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PROPOSED ABERFOYLE OPEN PIT &

QUARTZ GRADES IN THE ABERFOYLE DEPOSIT

ML 27M/77

ROSSARDEN DISTRICT

NORTHEAST TASMANIA

OPEN FILE

T.G. SUMMONS,

SUMMONS GEOSERVICES PTY. LTD.

JULY & AUGUST 1983

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PROPOSED ABERFOYLE OPEN PIT

ML27M/77

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JULY, 1983.

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PROPOSED ABERFOYLE OPEN PITGEOLOGY

The Aberfoyle vein system occurs as an intense swarm of quartz-cassiterite-wolframite-sulphide veins striking NNE, and dipping 50-60°W. It averages 50-70m in width, and was mined over a strike extent of 5-600m down to 4 Level, (120m below surface, and approx. 210m above the aplite cupola).

Drilling to the south of Spiers shaft, and to the north, (including the Spartan Prospect) indicates a strike extent for the vein swarm in excess of 1000m. In addition, the vein swarm continues into the hanging wall, west for a further 100-150m from the 60m wide zone presently under consideration.

MINERALIZATION

The Aberfoyle deposit is vertically and laterally zoned in terms of distance from the aplite cupola underlying the veins; this zonation takes the form of increasing W and decreasing Sn with increasing proximity to the aplite. Above 4 Level, the Sn:WO₃ ratio averages 20:1. In addition, the quartz grades (the undiluted combined grade of Sn + WO₃), show a dramatic increase at a distance of approx 200m from the aplite, changing from 3% CM below to 5-6%CM above 4 level.

The combination of these factors resulted in head grades of $\geq 2\%$ CM above 4 level; (head grade = the diluted in situ combined grade (CM%) of Sn+WO₃, due to mining a 1.2m wide stope).

VEIN SWARM CHARACTER

In a vein swarm such as that at Aberfoyle, where open pit extraction is the only likely method of mining, the in situ ore grade (OG) is a function of the quartz grade (QG) and volume (QV); the latter parameter is dependent on quartz

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vein width (QW) and the density of veining (QD).

Using QW values in centimetres, and QD in No/m, the QV is directly calculated in %.

Previous studies of the genetically related Lutwyche vein swarm, where a sample of 1182 vein widths, (from 15 surface diamond drill hole intersections) was taken, showed the distribution of QW to be log normal.

Further processing of this sample by selecting groups of veins (and using natural boundaries to groups of similar frequencies), resulted in a sample of 175 values of vein density (QD). These QD values were found to approximate a log normal distribution, as were the independent QV values derived from the sample of QD data.

Thus for the relationship $QV = QW \times QD$

It follows that $P(QV) = P(QW) \times P(QD)$

and $P(QV \geq QV_R) = P(QW \geq QW_R) \times P(QD \geq QD_R)$

where:

$P(QV \geq QV_R)$ is the probability that a given (randomly selected) quartz volume is greater than or equal to a predetermined quartz volume (QV_R).

$P(QW \geq QW_R)$ and $P(QD \geq QD_R)$ are similarly defined, but in terms of quartz vein widths and densities. Values of all three parameters may be estimated from their probability distributions.

A similar approach can be made with the estimation of ore grade (OG), where

$OG = QG \times QV$
and $P(OG \geq OG_R) = P(QG \geq QG_R) \times P(QV \geq QV_R)$

where:

$P(OG \geq OG_R)$ is the probability that a given ore grade is greater than or equal to the required ore grade (OG_R).

$P(QG \geq QG_R)$ is similarly defined in terms of quartz grade.

However, insufficient data on quartz vein widths and densities for the Aberfoyle

deposit, meant that other methods of "sampling" were necessary.

QUARTZ VOLUMES

Previous underground mining at Aberfoyle only extracted those quartz veins \gg 30cm thick; in the present study, "major" veins are those \gg 30cm thick, and "minor" or stringer veins are \ll 30cm thick.

A. Major Veins

1. The upper levels exposed 5 major veins, which averaged 1m wide, and where the swarm is 50m wide, indicating QV approx. 10%. The lower levels contained 8 major veins, with average width of \gg 1m, within a swarm width of \ll 100m, indicating QV approx 10%.
2. The production history of the upper 5 levels reveals that the head grade of this ore was approx. 2%CM; allowing for approx. 10% waste sorting underground, and combined with QG values of 4-6%CM, the quartz content in the 1.2m wide stopes ranged from 30-50%. Accordingly the indicated QV values, when totalled over the 5 veins within a swarm 50m wide, range from 3.5% to 6%.

B. Minor Veins

1. A parcel of ore taken from 4 Level in 1980, and consisting only of stringer veins, had an in situ grade of 0.36%CM; thus for QG values of 4-6%CM, QV values are indicated in the range 6-9%.
2. Limited drilling data from the upper levels indicates an average QV of 3% (excluding the previously mined major veins); in addition, the QD values range from 1/m for 2 and 3 Levels, to 0.5/m for 4 Level.
3. The width of the minor veins in the upper levels ranges from 1-25cm, with an estimated average of 5-10cm; assuming an average QW of 7.5cm and using the QD data above.

Surface - 3 Level : QV = 7.5 x 1 = 7.5%

3 - 4 Level : QV = 7.5 x 0.5 approx. 3.8%

006 C. Conclusions

Thus the major veins represent from 3.5 to 10% of the vein swarm (as defined), with an average value of 6%. The minor veins represent from 3 to 9 % of the vein swarm, with an apparent average also of 6%.

However, the most reliable (and conservative) data on the minor vein volumes is that obtained from the drill core, ie. QV = 3%.

QUARTZ VEIN VOLUME DISTRIBUTIONS

The following assumptions were made concerning the Aberfoyle vein swarm:

1. The distribution of total QV values (ie. major QV + minor QV values) is log normal;
2. The average values of 3% (minor veins) and 6% (major veins) approximate the median values of the distributions; ie. the median of total QV = 9%, and the median QV for minor veins = 3%. (ie. for the total quartz, $P(QV > 9) = 0.50$ etc.)
3. The maximum total QV value would not exceed 30%, (ie. approx. 10% for major veins, and $20 \times 1 = 20\%$ for minor veins). Thus for total QV, $P(QV < 30) \approx 0.99$.

Based on these assumptions, the probability distributions were calculated, as shown in Figure 1.

Comments on this Figure are as follows:

- (i) The remaining in situ (minor veins) P(QV) distribution is shown with a broken line, because it is unlikely that mining of the major veins would have been as statistically consistent as an unbroken curve would imply;
- (ii) The P(QV) median value for minor veins of 3% is probably underestimated, and may actually be 50% higher;
- (iii) The un-mined portion of the vein swarm, ($< 500m$ strike extent), because the major veins thin, or terminate at the extremities of the deposit, will have

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HAERFOYLE VEIN SYSTEM
PROBABILITY DISTRIBUTIONS
OF
QUARTZ VEIN VOLUMES

