

G.J. Johnson

File: Vangorda Metallurgy

017898

Richard Coleman  
156 Hollyrood Hts. Dr.  
Mississauga, Ont.  
L5G 2H4

25 January, 1989

Mr. Bill Weymark  
Manager  
Curragh Resources Inc.  
P.O. Box 1000  
Faro  
Yukon Y0B 1K0

Dear Sir:

The 1988 metallurgical research conducted by Lakefield Research on the Vangorda deposit has been completed and reports have been forwarded to your people. The work started in the spring of 1988 with suites of samples for a mineralogical examination followed by the laboratory mineral dressing research between June and December.

The research confirms the complexity of the deposit but suggests that reasonable grades and recoveries of lead, zinc and precious metals can be expected. Modifications to the existing Faro concentrator layout and equipment will be essential when processing this ore. In addition finer grinds and higher reagent consumptions can be expected although plant practice may not be as severe as indicated during the research.

The majority of the research was conducted on ore types E and G with minor oxidation and of a non-porous nature. This material represents 70% of the mineral inventory and was called Composite No 3 during the testing. The flowsheet developed for this ore was utilized for research on the other types of ore available. Favorable results on all NON-POROUS types of ore including even the low grade (represented by Composite 5) were obtained. However, ore type represented by Composite 1A was the most refractory, was porous and oxidized, was carbonaceous and contained secondary copper minerals. The results in general from this material were not acceptable except that the precious metal recovery was encouraging.

General comments about the ore types and responses would include the following remarks:

Composite 1A Most Refractory

Carbonaceous - Porous  
Poor selectivity  
Good lead concentrate grades not possible  
High zinc content of lead concentrate  
Good recovery of gold and fair recovery of silver  
in lead concentrate.

- Composite 2 Course grained  
Good lead, gold and silver recoveries  
High zinc loss with lead concentrate  
Good zinc concentrate grade but lowest recovery
- Composite 3 70% of deposit  
Good metallurgy with new flowsheet  
Reagent consumption (particularly NaCN) higher
- Composite 4 Graphitic quartzite  
Requires special depressant to improve lead grade  
Lowest lead, gold and silver recoveries  
Lowest grade tested (except for Composite 5 which may not be considered ore)  
Good zinc recovery acceptable zinc grade
- Composite 5 Low grade  
Good metallurgy
- Composite 6 Instructions for compositing not received.  
However, it is understood that material would be similar to that of Composite 5 and therefore good metallurgy could be expected with higher head assays.

General

If the samples tested are truly representative of the ores from the zones, a modified flowsheet with new reagents could be expected to produce

Lead Concentrates of	62% Pb	84% Recovery
	8% Zn	
	6 to 10 gms/T Au	62% Recovery
	700 gms/T Ag	70% Recovery
Zinc Concentrates of	1% Pb	
	54% Zn	82% Recovery
	45 gms/T Ag	

Deleterious metal contents of the concentrates may include copper, manganese, arsenic and magnesia in the lead concentrate and copper and silica in the zinc concentrate.

In the bulk scale test of material from Vangorda proceeds in the fall of 1989 with the flowsheet revisions and reagent regimes recommended, the metallurgy might be expected to be plus 61% Pb in Pb conc. 83% recovery  
plus 54% Zn in Zn conc. 86% recovery

Based on their research, Lakefield have drawn certain conclusions and make specific recommendations. I support their comments. At the same time I would like to emphasize certain features when ore from the Vangorda deposit is processed.

- 1. Finer primary grind will benefit precious metal recovery.
- 2. A new lead collector is recommended.
- 3. More lead products should be reground.
- 4. Open circuit lead cleaning is essential.
- 5. An organic depressant for the lead circuit is required for some of the ore types.
- 6. High speed conditioning in the zinc circuit will be extremely beneficial.
- 7. During the bulk scale testing of this deposit a representative of the Lakefield research company should be present.
- 8. If blending with Faro 3 ore is contemplated extensive laboratory research should be done.

#### Further Recommendations

Some of the knowledge gained during this research project should be rested in the current milling technique on the Faro 3 ores. Specifically the collector combination A317/3418A. Regrinding of all lead rougher and scavenger concentrates, open circuit cleaning of lead concentrates, the use of DS20 depressant, and high speed zinc circuit conditioning should be tested in the laboratory and on the circuit as soon as practical.

