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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 62-92

FLOTATION TESTS ON A SILVER-LEAD-ZINC ORE FROM CONWEST EXPLORATION COMPANY LIMITED, YUKON TERRITORY

by

T. F. BERRY

MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

In Test 2, a silver-lead concentrate assaying 139.78 oz Ag/ton and 73.72% Pb, and representing 62.6% of the silver and 74.9% of the lead was produced. In the same test a zinc concentrate containing 68.1% of the zinc and analysing 50.71% Zn was obtained.

In Test 3 an attempt to isolate a silver concentrate containing a minimum of lead and zinc was only partially successful.

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INTRODUCTION

Mr. W. P. Hammond, Manager, Exploration and Development, Conwest Exploration Company Limited, Suite 1001, 85 Richmond Street West, Toronto 1, Ontario, in a letter dated October 24, 1961, asked the Mines Branch to undertake an investigation on a silver-lead-zinc ore from its Yukon property.

Location of Property

The property is a silver-lead-zinc prospect located at latitude 61° 07' N, longitude 131° 10' W, approximately 120 miles northwest of Watson Lake, Yukon Territory.

Nature of Investigation Requested

Mr. Hammond asked that tests be made to determine the amenability of the ore to concentration by flotation, and in particular, to ascertain the distribution of the silver in the lead and zinc concentrates, since the net smelter return is not as attractive when the silver is recovered with the zinc.

Shipment

On October 25, 1961, a sample of ore consisting of rejects from channel and chip samples, from six sampled veins, weighing about 150 lb was received at the Mines Branch. Included in the shipment were three samples of high grade specimen ore to be used for a mineralogical study.

Sampling and Analysis

The three specimen samples were submitted to the Mineral Sciences Division for a mineralogical examination.

The 150 lb sample was crushed to -10m and a head sample was riffled out for a chemical analysis. A small portion of the head sample was retained for a semi-quantitative spectrographic analysis.

The results of this analytical work may be seen in the following tables.

TABLE 1

Semi-Quantitative Spectrographic Analysis*

Range	Elements
Principal constituent	Pb
Less than 10 %	Zn, Ca, Fe, Si
" " 1.0 %	Sb, Mg, Al
" " 0.1 %	Mn, Cu, Ti, Ag, Sn
" " 0.01 %	Ni
Trace	V, Cr, B

* From Internal Report MS-SL-61-844

TABLE 2

Chemical Analysis*

Element	
Silver (Ag)	52.64 oz/ton
Lead (Pb)	23.21 %
Zinc (Zn)	10.26 %
Antimony (Sb)	0.55 %
Arsenic (As)	0.07 %
Copper (Cu)	0.29 %
Iron (Soluble Fe)	5.63 %
Sulphur (Total S)	10.27 %
Insoluble	25.37 %

* From Internal Report MS-AC-61-1027

MINERALOGICAL EXAMINATION*

Introduction

On October 27, 1961, 5 specimens of ore labelled 1115, 1116, 1117, 1118, and 1119 were submitted to the Mineralogy Laboratory for examination.

Methods of Examination

Two polished sections were prepared from each specimen and the minerals were identified by means of microscopical and X-ray diffraction studies. Grain counts were made on polished sections to determine the relative quantities of the minerals present in the samples.

Results of Investigation

The metallic minerals present in the samples are galena, sphalerite, freibergite $(Cu,Ag)_{10}(Cu,Fe)_2Sb_4S_{13}$, meneghinite ($Pb_{13}Sb_7S_{23}$), jamesonite ($Pb_4FeSb_6S_{14}$), chalcopyrite, covellite, pyrite, goethite, and probably argentite. The principal non-metallic minerals are quartz, feldspar, calcite, a clay mineral, biotite and cerussite. The estimated mineral contents of the samples are given in Table 3.

TABLE 3

Estimated Mineral Content of Each Sample Supplied, as Determined by a Grain Count on Polished Sections

Mineral	Sample No.				
	1115 %	1116 %	1117 %	1118 %	1119 %
Galena	21	80	15	14	22
Sphalerite	26	3	54	20	25
Freibergite	7	1	2.6	31	1
Meneghinite	---	---	---	13	---
Jamesonite	---	---	0.3	1	---
Chalcopyrite	1.5	---	---	7	---
Pyrite	0.1	---	0.1	---	---
Argentite (?)	0.4	---	---	---	---
Covellite	tr.	---	---	tr.	---
Gangue	44	16	28	14	52
Total	100	100	100	100	100

* Internal Report MS-61-868 by W. Petruk, December 14, 1961.

