019341

GRUM AND VANGORDA

GEOLOGY AND RESERVES

3.3 GRUM GEOLOGY AND RESERVES

3.3.1 History

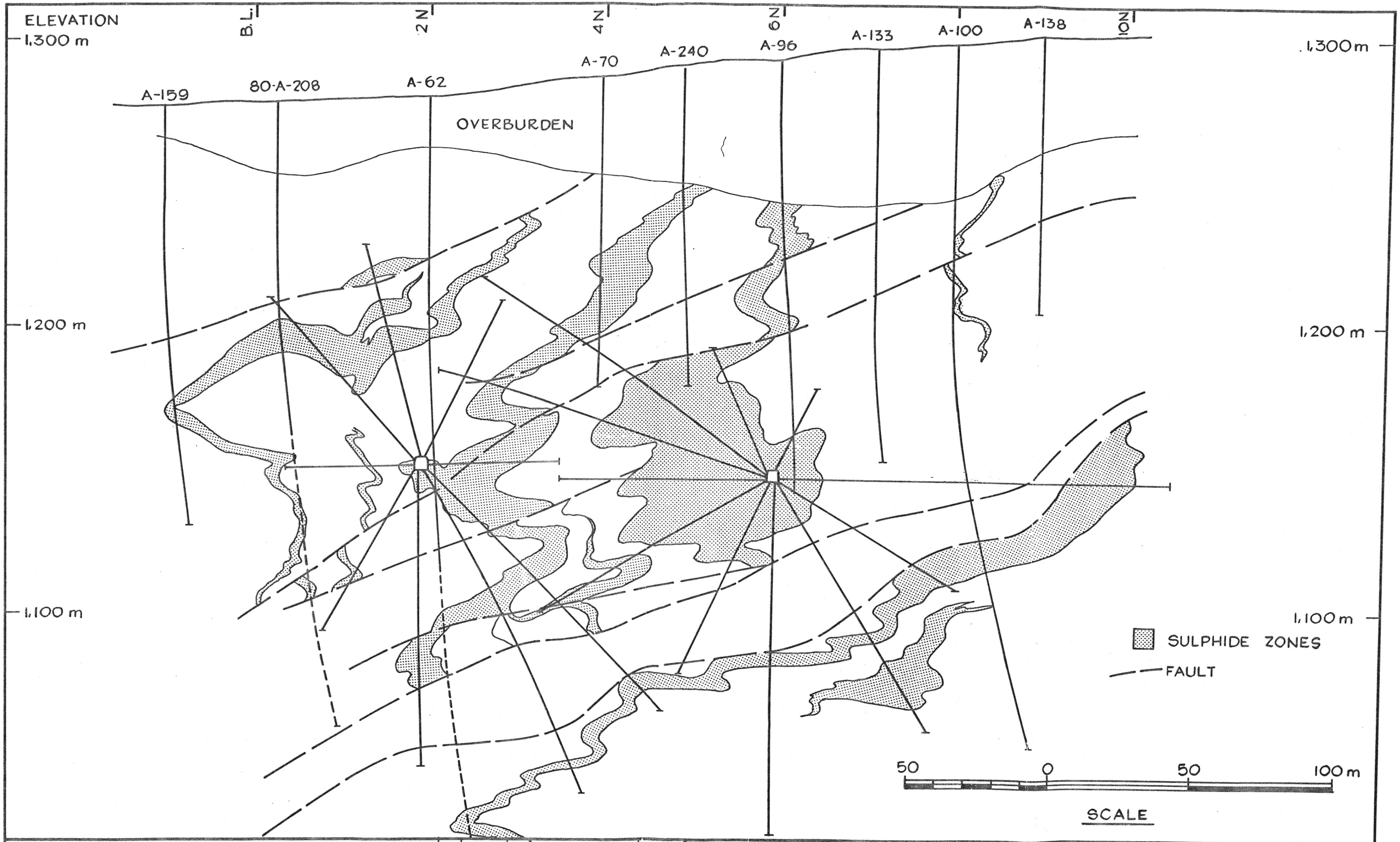
The Grum deposit was discovered in 1973 by AEX Minerals in joint venture with Kerr Addison Mines. Discovery was as the result of drill testing a gravity anomaly in an area down fold plunge from the Vangorda deposit along what was then a, as yet, poorly defined favourable trend.

Surface drilling in 1973 and 1974 indicated a significant deposit; in 1975 and 1976, an underground sampling and drilling program, along with further surface diamond drilling, was carried out to further define it.

Kerr Addison Mines sold the deposit, along with Vangorda and Swim, to Cyprus Anvil Mining Corporation in 1979. From 1980 to 1982, Cyprus Anvil drilled additional holes in and around the deposit and relogged all existing holes in it. All available sulphide intersections were resampled and reassayed at that time.

3.3.2 General Geology

Figures 3.3.2-1 and 3.3.2-2 are respectively longitudinal and cross-sectional view of the Grum deposit.



				SCALE AS SHOWN	DATE	CLIENT CURRAGH RESOURCES	FARO AREA DEPOSITS GRUM DEPOSIT X-SECTION (70W)
				DESIGNED JBF	MAR.87		
				DRAWN ZA	MAR.87	LOCATION FARO, YUKON	
ISSUED FOR TECHNICAL REVIEW	A	MAR.87	ZA	CHECKED		KILBORN	
REVISIONS	Nº	DATE	BY	APPROVED			PROJ. Nº 3509-19 DWG. Nº FIG. 3.3.2 - 2 REV. A

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(a) Stratigraphy and Lithology

The Grum deposit consists of three to five highly contorted layers of massive and disseminated sulphide mineralization within a 150 metre section of barren phyllite. The most important mineralized horizon occurs just beneath the basal carbonaceous member of the Vangorda formation. There are thin low-grade horizons within the Vangorda formation and more important horizons in the upper part of the Mount Mye formation.

At Grum, the Vangorda formation consists of soft, highly fissile, calcareous phyllites. Metabasites in the Grum area are minor and tend to be highly foliated chlorite phyllite rather than blocky, massive greenstones that typify the Vangorda formation elsewhere. The basal carbonaceous member of the formation thickens across the deposit from about 10 metres in the northeast to as much as 80 or 100 metres southwest of the deposit. The sulphide horizons appear to be associated with the northeast pinchout of this unit. Immediately above the main ore horizon the carbonaceous rocks are soft, highly sheared and gouged, but elsewhere they are moderately hard, highly fractured, black siliceous phyllites.

