

O T T A W A

July 11th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1675.

Concentration and Cyanidation Tests on a  
Sample of Gold Ore from the Francoeur Mine,  
near Arntfield, Quebec.

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Shipment:

A shipment of 25 sacks containing 1,920 pounds of ore was received on May 25th, 1944. The sample was submitted by John W. MacKenzie, Manager, Francoeur Gold Mines Limited, Arntfield, Quebec.

Location of Property:

The property from which this ore was taken is located at the western boundary of Beauchastel township, one mile west of the town of Arntfield, Timiskaming county, Quebec.



Sampling and Assaying:

A sample was riffled from the shipment and then assayed. Following are the results:

Gold	-	0.24 ounce per ton.
Silver	-	0.075 " " "
Iron	-	5.27 per cent.
Copper	-	Trace.
Arsenic	-	Nil.
Sulphur	-	1.28 per cent.

Experimental Tests:

A number of tests were conducted to determine the reason for the low extraction now being obtained at the mine. Cyanidation tests were conducted direct as well as with concentration and regrinding of sulphides. About 60 per cent of the gold is free and recoverable by barrel amalgamation with the ore ground 52 per cent finer than 200 mesh. Good tailing assays were obtained when sufficient agitation was given.

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CONCLUSIONS:

Tests indicate that this ore should be treated by cyanidation with selective fine grinding of the sulphides. The need for fine grinding of the sulphides is shown by the infrasizer analysis in Test No. 7.

Existing flotation equipment can be used to concentrate the sulphides, after which they should be reground in cyanide solution and agitated for 48 to 72 hours. The flotation tailing should also be agitated in cyanide solution for at least 24 hours, and preferably longer, because it will contain about 10 per cent of the gold and a good part of it is readily soluble in cyanide solution.

A study of the company's present mine flow sheet, combined with the results of these tests, appears to indicate



(Conclusions, cont'd) -

that:

- (1) There is not enough agitator capacity in the concentrate circuit.
- (2) The pulp density in the tailing circuit must be too high for proper dissolution of the gold since this pulp goes direct to a filter without being thickened.
- (3) There may also be a high dissolved value loss in the filter cake, as single-stage filtration hardly seems enough.

These points should be checked by assaying intermediate products at different points in the circuit to determine just where the trouble lies.

The reground pyrite concentrate should not contain more than 0.0021 ounce per ton of gold for each per cent of contained pyrite after it has been thoroughly agitated. This would mean 0.105 ounce per ton for a product carrying 50 per cent pyrite.

Gold dissolves more readily in a pulp of low density than in one of high density, and the tailing circuit should be checked on this point. In this series of tests (see Test No. 7) flotation tailings were agitated at 2:1 dilution and gave low cyanide tailings.

Samples of the final filter cake should be assayed as they come from the filter and after thorough washing, to check on dissolved losses escaping in the cake.

If the tailing leaving the concentrate thickeners has a high assay value it would be a good idea to bring the two agitators together in series after the primary thickener and, if possible, add a third. This would give more thorough agitation and would, to a large extent, prevent short-circuiting out of the agitation circuit.

If a high dissolved loss is found in the filter cake,



(Conclusions, cont'd) -

more thorough washing is needed. It would be a good idea to dilute the tailing circuit to a lower density and put one or two thickeners ahead of the filter as may be required. In this way 94 to 95 per cent extraction should be obtained without difficulty on ore of this grade.

Character of the Ore:

The sample, as received, was crushed to about  $\frac{1}{4}$ -inch size and six polished sections, prepared from several of the larger and better mineralized pieces, were examined microscopically to determine its character.

Gangue -

Gangue material is high siliceous and varies in character from translucent white quartz to greenish grey, brownish grey and reddish brown rock. It carried a small quantity of finely disseminated carbonate which gave a fairly strong microchemical test for iron.

Metallic Minerals:

Metallization is not very heavy and is represented chiefly by pyrite, which occurs as medium coarse to very fine subhedral crystals and irregular grains unevenly disseminated through gangue. It is not fractured, but some grains contain rather numerous small inclusions of gangue, right down to the limits of the microscope, about one micron, in size.

Magnetite and hematite are locally numerous in gangue, occasionally in pyrite, as scattered crystals and grains averaging about 40 to 50 microns (-280+400 mesh) in size. A small quantity of chalcopyrite is present, as small sporadic grains in gangue and pyrite.