The galena occurs as aggregates of cubic crystals and contains well rounded inclusions of sphalerite, freibergite and meneghinite (see Figures 1, 2 and 6) and a few tiny blebs of a white mineral that may be argentite. The rounded inclusions range between 10 and 300 microns in diameter but the tiny blebs are so small that they cannot be identified. A cell edge measurement on galena gives a value of 5.924A which indicates that it contains little or no silver or antimony in solid solution.

The sphalerite occurs as irregular shaped masses and generally does not have many impurities. However, it contains a few quartz-calcite veinlets, a few small rounded exsolution globules of chalcopyrite and a few irregular shaped grains of galena and freibergite. A cell edge measurement on the sphalerite gives a value of 5.41A which indicates that it contains little or no iron in solid solution.

The freibergite generally occurs as irregular shaped masses and as inclusions in galena. Some of the irregular shaped masses are surrounded by chalcopyrite and meneghinite (see Figure 4), and all the freibergite contains rounded to angular grains of meneghinite and exsolution globules of chalcopyrite and covellite. The meneghinite grains range between 10 and 300 microns in diameter and the chalcopyrite globules range between 1 and 5 microns in diameter. A cell edge measurement on freibergite gives a value of about 10.48A which indicates that it contains about 25% Ag and about an equal amount of Sb. A chemical analysis of the head sample of the ore gives a value of 0.16% Ag (52 ounces per ton) and 0.55% Sb. This suggests that all the silver in the ore occurs as a constituent of freibergite and the excess antimony occurs as a constituent of meneghinite and jamesonite.

The jamesonite occurs as irregular shaped grains that are up to 0.3 mm in diameter. These grains were observed only in the proximity of chalcopyrite and freibergite (see Figure 8).

A number of quartz-calcite-cerrusite-goethite veinlets are present in galena, and a number of quartz-calcite-goethite veinlets are present in the other metallic minerals. These veinlets follow cleavage directions in galena and are zoned wherever goethite or cerrusite is present with goethite or cerrusite occurring along the walls of the veinlets.

Conclusion

Mineralogical studies on 5 samples of this ore show that the zinc-bearing mineral is sphalerite; the silver-bearing mineral is freibergite; the lead-bearing minerals are galena, meneghinite, and jamesonite, and the copper-bearing minerals are chalcopyrite, freibergite and covellite. The galena, sphalerite and freibergite generally occur as irregular shaped masses containing inclusions of each other and of the other metallic minerals present in the ore. The inclusions range between 10 and 300 microns in diameter and most of them would be liberated at a grind of -325 mesh.

