86-390-15411

GEOLOGICAL BRANCH
ASSESSMENT REPORT

15,411

BIOLOGICAL PREOXIDATION AND CYANIDATION TEST WORK ON PORCHER ISLAND ORE

Tippy, Toby 1-2, Kerry Claims
Skeena Mining Division
N.T.S. 103J/2E
Lat. 54°01.8' Long. 130°34.6'

Prepared for:

Operator: Imperials Metals Corporation
Suite 1300, 409 Granville Street
Vancouver, B.C.
V6C 1T2

FILMED

Owner: Porcher Island Gold Mines Ltd.

Prepared by:

Extractive Metallurgy Group
Industrial Chemistry Division
B.C. Research
3650 Wesbrook Mall
Vancouver, B.C
V6S 2L2

July 1986

FOREWORD

Attached is a report on gold extraction tests carried out on ore-grade material from the Porcher Island property, by B.C. Research. The report is complete in itself as regards the tests, including table of contents. Other aspects of the property not covered by the report are described below.

Location:

The property is situated on the north end of Porcher Island near Prince Rupert, B.C. (see attached map), on the hill slope and down to the beach at Edye Point. Access is by boat from Prince Rupert.

Previous Work:

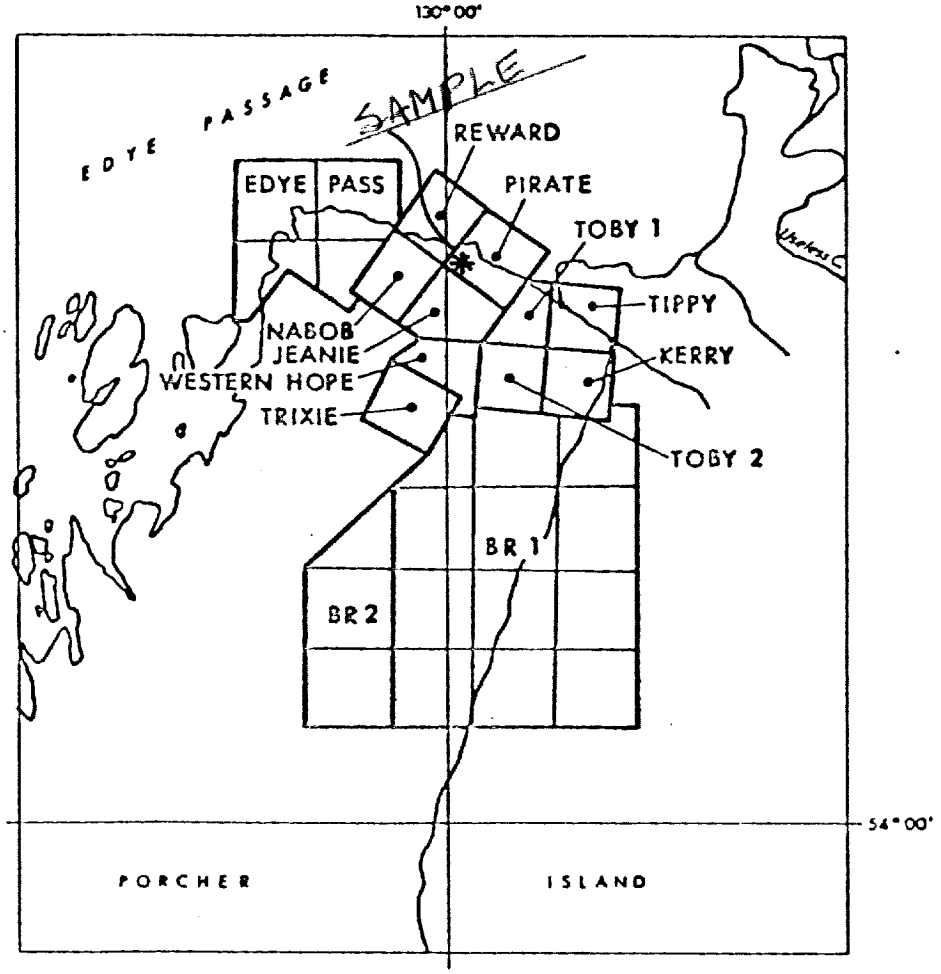
The property was first staked in 1916, and has been mined sporadically since then producing about 80,000 tons ore which gave about 23,000 oz gold. The property is a near viable mining operation with drill indicated ore reserves of about 156,000 tons grading 0.26 oz Au/ton and additional inferred reserves of about 93,000 tons grading 0.25 oz Au/ton. Gold extraction has been previously tested to be nil, by Bacon Donaldson (report in company files), so this series of extraction tests was undertaken to re-evaluate gold extraction using the new biological leaching methods, and to re-try cyanide extraction. The present report is the most recent report on this series of tests (the previous reports in this series have already been filed for assessment purposes).

