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C U R R A G H R E S O U R C E S I N C

INTER-OFFICE MEMORANDUM

FARO OFFICE

DATE: May 24, 1990

TO: WM. W. DUNN
CHIEF ENGINEER

FROM: DAVE TENNEY
CHIEF GEOLOGIST

SUBJECT: SPECIFIC GRAVITY FROM MULTIPLE REGRESSION

A specific gravity formula encompassing all ore bearing rock types in the Faro Pit (#20-#70) was calculated using the same database as previously. (see my memo dated March 23, 1990, for individual rock types-attachment 3). The regression formula for rock types 20 to 70 (Attachment 1) is:

$$S.G. = 2.43 + 0.05 * \%\,Pb + 0.02 * \%\,Zn + 0.05467 * \%\,Fe$$

The correlation coefficient for this regression surface is 0.915 which is very high. When this formula was tested against earlier data from the Faro Pit (1984 Diamond Drilling) a scattergram of measured specific gravity against regression specific gravity was obtained (Attachment 2). The diagonal line shows theoretically perfect predictions. The very low standard error of the estimates for rock types 20 and 30 (Both 0.14 - Attachment 3) is apparent amongst the lower specific gravity ranges (2.6 -3.7) on the scattergram, and it is in this density range that predictive value of the regression formula is most accurate. In practical terms this means that good estimates can be made of the specific gravities for all ore rock types, and quartzites in particular.

POROSITY:

It should be noted that specific gravities used above were from determinations done on diamond drill core pulps. No allowance for porosity is contained in the resulting regression formula. Currently, as a result of some preliminary work, porosity is estimated as 2%.

FARO BLASTHOLE DATABASE:

The regression formula noted above is now in use for all ore rock types in the Faro Pit Blasthole Database. Previously averages for individual rock types were employed. A comparison of the old calculation with the regression based calculation for part of the 3490 bench in the blasthole database is shown in attachment 4. Also included is a % breakdown of 3490 bench by rock type (attachment #5). Baritic ore is almost absent and therefore causes no problem in the tonnage estimates. The 6% increase in tonnage (1) predicted using regression rather than mean density values is to be expected. This is because combined lead/zinc grade for the 3490 bench was 8.53% (3490 bench to April 10/90), which is above the mean grade (7.00% combined Pb/Zn in attachment # 1). Higher grade is accompanied by higher specific gravity, and therefore higher tonnage (volume of 3490 bench in database unchanged).

CONTINUING INVESTIGATIONS:

Further checks will be done as work progresses. These will include:

1) Checks for accuracy against old data
2) Investigation of polynomial trend surfaces and other estimators as alternatives to multiple (planar) regression.
3) Investigation of other deposits (Vangorda, Grum, Dy) using similar techniques.

(1) 527886 from regression; 498531 from mean values

4) If formulae for these deposits show a high enough correlation, density determinations on a routine basis for the Vangorda and Grum will be suspended. We already have a very good database built up and extreme variations from it would not be expected.

5) In deposits where densities have been determined only on diamond drill core pulps, whole rock (diamond drill core) densities will also be done to confirm pulp results and indicate what porosity might be expected for individual rock types.

D. Tenney

Dave Tenney
Chief Geologist

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ATTACHMENT # 1

MULTIPLE REGRESSION FORMULA AND ASSOCIATED STATISTICS

The following formula was calculated from diamond drill hole assays and pulp densities in the database using only the most recent Faro Pit diamond drilling completed during December 1989 and early 1990. It represents all ore rock types (# 20 -# 70)

