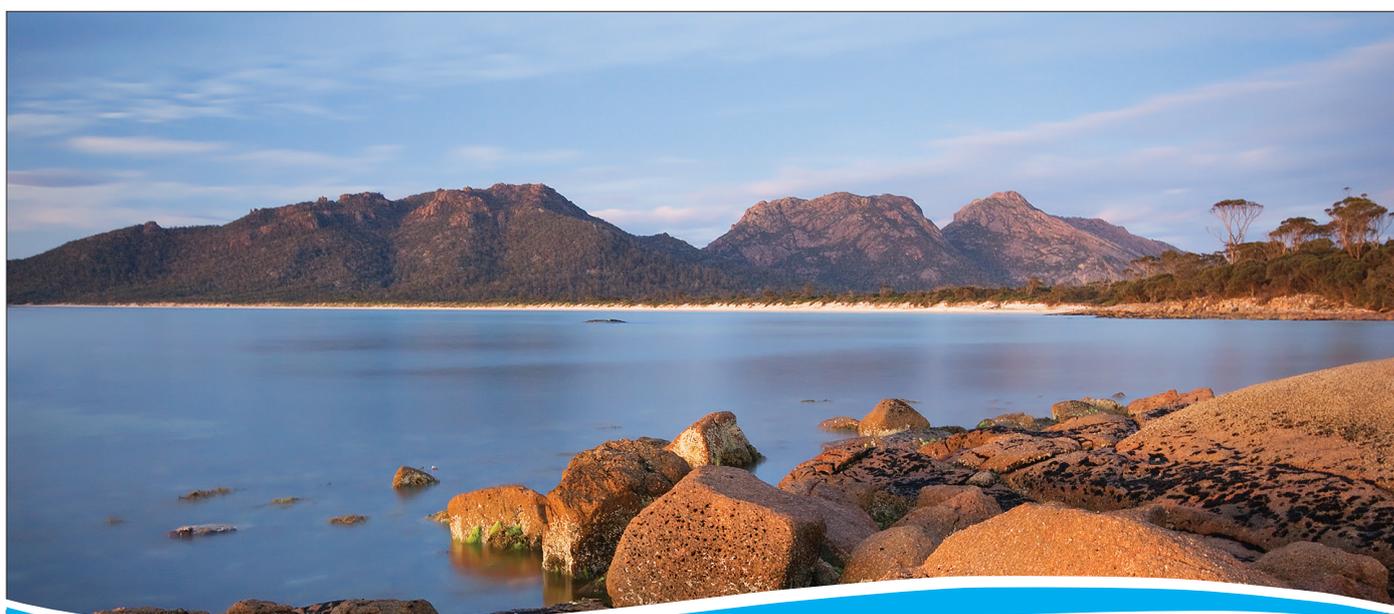
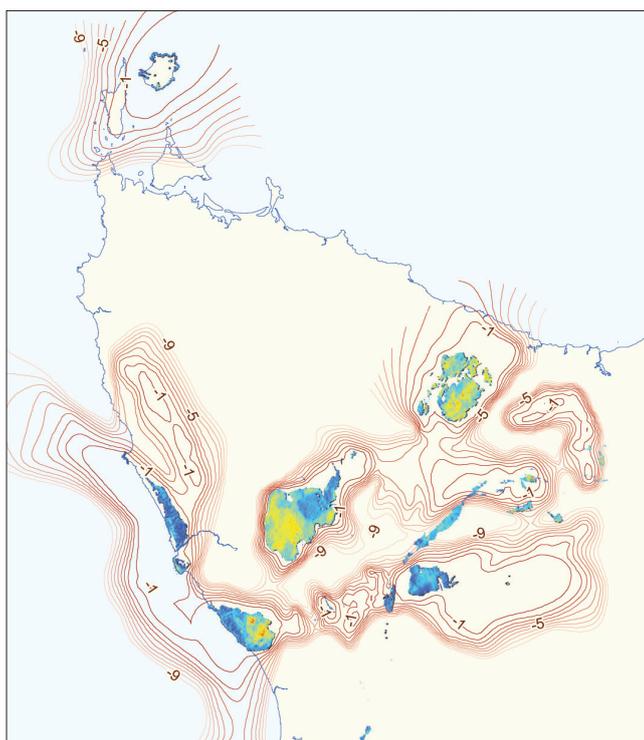


# The radioactive heat generation of Tasmanian granites, calculated from Th, U and K whole-rock analyses and airborne radiometric data

J. L. Everard and M. L. Duffett

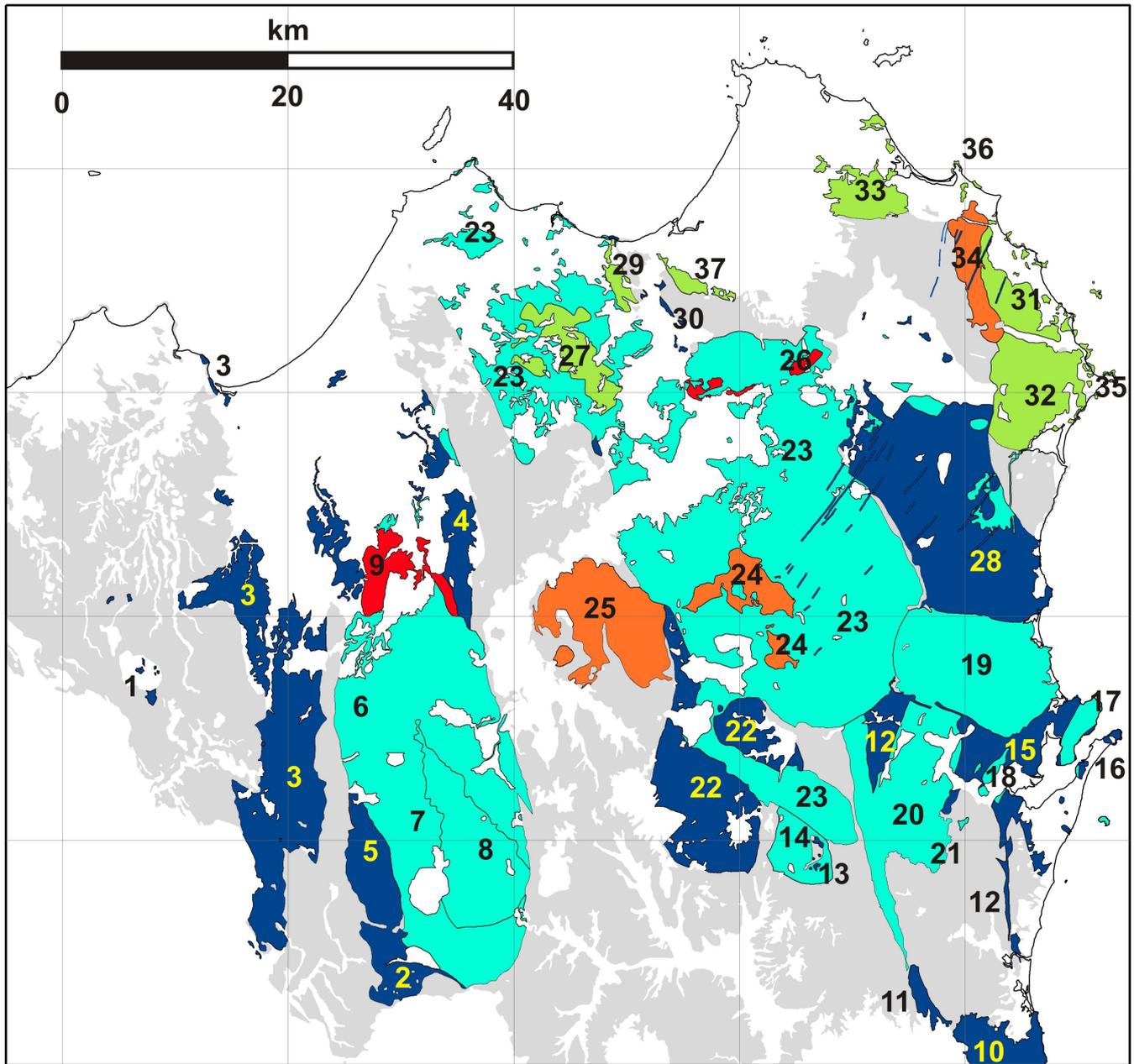




Tasmanian Geological Survey Record UR2016/03

# The radioactive heat generation of Tasmanian granites, calculated from Th, U and K whole-rock analyses and airborne radiometric data

*by J. L. Everard and M. L. Duffett*



**SCOTSDALE BATHOLITH**

- 1 Lisle
- 2 Upper Blessington
- 3 Diddleum
- 4 Tulendeena
- 5 Porcupine Creek
- 6 Russells Road
- 7 Hogarth Road
- 8 Tombstone Creek
- 9 Mt Stronach

**BLUE TIER BATHOLITH**

- 10 St Marys Porphyry
- 11 Catos Creek
- 12 Scamander Tier
- 13 Hogans Road
- 14 Haleys New Country
- 15 George River
- 16 Akaroa
- 17 Grants Point
- 18 Medeas Cove
- 19 Mt Pearson North
- 20 Mt Pearson South
- 21 Constable Creek
- 22 Pyengana
- 23 Poimena
- 24 Lottah
- 25 Mt Paris
- 26 Mt Cameron
- 27 Little Mt Horror
- 28 Gardens
- 29 Sheoak Hill
- 30 Vicarys Creek

**EDDYSTONE BATHOLITH**

- 31 Ansons Bay North
- 32 Ansons Bay South
- 33 Rushy Lagoon
- 34 Mt William
- 35 Eddystone Point
- 36 Musselroe Point
- 37 Boobyalla

Location map of northeast Tasmania granites.  
Legend as for map on inside cover.

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## Abstract

A comprehensive sample set of Tasmanian granites (190 samples) was analysed by inductively coupled plasma mass spectroscopy (ICPMS) at Geoscience Australia. Results were combined with previously available ICPMS, instrumental neutron activation analysis (INAA) and good quality X-ray fluorescence (XRF) data to calculate the mean specific heat generation (HGU) of each pluton (~105 bodies) from its mean K, Th and U contents. The highest values are obtained from strongly fractionated granites, which tend to be higher in U, and especially from strongly fractionated I-types, which are also elevated in Th, whereas K makes a subordinate contribution.

In eastern Tasmania, the calculated mean heat generation is highest for the granites of the Freycinet Peninsula, especially The Hazards Granite (~50 x 10<sup>-10</sup> W/kg), and those of the Ben Lomond Batholith, especially the I-type Henbury Granite (~43 x 10<sup>-10</sup> W/kg). Moderately high mean values are calculated for the Mt Stronach Granite (~28.5 x 10<sup>-10</sup> W/kg) and some of the fractionated alkali feldspar granites of the Blue Tier Batholith, whether designated I- or S-type. All plutons from the Eddystone Batholith and the Furneaux Islands yield low to moderately low values. Relatively mafic I-type granodiorites have uniformly low heat generation (generally <10 x 10<sup>-10</sup> W/kg)

In western Tasmania, the highest mean heat generation is also from fractionated I-types, notably the Housetop Granite (~29 x 10<sup>-10</sup> W/kg) and the similar small Dolcoath Granite (~32 x 10<sup>-10</sup> W/kg). Other moderately “hot” plutons (20–30 x 10<sup>-10</sup> W/kg) are the I-type Heemskirk Red and Renison/Pine Hill Granites and the unfractionated Sandblow Granite on King Island. The S-type Heemskirk White Granite (28 x 10<sup>-10</sup> W/kg) and small Birthday Granite (~25 x 10<sup>-10</sup> W/kg), have moderately high mean values due to their high uranium content.

In northeast Tasmania, analytical data for K, Th and U from granite samples have been compared to gamma ray counts extracted from airborne radiometric data. However, correlations are moderate to poor. Correlations for Th and U are better than those for K, and are slightly better when data from individual sample localities are averaged by pluton. Correlations between elemental and count ratios (e.g. U/K, Th/K and U/Th) are weaker than for the elements themselves. Thus the hue of particular plutons on ternary images derived from airborne radiometric data does not always match well with that predicted from analytical data. For example the green hue of the Ansons Bay Granite is not clearly linked to a high Th content in analysed samples. This turns out to be mainly due to an unusually attenuated K radiometric signal, rather than particularly high Th response.

## Introduction

In recent years there has been an upsurge of interest in geothermal energy as a clean and quasi-renewable alternative to fossil fuels (e.g. Barbier 2002). Investigations have usually targetted areas of high geothermal gradient and heat flow. Most currently operating geothermal power stations are located in active geothermal areas, often near active volcanism (e.g. in Iceland and Hawaii), and capture hot fluid at or near the surface for direct heating or to generate electricity. A more recent development, known as “enhanced (or engineered) geothermal systems (EGS)”, targets higher temperatures, usually unrelated to active volcanism at greater depths (~3–5 km). The thermal anomalies are usually due to the presence of rock units at depth, chiefly granites, which are high natural heat generators because of their relatively high concentrations of natural radioactive elements. Heat is extracted either from naturally present hydrothermal fluids (“hot wet rock”) or by injecting water into the heat source (“hot dry rock”).

## Geothermal gradient and heat flow

The determination of geothermal gradient requires the accurate down-hole measurement of temperature in a drill-hole, which must be sufficiently deep (at least several hundred metres) and allowed to reach thermal equilibrium (commonly requiring several months after drilling). Corrections may be needed to allow for the influence of topographic irregularities, and temperatures may be perturbed by groundwater. The heat flow is given by the product of geothermal gradient and thermal conductivity, which must be determined on core or other representative samples in the laboratory.

Beardsmore and Cull (2001, p. 11) tabulated global mean heat flows by the age and nature of the terrain. The global means for Proterozoic and Phanerozoic continental terrains range from 57.7 to 63.9 mWm<sup>-2</sup>, except for Cenozoic igneous terrains (97 mWm<sup>-2</sup>).

## Heat flow measurements in Tasmania

The first heat flow measurements in Tasmania were made by Newstead and Beck (1953), who obtained values (converted to SI units) of 85.4 to 86.6 mWm<sup>-2</sup> from three Hydro-Electric Commission (HEC) drill holes near Great Lake, and 103.3 to 106.3 mWm<sup>-2</sup> at Rosebery. Jaeger and Sass (1963) obtained 76.4 mWm<sup>-2</sup> from another hole near Great Lake, and 159.3 mWm<sup>-2</sup> from a hole in Mathinna Supergroup near Storeys Creek. The latter is still one of Australia's highest heat flow measurements. Wronski (1977) obtained 87 mWm<sup>-2</sup> from the dolerite section in a Department of Mines drill-hole at Glenorchy, and 57 mWm<sup>-2</sup> from the mudstone section of an HEC hole in the Tyennan Region, at Olga Ridge in southwest Tasmania. Green (1989) however regarded the latter value as a minimum, because of probable heat refraction through adjacent quartzites, and possible groundwater flow.

Green (1989) reviewed this early data and presented data from a deep (830 m) drill hole in Devonian granite at Coles Bay. These were a geothermal gradient of ~28 deg km<sup>-1</sup> and a heat flow of 93 mWm<sup>-2</sup> in the lower part of the hole, increasing to 102.3 mWm<sup>-2</sup> in the upper part. The upward increase was "entirely accounted for by heat production from radiogenic elements within the granite section drilled." Average gradients of 41 deg km<sup>-1</sup> at Tunbridge and 27.8 deg km<sup>-1</sup> near Stanley were also quoted, but thermal conductivity measurements from these holes, reportedly in progress, were not published.

In a more systematic approach, KUTh Exploration P/L began a drilling program in eastern and central Tasmania in 2007, specifically devised to assess geothermal potential (Lewis et al. 2007; Ward et al. 2008). Seven of their published heat flow values in the Eastern Tiers–Ben Lomond region range from 83 to 92 mWm<sup>-2</sup>. Lower values were reported from Epping Forest (62 mWm<sup>-2</sup>, although 92 mWm<sup>-2</sup> at the base of the hole). Generally lower values were also recorded from the Tamar region (48–86 mWm<sup>-2</sup> from nine holes) (Holgate 2011). Six of seven holes in southeast Tasmania also recorded lower values (70–84 mWm<sup>-2</sup>, with 94 mWm<sup>-2</sup> near Rheban) (Holgate and Goh 2010; Holgate 2011, 2012). Further data were obtained but are not yet in the public domain.

Most of these heat flow measurements are well above typical continental values, suggesting that Tasmania has potential for power generation by enhanced geothermal systems.

## Heat flow and heat generation

Of related interest is the heat generation of various rock types. Although of less direct relevance to geothermal exploration than heat flow measurements, the specific heat generation of a particular rock sample is easily calculated from its radiogenic element contents, which can be determined either analytically or radiometrically.

In many parts of the world, an empirical linear relationship exists between surface heat generation (A) and surface heat flow (Q) (Birch et al. 1968; Lachenbruch 1968):

$$Q = q + AD$$

where D is a constant with dimensions of length, of the order of 10–15 km, related to the distribution of radiogenic elements with depth and characteristic of a particular heat flow province, and q represents heat flow from the mantle. The theoretical implications of this relationship are discussed by, amongst others, Sawka and Chappell (1986) and Beardsmore and Cull (2001). One popular model is an exponential upward increase in radiogenic elements in the crust, which would allow the relationship to remain valid with differential erosion. Other more complex models have been advocated, including stepwise changes in radiogenic element contents, and different constants for K, Th and U (see above references for reviews). In any case, it is very doubtful whether a linear relationship between surface heat generation and heat flow can

be defined in Tasmania, where Jurassic dolerite and Cenozoic basalt, rocks with low contents of radiogenic elements, are widespread at the surface.

High heat generation of a rock unit does not necessarily translate into a high potential for geothermal power generation. Many other factors are involved. For instance, adequately high temperatures will not be attained unless the heat generating rocks are at sufficient depth. The presence of an overlying insulating cap or “blanket” of low thermal conductivity, such as coal seams or carbonaceous shales, is also important. A high rock permeability for convective fluids beneath this cap may be desirable.

Therefore, the mean heat generation of Tasmanian granites, calculated below, cannot be used directly to identify regions of high potential for geothermal power generation, particularly as most samples are from surface outcrops of unroofed granite plutons. However, they may be indicative of granite types present at depth. To assess potential, it needs to be combined with the depth of granite from surface (Leaman and Richardson 2003) and other geological information.

## Analytical considerations

The specific heat generation for a rock unit of particular composition is given by (see Appendix 1):

$$\text{HGU (x10}^{-10} \text{ W/kg)} = 0.2884 \cdot \text{K}_2\text{O (wt\%)} \\ + 0.256 \cdot \text{Th (ppm)} + 0.9523 \cdot \text{U (ppm)}$$

There are various forms of this equation, with slightly different coefficients or different units. Some give heat generation per unit volume (e.g. in  $\mu\text{W/m}^3$ ) and therefore include rock density as a variable. In this report, heat generation is calculated per unit mass, as density data are available for only a few samples. However, the density of granites typically varies over a small range from  $\sim 2600 \text{ kg/m}^3$  (felsic granites) to  $\sim 2700 \text{ kg/m}^3$  (granodiorites), and if the calculated heat generation rates given below in  $10^{-10} \text{ W/kg}$  are converted to  $\text{W/m}^3$  by multiplying by 2650, the additional error introduced is unimportant.

Tasmanian granites contain, at the 95% percentile level, between 2.6 and 5.5 %  $\text{K}_2\text{O}$ , between 7 and 77 ppm Th, and between 2.1 and 28 ppm U (this dataset). Most of the variation in calculated heat generation

between plutons or individual samples is therefore due to differences in their Th and U content, with K playing a subordinate role. Thus, to accurately calculate their heat generation, the concentration of Th and U must be accurately and precisely determined. For example, an uncertainty or error of 1 ppm in U content is equivalent to the heat contribution of the entire K content for a rock with 3.3%  $\text{K}_2\text{O}$ .

## Previous Th and U data from Tasmanian granites

Thorium and uranium data from Tasmanian granites have been obtained by several laboratories using a range of methods with various accuracy and precision.

Black et al. (2010) reported major (XRF) and trace element (ICPMS) analyses, including K, Th and U, for 25 samples of Tasmanian granites, which they used for SHRIMP geochronology (Black et al. 2005), inherited zircon and isotope studies. This dataset is closely comparable to the new ICPMS data reported herein, and has been combined with it.

The instrumental neutron activation analysis (INAA) method has been used to determine rare-earth elements (REE) in some Tasmanian granites; usually Th and sometimes U were also analysed. Most INAA analyses were done commercially by Becquerel Laboratories, using the HIFAR reactor at Lucas Heights. Their accuracy and precision are considered comparable to, or better than ICPMS, particularly as sample dissolution is not required. INAA data for both Th and U are available from the Heemskirk White and Heemskirk Red granites (McClenaghan 1994), the Ben Lomond Batholith, and the Maria Island, Deep Glen Bay and Loorana Granites (MRT databases, see [www.mrt.tas.gov.au](http://www.mrt.tas.gov.au)).

The use of Th and U data obtained by X-ray fluorescence (XRF) is more problematical, as these elements (particularly U) are often present at levels close to or below their detection limits, particularly those on older instruments. For instance, at Mineral Resources Tasmania, the detection limit of both Th and U was, until 2009, routinely quoted as 10 ppm. Accordingly, pre-2009 MRT data for Th and U have not been used to calculate specific heat generation. Subsequent commissioning of a new XRF machine at MRT has reduced detection limits

to 2 ppm (Th) and 1 ppm (U), well below values in most Tasmanian granites. A case can be made to re-analyse samples from the MRT collection on the new machine, to improve data quality (both for Th and U, and also other trace elements).

The database of granite analyses of B. W. Chappell and co-workers, obtained by XRF and available on the Geoscience Australia website, also has similar low detection limits (~1–2 ppm) for Th and U. Both recent MRT data (28 analyses of granites, mostly from King Island) and the Chappell dataset (373 analyses) are considered to be of good precision and accuracy and have been used to calculate specific heat generation. This XRF dataset is compared below, on a pluton-by-pluton basis, with the ICPMS and INAA results.

Goh (2008) determined the K, Th and U content of a limited number of drill core samples of the Royal George, Henbury, Poimena and Coles Bay granites, and of the Mathinna Supergroup, by XRF and laser ablation ICPMS of fused discs. Although this is a less reliable method of determining trace elements, she showed that well-controlled laboratory gamma ray spectroscopy of the cores yields results that correlate well with the analytical data, and also can be used, after calibration, to rapidly and cheaply determine K, Th and U contents. Although her data are not used in this report, they are broadly consistent with the other data utilised here.

## Sample selection for new ICPMS analyses

This report is largely based on a new dataset of 190 representative samples of mainly Devonian Tasmanian granites, analysed by both the XRF (major and trace elements) and ICPMS (trace elements) methods at Geoscience Australia. All but one of the samples were also analysed by XRF (major and trace elements) at Mineral Resources Tasmania.

Most samples were retrieved as crushed powders, from the MRT collection. The majority had been collected as bulk samples, using explosives or a wedge technique, specifically for geochemical analysis or SHRIMP geochronology and are thus considered of high quality. Eleven samples were from drill core. Some additional samples, mostly collected from the islands of the Furneaux Group as part of PhD studies by Cocker (1977;

19 samples) and Reid (1987; 10 samples), were obtained from the University of Tasmania collection.

Nomenclature of plutons follows Everard (2005), except that the Proterozoic “West Coast Granite” of King Island is subdivided into the Loorana and Cape Wickham Granites. At least one sample was analysed from most plutons. No samples were available, at the time of dispatch, from the following bodies, most of which are in remote areas and/or of dubious status: the Sea Elephant Granite, the Cape Wickham Granite, the Cleveland porphyry (a subsurface body near Luina), the Schouten Island Granite, the Boulder Point Granodiorite (a small body within the Ansons Bay Granite), the Dutchman Granite (a poorly defined body on Flinders Island) or those granites from the islands between Flinders Island and Wilsons Promontory. (However, previous INAA or good quality XRF data are available from most of these granites). Also, no new analyses were made from the Heemskirk Batholith, as most available samples had already been analysed for Th, U (and other trace elements) by INAA or ICPMS.

The granites are classified as I-type (infracrystal, or derived from partial melting of predominantly igneous source rocks) and S-type (supracrystal, or derived from partial melting predominantly sedimentary source rocks), following Chappell and White (1974, 1992) and numerous other publications. For further discussion of the petrogenesis of southeast Australian and Tasmanian granites, the reader is referred to Collins (1998) and Black et al. (2010).

Unfractionated granites are considered to be those with generally <250 ppm Rb, >50 ppm Sr and >200 ppm Ba, as defined elsewhere in the Lachlan Fold Belt (e.g. Chappell et al. 1991; Chappell & White 1992). Weak (250–300 ppm Rb), moderate (300–500 ppm Rb), strong (500–1000 ppm Rb) and very strong (>1000 ppm Rb) fractionation are arbitrarily defined for the purposes of this report.

## Results

Analytical results for Th and U (by ICPMS) and K<sub>2</sub>O contents (by XRF), together with calculated heat generation are given for each sample in Table 1 and the mean values for each pluton in Table 2. The mean calculated heat generation, by pluton, is also shown as three sets of histograms, with the relative contribution

of K, Th and U indicated. The first set of histograms (Fig. 1) utilises only ICPMS and INAA data, the second set (Fig. 2) shows good quality XRF data, and the third set (Fig. 3) combines both ICPMS, INAA and XRF data.

### *Thorium, uranium and potassium by granite type and fractionation state*

Of the 635 individual analyses (ICPMS, INAA and XRF), 633 were classified by region (eastern or western Tasmania), pluton age, type (I or S) and fractionation state. (Two analyses, of the Mt Bischoff and Cleveland porphyries, were not classified in this way due to hydrothermal alteration.) The mean Th, U and  $K_2O$  contents were calculated for each group (Table 3).

Unfractionated granites from eastern Tasmania are relatively low in both Th (typically ~15 ppm) and U (typically ~3–5 ppm), and thus radiogenic heat generation is also low. This is equally applicable to I- and S-type granites. In western Tasmania, the dataset is less extensive, and there are fewer unfractionated or weakly fractionated granites (especially S-types), but broadly these generally have similar, or slightly higher, Th (~12–24) and U values (~4–11 ppm) to comparable granites in eastern Tasmania.

Uranium tends to become more abundant with increasing fractionation state. In Devonian-Carboniferous granites, this is clearly seen in both I- and S-types, and in both eastern and western Tasmania, although the data are more limited for Cambrian and Cryogenian granites. However, the data are scattered, and variance in uranium content is the main cause of large variations (of a factor of 3 or more) in calculated heat generation between individual samples of some fractionated granite bodies. These are mostly S-type plutons (e.g. the Sandy Cape, Heemskirk White, Royal George, Lottah and Strzelecki granites), but also include the I-type Henbury Granite. A few very strongly fractionated S-types from eastern Tasmania (mainly from the Lottah Granite) display erratic values of U (2.5–16.9 ppm), generally lower than in less strongly fractionated granites. This may be due to mobility of uranium in hydrothermal fluids.

Thorium also correlates positively with fractionated state in I-types, especially in eastern Tasmanian I-types (of which there are the most data), but is relatively low in all S-types, and tends to decrease in the late stages of fractionation. This contrasting behaviour of thorium with fractionation in I- and S-types has been noted by previous workers (e.g. Sawka et al. 1990; Chappell 1999)

and attributed to differences in phosphorus solubility between metaluminous and peraluminous silicate melts (Montel et al. 1988; Pichavant et al. 1992). As metaluminous, I-type, granites fractionate, phosphorus saturation soon occurs and apatite precipitates early, depleting the remaining melt in  $P_2O_5$ . Crystallisation of rare earth and thorium phosphates such as monazite is delayed or does not occur at all, and very high levels of thorium may be attained. In peraluminous, S-type granites, in contrast, phosphorus is more soluble and increases steadily with fractionation, and saturation in monazite and other REE-Th phosphates may occur, depleting the remaining melt in Th.

No clear trends with fractionation state are evident for potassium, although there is some suggestion that it is higher in weakly to moderately fractionated granites than either unfractionated or strongly fractionated granites.

