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August 22, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 885.

Cyanidation, Amalgamation, and
Concentration of a Gold Ore from
the Gold Frontier Mines, Limited,
Red Lake, Ontario.



BUREAU OF MINES
DIVISION OF METALLIC MINERALS
—
ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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the Gold Frontier Mines, Limited,
Red Lake, Ontario.

Shipment:

One bag of ore, weighing fifty pounds, was received on July 22, 1940, from Mr. R. C. Gamble, President, Gold Frontier Mines, 224 Bay Street, Toronto, Ontario.

Location of the Property:

The property of the Gold Frontier Mines, Limited, from which the present shipment was received is situated in Todd Township, Pipestone Bay section, Red Lake area, Patricia District, North Western Ontario.

Sampling and Analysis:

After crushing, cutting, and grinding by standard methods, a representative sample of the shipment was obtained, which assayed as follows:

Gold (Au)	- 1.95 ounce per ton
Silver (Ag)	- 0.68 ounce per ton
Iron (Fe)	- 1.86 per cent
Sulphur (S)	- 0.61 per cent
Copper (Cu)	- 0.05 per cent
Arsenic (As)	- Nil

Characteristics of the Ore:

Six polished sections were prepared and examined microscopically for the purpose of determining the character of the ore.

Gangue - The gangue is composed of impure glassy quartz which is somewhat fractured and transected by narrow sinuous cracks.

Metallie Minerals - The metallie mineral content of the sections is very small and is represented chiefly by sparsely disseminated pyrite and pyrrhotite. The former occurs as coarse to fine irregular grains which are rather poorly polished; the latter as medium to fine irregular grains in which the finer sizes predominate. Chalcopyrite is visible as occasional small grains in gangue often associated with pyrrhotite, and a negligible amount of sphalerite is present as very rare small grains in gangue.

No native gold was observed in the six polished surfaces, although each was carefully traversed under the microscope.

Investigative Work:

The test work comprised straight cyanidation, amalgamation of jig and blanket concentrates, and tabling and flotation concentration of the amalgam residues and blanket tailing. The best results were obtained by straight cyanidation, when a cyanide residue of 0.01 ounce gold per ton was obtained in twenty-four hours agitation at a grind of seventy-six per cent -200. Details of the test work follow:

Test No. 1 (A to D)

Straight Cyanidation

The ore at -14 mesh was ground in cyanide solution of one pound NaCN per ton strength to different degrees of fineness. The pulp was then bottle agitated for twenty-four hours. Enough lime was added to the grind and agitation to maintain protective alkalinity.

Results: Feed, 1.95 ounce gold per ton.

Test No.	Agitation, hours	Grind, per cent -200	Tailing Assay, gold, oz./ton	Extraction of gold, per cent	Titration, lb./ton solution		Reagents Consumed, lb./ton ore	
					NaCN	CaO	NaCN	CaO
1A	24	53.6	0.075	96.2	1.00	0.25	0.60	4.5
B	24	63.4	0.025	98.7	0.90	0.20	0.60	4.6
C	24	76.1	0.01	99.5	0.96	0.25	0.70	4.8
D	24	91.3	0.01	99.5	0.96	0.20	0.75	4.8

Test No. 2

Concentration - Amalgamation

The ore at -14 mesh was ground in a ball mill.

to pass 60.2 per cent -200 mesh. The pulp was then passed through a Denver Gold Jig and the jig overflow passed over a corduroy blanket. The jig and blanket concentrates were then amalgamated with mercury in a mortar, and the amalgam residue added to the blanket tailing. This product was then concentrated on a Wilfley Table.

Jig and Blanket Concentration

Results:

Product	Weight, per cent	Assays, gold, oz./ton	Distribution of gold, per cent	Ratio of Concentration
Feed	100.00	1.95	100.0	37.3:1
Jig + Blanket Conc.	2.68	61.50*	84.5	
Blanket Tailing	97.32	0.51	15.5	

* Calculated.

Some coarse gold was observed in the jig concentrate.

After amalgamation of the combined jig and blanket concentrates, the amalgam residue was added to the blanket tailing. This product assayed 0.37 ounce gold per ton, and showed a recovery of 81.0 per cent of the gold in the ore by amalgamation.

The amalgam residue and blanket tailings were then concentrated on a Wilfley Table as follows:

Product	Weight, per cent	Assays, gold, oz./ton	Distribution of gold, per cent	Ratio of Concentration
Feed	100.00	0.305*	100.0	60:1 71:1
Table Conc.	1.66	4.44	24.2	
Table Middlings	1.40	1.96	9.0	
Table Tailing	96.94	0.21	66.8	

* Calculated.

Summary

Gold recovered by amalgamation	-	81.0 per cent
Gold recovered in Table Conc. and Table Middlings	-	<u>6.3 per cent</u>
Overall recovery	-	87.3 per cent

Test No. 3

Concentration - Amalgamation

The ore at -14 mesh was concentrated by means of a jig and blankets, as in Test No. 2. The concentrates were then amalgamated as before, and the amalgam residue added to the blanket tailings. This product was then reground in a ball mill with two pounds of soda ash, 0.05 pound of potassium amyl xanthate, and 0.05 pound of pine oil per ton to pass 76.0 per cent -200. The pulp was then transferred to a flotation machine, and a concentrate removed by the further additions of 0.05 pound potassium amyl xanthate, and 0.05 pound of pine oil per ton. This concentrate was then cleaned in a smaller machine.

Results of Jig and Blanket Concentration

Product	Weight, per cent	Assays, gold, oz./ton	Distribution of gold, per cent	Ratio of Concentration
Feed	100.00	1.95	100.0	
Jig + Blanket Conc.	5.00	32.92*	84.4	20:1
Blanket Tailing	95.00	0.32	15.6	

* Calculated.

The combined jig and blanket concentrates were amalgamated, and the amalgam residue added to the blanket tailing. This product assayed 0.39 ounce gold per ton, and showed a recovery of 80.0 per cent of the

gold in the ore by amalgamation.

Results of Flotation of Amalgam Residue
and Blanket Tailings

Product	Weight, per cent	Assays, gold, oz./ton	Distribution of gold, per cent	Ratio of Concentration
Feed	100.00	0.37*	100.0	
Flot. Conc.	1.99	15.80	85.5	50:1
Flot. Middlings	3.55	0.32	2.9	
Flot. Tailings	94.66	0.045	11.6	

* Calculated.

The P. H. of the pulp was 9.1.

Summary

Gold recovered by amalgamation	80.0 per cent
Gold recovered in Flotation Conc. and Flotation Middlings	<u>17.7 per cent</u>
Overall recovery	97.7 per cent

Summary and Conclusions:

By straight cyanidation of the ore, at a grind of seventy-six per cent -200 mesh, a cyanide residue of 0.01 ounce gold per ton was obtained in twenty-four hours agitation. Reagent consumption was normal.

Concentration of the gold by means of jigs and blankets, followed by amalgamation of the resulting concentrates, gave a recovery of 80 to 81 per cent of the gold by amalgamation. When the blanket tailings and amalgam residue was further concentrated by flotation, an additional seventeen per cent of the gold was recovered in the flotation concentrate and middling products.

As is shown in the results of the test work, the ore cyanides readily, and this is the milling method

that should be adapted.

Alternately, amalgamation and concentration of the ore will give a good recovery of the gold, if the installation of a cyanide plant is not feasible.

This sample shipment assayed 1.95 ounce gold per ton. As this appears to be too high to be representative of the ore on the property, the percentages of recovery of the gold in both cyanidation and amalgamation would probably be lowered considerably in practice.

HLB:EPF