DY - PRELIMINARY LABORATORY TESTWORK

017396

P. J. Brown

August 23, 1978

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SUMMARY

An examination of high grade products derived from the laboratory tests failed to show the presence of deleterious elements in quantities which could affect marketability of concentrates. The metallurgical response of the ore was, as expected, similar to that exhibited by the Faro area ore bodies tested to date. Excessive zinc flotation in the lead circuit is the root of the problem, however, results from a single cleaning test indicated that the zinc could be cleaned out of the lead concentrate by regrinding with an appropriate reagent scheme.

More test work is required to make a realistic assessment of the probable metallurgy which DY ores, represented by DY-1 and DY-2, would exhibit in the Anvil concentrator. The probability of a favourable response is good.

INTRODUCTION

In late July, two samples of crushed core from the DY ore zone were received. The samples, designated DY-1 and DY-2, were respectively described as "high barite" and "high iron" ore types. On arrival at Faro, the samples were divided into 2.0 Kg lots prior to testing.

The objectives of this preliminary test work were:

(a) To attempt to produce from each ore type near saleable grade concentrates and to assess the level, if any, of possible deleterious elements.

(b) To attempt to assess if the ore would be suitable for blending and subsequent treatment with the present Anvil ore type and reagent scheme in the Anvil concentrator.

The work was performed in the Anvil laboratory during three afternoon shifts and the assays, on the samples generated, were carried out at the Kamloops Research and Assay Laboratory. Sufficient sample from DY-1 and DY-2 remain to permit a total of seven more tests to be performed.

THE LABORATORY TEST WORK - DISCUSSION

(a) Concentrate Metal Contents:

The two ore types, as received, were each sampled and the composition of the sample determined. The results are shown below in Table 1.

Table 1

Element %	Sample Composition	
	Sample DY-1	Sample DY-2
Cu	0.11	0.18
Pb	5.36	4.05
Zn	8.48	5.30
Fe	19.40	24.64
Po	3.6	3.2
Mn	0.28	0.23
Au	0.016	0.020
Ag	2.61	1.93
As	0.12	0.28
Hg	130.00	60.00
MgO	4.29	3.70
CaO	7.00	6.38
Bi	0.01	0.01
Insol.	30.30	27.71
Cd	0.030	0.036

Notes: 1) Po in terms of percentage iron in ferric form.

2) Silver and gold in terms of oz/SDT.

3) Hg in terms of p.p.m.

The details and procedures used in laboratory tests performed are described comprehensively in Appendix I. Primarily, the tests were designed to provide samples of near saleable grades of concentrates to facilitate impurity determination, and as a secondary objective, to provide some information regarding the metallurgical response of the ore to the standard Anvil test procedure.

Shown below in Table 2 are the ranges of composition of the high grade fractions obtained during the test work. To facilitate comparison, both DY-1 and DY-2 results are grouped together; recent Anvil data are shown also.

Table 2

Ranges of Composition of Concentrates

Element* %	DY Samples		Anvil	
	Lead Concentrate	Zinc Concentrate	Lead Concentrate	Zinc Concentrate
Cu	0.25 - 0.40	0.13 - 0.18	0.20 - 1.10	0.47 - 1.08
Pb	44.00 - 57.00	0.80 - 4.00	60.00 - 67.00	1.20 - 2.60
Zn	6.00 - 11.00	47.00 - 54.00	5.00 - 7.00	49.00 - 51.50
Fe	7.00 - 15.00	7.50 - 8.50	5.00 - 7.00	10.10 - 11.30
Au (TROZ/SDT)	0.05 - 0.12	ND	0.02 - 0.04	ND
Ag (TROZ/SDT)	18.00 - 23.00	1.00 - 2.50	8.00 - 15.00	1.00 - 2.00
As	0.10 - 0.30	0.10 - 0.15	0.02 - 0.07	0.01 - 0.18
Hg (ppm)	100.00 - 200.00	400.00 - 500.00	20.00 - 70.00	100.00 - 350.00
MgO	0.30	0.73	ND	ND
CaO	0.75	1.32	0.10 - 0.30	ND

Notes:

1) DY data represents average values obtained from concentrates produced during roughing and cleaning tests.
2) ND - not determined.
3) Anvil data based on Toho range of composition summary 1975-1977.

* Footnote: Details of these minor element assays are shown in Appendix II in the assay certificates.

