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HAILSTORM EXPLORATION

PRELIMINARY FLOTATION AND CYANIDATION STUDY

BY

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SUMMARY

The gold and silver in this ore appears to be readily available for treatment in a cyanidation circuit. Results from a single cyanide test indicate in excess of 85% of the silver and 94% of the gold can be recovered into a cyanide liquor. The presence of pyrrhotite may have a detrimental effect on recycling cyanide solutions due to extensive solution fouling resulting from the decomposition of pyrrhotite.

Initial flotation tests were not as successful as the cyanidation test with at least 20% of the silver remaining unrecovered.

Further testwork, to confirm the results from this program and to optimize grinds and reagent usages, is required prior to final flowsheet selection.

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INTRODUCTION

On October 24th, 1983, Mr. Tony Shearcroft of Hailstorm Explorations requested Kamloops Research and Assay Laboratories to perform a preliminary metallurgical examination on a sample of their ore.

The objectives of this study were to examine the response of a sample of oxidized ore to the flotation and cyanidation processes.

Testwork commenced October 25th, 1983, with the final report submitted to Mr. Shearcroft early November, 1983.

DISCUSSION OF RESULTS

The sample consisted of coarse angular chips and appeared to have undergone a considerable amount of weathering. Initial microscopic examination of the sample showed the predominant non-sulphide mineral to be skarns, with secondary non-sulphide minerals being calcite, and magnetite. The sulphides observed include pyrrhotite, pyrite, sphalerite, galena and chalcopyrite. Also noted was a metallic grey mineral possibly acanthite, a silver sulphide.

Prior to testing, the sample was crushed in a laboratory jaw crusher and a head sample was removed and analysed for various elements of interest. Table 1 details these assays.

TABLE 1

Head Sample Analysis

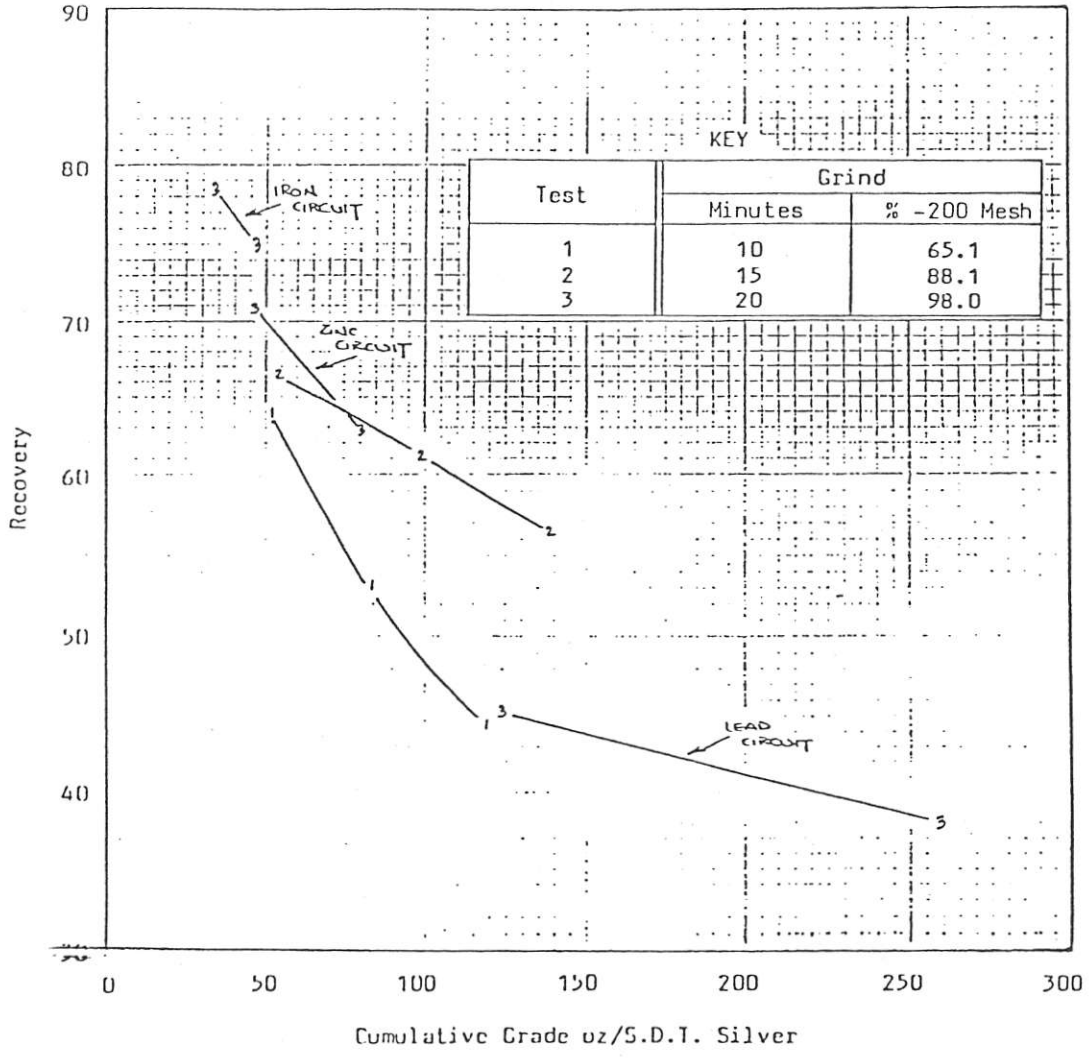
Assays %					
Au*	Ag*	Pb	Zn	Cu	Fe
.064	9.2	.18	.15	.03	5.4