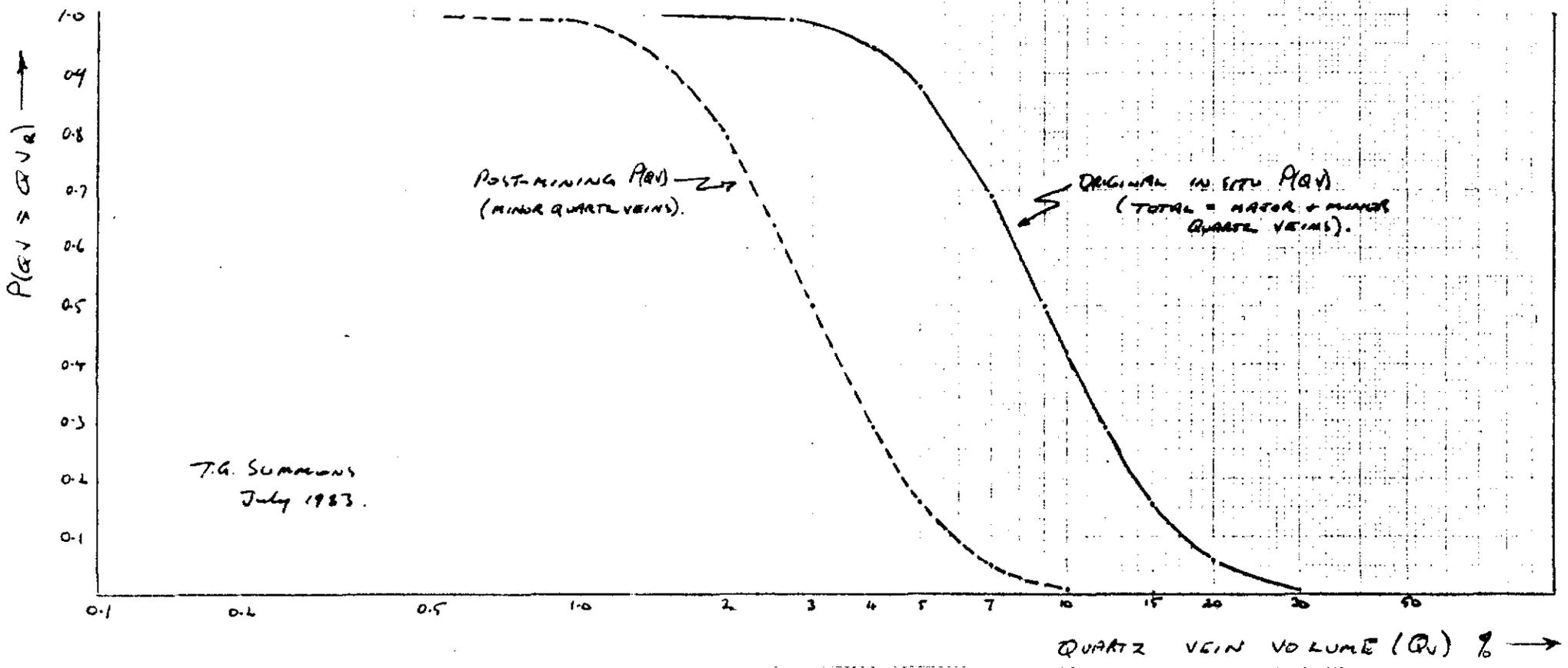


FIGURE 1.
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 a distribution intermediate to those shown in Figure 1.

IN SITU ORE GRADES

Based on the relationship of ore grade (OG) to quartz grade (QG) and quartz volume (QV). probability distribution curves of $P(OG \geq OG_R)$ were calculated using QG values of 2, 4 and 6% CM, and the minor vein $P(QV)$ distribution.

Because detailed data on the distribution of quartz grades is not available for the upper levels, and in view of the well documented production data (ie. quartz, head and recovered grades) of the deposit, it was decided that a reasonable presentation of the $P(OG)$ values would be afforded by assuming $P(QG = x\%) = 1.0$ for the three $P(QG)$ curves shown in Figure 2.

Hence the probability distributions depicted reduce from

$$\begin{aligned} P(OG \geq OG_R) &= P(QG \geq QG_R) \times P(QV \geq QV_R) \\ \text{to " " " } &= P(QV \geq QV_R) \end{aligned}$$

Previous studies into the open pit potential have quoted $QV = 3\%$, and $QG = 4 - 6\%$ CM, indicating OG values of 0.12 to 0.18% CM: using Figure 2, the following $P(OG)$ values are obtained-

1. For $QG = 4\%$ CM

$$P(OG \geq 0.12) = 0.50$$

$$\text{and } P(OG \geq 0.18) = 0.21$$

2. for $QG = 6\%$ CM

$$P(OG \geq 0.12) = 0.79$$

$$\text{and } P(OG \geq 0.18) = 0.50$$

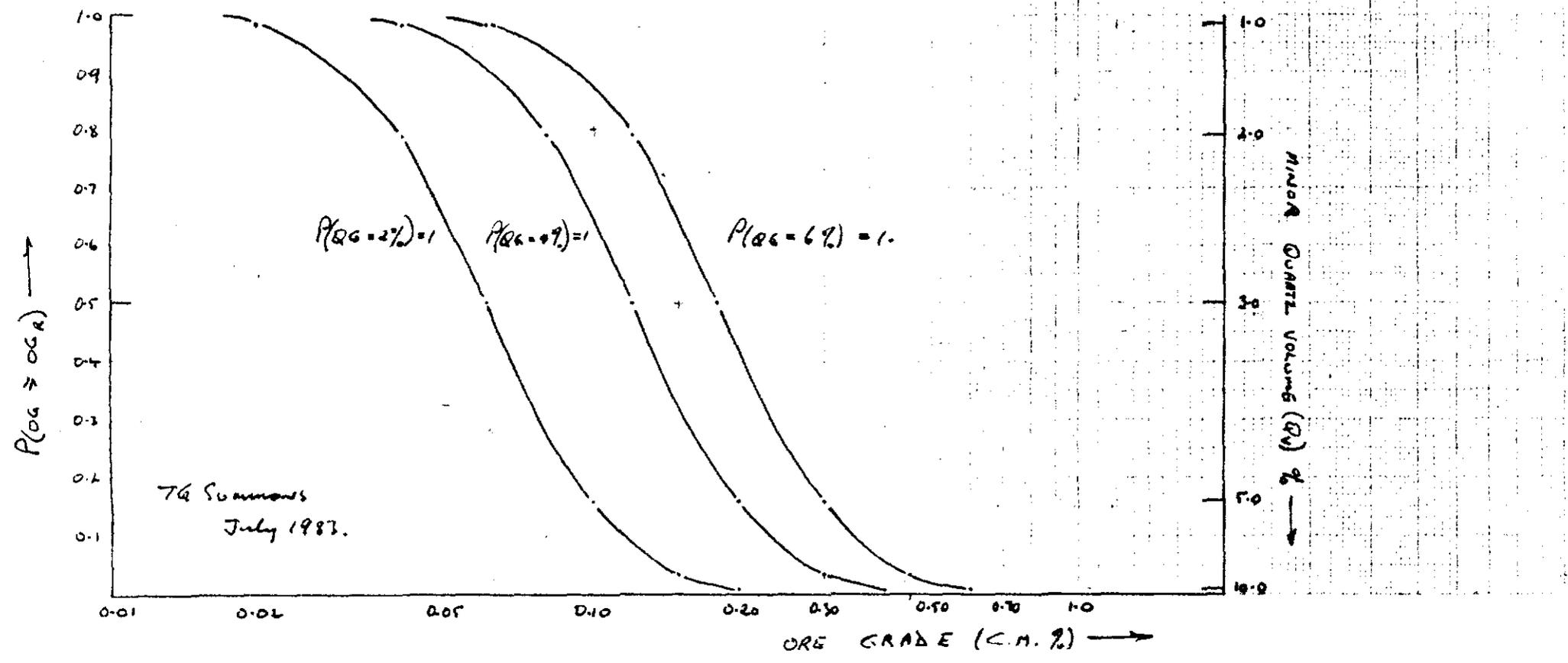
It should be noted that the $P(OG)$ curves shown in Figure 2 relate to the central 500m (mined out major veins) of the vein swarm, and that the extremities of the swarm would have curves transposed towards higher in situ ore grades.

ADERTFOYLE VEIN SYSTEM

PROBABILITY DISTRIBUTIONS
OF
IN SITU ORE GRADIES

(FOR REMAINING QUARTZ VOLUME, SURFACE TO 4 LEVEL)

$$P(O_G \geq O_{G_R}) = P(Q_G \geq Q_{G_R}) \times P(Q_V \geq Q_{V_R})$$



488010 FIGURE 2.

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PRODUCTION COST/ORE GRADE/ORE VALUE SENSITIVITY

The metallurgical character of the Aberfoyle-Storeys Creek type Qtz-Cs-Wf veins is shown in simple CM% recovery terms in Figure 3.

