Bo N-J Bolin, 871217/KHo

B O L I D E N   R E P O R T

Vän för kännedom
Retur RH.

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006495

To: Bill Scheding, Curragh Resources Inc.

From: Nils Johan Bolin, Boliden Mineral AB

Subject: Testwork on the Vangorda ore performed up to 1982

Summary

The brief summary attached refers to the testwork that has been performed on the Vangorda ore up to 1982.

A weakness in the most recent testwork is that it does not state from where in the ore the feed samples have been taken. Brunswick M&S got rather good lead flotation results in 1970, about 50 % Pb at 85 % recovery on samples from known locations. Most of the zinc flotation results are from open circuit tests. The recovery should therefore be higher in closed circuit operation. Brunswick M&S achieved about 55 % Zn at 71 % recovery, which could mean something like 80 % recovery in closed circuit.

The reagent consumption has varied a lot between all tests, but the standard procedure for Faro is likely to give fairly good results on Vangorda ore.

A laboratory grind of about 90 %-74 microns is required, but will probably vary with the ore types.

The ongoing plans for new testing with samples from different ore types taken from all of the ore that is going to be mined will give a good basis for economic evaluation of the project.

Some recommendations are given at the end of the report regarding mostly lab testing.

One recommendation regarding regrinding is given and this will also be outlined in more detail separately.

Nils Johan Bolin

Testwork on the Vangorda ore performed up to 1982

1. Introduction

On a visit to Faro, I (N J Bolin, Boliden Mineral AB) was asked to give my opinion on previous work that has been done on the Vangorda deposit up to 1982.

Available data was in the form of reports, letters, memos, etc. A list is given in Appendix A.

This report consists of a summary of data that is revelant to future work and some conclusions have been drawn from previous results. Some recommendations are also given. The recommendations relate not only to Vangorda but also to Faro and Grum.

2. Samples for testing

Data from samples that have been tested throughout the years are presented in Appendix B

Detailed knowledge can only be obtained in a few cases since location for samples used for testing are missing from most reports. The footages are given for Holes 10A, 15A-D and 5CA and the Hole number for some other tests. Very little is known about what samples were used in the tests performed from 1979 to 1982. This is unfortunate, because these latest tests gave the most encouraging results.

3. Grinding

A summary of recommendations about mesh-of-grind from various investigations was given in a memo by P. Taggart.

In this memo, P. Taggart gives an estimate of the effect of a coarser grind (60% -74 microns) than the Noranda recommendations of 90% -74 microns.

This estimate is given in Table 1 below.

Table 1

Influence of grinding on metallurgy from Vangorda ore

	Grind	Lead		Zinc	
	%-74 microns	Grade	Recov.	Grade	Recov.
Noranda forecast	90	62	80	56	84
Estimate	60	58	78	53	82

It is quite clear that a fine grind gives a better metallurgical result. It is not possible to state that the K80 should be a certain size since the grain size of the ore is variable. Particle size distributions are rarely given. k80 or % minus a certain size are sometimes given.

Kamloops performed tests with finer grind than any time before judging from a few particle size distributions given in papers not included in the formal reports. The sizing could have been done by cyclosizer and in that case it is not possible to compare this with other sieve analyses

For one sample (1A4G)the k80 was 19 microns after 15 minutes grinding while another sample (2B4E) gave 34 um after the same time.

4. Lead flotation

Test data are given in Appendix C and results in Appendix D.

The most important factor for good lead flotation is fine grinding. Only a few tests had been performed at a fine grind, before the final testing done by Kamloops.

BM&S (August 1970) 94-97% -74 microns.
Noranda (April 1970) 80% -45 microns.
Noranda (February 1975) 90-96% -74 microns.
Dowa (May 1975) 80% -39 microns.
Kamloops (1979-1982)80% -39 to 19 microns and probably even finer.

Conditions for lead flotation have varied as follows:

Na_2CO_3	0.7 - 5	kg/ton
pH	9.5 - 10	
NaCN	0.1 - 0.6	kg/ton (added both in rougher and cleaner)

The highest additions were made by Kamloops. Na_2S was tested by Noranda in a few tests for copper-lead separation. Kamloops tested Na_2SO_3 in combination with NaCN with poor results. Galigher tested a lime circuit with NaCN in combination with $ZnSO_4$. Testing by Dowa with H_2SO_3 + NaCN in the cleaning steps seems to be promising. Very little work has been done on systems other than Na_2CO_3-NaCN.

