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THE SHELL COMPANY OF AUSTRALIA LIMITED  
METALS DIVISION

A PRELIMINARY REGIONAL ASSESSMENT OF THE GRANITES & TIN  
POTENTIAL OF N.E. TASMANIA

Author: L de Graaf  
Date : October, 1983

Report No.: 08.2132  
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- APPENDIX III Royal George tin mine, Collingwood style mineralisation in N.E. Tasmania (P. Ruxton).

I. INTRODUCTION

This review summarises some of the known aspects of tin mineralisation and granites in N.E. Tasmania. It is restricted to Sn-mineralisation contained in granites and overlying rocks and excludes alluvial tin. The main objective of the report is to review regional aspects of tin mineralisation in N.E. Tasmania, based on literature, open file reports as well as on geochemical and petrographical data from about 60 samples collected during the reconnaissance trip in the company of Dr. Peter Ruxton.

In geographical terms this report is restricted to the main granite batholiths of N.E. Tasmania (Blue Tier and to a lesser extent Scottsdale) excluding the Furneaux Group of islands off the N.E. coast and the Freycinet peninsula in the South.

The main aim is to provide a preliminary framework for further regional reconnaissance and exploration in N.E. Tasmania. Sampling was carried out to provide additional petrographical- and geochemical data to further our understanding of regional aspects of the granitoids and Sn-mineralisation as well as to provide new data on the less well recorded Sn occurrences. The geochemical data will also add to our data bank on granites of Tasmania which will be used for regional tin granite studies at a later stage.

It was not the intention to carry out an in depth study of all published information on tin mineralisation and granites. For this the reader is referred to Geological Survey Bulletins (e.g. Groves et al 1977, McClenaghan, 1982) as well as an internal report by Ian Buchhorn (1980, No. 08/605/MT24).

The report starts with a brief review of the regional geology followed by a brief discussion on the distribution-, styles- of known Sn-mineralisation. This is followed by a review of the collected petrographical and geochemical data. The last chapters of the report are concerned with a discussion of the tin potential of N.E. Tasmania as well as a number of suggestions and guidelines for exploration.

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II. REGIONAL GEOLOGY AND STRUCTURE (Fig.1)

The regional geology of N.E. Tasmania is dominated by Pre-Carboniferous rocks comprising Silurian-Devonian sedimentary sequences of micaceous quartzwackes and interbedded mudstones, the so-called Mathinna Beds, intruded by late Devonian granitoids. The Mathinna Beds are unconformably overlain by L. Carboniferous-Triassic fluvio-lacustrine and shallow glacio-marine sediments of the so called Parmeener Supergroup. The upper part of this Supergroup is intruded by large volumes of tholeiitic Triassic dolerite forming massive sills, dykes and irregular bodies.

The Parmeener Supergroup is unconformably overlain by terrestrial, Tertiary and Recent alluvial and minor marine sediments, which locally contain basalt of middle Miocene age.

The geological history of the region is schematically shown in Fig. 2a. This diagram also shows the main rock formations of importance to Sn-mineralisation, namely the granitoids, the Mathinna beds when forming in roof zones and the paleo river channels in Tertiary and Recent sediments.

According to local convention, the granitoids are subdivided into the Scottsdale and Blue Tier Batholiths (see Fig.1), the Avoca area (Ben Lomond granite) probably belonging to the former and the St. Mary's area belonging to the latter. On the basis of geological- and geophysical observations, the Scottsdale and Blue Tier Batholith are separated by a wedge of folded (NW axis) Mathinna Bed sediments (see Fig.2b). The diagram also illustrates the interpreted sheet like nature of the granodiorites (Turner, 1980).

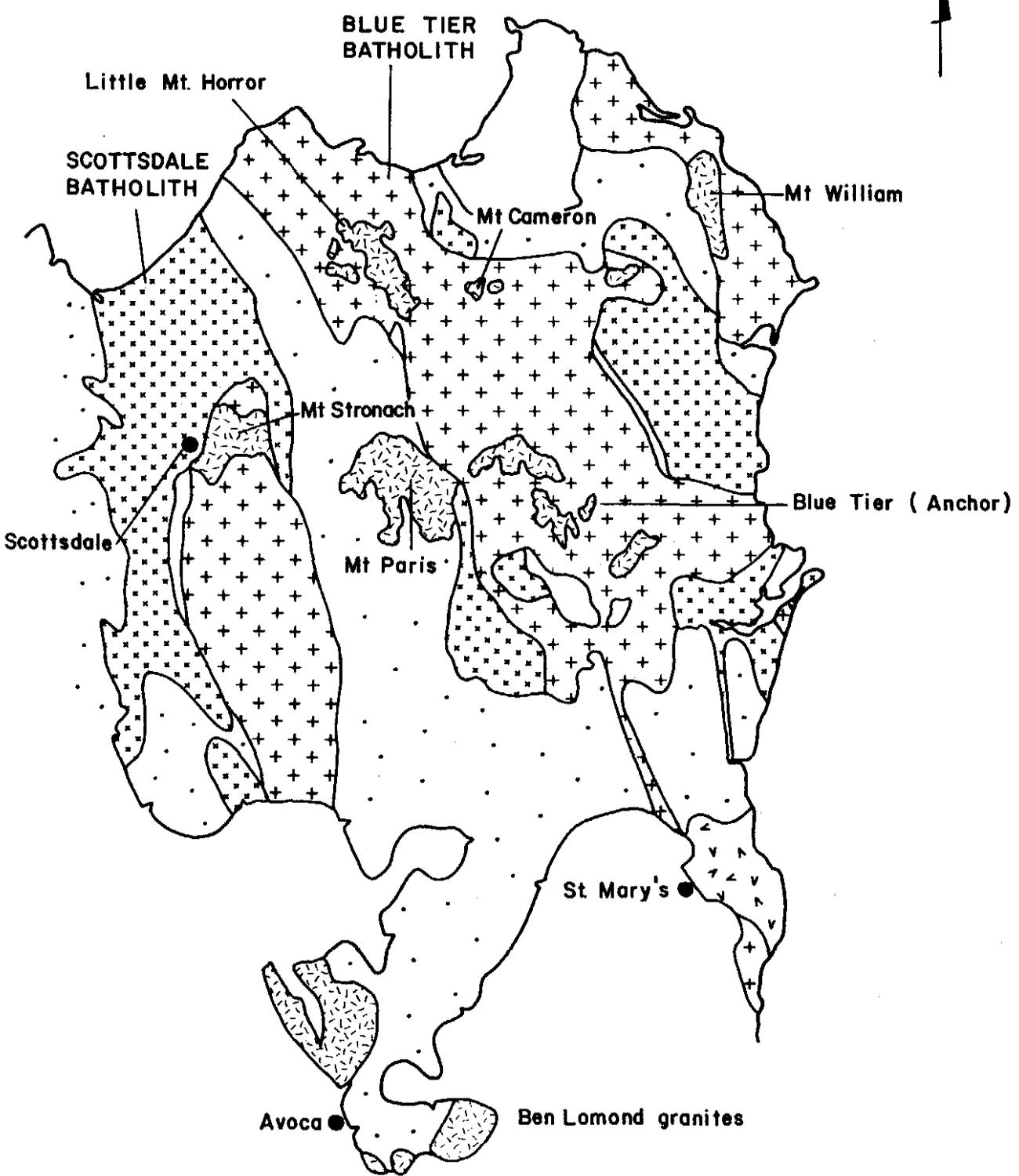
Both the Scottsdale and Blue Tier Batholiths contain three main granitic phases, namely granodiorites, adamellites and alkali-granites. On the basis of composition and contact relationships, the Blue Tier batholith is traditionally subdivided, into a number of plutons and sheets. The lack of such a regional subdivision in the Scottsdale batholith (including the so called Ben Lomond granites) mainly reflects a lack of geological attention rather than the absence of different granite lithologies.

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The Blue Tier and Scottsdale batholith have been interpreted to be multiple intrusive in character, with the granodiorites being slightly older (377-398 m.y.) than the adamellites (368-382 m.y.) which in turn are again slightly older than the alkali granites (364-374 m.y.), (Rb-Sr dating by various workers as reported by Turner, 1980).

The regional structural grain of N.E. Tasmania is N to NW as illustrated by the granitoid outcrop pattern (see Fig. 1). The pattern probably reflects Lower Paleozoic structural lineaments.

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-  ALKALI GRANITE
-  ADAMELLITE
-  GRANODIORITE
-  HYPERSTHENE ADAMELLITE PORPHYRY
-  MATHINNA BEDS

The Shell Company of Australia Limited METALS DIVISION	
NE TASMANIA PRE - CARBONIFEROUS REGIONAL GEOLOGY ( After N.I. Turner, 1980 )	
SCALE	DATE NOV 83
AUTHOR LDG	DRAWN
OFFICE AHO	REP.No.
DRG.No. MT27/1026	FIG.No. 1

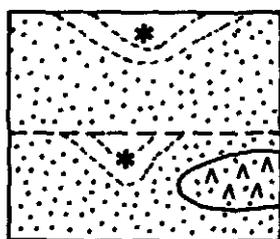
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SCHMATIC DIAGRAM  
MAIN GEOLOGICAL EVENTS

N.E. TASMANIA

(Various Sources)

FIG. 2a



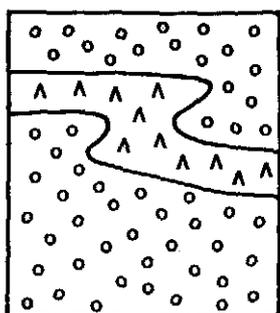
Locally deep chemical weathering (laterite and kaolinite)

Middle miocene basalts

\* = Sn Mineralisation in alluvials

RECENT AND TERTIARY  
(Alluvials and minor marine sediments)

± 65 m.y. unconformity (low angle)



Extension (block faulting)

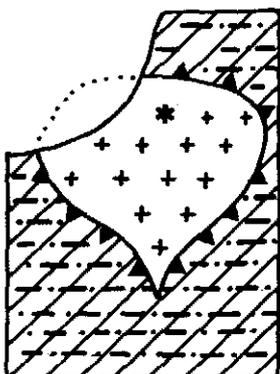
Tholeiitic Jurassic dolerite

Faulting, horst and graben, unroofing of granites

PARMEENER SUPER GROUP  
(Fluvio-lacustrine - glacio marine)

TRIASSIC - L. CARB.

± 350 m.y. unconformity

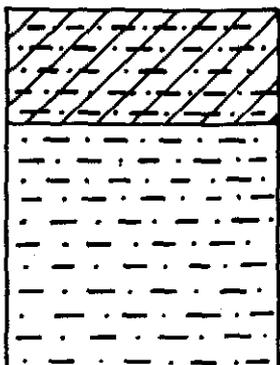


Mild deformation (compression), granite intrusion (364 - 398 m.y.)

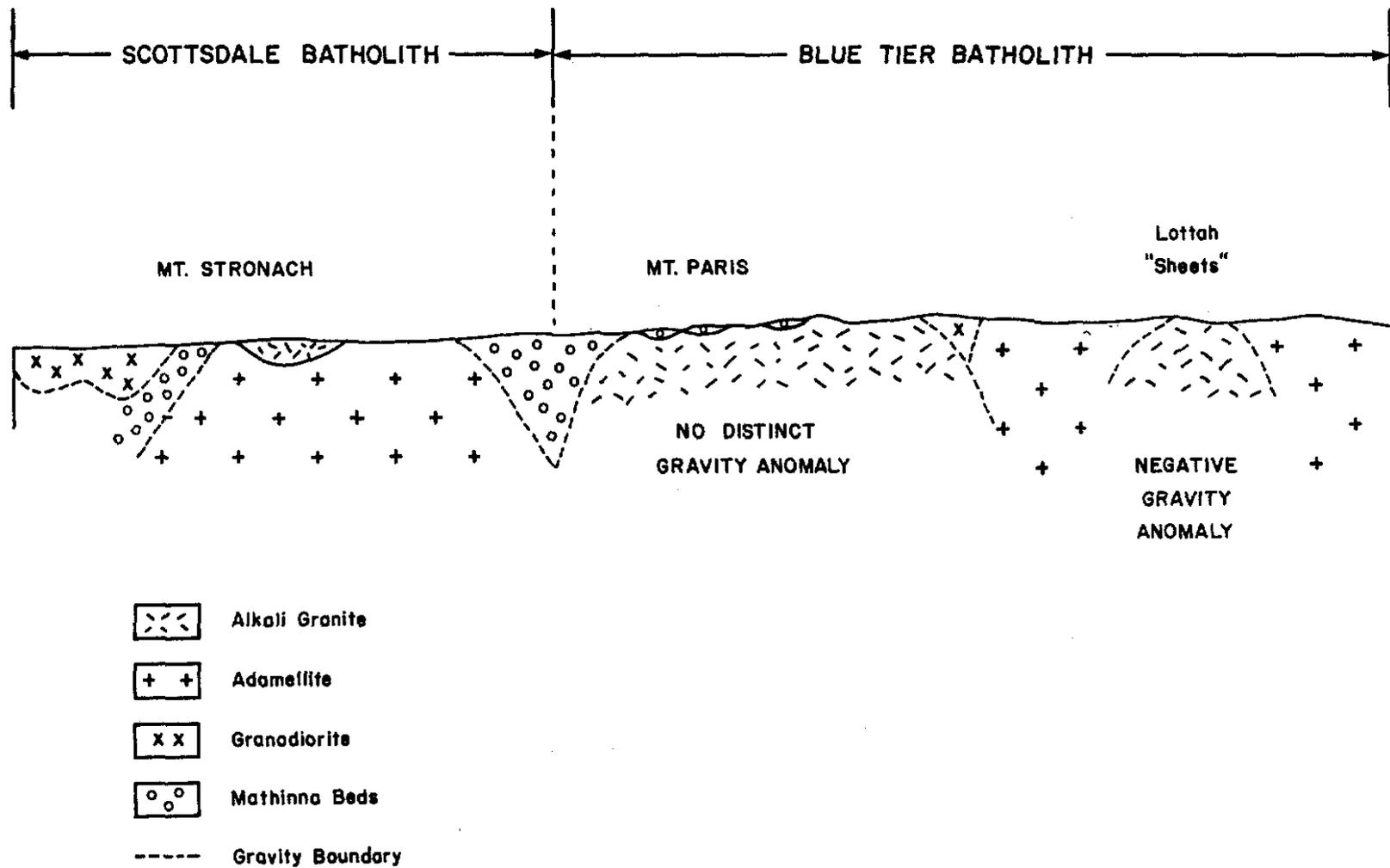
\* = Sn mineralisation in roof zones (granite and sediments)

▲ = Contact m.m.

MATHINNA BEDS  
SILURO - DEVONIAN  
(Turbidite and mudstone)



Early - Middle Devonian Orogenesis (N.W. fold axis compression, mild m.m.)



013

FIG.2b - SCHEMATIC SECTION THROUGH N.E. TASMANIA ( After Turner, 1980)

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III. OVERVIEW OF HISTORICAL TIN PRODUCTION

Tin in N.E. Tasmania occurs in three main styles, viz.:

- alluvial/elluvial cassiterite in palaeo- and recent placer deposits.
- exo-granitic veins/stockworks and lodes in Mathinna Beds.
- endo-granitic lodes/veins and disseminated deposits within a alkali-granite.

The main areas with a history of tin production are shown in Fig.4. This figure shows that nearly all the recorded tin mining, whether it is alluvial or hard rock mining, was carried out within the vicinity of known alkali-granites.

Table 1 shows a breakdown of the historical tin production according to source. The total recorded production for the region is in the order of 70,000 tons of metallic tin as well as minor tungsten. About 60% was derived from alluvial sources. There are 3 districts with production over 10,000 tons namely:- Mt. Paris, Avoca and Mt. Cameron. The Avoca area is the only district with a substantial production from hard rock.

Except for some minor small scale operations, present mining activities are restricted to the Mt. Cameron area (alluvials). Hard rock mining came to an end in the Avoca area with the recent closure of the Rossarden Mine (1979).

The main historical hard rock mining centres are thus the Avoca area (Rossarden/Storeys Creek, Royal George), Anchor, Great Pyramid and Mt. Paris. The main styles of mineralisation are briefly described below:-

- Avoca Area (production over 20,000 t, from (a)).

(a) Rossarden/Storeys Creek: Major quartz-cassiterite wolframite veins within Mathinna Beds, overlying an aplitic apophyse. Tungsten content increases with depth while Sn- content drops

with depth (Grades: SN- 1.5-1%, 0.3%  $WO_3$  Rossarden, 1.3%  $WO_3$  Storeys Creek).

(b) Royal George: Steeply dipping greisen vein deposit associated with greisenized, tourmaline bearing, porphyritic granite.

- Anchor (production  $\pm 2500t$ ).

Disseminated cassiterite in flat lying greisen sheets, and alkali granites underlying porphyritic adamellites of the Blue Tier batholith. (Grades  $\pm 0.25\%$  Sn).

- Great Pyramid (Production limited to 336t).

Cassiterite stock works in Mathinna Beds. (Grades: Sn  $\pm 0.2\%$  Sn).

- Mt. Paris Area (Recorded hard rock production 22.6t).

Several small mining areas containing steeply dipping, cassiterite bearing greisen veins, in the roof zone of an alkali granite (exo- and endo-granitic). Mineralisation has proved very patchy and scattered.

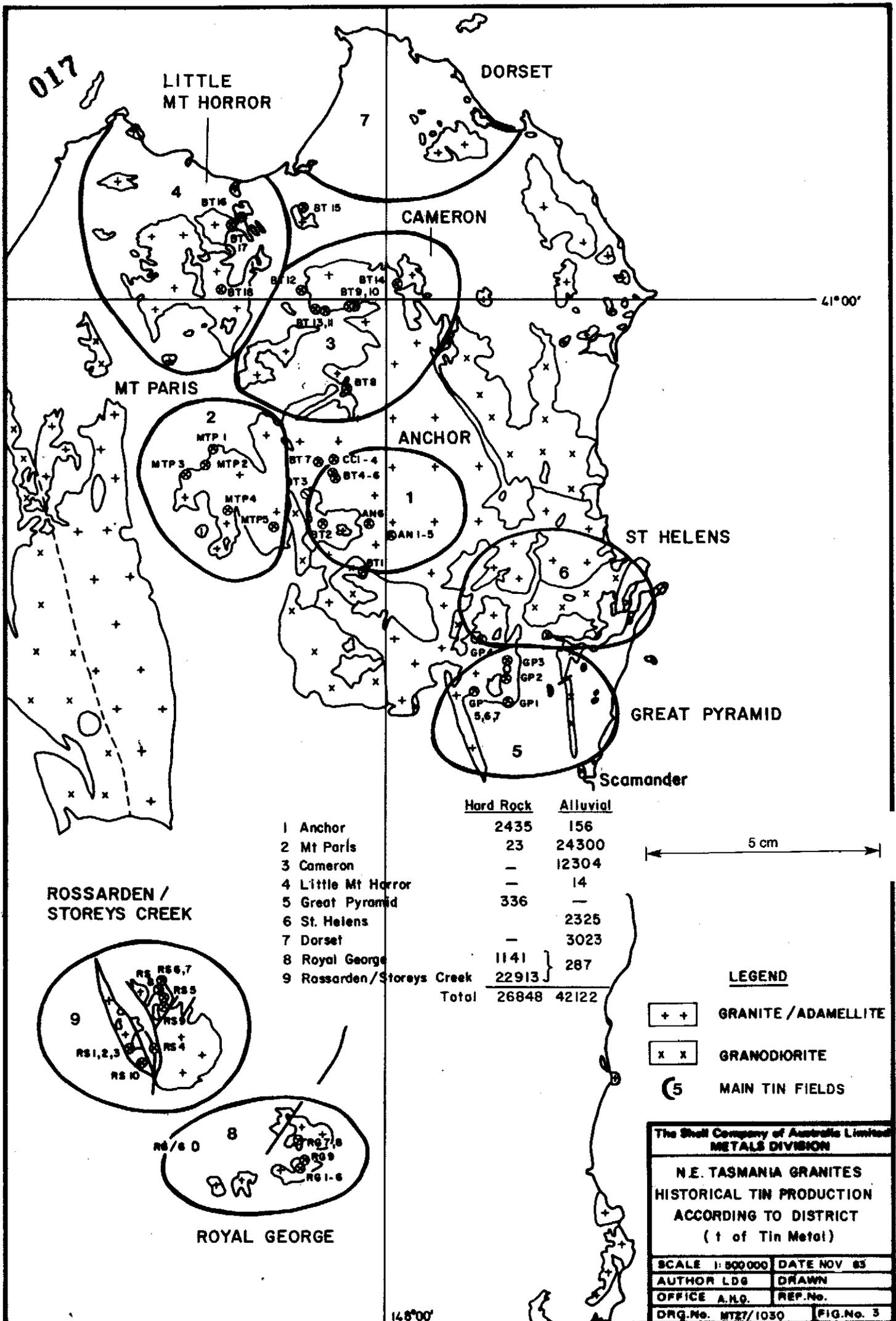
Additional details on Sn-styles of mineralisation will be discussed in subsequent chapters.

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TABLE 1  
Historical Tin Production N.E. Tasmania  
 (tons tin metal)

	Exo- granitic	Endo- granitic	Total Hard rock	Alluvial
1. <u>Mt. Paris</u>	-	-	23	24,300
2. <u>Avoca</u> (Total a & b)	22,913	1,141	24,054	287
(a) <u>Rossarden/Storeys Creek</u>	(22,913)	-	(22,913)	
(b) <u>Royal George</u>	-	(1,141)	(1,114)	
3. <u>Mt. Cameron</u>	-	-	-	12,304
4. <u>Anchor/Emu Hill</u>	-	2,435	2,435	156
5. <u>Dorset</u>	-	-	-	3,023
6. <u>St. Helens</u>	-	3	3	2,325
7. <u>Great Pyramid</u>	336	-	336	-
8. <u>Little Mt. Horror</u>	-	-	-	14
	23,249	3,579	26,848	42,122

(Various sources, e.g. King, 1963)



IV. PETROGRAPHY(a) Introduction

The petrography of the granites of N.E. Tasmania has been described in detail by Groves et al (1977) and more recently by McClenaghan et al (1982) and McClenaghan and Williams (1982(b)). The plutons and sheets of the Blue Tier batholith have received most recent attention. Relatively few modern details have been published on the Ben Lomond granite in the Avoca area. The granitic rocks are generally classified according to their volume percentage of alkali feldspar into (see table 2):

- granodiorites
- adamellites
- calc-alkali granites
- alkali granites

Experience in N.E. Tasmania has shown that granitic rocks with hornblende as the dominant dark mineral are granodiorites, rock with biotite greater than 5% are generally adamellites and rocks with less than 5% biotite are generally alkali granites. The latter may lack biotite and may contain muscovite and/or tourmaline. The issue is complicated by the fact that some adamellites are hydrothermally altered and may contain muscovite and other alteration minerals. It is therefore often not possible to distinguish between adamellites and alkali granites with a hand lens.

It has been suggested that the granitic rocks can easily be classified on chemical grounds, by using a triangular discrimination diagram RB/3-Ti/10-Sr. (McClenaghan and Williams, 1982). It is pointed out however that the diagram shown in this publication (p.25) is wrong. A corrected version is shown in Figure 4).

In thin section, adamellites are generally distinguished from the alkali granites by more calcic plagioclase (oligoclase) rather than albite.

TABLE 2

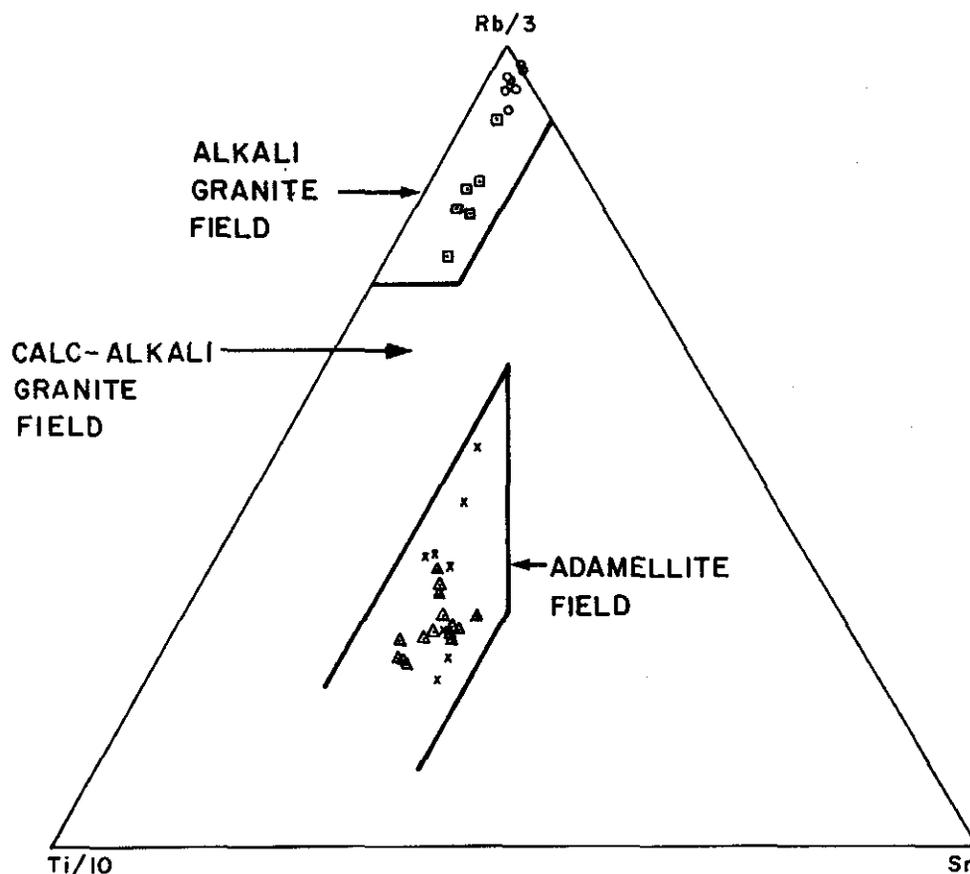
CLASSIFICATION OF GRANITIC ROCKS

% alkali feldspar in total modal feldspar	Nockolds (1954) classification	Streckeisen (1976) classification	Hatch, Wells & Wells
90%	Alkali granite	Alkali granite	
60%	Calc-alkali granite	Syenogranite	Alkali granite
40%	Adamellite		
10%	Granodiorite	Monzogranite	Adamellite
	Tonalite	Granodiorite	Granodiorite
		Tonalite	

66%

33%

In line with local convention, Nockolds classification is used in this report. The consultation report (CMS) is based on Hatch, Wells and Wells' classification.



- Equigranular alkali-feldspar granite
- ◻ Phyrlic alkali-feldspar granite
- ▲ Phyrlic coarse-grained adamellite
- x Phyrlic medium-grained adamellite
- x Phyrlic fine-grained adamellite

( Corrected and modified from Mc Clenaghan and Williams (1982) )

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**TERNARY DIAGRAM**  
Rb/3 - Tr/10 - Sr  
GENERAL  
CLASSIFICATION

SCALE	DATE NOV 83
AUTHOR L.06	DRAWN
OFFICE AHO	REP.No.
DRG.No. MT27/1027	FIG.No. 4

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For field mapping a simple classification based on grain size, texture and mafic mineral content is recommended. An example of such a classification is shown in Appendix II. (The use of cobaltnitrite as a stain for identifying K-feldspar on cut slabs or core is a useful technique for estimating the volume percentage of K-feldspar).

During a reconnaissance trip, a total of 62 granitic and lode samples were collected from the following 6 districts:

- Rossarden and Royal George (Avoca area)
- Great Pyramid/George River
- Anchor/Cream Creek (Lottah)
- Mt. Paris
- Mt. Cameron
- Little Mt. Horror

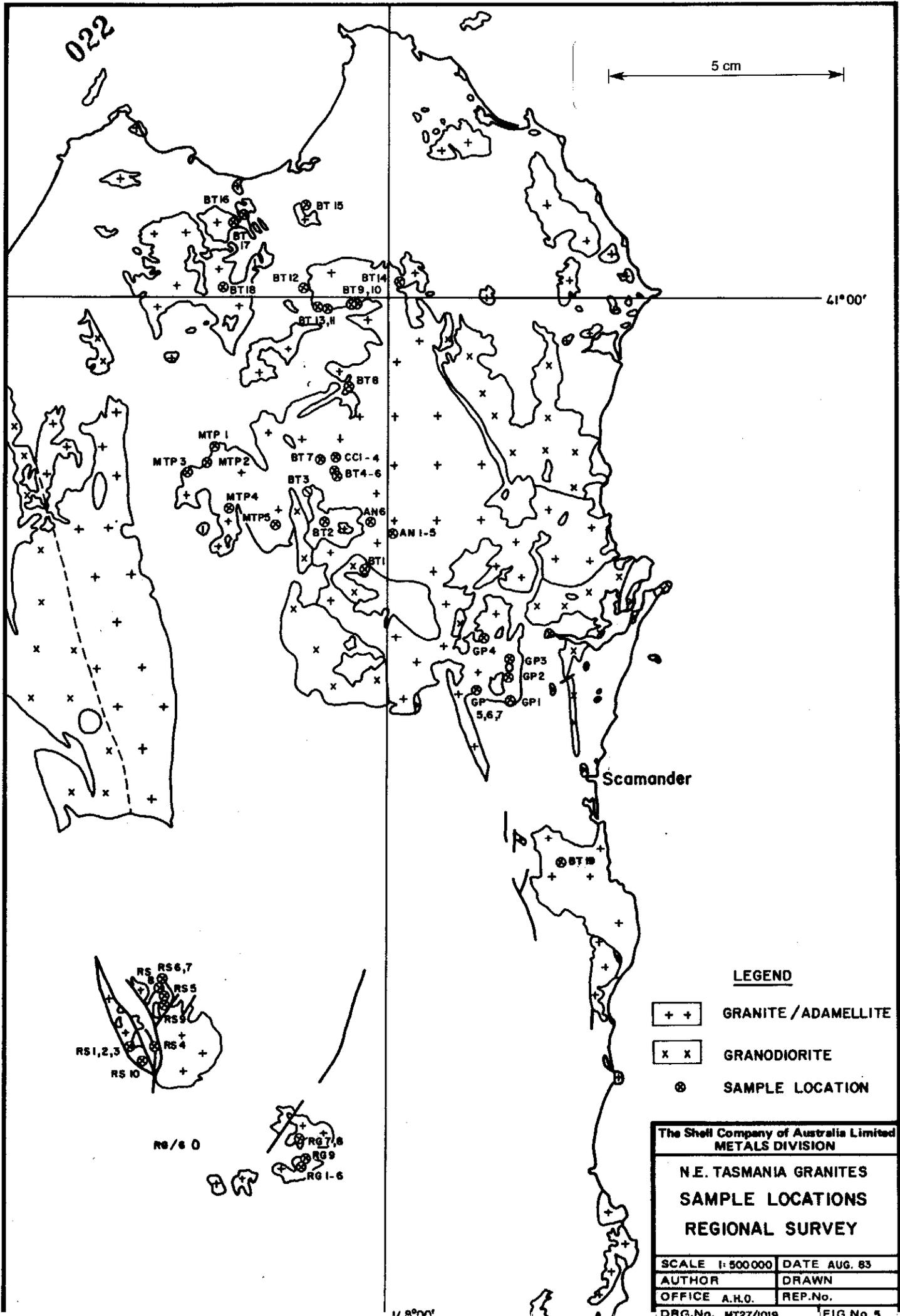
Sample locations are shown in Fig.5. Samples were collected to create an initial data set of the granites of N.E. Tasmania. Some of these samples were specially selected to become part of the BXR collection of tin granites. Special attention was paid to alkali granites and centres of mineralisation. It is pointed out however, that the reconnaissance sampling was only very preliminary and did not cover all areas of interest. Findings are therefore provisional.

All samples were submitted for mineralogical and geochemical analyses. (Major, minor and trace elements). Thin section descriptions were carried out by Central Mineralogical Services (CMS) in Adelaide, who were instructed to pay particular attention to biotite pleochroism and alteration and accessory minerals as well as the An- content of plagioclase. The results are contained in the mineralogical report (Appendix I). All thin sections and hand specimens will be made available to the Tasmanian office. This rock collection may prove useful when further field work is undertaken. The main aspects of the granite types, their field relationships (if established) and their distribution will be briefly described below according to region.

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5 cm

41°00'



**LEGEND**

- + + GRANITE / ADAMELLITE
- x x GRANODIORITE
- ⊙ SAMPLE LOCATION

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<b>N.E. TASMANIA GRANITES SAMPLE LOCATIONS REGIONAL SURVEY</b>	
SCALE 1:500000	DATE AUG. 83
AUTHOR	DRAWN
OFFICE A.H.O.	REP.No.
DRG.No. MT27/1019	FIG No 5

023

(b) Ben Lomond Granite, Avoca Area

Several different granitic phases were recognised in the Ben Lomond area. A total of twenty samples was collected, marked RS (Rossarden) and RG (Royal George). The sample locations are shown in Fig.6.

- Rossarden

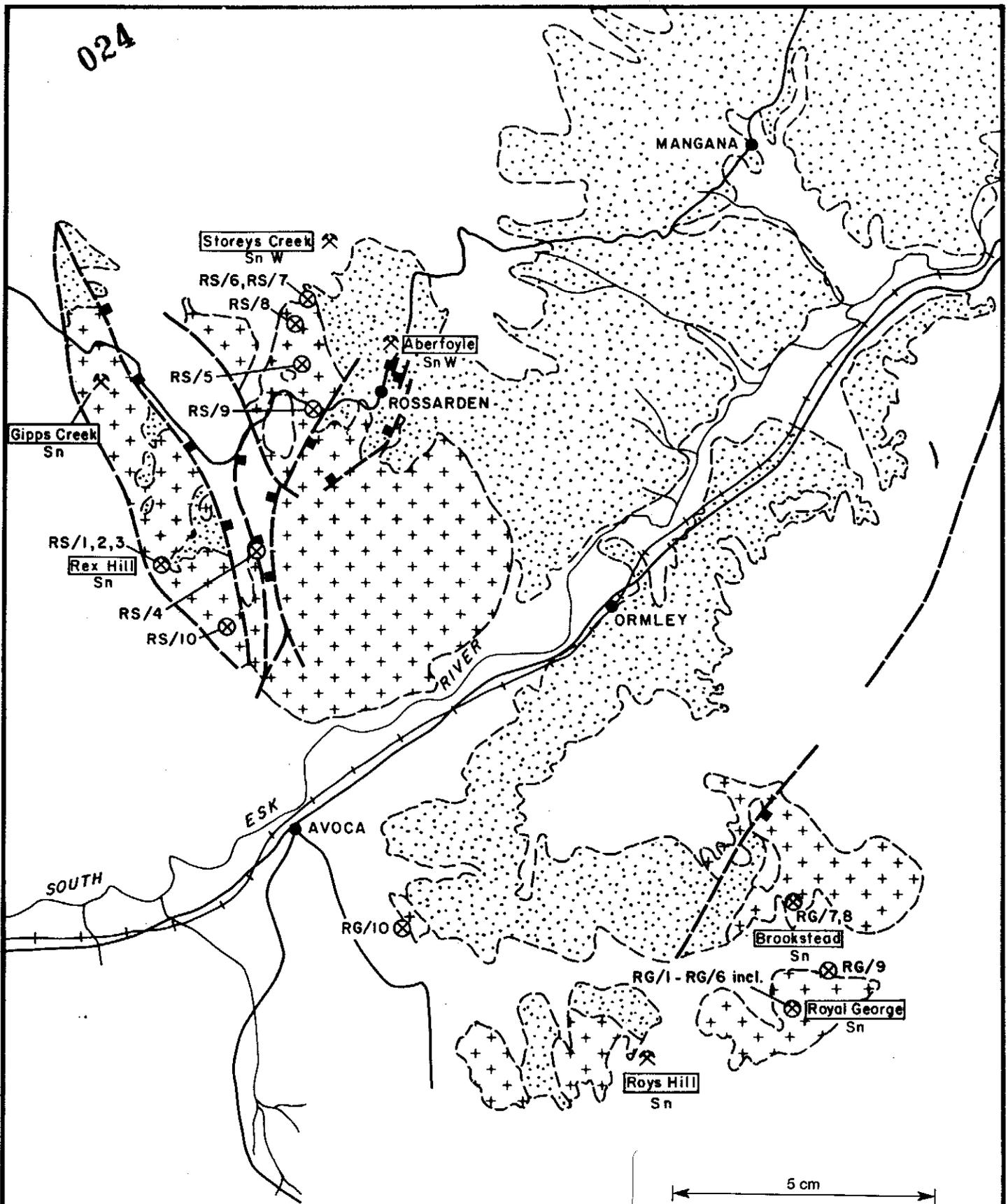
The dominant granite type in the area is a coarse, uneven-grained pink, biotite granite. It is well exposed in some new road cuttings along the Castle Creek Rivulet. The dark colour of the quartz grains is striking (See photo RS/10). Near the roof of the granite towards the contact with the Mathinna beds (e.g. near Rex Hill and south of Storeys Creek) porphyritic phases are common (photo RS/9).

At the contact with the Mathinna Beds there is a sheet of aplitic, sericitized, tourmaline granite (RS/6) which is underlain by an equigranular to inequigranular muscovite bearing tourmaline granite (photo RS/7).

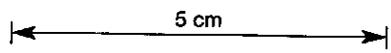
In the vicinity of the mineralised site of Rex Hill, which is also near the contact with the Mathinna beds (see Fig.6) there is a porphyritic phase which is locally strongly sericitized. The quartz in the porphyritic granite is subhedral in shape and very dark. In addition a pale, weakly microlitic, aplitic granite, occurs as dykes.

Thin section studies (see Appendix I), show that the coarse grained granite (RS/4 and RS/10) contains minor traces of fluorite and may contain minor Topaz. These samples have respectively been classified as alkali granite and as adamellite. According to the Ti/10-Rb/3-Sr classifier, the rocks are calc-alkali granites rather than adamellites (see Fig.7a). This diagram shows that the ternary composition of the rocks is identical. The remainder of the samples plot in the alkali granite field.