The Mount Mye formation also consists of soft phyllites which are distinguished from those of Vangorda formation by being non-calcareous and less distinctly banded.

There are no significant post metamorphic dykes at Grum. The Anvil Batholith crops out 1.5 kilometres northeast of the deposit, but is separated from it by major faults. The batholith is unrelated to the deposit and does not appear to have significantly affected it.

(b) Structure

The ore layers at Grum are contorted into a complex, shallowly northwest plunging, polyphase fold structure. The prominent "S" shaped folds are second phase structures. They are superimposed on a larger "Z" shaped first phase fold. The dominant plane of fissility in the phyllites at Grum is axial planar to the second phase folds and dips shallowly (10 to 30 degrees) generally to the southwest. This fissility is a major factor in assessing slope stability for a Grum pit. The overall deposit elongation parallels the axial direction of the second phase folds (315 degrees trend 11 degrees plunge).

There are several important faults at Grum. The largest displacements occur on moderately (35-45 degrees) dipping structures that truncate the deposit at both its northwest and southeast ends. Neither of these structures would crop out in an open pit, but smaller subparallel faults will be found in the pit. A steeply northwest dipping fault trending about 060 degrees, passes between sections 70W and 72W and downdrops the deposit about 60 metres to the northwest. A myriad of smaller faults were mapped underground by Kerr Addison Mines, trending on the average 080 degrees and dipping steeply. Joints mapped underground and on surface tend to strike 060 degrees and dip subvertically.

(c) Surficial Geology

The subcrop of the ore deposit is covered by up to 100 metres of morainal material (tills) and better sorted galciofluvial silts, sands and gravels. These unconsolidated sediments are water saturated and may contain pockets of permafrost. The northeast wall of any pit designs at Grum must contend with thick sections of these sediments. Dewatering in advance of stripping may help increase stability substantially as well as simplify operations in the pit.

(d) Ore Deposit Geology

As with other deposits in the Anvil Range, a given ore horizon at Grum tends to have a massive sulphide upper and central portion and a quartzose, disseminated sulphide lower and peripheral portion. The horizons can be up to 30 metres thick, but are mostly 15 metres or less thick. Grade is strongly partitioned into massive, particularly baritic, sulphides thus the tops of horizons tend to be high grade and the bottoms low grade (except, of course, where the horizons are overturned). The sulphide horizons are separated by significant thicknesses of barren phyllite. Interfaces between ore and waste tend to be sharp at the stratigraphic hangingwall contact against barren phyllite, and gradational both at the footwall and laterally against sulphide waste.

Grum, like Vangorda and Dy, has several characteristics that distinguish it from Faro. In large part, this is due to the lower metamorphic grade the deposit has reached. The most outstanding difference between Grum and all the other Vangorda Plateau deposits, as opposed to Faro, is the form of the deposit. The Vangorda Plateau deposits consist of several distinct, highly contorted horizons separated by barren phyllite waste. Faro, on the other hand, is essentially one thick horizon in overall outline with lesser phyllitic waste but substantial barren sulphide waste banding. This implies that dilution by phyllite will be higher at Grum than at Faro. Faro, however, contains considerable internal sulphide waste, thus its mining dilution is higher than might appear at first glance. Nonetheless, Grum has a higher potential for mining dilution and will have more complex mining problems than Faro. However, the dilutant at Grum will be predominantly the more easily identifiable phyllite rather than low grade sulphides as at Faro. Experience at Faro shows that phyllite dilution is much easier to control than low grade sulphides.

Grum ores have a finer grain size and more complex material intergrowth than Faro ores, necessitating finer grinding.

At a given lead-zinc cutoff grade, ores at Grum are higher grade than those remaining at Faro, and are higher in precious metals relative to base metals. The average gold content of Grum is several times higher than Faro. Similarly, other elements that tend to be geochemical associates of gold, i.e. mercury and arsenic, tend to be higher at Grum. The sphalerite at Grum, and likely other Vangorda Plateau deposits, is richer in zinc and lower in iron content due to lower metamorphic grade.

A feature unique to Grum among the Vangorda Plateau deposits is the relative abundance of quartzose ore types, particularly carbonaeous pyritic quartzites which comprise about 35 percent of the reserves above 4 percent lead and zinc.

3.3.3 Drilling Definition and Information Base

The Grum deposit extends from section 52W in the southest to section 112W in the northwest. The deposit has been most densely drilled between 62W and 86W, and it is this portion of the deposit for which proven geologic reserves are reported.

Most of the deposit southeast of 88W has been drilled from the surface on at least a 61 metre by 30.5 metre (200 foot by 100 foot) pattern. Most surface holes are vertical.

Between sections 62W and 86W, the deposit has also been explored by 15,000 metres of underground drilling in fans from a pair of parallel inclines following the deposit trend. The strike length of the deposit examined from underground is 700 metres, underground workings, now flooded, total 2,900 metres.

The fans are most complete on even numbered sections (i.e. spaced 61 metres apart); on the odd numbered sections, inbetween, some fill-in drilling has also been carried out from underground. The overall density of drilling is on the order of 15 metres by 30 metres with local areas being much in excess of that.

In the southeast part of the deposit, additional fill-in drilling was carried out by Cyprus Anvil in 1980-82 from the surface to more closely define shallow ore for early production.

Total drilling at Grum is 67,200 metres of which 15,000 metres is underground drilling and 52,200 metres is surface drilling. Between 62W and 86W, there is a total of 53,600 metres of drilling in 372 drill holes (154 surface and 218 underground) of which 344 are used in the current model. The remainder, not included in the model, are underground holes that are at high angles to the geological sections and some short holes that did not intersect ore.

There are 9,000 samples in the Grum deposit assay database. Assay intervals generally average 1.5 metres in length and are normally cross-referenced to sulphide rock types. Assaying was completed by Kamloops Research and Assay Laboratories. All assays were determined using a set of Anvil District ore type standards for control. Rejects and N_2 purged pulps (by now somewhat oxidized) have been retained for additional analytical work.