The following points should be noted in regard to the concentrate assays shown in Table 2:

(i) The concentrate ranges shown represent high grade fractions produced during roughing-scavenging tests. They do not represent ultimate concentrate grades.

(ii) Although the mercury assays are quite high, especially in the zinc concentrates, the levels are not excessive and do not pose a significant threat to saleability. (Mercury in the Grum zinc concentrate is reported to average 650 ppm.)

(iii) Silver recovery into the lead concentrates appears excellent. Based on the results of the rougher tests, 80-85% of the silver could be recovered in the lead concentrate at about 20 oz Ag/SDT. However, the results of the lone cleaner test (No. 6 in Appendix I) suggest that possibly some of the silver is in the form of minerals which could be dispersed into the tailings during cleaning stages. Clearly, this is a point of some economic importance which would merit considerable additional test work.

(iv) Gold recovery is difficult to estimate from the available data, but a conservative estimate would be, of the total gold, 35-40% should report to the lead concentrate to average about 0.10 oz/ton of concentrate.

(v) Arsenic levels, particularly in the lead concentrates originating from DY-2 samples are high, averaging 0.30% As. However, an average 0.20 As in a lead concentrate and 0.15 As in zinc concentrates are quite acceptable. (Comparative Grum data indicate 0.10 As for both concentrates.)

(vi) CaO and MgO contents, which have some influence on the fluxing properties during smelting, are not at a level which could cause a conventional smelter any problems.

(b) Metallurgical Response:

In general, the metallurgical response to the standard test procedure was as expected, with good metal recoveries and extensive preactivation of zinc in the lead rougher circuit. Based on the test data, it would appear that DY ore, if treated in the Anvil concentrator with the existing reagent scheme, would result in a response quite similar to that exhibited by some Anvil ore types. Anvil laboratory and plant data and Grum laboratory and pilot plant test data show that about 45% of the zinc in the mill feed comprising these ores will float in the lead rougher scavenger concentrate; identical to the DY ore response in the laboratory test.

Much more test work will have to be completed before an accurate assessment of the response of the DY ore can be made. However, at this time, it is sufficient to note that the response appears to be precisely the same as the Anvil, Grum, Vangorda and Swim ore responses.

Of a more immediate interest, and rather surprisingly, the DY ore appears very friable. Based on the laboratory test work, the work index appears to be about 4-7 KWH/ton compared with 9-10 KWH/ton for normal Anvil ore. (See Appendix III for details of calculations.) Thus, provided, of course, that the samples are representative, grinding power requirements for DY type ore would be considerably less than for normal Anvil ore to achieve the same grind level.

A final point of interest was that only about 1500 g/ton (3.0 lb./ton) of soda ash were needed to achieve target lead flotation pH levels. This, despite the fact that the samples were not preserved under nitrogen and were thus free to oxidize for about one year. The conclusion is that the DY ore oxidizes somewhat more slowly than Anvil ore and oxidizes at a considerably lower rate than Grum ore.

CONCLUSIONS

1. The concentrates do not contain deleterious elements in quantities which could seriously affect marketability of the DY concentrates. If the DY concentrates are blended with Anvil concentrates in the ratio 1:3, the rise in the level of As and Hg would, in total, not be significant.

2. Silver and gold recovery in the lead concentrate are quite good - more work is needed to establish if a depressable silver mineral is present.

3. Metal recoveries in the DY ores are good. Preactivated zinc in the lead flotation circuit is a problem, but data indicates that regrinding may be the route to solving this problem.

4. Considerably more test work is needed to assess the probable metallurgical response of the ore. At this time, the possibility of a favourable response is good.

APPENDIX I

DETAILS OF FLOTATION TESTS

Test No. 1:

Purpose: Standard test procedure to evaluate flotation response.

Procedure: Grind and float five lead rougher scavenger concentrates and five rougher scavenger zinc concentrates.

Feed: 2.0 Kg minus 10 mesh of sample DY-1.

Grind: Standard.