024



- + Ben Lomond Granite
- ⊗ RS/10 Sample Location
- ⋯ Mathinna Beds
- Main road
- +— Railway
- Fault (and throw)



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**NE TASMANIA**  
**BEN LOMOND GRANITE**  
**AVOCA AREA**  
**SAMPLE LOCATIONS**

SCALE -	DATE NOV 1983
AUTHOR L. de G	DRAWN V.C
OFFICE AHO	REP.No.
DRG.No. L001/1001	FIG No 6

025

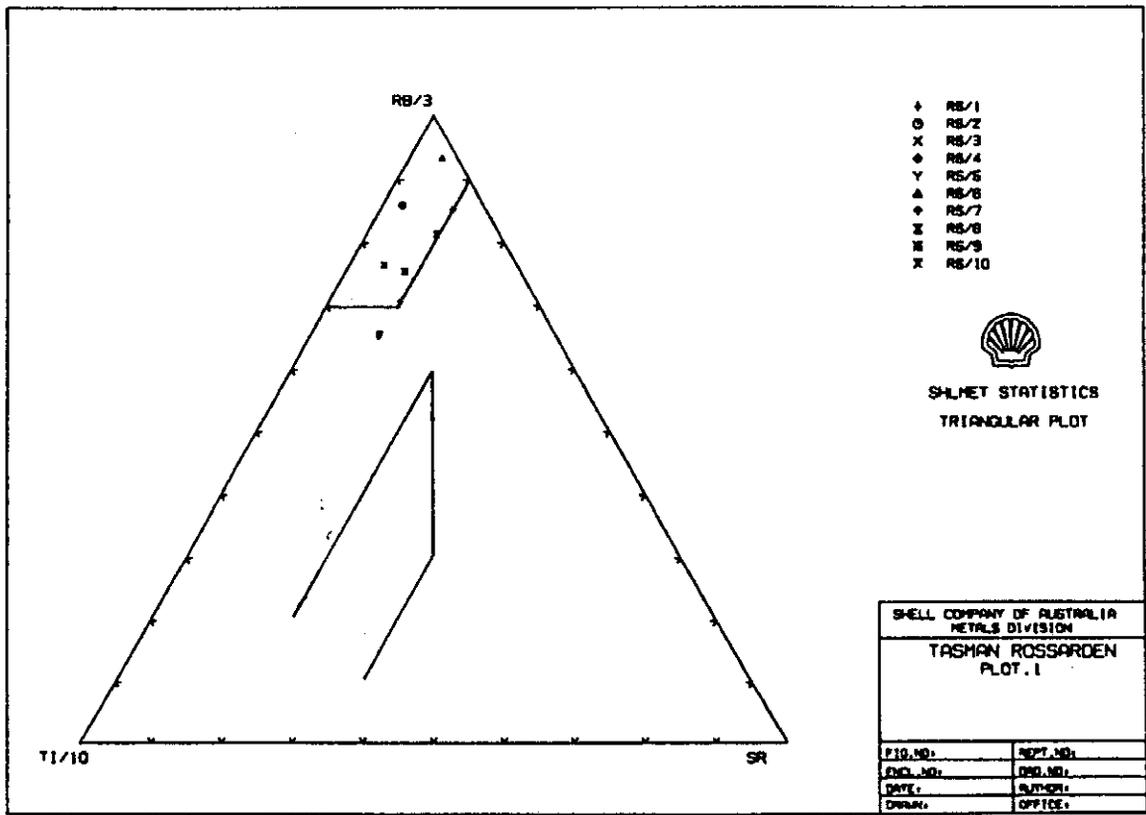


FIG.7(a) Ternary diagram Rb/3-Ti/10-Sr,  
plot of Rossarden samples

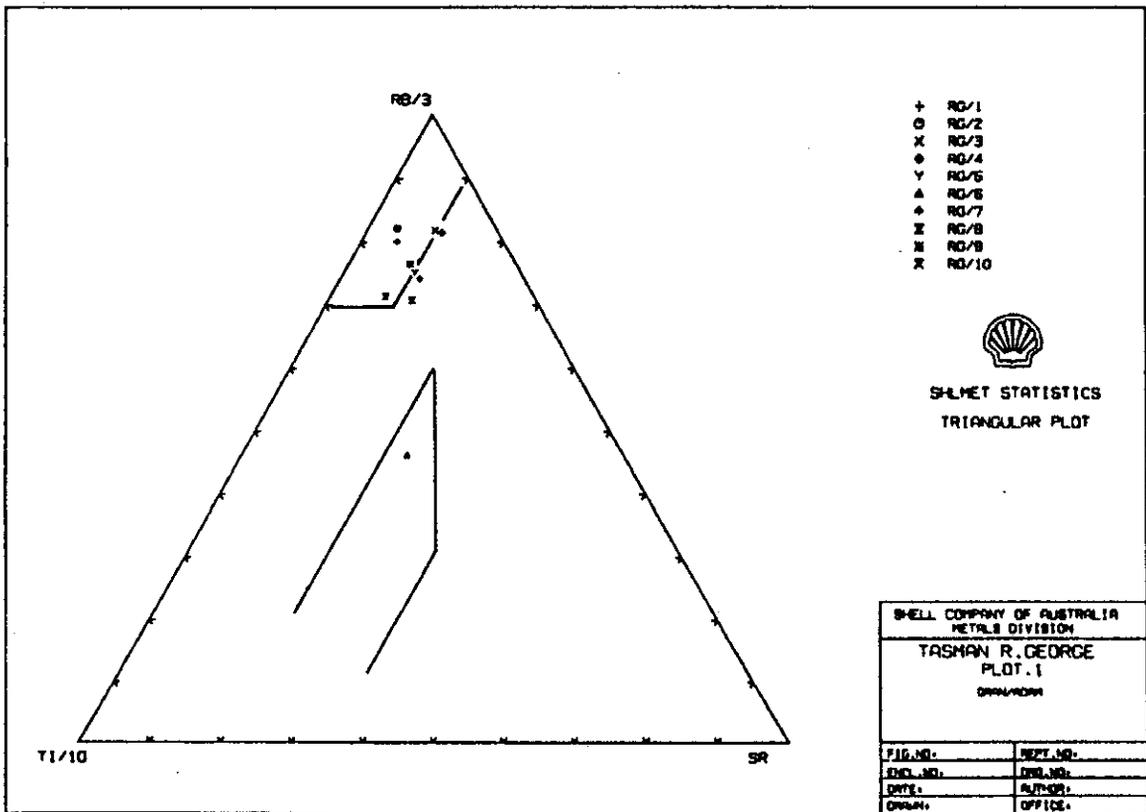


FIG.7(b) Royal George samples

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Thin section studies of the roof zone granites show tourmaline and/or topaz are common as minor accessory minerals (photo micrograph RS/6 and RS/7). It is of interest to note that the "contact" aplitic tourmaline granite is miarolitic with tourmaline partly concentrated within vugs, indicative of second boiling activity.

The granites in the Rossarden area are generally mildly sericitized. The biotites are generally brown and are not strongly chloritized.

- Royal George

Sampling in the Royal George area was mainly confined to the old Royal George tin mine and the Brookstead Sn- prospect. In the immediate surroundings of the Royal George tin mine, there are two main granite types, a porphyritic, tourmaline granite with a fine matrix and a coarse inequigranular, tourmaline bearing biotite granite (see photo RG/3 and RG/5). The former contains pegmatitic eyes of K-feldspar as well as clots of tourmaline. Tourmaline may occur with quartz and may form flat lying (?) zones. Sericitization is prominent especially near the siliceous lode material. The porphyritic granites resemble those at Rex Hill. This type of granite is widely distributed as is shown by the occurrence of a similar tourmaline bearing granite at RG/10, a few km south of Avoca. Coarse grained inequigranular tourmaline bearing biotite granite resembling RG/5 also occurs at the Brookstead prospect. Thin section work has shown that in addition to tourmaline, topaz is a very common constituent.

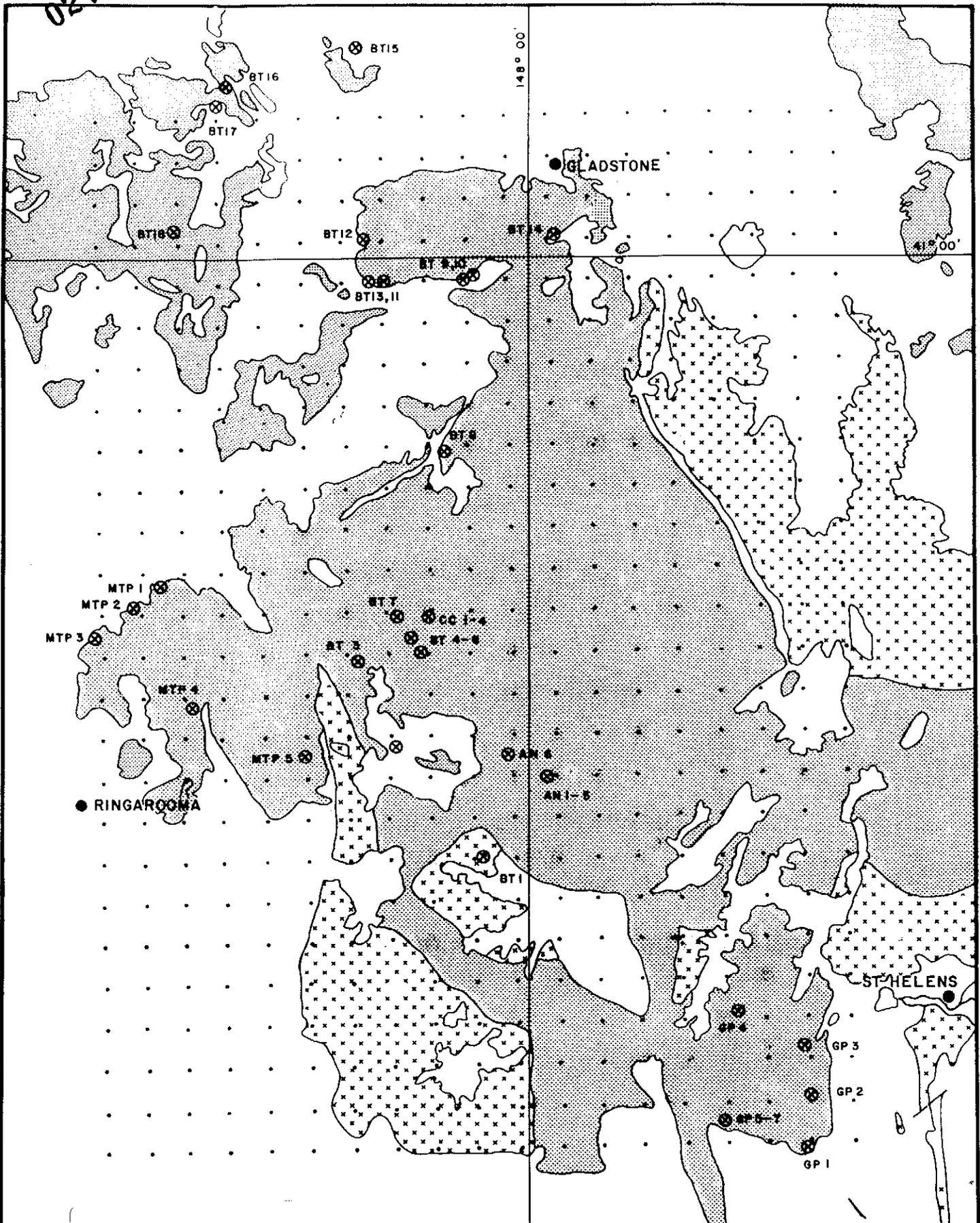
On the basis of the Ti/10-Rb/3-Sr ternary diagram all samples can be classified as alkali-granites (see Fig.7b).

(c) Blue Tier

The petrography of the Blue Tier granites will be briefly described according to the districts mentioned above. The sample locations are shown in Fig.8.

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466028



5 cm

SAMPLE LOCATIONS

⊗ SHELL

GRANITE

GRANODIORITE

The Shell Company of Australia Limited  
METALS DIVISION

NORTH EAST TASMANIA  
ROCK SAMPLE LOCATIONS  
BLUE TIER BATHOLITH

SCALE 1:250 000	DATE 18-7-83
AUTHOR L de G	DRAWN AS
OFFICE AHO	REP.No.
DRG.No. MT 27/1025	FIG.No. 8

028

- Anchor/Emu Hill

Several samples were collected in the old Anchor open cut. Samples AN1- to AN3 were collected from bottom to top along the benches of the old open cut in the cassiterite bearing, alkali granite.

The alkali granites occur as lenses(?) overlain by porphyritic to inequigranular adamellites (photo AN5) separated by a thin zone of quartz-K-feldspar pegmatite. The mineralised granites are sericitized, medium grained, equigranular muscovite/biotite granites (see photo AN/1) and contain disseminated cassiterite.

A similar granite was observed in a road cut (as a lens or dyke?), several kilometres S.W. of the Anchor open cut. Thin section work has shown that this sample contains rare cassiterite. Towards the south of the Anchor mine, hornblende bearing granodiorites of the Pyengana pluton crop out (BT/1).

Thin section work has shown that the biotites in the mineralised granites is invariably green coloured as distinct from the brown to orange biotite of the overlying adamellites.

Topaz is a common constituent of the mineralised granite. Topaz bearing granites are widespread in the area as is demonstrated by an outcrop of coarse equigranular topaz bearing biotite granite which occurs about 2 km south-east of Weldborough (photo BT/2).

The adamellites overlying the alkali granites at Anchor contain secondary muscovite.

The Emu Hill area contains several old hard rock tin workings. In the so called Cream Creek prospect area (samples CC/1-CC/4) several topaz alkali-granites were sampled, (porphyritic and equigranular) although we failed to locate the old workings. These rock types are also common south of Emu Hill (photo BT/6).

029

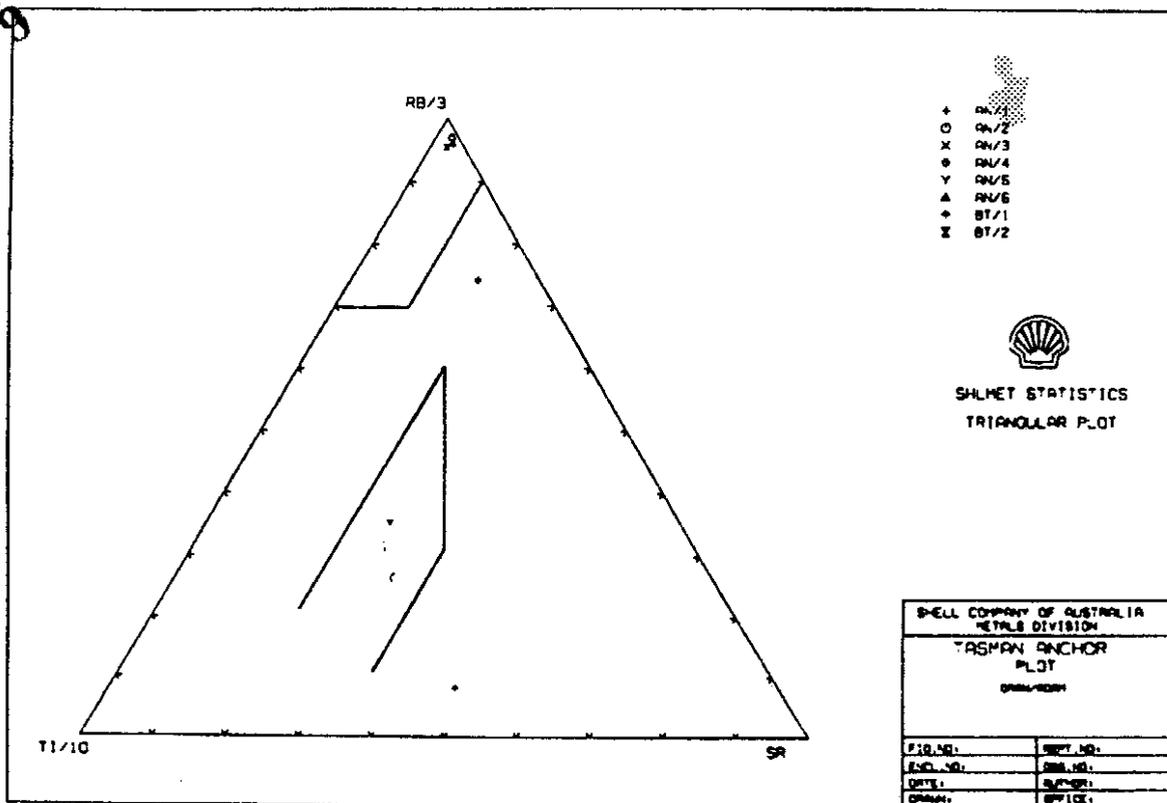


FIG.9(a) Ternary diagram Rb/3 - Ti/10 - Sr plot of Anchor samples

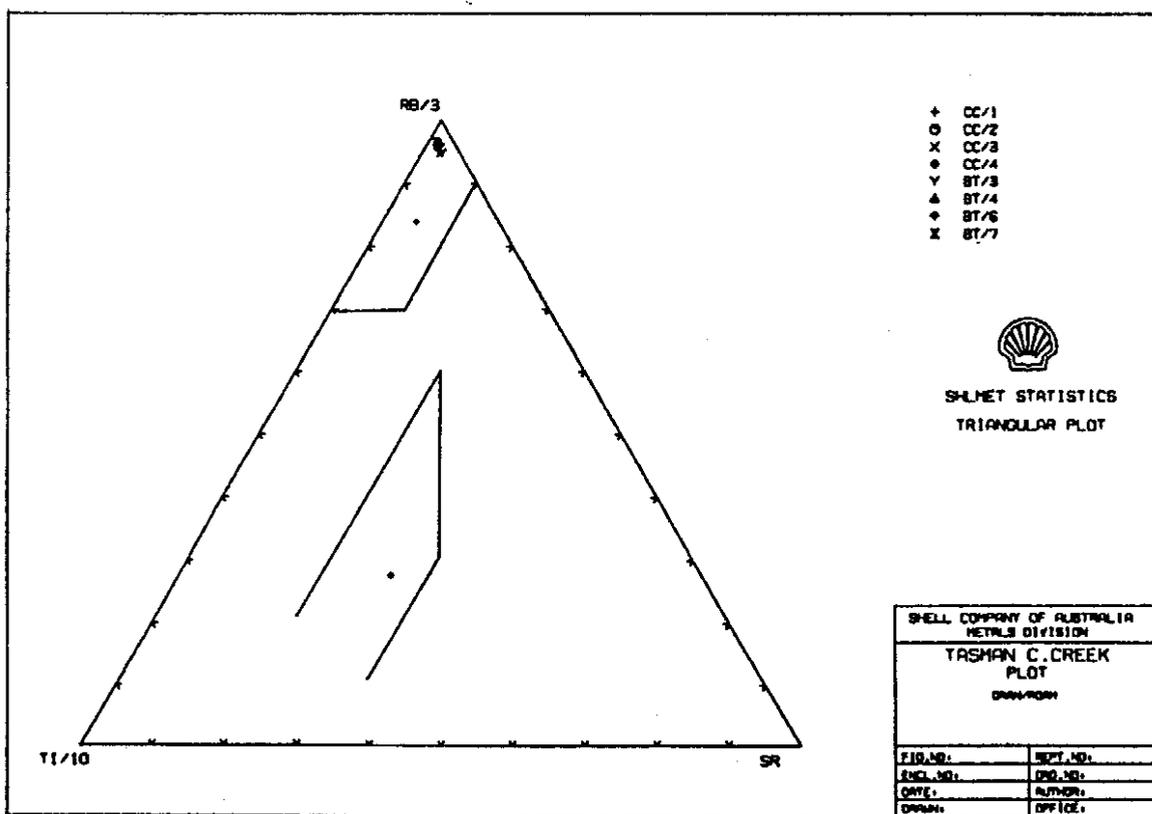


FIG.9(b) Emu Hill samples

The classification based on thin section studies is more or less confirmed by the Ti/20-Rb/3-Sr classifier (see Figs.9a and 9b). The adamellites sampled in the Anchor and Emu Hill areas (AN/5 and CC/7) plot in a similar position.

The mineralogical studies have shown that topaz is a common accessory mineral in this area, with a virtual absence of tourmaline. (Cf Ben Lomond where tourmaline is very common).

The greisenized sample (BT/4) has a kaolinized appearance, and is unlike the greisens from the Anchor Mine which show strong sericitization.

- Mt. Paris (MTP/1 - MTP/5)

The so called Mt. Paris mass intrudes the Mathinna Beds. The structural setting of these granites is more like those of the Ben Lomond granites and quite unlike the Anchor area. A total of five samples was collected from this mass, which still has not been mapped in detail. There are two main textural varieties, a porphyritic and an equigranular. All sampled granites are muscovite bearing biotite granites (biotite less than 5%) with the exception of MTP/2 which contained more than 5% biotite and less conspicuous muscovite. The samples were not collected near sites of mineralisation.

Thin section work has shown that all granites are topaz bearing. The samples collected in the southern part of the area (MTP/4&5) are more leucocratic when compared to other samples.

The samples were classified on mineralogical grounds as alkali granites, which is confirmed by the Ti/10-Rb/3-Sr ternary diagram (Fig.10a). Please note that the field classification based on biotite content, identified as sample MTP/2 the least differentiated, which is better classified as a calc-alkali granite. In thin section biotites are altered and colour variable (green/brown). This seems to be common in differentiated granites in the Blue Tier (cf. Ben Lomond).

031

- Georges River (Samples GP1-7)

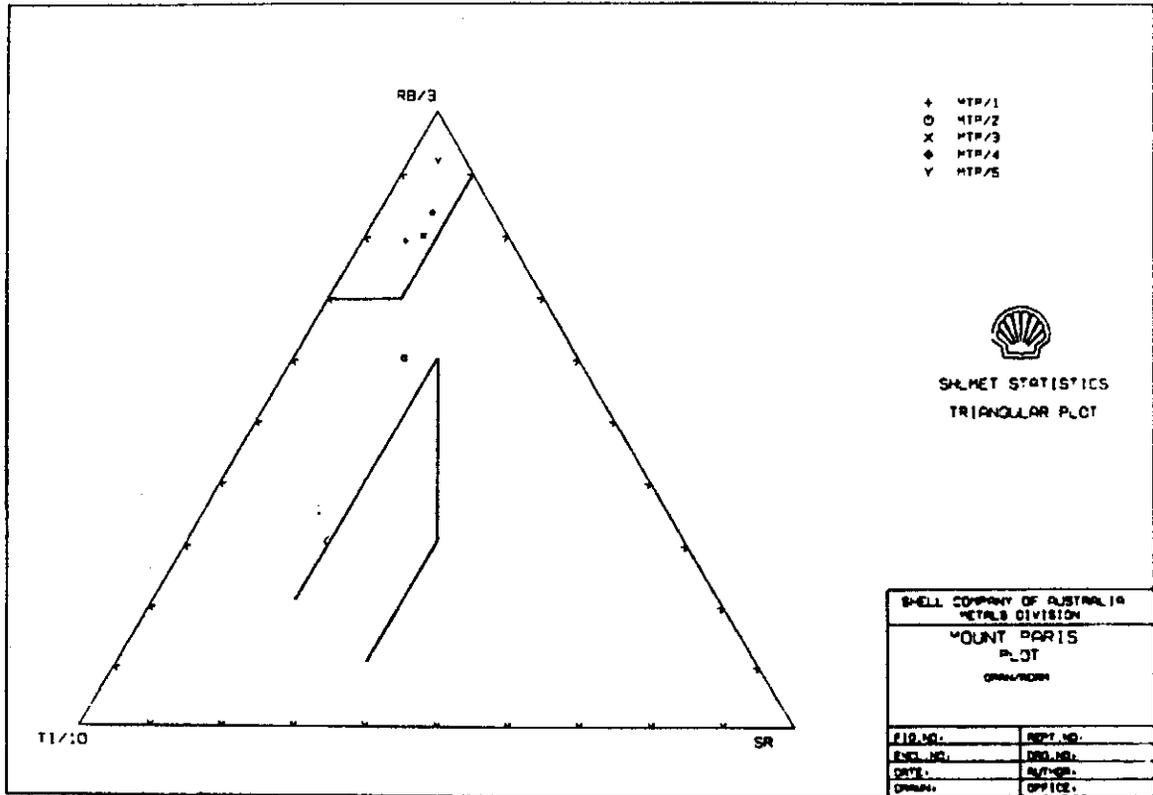
A number of samples were collected in the Georges River area close to the contact with the Mathinna Beds. These contact granites belong to the so called Constable Creek Sheet of Groves et al (1977). Two main varieties were observed: a biotite granite (biotite smaller than 5%) and a tourmaline bearing, aplitic, two mica granite. The latter probably occurs as small lenses and/or dykes close to the contact with the overlying sediments. The tourmaline aplitic granite contains locally pegmatitic eyes or clots of K-feldspar and granites as well as of tourmaline. Sample GP/5 showed some compositional layering, with thin layers of massive K-feldspar (photo GP/5). The biotite granites occur in a number of textural varieties: coarse equi- and inequigranular - as well as a coarse porphyritic variety. (e.g. GP1).

Thin section work has shown that the biotite granites may contain minor primary- and secondary muscovite. Topaz is relatively uncommon and tourmaline is restricted to the late aplitic phases.

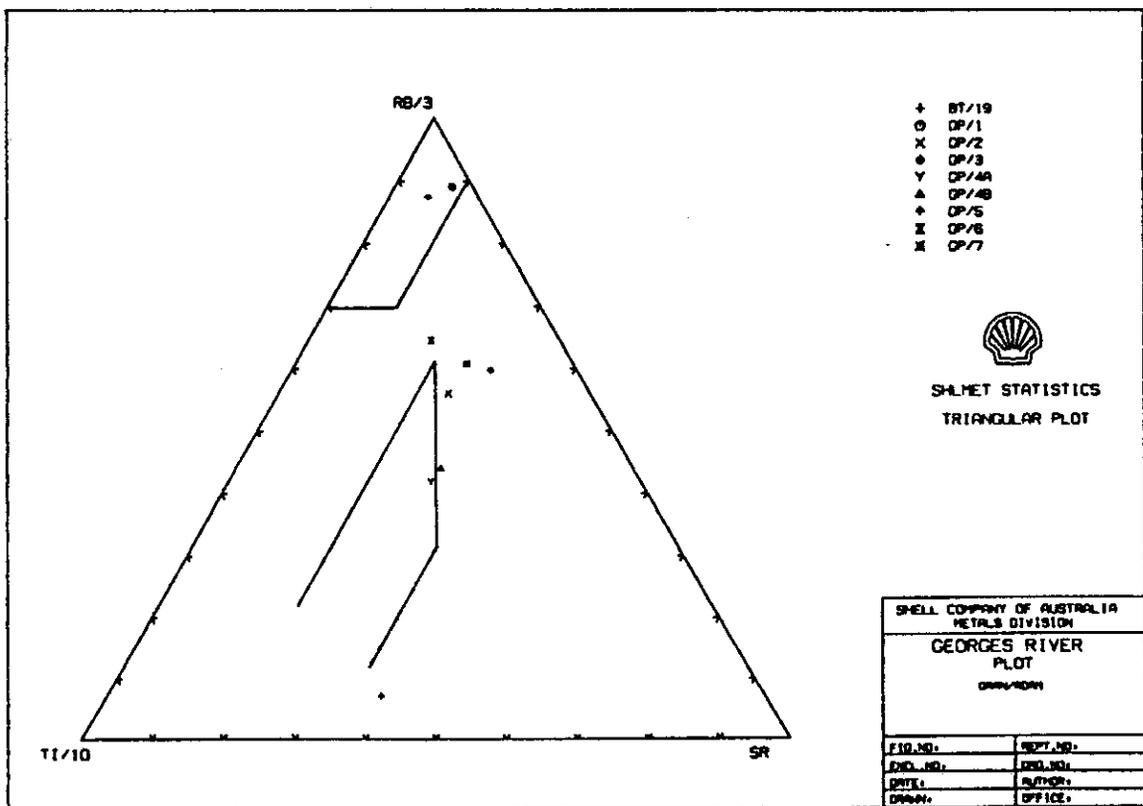
On the basis of mineralogy, the aplitic, tourmaline aplitic granites have been classified as alkali granites while the biotite (minor muscovite) varieties have been identified as adamellites. This corresponds quite well with the Ti/10-Tb/3-Sr ternary plot classification (Fig.10b) although some samples would be better classified as calc-alkali granites. It is interesting to note that most granites are mildly sericitized and chloritized and the biotite is commonly colour variable (green/brown). (photo micrographs GP/4a and GP/5).

Compared with the granites of the Mt. Paris mass, the Georges River contact granites are less differentiated (cf. Fig.10a) with the exception of the aplitic phases. In addition the granites lack topaz.

032



**FIG.10(a) Ternary diagram Rb/3-Ti/10-Sr,  
plot of Mt. Paris samples**



**FIG.10(b) plot of George's River samples**

033

- Mt. Cameron and Little Mt. Horror (BT-8 - BT19)

A number of samples were collected in the northern part of the Blue Tier. On a regional scale coarse, porphyritic biotite adamellites are common (photo BT17). Near the southern foot of Mt. Cameron several alkali granites were sampled (e.g. BT/11). They occur in numerous textured varieties from coarse grained inequigranular to porphyritic and are generally muscovite bearing.

Thin section descriptions indicate that there is considerable compositional difference in the An- content of the plagioclases between the two rock types. The 2 mica granites are generally topaz-bearing. The biotite of the latter is often altered and display colour variations. Cassiterite has been observed in one of the samples (BT/14). This, to my knowledge, is a rare observation.

The reconnaissance sampling in the Little Mt. Horror area failed to locate alkali granites. Although some of the samples contain muscovite and topaz, on the basis of thin section studies and the ternary diagram, the samples are all adamellites (see Fig.11a).

(d) Remarks

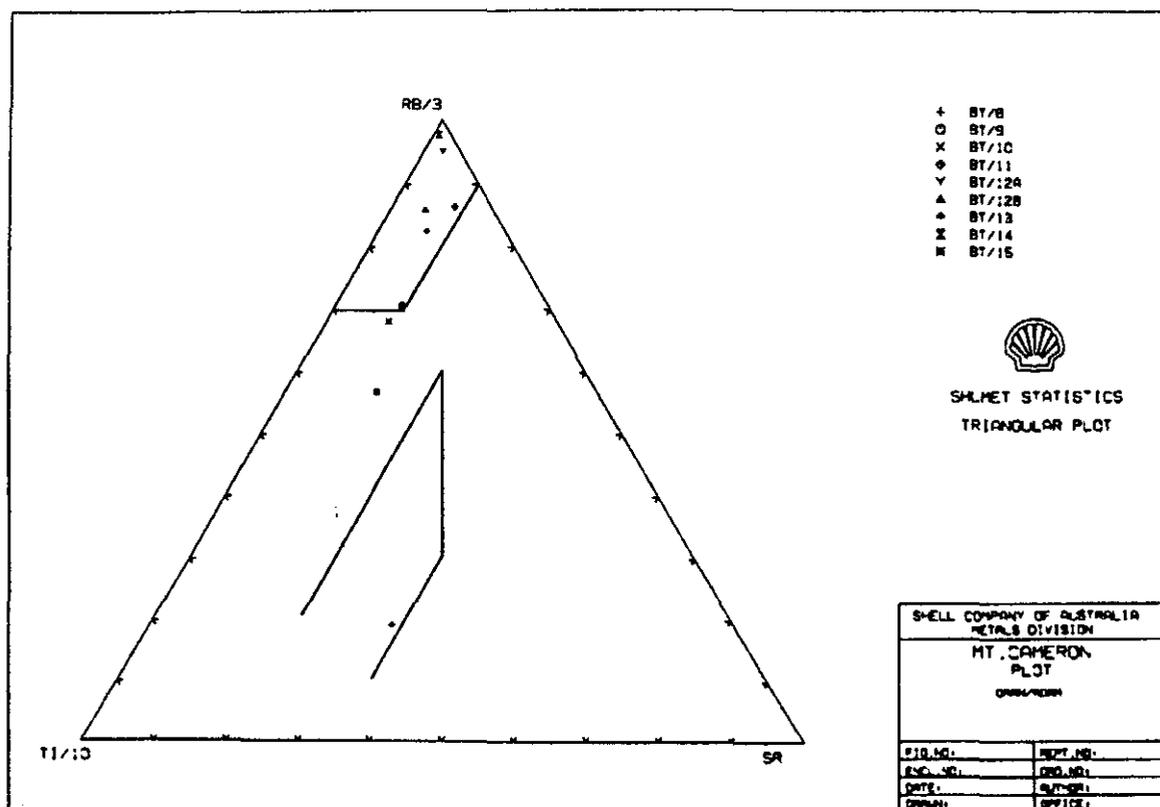
The distribution of alkali granites is widespread in N.E. Tasmania. The alkali-granites from the Avoca area are less well known.

The sampled alkali-granites can be grouped into two main types according to their structural setting:

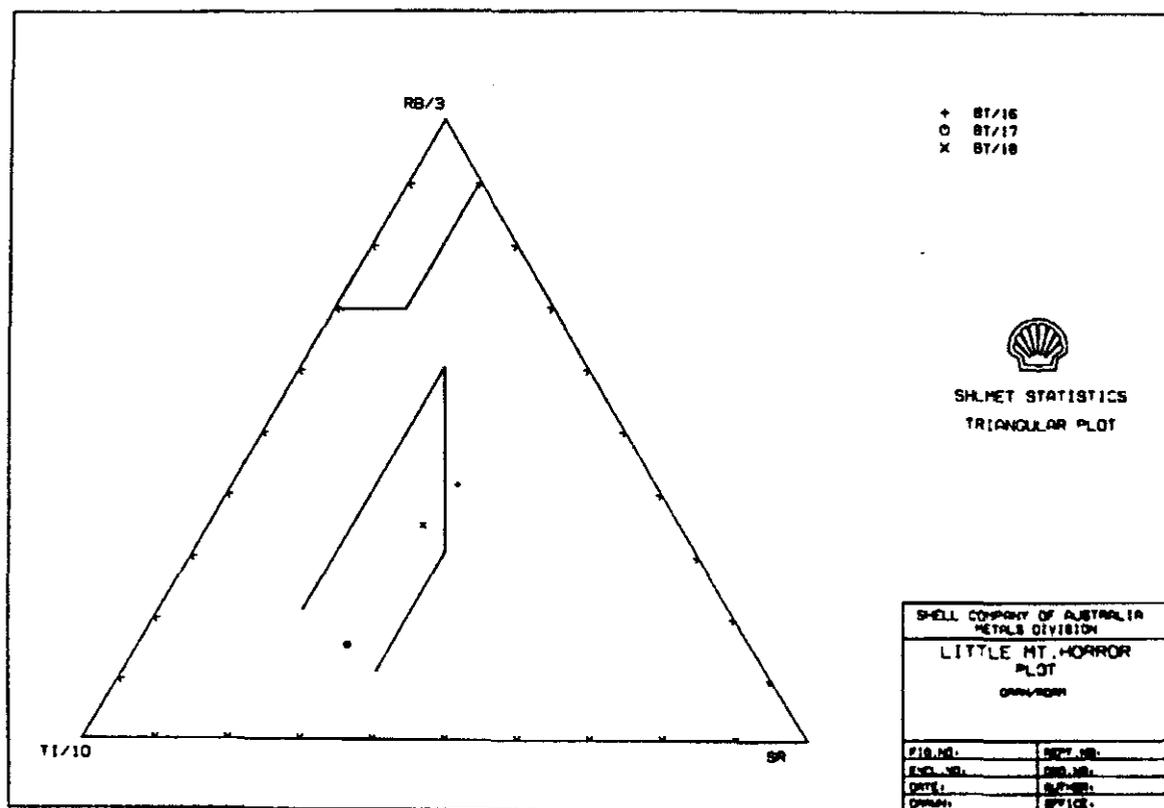
- Contact or roof zone alkali granites
- Granite-contained or endogranitic alkali granites

The contact alkali-granites are associated with exogranitic mineralisation (e.g. Ben Lomond, Mt. Paris) or with steeply dipping lodes within the roof zone granite (e.g. Royal George). The

034



**FIG. 11(a) Ternary diagram Rb/3-Ti/10-Sr, plot of Mt. Cameron samples**



**FIG. 11(b) Little Mt. Horror samples**

endogranitic alkali granites are associated with disseminated Sn-mineralisation (e.g. Anchor, Cream Creek).

Tourmaline appears to be common in the contact alkali granite (e.g. Ben Lomond, Georges River) but not in the endogranitic alkali-granites. Topaz is a common constituent of all alkali-granites, but is lacking in the Georges River Area.

The alkali granites of both settings are associated with flat lying greisen sheets. The degree of flat greisen development is, however, different. It is extensively developed in the endo-granitic alkali granites (Anchor, Emu Hill) but limited to a thin contact zone in contact granites (e.g. Mt. Paris).

On the basis of the Ti/10-Rb/3-Sr plots it is interesting to note that the main granitic phases in the Georges River area are not very highly differentiated, when compared to other granites in similar settings (e.g. Mt. Paris, Ben Lomond).

The biotites of the N.E. Tasmania granitic rocks vary in colours from shades of brown in the adamellites and calc-alkali granites, to green/brown and green in the alkali-granites. In addition, biotites of alkali-granites often display the following colour variation with increasing differentiation and alteration: green-pale green to colourless. (This does not hold for the biotite of the Ben Lomond alkali-granite which are generally brown).

The most apparent alteration feature is muscovitisation/sericitization, generally well developed at mineralised locations. Presence of tourmaline and topaz indicate past action of volatile components. Extensively altered, greisenised rocks often contain secondary carbonate (see Appendix I).

The classification of the samples based on the petrographical studies is in general agreement with the classification based on the Ti/10-Rb/3-Sr ternary diagram. However, a few samples especially of the Ben Lomond granite were wrongly classified as adamellites. On chemical grounds these were classed as calc-alkali granites. The petrography proved however very useful in

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identifying tell-tale accessory minerals such as cassiterite, topaz, tourmaline, as well as alteration features.

V. GEOCHEMISTRY

All samples (62) were submitted for chemical analyses. Samples were analysed for major elements as well as for the following minor - and trace elements, F, Ga, Li, Mo, Nb, Rb, Sn, Sr, U, W and Zr. In addition the total gamma radiation was measured for each sample. The latter is expressed as equivalent uranium oxide ( $\text{EU}_3\text{O}_8$ ). The range of elements was selected to satisfy demands of this study as well as to provide extra data for the SCOA granite data base. The latter will be used for comparative geochemical studies at a later date. Analytical results are listed in Appendix II.

The total sampled population forms a fairly regular differentiation series as is demonstrated in Fig.11c.

(a) Ben Lomond Granite (RS & RG)

On the basis of Ti/10- RB/3- Sr- diagrams (Fig.7a & 7b) it was already established that all Ben Lomond granites sampled are differentiated alkali granites. As such it is difficult to establish trends, as all granites represent the differentiated end of the granitoid field.

- Major Elements

Overall, the major elements have a restricted composition.  $\text{SiO}_2$  is slightly higher in the altered and greisenised samples (see table 3). The generally low ferro-magnesium levels are typical of highly fractionated granites. The slight increase of iron in the the greisenized samples is probably caused by the presence of ankerite and/or sulphides (see mineralogical description Appendix I). The perceived mineralogical differences between granites and adamellites (e.g. An content of plagioclase) are not readily evident from the average major element composition of these groups. On the basis of the major elements the granites can be classified as high silica, peraluminous alkali granites. The aluminium index (the ratio of molecular  $\text{Al}_2\text{O}_3/(\text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O})$ ) is well over 1. In the absence of less differentiated members (Scottsdale batholith?)

038

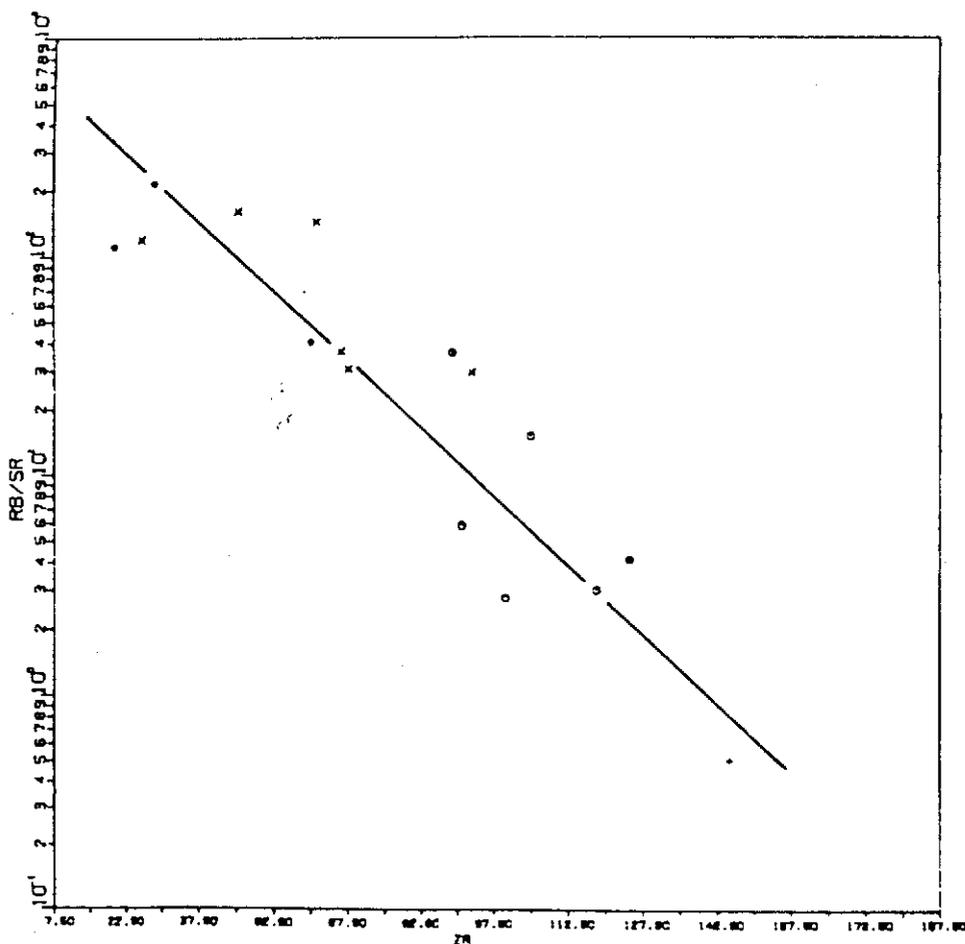


Fig. 11c

Binary plot Rb/Sr vs Zr.  
Averages of all samples based on CMS classification  
(excluding lode samples).

- + GRANODIORITES(D)
- C ADAMELLITES(A)
- X GRANITES(G)
- ♦ GNEISSES(S)

CORRELATION COEFFICIENT = -0.76

The Shell Company of Australia Limited METALS DIVISION	
<p><b>BINARY PLOT</b> Rb/Sr vs. Zr</p>	
SCALE	DATE NOV 83
AUTHOR LDG	DRAWN
OFFICE AHO	REP.No.
DRG No	FIG No 11c

it is somewhat premature to use this as evidence for classing these granites as S-types.

Fluorite levels are high and increase systematically with the Al index, the greisenised and cassiterite bearing greisens having the highest F-levels.

- Trace Elements

The trace element levels of the Ben Lomond granites (table 4) generally correspond well with the established ranges and patterns of the alkali-granites of the Blue Tier batholith as established by Groves et al (1977), McClenaghan et al (1982), i.e.

\* enriched in: F, Li, Rb, Nb, Sn, W

\* depleted in: Ba, Sr, Zr

Uranium levels with an average of 23 ppm (range 7-36 ppm) can be regarded as anomalously high. This, however, is not uncommon for tin granites. The Y- levels have a large range and decrease with increasing alteration.

Gallium does not vary between the two groups of granites but is depleted in the silicified greisens. This may be related to the lower  $Al_2O_3$  levels in the latter.

Trace element trends are illustrated in the Ba/Rb-Ti and Rb/Sr-Zr plots (Fig.12 & 13). The plots are based on averages according to field classification. Both figures show a regular trend from Biotite granite - two mica granite - two mica tourmaline granite - to muscovite tourmaline (contact zone) and greisenised granites, illustrating increasing differentiation in the direction of the contact zone. This trend may be explained by the combined effects of fractionation and hydrothermal alteration in the roof zone.