S.G. (pulp) = 2.43 + 0.05 * % Pb + 0.02 * % Zn + 0.05467 * % Fe

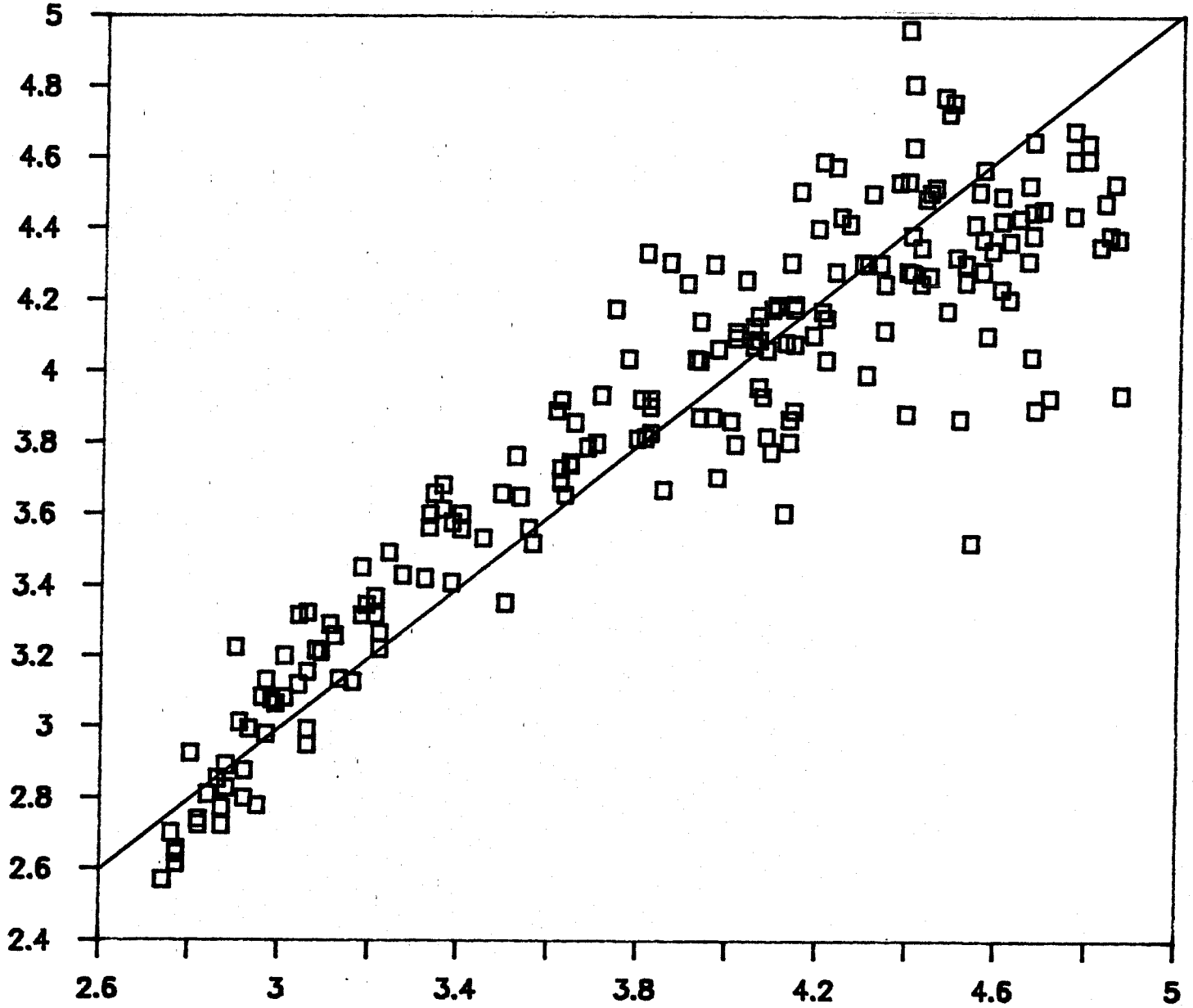
MEAN VALUES (IN DATABASE)			STD. DEVIATION
S.G.	=	3.874	0.627
Pb	=	2.634%	2.191
Zn	=	4.367%	3.423
Pb+Zn	=	7.001%	
Fe	=	22.123	9.562