Samples:

The samples were collected from a stockpile of ore-grade material mined in 1980 and situated at the portal of the Edye Pass Adit on the Edye Pass claim. This is the same suite of samples as used for previous extraction tests in this series of tests.

Statement of Costs:

$2,350.00 for B.C. Research tests and report.



E&B Explorations Ltd

PROJECT # 1007-00

MINERAL DISPOSITION MAP OF PROJECT BANWAN GOLD MINES, B.C.

CLAIMS SHOWN ON MAP

NTS 103-J

SCALE 1:50000

1 0 1 2 Kilo

JANUARY 1980

TABLE OF CONTENTS

	Page
SUMMARY	1
INTRODUCTION	1
Background	1
Objectives	1
MATERIALS AND METHODS	1
Sample Preparation	1
Analytical Methods	1
Direct Cyanidation	2
Column Leaching	2
RESULTS AND DISCUSSION	3
Direct Cyanidation	3
Column Leach Test	4
CONCLUSIONS	5

SUMMARY

This report presents the results of an extension of earlier investigations on Porcher Island Ore.

Objectives of the present study were to investigate optimization of cyanide reagent consumption in direct cyanidation of fine ground ore, and to investigate heap leaching (biological preoxidation) followed by washing and column cyanidation of the coarse fraction of crushed ore.

Results of direct cyanidation tests on fine ground ore indicate satisfactory (approximately 80%) gold recovery at a maintained level of 0.5% dissolved in NaCN in a 50% solids pulp. No significant improvement in recovery was obtained by leaching in 1% NaCN solution, and a reduced recovery (65.8%) was observed from leaching with a maintained level of 0.25% dissolved cyanide. At the 0.5% NaCN level, cyanide consumptions were in the range of 5.6 - 6.1 kg NaCN per tonne of ore; lead acetate addition at a level of 0.5 kg/t did not reduce cyanide consumption.

Column leaching tests on the coarse fraction of crushed ore indicated unsatisfactory gold extraction (26.5%) after biological preoxidation of approximately 15% of the sulphide sulphur content of the head material. This result is considered due to unsatisfactory exposure of pyrite and/or gold in the relatively coarse material. Size degradation (weathering) of the coarse material was negligible during biological preoxidation and cyanide leaching.

The claims appear to be underlain by hornblende diorite where gold in pyrite is associated with quarte veins and shear zones. Results of direct cyanidation tests on fine ground ore indicate satisfactory (approximately 80%) gold recovery.

INTRODUCTION

BACKGROUND

The current testwork on Porcher Island ore was carried out as an extension of earlier investigations reported in 1984 and 1985.

OBJECTIVES

Objectives of the current program were:

- Investigation of optimization of cyanide reagent in direct cyanidation of fine ground ore.

- Preliminary investigation of heap leaching (biological preoxidation followed by washing and cyanidation) as an approach to gold recovery from the coarse fraction of crushed ore.

MATERIALS AND METHODS

SAMPLE PREPARATION

The remainder of Porcher Island Ore from previous test work (cone crushed) was screened at 35 mesh. Fine material was rod milled for 30 minutes at 75% solids to produce a 90.5% -325 mesh sample for direct cyanidation testwork. The +35 mesh material was used for column leaching experiments.

ANALYTICAL METHODS

Solutions were assayed for gold and silver by atomic absorption spectrophotometry (AAS); solid samples were fire assayed for gold and silver by General Testing Laboratories Limited, Vancouver.

Cyanide was determined by titration with silver nitrate.