A number of collectors have been used, with NaIPX being used in most cases, often in combination with various dithiophosphates. As for frother, Dowfroth 250 has been used most frequently. Kamloops does not state if they used any frother.

My conclusion is that the lead flotation of Vangorda ore needs fine grinding and that the normally used reagents at Faro also give fairly good results on Vangorda. Most probably the different ore types require different grinds for the same liberation state, but an estimate of the necessary grind would be 90 +-5% - 74 microns.

This estimate relates to laboratory testing. When it comes to grinding in the plant, one has to make a comparision between what grinding is needed for Faro in the lab and in the plant and then make adjustment to allow for the different slope of the particle size distributions.

5. Zinc flotation

Test data are given in Appendix C and results in Appendix D. Fine grinding is very important for zinc flotation also. The conditions in zinc flotation have varied as follows:

Ca(OH)2	0.5 - 2	kg/ton
pH	9 - 11.5	
CuSO4	0.3 - 1.5	kg/ton
	Again, the highest additions were made in tests by Kamloops.	

Most tests have been performed with NaIPX as collector. Z-200 has been used by Galigher. MIBC, Dowfroth 250 and Frother 65 have been tried as frothers, Dowfroth 250 being the most common used. Kamloops does not state what frother they have used, if any.

My conclusion is the same as for lead flotation, fine grinding and the same procedure as already applied to Faro should give satisfactory results.

6. Discussions - Recommendations

An effort should be made to define from where the test samples were taken in previous testing programs, especially for the Kamloops tests. The reason is that the results have varied a lot especially for Au, in Kamloops tests, depending on what sample they have used, see Appendix E.

The program for testing of new core from Vangorda ought to give reliable results regarding the best grind stated both as kWh/ton(netto) needed or as particle size distributions for the different ore types. The test program will also give guidelines for the reagent levels needed for the different ore types. If Kamloops results are valid, not only for the ore samples they tested but also for the new samples then there should not be any significant problems besides maybe grinding, flotation and dewatering capacity since the Vangorda ore seems to be finer-grained.

On the other hand the graphitic ore could give special problems and some 4E-type samples have given rather poor grades in the concentrates.

My recommendations do not apply only to Vangorda but can also be

applied to current operation, as well as to Grum.

The recommendations concern mainly lab testing and are given below:

* Reagent additions should be kept to the minium needed, otherwise selectivity problems will soon occur.

* H_2SO_3 +NaCN and H_2SO_3+$ZnSO_4$ as alternatives to NaCN only in lead flotation should be tested more fully.

* MIBC should be avoided for the graphitic ore since MIBC has a collecting effect on graphite. Dowfroth 250 has given good results in our Stekenjokk plant. The carbon content went down from 3% to 1% in the copper-lead concentrate.

* The special dye I brought with me gives good depression of graphite in our Stekenjokk plant. Na-lignosulphonate can be used to dilute the dye to reduce the cost. It should be mixed prior to addition. Our proportion is 3:1.

* We are using isobutylxanthate for many ores for zinc flotation. It is stronger and cheaper than isopropylxanthate. However IBX does not work well on Laisvall lead-zinc ore, so we are using IPX for this ore.

* We are using diisopropyldithiophosphate in the scavenger flotation for some ores to get better selectivity against pyrite. Aerofloat 404 is also in use on some ores.

* In our plants we are careful not to grind mineral particles that are already liberated. Therefore grinding is performed on scavenger concentrate and/or 1st cleaner tail. I strongly recommend that this is tried before Vangorda comes into the plant, when the grind most probably will be finer and overgrinding should be avoided as much as possible.

  Regrinding should be performed in open circuit to prevent coarse pyrite being ground down to slime particles. We performed a test on our Langsele ore with closed circuit regrinding, which gave us a build up of fine circulating pyrite and great difficulty in maintaining zinc concentrate grade.

* $CuSO_4$-distribution to many points in rougher, scavenger and cleaners can sometimes give better froth characteristics and even decrease the amount needed, because some zinc mineral is readily activated and does not need much $CuSO_4$.

* Gold recovery can be improved by a new reagent from Hoechst, Hoef 3403. It is not good for lead flotation which is why it should be used in combination with other collectors. The additions should be about three times the collector it replaces. Hoef 3403 has frothing properties that can cause problems.