Additionally it is a good time to start the research on the Grum deposit so that results can be available for your long term planning. I continue to recommend that Lakefield Research be engaged for this purpose and I am available to assist if you wish my services.

Since carbonaceous ores may be a factor in the life of your company, it might be worthwhile for a new project to be initiated to do basic research on this type of refractory material.

Yours Very Truly

R. L. Coleman

*Rick Coleman*

cc. K. Forgaard  
E. Beaumont  
G. Jilson.

# Summary of Locked Cycle

(1a) porous core with little oxidation

fine grinding? any merit

(1b) non porous core with oxidation

	Pb	Zn	Au	Ag	
<u>Pb con</u> Assay	63.9	7.17	6.17	701	} <u>head</u> 585
Recy	83.5	<del>8.3</del>	60.0	70.8	
		8.3			
<u>Zn con</u> Assay	1.03	57.2	0.31	38.4	0.79
	1.7	82.2	3.8	4.8	75.6

(2) EG from SE

	Pb	Zn	Au	Ag	
<u>Pb</u> Ass	65.4	8.93	11.19	705	} <u>head</u> 4.88
	59.3	10.8	74.4	74.1	
<u>Zn con</u>	1.07	54.7	0.84	56.9	
Rec	1.7	76.9	6.5	7.0	
					1.09
					63.4

(3) EG from West

	Pb	Zn	Au	Ag	
<u>Pb con</u> l	66.2	7.17	8.56	814	} <u>head</u> 4.14
Rec	88.4	7.6	65.0	75.3	
<u>Zn con</u>	7.03	55.3	0.28	48.5	
	2.0	85.6	3.2	6.5	
					0.73
					59.7

(4) A type

Low Py low grade - problem in high Pb grade con  
graphite floating

finer grinding - got improvement in recy  
78 → 85%

zinc recy not affected  
64-65%

(5) EC low grade,

- no tests

What is Plan for now and timeframe  
for final results

Comp C of higher grade EC+C  
one.

Comp B

Band of 1 year material

Band for entire deposit

end January maybe  
February

**Table No. 8 - Impurity Analyses of Lead and Zinc Concentrate -  
Products from Locked Cycle Test ON VANIGORDA - COMPOSITE 3**

Element	Assays % g/t	
	Lead Concentrate	Zinc Concentrate
Lead (Pb)	66.20	1.03
Zinc (Zn)	7.20	54.90
Iron (Fe)	4.12	6.72
Bismuth (Bi)	0.002	<0.002
Cadmium (Cd)	0.011	0.069
Chromium (Cr)	0.022	0.036
Cobalt (Co)	<0.002	<0.002
Mercury (Hg)	0.0050	0.0280
Nickel (Ni)	<0.002	<0.002
Tin (Sn)	0.002	<0.001
Arsenic (As)	<0.001	0.007
Sulphur (S)	17.800	33.3
Fluorine (F)	0.093	0.11
Manganese (Mn)	0.10	0.33
Silica (SiO <sub>2</sub> )	2.36	0.25
Alumina (Al <sub>2</sub> O <sub>3</sub> )	0.085	0.034
Calcium (CaO)	0.120	0.40
Acid Insol.	5.79	2.00
Magnesia (MgO)	0.92	0.14
Antimony (Sb)	0.23	0.006
Gold (Au)	8.60	0.28
Silver (Ag)	813.00	48.5

