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MINES BRANCH INVESTIGATION REPORT IR 63-92

SILVER IN TAILINGS FROM THE QUEMONT MILL, NORANDA, QUEBEC

by

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MINERAL SCIENCES DIVISION

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W. Petruk*

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SUMMARY OF RESULTS

Samples of mill feed, flotation tailing and cyanidation residue from the Quemont mill were studied in order to determine the mode of occurrence of silver. No silver-bearing minerals were found, but chemical analyses show that some silver is present, and indicates that it is associated with chalcopyrite, pyrite, sphalerite and pyrrhotite. The silver content of the pyrite is 0.73 oz/ton, of the sphalerite, 0.60 oz/ton, and of the pyrrhotite, 0.40 oz/ton. Impure fractions, consisting of gangue with inclusions of chalcopyrite, pyrite, sphalerite and pyrrhotite were found to contain up to 1.66 oz of Ag/ton.

Chemical analyses of sized fractions of the mill feed sample show that the fine fractions have a higher silver content than the coarse ones. Chemical analyses of sized fractions of the flotation tailing and cyanidation residue samples show virtually no variation in silver content with respect to grain size.

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INTRODUCTION

On October 16, 1962, M.J.S. Bennett, mill superintendent of Quemont Mining Corporation Limited wrote to L.E. Djingheuzian, Chief of the Mineral Processing Division, Mines Branch, stating that the company officials were concerned about silver losses in their flotation and cyanidation tailings and asked whether Mines Branch mineralogists would identify the silver-bearing minerals in samples of the tailings. Mr. Djingheuzian consulted Dr. A.T. Prince, Chief of the Mineral Sciences Division and it was agreed that the work would be undertaken in the Mineralogy Section of the Mineral Sciences Division. Mr. Bennett was then informed that, in order to make a thorough study, samples of mill feed, flotation tailing and cyanidation residue would be required. These were received on November 16, 1962.

METHOD OF INVESTIGATION

Polished sections were prepared from the samples received, and studied microscopically. Each sample was then sized and separated into fractions and sub-fractions by means of heavy liquids (specific gravity = 2.96, 3.33 and 3.70), the hand magnet, the Jones magnetic separator*, and the Frantz isodynamic separator. The resulting fractions and sub-fractions were weighed, examined under the ore microscope, and analysed for silver.

RESULTS OF INVESTIGATION

The metallic minerals in the samples are pyrite, pyrrhotite, sphalerite, chalcopyrite and galena. The non-metallic minerals are quartz, chlorite, calcite and rutile. No silver-bearing minerals were found but

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*Separation by G.O. Hayslip, Mineral Processing Division, Mines Branch.

chemical analyses* show that the flotation tailing and cyanidation residue samples contain 0.31 and 0.30 ounces of silver per ton, respectively.

An attempt was made to find the silver-bearing mineral by determining the distribution of silver and, if possible, by concentrating it. The distribution of silver with respect to grain size was determined by analysing the sized samples. The results for the mill feed sample show that the fine fractions have a higher silver content than the coarse ones (see Table 1). Those for the flotation tailing and cyanidation residue samples show virtually no variation in silver content with respect to grain size (see Table 1).

TABLE 1

Distribution of Silver in the Mill Feed, Flotation Tailing and Cyanidation Tailing Samples with Respect to Grain Size

Fraction (Tyler mesh)	Mill Feed Sample		Flotation Tailing Sample		Cyanidation Residue Sample	
	Ag* (oz/ton)	Wt. % of fraction	Ag* (oz/ton)	Wt. % of fraction	Ag* (oz/ton)	Wt. % of fraction
+ 65	n.d.	62.8	----	----	----	----
-65 + 100	0.76	9.8	n.d.	4.3	----	----
-100+ 200	0.93	11.3	0.39	5.0	0.25	n.d.
-200	1.28	16.1	0.29	90.7	0.30	n.d.

n.d. = not determined.

*Analyses by L. Lutes and C. Derry, Internal Report MS-AC-63-549, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

The distribution of silver in the -100 +200 mesh fractions of the samples was studied in detail. Although these sized fractions represent a relatively small proportion of the total, they were selected because finer fractions are less readily amenable to separation, and because in the coarser fractions there is less liberation. The fractions were separated into sub-fractions by means of the Jones magnetic separator and heavy liquids, and analysed chemically and spectrographically. The spectrographic analyses were made because some of the fractions were too small for chemical analysis. The spectrographic results, although less accurate, can nevertheless be used to indicate relative amounts. The results of the analyses, given in Tables 2 and 3, indicate that the mill feed and flotation tailing sub-fractions with specific gravities from 3.33 to 3.70 contain the most silver.

Microscopical studies of the sub-fractions show that those having specific gravities below 2.96 consist of quartz, calcite, trace amounts of chlorite and a few inclusions of metallic minerals. Those having specific gravities of 2.96 to 3.33 and 3.33 to 3.70 consist of chlorite, small amounts of quartz and calcite, a somewhat magnetic black mineral that could not be identified by microscopical and X-ray diffraction methods, and inclusions of chalcopyrite, sphalerite, pyrite and pyrrhotite. The fractions whose specific gravities are greater than 3.70 consist of pyrite, pyrrhotite, sphalerite, and trace amounts of chalcopyrite and galena.