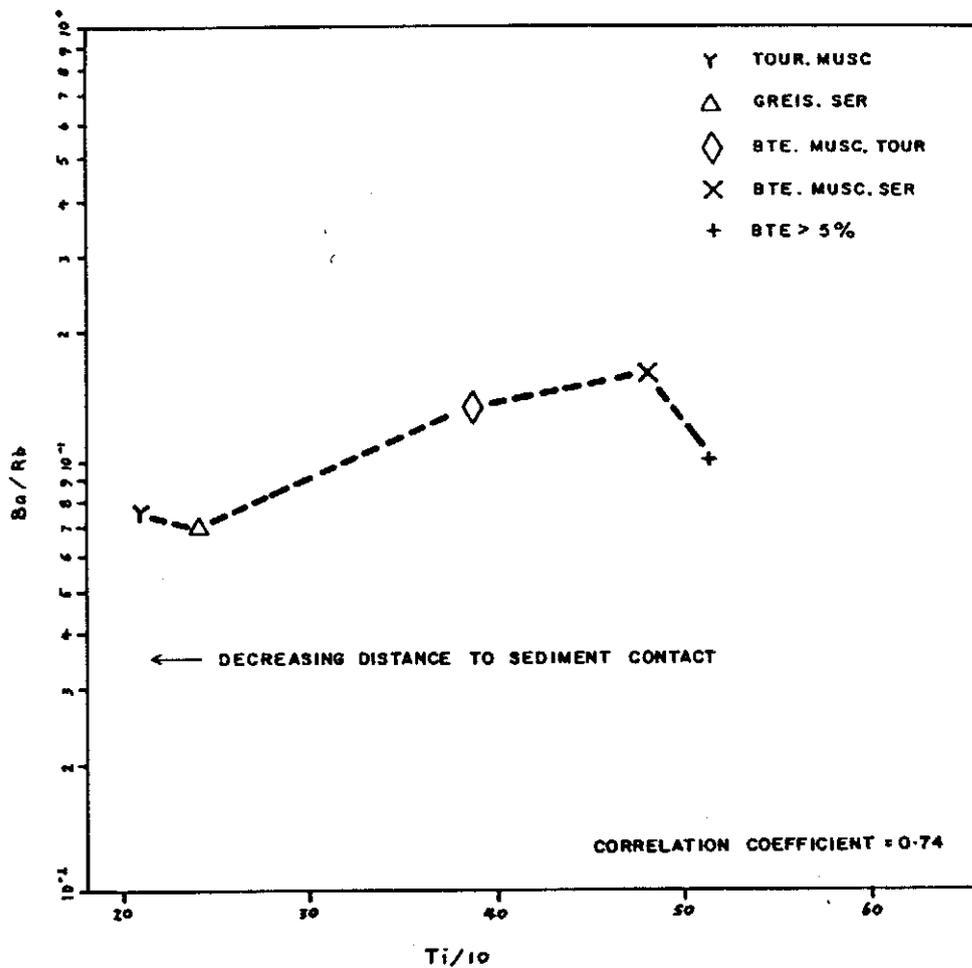


Fig. 12

Binary plot Ba/Rb vs Ti/10 Ben Lomond granites. The trend shows little variation in the Ba/Rb ratio, but a notable decrease in Ti towards the sediment contact. Plotted values are averages according to granite type (field classification).

041

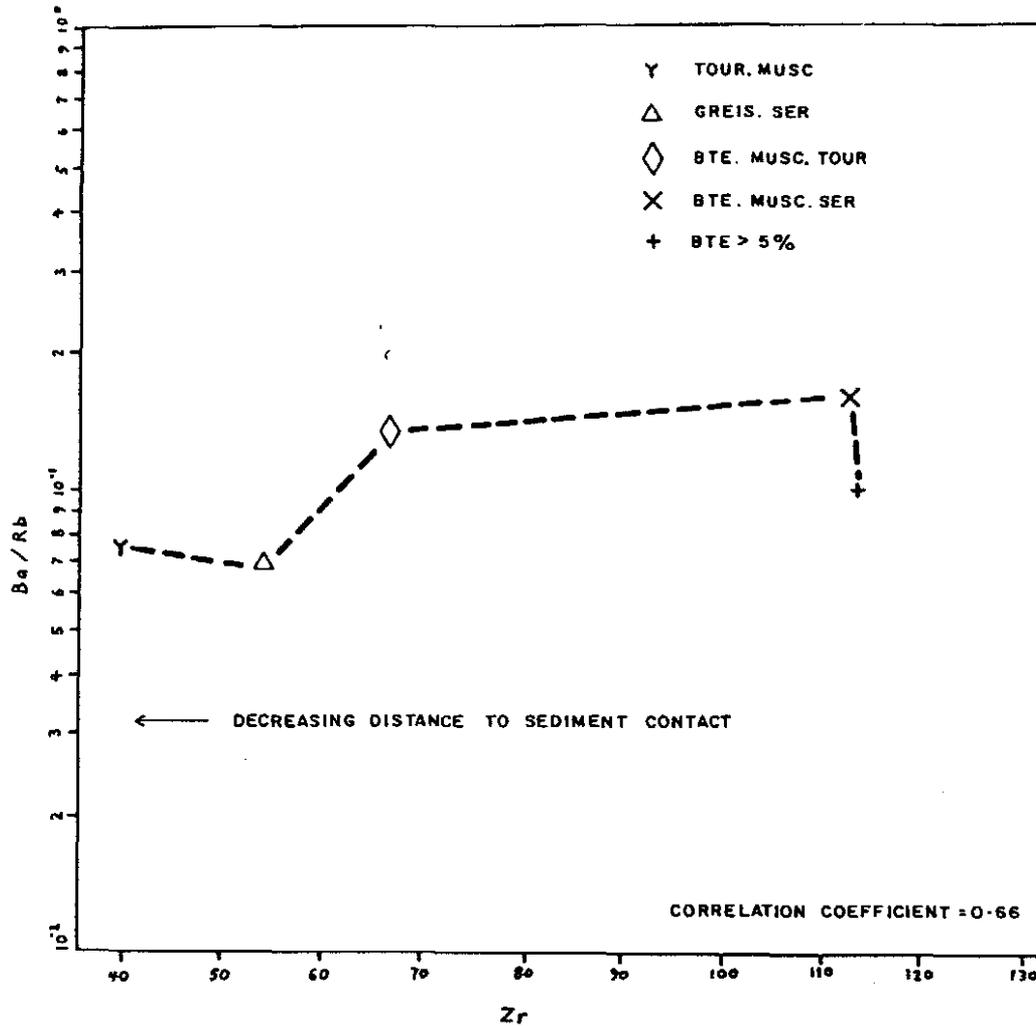


Fig. 13

Binary plot Ba/Rb vs Zr Ben Lomond granites. The trend is similar to the one in Fig. 12. Plotted values are averages according to granite type.

042

TABLE 3

Average major element compositions - Ben Lomond Granite.

	R. . G*) 9 MEAN	R. . A 6 MEAN	R. . S 2 MEAN
SiO <sub>2</sub>	75.78	76.25	78.10
Al <sub>2</sub> O <sub>3</sub>	12.71	13.00	12.90
TiO <sub>2</sub>	0.07	0.06	0.05
Fe <sub>2</sub> O <sub>3</sub>	1.43	1.21	2.26
MgO	0.03	0.03	0.01
CaO	0.38	0.34	0.04
Na <sub>2</sub> O	2.31	2.37	0.57
K <sub>2</sub> O	5.03	4.99	3.42
MnO	0.03	0.02	0.05
P <sub>2</sub> O <sub>5</sub>	0.11	0.06	0.06
LOI	0.91	0.98	1.70
TOTAL	98.80	99.32	99.18

TABLE 4

Average trace element composition - Ben Lomond Granite.

	R. . G 9 MEAN	R. . A 6 MEAN	R. . S 2 MEAN
BA	65.00	75.83	42.50
Fz	0.39	0.31	1.67
GA	25.78	25.00	18.00
LI	153.33	159.17	145.00
MO	23.33	20.67	22.00
NB	24.67	29.67	28.00
RB	638.89	636.67	550.00
SN	31.11	27.33	3490.00
SR	24.67	22.50	15.00
U	22.00	16.33	13.00
W	25.56	17.50	22.50
Y	44.33	72.50	15.00
ZR	93.00	89.00	60.00
EU308	40.11	36.17	17.00
BA/RB	0.10	0.12	0.08
RB/SR	29.71	36.50	40.83
SNFORM1	0.58	0.72	2.25
SNFORM2	10.02	6.76	28.41
SNFORM3	0.75	0.08	0.06
TI/10	44.63	33.97	32.97
ALINDEX	1.28	1.32	3.67
RB/3	212.96	212.22	183.33

\*) Coding

R = Rossarden/Royal George

A = Calc-Alkali Granites

G = Alkali Granite

S = Craisen

From an exploration point of view, the tin potential of the Ben Lomond granites (excluding the altered and greisenized types) can be recognised by low Ba/Rb ( $< 0.2$ ) and high Rb/Sr ( $> 20$ ) ratios. In addition the F- and Li- contents are distinctly elevated. Also the granites are anomalous in U and total gamma radiation ( $EU_3O_8$ ).

(b) Blue Tier

The Blue Tier granites samples have a wider compositional range than the sampled Ben Lomond granites as the samples include adamellites and granodiorites. The geochemistry has already been described in detail (Groves et al, 1977, McClenaghan et al, 1982c, McClenaghan & Williams, 1982), who have established that the granitic rocks of the Blue Tier form a differentiated series, from granodiorites-adamellites to alkali granites.

- Major Elements (Table 5)

With the exception of the granodiorites, all granitic rocks have an Al- index greater than 1, so can be classed as peraluminous. On major element grounds the difference between Alkali granites and calc-alkali granites/adamellites are only marginal, with adamellites having generally lowest  $SiO_2$ ,  $Al_2O_3$  and higher CaO and, ferromagnesium elements. Potassium is less regular, being highest in the Anchor and Emu Hill adamellites. Overall the differences between granites and adamellites are slight. Granodiorites are distinctly more mafic (i.e. higher Ferromagnesium,  $TiO_2$  and CaO). Like the Ben Lomond granite, the Al index has a positive correlation with fluorine.

- Trace Elements

The average values according to the main rock types and districts are listed in table 6. Depletion and enrichment trends contain to the established patterns i.e.:

Table 5

Average major element composition  
Blue Tier Batholith

\*) classifiers

first column

- A = Anchor
- G = Georges River
- C = Cameron
- K = Cream Creek
- H = Honor

	* A..G 4 MEAN	A..A 1 MEAN	A..S 1 MEAN	G..G 3 MEAN	G..A 5 MEAN	C..G 5 MEAN	C..A 4 MEAN	K..G 6 MEAN	K..A 1 MEAN	K..S 1 MEAN	H..A 3 MEAN	P..G 5 MEAN	A..D 1 MEAN	G..D 1 MEAN
SIO2	74.10	72.20	74.40	76.53	76.28	76.58	76.32	76.03	73.00	77.60	73.27	76.42	64.70	68.10
AL2O3	14.50	14.20	14.40	12.60	12.52	12.86	12.27	13.32	13.50	10.90	13.50	12.74	14.60	14.20
TIO2	0.01	0.02	0.01	0.03	0.02	0.03	0.16	0.02	0.27	0.01	0.23	0.05	0.58	0.61
FE2O3	1.83	1.91	2.10	1.40	1.52	1.12	1.80	1.34	2.05	4.70	2.19	1.53	3.40	4.73
MgO	0.02	0.35	0.01	0.02	0.10	0.04	0.18	0.04	0.54	0.01	0.39	0.06	2.65	1.62
CaO	0.40	0.48	0.34	0.49	0.76	0.23	0.70	0.31	1.29	0.76	1.10	0.44	4.65	3.90
Na2O	3.64	1.96	3.90	2.90	2.86	3.11	2.74	2.82	3.15	0.01	2.83	2.71	2.35	2.85
K2O	3.64	3.35	3.75	4.87	4.80	4.71	4.45	4.72	4.85	3.45	4.85	4.91	3.60	3.15
MnO	0.07	0.03	0.07	0.04	0.03	0.04	0.03	0.04	0.05	0.16	0.04	0.03	0.10	0.08
P2O5	0.23	0.09	0.27	0.02	0.02	0.02	0.06	0.08	0.14	0.09	0.14	0.09	0.22	0.10
LOI	1.27	2.80	1.20	0.67	0.68	0.72	0.77	0.72	0.80	2.40	0.93	0.78	0.90	0.35
TOTAL	98.77	99.61	99.45	99.56	99.65	99.45	99.50	99.44	99.64	100.09	99.90	99.75	99.75	99.71

4th column

- A = Ademellite
- D = Granodiorite
- G = Granite
- S = Greisen

Table 6

Average trace element composition  
Blue Tier Batholith

	A..G 4 MEAN	A..A 1 MEAN	A..S 1 MEAN	G..G 3 MEAN	G..A 5 MEAN	C..G 5 MEAN	C..A 4 MEAN	K..G 6 MEAN	K..A 1 MEAN	K..S 1 MEAN	H..A 3 MEAN	P..G 5 MEAN	A..D 1 MEAN	G..D 1 MEAN
BA	6.23	370.00	3.00	30.00	132.00	26.00	127.50	10.00	280.00	15.00	323.33	50.00	370.00	520.00
FX	1.03	0.08	1.15	0.07	0.06	0.16	0.10	0.50	0.09	0.66	0.03	0.38	0.08	0.06
GA	45.00	16.00	44.00	17.33	14.80	26.80	20.50	29.67	14.00	36.00	14.00	23.20	16.00	20.00
LI	477.50	113.00	490.00	36.00	47.80	139.00	87.50	198.33	80.00	80.00	65.00	132.00	60.00	40.00
MO	25.75	18.00	32.00	7.33	6.80	18.00	18.30	19.67	16.00	12.00	13.33	4.00	12.00	14.00
NB	53.00	16.00	46.00	17.33	14.40	23.60	18.30	18.67	16.00	22.00	16.67	18.40	14.00	14.00
RB	1220.00	380.00	1350.00	446.67	342.00	718.00	409.00	691.67	310.00	870.00	283.33	572.00	190.00	145.00
SN	2440.50	55.00	90.00	14.67	11.60	27.00	11.00	36.00	10.00	1400.00	16.67	22.00	2.00	6.00
SR	10.25	90.00	12.00	19.67	59.60	11.60	54.23	5.83	110.00	4.00	101.67	18.80	370.00	26.00
U	17.00	6.00	26.00	10.00	8.80	10.00	4.30	14.33	8.00	16.00	2.67	16.40	2.00	4.00
W	36.25	19.08	20.00	11.67	9.00	49.00	8.75	11.67	5.00	20.00	6.67	12.00	13.00	10.00
Y	25.75	20.00	1.00	68.67	88.00	63.40	62.75	26.00	26.00	14.00	21.33	37.20	20.00	30.00
ZR	25.50	125.00	20.00	67.67	91.00	61.00	105.00	45.00	100.00	28.00	118.33	66.20	145.00	190.00
EU308	23.50	10.00	42.00	26.00	16.80	20.80	21.50	22.00	10.00	20.00	10.00	29.60	10.00	10.00
BA/RB	0.01	0.97	0.00	0.08	0.39	0.04	0.42	0.01	0.90	0.02	1.19	0.11	3.00	3.59
RB/SR	121.50	4.22	112.50	30.67	5.97	145.94	13.32	162.74	2.82	217.50	3.07	36.82	0.51	0.56
SNFORM1	38.07	0.00	39.64	0.00	0.00	11.43	0.12	7.19	0.00	8.76	0.00	1.37	0.00	0.00
SNFORM2	11282.76	0.00	10701.46	6.62	0.01	2113.12	1.19	1026.84	0.00	508.28	0.00	32.84	0.00	0.00
SNFORM3	3760.33	0.00	1806.48	0.00	0.00	40.04	0.00	26.16	0.00	23.98	0.00	0.82	0.00	0.00
TI/IO	3.99	143.68	5.99	17.83	47.96	15.99	94.42	9.99	161.86	5.99	147.88	28.78	347.71	365.69
ALINDEX	1.64	1.44	1.52	1.15	1.11	1.21	1.16	1.29	1.06	2.12	1.17	1.21	0.90	0.94
RB/3	406.67	126.67	450.00	148.89	114.00	239.33	135.00	230.56	103.33	290.00	94.44	190.67	63.33	48.33

- . enrichment of F, Li, Rb, Nb, Sn, U, W
- . depletion of Ba, Sr, Zr.

On a district basis there are marked differences in the degree of trace element depletion and enrichment. When comparing the element distributions of the various districts, it has to be kept in mind that some of the differences are caused by the presence of mineralisation, reflecting differences between mineralised and unmineralised granites or less mineralised granites. The former contain minerals which contribute to the trace element levels.

- Anchor Area

The mineralised granites of the Anchor area are characterised by extreme enrichment of F, Li, Sn, Rb while Ga, Nb and U occur at significantly higher levels than in the other sampled areas. Extreme depletion occurs for the elements Ba, Sr, Y and Zr. The extreme depletion/enrichment is probably the result of a combination of magmatic differentiation and fluid-rock interaction, the latter causing the greisenization.

It is interesting to note that the adamellites directly overlying the greisenised Anchor granites are enhanced in Sn, Li, W when compared to the other adamellites of the Blue Tier (see table 5). These adamellites are also slightly altered (sericite/muscovitised biotites, see Appendix I). These two aspects might prove to be an exploration guide for hidden Anchor style mineralisation, although further data are required to substantiate this.

- Emu Hill

The setting of the Emu Hill alkali granites resembles those in the Anchor Area. The trace element enrichment patterns are similar to those of Anchor, only less extreme. Nb and Y are respectively less enriched and depleted, while the tin content of the alkali-granites is generally low (especially those sampled in the Cream Creek samples CC1-4). However, some of the greisenised granites (BT/4)

contain 1700 ppm Sn, although no cassiterite was observed (disseminated?).

The adamellite sampled in the Emu Hill area does not show the same (Sn, Li, W) enrichment as the adamellite from the Anchor area. The locations of these adamellite samples in relation to the alkali-granites is quite different - vertically above the alkali-granite in the Anchor while horizontally away from the alkali-granite in Emu Hill.

- Mt. Paris

The alkali-granites of the Mt. Paris mass are enriched in F, Li, Rb and depleted in Ba, Sr, Zr and Y, but less so when compared with the Lottah sheets. It should be noted however that none of the samples from the Mt. Paris mass are highly altered and/or mineralised so that a direct comparison is not possible.

The uranium level of one of the granites (MTP/7) is the highest recorded (40 ppm).

- Mt. Cameron

There is a distinct difference between the adamellites and the alkali granites. The enrichment and depletion patterns being the same as for the other alkali granites. Uranium is however not particularly enriched. Zr is not highly depleted in the alkali granites. Tungsten levels of the sample containing cassiterite (BT/14) are highly anomalous (170 ppm), higher than any other mineralised granite sampled. There is no distinct enrichment and depletion of respectively F, Nb and Y.

- Little Mt. Horror

The samples collected are quite mafic with trace element levels typical of Blue Tier adamellites.

047

- Georges River

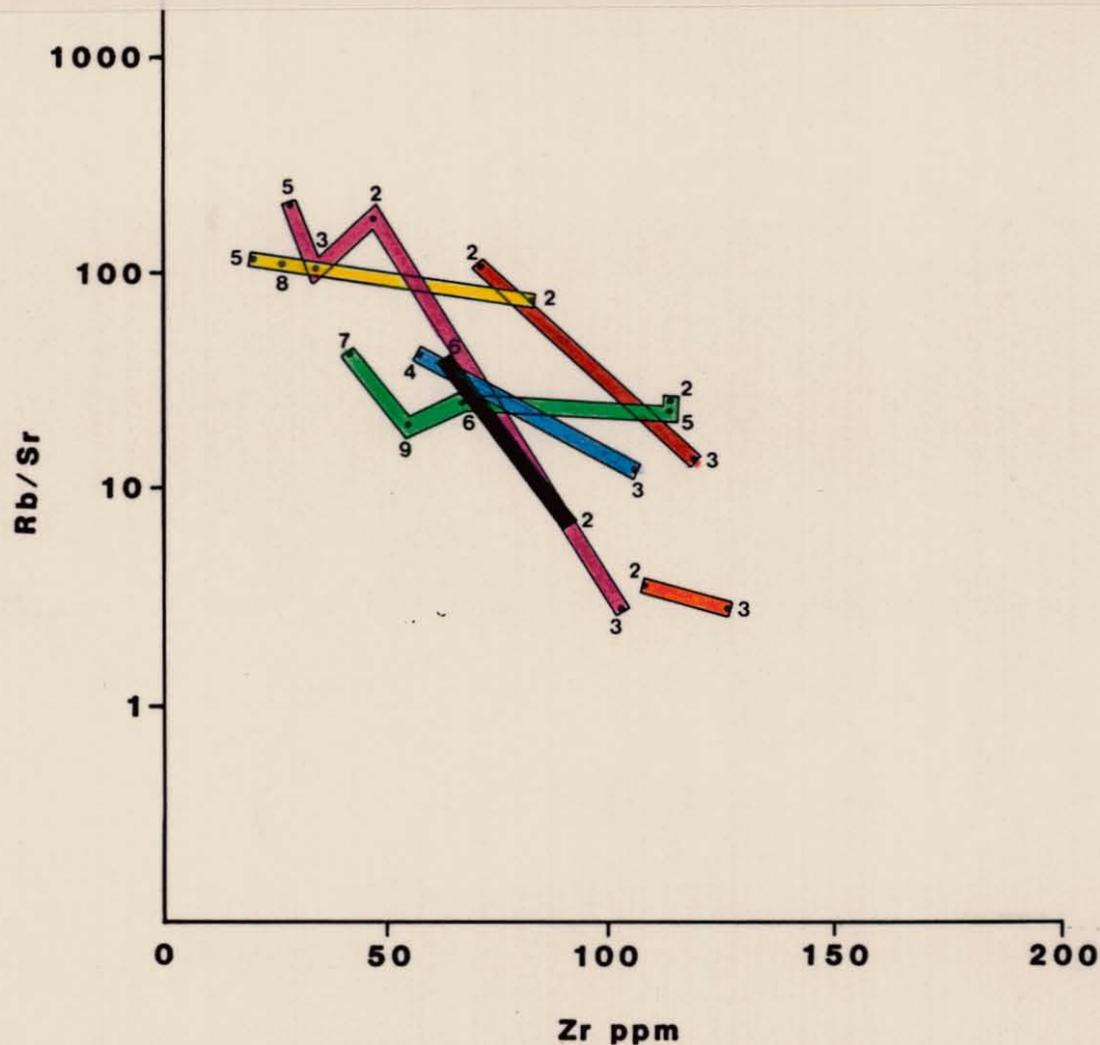
The samples collected near the contact display the expected depletion and enrichment trends, with the tourmaline granites being more differentiated. The level of differentiation is not very extreme (see Table 6). For example the Li, Y, U levels of these are more characteristic of adamellites than of alkali granites, while F and Sn are not highly enriched. In other words the tourmaline granites are not particularly differentiated, suggesting a low potential for tin mineralisation in this contact area. This is well brought out when the trace element levels are compared with those of the tourmaline granite of the Ben Lomond area. The latter have distinctively higher and lower levels of the indicator trace elements (e.g. cf F, Li, Rb).

(c) Discussion

The geochemical differences between the various areas are illustrated by a plot of Rb/Sr against Zr (Fig.14) as well as F against Li (Fig.16). These diagrams show some of the differences between the degree of differentiation according to district and rock type (field classification). The plot shows that granites of the Anchor and Emu Hill district reach the highest levels of Rb/Sr and the lowest in Zr. Mt. Cameron reaches similar levels of Rb/Sr but is less depleted in Zr. According to the Rb/Sr ratio, the degree of enrichment in the Rossarden area is well below that of the endogranitic differentiated granites (Anchor, Emu Hill, Mt. Cameron). The samples from Mt. Paris and Georges River reach similar levels of enrichment, but both areas contain granitic rocks of a more calc-alkali affinity when compared to Rossarden. The samples from Little Mt. Horror are distinctly less differentiated and can be classed as adamellites. For further details see captions of Figs.14 and 16.

The relative enrichment of Uranium in the Ben Lomond granite is illustrated by the Rb/Sr vs. U diagram (Fig.15). Both the alkali granites and the calc-alkali granites/adamellites are distinctly enriched in U. The dark quartz grains in many of the Ben Lomond granites are probably related to the high U content.

Binary Plot Rb/Sr - Zr according to regions and districts. The plot shows some significant differences between the districts and types of alkali granites. The endogranitic alkali granites (Anchor, Emu Hill and Mt Cameron are significantly enriched in Rb and depleted in Sr (as shown by their higher Rb/Sr ratios) compared with the "contact" alkali granites. Zr depletion patterns indicate that the less prospective alkali granites (e.g. Mt Cameron, George's River) are less depleted when compared to Anchor-Emu Hill and Ben Lomond.

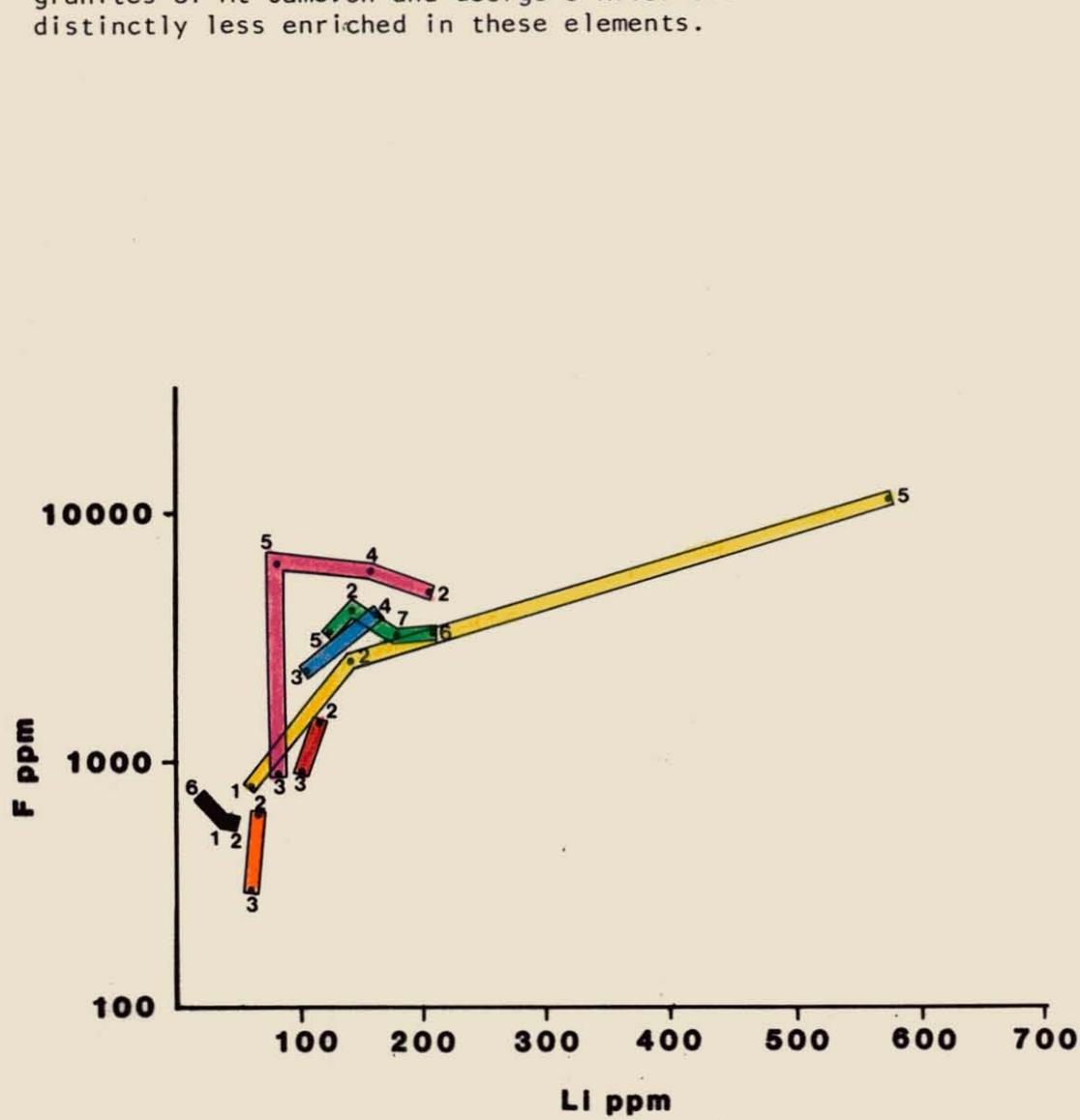


- Anchor
- Avoca
- Cameron
- Emu Hill
- Georges River
- Mt Horror
- Mt Paris

- 2 bte 5%
- 3 bte 5%
- 4 bte / musc
- 5 bte / musc / ser
- 6 bte / musc / tourm
- 7 musc / tourm
- 8 musc / ser
- 9 ser / greisen

**FIGURE 14**  
*Binary plot Rb/Sr - Zr*  
*according to Regions,*  
*Districts & Type*

Binary Plot F-Li according to region and district. With the exception of Anchor, the other prospective alkali-granites reach similar levels of F and Li enrichment. Note that the less prospective alkali granites of Mt Cameron and George's River are distinctly less enriched in these elements.



- Anchor
  - Avoca
  - Cameron
  - Emu Hill
  - Georges River
  - Mt Horror
  - Mt Paris
- 
- 1 granodiorite
  - 2 bte < 5%
  - 3 bte > 5%
  - 4 bte / musc
  - 5 bte / musc / ser
  - 6 bte / musc / tourm

FIGURE 16  
Binary plot F-Li all regions and districts according to type



The distinctly lower enrichment of the Li, and F in the Georges River area is illustrated by Fig.16.

It is interesting to note that the endo-granitic alkali granites (Anchor, Mt. Cameron, Emu Hill) reach a higher degree of differentiation compared with the "contact" granites. This can possibly be explained by the influence of the volatile phase as explained in Fig.22 and Chapter VI (e).

VI EXPLORATION GUIDES(a) Differentiation

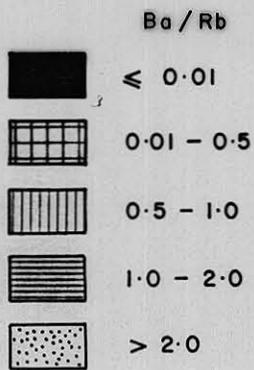
The above review of the distribution of the collected geochemical data has indicated that the levels of certain elements e.g. Ba, Rb, Zr as well as Li, F, U give an indication of the degree of differentiation. The use of simple ratio's is generally preferred in weathered rocks as this overcomes to a certain extent the effects of modal variations caused by preferential weathering (e.g. plagioclase vs. micas).

An example of the regional application of Ba/Rb ratios for the Blue Tier based on samples collected during this survey as well as on data from open file reports (Young, 1979) shows a number of regional lows ( $<0.01$ ), which are directly related to known area of tin mineralisation (Fig.17). Ba/Rb levels between 0.01- and 0.5 may or may not be related to known Sn-mineralisation (e.g. Mt. Cameron, Georges River). However the ratios only give a general idea of differentiation and are not sufficiently specific with respect to the potential for tin mineralisation. By taking into account an extra factor such as the level of fluorine, the indicator can be made more specific. This is illustrated by the variation of Ba/Rb and F along a N-S traverse across the Blue Tier batholith (Fig.18). The diagram shows that not all low Ba/Rb ratios have the same concentrations of fluorine. The extra factor of fluoroine allows a ranking of the differentiated areas. A comparison of the two plots shows that e.g. the Georges River area is not particularly enriched in fluorine.

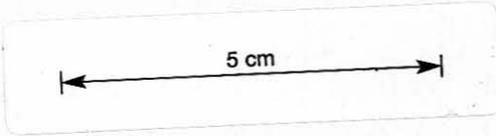
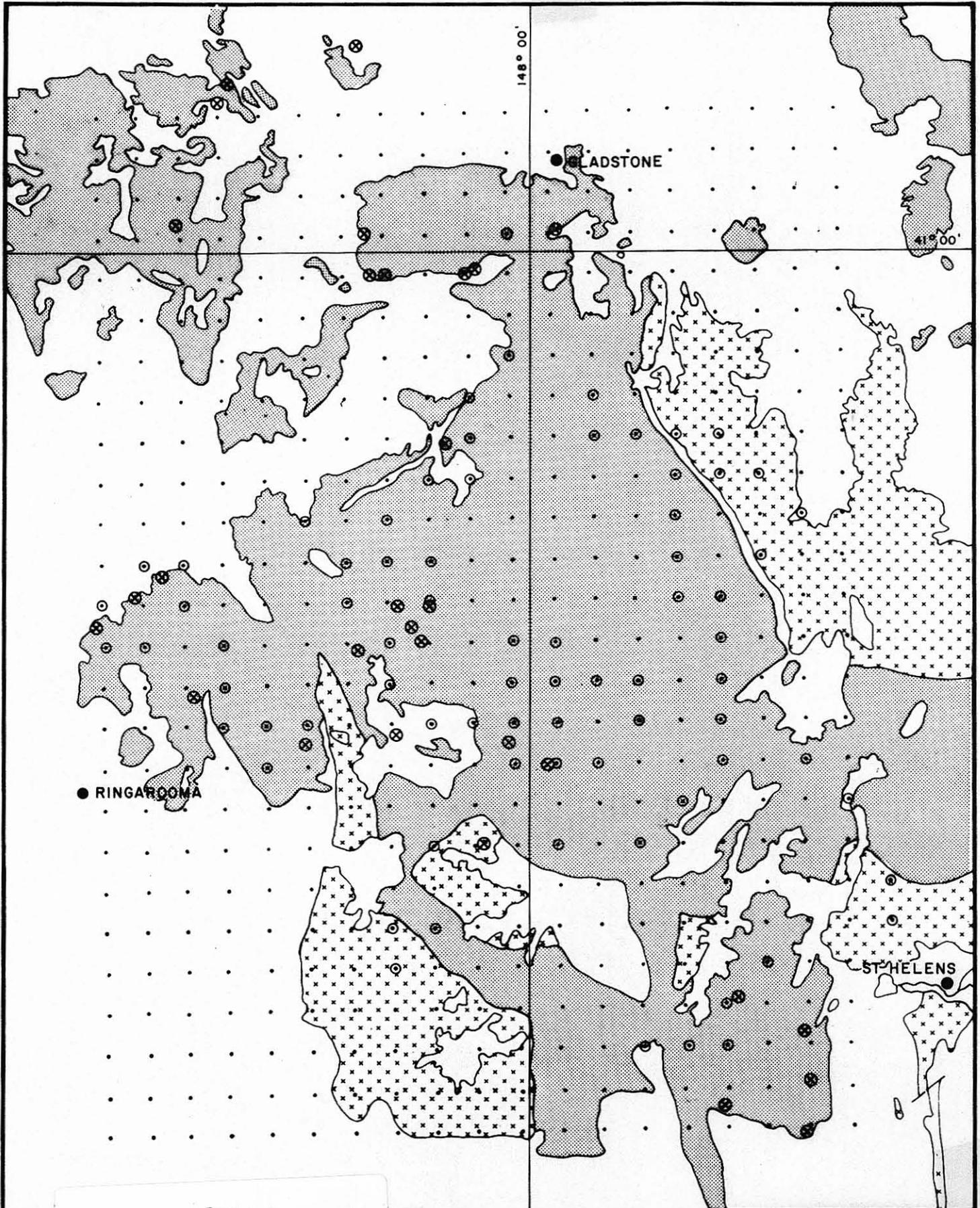
In general it can be said that all areas in N.E. Tasmania (including Ben Lomond) with Ba/Rb smaller than .5 and all areas with Rb/Sr  $> 20$  show a sufficient degree of differentiation to be associated with primary tin mineralisation.

The combined effects of certain elements can be formalised by developing so called tin formula's (Govett, 1982) which combine the effects of several element ratios (e.g. Rb/K, Li/Mg, Rb/Sr, Ba/Rb). Three tin formulas were developed (all expressed in ppm).

053

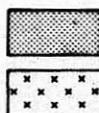


The Shell Company of Australia Limited METALS DIVISION	
NE TASMANIA REGIONAL DISTRIBUTION Ba / Rb	
SCALE	DATE OCT '83
AUTHOR LDG	DRAWN TE
OFFICE AHO	REP.No.
DRG.No.	FIG.No. 17



**SAMPLE LOCATIONS**

- ⊗ SHELL
- ABERFOYLE



- GRANITE
- GRANODIORITE

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**NORTH EAST TASMANIA  
ROCK CHIP SAMPLING**

SCALE 1:250 000	DATE 18-7-83
AUTHOR L de G	DRAWN AS
OFFICE AHO	REP.No.
DRG.No. MT 27/1016	FIG.No.

053

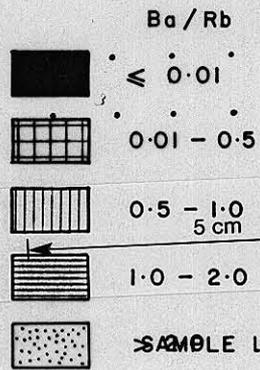
148° 00'

41° 00'

GLADSTONE

RINGAROOMA

ST HELENS



-  SHELL
-  ABERFOYLE

-  GRANITE
-  GRANODIORITE

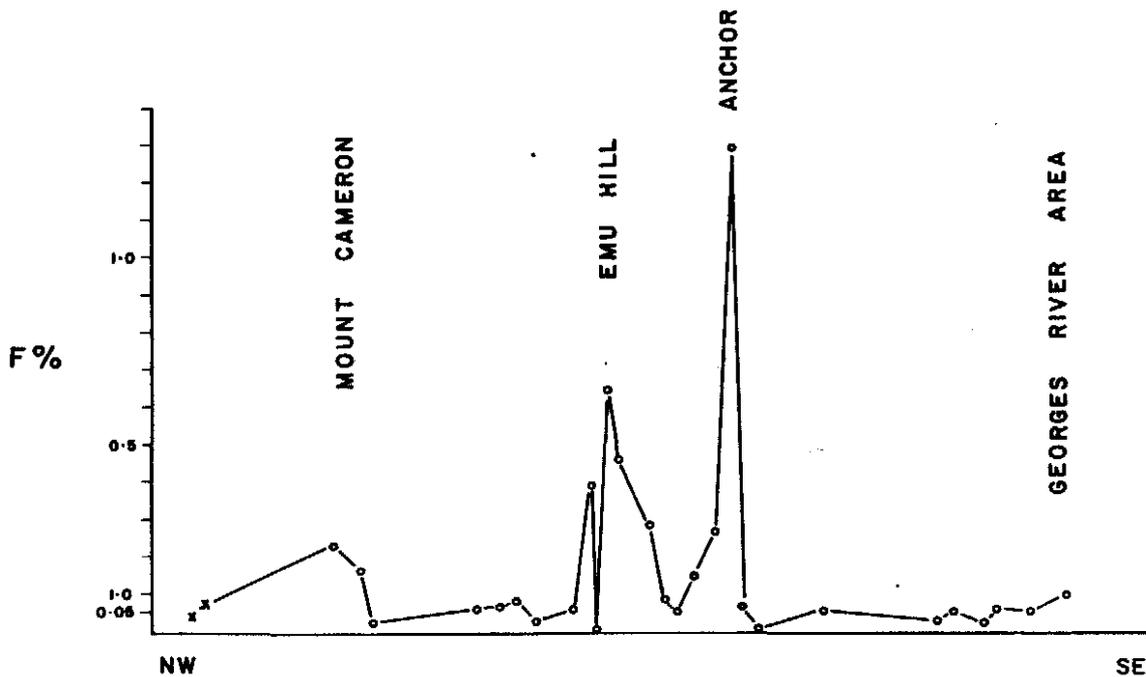
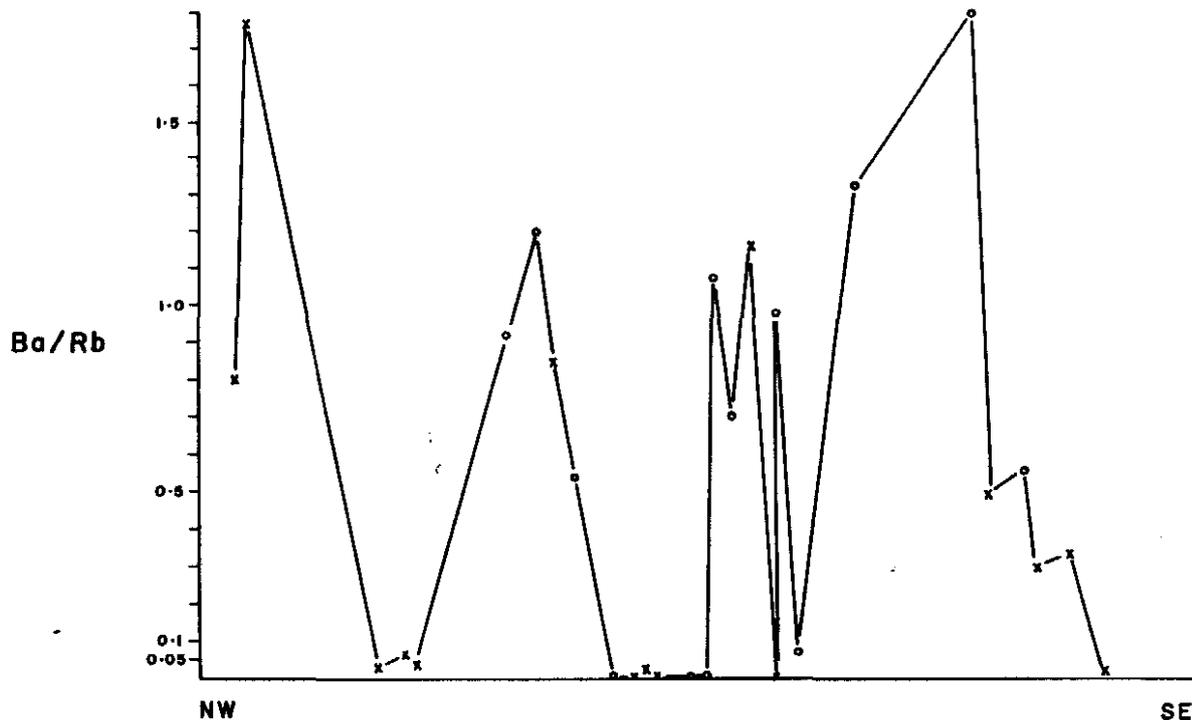
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NORFOLK ISLANDS  
ROCKING ISLAND SAMPLING  
Ba / Rb

SCALE 1:250 000	DATE OCT-63
AUTHOR LWP	DRAWN AS
OFFICE AHO	REP. No.
DRG. No. MT 27/1016	FIG. No. 17

054

466056



- x SCOA Sample
- o Aberfoyle Sample

The Shell Company of Australia Limited METALS DIVISION	
NE TASMANIA VARIATION of Ba/Rb & F along a NW - SE SECTION of the BLUE TIER BATHOLITH	
SCALE	DATE NOV 83
AUTHOR LDG	DRAWN TE
OFFICE AHO	REP.No.
DRG No MT27/1029 FIG No 18	

055

$$\text{Sn Form 1} = \frac{\text{Rb}^2 \times \text{Li}}{\text{K} \times \text{Mg} \times \text{Sr}}$$

$$\text{Sn Form 2} = \frac{\text{Rb}^3 \times \text{Li}}{\text{K} \times \text{Mg} \times \text{Ba} \times \text{Sr}}$$

$$\text{Sn Form 3} = \frac{\text{Rb}^3 \times \text{Li} \times \text{Ga} \times \text{Nb}}{\text{K} \times \text{Mg} \times \text{Ba} \times \text{Sr} \times \text{Ti}/10 \times \text{Zr}} \quad /100$$

Results of these formulas are listed in Appendix II. A plot of Sn Form 1 (based on average trace element composition per rock type) shows that there are three main fields (Fig.19a). Rocks with Anchor style, endogranitic differentiated granites ( $\pm$  mineralisation) having the highest score (Anchor, Emu Hill, Mt. Cameron), the second group contains the differentiated and/or mineralised granites of the contact zone (Mt. Paris, Ben Lomond), the third group containing the adamellites and the Georges River granites. Please note that the so-called adamellites of the Ben Lomond mass are on geochemical grounds calc-alkali granites. The granodiorites fall outside the boundaries of the plot.