## CURRAGH RESOURCES INC.

## Inter-Office Memorandum

TO: Bill Weymark  
General Manager  
Faro Office

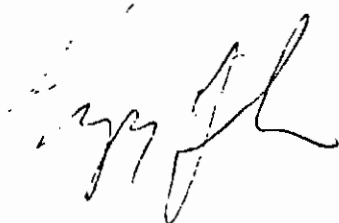
DATE: 1989 02 20

FROM: Gregg Jilson  
Vice-President, Exploration  
Whitehorse Office

RE: Vangorda Deposit Metallurgical Testing

---

1. In light of the declining grade of Faro deposit it seems likely that some consideration will be given to accelerating mill feed from the Vangorda deposit to supplement that from the Faro pit. This, of course, will require testing for compatability of Faro ores with Vangorda ores and examination of the behaviour of Faro ores in the modified flow sheet required for Vangorda. The purpose of this memo is to let you know that from last years drilling program we have stored a large amount of core from the southwest end of the Vangorda deposit for possible eventual usage for metallurgical testing. The holes from last year are largely cluster in the area where the initial bulk sample would come from and from the area of the shallowest reserves where earliest production would originate. Should you decide that further testing is required and need more material these samples could be composited in very short order. Just let me know somewhat in advance when the samples are required, if at all, and I will see that they are prepared for you.



**CURRAGH RESOURCES INC.**  
Inter-Office Memorandum

**TO:** Godfrey McDonald, Vice-President, Metallurgy  
Toronto Office  
Dumitru Tului, Senior Metallurgist  
Faro Minesite

**FROM:** Cam Reed, Geologist  
Whitehorse Office

**cc:** Gregg A. Jilson, Vice-President, Exploration  
Whitehorse Office

**RE:** **METALLURGICAL COMPOSITING OF EARLY VANGORDA FEED FROM 1988 DDH CORE**

**DATE: 03 16 1990**

---

The following pages include a list of split drillcore samples obtained from the 1988 diamond drilling program at Vangorda. The samples are selected to be representative of the type of feed expected from the first 500,000 tonnes of feed from the Vangorda pit. The samples were drilled from 9 holes between Sections 20E and 26E and are geographically located within the circled area on the accompanying drillhole plan map.

The feed from this part of the deposit is moderately oxidized and some samples are porous. JSX 550 polymer mud was used to maximize drilling recovery, so it is advisable to wash the final bucked metallurgical sample before bench testing begins.

The gangue mineralogy of the early feed material is a medium-to-fine grained, massive, pyritic/baritic, sulphide/sulphate which will contain some iron and base metal oxides. Minor pyrrhotite, magnetite, quartz, muscovite, chlorite, calcite and dolomite are common. Accessory chalcocopyrite, marcasite and tetrahedrite are also present. A minor amount of dilution from altered phyllites at the hanging wall and low grade semi-massive pyritic quartzite of the footwall is expected. I have included a few samples of this material (rock types 4L and 4C) to account for this type of dilution.

The samples are located in the old kitchen of the Grum Camp. They are in labelled bags in pails labelled "B" on the lid and the sample #'s (from \_ to \_\_) on the side. There are 5-6 samples in each pail.

The samples were kept frozen up to June of last year, but were allowed to thaw when the generator was moved to an exploration camp. It is likely that the temperatures were above 0 for 2 1/2 months. The kitchen area is always cool and it is unlikely that the material would have oxidized to any noticeable degree during this period.

If there are any problems, give me a call.

data\vanplat\feb27mem.cr

**CURRAGH RESOURCES INC.**  
Inter-Office Memorandum

To:           Gregg Jilson, V.P. Exploration  
              Whitehorse Office

              Dave Tenney, Chief Geologist  
              Faro Minesite

From:         Cam Reed, Exploration Geologist  
              Whitehorse office

RE:           Vangorda Metallurgical Composite Descriptions and  
              Characteristics

Date: 10 22 1990

Metallurgical composites of diamond drillcore samples from drilling projects completed in 1987 and 1988 were sent to Lakefield research for metallurgical testing. 5 composites separated on the basis of ore type, geographic location in the orebody, weathering and porosity were sampled from the 1987 DDH core and sent to Lakefield in May 1988. A description of each composite is included below.

In March 1990, an additional composite representing early more oxidized high grade feed from the SE section of the orebody located between vertical X-sections 20E and 26E was sampled from the 1988 drillcore with bench testing to be completed at Faro.

Description of 1988 Vangorda Metallurgical Composites

1a - Visibly oxidized, porous, Massive baritic/pyritic sulphides. No separation based on geographic location in the orebody, however most of the samples were taken from holes drilled in the shallow SE section of the orebody. The gangue mineralogy is medium to fine grained pyritic/baritic sulphide/sulphate which will contain significant iron and base metal oxides. Minor quartz, muscovite, chlorite, pyrrhotite, magnetite, calcite and dolomite are common. Accessory chalcopryite, marcasite, tetrahedrite are also present. This composite is the most refractory of all the ore types.