From a petrogenetic viewpoint, it is more valid to attribute these empirical observations to a specific process (such as crystal fractionation) if trends are established from samples that are likely to be genetically related. For this reason, plots of Th and U against Rb were made for some individual plutons, or groups of plutons thought to constitute a genetically related suite (e.g. Hine et al. 1978; Griffin et al. 1978; Chappell & White 1992) (Fig. 4). These plots show the data, when assessed, at pluton or suite level, have considerable scatter. Thorium is consistently higher in I-types than S-types, but fractionation trends are poorly defined for most suites (Fig. 4a, c). Uranium shows a fairly clear increase with fractionation in some I-type suites (Freycinet, Husetop; Fig. 4b) but data for S-type suites are very scattered and, as noted above, it appears to be depleted in the most highly fractionated members of the Lottah Suite (Fig. 4d).

The reason for this scatter is beyond the scope of this report, but possible explanations include:

- Insufficient sample size and the analytical “nugget effect”, since Th and U are largely contained at high concentrations in volumetrically small accessory minerals.
- Irregular crystal fractionation of Th- and U-bearing accessory minerals due to their small size and because they themselves may be inclusions in other minerals (e.g. zircon and monazite in biotite).
- Mobility of U and Th by secondary processes (e.g. hydrothermal alteration, leaching from

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). Digital data available from authors upon request.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation						Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>		
Cape Wickham	Cryogenian	KE2902	R017733	JLE	I	237906	5612586	xrf	5.45	7	6	1.57	1.79	5.71	9.08	1397.2	28.5	77.5		
Cape Wickham	Cryogenian	KE2918B	R017737	JLE	I	242456	5612250	xrf	4.98	17	7	1.44	4.35	6.67	12.45	1276.8	69.2	90.4		
Cape Wickham	Cryogenian	KE3167	R017753	JLE	I	245209	5610264	xrf	4.96	19	5	1.43	4.86	4.76	11.06	1271.6	77.3	64.6		
Cape Wickham	Cryogenian	KE3351	R017767	JLE	I	238848	5613545	xrf	4.70	45	9	1.36	11.52	8.57	21.45	1205.0	183.1	116.3		
Cape Wickham	Cryogenian	KE3173	R017755	JLE	I	245790	5609932	xrf	5.12	19	7	1.37	7.27	1.42	13.00	1312.6	77.3	90.4		
Loorana	Cryogenian	R011165	R011165	CRC	I	231200	5575700	icpms	4.74	28.38	1.49	1.37	7.27	1.42	10.05	1213.9	115.5	19.2		
Loorana	Cryogenian	BBC2			I	232850	5571200	inaa	4.69	22.5	5.49	1.35	5.76	5.23	12.34	1202.4	91.6	70.9		
Loorana	Cryogenian	KE935	R014661	JLE	I	231371	5573016	xrf	4.82	20	7	1.39	5.12	6.67	13.18	1235.7	81.4	90.4		
Loorana	Cryogenian	KE1474	R014724	JLE	I	232130	5560593	xrf	3.40	26	6	0.98	6.66	5.71	13.35	871.7	105.8	77.5		
Loorana	Cryogenian	KE1480	R014725	JLE	I	232563	5560666	xrf	3.72	18	4	1.07	4.61	3.81	9.49	953.7	73.2	51.7		
Loorana	Cryogenian	KE2062	R015721	JLE	I	231613	5572835	xrf	4.73	20	10	1.36	5.12	9.52	16.01	1212.7	81.4	129.2		
Loorana	Cryogenian	KE2218	R015748	JLE	I	230210	5575430	xrf	4.60	28	6	1.33	7.17	5.71	14.21	1179.3	113.9	77.5		
Loorana	Cryogenian	KE2312	R015769	JLE	I	229877	5579943	xrf	5.48	31	12	1.58	7.94	11.43	20.94	1404.9	126.1	155.0		
Loorana	Cryogenian	KE2599	R015796	JLE	I	231025	5587728	xrf	5.54	22	9	1.60	5.63	8.57	15.80	1420.3	89.5	116.3		
Loorana	Cryogenian	KE2626	R015799	JLE	I	231359	5588443	xrf	6.19	40	5	1.79	10.24	4.76	16.79	1587.0	162.8	64.6		
Loorana	Cryogenian	KE2969	R017740	JLE	I	232425	5571580	xrf	4.75	18	5	1.37	4.61	4.76	10.74	1217.8	73.2	64.6		
Loorana	Cryogenian	KE3019	R017744	JLE	I	230017	5580166	xrf	5.24	26	13	1.51	6.66	12.38	20.55	1343.4	105.8	167.9		
Loorana	Cryogenian	KE3123	R017750	JLE	I	232397	5576768	xrf	4.65	16	9	1.34	4.10	8.57	14.01	1192.1	65.1	116.3		
Loorana	Cryogenian	KE3293	R017761	JLE	I	232332	5576113	xrf	4.62	17	8	1.33	4.35	7.62	13.30	1184.5	69.2	103.3		
Beulah	Cambrian	WT37		BWC	I	447500	5410600	xrf	5.30	30.0	8.0	1.53	7.68	7.62	16.83	1358.8	122.1	103.3		
Mersey (Dove)	Cambrian	WT22		BWC	I	435000	5393500	xrf	2.06	12.0	3.2	0.59	3.07	3.05	6.71	528.1	48.8	41.3		
Mersey (Dove)	Cambrian	WT23		BWC	I	435700	5394400	xrf	4.13	26.5	6.0	1.19	6.78	5.71	13.69	1058.8	107.8	77.5		
Mersey (Dove)	Cambrian	G401402		RGR	I	435705	5394260	xrf	7.05	25.0	5.0	2.03	6.40	4.76	13.19	1807.5	101.7	64.6		
Forth (Dove)	Cambrian	WT21		BWC	I	427000	5397600	xrf	5.14	45.0	4.4	1.48	11.52	4.19	17.19	1317.8	183.1	56.8		
Murchison	Cambrian	WT14		BWC	I	387400	5373300	xrf	5.16	15.8	4.8	1.49	4.04	4.57	10.10	1322.9	64.3	62.0		
Murchison	Cambrian	WT13		BWC	I	387800	5374300	xrf	5.66	19.8	4.4	1.63	5.07	4.19	10.89	1451.1	80.6	56.8		
Murchison	Cambrian	LFB2002		BWC	I	388300	5373900	xrf	8.07	21.0	3.6	2.33	5.38	3.43	11.13	2069.0	85.4	46.5		
Darwin	Cambrian	WT50		BWC	I	383000	5315600	xrf	5.42	51.0	7.4	1.56	13.06	7.05	21.67	1389.6	207.5	95.6		
Darwin	Cambrian	WT48		BWC	I	383000	5315600	xrf	5.31	42.0	7.0	1.53	10.75	6.67	18.95	1361.4	170.9	90.4		
Darwin	Cambrian	WT49		BWC	I	383000	5315700	xrf	2.66	39.0	1.8	0.77	9.98	1.71	12.47	682.0	158.7	23.3		
Elliott Bay	Cambrian	SW61ga	R011516	JLE	I	377590	5239760	icpms	4.61	30.7	4.75	1.33	7.86	4.52	13.71	1180.9	124.9	61.4		
Elliott Bay	Cambrian	WT45		BWC	I	381200	5240400	xrf	5.11	26.0	5.2	1.47	6.66	4.95	13.08	1310.1	105.8	67.2		
Elliott Bay	Cambrian	WT47		BWC	I	377900	5239900	xrf	4.70	27.0	7.8	1.36	6.91	7.43	15.70	1205.0	109.9	100.8		
Little Rocky R	Cambrian	WT46		BWC	I	385400	5240100	xrf	5.98	59.0	7.2	1.72	15.10	6.86	23.69	1533.1	240.1	93.0		
Little Rocky R	Cambrian	SW62	R011517	JLE	I	385100	5240340	icpms	5.98	50.62	28.61	1.72	12.96	27.25	41.93	1531.8	206.0	369.6		
SW Cape	Cambrian	SW37ga	R011515	JLE	S	421980	5176960	icpms	4.74	8.7	2.98	1.37	2.23	2.84	6.43	1214.2	35.4	38.5		
The Mewstone	Cambrian	70937		NB	S	449300	5156800	icpms	5.70	8.81	2.26	1.65	2.26	2.15	6.05	1462.4	35.8	29.2		
Sea Elephant	Carbonif.	WV25		BWC	I	250700	5590000	xrf	3.70	19.6	3.8	1.07	5.02	3.62	9.70	948.6	79.8	49.1		
Sea Elephant	Carbonif.	WV26		BWC	I	250500	5590300	xrf	3.85	19.4	3.0	1.11	4.97	2.86	8.93	987.0	78.9	38.8		
Bold Head	Carbonif.	WV19		BWC	I	249500	5564400	xrf	4.13	35.0	8.0	1.19	8.96	7.62	17.77	1058.8	142.4	103.3		

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												U Jkg <sup>-1</sup>	K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>
Bold Head	Carbonif.	WV20		BWC	I	249500	5564400	xrf	3.88	35.0	11.6	1.12	8.96	11.05	21.13	994.7	142.4	149.8	
Sandblow	Carbonif.	99220059 agso		BWC	I	249450	5561850	icpms	4.07	38.8	15.1	1.17	9.93	14.38	25.49	1043.5	157.9	195.1	
Sandblow	Carbonif.	WV16b		BWC	I	249500	5560900	xrf	4.06	45.0	11.0	1.17	11.52	10.48	23.17	1040.9	183.1	142.1	
Sandblow	Carbonif.	WV17b		BWC	I	248800	5562100	xrf	4.37	35.0	6.6	1.26	8.96	6.29	16.51	1120.4	142.4	85.3	
Sandblow	Carbonif.	WV18		BWC	I	249200	5561800	xrf	4.10	38.5	13.6	1.18	9.86	12.95	23.99	1051.1	156.7	175.7	
Sandblow	Carbonif.	WV21b		BWC	I	248000	5559400	xrf	4.21	41.0	10.0	1.21	10.50	9.52	21.23	1079.3	166.8	129.2	
Sandblow	Carbonif.	WV22		BWC	I	247400	5559300	xrf	3.75	31.8	8.4	1.08	8.14	8.00	17.22	961.4	129.4	108.5	
Sandblow	Carbonif.	WV23		BWC	I	244600	5556800	xrf	3.98	31.5	7.6	1.15	8.06	7.24	16.45	1020.4	128.2	98.2	
Sandblow	Carbonif.	WV24b		BWC	I	243200	5559900	xrf	4.01	36.5	14.6	1.16	9.34	13.90	24.40	1028.1	148.5	188.6	
Sandblow	Carbonif.	99220059		BWC	I	249450	5561850	xrf	3.97	31.0	12.0	1.14	7.94	11.43	20.51	1017.8	126.1	155.0	
Sandblow	Carbonif.	KE10	R013401	JLE	I	248220	5559750	xrf	3.71	27.0	6.0	1.07	6.91	5.71	13.70	951.6	109.9	77.5	
Sandblow	Carbonif.	KE217	R013441	JLE	I	244830	5557163	xrf	4.49	32.0	19.0	1.29	8.19	18.09	27.58	1151.1	130.2	245.4	
Sandblow	Carbonif.	KE1241	R014711	JLE	I	247557	5559702	xrf	4.09	35.0	11.0	1.18	8.96	10.48	20.61	1048.6	142.4	142.1	
Currie porphyry	Carbonif.	LB57		SFC	I	230500	5573700	xrf	2.04	16.0	4.5	0.59	4.10	4.29	8.97	523.0	65.1	58.1	
Three Hummock	Devonian	TH5	R000841	JLE	S	316600	5520200	icpms	4.50	10.73	5.03	1.30	2.75	4.79	8.83	1153.4	43.7	65.0	
Three Hummock	Devonian	TH9	R000845	JLE	S	319800	5517200	icpms	5.46	21.45	3.63	1.58	5.49	3.46	10.52	1400.3	87.3	46.9	
Three Hummock	Devonian	WT66		BWC	S	320400	5524100	xrf	4.76	17.0	8.0	1.37	4.35	7.62	13.34	1220.3	69.2	103.3	
Three Hummock	Devonian	WT65		BWC	S	326400	5526400	xrf	4.63	13.8	5.6	1.34	3.53	5.33	10.20	1187.0	56.2	72.3	
Penguin Islet	Devonian	PI2	R000835	JLE	S	314600	5505800	icpms	4.69	5.46	6.1	1.35	1.40	5.81	8.56	1202.1	22.2	78.8	
Sandy Cape	Devonian	99220047 agso		BWC	S	312248	5412826	icpms	4.83	15.9	6.2	1.39	4.07	5.90	11.37	1238.3	64.7	80.1	
Sandy Cape	Devonian	LJ1008	R011750	JLE	S	314410	5409700	icpms	4.18	3.71	2.88	1.21	0.95	2.74	4.90	1072.4	15.1	37.2	
Sandy Cape	Devonian	WT56		BWC	S	312000	5411500	xrf	4.74	24.5	6.8	1.37	6.27	6.48	14.11	1215.2	99.7	87.8	
Sandy Cape	Devonian	WT57		BWC	S	311700	5411900	xrf	4.11	3.4	21.0	1.19	0.87	20.00	22.05	1053.7	13.8	271.3	
Sandy Cape	Devonian	WT58		BWC	S	312200	5412800	xrf	4.85	22.0	24.0	1.40	5.63	22.86	29.89	1243.4	89.5	310.0	
Sandy Cape	Devonian	WT59		BWC	S	312800	5410900	xrf	4.18	2.8	3.4	1.21	0.72	3.24	5.16	1071.7	11.4	43.9	
Sandy Cape	Devonian	WT63		BWC	S	312100	5412700	xrf	4.24	9.2	4.4	1.22	2.36	4.19	7.77	1087.0	37.4	56.8	
Interview	Devonian	LJ954	R011742	JLE	S	320260	5403390	icpms	4.77	24.07	9.99	1.37	6.16	9.51	17.05	1221.9	97.9	129.1	
Interview	Devonian	401390	G401390	RGR	S	322900	5397500	icpms	4.66	21.46	3.41	1.34	5.49	3.25	10.08	1194.2	87.3	44.1	
Interview	Devonian	WT60		BWC	S	324400	5398400	xrf	5.19	21.5	6.8	1.50	5.50	6.48	13.48	1330.6	87.5	87.8	
Interview	Devonian	WT61		BWC	S	325900	5389400	xrf	4.78	24.5	5.2	1.38	6.27	4.95	12.60	1225.5	99.7	67.2	
Interview	Devonian	WT62		BWC	S	324500	5392000	xrf	4.91	24.0	4.0	1.42	6.14	3.81	11.37	1258.8	97.7	51.7	
Conical Rocks	Devonian	99220044		MPM	S	329007	5379562	icpms	5.21	15.45	28.79	1.50	3.96	27.42	32.87	1335.5	62.9	371.9	
Conical Rocks	Devonian	401384	G401384	RGR	S	326200	5382500	icpms	4.90	18.6	4.32	1.41	4.76	4.11	10.29	1255.0	75.7	55.8	
Conical Rocks	Devonian	WT51		BWC	S	326500	5383500	xrf	5.08	32.5	4.2	1.47	8.32	4.00	13.78	1302.4	132.2	54.3	
Conical Rocks	Devonian	WT52		BWC	S	328300	5379000	xrf	5.13	22.5	4.6	1.48	5.76	4.38	11.62	1315.2	91.6	59.4	
Conical Rocks	Devonian	WT53		BWC	S	327200	5379900	xrf	5.32	24.5	4.6	1.53	6.27	4.38	12.19	1363.9	99.7	59.4	
Conical Rocks	Devonian	WT54		BWC	S	326600	5381500	xrf	5.11	33.5	3.6	1.47	8.58	3.43	13.48	1310.1	136.3	46.5	
Conical Rocks	Devonian	WT55		BWC	S	326600	5382700	xrf	5.22	33.0	4.2	1.51	8.45	4.00	13.95	1338.3	134.3	54.3	
Housetop	Devonian	99220042 agso		BWC	I	408324	5437659	icpms	4.94	59.2	8	1.42	15.16	7.62	24.20	1266.5	240.9	103.3	
Housetop	Devonian	99220040		MPM	I	404740	5431712	icpms	5.51	81.78	19.54	1.59	20.94	18.61	41.13	1412.4	332.8	252.4	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation						Decay rates		
												U Jkg <sup>-1</sup>	K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Housetop	Devonian	99220041		MPM	I	406569	5433436	icpms	4.94	37.22	9.1	1.42	9.53	8.67	19.62	1265.2	151.4	117.6		
Housetop	Devonian	VA4		PWB	I	409600	5428500	icpms	4.96	49.79	15.97	1.43	12.75	15.21	29.39	1272.1	202.6	206.3		
Housetop	Devonian	VA9		PWB	I	407000	5425500	icpms	5.21	49.44	21.09	1.50	12.66	20.08	34.24	1336.7	201.2	272.4		
Housetop	Devonian	VA11		PWB	I	407700	5426800	icpms	5.14	57.7	20.28	1.48	14.77	19.31	35.57	1318.3	234.8	262.0		
Housetop	Devonian	VA25		PWB	I	410200	5434500	icpms	5.13	48.74	11.05	1.48	12.48	10.52	24.48	1314.2	198.3	142.7		
Housetop	Devonian	401408	G401408	RGR	I	402340	5437580	icpms	4.91	41.87	13.83	1.41	10.72	13.17	25.30	1257.8	170.4	178.7		
Housetop	Devonian	401409	G401409	RGR	I	402120	5426800	icpms	4.97	57.94	15.89	1.43	14.83	15.13	31.40	1274.2	235.8	205.3		
Housetop	Devonian	401412	G401412	RGR	I	410600	5426400	icpms	4.59	49.5	7.94	1.32	12.67	7.56	21.56	1176.3	201.4	102.6		
Housetop	Devonian	WT29		BWC	I	406500	5433600	xrf	5.07	53.0	11.2	1.46	13.57	10.67	25.70	1299.8	215.7	144.7		
Housetop	Devonian	TAS210		BWC	I	404700	5432100	xrf	5.06	52.0	11.2	1.46	13.31	10.67	25.44	1297.3	211.6	144.7		
Housetop	Devonian	WT32		BWC	I	403400	5439100	xrf	5.24	52.0	8.8	1.51	13.31	8.38	23.20	1343.4	211.6	113.7		
Housetop	Devonian	WT24		BWC	I	408800	5439200	xrf	5.49	61.0	12.2	1.58	15.62	11.62	28.82	1407.5	248.2	157.6		
Housetop	Devonian	TAS213		AC	I	410800	5426600	xrf	5.28	49.0	10.6	1.52	12.54	10.09	24.16	1353.7	199.4	136.9		
Housetop	Devonian	TAS214		BWC	I	410800	5426600	xrf	5.12	43.0	5.6	1.48	11.01	5.33	17.82	1312.6	175.0	72.3		
Housetop	Devonian	WT26		BWC	I	410000	5434700	xrf	5.12	113.0	12.8	1.48	28.93	12.19	42.59	1312.6	459.8	165.4		
Housetop	Devonian	WT30		BWC	I	401900	5426200	xrf	5.01	75.0	15.6	1.44	19.20	14.86	35.50	1284.4	305.2	201.5		
Housetop	Devonian	TAS218		BWC	I	404700	5431600	xrf	5.12	51.0	17.6	1.48	13.06	16.76	31.29	1312.6	207.5	227.4		
Housetop	Devonian	WT31		BWC	I	400200	5432300	xrf	5.07	71.0	27.0	1.46	18.18	25.71	45.35	1299.8	288.9	348.8		
Housetop	Devonian	WT28		BWC	I	410800	5426500	xrf	5.03	54.0	8.8	1.45	13.82	8.38	23.65	1289.6	219.7	113.7		
Housetop	Devonian	WT35		BWC	I	395400	5425700	xrf	4.91	58.0	13.2	1.42	14.85	12.57	28.83	1258.8	236.0	170.5		
Housetop	Devonian	WT64		BWC	I	397800	5425700	xrf	5.18	77.0	17.8	1.49	19.71	16.95	38.16	1328.0	313.3	229.9		
Housetop	Devonian	WT36		BWC	I	396000	5424600	xrf	5.14	53.0	16.0	1.48	13.57	15.24	30.29	1317.8	215.7	206.7		
Housetop	Devonian	WT27		BWC	I	414800	5435500	xrf	4.79	59.0	9.0	1.38	15.10	8.57	25.06	1228.0	240.1	116.3		
Dolcoath	Devonian	401406	G401406	RGR	I	427850	5405550	icpms	5.67	45.7	19.17	1.63	11.67	18.26	31.56	1453.1	185.4	247.6		
Dolcoath	Devonian	WT38		BWC	I	426800	5406100	xrf	4.95	56.0	16.4	1.43	14.34	15.62	31.38	1269.1	227.9	211.9		
Birthday	Devonian	OCDH3		JLE	S	418180	5374280	icpms	4.64	4.7	23.03	1.34	1.20	21.93	24.47	1190.4	19.1	297.5		
Granite Tor	Devonian	401393	G401393	RGR	S	397600	5377900	icpms	4.61	9.13	6.83	1.33	2.34	6.50	10.17	1182.9	37.1	88.2		
Granite Tor	Devonian	WT72		BWC	S	396200	5378100	xrf	4.56	8.8	23.0	1.32	2.25	21.90	25.47	1169.1	35.8	297.1		
Granite Tor	Devonian	WT71		BWC	S	397100	5377800	xrf	4.73	11.6	10.8	1.36	2.97	10.28	14.62	1212.7	47.2	139.5		
Bischoff porphyries	Devonian	GT63	R011543	JLE	I	376320	5412600	icpms	0.04	12.04	5.68	0.01	3.08	5.41	8.50	11.3	49.0	73.4		
Bischoff porphyries	Devonian	GT64	R011545	JLE	I	376030	5412680	icpms	3.26	14.61	6.78	0.94	3.74	6.46	11.14	836.0	59.4	87.6		
Wombat Flat	Devonian	99220043agso		JLE	I	372056	5405354	icpms	4.77	25	8.2	1.38	6.40	7.81	15.58	1222.9	101.7	105.9		
Wombat Flat	Devonian	GT366	R011619	JLE	I	371670	5408750	icpms	2.88	21.25	10.8	0.83	5.44	10.28	16.56	739.4	86.5	139.5		
Wombat Flat	Devonian	TAS226		BWC	I	372700	5403500	xrf	4.61	31.0	9.6	1.33	7.94	9.14	18.41	1181.9	126.1	124.0		
Wombat Flat	Devonian	TAS227		BWC	I	370900	5405100	xrf	4.87	31.0	9.6	1.40	7.94	9.14	18.48	1248.6	126.1	124.0		
Wombat Flat	Devonian	TAS228		BWC	I	371100	5403900	xrf	4.84	32.0	8.4	1.40	8.19	8.00	17.59	1240.9	130.2	108.5		
Wombat Flat	Devonian	TAS229		BWC	I	372700	5400000	xrf	4.94	28.0	8.0	1.42	7.17	7.62	16.21	1266.5	113.9	103.3		
Wombat Flat	Devonian	TAS230		BWC	I	371100	5402000	xrf	4.96	32.0	8.4	1.43	8.19	8.00	17.62	1271.6	130.2	108.5		
Meredith (felsic)	Devonian	401383	G401383	RGR	I	355160	5386000	icpms	4.80	20.84	9.51	1.38	5.34	9.06	15.78	1230.9	84.8	122.9		
Meredith (felsic)	Devonian	401385	G401385	RGR	I	353500	5387300	icpms	5.15	18.94	6.45	1.48	4.85	6.14	12.48	1319.3	77.1	83.3		