A plot of "Sn Form 2" and "Sn Form 3" shows a similar pattern, with the separation of the first and second/third group becoming more distinct (Fig.19b & c). A regional plot (excluding ore samples) of the Sn form values is shown in Fig.20a, 20b & 20c. These show a very similar picture. Sn form 3 is perhaps the least successful as it does not particularly highlight the Ben Lomond and Mt. Paris granites while it features the Georges River aplitic tourmaline granite. Sn forms 1 & 2 are perhaps the more useful ones.

The application of tin formulas is only felt to be useful in regional exploration (e.g. in reconnaissance of other granitic areas in N.E. Tasmania (e.g. Furneaux Islands, Freycinet Peninsula), as well as in local exploration for Anchor style mineralisation in the central Blue Tier. For exploration on a local scale in the roof zone granites (e.g. Ben Lomond granites) the use of simple ratios will probably suffice. Ratios can also be used to determine the degree of differentiation near Mathinna Bed

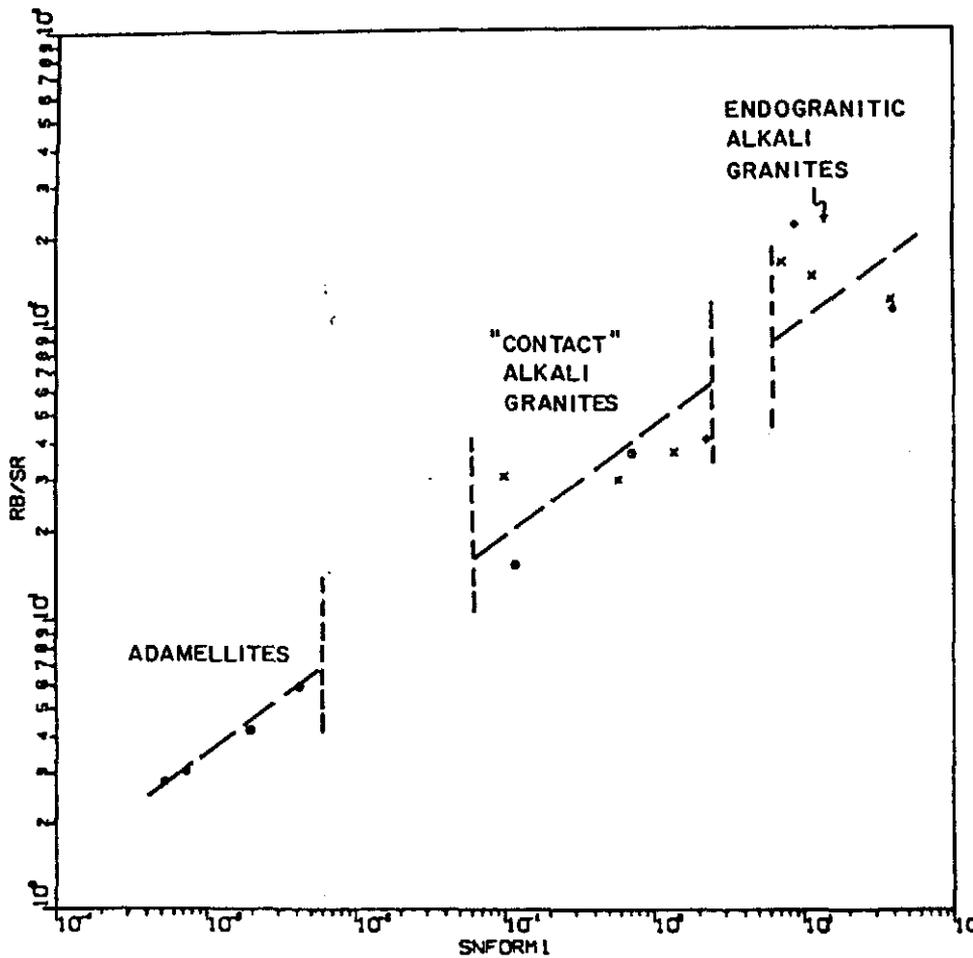


Fig. 19a

Binary plot of Sn-Form 1 vs Rb/Sn. The plotted values are averages according to granite type (CMS classification) and region. The overall positive correlation trend falls into three fields (from left to right):

- Adamellites
- Contact alkali granites (plus calc-alkali granites)
- Endogranitic alkali granites.

+ GRANODIORITES(O)  
 O ADAMELLITES(O)  
 X ALK. GRANITES(O)  
 o DREISENSIS:

See also Fig. 19b and 19c as well as the text.

CORRELATION COEFFICIENT = 0.54

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Binary Plot of Sn - Form 1 vs. Rb/Sr	
SCALE	DATE NOV 83
AUTHOR LDG	DRAWN
OFFICE AHO	REP No

057

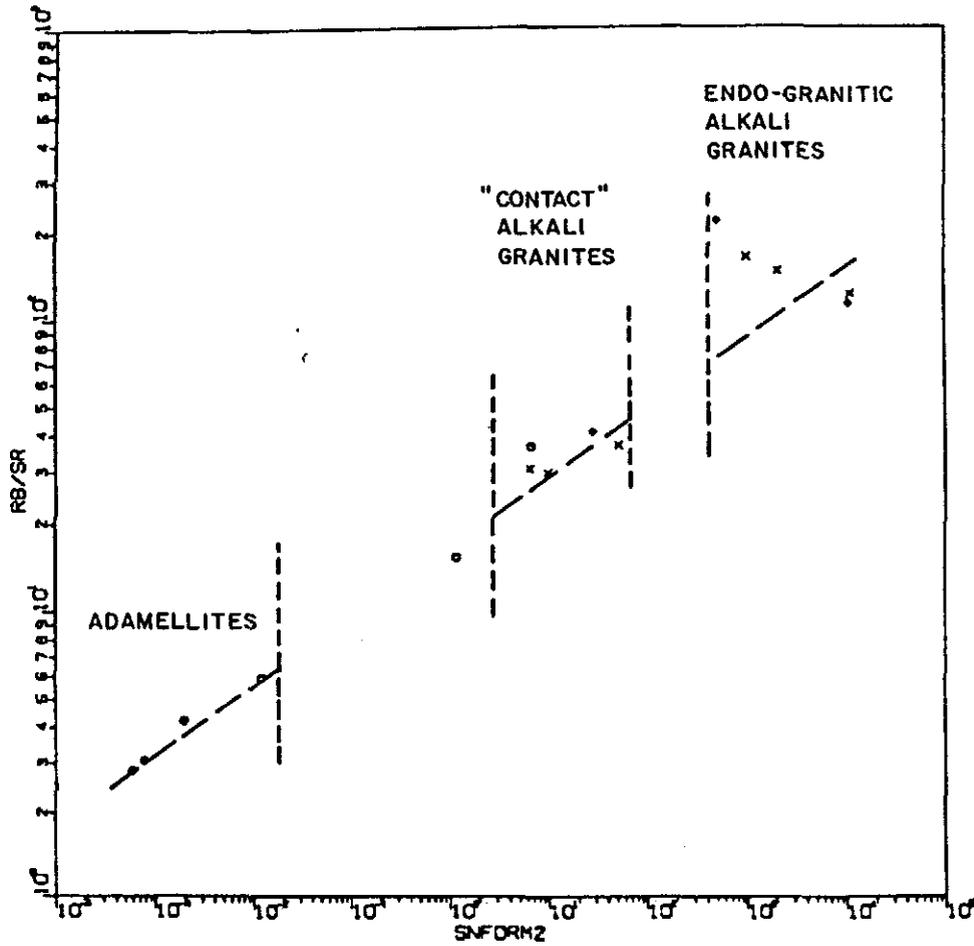


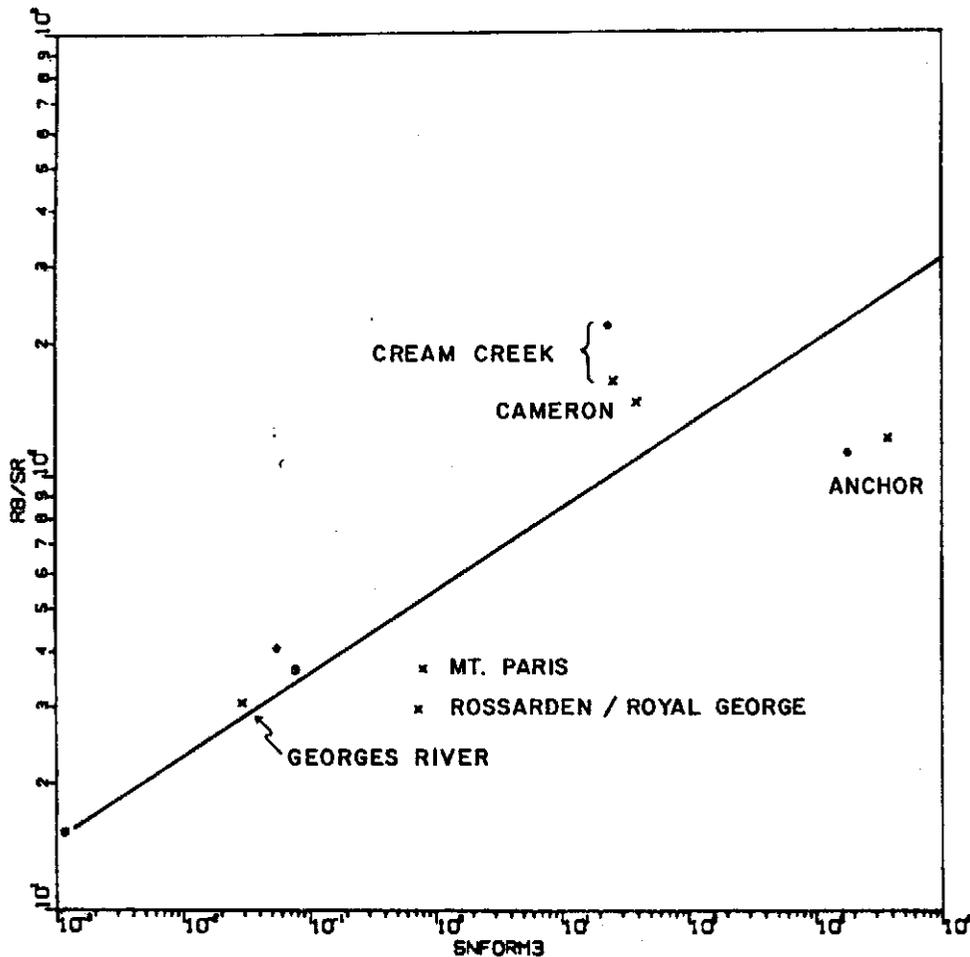
Fig. 19b

Binary plot of Sn-Form 1 vs Rb/Sr. For details see Fig. 19a and the text.

- + GRANODIORITES(D)
- o ADAMELLITES(R)
- x GRANITES(G)
- o DREISENS

CORRELATION COEFFICIENT = 0.41

The Shell Company of Australia Limited METALS DIVISION	
Binary Plot of Sn-Form 2 vs. Rb/Sr	
SCALE	DATE NOV 65
AUTHOR LDG	DRAWN
OFFICE AHO	REP.No.



- + GRANODIORITES(D)
- ROMELLITES(A)
- x GRANITES(D)
- ◊ OREISENSIS

CORRELATION COEFFICIENT = 0.23

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Binary Plot of  
Sn Form - 3 vs. Rb/Sr

SCALE	DATE NOV 83
AUTHOR LDG	DRAWN
OFFICE AHO	REP.No.
DRG No MT27/1034	FIG No 19c

059

5 cm

41°00'

Scamander

LEGEND

- + + GRANITE / ADAMELLITE
- GRANODIORITE
- ⊗ SAMPLE LOCATION

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METALS DIVISION

NE TASMANIA  
LITHOGEOCHEMISTRY  
SN FORM - I

SCALE 1:500000	DATE AUG. 83
AUTHOR LDS	DRAWN TE
OFFICE A.H.O.	REP.No.
DRG No MT27/1021	FIG No 20a

- ★ > 0.1 - 0.5
- ★ 0.5 - 1.0
- ★ 1.0 - 10.0
- ★ > 10.0

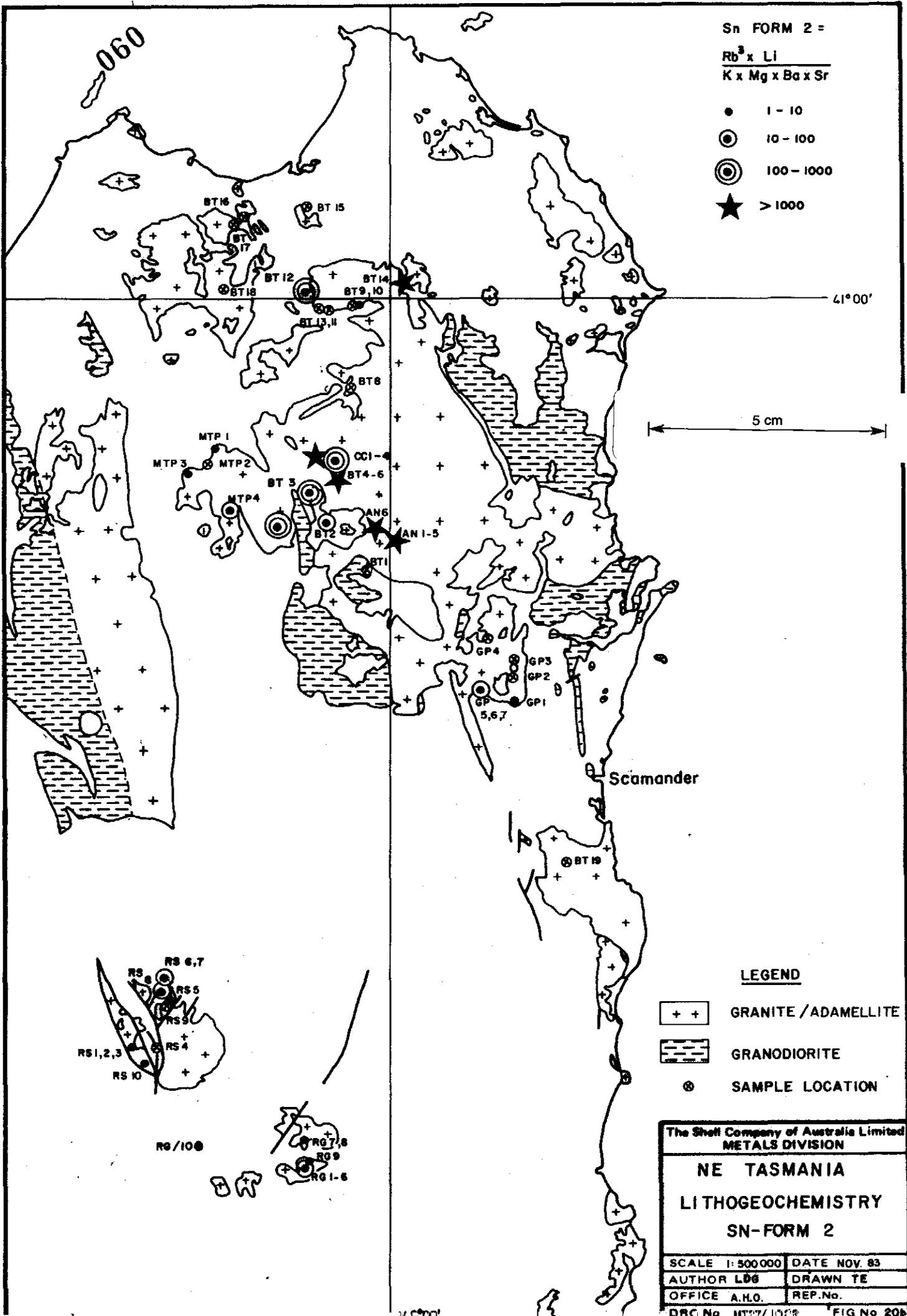
$$\text{Sn FORM I} = \frac{\text{Rb}^2 \times \text{Li}}{\text{K} \times \text{Mg} \times \text{Sr}}$$



RG/10★

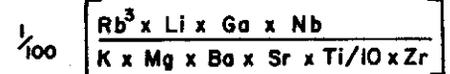


148°00'



061

Sn FORM 3 =

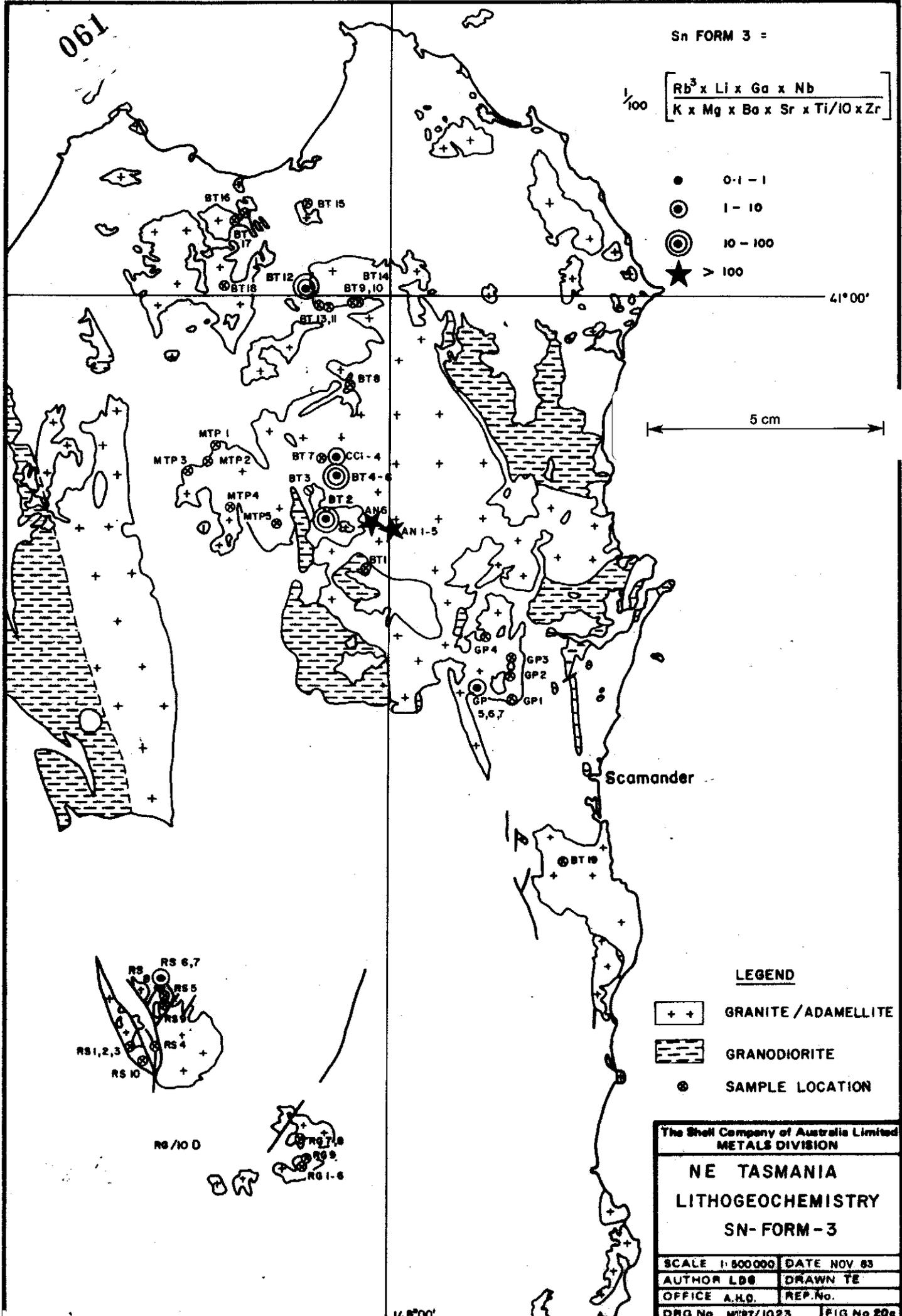


1/100

- 0-1-1
- ⊙ 1-10
- ⊗ 10-100
- ★ > 100

41°00'

5 cm



**LEGEND**

- ++ GRANITE / ADAMELLITE
- ▨ GRANODIORITE
- ⊙ SAMPLE LOCATION

The Shell Company of Australia Limited  
**METALS DIVISION**

**NE TASMANIA  
 LITHOGEOCHEMISTRY  
 SN-FORM-3**

SCALE 1:500000	DATE NOV 83
AUTHOR LBS	DRAWN TE
OFFICE A.H.D.	REP.No.
DRG No M/17/1023	FIG No 20a

062

contact zones and obtain a semi-regional picture of differentiation trends in the coarse Ben Lomond granite and to differentiate between alkali- and calc-alkali granite.

(b) Diffusion

It was earlier pointed out that adamellites overlying the greisenized Anchor sheets are enhanced in Sn, W and Li. This is probably caused by diffusion. This may prove a valuable tool in regional exploration for Anchor-style mineralisation but needs further confirmation. Geochemistry and petrography should in such a survey be combined, as the geochemically anomalous adamellites also show signs of alteration (sericite and secondary biotite).

(c) Mineralogy

The petrographical work has shown that occurrences of accessory topaz and/or tourmaline are important indicators of differentiated/mineralised granites. In addition the occurrence of colour variable biotite (green/brown) appears to coincide with differentiated/altered granites. This is especially notable in the Blue Tier but is not so conspicuous in the Ben Lomond granites.

(d) Topography

According to a plot of Rb versus topographic height (see Fig.21) it appears that the highest altitudes of the Mt. Paris mass coincide with the highest levels of Rb. From this it can be concluded that at least in the Blue Tier the original granite topography has not been severely affected by displacement through tilting. Topographic height will therefore remain an important exploration criterium in N.E. Tasmania, especially for mineralisation associated with "contact" granites.

(e) Geological Setting

As explained in Fig.22a & b, the geological setting with respect to roof rocks has important implications in terms of styles of mineralisation. Flat lying greisenized sheets (Fig.22b) are mainly

063

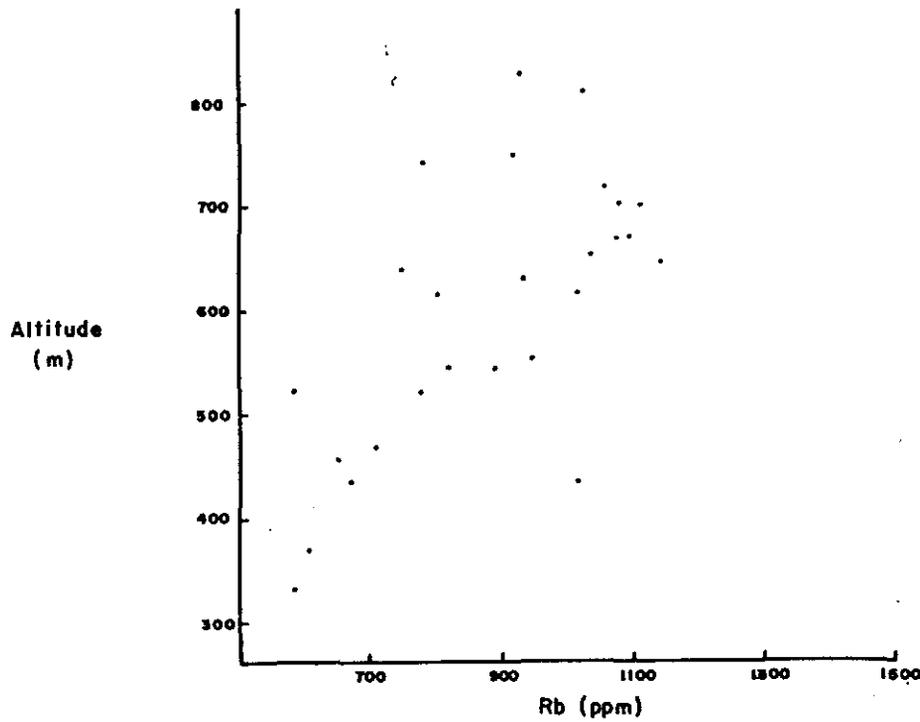


Fig. 21

Relationship between height and Rb content of granite mapped as Alkali granites in the Mt Paris area. (From: McClenaghan et al, 1982)

064

confined to endogranitic settings (e.g. Anchor, Bushveld complex, Erzgebirge). The protracted period of interaction between volatiles and roof granite will result in extensive alteration/greisenization and may be accompanied by mineralisation. This will also result in extreme depletion and enrichment through alteration of the already highly fractionated upper part of the alkali-granites. The extra depletion/alteration processes may partly be responsible for the compositional gap between extremely differentiated alkali-granites and less differentiated granites of the same suite.

In contrast "contact alkali granites" are rarely associated with extensive greisenized sheets (Fig.22a). The degree of enrichment/depletion reaches a lower level, which partly could be explained by the limited interaction between volatiles and contact granite. The competency of the roof rocks will have a great influence on fracturing and therefore on mineralisation.

(f) Gamma Radiation

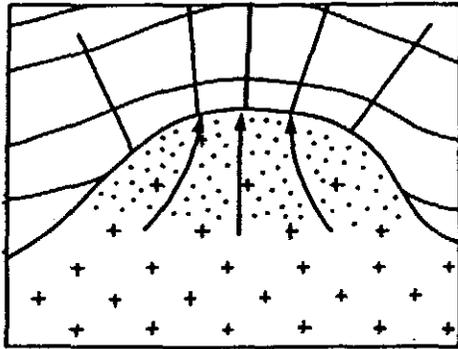
The level of total gamma radiation (total count of K, Th and U) can be used as a rough guide to the degree of differentiation. Compared with geochemistry the method is cheap and quick. Semi-quantitative measurements of a standard volume of crushed rock in a cylinder would provide useful regional information.

(g) Structure

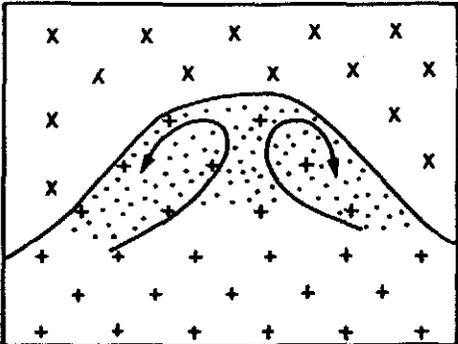
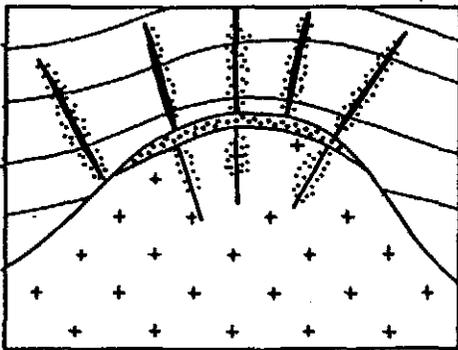
In the Ben Lomond granite, post-granitic tensional forces have produced a host and graben system. The most prospective areas will be the downfaulted blocks of Mathinna beds. Both Rossarden, Storeys Creek and Royal George are according to the regional geological map (1:250,000) located in downfaulted blocks. A careful structural analysis of the area, in combination with litho-geochemistry (to determine the degree of trends of differentiation) might prove useful in ranking of prospects. It speaks for itself that anticlinal structures in the Mathinna Beds are the favoured location for cupola's. The depth of granites below Mathinna Beds can be estimated from metamorphic mineral

065

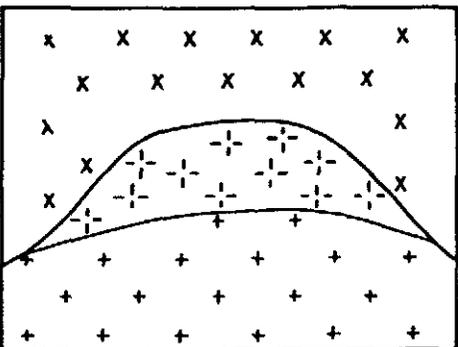
## TWO TYPES OF ALKALI GRANITE SETTINGS

(a) Contact of roof zone Alkali granite

Owing to the nature of the roof rocks, volatile build-up will partially escape into fractures - in roof zone. Development of flat lying greisen zones is limited and rarely present an economic exploration target. Sn-mineralization occurs mainly in vein systems in roof zone of granite and/or sedimentary cap rocks.

(b) Endogranitic alkali granite

Roof zones of granite rocks form frequently a very tight seal. This is especially the case when the roof granite has a similar age as the enclosed alkali-granite. The former would still be plastic and form a perfect barrier to volatiles. Volatile build-up will extensively alter the fractionated top of alkali-granite as it will "stew" in a mixture of water, HF, HCl, etc. for a protracted period of time, resulting in extensive greisenisation. Sn-mineralization is mainly confined to these "sheets" of greisens.



-  SEDIMENTARY ROCKS
-  UNDIFFERENTIATED GRANITES
-  ALKALI GRANITES
-  VOLATILES AND GREISENS
-  EXTENSIVE FLAT LYING GREISENS

066

indicators. The application of geophysical methods such as gravity and I.P. should be investigated (see below).

(h) Gravity

Detailed gravity surveys in the Rossarden-Storeys Creek area carried out by the Geological Survey, Tasmania (Leaman, 1975) has shown that such surveys are only useful if very detailed geological information is available. Nevertheless, the 1974 study was able to outline a number of interesting negative anomalies, which are worth follow-up.

It is interesting to note the shape and size of the cupola's as inferred by gravity. The cupola's are very steep sided and very small in areas extent, presenting difficult drilling targets.

(i) Fluid Inclusions

Fluid inclusion studies of the mineralized vein system at Great Pyramid has shown that temperature varies systematically with depth. However, sampling has to be carried systematically according to "vein generation" for results to be meaningful (G. Plummer, pers. Comm.). It is anticipated that when results of the sponsored M.Sc study become available, guidelines for the application of fluid inclusions studies in exploration will be written-up.

Decrepitation\* studies on vein material from Rossarden (carried out by Burlison Geochemical Services in association with the CSIRO) have shown that mineralized systems can be differentiated from barren veins (Summons, 1983).

Systematic sampling is again of great importance.

---

\*Footnote: Decrepitation studies are based on the detection and analyses of the crackling noise emitted by exploding fluid inclusions on heating.

VI. EXPLORATION POTENTIAL

On the basis of historical records, examination of open file reports as well as the data presented in this report, the following comments can be made on the tin potential of the districts visited:

(a) Mt. Paris

From a historical point of view the Mt. Paris area has been a prolific producer of alluvial tin ( $\pm$  25,000 tons of Sn). The granites are relatively differentiated, although the top roof-zone granites as well as the Mathinna Beds cover are largely removed. The alluvial cassiterite is possibly directly related to this phase of erosion.

There is no shortage of Sn prospects in the area but none has shown any promise despite a long history of exploration. There are two styles of hard rock mineralisation:

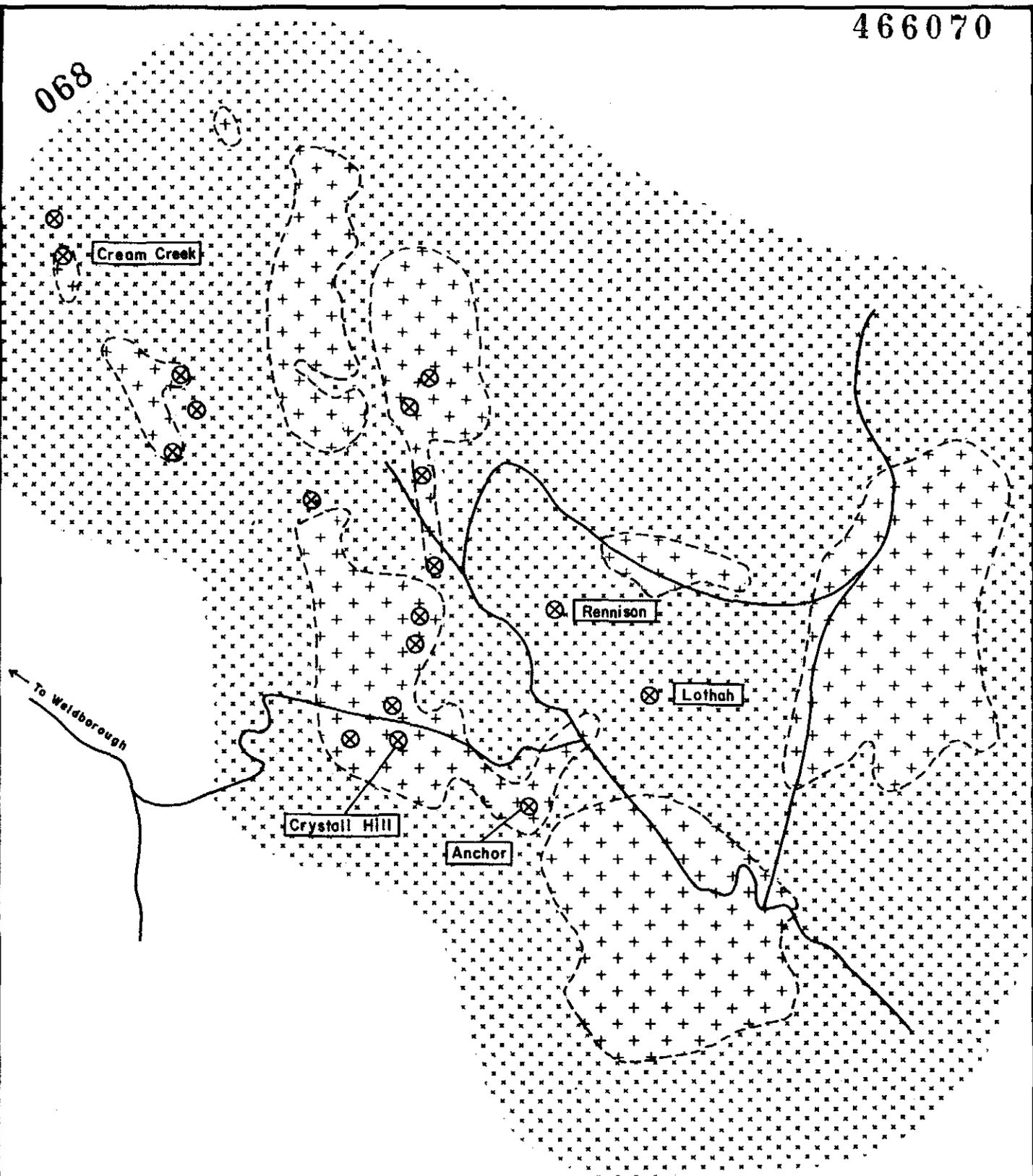
- greisenised granites beneath preserved cap. rock remnants.
- steeply dipping greisenised veins.

The former proved to be very thin with low levels of mineralisation (Star of Peace, Newmont  $<0.1\%$  Sn), confirming the view that contact granites are not a very good site for extensive flat lying greisens. Greisenised veins are presently being investigated by AMAX (Rattler's Hill), and requires further checking (De Graaf, 1982a).

(b) Anchor/Emu Hill

Occurrences of flat lying greisenised, endo-granitic, stanniferous sheets (Fig.24) have a relatively widespread distribution in the central Blue Tier. Apart from the Anchor mine there are several other known prospects with a similar style of mineralisation, (e.g. Don, Crystal Hill, Cream Creek, Emu Hill) as well as several lode style deposits (Taylor, 1980).

068



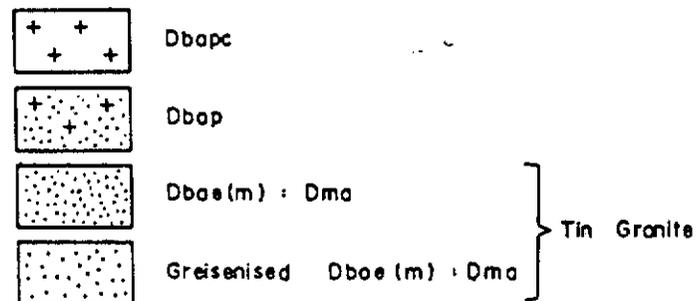
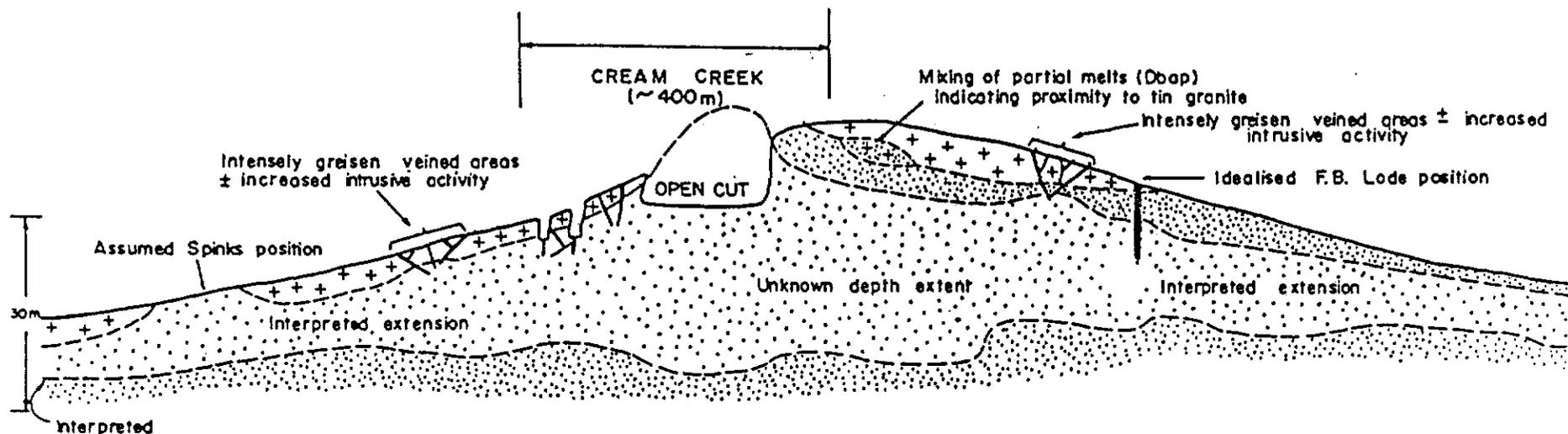
- ⊗ Tin Occurrence
- ⋄ Adamellite
- ⊕ Areas with occurrences of alkali granite

The Shell Company of Australia Limited METALS DIVISION	
NE TASMANIA ANCHOR - EMU HILL AREA TIN OCCURRENCES	
SCALE	DATE OCT '83
AUTHOR LDG	DRAWN TE
OFFICE AHO	REP.No.
DRG No MT27/1024 FIG No 24	

## Alteration and Mineralization

Note: Diagrammatic representation - distorted horizontal scale

- Position of greisen sheet with respect to other granitic phases
- Altitude of Contacts



Diagrammatic representation of the processes involved with the alteration and mineralization. The following factors are considered to represent excellent indicators of unnaturally high late stage crystallization and hence prospective areas for unexposed tin mineralization.