1b - Moderately oxidized, non porous high grade ore with same mineralogy as 1a. No separation based on geographic location in the orebody. These samples were excluded from 1a because of the possible deleterious effects of drilling mud which is likely to be more abundant in the porous composite 1a.

2 - High grade massive nonporous pyritic/baritic sulphide which is moderately oxidized to fresh and located in the SE section of the orebody. Contains minor quartz, muscovite, chlorite, pyrrhotite, calcite and dolomite. Accessory magnetite, chalcopryite, marcasite, and tetrahedrite are common. This composite represents the bulk of early feed from SE section of the vangorda orebody.

3 - Slightly oxidized to fresh, high grade massive pyritic/baritic sulphide located in the NW section of the orebody. This composite is mineralogically similar to composite 2. This composite represents the bulk of the millfeed NW of X-section 12E.

4 - Fresh to slightly oxidized, medium grade ribbon-banded carbonaceous quartzite. No separation based on geographic location in the orebody. Pyrite content ranges from 10 to 20%. Contains the lowest concentration of copper and precious metal of all the ore types. The bulk of this ore type is located in the early benches in the NW section of the deposit. Some minor thin bands are located in the SE section. This ore type represents about 15% of the total high grade feed.

5 - Low grade, non-carbonaceous, semi-massive footwall quartzite. This material will likely make up the bulk of dilution expected in the main ore zone in both NW and SE sections. Pb+Zn is generally less than 2% with significant gold content (near 1 gram/tonne). Pyrite content ranges from 30% to 60% and is generally highest near the high grade contact. Contains minor magnetite, pyrrhotite, muscovite, and chlorite.

Table 1: Head Analyses of Composites (from lakefield research)

Composite	Assays %, g/t											
	Cu	Pb	Zn	Fe	S	Mn	Hg	Au	Ag	C(T)	C(g)	Po
Comp 1A	0.26	3.95	4.20	26.8	28.5	0.45	0.0018	0.57	49.1	1.47	0.057	11.2
Comp 1B	0.22	5.75	6.69	28.1	28.9	1.16	0.0049	0.79	77.8	1.71	0.049	17.0
Comp 2	0.20	4.75	5.70	24.5	26.8	0.79	0.0036	0.93	64.5	1.67	0.049	12.5
Comp 3	0.15	3.96	5.35	21.7	28.2	0.61	0.0043	1.57	64.8	0.20	0.015	10.3
Comp 4	0.037	2.20	3.87	7.54	8.83	0.054	0.0023	0.44	31.2	2.20	0.64	12.5
Comp 5	0.36	0.72	0.89	29.1	26.6	0.58	0.00023	1.60	12.7	1.01	0.060	9.40
Master	0.22	3.76	4.47	24.2	27.1	0.71	0.0025	0.96	57.9	1.37	0.081	17.2

Table 2: Statistics by Ore Type - V9009 Interpretation  
Within VIV 89 ultimate pit - Total Mineral In-situ undiluted  
sulphide inventory. No grade cutoff applied.