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Meredith (felsic)	Devonian	TAS231		BWC	I	373400	5405800	xrf	5.52	43.0	14.2	1.59	11.01	13.52	26.12	1415.2	175.0	183.4	
Meredith (felsic)	Devonian	TAS232		BWC	I	371700	5394600	xrf	5.09	25.0	11.2	1.47	6.40	10.67	18.53	1305.0	101.7	144.7	
Meredith (felsic)	Devonian	TAS233		BWC	I	359700	5400000	xrf	5.52	22.5	11.4	1.59	5.76	10.86	18.21	1415.2	91.6	147.3	
Meredith (felsic)	Devonian	WT42		BWC	I	358500	5392700	xrf	4.77	24.5	11.4	1.38	6.27	10.86	18.50	1222.9	99.7	147.3	
Meredith (felsic)	Devonian	WT43		BWC	I	364800	5390700	xrf	5.20	29.5	13.6	1.50	7.55	12.95	22.00	1333.2	120.0	175.7	
Meredith (felsic)	Devonian	WT44		BWC	I	357200	5387100	xrf	5.08	26.0	9.4	1.47	6.66	8.95	17.07	1302.4	105.8	121.4	
Cleveland	Devonian	WT19		BWC	I	365000	5406700	xrf	0.07	84.0	24.4	0.02	21.50	23.24	44.76	17.9	341.8	315.2	
Heemskirk White	Devonian	99220045agso			S	337284	5368792	icpms	4.90	21.6	18.2	1.41	5.53	17.33	24.27	1256.2	87.9	235.1	
Heemskirk White	Devonian	H3		MPM	S	348000	5358200	inaa	4.93	19.9	20.7	1.42	5.09	19.71	26.23	1263.9	81.0	267.4	
Heemskirk White	Devonian	H4		MPM	S	345800	5360500	inaa	5.11	19.1	15.8	1.47	4.89	15.05	21.41	1310.1	77.7	204.1	
Heemskirk White	Devonian	H6		MPM	S	337200	5368800	inaa	4.97	22.2	13.5	1.43	5.68	12.86	19.97	1274.2	90.3	174.4	
Heemskirk White	Devonian	H7		MPM	S	340500	5363900	inaa	5.13	25.4	8.29	1.48	6.50	7.89	15.88	1315.2	103.4	107.1	
Heemskirk White	Devonian	H8		MPM	S	341300	5363200	inaa	4.95	11.9	60.3	1.43	3.05	57.42	61.90	1269.1	48.4	779.0	
Heemskirk White	Devonian	WT1		BWC	S	342200	5362900	xrf	5.19	26.5	3.0	1.50	6.78	2.86	11.14	1330.6	107.8	38.8	
Heemskirk White	Devonian	WT2		BWC	S	343100	5362000	xrf	5.09	23.5	16.8	1.47	6.02	16.00	23.48	1305.0	95.6	217.0	
Heemskirk White	Devonian	WT3		BWC	S	345700	5361200	xrf	5.18	30.0	11.8	1.49	7.68	11.24	20.41	1328.0	122.1	152.4	
Heemskirk White	Devonian	WT4		BWC	S	346800	5360700	xrf	5.50	25.0	19.4	1.59	6.40	18.47	26.46	1410.1	101.7	250.6	
Heemskirk White	Devonian	WT5		BWC	S	348500	5358300	xrf	5.02	27.0	24.0	1.45	6.91	22.86	31.21	1287.0	109.9	310.0	
Heemskirk White	Devonian	WT9		BWC	S	336300	5369000	xrf	5.23	25.0	3.4	1.51	6.40	3.24	11.15	1340.8	101.7	43.9	
Heemskirk White	Devonian	WT10		BWC	S	336300	5369000	xrf	5.04	20.5	4.8	1.45	5.25	4.57	11.27	1292.1	83.4	62.0	
Heemskirk White	Devonian	WT11		BWC	S	336300	5369000	xrf	5.45	34.5	13.4	1.57	8.83	12.76	23.16	1397.2	140.4	173.1	
Heemskirk White	Devonian	WT12		BWC	S	339900	5365800	xrf	5.23	28.5	11.8	1.51	7.30	11.24	20.04	1340.8	116.0	152.4	
Heemskirk Red	Devonian	99220046agso			I	352805	5357787	icpms	5.14	52.3	11.9	1.48	13.39	11.33	26.20	1317.8	212.8	153.7	
Heemskirk Red	Devonian	H1		MPM	I	353500	5358200	inaa	5.23	40.3	7.5	1.51	10.32	7.14	18.97	1340.8	164.0	96.9	
Heemskirk Red	Devonian	H2		MPM	I	352700	5357800	inaa	5.16	37.4	11.1	1.49	9.57	10.57	21.63	1322.9	152.2	143.4	
Heemskirk Red	Devonian	H5		MPM	I	347700	5360300	inaa	5.33	34.9	14	1.54	8.93	13.33	23.80	1366.5	142.0	180.9	
Heemskirk Red	Devonian	WT6		BWC	I	349100	5357300	xrf	5.39	53.0	14.0	1.55	13.57	13.33	28.45	1381.9	215.7	180.9	
Heemskirk Red	Devonian	WT7		BWC	I	352200	5357600	xrf	5.36	55.0	14.0	1.55	14.08	13.33	28.96	1374.2	223.8	180.9	
Heemskirk Red	Devonian	WT8		BWC	I	349200	5356800	xrf	5.36	51.0	21.0	1.55	13.06	20.00	34.60	1374.2	207.5	271.3	
Heemskirk Red	Devonian	LFB1971		BWC	I	349200	5356800	xrf	5.36	51.0	21.0	1.55	13.06	20.00	34.60	1374.2	207.5	271.3	
Pine Hill (Renison)	Devonian	61706		MAW	I	370000	5369500	icpms	4.79	36.11	13.82	1.38	9.24	13.16	23.79	1228.6	146.9	178.5	
Pine Hill (Renison)	Devonian	TAS234		BWC	I	371000	5371300	xrf	5.04	38.0	14.0	1.45	9.73	13.33	24.51	1292.1	154.6	180.9	
Pine Hill (Renison)	Devonian	LFB2145		BWC	I	369900	5371000	xrf	4.44	37.0	37.0	1.28	9.47	35.24	45.99	1138.3	150.6	478.0	
Pine Hill (Renison)	Devonian	LFB2146		BWC	I	371000	5370900	xrf	3.33	29.5	26.5	0.96	7.55	25.24	33.75	853.7	120.0	342.3	
Grandfathers	Devonian	01CH-6		MPM	S	350494	5321512	icpms	5.32	17.65	11.75	1.53	4.52	11.19	17.24	1363.2	71.8	151.8	
Cox Bight	Devonian	CXB4ga	R011514		S	438510	5184380	icpms	3.86	14.2	7.2	1.11	3.64	6.86	11.60	989.6	57.8	93.0	
Hippolyte Rocks	Devonian	HRga	R011503		S	585450	5225090	icpms	5.05	22.3	6.09	1.46	5.71	5.80	12.96	1294.2	90.7	78.7	
Deep Glen Bay	Devonian	DGB3ga	R011502		S	580320	5241800	icpms	5.04	22.1	6.52	1.45	5.66	6.21	13.32	1291.9	89.9	84.2	
Deep Glen Bay	Devonian	DGB2			S	580500	5241200	inaa	4.87	17.4	7.4	1.41	4.45	7.05	12.91	1249.3	70.8	95.6	
Maria Island (South)	Devonian	MIZ		MPM	S	586900	5269700	icpms	4.96	20.05	15.45	1.43	5.13	14.71	21.28	1271.6	81.6	199.6	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												U Jkg <sup>-1</sup>	K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>
Maria Island (South)	Devonian	TAS168		BWC	S	588500	5269500	xrf	5.23	17.4	11.8	1.51	4.45	11.24	17.20	1340.8	70.8	152.4	
Maria Island (South)	Devonian	TAS169		BWC	S	588100	5271100	xrf	4.84	13.0	3.2	1.40	3.33	3.05	7.77	1240.9	52.9	41.3	
Maria Island (South)	Devonian	TAS170		BWC	S	589600	5270900	xrf	4.98	20.5	3.8	1.44	5.25	3.62	10.30	1276.8	83.4	49.1	
Maria Island (South)	Devonian	TAS171		BWC	S	588200	5269300	xrf	4.98	18.4	10.4	1.44	4.71	9.90	16.05	1276.8	74.9	134.3	
Maria Island (North)	Devonian	MI1			S	592200	5275300	inaa	5.22	24.6	3.61	1.51	6.30	3.44	11.24	1339.4	100.1	46.6	
Maria Island (North)	Devonian	43259		JDC	S	592200	5276000	icpms	4.95	23.08	9.41	1.43	5.91	8.96	16.30	1269.8	93.9	121.6	
Maria Island (North)	Devonian	TAS164		BWC	S	592200	5276000	xrf	5.05	25.0	8.4	1.46	6.40	8.00	15.86	1294.7	101.7	108.5	
Maria Island (North)	Devonian	TAS165		BWC	S	595600	5277500	xrf	5.15	24.5	7.8	1.49	6.27	7.43	15.19	1320.3	99.7	100.8	
Maria Island (North)	Devonian	TAS166		BWC	S	592500	5282700	xrf	5.32	24.0	8.0	1.53	6.14	7.62	15.30	1363.9	97.7	103.3	
Maria Island (North)	Devonian	TAS167		BWC	S	591600	5275200	xrf	5.28	25.0	4.2	1.52	6.40	4.00	11.92	1353.7	101.7	54.3	
Ile des Phoques	Devonian	IDP	R004449	JLE	S	595600	5303400	icpms	4.86	13.12	3.79	1.40	3.36	3.61	8.37	1245.2	53.4	49.0	
Ile des Phoques	Devonian	TAS163		BWC	S	595600	5303300	xrf	5.13	17.6	3.4	1.48	4.51	3.24	9.22	1315.2	71.6	43.9	
Schouten Island	Devonian	TAS157		BWC	I	605200	5313100	xrf	5.18	72.0	17.0	1.49	18.43	16.19	36.12	1328.0	293.0	219.6	
Schouten Island	Devonian	TAS158		BWC	I	606300	5316700	xrf	5.10	76.0	18.0	1.47	19.46	17.14	38.07	1307.5	309.2	232.5	
Schouten Island	Devonian	TAS159		BWC	I	609200	5311900	xrf	5.01	77.0	21.5	1.44	19.71	20.47	41.63	1284.4	313.3	277.7	
Schouten Island	Devonian	TAS160		BWC	I	607400	5311200	xrf	5.36	54.0	21.0	1.55	13.82	20.00	35.37	1374.2	219.7	271.3	
Schouten Island	Devonian	TAS161		BWC	I	608000	5309700	xrf	5.07	77.0	14.8	1.46	19.71	14.09	35.27	1299.8	313.3	191.2	
Schouten Island	Devonian	TAS162		BWC	I	607400	5311200	xrf	5.08	122.0	28.5	1.47	31.23	27.14	59.84	1302.4	496.4	368.2	
Schouten Island	Devonian	LFB1874		BWC	I	607400	5311200	xrf	3.71	36.0	8.4	1.07	9.22	8.00	18.29	951.2	146.5	108.5	
Freycinet	Devonian	FY1	R004459	JLE	I	604920	5324870	icpms	5.63	35.8	9.52	1.62	9.16	9.07	19.85	1443.9	145.7	123.0	
Freycinet	Devonian	FY7	R004461	JLE	I	604600	5320990	icpms	4.88	50.71	15.94	1.41	12.98	15.18	29.57	1251.1	206.3	205.9	
Freycinet	Devonian	FY9	R004462	JLE	I	606430	5319120	icpms	4.72	47.41	17.74	1.36	12.14	16.89	30.39	1208.8	192.9	229.2	
Freycinet	Devonian	LC6	R004442	JLE	I	606360	5327460	icpms	5.33	30.52	10.12	1.54	7.81	9.64	18.99	1367.5	124.2	130.7	
Freycinet	Devonian	LC7	R004443	JLE	I	606480	5327650	icpms	5.91	34.55	6.17	1.70	8.84	5.88	16.43	1515.4	140.6	79.7	
Freycinet	Devonian	TAS151		BWC	I	604100	5329600	xrf	5.36	33.5	10.6	1.55	8.58	10.09	20.22	1374.2	136.3	136.9	
Freycinet	Devonian	TAS152		BWC	I	606500	5319000	xrf	5.04	55.0	16.8	1.45	14.08	16.00	31.53	1292.1	223.8	217.0	
Freycinet	Devonian	TAS153		BWC	I	604800	5325000	xrf	5.61	57.0	23.0	1.62	14.59	21.90	38.11	1438.3	231.9	297.1	
Freycinet	Devonian	TAS154		BWC	I	611200	5328800	xrf	4.93	59.0	17.8	1.42	15.10	16.95	33.48	1263.9	240.1	229.9	
Freycinet	Devonian	TAS155		BWC	I	610700	5324700	xrf	5.28	74.0	19.2	1.52	18.94	18.28	38.75	1353.7	301.1	248.0	
Freycinet	Devonian	TAS156		BWC	I	608700	5320200	xrf	5.08	76.0	19.4	1.47	19.46	18.47	39.40	1302.4	309.2	250.6	
The Hazards	Devonian	R004499	R004499	JLE	I	605330	5332950	icpms	5.02	61.47	32.64	1.45	15.74	31.08	48.27	1286.0	250.1	421.6	
The Hazards	Devonian	TAS147		BWC	I	605300	5332900	xrf	4.83	86.0	26.0	1.39	22.02	24.76	48.17	1238.3	349.9	335.9	
The Hazards	Devonian	TAS148		BWC	I	605300	5332900	xrf	4.92	82.0	31.0	1.42	20.99	29.52	51.93	1261.4	333.7	400.5	
The Hazards	Devonian	TAS149		BWC	I	608600	5331800	xrf	4.91	79.0	29.5	1.42	20.22	28.09	49.73	1258.8	321.5	381.1	
The Hazards	Devonian	TAS150		BWC	I	605300	5332900	xrf	4.84	80.0	31.0	1.40	20.48	29.52	51.40	1240.9	325.5	400.5	
Coles Bay	Devonian	FY39	R004467	JLE	I	608910	5340060	icpms	4.88	49.69	11.72	1.41	12.72	11.16	25.29	1252.1	202.2	151.4	
Coles Bay	Devonian	R004500	R004500	JLE	I	603160	5338500	icpms	4.99	22.84	19.84	1.44	5.85	18.89	26.18	1279.1	92.9	256.3	
Coles Bay	Devonian	TAS143		BWC	I	607400	5340300	xrf	5.17	49.5	2.6	1.49	12.67	2.48	16.64	1325.5	201.4	33.6	
Coles Bay	Devonian	TAS144		BWC	I	604300	5337400	xrf	4.95	26.5	23.0	1.43	6.78	21.90	30.11	1269.1	107.8	297.1	
Coles Bay	Devonian	TAS145		BWC	I	606600	5350400	xrf	5.10	58.0	17.4	1.47	14.85	16.57	32.89	1307.5	236.0	224.8	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Coles Bay	Devonian	TAS146		BWC	I	605800	5335300	xrf	5.03	21.5	25.0	1.45	5.50	23.81	30.76	1289.6	87.5	323.0	
Bluestone Bay	Devonian	LC4	R004439	JLE	I	606510	5327880	icpms	3.16	17.24	3.86	0.91	4.41	3.68	9.00	809.1	70.1	49.9	
Bluestone Bay	Devonian	FY40	R004468	JLE	I	609980	5337450	icpms	4.18	18.74	3.75	1.20	4.80	3.57	9.57	1071.1	76.3	48.4	
Bluestone Bay	Devonian	TAS136		BWC	I	610600	5335700	xrf	3.31	23.0	3.8	0.95	5.89	3.62	10.46	848.6	93.6	49.1	
Bluestone Bay	Devonian	TAS137		BWC	I	609500	5335200	xrf	3.43	27.5	4.6	0.99	7.04	4.38	12.41	879.4	111.9	59.4	
Bluestone Bay	Devonian	TAS138		BWC	I	610100	5337600	xrf	3.71	29.5	4.6	1.07	7.55	4.38	13.00	951.2	120.0	59.4	
Bluestone Bay	Devonian	TAS139		BWC	I	609700	5335600	xrf	3.79	30.5	5.0	1.09	7.81	4.76	13.66	971.7	124.1	64.6	
Bicheno	Devonian	GCHga	R004498		S	608700	5363250	icpms	4.99	20.5	9.65	1.44	5.25	9.19	15.88	1279.8	83.4	124.7	
Bicheno	Devonian	43170/3		JDC	S	609000	5357200	icpms	5.54	20.85	4.55	1.60	5.34	4.33	11.27	1420.6	84.8	58.8	
Bicheno	Devonian	43172/3		JDC	S	607800	5354900	icpms	5.42	24.92	6.8	1.56	6.38	6.48	14.42	1388.8	101.4	87.8	
Bicheno (Llandaff DDH4)	Devonian	LDDH4		JLE		599300	5363600	icpms	5.63	17.9	2.9	1.62	4.58	2.76	8.97	1442.4	72.8	37.5	
Bicheno (Llandaff DDH7)	Devonian	LDDH7		JLE		596300	5354600	icpms	5.15	20.13	3.48	1.48	5.15	3.31	9.95	1319.6	81.9	45.0	
Bicheno	Devonian	TAS140		BWC	S	608400	5363400	xrf	5.23	20.5	13.4	1.51	5.25	12.76	19.52	1340.8	83.4	173.1	
Bicheno	Devonian	TAS141		BWC	S	607400	5362400	xrf	5.14	19.0	12.4	1.48	4.86	11.81	18.15	1317.8	77.3	160.2	
Bicheno	Devonian	TAS142		BWC	S	608600	5360300	xrf	5.20	18.6	10.4	1.50	4.76	9.90	16.17	1333.2	75.7	134.3	
Royal George	Devonian	SG2	R000542	JLE	S	574230	5372390	icpms	4.82	13.81	5.53	1.39	3.54	5.27	10.19	1236.2	56.2	71.4	
Royal George	Devonian	SG3	R000543	JLE	S	573550	5374730	icpms	5.14	21.65	5.03	1.48	5.54	4.79	11.81	1317.8	88.1	65.0	
Royal George	Devonian	SG7	R000547	JLE	S	573470	5366620	icpms	5.13	19.19	10.13	1.48	4.91	9.65	16.04	1314.4	78.1	130.9	
Royal George	Devonian	SG9	R000549	JLE	S	573400	5367910	icpms	5.00	9.44	30.73	1.44	2.42	29.26	33.12	1282.9	38.4	397.0	
Royal George	Devonian	SG11	R000551	JLE	S	576870	5373150	icpms	4.69	10.03	35.91	1.35	2.57	34.20	38.12	1201.9	40.8	463.9	
Royal George	Devonian	SG15	R000555	JLE	S	562860	5370810	icpms	5.33	18.39	29.76	1.54	4.71	28.34	34.59	1366.7	74.8	384.4	
Royal George	Devonian	SG20	R000560	JLE	S	566780	5366790	icpms	4.76	19.06	21.03	1.37	4.88	20.03	26.28	1219.1	77.6	271.7	
Royal George	Devonian	SG21	R000561	JLE	S	564750	5367140	icpms	5.18	13.31	30.7	1.50	3.41	29.24	34.14	1329.1	54.2	396.6	
Royal George	Devonian	SG22rpt	R000562	JLE	S	567270	5372100	icpms	5.23	20.68	10.98	1.51	5.29	10.46	17.26	1340.3	84.1	141.8	
Royal George	Devonian	SG23rpt	R000563	JLE	S	570920	5371170	icpms	5.19	12.14	24.46	1.50	3.11	23.29	27.90	1331.6	49.4	316.0	
Royal George	Devonian	SG34	R000574	JLE	S	569620	5373070	icpms	4.58	9.2	15.87	1.32	2.36	15.11	18.79	1173.7	37.4	205.0	
Royal George	Devonian	SG6	R000546		S	575010	5369180	inaa	4.13	8.39	6.65	1.19	2.15	6.33	9.67	1058.8	34.1	85.9	
Royal George	Devonian	SG24	R000564		S	572150	5370250	inaa	4.96	8.53	4.14	1.43	2.18	3.94	7.56	1271.6	34.7	53.5	
Royal George	Devonian	TAS206		BWC	S	574700	5369500	xrf	4.76	23.5	24.0	1.37	6.02	22.86	30.24	1220.3	95.6	310.0	
Henbury	Devonian	FA232Xagso	R004492		I	561690	5385810	icpms	4.81	53.1	23.4	1.39	13.59	22.28	37.26	1232.1	216.1	302.3	
Henbury	Devonian	SG13	R000553	JLE	I	561600	5377090	icpms	4.91	43.87	24.28	1.41	11.23	23.12	35.77	1257.5	178.5	313.6	
Henbury	Devonian	SG25	R000565	JLE	I	557720	5379380	icpms	4.82	63.59	32.19	1.39	16.28	30.65	48.32	1235.5	258.7	415.8	
Henbury	Devonian	SG27	R000567	JLE	I	559880	5387150	icpms	5.30	67.54	14.77	1.53	17.29	14.07	32.88	1359.3	274.8	190.8	
Henbury	Devonian	SG33	R000573	JLE	I	555750	5381370	icpms	5.24	66.44	29.98	1.51	17.01	28.55	47.07	1340.6	270.3	387.3	
Henbury	Devonian	FA230		RHF	I	565850	5381900	icpms	5.24	52.38	83.87	1.51	13.41	79.87	94.79	1343.2	213.1	1083.4	
Henbury	Devonian	FA231		RHF	I	565850	5381900	icpms	4.87	61.25	29.88	1.40	15.68	28.45	45.54	1248.3	249.2	386.0	
Henbury	Devonian	FA233		RHF	I	562220	5384230	icpms	5.25	39.61	4.56	1.51	10.14	4.34	16.00	1344.9	161.2	58.9	
Henbury	Devonian	FA234		RHF	I	564340	5383960	icpms	4.91	45.98	14.81	1.42	11.77	14.10	27.29	1258.8	187.1	191.3	
Henbury	Devonian	FA235		RHF	I	558200	5381900	icpms	4.94	60.28	29.65	1.43	15.43	28.24	45.09	1267.0	245.3	383.0	
Henbury	Devonian	TUU2/59ft		JLE	I	560150	5383980	icpms	6.70	28.9	16.88	1.93	7.40	16.07	25.41	1718.0	117.6	218.1	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Henbury	Devonian	SG14	R000554		I	562350	5377690	inaa	5.26	71.3	23.5	1.52	18.25	22.38	42.15	1348.5	290.1	303.6	
Henbury	Devonian	TAS203		BWC	I	558200	5381800	xrf	4.98	77.0	28.0	1.44	19.71	26.66	47.81	1276.8	313.3	361.7	
Henbury	Devonian	TAS204		BWC	I	557800	5380300	xrf	5.12	77.0	30.5	1.48	19.71	29.05	50.23	1312.6	313.3	394.0	
Henbury	Devonian	TB68		BWC	I	560200	5386300	xrf	5.03	69.0	27.0	1.45	17.66	25.71	44.83	1289.6	280.8	348.8	
Gipps Creek	Devonian	SG26	R000566	JLE	S	559780	5389570	icpms	4.42	10.43	5.62	1.28	2.67	5.35	9.30	1134.0	42.4	72.6	
Gipps Creek	Devonian	SG28	R000568	JLE	S	554770	5390420	icpms	4.61	14.98	22.69	1.33	3.83	21.61	26.77	1182.4	61.0	293.1	
Gipps Creek	Devonian	SG29	R000569	JLE	S	553810	5388700	icpms	4.94	14.94	21.65	1.42	3.82	20.62	25.87	1265.7	60.8	279.7	
Gipps Creek	Devonian	SG30rpt	R000570	JLE	S	556630	5384940	icpms	4.80	21.53	13.21	1.38	5.51	12.58	19.48	1230.6	87.6	170.6	
Gipps Creek	Devonian	SG31	R000571	JLE	S	554920	5386850	icpms	4.74	18.56	3.82	1.37	4.75	3.64	9.76	1216.2	75.5	49.3	
Gipps Creek	Devonian	SG32	R000572	JLE	S	552900	5387920	icpms	4.48	14	19.64	1.29	3.58	18.70	23.58	1149.1	57.0	253.7	
Gipps Creek	Devonian	SG36	R004493	JLE	S	556420	5385000	icpms	4.79	16.65	24.17	1.38	4.26	23.02	28.66	1229.1	67.7	312.2	
Gipps Creek	Devonian	FA236		RHF	S	560600	5387200	icpms	4.26	9.43	4.52	1.23	2.41	4.30	7.95	1092.2	38.4	58.4	
Gipps Creek	Devonian	FA237		RHF	S	555900	5384800	icpms	4.81	19.94	8.12	1.39	5.10	7.73	14.22	1233.4	81.1	104.9	
Lisle	Devonian	C102987	C102987	RSB	I	527836	5434671	icpms	2.13	11.95	3.3	0.62	3.06	3.14	6.82	547.1	48.6	42.6	
Upper Blessington	Devonian	99220052ga		MPM	I	549422	5409278	icpms	1.96	11.1	2.14	0.57	2.84	2.04	5.45	503.5	45.2	27.6	
Upper Blessington	Devonian	R1041		MPM	I	548000	5411700	icpms	3.47	17.24	3.45	1.00	4.41	3.29	8.70	889.1	70.1	44.6	
Upper Blessington	Devonian	TB55		BWC	I	549500	5409600	xrf	2.03	11.2	1.6	0.59	2.87	1.52	4.98	520.4	45.6	20.7	
Diddleum	Devonian	99220048ga		BWC	I	541123	5428252	icpms	2.25	14.7	2.71	0.65	3.76	2.58	6.99	577.4	59.8	35.0	
Diddleum (Bridport)	Devonian	SB22		MPM	I	532300	5463100	icpms	3.02	14.41	4.01	0.87	3.69	3.82	8.38	773.0	58.6	51.8	
Diddleum	Devonian	SB1		MPM	I	543900	5447900	icpms	3.71	16.06	6.68	1.07	4.11	6.36	11.54	951.9	65.3	86.3	
Diddleum	Devonian	SB21		MPM	I	535400	5421500	icpms	2.86	14.52	5.02	0.82	3.72	4.78	9.32	733.2	59.1	64.8	
Diddleum (Bridport)	Devonian	TB59		BWC	I	533500	5459800	xrf	2.44	16.4	3.0	0.70	4.20	2.86	7.76	625.6	66.7	38.8	
Diddleum (Bridport)	Devonian	TB60		BWC	I	532300	5463000	xrf	2.94	15.6	2.8	0.85	3.99	2.67	7.51	753.7	63.5	36.2	
Diddleum	Devonian	TB17		BWC	I	538700	5425200	xrf	2.77	21.5	2.8	0.80	5.50	2.67	8.97	710.2	87.5	36.2	
Diddleum	Devonian	TB18		BWC	I	542200	5430200	xrf	2.56	14.0	2.4	0.74	3.58	2.29	6.61	656.3	57.0	31.0	
Diddleum	Devonian	TB19		BWC	I	544600	5444500	xrf	2.87	20.0	4.0	0.83	5.12	3.81	9.76	735.8	81.4	51.7	
Diddleum	Devonian	TB70		BWC	I	539100	5420200	xrf	2.63	16.8	2.0	0.76	4.30	1.90	6.96	674.3	68.4	25.8	
Diddleum	Devonian	TB73		BWC	I	540000	5440500	xrf	2.87	20.0	4.6	0.83	5.12	4.38	10.33	735.8	81.4	59.4	
Diddleum	Devonian	TB74		BWC	I	535200	5444100	xrf	2.83	19.6	4.0	0.82	5.02	3.81	9.64	725.5	79.8	51.7	
Diddleum	Devonian	TB75		BWC	I	543400	5446600	xrf	2.94	18.2	5.0	0.85	4.66	4.76	10.27	753.7	74.1	64.6	
Diddleum	Devonian	TB80		BWC	I	535900	5420600	xrf	3.07	23.5	3.8	0.89	6.02	3.62	10.52	787.1	95.6	49.1	
Diddleum	Devonian	LFB1864		BWC	I	540900	5433200	xrf	2.90	20.5	3.6	0.84	5.25	3.43	9.51	743.5	83.4	46.5	
Diddleum	Devonian	LFB1865		BWC	I	540800	5433400	xrf	2.91	20.0	4.2	0.84	5.12	4.00	9.96	746.1	81.4	54.3	
Tulendeena	Devonian	SB4		MPM	I	554000	5449700	icpms	3.08	14.66	6.28	0.89	3.75	5.98	10.62	790.7	59.7	81.1	
Tulendeena	Devonian	SB5		MPM	I	555200	5441100	icpms	2.89	12.44	4.77	0.81	3.18	4.54	8.53	715.8	50.6	61.6	
Tulendeena	Devonian	TB20		BWC	I	555000	5440700	xrf	2.79	19.4	3.8	0.83	4.97	3.62	9.42	740.9	78.9	49.1	
Tulendeena	Devonian	TB21		BWC	I	555200	5439700	xrf	3.13	17.0	4.2	0.90	4.35	4.00	9.25	802.5	69.2	54.3	
Tulendeena	Devonian	TB21		BWC	I	555200	5439700	xrf	3.13	17.0	4.2	0.90	4.35	4.00	9.25	802.5	69.2	54.3	
Tulendeena	Devonian	TB58		BWC	I	544100	5461300	xrf	3.16	17.2	3.8	0.91	4.40	3.62	8.93	810.1	70.0	49.1	
Tulendeena	Devonian	TB76		BWC	I	554500	5451200	xrf	3.17	18.6	4.2	0.91	4.76	4.00	9.68	812.7	75.7	54.3	
Tulendeena	Devonian	TB77		BWC	I	551700	5458400	xrf	2.99	18.4	4.2	0.86	4.71	4.00	9.57	766.6	74.9	54.3	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Porcupine Creek	Devonian	SB11		MPM	I	546900	5420500	icpms	2.59	12.13	5.05	0.75	3.11	4.81	8.66	664.0	49.4	65.2	
Porcupine Creek	Devonian	R1037		MPM	I	547200	5416700	icpms	2.14	8.56	2.95	0.62	2.19	2.81	5.62	548.1	34.8	38.1	
Russells Road	Devonian	R1042		MPM	I	555300	5407900	icpms	3.00	11.25	2.54	0.87	2.88	2.42	6.16	769.6	45.8	32.8	
Russells Road	Devonian	AG18	R004488	JLE	I	555600	5429270	icpms	4.15	19.93	5.38	1.20	5.10	5.12	11.42	1064.2	81.1	69.5	
Russells Road	Devonian	TB14		BWC	I	555500	5408100	xrf	2.83	13.4	2.0	0.82	3.43	1.90	6.15	725.5	54.5	25.8	
Russells Road	Devonian	TB53		BWC	I	555800	5438800	xrf	4.33	40.0	7.6	1.25	10.24	7.24	18.73	1110.1	162.8	98.2	
Russells Road	Devonian	TB56		BWC	I	557200	5408500	xrf	3.22	17.0	2.8	0.93	4.35	2.67	7.95	825.5	69.2	36.2	
Russells Road	Devonian	TB69		BWC	I	556300	5438500	xrf	4.32	38.0	7.2	1.25	9.73	6.86	17.83	1107.5	154.6	93.0	
Russells Road	Devonian	TB71		BWC	I	559600	5421900	xrf	4.37	22.5	3.0	1.12	5.76	2.86	9.73	992.2	91.6	38.8	
Russells Road	Devonian	TB72		BWC	I	558600	5427700	xrf	3.82	29.0	5.8	1.25	7.42	5.52	14.19	1107.5	118.0	74.9	
Russells Road	Devonian	TB79		BWC	I	558000	5430400	xrf	4.29	33.0	4.4	1.24	8.45	4.19	13.88	1099.9	134.3	56.8	
Hogarth Road	Devonian	99220050ga			I	553842	5413183	icpms	3.46	20.7	3.81	1.00	5.30	3.63	9.93	887.8	84.2	49.2	
Hogarth Road	Devonian	AG17	R004487	JLE	I	555250	5428810	icpms	3.84	16.85	6.1	1.11	4.31	5.81	11.23	983.7	68.6	78.8	
Hogarth Road	Devonian	R1049		MPM	I	558300	5411100	icpms	3.01	15.11	4.3	0.87	3.87	4.09	8.83	772.2	61.5	55.5	
Hogarth Road	Devonian	TB15		BWC	I	556000	5408800	xrf	3.35	19.4	3.2	0.97	4.97	3.05	8.98	858.9	78.9	41.3	
Hogarth Road	Devonian	TB57		BWC	I	553800	5413200	xrf	3.48	22.5	3.8	1.00	5.76	3.62	10.38	892.2	91.6	49.1	
Hogarth Road	Devonian	TB78		BWC	I	552100	5420700	xrf	3.91	22.0	4.2	1.13	5.63	4.00	10.76	1002.4	89.5	54.3	
Hogarth Road	Devonian	TB81		BWC	I	550700	5424600	xrf	4.79	29.5	42.5	1.38	7.55	40.47	49.41	1228.0	120.0	549.0	
Tombstone Creek central	Devonian	99220051ga	R006912		I	558526	5414617	icpms	4.45	30	15.58	1.28	7.68	14.84	23.80	1141.9	122.1	201.3	
Tombstone Creek central	Devonian	R1045		MPM	I	556700	5416300	icpms	4.11	21.71	4.92	1.19	5.56	4.69	11.43	1054.5	88.3	63.6	
Tombstone Creek marginal	Devonian	AG19	R004489	JLE	I	554610	5425780	icpms	4.66	23.73	11.79	1.34	6.07	11.23	18.65	1193.9	96.6	152.3	
Tombstone Creek marginal	Devonian	TB16		BWC	I	554300	5417800	xrf	4.07	32.0	10.4	1.17	8.19	9.90	19.27	1043.5	130.2	134.3	
Tombstone Creek marginal	Devonian	TB82		BWC	I	552100	5425400	xrf	4.44	35.0	18.8	1.28	8.96	17.90	28.14	1138.3	142.4	242.9	
Mt Stronach	Devonian	SB2		MPM	I	546700	5440100	icpms	4.49	27.35	13.49	1.30	7.00	12.85	21.14	1151.4	111.3	174.3	
Mt Stronach	Devonian	SB6		MPM	I	554100	5440500	icpms	4.51	29.73	19.33	1.30	7.61	18.41	27.32	1155.7	121.0	249.7	
Mt Stronach	Devonian	DMS1		JLE	I	547085	5443095	icpms	4.41	32.54	24.32	1.27	8.33	23.16	32.76	1129.6	132.4	314.2	
Mt Stronach	Devonian	LFB1866		BWC	I	548300	5440300	xrf	4.58	38.0	18.0	1.32	9.73	17.14	28.19	1174.2	154.6	232.5	
Mt Stronach	Devonian	LFB1867		BWC	I	546900	5439800	xrf	4.53	37.5	23.5	1.31	9.60	22.38	33.29	1161.4	152.6	303.6	
Long Point	Devonian	99220058agso			I	608154	5377148	icpms	3.44	16.2	4.27	0.99	4.15	4.07	9.20	881.2	65.9	55.2	
Long Point	Devonian	TAS120		BWC	I	608200	5377200	xrf	3.61	23.0	4.0	1.04	5.89	3.81	10.74	925.5	93.6	51.7	
Long Point (Piccaninny Pt)	Devonian	83/37		NJT	I	607700	5383300	icpms	3.42	14.27	4.04	0.99	3.65	3.85	8.49	876.8	58.1	52.2	
Long Point (Piccaninny Pt)	Devonian	TAS121		BWC	I	607700	5383300	xrf	3.66	25.0	6.4	1.06	6.40	6.09	13.55	938.3	101.7	82.7	
Piccaninny Creek	Devonian	83/35		NJT	I	605400	5388400	icpms	3.58	12.93	4.49	1.03	3.31	4.28	8.62	917.3	52.6	58.0	
Piccaninny Creek	Devonian	TAS122		BWC	I	605100	5386300	xrf	3.96	18.0	4.2	1.14	4.61	4.00	9.75	1015.2	73.2	54.3	
St Marys	Devonian	83/28		NJT	I	602800	5401000	icpms	3.13	13.87	4.11	0.90	3.55	3.91	8.37	801.2	56.4	53.1	
St Marys	Devonian	83/24		NJT	I	602400	5403100	icpms	3.57	14.78	5.06	1.03	3.78	4.82	9.63	915.0	60.1	65.4	
St Marys	Devonian	TB7		BWC	I	602600	5400300	xrf	3.11	16.0	3.0	0.90	4.10	2.86	7.85	797.3	65.1	38.8	
St Marys	Devonian	TB8		BWC	I	601200	5399000	xrf	3.19	16.4	3.2	0.92	4.20	3.05	8.17	817.8	66.7	41.3	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												U Jkg <sup>-1</sup>	K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>
St Marys	Devonian	LFB2626		BWC	I	603700	5401800	xrf	3.02	16.0	3.6	0.87	4.10	3.43	8.40	774.3	65.1	46.5	
St Marys	Devonian	LFB2627		BWC	I	603000	5401200	xrf	3.25	16.2	3.8	0.94	4.15	3.62	8.70	833.2	65.9	49.1	
St Marys	Devonian	LFB2628		BWC	I	602800	5399800	xrf	3.11	16.8	3.8	0.90	4.30	3.62	8.82	797.3	68.4	49.1	
St Marys	Devonian	LFB2629		BWC	I	600400	5398200	xrf	3.45	17.6	2.0	0.99	4.51	1.90	7.41	884.5	71.6	25.8	
St Marys	Devonian	NJ444	R013373	JLE	I	608100	5397200	xrf	3.12	11.0	5.0	0.90	2.82	4.76	8.48	799.9	44.8	64.6	
St Marys	Devonian	NJ445	R013374	JLE	I	607060	5400290	xrf	3.02	11.0	5.0	0.87	2.82	4.76	8.45	774.3	44.8	64.6	
Catos Creek	Devonian	83/22		NJT	I	594800	5408700	icpms	3.34	14.87	4.25	0.96	3.81	4.05	8.82	856.6	60.5	54.9	
Catos Creek (Goshen)	Devonian	MSH177		MPM	I	592200	5426500	icpms	3.45	15.74	4.72	0.99	4.03	4.49	9.52	884.0	64.0	61.0	
Catos Creek	Devonian	TB9		BWC	I	594600	5408200	xrf	3.42	17.6	3.6	0.99	4.51	3.43	8.92	876.8	71.6	46.5	
Scamander Tier	Devonian	83/21		NJT	I	603600	5415300	icpms	3.56	18.5	4.65	1.03	4.74	4.43	10.19	912.2	75.3	60.1	
Scamander Tier	Devonian	TB1		BWC	I	603800	5414900	xrf	3.68	21.0	4.0	1.06	5.38	3.81	10.25	943.5	85.4	51.7	
Scamander Tier	Devonian	TB2		BWC	I	603500	5417700	xrf	3.77	22.5	4.6	1.09	5.76	4.38	11.23	966.5	91.6	59.4	
Scamander Tier	Devonian	TB23		BWC	I	604200	5423700	xrf	3.51	19.4	3.8	1.01	4.97	3.62	9.60	899.9	78.9	49.1	
Scamander Tier	Devonian	TB35		BWC	I	602400	5429100	xrf	3.12	15.6	3.2	0.90	3.99	3.05	7.94	799.9	63.5	41.3	
Hogans Road	Devonian	MSH22		MPM	I	586900	5419700	icpms	0.90	7.93	2	0.26	2.03	1.90	4.19	231.3	32.3	25.8	
Haleys New Country	Devonian	AG3	R004472	JLE	I	583680	5421620	icpms	4.01	12.86	5.48	1.16	3.29	5.22	9.67	1028.3	52.3	70.8	
Haleys New Country	Devonian	AG6	R004476	JLE	I	583270	5418880	icpms	3.44	9.29	3.12	0.99	2.38	2.97	6.34	881.2	37.8	40.3	
George River	Devonian	MSH184		MPM	I	599400	5425500	icpms	3.83	20.48	3.41	1.10	5.24	3.25	9.59	981.4	83.3	44.1	
George River	Devonian	37769dom		JDC	I	606200	5425800	icpms	3.42	17.96	5.4	0.99	4.60	5.14	10.73	876.5	73.1	69.8	
George River	Devonian	TB22		BWC	I	606800	5418300	xrf	3.82	19.4	3.8	1.10	4.97	3.62	9.69	979.4	78.9	49.1	
Akaroa	Devonian	MSH168		MPM	I	612200	5429100	icpms	3.08	9.56	5.19	0.89	2.45	4.94	8.28	788.4	38.9	67.0	
Akaroa	Devonian	MSH170		MPM	I	611300	5429600	icpms	4.02	9.07	2.28	1.16	2.32	2.17	5.65	1030.9	36.9	29.5	
Akaroa	Devonian	TB10		BWC	I	610700	5426800	xrf	3.50	11.2	3.4	1.01	2.87	3.24	7.11	897.3	45.6	43.9	
Grants Point	Devonian	MSH167		MPM	I	613600	5429700	icpms	4.77	11.48	2.85	1.37	2.94	2.71	7.03	1221.6	46.7	36.8	
Grants Point	Devonian	TB85		BWC	I	611900	5432000	xrf	4.89	21.0	3.8	1.41	5.38	3.62	10.41	1253.7	85.4	49.1	
Medeas Cove	Devonian	37770mrt		JDC	I	602200	5425500	icpms	4.80	29.59	16.57	1.39	7.58	15.78	24.74	1231.4	120.4	214.1	
Mt Pearson (N)	Devonian	MBT241		MPM	I	607100	5434800	icpms	4.72	19.97	5.82	1.36	5.11	5.54	12.02	1211.1	81.3	75.2	
Mt Pearson (N)	Devonian	MBT242		MPM	I	596500	5435400	icpms	4.54	25.92	6.12	1.31	6.64	5.83	13.77	1164.2	105.5	79.1	
Mt Pearson (N)	Devonian	TB34		BWC	I	598200	5432600	xrf	4.48	32.0	4.6	1.29	8.19	4.38	13.86	1148.6	130.2	59.4	
Mt Pearson (N)	Devonian	TB36		BWC	I	607000	5434800	xrf	5.35	28.5	5.6	1.54	7.30	5.33	14.17	1371.6	116.0	72.3	
Mt Pearson (S)	Devonian	40524		JDC	I	593600	5425200	icpms	4.82	28	9.92	1.39	7.17	9.45	18.00	1235.7	113.9	128.1	
Mt Pearson (S)	Devonian	40526rpt1		JDC	I	595000	5428900	icpms	4.51	26.18	5.25	1.30	6.70	5.00	13.00	1155.1	106.5	67.8	
Mt Pearson (S)	Devonian	NJ458	R013387	JLE	I	592620	5415540	xrf	4.72	25.0	5.0	1.36	6.40	4.76	12.52	1210.1	101.7	64.6	
Mt Pearson (S)	Devonian	NJ460	R013389	JLE	I	593310	5422470	xrf	4.63	26.0	9.0	1.34	6.66	8.57	16.56	1187.0	105.8	116.3	
Constable Ck (Mt Pearson marginal phase)	Devonian	NJ459	R013388	JLE	I	593230	5420260	xrf	4.96	29.0	22.0	1.43	7.42	20.95	29.81	1271.6	118.0	284.2	
Pyengana	Devonian	MAL7		MPM	I	584800	5427300	icpms	3.64	11.48	3.18	1.05	2.94	3.03	7.02	932.7	46.7	41.1	
Pyengana	Devonian	AG7	R004477	JLE	I	575150	5417500	icpms	3.47	12.77	5.01	1.00	3.27	4.77	9.04	889.9	52.0	64.7	
Pyengana	Devonian	AG14	R004484	JLE	I	579600	5417450	icpms	3.57	14.91	4.62	1.03	3.82	4.40	9.25	914.7	60.7	59.7	
Pyengana	Devonian	TB66		BWC	I	580700	5432200	xrf	3.44	23.0	5.2	0.99	5.89	4.95	11.83	881.9	93.6	67.2	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												U Jkg <sup>-1</sup>	K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>
Pyngana	Devonian	TB64		BWC	I	581300	5430200	xrf	3.52	24.0	6.6	1.02	6.14	6.29	13.44	902.4	97.7	85.3	
Poimena	Devonian	99220057agso			I	593216	5435716	icpms	4.83	23	10	1.39	5.89	9.52	16.80	1238.3	93.6	129.2	
Poimena	Devonian	CPJ42	R004377	JLE	I	556440	5480530	icpms	2.89	13.96	4.54	0.83	3.57	4.32	8.73	739.9	56.8	58.6	
Poimena	Devonian	CPJ43	R004378	JLE	I	565170	5474680	icpms	4.27	15.19	4.19	1.23	3.89	3.99	9.11	1095.8	61.8	54.1	
Poimena	Devonian	AG16	R004486	JLE	I	576510	5428150	icpms	4.23	15.59	4.95	1.22	3.99	4.71	9.92	1084.5	63.4	63.9	
Poimena	Devonian	MAL6		MIPM	I	579600	5426900	icpms	4.48	12.03	4.84	1.29	3.08	4.61	8.98	1148.6	49.0	62.5	
Poimena	Devonian	MBT250		MIPM	I	585400	5436400	icpms	5.28	17.69	4.54	1.52	4.53	4.32	10.38	1354.2	72.0	58.6	
Poimena	Devonian	TB24		BWC	I	588000	5432000	xrf	4.54	28.0	13.2	1.31	7.17	12.57	21.05	1163.9	113.9	170.5	
Poimena	Devonian	TB25		BWC	I	591400	5442900	xrf	4.85	24.0	7.2	1.40	6.14	6.86	14.40	1243.4	97.7	93.0	
Poimena	Devonian	TB26		BWC	I	589100	5450900	xrf	4.53	19.0	6.4	1.31	4.86	6.09	12.27	1161.4	77.3	82.7	
Poimena	Devonian	TB27		BWC	I	587900	5450500	xrf	4.12	22.5	9.2	1.19	5.76	8.76	15.71	1056.3	91.6	118.8	
Poimena	Devonian	TB28		BWC	I	585800	5451700	xrf	4.54	16.8	3.2	1.31	4.30	3.05	8.66	1163.9	68.4	41.3	
Poimena	Devonian	TB29		BWC	I	581900	5450900	xrf	4.63	20.5	10.2	1.34	5.25	9.71	16.30	1187.0	83.4	131.8	
Poimena	Devonian	TB30		BWC	I	579600	5451500	xrf	4.32	26.0	7.6	1.25	6.66	7.24	15.14	1107.5	105.8	98.2	
Poimena	Devonian	TB38		BWC	I	568600	5468700	xrf	4.11	18.0	5.0	1.19	4.61	4.76	10.55	1053.7	73.2	64.6	
Poimena	Devonian	TB41		BWC	I	590000	5437500	xrf	5.61	26.5	4.8	1.62	6.78	4.57	12.97	1438.3	107.8	62.0	
Poimena	Devonian	TB42		BWC	I	585300	5436400	xrf	5.49	22.5	2.2	1.58	5.76	2.10	9.44	1407.5	91.6	28.4	
Poimena	Devonian	TB43		BWC	I	586300	5438500	xrf	4.80	24.5	2.6	1.38	6.27	2.48	10.13	1230.6	99.7	33.6	
Poimena	Devonian	TB61		BWC	I	591000	5445400	xrf	4.01	22.0	6.2	1.16	5.63	5.90	12.69	1028.1	89.5	80.1	
Poimena	Devonian	TB62		BWC	I	591000	5448200	xrf	4.35	21.0	7.0	1.25	5.38	6.67	13.30	1115.2	85.4	90.4	
Poimena	Devonian	TB63		BWC	I	591000	5448200	xrf	3.47	7.0	24.5	1.00	1.79	23.33	26.12	889.6	28.5	316.5	
Poimena	Devonian	TB65		BWC	I	579600	5426800	xrf	4.64	20.5	3.0	1.34	5.25	2.86	9.44	1189.6	83.4	38.8	
Poimena	Devonian	TB67		BWC	I	569700	5452400	xrf	4.33	19.8	4.2	1.25	5.07	4.00	10.32	1110.1	80.6	54.3	
Poimena	Devonian	LFB1859		BWC	I	554600	5479300	xrf	4.36	19.6	4.6	1.26	5.02	4.38	10.66	1117.8	79.8	59.4	
Poimena	Devonian	LFB1860		BWC	I	556100	5480600	xrf	4.29	19.0	6.2	1.24	4.86	5.90	12.01	1099.9	77.3	80.1	
Poimena	Devonian	LFB1861		BWC	I	556100	5480600	xrf	2.05	16.4	4.4	0.59	4.20	4.19	8.98	525.6	66.7	56.8	
Poimena	Devonian	LFB1862		BWC	I	557900	5478600	xrf	4.36	16.6	7.6	1.26	4.25	7.24	12.74	1117.8	67.5	98.2	
Poimena	Devonian	LFB1863		BWC	I	557900	5478600	xrf	6.02	10.2	6.8	1.74	2.61	6.48	10.82	1543.4	41.5	87.8	
Lottah	Devonian	99220053agso			S	583813	5436084	icpms	4.24	9.2	16.9	1.22	2.36	16.09	19.67	1087.0	37.4	218.3	
Lottah	Devonian	99220061			S	581300	5443900	icpms	5.08	15.5	15.1	1.47	3.97	14.38	19.81	1302.4	63.1	195.1	
Lottah	Devonian	84162012		DEM	S	583660	5436280	icpms	3.84	8.62	3.84	1.11	2.21	3.66	6.97	985.3	35.1	49.6	
Lottah?	Devonian	84162019		DEM	S	587110	5438140	icpms	4.47	5.64	24.3	1.29	1.44	23.14	25.87	1145.0	22.9	313.9	
Lottah	Devonian	84162021		DEM	S	584220	5439930	icpms	3.97	7.73	7.9	1.15	1.98	7.52	10.65	1018.3	31.5	102.1	
Lottah	Devonian	84162203		DEM	S	578310	5442090	icpms	4.35	12.42	14.06	1.25	3.18	13.39	17.82	1115.5	50.5	181.6	
Lottah	Devonian	84162205		DEM	S	577910	5442840	icpms	4.59	12.68	6.74	1.27	3.25	6.42	10.93	1126.5	51.6	87.1	
Lottah	Devonian	TB49		BWC	S	579500	5441100	xrf	4.32	14.8	38.5	1.30	3.79	36.66	41.76	1158.8	60.2	497.3	
Lottah	Devonian	TB50		BWC	S	583300	5436400	xrf	2.70	9.2	12.8	0.78	2.36	12.19	15.32	692.2	37.4	165.4	
Lottah	Devonian	TB51		BWC	S	575600	5441100	xrf	4.38	12.6	2.6	1.26	3.23	2.48	6.96	1122.9	51.3	33.6	
Lottah	Devonian	TB83		BWC	S	584000	5436100	xrf	4.09	11.8	3.4	1.18	3.02	3.24	7.44	1048.6	48.0	43.9	
Lottah	Devonian	BT11		DEM	S	583120	5436410	xrf	4.11	7.0	6.5	1.19	1.79	6.19	9.17	1053.7	28.5	84.0	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation						Decay rates		
												U Jkg <sup>-1</sup>	K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Lottah	Devonian	BT12		DEM	S	583660	5436280	xrf	4.23	10.0	4.0	1.22	2.56	3.81	7.59	1084.5	40.7	51.7		
Lottah	Devonian	BT13		DEM	S	584000	5436120	xrf	4.04	12.0	8.0	1.17	3.07	7.62	11.86	1035.8	48.8	103.3		
Lottah	Devonian	BT16		DEM	S	583550	5427810	xrf	4.16	9.0	2.5	1.20	2.30	2.38	5.88	1066.5	36.6	32.3		
Lottah	Devonian	BT19		DEM	S	587110	5438140	xrf	4.29	6.0	25.0	1.24	1.54	23.81	26.58	1099.9	24.4	323.0		
Lottah	Devonian	BT21		DEM	S	584220	5439930	xrf	3.94	9.0	7.0	1.14	2.30	6.67	10.11	1010.1	36.6	90.4		
Lottah	Devonian	BT22		DEM	S	586030	5435460	xrf	4.26	7.0	26.0	1.23	1.79	24.76	27.78	1092.2	28.5	335.9		
Lottah	Devonian	D2		DEM	S	578120	5441980	xrf	4.45	11.0	7.5	1.28	2.82	7.14	11.24	1140.9	44.8	96.9		
Lottah	Devonian	D3		DEM	S	578310	5442090	xrf	4.38	14.0	16.0	1.26	3.58	15.24	20.08	1122.9	57.0	206.7		
Lottah	Devonian	D4		DEM	S	577800	5442770	xrf	4.44	15.0	3.8	1.28	3.84	3.62	8.74	1138.3	61.0	49.1		
Lottah	Devonian	D5		DEM	S	577910	5442840	xrf	4.50	15.0	7.5	1.30	3.84	7.14	12.28	1153.7	61.0	96.9		
Lottah	Devonian	SR8		DEM	S	581290	5443870	xrf	5.07	17.0	14.0	1.46	4.35	13.33	19.15	1299.8	69.2	180.9		
Lottah	Devonian	63036		DEM	S	584800	5435300	xrf	4.35	10.0	19.0	1.25	2.56	18.09	21.91	1115.2	40.7	245.4		
Lottah	Devonian	63037		DEM	S	584800	5435300	xrf	4.76	17.0	16.0	1.37	4.35	15.24	20.96	1220.3	69.2	206.7		
Lottah	Devonian	742519		DEM	S	580000	5441100	xrf	4.54	13.0	22.0	1.31	3.33	20.95	25.59	1163.9	52.9	284.2		
Lottah	Devonian	742520		DEM	S	579900	5441100	xrf	5.01	15.0	23.0	1.44	3.84	21.90	27.19	1284.4	61.0	297.1		
Lottah	Devonian	742521		DEM	S	579000	5443400	xrf	4.46	15.0	26.0	1.29	3.84	24.76	29.89	1143.4	61.0	335.9		
Lottah	Devonian	742524		DEM	S	579300	5442900	xrf	5.10	16.0	18.0	1.47	4.10	17.14	22.71	1307.5	65.1	232.5		
Lottah	Devonian	742608		DEM	S	583100	5436400	xrf	3.98	6.0	5.5	1.15	1.54	5.24	7.92	1020.4	24.4	71.0		
Lottah	Devonian	84162193		DEM	S	579800	5441200	xrf	4.43	14.0	28.0	1.28	3.58	26.66	31.53	1135.7	57.0	361.7		
Lottah	Devonian	84162194		DEM	S	580200	5441200	xrf	4.56	13.0	24.0	1.32	3.33	22.86	27.50	1169.1	52.9	310.0		
Lottah	Devonian	84162195		DEM	S	578900	5443400	xrf	4.67	14.0	25.0	1.35	3.58	23.81	28.74	1197.3	57.0	323.0		
Lottah	Devonian	84162196		DEM	S	582500	5440700	xrf	4.35	11.0	15.0	1.25	2.82	14.28	18.36	1115.2	44.8	193.8		
Mt Paris	Devonian	DDH2	R011149	JLE	S	563700	5438300	icpms	4.82	15.48	16.58	1.39	3.96	15.79	21.14	1236.8	63.0	214.2		
Mt Paris	Devonian	Bald Hill DDH1	R011150	JLE	S	572100	5434800	icpms	4.48	11.99	27.6	1.29	3.07	26.28	30.64	1148.3	48.8	356.5		
Mt Paris	Devonian	Bald Hill DDH4	R011151	JLE	S	572065	5434870	icpms	4.61	11.23	20.8	1.33	2.87	19.81	24.01	1181.4	45.7	268.7		
Mt Paris	Devonian	TB52		BWC	S	563700	5441900	xrf	4.99	15.4	11.6	1.44	3.94	11.05	16.43	1279.3	62.7	149.8		
Mt Cameron	Devonian	EA2		PWB	I	585300	5464500	icpms	4.43	30.04	13.72	1.28	7.69	13.07	22.03	1134.5	122.2	177.2		
Mt Cameron	Devonian	TB46		BWC	I	585600	5463700	xrf	4.49	38.5	10.4	1.29	9.86	9.90	21.05	1151.1	156.7	134.3		
Mt Cameron?	Devonian	NJ465	R013394	JLE	S	579130	5462650	xrf	5.87	4.0	39.0	1.69	1.02	37.14	39.86	1504.9	16.3	503.8		
Little Mount Horror	Devonian	702697		DIG	S	567950	5459630	icpms	5.38	18.56	5.37	1.55	4.75	5.11	11.42	1379.0	75.5	69.4		
Little Mount Horror	Devonian	TB40		BWC	S	567400	5461600	xrf	4.78	19.2	12.0	1.38	4.92	11.43	17.72	1225.5	78.1	155.0		
Little Mount Horror	Devonian	NJ462	R013391	JLE	S	567060	5459320	xrf	4.69	13.0	16.0	1.35	3.33	15.24	19.92	1202.4	52.9	206.7		
Little Mount Horror	Devonian	NJ463	R013392	JLE	S	567290	5460490	xrf	4.56	11.0	12.0	1.32	2.82	11.43	15.56	1169.1	44.8	155.0		
Little Mount Horror	Devonian	NJ464	R013393	JLE	S	567440	5461840	xrf	4.85	13.0	27.0	1.40	3.33	25.71	30.44	1243.4	52.9	348.8		
Gardens	Devonian	99220055agso		PWB	I	607451	5441454	icpms	3.64	10.8	6.78	1.05	2.76	6.46	10.27	933.2	43.9	87.6		
Gardens	Devonian	EA5		PWB	I	594200	5466700	icpms	3.75	16.68	2.67	1.08	4.27	2.54	7.90	962.4	67.9	34.5		
Gardens	Devonian	MBT258		MPM	I	597800	5455900	icpms	2.96	12.67	2.87	0.85	3.24	2.73	6.83	758.6	51.6	37.1		
Gardens	Devonian	BT3/58		MPM	I	590100	5452300	icpms	2.36	8.83	3.23	0.68	2.26	3.08	6.02	606.1	35.9	41.7		
Gardens	Devonian	MBT256		MPM	I	603300	5443400	icpms	4.95	17.95	3.54	1.43	4.60	3.37	9.39	1268.3	73.0	45.7		
Gardens	Devonian	TB31		BWC	I	595100	5449200	xrf	3.10	23.0	3.4	0.89	5.89	3.24	10.02	794.8	93.6	43.9		