Conditions:

	Reagents Added g/ton*						Time (minutes)			
Stage	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$Ca(OH)_2$	$CuSO_4$	Grind	Condition	Froth	pH
Primary Grind	1500	-	90	50	-	-	13	2	-	10.0
Lead Flotation	-	-	-	25	-	-	-	-	11	9.8
Conditioning	-	-	-	70	1500	500	-	10	-	11.1
Zinc Flotation	-	-	-	25	-	-	-	-	11	11.0

* Metric Ton

Metallurgical Results:

Product	Weight %	Assays			Distribution		
		Ag	Pb	Zn	Ag	Pb	Zn
Lead Rougher Concentrate No. 1	0.06	22.10	46.70	13.20	55.12	56.63	9.76
Lead Rougher Concentrate No. 2	0.04	12.30	28.00	18.00	19.92	22.05	8.65
Lead Scavenger Concentrate No. 1	0.05	4.40	9.50	20.70	9.46	9.93	13.20
Lead Scavenger Concentrate No. 2	0.02	3.30	6.60	20.20	2.20	2.14	4.00
Lead Scavenger Concentrate No. 3	0.03	2.00	3.50	16.40	2.74	2.33	6.66
Zinc Rougher Concentrate No. 1	0.06	0.87	0.86	50.50	2.19	1.05	37.66
Zinc Rougher Concentrate No. 2	0.03	1.11	1.05	40.50	1.10	0.51	11.94
Zinc Scavenger Concentrate No. 1	0.03	1.24	1.51	14.80	1.51	0.90	5.36
Zinc Scavenger Concentrate No. 2	0.02	1.06	1.48	4.40	0.89	0.60	1.09
Zinc Scavenger Concentrate No. 3	0.01	0.87	1.40	2.90	0.46	0.36	0.48
Zinc Scavenger Tailing	0.63	0.18	0.29	0.17	4.40	3.51	1.23
Heads		2.55	5.24	8.59			

Lead Cumulative Grades	Lead Cumulative Recoveries	Zinc Cumulative Grades	Zinc Cumulative Recoveries
46.70	56.63	50.50	37.66
39.34	78.67	47.67	49.60
29.10	88.60	39.18	54.96
26.93	90.75	33.96	56.05
23.07	93.07	31.27	56.50

Test No. 2:

Purpose: Standard test procedure with an attempt to reduce zinc and iron flotation in the lead circuit by additions of extra cyanide and sodium sulphite.

Procedure: Standard test with sulphite, extra cyanide and reduced collector additions.

Feed: 2.0 Kg minus 10 mesh of sample DY-1.

Grind: Standard.

Conditions:

	Reagents Added g/ton						Time (minutes)			
Stage	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$Ca(OH)_2$	$CuSO_4$	Grind	Condition	Froth	pH
Primary Grind	1500	1500	150	50	-	-	13	2	-	10.1
Lead Flotation	-	-	-	35	-	-	-	-	11	10.0
Conditioning	-	-	-	70	1500	500	-	10	-	11.1
Zinc Flotation	-	-	-	25	-	-	-	-	11	11.0

Metallurgical Results:

Product	Weight %	Assays			Distribution		
		Ag	Pb	Zn	Ag	Pb	Zn
Lead Rougher Concentrate No. 1	0.13	13.40	33.20	21.00	70.73	77.17	31.12
Lead Rougher Concentrate No. 2	0.02	10.10	23.10	25.00	9.10	9.17	6.32
Lead Scavenger Concentrate No. 1	0.02	4.93	9.80	28.70	3.52	3.08	5.75
Lead Scavenger Concentrate No. 2	0.02	2.90	5.50	27.40	2.28	1.91	6.06
Lead Scavenger Concentrate No. 3	0.02	2.00	3.40	28.20	1.82	1.36	7.21
Zinc Rougher Concentrate No. 1	0.05	1.06	0.89	49.90	2.05	0.76	27.06
Zinc Rougher Concentrate No. 2	0.01	1.33	1.19	38.60	0.81	0.32	6.63
Zinc Scavenger Concentrate No. 1	0.03	1.42	1.49	17.60	1.58	0.73	5.50
Zinc Scavenger Concentrate No. 2	0.03	1.16	1.43	5.90	1.39	0.74	1.96
Zinc Scavenger Concentrate No. 3	0.03	0.96	1.22	2.50	1.17	0.65	0.85
Zinc Scavenger Tailing	0.65	0.20	0.34	0.20	5.54	4.11	1.54
Heads		2.38	5.40	8.47			

Lead Cumulative Grades	Lead Cumulative Recoveries	Zinc Cumulative Grades	Zinc Cumulative Recoveries
33.20	77.17	49.90	27.06
31.73	86.34	47.18	33.69
29.45	89.42	38.17	39.19
27.00	91.32	30.29	41.15
24.50	92.69	24.71	42.00

Test No. 3:

Purpose: Attempt to reduce zinc flotation in the lead circuit.

