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DEPARTMENT OF ENERGY, MINES AND RESOURCES

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MINES BRANCH INVESTIGATION REPORT IR 67-74

RECOVERY OF SILVER FROM A CALCINE FROM SILVER TOWN MINES LIMITED, COBALT, ONTARIO

by

T. F. BERRY

MINERAL PROCESSING DIVISION

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RECOVERY OF SILVER FROM A CALCINE FROM SILVER TOWN MINES LIMITED, COBALT, ONTARIO.

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SUMMARY OF RESULTS

The silver-bearing calcine assayed 23.05 oz Ag/ton.

A screen analysis on the sample as received showed that 46.3% of the silver was present in the -325 mesh screen fraction.

There was no amalgamable silver in the sample.

Attempts to recover the silver by flotation and gravity concentration were only partially successful. The highest recovery is reported in Table 6-b (Test 5) in which only 68.8% of the silver was recovered by flotation and an additional 1.0% by tabling the flotation tailing.

A limonite-goethite coating on the mineral particles was identified.

* Technical Officer, Mineral Processing Division, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

INTRODUCTION

Mr. M. C. Halstead, Consulting Engineer, Silver Town Mines Limited, P.O. Box 590, Cobalt, Ontario, asked the Mines Branch to determine if the silver in a roaster calcine could be concentrated by flotation.

Location of Property.

Silver Town Mines Limited is a silver producer in the Cobalt area of Ontario.

Shipment

A 40 lb shipment of calcine, dull red in colour, containing what was said to be gravel, was received at the Mines Branch on May 12, 1967 and was given the project number MP-OD-6708.

Sampling and Analysis

The sample as received was slightly damp. It was dried, carefully mixed and a sample was riffled out for a chemical and screen analysis. In Tables 1 and 2 the results of this work may be seen.

Table 1

Head Sample Analysis*

Silver (Ag)	-	23.05 oz/ton
Nickel (Ni)	-	0.21 per cent
Cobalt (Co)	-	0.27 " "
Copper (Cu)	-	0.46 " "
Bismuth (Bi)	-	0.013 " "
Iron (Sol Fe)	-	9.10 " "
Sulphur (Total S)	-	0.56 " "
Insoluble	-	66.10 " "

*From Internal Report MS-AC-67-575

Table 2

Head Sample Screen Analysis

Particle Size	Weight %	Assays* Ag oz/ton	Distn Ag%
+4 mesh	10.9	17.61	7.8
+8 "	20.9	20.38	17.5
+14 "	13.9	13.23	7.5
+20 "	3.2	11.11	1.4
+28 "	3.7	10.36	1.6
+35 "	3.8	11.99	1.9
+48 "	3.2	11.01	1.4
+65 "	3.5	10.93	1.6
+100 "	3.6	14.55	2.1
+150 "	3.5	14.69	2.2
+200 "	3.1	21.65	2.8
+325 "	3.5	41.58	5.9
-325 "	23.2	48.87	46.3
Total	100.0	24.47	100.0

*From Internal Report MS-AC-67-522

Mineralogical Examination*

Gangue and ore minerals were identified in the ore when it was studied under a microscope.

The gangue minerals are feldspar, chlorite, quartz, pyroxene, hornblende, a carbonate mineral, rutile and apatite. The ore minerals are chalcopyrite, arsenopyrite, goethite, hematite, ilmenite, pyrite, native bismuth, covellite and the two silver-bearing minerals, pyrargyrite (ruby silver) and stephanite.

Some of the chalcopyrite grains are coated with a thin layer of unidentified sooty mineral. It is possible that the other minerals are also coated with a similar but thinner layer of this same material.

DETAILS OF INVESTIGATION

Amalgamation (Test 1)

A 1000 gram sample of the ore was ground for 30 min and was amalgamated for 1 hr with 1.0 lb CaO/ton and 20 ml of new mercury. The amalgamation residue was assayed for silver and the recovery was calculated by difference from a head assaying 23.05 oz Ag/ton.

*From Internal Report MS-67-64 by W. Petruk, August 4, 1967.

Head - 23.05 oz Ag/ton
Residue - 23.885* " " "
Recovery - nil

*The residue assay was higher than the head but was within an allowable error and it must be concluded that there was no amalgamable silver in the ore.

Flotation (Test 2)

A 2000 gram sample of the ore was ground and floated using the conditions outlined in Table 3-a. The results of the test are shown in Table 3-b.

Table 3-a

Flotation Scheme Test 2

Operation	Time Min	pH	Reagents lb/ton ore
Grinding	20	7.5	(74.4% -325 mesh)
Conditioning	10		Aerofloat - 0.06
			Amyl Xanthate - 0.10
Flotation	8		Dowfroth 250 - 0.04
Conditioning	5		Aerofloat 25 - 0.02
			Amyl Xanthate - 0.05
Flotation	8		Dowfroth 250 - 0.02

Table 3-b

Results of Test 2

Product	Weight %	Assays* Ag oz/ton	Distn Ag%
Concentrate	15.3	89.32	53.4
Flot tail	84.7	14.06	46.6
Feed (calcd)	100.0	25.57	100.0

*From Internal Report MS-AC-67-552

Test 3

A 2000 gram sample of -10 mesh ore was ground for 30 min with reagents added to the grind. The ore was floated in a 1000 gram flotation cell (double the pulp density of that of Test 2). The same reagents were used in this test as in Test 2 but the amount was increased. Thus the reagent concentration in the cell was more than double that of Test 2. The rougher concentrate was cleaned twice. The flotation scheme and the results of this work are shown in the following tables.

