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DEPARTMENT OF ENERGY, MINES AND RESOURCES

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MINES BRANCH INVESTIGATION REPORT IR 70-52

THE DEVELOPMENT OF A TREATMENT SCHEME FOR A COMPLEX BASE METAL ORE FROM PRAIRIE CREEK, NORTHWEST TERRITORIES

by

W. ARTHUR WALL AND R. W. BRUCE

MINERAL PROCESSING DIVISION

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OCTOBER 1970

01-7988786

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Mines Branch Investigation Report IR 70-52

THE RECOVERY OF SILVER, COPPER, LEAD AND ZINC
FROM SAMPLES OF ORE SUBMITTED BY CADILLAC
EXPLORATION LIMITED, (N.P.L.) PRAIRIE CREEK,
NORTHWEST TERRITORIES

by

W. Arthur Wall* and R. W. Bruce**

- - -

SUMMARY OF RESULTS

The sulphide ore sample was successfully concentrated by standard flotation methods as illustrated by the results of Test 43 which follow:

Product	Assays				Distribution %			
	Ag oz/ton	Cu %	Pb %/	Zn %	Ag	Cu	Pb	Zn
Cu conc	220.46	27.90	8.30	12.20	44.8	55.8	1.1	0.8
Pb conc	19.83	-	67.00	9.36	38.8	-	82.4	6.0
Zn conc	2.80	-	4.01	58.19	12.5	-	11.2	86.3
Cl tail	3.34	-	5.60	20.60	2.9	-	3.0	5.9
Ro tail	0.385	-	1.35	1.08	1.0	-	2.3	1.0
Feed (calcd)	9.83	1.00 ⁽¹⁾	15.62	29.60	100.0	-	100.0	100.0

(1) Assay.

The carbonate ores represented by Samples No. 1 and 2, can be floated and satisfactory lead concentrates produced. The zinc can be floated but the production of a satisfactory grade of zinc concentrate was

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not achieved. If the rougher lead concentrate and rougher zinc concentrate are combined, a low grade silver, lead and zinc concentrate is obtained with satisfactory recoveries. The following table shows the assays and recoveries of the cleaned lead concentrate, the cleaned zinc concentrate and the calculated bulk concentrate of two tests.

	Test 17 ⁽¹⁾			Test 48 ⁽²⁾		
	Weight %	Assay	Dist. %	Weight%	Assay	Dist%
Lead conc	25.4			38.6		
Ag oz/ton		19.31	74.1		-	-
Pb %		68.61	79.3		50.72	89.9
Zn %		1.02	15.0		11.41	23.5
Zinc conc	5.5			30.3		
Ag oz/ton		7.56	6.3		-	-
Pb %		18.77	4.7		2.31	3.2
Zn %		10.77	34.4		32.25	52.3
Ro bulk conc (calcd)	57.2			74.1		
Ag oz/ton		11.08	95.7		-	-
Pb %		37.66	98.0		28.92	98.4
Zn %		2.53	83.9		20.62	81.7

(1) Composite Sample No. 1, Lead and Zinc Concentrates cleaned once.

(2) Composite Sample No. 2, Lead and Zinc Concentrates not cleaned.

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INTRODUCTION

Location of Property

The property of Cadillac Explorations Limited (N.P.L.) is located on Prairie Creek in the Northwest Territories, one hundred and ten miles due west of Fort Simpson. The property consists of approximately 10,000 acres.

Shipments

A shipment of thirty bags of ore, each weighing approximately one hundred pounds, was received January 20, 1969. These samples had been crushed to approximately one half inch and were representative of the carbonate ore in the deposit.

On November 4, 1969, a sample of sulphide ore weighing 215 pounds was received.

Purpose of Investigation

Cadillac Exploration Limited requested an investigation to determine the amenability of the carbonate ore to flotation concentration. Upon receipt of the sulphide sample, the company requested a preliminary investigation be carried out on this sample. An intensive investigation was not warranted because this sulphide sample came from one development heading.

Sampling and Analysis

The thirty carbonate samples were composited according to instructions received from the mining company as outlined below:

Our Sample No.	Components
1.	Samples No. 14047, 14049, 14052, 14053, and 14057 all from No. 3 Vein, No. 3 Zone.
2.	Samples No. 14032, 14033, and 14034 all from Zone 8, Trench E, footage 0' -17'.
3.	Samples No. 14048, and 14050, from No. 2 Vein, No. 3 Zone, No. 3 X-cut.
4.	Samples No. 14043 to 14046 all from Zone 7, Trench 1-4.

Our Sample No.	Components (Cont'd)
5.	Samples No. 14029 to 14031 from Zone 8, Trench D, footage 0'-20'.
6.	Samples No. 14036 to 14038 from Zone 8, Trench F, footage 0'-13'.
7.	Samples No. 14039 to 14042, from Zone 8, Trench G, H, I and J.
8.	Samples No. 14026 to 14028 from Zone 8, Trenches A, B, C, and D.

Each of the composite samples Nos. 1 to 8 was crushed and sampled by conventional methods. Representative portions of Sample No. 1 were split out for microscopic examination, chemical analysis, and semi-quantitative spectrographic analysis. The representative portions of the seven other composite samples were submitted for chemical analysis. Each of the thirty samples received from Cadillac Exploration Ltd. had been sampled and assayed. Using their assay results, the assays of the eight composite samples were calculated. These calculated assays have been tabulated in Table 1, beside the actual assays for comparative purposes.

TABLE 1
Chemical Analyses* of Composite Samples

Sample No.	1		2		3		4	
	Head		Head		Head		Head	
Metal	Assay	Calc.	Assay	Calc.	Assay	Calc.	Assay	Calc.
Silver oz/ton	6.07	7.25	14.19	13.63	2.36	2.67	13.11	11.64
Lead % (total)	20.00	24.25	21.91	22.75	6.00	6.93	14.75	14.41
N.S. Lead % **	5.00	-	19.97	-	3.07	-	10.55	-
Zinc % (total)	1.72	1.79	18.35	18.87	2.96	3.24	4.45	4.56
N.S. Zinc %	1.52	-	18.26	-	2.85	-	4.34	-
Copper %	0.19	0.24	0.77	0.68	0.07	0.07	1.16	0.78

Sample No.	5		6		7		8	
	Head		Head		Head		Head	
Metal	Assay	Calc.	Assay	Calc.	Assay	Calc.	Assay	Calc.
Silver oz/ton	5.93	5.63	9.44	9.79	11.65	10.30	6.10	5.84
Lead % (total)	14.75	15.84	23.14	24.59	17.76	16.59	20.00	18.34
N.S. Lead % **	9.28	-	10.99	-	13.48	-	13.22	-
Zinc % (total)	23.00	13.99	11.50	9.41	14.00	13.02	15.00	13.48
N.S. Zinc %	22.84	-	11.38	-	13.88	-	14.87	-
Copper %	0.22	0.15	0.22	0.25	0.78	0.56	0.25	0.19

* From Internal Reports MS-AC-69-448, 453, 486, 488, and 494.

** N. S. means non-sulphide

The semi-quantitative spectrographic analysis of Composite Sample No. 1 is shown in Table 2.

TABLE 2

Semi-quantitative Spectrographic Analysis* of Sample No. 1

Principal Constituent (> 1%)	Si
Prominent Constituent (< 1% > 0.1%)	Mg, Pb, Fe, Zn, Ni,
Minor Constituent (< 0.1%)	Mn, Cr, Al, Cu, Ag, Ti
Not Detected	Sb, As, Mo, W, Sn, Bi, V, Ca, In, Zr, Co, Sr

* From Internal Report MS-AC-69-38.

The sulphide ore sample was crushed to minus one half inch. One quarter of the sample was split out and crushed to minus 10 mesh. The minus 10 mesh material was split into 1000 gram samples for chemical analysis, microscopic analysis, semi-quantitative spectrographic analysis and flotation investigative tests. The chemical analysis is reported in Table 3 and spectrographic analysis in Table 4.

TABLE 3

Chemical Analysis* of Sulphide Ore Sample

Silver	9.95 oz/ton
Lead (Total)	17.40%
N. S. Lead **	1.94%
Zinc (Total)	30.80%
N. S. Zinc	1.14%
Copper	1.00%

* From Internal Reports MS-AC-69-779 and 784

** N. S. means non-sulphide

TABLE 4

Semi-Quantitative Spectrographic Analysis* of Sulphide Ore Sample

Major Constituent ($>1\%$)	Pb, Zn, Si
Prominent Constituent ($<1.0\% >0.1\%$)	Mg, Fe, Al, Ca, Cu, Ni
Minor Constituent ($<0.1\%$)	Cr, Mn, Ag, Ti
Not Detected	Ba, B, Sb, Ge, As, Mo, W, Sn, Nb, Ta, In, Bi, V, Sr, Li, Zr, Na, Co

* From Internal Report MS-AC-69-670

MINERALOGICAL EXAMINATIONS

Mineralogical examinations were carried out on the carbonate ore Sample No. 1 and on the sulphide ore sample.

Carbonate Ore, Sample No. 1

A copy of the report* covering the mineralogical examination of the carbonate ore Sample No. 1 is attached as Appendix A.

The copper, lead and zinc occur both as sulphides and as carbonates and the silver in the sample occurs as a constituent of argentiferous tetrahedrite. The minerals are galena, bournonite, cerussite, sphalerite, smithsonite, covellite, enargite, chalcopyrite and malachite. Also present are pyrite, goethite, quartz, dolomite, and pyroxene.

The major lead-bearing mineral is galena with small amounts of cerussite and bournonite. Galena occurs mainly as free grains, even in the 48 to 65-mesh fraction, but to a minor degree as inclusions (5 to 70 microns in size) in sphalerite, cerussite and gangue. The cerussite is present as free grains and in association with galena and other carbonates.

Sphalerite and smithsonite are present in small quantities. The chief occurrence of sphalerite is as free grains and in association with the galena, although some occurs as inclusions in gangue and in combination with covellite. Electron-probe microanalysis of the sphalerite shows that it has a low iron content (about one percent or less).

Smithsonite occurs as free grains and in association with the other carbonates.

Argentiferous tetrahedrite, containing about 1.3 per cent silver, occurs as free grains, as inclusions in galena and in association with bournonite and enargite.

Small amounts of copper minerals were present mainly covellite which occurs as inclusions in gangue and in association with galena and sphalerite. Minute amounts of enargite and traces of chalcopyrite and malachite were seen.

The gangue is composed essentially of quartz. Also present are a small quantity of dolomite and traces of pyroxene.

* Mines Branch Internal Report MS-69-40 by D. R. Owens.

Sulphide Ore

The microscopic examination* of the sulphide sample shows that the ore is composed essentially of massive sulphides and of small masses and grains of sulphide minerals in a largely siliceous gangue. The zinc is present in the ore as sphalerite, with the lead occurring principally as galena and as minute amounts of cerussite. Tetrahedrite accounts for nearly all of the copper although traces of the secondary copper sulphide, covellite, are also present. The presence of silver was confirmed only as trace amounts in the tetrahedrite.

Quartz greatly predominates over the other gangue minerals. Small amounts of both siderite and dolomite occur in the quartz and in the ore minerals as veinlets and inclusions.

The sphalerite, galena and tetrahedrite appear to be of a sufficiently coarse size to permit a high degree of liberation by standard milling methods although some galena may be retained in both the sphalerite and tetrahedrite as very small inclusions.

OUTLINE OF INVESTIGATION

Sample No. 1 was composited from samples of No. 3 Vein underground and was considered the most representative of the oxidized material. Consequently this sample was investigated first. Grinding and flotation testing resulted in the production of a silver-lead concentrate of satisfactory grade and with satisfactory recovery of the silver and lead. A satisfactory zinc concentrate was not produced. However, if the rougher lead and zinc concentrates are combined, as in Test 17, a bulk concentrate would be obtained. The bulk concentrate assayed 11.1 oz silver per ton, 37.7% lead and 2.50% zinc representing 95.7% of the silver, 98.0% of the lead, and 83.9% of the zinc in the feed.

The investigation was continued on Sample No. 2 which assayed 21.91% lead and 18.35% zinc as compared with Sample No. 1 assaying 20.0% lead and 1.72% zinc. A limited amount of flotation testing was carried out with some success in the production of a zinc concentrate. This phase of the investigation was stopped when the company requested an investigation of a sample of sulphide ore from the property.

Full details of all tests are shown in the Test Data Reports in Appendix B.

* Mines Branch Investigation Report IR-70-10 by D. R. Owens.

DISCUSSION OF RESULTS

Results obtained on Composite Sample No. 1

Composite Sample No. 1 assayed 6.07 oz silver per ton, 20.0 per cent total lead, 5.0 per cent non-sulphide lead, 1.72 per cent total zinc, 1.52 per cent non-sulphide zinc and 0.19 per cent copper.

Tests 2 to 20, with the exception of Tests 3 and 7, were carried out on Composite Sample No. 1 to determine the grind, flotation conditions and reagents necessary for the production of lead and zinc concentrates. Satisfactory lead concentrates were produced (see Tests 15 and 17) but the production of satisfactory zinc concentrates was not achieved.

Tests 14 and 16 were gravity concentration tests carried out on a Wilfley Table. In each test, a satisfactory lead concentrate was produced but the zinc was concentrated into a low-grade middling product. The metal recoveries in the concentrate and middling were too low to warrant further investigation.

Test 2 was a preliminary flotation test carried out on ore ground to 66.8 per cent minus 200 mesh with the flotation conditions and reagents as shown in Table 5. The results of this test are tabulated in Table 6.