Native Gold -

Since no native gold or gold minerals were observed



(Character of the Ore, cont'd) -

in the six polished sections made from the ore, even after examination under a high-power oil-immersion objective, six more sections were prepared from mill products made from the ore and these were examined under a reflecting microscope. Three of these sections were from a flotation concentrate test, No. 6, and three from a superpanner concentrate of the flotation concentrate. Each of the six polished surfaces contains native gold, fifty small particles being observed and measured. They range from 48 microns down to 4 microns in size. All are free in the mounting medium (bakelite) except one, 9 microns in diameter, which is attached to a grain of pyrite about the same size. The grain size of the gold is tabulated below:

Grain Size Analysis -

<u>Screen Size</u>	<u>Per Cent</u>
+ 400	13.2
- 400+ 560	10.2
- 560+ 800	16.9
- 800+1100	27.8
-1100+1600	13.5
-1600	18.4
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	100.0

DETAILS OF INVESTIGATION:

Test No. 1. - Barrel Amalgamation.

A sample of the ore was ground 51.8 per cent finer than 200 mesh with lime added to the charge at the rate of 2 pounds per ton of ore. The pulp was amalgamated with new mercury for one hour, after which the amalgam, as well as the amalgamation tailing, was assayed for gold.

(Continued on next page)



(Test No. 1, cont'd) -

Screen Analysis of Amalgamation Tailing.

<u>Size</u>	<u>Weight, per cent</u>	<u>Gold assay, Au, oz./ton</u>
+ 48 mesh	3.75	0.202
- 48+ 65 "	8.85	0.085
- 75+100 "	11.30	0.109
-100+150 "	15.55	0.125
-150+200 "	8.75	0.124
-200 "	51.80	0.065
<u>Average tailing + 100.00</u>		<u>0.091</u>

The gold assay of the amalgam, expressed in ounces per ton of ore treated, is 0.133. These two assays added together give a feed sample of 0.224 ounce per ton. 59.38 per cent of the gold is therefore free at this grind.

Tests Nos. 2 to 5. - Straight Cyanidation.

Samples of the ore were ground in cyanide solution for 10 minutes and then agitated for periods of 24, 48, 73, and 96 hours. The grinds of the various lots ranged from 47 to 57 per cent finer than 200 mesh. The tailings were assayed for gold.

Screen Analyses of the Cyanide Tailings -

Test No. 2 (24 hours)

<u>Mesh</u>	<u>Weight, per cent</u>	<u>Assay, Au, oz./ton</u>
+ 65	5.65	0.026
- 65+100	10.00	0.023
-100+150	17.95	0.030
-150+200	9.95	0.022
-200	56.45	0.015
<u>Average tailing - 100.00</u>		<u>0.0198</u>

(Continued on next page)



(Tests Nos. 2 to 5, cont'd) -

Screen Analyses of the Cyanide Tailings, cont'd) -

Test No. 3 (48 hours)

<u>Mesh</u>		<u>Weight, per cent</u>	<u>Assay, Au, oz./ton</u>
+65	+	10.00	0.029
-65+100	-	12.45	0.03
-100+150	-	17.25	0.03
-150+200	-	8.70	0.025
-200	-	51.60	0.010
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Average tailing	-	100.00	0.0191

Test No. 4 (72 hours)

+ 65	-	5.90	0.025
- 65+100	-	9.65	0.023
-100+150	-	17.00	0.025
-150+200	-	9.60	0.022
-200	-	57.85	0.010
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Average tailing	-	100.00	0.0158

Test No. 5 (96 hours)

+ 65	-	11.95	0.019
- 65+100	-	13.75	0.022
-100+150	-	17.70	0.025
-150+200	-	9.30	0.023
-200	-	47.30	0.010
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Average tailing	-	100.00	0.0165

The higher average tailing assay in Test No. 5, as compared with Test No. 4, is doubtless due to the coarser grinding in Test No. 5.

The following table shows the extractions obtained in Tests Nos. 2 to 5. They are based on an average feed sample assay of 0.024 ounce per ton, taken from Test No. 1.

(Continued on next page)



(Tests Nos. 2 to 5, cont'd) -

Test No.	Tailing assay, Au oz./ton	Extraction, per cent	Reagent consumption, lb./ton ore	
			NaCN	CaO
2	0.0198	91.16	0.70	4.66
3	0.0191	91.47	0.70	4.69
4	0.0158	92.95	0.70	4.66
5	0.0165	92.63	0.76	4.69

This series of tests indicates that a reasonably good extraction of the gold can be obtained by examination at a moderate grind, without special treatment of the sulphides.

#### Test No. 6. - Flotation.

A sample of the ore was ground 76 per cent finer than 200 mesh and floated as follows:

#### Charge to Ball Mill -

Ore - 2,000 grams at minus 14 mesh.  
 Soda ash - 2.0 lb./ton.  
 Barrett's No. 4 - 0.044 "  
 Grinding time - 15 minutes.

