G9009 DOCUMENTATION

COORDINATE SYSTEM

The Grum 9009 geological interpretation uses the same coordinate system as the earlier G8705 model. The grid system is tied to survey control station 1404 (earlier named VG4) located on the Blind Creek road between the Grum and Vangorda areas. Table 1 lists the UTM and Grum local coordinates for this survey station.

Table 1. Coordinates for 1404 (VG4)		
UTM	Northing	6,904,623.172
	Easting	593,847.979
	elevation	1,300.062
GRUM LOCAL	Northing	5,000.000
	Easting	3,500.000
	elevation	1,300.062

The local Grum coordinate grid is an orthogonal grid oriented parallel to the exploration cross and long sections. It is also parallel to the current PC-MINE model blocks. Local north (for this grid) is rotated 47.7741667 degrees (0.833816 radians) counterclockwise from UTM north.

Horizontal and vertical units for the local grid are metres. UTM coordinates for Station 1404 were established as part of the 1979 Anvil District orthophoto survey completed by Northwest Surveys. Elevations in both the local and UTM coordinate grids correspond exactly to the elevation datum established in this 1979 Anvil District orthophoto survey.

Conversion between Grum Local and Anvil District UTM coordinate systems can be completed using the following equations:

Nutm = No + Sh * (Nlocal * cos(x) + Elocal * sin(x))
Eutm = Eo + Sh * (Elocal * cos(x) - Nlocal * sin(x))

where	No	=	6,898,674.069
	Eo	=	595,197.633
	Sh	=	0.99959853
	x	=	47.7741667 degrees (0.833816 radians).

These equations have been incorporated into the spreadsheet GRIDS. The Sh scaling factor is averaged for the elevations typically encountered on the Vangorda Plateau.

GRUM MODEL PROPERTY DEFINITION

The plan size, plan location, and block size of the Grum G9009 model have been slightly modified from the earlier G8705 model. These changes were made to allow the G9009 rows and columns to correlate exactly with the exploration drill grid pattern. Table 2 lists the new overall coordinate information for the G9009 location.

Table 2. GRUM G9009 Model Coordinates

Lower Left Corner	UTM	Northing	6,903,971.02
		Easting	592,684.25
	LOCAL	Northing	5,423.67
		Easting	2,234.37
Lower Right Corner	UTM	Northing	6,904,687.28
		Easting	593,334.31
	LOCAL	Northing	5,423.67
		Easting	3,202.11
Upper Left Corner	UTM	Northing	6,905,081.97
		Easting	591,460.15
	LOCAL	Northing	7,077.55
		Easting	2,234.37

Upper Right Corner	UTM	Northing	6,905,798.23
		Easting	592,110.21
	LOCAL	Northing	7,077.55
		Easting	3,202.11

Row Length = 15.17325 m (109 rows total)
Column Length = 7.62 m (127 columns total)

Column centres for the G9009 model correspond exactly to the long section lines. The cross section lines pass along the margins between two rows. The correspondence between the model blocks and the cross and long sections is listed in Tables 4 and 3 respectively.

Table 3. Location of Grum Long Sections

Section	Local Easting	Model Column
12 S	2,245.8	2
10 S	2,306.8	10
08 S	2,367.8	18
06 S	2,428.7	26
04 S	2,489.7	34
02 S	2,550.6	42
00 B/L	2,611.6	50
02 N	2,672.6	58
04 N	2,733.5	66
06 N	2,794.5	74
08 N	2,855.4	82
10 N	2,916.4	90
12 N	2,977.3	98
14 N	3,038.3	106
16 N	3,099.3	114

18 N	3,160.2	122

Even long sections are spaced every 60.96 metres (200 feet)

Table 4. Location of Grum Cross Sections		
Section	Local Northing	Model Rows
42 W	5,423.7	109/Model Edge
44 W	5,484.3	105/106
46 W	5,545.0	101/102
48 W	5,605.7	97/98
50 W	5,666.4	93/94
52 W	5,727.1	89/90
54 W	5,787.8	85/86
56 W	5,848.5	81/82
58 W	5,910.0	77/78
60 W	5,969.9	73/74
62 W	6,030.6	69/70
64 W	6,091.3	65/66
66 W	6,152.0	61/62
68 W	6,212.7	57/58
70 W	6,273.4	53/54
72 W	6,334.1	49/50
74 W	6,394.7	45/46
76 W	6,455.4	41/42
78 W	6,516.1	37/38
80 W	6,576.8	33/34
82 W	6,637.5	29/30
84 W	6,698.2	25/26

86 W	6,758.9	21/22
88 W	6,819.6	17/18
90 W	6,880.3	13/14
92 W	6,941.0	9/10
94 W	7,001.7	5/6
96 W	7,062.4	1/2

Even cross sections are spaced every 60.693 metres (199.1 feet).