TABLE 5

Test 2 Flotation Conditions and Reagents

Operation	pH	Reagents	lb/ton
Grind	6.0	Aerofloat 31	0.04
		Sodium Cyanide	0.20
		Zinc Sulphate	0.40
Condition	7.0	Z-11	0.10
		CaO	1.00
Lead Flotation	6.0	Cresylic Acid	0.03
Zinc Condition	8.3	CaO	1.00
		CuSO ₄	0.50
Zinc Float	6.7	Z-11	0.10
		Cresylic Acid	0.03
Lead Clean			
Zinc Clean			

TABLE 6

Results of Flotation Test 2

Product	Wt. %	Assay %				Distribution %			
		Ag*	Pb	Zn	Cu	Ag	Pb	Zn	Cu
Clean Pb conc	16.0	21.68	81.52	0.26	0.23	53.1	62.6	2.6	18.5
Clean Pb tail	5.2	20.73	48.39	2.48	0.84	16.5	12.1	7.8	22.0
Ro Pb conc	21.2	21.45	73.39	0.81	0.38	69.6	74.7	10.4	40.5
Clean Zn conc	2.7	12.54	24.00	3.11	0.80	5.2	3.6	5.1	11.0
Clean Zn tail	4.0	7.96	18.63	3.27	0.45	4.9	3.6	7.9	9.0
Ro Zn conc	6.7	9.80	22.28	3.21	0.60	10.1	7.2	13.0	20.0
Bulk conc	27.9	18.65	61.12	1.38	0.43	79.7	81.9	23.4	60.5
Rougher tail	72.1	1.83	5.25	1.89	0.11	20.3	18.1	76.6	39.5
Feed (calcd)	100.0	6.53	20.80	1.65	0.20	100.0	100.0	100.0	100.0

* oz/ton

As can be seen from the above table, the separation of the lead from the zinc was not satisfactory nor was the overall recovery.

Test 4 was carried out on ore ground to 53.7 per cent minus 200 mesh with exactly the same flotation conditions and reagents as used in Test 2. The results obtained in Test 4 were similar to those of Test 2 indicating that finer grinding was not warranted.

Test 6 was carried out on ore ground to 44.0 per cent minus 200 mesh with the same reagents used in the two previous tests. The results of this test were not as good as Test 2 and 4. Test 9 was carried out on ore ground to 44.0 per cent minus 200 mesh using sodium carbonate instead of lime for alkalinity control. No zinc depressants (sodium cyanide and zinc sulphate) were used. The results of this test were not satisfactory.

Test 5 was a repeat of Test 4 with a few small changes in flotation conditions and reagents. The lime was added to the rod mill instead of during conditioning. Aerofloat 31 was used instead of cresylic acid. The pH during flotation was 6.9. The silver, lead and zinc recoveries in the lead concentrate were all higher than in Test 4. The zinc concentrate was equal in grade and recovery to the zinc concentrate in Test 4. The reagents used in Test 5 produced better results than those used in Tests 2 and 4.

Test 8 was carried out on ore ground to 53.7 per cent minus 200 mesh instead of 44.0 per cent minus 200 mesh as in Test 9. The reagents and conditions in Tests 8 and 9 were the same but somewhat different to those of Test 4. The finer grind of Test 8 resulted in an improvement of the results compared to those of Test 9 but they were still inferior to Test 4.

Tests 10, 11, 12, and 13 were carried out on ore ground to 53.7 per cent minus 200 mesh with slight changes in reagents which did not materially effect the grades of concentrates or recoveries. The concentrates were all lower in grades and recoveries than those obtained in Tests 2 and 4.

In Test 17, carried out on ore ground 53.7 per cent minus 200 mesh, Reagent 404 was used in the lead flotation and markedly increased the lead recovery. Sodium sulphide and Reagent 3037 were used in the zinc flotation and increased the zinc recovery. The rougher tailing assayed 0.67 oz silver per ton, 1.00 per cent lead and 0.65 per cent zinc and contained 4.3 per cent of the silver, 2.0 per cent of the lead and 16.1 per cent of the zinc in the feed.

Test 18 in which ammonium phosphate was used in the lead float did not produce results comparable to Test 17.

Tests 15, 19 and 20 were carried out on ore ground to 66.8 per cent minus 200 mesh with reagents very similar to those used in Test 18. The results of Test 20 were better than Test 18 but not as good as Test 17.

From the results of these tests, it is apparent that Test 17 illustrates the grind, flotation conditions and reagents for the most satisfactory treatment of the ore represented by Composite Sample No. 1.

Results Obtained on Composite Sample No. 2.

Composite Sample No. 2 assayed 14.19 oz silver per ton, 21.91 per cent total lead, 19.97 per cent non-sulphide lead, 18.35 per cent total zinc, 18.25 per cent non-sulphide zinc and 0.77 per cent copper.

Tests 21, 22, 25, and 26 were conducted with similar flotation conditions and reagents but each test was conducted on ore ground to a different degree of fineness. Test 22 at a grind of 53.7 per cent minus 200 mesh produced the best results. The rougher lead concentrate assayed 42.10 per cent lead and 13.24 per cent zinc and contained 89.1 per cent of the lead and 33.3 per cent of the zinc in the feed. The rougher zinc concentrate assayed 6.21 per cent lead and 35.89 per cent zinc and contained 7.9 per cent of the lead and 54.3 per cent of the zinc in the feed.

Another series of tests (Nos. 23, 24, 45, and 46) was carried out on the ore at a grind of 53.7 per cent minus 200 mesh and with reagents similar to those used in Test 22. Each test has some slight difference in the reagents. Test 22, with the results as outlined previously, produced better results than any test in this series.

Another series of tests (Nos. 47, 48, 52 and 53) was carried out at the same grind (53.7 per cent minus 200 mesh) but with lead flotation reagents different from those used in the previous series of tests. The zinc flotation reagents were quite similar to those used in the previous tests. The concentrates produced in Test 48 are considered to be the best of those produced from this sample. In Test 48, three lead concentrates and one zinc concentrate were produced. These concentrates can be combined as shown in Table 7.

TABLE 7

Test 48 Flotation Concentrates

Product	Weight %	Assay %		Distribution %	
		Pb	Zn	Pb	Zn
No. 1 Pb conc	11.0	46.56	10.73	23.5	6.3
No. 2 Pb conc	27.6	52.37	11.69	66.4	17.2
Combined No. 1 & No. 2	38.6	50.72	11.41	89.9	23.5
No. 3 Pb conc	5.2	22.22	21.15	5.3	5.9
Zinc conc	30.3	2.31	32.25	3.2	52.3
No. 3 Pb + Zn conc	35.5	5.22	30.63	8.5	58.2
Total conc	74.1	28.92	20.62	98.4	81.7

The results illustrated above are very similar to those obtained in Test 17 on Composite Sample No. 1, especially the lead grades and recoveries. In each test, the grind was 53.7 per cent minus 200 mesh and the flotation reagents used were similar.

Results Obtained on Sulphide Ore

The sulphide ore assayed 9.95 oz silver per ton, 17.40 per cent lead, 30.80 per cent zinc and 1.00 per cent copper. Tests 27 to 44 excluding Test 36 were carried out to determine the flotation conditions and reagents necessary for the production of satisfactory lead and zinc concentrates.

Three preliminary flotation tests (Nos. 27, 28, and 29) were carried out on ore ground to 74.5 per cent minus 200 mesh and each was floated with different reagent combinations. From the results of these tests, it can be seen that it was possible to float the silver, lead, zinc and copper with high recoveries. The separation of the lead and zinc into separate concentrates was not achieved in these tests.

Tests 30 and 32 were carried out on ore samples ground to 58.0 per cent minus 200 mesh and with the same flotation conditions and reagents as used in Test 29 which was carried out on ore ground to 74.5 per cent minus 200 mesh. The finer grind used in Test 29 resulted in slightly higher metal recoveries than in Tests 30 and 32.

Tests 31, 34, and 35 were carried out on ore ground to 58.0 per cent minus 200 mesh with reagents and conditions similar to those used in Test 28. Test 34 resulted in the best overall recovery but Test 35 resulted

in the better lead concentrate and zinc concentrate grades and recoveries. Test 34 was also better than Test 28 or Test 29. A grind of 58.0 per cent minus 200 mesh appears to be sufficient to produce satisfactory results.

Tests 33 and 37 were carried out on ore at a grind of 91.5 per cent minus 200 mesh and with the reagents and conditions similar to those used in Test 29. Lead and zinc concentrates with satisfactory grades and recoveries were produced. The lead and zinc separation was better than that achieved in Tests 29, 30 and 32 but there was a slight decrease in recoveries.

In Test 38, sodium sulphite was used as a zinc depressant as well as sodium cyanide and zinc sulphate but it gave no improvement in zinc depression.

Test 39 was a repeat of Test 38 at a coarser grind of 74.5 per cent minus 200 mesh and with the lead float at a pH of 8.0. The results of this test were superior to Test 33, 37, and 38 which were carried out at a grind of 91.5 per cent minus 200 mesh but the results of Tests 34 and 35 at grinds of 58.0 per cent minus 200 mesh were slightly better than Test 39.

Test 40 was carried out on ore at a grind of 75.5% with sulphidization of the lead carbonate minerals with sodium sulphide. The lead-zinc separation was very good but the metallurgical recoveries were not as satisfactory as Tests 34 and 35.

Tests 41 and 42 were carried out to determine the effect of flotation at different per cent solids. In Test 41, flotation roughing was carried out at 15 per cent solids and in Test 42 at 33 per cent solids. Test 41 resulted in better lead and zinc recoveries but Test 42 at 33 per cent solids showed greater lead-zinc selectivity.

Test 43 was carried out to illustrate the results to be obtained when making a copper-lead separation. The ore was ground to 74.5 per cent minus 200 mesh and the lead-zinc flotation reagents were similar to those used in Test 29. The results are shown in condensed form in Table 8.

TABLE 8

Test 43 Flotation Results

Product	Wt. %	Assay				Distribution %			
		Ag oz/ton	Cu %	Pb %	Zn %	Ag	Cu (1)	Pb	Zn
Cu conc	2.0	220.46	27.90	8.30	12.20	44.8	55.8	1.1	0.8
Pb conc(2)	19.2	19.83	-	67.00	9.36	38.8	-	82.4	6.0
Zn conc (3)	43.9	2.80	-	4.01	58.19	12.5	-	11.2	86.3
Zn clean tail	8.4	3.34	-	5.60	20.60	2.9	-	3.0	5.9
Rougher tail	26.5	0.38	-	1.35	1.08	1.0	-	2.3	1.0

- (1) Based on 1.00% copper head assay.
- (2) Combined lead concentrate and copper-lead re-recleaner tail.
- (3) Combined clean zinc concentrate and copper-lead clean and reclean tail.

CONCLUSIONS

The investigation on the oxidized samples was done on Composite Sample No. 1 (No. 3 Vein, No. 3 Zone), containing 5.0 per cent non-sulphide lead and 1.5 per cent non-sulphide zinc and Composite Sample No. 2 (Zone 8, Trench E, Footage 0'-17'), containing 20 per cent non-sulphide lead and 18.3 per cent non-sulphide zinc. The remaining six samples of oxidized ore had similar assays to Sample No. 1 or Sample No. 2 and it was not considered necessary to test these as results were expected to be similar.

The results of the investigation on this ore, showed that at a relatively coarse grind of 58 per cent minus 200 mesh a satisfactory silver-lead concentrate could be floated, but no success was achieved in making a separate high-grade zinc concentrate. However, a low-grade bulk silver-lead-zinc concentrate could be produced with good metal recoveries.

Selective flotation of a silver-lead concentrate gave products assaying from 50 to 68 per cent lead with 80 to 90 per cent lead recovery and 75 per cent recovery of the silver. The high recoveries were associated with the higher grade samples, (see Test 17 and 48 in appendices). In the flotation of a bulk silver-lead-zinc concentrate, containing in the order of 50 per cent of the weight of the feed, recoveries of 95 per cent silver, 98 per cent lead and 84 per cent zinc were obtained.

The Investigation on the sample of ore, which was designated as "Sulphide Ore", showed that it responded readily to flotation concentration. Satisfactory grades and recoveries of copper, lead, and zinc were produced as indicated by the following summary of results from Test 43:

Product	Assays				Distribution %			
	Ag oz/ton	Cu %	Pb %	Zn %	Ag	Cu	Pb	Zn
Cu conc	220.46	27.90	8.30	12.20	44.8	55.8	1.1	0.8
Pb conc	19.83	-	67.00	9.36	38.8		82.4	6.0
Zn conc	2.80	-	4.01	58.19	12.5		11.2	86.3

The above results were obtained at a grind of 74 per cent minus 200 mesh. In other tests done at grind of 58 per cent minus 200 mesh, similar results were obtained (See Test 34). It is expected that a grind of 60 per cent minus 200 mesh would be sufficient for the liberation of the minerals in the sulphide sample.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of the following members of the Mineral Sciences Division: Mr. D. R. Owens who carried out the mineralogical examination of the ores, Mr. D. P. Polombo who performed the spectrographic analyses, Messrs. C. A. Derry and J. Graham who did the fire assaying and Messrs. R. W. Buckmaster, R. Craig, D. Cumming, R. Donahue, J. C. Hole, B. Kobus, R. Kobus, P. Lanthier, H. Lauder, E. MacEachern and Miss C. Smith who carried out the chemical analyses.

