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*ZEEHAN DEPOSITS  
PROGRESS REPORT No. 1*

**1844**

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November, 1982

Report No: CMS/82/20

Date Issued: 30/11/82

Classification: Internal

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PROGRESS REPORT NO.1

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RECOVERIES OBTAINED FOR EACH AREA

AREA	FLOWSHEET		
	A	B	C
Queen Hill Lower	48-57 (29-31)	58-64 (50)	58-63 (50)
Severn	63-76 (32-42)	72-80 (50)	69-76 (50)
Montana	59-64 (30-33)	75-83 (50)	75-83 (50)

[The range given is the highest and lowest for each area and the grades achieved (% Sn) are given in brackets].

SUMMARY

- This report covers C.M.S. investigations from July 1981 to February 1982 into 10 diamond drill cores from three mineralised areas (Queen Hill Lower, Severn and Montana) of the Zeehan Deposits.
- The metallurgy of each area was determined by standard laboratory procedures combined with mineralogical studies. The results show the relative ease of processing of each area to be:-

Severn > Montana > Queen Hill Lower

- Three types of flowsheet have been simulated from the results:-
  - A - Current complex tin ore milling circuit with the emphasis on gravity and some flotation
  - B - An 'integrated' flowsheet, incorporating sulphide flotation, gravity and cassiterite flotation to a low grade concentrate, with upgrading by Matte Fuming
  - C - An 'all flotation' flowsheet, incorporating sulphide flotation and cassiterite flotation to low grade concentrate with upgrading by Matte Fuming
- The mass balances produce the recoveries shown opposite.
- Flowsheet A - only Severn material would achieve acceptable recovery.
- Matte Fuming increases overall recoveries by approximately 10%, and increases the grade of product from ~ 30% Sn to 50% Sn.
- Flowsheet B is the process flowsheet indicated from the testwork so far. This has slightly higher recoveries and potentially lower operating costs (compared to Flowsheet C).
- Further fill-in work on the cores tested is indicated to confirm the major tin losses in - sulphide flotation rejects
  - cassiterite flotation tails



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TABLE 1.1: INFERRED TONNAGES OF ZEEHAN MINERALISED AREAS

Area	Number of Drill Holes	Inferred Tonnage ( $\times 10^6$ tonnes) (% Sn @ 0.1% Sn cut-off)
Queen Hill	55	1.8 (0.8)
Severn	19	5.0 (0.6)
Montana	12	0.5 (1.5)
TOTAL	89*	7.3 (0.7)

\*(The remaining holes have been drilled in the Golf course area)

## 1. INTRODUCTION

Aberfoyle Exploration has been active in exploring the area around Queen Hill (near the town of Zeehan, Tasmania) since 1970. Some 89 diamond drill holes have since been drilled identifying three mineralised areas - Queen Hill, Severn and Montana. Collectively these have become known as the ZEEHAN DEPOSITS.

The relative volumes of each area inferred from the drilling results are summarised in Table 1.1 opposite.

The Queen Hill outcrops at surface and has been subdivided into Queen Hill Upper and Lower. Considered in cross-section, Queen Hill Upper extends from the surface to a depth of approximately 100 metres (in vertical section), Queen Hill Lower from approximately 150-250 metres with the Severn and Montana areas being at a similar horizontal level - although some distance away.

Some metallurgical testwork has previously been performed on Queen Hill Upper material (1, 2, 3), the results of which show complex mineral associations and very difficult metallurgy. In view of these difficulties ore characterisation has been performed on drill core samples to determine the metallurgy of the other areas.

Ore characterisation procedures undertaken include heavy liquid analysis, sulphide and cassiterite flotation, release analysis, natural grain size determination and mineralogical investigations. These tests simulate current complex tin ore milling circuits (300 micron primary grind, with mostly gravity and some flotation as processing priorities) and give size/recovery/grade estimates for this type of flowsheet.

Estimates are also provided for the new processing philosophy - an integrated 'unstressed' circuit incorporating the best features of each unit process including concentrate upgrading by Matte Fuming.

TABLE 2.1: SUMMARY OF CMS TESTWORK ON ZEEHAN DIAMOND DRILL CORES

MINERALISED AREA	D.D. CORE NO.	LENGTH OF CORE TESTED (METRES FROM COLLAR)	TESTWORK PERFORMED *
Queen Hill Lower	G49	115 - 204	1, 2, 3, 4, 5, 6, 7, 8
	G62	200 - 255	1, 2, 3, 4, 5, 6, 8
Severn	G65	202 - 272	1, 2, 3, 4, 5, 6, 8
	G72	275 - 313	1, 2, 3, 4, 5, 6, 8
	G74	345 - 371	2, 3, 4, 7, 8
	G81 L.G.	437 - 441, 454 - 464	1, 2, 3, 4, 5, 6, 8
	G81 H.G.	442 - 453	2, 3, 4, 6, 8
Montana	G78	331 - 352	2, 3, 4, 5, 6, 7, 8
	G67 L.G.	185 - 192, 200 - 207	1, 2, 3, 4, 6, 8
	G67 H.G.	192 - 200	2, 3, 4, 6, 8

\*

1. Heavy liquid analysis
2. Sulphide flotation (-300 µm)
3. Release analysis (superpanning)
4. Oxide flotation (-106 µm)
5. Grain size analysis
6. Elemental analysis
7. QEM\*SEM
8. Mineralogy of selected products

L.G. Low Grade

H.G. High Grade

## 2. TESTWORK PROCEDURE

The standard (4) laboratory tests undertaken are described in Appendix I. Table 2.1 (opposite) outlines the details of the drill core samples that have been tested from each area. In two cases (Cores G81 (Severn) and G67 (Montana)) low and high grade sections of the same core were tested separately. The results have been combined for G81 to give an average for the total section. It was not possible to do this for G67 because the low grade results were inconclusive.

TABLE 3.2: TIN AND SULPHUR HEAD ASSAYS

D.D. Core	% Sn		% S
G49	0.41	(0.49)	15.9
G62	0.62	(0.71)	18.6
G65	0.52	(0.48)	10.3
G72	0.50	(0.48)	7.4
G74	0.57	(0.56)	7.8
G81 L.G.	0.34	(0.38)	6.5
G81 H.G.	1.44	(1.10)	12.8
G78	1.25	(1.15)	20.0
G67 L.G.	0.067	(0.066)	1.82
G67 H.G.	3.25	(3.34)	22.4

TABLE 3.3: GENERAL MINERALOGICAL SUMMARY

	CASSITERITE GRAIN SIZE (µm)	CASSITERITE ASSOCIATIONS	SULPHIDES	GANGUE
Queen Hill Lower	2-30	Quartz Sericite Carbonate Chlorite	Pyrite Pyrrhotite Sphalerite traces - Galena Arsenopyrite Chalcopyrite Stannite	Quartz Carbonate Chlorite accessory-Sericite trace - Talc
Severn	3-320	Quartz Chlorite Carbonate	Pyrite Pyrrhotite traces - Sphalerite Chalcopyrite	Quartz/clays Chlorite accessory-Talc Sericite, Carbonate Leucoxene - Rutile
Montana	2-40	Carbonate Sellaite	Pyrite Pyrrhotite traces - Stannite Sphalerite Chalcopyrite	Carbonate Sellaite accessory - Quartz Chlorite

Accessory: ~1 - 10%

Trace: ~ <1%

### 3. ORE CHARACTERISATION: RESULTS AND DISCUSSION

The results obtained for each core are tabulated in the relevant Appendix, and are summarised as necessary in the text.

#### 3.1 Head/Whole Rock Assays

The assays are given in Table 3.1, and the tin and sulphur assays are summarised in Table 3.2 (opposite).

The figures in brackets are the geological assays composited over the interval of core tested. Some assay differences will always be apparent in considering two similar sections of core, and as such, the agreement is reasonable.

#### 3.2 Mineralogy

The relevant mineralogical reports are given in Appendix II. Head samples of each core were examined by microscope techniques and a reasonable indication of the mineralogical associations obtained. These are summarised in Table 3.3 (opposite).

##### 3.2.1 Queen Hill Lower

These cores have the most complicated mineralogy, with the cassiterite being fine grained and associated with several gangue minerals. However, no major cassiterite/sulphide association is reported. The presence of stannite is observed and its extent requires quantifying.

##### 3.2.2 Severn

These cores have coarser grained cassiterite (with the exception of G72) and reasonable liberation is achieved at the size tested. Evidence of bi-modal cassiterite is reported in Core G81 with the cassiterite being both coarse and well liberated, and very fine and intimately associated with assorted gangue minerals. In addition leucoxene-rutile is reported present in Core G81. This can contain tin in solid solution (for example in some Ardlethan ores) and if so will be a source of tin loss.

##### 3.2.3 Montana

These cores have a fine cassiterite grain size, but the crystals are well formed and the mineralogy relatively simple. Cassiterite associations are almost entirely with carbonate (which is the dominant mineral present) and sellaite ( $MgF_2$ ).

**TABLE 3.5: D<sub>50</sub> FROM THE NATURAL GRAIN SIZE ANALYSIS**

Area	Sample	D <sub>50</sub> (μm)
Queen Hill Upper (3)		14
Queen Hill Lower	G49	21
	G62	21
Montana	G78	31
Severn	G81 L.G.	44
	G72	65
	G65	69
Cleveland	Halls	74

### 3.3 QEM\*SEM

Samples from each area (Cores G49, 72 and 78) were submitted for analysis by QEM\*SEM. Due to the complexity and volume of the results given a full analysis has not yet been completed. However, a summary of the relative volumes of each mineral present for each sample is given in Appendix III. In general these results confirm the mineralogy summarised in Table 3.3 albeit in much more detail.

### 3.4 Natural Grain Size Analysis

The grain size distributions in the leach residues are given in Table 3.4 and are plotted in Figure 1. Corresponding data for a Cleveland sample and Queen Hill Upper (3) are shown for comparison. The D<sub>50</sub> (50% passing size) for each sample is given in Table 3.5 (opposite).

Figure 1 and Table 3.5 show the differences in the grainsize distributions of the three areas. This information shows that the cassiterite is coarsest in the Severn area and finest in Queen Hill Lower (Severn > Montana > Queen Hill Lower), and gives an indication of the ease of conventional processing (generally the coarser the cassiterite the higher the recovery). For example, the early metallurgical testwork on Queen Hill Upper (1, 2, 3) showed very poor conventional recoveries, and this has the finest average grainsize. The Cleveland ore sample (Halls) has the coarsest average grainsize and this material has a very good conventional recovery (70-75% in the Cleveland plant). Taken in isolation these results indicate that the conventional processing recoveries of the areas considered will be Severn > Montana > Queen Hill Lower. (The Mineralogical comments on the leach residues are included in Appendix II).

### 3.5 Heavy Liquid Analysis

Indications of the amenability to preconcentration by heavy media separation (H.M.S.) is given by interpreting the heavy liquid analyses for the cores (these are given for each core in Appendix IV).

The practical lowest size of H.M.S. operation is 0.85 mm and the overall weight and tin rejections for the +0.85 mm fractions of each core are summarised in Table 3.6. The cumulative results are graphically represented in Figure 2 for each area, compared with the data for the Cleveland Standard Mill Feed (Period 8, 1980).

TABLE 3.10 SUPERPANNING STAGE RECOVERIES AT 50% Sn GRADE

Area	Core	Stage Recovery
Queen Hill Lower	G49 G62	17.5 28.7
Severn	G65 G72 G74 G81 H.G.	65.0 35.6 69.5 40.6
Montana	G78 G67H.G.	25.6 18.0
Cleveland Standard Mill Feed (P.11, 1981)		70.4

For Queen Hill Lower and Severn cores the curves show slightly lower weight percentages and considerably lower tin distributions to the float fractions. The Montana core has very little weight distribution in the float fractions. This is because the dominant mineral type is carbonate (S.G. > 4.0).

The indications are that Queen Hill Lower and Severn will be amenable to preconcentration by H.M.S. However the actual topsize of processing by H.M.S. (and hence the overall weight and tin reject) cannot be determined until coarser samples are tested.

### 3.6 Preconcentration using Heavy Liquid (S.G. 2.96)

Preconcentration was performed on cores G49, 62, 65, 72 and 74 prior to the remaining unit process work. The float fraction was removed from each size range (down to 45 microns). The results are given in Table 3.7 together with the corresponding results for the Cleveland Standard Mill Feed (Period 8 1980). [Comparisons of the weight rejected and tin assay and distribution of the reject fractions is further evidence that each of these cores would be amenable to preconcentration by H.M.S., but again does not give a clear indication of the topsize of processing by H.M.S.].

### 3.7 Sulphide Flotation (-300 microns)

The results of each test are given in Appendix V, and these are summarised in Table 3.8. The sulphides are readily floatable (recoveries in excess of 95% in each case), but tin losses are substantial. This is due to incomplete liberation and some entrainment of fine cassiterite. Regrinding and cleaner flotation will considerably reduce these losses.

### 3.8 Release Analysis

The results of each test are given in Appendix VI, and the cumulative grade/recovery data obtained for each core is summarised in Table 3.9. The grade/recovery curves (these recoveries are for the gravity stage only) for these tests are plotted in Figure 3 for each area.

Table 3.10 (opposite) shows the stage recoveries achieved to a grade of 50% Sn compared to that of the Cleveland Standard Mill Feed. These recoveries are a function of the cassiterite liberation at this grind size. Two of the Severn cores (G65 and G74) are well liberated but the remainder are only partially liberated.

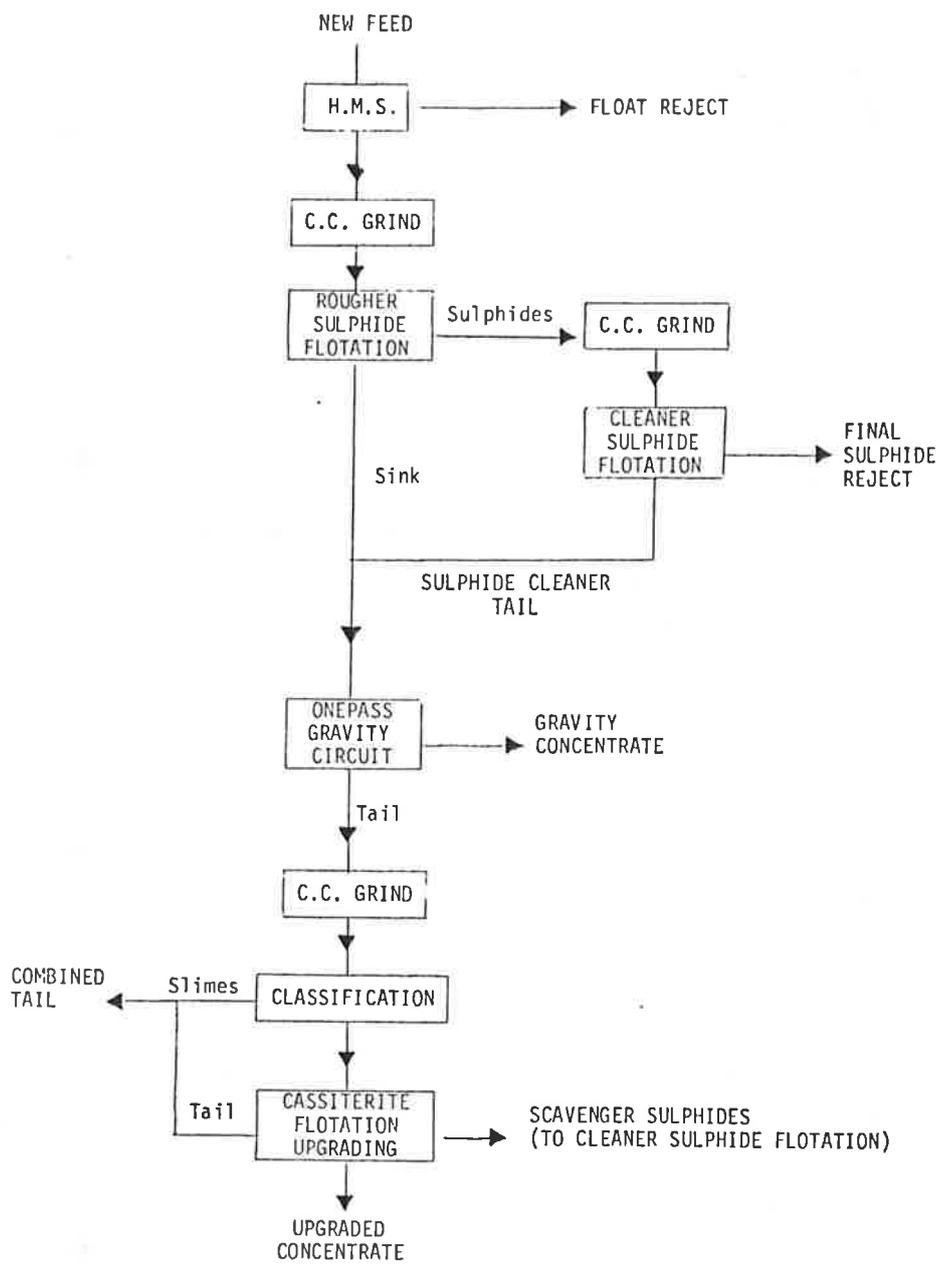


Finer grinding will increase the liberation of these cores (and consequently the gravity recovery). Similar treatment of the liberated Severn cores may incur overgrinding and slimes losses of the already free cassiterite. (The testwork to substantiate the extra recovery/losses has not been performed).

### 3.9 Cassiterite Flotation

The results of each test are given in Appendix VII. For cores G49 - G74 very minimal desliming was performed prior to flotation to maximise recovery. Neither grade or recovery were achieved as the results were masked by low grade slimes in all products. Consequently each flotation product was rigidly deslimed and the products assayed. In addition the flotation tail product was refloated (to determine the possible limit tail grade). This enabled a plus and minus 5 micron performance to be calculated which is summarised in Tables 3.11 and 3.12.

These results show that high grade concentrates are achievable if adequate desliming is carried out prior to flotation, and also that slimes fractions are relatively barren.



**FIGURE 4:** FLOWSHEET A -  
CURRENT COMPLEX TIN ORE MILLING CIRCUIT

#### 4. PROPOSED FLOWSHEETS: MASS BALANCES AND DISCUSSION

##### 4.1 Mass Balances

The data accumulated provides the basis from which mass balances and therefore recovery predictions can be made for different types of flowsheet. Implicit in these calculations are certain assumptions (which are stated where applicable).

Three processing options at a primary grind of 300 microns are considered:-

- a) Mostly gravity plus some flotation to conventional products (the current complex tin ore milling circuit design).
- b) An integrated flowsheet incorporating gravity, and flotation to a low grade product with upgrading by matte fuming.
- c) The "all flotation" flowsheet to a low grade product with upgrading by matte fuming.

##### 4.1.1 Flowsheet A

The flowsheet is schematically outlined in Figure 4 (opposite). The heavy media sink is ground and the sulphides recovered and cleaned by flotation. The combined sulphide sink is subjected to gravity treatment (producing a high grade gravity concentrate), and the tails are ground and floated producing a low grade concentrate. This is upgraded by cleaner flotation and magnetic separation.

The assumptions made in calculating the mass balances are:-

- i) Heavy media reject - the weight and tin distribution is actually what occurred in the preconcentration stage.
- ii) Sulphide flotation - the weights and grades taken are those that occurred (summarised in Table 3.8). It is estimated that after further grinding and flotation, 80% of the weight and 50% of the tin passed through this circuit will be discarded in the final sulphide reject.
- iii) Gravity concentration - taken from the superpanning grade/recovery curves (Figure 3). In each case the gravity recovery taken is that for a 50% Sn grade concentrate.

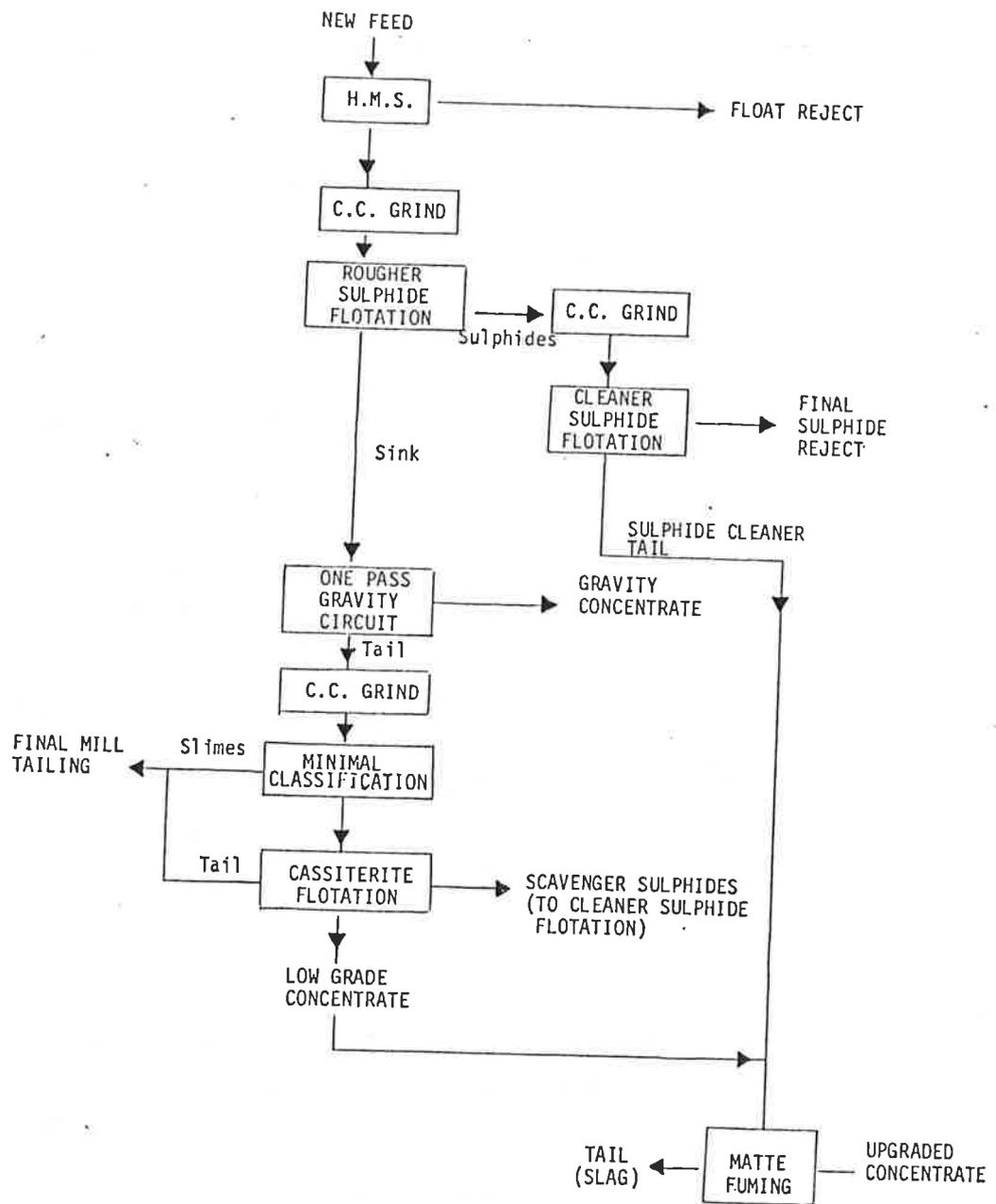


FIGURE 5: FLOWSHEET B -  
INTEGRATED CIRCUIT WITH LOW-GRADE  
CONCENTRATE UPGRADING BY MATTE FUMING

- iv) Desliming - the weight fraction of slimes is the percentage that occurred in each case (Table 3.12). The assay used is calculated from the proportion of the slimes assay/feed assay in the desliming unit process (Table 3.12), pro-rated to the feed grade in question.
- v) Cassiterite rougher flotation/concentrate upgrading - The stage recoveries to the rougher flotation concentrate are calculated using the 2-product formula, using the tail assays achieved in the laboratory and a concentrate grade of 5%. The % weight to concentrate is given by:-

$$\% \text{ Wt (C)} = \frac{(f-t)}{(c-t)} \times 100$$

and the recovery is given by:-

$$R = \frac{C.c}{100.f} \times 100$$

where c, f, and t are the assays of the concentrate, feed and tailings respectively.

[These formulae are quoted in all metallurgical textbooks and are commonly used in mass balance calculations. As an example consider the cassiterite rougher flotation of G49. The assays of c, f and t are 5, 1.26 and 0.3 % respectively.]

$$\therefore C = 20.4\%, \text{ and from this the stage recovery } R = 81.0\%$$

The stage recoveries obtained in upgrading the rougher flotation concentrates are calculated in the same way using 5%, 25% and 1% for the feed, concentrate and tail assays.

The mass balances obtained (for each core tested) for this flowsheet are given in Table 4.1.

#### 4.1.2 Flowsheet B

The flowsheet is schematically outlined in Figure 5 (opposite). The heavy media sink is ground and the sulphides removed. These are cleaned in a separate circuit. The sulphide sink is subjected to gravity treatment (producing a high grade concentrate) and the tails are ground and floated to produce a low grade concentrate. This is

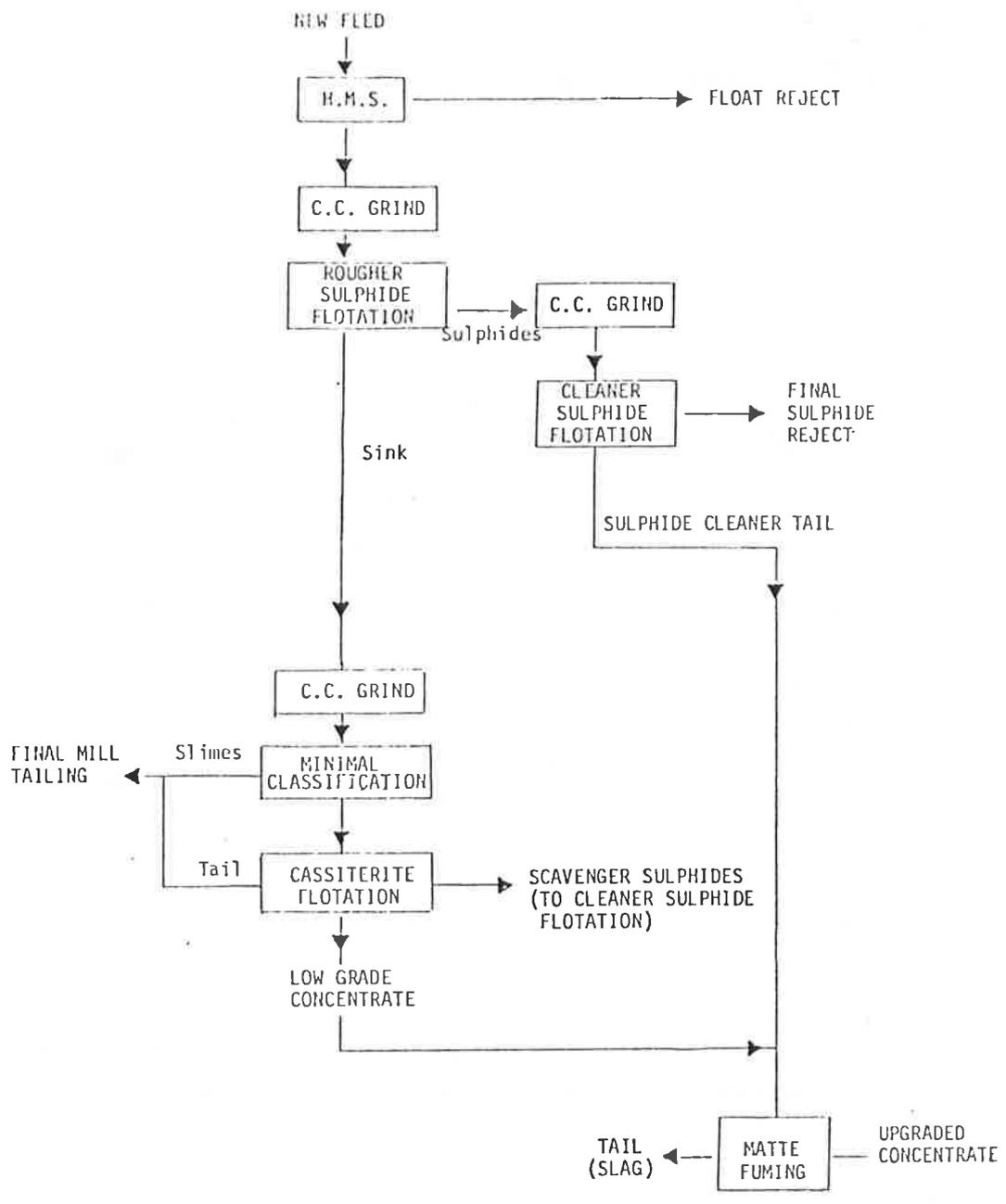


FIGURE 6: FLOWSHEET C -

ALL FLOTATION CIRCUIT WITH CONCENTRATE  
UPGRADING BY MATTE FUMING

combined with the sulphide cleaner tailing (containing most of the tin in the sulphide section) for upgrading by matte fuming.

The assumptions made in calculating the mass balances are:-

- i) Heavy media reject - as for 4.1.1
- ii) Cleaner sulphide flotation - The feed is the rougher sulphide flotation product plus the scavenger sulphide product taken prior to cassiterite flotation. The cleaner tail product is estimated as 15% of the feed weight, either to a grade of 1.5% Sn, or, where there is a large tin distribution, a sulphide reject grade of 0.3% Sn.
- iii) Gravity concentrate - as for 4.1.1
- iv) Desliming - No slimes losses are assumed. (In practice the slimes and flotation tails assays were of the same order).
- v) Cassiterite rougher flotation - The stage recoveries are calculated from the 2-product formula (as in section 4.1.1), using the tail assays achieved in the laboratory, and a 10% Sn concentrate grade. This product is combined with the sulphide cleaner tail as feed for upgrading by matte fuming. Metallurgical studies of this process indicate optimum feed grades could be  $\geq 4\%$  Sn. Consequently the flotation concentrate is taken as 10% to produce the required feed grade for fuming when combined with the sulphide cleaner tail.
- vi) Matte Fuming concentrate - The stage recovery to a 50% Sn grade concentrate is taken as 92%.

The mass balances obtained (for each core tested) for this flowsheet are given in Table 4.2.

#### 4.1.3 Flowsheet C

The flowsheet is schematically outlined in Figure 6 (opposite). The assumptions made are as for section 4.1.2 (except no gravity concentrate is taken) and the mass balances (for each core tested) of this flowsheet are given in Table 4.3.

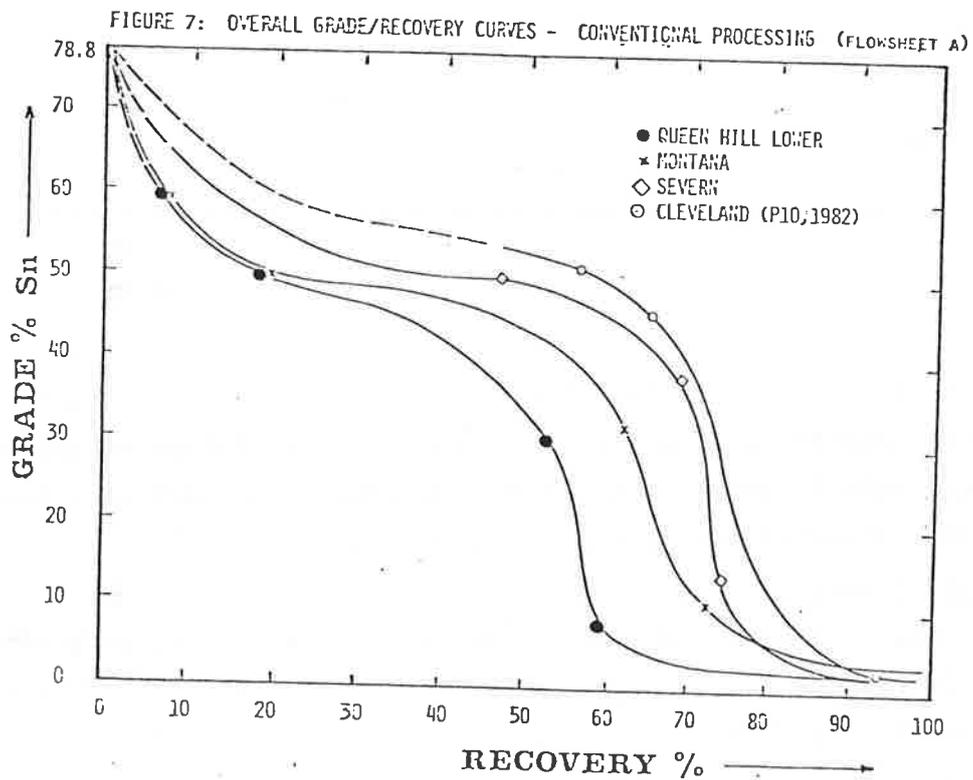
#### 4.1.4 Grade/Recovery Curves

The data accumulated in each of the mass balances may be graphically represented as "Grade/Recovery Curves". These have been drawn for each flowsheet based on new feed from Tables 4.1 - 4.3 and are included as Appendix VIII. (Dotted lines are used in the areas where no information is available - particularly at the highest grade, lowest recovery section of the curves).