Table 4-a

Flotation Scheme Test 3

Operation	Time min	pH	Reagents* lb/ton ore
Grinding (76.1% -325 m)	30	7.7	Aerofloat 25 - 0.02 Amyl Xanthate - 0.10
Conditioning	10		Aerofloat 25 - 0.10 Amyl Xanthate - 0.10
Flotation	15		Dowfroth 250 - 0.06
1st cleaner	4		
2nd cleaner	2½		

*Reagents were stage added;

Table 4-b

Results of Test 3

Product	Weight %	Assays* Ag oz/ton	Distn Ag%
Final conc	3.7	188.58	28.4
2nd cl tail	5.7	54.90	12.7
1st " "	16.8	26.25	18.0
Flot tail	73.8	13.59	40.9
Feed (calcd)	100.0	24.55	100.0

*From Internal Report MS-AC-67-592

A screen analysis was done on the flotation tailing with the following results.

Table 4-c

Results of Screen Analysis - Test 3

Product	Weight %	Assays* Ag Oz/ton	Distn Ag%
+150 mesh	3.0	15.43	3.4
+200 "	7.3	12.51	6.7
+325 "	13.6	12.55	12.4
-325 "	76.1	13.95	77.5
Head (calcd)	100.0	13.70	100.0

*From Internal Report MS-AC-67-592

Test 4

A 2000 gram sample of the ore was ground for 25 minutes and the pulp was acid leached for 2 hours with HCl at a pH of 5.7. The pulp was then made alkaline to a pH of 7.3 with Na_2CO_3 and floated using the same reagents and conditions as in Test 3.

Table 5

Results of Test 4

Products	Weight %	Assays* Ag oz/ton	Distn Ag%
Final conc	2.6	292.97	28.2
2nd cl tail	4.4	29.99	4.9
1st " "	15.8	50.68	29.6
Flot tail	77.2	13.03	37.3
Feed (calcd)	100.0	27.00	100.0

*From Internal Report MS-AC-67-878

Test 5

A 2000 gram sample was ground for 40 minutes and was floated in a 1000 gram cell. Five separate concentrates were floated in this test over a period of 25 minutes and the flotation tailing was tabled.

Tables 6-a and 6-b show the operating conditions and the results which were obtained.

Table 6-a

Flotation Scheme Test 5

Conc	Operation	Time min	pH	Reagents lb/ton ore	
	Grinding (81.2%-325m)	40	7.8	Soda ash	- 4.0
				Copper sulphate	- 2.0
	Conditioning	10	8.1	Soda ash	- 4.0
				Amyl xanthate	- 0.1
1	Flotation	5	8.0	Pine oil	- 0.04
	Conditioning	5	8.2	Amyl xanthate	- 0.1
2	Flotation	5	8.2	Pine oil	- 0.02
	Conditioning	5	8.2	Amyl xanthate	- 0.05
3	Flotation	5	8.2	Pine oil	- 0.02
	Conditioning	5	8.2	Amyl xanthate	- 0.05
4	Flotation	5	8.3	Pine oil	- 0.02
5	Flotation	5	8.3	Aerofloat 25	- 0.04

Table 6-b

Results of Test 5

Product	Weight %	Assays* Ag oz/ton	Distn Ag%
Conc No. 1	6.9	124.76	34.2
" " 2	7.0	57.67	16.0
" " 3	5.1	40.55	8.2
" " 4	5.3	27.70	5.8
" " 5	4.4	25.60	4.6
Flot tail (calcd)	71.3	11.00	31.2
Table conc	0.3	88.45	1.0
" tail	71.0	10.67	30.1
Feed (calcd)	100.0	25.15	100.0

*From Internal Report MS-AC-67-686

CONCLUSIONS

Only two silver-bearing minerals were identified in the sample. These were pyrargyrite (ruby silver) and stephanite.

The recovery of silver by flotation and gravity concentration was generally poor. In Test 5 only 68.8% of the silver was recovered after 25 minutes of flotation time.

The mineralogical examination showed that some of the grains of chalcopyrite and pyrite were coated with a gray sooty material. This coating was later identified as a mixture of limonite and goethite. Because of the fine grain size of the silver-bearing minerals, a coating on these minerals could not be detected, but the probability of their being coated with the iron oxide film was considered to be a possible cause of the low silver recovery.

The acid leach test, the results of which are shown in Table 5, was an attempt to remove the film around the mineral particles, thus making them more amenable to flotation. This was not successful, and although the grade of the final concentrate was raised, the over-all recovery remained low.

It was not possible to conduct further test work because of the small size of the sample received for this investigation.

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