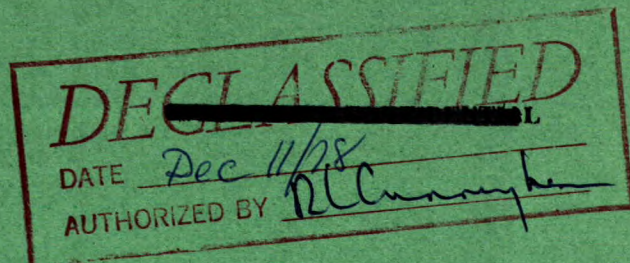


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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 61-40

**FLOTATION OF SILVER-LEAD-ZINC ORE
FROM JORDAN RIVER MINES PROPERTY
FOR BRALORNE PIONEER MINES LIMITED,
VANCOUVER, B.C.**

by

GILLES MATHIEU

MINERAL PROCESSING DIVISION

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MAY 9, 1961

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Gilles Mathieu *

SUMMARY OF RESULTS

The main ore constituents were lead and silver in the West Zone sample, and lead, zinc, silver in the Cliff Zone sample.

A lead concentrate, assaying 64.5% Pb, with a recovery of 80.2% was floated from the West Zone ore. This concentrate contained 76.8% of the silver in the ore.

Selective flotation tests on the Cliff Zone sample produced lead and zinc concentrates as follows:

<u>Product</u>	<u>Grade</u>	<u>Recovery</u>
Lead concentrate	38.98 - 48.90% Pb	57.9 - 66.4% Pb
Zinc concentrate	37.13 - 50.38% Zn	57.6 - 72.5% Zn

The total silver recovered in both lead and zinc concentrates was between 59.5% and 72.2%.

Bulk flotation of the Cliff Zone ore, recovered 84.5% of the lead and 76.6% of the zinc.

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INTRODUCTION

Shipment and Instruction

A shipment of two lots of silver-lead-zinc ore was received on October 28, 1960. The West Zone lot, weighing 85 pounds, was marked "Sample No. 1" and the Cliff Zone lot, weighing 65 pounds, was marked "Sample No. 2". It was submitted by Mr. J. E. McMynn, General Manager, Bralorne Pioneer Mines Limited, 355 Burrard St., Vancouver 1, B. C.

Mr. McMynn wished to know the recovery and grade of concentrate that might be expected at grinds of 70% -200 M and 90% -200 M on both types of ore. He also asked that one-half of each sample be retained for leaching tests by Prof. Frank Forward, Head, Department of Mining and Metallurgy, University of British Columbia. On a visit to the Mines Branch, Prof. Forward suggested that differential flotation tests should be carried out on the Cliff Zone sample.

Location of Property

The property from which this material originated was the Jordan River Mines formerly owned by Consolidated Standard Mines Ltd. The mine is located 20 miles north west of Revelstoke, Revelstoke mining division, B. C.

Sampling and Analysis

The two samples were each crushed to -1 inch and cut into two parts. Half of each sample was set aside to await instructions regarding leaching tests. From the second half of each sample

approximate 1/2 pound samples were riffled out for microscopic examination. The remainder was crushed to -20 M and head samples were cut out by conventional methods for analysis.

The chemical analysis gave the following results:

	West Zone	Cliff Zone
Gold (Au)	Trace	Trace
*Silver (Ag)	2.81 oz/ton	0.92 oz/ton
Lead (Pb)	14.35%	4.50%
Zinc (Zn)	1.07%	5.42%
Iron (Fe)	5.45%	11.27%
Sulphur (S)	15.74%	10.68%
Copper (Cu)	0.07%	0.02%

*The silver assay was an average calculated from test results.

A spectrographic analysis on a portion of the head sample indicated the elements present in the following approximate order of decreasing abundance:

West Zone (Sample No. 1)

- I Pb, Ba, Si, Fe.
- II Ca, Zn, Sr.
- III Al, Mg, Mn, Cu, Cd.
- IV Ag, Ni, Ti, V.

Cliff Zone (Sample No. 2)

- I Fe, Si, Zn, Pb.
- II Al, Ca, Mg.
- III Ba, Cd, Mn, Cu, Ti.
- IV Ni, Cr, Ag, V.

MINERALOGICAL EXAMINATION*

A portion of each head sample, crushed to minus one inch, was submitted to the Mineralogical Section of the Mineral Sciences Division for microscopic examination.

Results of Examination

The six polished sections were examined microscopically and in some instances mineral identifications were confirmed by X-ray diffraction analyses. Brief descriptions of the two samples follow.

Sample No. 1 (West Zone)

Sample No. 1 consists essentially of coarse to fine sulphides abundantly disseminated in a quartz-carbonate gangue. In places the gangue consists of rounded quartz grains cemented with interstitial carbonate strongly suggesting that it may represent sandstone.

The most abundant sulphide is pyrite which occurs as irregular to somewhat rounded grains, though poorly-developed pyritohedral crystals are sometimes present. The size range is wide, but the coarser sizes predominate. Much of the pyrite has been intricately fractured, and some of these openings have been invaded and partially filled by galena and sphalerite (see Figure 1).

Galena occurs most commonly as medium to very fine irregular grains in the gangue (see Figure 2). It is frequently

* From Internal Report MS 61-31 by M. H. Haycock, April 5, 1961.

associated with sphalerite, pyrite and gangue (see Figures 3 and 4). Where in contact with pyrite, it usually occurs around the borders of the grains or along the fine fractures previously mentioned. In some instances galena contains very fine inclusions of sphalerite, and this sphalerite exhibits dark red internal reflections in contrast to the bulk of the sphalerite, which is very light in colour. The significance of the dark sphalerite is doubtful however, since the relative quantity is very small and hence would contribute only a small amount of iron. Part of the galena, the proportion of which is impossible to estimate accurately, occurs as larger irregular grains and masses up to several millimetres in cross section, but the smaller sizes greatly predominate.

Sphalerite is scattered through the gangue in the form of medium to fine irregular grains which are frequently associated with, and in some instances enclosed within, galena (see Figures 1 and 3). Occasionally it occurs as comparatively large masses up to several millimetres in size. The sphalerite in this sample appears to be medium red in colour, which indicates that its iron content is probably moderate.

Chalcopyrite is present in only a negligible quantity. It occurs as very rare tiny grains in a small percentage of the sphalerite, which in general is quite free from chalcopyrite inclusions.

