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REPORT ON
A MICROSCOPIC EXAMINATION OF
ORE FROM THE
TATLAYOKO LAKE DISTRICT,
BRITISH COLUMBIA.

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Information on the geology and accessibility of the district were obtained from an article by Dr. V. Dolmage in the Canadian Geological Survey, Summary Report, 1924, Part A, pages 70-72.

A MICROSCOPIC EXAMINATION OF ORE FROM TATLAYOKO LAKE DISTRICT.

The ore examined for this report is from the Tatlayoko Lake Gold Mines Ltd. which is better known as the Morris Mine. The ore deposit, 5900 feet in elevation, is situated three miles south-east of the south end of Tatlayoko Lake. This district was formerly in the Nanaimo Mining Division but as a result of boundary changes it is now included in the Clinton Mining Division.

The mine is accessible by means of 160 miles of motor road, from Williams Lake on the Pacific Great Eastern Railway to the north end of Tatlayoko Lake. The distance from this point to the south end of the lake is best travelled by boat. If this district proves to be of sufficient importance, a shorter route 60 miles long to tide-water at Butte Inlet could be developed, although at considerable expense.

General Geology.

The Morris deposit consists of three quartz veins cutting Triassic sediments, chiefly argillites and fine sandstones. A stock of quartz diorite, probably related to the Coast Range batholith, is situated a short distance northeast of the veins. Many dykes cut the veins and are consequently younger. They are chiefly basaltic but vary to diorite. One basalt dyke follows the main vein throughout its length, crossing it and recrossing it. The veins have quartz as the gangue mineral with stibnite, arsenopyrite and pyrite as the predominant sulphides. Stibnite tends to occur in the central portion of the vein while arsenopyrite is more plentiful

along the margins. The main vein has been drifted on for 400 feet and varies in width from 8 inches to 5 feet with an average width of two feet. The second vein has been traced for 250 feet and has an average width of 8 inches. The third vein has been developed slightly and appears to be similar in character to the others.

Preparation and Megascopic Examination of Specimens.

Specimens examined were taken from an 250 pound sample of the ore. This sample assayed considerably in excess of average assays obtained by government engineers who have examined the property. Due to the small number of specimens examined, a representative report on there is made difficult. Chemical analysis, obtained by accurate sampling of the shipment, is given below.

Gold	-----	1.42 oz. per ton.
Silver	-----	22.30 oz. per ton.
Arsenic	-----	3.40 %
Antimony	-----	7.40 %
Sulphur	-----	6.40 %
Copper	-----	0.12 %
Iron	-----	6.0 %

Specimen 1

This specimen was chosen as a typical sample of the stibnite. This was the only mineral that could be seen by the naked eye and it presented the characteristic cleavage striations.

Specimen 2

This sample contained about 50 % quartz and 50 % arsenopyrite with no visible stibnite. In choosing specimens it was noted that those containing high stibnite were poor in arsenopyrite and vice-

versa. This suggests a banded vein.

Specimen 3.

A bakelite briquet made with a high grade antimony concentrate from a flotation test.

Specimen 4.

A briquet using the tails from the test that specimen 3 was made from.

Specimen 5.

For this briquet, a concentrate similar to that used in specimen three but with finer grinding was used.

Microscopic Examination.

Quartz is the predominant gangue mineral with minute amounts of a carbonate mineral, probably calcite. In approximate order of abundance the sulphide minerals represented are stibnite, arsenopyrite, pyrite, tetrahedrite, sphalerite, galena, mineral A, and chalcopyrite. Roughly calculated mineral percentages are given in the following table.

Stibnite	-----	10 %	Tetrahedrite	-----	0.5 %
Arsenopyrite	-----	11 %	Others	-----	1.0 %
Pyrite	-----	1 %	Quartz	-----	70.0 %

Stibnite. Stibnite is the most prominent sulphide mineral in the ore and occurs massively and in well crystalized fan-like radiating forms. It is one of the younger minerals in the ore and therefore often found filling tiny fractures in the older minerals. In some places stibnite is found in little veins in the quartz while in others it occurs along with the quartz and aids in filling fractures in the arsenopyrite.