* Gold floats well if not oxidized. Na_2S can reestablish the floatability, but we have not tried it in a plant ourselves yet. A short flotation time should be preferred if possible. The very

first rougher concentrates can be sent to the last cleaner step to achieve this.

* Autogenous grinding is to be preferred for good gold recovery according to our pilot plant testing results and to research work done in the laboratory (iron exerts a depressant effect).

Metallurgical reports on Vangorda ores

File	Company	Title	Date
V-1	K.R.A.L. KM007	A Preliminary Study of Flotation Response-Vangorda Ore type 4G	July 1979
V-2	K.R.A.L KM010	A Preliminary Study of Glotation Response-Vangorda Ore types 4E and 4A	Dec 1979
V-3	K.R.A.L. KM022	Effect of Ultrafine Grinding on Metallurgy-Vangorda Plateau Ores	Sept 1980
V-4	K.R.A.L. KM043	Effect of Grind on Metallurgy-Vangorda types 1B4G, 2B4E	Dec 1980
V-5	K.R.A.L. KM044	Metallurgical Response of Vangorda Ore-Vangorda Deposit-Eastern Section	Jan 1982
V-6	K.R.A.L. KM050	Flotation Response of Vangorda Ore-Detailed Testwork	Jan 1982
V-7	Dowa letter	Considerations on The Vangorda and Swim Lake Ore	Mar 1969
V-8	Galigher letter	Closed Circuit Test Vangorda Ores	July 1969
V-9	BM&S Memo	Metallurgical Laboratory Tests on Vangorda Ore Sample	1969
V-10	BM&S Summary	Refractory Ores Metallurgical Comparision	1969
V-11	Noranda Report	Vangorda and Brunswick M&S Ore Samples Bench Tests Carried out at the Galigher Company	Dec 1969
V-12	Noranda Report No. 4	Tests Preliminaries (Locked Test) Sur Les Echantillons "Low, Medium, et High Grade," Provenant de Vangorda Creek	Feb 1975
V-13	Dowa Report	Report on The Metallurgical Test of The Vangorda Ore	May 1975
V-14	Noranda Report No. 1	Preliminary Flotation Testwork on Vangorda D.D. Cores	April 1970
V-15	Spedden letter	Cyprus Anvil Testwork	May 1980
V-16	Michaelsen letter	Expansion of Faro Concentrator	May 1980
V-17	Mitsui 1031	Milling Test REport on Lead & Zinc Ores of Vangorda, Canada	Feb 1965
V-18	Anon	A Synopsis of Testwork Terformed on	

Vangorda Ore

V-19	C.A.M.C.	Cyprus Anvil Mining Corporation Ownership, Assets etc.	1983
V-20	Curragh Telefax	Mercury Content Vangorda & Grum Lead Concentrates	April 1987
	Noranda Memo	Bulk Flotation Tests	Nov 1964- Mar 1965
	Cyprus Anvil	Vangorda Plateau Metallurgical Testwork	Jan 1982
	Cyprus Anvil P Taggart Memo	Vangorda Metallurgy	Jan 1983

Paper available for this study

VANGORDA

Samples for metallurgical testing

Date	Sample description
1954	A list of hole no, sample no, footage and classification is given
Dec 16/65	Sample no 1 bulk sample of core received 2 massive sulphides 3 pyrite 4 disseminated sulphides 5 graphite schist
L v 11/63	A portion of no 2 to 5 was combined for make a bulk sample for testing by Dowa
Nov 6/64	15A, 15B was sent to Noranda 336 lbs Noranda 168 lbs Noranda 58 lbs Dowa 50 kg
Nov 27/64	Hole No 15A 160'-247' 2.69 % Pb 5.31 % Zn 15B 160'-247' 3.25 % Pb 6.32 % Zn Sum: 2.97 % Pb 5.82 % Zn
Sept 67	150 lbs of -64 year sample left. A portion of +4 mesh screened out and sent to Kerr Addison.
Sept 5/68	15C150'-200' 36 lbs 1.66 Ag, 4.30 % Pb, 5.06 % Zn, 0.12 % Cu to Galigher 15C 201'-250' 36 lbs 1.77 Ag, 4.74 % Pb, 5.22 % Zn, 0.15 % Cu to Dowa
Sept 18/69	One box from D D H 15-D 157'-250' 60 lbs sent to Brunswick
Jan 26/70	
Feb 4/70	50A 107'-183' (surface sample) to be drilled near to Hole 50 183'- for later use. 10A 270'-338' (deep sample) to be drilled near to Hole 10 338'- for later use Composite: Nine holes near to old holes No 1, 26, 15, 10, 47, 50, 52, 75, 81 Totally 11 samples to be sent to Noranda.
Drilled in June 1979	4G, 4E, 4A Geologically typed by D Hansen and D Jennings Grouped together according to geological species and average grade on instructions by D Hansen 4BCD East of 12th paralell (as above)

