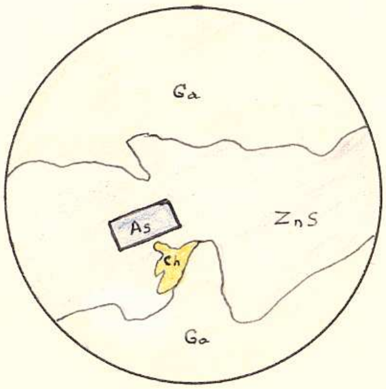


Fig. 3 - Euhedrial crystals of arsenopyrite occurring in massive sphalerite.

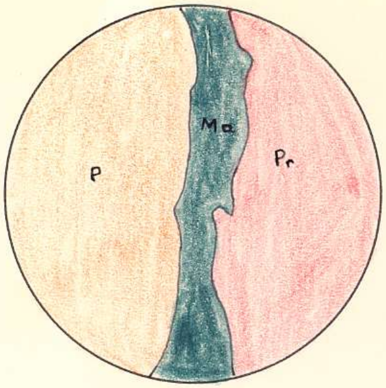


Fig. 4 - Irregular, characteristic lamellae of marcasite separating pyrite from pyrrhotite.

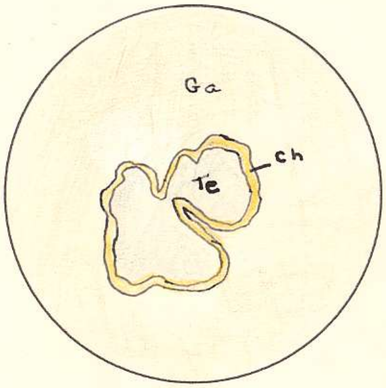


Fig. 5 - Rims of chalcopyrite around tetrahedrite.

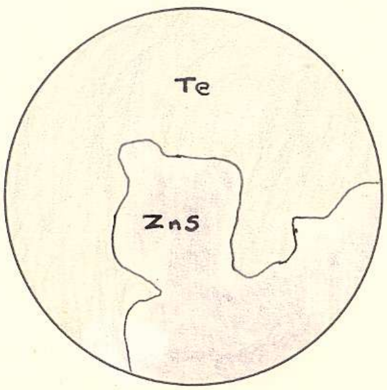


Fig. 6 - Shows tetrahedrite replacing sphalerite.

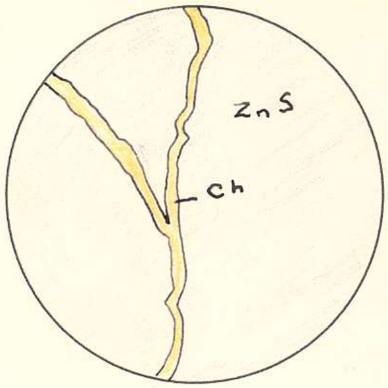


Fig. 7 - Vein with matching walls in sphalerite. The vein filling of chalcopyrite has filled a fracture and opened it without replacing the sphalerite.

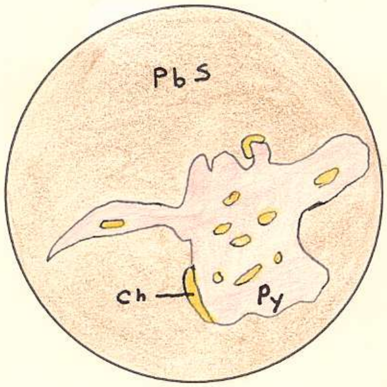


Fig. 8 - "Mottled" texture between pyrargyrite and galena. Pyrargyrite is replacing galena.

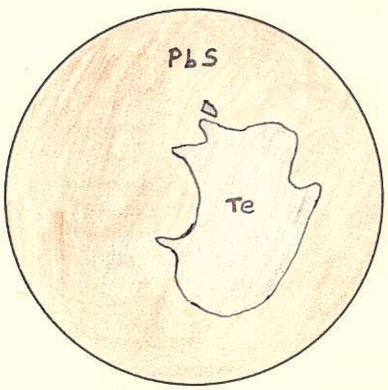


Fig. 9 - Shows Galena replacing tetrahedrite.