Multiple correlation = 0.915

Standard error of estimate = 0.25

SPECIFIC GRAVITY SCATTERGRAM

S.G.=2.43 + 0.05 * % Pb +0.02 * % Zn + 0.05467 * % Fe



Attachment # 3

CURRAGH RESOURCES INC

INTER OFFICE MEMORANDUM

FARO OFFICE

DATE: March 23, 1990

TO: BILL DUNN
CHIEF ENGINEER

FROM: DAVE TENNEY
CHIEF GEOLOGIST

SUBJECT: SPECIFIC GRAVITY FROM MULTIPLE REGRESSION

The attached table shows the results of using over 800 diamond drill core pulps in a multiple regression calculation to obtain specific gravity of the main ore bearing rock types in the Faro Pit from the percentages of lead, zinc and iron in the drill core samples. Porosity, estimated at 2% for all rock types, will reduce the calculated sepcific gravities accordingly. The specific gravities and lead, zinc and iron assaying were done in Whitehorse by Northern Analytical, using the sample pulps.

From the diamond drill hole database for drilling during late 1989 and early 1990, 44 drill holes were extracted (record 317 to 360: 89F-05, 90F-19) which produced an s.g. & assay database containing 963 records. These were sorted by rock type using the computer codes 20,30,40,50,60,70 etc (see attached) and the data "cleaned" by removing records where information was missing (indicated by -1) to provide a main database containing 863 records. Individual databases for each rock type were then prepared and multiple regression analysis run as indicated in the attachments. (Fig 2). Very little data, eight records, were available for rock type 60, baritic ore, but this rock type will not be encountered in significant quantities during the remaining life of the Faro Pit. As the diamond drilling is in areas we are about to mine the regression formulae should fairly predict actual densities.

STATISTICAL CORRELATION

Correlation coefficients varied from 0.944 for pyritic quartzite (considered excellent) to .648 for siliceous semi-massive pyritic sulphide. Note that no waste rock types were included in this study (Fig. 1) The correlation co-efficients are all in the good to excellent range and in my view indicate some improvement in the precision of tonnage estimates will result when the regression formulae are put into use.

CONCLUSION:

The available data is sufficient to give very high confidence in our specific gravity regression formulae for all ore types. The formulae will now be put into use in the diamond drill and blasthole databases, and monitored to ensure accuracy. Specific gravity determinations on diamond drill core pulps from the Faro Pit previously done at Northern Analytical will be stopped.

D. Tenney.

Dave Tenney
Chief Geologist

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FIG 2

REC	STAT	ROCK CODE	DESCRIPTION	RELATIVE DENSITY [tn/bcf]	PEN	SLOPE ANGLES [DEGREES] NW	N	NE	W	E	SW	S	SE
1	2	20	2ACD ribbon banded graphitic quartzite	.083	1	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
2	2	21	2ACD-ribbon banded graphitic quartzite/basal horizon	.083	1	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
3	2	22	2ACD ribbon banded graphitic quartzite/middle horizon	.083	1	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
4	2	23	2ACD ribbon banded graphitic quartzite/upper horizon	.083	1	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
5	2	30	2BCD pyritic quartzite	.090	2	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
6	2	31	2BCD pyritic quartzite/basal horizon	.090	2	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
7	2	32	2BCD pyritic quartzite/middle horizon	.090	2	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
8	2	33	2BCD pyritic quartzite/upper horizon	.090	2	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
9	2	40	2EC semi-massive quartzose pyritic sulphides	.099	4	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
10	2	50	2EF pyritic massive sulphides	.107	4	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
11	2	60	2EFG baritic massive sulphides	.112	4	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
12	2	70	2H pyrrhotitic massive sulphides	.104	5	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
13	2	80	1H/2ABCDEFG Altered metabasite interbanded with ore	.085	4	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
14	1	100	1D0/1C0/1CD schist and phyllite waste	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
15	1	110	1D2/1E0 graphitic schist and phyllite	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
16	1	120	2L/1D4 altered schist and phyllite (WME)	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
17	1	130	1H/1F Altered metabasite	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
18	1	150	3A basal graphitic unit of 3D Calc-silicate	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
19	1	160	3D Calc-silicate	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
20	1	170	3D BXA Calc-silicate breccia	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
21	1	180	10E Biotite hornblende quartz diorite	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
22	1	190	10F Smokey quartz feldspar porphyry	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
23	1	300	Unconsolidated overburden	.060	7	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
24	1	400	Partially above topography	.076	7	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
25	1	500	Air	.000	0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
26	1	1	simplified ore type "A"	.085	1	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
27	1	2	simplified ore type "BG"	.104	4	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
28	1	3	simplified ore type "H"	.105	5	45.0	39.0	36.5	45.0	38.5	45.0	45.0	45.0
29	1	10	Quartzose Ore Types - 2a,2bcd	.089	2	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
30	1	11	Massive Sulphide Ore Types - 2ef, 2eg, 2ec, 2eh	.111	4	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