APPENDICES

INDUSTRIAL CONFIDENTIAL

MINERAL SCIENCES DIVISION

Internal Report MS 69-40

MINERALOGICAL EXAMINATION OF A HEAD SAMPLE OF LEAD-SILVER
ORE FROM PRAIRIE CREEK, NORTHWEST TERRITORIES, ON BEHALF OF
CADILLAC EXPLORATIONS LIMITED

by

D. R. Owens*

- - -

INTRODUCTION

A head sample of lead-silver ore from a deposit located on Prairie Creek, B. C., 210 miles north of Ft. Nelson and 110 miles west of Ft. Simpson, was received from Mr. A. Wall of the Mineral Processing Division on April 10, 1969. Mr. Wall stated that the ore had originally been submitted to the Mines Branch by the consulting mining engineer, Mr. K. V. Christie, 1310- 56th Street, Tsawwassen, Ladner, B. C., on behalf of Cadillac Explorations Limited, 570 Crown Trust Bldg., 407- 8th Avenue, Calgary 2, Alberta. Mr. Wall requested that the head sample be examined microscopically to identify its constituent minerals.

SAMPLE

The sample, as received, consisted of a portion of the head sample crushed to minus 10 mesh. The head sample was labelled No. 1 and was reported by Mr. Wall to contain 24.24% Pb, 1.79% Zn, 0.24% Cu, and 7.25

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ounces of silver per ton. It was also stated by Mr. Wall that the ore was reported to be contained in a quartz-carbonate matrix, throughout the shear zone, which is highly oxidized to a depth of at least 500 feet.

METHOD OF INVESTIGATION

The head sample was screened and the 48 to 65, 65 to 150 and 150 to 270-mesh fractions were removed. These fractions were each separated into a number of sink and float products by means of heavy liquids in order to concentrate the heavier ore minerals. The float products were analysed by Mr. E. J. Murray of the Crystal Structure Group by means of an X-ray diffractometer to identify the major gangue minerals. Polished sections were prepared from the sink products and examined microscopically to identify the heavier ore minerals. When corroboration of the identity of a mineral was necessary, samples were submitted to Mr. J. M. Stewart and Mr. E. J. Murray of the Structure Group for powder X-ray diffraction analysis.

RESULTS OF INVESTIGATION

General Mineralogy of the Head Sample

Since no hand specimens of the ore were available, the results of the examination are based solely on the head sample.

The examination of the head sample shows that the lead, zinc and copper occurs both as sulphides and as carbonates, and that the silver in the sample occurs as a constituent of argentiferous tetrahedrite. The lead-bearing minerals are galena, bournonite, and cerussite; the zinc-bearing minerals are sphalerite and smithsonite; and the copper-bearing minerals are covellite, enargite, chalcopyrite and malachite. Also present in the

head sample are pyrite, goethite, quartz, dolomite, pyroxene and an unidentified phase. Galena is the major metallic mineral in the head sample, with the other minerals occurring in much smaller amounts.

Detailed Mineralogy of the Head Sample

Lead-bearing minerals

The lead-bearing minerals are galena, cerussite and bournonite, (PbCuSbS_3), with galena greatly predominating. Galena occurs mainly as free grains, but also to a minor degree as inclusions from about 5 to 70 microns in size in sphalerite, cerussite and gangue. (The word "size" as used in this report, refers to the greatest dimension of the mineral grain being described.) The galena itself contains few inclusions, and these are comprised of sphalerite, pyrite, covellite, bournonite and tetrahedrite.

The relatively small amount of cerussite in the sample is present as free grains and in association with galena and the other carbonates.

The amount of bournonite found in the sample is very small. It occurs as free grains, as inclusions in galena and gangue, and in combination and association with galena, tetrahedrite and enargite.

Zinc-bearing minerals

Only very small quantities of sphalerite and smithsonite are present in the head sample. The chief occurrence of the sphalerite is as free grains and in association with the galena, although some occurs as inclusions in gangue and in combination with covellite. Electron-probe microanalysis of the sphalerite shows that it has a low iron content (about one per cent or less).

The small amount of smithsonite present in the sample also occurs as free grains and in association with the other carbonates. The relative proportions of sphalerite and smithsonite are difficult to estimate because of the difficulty of distinguishing smithsonite from cerussite.

Copper-bearing minerals

The reported copper content of the head sample is quite low and therefore only very small amounts of copper-bearing minerals were seen. Chief amongst these is covellite, which occurs as inclusions in gangue and in association with sphalerite and galena. Minute amounts of enargite $[\text{Cu}_3(\text{As}, \text{Sb})\text{S}_4]$ are present as free grains and as inclusions in tetrahedrite and gangue. Only traces of chalcopyrite and malachite were seen in the head sample. The chalcopyrite was observed as a number of minute grains in sphalerite, and malachite as a few free grains.

Silver-bearing minerals

Only one silver-bearing mineral was identified in the head sample. This is argentiferous tetrahedrite, containing about 1.3% silver as determined by electron-probe microanalysis. The tetrahedrite occurs as free grains, as inclusions in galena, and in association with bournonite and enargite.

Other ore minerals

The other ore minerals are pyrite and goethite. These occur in small amounts and are generally associated with each other, with the goethite veining or rimming about one half of the pyrite grains in the sample.

Gangue minerals

The gangue is composed essentially of quartz. Also present is a small quantity of dolomite and traces of pyroxene. A few grains of an unidentified mineral were also found in the float products of the head sample. X-ray diffraction studies of a few of these grains gave a powder pattern close to that of beudantite, which is a sulphate-arsenate of lead and ferric iron. This identity, however, could not be substantiated by the literature and its identification is therefore only tentative.

CONCLUSIONS

The mineralogical examination of the head sample leads to the following conclusions: Galena is the major lead-bearing mineral, and also the major ore mineral. It is largely free from the other minerals in the sample, even in the 48 to 65-mesh fraction. Much less lead occurs as cerussite, which is also of a generally coarse grain size. Zinc, on the other hand, appears to be present in approximately equal amounts as a sulphide and as a carbonate. While some of the tetrahedrite is present as free grains, it is expected that a small proportion of it will present problems in liberation from the other minerals in the head sample. The very small amounts of copper-bearing minerals preclude an assessment of their liberation characteristics.

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APPENDIX B

Test Report Data Sheets

Abbreviations used in Test Data Reports:

NaCN	Sodium Cyanide
ZnSO ₄	Zinc Sulphate
CaO	Lime
A. 31	Aerofloat Reagent 31
Z-11	Sodium Isopropyl Xanthate
404	Cyanamid Promoter 404
DF250	Dow Froth 250
CuSO ₄	Copper Sulphate
SB	Sodium Bichromate
H ₂ SO ₄	Sulphuric Acid
Z-200	Isopropyl ethyl thiono carbomate
Z-6	Potassium Amyl Xanthate
CA	Cresylic Acid
Ammo Phos	Ammonium Phosphate
Na ₂ SO ₃	Sodium Sulphite
Na ₂ S	Sodium Sulphide
Na ₂ SiO ₃	Sodium Silicate
3037	Aeromine 3037 Promoter
Z-5	Potassium sec amyl xanthate
PO	Pine Oil
444	Cyanamid Promoter 444
Z-8	Potassium sec butyl xanthate
Na ₂ CO ₃	Sodium Carbonate
RM	Rod Mill

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 2	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3						DATE: April 9, 1969						
OBJECT OF TEST: Preliminary flotation test.						CHARGE: 1000-g							
						TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					A31	ZnSO ₄	NaCN	Z-11	CA	CuSO ₄	CaO		
Grind (66.8%-200 m)	20	67	6.0	7 x 14 RM	0.04	0.40	0.20						
Condition	2	45	7.0	1000-g cell				0.10			1.0		
Pb float	7	25	6.0						0.03				
Zn condition	5	20	8.3							0.50	1.0		
Zn float	6	20	6.7					0.10	0.03				
Pb clean	3			500-g cell									
Zn clean	2			250-g cell									
PRODUCT	WT %	ANALYSIS % *							DISTRIBUTION %				
		Ag	Pb	N.S.Pb	S. Pb	Zn	Cu	Ag	Pb	Zn	Cu		
Clean Pb conc	16.0	21.68	81.52			0.26	0.23	53.1	62.6	2.6	18.5		
Clean Pb tail	5.2	20.73	48.39			2.48	0.84	16.5	12.1	7.8	22.0		
Rough Pb conc (calcd)	21.2	21.45	73.39			0.81	0.38	69.6	74.7	10.4	40.5		
Clean Zn conc	2.7	12.54	24.00			3.11	0.80	5.2	3.6	5.1	11.0		
Clean Zn tail	4.0	7.96	18.63			3.27	0.45	4.9	3.6	7.9	9.0		
Rougher Zn conc (calcd)	6.7	9.80	22.28			3.21	0.60	10.1	7.2	13.0	20.0		
Bulk rough conc (calcd)	27.9	18.65	61.12			1.38	0.43	79.7	81.9	23.4	60.5		
Rougher tail	72.1	1.83	5.25	4.83	0.42	1.89	0.11	20.3	18.1	76.6	39.5		
Feed (calcd)	100.0	6.53	20.80			1.65	0.20	100.0	100.0	100.0	100.0		
REMARKS: * From Internal Reports MS-AC-69-406 and 448.													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 4	SAMPLE: Cadillac Exploration, Sample No.1, Vein No.3, Zone No.3	DATE: April 9, 1969
OBJECT OF TEST: Preliminary flotation test		CHARGE: 1000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					A.31	ZnSO ₄	NaCN	Z-11	CaO	CuSO ₄	CA		
Grind (53.7%-200 m)	15	67		7 x 14 RM	0.04	0.40	0.20						
Condition	2	45	8.5	1000-g cell				0.10	1.00				
Pb float	7	20	6.3								0.03		
Zn condition	5	20	9.9						1.00	0.50			
Zn float	6		9.0					0.10			0.03		
Pb clean	3			500-g cell									
Zn clean	2			250-g cell									

PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %			
		Ag	Pb	N.S.Pb	S. Pb	Zn	Cu	Ag	Pb	Zn	Cu
Clean Pb conc	12.4	22.76	80.50			0.57	0.43	43.7	45.5	3.3	24.9
Clean Pb tail	12.1	16.49	58.50			1.97	0.47	30.9	32.6	10.9	26.8
Ro Pb conc (calcd)	24.5	19.66	69.23			1.26	0.45	74.6	78.1	14.2	51.7
Clean Zn conc	2.1	8.42	20.00			4.60	0.58	2.7	1.9	4.5	5.6
Clean Zn tail	1.9	7.97	13.25			1.44	0.62	2.3	1.2	1.2	5.6
Ro Zn conc	4.0	8.21	16.80			3.10	0.60	5.0	3.1	5.7	11.2
Bulk rough conc (calcd)	28.5	18.06	61.87			1.52	0.47	79.6	81.2	19.9	62.9
Rougher tail	71.5	1.84	5.73	5.31	0.42	2.44	0.11	20.4	18.8	80.1	37.1
Feed (calcd)		6.47	21.73			2.18	0.21	100.0	100.0	100.0	100.0

REMARKS: * From Internal Reports MS-AC-69-406 and 453.