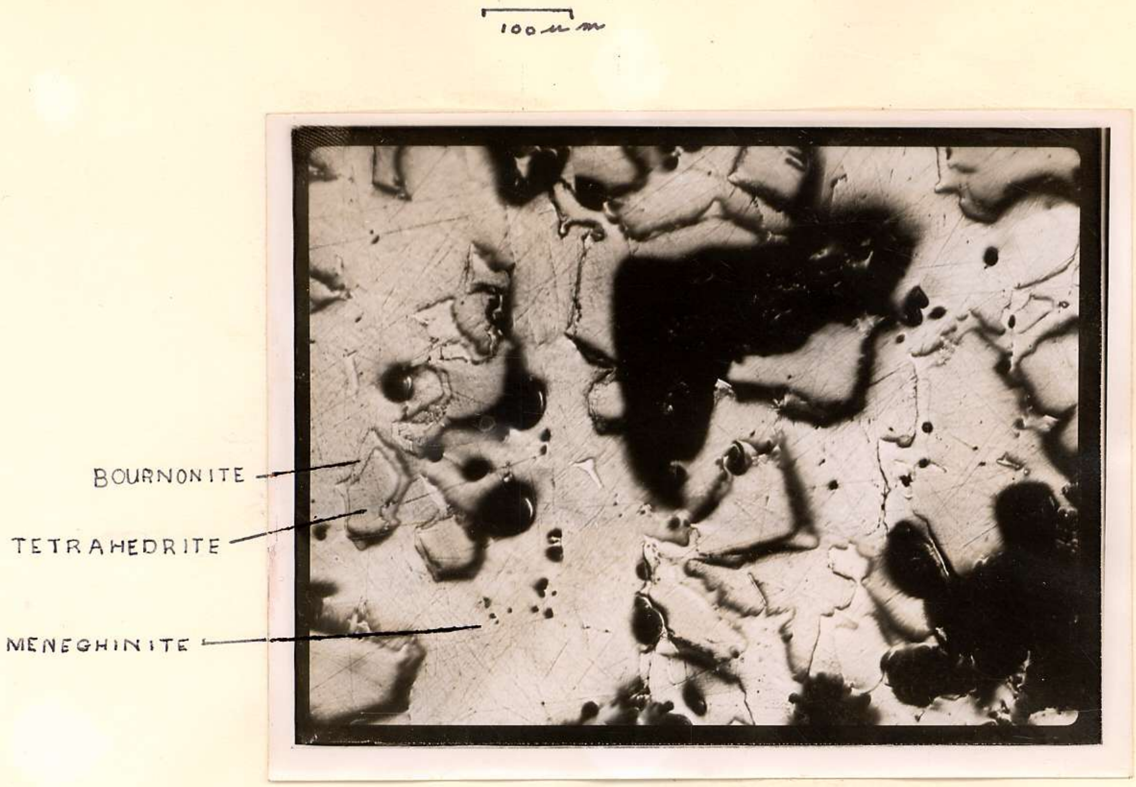


Fig. 10 - Shows rim of Bournonite around tetrahedrite.

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CANADA

DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

BUREAU OF GEOLOGY AND TOPOGRAPHY

GEOLOGICAL SURVEY

LEGEND

CENOZOIC

TERTIARY

EOCENE OR LATER

6 — Andesite and dacite

CRETACEOUS OR TERTIARY

UPPER CRETACEOUS OR LATER

5 — Granodiorite, minor diorite (Age relation to 4 uncertain)

UPPER CRETACEOUS OR PALEOCENE

4 — Conglomerate, sandstone, shale, and coal

MESOZOIC

JURASSIC AND CRETACEOUS

LOWER CRETACEOUS OR LATER

3 — Andesitic dacitic, rhyolitic, and basaltic flows, tuffs, and breccias; minor sandstone, shale, and conglomerate

UPPER JURASSIC AND LOWER CRETACEOUS

2 — Greywacke, shale, conglomerate, argillite, tuff, quartzite, hornfels, and coal; 2a, sedimentary rocks containing Blairmore flora

MIDDLE JURASSIC

1 — Andesitic, dacitic, rhyolitic, and basaltic flows, tuffs, and breccias

HAZELTON GROUP

Heavily drift-covered area ....

Glacier .... Gl.

Bedding (inclined, vertical, horizontal) ....

Anticlinal axis ....

Fault ....

FOSSIL LOCALITIES

Plants of Paleocene age .... (P)

Plants of Blairmore age .... (B)

Plants of Kootenay age .... (K)

Plants of Blairmore or Kootenay age .... (KB)

Shells of Upper Jurassic age .... (UJ)

Shells of Jurassic or Cretaceous age .... (JC)

Mine or Prospect .... ●

MINES AND PROSPECTS

(Productive Mines are Underlined)

COMPLEX SILVER-LEAD-ZINC DEPOSITS

4. Silver Bell
5. Barber Bill
6. Silver Cup
7. Pole Star
8. Sunrise
9. Lead King
10. Slocan
11. Silver Pick
13. True Fissure
15. American Boy
18. Silver Standard
19. Babine
20. Erie
21. Comet
35. Brunswick
37. Brian Boru
38. Killarney

