

000

489001

MICROFILMED

TIN - TUNGSTEN - BASE METAL MINERALIZATION

ASSOCIATED WITH

THE BEN LOMOND GRANITE BATHOLITH

ML 27M/77

ABERFOYLE DISTRICT

NORTHEAST TASMANIA.

T. G. SUMMONS,
SUMMONS GEOSERVICES PTY. LTD.
JULY, 1983.

TABLE OF CONTENTS

001

	<u>PAGE NO.</u>
SUMMARY	(i)
INTRODUCTION	1.
GEOLOGY OF THE BEN LOMOND BATHOLITH	3.
A. LITHOLOGIES	3.
B. GEOCHEMICAL CHARACTERISTICS	3.
C. COMPARISON WITH THE BLUE TIER BATHOLITH	5.
D. CONCLUSION	6.
MINERALIZATION	8.
A. MINERALIZATION ASSOCIATED WITH THE BLUE TIER BATHOLITH	8.
B. MINERALIZATION ASSOCIATED WITH THE BEN LOMOND BATHOLITH	9.
C. GREISEN POTENTIAL IN THE BEN LOMOND BATHOLITH	9.
D. TUNGSTEN-TIN-COPPER-SILVER/LEAD/ZINC ZONING POTENTIAL ASSOCIATED WITH THE BEN LOMOND BATHOLITH.	13.
EXPLORATION RATIONALE	15.
A. RANK OF DEPOSITS	15.
B. STRUCTURAL CONSIDERATIONS	17.
1. JOINTS, FAULTS AND VEIN ORIENTATIONS	17.
2. SUB SURFACE GRANITE MORPHOLOGY	18.
3. DISCUSSION	19.
PROSPECTS AND ANOMALIES	21.

002

SUMMARY

The Ben Lomond Granite Batholith shows a strong mineralogical and geochemical affinity with the fractionated granitoids of the Blue Tier Batholith, and has itself been fractionated from a calc-alkali granite (biotite granite) to an alkali granite (inferred biotite/muscovite granite).

The inferred biotite/muscovite granite shows a strong geochemical correlation with several muscovite/biotite granites ("tin granites") in the Blue Tier Batholith.

Five primary associations of mineralization occur in or related to the Ben Lomond Batholith, namely:

- (i) Exogranitic quartz vein systems (strike extent \geq 500m);
- (ii) Exogranitic quartz vein systems (strike extent \leq 100m) and fracture stockworks;
- (iii) Endogranitic quartz veins and greisen veins;
- (iv) Endogranitic fracture stockworks and greisen pipes;
- (v) Aplite and greisenized aplite bodies.

The potential occurrence of large greisen sheets (eg. Anchor deposit) is considered to be minor, and the potential for massive "greisens" (Ardlethan type) even more remote.

The potential for zoned W-Sn-Cu-Ag/Pb/Zn mineralization is indeterminate on present knowledge, and several possibly relevant features in the area require evaluation.

Structural considerations involving mapped defects, and gravity based sub-surface granite morphology imply major NW (and probably NE) trending linears influenced both the granite/aplite intrusions, and the subsequent primary mineralization.

003

Several major residual Bouguer gravity anomalies exist in the area, and appear similar in status to the Aberfoyle and Storeys Creek aplite bodies.

The primary mineral deposits in the Rossarden area have been ranked according to inherent tin metal content, probability of occurrence, assumed metallurgical character, and the suitability for various mining methods.

The three highest ranking categories of mineralization are exogranitic quartz vein systems, aplite/greisenized aplite bodies, and exogranitic veins in association with fracture stockworks.

004

INTRODUCTION

Consolidated Mineral Lease 27M/77 covers an area of 2500 ha in northeast Tasmania, and includes the town of Rossarden which is approximately 100km by road from Launceston.

The lease boundaries are shown on Mines Department Mineral Charts Mt. Rex, Rossarden, Ben Lomond and Sphinx Bluff.

The lease was previously held by Aberfoyle Ltd. and Rossarden Mines Ltd. who operated the now abandoned Storeys Creek (tungsten) and Aberfoyle (tin-tungsten) mines. At present the transfer of ML27M/77 to H. J. Stacpoole is in the final stages of preparation.

Amongst the large number of authors who have contributed to the knowledge of the geology of the Rossarden area are the following: Blisset (1959), Clayton (1981), Edwards and Lyon (1957), Groves (1972, 1977), Groves and Taylor (1973), Hellsten (1979), Henderson (1935, 1936, 1946), Keid (1954), Kingsbury (1965), Lyon (1957), Nye (1941), Reid and Henderson (1929), Scott (1929, 1934) and Urquhart (1966, 1967).

In the Rossarden area, aplite cupolas have long been recognized as having an important, but generally unspecified role in the formation of large (hydro-thermal) exogranitic quartz vein systems (eg. Aberfoyle and Storeys Creek deposits).

The limited exploration conducted in the area has consequently been directed at locating additional vein systems, with apparently minimum effort made to establish the potential of the Ben Lomond Granite to host other types of mineralization, such as occur in the adjacent Blue Tier Batholith of north east Tasmania.

This report attempts to integrate all previous geological studies in the area, with the object of comprehensively re-appraising the area represented by ML 27M/77 for its remaining mineral potential.

005

Previous work by the author in a report entitled "Preliminary Report on Tin-Tungsten Mineralization in ML 27M/77", concentrated mainly on the Lutwyche-Kookaburra prospects, and should be read in conjunction with the present report.

006

GEOLOGY OF THE BEN LOMOND BATHOLITHA. LITHOLOGIES

Following some detailed investigations in recent years (Hellsten 1979, and Clayton 1981), data on the Ben Lomond Granite has increased considerably, the main granitoid types in the Rossarden area are:

1. Coarse grained, variably porphyritic biotite granite;
2. Fine grained porphyritic biotite granite;
3. Fine/medium grained quartz-muscovite-tourmaline rock(QMT);
4. Microgranite;
5. Aplite;
6. Pegmatite;
7. Quartz-feldspar porphyries.

The course grained (cg.) biotite granite occupies the largest volume, with the fine grained (fg) porphyrite granite variably present within or surrounding the former.

The tourmaline leucogranite [QMT]) outcrops mainly between Tasmania and Nisbet Creeks northwest of Aberfoyle. Minor intrusive phases are represented by microgranite, aplite, pegmatite, and porphyry dykes; the aplite also occurs as stocks of cupolas emanating from the main granite body, and the latter variably enveloped by a carapace of microgranite.

B. GEOCHEMICAL CHARACTERISTICS

Typical elements used as indicators of increasing fractionation in granitic rocks are Mg, Ca, Sr, Ba, Li, Na, K, Rb, Sn and W. The depletion of Na(+K) and the alkaline earth elements is accompanied by increases in Li, Rb, Sn, W and F. The conventional method of presenting fractionation trends in granitic rocks is to graph the ratio of Mg/Li versus the ratio K/Rb, such that

progressively lower values for both ratios indicate a trend toward the alkali granites.

The chemistry of six granitic rocks from the Ben Lomond Granite were studied, namely e.g. biotite granite, f.g. porphyritic granite, microgranite (dyke), quartz-muscovite-tourmaline rock, aplite, and greisenized aplite (II Level Aberfoyle).

However, the limited analytical data, combined with some anomalously high Mg, anomalously low Ca, and erratic Li values from the microgranite and the Q-M-T rock, meant that the Mg/Li ratio in particular was not a useful discriminant of fractionation. The high Mg values probably reflect the formation of secondary tourmaline, while the low Ca reflects the absence of fluorite in the Q-M-T rock.

The K/Rb ratio showed a distinct trend from f.g. porphyritic granite to c.g. biotite granite to microgranite to Q-M-T rock to aplite to greisenized aplite.

Excluding the microgranite data, the trends of increasing Li and decreasing Ba and Na also follows the K/Rb trend, but the trend of Sr is erratic, due partly to the high values in the greisenized aplite (? similar to the greisen at the Anchor mine).

The trend of increasing Rb suggests that the Q-M-T rock is a differentiate of the aplite, whereas the trends of decreasing K and Na imply the opposite. Consequently, (because of the anomalous Mg and Ca values, and because isomorphous substitution of these elements seemed likely), it was decided to combine all elements with common fractionation trends in the following ratios:

1. $\frac{K + Na}{Li + Rb}$ - decreasing values of this ratio confirmed the K/Rb trend, but also emphasised a major gap between the group of Q-M-T rock, aplite and greisenized aplite, and the granites.

2. $\frac{\text{Mg}+\text{Ca}+\text{Sr}+\text{Ba}}{\text{Li}+\text{Rb}}$ - progressively declining values of this ratio also confirmed the K/Rb trend and also indicated three groups of similar values, ie: f.g. porphyritic granite (13), c.g. biotite granite (13), microgranite (7), aplite (4.6), greisenized aplite (4.1) and Q-M-T rock (3.5).

C. COMPARISON WITH THE BLUE TIER BATHOLITH

Groves (1977) gave a succinct description of the geology etc. of the Blue Tier Batholith, from which the following salient features are taken:

1. The Blue Tier Batholith consists of a suite of calcalkaline granitic rocks which show a normal fractionation trend characterised by increasing Si, Al, K, Li, Rb, F and Sn, and decreasing Fe, Mg, Ca, Sr and Ba. The geochemical evidence suggests a single magmatic fractionation series, from granodiorite to adamellite to calc-alkali granite to alkali granite.
2. The adamellite and calc-alkali granite interval of this series is represented by biotite granites/adamellites which are typically coarse grained or porphyritic. They form large homogenous steep sided plutons, and collectively account for > 50 vol% of the Blue Tier Batholith.
3. The alkali granites are represented by muscovite-biotite granite, typically fine medium grained, with a general sheet like form; they are strongly fractionated with low K/Rb, Mg/Li, Sr and Ba, but high Sn, W and F. Main examples are the Mt. Paris, Mt. William, Mt. Cameron and Lottah sheets; related but slightly different sheets of biotite-muscovite granite occur at Sheoak Hill, Little Mt. Horror and Constable Creek. These latter sheets of granite are characterised by the presence of tourmaline, lack of fluorite, and biotite in excess of muscovite.

All muscovite/biotite granites are younger than the c.g. biotite granites, and occupy 2 vol% of the Blue Tier Batholith.

