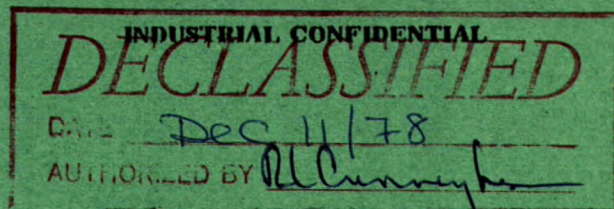


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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 61-73

**FLOTATION TESTS ON TWO SAMPLES OF COPPER
ORE FROM THE SUNRO MINE FOR COWICHAN
COPPER CO. LTD., VANCOUVER, B.C.**

by

G. I. MATHIEU

MINERAL PROCESSING DIVISION

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FLOTATION TESTS ON TWO SAMPLES OF COPPER ORE FROM THE
SUNRO MINE FOR COWICHAN COPPER CO. LTD., VANCOUVER, B.C.

by

G. I. Mathieu*

SUMMARY OF RESULTS

The main constituents of this ore are chalcop-
pyrite, pyrrhotite and a silicate gangue. The chalcop-
pyrite is more abundant in the sample marked "River B
Zone", but the pyrrhotite is higher in the "Cave Zone"
ore with a small amount of nickel intimately assoc-
iated with it.

Three flotation tests, tried at different
grinds, gave the following results with the "River B
Zone" ore:

<u>Test No.</u>	<u>Grind</u> <u>% -200 M</u>	<u>Assays</u> <u>% Cu</u>	<u>Distribution</u> <u>% Cu</u>
1	55	23.9	89.4
2	65	24.8	90.4
3	78	24.8	94.1

The same tests were repeated on a composite
mixture containing 70% of "River B Zone" ore and 30%
of "Cave Zone" ore. The results obtained were as
follows:

<u>Test No.</u>	<u>Grind</u> <u>% -200 M</u>	<u>Assays</u> <u>% Cu</u>	<u>Distribution</u> <u>% Cu</u>
4	55	24.4	83.4
5	64	23.9	87.8
6	76	25.0	92.0

* Scientific Officer, Mineral Processing Division, Mines
Branch, Department of Mines and Technical Surveys,
Ottawa, Canada.

Tests on the "Cave Zone" ore gave the following results:

<u>Test No.</u>	<u>Grind</u> <u>% -200 M</u>	<u>Assays</u> <u>% Cu</u>	<u>Distribution</u> <u>% Cu</u>
7	55	19.5	59.1
8	64	25.1	78.1
9	80	22.5	81.7

An iron concentrate, assaying 57.3% Fe with a recovery of 80% Fe and containing 86% of the nickel in the ore, was floated from a copper flotation tailing.

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INTRODUCTION

Shipment and Instructions

A shipment consisting of two lots of copper ore was received on May 11, 1961. The sample marked "River B Zone" weighed 80 pounds and the sample marked "Cave Zone" weighed 70 pounds. The shipment was submitted by Mr. W. B. Montgomery, Mine Manager, Cowichan Copper Co. Ltd., P. O. Box 320, River Jordan, B.C., on instructions from Mr. Stanley Gray, P. Eng., Metallurgical Consultant, 196 West 44th Avenue, Vancouver 15, B.C.

Mr. Gray requested the following tests to be carried out on the two samples of ore:

- (1) One roughing and cleaning test on each sample at grinds of 50-55%, 60-65% and 75-80% minus 200M;
- (2) That an iron sulphide float be made from the tailing of the 60-65% minus 200M grind on the high-sulphide sample;
- (3) That roughing and cleaning tests be made on a feed composed of 30% of the high-iron and 70% of the low-iron sulphide samples;
- (4) A complete assay on one sample of the cleaned copper concentrate from each sample and also on the iron concentrate from the tailing, ie, Cu, Fe, Ni, Co, Zn, Insol, Au, Ag.

Location of Property

The property from which these samples were taken is the former Sunro Mine and is located on the Jordan River, near Victoria, B.C.

Sampling and Analysis

The two lots received were crushed to minus 20M and a representative head sample was riffled out by conventional methods. Portions of the head sample from each lot were sent to the Mineral Sciences Division for chemical analyses, spectrographic analyses and mineralogical examination.

