GEOLOGY 24 REPORT

by

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MINERALOGY

of the

NICOLA MINE

I N D E X

INTRODUCTION

The following is a report on the study of ore from the Nicola Gold Mine.

The chief objects of the study were to determine the mode of occurrence of the gold and to ascertain with which minerals it is associated.

Laboratory procedure consisted of cutting, mounting and polishing sections of ore from different parts of the mine. These sections were then examined under the microscope and the various minerals and their relationships were determined. The determination of the minerals was accomplished by means of etch tests and microchemistry.

The work was carried out under the supervision of Dr. H.V. Warren as a partial requirement for the degree of Master of Arts in Geology.

The writer wishes to express his appreciation of the cooperation and assistance given him by Dr. H.V. Warren and Assistants of the Department of Geology.

LIST OF ILLUSTRATIONS

NICOLA MINE

DESCRIPTION OF PROPERTY

LOCATION

The property of the Nicola Mines and Metals Ltd., consisting of twenty-six claims, is situated on the west side of Mineral hill, on the south shore of Stump Lake.

The workings are about thirty miles from the town of Merritt, B.C. They can be reached by a road branching off to the north from the Merritt-Kamloops highway.

HISTORY

Claims were first staked on Mineral hill between 1882 and 1885, and soon after, several shafts were put down by the Nicola Mining and Milling Company and the Star Mining Company but other than this little work was done. In 1916, the Donahue Mines Corporation built a mill and shipped out less than 100 tons of ore before closing down. Again in 1925, work was started by the Planet Mines and Reduction Company Ltd. This consisted mainly of a crosscut on the 320 level and construction of an 80 ton mill. About 17,000 tons of ore were shipped before 1931, when operations were abandoned. In 1933 the Nicola Mines and Metals Ltd., started development work, and since then, except for a few months, operation has been continuous.

GENERAL GEOLOGY

In general, the rocks of the district consist of altered volcanics, tuffs and breccias of the Nicola formation, but locally the types range from the usual andesite to a rather coarse-grained diabase. Chloritization is extensive, and except for local shears, the rocks are massive with a green colour.

The major structure is probably a large anticline plunging to the north. In the producing area the beds are almost vertical with a northeast strike.

Andesite dykes occur in places cutting the veins. These are dark-coloured, and vary in width from a few inches to eight feet.

ECONOMIC GEOLOGY

The veins of the deposit consist of quartz-filled shear-fracture zones in the diabase. These vary in strike from north forty-five degrees west to north twenty-five degrees east, and dip usually between forty-five degrees east and vertical. The most important of the veins are the Enterprise and King William, which may turn out to be one vein when more development is done. Heavy drift makes prospecting and correlation very difficult.

Pinching and swelling of the veins is common and varies from five inches to fifty inches. A zone of bleached and pyritized wallrock accompanies the veins to a maximum width of fifteen feet, but carries no appreciable values.

MINERALIZATION

The veins are mineralized irregularly with sulphides in a gangue of white quartz. These sulphides occur in segregations, thin bands and disseminations, which form a small percentage of the total vein material. Gold and silver values vary in different parts of a vein and also in different veins.

MINERALOGY

INTRODUCTION

A megascopic examination of this ore shows mainly a rude banding of the sulphides and quartz. Some samples, however, show small segregations or pockets of the sulphides in the quartz gangue. Pyrite, sphalerite, and galena are the usual minerals visible in the ore without the aid of a microscope.

Eleven sections of ore from different parts of the Enterprise and King William veins were prepared and studied microscopically. These are referred to by number, and the location from which each sample was taken is given in the accompanying table.

The following metallic minerals were determined by microscopic examination to be present in the ore. They are listed in order of abundance.

1. Pyrite
2. Sphalerite
3. Galena
4. Chalcopyrite
5. Pyrrhotite
6. Arsenopyrite
7. Tetrahedrite
8. Bornite

9. Chalcocite   11. Gold

10. Covellite

Quartz was the only gangue mineral observed in the ore.