Screening of ore from the 4 Level drive between Brandon and Spiers Shafts, resulted in the rejection of 70% of the material as waste (oversize), ie. the ore was pre-concentrated by a factor of 100/30, approx.=3.

Break-even (cut off) grades of CM% were thus calculated using the formula:

$$\text{Cut off grade} = \frac{\text{Production Cost}}{\text{Selling price} \times \text{sorting} \times \text{recovery}}$$

Metal recoveries are dependent on ore grade, and were grouped as follows:

Head grade to mill (after pre concentration) 0.1 - 0.3% CM : recovery approx. 50%.

0.3 - 0.5%CM : recovery approx. 65%

0.5 - 0.7%CM : recovery approx. 73%

0.7 - 1.0%CM : recovery approx. 80%

Details of the break even curves in terms of metal value and production costs are shown in Figures 4,5,6,7 and 8.

One of the more sensitive parameters in these graphs is the ore grade - including the mode of occurrence of the cassiterite and wolframite (eg. fracture stock-works devoid of quartz are to be expected), the in situ ore grade (ie. the quartz volume in conjunction with the confidence levels of quartz grades and, the viability of upgrading the ore (pre-concentration) on a large operational scale.

* *See for example Figure 4*

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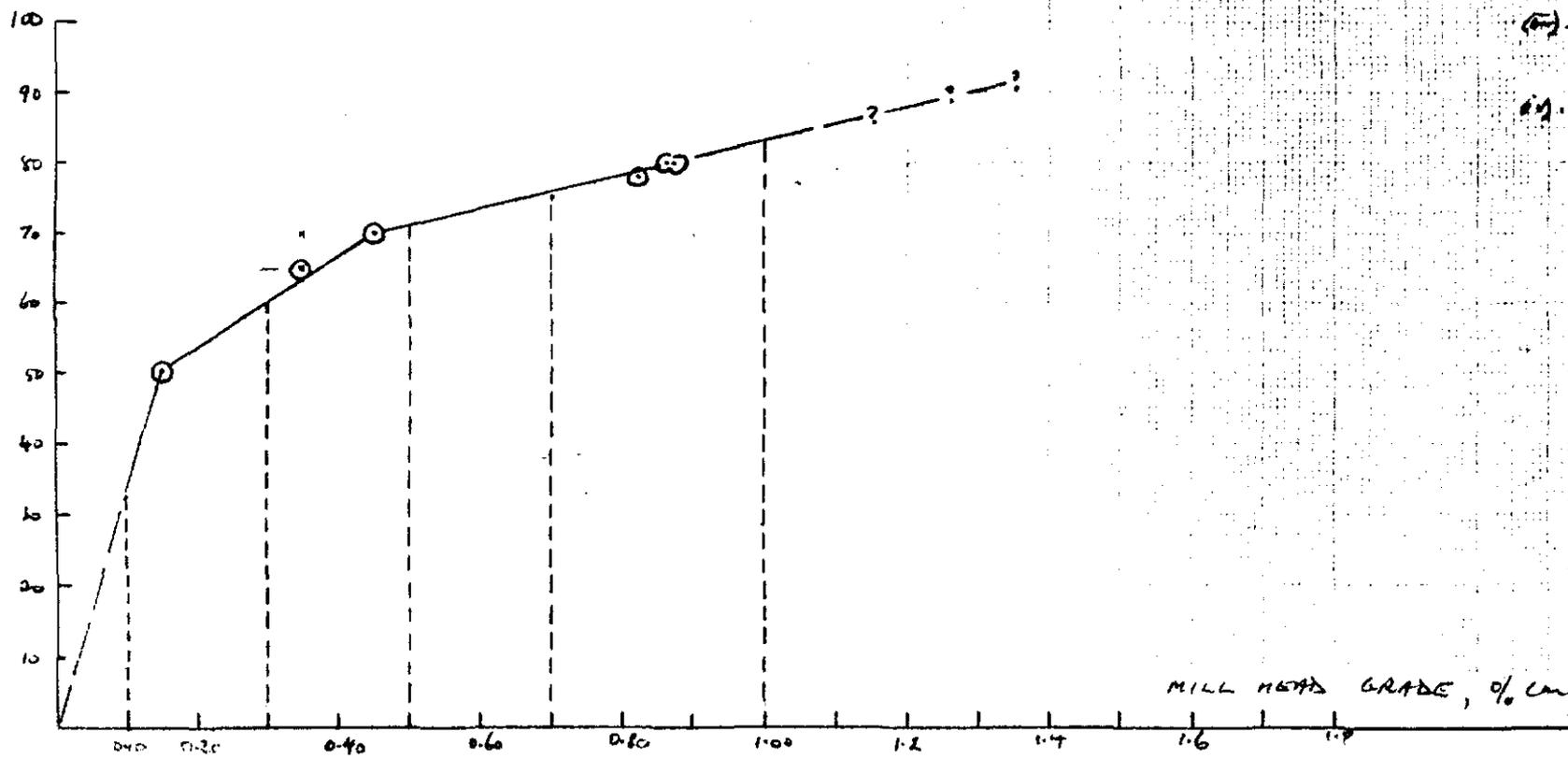
ABERFOYLE AND STOREY'S CREEK MINES

APPROXIMATE METAL RECOVERY

VERSUS

MILL HEAD GRADE

C.M. % recovery



- SOURCES
- (1). Aberfoyle + Storey's Creek Mines Production data 1978, 79
 - (2). Aberfoyle Mine Ore Reserve 1980 (October)
 - (3). ATL memo from Mr Houston dated Sept. 1980.
 - (4). ATL memo from Mr Palmer dated Dec. 1980

T.G. Swannell July 1983.

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MILL HEAD GRADE, % Cu; ABERFOYLE + STOREY'S CREEK

TOTAL OPERATING COSTS, \$ / TONNE ORE

PROPOSED ABERFOYLE OPEN PIT

BREAK-EVEN HEAD GRADE (AFTER PRE-CONCENTRATION OF 10/33)

VERSUS
TOTAL OPERATING COSTS

ORE HEAD GRADE : 0.1 - 0.3 % Cu.
(= 0.03 - 0.10 % Cu IN SPIN)

RECOVERY = 50%
METAL PRICE VARIABLE.