The chemical analysis* gave the following results:

	<u>River B Zone</u>	<u>Cave Zone</u>
Gold (Au)	0.015 oz/ton	Tr
Silver (Ag)	0.215 "	0.025 oz/ton
Copper (Cu)	2.30 %	0.33 %
Iron (Sol Fe)	8.70 "	25.60 "
Nickel (Ni)	-	0.27 "
Sulphur (S)	3.80 %	15.45 "
Insoluble (Insol)	72.1 "	47.5 "

A spectrographic analysis on the two head samples gave the following elements listed in their decreasing order of abundance:

<u>River B Zone</u>	<u>Cave Zone</u>
I. Si, Fe	I. Si, Fe
II. Al, Ca, Mg, Na, Cu	II. Al, Ca, Mg, Na
III. Ti, Mn, W, Co	III. Ni, Ti, Cu, Mn, W, Co
IV. Ni, V, Cr, Ag	IV. V, Cr

* From Internal Report MS-61-194, by R. C. McAdam and L. Lutes, May 31, 1961.

MINERALOGICAL EXAMINATION^{*}

A portion of each head sample, crushed to -20M, was submitted to the Mineralogical Section of the Mineral Sciences Division for microscopic examination.

Results of Examination

Four polished sections, two from each sample, were prepared and examined under a reflecting microscope. One section of each sample consists of coarse particles, 1-3 mm in longest diameter, picked out and mounted in bakelite. The other section of each sample is composed of particles that passed through a 65 Tyler mesh (0.208 mm) screen.

Cave Zone Ore

The metallic minerals present in the two polished sections, listed in order of decreasing abundance, are pyrrhotite, chalcopyrite, ilmenite, pyrite, and pentlandite (?). These minerals are predominantly free of each other and of gangue in the section made from the finer fraction but show some association with each other and with gangue in the coarser material.

Pyrrhotite is more abundant than all of the other ore minerals combined. Chalcopyrite, ilmenite, and pyrite are present in minor amounts as occasional to rare small particles, which are largely

* From Internal Report MS-61-56, by Wm. E. White, June 27, 1961.

free but are also combined with gangue, pyrrhotite, and each other. Some particles of pyrrhotite enclose tiny blades of a mineral whose mode of occurrence suggest pentlandite (?), but all are too small for confirmatory tests (Figure 1).

Gangue material consists essentially of amphibole and plagioclase.

River B Ore

The two polished sections of this sample are very similar to those of the Cave Zone ore. In addition to the ore minerals found in the Cave Zone sections, however, two small particles of sphalerite were observed in the coarse material from this sample. Both are associated with chalcopyrite, the larger one being shown in Figure 2.

Conclusion

The examination of four polished sections indicates that the chalcopyrite particles will be predominantly free for concentration purposes by grinding to -100 mesh.

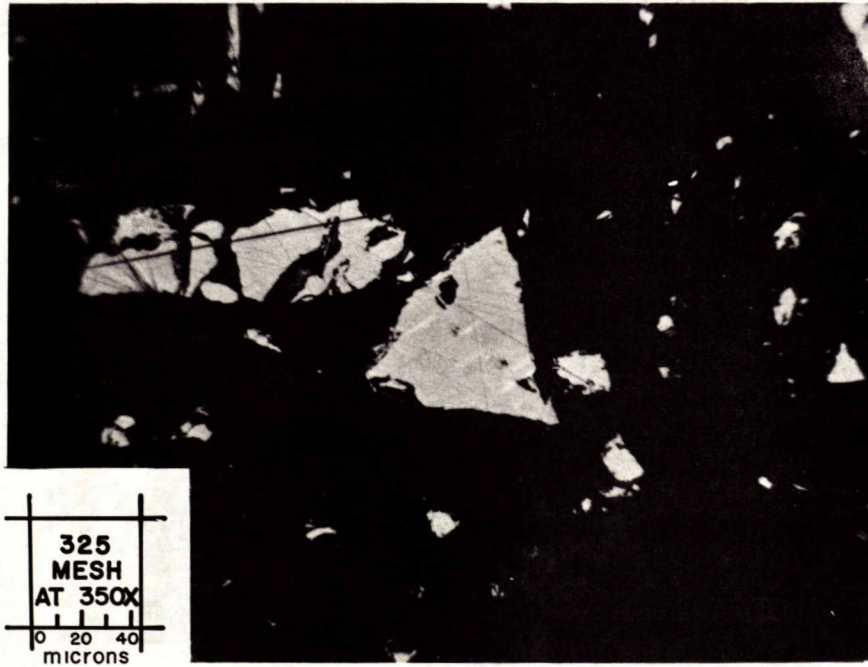


Figure 1. - Photomicrograph showing particles of pyrrhotite (grey) in bakelite (black), Cave Zone ore fine fraction; note tiny blades of pentlandite (?), white, in triangular grain of pyrrhotite near centre; straight black lines are polishing scratches.