DESCRIPTION OF THE MINERALS

PYRITE

Pyrite is the most abundant metallic constituent in the ore. Each section studied consisted of at least fifty percent of this mineral. It occurs mainly in large, irregular masses, but some crystal boundaries were observed at the edges of the pyrite masses against galena or sphalerite. In all cases it is greatly fractured and these fractures have been filled by quartz, sphalerite, galena and chalcopyrite. Small stringers and blebs of galena, sphalerite and chalcopyrite occur in the pyrite. The pyrite also contains minute inclusions of pyrrhotite and in some cases of gold. Some of the chalcopyrite occurring in the pyrite appears to be inclusions like the pyrrhotite.

Pyrite was evidently one of the first minerals to be deposited in the veins.

QUARTZ

Quartz is the only conspicuous gangue mineral in the ore. Two generations of it were identified. The early quartz occurs filling the interstices between pyrite masses and filling cracks in the pyrite. This early quartz has been fractured and these fractures healed to some extent by later sulphides. The later generation of quartz is darker in colour than the first, is not as abundant, and fills fractures in all the other sulphides and early quartz.

SPHALERITE

Sphalerite is relatively abundant in most of the sections. It is present as irregular masses in quartz, as inclusions in galena and in fractures in pyrite. The sphalerite usually contains minute specks of chalcopyrite. Irregular masses or blebs of intimately associated sphalerite and chalcopyrite occur in fractured pyrite and in quartz where sphalerite and galena are in contact, the boundaries are usually very smooth and mutual, but a few places were seen where the galena veined into the sphalerite indicating deposition later than the sphalerite.

GALENA

Galena has the same general distribution as sphalerite but is not quite as abundant in the sections studied. Generally the galena forms mutual boundaries with sphalerite, but as stated previously, it veins sphalerite in one or two places indicating that it was deposited at the same time and later than the zinc sulphide. Rounded and irregular blebs of chalcopyrite are included in galena and veins of chalcopyrite cut the galena.

CHALCOPYRITE

Chalcopyrite is locally abundant, but is actually a minor constituent of the ore. It occurs as minute blebs in pyrite and sphalerite, as irregular masses and veins in quartz and pyrite and as rounded masses in galena and sphalerite. It generally forms smooth, regular boundaries with sphalerite and galena but does to some extent vein the latter sulphide. These criteria suggest that it was deposited with sphalerite and also later than the sphalerite.

PYRRHOTITE

Pyrrhotite is not plentiful in the ore. It occurs very sparingly in most of the sections as tiny specks in the pyrite and arsenopyrite, while a few larger blebs consist of both chalcopyrite and pyrrhotite intimately associated. In two sections, (Enterprise No. 3) and (King William No. 1) the mineral is more abundant. Here it occurs in fairly large irregular masses and appears to replace pyrite. Tongues and veinlets of pyrrhotite penetrate into the pyrite leaving remnants of pyrite as "islands" in pyrrhotite. Often a rim of massive pyrite surrounds the pyrrhotite mass.

ARSENOPYRITE

Arsenopyrite was seen in only one section (King William No. 1). Here a few grains of moderate size occurred at a quartz-pyrite boundary. Smooth regular boundaries between arsenopyrite and pyrite indicate contemporaneous deposition. First generation quartz fills fractures in the arsenopyrite.

TETRAHEDRITE

Tetrahedrite occurred in only one of the sections studied. In (King William No. 4) it was determined in one small patch intimately associated with galena.

BORNITE, CHALCOCITE AND COVELLITE

A minute quantity of these three minerals was observed and determined on one section, (King William No. 4).

A large bleb of chalcopyrite is rimmed by bornite, which is in turn rimmed by chalcocite. Some small bluish specks in the bornite may be covellite, but were not definitely determined. In all cases, the bornite and chalcocite are intergrown.

GOLD

Gold was observed in only three sections, (King William Nos. 1 and 4), and (Enterprise No. 3). It occurs in the following ways.

1. With galena in fractures in pyrite.
2. With chalcopyrite at the contact of arsenopyrite and pyrite.
3. At the contact of pyrite and sphalerite.