TABLE 22

VANCOPPER METALLURGY BY ORE TYPE

TEST NO.	TEST METALLURGY LEAD GRADE	TEST METALLURGY LEAD RECOVERY	TEST METALLURGY ZINC GRADE	TEST METALLURGY ZINC RECOVERY	CORRECTED METALLURGY LEAD GRADE	CORRECTED METALLURGY LEAD RECOVERY	CORRECTED METALLURGY ZINC GRADE	CORRECTED METALLURGY ZINC RECOVERY	GRIND TIME (min.)	ORE TYPE	Grind 80 % -X μm	Recovery Au	Recovery Ag
1	45.5	43.9	54.1	69.6	45.5	58.0	54.1	74.7	15	1A4G	19		
2	36.4	88.4	55.7	66.0	36.4	90.3	55.7	68.6	15	1A4G	19		
3	55.7	85.6	56.7	76.4	55.7	87.1	56.7	79.0	15	1A4G	19	54.6	70.6
4	54.6	87.2	54.9	76.2	54.6	89.2	54.9	78.7	15	1A4G	19	47.4	71.7
5	57.8	83.2	56.6	75.2	57.8	85.7	56.6	77.7	15	1A4G	19	42.2	63.3
6	40.3	84.2	55.1	63.3	40.3	86.7	55.1	67.4	10	1A4G	33		
7	48.2	85.0	57.5	62.3	48.2	87.5	57.5	67.9	10	1A4G	33		
8	60.8	77.5	54.2	61.8	60.8	81.3	54.2	69.3	10	1A4G	33		
13	57.3	83.1	55.9	71.7	57.3	83.4	55.9	75.2	15	1A4G	19		
14	61.4	79.7	55.9	77.9	61.4	81.4	55.9	80.6	15	1A4G	19		
9	36.4	72.5	47.7	63.3	36.4	76.5	47.7	69.3	10	1B4G			
10	45.9	76.2	51.4	72.3	45.9	79.2	51.4	75.3	15	1B4G			
11	49.6	67.9	52.4	75.9	49.6	73.6	52.4	81.6	15	1B4G		23.5	58.3
12	41.8	73.6	54.1	71.5	41.8	77.2	54.1	74.5	15	1B4G			
15	41.3	71.3	51.6	76.0	41.3	74.4	51.6	78.3	15	1B4G			
16	50.0	77.4	55.0	78.9	50.0	80.2	55.0	81.6	25	1B4G		33.3	70.9
17	49.3	80.8	55.1	74.8	49.3	82.1	55.1	76.8	15	1B4G		28.9	62.7
18	53.6	69.6	56.8	46.5	53.6	72.6	56.8	61.5	15	1B4G		30.6	51.5
19	56.9	67.9	58.1	59.8	56.9	72.5	58.1	67.4	20	1B4G		23.1	50.3
34	43.3	78.2	53.0	57.6	43.2	81.2	53.0	64.5	20	2A4E			81.5
30	33.7	79.6	37.2	68.7	33.7	81.3	37.2	71.7	10	2B4E	44		
31	39.9	77.7	41.2	67.5	39.9	80.7	41.2	72.5	15	2B4E	34		
32	44.4	77.5	51.0	65.8	44.4	79.5	51.0	70.9	20	2B4E	28		53.9
33	29.7	74.6	40.6	59.9	29.7	77.6	40.6	65.0	5	2B4E			
35	50.7	78.8	49.8	65.7	50.7	82.8	49.7	72.0	20	2B4E	28		64.4
20	37.9	51.9	44.9	17.7	37.9	56.3	44.9	43.2	15	2C4E			
21	42.9	53.6	50.4	43.1	42.9	61.1	50.4	55.6	20	2C4E			
22	45.2	74.2	52.3	69.5	45.2	76.3	52.3	74.3	20	2C4E			36.2
23	33.4	72.5	42.7	74.6	33.4	75.5	42.7	77.6	15	2C4E			42.5
24	33.7	73.3	44.6	63.2	33.4	76.3	44.6	69.2	15	2C4E			
25	38.4	58.0	42.4	73.1	38.4	64.0	42.4	77.0	15	2C4E			
26	34.2	59.9	45.8	57.3	34.2	65.9	45.8	67.3	10	2C4E			
41	36.5	55.5	41.4	55.3	36.5	62.5	41.4	67.0	5	2C4E			
37	23.3	66.9	32.1	50.4	23.3	72.9	32.1	59.4	5	2D4E			
38	37.2	74.7	46.7	53.3	37.2	77.7	46.7	61.0	20	2D4E			51.3
39	37.7	65.6	45.3	57.8	37.7	68.6	45.3	63.8	15	2D4E			42.7
40	42.5	60.6	42.6	61.2	42.4	64.0	42.6	67.2	10	2D4E			
42	38.9	76.3	46.8	69.9	38.9	76.3	46.8	75.9	5	3A4A			
43	58.9	70.0	52.4	58.8	58.9	76.0	52.4	69.8	10	3A4A			
44	67.2	62.6	49.9	76.2	67.2	70.6	49.9	82.2	15	3A4A		40.1	46.4
45	58.6	78.8	56.5	69.8	58.6	81.8	56.5	75.8	25	3A4A		37.7	59.9
46	48.8	80.5	51.5	77.2	48.8	83.5	51.5	81.2	25	3B4A		32.9	61.0
47	33.4	82.8	50.3	69.9	33.4	84.8	50.3	77.9	15	3B4A			
48	31.9	82.8	44.8	72.2	31.9	83.8	44.8	75.2	10	3B4A			
49	40.2	71.8	45.5	79.4	40.2	74.8	45.5	83.4	10	3C4A		42.3	57.9
50	36.9	75.0	46.3	76.0	36.9	79.0	46.3	80.0	15	3C4A			
51	31.0	72.8	52.2	73.1	31.0	77.8	52.2	78.1	20	3C4A			
56	30.6	74.2	52.1	74.2	30.6	79.2	52.1	79.2	25	3C4A			
52	35.2	80.4	53.9	66.1	35.2	82.4	53.9	72.1	25	3D4A		59.4	67.9
53	27.2	72.7	45.5	69.8	27.2	74.7	45.5	74.8	10	3D4A			
54	21.8	63.0	42.3	73.8	21.8	68.0	42.3	75.5	15	3D4A			
55	20.9	75.4	48.6	66.6	20.9	79.3	48.6	72.5	20	3D4A			