Arsenopyrite. This mineral presents a highly shattered appearance but it is visible in both massive and crystalline form. Fractures are

healed with quartz, stibnite and tetrahedrite. The finest fractures seem to be filled with the sulphide minerals while the larger gaps are filled with quartz. Occasionally, small crystals of arsenopyrite which had not been shattered were noticed in the stibnite veinlets. They suggest a second generation of arsenopyrite although they are too small and infrequent to yield any positive information.

Pyrite. Small euhedral and subhedral crystals of pyrite were observed adjacent to some stibnite and appearing in quartz. Where pyrite occurred with arsenopyrite it was shattered and healed in the same way.

Tetrahedrite. This mineral is not very prominent but where observed was present with the veinlets of stibnite and an unknown mineral A. The close relation between stibnite and tetrahedrite makes it difficult to determine which mineral the silver is associated with.

Sphalerite. No relations could be determined from the small amount of this mineral that was observed. Other reports indicate that there is a considerable amount of sphalerite in the ore, probably 1%.

Galena. The small amounts of galena observed were related to stibnite and appear to have come in at the same time.

Mineral A. Microchemical tests show that this mineral contains lead and antimony. It is negative to all reagents used and is anisotropic. Due to its association with and its similarity to stibnite and tetrahedrite it was very difficult to observe.

Chalcopyrite. Extremely minute specks of chalcopyrite were observed in the unknown mineral A.

Gold. One particle of native gold was observed in specimen two, associated with arsenopyrite. This particle was 130 x 40 microns

and it is interesting to determine what effect this one piece of gold would have on the assay of the specimen containing the gold. The area of the polished surface is 2 x 3 cms. and we assume that the volumes are proportional to the respective areas.

Area of specimen ---- 2 x 3 cms. ----- 6 sq. cms.

Area of gold ---- 130 x 40 microns -- .004 x .013 ---

----- .000052 sq. cms.

Because gold is approximately 5 times as heavy as the ore the equivalent area of the gold is 5 x .000052 --- .0003 sq. cms. Therefore the number of ounces of gold per ton represented by the particle of gold in the specimen is $\frac{(.0003)(29100)}{(6)} = 1.2$ oz. /ton.

Examination of Flotation Products.

The concentrate for specimen 3 was obtained from a flotation test made in the University ore dressing laboratory. A 1000 gram portion of the ore was ground in a rod mill for fifteen minutes with .5 pounds per ton of Potassium Cyanide and .5 pounds per ton of Zinc Sulphate. The resulting pulp was diluted to a 4 : 1 ratio with water and conditioned in a flotation cell for two minutes with 0.1 pounds per ton of number 5 Pine Oil. The concentrate, representing 6 % of the weight of the charge was removed for ten minutes and it gave the following assay.

Gold	----- 2.0 oz. per Ton	Arsenic	---- 3.9 %
Silver	----- 144.7 oz. / Ton.	Antimony	---- 47.0 %

The specimen is approximately 65 % stibnite and very few free particles of arsenopyrite could be observed. Finer grinding would be necessary to unlock the particles of arsenopyrite that are still connected with the stibnite. Finer grinding is impractical because

of the difficulty in handling finer particles and the fact that finer grinding decreases the grade of the antimony concentrate obtainable with the set of reagents used. The ratio of the number of particles in various mesh ranges indicates the extreme fineness which would be necessary for complete separation of the sulphide minerals.

	<u>+ 200 Mesh</u>	<u>- 200 + 325 Mesh.</u>	<u>- 325 Mesh.</u>
No. of Particles.	I	5	70

Further concentrates were taken from this same charge by means of activators and collectors. The resulting tailing was 75 % of the charge by weight and assayed as follows.