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 5	SAMPLE: Cadillac Exploration #1, Vein #3, Zone #3						DATE: April 10, 1969						
OBJECT OF TEST: Preliminary Flotation Test						CHARGE: 1000-g							
						TESTED BY: WAW							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					A 31	NaCN	ZnSO ₄	CaO	Z-11	CuSO ₄	CA		
Grind (53.7%-200 m)	15	67		7 x 14 RM	0.04	0.2	0.4	1.0					
Condition	2	45	7.9	1000-g cell					0.10				
Flotation	9	25	6.9		0.01								
Condition	5	25	11.0					2.0		2.00			
Flotation	5	20	9.6						0.05		0.02		
Pb clean	2			500-g cell									
Zn clean	1½			250-g cell									
PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %					
		Ag	Pb	N.S.Pb	Zn	Cu	Ag	Pb	Zn	Cu			
Clean Pb conc	20.0	21.20	77.7		0.62	0.33	63.9	70.7	6.6	27.6			
Clean Pb tail	9.1	11.81	28.0		3.10	0.62	16.2	12.5	14.9	23.4			
Ro Pb conc (calcd)	29.1	18.26	62.85		1.40	0.42	80.1	83.2	21.5	51.0			
Clean Zn conc	1.6	7.03	19.2		3.25	0.90	1.7	1.4	2.7	5.9			
Clean Zn tail	1.3	4.95	14.9		5.70	0.58	1.0	0.9	3.9	3.3			
Ro Zn conc (calcd)	2.9	6.07	17.3		4.34	0.76	2.7	2.3	6.6	9.2			
Rougher tail	68.0	1.68	4.7	4.27	2.00	0.14	17.2	14.5	71.9	39.8			
Feed (calcd)	100.0	6.63	21.98		1.89	0.24	100.0	100.0	100.0	100.0			
Feed (assayed)	100.0	6.07	20.00	5.00	1.72	0.19							
Rough bulk conc (calcd)	32.0	17.16	58.82		1.66	0.45	82.8	85.5	28.1	60.2			
REMARKS: * From Internal Reports MS-AC-69-406 and 453													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 6	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3						DATE: April 11, 1969							
OBJECT OF TEST: Coarser Grind						CHARGE: 1000-g								
						TESTED BY: WAW								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					A. 3l	ZnSO ₄	NaCN	CaO	Z-11	CuSO ₄				
Grind (44.0%-200 m)	10	67		7 x 14 RM	0.04	0.40	0.20	1.0						
Condition	2	45	8.9	1000-g cell				1.0	0.10					
Pb float	7	25	6.9											
Zn condition	5	20	9.7					1.0		0.50				
Zn float	6		7.7						0.10					
Pb clean	3			500-g cell										
Zn clean	1.5			250-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
		Ag	Pb	N.S.Pb	S. Pb	Zn	Cu	Ag	Pb	Zn	Cu			
Clean Pb conc	15.6	20.70	75.32			0.66	0.28	54.8	59.0	6.1	23.7			
Clean Pb tail	7.7	12.03	34.00			2.69	0.44	15.6	13.1	12.1	18.3			
Ro Pb conc (calcd)	23.3	17.84	61.67			1.33	0.33	70.4	72.1	18.2	42.0			
Clean Zn conc	3.3	6.24	15.88			3.38	0.41	3.5	2.6	6.5	7.5			
Clean Zn tail	2.7	4.46	12.48			3.10	0.33	2.1	1.7	4.9	4.8			
Ro Zn conc (calcd)	6.0	5.95	14.35			3.25	0.38	5.6	4.3	11.4	12.3			
Bulk ro conc (calcd)	29.3	15.30	51.98			1.72	0.34	76.0	76.4	29.6	54.3			
Rough tail	70.7	2.00	6.50	4.51	1.99	1.70	0.12	24.0	23.6	70.4	45.7			
Feed (calcd)	100.0	5.90	19.92			1.70	0.19	100.0	100.0	100.0	100.0			
REMARKS: * From Internal Reports MS-AC-69-406 and 448														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 8	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3							DATE: April 30, 1970					
OBJECT OF TEST: pH control with sodium carbonate							CHARGE: 1000-g						
							TESTED BY: WAW						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					A. 31	NaCO ₃	Z-11	CA	CaO	CuSO ₄			
Grind (53.7%-200 m)	15	67		7 x 14 RM	0.06	1.0							
Condition	3	45	7.2	1000-g cell		3.0	0.10						
Pb float	6	25	6.7					0.03					
Zn condition	5	20	10.6						1.00	1.00			
Zn float	4	20						0.03					
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %					
			Cu	Pb	Zn				Cu	Pb	Zn		
Ro Pb conc	21.4		0.56	72.00	0.85				52.9	74.0	10.3		
Ro Zn conc	5.9		0.46	14.27	3.66				11.9	4.0	12.2		
Bulk conc (calcd)	27.3		0.54	59.52	1.46				64.8	78.0	22.5		
Rougher tail	72.7		0.11	6.27	1.89				35.2	22.0	77.5		
Feed (calcd)	100.0		0.23	20.81	1.77				100.0	100.0	100.0		
REMARKS: * From Internal Report MS-AC-69-472													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 9		SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3						DATE: April 30, 1970						
OBJECT OF TEST: Repeat of Test 8 at coarser grind								CHARGE: 1000-g						
								TESTED BY: WAW						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					A.31	Na ₂ CO ₃	Z-11	CaO	CuSO ₄	CA				
Grind (44.0%-200 m)	10	67		7 x 14 RM	0.06	1.0								
Condition	7	45	7.3	1000-g cell		2.0	0.10							
Pb float	7	25	6.7								0.03			
Zn condition	5	20	10.8					2.0	1.0					
Zn float	4	20	9.7								0.03			
Pb clean	3			250-g cell										
Zn clean	1½			250-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Cu	Pb	Zn				Cu	Pb	Zn			
Clean Pb conc	15.1		0.44	79.17	0.62					33.0	56.7	5.3		
Clean Pb tail	6.5		0.41	47.00	2.28					13.5	14.5	8.4		
Ro Pb conc (calcd)	21.6		0.43	69.49	1.12					46.5	71.2	13.7		
Clean Zn conc	1.6		0.41	10.98	3.29					3.5	0.8	3.0		
Clean Zn tail	2.4		0.44	12.12	2.63					5.5	1.4	3.6		
Ro Zn conc (calcd)	4.0		0.45	11.70	2.90					9.0	2.2	6.6		
Bulk conc (calcd)	25.6		0.43	60.46	1.40					55.5	73.4	20.3		
Rougher tail	74.4		0.12	7.52	1.89					44.5	26.6	79.7		
Feed (calcd)	100.0		0.20	21.07	1.76					100.0	100.0	100.0		
REMARKS: * From Internal Report MS-AC-69-472.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 10	SAMPLE: Cadillac Exploration Sample No. 1, Vein No.3, Zone No. 3							DATE: May 2, 1969					
OBJECT OF TEST: Promoter 404							CHARGE: 1000-g						
							TESTED BY: WAW						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					A. 31	ZnSO ₄	NaCN	CaO	Z-11	404	CA	CuSO ₄	
Grind (53.7%-200 m)	15	67	7.0	7 x 14 RM	0.04	0.4	0.2	1.0					
Condition	6	45	8.6	1000-g cell				1.0	0.05	0.05			
Pb float	7	25	7.1								0.02		
Zn condition	5	25	10.1					2.0	0.05			2.00	
Zn float	4	20	9.1						0.05				
Pb clean	2			500-g cell									
Zn clean	1.5			250-g cell									
PRODUCT	WT %	ANALYSIS % *					DISTRIBUTION %						
			Cu	Pb	Zn			Cu	Pb	Zn			
Clean Pb conc	18.6		0.37	79.35	0.52			29.7	67.4	6.5			
Clean Pb tail	5.8		0.62	29.59	2.31			15.2	7.8	9.0			
Rough Pb conc (calcd)	24.4		0.43	67.52	0.95			44.9	75.2	15.5			
Clean Zn conc	2.4		0.73	17.50	3.36			7.2	1.9	5.4			
Clean Zn tail	3.2		0.55	15.14	2.41			7.2	2.2	5.2			
Rough Zn conc (calcd)	5.6		0.61	16.14	2.82			14.4	4.1	10.6			
Bulk conc (calcd)	30.0		0.47	60.46	1.20			59.3	79.3	26.1			
Rougher tail	70.0		0.14	6.47	1.58			40.7	20.7	73.9			
Feed (calcd)	100.0		0.24	21.91	1.50			100.0	100.0	100.0			
REMARKS: * From Internal Report MS-AC-69-512.													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 11	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3							DATE: May 2, 1969					
OBJECT OF TEST: pH control with sodium carbonate							CHARGE: 1000-g						
							TESTED BY: WAW						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					A. 31	ZnSO ₄	NaCN	Na ₂ CO ₃	404	Z-11	CuSO ₄	CaO	
Grind (53.7%-200 m)	15	67		7 x 14 RM	0.04	0.40	0.20	1.0	0.05				
Condition	2	45	6.7	1000-g cell				3.0		0.05			
Pb float	7	25	7.0										
Zn condition	5	25	10.4							0.05	2.00	2.00	
Zn float	4	20	9.9							0.10			
Pb clean	2			500-g cell									
Zn clean	1.5			250-g cell									
PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %					
		Cu	Pb	Zn				Cu	Pb	Zn			
Clean Pb conc	18.0	0.33	82.73	0.50				26.3	70.2	5.1			
Clean Pb tail	7.7	0.64	20.42	2.40				21.9	7.4	10.5			
Ro Pb conc (calcd)	25.7	0.42	64.10	1.07				48.2	77.6	15.6			
Clean Zn conc	4.6	0.50	12.17	4.31				10.3	2.7	11.2			
Clean Zn tail	3.0	0.42	12.35	2.96				5.8	1.7	5.1			
Ro Zn conc (calcd)	7.6	0.47	12.25	3.77				16.1	4.4	16.3			
Bulk conc (calcd)	33.3	0.67	52.24	1.69				64.3	82.0	31.9			
Rougher tail	66.7	0.12	5.71	1.80				35.7	18.0	68.1			
Feed (calcd)	100.0	0.22	21.82	1.76				100.0	100.0	100.0			
REMARKS: * From Internal Report MS-AC-69-515.													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 12		SAMPLE: Cadillac Exploration, Sample No. 1, Vein No. 3, Zone No. 3						DATE: May 6, 1970.						
OBJECT OF TEST: Repeat of Test 11								CHARGE: 1000-g						
								TESTED BY: W.A.W.						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					A. 31	ZnSO ₄	NaCN	Na ₂ CO ₃	404	Z-11	CaO	CuSO ₄	CA	
Grind (53.7%-200 m)	15	67		7 x 14 RM	0.04	0.4	0.20	1.0	0.10					
Condition	2	45	7.5	1000-g cell				3.0		0.05				
Pb flotation	7	25	7.1											
Zn condition	5	25	10.2							0.05	2.00	2.00		
Zn float	4	20	9.4											0.03
Pb clean	2			250-g cell										
Zn clean	1.5			" "										
PRODUCT	WT %	ANALYSIS %*					DISTRIBUTION %							
		Cu	Pb	Zn			Cu	Pb	Zn					
Clean Pb conc	16.8	0.32	83.64	0.35			27.0	61.4	3.3					
Clean Pb tail	3.9	0.46	57.16	1.50			9.0	9.8	3.3					
Ro Pb conc (calcd)	20.7	0.34	78.60	0.57			36.0	71.2	6.6					
Clean Zn conc	2.1	1.51	37.59	8.24			16.0	3.4	9.7					
Clean Zn tail	2.3	0.69	19.39	1.56			7.0	2.0	2.0					
Ro Zn conc (calcd)	4.4	1.05	28.07	4.75			23.0	5.4	11.7					
Bulk conc (calcd)	25.1	0.47	69.78	1.30			59.0	76.6	18.3					
Rougher tail	74.9	0.11	7.15	1.94			41.0	23.4	81.7					
Feed (calcd)	100.0	0.20	22.87	1.78			100.0	100.0	100.0					
REMARKS: * From Internal Report MS-AC-69-538														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 13	SAMPLE: Cadillac Exploration, Sample No. 1, Vein No. 3, Zone No. 3						DATE: May 6, 1969							
OBJECT OF TEST: No sphalerite depression						CHARGE: 1000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					A. 31	Na ₂ CO ₃	404	Z-11	CuSO ₄	CaO				
Grind (53.7% - 200 m)	15	67		7 x 14 RM	0.04	1.0	0.10							
Condition	2	45	7.8	1000-g cell		3.0		0.05						
Pb floatation	7	25	7.7		0.04									
Zn condition	5	20	10.5					0.05	2.0	2.0				
Zn floatation	3	20	10.2											
Pb clean	2			500-g cell										
Zn clean	1.5			250-g cell										
PRODUCT	WT. %	ANALYSIS %*						DISTRIBUTION %						
			Cu	Pb	Zn				Cu	Pb	Zn			
Clean Pb conc	17.9		0.35	81.19	0.56				29.7	69.6	6.1			
Clean Pb tail	6.8		0.54	31.55	2.75				17.4	10.3	11.3			
Ro Pb conc (calcd)	24.7		0.40	67.52	1.16				47.1	79.9	17.4			
Clean Zn conc	1.4		0.60	13.68	3.01				3.8	0.9	2.5			
Clean Zn tail	2.6		0.42	10.35	2.88				5.2	1.3	4.5			
Ro Zn conc (calcd)	4.0		0.48	11.50	2.92				9.0	2.2	7.0			
Bulk conc (calcd)	28.7		0.41	59.70	1.42				56.1	82.1	24.4			
Rougher tail	71.3		0.13	5.26	1.75				43.9	17.9	75.6			
Feed (calcd)	100.0		0.21	20.89	1.65				100.0	100.0	100.0			
REMARKS: * From Internal Report MS-AC-69-538														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 14	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3	DATE: May 5, 1969
OBJECT OF TEST: Tabling		CHARGE: 2000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton														
Grind (1)																			
Wilfley Table																			

PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %			
		Pb	NS. Pb	S. Pb	Zn			Pb	NS. Pb	S. Pb	Zn
Table conc	19.7	81.16	13.71	67.45	0.67			71.6	48.0	79.5	7.7
Table midd.	13.7	25.66	14.02	11.64	8.04			15.7	34.1	9.5	64.1
Table tail (calcd)	66.6	4.26	1.51	2.75	0.72			12.7	17.9	11.0	28.2
Feed (calcd)	100.0	23.34	5.63	16.71	1.72			100.0	100.0	100.0	100.0
Conc + Midd (calcd)	33.4	58.31	13.81	44.50	3.69			87.3	82.1	89.0	71.8

REMARKS: * From Internal Report MS-AC-69-544
 (1) Stage ground to minus 65 mesh

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 15	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3						DATE: May 14, 1969						
OBJECT OF TEST: Affect of Reagent 404 and Ammonium Phosphate						CHARGE: 1000-g							
						TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					Ammo Phos	404	A31	CuSO ₄	CaO	Z-11			
Grind (66.8%-200 m)	20	67		7 x 14 RM	4.0								
Condition	1	45	7.1	1000-g cell		0.1							
Float	12	25	7.0			0.4	0.04						
Condition	3	25	10.6					2.0	2.5	0.06			
Float	3	20	10.4										
PRODUCT	WT %	ANALYSIS % *							DISTRIBUTION %				
		Pb	NS.Pb	S.Pb		Zn	NS. Zn	S. Zn	Pb	NS Pb	S. Pb	Zn	N.S.Zn
Ro Pb conc	36.0	58.90	14.00	44.90		1.60	1.19	0.41	95.7	88.6	98.2	33.6	28.0
Ro Zn conc	3.4	9.05	5.13	3.92		3.83	3.57	0.26	1.4	3.1	0.8	7.6	7.9
Bulk conc (calcd)	39.4	54.60	13.23	41.37		1.79	1.39	0.40	97.1	91.7	99.0	41.2	35.9
Rougher tail	60.6	1.06	0.78	0.28		1.66	1.62	0.04	2.9	8.3	1.0	58.8	64.1
Feed (calcd)	100.0	22.15	5.68	16.47		1.71	1.53	0.18	100.0	100.0	100.0	100.0	100.0
REMARKS: * From Internal Report MS-AC-69-545													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 16	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3	DATE: June 13, 1969
OBJECT OF TEST: Repeat of Tabling Test No. 14		CHARGE: 2000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton															
Grind (1)																				
Wilfley Table																				

PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %			
		Pb	NS.Pb	S.Pb	Zn			Pb	NS.Pb	S.Pb	Zn
Table conc	16.3	80.11	12.31	67.80	0.30			65.0	39.3	73.7	3.0
Table midd.	18.4	21.58	10.87	10.71	6.0			19.8	39.2	13.2	66.6
Combined conc-midd (calcd)	34.7	49.07	11.55	37.52	3.31			84.8	78.5	86.9	69.6
Table tail	65.3	4.69	1.68	3.01	0.77			15.2	21.5	13.1	30.4
Feed (calcd)	100.0	20.09	5.10	14.99	1.65			100.0	100.0	100.0	100.0

REMARKS: * From Internal Report MS-AC-69-599
 (1) Stage ground to minus 65 mesh

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 17	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3							DATE: June 26, 1969						
OBJECT OF TEST: Improvement of sphalerite flotation							CHARGE: 1000-g							
							TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	CaO	404	Z-11	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	3037	
Grind (53.7% - 200 M)	15	67		7 x 14 RM										
Condition	5	45	7.3	1000-g cell	0.2	0.4	1.0	0.5						
Flotation	6	25							0.10					
Condition	10	25	11.5							2.0	2.0	10.0	0.5	
Flotation	6	25												
Pb Clean	2			500-g cell										
Zn Clean	1			250-g cell										
PRODUCT	WT %	ANALYSIS % *					DISTRIBUTION %							
		Ag(1)	Pb	Zn			Ag	Pb	Zn					
Clean Pb conc	25.4	19.31	68.61	1.02			74.1	79.3	15.0					
Clean Pb tail	21.7	4.16	13.27	2.40			13.6	13.1	30.3					
Ro Pb conc	47.1	12.33	43.11	1.65			87.7	92.4	45.3					
Clean Zn conc	5.5	7.56	18.77	10.77			6.3	4.7	34.4					
Clean Zn tail	4.6	2.48	4.43	1.58			1.7	0.9	4.2					
Ro Zn conc (calcd)	10.1	5.25	12.18	6.66			8.0	5.6	38.6					
Bulk conc (calcd)	57.2	11.1	37.7	2.50			95.7	98.0	83.9					
Rougher tail	42.8	0.67	1.00	0.65			4.3	2.0	16.1					
Feed (calcd)	100.0	6.63	21.97	1.72			100.0	100.0	100.0					
REMARKS: * From Internal Reports MS-AC-69-591 and 625 (1) ounces per ton														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 18	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3	DATE: June 26, 1969
OBJECT OF TEST: Different reagent combination		CHARGE: 1000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	CaO	404	A. 31	Na ₂ CO ₃	CuSO ₄	Na ₂ S	3037		
Grind (53.7%-200 m)	15	67		7 x 14 RM										
Condition	10	45	8.8	1000-g cell	4.0	2.0	0.10	0.02						
Pb flotation	11	25					0.04							
Zn condition	10	25	11.7						4.0	2.0	15.0	0.20		
Zn flotation	5	25										0.20		
Pb clean	1.5													
Zn clean	1.5													

PRODUCT	WT %	ANALYSIS %*					DISTRIBUTION %		
		Ag ⁽¹⁾	Pb	Zn			Ag	Pb	Zn
Clean Pb conc	17.8	23.33	82.86	0.60			65.3	78.1	10.7
Clean Pb tail	3.8	14.03	35.17	2.81			8.4	7.1	10.6
Ro Pb conc (calcd)	21.6	21.69	74.47	0.99			73.7	85.2	21.3
Clean Zn conc	1.2	11.02	33.68	9.13			2.1	2.1	10.9
Clean Zn tail	3.1	8.51	24.97	4.55			4.1	4.1	14.0
Ro Zn conc (calcd)	4.3	9.21	27.40	5.84			6.2	6.2	24.9
Bulk rougher conc (calcd)	25.9	19.62	66.65	1.80			79.9	91.4	46.2
Rougher tail	74.1	1.73	2.20	0.73			20.1	8.6	53.8
Feed (calcd)	100.0	6.36	18.89	1.00			100.0	100.0	100.0

REMARKS: * From Internal Reports MS-AC-69-591 and 625
(1) ounces per ton

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 19	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3						DATE: July 7, 1969							
OBJECT OF TEST: Repeat Test 18 at finer grind						CHARGE: 1000-g								
						TESTED BY: W.A.W								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	404	A.31	CaO	CuSO ₄	Na ₂ S	3037			
Grind (66.8%-200 m)	20	67		7 x 14 RM										
Condition	10	45	7.0	1000-g cell	4.0	0.10								
Pb flotation	12	25	7.0			0.40	0.04							
Zn condition	3	25	11.1					4.5	2.0	15.0	0.2			
Zn flotation	5	25	11.5								0.2			
Pb clean	2													
Zn clean	1.5													
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Pb	Zn					Pb	Zn				
Clean Pb conc	25.9		66.25	0.48					80.5	7.5				
Clean Pb tail	6.7		27.68	2.75					8.8	11.1				
Ro Pb conc (calcd)	32.6		58.30	0.94					89.3	18.6				
Clean Zn conc	3.2		25.12	2.46					3.8	4.7				
Clean Zn tail	5.1		14.09	2.44					3.4	7.4				
Ro Zn conc (calcd)	8.3		18.30	2.45					7.2	12.1				
Bulk rough conc (calcd)	40.9		50.20	1.25					96.5	30.7				
Rough tail	59.1		1.30	1.95					3.5	69.3				
Feed (calcd)	100.0		21.31	1.66					100.0	100.0				
REMARKS: * From Internal Report MS-AC-69-625.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 20	SAMPLE: Cadillac Exploration Sample No. 1, Vein No. 3, Zone No. 3	DATE: July 9, 1969
OBJECT OF TEST: Deslime Pb flotation tailing before zinc flotation		CHARGE: 2000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	404	A. 31	CaO	CuSO ₄	Na ₂ S	3037			
Grind (66.8%-200 m) ⁽¹⁾	20	67		7 x 14 RM	4.0									
Condition	5	45		2000-g cell		0.1								
Pb flotation	9	25	6.8			0.4	0.04							
Deslime (2)														
Zn condition	10	40	11.5					4.0	2.0	8.0	0.2			
Zn flotation	7	25	11.9								0.2			
Pb clean	2			500-g cell										
Zn clean	1.5			500-g cell										

PRODUCT	WT %	ANALYSIS % *					DISTRIBUTION %				
		Pb	Zn				Pb	Zn			
Clean Pb conc	22.5	73.25	0.91				78.2	11.0			
Clean Pb tail	13.7	26.50	2.80				17.2	20.7			
Rough Pb conc (calcd)	36.2	55.55	1.63				95.4	31.7			
Clean Zn conc	1.2	12.68	5.17				0.7	3.3			
Clean Zn tail	3.1	4.22	2.45				0.7	4.1			
Rough Zn conc (calcd)	4.3	7.07	3.20				1.4	7.4			
Bulk rough conc (calcd)	40.5	50.41	1.80				96.8	39.1			
Slime	7.5	3.91	2.19				1.4	8.8			
Rougher tail	52.0	0.71	1.86				1.8	52.1			
Feed (calcd)	100.0	21.07	1.86				100.0	100.0			

REMARKS: * From Internal Report MS-AC-69-700
 (1) Ground in 2 1000-gram batches
 (2) Removed minus 10 micron fraction

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 21	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 & 34						DATE: Sept. 15, 1969							
OBJECT OF TEST: Oxide flotation						CHARGE: 1000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Ammo. Phos	Reagents, lb per ton								
						404	ZnSO ₄	A. 31	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	3037	DF250	
Grind (66.8%-200 m)	20	67		7 x 14 RM	4.0									
Condition	5	45	7.3	1000-g cell		0.25	0.10							
Pb flotation	7.5	25				0.125		0.04						
Zn condition	10	25	10.9						4.0	3.0	15.0	0.25	0.03	
Zn flotation	4.5											0.25	0.04	
Pb clean	3			500-g cell										
Zn clean	3			500-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
		Pb	Zn					Pb	Zn					
Clean Pb conc	9.4	9.39	11.95					4.8	6.4					
Clean Pb tail	24.0	19.47	18.94					25.1	25.8					
Clean Zn conc	29.1	4.87	28.25					7.6	46.8					
Clean Zn tail	12.6	2.27	8.71					1.5	6.2					
Rougher tail	24.9	45.50	10.42					61.0	14.8					
Feed	100.0	18.59	17.58					100.0	100.0					
REMARKS: * From Internal Report MS-AC-69-721														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 22	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33, & 34							DATE: Sept. 23, 1969						
OBJECT OF TEST: Repeat of Test No. 21 at coarser grind							CHARGE: 1000-g		TESTED BY: W.A.W.					
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	404	Z-11	A.31	Na ₂ CO ₃	Na ₂ SiO ₃	CuSO ₄	Na ₂ S	3037	DF250
Grind (53.7%-200 m)	15	67		7 x 14 RM	4.0									
Condition	5	45	7.4	1000-g cell		0.40								
Pb flotation	12	25				0.20	0.1	0.04					4.0	
Zn condition	10	25			4.0				6.0	3.0	1.0			
Zn flotation	8	25	11.0										15.0	0.60 0.03
No. 1 Zn clean	2			500-g cell										
No. 2 Zn clean	1			250-g cell										
PRODUCT	WT %	ANALYSIS %*					DISTRIBUTION %							
		Pb	Zn				Pb	Zn						
Ro Pb conc	47.7		42.10	13.24						89.1	33.3			
Cl Zn conc	6.4		12.63	37.20						3.6	12.5			
Cl Zn tail	13.9		2.83	32.80						1.7	24.1			
Recl Zn tail	8.4		6.92	40.00						2.6	17.7			
Ro Zn conc (calcd)	28.7		6.21	35.89						7.9	54.3			
Ro tail	23.6		2.91	10.00						3.0	12.4			
Feed (calcd)	100.0		22.55	18.98						100.0	100.0			
REMARKS: * From Internal Report MS-AC-69-731.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 23		SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34						DATE: Sept. 24, 1969						
OBJECT OF TEST: Pb-Zn separation						CHARGE: 1000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammon Phos	404	ZnSO ₄	A.31	Z-11	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	3037	DF250
Grind (53.7%-200 m)	15	67		7 x 14 RM	4.0									
Condition	5	45		1000-g cell		0.25	0.20		0.10					
Pb flotation	10	25	7.5			0.20		0.02						
Zn condition	10	25								4.0	6.0			
Zn flotation	5	25	11.0									15.0	0.30	0.015
Pb clean	2			250-g cell										
Zn clean	1.5			250-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
		Pb	Zn					Pb	Zn					
Clean Pb conc	17.8	45.05	11.92					37.1	11.5					
Clean Pb tail	12.5	28.47	16.44					16.5	11.1					
Rough Pb conc (calcd)	30.3	38.21	13.79					53.6	22.6					
Clean Zn conc	22.5	27.04	25.44					28.2	30.9					
Clean Zn tail	17.4	10.89	27.63					8.8	25.9					
Rough Zn conc (calcd)	39.9	20.00	26.40					37.0	56.8					
Rougher tail	29.8	6.80	12.84					9.4	20.6					
Feed (calcd)	100.0	21.58	18.54					100.0	100.0					
REMARKS: * From Internal Report MS-AC-69-733.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 24	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34						DATE: Oct. 16, 1969							
OBJECT OF TEST: Pb-Zn separation						CHARGE: 1000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	A.31	CuSO ₄	Na ₂ S	404	Z-5	Na ₂ CO ₃	Na ₂ SiO ₃	3037	DF250
Grind (53.7%-200 m)	15	67		7 x 14 RM	4.0 ⁽¹⁾									
Condition	5	45	7.5	1000-g cell		0.04	2.0							
Pb flotation	11	25				0.04		0.3	0.25	0.25				
Zn condition	10	25	9.8		4.0		1.5				6.0	9.0		
Zn flotation	10	25	9.8					17.0					0.30	0.03
Pb clean	2.5													
Zn clean	2.5													
PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %						
			Pb	Zn					Pb	Zn				
Clean Pb conc	18.1		42.28	12.90					35.6	12.5				
Clean Pb tail	27.4		27.84	18.23					35.4	26.8				
Rough Pb conc (calcd)	45.5		33.58	16.11					71.0	39.3				
Clean Zn conc	15.7		32.12	22.63					23.4	19.0				
Clean Zn tail	21.1		4.00	26.85					3.9	30.4				
Rough Zn conc (calcd)	36.8		16.00	25.05					27.3	49.4				
Rougher tail	17.7		2.08	11.95					1.7	11.3				
Feed (calcd)	100.0		21.54	18.66					100.0	100.0				
REMARKS: * From Interanal Report MS-AC-69-749														
(1) Additional reagents added to grind ZnSO ₄ = 0.80 and NaCN 0.20 lb/ton.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 25	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34										DATE: Oct. 17, 1969					
OBJECT OF TEST:	Pb-Zn Separation at fine grind										CHARGE: 1000-g					
											TESTED BY: W.A.W.					
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton											
					Ammo. Phos	404	Z-5	A.31	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	3037	DF250			
Grind (approx. 75%-200m)	25	67		7 x 14 RM	4.0											
Condition	5	45		1000-g cell		0.25	0.10	0.04								
Pb flotation	5	25	7.2			0.13										
Zn condition	10	25	10.9						4.0	6.0	15.0	0.25	0.03			
Zn flotation	7	25										0.25				
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %								
		Pb	Zn					Pb	Zn							
Lead conc	31.1	38.60	13.93					56.3	23.1							
Zinc conc	29.8	25.18	21.75					35.2	34.6							
Rougher tail	39.1	4.61	20.20					8.5	42.3							
Feed (calcd)	100.0	21.31	18.71					100.0	100.0							
REMARKS: * From Internal Report MS-AC-69-756.																

