



DEPARTMENT OF MINES
CANADA

MINES BRANCH

OTTAWA January 9th, 1933.

WELLINGTON BOND

R E P O R T
of the

ORE DRESSING AND METALLURGICAL LABORATORIES

Int. 459

Experimental Tests on Two Samples of Gold Ore
from Beaufer Gold Mines, Limited,
Pascalis Township, Northwestern Quebec.

O T T A W A

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Report No.

Experimental Tests on Two Samples of Gold Ore
from Beaufer Gold Mines Limited,
Pascalis Township, North-Western Quebec.

Shipment -

A shipment of 11 sacks of ore, net weight 1507 pounds, was received October 29, 1932. The shipment represented two distinct samples of ore, one from No. 1 vein and the other from No. 4 vein, the weight of each being approximately 750 pounds.

The sample was submitted by J. C. R. MacPherson,
Manager, Beaufer Gold Mines Limited, Amos, Quebec.

Characteristics of the Ore -

1" The ore consists essentially of coarse pyrite in a quartz gangue. Locally this sulphide is disseminated in a black rock which is also traversed by veinlets of quartz. The quartz varies from a comparatively clear glassy type to a milky white type, and more rarely a light blue, almost opalescent variety is associated with chloritic material with small amounts of carbonate. The sulphides appear to follow the glassy or milky types, as does the gold.

That the sulphide and gold mineralization took place at a comparatively high temperature is indicated by the associated high temperature type of quartz and the presence of needles of tourmaline in this quartz, and more rarely within the pyrite itself."

An average analysis of each of the samples was as follows:-

	<u>Sample No. 1</u>	<u>Sample No. 4</u>
Au - oz./ton	1.05	0.565
Ag - oz./ton	0.03	0.17
Cu - %	0.04	0.08
Pb - %	Trace	0.05
Zn - %	0.35	0.12
Fe - %	5.40	4.10
Insol. - %	77.73	67.10

Experimental Tests -

Head samples were cut by standard methods from each of the two types of ore contained in the shipment.

A series of small scale tests was made on each type of ore as well as a larger scale mill run using a unit of 100 pounds per hour capacity. The small scale work

1 From Report of Mineralogical Laboratory by Maurice Haycock.

included in each case flotation tests on both the ore and amalgamation tailings as well as cyanidation and amalgamation tests on both the ore and flotation concentrates.

The flowsheet for the larger scale unit tests was plate amalgamation followed by flotation of the amalgamation tailings.

In some cases erratic results were obtained, due no doubt to the presence of free gold in varying amounts and sizes.

The results of tests may be summarized as follows:-

Test	Sample No. 1		Sample No. 4	
	Recovery %	Tailing Assay: Au oz./ton	Recovery %	Tailing Assay: Au oz./ton
Flotation	98.0	0.02	97.1	0.01
	90.8	0.185	86.4	0.065
Amalgamation				
- 35 mesh:	50.0	0.525	74.8	0.092
- 65 mesh:	70.4	0.311	82.1	0.175
-150 mesh:	76.8	0.25	86.7	0.150
Cyanidation				
- 35 mesh:	90.0	0.105	89.0	0.04
- 65 mesh:	95.2	0.05	93.2	0.025
-150 mesh:	97.6	0.025	97.3	0.01
Amalgamation and Cyanidation at				
-65 mesh	96.7	0.045	91.8	0.03
Amalgamation and Flotation at				
-65 mesh	97.8	0.025	98.4	0.007

Details of the tests follow.

Test No. 1 - Sample No. 1 -

This is a flotation test on the ore ground 20 minutes in a Denver rod mill.

Charge to Rod Mill:

Ore - 2000 grams at +14 mesh.
 Water - 1000 c.c.
 Na₂CO₃ - 2 lb./ton.
 Aerofloat No. 25 - 0.07 lb./ton.

Reagents to Flotation Cell:

Sodium Ethyl Xanthate - 0.10 lb./ton.
 Pine Oil - 0.05 lb./ton.