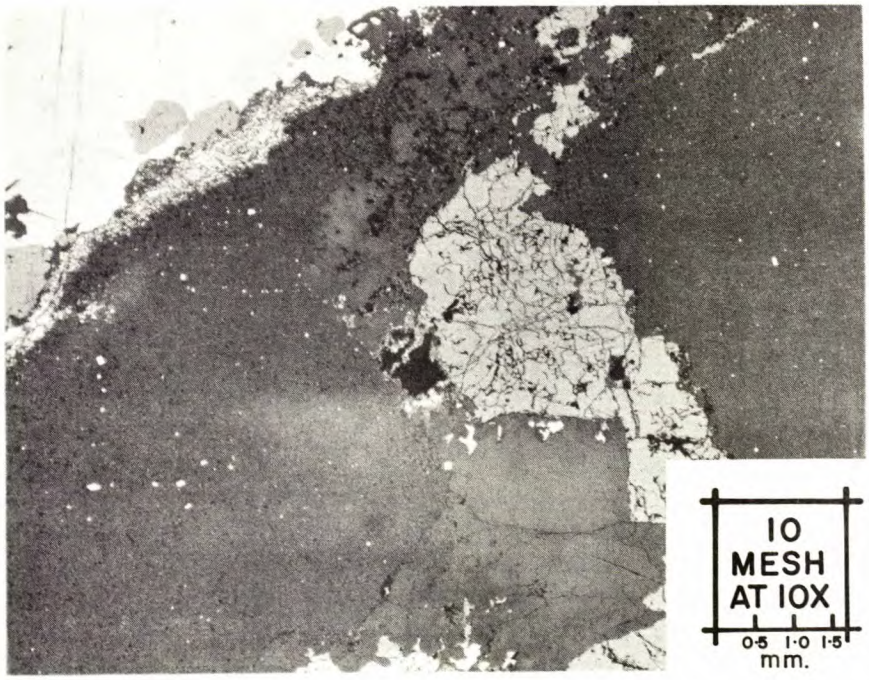

Figure 1. - Photomicrograph of a polished section from Sample No. 1115. The white area is galena containing freibergite inclusions (not visible at this magnification but see Figure 6); the grey is sphalerite and the dark grey is gangue. The tiny white grains in the gangue are pyrite.

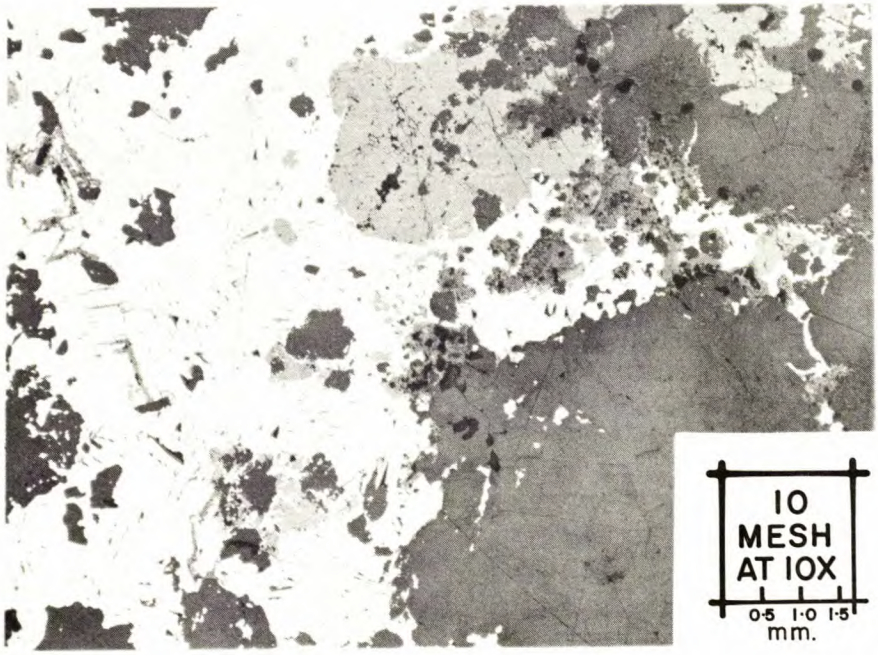

Figure 2. - Photomicrograph of a polished section from Sample No. 1116. The white area is galena containing freibergite inclusions (not visible at this magnification); the grey is sphalerite and the dark grey is gangue.

Figure 3. - Photomicrograph of a polished section from Sample No. 1117. The white area is galena containing freibergite inclusions (not visible at this magnification); the sphalerite is grey and the gangue is dark grey.