Geochemical analyses of the Ben Lomond granitoids indicate strong affinities

009

with granitoids from the Blue Tier area, based on petrological and geochemical characteristics (particularly Mg/Li, K/Rb, Sn, Li, Sr, Ba);

(i) The Ben Lomond c.g. biotite granite ^{is} very similar to the Boobyalla and Poimena (adjacent to the Anchor mine) granite plutons;

(ii) The tourmaline leucogranite (Q-M-T rock) is very similar to the Mt. Paris muscovite-biotite granite sheet, but also has affinity with the Sheoak Hill, Little Mt. Horror and Constables Creek biotite-muscovite granite

The Poimena biotite granite forms part of the fractionated series of granitic rocks mentioned previously, and is intruded by the muscovite-biotite granite (alkali or "tin granite") of the Lottah sheets.

The Mt. Paris muscovite-biotite granite sheet intrudes both Mathinna Beds, and the western edge of the Poimena granite, and both the Lottah and Mt. Paris sheets host important primary tin deposits.

D. CONCLUSIONS.

1. The sequence of crystallization of the Ben Lomond granitic rocks appears to represent the calc alkali to alkali granite end of a normal granitic fractionation series, as follows:

(i) f.g. porphyritic granite [chilled margin of (ii)]

(ii) c.g. biotite granite (major phase of Ben Lomond Batholith)

(iii) Microgranite

(iv) f/m.g. biotite/muscovite granite (inferred, and now altered to quartz-muscovite-tourmaline rock).

(v) Aplite (and probably pegmatite, quartz-feldspar porphyry)

(~~iv~~) Greisenization of the biotite/muscovite granite + aplites.

2. A major geochemical hiatus occurs generally about the same time as the intrusion of the microgranite dykes.

3(i) A strong mineralogical and geochemical affinity exists between the Ben Lomond c.g. biotite granite and the Poimena biotite granite;

- 010³⁽ⁱⁱ⁾ A strong geochemical affinity exists between the Ben Lomond (inferred) biot/mus granite and the Mt. Paris muscovite-biotite granite;
- 3(iii) A less significant mineralogical and geochemical affinity exists between the Ben Lomond (inferred) biotite/muscovite granite and the Constables Creek biotite-muscovite granite.
4. The sequence of crystallization (points 1,2 above) and the correlations made (in point 3 above) with the Blue Tier Batholith, suggest the Ben Lomond (inferred) biotite/muscovite granite is a younger intrusive body, enplaced near the top of the older Ben Lomond biotite granite.
5. In common with the primary tin mineralization in the Blue Tier Batholith, the Ben Lomond (inferred) biotite/muscovite granite and the aplite (cupolas etc) appear to be the penultimate crystallized portions of the residual magmatic fluids that were eventually to greisenise both rock types, and to precipitate the Sn-W-Sulphide minerals present in the Aberfoyle etc. quartz veins.

011

MINERALIZATION

It is considered appropriate, in view of the mineralogical and geochemical affinity of the Ben Lomond Batholith with portions of the Blue Tier Batholith, to review the primary mineralization in the latter, in order to fully assess the mineral potential of the Ben Lomond Batholith.

A. MINERALIZATION ASSOCIATED WITH THE BLUE TIER BATHOLITH

Primary mineralization occurs in three groups, Sn + W, Cu + Ag-Pb-Zn, and Au, Au-Ag deposits.

1. Tin - Tungsten

This mineralization (cassiterite and wolframite) shows a close spatial relationship with the muscovite-biotite granites, although small lodes occur in the Constables Creek sheet (biotite > muscovite granite) and in the Poimena pluton (biotite granite).

The main modes of mineralization are exogranitic quartz-wolframite-cassiterite veins, and cassiterite in fractures, and endo granitic greisen veins, pipes and sheets, and quartz-wolframite (\pm molybdenite \pm bismuthinite) veins.

2. Copper and Silver-Lead-Zinc

This mineralization is exemplified in the Scamander area where it is part of a zonal sequence associated with the Constables Creek biotite-muscovite granite. The zonation appears to follow the classic hydrothermal sequence, namely from the contact aureole outward the zones are W(\pm Mo \pm Bi), Sn, (Cu(-As-Zn-Pb), and Ag-Pb-Zn [-As-Cu]). The genetic association of the latter zone with the Constables Creek granite is conjectural, and it may be related to a granodiorite porphyry dyke.

3. Gold and Gold-Silver

This type of mineralization occurs to the west of the zonal sequence described above, and is probably associated with the Pyengana granodiorite.

012

B. MINERALIZATION ASSOCIATED WITH THE BEN LOMOND BATHOLITH

Actual and potential primary mineralization associated with the Ben Lomond Batholith is detailed in Table 1.

Although 13 categories are shown in this table, there is considerable overlap between the groups, such that 5 main primary associations can be recognized:

- 1A : exogranitic quartz vein systems (strike extent $> 500\text{m}$);
- 1B+2 : exogranitic quartz vein systems (strike generally $< 100\text{m}$), and fracture stockworks;
- 3+8A : endogranitic quartz veins, and greisen veins;
- 4+8B : endogranitic fracture stockworks(minor) and greisen pipes;
- 6+8D : aplite and greisenized aplite bodies.

Categories 5 and 7 are considered either too small, or to have insufficient grades to be of economic interest. It is apparent that the modes of primary W-Sn-base metal sulphide mineralization are virtually identical between the Blue Tier and Ben Lomond batholiths, the main difference being the apparent absence of greisen sheets (8C) and disseminated cassiterite in granite (5).

C. GREISEN POTENTIAL IN THE BEN LOMOND BATHOLITH

The formation of greisen sheets requires a minimum of roof rock fracturing and Groves (1977) suggested that provided the roof rocks were not fractured, greisen veins were associated with thick muscovite-biotite granites (eg. Mt. Paris), and that greisen sheets were associated with thin "tin granites" [eg. Lottah sheets, Anchor deposit etc.]).

The validity of these greisen models (thick and thin "tin granites"), cannot be disproven at present and if geochemical similarity is any guide, the inferred Ben Lomond "tin granite", by analogy with the Mt. Paris "tin granite", would appear only to have the potential to form greisen veins.

TABLE 1

ACTUAL AND POTENTIAL MINERALIZATION ASSOCIATED WITH THE BEN LOMOND BATHOLITH

MINERALIZATION TYPE	ORE MINERALS	GANGUE MINERALS	GRADE	SIZE (TONNES)	EXAMPLES
<u>EXOGRANITIC</u>					
1.A. Quartz Veins ($\geq 500m$ strike)	Cs Wf (Cp Sp Gn)	Qtz Apy Py	1.2%CM ?0.1-0.5%CM	2.1x10 ⁶ (UG) 10x10 ⁶ (OP)	Aberfoyle (actual production) Aberfoyle
1.B. Quartz Veins ($< 100m$)	Cs (Wf Mo)	Qtz	0.4-0.9%Sn	$< 50\ 000$ (UG)	Brocks, Flahertys Plummers
2. Fracture Stockworks	Cs (Cp Sp)	(\pm Qtz Py)	0.25%Sn	$\leq 3.5 \times 10^6$ (OP)	(Great Pyramid), Brocks Storeys Creek
<u>ENDOGRANITIC</u>					
3. Quartz Veins	Wf (Mo Cs Bi Cp)	Qtz Tm Musc Py Apy	0.7%Sn	5-50 000 (UG)	Mammoth, Ben Lomond Tungsten
4. Fracture Stockworks	Cs	(\pm Musc, Kaol)	0.25-1.0%Sn	$> 150\ 000$ (UG)	Rex Hill (see 8B)
5. Granite	Cs	Qtz Feld Musc Biot	?	?	(Lottah Sheet)
6. Aplite	Wf Cs (Sp Mo)	Qtz Kfeld Ab	$\approx 0.20-0.50\%CM$	10x10 ⁶ (OP)	Aberfoyle
7. Pegmatite	Cs	Qtz Feld Tm Musc Top	?0.05%Sn	?	Ivanhoe (Ransome)
8. Greisen					
A. Veins	Cs (Wf)	Qtz Musc Tm Fl Py Kaol	0.02%Sn	75 000 (UG)	Mammoth
	Sp Cp Cs (Gn)	Qtz Musc Py Apy Fl Tm Kaol	0.45%Sn	500 000 (UG)	Royal George
	Cs	Qtz Musc Tm Fl Py	5%Sn	$< 10\ 000$ (UG)	Ben Lomond Tin
B. Pipe	Cs	Qtz (Musc) Fl Tm Kaol	5.9%Sn	$\geq 15\ 000$ (UG)	Great Republic
	Sp, Gn Cp Cs Wf	Qtz (Musc) Apy Fl Chl Py	0.25-1.0%Sn	$\geq 150\ 000$ (UG)	Rex Hill (Carpathia)
C. Sheet	Cs Cp Mo (Wf Sch Gn)	Qtz Musc Fl	0.2%Sn	2x10 ⁶ (OP)	(Anchor)
D. Cupola	Wf Cs Sp Mo	Qtz Musc Chl Kaol	$\approx 0.20-0.5\%CM$	10x10 ⁶ (OP)	Aberfoyle
E. Massive	Cs (Wf Mo Bi Cp Sp)	Qtz Musc Chl Tm Kaol	0.5-0.7%Sn	0.5-2x10 ⁶ (OP)	(Ardwest, South Wild Cherry)
<u>ALLUVIAL</u>					
9. Stream Placer	Cs	NA	?	?	Storeys Creek

489015

01A

TABLE 1

NOTES AND LEGEND

NOTES

- (i) All size data refers to in situ tonneages.
- (ii) UG - in situ tonnage amenable for underground extraction.
- (iii) OP - in situ tonnage amenable for open pit extraction.
- (iv) Tonnage and grade data in Category 2 mineralization refer to the Great Pyramid.
- (v) Examples shown in brackets are not associated with the Ben Lomond Granite but have a similar hydrothermal origin.
- (vi) CM - Sn + WO₃%.