Concentrate and tailing were filtered, washed and assayed for gold.

Summary Test No. 1 - Sample No. 1 -

Product	Weight %	Assay Au oz./ton	Recovery %
Conc.	5.96	15.18	97.96
Tailing	94.04	0.02	2.04
Head (cal.)	100.00	0.924	100.0

The ratio of concentration is 16.75:1

Screen Analysis of Flotation Tailing -

Mesh	Weight %	Assay Au oz./ton	Average Tailing Au oz./ton
+200	52.0	0.02	0.02
-200	48.0	0.02	

Test No. 2 - Sample No. 1 -

In this test the ore at -14 mesh was ground for 20 minutes in a Denver rod mill then floated. Samples of the flotation concentrate were then treated by cyanidation, amalgamation, and amalgamation followed by cyanidation, the period of agitation being in each case about 40 hours.

Charge to Rod Mill:

Ore - 2000 grams.
 Water - 1000 c.c.
 Na₂CO₃ - 3 lb./ton.
 Aerofloat No. 25 - 0.07 lb./ton.

Reagents to Cell:

Sodium Ethyl Xanthate - 0.10 lb./ton.
 Pine Oil - 0.05 "
 Tarel No. 1 - 0.025 "

All products were assayed for gold.

Summary Test No. 2 - Sample No. 1 -

Product	Weight %	Assay Au oz./ton	Recovery %
Conc.	7.6	22.24	90.8
Tailing	92.4	0.185	9.2
Head (cal.)	100.0	1.88	100.0

Ratio of Concentration 13.16:1

Summary Tests on Flotation Concentrate Sample No. 1 -

Product	Assay		Recovery %	Reagents Consumed lb./t	
	Head Au oz./t	Tailing Au oz./t		KCN	CaO
Cyanide Tailing	22.24	0.61	97.3	5.5	12.7
Amalgamation Tailing	22.24	3.665	70.0		
Cyanidation Tailing from Amal. Tailing	3.665	0.60	91.0	5.5	13.4

Overall recovery by Amalgamation and Cyanidation

$$= 70.0 + (91.0 \times 30.0) = 97.3\%$$

Test No. 3 - Sample No. 1 - Amalgamation -

Three lots of the ore were ground to the following sizes, -35, -65 and -150 mesh. Amalgamation tests were made on samples of each of these, 1000 grams of the ore in 1:1 pulp being amalgamated for 30 minutes with 100 grams of mercury. The -65 mesh amalgamation tails were floated with the following reagents:

H ₂ CO ₃	-	3 lb./ton
Aerofloat No. 25	-	0.07 lb./ton
Sodium Ethyl Xanthate	-	0.1 lb./ton
Pine Oil	-	0.05 lb./ton

Summary Amalgamation Tests, Sample No. 1 -

Head Sample Au - 1.05 oz./ton.

Mesh	Tailing Assay Au oz./ton	Recovery %
- 35	0.525	50.0
- 65	0.311	70.4
-150	0.25	76.2

Flotation Test Amalgamation Tails -65 mesh -

Product	Weight %	Assay Au oz./ton	% Value
Conc.	9.0	3.20	92.7
Tailing	91.0	0.025	7.3
Amal. Tail. (cal.)	100.0	0.311	100.0

Overall recovery of gold resulting from amalgamation and flotation of the -65 mesh ore is 97.6%.

Test No. 4 - Sample No. 1 - Cyanidation -

Cyanidation tests were made on samples of the same three lots of ore as the amalgamation tests described above were made on. The pulp, at 3:1 dilution, was agitated for 24 hours in solution running 2 lb./ton in KCN.

Summary of Cyanidation Tests, Sample No. 1 -

Head Sample Au - 1.05 oz./ton.