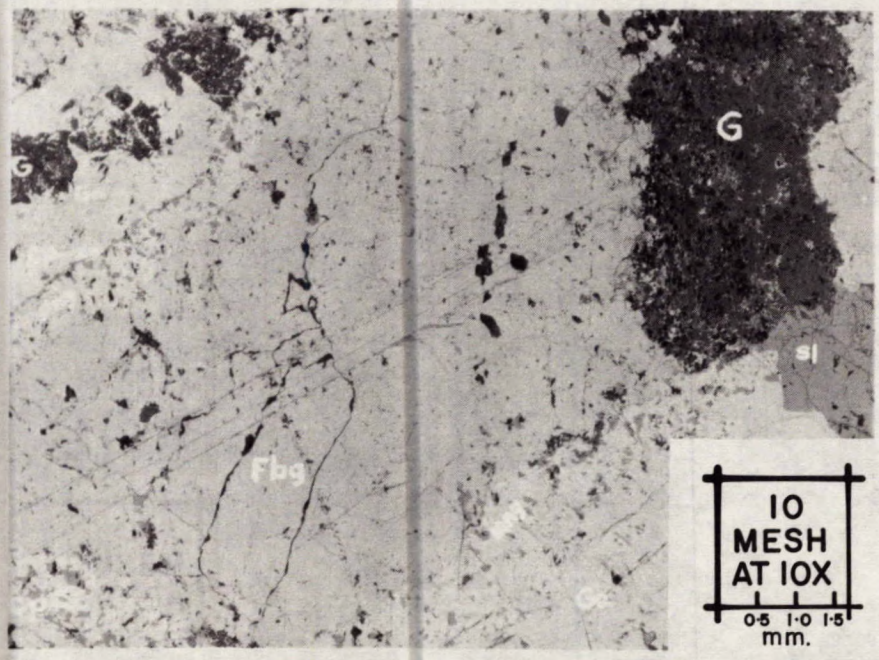

Figure 4. - Photomicrograph of a polished section from Sample No. 1118. The large grey area marked Fbg is freibergite; the small grey blebs marked Cp are chalcopyrite and the white zone between the freibergite and chalcopyrite, marked Mng, is meneghinite. The other areas in the photograph are galena (Ga), sphalerite (Sl), and gangue (G).

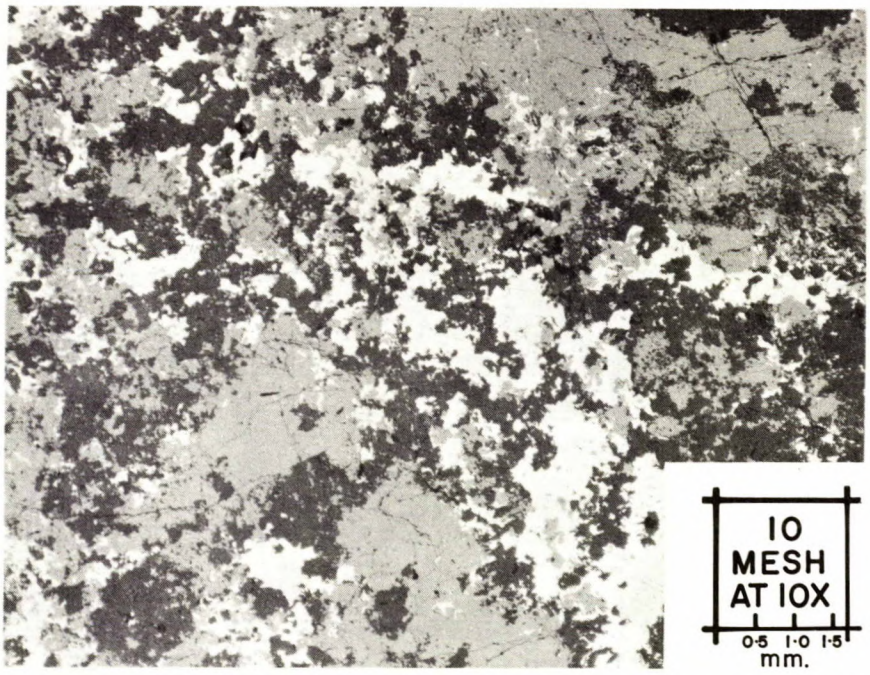

Figure 5. - Photomicrograph of a polished section from Sample No. 1119. Galena is white; sphalerite is medium grey; gangue is dark grey and pits are black.