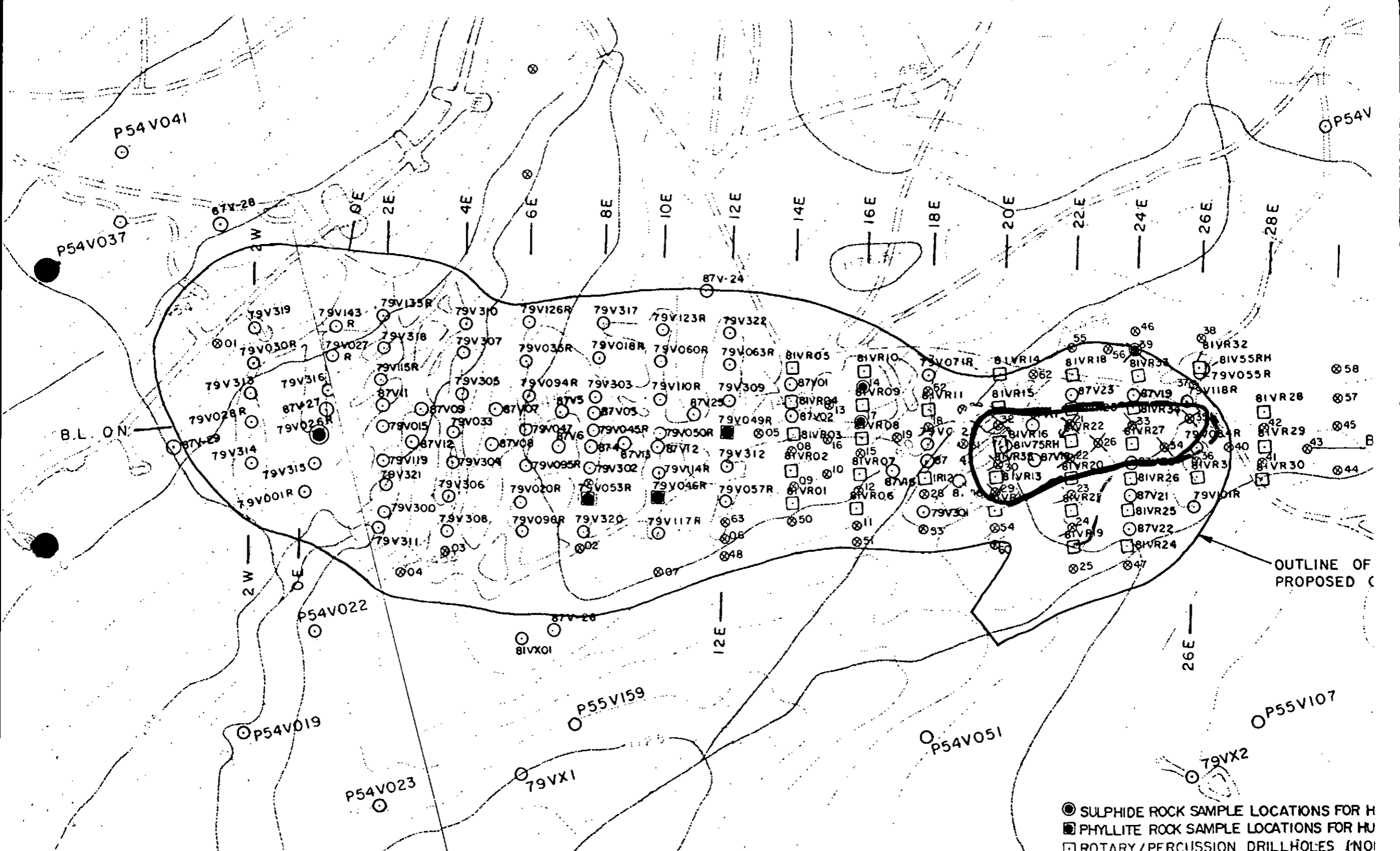
Rock Type	Tonnes	%Pb+Zn	Ag g/mt	Au g/mt	%Cu
<u>SE SECTOR</u>					
Massive Sulphide	1696640	10.05	56.36	0.921	0.21
Footwall noncarbonaceous qtzite	1001800	2.22	18.41	0.915	0.31
Carbonaceous qtzite	174590	7.23	35.71	0.641	0.12
<u>NW SECTOR</u>					
Massive Sulphide	3232840	10.05	56.27	0.779	0.13
Footwall noncarbonaceous qtzite	1014350	2.09	16.72	0.904	0.31
Carbonaceous qtzite	1249750	4.82	26.29	0.476	0.07
<u>TOTAL PIT</u>					
Massive Sulphide	4929480	10.05	56.30	0.828	0.16
Footwall noncarbonaceous qtzite	2016150	2.15	17.56	0.909	0.31
Carbonaceous qtzite	1424340	5.11	27.44	0.496	0.08

\*\*\*\*\*  
 VANGORDA METALLURGICAL COMPOSITE INTERVALS  
 1988 DIAMOND DRILLING PROGRAM  
 \*\*\*\*\*

Composite Number : V90-01 February 26, 1990  
 Description: Early Feed Vangorda Metallurgical Composite Samples - Sections 20E to 26E  
 Total Intervals: 60 Approximate Weight of Composite: 240.61 kg