Sample No. 2(Cliff Zone)

Sample No. 2 is somewhat different from Sample No. 1. The sulphides occur in gangue consisting essentially of white quartz, which is stained yellow by iron oxides.

Pyrite, the predominating sulphide, occurs as coarse-textured masses and irregular grains ranging from very coarse to very fine sizes. In some specimens well-formed crystals are prominent, but in this sample they are cubes, not pyritohedrons as in Sample No. 1 (see Figures 5 and 6). The significance of this difference in crystal form is not known. Other specimens contain pyrite which shows alteration along fractures; this alteration has resulted in the formation of marcasite and, in some instances, iron oxides (see Figure 7). The alteration to marcasite is quite striking and is shown in Figure 1.

Sphalerite occurs as coarse masses and irregular grains. It is not as intimately associated with galena as is the case in Sample No. 1, and its colour is markedly lighter, indicating that its iron content is lower. Some of the sphalerite masses contain much finely-divided pyrite which may be difficult to separate mechanically, and in practice this iron may be expected to report with the zinc (see Figure 8).

Galena is comparatively sparse and occurs as medium to small grains. The quantity is considerably less than in specimens from Sample No. 1. Frequently grains of galena occur adjacent to or within sphalerite.

Magnetite is a very minor constituent, occurring as small masses and grains in the gangue.

Chalcopyrite is extremely rare in Sample No. 2, and was observed as very tiny grains within sphalerite and, more rarely, within pyrite.

Conclusion

Although some differences in the character of the two samples were observed, a number of features are common to both. First, appreciable proportions of both the galena and sphalerite occur as very finely disseminated grains which are frequently mutually associated. Much of the pyrite, on the other hand, appears to be comparatively free from intimate association with the sphalerite and galena. However, a comparatively small proportion may prove difficult to separate satisfactorily.

Sample No. 1 shows no evidence of surface alteration. On the other hand, Sample No. 2 shows widespread evidence of such alteration, with the development of oxides along fractures and of yellow stains throughout the quartz gangue. The development of marcasite is no doubt a result also of surface alteration.

The quantity of chalcopyrite in both samples is so small that for practical purposes it may be neglected.

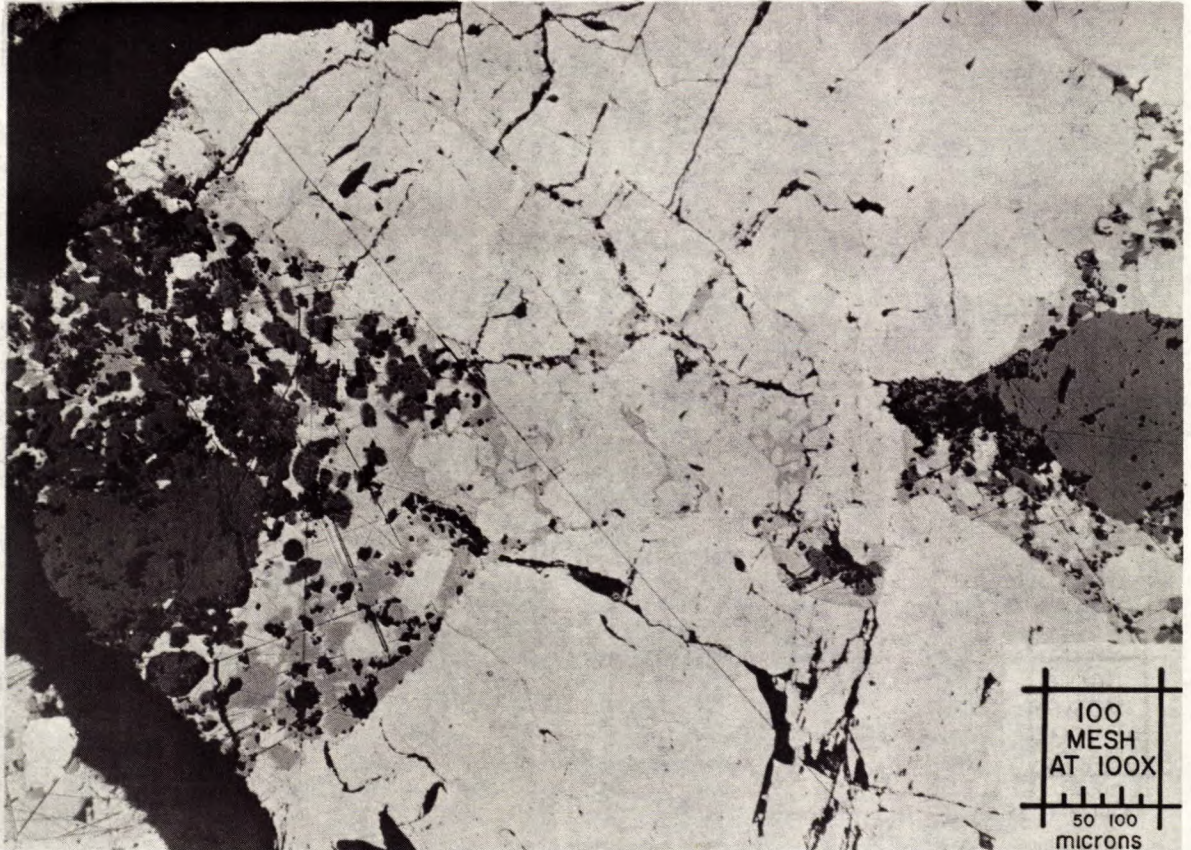


Figure 1. Photomicrograph of Sample No. 1 showing coarse fractured pyrite (white) with penetrating veinlets containing galena (light grey with scratches) and sphalerite (medium grey). Gangue is dark grey, pits are black. Magnification 100X.