LEGEND

ORE MINERALS

Bi: Bismuthinite
Cp: Chalcopyrite
Cs: Cassiterite
Gn: Galena
Mo: Molybdenite
Sch: Scheelite
Sp: Sphalerite
Wf: Wolframite

GANGUE MINERALS

Ab: Albite
Apy: Arsenopyrite
Biot: Biotite
Chl: Chlorite
Feld: Feldspar
KFeld: Potassium feldspar
Kaol: Kaolin
Musc: Muscovite
Py: Pyrite
Qtz: Quartz
Top: Topaz
Tm: Tourmaline

015

The following features of the Ben Lomond Batholith appear relevant in the assessment of greisen sheet potential;

1. The present western and southern margins are characterised by primary mineralization in the form of greisen veins (3+8A) and greisen pipes (4+8B), formed by the alteration of c.g. biotite granite and f.g. porphyritic granite, (presumably both are equivalent to the older granite in the Rossarden area).
2. There is an apparent absence of muscovite-biotite granite ("tin granite") in the western and southern areas.
3. The northeast area, on present knowledge, appears to be characterised by exogranitic quartz veins, and fracture stockworks; this implies that both incipient (1B+2) and extensive (1A) fracturing occurred in the Mathinna Beds.
4. The inferred "tin granite" in the north east area has been greisenized to a quartz-muscovite-tourmaline rock.

These features are interpreted to indicate different degrees of unroofing of the Ben Lomond Batholith, namely the western and southern sides of the granite have been more deeply eroded than the north east area.

The greisen veins and pipes typical of the western side are thought to represent the effects of mineralizing fluids traversing the older granite en route to a high level (and now totally eroded) "tin granite".

Accordingly the potential occurrence of greisen sheets in the north east portion of the Ben Lomond Batholith can not be precluded, and statistically would appear to have a similar probability of occurrence to that of the greisen veins and pipes, (see Table 2).

The Ardlethan type mineralization (8E) has also been included in the greisen category in Table 1, although it is characterised by low temperature hydro-thermal alteration and may not be a true greisen.

However, kaolin is not uncommon in both the Blue Tier and Ben Lomond batholiths. (eg. categories 4, 6, 8A, 8B, 8D) and the potential for "massive greisens" to

016

occur in association with categories 8A, B (and ? C) requires further evaluation.

At present, because of the speculative status of this type of mineralization (in NE Tasmania), its probability of occurrence must be low ($\ll 0.01$), [see Table 2].

D. TUNGSTEN-TIN-COPPER-SILVER/LEAD/ZINC ZONING POTENTIAL ASSOCIATED WITH THE
BEN LOMOND BATHOLITH

The mineralogical and geochemical affinity of the Ben Lomond (inferred) biotite/muscovite granite with the Constables Creek biotite-muscovite granites has been mentioned in the preceding sections; this latter granite is associated with a W-Sn-Cu-Ag/Pb/Zn zoned sequence of mineralization in the Scamander area.

Minor, localized zoning occurs in the greisenized muscovite-biotite granite of the Lottah sheet (Anchor deposit), and consists of successive partly overlapping Mo, Sn and Cu rich intervals.

The potential for a zonal sequence of mineralization to be associated with the Ben Lomond Granite is difficult to assess, mainly because of the lack of exploration east of the Lutwyche deposit. The available data for the Rossarden area is as follows:

1. Mineralogical zoning in the Aberfoyle deposit (and to a lesser extent in the Storeys Creek deposit) is well documented, with Sn increasing and W decreasing with distance from the granite/aplite.
2. The composition of wolframite in the Aberfoyle and Storeys Creek deposits shows a depletion in Mn with distance from the granite/aplite. Wolframite from the W zone in the Scamander area show a similar trend with distance from the Constables Creek Granite.
3. Late stage sulphides (typically Zn rich) occur within a 50m radius of the aplites in the Aberfoyle and Storeys Creek deposits. In addition, some of the quartz veins at Storeys Creek have been replaced by masses of galena sphalerite

017

and chlorite.

4. There is a crude mineral zonation in the Rossarden area from the greisenized (inferred) "tin granite" in the vicinity of the Mammoth deposit hosting W (\pm Mo \pm Sn \pm Bi) mineralization outward to the Aberfoyle-Storeys Creek line of deposits hosting Sn-W (\pm Cu \pm Zn \pm Pb) mineralization.

5. Soil geochemical work by Aberfoyle Ltd. in the Rifle Range area (1500m NE of Aberfoyle and approx 2000m from the nearest granite), located coincident Cu -As-Zn anomalies; this area is also noted for the lack of Sn-W mineralization. However, the Lutwyche vein system (Sn-W) is located only 500m SW of Rifle Range.

EXPLORATION RATIONALEA. RANK OF DEPOSITS

The categories of mineralization shown in Table 1 were combined in to the five main associations, and then initially ranked according to the contained (in situ) tin metal as shown in Table 2. Grades used in this calculation were as shown in Table 2, except for the following: 1A (0.20% Sn), 1B (0.50%Sn), 4 + 8B (0.50% Sn), 6 + 8D (0.20% Sn) and 8E (0.50% Sn).

Additional factors considered relevant in the ranking of these associations for exploration priority include the probability of occurrence, the metallurgical character and mining methods (cut off grades etc).

The probability of occurrence of a given category of mineralization can only be estimated from the 21 recorded deposits associated with the Ben Lomond Batholith, whilst the metallurgical characteristics are largely assumed, and based on limited data from Aberfoyle Ltd. Pre-concentration factors are a measure of the quartz vein content of the deposit.

In addition, the gross dimensions of the deposit were considered in terms of suitability for open pit extraction using an arbitrary scale of probabilities ranging from low (10% chance) to medium (50% chance) to high (100% chance). Application of the foregoing parameters is shown in Table 2,

The resultant rank values correlate with the tonnage (contained Sn) ranking for the three most prospective targets, namely exogranitic quartz veins, followed by aplite/greisenized aplite stocks, followed by exogranitic quartz veins and fracture stockworks.

The intermediate rankings are represented by greisen sheets, greisen veins and massive greisen, and the lowest rank by greisen pipes.

TABLE 2

PRIMARY MINERALIZATION	CODE	CONTAINED TIN (TONNES)	PROBABILITY OF OCCURRENCE (%)	METALLURGICAL CHARACTER		PROBABILITY OF OPEN PIT POTENTIAL (%)	RANK 1x2x3x4	RANK 5x6
				PRE-CON ^N FACTOR	RECOVERY (%)			
		1	2	3	4	5	6	7
Exogranitic quartz veins	1A	20 000	28	3	70	100	11 760	11 760
Aplite/greisenized aplite cupola	6 + 8D	20 000	20	1	≥50	100	2 000	2 000
Massive greisen	8E	10 000	?1	?1	?70	100	70	70
Exogranitic quartz veins and fracture stockworks	1B + 2	9 000	12	≤ 1	?<50	75	540	405
Greisen sheet	8C	4 000	?8	1	≥50	100	160	160
Endogranitic quartz veins and greisen veins	3 + 8A	2 500	23	1.2	65	10	449	45
Endogranitic fracture stockworks & greisen pipe	4 + 8B	1 000	8	1	?65	10	52	5

16/.

020
B. STRUCTURAL CONSIDERATIONS

1. JOINTS, FAULTS AND VEIN ORIENTATIONS

The country rock Mathinna Beds have been folded along generally NW trending folds, which are tight, symmetrical and similar in style. Slaty and fracture cleavages are axial plane to the major folds, which plunge gently to the SE; axial planes dip steeply to the SW.

(a) Joints

Joints in the Ben Lomond Granite trend NNW, NE and ENE, and are regarded as pre-Permian in age. Joints in the Mathinna Beds trend WNW, NNW and NE are best developed in quartzite rich units, and are considered to be fold related (ie. pre-granite).

(b) Faults

Faults in the Ben Lomond Granite are sinuous and generally trend NW to NNW (Castle Carey Fault) and NNE to NE (Burns Marsh, Aberfoyle 1, 2 and 3 Faults); they were considered by Blissett(1959) to have both pre and post Permian movement, with most of the displacement occurring in several post-Permian episodes (ie. Jurassic and Tertiary).

The faults are normal resulting in horst and graben structures, and in the Rossarden area the NW set appear to pre date the NE set.

Faults in the Mathinna Beds (Rossarden area) essentially match those in the granite, as follows:

- (i) NW set - bedding faults, dipping 60-80° SW (eg Kookaburra Fault)
- (ii) N-NNE set - dipping 40-70°W (eg Aberfoyle faults)
- (iii) NE set - vertically dipping 45° NW and 90°

(c) Vein Orientations

Mineralized quartz veins occur in three groups:

- (i) Aberfoyle type - strike N-NNE, dipping 50-70°W
- (ii) Lutwyche type - strike NW, dipping 45-70°SW
- (iii) Battery type - strike NE, dipping approx. 90°.

021

Aplite dykes have generally similar orientations to the quartz veins, while some microgranite dykes trend ENE.

2. SUB-SURFACE GRANITE MORPHOLOGY

The gravity survey of part of the Rossarden area by Leaman (1974) indicated that this was the most useful method of geophysical exploration, following the failure of seismic and electrical methods. Interpretation of Mathinna Beds isopachs allowed the construction of sub-surface contours on top of the granite, with the following results:

(a) Faults - orientations ranging from NNE-NE to NW and thus confirming the NNE-NE trending Burns Marsh and Aberfoyle faults. However, a previously unrecognised NW trending fault, (termed the Eastern Hill Fault), was located, and is a major feature.

(b) Regions of steep gradients on the granite surface, which trend NW, NE and ENE, and defining the following:

(i) A NW trending "plateau" containing the Storeys Creek deposit, in which the aplite cupola is similarly orientated;

(ii) A NE trending "peninsula" containing the Aberfoyle deposit, but in which the aplite cupola is apparently orientated NE;

(iii) A NE trending "peninsula" (?horst) originating near the junction of the Eastern Hill and Burns Marsh faults. The Aberfoyle West gravity anomaly, (Table 3) is located at the SW end of this feature, termed Egans Peninsula;

(iv) A very prominent rectangular "peak" (? aplite stock) offset from the NE extremity of Egans Peninsula. It is termed the Golf Course West gravity anomaly, (Table 3).

(v) An ENE trending "plateau" containing Brocks Prospect at its northern margin. This feature is termed Brocks Plateau, and is bounded to the west by the Burns Marsh Fault, and the east by the Aberfoyle No. 3 fault. The northern margin of this plateau trends similarly to one of the joints in the granite.