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation						Decay rates		
												K Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Gardens	Devonian	TB32		BWC	I	594900	5449700	xrf	3.52	17.0	5.8	1.02	4.35	5.52	10.89	902.4	69.2	74.9		
Gardens	Devonian	TB33		BWC	I	593900	5448400	xrf	3.37	20.5	3.8	0.97	5.25	3.62	9.84	864.0	83.4	49.1		
Gardens	Devonian	TB37		BWC	I	606300	5440400	xrf	3.63	19.2	5.2	1.05	4.92	4.95	10.91	930.6	78.1	67.2		
Gardens enclave	Devonian	99220056agso			I	607451	5441454	icpms	2.21	9	5.98	0.64	2.30	5.69	8.64	566.1	36.6	77.2		
Sheoak Hill	Devonian	702704		DIG	S	569030	5468770	icpms	4.99	7.7	10.01	1.44	1.97	9.53	12.94	1278.3	31.3	129.3		
Vicarys Creek	Devonian	VCP	C108648	JLE	I	573150	5469340	icpms	3.72	9.92	5.1	1.07	2.54	4.86	8.47	953.7	40.4	65.9		
Vicarys Creek	Devonian	TB39		BWC	I	572900	5469200	xrf	3.90	15.6	4.0	1.12	3.99	3.81	8.93	999.9	63.5	51.7		
Ansons Bay North	Devonian	43136c		JDC	S	606649	5471300	icpms	5.08	16.16	2.7	1.46	4.14	2.57	8.17	1301.4	65.8	34.9		
Ansons Bay North	Devonian	EA6	85-0258	PWB	S	599000	5479500	icpms	4.17	12.7	4.85	1.20	3.25	4.62	9.07	1069.9	51.7	62.7		
Ansons Bay North	Devonian	LFB1854		BWC	S	601500	5469700	xrf	4.23	20.5	4.4	1.22	5.25	4.19	10.66	1084.5	83.4	56.8		
Ansons Bay N/Musselroe Pt?	Devonian	LFB1856		BWC	S	599200	5479200	xrf	5.09	9.4	7.6	1.47	2.41	7.24	11.11	1305.0	38.2	98.2		
Ansons Bay N/Musselroe Pt?	Devonian	LFB1857		BWC	S	599100	5479400	xrf	4.42	17.4	3.6	1.27	4.45	3.43	9.16	1133.2	70.8	46.5		
Ansons Bay South	Devonian	99220054agso			S	610543	5463511	icpms	4.99	22.2	2.9	1.44	5.68	2.76	9.88	1279.3	90.3	37.5		
Ansons Bay South	Devonian	43132c		JDC	S	607700	5459400	icpms	4.19	18.7	2.88	1.21	4.79	2.74	8.74	1075.2	76.1	37.2		
Ansons Bay South	Devonian	EA4		PWB	S	610700	5463500	icpms	4.29	17.3	2.87	1.24	4.43	2.73	8.40	1099.3	70.4	37.1		
Ansons Bay South	Devonian	TAS129			S	608600	5459400	xrf	4.62	20.5	3.4	1.33	5.25	3.24	9.82	1184.5	83.4	43.9		
Rushy Lagoon	Devonian	EA9	85-0261	PWB	S	596300	5478500	icpms	3.68	11.68	3.86	1.06	2.99	3.68	7.73	942.7	47.5	49.9		
Rushy Lagoon	Devonian	Musselroe 1A		JLE	S	591180	5480656	icpms	5.06	17.61	12.74	1.46	4.51	12.13	18.10	1296.5	71.7	164.6		
Mt William	Devonian	EA8	85-0260	PWB	S	600400	5472300	icpms	4.57	17.6	6.4	1.32	4.51	6.09	11.92	1171.9	71.6	82.7		
Mt William	Devonian	LFB1858		BWC	S	600000	5475600	xrf	4.59	20.5	8.8	1.32	5.25	8.38	14.95	1176.8	83.4	113.7		
Eddystone Point	Devonian	EA3	85-0255	PWB	S	613100	5461200	icpms	4.40	18.61	3.54	1.27	4.76	3.37	9.40	1128.1	75.7	45.7		
Eddystone Point	Devonian	TB45		BWC	S	613200	5461200	xrf	4.77	19.8	2.6	1.38	5.07	2.48	8.92	1222.9	80.6	33.6		
Musselroe Point	Devonian	EA7	85-0259	PWB	S	598900	5479500	icpms	4.84	15.6	2.25	1.40	3.99	2.14	7.53	1240.6	63.5	29.1		
Musselroe Point	Devonian	TB47		BWC	S	598900	5479700	xrf	4.31	17.2	2.8	1.24	4.40	2.67	8.31	1105.0	70.0	36.2		
Boobyalla	Devonian	BBY	R108647	JLE	S	574830	5469710	icpms	5.23	16.16	13.02	1.51	4.14	12.40	18.04	1339.6	65.8	168.2		
Boobyalla	Devonian	43218c		JDC	S	574685	5469475	icpms	4.03	24.62	5.79	1.16	6.30	5.51	12.98	1034.2	100.2	74.8		
Boobyalla	Devonian	TB48		BWC	S	574900	5469600	xrf	5.16	17.8	7.6	1.49	4.56	7.24	13.28	1322.9	72.4	98.2		
Clarke Island East	Devonian	43268	R011157	JDC	S	602100	5515900	icpms	6.06	12.79	2.39	1.75	3.27	2.28	7.30	1554.4	52.0	30.9		
Kent Bay	Devonian	BA10	R011915	JLE	S	612700	5520800	icpms	4.06	12.45	4	1.17	3.19	3.81	8.17	1039.9	50.7	51.7		
Kent Bay (Forsyth Is)	Devonian	43276a		JDC	S	611000	5513900	icpms	4.12	12.76	2.35	1.19	3.27	2.24	6.69	1056.0	51.9	30.4		
Kent Bay (Forsyth Is)	Devonian	LFB1712		BWC	S	611200	5513900	xrf	4.16	14.0	2.8	1.20	3.58	2.67	7.45	1066.5	57.0	36.2		
Kent Bay? (Passage Is)	Devonian	LAG1960		BWC	S	612700	5516000	xrf	2.25	14.2	6.6	0.65	3.64	6.29	10.57	576.8	57.8	85.3		
Kent Bay? (Passage Is)	Devonian	LAG1961		BWC	S	612700	5516000	xrf	2.31	15.6	4.2	0.67	3.99	4.00	8.66	592.2	63.5	54.3		
Kent Bay? (Passage Is)	Devonian	LAG1968		BWC	S	612700	5516000	xrf	4.00	15.6	3.2	1.15	3.99	3.05	8.19	1025.5	63.5	41.3		
Key Bay	Devonian	43201a		JDC	S	587200	5523900	icpms	4.91	22.14	2.64	1.42	5.67	2.51	9.60	1258.5	90.1	34.1		
Key Bay	Devonian	43203a		JDC	S	588400	5521900	icpms	5.06	38.37	3.32	1.46	9.82	3.16	14.44	1296.5	156.1	42.9		
Key Bay	Devonian	LAG1990			S	590400	5518200	xrf	5.42	30.5	5.4	1.56	7.81	5.14	14.51	1389.6	124.1	69.8		
Key Bay	Devonian	FG7		EJR	S	593200	5513100	xrf	4.85	29.5	5.2	1.40	7.55	4.95	13.90	1243.4	120.0	67.2		