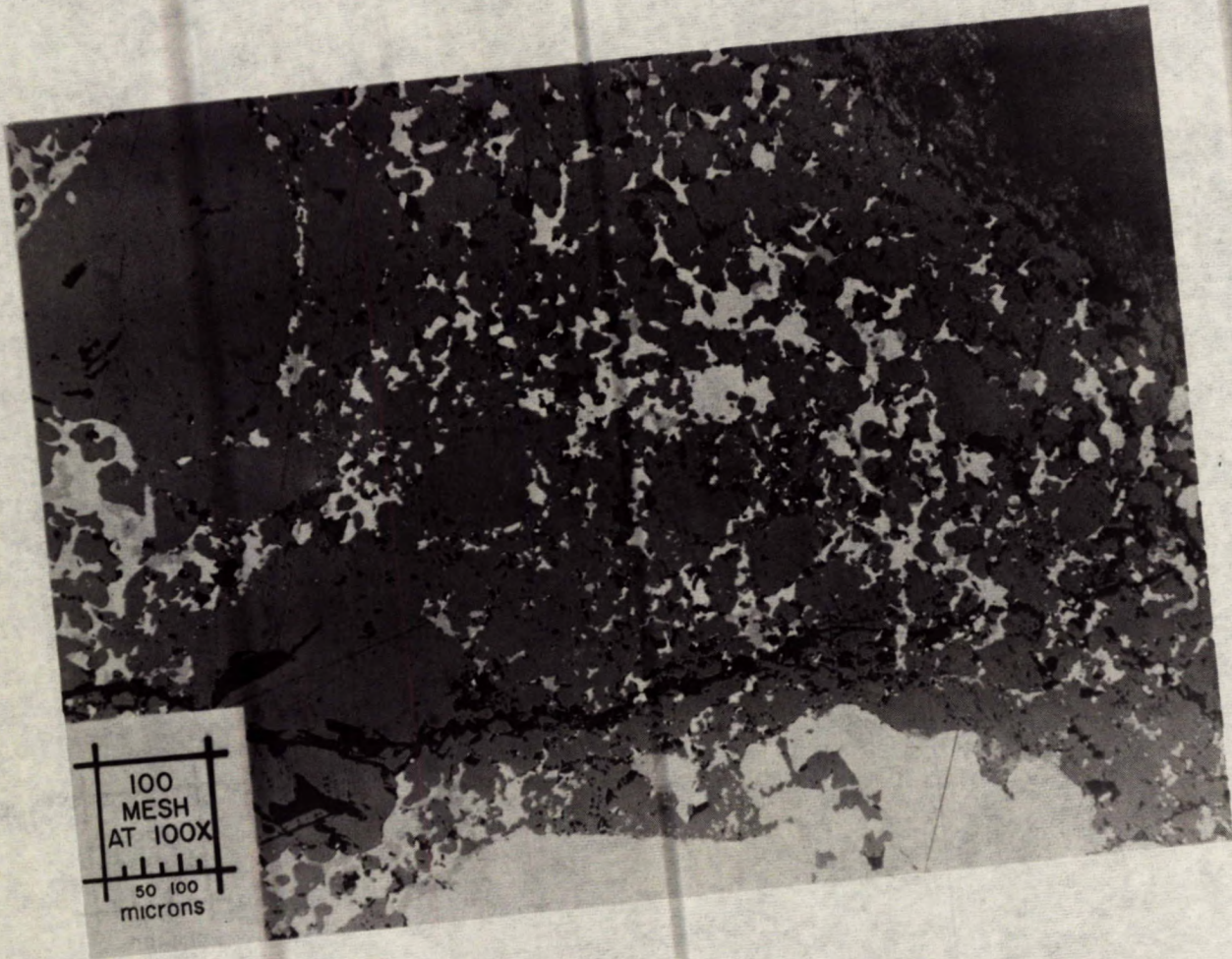


Figure 2. Photomicrograph of Sample No. 1, showing numerous small irregular grains of galena (light grey) in gangue (dark grey). The large white area at the bottom is pyrite; pits are black. Magnification 100X.

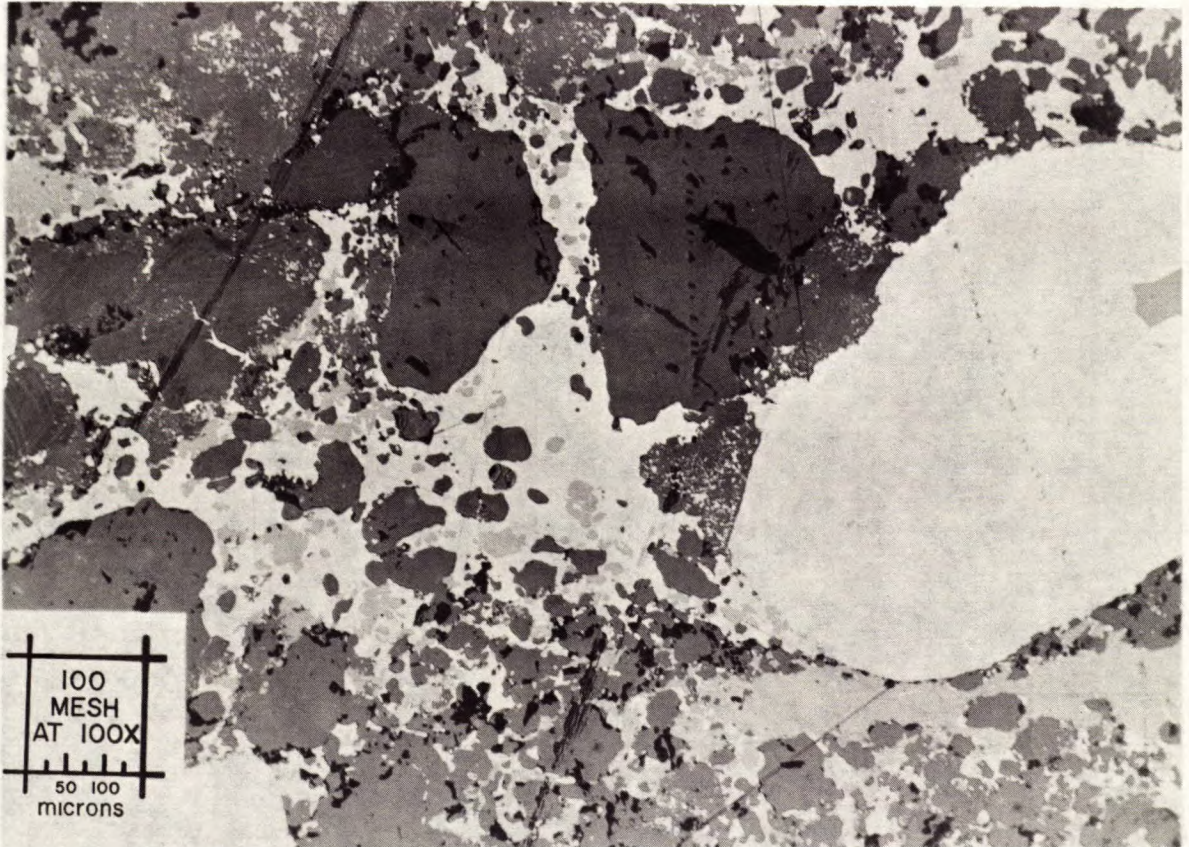


Figure 3. Photomicrograph of Sample No. 1. Pyrite (white), galena (light grey), sphalerite (medium grey). Gangue is dark grey and pits are black. This area shows the intimate admixture of the sphalerite and galena, and the numerous gangue inclusions. Several inclusions of quartz are well shown, as is a fairly large inclusion of galena in pyrite. Magnification 100X.