DIRECT CYANIDATION

Standard bottle roll tests at 50% pulp density were carried out for 72 hours contact time. Initially, after pH adjustment, cyanide was added to solution strengths of 0.25% and 0.5% dissolved NaCN. At the 0.5% NaCN solution strength, a parallel test was done with addition of 0.05% lead acetate (0.5 kg/t of ore). Free cyanide was determined by titration after 24 and 48 hours of leaching; further cyanide was added to maintain the initial solution strengths.

COLUMN LEACHING

A column (3 inch diameter and 2.5 feet long) was set up with remixed coarse ore. Material in the column was first wetted with tap water then treated with dilute sulphuric acid for pH stabilization (pH 1.5 - 2.5). A culture of T.ferrooxidans, previously grown on pyrite, was used to innoculate the column for biological leaching. Progression of the leach was followed by measurement of pH, Eh and dissolved iron. During the biological leaching, sulphuric acid addition was continued to maintain pH in the indicated range, as the ore alkalinity was not neutralized by acid generated from the biological oxidation of pyrite. The bioleach was terminated after 30 days, when solution Eh reached 570 mV.

The bioleach solution was drained from the column which was then washed with tap water to displace residual acidic material. The pH of column liquid phase was then adjusted by passing a dilute lime slurry through the column to a permeate pH of 11.

After drainage of excess lime solution, cyanidation was performed with a 0.1% NaCN solution. Solution strength was maintained by cyanide addition after each solution pass through the column. The test was terminated after 10 solution passes (21 days) when no further increase

in gold dissolution was observed. The column was then washed, drained, discharged and the residue dried. Subsamples of residue were screened to determine size consist and pulverized for fire assay.

RESULTS AND DISCUSSION

DIRECT CYANIDATION

In earlier work on Porcher Island ore, high (1%) dissolved cyanide levels were used to ensure maximum extraction of exposed precious metals. Results of current test work are presented in Tables 1 (summary) and Table 2 (material balances). For comparison purposes, previously reported data on cyanidation of 90% - 325 mesh material with 1% cyanide solution are included in both tables.

Tabulated results indicate that - for 50% pulp density - a solution free cyanide level of 0.5% NaCN is near the optimum value for obtaining gold extraction of approximately 80% which - on the basis of the test result with 1% cyanide solution - is the best that can be obtained with the grind tested.

The lead acetate addition did not have a significant effect on reagent consumption or gold extraction.

With respect to silver, the data of Table 2 suggest that the head assay was in error since the total silver recovered was substantially greater than feed in all cases. Silver recovery results are somewhat erratic, but there does appear to be an appreciable increase in silver recovery associated with high (1%) cyanide content of leach solution.

Overall, the maximum gold extraction from ore at the test grind appears to be in the 80 $\pm$ 2% range and 0.5% NaCN solution is adequate to obtain this extraction. There is significant reduction in gold extraction at the lower (0.25%) cyanide strength and a considerably higher cyanide consumption at the 1% solution strength level, although

this higher cyanide level may result in improved silver recovery.

COLUMN LEACHING TEST

Results of the column leach test are presented in Tables 3 and 4. The head grade of column leached material (6.6 g/t Au, 3.1 g/t Ag) is significantly lower than that of the -35 mesh material used for direct cyanidation tests. This suggests some segregation of gold and/or host-sulphides in the fine fraction of finely crushed (-6 mesh) material.

During the biological preoxidation, intermittent sulphuric acid addition to a total of 14.5 kg/t was required to maintain a pH suitable for active leaching.

Despite the relatively fine size consist, no deterioration in flow rate was observed during either preoxidation or cyanidation leaching. Pre- and post-test screen analyses (Table 3) indicate no significant disintegration of particles.

The biological pre-leach oxidized 15% of the sulphide sulphur content of the feed material.

After preoxidation, column cyanidation (see Table 4) resulted in a total gold extraction of 26.5%, most of which (15.6% of total gold) occurred in the first and second solution passes totalling 3 days leaching time.

Although insufficient, +35 mesh material was available to run a control column withouth preoxidation, the results of the column leach test suggest that the Porcher Island Ore does not respond particularly well to biological preoxidation leaching, even in a finely crushed form.