For most samples, assays were determined for lead, zinc, copper and silver. For two-thirds of these samples, determinations were also made for insoluble iron, soluble (in hot concentrated HCL) iron, gold and pulp SG. For approximately 10 percent of the total samples from the property, assays were determined for lead, zinc and silver only. There are no barium or manganese assays available, nor systematic data for mercury, arsenic, cadmium or any other elements.

3.3.4 Reserve Calculation

(a) Introduction

To evaluate the Grum ore reserves, a new block model, the G8606 Model, was constructed by Curragh in June and July 1986. New reserves were calculated for the deposit in two portions: one from surface (1,336 metre maximum elevation) to 1,088.5 metre elevation, and a second from 1,088.5 to 868.0 metre elevation. This was due to software and hardware limitations brought about by a low bench height (4.5 metres) and correspondingly larger number of benches.

The PC Mine software package was used for grade interpolation and reserve calculation. The block geology and composites had been previously calculated using Mintec's Medsystem release 10. The results of the calculation are outlined in Section 3.3.5 of this Report.

Geological data will be continually updated during production to facilitate detailed bench-by-bench mine planning.

(b) Block Geology and Drill Hole Information

The reserves are calculated from a computer-based 3D Block Model based on a set of cross-sections produced by Cyprus Anvil geologists in 1982. The sections are parallel to the columns in the mine model and perpendicular to the elongation of the deposit. The cross-sections are 61 metres apart and provide the geologic control for the mine model. These sections were used for the sectional calculations by Cyprus Anvil in 1983, and for recalculations by Dome in 1984. All sections are available in a supporting document available at Curragh's Toronto and Whitehorse offices.

The logging and drill hole orientation data used were the most current available for the deposit. Most of the deposit is so densely drilled that there is little scope for variations in geologic interpretation to change the volume of the deposit significantly. However, the details of ore distribution on a given bench can change. For the purposes of annual projections of production, the current geological model is considered adequate.

The block geology was generated manually by laying a grid over the geologic sections and hand coding the rock types. Block dimensions are 4.5 metres high, 8.0 metres across deposit trend, and 15.0 metres along deposit trend. These block sizes provide a reasonable approximation of the complex structure of Grum. Codes were assigned by visual estimation of the most abundant rock types in the area. If the block was more than 50 percent sulphides, it was coded as a sulphide type, otherwise the block was considered waste. One code is assigned per block and that code is assumed to apply homogenously to the entire block. The sectional codes were plotted, checked and edited for each section. The blocks in overburden or air were assigned from interpolated grids representing topography and bedrock surfaces based on digitized contour maps. Blocks more than 50 percent above topography were coded as air, and more than 50 percent between topography and bedrock as overburden. One generic waste code was carried for the remainder of the model not coded as air, overburden or sulphide.

Sectionally assigned codes were applied to two columns of blocks on either side of the section. Since the Grum deposit plunges to the northwest, this assignment would create a stairstep appearance in long section. By coincidence, the diagonal of two blocks in long section is parallel to the deposit plunge, thus a "plunge correction" was made by raising the first column of blocks one level (southeast of the section) and lowering the fourth column of blocks one level (northwest of the section). The second and third columns of blocks are kept the same. This has no affect on deposit reserves. All this block coding was carried out outside PC Mine either using the Mintec Medsystem release 10 software package or by manual means. The block codes were reformatted to suit PC Mine, then imported.

DDH data and composites were imported directly to PC Mine from reformatted Mintec output files.

(c) Composite Calculation

Composites were calculated by Medsystem on a 4.5 metre bench basis for holes steeper than 45 degrees. For holes shallower than 45 degress, composites were based on 4.5 metre horizontal intervals from the drill hole collar. Composite intervals can range from 4.5 metres to 6.5 metres depending on borehole orientation. Waste intervals less than one-half bench height (2.25 metres) were considered internal waste and included in the composite interval. Intervals greater than one-half bench height were external waste and not included. This procedure was intended to accurately represent the grade of ore in blocks of all settings, but did not automatically include all dilution in marginal composites. Such dilution adjustments must be made separately and are addressed in Section 4.0.

Drill hole assay data were clipped to the 95th percentile levels to avoid assigning unusually high assays to large blocks. These levels are listed in Table 3.3.4-1. Intervals with no measured SG were assigned an SG depending on rock type as listed in Table 3.3.4-2. These were based on statistical analysis of the measured data.

Composite calculation was carried out for the mineralized sections using this modified assay data and weighting by length and specific gravity. The length of the composite within a mineralized band was carried as well as the values since only the length of the mineralized part of an interval was composited.

The final composites used were as short as 0.1 metres but only if a small part of a mineralized band was within a composite interval. After calculation, the composites were also clipped to the 95th percentile level as outlined in Table 3.3.4-3. Every composite was manually checked against the cross-sections to ensure that the codes applied to sectional units were consistent with the composite codes.

(d) Interpolation

The geostatistical analysis carried out was not adequate to use kriging as an interpolation method, thus inverse square distance weighting was used following precedent set at Faro. The search volume was an ellipsoid with major axis of 150 metres parallel to the deposit plunge and with diameter in cross-section of 106 metres. The ellipsoid centered on the block being interpolated, thus the maximum distance a sample can be used to weight a block is 75 metres. A horizontal and vertical anisotopy of 1.41 was used. This results in samples along trend being weighted twice as heavily as those across trend (with an anisotopy of 1.41, a sample 53 metres across strike is weighted the same as one 75 metres along plunge because the sample is treated as if it is 53 by 1.41 or 75 metres from the block centre, once this apparent distance is squared the factor of 2 [= 1.41^2] appears). A search volume radius much larger than the range was used in order to ensure that the blocks in the less intensely drilled part of the deposit would get grades assigned.

TABLE 3.3.4-1
MAXIMUM PERMITTED ASSAY VALUES AND SG VALUES

Pb	11.0 %
Zn	20.0 %
Ag	175.0 g/tonne
Au	2.8 g/tonne
Cu	0.4 %
Pulp SG	5.0

TABLE 3.3.4-2
SG VALUES ASSIGNED FOR EACH MAJOR ORE TYPE IN CASE OF MISSING ANALYTICAL DATA

Ore Type	SG
4A0	3.23
4A4/4AE	3.31
4B	3.00
4C	3.45
4D	3.53
4E	4.32
4G	4.42
4H	3.86
4J	3.87
4K	3.84
4L0	3.11
4L4/4LE	3.29

TABLE 3.3.4-3
MAXIMUM PERMITTED ASSAY AND SG FOR DDH COMPOSITES

Pb	9.00 %
Zn	17.00 %
Ag	150.00 g/tonne
Au	2.30 g/tonne
Cu	0.34 %
Pulp SG	4.80

In the model, the most important test that a sample within the search volume must pass before being used to interpolate a block is the equivalence of geological codes. This is important in Anvil District deposits because of the strong ore type zoning and coupled grade zoning. The implications of this restrictive code matching for use of the model are very significant.