Gold -----	0.46 oz. per ton.	Arsenic ----	1.4 %
Silver -----	2.1 oz. per ton.	Antimony ----	0.6 %

Quartz particles are much larger than the sulphide particles subjected to the same grind. Most of the sulphide observed in the tails was still included in the quartz particles and therefore given no contact with the flotation reagents. Very few particles of free sulphide minerals were observed so that a cleaner tailing would require finer grinding of the quartz particles. By comparison with specimen 3, the relative size of the gangue and sulphide particles can be readily noted.

	<u>+ 200 Mesh.</u>	<u>- 200 + 325 Mesh.</u>	<u>- 325 Mesh.</u>
No. of Particles.	2	4	I

The concentrate for making specimen 5 briquet was obtained in a similar manner to that for specimen 3 with one variation. The time of grinding was increased from 15 to 30 minutes. The concentrate was removed for a longer time and represented 15 % of the charge by

weight. Assays for this concentrate are as follows.

Gold	----	3.20 oz. per ton.	Arsenic	-----	6.3 %
Silver	----	129.6 oz. per ton.	Antimony	-----	34.2 %

It is interesting to note that with only one change in the method the grade of antimony concentrate is reduced from 47 to 34 %. The particles in this concentrate are extremely fine and difficult to determine. Several of these minute particles still contained two minerals and further illustrate the difficulty to be encountered in selective flotation. The following table gives a rough ratio of particle size.

	<u>+ 200 Mesh.</u>	<u>-200 +325.</u>	<u>-325 + 500.</u>	<u>-500 Mesh.</u>
No. of Particles.	I	5	25	600

Explanation of Diagrams.

Figure I shows the occurrence of a particle of free gold with arsenopyrite, thereby strengthening the opinion that gold and arsenopyrite are closely related. Figure 2 shows quartz crystals in stibnite, suggesting that stibnite might be younger. Quartz is also shown filling fractures in the arsenopyrite. Figure 3 shows marked similarity between the opposite walls of a quartz fracture that has been filled with stibnite that is therefore younger than the quartz. In a less illustrative place on this same veinlet, galena was found in direct contact with the stibnite. Figure 4 shows stibnite and quartz that appear to be of the same age, filling fractures in arsenopyrite.

Paragenesis.

Indications are that there were several periods of mineralization but sufficient evidence to divide the deposition into more than two generations was not found. Quartz, arsenopyrite and pyrite belong

to the first generation and are clearly the oldest minerals present. Stibnite, galena, Sphalerite, Tetrahedrite, Mineral A, chalcopyrite and a second generation of quartz are all younger than the first generation group. Indications of a second generation of arsenopyrite are also present although quite weak.

Metallurgical Treatment.

Cyanide tests result in an excessive cyanide consumption due to the presence of stibnite, and a low extraction of gold and silver. Selective flotation resulted in a commercial antimony concentrate but this method is limited by the fineness of the minerals. Leaching of the stibnite by a caustic solution was successful up to 60 % extraction but further leaching with fresh solution brought little better extraction. Electrolysing this solution is a possible means of recovering antimony and it met with a fair degree of success in the laboratory. A flotation concentrate with a ratio of concentration of 4 : 1, carrying 80 % of the gold and 94 % of the silver can be made.

The following table is the result of flotation tests and shows the values of gold and silver as arsenic and antimony increase.

<u>% Arsenic.</u>	<u>Oz. gold/ton.</u>	<u>% Antimony.</u>	<u>Oz. Silver/ton.</u>
2.4	2.48	1.7	2.8
3.3	1.84	3.3	9.1
5.9	2.40	7.4	16.1
7.6	2.96	8.9	17.7
8.2	3.28	10.2	16.0
9.6	3.04	13.8	43.5
11.9	4.08	16.8	94.8
11.9	5.44	22.0	65.0
12.7	4.32	22.8	113.3
12.9	6.08	28.8	108.0
14.0	5.99	39.2	122.9
15.7	6.00	47.0	144.7

This group of results was chosen at random from over fifty flotation tests and therefore show the general relation as indicated.

Conclusions.

A general relation between arsenopyrite and gold exists but discrepancies show that it is not direct.