LEAD-SILVER DEPOSITS

12. O. K.

COPPER-GOLD-SILVER DEPOSITS

22. Daly West
23. Hecla
24. Golden Wonder
25. Cap (Conneau)
30. Highland Boy
31. Rocher Déboulé
32. Great Ohio
33. Spaulding
36. Sultana

LOW GRADE GOLD-SILVER DEPOSITS

1. Fortune Hill
2. Silverton
14. Higgins
17. Surprise
27. Lone Star
28. Macdonald

TUNGSTEN DEPOSITS

29. Black Prince
34. Red Rose

GOLD-COBALT-ARSENIC DEPOSITS

26. Hazelton View

COAL AREAS

3. Kispiox-Shegunia
39. Skeena Crossing
40. Seaton

MARL DEPOSITS

16. Robinson Lake

NOTE. For detailed descriptions of properties see Geological Survey Memoir 223

Geology by J. E. Armstrong and J. G. Gray, 1938; E. D. Kindle, 1938, 1939.
Geological compilation and descriptive notes by J. E. Armstrong, 1944.

Road ....

Trail ....

Contour interval, 500 feet

56°00'

45'

30'

15'

55°00'

128°00' COAST DISTRICT, RANGE 5 45' 15' 127°00'

Surveyed and compiled by the Topographical Survey.
Issued 1944.

DESCRIPTIVE NOTES

Bedrock is well exposed above timberline, at an elevation of about 5,000 feet, but elsewhere rock outcrops occupy less than 5 per cent of the map-area and are found mainly in cliff and stream canyons. Drift deposits, chiefly of glacial origin, mantle the timbered slopes and spread out widely and deeply in most of the lowland areas.

The cores of the mountains are composed of igneous rocks and these have metamorphosed and hardened the enveloping formations, thus forming massifs resistant to erosion, whereas the valleys are for the most part carved from softer, unmetamorphosed rocks.

The Hazelton group consists of an apparently conformable succession, possibly 10,000 feet thick, of interbedded sedimentary and volcanic rocks ranging in age from pre-Middle Jurassic to Lower Cretaceous, and including what have been called Hazelton group and Skeena formation or series. In the adjoining Smithers map-area to the south a five-fold division of the Hazelton group has been made, namely: a pre-Middle Jurassic volcanic division; a Middle Jurassic marine sedimentary division; a Middle or Upper Jurassic volcanic division; an Upper Jurassic and Lower Cretaceous marine and continental sedimentary division; and a Lower Cretaceous or later volcanic division. In the Hazelton area the first two of these divisions are either missing or have not been recognized. The rocks of the upper two volcanic divisions (1 and 3) are lithologically similar and can be separated only on the basis of stratigraphy. The age of the volcanic rocks outcropping on the west slopes of Rocher Déboulé Range has not been established definitely, but the rocks there have been correlated provisionally with the youngest volcanic division (3). The Upper Jurassic and Lower Cretaceous sedimentary division (2) consists of at least 5,000 feet of interbedded continental and marine strata. Fossil plants were collected from more than forty localities. These plants represent two distinct flora correlated provisionally with the Kootenay and Lower Blairmore of Alberta and, presumably, of Lower Cretaceous age. Fossil fauna were collected from at least twenty localities, but only two of the collections contained diagnostic specimens. These are of late Upper Jurassic age. They were collected from beds that apparently lie stratigraphically above beds containing fossil plants of Kootenay age. Strata of Blairmore age (2a) have been mapped separately in a few places, but elsewhere in the area they are included with older Hazelton strata. Coal is found associated with continental strata throughout the Hazelton group, although the best coal appears to occur in rocks of Blairmore age. These continental, coal-bearing members of the Hazelton group have hitherto been thought to comprise the Skeena formation or series and to overlie the Hazelton group conformably, according to some geologists, or unconformably according to others. Recent studies in this and the adjoining Smithers map-areas have, however, indicated that no satisfactory stratigraphic division can be made, and that continental strata comparable with the Skeena appear at various horizons in the Hazelton group. Near the larger bodies of granodiorite the strata have been indurated, and impregnated with pyrite.

Continental strata with coal and fossil plants of Upper Cretaceous or Paleocene age (4) occur in Bulkley Valley between Seaton and Moricetown. These rocks are lithologically similar to rocks in the Hazelton group (2), and it is quite probable that they occur elsewhere in the map-area but have not been recognized.

The granodiorite bodies (5) cut Lower Cretaceous strata and probably were intruded at the close of the Mesozoic era. Their relation to the Upper Cretaceous or Paleocene (4) sedimentary rocks is not known.

The Upper Cretaceous or Paleocene strata (4) are cut by andesitic dykes and are overlain unconformably by andesitic flows (6).

Dykes of andesite, dacite, rhyolite, aplite, and lamprophyre also cut the granodiorite and older rocks. These dykes are most abundant along the railway west of Skeena Crossing.