The minimum number of composites required to interpolate a block was set at two, the maximum at eight. The minimum limit was set to avoid the possibility that one very short composite could bias an entire block, the possibility that two very short composites could be used cannot be excluded; however, in most cases, a very short composite would be near a longer one.

Specific gravity was interpolated in the same fashion as assays. Uninterpolated sulphide blocks were assigned an SG of 2.7. Pulp SG was reduced by 5 percent in the final model in order to convert the pulp SG to insitu whole rock SG. The average SGs for the Grum deposit are given with the geological reserves in Tables 3.3.4-4 and 3.3.4-5.

(e) Geological Reserve Reporting

Reserves were calculated by the weighted average of block values for all blocks that exceed an arbitrary percent lead plus percent zinc cutoff value. Geologic reserves are the sum of all blocks in the model below topography, but irrespective of any pit outlines.

Since there are two partial Grum models to cover the whole deposit, the results from the two models were combined by a spreadsheet.

Sectional geologial reserves were also computed for each cross-section by reporting the reserves within a plan view polygon representing the area of influence of each section (± 30.5 metres from the section line). The sectional reserves were needed to compare to previous manual calculations.

3.3.5 Results

(a) Geological Reserves

The geological reserves calculated for Grum are summarized in Table 3.3.4-4 for the two constituent models and for the entire deposit. Sectional geological reserves are summarized in Table 3.3.4-5 for the entire deposit.

The Champ Zone southeast of section 62W and separate from Grum, is estimated to contain an additional 1.7 million tonnes of geological reserves averaging 3.5 percent lead, 4.3 percent zinc, and 46 grams per tonne of silver. These figures are based on sectional calculations and quoted at a 4 percent lead-zinc cutoff. Northwest of 86W and part of the Grum deposit, preliminary drilling indicates that there may be an additional 5 to 10 million tonnes of deep mineralization.

(b) Reliability of Reserves

The current level of geostatistical knowledge of the deposit has precluded determination of block estimation variance. Thus, quantifiation of overall deposit variance is not yet possible. However, the density of drilling is sufficient to limit the possibility of major changes in deposit volume due to variance in interpretation. Volume ranges of plus or minus 10 percent would be possible.

TABLE 3.3.4-4

G8606 MODEL GEOLOGICAL RESERVES FOR THE TWO CONSTITUENT MODELS AND FOR THE ENTIRE DEPOSIT

Grade Category	Volume (bcm)	SG	Ore (tonnes)	Lead (%)	Zinc (%)	Pb+Zn (%)	Silver (g/t)	Gold (g/t)
Above Grum (1336.0 m to 1088.5 m)								
+ 6%	4,677,480	3.37	15,765,300	3.84	6.50	10.34	64.0	0.92
4 - 6%	1,942,920	3.12	6,065,990	1.90	3.10	4.99	33.0	0.77
+ 4%	6,620,400	3.30	21,831,290	3.30	5.56	8.85	55.4	0.88
Under Grum (1088.5 m to 868.0 m)								
+ 6%	1,880,820	3.75	7,057,100	4.04	6.36	10.40	68.5	1.18
4 - 6%	522,720	3.37	1,760,770	2.12	2.76	4.88	35.5	0.99
+ 4%	2,403,540	3.67	8,817,870	3.66	5.64	9.30	61.9	1.14
Total Deposit (1336.0 m to 868.0 m)								
+ 6%	6,558,300	3.48	22,822,400	3.90	6.46	10.36	65.4	1.00
4 - 6%	2,465,640	3.17	7,826,760	1.95	3.02	4.97	33.6	0.82
+ 4%	9,023,940	3.40	30,649,160	3.40	5.58	8.98	57.2	0.95

TABLE 3.3.4-5

GEOLOGICAL RESERVES BY CROSS-SECTION FROM G8606 COMPUTER MODEL, 1986

TOTAL DEPOSIT - 4% Pb+Zn CUTOFF GRADE

Sec.	Volume (bcm)	SG	Ore (tonnes)	Lead (%)	Zinc (%)	Silver (g/t)	Gold (g/t)	Pb+Zn (%)	Total Metal (tonnes)
86W	684,180	3.09	2,116,210	2.60	4.99	46.0	0.44	7.59	160,592
84W	584,820	3.16	1,849,610	2.80	4.90	47.6	0.60	7.70	142,432
82W	787,860	3.40	2,680,540	3.19	5.55	56.5	0.84	8.73	234,069
80W	1,297,080	3.35	4,340,270	3.10	4.85	51.8	1.05	7.95	345,081
78W	975,780	3.27	3,195,500	3.16	5.50	54.7	1.04	8.66	276,762
76W	907,200	3.36	3,048,860	3.49	5.80	58.6	1.07	9.29	283,135
74W	1,013,040	3.45	3,498,640	3.72	6.20	62.3	1.05	9.92	347,148
72W	748,440	3.45	2,584,690	3.64	5.77	61.2	1.02	9.41	243,256
70W	694,980	3.52	2,449,940	3.86	6.57	63.6	1.04	10.43	255,415
68W	355,320	3.70	1,314,260	4.10	6.27	66.7	1.00	10.37	136,297
66W	442,260	3.69	1,632,190	4.14	5.75	66.7	0.99	9.90	161,507
64W	301,860	3.61	1,091,070	3.79	5.52	61.2	0.99	9.30	101,486
62W	178,200	3.69	657,640	3.39	5.03	54.8	1.10	8.42	55,347
	8,971,020	3.40	30,459,410	3.41	5.60	57.3	0.95	9.00	2,742,527

Possible variance due to calculation methods is also not quantified, but changes of a few percent would be possible through adjustment of interpolation parameters such as anisotopy, weighting scheme and range, and the geology matching scheme.