Mesh	Tailing Assay Au oz./ton	Recovery %	Reagents Consumed lb./ton	
			KCN	CaO
- 35	0.105	90.0	0.60	2.17
+ 65	0.05	95.2	0.90	2.25
-130	0.025	97.6	1.50	6.60

Test No. 5 - Sample No. 1 - Amalgamation

followed by Cyanidation of Amalgamation Tailing -

In this test 1000 grams of the ore at -35 mesh was amalgamated in 1:1 pulp for 30 minutes with 100 grams of mercury. The amalgamation tailing was agitated for 24 hours in solution running one lb./ton in KCN. Dilution was 2.5:1 and lime was added at the rate of three lb./ton tailing.

Summary Test No. 5 - Sample No. 1 -

Head Sample Au 1.05 oz./ton.

Product	Assay Au oz./t	Recovery by Amalgamation	Recovery by Cyanidation	Total Recovery	Reagents lb./ton	
					KCN	CaO
Amal. Tail.	0.311	70.4	25.3	95.7	0.58	2.25
Cyanid. Tail.	0.045					

Test No. 6 - Sample No. 1 - Hydraulic Classification -

In this test the ore at -65 mesh was put through a hydraulic classifier, the heavy sulphides and coarse gold being allowed to settle against a slowly rising current of water. The classifier concentrate and overflow were assayed for gold.

Summary Test No. 6 - Sample No. 1 -

Product	Weight %	Assay Au oz./ton	% Value
Cons.	1.3	34.70	33.2
Overflow	99.7	0.805	63.8
Head (cal.)	100.0	1.25	100.0

Ratio of Concentration 73.9:1

Mill Run - Sample No. 1 -

The ore at -14 mesh was fed into a rod mill, the discharge from which dropped onto an amalgamation plate. The amalgamation tails were floated with the following reagents:

Na₂CO₃ - 3 lb./ton
 Sodium Ethyl Xanthate - 0.1 lb./ton
 Pine Oil - 0.05 lb./ton

Samples were taken at 15 minute intervals of the feed, rod mill discharge, plate discharge, flotation concentrate, and flotation tailing. These products were assayed for gold, the assays being as follows:

	<u>Au - oz./ton</u>
Mill feed	1.44
Rod mill discharge	0.99
Plate discharge	0.44
Flotation concentrate	4.10
Flotation tailing	0.01
Mill clean-up	2.62

A screen test on the rod mill discharge showed the grinding to be as follows:

Mesh	Weight %	Cum. Wt. %
+100	7.5	7.5
+200	27.2	34.7
-200	65.5	100.0

Summary Mill Run - Sample No. 1 -

Flowsheet - Amalgamation and Flotation.

Test started - 2.30 p.m.

Test finished - 4.45 p.m.

Power off ten minutes.

Duration of test - 2 hours and 5 minutes.

Feed rate 90 pounds per hour.

Total feed during test 187.5 pounds.

Total concentrate produced 19.7 pounds.

Ratio of conc. 9.5:1

Product	Weight %	Assay Au oz./ton	% Values
Mill feed	100.0	1.64	100.0
Rod mill discharge	100.0	0.99	68.75
Plate discharge	100.0	0.44	30.60
Flot. conc.	10.5	4.10	29.90
Flot. tailing	89.5	0.01	0.62

Percent total gold remaining in rod mill - 31.25 %

Percent total gold recovered on plate - 38.15

Percent total gold recovered in flot. conc. - 29.90

Total recovery by amalgamation and flotation - 68.05

Recovery from mill clean-up by amalgamation - 23.2

Total recovery 68.05 + 23.20 = 91.25 %

% Gold recovered from flotation concentrate by cyanidation 97.1
% Gold recovered from flotation concentrate by amalgamation 36.0

Test No. 1 - Sample No. 4 -

This is a flotation test on the ore ground for 20 minutes in a Denver rod mill.

Ore - 2000 grams -14 mesh.
Water - 1000 c.c.
Na₂CO₃ - 3 lb./ton.
Aerofloat #25 - 0.07 lb./ton.

Reagents to Cell:

Sodium Ethyl Xanthate - 0.1 lb./ton.
Pine Oil - 0.03 lb./ton.