* oz/S.D.T.

Four metallurgical tests were performed on the sample, three examining the effects of flotation and one examining the effects of cyanidation on precious metal recovery. Graph 1 summarizes the results of the flotation test and indicates that a fine primary grind is required to maximize mineral liberation. However, even the best test indicates a substantial amount of unrecovered silver reporting to the final tails. Further test details are provided in Appendix I.

GRAPH NO. 1

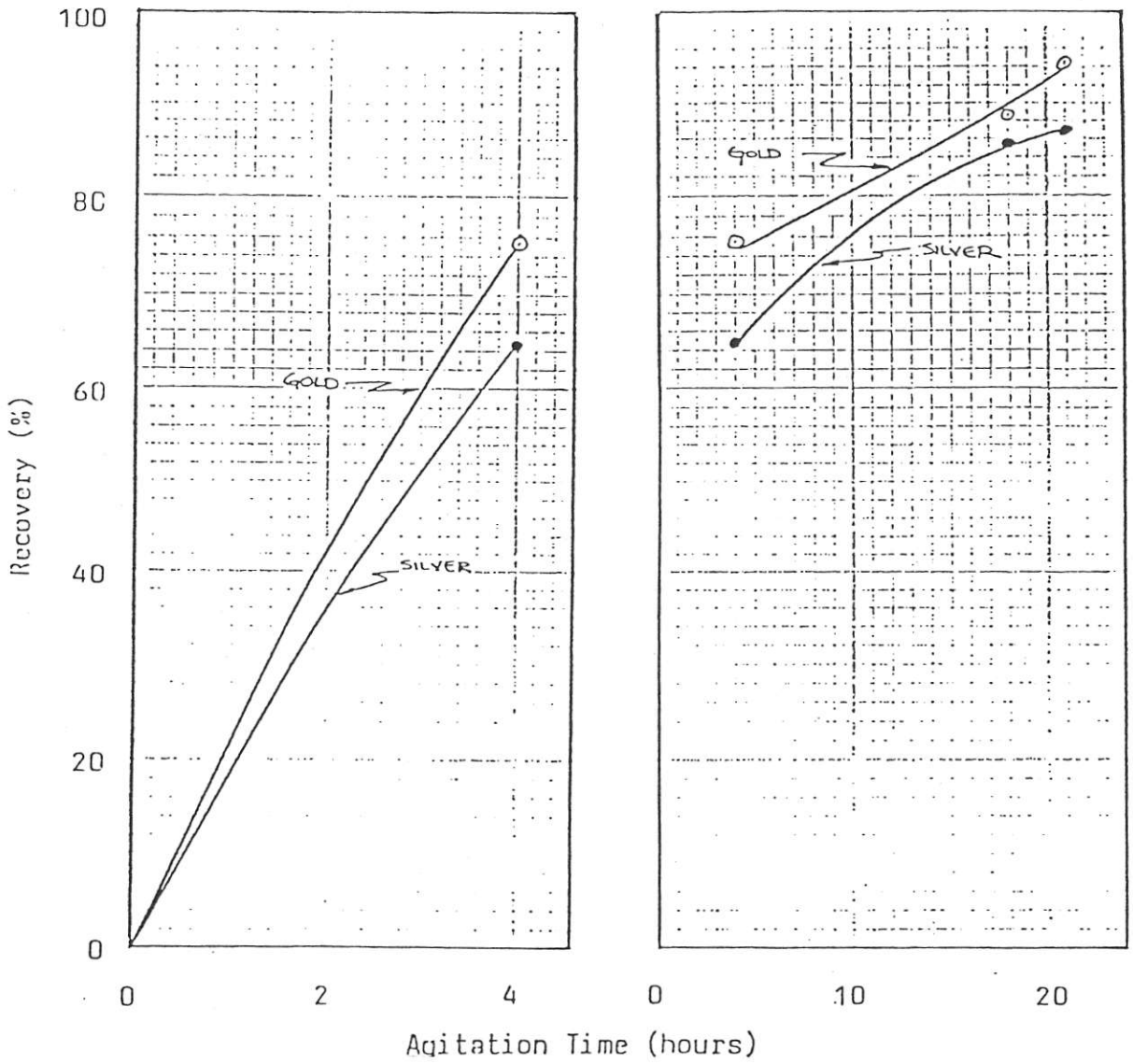
Flotation Grade Recovery Curves



The final test involved leaching the ground ore for 21 hours using standard cyanidation techniques. Graph 2 summarizes the results obtained from the single leach test. Test details are shown in Appendix I.

GRAPH NO. 2

Rate of Gold and Silver Recovery into Cyanide Liquor



As the graph indicates a maximum recovery of 86.8% for silver and 94.4% for gold was obtained from a relatively short agitation time. Due to the oxidized state of this ore a considerable amount of lime was required to stabilize pH to maintain protective alkalinity. It should be noted that cyanide solution fouling, resulting from the decomposition products of pyrrhotite, will in all probability increase cyanide consumption in an operating plant. This effect will have to be examined fully in the laboratory.

CONCLUSIONS AND RECOMMENDATIONS

Cyanidation gave the most encouraging results where in excess of 94% of the gold and 85% of the silver were recovered into the leach liquor. Further testwork is required to optimize reagent usage, grind effects and solution fouling effects. Another area worth considering would be to study the effects of heap leaching this ore to determine if in situ treatment is a possibility.

Recovery losses of at least 20% silver in the flotation tails are most probably due to the highly oxidized state of this ore type. More work is required to optimize grind and reagent additions in the flotation cirucit.

APPENDIX I

TECHNICAL DETAILS OF FLOTATION TESTS 1 - 4 INCLUSIVE

For each flotation test is shown a flowsheet schematic, details of reagents used, essential test parameters, assays and metallurgical balances.