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Key Bay	Devonian	FG8		EJR	S	593200	5513100	xrf	5.17	19.2	14.6	1.49	4.92	13.90	20.31	1325.5	78.1	188.6	
Key Bay	Devonian	FG42		BWC	S	588500	5521900	xrf	5.00	20.5	2.2	1.44	5.25	2.10	8.79	1281.9	83.4	28.4	
Key Bay	Devonian	43204a			S	588400	5521900	xrf	4.72	29.0	32.0	1.36	7.42	30.47	39.26	1209.1	118.0	413.4	
Modder River	Devonian	62591		EJR	I	591800	5533900	icpms	4.78	18.95	10.55	1.38	4.85	10.05	16.28	1224.5	77.1	136.3	
Modder River	Devonian	FG9		BWC	I	593400	5513800	xrf	4.27	15.8	3.4	1.23	4.04	3.24	8.51	1094.7	64.3	43.9	
Modder River	Devonian	FG10		EJR	I	593600	5513900	xrf	4.07	13.6	5.4	1.17	3.48	5.14	9.80	1043.5	55.3	69.8	
Modder River	Devonian	FG11		EJR	I	591800	5533900	xrf	4.63	15.0	5.2	1.34	3.84	4.95	10.13	1187.0	61.0	67.2	
Modder River	Devonian	FG36		EJR	I	591800	5533900	xrf	4.87	21.5	7.8	1.40	5.50	7.43	14.34	1248.6	87.5	100.8	
Corner	Devonian	62599		EJR	I	584400	5529100	icpms	4.04	14.01	5.81	1.16	3.59	5.53	10.28	1035.5	57.0	75.1	
Corner	Devonian	FG6		EJR	I	585700	5530000	xrf	3.98	13.4	4.0	1.15	3.43	3.81	8.39	1020.4	54.5	51.7	
Corner	Devonian	FG12		EJR	I	584300	5529200	xrf	4.03	15.6	5.2	1.16	3.99	4.95	10.11	1033.2	63.5	67.2	
Corner	Devonian	FG13		EJR	I	584300	5529300	xrf	3.96	16.4	6.4	1.14	4.20	6.09	11.44	1015.2	66.7	82.7	
Corner	Devonian	LFB2616		BWC	I	584800	5529800	xrf	2.16	14.2	5.0	0.62	3.64	4.76	9.02	553.8	57.8	64.6	
Cape Sir John	Devonian	62607		EJR	I	583700	5525000	icpms	3.93	16.57	2.67	1.13	4.24	2.54	7.92	1006.3	67.4	34.5	
Cape Sir John	Devonian	FG16		EJR	I	583700	5525000	xrf	3.96	17.8	2.8	1.14	4.56	2.67	8.37	1015.2	72.4	36.2	
Cape Sir John	Devonian	FG17		EJR	I	584200	5524500	xrf	4.06	15.8	4.0	1.17	4.04	3.81	9.02	1040.9	64.3	51.7	
Rooks River	Devonian	62598		EJR	I	595100	5533700	icpms	4.86	29.6	6.53	1.40	7.58	6.22	15.20	1245.5	120.4	84.4	
Dover River	Devonian	LAG2009		BWC	S	605800	5520900	xrf	5.00	23.5	11.6	1.44	6.02	11.05	18.50	1281.9	95.6	149.8	
Dover River	Devonian	BA7	R011912	JLE	S	608100	5523100	icpms	4.16	18.04	3.64	1.20	4.62	3.47	9.28	1065.5	73.4	47.0	
Mt Kerford	Devonian	43242		JDC	S	626700	5522800	icpms	4.73	15.08	3.39	1.36	3.86	3.23	8.45	1213.4	61.4	43.8	
Mt Kerford	Devonian	43251		JDC	S	621400	5522000	icpms	3.92	25.42	7.53	1.13	6.51	7.17	14.81	1004.7	103.4	97.3	
Mt Kerford	Devonian	BA11	R011916	JLE	S	613200	5519800	icpms	5.13	15.78	3.1	1.48	4.04	2.95	8.47	1314.7	64.2	40.0	
Mt Kerford	Devonian	BA13	R011918	JLE	S	620900	5519800	icpms	5.15	16.32	3.99	1.49	4.18	3.80	9.46	1320.8	66.4	51.5	
Mt Kerford	Devonian	LAG1994		BWC	S	617300	5517900	xrf	5.08	19.6	6.6	1.47	5.02	6.29	12.77	1302.4	79.8	85.3	
Mt Kerford	Devonian	LAG2001		BWC	S	613700	5517100	xrf	5.16	17.8	5.2	1.49	4.56	4.95	11.00	1322.9	72.4	67.2	
Mt Kerford	Devonian	FG14		EJR	S	624500	5522200	xrf	4.79	17.8	7.6	1.38	4.56	7.24	13.18	1228.0	72.4	98.2	
Mt Kerford	Devonian	FG15		EJR	S	624500	5522200	xrf	5.19	17.2	5.8	1.50	4.40	5.52	11.42	1330.6	70.0	74.9	
Mt Kerford	Devonian	FG43		JDC	S	613000	5519900	xrf	4.88	16.0	2.8	1.41	4.10	2.67	8.17	1251.1	65.1	36.2	
Mt Kerford	Devonian	FG48		BWC	S	624500	5522200	xrf	5.52	11.8	6.4	1.59	3.02	6.09	10.71	1415.2	48.0	82.7	
Hogans Hill	Devonian	43156a		JDC	S	618700	5524100	icpms	4.74	11.45	8.43	1.37	2.93	8.03	12.33	1215.0	46.6	108.9	
Hogans Hill	Devonian	BA14	R011919	JLE	S	621600	5523300	icpms	4.58	8.18	8.72	1.32	2.09	8.30	11.72	1174.7	33.3	112.6	
Thirsty Lagoons	Devonian	BA32	R011925	JLE	S	618380	5531840	icpms	4.91	5.85	3.64	1.42	1.50	3.47	6.38	1258.0	23.8	47.0	
Puncheon Point	Devonian	BA33	R011926	JLE	S	611150	5536800	icpms	3.75	7.5	2.76	1.08	1.92	2.63	5.63	960.1	30.5	35.7	
Puncheon Point	Devonian	FG33		EJR	S	611000	5536500	xrf	3.78	8.8	3.0	1.09	2.25	2.86	6.20	969.1	35.8	38.8	
Long Toms Nose	Devonian	68538		EJR	S	609800	5541800	icpms	5.04	23.65	6.43	1.45	6.05	6.12	13.63	1292.6	96.2	83.1	
Long Toms Nose	Devonian	LAG2004		EJR	S	609100	5540000	xrf	4.91	24.0	15.4	1.42	6.14	14.67	22.23	1258.8	97.7	198.9	
Long Toms Nose	Devonian	LAG2005		BWC	S	602600	5543000	xrf	4.99	27.5	9.2	1.44	7.04	8.76	17.24	1279.3	111.9	118.8	
Long Toms Nose	Devonian	LAG2016		BWC	S	602600	5543000	xrf	4.90	22.5	7.8	1.41	5.76	7.43	14.60	1256.2	91.6	100.8	
Franklin Sound	Devonian	43083		JDC	I	596200	5538600	icpms	3.83	13.52	6.42	1.10	3.46	6.11	10.68	981.9	55.0	82.9	
Franklin Sound	Devonian	LAG1995		BWC	I	590800	5539500	xrf	4.41	13.2	5.4	1.27	3.38	5.14	9.79	1130.6	53.7	69.8	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Franklin Sound?	Devonian	LFB1714		BWC		596200	5538600	xrf	3.94	15.2	5.8	1.14	3.89	5.52	10.55	1010.1	61.8	74.9	
Lady Barron	Devonian	62641		EJR	S	607800	5547100	icpms	3.81	6.09	5.83	1.10	1.56	5.55	8.21	975.8	24.8	75.3	
Lady Barron	Devonian	FG31		EJR	S	606800	5547800	xrf	4.11	6.8	1.8	1.19	1.74	1.71	4.64	1053.7	27.7	23.3	
Lady Barron	Devonian	FG32		EJR	S	607800	5547200	xrf	3.81	7.0	5.4	1.10	1.79	5.14	8.03	976.8	28.5	69.8	
Lady Barron	Devonian	LAG1998		BWC	S	605100	5548000	xrf	3.65	6.8	5.6	1.05	1.74	5.33	8.13	935.8	27.7	72.3	
Strzelecki	Devonian	F3	R006956	MIPM	S	588560	5544970	icpms	5.19	17.77	5.14	1.50	4.55	4.89	10.94	1330.6	72.3	66.4	
Strzelecki	Devonian	F2ga	R006955		S	588561	5544971	icpms	2.35	15.2	5.76	0.68	3.89	5.49	10.06	603.3	61.8	74.4	
Strzelecki	Devonian	LAG2024		BWC	S	592500	5541800	xrf	3.86	4.8	4.0	1.11	1.23	3.81	6.15	989.6	19.5	51.7	
Strzelecki	Devonian	LAG2026		BWC	S	589300	5550500	xrf	3.97	5.4	5.0	1.14	1.38	4.76	7.29	1017.8	22.0	64.6	
Strzelecki	Devonian	FG3		EJR	S	588600	5544900	xrf	5.27	22.0	3.4	1.52	5.63	3.24	10.39	1351.1	89.5	43.9	
Strzelecki	Devonian	FG19		EJR	S	593200	5550500	xrf	4.70	14.4	17.6	1.36	3.69	16.76	21.80	1205.0	58.6	227.4	
Strzelecki	Devonian	FG40		EJR	S	588600	5544900	xrf	5.42	15.2	3.6	1.56	3.89	3.43	8.88	1389.6	61.8	46.5	
Strzelecki	Devonian	FG41		EJR	S	587700	5546000	xrf	5.03	20.0	3.6	1.45	5.12	3.43	10.00	1289.6	81.4	46.5	
Martins Rise	Devonian	62638		EJR	S	589000	5558400	icpms	4.42	11.87	1.98	1.27	3.04	1.89	6.20	1132.3	48.3	25.6	
Martins Rise	Devonian	FG28		EJR	S	590800	5552000	xrf	4.48	12.2	2.0	1.29	3.12	1.90	6.32	1148.6	49.6	25.8	
Martins Rise	Devonian	FG29		EJR	S	589000	5558400	xrf	4.43	12.2	2.4	1.28	3.12	2.29	6.69	1135.7	49.6	31.0	
Martins Rise	Devonian	LAG1991			S	595200	5559100	xrf	3.96	17.2	3.4	1.14	4.40	3.24	8.78	1015.2	70.0	43.9	
Martins Rise	Devonian	LAG1997		BWC	S	594800	5559600	xrf	4.73	20.0	5.4	1.36	5.12	5.14	11.63	1212.7	81.4	69.8	
Martins Rise	Devonian	LAG2000			S	589300	5563700	xrf	4.46	11.0	4.2	1.29	2.82	4.00	8.10	1143.4	44.8	54.3	
Darling Range	Devonian	FLG2	R011933	JLE	I	593370	5563480	icpms	4.62	15.04	6.95	1.33	3.85	6.62	11.80	1184.5	61.2	89.8	
Darling Range	Devonian	LAG2012			S	593600	5572800	xrf	5.08	20.0	8.2	1.47	5.12	7.81	14.39	1302.4	81.4	105.9	
Darling Range	Devonian	LAG2014		BWC	S	596200	5568900	xrf	4.79	20.0	7.8	1.38	5.12	7.43	13.93	1228.0	81.4	100.8	
Darling Range	Devonian	LAG2019		BWC	S	592800	5565000	xrf	4.81	19.6	8.4	1.39	5.02	8.00	14.40	1233.2	79.8	108.5	
Darling Range	Devonian	LAG2020		BWC	S	596800	5558500	xrf	5.03	26.5	18.8	1.45	6.78	17.90	26.14	1289.6	107.8	242.9	
Darling Range	Devonian	LAG2021			S	591600	5562600	xrf	4.44	12.0	12.0	1.28	3.07	11.43	15.78	1138.3	48.8	155.0	
Darling Range	Devonian	LAG2027		BWC	S	594300	5556700	xrf	4.73	10.4	6.2	1.36	2.66	5.90	9.93	1212.7	42.3	80.1	
Darling Range	Devonian	FG30			S	597100	5567600	xrf	4.80	19.4	7.6	1.38	4.97	7.24	13.59	1230.6	78.9	98.2	
The Dutchman	Devonian	LAG1988		BWC	S	599700	5559700	xrf	3.63	10.6	2.6	1.05	2.71	2.48	6.24	930.6	43.1	33.6	
The Dutchman	Devonian	LAG2015		BWC	S	598700	5557400	xrf	4.71	15.4	8.4	1.36	3.94	8.00	13.30	1207.5	62.7	108.5	
The Dutchman	Devonian	LAG2017		BWC	S	598500	5556200	xrf	4.89	16.8	6.8	1.41	4.30	6.48	12.19	1253.7	68.4	87.8	
Babel Island	Devonian	62580	R011159	EJR	S	613800	5575900	icpms	4.72	14.83	5.93	1.36	3.80	5.65	10.81	1210.4	60.3	76.6	
Babel Island	Devonian	67544	R011161	EJR	S	614300	5577500	icpms	5.04	7.16	5.24	1.45	1.83	4.99	8.28	1292.1	29.1	67.7	
Babel Island	Devonian	FG4		EJR	S	613600	5575900	xrf	4.87	16.4	5.6	1.40	4.20	5.33	10.94	1248.6	66.7	72.3	
Babel Island	Devonian	FG39		EJR	S	613800	5578200	xrf	4.79	13.2	5.8	1.38	3.38	5.52	10.28	1228.0	53.7	74.9	
Babel Island	Devonian	FG50		EJR	S	614300	5577500	xrf	5.09	8.6	6.6	1.47	2.20	6.29	9.95	1305.0	35.0	85.3	
Patriarchs	Devonian	RBL	R006530	JLE	I	602600	5577200	icpms	4.35	20.6	6.62	1.25	5.27	6.30	12.83	1114.0	83.8	85.5	
Patriarchs	Devonian	FLG3	R011934	JLE	I	602700	5571020	icpms	5.02	13.21	3.14	1.45	3.38	2.99	7.82	1286.8	53.8	40.6	
Patriarchs	Devonian	77/901		DJJ	I	606300	5575600	icpms	5.01	22.43	4.8	1.45	5.74	4.57	11.76	1284.7	91.3	62.0	
Patriarchs	Devonian	LAG1999			I	602700	5577300	xrf	4.43	23.0	7.8	1.28	5.89	7.43	14.59	1135.7	93.6	100.8	
Patriarchs	Devonian	LAG2002			I	601500	5572900	xrf	5.03	15.0	4.4	1.45	3.84	4.19	9.48	1289.6	61.0	56.8	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation				Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>
Patriarchs	Devonian	LAG2003			I	602700	5576800	xrf	4.78	26.0	6.0	1.38	6.66	5.71	13.75	1225.5	105.8	77.5
Patriarchs	Devonian	LAG2025			I	606400	5575600	xrf	5.06	22.0	4.8	1.46	5.63	4.57	11.66	1297.3	89.5	62.0
Patriarchs	Devonian	LAG2029			I	606400	5575600	xrf	5.11	25.5	6.0	1.47	6.53	5.71	13.72	1310.1	103.8	77.5
Pats River	Devonian	77/902		DJJ	I	585500	5561800	icpms	2.70	13.37	2.11	0.78	3.42	2.01	6.21	691.7	54.4	27.3
Pats River	Devonian	LAG1964		BWC	I	587000	5568500	xrf	2.96	20.5	4.0	0.85	5.25	3.81	9.91	758.9	83.4	51.7
Pats River	Devonian	FG20		EJR	I	586000	5563700	xrf	3.02	17.8	2.2	0.87	4.56	2.10	7.52	774.3	72.4	28.4
Pats River	Devonian	FG23		EJR	I	585600	5562300	xrf	2.95	15.4	2.2	0.85	3.94	2.10	6.89	756.3	62.7	28.4
Pats River	Devonian	FG25		EJR	I	585400	5562900	xrf	2.89	15.4	2.0	0.83	3.94	1.90	6.68	740.9	62.7	25.8
Wybalenna	Devonian	F1ga			I	577489	5568246	icpms	3.71	22.2	7.75	1.07	5.68	7.38	14.13	950.1	90.3	100.1
Wybalenna	Devonian	77/909a		DJJ	I	578400	5542400	icpms	4.15	23.47	4.95	1.20	6.01	4.71	11.92	1062.9	95.5	63.9
Wybalenna	Devonian	77/881		DJJ	I	583400	5550500	icpms	2.12	7.45	1.25	0.61	1.91	1.19	3.71	543.8	30.3	16.1
Wybalenna (on Beagle Is)	Devonian	LAG1965		BWC	I	578300	5534400	xrf	3.24	14.2	2.8	0.93	3.64	2.67	7.24	830.7	57.8	36.2
Wybalenna (on Mt Chappell Is)	Devonian	LAG1966		BWC	I	577500	5541000	xrf	3.71	22.5	4.4	1.07	5.76	4.19	11.02	951.2	91.6	56.8
Wybalenna	Devonian	LAG1967			I	577300	5568200	xrf	3.82	18.6	6.4	1.10	4.76	6.09	11.96	979.4	75.7	82.7
Wybalenna (at Tanners Bay)	Devonian	LAG1969			I	573400	5582900	xrf	3.89	17.2	5.0	1.12	4.40	4.76	10.29	997.3	70.0	64.6
Wybalenna	Devonian	LAG1970		BWC	I	578900	5571300	xrf	3.89	20.0	3.6	1.12	5.12	3.43	9.67	997.3	81.4	46.5
Wybalenna	Devonian	LAG1974		BWC	I	577800	5571100	xrf	3.96	23.5	4.4	1.14	6.02	4.19	11.35	1015.2	95.6	56.8
Wybalenna	Devonian	LAG1975		BWC	I	578700	5568700	xrf	4.00	18.8	4.4	1.15	4.81	4.19	10.16	1025.5	76.5	56.8
Wybalenna	Devonian	LAG1977		BWC	I	579900	5567200	xrf	4.04	16.0	4.8	1.17	4.10	4.57	9.83	1035.8	65.1	62.0
Wybalenna (at Castle Rock Pt)	Devonian	LAG1985			I	577200	5574100	xrf	4.42	19.2	6.6	1.27	4.92	6.29	12.48	1133.2	78.1	85.3
Wybalenna (on Big Green Is)	Devonian	FG2		BWC	I	583400	5551700	xrf	2.62	13.8	1.8	0.76	3.53	1.71	6.00	671.7	56.2	23.3
Wybalenna	Devonian	FG26		EJJ	I	575300	5568700	xrf	4.00	20.0	7.2	1.15	5.12	6.86	13.13	1025.5	81.4	93.0
Little Chalky Island	Devonian	77/879		DJJ	I	576000	5556400	icpms	3.79	14.76	2.5	1.09	3.78	2.38	7.25	972.2	60.1	32.3
Little Chalky Island	Devonian	77/890		DJJ	I	576000	5550500	icpms	3.48	14.67	2.5	1.00	3.76	2.38	7.14	891.4	59.7	32.3
Little Chalky Island	Devonian	LAG1972		BWC	I	575700	5550500	xrf	3.41	12.2	3.0	0.98	3.12	2.86	6.96	874.2	49.6	38.8
Little Chalky Island	Devonian	FG1		EJR	I	575500	5561200	xrf	3.61	20.5	2.8	1.04	5.25	2.67	8.96	925.5	83.4	36.2
Emita	Devonian	67546		EJR	I	576400	5571900	icpms	5.83	15.35	3.41	1.68	3.93	3.25	8.86	1494.7	62.5	44.1
Emita	Devonian	LAG2030			I	576100	5571900	xrf	5.49	22.5	14.0	1.58	5.76	13.33	20.68	1407.5	91.6	180.9
Cape Frankland	Devonian	FLG5	R011936	JLE	S	564010	5585580	icpms	5.17	15.94	4	1.49	4.08	3.81	9.38	1324.4	64.9	51.7
Cape Frankland	Devonian	LAG1981			S	565600	5589800	xrf	4.31	20.5	6.4	1.24	5.25	6.09	12.59	1105.0	83.4	82.7
Cape Frankland	Devonian	LAG1989			S	566900	5583100	xrf	4.26	15.8	2.4	1.23	4.04	2.29	7.56	1092.2	64.3	31.0
Cape Frankland	Devonian	LAG1992			S	565200	5576700	xrf	4.86	19.8	8.4	1.40	5.07	8.00	14.47	1246.0	80.6	108.5
Lughrata	Devonian	77/900		DJJ	I	580600	5574700	icpms	3.88	18.17	3.16	1.12	4.65	3.01	8.78	994.0	73.9	40.8
Lughrata	Devonian	FG37		EJR	I	576000	5581600	xrf	4.30	20.5	6.6	1.24	5.25	6.29	12.77	1102.4	83.4	85.3
Killiecrankie	Devonian	77/904		DJJ	S	572000	5592500	icpms	5.38	16.88	7.98	1.55	4.32	7.60	13.47	1378.5	68.7	103.1
Killiecrankie	Devonian	77/905		DJJ	S	572000	5592500	icpms	5.22	32.15	9.72	1.51	8.23	9.26	18.99	1338.5	130.8	125.6
Killiecrankie	Devonian	LAG1993			S	572700	5593500	xrf	4.32	8.4	4.6	1.25	2.15	4.38	7.78	1107.5	34.2	59.4