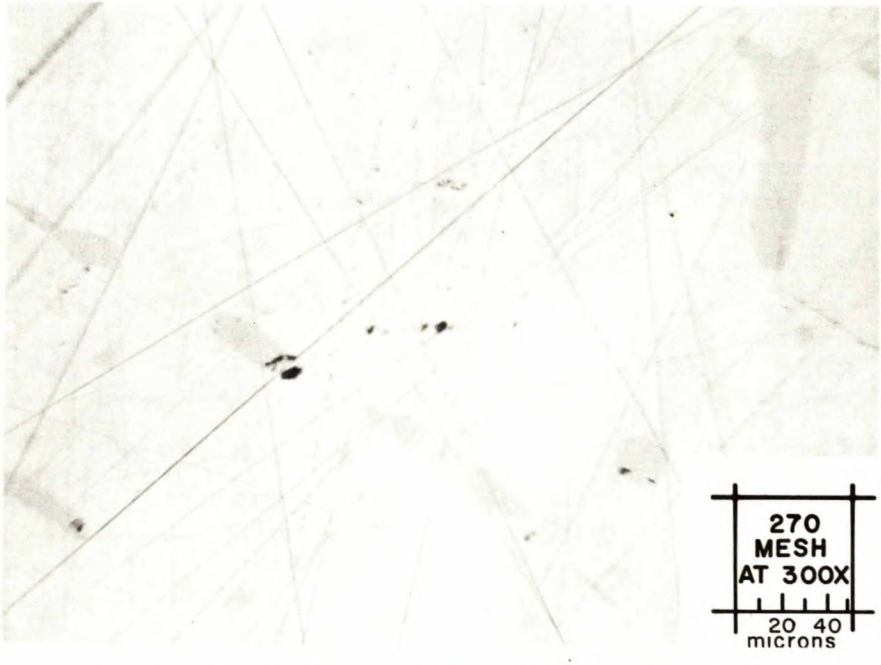

Figure 6. - Photomicrograph of a polished section of galena in Sample No. 1115, showing freibergite inclusions (grey) in galena (white). The straight lines across the photograph are scratches produced in polishing.

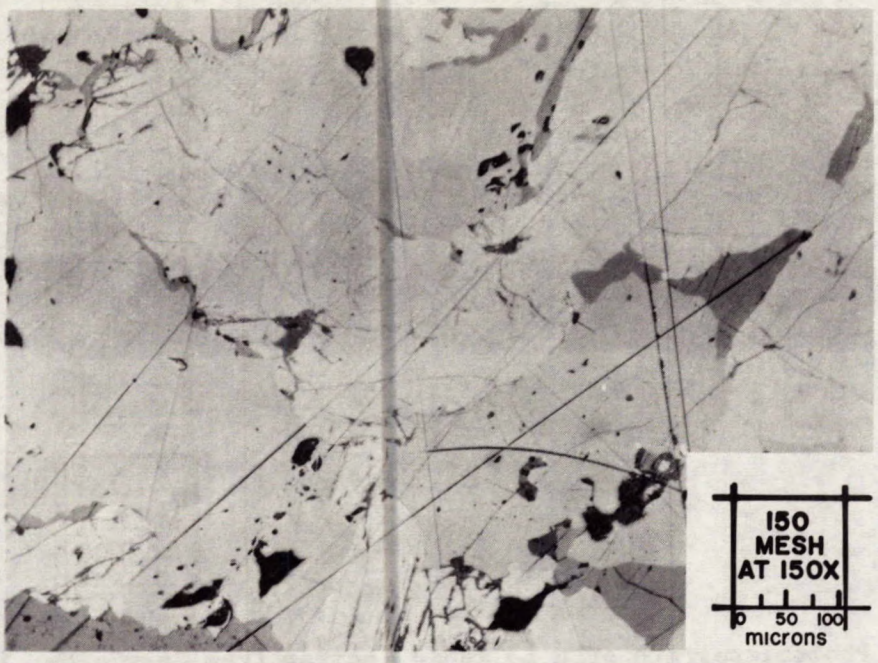

Figure 7. - Photomicrograph of a polished section of Sample No. 1118 showing the relationship between meneghinite (whitish-grey) and freibergite (grey). The small darker grey areas are chalcopyrite and the straight lines across the photograph are scratches on the polished section.