Summary Test No. 1 - Sample No. 4 -

Product	Weight %	Assay Au oz./ton	Recoveries %
Conc.	7.6	4.03	97.1
Tailing	91.4	0.01	2.9
Head (cal.)	100.0	0.32	100.0

Ratio of Concentration 13.18:1

Screen Analysis Flotation Tailing -

Mesh	Weight %	Assay Au oz./ton	% Values	Average Tailing
+200	31.8	0.01	31.8	0.01
-200	68.2	0.01	68.2	

Test No. 2 - Sample No. 4 -

In this test the flotation concentrate produced from 2000 grams of ore was treated in the following ways:

- (1) Straight Cyanidation.
- (2) Amalgamation.
- (3) Amalgamation followed by Cyanidation.

The ore at -14 mesh was ground for 20 minutes in a Denver rod mill, the charge being as follows:

Ore - 2000 grams.
 Water - 1000 c.c.
 Na₂CO₃ - 3 lb./ton.
 Aerofloat #25 - 0.07 lb./ton.

Reagents to Cell:

Sodium Ethyl Xanthate - 0.1 lb./ton.
 Pine Oil - 0.05 lb./ton.

Summary Test No. 2 - Sample No. 4 -

Recovery by Flotation of Ore -

Product	Weight %	Assay Au oz./ton	Recovery %
Conc.	7.6	6.56	96.4
Tailing	92.4	0.035	15.6
Head (cal.)	100.0	0.58	100.0

Ratio of Concentration 13.15:1

Summary of Tests on Flotation Conc. - Sample No. 4 -

Product	Assay Heads	Assay Tailing	Recovery %	Reagents Consumed lb./ton	
	Au oz./ton	Au oz./ton		KCN	CaO
Cyanide Tailing	6.56	0.165	97.5	3.0	10.6
Amalgamation Tailing	6.56	1.89	71.2		
Cy. Tailing from Anal. Tailing	1.89	0.15	92.1	3.0	11.2

Test No. 3 - Sample No. 4 - Amalgamation -

Three lots of the ore were ground to the following sizes -35, -45, and -150 mesh and amalgamated as was done with No. 1 sample. In each case 1000 grams of the ore was amalgamated for 30 minutes in 1:1 pulp with 100 grams of

mercury. The -65 mesh amalgamation tailing was floated using the following reagents:

Na ₂ CO ₃	-	5 lb./ton.
Aerofloat	-	0.07 "
Sodium Ethyl Xanthate	-	0.1 "
Pine Oil	-	0.05 "

Summary Test No. 3 - Sample No. 4 -

Head Sample Au - 0.365 oz./ton -

Mesh	Tailing Assay Au oz./ton	Recovery %
- 35	0.098	74.8
- 65	0.175	52.1
-150	0.158	56.7

Flotation -65 mesh Amalgamation Tailing -

Product	Weight %	Assay Au oz./ton	% Values
Cons.	15.7	1.08	95.6
Tailing Amalgam.	84.3	0.007	5.4
Tailing (cal.)	100.0	0.175	100.0

Screen Analysis Flotation Tailing from -65 mesh Amalgamation Tail.

Mesh	Weight %	Assay Au oz./ton	% Values	Average Tailing Au oz./ton
+200	52.6	0.005	35.7	0.007
-200	47.4	0.010	64.3	

Test No. 4 - Sample No. 4 - Cyanidation -

Cyanidation tests were made on samples of the ore dry crushed to pass through the following meshes, 35, 65 and 150. The pulp was agitated for 24 hours at 3:1 dilution and KCN 2 lb./ton solution.

Summary of Cyanidation Tests, Sample No. 4 -

Head Sample Au - 0.385 oz./ton.