How well the reported geological reserves will relate to mill feed depends on the type and degree of dilution allowed. The need to use a higher dilution than the historic 5 percent used for Anvil District deposits in the past is brought on largely by the restrictive geology matching used during interpolation. This matching was not carried out previously, thus the models tended to dilute themselves in unpredicable ways during interpolation. The modelling technique was changed in order to present a more accurate portrayal of grade distribution, especially with respect to grade averaging into otherwise barren sulphides, particularly footwall sulphides. As in the case for Faro, dilution will be specific to each ore zone, taking into account the complexity of the geological structure and the nature of the surrounding waste rock.

3.3.6 Additional Work Required

The complex geology of the Grum deposit and its multi-horizon nature creates some difficulty in producing an interpretation that is consistent from section to section. Horizons are difficult to distinguish from one another in drill core, thus the iterative process of section by section interpretation and comparison must be used. The current interpretation requires further refinement in this regard. Additionally, 60.5 metre spaced sections do not fully utilize of all available drill hole information. A revised detailed interpretation, based on thirty metre spaced sections, is being prepared for short range production planning.

The Champ Zone will be included in the Grum deposit models since mining that area might influence the overall pit economics by lowering the main pit exit. Considering both zones together offers the possibility of enhancing the economics of both.

Due to the wide spacing of drill holes in most Anvil District deposits, geostatistical analyses have been difficult. At Grum, the drill pattern is dense enough to produce meaningful analysis once the basic geologic data is organized into the thirty metre spaced interpretation. Such analysis should allow interpolation methods other than the simple inverse square method to be used.

Further geotechnical data is required at Grum in order to design the final pit slopes. A program of oriented core drilling will be undertaken. These holes will also sample the overburden to evaluate its clay content and hydrogeology. If the overbruden is amenable to dewatering and can be kept dry, then pit slopes steeper than those currently designed may be possible.

The foundation conditions of the proposed waste dump sites will be investigated.

It may be necessary to carry out fill-in drilling to further delineate and detail the reserves in early production areas. This work could be coordinated with the collection of metallurgical samples.

3.4 VANGORDA GEOLOGY AND RESERVES

3.4.1 History

Vangorda was the initial discovery in the Anvil Range. The deposit was drill tested from 1953 to 1955 by Prospector Airways, a predecessor to Kerr Addison Mines. This drilling showed a significant deposit existed, but a production decision was not warranted at that time. Minor additional drilling was carried out by Kerr Addison, largely for metallurgical sampling. The deposit was sold to Cyprus Anvil in 1979. Cyprus Anvil geologists examined the available drill core and concluded that it would be necessary to redrill the deposit to provide adequate material to re-evaluate it.

In 1979, the portion of the deposit from 2W to 12E was redrilled with NQ core holes. Scattered core holes were put down in the southeast part of the deposit. Because of anticipated poor recoveries in this area, it was judged advisable to drill this part of the deposit with rotary methods. This fill-in drilling was carried out in 1981. Since 1981, no additional drilling has been carried out.

3.4.2 General Geology

Figure 3.4.2-1 is a cross-sectional view of the Vangorda deposit.

(a) Stratigraphy and Lithology

The Vangorda deposit consists of one major sulphide horizon about 50 to 120 metres beneath the basal carbonaceous member of the Vangorda formation. The host rocks for the deposit are dominantly non-calcareous phyllites, probably part of the Mount Mye formation; however, formational assignments near this deposit are ambiguous. The reason for the ambiguity is largely due to the strong wall rock alteration developed around the deposit. Most phyllites, especially in the deposit footwall, are bleached, locally silicified and/or chloritic- and sulphide-bearing.

A number of thin sulphide horizons occur above the main horizon; one, at the base of the carbonaceous phyllites southwest of (stratigraphically above) the deposit, may equate to the main horizon at Grum. In general, these horizons are too thin or too low grade to be mineable.

(b) Structure

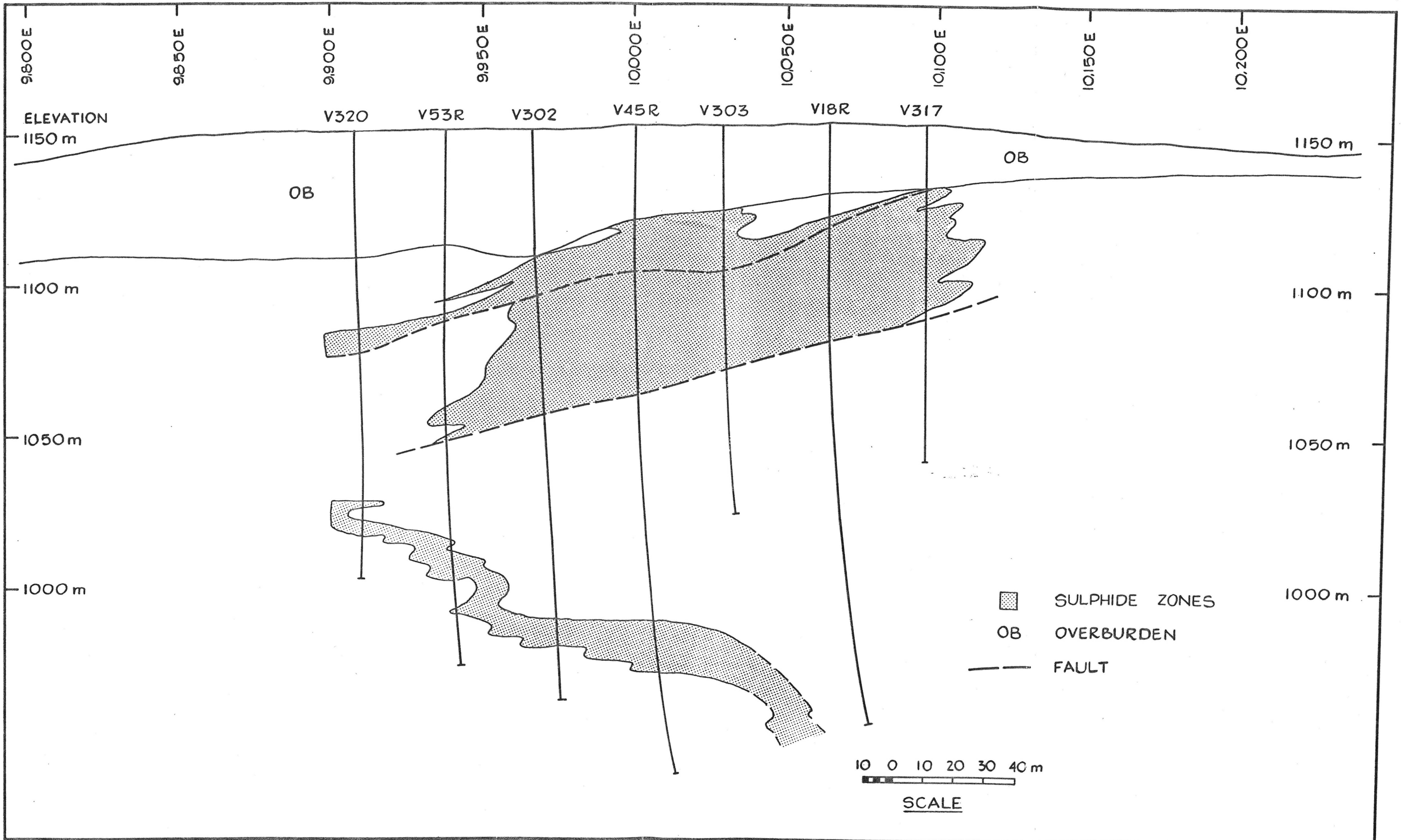
The Vangorda deposit occurs in the hinge of a large second phase fold. Overall, the deposit has the shape of a reclining "M" or a "3" in cross-section; however, there is some uncertainty in the details of fold morphology. The deposit is elongate in the northwest-southwest direction parallel to fold axes. It has been traced over a 1,300 metre by 200 metre area.