In view of the observed higher concentration of gold and silver in the -35 mesh fraction of fine crushed ore, it may be advisable to investigate gravity concentration (or preconcentration) of coarse crushed material to make a low grade reject and minimize the volume of material to be treated by fine grinding and cyanidation.

CONCLUSIONS

With fine grinding (90% -325 mesh), the fine fraction of Porcher Island ore, and by inference the whole ore, appears to be amenable to direct cyanidation. Gold recovery in the 80% range with a sodium cyanide consumption of 5 - 6 kg/t is indicated by the results of current work.

Biological preleaching of the coarse fraction of crushed ore does not appear to be an attractive option for treatment of this ore fraction. Gravity preconcentration of +35 mesh crushed ore may be a useful approach to minimizing the volume of material to be treated by direct cyanidation.

A. Vizsolyi
Senior Research Officer
Extractive Metallury Group
Industrial Chemistry Division

R. O. McElroy
Program Leader
Extractive Metallurgy Group
Industrial Chemistry Division

TABLE 1

DIRECT CYANIDATION TESTS - SUMMARY

		NaCN kg/t MAINTENANCE[1]			
		2.5	5.0	5.0[2]	10.0
Initial wt	g	300	300	300	500
CaO addition	g	2.0	2.0	2.0	5.0
CaO addition	kg/t	6.7	6.7	6.7	10
Initial pH		11.0	11.0	11.0	11.0
NaCN addition	g	1.26	2.34	2.46	2.58
NaCN addition	kg/t	4.2	7.8	8.2	17.2
Excess NaCN	g	0.21	0.66	0.63	3.43
Excess NaCN	kg/t	0.7	2.2	2.1	6.9
NaCN consumption	g	1.05	1.68	1.83	5.15
NaCN consumption	kg/t	3.5	5.6	6.1	10.3
Final pH		11.1	11.0	11.0	11.3
Final wt	g	301.0	301.3	301.8	507.7
Head, Au	g/t	14.09	14.09	14.09	7.406
Ag		5.83	5.83	5.83	5.49
Residue, Au	g/t	4.80	3.09	2.78	1.543
Ag		7.54	7.54	6.51	2.74
Extraction[3], Au	%	65.8	78.0	80.2	78.8

(1) NaCN addition at the start, and adjustment to the same level by increment at 24 h and 48 h. Total leaching time: 72 h.

(2) 0.5 kg/t lead acetate added.

(3) Calculated on solid/solid weight basis.

TABLE 2

DIRECT CYANIDATION; MATERIAL BALANCE

FEED/PRODUCT	QUANTITY	ASSAY (ppm)		UNITS (mg)		DISTRIBUTION (%)**	
	mL or g	Au	Ag	Au	Ag	Au	Ag
2.5 kg NaCN Maintenance							
Head (input)	300	14.09	5.83*	4.23	1.75	(100)	(100)
SOLUTION	187	9.38	4.31	1.75	0.81		
Wash/Repulp	202	4.96	2.37	1.00	0.48	65.6	36.2
RESIDUE	301	4.80	7.54	1.44	2.27	34.4	63.8
Total (Calculated Head)				4.19	3.56	100	100
5.0 kg NaCN Maintenance							
Head (input)	300	14.09	5.83*	4.23	1.75	(100)	(100)
SOLUTION	197	9.93	3.59	1.96	0.71		
Wash/Repulp	250	4.14	1.55	1.04	0.39	76.3	32.6
RESIDUE	301.3	3.09	7.54	0.93	2.27	23.7	67.4
Total (Calculated Head)				3.93	3.37	100	100
5.0 kg NaCN Maintenance + 0.5 kg/t Pb-Acetate Addition							
Head (input)	300	14.09	5.83*	4.23	1.75	(100)	(100)
SOLUTION	192	9.93	5.32	1.91	1.02		
Wash/Repulp	215	4.85	2.49	1.04	0.54	77.8	44.3
RESIDUE	301.8	2.78	6.51	0.84	1.96	22.2	55.7
Total (Calculated Head)				3.79	3.52	100	100
10.0 kg NaCN Maintenance							
Head (input)	500	7.406	5.49*	3.702	2.74	(100)	(100)
SOLUTION	375	6.4	2.40	2.40	1.42		
Wash/Repulp	380	3.5	1.33	1.33	0.72	82.6	60.6
RESIDUE	507.7	1.543	2.74	0.783	1.39	17.4	39.4
Total (Calculated Head)				4.51	3.53	100	100

* Fire assay; back calculated average grade from solution + residue analyses is 11.7 ± 0.5 g/t.

