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**A gamma-ray  
spectrometer and  
magnetic  
susceptibility  
survey of  
Tasmanian  
granitoids**

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1981/41. A gamma-ray spectrometer and magnetic susceptibility survey of Tasmanian granitoids

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Abstract

Gamma-ray spectrometer measurements of granitic rocks in eastern and north-western Tasmania indicate that high radioactivity, due mainly to increased uranium, accompanies highly fractionated granitoids which also host tin and less commonly tungsten (as wolframite) mineralisation.

In eastern Tasmania, biotite-muscovite alkali granites (e.g. Mt Paris and Lottah Plutons) with more than 5 g/t U, U/Th ratios greater than 0.5, and plotting above the 50% U line in a K<sub>2</sub>O/10000-U-Th/4 ternary diagram, have associated tin mineralisation. Alkali granites which lack known tin mineralisation (e.g. Mt William Pluton) also have low radioactivity. Granitoids in north-western Tasmania have similar characteristics, although the U/Th ratios of some granites with associated tin mineralisation may be as low as 0.33.

Granitoids with adjacent tungsten (as scheelite)-bearing skarns do not satisfy the above criteria, but are more magnetic than other granitoids, most of which are non-magnetic.

Mafic and ultramafic rocks are moderately to strongly magnetic, and are non-radioactive, except for spilitic basalt subjected to potassic alteration adjacent to cassiterite-sulphide replacement deposits at the Cleveland mine.

Gamma-ray spectrometry may be used in mineral exploration to delineate those phases of a batholith that are prospective hosts of tin mineralisation, and to search for zones of granitoid-derived potassic alteration.

INTRODUCTION

Recent investigations in the Lachlan Fold Belt in New South Wales have shown that granitic rocks hosting tin and tungsten mineralisation have a higher radioactivity than other granitic rocks. This is mainly due to increased uranium, and is easily detected with a portable four-channel gamma-ray spectrometer (Yeates et al., *in prep.*).

To see whether this relationship holds elsewhere, a joint Bureau of Mineral Resources - Tasmania Department of Mines survey of Tasmanian granitic rocks was undertaken in February, 1981.

The survey began in the Blue Tier Batholith in north-eastern Tasmania. The geology of this composite body is well known, and alkali granites within the batholith host cassiterite-bearing greisens and are the probable source of deposits of alluvial cassiterite. Measurements at seventy sites within this batholith allowed an early assessment to be made of the tech-

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nique and of its application to Tasmanian granitoids. Gamma-ray radiation was measured at a further 126 outcrops of granitic rocks throughout eastern and western Tasmania, including King and Flinders Islands, and at twelve outcrops of mafic and ultramafic rocks in western Tasmania. The magnetic susceptibility was also measured at each locality.

From the gamma-ray spectrometer measurements, values of mass% K<sub>2</sub>O, g/t U and g/t Th, and heat generation units (H.G.U.) have been calculated. All of the geophysical data, the calculated element concentrations and H.G.U.s, and locations of sample sites are tabulated in Appendix 1.

#### ASSOCIATION OF HIGH RADIOACTIVITY WITH TIN AND TUNGSTEN MINERALISING GRANITES

The association of high radioactivity with tin and tungsten mineralising granites has been reviewed by Yeates *et al.* (in prep.) and is summarised below.

Elements such as U, Th, Sn, and W which have high valencies and large atomic radii are not readily accommodated in the lattices of common rock-forming minerals (Ringwood, 1955; Adams *et al.* 1959; Hamaguchi and Kuroda, 1969; Krauskopf, 1970; Horsnail, 1979). These elements may form accessory species if they are highly concentrated in magmas, but more commonly U and Th are either substituted into other accessory minerals or remain mobile until their eventual concentration in residual phases of granitic intrusions (Tauson *et al.*, 1968). Similarly, Sn and W can migrate as large complex ions and, independently of U and Th, may also concentrate in water-rich residual solutions. Such concentrations result from a high degree of fractionation.

Sn(IV) and rarely W(IV) ions in magmas may also substitute for Fe(III), Ti(IV), and Zr(IV) ions in a variety of oxides and ferromagnesian minerals (Barsukov, 1958; Jeffrey, 1959; Taylor, 1965). In this form, Sn and W can be released to form tin or tungsten minerals only if the Sn or W-bearing minerals are later altered, and if the released metal is not incorporated into any secondary mineral lattice.

It is not essential to have a tin or tungsten-rich source. Theoretically, tin or tungsten can be sufficiently concentrated to form deposits associated with any granitic magma (Hunter, 1972), provided it has undergone the necessary fractionation and/or alteration. It is these granites which are the most radioactive.

Late-stage magmatic differentiates are enriched in trace elements related to potassium (*e.g.* Rb, Pb) and to the volatile components fluorine, chlorine *etc.* (*e.g.* U, Th, Sn, Be, Nb, Ta) (Hunter, 1972). Tungsten can also be included in this latter category. Thus, prospective tin and tungsten mineralising granites generally have a highly evolved character (Floyd, 1972), and are the most radioactive. In late stage differentiates, thorium may be either enriched, depleted, or unaffected depending on oxidation conditions (De Voto, 1978), particularly during any secondary alteration.

The respective amounts of the radioactive elements K, U, and Th are readily determined with a gamma-ray spectrometer. Their differences in abundance can reveal different phases of composite bodies and the relative degree of fractionation between phases.

5 cm

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Plate 1. *The gamma-ray spectrometer*

METHODOLOGY OF GAMMA-RAY SPECTROMETRY

Ground gamma-ray spectrometer measurements were obtained with a Geometrics Exploranium DISA-400A spectrometer housing a 347 ml NaI crystal. Measurements were made with the detector suspended from a tripod so that it was 600 mm above the exposed rock surface (Plate 1). The counting period for all measurements was six minutes.

The observed radiometric data have been converted to K<sub>2</sub>O, U, and Th using the following equations, and assuming that equilibrium has been attained in the uranium decay series.

$$\frac{g/t \text{ Th}}{S_{\text{Th}}} = N_{\text{Th}} = \text{Ch4} - B_4 \tag{1}$$

$$\frac{g/t \text{ U}}{S_{\text{U}}} = N_{\text{U}} = \text{Ch3} - \alpha \cdot N_{\text{Th}} - B_3 \tag{2}$$

$$\frac{\text{mass\% K}_2\text{O}}{S_{\text{K}}} = N_{\text{K}} = \text{Ch2} - \beta \cdot N_{\text{Th}} - \gamma \cdot N_{\text{U}} - B_2 \tag{3}$$

where: Ch2, Ch3, and Ch4 are counts in channels 2, 3 and 4 respectively; B2, B3, and B4 are background counts (20, 10, 9 counts per minute in channels 2, 3, and 4 respectively);  $\alpha$ ,  $\beta$ , and  $\gamma$  are spectral stripping coefficients (0.75, 1.18, and 0.95 respectively); N<sub>Th</sub>, N<sub>U</sub>, and N<sub>K</sub> are corrected count rates for channels 4, 3, and 2 respectively; and

$S_{Th}$ ,  $S_U$ , and  $S_K$  are sensitivities relating corrected counts per minute to g/t Th, g/t U, and mass%  $K_2O$  (8.5, 10.6, 117 respectively).

The background in channel 1 (total counts) is 514 counts per minute. The background constants have been established by measurements over water (greater than three metres deep), and the sensitivity constants in the above equations by regression analysis of approximately 300 sets of field measurements in New South Wales, and their corresponding chemical analyses by X-ray fluorescence spectrography. The spectrometer measures gamma-radiation emitted from a specific volume of rock. Hence, the conversion of the radiometric data to a mass proportion (rather than a volume proportion) is done on the assumption that density variation between granitoids is minimal and is not significant.

A source of error in the technique is caused by imperfect geometry of the gamma-ray source. The ideal geometry, an infinite half space (or  $2\pi$  solid angle), is approached by many granite outcrops. However, if the detector is exposed to more than a  $2\pi$  solid angle of rock (e.g. in drains, road cuttings, quarries, cliffs, and mines) then the measurements will be too high. Other errors arise from fresh rock being partially concealed by soil, vegetation, or transported overburden which absorb gamma-radiation, causing lower measured concentrations. The errors introduced by imperfect source geometry are proportional for the three elements K, U, and Th. For this reason, comparisons of ratios are more reliable and consistent where local topography and cover are variable. Ratios are generally expressed either directly as U/Th (i.e. U versus Th diagram) or as points on a K-U-Th ternary diagram.

The importance of site geometry is shown by the following example: At a granite quarry on the Tasman Highway, two kilometres north of Weldborough (Site 58) two readings inside the quarry gave six minute total counts of 94000 and 99000, with 7.0%  $K_2O$ , 24 g/t U, and 16 g/t Th. Another reading on the outer edge of the quarry gave a total count of 77000 with 4.4%  $K_2O$ , 18 g/t U, and 13 g/t Th. However, two further readings on equally fresh, flat outcrops above and clear of the quarry gave total counts of 47000, and 4.0%  $K_2O$ , 7 g/t U, and 9 g/t Th. A chemical analysis of granite from the quarry indicates 3.9 mass%  $K_2O$  (Groves, 1977; analysis 702694). Thus, when the spectrometer was set up in the granite floor of the quarry, additional radiation from the vertical sides enhanced the recorded radiation on all four channels, causing significant increases in the calculated  $K_2O$ , U, and Th contents.

#### SPECTROMETRY OF GRANITIC ROCKS OF EASTERN TASMANIA

##### BLUE TIER BATHOLITH

The Blue Tier Batholith (fig. 1) underlies an area of about 1800 km<sup>2</sup>. It is a composite body consisting of early mafic granodiorite and granite/adamellite intruded by later alkali granite (Groves, 1977; Gee and Groves, 1971; McClenaghan *et al.*, 1981). An early hypersthene-bearing, adamellite porphyry occurs east of St Marys (fig. 1).

Small bodies of biotite-muscovite alkali granite (e.g. at Mt Paris and Blue Tier) are the youngest major intrusions of the batholith and have associated cassiterite (and wolframite) mineralisation occurring either in close spatial association or in their greisenous equivalents (e.g. Anchor and Moon mines; Groves, 1968a; Groves and Taylor, 1973).

The batholith consists of eighteen major plutons, each being predominantly one of three granitic types: viz. (Groves, 1977) hornblende granodiorite and adamellite; biotite granite/adamellite; and biotite-muscovite alkali granite. The results of the gamma-ray spectrometer measurements are discussed for each pluton and in terms of these three granitic types.

The terminology and distribution of granitoids used in this report is that established by Gee and Groves (1971) and Groves (1977), with minor amendments (e.g. McClenaghan *et al.*, 1981). The different granitic bodies are designated as plutons; terms such as 'sheet' and 'mass' have been avoided, except for the St Marys Sheet. In the St Helens area, the term 'St Helens Pluton' is used for uniformity with the remainder of Groves' (1977) terminology for the Blue Tier Batholith, although Cocker (1977) rejects the term 'pluton'.

Twelve of the eighteen major bodies within the batholith were sampled during the course of the survey. These included two granodiorite plutons, three granite/adamellite plutons, and four alkali granite plutons, as well as two mixed granodiorite and adamellite plutons, and the St Marys Sheet. Gamma-radiation was measured at seventy sites scattered throughout the batholith (fig. 1) and the results are listed in Table 1 and illustrated in Figures 2 - 6.

#### *St Marys Sheet (Sites 26, 27)*

The St Marys Sheet, which lies south of the main mass of the Blue Tier Batholith (fig. 1), is an homogeneous, hypersthene-biotite adamellite porphyry, emplaced as a sheet with an associated feeder (McNeil, 1965; Groves, 1977; Turner *et al.*, *in prep.*).

The gamma-ray spectrometer results indicate 2.5 - 4.6% K<sub>2</sub>O, 2 - 4 g/t U, and 13 - 16 g/t Th. These values are similar to other granitic rock of the batholith, especially the granodiorite (fig. 2a, b).

#### *Pyengana Pluton (Sites 46-52)*

The Pyengana Pluton occurs on the south-west margin of the Blue Tier Batholith and consists of two segments; a rectangular north-east segment at Pyengana, and a larger elongate south-west segment which has a northward tapering extension (fig. 1). The pluton consists of relatively homogeneous, medium-grained biotite-hornblende granodiorite which is mostly massive but may be strongly foliated in places (Groves, 1977). East of the Pyengana Pluton (at Site 46) is a small body of similar biotite granodiorite and hornblende-biotite granodiorite (Groves, 1977).

The north-western segment and the small granodiorite body have radiometric characteristics (2.8 - 5.0% K<sub>2</sub>O, 3 - 5 g/t U, and 11 - 19 g/t Th) similar to the bulk of the Blue Tier granitic rock (Table 1; fig. 2a, b). However the south-western segment, near St Columba Falls (Sites 49, 50), has much higher values (4.2 - 6.3% K<sub>2</sub>O, 10 - 19 g/t U, 29 - 33 g/t Th; Table 1, fig. 2a, b), but the tapered northern end of this segment has values similar to the remainder of the mass (Site 52; fig. 2a, b). The higher gamma-radiation in the St Columba Falls area could be partly due to imperfect site geometry, as both sites are in a steep-sided valley.

#### *Gardens Pluton (Sites 73-76)*

The Gardens Pluton consists of hornblende-biotite granodiorite, with

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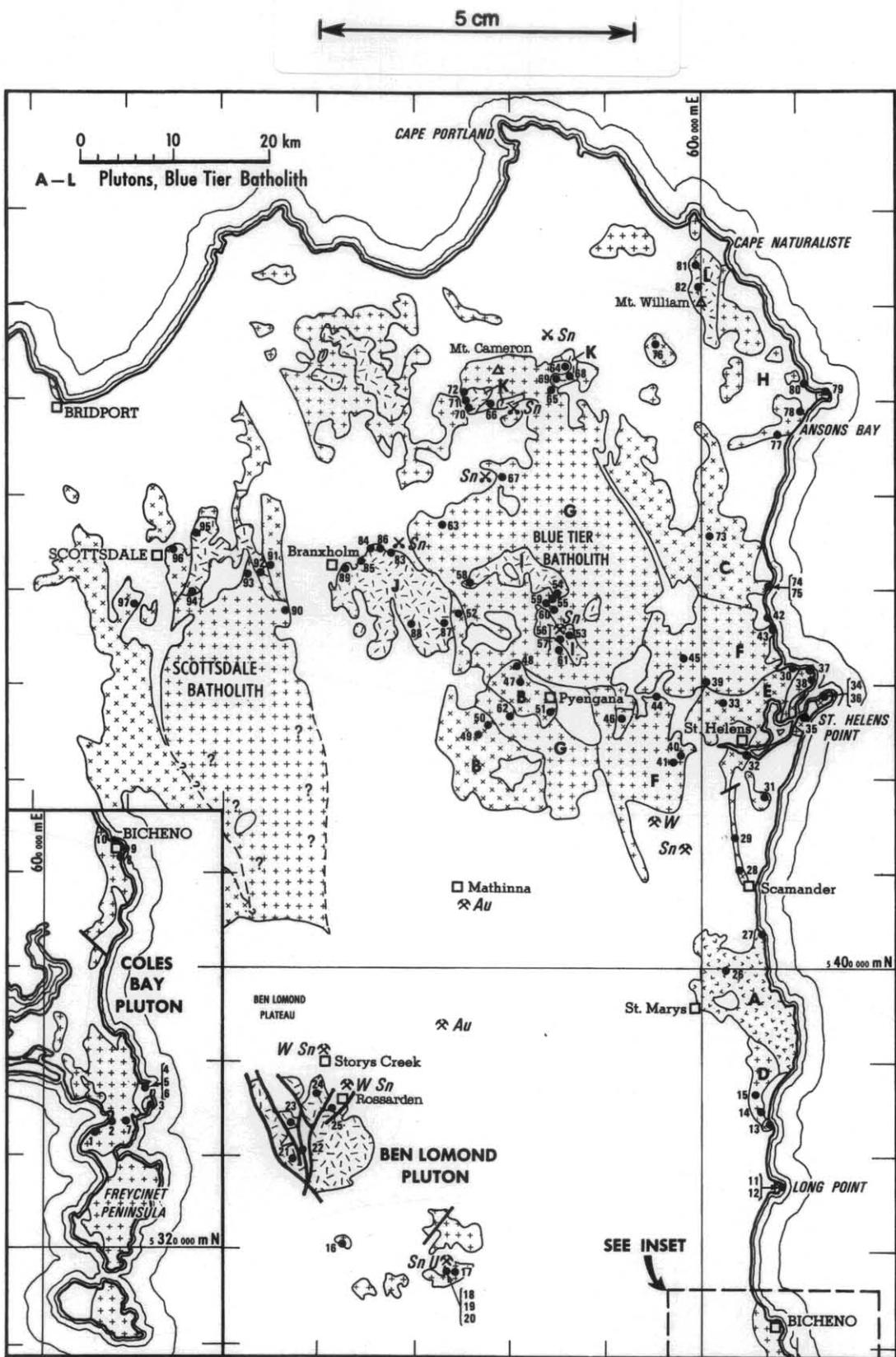


Figure 1. Granitoids of eastern Tasmania showing geophysical sample sites and some tin and tungsten occurrences (see Figure 10 for legend). Geology based on Groves et al., 1977; McClenaghan and Baillie, 1975; Gulline and Forsyth, 1976; McClenaghan et al., 1981; Turner, 1980. Plutons in the Blue Tier Batholith sampled during the survey are as follows: A = St Marys Sheet, B = Pyengana Pluton, C = Gardens Pluton, D = Piccaninny Creek Pluton, E = St Helens Pluton, F = Mt Pierson Pluton, G = Poimena Pluton, H = Ansons Bay Pluton, I = Lottah Pluton, J = Mt Paris Pluton, K = Mt Cameron Pluton, and L = Mt William Pluton.

minor hornblende diorite and biotite granodiorite (Groves, 1977) cropping out in the north-eastern part of the batholith. The granodiorite is generally massive, though at The Gardens it has a cataclastic foliation, and is similar in appearance and mineralogy to granodiorite of the Pyengana Pluton (Groves, 1977).

The gamma-ray spectrometer results were 2.5 - 4.7% K<sub>2</sub>O, 2 - 7 g/t U, and 13 - 20 g/t Th, which are similar to the north-western segment of the Pyengana Pluton (Table 1, fig. 2a, b).

*Piccaninny Creek Pluton (Sites 11-15)*

The Piccaninny Creek Pluton is a north-south trending elongate body that intrudes the St Marys Sheet (McNeil, 1965) and extends south to Long Point (fig. 1). It is composed mainly of homogeneous, massive biotite adamellite and hornblende-biotite adamellite. Foliated hornblende-biotite granodiorite occurs at Piccaninny Point and Long Point.

Gamma-ray spectrometer results indicate 2.3 - 5.4% K<sub>2</sub>O, 2 - 7 g/t U, and 14 - 22 g/t Th, again similar to the bulk of the granitic rock of the Blue Tier Batholith (fig. 2a, b). A pink granite dyke (Site 12) that post-dates the foliation at Long Point has much higher potassium (8.4% K<sub>2</sub>O) and thorium (32 g/t) than the host granodiorite, but similar uranium (6 g/t).

*St Helens Pluton (Sites 28-39)*

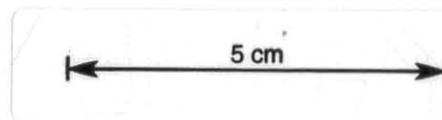
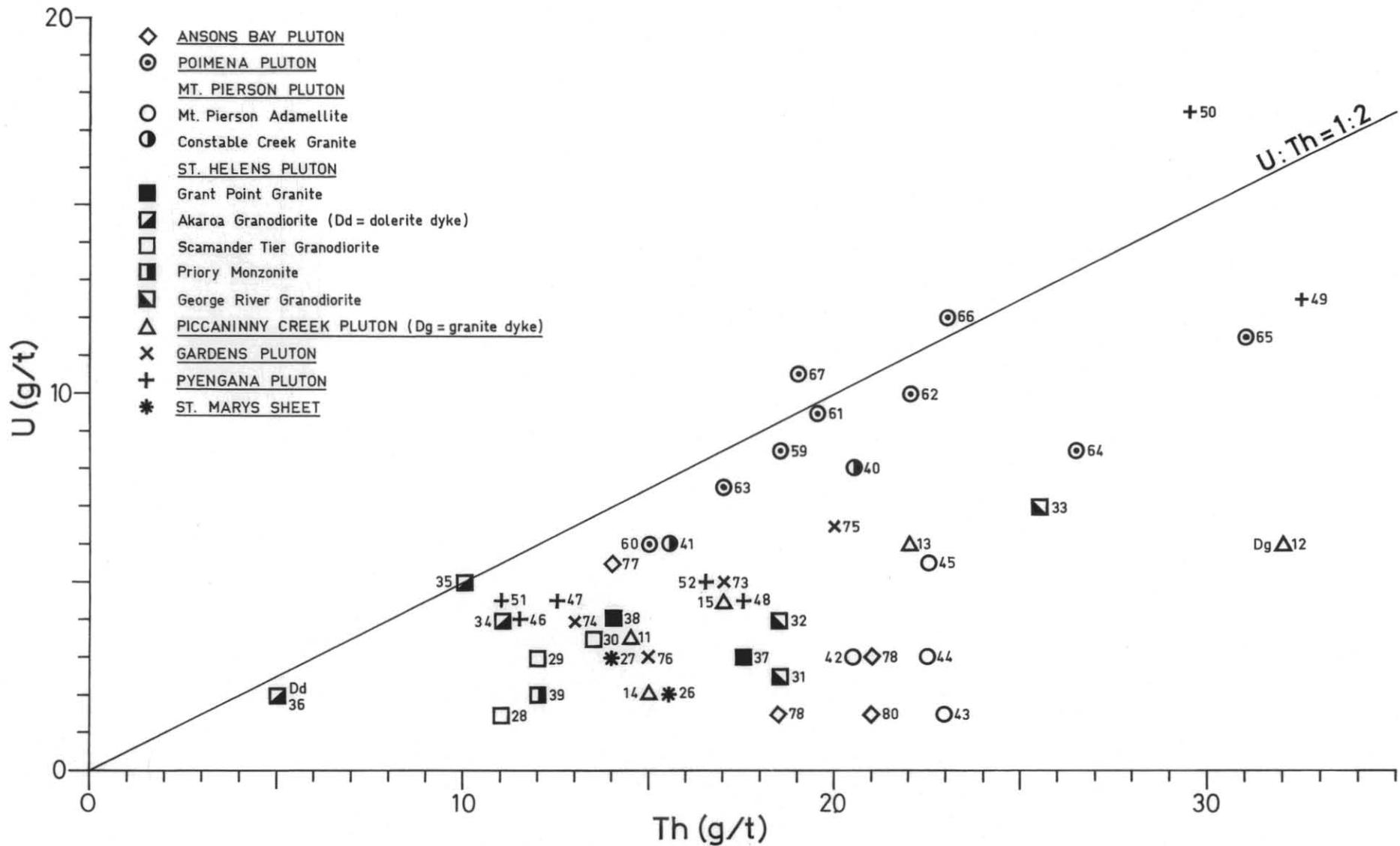
The granitic rocks of the St Helens area are more heterogeneous and structurally irregular than the remainder of the Blue Tier Batholith. They consist of a complex sequential emplacement of monzonite, diorite, granodiorite, adamellite, and granite (Cocker, 1971; 1977, Groves, 1972a; 1977). The most common rock type ranges from hornblende-biotite granodiorite to hornblende-biotite adamellite or biotite adamellite.