SAMPLE	DDHID	FROM (ft)	TO (ft)	INT. (ft)	REC. (ft)	REC. (%)	ROCK TYPE	PULP S.G.	% Pb+Zn	% Pb	% Zn	Ag (g/tnn)	Au (g/tnn)
16657	88V-21	48.2	49.9	1.6	1.4	85	4C0	3.1	4.68	1.44	3.24	32	0.41
16658	88V-21	49.9	53.1	3.3	3.3	100	464 &&	4.3	14.71	5.70	9.01	106	1.37
16659	88V-21	53.1	57.4	4.3	4.3	100	4C3	3.8	1.20	0.61	0.59	21	1.51
16384	88V-22	23.0	27.6	4.6	4.6	100	464	4.5	14.60	7.20	7.40	97	0.55
16385	88V-22	27.6	31.5	3.9	3.9	100	460	4.3	7.31	3.27	4.04	50	0.75
16386	88V-22	31.5	35.8	4.3	4.3	100	464	4.2	13.03	5.18	7.85	75	0.93
16388	88V-22	38.4	40.4	2.0	2.0	100	4E4	4.1	2.01	1.36	0.65	36	1.17
16389	88V-22	40.4	44.9	4.6	4.6	100	4E4	4	12.69	4.44	8.25	67	0.27
16390	88V-22	44.9	47.9	3.0	3.0	100	4A4	4	12.01	2.92	9.09	51	0.55
16391	88V-22	64.6	69.6	4.9	4.9	100	4L1	3.2	0.59	0.04	0.55	2	0.07
16392	88V-22	91.9	95.1	3.3	3.3	100	464	2.9	14.27	5.07	9.20	82	0.69
16393	88V-22	95.1	98.4	3.3	3.3	100	4E0 &1	3.9	1.48	0.72	0.76	24	1.23
16394	88V-22	98.4	103.3	4.9	4.8	98	4C0	3.6	0.81	0.32	0.49	10	0.82
16639	88V-26	36.7	40.4	3.6	3.3	91	4E4	3.5	6.25	3.16	3.09	48	0.34
16640	88V-26	40.4	46.6	6.2	3.9	63	4E4	3.8	10.56	6.02	4.54	66	1.30
16641	88V-26	46.6	48.6	2.0	2.0	100	4E4 &1	3	7.16	2.05	5.11	28	0.27
16642	88V-26	71.9	76.1	4.3	4.3	100	464 &&	4	12.18	3.93	8.25	66	0.55
16643	88V-26	76.1	80.1	3.9	3.9	100	460 &&	4.1	8.83	3.32	5.51	40	1.44
16644	88V-26	80.1	84.0	3.9	3.9	100	4E1 &&	4.2	3.43	1.75	1.68	22	1.51
16645	88V-26	84.0	87.9	3.9	3.9	100	4E1 &&	4.3	0.90	0.52	0.38	19	4.77
16337	88V-29	25.9	28.5	2.6	2.6	100	464&	4.2	12.87	5.67	7.20	78	0.86
16338	88V-29	28.5	32.5	3.9	3.9	100	460	4.2	3.00	1.81	1.19	28	1.23
16339	88V-29	32.5	37.1	4.6	4.6	100	460	4.6	3.90	2.12	1.78	32	0.79
16340	88V-29	37.1	42.0	4.9	4.9	100	4A4	2.9	13.82	4.75	9.07	70	0.58
16341	88V-29	42.0	46.9	4.9	4.9	100	4A4	3.1	16.10	5.10	11.00	82	0.58
16342	88V-29	46.9	52.5	5.6	4.5	80	4A4	3.1	15.32	5.12	10.20	82	0.45
16343	88V-29	135.5	137.8	2.3	2.3	100	4L24 &	2.8	1.71	0.73	0.78	8	0.05
16344	88V-29	137.8	141.7	3.9	2.6	66	460&&	4.1	8.48	3.46	5.02	49	0.82
16345	88V-29	141.7	146.3	4.6	4.6	100	4E0	4.2	3.26	1.67	1.59	29	3.19
16346	88V-29	146.3	151.2	4.9	4.1	84	4E0	4.2	2.31	1.12	1.19	21	0.79
16347	88V-29	151.2	155.8	4.6	4.6	100	4L124	2.9	0.55	0.04	0.51	0	0.07
16133	88V-30	72.2	75.8	3.6	3.6	100	464&	4.1	13.93	5.13	8.80	77	1.03
16134	88V-30	75.8	79.7	3.9	3.9	100	464&	4.3	13.97	5.14	8.83	79	1.03
16135	88V-30	79.7	86.3	6.6	6.6	100	4E486	4.3	18.17	6.57	11.60	88	1.58
16136	88V-30	86.3	89.6	3.3	3.3	100	464&	4	20.32	8.52	11.80	106	2.23
16137	88V-30	89.6	93.8	4.3	4.3	100	464&	4.3	16.90	6.40	10.50	86	1.71
16138	88V-30	93.8	97.4	3.6	3.6	100	464&	3.4	9.50	3.40	6.10	63	1.61
16139	88V-30	97.4	104.3	6.9	6.9	100	4C3	3.4	1.14	0.56	0.58	12	1.23
16627	88V-32	32.2	36.4	4.3	1.8	42	4E1	3.6	0.50	0.30	0.20	14	0.55
16628	88V-32	36.4	40.0	3.6	3.4	95	4E8 &4	4.3	7.94	3.86	4.08	32	1.71
16629	88V-32	40.0	42.0	2.0	2.0	100	464	4.6	13.15	5.46	7.69	48	0.82
16630	88V-32	42.0	44.0	2.0	2.0	100	4E0	4	1.99	0.94	1.05	23	0.75
16631	88V-32	44.0	47.9	3.9	3.7	95	4E8	3.4	2.79	1.55	1.24	27	1.03
16632	88V-32	47.9	51.5	3.6	3.5	97	4E48	3.5	7.13	4.26	2.87	54	2.19
16633	88V-32	51.5	55.4	3.9	3.9	100	4C3	3.6	2.38	0.98	1.40	16	1.92
16399	88V-33	91.5	95.5	3.9	3.9	100	464	4.5	16.65	7.69	8.96	97	0.62