Procedure: Standard test with sulphite and increased conditioning prior to the zinc flotation.

Feed: 2.0 Kg minus 10 mesh of sample DY-1.

Grind: Standard.

Conditions:

	Reagents Added g/ton						Time (minutes)			
Stage	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$Ca(OH)_2$	$CuSO_4$	Grind	Condition	Froth	pH
Primary Grind	1700	1500	90	50	-	-	13	2	-	9.9
Lead Flotation	-	-	-	30	-	-	-	-	11	9.8
Conditioning	-	-	-	30	1500	800	-	15	-	11.1
Zinc Flotation	-	-	-	50	-	-	-	-	11	11.9

Metallurgical Results:

Product	Weight %	Assays			Distribution		
		Ag	Pb	Zn	Ag	Pb	Zn
Lead Rougher Concentrate No. 1	0.08	18.90	42.20	16.00	58.03	61.70	14.96
Lead Rougher Concentrate No. 2	0.04	10.90	23.70	20.40	18.71	19.38	10.67
Lead Scavenger Concentrate No. 1	0.05	5.50	11.80	22.20	10.46	10.69	12.86
Lead Scavenger Concentrate No. 2	0.02	2.60	4.80	24.30	2.18	1.21	6.20
Lead Scavenger Concentrate No. 3	0.01	1.90	3.00	22.10	1.09	0.82	3.85
Zinc Rougher Concentrate No. 1	0.09	0.94	0.62	43.50	3.21	1.01	42.26
Zinc Rougher Concentrate No. 2	0.02	1.12	1.34	16.50	0.73	0.41	3.26
Zinc Scavenger Concentrate No. 1	0.02	0.87	1.22	5.20	0.64	0.42	1.16
Zinc Scavenger Concentrate No. 2	0.01	0.66	1.10	2.90	0.22	0.17	0.29
Zinc Scavenger Concentrate No. 3	0.01	0.63	1.12	2.30	0.35	0.29	0.39
Zinc Scavenger Tailing	0.64	0.18	0.27	0.15	4.39	3.19	1.11
Heads		2.59	5.44	8.51			

Lead Cumulative Grades	Lead Cumulative Recoveries	Zinc Cumulative Grades	Zinc Cumulative Recoveries
42.20	61.70	43.50	45.26
35.57	81.07	39.19	48.52
28.81	91.76	34.01	49.68
26.14	93.68	32.02	49.97
24.50	94.50	29.14	50.35

Test No. 4:

Purpose: Standard test procedure modified to investigate sample DY-2.

Procedure: Standard test with sulphite and additional copper sulphate.

Feed: 2.0 Kg minus 10 mesh of sample DY-2.

Grind: Standard.

Conditions:

	Peagents Added g/ton						Time (minutes)			
Stage	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$Ca(OH)_2$	$CuSO_4$	Grind	Condition	Froth	pH
Primary Grind	1500	1000	90	50	-	-	13	2	-	10.0
Lead Flotation	-	-	-	25	-	-	-	-	11	9.9
Conditioning				50	2000	800	-	10	-	11.7
Zinc Flotation	-	-	-	75	-	-	-	-	11	11.8

Metallurgical Results:

	Weight	Assays			Distribution		
Product		Ag	Pb	Zn	Ag	Pb	Zn
Lead Rougher Concentrate No. 1	0.06	17.90	41.40	9.40	53.33	57.47	9.90
Lead Rougher Concentrate No. 2	0.04	8.10	18.60	10.30	18.10	19.36	8.13
Lead Scavenger Concentrate No. 1	0.03	3.30	7.30	9.40	5.55	5.72	5.59
Lead Scavenger Concentrate No. 2	0.02	2.60	4.90	8.50	2.57	2.26	2.97
Lead Scavenger Concentrate No. 3	0.01	2.30	3.80	9.60	1.67	1.29	2.46
Zinc Rougher Concentrate No. 1	0.05	0.96	0.71	44.11	2.49	0.86	40.43
Zinc Rougher Concentrate No. 2	0.01	1.21	1.02	36.30	0.84	0.33	8.93
Zinc Scavenger Concentrate No. 1	0.02	1.42	1.53	24.10	1.32	0.66	7.92
Zinc Scavenger Concentrate No. 2	0.03	1.20	1.45	11.60	1.65	0.93	5.64
Zinc Scavenger Concentrate No. 3	0.04	1.00	1.40	5.10	2.02	1.32	3.64
Zinc Scavenger Tailing	0.70	0.28	0.56	0.33	10.45	9.81	4.39
Heads		1.66	3.99	5.26			