Figure 2. - Photomicrograph of polished section composed of coarse particles of River B ore, showing grain of chalcopyrite (light grey) in gangue (dark grey) and containing small inclusions of gangue and pyrite (white); the relatively large medium grey particle penetrating the chalcopyrite at bottom is sphalerite; polishing pits and scratches, black.

DETAILS OF INVESTIGATION

The investigative tests on the samples of ore from this property were divided into three parts. Tests 1 to 3 were conducted on the River B Zone sample. Tests 4 to 6 were conducted on a composite mixture prepared by combining 70% by weight of the River B Zone sample with 30% by weight of the Cave Zone sample. Tests 7 to 9 were conducted on the Cave Zone sample.

Test 1, River B Zone

A 2000 g sample of this ore was ground for 12 minutes to 55% -200M and floated as follows:

<u>Operation</u>	<u>Reagents and Conditions</u>		<u>Time min</u>	<u>pH</u>
	<u>Reagents</u>	<u>- lb/ton</u>		
Grind	CaO	- 1.50	12	
	NaCN	- 0.05		
Rougher flot	Z-6	- 0.08	10	10.5
	Dowfroth 250	- 0.06		
Cleaner flot			5	

Results of Test 1

<u>Product</u>	<u>Weight %</u>	<u>Assays % Cu</u>	<u>Distn % Cu</u>
Cu cl conc	8.5	23.90	89.4
Cu cl tail	1.7	2.51	1.9
Flot tail	89.8	0.22	8.7
Head (calcd)	100.0	2.27	100.0

Test 2, River B Zone

This test was similar to Test 1, except that the ore was ground for 15 minutes to 65% -200M.

Results of Test 2

Product	Weight %	Assays % Cu	Distn % Cu
Cu cl conc	7.8	24.80	90.4
Cu cl tail	1.7	2.94	2.3
Flot tail	90.5	0.17	7.3
Head (calcd)	100.0	2.14	100.0

Test 3, River B Zone

This test was also similar to Test 1, except that the ore was ground for 20 minutes to 78% -200M.

Results of Test 3

Product	Weight %	Assays % Cu	Distn % Cu
Cu cl conc	8.4	24.80	94.1
Cu cl tail	1.8	2.59	2.1
Flot tail	89.8	0.094	3.8
Head (calcd)	100.0	2.21	100.0

The following additional assays were run on the Cu cl conc:

oz/ton		%				
Au	Ag	Sol Fe	Ni	Co	Zn ^{As}	Insol
0.15	1.80	32.27	0.23	0.07	0.9	4.50

^{As}Zn determination by semi-quantitative spectro-graphic analysis.

A fourth test was run on the River B Zone ore with conditions similar to Test 3, except that 0.04 lb/ton of Z-200 was used instead of 0.08 lb/ton of Z-6. The results of this test showed a higher grade of copper (29.0%) but the recovery of copper dropped to 80.9%.

Test 4, Composite Mixture

A composite mixture of 70% River B Zone ore and 30% Cave Zone ore was prepared for the following tests:

A 2000 g sample of the composite mixture was ground for 11 minutes to 55% -200M and floated, using the same procedure as for Test 1.

Results of Test 4

Product	Weight %	Assays % Cu	Distn % Cu
Cu cl conc	6.7	24.40	83.4
Cu cl tail	4.1	1.64	3.4
Flot tail	89.2	0.29	13.2
Head (calcd)	100.0	1.96	100.0

Test 5, Composite Mixture

This test was similar to Test 1, except that the ore was ground for 14 minutes to 64% -200M.

Results of Test 5

Product	Weight %	Assays % Cu	Distn % Cu
Cu cl conc	7.0	23.90	87.8
Cu cl tail	3.1	3.44	5.6
Flot tail	89.9	0.14	6.6
Head (calcd)	100.0	1.91	100.0

Test 6, Composite Mixture

This test was a repetition of Test 1, except that the mixed ore was ground for 20 minutes to 76% -200M.