Boundaries between gold and galena, gold and chalcopyrite, and between gold and sphalerite are smooth and intimate suggesting deposition with these sulphides. The gold which occurs in fractures forms small veinlets while that occurring with galena, chalcopyrite and sphalerite is in irregular blebs.

PARAGENESIS

The following paragenesis is suggested.

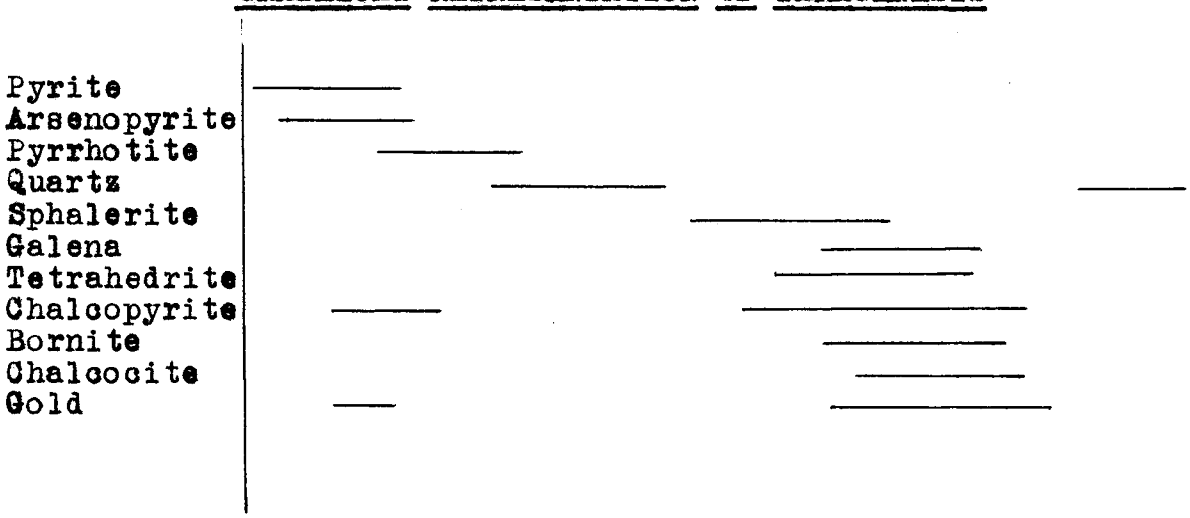
From the relationships observed in the microscopic study of these polished sections the following order of deposition of the minerals is indicated.

Pyrite and arsenopyrite appear to have been deposited at the same time, and pyrrhotite partly simultaneous with and partly later than these two. The deposition of pyrite, arsenopyrite and pyrrhotite was followed by fracturing of the minerals. Quartz was then deposited in these fractures. The later sulphides; sphalerite, galena, chalcopyrite, tetrahedrite, bornite and chalcocite, occur to some extent in fractures in the quartz. A later quartz was noted filling a fracture in sphalerite. In general the later sulphides are not much fractured.

From the study of the sections it seems apparent that galena was deposited contemporaneously with, and later than the sphalerite. Chalcopyrite came in mainly with the galena and sphalerite, but also occurs as inclusions in the pyrite and must have been precipitated with this mineral. Bornite and chalcocite are probably of the same period as the galena, as also is the tetrahedrite.

The greater part of the gold seen in the sections was deposited later than the pyrite. In all cases it was observed to be intimately associated with the later sulphides.

GRAPHICAL REPRESENTATION OF PARAGENESIS



ASSAYS

Rejects from the following sections were assayed to determine whether or not the values obtained bore any relation to the amount of gold observed microscopically in the sections.

Section		Gold	Silver
S. Enterprise No. 2	....	0.58 oz	2.06 oz.
Enterprise No. 3	....	0.38	1.94
King William No. 4	....	0.106	11.68
King William No. 1	....	0.86	7.74
Enterprise No. 1	....	0.48	7.50

Average for gold .... 0.481 oz. per ton.

Average for silver .... 6.080 oz. per ton.

The results of these assays are interesting in that section No. 4 (King William) gave the highest assay for silver, and this section was the only one in which tetrahedrite was observed. Section No. 1 (King William), which assayed highest in gold was the section in which most of the gold was seen microscopically.