Lead Cumulative Grades	Lead Cumulative Recoveries	Zinc Cumulative Grades	Zinc Cumulative Recoveries
41.40	57.47	44.11	40.43
31.63	76.82	42.46	49.36
25.69	82.55	38.41	57.27
23.08	84.81	31.82	60.92
21.46	86.09	24.74	66.55

Test No. 5:

Purpose: Modified standard to attempt to improve selectivity in the lead flotation.

Procedure: Standard test with sulphite.

Feed: 2.0 Kg of minus 10 mesh of sample DY-2.

Grind: Standard.

Conditions:

	Reagents Added g/ton						Time (minutes)			
Stage	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$Ca(OH)_2$	$CuSO_4$	Grind	Condition	Froth	pH
Primary Grind	1500	1000	90	50	-	-	13	2	-	9.9
Lead Flotation			-	25	-	-	-		11	9.8
Conditioning	-	-	-	35	1500	500	-	10	-	11.0
Zinc Flotation	-	-	-	35	-	-	-	-	11	11.0

Metallurgical Results:

Product	Weight %	Assays Ag	Assays Pb	Assays Zn	Distribution Ag	Distribution Pb	Distribution Zn
Lead Rougher Concentrate No. 1	0.05	18.20	41.80	9.70	52.19	56.48	10.21
Lead Rougher Concentrate No. 2	0.02	10.60	23.70	10.80	13.36	14.08	5.00
Lead Scavenger Concentrate No. 1	0.02	5.80	13.70	10.50	6.92	7.71	4.60
Lead Scavenger Concentrate No. 2	0.03	3.60	6.80	9.40	4.86	4.53	4.65
Lead Scavenger Concentrate No. 3	0.01	2.70	4.70	9.40	2.10	1.72	2.68
Zinc Rougher Concentrate No. 1	0.04	1.30	0.82	54.10	2.70	0.80	41.25
Zinc Rougher Concentrate No. 2	0.02	1.50	1.61	34.10	1.78	0.90	14.87
Zinc Scavenger Concentrate No. 1	0.02	1.30	1.74	13.00	1.57	0.99	5.76
Zinc Scavenger Concentrate No. 2	0.02	1.20	1.78	8.60	0.96	0.67	2.53
Zinc Scavenger Concentrate No. 3	0.03	1.30	1.93	5.20	1.85	1.30	2.73
Zinc Scavenger Tailing	0.73	0.30	0.60	0.40	11.69	11.02	5.72
Heads		1.86	3.99	5.13			

Lead Cumulative Grades	Lead Cumulative Recoveries	Zinc Cumulative Grades	Zinc Cumulative Recoveries
41.80	56.48	54.10	41.25
35.27	70.56	41.82	56.12
31.21	78.27	37.69	61.83
26.27	82.59	33.28	64.41
24.02	84.32	27.30	67.14

Test No. 6:

Purpose: To attempt to produce, by regrinding lead rougher-scavenger concentrates with cyanide and lime, a 55-60% Pb concentrate.

Procedure: Anvil standard test procedure to produce a lead rougher-scavenger concentrate, then by regrinding this concentrate for 5 minutes in the rod mill with 750 g/ton feed of lime to pH 11.5 a cleaner concentrate was produced. The cleaner tailing was diverted to the zinc rougher flotation stage.

Feed: 2.0 Kg of sample DY-1.

Grind: Standard procedure and time.