022

3. DISCUSSION

(a) The gravity defined faults and regions of steep gradient in the granite surface (See Plan) have trends which can be entirely correlated with the known regional defects (joints, faults) in both the Ben Lomond Granite and the Mathinna Beds.

(b) The Ben Lomond Batholith is elongate in the direction of the regional trend of the Mathinna Beds (NW-SE), and it is likely that some of the aplite bodies are controlled by this orientation. Additional controls on aplite orientation are likely to be those exerted by the original granite morphology, and which can be inferred from the trend of defects in both the Ben Lomond Batholith and Mathinna Beds, (eg. the NE trend).

(c) Reconstruction of the granite topography in the Aberfoyle Graben (during pre-Permian time), by extending the Eastern Hill Fault to the SE shows that the Storeys Creek and Aberfoyle aplite cupolas, plus the inferred Egans cupola (Aberfoyle West gravity anomaly), are all located immediately east of this fault (See Plan).

(d) The Golf Course West gravity anomaly occurs within a NW trending horst bounded by the Rifle Range and (extrapolated) Kookaburra faults on the east and west sides respectively. The Lutwyche vein system is also located within this horst, including the SE extension, and the location of anomalous stream sediment samples (SS37, SS26) either in, or draining from, this horst (or its extension) imply that it has a potential strike of >5 km.

(e) The broad symmetry of the Eastern Hill Fault (with associated aplite cupolas), and the similarly trending Kookaburra fault (with inferred aplite bodies at Lutwyche and Golf Course West), suggests that these NW trending faults are major features; and are probably syn-tectonic with granite emplacement.

(f) Hellsten (1979) showed that abrupt changes in granite morphology (including aplite protrusions), could act as zones of stress concentration due to the combination of overburden stress modified by granite/aplite shape, and the high fluid pressure within the granite/aplite.

The interaction of these stresses results in the differential stress being

023

maximized along the upper edge of these obtuse angled features, resulting in a concentration of hydraulic fractures.

(g) Zones of mineralization will follow those hydraulic fractures, and may be broadly distributed about the primary granite/aplite obtuse angled features;

(i) abrupt change in granite shape → maximum hydraulic fracturing →

6 (+8D), 1A;

(ii) granite shelf, marginal to fault → moderate hydraulic fracturing →

1B+2;

(iii) granite shelf → minimum hydraulic fracturing → 3+8A/4+8B →

8C.

024

PROSPECTS AND ANOMALIES

The area covered by ML 27M/77 contains numerous prospects as detailed in Table 3, and the Plan. The 16 known prospects (13 of which are primary) may be grouped as follows:

Category 1A = Aberfoyle, Kookaburra, Lutwyche, Egans;

" 1(undiff) = Kookaburra SE, Lutwyche SE, Eastern Hill;

" 1B+2 = NW Storeys Creek, Brocks, Flaherty-Plummers, McDonnells,

" 3+8A = Mammoth;

" 9 = Storeys Creek, Egans Alluvial, Upper Aberfoyle Rivulet;

" unknown = Rifle Range.

Gravity Anomalies are shown in Table 4, and the possible associations are as follows:

? Category 1A = Golf Course West, Aberfoyle West (= Egans);

? " 6 + 8D = Nisbet Creek.

Geochemical (stream sediment) anomalies are shown in Table 4, with the following possible associations :

? Category 1A = SS 25 (see Kookaburra SE and/or Lutwyche SE)

? " 1 = SS 26

? " 1B+2 = SS 45 (see Brocks Prospect)

Unknown (possibly 1) = SS 37.

Combining the prospects and anomalies gives a mixed total of 20, of which 17 are presumed to be primary in origin. The distribution of the categories of mineralization in this total is as follows:

1A:- 30%, 1(undiff):- 23%, 1B + 2 - 23%, 3+8A:-6%, 6+8D:-6%, and 12% unknown.

These results, when compared to the probabilities of occurrence shown in Table 2, indicate a bias toward category 1B + 2, at the expense of category 6 + 8D.

This bias is interpreted to reveal the likely deeply-buried status of many of the aplite bodies in the NE area of the Ben Lomond Granite.

025

However, it should be noted that the 1974 gravity survey, would have missed the Aberfoyle and Storeys Creek aplite cupolas, (due to the nature of the survey, in relation to the size of these aplite bodies).

Accordingly, the gravity anomalies located in this survey, assume some significance, particularly the Golf Course West Anomaly.

Thus the previous knowledge of the subsurface granite morphology is incomplete, and the potential occurrence of other blind aplite bodies and quartz vein systems within ML27M/77 must be considered attractive targets for further exploration.

TABLE 3

WHEAL LUTWYCHE PTY. LTD. - PROSPECT TABULATION

026

PROSPECT	STRIKE LENGTH (m)	WIDTH (m)	DEPTH (m)	GRADE	MIN ⁿ TYPE	WORK COMPLETED	APPROX. SIZE	COMMENTS	RECOMMENDATIONS
ABERFOYLE Surface:	>1000	>50	120 4L.	?	1.A	9 Percussion holes Milling of 1895 T parcel.	10x10 ⁶ T (open pit)	Good Open Pit Potential; vein swarm possibly closed to south but open to north through Spartan Prosp.	Grid & topographic survey; Diamond drilling, L, S, A; Gravity survey on 100x15m grid; costean for bulk sample.
U. G.:	N.A.	N.A.	N.A.	1.2%cm	1.A.	U.G. development, diamond drilling, mining etc.	-	Abandoned mine; Production over 50 yrs. yielded 2.1x10 ⁶ tonnes @ 0.91%Sn, 0.28% WO ₃ .	No further work required.
KOOKABURRA JOHNSONS: Surface:	200	40	100	?	1.A.	Fact mapping; 1 diamond hole (Johnsons Veins)	2x10 ⁶ T (open pit)	Open pit potent- ial not assessed strike extension to the NW needs evaluation.	Grid & topographic survey. Gravity survey on 100x15m grid, (NW of Battery vein); Costeaning L, S, A; Diamond drilling L, S, A.
U. G.:	>75	0.2	350 13L	?	1.A.	2 diamond holes on 13 Level	0.6x10 ⁶ T (open pit)	UG potential only partly evaluated.	No work at this stage.

489027

PROSPECT	STRIKE LENGTH (m)	WIDTH (m)	DEPTH (m)	GRADE	MIN ⁿ TYPE	WORK COMPLETED	APPROX. SIZE	COMMENTS	RECOMMENDATIONS
LUTWYCHE: Surface:	~800	40-80	100	?	I.A.	Fact mapping 19 diamond holes	8x10 ⁶ T (open pit)	Open pit potential not assessed.	Grid & topographic survey; Costean, L, S, A; Diamond drilling L,S,A.
U.G.:	~350	0.3-0.7	500	~1%CM	I.A.	Numerous diamond holes on 12 & 13 Levels	~1x10 ⁶ T	UG potential considered marginal by Aberfoyle Gp.	No work at this stage.
KOOKABURRA S.E.	500	~40	?	?	I.	Scout mapping	?	SE strike extension of Kookaburra vein system; mineralization open to the S.E.	Grid & topographic survey; mapping; costeaning, L,S,A; Percussion drilling L,S,A.
LUTWYCHE S.E.	500	~50	?	?	I.	Scout mapping; Soil sampling; Electrical geophysics.	?	SE strike extension of Lutwyche vein system - mineralization open to the SE.	Grid & topographic survey; mapping; costeaning, L,S,A, Percussion drilling L,S,A.

PROSPECT	STRIKE LENGTH (m)	WIDTH (m)	DEPTH (m)	GRADE	MIN. TYPE	WORK COMPLETED	APPROX. SIZE	COMMENTS	RECOMMENDATIONS
RIFLE RANGE	1000 (700m soil anomaly)	30	?	?	?	Scout mapping Soil sampling 2 diamond holes.	?	No Sn or W mineralization observed in outcrop, but sulphides inferred. drilling appears misdirected, may represent fault line	Grid & topographic survey; mapping; costeaning, LSA; Percussion drilling, LSA.
EASTERN HILL	500	≈100	≥50	?	1.	Fact mapping, Several adits shafts; 7 diamond holes.	6x10 ⁶ T (open pit)	Three vein swarms; interpretation complicated by low angle reverse fault and insufficient drilling.	Grid & topographic survey; Costeaning LSA; Diamond drilling, LSA.
N.W. STOREYS CREEK:	?	?	?	?	?1B+2	4 diamond holes	?	Situated ≈600m NE of Storeys Creek Mine; Drill logs ? unavailable, minimal data.	Locate drill logs, Scout mapping (photo-scale) and assessment.

PROSPECT	STRIKE LENGTH (m)	WIDTH (m)	DEPTH (m)	GRADE	MINI? TYPE	WORK COMPLETED	APPROX. SIZE	COMMENTS	RECOMMENDATIONS
FLAHERTY-PLUMMERS:	50-150	0.6-1.5	>20	0.4% Sn	1B.+2	Several shafts	20 000T (veins)	Four quartz veins grading 0.4%Sn; grade of fracture stockworks unknown.	As for Egans Prospect.
McDONNELLS:	>50	?	?	?	?1.B.+2	Minor trenching	?	Possible extension to Flaherty and Plummers prospects.	As for Egans Prospect.
STOREYS CREEK (S.S.)	1200	50	>8	?	9	Early sluicing near Nisbet Creek	500 000 m ³ (West of Burns Marsh Fault).	Quaternary age, limited data; potential appears limited east of Burns Marsh fault.	Grid & topographic survey. Drilling LSA.
UPPER ABERFOYLE RIVULET:	← max. area 500 000m ² →		?	?	?	?	?	Tertiary and Quaternary age; no other data.	Stream sampling and assay.

PROSPECT	STRIKE LENGTH (m)	WIDTH (m)	DEPTH (m)	GRADE	MINI TYPE	WORK COMPLETED	APPROX. SIZE	COMMENTS	RECOMMENDATIONS
EGANS ALLUVIAL	—	max area 175 000m ²	?	?	9	Early sluicing	?	Tertiary age Limited records	Grid & topographic survey. Drilling, LSA, Costeaming LSA.

