O T T A W A August 25th, 1941.

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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1073.

Amalgamation and Cyanidation Tests on Samples of Arsenical Gold Ore from the Preview Mines Limited, at Contact Lake, Saskatchewan.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Shipment:

Eight sacks of ore, representing three samples, were received on June 23rd, 1941. The samples were submitted by Robert Caldwell, President, Preview Mines Limited, Contact Lake, Saskatchewan, c/o M. & C. Aviation Company Limited, Prince Albert, Saskatchewan.

Location of Property:

The property from which this ore was taken is located on the northwest side of Preview lake, about 24 miles northeast of Lac la Ronge, Saskatchewan.

Character of the Ore:

Twelve polished sections, six from Lot No. 1, North Zone Quartz, two from Lot No. 1, North Zone Schist, and four from Lot No. 2, C Zone, were prepared and examined under the reflecting microscope for the purpose of determining the character of the ore.

Lot No. 1, North Zone Quartz -

Gangue material consists essentially of glassy quartz, which bears local brown stains of iron oxides and encloses irregular patches of creamy white carbonate.

Metallic mineralization is moderately heavy and occupies slightly more than one-half the six polished surfaces. Pyrite predominates largely as slightly fractured masses, but a small percentage occurs also as irregular disseminated grains. It is rather severely weathered and altered to "limonite" around edges and along fractures. Arsenopyrite is locally abundant, scattered through gangue as coarse to fine irregular grains which are intimately admixed with pyrite in a few places.

A small amount of chalcopyrite is present in gangue as irregular grains and small masses which are often associated with pyrite. It also occurs as small inclusions and veins in pyrite. In general the chalcopyrite is more extensively oxidized and altered to "limonite" than is the pyrite.

(Continued on next page)

(Lot No. 1, North Zone Quartz, cont'd) -

Besides the rust stains in gangue already noted, "limonite" is prevalent around borders and along fractures in pyrite and chalcopyrite. It is also visible in gangue as irregular grains which are probably the result of complete replacement of a sulphide. Pyrrhotite and covellite are visible in practically negligible amounts, the former as small irregular grains in gangue and in pyrite, the latter as rare, tiny scales in chalcopyrite.

Nine irregular particles of native gold, ranging from 90 microns (-150+200 Tyler mesh) down to 4 microns (-2300 Tyler mesh) in size, were observed and measured. Four of these occur in gangue and five in pyrite. Of the former occurrence, three are alone and one against chalcopyrite; of the latter, two are along a fracture with grains of chalcopyrite, while three are visible in apparently dense sulphide. The surfaces of most of the gold particles appear rough and slightly tarnished but this condition may be due to polishing. The tarnish was removed from the surface of one grain when a drop of 1:1 HNO_3 was applied.

Lot No. 1, North Zone Schist -

The gangue is high siliceous, dark-grey, schistose rock which bears numerous light-brown stains of iron oxides.

Metallic minerals are represented almost entirely by pyrite and "limonite", which are very sparsely disseminated through gangue as medium to fine irregular grains. Nearly all grains of pyrite are extensively altered to "limonite". In many cases this alteration has proceeded so far as to have entirely or almost entirely replaced the iron sulphide. No gold and only one grain of arsenopyrite was observed in the two polished sections.

Lot No. 2, C Zone -

Gangue is composed of transparent glassy quartz which is locally stained a light brown colour by iron oxides.

Metallic mineralization is moderately abundant and is represented largely by arsenopyrite. This mineral occurs as coarse to fine irregular grains and fine granular aggregates unevenly distributed through gangue. Pyrite is present in minor quantity as occasional small irregular grains, which usually occur in the spaces between grains or masses of arsenopyrite. In one place, however, pyrite is intergrown with grains of arsenopyrite in a crystalline aggregate. A very small quantity of a hard, brownish grey, anisotropic mineral is visible in gangue, more rarely in arsenopyrite, as occasional, small, irregular grains. It could not be identified with certainty since it is negative to all standard etching reagents but its physical properties correspond to those of ilmenite. Chalcopyrite is visible as rare small grains in gangue, and "limonite" shows itself only as rusty brown stains in gangue.

Since neither native gold nor gold minerals were observed in the sections nothing was learned as to this metal's mode of occurrence.

Sampling and Assaying:

Lot No. 1 Quartz and Lot No. 1 Schist were sampled separately for assay, then mixed together for testing, and a sample of the mixture was also taken for assay. Lot No. 2, C Zone, was sampled and tested separately.