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 26	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34										DATE: Oct. 17, 1969						
OBJECT OF TEST: Pb-Zn separation at coarse grind											CHARGE: 1000-g						
											TESTED BY: W.A.W.						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton												
					Phos	CuSO ₄	A.31	404	Z-5	Na ₂ S	Na ₂ CO ₃	3037	DF250				
Grind (44%-200 m)	10	67		7 x 14 RM	4.0 ¹⁾												
Condition	5	45	7.5	1000-g cell		2.0	0.04	0.20	0.05								
Pb flotation	10	25						0.25	0.30	0.3							
Zn condition	10	25	9.4		4.0							6.0					
Zn flotation	7	25									15.0		0.60	0.03			
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %									
			Pb	Zn					Pb	Zn							
Lead conc	49.3		32.92	16.25					75.7	43.7							
Zinc conc	2.5		15.48	12.08					1.8	1.6							
Rougher tail	48.2		10.00	20.78					22.5	54.7							
Feed (calcd)	100.0		21.44	18.33					100.0	100.0							
REMARKS: * From Internal Report MS-AC-69-756																	
1) Additional Reagents to grind ZnSO ₄ -0.80, and NaCN-0.20 lb/ton																	

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 27		SAMPLE: Cadillac Exploration - Sulphide Ore						DATE: Nov. 5, 1969					
OBJECT OF TEST;		Preliminary test						CHARGE: 1000-g					
								TESTED BY: W.A.W.					
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					CaO	Z-11	404	A.31	CA	CuSO ₄	CaO	DF250	
Grind (74.5%-200 m)	15	67		7 x 14 RM									
Condition	5	45	7.5	1000-g cell	1.0	0.1	0.04	0.04					
Pb float	6	30	7.5						0.03				
Zn condition	10	30	10.5			0.05				2.0	2.0		
Zn float	3	30	10.5									0.03	
Pb Conc Clean	2			500-g cell									
PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %					
		Ag ⁽¹⁾	Cu	Pb	N.S.Pb	Zn	N.S.Zn	Ag	Cu	Pb	Zn		
Cl Pb conc	36.2	21.51	2.06	36.92		32.36		79.1	78.9	84.7	38.8		
Cl Pb tail	36.6	3.86	0.36	4.09		44.10		14.3	14.0	9.5	53.5		
Ro Pb conc (calcd)	72.8	12.64	1.22	20.40		38.30		93.4	92.9	94.2	92.3		
Zinc conc	5.0	7.14	0.32	9.90		29.12		3.6	1.7	3.1	4.8		
Ro tail	22.2	1.32	0.23	1.93		3.92		3.0	5.4	2.7	2.9		
Feed (calcd)	100.0	9.85	0.94	15.79		30.18		100.0	100.0	100.0	100.0		
Feed (assay)		9.95	1.00	17.40	1.94	30.80	1.14						

REMARKS: * From Internal Report MS-AC-69-779, 784 and 822.
(1) ounce per ton

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 28		SAMPLE: Cadillac Exploration - Sulphide Ore						DATE: Nov. 6, 1969						
OBJECT OF TEST: Preliminary Reagent Investigation								CHARGE: 1000-g						
								TESTED BY: W.A.W.						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	Z-11	404	A.31	CA	CaO	CuSO ₄			
Grind (74.5%-200 m)	15	67		7 x 14 RM	4.0									
Condition	5	45	8.1	1000-g cell		0.1	0.05	0.06						
Pb float	6	30							0.03					
Zn condition	10	30	9.2			0.05				2.0	2.0			
Zn float	3	30	9.2											
Pb clean	3.5													
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Cu	Pb	Zn				Cu	Pb	Zn			
C1 Pb conc.	24.3		3.44	55.9	17.14					82.0	81.9	13.5		
C1 Pb tail	28.0		0.35	7.05	56.65					9.6	11.9	51.4		
Ro Pb conc	52.3		1.79	29.63	38.30					91.6	93.8	64.9		
Zn conc	20.4		0.29	3.26	49.00					5.8	4.0	32.4		
Ro tail	27.3		0.10	1.35	3.06					2.6	2.2	2.7		
Feed (calcd)	100.0		1.02	16.59	30.86					100.0	100.0	100.0		
Zn conc plus c1 Pb tail	48.4		0.32	5.45	53.42					15.4	15.9	83.8		

REMARKS: * From Internal Report MS-AC-69-822

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 29	SAMPLE: Cadillac Exploration - Sulphide Ore										DATE: Nov. 7, 1969			
OBJECT OF TEST: Preliminary Reagent Investigation											CHARGE: 1000-g			
											TESTED BY: W.A.W.			
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄		
Grind (74.5%-200 m)	15	67		7 x 14 RM	0.2	0.8	1.0	0.04						
Condition	5	45	7.0	1000-g cell					0.2	0.05				
Pb float	6	25	7.0								0.03			
Zn condition	10	30	10.1				2.0					2.0		
Zn float	6	30	10.1						0.05					
Pb clean	2			500-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Cu	Pb	Zn				Cu	Pb	Zn			
Cl Pb conc	64.3		1.39	21.92	38.92				89.1	91.6	83.8			
Cl Pb tail	13.3		0.47	5.92	27.65				6.3	5.1	12.3			
Ro Pb conc (calcd)	77.6		1.23	19.18	36.99				95.4	96.7	96.1			
Zn conc	5.4		0.36	3.82	11.50				1.9	1.4	2.1			
Ro tail	17.0		0.16	1.74	3.24				2.7	1.9	1.8			
Feed (calcd)	100.0		1.00	15.38	29.88				100.0	100.0	100.0			
REMARKS: * From Internal Reports MS-AC-69-940														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 30	SAMPLE: Cadillac Exploration - Sulphide Ore							DATE: Nov. 7, 1969					
OBJECT OF TEST: Grind coarser, Reagents same as Test 29							CHARGE: 1000-g		TESTED BY: W.A.W.				
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄	
Grind (58%-200 m)	10	67		7 x 14 RM	0.2	0.8	1.0	0.04					
Condition	5	45	7.1	1000-g cell					0.2	0.05			
Pb float	6	30									0.03		
Zn condition	10	30	10.1				2.0					2.0	
Zn float	3										0.015		
Pb clean	2			500-g cell									
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %					
			Cu	Pb	Zn				Cu	Pb	Zn		
Cl Pb conc	32.3		2.3	38.24	31.24				74.8	85.7	33.0		
Cl Pb tail	36.4		0.5	3.61	47.82				18.3	9.1	57.0		
Rougher Pb conc	68.7		1.35	19.89	40.00				93.1	94.8	90.0		
Zn conc	6.7		0.39	4.20	33.00				2.6	2.0	7.2		
Rougher tail	24.6		0.17	1.90	3.40				4.3	3.2	2.8		
Feed (calcd)	100.0		0.99	14.41	30.54				100.0	100.0	100.0		
Zn conc plus Cl Pb tail	43.1		0.48	3.70	45.52				20.9	11.1	64.2		
REMARKS: * From Internal Report MS-AC-69-940													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 31	SAMPLE: Cadillac Exploration - Sulphide Ore							DATE: Nov. 7, 1969						
OBJECT OF TEST: Repeat of Test 28 but at coarser grind							CHARGE: 1000-g			TESTED BY: W.A.W.				
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	Z-11	404	A.31	DF250					
Grind (58%-200 m)	10	67		7 x 14 RM	4.0									
Condition	5	45	7.9	1000-g cell		0.10	0.05	0.04						
Pb float	2.5	30	7.9											
Seavenger float	4.5	30	7.9						0.015					
PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %						
			Cu	Pb	Zn				Cu	Pb	Zn			
Pb conc	24.1		3.70	58.20	16.05				86.7	87.5	12.2			
Scavenger conc	26.5		0.33	4.36	57.70				8.6	7.2	48.2			
Rougher tail**	49.4		0.10	1.71	25.45				4.7	5.3	39.6			
Feed (calcd)	100.0		1.03	16.03	31.73				100.0	100.0	100.0			
REMARKS: * From Internal Report MS-AC-70-83 ** No zinc flotation attempted.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 32	SAMPLE: Cadillac Exploration - Sulphide Ore										DATE: Nov. 10, 1969						
OBJECT OF TEST: Repeat of Test 30 Reagents but with scavenger float as in Test 31										CHARGE: 1000-g							
										TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton												
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄					
Grind (58%-200 m)	10	67		7 x 14 RM	0.2	0.8	1.0	0.04									
Condition	5	47	7.1	1000-g cell						0.1	0.05						
Pb float	4	30	7.1														
Scavenger float	4	30	7.1									0.015					
Zn condition	10	30	10.4				2.0							2.0			
Zn float	2	35								0.05		0.015					
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %									
			Cu	Pb	Zn				Cu	Pb	Zn						
Pb conc	52.6		1.61	25.00	36.00				85.9	88.3	64.5						
Scavenger conc	29.8		0.33	4.45	32.00				9.9	8.8	32.5						
Zn conc	1.6		0.35	4.00	10.84				0.6	0.5	0.6						
Rougher tail	16.0		0.22	2.22	4.44				3.6	2.4	2.4						
Feed (calcd)	100.0		0.99	14.90	29.36				100.0	100.0	100.0						
Scav. conc + Zn conc	31.4		0.33	4.43	30.92				10.5	9.3	33.1						
REMARKS: * From Internal Report MS-AC-70-83																	

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 33	SAMPLE: Cadillac Exploration - Sulphide Ore							DATE: Nov. 10, 1969						
OBJECT OF TEST: Repeat of Test 32 at finer grind							CHARGE: 1000-g							
							TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄		
Grind (91.5%-200 m)	20	67		7 x 14 RM	0.2	0.8	1.0	0.04						
Condition	5	47	7.1	1000-g cell					0.2	0.05				
Pb float	2	30												
Scavenger float	4	30									0.015			
Condition	10	25	10.4				2.0					2.0		
Zn float	*								0.05					
PRODUCT	WT %	ANALYSIS % (1)						DISTRIBUTION %						
			Cu	Pb	Zn				Cu	Pb	Zn			
Pb conc	27.0		2.69	49.20	16.97				75.9	84.0	15.3			
Scavenger conc	47.0		0.42	4.00	50.00				20.6	11.9	78.5			
Ro tail	26.0		0.13	2.48	7.20				3.5	4.1	6.2			
Feed (calcd)	100.0		0.96	15.81	29.95				100.0	100.0	100.0			
REMARKS: * No zinc float obtained (1) From Internal Report MS-AC-70-83														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 34	SAMPLE: Cadillac Exploration - Sulphide Ore	DATE: Dec. 4, 1969
OBJECT OF TEST: Repeat of Test 31 with longer conditioning and a zinc float		CHARGE: 1000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	Z-11	404	A.31	CaO	CuSO ₄	Z-200			
Grind (58%-200 m)	10	67		7 x 14 RM										
Condition	25	45	7.1	1000-g cell	4.0	0.05	0.05	0.02						
Pb float	3	25	7.1					0.02						
Zn condition	10	25	9.0						2.0	2.0	0.05			
Zn float	3	25												
Pb conc clean	1½			250-g cell										
Zn conc clean	3			1000-g cell										

PRODUCT	WT %	ANALYSIS % *					DISTRIBUTION %		
		Cu	Pb	Zn			Cu	Pb	Zn
Cl Pb conc	24.5	34.6	54.75	18.13			81.1	81.3	14.7
Cl Pb tail	21.1	0.27	5.04	55.80			5.5	6.4	39.1
Ro Pb conc	45.6	1.98	31.75	35.56			86.6	87.7	53.8
Cl Zn conc	24.9	0.32	4.36	51.07			7.6	6.6	42.2
Cl Zn tail	6.2	0.64	9.38	14.00			3.8	3.5	2.8
Ro Zn conc	31.1	0.39	5.36	43.68			11.4	10.1	45.0
Rougher tail	23.3	0.09	1.55	1.50			2.0	2.2	1.2
Feed (calcd)	100.0	1.04	16.50	30.15			100.0	100.0	100.0
Cl Pb tail + Cl Zn conc	46.0	0.30	4.67	53.24			13.1	13.0	81.3