- strongly greisen veined zones
- abundant aplitic and pegmatic intrusions
- abundant late stage phases e.g. muscovite  
tourmaline (miarolitic matrix)  
topaz etc.

Fig. 25 Geological Section of Cream Creek Prospect area  
(from J R Taylor, 1980, Aberfoyle, open file report)

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The flat lying greisenised sheets of Anchor present an attractive target as some of these can be mined by open pit methods. Grades at Anchor vary considerably within the 'sheets'. The three composite samples collected during reconnaissance from Anchor contain (from floor to top of open cut) 0.009%, 0.67% and 0.33% Sn, with negligible W. A feasibility study by Rensison indicates that grades in the tin granite vary from 0.2% (cut off) to greater than 1%. Reserves have been established in the order of 2 Mt @ 0.4% Sn. Only a small part of the deposit is amenable to open cut mining, the remainder has to be extracted by open stopping methods, with access by decline (De Graaf, 1982b). Prospects in the vicinity of Emu Hill return values of 0.17% Sn in kaolinised/greisenised granite.

In the Emu Hill area, at Cream Creek, Aberfoyle have established the occurrence of greisenised sheets similar to that of Anchor (Fig.26). There is no information available as to the tin grades, but by analogy with Anchor and other endogranitic greisenised tin occurrences in the world e.g. Erzgebirge and the Bushveld complex, it can be safely assumed that grades will average in the order of 0.1-0.3% Sn. If this assumption is correct while accepting the view that such grades do not lend themselves to underground mining, one is restricted to open cut mining.

In summary the Anchor-Emu Hill area has established reserves of approximately 10,000t of tin metal. There are indications that the Anchor-style of mineralisation is relatively common in this district, although details on grades are lacking. From an exploration point of view, the district poses problems in terms of outcrop, access, thick vegetation and locally relatively steep topography. As the target must be located near surface, shallow drilling should, however, suffice.

(c) Mt. Cameron Little Mt. Horror

Although the so called Mt. Cameron sheets are highly differentiated, there is no record of hard rock tin production. Sn prospects (excluding alluvials) are not known in the area. The source of the alluvial tin is either eroded sheet or lode style

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mineralisation or the presently outcropping alkali-granites in which minor cassiterite has been recorded (see above, Chapter IV).

The Little Mt. Horror area is not felt to have any potential for Sn- mineralisation.

(d) Georges River

The so called Constable Creek Sheet host several minor greisenised zones. The area does not contain any prominent Sn- prospects. From the geochemical data it was concluded that the alkali-granites are not highly differentiated, which is a negative factor in terms of Sn-potential. On this basis the Sn- potential of this area is ranked very low.

(e) Ben Lomond Granite

The highest recorded production of hard rock tin in N.E. Tasmania originates from the Avoca area. The recorded production originated from essentially 3 mines (see Table 7). All mining activities have been abandoned in the area, the last ones to close being the underground operations at the Rossarden and Storeys Creek Mines (1979).

The known reserves are estimated to be at least 14,000 t Sn metal (based on a preliminary assessment of mining the Rossarden vein system by open cut methods (Wright, 1983) and informal information obtained from Amax on Royal George).

Apart from the mines, the area contains numerous Sn- prospects as well as Uranium occurrences (see Fig.22). From limited field observation, the styles of Sn- mineralisation can be divided into two types:

- Sn-W bearing vein systems within the Mathinna Beds
- Steeply dipping quartz greisen lodes within granite.

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The former has been mined at Rossarden and Storeys Creek. The mineralised veins are massive, milky quartz (high temp?) and may reach over 1m in thickness. The vein system coalesces and splits up. The vein system at Rossarden is spatially directly related to an aplitic granite. Sn- grades generally decrease with depth while W increases with depth. The overall grade drops with depth (Blissett, 1959). Several mineralised vein systems are known in the area. Some may be amenable to open cut mining, but need further exploration.

Steeply dipping quartz greisen lodes occur at Rex Hill, Royal George, Brookstead, Roys Hill, "Ben Lomond Tin and Tungsten Mines", the Great Republic Mine, Longtunnel and Roys (see Fig.22).

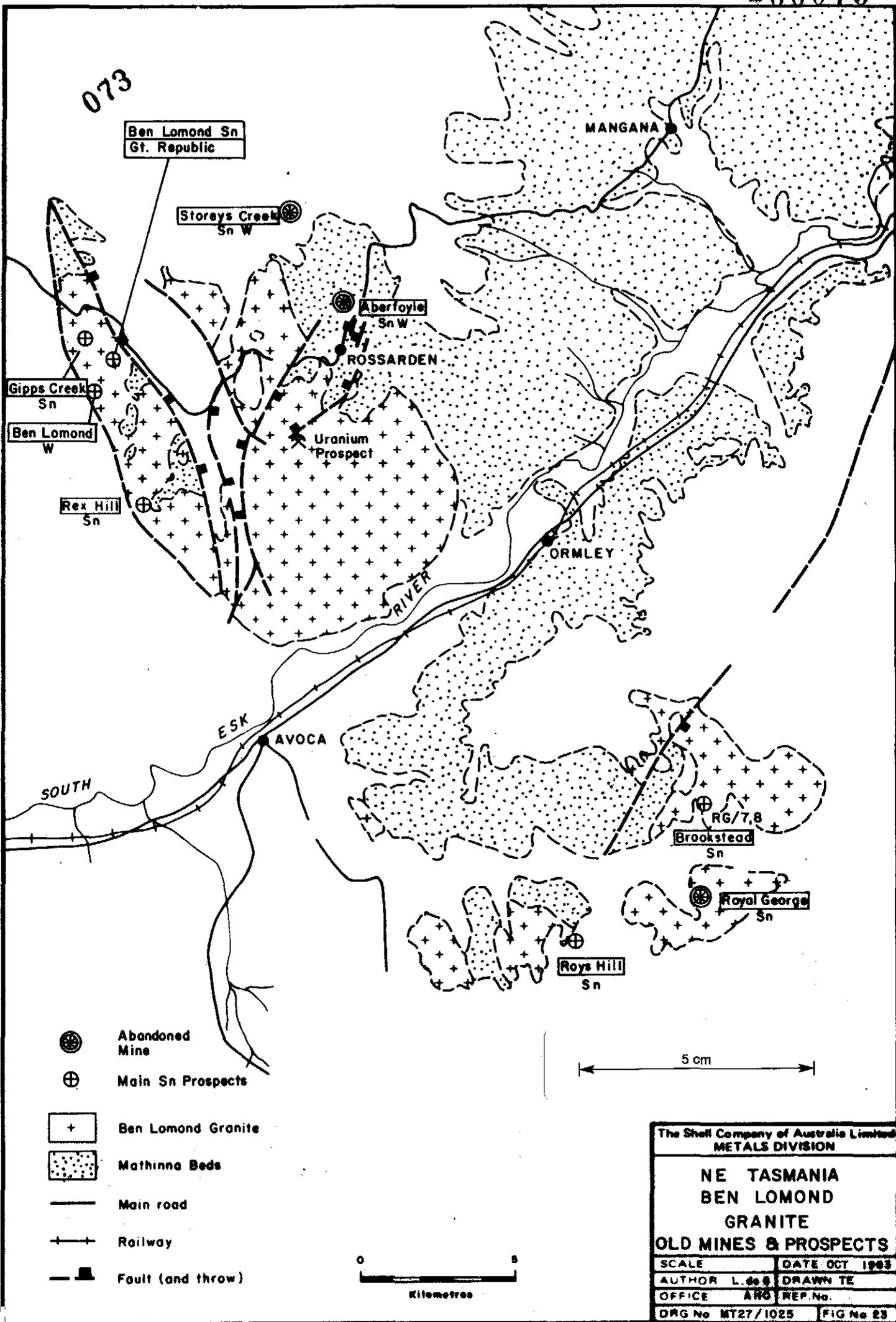
The first four mentioned were briefly visited. Examination showed that the Royal George is a sheeted silicic greisen vein system surrounded by an envelope of sericitised granite. The style of mineralisation at Royal George and to a certain extent Rex Hill, is very similar to that of Collingwood in terms of style, granites, granite geochemistry, setting and mineralogy. (For more information see Appendix III, compiled by P. Ruxton). The main difference is that the former are exposed while the latter is covered by sedimentary rocks (Fig.26). In addition, the lodes at Royal George are more silicic when compared with the sericitic lodes of Collingwood.

A number of assays of grab samples from some of the steeply dipping lodes prospects shown on Fig.23 are shown in Table 8. Sn-grades are sufficiently promising to warrant further follow-up.

On the basis of the factors listed below, the exploration potential is ranked high.

- Differentiated granites close to the roof zone.
- Widespread occurrences of exo- and endo-granitic tin mineralisation.

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-  Abandoned Mine
-  Main Sn Prospects
-  Ben Lomond Granite
-  Mathinna Beds
-  Main road
-  Railway
-  Fault (and throw)

5 cm

0 5  
Kilometres

The Shell Company of Australia Limited METALS DIVISION	
<b>NE TASMANIA BEN LOMOND GRANITE OLD MINES &amp; PROSPECTS</b>	
SCALE	DATE OCT 1983
AUTHOR L. de S.	DRAWN TE
OFFICE ARG	REP. No.
DRG No MT27/1025	FIG No 23

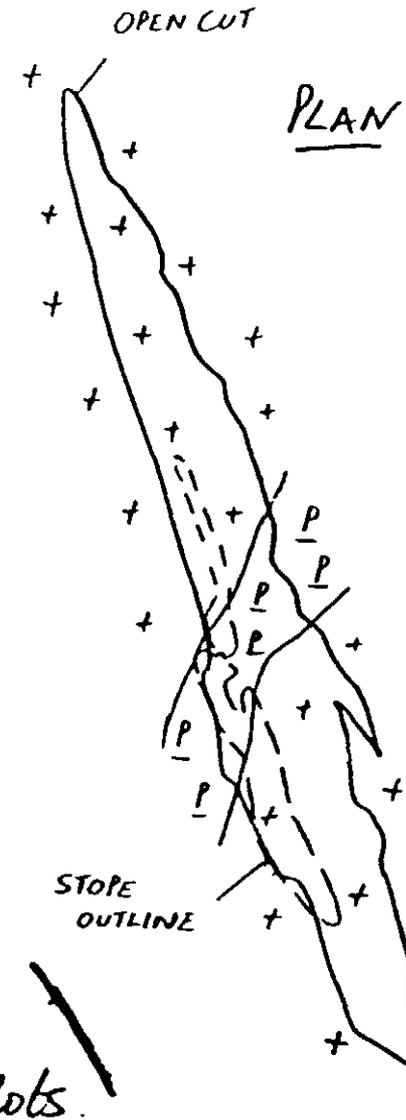
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PLAN OF OPEN CUT  
ROYAL GEORGE PROSPECT

T.N.  
↑  
50M

PLAN OF THE ROYAL  
GEORGE PROSPECT

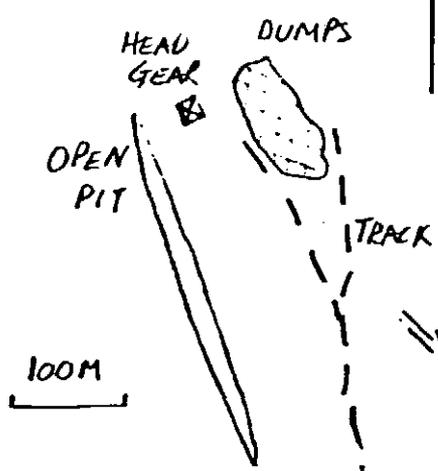
(A)



PLAN

(B)

Plan

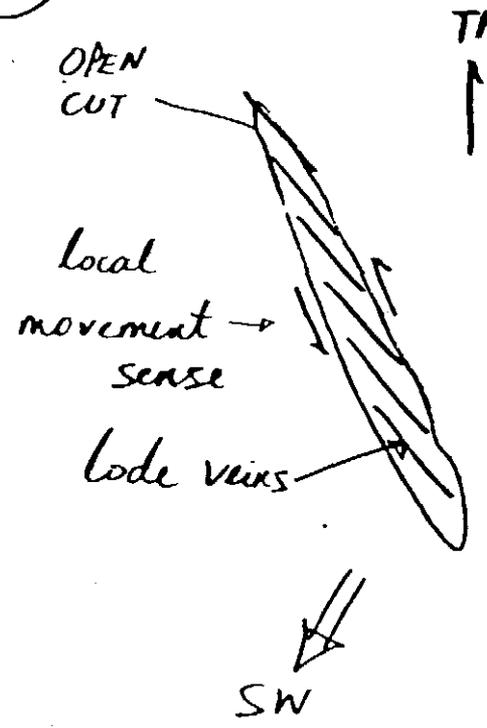


100M

T.N.  
↑

Lode veins  
Pegmatite clots.

(C)



T.N.  
↑

NE  
PRINCIPLE STRESS  
SW

- [+ ] coarse grained inequigranular
- [P ] Porphyritic fine grained granite

5 cm

STRUCTURAL  
INTERPRETATION  
ROYAL GEORGE  
PROSPECT

The Shell Company of Australia Limited METALS DIVISION	
ROYAL GEORGE PROSPECT (A,B,C) 15km SE of Avoca	
SCALE	DATE
AUTHOR P.R.	DRAWN
OFFICE	REP No

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- The granite hosted silicic stanniferous lodes closely resemble Collingwood-style mineralisation.
- Presence of Mathinna Bed cover, which might not have been explored for Collingwood-style, granite hosted sheeted vein deposits.
- In-house experience in exploration for Collingwood style.
- Potential for exogranitic/endogranitic Sn stockworks.
- Established reserves of at least 14,000 t Sn metal.
- Thin cover of Permo-Triassic sediments covers part of the prospective area.
- Good access and infrastructure.

(f) Other Areas in N.E. Tasmania

There are four other areas with a potential for Sn mineralisation in N.E. Tasmania viz:

- Mt. William sheet
- Mt. Stronach
- Furneaux Group of Islands
- Freycinet Peninsula (Bicheno)

Mt. William, N.E. of the Blue Tier is partially underlain by alkali-granites. However, as no hard Sn rock tin occurrences have been recorded to date, the area is ranked very low.

The alkali-granites of Mt. Stronach, located in the Scottsdale batholith contain a number of Sn and Mo- prospects. Open file reports do not indicate a great potential. Nevertheless, to complete our regional picture, the area requires examination.

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Small tin occurrences have been recorded in the Furneaux islands and in the Freycinet Peninsula. A brief reconnaissance is warranted.

(g) Discussion

A comparison of the areas discussed above shows that the areas with the best economic tin potential are the Anchor-Emu Hill and Avoca areas. It is perhaps not surprising, that these areas also have the best known potential (see Fig.27). The Anchor and Avoca areas have both prospects with reserves of 10,000 t of tin metal or more. A comparison of these two areas is listed in table 9. On balance the Avoca area has been ranked higher than the Anchor/Emu Hill area. This ranking is partly influenced by the fact that the author is at this stage more familiar with the former than with the latter area.

Nevertheless, the main negative point of the Anchor area is the fact that the potential is restricted to one style of mineralisation which is only suitable for O.P. mining. Despite the fact that there are some promising areas, there are no prospects with established economic grades. The latter are, however, present in the Avoca Area.

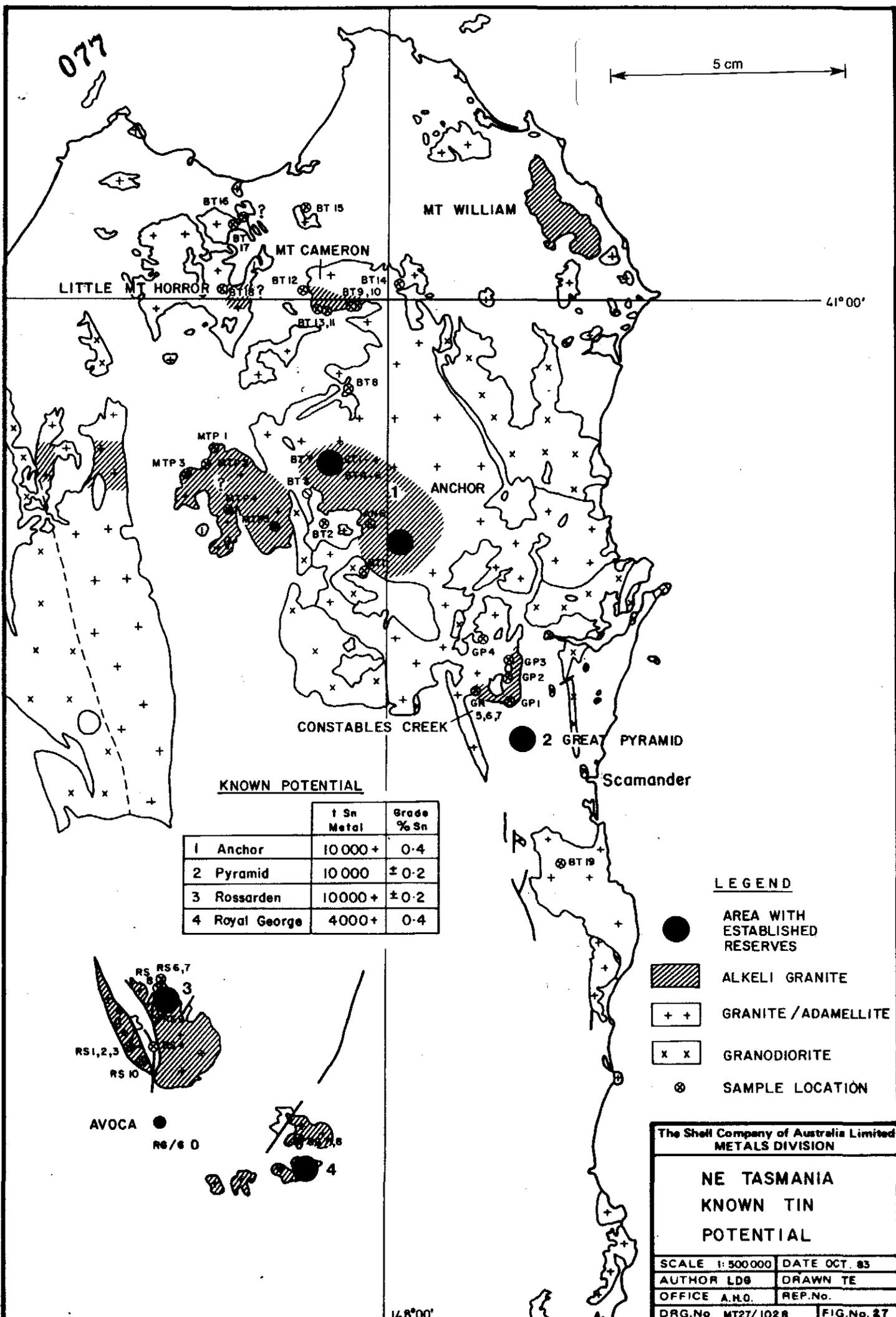
On this basis I would like to recommend the Avoca area for further exploration. The Anchor area remains important and a detailed review of that district remains warranted.

If exploration in the Avoca district is decided upon, I would like to recommend that we try to get control of the whole area, to allow a district-wide exploration of the Ben Lomond granite and marginal Mathinna Beds. A regional approach based on structural analysis (aerial photograph and Huntings study), historical exploration results, prospect examination and sampling, stream geochemistry (in marginal Mathinna Beds), litho-geochemistry and geological mapping would provide a basis for target generation and ranking.

It is in my opinion important that some work is carried out on economic modelling. Broad guidelines on minimum required tonnage

077

5 cm



**KNOWN POTENTIAL**

	1 Sn Metal	Grade % Sn
1 Anchor	10 000 +	0.4
2 Pyramid	10 000	± 0.2
3 Rossarden	10000 +	± 0.2
4 Royal George	4000 +	0.4

**LEGEND**

- AREA WITH ESTABLISHED RESERVES
- ▨ ALKALI GRANITE
- ++ GRANITE / ADAMELLITE
- xx GRANODIORITE
- ⊙ SAMPLE LOCATION



The Shell Company of Australia Limited  
METALS DIVISION

**NE TASMANIA  
KNOWN TIN  
POTENTIAL**

SCALE 1: 500 000	DATE OCT. 83
AUTHOR LDG	DRAWN TE
OFFICE A.H.O.	REP.No.
DRG.No MT27/1028	FIG.No. 27

148° 00'

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contained metal and minimum required grade, could prove very useful in maintaining target turnover, which in turn could save exploration dollars. A limited amount of work on tin recovery either through polished section - and petrographical studies in combination with assaying or through micro- bench testing (in collaboration with the engineering dept.) would add confidence to target evaluation.

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TABLE 7

Recorded Tin Production and Established Tin Potential,  
Rossarden, Royal George, Avoca Area  
(Various Sources)

	Ore (Mln. t)	Grade (%)	Sn-Metal (t)	W <sub>3</sub> (t)	Potential (Sn-Metal)
Rossarden (1939-1979)	2.1	0.5 Sn, 0.3 W <sub>3</sub>	15,489	5,383	>10,000 (@ ±0.2% Sn) (Open cut)
Storeys Creek (1939-1979)	1.1	0.2 Sn, 1.3 W <sub>3</sub>	1,980	11,990	?
Royal George	N/A	>0.5 Sn(?)	1,141	?	>4,000 (@ 0.4% Sn)
Rex Hill	N/A		826xSnO <sub>2</sub>		?
Total					>14,000

TABLE 8

Assay Results, Grab Samples Avoca Area

Location	Sample	Sn ppm	W ppm	Mo ppm	F%
R. George	sericitized granite	6,700	25	26	0.44
R. George	silicic lode	7,350	50	26	2.77
Brookstead	tourmaline/quartz	7,100	1,95%	28	1.20
Rex Hill	silicic lode	7,150	30	30	0.55
	sericitized granite	1.02%	-	-	-

TABLE 9

Comparison of Exploration Potential:-  
Central Blue Tier - Avoca Areas

	Anchor - Emu Hill	Avoca
Historial tin production for district (excl. alluvial)	2,735 t tin	27,000 t tin
Established Reserves	10,000 t tin	14,000 t tin
Grade Sn (%)	± 0.3%	0.2% O.P., >0.4% U.G.
Style of mineralisation	flat lying greisen	stockworks and sheeted veins in Mathinna Beds and granites.
Mining style	grades lend themselves for open cut only	open cut and underground mining
Prospects	except for Anchor, numerous prospects but grades are low	numerous prospects, encouraging grades.
New perspective on mineralisation	-	occurrence of & potential for Collingwood style & grade
Estimated grade potential	± 0.2% on average	± 0.2% for O.P. ± 0.6% underground
Infrastructure	poor	excellent, including railway.
Ranking	2	1

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VIII. SUMMARY AND CONCLUSIONS

- The historical tin production of N.E. Tasmania totals approximately 69,000 t of tin metal. About 40% or 27,000 t originated from hard rock mining and 60% or 42,000 t from alluvial mining. Hard rock tin was mainly mined from exogranitic occurrences in the Avoca area (23,000 t or 85% of the total hard rock production).
- All tin mining (hard rock and alluvial) was carried out in the vicinity of alkali-granites.
- The distribution of alkali-granites is widespread throughout the Blue Tier and Scottsdale Batholiths. The alkali-granites from the Avoca area (Ben Lomond granite) being generally less well known.
- On the basis of geological setting, alkali-granites can be divided into two groups: contact of roof zone alkali-granites which occur near the contact with overlying sedimentary rocks and endogranitic alkali-granites overlain by undifferentiated adamellites.
- Alkali-granites can generally readily be recognised by thin section studies, without geochemical support, on the basis of the An-content of the plagioclase, colour of biotite and presence of accessory minerals such as topaz and tourmaline. Biotites of alkali-granites of the Blue Tier Batholith are generally green or colour variable.
- Tourmaline is not common in endogranitic alkali granites.
- The contact granites often display a crude mineralogical (and geochemical) zonation from biotite granite to biotite muscovite granite. Tourmaline, topaz and sericite become increasingly common towards the roof contact. Tourmaline bearing aplitic granite is often developed at the contact.
- Flat lying greisens are well developed in endogranitic alkali granite but reach only limited thickness in the contact alkali granites. This observation has implications for exploration.

- Undifferentiated adamellites overlying endogranitic alkali granites may have suffered alteration and can be recognised by secondary muscovite and secondary biotite development.
- Contact alkali granites are associated with exogranitic mineralisation or with steeply dipping lodes within the roof zone granite. Endogranitic alkali granites are mainly associated with disseminated Sn-mineralisation in greisens.
- The adamellites and alkali-granites of N.E. Tasmania have an Al-index (molecular  $\text{Al}_2\text{O}_3/(\text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O})$ ) greater than 1.
- The granitic rocks of N.E. Tasmania can easily be classified though ternary plot of Rb/3-Ti/20-Sr into granodiorites, adamellites, calc-alkali granites and alkali granites.
- Alkali granites are generally enriched in F, Li, Rb, Sn, U, W, while depleted in Ba, Sr, Zr, Ti. The distribution of Ga, Rb and Y are less regular. Ga and Nb show enrichment trends while Y is commonly depleted.
- On a regional scale the Ben Lomond granites are generally enriched in U, when compared to the granites of the Blue Tier.
- On a district scale, the areas lacking prominent tin mineralisation can often be recognised by a lack of enrichment and depletion of certain indicator elements (e.g. respectively F, Li, Nb, U and Y, Zr).
- On a regional scale, ratio's of Ba/Rb and Rb/Sr provide a simple geochemical tool for distinguishing differentiated alkali granites. The use of additional elements such as F allows further discrimination into tin- and unmineralised granites.
- A number of so-called Sn-formula's were developed to distinguish tin and non-tin bearing granites. The formula's are based on the multiplication of a number of indicator element ratio's. The Sn-formula's have limited application in regional exploration.

- Undifferentiated adamellites overlying endogranitic alkali granites are enhanced in Sn, W and Li. Enhancement of these elements probably took place by a process of diffusion.
- The endogranitic alkali granites reaches a higher degree of differentiation than the contact alkali granites. The two groups can readily be distinguished by means of the tin formula's.
- Gravity-, gamma radiation- and possibly fluid inclusion data can be used to advantage in regional and local exploration.
- The Avoca (Ben Lomond granite) and the Anchor-Emu Hill areas are considered to have a good potential for economic tin mineralisation. Both areas contain known prospects with over 10,000 t of tin metal.
- Collingwood style, sheeted vein, tin mineralisation has been recognised in the Avoca area. This area also has a potential for exogranitic vein mineralisation (stockwork or major vein systems).
- The Anchor area has a known potential for disseminated tin mineralisation in flat lying greisens.
- On the basis of grades and geological setting the Avoca area has been ranked higher than the Anchor-Emu Hill area. Both areas require further investigation. Furthermore it is recommended that minor follow-up work be carried out on the Mt. Paris mass (endogranitic lode style mineralisation), Mt. Stronach, and on the Furneaux Islands and Freycinet Peninsula.
- It is recommended that economic parameters be established for guidance of exploration. In addition it is recommended that limited work on cassiterite recovery be carried out early in exploration.

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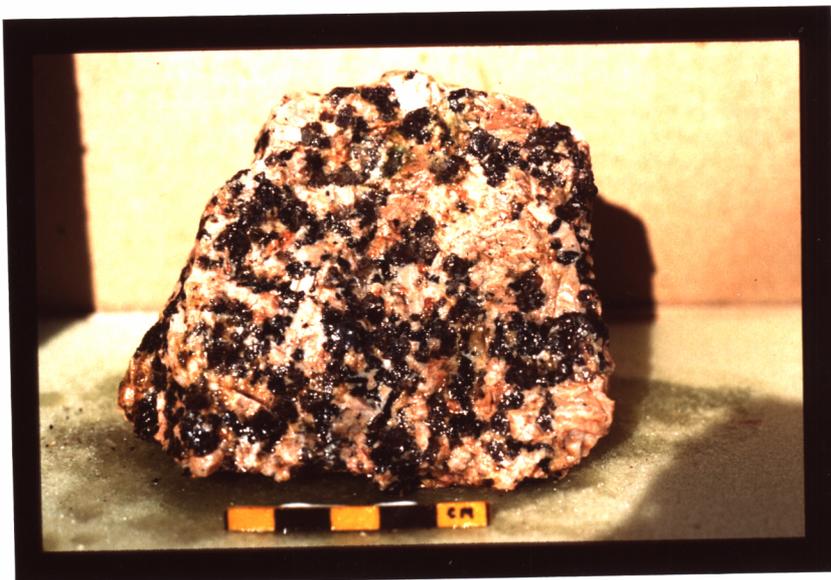
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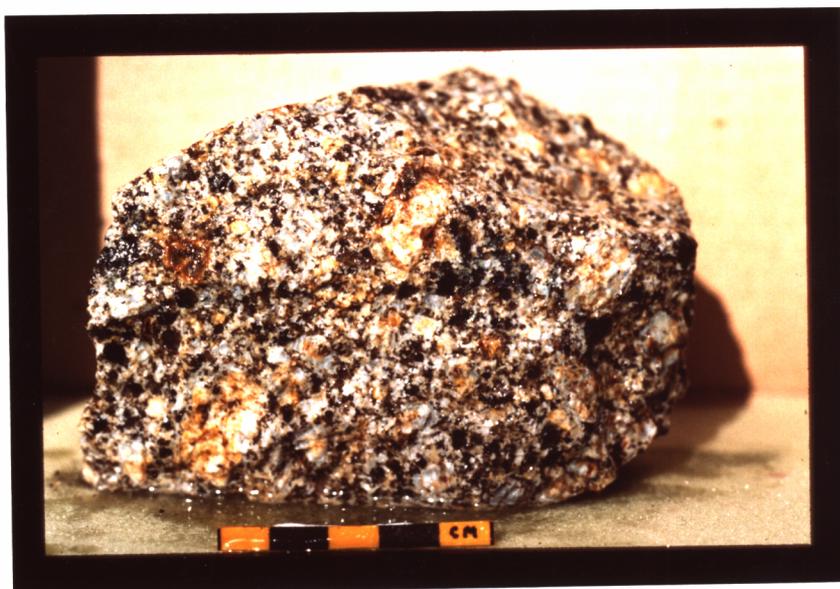
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RS/10 Coarse Ben Lomond granite

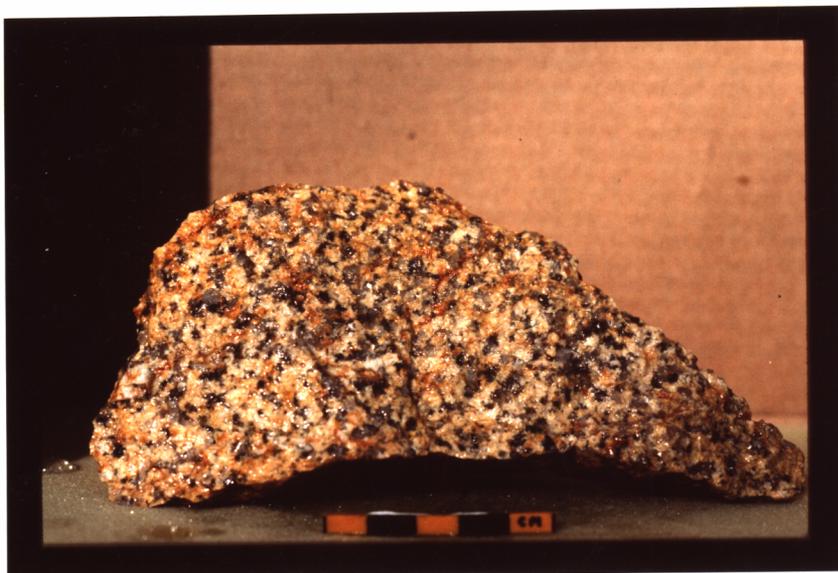
Coarse grained, pink inequigrannlar biotite, calc-alkali granite. This granite phase is dominantly developed in the Rossarden area. Note dark, "smoky" quartz grains. This granite may contain minor fluorite and secondary tourmaline.

RS/9 Porphyritic Ben Lomond granite

Altered porphyritic, alkali-granite from the Rossarden area. Porphyritic phases are well developed near the roof contact. Biotite has been replaced by muscovite pseudomorphs. Sample contains traces of secondary fluorite, schorl and anatase. Note dark smoky quartz.

RS/7 medium to fine grain Ben Lomond granite

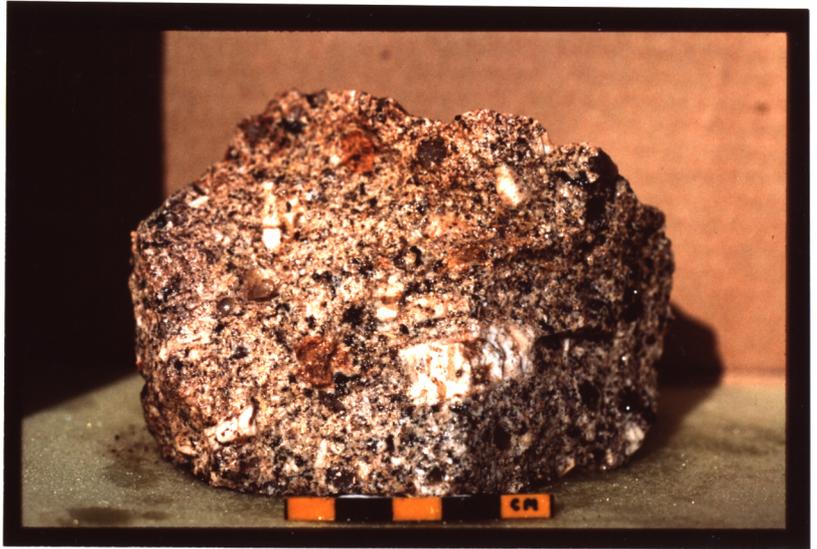
Sericitized, muscovite, tourmaline alkali granite. Plagioclase is extensively altered by sericite. Sample contains minor primary schorl and sporadic cluster of primary muscovite.



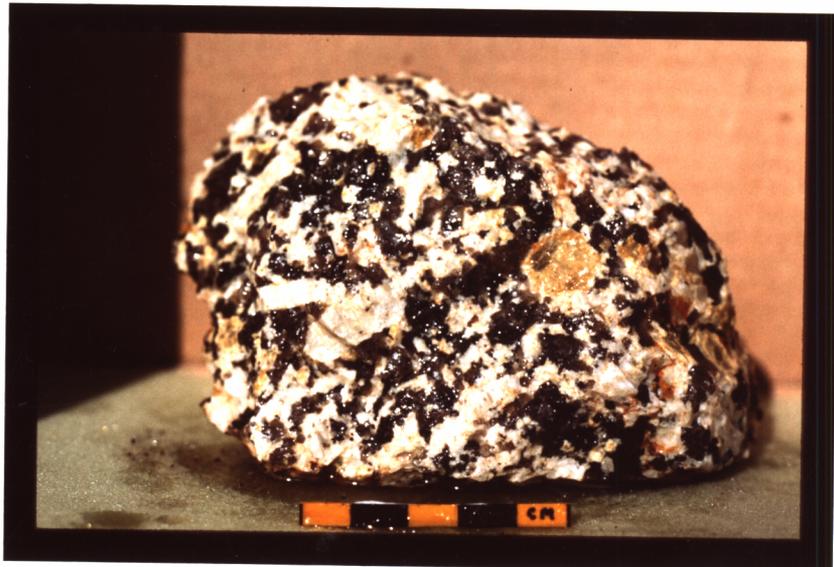
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RG/3 Ben Lomond porphyritic granite

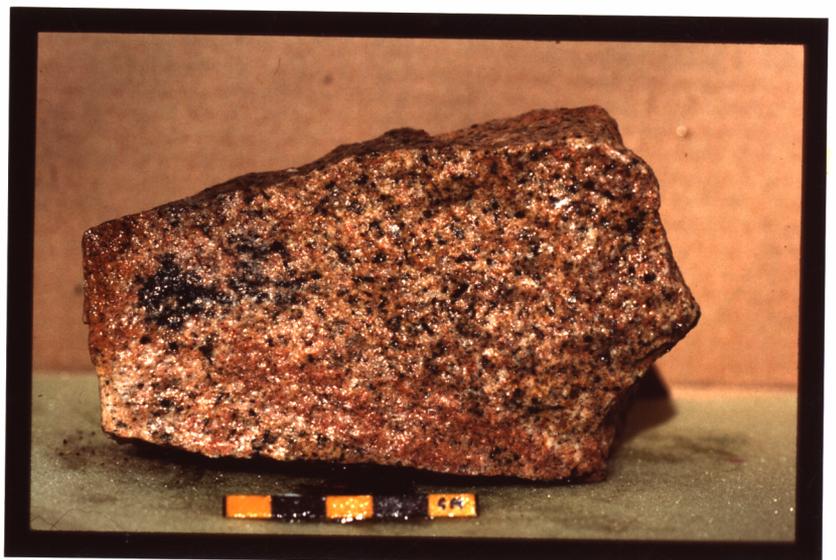
Two mica, tourmaline bearing, alkali granite from Royal George tin mine. Sample contains small clots of primary tourmaline as well as topaz. Brown biotite may have selvages of muscovite.

RG/5 Ben Lomond inequigrannlar granite

Medium to coarse, uneven grained tourmaline, topaz, alkali granite from Royal George Mine. Sample contains primary biotite and muscovite and both primary (green-brown) and secondary (red-brown) schorl.

GP/5 Georges River aplikic, tourmaline granite

Alkali micro-granite developed at the contact. Sample contains clots of schorl (blue). Note compositional layering of pink K-feldspar (quench feature?). Sample contains minor garnet, minor biotite and muscovite (the latter both primary and secondary).



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AN/1 medium grained greisenised  
granite from Anchor Mine

Greisenised, endogranitic, alkali granite from the floor of the Anchor open cut. Sample contains  $\pm$  5% pale green biotite (core may be brown). The altered granite contains minor topaz, cassiterite and molybdenite. This granite comprises the ore of the Anchor Mine.



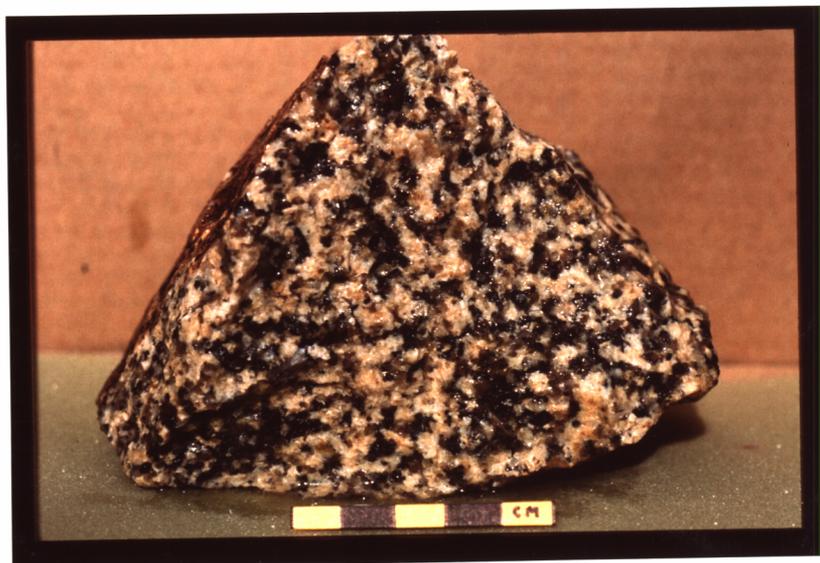
AN/5 Porphyritic adamellite from  
Anchor Mine

Porphyritic, altered, biotite adamellite. Biotite is partly altered to muscovite. This undifferentiated adamellite overlies the endogranitic alkali granite (AN/1).



BT/2 medium to coarse alkali granite

Coarse, equigranular, topaz, biotite granite from Weldborough area. Biotite is green to brown-green. Sample is weakly sericitized.