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Killiecrankie	Devonian	LAG2007			S	570400	5584800	xrf	4.97	23.5	14.8	1.43	6.02	14.09	21.54	1274.2	95.6	191.2	
Killiecrankie	Devonian	LAG2008			S	570400	5582400	xrf	5.27	31.0	13.8	1.52	7.94	13.14	22.60	1351.1	126.1	178.3	
Killiecrankie	Devonian	LAG2010			S	574200	5595200	xrf	5.29	32.0	9.2	1.53	8.19	8.76	18.48	1356.2	130.2	118.8	
Killiecrankie	Devonian	LAG2018			S	573600	5594100	xrf	5.18	26.0	13.8	1.49	6.66	13.14	21.29	1328.0	105.8	178.3	
Killiecrankie	Devonian	LAG2022			S	570400	5582400	xrf	4.94	19.8	19.0	1.42	5.07	18.09	24.59	1266.5	80.6	245.4	
Killiecrankie	Devonian	LAG2023			S	571000	5590300	xrf	4.83	15.0	6.2	1.39	3.84	5.90	11.14	1238.3	61.0	80.1	
Killiecrankie	Devonian	LAG2028			S	570900	5590300	xrf	5.97	17.4	5.0	1.72	4.45	4.76	10.94	1530.6	70.8	64.6	
Palana	Devonian	77/893		DJJ	I	582300	5601900	icpms	4.63	21.75	3.71	1.34	5.57	3.53	10.44	1186.8	88.5	47.9	
Palana	Devonian	LAG1962			I	580100	5601800	xrf	2.37	23.0	3.8	0.68	5.89	3.62	10.19	607.6	93.6	49.1	
Palana	Devonian	LAG1963			I	580100	5601800	xrf	2.31	32.0	7.0	0.67	8.19	6.67	15.52	592.2	130.2	90.4	
Palana	Devonian	LAG1976			I	582800	5609600	xrf	3.68	40.0	3.8	1.06	10.24	3.62	14.92	943.5	162.8	49.1	
Palana	Devonian	LAG1978			I	575000	5598400	xrf	4.07	16.8	5.0	1.17	4.30	4.76	10.24	1043.5	68.4	64.6	
Palana	Devonian	LAG1979			I	582500	5602900	xrf	4.19	23.0	4.8	1.21	5.89	4.57	11.67	1074.2	93.6	62.0	
Palana	Devonian	LAG1980			I	574600	5598600	xrf	3.71	12.0	7.0	1.07	3.07	6.67	10.81	951.2	48.8	90.4	
Palana	Devonian	LAG1982			I	576000	5606300	xrf	4.16	22.0	6.2	1.20	5.63	5.90	12.74	1066.5	89.5	80.1	
Palana	Devonian	LAG1983			I	574500	5598400	xrf	4.19	21.0	1.8	1.21	5.38	1.71	8.30	1074.2	85.4	23.3	
Palana	Devonian	LAG1984			I	580100	5601800	xrf	4.33	23.0	3.8	1.25	5.89	3.62	10.76	1110.1	93.6	49.1	
Palana	Devonian	LAG2006			I	573700	5597300	xrf	5.54	16.2	3.2	1.60	4.15	3.05	8.79	1420.3	65.9	41.3	
Mt Chappell Island microgranite	Devonian	43908	R011158	JDC		579600	5542700	icpms	4.49	24.5	2.78	1.30	6.27	2.65	10.21	1151.4	99.7	35.9	
Prime Seal Island	Devonian	77/887		DJJ	S	564300	5565200	icpms	5.14	11.24	4.07	1.48	2.88	3.88	8.24	1318.3	45.7	52.6	
Prime Seal Island	Devonian	LAG1986		BWC	S	564200	5561200	xrf	4.62	18.0	6.6	1.33	4.61	6.29	12.23	1184.5	73.2	85.3	
Prime Seal Island	Devonian	LAG1987		BWC	S	566600	5567800	xrf	4.67	18.0	3.0	1.35	4.61	2.86	8.81	1197.3	73.2	38.8	
Prime Seal Island	Devonian	LAG2011		BWC	S	566000	5569200	xrf	5.24	13.0	3.4	1.51	3.33	3.24	8.08	1343.4	52.9	43.9	
Unicorn Point	Devonian	77/906		DJJ	I	567000	5539000	icpms	4.07	15.75	2.45	1.17	4.03	2.33	7.54	1044.5	64.1	31.6	
Unicorn Point	Devonian	LAG1958		BWC	I	572200	5535900	xrf	2.35	23.0	3.4	0.68	5.89	3.24	9.80	602.5	93.6	43.9	
Unicorn Point	Devonian	LAG1971		BWC	I	566700	5538800	xrf	4.02	17.0	4.6	1.16	4.35	4.38	9.89	1030.6	69.2	59.4	
Unicorn Point	Devonian	LAG1973		BWC	I	566700	5538800	xrf	4.02	18.6	2.8	1.16	4.76	2.67	8.59	1030.6	75.7	36.2	
Craggy Island	Devonian	LAG1996			S	558100	5606300	xrf	4.97	19.6	8.4	1.43	5.02	8.00	14.45	1274.2	79.8	108.5	
Craggy Island	Devonian	LAG2013			S	558100	5606300	xrf	4.97	7.6	4.6	1.43	1.95	4.38	7.76	1274.2	30.9	59.4	
Deal Island	Devonian	TAS049			S	530700	5630100	xrf	4.33	22.5	3.0	1.25	5.76	2.86	9.87	1110.1	91.6	38.8	
Deal Island	Devonian	TAS050			S	529400	5632900	xrf	5.21	15.8	14.4	1.50	4.04	13.71	19.26	1335.7	64.3	186.0	
Deal Island	Devonian	TAS051			S	530100	5631900	xrf	5.13	21.0	6.4	1.48	5.38	6.09	12.95	1315.2	85.4	82.7	
Deal Island	Devonian	TAS052			S	527000	5631500	xrf	5.08	13.2	5.2	1.47	3.38	4.95	9.80	1302.4	53.7	67.2	
Deal Island	Devonian	TAS053			S	524400	5633700	xrf	5.13	13.0	15.8	1.48	3.33	15.05	19.85	1315.2	52.9	204.1	
Deal Island	Devonian	TAS054			S	529800	5627900	xrf	5.11	13.8	9.6	1.47	3.53	9.14	14.15	1310.1	56.2	124.0	
Deal Island	Devonian	TAS055			S	524000	5631200	xrf	5.09	13.0	5.4	1.47	3.33	5.14	9.94	1305.0	52.9	69.8	
Northeast Island	Devonian	TAS056			S	532700	5633400	xrf	4.99	21.5	4.6	1.44	5.50	4.38	11.32	1279.3	87.5	59.4	
Southwest Island	Devonian	TAS048			S	511300	5625100	xrf	4.38	10.8	5.4	1.26	2.76	5.14	9.17	1122.9	43.9	69.8	
Hogan Island	Devonian	TAS045			S	499500	5658400	xrf	4.85	17.8	8.4	1.40	4.56	8.00	13.95	1243.4	72.4	108.5	

**Table 1.** Sample details, analytical data for K<sub>2</sub>O, Th and U, calculated heat production and calculated decay rates (both new data and previous data utilised in this report). cont.

Pluton	Age	Field No.	Tasrok No.	Collector	Type	mE AGD66	mN AGD66	method (Th, U)	K <sub>2</sub> O %	Th ppm	U ppm	Heat generation					Decay rates		
												K Jkg <sup>-1</sup>	Th Jkg <sup>-1</sup>	U Jkg <sup>-1</sup>	total Jkg <sup>-1</sup>	K kg <sup>-1</sup> s <sup>-1</sup>	Th kg <sup>-1</sup> s <sup>-1</sup>	U kg <sup>-1</sup> s <sup>-1</sup>	
Hogan Island	Devonian	TAS046			S	498700	5660300	xrf	4.58	17.2	6.0	1.32	4.40	5.71	11.44	1174.2	70.0	77.5	
Hogan Island	Devonian	TAS042			S	498000	5657300	xrf	4.05	23.0	2.8	1.17	5.89	2.67	9.72	1038.3	93.6	36.2	
Hogan Island	Devonian	TAS044			S	498000	5657300	xrf	4.47	19.0	2.6	1.29	4.86	2.48	8.63	1146.0	77.3	33.6	
Hogan Island	Devonian	TAS043			S	501800	5659200	xrf	4.77	19.8	3.6	1.38	5.07	3.43	9.87	1222.9	80.6	46.5	
Rodondo Island	Devonian	TAS041			S	447000	5657800	xrf	3.61	16.2	4.6	1.04	4.15	4.38	9.57	925.5	65.9	59.4	
Moncoeur Is	Devonian	TAS047			S	460000	5657500	xrf	4.65	20.5	5.6	1.34	5.25	5.33	11.92	1192.1	83.4	72.3	
(Bluebone-1 well)	Devonian	R004381	R004381	JLE	I	573010	5637730	icpms	2.27	14.3	2.79	0.66	3.66	2.66	6.97	582.5	58.2	36.0	

Table 2. Analytical data, calculated heat production and calculated decay rates, averaged by pluton.

Pluton	Age	No of analyses				Mean abundance				Mean heat generation				Mean decay rate			
		ICPMS		XRF		K <sub>2</sub> O	Th	U	ppm	K	Th	U	total	K	Th	U	
		INAA	N	%	ppm												Jkg <sup>-1</sup>
Cape Wickham	Proterozoic	5	5	5.04	21.4	6.8	1.4	1.4	6.0	5.4	13.41	1293	87	88			
Loorana	Proterozoic	1	14	4.80	23.8	7.2	1.4	6.1	6.1	6.9	14.34	1230	97	93			
Beulah	Cambrian	1	1	5.30	30.0	8.0	1.5	7.7	7.7	7.6	16.83	1359	122	103			
Mersey (Dove)	Cambrian	3	3	4.41	21.2	4.7	1.3	5.4	5.4	4.5	11.20	1131	86	61			
Forth (Dove)	Cambrian	1	1	5.14	45.0	4.4	1.5	11.5	11.5	4.2	17.19	1318	183	57			
Murchison	Cambrian	3	3	6.30	18.9	4.3	1.8	4.8	4.1	10.71	1614	77	55				
Darwin	Cambrian	3	3	4.46	44.0	5.4	1.3	11.3	11.3	5.1	17.69	1144	179	70			
Elliot Bay	Cambrian	1	2	4.81	27.9	5.9	1.4	7.1	7.1	5.6	14.16	1232	114	76			
Little Rocky R	Cambrian	1	1	5.98	54.8	17.9	1.7	14.0	14.0	17.1	32.81	1532	223	231			
SW Cape	Cambrian	1	1	4.74	8.7	3.0	1.4	2.2	2.2	2.8	6.43	1214	35	38			
The Mewstone	Cambrian	1	1	5.70	8.8	2.3	1.6	2.3	2.3	2.2	6.05	1462	36	29			
Sea Elephant	Carbonif.	2	2	3.78	19.5	3.4	1.1	5.0	5.0	3.2	9.32	968	79	44			
Bold Head	Carbonif.	2	2	4.01	35.0	9.8	1.2	9.0	9.0	9.3	19.45	1027	142	127			
Sandblow	Carbonif.	1	11	4.07	35.3	11.2	1.2	9.0	9.0	10.7	20.90	1043	143	145			
Currie porphyry	Carbonif.	1	1	2.04	16.0	4.5	0.6	4.1	4.1	4.3	8.97	523	65	58			
Three Hummock	Devonian	2	2	4.84	15.7	5.6	1.4	4.0	4.0	5.3	10.73	1240	64	72			
Penguin Islet	Devonian	1	1	4.69	5.5	6.1	1.4	1.4	1.4	5.8	8.56	1202	22	79			
Sandy Cape	Devonian	2	5	4.45	11.6	9.8	1.3	3.0	3.0	9.3	13.61	1140	47	127			
Interview	Devonian	2	3	4.86	23.1	5.9	1.4	5.9	5.9	5.6	12.92	1246	94	76			
Conical Rocks	Devonian	2	5	5.14	25.7	7.8	1.5	6.6	6.6	7.4	15.45	1317	105	100			
Housetop	Devonian	10	15	5.08	58.2	13.6	1.5	14.9	14.9	13.0	29.31	1302	237	176			
Dolcoath	Devonian	1	1	5.31	50.8	17.8	1.5	13.0	13.0	16.9	31.47	1361	207	230			
Birthday	Devonian	1	1	4.64	4.7	23.0	1.3	1.2	1.2	21.9	24.47	1190	19	298			
Granite Tor	Devonian	1	2	4.63	9.8	13.5	1.3	2.5	2.5	12.9	16.75	1188	40	175			
Bischoff porphyries	Devonian	2	2	1.65	13.3	6.2	0.5	3.4	3.4	5.9	9.82	424	54	80			
Wombat Flat	Devonian	2	5	4.55	28.6	9.0	1.3	7.3	7.3	8.6	17.21	1167	116	116			
Meredith	Devonian	2	6	5.14	26.3	10.9	1.5	6.7	6.7	10.4	18.59	1318	107	141			
Cleveland porphyry	Devonian	1	1	0.07	84.0	24.4	0.0	21.5	21.5	23.2	44.76	18	342	315			
Heemskirk White	Devonian	1	9	5.13	24.0	16.3	1.5	6.2	6.2	15.6	23.20	1315	98	211			
Heemskirk Red	Devonian	1	4	5.29	46.9	14.3	1.5	12.0	12.0	13.6	27.15	1357	191	185			
Pine Hill/Renison	Devonian	1	3	4.40	35.2	22.8	1.3	9.0	9.0	21.7	32.01	1128	143	295			
Grandfathers	Devonian	1	1	5.32	17.7	11.8	1.5	4.5	4.5	11.2	17.24	1363	72	152			
Cox Bight	Devonian	1	1	3.86	14.2	7.2	1.1	3.6	3.6	6.9	11.60	990	58	93			
Hippolyte Rocks	Devonian	1	1	5.05	22.3	6.1	1.5	5.7	5.7	5.8	12.96	1294	91	79			
Deep Glen Bay	Devonian	1	1	4.96	19.8	7.0	1.4	5.1	5.1	6.6	13.11	1271	80	90			
Maria Island (South)	Devonian	1	4	5.00	17.9	8.9	1.4	4.6	4.6	8.5	14.52	1281	73	115			
Maria Island (North)	Devonian	1	4	5.16	24.4	6.9	1.5	6.2	6.2	6.6	14.30	1324	99	89			
Ile des Phoques	Devonian	1	1	4.99	15.4	3.6	1.4	3.9	3.9	3.4	8.80	1280	62	46			
Schouten Island	Devonian	7	7	4.93	73.4	18.5	1.4	18.8	18.8	17.6	37.80	1264	299	238			
Freycinet	Devonian	5	6	5.25	50.3	15.1	1.5	12.9	12.9	14.4	28.79	1346	205	195			
The Hazards	Devonian	1	4	4.90	77.7	30.0	1.4	19.9	19.9	28.6	49.90	1257	316	388			
Coles Bay	Devonian	2	4	5.02	38.0	16.6	1.4	9.7	9.7	15.8	26.98	1287	155	214			
Bluestone Bay	Devonian	2	4	3.60	24.4	4.3	1.0	6.2	6.2	4.1	11.35	922	99	55			
Bicheno	Devonian	5	3	5.29	20.3	7.9	1.5	5.2	5.2	7.6	14.29	1355	83	103			
Royal George	Devonian	11	1	4.92	14.8	18.2	1.4	3.8	3.8	17.3	22.55	1262	60	235			
Henbury	Devonian	11	3	5.16	58.5	27.6	1.5	15.0	15.0	26.2	42.70	1322	238	356			

Table 2. Analytical data, calculated heat production and calculated decay rates, averaged by pluton. cont.

Pluton	Age	No. of analyses				Mean abundance				Mean heat generation				Mean decay rate			
		ICPMS	XRF	INAA	N	K <sub>2</sub> O	Th	U	ppm	Jkg <sup>-1</sup>	K	U	total	Jkg <sup>-1</sup> s <sup>-1</sup>	K	Th	U
Gipps Creek	Devonian	9			9	4.65	15.6	13.7	1.3	4.0	13.1	18.40	1193	64	177		
Lisle	Devonian	1			1	2.13	12.0	3.3	0.6	3.1	3.1	6.82	547	49	43		
Upper Blessington	Devonian	2			3	2.49	13.2	2.4	0.7	3.4	2.3	6.37	638	54	31		
Diddleum	Devonian	4	1		16	2.85	17.9	3.8	0.8	4.6	3.6	9.00	730	73	49		
Tulendeena	Devonian	2	5		7	3.03	16.8	4.5	0.9	4.3	4.3	9.43	777	68	58		
Porcupine Creek	Devonian	2			2	2.36	10.3	4.0	0.7	2.6	3.8	7.14	606	42	52		
Russells Road	Devonian	2	7		9	3.81	24.9	4.5	1.1	6.4	4.3	11.78	978	101	58		
Hogarth Road	Devonian	3	4		7	3.69	20.9	9.7	1.1	5.3	9.2	15.64	946	85	125		
Hogarth Road	Devonian	3	4		7	3.51	19.4	4.2	1.0	5.0	4.0	10.02	900	79	55		
Tombstone Creek	Devonian	3	2	excluding outlier	[6]	4.35	28.5	12.3	1.3	7.3	11.7	20.26	1114	116	159		
Mt-Stronach	Devonian	3	2		5	4.50	33.0	19.7	1.3	8.5	18.8	28.54	1154	134	255		
Long Point	Devonian	1	1		2	3.52	19.6	4.1	1.0	5.0	3.9	9.97	903	80	53		
Long Pt (Piccaninny Pt)	Devonian	1	1		2	3.54	19.6	5.2	1.0	5.0	5.0	11.02	908	80	67		
Piccaninny Creek	Devonian	1	1		2	3.77	15.5	4.3	1.1	4.0	4.1	9.18	966	63	56		
St Marys	Devonian	2	8		10	3.20	15.0	3.9	0.9	3.8	3.7	8.43	819	61	50		
Catos Creek	Devonian	2	1		3	3.40	16.1	4.2	1.0	4.1	4.0	9.09	872	65	54		
Scamander Tier	Devonian	1	4		5	3.53	19.4	4.1	1.0	5.0	3.9	9.84	904	79	52		
Hogans Road	Devonian	1			1	0.90	7.9	2.0	0.3	2.0	1.9	4.19	231	32	26		
Haleys New Country	Devonian	2			2	3.72	11.1	4.3	1.1	2.8	4.1	8.00	955	45	56		
George River	Devonian	2	1		3	3.69	19.3	4.2	1.1	4.9	4.0	10.00	946	78	54		
Akaroo	Devonian	2	1		3	3.53	9.9	3.6	1.0	2.5	3.5	7.01	906	40	47		
Grants Point	Devonian	1	1		2	2.45	10.5	1.9	0.7	2.7	1.8	5.20	627	43	25		
Medeas Cove	Devonian	1			1	4.80	29.6	16.6	1.4	7.6	15.8	24.74	1231	120	214		
Mt-Pearson (N)	Devonian	2	2		4	4.77	26.6	5.5	1.4	6.8	5.3	13.46	1224	108	72		
Mt-Pearson (S)	Devonian	2	2		4	4.67	26.3	7.3	1.3	6.7	6.9	15.02	1197	107	94		
Constable Ck	Devonian	1	1		1	4.96	29.0	22.0	1.4	7.4	21.0	29.81	1272	118	284		
Pyengana	Devonian	3	2		5	3.53	17.2	4.9	1.0	4.4	4.7	10.12	904	70	64		
Poimena	Devonian	6	21		27	4.42	19.2	6.6	1.3	4.9	6.3	12.50	1134	78	86		
Lottah	Devonian	7	27		34	4.36	11.7	14.6	1.3	3.0	13.9	18.12	1117	47	188		
Mt-Paris	Devonian	3	1		4	4.73	13.5	19.1	1.4	3.5	18.2	23.06	1211	55	247		
Mt Cameron	Devonian	1	2		3	4.93	24.2	21.0	1.4	6.2	20.0	27.65	1264	98	272		
Little Mount Horror	Devonian	1	4		5	4.85	15.0	14.5	1.4	3.8	13.8	19.01	1244	61	187		
Gardens	Devonian	5	4		9	3.48	16.3	4.1	1.0	4.2	3.9	9.12	891	66	54		
Gardens enclave	Devonian	1			1	2.21	9.0	6.0	0.6	2.3	5.7	8.64	566	37	77		
Sheoak Hill	Devonian	1			1	4.99	7.7	10.0	1.4	2.0	9.5	12.94	1278	31	129		
Vicarys Creek	Devonian	1	1		2	3.81	12.8	4.6	1.1	3.3	4.3	8.70	977	52	59		
Ansons Bay North	Devonian	2	3		5	4.60	15.2	4.6	1.3	3.9	4.4	9.63	1179	62	60		
Ansons Bay South	Devonian	3	1		4	4.52	19.7	3.0	1.3	5.0	2.9	9.21	1160	80	39		
Rushy Lagoon	Devonian	2			2	4.37	14.6	8.3	1.3	3.7	7.9	12.91	1120	60	107		
Mt William	Devonian	1	1		2	4.58	19.1	7.6	1.3	4.9	7.2	13.44	1174	78	98		
Eddystone Point	Devonian	1	1		2	4.59	19.2	3.1	1.3	4.9	2.9	9.16	1175	78	40		
Musselroe Point	Devonian	1	1		2	4.57	16.4	2.5	1.3	4.2	2.4	7.92	1173	67	33		
Boobyalla	Devonian	2	1		3	4.81	19.5	8.8	1.4	5.0	8.4	14.77	1232	79	114		
Clarke Island East	Devonian	1			1	6.06	12.8	2.4	1.7	3.3	2.3	7.30	1554	52	31		
Kent Bay	Devonian	2	4		6	3.48	14.1	3.9	1.0	3.6	3.7	8.29	893	57	50		
Key Bay	Devonian	2	5		7	5.02	27.0	9.3	1.4	6.9	8.9	17.26	1286	110	121		

Table 2. Analytical data, calculated heat production and calculated decay rates, averaged by pluton. cont.

Pluton	Age	No of analyses			Mean abundance			Mean heat generation			Mean decay rate			
		ICPMS	XRF	INAA	N	K <sub>2</sub> O	Th	U	ppm	Jkg <sup>-1</sup>	Th	U	total	K
Modder River	Devonian	1	4	5	4.52	17.0	6.5	1.3	4.3	6.2	11.81	1160	69	84
Corner	Devonian	1	4	5	3.63	14.7	5.3	1.0	3.8	5.0	9.85	932	60	68
Cape Sir John	Devonian	1	2	3	3.98	16.7	3.2	1.1	4.3	3.0	8.44	1021	68	41
Rooks River	Devonian	1	1	1	4.86	29.6	6.5	1.4	7.6	6.2	15.20	1245	120	84
Dover River	Devonian	1	1	2	4.58	20.8	7.6	1.3	5.3	7.3	13.89	1174	85	98
Mt Kerford	Devonian	4	6	10	4.96	17.3	5.2	1.4	4.4	5.0	10.84	1270	70	68
Hogans Hill	Devonian	2			4.66	9.8	8.6	1.3	2.5	8.2	12.02	1195	40	111
Thirsty Lagoons	Devonian	1			4.91	5.9	3.6	1.4	1.5	3.5	6.38	1258	24	47
Puncheon Point	Devonian	1	1	2	3.76	8.2	2.9	1.1	2.1	2.7	5.91	965	33	37
Long Toms Nose	Devonian	1	3	4	4.96	24.4	9.7	1.4	6.2	9.2	16.92	1272	99	125
Franklin Sound	Devonian	1	2	3	4.06	14.0	5.9	1.2	3.6	5.6	10.34	1041	57	76
Lady Barron	Devonian	1	3	4	3.84	6.7	4.7	1.1	1.7	4.4	7.25	986	27	60
Strzelecki	Devonian	2	6	8	4.47	14.3	6.0	1.3	3.7	5.7	10.69	1147	58	78
Martins Rise	Devonian	1	5	6	4.41	14.1	3.2	1.3	3.6	3.1	7.95	1131	57	42
Darling Range	Devonian	1	7	8	4.79	17.9	9.5	1.4	4.6	9.0	15.00	1227	73	123
The Dutchman	Devonian	3	3	3	4.41	14.3	5.9	1.3	3.7	5.7	10.57	1131	58	77
Babel Island	Devonian	2	3	5	4.90	12.0	5.8	1.4	3.1	5.6	10.05	1257	49	75
Patriarchs	Devonian	3	5	8	4.85	21.0	5.4	1.4	5.4	5.2	11.95	1243	85	70
Pats River	Devonian	1	4	5	2.90	16.5	2.5	0.8	4.2	2.4	7.44	744	67	32
Wybalenna	Devonian	3	11	14	3.68	18.4	4.7	1.1	4.7	4.4	10.21	944	75	60
Little Chalky Island	Devonian	2	2	4	3.57	15.5	2.7	1.0	4.0	2.6	7.58	916	63	35
Emita	Devonian	1	1	2	5.66	18.9	8.7	1.6	4.8	8.3	14.77	1451	77	112
Cape Frankland	Devonian	1	3	4	4.65	18.0	5.3	1.3	4.6	5.0	11.00	1192	73	68
Lughrata	Devonian	1	1	2	4.09	19.3	4.9	1.2	4.9	4.6	10.78	1048	79	63
Killiecrankie	Devonian	2	8	10	5.14	22.2	10.4	1.5	5.7	9.9	17.08	1317	90	134
Palana	Devonian	1	10	11	3.93	22.8	4.6	1.1	5.8	4.3	11.31	1006	93	59
Mt-Chappell Is	Devonian	1			4.49	24.5	2.8	1.3	6.3	2.6	10.21	1151	100	36
microgranite	Devonian	1	3	4	4.92	15.1	4.3	1.4	3.9	4.1	9.34	1261	61	55
Prime Seal Island	Devonian	1	3	4	3.62	18.6	3.3	1.0	4.8	3.2	8.96	927	76	43
Unicorn Point	Devonian	1	2	2	4.97	13.6	6.5	1.4	3.5	6.2	11.10	1274	55	84
Craggy Island	Devonian	7			5.01	16.0	8.5	1.4	4.1	8.1	13.69	1285	65	110
Deal Island	Devonian	1	1	1	4.99	21.5	4.6	1.4	5.5	4.4	11.32	1279	87	59
Northeast Island	Devonian	1	1	1	4.38	10.8	5.4	1.3	2.8	5.1	9.17	1123	44	70
Southwest Island	Devonian	5	5	5	4.54	19.4	4.7	1.3	5.0	4.5	10.72	1165	79	60
Hogan Island	Devonian	1	1	1	3.61	16.2	4.6	1.0	4.1	4.4	9.57	926	66	59
Rodondo Island	Devonian	1	1	1	4.65	20.5	5.6	1.3	5.2	5.3	11.92	1192	83	72
Moncoeur Is	Devonian	1			2.27	14.3	2.8	0.7	3.7	2.7	6.97	582	58	36
(Bluebone-1 well)	Devonian	1												