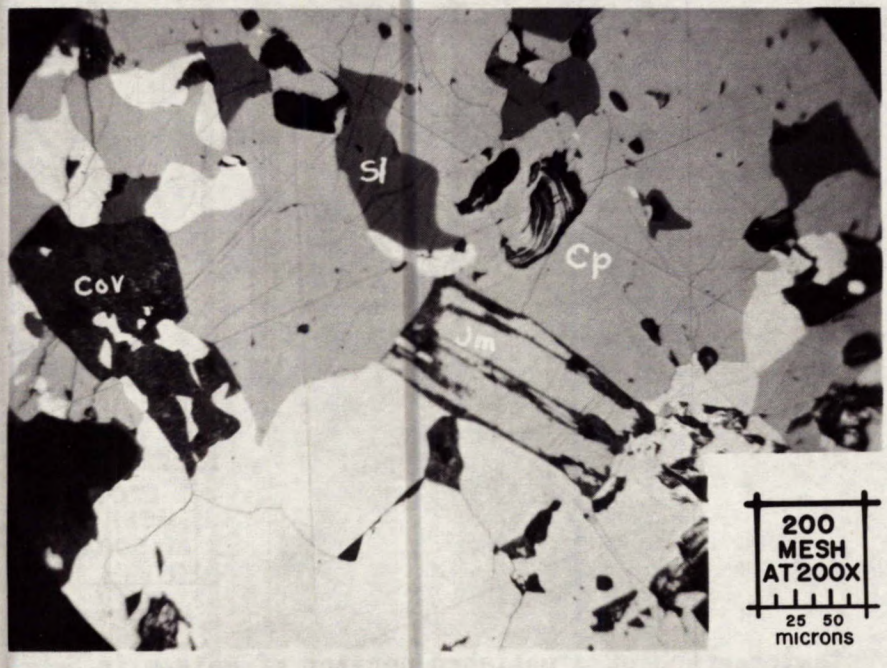

Figure 8. - Photomicrograph of a polished section of Sample No. 1118 showing jamesonite (Jm) in freibergite (Fbg) and chalcopyrite (Cp). The dark grey areas are sphalerite (Sl) and the area marked COV is covellite. The pits are black.

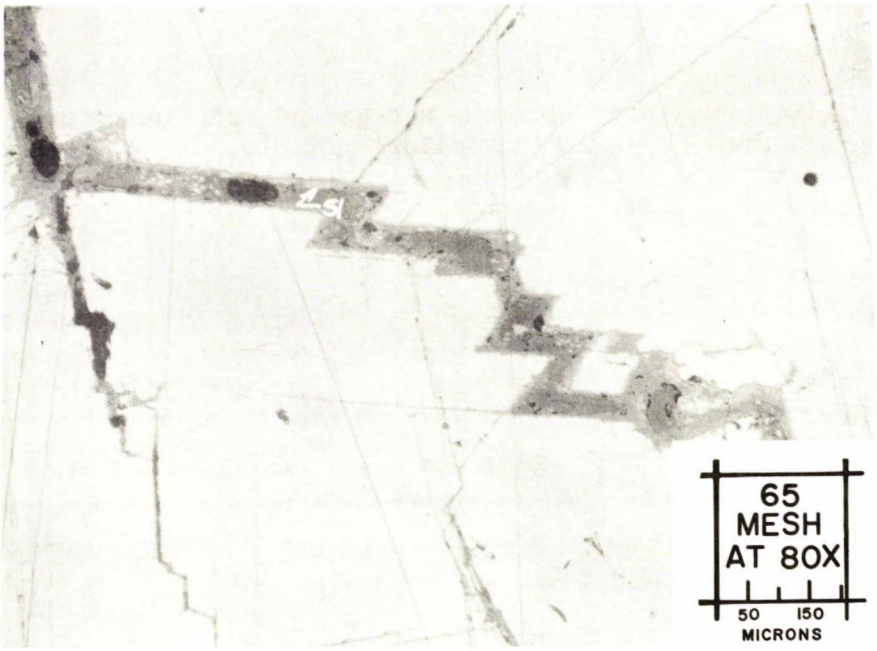

Figure 9. - Photomicrograph of a polished section showing a quartz-calcite-cerrusite-goethite veinlet in galena. The small grey area marked (S1) is goethite. The slightly darker grey areas along the walls are calcite and cerrusite, and the central dark grey areas are quartz.

DETAILS OF INVESTIGATION

Test 1

A 2000 g sample of -10m ore was ground and floated using the reagents and conditions shown in the following table.

TABLE 4

Flotation Scheme - Test 1

Operation	Reagents - lb/ton	Time - min	pH
Grinding (71% -200m)	Lime - 2.0	20	
	$ZnSO_4$ - 1.0		
Pb conditioning	Lime - 1.0		9.2
	NaCN - 0.4	2	
	Z-3 - 0.1	3	
Pb rougher flotation	Cresylic acid - 0.03	2	8.7
	" - 0.015	5	
" cleaner "	Lime - 0.2	4	
	NaCN - 0.1		
" recleaner "		3	
Zn conditioning	Lime - 0.5	3	10.0
	$CuSO_4$ - 1.0	10	
" rougher flotation	Z-11 - 0.1	4	
	Dow. 250 - 0.02		
	Z-11 - 0.03	2	8.7
" cleaner "		3	
" recleaner "		2	
Scavenger "	Z-5 - 0.05		
	Dow. 250 - 0.02	2	

The results of this test are shown in Table 5.

