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MINES BRANCH INVESTIGATION REPORT IR 67-92

CONCENTRATION OF A COPPER ORE FROM THE R. M. CLARKE MINING COMPANY LIMITED, PARRY SOUND, ONTARIO

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The ore contains 3.70% copper, 0.51 oz silver/ton and 0.01 oz gold/ton. Bornite and chalcocite are the principal copper minerals.

At a grind of 57% -200 mesh the copper minerals floated readily to produce a copper concentrate assaying better than 50% copper with copper and precious metal recoveries of 98% and 90% respectively.

Tabling of the ore at the same grind as used for flotation gave a concentrate assaying 24.9% copper with a recovery of 62.8%. Similar results were obtained when a -10 mesh sample was jigged.

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INTRODUCTION

Location of Property

The property is located near Parry Sound, Ontario.

Shipment

The ore sample which was received on December 28, 1965 weighed 325 lb and consisted of 5 bags of lump ore. It was submitted by Mr. Ronald M. Clarke, President-Manager, R.M. Clarke Mining Co. Ltd., Box 1773, Parry Sound, Ontario.

Nature of Investigation Requested

In his letter of November 10, 1965 Mr. Clarke requested that a processing method be developed for the ore. He also stated that the use of jigs and/or tables was being considered for concentrating the minerals in the ore.

Sampling and Analysis

After selecting well-mineralized specimens for mineralogical examination, the ore sample was crushed to -½ inch and riffled into quarters. One quarter was crushed to -10 mesh to provide material for testwork while the remaining quarters were stored for possible future use. Chemical and semi-quantitative spectrographic analyses of a head sample cut from the -10 mesh material are given in Tables 1 and 2.

TABLE 1

Head Sample Analysis*

Copper (Cu)	3.70%
Soluble Iron (Fe)	8.80%
Sulphur (S)	1.47%
Gold (Au)	0.01 oz/ton
Silver (Ag)	0.51 oz/ton

*From Internal Report MS-AC-66-134.

TABLE 2

Semi-Quantitative Spectrographic Analysis*

Range %	Elements
10.0 to 1.0	Al, Si, Fe, Mg, Ca
1.0 to 0.1	Zn, Cu, Mo, Ti, Mn
0.1 to 0.01	Cr, Ni, V, Zr

*From Internal Report MS-AC-66-25

Mineralogical Examination*

A study of polished sections made from the specimens submitted gave the following information:

The ore consists of small masses and grains of copper-bearing and iron-bearing minerals in gangue, as well as a small amount of gold. The principal copper-bearing minerals are bornite and chalcocite, with trace amounts of digenite, covellite and chalcopyrite, the iron-bearing minerals are magnetite and hematite. The gangue consists of quartz, amphibole, mica, feldspar, chlorite, garnet and rutile.

Bornite occurs mainly as irregular masses and disseminated grains, varying in size from a few microns to about 6 millimeters. It is closely associated with other copper minerals, particularly chalcocite, with which it forms intimate intergrowths in some places. It also contains veinlets and inclusions of chalcocite, inclusions of magnetite, gangue, rutile, hematite and chalcopyrite. These inclusions vary from a few microns to about 800 microns in diameter. In a few instances the bornite was found rimmed with digenite.

Chalcocite is present largely as coarse to fine-grained intergrowths with bornite, and occasionally as inclusions and veinlets in bornite. The chalcocite varies in size from about 5 microns to 2 millimeters. It contains inclusions of bornite, magnetite, rutile, hematite and gangue. These inclusions range from about 2 to 800 microns in size.

A few minute grains of native gold were found in the ore. They occur as inclusions, from 1 to 4 microns in size, in a pale yellowish brown grain in chalcocite. The pale yellowish brown grain, which is about 20 microns in size, could not be identified.

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*From Mines Branch Investigation Report IR 66-42 by D. Owens.

DETAILS OF INVESTIGATION

Jigging (Test 1)

A 2000-gram sample of -10 mesh ore was fed to a Denver lab mineral jig under the following conditions:

Ragging:	-4 +6 mesh chromite
Water flow rate:	0.22 US gpm
Stroke:	3/16 inches
Speed:	260 rpm

At the completion of the test the material in the jig bed was screened from the ragging and assayed separately. Results are given in Table 3.

TABLE 3

Results of Jigging (Test 1)

Product	Wt %	Assays *			Distribution %		
		Cu	Au	Ag	Cu	Au	Ag
Jig conc	8.0	29.10	0.06	2.33	65.7	45.7	61.6
Jig bed	6.2	2.15	0.01	0.21	3.8	5.7	4.3
Jig tail	85.8	1.26	0.006	0.12	30.5	48.6	34.1
Feed (calcd)	100.0	3.54	0.01	0.30	100.0	100.0	100.0

* Assays are from Internal Report MS-AC-66-340 and in all tables are expressed in % except Au and Ag which are in oz/ton.