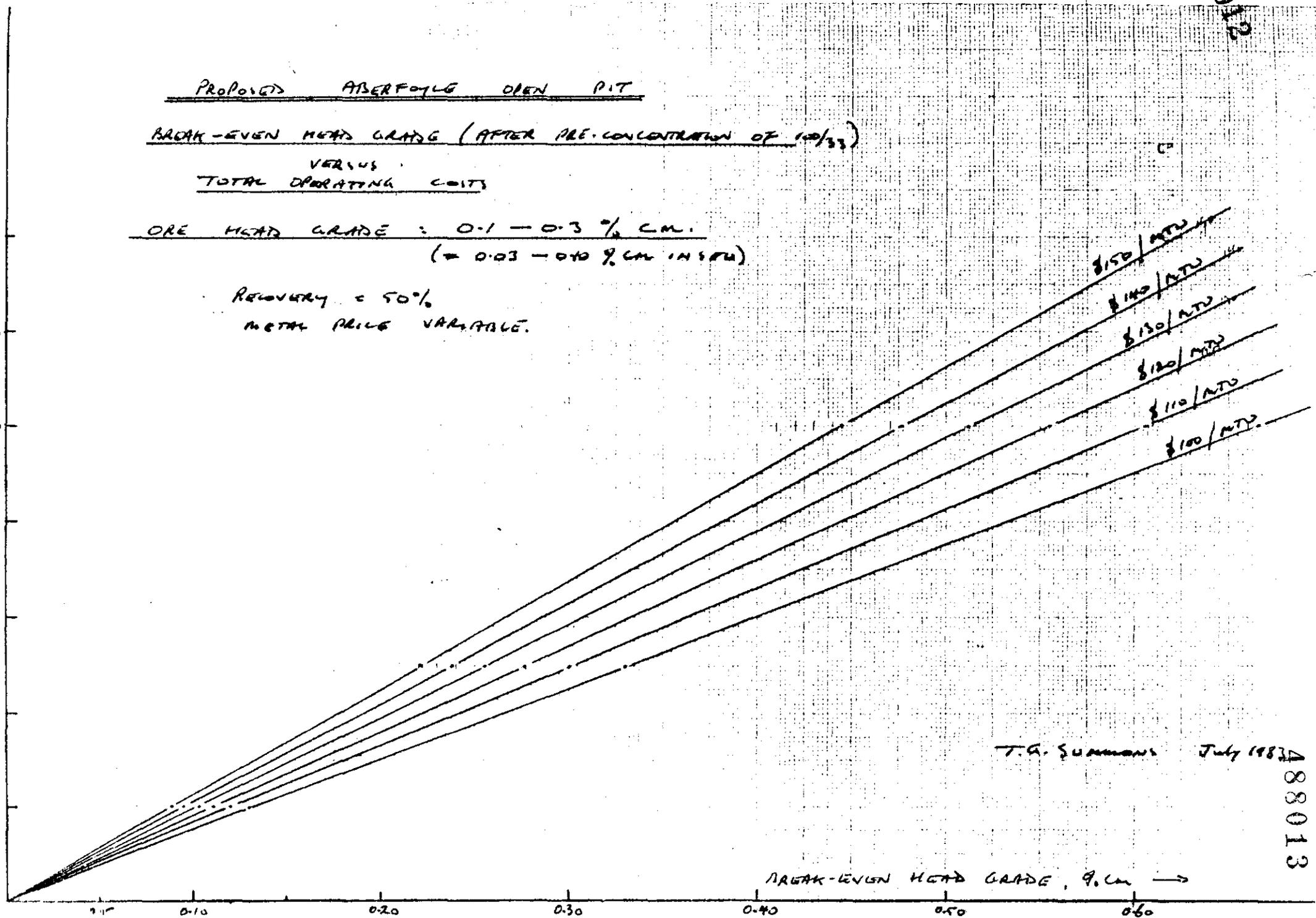
\$150/MTU
\$140/MTU
\$130/MTU
\$120/MTU
\$110/MTU
\$100/MTU

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BREAK-EVEN HEAD GRADE, % Cu →

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0.3



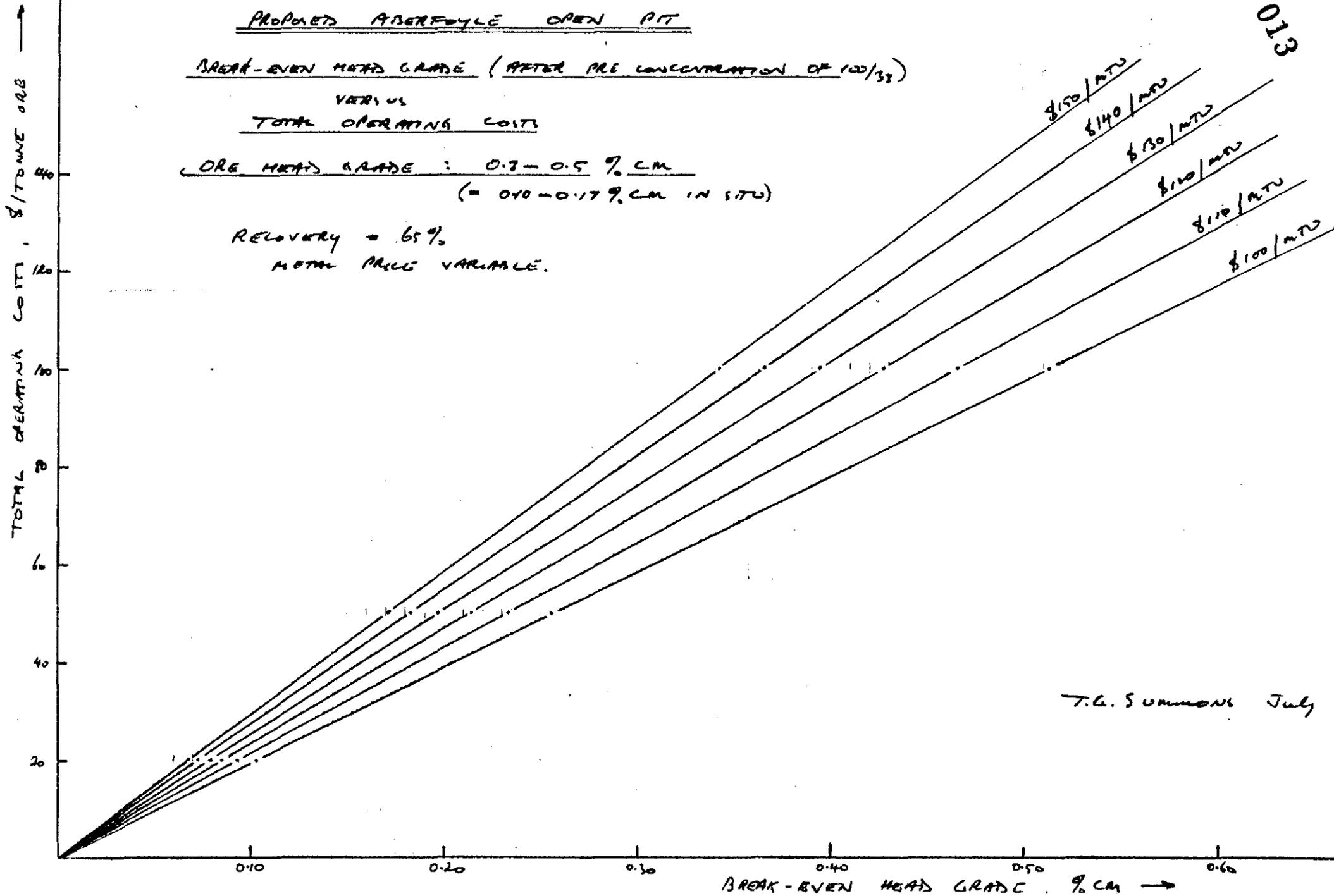
PROPOSED ASBERFOYLE OPEN PIT

BREAK-EVEN HEATS GRADE (AFTER PRE CONCENTRATION OF 100/33)

VERSUS
TOTAL OPERATING COSTS

ORE HEATS GRADE : 0.3 - 0.5 % CM
(= 0.10 - 0.17 % CM IN SITU)

RECOVERY = 65%
MILL PRICE VARIABLE.



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TOTAL OPERATING COSTS, \$/Tonne ore