(Continued on next page)

(Sampling and Assaying, cont'd) -

The samples assayed were reported as follows:

	Gold, oz./ ton	Silver, oz./ ton	Copper, per cent	Arsenic, per cent	Iron, per cent	Sulphur, per cent
Lot No. 1 Quartz	2.69	0.21	0.07	5.01	6.79	3.11
Lot No. 1 Schist	0.37	0.11	0.05	0.26	4.03	0.19
Lot No. 1 Mixed	1.58	0.17	0.07	3.28	5.73	2.03
Lot No. 2, C Zone	0.505	0.10	0.09	6.57	7.74	2.98

Experimental Tests:

A series of small-scale tests was conducted on Lot No. 2 and the mixture of Lot No. 1 Quartz and Lot No. 1 Schist. The processes used included concentration, amalgamation and cyanidation. Preliminary examination of the samples revealed the presence of abundant free gold in each of them, some of the gold being quite coarse and some being tarnished. The tarnishing is believed to be due to surface oxidation, considerable evidence of which was noticed in the samples. The tarnished gold was slow to amalgamate but this condition may not be met with at depth. High cyanide consumption by unwashed ore is believed to be due to the presence of ferric arsenate, another product of surface oxidation.

Pre-washing of the ore causes considerable reduction in the amount of cyanide consumed but this trouble is not likely to be encountered at depth. Small amounts of copper in all of the samples will also account for part of the cyanide consumed.

Tests have shown that in the mixture of samples No. 1 Quartz and No. 1 Schist, more than 90 per cent of the gold is free with the ore ground 64 per cent finer than 200 mesh, while 79 per cent of the gold is free in

(Experimental Tests, cont'd) -

Sample No. 2 when the ore is ground 54 per cent finer than 200 mesh. Cyanidation of the amalgamation tailings brings the total extractions up to 98 and 96 per cent respectively.

Details of Tests:

Tests 1 and 2. - Amalgamation and Cyanidation of Samples Nos. 1 and 2.

Samples of the ores were ground 64 and 54 per cent finer than 200 mesh in water and amalgamated with new mercury for one hour. The amalgams were assayed for gold and the tailings were filtered, washed, and agitated in cyanide solution, 1.0 pound per ton NaCN, for 24 hours. The products were assayed for gold.

Summary of Results:

Sample	Grind, per cent -200 mesh	Tailing Assays, Au oz./ton		Extraction, per cent		Reagents consumed, lb./ton ore	
		Amalgamation	Cyanidation	Amalgamation	Cyanidation	NaCN	CaO
Lot No. 1, Mixed	64	0.134	0.03	91.52	6.58	1.45	15.85
Lot No. 2, C Zone	54	0.107	0.02	78.81	17.23	1.85	17.85

Examination of the amalgamation tailing with the aid of a superpanner failed to reveal the presence of any free gold. Any coated or tarnished gold that may have been in the ore was evidently scoured clean in the grinding operation.

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Tests 3 and 4. - Amalgamation of Jig Concentrate followed by Cyanidation.

Samples of the two ores at minus 14 mesh were treated in a jig to remove coarse free gold. The jig concentrate was reground and amalgamated with new mercury.

(Continued on next page)

(Tests 3 and 4, cont'd) -

The amalgamation tailing was then reunited with the jig overflow and the mixture reground in cyanide solution to approximately 80 per cent finer than 200 mesh and agitated for 48 hours. The solution was kept at 1.0 pound per ton NaCN and a dilution ratio of 1.5:1. The cyanide tailings and amalgam were assayed for gold.

Summary of Results:

Sample	Grind, per cent -200 mesh	Tailing assays, Au oz./ton: Amalgamation	Tailing assays, Au oz./ton: Cyanidation	Extraction of gold, per cent: Amalgamation	Extraction of gold, per cent: Cyanidation	Reagents consumed, lb./ton ore: NaCN	Reagents consumed, lb./ton ore: CaO
Lot No. 1, Mixed	84.1	0.732	0.035	53.67	44.11	1.87	26.6
Lot No. 2, C Zone	77.6	0.282	0.025	44.16	50.88	3.60	34.8

Higher cyanide and lime consumptions will be noted in Tests 3 and 4 than in Tests 1 and 2. This is because the ore was not washed before coming in contact with the cyanide solution in Tests 3 and 4 and the ferric arsenate formed by slow surface oxidation consumed cyanide. This is particularly true in the case of the ore from C Zone, which contains twice as much arsenic as the mixture of No. 1 samples.

Conclusions:

The results of tests conducted on these two samples of ore indicate that ore mined from depth should respond to a simple method of treatment such as grinding in cyanide solution with a jig between mill and classifier to remove coarse free gold.

The samples submitted contain a lot of free gold, most of which is much too coarse to be treated in a cyanide

(Conclusions, cont'd) -

circuit. Such gold should be removed and amalgamated.

The problems of coated gold and high cyanide consumption due to ferric arsenate are both products of surface oxidation and should disappear when ore free from oxidation is being treated. It is, however, possible that below the zone of oxidation the ore may become more refractory and it would be wise to submit a further sample when this zone is reached.

There seems to be no doubt that ore from both zones can be treated by the above process but if the amount of free gold in the ore should diminish with depth lower recovery by amalgamation will be the result.

Grinding need not be carried beyond 65-70 per cent finer than 200 mesh.

To operate this property on a 10-15 tons per day basis a specially designed small mill should be used - a grinding mill and classifier with a jig between them, and an agitator plant that might be operated on the batch system. Such a mill is described in a pamphlet sent under separate cover.

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Note: 2 pamphlets
"Milling Practice for Small Gold Mines"
by C.S. Parsons
(1935)