REMARKS: * From Internal Report MS-AC-70-93

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 35		SAMPLE: Cadillac Exploration - Sulphide Ore										DATE: Dec. 4, 1969			
OBJECT OF TEST: Repeat of Test 31 with zinc float instead of scavenger float												CHARGE: 1000-g		TESTED BY: W. A. W.	
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton										
					Ammo Phos	Z-11	404	A.31	CaO	CuSO ₄	DF250				
Grind (58.0%-200 m)	10	67		7 x 14 RM	4.0										
Condition	5	45	8.2	1000-g cell		0.1	0.05	0.04							
Pb float	5	25	8.2												
Zn condition	5	25	8.2						2	2					
Zn float	10	25	8.2								0.03				
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %							
			Cu	Pb	Zn				Cu	Pb	Zn				
Pb conc	22.3		3.60	61.95	9.10				79.1	85.1	6.7				
Zn conc	48.0		0.36	3.83	54.00				17.1	11.3	85.2				
Ro tail	29.7		0.13	2.00	8.27				3.8	3.6	8.1				
Feed (calcd)	100.0		1.01	16.24	30.41				100.0	100.0	100.0				
REMARKS: * From Internal Report MS-AC-70-83															

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 37	SAMPLE: Cadillac Exploration - Sulphide Ore	DATE: Dec. 30, 1969
OBJECT OF TEST: Repeat of Test 33 with zinc float instead of scavenger float		CHARGE: 1000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton											
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄				
Grind (91.5%-200 m)	20	67		7 x 14 RM	0.2	0.8	1.0	0.04								
Condition	5	45	7.1	1000-g cell					0.1	0.05						
Pb float	2	30	7.1													
Zn condition	5	30	9.6				1.0		0.1		0.015	1.0				
Zn float	7	30	9.6								0.05					

PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %			
		Cu	Pb	Zn				Cu	Pb	Zn	
Lead concentrate	25.8	2.88	52.40	17.20				75.4	82.0	14.4	
Zinc concentrate	50.3	0.42	4.51	49.92				21.4	13.8	81.7	
Tailing	23.9	0.13	2.91	5.00				3.2	4.2	3.9	
Feed (calcd)	100.0	0.98	16.48	30.74				100.0	100.0	100.0	

REMARKS: * From Internal Report MS-AC-70-98

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 38	SAMPLE: Cadillac Exploration - Sulphide Ore										DATE: Dec. 30, 1969				
OBJECT OF TEST: Affect of sodium Sulphite as zinc depressant										CHARGE: 1000-g					
										TESTED BY: W.A.W.					
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton										
					NaCN	ZnSO ₄	CaO	Na ₂ SO ₃	A.31	Z-11	404	DF250	CuSO ₄		
Grind (91.5%-200 m)	20	67		7 x 14 RM	0.2	0.8	1.0	1.0	0.04						
Condition	5	50		1000-g cell							0.10	0.05			
Lead float	3	25	7.2												
Scavenger float	2.5	25	7.2										0.015		
Zinc condition	5	25	10.3					1.0			0.10		0.015	1.0	
Zinc float	3	25	10.3												
Lead clean	3			250-g cell											
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %							
			Cu	Pb	Zn				Cu	Pb	Zn				
Cl Pb conc	30.8		2.61	44.38	24.96				82.6	85.1	25.6				
Cl Pb tail	26.1		0.27	3.16	51.92				7.2	5.1	45.2				
Ro Pb conc (calcd)	56.9		1.54	25.47	37.33				89.8	90.2	70.8				
Scavenger conc	18.2		0.26	4.16	35.32				4.8	4.7	21.4				
Zinc conc	7.4		0.27	4.16	15.51				2.1	1.9	3.8				
Rougher tail	17.5		0.18	2.91	6.78				3.3	3.2	4.0				
Feed (calcd)	100.0		0.97	16.07	30.00				100.0	100.0	100.0				
Combined Zn conc**	51.7		0.26	3.65	40.86				14.1	11.7	70.4				
REMARKS: * From Internal Report MS-AC-70-99															
** Combination of Cl Pb tail, scavenger conc and zinc conc.															

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 39		SAMPLE: Cadillac Exploration - Sulphide Ore							DATE: Dec. 30, 1969					
OBJECT OF TEST: Repeat of Test 38 at a coarser grind									CHARGE: 1000-g		TESTED BY: W.A.W.			
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	Na ₂ SO ₃	CaO	A.31	Z-11	404	DF250	CuSO ₄	
Grind (74.5%-200 m)	15	67		7 x 14 RM	0.2	0.8	1.0	1.0	0.04					
Condition	5	50	8.0	1000-g cell						0.05	0.05			
Lead float	6	30	8.0											
Scavenger float	4	30	7.4							0.05		0.015		
Zinc float	5	30	9.7					0.5		0.05				0.5
Clean lead zone	3			250-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Cu	Pb	Zn				Pb	Zn				
Clean Pb conc	23.8			54.60	15.60				84.9	12.9				
Clean Pb tail	20.2	0.43		4.17	7.03				5.5	4.9				
Rougher Pb conc (calcd)	44.0			31.45	11.67				90.4	17.8				
Scavenger conc	40.8	0.12		2.18	54.06				5.8	76.3				
Zinc conc	3.2			10.55	29.30				2.2	3.2				
Rougher tail	12.0	0.10		2.06	6.47				1.6	2.7				
Feed (calcd)	100.0			15.31	28.90				100.0	100.0				
Scav. conc plus Zn conc	44.0			2.79	52.26				8.0	79.5				
REMARKS: * From Internal Report MS-AC-70-99 and Bondar-Clegg & Co. Ltd. Report A-11-70														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 40	SAMPLE: Cadillac Exploration - Sulphide Ore										DATE: Jan. 2, 1970				
OBJECT OF TEST: Sulphidize lead minerals											CHARGE: 1000-g				
											TESTED BY: W.A.W.				
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton										
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	Na ₂ S	DF250	CuSO ₄		
Grind (74.5%-200 m)	15	67		7 x 14 RM	0.2	0.8	1.0	0.04							
Condition	5	50		1000-g cell					0.05	0.05					
Lead float	5	30	8.2						0.05		2.0	0.015			
Zinc condition	5	25	11.1				2.0							1.0	
Zinc float	7	25	11.0						0.05			0.03			
Clean lead conc	2			250-g cell											
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %							
				Pb	Zn				Pb	Zn					
Clean Pb conc	25.3			53.80	16.20				85.3	13.7					
Clean Pb tail	3.9			10.89	42.36				2.7	5.5					
Rougher Pb conc (calcd)	29.2			48.07	19.70				88.0	19.2					
Zinc conc	46.3			3.05	50.10				8.8	77.6					
Rougher tail	24.5			2.09	3.89				3.2	3.2					
Feed (calcd)	100.0			15.90	29.90				100.0	100.0					
Cl Pb tail + Zn conc (calcd)	50.2			3.66	49.50				11.5	83.1					
REMARKS: * From Internal Report MS-AC-70-99 and Bondar-Clegg Co. Ltd., Report A-11-70.															

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 41	SAMPLE: Cadillac Exploration - Sulphide Ore										DATE: Jan. 12, 1970			
OBJECT OF TEST: Flotation at 15% solids											CHARGE: 1000-g			
TESTED BY: W.A.W.														
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄		
Grind (91.5%-200 m)	20	67		7 x 14 RM	0.2	0.8	1.0	0.04						
Condition	5	50	7.2	2000-g cell					0.1	0.05	0.015			
Lead float	5	15	7.2											
Zinc condition	5	15	9.0				1.0		0.2	0.10	0.03	1.0		
Zinc float	5	15	9.0											
Clean lead conc (twice)	2			500-g cell										
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
				Pb	Zn				Pb	Zn				
Clean Pb conc	21.2			56.95	18.28				73.3	12.5				
Clean Pb tail	45.7			7.00	51.42				19.4	75.7				
Rougher Pb conc (calcd)	66.9			22.83	40.92				92.7	88.2				
Zinc conc	15.2			5.71	20.39				5.3	10.0				
Rougher tail	17.9			1.89	3.20				2.0	1.8				
Feed (calcd)	100.0			16.48	31.04				100.0	100.0				
Combined Cl Pb tail and Zn conc (calcd)	60.9			6.68	43.67				24.7	85.7				
REMARKS: * From Internal Report MS-AC-70-99														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 42	SAMPLE: Cadillac Exploration - Sulphide Ore							DATE: Jan. 13, 1970					
OBJECT OF TEST: Flotation at 33% solids							CHARGE: 1000-g						
							TESTED BY: W.A.W.						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					NaCN	ZnSO ₄	CaO	A. 31	Z-11	404	DF250	CuSO ₄	
Grind (91.5%-200 m)	20	67		7 x 14 RM	0.2	0.8	1.0	0.02					
Condition	5	50	7.2	1000-g cell					0.05	0.10			
Lead float	6	33	7.2										
Zinc condition	10	30	9.4				1.0		0.20	0.10	0.03	1.0	
Zinc float	6	30											
Clean Pb conc	2	8		500-g cell									
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %					
		Ag(l)	Cu	Pb	Zn			Ag	Pb	Zn			
Cl Pb conc	20.2	35.94		67.80	5.90			77.0	83.6	4.0			
Cl Pb tail	10.3	13.16	1.47	8.28	46.67			14.6	5.2	16.2			
Rougher Pb conc (calcd)	30.5	27.91		47.37	19.67			91.6	88.8	20.2			
Zinc conc	49.2	3.08		2.61	46.30			5.7	7.8	76.9			
Rougher tail	20.3	1.23	0.13	2.76	4.24			2.7	3.4	2.9			
Feed (calcd)	100.0	9.30		16.39	29.64			100.0	100.0	100.0			
Combined Cl Pb tail and Zn conc (calcd)	59.5	3.17		3.59	46.36			20.3	13.0	93.1			
REMARKS: * From Internal Report MS-AC-70-88 and 99 and Bondar-Clegg Co. Ltd. Report A-11-70													
(l)ounces per ton													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 43		SAMPLE: Cadillac Exploration - Sulphide Ore						DATE: Jan. 15, 1970						
OBJECT OF TEST: Copper-lead separation.								CHARGE: 3000-g						
								TESTED BY: W.A.W						
OPERATION	Time min.	% Solids	PH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	CaO	A.31	Z-11	404	DF250	CuSO ₄	S.B.	H ₂ SO ₄
Grind (74.5%-200 m)	15	67		7 x 14 RM		1.0	1.0	0.02						
Condition	5	50	6.9	2000-g cell					0.05	0.05				
Lead-copper float	10	32	6.9						0.017*	0.017*	0.03			
Zinc condition	10		9.8				1.0		0.20	0.10		2.0		
Zinc float	8	30									0.03			
Clean zinc conc	2			2000-g cell										
Clean Pb-Cu conc	3	10		1000-g cell	0.1	0.15								
Reclean Pb-Cu conc	3			1000-g cell	0.05	0.15								
Re-Reclean Pb-Cu conc	5			1000-g cell		1.0								
Lead-copper separation	3		5.5	1000-g cell									1.5	10
Clean Cu conc	2			500-g cell									2.0	
Reclean Cu conc	2			500-g cell									2.0	

PRODUCT	WT %	ANALYSIS % ⁽¹⁾					DISTRIBUTION %				
		Ag ⁽²⁾⁽⁵⁾	Cu	Pb	Zn		Ag	Cu ⁽⁴⁾	Pb	Zn	
Reclean Copper conc	2.0	220.46	27.90	8.30	12.20		44.8	55.9	1.1	0.8	
Lead conc. (3)	14.7	21.04	1.25	72.90	6.10		31.5	18.4	68.6	3.0	
Re-Reclean Pb-Cu conc (calcd)	16.7	44.92	4.44	65.16	6.83		76.3	74.2	69.7	3.8	
Pb-Cu clean & reclean tail	11.9	6.29		12.50	50.90		7.6		9.5	20.5	
Pb-Cu Re-reclean tail	4.5	15.86		47.80	20.00		7.3		13.8	3.0	
Pb-Cu rougher conc (calcd)	33.1	27.00		43.87	24.47		91.2		93.0	27.3	
Cl Zinc conc	32.0	1.50		0.85	60.90		4.9		1.7	65.8	
Cl Zinc tail	8.4	3.34		5.60	20.60		2.9		3.0	5.9	
Ro Zinc conc (calcd)	40.4	1.88		1.84	52.52		7.8		4.7	71.7	
Rougher tail	26.5	0.385		1.35	1.08		1.0		2.3	1.0	
Feed (calcd)	100.0	9.83		15.62	29.60		100.0		100.0	100.0	

REMARKS: * Stage added	(1) Bondar and Clegg Report No. A-14-9.	(2) From Internal Report MS-AG-70-124.
	(3) Lead conc plus clean & reclean Cu tails.	(4) Based on Assay Head 1.00% copper.
		(5) ounces per ton.