TABLE 4.5: RECOVERIES OBTAINED FOR EACH AREA

AREA	FLOWSHEET		
	A	B	C
Queen Hill Lower	48-57 (29-31)	58-64 (50)	58-63 (50)
Severn	63-76 (32-42)	72-80 (50)	69-76 (50)
Montana	59-64 (30-33)	75-83 (50)	75-83 (50)
Cleveland P.10 1982 (6)	65.5 (46.2)		

[The range given is the highest and lowest for each area and the grades achieved (% Sn) are given in brackets].



## 4.2 Discussion

### 4.2.1 Recovery Predictions

The calculations made to determine the mass balances for each flowsheet were largely based on data obtained in the laboratory. Assumptions have been made in two areas (sulphide cleaner flotation and flotation concentrate upgrading) and these are based on current data from operating mines.

The actual recoveries and grades produced for each core from each flowsheet are summarised in Table 4.4, and the high and low recoveries and grades from each area are given in Table 4.5 (opposite).

The major tin losses are equally spread between the sulphide flotation reject and the cassiterite flotation tail (with smaller losses in the slimes). Additional work is required to determine if these losses may be further reduced. It is felt, however, that the cassiterite flotation tail is most likely to be reduced (if a 0.1% Sn tail could be achieved the overall recovery increases by approximately 7-9% (Queen Hill Lower), 3% (Severn) and 3-6% (Montana).

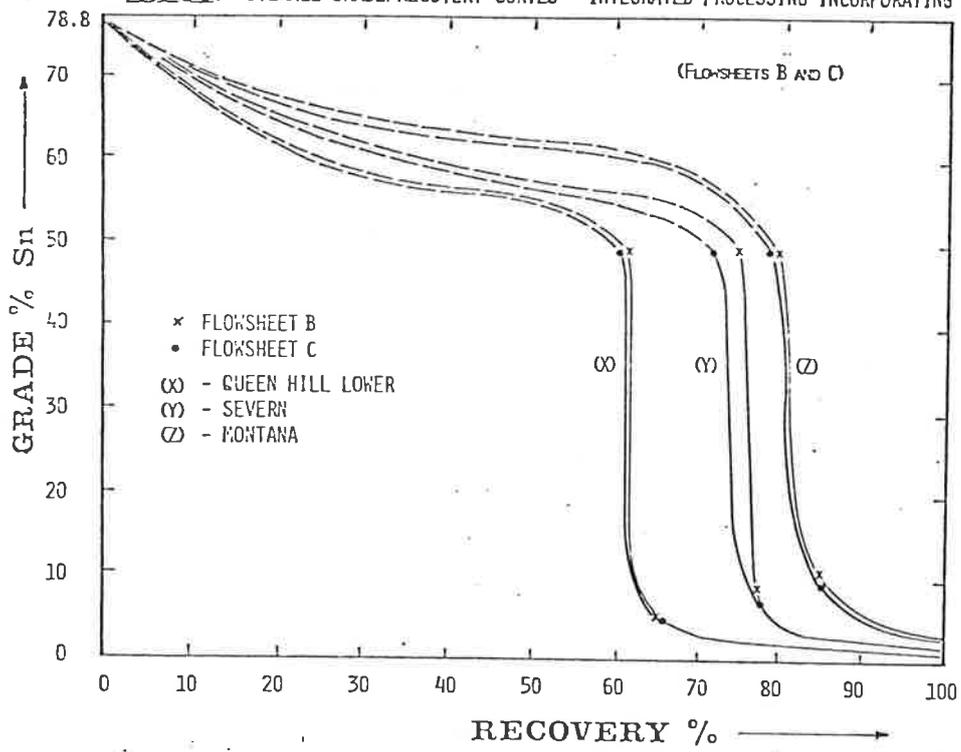
Consequently the confidence range that is placed on the recoveries for each core are in the range of -5% +10%.

### 4.2.2 Flowsheet Comparisons

Flowsheet A - Composite grade/recovery curves for each area (the arithmetic averages of relevant cores) for this flowsheet are summarised in Figure 7 (opposite). As has been stated previously there are substantial differences in the gravity responses of each area. This is clearly shown by the differences in recovery at 50% Sn concentrate grade.

Compared with the corresponding data from Cleveland (results for Period 10, 1982) Severn material is the most amenable to conventional processing with reasonable recovery to a lower overall grade. (This is due to the greater emphasis on gravity at Cleveland and shows that the higher the production by flotation the lower the overall grade of concentrate. Queen Hill Lower and Montana material types are less amenable to this type of flowsheet (because of their finer cassiterite grain size they are more dependent on flotation).

FIGURE 8: OVERALL GRADE/RECOVERY CURVES - INTEGRATED PROCESSING INCORPORATING MATTE FURING



Flowsheets B and C - Composite grade/recovery curves for each area are summarised in Figure 9 (opposite). The final recoveries in each case are greater for Flowsheet B than Flowsheet C. This is contrary to what was expected. The reason for this is that some tin losses occur following each unit process (e.g. fine grinding - slimes, flotation - tails, fuming - slag). The gravity circuit, however, incurs no real loss as two products are taken - concentrate and tailings. All the tails are reground but regrinding slimes losses are minimised because the majority of the liberated cassiterite has been removed. In addition recovery losses in the other processes are also reduced because of the reduced amounts of tin being processed. Thus Flowsheet B has lower overall tin losses than Flowsheet C.

This effect is largest for the Severn material (which is the most gravity responsive) - the difference is approximately 3% to the same grade to concentrate. The effect is less marked in the Queen Hill Lower and Montana area because of their poorer gravity response.

Another factor arises from the inclusion of a gravity circuit, and this is the reduction of the flotation preconcentrate weight to be upgraded by fuming. Table 4.6 (obtained from the relevant mass balances - Tables 4.2 and 4.3) summarises the differences in the weights of preconcentrate between the two flowsheets. Fuming is a relatively expensive unit process and the overall operating costs of any flowsheet incorporating it must be sensitive to the total weight processed. Consequently the overall operating costs of Flowsheet B are potentially lower than those for Flowsheet C. This could be a significant factor in final process selection.

#### 4.2.3 Benefit of Matte Fuming

Examination of the range of recoveries achieved for each flowsheet (Table 4.5) shows the recovery benefit of the flowsheets incorporating Matte Fuming to be approximately 10% greater than the conventional flowsheet. This is lower than was first expected but could increase if the tin losses in flotation can be reduced. However, a very important benefit of fuming is the production of a high grade (50% Sn+) product. This is much more saleable at higher revenues than conventionally upgraded flotation products.

## 5. CONCLUSIONS

- Laboratory test results indicate the three geological areas tested (Queen Hill Lower, Severn and Montana) have significantly different metallurgical responses. These differences are due mainly to the different mineralogical characteristics of each area.
  - Queen Hill Lower and Severn areas show amenability to preconcentration by heavy media separation (H.M.S.), while Montana does not. At this time it is not possible to determine the top size at which H.M.S. could be carried out, or the maximum overall weight rejection. (This increases with increasing top size). The minimum overall weight rejection indicated is approximately 20% for a metal loss of less than 5%.
  - A finer primary grind is indicated (probably -210 microns) although testwork to prove this has not yet been performed.
  - At a primary grind of 300 microns recoveries from conventional complex tin ore milling circuits indicate that only Severn could be economically\* viable.
  - Recoveries from circuits incorporating Matte Fuming indicate that each area could be economically viable. Matte Fuming significantly increases both the grade of concentrate produced and the overall recovery. (This increases the revenue as all products are 50% Sn+).
  - The process flowsheet indicated is that of an integrated circuit (a concept utilising the best features of each unit process) - sulphide flotation, gravity, cassiterite flotation and upgrading by matte fuming. This system has slightly higher recoveries (and potentially lower operating costs) than the less integrated, and more stressed flowsheet (with greater emphasis on one unit process) - sulphide flotation, cassiterite flotation and upgrading by matte fuming.
- \*[It is beyond the scope of this current work to define and calculate the actual economics of the flowsheets proposed. The economic comments at this stage therefore are intuitive rather than absolute].

## 6. RECOMMENDATIONS

### 6.1 Further Testwork

The scope of this work was the determination of the metallurgical performance of each of the Zeehan mineralised areas (5, 6) on the basis of the results obtained and on the relative volumes of each mineralised area (Table 1.1) further investigations are required into:-

- a) Sulphide regrinding and cleaning
- b) Determination of flotation limit tailing grades
- c) Release analysis at finer primary grinds
- d) Flowsheet optimisation on a composite of drill cores

#### 6.1.1 Severn

These cores have the best overall metallurgy and the area has the largest inferred reserve. Allowing for the above, sufficient testwork will have been performed on Cores G65, 72 and 74. However, lower recoveries were obtained for Core G81 which is the deepest (~450 metres from collar) of all the samples tested. Deeper ores at current operating tin mines (for example, Ardlethan Cleveland and Renison) have poorer metallurgical performances due to finer and less well-formed cassiterite, and more complex mineral associations. This is evident in G81. Consequently more samples are required to assess the overall metallurgy of the Severn area - at depth and over its full extent.

#### 6.1.2 Queen Hill Lower

These cores have more complex metallurgy and lower recoveries than the other areas. However, the extent and indicated reserves are now well defined by drilling. Further testwork (as outlined above) is required on the existing cores, and ore characterisation is required on other cores in the area.

#### 6.1.3 Montana

These cores have relatively simple metallurgy. The cassiterite grain size is fine but the crystals are well formed. A small high grade area is inferred from drilling, so the further work required is of low priority.

## 6.2 Current Aberfoyle Strategy

This is to develop the Zeehan Deposits through Queen Hill Upper and the Lower - to generate a cash flow in the development of the major portion of the mineralisation. The metallurgical performance of these areas is thus critical to the success of the strategy, and the major requirement is the design of a processing plant to determine project economics.

Previous metallurgical testwork on Queen Hill Upper samples have indicated very poor recoveries to conventional products (1, 2). This testwork was undertaken before the new Aberfoyle concept of low grade preconcentration by flotation with concentrate upgrading by Matte Fuming had been developed.

Matte Fuming is a proven process for upgrading Queen Hill Upper material (an 85% recovery to a 30% Sn concentrate was achieved from a head grade of 0.70% Sn during the Matte Fuming pilot plant trials) - however at present this is not economic at the low head grades tested. Preconcentration by flotation is the only method possible to achieve an economic feed grade to Matte Fuming.

Consequently if the current Aberfoyle development strategy is to be achieved the following test programme will be required.

### 6.2.1 Queen Hill Lower

On current samples, investigations will include:-

- a) Sulphide regrinding and cleaning
- b) Determination of flotation limit tailing grade
- c) Release analysis at finer primary grinds
- d) Alternative cassiterite flotation systems

Ore characterisation is also required on further drill cores (G26, 51 and 61).

### 6.2.2 Queen Hill Upper

On a bulk representative sample, investigations at fine grind sizes (-53 microns) will include:-

- a) Liberation analysis
- b) Sulphide flotation
- c) Cassiterite flotation
- d) Flowsheet optimisation

### 6.2.3 Severn

Further work (discussed in 6.1.1) will have a much lower priority until the completion of the Queen Hill Upper and Lower test programmes.

REFERENCES

- (1) Bollen, L., "Queen Hill, Metallurgical Investigation No.1" June 1972
- (2) Bollen, L., "Queen Hill, Metallurgical Investigation No.2" February 1973
- (3) Foo, K.A., "Process Design Study for the Beneficiation of a Tin Ore from Queen Hill, Tasmania" September 1974
- (4) Central Metallurgical Services - Laboratory Manual
- (5) Memorandum, "Metallurgical Testwork - Zeehan Deposits"  
K.A. Foo to N. E-Moony, 11 February, 1982 (Ref. 30.18.3)

ACKNOWLEDGEMENTS

The author wishes to thank all CMS staff for their contribution and Dr. D. Conochie for his helpful comments on the presentation.

DISTRIBUTION:

Melbourne	-	K.G. Palmer S.M. Richards K.A. Foo
Exploration	-	E.H. Skey
Ardlethan	-	M.A. Eager
Que River	-	M.J. Hillbeck
CMS	-	N. E-Moony S.S. Meik Library

FIGURES 1 - 8

FIGURE 1: NATURAL GRAINSIZE OF CASSITERITE

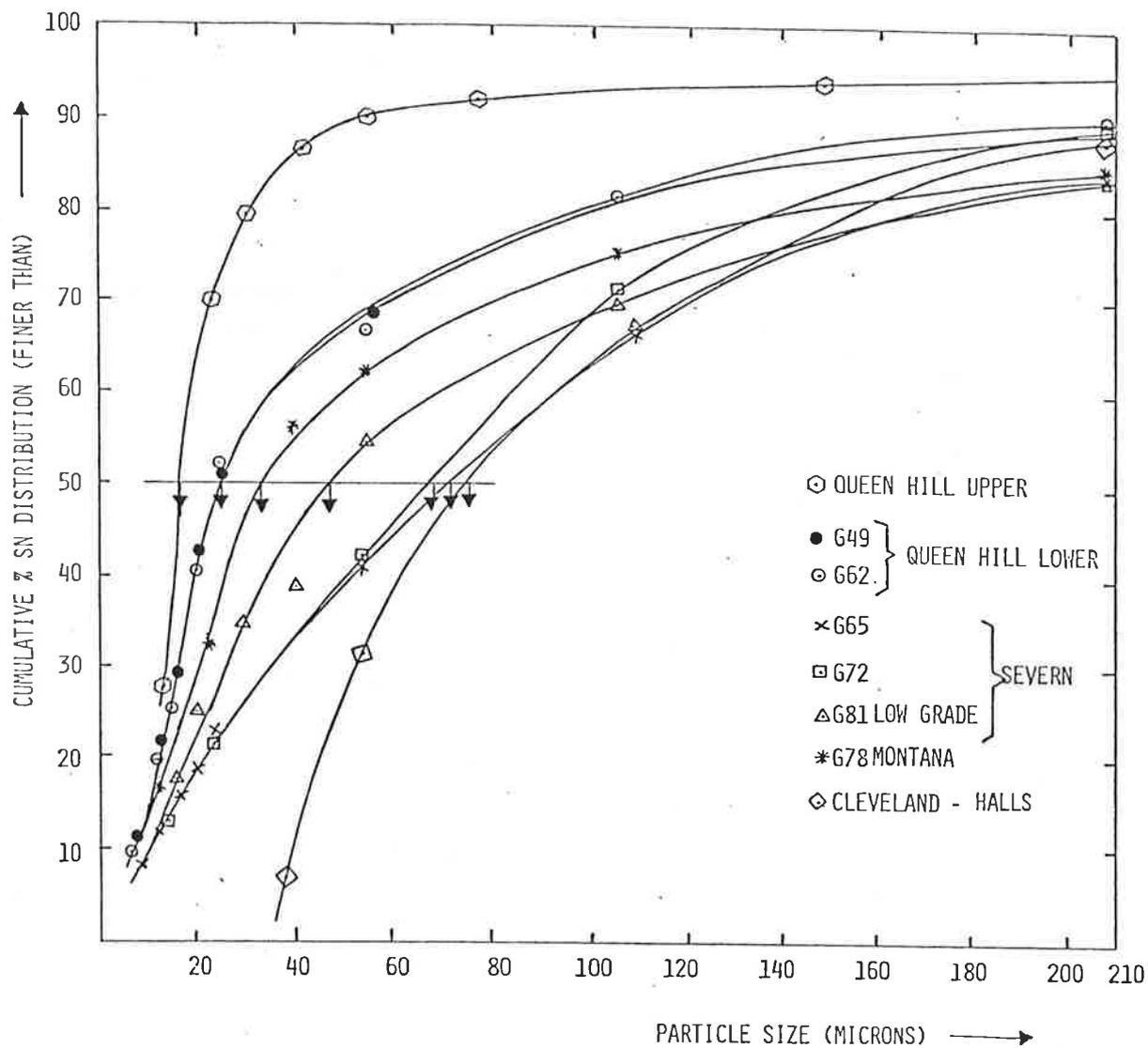
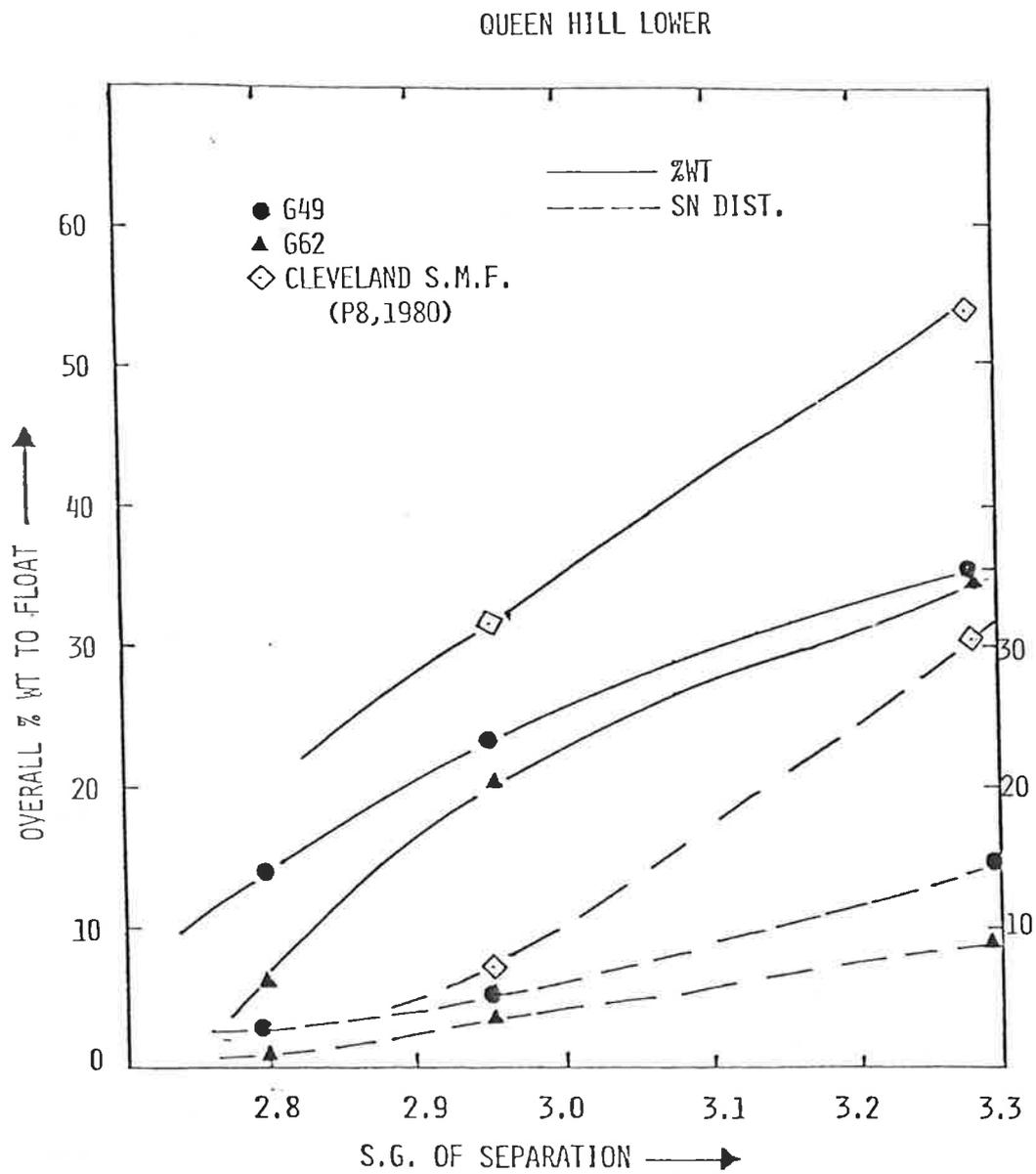


FIGURE 2: % WEIGHT AND SN DISTRIBUTION - REJECTION VS.  
S.G. OF SEPARATION (+850 MICRONS, OVERALL).



Cont.d

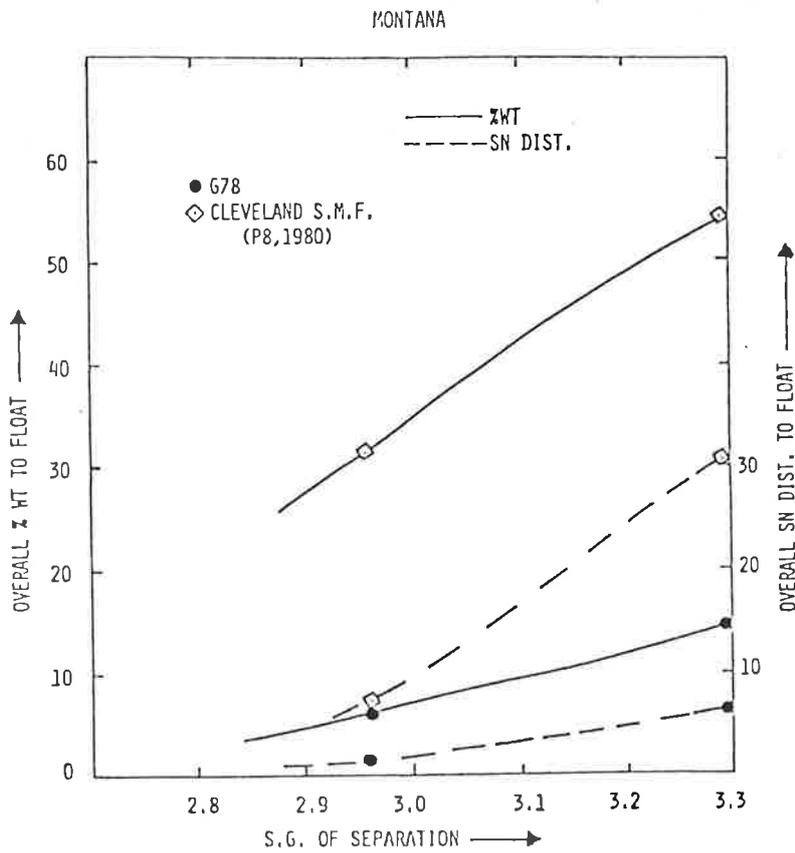
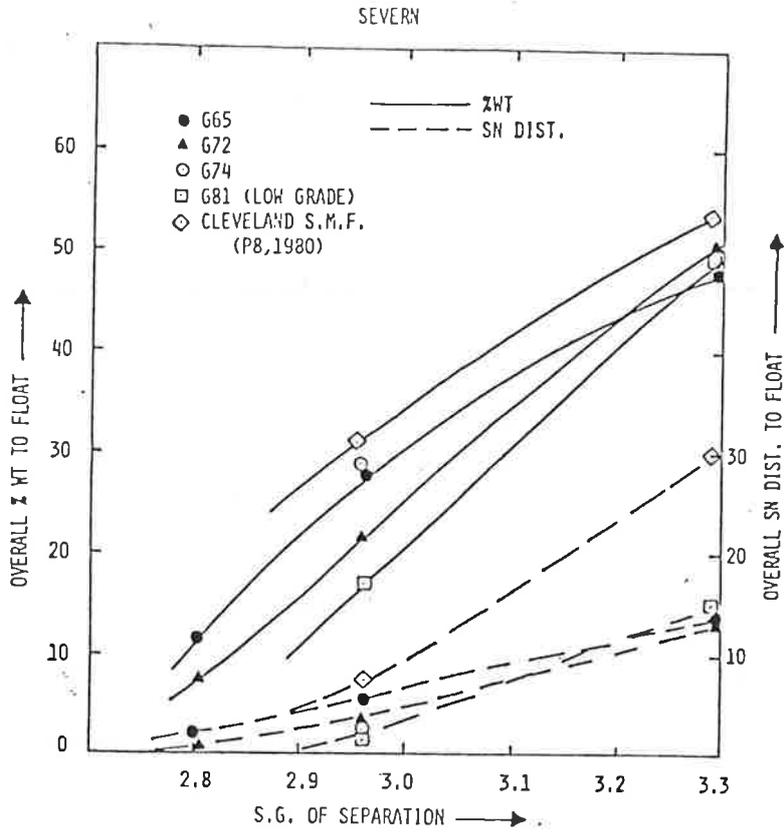
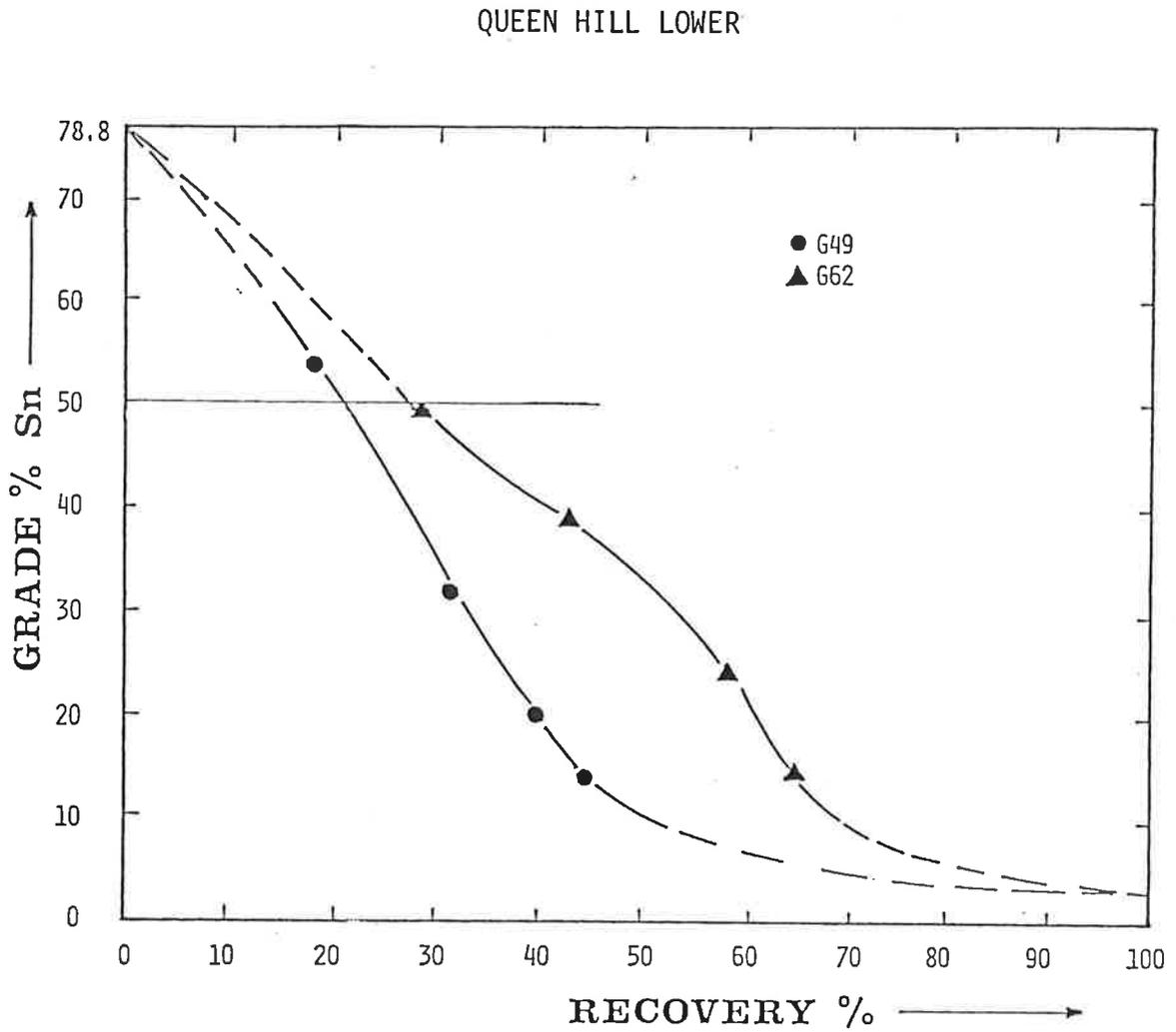


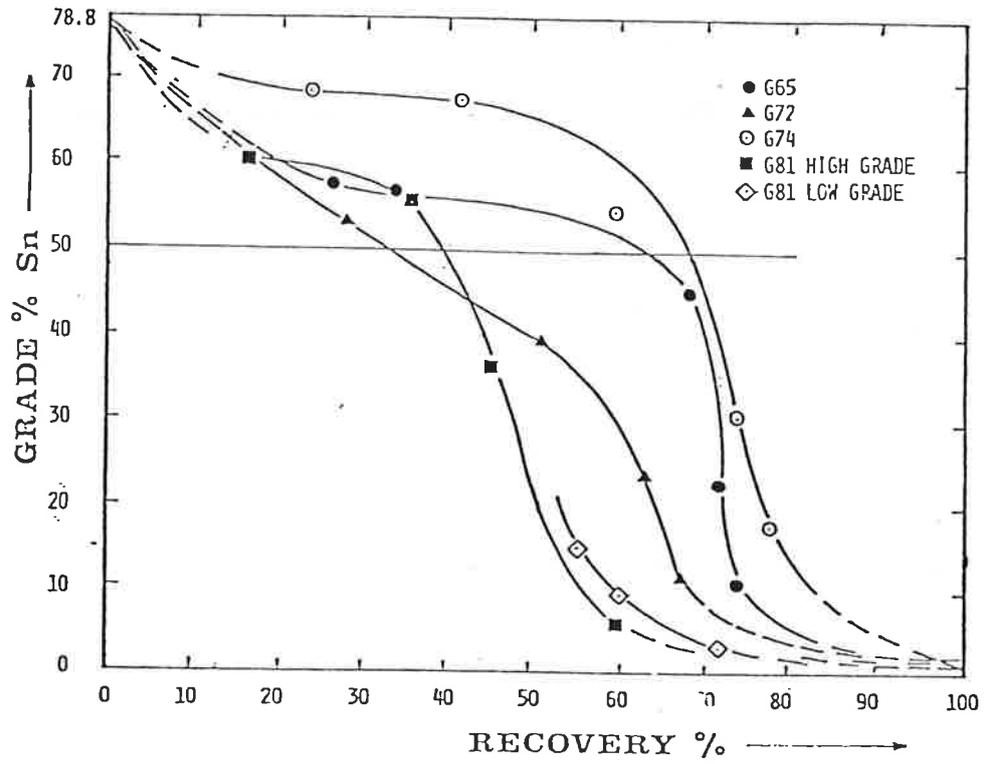
FIGURE 3: GRAVITY SEPARATION STAGE - GRADE/RECOVERY CURVES



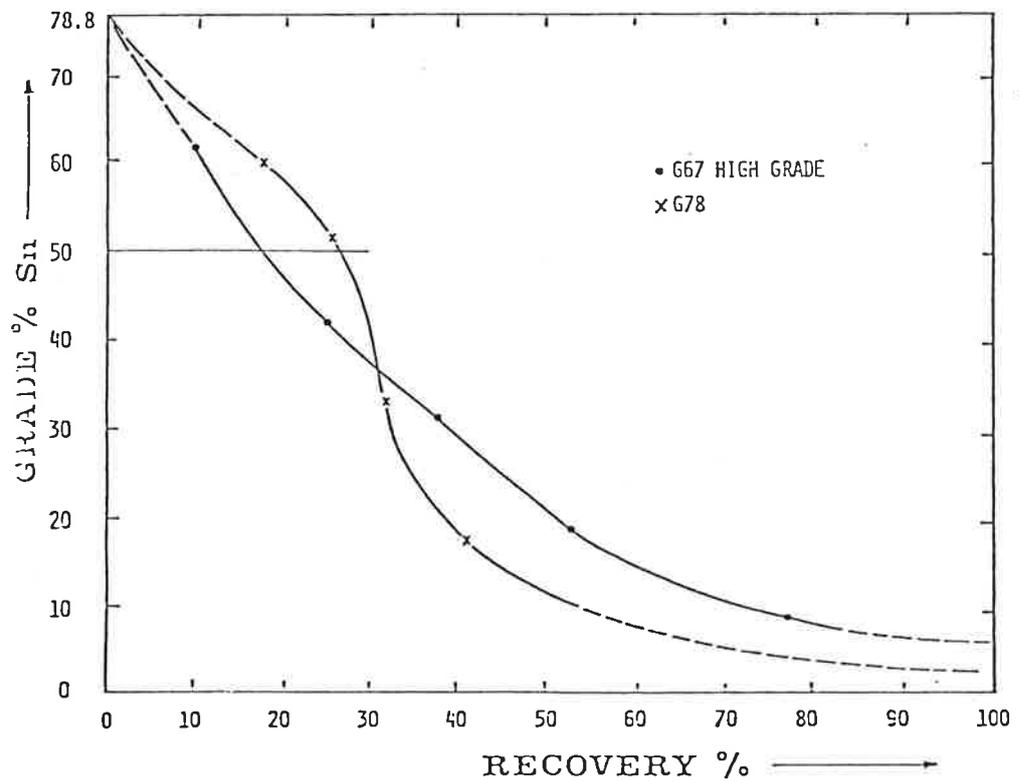
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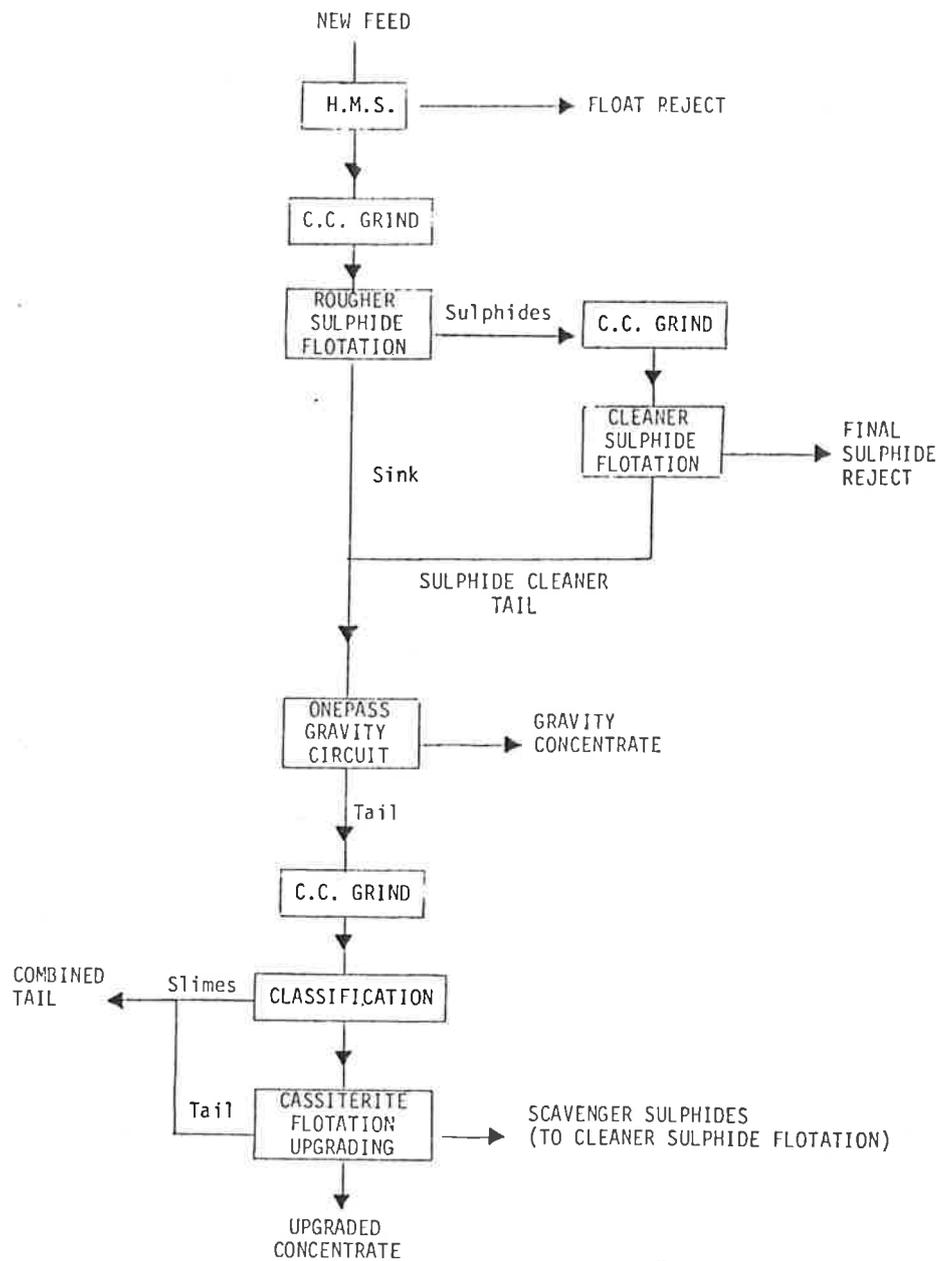
Figure 3 cont.d