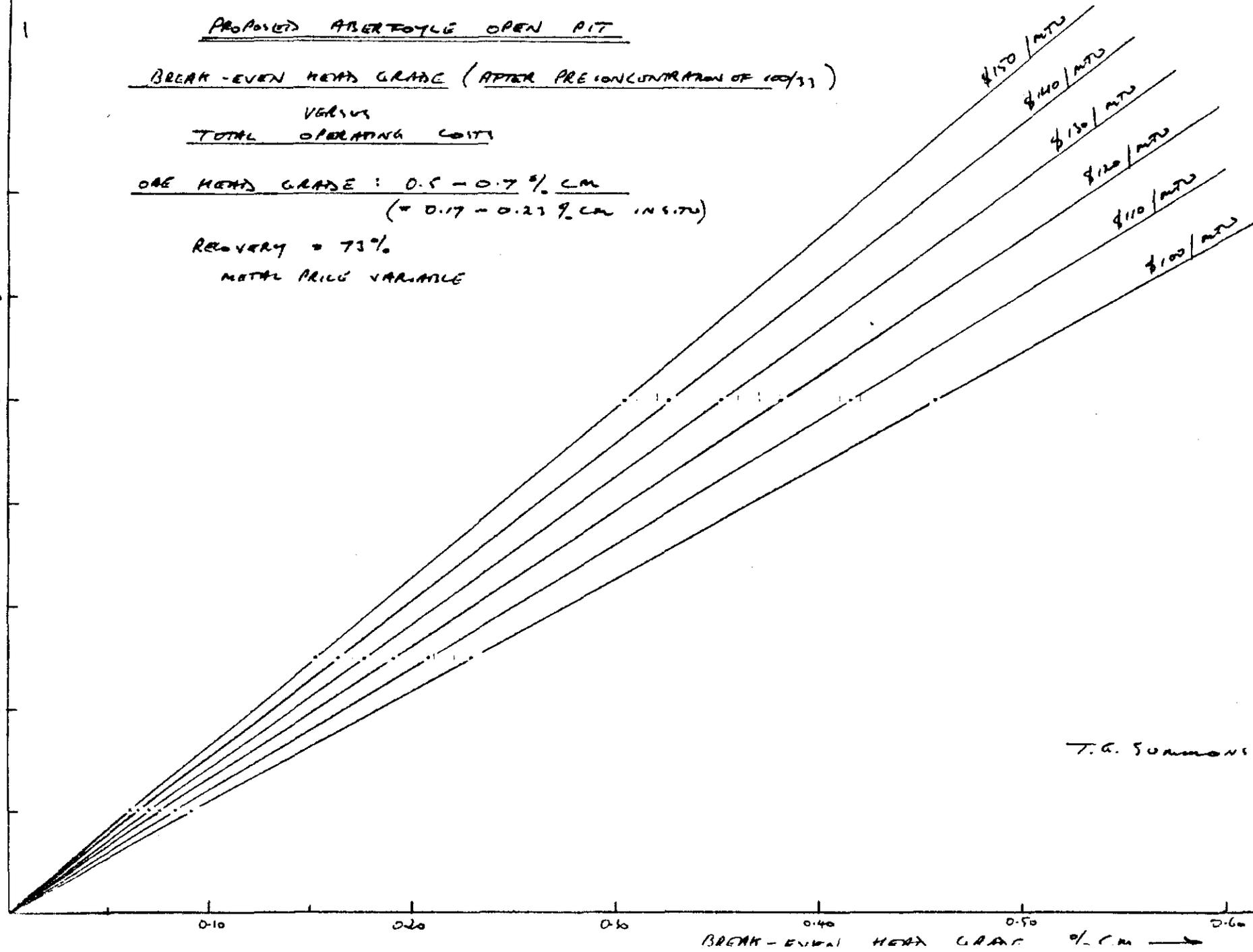
PROPOSED ASBERTOYLE OPEN PIT

BREAK-EVEN HEAD GRADE (AFTER PRE-CONCENTRATION OF 100/33)

VERSUS
TOTAL OPERATING COSTS

ORE HEAD GRADE: 0.5 - 0.7 % Cu
(= 0.17 - 0.23 % Cu IN SITU)