Figure 1 CLEANER TEST - TEST 1, 2

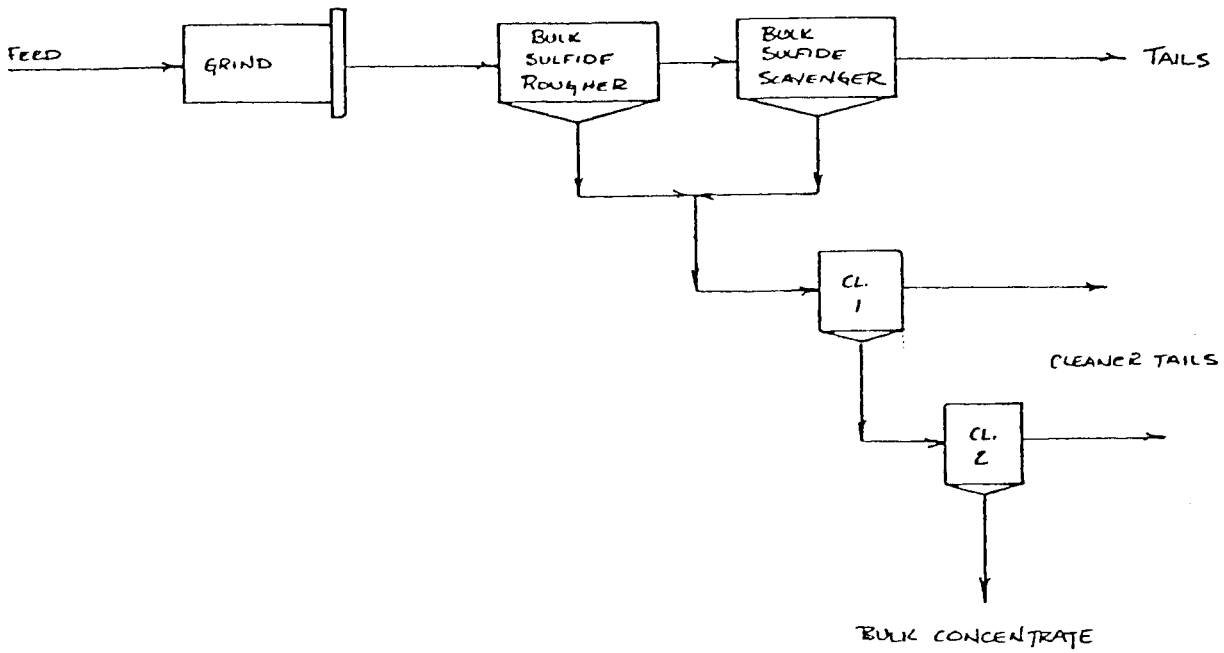
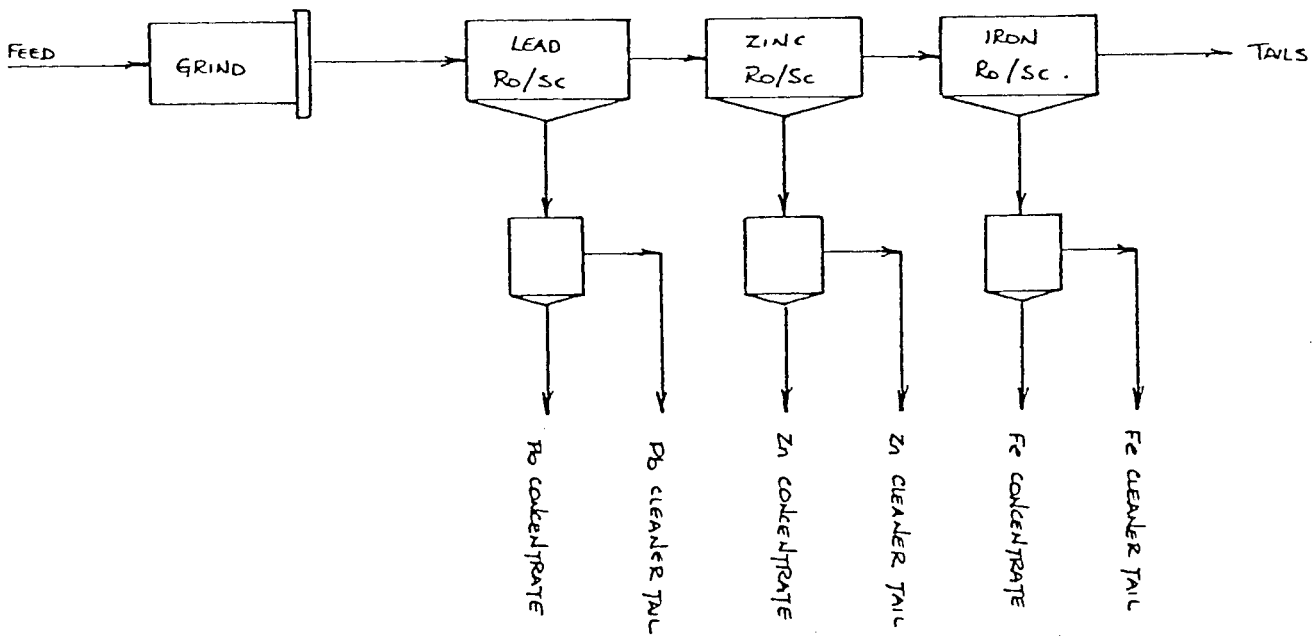


Figure 2 CLEANER TEST - TEST 3



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TEST NO. 1

PURPOSE: Preliminary Bulk Flotation - Coarse Grind

PROCEDURE: Grind with soda ash and TM3. Condition with $CuSO_4$, Z-11 and soda ash and float a bulk sulphide concentrate. Clean 2 times.

FEED: 1 kg. ore

GRIND: 10 minutes in laboratory rod mill with 600 ml. water.

Stage	Reagents added g/tonne				Time, Minutes			pH	
	Na_2CO_3	TM3	$CuSO_4$	Z-11	Grind	Cond	Froth	Start	Finish
Primary Grind	1000	24			10				6.4
Conditioning	2000		100	30		5		8.2	8.0
Rougher							2	8.0	7.6
Scavenger				20			3	7.6	7.6
1st Cleaner	350			10		2	3	9.4	8.6
2nd Cleaner	220			-		1	1	9.4	9.2

Product	Weight	Assays ozs/S.D.T.				Distribution			
	%	Ag				Ag			
Concentrate	3.16	119.57				44.64			
Cleaner Tails 2	2.16	33.54				8.53			
Cleaner Tails 1	5.12	17.79				10.76			
Tails	89.56	3.41				36.06			
~~Calculated Head~~	~~100.00~~	~~8.47~~				~~100.00~~			