The northwest half of the deposit plunges about 10 degrees towards the northwest, while the southeast half has a subhorizontal plunge. The foliation dips shallowly toward the southwest as at Grum, but is locally quite variable.

The deposit is truncated by a steep normal fault at its northwest end. Many gouge zones were observed in drill core, but the orientation of the structures responsible for them is not well known. A number of faults parallel to foliation are predicted. These are "required" to make the structure and stratigraphy fit. These low angle structures are best thought of a sheared-out fold limbs; they are not generally gouge zones and will pose no more serious a problem for slope stability than the foliation itself and the myriad of small gouge zones that parallel it.

(c) Deposit Geology

The deposit is quite shallow; in most places, subcroping beneath glacial till. The till blanket is up to about 30 metres thick in the northwest part of the deposit, but thin in the southeast. Northwest of Vangorda Creek, till cover is also quite thin. Locally, the basal overburden and uppermost broken bedrock are cemented by iron oxides into a tough breccia.



ISSUED FOR TECHNICAL REVIEW	A	MAR 87	ZA
REVISIONS	Nº	DATE	BY

SCALE	AS SHOWN	DATE
DESIGNED	J.B.F.	MAR.87
DRAWN	Z.A.	MAR.87
CHECKED		
APPROVED		

CLIENT CURRAGH RESOURCES
LOCATION FARO, YUKON
KILBORN

FARO AREA DEPOSITS
VANGORDA DEPOSIT
X-SECTION (8E)

PROJ. Nº 3509-19 DWG. Nº FIG. 3.4.2-1 REV. A

The deposit consists of the same sulphide rock types as the Faro and Grum deposits, but two rock types are particularly prominent. In the footwall (also the interpreted stratigraphic footwall) of the deposit is a sulphide-rich quartzite which grades downwards into siliceous phyllite and ultimately altered phyllite. Parallel to this downward decrease in silica is a downward decrease in the abundance of sulphides from quartz-rich semi-massive sulphide at the top to weakly pyritic altered phyllite at the base. Most of the sulphides in the quartzite are pyrite; however, pyrrhotite is generally present and locally abundant or dominant. Magnetite is unusually well developed in the quartzite. The quartzite contains only minor lead and zinc, but is relatively rich in copper and unusually high in gold (see Table 3.4.2-1) The quartzite is similar to the semi-massive zone along the northeast edge of Zone 3 at Faro, and one of the lower ore panels at Grum.

From a reserve estimation point of view, the barren pyritic quartzite is significant in that it is located beneath, and sharply delineated from, the high grade massive sulphides. For this reason, it was important to restrict the selection of assay composites during grade interpolation to equivalent geology, thus preventing excessive averaging of grades into the deposit footwall and lowering of the overall deposit grade.

The massive sulphides that overlie the pyritic quartzite are commonly baritic and rich in lead and zinc. Of the mineralization exceeding 6 percent lead and zinc, 90 percent is barite-bearing massive sulphides. Most pyritic quartzite is sulphide waste on the basis of lead-zinc content (see Table 3.4.2-1).

