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Geol. 409

600295

Silver Standard Mine

Silver Standard Mine.

The mine is located on Glen Mountain, B.C. north of the communities of Hazelton and New Hazelton, B.C.

General Geology.

Most of the area is underlain by members of a thick series of sedimentary and volcanic rocks called the Hazelton Group. The remainder of the area is underlain by numerous bodies of granitic rock.

The Hazelton Group has been tentatively subdivided into three parts. Subdivision A. includes mainly tuffaceous sandstone and greywacke, some pebble conglomerate, and few dark argillaceous laminae. Subdivision B. includes dark shaly beds interbedded with tuffaceous sandstone and greywacke and numerous coal beds.

Subdivision C. includes mostly sandy beds, less tuffaceous than those of subdivision A, and a small proportion of shaly beds.

The transition from subdivision A. to B. appears to be gradational, and no break is known between subdivision B. and C.

The Hazelton Group is thought to be of Jurassic to Early Cretaceous in age.

The granitic rocks are mostly quartz and feldspar porphyries and include what is probably altered

granodiorite and some hornblende porphyry. Most of these rocks are altered, with carbonate and sericite replacing feldspar. Pyrite is common in these rocks.

All plutonic bodies presumably are of the same age and younger than Early Cretaceous.

Structural Geology.

The members of the Hazelton group have been gently folded, the dips are moderate to low. The folds trend slightly east of north except at Glen Mountain, where the axes trend slightly west of north.

Southwest of the Silver Standard mine is an anticline and syncline which seems to die out toward the south.

No major faults are present. Numerous faults are exposed in the Silver Standard mine, but the displacement on most is only a few inches or a few feet.

Fracture cleavage is fairly well developed in the rocks of the southern part of Glen Mountain. The cleavage planes as a rule strike southeasterly and dip steeply, nearly vertical.

Many quartz and carbonate veins cut all types of country rock. Most veins have a northerly to northeasterly strike and dip eastward. The veins may contain a considerable proportion of metallic minerals, chiefly sulphides and sulpho-salts.

legend.

- Granodioritic and porphyritic bodies - Post Early - Cret
- chiefly sandstone & argillite. Early - Cret.
- tuffaceous s.s, greywacke argillite, coal - Late Jur.
- chiefly tuffaceous s.s, greywacke, some argillite and conglomerates. - Jurassic

From?

Surface Geol., Glen and Nine Mile Mountains Area, Hazelton, B.C.

1 mi
Scale

Geology of the Silver Standard Mine.

Most of the Hazelton group rocks are tuffaceous and argillaceous sandstones and greywackes. They are in beds a few feet thick and are massive, grey, fine grained and have a smooth, blocky fracture. Many of the beds have been altered by the introduction of carbonate and pyrite.

Intense alteration within a few feet of the veins, the result of the replacement of some of the minerals by carbonates, has changed the colour of many beds from grey to cream or ivory. After alteration the bedding has become very obscured and is difficult to recognize.

The granitic rocks are sericitized and carbonatized, and the rocks of the Hazelton Group near them are also altered.

Many fractures cut the beds of the Hazelton group and extend southward into the granitic rocks. The fractures contain up to an inch or two of gouge. These fractures contained the veins that have been mined. The veins vary in width from a fraction of an inch to as much as 12 feet. Some parts of the vein fractures contain no vein material, only gouge.

The veins are called 00, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Megascopic Description of Handspecimens.

#4 Vein. Hanging wall South Drift, 1300' level.

Nine handspecimens were examined. All handspecimens are of light grey colour and consist largely of, massive, grey, fine-grained, highly altered, irregular chunks of country rock. The spaces between these fragments are in some places filled with euhedral quartz crystals and dark brown sphalerite crystals, more commonly the spaces are filled with massive quartz, brown sphalerite, galena, tetrahedrite and chalcopyrite. Some specimens show chlorite mineralization.

#6 Vein. 1400 Stope.

The two handspecimens are an massive ore of galena and sphalerite. Galena is of leaden color and the sphalerite of dark brown color. Sphalerite occurs as chunks as big as $\frac{1}{2}$ inch. dia. within the medium grained galena. No gangue or alteration products are present.