Figure 4. Photomicrograph of Sample No. 1 showing an assemblage similar to that shown in Figure 3. Magnification 100X.

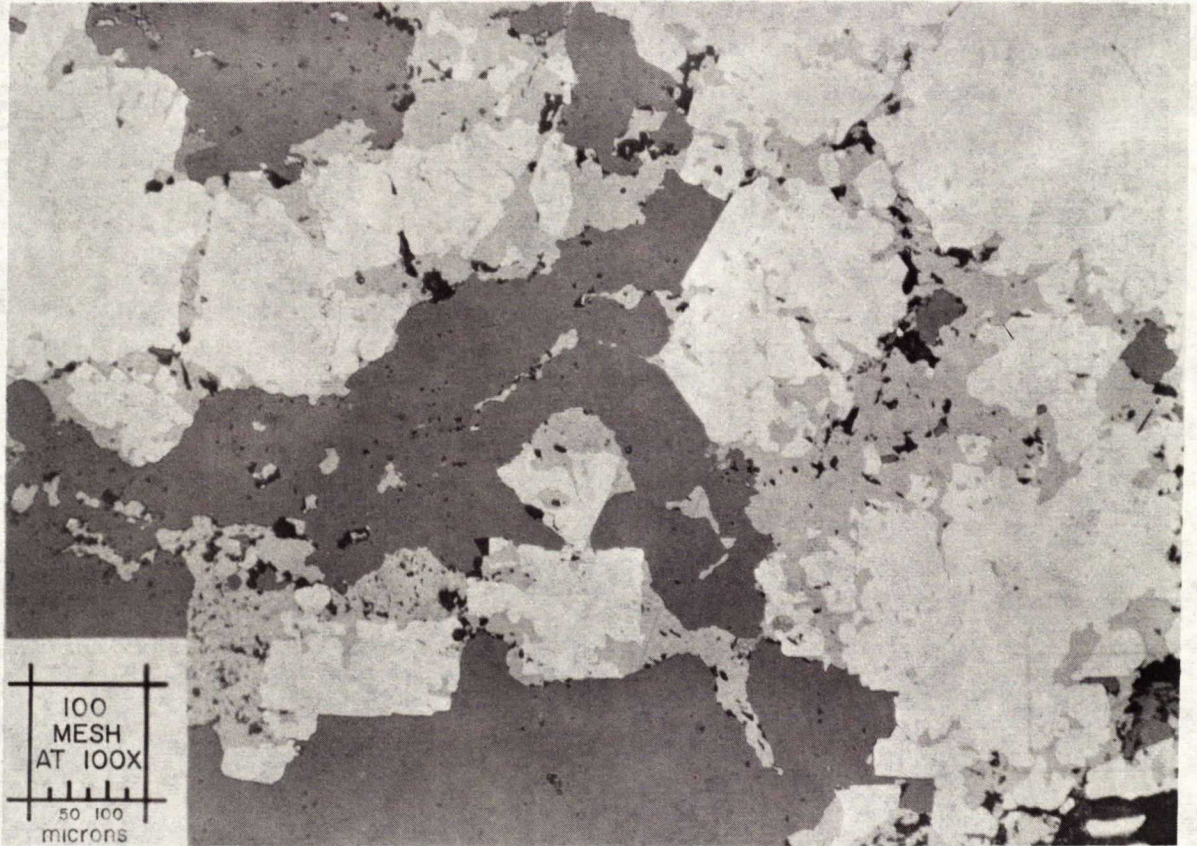


Figure 5. Photomicrograph of Sample No. 2 showing coarse pyrite (white) invaded by sphalerite (medium grey). Quartz gangue is dark grey, pits are black. Note several well-formed cubic sections. Magnification 110X.