Conditions:

Stage	Reagents Added g/ton						Time (minutes)			
	Na_2CO_3	Na_2SO_3	NaCN	Z-11	$Ca(OH)_2$	$CuSO_4$	Grind	Condition	Froth	pH
Primary Grind	1500	-	90	30	-	-	13	2	-	10.1
Lead Flotation - Standard	-	-	-	-	-	-	-	-	11	-
Lead Regrind	-	-	45	10	750	-	5	2	-	11.5
Lead First Cleaner Flotation	-	-	-	10	-	-	-	-	8	11.3
Zinc Rougher Conditioning with Lead First Cleaner Tail	-	-	-	-	2500	1000	-	10	-	11.7
Zinc Rougher Scavenger Flotation	-	-	-	60	-	-	-	-	8	11.5

Metallurgical Results:

Product	Weight	Assays			Distribution %		
		Ag	Pb	Zn	Ag	Pb	Zn
Lead First Cleaner Concentrate	5.7	18.10	56.80	11.10	41.20	60.60	7.20
Zinc Rougher Concentrate No. 1	10.3	2.50	4.40	47.30	10.10	8.50	55.60
Zinc Rougher Concentrate No. 2	5.8	4.20	9.00	38.20	9.70	10.00	25.60
Zinc Scavenger Concentrate No. 1	3.3	7.10	10.90	19.30	9.20	6.70	7.20
Zinc Scavenger Tailing	74.9	0.99	1.00	0.51	29.80	14.20	4.40
Head (Calculated)	100.0	2.50	5.30	8.72	100.00	100.00	100.00

APPENDIX II

ASSAY CERTIFICATES FROM KRAL

B.C. LICENSED ASSAYERS
GEOCHEMICAL ANALYSTS

Kamloops Research & Assay Laboratory Ltd.

2095 WEST TRANS CANADA HIGHWAY--KAMLOOPS, B.C. V1S 1A7
TELEPHONE 372-2784 · TELEX 048-8320

CERTIFICATE OF ASSAY

TO Mr. Peter Brown,
c/o Cyprus Anvil Mining Corporation,
Faro, Yukon Territory. Y0B 1K0.

Certificate No. K-1716
Date August 8, 1978.

I hereby certify that the following are the results of assays made by us upon the herein described fle[illegible] sample.

Kral No.	Marked	Wt. Gm.	SILVER Short dry Ounces Per Ton	Pb Percent	Zn Percent	Fe Percent	Cu Percent	Hg Percent	As Percent	Au Oz./S DT
1	A 07457	158.820	18.90	42.17	16.03	11.71	.53	.018	.20	.05
2	B 07457	88.780	10.92	23.65	20.35	17.46	.39	.025	.20	.06
3	C 07457	98.398	5.57	11.78	22.17	21.87	.29			
4	D 07457	43.291	2.57	4.80	24.34	23.21	.22			
5	E 07457	29.615	1.89	3.03	22.11	19.29	.23			
6	A 07458	176.706	.94	.62	43.51	12.02	.10	.047	.11	
7	B 07458	33.547	1.12	1.34	16.54	24.45	.12	.027	.18	
8	C 07458	37.820	.87	1.22	5.15	30.32	.19			
9	D 07458	16.885	.66	1.10	2.93	31.15	.14			
10	E 07458	28.461	.63	1.12	2.27	30.22	.19			
11	A 07461	124.435	.87	.86	50.53	8.76	.08	.046	.09	
12	B 07461	49.126	1.15	1.06	40.52	12.38	.11	.040	.11	
13	C 07461	60.321	1.24	1.51	14.81	26.56	.16			
14	D 07461	41.301	1.06	1.48	4.42	30.84	.15			
15	E 07461	25.958	.87	1.40	2.94	29.60	.16			

NOTE:
Rejects retained three weeks
Pulps retained three months
unless otherwise arranged.

Dons for Peters
.....
Registered Assayer, Province of British Columbia

B.C. LICENSED ASSAYERS
GEOCHEMICAL ANALYSTS

Kamloops Research & Assay Laboratory Ltd.

2095 WEST TRANS CANADA HIGHWAY–KAMLOOPS, B.C. V1S 1A7
TELEPHONE 372-2784 · TELEX 048-8320

CERTIFICATE OF ASSAY

TO Mr. Peter Brown

Certificate No. K-1716

Date August 8, 1978.

I hereby certify that the following are the results of assays made by us upon the herein described fl[illegible] sample.