#### Reagents to Cell -

No. 208 - 0.05 lb./ton.  
 No. 301 - 0.05 "  
 Barrett's No. 4 - 0.088 "  
 Pine oil - 0.06 "

#### Screen Analysis, Flotation Tailing -

Size	Weight, per cent	Assays	
		Gold, oz./ton	Sulphur, per cent
+150	13.25	0.036	0.14
-150+200	10.60	0.058	0.22
-200	76.15	0.015	0.08
Average tailing	100.00	0.022	0.10

The fact that the gold assays vary directly as the



(Test No. 6, cont'd) -

sulphur assays would indicate that the two were associated.

Summary of Results, Test No. 6 -

Product	:Weight,	: A S S A Y S		: Distrubution,	
	: per	: Au,	: Sulphur,	: per cent	
	: cent	: oz./ton	: per cent	: Au :	: S
Concentrate	: 4.10	: 4.23	: 27.78	: 89.15:	: 92.23
Tailing	: 95.90	: 0.022	: 0.10	: 10.85:	: 7.77
Feed (cal.)	: 100.00	: 0.195	: 1.23	: 100.00:	: 100.00

Test No. 7. - Flotation and Cyanidation.

In this test 24,000 grams of ore was ground and floated in 2,000-gram lots, to produce enough concentrate for regrinding and cyanidation. The grind was coarser than in Test No. 6, 61.22 per cent finer than 200 mesh, and a slightly higher flotation tailing was produced. The flotation tailing was also treated by cyanidation.

Results of Flotation:

Product	: Weight, : per : cent	: Assay, : Au, : oz./ton	: Distribution, : per cent
Concentrate	: 5.14	: 3.49	: 87.71
Tailing	: 94.86	: 0.0265	: 12.29
Feed (cal.)	: 100.00	: 0.204	: 100.00

A sample of the concentrate was reground for one hour in cyanide solution, 96 per cent finer than 325 mesh, and agitated at 2.66:1 dilution for 72 hours. The solution was



(Test No. 7, cont'd) -

maintained at 1.0 pound NaCN per ton and 0.50 pound CaO per ton throughout the agitation period. The cyanide tailing was assayed for gold by bulk sample as well as the products of an infrasizing test. Samples of the flotation tailing were also agitated in cyanide solution, without further grinding, at 2.0:1 dilution for periods of 24, 48, and 73 hours. The solution was maintained at 1.0 pound per ton NaCN and 1.0 pound per ton CaO, throughout the agitation period.

The bulk assay of the cyanide tailing from the flotation concentrate was 0.086 ounce per ton in gold, while the infrasizer analysis was as follows:

Size	Weight, per cent	A S S A Y S				Gold assay of
		Au, oz./ton	Sulphur, per cent	Pyrite (cal.) per cent	Pyrite, in oz.	
					/ton, assuming all the gold is in the pyrite	
+ 200 mesh	0.76	0.194	15.61	29.23	0.664	
-200 mesh + 56 microns	1.28	0.364	44.93	84.14	0.433	
-56 " + 40 "	8.40	0.25	42.94	80.41	0.311	
-40+28 " + 28 "	10.53	0.185	39.50	73.97	0.250	
-28 " + 20 "	11.05	0.13	35.34	66.18	0.196	
-20 " + 14 "	10.95	0.085	28.50	53.37	0.159	
-14 " + 10 "	11.73	0.055	20.83	39.01	0.141	
-10 " "	45.30	0.025	10.10	18.91	0.132	
Average tailing -	100.00	0.088	22.50	42.13	0.209	

#### Summary of Cyanidation Results:

Product treated	Period of agitation, hours	Tailing assay, Au, oz./ton	Extraction, per cent total gold	Reagents consumed, lb./ton product	
				NaCN	CaO
Flotation concentrate	72	0.088	85.50	4.92	19.97
Flotation tailing	24	0.007	9.04	0.15	2.43
" "	48	0.005	9.97	0.23	2.86
" "	72	0.004	10.43	0.36	33.20

The above infrasizer analysis shows the need for selective grinding and agitation of the pyrite. In view of the



(Test No. 7, cont'd) -

low cyanide tailing assay obtained by agitating the flotation tailing for 72 hours, the assumption that all the refractory gold in the cyanide tailing from the reground concentrate is associated with the pyrite is considered reasonably accurate. The procedure followed in this test follows along the same broad lines as the mill practice at this property, and with some of the details corrected as outlined under "Conclusions", better extraction can be expected.

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