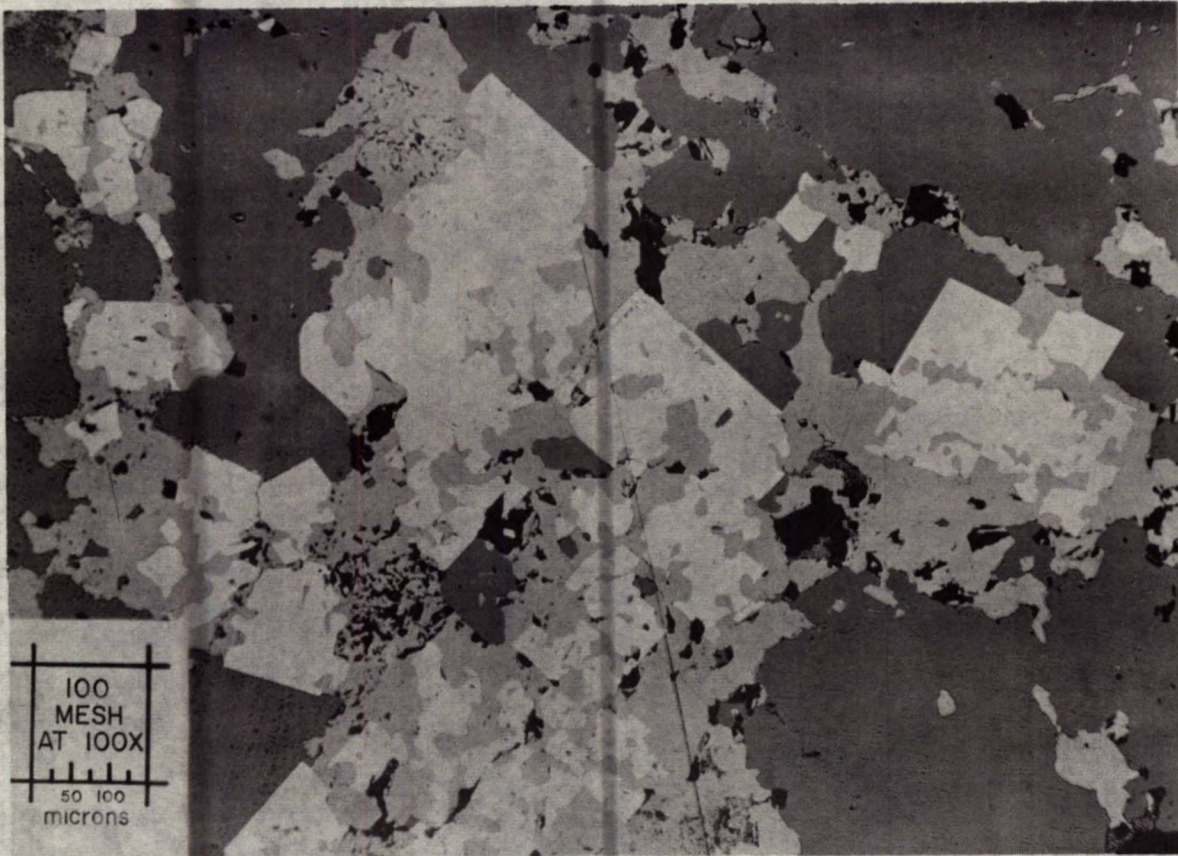


Figure 6. Photomicrograph of Sample No. 2. Pyrite and sphalerite in much the same relationship as those shown in Figure 5. The well-marked cubic sections show even more fragmentation and inclusion of the pyrite in sphalerite, which has apparently invaded and partially replaced pyrite cubes. Magnification 100X.

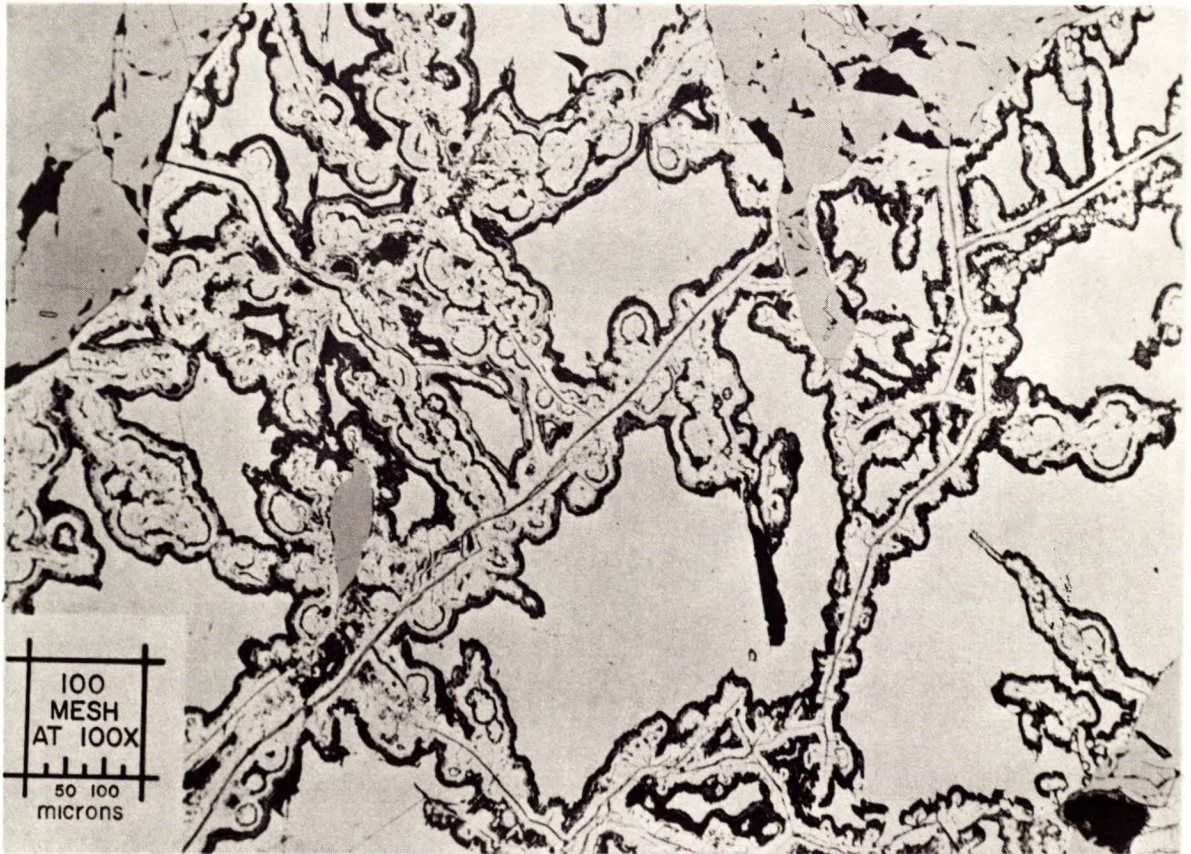


Figure 7. Photomicrograph of Sample No. 2 showing pyrite (white) altered to marcasite along tiny fractures. Sphalerite (medium grey). Pits are black. Magnification 100X.