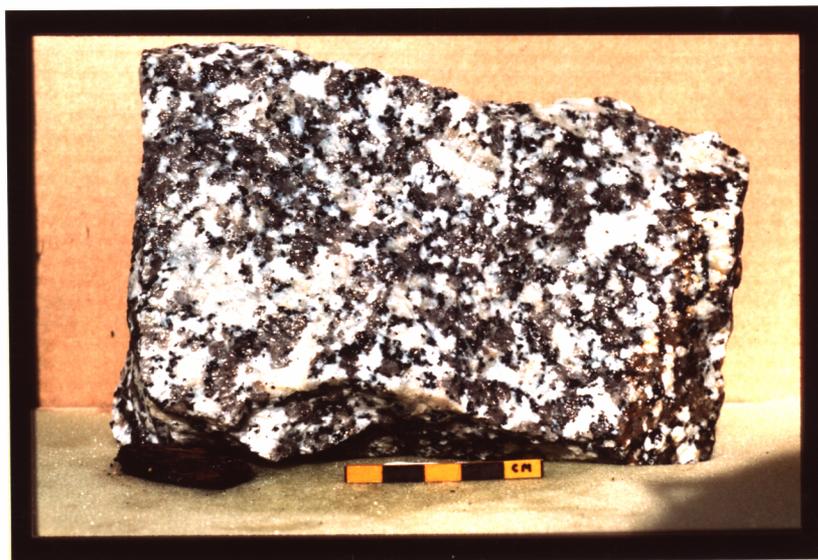
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BT/6 Medium grained alkali granite

Medium grained, biotite, topaz, alkali granite endogranitic(?). Sample contains minor primary muscovite and is weakly sericitized. Biotite green to brown (Emu Hill area).

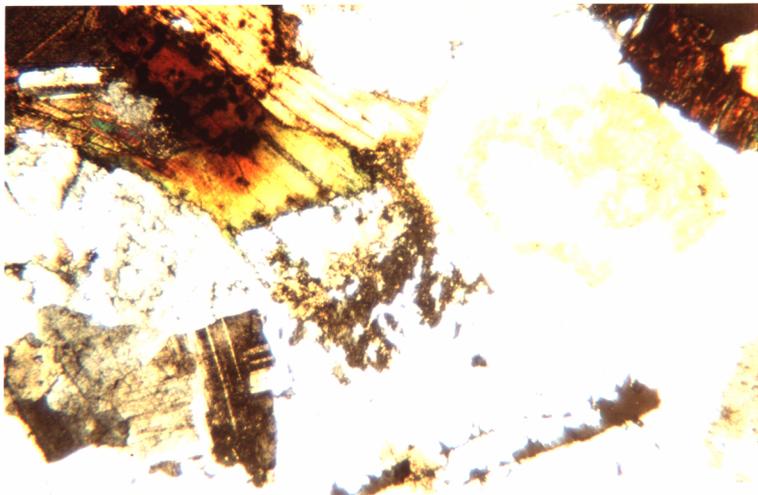


BT/17 Porphyritic biotite adamellite

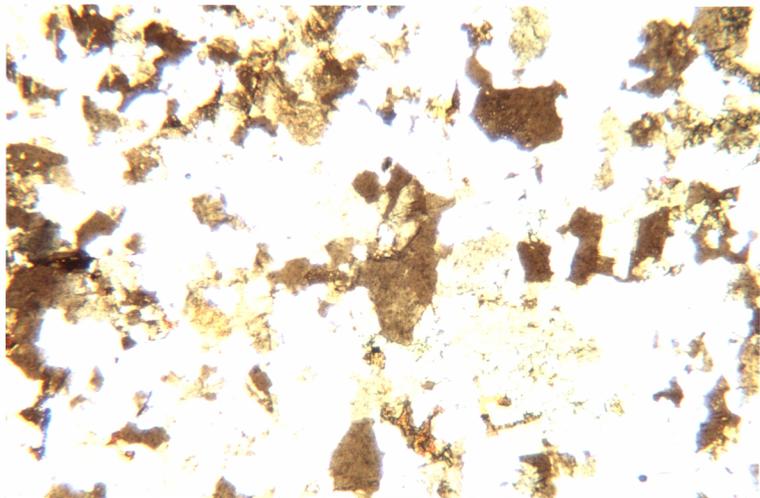
Coarse, uneven grained to porphyritic, biotite adamellite from Mt Cameron. Brown biotite may show minor signs of chloritization.

GP/4A

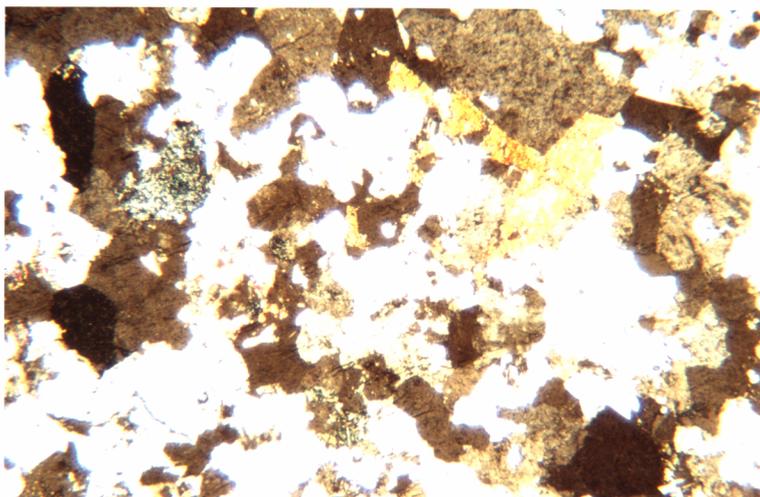
Dark green to brown, colour-zoned biotite. This style of biotite alteration is common near the contact zones. Note also the zoned plagioclase to the left (Georges River area).

GP/5

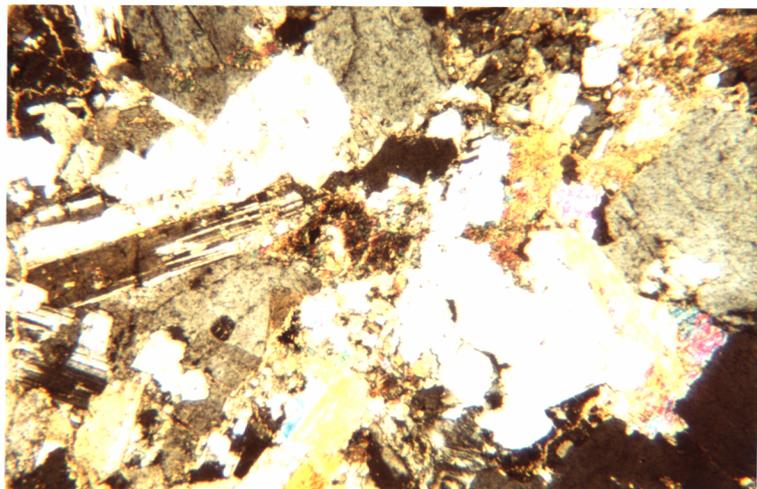
Euhedral quartz (middle centre, dark) and tourmaline replacing quartz (lower right). Dark green, muscovitized, biotite occurs at middle left. From contact aplitic granite, Georges River.

RS/6

Primary tourmaline (yellow longitudinal sections and grey/blue for basal sections and black in extinction) set in quartz/k-feldspar/plagioclase.

RS/7

Primary muscovite surrounding a corroded quartz grain (top left) with secondary muscovite/sericite developed in plagioclase, (middle right), contact alkali granite, Ben Lomond Rossarden.



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APPENDIX 1

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## METALS DIVISION

Your ref

Our ref BXR:LDG:ES

Date May 27, 1983.

Correspondence  
Shell Corner  
155 William Street  
P.O. Box 872K  
Melbourne 3001

Location  
30th Floor  
Marland House  
570 Bourke St.  
Melbourne

Central Mineralogical Laboratories  
39 Beulah Road  
NORWOOD, S.A. 5067.

Cable Address Shell Melbourne  
Telex Noe 30560 - 30973  
Telephones  
Switchboard - 609 1711  
Direct Lines - 609 Ext

Dear Sirs,

Under separate cover, please find 65 granite samples (Marked: RS/1-10, RG/1-10, AN/1-6, CC/1-4, BT/1-19, GP/1-7 and MTP/1-5) for thin section preparation and brief petrological descriptions. I am particularly interested in the following aspects:

- mafic minerals; type and approximate content (visual estimate);
- biotite pleochroism (colour range);
- biotite chloritization;
- zoning of feldspars;
- approximation of An content of plagioclase (extinction angle);
- zoning of feldspars (comment only);
- alteration, development of sericite, chlorite, secondary quartz, secondary K-feldspar and/or albite, silification;
- accessory minerals, fluorspar, topaz, tourmaline, etc.

In addition, please prepare colour slides of fractured surfaces of the following hand specimens:

- RS/2,6,7,9,10; RG/2,3,5; AN/1,5,6; CC/1; BT/1,2,6,11,17; GP/1,5,6; MTP/2,5.

I would be pleased if you could forward the samples as soon as possible to COMLABS (305 South Road, Mile End South, 5031). Please do not retain other than the *minimum amount of required material*.

Yours faithfully,  
For: THE SHELL COMPANY OF AUSTRALIA LIMITED

L. de Graaf  
Supervising Geologist - Research

09A

## Central Mineralogical Services

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39 Beulah Road  
Norwood, S.A. 5067  
Telephone 42 5659

Dr. L. de Graaf  
Supervising Geologist - Research  
The Shell Co. of Aust. Ltd.  
Metals Division  
G.P.O. Box 872K  
MELBOURNE / VIC. 3001

5th July, 1983

### REPORT CMS 83/5/41

YOUR REFERENCE:	Sample Despatch No. 4851
DATE RECEIVED:	30th May, 1983
SAMPLE NOS.:	62 Samples
SUBMITTED BY:	Dr. L. de Graaf
WORK REQUESTED:	Petrology

  
H.W. Fander, H. Sc.

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REPORT CMS 83/5/41

Sixty-two samples of granitic rock were received for petrological examination and brief description. An accompanying letter defined criteria of petrological interest.

Representative thin-sections were prepared and examined together with their respective cobaltinitrite-stained offcuts. Visual modal mineralogical analyses were prepared for all but a few relatively coarse-grained or compositionally variable rocks. Feldspar (plagioclase) compositions were determined by the twin-extinction-angle method in conjunction with determination of R.I. (relative to quartz) and optical character, and are expressed as An (anorthite) contents. These represent approximate modes in the case of zoned plagioclase. The data, together with notes on biotite colour variations, alteration features and comparisons is summarised in the attached tabulated descriptions.

With few exceptions, notably a few pneumatolytic rocks (greisens) and two hybridised intrusives, the igneous rocks are classified both compositionally and texturally following the Hatch & Wells classification. Thus, the prefix micro- is used to denote medium-grained rocks.

For the purpose of brevity, the Hatch & Wells classification scheme has been slightly modified with respect to minor primary components. Since all the igneous rocks carry biotite (or its alteration products), the prefix "mica-" is used to denote only those rocks carrying both primary biotite and white mica. This modification permits delineation of the distribution of other more potentially significant components, notably the white mica, topaz and tourmaline, and negates the otherwise unwieldy long terminology which would result from a strict application of the classification scheme.

Similarly, the prefix "leuco-" has been used to denote relatively pale granitic rocks. These are typically characterised by relatively abundant white mica.

SUMMARY

With the above-noted exceptions, the bulk of this suite can be classified as adamellitic, granitic or leuco-granitic. A typical rock consists of quartz, plagioclase and orthoclase in near-equant proportions, with relatively minor biotite. The main variant, apart from textural features, is then the composition of the plagioclase component. Overall, plagioclase exhibits a more or less continuous composition from calcic oligoclase to sodic albite. In detail, however, there is an apparent break in the range circa An 8 to An 12. That is, few rocks include plagioclase of compositions around An 10 and, in the petrological sense, the distinction between granite (or strictly alkali granite, following Hatch & Wells) and adamellite is generally quite marked. Leucogranites, as noted, contain relatively conspicuous primary white mica. These rocks also tend to reflect concentrations of relatively pure (i.e. low An-content) albite, although this is an inconsistent trend in that a few exhibit a subtle trend to K-enrichment.

Adamellites are further semi-characterised by relatively zoned plagioclase. In contrast, albite in granites is at best rather incipiently zoned and in leucogranites essentially unzoned. Similarly, K-feldspar in granites and leucogranites is relatively perthitic.

Parallelling the trend from adamellitic to (alkali) granitic and leucogranitic, subordinate and accessory constituents exhibit certain albeit rather inconsistent variations. These may be summarised in respect of the various phases, together with relevant textural features.

Biotite. The Fe-(Mg) mica is typically relatively dark in the adamellites where it is strongly pleochroic in shades of brown to orange- or red-brown. In the granites and leucogranites biotite is usually relatively pale, often greenish and is relatively weakly pleochroic. Exceptions are noted, particularly a small proportion of the granites which include orange-brown titaniferous biotites, and similarly adamellites with colour-variable (brown to green) biotites.

The "pale" granitic biotites tend to be colour-zoned with relatively dark brown cores and pale brown to pale green marginal zones. These types may be overgrown with optically continuous selvages of primary white mica. In detail, the distribution of pale green biotite and muscovite in the complex zoned micas is crystallographically controlled. In sections parallelling the C axis, mid-green mica is concentrated in circumferential zones, whereas relatively pale green mica and muscovite generally appear as unidirectional overgrowths at one end of the composite flake and/or in one segment of the basal plane. The composite flakes are thus typically asymmetrical both in terms of colour variations and habit.

Given that some of the composite flakes exhibit optically continuous variations from biotite to muscovite with relatively quite pale green mica as the intermediate phase, it seems likely that the paler green primary micas are strictly ferroan muscovites, at least in part. Leucogranites carry pale green micas as discrete flakes. These tend to be colour-variable and zoned.

Topaz, Tourmaline. Topaz, as a primary constituent, is relatively concentrated in the granites. Topaz-bearing rocks typically also include primary muscovite, and both phases may be affected by pneumatolytic sericite or muscovite alteration.

A few topaz-mica adamellites are present in this suite and these enhance the petrological links between the two major (i.e. adamellitic/granitic) groups.

In contrast, primary tourmaline appears more or less strictly concentrated in the granites. Habit is variable from disseminated stumpy subhedral grains to semi-poikilitic networks of films, semi-granularly intergrown with quartz and feldspar. This variation is closely analogous to the distribution of late-magmatic white mica.

Primary tourmaline is colour-variable, typically pale blue to pale green, but variously mottled pale brown. In contrast, secondary (or pneumatolytic) tourmaline, weakly developed in a few rocks, is relatively dark brown to orange-brown where it replaces biotite.

White Mica. With a few exceptions (the topaz-mica adamellites), primary muscovite is restricted to the granites and leucogranites. Habit is variable from overgrowths on colour-zoned biotite to discrete flakes and fine-grained semi-graphic intergrowths with quartz and feldspar in which habit primary muscovite may be confused with pneumatolytic white mica.

In detail, primary white mica is colourless to incipiently pleochroic in pink, has a high 2V and may develop pleochroic haloes around included zircons, consistent with traces of Fe in the lattice.

In contrast, secondary (pneumatolytic) white mica is colourless to pale green, with a low 2V (the bulk is optically uni-axial) and, on the basis of these features, can be broadly classified as hydromuscovite. The contrast is not always apparent, particularly in finer-grained intergrowths with feldspar where the distinction is rather academic in view of the probable, more or less continuous development of white mica in the temporal span from late- to early post-magmatic. Significantly, however, the primary muscovite is locally replaced by secondary white mica.

#### Textures

Adamellites and granites exhibit a similar range of textural variations. In comparison, however, the granite category includes the greater bulk of "porphyries" (i.e. porphyritic, medium-grained rocks). Additionally, the coarse-grained granites tend to exhibit a weakly developed dimensional orientation or "fluxion" texture. These features are consistent with intrusion of the granites as stocks and sills within a relatively massive adamellitic pluton.

The suite includes a single pegmatite. Aplites (sensu stricto) are not represented, but may be expected in this environment. Medium-grained rocks exhibit, at best, only incipient development of micrographic textures. Microlitic features are conspicuous by their absence. In synthesis, general features are consistent with a medium level intrusive complex.

#### Minor Rock Types

The suite includes a few pneumatolytic rocks, classified broadly as greisens. Typical assemblages are quartz and topaz or quartz and white mica. These rocks represent pneumatolytic segregations and are altered granitic, in part at least.

They are significant in carrying disseminated cassiterite, colour-variable, notably in shades of brown and red (as is rather characteristic of hypogene and greisen-related cassiterite).

A single quartz-schorl vein with disseminated wolframite is represented and two hybrid igneous rocks are present in the suite.

#### Alteration/Mineralisation

The main apparent feature of significance here is the development of cassiterite-bearing greisens.

There is an apparent spectrum from mildly pneumatolytically muscovitised, through relatively muscovitised rocks to the thoroughly greisenized types. Significantly, the few "intermediate" types (in terms of alteration) are leucogranitic, and the granites in general include rare particles of hypogene cassiterite. These features, together with the noted concentrations of "volatiles" (reflected mineralogically as topaz, schorl, white mica), suggest the tin mineralisation reflects a hypogene component and is simply relatively concentrated in pneumatolysed zones.

Considering the granitoids in general, the only apparent significant alteration phenomenon is muscovitisation. Plagioclase feldspar is more or less ubiquitously stained with sericite and/or fine-grained muscovite but, in relatively muscovitised leucogranites, the K-feldspar is selectively altered, at least locally. Similarly, semi-ubiquitous argillic clouding of K-feldspar in the granitoids appears insignificant in terms of the pneumatolytic effects and, given that the suite is composed of hand specimens, it is by no means certain that this is not a weathering phenomenon.

Fluorite, variously colourless to mottled mauve, is an accessory alteration phase with an apparently close correlation, spatially and temporally, to alteration of biotite. Fluorite is relatively concentrated in greisens and veins.

Biotite, where altered, is generally muscovitised. A few rocks exhibit selectively chloritised or vermiculitised biotite and the pseudomorphous aggregates then typically include films of secondary K-feldspar representing released K and Al. Tourmalinisation of biotite is a relatively rare phenomenon.

Temporally late sideritic carbonate is semi-ubiquitous in greisens and relatively greisenised granites. These rocks also include varying proportions of disseminated sulphide and "secondary" apatite. Both the "heavy" carbonate and sulphide components may be of significance in terms of recovery and concentration of cassiterite, as may similarly the apparently erratically distributed traces of wolframite.

#### Comparison with Tin-Granite Situations

Certain mineralogical "fingerprints", notably the colour-variable/locally complexly colour-zoned micas and isolated occurrences of pink-pleochroic topaz, tend to identify at least some of these rocks as representative of the Blue Tier Batholith of N.E. Tasmania.

Whilst typical of the Devonian "tin granites" of Tasmania, the Blue Tier complex can be contrasted with the relatively high level intrusive/contact-metasomatic/structurally controlled tin situations developed for example at Renison and Cleveland where the granites represent only relatively minor concentrations of cassiterite tin. Indeed, there are certain analogies between Blue Tier and the pegmatite-related occurrences in the Pilbara region of W.A. In detail, the Blue Tier situation may be considered as transitional between these deep level intrusive/pegmatite-related/insignificant greisen and high level/metasomatic types.

D. Cowan, B. Sc.

Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
RS-1 (T.S. 46022)	Alkali Granite. Quartz (30 %), microcline-microperthite (35 %), weakly muscovitised albite (weakly zoned An 7, 30 %), and extensively muscovitised-sericitised pale to mid-brown biotite (5 %).	Porphyritic (quartz, K-feldspar, rarely albite), uneven-grained granitic. Incipiently stressed.	Traces primary muscovite, apatite, zircon, rare green schorl. Traces secondary fluorite, biotite-refractive limonite.	Mildly greisenized biotite granite, strictly alkali granitic. Biotite and phenocrystal plagioclase selectively altered. Fluorite develops from biotite. Sericite is hydromuscovite in part.
RS-2	Micro-Adamellite. Quartz (35 %), orthoclase (30 %), weakly/variably sericite-muscovite-stained oligoclase (incipiently zoned An 25, 30 %), with minor sericitised biotite (2-3 %).	Weakly quartz-porphyritic, slightly quartz-vuggy, medium, even-grained granitic. Incipiently stressed.	Traces primary green-brown schorl, minor traces zircon, rare ultrafine magnetite.	Slightly vuggy character consistent with a relatively shallow minor intrusive. Alteration analogous to RS-1. Rare biotite inclusions in quartz are mid- to dark brown.
RS-3	"Greisen". Quartz variably stained with micro-inclusions of topaz, fluorite, green biotite. Disseminated films semi-sericitic white mica. Disseminated grains, clusters cassiterite. Late clots of siderite.	Variable, but essentially medium- to coarse-grained, granular to subhedral quartz. Weakly banded (mica, cassiterite).	Traces sericitised biotite, minor traces galena, pyritised pyrrhotite, late limonite (after siderite).	Siliceous greisen-type vein characteristics. Cassiterite colour-variable (colourless, brown-red), sized <50µ to 1.5 mm, mode 100-200 µ, variously embedded in quartz, "sericite".
RS-4	Alkali Granite. Orthoclase-perthite and quartz with relatively minor weakly zoned, variably sericitised albite (An 5), disseminated variably muscovitised brown/red-brown biotite.	Coarse, but uneven-grained granitic. Incipiently stressed. Rare quartz-healed microfractures.	Minor traces zircon, topaz. Rare apatite. Traces secondary chlorite, vermiculite, fluorite, limonite (after biotite).	Affinities with RS-1, but distinctly coarser-grained to the extent that modal analysis is impractical. Topaz is partly sericitised. Quartz veinlets include rare fluorite.
RS-5	Alkali Microgranite. Quartz (30 %), orthoclase-microperthite (35 %), weakly sericitised incipiently zoned albite (An 5, 30 %), with disseminated sericitised/muscovitised biotite (5 %).	Coarsely quartz (-orthoclase-albite) porphyritic with an even, medium-grained granitic to micrographic groundmass.	Traces primary topaz, minor traces zircon, (oxidised) magnetite. Traces secondary anatase.	Weakly micrographic (granophyric) "quartz-feldspar porphyry". Rare relict biotite is red-brown (titaniferous); anatase represents "ex-solved" TiO <sub>2</sub> in altered biotite.
RS-6	Tourmaline Microgranite. Incipiently zoned albite (An 5, 40 %), quartz (30 %), orthoclase (20 %), with disseminated pale blue-green schorl (3 %), clots of muscovite (2-5 %).	Slightly vuggy, medium, uneven-grained granitic.	Traces topaz.	Distinctly relatively albitic (sodic) alkali microgranite with "primary" tourmaline, partly concentrated in microlytic vugs with quartz, muscovite.
RS-7	Greisenized Adamellite. Quartz (30 %), sericite-stained to sericite- and muscovite-pseudomorphed oligoclase (unzoned, An 17, 40 %), and relatively weakly sericitised orthoclase (30 %).	Even-grained, granitic (mean 2 mm). Stressed variably microfractured/sericite-healed.	Sporadic clusters of primary muscovite, traces variably sericitised schorl, traces zircon, rare sphene.	Variably muscovitised-sericitised adamellite with traces primary schorl, but no tangible altered biotite. ?Wolfram is ultrafine, fracture-related.
RS-8	Mica Adamellite. Quartz (30 %), orthoclase-perthite (25 %), weakly muscovite-stained oligoclase (unzoned, An 13, 35 %), disseminated flakes, clusters muscovite (5 %), mid-brown biotite (2 %).	Uneven-grained, granitic, weakly feldspar-porphyritic. Unstressed.	Traces primary colour-variable schorl, apatite, zircon.	Mildly muscovitised mica adamellite with affinities to RS-7. Biotite, muscovite are locally intergrown, with muscovite overgrowing biotite.

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Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
RS-9	Porphyritic Adamellite. Quartz (30 %), orthoclase-microperthite (35 %) and weakly muscovitised oligoclase (unzoned, An 13, 30%) with disseminated siderite-stained white mica pseudomorphs after biotite.	Orthoclase-porphyritic uneven-grained granitic, essentially unstressed.	Traces relict biotite, zircon. Traces secondary fluorite, schorl, anatase.	Similarities with RS-8 and RS-7. Mildly muscovitised, with traces oligoclase-replacive schorl, mica-derived fluorite. Biotite is mid-brown, locally weakly mottled to
RS-10	Adamellite. Quartz (35 %), orthoclase-perthite (30 %) and weakly muscovite-stained oligoclase (unzoned, An 27, 30 %) with disseminated variably chloritised mid- to dark brown biotite.	Relatively coarse and even-grained granitic, very incipiently stressed.	Relatively conspicuous zircons (in biotite). Traces secondary K-spar and fluorite.	Slightly relatively green-brown. "basic" biotite adamellite. Secondary K-feldspar is interleaved with chloritised biotite, represents "exsolved" potassium. Fluorite is altered mica-derived.
RG-1	"Greisen". Quartz with subordinate intergrown topaz, subordinate to minor included and intergranular fine-grained white mica, disseminated cassiterite and degraded/ferruginised siderite.	Similar to RS-3 (medium-grained granular quartz, weakly banded). Quartz-intergranular cassiterite.	Rare corroded relict phenocrystal quartz. Minor traces biotite, rare zircon as inclusions in quartz.	Affinities with RS-3. In comparison, this rock exhibits certain ill-defined altered "porphyry" characteristics. Cassiterite is relatively pale, sized 25-200 $\mu$ , mean
RG-2	Greisened "Granite". Quartz and muscovite in varying proportions with frequent muscovite pseudomorphs after biotite. Minor vugs of quartz and colour-variable schorl.	Medium-grained, crudely banded. Incipiently stressed/microfractured.	Minor traces topaz, relict granitic zircons, secondary sphene, rare cloudy ultrafine ?cassiterite.	Thoroughly greisened (silicified, muscovitised) biotite-rich granitoid. Stress postdates the texturally late vuggy quartz. ?Cassiterite restricted to biotite-pseudomorphous muscovite aggregates.
RG-3	Topaz-Mica Micro-Adamellite. Quartz (30 %), orthoclase-microperthite (30 %), weakly muscovitised oligoclase (unzoned, An 25, 30 %), disseminated variably muscovitised biotite (3 %), weakly sericitised topaz (3 %).	Quartz-feldspar-porphyritic, medium-grained granitic, locally micrographic, unstressed.	Rare zircons, minor trace primary muscovite.	Quartz-feldspar porphyry with affinities to RS-8, similarly locally muscovite-selvaged mid-brown biotite. Relatively conspicuous primary topaz.
RG-4	Topaz-Mica Microgranite. Quartz (35 %), orthoclase-microperthite (30 %), weakly sericitised muscovitised albite (unzoned, An 7, 30 %), weakly/variably sericitised orange-brown biotite (5 %), similarly altered topaz (2 %).	Weakly quartz-feldspar-porphyritic, medium-grained granitic.	Minor traces zircon, primary muscovite, secondary pyrite (in relatively sericitised biotite and albite).	Close affinities with RG-3, but contrasting in relatively sodic plagioclase and relatively titaniferous biotite. Similarly mildly greisened (muscovitised).
RG-5	Tourmaline-Topaz Granite. Quartz (40 %), orthoclase-perthite (35 %), weakly sericitised albite (relatively zoned, An 7 to An 4, 15 %), disseminated green-brown schorl (3 %), moderately sericitised biotite, topaz.	Coarse, uneven-grained granitic. Incipiently stressed.	Minor traces primary apatite, zircon, muscovite, secondary red-brown schorl.	Relatively differentiated (potassic) alkali granite with late magmatic green schorl, topaz, orange Ti-biotite. The secondary schorl is biotite-replacive, titaniferous.
RG-6	Greisen. Quartz with varying proportions of topaz, disseminated pyritised pyrrhotite. Sporadic vugs of quartz and colour-variable schorl. Disseminated clots of sericite, minor disseminated cassiterite.	Variable, but essentially medium-grained, semi-banded, locally vaguely "granite"-pseudomorphous.	Traces stannite, arsenopyrite, chalcopyrite, white mica (inclusions in quartz), rare zircons.	Affinities with RS-3, RG-1. Probably a vein with greisened (silicified/topazised) "granite" intraclasts. Cassiterite is colour-variable, <50 $\mu$ to 350 $\mu$ grains in quartz, locally selvaged with stannite.

Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
RG-7	<u>Quartz-Schorl Vein.</u> Quartz with subordinate to minor blue-green to brown schorl, thinly disseminated wolframite. Sporadic late veins, veinlets of muscovite, fluorite, kaolin-illite.	Coarse mildly stressed to fractured muscovite-fluorite-healed quartz. Semi-granulated wolframite.	Minor traces sulphide (?jamesonite) as inclusions in fluorite.	Fractured quartz-schorl(-wolframite) vein with "secondary" white mica-kaolin-fluorite veins, veinlets. Granulated wolframite is corroded by fluorite, clays.
RG-8	<u>Tourmaline-Topaz Granite.</u> Quartz (30%), orthoclase-perthite (30%), sericite-stained albite (sim. RG-5, 30%), disseminated variably muscovitised orange-brown biotite (5%), green-brown schorl, topaz.	Similar to RG-5, weakly albite-porphyrific.	Zircon, rare apatite. Traces secondary siderite (partly ferruginised), fluorite, schorl (sim. RG-5).	Close affinities, in terms of primary and secondary features, with RG-5. Main contrast is the presence of siderite stainings in altered biotite and relatively sericitised albite.
RG-9	<u>Topaz Granite.</u> Quartz (30%), orthoclase-perthite (35%), sericite-muscovite-stained albite (weakly zoned, An 7, 30%) with disseminated variably muscovitised orange-brown biotite (5%), minor weakly sericitised topaz.	Analogous to RG-5, RG-8.	Traces primary muscovite, zircon, secondary fluorite, oxidised siderite.	Close affinities with RG-5, RG-8, but devoid of primary schorl. Similarly altered (mildly greisenised).
RG-10	<u>Tourmaline Microgranite.</u> Quartz (30%), orthoclase (35%), incipiently sericite-stained plagioclase (weakly zoned, An 10, 25%) with disseminated variously chloritised or tourmalinised biotite, patchy poikilitic schorl.	Feldspar-quartz (-biotite)-porphyritic, medium-grained, granitic to weakly micrographic.	Minor traces zircon, apatite, late-magmatic muscovite, secondary siderite, fluorite, muscovite.	Tourmaline grades from late-magmatic blue-green/mottled green-brown schorl in semi-graphic intergrowths with feldspar to late biotite-replacive orange-brown schorl.
AN-1	<u>"Leucogranite".</u> Quartz (50%), weakly muscovite-stained albite (incipiently zoned, An 2, 20%), muscovite (25%), pale green to pale brown biotite (5%), minor topaz, thinly disseminated cassiterite.	Essentially even-grained granitic. Minor muscovite pseudomorphs after K-feldspar.	Traces oxidised siderite, rare apatite, zircon. Minor sericite as partial replacement of topaz.	Muscovite-rich albitic alkali granitic segregation with characteristic pale ?stanniferous biotite. Minor K-spar component is selectively muscovitised.
AN-2	<u>"Leucogranite".</u> Quartz (40%), weakly muscovitised albite (weakly zoned, An 5, 30%) variably silicified/muscovitised orthoclase (20%), with disseminated muscovite, colour-variable biotite, variably sericitised topaz.	Uneven-grained, granitic. Biotite semi-colour-zoned, pale brown cores, green margins, muscovite selvages.	Traces apatite, rare zircon.	Close affinities with AN-1, similarly altered with orthoclase selectively corroded by late- to early post-magmatic quartz, muscovite.
AN-3	<u>Greisenised Leucogranite.</u> Quartz (45%), weakly muscovitised albite (incipiently zoned, An 5, 30%) and extensively muscovitised orthoclase (20%), with disseminated pale green-brown biotite, minor topaz.	Uneven-grained, granitic.	Minor late-magmatic muscovite, minor trace apatite, rare zircon, very fine acicular wolframite.	Affinities with AN-1, AN-2. In comparison, this rock is relatively deficient in late-magmatic muscovite, but is relatively greisenised.
AN-4	<u>Pegmatite.</u> Orthoclase-perthite with subordinate quartz and weakly antiperthitic albite (An 3) with minor secondary fine-grained muscovite films, impregnations, veinlets.	Variable, coarse-grained, granitic to finer-grained and subgraphic.	Minor traces primary white mica and green schorl.	Strictly a subgraphic granite, but may grade with increasing grain-sizing into a simple pegmatite. Mild greisenising muscovitisation is partly selective (after perthite films).

Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
AN-5	Adamellite. Quartz (40 %), sericite-stained oligoclase (zoned, An 20, 35 %), and weakly perthitic orthoclase (20 %), with relatively conspicuous red-brown Ti-biotite (10 %).	Even-grained, granitic. Incipiently stressed, microfractured.	Relatively conspicuous apatite, zircon, ilmenite inclusions in biotite. Traces chlorite, muscovite after biotite.	Relatively distinctive biotite adamellite (trend granodioritic) with no obvious affinities to the leucogranites.
AN-6	Leucogranite. Quartz (25 %), weakly sericite-stained orthoclase (30 %), incipiently sericitic albite (incipiently zoned, An 5, 35 %), disseminated very pale brown biotite (3 %) and topaz (3 %), muscovite (1 %).	Uneven-grained, granitic, strictly medium-grained (microgranite).	Traces pale green, partly degraded (collophane-pseudomorphed) manganapatite. Rare cassiterite.	Affinities with AN-1, 2, 3, but relatively albite- and muscovite-deficient. Only incipiently altered. Cassiterite is reddish, primary, sized < 20 - 120 μ.
CC-1	Topaz-Mica Microgranite. Quartz (30 %), orthoclase (35 %), incipiently sericitic plagioclase (incipiently zoned, An 10, 30 %), with colour-variable biotite (5 %), thinly disseminated topaz, minor muscovite.	Weakly quartz-porphyritic, medium-grained granitic to micrographic ("granophyric").	Traces zircon, rare apatite. Minor traces chlorite, secondary muscovite (after biotite).	Topaz-mica adamellitic/alkali granitic transitional phase. Biotite exhibits orange titaniferous cores, pale brown margins, trending to green-brown.
CC-2	Topaz Granite. Quartz (30 %), orthoclase-perthite (35 %), albite (incipiently zoned, An 6, 30 %) with disseminated mid- to pale green, locally zoned brown biotite (5 %), thinly disseminated topaz.	Even-grained, granitic, incipiently stressed.	Zircons, rare apatite. Traces secondary sericite, muscovite (after albite, biotite, chlorite, fluorite, oxide).	Incipiently altered alkali granite trending towards a leucogranite. Albite locally mantles, corrodes orthoclase. (disid siderite).
CC-3	Topaz Granite. Quartz (35 %), orthoclase-perthite (30 %), incipiently sericitic albite (incipiently zoned, An 9, 30 %) with disseminated green, locally zoned red-brown biotite (3-5 %), thinly disseminated topaz.	Similar to CC-2, slightly coarser and uneven-grained.	Zircons, rare apatite, primary muscovite. Traces secondary muscovite, siderite (after biotite), sericite (after topaz).	Close affinities with CC-2 and similarly weakly altered.
CC-4	Adamellite. Orthoclase-microperthite (30 %), quartz (30 %) and sericite-stained oligoclase (relatively strongly zoned, An 17, 30 %), with conspicuous weakly chloritised red-brown Ti-biotite.	Relatively coarse, uneven-grained granitic. Mildly stressed. Biotite is variably recrystallized.	Zircon, apatite (inclusions in biotite), minor traces magnetite, ilmenite.	Mildly stressed adamellite with partial recrystallization of biotite consistent with incipient/marginal hornfelsing. Compositional affinities with AN-5.
BT-1	"Quartz-Mica Monzonite". Quartz (30 %), orthoclase (20 %), saussurite-stained andesine (strongly zoned, An 35-40, 30 %) with conspicuous yellow/green-brown biotite (10 %) and green-brown hornblende (10 %).	Variabile. Essentially dioritic with millimetric zones of near-massive quartz. Mildly stressed.	Traces apatite, magnetite. Rare corroded fibrolitic sillimanite (in biotite), hornblende-selvaged staurolite, metapelite.	Distinctly hybrid characteristics. Essentially a monzonite with partly assimilated xenoliths of regional metamorphosed quartzite, aluminous metapelite.
BT-2	Topaz Granite. Quartz (35 %), orthoclase-perthite (30 %), incipiently sericitic albite (incipiently zoned, An 6, 30 %) with disseminated biotite (brown-green to green, minor brown, 3 %), weakly sericitised topaz (1 %).	Uneven-grained, weakly directed, granitic.	Zircon, rare apatite inclusions in biotite. Traces secondary fine-grained muscovite (after albite, biotite).	Close affinities with CC-3, CC-2, and similarly weakly altered.

Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
BT-3	Topaz Granite. Quartz (30 %), orthoclase-perthite (35 %), albite (unzoned, An 7, 30 %) with disseminated colour-variable biotite, variably sericitised topaz. Traces fluorite.	Analogous to BT-2, slightly coarser-grained.	Zircon, rare apatite, garnet. Minor but variable proportions of feldspar-replacive sericite, fine muscovite.	Close affinities with CC-2, CC-3, BT-2. In comparison, this rock is slightly relatively sericitised/muscovitised with orthoclase and perthite lamellae selectively re-
BT-4	Greisen. Quartz and incipiently pale green hydromuscovite in varying proportions with disseminated fluorite-stained white mica pseudomorphs after biotite, thinly disseminated apatite.	Medium-grained granular quartz, intergranular to semi-massive mica. Incipiently banded.	Semi-pervasive limonite stainings (after ?siderite). Minor traces topaz, rare green schorl, chlorite, chalcopyrite.	Pneumatolytic quartz-mica rock, apparently a thoroughly altered granite on the basis of more or less evenly disseminated altered biotite flakes. No detectable cassiterite.
BT-5	Topaz Granite. Quartz (30 %), orthoclase-perthite (35 %), weakly sericite-muscovite-stained albite (unzoned, An 6, 30 %) with disseminated pale green to locally brown biotite (3 %), minor weakly sericitised topaz.	Analogous to BT-2, BT-3.	Thinly disseminated zircons, rare apatite, rare primary muscovite overgrowths on biotite	Close affinities with CC-2, BT-2 etc. and similarly weakly altered.
BT-7	Topaz Granite. Quartz (25 %), orthoclase-perthite (35 %), incipiently sericitic albite (incipiently zoned, An 6, 35 %) with disseminated green biotite (2 %), relatively conspicuous weakly sericitised topaz.	Similar to BT-2 etc., but relatively coarse, uneven-grained.	Trace apatite, rare zircon, minor traces primary (sim. BT-5) and secondary muscovite.	Closely analogous to BT-5 (CC-2 etc.) relatively topaz-rich, coarser-grained. Similarly weakly altered.
BT-8	Adamellite. Quartz (35 %), orthoclase-microperthite (30 %), oligoclase (strongly zoned, An 25, 30 %) with disseminated flakes, loose clusters of dark brown biotite (5 %). Minor sericite (after oligoclase).	Orthoclase-porphyritic, uneven-grained, granitic.	Minor traces zircon, apatite, magnetite; secondary chlorite and rare epidote (after biotite).	Incipiently altered (biotite-) adamellite with affinities to AN-5, CC-4.
BT-9	Adamellite. Quartz (35 %), orthoclase-perthite (30 %), incipiently muscovite-stained oligoclase (incipiently zoned, An 15, 30 %), disseminated flakes, clusters of slightly reddish brown biotite.	Even-grained, incipiently directed, granitic.	Rare zircon, apatite.	Incipiently altered adamellite similar to AN-5 etc. Main contrast is the relatively sodic oligoclase. Only incipiently altered.
BT-10	Adamellite. Quartz (30 %), orthoclase-perthite (30 %), incipiently sericite-muscovite-stained oligoclase (weakly zoned, An 13, 35 %) with disseminated flakes, clusters orange-brown to green-fringed biotite.	Uneven-grained, granitic.	Minor traces zircon, rare apatite, minor traces chlorite (after biotite).	Slightly relatively sodi-potassic (trend granitic) adamellite with slightly paler biotite, locally selvaged with thin marginal zones of green biotite.
BT-11	Porphyritic Microgranite. Quartz (30 %), orthoclase (35 %), incipiently muscovite-stained albite (unzoned, An 5, 30 %) with disseminated flakes dark green vermiculitised biotite, minor primary muscovite.	Quartz-feldspar-porphyritic, medium-grained, granitic, locally weakly micrographic.	Thinly disseminated zircons. Traces biotite-replacive sericite, chlorite.	Incipiently altered quartz-feldspar porphyry. Affinities with e.g. RS-5. Vermiculite represents a weathering induced alteration of biotite.