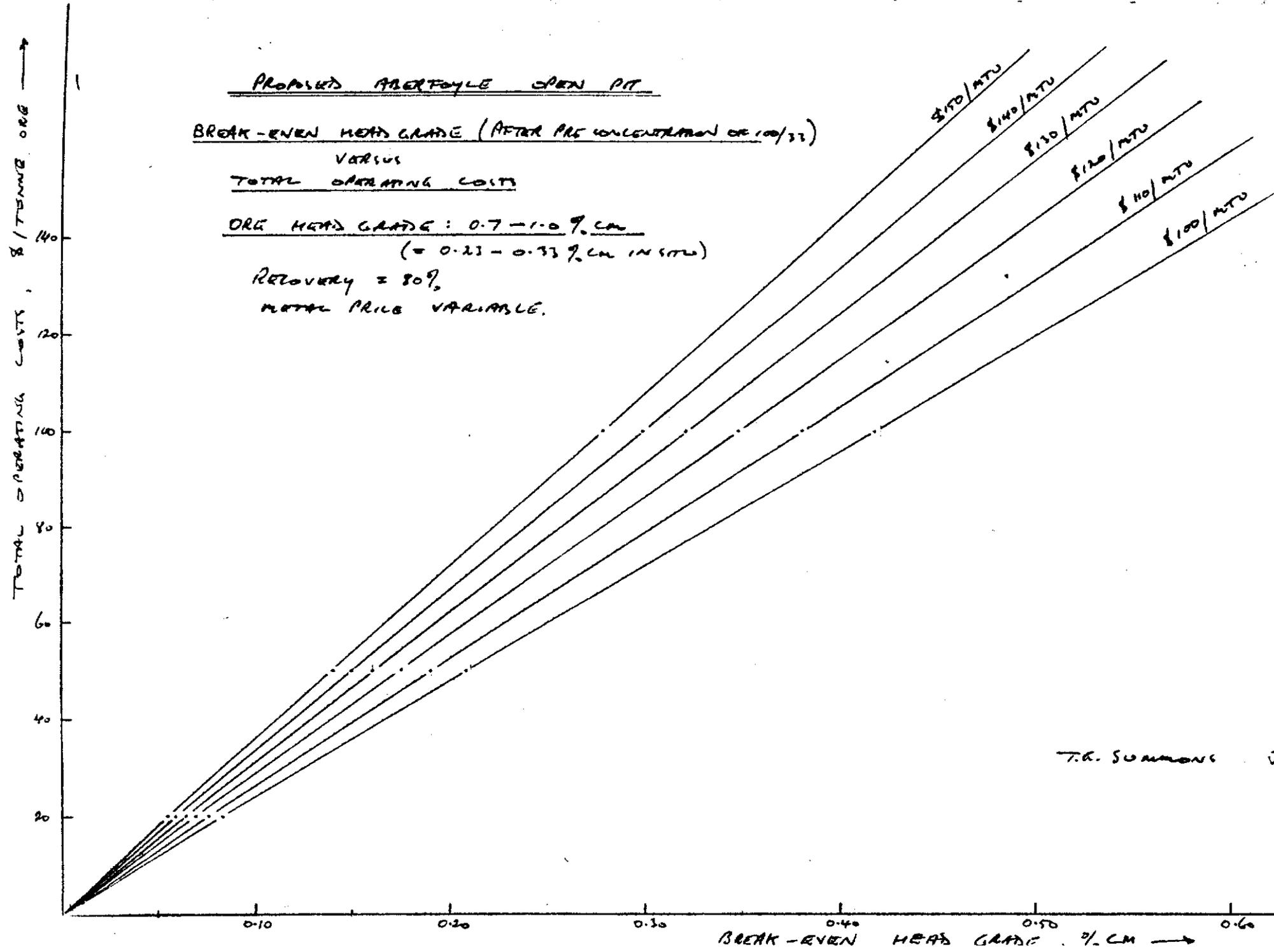
RECOVERY = 73%
METAL PRICE VARIABLE



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T.R. SUMMONS July 1983

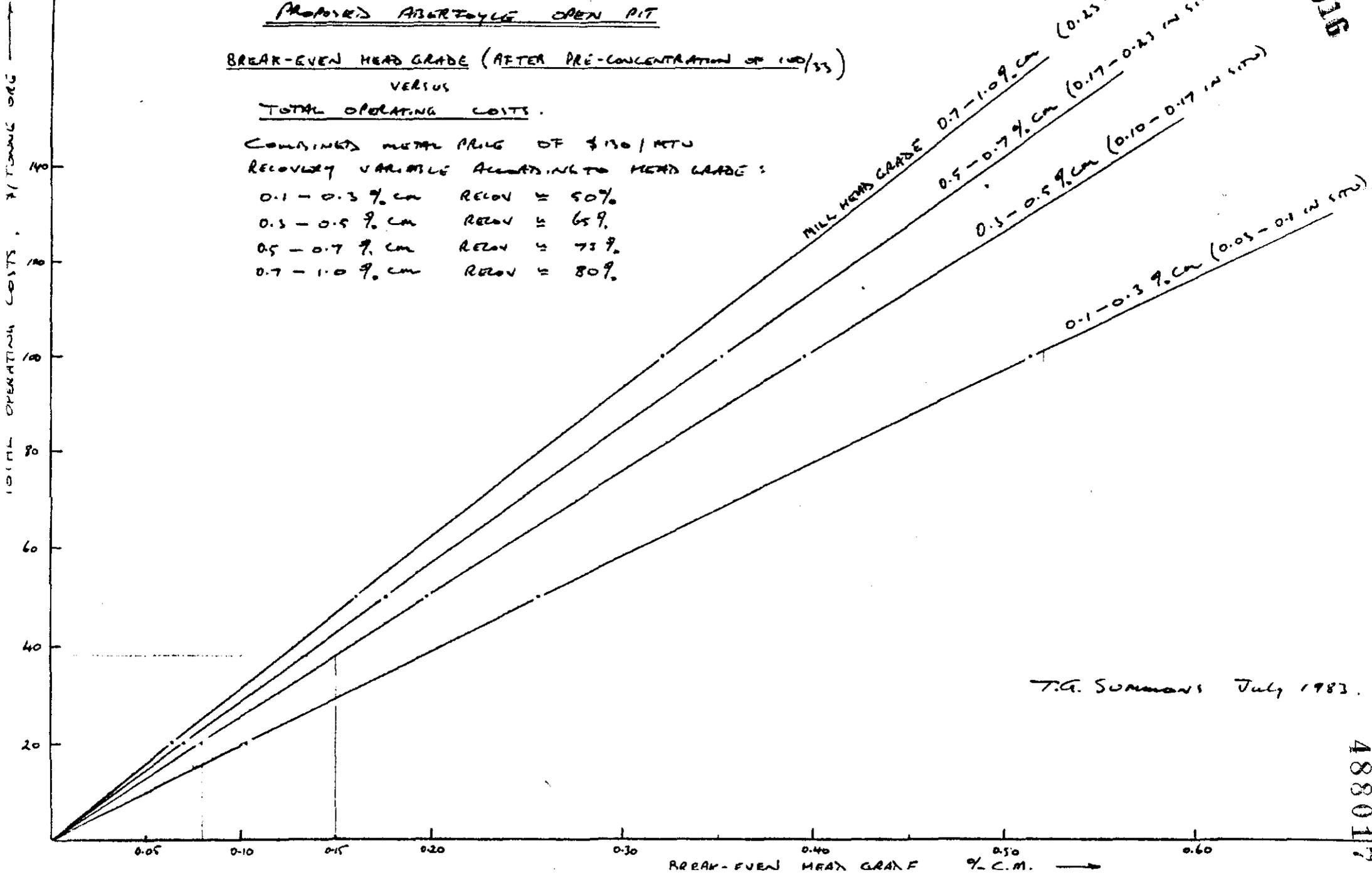
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PROPOSED ABERTOYLE OPEN PIT

BREAK-EVEN HEAD GRADE (AFTER PRE-CONCENTRATION OF 100/33)
 VERSUS
TOTAL OPERATING COSTS.

COMBINED METAL PRICE OF \$150/MTU
 RECOVERY VARIABLE ACCORDING TO HEAD GRADE:

0.1 - 0.3 % Cu	RECOV = 50%
0.3 - 0.5 % Cu	RECOV = 65%
0.5 - 0.7 % Cu	RECOV = 73%
0.7 - 1.0 % Cu	RECOV = 80%



T.G. SUMMERS July 1983.

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PRELIMINARY ABERFOYLE OPEN PIT DESIGN

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This section is intended to provide order of magnitude figures relating to the proposed open cut extraction of the Aberfoyle vein swarm. As discussed in an earlier report by the author, the previous investigations by Aberfoyle Ltd. were less than satisfactory, such that the potential of the vein swarm for open cut mining is essentially untested.

The cross section shown in Figure 9 is based on the following parameters:

1. Average overburden thickness of 15m (Permian sediments);
2. Overall slope angles
 - (a) Surface to 20m depth = 50°
 - (b) 20m to 120m depth = 60° (footwall + hanging wall);
3. Total depth of 120m, (ie. 4 level);
4. Batter slope angles of 74.5°;
5. Bench intervals of 10m;
6. Bench widths of 3m;
7. 100% extraction of the 60m wide vein swarm at the depth of 120m;
8. Open pit length at surface of 1000m;
9. SG of quartz = 2.65 T/m³, quartz + waste = 2.56 T/m³.

The area of ore on Figure 9 = 6375m², and the area of waste (including 15m of overburden) = 9580m². The volume of the extreme 100m at the either end of the open pit was calculated as follows $V = 1/3 \times A \times W$.

(A = cross section area, W = half the width of the open pit at surface).

Production data indicate approx. 1.5×10^6 tonnes were mined from the top 4 levels, (ie. 0.57×10^6 m³ ore).

$$\begin{aligned} \therefore \text{Volume of ore} &= (800 \times 6375) + (1/3 \times 6375 \times 105 \times 2) - (0.57 \times 10^6) \\ &= 4.98 \times 10^6 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} \text{and Volumes of waste} &= (800 \times 9580) + (1/3 \times 9580 \times 105 \times 2) \\ &+ 8.33 \times 10^6 \text{ m}^3 \end{aligned}$$

$$\therefore \text{Ratio of waste : ore} = 1.67 : 1$$

$$\text{Total tonnes waste} = 21.32 \times 10^6$$

$$\text{" " ore} = 13.2 \times 10^6$$

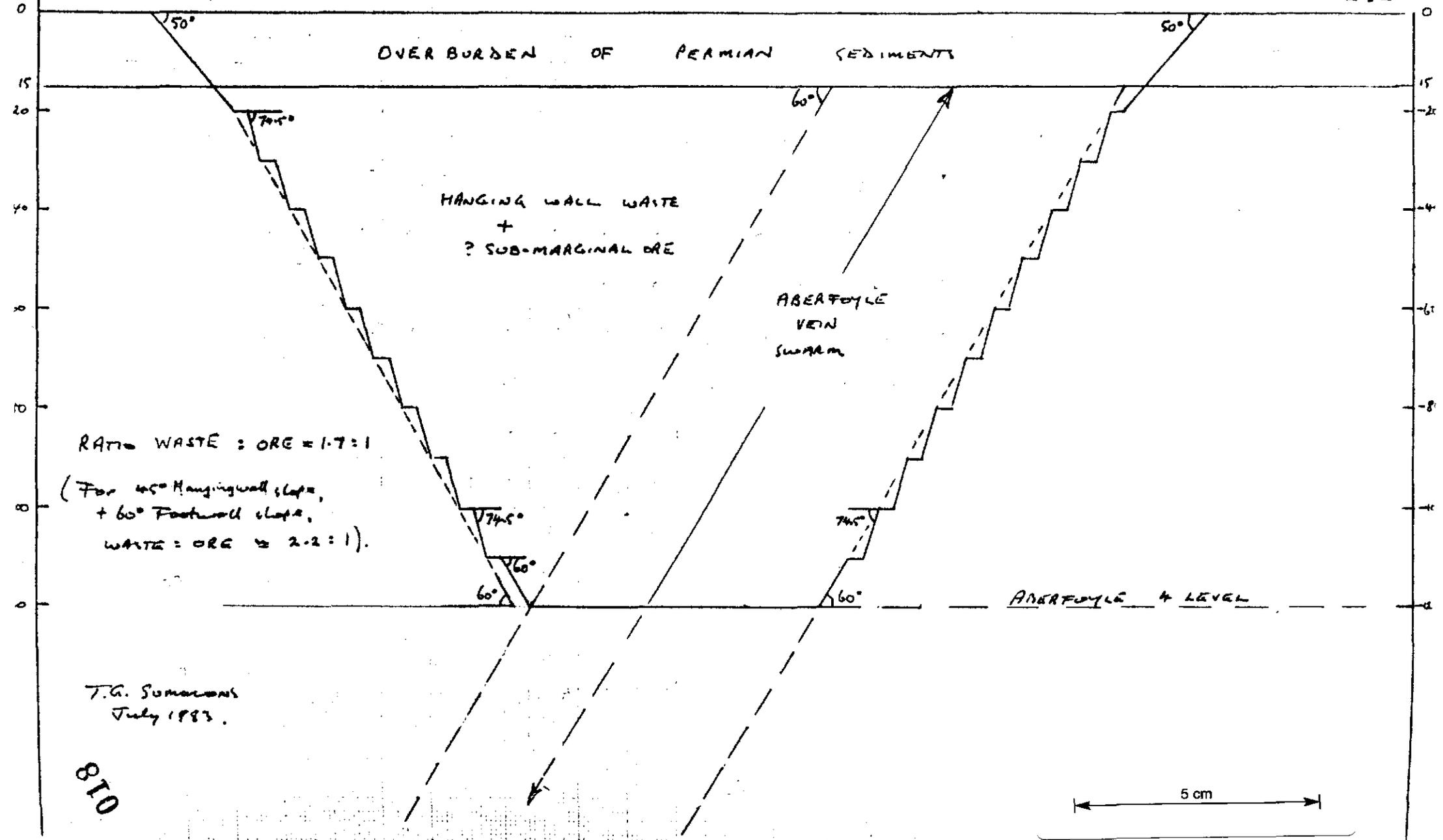
PROPOSED ABERFOYLE OPEN PIT
 FOR
 100% EXTRACTION OF ORE
 4 LEVEL (-120m)

