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MINES BRANCH INVESTIGATION IR 66-97

CONCENTRATION OF A COBALT-NICKEL ORE FROM RUSTY LAKE MINING CORPORATION LIMITED, GOWGANDA, ONTARIO

by

T. F. BERRY

MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The sample of ore from Rusty Lake assayed 1.36% Co, 0.66% Ni, 0.089% Bi and 0.07 oz Ag/ton.

Best results were obtained in a flowsheet using jigging and tabling followed by flotation of the table tailing. No distinct separation of the valuable minerals was achieved. Combining the three concentrates into a bulk concentrate gave the following results.

Weight %	Assays				Distribution %			
	Co %	Ni %	Bi %	Ag oz/ton	Co	Ni	Bi	Ag
11.0	11.56	5.78	0.56	1.27	89.2	95.6	73.9	79.6

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INTRODUCTION

Mr. Bernard Mariott, Vice-President of Rusty Lake Mining Corporation Limited, 1015 Beaver Hall Hill, Montreal, P.Q., requested an investigation on a sample of Co-Ni-Bi-Ag ore with a view to recovering these elements in one or more concentrates suitable for shipment to a smelter.

Location of Property

The mine property is located in the Gowganda area of northern Ontario. It has been mined periodically for its silver, since its original staking in 1908.

Shipment

On May 13, 1965 a shipment of ore weighing approximately 1200 lb was received at the Mines Branch from the above property.

Sampling and Analysis

The entire shipment was crushed to 1/4 inch and a 200 lb sample was riffled out and reduced to -10 mesh. A head sample was retained for a semi-quantitative spectrographic analysis and for a chemical analysis.

The spectrographic analysis showed that no elements other than cobalt, nickel and bismuth were present in sufficient quantity to be of economic interest. A chemical analysis of the ore gave the following results:

TABLE 1

Chemical Analysis* of Head Sample

Element	Grade
Cobalt (Co)	1.36 per cent
Nickel (Ni)	0.66 " "
Bismuth (Bi)	0.089 " "
Iron (sol. Fe)	3.26 " "
Sulphur (tot S)	0.58 " "
Insoluble	61.93 " "
Silver (Ag)	0.07 oz/ton

* Internal Report MS-AC-65-901

Mineralogy of the Ore

The results of the mineralogical investigation in representative samples of this ore have been reported in Mines Branch Investigation Report IR-66-14 by W. Petruk. Only a summary of the results of that report will be included here.

"A sample of ore from 213 E drift in the Rusty Lake mine near Gowganda, Ontario, was studied mineralogically. The results show that the sample was taken from a vein-type deposit and that the vein is composed of masses, botryoidal bodies and disseminations of ore minerals in carbonate. The masses consist largely of cobalt arsenides, the botryoidal bodies of nickel arsenides, and the disseminated grains of a mixture of cobalt and nickel arsenides. The cobalt arsenides are safflorite and skutterudite, and the nickel arsenides are pararammelsbergite, rammelsbergite, niccolite and gersdorffite. Other minerals in the ore are arsenopyrite, ullmannite, native bismuth, bismuthinite, sphalerite, galena, chalcopyrite, tetrahedrite, pyrite, stephanite and native silver. The arsenides are present as relatively large grains, while the other minerals occur only as minute grains".

DETAILS OF INVESTIGATION

Tests 1 to 5

A series of concentration tests was done on 2000 gram samples of ore in which the -10 mesh ore was ground and tabled followed by flotation of the table tailing. In each of these tests the grinding time was varied while the flotation reagent scheme remained the same.

TABLE 2

Reagents and Operating Conditions Tests 1 to 5

Operation	Reagents	lb/ton feed	Time min.	Grind %-200 mesh	pH
Grinding			10 (Test 1) 15 (" 2) 20 (" 3) 25 (" 4) 30 (" 5)	39.6 54.0 63.5 72.5 74.7	
Conditioning	Z-6*	0.10	3		7.7
	Aerofloat 25	0.04			
Flotation	Pine Oil	0.02	10		