The *George River Granodiorite (Sites 31-33)*, the largest intrusive unit in the St Helens area, is a heterogeneous body ranging from hornblende-biotite granodiorite north of St Helens, to biotite adamellite south of St Helens. The gamma-ray spectrometer results are similar for these two major rock types (3.8 - 4.9% K<sub>2</sub>O, 2 - 4 g/t U, and 18 - 19 g/t Th) but coarse-grained granodiorite at Reids Road (Site 33) has much lower potassium (1.6% K<sub>2</sub>O) and higher uranium and thorium (7 g/t and 25 g/t respectively).

The *Priory Monzonite (Site 39)* occurs as small separate bodies of medium to coarse-grained hornblende monzonite restricted within, though petrogenetically unrelated to, the George River Granodiorite (Cocker, 1971; 1977). The single site at Priory indicated 3.0% K<sub>2</sub>O, 2 g/t U, and 12 g/t Th.

The *Scamander Tier Granodiorite (Sites 28-30)* forms a north-south trending dyke, 24 km long, extending from Scamander in the south to Binalong Bay in the north (Cocker, 1971; 1977). It is predominantly a granodiorite porphyry, although hornblende-biotite adamellite and porphyritic biotite adamellite also occur (Cocker, 1971; 1977; Groves, 1972a; 1977). Gamma-ray spectrometer results indicate 2.8 - 4.4% K<sub>2</sub>O, 1 - 4 g/t U, and 10 - 14 g/t Th.

The *Akaroa Granodiorite (Sites 34-36)* is a biotite granodiorite which crops out on St Helens Point east of the Grant Point Granite (fig. 1). Values obtained from spectrometer measurements are 2.4 - 4.2% K<sub>2</sub>O, 3 - 5 g/t U, and 9 - 12 g/t Th. At Burns Bay, the granodiorite is intruded by a



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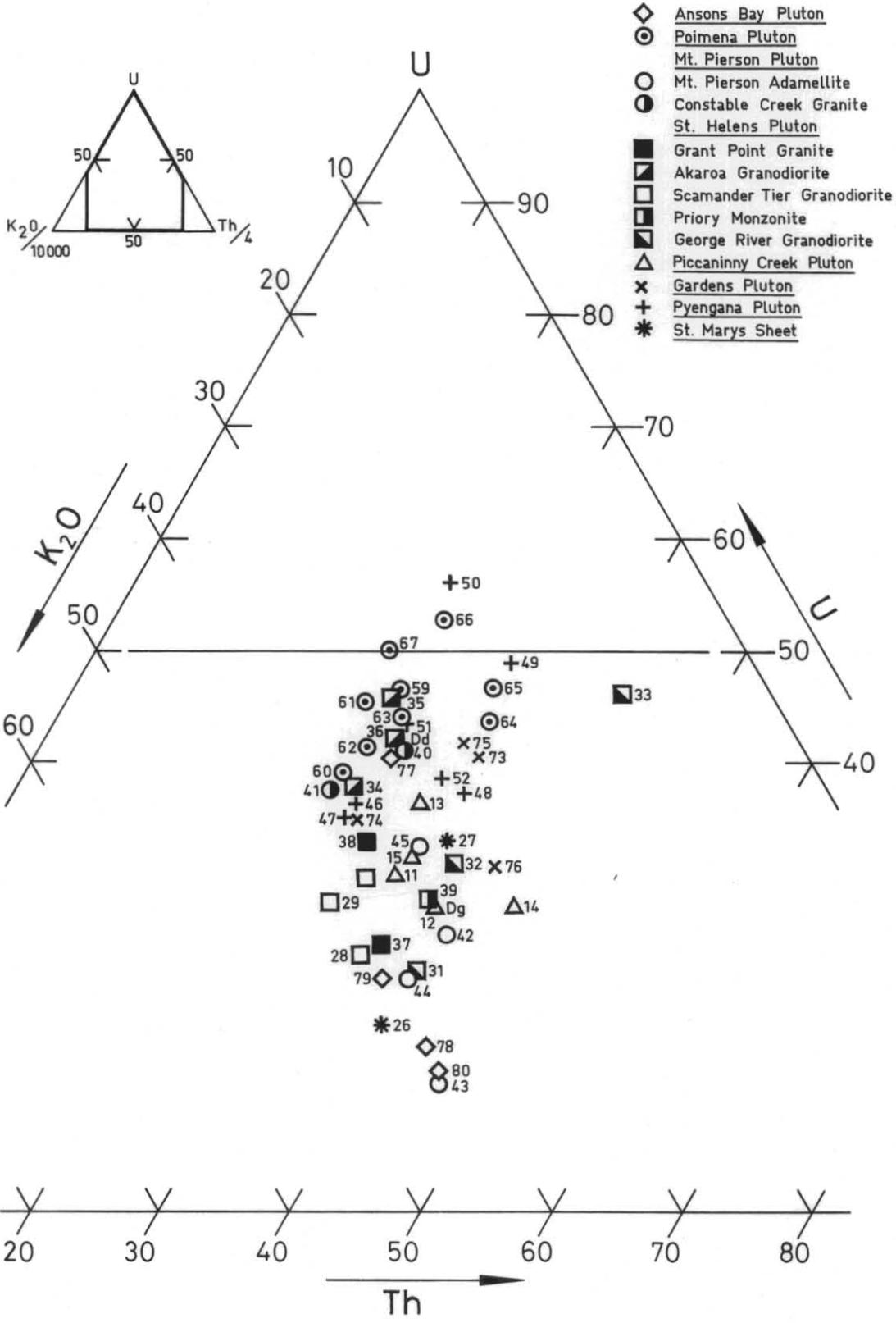


Figure 2b. K-U-Th ternary diagram for data in Figure 2a.

pre-Permian, fine-grained dolerite dyke (Site 36) containing minor pyrrhotite. A single gamma-ray spectrometer reading indicates very low thorium (5 g/t) and low potassium and uranium (fig. 2a, b).

The *Grant Point Granite* (Sites 37, 38) forms a curved dyke on Grants and St Helens Points, where it intrudes the Scamander Tier Granodiorite and the Akaroa Granodiorite (fig. 1). It consists of porphyritic, fine-grained biotite granite containing minor hornblende (Cocker, 1977; Groves, 1977). Gamma-ray spectrometer readings indicate 4.4 - 5.1% K<sub>2</sub>O, 2 - 4 g/t U, and 14 - 18 g/t Th (Table 1, fig. 2a, b).

*Mt Pierson Pluton (Sites 40-45)*

The Mt Pierson Pluton is the second largest biotite granite/adamellite pluton in the Blue Tier Batholith, skirting the St Helens Pluton (fig. 1). The two units of the pluton, the Mt Pierson Adamellite and Constable Creek Granite, have a gradational contact (Cocker, 1977; Groves, 1972a; 1977).

The *Mt Pierson Adamellite* (Sites 42-45) is the major unit and is predominantly coarse-grained biotite granite/adamellite, though porphyritic varieties occur in places. The gamma-ray spectrometer results indicate 4.6 - 6.2% K<sub>2</sub>O, 1 - 6 g/t U, and 19 - 26 g/t Th, and plot as a neat group in Figures 2a and 2b, but with higher thorium values than most granite/adamellite in the batholith.

The *Constable Creek Granite* (Sites 40, 41) is a composite assemblage of fine to coarse-grained biotite granite flanking the eastern and southern margin of the Mt Pierson Adamellite (Cocker, 1977; Groves, 1972a; 1977). Tungsten, molybdenum, and bismuth minerals occur in quartz veins in a local dome of the granite (Echo mine), and other tungsten and molybdenum deposits occur in a zone marginal to the pluton (Groves, 1972a). The granite has similar potassium and thorium contents to the Mt Pierson Adamellite, but higher uranium values (5 - 9 g/t) (fig. 2a, b).

*Poimena Pluton (Sites 59-67)*

The Poimena Pluton is the largest pluton of the Blue Tier Batholith, occupying about 45% of its surface area (fig. 1). It is a relatively homogeneous, porphyritic biotite and biotite-minor muscovite granite/adamellite, although variation occurs in the proportion of K-feldspar phenocrysts, biotite and muscovite, and in the grain size of the ground-mass (Groves, 1977; McCleneghan et al., 1981).

The uniformity of the pluton is reflected in the gamma-ray spectrometer results, with 4.4 - 7.7% K<sub>2</sub>O (most between 4.4 - 6.0% K<sub>2</sub>O), 6 - 13 g/t U, and 14 - 31 g/t Th. The pluton is higher in both uranium and thorium than the majority of the granite/adamellite in the batholith (fig. 2a), and in the K-Th-U diagram its relative position is closer to the U apex (fig. 2b).

The Poimena Pluton hosts tin-mineralised alkali granite (e.g. the Lottah Pluton). No variation in the uranium and thorium values was detected in the host pluton close to the contact with the alkali granite.

*Ansons Bay Pluton (Sites 77-80)*

The Ansons Bay Pluton occurs in the north-east of the Blue Tier Batholith, between Cape Naturaliste and Ansons Bay (fig. 1). It consists of coarse, densely to sparsely porphyritic, coarse-grained biotite granite/

adamellite with minor fine-grained biotite adamellite, and is similar to the adamellite of the Mt Pierson Pluton.

Gamma-ray spectrometer results indicate 4.4 - 6.7% K<sub>2</sub>O, 1 - 3 g/t U, and 17 - 21 g/t Th, similar to the Mt Pierson Adamellite (fig. 2a, b). A very fine grained granite/adamellite variant cropping out on the north shore of Ansons Bay (Site 77) gave lower potassium and thorium and higher uranium values when compared to the coarser-grained adamellite (4.2% K<sub>2</sub>O, 14 g/t Th, and 5 g/t U) (Table 1; fig. 2a, b).

*Lottah Pluton (Sites 53-58)*

The Lottah Pluton occurs in the Blue Tier area in the central part of the Poimena Pluton, where it crops out as a group of essentially flat-topped bodies consisting mainly of medium-grained, equigranular, muscovite-biotite alkali granite with quartz and feldspar-porphyrific variants. The granite contains accessory tourmaline, topaz, cassiterite, and fluorite, and has leucogranite, aplite, and pegmatite variants (Groves, 1968a; 1977; McClenaghan *et al.*, 1981). Adjacent to the upper contact, the alkali granite is commonly greisenised, but this alteration does not extend into the overlying porphyritic adamellite (Poimena Pluton). Greisens at the Anchor mine and at Poimena include variable amounts of cassiterite, topaz, fluorite, siderite, chalcopyrite, bornite, and molybdenite (Groves and Taylor, 1973; Groves, 1968a).

The gamma-ray spectrometer results indicate a broad range in composition (1.2 - 7.0% K<sub>2</sub>O, 3 - 34 g/t U, and 4 - 21 g/t Th) (Table 1, fig. 3a, b). However, most of this variation is due to radiation measured from mineralised greisens at the Anchor and Moon mines. The alkali granite (Sites 53, 54, 56, 58) is more consistent with 2.2 - 4.5% K<sub>2</sub>O, 3 - 12 g/t U, and 4 - 17 g/t Th. At the Moon mine (Site 55), readings at four separate locations less than 50 m apart have a broad range in K<sub>2</sub>O (1.2 - 4.0%), but limited ranges of high uranium (9 - 11 g/t) and low thorium (9 - 12 g/t).

The highest radioactive element values are at the Anchor mine (Site 57), with 5.5 - 6.0% K<sub>2</sub>O, 19 - 34 g/t U, and 17 - 20 g/t Th. These high values may be partly due to imperfect site geometry, as measurements were necessarily made in an old open cut mine. However, in the K-U-Th diagram (fig. 3b) this site plots well towards the uranium apex, indicating significant enrichment in that element.

*Mt Paris Pluton (Sites 83-89)*

The Mt Paris Pluton is the largest single exposed alkali granite body of the Blue Tier Batholith, cropping out on its western flank (fig. 1). The pluton consists predominantly of pink to yellow-brown, fine to medium-grained, equigranular muscovite-biotite alkali granite, though porphyritic biotite alkali granite (with quartz and feldspar phenocrysts) is common in the north (Groves, 1977; McClenaghan *et al.*, 1981). Topaz, cassiterite, and fluorite are common accessory minerals, and numerous greisen bodies with cassiterite, wolframite, and sulphides (*e.g.* Bells Hill, Mammoth, and Star of Peace mines) occur along its south-west flank (Jack, 1966a; Groves, 1977).

The gamma-ray spectrometer results for the pluton indicate 4.5 - 6.6% K<sub>2</sub>O, 7 - 17 g/t U, and 10 - 17 g/t Th. The results are closely grouped on the U-Th diagram and plot as a short linear trend towards the U apex on the K-Th-U diagram (fig. 3a, b). In both diagrams, high uranium values cause this granite to plot clear of the majority of the granitic rocks of the

41-12

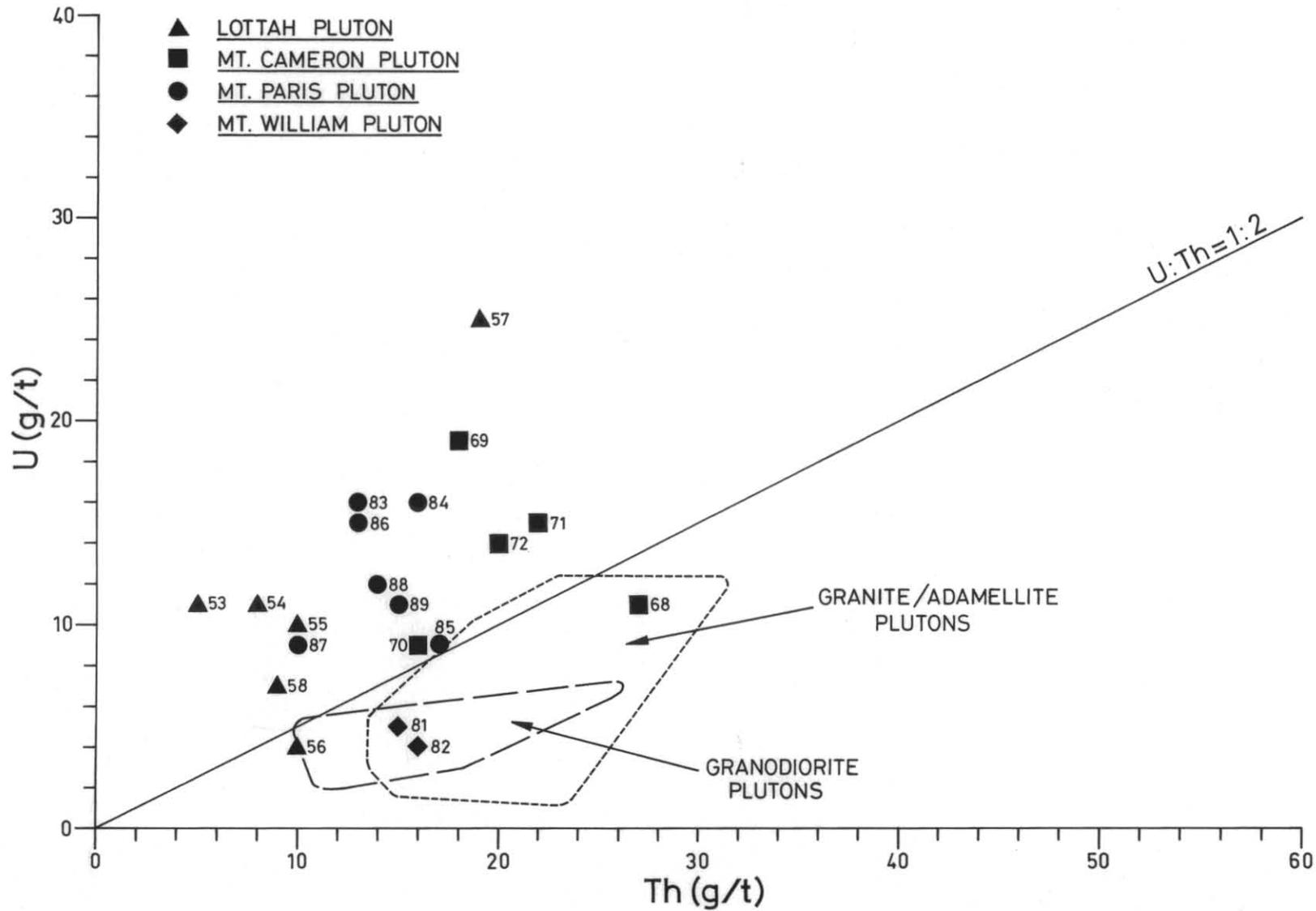
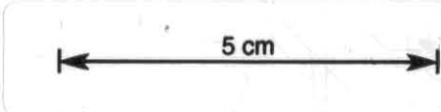


Figure 3a. *U and Th values for some alkali granite plutons of the Blue Tier Batholith showing their higher U values compared with the fields for granodiorite and granite/adamellite plutons from Figure 2a.*



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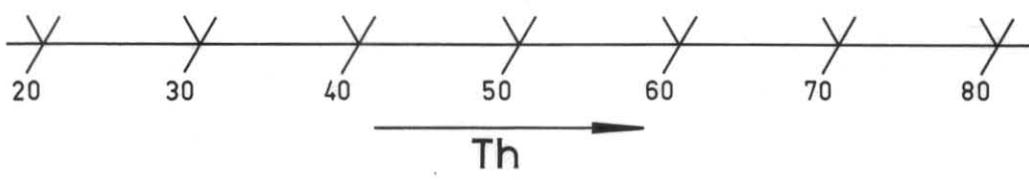
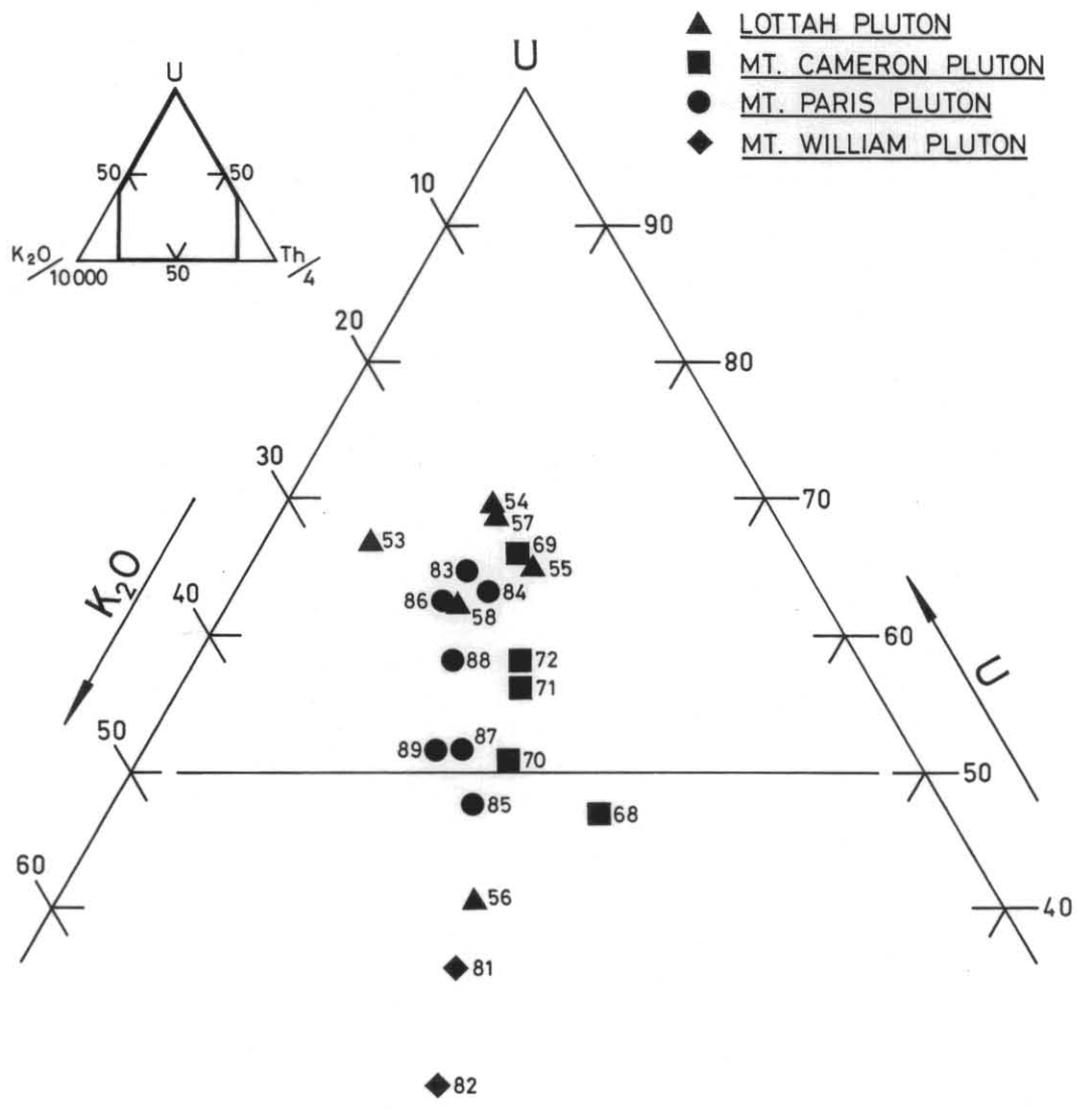
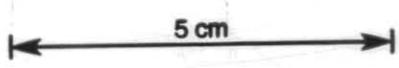


Figure 3b. K-U-Th ternary diagram for data in Figure 3a.



Blue Tier Batholith (*cf.* fig. 2a with 3a; 2b with 3b). There is no radiometric distinction between the equigranular and porphyritic varieties.

*Mt Cameron Pluton (Sites 68-72)*

The Mt Cameron Pluton includes several small discontinuous bodies on the eastern, southern, and western flanks of Mt Cameron (fig. 1) where they may either intrude or are gradational with the biotite granite/adamellite of the Poimena Pluton. The bodies consist of fine to coarse-grained, equigranular muscovite-biotite alkali granite which have phenocrysts of quartz and feldspar in places (Groves, 1977; McClenaghan *et al.*, 1981). Alluvial tin deposits surround Mt Cameron (*e.g.* Endurance mine).