SEVERN



MONTANA





**FIGURE 4:** FLOWSHEET A -  
CURRENT COMPLEX TIN ORE MILLING CIRCUIT

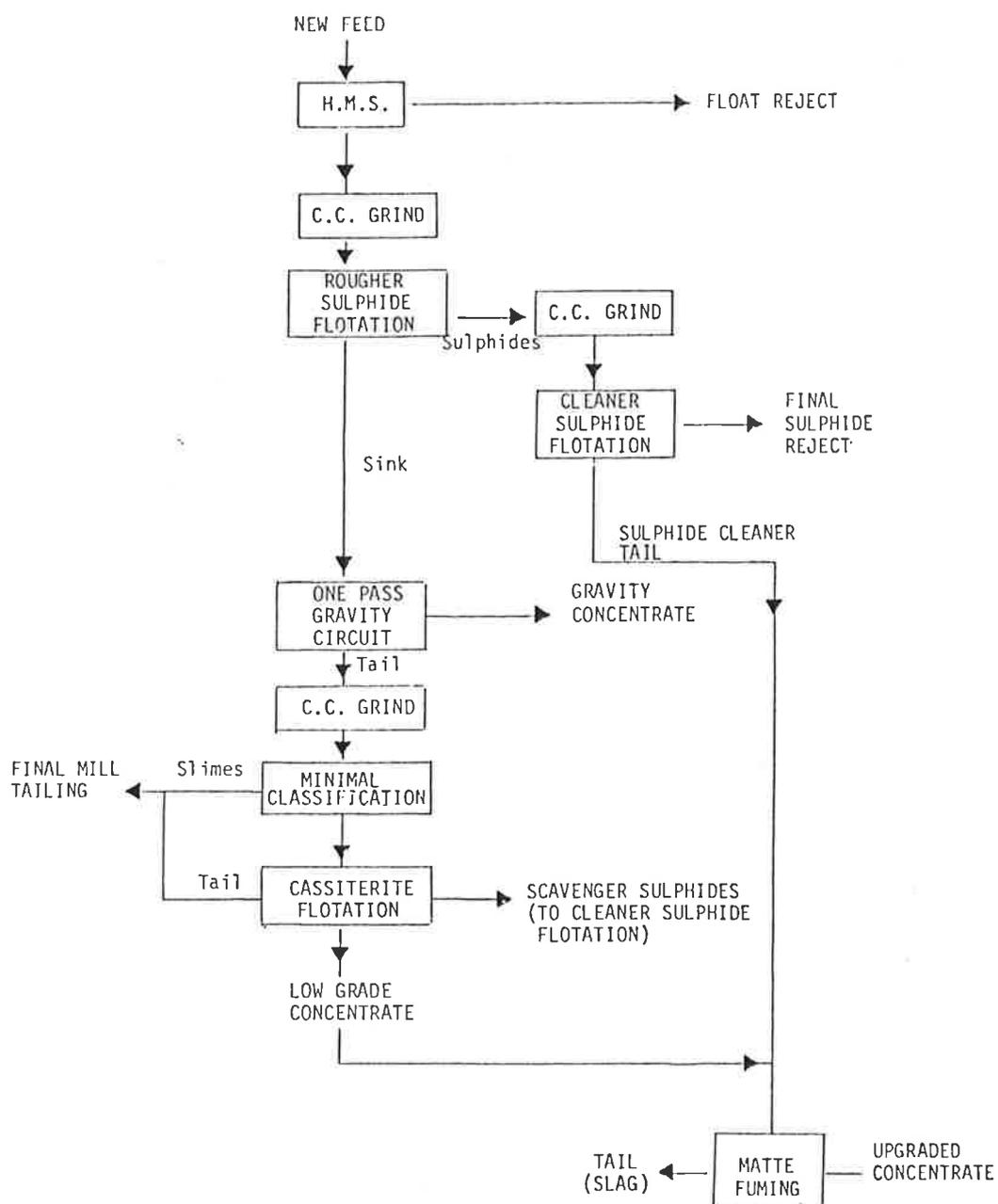
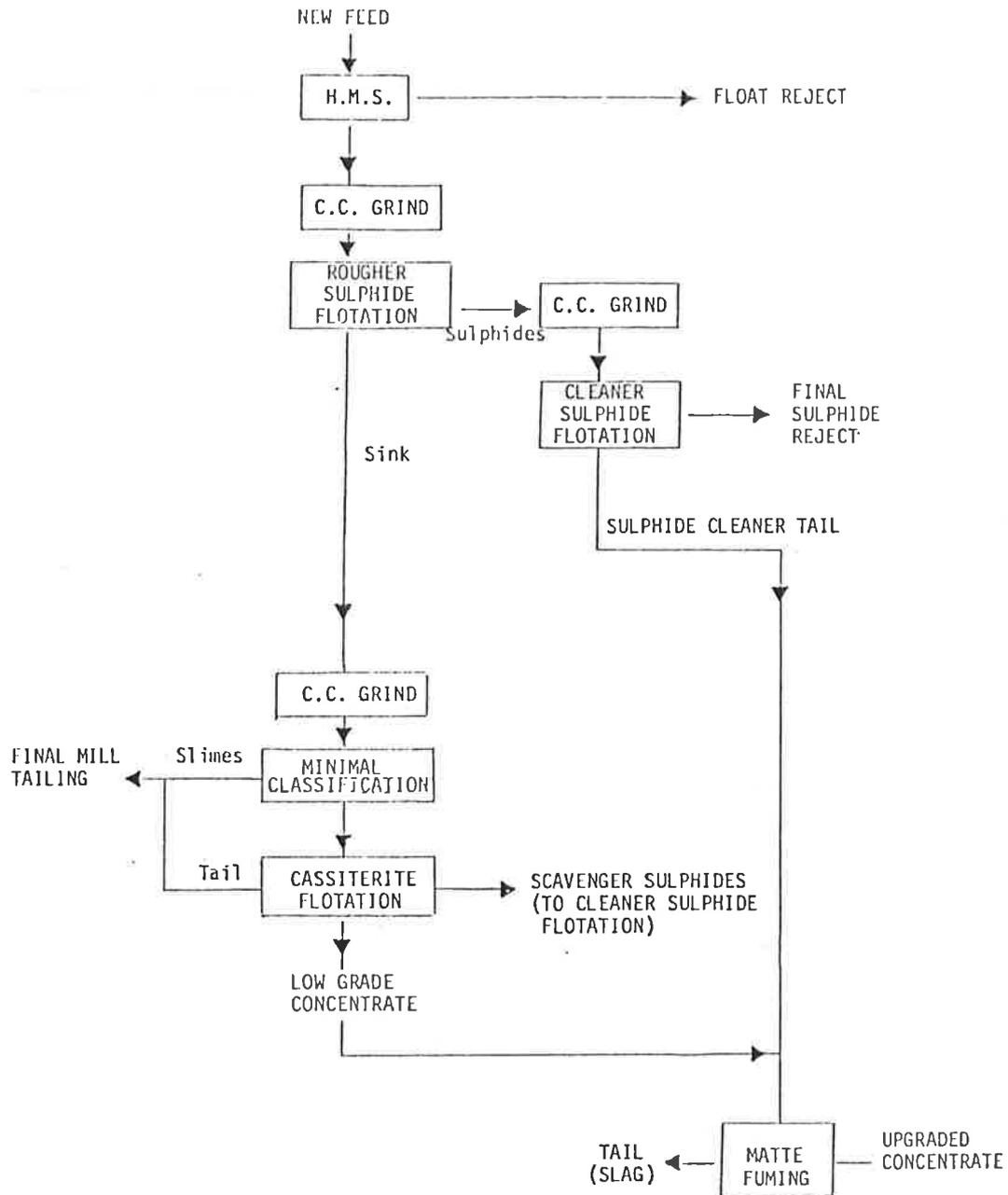


FIGURE 5: FLOWSHEET B -  
 INTEGRATED CIRCUIT WITH LOW-GRADE  
 CONCENTRATE UPGRADING BY MATTE FUMING



**FIGURE 6:** FLOWSHEET C -

ALL FLOTATION CIRCUIT WITH CONCENTRATE  
UPGRADING BY MATTE FUMING

FIGURE 7: OVERALL GRADE/RECOVERY CURVES - CONVENTIONAL PROCESSING (FLOWSHEET A)

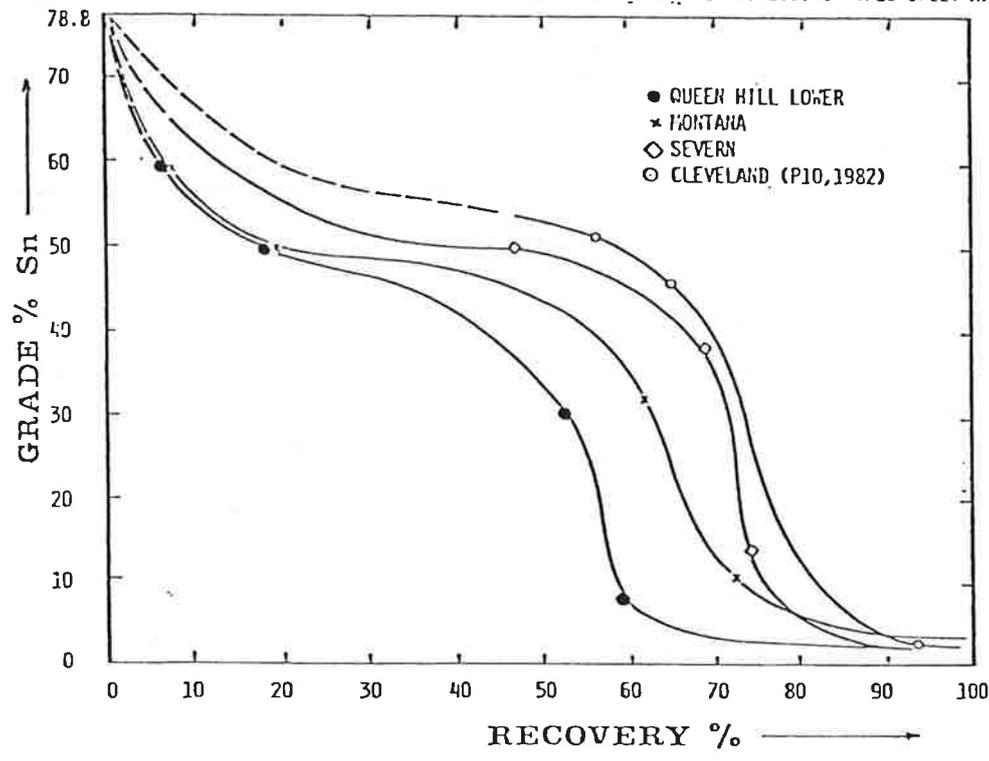
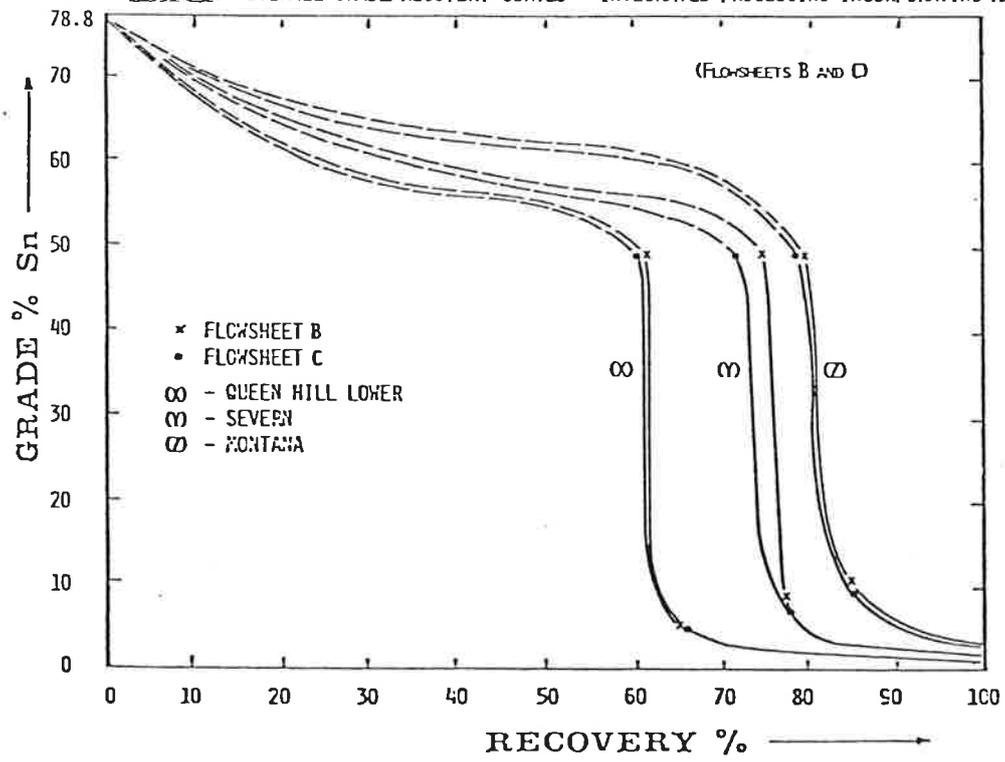


FIGURE 8: OVERALL GRADE/RECOVERY CURVES - INTEGRATED PROCESSING INCORPORATING MATTE FUMING (FLOWSHEETS B AND D)



TABLES 1.1 - 4.6

TABLE 1.1: INFERRED TONNAGES OF ZEEHAN MINERALISED AREAS

Area	Number of Drill Holes	Inferred Tonnage ( $\times 10^6$ tonnes) (% Sn @ 0.1% Sn cut-off)
Queen Hill	55	1.8 (0.8)
Severn	19	5.0 (0.6)
Montana	12	0.5 (1.5)
TOTAL	89*	7.3 (0.7)

\*(The remaining holes have been drilled in the Golf course area)

TABLE 2.1: SUMMARY OF CMS TESTWORK ON ZEEHAN DIAMOND DRILL CORES

MINERALISED AREA	D.D. CORE NO.	LENGTH OF CORE TESTED METRES FROM COLLAR)	TESTWORK PERFORMED *
Queen Hill Lower	G49	115 - 204	1, 2, 3, 4, 5, 6, 7, 8
	G62	200 - 255	1, 2, 3, 4, 5, 6, 8
Severn	G65	202 - 272	1, 2, 3, 4, 5, 6, 8
	G72	275 - 313	1, 2, 3, 4, 5, 6, 8
	G74	345 - 371	2, 3, 4, 7, 8
	G81 L.G.	437 - 441, 454 - 464	1, 2, 3, 4, 5, 6, 8
	G81 H.G.	442 - 453	2, 3, 4, 6, 8
Montana	G78	331 - 352	2, 3, 4, 5, 6, 7, 8
	G67 L.G.	185 - 192, 200 - 207	1, 2, 3, 4, 6, 8
	G67 H.G.	192 - 200	2, 3, 4, 6, 8

\*

1. Heavy liquid analysis
2. Sulphide flotation (-300  $\mu$ m)
3. Release analysis (superpanning)
4. Oxide flotation (-106  $\mu$ m)
5. Grain size analysis
6. Elemental analysis
7. QEM\*SEM
8. Mineralogy of selected products

L.G. Low Grade

H.G. High Grade

TABLE 3.1: WHOLE ROCK AND ELEMENTAL ASSAYS (AMDEL)

(Assays as percentages)									
Element/Compound	G49	G62	G65	G72	G81 L.G.	G81 H.G.	G78	G67 L.G.	G67 H.G.
Sn	0.51	0.73	0.52	0.50	0.34	1.44	1.25	0.07	3.25
S	15.9	18.6	10.3	7.40	6.50	12.8	20.0	1.82	22.4
Co <sub>2</sub>	4.40	4.1	4.00	2.70	3.55	1.60	8.40	25.3	12.1
Total Fe (as Fe <sub>2</sub> O <sub>3</sub> )	16.0	18.1	17.6	17.7	30.7	29.6	30.0	40.7	49.3
SiO <sub>2</sub>	41.8	33.8	39.0	41.6	39.9	41.6	21.6	21.2	14.7
Al <sub>2</sub> O <sub>3</sub>	4.0	4.14	5.29	5.82	10.5	10.5	3.16	0.83	1.93
MnO	0.35	0.27	0.20	0.13	0.17	0.07	0.50	4.58	1.24
MgO	N/A	N/A	N/A	N/A	5.00	2.98	5.98	3.96	1.40
CaO	N/A	N/A	N/A	N/A	0.70	0.47	1.55	0.74	0.45
K <sub>2</sub> O	N/A	N/A	N/A	N/A	1.09	0.13	0.25	0.16	0.15
TiO <sub>2</sub>	0.43	0.71	0.84	1.00	1.64	1.47	0.06	0.04	0.03
F	0.78	0.40	0.22	0.48	N/A	N/A	N/A	N/A	N/A
P	N/A	N/A	N/A	N/A	0.27	0.33	0.035	0.09	0.07
Zn	1.10	0.05	0.01	0.01	N/A	N/A	N/A	N/A	N/A
Loss on ignition	N/A	N/A	N/A	N/A	(9.40)	(7.80)	(20.9)	(9.40)	(25.6)
TOTAL	85.27	85.50	77.98	77.34	100.25	103.44	91.65	99.43	106.95
(Assays in ppm)									
Trace Elements									
Cu	820	310	480	550	N/A	N/A	N/A	N/A	N/A
Co	15	20	30	30	↓	↓	↓	↓	↓
Ni	45	70	85	65	↓	↓	↓	↓	↓
Bi	70	30	20	70	↓	↓	↓	↓	↓
Ag	43	9	3	5	↓	↓	↓	↓	↓
Mo	5	3	3	3	↓	↓	↓	↓	↓
WO <sub>3</sub>	10	20	<10	40	↓	↓	↓	↓	↓
Ta	<10	<10	<10	<10	↓	↓	↓	↓	↓
Nb	32	55	26	28	↓	↓	↓	↓	↓
Sb	90	34	8	6	↓	↓	↓	↓	↓
In	N/D	N/D	N/D	N/D	↓	↓	↓	↓	↓
Ge	2	3	N/D	2	↓	↓	↓	↓	↓
Pd	<0.05	0.10	<0.05	0.1	N/A	<0.05	<0.005	N/A	<0.005
Pt	<0.05	<0.05	<0.05	<0.05	N/A	<0.05	<0.05	N/A	<0.05
Au	0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1	N/A	<0.1

TABLE 3.2: TIN AND SULPHUR HEAD ASSAYS

D.D. Core	% Sn		% S
G49	0.41	(0.49)	15.9
G62	0.62	(0.71)	18.6
G65	0.52	(0.48)	10.3
G72	0.50	(0.48)	7.4
G74	0.57	(0.56)	7.8
G81 L.G.	0.34	(0.38)	6.5
G81 H.G.	1.44	(1.10)	12.8
G78	1.25	(1.15)	20.0
G67 L.G.	0.067	(0.066)	1.82
G67 H.G.	3.25	(3.34)	22.4

TABLE 3.3: GENERAL MINERALOGICAL SUMMARY

	CASSITERITE GRAIN SIZE ( $\mu\text{m}$ )	CASSITERITE ASSOCIATIONS	SULPHIDES	GANGUE
Queen Hill Lower	2-30	Quartz Sericite Carbonate Chlorite	Pyrite Pyrrhotite Sphalerite traces - Galena Arsenopyrite Chalcopyrite Stannite	Quartz Carbonate Chlorite accessory-Sericite trace - Talc
Severn	3-320	Quartz Chlorite Carbonate	Pyrite Pyrrhotite traces - Sphalerite Chalcopyrite	Quartz/clays Chlorite accessory-Talc Sericite, Carbonate Leucoxene - Rutile
Montana	2-40	Carbonate Sellaite	Pyrite Pyrrhotite traces - Stannite Sphalerite Chalcopyrite	Carbonate Sellaite accessory - Quartz Chlorite

Accessory: ~ 1 - 10%

Trace: ~ &lt;1%

TABLE 3.4:

## WEIGHT AND TIN DISTRIBUTION IN THE LEACH RESIDUES

Size (Microns)	% Wt	% Sn	Sn Dist.	Cum % Finer	Size (Microns)	% Wt	% Sn	Sn Dist.	Cum % Finer
<u>G49</u>					<u>G62</u>				
+420	13.8	3.9	5.2	94.8	+420	9.3	5.76	4.2	95.8
+210	8.1	6.8	5.3	89.5	+210	5.8	10.2	4.6	91.2
+105	7.5	10.8	7.5	82.0	+105	7.2	15.9	8.9	82.3
+53	10.9	12.0	12.7	69.3	+53	11.2	17.5	15.2	67.1
+22	9.6	18.6	17.3	52.0	+22	10.7	17.3	14.3	52.8
+17	3.8	27.7	10.2	41.8	+17	4.5	35.4	12.4	40.4
+12	7.8	19.1	14.4	27.4	+12	9.2	21.6	15.4	25.0
+8	6.8	16.6	10.9	16.5	+8	9.3	14.8	10.7	14.3
+5	4.3	13.6	5.7	10.8	+5	6.1	10.3	4.8	9.5
-5	27.4	4.1	10.8	-	-5	26.7	4.57	9.5	-
TOTAL	100.0	(10.3)	100.0			100.0	(12.9)	100.0	
<u>G65</u>					<u>G72</u>				
+420	2.1	37.6	6.6	93.4	+420	1.9	25.6	3.6	96.4
+210	2.3	43.6	8.4	85.0	+210	1.8	45.6	6.2	90.2
+105	4.5	47.6	18.0	67.0	+105	3.4	62.3	15.8	74.4
+53	7.0	43.6	25.7	41.3	+53	7.1	60.3	32.3	42.1
+22	5.0	46.0	19.3	22.0	+22	4.9	56.1	20.5	21.6
+17	2.4	22.5	4.6	17.4	+17				
+12	5.7	10.6	5.1	12.3	+12	5.2	24.0	9.3	12.3
+8	7.8	5.37	3.6	8.7	+8	4.4	8.4	2.8	9.5
+5	7.5	3.46	2.2	6.5	+5	1.8	4.37	0.6	8.9
-5	55.7	1.38	6.5	-	-5	69.5	1.72	8.9	-
TOTAL	100.0	(11.9)	100.0			100.0	(13.4)	100.0	
<u>G81 L.G.</u>					<u>G78</u>				
+420	1.0	74.8	6.6	93.4	+420	11.5	7.32	7.9	92.1
+210	1.4	72.0	8.5	84.9	+210	9.2	7.42	6.4	85.7
+105	2.2	80.4	14.8	70.1	+105	11.7	8.04	8.8	76.9
+53	2.4	75.7	14.9	55.2	+53	17.3	8.82	14.3	62.6
+38	3.1	63.1	16.3	38.9	+38	6.2	10.1	5.9	56.7
+22	1.5	35.3	4.5	34.4	+20	14.2	18.5	24.6	32.1
+17					+10	13.5	10.8	13.6	18.5
+12	4.3	26.1	9.5	24.9	-10	16.4	12.0	18.5	-
+8	8.2	11.6	7.9	17.0					
+5	13.1	3.0	3.3	13.7					
-5	62.8	2.6	13.7	-					
TOTAL	100.0	(11.9)	100.0			100.0	(10.70)	100.0	

CLEVELAND - HALLS

QUEEN HILL UPPER (3)

+420	6.0	1.74	1.8	98.2	+150	4.4	74.1	4.9	95.1
+210	10.7	4.84	9.0	89.2	+75	1.8	74.1	2.0	93.1
+105	22.2	6.00	23.2	66.0	+53	2.2	71.8	2.4	90.7
+53	33.5	5.85	34.1	31.9	+37	2.2	74.1	2.5	88.2
+38	23.8	5.80	24.0	7.9	+30	5.4	74.1	6.0	82.2
-38	3.8	12.00	7.9	-	+20	10.8	74.1	12.1	70.1
					+10	44.5	65.15	43.6	26.5
					-10	28.7	61.18	26.5	-
TOTAL	100.0	(5.75)	100.0			100.0	(66.3)	100.0	

TABLE 3.5:  $D_{50}$  FROM THE NATURAL GRAIN SIZE ANALYSIS

Area	Sample	$D_{50}$ ( $\mu\text{m}$ )
Queen Hill Upper (3)		14
Queen Hill Lower	G49	21
	G62	21
Montana	G78	31
Severn	G81 L.G.	44
	G72	65
	G65	69
Cleveland	Halls	74

TABLE 3.6: % WT, % Sn AND Sn DISTRIBUTION OF 2.96 FLOAT FRACTIONS (+850 MICRONS OVERALL)

Area	Core	% Wt	% Sn	Sn Dist.
Queen Hill lower	G49	23.1	0.08	4.7
	G62	20.1	0.10	3.0
Severn	G65	27.8	0.10	5.5
	G72	21.5	0.12	3.5
	G74	28.0	0.05	2.3
	G81L.G	16.7	0.05	2.1
Montana	G78	5.8	0.22	1.0
Cleveland	Halls	31.9	0.14	7.0

TABLE 3.7: PRECONCENTRATION AT S.G. 2.96 (CORES G49, 62, 65, 72, 74)

Core No.	Wt (g)	Product (S.G.)	% Wt	% Sn	Sn Dist.
G49	8662	2.96F	41.4	0.078	7.8
		2.96S	58.6	0.65	92.2
G62	8068	2.96F	30.9	0.056	2.7
		2.96S	69.1	0.89	97.3
G65	7120	2.96F	39.6	0.06	4.8
		2.96S	60.4	0.78	95.2
G72	7228	2.96F	33.0	0.07	4.2
		2.96S	67.0	0.79	95.8
G74	4336	2.96F	48.0	0.046	3.5
		2.96S	52.0	1.07	96.5
Cleveland S.M.F.		2.96F	48.5	0.13	10.0
		2.96S	51.5	1.10	90.0

TABLE 3.8: SULPHIDE FLOTATION (-300 MICRONS)

Sample	Product	%Wt	%Sn	Sn Dist	%S	S Dist	Sample	%Wt	%Sn	Sn Dist	%S	S Dist	Sn Dist	%S	S Dist	
G49	S.Con 1	38.4	0.30	17.6	42.6	71.9	681 L.G.	20.2	0.40	22.8	29.9	85.2	22.8	29.9	85.2	
	S.Con 2	14.3	0.40	8.8	34.6	21.8		5.0	0.52	7.3	15.6	11.0	11.0	7.3	15.6	11.0
	Scav. Con	5.6	0.78	6.7	16.8	4.1		1.1	0.41	1.3	4.7	0.7	0.7	1.3	4.7	0.7
	Sink	41.7	1.05	66.9	1.2	2.2		73.7	0.33	68.6	0.3	3.1	3.1	68.6	0.3	3.1
	TOTAL	100.0	(0.65)	100.0	(22.7)	100.0		100.0	(0.35)	100.0	(7.0)	100.0		(7.0)	100.0	
G62	S.Con 1	29.2	0.38	12.4	47.1	59.4	681 H.G.	51.0	0.60	32.6	30.6	83.7	32.6	30.6	83.7	
	S.Con 2	16.1	0.62	11.2	40.1	27.9		12.8	1.08	13.8	17.9	12.3	12.3	13.8	17.9	12.3
	Scav. Con	7.0	1.20	9.5	24.7	7.5		4.6	1.30	6.4	(6.0)	1.5	1.5	6.4	(6.0)	1.5
	Sink	47.0	1.25	66.9	2.5	5.2		31.6	1.40	47.2	1.5	2.5	2.5	47.2	1.5	2.5
	TOTAL	100.0	(0.89)	100.0	(23.1)	100.0		100.0	(0.94)	100.0	(18.6)	100.0		(18.6)	100.0	
G65	S.Con 1	20.1	0.24	6.2	38.6	59.6	678	26.9	0.40	8.4	40.5	61.2	8.4	40.5	61.2	
	S.Con 2	11.1	0.48	6.8	34.6	29.4		12.9	0.44	4.4	39.8	28.8	4.4	39.8	28.8	
	Scav. Con	5.6	0.89	6.4	20.9	9.0		6.4	1.08	5.4	22.9	8.2	5.4	22.9	8.2	
	Sink	63.2	0.99	88.6	0.4	2.0		53.8	1.95	81.8	0.6	1.8	1.8	81.8	0.6	1.8
	TOTAL	100.0	(0.78)	100.0	(13.0)	100.0		100.0	(1.28)	100.0	(17.8)	100.0		(17.8)	100.0	
G72	S.Con 1	13.7	0.14	2.4	40.3	43.5	667 L.G.	12.9	0.10	17.1	19.5	83.7	17.1	19.5	83.7	
	S.Con 2	7.9	0.25	2.5	31.8	19.8		4.2	0.11	6.1	7.7	10.8	6.1	7.7	10.8	
	Scav. Con	12.4	0.59	9.3	20.0	19.7		82.9	0.07	76.8	0.2	5.5	5.5	76.8	0.2	5.5
	Sink	72.0	0.94	85.8	3.0	17.0										
	TOTAL	100.0	(0.79)	100.0	(12.7)	100.0		100.0	(0.08)	100.0	(3.0)	100.0		(3.0)	100.0	
G74	S.Con 1	14.1	0.25	3.7	46.3	53.7	667 H.G.	45.0	1.35	19.8	34.9	93.0	19.8	34.9	93.0	
	S.Con 2	10.3	0.50	5.4	41.4	35.1		6.9	2.95	6.6	7.4	3.0	6.6	7.4	3.0	
	Scav. Con	5.1	0.40	2.1	16.8	7.1		1.8	4.40	2.6	6.3	0.7	2.6	6.3	0.7	
	Sink	70.5	1.21	88.8	0.7	4.1		46.3	4.70	71.0	1.2	3.3	3.3	71.0	1.2	3.3
	TOTAL	100.0	(0.96)	100.0	(12.1)	100.0		100.0	(3.07)	100.0	(16.9)	100.0		(16.9)	100.0	