* Potassium Amyl Xanthate

TABLE 3

Results of Tests 1 to 5

Product	Weight %	Assays *				Distribution %			
		Co %	Ni %	Bi %	Ag oz/ton	Co	Ni	Bi	Ag
Test 1									
Table conc.	7.0	12.12	6.74	0.70	0.71	66.1	70.8	58.7	47.2
Flot "	3.0	3.44	1.64	0.43	1.16	8.0	7.4	15.5	33.1
Flot tailing	90.0	0.37	0.161	0.024	0.23	25.9	21.8	25.8	19.7
Head (calcd)	100.0	1.28	0.66	0.08	0.10	100.0	100.0	100.0	100.0
Test 2									
Table conc.	7.5	13.64	6.50	0.61	0.70	70.6	80.2	60.2	47.4
Flot "	4.6	3.14	1.27	0.22	0.79	10.0	9.6	13.3	32.8
Flot tailing	87.9	0.32	0.07	0.23	0.025	19.4	10.2	26.5	19.8
Head (calcd)	100.0	1.45	0.61	0.08	0.11	100.0	100.0	100.0	100.0
Test 3									
Table conc.	7.7	12.84	5.96	0.62	1.46	67.6	73.8	58.7	69.2
Flot "	6.3	3.41	1.77	0.30	0.68	14.7	17.9	23.3	25.5
Flot tailing	86.0	0.30	0.06	0.017	0.01	17.7	8.3	18.0	5.3
Head (calcd)	100.0	1.46	0.62	0.08	0.16	100.0	100.0	100.0	100.0
Test 4									
Table conc.	5.8	14.76	6.90	0.64	1.13	60.0	68.5	49.9	51.5
Flot "	6.3	3.75	1.87	0.34	0.70	16.6	20.2	28.8	34.7
Flot tailing	87.9	0.38	0.075	0.018	0.02	23.4	11.3	21.3	13.8
Head (calcd)	100.0	1.43	0.58	0.07	0.13	100.0	100.0	100.0	100.0
Test 5									
Table conc.	7.7	11.02	5.20	0.56	0.72	59.4	67.3	53.8	47.8
Flot "	8.4	3.11	1.60	0.27	0.47	18.3	22.6	28.3	34.1
Flot tailing	83.9	0.38	0.072	0.017	0.025	22.3	10.1	17.9	18.1
Head (calcd)	100.0	1.43	0.60	0.08	0.12	100.0	100.0	100.0	100.0

* Internal Report MS-AC-65-1022 and 65-1037

Test 6

A 2000 gram sample of -10 mesh ore was jigged and the jig tailing was ground to 63.5% -200 mesh and tabled. The table tailing was floated for 8 minutes at approximately 38% solids using the reagent scheme shown in Table 2. The results of this test were as follows:

TABLE 4

Results of Test 6

Product	Weight %	Assays *				Distribution %		
		Co %	Ni %	Bi %	Ag oz/ton	Co	Ni	Bi
Jig conc	8.3	11.00	6.80	0.54	1.25	74.8	78.0	55.4
Table "	1.4	10.20	4.10	1.02	2.48	11.6	7.9	17.7
Flot " No.1	1.9	3.58	1.17	0.39	-	5.6	3.1	9.1
Flot " No.2	4.2	0.58	0.20	0.066	-	2.0	1.2	3.5
" " No.3	9.6	0.25	0.53	0.035	-	2.0	7.0	4.2
" Tailing	74.6	0.065	0.027	0.011	-	4.0	2.8	10.1
Head (calcd)	100.0	1.22	0.72	0.08	-	100.0	100.0	100.0

* Internal Report MS-AC-65-1074

Tests 7 and 8

In these tests 8000 gram samples of -10 mesh ore were jigged and the jig tailing from each test was stage ground in closed circuit with a 65 mesh screen (Test 7) and a 100 mesh screen (Test 8). The ground jig tailing was tabled in each test and the table tailing was floated.

TABLE 5

Reagents and Operating Conditions Tests 7 and 8

Operation	Reagents	Lb/ton feed	Time min.	Grinding		pH
				All minus	%-200 mesh	
Grinding				65 mesh (Test 7) 100 " (Test 8)	52.8 62.0	
Conditioning	Cu SO4	0.50	7			8.4
	Aerofloat 25	0.04	3			
	Z-6	0.10				
Flotation	Pine oil	0.02	4			
Condition	Aerofloat 25	0.02	1			
Flotation	Pine oil	0.02	3			
Condition	Aerofloat 25	0.01	1			
Flotation	Pine oil	0.01	3			
Cleaner Flot			3			
Test 8 only						
Scavenger Flotation						
Conditioning	Aerofloat 25	0.01	1			
	Z-6	0.05				
Flotation	Pine oil	0.01	3			

TABLE 6

Results of Test 7

Product	Weight %	Assays *				Distribution %			
		Co %	Ni %	Bi %	Ag oz/ ton	Co	Ni	Bi	Ag
Jig conc	5.8	12.46	7.90	0.62	1.65	61.2	60.4	42.8	41.2
Jig bed	1.2	1.37	0.62	0.11	0.115	1.4	1.0	1.5	0.6
Table conc	2.8	9.23	4.82	0.71	2.22	21.9	17.8	23.6	26.8
Flot cl "	1.4	2.60	1.68	0.44	2.69	3.1	3.1	7.4	16.2
Flot " tailing	4.3	1.27	0.58	0.13	0.44	4.6	3.3	6.6	8.1
Flot tailing	84.5	0.11	0.13	0.018	0.02	7.8	14.4	18.1	7.1
Head (calcd)	100.0	1.18	0.76	0.08	0.23	100.0	100.0	100.0	100.0