The gamma-ray spectrometer results indicate 3.9 - 5.9% K<sub>2</sub>O, 8 - 19 g/t U, and 16 - 29 g/t Th. The results plot as scattered points on the U-Th and K-Th-U diagrams (figs. 3a, b), but like the Mt Paris and Lottah Plutons they plot clear of the majority of the granite/adamellite and granodiorite of the batholith due to higher uranium. However, unlike the Mt Paris Pluton, it appears there may be a radiometric distinction between the porphyritic and equigranular varieties with 14 - 19 and 8 - 12 g/t U respectively.

*Mt William Pluton (Sites 81, 82)*

The Mt William Pluton occurs as a north-south trending elongate body in the north-east of the Blue Tier Batholith (fig. 1). It consists of pink to yellow-brown, medium-grained, equigranular, muscovite-biotite alkali granite and is petrographically similar to tin-bearing alkali granites of the Mt Cameron and Mt Paris plutons (Groves, 1977; Jennings, 1977).

Gamma-ray spectrometer measurements taken at two separate sites indicate 4.7 and 5.4% K<sub>2</sub>O, 3 and 5 g/t U, and 5 and 6 g/t Th. Gravel derived from the granite recorded similar values. In the U-Th and K-Th-U diagrams, the Mt William Pluton plots in the same fields as the bulk of the granodiorite and granite/adamellite (fig. 3a, b) and therefore differs from the other alkali granite plutons.

Despite its petrological similarity to the other tin-bearing or tin-associated alkali granites (*i.e.* Mt Paris, Lottah, and Mt Cameron Plutons) the Mt William Pluton has no known associated lode or alluvial tin deposits, and chemical data indicate it has only limited potential as a source rock for tin mineralisation (Jennings, 1977). Thus it is significant that the Mt William Pluton, which has no tin, has low U and Th values similar to the bulk of the non-mineralised granitic rocks of the batholith, whereas the other alkali granites, with a high tin content and associated tin mineralisation, have a higher uranium content (*cf.* fig. 2a with 3a, 2b with 3b). Thus the radiometric measurements support Jennings' (1977) conclusion that it is not a suitable host rock for tin.

*EVALUATION OF SPECTROMETER DATA FOR THE BLUE TIER BATHOLITH*

The potassium, uranium, and thorium values for the granodiorite and granite/adamellite plutons (excepting the Poimena Adamellite) are similar, but the alkali granite plutons generally have much higher uranium values (fig. 2a, b and 3a, b). The Poimena Pluton has uranium values slightly higher than other granite/adamellite plutons.

The radiometric data also reflects the Batholith's three main rock types, irrespective of pluton. Each granitic type tends to plot in a

18/10

specific part of the U-Th and K-U-Th diagrams (fig. 4, 6).

In the U-Th diagram (fig. 4) the granodiorites lie in the range 2 - 6 g/t U and 10 - 20 g/t Th. The granite/adamellites partially overlap this field, but tend towards both higher uranium and thorium, with most points in the ranges of 2 - 12 g/t U and 14 - 23 g/t Th. The alkali granites are more widely scattered, with ranges of 4 - 25 g/t U and 5 - 27 g/t Th, but generally have higher uranium values than the granodiorite and granite/adamellite. The alkali granites are separated from the remainder of the granitic rocks, with few exceptions, by a line with the ratio U:Th = 1:2 (fig. 4). Exceptions to this distinction include two points of granite/adamellite of the Poimena Pluton (Sites 66, 67) (these are less than 1 g/t U above the line) and one granodiorite locality (Site 50) with poor site geometry.

All but four of the alkali granite points plot above this arbitrary dividing line. One of these points (Site 68) is of equigranular biotite-muscovite alkali granite on the east flank of Mt Cameron, whereas the porphyritic variety in this pluton is much higher in uranium. Another point (Site 56) is of biotite-muscovite alkali granite from the Lottah Pluton near the Anchor mine greisen. The other two points are from the Mt William Pluton, which has a relatively low tin content, no known associated tin mineralisation, and low uranium values.

Therefore, the radiometric data for the batholith indicate distinction in the uranium and U/Th values for granitoids (particularly alkali granites) which have a high tin content and associated tin mineralisation, from those with low (or average) tin contents and no associated tin mineralisation.

This distinction in uranium and thorium values of alkali granites compared with other granitic rocks of the Blue Tier Batholith is also shown in Figure 5, in which the average tin content of each pluton (analyses from Groves, 1977) is plotted against U/Th. The line U:Th = 1:2 and the maximum tin content (16 g/t) of granodiorite and granite/adamellite of the batholith (though the majority have less than 10 g/t Sn) are also plotted. The 'average' granite and granodiorite are also shown for comparison. As in Figure 4, alkali granites with high tin contents and associated tin deposits (i.e. Mt Cameron, Lottah, and Mt Paris Plutons) plot apart from the remainder of the granitic rocks of the batholith. Alkali granite of the Mt William Pluton has a similar U/Th ratio to the granodiorite and granite/adamellite plutons, but a slightly higher average tin content. In compiling Figure 5, data for greisens and greisenised granites (i.e. at the Anchor and Moon mines) have not been used in calculating the average U/Th values and average tin content.

In the K-Th-U diagram (fig. 6) all points plot on a linear trend which approaches the uranium apex as fractionation increases. The majority of the granodiorites and granite/adamellites plot in the lower part of the diagram, below the 50% uranium line, whereas most of the alkali granites plot above this line. The only granodiorite and granite/adamellite exceptions plotting above this dividing line are the same as in Figure 4 (i.e. Sites 50 and 66) but there are five alkali granite points plotting below the 50% uranium line. The two lowest points are from the Mt William Pluton (no associated tin mineralisation) and plot well within the field of granodiorite and granite/adamellite. Two of the remaining three points are the same as those previously explained and shown in Figure 4 (i.e. Sites 56, 68), whilst the fifth point (Site 85) is of porphyritic biotite-muscovite granite from the Mt Paris Pluton. Thus, the distinction between the alkali granites with associated tin mineralisation and the remaining

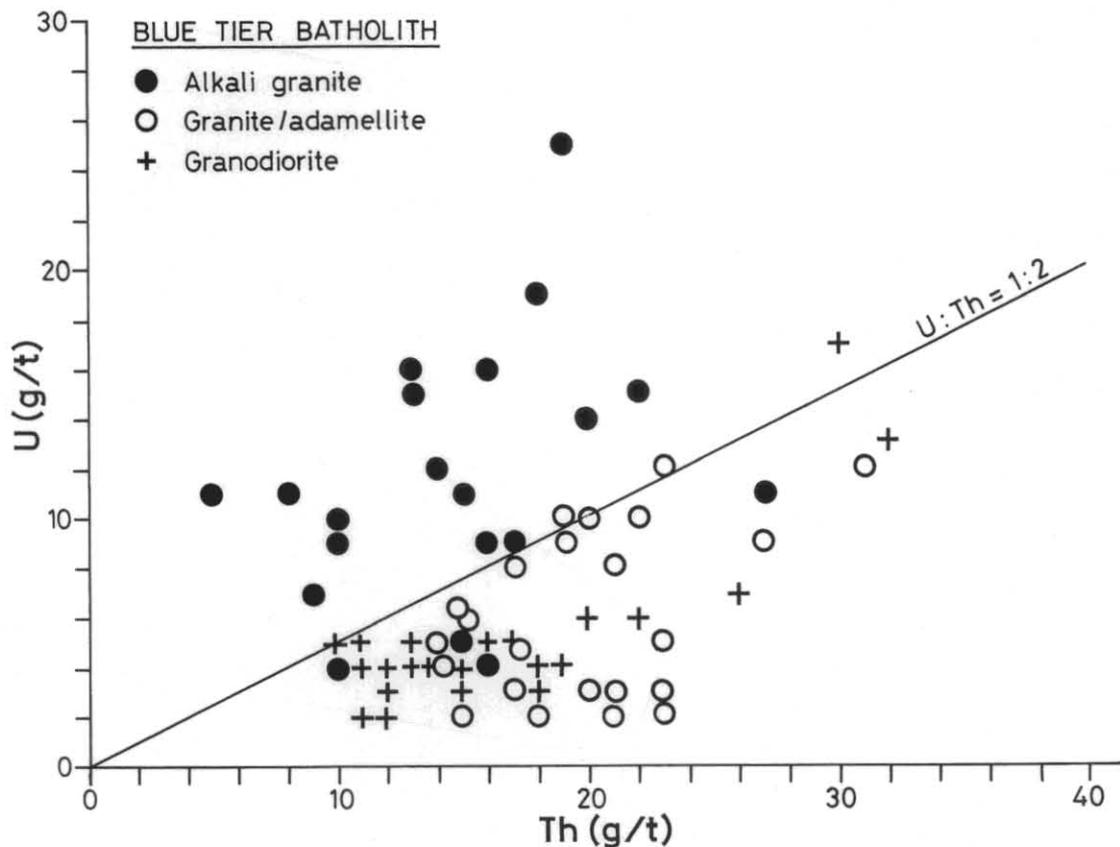


Figure 4. U and Th values for the three main granitic rock types of the Blue Tier Batholith.

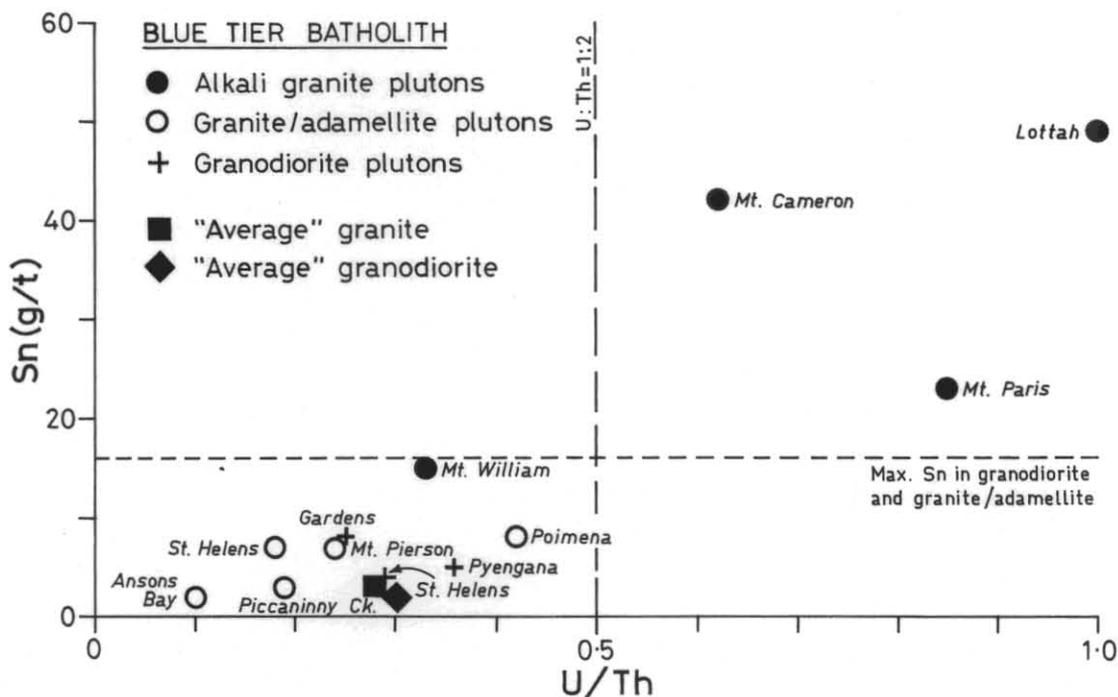
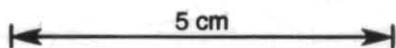


Figure 5. The average Sn content and the average U/Th ratios for selected plutons of the Blue Tier Batholith. Sn data are from Groves (1977). Data from greisens have not been used to calculate the average values. 'Average' granite and granodiorite from Levinson (1974).





granitic rock of the Blue Tier Batholith is not quite as clear cut in the K-Th-U ternary diagram as it is in the U-Th diagram, but the majority of the respective points plot in separate fields.

These dividing lines, which may be used to distinguish granites with associated tin mineralisation from other granitic rocks in the Blue Tier Batholith, are included on Figures 2 and 3 and also on all other U-Th and K-Th-U diagrams for comparison.

*COLES BAY PLUTON (SITES 1-10)*

The Coles Bay Pluton (fig. 1) is a predominantly coarse-grained, porphyritic to sub-porphyritic red biotite adamellite (Groves, 1966). A small body of biotite-hornblende granodiorite (Sites 4, 6) extends south of Bluestone Bay, and younger, molybdenite-bearing, pink micro-granite (Site 3) occurs as a sheet-like body at Cape Tourville. Coarse-grained, porphyritic biotite adamellite (Sites 8-10), which may exhibit lineation of the feldspar phenocrysts, is common in the Bicheno area. Alluvial tin deposits occur north of Coles Bay.

Radiometric results indicate that the Coles Bay Pluton is relatively high in potassium (4.2 - 8.1% K<sub>2</sub>O) and exhibits variable uranium (3 - 49 g/t) and thorium (17 - 78 g/t) (fig. 7). The red adamellite at Coles Bay (Sites 1, 2) has anomalously high values of uranium (35 and 48 g/t) and thorium (59 and 78 g/t), but a porphyritic variety at Sleepy Bay (Site 7) contains only 5 g/t uranium and still has a high thorium value (42 g/t). The granite/adamellite in the Bicheno area has 7 - 16 g/t U and 17 - 20 g/t Th, whilst the granodiorite at Bluestone Bay contains 2 - 4 g/t U and 18 - 20 g/t Th. The microgranite at Cape Tourville is more radioactive with 17 g/t U and 34 g/t Th.

Only the granodiorite at Bluestone Bay and one granite/adamellite (Site 9) at Bicheno are similar to the granite/adamellite and granodiorite of the Blue Tier Batholith. The remainder have higher uranium, thorium, or both. Several of the granite/adamellites plot in the field of Blue Tier Batholith granites with associated tin mineralisation (fig. 7a, b). The anomalously high results at Coles Bay may be partly due to poor site geometry, as the granite hills on Freycinet Peninsula could not be avoided. But even so, the U/Th ratios are greater than 0.5, and the two sites plot well above the 50% U line in Figure 7b. The microgranite at Cape Tourville plots on and slightly above the dividing lines in Figures 7a and 7b respectively and may be marginally prospective as a source of tin.

*BEN LOMOND PLUTON (SITES 16-25)*

The Ben Lomond Pluton (fig. 1) crops out south of the Ben Lomond Plateau and may be divided into two parts; a northern segment near Rossarden with associated tin and tungsten lode deposits (e.g. Storeys Creek, Aberfoyle mines; Blissett, 1959) and a southern segment at Royal George with associated Sn-U greisen mineralisation (e.g. Royal George mine; Urquhart, 1968). The pluton may be part of the Scottsdale Batholith (Turner, 1980) but is discussed here as a separate body.

The predominant granitic rock in the Royal George area is coarse-grained porphyritic biotite granite/adamellite (Site 16) which, at the Royal George mine, is intruded by a younger porphyritic, fine-grained biotite granite (Site 17). Here, both varieties are greisenised (Urquhart, 1968). The granite/adamellite has similar K<sub>2</sub>O, U, and Th values to the granite/adamellites of the Blue Tier and Scottsdale Batholiths, but the

porphyritic granite has a much higher uranium content and plots in the field of granites associated with tin mineralisation in the Blue Tier Batholith (fig. 7a, b). This implies that the greisenisation is associated with intrusion of the younger porphyritic granite. The greisen exposed in the open cut and on the dump at the Royal George mine (Sites 18-20) has a very high uranium value (up to 304 g/t), due mainly to secondary torbernite on joint surfaces.

The northern segment of the Ben Lomond Pluton, north of Avoca, consists mainly of coarse-grained, equigranular to porphyritic, pink biotite granite with fine-grained biotite-muscovite granite, microgranite, and porphyritic microgranite (Blissett, 1959). It is considered by Turner (1980) to be predominantly alkali granite. The gamma-ray spectrometer results indicate 5.0 - 7.1% K<sub>2</sub>O, high U (14 - 22 g/t), and variable Th (16 - 63 g/t) (Table 1, fig. 7a, b). The biotite-muscovite granite has the lowest thorium value and in the Sundial Creek area (Site 23) it plots within the field of tin-associated granites of the Blue Tier Batholith (fig. 7a, b). The biotite granite and microgranite (Sites 21, 22, 24) have much higher thorium values than all other granitic rocks in eastern Tasmania, except for Site 2 at Coles Bay (cf. figs. 2a, b; 3a, b; 7a, b), but the U/Th ratios of 0.27 - 0.35 are not unlike the Blue Tier Batholith granitoids.

SCOTTSDALE BATHOLITH

The Scottsdale Batholith (fig. 1) underlies an area of 750 km<sup>2</sup> and consists mainly of medium-grained, equigranular, hornblende-biotite granodiorite with a possible sheeted dome of equigranular, coarse-grained biotite granite/adamellite, with molybdenite-bearing, pink, biotite alkali granite on its eastern side (Longman, 1966; Turner, 1980; McClenaghan et al., 1981). Alluvial tin occurs north-east of Scottsdale, north of the alkali granite at Mt Stronach, but its source is not known.

Gamma-ray spectrometer measurements were made across the northern part of the batholith, between Billycock Hill in the east and Scottsdale in the west. All three granitic types were sampled.

The granodiorite (Sites 91, 96, 97) has consistent values of 2.2 - 3.3% K<sub>2</sub>O, 2 - 4 g/t U, and 9 - 11 g/t Th (Table 1, fig. 7a, b), which are similar to granodiorites of the Blue Tier Batholith. The granite/adamellite (Sites 90, 93) has 4.9 and 6.3% K<sub>2</sub>O, consistent uranium (4 and 6 g/t), but variable thorium (22 and 37 g/t).

The alkali granite (Sites 92, 94, 95) contains 4.2 - 5.5% K<sub>2</sub>O, 5 - 13 g/t U, and 19 - 29 g/t Th. In the U-Th diagram, two of these sites plot below the line U:Th = 1:2 with one point just above. In the K-Th-U diagram two sites plot just above the 50% U line with the third point (Site 95) well below (fig. 7a, b). When compared with the observations on the Blue Tier Batholith, the alkali granite at Mt Stronach is only marginally prospective as a potential source or host for tin mineralisation.

FLINDERS ISLAND GRANITES

The granitic rocks of Flinders Island (fig. 8) are generally similar to the granitic rocks of the Blue Tier Batholith. The dominant granitic rock is a coarsely porphyritic to coarse-grained equigranular, biotite granite/adamellite with small bodies of medium-grained, equigranular biotite-muscovite granite. Medium-grained, equigranular, biotite and biotite-hornblende granodiorite crops out at Pats River (Groves, 1972c). Alluvial tin prospects occur west of Mt Boyes in the north-west corner of the island,

41-20

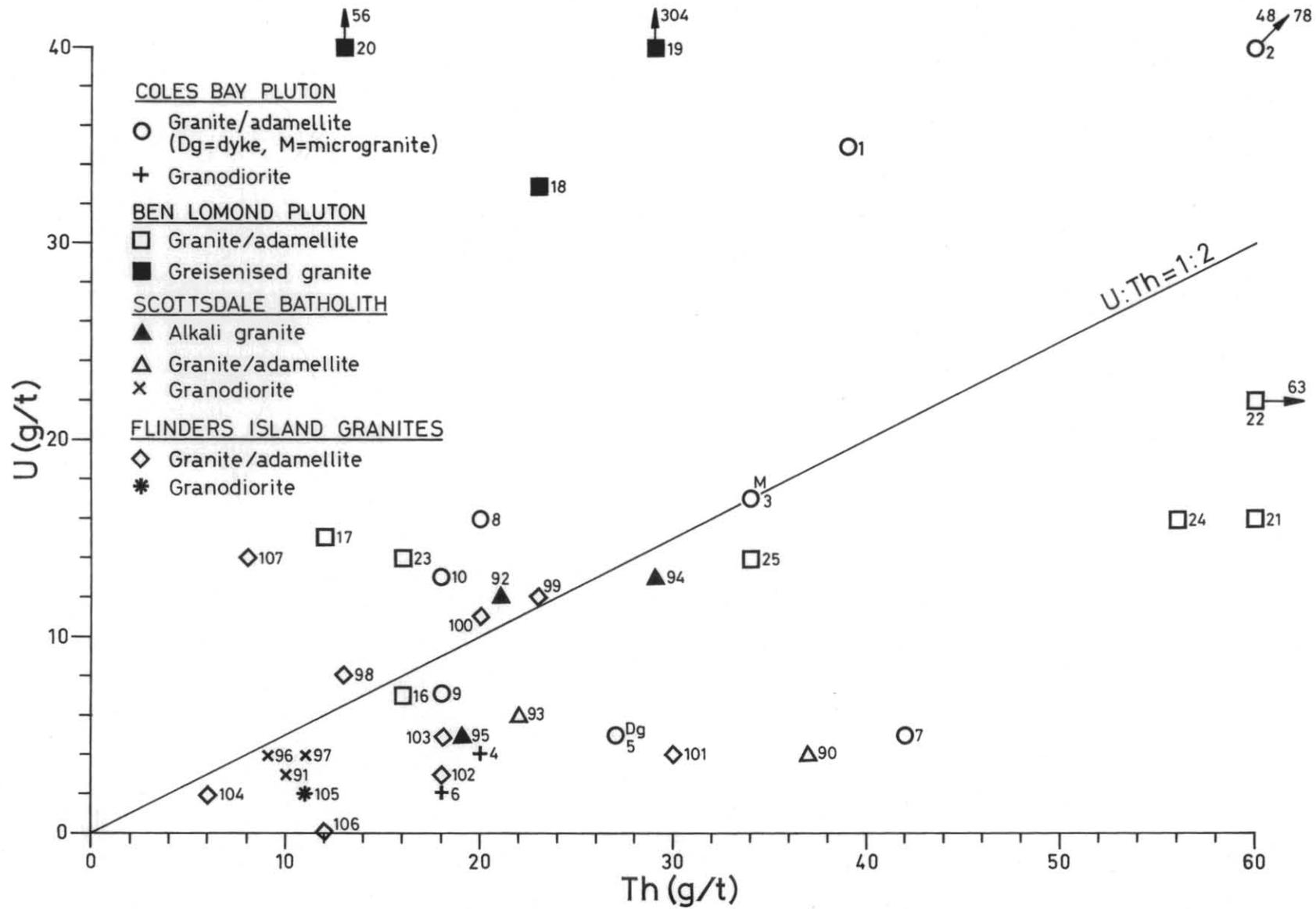
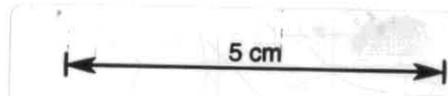


Figure 7a. U and Th values for selected phases of the Coles Bay Pluton, Ben Lomond Pluton, Scottsdale Batholith and Flinders Island granites.