DISTRIBUTION AND SIZE OF GOLD PARTICLES

Although the gold particles were rather scarce in these sections, they were most frequently observed occurring with or near galena. Particles were also seen at the contact of pyrite and sphalerite and with chalcopyrite. Apparently most of the gold was deposited at the same time as the galena, sphalerite and chalcopyrite, although some is contemporaneous with pyrite and arsenopyrite.

Although the gold is light-coloured, the etch reactions obtained from this mineral corresponded very satisfactorily with those for gold and not for the gold-silver alloy electrum.

The size of the gold particles varies from 4 microns to 15 microns with an average of 6 microns.

DISTRIBUTION OF GOLD

Mesh	Gold in quartz, with sulphides but not enclosed by them	Gold in sulphides						Totals %
		In pyrite		In dense arsenopyrite percent	In galena percent	In sphalerite percent	In chalcopyrite percent	
		Along fractures percent	In dense pyrite percent					
+1100								
-1100+1600		20						20
-1600+2300		20						20
-2300+3200							20	20
-3200					20	20		40
		40						
Totals %		40			20	20	20	100

LIST OF SECTIONS STUDIED

Enterprise No. 1 ...... From the 440 level, No. 9 Stope.

Enterprise No. 2 ...... From the 320 level, No. 21 Stope (a)

Enterprise No. 3 ...... From the 320 level, No. 21 Stope (b)

Enterprise No. 4 ...... From the 540 level, Hanging wall by track below No. 9 Stope.

Enterprise No. 5 ...... From the 320 level, Face.

N. Enterprise No. 1...... From the 675 level.

S. Enterprise No. 1...... From the 675 level, Stope 2.

S. Enterprise No. 2...... From the 900 level, Stope 4.

King William No. 1 ...... From 4N. - cross-cut.

King William No. 3 ...... From the 675 level, St. 14 20.

King William No. 4 ...... From the 675 level, St. 14 2d.

DESCRIPTION OF SECTIONS

The following is a list of the sections with their constituent minerals. The minerals are separated according to their abundance in each individual section.

Enterprise No. 1

Major ...... Pyrite, sphalerite and galena.
Minor ...... Quartz and chalcopyrite.

Enterprise No. 2

Major ...... Pyrite and quartz.

Enterprise No. 2 (Continued)

Minor ...... Sphalerite and chalcopyrite.
Rare ...... Pyrrhotite.

Enterprise No. 3

Major ...... Pyrite, quartz and sphalerite.
Minor ...... Galena and chalcopyrite.
Rare ...... Gold (one grain.)

Enterprise No. 4

Major ...... Pyrite and sphalerite.
Minor ...... Galena, quartz and chalcopyrite.
Rare ...... Pyrrhotite.

Enterprise No. 5

Major ...... Quartz and pyrite.
Minor ...... Galena.
Rare ...... Sphalerite, chalcopyrite and pyrrhotite.

N. Enterprise No. 1

Major ...... Quartz and pyrite.
Minor ...... Sphalerite and galena.
Rare ...... Chalcopyrite and pyrrhotite.

S. Enterprise No. 1

Major ...... Quartz, pyrite and sphalerite.
Minor ...... Galena, pyrrhotite and chalcopyrite.

S. Enterprise No. 2

Major ...... Pyrite, sphalerite and quartz.
Minor ...... Galena.
Rare ...... Chalcopyrite and pyrrhotite.

King William No. 1

Major ...... Pyrite, quartz, sphalerite and pyrrhotite.

King William No. 1 (Continued)

Minor ...... Galena.
Rare ...... Arsenopyrite and gold.

Gold is important in this section.

King William No. 3

Major ...... Quartz, pyrite and galena.
Minor ...... Pyrrhotite and chalcopyrite.

King William No. 4

Major ...... Pyrite.
Minor ...... Quartz, sphalerite, galena and chalcopyrite.
Rare ...... Tetrahedrite, bornite, chalcocite and pyrrhotite.