** From solution and residue assays.

TABLE 3

COLUMN LEACH - SUMMARY

1. SIEVE ANALYSES OF ORE (Charged Into and Discharged from Column)

TYLER SIEVE		WEIGHT (%)	
Mesh	mm	Average	Discharge
+9	2.00	33.5	34.4
9 x 16	1.00	47.0	46.0
16 x 28	0.595	19.5	17.9
Pan	-	0	1.7

2. CHEMICAL ANALYSES OF COLUMN INPUT AND PRODUCTS

	Au (g/t)	Ag	Fe (%)	S_T (%)	$S_{SO_4^=}$	($S_{S^=}$) (%)	Insol
Head/Input	6.62	3.09	2.48	1.45	Nil	1.45	84.1
Bioleach Residue	(6.62	3.09)	2.84	1.40	0.17	1.23	86.7
Cyanidation Tail	3.87	3.77	-	-	-	-	-

3. COLUMN BIOLEACH DATA

End pH	2.05
Eh(1)	570 mV
Retention (days)	30
H_2SO_4 addition (kg/t)	14.5
Sulphur oxidation (%)	15.2

(1) Measured with silver chloride reference electrode.

TABLE 3 (CONT'D)

COLUMN LEACH - SUMMARY

4. COLUMN CYANIDATION DATA

Charge wt:	3.486 kg
CaO addition:	1.0 kg/t
NaCN addition:	3.77 kg/t
Excess NaCN	1.33 kg/t
NaCN consumption:	2.44 kg/t
Final pH	9.7
Final wt:	3.487 kg
Retention:	23 days
Head(1) Au	5.409 g/t
Ag	5.179 g/t
Residue Au	3.87 g/t
Ag	3.77 g/t
Extracted Au	26.5 %
Ag	27.2 %

(1) Calculated from material balance.

TABLE 4

COLUMN CYANIDATION LEACH PROGRESSION

Charge: 3.486 kg PORCHER ISLAND ORE
Au 6.62 g/t, Ag 3.09 g/t(1)

RETENTION (Days)	LEADING MODE	pH	NaCN kg/t			VOL	Au		
			Added	Excess	Cumulative Total	(L)	Assay (ppm)	(mg)	Extr(2) (%)
0	CaO addition 1.0 kg/t	11.2	-	-	-				
1	NaCN sol (1st pass)	11.2	1.0	1.0	1.0				
3	(2nd pass)	10.6	0.45	0.55	1.45	1.20	2.45	2.94	15.6
8	(4th pass)	10.8	0.44	0.56	1.89	1.25	2.94	3.68	19.5
11	(6th pass)	10.7	0.43	0.57	2.32	1.20	3.21	3.86	20.5
16	(8th pass)	10.8	0.45	0.55	2.77	1.20	3.54	4.25	22.5
21	(10th pass)	11.0	-	0.54	(2.23)	1.25	3.49	4.36	23.1
21	NaCN wash	-	1.0	1.0	3.23				
23	(2nd pass)	10.6	-	0.71	(2.52)	1.20	0.53	0.64	26.5
23	Tap water wash	-	-	-	(2.52)				
24	(2nd pass)	9.7	-	0.08	(2.44)	1.20	tr	-	(26.5)

(1) Split out head sample assay.

(2) Extraction values were based on calculated head (from material balance).

Tail (3.487 kg)	Au 3.87 g/t	= 13.87 mg
	Au dissolved	5.00 mg
	Total (Head : Au)	18.87 mg or 5.409 g/t
	Ag 3.77 g/t	= 13.14 mg
	Ag dissolved	4.92 mg
	Total (Head : Ag)	18.06 mg or 5.179 g/t