The relation between stibnite and silver seems evident but it cannot be proven or disproven until the relation of silver to tetrahedrite and possible lead minerals is shown.

The presence of such a large amount of antimony in this ore prevents any profitable use of cyanide treatment.

The extremely fine fractures and veinlets in this ore require impractical grinding for efficient selective flotation and interfere greatly in obtaining a clean tailing.






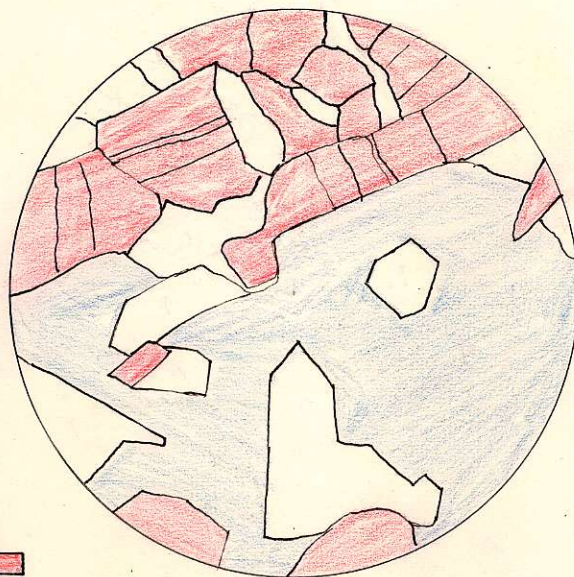
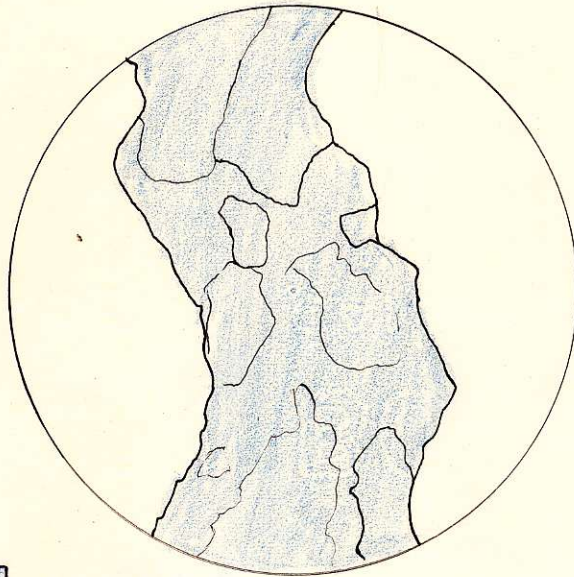
Arsenopyrite 
Gold 
Quartz 

Figure 1 x50



Arsenopyrite 
Stibnite 
Quartz 

Figure 2 x50





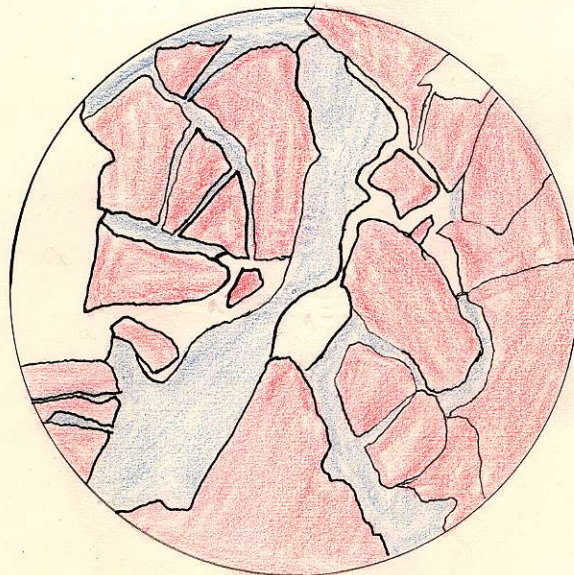
Stibnite 
Quartz 

Figure 3 x50






Arsenopyrite 
Stibnite 
Quartz 

Figure 4 x50