Mesh	Tailing Assay Au oz./ton	Recovery %	Reagents Consumed lb./ton	
			KCN	CaO
- 55	0.04	89.0	0.3	2.00
- 65	0.028	93.2	0.3	2.00
-150	0.01	97.3	0.9	6.80

Test No. 5 - Sample No. 4 - Amalgamation followed
by Cyanidation of Amalgamation Tailing -

The ore dry crushed to pass through a 65 mesh screen was amalgamated with mercury and the amalgamation tailing agitated for 24 hours in cyanide solution running one pound per ton in KCN. Dilution was 2.5:1

Summary Test No. 5 - Sample No. 4 -

Head Sample Au - 0.385 oz./ton.

Product	Assay Au oz./t	Recovery by:		Total Recovery	Reagents Consumed lb./ton	
		Amalgamation	Cyanidation		KCN	CaO
Amal. Tail.	0.175	52.1	39.7	91.8	.53	2.00
Cy. Tail.	0.03					

Test No. 6 - Sample No. 4 -

Hydraulic Classification -

In this test, as in Test No. 6 - Sample No. 1, the ore at -65 mesh was put through a hydraulic classifier, the coarse gold and heavy sulphides being allowed to settle against a slowly rising current of water. The classifier concentrate and overflow were assayed for gold.

Summary Test No. 6 - Sample No. 4 -

Product	Weight %	Assay Au oz./ton	% Values
Conc.	1.95	7.49	39.5
Overflow	96.05	0.23	60.7
Head (cal.)	100.00	0.37	100.0

Ratio of Concentration 51.3:1

Mill Run Sample No. 4 -

The flowsheet for the mill run was exactly the same as it was for sample No. 1. The pine oil used for sample No. 4 was slightly less than that used for sample No. 1, but otherwise the reagent combination was exactly the same.

A similar set of samples was taken and gave the following assays:

	<u>Au oz./ton</u>
Mill feed	0.59
Red mill discharge	0.33
Plate discharge	0.215
Flotation concentrate	2.35
Flotation tailing	0.015

A screen test on the red mill discharge showed the grinding to be as follows:

Mesh	Weight %	Cum. Weight %
+100	1.5	1.5
+200	15.7	17.2
+300	82.8	100.0

Summary Mill Run Sample No. 4 -

Flowsheet - Amalgamation and Flotation.

Test started - 3.30 p.m.

Stopped - 4.30 p.m.

Restarted - 9.30 a.m.

Finished - 10.45 a.m.

Duration of tests 2 hours, 15 minutes.

Feed rate 97.5 pounds per hour.

Total feed during test 219.4 pounds.

Total conc. produced 18.9 pounds.

Ratio of concentration 11.6:1

Product	Weight %	Assay Au oz./ton	Units	% Values
Mill Feed	100.0	0.39	39.0	100.0
Rod Mill Discharge	100.0	0.38	38.0	97.4
Plate Discharge	100.0	0.218	21.5	55.1
Flot. Conc.	8.6	2.36	20.3	52.0
Flot. Tailing	91.4	0.018	1.4	3.5

Percent of total gold remaining in rod mill	2.6
Percent of total gold recovered on plate	42.3
Percent of total gold recovered in flot. conc.	58.0
Total recovery by amalgamation and flotation	94.3
% Gold recovered from flotation concentrate by cyanidation	97.7
% Gold recovered from flotation concentrate by amalgamation	47.7

Conclusions -

This ore might be treated by any one of a number of flowsheets. Straight cyanidation will give excellent recoveries on both samples of ore when ground to 85% -200 mesh. Approximately 75% of the gold in either sample of ore can be recovered by amalgamation, but to accomplish this sample No. 1 should be ground to 85% -200 mesh and sample No. 4 much coarser at not more than 41% -200 mesh. Flotation alone would not be practical with an ore that contains so much free gold and some of it coarse.

A simple flowsheet would be to grind the ore all through 65 mesh and amalgamate on plates. The amalgamation tailing would be concentrated by flotation. The flotation concentrate would then be reground if necessary or desirable and cyanided. This flowsheet would save a lot of grinding as compared to straight cyanidation since in that case the ore would all have to be crushed through 150 mesh or 85 to 90 percent -200 mesh.