An attempt was made to concentrate the silver-bearing minerals from a -100 +200 mesh mill feed sub-fraction having a specific gravity of 3.33 to 3.70 by means of heavy liquids, the hand magnet, and the Frantz isodynamic separator. The resulting products were studied microscopically and analysed chemically for silver. The results are given in Table 4.

TABLE 2

Distribution of Silver in Sub-Fractions Obtained from -100 +200 Mesh Fractions of the Mill Feed, Flotation Tailing and Cyanidation Tailing Samples

Fraction (Specific Gravity)	Mill Feed (10 amp from Jones Magnetic Separator) Ag*(oz/ton)	Mill Feed Sample		Flotation Tailing Sample		Cyanidation Residue Sample	
		Ag* (oz/ton)	Wt. % of fraction	Ag* (oz/ton)	Wt. % of fraction	Ag* (oz/ton)	Wt. % of fraction
< 2.96	0.14	tr	6.3	0.15	51.1	n.d.	1.7
2.96 to 3.33	0.83	0.66	5.1	1.25 (2.96 to 3.70 combined)	8.4	n.d.	1.0
3.33 to 3.70	1.66	n.d.	1.5		1.3	n.d.	1.2
>3.70	n.d.	0.82	87.1	0.53	39.2	0.24	96.1

n.d. = not determined.

*Chemical analyses by L. Lutes, C. Derry and D. Cumming, Internal Reports MS-AC-63-549 and MS-AC-63-1142, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

TABLE 3

Semi-Quantitative Spectrographic Analysis of Sub-Fractions Obtained from -100 +200 Mesh Fractions of the Mill Feed, Flotation Tailing and Cyanidation Tailing Samples

Fraction (Specific Gravity)	Mill Feed Sample	Flotation Tailing Sample	Cyanidation Residue Sample
	Wt. % Ag*	Wt. % Ag*	Wt. % Ag*
<2.96	0.002	0.003	0.001
2.96 to 3.33	0.004	0.003	0.005
3.33 to 3.70	0.008	0.008	0.004
>3.70	0.006	0.003	0.004

*Semi-quantitative spectrographic analyses by E.M. Kranck, Internal Report SL-63-056, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

TABLE 4

Mineralogy and Distribution of Silver in Products Obtained from -100 +200 Mesh Mill Feed Sub-Fraction Having a Specific Gravity of 3.33 to 3.70

Product	Ag (oz/ton)	Principal Constituents	Minor Constituents	Trace Constituents
Hand magnet		pyrrhotite		chalcopyrite, sphalerite, pyrite.
3.4 sink	1.15	chalcopyrite, sphalerite and pyrite	gangue minerals	
3.4 float (moderately magnetic)	0.18	unknown black mineral, pyrrhotite	chalcopyrite, sphalerite, pyrite, gangue	
3.4 float (non-magnetic	0.17	chlorite	chalcopyrite, pyrite, sphal-erite	rutile

Analyses by L. Lutes, C. Derry and D. Cumming, Internal Report MS-AC-63-1142, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

Table 4 shows that the product whose principal constituents are chalcopyrite, sphalerite and pyrite (3.4 sink) contains the most silver. This suggests that the silver may be present as a trace element in one or more of these minerals.

The amount of silver present in pyrite, pyrrhotite and sphalerite was determined by preparing a relatively clean fraction of each mineral and analysing it (see Table 5). Attempts to prepare a clean fraction of chalcopyrite proved unsuccessful.

TABLE 5

Silver Content in Metallic Minerals Present in the Mill Feed, Flotation Tailing, and Cyanidation Tailing Samples

Mineral	Source	Ag (oz/ton)
Pyrite	Mill feed sample	0.73
Pyrite	Cyanidation residue sample	0.18
Pyrrhotite	Mill feed sample	0.40
Pyrrhotite	Flotation tailing sample	0.34
Sphalerite	Mill feed Sample	0.60

Analysis by L. Lutes, C. Derry and D. Cumming, Internal Report MS-AC-63-1142, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

Table 5 shows that the minerals in the ore from Quemont have the following characteristics:

(1) The pyrite, sphalerite and pyrrhotite contain small amounts of silver.
(2) The pyrite in the mill feed contains more silver than that in the cyanidation residue. This indicates that some of the silver in the pyrite has been recovered by cyanidation.
(3) The pyrrhotite in the mill feed contains a similar amount of silver to that in the flotation tailing.

(4) The pyrite, sphalerite and pyrrhotite contain less silver than was concentrated in sub-fractions having specific gravities of 3.33 to 3.70 (see Tables 2, 4 and 5). This indicates that the silver in the ore is also present in some other mineral. Since the sub-fractions whose specific gravities range from 3.33 to 3.70 contain significant amounts of chalcopyrite it is inferred that the chalcopyrite contains the most silver.

CONCLUSIONS

No silver-bearing minerals were found in the ore from the Quemont Mining Corporation, but the present study indicates that the silver is present as a trace element in chalcopyrite, pyrite, sphalerite and pyrrhotite. This suggests that the silver can be recovered only by recovering these minerals.

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