Kral No.	Marked	Wt. Gm.	SILVER Short dry Ounces Per Ton	Pb Percent	Zn Percent	Fe Percent	Cu Percent	Hg Percent	As Percent	Au Oz/SDT
16	A 07460	123.173	22.08	46.68	13.19	10.19	.60	.019	.18	.06
17	B 07460	79.974	12.30	28.04	17.97	16.65	.44	.025	.17	.08
18	C 07460	106.207	4.43	9.50	20.71	23.52	.33			
19	D 07460	32.987	3.28	6.64	20.24	24.34	.30			
20	E 07460	67.585	1.97	3.51	16.40	27.48	.23			
21	A 07463	81.507	8.14	18.59	10.33	26.25	.34	.010	.39	.08
22	B 07463	108.747	17.92	41.43	9.41	16.15	.46	.012	.28	.10
23	C 07463	61.348	3.27	7.32	9.41	32.88	.37			
24	D 07463	36.162	2.58	4.83	8.51	33.88	.46			
25	E 07463	26.520	2.25	3.76	9.56	33.31	.76			
26	A 07464	94.597	.96	.71	44.11	11.72	.11	.042	.17	
27	B 07464	25.361	1.21	1.02	36.30	14.26	.15	.035	.20	
28	C 07464	33.886	1.42	1.53	24.11	22.38	.25			
29	D 07464	50.164	1.18	1.45	11.59	28.31	.40			
30	E 07464	73.611	1.00	1.40	5.09	32.70	.59			

NOTE:
Rejects retained three weeks
Pulps retained three months
unless otherwise arranged.

.....
Registered Assayer, Province of British Columbia

B.C. LICENSED ASSA..RS
GEOCHEMICAL ANALYSTS

Kamloops Research & Assay Laboratory Ltd.

2095 WEST TRANS CANADA HIGHWAY–KAMLOOPS, B.C. V1S 1A7
TELEPHONE 372-2784 · TELEX 048-8320

CERTIFICATE OF ASSAY

TO Mr. Peter Brown

Certificate No. K-1716

Date August 8, 1978.

I hereby certify that the following are the results of assays made by us upon the herein described flot. prod. samples

Kral No.	Marked	~~XXXXX~~ Wt. Gm. ~~XXXXX~~	SILVER Short dry Ounces Per Ton	Pb Percent	Zn Percent	Fe Percent	Cu Percent	Hg Percent	As Percent	Au Oz/SDT ~~XXXXX~~
31	A 07466	227.894	13.44	33.27	21.00	10.80	.39	.026	.17	.05
32	B 07466	38.911	10.06	23.06	25.00	13.12	.29	.036	.18	.05
33	C 07466	30.808	4.93	9.75	28.74	18.57	.19			
34	D 07466	33.794	2.92	5.46	27.41	20.83	.14			
35	E 07466	39.281	2.00	3.40	28.18	22.07	.13			
36	A 07467	83.392	1.06	.89	49.93	8.25	.10	.045	.08	
37	B 07467	26.420	1.33	1.19	38.56	13.96	.13	.040	.11	
38	C 07467	48.054	1.42	1.49	17.62	28.05	.21			
39	D 07467	51.027	1.18	1.43	5.90	33.83	.25			
40	E 07467	52.455	.96	1.22	2.50	37.23	.28			
41	A 07469	102.839	18.18	41.79	9.67	15.89	.51	.015	.27	.12
42	B 07469	45.188	10.64	23.65	10.81	23.67	.44	.020	.35	.11
43	C 07469	42.780	5.83	13.70	10.48	29.29	.40			
44	D 07469	48.403	3.56	6.81	9.41	32.49	.37			
45	E 07469	27.944	2.74	4.70	9.36	33.57	.49			

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Certificate No. K-1716

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I hereby certify that the following are the results of assays made by us upon the herein described flot. prod. samples

Kral No.	Marked	~~XXXX~~ Wt. Gm. ~~XXXXXXX~~	SILVER Short dry Ounces Per Ton	Pb Percent	Zn Percent	Fe Percent	Cu Percent	Hg Percent	As Percent	Au Oz/SDT ~~XXXXX~~
46	A 07470	74.499	1.30	.82	54.14	7.54	.12	.043	.12	
47	B 07470	42.563	1.54	1.54	34.13	16.10	.19	.034	.25	
48	C 07470	43.282	1.27	1.74	13.01	28.42	.26			
49	D 07470	28.713	1.24	1.78	8.67	30.22	.33			
50	E 07470	51.182	1.30	1.93	5.16	30.43	.63			
51	B 07488	111.500	18.06	56.76	11.14	7.08	.36	.014	.15	.06
52	A 07489	201.790	2.45	4.44	47.32	8.30	.13	.040	.11	
53	B 07489	114.766	4.17	5.49	38.16	10.49	.19	.038	.13	
54	C 07489	64.151	7.09	5.79	19.28	20.73	.42			
55	7456	1283.92	.177	.27	.147	18.99	.033			
56	7462	1228.2	.177	.29	.167	18.58	.030			
57	7465	1371.9	.278	.56	.33	25.05	.096			
58	7468	1184.4	.202	.34	.20	18.99	.045			
59	7471	1397.2	.303	.60	.40	25.67	.120			
60	7490	1477.4	.99	1.00	.51	21.25	.091			
61	Heads #1		2.61	5.36	8.48	19.40	.11	.013	.12	.016
62	Heads #2		1.93	4.05	5.30	24.64	.18	.006	.28	.020