#7 Vein.

This handspecimen consists of medium grained galena and massive tetrahedrite. A small amount of chalcopyrite is present in the tetrahedrite. No gangue or alteration products are present.

8 Vein. North Drift on 1500' level.

The two Landspecimens consist of about 90% lightly fractured, white Quartz. The fractures are filled mainly with ~~Quartz~~ Galena. The very fine fractures do not have any mineralization. Some limonite alteration is present. The specimens are very friable.

1304 South Drift.

The Landspecimens are of light grey color and consist largely of the altered country rock. The rock is fractured and the small fractures ($\frac{1}{8}$ inch) are filled with chlorite. In the larger fractures euhedral Quartz crystals are a common feature and in a few occasions grew from wall to wall. Mineralization of Galena, Sphalerite, Chalcopyrite, and sometimes pyrrhotite, occurs in the Quartz veins. Some pyrite mineralization occurs in the country rock.

1306 South Drift.

The Landspecimens consist largely of altered country rock which is veined by siderite and Quartz. Within the Quartz veins mineralization of, fine grained Galena, Sphalerite, Tetrahedrite, Boulangerite and Chalcopyrite occurs.

Some Chalcopyrite mineralization occurs in the altered country rock.

Microscopic examination.

4. Vein. Hanging wall South Drift. 1300' level.

Minerals present:

1. Galena - The mineral is of hardness B and of galena white colour. Many triangular pits were present. It was found to be isotropic. Etch tests confirmed it to be galena. (PbS)
2. Sphalerite - Associated with galena was the grey isotropic mineral with hardness C. Etch tests gave positive reactions for HNO_3 and aqua regia, and negative reactions for the other reagents. The internal reflection was found to be brown. All properties confirm sphalerite (ZnS)
3. Tetrahedrite - Etch tests confirmed that the greyish, isometric mineral, with hardness D was tetrahedrite. ($Cu_{12}Sb_4S_{13}$)
4. Chalcopyrite - small whispy masses of brass yellow colour are distributed throughout the section. Its hardness, and etch tests performed on this mineral confirmed it to be chalcopyrite ($CuFeS_2$)
5. Arsenopyrite - A white mineral with hardness F was found to be weakly anisotropic and negative to all etch tests except HNO_3. Some diamond-shaped cross-sections were observed. The mineral proved to be arsenopyrite (FeAsS)
6. Pyrite - Optical and etch tests confirmed pyrite (FeS_2). Generally, the pyrite was distributed in irregular patches.
7. Quartz
8. Calcite

Estimated abundance:

The estimated percentages of mineral constituents present are as follows:

Galena	30 %
tetrahedrite	25 %
sphalerite	25 %
chalcopyrite	5 %
arsenopyrite	5 %
pyrite	5 %
quartz } calcite	5 %

#6 Vein. 1400 stope.

Minerals present:

1. Galena
2. Sphalerite
3. Pyrite

Estimated abundance:

Galena	60 %
sphalerite	35 %
pyrite	3 %
carbonate gangue	2 %

#7 Vein.

Minerals present:

1. Tetrahedrite
2. Galena
3. Sphalerite
4. Pyrite
5. Chalcopyrite
6. Quartz

Estimated abundance:

Tetrahedrite - 55%
Galena - 35%
Sphalerite - 3%
Pyrite - 3%
Chalcopyrite - 3%
Quartz - 1%

#8 Vein. North Drift on 1500' level.

Minerals present:

1. Quartz
2. Galena

Estimated abundance:

1. Quartz - 80%
   Galena - 20%

1304 South Drift.

Minerals present:

1. Sphalerite.
2. Pyrrhotite. - The pinkish - cream mineral, which was found to be strongly anisotropic (light blue, brown) and magnetic, had a hardness D and was suspected of pyrrhotite. ($Fe_{1-2}S$). Etch tests confirmed this to be true.
3. Galena
4. Chalcopyrite
5. Pyrite
6. Pyrargyrite - In small amounts present was a bluish grey mineral with hardness C. It was not possible to determine whether the mineral was anisotropic as the ruby-red internal reflection obscured any polarization colors. Etch tests proved this mineral to be pyrargyrite ($3Ag_2S \cdot Sb_2S_3$)
7. Tetrahedrite.