TABLE 5

Results of Test 1

Product	Weight %	Analysis * oz/ton Ag	Analysis * % Pb	Analysis * % Zn	Distribution % Ag	Distribution % Pb	Distribution % Zn
Pb recl conc	22.2	130.18	67.25	5.98	55.8	72.2	12.1
" " tail	2.1	132.21	25.45	15.50	5.4	2.6	3.0
" cl "	5.4	162.08	35.30	11.50	16.9	9.2	5.6
Zn recl conc	12.9	34.10	3.70	54.38	8.5	2.3	63.8
" " tail	1.9	57.86	12.83	21.59	2.1	1.2	3.7
" cl "	2.5	44.36	13.48	8.31	2.1	1.6	1.9
Scavenger conc	5.3	36.10	12.18	5.27	3.7	3.1	2.5
Flot tail	47.7	6.02	3.37	1.70	5.5	7.8	7.4
Head (calcd)	100.0	51.82	20.68	11.00	100.0	100.0	100.0

* From Internal Report MS-AC-62-290

Test 2

A 2000 g sample of -10m ore was ground and floated using reagents and conditions closely following those outlined in the previous test. The chief difference between the two tests was the addition of 1.0 lb NaCN/ton to the grinding mill, and an additional 0.5 lb NaCN/ton during the lead rougher flotation in an attempt to depress the sphalerite.

The results of this test were as follows:

TABLE 6

Results of Test 2

Product	Weight %	Analyses* oz/ton Ag	Analyses* % Pb	Analyses* % Zn	Distribution % Ag	Distribution % Pb	Distribution % Zn
Pb recl conc	23.1	139.78	73.72	4.40	62.6	74.9	9.4
" " tail	4.1	173.43	42.51	11.45	13.8	7.7	4.3
" cl "	2.1	75.22	20.96	10.12	3.1	1.9	2.0
Zn recl conc	14.5	28.87	4.56	50.71	8.1	2.9	68.1
" " tail	3.0	41.49	10.98	16.74	2.4	1.4	4.6
" cl "	4.6	30.07	10.43	7.52	2.7	2.1	3.2
Scavenger conc	5.8	23.71	8.54	3.97	2.7	2.2	2.1
Flot tail	42.8	5.54	3.64	1.58	4.6	6.9	6.3
Head (calcd)	100.0	51.54	22.74	10.81	100.0	100.0	100.0

* From Internal Report MS-AC-62-872.

Test 3

In this test an attempt was made to remove a silver concentrate from the lead recleaner concentrate using potassium dichromate.

A 2000 g sample of -10m ore was ground to about 70% -200m and floated using reagents and conditions similar to those prevailing in Test 2. The lead recleaner concentrate was conditioned with 1.0 lb potassium dichromate for 5 min and floated for 3 min.

The flotation results are shown in the following table:

TABLE 7

Results of Test 3

Product	Weight %	Analyses *				Distribution %		
		oz/ton	%					
		Ag	Pb	Zn	Sb	Ag	Pb	Zn
Ag conc	2.6	513.26	55.73	5.25	5.67	26.5	6.6	1.4
Pb recl conc	21.9	94.18	69.58	8.11	-	41.0	69.6	18.2
Pb " tail	4.3	118.13	31.18	12.27	-	10.1	6.1	5.4
Pb cl "	2.9	84.31	27.11	10.75	-	4.8	3.6	3.2
Zn recl conc	11.1	23.71	4.12	50.19	-	5.2	2.1	57.1
Zn " tail	1.9	51.88	14.32	24.54	-	2.0	1.2	4.8
Zn cl "	2.5	35.78	12.71	4.72	-	1.8	1.4	1.2
Flot "	52.8	8.19	3.85	1.60	-	8.6	9.4	8.7
Head (calcd)	100.0	50.33	21.90	9.75	-	100.0	100.0	100.0

* From Internal Report MS-AC-62-211.

CONCLUSIONS

The three tests shown in this report are typical of the results obtained from flotation tests done on the sample of ore.

High grade lead concentrates containing most of the silver were produced and while the grade of the zinc concentrates was generally high, more test work would be necessary to increase the recovery of this element.

This investigation was terminated when it was learned, from the August 2, 1962, issue of the Northern Miner, that a statement had been issued by F. M. Connell, President, to the effect that exploration work at this property failed to indicate enough ore to warrant a mining operation.

ACKNOWLEDGEMENT

The writer wishes to thank the chemists and assayers of the Analytical Chemistry Sub-division of the Mineral Sciences Division for the chemical analyses done in this investigation.

TFB:EBM