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Registered Assayer, Province of British Columbia

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CERTIFICATE OF ASSAY

TO Mr. Peter Brown

Certificate No. K-1716

Date August 8, 1978.

I hereby certify that the following are the results of assays made by us upon the herein described flot. prod. samples

Kral No.	Marked	GOLD Ounces Per Ton	SILVER Ounces Per Ton	Insol Percent	Bi Percent	CaO Percent	Mn Percent	MgO Percent	Cd Percent	Po Percent
61	Heads #1			30.30	L.01	7.00	.28	4.29	.03	3.6
62	Heads #2			25.71	L.01	6.38	.23	3.7	.036	3.2

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.....
Registered Assayer, Province of British Columbia

APPENDIX III

AN ESTIMATE OF WORK INDEX - DY SAMPLES 1 AND 2

SUMMARY

The tailings samples from the flotation tests exhibited very fine grinds during the Anvil standard grinding and flotation test procedure. By assuming constant power input to the laboratory mill, and knowing the average work index for Anvil ore, it was possible to arrive at an estimate of the work indicies (W_I) of the ore represented by samples DY-1 and DY-2. The results are summarized below:

Table 1

Comparison of Data

Samples	% Retained on Screen*			Estimated W_I
	+105 μ	+74 μ	-74 μ	KWH/Ton
DY-1	-	2.5	97.5	4-6
DY-2	0.1	8.5	91.4	5-7
Anvil Av.	12.0	23.0	65.0**	9-10

* Lab test data

** Averaged standard test grind data

DERIVATION OF WORK INDEX

Calculations are based on the standard Bond equation and Schumann plot data from the Cyprus Anvil mill operation.

$$W_0 = W_I \left\{ \frac{10}{\sqrt{P_{80}}} - \frac{10}{\sqrt{F_{80}}} \right\}$$

Where W_0 = Work Factor
W_I = Work Index
F_{80} = 80% Passing Size
P_{80} = 80% Passing Size

In the laboratory flotation test, the grinding stage is for a standard length of time (13 minutes) with the same rod charge and hence the same power input for a change of 2 Kg of ore; thus W_0 is always the same as is F_{80} since sample preparation is standard.

$$W_0 = W_I \left\{ \frac{10}{\sqrt{P_{80}}} - \frac{10}{\sqrt{F_{80}}} \right\}$$

$$W_{0_1} = W_{I_1} \left\{ \frac{10}{\sqrt{P_1}_{80}} - \frac{10}{\sqrt{F_1}_{80}} \right\}$$

Thus, $W_0 = W_{0_1}$ and $F_{80} = F_{1_{80}}$

$$\therefore \quad \frac{W_{I_1}}{W_I} = \frac{\left\{ \frac{10}{\sqrt{P_{80}}} - \frac{10}{\sqrt{F_{80}}} \right\}}{\left\{ \frac{10}{\sqrt{P_1}_{80}} - \frac{10}{\sqrt{F_1}_{80}} \right\}}$$

Now average standard test for Anvil ore results are 65% -250#, eg. $P_{80} = 110\,\mu$ and $F_{80} = 400\,\mu$, for average ore of $W_I = 9.2$.

$$\therefore \quad W_{I_1} = \frac{9.2(0.45)}{\left\{ \frac{10}{\sqrt{P_1}_{80}} - 0.50 \right\}}$$

Now the test samples exhibited under standard conditions a grind of 90% -200#, then P_{80} would be $P_{1_{80}} = 55\,\mu \quad \sqrt{P_{1_{80}}} = 7.4$

$$\therefore \text{ Ore } W_{I_1} = \frac{4.14}{0.85}$$

$$\therefore \quad W_{I_1} = 4.87$$

By calculating various hypothetical grind levels for the standard, a grind/ W_I curve can be constructed.