ROCK TYPE MODEL

Geology for the rock type model was derived from the earlier Simpson-Adamson Grum cross section interpretation (Simpson and Adamson, 1982). The Simpson-Adamson model interpreted the geology for the even cross sections (spaced every 60.693 metres). The G9009 model extends from cross sections 61W through 87W. This corresponds to rows 20-71 in the model.

Simpson-Adamson ore outlines for the even cross sections (spaced every 199.1 feet) were modified slightly to take into account the results from the 1987-1989 drilling programs in the Grum area. The resulting ore outlines were then digitized using PC-MINE software. The rock type assigned to each polygon was based on the earlier Simpson-Adamson rock type.

Ore rock types are exactly the same as those used for the Vangorda and Faro deposits.

Each of the even cross sections corresponds to four rows in the G9009 model. Therefore the polygons digitized on an even section were loaded into two rows on each side of the cross section. Elevations for the ore polygons were adjusted when loading them into the rock type model to account for the overall 11 degree plunge of the deposit towards model north. The amount of plunge correction for each row was calculated using simple trigonometry. Table 5 lists the corrections for each of the four rows adjacent to an even section.

Table 5. Elevation Correction for Model Rows		
Row	Distance to section	Elevation Correction
Row 4 (most NW)	22.759875	-4.42
Row 3	7.586625	-1.47
Even Cross Section	0.0	0.0
Row 2	-7.586625	1.47
Row 1 (most SE)	-22.759875	4.42

This elevation change for each row was completed to reduce the "choppiness" in long section and plan by following the structural grain of the Grum deposit. Cross-cutting faults are obviously not adequately modelled using this procedure. A more detailed geologic interpretation is required to properly include both fault and fold geologic information.

All waste phyllites were assigned to rock type 160 (calcareous phyllite of the Vangorda formation). No attempt was made to differentiate greenstones, altered phyllites, carbonaceous phyllites, or noncalcareous phyllites.

Overburden was digitized as a polygon using the triconed portions of the drill holes on each section. This crude overburden surface was then entered into the model for each row as rock type 310.

Overburden as rock type 300 was also entered into the model as a surface grid using GEO-MODEL. The overburden surface grid was prepared by hand contouring the triconed elevations in plan at five metre intervals. This surface was digitized into GEO-MODEL and converted to a surface grid using the average from both rows and columns. The program RKSURF (Pigage 1987) was then used to convert all blocks whose centres occur at a higher elevation than this surface to an overburden rock code (300).

This approach guaranteed that blocks above the triconed surface but below the contoured surface would be entered into the rock model as overburden (rock type 310) and not as unverified ore or waste blocks.

Air (rock type 500) was also entered into the rock type model using the RKSURF program with the surface topography grid. The topography grid was created in GEO-MODEL by digitizing the 1:2,000 topography and exporting it to a PC-MINE grid using the averages of the rows and columns. In this instance only those blocks whose toes occur at elevations higher than the surface grid are converted to the air rock code.

COMPOSITES

Drill holes are entered into a PC-XPLOR database (database B). The database contains header information in table 1, downhole deviations in table 2, lithologies in table 3, assays in table 4, and different kinds of composites in tables 5 through 8.

The Anvil District alphanumeric rock codes in Tables 3 and 4 were converted to numeric values using the Fortran program LITHCOMP (Pigage 1990). This program substituted an integer rock code for the alphanumeric rock name of the dominant unit for a particular assay interval (table 4) or lithology interval (table 3). Rock code 40 (4EC) was not incorporated into this conversion because it has such a limited occurrence in the Grum drill holes.

Assays for the quartzose ores (rock codes 20, 30) and massive sulphide ores (50, 60, 70) were grouped and analyzed using univariate histograms (Zbeetnoff 1990). Pb, Zn, Ag, Au, and pulp SG assays for each of these two groups were then cut to the 95th percentile. Table 6 contains the 95th percentile values used to cut the assays.

ROCK CODE	Table 6. 95th PERCENTILE CUT OFF VALUES				
	Pb %	Zn %	Ag g/t	Au g/t	SG
20-30	6.44	11.34	106.68	1.848	3.86
50-70	9.68	16.85	160.44	2.36	4.85
210	3.48	5.66	56.44	1.26	3.5

Two different schemes were used to create composites of roughly equal length. Both schemes created 6 metre bench composites for the steep drill holes (inclined at an angle of greater than 45°). They differed in the manner that the shallowly inclined drill hole composites were created. In scenario one the shallow holes were composited using 6 metre equal length intervals starting at the drill hole collar. In scenario two the shallow holes were composited using parallel vertical planes spaced 6 metres apart along both the cross and long section azimuths.

For each of these scenarios two sets of composites were created. For the first set the composites were length weighted. In the second set the composites were weighted by length and SG. Table 7 summarizes the compositing algorithms for the different PC-XPLOR composite tables in database B.