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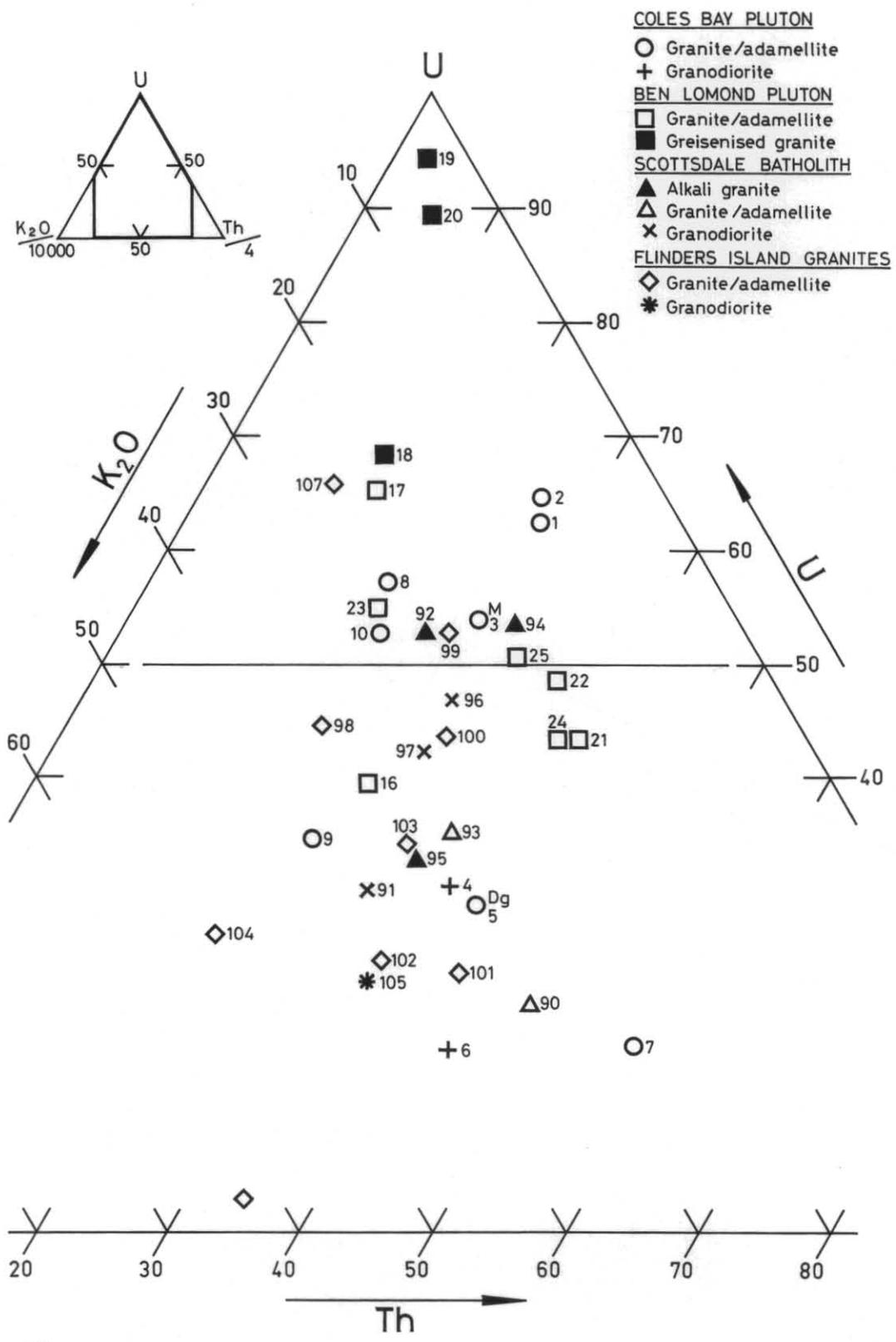
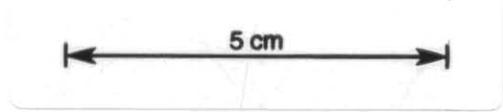


Figure 7b. K-U-Th diagram for data in Figure 7a.



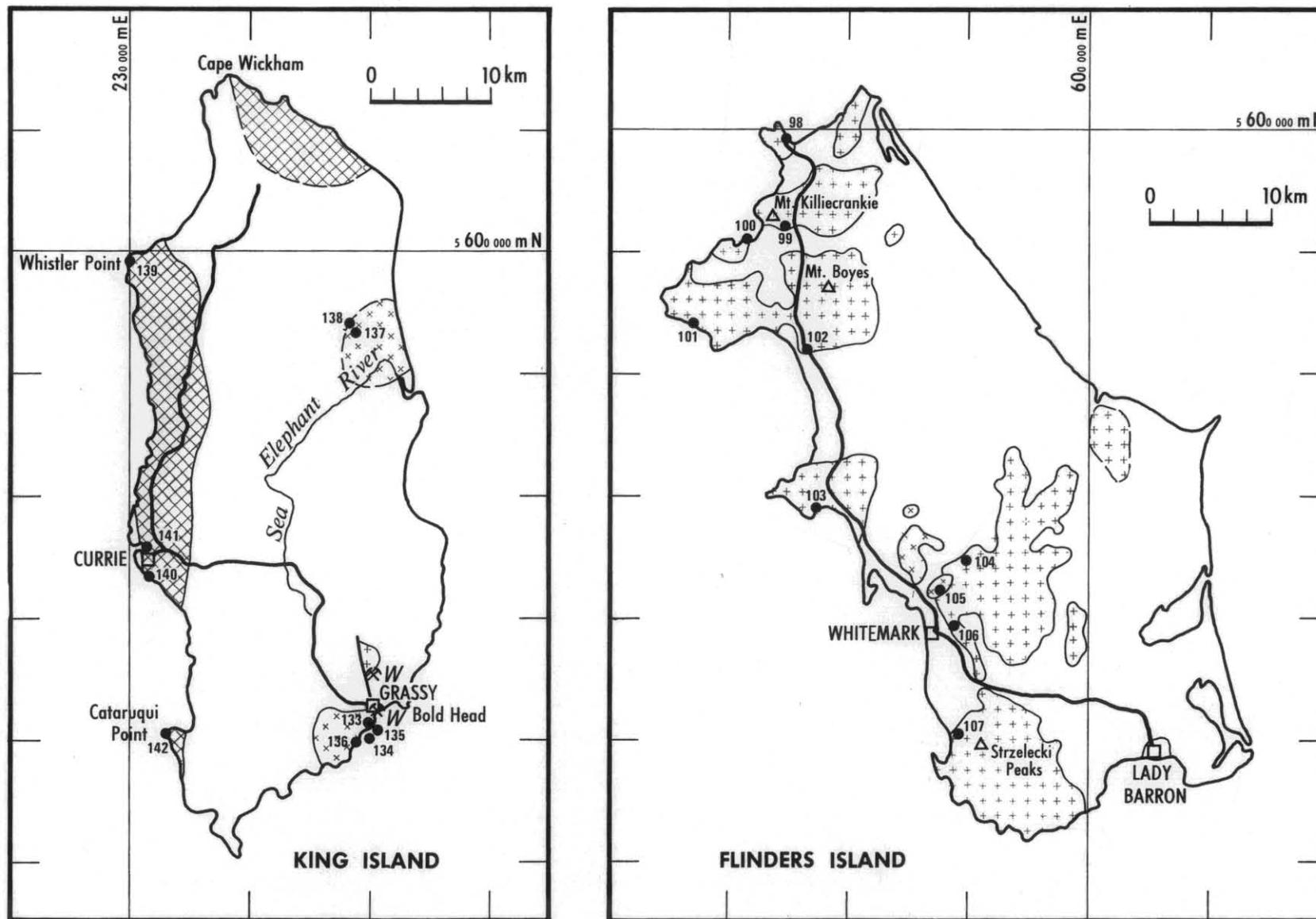


Figure 8. Granitoids of King Island and Flinders Island showing geophysical sample sites (see Figure 10 for legend). Geology based on Jennings and Cox (1978).

5 cm

25/70

and east and north-east of Whitemark.

Gamma-ray spectrometer measurements were made on the three main granitic types, though some plutons on the island were not sampled.

Granodiorite at Site 105 has 3.5% K<sub>2</sub>O, 2 g/t U, and 17 g/t Th, similar to granodiorite elsewhere in eastern Tasmania (cf. figs. 2a, b; 7a, b). The biotite granite/adamellite (Sites 98-103) exhibits a range of 5.0 - 6.7% K<sub>2</sub>O, 3 - 13 g/t U, and 12 - 30 g/t Th. In the U-Th diagram, the granite/adamellite points are relatively scattered, but the three sites in the Mt Killiecrankie area plot slightly above the line U:Th = 1:2 (fig. 7a). In the K-Th-U diagram only one of these sites (99) plots above the 50% U line, but the other two sites are relatively close below it (fig. 7b).

The biotite-muscovite granite (Sites 104, 106, 107) lack consistency in their radiometric results with 4.0 - 5.5% K<sub>2</sub>O, 0 - 14 g/t U, 6 - 12 g/t Th. Site 107 on the north-west flank of Mt Strzelecki has relatively high uranium (14 g/t), high U/Th (1.75) and falls well within the field of the granitic rocks with associated tin mineralisation (e.g. the Blue Tier Batholith). This granite could well be significant as a potential source or host for tin mineralisation. The other two sites (104, 106) have only 2 and 0 g/t U, and although they contain muscovite, they are not regarded as being prospective for tin (cf. the Mt William Pluton), although there are alluvial tin workings nearby (Jack, 1966b).

#### SPECTROMETRY OF GRANITIC ROCKS OF WESTERN TASMANIA

##### GRANITIC ROCKS OF KING ISLAND

Isotopic dating (McDougall and Leggo, 1965) has revealed Precambrian granite on the west and north coasts of King Island, and Devonian granitic rocks on the east coast (fig. 8). Gamma-radiation was measured on the Precambrian granite and on the Devonian granite at Grassy and Counsel Hill (fig. 8), but could not be measured on the Bold Head Adamellite north of Grassy.

##### *West Coast Granite (Precambrian) (Sites 139-142)*

The West Coast Granite crops out as a regionally concordant sheeted complex between Whistler and Cataragui Points, and as a separate granitic body east of Cape Wickham (fig. 8). The complex consists of equigranular, medium-grained biotite adamellite/granodiorite and porphyritic biotite adamellite in which phenocrysts locally exhibit a prominent lineation (McDougall and Leggo, 1965; Cox 1973). East of Cape Wickham it consists of coarsely porphyritic biotite adamellite (Cox, 1973).

Spectrometer measurements on the granitic rocks (Sites 139-141) gave variable results (4.5 - 8.2% K<sub>2</sub>O, 0 - 7 g/t U, and 24 - 33 g/t Th; Table 1, fig. 9a, b). At Cataragui Point, conformable bodies of altered, felsic, fine-grained igneous rock (Site 142), in an area mapped as granite, have 2.5% K<sub>2</sub>O, 4 g/t U, and 18 g/t Th.

##### *Sea Elephant Granodiorite (Devonian) (Sites 137 and 138)*

At Counsel Hill, near the mouth of the Sea Elephant River, is a small pluton of medium-grained, equigranular biotite-(hornblende) adamellite/granodiorite (fig. 8). Deposits of alluvial tin occur to the south-east, but their relationship to the pluton is not known.

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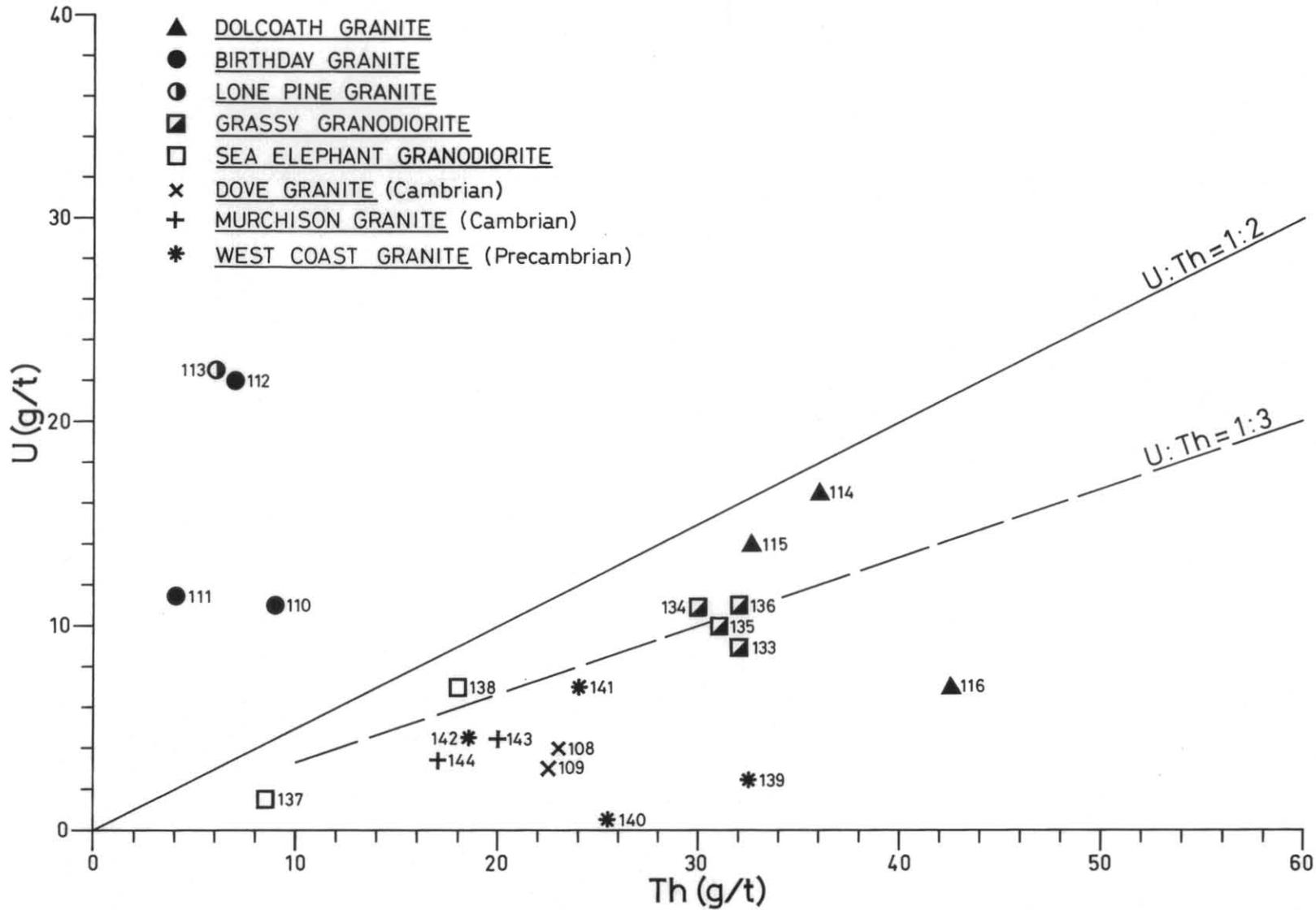
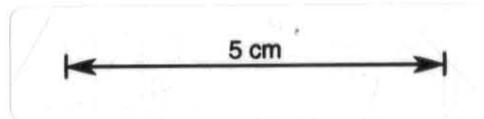


Figure 9a. U and Th values for the Dolcoath, Birthday, and Lone Pine Granites, the granitoids of King Island and Cambrian granites.



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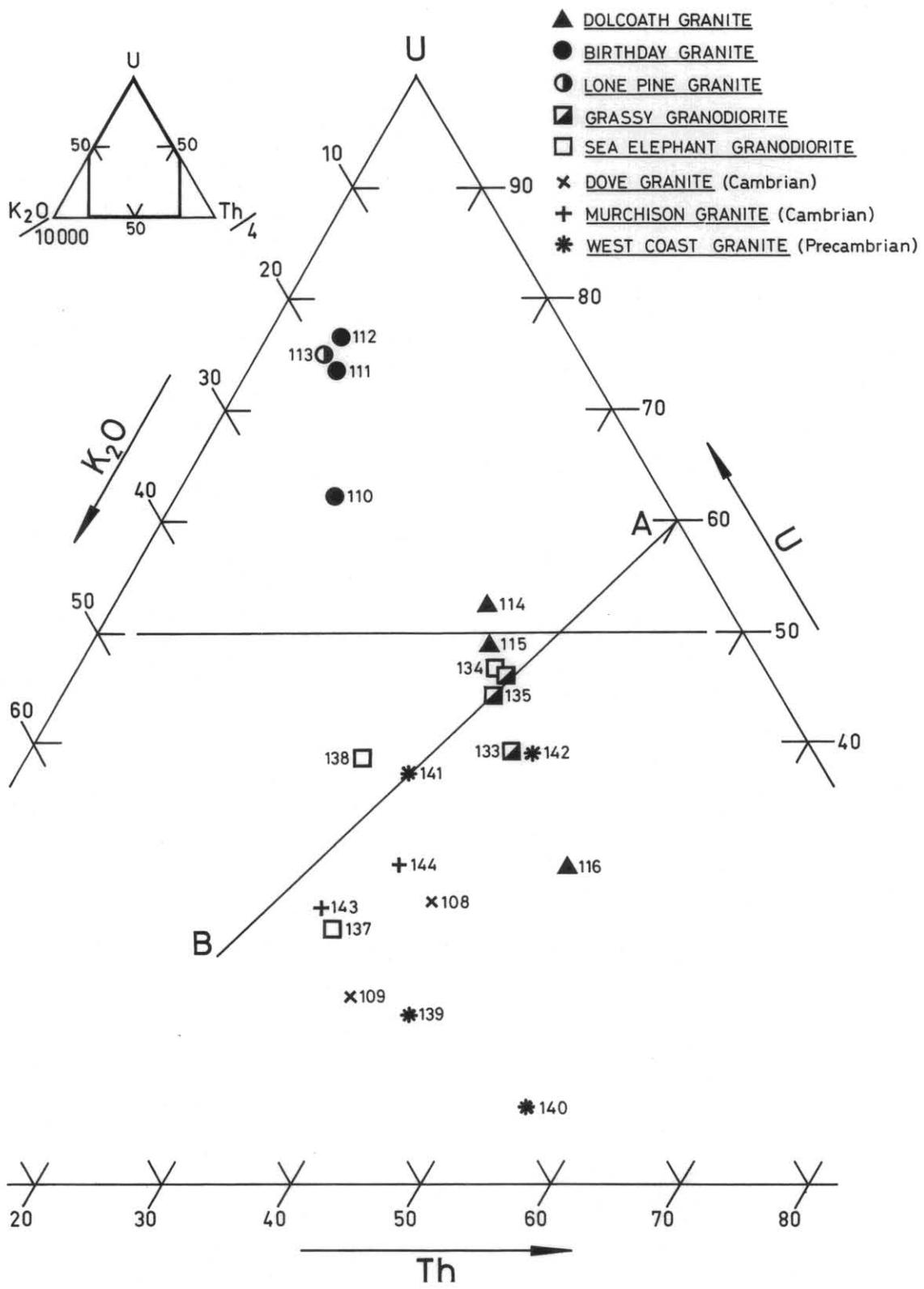


Figure 9b. K-U-Th ternary diagram for data in Figure 9a.

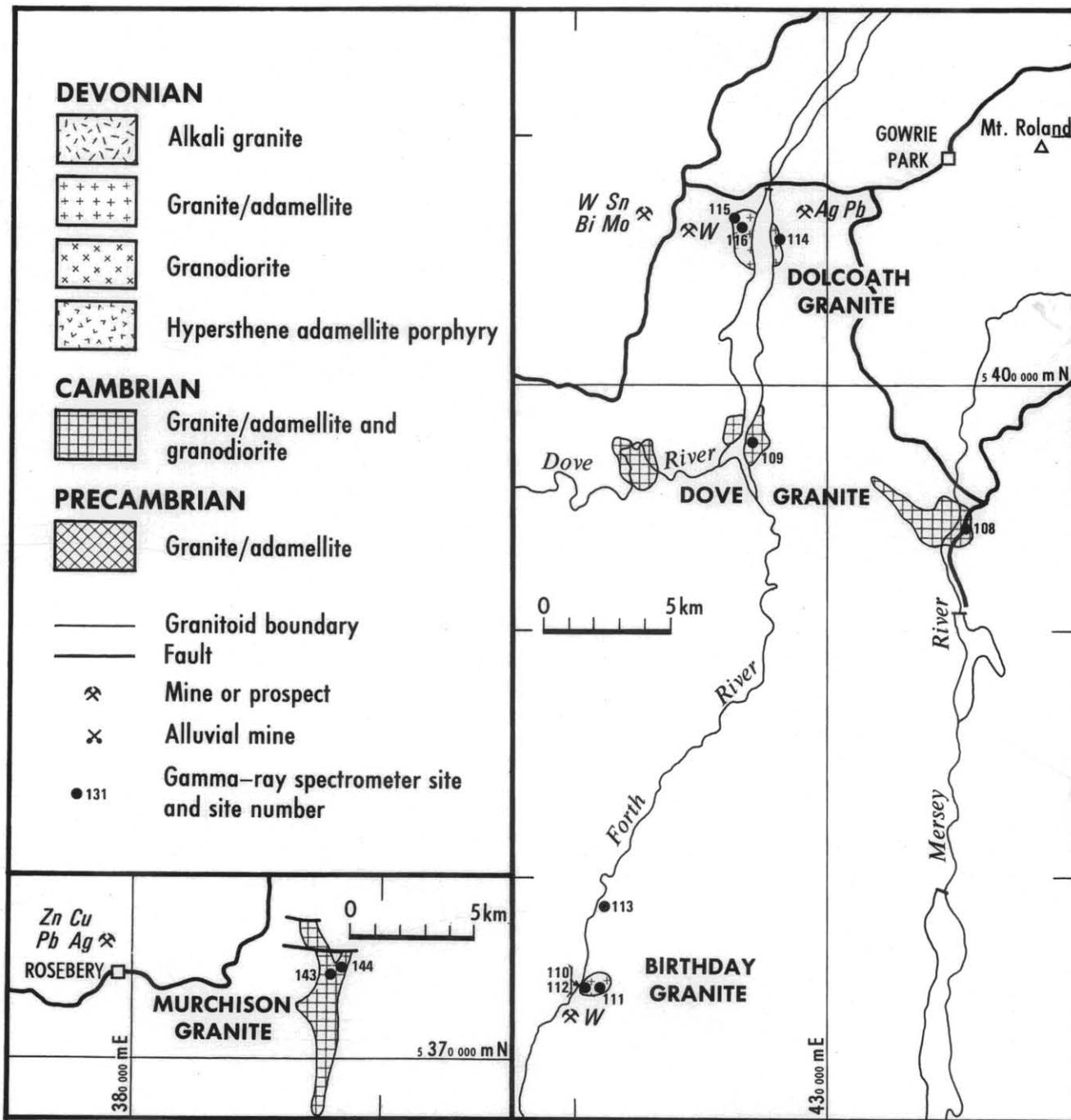


Figure 10. Maps showing the Devonian granitoids in the Forth Valley and the Cambrian granites, and geophysical sample sites. Geology based on Williams and Turner (1973).