Estimated abundance:

sphalerite	35%
pyrrhotite	25%
galena	10%
chalcopyrite	10%
pyrite	8%
pyrargyrite	3%
tetrahedrite	trace
quartz	10%

1306 South Drift.

Minerals present:

1. Boulangerite - A fulvous white mineral with hardness B^+ was found to be strongly anisotropic (white, brownish gray, dark gray). All etch tests were negative except HNO_3 which effervesced and blackened the surface. The mineral proved to be boulangerite ($5PbS.2Sb_2S_3$)
2. Tetrahedrite - microchemical tests indicated silver.
3. Sphalerite
4. Chalcopyrite
5. Bournonite - veins around the tetrahedrite are formed by a gray mineral of hardness C-. It was found to be anisotropic (dark gray, purple) All etch tests were negative except aqua regia which stained iridescent. The mineral was found to be bournonite $Cu_2S.2PbS.Sb_2S_3$
6. Pyrite

Estimated abundance:

boulangerite	30 %
tetrahedrite	10 %
sphalerite	5 %
chalcopyrite	5 %
bournonite	5 %
pyrite	5 %
siderite	40 %

Textures & Paragenitic Sequence.

The pyrite was distributed as irregular masses and small grains with a shattered appearance in all polished sections. The pyrite was most frequently surrounded by sphalerite and tetrahedrite with irregular boundaries indicating that the pyrite was a mineral to crystallize early in the sequence. In the polished section of 1304 S. drift, a mass of pyrrhotite was found to be almost entirely surrounded by pyrite. The boundary between these two minerals was highly irregular and it was suggestive that pyrite replaces pyrrhotite.

Also crystallized early is the arsenopyrite. This mineral was only found in polished section of #4. vein. No boundaries were observed between arsenopyrite and pyrite. No evidences were found from which could be determined which mineral was formed first in the sequence. Most likely ~~pyrite~~ arsenopyrite was deposited before pyrite.

Sphalerite occurs in the polished section of #4. vein in whispy irregular masses which are completely surrounded by galena. In all other polished sections galena replaces clearly sphalerite. In the polished section of the 1306 S. Drift galena occurs often at the boundary of pyrrhotite and sphalerite and seems to "eat through" both these minerals. The boundary of pyrrhotite and sphalerite is irregular but no good evidence has been found of one replacing the other.

Tetrahedrite occurs in most polished sections and in that

of #4 vein shows very irregular boundaries with galena. Many small narrow extensions of galena penetrate the tetrahedrite, and the galena is suspected of replacing the tetrahedrite. From the polished section of number 7. vein it is clear that tetrahedrite replaces sphalerite.

The above observations indicate that sphalerite, tetrahedrite and galena are of later origin than pyrrhotite, pyrite and arsenopyrite; the first three minerals are laid down in the following sequence - sphalerite, tetrahedrite, galena.

Within the galena, pyrargyrite was found in only one polished section, - 1304 S. Drift. The pyrargyrite occurred in irregular masses and was usually brimmed by chalcopyrite. Tiny spots of chalcopyrite were also observed in pyrargyrite. It is therefore likely that pyrargyrite and chalcopyrite crystallized out at the same time, possible chalcopyrite a little bit later than pyrargyrite. In the same polished section chalcopyrite was found to vein sphalerite and in polished section #7 vein chalcopyrite clearly replaces tetrahedrite. Evidences seem to indicate that chalcopyrite and pyrargyrite crystallized out after sphalerite and tetrahedrite, and likely a bit later than galena.

Boulangerite and bournonite were only encountered in polished section 1306 S. Drift. The bournonite occurs as rims around tetrahedrite and are in turn surrounded by a mass of boulangerite. Chalcopyrite is present in small irregular masses within the boulangerite and the bournonite rims, but is not present in the tetrahedrite. Uytenbogaardt states that reaction rims exist

between boulangerite and chalcopyrite, and tetrahedrite and galena. The most likely explanation for the bournonite veins are then that galena and tetrahedrite have formed these veins and that the galena has been replaced by boulangerite. Chalcopyrite is found in the veins but never was a bournonite vein found around chalcopyrite ~~which is~~ embedded in boulangerite. Furthermore, chalcopyrite must have crystallized after the veins were formed as it was found that chalcopyrite masses cut through the boundary of boulangerite and bournonite.