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SCALE 1:1000
 (1cm = 10m) V(H) = 1.

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ABERFOYLE DEPOSIT

QUARTZ GRADES

ML 27M/77

ROSSARDEN DISTRICT

NORTHEAST TASMANIA

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AUGUST, 1983.

ABERFOYLE DEPOSITQUARTZ GRADESINTRODUCTION

The quartz grade (QG) is the undiluted in situ grade of Sn + WO₃% in a quartz vein; quartz grade is variably diluted by waste (wall rock surrounding the vein in the stope to constitute the head grade (the diluted in situ grade of Sn + WO₃%). The main references to Q.G. in the Aberfoyle deposit are those by Edwards and Lyon (1957) and Blissett (1959).

CONVENTIONAL GRADE ESTIMATION

Estimation of quartz grades in veins characterised by "nugget type" mineralization is extremely difficult, and represents a major problem.

Aberfoyle Tin Ltd attempted the following methods:

1. Analysis of drill core;
2. Visual estimates of drill core;
3. Analysis of channel, chip, groove etc. samples;
4. Analysis of bulk samples
5. Visual estimates of in situ ore.

The various advantages and disadvantages of each method have been discussed in a previous report by the author, and the only method with any potential (but not used) is point counting.

Historically, the visual estimation of grade of in situ ore has been the most commonly used method; it was done by shift bosses who estimated the equivalent width of "metal" (cassiterite + wolframite) in the quartz vein, measured the latter, and the stope, and then estimated the stope grade in CM% (=Sn + WO₃%) by use of either a graph or table, (see enclosed table).

Calculation from first principles suggests the Tables understate the grade by approx. 30%, but the table grades, reduced by a correction factor (typically 0.50), showed a good approximation to mill head grades.

This method of grade estimation, although cumbersome, was generally workable, and served to illustrate the problems involved in grade estimation of sporadic mineralization in veins.

For the purpose of ore reserve calculations, grades were initially estimated

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VISUAL GRADE ESTIMATION — READY RECKONER

METAL WIDTH IN mm	SLOPE WIDTH IN METRES																						
	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
2	0.81	0.65	0.55	0.48	0.42	0.38	0.33	0.31	0.29	0.27	0.25	0.23	0.22	0.21	0.20	0.19	0.18	0.18	0.17	0.16	0.15	0.14	0.14
4	1.55	1.30	1.11	0.95	0.83	0.75	0.69	0.62	0.58	0.52	0.49	0.45	0.42	0.40	0.38	0.37	0.35	0.33	0.31	0.30	0.29	0.28	0.27
6	2.25	1.90	1.64	1.43	1.28	1.14	1.03	0.94	0.86	0.80	0.75	0.70	0.65	0.61	0.58	0.55	0.52	0.49	0.47	0.45	0.43	0.41	0.40
8	3.0	2.45	2.14	1.88	1.68	1.51	1.38	1.26	1.15	1.07	1.00	0.94	0.88	0.83	0.78	0.74	0.70	0.67	0.64	0.61	0.58	0.55	0.53
10	3.7	3.0	2.67	2.31	2.09	1.88	1.70	1.57	1.45	1.35	1.26	1.17	1.10	1.04	0.98	0.93	0.89	0.85	0.81	0.78	0.75	0.71	0.68
15	5.3	4.5	3.9	3.4	3.05	2.75	2.50	2.30	2.12	1.98	1.84	1.73	1.63	1.55	1.48	1.40	1.34	1.28	1.22	1.16	1.11	1.07	1.03
20	7.0	5.8	5.1	4.5	4.0	3.6	3.3	3.03	2.80	2.61	2.43	2.30	2.17	2.04	1.93	1.84	1.76	1.68	1.61	1.55	1.49	1.43	1.38
25	8.4	7.2	6.2	5.5	4.9	4.5	4.1	3.8	3.6	3.25	3.03	2.84	2.68	2.53	2.41	2.30	2.19	2.10	2.01	1.93	1.85	1.78	1.72
30	9.8	8.4	7.4	6.5	5.8	5.3	4.9	4.5	4.1	3.8	3.6	3.4	3.2	3.04	2.88	2.72	2.60	2.50	2.40	2.30	2.20	2.14	2.06
35	11.3	9.6	8.4	7.5	6.7	6.0	5.5	5.1	4.8	4.5	4.2	4.0	3.7	3.5	3.3	3.2	3.02	2.89	2.77	2.66	2.55	2.45	2.36
40	12.4	10.8	9.4	8.3	7.5	6.9	6.3	5.8	5.4	5.0	4.7	4.4	4.2	4.0	3.8	3.6	3.4	3.3	3.2	3.04	2.90	2.80	2.70
45	13.7	11.9	10.4	9.2	8.3	7.6	7.0	6.5	6.0	5.6	5.3	5.0	4.7	4.4	4.2	4.0	3.8	3.7	3.5	3.4	3.3	3.15	3.03
50	15.0	13.0	11.5	10.1	9.1	8.3	7.6	7.1	6.6	6.2	5.8	5.4	5.1	4.9	4.7	4.4	4.2	4.1	3.9	3.7	3.6	3.5	3.3

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visually (as described above), following which the grades were reconciled with actual production grades, and after appropriate factoring, and allowances for waste sorting, the resultant grades were used in the reserve statements.

DILUTION

Aberfoyle Tin Ltd. quoted geological reserves, which consisted of indicated (categories A, B, C + D) and inferred (category E) groups. The indicated reserve was classed in to diluted mineable reserves (A + B), and non mineable reserves, (C + D , reflecting either sub-ore or non recoverable ore).

Planned dilution was calculated as the difference between the average vein width and the 1.2m stope width. The Aberfoyle ore reserve of 7th October, 1980 stated that for vein widths < 1.2 m, 55% dilution was applied in reserve estimates, (with an implied average vein width of 0.54m).

However, examination of the ore reserves figures for the period 1975-80 reveals that (for a 1.2m stope), planned dilution of ore in the upper four levels averaged 79% (with an implied average vein width of 0.26m). The 79% dilution value reflects the "scavenging" nature of the mining operation during the last year of production at Aberfoyle.

The 55% dilution value is probably an indication of the proportion of ore derived from the lower levels with thicker quartz veins.

Consequently, the 60-70% dilution quoted by Edwards and Lyon (1957), assumes credibility for the upper four levels during the early, major phase of mining.

Actual quantification of dilution is a difficult exercise, since it depends on the interaction of the principle variables, namely vein width, and stope width. The nominal minimum vein width used in practice was 0.30m, and it appears that this value was generally adhered to during mining. The nominal stope width was 1.2m, but there is evidence (due to overbreak etc.), that some of the stopes were much wider than 1.2m.

REVIEW OF PRODUCTION DATA

The only original published data on quartz grades in the Aberfoyle deposit is that by Edwards and Lyon (1957), who stated that the upper levels "down

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to about 4 Level" had an average cassiterite content of 2% in the ore (equal to >5% of the veins due to wall rock dilution of 60-70%).