TABLE 3.4.2-1

GEOLOGICAL RESERVES FOR VANGORDA DEPOSIT FROM V8607 MODEL

NO DILUTION

Rock Type		% of Ore Type	Tonnes (x1000)	Density (tn/bcm)	Pb (%)	Zn (%)	Pb+Zn (%)	Ag (g/t)	Au (g/t)
PLUS 6% Pb+Zn									
4A	1	7.1	382.33	2.81	3.17	4.66	7.83	39.74	0.68
4C	2	0.0	1.42	3.50	6.40	1.01	7.41	57.51	1.77
4EC	3	0.4	21.41	3.65	2.97	3.79	6.75	46.65	0.80
4E	4	0.1	4.16	3.43	2.57	4.12	6.69	46.50	0.63
4EG	5	90.8	4,917.88	3.96	4.51	5.83	10.34	64.03	0.75
4EH	6	1.7	90.23	3.65	6.82	5.05	11.87	83.15	0.54
TOTAL		100.0	5,417.43	3.88	4.45	5.72	10.17	62.55	0.74
4% TO 6%									
4A	1	58.6	1,194.40	2.83	1.86	3.02	4.88	26.48	0.46
4C	2	9.5	194.12	3.27	2.34	2.08	4.42	25.82	0.79
4EC	3	14.1	286.99	3.68	2.28	2.40	4.68	33.18	0.85
4E	4	10.2	207.58	3.76	1.90	2.87	4.77	37.94	0.14
4EG	5	6.7	137.28	3.75	2.47	2.76	5.23	36.96	0.76
4EH	6	0.9	19.13	3.78	2.43	2.95	5.38	34.31	0.41
TOTAL		100.0	2,039.51	3.16	2.01	2.81	4.83	29.30	0.53
MINUS 4%									
4A	1	36.2	3,721.08	2.92	0.90	1.44	2.34	12.48	0.33
4C	2	42.8	4,393.21	3.27	0.79	1.00	1.79	14.50	0.65
4EC	3	17.9	1,842.51	3.67	1.33	1.34	2.67	21.57	0.94
4E	4	2.9	299.17	3.65	1.50	1.40	2.90	17.48	0.28
4EG	5	0.1	5.88	3.23	0.67	0.86	1.53	11.66	0.65
4EH	6	0.1	9.09	2.99	0.39	0.49	0.88	5.95	0.08
TOTAL		100.0	10,270.94	3.23	0.95	1.23	2.18	15.12	0.57
TOTAL DEPOSIT (ALL GRADES)									
4A	1	29.9	5,297.81	2.89	1.28	2.03	3.31	17.60	0.38
4C	2	25.9	4,588.75	3.27	0.86	1.04	1.90	15.00	0.66
4EC	3	12.1	2,150.90	3.67	1.47	1.51	2.98	23.37	0.93
4E	4	2.9	510.92	3.69	1.67	2.02	3.69	26.03	0.23
4EG	5	28.5	5,061.05	3.96	4.45	5.74	10.19	63.24	0.75
4EH	6	0.7	118.46	3.62	5.62	4.36	9.98	69.33	0.48
TOTAL		100.0	17,727.88	3.42	2.14	2.78	4.92	31.24	0.62
PLUS 4%									
4A	1	21.1	1,576.72	2.83	2.18	3.42	5.60	29.69	0.51
4C	2	2.6	195.54	3.27	2.37	2.07	4.44	26.05	0.80
4EC	3	4.1	308.40	3.68	2.32	2.50	4.82	34.11	0.84
4E	4	2.8	211.75	3.75	1.91	2.90	4.81	38.11	0.15
4EG	5	67.8	5,055.17	3.96	4.45	5.74	10.20	63.30	0.75
4EH	6	1.5	109.36	3.67	6.05	4.68	10.74	74.60	0.52
TOTAL		100.0	7,456.94	3.68	3.78	4.92	8.71	53.46	0.69

The shallow depth of burial of the deposit may create metallurgical difficulties because of oxidation. Early metallurgical work seemed to show this; however, later work carried out by Cyprus Anvil on fresh core achieved better results. The limited core observed by the writer was not visibly oxidized and oxidation is not extensively described in most drill logs below the first few metres of bedrock. Diamond drill core recoveries in massive sulphides were generally good except locally near Vangorda Creek and in the southeast end of the deposit (at Faro, oxidized massive sulphides yield poor core recoveries). In much of the southeast end of the deposit, information on core recoveries from recent drilling is not available, but it is known that the older holes did not core well. It seems prudent to assume that the portion of the deposit southeast of 12E, where till cover is thin, will be oxidized. This could affect up to 1,900,000 tonnes of baritic sulphides or 37 percent of the baritic sulphides in the geological reserves.

3.4.3 Drilling Definition and Information Base

In the portion of the deposit from 2W to 12E, there are 53 diamond drill holes in a 60 metre by 30 metre pattern. All holes are vertical and all are NQ diameter. Collar locations have been surveyed, checked and appear accurate. Assay intervals are 1.5 to 2 metres long and, where possible, are confined to one rock type.

In the remainder of the deposit, there are forty-five rotary holes and eight recent NQ and HQ diamond drill holes. The pattern is also 60 metres by 30 metres. There appears to have been a sampling problem with some of the rotary holes that resulted in unuseable assays which have cast doubt on the assay results from the remainder of the rotary holes. For this reason, where a Prospector Airways hole was also available and good recovery was obtained, the information from the older hole has been used in preference to that from a rotary hole.

For most assay intervals, copper, lead, zinc, silver, gold, soluble (in hot HCl) iron, insoluble iron, and barium assays were determined. Old diamond drill holes were only assayed for lead, zinc and silver. The newer assays are the same as those described for Grum. The lead assays from the older holes are suspect because no correction for barium interference was made.

3.4.4 Reserve Calculation

(a) Introduction

The Vangorda deposit reserves were generated using a computer-based 3D Block Model, the V8607 Model, constructed by Curragh during June and July 1986. The PC Mine software package was used for all stages of model construction.

(b) Block Geology and Drill Hole Information

The model was generated using geologic control provided by 60 metre spaced cross-sections. The cross-sections were newly interpreted for this model in order to provide a uniform structural concept for the entire deposit. The assumptions used in cross-section construction were:

i) The deposit must fit the overall structural setting of this part of the Vangorda Plateau as defined by surface mapping and deep drilling nearby. This work shows that the deposit is in the hinge region of a large recumbent second phase fold.

ii) Stratigraphic facings implied by Anvil cycles were followed wherever possible. Of particular importance was the barren pyritic quartzite which shows strong indications of being a footwall facies.

iii) Symmetric suphide intersections were taken to imply folds.

iv) The dominant deformation eposide would be the second phase implying a deposit shape similar to Grum, but different from Faro.

Assumption i) and ii) together require highly attenuated folds in order to produce a consistent interpretation. The resulting fold shapes are consistent with the deformation style observed in nearby outcrops on a small scale and with the inferred shapes of more closely controlled folds at Grum. All sections are included in supporting documents at Curragh's Toronto and Whitehorse offices.

The density of drilling at Vangorda is sufficient to produce geological interpretations and a global estimate of reserves with reasonable confidence (changes in volume of plus or minus 10 percent to 15 percent may be possible due to interpretation).

The rotary drilling results in the southeast part of the deposit are more difficult to interpret because the rock type logging was not as precise or reliable as the diamond drilled part of the deposit. As a result, there is more uncertainty in the geologic sections of this part of the deposit.

For computerized reserves calculation, the cross-sections were digitized and block assignments were made. The logic used for assignment of the geological rock type code for each block was based on the geology at the centre of that block. The block size used was 4.5 metres high, 4.5 metres across strike, and 10.0 metres along strike. This was essentially the smallest block size practical that allowed maximum resolution of geologic detail. Rows of blocks were arranged in the model parallel to the geologic sections. The same geological codes were applied to three rows of blocks on either side of a section, for a strike length of 60 metres, but each 10 metre segment was treated separately for purposes of interpolation. There are 45 levels in the model extending from 1209.5 to 1007.0 metre elevation (1979 Cyprus Anvil Datum).