Boulangerite and bournonite are formed at the last stages of crystallisation after chalcopyrite and pyrargyrite.

Quartz shows replacement by siderite.

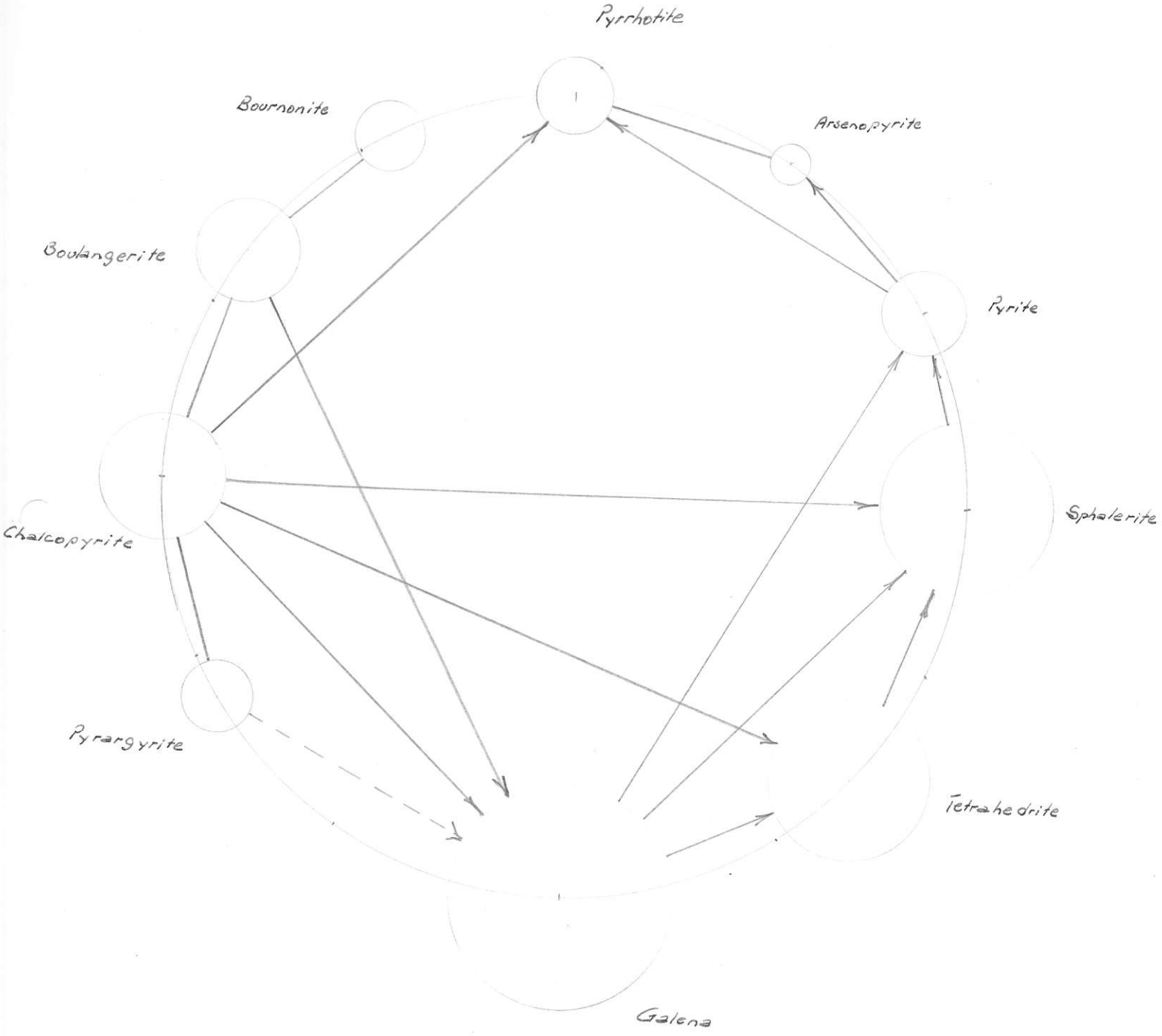
Temperature Determination.