TABLE 4

WHEAL LUTWYCHE PTY. LTD.
ANOMALY TABULATION

0322

ANOMALY	VALUE	LOCATION	RELATED MIN?	WORK COMPLETED	COMMENTS	RECOMMENDATIONS
GOLF COURSE WEST	-1.4 mgal.	1300m east of Storeys Creek Mine.	? I.A.	- <u>GEOPHYSICAL</u> - Regional gravity survey. (D.E. Leaman, 1974).	Residual Bouguer anomaly indicates major apophysis similar in gross form to Aberfoyle & Storeys Creek cupolas.	Grid & topographic survey; mapping; costeaming; drilling.
ABERFOYLE WEST (EGANS)	-0.6 mgal.	1200m NW of Aberfoyle mine.	? I.A.	As above.	This is the SW end of a major NE trending granite high. Interpretation complicated by post Permian faulting & gravity station spacing.	As above.
NISBET CREEK	-0.8 mgal.	600m SW of Storeys Creek Mine	? 6+8D	As above	Although located in granite "shelf" - an aplite body is recorded here.	As above.

489033

ANOMALY	VALUE	LOCATION	RELATED MIN. ^a	WORK COMPLETED	COMMENTS	RECOMMENDATIONS
SS 25	130ppm. Sn 45ppm. W	700m NE of Aberfoyle Mine. (unnamed trib. Aberfoyle Rivulet.)	? 1.A.	- <u>GEOCHEMICAL</u> - Stream sediment sampling. (Rossarden Mines Ltd. 1982)	Anomalous values for both Sn and W; possibly related to Kookaburra S.E.	Additional stream sediment sampling; mapping; costeaning.
SS 26	160ppm. Sn 60ppm. W	1km Se of Aberfoyle Mine. (unnamed trib. Aberfoyle Rivulet).	? 1	As above.	Very anomalous values for both Sn and W may be due to either strike extension of Lutwyche SE, or to contamination from Aberfoyle tailings.	As above.
SS 37	34ppm. Sn 40ppm. W	1200m NE of Storeys Creek Mine. (Upper Aberfoyle Rivulet)	?	Stream sediment sampling. Rossarden Mines Ltd. 1982.	Anomalous value for W only. Sample located on structural "high" and along strike from Golf Course West, Lutwyche etc.	Additional stream sediment sampling, mapping, costeaning.
SS 45	3300ppm. Sn 15ppm. W.	1km WSW of Aberfoyle Mine. (Junction Tiger & Storeys Cks.)	?1B,+2	As above	Very anomalous value for Sn only. Possibly related to Brocks Prospect etc.	As above (see also program for Brocks Prospect).

- BLISSETT, A.H. 1959
The Geology of the Rossarden-Storeys Creek District, Geol. Surv. Tas. Bull. 46.
- CLAYTON, W.F. 1981
The Petrology and Geochemistry of the Ben Lomond Granite and Associated Tin-Tungsten Min. Unpub. B. Sc. (Hons.) Thesis, Univ. Tas.
- EDWARDS, A.B. & LYON R.J.P. 1957
Mineralization at Aberfoyle Tin Mine Rossarden, Tasmania. Proc. Aus. IMM 181 p. 93-145
- GROVES, D.I. 1972
The zoned mineral deposits of the Scamander-St. Helens District. Geol. Surv. Tas. Bull. 53.
- GROVES, D.I. 1977;
The Blue Tier Batholith. Geol. Surv. Bull. 55.
- GROVES, D.I. & TAYLOR, R.G. 1973
Greisenization and mineralization at Anchor Tin Mine, NE Tasmania Trans. Inst. Min. Metall. 82 B p. 135-146.
- HELLSTEN, K.J. 1979
The Emplacement and Geometry of the Mineralized Quartz Veins at Rossarden-Storeys Creek. Unpub. B. Sc. (Hons.) Thesis, Monash Univ.
- HENDERSON, Q.J. 1935
The Mt. Rex Mine. Tas. Dept Mines. Unpub Rep.
- HENDERSON, Q.J. 1936
Eastern Hill, Storeys Creek. Tas. Dept. Mines Unpub. Rep.
- HENDERSON, Q.J. 1946
The geology of the Tin-Tungsten deposits, Aberfoyle Tas. Dept. Mines Unpub. Rep.
- KEID, H.G.W. 1954
Brocks Prospect, Rossarden, Tas. Dept. Mines Unpub. Rep.
- KINGSBURY, C.J.R. 1965
Cassiterite and Wolframite Veins of Aberfoyle and Storeys Creek. 8th Comm. Min. and Metall. Cong. 1, p. 506-511.
- LYON R.J.P. 1957
The Aberfoyle Vein System, Rossarden, Tas. Proc. Aus. IMM 181 p. 75-91.
- NYE, P.B. 1941
Plummers workings, Rossarden. Tas, Dept. Mines Unpub. Rep.
- REID, A.M. & HENDERSON Q.J. 1929
The Avoca Mineral District. Geol. Surv. Tas. Bull 40.
- SCOTT, J.B. 1929
Mammoth Tin Areas, Storeys Creek. Tas Dept. Mines Unpub. Rep.
- SCOTT, J.B. 1934
Storeys Creek Mine. Tas. Dept. Mines Unpub. Rep.
- URQUHART, G. 1966
Notes on the Royal George Tin Mine. Tas. Dept. Mines. Tech. Rep. 11 p. 57 -65.
- URQUHART, G. 1967
The Rex Hill Mine. Geol. Surv. Tas. Rep. No. 9.

OPEN FILE

WHEAL LUTWYCHE PTY. LTD.

RELINQUISHMENT REPORT

EL59/83

MAY 1988

MINES	
File Ref. E.L. 59/83	
17 MAY 1988	
Doc. Ref.	
Action Officer	Initials
REFERS TO	TO
LETTER 12.5.88	
Resubmit to	Date

THIS PAPER OUTLINES THE TIN-TUNGSTEN MINERALIZATION
OF THE EXPLORATION LICENSE.

IT APPLIES TO THE AREA TO BE RELINQUISHED AS WELL
AS THE RETAINED AREA.

RESEARCH WORK ON THE AREA SHOWED IT TO BE LESS
PROSPECTIVE THAN THE AREA RETAINED THEREFORE NO
FIELD WORK WAS CARRIED OUT.

TIN - TUNGSTEN - BASE METAL MINERALIZATION

ASSOCIATED WITH

THE BEN LOMOND GRANITE BATHOLITH

ABERFOYLE DISTRICT

NORTHEAST TASMANIA.

F. G. SUMMONS.

SUMMONS GEOSERVICES PTY. LTD.

TABLE OF CONTENTS

	<u>PAGE NO.</u>
SUMMARY	(1)
GEOLOGY OF THE BEN LOMOND BATHOLITH	3.
A. LITHOLOGIES	3.
B. GEOCHEMICAL CHARACTERISTICS	3.
C. COMPARISON WITH THE BLUE TIER BATHOLITH	5.
D. CONCLUSION	6.
MINERALIZATION	8.
A. MINERALIZATION ASSOCIATED WITH THE BLUE TIER BATHOLITH	8.
B. MINERALIZATION ASSOCIATED WITH THE BEN LOMOND BATHOLITH	9.
C. GREISEN POTENTIAL IN THE BEN LOMOND BATHOLITH	9.
D. TUNGSTEN-TIN-COPPER-SILVER/LEAD/ZINC ZONING POTENTIAL ASSOCIATED WITH THE BEN LOMOND BATHOLITH.	13.
EXPLORATION RATIONALE	15.
A. RANK OF DEPOSITS	15.
B. STRUCTURAL CONSIDERATIONS	17.
1. JOINTS, FAULTS AND VEIN ORIENTATIONS	17.
2. SUB SURFACE GRANITE MORPHOLOGY	18.
3. DISCUSSION	19.
PROSPECTS AND ANOMALIES	21.

SUMMARY

The Ben Lomond Granite Batholith shows a strong mineralogical and geochemical affinity with the fractionated granitoids of the Blue Tier Batholith, and has itself been fractionated from a calc-alkali granite (biotite granite) to an alkali granite (inferred biotite/muscovite granite).

The inferred biotite/muscovite granite shows a strong geochemical correlation with several muscovite/biotite granites ("tin granites") in the Blue Tier Batholith.

Five primary associations of mineralization occur in or related to the Ben Lomond Batholith, namely:

- (i) Exogranitic quartz vein systems (strike extent $> 500\text{m}$);
- (ii) Exogranitic quartz vein systems (strike extent $< 100\text{m}$) and fracture stockworks;
- (iii) Endogranitic quartz veins and greisen veins;
- (iv) Endogranitic fracture stockworks and greisen pipes;
- (v) Aplite and greisenized aplite bodies.

The potential occurrence of large greisen sheets (eg. Anchor deposit) is considered to be minor, and the potential for massive "greisens" (Ardlethan type) even more remote.

The potential for zoned W-Sn-Cu-Ag/Pb/Zn mineralization is indeterminate on present knowledge, and several possibly relevant features in the area require evaluation.

Structural considerations involving mapped defects, and gravity based subsurface granite morphology imply major NW (and probably NE) trending linears influenced both the granite/aplite intrusions, and the subsequent primary mineralization.

Several major residual Bouguer gravity anomalies exist in the area, and appear similar in status to the Aberfoyle and Storeys Creek aplite bodies.

The primary mineral deposits in the Rossarden area have been ranked according to inherent tin metal content, probability of occurrence, assumed metallurgical character, and the suitability for various mining methods.

The three highest ranking categories of mineralization are exogranitic quartz vein systems, aplite/greisenized¹ aplite bodies, and exogranitic veins in association with fracture stockworks.

GEOLOGY OF THE BEN LOMOND BATHOLITHA. LITHOLOGIES

Following some detailed investigations in recent years (Hellsten 1979, and Clayton 1981), data on the Ben Lomond Granite has increased considerably, the main granitoid types in the Rossarden area are:

1. Coarse grained, variably porphyritic biotite granite;
2. Fine grained porphyritic biotite granite;
3. Fine/medium grained quartz-muscovite-tourmaline rock(QMT);
4. Microgranite;
5. Aplite;
6. Pegmatite;
7. Quartz-feldspar porphyries.

The coarse grained (cg.) biotite granite occupies the largest volume, with the fine grained (fg) porphyrite granite variably present within or surrounding the former.

The tourmaline leucogranite (QMT) outcrops mainly between Tasmania and Nisbet Creeks northwest of Aberfoyle. Minor intrusive phases are represented by microgranite, aplite, pegmatite, and porphyry dykes; the aplite also occurs as stocks of cupolas emanating from the main granite body, and the latter variably enveloped by a carapace of microgranite.