5 cm

Gamma-ray spectrometer measurements indicate 3.1% K<sub>2</sub>O, 1 - 2 g/t U, and 7 - 10 g/t Th in the granodiorite (Site 137), whereas an aplitic granite intruding calc-silicate rocks near the margin of the pluton (Site 138) is much more radioactive (6.0% K<sub>2</sub>O, 7 g/t U, and 18 g/t Th; Table 1, fig. 9a, b).

*Grassy Granodiorite (Devonian) (Sites 133-136)*

South of Grassy is a small body of porphyritic biotite-hornblende granodiorite, the Grassy Granodiorite (fig. 8). Adjacent to the northern margin of the pluton are scheelite-bearing skarns at the Grassy mine (Large, 1971; Rogers, 1978).

Spectrometer measurements indicate consistent values of 4.7 - 5.3% K<sub>2</sub>O, 9 - 11 g/t U, and 30 - 32 g/t Th (fig. 9). The uranium and thorium values are high for granodiorite (cf. figs. 2a, 7a, and 9a), with the uranium values being as high as some tin and tungsten-mineralised granites in the Blue Tier Batholith (cf. figs. 3a and 9a).

*DOLCOATH GRANITE (SITES 114-116)*

The Dolcoath Granite is a small circular body deeply dissected by the River Forth (fig. 10). It consists of fine to medium-grained equigranular biotite granite/adamellite which is locally greisenised around its margins, where it contains accessory fluorite, topaz, and magnetite (Gee, 1966; Webb, 1974). Significant tin, tungsten, and bismuth mineralisation (e.g. Shepherd and Murphy mine) and silver-lead mineralisation (e.g. Round Hill mines) is genetically associated with this intrusion (Jennings, 1965; Collins, 1979).

Gamma-ray spectrometer measurements indicate consistent K<sub>2</sub>O (5.2 - 5.7%) but variable uranium (4 - 20 g/t) and thorium (30 - 50 g/t). In the U-Th and K-Th-U diagrams the greisenised granite (Sites 114 and 115) plots apart from the biotite granite/adamellite (Site 116) which has less uranium but higher thorium (fig. 9a, b).

*BIRTHDAY GRANITE AND LONE PINE GRANITE (SITES 110-113)*

The Birthday Granite, less than 500 m in diameter, crops out in the southern end of the Forth Valley (fig. 10). It is predominantly a fine to medium-grained, equigranular to sub-porphyritic biotite-muscovite granite with minor fine-grained muscovite-quartz porphyry. The granite and its country rocks are penetrated by quartz veins bearing wolframite and minor molybdenite and cassiterite (e.g. Oakleigh Creek mine).

The Lone Pine Granite is another very small body (100 m diameter) of fine-grained muscovite granite cropping out approximately three kilometres north of the Birthday Granite (fig. 10).

Spectrometer measurements indicate high uranium (11 - 22 g/t) and low thorium (less than 10 g/t), and high U/Th ratios (1.5 - 3.7) for both granites (fig. 9a). They plot well within the field of mineralised granites (fig. 9a, b), though in this case it is tungsten (as wolframite) mineralisation. Thus the sampled granitoids with associated tungsten mineralisation occurring as wolframite (as distinct from scheelite) are accompanied by high uranium and high U/Th ratios, similar to granite hosting tin mineralisation.

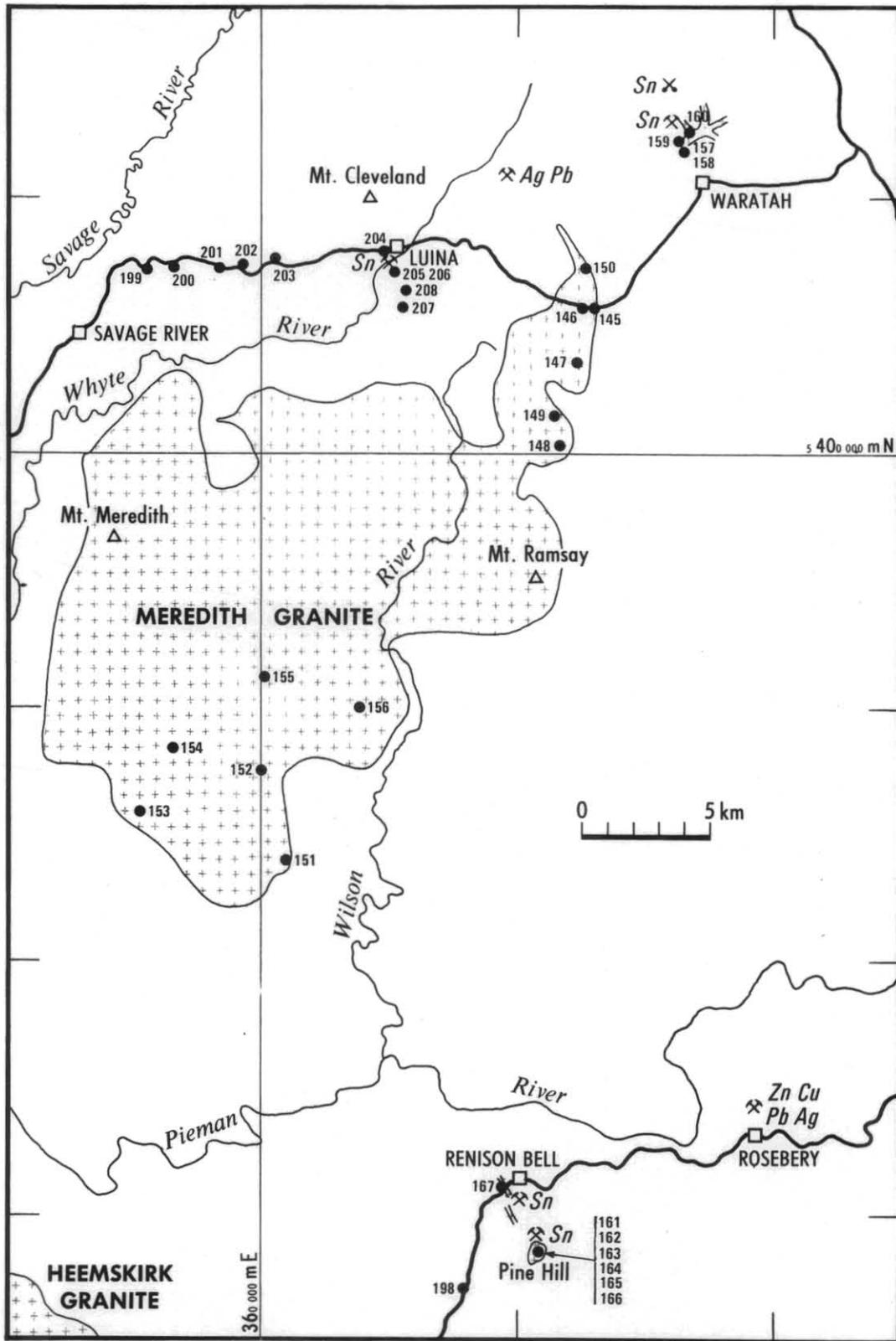


Figure 11. Map showing the Meredith Granite, Pine Hill Porphyry and dyke near Renison Bell, the porphyry dykes at Mt Bischoff near Waratah; and geophysical sample sites on granitoids and also on mafic and ultramafic rocks (see Figure 10 for legend). Geology based on Williams and Turner (1973) and Corbett and Brown (1975).

5 cm

MEREDITH GRANITE (SITES 145-156)

The Meredith Granite is the largest granitic body in north-western Tasmania (fig. 11). It is composed predominantly of fine to medium-grained, equigranular biotite adamellite and medium-grained porphyritic biotite granite/adamellite (Groves, 1968b; Groves et al., 1973; Stockley, 1972). Emanating from the northern margin of the granite are quartz feldspar porphyry dykes similar to the dykes at Mt Bischoff (Groves, 1968b; Collins, 1981). Adjacent to the Meredith Granite are several occurrences of skarn mineralisation (e.g. Mt Ramsay and Mt Lindsay) and nearby there are large cassiterite-pyrrhotite replacement deposits at Renison Bell, Luina, and Mt Bischoff (fig. 11).

Spectrometer readings indicate that the granite/adamellite has 5.1 - 6.6% K<sub>2</sub>O, 4 - 15 g/t U, and 19 - 30 g/t Th (fig. 12a, b), which are similar to the granite/adamellite in eastern Tasmania. The quartz-feldspar porphyry dyke (Site 150) has less potassium (3.9% K<sub>2</sub>O) and lower uranium and thorium (4 and 21 g/t respectively) than most of the granite/adamellite.

There is a distinct spatial variation in the results as defined by the measured uranium values. At localities in the southern part of the granite (Sites 151-156; fig. 11) the uranium values are higher than localities in the north-east (Sites 145-149), and the U/Th ratios are greater than 1:3 (fig. 12a). By comparing these results with those from elsewhere in Tasmania, the southern part of the Meredith Granite is more prospective as a host for tin mineralisation than the area sampled in the north-east.

PORPHYRY DYKES AT MT BISCHOFF (SITES 157-160)

At Mt Bischoff, near Waratah (fig. 11), anastomosing quartz-orthoclase porphyry dykes and sills have been extensively altered to assemblages containing variable topaz, tourmaline, quartz, carbonate, fluorite, sulphides, and cassiterite. The dykes are adjacent to dolomite which hosts metasomatic, massive pyrrhotite-cassiterite bodies (Groves, 1968b; Groves et al., 1973).

Their variable alteration is reflected in the spectrometer results by erratic K<sub>2</sub>O values (0.1 - 3.3%), though uranium (3 - 6 g/t) and thorium (4 - 12 g/t) are more consistent. These values are comparable to chemical analytical data which show <0.4 - 6.0% K<sub>2</sub>O, 3 - 22 g/t U, and <3 - 100 g/t Th in the dykes (Groves et al., 1973).

PINE HILL PORPHYRY (SITES 161-167)

The Pine Hill Porphyry is a small, composite cupola at Pine Hill, three kilometres south of Renison Bell (fig. 11). It consists mainly of porphyritic and equigranular sodoclase adamellite, which is extensively greisenised and tourmalinised (Groves, 1968b). Radiating from the porphyry are numerous quartz porphyry dykes which have also been extensively greisenised (Groves, 1968b; Collins, 1972). Analytical data (Groves, 1968b) exhibit erratic values of 0.1 - 4.9% K<sub>2</sub>O, <3 - 46 g/t U, and <3 - 61 g/t Th.

The porphyry exhibits much variation in the spectrometer results (0.2 - 1.8% K<sub>2</sub>O, 3 - 15 g/t U, and 0 - 25 g/t Th; Table 1, fig. 12a, b). A quartz porphyry dyke near Renison Bell (Site 167) is more potassic (3.8% K<sub>2</sub>O) than the porphyry on Pine Hill, but has similar uranium and thorium. Like the results obtained at Mt Bischoff, the erratic values are due to the variable alteration.

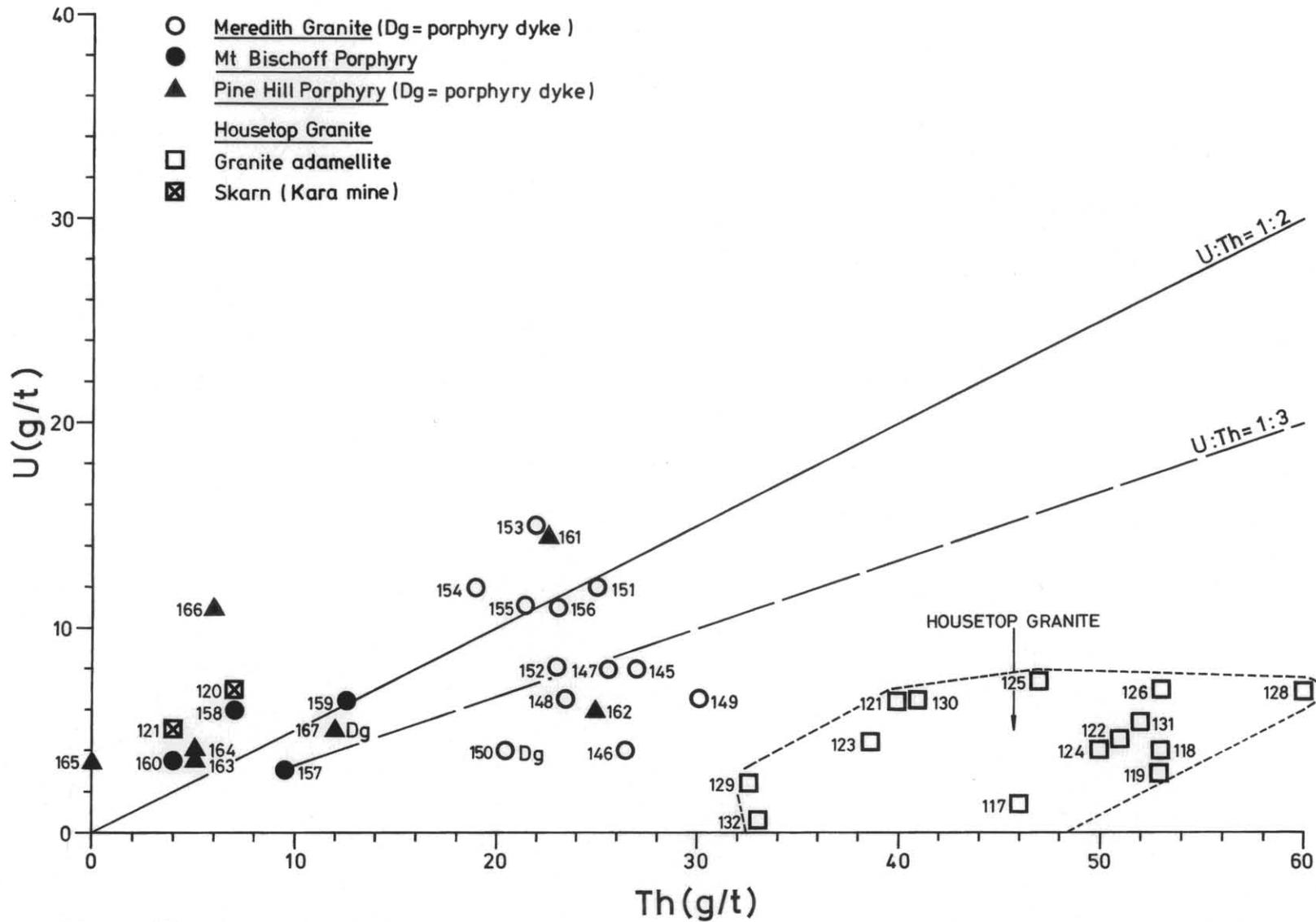
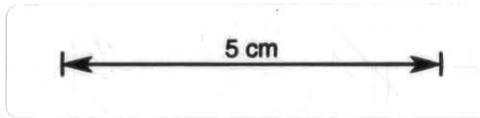


Figure 12a. *U and Th values for the Meredith Granite, Mt Bischoff and Pine Hill porphyry bodies, and the Housetop Granite.*



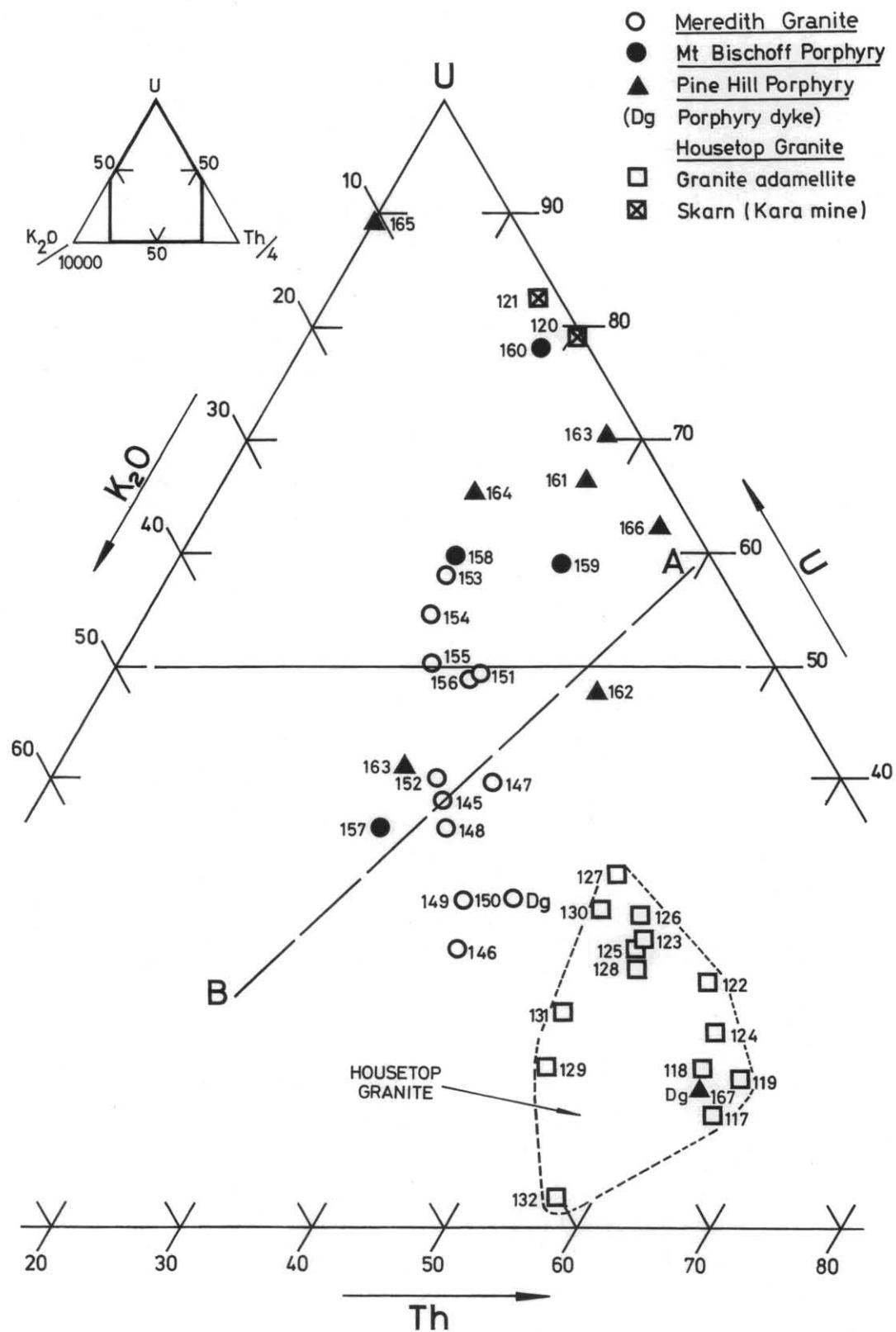


Figure 12b. K-U-Th ternary diagram for data in Figure 12a.

5 cm

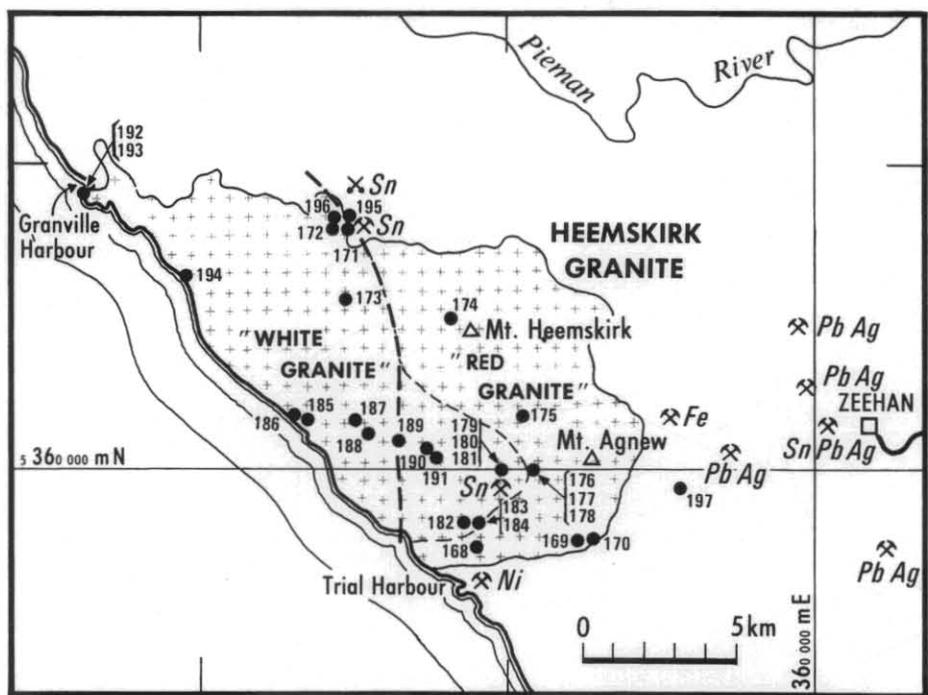
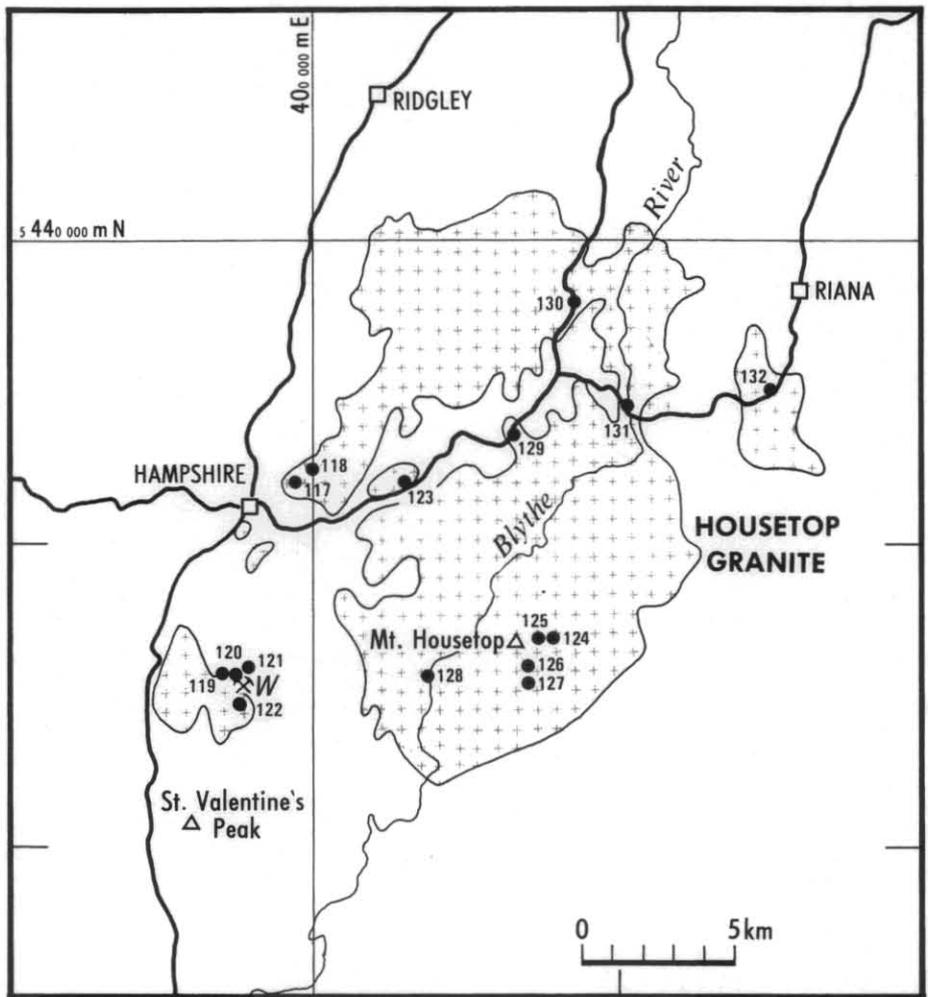
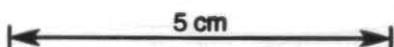


Figure 13. The Housetop Granite and the Heemskirk Granite showing geophysical sample sites (see Figure 10 for legend). Geology based on Williams and Turner (1973).