Results of Test 6

Product	Weight %	Assays % Cu	Distn % Cu
Cu cl conc	6.7	25.00	92.0
Cu cl tail	3.2	2.02	3.6
Flot tail	90.1	0.09	4.4
Head (calcd)	100.0	1.82	100.0

Test 7, Cave Zone

A 2000 g sample of the Cave Zone ore was ground for 9 minutes to 55% -200M and floated as follows:

<u>Reagents and Conditions</u>					
<u>Operation</u>	<u>Reagents</u>	<u>-</u>	<u>lb/ton</u>	<u>Time</u> <u>min</u>	<u>pH</u>
Grind	CaO	-	1.50	9	
	NaCN	-	0.05		
Rougher flot	Z-6	-	0.05	5	10.5
	Dowfroth 250	-	0.04		
Cleaner flot				5	

Results of Test 7

<u>Product</u>	<u>Weight</u> <u>%</u>	<u>Assays</u> <u>% Cu</u>	<u>Distn</u> <u>% Cu</u>
Cu cl conc	0.9	19.47	59.1
Cu cl tail	0.9	1.47	4.5
Flot tail	98.2	0.11	36.4
Head (calcd)	100.0	0.30	100.0

Test 8, Cave Zone

This test was similar to Test 6 for the copper flotation, except that the ore was ground for 12 minutes to 64% -200M. After the copper flotation an iron sulphide concentrate was floated from the copper flotation tailing as follows:

Reagents and Conditions

<u>Operation</u>	<u>Reagents</u>	<u>lb/ton</u>	<u>Time</u> <u>min</u>	<u>pH</u>
Fe conditioning	H ₂ SO ₄	- 1.00	5	6.4
Fe rougher flot	Reagent 301	- 0.10	12	
	Pine oil	- 0.06		
Fe cleaner flot			7	

Results of Test 8

Product	Weight %	Assays %			Distn %		
		Cu	Fe	Ni	Cu	Fe	Ni
Cu cl conc	0.9	25.10	34.14	0.32	78.1	1.1	1.1
Cu cl tail	1.2	1.87	47.82	0.83	7.7	2.2	3.7
Fe cl conc	37.0	0.09	57.25	0.62	11.5	80.2	86.0
Fe cl tail	2.7	0.08	24.93	0.26	0.7	2.5	2.6
Flot tail	58.2	0.01	6.35	0.03	2.0	14.0	6.6
Head (calcd)	100.0	0.29	26.83	0.27	100.0	100.0	100.0

The following additional assays were made on the copper and iron concentrates produced in Test 8:

Assays:	oz/ton		%				
	Au	Ag	Fe	Ni	Co	Zn	Insol
Cu cl conc	0.05	0.36	34.14	0.32	0.10	0.2	3.80
Fe cl conc	Tr	0.03	57.25	0.62	0.08	0.2	3.60

Test 9, Cave Zone

This test was similar to Test 6, except that the ore was ground for 18 minutes to 80% -200M.

Results of Test 9

Product	Weight %	Assays % Cu	Distn % Cu
Cu cl conc	1.2	22.51	81.7
Cu cl tail	1.8	1.20	6.5
Flot tail	97.0	0.04	11.8
Head (calcd)	100.0	0.33	100.0

A final test was carried out on the Cave Zone ore similar to Test 9, except that .02 lb/ton of Z-200 was used as the collector instead of Z-6. The results of this test again gave a higher grade of copper concentrate (27.0% Cu) but the recovery dropped to 66.9%.

CONCLUSIONS

The sample of ore identified as River B Zone contained 2.30% Cu, 8.70% Fe and 72.1% insoluble silicate. The gold and silver assayed, respectively, 0.015 oz/ton and 0.215 oz/ton.

The mineralogical examination indicated that the chalcopyrite is predominantly free for concentration purposes after grinding to -100 mesh. This is borne out in the test work which showed that at a grind of 78% -200M, a cleaner copper concentrate assaying 24.8% Cu with a 94.1% recovery was obtained by flotation (Test 3). Although the

precious metal content of this ore was quite low, approximately 84% of the gold and 65% of the silver was recovered with the copper, which increases the value of this concentrate.

The main constituents of the Cave Zone ore are chalcopyrite, nickeliferrous pyrrhotite and a silicate gangue. The head sample analysis gave the metal content of this ore as: 0.33% Cu, 25.60% Fe and 0.27% Ni. The nickel mineral, believed to be pentlandite, occurs as very tiny blades in the pyrrhotite grains (Figure 1).

A cleaner copper concentrate assaying 25% Cu, with a recovery of 92% Cu, was produced from a composite mixture containing 70% of River B Zone and 30% of Cave Zone ore, at a grind of 76% -200M (Test 6).

When the Cave Zone ore was treated alone, it was possible to float a high grade iron concentrate from the copper flotation tailing. In Test 8, after floating a copper concentrate, assaying 25.1% Cu with a recovery of 78.1% Cu, an iron concentrate was floated assaying 57.25% Fe with a 80% recovery. This pyrrhotite concentrate contained 86% of the nickel in the ore.

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