The graphs shown in the figure are based on data compiled from production figures of tonnes of ore milled, and tonnes of recovered Sn and WO_3 , from which the head grades were calculated by assuming the recovered grades represent approx. 80% of the in situ ore grades.

This assumption is probably conservative, because early recoveries were likely to have been <80% such that the calculated head grades will be understated.

The figure depicts three aspects of annual production : the level contribution of ore milled, the head grade of ore delivered to the mill, and the Sn : WO_3 ratios of the (estimated) ore head grades,

Several distinctive features are apparent:

1. Production was exclusively from levels 1, 2, 3, and 4 until 1945, and most of the production from these levels was completed by 1951;
2. The head grades of ore milled were relatively static until 1945-46, when they began a gradual decline from 1.8% CM in 1945 to 0.70% CM in 1970. This decline corresponds to the decline in production from the upper four levels (beginning in approx. 1945);
3. The head grades of ore delivered to the mill for the period 1933-45 (and allowing for contamination by development ore in 1945), had an average value of 2.10% CM.
4. The average Sn : WO_3 ratio for the period 1933-45 was approx. 10:1.

RE-APPRAISAL OF QUARTZ GRADES

MAJOR VEINS

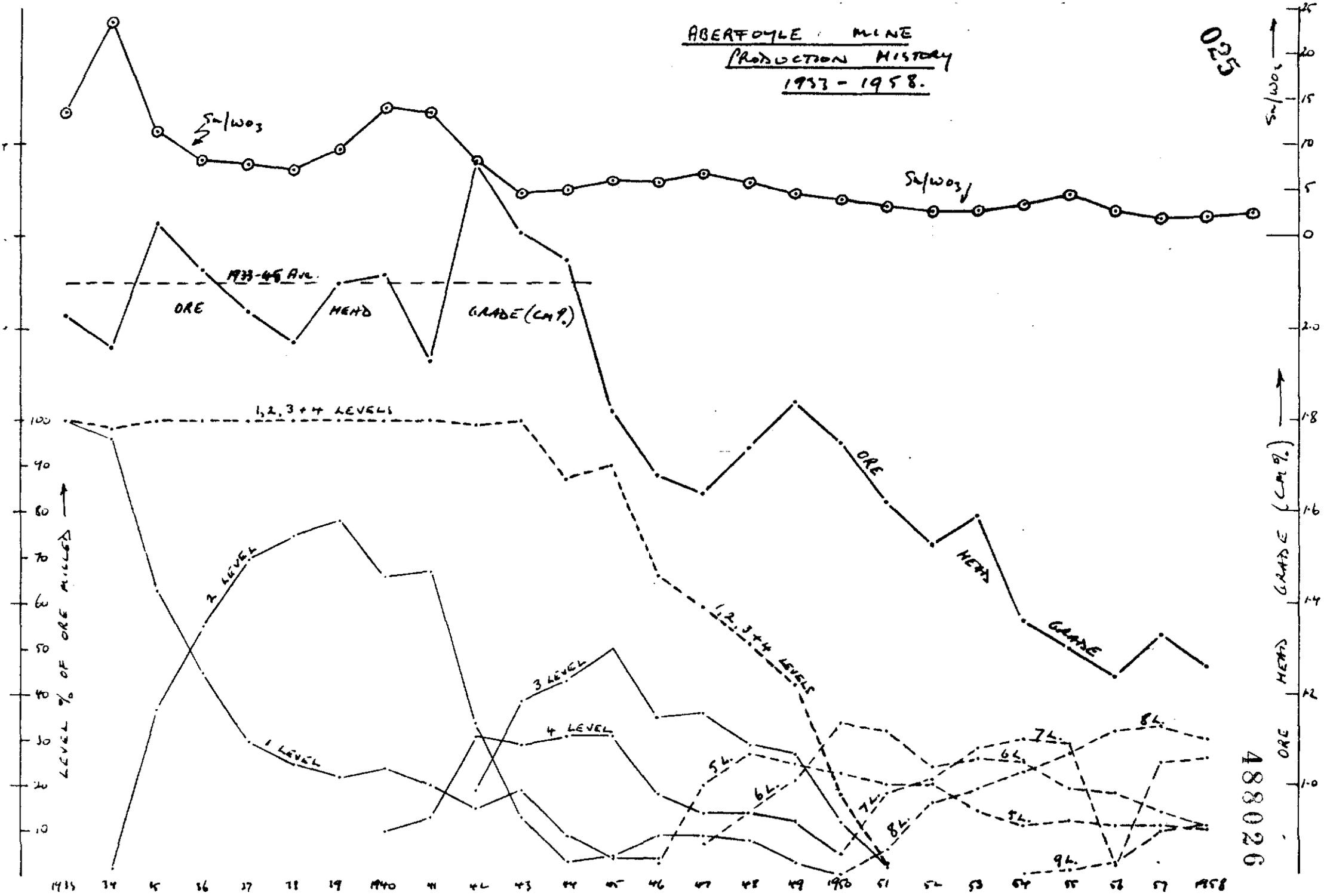
Ore mined from the top four levels of the Aberfoyle mine was characterised by an average head grade of 2.10% CM and an average Sn: WO_3 ratio of 10:1; this indicates Sn = 1.91%, WO_3 = 0.19%.
ie., cassiterite (SnO_2) = 2.45% (in the ore).

This value is therefore in good agreement with the figure of 2% cassiterite (in the ore) of Edwards and Lyon (1957).

Further processing of this data, by assuming a minimum mined vein width of

ABERFOYLE MINE
PRODUCTION HISTORY
 1953 - 1958.

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of 0.30m shows that for variable stope widths the following quartz grades apply:

No dilution	-	QG = 2.1% CM
60% dilution	-	QG = 5.2% CM
70% dilution	-	QG = 7.0% CM

Alternatively, for variable stope widths and maximum ranges of dilution (ie., for minimum vein widths of 0.30m) =

For a 1.2m stope, 75% dilution (max), QG = 8.4% CM;

" " 1.5m " , 80% " " , QG = 5.2% CM;

" " 1.8m " , 83% " " QG = 7.0% CM.

Considering only the first two cases,

for a 1.2m stope, the range of QG is 2.1 - 8.4 (ave 5.2% CM)

" " 1.5m " , " " " " " 2.1 - 10.5 (ave 6.3% CM).

The possibility that the early mining of the Aberfoyle deposit involved some "high grading" of the ore from the upper levels, relative to the lower levels in later years, requires consideration;

In the Aberfoyle Mine ore reserve statements for the period 1975-1980, the average quartz grade (factored visual estimates etc.) of ore remaining in the top four levels was stated as 3.3% CM.

This volume relates to the veins previously regarded as unmineable, but only represents approx. 40,000 tonnes out of approx. 250,000 tonnes mined to 1951;

ie., the value of 3.3% CM represents approx. 15% of the major veins, and by implication, the modal quartz grade (representing approx. 85% of the major veins), lies between 5 and 7% CM.

Accordingly, any bias in head grades due to "high grading" of the ore from the top four levels during mining would appear to have been minimal.

MINOR (STRINGER) VEINS

The grade of the minor veins in the upper levels cannot be directly estimated in the same manner as for the major veins. However, it is unlikely that the physical and chemical conditions effective at the time of mineralization, would have resulted in preferential deposition of cassiterite and wolframite only in large fractures (ie., sites for major veins), in the host rocks.

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The paragenesis deduced by Edwards and Lyon (1957) for the Aberfoyle veins, involved an early stage of cassiterite, wolframite etc. followed by an intermediate stage of quartz, sulphides etc.

Consequently the status of quartz veins as either major ($>30\text{cm}$) or minor ($<30\text{cm}$) can be seen to have been a function primarily of the fluid pressures operative during the intermediate stage.

Accordingly, the minor quartz veins may be inferred to have similar quartz grades to the major veins, (ie., a mean value of QG of 5-7%).

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