TABLE 3.9: CUMULATIVE SUPERPANNING GRADE/RECOVERY RESULTS

PRODUCT	$\%Sn$ Sn Dist.		$\%Sn$ Sn Dist.		$\%Sn$ Sn Dist.	
	G49		G62		G65	
C <sub>1</sub>	31.6	31.9	39.4	43.2	46.8	68.7
C <sub>1</sub> + C <sub>2</sub>	19.9	40.6	23.6	59.9	23.2	72.6
C <sub>1</sub> + C <sub>2</sub> + C <sub>3</sub>	12.9	45.1	13.4	65.8	11.1	74.8
Tails	0.64	37.6	0.45	22.4	0.23	12.1
Slimes	0.67	17.3	0.86	11.8	0.35	13.1
	G72		G74		G81 L.G.	
C <sub>1</sub>	40.8	51.5	56.9	58.3	25.3	55.8
C <sub>1</sub> + C <sub>2</sub>	24.8	63.6	31.9	74.6	9.4	62.2
C <sub>1</sub> + C <sub>2</sub> + C <sub>3</sub>	12.0	67.8	18.1	78.7	2.7	73.0
Tails	0.27	17.9	0.26	11.5	0.08	14.4
Slimes	0.56	14.3	0.56	9.8	0.20	12.6
	G81 H.G.		G78			
C <sub>1</sub>	57.6	35.5	52.7	25.2		
C <sub>1</sub> + C <sub>2</sub>	37.8	45.5	33.5	31.3		
C <sub>1</sub> + C <sub>2</sub> + C <sub>3</sub>	5.5	60.5	17.4	40.8		
Tails	0.24	8.6	1.15	42.3		
Slimes	0.84	15.8	1.14	16.9		
	G67 H.G.					
C <sub>1</sub>	42.5	24.4				
C <sub>1</sub> + C <sub>2</sub>	31.9	37.2				
C <sub>1</sub> + C <sub>2</sub> + C <sub>3</sub>	18.8	52.6				
C <sub>1</sub> + C <sub>2</sub> + C <sub>3</sub> + C <sub>4</sub>	8.0	77.3				
Tails	0.80	4.8				
Slimes	2.86	17.9				

TABLE 3.10 SUPERPANNING STAGE RECOVERIES AT 50% Sn GRADE

Area	Core	Stage Recovery
Queen Hill Lower	G49	17.5
	G62	28.7
Severn	G65	65.0
	G72	35.6
	G74	69.5
	G81 H.G.	40.6
Montana	G78	25.6
	G67H.G.	18.0
Cleveland Standard Mill Feed (P.11, 1981)		70.4

PRODUCT	G49			G62			G65		
	%Wt	%Sn	Sn Dist	%Wt	%Sn	Sn Dist	%Wt	%Sn	Sn Dist
Sulphide Con	5.5	1.16	4.0	13.0	1.56	8.6	2.1	1.10	1.3
Oxide Con 1	0.5	23.10	7.0	1.6	36.90	24.6	0.8	20.70	9.7
2	0.3	20.60	3.2	3.0	18.40	23.9	1.9	14.60	16.2
3	0.7	11.40	5.1	1.1	11.40	5.5	1.5	16.55	14.4
4	4.5	8.92	25.3	8.5	6.44	23.4	1.1	13.70	9.6
5	20.6	3.26	42.6	10.8	1.30	6.0	12.8	5.37	41.5
Tail	67.9	0.30	12.8	62.0	0.30	8.0	79.9	0.15	7.3
TOTAL	100.0	(1.59)	100.0	100.0	(2.33)	100.0	100.0	(1.65)	100.0
	G72			G74			G81 L.G.		
Sulphide Con	4.6	0.35	1.2	Overall Results N/A			2.3	0.58	3.0
Oxide Con 1	1.7	15.50	19.6				5.8	4.70	62.3
2	1.1	14.50	12.1				8.0	0.96	17.5
3	9.4	7.99	57.6				6.0	0.39	5.3
4							7.0	0.14	2.2
Tail	83.2	0.15	9.5				70.9	0.06	9.7
TOTAL	100.0	(1.31)	100.0				100.0	(0.44)	100.0
	G81 H.G.			G78			G67 H.G.		
Sulphide Con	4.5	1.75	3.6	2.5	1.15	1.0	7.6	7.85	10.9
Oxide Con 1	13.4	12.00	74.1	1.7	12.50	10.0	25.6	13.40	62.6
2	4.0	4.20	7.7	2.8	13.00	17.3	21.5	3.45	13.6
3	4.2	1.6	3.1	4.3	6.80	13.9	19.5	2.50	8.9
4	8.7	0.92	3.7	22.2	2.45	26.0	2.5	1.70	0.8
Tail	65.2	0.28	7.8	66.5	1.00	31.8	23.3	0.74	3.2
TOTAL	100.0	(2.17)	100.0	100.0	(2.09)	100.0	100.0	(5.47)	100.0

TABLE 3.12: WEIGHT, ASSAYS AND DISTRIBUTIONS OF SAMPLES GROUND -106 MICRONS (AFTER DESLIMING)

CORE	PRODUCT (+/- 5 microns)	%WT	%SN	SN DIST	DESLIMING METHOD
G49	+	52.3	1.59	84.1	Cyclosizer
	-	47.7	0.33	15.9	
	TOTAL	100.0	(0.99)	100.0	
G62	+	56.6	2.33	91.6	
	-	43.4	0.28	8.4	
	TOTAL	100.0	(1.44)	100.0	
G65	+	58.0	1.65	89.4	
	-	42.0	0.27	10.6	
	TOTAL	100.0	(1.07)	100.0	
G72	+	64.2	1.31	92.1	
	-	35.8	0.20	7.9	
	TOTAL	100.0	(0.91)	100.0	
G81 HG	+	67.7	2.17	86.4	Decantation
	-	32.3	0.72	13.6	
	TOTAL	100.0	(1.70)	100.0	
G78	+	76.8	2.09	89.2	
	-	23.2	0.84	10.8	
	TOTAL	100.0	(1.80)	100.0	
G67 HG	+	74.9	5.47	87.2	
	-	25.1	2.40	12.8	
	TOTAL	100.0	4.70	100.0	

TABLE 4.1:

## MASS BALANCES - FLOWSHEET A

FLOWSHEET A (as given in Figure 4)	QUEEN HILL LOWER		SEVERN				MONTANA	
	G49	G62	G65	G72	G74	G81 Comb.	G78	G67H.G.
FEED	(100.0) 0.41 [100.0]	(100.0) 0.63 [100.0]	(100.0) 0.49 [100.0]	(100.0) 0.55 [100.0]	(100.0) 0.58 [100.0]	(100.0) 0.82 [100.0]	(100.0) 1.25 [100.0]	(100.0) 3.25 [100.0]
HEAVY MEDIA FLOAT REJECT	(41.4) 0.078 [7.8]	(30.9) 0.056 [2.7]	(39.6) 0.06 [4.8]	(33.0) 0.07 [4.2]	(48.0) 0.046 [3.5]			
SINK	(58.6) 0.65 [92.2]	(69.1) 0.89 [97.3]	(60.4) 0.78 [95.2]	(67.0) 0.79 [95.8]	(52.0) 1.07 [96.5]			
FINAL SULPHIDE REJECT	(27.3) 0.25 [16.6]	(29.3) 0.36 [16.6]	(17.8) 0.27 [9.7]	(15.0) 0.26 [7.1]	(12.3) 0.37 [7.9]	(31.7) 0.52 [20.1]	(37.0) 0.30 [9.0]	(53.7) 1.66 [27.4]
SINK	(31.3) 0.99 [75.6]	(39.8) 1.27 [80.7]	(42.6) 0.98 [85.5]	(52.0) 0.94 [88.7]	(39.7) 1.29 [88.6]	(68.3) 0.96 [79.9]	(63.0) 1.81 [91.0]	(46.3) 5.10 [72.6]
GRAVITY CONCENTRATE	(0.11) 50 [13.2]	(0.28) 50 [22.6]	(0.54) 50 [55.6]	(0.35) 50 [31.5]	(0.71) 50 [61.6]	(0.61) 50 [37.0]	(0.58) 50 [23.3]	(0.85) 50 [13.1]
TAIL	(31.19) 0.82 [62.4]	(39.52) 0.93 [58.1]	(42.06) 0.35 [29.9]	(51.65) 0.61 [57.2]	(38.99) 0.40 [27.0]	(67.69) 0.52 [42.9]	(62.42) 1.36 [67.7]	(45.45) 4.25 [59.5]
SLIMES	(13.94) 0.27 [9.3]	(17.15) 0.18 [8.4]	(17.66) 0.11 [3.9]	(18.5) 0.13 [4.4]	(15.17) 0.12* [3.2]	(26.34) 0.16* [5.1]	(14.48) 0.63 [10.7]	(11.41) 2.17 [7.6]
CASSITERITE FLOT. FEED	(17.25) 1.26 [53.1]	(22.37) 1.40 [49.7]	(24.40) 0.52 [26.0]	(33.15) 0.88 [52.8]	(23.82) 0.58 [23.8]	(41.35) 0.75 [37.8]	(47.94) 1.49 [57.0]	(34.04) 4.96 [51.9]
FLOTATION CONCENTRATE	(3.52) 5.0 [43.0]	(5.23) 5.0 [41.5]	(1.86) 5.0 [19.1]	(4.99) 5.0 [45.2]	(2.11) 5.0 [18.2]	(5.12) 5.0 [31.2]	(12.14) 5.0 [48.4]	(15.51) 10.0 [47.7]
FLOTATION TAIL	(13.73) 0.30 [10.1]	(17.14) 0.30 [8.2]	(22.54) 0.15 [6.9]	(28.16) 0.15 [7.6]	(21.71) 0.15 [5.6]	(36.23) 0.15 [6.6]	(35.80) 0.30 [8.6]	(18.53) 0.74 [4.2]
UPGRADED FLOTATION CONCENTRATE	(0.59) 25.0 [35.8]	(0.87) 25.0 [34.6]	(0.31) 25.0 [15.9]	(0.83) 25.0 [37.7]	(0.35) 25.0 [15.2]	(0.85) 25.0 [26.0]	(2.02) 25.0 [40.3]	(4.91) 30.0 [45.5]
COMBINED TAIL	(30.60) 0.36 [26.6]	(38.65) 0.38 [23.5]	(41.75) 0.16 [14.0]	(50.82) 0.19 [19.5]	(38.64) 0.18 [11.8]	(66.84) 0.21 [16.9]	(60.40) 0.57 [27.4]	(39.53) 1.49 [14.0]
COMBINED CONCENTRATE	(0.70) 28.7 [49.0]	(1.15) 31.3 [57.2]	(0.85) 41.2 [71.5]	(1.18) 32.2 [69.2]	(1.06) 42.0 [76.8]	(1.46) 35.4 [63.0]	(2.6) 30.6 [63.6]	(5.76) 33.1 58.6]

Legend: (% Weight)  
% Sn  
[% Distribution]

\* [Taken as 0.3 x the feed grade]

TABLE 4.2:

MASS BALANCE - FLOWSHEET B

FLOWSHEET B (as given in Figure 5)	QUEEN HILL LOWER		SEVERN				MONTANA	
	G49	G62	G65	G72	G74	G81 Comb.	G78	G67 H.G.
FEED	(100.0) 0.41 [100.0]	(100.0) 0.63 [100.0]	(100.0) 0.49 [100.0]	(100.0) 0.55 [100.0]	(100.0) 0.58 [100.0]	(100.0) 0.82 [100.0]	(100.0) 1.25 [100.0]	(100.0) 3.25 [100.0]
HEAVY MEDIA FLOAT REJECT	(41.4) 0.078 [7.8]	(30.9) 0.056 [2.7]	(39.6) 0.06 [4.8]	(33.0) 0.07 [4.2]	(48.0) 0.046 [3.5]			
SINK	(58.6) 0.65 [92.2]	(69.1) 0.89 [97.3]	(60.4) 0.78 [95.2]	(67.0) 0.79 [95.8]	(52.0) 1.07 [96.5]			
ROUGHER (Ro) SULPHIDES	(34.2) 0.37 [30.5]	(36.6) 0.56 [32.4]	(22.2) 0.41 [19.3]	(18.8) 0.40 [13.6]	(15.3) 0.54 [14.4]	(44.8) 0.85 [46.5]	(46.2) 0.44 [16.1]	(53.7) 1.76 [29.0]
SINK	(24.4) 1.04 [61.7]	(32.5) 1.25 [64.8]	(38.2) 0.97 [75.9]	(48.2) 0.94 [82.2]	(36.7) 1.30 [82.1]	(55.2) 0.79 [53.5]	(53.8) 1.95 [83.9]	(46.3) 4.98 [71.0]
GRAVITY CONCENTRATE	(0.09) 50 [10.8]	(0.23) 50 [18.1]	(0.48) 50 [49.4]	(0.32) 50 [29.2]	(0.66) 50 [57.1]	(0.41) 50 [24.8]	(0.54) 50 [21.5]	(0.83) 50 [12.8]
TAIL	(24.31) 0.86 [50.9]	(32.27) 0.91 [46.7]	(37.72) 0.34 [26.5]	(47.88) 0.61 [53.0]	(36.04) 0.40 [25.0]	(54.79) 0.43 [28.7]	(53.26) 1.46 [62.4]	(45.47) 4.16 [58.2]
SCAVENGER (Sc) SULPHIDES	(2.43) 0.69 [4.1]	(4.49) 1.03 [7.3]	(1.96) 0.46 [1.9]	(3.21) 0.32 [1.9]	(2.14) 0.39 [1.4]	(1.57) 0.62 [1.2]	(1.30) 1.15 [1.2]	(3.46) 5.97 [6.4]
SINK	(21.88) 0.88 [46.8]	(27.78) 0.89 [39.4]	(35.76) 0.34 [24.6]	(44.67) 0.63 [51.1]	(33.90) 0.40 [23.6]	(53.22) 0.42 [27.5]	(51.96) 1.47 [61.2]	(42.01) 4.01 [51.8]
FLOTATION CONCENTRATE	(1.38) 10 [31.8]	(1.69) 10 [26.9]	(0.70) 10 [14.0]	(2.18) 10 [39.5]	(0.86) 10 [15.0]	(1.46) 10 [17.9]	(6.27) 10 [50.2]	(14.79) 10 [45.6]
FLOTATION TAIL	(20.50) 0.30 [15.0]	(26.09) 0.30 [12.5]	(35.06) 0.15 [10.6]	(42.49) 0.15 [11.6]	(33.04) 0.15 [8.6]	(51.76) 0.15 [9.6]	(45.69) 0.30 [11.0]	(27.22) 0.74 [6.2]
SULPHIDE CLEANER FLOT. FEED (Ro & Sc SULPHIDES)	(36.63) 0.39 [34.6]	(41.09) 0.61 [39.7]	(24.16) 0.43 [21.2]	(22.01) 0.39 [15.5]	(17.44) 0.52 [15.8]	(46.37) 0.84 [47.7]	(47.50) 0.46 [17.3]	(57.16) 2.01 [35.4]
FINAL SULPHIDE REJECT	(31.13) 0.19 [14.7]	(34.92) 0.30 [16.5]	(20.54) 0.20 [10.1]	(18.71) 0.19 [6.6]	(14.82) 0.25 [6.3]	(39.41) 0.30 [14.5]	(40.40) 0.27 [8.8]	(48.59) 0.3 [4.5]
SULPHIDE CLEANER TAIL	(5.50) 1.5 [19.9]	(6.17) 2.37 [23.2]	(3.62) 1.5 [11.1]	(3.30) 1.5 [8.9]	(2.62) 2.1 [9.5]	(6.97) 3.9 [33.2]	(7.10) 1.5 [8.5]	(8.57) 11.7 [30.9]
MATTE FUMING FEED (FLOT.CON. & SULPHIDE CLEANER TAIL)	(6.88) 3.08 [51.7]	(7.86) 4.0 [50.1]	(4.32) 2.8 [25.1]	(5.48) 4.86 [48.4]	(3.48) 4.08 [24.5]	(8.42) 4.97 [51.1]	(13.37) 5.49 [58.7]	(23.36) 10.6 [76.5]
MATTE FUMING CONCENTRATE	(0.39) 50 [47.6]	(0.58) 50 [46.1]	(0.23) 50 [23.1]	(0.49) 50 [44.5]	(0.26) 50 [22.5]	(0.77) 50 [47.0]	(1.35) 50 [54.0]	(4.58) 50 [70.4]
COMBINED CONCENTRATE	(0.48) 50 [58.4]	(0.81) 50 [64.2]	(0.71) 50 [72.5]	(0.81) 50 [73.7]	(0.92) 50 [80.5]	(1.18) 50 [71.8]	(1.89) 50 [75.5]	(5.41) 50 [83.3]

Legend: (% Weight)  
% Sn  
[% Distribution]

TABLE 4.3:

MASS BALANCE - FLOWSHEET C

FLOWSHEET C (as given in Figure 6)	QUEEN HILL LOWER		SEVERN				MONTANA	
	G49	G62	G65	G72	G74	G81	G78	G67 L.G.
FEED	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
	0.41	0.63	0.49	0.55	0.58	0.82	1.25	3.25
	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]
HEAVY MEDIA FLOAT REJECT	(41.4)	(30.9)	(39.6)	(33.0)	(48.0)			
	0.078	0.056	0.06	0.07	0.046			
	[7.8]	[2.7]	[4.8]	[4.2]	[3.5]			
SINK	(58.6)	(69.1)	(60.4)	(67.0)	(52.0)			
	0.65	0.89	0.78	0.79	1.07			
	[92.2]	[97.3]	[95.2]	[95.8]	[96.5]			
ROUGHER (Ro) SULPHIDES	(34.2)	(36.6)	(22.2)	(18.8)	(15.3)	(44.8)	(46.2)	(53.7)
	0.37	0.56	0.41	0.40	0.54	0.85	0.44	1.76
	[30.5]	[32.4]	[19.3]	[13.6]	[14.4]	[46.5]	[16.1]	[29.0]
SINK	(24.4)	(32.5)	(38.2)	(48.2)	(36.7)	(55.2)	(53.8)	(46.3)
	1.04	1.25	0.97	0.94	1.30	0.79	1.95	4.98
	[61.7]	[64.8]	[75.9]	[82.2]	[82.1]	[53.5]	[83.9]	[71.0]
SCAVENGER (Sc) SULPHIDES	(2.44)	(4.52)	(1.99)	(3.23)	(2.18)	(1.58)	(1.35)	(3.52)
	0.69	1.03	0.46	0.32	0.39	0.82	1.15	7.15
	[4.0]	[7.4]	[1.5]	[1.9]	[1.5]	[1.6]	[1.2]	[7.7]
SINK	(21.96)	(27.98)	(36.21)	(44.97)	(34.52)	(53.62)	(52.45)	(42.78)
	1.07	1.29	1.01	0.98	1.35	0.79	1.97	4.8
	[57.7]	[57.4]	[74.4]	[80.4]	[80.6]	[51.9]	[82.7]	[63.3]
FLOTATION CONCENTRATE	(1.74)	(2.86)	(3.16)	(3.79)	(4.21)	(3.48)	(9.03)	(18.76)
	10	10	10	10	10	10	10	10
	[42.8]	[45.4]	[64.3]	[69.1]	[72.7]	[42.7]	[72.3]	[57.8]
FLOTATION TAIL	(20.22)	(25.12)	(33.05)	(41.18)	(30.31)	(50.14)	(43.42)	(24.02)
	0.30	0.30	0.15	0.15	0.15	0.15	0.30	0.74
	[14.9]	[12.0]	[10.1]	[11.3]	[7.9]	[9.2]	[10.4]	[5.5]
SULPHIDE CLEANER FLOT. FEED (Ro & Sc SULPHIDES)	(36.64)	(41.12)	(24.19)	(22.03)	(17.48)	(46.38)	(47.55)	(57.22)
	0.39	0.61	0.42	0.39	0.53	0.85	0.45	2.08
	[34.5]	[39.8]	[20.8]	[15.5]	[15.9]	[48.1]	[17.3]	[36.7]
FINAL SULPHIDE REJECT	(31.14)	(34.95)	(20.56)	(18.73)	(14.86)	(39.42)	(40.42)	(48.04)
	0.19	0.3	0.23	0.19	0.25	0.30	0.27	0.3
	[14.6]	[16.6]	[9.7]	[6.6]	[6.4]	[14.4]	[8.6]	[4.5]
SULPHIDE CLEANER TAIL	(5.50)	(6.17)	(3.63)	(3.30)	(2.62)	(6.96)	(7.13)	(8.58)
	1.5	2.37	1.5	1.5	2.1	3.97	1.5	12.0
	[19.9]	[23.2]	[11.1]	[8.9]	[9.5]	[33.7]	[8.7]	[32.2]
MATTE FUMING FEED (FLOT. CON & SULPHIDE CLEANER TAIL)	(7.24)	(9.03)	(6.79)	(7.09)	(6.83)	(10.44)	(16.16)	(27.34)
	3.55	4.78	5.44	6.05	6.98	6.00	6.26	10.7
	[62.70]	[68.6]	[75.4]	[78.0]	[82.2]	[76.4]	[81.0]	[90]
MATTE FUMING CONCENTRATE	(0.47)	(0.79)	(0.68)	(0.79)	(0.85)	(1.15)	(1.86)	(5.4)
	50	50	50	50	50	50	50	50
	[57.7]	[63.1]	[69.4]	[71.8]	[75.6]	[70.3]	[74.5]	[82.8]

Legend:

(% Weight)  
% Sn  
[% Distribution]

Area	Core No.	FLOWSHEET					
		A Recovery/Overall Grade		B Recovery/Overall Grade		C Recovery/Overall Grade	
Queen Hill Lower	G49	49	29	58	50	58	40
	G62	57	31	64	50	63	50
Severn	G65	71	41	73	50	69	50
	G72	69	32	74	50	72	50
	G74	77	42	80	50	76	50
	G81 (comb.)	63	35	72	50	70	50
Montana	G78	64	30	75	50	75	50
	G67 H.G.	59	33	83	50	83	50

Flowsheet A Conventional (Complex tin ore milling circuit)

Flowsheet B Gravity, low grade flotation as preconcentration with upgrading by Matte Fuming

Flowsheet C Low grade flotation as preconcentration with upgrading by Matte Fuming

TABLE 4.5: RECOVERIES OBTAINED FOR EACH AREA

AREA	FLOWSHEET		
	A	B	C
Queen Hill Lower	48-57 (29-31)	58-64 (50)	58-63 (50)
Severn	63-76 (32-42)	72-80 (50)	69-76 (50)
Montana	59-64 (30-33)	75-83 (50)	75-83 (50)
Cleveland P.10 1982 (6)	65.5 (46.2)		

[The range given is the highest and lowest for each area and the grades achieved (% Sn) are given in brackets].

TABLE 4.6: RELATIVE PROPORTION OF FEED TO FUMING (AS % OF NEW FEED)

Core	Flowsheet (b)	Flowsheet (c)	% Increase (c)/(b)
G49	6.88	7.24	5.2
G62	7.86	9.03	14.5
G65	4.32	6.79	57.1
G72	5.48	7.09	29.4
G74	3.48	6.83	96.2
G81 COMB	8.42	10.44	24.0
G78	13.37	16.16	20.9
G78 H.G.	23.36	27.30	16.9

APPENDIX I

APPENDIX I  
TESTWORK PROCEDURES

Head Analysis

Head and whole rock analyses were performed at AMDEL. In addition 2 kilograms of sample were submitted for natural grain size analysis by acid dissolution.

The sample is first leached with hydrofluoric acid to remove the silicates, and then with nitric acid to remove the sulphides. The leach residue is then screened (and cyclonized) and each size fraction assayed to give a size/assay distribution, and mineralogically examined to complete the natural cassiterite grain size analysis.

Heavy Liquid Analysis

A sample of the crushed (-3.35 mm) core was subjected to a standard heavy liquid wash - sized fractions (to 45 microns) were tested in liquid S.G.'s of 2.80, 2.96 and 3.31. The distribution of weight and assays at each liquid S.G. indicates component mineral liberation characteristics. The higher the weight and the lower the assay at the lighter S.G.'s, the greater the potential of barren waste rejection by heavy media separation (H.M.S.).

Sulphide Flotation

Sulphide flotation tests were performed on the samples ground in closed circuit to minus 300 microns. The procedures involve conditioning the pulp for a standard time with copper sulphate for sulphide activation, and a combination of Sodium Ethyl Xanthate (S.E.X.) and Potassium Amyl Xanthate (P.A.X.) for sulphide collection. Standard quantities of frothers (M.I.B.C./A.F.65) are added before timed sulphide concentrates are floated. Other standard factors are the % Solids and pH of the pulp.

Release Analysis

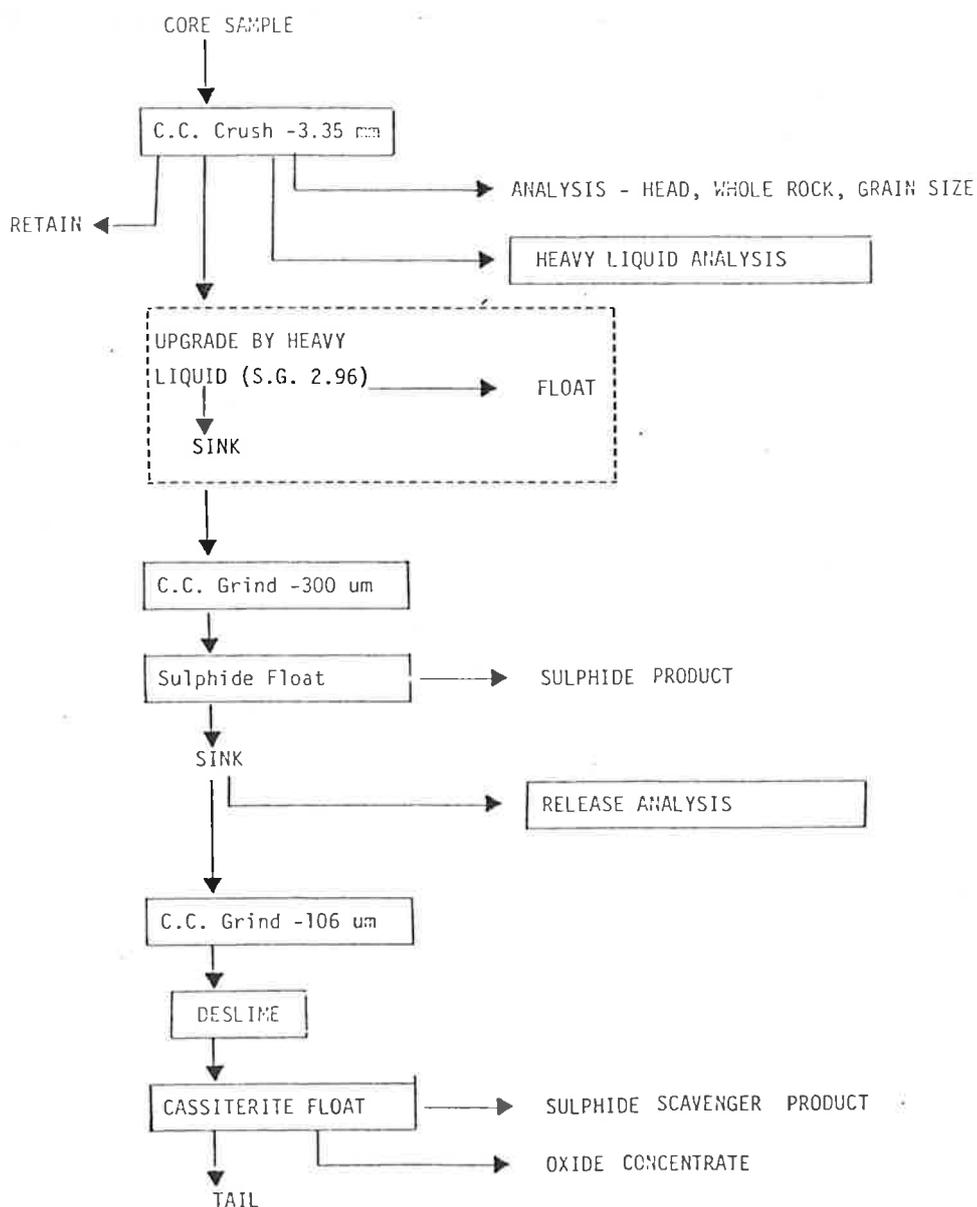
A sample of the sulphide sink was subjected to a release analysis by superpanning. This studies the liberation characteristics of the sample and indicates grades and recoveries attainable by gravity separation techniques.

/Cont'd ...

### Cassiterite Flotation

Cassiterite flotation tests were performed on the samples ground in closed circuit to minus 106 microns. The procedures involve a sulphide scavenging step prior to conditioning the pulp for a standard time with sulpho-phosphonic acid (S.P.A.) for cassiterite collection and sodium silica fluoride (S.S.F.) for gangue depression. Standard quantities of frothers (M.I.B.C./A.F.65) are added before the cassiterite concentrators are floated. Other standard factors are the % Solids and pH of the pulp.

#### GENERAL TEST PROCEDURES FOR ZEEHAN DRILL CORES



APPENDIX II



The Australian  
Development  
Laboratories

Street: FICA, 6  
Adelaide 5063  
Adelaide 79 1662  
Telex: AA 62520

Please address all  
correspondence to  
Box 114 Eastwood  
SA 5063  
In reply quote

# amdel

23 December, 1981.

GS 3/43/3/0

Aberfoyle Services Pty. Ltd.,  
Central Metallurgical Services,  
P.O. Box 952,  
BURNIE. TAS. 7320

Attention: Mr. N.E. Mooney

REPORT GS 725/82 Part 11

YOUR REFERENCE: Phone call of 26/10/81

MATERIAL: Six tin-bearing samples

IDENTIFICATION: Mt. Eischoff (7.009/SN6416 and 6417), Queen Hill  
(4.003/SN/6418 and 6420) and Severn (7.003/SN/  
6422 and 6424)

DATE RECEIVED: 26/10/81

WORK REQUIRED: Detailed mineralogy of the sized leach residues  
produced for GS 725/81 dated 23 October 1981  
and further sizing of the -38 $\mu$ m fractions of  
the residues.

Investigation and Report by: Michael Till and Helen Brown

Chief - Geological Services Section: Dr. Keith J. Henley  
Manager, Mineral and Materials Sciences Division: Dr. William G. Spencer

*Keith Henley*

for Norton Jackson,  
Managing Director.

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Thebarton S.A.  
Telephone 43 8083

Branch Laboratories  
Forth W.A.  
Telephone 325 7311

Mt. Bourne Vic  
Telephone 645 3083

88/10

- 4 -

<u>-36+102E</u>		
Cassiterite	10-20	anhedral equant yellowish brown crystals.
Topaz	30-40	angular fragments.
Zircon	20-30	anhedral grains.
Tourmaline	5-10	light brown and blue/green elongated crystals.
Sellaite	5-10	

Queen Hill G49 (4.003/SN/6418)

A visual estimate of the constituents is as follows:

<u>+4202E</u>		
Cassiterite	trace-1	clusters of smaller dark brown crystals.
Topaz	99-100	light grey to milky white clusters of crystals.
<u>-420+2102E</u>		
Cassiterite	5	clusters of small light brown crystals.
Topaz	95	anhedral grains with abundant inclusions.
Fluorite	trace	
<u>-210+1052E</u>		
Cassiterite	2-3	separate anhedral to subhedral light brown crystals.
Topaz	90-95	anhedral grains with abundant inclusions.
Zircon	2-3	
Opagues	trace	
<u>-105+532E</u>		
Cassiterite	5	separate anhedral to subhedral yellowish brown crystals, with minor clusters of subhedral crystals.
Topaz	90-95	anhedral grains or clusters of grains, most with abundant inclusions.
Zircon	2-3	euhedral stubby to prismatic crystals.
Sellaite	2-3	angular fragments.
<u>-53+382E</u>		
Cassiterite	20-30	equant separate yellowish brown crystals, clusters of smaller crystals, and minor elongated crystals.
Topaz	60-70	anhedral to subhedral grains and clusters of grains with abundant inclusions.
Zircon	5	prismatic crystals.
Fluorite	trace	
Tourmaline	trace	brown subhedral crystals.

