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MINES BRANCH INVESTIGATION REPORT IR 65-57

MINERALOGICAL INVESTIGATION OF COPPER FLOTATION CONCENTRATES FROM McINTYRE PORCUPINE MINES LTD.

by

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EXTRACTION METALLURGY DIVISION

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SUMMARY

Microscopic examination of sized fractions of two copper flotation concentrates showed that chalcopyrite is the main mineral constituent and smaller amounts of transparent gangue minerals, bornite, tennantite, pyrite and other minerals are present. Screen analyses and point count analyses showed that the difference in the grades of the two concentrates is due mainly to the difference in the proportions of non-sulphide gangue minerals. To achieve a high grade final concentrate fine grinding of the rougher flotation concentrate is indicated.

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INTRODUCTION

Samples of two copper flotation concentrates and of the corresponding tailings from McIntyre Porcupine Mines Ltd., Schumacher, Ont. were submitted to the Mineralogy Section on May 20, 1965, by Mr. C.S. Stevens, Liaison Officer of Extraction Metallurgy Division, and were assigned our Reference No. 5/65-2. The sample designations and reported copper contents were as follows:

TABLE 1

Submitted Samples

Sample Designation	Cu %
C20-21-22, April 20, Concentrate No. 1	32.4
C40-41-42, April 20, Tailing No. 1	0.062
C20-21-22, April 28, Concentrate No. 2	27.7
C40-41-42, April 28, Tailing No. 2	0.057

Mr. Stevens reported that it had been requested by Mr. P.B. McCrodan, Mine Manger, that a mineralogical study be made of the samples to attempt to determine the cause of the difference in copper grade between the two concentrates.

PROCEDURE AND RESULTS

Representative head samples were riffled out of the submitted concentrates for chemical analysis. The results were as follows:

TABLE 2

Chemical Analyses of Copper Concentrates *

Sample	Cu %	SiO_2 %
Conc. No. 1	32.8	3.40
Conc. No. 2	29.0	7.90

*From Reports No. EML 795 and EML 796, Chemical Analysis Section.

Screen analyses were performed on both the concentrate and tailing samples. The results which are presented in Table 3 show that there is little difference in the size distribution in the two tailings samples. The

TABLE 3

Screen Analyses

Mesh Size	Conc. No. 1 (Wt %)	Conc. No. 2 (Wt %)	Tails. No. 1 (Wt %)	Tails. No. 2 (Wt %)
+65	0.3	2.1	8.0	10.7
- 65+100	1.3	6.7	16.9	17.3
-100+150	3.3	8.7	12.1	11.3
-150+200	10.2	18.8	12.7	11.5
-200+270	7.2	10.2	5.5	4.5
-270+325	7.8	9.1	3.9	3.3
-325	69.9	44.4	40.9	41.4
Totals	100.0	100.0	100.0	100.0

concentrates, however, differ considerably, concentrate No. 1 being much finer grained than concentrate No. 2.

Polished sections were prepared of three sized fractions of each concentrate, namely the -100+150 mesh, the -150+200 mesh and the -270+325 mesh fractions. Microscopic examination of the polished sections supplemented by X-ray diffraction analysis showed that the fractions consist mainly of chalcopyrite. Smaller proportions of transparent gangue minerals are present as well as bornite, tennantite and pyrite and trace amounts of

rutile, molybdenite, pyrrhotite, etc. The non-sulphide minerals present include quartz, feldspar and dolomite. The sulphide minerals occur in the sized fractions as free grains or intergrown with other sulphides and/or with transparent gangue minerals. Chalcopyrite often occurs as fine-grained oriented inclusions in bornite.

Point count analyses were made of the polished sections, using a Swift counter, in order to compare the mineralogical composition of corresponding sized fractions of the two concentrates. The number of occurrences of each mineral constituent encountered in the traverse was taken as a measure of its volume proportion. From this value and the specific gravity the weight percentage was calculated. The results of the point count analyses are shown in Table 4.

In the polished sections the non-sulphide gangue minerals appear to occur either free or with inclusions or attachments of sulphide minerals. The approximate proportion of apparently free non-sulphide gangue was determined from the point count analyses and the results are shown in Table 5 expressed as a percentage of the total non-sulphide gangue content of the fraction.

Sized samples of the flotation tailings were fractionated on the Haultain Superpanner. Microscopic examination of the gravity concentrates showed that pyrite is the main sulphide mineral in the tailings and some molybdenite and chalcopyrite are also present.

DISCUSSION AND CONCLUSIONS

The copper contents of the flotation concentrates as determined by chemical analysis (Table 2) confirm that concentrate No. 1 is higher grade than concentrate No. 2. The silica contents show that concentrate No. 2 contains a considerably higher proportion of siliceous gangue minerals than is present in concentrate No. 1.