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TEST NO. 2

PURPOSE: Preliminary Bulk Flotation - Medium Grind

PROCEDURE: Same as Test No. 1 with a finer primary grind

FEED: 1 kg. ore

GRIND: 15 minutes in laboratory rod mill with 600 ml. water

Stage	Reagents added g/tonne				Time, Minutes			pH	
	Na_2CO_3	TM3	$CuSO_4$	Z-11	Grind	Cond	Froth	Start	Finish
Primary Grind	5000	24			15				8.2
Conditioning			100	30		5			
Rougher							2	8.2	8.2
Scavenger				20			3	8.2	8.2
1st Cleaner	210			10		2	3	9.0	8.6
2nd Cleaner	180			10		1	2	9.4	9.1

Product	Weight	Assays (%)				Distribution			
	%	Ag *	As	Sb	Hg	Ag			
Concentrate	3.91	138.52	.47	.05	L.001	56.59			
Cleaner Tails 2	2.00	22.78				4.75			
Cleaner Tails 1	5.95	8.28				5.15			
Tails	88.14	3.64				33.51			
Calculated Head	100.00	8.57				100.00			

* Oz/SDT

L-less than

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EST NO. 3

URPOSE: Preliminary lead, zinc, iron separation

ROCEDURE: Grind with soda ash and $ZnSO_4$ to depress zinc minerals. Float lead and clean it. Condition and activate zinc. Float zinc and clean it. Condition, activate and float iron cleaning once.

EED: 1 kg. ore

RIND: 20 minutes in laboratory rod mill with 600 ml. water

Stage	Reagents added g/tonne						Time, Minutes			pH	
	Na_2CO_3	Soda	$ZnSO_4$	TM3	Z-11	$CuSO_4$	Grind	Cond	Froth	Start	Finish
ıary Grind	5000		500	48			20				8.4
ditioning					10			2		8.4	
d Rougher									2		8.4
d 1st Cleaner					10			1	1	8.1	8.0
: Conditioning	4000				100	200		5		11.5	
: Rougher									3		11.0
: 1st Cleaner	500				10			1	2	11.5	11.3
ı Conditioning		5000								6.0	7.0
ı Rougher					10000			5	3	7.0	7.5
ı 1st Cleaner					100			1	2	8.3	8.3

TEST NO. 3

Product	Weight	Assays %				Distribution			
	%	Ag*	Pb	Zn	Fe	Ag	Pb	Zn	Fe
Lead Concentrate	1.34	259.41	3.18	2.02	22.10	38.05	22.86	23.63	5.16
Lead Cleaner Tails	1.98	34.09	0.39	0.25	9.50	7.41	4.15	4.33	3.29
Zinc Concentrate	3.82	41.70	0.39	1.23	26.90	17.47	8.01	41.10	17.95
Zinc Cleaner Tails	6.58	11.11	0.23	0.09	6.60	8.02	8.14	5.18	7.59
Iron Concentrate	0.63	60.54	2.43	0.34	13.10	4.20	8.27	1.88	1.45
Iron Cleaner Tails	3.86	7.96	0.22	0.07	6.60	3.37	4.56	2.36	4.45
Tails	81.80	2.39	0.10	0.03	4.20	21.47	44.02	21.50	60.10
Calculated Head	100.00	9.11	0.19	0.11	5.72	100.00	100.00	100.00	100.00

* ozs/S.D.T.

PROJECT NO. KM145 - '

PURPOSE: Preliminary Cyanidation Test

PROCEDURE: Grind 200 g sample for 10 minutes in small rod mill. Remove and condition with lime for 15 minutes to constant pH 11.5 with 600 ml. H_2O and 1.56 g CaO. Cyanide for 24 hours removing rougher liquor and 2 scavenger liquors.

TECHNICAL DETAILS:

Time (hr)		pH		Reagent Balance					
				Added (g)		Residual (g)		Consumed (g)	
S	F	S	F	NaCN	CaO	NaCN	CaO	NaCN	CaO
0	4	11.5	10.8	1.0	1.56	ND	ND	ND	ND
0	14	12.3	11.8	1.07	2.03	ND	ND	ND	ND
0	3	12.2	12.1	1.0	2.0	ND	ND	ND	ND

NOTES:

1. Reagent Consumption (g/t)

GOLD SILVER BALANCE:

Product	Sample Composition				Metal Dist.	
	Gold		Silver		Gold	Silver
	mg	oz/T	mg	oz/T	%	%
Rougher Concentrate	.40	-	43.1	-	75.5	64.7
Scavenger Concentrate 1	.07	-	14.0	-	13.2	21.0
Scavenger Concentrate 2	.03	-	.7	-	5.7	1.1
Tail (198.5)	.03	.0045	8.8	1.3	5.6	13.2
Calculated Head (200)	.53	.077	66.6	9.7	100.0	100.0
Assayed Head (200)	.44	.064	63.1	9.20		