- 5 -

<u>-36+20.0</u>		
Cassiterite	20-25	clusters of small crystals, with lesser amounts of separate equant dark yellowish brown crystals.
Topaz	40-50	anhedral grains with abundant inclusions.
Zircon	15-20	subhedral to prismatic euhedral crystals.
Sellaite	10-15	anhedral grains.
<u>-20.00</u>		
Cassiterite	10-15	clusters of equant to prismatic dark yellowish brown crystals.
Topaz	75-80	angular fragments and anhedral grains with abundant inclusions.
Zircon	5-10	anhedral to prismatic subhedral crystals.
Tourmaline	2-3	light brown anhedral grains.

62 ✓  
Queen Hill G. (4.003/SN/6420)

A visual estimate of the constituents is as follows:

<u>+420.00</u>		
Cassiterite	30-35	clusters of small equant and prismatic dark brown crystals, with minor compact anhedral grains.
Topaz	60-70	clusters of smaller crystals.
Sellaite	2-3	anhedral grains.
<u>-420+210.00</u>		
Cassiterite	10-15	clusters of small equant and prismatic light orange brown crystals in a radiating form.
Topaz	80-85	
Zircon	5	slender prismatic crystals
<u>-210+105.00</u>		
Cassiterite	35-40	clusters of small orange brown crystals, usually slender prismatic crystals in radiating form (see Fig. 1.C).
Topaz	45-50	anhedral grains with abundant inclusions.
Zircon	10-15	
<u>-105+53.00</u>		
Cassiterite	60-70	anhedral to subhedral orange brown crystals and clusters of smaller equant to columnar crystals (see Fig. 1.D), some of which have slender prismatic crystals protruding from the surface.
Zircon	15-20	euhedral prismatic crystals.
Topaz	10-15	anhedral grains with abundant inclusions.

- 6 -

<u>-53+3E:±</u>		
Cassiterite	75-80	Clusters of small anhedral to subhedral orange brown crystals, with minor amount of columnar crystals, either separate or in groups of 2 or 3 in radiating form (see Fig. 1E).
Zircon	15-20	euhedral prismatic crystals.
Opagues	2-3	anhedral grains.
Topaz	2-3	anhedral grains with abundant inclusions.
<u>-3E:±</u>		
Cassiterite	25-35	separate anhedral light orange brown crystals with minor clusters of smaller crystals.
Zircon	60-70	euhedral prismatic crystals.
Topaz	2-3	angular fragments.
Opagues	2-3	
Tourmaline	trace	
Sellaite	trace	

72 ✓  
Severn C . (7.003/SK/6422)

A visual estimate of the constituents is as follows:

<u>-420:±</u>		
Cassiterite	15-20	clusters of small equant and prismatic dark brown crystals.
Topaz	70-80	clusters of medium to very fine grained crystals, with minor inclusions of ?cassiterite.
Sellaite	3-5	
Zircon	trace-1	
<u>-420+210:±</u>		
Cassiterite	10	clusters of small equant to elongated yellowish brown crystals.
Topaz	90	anhedral grains with abundant inclusions. The larger inclusions are of cassiterite crystals.
<u>-210+105:±</u>		
Cassiterite	10	clusters of small crystals, with prismatic crystals protruding from surface.
Topaz	90	anhedral grains with abundant inclusions.
Zircon	trace	

- 7 -

<u>-105+53:z</u>		
Cassiterite	40-45	clusters of subhedral equant to columnar brown crystals, or of sub-microscopic crystals. Minor amounts of separate equant crystals.
Topaz	30-40	anhedral grains with abundant inclusions.
Zircon	10	
Sellaite	5-10	angular grains.
Opaques	trace	anhedral to subhedral reddish brown grains
Tourmaline	trace	brown anhedral grains.
<u>-53+38:z</u>		
Cassiterite	75-80	Clusters of small orange brown crystals, some of which have slender prismatic crystals protruding from the surface.
Zircon	10	euhedral prismatic crystals.
Topaz	10-15	anhedral grains with abundant inclusions.
Opaques	2-3	anhedral grains.
<u>-38:z</u>		
Cassiterite	40-50	equant subhedral light brown crystals with lesser amounts of clusters of smaller crystals.
Zircon	40-45	euhedral prismatic crystals.
Topaz	5-10	anhedral grains with inclusions.
Tourmaline	trace	

Severn G65 (7.003/SN/6424)

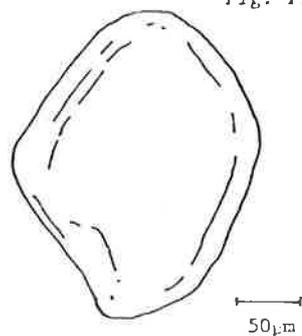
A visual estimate of the constituents is as follows:

<u>+420:z</u>		
Cassiterite	35-40	Clusters of small to medium sized equant dark brown crystals, with some compact anhedral grains.
Topaz	55-60	clusters of very fine to medium grained crystals.
Sellaite	2-3	
<u>-420+210:z</u>		
Cassiterite	25-30	clusters of small equant dark brown crystals.
Topaz	65-70	anhedral grains with abundant inclusions, some of which are opaques.
Zircon	5-10	
Sellaite	2-3	
Fluorite	trace	

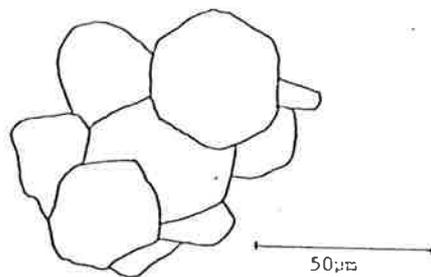
- 8 -

<u>-210+105</u>		
Cassiterite	15-15	separate anhedral to subhedral dark brown crystals, and clusters of smaller equant crystals.
Topaz	75	anhedral grains with abundant inclusions.
Zircon	5-10	fractured euhedral crystals.
Sellaite	5	angular grains.
<u>-105+53</u>		
Cassiterite	25-30	separate equant brown crystals, with lesser amount of clusters of smaller equant crystals and intergrown columnar crystals.
Topaz	50-60	anhedral grains with abundant inclusions.
Zircon	5-10	angular grains with minor euhedral crystals.
Tourmaline	2-3	brown elongated grains.
<u>-55+38</u>		
Cassiterite	60-65	anhedral to euhedral equant dark brown crystals, but mainly equant to elongated clusters of smaller crystals.
Topaz	15	anhedral grains with abundant inclusions.
Zircon	20	fractured euhedral prismatic crystals.
Tourmaline	5	columnar crystals.
Sellaite	trace	
<u>-38</u>		
Cassiterite	35-40	equant to elongated clusters of smaller dark brown crystals with lesser amounts of equant crystals.
Zircon	45-50	euhedral prismatic crystals.
Topaz	10-15	anhedral grains with inclusions.
Tourmaline	trace	
Sellaite	trace	

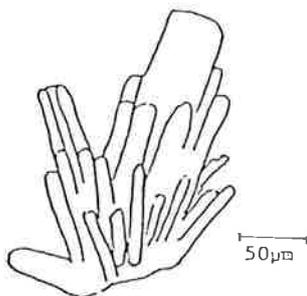
fig. 1. Various shapes of cassiterite.



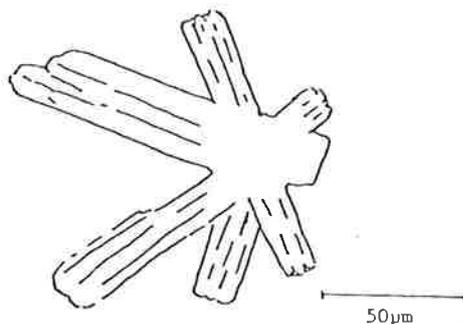
A. Equant anhedral grain



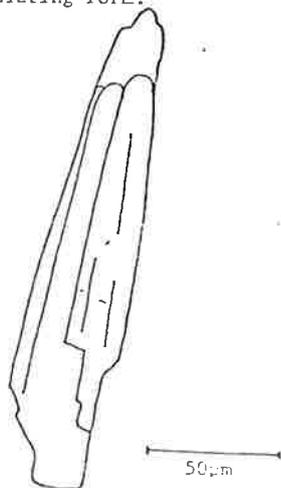
B. Cluster of small crystals.



C. Slender prismatic crystals in radiating form.



D. Cluster of columnar crystals.



E. Columnar crystals in radiating form.



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SA 5063  
In refs, quote

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# amdel

28 April, 1982

GS3/43/3/0

Aberfoyle Services Pty. Ltd.,  
Central Metallurgical Services,  
P.O. Box 952,  
BURNIE, Tas 7320

Attention: Dr S.S. Meik

REPORT GS 3452/82

YOUR REFERENCE: Telephone conversation with Helen Brown and  
memorandum dated 5th February, 1982

MATERIAL: Two tin-bearing samples

IDENTIFICATION: 155: Black Reef Group 1A  
56: G78 Montana

DATE RECEIVED: 18/12/81

WORK REQUIRED: Grain size analysis of cassiterite

Investigation and Report by: Michael Till

Chief - Geological Services Section: Dr Keith J. Henley  
Manager, Mineral and Materials Sciences Division: Dr William G. Spencer

*Keith Henley*  
for Norton Jackson  
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Queensland 4814  
Telephone (077) 75 1377

zbb/7

CMS REC'D		FILE	
ATTENTION			
NEM		DCK	
ACG		SSM	
CJ2		AF	
RJ5		FTO	
NS5		DJS	
EJ8		CS	
EMC		GCT	
JFC		IT	
NMF		WLS	
KCG		WLS	

## GRAIN SIZE ANALYSIS OF CASSITERITE IN TWO SAMPLES

### 1. INTRODUCTION

In a telephone conversation with Helen Brown on the 18th December 1981, Mr R.E. Mosney of Aberfoyle Services Pty. Ltd. requested that a grain size analysis of cassiterite be undertaken on the samples labelled 155: Black Reef Group 1A and 156: Montana G78. This was confirmed by Dr S. Meik in a memorandum dated 5th February 1982.

### 2. PROCEDURE

After Sn analysis of a small riffled portion of each sample, the remaining material was leached first with hydrofluoric acid to remove the silicates and then with nitric acid to remove the sulphides. The leach residues were dry sieved at 420  $\mu\text{m}$ , 210  $\mu\text{m}$ , 105  $\mu\text{m}$ , 53  $\mu\text{m}$  and 38  $\mu\text{m}$ , and the  $-53 \mu\text{m}$  size fraction was separated at 20  $\mu\text{m}$  and 10  $\mu\text{m}$  by sedimentation. A riffled portion of each size fraction and a riffled portion of the unsized leach residue was analysed for Sn by A-ray fluorescence methods.

The 410  $\mu\text{m}$  size fractions of the two samples were examined in loose grain mounts and/or temporary oil mounts using stereo binocular and transmitted light microscopy. Visual estimates of the constituents were given and particular attention was given to the cassiterite. Cassiterite in 156 Montana G78 was not easily distinguished in the  $+105 \mu\text{m}$  size fractions because its pale brown colour was similar to the colour of the other constituents. Thus a visual estimate of its content in these size fractions was made after each had been added to dilute hydrochloric acid in a zinc crucible. The cassiterite was distinguished from the other constituents by its zinc-plating.

### 3. RESULTS

The results of the leaching and Sn analysis of the head sample and unsized leach residue are as follows.

5.

001. 211.1.1.078

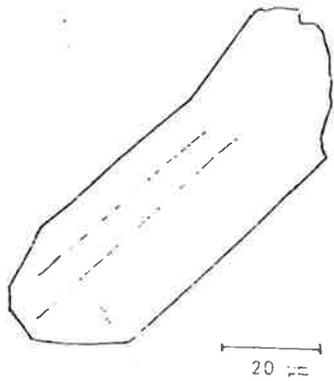
A visual estimate of the constituents is as follows:-

<u>+420 <math>\mu</math>m</u>	<u>%</u>	
Cassiterite	5-10	Clusters of pale brown equant crystals.
Sellaite (MgF <sub>2</sub> )	50-55	Colourless, translucent clusters of smaller crystals.
Topaz	40-45	Clusters of small white, crystals with sub-vitreous lustr
Opques	trace	Occur as black anhedral crystals and as microcrystalline growths on topaz crystals.
<u>-20+210 <math>\mu</math>m</u>	<u>%</u>	
Cassiterite	5-10	Occurs as pale brown equant to elongated anhedral crystal Irregularly shaped clusters of smaller equant crystals ar also present.
Sellaite	60-85	Occurs as individual transparent crystals and as smaller crystals in composite clusters of sellaite and topaz.
Topaz	5-10	Occurs as a minor component of composite clusters of sellaite and topaz.
Opques	trace	Occur as very fine inclusions in sellaite-topaz clusters.
Fluorite	trace	Anhedral crystals.
<u>-210+105 <math>\mu</math>m</u>	<u>%</u>	
Cassiterite	5-10	Equant, subhedral crystals from 10 to 20 $\mu$ m in size occurring as inclusions in topaz. Liberated cassiterite crystals are rare, and these consist of light yellowish brown clusters of equant crystals 40 to 60 $\mu$ m in size.
Sellaite	70-80	Occurs as transparent separate crystals and as composite clusters of sellaite and topaz crystals.
Opques	15-20	Anhedral crystals with inclusions of sellaite and minor cassiterite.
<u>-100+53 <math>\mu</math>m</u>	<u>%</u>	
Cassiterite	5-10	Light yellowish-brown translucent to cloudy crystals, usually occurring in clusters either of numerous small crystals or of two or three equant crystals approximately 10 $\mu$ m in size. Cassiterite also occurs as inclusions of equant crystals in topaz and, rarely, in sellaite.
Sellaite	75-95	Colourless anhedral grains. Cassiterite inclusions are approximately 5 $\mu$ m in size.
Opques	5-10	Anhedral crystals, crystals with very fine opaque inclusions. Inclusions of sellaite and cassiterite (equant crystals varying from 5 to 10 $\mu$ m in size) are also present.

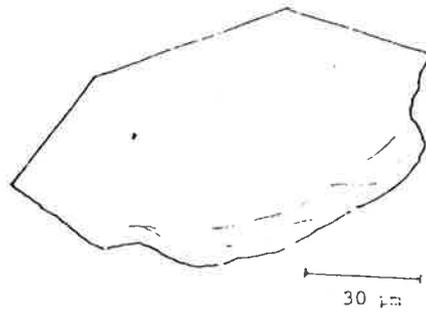
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<u>0.01-0.05 μm</u>	trace	Yellowish-green crystals.
<u>0.01-0.05 μm</u>	trace	Transparent fractured crystals.
<u>0.01-0.05 μm</u>	trace	Anhedral crystals.
<u>-55-58 μm</u>	<u>1</u>	
Cassiterite	5-10	Usually light yellow irregular clusters of smaller anhedral crystals. Compact anhedral crystals are also present.
Sellaite	90-95	Anhedral colourless crystals showing conchoidal fracture.
Quartz	2-3	Transparent to light brown crystals crowded with minute opaque inclusions. Inclusions of sellaite and cassiterite (equant, 3 to 8 μm) are also present.
Calcite	1-2	Anhedral crystals.
Tourmaline	trace-1	Yellowish green anhedral equant to elongated fragments.
Zircon	trace	Fractured prismatic crystals.
<u>-36-20 μm</u>	<u>1</u>	
Cassiterite	10-15	Usually light yellow equant crystals either separate or in clusters of 2 or 3 crystals. The single crystals are usually fractured subhedral crystals (see Fig 1.B) with some perfect anhedral crystals.
Sellaite	75-85	Transparent anhedral crystals.
Zircon	5-10	Subhedral to euhedral prismatic crystals.
Tourmaline	trace	Light green columnar crystals.
Quartz	trace	Anhedral crystals.
<u>-15-10 μm</u>	<u>1</u>	
Cassiterite	5-10	Colourless to light brown equant crystals which vary from irregularly shaped anhedral to compact subhedral and subhedral crystals (see Fig 1.E).
Sellaite	70-80	Anhedral fragments.
Quartz	10-15	Equant crystals and clusters of needle-like crystals.
Calcite	trace-1	Anhedral crystals with inclusions of microcrystalline opaque crystals.
Quartz	trace	Anhedral crystals.
Tourmaline	trace	Elongated crystals.

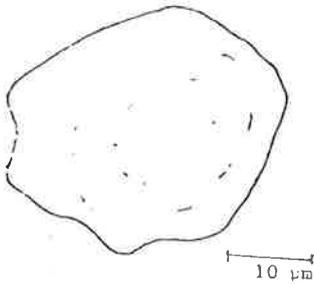
FIG. 1 VARIOUS SHAPES OF CASITERITE



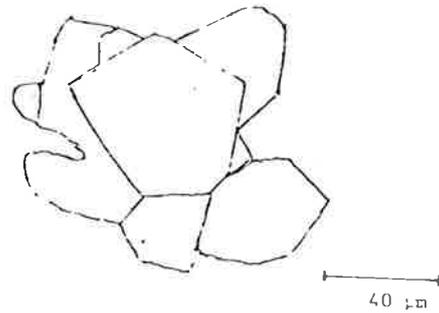
A. Fractured cuboidal elongated crystal.



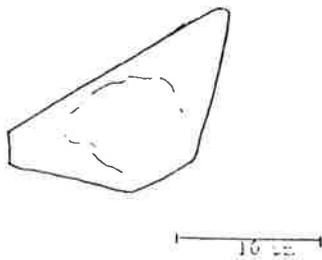
B. Fractured subhedral equant crystal.



C. Equant anhedral crystal.



D. Cluster of smaller anhedral to cuboidal equant crystals.



E. Equant crystal.

7.004



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correspondence to  
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SA 5063  
In reply quote:

# amdel

19th July, 1982.

GS 3/43/3/0

Aberfoyle Services Pty. Ltd.,  
Central Metallurgical Services,  
PO Box 952,  
BURNIE TAS 7320

Attention: Mr. N. Mooney/Dr. S.S. Meik

REPORT GS 4113/82

YOUR REFERENCE: Memorandum dated 5th February, 1982 and  
Order No. 01593

MATERIAL: Crushed drill core

LOCALITY: Montana (Zeehan)

IDENTIFICATION: G81 (low grade) numbered 1671

DATE RECEIVED: 8th February, 1982.

WORK REQUIRED: Grain size analysis of cassiterite.

Investigation and Report by: Michael Till

Chief - Geological Services Section: Dr. Keith J. Henley  
Manager, Mineral and Materials Sciences Division: Dr. William G. Spence

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CMS REC'D	
ANS _____ FILE _____	
ATTENTION	
NDM	LCK
ACG	SMY
CJD	AM
RJD	RTQ
RTO	DGS
EIS	CS
FSD	CGT
sac/TC	IT
SHL	
KCS	

*Alan Jackson*

Acting Chief  
Geological Services Section  
for Norton Jackson  
Managing Director

### 1. INTRODUCTION

One sample of Montana (Zeehan) crushed drill core G81 (low grade) numbered 1671 was received from Dr. S.S. Meik of Aberfoyle Services Pty. Limited on the 8th February 1962. The procedure was discussed in a telephone conversation with Mr. N. Mooney and a letter outlining the revised procedure and price for leaching and Sn grain size analysis was sent on to him on the 18th May, 1962.

### 2. PROCEDURE

A small riffled portion of the head sample was analysed for Sn. The remaining material was leached first with hydrofluoric acid to remove the silicates and then with nitric acid to remove the sulphides. The leach residue was wet sieved at 420  $\mu\text{m}$ , 210  $\mu\text{m}$ , 105  $\mu\text{m}$ , 53  $\mu\text{m}$  and 38  $\mu\text{m}$ . The -10  $\mu\text{m}$  size fraction was decanted and the -38+10  $\mu\text{m}$  size fraction dried and cyclo-sized.

Due to the abundance of sellaite ( $\text{MgF}_2$ ) in the sample, the sample was separated using methylene iodide (3.3 sp.gr.). The +53  $\mu\text{m}$  size fractions were separated statically and the -53+13  $\mu\text{m}$  size fractions centrifugally. A riffled portion of the >3.3 sp.gr. size fractions and a riffled portion of the unsized leach residue was analysed for Sn by X-ray fluorescence methods. Two size fractions were also analysed for tungsten.

The >3.3 sp.gr. +13  $\mu\text{m}$  size fractions were examined in loose grain mounts and/or temporary oil mounts using stereo binocular and transmitted light microscopy. Particular attention was given to the shape of cassiterite. Visual estimates of the constituents were also given. Following a request from Mr. N. Mooney to determine if wolframite was present, the >3.3 sp.gr. -105+53  $\mu\text{m}$  size fraction was selected and separated magnetically on a Frantz isodynamic magnetic separator on a range of currents in order to concentrate any wolframite present. These magnetic fractions were also examined using stereo binocular and transmitted light microscopy.

### 3. RESULTS

The results of the leaching and Sn analysis of the head sample and unsized leach residue are as follows:

Initial Wt. (g)	Residue Wt. (g)	% Residue	Sn Assay (%)	
			Head sample	Leach Residue
1898.0	72.1	4.11	0.4	9.48

2.

The weight and tin distribution in the sized leach residues appears in Table 1. In addition the -28+19  $\mu$ m and -19+13  $\mu$ m >3.3 sp.gr. fractions were analysed for tungsten. The results are, respectively, 1180 and 730 ppm. Wolframite was not detected in the magnetic separation products of the >3.3 sp.gr. -105+53  $\mu$ m size fraction. In the non-magnetic fraction several crystals of scheelite were identified under short-wave ultra-violet radiation.

Typical shapes of cassiterite are shown in Figure 1 and in Plates 1 and 2.

3.

A visual estimate of the constituents in the >3.3 specific gravity fraction is as follows:

<u>+420 <math>\mu</math>m</u>	<u><math>\lambda</math></u>	
Cassiterite	90-95	<p>Cassiterite occurs as light to dark brown clusters of smaller crystals.</p> <p>The forms of cassiterite with estimated relative abundance are as follows:</p> <ul style="list-style-type: none"> <li>(a) single euhedral or subhedral crystals: these are not present</li> <li>(b) clusters of two to four equant crystals with a slightly irregular overall shape, but with the relatively large individual crystals possessing smooth surfaces (see Fig. 1.B and Plate 1a): approximately 5%</li> <li>(c) compact clusters of smaller crystals with no prominent protrusions of individual crystals (see Fig. 1.C), and large crystals with an uneven surface: approximately 60%</li> <li>(d) clusters of smaller crystals with individual crystals protruding from an irregular surface (see Fig. 1.D). Some of the clusters have a branching form: approximately 35%.</li> </ul>
Zircon	3-5	Light brown elongated euhedral crystals.
Topaz	3-5	Clusters of small, sub-vitreous, white crystals with minor inclusions of euhedral equant cassiterite inclusions.

4.

<u>-420+210 μm</u>	<u>%</u>	
Cassiterite	85-90	<p>Cassiterite occurs as yellowish to dark brown crystals. The forms of cassiterite with estimated relative abundance are as follows:</p> <ul style="list-style-type: none"> <li>(a) euhedral equant crystals usually with one uneven face but otherwise very smooth, regular faces: approximately 10%</li> <li>(b) clusters of two or three equant euhedral crystals with an overall irregular shape due to the intergrowth of the crystals, but with the surfaces of the individual crystals being smooth: approximately 25%</li> <li>(c) compact clusters of small crystals with an overall slightly irregular surface, but often with one relatively large flat or slightly curved surface: approximately 25%</li> <li>(d) clusters of numerous intergrown crystals with an irregular surface due to protruding individual crystals: approximately 40%.</li> </ul>
Topaz	5-10	Single anhedral crystals or clusters of small crystals.
Zircon	1-2	Light brown euhedral crystals.

5.

-210+105 wt%

Cassiterite

85-90

Cassiterite occurs as yellowish to orange brown crystals. The forms of cassiterite with estimated relative abundance are as follows: .

- (a) single equant euhedral crystals with smooth crystal faces, but always containing one uneven face: approximately 20%
- (b) clusters of two to three equant crystals, with the overall surface being slightly irregular, but the individual crystals having smooth surfaces: approximately 15%
- (c) compact clusters of smaller crystals with a slightly irregular surface: approximately 35%
- (d) clusters of numerous small crystals with an overall irregular surface due to protruding individual crystals: 30%.

Zircon

5-10

Euhedral elongated crystals.

Topaz

1-2

Clusters of very small crystals.

6.

-105+53 μm7.

Cassiterite

80-85

Cassiterite occurs as light yellowish to orange-brown crystals. The forms of cassiterite with estimated relative abundance are as follows:

- (a) compact subhedral crystals with smooth crystal faces and usually one uneven face: approximately 20%
- (b) clusters of two to five equant crystals. The clusters have a slightly irregular overall shape but the individual crystals have smooth faces: approximately 20%
- (c) compact clusters of numerous intergrown crystals with a slightly irregular surface but without individual crystals prominently protruding from it: approximately 20%
- (d) clusters of numerous intergrown crystals with an irregular surface due to protruding individual crystals: approximately 40%.

Zircon

10-15

Light brown euhedral crystals.

Topaz

1-2

Clusters of small crystals.

7.

-53+38 wt%

Cassiterite

70-75

Cassiterite occurs as light yellowish to orange-brown crystals. The forms of cassiterite with estimated relative abundance are as follows:

- (a) single compact euhedral or subhedral crystals with smooth surfaces: approximately 20%
- (b) clusters of two to four equant crystals, with the cluster having an overall slightly irregular surface: approximately 20%
- (c) compact clusters of small intergrown crystals with a slightly irregular surface but no prominently protruding crystals: approximately 10%
- (d) clusters of numerous intergrown equant and (to a lesser extent) elongated crystals. The clusters have a highly irregular surface: approximately 50%.

Zircon

15-20

Light brown euhedral crystals.

Sellaite

5-7

Anhedral crystals with cassiterite inclusions.

Topaz

Trace-1

Anhedral crystals.

Opagues

Trace-1

Anhedral grains.

8.

-38+28 μmz

Cassiterite

40-45

Cassiterite occurs as yellowish to orange brown crystals. The forms of cassiterite with estimated relative abundance are as follows:

- (a) single euhedral or subhedral crystals with smooth surfaces: approximately 5%
- (b) clusters of less than five equant crystals: these were not observed
- (c) compact clusters of intergrown small crystals with a slightly irregular surface but no prominently protruding individual crystals: approximately 5%
- (d) clusters of numerous small equant crystals which are intricately intergrown to form a highly irregular and branching surface with abundant protruding crystals (see Plate 1b): approximately 90%
- (e) elongated crystals occurring as either a single column or in clusters (see Fig. 1.E): less than 1%.

Sellaite

25-30

Anhedral crystals.

Zircon

15-20

Euhedral prismatic crystals.

Tourmaline

5-10

Light green columnar prisms.

Topaz

Trace-1

Anhedral crystals.

9.

2-19-57

Cassiterite	W-1	<p>on stibnite occurs as light yellowish to dark brown crystals. The forms of cassiterite with distinct habit characteristics are as follows:</p> <p>(a) single prismatic cuboidal crystals with {100} faces: approximately 12</p> <p>(b) clusters of two or three equant cuboidal crystals: the clusters are compact in shape and have a slightly irregular surface: approximately 5</p> <p>(c) compact clusters of intergrown crystals with a slightly irregular surface and without any prominently protruding crystals: approximately 25</p> <p>(d) clusters of numerous equant crystals with a highly irregular surface due to numerous protruding crystals: approximately 10</p> <p>(e) elongated crystals, usually occurring as single crystals, but also in clusters with a highly irregular surface (see Plate III: approximately 162.</p>
Zircon	B-1	light brown cuboidal crystals.
Tourmaline	B-1	light green columnar prisms.
Sellaite	W-1	rhombic crystals, some with inclusions of equant cassiterite crystals.
Topaz	B	colorless crystals.

10.

-19+13 μm%

Cassiterite

35-40

Cassiterite occurs as light yellow to light brown crystals. The forms of cassiterite with estimated relative abundances are as follows:

- (a) single euhedral or subhedral crystals: these were not observed
- (b) clusters of two or three equant euhedral crystals with a slightly irregular surface: approximately 20%
- (c) compact clusters of equant crystals with a slightly irregular surface: approximately 20%
- (d) clusters of small equant crystals with a highly irregular surface: approximately 40%
- (e) elongated single crystals. Bunches of needle-like crystals in radiating form are present but rare: approximately 20%.

Tourmaline

20-30

Light-green elongated prisms.

Sellaite

15-20

Anhedral crystals.

Zircon

10-15

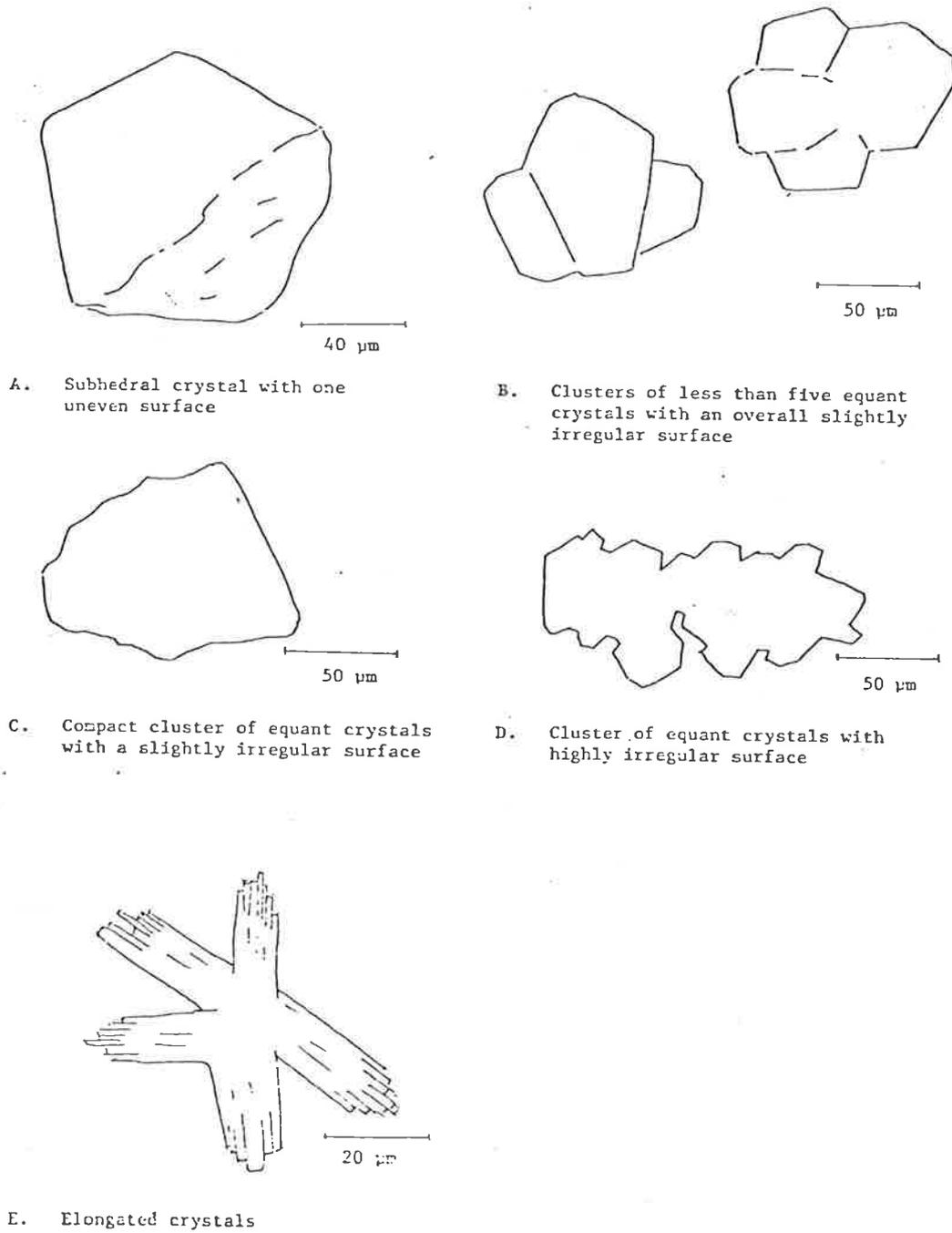
Light yellow anhedral crystals.

Topaz

1-2

Anhedral crystals.