SUMMARY AND CONCLUSIONS

1. The primary ore of the mine consists of pyrite, arsenopyrite, pyrrhotite, sphalerite, galena, chalcopyrite, tetrahedrite, bornite, and chalcopyrite.

2. The minerals belong to the mesothermal zone of deposition.

3. The gold is intimately associated with sphalerite, chalcopyrite, and particularly with galena. A minor amount occurs as inclusions in pyrite.

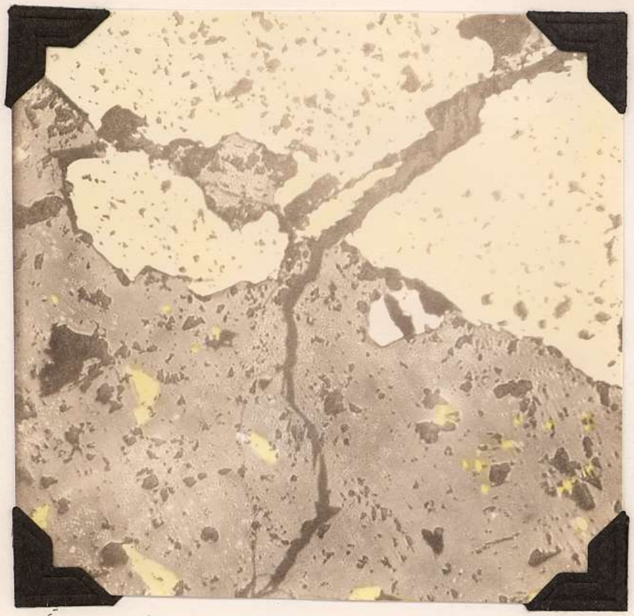
4. A large percentage of the gold tends to solidify in fractures in the pyrite with the other sulphides.

5. The gold is not distributed regularly throughout the ore, but occurs in "swarms" of particles.

6. Tetrahedrite and possibly galena are thought to account for the silver values in the ore.

7. From the microscopic study of this ore it appears that the highest gold values occur where fractured pyrite is associated with galena, sphalerite and chalcopyrite.

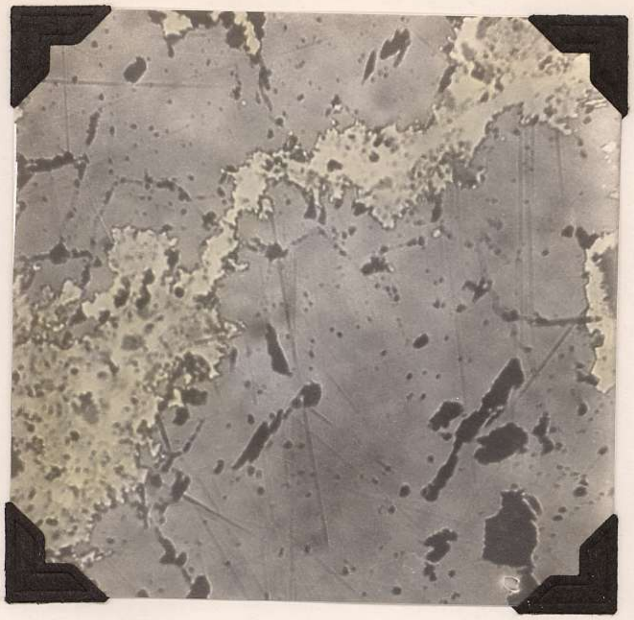
PLATE I



X 240

Showing late quartz filling a
fracture in pyrite and sphalerite.