Drill hole data was imported as ASCII files into the mine modelling system from the Hewlett Packard HP3000 based database for Vangorda drill hole information.

(c) Composite Calculation

The assays were composited on the basis of geology with an attempt to conform to a 4 to 6 metre length. This composite coding ensured that an interpreted geologic unit would only be assigned an assay from a length of drill core that was actually used to define the unit. In some cases, these defined units actually contained two or more different geological types, but the single assignment was necessary in order to produce units that would be reasonable from a mining point of view with the minimum number of necessary ore types.

In general, these mixed types are related. The minimum composite length was about one metre. Internal waste was included in the composites at a zero percent assay value. Unlike most previous models, except the F4, bench composites were not used.

Assays were weighted by length of the sample, but not by its specific gravity (SG). Since composite intervals tend to be restricted to one ore type, SG weighting would have relatively little effect. There was no "clipping" of assay values to arbitrary maxima prior to compositing calculations.

(d) Interpolation

Interpolation was carried out in essentially the same fashion as the Grun G8606 Model described previously. Experimental variograms calculated from these composites showed only nugget effect due to the relatively large drill hole spacing. For this reason, the anisotopy developed for Grum was used at Vangorda with a slightly larger search volume. Search volume parameters were:

Elongation - Model 090° (i.e. along deposit trend)
Plunge - -10° (i.e. 10° northwest plunge)
Horizontal Anisotopy - 1.41
Vertical Anisotopy - 1.41
Maximum Range - 90 m (1.5 x section spacing)
Minimum Number Composites Used for a Block - 2
Maximum Number Composites Used for a Block - 8

Composites were weighted by the inverse square of the distance from the composite centre to the block centre. A composite could be used to interpolate a block only if its geologic code matched the code of the block being estimated.

SG was treated as an assay and interpolated into blocks based on measured pulp SG of composite intervals. These SGs were determined by air pycnometer on assay pulps, and consequently do not account for void space. For tight quartzose ore types, these SGs are high by about 5 percent and for vuggy, porous, massive ore types, they are high by as much as 10 percent based on comparison of whole rock and pulp SGs carried out on Grum, Faro and Dy ores. In order to recast the SG data in terms of whole rock values, the pulp SG was reduced by 5 percent in the final model.

Geological reserves were computed by weighted average of block values between certain lead plus zinc grades for all levels below topography.

3.4.5 Results

(a) Geological Reserves

Geological reserves at 4 percent and 6 percent lead plus zinc cutoff grades are summarized in Table 3.4.2-1. The results quoted are for all mineralization regardless of potential pit outlines. There has been no allowance made for dilution or mining recovery in the geological reserves.

(b) Comparison of Geological Reserves

Two manual calculations have been carried out for the entire Vangorda deposit. Both are based on the old drilling and assays for the deposit. Table 3.4.5-1 below compares these results to the present computer model.

TABLE 3.4.5-1

EARLIER GEOLOGICAL RESERVE ESTIMATES FOR THE ENTIRE DEPOSIT COMPARED TO THE V8707

	Tonnes (x1000)	Density (tn/bcm)	Pb (%)	Zn (%)	Pb+Zn (%)	Ag (g/t)	Au (g/t)	Total Metal (tonnes)
PROSPECTORS AIRWAYS / CHISHOLM ET AL [Extent unknown - may be 4W to 40E]								
High Grade (+ 4%?)	8,528	4.0 ?	3.16	4.96	8.12	60.33	0.69	692,474
Low Grade	11,431	------------not determined------------						
TOTAL DEPOSIT	19,959							
KERR ADDISON MINES / PAXTON [Recalculated to 3W to 29E]								
High Grade (+ 4%?)	6,942	4.0 ?	----nd----		8.67	----nd-----		601,871
Low Grade	9,139	3.5 ?	----not determined-----------					
TOTAL DEPOSIT	16,081							
THIS CALCULATION [3W to 29E]								
High Grade (+ 4%)	7,457	3.68	3.78	4.92	8.71	53.46	0.69	649,224
Low Grade (- 4%)	10,271	3.23	0.95	1.23	2.18	15.12	0.57	
TOTAL DEPOSIT	17,728	3.42	2.14	2.78	4.92	31.24	0.62	

The oldest one by Prospector Airways is based on the triangular calculation method. The comparison to the present model is reasonably close. The large variance in lead grade is expected as it is known that the older lead assays were low probably because a correction for barium was not made. The areal extent of this calculation is not known, but it may extend as far as 40E. The amount of ore in the far southeast sections (between 30E and 40E) is slight but this detracts from the comparison since the V8607 Model only extends to 29E.

The Kerr Addison reserves are based on a sectional calculation by J. Paxton using sections between 4W and 30E in 1966. These sections show unconnected enechelon pods of ore, thus the tonnage should be lower than the current model where the assumptions outlined above imply the pods should be connected into fold patterns.

(c) Reliability of Geological Reserves

As a check on model computations, the areas of geological units output during digitizing of unit outlines was used to compute the volume of the overall deposit at the zero percent combined cutoff grade. The average SGs of the ore types were used to calculate tonnes of mineralization. This calculation gave a total deposit tonnage of 18,921,000 tonnes compared to 18,660,930 from the block model (all these tonnages are prior to SG reduction), or compared to 18,732,000 if the 97 uninterpolated blocks are included.

During test interpolation, increasing the degree of anisotopy tended to increase the spread in extreme block values. The effect on the average is not known but, above a given cutoff, the average grade would probably increase.

The reliability of the Vangorda geological reserves is within the range of plus or minus 10 percent to plus or minus 20 percent.

In calculating Vangorda mill feed, mining dilution must be considered in a manner similar to that described previously for Grum in Section 3.3.5 (b). Mining recovery and dilution are quantified in Section 4.3.1.

3.4.6 Additional Work Required

More diamond drilling will be required at Vangorda to facilitate detailed mine production planning. In particular, fill-in holes will be necessary where previously drilled holes deviated from their planned courses and left information gaps, in the area explored by rotary drilling, and in likely areas of oxidation.

It is likely that a staggered triangular pattern will be diamond drilled to supplement the information provided from the current 100 ft by 200 ft rectangular pattern.