The first formed sulphide, pyrrhotite, pyrite, and arsenopyrite were likely deposited between 450° and 600°C. The textures and associations of sphalerite, tetrahedrite and galena suggest formation in a temperature range between 500° and 250°C.

Pyrargyrite, chalcopyrite, boulangerite and siderite are formed at moderate temperatures (below 250°C)

It is concluded from the above that the ore is of mesothermal type.

Seguence: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Bournonite
Arsenopyrite
Boulangerite
Pyrite
Chalcopyrite
Sphalerite
Pyrargyrite
Tetrahedrite
Galena

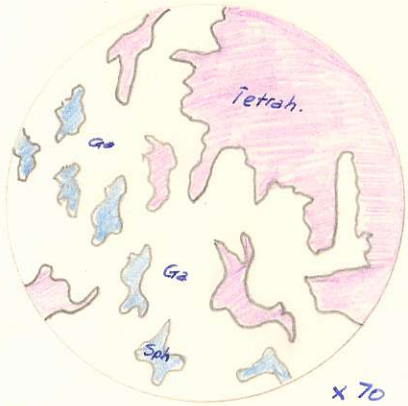

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Fig 1. # 4 Vein.

Galena replacing sphalerite & tetrahedrite.
Replacing of sphalerite in advanced stage.

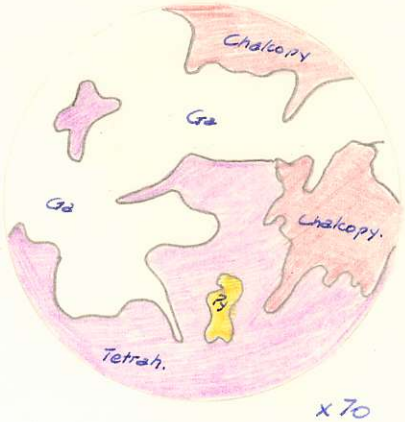

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Fig. 2 # 7 Vein

Galena replacing tetrahedrite.
Chalcopy. replacing tetrahedrite & galena.

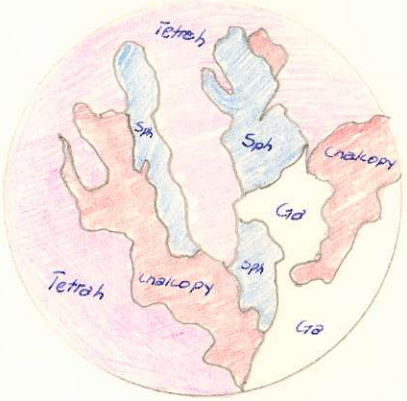

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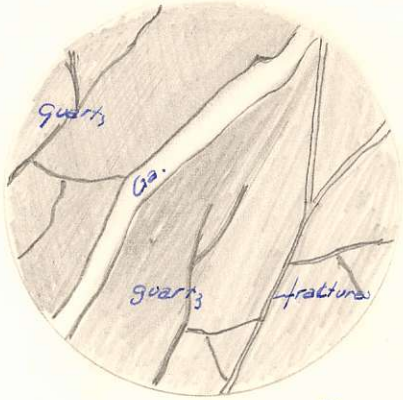
Fig. 3 # 7 Vein

Chalcopy. replacing Sphalerite & galena.
Tetrahedrite replacing sphalerite.



x 70

Fig. 4 # 8 Vein

Highly fractured quartz, fratture filling of galena

Legend:

- galena.
- chalcopyrite
- tetrahedrite
- sphalerite
- pyrite
- pyrargyrite
- bournonite
- boulangerite
- pyrrhotite

References:

Edwards, A. B. Textures of the Ore Minerals, Australasian Institute of Mining and Metallurgy, 1954.

Report of Minister of Mines, B.C. 1950. pp. A.87-95

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

Geological Survey Bulletin 825, Microscopic Determination of Ore Minerals.