Notes: a) Test metallurgy is recovery at final cleaner concentrate grade.

b) Corrected metallurgy was arrived at by redistribution of the cleaner tailings.

c) Grind time refers to time in the laboratory test mill: Product P_{80} is proportional to grind time.

VANGORDA data for labtesting

Report	Date	Grind	Lead-flotation kg / ton						Zinc-flotation kg / ton					Sample, e t c
			Ca(OH)2	Na2CO3	pH	NaCN	Collec.-froth.	Na2S	ZnSO4	Ca(OH)2	pH	CuSO4	Collec.-froth.	
Noranda	Apr 2/70	80%-40um			10	0.11	Af 242, 130, R-343	0.1		0.45	9.7	0.45	R-343, MIBC	*10A*
	Apr 2/70	80%-30um		0.68	10	0.11	Af 242, 404, R-343	0.2						*50A*
Saligner	July -69		1.4		9.3	0.27	R-343, MIBC		0.9	1.1	11.2	0.68	Z-200, Froth 65	
BM&S	Aug 70	34 min		1.8	9.6	0.09	Z-9, Af 242, Dow 250			0.9	10.6	0.27	Z-9, Dow 250	Composite
	Aug 70	34 min		1.4	9.7	0.09	Z-9, Af 242, Dow 250			0.9	10.6	0.27	Z-9, Dow 250	*10A*
	Aug 70	34 min		1.5	9.8	0.09	Z-9, Af 242, Dow 250			0.9	10.6	0.45	Z-9, Dow 250	*50A*
Dowa	Mar 17/69			0.9	10	0.18	Af 25, 31, Dow 250			0.54	10	0.36	Nikko 125, Ex	
**	May -75			2.25	10	0.14	Af 25, 31, Dow 250			'*'	10	0.45	Nikko 125, Ex	H2SO3 in Cu-flot
							NaAx, Dow 250			'*'	9	'*'		pH 11-11.5 in Zn-cleaner
Kamloops	1982	30 min		3	9.6	0.4	Z-11			2	11	1.5	Z-11	
	1982	30 min		5	9.6	0.4	Z-11			2	11	1.5	Z-11	
	1982	30 min		3	9.5	0.4	Z-11			1	11	1.5	Z-11	
	1982	30 min		2.5	10	0.6	Z-11			0.5	11.5	0.25	Z-11	