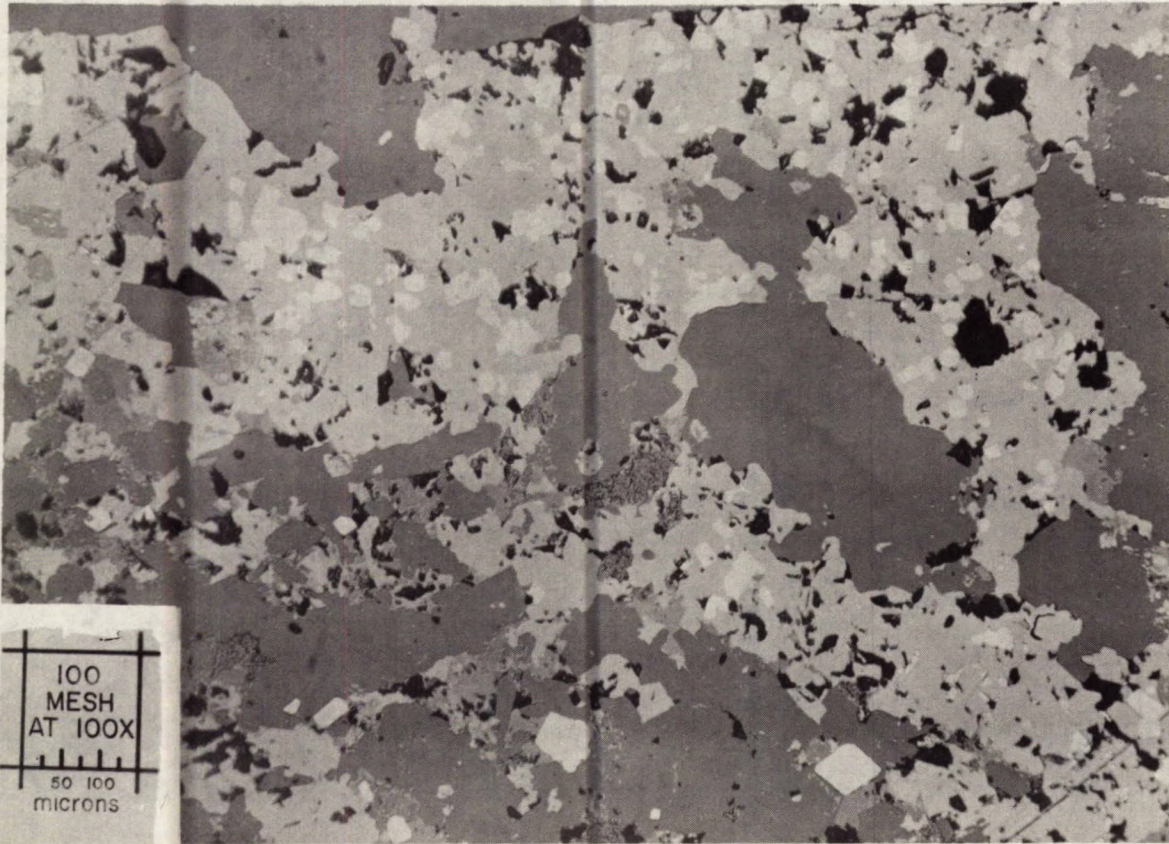


Figure 8. Photomicrograph of Sample No. 2. Sphalerite (medium grey) in quartz (dark grey) gangue. The sphalerite contains numerous small grains of pyrite (white). Pits are black. Magnification 100X.

DETAILS OF INVESTIGATION

Test No. 1 (Sample No. 1)

A 1000 g sample of ore was ground for 6 minutes to 68.1% finer than 200 M and transferred to a flotation cell.

Reagents and Conditions

Operation	Reagents: lb/ton	Time: min	pH
Grinding		6	
Pb conditioning	CaO 0.60 ZnSO ₄ 0.60 NaCN ⁴ 0.20 Aerofloat 31 0.12 Cresylic acid 0.02	5	9.0
Pb rougher flotation		12	
Pb cleaner flotation	ZnSO ₄ 0.04 NaCN ⁴ 0.02 Cresylic acid 0.01	8	

Results of Test No. 1

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb cleaner concentrate	17.7	58.89	1.63	10.78	74.6	25.1	68.4
Pb cleaner tailing	6.0	19.66	1.66	3.73	8.4	8.6	8.0
Flotation tailing	76.3	3.11	1.00	0.86	17.0	66.3	23.6
Head (calcd)	100.0	13.97	1.15	2.79	100.0	100.0	100.0

Test No. 2 (Sample No. 1)

The procedure was the same as for Test No. 1, except that the 1000 g sample was ground for 15 minutes to 91.4% -200 M.

Results of Test No. 2

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb cleaner concentrate	18.8	61.66	1.60	11.32	84.1	25.5	75.4
Pb cleaner tailing	6.4	13.68	1.76	2.74	6.4	9.6	6.3
Flotation tailing	74.8	1.76	1.02	0.69	9.5	64.9	18.3
Head (calcd)	100.0	13.78	1.18	2.82	100.0	100.0	100.0

Test No. 3 (Sample No. 1)

A 1000 g sample was ground for 15 minutes to 91.4% -200 M and transferred to a flotation cell.

Reagents and Conditions

Operation	Reagents: lb/ton	Time: min	pH
Grinding		15	
Pb conditioning	CaO 0.60 ZnSO ₄ 0.60 NaCN ⁴ 0.20 Aerofloat 31 0.12 Cresylic acid 0.02	5	8.9
Pb rougher flotation	Aerofloat 31 0.06 (after 6 min)	12	
Pb cleaner flotation	ZnSO ₄ 0.04 NaCN ⁴ 0.02 Cresylic acid 0.01	8	
Pb recleaner flotation	NaCN 0.02 Cresylic acid 0.01	5	

This test was similar to Test No. 2 except that a second cleaning stage was added to improve the grade of the lead concentrate.

Results of Test No. 3

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	18.6	64.52	1.96	11.72	80.2	31.3	76.8
Pb cleaner tailing	4.6	23.73	2.05	4.42	7.3	8.1	7.2
Pb recleaner tailing	7.5	11.52	1.64	2.16	5.8	10.5	5.7
Flotation tailing	69.3	1.45	0.84	0.42	6.7	50.1	10.3
Head (calcd)	100.0	14.94	1.16	2.83	100.0	100.0	100.0

Test No. 4 (Sample No. 1)

This test was similar to Test No. 3, except that Aerofloat 242 was used instead of Aerofloat 31.

Results of Test No. 4

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	19.0	60.89	1.78	11.37	81.0	27.3	76.5
Pb cleaner tailing	3.8	20.25	2.17	3.98	5.3	6.6	5.3
Pb recleaner tailing	8.9	11.34	1.82	2.18	7.1	13.1	6.6
Flotation tailing	68.3	1.37	0.96	0.48	6.6	53.0	11.6
Head (calcd)	100.0	14.26	1.24	2.82	100.0	100.0	100.0

Test No. 5 (Sample No. 1)

A 1000 g sample was ground for 15 minutes to 91.4% -200 M.

Reagents and Conditions

Operation	Reagents: lb/ton	Time: Min	pH
Grinding	CaO 0.40	15	
	ZnSO ₄ 0.80		
	NaCN ⁴ 0.40		
	Aerofloat 31 0.06		
Pb conditioning	Aero Promoter 404 0.04	2	8.8
	Aerofloat 31 0.06		
	Cresylic acid 0.02		
Pb rougher flotation		12	
Pb cleaner flotation	ZnSO ₄ 0.10	8	
	NaCN ⁴ 0.04		
	Cresylic acid 0.02		
Pb recleaner flotation	NaCN 0.01	5	
	Cresylic acid 0.01		

In this test some of the conditioning reagents were added to grinding and the Pb conditioning time after grinding was reduced.