Within each local mountain range the bedded formations have been folded in a fairly uniform direction, which, however, in most places, does not persist across intervening valleys to neighbouring ranges. Further, the sedimentary strata in the main valleys are intensely deformed and the structures there exhibit no regular pattern. These facts suggest that the principal valleys lie along major fault zones, and that each individual mountain range or massif, as for example Rocher Déboulé Range, may represent a fault block. Much of the folding is asymmetrical, and in places overturned folds have developed into overthrust faults. Both normal and reverse faults are numerous throughout the map-area. Only those fold axes and faults that were actually mapped in the field are shown on the map. Many others were seen from a distance but are not mapped.

Most of the metalliferous deposits consist of sulphide-bearing quartz veins and vein-like replacements occupying fissure, fault, or shear zones in or near granodiorite intrusions. As a rule the higher temperature deposits, those carrying copper and tungsten ores, occur in or close to the larger stocks, whereas the lower temperature, silver-lead-zinc deposits lie either farther from these stocks or are found in or close to only the smaller intrusive bodies. Many of the known veins are both wide and long. The main veins on the Rocher Deboule (31) and Highland Boy (30) properties exceed 3,500 feet in length and range up to 8 feet in width. On the Silver Standard property (18) ten veins range from 100 to 1,500 feet in length and from a few inches to 10 feet in width. Veins on many of the other properties are 100 to 500 feet long and up to 5 feet wide.

The lead-zinc-silver deposits consist of varying amounts of galena, sphalerite, tetrahedrite, argentite, freibergite, jamesonite cosalite, arsenopyrite, and pyrite in a quartz gangue with minor amounts of carbonates. Principal values are in lead, zinc, and silver, but some properties, such as the Silver Standard (18) contain appreciable gold and arsenic, and others, including the Sunrise (8) and Lead King (9), contain significant amounts of antimony and bismuth. The Silver Standard (18) was operated intermittently from 1910 to 1922. In that period 14,500 tons of ore were mined and milled and 1,100 ounces of gold, 626,000 ounces of silver, 1,225,000 pounds of lead, and 1,400,000 pounds of zinc were recovered. Approximately 5,710 tons of ore were treated at the Silver Cup (6) mine in 1929. The Sunrise (8), Lead King (9), and American Boy (15) have made small shipments of hand-sorted ore.

The more important copper deposits consist of vein-like replacements along fissure or shear zones in granodiorite. These replacements contain chalcopyrite and lesser amounts of pyrite, magnetite, pyrrhotite, arsenopyrite, tetrahedrite, and molybdenite in a gangue of hornblende, actinolite, chlorite, and quartz. Safflorite, a cobalt diarsenide, is found in places in the Rocher Déboulé mine (31). From 1915 to 1918 the Rocher Déboulé produced 39,833 tons of ore containing 4,214 ounces of gold, 62,865 ounces of silver, and 5,746,306 pounds of copper. A small shipment of hand-sorted ore was made from the Highland Boy (30) in 1917.

One of the more promising of the low-grade gold-silver deposits is the Higgins (14). A vein on this property, 2,000 feet long and 2 to 7 feet wide, is sparsely mineralized with galena, sphalerite, tetrahedrite, pyrite, and scheelite.

The Black Prince (29) and Red Rose (34) tungsten deposits consist of quartz veins occupying shear zones in or close to granodiorite and diorite stocks. The tungsten occurs as wolframite, ferberite, and scheelite, and is associated with molybdenite, chalcopyrite, and tourmaline. The main vein on the Red Rose property is up to 12 feet wide and about 400 feet long. The property was in operation from January 1942 to November 1943, during which time approximately 625,000 pounds of tungsten were recovered.

The ore in the Hazelton View property (26) is essentially gold-bearing arsenopyrite, and occurs as shoots along a strong fault fissure, from a few inches to 3 feet wide, in granodiorite. Where ore shoots occur the altered granodiorite along the fissure is replaced by quartz and hornblende and by metallic minerals, which, in order of their abundance, are: arsenopyrite, safflorite, molybdenite, and chalcopyrite. Several carloads of ore have been shipped from this property.

The Kispiox-Shegunia (3) and Seaton (40) coal fields contain seams up to 5 feet thick, but these commonly include shale bands and are crushed and discontinuous. Various analyses show that the coal contains 10 to 20 per cent volatile matter, 40 to 70 per cent fixed carbon, and 20 to 30 per cent ash.

PRELIMINARY MAP 44-24

HAZELTON

CASSIAR DISTRICT

BRITISH COLUMBIA

Scale: 1 inch to 2 miles

2 0 2 4 6 8

inches 0 1

0 1 2 centimetres

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.