HOUSETOP GRANITE (SITES 117-132)

The Housetop Granite crops out discontinuously around Mt Housetop (fig. 13). It is generally a pink, equigranular, medium to coarse-grained biotite adamellite, with variants of coarsely porphyritic (feldspar) biotite adamellite and fine-grained porphyritic (quartz and feldspar) biotite adamellite, and fine-grained porphyritic (quartz and feldspar) biotite granite/adamellite (Hughes, 1959; Burns, 1965; Gee, 1977; P.W. Baillie, pers. comm.). In the south-west there are several scheelite-magnetite skarns occurring as roof pendants (e.g. Kara mine; Wolff, 1978).

The spectrometer results of this large mass are variable with 4.0 - 8.3% K<sub>2</sub>O, 0 - 8 g/t U, and 32 - 60 g/t Th. In the U-Th and K-Th-U diagrams (fig. 12a, b), the high thorium values cause it to plot as a group separate from most other Tasmanian granitic rocks.

HEEMSKIRK GRANITE (SITES 168-196)

The Heemskirk Granite crops out as a large, stock-like, complex intrusion on the west coast of Tasmania (fig. 13). It consists of two main granitic types: an older 'red granite' which varies from coarse-grained biotite granite/adamellite to medium-grained, porphyritic biotite granite/adamellite; and a younger, more alkaline 'white granite', which is predominantly a yellow to white, fine to medium-grained, equigranular biotite granite/adamellite. The two granitic types have the same mineralogy and geochemistry (Green, 1966; Groves, 1968b; Klominsky, 1972; Wells, 1978). Tourmaline nodules occur throughout the Heemskirk Granite, though mainly in the 'white granite' (Green, 1966; Wells, 1978). Cassiterite-bearing quartz-topaz-tourmaline-chlorite-pyrite-arsenopyrite greisen veins (e.g. Federation mine, Sweeney's prospect) occur mainly in the southern part of the granitoid (Blissett, 1962). Wells (1978) considers this tin mineralisation to be associated with the emplacement of the 'white granite'.

The spectrometer results show a considerable variation in element abundances (Table 1, fig. 14a, b), but much of this variation is attributable to the various granitic types. The quartz-topaz-tourmaline greisen alteration (Sites 177, 179, 184) has low potassium (0.8 - 1.4% K<sub>2</sub>O) and uranium (1 - 4 g/t), but high thorium (22 - 37 g/t), with resultant low U/Th ratios (less than 0.2).

The greisenised muscovite biotite granite (Sites 171, 195) near the St Dizier tin deposit on the northern margin of the Heemskirk Granite (fig. 13) contains high uranium (13 and 21 g/t) and has a U/Th ratio of 1.05. This granite plots well within the field of granitic rocks associated with tin mineralisation (e.g. U/Th greater than 0.5) as defined for the Blue Tier Batholith (fig. 14a, b).

The biotite granite/adamellite comprising the bulk of the Heemskirk Granite has variable radioactive element concentrations equivalent to 3.5 - 8.1% K<sub>2</sub>O, 2 - 22 g/t U, and 11 - 64 g/t Th. However, the uranium and thorium values exhibit a distinct spatial variation corresponding with the distribution of the 'red' and 'white' granites. Sites having U/Th ratios of less than 0.33 occur in the eastern and southern parts of the granite and generally correspond to the distribution of the 'red granite', whereas sites in the northern and western parts of the Heemskirk Granite have ratios greater than 0.33 and generally correspond to the 'white granite' (fig. 13). The implications of this distinction are discussed below.

Three sites (185, 187, 188) in the 'white' granite midway between

41-34

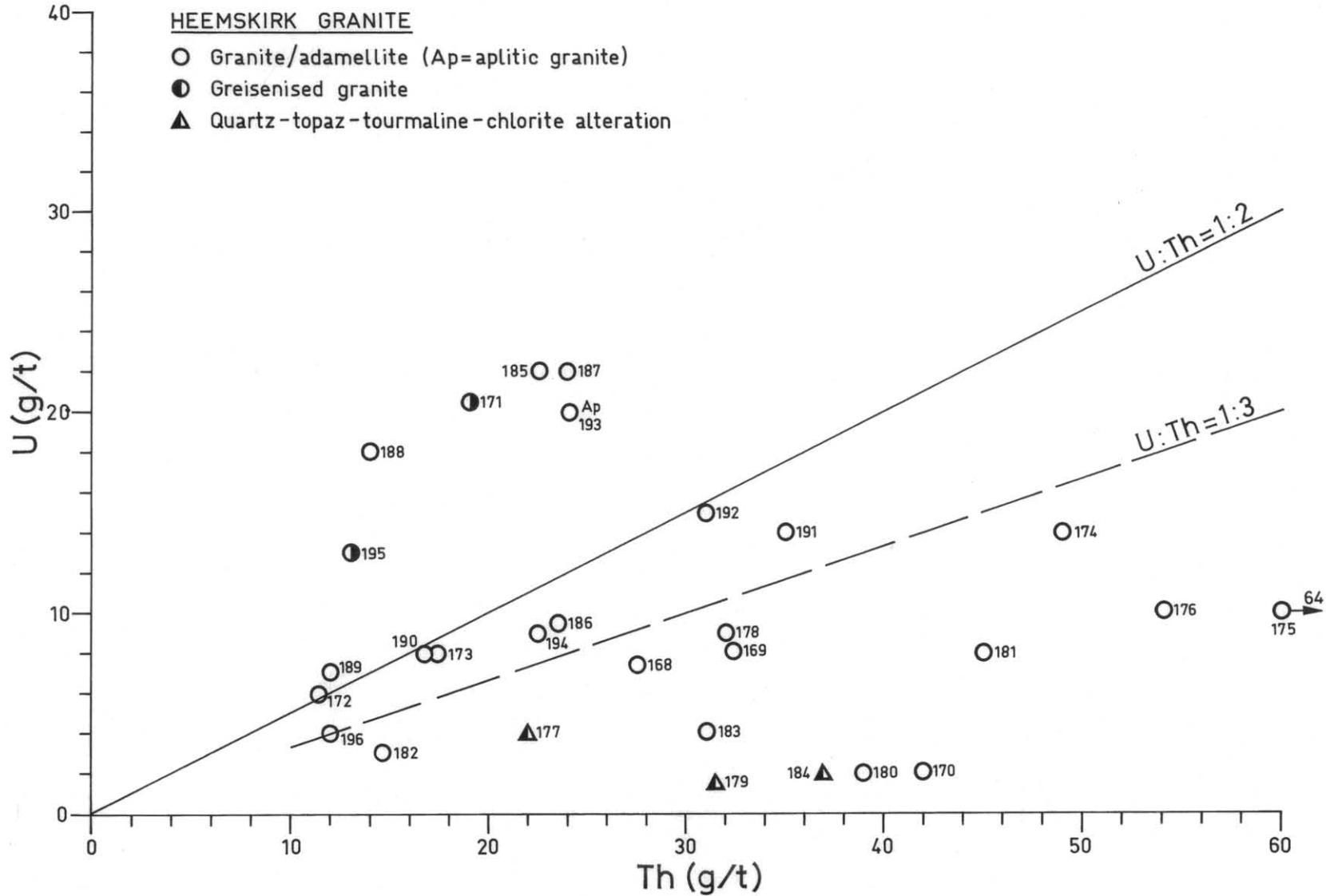
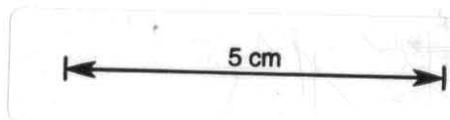


Figure 14a. *U* and *Th* values for the Heemskirk Granite. The dashed line divides data for the 'red' and 'white' granites.



37/10

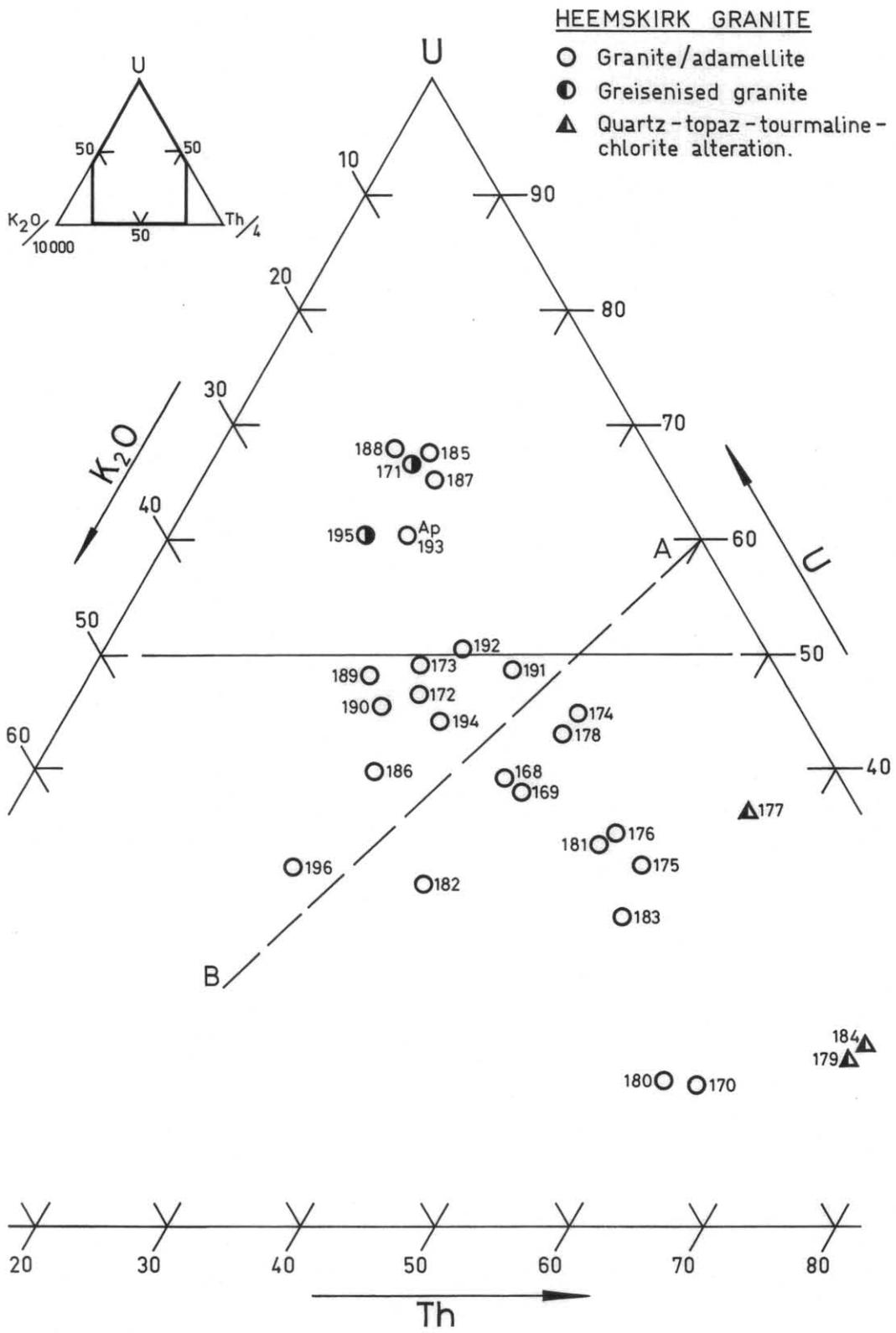
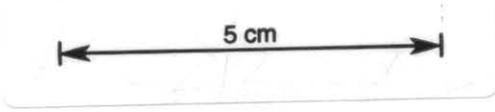


Figure 14b. K-U-Th ternary diagram for data in Figure 14a.



Trial and Granville Harbours, and aplitic granite on the contact at Granville Harbour (Site 193) have high uranium values and high U/Th ratios, comparable to the greisenised granite at St Dizier.

#### CAMBRIAN GRANITES

The Dove Granite (Sites 108, 109) crops out as three small isolated bodies of variable composition in the Dove, Forth, and Mersey Valleys in northern Tasmania (fig. 10). These bodies vary from biotite-hornblende adamellite/granodiorite to biotite adamellite and biotite granodiorite (Jennings, 1965; McDougall and Leggo, 1965). Spectrometer measurements on two of the bodies gave 5.5 and 7.2%  $K_2O$ , 3 - 4 g/t U, and 22 - 23 g/t Th (Table 1, fig. 9a, b).

The Murchison Granite (Sites 143, 144) is an elongate body trending north-south and cropping out in the Murchison River to the east of Rosebery (fig. 10). It consists of biotite-hornblende adamellite occurring as a sub-volcanic body within the Mt Read Volcanics (Corbett and Brown, 1976). The spectrometer results are similar to the Dove Granite (Table 1, fig. 9a, b).

#### SYNTHESIS OF NORTH-WEST TASMANIAN DEVONIAN GRANITE RESULTS

Gravity data (Leaman et al., 1980) indicates that all of the Devonian granitic bodies in north-western Tasmania may be linked at relatively shallow depth as part of a single batholith extending over an area of some 8000 km<sup>2</sup>. If this is so, then its outcropping phases exhibit considerable variation in the spectrometer results. This variation is much greater than that shown by granitic rocks in eastern Tasmania, which are also thought to be linked at shallow depth as a single mass on the basis of gravity data (Leaman et al., 1980). The granitic bodies in north-western Tasmania tend to have similar uranium, but more variable and higher thorium values than most of the east coast granitic rocks (e.g. Heemskirk Granite and Housetop Granite).

For the Heemskirk Granite, there is a clear radiometric distinction between the 'red' and 'white' granites which are separated in the U-Th diagram by the line U:Th = 1:3, the 'white' granite, which has associated tin mineralisation, plotting above this line (fig. 14a). When plotted on Figure 12a, this line also separates the granitic rocks of the southern part of the Meredith Granite, which plot above the line, from the north-east part which plot below it. Also, this line divides greisenised granite from its host biotite adamellite of the Dolcoath Granite (fig. 9a). Most of the Pine Hill Porphyry and Mt Bischoff dykes plot above this line (fig. 12a). The Housetop Granite, with only minor associated(?) alluvial tin deposits, plots well below this line.

Whereas the granitic rocks in north-eastern Tasmania which have associated tin mineralisation are separated from the remainder of the granitoids by the line U:Th = 1:2 (as defined for the Blue Tier Batholith), a similar distinction may be applicable to the lesser known granitic rocks of north-western Tasmania, but in this case the dividing line may be as low as U:Th = 1:3 for granitoids with more than 5 g/t uranium.

In the K-Th-U ternary diagram, the 'red' and 'white' granites of the Heemskirk Granite plot as two separate groups on either side of an arbitrary line (AB in fig. 14b), with the 'white granite' plotting towards the U apex. This line also separates the granitic phases in the north and south of the Meredith Granite (fig. 12b) and granitic types of the Dolcoath Granite

(fig. 9b) as for the dividing line in the U-Th diagrams discussed above.

An interesting feature of these lines in the U-Th and K-Th-U diagrams is that the Sea Elephant and Grassy Granodiorites (King Island) plot on the boundary between the two fields (fig. 9a, b).

The gamma-ray spectrometer results indicate a definite distinction between granitic rock associated with tin (or wolframite) mineralisation and 'barren' granitic rocks, but the same distinction as defined by ratios of radioactive elements may not be the same for all batholiths (cf. the Blue Tier Batholith and the Heemskirk Granite).

However, for two granitoids with nearby tungsten (as scheelite) in adjacent skarns (e.g. Kara mine, Grassy) only one, the Grassy Granodiorite, has high uranium values (9 - 11 g/t), which would indicate a relatively advanced stage of fractionation, and both lacked high U/Th ratios. Most of the uranium values for the Housetop Granite are less than 5 g/t which, with very low U/Th ratios, would indicate that much of this mass is unprospective. In this case, other factors such as the presence of adjacent carbonate country rock, different physico-chemical conditions, and the possible lack of exposure of more evolved phases present, may have to be inferred to explain the mineralisation.

#### SPECTROMETRY OF SOME MAFIC AND ULTRAMAFIC ROCKS IN WESTERN TASMANIA

The Heazlewood River Ultramafic Complex between Savage River and Luina (Sites 199-203), the Whyte River Complex at Luina (Site 204), the Serpentine Hill Complex south of Renison Bell (Site 198), the McIvor Hill Gabbro between Zeehan and Trial Harbour (Site 197), and the Deep Creek Volcanics at Luina (Sites 205-208) (figs. 11 and 13) were sampled, and the spectrometer results are listed in Table 1.

The ultramafic complexes at Heazlewood River and Serpentine Hill and the mafic complex at Whyte River all recorded total counts similar to background levels and, as expected, very low potassium, uranium, and thorium. The McIvor Hill Gabbro recorded a slightly higher total count due to the indicated 0.5% K<sub>2</sub>O, but uranium and thorium were not present in sufficient amounts to be detected.

At the Cleveland mine, near Luina (fig. 11), two sets of gamma-ray spectrometer measurements were recorded for spilitic basalt of the Deep Creek Volcanics in which potassic alteration is spatially associated with the tin mineralisation. Adjacent to the cassiterite-pyrrhotite-stannite replacement mineralisation, the spilitic basalt has been hydrothermally altered, with K<sub>2</sub>O increasing from less than 0.5% in unaltered rock to over 2% in altered rock adjacent to the ore (Collins, 1981). The spectrometer measurements reflect this alteration with an average of 0.7% K<sub>2</sub>O, 0 g/t U, and 2 g/t Th in the spilitic basalt (Sites 207 and 208); but where hydrothermally altered, close to the mineralisation (Sites 205 and 206), it has between 1.5 and 2.3% K<sub>2</sub>O, 1 - 2 g/t U, and up to 5 g/t Th (Table 1). Although these variations are small, they are sufficient to suggest that gamma-ray spectrometry of spilitic basalts in this area could be used in ground exploration for potassic alteration zones.

#### RESULTS OF MAGNETIC SUSCEPTIBILITY MEASUREMENTS

The magnetic susceptibility was measured at each locality using a Bison Magnetic Susceptibility Instrument, model 3101, with a 160 mm diameter detector. The results (Table 1) show that the majority of Tasmanian

granitoids are non-magnetic, which is a feature of some other large tin provinces (see Ishihara, 1977). Of the Tasmanian granitoids sampled, only a few granodiorites are magnetic, and are generally much less so than those in the Sn-poor eastern half of the Lachlan Fold Belt of New South Wales (Wyatt *et al.*, *in prep.*).

Three Devonian granite exceptions are the moderately magnetic Housetop Granite (Sites 117-132) and Grassy Granodiorite (Sites 133-136) in western Tasmania, both of which have nearby scheelite-bearing skarns, and the Pyengana Pluton (Sites 47-52) in north-eastern Tasmania. The south-west segment of the Pyengana Pluton between St Columba Falls and Weldborough is more magnetic than the north-east segment at Pyengana, and also has different radiometric characteristics. A few greisens are slightly magnetic because of accessory pyrrhotite. A pre-Permian dolerite dyke intruding granite on St Helens Point is strongly magnetic (Site 36).

The Cambrian Dove River Granite is moderately magnetic and the Murchison Granite, with accessory pyrrhotite, is strongly magnetic. The Precambrian West Coast Granite is non-magnetic.

Mafic and ultramafic rocks gave variable responses. The Heazlewood River Ultramafic Complex (Sites 199-203) is strongly magnetic, but the Serpentine Hill Complex (Site 198), with magnetite in shear zones, varies from non-magnetic to strongly magnetic. The McIvor Hill Gabbro (Site 197) and Priory Monzonite (Site 39) are moderately magnetic. The spilitic basalt of the Deep Creek Volcanics (Sites 207 and 208) are moderately magnetic, but the magnetic susceptibility decreases with increased potassic alteration (Sites 205 and 206).

#### CONCLUSIONS

Tin and tungsten (as wolframite) mineralisation is generally associated with late stage, highly fractionated granitoids. These granitoids are also the most radioactive, due to enrichment in radioactive elements, of which uranium is the most significant.

The spectrometer results for the Blue Tier Batholith indicate that high uranium (>5 g/t) and high U/Th ratios (>0.5) correlate with late phase, highly fractionated biotite-muscovite alkali granite hosting tin (and tungsten) mineralisation. Also, these granitoids generally plot above the 50% U line in a K<sub>2</sub>O/10000-U-Th/4 ternary diagram. These characteristics are applicable to other granitoids in eastern Tasmania, and for granitoids in western Tasmania the same correlation applies, though the U/Th ratio may be as low as 0.33. Where tungsten occurs as scheelite in skarns, the adjacent granitoids do not entirely satisfy the above criteria.

The above characteristics can be readily determined by measuring radioactivity with a portable, four-channel gamma-ray spectrometer, and converting the data to mass% K<sub>2</sub>O and g/t U and Th, making it a useful ground exploration technique in the search for suitable tin or tungsten source and host rocks, be they either single plutons or the most fractionated phases of composite bodies.

As expected, the radioactive element concentration in mafic and ultramafic rocks is very low. However, spilitic basalt with secondary potassic alteration associated with tin mineralisation at the Cleveland mine exhibits detectable potassium anomalies. Thus, in addition to its application to granitic rocks, gamma-ray spectrometry may also be used to search for potassic alteration zones associated with metasomatic replacement deposits (*e.g.* Cleveland mine) and other deposits, provided that the

country rocks are initially depleted in radioactive elements, particularly potassium.

Most granitoids in Tasmania are non-magnetic, except for the weakly to moderately magnetic Husetop Granite and Grassy Granodiorite, both of which have adjacent scheelite-bearing skarns, the Pyengana Pluton, and the Cambrian granites. Mafic and ultramafic rocks examined are mostly strongly magnetic, though spilitic basalt subjected to potassic alteration is only weakly magnetic.

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G.E. Wilford, D.C. Stuart, G.A. Young, and D.C. Green critically read the manuscript.