** Lime +H2SO3 + NaCN in lead-cleaner

R-343	NaIPX	Af 25	Dikresyldithiophosphate
Z-9	PIPX	Af 31	Af 25 + secondary collector
Z-11	NaIPX	Af 130	Thiocarbanilid
Dow 250	Polypropyleneglycolmethylether	Af 242	Ammoniumsalt of 31
MIBC	Methylisobutylcarbinol	Af 404	Mixture of Disecbutyldithophosphate and mercaptobenzothiazol
Froth 65	Polypropyleneglycol		
Z-200	Isopropylethylthionocarbamate		

VANGORDA

metallurgical balances

Company		Date	Head grade Pb	Head grade Zn	Head grade S	Head grade Cu	Head grade Au	Head grade Ag	Pb-concentrate Grade Pb	Pb-concentrate Grade Zn	Pb-concentrate Recovery Pb	Pb-concentrate Recovery Zn	Pb-concentrate Recovery Au	Pb-concentrate Recovery Ag	Zn-concentrate Grade Pb	Zn-concentrate Grade Zn	Zn-concentrate Recovery Pb	Zn-concentrate Recovery Zn	Sample description
Dept of	*	1954	3.35	4.78	22	0.13	0.60	53	52		74				49			65	Shipm. no 1
Mines	*	1954	2.94	4.40	16	0.08	0.50	40	38		75				48			63	Shipm. no 3
Noranda	*	1954	3.20	4.90	20	0.15	0.45	47	54		60				50			53	
	*	1954	3.20	5.20					46		78				53			50	
Noranda	**	Apr 2/-70	5.60	6.60	22	0.12													
	*	Apr 2/-70	3.32	3.46	32	0.22			54	1	70	1			0	52	1	85	Hole 50A
Noranda	*	Febr -75	1.60	2.70					48	12	80	18			2	55	3	62	Hole 10A
	*	Febr -75	3.60	4.10					37		78					49		77	low grade
	*	Febr -75	3.70	6.80					54		78					52		77	aver.grade
	*	Febr -75	6.20	10.50					49		81					54		80	medium grade
									25		93					49		65	high grade
Galigher	*	1968	3.90	5.10					57		73					51		52	Hole 15C 160'-200'
	*	1968	4.37	5.00					23		85					24		60	Hole 15C 160'-200'
Galigher	*	July -69	4.32	4.87					51	7	79	9			3	54	5	78	Hole 15C 160'-200'
Br.wick	*	Nov -69	4.10	5.17		0.30		47	52	8	90	11		83	1	55	2	78	Hole 15D ?
Br.wick	*	Aug -70	3.76	4.90					52	10	87	12			1	56	2	72	Composite
	*	Aug -70	3.55	4.07					48	6	86	10			1	56	2	72	Hole 10A
	*	Aug -70	5.27	6.60					52	11	84	14			3	53	5	70	Hole 50A
Dowa	*	Febr -65		BAD RESULTS															
Dowa	*	Mar 17/69	4.01	4.91		0.14													
	**	Mar 17/69	4.18	5.25		0.12			50	10	77					49		60	Hole 15C 201'-250'
Dowa	*	May -75	3.08	4.42		0.21			49	10	79	13			4	49	7	64	Hole 15C 201'-250'
									62	5	78	5			2	55	5	87	Sample no 1 to 7
Kamloops	***	Jan -82	3.56	6.78					55	10	84	8	45	75	!55!	52		85	Ore type 4G
	***	Jan -82	3.43	4.27					50	8	78	9	40	50		50	!74!	82	Ore type 4E
	***	Jan -82	2.88	4.24					!50!	45	6	83	7	25	65	51	!82!	83	Ore type 4A
	***	Jan -82	2.06	3.35					51		86		35	60		49		83	Ore type 4BCD

! ! Results calculated by alternative method

* labresults

** predicted from pilot plant tests

*** predicted from labtests