FIG. 1 VARIOUS SHAPES OF CASSITERITE



7.003

Central Mineralogical Services



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Mr. N.E. Moony  
Metallurgical Services  
Superintendent  
Aberfoyle Services Pty. Ltd.  
Central Metallurgical Services  
P.O. Box 952  
BURNIE / TAS. 7320

24th November, 1981

MEMO	LOG			
<b>CMS</b>				
REC'D. 22.11.81				
A/S FILE				

REPORT CMS 81/10/47

YOUR REFERENCE: Order No. 0049  
 DATE RECEIVED: 23rd October, 1981  
 SAMPLE NOS.: 23 Samples  
 SUBMITTED BY: N.E. Moony  
 WORK REQUESTED: Mineralogy

Copy to:  
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MELBOURNE / VIC. 3000

*H.W. Fander*  
H.W. Fander, M. Sc.

REPORT CMS 81/10/47

Mineralogy of Metallurgical Test Products

About sixty samples of test products were received, for selective mineralogical examination. They included sized and unsized head samples (G 49, G 62, G 65, G 72 and G 74), and various superpanner concentrates and tailings in several size ranges. Twenty-three samples were actually selected, as listed in the mineralogical tables, and comprised the coarsest size fraction (+2440  $\mu$ ) of each head sample, a representative portion of G 74, and all the superpanner concentrates; it was felt that these would yield sufficient information for the present, bearing in mind that any or all of the other fractions could be examined later if necessary.

Each sample is described in the accompanying tables, and the minerals are listed semi-quantitatively according to the following convention:

- D = Dominant (> 60 %)
- M = Major (30-60 %)
- m = minor (10-30 %)
- a = accessory (1-10 %)
- tr = trace (< 1 %)

Also, cassiterite composites with > 50 % (by volume) of cassiterite are classed as "free" grains as specified by T. Choo (phonecall from Brisbane, 20th November, 1981).

Comments

1. The results of examining the coarse head sample fractions gave a good idea not only of the compositions of the samples, but more particularly of the nature of the tin minerals, and enabled prediction of the behaviour of the cassiterite; thus, the superpanner results on G 49 and G 74 were entirely consistent with these findings.
2. It is clear that in the Queen Hill samples (G 49, G 62), stannite is a significant component, and assays for soluble Sn should be considered.
3. There is a marked difference, in the various superpanner concentrates, between G 49 and G 74, due to the very significant differences in cassiterite grainsizes. In a more general way, there are differences in gangue minerals (and, more broadly, in the host rocks) which also contribute to this situation, but these are less clearly defined.

Page 2

CMS 81/10/47

4. Superpanning seems to have been efficient, and it is very probable that the bulk of any Sn present in superpanner tailings will be in the form of light composites with ultrafine cassiterite, and that the G 49 tailings will contain more cassiterite than the G 74 tailings.

H.W. Fander, M. Sc.

Sample No.	Occurrence of Sn Minerals	Occurrence of Other Minerals
G 49 +2440 $\mu$	Cassiterite as small cloudy grains, $3\mu - 30\mu$ , in quartz and in sericite, singly and as clusters up to $50\mu$ . Stannite occurs as patches $50\mu$ to $1200\mu$ , with sphalerite, pyrite.	Major sulphides, major quartz; minor carbonate (near siderite); accessory sericite, traces of talc, pale (Mg) chlorite, fluorite. Sulphides are mostly pyrite, minor arsenopyrite, stannite, sphalerite, and traces of galena, chalcopyrite.
G 62 +2440 $\mu$	Cassiterite as well-formed crystals, $3\mu - 25\mu$ , in quartz and carbonate, singly and as clusters up to $60\mu$ . Minor traces of <u>stannite</u> ( $< 50\mu$ ) with sphalerite.	Major volcanic (frothy lava) particles of fine siliceous, glassy and chloritic material. Major sulphides; minor quartz, carbonate; accessory sericite. Sulphides are pyrite, pyrrhotite, small traces of stannite, sphalerite, arsenopyrite, chalcopyrite, galena.
G 65 +2440 $\mu$	Cassiterite as well-formed crystals, $5\mu - 100\mu$ in quartz; also as very fine cloudy grains ( $< 25\mu$ ) in talc, carbonate and chlorite. Minor traces of stannite as $< 30\mu$ irregular grains.	Major quartz, and siltstone fragments (fine quartz and clays); minor sulphides; accessory chlorite, sericite, carbonate. Sulphides are pyrite, pyrrhotite, small traces of sphalerite, chalcopyrite, stannite.
G 72 +2440 $\mu$	Cassiterite as cloudy, shapeless grains, $3\mu - 50\mu$ , dominantly $< 25\mu$ , mostly embedded in pale chlorite. No stannite was detected.	Major chlorite and quartz; minor sulphides and carbonate; accessory talc, sericite. Sulphides are pyrrhotite and pyrite (mostly from pyrrhotite), with traces of fine chalcopyrite and sphalerite.
G 74 Head	Cassiterite as irregular grains and good crystals, $40\mu - 320\mu$ , mainly embedded in pyrite, with carbonate. No stannite was detected. Clusters, up to $500\mu$ , of small ( $< 50\mu$ ) cassiterite crystals occur.	Dominantly dark carbonaceous siltstone fragments (fine quartz, clays, carbon); accessory sulphides, carbonate, chlorite; traces of fluorite. Sulphides are pyrite, traces of fine chalcopyrite, isolated grains of coarse galena.
<u>Queen Hill</u>	Rock types are fine sediments (siltstones), scoriaceous (frothy) siliceous lavas, quartz-carbonate vein material	
<u>Severn</u>	Rock type is mainly fine siltstone, with quartz-carbonate vein material.	

Sample No.	Free Cassiterite	Composite Cassiterite	Sulphides	Carbonate	Sericite	Chlorite	Topaz	Zircon	Fluorite	Quartz	Comments
G 74 -300+75 Con 1	D	a	m	m	-	tr	-	-	tr	tr	Cassiterite as single crystals and aggregates
Con 2	a	a	m	D	-	tr	-	tr	tr	-	Sulphides are dominantly pyrite, pyrrhotite.
Con 3	a	a	m	D	-	a	tr	-	-	<sup>m</sup> (dark rock particles)	Cassiterite 5-70µ crystals, in all proportions with carbonate, quartz, chlorite
-75+45µ Con 1	D	tr	a	a	-	-	-	-	tr	tr	Cassiterite as complete and broken crystals, and aggregates.
Con 2	a	a	M	M	-	tr	tr	-	tr	-	Main sulphide is pyrite, Cassiterite composite with carbonate
Con 3	tr	a	m	D	-	tr	tr	tr	tr	<sup>a</sup> (dark rock particles)	Cassiterite as 20-40µ Inclusions in carbonate, quartz, chlorite.
-45+12µ Con 1	D	-	a	a	-	-	-	tr	-	-	Cassiterite as single, complete crystals and fragments.
Con 2	D	-	a	a	-	-	-	-	-	-	As above.
Con 3	a	tr	M	D	-	tr	tr	tr	-	-	Cassiterite as clusters of small cloudy crystals.

Sample No.	Free Cassiterite	Composite Cassiterite	Sulphides	Carbonate	Sericite	Chlorite	Topaz	Zircon	Fluorite	Comments
G 49 -425+75u Con 1	m	a	a	D	tr	tr	-	-	-	In this context "free cassiterite" is defined below. Main sulphide is galena.
Con 2	a	a	a	D	tr	tr	-	-	-	Cassiterite mostly composite with carbonate. Sulphides include stannite.
Con 3	tr	a	m	D	tr	tr	tr	-	-	<30u cassiterite embedded in carbonate, sericite. Sulphide mainly pyrite. Most cassiterite grains are actually aggregates of much smaller grains.
-75+45u Con 1	M	a	a	D	-	-	-	tr	-	Cassiterite as 5-30u grains embedded in carbonate, rarely in quartz.
Con 2	a	a	a	D	-	-	tr	-	-	Cassiterite mostly as <20u grains in carbonate.
Con 3	tr	a	a	D	tr	tr	tr	-	tr	The great majority of cassiterite grains are single, complete crystals.
-45+12u Con 1	D	tr	a	m	-	-	-	tr	-	As above.
Con 2	M	tr	a	D	tr	tr	tr	tr	-	
Con 3	a	a	a	D	-	-	tr	tr	-	Cassiterite as single crystals and splinters.

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	REC'D. 13/1/82				
Central Mineralogical Services					
	A/S FILE				



Mr. D.J. Jones  
Metallurgist  
Aberfoyle Services Pty. Ltd.  
Central Metallurgical Services  
P.O. Box 952  
BURNIE / TAS. 7320

15th March, 1982

REPORT CMS 82/1/9

YOUR REFERENCE:      Order No. 01537  
DATE RECEIVED:        13th January, 1982  
SAMPLE NOS.:            21 Samples  
SUBMITTED BY:         D.J. Jones  
WORK REQUESTED:      Mineralogy

Copy to:  
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Chief Metallurgist  
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367, Collins Street  
MELBOURNE / VIC. 3000

*H. W. Fander*  
H.W. Fander, M.Sc.

REPORT CMS 62/1/9

Metallurgical Test Samples - Cleveland and Montana (G 78)

A total of 21 samples was received for mineralogical examination; 14 were from a Cleveland Standard mill feed test programme, 6 were from G 78 Montana ore, and one was from Cleveland tailings retreatment.

Depending on the type of sample, it was examined in polished section or as a grain-mount (or both, in many cases); the results are presented in the attached tables, using the established semi-quantitative notation and defined, at the end of the tables.

Comments

1. Cleveland Ore

- a. In the sulphide flotation concentrates, Sn losses can be ascribed to the occurrence of stannite, and to cassiterite/sulphide composites; no free cassiterite was detected.
- b. In the oxide flotation concentrates, cassiterite is characterised by minute gangue inclusions; most of these seem to be carbonate (a sideritic variety) and would thus be responsible for weakly magnetic properties. This characteristic is also seen in the cassiterite in the superpanner concentrates, and an estimated 10 % of all cassiterite grains contain such inclusions.
- c. Superpanner tails contain Sn almost entirely in composite form, as small (< 50  $\mu$ ) inclusions of cassiterite and stannite.

2. G 78 Montana Ore

- a. The sulphide concentrates contain composite Sn minerals, principally cassiterite as minute inclusions in gangue (carbonate); some of the gangue is composite with sulphides, hence its presence in these products, but evidently free gangue has also floated and has been responsible for the Sn losses.
- b. In oxide flotation concentrates, these carbonate grains with minute cassiterite inclusions are again present, and the main Sn losses into tailings are in this form.

3. Cleveland Tailings Retreatment

As might be expected, most of the components are iron-stained; however, the cassiterite appears to be free and clean, and its presence must be due to mechanical entrainment. The particles are mostly fine-grained and would tend to form felted masses in a magnetic field, thus hindering the movement of non-magnetic grains.

H.W. Fander, M. Sc.

Sample No.	Sn Minerals	Other Minerals
0268	Accessory cassiterite; a few free coarse grains (up to 200 $\mu$ ), some substantially free, some composite (< 50 $\mu$ ) with gangue.	Dominant gangue (mostly carbonate, conspicuous fluorite); accessory pyrrhotite, trace pyrite, rutile.
0269	Minor trace of stannite (< 50 $\mu$ ) inclusions in gangue. Irregular cassiterite (< 50 $\mu$ ) in gangue (fluorite, quartz, chlorite). Isolated free grains.	Dominant gangue - quartz, quartz/soricite, accessory chlorite, fluorite, tourmaline. Accessory pyrrhotite, mostly free, minor trace chalcopyrite in gangue.
0270	Trace cassiterite, as < 50 $\mu$ inclusions in quartz, tourmaline.	Dominant gangue - major quartz; minor fluorite, minor tourmaline; accessory carbonate, chlorite, actinolite. Trace free pyrrhotite, minor trace composite chalcopyrite.
0229	Isolated stannite, composite with pyrite. 2-10 $\mu$ cassiterite inclusions in gangue (carbonate), rarely up to 30 $\mu$ .	Dominant sulphides - mostly pyrite, minor pyrrhotite, trace chalcopyrite, arsenopyrite; accessory gangue, free and composite with sulphides.
0230	Cassiterite as 1-50 $\mu$ (mostly < 20 $\mu$ ) inclusions in gangue, often in swarms.	Major sulphides, mainly pyrite with subordinate pyrrhotite, mostly composite with gangue; major gangue, free and composite.
0231	Isolated stannite up to 100 $\mu$ , composite with gangue. Free cassiterite grains, 10-30 $\mu$ .	Dominant gangue - major coarse/fine quartz, major free carbonate; trace tourmaline, sellaitite. 1-2 % sulphides, free and composite, mainly pyrrhotite, trace pyrite.
0318	Minor free cassiterite, 5-30 $\mu$ ; trace cassiterite as < 10 $\mu$ inclusions in carbonate.	Dominant carbonate, mostly < 15 $\mu$ grains, lightly iron-stained; minor quartz.
0319	Accessory cassiterite as free grains up to 40 $\mu$ , and as 3 $\mu$ - 15 $\mu$ inclusions in carbonate.	Dominant carbonate; accessory quartz; trace sellaitite, tourmaline.
0320	Cassiterite as < 15 $\mu$ inclusions in quartz and carbonate; rare free grains up to 30 $\mu$ .	Major quartz, major sellaitite; minor carbonate.
0603	Cassiterite as free grains up to 20 $\mu$ , and composite with quartz up to 40 $\mu$ . Not iron-stained.	Dominant gangue, mostly iron-stained; quartz, minor carbonate and micas; accessory tourmaline, goethite. 2-3 % sulphides, almost all free, pyrrhotite, pyrite, trace chalcopyrite.

Dominant = > 60 %; Major = 30-60 %; minor = 10-30 %; accessory = 1-10 %; trace = < 1 %.

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<b>Central Mineralogical Services</b>				
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11th March, 1982

REPORT CMS 82/1/28

YOUR REFERENCE:      Order No. 01571  
DATE RECEIVED:        26th January, 1982  
SAMPLE NOS.:            *[Handwritten]*  
                                  4 - Montana  
                                  3 - Cleveland  
SUBMITTED BY:         D.J. Jones  
WORK REQUESTED:      Mineralogy

Copy to:  
Mr. K. Foo  
Chief Metallurgist  
Aberfoyle Ltd.  
367, Collins Street  
MELBOURNE / VIC. 3000

*[Handwritten Signature]*  
H.W. Fander, M. Sc.

REPORT CMS 82/1/28Metallurgical Test Products - Montana and Cleveland

Four samples of gravity products from Montana ore, and three samples of secondary gravity products from a reground Cleveland primary tailing, were received for mineralogical examination. They were examined as received, without further preparation except for preparing grain-mounts, and the results are presented in the attached table; the results are semi-quantitative only.

Comments1. Montana Samples

As might be expected, the concentrates show a trend from free cassiterite to fine composite cassiterite, and as already described and discussed, some of the cassiterite is very fine-grained and occurs as minute inclusions in carbonate.

The major gangue mineral is sideritic carbonate, with a beige to light biscuit-brown colour in the mass due to incipient oxidation and iron-staining. Pyrrhotite is the principal sulphide, occurring as much coarser grains than the other minerals. Cautious magnetic separations may achieve worthwhile upgrading without losing too much cassiterite in composites.

2. Cleveland Samples

Clearly, a good deal of cassiterite has been liberated by regrinding, and is available for further upgrading; since the bulk of the cassiterite is free, especially in Con. 1, several techniques should be suitable, though it is suspected that the cloudy cassiterite may be weakly magnetic. In the tailing, cassiterite occurs only as very fine inclusions in gangue, and further processing may not be economic.

H.W. Fander, M. Sc.

Sample No.	Sn Minerals	Other Minerals
0733 Con. 1	Dominant cassiterite, as free grains, crystals, clusters 20 $\mu$ - 250 $\mu$ ; also as 10-70 $\mu$ inclusions in carbonate.	5-10 % pyrrhotite, as free grains up to 400 $\mu$ and a few composites with quartz. 15-20 % carbonate, mostly as free crystal fragments 20-150 $\mu$ , mostly < 50 $\mu$ ; trace quartz.
0734 Con. 2	15-20 % cassiterite, mostly free cloudy grains 10-80 $\mu$ , a few up to 250 $\mu$ ; also as inclusions 3 $\mu$ - 30 $\mu$ (mostly < 15 $\mu$ ) in carbonate.	15-20 % sulphides (pyrrhotite, trace pyrite) as free coarse grains up to 400 $\mu$ . 10-15 % sellaite fragments, dominantly free. About 50 % carbonate. Traces of quartz, chlorite.
0735 Con. 3	About 10 % cassiterite, partly as free grains, 10-30 $\mu$ , mostly as inclusions 3-40 $\mu$ in carbonate.	2-3 % pyrrhotite, as coarse grains; about 10 % sellaite, as free fragments. 75-80 % carbonate - many grains are lightly iron-stained.
0736 (Tail)	Trace to 1 % cassiterite, as < 20 $\mu$ free grains and inclusions in carbonate, quartz.	About 70 % carbonate, 20 % sellaite, 8-10 % quartz, 1-2 % sulphides. Quartz and sulphides generally much coarser than sellaite, carbonate. All are free.
<hr/>		
0457 Con. 1	Major (30-35 %) cassiterite as free, clear and cloudy grains; a few composites with chlorite, pyrrhotite, quartz.	Major carbonate, minor sulphides, accessory chlorite, tourmaline, quartz; traces of apatite, fluorite. Sulphides are pyrrhotite > pyrite > arsenopyrite. Minerals are free.
0458 Con. 2	1-2 % cassiterite, partly as free grains up to 80 $\mu$ , clear and cloudy; partly as < 30 $\mu$ inclusions in gangue.	10-15 % fluorite, 5-10 % sulphides, 5 % hastingsite, 20 % tourmaline, 10 % chlorite, 50 % carbonate, 5 % others (including apatite, quartz, goethite). Carbonate grains often iron-stained.
0459 Tail	Trace cassiterite as 10-50 $\mu$ inclusions in gangue (carbonate, quartz).	Major quartz, minor tourmaline and hastingsite, minor carbonate, accessory fluorite, chlorite, sulphides.

Dominant = > 60 %; Major = 30-60 %; minor = 10-30 %; accessory = 1-10 %; trace = 8-1 %.

MEM	ACG				
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ANS _____ FILE _____					

7004



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19th April, 1982

REPORT CMS 82/2/32

YOUR REFERENCE: Order No. 00515  
7.004 Ceehan Deposits

DATE RECEIVED: 19th February, 1982

SAMPLE NOS.: 20 Samples

SUBMITTED BY: Dr. S. Meik

WORK REQUESTED: Mineralogy

Copy to:  
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*H. Fander*  
H. Fander, M. Sc.

REPORT CMS 82/2/32G 67, G 81 Superpanner Products

A number of superpanner fractions were received, with a request for mineralogical examination of twenty selected samples. No preparation was needed other than simple grain-mounting of samples as received; these were examined in transmitted and oblique incident light (stereobinocular microscope). The results are expressed semi-quantitatively in the attached tables.

Comments

There are considerable differences between G 67 and G 81, in terms of both cassiterite occurrence and gangue mineralogy.

In G 67, cassiterite is very closely associated with siderite, with composites occurring into the finest sizes; hence, the cassiterite will go where the siderite goes. For this reason, superpanner tails are very low grade and various concentrates all contain appreciable Sn values. Evidently, the bulk of the cassiterite is fine- to very fine-grained, but despite this it occurs as very well-formed, clean crystals, contrary to the usual poorly-defined habit of fine cassiterite. The gangue mineralogy is very simple; virtually the only heavy gangue is siderite.

In G 81, cassiterite evidently has a more or less bimodal size distribution; the very fine cassiterite is distributed in a number of gangue minerals, which occur in much wider variety than in G 67; hence, fine cassiterite is also much more widely distributed, throughout concentrates and tailings, especially since cassiterite is associated with light gangue minerals such as quartz, sericite and chlorite. Thus, G 81 can be upgraded to produce a high-grade concentrate and a high-Sn tailing, where the concentrate consists of coarse, easily liberated cassiterite, and the tailing contains fine, poorly-defined cassiterite spread through at least seven different gangue minerals (quartz, sericite, chlorite, siderite, sellaite, tourmaline, topaz).

H.W. Fander, M. Sc.

Sample No.	Cassiterite Occurrence	Other Minerals
<u>G.67 H.G.</u> 1875	Dominant, mostly as compact clusters of 5-15 $\mu$ grains, free and intergrown with siderite in all proportions. Also single crystals, fragments.	Accessory free siderite; trace quartz, chlorite, minor siderite in composite form with cassiterite in all proportions.
1876	Major cassiterite as clusters of 5-25 $\mu$ grains, seldom completely free of carbonate, > 90% carbonate with fine cassiterite inclusions, to > 90% cassiterite.	Major free siderite, major composite siderite; trace tourmaline. Accessory sulphides and contaminants.
1877	Minor cassiterite, all composite, from small single crystals in siderite to clusters with minor intergrown siderite.	Dominant siderite, free and composite with cassiterite. Accessory sulphides and contaminants.
1878	Minor, as composites only, as single crystals 5-15 $\mu$ and as small clusters, generally < 50% of any composite grain.	Dominant siderite, free and composite, though seldom entirely without cassiterite. Accessory sulphides and contaminants.
1885	Accessory, as 5-15 $\mu$ crystals mostly included in siderite, but also in quartz; single grains and small clusters (up to 50 $\mu$ ). Rare clusters are almost free.	Major siderite, mostly free, also composite with cassiterite as described, and sometimes with quartz.
1886	Minor, as grains/crystals ranging from 1 $\mu$ to 15 $\mu$ , singly and in clusters, embedded in siderite; also free/substantially free grains, clusters.	Dominant siderite, mostly free. Accessory quartz. Much of siderite is cloudy or iron-stained.
<u>G.67 L.G.</u> 1607	Accessory, as single crystals up to 80 $\mu$ in siderite, and as substantially free clusters with minor/trace siderite. Also free grains down to 50 $\mu$ .	Dominant free siderite, cloudy and clear. Accessory free sulphides (pyrite, galena, pyrrhotite, sphalerite). Trace magnetite.
1627	Trace cassiterite as single grains < 30 $\mu$ embedded in siderite.	Dominant free siderite. No other minerals.
<u>Comments</u>	Because of the very fine grain size of the cassiterite, very few free crystals occur, though there are clusters or compact aggregates of more or less pure cassiterite with minimal siderite. Although the cassiterite is fine, it is commonly well-crystallized with good clean outlines. Composites between cassiterite and siderite occur with the two minerals in all proportions, so that there is a continuous range of particles with S.G.'s between that of siderite and cassiterite; hence, composites will inevitably report in all fractions. Dominant = > 60%; Major = 30-60%; minor = 10-30%; accessory = 1-10%; trace = < 1%.	

Sample No.	Cassiterite Occurrence	Other Min. als
G 81 H.G. 1568	Dominant, as cloudy dark fragments, free and substantially free, with minor carbonate, chlorite, topaz, generally as rims.	Accessory pyrrhotite, accessory siderite.
1569	Minor; free grains and composite in varying proportions with gangue, up to substantially free clusters.	Major siderite, major topaz; accessory sulphides (mainly pyrrhotite), accessory chlorite (mostly as envelopes on cassiterite clusters).
1570	Accessory; isolated free grains, but mostly as inclusions of < 20 $\mu$ grains, larger clusters, in chlorite, topaz, siderite, tourmaline.	Major siderite, major topaz, major tourmaline; accessory chlorite, accessory sulphides (mostly composite).
1634	Accessory; all as < 30 $\mu$ inclusions in topaz, tourmaline, quartz, chlorite, single grains and a few clusters.	Major siderite, major topaz; minor tourmaline, minor sellaite; accessory chlorite, accessory pyrrhotite.
G 81 L.G. 1888	Major; mostly as free but cloudy grains, clear crystals and splinters. Also composite with inclusions in quartz, siderite, sericite.	Major siderite; accessory tourmaline; trace topaz, quartz, chlorite; accessory magnetite, trace sulphides.
1891	Accessory; a few free/substantially free grains and clusters, but mostly as inclusions < 5 $\mu$ - 50 $\mu$ in siderite, tourmaline.	Dominant siderite; accessory tourmaline, magnetite; trace sericite, chlorite, talc.
1894	Accessory; as free (dark, cloudy) grains and as < 5 $\mu$ - 30 $\mu$ inclusions in gangue (mainly in siderite).	Dominant siderite; minor tourmaline; accessory chlorite, magnetite, sulphides (composite); trace quartz, sellaite, sericite.
1897	Accessory; as fine inclusions (5-20 $\mu$ , rarely up to 40 $\mu$ ) in siderite, sericite, tourmaline. Rare substantially free grains.	Dominant cloudy siderite; minor chlorite; accessory tourmaline, sellaite; trace magnetite and sulphides.
1902	Trace; < 5 - 30 $\mu$ inclusions in siderite, chlorite, tourmaline, sellaite, sericite; isolated larger crystals, clusters up to 60 $\mu$ .	Dominant cloudy siderite; minor tourmaline, chlorite; accessory sellaite, sericite, sulphides.
1903	Trace; isolated free grains, and 10-40 $\mu$ inclusions in sericite aggregates, siderite, tourmaline, chlorite.	Dominant cloudy siderite; minor tourmaline, chlorite. Accessory sellaite, sericite, composite sulphides.
1904	Trace; as 3 $\mu$ - 15 $\mu$ grains, rarely as clusters up to 40 $\mu$ , in quartz, chlorite, sericite, siderite.	Dominant quartz; minor sericite, chlorite; accessory siderite, sellaite, fine composite sulphides.
1908	Trace; as 5 $\mu$ - 25 $\mu$ inclusions in sericite, chlorite.	Dominant rock fragments (finely intergrown sericite-quartz); minor chlorite, sericite; accessory siderite, fine composite sulphides.

APPENDIX III

MINERAL	G49	G74	G78
chalcopyrite	0.07	0.05	0.05
sphalerite	0.76	0.10	0.55
galena	0.11	0.07	-
pyrite	13.5	3.7	13.4
pyrrhotite	0.56	0.53	11.4
arsenopyrite	0.23	-	0.23
cassiterite	0.21	0.12	0.36
stannite	0.05	-	-
malayite (?)	0.09	0.03	0.17
quartz	36.5	16.3	27.1
Al-silicates	2.2	1.9	2.1
serpentine	0.06	0.2	-
* (Fe, Mg, Ca, K) silicates	30.1	59.7	15.5
"Other" silicates	6.5	8.1	2.7
Mg carbonates	-	-	0.16
talc	-	-	0.10
Fe oxides	1.2	1.4	7.2
Fe carbonates	6.3	4.7	14.4
dolomite	0.27	0.87	0.84
calcite, fluorite	0.38	0.53	2.0
rutile	0.19	0.47	-
ilmenite, sphene	0.18	1.2	0.04
other	0.54	0.23	1.7
TOTAL (Vol %)	100.00	100.00	100.00

Bulk Density Calc.      3.79                      3.74                      3.43

NOTE: (?) doubtful

- less than 0.03% volume

\* a major proportion in Fe-silicates

Decreasing Volume %

MINERAL	ASSOCIATED MINERALS <span style="float: right;">Decreasing order of importance →</span>
(Fe, Ca, Mg, K) - silicates	serpentine, ilmenite, Fe-carbonates
quartz	other-silicates, Al-silicates, galena, Malayite
pyrite	pyrrhotite, arsenopyrite, Fe-silicates Malayite, other-silicates
Fe-carbonates	Fe-oxides, Fe-silicates, ilmenite
sphalerite	other-silicates, Fe-oxides/carbonates, quartz
pyrrhotite	pyrite, Fe-silicates, other-silicates, rutile
arsenopyrite	pyrite, galena, quartz, pyrrhotite
cassiterite	calcite/fluorite, quartz, Fe-silicates, Fe-carbonates, stannite
chalcopyrite	"other" minerals, stannite

G74 ASSOCIATION OF SELECTED MINERALS

Decreasing Volume %

MINERAL	ASSOCIATED MINERALS <span style="float: right;">Decreasing order of importance →</span>
(Fe, Ca, Mg, K) - silicates	serpentine, other-silicates, Fe-oxides/carbonates
quartz	other-silicates, Fe-silicates
Fe-carbonates	Fe-oxide/silicates
pyrite	pyrrhotite, chalcopyrite, Fe-silicates
pyrrhotite	pyrite, Fe-silicates
cassiterite	Fe-carbonates, Fe-silicates, other silicates
sphalerite	other-silicates, Fe-silicates
galena	pyrite, other-silicates
chalcopyrite	pyrrhotite

## G78 ASSOCIATION OF SELECTED MINERALS

MINERAL	ASSOCIATED MINERALS <span style="float: right;">Decreasing order of importance →</span>
quartz	other-silicates, talc, malayite, serpentine, (Fe, Ca, K) - silicates
pyrite	pyrrhotite
pyrrhotite	arsenopyrite, pyrite
Fe-silicates	quartz, serpentine, Fe-carbonates, Fe-oxides, ilmenite
Fe-carbonates	Fe-oxides
Fe-oxides	Fe-carbonates
sphalerite	chalcopyrite, Fe-oxides/carbonates
cassiterite	Fe-carbonates, malayite, quartz Al-silicates, Ca-silicates, calcite/fluorite
arseno pyrite	pyrrhotite
chalcopyrite	sphalerite, pyrrhotite, arsenopyrite

Decreasing Volume %



APPENDIX IV

HEAVY LIQUID ANALYSIS

G49

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL		
		%VL	%Sn	Sn Dist	%WL	Sn Dist	Sn Dist
+2440	-2.80	23.9	0.05	3.7	1.60		0.2
	-2.96	30.1	0.07	6.6	2.02		0.4
	-3.31	22.7	0.31	21.8	1.52		1.2
	+3.31	23.3	0.94	67.9	1.56		3.8
		100.0	(0.32)	100.0	6.7		5.6
+850	-2.80	27.2	0.07	5.8	12.02		2.2
	-2.96	16.7	0.10	5.1	7.38		1.9
	-3.31		0.28	20.5	10.61		7.7
	+3.31	32.1	0.70	68.6	14.19		25.5
		100.0	(0.33)	100.0	44.2		37.3
+300	-2.80	22.9	0.07	4.9	6.02		1.1
	-2.96	23.4	0.10	7.2	6.15		1.6
	-3.31	13.9	0.30	12.9	3.66		2.8
	+3.31	39.8	0.61	75.0	10.47		16.5
		100.0	(0.32)	100.0	26.3		22.0
+45	-2.80	33.2	0.057	6.0	5.67		0.8
	-2.96	11.4	0.12	4.3	1.95		0.6
	-3.31	6.7	0.31	6.6	1.15		0.9
	+3.31	48.7	0.54	83.1	8.33		11.6
		100.0	(0.32)	100.0	17.1		13.9
-45			1.44		5.7		21.2
TOTAL			(0.39)		100.0		100.0

HEAVY LIQUID ANALYSIS

G62

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL		
		%VL	%Sn	Sn Dist	%WL	Sn Dist	Sn Dist
+2440	-2.80	8.3	0.06	0.6	0.77		0.1
	-2.96	24.8	0.10	3.2	2.31		0.4
	-3.31	22.7	0.26	7.7	2.11		0.8
	+3.31	44.2	1.54	88.5	4.11		9.8
		100.0	(0.77)	100.0	9.3		11.1
+850	-2.80	9.5	0.05	0.8	4.91		0.4
	-2.96	23.4	0.11	4.0	12.10		2.1
	-3.31	23.1	0.29	10.5	11.94		5.3
	+3.31	44.0	1.23	84.7	22.75		43.2
		100.0	(0.64)	100.0	51.7		51.0
+300	-2.80	14.5	0.06	1.4	2.96		0.3
	-2.96	18.6	0.12	3.6	3.79		0.7
	-3.31	22.0	0.27	9.5	4.49		1.9
	+3.31	44.9	1.19	85.5	9.16		16.8
		100.0	(0.63)	100.0	20.4		19.7
+45	-2.80	17.3	0.08	2.5	2.21		0.3
	-2.96	11.8	0.08	1.7	1.51		0.2
	-3.31	12.8	0.18	4.1	1.64		0.4
	+3.31	58.1	0.88	91.7	7.44		10.1
		100.0	(0.56)	100.0	12.8		11.0
-45			0.80		5.8		7.2
TOTAL			(0.65)		100.0		100.0