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 44	SAMPLE: Cadillac - Exploration - Sulphide Ore							DATE: Jan. 27, 1970					
OBJECT OF TEST: Promoter Z-200							CHARGE: 3000-g						
							TESTED BY: W.A.W.						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					ZnSO ₄	CaO	A.31	Z-200	DF250	Z-6	CuSO ₄	NaCN	
Grind (74.5%-200 m)	15	67		7 x 14 RM	1.0	1.0	0.02						
Condition	5	50	6.9	2000-g cell				0.03	0.015				
Pb float	10	35	6.9					0.10					
Pb float	6	35	5.8					0.10		0.03			
Zn condition	10	35	10.0			1.0			0.03		1.0		
Zn float	6	35	10.0							0.10			
Pb clean	2			1000-g cell	0.2							0.1	
Zn clean	2			2000-g cell									
PRODUCT	WT %	ANALYSIS % *					DISTRIBUTION %						
		Ag(l)	Pb	Zn			Ag	Pb	Zn				
Clean Pb conc	14.1	47.76	53.30	13.45			67.7	42.2	6.3				
Clean Pb tail	14.6	13.12	24.90	33.80			19.2	20.4	16.4				
Rougher Pb conc (calcd)	28.7	30.14	38.85	23.80			86.9	62.6	22.7				
Clean Zn conc	24.7	2.18	6.87	54.50			5.4	9.5	44.6				
Clean Zn tail	23.9	2.22	14.30	38.00			5.3	19.2	30.5				
Rougher Zn conc (calcd)	48.6	2.20	10.52	46.63			10.7	28.7	75.1				
Rougher tail	22.7	1.04	6.79	2.93			2.4	8.7	2.2				
Feed (calcd)	100.0	9.96	17.81	30.16			100.0	100.0	100.0				
REMARKS: *From Internal Report MS-AC-70-124 and Bondar-Clegg Co. Ltd., Report A-20-70.													
(1) Ounces per ton.													

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 45	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34							DATE: April 14, 1970								
OBJECT OF TEST: Pb - Zn separation							CHARGE: 1000-g									
							TESTED BY: W.A.W.									
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton											
					Ammo Phos.	404	Z-11	A. 31	Na ₂ S	Na ₂ CO ₃	Na ₂ SiO ₃	CuSO ₄	3037	DF250		
Grind (53.7%-200 m)	15	67		7 x 14 RM	4.0											
Condition	5	45	7.0	1000-g cell		0.40										
No. 1 Pb floatation	3	30														
No. 2 Pb floatation	9	25	8.3			0.20	0.10	0.04	4.0							
Zn condition	10	25			4.0					6.0	6.0	1.0				
Zn floatation	12	25	10.3						15.0				0.60	0.03		
No. 1 Pb conc clean	1			250-g cell												
No. 2 Pb conc clean	2			500-g cell												
Zn conc clean	3			500-g cell												
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %								
		Pb	NS Pb	S. Pb	Zn	NS Zn	S. Zn	Pb	NS Pb	S. Pb	Zn	NS Zn				
No. 1 Clean Pb conc	4.7	61.12	36.12	25.00	6.00	5.58	0.42	12.6	8.2	54.0	1.5	1.5				
No. 1 Clean Pb tail	5.4	36.32	33.43	2.89	14.60	14.41	0.19	8.6	8.7	7.2	4.3	4.3				
No. 1 Ro Pb conc (calcd)	10.1	47.86	34.68	13.18	10.59	10.59	0.29	21.2	16.9	61.2	5.8	5.8				
No. 2 Clean Pb conc	9.4	32.37	30.37	2.39	16.00	15.79	0.21	13.5	13.8	10.3	8.2	8.2				
No. 2 Clean Pb tail	13.4	24.58	23.61	0.97	18.40	18.07	0.33	14.4	15.3	6.0	13.5	13.4				
No. 2 Ro Pb conc (calcd)	22.8	27.95	26.40	1.55	17.41	17.13	0.28	27.9	29.1	16.3	21.7	21.6				
Combine Ro Pb conc	32.9	34.06	28.94	5.12	15.32	15.03	0.29	49.1	46.0	77.5	27.5	27.4				
Clean Zn conc	10.8	39.57	38.12	1.45	16.80	16.72	0.08	18.7	19.9	7.2	9.9	10.0				
Clean Zn tail	9.5	23.62	22.43	1.19	19.20	19.06	0.14	9.8	10.3	5.2	10.0	10.0				
Ro Zn conc (calcd)	20.3	32.11	30.78	1.33	17.92	17.82	0.08	28.5	30.2	12.4	19.9	20.0				
Rougher tail	46.8	10.97	10.50	0.47	20.60	20.33	0.27	22.4	23.8	10.1	52.6	52.6				
Feed (calcd)	100.0	22.86	20.68	2.18	18.32	18.08	0.24	100.0	100.0	100.0	100.0	100.0				
REMARKS: * From Internal Report MS-AC-70-431																

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 46	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34							DATE: April 14, 1970						
OBJECT OF TEST: Pb - Zn separation							CHARGE: 1000-g							
							TESTED BY: W.A.W							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Ammo Phos	404	Z-11	A. 31	DF250	Na ₂ S	Na ₂ CO ₃	Na ₂ SiO ₃	CuSO ₄	
Grind (53.7%-200 m)	15	67		7 x 14 RM	4.0									
Condition	5	45	6.8	1000-g cell		0.40								
No. 1 Pb flotation	5	30					0.10	0.04	0.03					
No. 2 Pb flotation	8	30	9.3			0.20				4.0				
Zn condition	10	25	10.4								6.0	8.0	1.0	
Zn flotation	4	25	10.4			0.20	0.10		0.03	15.0				
PRODUCT	WT %	ANALYSIS %*						DISTRIBUTION %						
		Pb	Zn					Pb	Zn					
No. 1 Pb conc	59.7	30.31	17.41					83.2	58.2					
No. 2 Pb conc	6.0	25.00	17.41					6.9	5.9					
Pb conc (calcd)	65.7	29.82	17.41					90.1	64.1					
Zn conc	6.2	16.64	17.58					4.7	6.1					
Rougher tail	28.1	4.00	18.96					5.2	29.8					
Feed (calcd)	100.0	21.75	17.86					100.0	100.0					
REMARKS: * From Internal Report MS-AC-70-510.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 47	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34							DATE: April 16, 1970						
OBJECT OF TEST: Pb-Zn selective flotation							CHARGE: 1000-g							
							TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Z-6	CA	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	404	A.31	P.O.	3037	
Grind (53.7%-200 m)	15	67		7 x 14 RM										
Condition	5	50		1000-g cell	0.10	0.04								
No. 1 Pb flotation	3.5	30	6.5											
Condition	5	30					2.0	2.0	1.0					
No. 2 Pb flotation	3	30	7.5		0.10						0.20			
Condition	5	30						1.0						
No. 3 Pb flotation	3	30			0.10						0.20	0.10		
Condition	5	30			0.1		3.0	1.0	10.0	0.20				
Zn flotation	3	25	10.5										0.03	0.40 0.03
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Pb	ZN					Pb	ZN				
No. 1 Pb conc	7.7		50.00	9.76					17.7	4.0				
No. 2 Pb conc	24.7		51.27	13.00					58.0	17.2				
No. 3 Pb conc	14.2		30.00	18.30					19.5	13.9				
Total Pb conc (calcd)	46.6		44.58	14.08					95.2	35.1				
Zn conc	32.8		2.15	25.59					3.2	44.8				
Bulk conc (calcd)	79.4		27.05	18.84					98.4	79.9				
Rougher tail	20.6		1.66	18.26					1.6	20.1				
Feed (calcd)	100.0		21.82	18.72					100.0	100.0				
REMARKS: * From Internal Report MS-AC-70-507.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 48	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34							DATE: April 16, 1970						
OBJECT OF TEST: Lead-zinc separation							CHARGE: 1000-g							
							TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Z-6	CA	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	ZnSO ₄	NaCN	3037	404	
Grind (53.7%-200 m)	15	67		7 x 14 RM										
Condition	5	50		1000-g cell	0.10	0.03								
No. 1 Pb float	3	30	6.5											
Condition	5		7.5				2.0	0.5	0.5	1.0	0.2			
No. 2 Pb float	3		8.8		0.10									0.2
Condition	5		8.4					0.5	0.5					
No. 3 Pb float	3		9.3		0.10									0.2
Zn condition	5		10.4		0.10			0.5	5.0			0.60	0.2	
Zn float	5													
PRODUCT	WT %	ANALYSIS % *					DISTRIBUTION %							
		Pb	ZN				Pb	ZN						
No. 1 Pb conc	11.0	46.56	10.73				23.5	6.3						
No. 2 Pb conc	27.6	52.37	11.69				66.4	17.2						
No. 3 Pb conc	5.2	22.22	21.15				5.3	5.9						
Bulk Pb conc (calcd)	43.8	47.33	12.59				95.2	29.4						
Zinc conc	30.3	2.31	32.25				3.2	52.3						
Bulk conc (calcd)	74.1	28.92	20.62				98.4	81.7						
Rougher tail	25.9	1.35	13.22				1.6	18.3						
Feed (calcd)	100.0	21.78	18.70				100.0	100.0						
REMARKS: * From Internal Report MS-AC-70-518.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 51	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34							DATE: April 24, 1970						
OBJECT OF TEST: Coarse grind							CHARGE: 2000-g							
							TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					NaCN	ZnSO ₄	Na ₂ CO ₃	Z-8	444	DF250	Na ₂ S	CuSO ₄	3037	
Grind (approx. 35%-200 m)	15	67		7 x 14 RM	0.50	1.50	3.0							
Condition	3	25	7.2	2000-g cell				0.05						
No. 1 float	5		9.0					0.05	0.25	0.04				
No. 2 "	5							0.10	0.50	0.05				
No. 3 "	5							0.10	0.50	0.05				
No. 4 "	10										2.0	1.0	1.2	
No. 5 "	5		9.8					0.40	1.00	0.05	10.0			0.6
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
			Pb	ZN					Pb	ZN				
No. 1 conc	6.1		52.31	13.33					14.1	4.3				
No. 2 conc	5.3		37.48	14.67					8.8	4.1				
No. 3 conc	14.8		42.49	14.22					27.7	11.1				
No. 4 conc	34.5		14.99	17.31					22.8	31.6				
No. 5 conc	13.4		14.99	19.56					8.9	13.8				
Rougher tail	25.9		15.51	25.63					17.7	35.1				
Feed (calcd)	100.0		22.65	18.93					100.0	100.0				
REMARKS: * From Internal Report MS-AC-70-531.														

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 52	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34							DATE: May 11, 1970							
OBJECT OF TEST: Zinc Recovery							CHARGE: 1000-g								
							TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton										
					Z-6	C.A.	Na ₂ CO ₃	Na ₂ SiO ₃	Na ₂ S	NaCN	ZnSO ₄	404	3037	CuSO ₄	
Grind (53.7%-200 m)	15	67		7 x 14 RM											
Condition	5	50	6.7	1000-g cell	0.10	0.04									
No. 1 Pb float	3	30	6.5												
Condition	5		7.5				3.0	1.0	1.0	0.20	1.00				
No. 2 Pb float	14		8.0		0.10							0.20			
Zinc condition ⁽¹⁾	5		9.8		0.10		6.0	8.0				0.20			1.0
Zinc float	5								18.0					0.80	
Zinc clean	3														
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %							
		Pb	ZN					Pb	ZN						
No. 1 Pb conc	5.0	56.55	8.27					12.7	2.2						
No. 2 Pb conc	17.6	28.82	16.48					22.9	15.7						
Combined Pb conc (calcd)	22.6	34.95	14.66					35.6	17.9						
Cl Zn conc	46.5	23.51	21.65					49.2	54.7						
Cl Zn tail	23.5	13.63	18.54					14.4	23.7						
Rougher Zn conc (calcd)	70.0	20.19	20.61					63.6	78.4						
Rougher tail	7.4	2.38	9.13					0.8	3.7						
Feed (calcd)	100.0	22.21	18.41					100.0	100.0						
REMARKS: * From Internal Report MS-AC-70-567															
(1) Additional Reagent Ammonium Phosphate 4.0 lb./ton															

MINES BRANCH FLOTATION TEST REPORT

TEST NO. 53	SAMPLE: Cadillac Exploration Sample No. 2, Lots 32, 33 and 34	DATE: May 12, 1970
OBJECT OF TEST: Zinc Recovery		CHARGE: 1000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton											
					Z-6	A.31	C.A.	Na ₂ CO ₃	Na ₂ S ₂ O ₃	NaCN	ZnSO ₄	404	Na ₂ S	3037		
Grind (53.7%-200 m)	15	67		7 x 14 RM												
Condition	5	50	6.8	1000-g cell	0.10	0.06	0.015									
Pb flotation No. 1	5	30	6.8													
Condition	5	30	7.3					2.0	1.5	0.2	1.0					
Pb flotation No. 2					0.20							0.40				
Condition ⁽¹⁾	5	25	10.5						12.0			0.20				
Zn flotation No. 1	5		11.0			0.04									15.0	1.0
Zn flotation No. 2	3		11.0			0.04									12.0	0.5

PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %			
		Pb	Zn					Pb	Zn		
No. 1 Pb conc	22.9	36.61	15.16					38.3	18.7		
No. 2 Pb conc	14.5	42.05	13.36					27.9	10.4		
Combined Pb conc (calcd)	37.4	38.72	14.46					66.2	29.1		
No. 1 Zn conc	25.4	25.10	20.85					29.1	28.6		
No. 2 Zn conc	4.7	8.52	20.55					1.8	5.2		
Combined Zn conc (calcd)	30.1	22.51	20.80					30.9	33.8		
Rougher tail	32.5	1.92	21.14					2.9	37.1		
Feed (calcd)	100.0	21.88	18.54					100.0	100.0		

REMARKS: * From Internal Report MS-AC-70-565
 (1) Additional Reagents; NaOH - 5.0, Ammo Phos, - 4.0; CuSO₄ - 2.0 lb/ton.