PLATE II



X 240

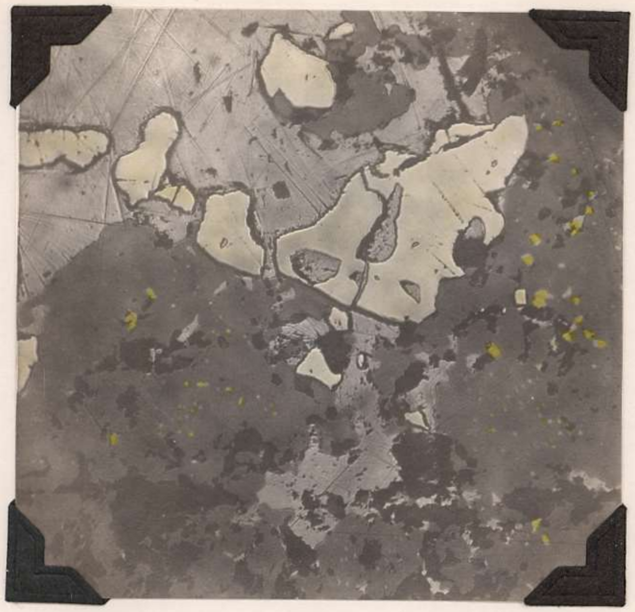
Showing pyrrhotite replacing pyrite.

PLATE III

X 240

Showing the relationships between pyrite, sphalerite, galena and chalcopyrite.

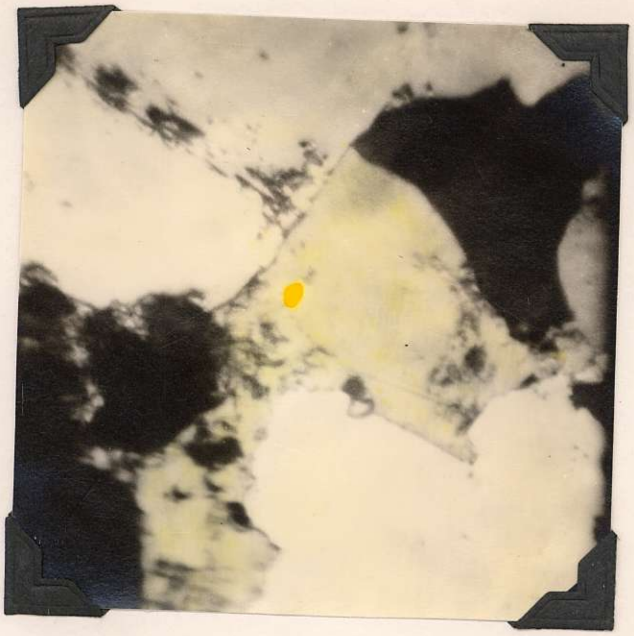
PLATE IV



X 240

Showing relationships between galena and sphalerite. Note inclusions of one meneral in the other.

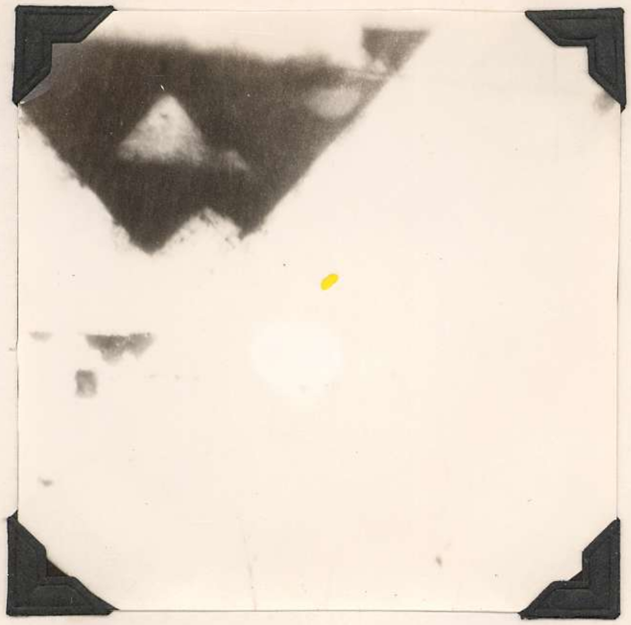
PLATE V



X 1050

Showing gold included in chalcopyrite.
Both occur in a fracture in pyrite.

PLATE VI



X 1050

Showing gold in galena, illustrating the intimate association between the two minerals.

PLATE VII

X 1050

Showing gold with chalcopyrite along a pyrite-arsenopyrite boundary.

PLATE VIII

X 1050

Showing gold and galena in a pyrite fracture.