Table 7. Composite Tables in PC-XPLOR Database B

PCXPLOR TABLE	STEEP DDH	SHALLOW DDH	WEIGHTING
5	Bench	Equal length	Length
6	Bench	Equal length	Length * SG
7	Bench	Parallel planes	Length
8	Bench	Parallel planes	Length * SG

PC-XPLOR assigns a rock code to the composited interval based on the lithology at the centre of the interval. It does not take into account whether that particular rock type is the dominant lithology in the interval. To overcome this problem, the Fortran program RKCOMP (Pigage 1990) was written to incorporate a weighting factor when assigning the rock code to a particular composite interval. The rock type could be assigned to the composites using either a length weighting or length*SG weighting algorithm. The weighted length of each different rock code in the composite interval was calculated separately. Waste rock types therefore, were not lumped into a single rock type. The rock code assigned to the composite was the dominant rock type based on the weighted lengths.

Comparison of the univariate statistics for each ore type in Tables 6 and 8 indicate that the means and frequency distributions are statistically identical.

For the G9009 model, Table 6 was used for Pb, Zn, Ag, and Au composite values. Table 5 was used for the composite SG values. All composite SG values were reduced from the measured pulp SG values by 2 percent to account for porosity.

GRADE INTERPOLATION

Several interpolation tests were completed for bench 34 in the G8911 model using different search parameters. With these test runs I looked at varying the search distance in the model north direction, east direction, and elevation, using different powers with inverse distance weighting, and tilting the search ellipsoid to account for the structural grain. The parameters selected based on these tests are middle-of-the-road in their effect upon the grades of the block grades.

Models for SG, Pb, Zn, Ag, and Au were then interpolated. The Pb+Zn model was calculated by adding the interpolated values for Pb and Zn for each block.

The models were interpolated in four passes. Table 8 contains the pertinent search parameters for each of the passes. Model files were saved for passes three and four.

Table 8. Interpolation parameters for G9009

	Pass 1	Pass 2	Pass 3	Pass 4
North search	50 m	75 m	75 m	75 m
East search	50 m	50 m	50 m	50 m
Elev search	13 m	13 m	20 m	50 m
Tilt	-11	-11	-11	-11
Weighting	inverse distance	inverse distance	inverse distance	inverse distance
Power	1	1	1	1
Minimum #	2	2	2	2
Maximum #	10	10	10	10

Loose rock matching was used during the interpolation. All massive sulphides (rock codes 40, 50, 60, 70) were considered equivalent, and all quartzites with disseminated sulphides were considered equivalent (rock codes 20, 30).

After the interpolation was completed the specific gravity model was edited using program RKDENS (Pigage 1987) to put in the missing SG values. All waste phyllite blocks were assigned an SG of 2.7. All overburden blocks were assigned an SG value of 2.2. The uninterpolated ore blocks were assigned the average SG values (reduced by 2 %) for that particular ore type (as determined from the univariate statistics of the assays.

GEOLOGICAL AND MINING RESERVES

The pass 4 interpolation compares closely to the G8606 and G8705 models in terms of search parameters used for the block interpolation. The following tables contain incremental and cumulative mining reserves for the G8705, G8911, and G9009 models. All of the reserves use the Ion Vintila 6-metre ultimated Grum open pit (stage 3 pit). All tables are reporting reserves with no dilution and no mining loss.

For a 4% (Pb+Zn) cutoff, the tonnages for the 6 metre (G9009) and 7 metre (G8911) models are essentially identical. In contrast the tonnage for the 4.5 metre model (G8705) is significantly reduced. The 6 metre (G9009) and 7 metre (G8911) model also give similar total Pb+Zn grades at a 4% cutoff. The 4.5 metre model (G8705) has a substantially higher deposit Pb+Zn value for the same cutoff grade.

DISCUSSION

The loss in grade for the more recent models (G8911, G9009) probably is related to the strict rock type matching used for grade interpolation of the G8705 model and the looser rock type matching used for the G8911 and G9009 models. The more recent models, for example, did not differentiate between a high grade and low grade 4A ore type during the interpolation.

SUMMARY

Recent 6 metre (G9009) and 7 metre (G8911) bench composite grade interpolations for the Grum deposit have similar reported mining reserves using a 4% (Pb+Zn) cutoff. These reserves contain significantly less metal than the 1989 Curragh official G8606 (=G8705) reserves for the Grum deposit.

At least part of this difference is related to the looser rock type matching incorporated into the G9009 and G8911 grade interpolations. These two models used a rock type matching which did not distinguish between low and high grade composites for the same ore type during the interpolation. This approach contrasts with the more stringent rock type matching during the grade interpolation in the G8606 model (especially for rock types 4A and 4A4).

Long term planning and budgeting must consider the differences in total metal implied with the G9009 and G8911 grade interpolations compared to the G8606 grade interpolation. Part of the consideration should encompass the assumptions used in the grade interpolations for the different models. The lower grade results from the newer models is based on what appears to be more reasonable rock type matching constraints. Possible further testing of these assumptions could be conducted and the results compared to the existing models.