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Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
BT-12A (T.S. 46062A)	Topaz Granite. Quartz (25 %), orthoclase-microperthite (30 %), incipiently sericitised/muscovitised albite (incipiently zoned, An 7, 40 %), disseminated colour-variable (mid- to pale brown, green) biotite (3 %), minor variably sericitised topaz.	Weakly directed, uneven-grained, granitic (similar to BT-2).	Rare zircon, apatite. Traces biotite-replacive muscovite, chlorite.	Typical mildly altered topaz granite with characteristic colour-variable biotite.
BT-12B (T.S. 46062B)	Topaz-Mica Microgranite. Quartz (25 %), orthoclase (35 %), incipiently sericitic albite (incipiently zoned, An 6, 30 %), disseminated brown to pale brown, locally muscovite-selvedged biotite, minor muscovite, topaz.	Quartz-feldspar-porphyrific, medium-grained, weakly directed, granitic.	Rare zircons. Traces vermiculite (after biotite), biotite-and topaz-replacive sericite.	Incipiently altered (sericitised/muscovitised) topaz microgranite ("quartz-feldspar porphyry").
BT-13	Topaz-Mica Granite. Quartz (30 %), orthoclase-perthite (35 %), weakly muscovite-fluorite-stained albite (unzoned, An 7, 30%), disseminated mid- to pale brown biotite, minor primary muscovite, sericitic topaz.	Coarsely orthoclase-porphyrific, weakly directed, uneven-grained, granitic.	Zircons, rare apatite. Minor traces biotite-replacive white mica, K-feldspar.	Coarsely porphyritic, but texturally similar to BT-2 etc. and compositionally closely analogous to BT-12B. Only incipiently altered.
BT-14	Topaz-Mica Granite. Quartz (25%), orthoclase (30 %), incipiently muscovite-stained albite (unzoned, An 6, 40 %), disseminated pale brown to green biotite, minor primary muscovite, sericitic topaz.	Uneven-grained, incipiently directed, granitic, trend medium-grained.	Rare zircon, extremely rare cassiterite, colourless garnet (inclusions in quartz).	Incipiently muscovitised topaz-mica granite with isolated red cassiterite (to 150 µ) in biotite. Biotite is partly colour-zoned/muscovite-selvedged.
BT-15	Topaz-Mica Adamellite. Quartz (40 %), orthoclase-microperthite (30 %), weakly sericitic oligoclase (weakly zoned, An 25, 25 %), disseminated red-brown Ti-biotite, minor primary muscovite, rare sericitic topaz.	Quartz- and weakly oligoclase-porphyrific, uneven-grained, granitic. Weakly vuggy (quartz, biotite).	Relatively conspicuous zircons. Rare garnet. Trace to minor chlorite (after biotite).	Essentially an orthoclase-biotite adamellite. Quartz phenocrysts are post-magmatic, suggestive of a proximal younger granite.
BT-16	Topaz-Mica Micro-Adamellite. Quartz (30 %), orthoclase-microperthite (35 %), variably muscovite-stained albite (mildly zoned, An 10, 30 %), disseminated, similarly altered red-brown biotite and topaz. Minor green to brown schorl.	Even/medium-grained to weakly feldspar-porphyrific, weakly directed, granitic. Locally incipiently micrographical. Biotite).	Traces primary muscovite, apatite, zircon, secondary chlorite (after micrographical. biotite).	Verges on alkali granitic composition. Biotite is locally colour-zoned to mid-green. Schorl is partly late-magmatic, but grades into a minor dark biotite-replacive type, analogous to muscovite.
BT-17	Adamellite. Quartz (35 %), orthoclase-perthite (30 %), weakly to strongly sericitic oligoclase (strongly zoned, An 29-20, 30 %) with relatively conspicuous mid- to dark brown biotite (5 %), traces cloudy sphene.	Coarse, uneven-grained, weakly orthoclase-porphyrific, granitic.	Traces apatite, rare zircon. Traces secondary chlorite, minor traces epidote, after biotite. Rare clots pumpellyite.	Moderately sericitic/saussuritic chloritic altered biotite adamellite, relatively quite "basic" in comparison to e.g. BT-15 and BT-16.
BT-18	Micro-Adamellite. Quartz (30 %), orthoclase-microperthite (30 %), variably sericitic oligoclase (zoned, An 20, 35 %), disseminated variably chloritised, locally muscovitised orange to red-brown Ti-biotite (5 %).	Weakly feldspar-quartz porphyritic, medium-grained, granitic.	Traces zircon, apatite, rare primary muscovite.	Compositionally "intermediate" (in terms of oligoclase composition) adamellite quartz-feldspar porphyry. Mildly altered.

Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
BT-19	Hybrid Porphyry. Abundant phenocrysts of zoned andesine (An 45-40), hornblende-biotite-selvaged hypersthene, quartz and biotite in a groundmass of orthoclase, minor quartz, oligoclase.	Strongly porphyritic. Quartz phenocrysts corroded, feldspar partly fragmented. Microgranular groundmass.	Thinly disseminated magnetite, zircons, apatite. Minor traces secondary semi-sericitic white mica.	Approximates compositionally to a quartz-hypersthene diorite/trend monzonite. Reflects an unstable cooling history (elevated, chilled) and marked hybrid characteristics.
GP-1	Tourmaline Granite. Quartz (30%), microcline-micropertthite (30%), weakly sericitic albite (unzoned, An 6, 35%), disseminated sericite-chlorite-oxidised siderite-pseudomorphed biotite, minor blue to mottled yellow-brown schorl.	Weakly orthoclase-porphyritic, slightly directed, even-grained granitic, moderately stressed.	Traces zircon, primary muscovite. Minor feldspar-replacive clots secondary muscovite, siderite.	Strictly a tourmaline-mica granite, muscovite-deficient in comparison with the leucogranites. Primary biotite characteristics obscured by alteration.
GP-2	Mica Adamellite. Quartz (30%), orthoclase-micropertthite (35%), weakly sericitic oligoclase (zoned, An 12, 30%), disseminated variably chloritised to locally muscovitised red-brown biotite (3%), minor primary muscovite.	Coarse, uneven-grained, granitic, weakly stressed.	Traces zircon, apatite; minor traces cloudy sphene, epidote in chloritised biotite.	Verges on granitic composition, consistent with the minor primary muscovite.
GP-3	Adamellite. Quartz (30%), microcline-micropertthite (35%), weakly sericitic zoned oligoclase (An 12, 30%), disseminated variably chloritised dark brown biotite. Minor rosettes of secondary muscovite.	Coarse, uneven-grained, granitic, moderately stressed.	Traces zircon, apatite. Traces secondary orthoclase (interleaved with chloritised biotite) and fluorite.	Close affinities with GP-2, texturally and compositionally. Main contrast is the presence of microcline, a reflection of the relatively marked stress effects.
GP-4A (T.S. 46073A)	Adamellite. Quartz (30%), orthoclase-micropertthite (30%), weakly sericitic oligoclase (zoned, An 15, 35%), disseminated brown to colour-zoned green biotite, sporadic films secondary muscovite.	Coarse, weakly orthoclase-porphyritic, uneven-grained, granitic, variably stressed.	Traces apatite, zircon, minor secondary chlorite (after biotite).	Close affinities with GP-2, GP-3, similarly altered. Orthoclase is locally stress-twinned. The green biotite component is relatively dark.
GP-4B (T.S. 46073B)	Adamellite. Quartz (30%), orthoclase-micropertthite (35%), weakly sericitic oligoclase (zoned, An 15, 30%) with disseminated extensively vermiculitised biotite.	Coarse, oligoclase-porphyritic, uneven-grained, granitic, moderately stressed.	Traces zircon, rare apatite. Traces secondary K-feldspar as films in biotite (sim. GP-3).	Very similar to GP-2, GP-3, GP-4A, only mildly altered. Orthoclase exhibits patchy stress-induced twinning.
GP-5	Tourmaline-Garnet Microgranite. Quartz (25%), orthoclase (35%), incipiently sericitic albite (unzoned, An 6, 35%) with disseminated weakly muscovitised dark green-brown biotite, minor blue schorl, sparse garnet.	Even/medium-grained, granitic.	Rare zircon, primary muscovite. Minor clots, discontinuous films, rosettes of secondary muscovite.	Compositionally similar to GP-1, but finer-grained. Biotite is incipiently colour-zoned, rarely muscovite-selvaged. Garnet is a pale pink almandine.
GP-6	Mica Microgranite. Quartz (25%), orthoclase-micropertthite (35%), incipiently sericitic albite (unzoned, An 5, 35%) with disseminated colour-variable (red-brown to green, locally pale green) biotite, minor primary muscovite.	Quartz-feldspar-porphyritic, medium-grained, granitic to incipiently micro-graphic.	Traces zircon, rare apatite. Minor films, impregnations secondary muscovite. Rare muscovitised topaz.	Similarities with GP-5, but distinctly porphyritic, with colour-variable/locally colour-zoned biotite and minor primary muscovite.

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Sample No.	Classification - Composition	Fabric	Accessories	CENTRAL MINERALOGICAL SERVICES Comments
GP-7	Adamellite. Quartz (35 %), orthoclase-perthite (30 %), variably sericite-stained oligoclase (zoned, An 16, 30 %) with disseminated, partly vermiculitised dark brown biotite with rare garnet inclusions.	Coarse, uneven-grained, granitic. Incipiently stressed.	Traces zircon, rare apatite. Minor traces of secondary K-feldspar as films in biotite.	Close affinities with GP-4B (etc.), similarly incipiently altered.
MTP-1	Topaz-Mica Granite. Quartz (30 %), orthoclase-perthite (35 %), incipiently sericitic albite (zoned, An 6, 30 %), disseminated red-brown to green/pale green biotite, minor primary muscovite.	Coarse, uneven-grained, granitic, essentially unstressed.	Traces zircon, rare topaz, apatite, garnet (inclusions in biotite). Minor clots, films of secondary hydromuscovite.	Affinities with GP-6, particularly in respect of the distinctly colour-variable, partly colour-zoned biotite.
MTP-2	Topaz-Mica Microgranite. Quartz (30 %), orthoclase-perthite (35 %), weakly sericitic albite (incipiently zoned, An 7, 35 %), variably chloritised orange-brown to locally green biotite, minor topaz, primary muscovite.	Coarsely orthoclase (-quartz-albite)-porphyritic, medium-grained, granitic. Unstressed.	Traces zircon, apatite, magnetite. Traces secondary muscovite.	Quartz-feldspar porphyry, compositionally closely analogous to MTP-1. Colour variations in biotite partly obscured by relatively marked chloritisation.
MTP-3	Topaz-Mica Microgranite. Quartz (25 %), orthoclase-microperthite (35 %), weakly muscovite-stained albite (incipiently zoned, An 6, 35 %), disseminated chloritised biotite (3 %), flakes, films primary muscovite, sericitised topaz.	Quartz-feldspar-porphyritic, medium-grained, granitic, weakly cognate-xenoblastic, lithic.	Traces zircon, rare apatite. Rare relics of mid-brown/orange-brown biotite.	Close affinities with MTP-2, main contrast is relatively marked chloritisation of biotite. Late magmatic muscovite partly as subgraphic films in feldspar.
MTP-4	Mica Granite. Quartz (30 %), orthoclase-perthite (30 %), weakly sericite-muscovite-stained albite (incipiently zoned, An 5, 35 %) with disseminated primary muscovite (3 %), muscovitised biotite (2 %).	Even-grained, incipiently directed, granitic.	Disseminated zircons, traces secondary fluorite.	Relatively white-micaceous granite/trend leucogranite. Late magmatic muscovite is relatively pink in contrast to pale green biotite-pseudomorphous hydromuscovite.
MTP-5 (T.S. 46081)	Topaz-Mica Granite. Quartz (35 %), orthoclase-perthite (30 %), weakly sericitic albite (unzoned, An 4, 30 %) with disseminated mildly sericitised pale green-brown biotite, relatively sericitised muscovite, partly sericitised topaz.	Relatively coarse, uneven-grained, weakly directed, granitic.	Disseminated zircons, relatively conspicuous apatite, traces secondary fluorite.	Similarities with MTP-4, similarly transitional between micaceous alkali granite and leucogranite. Primary muscovite is relatively altered.

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Central Mineralogical Services

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39 Beulah Road  
Norwood, S.A. 5067  
Telephone 42 5659

Dr. L. de Graaf  
Supervising Geologist - Research  
The Shell Co. of Aust. Ltd.  
Metals Division  
G.P.O. Box 872K  
MELBOURNE / VIC. 3001

12th July, 1983

Dear Burtos,

Attached as requested the 35 mm transparencies of your recent suite of granites, together with explanatory notes and additional notes on determination of the total magnification of projected images. All magnifications quoted refer to the actual magnification on the transparency.

Regards,



D. Cowan, B. Sc.

SET 2 (Labelled with respective Sample Numbers)

Low magnification general views of thin-sections.

Samples RS-5, 6, 7, 8, 9; RG-2, 3, 5; AN-1; GP-1, 2, 4A, 5, 6; MTP-2, 5.

All photographs taken with partly crossed Nicols at the same magnification (4x).

SET 3

Semi-macro photographs of hand specimens. Labelled with respective sample numbers.  
The scale is centimetric.

D. Cowan, B. Sc.

REPORT CMS 83/5/41PhotomicrographsSET 1 (Numbered 1 to 14 inclusive)

1. Sample CC-1 PPL 15x  
Brown, colour-zoned biotite.
2. Sample GP-4A PPL 15x  
Dark brown to green, colour-zoned biotite.
3. Sample MTP-4 PPL 15x  
Late-magmatic (or primary) pale pink muscovite with pleochroic haloes around included zircons.
4. Sample MTP-4 PPL 15x  
Muscovitised biotite with traces secondary fluorite (dark) penetrating cleavage planes.
5. Sample MTP-5 PPL 15x  
Selectively "sericitised" primary muscovite intergrown with unaltered pale biotite.
6. Sample RS-4 PPL 60x  
Colour-zoned, brown-green to green biotite with overgrowth of primary muscovite.
7. Sample RS-10 PPL 15x  
Colour-zoned, brown to green biotite with overgrowth of primary muscovite.
8. Sample GP-1 PPL 15x  
Primary blue/mottled brown tourmaline.
9. Sample RG-10 PPL 15x  
Secondary biotite-pseudomorphous schorl.
10. Sample BT-8 PPL 15x  
Dark brown biotite.
11. Sample CC-3 PPL 15x  
Colour-variable/zoned biotite with interspersed weakly sericitised primary topaz.
12. Sample BT-7 PPL 15x  
Pale biotite and primary topaz.
13. Sample BT-7 X Nicols 15x  
Secondary muscovite films in topaz.
14. Sample RS-3 PPL 60x  
Colour-variable cassiterite with interspersed siderite (cloudy, medium relief) in siliceous greisen.

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APPENDIX II

Appendix II:

- (a) Results of rock analyses, NE Tasmania
- (b) Averages according to rock type
- (c) Correlation coefficients

COMPUTER CODING OF N.E. TASMANIA GRANITE SAMPLESColumn 1 = Regional Classifier

R = Rossarden/Royal George  
A = Anchor  
K = Cream Creek  
C = Mt. Cameron  
H = Little Mt. Honor  
L = Lode  
P = Mt. Paris  
G = Georges River.

Column 2 = Texture

1 = porphyritic  
2 = aplitic/porphyritic  
3 = Coarse equigranular  
4 = Coarse inequigranular  
5 = Medium to coarse grained  
6 = Medium to fine grained  
7 = micro grained/aplitic  
8 = Pegmatite  
0 = Lode

Column 3 = Mineralogy (field classification)

1 = Hornblende/Biotite  
2 = Biotite < 5%  
3 = Biotite > 5%  
4 = Biotite/Muscovite  
5 = Sericitized Biotite/Muscovite  
6 = Biotite/Muscovite/Tourmaline  
7 = Tourmaline/Muscovite  
8 = Muscovite/sericite  
9 = Greisenised  
0 = Lode

Column 4 = Classification CMS Adelaide

A = Adamellite  
D = Granodiorite  
E = Lode  
G = Alkali Granite  
P = Pegmatite  
S = Greisen

SHELL METALS AUSTRALIA  
 SHLMET FILE PRINT PROGRAM  
 BLUE TIER GRANITES

REC #	STATION NUMBER	STATION NAME	SI02	AL203	TIO2	FE203	MGO	CAO	NA2O	K2O	MNO	P2O5	LOI	BA
1R156	00	RR	73.70	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
2R28A	0000	RR	77.40	1.10	0.05	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
3L0DE	0000	RR	77.60	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
4R42G	0000	RR	77.10	1.10	0.12	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
5R12G	0000	RR	77.60	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
6R27C	0000	RR	75.30	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
7R57A	0000	RR	75.00	1.10	0.02	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
8R56A	0000	RR	74.80	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
9R12A	0000	RR	75.40	1.10	0.08	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
10R42A	0000	RR	78.40	1.10	0.11	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
11R29S	0000	RR	77.90	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
12R17S	0000	RR	78.70	1.10	0.07	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
13R17A	0000	RR	76.90	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
14R12G	0000	RR	76.70	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
15R45G	0000	RR	76.00	1.10	0.07	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
16L0DE	0000	RR	73.70	1.10	0.00	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
17L0DE	0000	RR	76.00	1.10	0.06	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
18R42G	0000	RR	75.20	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
19R42G	0000	RR	75.10	1.10	0.07	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
20R16G	0000	RR	75.30	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
21A65G	0000	AN	76.00	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
22A65G	0000	AN	68.90	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
23A65G	0000	AN	74.40	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
24A8DP	0000	AN	76.80	1.10	0.03	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
25A12A	0000	AN	72.20	1.10	0.24	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
26A68G	0000	AN	74.70	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
27K12G	0000	CC	76.30	1.10	0.05	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
28K62G	0000	CC	76.30	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
29K62G	0000	CC	75.90	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
30K43A	0000	CC	73.00	1.10	0.27	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
31A51D	0000	BT	64.70	1.10	0.58	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
32A52G	0000	BT	76.80	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
33K34G	0000	BT	76.40	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
34K55S	0000	BT	77.60	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
35K52G	0000	BT	74.90	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
36K52G	0000	BT	76.40	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
37C13A	0000	BT	72.20	1.10	0.34	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
38C52A	0000	BT	77.90	1.10	0.08	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
39C73A	0000	BT	79.10	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
40C13G	0000	BT	76.60	1.10	0.02	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
41C52G	0000	BT	76.20	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
42C13G	0000	BT	76.60	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
43C42G	0000	BT	76.30	1.10	0.05	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
44C62G	0000	BT	77.30	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
45C12A	0000	BT	76.30	1.10	0.12	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
46H63A	0000	BT	74.30	1.10	0.11	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
47H13A	0000	BT	71.30	1.10	0.15	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
48H12A	0000	BT	74.20	1.10	0.18	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
49G51D	0000	BT	68.10	1.10	0.61	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
50G36G	0000	GP	76.30	1.10	0.01	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
51G52A	0000	GP	76.00	1.10	0.07	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
52G52A	0000	GP	76.20	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
53G52A	0000	GP	75.90	1.10	0.13	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
54G52A	0000	GP	77.00	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
55G52G	0000	GP	77.10	1.10	0.11	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
56G52G	0000	GP	77.00	1.10	0.02	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
57G52A	0000	GP	76.30	1.10	0.05	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
58G54G	0000	GP	77.00	1.10	0.05	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
59P13G	0000	MTP	77.30	1.10	0.09	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
60P14G	0000	MTP	76.60	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
61P64G	0000	MTP	76.20	1.10	0.04	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00
62P54G	0000	MTP	76.00	1.10	0.02	1.51	0.01	0.00	0.62	0.00	0.00	0.00	1.10	11.00

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SHELL METALS AUSTRALIA  
 SHLMET FILE PRINT PROGRAM

BLUE TIER GRANITES

REC #	STATION NUMBER	STATION NAME	FZ	GA	LI	NO	NB	RB	SN	SR	U	W	Y	ZR
1R15G	0	RS/1	0.31	22	70	30	24	590	18	28	22	10	80	155
2R28A	0	RS/3	0.10	00	140	18	30	670	22	7	00	15	75	120
3L0DE	0	RS/4	0.35	22	240	30	40	660	71	20	24	30	100	155
4R42G	0	RS/4	0.37	22	65	18	24	560	16	28	28	30	115	150
5R12G	0	RS/5	0.16	22	160	28	26	560	18	14	16	3	65	160
6R27G	0	RS/6	0.26	22	170	16	34	740	44	22	20	15	3	18
7R57A	0	RS/7	0.23	22	200	20	38	650	48	20	10	20	14	15
8R56A	0	RS/8	0.32	22	150	16	30	650	42	20	20	20	14	15
9R12A	0	RS/9	0.47	22	130	32	30	560	16	20	20	20	175	130
10R42A	0	RS/10	0.32	22	85	14	39	520	8	20	20	15	125	155
11R29S	0	RG/1	0.90	22	90	26	35	360	67	20	20	25	14	100
12R17S	0	RG/2	0.44	22	200	18	20	740	28	20	20	20	15	55
13R17A	0	RG/3	0.43	22	150	24	22	670	28	20	20	20	30	55
14R12G	0	RG/4	0.45	22	160	18	25	730	80	20	20	20	44	44
15R45G	0	RG/5	0.36	22	175	38	22	630	50	20	48	30	30	70
16L0DE	0	RG/6	0.70	22	100	26	34	190	73	30	30	20	20	75
17L0DE	0	RG/7	0.20	22	210	26	110	570	41	20	1	19	10	65
18R42G	0	RG/8	0.60	22	180	18	22	650	18	20	20	5	25	75
19R42G	0	RG/9	0.59	22	230	34	24	640	20	20	24	9	25	80
20R16G	0	RG/10	0.37	22	170	10	20	550	16	20	20	20	35	85
21A65G	0	AN/1	0.75	22	46	35	50	1250	33	20	22	33	1	18
22A65G	0	AN/2	0.00	22	60	38	70	1700	64	20	22	33	1	18
23A65S	0	AN/3	0.15	22	44	32	46	1350	90	20	26	20	1	20
24ABDP	0	AN/4	0.06	22	18	16	18	160	20	20	22	10	1	16
25A12A	0	AN/5	0.08	22	16	18	16	380	35	20	26	15	20	125
26A68G	0	AN/6	0.89	22	500	14	70	1250	50	20	20	40	1	26
27K12G	0	CC/1	0.38	22	244	18	18	650	20	20	16	15	44	70
28K62G	0	CC/2	0.50	22	170	18	16	600	18	20	30	15	28	44
29K62G	0	CC/3	0.46	22	170	24	16	590	10	20	18	10	32	46
30K43A	0	CC/4	0.09	22	80	16	16	310	10	20	8	5	100	100
31A51D	0	BT/1	0.08	22	60	12	14	190	2	37	2	15	22	145
32A52G	0	BT/2	0.49	22	180	16	22	680	12	20	18	15	24	40
33K54G	0	BT/3	0.59	22	160	20	22	730	12	20	12	10	22	34
34K55S	0	BT/4	0.66	22	80	22	22	670	140	20	16	20	14	28
35K52G	0	BT/5	0.57	22	270	24	22	670	22	20	6	5	12	36
36K52G	0	BT/6	0.52	22	180	14	18	710	20	20	8	15	18	40
37C13A	0	BT/7	0.08	22	80	22	14	250	10	14	4	10	24	130
38C52A	0	BT/8	0.07	22	75	18	20	500	14	20	22	10	90	85
39C73A	0	BT/9	0.10	22	125	10	24	470	14	20	10	5	115	105
40C12G	0	BT/10	0.04	22	40	14	22	600	10	20	14	25	55	55
41C32G	0	BT/11	0.21	22	145	16	22	680	22	20	6	10	55	40
42C12G	0	BT/12	0.26	22	160	14	22	650	22	20	6	5	80	65
43C42G	0	BT/13	0.17	22	70	14	22	670	22	20	10	10	75	75
44C62G	0	BT/14	0.13	22	200	10	20	990	55	20	14	195	70	100
45C12A	0	BT/15	0.05	22	55	16	16	400	16	20	4	10	12	155
46H63A	0	BT/16	0.08	22	80	16	16	300	16	20	4	5	155	155
47H13A	0	BT/17	0.03	22	60	16	16	320	16	20	4	10	155	155
48H12A	0	BT/18	0.03	22	60	16	16	320	16	20	4	10	155	155
49G51D	0	BT/19	0.06	22	40	14	14	145	16	20	4	10	100	100
50G56G	0	GP/1	0.11	22	24	20	20	330	18	20	10	10	170	155
51G52A	0	GP/2	0.06	22	60	16	16	350	18	20	10	10	170	155
52G52A	0	GP/3	0.07	22	38	4	4	350	18	20	10	10	170	155
53G52A	0	GP/4	0.11	22	60	16	16	330	16	20	10	10	170	155
54G42A	0	GP/5	0.02	22	45	14	14	320	10	20	8	10	170	155
55G26G	0	GP/6	0.04	22	24	18	18	430	14	20	14	15	100	105
56G22G	0	GP/7	0.05	22	60	14	14	380	14	20	14	15	100	105
57G52A	0	GP/8	0.03	22	36	2	2	360	4	20	4	15	100	105
58P54G	0	MTF/1	0.30	22	135	4	4	480	10	20	4	10	100	105
59P13G	0	MTF/2	0.24	22	105	4	4	400	18	20	6	10	100	105
60P14G	0	MTF/3	0.37	22	100	4	4	480	18	20	6	10	100	105
61P64G	0	MTF/4	0.44	22	170	4	4	480	22	20	40	15	100	105
62P54G	0	MTF/5	0.56	22	250	4	4	620	22	20	40	15	100	105

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SHELL METALS AUSTRALIA  
 SHLMET FILE PRINT PROGRAM  
 BLUE TIER GRANITES

REC #	STATION NUMBER	STATION NAME	EU308	BA/RB	RB/SR	SNFORM1	SNFORM2	SNFORM3	T1/10	ALINDEX	RB/3
1	0	RS/ 1	40.00	0.19	21.07	0.33	1.74	0.00	53.95	1.08	196.67
2	0	RS/ 2	22.00	0.12	95.71	0.00	4.81	0.01	29.97	1.36	223.33
3	0	RS/ 3	42.00	0.01	47.14	0.00	46.87	0.06	53.95	1.86	220.00
4	0	RS/ 4	55.00	0.13	20.00	0.00	0.33	0.00	71.94	1.16	186.67
5	0	RS/ 5	42.00	0.06	47.14	0.00	7.46	0.00	53.95	1.23	220.00
6	0	RS/ 6	10.00	0.03	61.67	1.99	58.80	6.67	5.99	1.42	246.67
7	0	RS/ 7	10.00	0.12	25.00	1.43	11.59	0.37	11.99	1.49	216.67
8	0	RS/ 8	24.00	0.18	25.00	0.85	4.78	0.03	23.98	1.42	216.67
9	0	RS/ 9	70.00	0.13	27.50	0.00	0.11	0.00	47.96	1.18	220.00
10	0	RS/ 10	65.00	0.10	20.00	0.00	3.71	0.00	65.94	1.10	173.33
11	0	RG/ 1	24.00	0.07	20.00	0.00	8.47	0.03	23.98	5.63	120.00
12	0	RG/ 2	10.00	0.08	61.67	3.92	48.35	0.09	41.96	1.71	246.67
13	0	RG/ 3	24.00	0.07	25.77	0.99	14.81	0.06	23.98	1.33	223.33
14	0	RG/ 4	24.00	0.06	22.81	0.25	4.07	0.03	23.98	1.43	243.33
15	0	RG/ 5	60.00	0.13	22.50	0.33	2.42	0.01	41.96	1.34	210.00
16	0	RG/ 6	40.00	0.13	5.94	0.02	0.18	0.00	41.96	9.78	63.33
17	0	RG/ 7	28.00	0.04	47.50	0.31	8.81	0.11	35.97	2.82	190.00
18	0	RG/ 8	42.00	0.13	18.06	0.83	6.33	0.01	53.95	1.35	216.67
19	0	RG/ 9	44.00	0.12	26.67	0.80	6.83	0.01	41.96	1.30	213.33
20	0	RG/ 10	44.00	0.09	27.50	0.20	2.17	0.00	53.95	1.25	183.33
21	0	AN/ 1	22.00	0.00	104.17	44.31	11076.46	2336.84	5.99	1.87	416.67
22	0	AN/ 2	28.00	0.00	141.67	92.99	31481.42	12252.98	5.99	2.08	566.67
23	0	AN/ 3	42.00	0.00	112.50	39.64	10701.46	1805.48	5.99	1.52	450.00
24	0	AN/ 4	10.00	0.10	12.78	0.01	0.14	0.00	17.98	1.21	153.33
25	0	AN/ 5	10.00	0.97	4.22	0.00	0.00	0.00	143.88	1.44	126.67
26	0	AN/ 6	10.00	0.00	104.17	8.39	2097.23	414.41	5.99	1.39	416.67
27	0	AN/ 7	24.00	0.04	54.17	0.32	8.22	0.02	29.97	1.19	216.67
28	0	CC/ 1	38.00	0.01	200.00	0.92	110.87	2.15	5.99	1.25	200.00
29	0	CC/ 2	40.00	0.01	118.00	5.03	593.46	9.64	5.99	1.23	176.67
30	0	CC/ 3	10.00	0.90	2.82	0.00	0.00	0.00	161.86	1.06	103.33
31	0	CC/ 4	10.00	0.00	0.51	0.00	0.00	0.00	347.71	0.90	63.33
32	0	BT/ 1	42.00	0.01	136.00	7.72	475.95	13.10	5.99	1.23	226.67
33	0	BT/ 2	10.00	0.02	104.29	2.64	128.69	4.44	5.99	1.46	243.33
34	0	BT/ 3	20.00	0.01	217.00	8.76	508.28	23.98	5.99	2.12	290.00
35	0	BT/ 4	10.00	0.01	145.00	14.32	2491.93	81.29	5.99	1.39	290.00
36	0	BT/ 5	10.00	0.01	555.00	19.91	2827.90	59.44	5.99	1.35	236.67
37	0	BT/ 6	10.00	0.20	1.72	0.00	0.00	0.00	203.83	1.32	83.33
38	0	BT/ 7	20.00	0.10	2.73	0.09	0.93	0.00	47.96	1.14	166.67
39	0	BT/ 8	20.00	0.10	3.50	0.00	0.00	0.00	53.95	1.14	156.67
40	0	BT/ 9	34.00	0.05	30.33	0.04	3.79	0.01	11.99	1.14	200.00
41	0	BT/ 10	24.00	0.01	113.33	0.00	0.79	0.00	15.91	1.21	226.67
42	0	BT/ 11	10.00	0.06	54.17	0.14	38.09	0.15	23.98	1.29	216.67
43	0	BT/ 12	10.00	0.07	37.23	0.23	38.38	0.01	29.97	1.20	223.33
44	0	BT/ 13	28.00	0.01	495.00	30.00	9704.87	184.10	5.99	1.22	300.00
45	0	BT/ 14	10.00	0.29	13.33	0.00	0.05	0.00	71.94	1.13	133.33
46	0	BT/ 15	10.00	0.80	4.00	0.00	0.00	0.00	65.94	1.23	100.00
47	0	BT/ 16	10.00	1.78	1.64	0.00	0.00	0.00	267.77	1.07	76.67
48	0	BT/ 17	10.00	1.00	3.56	0.00	0.00	0.00	107.71	1.25	106.67
49	0	BT/ 18	10.00	3.59	0.00	0.00	0.00	0.00	365.69	0.94	48.33
50	0	GP/ 1	20.00	0.02	33.13	0.04	2.30	0.04	5.99	1.35	176.67
51	0	GP/ 2	20.00	0.34	7.00	0.01	0.02	0.00	41.96	1.08	116.67
52	0	GP/ 3	10.00	0.30	6.36	0.00	0.01	0.00	23.98	1.09	116.67
53	0	GP/ 4A	24.00	0.55	4.40	0.00	0.01	0.00	77.93	1.04	110.00
54	0	GP/ 4B	20.00	0.48	4.57	0.00	0.00	0.00	65.94	1.19	106.67
55	0	GP/ 5	36.00	0.01	47.78	0.00	17.28	0.05	11.99	1.17	143.33
56	0	GP/ 6	22.00	0.20	11.18	0.00	0.27	0.00	35.97	1.13	126.67
57	0	GP/ 7	10.00	0.28	7.50	0.01	0.02	0.00	29.97	1.17	120.00
58	0	MTP/ 1	22.00	0.05	40.00	0.21	4.10	0.01	29.97	1.14	160.00
59	0	MTP/ 2	30.00	0.35	11.76	0.01	0.04	0.00	53.95	1.16	133.33
60	0	MTP/ 3	30.00	0.07	30.00	0.08	1.15	0.00	23.98	1.20	160.00
61	0	MTP/ 4	40.00	0.04	34.00	0.54	12.23	0.05	23.98	1.27	226.67
62	0	MTP/ 5	26.00	0.02	68.33	0.02	246.69	4.02	11.99	1.26	273.33

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SHELL METALS AUSTRALIA

PAGE NO.

	R..G 9 MEAN	R..A 6 MEAN	R..B 2 MEAN	A..G 4 MEAN	A..A 1 MEAN	A..S 1 MEAN	G..G 3 MEAN	G..A 3 MEAN	C..G 5 MEAN	C..A 4 MEAN	K..G 6 MEAN	K..A 1 MEAN	K..S 1 MEAN	H..A 3 MEAN	P..G 5 MEAN
SiO2	75.78	76.25	78.10	74.10	72.20	74.40	76.53	76.28	76.58	76.32	76.03	73.00	77.60	73.27	76.42
AL2O3	12.71	13.00	12.90	14.50	14.20	14.40	12.60	12.52	12.86	12.27	13.32	13.50	10.90	13.90	12.74
TiO2	0.07	0.06	0.05	0.01	0.24	0.01	0.03	0.08	0.03	0.16	0.02	0.27	0.01	0.23	0.05
FE2O3	1.43	1.21	2.26	1.83	1.91	2.10	1.40	1.52	1.12	1.80	1.34	2.05	4.70	2.19	1.53
MGO	0.03	0.03	0.01	0.02	0.35	0.01	0.02	0.10	0.04	0.18	0.04	0.34	0.01	0.39	0.06
CAO	0.38	0.34	0.04	0.40	0.48	0.34	0.49	0.76	0.23	0.70	0.31	1.29	0.76	1.10	0.44
NA2O	2.31	2.37	0.97	2.69	1.96	2.90	2.90	2.86	3.11	2.74	2.82	3.19	0.01	2.83	2.71
K2O	5.03	4.99	3.42	3.64	5.35	3.75	4.87	4.80	4.71	4.45	4.72	4.85	3.45	4.83	4.91
MNO	0.03	0.02	0.05	0.07	0.03	0.07	0.04	0.03	0.04	0.03	0.04	0.05	0.16	0.04	0.03
P2O5	0.11	0.06	0.06	0.23	0.09	0.27	0.02	0.02	0.02	0.06	0.08	0.14	0.09	0.14	0.09
LDI	0.91	0.98	1.70	1.27	2.80	1.20	0.67	0.68	0.72	0.77	0.72	0.80	2.40	0.93	0.78
TOTAL	98.80	99.32	99.18	98.77	99.61	99.45	99.56	99.65	99.45	99.50	99.44	99.64	100.09	99.90	99.75

466118

	R..G 9 MEAN	R..A 6 MEAN	R..S 2 MEAN	A..G 4 MEAN	A..A 1 MEAN	A..S 1 MEAN	G..G 3 MEAN	G..A 5 MEAN	C..G 5 MEAN	C..A 4 MEAN	K..G 6 MEAN	K..A 1 MEAN	K..S 1 MEAN	H..A 3 MEAN	P..G 5 MEAN
BA	65.00	75.83	42.50	6.00	370.00	5.00	30.00	132.00	26.00	127.50	10.00	280.00	15.00	323.33	50.00
FA	0.00	0.31	1.67	1.00	0.08	0.00	0.07	0.06	0.16	0.10	0.50	0.09	0.66	0.03	0.00
LI	152.00	133.00	18.00	45.00	16.00	1.13	17.33	14.80	26.80	20.30	29.67	14.00	36.00	14.00	133.20
MD	224.33	199.17	145.00	477.00	119.00	490.00	36.00	47.80	139.00	87.30	198.33	80.00	80.00	65.00	132.00
NB	224.33	20.67	22.00	23.70	18.00	32.00	7.33	6.80	18.00	18.30	19.67	16.00	12.00	13.33	4.00
RB	638.89	639.67	358.00	1233.00	380.00	1350.00	446.67	342.00	23.60	18.30	18.67	16.00	16.67	16.67	18.40
SN	33.11	27.33	3490.00	440.00	39.00	90.00	14.67	11.60	27.00	405.00	691.67	310.00	870.00	283.33	372.00
SR	224.67	227.33	19.00	10.00	90.00	12.00	19.67	59.60	11.60	54.20	3.83	110.00	1400.00	16.67	18.80
U	22.11	16.33	17.00	17.00	16.00	26.00	10.00	8.80	10.00	4.30	14.33	8.00	16.00	2.67	16.40
W	44.33	72.90	22.90	36.20	13.00	20.00	11.67	9.00	49.00	8.73	11.67	29.00	20.00	6.67	12.00
Y	44.33	17.90	19.00	36.20	13.00	20.00	11.67	9.00	49.00	8.73	11.67	29.00	20.00	6.67	12.00
ZR	93.00	89.00	60.00	23.90	123.00	20.00	67.67	91.00	61.00	103.00	43.00	100.00	118.33	37.20	36.20
EU308	40.11	36.17	17.00	23.90	10.00	42.00	26.00	16.80	20.80	21.50	22.00	100.00	10.00	10.00	9.60
BA/RB	0.10	0.12	0.08	0.01	0.97	0.00	0.08	0.39	0.04	0.42	0.01	0.90	0.02	1.19	0.11
RB/RB	29.71	36.90	40.83	121.90	4.22	112.90	30.69	5.97	145.94	15.32	162.74	2.82	21.50	3.07	36.82
SNFORM1	0.58	0.72	2.23	38.07	0.00	39.44	0.10	0.00	11.43	0.12	7.19	0.00	8.76	0.00	1.37
SNFORM2	10.02	6.76	28.41	1282.76	0.00	10701.46	6.62	0.01	2113.12	1.19	1026.84	0.00	308.28	0.00	52.84
SNFORM3	0.75	0.08	0.06	3760.33	0.00	1806.48	0.03	0.00	40.04	0.00	26.16	0.00	23.98	0.00	0.82
TI/10	44.63	33.97	32.97	5.99	143.88	5.99	17.98	47.96	13.59	94.42	9.99	161.86	147.88	28.78	28.78
ALINDEX	1.28	1.32	3.67	1.64	1.44	1.32	1.13	1.11	1.21	1.16	1.29	1.06	2.12	1.17	1.21
RB/3	212.96	212.22	183.33	406.67	126.67	450.00	148.89	114.00	239.33	135.00	230.56	103.33	290.00	94.44	190.67
TOTAL	1512.20	1520.33	4731.27	20007.25	1513.26	15296.74	978.61	1012.10	3761.06	1192.99	2594.13	1255.07	3594.32	1240.81	1336.79

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466119

	R. 2. 7 MEAN	R. 5. 2 MEAN	R. 6. 2 MEAN	R. 7. 4 MEAN	R. 8. 1 MEAN	R. 9. 1 MEAN	A. 1. 1 MEAN	A. 2. 2 MEAN	A. 5. 3 MEAN	A. 8. 1 MEAN	G. 1. 1 MEAN	G. 2. 6 MEAN	G. 6. 2 MEAN	C. 2. 7 MEAN	C. 3. 2 MEAN
SiO2	76.50	74.85	75.05	76.37	77.40	77.50	64.70	74.50	73.10	74.70	68.10	76.27	76.70	76.70	73.65
AL2O3	12.23	12.55	13.35	13.55	12.80	13.80	14.60	13.50	14.97	14.70	14.20	12.52	12.65	12.67	12.35
TiO2	0.09	0.08	0.06	0.03	0.05	0.04	0.58	0.12	0.01	0.01	0.61	0.08	0.01	0.05	0.21
FE2O3	1.54	1.29	1.54	1.24	0.60	2.70	5.40	1.50	2.57	0.62	4.75	1.56	1.21	1.24	2.05
MGO	0.04	0.02	0.03	0.01	0.06	0.01	2.65	0.18	0.01	0.05	1.62	0.09	0.02	0.04	0.30
CaO	0.48	0.42	0.36	0.13	0.09	0.03	4.65	0.43	0.38	0.43	3.90	0.75	0.39	0.29	0.95
NA2O	2.06	2.47	2.40	2.44	2.20	0.01	2.35	2.38	2.32	3.90	2.85	2.83	3.00	3.02	2.67
K2O	5.14	5.20	5.00	4.57	5.20	2.20	3.60	5.05	3.48	3.10	3.15	4.81	4.87	4.77	3.97
MNO	0.03	0.02	0.03	0.04	0.01	0.04	0.10	0.03	0.09	0.04	0.08	0.03	0.03	0.03	0.04
P2O5	0.08	0.10	0.10	0.11	0.01	0.07	0.22	0.09	0.24	0.38	0.15	0.01	0.03	0.03	0.06
LOI	0.97	0.95	0.90	0.90	1.40	2.00	0.90	1.70	1.63	0.80	0.30	0.65	0.75	0.74	0.75
TOTAL	99.14	97.97	98.84	99.40	99.82	98.40	99.75	99.49	98.81	98.74	99.71	99.60	99.69	99.60	99.03

SHELL METALS AUSTRALIA

PAGE NO.