Flotation (Tests 2,3,4 and 5)

Four flotation tests were done on the ore employing various grinds and with or without the addition of lime to grinding. In each of the tests a 2000-gram sample of -10 mesh ore was ground in a 7 x 14 in. Denver rod mill at 65% solids and floated in a 1000-gram Denver lab cell at approximately 35% solids using the flotation test procedure given in Table 4.

TABLE 4

Flotation Test Procedure

Operation	Time min	Reagents added, lb/ton	
		Xanthate *	Dowfroth 250
Conditioning	5	0.01	
Rougher flotation	6	0.03 Stage fed	0.04 Stage fed
Rougher conc cleaning **			
No. 1 cleaner	3	none	added
No. 2 cleaner	2	"	"
No. 3 cleaner	1½	"	"

* Potassium amyl
** Tests 2 and 3 only, rougher concentrates in other tests were not cleaned.

Flotation test variables are given in Table 5 followed by the results in Table 6.

TABLE 5

Flotation Test Variables

Test No.	Grinding			pH in conditioning
	Time min	Grind % -200 m	Lime added lb/ton	
2	30	56.7	1.0	11.2
3	50	77.7	1.0	10.7
4	20	44.5	1.0	10.8
5	30	56.7	nil	9.0

TABLE 6

Results of Flotation

Test No.	Product	Wt %	Assays*			Distribution %		
			Cu	Au	Ag	Cu	Au	Ag
2	Copper conc	4.7	63.80	0.17	5.01	88.0	77.6	89.6
	No. 3 cleaner tail	0.3	39.25			3.5		
	No. 2 " "	0.3	29.20	0.076	1.52	2.6	13.3	10.4
	No. 1 " "	1.2	11.45			4.0		
	Rougher tail	93.5	0.07	0.001	trace	1.9	9.1	-
	Feed (calcd)	100.0	3.41	0.01		100.0	100.0	100.0
	Copper rougher conc (calcd)	6.5	51.41	0.14	0.26	98.1	90.9	100.0
3	Copper conc	4.7	64.50			88.7		
	No. 3 cleaner tail	0.4	42.00			4.9		
	No. 2 " "	0.4	14.30			1.7		
	No. 1 " "	2.5	3.60			2.6		
	Rougher tail	92.0	0.08			2.1		
	Feed (calcd)	100.0	3.42			100.0		
	Copper rougher conc (calcd)	8.0	41.83			97.9		
4	Copper ro conc	6.0	54.88	0.16	4.22	93.6	80.3	84.3
	Rougher tail	94.0	0.24	0.0025	0.05	6.4	19.7	15.7
	Feed (calcd)	100.0	3.52	0.012	0.30	100.0	100.0	100.0
5	Copper ro conc	6.1	54.48	0.15	4.41	96.7	90.7	89.1
	Rougher tail	93.9	0.12	0.001	0.035	3.3	9.3	10.9
	Feed (calcd)	100.0	3.44	0.01	0.30	100.0	100.0	100.0

*From Internal Reports MS-AC-66-329, 401 and 465.

Tabling (Test 6)

Two 2000-gram lots of -10 mesh ore were ground to 57% -200 mesh in a Denver rod mill, combined and fed to a Deister lab table. Results are given in Table 7.

TABLE 7

Results of Tabling (Test 6)

Product	Wt %	Assays *			Distribution %		
		Cu	Au	Ag	Cu	Au	Ag
Table conc	9.0	24.90	0.066	1.90	62.8	62.0	80.7
Table tail	91.0	1.46	0.004	0.045	37.2	38.0	19.3
Feed (calcd)	100.0	3.57	0.01	0.21	100.0	100.0	100.0

* From Internal Report MS-AC-66-465.

CONCLUSIONS

This ore responds readily to flotation at a relatively coarse grind to produce a high-grade copper concentrate with excellent recoveries of both copper and precious metals. As can be seen from the results in Table 6 (Test 2) a copper rougher concentrate assaying more than 50% copper can be produced and therefore further upgrading of the rougher concentrate by cleaning is not warranted. The average grade of Canadian copper concentrates shipped to custom smelters is about 25% copper.

A grind of about 57% -200 mesh (Tests 2 and 5) appears to be the optimum, a finer grind of 78% -200 mesh (Test 3) does not significantly affect the results while a coarser grind of 44.5% -200 mesh (Test 4) results in a higher tailing loss.

A slightly higher loss of copper in the tailing was obtained in the one test in which lime was not added to the grind (compare Test 5 with Test 2).

The inferior results obtained by jigging the ore crushed to -10 mesh is probably due to incomplete liberation of the copper minerals from the gangue at this size. The -10 mesh crushed feed would correspond roughly to a plant ball mill discharge which is normally the feed to a jig.

In tabling, the high copper content in the tailing can be attributed to the loss of some of the more finely ground copper sulphides, while the low concentrate grade is likely due to contamination by magnetite and hematite which lie in the same specific gravity range as the copper sulphides.

Flotation, therefore, is the only logical choice for concentrating the copper and precious metals in this ore. For a small tonnage operation, a single bank of flotation cells along with several reagent feeders would comprise all the equipment required for flotation.

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