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[20 August 1981]

APPENDIX 1

Geophysical data for some Tasmanian igneous rocks

Complete results of all gamma-ray spectrometer measurements and measurements of magnetic susceptibility at each sample site are presented in Table 1 for each granitoid and for other igneous bodies (not necessarily in the order described in the text).

The *site number* identifies each site at which measurements of gamma radiation and magnetic susceptibility were recorded.

The *A.M.G. reference* records the grid reference of each site to the nearest 100 m within each 100 km square of the Australian Map Grid, Zone 55.

The *gamma-ray spectrometer* measurements for a six minute counting period recorded on channels 1, 2, 3, and 4 are listed for all replicate determinations at each site. The equivalent  $K_2O$  (mass%), U (g/t), and Th (g/t) for each measurement have been calculated (see text), and these are presented graphically on a U-Th diagram (figs. 2a, 3a, 7a, 9a, 12a, 14a) and on a  $K_2O/10000-U-Th/4$  ternary diagram (figs. 2b, 3b, 7b, 9b, 12b, 14b). The average of the  $K_2O$ , U, and Th values for each site are plotted on these graphs. Measurements of gamma radiation at *Site 58* which are marked with an asterisk (\*) are not used to plot this site in Figures 3, 3a and 3b. They serve only to illustrate the effect of site geometry as explained in the text (p. 41-4).

The number of equivalent heat generation units (*H.G.U.*) for each measurement of gamma radiation is calculated from the potassium, uranium, and thorium values using the following expression:

$$H.G.U. = (0.19 \times \%K_2O) + (0.62 \times g/tU) + (0.17 \times g/tTh)$$

The H.G.U. is in  $10^{-13} cal/cm^{-3}/sec^{-1}$  units.

The magnetic susceptibility (*Mag.Sus*) of the rock cropping out at each site is given as an average or range of several measurements.

The *rock type* at each site on which the gamma radiation was measured is briefly described, and a brief description of the geographic *location* of each site is also given.

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Table 1. GAMMA-RAY SPECTROMETER AND MAGNETIC SUSCEPTIBILITY DATA FOR SOME TASMANIAN IGNEOUS ROCKS, THEIR CALCULATED POTASSIUM, URANIUM AND THORIUM CONTENTS AND HEAT GENERATION UNITS (HGU).

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Coles Bay Pluton	1	FP072341	Honeymoon Bay	red biotite	156036	9849	4343	3140	6.4	31	58	30	0
				adamellite	155912	9657	4370	3124	6.1	32	58	30	
					178114	10565	5397	3409	5.6	44	62	39	
	2	FP053329	Granite quarry	red biotite	215935	12901	6301	4210	7.3	49	78	45	0
				adamellite	216094	12612	6176	4186	7.1	47	77	44	
	3	FP109355	Cape Tourville	microgranite	113060	7678	2675	2177	6.2	16	40	18	0
				(with molybdenite)	113708	7324	2613	2025	5.8	17	37	18	
					94851	7523	2216	1347	6.8	19	24	17	
	4	FP102375	Bluestone Bay	biotite granodiorite	61765	4795	1131	1111	4.8	4	20	7	200
	5	FP102375	Bluestone Bay	red granite dyke	61658	4927	1156	1151	4.9	4	21	8	700
74829	5602	1397	1426	5.4	5	27	8	700					
6	FP103375	Bluestone Bay	biotite granodiorite	51091	4060	852	971	4.2	2	18	5	350	
7	FP087342	Sleepy Bay	porphyritic	97386	6039	2162	2381	4.7	6	45	12	0	
			red biotite	82850	5441	1745	2063	4.6	3	39	9		
			adamellite										
8	FP085625	Blowhole, Bicheno	coarse-grained porphyritic biotite	90445	6893	1786	1109	6.6	15	20	14	0	
			adamellite	89817	7082	1880	1106	6.8	16	19	14		
9	FP086629	The Gulch, Bicheno	coarse-grained porphyritic biotite	77068	7419	1361	952	8.1	10	17	10	0	
			adamellite	66954	6458	992	976	7.4	4	18	7		
10	FP081636	Waubs Bay, Bicheno	coarse-grained porphyritic biotite	80466	7019	1744	1039	6.9	15	18	14	0	
			adamellite	73938	5915	1426	1019	5.9	10	18	10		

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>	
					1	2	3	4						
Piccaninny Creek Pluton	11	FP080777	Long Point	foliated	48055	4101	864	857	4.2	3	15	5	0	
				hornblende	48678	4021	843	793	4.2	4	14	5		
	12	FP082775	Long Point	biotite adam- ellite/grano- diorite	87197	7284	1641	1687	7.4	6	32	10	0	
				granite dyke	63299	5240	1256	1125	5.2	6	21	8	0	
				foliated	65840	5376	1263	1197	5.4	5	22	8		
	13	FP076832	Piccaninny Point	hornblende	66000	5347	1341	1181	5.2	7	22	9		
				biotite	38262	2815	731	763	2.6	2	14	4	0	
				granodiorite	43137	2665	813	855	2.3	2	16	4		
	14	FP065848	Tasman High- way, 500 m north of Pic- caninny Creek	hornblende	59476	4571	1016	943	4.7	5	17	7	0	
				biotite	58255	4173	951	940	4.2	4	17	6		
	15	FP059868	Tasman High- way 1 km NW of Chain of Lagoons	adamellite	58902	5420	983	958	5.9	4	17	7	0	
				biotite	64363	5505	1354	902	5.4	10	16	10		
	Ben Lomond Pluton	16	EP626705	Royal George road at St Pauls River	coarse- grained por- phyritic gra- nite/adamellite	58636	5401	1079	901	5.7	6	16	8	
					porphyritic	78892	5429	1538	731	5.0	15	12	13	0
					granite	116538	10548	3180	1386	9.5	33	23	26	0
17		EP735683	East of Royal George open cut	tourmaline										
				quartz por- phyritic granite										
18		EP735683	Floor of Royal George open cut											

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Ben Lomond Pluton (continued)	19	EP735683	West wall, Royal George open cut	torbernite- bearing grei- senised gran- ite	615078	33288	21450	2784	11.0	304	29	145	0
	20	EP735683	Dump at Royal George open cut	greisenised granite	119899	7466	4317	946	3.2	56	13	38	0
	21	EP578803	Storys Creek Road	coarse red biotite granite	153002	9085	3613	3150	6.5	19	59	24	
					150524	9164	3329	3197	7.1	14	60	20	
	22	EP582819	Storys Creek Road	coarse- grained red biotite gran- ite (with tourmaline)	161992	9602	3743	3282	7.0	20	62	25	0
					171039	10126	4056	3371	7.2	24	63	27	
	23	EP572847	Gipps Creek Road, near Sundial Creek	fine-grained biotite musco- vite granite	65422	5767	1236	909	6.0	8	16	9	0
87829					6631	1952	993	6.0	19	17	15		
24	EP597873	Storys Creek Road, 1 km north of Rossarden Road	porphyritic microgranite	142939	9090	3259	3145	7.1	14	60	20	0	
				137862	8872	3273	2778	6.8	18	52	21		
25	EP616863	Storys Creek Bridge, Ross- arden Road	biotite mus- covite gran- ite	111706	6621	2445	1948	5.1	15	36	16	90	
				99232	6080	2089	1697	4.9	13	31	14		
St Marys Sheet	26	FP026999	Gravel quarry St Marys Pass	hypersthene	46584	4204	760	856	4.6	2	16	4	0
				biotite ad- amellite por- phyry	45436	3914	736	807	4.2	2	15	4	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
St Marys Sheet (continued)	27	FQ063043	Blowhole, Falmouth	hypersthene	49330	3375	873	809	3.2	4	14	5	0
				biotite ad-	46777	3417	839	804	3.3	3	14	5	
				amellite	39693	2702	704	703	2.5	2	13	4	
Scamander Tier Granodiorite	28	FQ043109	Corner of Skyline Road and Coach Road	porphyritic	41128	3620	655	654	3.9	2	12	4	0
				biotite granodiorite	32559	2636	521	550	2.8	1	10	3	
	29	FQ035139	Skyline Tier	porphyritic	44223	3962	670	652	4.4	3	12	4	0
				biotite granodiorite	44878	4036	742	699	4.4	3	12	5	
	30	FQ098327	Boat Harbour Point, Binalong Bay	biotite horn-	46501	4066	771	764	4.4	3	14	5	0
				blende grano-	45533	3951	807	732	4.1	4	13	5	
George River Granodiorite	31	FQ067183	Tasman Highway, Dianas Basin	biotite adam-	52488	4320	873	967	4.5	2	18	5	0
				ellite	56041	4685	971	1015	4.9	3	19	6	
	32	FQ049236	Lawrys Point, Georges Bay	biotite horn-	54804	4031	1044	1029	3.8	4	19	7	143
				blende grano-	54464	4108	1000	984	4.0	4	18	6	
	33	FQ022281	Reids Road at George River Bridge	coarse-grained	51933	2850	1274	1235	1.7	5	23	8	0
				hornblende bio-	65670	3285	1742	1526	1.5	9	28	11	
	34	FQ128295	Burns Bay, St Helens Point	biotite grano-	46231	3888	735	671	4.2	3	12	5	0
				diorite	40959	3405	748	567	3.5	5	10	5	
	35	FQ109266	500 m east of Akaroa	biotite grano-	41029	3138	770	544	3.1	5	9	5	0
				diorite	45841	3239	812	655	3.1	5	11	5	
					39655	2598	701	576	2.4	4	10	4	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus.
					1	2	3	4					S.I. x 10 <sup>-6</sup>
Akaroa Grano- diorite (cont- inued)	36	FQ130297	Burns Bay, St Helens Point	dolerite dyke	22496	1577	397	328	1.5	2	5	3	39813
Grant Point Granite	37	FQ113324	Skeleton Rock	biotite	56879	4928	1028	977	5.1	4	18	7	0
				granite	52506	4516	820	914	4.9	2	17	5	
Priory Monzonite	38	FQ118315	Grants Point	biotite	49666	4409	874	784	4.7	4	14	6	0
				granite	50128	4210	864	797	4.4	4	14	6	
	39	FQ005303	Priory	hornblende monzonite	39708	3037	696	700	3.0	2	12	4	4608
Constable Creek Granite	40	EQ979228	Trafalgar Track, near Ferntree Falls	biotite	71026	6051	1290	1071	6.3	7	19	9	0
				granite	75278	5933	1487	1233	5.8	9	22	10	
	41	EQ976224	Trafalgar Track, 500 m south of Fern- tree Falls	biotite	69386	5918	1157	1127	6.3	5	21	8	0
				granite	54962	5052	918	592	5.5	7	10	7	
Mt Pierson Adamellite	42	FQ070370	South end of Taylors Beach	coarse-grained	61283	4693	1094	1162	4.7	3	21	7	0
				biotite gran- ite/adamellite	58616	4545	1015	1062	4.6	3	20	6	
	43	FQ075362	Cosy Corner	coarse-grained	64208	5142	1055	1253	5.4	2	23	6	0
				biotite gran- ite/adamellite	62338	5170	1015	1212	5.5	1	23	6	
	44	EQ951287	Terryvale Road	coarse-grained	68338	5570	1180	1384	5.8	2	26	7	0
				biotite gran- ite/adamellite	59994	5480	1036	1017	5.9	4	19	7	
	45	EQ982326	Ansons Bay Road at Foresters Creek	porphyritic	66980	5361	1262	1187	5.3	6	22	8	100
				biotite gran- ite/adamellite	71189	5977	1295	1253	6.2	5	23	8	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					Channel								
					1	2	3	4					
Small granodior- ite body	46	EQ919265	McAuliffs Hill	porphyritic	43006	3684	728	687	3.9	3	12	5	55
				hornblende	43819	3823	785	613	4.0	5	11	6	
Pyengana Pluton	47	EQ810303	Forest Lodge Road	hornblende	50528	4546	812	741	5.0	4	13	5	642
				biotite grano- diorite	48501	4175	855	709	4.4	5	12	6	
	48	EQ806321	Tasman High- way, 2.5 km N	hornblende	58827	4100	1125	1023	3.8	5	19	7	267
				biotite grano- diorite	50544	3459	920	863	3.2	4	16	6	
	49	EQ770250	St Columba Falls	hornblende	89793	5395	1965	1718	4.2	10	32	13	3713
				biotite grano- diorite	102597	6815	2312	1801	5.6	15	33	16	
	50	EQ782260	Intake Bridge, south George River	hornblende	103360	7273	2420	1626	6.1	19	29	18	4197
biotite grano- diorite				102456	7315	2294	1658	6.3	16	30	16		
51	EQ847273	Kohls Creek	foliated bio- tite grano- diorite	44650	3524	833	660	3.5	5	11	6	180	
				40195	2965	768	641	2.8	4	11	5		
52	EQ749371	Mt Paris Dam Road at Maa Min Chon Dam	hornblende	50675	3833	967	900	3.7	4	16	6	2608	
			biotite grano- diorite	53690	4133	1095	959	3.9	6	17	7		
Lottah Pluton	53	EQ859355	Lottah Road, south of Goughs Hill	muscovite	47277	4208	931	343	4.3	10	5	8	0
				granite	48830	4432	1017	318	4.5	12	4	9	
54	EQ846397	Sun Creek, Blue Tier	muscovite	44217	2891	1050	481	2.2	11	8	8	0	
			biotite granite	45852	3291	1027	494	2.9	10	8	8		

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Lottah Pluton (continued)	55	EQ843392	Moon Mine, Blue Tier	greisenised	49588	3531	1166	570	3.0	11	9	9	838
				granite (with	43731	3103	976	528	2.7	9	9	8	
				cassiterite)	43972	2245	1134	671	1.2	10	11	8	
					55476	4282	1149	719	4.0	9	12	8	
	56	EQ851353	Anchor Road, 1 km from Lottah	biotite mus-	38404	3287	677	612	3.4	3	11	4	0
				covite gran- ite	35307	2907	712	528	2.8	5	9	5	
	57	EQ849353	Anchor Mine, Blue Tier	greisenised	93734	6730	2360	1003	5.5	25	17	19	0
				biotite mus-	98532	7564	2369	1198	6.6	23	21	19	
				covite gran-	93893	7439	2063	1141	7.0	19	20	16	
				ite (with	95969	6816	2237	1105	5.8	22	19	18	
	58	EQ755409	Quarry, Tas- man Highway 2 km north of Weldbor- ough	cassiterite)	113823	7949	3058	1159	6.0	34	19	25	0
				biotite mus-	99203*	7941*	2335*	1018*	7.2	24	17	19	
covite gran-				93853*	7457*	2187*	914*	6.8	23	15	19		
ite				76989*	5260*	1783*	787*	4.4	18	13	14		
				47428	4077	849	547	4.3	7	9	7		
Poimena Pluton	59	EQ840391	west of Moon Mine, Blue Tier	porphyritic	65128	5183	1290	1000	5.1	8	18	9	0
				biotite ad- amellite	66770	5353	1350	1040	5.2	9	19	9	
	60	EQ842383	Poimena	porphyritic	62985	5666	1117	919	6.0	6	16	8	0
				biotite ad- amellite	58302	5164	1010	816	5.5	6	14	8	
	61	EQ850340	Groom River, near Gibsons Creek	porphyritic	74411	6337	1431	1091	6.5	9	20	10	
				biotite ad- amellite	75450	6681	1469	1084	6.9	10	19	11	
	62	EQ798269	Quarry, St Columba Falls Road	biotite ad-	78345	6830	1390	1217	7.2	7	22	9	0
				amellite	87781	7588	1733	1207	7.7	13	22	13	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag.
													S.I.
					1	2	3	4					
Poimena Pluton (continued)	63	EQ728467	Moorina	porphyritic	65459	4734	1294	969	4.4	9	17	9	0
				biotite adamellite	63321	4908	1110	966	5.0	6	17	8	
	64	EQ856635	Gladstone Road, 2 km south of Gladstone	porphyritic	75198	5316	1623	1428	4.6	8	26	10	0
				biotite adamellite	78306	5355	1716	1478	4.5	9	27	11	
	65	EQ841613	Gladstone Road, 1 km south of First Sugarloaf	porphyritic	87780	6009	1904	1660	5.1	10	31	13	0
				biotite adamellite	91034	6098	2087	1677	5.0	13	31	14	
66	EQ782597	north of west end of Blue Lake	porphyritic biotite adamellite	77714	5599	1722	1262	4.9	12	23	12	0	
67	EQ790517	Gladstone Road at Racecourse Creek, Pioneer	porphyritic	75375	6111	1601	1143	5.8	11	20	12	0	
			biotite adamellite	69893	5670	1398	1008	5.6	10	18	10		
Mt Cameron Pluton	68	EQ862625	Ogilvies Bridge Road, 500 m south west of Second Sugarloaf	biotite muscovite granite	82311	5765	1828	1412	4.9	12	26	13	0
					81425	5622	1770	1560	4.8	9	29	12	
	69	EQ850621	Gladstone Road	porphyritic	83246	6028	1964	969	5.1	19	16	15	0
				biotite muscovite granite	89179	6174	2128	1203	5.0	19	21	16	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag.
													S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Mt Cameron Pluton (con- tinued)	70	EQ755596	south-west extremity of Mt Cameron	biotite mus- covite gran- ite	65503 68778	4268 5015	1192 1301	889 911	3.9 4.8	8 9	16 16	8 9	0
	71	EQ753600	western edge of Mt Cameron	porphyritic	85551	6443	1836	1234	5.9	14	22	14	0
				biotite mus- covite	88012	6259	1905	1254	5.5	15	22	14	0
	72	EQ752604	west flank of Mt Cameron	porphyritic	81843	5879	1762	1105	5.2	14	19	14	0
biotite (mus- covite) granite/ adamellite				80477	5729	1745	1133	5.1	14	20	13	0	
Gardens Pluton	73	FQ007457	Ansons Bay	hornblende	52205	3597	1055	985	3.2	5	18	7	0
			Road at Last River	biotite grano- diorite	49916	3470	1024	881	3.1	5	16	7	0
	74	FQ073408	Margerys cor- ner, The Gardens	hornblende	47974	4290	747	712	4.7	3	13	5	0
				biotite grano- diorite	51075	4177	930	748	4.3	5	13	7	0
75	FQ075413	The Gardens	hornblende	60883	4281	1196	1093	3.9	6	20	8	0	
			biotite grano- diorite	61916	4436	1301	1100	4.0	7	20	8	0	
76	EQ953662	Eddystone Road	biotite horn- blende grano- diorite	49256 44302 45753	3321 2848 3097	953 825 771	911 854 801	3.0 2.5 3.0	4 3 2	16 15 14	6 5 4	0	
Ansons Bay Pluton	77	FQ080564	Shark Bay, Ansons Bay	fine-grained	53763	4372	929	803	4.5	5	14	6	0
				biotite adam- ellite	49708	3906	981	797	3.8	6	14	7	0
78	FQ104588	1 km north of Bayley Rock	porphyritic	57187	4541	946	1075	4.7	2	20	5	0	
			biotite gran- ite/adamellite	50016	4108	802	936	4.4	1	17	4	0	

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>	
					1	2	3	4						
Ansons Bay Pluton (continued)	79	FQ132612	Quarry, Eddy-stone Point	biotite granite/adamellite	68350	5450	1102	1191	5.7	3	22	7	0	
	80	FQ110620	2 km northwest of Eddy-stone Point	biotite granite/adamellite	64008	6062	1044	1105	6.7	3	20	7	0	
				biotite granite/adamellite	57284	4654	920	1110	4.9	1	21	5	0	
				biotite granite/adamellite	60084	4655	973	1115	4.8	2	21	6	0	
Mt William Pluton	81	EQ990738	Musselroe Road, 3 km north of Mt William	biotite muscovite granite	58607	4875	1071	870	5.0	6	15	8	0	
				biotite muscovite granite	56571	4182	1077	917	4.0	6	16	7	0	
				biotite muscovite granite	55116	4428	978	925	4.5	4	17	6	0	
				biotite muscovite granite	50003	4396	867	726	4.7	5	13	6	0	
				biotite muscovite granite	52030	4775	878	691	5.2	5	12	7	0	
				gravel derived from biotite muscovite granite	45495	4193	658	681	4.7	2	12	4	0	
				biotite muscovite granite	55592	4976	909	874	5.4	4	16	6	0	
Mt Paris Pluton	82	EQ991723	2 km NNW of Mt William	biotite muscovite granite	54510	4828	865	859	5.3	3	16	6	0	
				porphyritic biotite muscovite granite	73503	5563	1672	806	5.0	16	13	14	0	
	83	EQ676441	Cascade River, Tasman Highway	porphyritic biotite muscovite granite	73517	5748	1594	804	5.4	15	13	13	0	
				(with cassiterite, fluorite)										
				biotite muscovite granite	83323	6141	1825	963	5.5	17	16	14	0	
84	EQ653445	Tasman Highway, 1 km north of the valley	biotite muscovite granite	80280	5887	1748	950	5.3	16	16	14	0		
			porphyritic biotite muscovite granite	65520	5335	1166	937	5.5	7	17	8	0		
85	EQ642436	Tasman Highway at Derby Back Road intersection	porphyritic biotite muscovite granite	62145	4996	1225	910	4.9	8	16	8	0		
			porphyritic biotite muscovite granite	73101	6175	1489	963	6.1	12	17	11	0		
			porphyritic biotite muscovite granite											

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Mt Paris Pluton (continued)	86	EQ669447	Dorset Hotel, Derby	biotite muscovite granite	71529 67198	6257 5742	1581 1520	798 733	6.1 5.5	15 15	13 12	13 13	0
	87	EQ734367	Mt Paris Dam Road at East Cascade River	biotite muscovite granite/	52059 54584	4657 4583	991 1159	609 590	4.8 4.5	8 11	10 10	8 9	0
				adamellite (with fluorite)									
	88	EQ698365	Mt Paris Dam Road, 2 km west of Mt Paris Dam	biotite muscovite granite/	63278 66514	5419 5358	1321 1398	756 796	5.4 5.1	12 12	13 14	10 11	0
adamellite (with topaz)													
89	EQ629424	Tasman Highway, Branxholm Creek	porphyritic	72588	6405	1428	866	6.6	12	15	11	0	
			biotite (muscovite) granite	65177	5589	1268	864	5.7	9	15	9		
Scottsdale Batholith	90	EQ565382	Billycock Hill	coarse-grained	97149	6798	2010	2329	6.0	4	44	11	0
				biotite adamellite	79646	6511	1478	1616	6.6	4	30	8	
	91	EQ550428	Arnon River, 500 m south of Kamona	hornblende biotite granodiorite	34187 36452	2987 3168	586 622	527 613	3.2 3.3	3 2	9 11	4 4	0
				pink biotite adamellite	80994 74383	6061 5888	1762 1598	1274 1100	5.5 5.5	12 12	23 20	13 12	0
92	EQ539420	north end of the rocks	pink biotite adamellite	80994 74383	6061 5888	1762 1598	1274 1100	5.5 5.5	12 12	23 20	13 12	0	
93	EQ525418	Tasman Highway, east of Maryvale Flats	coarse-grained biotite adamellite	53829 77698	4280 5916	1038 1542	1026 1354	4.2 5.6	4 8	19 25	7 10	298	
94	EQ468400	quarry, south end of Mt Stronach	pink biotite adamellite	81998 106425	4672 5854	1661 2278	1329 1696	3.7 4.3	10 16	24 31	11 16	0	
			(with fluorite molybdenite)	104208	6005	2229	1739	4.6	14	32	15		