Results of Test No. 5

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	18.7	60.62	1.77	11.01	78.0	32.5	73.5
Pb recleaner tailing	4.6	28.47	2.30	5.32	9.1	9.9	8.8
Pb cleaner tailing	6.5	15.57	2.02	3.12	6.9	12.0	7.2
Flotation tailing	70.2	1.24	0.70	0.42	6.0	45.6	10.5
Head (calcd)	100.0	14.53	1.08	2.80	100.0	100.0	100.0

The lower lead recovery in this test was attributed to a less effective cleaner and recleaner operation. The iron assayed 6.11% in the lead recleaner concentrate.

Remarks

In Test Nos. 1 to 5, which were carried out on the West Zone ore, several attempts were made to float a zinc concentrate from the lead flotation tailing. However, in each case, the amount of zinc concentrate produced was small and microscopic examination indicated that it was low grade.

Test No. 6 (Sample No. 2)

A 1000 g sample of ore was ground for 20 minutes to 70.2% -200 M and the pulp was transferred to a flotation cell.

Reagents and Conditions

Operation	Reagents: lb/ton	Time:min	pH
Grinding		20	
Pb conditioning	CaO 0.60 ZnSO ₄ 0.60 NaCN ⁴ 0.20 Aerofloat 31 0.12 Cresylic acid 0.02		5.4
Pb rougher flotation		5	
Pb cleaner flotation	Cresylic acid 0.02	5	
Zn conditioning	CaO 3.00 CuSO ₄ 1.50 Sodium Aero- float 0.08 Cresylic acid 0.06		9.5
Zn rougher flotation		10	
Zn cleaner flotation	Cresylic acid 0.01	8	

Results of Test No. 6

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb cleaner conc	6.5	42.00	12.64	8.43	62.3	14.9	60.9
Pb cleaner tailing	4.2	8.75	14.20	1.94	8.4	10.8	9.1
Zn cleaner conc	7.9	4.59	41.81	1.30	8.2	59.1	11.3
Zn cleaner tailing	3.0	3.46	3.43	0.92	2.4	1.9	3.1
Flotation tailing	78.4	1.05	0.94	0.18	18.7	13.3	15.6
Head (calcd)	100.0	4.39	5.54	0.90	100.0	100.0	100.0

Test No. 7 (Sample No. 2)

This test was similar to Test No. 6, except the 1000 g sample was ground 40 minutes to 92.1% -200 M.

Results of Test No. 7

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb cleaner conc	6.0	42.95	15.60	8.96	60.3	17.1	58.5
Pb cleaner tailing	5.1	13.90	15.96	2.72	16.4	14.8	15.0
Zn conc	8.5	3.42	37.13	1.07	6.9	58.3	10.0
Zn cleaner tailing	6.1	1.70	1.82	0.47	2.4	2.0	3.1
Flotation tailing	74.3	0.80	0.57	0.16	14.0	7.8	13.4
Head (calcd)	100.0	4.26	5.44	0.91	100.0	100.0	100.0

Test No. 8 (Sample No. 2)

In this test, 1000 g of ore was ground for 20 minutes to 70.2% -200 M. Both the lead and the zinc concentrates were cleaned twice. The lead cleaner tailing was fed to the head of the zinc circuit to limit the amount of zinc lost during lead flotation.

Reagents and Conditions

Operation	Reagents: lb/ton	Time:min	pH
Grinding		20	
Pb conditioning	CaO 1.00 ZnSO ₄ 1.00 NaCN ⁴ 0.40 Aerofloat 31 0.06 Cresylic acid 0.02	5	6.5
Pb rougher flotation		5	
Pb cleaner flotation	ZnSO ₄ 0.10 NaCN ⁴ 0.04 Cresylic acid 0.01	5	
Pb recleaner flotn	Cresylic acid 0.01	5	
Zn conditioning	CaO 2.40 CuSO ₄ 2.00 Sodium Aero- float 0.10 Cresylic acid 0.04	10	9.6
Zn rougher flotation		10	
Zn cleaner flotation	Cresylic acid 0.01	5	
Zn recleaner flotn	Cresylic acid 0.01	5	

Results of Test No. 8

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	6.4	38.98	3.33	7.78	61.8	4.1	58.4
Pb recleaner tailing	2.2	18.59	13.73	3.72	10.2	5.8	9.7
Zn recleaner conc	8.6	4.43	43.68	1.20	9.5	72.5	12.3
Zn recleaner tailing	2.0	4.30	12.17	1.75	2.1	4.5	4.0
Zn cleaner tailing	3.5	2.35	3.68	0.68	2.1	2.6	2.8
Flotation tailing	77.3	0.74	0.71	0.14	14.3	10.5	12.8
Head (calcd)	100.0	4.01	5.21	0.85	100.0	100.0	100.0

Test No. 9 (Sample No. 2)

This test was similar to Test No. 8, except that the ore was ground 40 minutes to 90% -200 M.

Results of Test No. 9

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	7.1	39.74	13.00	8.08	66.4	16.9	63.9
Pb recleaner tailing	1.6	4.58	11.13	1.22	1.7	3.3	2.2
Zn recleaner conc	6.9	2.05	46.18	0.82	3.3	57.7	6.2
Zn recleaner tailing	4.0	10.50	16.12	2.72	9.8	11.6	12.0
Zn cleaner tailing	5.2	2.95	3.61	0.70	3.6	3.4	4.0
Flotation tailing	75.2	0.86	0.52	0.14	15.2	7.1	11.7
Head (calcd)	100.0	4.27	5.50	0.90	100.0	100.0	100.0

Pb recleaner conc: Fe = 14.36%

Zn recleaner conc: Fe = 15.93%

Test No. 10 (Sample No. 2)

This test was similar to Test No. 9, except Aerofloat 242 was used instead of Aerofloat 31.

Results of Test No. 10

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	5.8	47.35	11.96	9.20	60.4	12.4	56.0
Pb recleaner tailing	2.8	16.68	16.12	3.38	10.5	8.3	10.2
Zn recleaner conc	7.5	3.47	44.72	1.16	5.7	60.2	9.1
Zn recleaner tailing	2.2	6.29	13.52	1.55	3.1	5.3	3.6
Zn cleaner tailing	6.3	3.60	3.38	0.86	5.1	3.9	6.0
Flotation tailing	75.4	0.91	0.73	0.19	15.2	9.9	15.1
Head (calcd)	100.0	4.51	5.55	0.95	100.0	100.0	100.0

Aerofloat 242 was more effective on this ore than Aerofloat 31.