* Internal Report MS-AC-66-573

TABLE 7

Results of Test 8

Product	Weight %	Assays *				Distribution %			
		Co %	Ni %	Bi %	Ag oz/ton	Co	Ni	Bi	Ag
Jig conc	6.8	14.21	7.58	0.56	0.70	67.8	77.5	46.0	27.2
Table "	2.0	12.81	5.20	0.87	2.88	18.0	15.6	21.0	32.8
Flot cl conc	2.2	2.21	0.76	0.26	1.56	3.4	2.5	6.9	19.6
Flot " tailing	3.5	1.36	0.33	0.13	0.73	3.3	1.7	5.5	14.6
Scavenger conc	1.6	1.42	0.15	0.077	0.115	1.6	0.4	1.4	1.0
Flot tailing	83.9	0.10	0.018	0.019	0.01	5.9	2.3	19.2	4.8
Head (calcd)	100.0	1.43	0.66	0.08	0.17	100.0	100.0	100.0	100.0

* Internal Report MS-AC-66-749

The jig bed in Test 8 was added to the jig tailing which was ground and tabled.

Test 9

For comparison purposes it was desirable to determine whether straight flotation of the ground ore would give the same results as jigging, tabling and flotation.

TABLE 8

Reagents and Operating Conditions Test 9

Operation	Reagents	Lb/ton feed	Time min.	Grind %-200 mesh	pH
Grinding	$CuSO_4$	0.50	25	72.5	8.3
Conditioning	Aerofloat 25	0.04	3		
	Z-6	0.10			
Flotation	Pine oil	0.02	3		
Conditioning	Aerofloat 25	0.02	1		
Flotation	Pine oil	0.02	2		
Conditioning	Aerofloat 25	0.02	2		
	Z-6	0.05			
Flotation	Pine oil	0.02	4		
Conditioning	Aerofloat 25	0.02	1		
Flotation	Pine oil	0.02	2		
1st Cleaner			3		
2nd Cleaner			2		

The flotation tailing was tabled to recover additional silver and sulphides. The results of this test are shown in Table 9.

TABLE 9

Results of Test 9

Product	Weight %	Assays *				Distribution %			
		Co %	Ni %	Bi %	Ag oz/ ton	Co	Ni	Bi	Ag
Flot conc.	3.5	12.28	11.50	0.55	1.16	31.8	56.2	25.7	23.1
2nd Cl tailing	2.3	7.94	4.33	0.44	0.80	13.5	13.9	13.5	10.4
1st Cl tailing	6.2	2.19	0.85	0.16	0.16	10.0	7.4	13.2	5.6
Table conc	2.8	14.58	3.21	0.72	2.91	30.2	12.6	27.1	46.3
Table tailing	85.2	0.23	0.084	0.018	0.03	14.5	9.9	20.5	14.6
Head (calcd)	100.0	1.35	0.72	0.07	0.17	100.0	100.0	100.0	100.0

* Internal Report MS-AC-66-851

CONCLUSIONS

The cobalt and nickel arsenides in this ore are present as safflorite, skutterudite, pararammelsbergite, rammelsbergite, niccolite, and gersdorffite and are so intimately associated with each other that separate concentrates of cobalt and nickel could not be made.

In most operations where silver is an important constituent, jigging followed by tabling and flotation has been found to be the best method of treatment. The present investigation followed this course although in the sample submitted the silver content was so low that the jigging step could have been omitted. However, the history of this property and its location near the silver producers of Gowganda indicates that silver may become important, in which case jigs should be used in the flowsheet for processing this ore.

In Test 8, the results of which are shown in Table 7, the above method of treatment showed the best overall results. In this test the jig tailing and jig bed was ground in closed circuit with a 100 mesh screen and then tabled. The table tailing was floated.

In a comparison test involving straight flotation of the ore ground to 72.5% - 200 mesh (Test 9), considerably poorer results were obtained than in Test 8. In this test it was necessary to table the flotation tailing to recover additional cobalt and nickel. The amounts of these elements lost in the final tailing were too high to make this method of treatment attractive.

Additional tests, which are not included in this report, were done in unsuccessful attempts to increase the cobalt-nickel grade of a final concentrate by the flotation of ground jig and table concentrates.

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TFB/dg