B. GEOCHEMICAL CHARACTERISTICS

Typical elements used as indicators of increasing fractionation in granitic rocks are Mg, Ca, Sr, Ba, Li, Na, K, Rb, Sn and W. The depletion of Na(+K) and the alkaline earth elements is accompanied by increases in Li, Rb, Sn, W and F. The conventional method of presenting fractionation trends in granitic rocks is to graph the ratio of Mg/Li versus the ratio K/Rb, such that

progressively lower values for both ratios indicate a trend toward the alkali granites.

The chemistry of six granitic rocks from the Ben Lomond Granite were studied, namely e.g. biotite granite, f.g. porphyritic granite, microgranite (dyke), quartz-muscovite-tourmaline rock, aplite, and greisenized aplite (II Level Aberfoyle).

However, the limited analytical data, combined with some anomalously high Mg, anomalously low Ca, and erratic Li values from the microgranite and the Q-M-T rock, meant that the Mg/Li ratio in particular was not a useful discriminant of fractionation. The high Mg values probably reflect the formation of secondary tourmaline, while the low Ca reflects the absence of fluorite in the Q-M-T rock.

The K/Rb ratio showed a distinct trend from f.g. porphyritic granite to c.g. biotite granite to microgranite to Q-M-T rock to aplite to greisenized aplite.

Excluding the microgranite data, the trends of increasing Li and decreasing Ba and Na also follows the K/Rb trend, but the trend of Sr is erratic, due partly to the high values in the greisenized aplite (? similar to the greisen at the Anchor mine).

The trend of increasing Rb suggests that the Q-M-T rock is a differentiate of the aplite, whereas the trends of decreasing K and Na imply the opposite. Consequently, (because of the anomalous Mg and Ca values, and because isomorphous substitution of these elements seemed likely), it was decided to combine all elements with common fractionation trends in the following ratios:

1. $\frac{K + Na}{Li + Rb}$ - decreasing values of this ratio confirmed the K/Rb trend, but also emphasised a major gap between the group of Q-M-T rock, aplite and greisenized aplite, and the granites.

2. $\frac{\text{Mg}+\text{Ca}+\text{Sr}+\text{Ba}}{\text{Li}+\text{Rb}}$ - progressively declining values of this ratio also confirmed the K/Rb trend and also indicated three groups of similar values, ie: f.g. porphyritic granite (13), c.g. biotitegranite (13), microgranite (7), aplite (4.6), greisenized aplite (4.1) and Q-M-T rock (3.5).

C. COMPARISON WITH THE BLUE TIER BATHOLITH

Groves (1977) gave a succinct description of the geology etc. of the Blue Tier Batholith, from which the following salient features are taken:

1. The Blue Tier Batholith consists of a suite of calcalkaline granitic rocks which show a normal fractionation trend characterised by increasing Si, Al, K, Li, Rb, F and Sn, and decreasing Fe, Mg, Ca, Sr and Ba. The geochemical evidence suggests a single magmatic fractionation series, from granodiorite to adamellite to calc-alkali granite to alkali granite.
2. The adamellite and calc-alkali granite interval of this series is represented by biotite granites/adamellites which are typically coarse grained or porphyritic. They form large homogenous steep sided plutons, and collectively account for > 50 vol% of the Blue Tier Batholith.
3. The alkali granites are represented by muscovite-biotite granite, typically fine medium grained, with a general sheet like form; they are strongly fractionated with low K/Rb, Mg/Li, Sr and Ba, but high Sn, W and F. Main examples are the Mt. Paris, Mt. William, Mt. Cameron and Lottah sheets; related but slightly different sheets of biotite-muscovite granite occur at Sheoak Hill, Little Mt. Horror and Constable Creek. These latter sheets of granite are characterised by the presence of tourmaline, lack of fluorite, and biotite in excess of muscovite.

All muscovite/biotite granites are younger than the c.g. biotite granites, and occupy 2 vol% of the Blue Tier Batholith.

Geochemical analyses of the Ben Lomond granitoids indicate strong affinities

with granitoids from the Blue Tier area, based on petrological and geochemical characteristics (particularly Mg/Li, K/Rb, Sn, Li, Sr, Ba),

(i) The Ben Lomond c.g. biotite granite, very similar to the Boobyalla and Poimena (adjacent to the Anchor mine) granite plutons;

(ii) The tourmaline leucogranite (Q-M-T rock) is very similar to the Mt. Paris muscovite-biotite granite sheet, but also has affinity with the Sheoak Hill, Little Mt. Horror and Constables Creek biotite-muscovite granite

The Poimena biotite granite forms part of the fractionated series of granitic rocks mentioned previously, and is intruded by the muscovite-biotite granite (alkali or "tin granite") of the Lottah sheets.

The Mt. Paris muscovite-biotite granite sheet intrudes both Mathinna Beds, and the western edge of the Poimena granite, and both the Lottah and Mt. Paris sheets host important primary tin deposits.

D. CONCLUSIONS.

1. The sequence of crystallization of the Ben Lomond granitic rocks appears to represent the calc alkali to alkali granite end of a normal granitic fractionation series, as follows:

(i) f.g. porphyritic granite [chilled margin of (ii)]

(ii) c.g. biotite granite (major phase of Ben Lomond Batholith)

(iii) Microgranite

(iv) f/m.g. biotite/muscovite granite (inferred, and now altered to quartz-muscovite-tourmaline rock).

(v) Aplite (and probably pegmatite, quartz-feldspar porphyry)

(vi) Greisenization of the biotite/muscovite granite + aplites.

2. A major geochemical hiatus occurs generally about the same time as the intrusion of the microgranite dykes.

3(i) A strong mineralogical and geochemical affinity exists between the Ben Lomond c.g. biotite granite and the Poimena biotite granite;

- 3(ii) A strong geochemical affinity exists between the Ben Lomond (inferred) biot/mus granite and the Mt. Paris muscovite-biotite granite;
- 3(iii) A less significant mineralogical and geochemical affinity exists between the Ben Lomond (inferred) biotite/muscovite granite and the Constables Creek biotite-muscovite granite.
4. The sequence of crystallization (points 1,2 above) and the correlations made (in point 3 above) with the Blue Tier Batholith, suggest the Ben Lomond (inferred) biotite/muscovite granite is a younger intrusive body, enplaced near the top of the older Ben Lomond biotite granite.
5. In common with the primary tin mineralization in the Blue Tier Batholith, the Ben Lomond (inferred) biotite/muscovite granite and the aplite (cupolas etc) appear to be the penultimate crystallized portions of the residual magmatic fluids that were eventually to greisenise both rock types, and to precipitate the Sn-W-Sulphide minerals present in the Aberfoyle etc. quartz veins.

MINERALIZATION

It is considered appropriate, in view of the mineralogical and geochemical affinity of the Ben Lomond Batholith with portions of the Blue Tier Batholith, to review the primary mineralization in the latter, in order to fully assess the mineral potential of the Ben Lomond Batholith.

A. MINERALIZATION ASSOCIATED WITH THE BLUE TIER BATHOLITH

Primary mineralization occurs in three groups, Sn + W, Cu + Ag-Pb-Zn, and Au, Au-Ag deposits.

1. Tin - Tungsten

This mineralization (cassiterite and wolframite) shows a close spatial relationship with the muscovite-biotite granites, although small lodes occur in the Constables Creek sheet (biotite > muscovite granite) and in the Poimena pluton (biotite granite).

The main modes of mineralization are exogranitic quartz-wolframite-cassiterite veins, and cassiterite in fractures, and endo granitic greisen veins, pipes and sheets, and quartz-wolframite (\pm molybdenite \pm bismuthinite) veins.

2. Copper and Silver-Lead-Zinc

This mineralization is exemplified in the Scamander area where it is part of a zonal sequence associated with the Constables Creek biotite-muscovite granite. The zonation appears to follow the classic hydrothermal sequence, namely from the contact aureole outward the zones are W(\pm Mo \pm Bi), Sn, (Cu(-As-Zn-Pb), and Ag-Pb-Zn [-As-Cu]). The genetic association of the latter zone with the Constables Creek granite is conjectural, and it may be related to a granodiorite porphyry dyke.

3. Gold and Gold-Silver

This type of mineralization occurs to the west of the zonal sequence described above, and is probably associated with the Pyengana granodiorite.

B. MINERALIZATION ASSOCIATED WITH THE BEN LOMOND BATHOLITH

Actual and potential primary mineralization associated with the Ben Lomond Batholith is detailed in Table 1.

Although 13 categories are shown in this table, there is considerable overlap between the groups, such that 5 main primary associations can be recognized:

- 1A : exogranitic quartz vein systems (strike extent $> 500\text{m}$);
- 1B+2 : exogranitic quartz vein systems (strike generally $< 100\text{m}$), and fracture stockworks;
- 3+8A : endogranitic quartz veins, and greisen veins;
- 4+8B : endogranitic fracture stockworks(minor) and greisen pipes;
- 6+8D : aplite and greisenized aplite bodies.

Categories 5 and 7 are considered either too small, or to have insufficient grades to be of economic interest. It is apparent that the modes of primary W-Sn-base metal sulphide mineralization are virtually identical between the Blue Tier and Ben Lomond batholiths, the main difference being the apparent absence of greisen sheets (8C) and disseminated cassiterite in granite (5).

C. GREISEN POTENTIAL IN THE BEN LOMOND BATHOLITH

The formation of greisen sheets requires a minimum of roof rock fracturing and Groves (1977) suggested that provided the roof rocks were not fractured, greisen veins were associated with thick muscovite-biotite granites (eg. Mt. Paris), and that greisen sheets were associated with thin "tin granites" [eg. Lottah sheets, Anchor deposit etc.].

The validity of these greisen models (thick and thin "tin granites"), cannot be disproven at present and if geochemical similarity is any guide, the inferred Ben Lomond "tin granite", by analogy with the Mt. Paris "tin granite", would appear only to have the potential to form greisen veins.