Test No. 11 (Sample No. 2)

This test is a repetition of Test No. 10, except that the ore was ground 20 minutes to 70% -200M.

Results of Test No. 11

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	6.0	40.45	8.72	8.24	58.6	9.7	49.6
Pb recleaner tailing	1.4	19.43	11.18	4.08	6.5	2.9	5.6
Zn recleaner conc	6.5	0.73	48.02	1.59	1.1	58.5	10.4
Zn recleaner tailing	2.5	10.88	23.85	2.38	6.5	11.1	5.9
Zn cleaner tailing	3.2	7.55	5.64	1.88	5.8	3.3	6.0
Flotation tailing	80.4	1.11	0.97	0.28	21.5	14.5	22.5
Head (calcd)	100.0	4.16	5.38	1.00	100.0	100.0	100.0

Test No. 12 (Sample No. 2)

A 1000 g sample of ore was ground for 20 minutes to 70.2% finer than 200 M and the pulp was transferred to a flotation cell. In this test, sodium carbonate was used instead of lime in the lead circuit, and Aerofloat 211 was added to float the sphalerite.

Reagents and Conditions

Operation	Reagents:	lb/ton	Time: min	pH
Grinding	Na ₂ CO ₃	3.00	20	
	ZnSO ₄	1.50		
	NaCN ⁴	0.50		
Pb conditioning	Aerofloat 242	0.06	3	6.6
	Cresylic acid	0.04		
Pb rougher flotn	Aerofloat 242	0.06	5	
Pb cleaner flotn	ZnSO ₄	0.10	5	
	NaCN ⁴	0.04		
	Cresylic acid	0.02		
	NaCN	0.02		
Pb recleaner flotn	Cresylic acid	0.01		
	NaCN	0.02		
	Cresylic acid	0.01		
Zn conditioning	CaO	2.40	10	9.9
	CuSO ₄	2.00		
	Sodium Aerofloat	0.10		
	Cresylic acid	0.04		
	Aerofloat 211	0.04		
Zn rougher flotn			10	
Zn cleaner flotn	Cresylic acid	0.01	5	
Zn recleaner flotn	Cresylic acid	0.01	5	

Results of Test No. 12

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	4.7	48.89	7.58	9.71	57.9	6.3	52.0
Pb recleaner tailing	2.9	11.36	11.93	3.02	8.4	6.1	10.1
Zn recleaner conc	6.8	3.90	50.38	1.14	6.8	61.1	9.0
Zn recleaner tailing	1.5	10.37	24.99	2.43	4.1	6.9	4.3
Zn cleaner tailing	9.3	4.19	7.94	1.50	9.9	13.0	16.0
Flotation tailing	74.8	0.68	0.50	0.10	12.9	6.6	8.6
Head (calcd)	100.0	3.93	5.65	0.87	100.0	100.0	100.0

Test No. 13 (Sample No. 2)

This test was similar to Test No. 12, except the grinding time was 40 minutes (90% -200 M).

Results of Test No. 13

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Pb recleaner conc	5.0	48.90	10.26	9.73	58.1	9.3	50.5
Pb recleaner tailing	2.0	22.03	12.62	4.52	10.6	4.7	9.5
Zn recleaner conc	6.6	2.02	48.63	1.33	3.1	58.0	9.0
Zn recleaner tailing	2.2	9.37	21.85	2.18	4.9	8.7	5.0
Zn cleaner tailing	6.2	5.02	7.39	1.40	7.5	8.4	9.0
Flotation tailing	78.0	0.85	0.77	0.21	15.8	10.9	17.0
Head (calcd)	100.0	4.21	5.50	0.96	100.0	100.0	100.0

Test No. 14 (Sample 2)

A 1000 g sample of ore was ground for 40 minutes to 92.1%
-200 M and a bulk concentrate was floated as follows:

Reagents and Conditions

Operation	Reagents:	lb/ton	Time:min	pH
Grinding			40	
Conditioning	CaO	3.00	10	7.0
	CuSO ₄	2.00		
	Aerofloat 31	0.12		
	Cresylic acid	0.02		
Bulk flotation	Aerofloat 31		15	
	(after 10 min)	0.06		
Cleaner flotation	Cresylic acid	0.01	8	

Results of Test No. 14

Product	Wt %	Assays			Distribution		
		%		oz/ton	%		
		Pb	Zn	Ag	Pb	Zn	Ag
Bulk concentrate	22.5	16.66	19.25	3.53	84.5	76.6	85.9
Bulk cleaner tailing	8.6	2.56	4.10	0.55	4.9	6.3	5.2
Flotation tailing	68.9	0.69	1.40	0.12	10.6	17.1	8.9
Head (calcd)	100.0	4.49	5.64	0.92	100.0	100.0	100.0

CONCLUSIONS

The West Zone sample was a high grade lead ore with a relatively low zinc and silver content. As indicated in the mineralogical report, galena occurred most commonly as medium to very fine grains, closely associated with sphalerite and pyrite (Figures 1 and 3) and finely disseminated in gangue (Figure 2). Fine grinding to at least 90% -200 M is required to liberate the lead mineral. At this fineness of grind, a lead recleaner concentrate was produced assaying 64.5% Pb with a recovery of 80.2% Pb. Although the ore contained less than 3 oz Ag/ton, 76.8% of the silver was recovered with the lead, adding to the value of this concentrate (Test No. 3). In plant flotation, recirculation of the middling products should increase the overall recovery to approximately 90%. Attempts to produce a commercial grade of zinc concentrate from the lead flotation tailing were unsuccessful.

The Cliff Zone sample contained 4.5% Pb and 5.4% Zn and a small quantity of silver. The zinc mineral is not as intimately associated with galena as it was in the West Zone sample but some of the sphalerite contained much finely-divided pyrite (Figure 8), which reported in the zinc concentrate.

The highest grades of concentrates obtained in selective flotation tests on this sample were a lead concentrate assaying 48.9% Pb with a 57.9% recovery and a zinc concentrate assaying 50.4% Zn with a recovery of 61.1% (Test No. 12). The poor results obtained on tests on this ore were due, in a large part, to the degree of oxidation that this sample had undergone (Figure 7). It is quite possible that fresh ore taken from a greater depth of the mine would not be so altered, in which case much of the difficulty experienced in producing high grade lead and zinc concentrates from this ore would be overcome.

The results of a bulk flotation test on the Cliff Zone sample were not encouraging due to the large amount of pyrite contained in the ore which floated in the bulk concentrate.