16400 88V-33	95.5	100.7	5.2	5.2	100 464	4.6	21.39	9.79	11.60	164	1.23
16401 88V-33	100.7	104.3	3.6	3.6	100 464	4.3	16.70	6.80	9.90	111	1.65
16402 88V-33	104.3	107.6	3.3	3.3	100 4E4	4.4	13.16	4.45	8.71	49	1.51
16403 88V-33	107.6	110.9	3.3	3.3	100 4E4	4.1	6.07	3.67	2.40	34	1.37
16404 88V-33	110.9	114.8	3.9	3.4	87 4E0	4	1.73	0.64	1.09	22	0.41
16405 88V-33	114.8	117.8	3.0	3.0	100 4E0	4.1	0.61	0.08	0.53	16	1.03
16724 88V-34	104.7	108.3	3.6	3.6	100 464	3.9	15.90	5.70	10.20	98	0.82
16725 88V-34	108.3	111.2	3.0	3.0	100 464	4.3	12.92	5.74	7.18	108	1.23
16726 88V-34	111.2	115.8	4.6	4.6	100 4E1 88	4.1	2.69	1.00	1.69	20	1.75
16149 88V-35	32.2	37.1	4.9	4.4	89 460	3.8	9.91	4.14	5.77	82	1.44
16150 88V-35	37.1	42.0	4.9	3.1	63 460	4.3	7.80	3.54	4.26	57	1.10
16151 88V-35	42.0	44.6	2.6	2.6	100 460	4.3	9.37	3.96	5.41	74	1.23
16152 88V-35	44.6	47.6	3.0	3.0	100 4E1	3.5	0.50	0.29	0.21	11	0.89
			233.6	221.5			8.91	3.64	5.27	55.5	1.18



● SULPHIDE ROCK SAMPLE LOCATIONS FOR H  
 ■ PHYLITE ROCK SAMPLE LOCATIONS FOR HU  
 □ ROTARY/PERCUSSION DRILLHOLES (NO)