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Scottsdale Batholith (continued)	95	EQ471461	Jensens Road, near Surveyors Creek	biotite adamellite	62190	4816	1118	1037	4.8	5	19	8	0
					63478	5270	1085	1038	5.5	5	19	7	
	96	EQ451447	North Scottsdale Road	hornblende biotite granodiorite	35653	2767	697	546	2.7	4	9	5	42
	97	EQ413387	Tasman Highway, 1 km east of Springfield	hornblende biotite granodiorite	37839	2944	731	606	2.8	4	11	5	259
					38001	2876	729	616	2.7	4	11	5	
	98	ER746987	Palana	porphyritic biotite granite/adamellite	53140	5127	966	701	5.5	7	12	8	0
Flinders Island Granites	99	ER747921	east flank of Mt Killiecrankie	porphyritic biotite granite	77504	5671	1644	1257	5.1	11	23	12	0
					83050	5957	1853	1275	5.2	14	23	14	
	100	ER712900	Killiecrankie	porphyritic biotite granite/adamellite	74398	6121	1500	1157	6.0	10	21	11	0
	101	ER670830	north end of West End Beach, Leeka	coarse-grained biotite granite/adamellite	79031	6517	1483	1588	6.6	4	30	9	0
					78631	6568	1452	1567	6.7	4	29	8	
	102	ER761816	Palana Road, south of Reedy Lagoon	biotite granite/adamellite	55571	4958	920	949	5.0	3	17	6	0
					49515	5133	995	1019	5.5	3	19	6	
	103	ER772682	Sawyers Bay	porphyritic biotite granite/adamellite	50467	4315	912	909	4.5	3	17	6	0
					64930	5449	1244	1034	5.5	7	19	8	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Flinders Island Granites (continued)	104	ER899649	Walkers Look-out Road	biotite muscovite granite	33505	3403	430	378	4.0	2	6	3	0
	105	ER877624	Merebin Farm, Memana Road	hornblende	34305	2942	562	566	3.1	2	10	3	0
				biotite granodiorite	40031	3491	616	658	3.8	2	12	3	
	106	ER888592	Thule Road, Hays Hill	biotite muscovite granite	46018	4959	532	673	6.0	0	12	3	0
				45284	4263	548	670	5.0	0	12	3		
107	ER892502	Trousers Point Road, north-west flank of Mt Strzelecki	coarse-grained to porphyritic	69035	5499	1413	586	5.3	15	9	12	0	
			biotite muscovite granite	60145	4934	1182	462	4.9	13	7	10		
Dove Granite (Cambrian)	108	DP357942	Lake Rowallan Road	biotite hornblende adamellite/granodiorite	67944	5450	1254	1301	5.5	4	24	8	8165
					66619	5417	1159	1213	5.6	4	22	7	
109	DP271976	Lorinna Road, Powerful mine	biotite adamellite	68682	6458	1025	1119	7.3	3	21	7	694	
				72567	6445	1138	1268	7.0	3	24	7		
Birthday Granite	110	DP203758	Patons Road	biotite muscovite granite (with fluorite)	54528	4342	1160	488	4.1	12	8	9	0
					57837	4818	1214	552	4.7	12	9	10	
111	DP205758	300 m west of Birthday mine	porphyritic	38127	3044	753	296	3.0	8	4	6	0	
			biotite muscovite granite	48214	3399	1249	329	2.6	15	4	11		
112	DP203759	Birthday mine dump	biotite muscovite granite	71366	5809	1801	499	5.1	22	7	16	0	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag.
													S.I.
					1	2	3	4					
Lone Pine Granite	113	DP211788	Patons Road	muscovite	73027	6216	1746	471	5.8	22	6	15	0
				granite/aplite	76291	6313	1821	468	5.8	23	6	16	
Dolcoath Granite	114	DQ280059	Lorinna Road, Tin Spur	greisenised	99996	6878	2171	1751	5.9	13	32	14	0
				biotite granite	119661	7361	2884	2154	5.4	20	40	20	
	115	DQ264066	east flank of Dolcoath Hill	greisenised	104252	6858	2478	1924	5.4	16	35	17	0
				biotite granite	87390	6066	1904	1643	5.2	10	30	13	
	116	DQ266063	east flank of Dolcoath Hill	biotite ad-	97110	6553	2050	1888	5.6	10	35	13	0
				amellite	108311	6830	2224	2627	5.7	4	50	12	
Housetop Granite	117	CQ994322	Coast View Hill	biotite gran-	93693	5479	1941	2280	4.3	3	43	10	72
				ite/adamellite	98488	5640	1985	2580	4.4	0	49	9	
	118	DQ000325	Emu River	biotite gran-	94116	5979	1837	2488	5.1	(-1)	48	8	0
				ite/adamellite	123686	6678	2794	3050	4.5	8	58	15	
	119	CQ971259	Kara mine, west of Tasminex pit	biotite gran-	133482	8339	2586	3597	7.1	(-2)	70	12	9012
				ite adamellite	90840	4382	2072	2819	2.4	(-1)	54	9	
	120	CQ973259	Tasminex pit Kara mine	magnetite	85143	5419	1977	1898	4.2	8	35	12	
				skarn	26799	986	776	432	0.0	7	7	5	up to 1000000
	121	CQ977260	Bobs Bonanza, Kara mine	epidote chlor-	18066	747	532	266	0.1	5	4	3	up to 750000
				ite skarn									
	122	CQ977248	Highwood Hill, south Kara track	coarse-grained	97765	5654	2085	2230	4.3	6	42	12	0
				granite/adamellite	113204	5954	2586	3151	3.8	3	60	13	
	123	DQ030318	Upper Natone Road at Lake Kara Road intersection	coarse-grained	85108	5242	1836	2094	4.1	4	40	10	5027
				biotite gran-ite/adamellite	82823	5143	1854	1985	4.0	5	37	10	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Housetop Granite (continued)	124	DQ078269	1 km east of Mt Housetop	coarse-grained biotite gran- ite/adamellite	101548 99025	5589 6189	2256 2178	3018 2195	3.8 4.9	0 8	58 41	10 13	4608
	125	DQ075269	700 m east of Mt House- top	biotite gran- ite/adamellite	105357 107511	6859 6987	2285 2419	2495 2470	5.6 5.6	6 9	47 47	13 14	3770
	126	DQ070259	1 km south of Mt House- top	porphyritic biotite gran- ite	116239	7062	2550	2764	5.5	7	53	14	0
	127	DQ070254	1.5 km south of Mt House- top	biotite gran- ite/adamellite	96116 89562	5993 5444	2109 1975	2277 1990	4.7 4.2	6 7	43 37	12 12	3696
	128	DQ036257	Black Creek Road at Blythe River	biotite gran- ite/adamellite	125428 135935	7902 8683	2586 3072	3102 3213	6.6 6.8	4 10	59 61	14 18	314
	129	DQ065334	Upper Natone Road at Hil- ders Road intersection	coarse-grained biotite gran- ite/adamellite	78920 75081	5936 5727	1495 1442	1706 1759	5.8 5.5	3 2	32 33	8 8	7233
	130	DQ085378	Upper Natone Road at Paton Creek	inequigranular biotite gran- ite/adamellite	85357 100289	5663 6464	1801 2248	2047 2228	4.8 5.2	4 9	39 42	10 14	6200
	131	DQ102345	South Riana Road, Blythe River	coarse-grained biotite gran- ite/adamellite	116217 124880	8522 9096	2296 2477	2559 2890	8.0 8.5	6 5	49 55	14 14	3982
	132	DQ149349	Pine Road, 1 km east of South Riana	coarse-grained biotite gran- ite/adamellite	72410 77052	5655 5977	1296 1401	1635 1843	5.7 5.9	1 0	31 35	7 7	1806

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag.
													S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Grassy Grano- diorite	133	BR493612	Golf course, Grassy	porphyritic	89819	6224	2013	1736	5.3	11	32	14	4217
				biotite horn- blende grano- diorite	82419	5618	1732	1721	4.9	7	32	10	
	134	BR493602	Penguin Is- land, Grassy Harbour	porphyritic	84740	5699	1913	1633	4.7	11	30	13	7236
				biotite horn- blende grano- diorite	84684	5675	1886	1578	4.7	11	29	13	
135	BR496607	Jetty Point, Grassy Har- bour	porphyritic	89634	6274	1936	1713	5.5	10	32	13	720	
			biotite horn- blende grano- diorite	88838	6111	1999	1705	5.1	11	31	14		
136	BR482598	Sandblow Point	porphyritic	88330	5866	2036	1711	4.7	12	32	14	10493	
			biotite horn- blende grano- diorite	90673	6139	2013	1743	5.1	11	32	14		
Sea Elephant Granodiorite	137	BR485935	Counsel Hill	biotite horn- blende grano- diorite	31894	2718	502	550	2.9	1	10	3	0
					30454	2878	475	435	3.2	2	7	3	
West Coast Granite	138	BR482939	Counsel Hill	aplitic granite	64533	5694	1180	986	6.0	7	18	8	0
	139	BR295990	Whistler Point	foliated por-	73050	7027	1173	1169	7.9	4	22	8	0
				phyritic gran- ite/adamellite	100692	8210	1773	2227	8.4	1	43	9	
	140	BR305737	Netherby Point, Currie	foliated por-	59595	4353	1029	1319	4.3	0	25	5	0
phyritic bio- tite micro- granite				62485	4761	1130	1370	4.7	1	26	6		
141	BR303755	Currie Har- bour	biotite gran- ite/adamellite	78697	6495	1537	1304	6.5	8	24	10	0	
				71395	5903	1374	1278	5.9	6	24	9		

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-7</sup>
					1	2	3	4					
West Coast Granite (con- tinued)	142	BR318604	Cataraqui Point	conformable	44050	2781	1001	888	2.1	5	16	6	0
				felsic, fine- grained ig- neous rock	53077	3564	1135	1139	3.0	4	21	7	
Murchison Gran- ite (Cambrian)	143	CP879735	Murchison Dam	biotite adam- ellite	76164	6735	1150	1102	7.5	5	20	8	39300
	144	CP882738	Murchison Dam	biotite adam- ellite	75521	6835	1076	1098	7.8	4	20	7	25700
Meredith Granite	145	CQ730058	Corinna Road, 300 m west of scenic point	porphyritic	64472	4958	1015	1052	5.2	3	19	6	
				biotite ad- amellite	57059	4153	917	850	4.2	4	15	6	
	146	CQ727057	Scenic point, Corinna Road	biotite ad- amellite	77796	8754	1608	1386	9.6	9	25	12	10
				biotite ad- amellite	78554	5843	1589	1443	5.5	8	27	10	
	147	CQ722035	Mt Ramsay track, 2.6 km south of Corinna Road	porphyritic	82096	5972	1668	1487	5.5	8	27	11	8
				biotite ad- amellite (with molybdenite)	73531	6330	1330	1379	6.6	4	26	8	
	148	CQ717004	Mt Ramsay track, 6 km south of Corinna Road	porphyritic	76531	5864	1365	1437	5.9	4	27	8	10
				biotite ad- amellite	82093	5694	1599	1435	5.2	8	26	10	
149	CQ717018	Mt Ramsay track, 4.5 km south of Corinna Road	porphyritic	78929	5531	1533	1382	5.1	8	25	10	8	
			biotite ad- amellite	70320	5401	1281	1185	5.4	6	22	8		0
150	CQ727074	Butlers Road	porphyritic	78285	6315	1517	1382	6.3	7	25	10	9	
			biotite ad- amellite	83371	6998	1638	1519	7.0	8	28	11		0
				porphyritic	84927	6828	1587	1695	6.8	5	32	9	7
				quartz feld- spar porphyry dyke	61489	4349	1149	1202	4.1	4	22	7	
					47029	3922	1069	1057	3.6	4	19	7	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Meredith Granite (continued)	151	CP610840	Parsons Hood	porphyritic	96492	6541	2013	1493	5.7	14	27	14	0
				biotite gran-	90111	5973	1883	1364	5.2	13	25	14	
				ite/adamellite	73816	5281	1439	1253	4.9	8	23	9	
	152	CP600876	ridge north of Parsons Hood	coarse-grained	79992	5696	1588	1343	5.3	9	25	11	0
				porphyritic	75108	6447	1332	1145	6.8	7	21	9	
	153	CP552858	1 km north of Mt Liv- ingstone	porphyritic	83590	6142	1901	1231	5.4	15	22	14	0
154	CP565885	north of Mt Livingstone	biotite gran-	74362	5405	1489	1066	5.0	11	19	11	0	
155	CP602912	west of Little Wil- son River	ite/adamellite	75831	5674	1615	1010	5.2	13	18	12	0	
			coarse-grained	94928	6889	1808	1507	6.6	10	28	13		
156	CP638900	east of Little Wil- son River	biotite gran-	92433	5322	1413	859	5.1	12	15	11	0	
			ite/adamellite	81411	5700	1660	1287	5.1	11	23	12		
Mount Bischoff Porphyry Dykes	157	CQ765118	Southern Dyke Don Hill	quartz feldspar	39887	3096	651	552	3.2	3	9	4	0
				porphyry	40186	3151	617	551	3.3	3	10	4	
	158	CQ765119	White Face Dyke, Mt Bischoff	altered quartz	23455	1506	432	352	1.3	2	6	3	0
				feldspar por-	39814	2468	1029	483	1.7	10	8	8	
	159	CQ764123	Western Dyke, Mt Bischoff	altered quartz	40917	2337	923	665	1.7	6	11	6	0
				feldspar por-	39240	1985	967	768	1.1	6	14	6	
phyry (with cassiterite)				40673	2037	1005	733	1.1	7	13	7		
160	CQ767126	Queen Dyke, Mt Bischoff	altered quartz	18684	722	492	255	0.1	4	4	3	0	
			porphyry	17604	722	425	251	0.2	3	4	3		

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Pine Hill Por- phyry	161	CP708684	Pine Hill	altered tour- maline quartz porphyry	59566	2866	1565	1165	1.3	11	21	10	90
					76104	3493	2166	1346	1.1	18	24	15	
	162	CP708683	Pine Hill	altered tour- maline quartz porphyry	87381	4161	2147	2214	2.0	7	42	12	0 up to 10000 on secondary Fe
					33412	2241	744	504	1.8	5	8	5	
	163	CP706686	Pine Hill	altered tour- maline quartz porphyry	15044	534	385	274	0.0	3	4	3	0
					21440	964	584	385	0.3	4	6	3	
	164	CP705686	Pine Hill	altered quartz porphyry	23210	1421	542	334	1.0	4	5	3	0
165	CP704686	Pine Hill	altered tour- maline quartz porphyry	23530	1380	530	322	1.0	4	5	3	215	
				20319	712	260	38	0.5	3	0	2		
166	CP705687	Pine Hill	altered tour- maline quartz porphyry	18753	666	312	50	0.4	4	0	3	0	
				29581	1151	784	618	0.2	5	11	5		
167	CP693711	Quarry, Mur- chison High- way, 1 km east of Renison Bell	greisenised quartz por- phyry (with fluorite)	48274	3778	865	759	3.8	4	13	6	0	
				48647	3867	868	657	3.9	6	11	6		
Heemskirk Granite	168	CP490574	Trial Har- bour Road	biotite gran- ite/adamellite	82840	6288	1730	1671	5.8	7	31	11	0
					64485	4419	1397	1311	3.8	6	24	8	
					81370	5958	1784	1542	5.3	10	28	12	
169	CP523577	Trial Har- bour Road	biotite gran- ite/adamellite	87127	6486	1865	1670	5.9	9	31	12	0	
				88939	5878	1860	1819	5.0	7	34	13		

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Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
Heemskirk Granite (con- tinued)	170	CP527577	near Orient prospect	porphyritic tourmaline biotite gran- ite/adamellite	86361	5173	1808	2212	4.1	2	42	9	0
	171	CP446678	St Dizier Creek, near St Dizier prospect	greisenised	95262	6694	2048	1038	5.9	20	18	16	0
				tourmaline muscovite granite	95834	6351	2230	1140	5.1	21	20	18	
	172	CP445679	west of St Dizier pros- pect	tourmaline	52381	3593	1080	621	3.2	9	10	8	0
				biotite musco- vite granite	44322	3195	742	714	3.2	3	13	4	
	173	CP448656	North Heems- kirk spur	tourmaline bio- tite granite/ adamellite	66895	4779	1261	941	4.5	8	17	9	0
	174	CP480649	Mt Heemskirk trig.	biotite gran- ite/adamellite	123975	7413	2876	2595	5.4	14	49	18	0
	175	CP505617	2 km north- west of Mt Agnew	tourmaline bio- tite muscovite granite/adamel- lite	138423	8254	3173	3347	6.0	10	64	19	0
	176	CP508599	East Federa- tion prospect	tourmaline bio- tite muscovite granite/adamel- lite	123821	7449	2768	2823	5.6	10	54	16	0
177	CP509599	East Federa- tion prospect	altered quartz- topaz-chlorite- tourmaline rock	46236	2035	1130	1178	.8	4	22	6	168	
178	CP509599	East Federa- tion prospect	porphyritic bio- tite granite/ adamellite	84183	5195	1887	1724	4.0	9	32	12	0	

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag. sus. S.I. x 10 <sup>-6</sup>
					1	2	3	4					
					Heemskirk Granite (con- tinued)	179	CP499597	Federation mine					
	180	CP498597	west of Federation mine	biotite gran- ite/adamellite	82668	5122	1674	2033	4.2	2	39	8	0
	181	CP496597	west of Federation mine	coarse-grained biotite gran- ite/adamellite	105176	6629	2348	2404	5.2	8	45	14	0
	182	CP486583	Granville Harbour Road	tourmaline bio- tite granite/ adamellite	43191 50014	3812 3708	738 939	752 886	4.1 3.6	2 4	13 16	4 6	0
	183	CP489583	Montague mine	biotite gran- ite/adamellite	73488	4426	1545	1674	3.5	4	31	8	0
	184	CP489583	Montague mine	greisen (with cassiterite)	66658	3025	1608	1965	1.4	2	37	8	0
	185	CP437617	Granville Harbour Road, 500 m south of Granite Creek	tourmaline bio- tite granite/ adamellite	106256 87379	7311 6164	2595 2141	1326 1121	5.9 5.0	25 20	23 19	20 17	0
	186	CP430619	Granite Creek	biotite gran- ite/adamellite	90204 81749	7994 7259	1743 1430	1296 1286	8.3 7.8	12 7	23 24	13 10	0
	187	CP451617	Granville Harbour Road, Trig. Point	biotite gran- ite/adamellite	97285 107249	6972 7257	2317 2599	1241 1486	5.9 5.8	21 23	22 26	18 19	0
	188	CP455612	Granville Harbour Road	biotite gran- ite/adamellite	74047	5721	1786	832	5.0	18	14	14	0

Table 1. (continued)

Granitic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag.
					1	2	3	4					sus. S.I. x 10 <sup>-6</sup>
Heemskirk Granite (con- tinued)	189	CP465609	Granville Harbour Road at South Gap Creek	biotite gran- ite/adamellite	50687	4414	1006	718	4.5	7	12	88	0
	190	CP474607	Granville Harbour Road	biotite gran- ite/adamellite	68947	5650	1279	967	5.7	8	17	9	
	191	CP476603	Granville Harbour Road	tourmaline biotite gran- ite/adamellite	102917	6826	2317	1909	5.6	14	35	15	0
	192	CP360692	Granville Harbour	porphyritic biotite gran- ite/adamellite	102046	7310	2222	1699	6.5	15	31	15	0
	193	CP360694	Granville Harbour	aplitic gran- ite (at con- tact)	101864	7995	2315	1348	7.3	20	24	18	0
	194	CP394664	mouth of Tasman River	porphyritic biotite gran- ite/adamellite	75148 74805	5653 5770	1455 1559	1244 1224	5.4 5.4	8 10	23 22	10 11	0
	195	CP449683	Twelve Mile Creek	greisenised porphyritic (biotite) mus- covite granite	68830	5781	1461	782	5.6	13	13	12	0
	196	CP447682	St Dizier Creek	porphyritic biotite mus- covite granite	47019 50460	4829 4890	768 762	560 758	5.5 5.5	5 3	10 14	6 5	0
McIvor Hill Gabbro	197	CP556595	Trial Har- bour Road, west of Comstock	Gabbro	6555	386	64	45	.4	0	0	0	3795
					7379	545	69	45	.6	0	0	0	

Table 1. (continued)

Mafic body	Site	AMG ref.	Location	Rock type	Gamma-ray spectrometer Channel				K <sub>2</sub> O %	U g/t	Th g/t	HGU	Mag.
													S.I.
					1	2	3	4					x 10 <sup>-6</sup>
Serpentine Hill Complex	198	CP680677	Quarry, Ser- pentine Hill	serpentinite	2612	79	44	45	0.0	0	0	0	up to 300000
Heazlewood River Ultramafic Com- plex	199	CQ556072	Gravel Pit, Corinna Road	serpentinized pyroxenite	3218 3229	82 90	57 35	43 35	0.0 0.0	0 0	0 0	0 0	1620
	200	CQ566074	Gravel Pit, Corinna Road	serpentinized pyroxenite	3595	126	51	50	0.0	0	0	0	4084
	201	CQ585072	Quarry Cor- inna Road	serpentinized pyroxenite	3592	111	56	33	0.0	0	0	0	18710
	202	CQ593072	Corinna Road at Duff's Hill	serpentinized peridotite/ pyroxenite	3283	99	63	35	0.0	0	0	0	53784
	203	CQ605075	Gravel Pit, Corinna Road	serpentinized peridotite/ pyroxenite	2943	80	50	35	0.0	0	0	0	22860
Whyte River Com- plex	204	CQ648079	Luina	serpentinized dolerite	3834	124	68	45	0.0	0	0	0	24756
Deep Creek Vol- canics	205	CQ652068	No 2 level adit, Cleve- land mine	altered spili- tic basalt	18734	1457	301	273	1.5	1	4	2	927
					19892	1484	334	351	1.5	1	6	2	
	206	CQ651066	No 7 level adit, Cleve- land mine	altered spili- tic basalt	22995	2112	386	330	2.3	2	5	3	653
	207	CQ655058	1 km south- east of Cleveland	spilitic bas- alt	10778	700	174	210	.6	0	3	1	84412
208	CQ657063	500 m east of Cleve- land	spilitic bas- alt	9577	797	146	156	.8	0	2	1	36338	
				9340	739	148	157	.7	0	2	1		

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