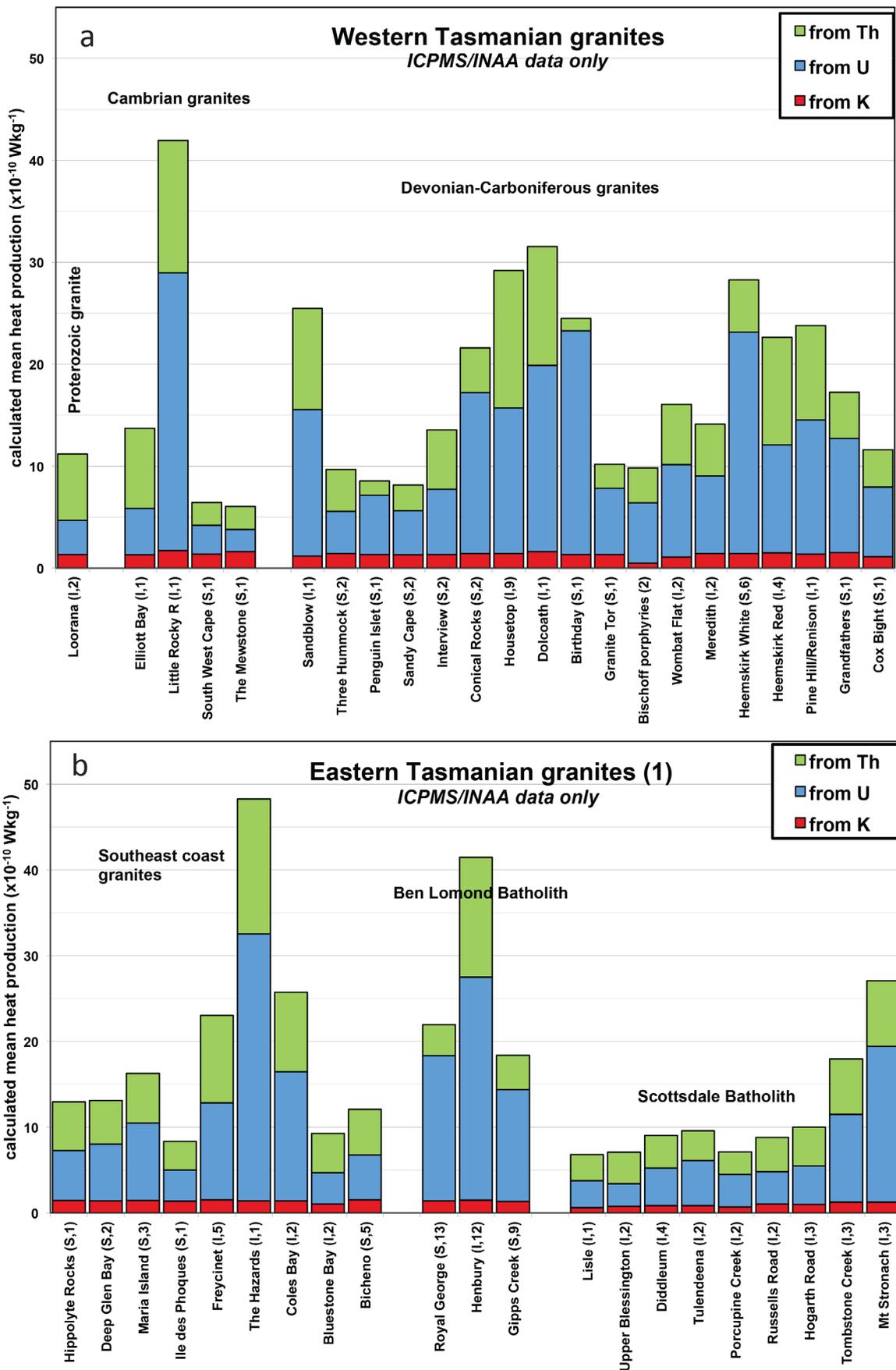
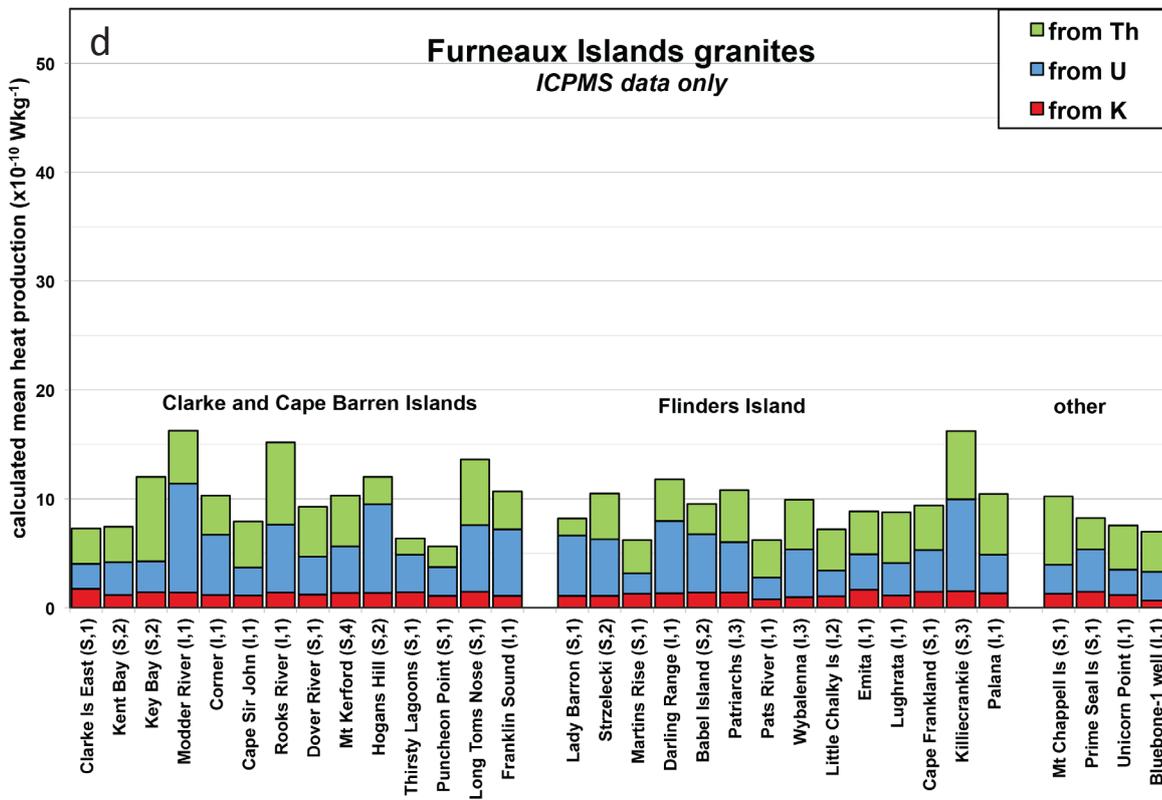
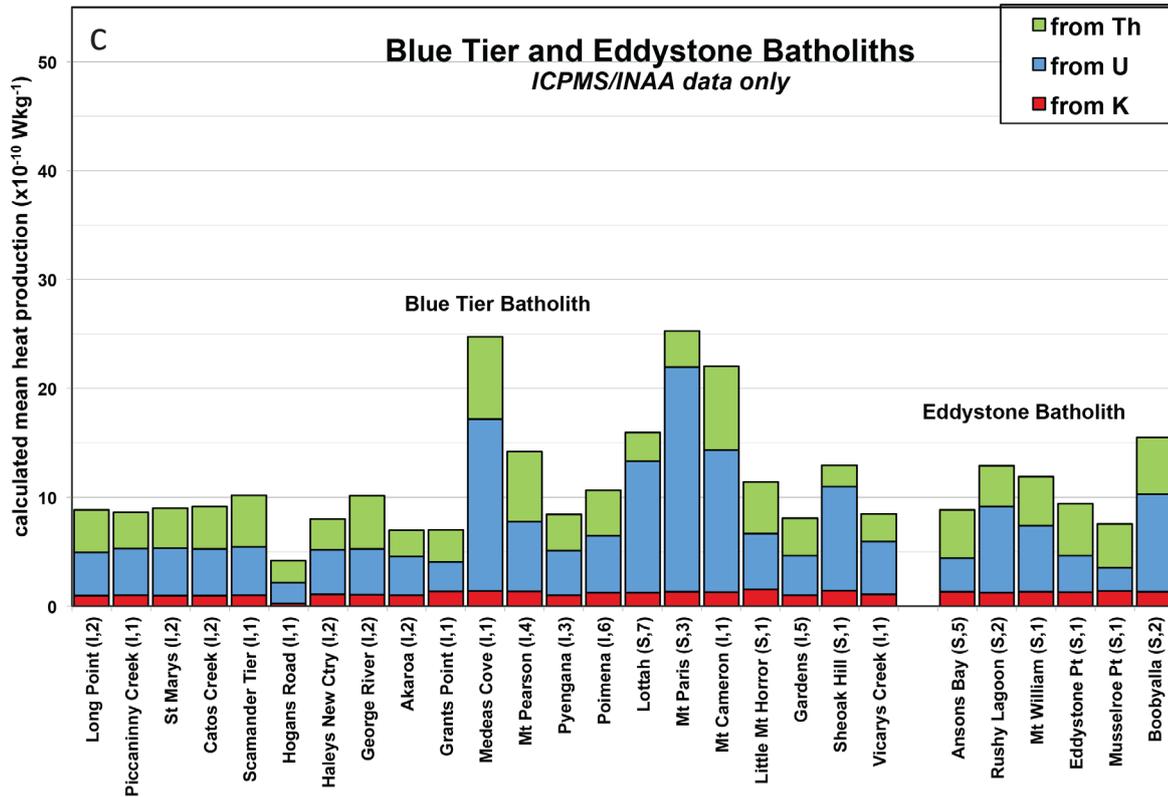


Figure 1. Calculated heat generation of Tasmanian granites, based on new ICPMS and previous INAA and ICPMS data, averaged by pluton. Characters after pluton names indicate granite type (I or S) and number of analyses averaged. (a) western Tasmanian granites; (b) eastern Tasmania: granites of the southeast coast and Ben Lomond and Scottsdale Batholiths; (c) eastern Tasmania: Blue Tier and Eddystone Batholiths; (d) granites of the Furneaux islands.



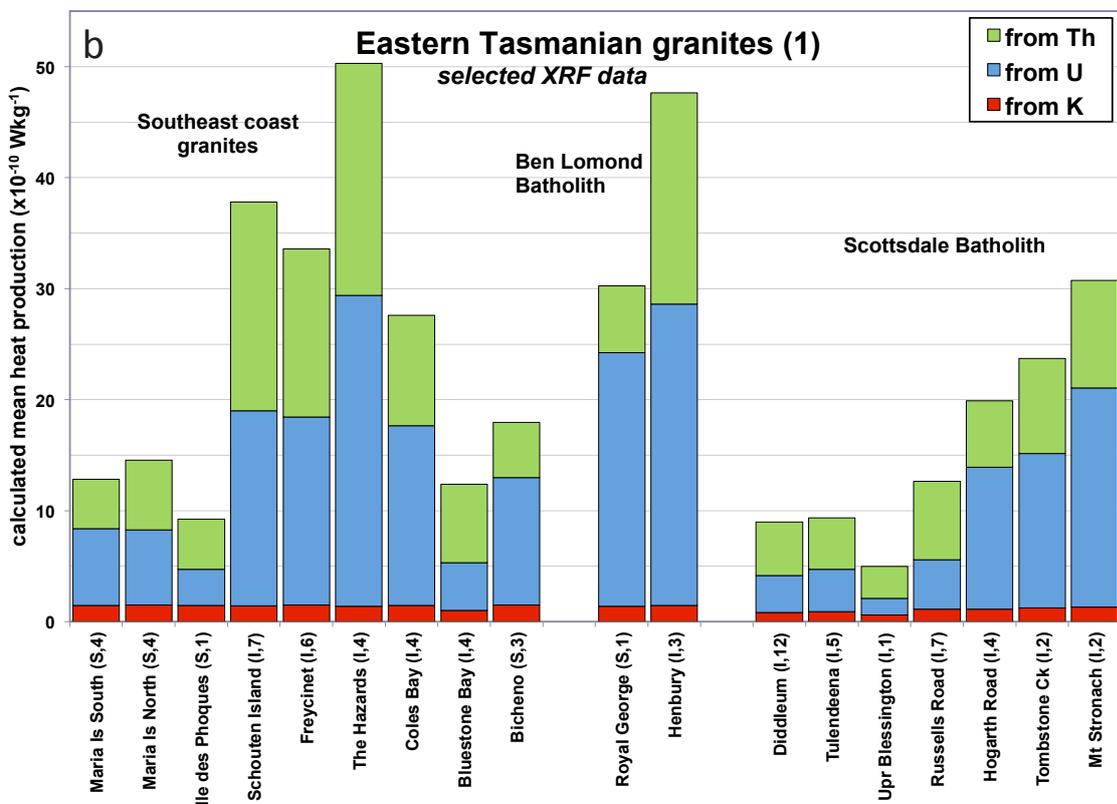
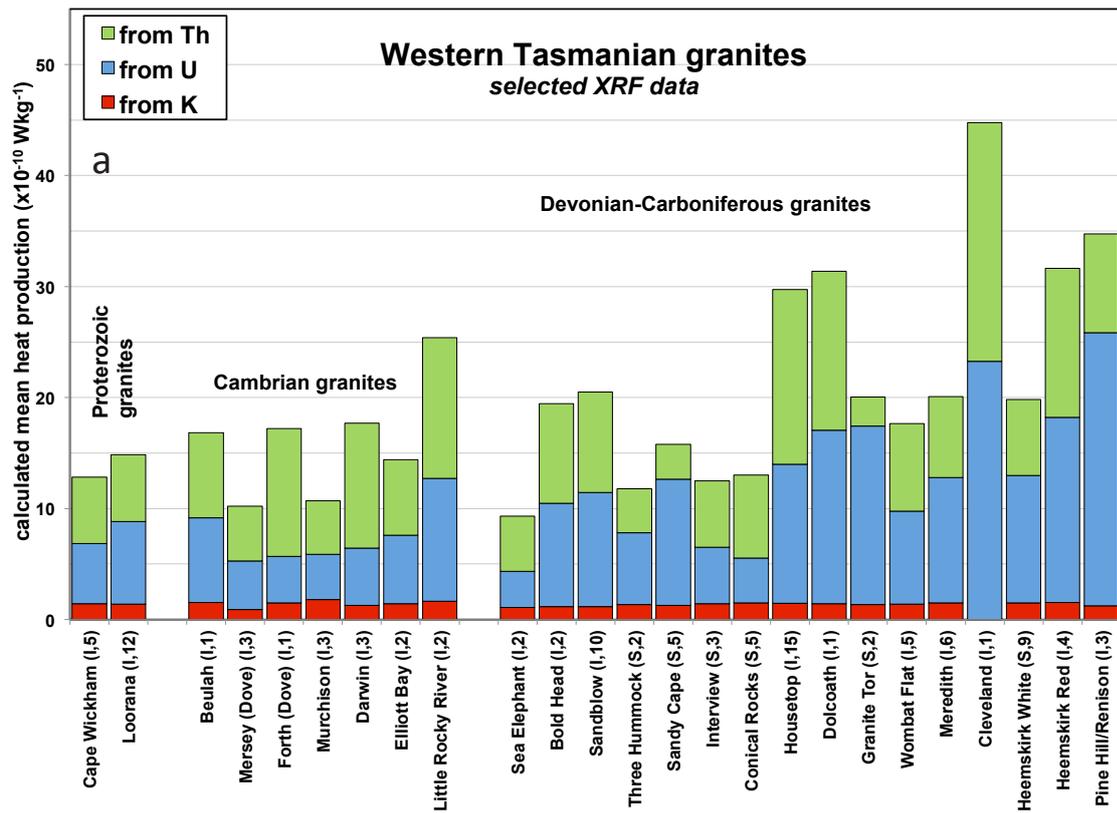
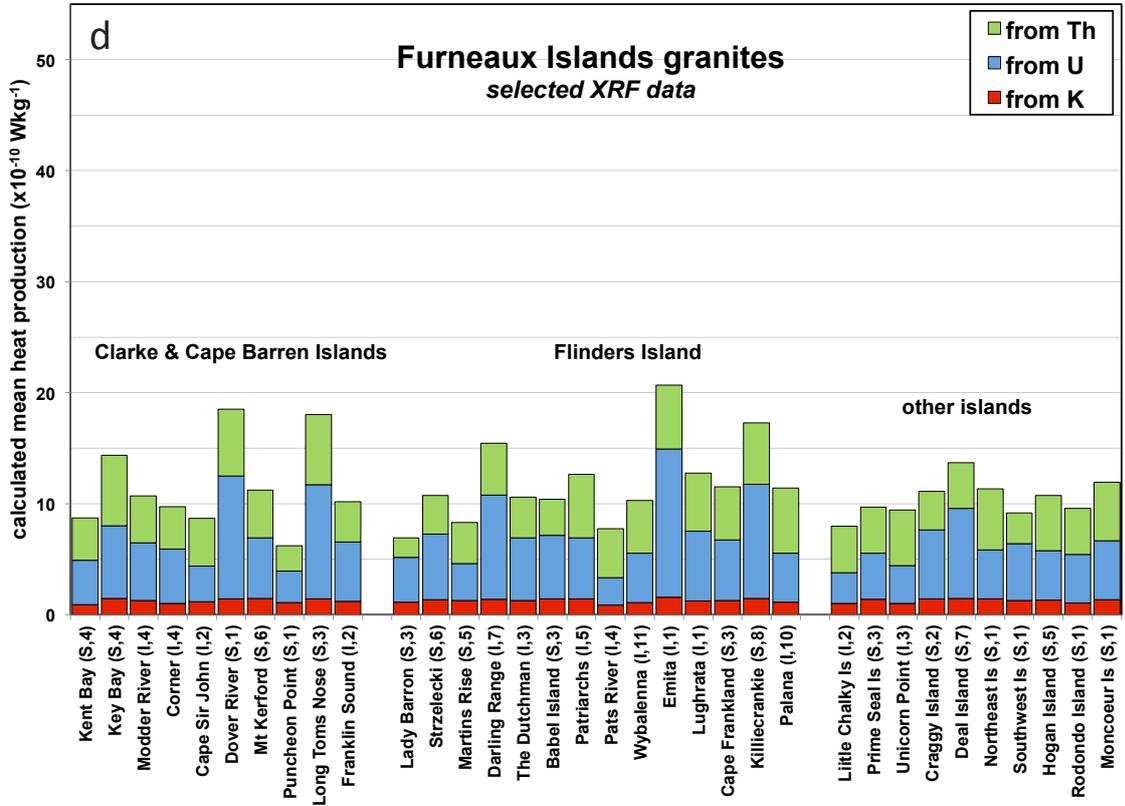
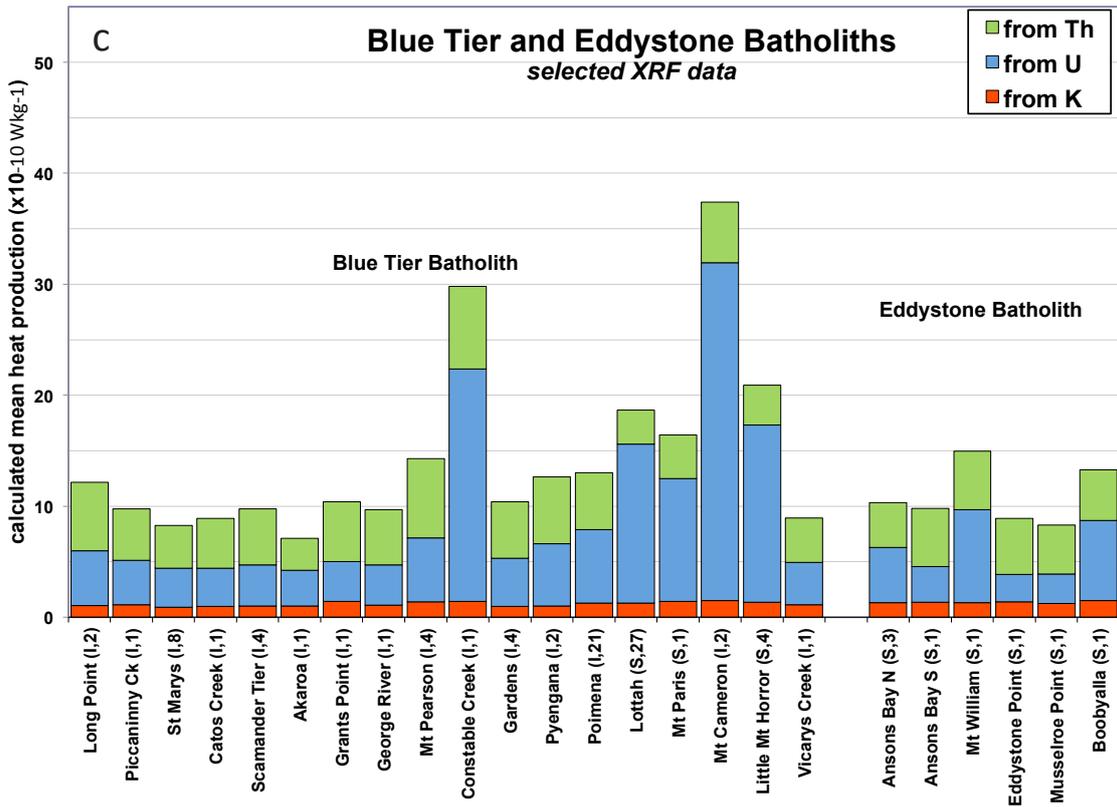


Figure 2. Calculated heat generation of Tasmanian granites, based on selected XRF data, averaged by pluton. (a) western Tasmanian granites; (b) eastern Tasmania: granites of the southeast coast and Ben Lomond and Scottsdale Batholiths; (c) eastern Tasmania: Blue Tier and Eddystone Batholiths; (d) granites of the Furneaux islands.



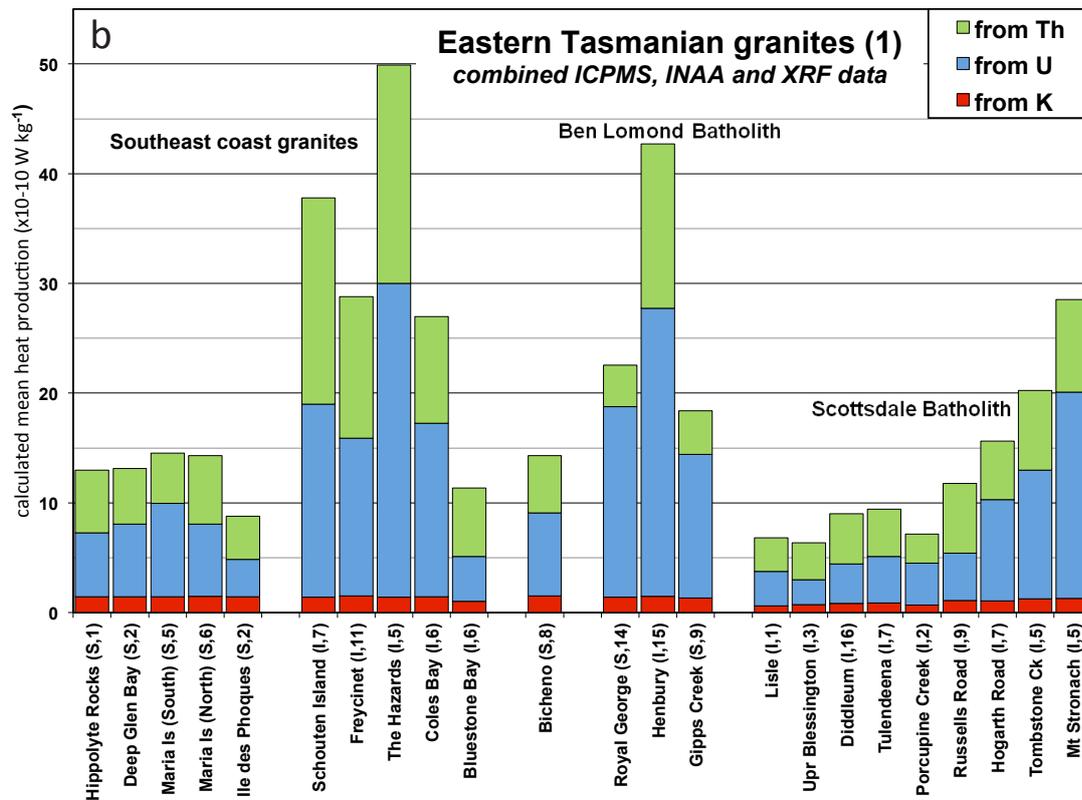
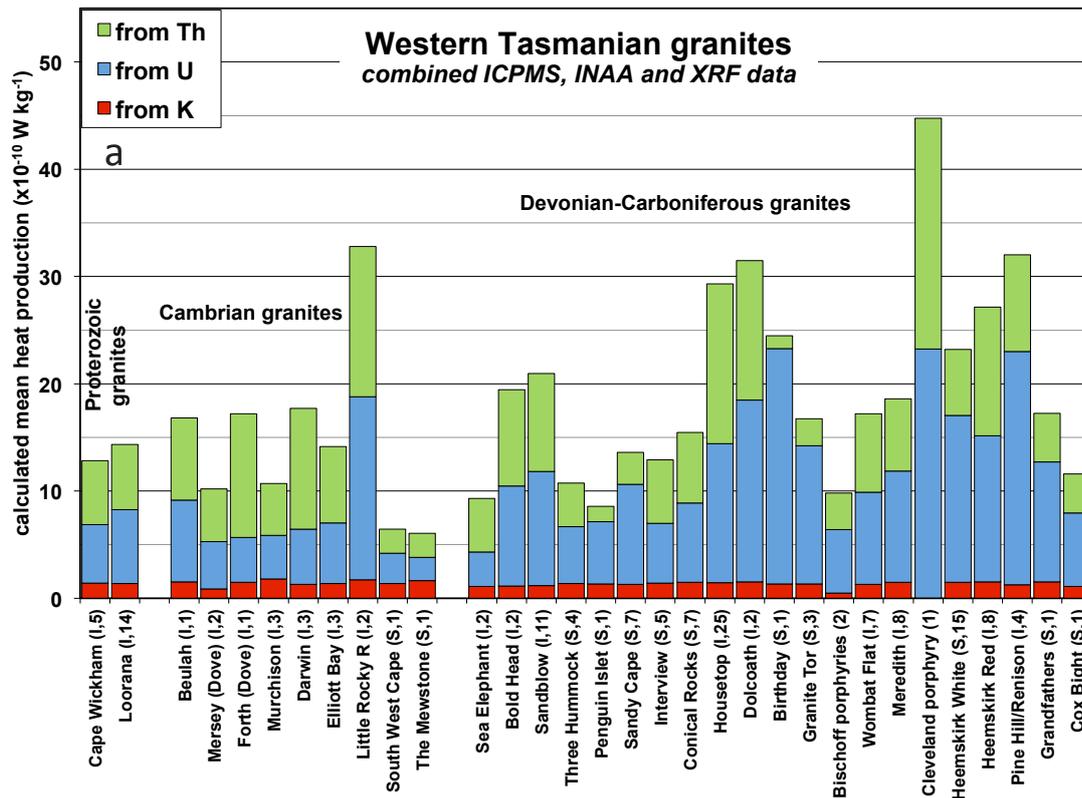


Figure 3. Calculated heat generation of Tasmanian granites, based on combined ICPMS, INAA and selected XRF data, averaged by pluton. (a) western Tasmanian granites; (b) eastern Tasmania: granites of the southeast coast and Ben Lomond and Scottsdale Batholiths; (c) eastern Tasmania: Blue Tier and Eddystone Batholiths; (d) granites of the Furneaux islands.

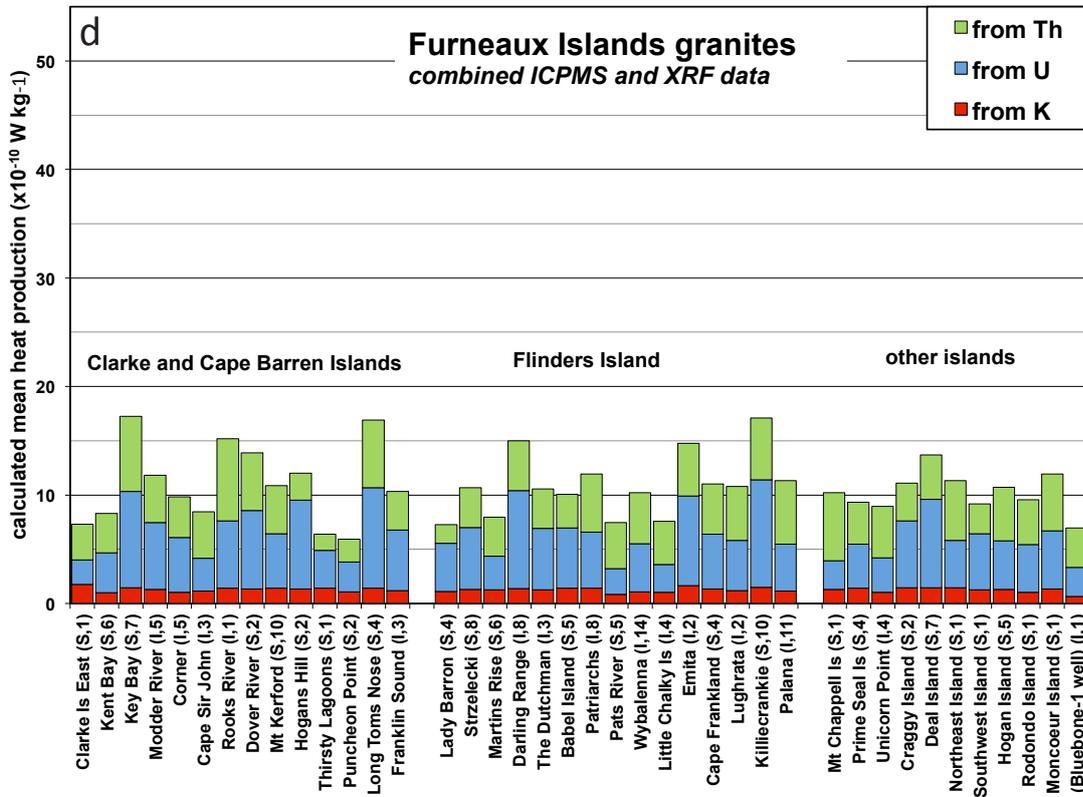
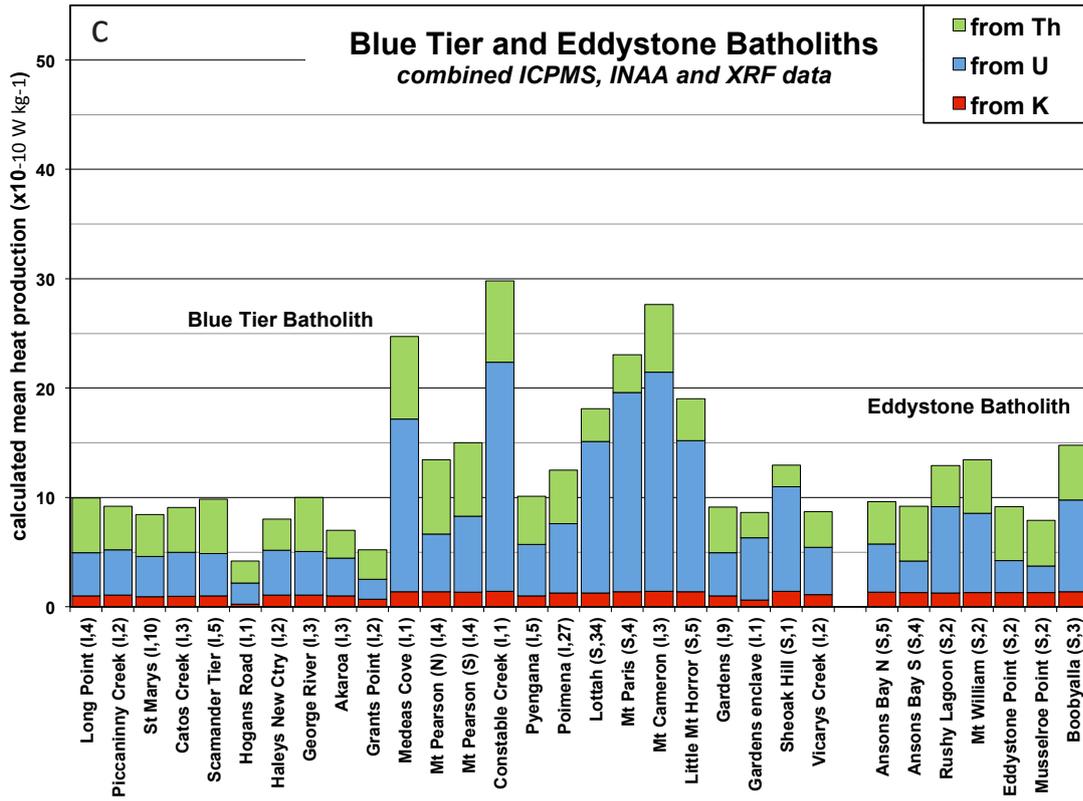


Table 3. Correlation coefficients between analytical and radiometric data

		N	r <sup>2</sup>	r	
K <sub>2</sub> O vs K <sub>rad</sub>	all NE analyses	261	0.0931	0.3051	
	pluton averages	all	51	0.1182	0.3438
	pluton averages	n>2 only	33	0.0968	0.3111
Th vs Th <sub>rad</sub>	all NE analyses	261	0.4706	0.6860	
	pluton averages	all	51	0.4966	0.7047
	pluton averages	n>2 only	33	0.5499	0.7416
U vs U <sub>rad</sub>	all NE analyses	261	0.3171	0.5631	
	pluton averages	all	51	0.6827	0.8263
	pluton averages	n>2 only	33	0.6259	0.7911
U/K <sub>2</sub> O vs U/K <sub>rad</sub>	all NE analyses	258	0.0576	0.2400*	
	pluton averages	all	51	0.1676	0.4094
	pluton averages	n>2 only	33	0.2578	0.5077
Th/K <sub>2</sub> O vs Th/K <sub>rad</sub>	all NE analyses	258	0.0318	0.1782*	
	pluton averages	all	51	0.0014	0.0375
	pluton averages	n>2 only	33	0.0070	0.0839
U/Th <sub>rad</sub> vs U/Th	all NE analyses	261	0.0421	0.2052	
	pluton averages	all	51	0.3161	0.5622
	pluton averages	n>2 only	33	0.3519	0.5932

\* excludes three samples with very low K<sub>rad</sub>

metamict grains). There is some evidence for this in the presence of secondary uranium minerals associated with Tasmanian granites, such as torbernite at Royal George and near Rossarden, and metatorbernite at Lottah (Bottrill and Baker 2009).