FIG. 1

SPECIFIC GRAVITY FORMULAE
FROM MULTIPLE REGRESSION ANALYSIS

ROCK TYPE	CONSTANT	COEFF %PB	COEFF % ZN	COEFF % FE	CORR(ERR) COEF	MEAN	SD
21	2.55	+.05	+.02	+.041	.91(.14)	3.07	.33
31	2.41	+.03	+.02	+.055	.944(.14)	3.61	.43
40	2.81	+.09	0.00	+.044	.648(.26)	4.26	.35
50	2.51	+.11	+.01	+.050	.791(.28)	4.37	.46
60	2.45	+.06	+.14	+.036	.887(.24)	4.33	.52
70	3.12	0.00	+.04	+.028	.717(.25)	4.20	.35

Note very high correlation coefficients.

March 21, 1990

ATTACHMENT # 4:

COMPARISON 3490S BENCH BLASTHOLE TONNAGES AND GRADES USING MEANS AND MULTIPLE REGRESSION TO DETERMINE DENSITIES

The following table shows 3490S Bench blasthole database production statistics for tonnage and grade to April 10, 1990. Tonnages were determined using rock type mean densities (old method) and a multiple regression formula (new method) which was calculated for all ore rock types.(1) This formula, quoted below, is based upon the percentages of lead, zinc and iron in the samples, and is applicable to rocks types # 20 to 70* in the computer rock numbering system:

$$S.G. = 2.43 + 0.05 * \%\,Pb + 0.02 * \%\,Zn + 0.0547 * \%\,Fe$$

(1) possible exception is rock type 60, baritic ore.

DATA FOR 3490S BENCH TO APRIL 10/90

	OLD CALCULATION (DENSITITES FROM ROCK TYPE MEANS)				NEW CALCULATION (DENSITIES FROM MULTIPLE REGRESSION)			
	Tonnes	%Pb+Zn	%Fe	S.G.	Tonnes	%Pb+%Zn	%Fe	S.G.
+6%	425,177	8.98	30.3		456,199	9.07	30.8	
5-6%	70,655	5.82	26.9		71,688	5.82	27.4	
3-5%	51,961	4.12	29.6		52,944	4.13	30.0	
Total: (+5%)	495,831	8.53	29.8	4.02**	527,886	8.62	30.4	4.28*

NOTE: Increased tonnages of higher grade (i.e. denser) ore categories using regression.

* assumes 2% porosity - regression value for pulps 4.37

** back calculated from tonnage differences.

ATTACHEMENT # 5

DISTRIBUTION OF ROCK TYPES 3490 BENCH

(ORE BEARING ROCKS ONLY) FOR GRADES 5%+

ROCK CODE		REGRESSION DENSITY	MEAN DENSITY	% OF BENCH
2A	20	3.49	3.35	13
2BCD	30	3.68	3.43	8
2EC	40	4.19	4.15	2*
2EF	50	4.42	4.27	70*
2EO	55	4.41	4.27	4*
2EG	60	4.34	4.23	0.1*
2EH	70	4.36	4.20	4*
TOTAL/AVERAGES 5%		4.20	4.07	
(+6%)		4.24		

* = 80% of bench is massive sulphides