TABLE 1

ACTUAL AND POTENTIAL MINERALIZATION ASSOCIATED WITH THE BEN LOMOND BATHOLITH

MINERALIZATION TYPE	ORE MINERALS	GANGUE MINERALS	GRADE	SIZE (TONNES)	EXAMPLES
EXOGENIC					
1.A. Quartz Veins ($>500m$ strike)	Cs Wf (Cp Sp Gn)	Qtz Apy Py	1.2%CM	2.1×10^6 (UG)	Aberfoyle (actual production)
1.B. Quartz Veins ($<100m$)	Cs (Wf Mo)	Qtz	?0.1-0.5%CM 0.4-0.9%Sn	10×10^6 (OP) $<50\ 000$ (UG)	Aberfoyle Brocks, Flahertys Plummers
2. Fracture Stockworks	Cs (Cp Sp)	(\pm Qtz Py)	0.25%Sn	$<3.5 \times 10^6$ (OP)	(Great Pyramid), Brocks Storeys Creek
ENDOGENIC					
3. Quartz Veins	Wf (Mo Cs Bi Cp)	Qtz Tm Musc Py Apy	0.7%Sn	5-50 000 (UG)	Mammoth, Ben Lomond Tungsten
4. Fracture Stockworks	Cs	(\pm Musc, Kaol)	0.25-1.0%Sn	$>150\ 000$ (UG)	Rex Hill (see 8B)
5. Granite	Cs	Qtz Feld Musc Biot	?	?	(Lottah Sheet)
6. Aplite	Wf Cs (Sp Mo)	Qtz Kfeld Ab	= 0.20-0.50%CM	10×10^6 (OP)	Aberfoyle
7. Pegmatite	Cs	Qtz Feld Tm Musc Top	?0.05%Sn	?	Ivanhoe (Itansome)
8. Greisen					
A. Veins	Cs (Wf)	Qtz Musc Tm Fl Py Kaol	0.02%Sn	75 000 (UG)	Mammoth
	Sp Cp Cs (Gn)	Qtz Musc Py Apy Fl Tm Kaol	0.45%Sn	500 000 (UG)	Royal George
	Cs	Qtz Musc Tm Fl Py	5%Sn	$<10\ 000$ (UG)	Ben Lomond Tin
B. Pipe	Cs	Qtz (Musc) Fl Tm Kaol	5.9%Sn	$>15\ 000$ (UG)	Great Republic
	Sp, Gn Cp Cs Wf	Qtz (Musc) Apy Fl Chl Py	0.25-1.0%Sn	$>150\ 000$ (UG)	Rex Hill (Carpathia)
C. Sheet	Cs Cp Mo (Wf Sch Gn)	Qtz Musc Fl	0.2%Sn	2×10^6 (OP)	(Anchor)
D. Cupola	Wf Cs Sp Mo	Qtz Musc Chl Kaol	= 0.20-0.5%CM	10×10^6 (OP)	Aberfoyle
E. Massive	Cs (Wf Mo Bi Cp Sp)	Qtz Musc Chl Tm Kaol	0.5-0.7%Sn	$0.5-2 \times 10^6$ (OP)	(Ardwest, South Wild Cherry)
ALLUVIAL					
9. Stream Placer	Cs	NA	?	?	Storeys Creek

TABLE 1

NOTES AND LEGEND

NOTES

- (i) All size data refers to in situ tonneages.
- (ii) UG - in situ tonnage amenable for underground extraction.
- (iii) OP - in situ tonnage amenable for open pit extraction.
- (iv) Tonnage and grade data in Category 2 mineralization refer to the Great Pyramid.
- (v) Examples shown in brackets are not associated with the Ben Lomond Granite but have a similar hydrothermal origin.
- (vi) CM - Sn + WO₃%.

LEGEND

ORE MINERALS

Bi: Bismuthinite
Cp: Chalcopyrite
Cs: Cassiterite
Gn: Galena
Mo: Molybdenite
Sch: Scheelite
Sp: Sphalerite
Wf: Wolframite

GANGUE MINERALS

Ab: Albite
Apy: Arsenopyrite
Biot: Biotite
Chl: Chlorite
Feld: Feldspar
KFeld: Potassium feldspar
Kaol: Kaolin
Musc: Muscovite
Py: Pyrite
Qtz: Quartz
Top: Topaz
Tm: Tourmaline

The following features of the Ben Lomond Batholith appear relevant in the assessment of greisen sheet potential;

1. The present western and southern margins are characterised by primary mineralization in the form of greisen veins (3+8A) and greisen pipes (4+8B), formed by the alteration of c.g. biotite granite and f.g. porphyritic granite, (presumably both are equivalent to the older granite in the Rossarden area).
2. There is an apparent absence of muscovite-biotite granite ("tin granite") in the western and southern areas.
3. The northeast area, on present knowledge, appears to be characterised by exogranitic quartz veins, and fracture stockworks; this implies that both incipient (1B+2) and extensive (1A) fracturing occurred in the Mathinna Beds.
4. The inferred "tin granite" in the north east area has been greisenized to a quartz-muscovite-tourmaline rock.

These features are interpreted to indicate different degrees of unroofing of the Ben Lomond Batholith, namely the western and southern sides of the granite have been more deeply eroded than the north east area.

The greisen veins and pipes typical of the western side are thought to represent the effects of mineralizing fluids traversing the older granite en route to a high level (and now totally eroded) "tin granite".

Accordingly the potential occurrence of greisen sheets in the north east portion of the Ben Lomond Batholith can not be precluded, and statistically would appear to have a similar probability of occurrence to that of the greisen veins and pipes, (see Table 2).

The Ardlethan type mineralization (8E) has also been included in the greisen category in Table 1, although it is characterised by low temperature hydro-thermal alteration and may not be a true greisen.

However, kaolin is not uncommon in both the Blue Tier and Ben Lomond batholiths, eg. categories 4, 6, 8A, 8B, 8D) and the potential for "massive greisens" to

occur in association with categories 8A, B (and ? C) requires further evaluation.

At present, because of the speculative status of this type of mineralization (in NE Tasmania), its probability of occurrence must be low (<0.01), [see Table 2].

D. TUNGSTEN-TIN-COPPER-SILVER/LEAD/ZINC ZONING POTENTIAL ASSOCIATED WITH THE
BEN LOMOND BATHOLITH

The mineralogical and geochemical affinity of the Ben Lomond (inferred) biotite/muscovite granite with the Constables Creek biotite-muscovite granites has been mentioned in the preceding sections; this latter granite is associated with a W-Sn-Cu-Ag/Pb/Zn zoned sequence of mineralization in the Scamander area.

Minor, localized zoning occurs in the greisenized muscovite-biotite granite of the Lottah sheet (Anchor deposit), and consists of successive partly overlapping Mo, Sn and Cu rich intervals.

The potential for a zonal sequence of mineralization to be associated with the Ben Lomond Granite is difficult to assess, mainly because of the lack of exploration east of the Lutwyche deposit. The available data for the Rossarden area is as follows:

1. Mineralogical zoning in the Aberfoyle deposit (and to a lesser extent in the Storeys Creek deposit) is well documented, with Sn increasing and W decreasing with distance from the granite/aplite.
2. The composition of wolframite in the Aberfoyle and Storeys Creek deposits shows a depletion in Mn with distance from the granite/aplite. Wolframite from the W zone in the Scamander area show a similar trend with distance from the Constables Creek Granite.
3. Late stage sulphides (typically Zn rich) occur within a 50m radius of the aplites in the Aberfoyle and Storeys Creek deposits. In addition, some of the quartz veins at Storeys Creek have been replaced by masses of gilent sphalerite

and chlorite.

4. There is a crude mineral zonation in the Rossarden area from the greisenized (inferred) "tin granite" in the vicinity of the Mammoth deposit hosting W (\pm Mo \pm Sn \pm Bi) mineralization outward to the Aberfoyle-Storeys Creek line of deposits hosting Sn-W (\pm Cu \pm Zn \pm Pb) mineralization.

5. Soil geochemical work by Aberfoyle Ltd. in the Rifle Range area (1500m NE of Aberfoyle and approx 2000m from the nearest granite), located coincident Cu -As-Zn anomalies; this area is also noted for the lack of Sn-W mineralization. However, the Lutwyche vein system (Sn-W) is located only 500m SW of Rifle Range.

EXPLORATION RATIONALEA. RANK OF DEPOSITS

The categories of mineralization shown in Table 1 were combined in to the five main associations, and then initially ranked according to the contained (in situ) tin metal as shown in Table 2. Grades used in this calculation were as shown in Table 2, except for the following: 1A (0.20% Sn), 1B (0.50%Sn), 4 + 8B (0.50% Sn), 6 + 8D (0.20% Sn) and 8E (0.50% Sn).

Additional factors considered relevant in the ranking of these associations for exploration priority include the probability of occurrence, the metallurgical character and mining methods (cut off grades etc).

The probability of occurrence of a given category of mineralization can only be estimated from the 21 recorded deposits associated with the Ben Lomond Batholith, whilst the metallurgical characteristics are largely assumed, and based on limited data from Aberfoyle Ltd. Pre-concentration factors are a measure of the quartz vein content of the deposit.

In addition, the gross dimensions of the deposit were considered in terms of suitability for open pit extraction using an arbitrary scale of probabilities ranging from low (10% chance) to medium (50% chance) to high (100% chance). Application of the foregoing parameters is shown in Table 2,

The resultant rank values correlate with the tonnage (contained Sn) ranking for the three most prospective targets, namely exogranitic quartz veins, followed by aplite/greisenized aplite stocks, followed by exogranitic quartz veins and fracture stockworks.

The intermediate rankings are represented by greisen sheets, greisen veins and massive greisen, and the lowest rank by greisen pipes.

TABLE 2

PRIMARY MINERALIZATION	CODE	CONTAINED TIN (TONNES)	PROBABILITY OF OCCURRENCE (%)	METALLURGICAL CHARACTER		PROBABILITY OF OPEN PIT POTENTIAL (%)	RANK 1x2x3x4	RANK 5x6
				PRE-CON ^N FACTOR	RECOVERY (%)			
		1	2	3	4	5	6	7
Exogranitic quartz veins	1A	20 000	28	3	70	100	11 760	11 760
Aplite/greisenized aplite cupola	6 + 8D	20 000	20	1	≥50	100	2 000	2 000
Massive greisen	8E	10 000	21	21	270	100	70	70
Exogranitic quartz veins and fracture stockworks	1B + 2	9 000	12	≈ 1	250	75	540	405
Greisen sheet	8C	4 000	28	1	≥50	100	160	160
Endogranitic quartz veins and greisen veins	3 + 8A	2 500	23	1.2	65	10	449	45
Endogranitic fracture stockworks & greisen pipe	4 + 8B	1 000	8	1	265	10	52	5

489055

B. STRUCTURAL CONSIDERATIONS

1. JOINTS, FAULTS AND VEIN ORIENTATIONS

The country rock Mathinna Beds have been folded along generally NW trending folds, which are tight, symmetrical and similar in style. Slaty and fracture cleavages are axial plane to the major folds, which plunge gently to the SE; axial planes dip steeply to the SW.