HEAVY LIQUID ANALYSIS

665

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL		
		%Wt	%Sn	Sn Dist	%Wt	Sn Dist	Sn Dist
+2440	-2.80	23.9	0.08	4.5	2.84	0.5	
	-2.96	18.4	0.14	6.0	2.19	0.6	
	-3.31	31.4	0.16	11.8	3.74	1.2	
	+3.31	26.3	1.26	77.7	3.13	8.1	
		100.0	(0.43)	100.0	11.9	10.4	
+850	-2.80	16.5	0.07	2.5	8.86	1.3	
	-2.96	25.9	0.11	6.2	13.91	3.1	
	-3.31	28.9	0.21	13.1	15.52	6.7	
	+3.31	28.7	1.26	78.2	15.41	39.9	
		100.0	(0.46)	100.0	53.7	51.0	
+300	-2.80	27.9	0.08	4.5	5.36	0.9	
	-2.96	14.0	0.08	2.3	2.69	0.5	
	-3.31	27.7	0.23	12.9	5.32	2.5	
	+3.31	30.4	1.30	80.3	5.83	15.5	
		100.0	(0.49)	100.0	19.2	19.4	
+45	-2.80	20.9	0.10	3.1	2.07	0.4	
	-2.96	14.2	0.11	2.4	1.41	0.3	
	-3.31	21.8	0.17	5.6	2.16	0.8	
	+3.31	43.1	1.37	88.9	4.26	12.0	
		100.0	(0.66)	100.0	9.9	13.5	
-45			0.51		5.3	5.7	
TOTAL			(0.49)		100.0	100.0	

HEAVY LIQUID ANALYSIS

672

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL		
		%Wt	%Sn	Sn Dist	%Wt	Sn Dist	Sn Dist
+2440	-2.80	14.7	0.05	1.3	2.00	0.1	
	-2.96	17.3	0.18	5.6	2.35	0.6	
	-3.31	49.9	0.22	19.9	6.78	2.0	
	+3.31	10.2	2.22	73.2	2.47	7.3	
		100.0	(0.55)	100.0	13.6	10.0	
+850	-2.80	10.7	0.09	1.0	5.35	0.6	
	-2.96	23.5	0.14	3.6	11.75	2.2	
	-3.31	46.2	0.24	12.0	23.10	7.4	
	+3.31	19.6	3.92	83.4	9.80	51.4	
		100.0	(0.92)	100.0	50.0	61.6	
+300	-2.80	17.5	0.08	2.8	3.40	0.4	
	-2.96	22.5	0.14	6.2	4.37	0.8	
	-3.31	37.6	0.25	18.6	7.28	2.4	
	+3.31	22.4	1.63	72.4	4.35	9.5	
		100.0	(0.50)	100.0	19.4	13.1	
+45	-2.80	17.7	0.06	1.8	2.04	0.2	
	-2.96	21.4	0.06	2.2	2.46	0.2	
	-3.31	26.4	0.25	11.0	3.04	1.0	
	+3.31	34.5	1.47	85.0	3.96	7.8	
		100.0	(0.60)	100.0	11.5	9.2	
-45			0.83		5.5	6.1	
TOTAL			(0.75)		100.0	100.0	

HEAVY LIQUID ANALYSIS  
G01 (LOW GRADE)

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL	
		%Wt	%Sn	Sn Dist	%Wt	Sn Dist
+2440	-2.96	27.1	0.05	4.0	3.3	0.4
	-3.31	50.4	0.13	19.4	6.2	2.1
	+3.31	22.5	1.15	76.6	2.7	8.0
		100.0	(0.34)	100.0	12.2	10.5
+850	-2.96	26.6	0.05	3.4	13.4	1.7
	-3.31	51.9	0.15	20.4	26.1	10.2
	+3.31	21.5	1.37	76.2	10.8	38.0
		100.0	(0.39)	100.0	50.3	49.9
+300	-2.96	27.0	0.05	3.8	5.3	0.7
	-3.31	53.4	0.19	28.2	10.4	5.1
	+3.31	19.6	1.25	68.0	3.8	12.2
		100.0	(0.36)	100.0	19.5	18.0
+45	-2.96	28.0	0.07	4.2	3.3	0.6
	-3.31	33.1	0.12	8.3	3.9	1.2
	+3.31	38.9	1.08	87.5	4.6	12.6
		100.0	(0.48)	100.0	11.8	14.4
-45			0.45		6.2	7.2
TOTAL			(0.39)		100.0	100.0

HEAVY LIQUID ANALYSIS  
G74

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL	
		%Wt	%Sn	Sn Dist	%Wt	Sn Dist
+2440	-2.96	56.4	0.04	5.4	5.0	0.4
	+2.96	43.6	0.91	94.6	3.9	5.9
		100.0	(0.42)	100.0	8.9	6.3
+850	-2.96	46.9	0.05	3.9	23.0	1.9
	+2.96	53.1	1.08	96.1	26.1	47.1
		100.0	(0.60)	100.0	49.1	49.0
+300	-2.96	50.4	0.05	4.7	11.0	0.9
	+2.96	49.6	1.04	95.3	10.9	19.0
		100.0	(0.54)	100.0	21.9	19.9
+45	-2.96	39.3	0.03	1.7	5.2	0.3
	+2.96	60.7	1.14	98.3	8.1	15.4
		100.0	(0.70)	100.0	13.3	15.7
-45			0.80		6.8	9.1
TOTAL			(0.60)		100.0	100.0

HEAVY LIQUID ANALYSIS  
Cleveland S.M.F. (PB,1980)

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL		
		%Wt	%Sn	Sn Dist	%Wt	Sn Dist	Sn Dist
+2440	-2.96	51.0	0.15	12.3	8.67	2.0	
	-3.31	35.6	0.70	40.2	6.05	6.5	
	+3.31	13.4	2.19	47.5	2.28	7.6	
		100.0	(0.62)	100.0	17.0	16.1	
+850	-2.96	49.0	0.14	11.5	23.22	5.0	
	-3.31	35.1	0.66	38.7	16.64	16.8	
	+3.31	15.9	1.87	49.8	7.54	21.6	
		100.0	(0.60)	100.0	47.4	43.4	
+300	-2.96	49.3	0.13	11.0	7.69	1.5	
	-3.31	30.7	0.54	28.4	4.79	4.0	
	+3.31	20.0	1.77	60.6	3.12	8.4	
		100.0	(0.58)	100.0	15.6	13.9	
+45	-2.96	42.3	0.11	5.5	5.29	0.9	
	-3.31	33.0	0.29	11.3	4.13	1.8	
	+3.31	24.7	2.86	83.2	3.08	13.5	
		100.0	(0.85)	100.0	12.5	16.2	
-45			0.90		7.5	10.4	
TOTAL			(0.65)			100.0	

HEAVY LIQUID ANALYSIS  
678

Size Fraction $\mu\text{m}$	S.G.	UNIT			OVERALL		
		%Wt	%Sn	Sn Dist	%Wt	Sn Dist	Sn Dist
+2440	-2.96	7.7	0.15	0.9	1.5	0.2	
	-3.31	12.2	0.82	7.7	2.4	1.6	
	+3.31	80.1	1.32	91.4	15.5	16.4	
		100.0	(1.30)	100.0	19.4	18.2	
+850	-2.96	9.6	0.24	1.8	4.3	0.8	
	-3.31	11.6	0.71	6.3	5.2	2.9	
	+3.31	78.8	1.53	91.9	35.6	44.3	
		100.0	(1.31)	100.0	45.1	48.0	
+300	-2.96	12.5	0.24	2.3	2.1	0.4	
	-3.31	12.2	0.70	6.7	2.0	1.1	
	+3.31	75.3	1.55	91.0	12.6	15.7	
		100.0	(1.28)	100.0	16.7	17.2	
+45	-2.96	13.3	0.22	1.9	1.6	0.2	
	-3.31	9.2	0.63	5.7	1.1	0.6	
	+3.31	77.5	1.31	92.4	9.3	9.8	
		100.0	(1.10)	100.0	12.0	10.6	
-45			1.10		6.8	6.0	
TOTAL			(1.25)		100.0	100.0	

APPENDIX V

FLOTATION TEST SHEET

Project 46003  
 Test No: \_\_\_\_\_  
 Sample: G49 2.96 SINK  
 Date: 16/9/81  
 Mill Feed Size: -3350 um  
 Flotation Feed Size: -300 um  
 Mill Type: \_\_\_\_\_  
 Cell Type: Agitair  
 Times (min): Interval Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_  
 No: \_\_\_\_\_ Charge: \_\_\_\_\_  
 rpm: 700

NAME	REAGENT		Point of addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	% Solids	Remarks on Froth Conditions, etc.
	m1	kg/ton.								
CuSO <sub>4</sub>	0.1	S. COND	3							
S.E.X./P.A.X.	0.2	S. COND	3	rougher	10	ROOM	4.5	35		
S.E.X./P.A.X.	0.05	SCAV	3	SCAVENGER	10	ROOM	4.5			
M.I.B.C.	4 DROPS	S. COND	14							
H <sub>2</sub> SO <sub>4</sub>	AS NEEDED									

Li/L No:	Product	Weight g.	Weight % Product	Cum.	% Sn	Assay %	% S	Units		Distribution %
								Sn	S	
	S. CON 1	2119.4	38.4		0.30	42.6		17.6	71.9	
	S. CON 2	793.2	14.3		0.40	34.6		8.8	21.8	
	SCAV CON	309.2	5.6		0.78	16.8		6.7	4.1	
	SINK	2304.6	41.7		1.05	1.2		66.9	2.2	
	TOTAL	5526.4	100.0		(0.65)	(22.74)		100.0	100.0	

Test Object: \_\_\_\_\_

FLOTATION TEST SHEET

Project No: 7.003  
 Test No: \_\_\_\_\_  
 Sample: G65 2.96 SINK  
 Date: 16/9/81  
 Mill Feed Size: -3350 um  
 Flotation Feed Size: -300 um  
 Mill Type: \_\_\_\_\_ No: \_\_\_\_\_ Charge: \_\_\_\_\_  
 Cell Type: Agitair No: \_\_\_\_\_ rpm: 700  
 Times (min): \_\_\_\_\_ Interval: \_\_\_\_\_ Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

REAGENT

IUPAC	Addition		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	% Solids	Remarks on Froth Conditions, etc.
	ml	kg/ton.								
CuSO <sub>4</sub>	0.1		S. COND	3						
S.E.X./P.A.X.	0.2		S. COND	3	ROUGH	10	ROOM	4.5	35	
	0.05		SCAV	3	SCAVENGER	10	ROOM	4.5		
M.I.B.C.	4 DROPS		S. COND	1						
H <sub>2</sub> SO <sub>4</sub>	AS NEEDED									

FLOTATION

I.L./No:	Product	Weight g.	Weight % Product	Cum.	% Sn	Assay %	% S	Units	
								Sn	Distribution %
	S. CON	1037.6	20.1		0.24		38.6	6.2	59.6
	S. CON 2	572.2	11.0		0.48		34.6	6.8	29.5
	SCAV CON	290.2	5.6		0.89		20.9	6.4	9.0
	SINK	3271.0	63.3		0.99		0.4	80.6	1.9
	TOTAL	5171.0	100.0		(0.78)		(13.0)	100.0	100.0

SE OBJECT:

FLOTATION: TEST SHEET

Project No: 7.004

Mill Feed Size: -3330 um

Times (min): Interval Cumulative

Test No:

Flotation Feed Size: -300 um

Grinding: \_\_\_\_\_

Sample: G67 HIGH GRADE

Mill Type: \_\_\_\_\_ No: \_\_\_\_\_ Charge: \_\_\_\_\_

ReJays: \_\_\_\_\_

Date: 28/1/82

Cell Type: Agitair No: 800 rpm

Conditioning: \_\_\_\_\_

Flotation: \_\_\_\_\_

FLOTATION

Type	Addition		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	% Solids	Remarks on Froth Conditions, etc.
	ml	kg/ton.								
Cu <sub>2</sub> SO <sub>4</sub>		0.1	S. COND	3						
S.E.X.		0.15	S. COND	3						
AF65	4 DROPS		S. COND	1	ROUGHER	5	ROOM	6.2	35	ACID ABSORBING - H <sub>2</sub> SO <sub>4</sub> AS REQUIRED (PASSIVE CARBONATES)
Cu <sub>2</sub> SO <sub>4</sub>		0.05	SCAV	3				6.0		
S.E.X.		0.06	SCAV	1				6.2		
AF65	4 DROPS		SCAV	1	SCAVENGER 1	6		6.5		
H <sub>2</sub> O	500				SCAVENGER 2	8		6.5		
AF65										

M/L No:	Product	Weight g.	Weight % Product Cum.	Assay %		Units		Distribution %	
				% Sn	% S	% Sn	% S	% Sn	% S
	S. CON 1	1387.5	45.0	1.35	34.9	19.8	93.0		
	SCAV CON 1	213.2	6.9	2.95	7.4	6.6	3.0		
	SCAV CON 2	54.9	1.8	4.40	6.3	2.6	0.7		
	STK	1424.4	46.3	4.70	1.2	71.0	3.3		
	TOTAL	3080.0	100.0	(3.07)	(16.9)	100.0	100.0		

ST PRODUCT:

FLOTATION TEST SHEET

Project No: 7.004  
 Test No: \_\_\_\_\_  
 Sample: G67 LOW GRADE  
 Date: 29/1/82  
 Mill Feed Size: -3550 um  
 Flotation Feed Size: -300 um  
 Mill Type: \_\_\_\_\_  
 Cell Type: Agitair  
 No. \_\_\_\_\_  
 Charac: \_\_\_\_\_  
 rpm: 900  
 Times (min): \_\_\_\_\_ Interval \_\_\_\_\_ Cumulative \_\_\_\_\_  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

REAGENT	Addition		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	% Solids	Remarks on Froth Conditions, etc.
	ml	g/ton.								
CuSO <sub>4</sub>		0.1	S.COND	3						
S.E.X.		0.15	S.COND	3						
AF65	2 DROPS		S.COND	1	ROUGHER	5	ROOM	6.5	40	ACID ABSORBING - H <sub>2</sub> SO <sub>4</sub> AS REQUIRED (MASSIVE CARBONATES)
CuSO <sub>4</sub>		0.05	SCAV	3						
S.E.X.		0.08	SCAV	3						
AF65	2 DROPS		SCAV	1	SCAVENGER	6		6.1		

M/L/No:	Product	Weight g.	Weight % Product	Cum.	Assay %		Units	Distribution %	
					%Sn	%S		Sn	S
	S. CON	295.3	12.9		0.10	19.5		17.1	83.8
	SCAV CON	97.9	4.2		0.11	7.7		6.1	10.7
	SINK	1896.8	82.9		0.07	0.2		76.8	5.5
	TOTAL	2290.0	100.0		(0.08)	(3.0)		100.0	100.0

St Contact:

FLOTATION TEST SHEET

Project No: 7.003  
 Test No: \_\_\_\_\_  
 Sample: G72 2,96 SINK  
 Date: 15/9/81

Mill Feed Size: -3350  $\mu$ m  
 Flotation Feed Size: -300  $\mu$ m  
 Mill Type: \_\_\_\_\_  
 Cell Type: Agitair

Times (min): Interval Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

Charge: \_\_\_\_\_  
 No: \_\_\_\_\_  
 rpm: 700

NAME	Addition		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. $^{\circ}$ C	pH	% Solids	Remarks on Froth Conditions, etc.
	ml	kg/ton.								
CUSO <sub>4</sub>		0.1	S. COND	3						
S.E.X./P.A.X.		0.2	S. COND	3	ROUGHER	10	ROOM	4.5	35	
		0.5	S. COND	3	SCAVENGER	10	ROOM	4.5		
N.I.B.C.	4 DROPS		S. COND							
	4		SCAV							
CUSO <sub>4</sub>		0.10	SCAV	3						
S.E.X./P.A.X.		0.2	SCAV	20	SCAVENGER	5	ROOM	4.5		
		0.1	SCAV	5	SCAVENGER	5	ROOM	4.5		

ML/No:	Product	Weight g.	Weight % Product	Cum.	Assay %		Units	
					% Sn	% S	Sn	S
	S. CON 1	649.9	12.9		0.14	40.3	2.4	43.6
	S. CON 2	136.4	2.7		0.17	33.8	0.6	7.6
	SCAV CON 1	240.0	4.8		0.30	30.6	1.9	12.3
	SCAV CON 2	304.6	6.0		0.38	27.6	3.1	13.8
	SCAV CON 3	286.6	5.7		0.82	12.0	6.3	5.7
	SINK	3418.7	67.9		0.94	3.0	85.7	17.0
	TOTAL	5036.2	100.0		(0.74)	(12.1)	100.0	100.0

SE CHECK:



FLOTATION TEST SHEET

Project No: 7.004  
 Test No: \_\_\_\_\_  
 Sample: G81 HIGH GRADE  
 Date: 28/1/82  
 Mill Feed Size: -2250 um  
 Flotation Feed Size: -300 um  
 Mill Type: \_\_\_\_\_ No: \_\_\_\_\_ Charge: \_\_\_\_\_  
 Cell Type: Agitair No: \_\_\_\_\_ rpm: 800  
 Times (min): \_\_\_\_\_ Interval: \_\_\_\_\_ Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

NAME	REAGENT		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	% Solids	Remarks on Froth Conditions, etc.
	ml	kg/ton.								
CuSO <sub>4</sub>	0.1	S. COND	3							
S.E.X.	0.15	S. COND	3							
AF65	4 DROPS	S. COND	1	ROUGHER	5	ROOM	5.5			
H <sub>2</sub> O	750									ACID ABSORBING - H <sub>2</sub> SO <sub>4</sub> AS REQUIRED
CuSO <sub>4</sub>	0.05	SCAV	3							
S.E.X.	0.08	SCAV	1	SCAVENGER	6		6			
AF65	8 DROPS	SCAV	2							
H <sub>2</sub> O	250	SCAV		SCAVENGER	6		6.1			

M/L No:	Product	Weight g.	Weight % Product	Cum.	% Sn	% S	Units	
							Sn	S
	S. CON	1355.9	51.0		0.60	30.6	32.6	83.9
	SCAV CON 1	342.7	12.8		1.08	17.9	13.8	12.3
	SCAV CON 2	121.6	4.6		1.30	5.0	6.4	1.2
	SINK	839.8	31.6		1.40	1.5	47.2	2.6
	TOTAL	2660.0	100.0		(0.94)	(18.6)	100.0	100.0

St Object:

FLOTATION TEST SHEET

Project No: 7.004  
 Test No: \_\_\_\_\_  
 Sample: G81 LOW GRADE  
 Date: 29/1/82  
 Mill Feed Size: -3350 um  
 Flotation Feed Size: - 300 um  
 Mill Type: \_\_\_\_\_ No: \_\_\_\_\_ Charge: \_\_\_\_\_  
 Cell Type: Agitair No: \_\_\_\_\_ rpm: 800  
 Times (min): \_\_\_\_\_ Interval: \_\_\_\_\_ Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

REAGENT		FLOTATION										
NAME	Addition ml	Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.			
CuSO <sub>4</sub>	0.1	S.COND	3									
S.E.X.	0.15	S.COND	3									
AF65	3 DROPS	S.COND	1	ROUGHER	5	ROOM	5.8	-42				
H <sub>2</sub> O	250	SCAV							H <sub>2</sub> SO <sub>4</sub> AS REQUIRED			
CuSO <sub>4</sub>	0.05	SCAV	3	SCAVENGER 1	6		6.0					
S.E.X.	0.08	SCAV	1									
H <sub>2</sub> O	500	SCAV										
AF65	2 DROPS	SCAV	1									
S.E.X.	0.1	SCAV		SCAVENGER 2			6.4					
l:l/No:	Product	Weight g.	Weight % Product	%Sn	%S	Units	Distribution %					
	S. CON	926.9	20.2	0.40	29.9		22.8	85.1				
	SCAV CON 1	229.4	5.0	0.52	15.6		7.3	11.1				
	SCAV CON 2	51.4	1.1	0.41	4.7		1.3	0.7				
	SINK	3392.5	73/7	0.33	0.3		68.6	3.1				
	TOTAL	4600.2	100.0	(0.35)	(7.04)		100.0	100.0				

See Object:

APPENDIX VI



CORE G65

SUPERPANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL	
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .
-300 +75	CON 1	2.8	39.00	75.1	0.9	35.0
	CON 2	3.9	1.53	4.1	1.3	2.0
	CON 3	7.4	0.61	3.1	2.5	1.4
	TAIL	50.7	0.27	9.4	16.9	4.4
	TAIL	25.9	0.26	4.6	8.7	2.1
	TAIL	26.6	0.20	3.7	8.9	1.7
	CALC. HEAD	117.3	1.24	100.0	39.2	46.6
	ASSAY HEAD	-	-	-	-	-
+53 +45 +12	CON 1	1.8	58.40	83.5	0.6	33.7
	CON 2	1.2	5.05	4.8	0.4	1.9
	CON 3	3.6	0.65	1.9	1.2	0.8
	TAIL	19.0	0.15	2.3	6.3	0.9
	TAIL	22.4	0.27	4.8	7.5	1.9
	TAIL	19.2	0.18	2.7	6.4	1.1
	CALC. HEAD	67.2	1.87	100.0	22.4	40.3
	ASSAY HEAD	-	-	-	-	-
	CALC. HEAD					
	ASSAY HEAD					
-12 +8 -8 +5 -5		17.8	0.73		5.9	4.2
		12.7	0.59		4.2	2.4
		85.0	0.24		28.3	6.5
	TOTAL	300.0	(1.04)		100.0	100.0

CORE G72

SUPERPANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL	
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .
-300 +75	CON 1	2.1	31.3	53.6	0.8	23.7
	CON 2	1.9	5.58	8.7	0.7	3.8
	CON 3	3.6	1.73	5.1	1.3	2.3
	TAIL	33.0	0.34	9.2	12.3	4.1
	TAIL	36.6	0.32	9.6	13.6	4.2
	TAIL	30.4	0.30	7.4	11.3	3.3
	CALC. HEAD	137.9	0.89	100.0	51.3	44.2
	ASSAY HEAD	-	-	-	-	-
+53 +45	CON 1	0.7	46.5	74.7	0.3	11.8
	CON 2	0.8	3.28	6.0	0.3	0.9
	CON 3	1.5	1.00	3.4	0.6	0.5
	TAIL	21.9	0.17	8.5	8.1	1.3
	TAIL	19.1	0.17	7.4	7.1	1.2
		CALC. HEAD	44.0	0.99	100.0	16.4
	ASSAY HEAD	-	-	-	-	-
	CALC. HEAD					
	ASSAY HEAD					
-45 +12		0.7	63.4	62.0	0.3	16.0
		0.9	22.7	28.6	0.3	7.4
		2.8	1.36	5.3	1.0	1.4
	TAIL	12.8	0.23	4.1	4.8	1.0
	CALC. HEAD	17.2	4.16	100.0	6.4	25.8
	ASSAY HEAD	-	-	-	-	-
-12 +8 -8 +5 -5		14.1	0.86		5.2	4.4
		9.6	0.63		3.4	6.6
		46.2	0.20		17.1	3.3
	TOTAL	269.0	(1.03)		100.0	100.0

CORE G74 SUPERANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL		
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .	
+150 +106 +75	CON 1	1.2	39.00	69.1	0.7	17.1	
	CON 2	1.4	3.88	8.0	0.8	2.0	
	CON 3	2.2	1.09	3.5	1.2	0.9	
	TAIL	10.2	0.26	3.9	5.8	1.0	
	TAIL	19.8	0.26	7.6	11.2	1.9	
	TAIL	20.6	0.26	7.9	11.7	2.0	
-300 +75	CALC. HEAD	55.4	1.22	100.0	31.4	24.9	
	ASSAY HEAD						
+53 +45	CON 1	0.7	69.4	81.0	0.4	17.8	
	CON 2	0.7	5.74	6.7	0.4	1.5	
	CON 3	1.0	1.65	2.8	0.6	0.6	
	TAIL	19.0	0.23	7.3	10.8	1.6	
	TAIL	8.2	0.16	2.2	4.6	0.5	
-75 +45	CALC. HEAD	29.6	2.02	100.0	16.3	22.0	
	ASSAY HEAD						
-45 +12	CON 1	0.9	70.9	54.0	0.5	23.4	
	CON 2	0.6	58.2	29.6	0.3	12.8	
	CON 3	1.2	5.88	6.0	0.7	2.6	
	TAIL	40.9	0.30	10.4	23.2	4.5	
-45 +12	CALC. HEAD	43.6	2.71	100.0	24.7	43.3	
	ASSAY HEAD						
-12 +8 -8 +5 -5		17.0	0.84		9.6	5.1	
		11.3	0.67		6.4	2.8	
		19.5	0.26		11.7	1.9	
	TOTAL	176.4	(1.55)		100.0	100.0	

CORE G81 L.G. SUPERPANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL	
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .
	CALC. HEAD					
	ASSAY HEAD					
	CALC. HEAD					
	ASSAY HEAD					
	CON 1	0.9	25.3	64.1	0.8	55.8
	CON 2	1.8	1.45	7.3	1.6	6.4
	CON 3	8.5	0.51	12.0	7.5	10.5
	TAIL	75.6	0.08	16.6	66.0	14.4
-300 +12	CALC. HEAD	86.9	0.42	100.0	75.9	87.1
	ASSAY HEAD		0.37			
-12 +8		7.1	0.34		6.2	5.7
-8 +5		4.4	0.24		3.9	2.6
-5		16.1	0.12		14.0	4.6
	TOTAL	114.5	0.36		100.0	100.0
	ASSAY HEAD					0.40

CORE G81 H.G. SUPERPANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL	
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .
	CON 1	1.1	52.3	30.1	0.3	9.4
	CON 2	1.7	16.1	13.7	0.4	4.2
	CON 3	10.9	4.35	24.3	2.9	7.5
+212	TAIL	26.4	0.63	8.5	6.9	2.6
+150	TAIL	37.4	0.62	11.9	9.8	3.7
+106	TAIL	40.1	0.56	11.5	10.5	3.6
-300 +106	CALC. HEAD	117.6	1.66	100.0	30.8	31.0
	ASSAY HEAD		1.82			
	CON 1	1.6	62.9	54.3	0.4	16.1
	CON 2	0.6	19.5	6.7	0.2	2.0
	CON 3	3.7	4.78	9.6	1.0	2.8
+75	TAIL	44.8	0.58	13.9	11.7	4.1
+53	TAIL	32.4	0.63	11.0	8.5	3.3
+45	TAIL	13.9	0.60	4.5	3.6	1.3
-106 +45	CALC. HEAD	97.0	1.92	100.0	25.4	29.6
	ASSAY HEAD		2.08			
	CON 1	1.2	55.3	40.3	0.3	10.0
	CON 2	1.4	17.2	15.4	0.4	3.9
	CON 3	4.7	5.77	17.4	1.2	4.4
+22	TAIL	5.4	2.55	8.6	1.4	2.2
+17	TAIL	22.6	0.77	11.0	5.9	2.8
+12	TAIL	25.2	0.46	7.3	6.6	1.8
-45 +12	CALC. HEAD	60.5	2.62	100.0	15.8	25.1
	ASSAY HEAD		2.64			
-12 +8)		47.4	1.07		12.4	8.1
-8 +5)		59.6	0.65		15.6	6.2
	TOTAL	382.1	(1.65)		100.0	100.0
	ASSAY HEAD					1.75

CORE G78

SUPERPANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL	
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .
-300 +75	CON 1	1.1	40.8	19.7	0.4	8.1
	CON 2	1.0	16.57	7.3	0.3	3.0
	CON 3	3.9	5.69	9.7	1.3	4.1
	TAIL	47.4	1.46	30.3	16.0	12.4
	TAIL	29.4	1.20	15.6	9.9	6.4
+75	TAIL	34.5	1.15	17.4	11.7	7.1
-300 +75	CALC. HEAD	117.3	1.94	100.0	39.6	41.1
	ASSAY HEAD		1.94			
+53 +45	CON 1	0.4	62.0	41.5	0.1	4.5
	CON 2	0.3	16.2	7.3	0.1	0.8
	CON 3	1.2	3.15	6.5	0.4	0.7
	TAIL	23.5	0.96	37.7	7.9	4.0
	TAIL	5.5	0.76	7.0	1.9	0.8
-75 +45	CALC. HEAD	30.9	1.94	100.0	10.4	10.8
	ASSAY HEAD		1.98			
-45 +12	CON 1	1.2	60.8	40.6	0.4	12.6
	CON 2	1.2	10.30	7.4	0.4	2.3
	CON 3	2.7	9.75	15.1	0.9	4.7
	TAIL	61.3	1.03	36.9	20.7	11.6
	TAIL					
-45 +12	CALC. HEAD	66.4	2.59	100.0	22.4	31.2
	ASSAY HEAD		2.85			
-12 +8 -8 +5 -5	CON 1	19.1	1.65		6.5	5.7
	CON 2	11.5	1.55		3.9	3.2
	CON 3	50.9	0.87		17.2	8.0
	TAIL					
	TAIL					
	TOTAL	296.0	1.81		100.0	100.0
	ASSAY HEAD		1.94			

ASSAY HEAD

1.94

CORE G67 H.G. SUPERPANNING RESULTS (SULPHIDE SINK)

Size (µm)	Product	UNIT			OVERALL	
		Wt (g)	%Sn	Dist <sup>n</sup> .	%wt	Dist <sup>n</sup> .
+150 +75	CON 1	1.0	43.0	20.8	0.9	8.2
	CON 2	1.9	22.8	21.0	1.7	8.3
	CON 3	4.3	9.43	19.2	3.9	7.6
	TAIL	19.1	3.95	35.3	17.6	13.8
	TAIL	17.5	0.44	3.7	16.1	1.5
-300 +75	CALC. HEAD	43.8	4.77	100.0	40.2	39.4
	ASSAY HEAD		4.84			
+45 +12	CON 1	2.0	42.3	37.9	1.8	16.2
	CON 2	1.2	19.8	10.6	1.1	4.5
	CON 3	4.4	9.41	18.2	4.0	7.8
	TAIL	17.5	3.33	25.6	16.2	10.9
	TAIL	14.1	1.25	7.7	12.9	3.3
-75 +12	CALC. HEAD	39.2	5.79	100.0	36.0	42.7
	ASSAY HEAD		5.63			
-12 +8 -8 +5 -5	CON 1	9.5	5.10		8.7	9.1
	CON 2	5.1	4.10		4.7	3.9
	CON 3	11.3	2.30		10.4	4.9
	TAIL					
	TAIL					
	TOTAL	108.9	4.88		100.0	100.0
	ASSAY HEAD		4.96			

ASSAY HEAD

4.96

APPENDIX VII

ABERFOYLE LTD.  
METALLURGICAL SERVICES  
FLOTATION TEST SHEET

Project No: 4.003/7,003  
 Test No: T7  
 Sample: G49  
 Date: 9/10/81

Mill Feed Size: -300 micron  
 Flotation Feed Size: -106 micron  
 Mill Type: No: Charge: 1.3 kg  
 Cell Type: No: Tm:

Times (min): Interval Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

REAGENT		FLOTATION													
ML/No:	Product	Addition ml	Point of Addition g/ton.	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.	Assay %				
											Weight g.	Product	Cum.	Sn	Units
	CuSO <sub>4</sub>		0.08 S.COND.	5											
	S.E.X.		0.15 S.COND.	3											
	MIBC	2 DROPS	S.COND.		S.CON.	10	ROOM	5.5		H <sub>2</sub> O & H <sub>2</sub> SO <sub>4</sub> AS REQUIRED.					
	S.S.F.		0.25 OX.COND.	5											
	S.P.A.		0.25 OX.COND.	15	OXIDE CON 1	3		4.7-5.1							
	MIBC	2 DROPS	OX.COND.		CON 2	3									
			OX.COND.		CON 3	4									
	SPA		0.1 OX.COND.	5											
	MIBC	2 DROPS	OX.COND.		CON 4	10		4.9-5.1							
			Weight Product		Assay % Sn										
	S.CON.		123.1	10.0								0.69			6.5
	OXIDE CON 1		27.1	2.2								4.75			9.9
		2	14.9	1.2								3.34			3.8
		3	41.9	3.4								2.11			6.8
		4	112.2	9.2								3.00			26.1
	SINK		906.5	74.0								0.67			46.9
	TOTAL		1225.7	100.0								(1.06)			100.0
	ULTRASLIMES		51.6									0.68			

Post Object:



**ABERFOYLE LTD.**  
**METALLURGICAL SERVICES**  
**FLOTATION TEST SHEET**

Project No: 4.003/7.003  
 Test No: T6  
 Sample: G65  
 Date: 8/10/81

Mill Feed Size: -300 micron  
 Flotation Feed Size: -106 micron  
 Mill Type: No: Charge: 1.30 kg  
 Cell Type: No: 800 rpm  
 Flotation: \_\_\_\_\_

Times (min): \_\_\_\_\_ Interval \_\_\_\_\_ Cumulative \_\_\_\_\_  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_