Although the ratio of concentration effected in the mill is not known the final flotation concentrate probably represents only a small proportion of the feed weight, with the bulk of the ore remaining in the tailing. Thus the difference in size distribution in the two concentrates (Table 3) does not necessarily indicate a significant difference in primary grind especially since the size distribution in the tailing samples is quite similar. In the mill the rougher flotation concentrate is reground to produce the final concentrate. Since the concentrate analyses show that concentrate No. 1 is considerably finer grained than concentrate No. 2 a pronounced difference in the secondary grind is indicated.

TABLE 4

Point Count Analyses of Concentrate Fractions

Mineral	Spec. Grav.	-100+150 mesh				-150+200 mesh				-270+325 mesh			
		Conc No. 1		Conc No. 2		Conc No. 1		Conc No. 2		Conc No. 1		Conc No. 2	
		Vol %	Wt %	Vol %	Wt %	Vol %	Wt %	Vol %	Wt %	Vol %	Wt %	Vol %	Wt %
Chalcopyrite	4.2	67.6	74.4	52.4	60.2	83.7	85.6	71.2	75.6	87.7	88.4	77.7	78.2
Bornite	5.1	3.1	4.1	3.3	4.6	4.5	5.5	2.7	3.4	4.6	5.6	4.5	5.5
Tennantite	4.6	0.6	0.7	3.5	4.5	1.0	1.1	4.3	5.0	0.7	0.8	4.3	4.8
Pyrite	5.0	0.6	0.8	0.9	1.2	1.1	1.3	1.7	2.1	0.9	1.1	4.6	5.5
Rutile	4.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Molybdenite	4.7	--	--	--	--	--	--	0.1	0.1	0.1	0.1	0.4	0.4
Gangue	2.7	27.9	19.8	39.7	29.3	9.5	6.3	19.8	13.6	5.7	3.7	8.2	5.3

TABLE 5

Point Count Analysis of Non-Sulphide Gangue Minerals

Sample	Combined Gangue(No. of Counts)	Free Gangue(No. of Counts)	Total Count	Free Gangue (%)
-100+150 mesh				
Concentrate No. 1	367	101	468	22
Concentrate No. 2	592	177	769	23
-150+200 mesh				
Concentrate No. 1	393	115	508	23
Concentrate No. 2	446	146	592	25
-270+325 mesh				
Concentrate No. 1	97	39	136	29
Concentrate No. 2	154	66	220	30

The point count analyses of the concentrate fractions (Table 4) show that chalcopyrite comprises approximately 75 to 88 per cent of the sized fractions of concentrate No. 1 and approximately 60 to 78 per cent of the fractions of concentrate No. 2. In all of the sized fractions of concentrate No. 1 investigated there is more bornite present than tennantite and the proportions of pyrite and tennantite are approximately equal. In the fractions of concentrate No. 2 there is less chalcopyrite present than in the corresponding fractions of concentrate No. 1. Also, the proportions of bornite and tennantite are roughly equal to one another and there is considerably more tennantite present than in the corresponding fractions of concentrate No. 1. Pyrite and, even more markedly, transparent gangue minerals are more abundant in concentrate No. 2.

The mineral distribution in the sized fractions investigated indicates that the decrease in the copper content is due mainly to the smaller proportion of chalcopyrite and the larger proportion of non-sulphide gangue minerals in concentrate No. 2, but is in part offset by the presence of more tennantite which contains a higher proportion of copper than chalcopyrite. Further, since the proportion of gangue minerals decreases as the size decreases and since concentrate No. 2 is much coarser grained (Table 3) finer grinding of the rougher concentrate is indicated.

In the microscopic study of the occurrence of transparent gangue minerals, some of the grains which appear to be free may actually contain intergrown sulphides below the surface of the polished section. However, the proportion of apparently free gangue in each concentrate can be used for

comparison purposes as an indication of the efficiency with which the non-sulphide mineral constituents have been depressed in the flotation circuit. The results in Table 5 show that uncombined transparent gangue minerals comprise approximately one quarter of the total non-sulphide minerals and that there is a slightly higher proportion of uncombined grains in the fractions of concentrate No. 2. While these results are only approximate they do indicate that conditions for depressing non-sulphide gangue were slightly better in the flotation of concentrate No. 1.

It is concluded from this study that

1. the lower copper grade of flotation concentrate No. 2 is due to the presence of a higher proportion of transparent gangue minerals at least 75 per cent of which are combined with sulphides, and

2. finer grinding of the rougher flotation concentrate may solve the problem of reduced copper grade.

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