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	K. 2. 5 MEAN	K. 3. 1 MEAN	K. 4. 1 MEAN	K. 5. 1 MEAN	H. 2. 1 MEAN	H. 3. 2 MEAN	P. 3. 1 MEAN	P. 4. 4 MEAN
SI02	75.96	73.00	76.40	77.60	74.20	72.80	76.30	76.45
AL203	13.32	13.50	13.30	10.90	13.80	13.95	12.60	12.77
TI02	0.02	0.27	0.01	0.01	0.18	0.28	0.09	0.04
FE203	1.36	2.05	1.21	4.70	1.76	2.40	1.80	1.46
MgO	0.05	0.54	0.02	0.01	0.23	0.47	0.13	0.04
CaO	0.31	1.29	0.32	0.76	0.64	1.33	0.62	0.39
NA2O	2.96	3.15	2.15	0.01	2.80	2.85	2.45	2.77
K2O	4.75	4.85	4.60	3.45	5.15	4.70	5.30	4.81
MNO	0.04	0.05	0.04	0.16	0.04	0.04	0.03	0.03
P2O5	0.08	0.14	0.08	0.09	0.07	0.17	0.07	0.09
LOI	0.64	0.80	1.10	2.40	1.10	0.85	0.60	0.82
TOTAL	99.48	99.64	99.23	100.09	99.97	99.86	99.99	99.69

466121

	R. 2. 7 MEAN	R. 5. 2 MEAN	R. 6. 2 MEAN	R. 7. 4 MEAN	R. 8. 1 MEAN	R. 9. 1 MEAN	A. 1. 1 MEAN	A. 2. 2 MEAN	A. 5. 3 MEAN	A. 8. 1 MEAN	G. 1. 1 MEAN	G. 2. 6 MEAN	G. 6. 2 MEAN	C. 2. 7 MEAN	C. 3. 2 MEAN
BA	64.29	97.50	82.50	52.50	80.00	23.00	570.00	190.00	5.00	5.00	520.00	122.50	7.50	42.14	172.50
FX	0.42	0.33	0.34	0.34	0.10	12.90	0.08	0.28	1.30	0.89	0.06	0.06	0.07	0.13	0.09
QA	24.00	26.00	25.00	27.50	26.00	12.00	16.00	23.00	50.00	44.00	20.00	15.00	18.00	25.14	20.00
LI	144.29	122.50	210.00	180.00	140.00	90.00	60.00	147.50	373.33	500.00	40.00	49.83	24.00	120.00	102.50
MO	23.14	34.00	13.00	19.50	18.00	26.00	12.00	17.00	35.00	14.00	14.00	6.33	9.00	18.86	16.00
NB	23.71	23.00	23.00	28.50	30.00	36.00	14.00	19.00	53.33	70.00	14.00	14.33	19.00	22.00	19.00
NR	631.43	610.00	600.00	700.00	670.00	360.00	190.00	530.00	1433.33	1250.00	145.00	348.33	480.00	641.43	360.00
SN	23.14	34.00	29.00	100.00	22.00	6700.00	2.00	33.50	3263.33	50.00	6.00	11.67	16.00	22.14	12.00
SR	26.29	29.00	23.00	19.00	7.00	18.00	370.00	47.50	12.00	12.00	260.00	55.33	12.50	15.71	82.50
U	23.43	35.00	13.00	6.50	16.00	20.00	2.00	12.00	18.67	20.00	4.00	8.33	12.00	7.71	7.00
W	26.43	20.00	20.00	18.75	15.00	23.00	19.00	15.00	36.67	40.00	10.00	10.00	10.00	37.86	7.50
Y	78.57	59.00	26.00	15.75	75.00	14.00	20.00	22.00	1.00	1.00	30.00	86.67	63.00	61.29	69.50
ZR	113.43	112.50	67.50	40.50	120.00	55.00	143.00	82.50	18.67	26.00	190.00	89.17	61.50	70.00	117.50
EU308	48.86	50.00	34.00	14.00	22.00	24.00	10.00	26.00	30.67	10.00	10.00	17.67	28.00	19.14	28.00
BA/RB	0.10	0.16	0.13	0.08	0.12	0.07	3.00	0.49	0.00	0.00	3.59	0.36	0.02	0.08	0.65
RB/SR	26.03	21.79	26.25	43.53	95.71	20.00	0.51	70.11	119.44	104.17	0.56	6.84	40.45	109.40	12.61
SNFORM1	0.41	0.33	0.52	2.08	0.57	0.59	0.00	3.50	58.84	8.39	0.00	0.01	0.12	8.18	0.18
SNFORM2	4.23	2.08	3.47	33.39	4.81	8.47	0.00	237.98	17753.11	2097.23	0.00	0.05	9.79	1509.51	1.89
SNFORM3	0.01	0.00	0.01	1.80	0.01	0.03	0.00	6.55	3473.43	414.41	0.00	0.00	0.04	28.60	0.00
TI/10	51.39	47.96	38.97	20.98	29.97	23.98	347.71	74.94	5.99	5.99	365.69	45.96	8.99	28.26	128.89
ALINDEX	1.25	1.21	1.33	1.49	1.36	5.63	0.70	1.33	1.83	1.39	0.94	1.12	1.16	1.19	1.18
RB/3	210.48	203.33	200.00	233.33	223.33	120.00	63.33	176.67	477.78	416.67	48.33	116.11	160.00	213.81	120.00
TOTAL	1549.30	1524.70	1439.04	1559.51	1597.00	7586.66	1841.54	1736.85	29424.72	5091.14	1682.17	1005.67	981.15	3002.60	1279.50

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466122

	K. 2. 5 MEAN	K. 3. 1 MEAN	K. 4. 1 MEAN	K. 5. 1 MEAN	H. 2. 1 MEAN	H. 3. 2 MEAN	P. 3. 1 MEAN	P. 4. 4 MEAN
BA	9.00	280.00	15.00	15.00	320.00	325.00	140.00	27.50
FX	0.49	0.09	0.59	0.66	0.03	0.06	0.24	0.42
GA	29.20	14.00	32.00	36.00	14.00	14.00	22.00	26.00
LI	206.00	80.00	160.00	80.00	60.00	67.50	105.00	163.75
MO	19.60	16.00	20.00	12.00	12.00	14.00	4.00	4.00
NB	18.00	16.00	22.00	22.00	18.00	16.00	16.00	19.00
RB	684.00	310.00	730.00	870.00	320.00	265.00	400.00	615.00
SN	19.20	10.00	120.00	1400.00	22.00	14.00	18.00	23.00
SR	5.60	110.00	7.00	4.00	90.00	107.50	34.00	15.00
U	14.80	8.00	12.00	16.00	2.00	3.00	6.00	19.00
W	12.00	5.00	10.00	20.00	10.00	5.00	10.00	12.50
Y	26.80	26.00	22.00	14.00	18.00	23.00	50.00	34.00
ZR	47.20	100.00	34.00	28.00	105.00	125.00	105.00	56.50
EU30B	24.40	10.00	10.00	20.00	10.00	10.00	30.00	29.50
BA/RB	0.01	0.90	0.02	0.02	1.00	1.29	0.35	0.05
RB/SR	174.43	2.82	104.29	217.50	3.56	2.82	11.76	43.08
SNFORM1	8.10	0.00	2.64	8.76	0.00	0.00	0.01	1.71
SNFORM2	1206.48	0.00	128.69	508.28	0.00	0.00	0.04	66.04
SNFORM3	30.31	0.00	4.44	23.98	0.00	0.00	0.00	1.02
TI/10	10.79	161.86	5.99	5.99	107.91	167.86	53.95	22.48
ALINDEX	1.26	1.06	1.46	2.12	1.22	1.15	1.16	1.22
RB/3	228.00	103.33	243.33	290.00	106.67	88.33	133.33	205.00
TOTAL	2775.87	1255.07	1685.46	3594.32	1221.38	1250.52	1140.85	1385.77

SHELL METALS AUSTRALIA  
 SHLMET FILE INFORMATION PROGRAM  
 N. E. TASMANIA GRANITE STUDY

VARIABLE	NO OF VALID SAMPLES	MINIMUM VALUE	MAXIMUM VALUE	MEAN	VARIANCE (UNBIASED)	STANDARD DEVIATION	SKEW NESS	KUR TOSIS
SI02	59	64.70	79.10	75.53	0.6103E 01	2.47	-2.22	6.01
AL203	59	10.80	17.20	13.05	0.1074E 01	1.04	0.90	2.85
TI02	59	0.01	0.61	0.09	0.1586E-01	0.13	2.74	7.47
FE203	59	0.29	5.40	1.70	0.8933E 00	0.95	2.16	5.13
MGO	59	0.01	2.65	0.15	0.1680E 00	0.41	4.66	23.21
CAO	59	0.03	4.65	0.60	0.6068E 00	0.78	3.75	15.11
NA2O	59	0.01	3.90	2.56	0.4691E 00	0.68	-1.63	4.40
K2O	59	2.20	6.10	4.65	0.4961E 00	0.70	-1.34	2.03
MNO	59	0.01	0.16	0.04	0.6635E-03	0.03	2.37	7.02
P2O5	59	0.01	0.38	0.09	0.6030E-02	0.08	1.27	1.85
LOI	59	0.30	2.80	0.94	0.2203E 00	0.47	1.93	4.14
BA	59	5.00	570.00	95.34	0.1594E 05	126.27	2.12	4.06
F	59	0.02	2.90	0.37	0.2190E 00	0.47	3.41	14.22
GA	59	12.00	60.00	24.58	0.8263E 02	9.09	1.31	2.68
LI	59	24.00	770.00	152.08	0.1725E 05	131.34	2.46	7.55
MO	59	2.00	55.00	16.93	0.9541E 02	9.77	1.05	2.39
NB	59	14.00	70.00	23.46	0.1339E 03	11.57	2.48	6.76
RB	59	145.00	1700.00	599.58	0.8069E 05	284.06	1.44	3.09
SN	59	2.00	6700.00	329.25	0.1594E 07	1262.47	4.28	17.58
SR	59	2.00	370.00	40.27	0.3793E 04	61.58	3.52	14.01
U	59	2.00	48.00	13.08	0.9549E 02	9.77	1.24	1.65
W	59	3.00	195.00	19.15	0.7372E 03	27.15	4.99	27.93
Y	59	1.00	175.00	44.46	0.1574E 04	39.68	1.39	1.70
ZR	59	16.00	195.00	77.22	0.1966E 04	44.34	0.75	-0.12
EU308	59	10.00	70.00	25.22	0.2322E 03	15.24	0.94	0.34
BA/RB	59	0.00	3.59	0.32	0.4362E 00	0.66	3.43	12.34
RB/SR	59	0.31	495.00	59.11	0.7443E 04	86.27	3.02	10.81
SNFORM1	57	0.00	92.59	5.66	0.2447E 03	15.64	3.84	15.94
SNFORM2	57	0.00	31481.00	1290.22	0.2235E 08	4727.18	4.96	26.98
SNFORM3	44	0.00	12253.00	391.83	0.3545E 07	1882.81	5.71	32.83
TI/10	59	3.99	365.69	53.24	0.5701E 04	75.50	2.74	7.47
ALINDEX	59	0.90	3.63	1.35	0.3725E 00	0.61	5.89	38.07
RB/3	59	48.33	566.67	199.86	0.8966E 04	94.69	1.44	3.09

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466124

CORRELATION MATRIX  
 (NUMBER OF SAMPLES)

	SI02	AL203	TIO2	FE203	MGO	CAO	NA2O	K2O
SI02	1.000	-0.689	-0.743	-0.641	-0.799	-0.782	-0.106	0.263
AL203	-0.689	1.000	0.189	0.163	0.295	0.198	0.188	-0.299
TIO2	-0.743	0.189	1.000	0.701	0.886	0.911	0.004	-0.205
FE203	-0.641	0.163	0.701	1.000	0.714	0.781	-0.395	-0.559
MGO	-0.799	0.295	0.886	0.714	1.000	0.954	0.035	-0.285
CAO	-0.782	0.198	0.911	0.781	0.954	1.000	0.038	-0.309
NA2O	-0.106	0.188	0.004	-0.395	0.035	0.038	1.000	0.168
K2O	0.263	-0.299	-0.205	-0.559	-0.285	-0.309	0.168	1.000
MNO	-0.429	0.254	0.232	0.779	0.361	0.409	-0.346	-0.642
P205	-0.511	0.643	0.182	0.280	0.271	0.232	0.029	-0.413
LOI	-0.077	0.168	-0.070	0.262	-0.078	-0.147	-0.655	-0.207
BA	-0.739	0.264	0.943	0.616	0.839	0.839	0.025	-0.100
F	-0.028	0.374	-0.275	0.178	-0.202	-0.221	-0.502	-0.536
GA	-0.039	0.363	-0.411	-0.017	-0.268	-0.273	0.011	-0.322
LI	-0.178	0.566	-0.314	-0.008	-0.216	-0.247	0.026	-0.346
MD	-0.038	0.124	-0.083	0.007	-0.101	-0.131	-0.182	-0.176
NB	-0.089	0.479	-0.326	-0.050	-0.238	-0.264	-0.043	-0.466
RB	0.079	0.337	-0.547	-0.150	-0.409	-0.439	-0.026	-0.237
SN	-0.131	0.388	-0.135	0.316	-0.089	-0.102	-0.523	-0.554
SR	-0.801	0.285	0.937	0.694	0.963	0.950	0.038	-0.231
U	0.254	-0.234	-0.286	-0.149	-0.279	-0.237	-0.207	-0.003
W	0.020	0.114	-0.161	-0.065	-0.099	-0.135	0.020	-0.137
Y	0.297	-0.593	-0.023	-0.171	-0.112	-0.008	0.079	0.268
ZR	-0.299	-0.280	0.728	0.371	0.481	0.568	-0.040	0.125
EU308	0.241	-0.361	-0.204	-0.133	-0.260	-0.178	-0.176	0.194
BA/RB	-0.786	0.292	0.962	0.707	0.920	0.936	0.054	-0.260
RB/SR	0.164	0.069	-0.353	-0.097	-0.211	-0.230	0.049	-0.176
SNFORM1	-0.385	0.526	-0.238	0.258	-0.189	-0.154	-0.028	-0.383
SNFORM2	-0.470	0.576	-0.203	0.278	-0.144	-0.099	-0.041	-0.338
SNFORM3	-0.728	0.634	-0.210	0.374	-0.159	0.075	-0.105	-0.251
TI/10	-0.743	0.189	1.000	0.701	0.886	0.911	0.004	-0.205
ALINDEX	0.130	0.185	-0.203	0.169	-0.176	-0.233	-0.639	-0.535
RB/3	0.079	0.337	-0.547	-0.150	-0.409	-0.439	-0.026	-0.237

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466125

CORRELATION MATRIX  
 (NUMBER OF SAMPLES)

	MNO	P205	LOI	BA	F	GA	LI	MO
S102	-0.429	-0.511	-0.097	-0.792	-0.028	-0.039	-0.178	-0.038
AL203	0.254	0.643	0.168	0.264	0.374	0.363	0.566	0.124
TI02	0.252	0.182	-0.070	0.943	-0.275	-0.411	-0.314	-0.083
FE203	0.779	0.280	0.262	0.616	0.178	-0.017	-0.008	0.007
MGO	0.361	0.271	-0.078	0.838	-0.202	-0.268	-0.216	-0.101
CAO	0.409	0.232	-0.147	0.837	-0.221	-0.275	-0.247	-0.151
NA2O	-0.346	0.029	-0.655	0.025	-0.302	0.011	0.026	-0.182
K2O	-0.642	-0.413	-0.207	-0.100	-0.536	-0.322	-0.346	-0.176
MNO	1.000	0.411	0.398	0.201	0.309	0.411	0.366	0.142
P205	0.411	1.000	0.151	0.176	0.373	0.498	0.621	0.280
LOI	0.398	0.151	1.000	0.017	0.454	0.230	0.264	0.314
BA	0.201	0.176	0.017	1.000	-0.336	-0.498	-0.351	-0.132
F	0.309	0.373	0.454	-0.336	1.000	0.466	0.575	0.303
GA	0.411	0.498	0.230	-0.498	0.466	1.000	0.862	0.375
LI	0.366	0.621	0.264	-0.351	0.575	0.862	1.000	0.387
MO	0.142	0.280	0.314	-0.132	0.303	0.375	0.387	1.000
NB	0.276	0.543	0.341	-0.360	0.616	0.753	0.844	0.397
RB	0.342	0.437	0.315	-0.595	0.518	0.918	0.901	0.413
SN	0.427	0.227	0.344	-0.162	0.849	0.349	0.469	0.264
SR	0.302	0.239	-0.081	0.928	-0.262	-0.398	-0.295	-0.140
U	-0.068	0.115	0.073	-0.369	0.292	0.300	0.209	0.364
W	0.198	0.115	0.071	-0.179	0.164	0.267	0.337	0.322
Y	-0.372	-0.648	-0.178	-0.063	-0.317	-0.316	-0.406	-0.131
ZR	-0.141	-0.286	-0.103	0.659	-0.373	-0.541	-0.471	-0.070
EU308	-0.212	-0.105	-0.033	-0.313	0.158	0.169	0.070	0.252
BA/RB	0.310	0.223	-0.089	0.940	-0.261	-0.370	-0.287	-0.126
RB/SR	0.315	0.000	0.035	-0.400	0.190	0.455	0.367	0.200
SNFORM1	0.589	0.382	0.303	-0.275	0.482	0.697	0.801	0.328
SNFORM2	0.547	0.399	0.323	-0.217	0.504	0.678	0.803	0.273
SNFORM3	0.488	0.398	0.421	-0.229	0.508	0.686	0.756	0.127
TI/10	0.252	0.182	-0.070	0.943	-0.275	-0.411	-0.314	-0.083
ALINDEX	0.205	0.104	0.315	-0.212	0.847	0.088	0.184	0.233
RB/3	0.342	0.437	0.315	-0.595	0.518	0.918	0.901	0.413

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466126

CORRELATION MATRIX  
 (NUMBER OF SAMPLES)

	NB	RB	SN	SR	U	W	Y	ZR
SIQ2	-0.089	0.079	-0.131	-0.801	0.254	0.020	0.297	-0.299
AL203	0.479	0.337	0.388	0.285	-0.234	0.114	-0.593	-0.280
TIQ2	-0.326	-0.547	-0.135	0.937	-0.286	-0.161	-0.023	0.728
FE203	-0.050	-0.150	0.316	0.694	-0.149	-0.065	-0.171	0.371
MGO	-0.238	-0.409	-0.089	0.963	-0.279	-0.099	-0.112	0.481
CAO	-0.264	-0.439	-0.102	0.950	-0.237	-0.135	-0.008	0.568
NA2O	-0.045	-0.026	-0.525	0.038	-0.207	0.020	0.079	-0.040
K2O	-0.466	-0.257	-0.534	-0.231	-0.003	-0.137	0.268	0.125
MNO	0.276	0.342	0.427	0.302	-0.068	0.198	-0.372	-0.141
P2O5	0.543	0.437	0.227	0.239	0.115	0.115	-0.448	-0.286
LOI	0.341	0.315	0.544	-0.081	0.073	0.071	-0.178	-0.105
BA	-0.360	-0.595	-0.162	0.928	-0.369	-0.179	-0.063	0.659
F	0.616	0.518	0.849	-0.262	0.292	0.164	-0.317	-0.373
GA	0.753	0.918	0.349	-0.398	0.300	0.267	-0.316	-0.541
LI	0.844	0.901	0.469	-0.295	0.209	0.337	-0.406	-0.471
MO	0.397	0.413	0.264	-0.140	0.364	0.322	-0.131	-0.070
NB	1.000	0.827	0.554	-0.301	0.239	0.328	-0.243	-0.388
RB	0.827	1.000	0.390	-0.518	0.301	0.395	-0.309	-0.588
SN	0.554	0.390	1.000	-0.111	0.066	0.166	-0.237	-0.250
SR	-0.301	-0.518	-0.111	1.000	-0.328	-0.147	-0.080	0.558
U	0.239	0.301	0.066	-0.328	1.000	0.182	0.162	-0.040
W	0.328	0.395	0.166	-0.147	0.182	1.000	-0.181	-0.145
Y	-0.243	-0.309	-0.237	-0.080	0.162	-0.181	1.000	0.472
ZR	-0.388	-0.588	-0.250	0.558	-0.040	-0.145	0.472	1.000
EU308	0.089	0.143	-0.012	-0.285	0.771	-0.000	0.445	0.186
BA/RB	-0.301	-0.513	-0.111	0.927	-0.344	-0.140	-0.099	0.603
RB/SR	0.249	0.526	0.104	-0.341	0.101	0.624	-0.257	-0.375
SNFORM1	0.668	0.794	0.583	-0.243	0.023	0.517	-0.317	-0.361
SNFORM2	0.686	0.754	0.625	-0.180	0.014	0.413	-0.270	-0.310
SNFORM3	0.655	0.715	0.672	-0.108	-0.074	0.185	-0.225	-0.248
TI/10	-0.326	-0.547	-0.135	0.937	-0.286	-0.161	-0.023	0.728
ALINDEX	0.333	0.170	0.810	-0.194	0.132	0.098	-0.239	-0.270
RB/3	0.827	1.000	0.390	-0.518	0.301	0.395	-0.309	-0.588

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466127

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CORRELATION MATRIX  
 (NUMBER OF SAMPLES)

	EU308	BA/RB	RB/SR	SNFORM1	SNFORM2	SNFORM3	TI/10	ALINDEX
SI02	0.241	-0.786	0.164	-0.385	-0.470	-0.728	-0.743	0.130
AL203	-0.361	0.292	0.069	0.326	0.576	0.634	0.189	0.185
TI02	-0.204	0.962	-0.353	-0.238	-0.203	-0.210	1.000	-0.203
FE203	-0.133	0.707	-0.097	0.258	0.278	0.374	0.701	0.169
MGO	-0.260	0.920	-0.211	-0.189	-0.144	-0.159	0.886	-0.176
CA0	-0.178	0.936	-0.230	-0.154	-0.099	0.075	0.911	-0.233
NA20	-0.176	0.054	0.049	-0.028	-0.044	-0.105	0.004	-0.639
K20	0.194	-0.260	-0.176	-0.383	-0.338	-0.251	-0.205	-0.535
MNO	-0.212	0.310	0.315	0.589	0.547	0.488	0.232	0.205
P203	-0.105	0.223	0.000	0.382	0.399	0.398	0.182	0.104
LOI	-0.033	-0.089	0.035	0.303	0.323	0.421	-0.070	0.515
BA	-0.313	0.940	-0.400	-0.275	-0.217	-0.229	0.943	-0.212
F	0.158	-0.261	0.190	0.482	0.504	0.508	-0.275	0.847
GA	0.169	-0.370	0.455	0.697	0.678	0.686	-0.411	0.088
LI	0.070	-0.287	0.367	0.801	0.803	0.756	-0.314	0.184
MO	0.232	-0.126	0.200	0.328	0.273	0.127	-0.083	0.233
NB	0.089	-0.301	0.249	0.668	0.686	0.655	-0.326	0.353
RB	0.143	-0.513	0.526	0.794	0.754	0.715	-0.547	0.170
SN	-0.012	-0.111	0.104	0.583	0.635	0.672	-0.135	0.810
SR	-0.285	0.957	-0.341	-0.245	-0.180	-0.108	0.937	-0.194
U	0.771	-0.344	0.101	0.023	0.014	-0.074	-0.286	0.132
W	-0.000	-0.140	0.624	0.517	0.413	0.185	-0.161	0.098
Y	0.445	-0.099	-0.257	-0.317	-0.270	-0.225	-0.023	-0.255
ZR	0.186	0.603	-0.375	-0.361	-0.310	-0.248	0.728	-0.270
EU308	1.000	-0.311	-0.110	-0.056	-0.015	-0.014	-0.204	-0.030
BA/RB	-0.311	1.000	-0.291	-0.214	-0.166	-0.241	0.962	-0.188
RB/SR	-0.110	-0.291	1.000	0.562	0.399	0.136	-0.353	0.075
SNFORM1	-0.056	-0.214	0.562	1.000	0.974	0.847	-0.258	0.174
SNFORM2	-0.015	-0.166	0.399	0.974	1.000	0.939	-0.203	0.174
SNFORM3	-0.014	-0.241	0.136	0.847	0.939	1.000	-0.210	0.165
TI/10	-0.204	0.962	-0.353	-0.258	-0.203	-0.210	1.000	-0.203
ALINDEX	-0.030	-0.188	0.075	0.174	0.174	0.165	-0.203	1.000
RB/3	0.143	-0.513	0.526	0.794	0.754	0.715	-0.547	0.170

466128

CORRELATION MATRIX  
(NUMBER OF SAMPLES)

	RB/3
S102	0.079 59
AL203	0.337 59
TI02	-0.547 59
FE203	-0.150 59
MGO	-0.409 59
CAO	-0.439 59
NA2O	-0.026 59
K2O	-0.257 59
MNO	0.342 59
P2O5	0.437 59
LOI	0.315 59
BA	-0.595 59
F	0.518 59
GA	0.918 59
LI	0.901 59
MO	0.413 59
NB	0.827 59
RB	1.000 59
SN	0.390 59
SR	-0.518 59
U	0.301 59
W	0.395 59
Y	-0.309 59
ZR	-0.588 59
EU308	0.143 59
BA/RB	-0.513 59
RB/SR	0.526 59
SNFORM1	0.794 57
SNFORM2	0.754 57
SNFORM3	0.715 44
TI/10	-0.547 59
ALINDEX	0.170 59
RB/3	1.000 59

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APPENDIX III

THE ROYAL GEORGE TIN PROSPECTAn Indicator of COLLINGWOOD - STYLE Tin Mineralization in NE TasmaniaSUMMARY

The Royal George Tin prospect located 15km SE of Avoca in NE Tasmania was visited with BXR on 20/4/83.

1.0 MINERALIZATION

The prospect consists of vertical to steeply dipping, fracture-related, sericitized and silicified granitic lodes in granitic rocks.

2.0 GEOLOGY

The lodes cross-cut coarse to medium grained inequigranular and porphyritic granite phases of the Ben Lomond granite. Pegmatitic clots of quartz, K-feldspar and tourmaline plus interstitial tourmaline and minor muscovite indicate a high structural level in the granite. The granite is capped by Mathinna Bed sediments to the West and Northwest of the Royal George Prospect.

3.0 LODE ZONE DIMENSIONS

Work by BHP, the Cornwall Coal Company and the Tasmanian Mines Department has defined a body of 250m long 20m wide and over 100m depth. The body remains open to the NW and SE and has not been closed off at depth. Reconnaissance in the area revealed lode vein material 80m to 100m NE of the prospect. The prospect itself is considered to form part of a granite lode system.

4.0 TONNAGE & GRADE

The Mines Department calculated a tonnage of 159,070 tonnes at 0.61% Sn (970 tonnes of contained tin).

5.0 COLLINGWOOD STYLE?

The occurrence contains many similarities to the Collingwood lodes - these are listed below.

6.0 STATUS OF THE GROUND

The prospect falls in E.L. 7/78 (108 km<sup>2</sup>) held by the Cornwall Coal Company who are currently in Joint Venture with Amax (since 1st March, 1983). The ground to the North covering prospective Mathinna Bed cap-rock stratigraphy is held by Seltrust as E.L. 48/81 (306 km<sup>2</sup>). Licence renewals are due on the 14/7/83 and 8/6/83 respectively.

7.0 COMMENT

Two other vertical greisenized granite lode deposits occur in the area one, the Brookstead Creek prospect along strike from the Royal George show.

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## REGIONAL GEOLOGY

The Royal George prospect occurs in the tin-rich Ben Lomond granite of NE Tasmania. The sheeted-vein systems of the Rossarden (15,500 tonnes Sn, 5,500 tonnes  $WO_3$ ) and Storeys Creek (800 tonnes Sn, 8000 tonnes  $WO_3$ ) mines (both now closed) are located on the NE margin of this granite. The Ben Lomond granite is capped by Mathinna Beds to the NW and W of the Royal George Prospect, in the Rossarden area and to the N of the Gipps Creek Prospects (Fig. 1). Permian sediments and Jurassic dolerites cover part of the region.

## ROYAL GEORGE PROSPECT

The lode veins of the Royal George Prospect are granite hosted (Fig.2).

### a) Granites

Two types of granite occur in the prospect area. Both types are leucocratic to mesocratic and contain a similar mineralogy. Pegmatitic clots of quartz, tourmaline and feldspar, upto 15cm long, occur in both types although they are more common in the porphyritic granite.

- (i) Coarse to medium grained granite, equigranular to inequigranular. The main minerals are K-feldspar and quartz with about 8% mafics, biotite and green/black tourmaline. This is the dominant granite type.
- (ii) Porphyritic granite with phenocrysts of euhedral K-feldspar (upto 40mm long) and subhedral to rounded, darkened quartz (upto 10mm across) set in a fine grained matrix of quartz, K-feldspar, biotite, tourmaline and minor muscovite. The porphyritic type generally contains more pegmatitic clots and is considered to represent a partial chill phase of the inequigranular coarse grained granite.

### b) Mineralization

The lodes cropout in a deep open cut and in underground stopes worked between 1911 and 1922. Ore reserve estimates by the Tasmanian Mines Department state 159,070 tonnes at 0.61% Sn (970 tonnes of contained tin). The mineralized body stands at 250m long, 20m wide and 100m deep but remains open to the SE and NW and at depth. The mineralized zone is reported to narrow to the NW and SE.

Lode veins from 0.3m to 1.5m thickness make up the mineralized body. Sn grades tend to be higher in the narrower veins. The veins strike  $325^\circ$  TN dipping  $70^\circ$  to  $80^\circ$  west forming an en echelon arrangement in the Open Cut which strikes  $340^\circ$  TN. This pattern suggests a strong fracture control which can be recognized in smaller veins. A similar structural control is evident in the Collingwood ore body. It is interesting to note that this structural sense suggests NE and SW extensional movements during ore emplacement, directions which conform to the major dilation directions of the Blue Tier Batholith.

The lode veins cross-cut the porphyritic and coarse grained inequigranular granite phases. Two types of rock can be recognized in the lodes:

- (i) Quartz-sericite-muscovite greisen. This type occurs close to the margins of the silicic lodes. The rocks are greenish/grey/yellow in colour containing a relic granitic texture in the form of quartz eyes. These quartz eyes are often darkened and smokey. They are surrounded by a silicified matrix which contains sericite muscovite, tourmaline and pyrite cubes. There is a transition from this type into the quartz lodes.
- (ii) Quartz greisen. Smokey quartz eyes in a siliceous matrix typify this rock. Matrix quartz occurs as small granular grains (1-3mm across) or interstitial cements. Small voids are common. Sericite and muscovite are present in trace quantities. Sulphides are more common, generally arsenopyrite and pyrite with minor chalcopyrite and sphalerite, collectively forming up to 10% of the rock. Interstitial tourmaline of secondary origin and finely disseminated cassiterite occur. Cassiterite grains appear to fill small voids (1-3mm across) and are difficult to distinguish from brown tourmaline (dravite). The mineral Torbenite (a uranium copper phosphate) is also reported. The uranium probably accounts for the discoloration of primary quartz crystals.

#### A Collingwood-style Deposit?

The prospect is similar to the Collingwood lodes in the following ways:

- a) the lodes cross-cut porphyritic and inequigranular granite phases.
- b) pegmatite clots are observed in the host granites and are more common in the porphyritic phases.
- c) the host granites contain tourmaline and altered phenocrysts of feldspar.
- d) the lodes are vertical or steeply dipping, are fracture related and form an en echelon arrangement.
- e) the lodes consist of sericitized, muscovitized and silicified granite (relic granite textures (quartz eyes) are common).
- f) cassiterite is associated with silicified lode (in hand specimen anyway).

In fact the Royal George prospect could be considered a dissected Collingwood lode system. The final test for the Collingwood Model lies in the surrounding Mathinna Bed sediments.

A number of small differences occur in the lode type:

- a) in the quartz greisen lodes very little sericite or muscovite is present. The lodes of Royal George are more siliceous than those of Collingwood with the quartz replacive to a large extent, forming essentially a quartz rock.
- b) open voids are present in the Royal George prospects but are rare at Collingwood.

#### Land Tenure Status/Exploration Potential

The Royal George prospect lies in E.L. 7/78 currently held in Joint Venture between the Cornwall Coal Company and Amax (108 km<sup>2</sup> with renewal due on the 14/7/83). Amax joined Cornwall Coal in March of this year and are still finding their feet in the area. Two other vertical greisenized granite vein systems have been located in the licence, the Brookstead Creek prospect consisting of a muscovite, sericite, tourmaline lodes (less silicified than Royal George lodes) which lie along strike from the Royal George prospect and the Roy's Hill prospect where vertical greisenized granite lodes poke through Permian cover eluvial sediments. Both prospects were visited.

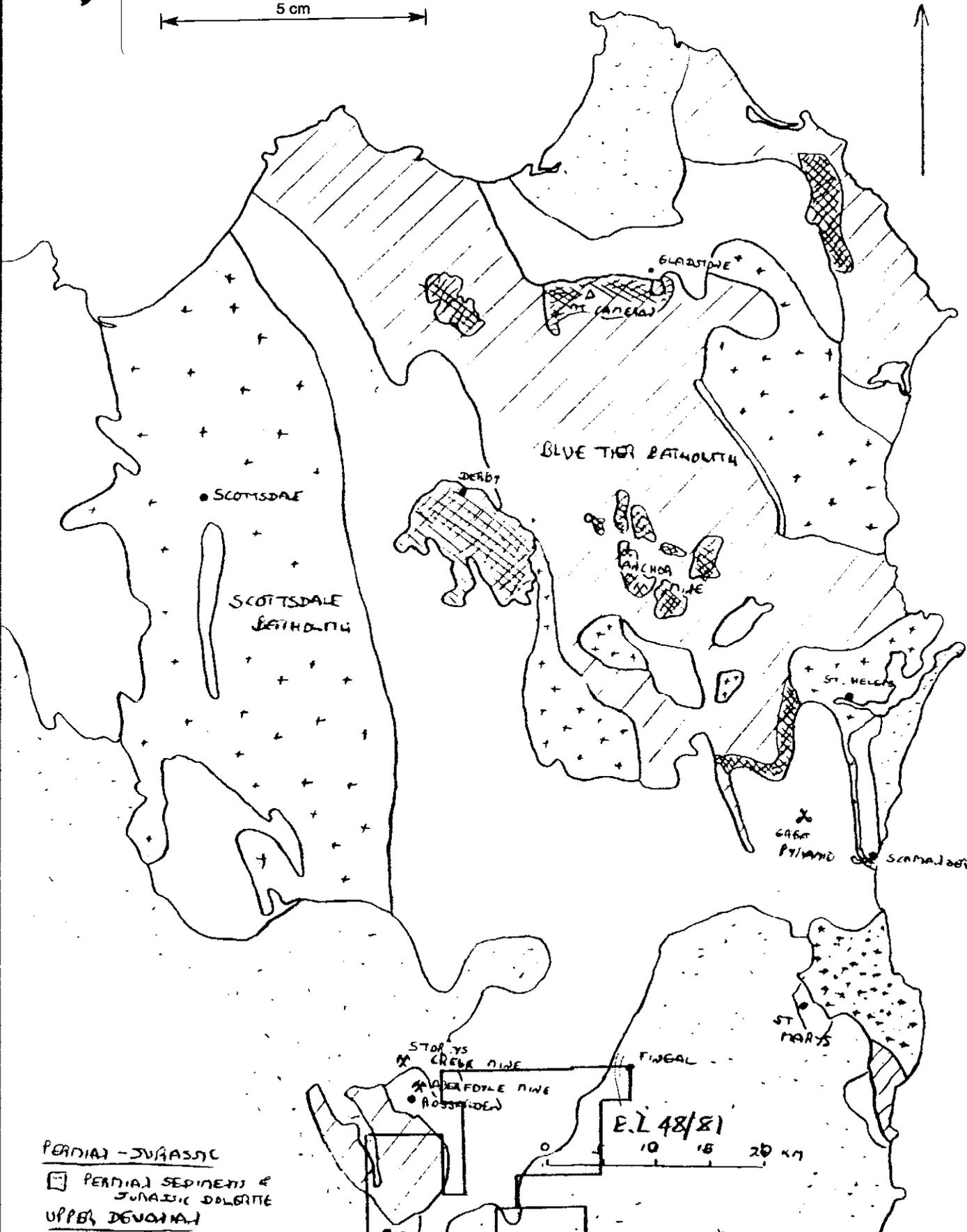
The ground to the North where Mathinna Beds cap the Ben Lomond Granite is held by Seltrust as E.L. 48/81 (306 sq km with renewal due on 8/6/83). Seltrust have been active in the area recently but it is presumed that they have not fully grasped the potential of their licence.

#### Comment

The Ben Lomond Granite is a highly prospective area for Sn-W with sheeted vein systems producing 2 mines and vertical vein greisen systems containing significant Sn. An attempt was made to secure ground in this region over the Rossarden/Storey's Creek and Rex Hill areas, however complications have arisen over an application by the Mines Department to withdraw the pegged ground as a Mining Concession. The details are not clear at this stage.

Following the regional work by BXR the Ben Lomond Granite is rapidly developing into one, if not the most prospective area in NE Tasmania for Sn-W. Further literature search, granite geochemical studies and thin section work by BXR will probably confirm this.

5 cm



PERMIAN - JURASSIC

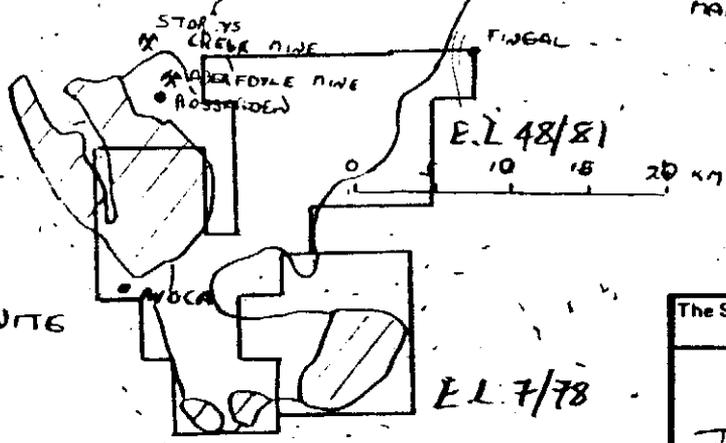
PERMIAN SEDIMENT & JURASSIC DOLOMITE UPPER DEVONIAN

GRANODIORITE / GRANITE

BIOTITE GRANITE

MUSCOVITE / BIOTITE GRANITE

HYPSTHENE ADAMELLITE



E.L. 7/78

The Shell Company of Australia Limited METALS DIVISION	
N.E. TASMANIA TIN PROVINCE	
SCALE 1:50,000	DATE 12/4/83
AUTHOR AGV	DRAWN S.L.
OFFICE DFT	REP. NO.

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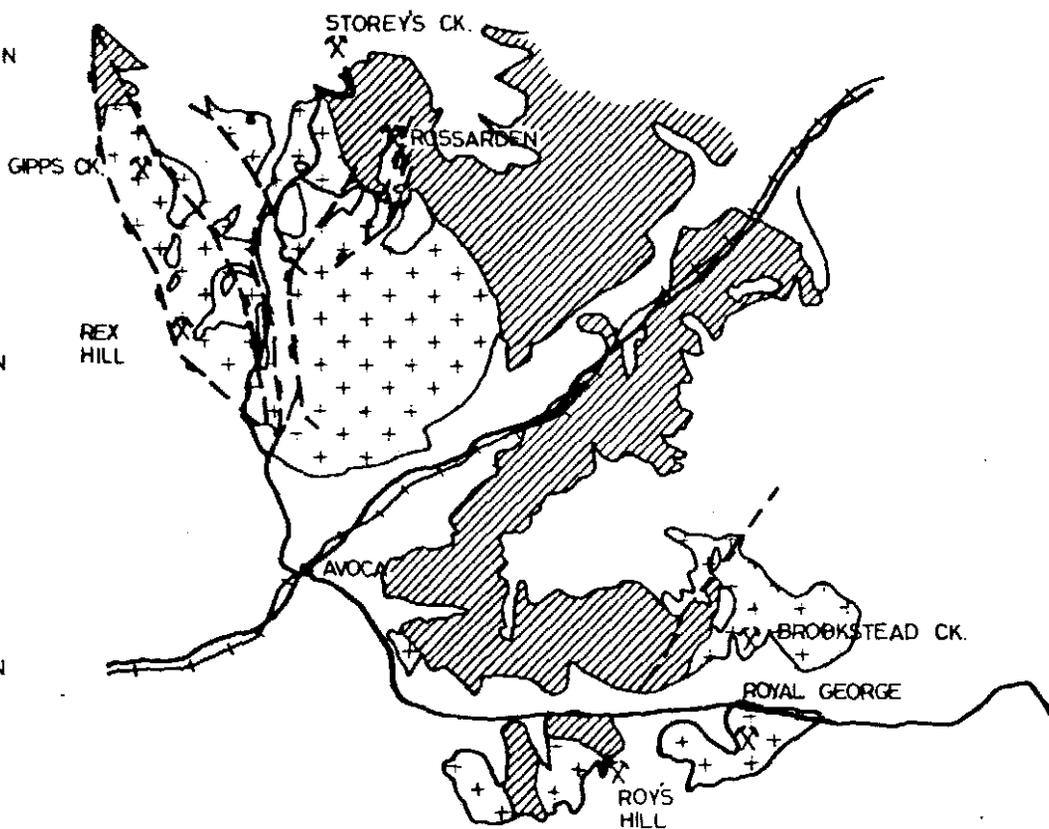
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**LEGEND**



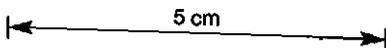
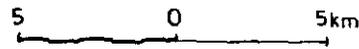
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GRANITE



The Shell Company of Australia Limited  
METALS DIVISION

**BEN LOMOND GRANITE  
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