REAGENT		FLOTATION										
NAME	Addition ml	Point of addition g/ton.	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.			
									Initial PHILP LEVEL = 28L	800 rpm/900 rpm MANUAL AFTER 6 MINS.		
CUSO <sub>4</sub>	0.08	S.COND.	5									
S.F.X.	0.15	S.COND.	3									
MIBC	2 DROPS	S.COND.	5	S.CON.	10	ROOM	5.2-5.5					
SSF	0.25	OX.COND.	15									
SPA	0.25	OX.COND.	5									
MIBC	2 DROPS	OX.COND.	5	OXIDE CON 1	3		5.7			200 ml H <sub>2</sub> O ADDED FOR CON. 1		
SPA	0.1	OX.COND.	5	CON 2	3		5.2			300 ml H <sub>2</sub> O ADDED FOR CON. 4		
MIBC	1 DROP		5	CON 3	4					400 ml H <sub>2</sub> O ADDED FOR CON. 5		
SPA	0.05		5	CON 4	5		4.0					
MIBC	1 DROP		5	CON 5	5							
ML/No:	Product	Weight g.	Weight Product Cum.	Assay %	Units							Distribution %
	S. CON.	62.4	5.2	Sn								Sn
	OXIDE C 1	31.6	2.6	0.46								2.2
	C 2	29.5	2.5	5.05								12.2
	C 3	43.6	3.6	3.22								7.5
	C 4	36.5	3.1	5.11								17.0
	C 5	72.9	6.1	4.04								11.6
	SINK	919.2	76.9	3.71								21.0
	TOTAL	1195.79	100.0	0.40								28.5
	ULTRASLIMES	75.4		(1.08)								100.0
	ULTRASLIMES	75.4		0.21								

Test Object:



**ABERFOYLE LTD.**  
**METALLURGICAL SERVICES**  
**FLOTATION TEST SHEET**

Project No: 4.003/7.003      Mill Feed Size: -300 microns      Times (min):            Interval            Cumulative

Test No: 75      Flotation Feed Size: -106 micron-      Grindlog:           

Sample: G72      Mill Type:            No:            Charge: 1.35 kg      Delay:           

Date: 8/10/81      Coll. Type:            No:            Con:                 Conditioning:           

Flotation:           

REAGENT										FLOTATION				
NAME	Addition		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.	Distribution %			
	ml	kg/ton.									Sn	Units	Sn	
CUSO <sub>4</sub>		0.8	S.COND.	5										
S.F.X.		0.15	S.COND.	3										
MIBC	4 DRIPS				S. CON.	10	ROOM	5.2	35					
SSF		0.25	OX.COND.	5										
SPA		0.25	OX.COND.	15										
MIBC					OXIDE CON 1	3		4.7						
SPA	2.8	0.10		5	CON 2	3								
MIBC					CON 3	4		5.0						
					CON 4	10		4.9						
HL/No:	Product	Weight g.	Weight Product	Cum.	Assay % Sn	Units				Distribution % Sn				
	S. CON.	88.5	6.7		0.32					2.1				
	OXIDE C 1	30.6	2.4		3.70					8.8				
	C 2	25.5	2.0		3.79					7.5				
	C 3	26.2	2.1		3.42					7.1				
	C 4	34.9	2.7		5.92					15.9				
	SINK	1092.2	84.1		0.70					58.6				
	TOTAL	1297.9g	100.0		(1.01)					100.0				
	ULTRASLIME	12.0			0.13									

TEST OBJECT:

AERPOYLE LTD.  
METALLURGICAL SERVICES  
FLOTATION TEST SHEET

Project No: 7.004  
 Test No: \_\_\_\_\_  
 Sample: G78  
 Date: 8/12/81

Mill Feed Size: -300 MICRON  
 Flotation Feed Size: .106 MICRON

Times (min): \_\_\_\_\_ Interval: \_\_\_\_\_ Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

Mill Type: \_\_\_\_\_ No: \_\_\_\_\_ Charge: \_\_\_\_\_  
 Cell Type: \_\_\_\_\_ No: \_\_\_\_\_ rpm: \_\_\_\_\_

REAGENT										FLOTATION					
NAME	Addition		Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.	Assay % Sn	Weight Product g.	Weight Product Cum.	Units	Distribution % Sn
	m1	g/ton.													
CuSO <sub>4</sub>	.08	S. COND.	3												
S.E.X.	.10	S. COND.	3	S. CON.	5	ROOM	5	3.5							
S.S.F.	.25	OX COND.	5												
S.P.A.	.25	OX COND.	15	OXIDE CON 1	3		5								
	.05	OX COND.	5	OXIDE CON 2	3		5								
MFBC	4 & 2 DROPS			OXIDE CON 3	4										
H <sub>2</sub> SO <sub>4</sub>	AS NEEDED			OXIDE CON 4	10										
HL/No:	Product	Weight g.	Point of Addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.	Assay % Sn	Weight Product g.	Weight Product Cum.	Units	Distribution % Sn
	S. CON.	29.89									1.15	2.4			1.05
	OXIDE CON 1	20.35									12.50	1.7			9.95
	CON 2	33.95									13.00	2.8			17.27
	CON 3	52.37									6.80	4.3			13.94
	CON 4	271.22									2.45	22.2			26.01
	SINK	811.93									1.00	66.6			31.78
	TOTAL	1219.71									(2.09)	100.0			100.00

Test Object:

**BEREFOYLE LTD.**  
**METALLURGICAL SERVICES**  
**FLOTATION TEST SHEET**

Project No: 7.004  
 Test No: \_\_\_\_\_  
 Sample: G81 Low Grade  
 Date: 2/2/82

Mill Feed Size: -300 micron  
 Flotation Feed Size: -106 micron  
 Mill Type: No: \_\_\_\_\_ Charge: 2.46 kg  
 Cell Type: No: \_\_\_\_\_ RPM: 800

Times (min): \_\_\_\_\_ Interval: \_\_\_\_\_ Cumulative  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

REAGENT		FLOTATION									
NAME	Addition ml	Point of addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.		
CUSO <sub>4</sub>		0.08 S.COND.	3								
S.E.X.		0.15 S.COND.	3								
AF65	5 DROPS	S.COND.	1	S.CON.	8	ROOM	5.0	35	H <sub>2</sub> SO <sub>4</sub> AS REQUIRED		
S.S.F.		0.3 OX.COND.	5								
S.P.A.		0.35 OX.COND.	15								
AF65	3 DROPS	OX.COND.	1	OXIDE CON 1	5		5.3				
S.P.A.				CON 2	5		5.0				
AF65	3 DROPS		5	CON 3	5		4.9				
				CON 4	5		5.0				
ML/No:	Product	Weight g.	Weight % Product Cum.	Assay % Sn	Units	Distribution %					
	S.CON.	58.7	2.3	0.58	Sn	3.0					
	OXIDE CON 1	144.0	5.8	4.70		62.3					
	CON 2	200.5	8.0	0.96		17.5					
	CON 3	148.9	6.0	0.39		5.3					
	CON 4	41.1	1.6	0.19		0.7					
	CON 5	135.4	5.4	0.12		1.5					
	SINK	1773.0	70.9	0.06		9.7					
	TOTAL	2501.6	100.0	(0.44)		100.0					

Post Effect: \_\_\_\_\_

ABERFOYLE LTD.  
METALLURGICAL SERVICES  
FLOTATION TEST SHEET

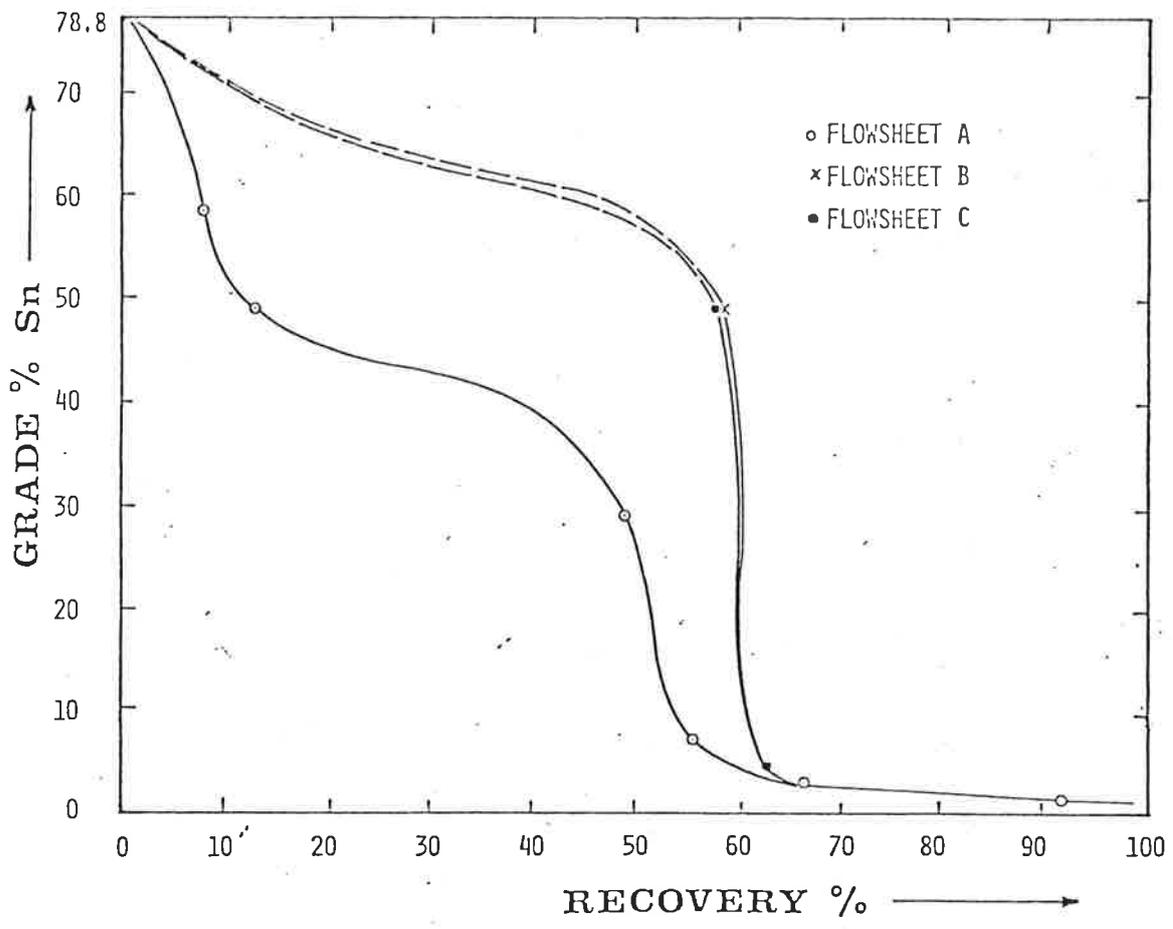
Project No: 7.004  
 Test No: \_\_\_\_\_  
 Sample: 681 High Grade  
 Date: 2/2/82  
 Mill Feed Size: \_\_\_\_\_  
 Flotation Feed Size: \_\_\_\_\_  
 Mill Type: \_\_\_\_\_ No: \_\_\_\_\_ Charge: 1.77 kg  
 Cell Type: \_\_\_\_\_ No: \_\_\_\_\_ RPM: 900  
 Times (min): \_\_\_\_\_ Interval: \_\_\_\_\_ Cumulative: \_\_\_\_\_  
 Grinding: \_\_\_\_\_  
 Delay: \_\_\_\_\_  
 Conditioning: \_\_\_\_\_  
 Flotation: \_\_\_\_\_

REAGENT		FLOTATION									
NAME	Addition ml	Point of addition	Cond. time (min.)	Stage	Time (min)	Temp. °C	pH	Solids	Remarks on Froth Conditions, etc.	Distribution	Units
CuSO <sub>4</sub>	0.08	S. COND	3								
S.E.X.	0.15	S. COND	3								
AF65	3 DROPS	S. COND	1	S. COND	10	ROOM	4.5		H <sub>2</sub> SO <sub>4</sub> AS REQUIRED		
S.S.F.	0.3	OX. COND.	5								
S.P.A.	0.35	OX. COND	15								
AF65	3 DROPS			OXIDE CON 1	5		4.5				
S.P.A	0.15		5	CON 2	5						
AF65	3 DROPS			CON 3	5		4.6				
S.P.A.				CON 4	5		4.7				
S.P.A. ML/No:				ASSON 5	8		4.9				
S. CON	53.7	4.5		Sn	1.75						
OXIDE CON 1	159.6	13.4			12.0						
CON 2	47.3	4.0			4.20						
CON 3	50.7	4.2			1.60						
CON 4	36.2	3.0			1.25						
CON 5	68.8	5.7			0.78						
SINK	781.1	65.2			0.26						
TOTAL	1197.4	100.0			(2.17)						100.0
ULTRASLIMES	572.6										0.72

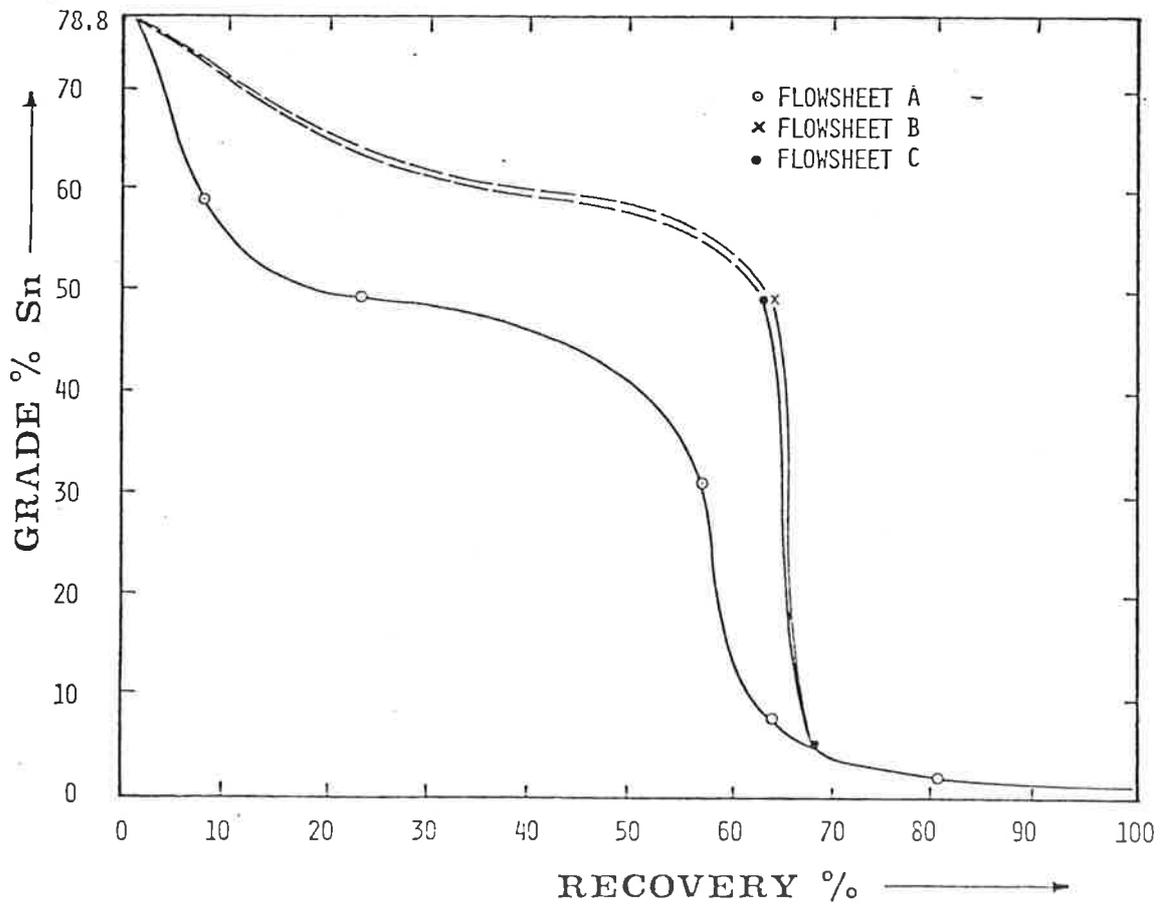
Test Object:

APPENDIX VIII

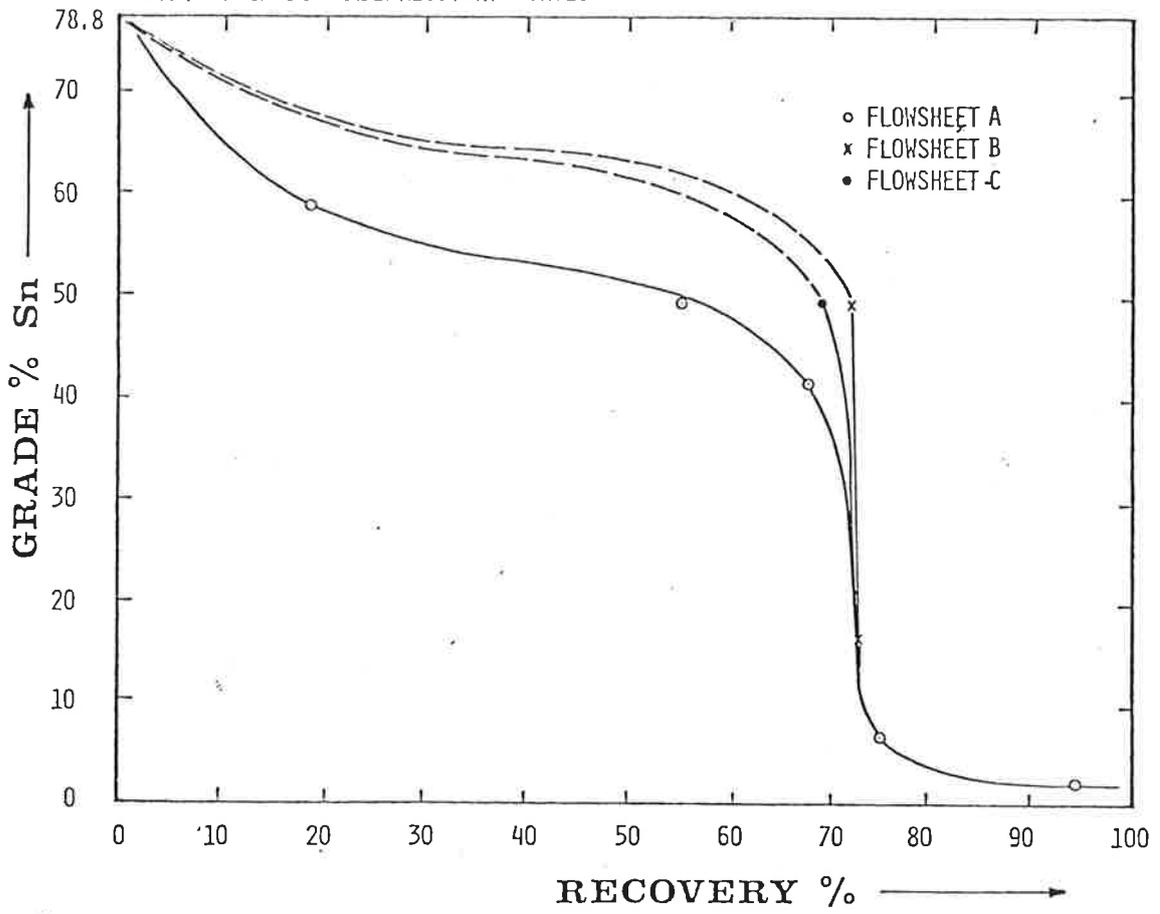
G49: OVERALL GRADE/RECOVERY CURVES



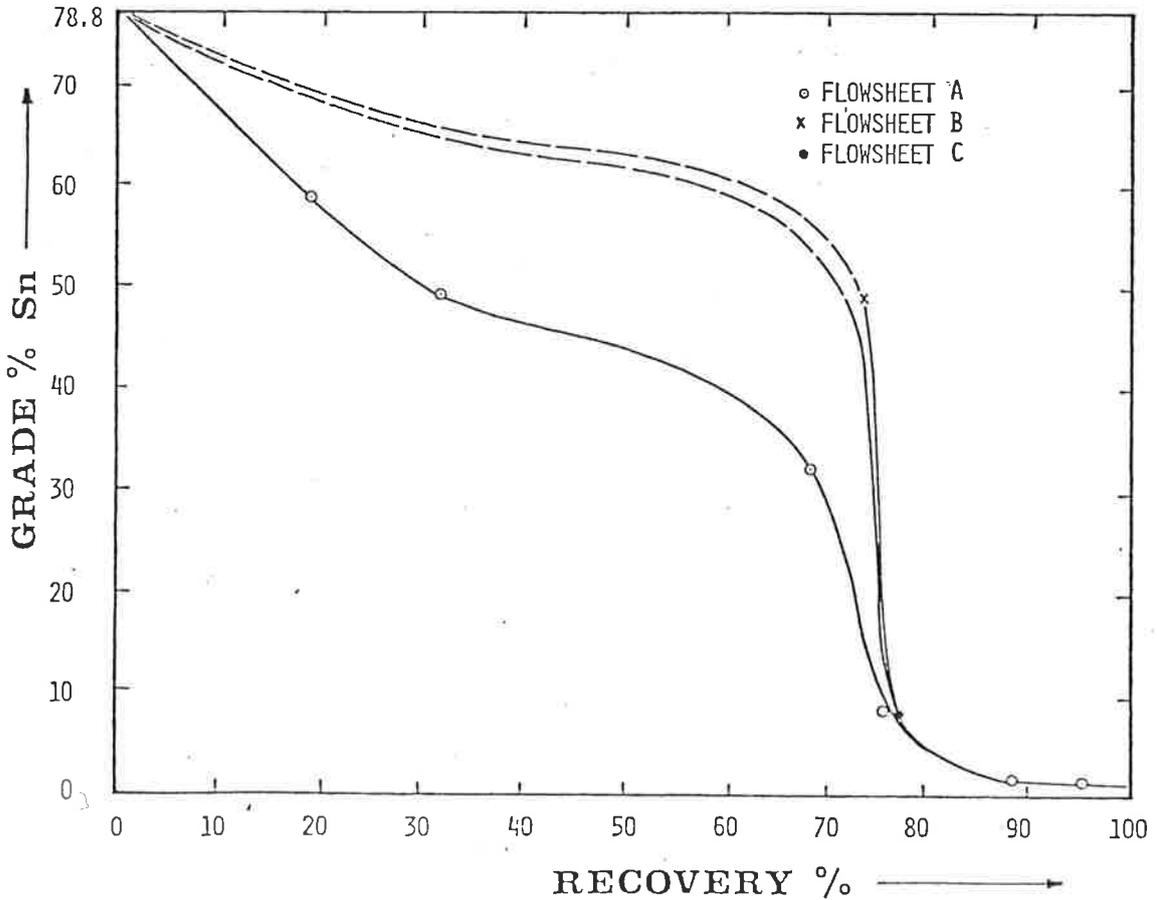
G62: OVERALL GRADE/RECOVERY CURVES



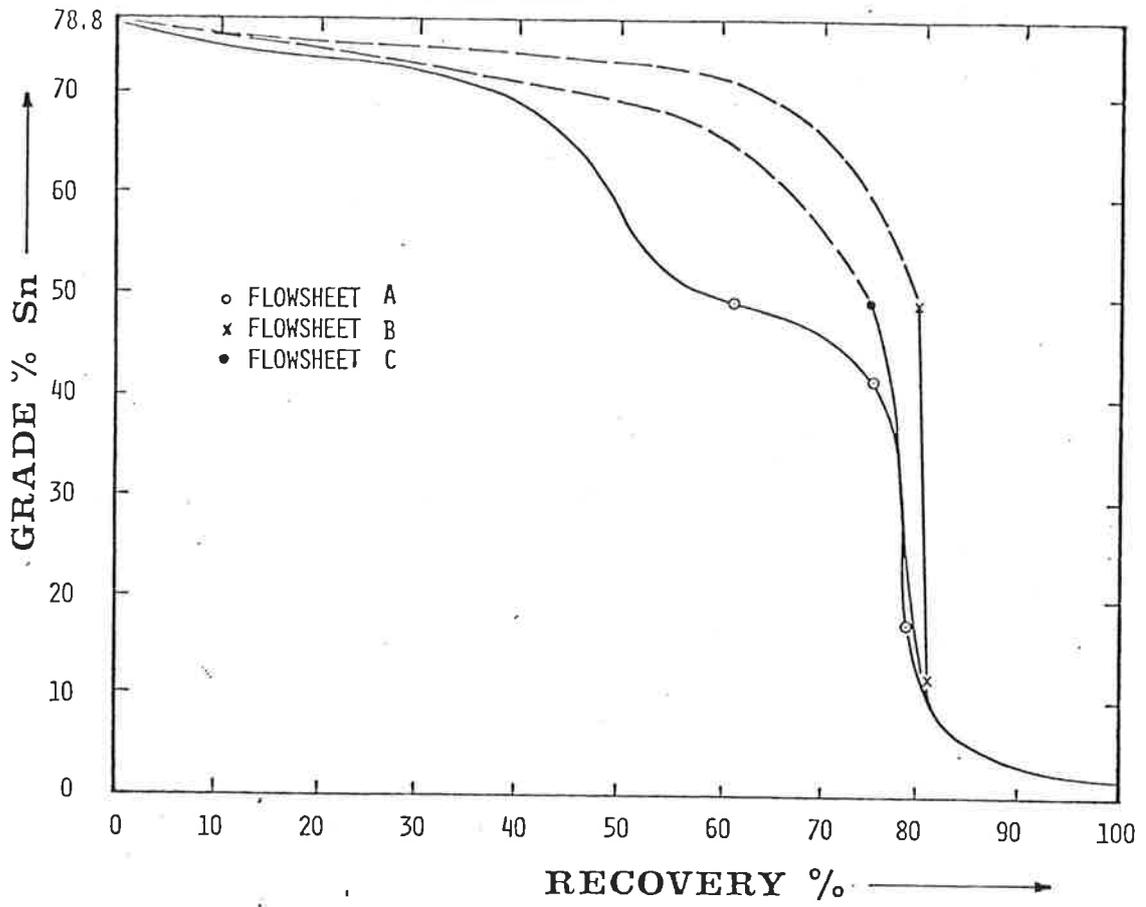
G65: OVERALL GRADE/RECOVERY CURVES



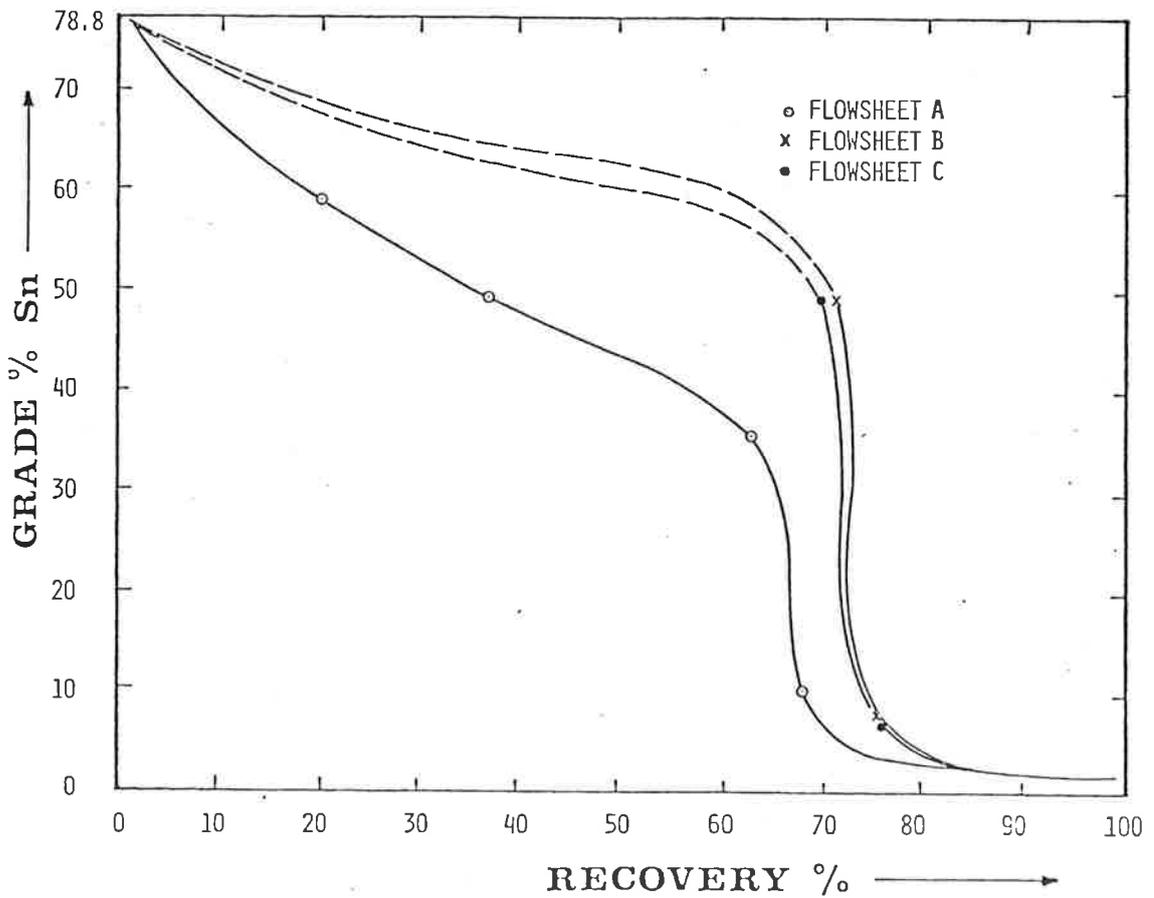
G72: OVERALL GRADE/RECOVERY CURVES



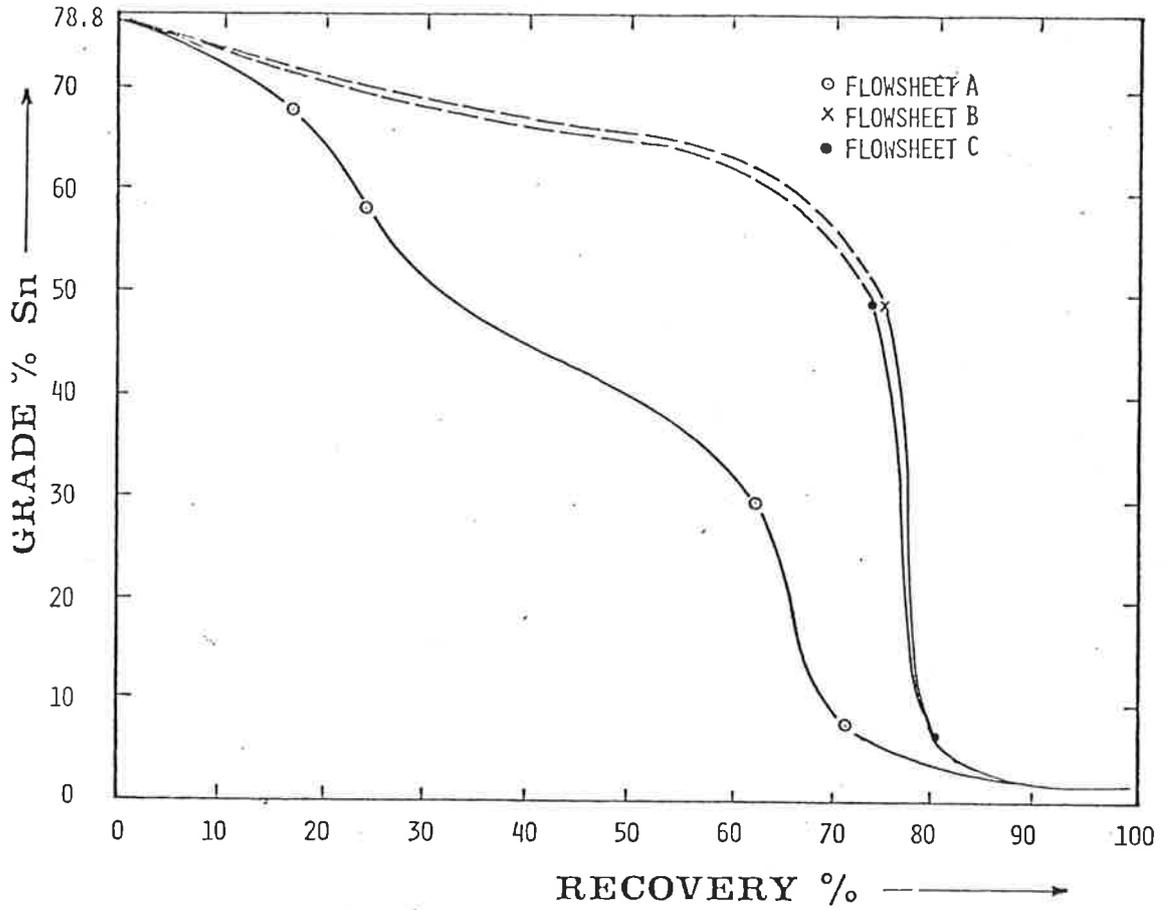
G74: OVERALL GRADE/RECOVERY CURVES



G81: COMBINED, OVERALL GRADE/RECOVERY CURVES



G78: OVERALL GRADE/RECOVERY CURVES



G67: (HIGH GRADE): OVERALL GRADE/RECOVERY CURVES