(a) Joints

Joints in the Ben Lomond Granite trend NNW, NE and ENE, and are regarded as pre-Permian in age. Joints in the Mathinna Beds trend WNW, NNW and NE are best developed in quartzite rich units, and are considered to be fold related (ie. pre-granite).

(b) Faults

Faults in the Ben Lomond Granite are sinuous and generally trend NW to NNW (Castle Carey Fault) and NNE to NE (Burns Marsh, Aberfoyle 1, 2 and 3 Faults); they were considered by Blissett(1959) to have both pre and post Permian movement, with most of the displacement occurring in several post-Permian episodes (ie. Jurassic and Tertiary).

The faults are normal resulting in horst and graben structures, and in the Rossarden area the NW set appear to pre date the NE set.

Faults in the Mathinna Beds (Rossarden area) essentially match those in the granite, as follows:

- (i) NW set - bedding faults, dipping 60-80° SW (eg Kookaburra Fault)
- (ii) N-NNE set - dipping 40-70°W (eg Aberfoyle faults)
- (iii) NE set - vertically dipping 45° NW and 90°

(c) Vein Orientations

Mineralized quartz veins occur in three groups:

- (i) Aberfoyle type - strike N-NNE, dipping 50-70°W
- (ii) Lutwyche type - strike NW, dipping 45-70°SW
- (iii) Battery type - strike NE, dipping approx. 90°.

Aplite dykes have generally similar orientations to the quartz veins, while some microgranite dykes trend ENE.

2. SUB-SURFACE GRANITE MORPHOLOGY

The gravity survey of part of the Rossarden area by Leaman (1974) indicated that this was the most useful method of geophysical exploration, following the failure of seismic and electrical methods. Interpretation of Mathinna Beds isopachs allowed the construction of sub-surface contours on top of the granite, with the following results:

(a) Faults - orientations ranging from NNE-NE to NW and thus confirming the NNE-NE trending Burns Marsh and Aberfoyle faults. However, a previously unrecognised NW trending fault, (termed the Eastern Hill Fault), was located, and is a major feature.

(b) Regions of steep gradients on the granite surface, which trend NW, NE and ENE, and defining the following:

(i) A NW trending "plateau" containing the Storeys Creek deposit, in which the aplite cupola is similarly orientated;

(ii) A NE trending "peninsula" containing the Aberfoyle deposit, but in which the aplite cupola is apparently orientated NE;

(iii) A NE trending "peninsula" (?horst) originating near the junction of the Eastern Hill and Burns Marsh faults. The Aberfoyle West gravity anomaly, (Table 3) is located at the SW end of this feature, termed Egans Peninsula;

(iv) A very prominent rectangular "peak" (? aplite stock) offset from the NE extremity of Egans Peninsula. It is termed the Golf Course West gravity anomaly, (Table 3).

(v) An ENE trending "plateau" containing Brocks Prospect at its northern margin. This feature is termed Brocks Plateau, and is bounded to the west by the Burns Marsh Fault, and the east by the Aberfoyle No. 3 fault. The northern margin of this plateau trends similarly to one of the joints in the granite.

3. DISCUSSION

- (a) The gravity defined faults and regions of steep gradient in the granite surface (See Plan) have trends which can be entirely correlated with the known regional defects (joints, faults) in both the Ben Lomond Granite and the Mathinna Beds.
- (b) The Ben Lomond Batholith is elongate in the direction of the regional trend of the Mathinna Beds (NW-SE), and it is likely that some of the aplite bodies are controlled by this orientation. Additional controls on aplite orientation are likely to be those exerted by the original granite morphology, and which can be inferred from the trend of defects in both the Ben Lomond Batholith and Mathinna Beds, (eg. the NE trend).
- (c) Reconstruction of the granite topography in the Aberfoyle Graben (during pre-Permian time), by extending the Eastern Hill Fault to the SE shows that the Storeys Creek and Aberfoyle aplite cupolas, plus the inferred Egans cupola (Aberfoyle West gravity anomaly), are all located immediately east of this fault (See Plan).
- (d) The Golf Course West gravity anomaly occurs within a NW trending horst bounded by the Rifle Range and (extrapolated) Kookaburra faults on the east and west sides respectively. The Lutwyche vein system is also located within this horst, including the SE extension, and the location of anomalous stream sediment samples (SS37, SS26) either in or draining from this horst (or its extension) imply that it has a potential strike of >5 km.
- (e) The broad symmetry of the Eastern Hill Fault (with associated aplite cupolas), and the similarly trending Kookaburra fault (with inferred aplite bodies at Lutwyche and Golf Course West), suggests that these NW trending faults are major features; and are probably syn-tectonic with granite emplacement.
- (f) Hellsten (1979) showed that abrupt changes in granite morphology (including aplite protrusions), could act as zones of stress concentration due to the combination of overburden stress modified by granite/aplite shape, and the high fluid pressure within the granite/aplite.

The interaction of these stresses results in the differential stress being

maximized along the upper edge of these obtuse angled features, resulting in a concentration of hydraulic fractures.

(g) Zones of mineralization will follow those hydraulic fractures, and may be broadly distributed about the primary granite/aplite obtuse angled features;

(i) abrupt change in granite shape → maximum hydraulic fracturing →

6 (+8D), 1A;

(ii) granite shelf, marginal to fault → moderate hydraulic fracturing →

1B+2;

(iii) granite shelf → minimum hydraulic fracturing → 3+8A/4+8B →

8C.

ANOMALY	VALUE	LOCATION	RELATED MIN. ²	WORK COMPLETED	COMMENTS	RECOMMENDATIONS
SS 25	130ppm. Sn 45ppm. W	700m NE of Aberfoyle Mine. (unnamed trib. Aberfoyle Rivulet.)	? 1.A.	- <u>GEOCHEMICAL</u> - Stream sediment sampling. (Rossarden Mines Ltd. 1982)	Anomalous values for both Sn and W; possibly related to Kookaburra S.E.	Additional stream sediment sampling; mapping; costeaning.
SS 26	160ppm. Sn 60ppm. W	1km Se of Aberfoyle Mine. (unnamed trib. Aberfoyle Rivulet).	? 1	As above.	Very anomalous values for both Sn ² and W may be due to either strike extension of Lutwyche SE, or to contamination from Aberfoyle tailings.	As above.
SS 37	34ppm. Sn 40ppm. W	1200m NE of Storeys Creek Mine. (Upper Aberfoyle Rivulet)	?	Stream sediment sampling. Rossarden Mines Ltd. 1982.	Anomalous value for W only. Sample located on structural "high" and along strike from Golf Course West, Lutwyche etc.	Additional stream sediment sampling, mapping, costeaning.
SS 45	3300ppm. Sn 15ppm. W.	1km WSW of Aberfoyle Mine. (Junction Tiger & Storeys Cks.)	? 1B,+2	As above	Very anomalous value for Sn only. Possibly related to Brocks Prospect etc.	As above (see also program for Brocks Prospect).

- BLISSETT, A.H. 1959 The Geology of the Rossarden-Storeys Creek District, Geol. Surv. Tas. Bull. 46.
- CLAYTON, W.F. 1981 The Petrology and Geochemistry of the Ben Lomond Granite and Associated Tin-Tungsten Min. Unpub. B. Sc. (Hons.) Thesis, Univ. Tas.
- EDWARDS, A.B. & LYON R.J.P. 1957 Mineralization at Aberfoyle Tin Mine Rossarden, Tasmania. Proc. Aus. IMM 181 p. 93-145
- GROVES, D.I. 1972 The zoned mineral deposits of the Scamander-St. Helens District. Geol. Surv. Tas. Bull. 53.
- GROVES, D.I. 1977; The Blue Tier Batholith. Geol. Surv. Bull. 55.
- GROVES, D.I. & TAYLOR, R.G. 1973 Greisenization and mineralization at Anchor Tin Mine, NE Tasmania Trans. Inst. Min. Metall. 82 B p. 135-146.
- HELLSTEN, K.J. 1979 The Emplacement and Geometry of the Mineralized Quartz Veins at Rossarden-Storeys Creek. Unpub. B. Sc. (Hons.) Thesis, Monash Univ.
- HENDERSON, Q.J. 1935 The Mt. Rex Mine. Tas. Dept Mines. Unpub Rep.
- HENDERSON, Q.J. 1936 Eastern Hill, Storeys Creek. Tas. Dept. Mines Unpub. Rep.
- HENDERSON, Q.J. 1946 The geology of the Tin-Tungsten deposits, Aberfoyle Tas. Dept. Mines Unpub. Rep.
- KEID, H.G.W. 1954 Brocks Prospect, Rossarden, Tas. Dept. Mines Unpub. Rep.
- KINGSBURY, C.J.R. 1965 Cassiterite and Wolframite Veins of Aberfoyle and Storeys Creek. 8th Comm. Min. and Metall. Cong. 1, p. 506-511.
- LYON R.J.P. 1957 The Aberfoyle Vein System, Rossarden, Tas. Proc. Aus. IMM 181 p. 75-91.
- NYE, P.B. 1941 Plummers workings, Rossarden. Tas, Dept. Mines Unpub. Rep.
- REID, A.M. & HENDERSON Q.J. 1929 The Avoca Mineral District. Geol. Surv. Tas. Bull 40.
- SCOTT, J.B. 1929 Mammoth Tin Areas, Storeys Creek. Tas Dept. Mines Unpub. Rep.
- SCOTT, J.B. 1934 Storeys Creek Mine. Tas. Dept. Mines Unpub. Rep.
- URQUHART, G. 1966 Notes on the Royal George Tin Mine. Tas. Dept. Mines. Tech. Rep. 11 p. 57 -65.
- URQUHART, G. 1967 The Rex Hill Mine. Geol. Surv. Tas. Rep. No. 9.