Little systematic work has been done to determine which minerals bear Th and U in Tasmanian granites. However, Bea (1996) quantitatively determined the mineralogical residence sites of Th and U (together with REE and Y) in a diverse group of Iberian, Italian and Russian granites, and his broad conclusions are probably generally applicable. He found that, in S-types, Th is mostly borne by monazite and, to a lesser degree, thorite, whereas in some I-types, allanite and amphibole may also contain a significant proportion of the whole-rock thorium. The main uranium-bearing minerals are zircon and monazite, together with xenotime in some S-types and allanite in some I-types; accessory minerals with essential uranium such as uraninite and huttonite are usually of only subordinate importance.

Sawka and Chappell (1986), in considering the behaviour of radioactive elements in Lachlan Fold Belt granites, noted a general increase of both Th and U as the granites became more felsic (i.e. a broad positive

correlation with SiO<sub>2</sub>). With the implicit assumption that granites become more felsic as they rise and fractionate in the crust, they suggested that in terranes dominated by I-type granites, Th and U and therefore heat generation decrease with depth, whereas in S-type terranes no significant change in heat generation with depth is expected.

In southeastern Australia, a north-south trending "I-S" line can be identified, east of which the crust is relatively thin and the granites are entirely I-type; to the west, both I- and S-types are present and the crust is thicker (White et al. 1976; White & Chappell 1983). This led Sawka and Chappell (1986) to suggest that anomalously high heat flow in southeastern Australia, which corresponds to areas of S-type granites, is due to deep crustal radioactivity rather than Cainozoic volcanism. In Tasmania, however, there is no simple spatial pattern to the distribution of I- and S-granites, and no continuation of the I-S-line can be defined. Furthermore, Tasmanian S-types are generally fractionated granites, and no relatively mafic S-types, comparable for example to the Bullenbalong Supersuite of the Lachlan Fold Belt, are known.

# Calculated heat generation

## General

The data show that the principal contributions to radiogenic heat from granites are made by the decay of thorium and uranium, whereas potassium typically accounts for about 10% of the total heat generation (Figs 1, 2, 3). Furthermore, Th (3.7–82 ppm) and U (1.25–84 ppm) contents range between samples by more than an order of magnitude, accounting for most variation in calculated heat generation, both within and between plutons, whereas the range of K<sub>2</sub>O (mostly 2–6 %) is of comparatively minor importance.

## Proterozoic (Cryogenian) granites (Figs 1a, 2a, 3a)

On King Island, both the Cape Wickham Granite (mean  $13.4 \times 10^{-10}$  W/kg) and the similar but less felsic Loorana Granite (mean  $14.3 \times 10^{-10}$  W/kg) are moderately low heat generators, with values calculated for individual analyses ranging from  $9.1$  to  $21.5 \times 10^{-10}$  W/kg. The data are mainly by XRF. The INAA and ICPMS analyses from the Loorana Granite are broadly consistent although there is a significant difference in uranium content between the two samples.

## Cambrian granites (Figs 1a, 2a, 3a)

The limited data, mostly by XRF, available for western Tasmanian Cambrian granites mostly suggest moderately low heat generation (pluton means  $10.2$ – $17.7 \times 10^{-10}$  W/kg). However, the two samples from the Little Rocky River Granite, east of Elliott Bay, have higher Th and U contents, and higher calculated heat generation ( $29.6$  and  $42.1 \times 10^{-10}$  W/kg). In southwest Tasmania, the S-type Southwest Cape Granite has lower uranium and especially Th contents, and is a very low heat generator ( $6.4 \times 10^{-10}$  W/kg). The isolated Mewstone Granite, which is now known to be Cambrian (S. Meffre, pers. comm.), appears similar ( $6.1 \times 10^{-10}$  W/kg).

## Western Tasmanian Devonian granites (Figs 1a, 2a, 3a)

The highest calculated heat generation ( $44.8 \times 10^{-10}$  W/kg) of these granites is from a single sample of the Cleveland porphyry, a relatively small and altered intrusion beneath the Cleveland Sn-Cu deposit at Luina. This is due to its high content of both uranium and thorium, and despite negligible potassium. It is doubtful, however, whether this value can be extrapolated and applied to any significant volume of rock.

The “hottest” of the major western Tasmanian plutons is the fractionated I-type Husetop Granite (mean  $29.3 \times 10^{-10}$  W/kg from 25 analyses), with individual samples ranging from  $17.8$  to  $42.6 \times 10^{-10}$  W/kg. A slightly higher value ( $31.5 \times 10^{-10}$  W/kg) is calculated for the small, petrologically similar Dolcoath Granite, which has also been assigned to the Husetop Suite. More data are desirable from this body, as the mean is based on only two, albeit very similar, analyses.

Another small body, the Renison-Pine Hill Granite, yields a similar high mean ( $32.0 \times 10^{-10}$  W/kg from four analyses). Like the Cleveland porphyry, this granite is variably and locally intensely altered, and limited confidence can be placed on this value without further data.

Moderate to high mean values are also calculated from both the Heemskirk Red Granite ( $27.2 \times 10^{-10}$  W/kg) and the Heemskirk White Granite ( $23.2 \times 10^{-10}$  W/kg), which being an S-type, has somewhat lower thorium. A single sample of the small S-type Birthday Granite, also yields a moderately high value ( $24.5 \times 10^{-10}$  W/kg), almost entirely because of its uranium content.

Lower values are calculated for other S-types, particularly the more peraluminous members of the Sandy Cape Suite (e.g. Sandy Cape, Interview and Three Hummock Island granites) which generate less than  $15 \times 10^{-10}$  W/kg.

The largest exposed pluton in western Tasmania, the Meredith Granite, appears not to be a particularly “hot” granite (mean  $18.6 \times 10^{-10}$  W/kg from eight analyses).

It is important to note that the unroofing of Devonian granites is less advanced in western Tasmania than in the east, and gravity data indicate that some of the smaller “plutons” mentioned above represent local unroofing of much larger subsurface bodies. In particular, a large granite ridge extends ENE from the Heemskirk Granite, through the Pine Hill and Granite Tor granite to the Birthday Granite. The relatively small Dolcoath Granite is also probably the exposed portion of a much larger body. Relatively shallow but unexposed granites are probably present in the Norfolk Range area and in much of southwest Tasmania (Leaman & Richardson 2003). Some of the small exposures, such as the Pine Hill, Birthday and Dolcoath granites, may be more significant than their size suggests, and there may be potential for geothermal energy resources in the deeper parts of the inferred subsurface bodies.

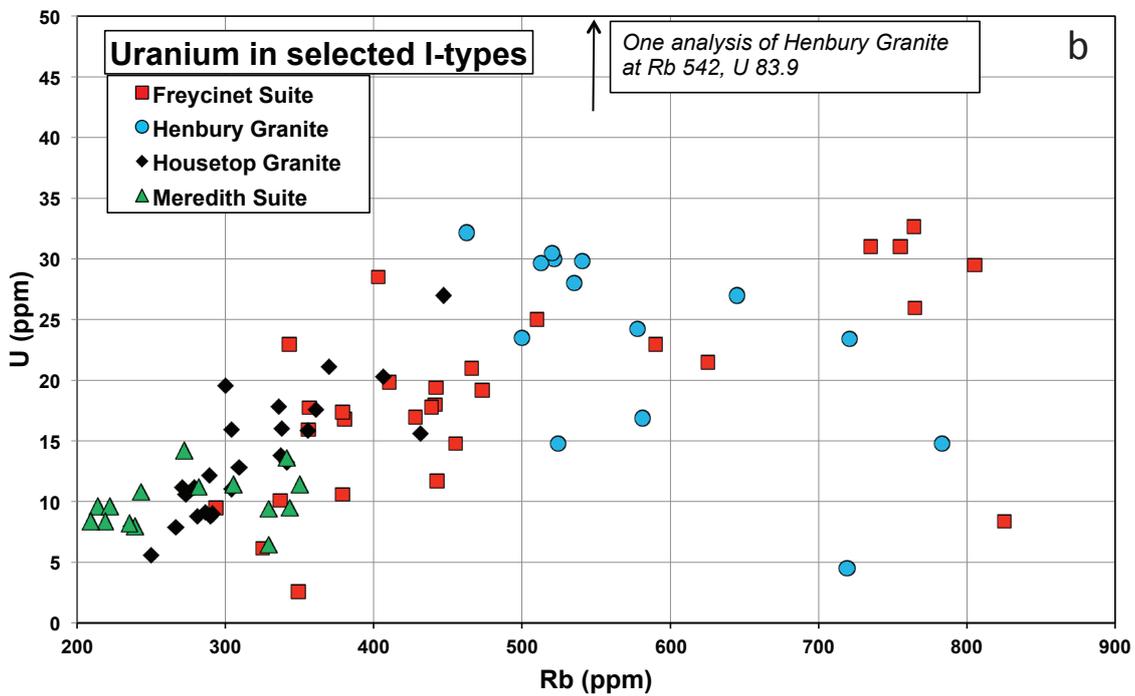
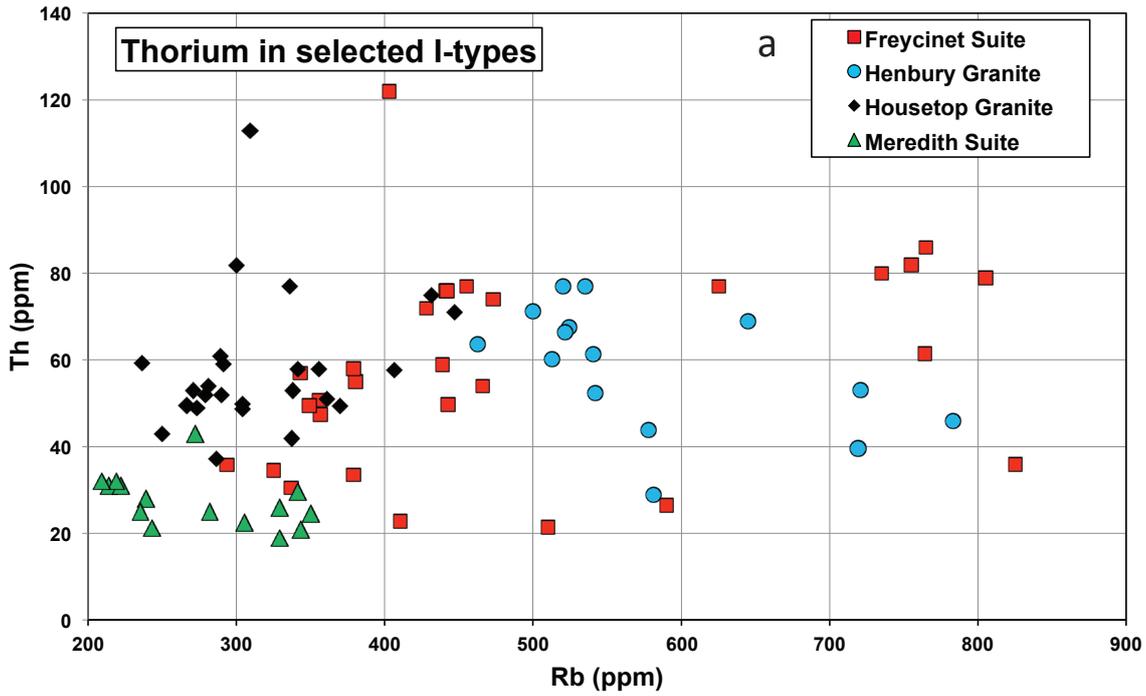
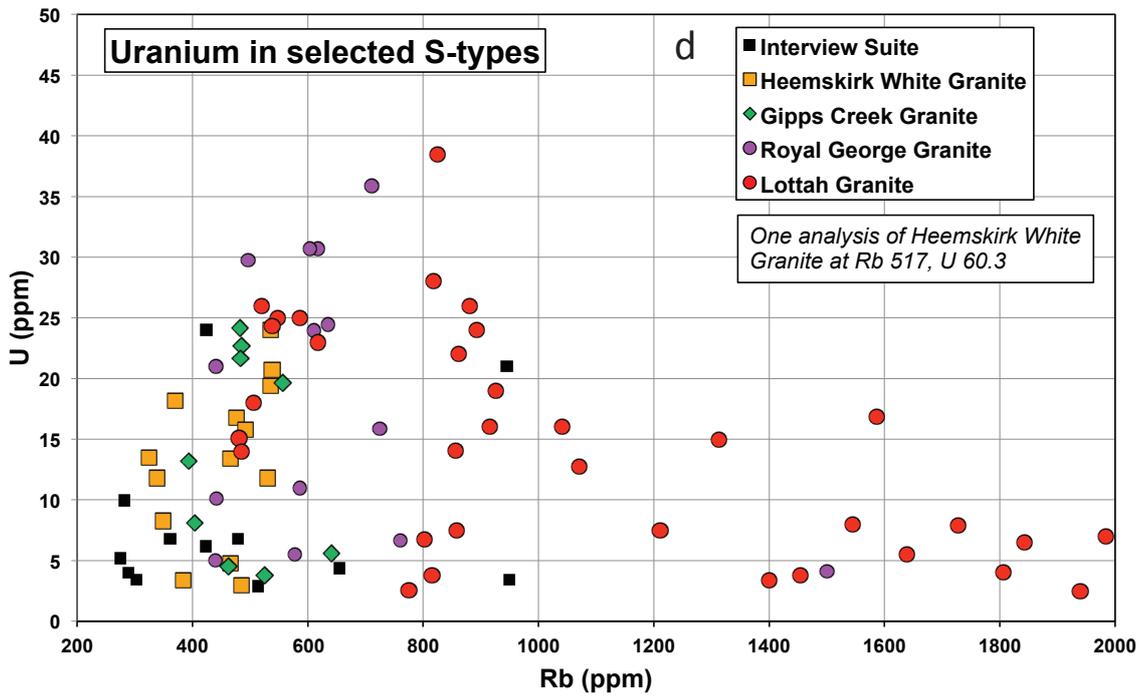
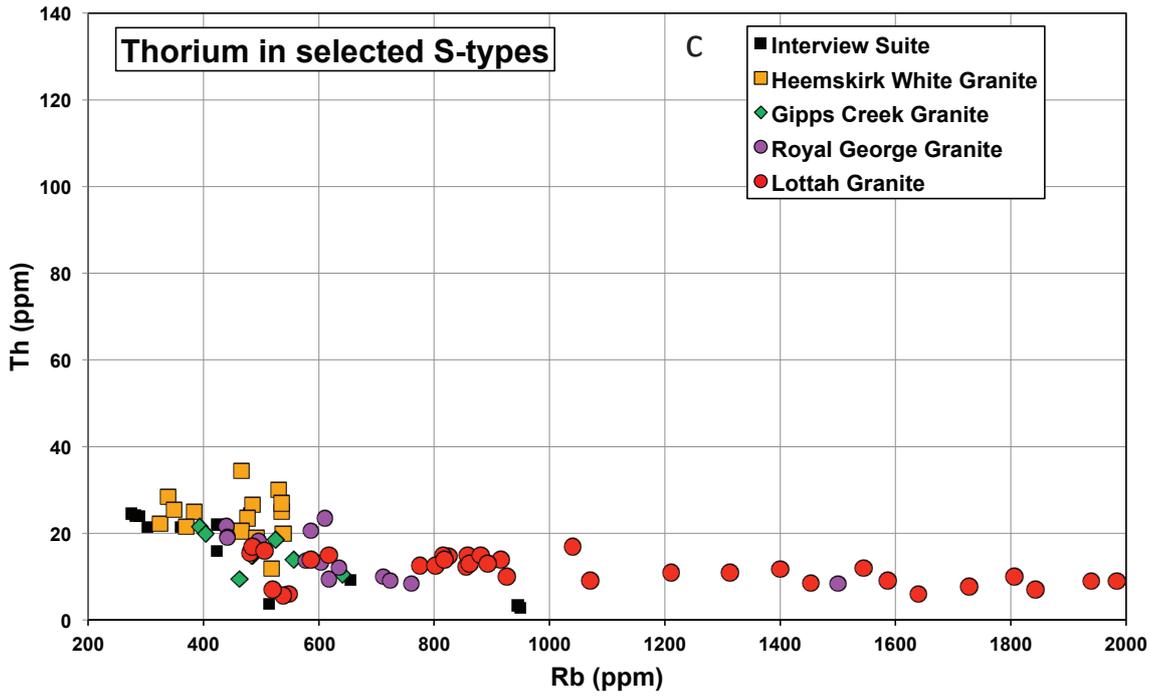


Figure 4. Plots of (a) Th versus Rb and (b) U versus Rb for selected I-type granite suites; (c) Th versus Rb and (d) U versus Rb for selected S-type granite suites.



The Sandblow and Bold Head granites of eastern King Island are moderate heat producers ( $\sim 20 \times 10^{-10}$  W/kg), even though they are unfractionated I-types, whereas two analyses from nearby and petrologically similar Sea Elephant Granite yield a much lower mean ( $9.3 \times 10^{-10}$  W/kg).

### *Eastern Tasmania: Ben Lomond Batholith (Figs 1b, 2b, 3b)*

The granites of the Rossarden area, traditionally termed the “Ben Lomond granite,” and the Royal George Granite are similar, highly felsic, strongly fractionated alkali feldspar granites that together seem to constitute a small batholith. The “Ben Lomond granite” can be subdivided into the S-type Gipps Creek Granite and I-type Henbury Granite, mainly on trace element criteria, whereas the Royal George Granite appears to be entirely S-type. All bodies have high to very high average heat generation because of their generally high uranium content, although there is a great deal of variation between individual samples. The Henbury Granite has higher average U and also consistently higher Th, and its mean heat generation of  $42.7 \times 10^{-10}$  W/kg, based on 15 samples, is one of the highest of any Tasmanian granite. Sample FA230, collected from near Aberfoyle Farm, has the highest calculated heat generation ( $94.8 \times 10^{-10}$  W/kg) of any individual sample in Tasmania. Goh (2008) also noted the high heat generation of granites from this batholith. It should be noted, however, that her drillcore samples of the “Gipps Creek (S)” granite, are actually from the Henbury Granite, an I-type. This is apparent both from their location, from drill holes near Storeys Creek, and their chemistry (e.g. REE patterns and Th contents).

### *Scottsdale Batholith (Figs 1b, 2b, 3b)*

This batholith comprises eight I-type plutons, progressively intruded in an asymmetric, crudely concentric pattern. The early Diddleum, Tulendeena and Porcupine Creek granodiorites are chemically similar and consistently low heat generators (pluton averages  $7.1$  to  $9.1 \times 10^{-10}$  W/kg); the slightly younger Upper Blessington Granodiorite is even lower ( $6.4 \times 10^{-10}$  W/kg). A single sample of the Lisle Granodiorite, which comprises a series of small outcrops to the west of the batholith, gives a similar value ( $6.8 \times 10^{-10}$  W/kg). Later plutons are successively more fractionated and felsic and, although data from each pluton are quite scattered, the mean content of the radioactive elements progressively increases. Consequently calculated heat generation increases from the unfractionated Russells

Road Granite (mean  $11.8 \times 10^{-10}$  W/kg), through the weakly fractionated Tombstone Creek Granite (mean  $20.3 \times 10^{-10}$  W/kg) to the strongly fractionated Mt Stronach Granite ( $28.5 \times 10^{-10}$  W/kg). Most of this increase is due to higher U, with Th and K playing a subordinate role.

The Hogarth Road Granite is a generally unfractionated body chemically similar but finer-grained than the Russells Road Granite. Its mean heat generation ( $15.6 \times 10^{-10}$  W/kg) is affected by a fractionated and very felsic sample (TB81), from the Chappell database, with anomalously high U. If this sample is excluded, the six remaining samples give a mean of  $10.0 \times 10^{-10}$  W/kg, comparable to the Russells Road Granite.

### *Blue Tier Batholith (Figs 1c, 2c, 3c)*

The components and sequence of intrusion of the large Blue Tier Batholith are similar to, but more complex than, that of the Scottsdale Batholith. In general, early I-type granodiorites were followed by more felsic I-types, and then strongly fractionated granites, both I- and S-type (Black et al. 2005). In the St Helens area, granodiorites of the Scamander Tier Suite (including the Catos Creek Granodiorite and St Marys Porphyry) intruded after members of the Gardens Suite and the more felsic Mt Pearson Granite (McClenaghan et al. 1992).

As for the Scottsdale Batholith, the “hottest” granites in this batholith are also felsic, strongly fractionated granites, principally because of their high U content.

The highest value ( $\sim 30 \times 10^{-10}$  W/kg) is from the single analysed sample of the Constable Creek Granite, a fine-grained marginal phase of the Mt Pearson Granite (Groves 1977; McClenaghan et al. 1992). The poorly defined Mt Cameron Granite (mean  $27.8 \times 10^{-10}$  W/kg, three analyses) near Gladstone and the small Medeas Cove Granite near St Helens ( $24.7 \times 10^{-10}$  W/kg from a single sample) also yield high values, but clearly more data are desirable. These are small I-type bodies.

The larger strongly fractionated S-type Lottah, Mt Paris and Little Mt Horror granites yield moderately high mean heat generation values ( $19$  to  $23.1 \times 10^{-10}$  W/kg). However, the large (34) number of analyses from the Lottah Granite shows an extreme range ( $\sim 6$  to  $41 \times 10^{-10}$  W/kg), principally to variations in their U content ( $2.5$  to  $38.5$  ppm). In the Lottah Granite, uranium appears to vary erratically and does not correlate with degree

of fractionation (quantified by, for example Rb content, 480 to 2340 ppm), unlike Th (17 to 6 ppm) which correlates negatively with Rb. It is possible, therefore, that the more limited datasets from the Mt Paris Granite (4 adequate samples) and Little Mt Horror Granite (5 samples) are not representative of these plutons.

The felsic but unfractionated or weakly fractionated Poimena and Mt Pearson granites, which are now regarded as I-types, yield low to moderate mean heat generation values ( $12.5$  to  $15 \times 10^{-10}$  W/kg). The sole sample of the Sheoak Hill Granite, which is probably an S-type, yields a similar value ( $12.9 \times 10^{-10}$  W/kg). Relatively limited data from the Akaroa Granodiorite, Grants Point Granite and Haleys New Country Granite, which are relatively felsic but unfractionated I-types, suggest low heat generation ( $\sim 5$  to  $8 \times 10^{-10}$  W/kg). Members of the both the Gardens Suite and Scamander Tier Suite, and other relatively mafic I-type hornblende-bearing granodiorites such as the Long Point/Piccaninny Point and Vicarys Creek bodies, are also low in calculated heat generation, with mean values of  $\sim 8$  to  $10 \times 10^{-10}$  W/kg.

### *Eddystone Batholith (Figs 1c, 2c, 3c)*

This batholith consists almost entirely of felsic S-type granites. The major pluton, the Ansons Bay Granite, has tentatively been subdivided by Chappell et al. (1991) into a mostly unfractionated southern section and a more fractionated northern part. Considered separately or together, they have low calculated heat generation (mean  $9.4 \times 10^{-10}$  W/kg), not much higher than the I-type granodiorites of the Blue Tier Batholith. The small, petrographically distinct, bodies at Musselroe Point and Eddystone Point yield similar values.

On the basis of two analyses from each, the Boobyalla Granite ( $14.8 \times 10^{-10}$  W/kg) and more strongly fractionated Mt William Granite ( $13.4 \times 10^{-10}$  W/kg) have slightly higher heat generation due to their higher U content, although more data are desirable.

The Rushy Lagoon Granite (including the Musselroe Granite of Groves et al. 1977) is a poorly defined coarse-grained body. It chemically and petrographically resembles the Ansons Bay Granite, and was mapped as the same unit by Baillie (1984). The inferred pluton is prominent on images derived from airborne radiometric data, with high total counts and a particularly prominent thorium signature, yet neither is apparent in the two analyses of sufficient quality available. Interrogation of

the radiometric data shows that the Ansons Bay Granite's distinctive bluish-green hue in the ternary image is in fact due primarily to unusually attenuated K response, rather than high Th. Spatially averaged radiometric Th/K ratios range as high as 25; typical values for Tasmanian granitoid responses are half that or less. Sample EA9, from the east of the body, is an unfractionated granite with low calculated heat generation ( $7.7 \times 10^{-10}$  W/kg) whereas the more fractionated sample from Musselroe DDH1A has higher K, Th and especially U and yields  $18.1 \times 10^{-10}$  W/kg. Clearly further analytical work, and possibly further sampling, are required to calculate its mean heat generation and assess its relationship with the Ansons Bay Granite.

### *Granites of the Furneaux islands (Figs 1d, 2d, 3d)*

Most of this region has been geologically mapped at only reconnaissance level. Good quality Th and U data for the granites are mainly from the Chappell XRF database, and for most plutons only a few samples were available for further analyses by ICPMS. The classification and status of some granite bodies, particularly from the outlying islands, is doubtful.

Calculated heat generation, averaged by pluton, is generally low to moderate in this region. Probably the "hottest" body is the Killiecrankie Granite (mean  $17.1 \times 10^{-10}$  W/kg), a fractionated S-type. The Key Bay Granite of western Cape Barren Island and Clarke Island, yields a slightly high mean ( $17.3 \times 10^{-10}$  W/kg), but the seven analyses vary widely, particularly in U content. Other moderately high mean values are from the Long Toms Nose (or Vansittart Island) Granite ( $16.9 \times 10^{-10}$  W/kg), the Darling Range Granite of central Flinders Island ( $15.0 \times 10^{-10}$  W/kg) and the sole analysis from the Rooks River Granite from Cape Barren Island. A few individual samples from other plutons yield moderately high values. Data from the Dover River Granite and the small Emita Granite (two samples each) are divergent and further sampling is desirable from these and other bodies. The correlation between high heat generation and strong fractionation is less clear than on mainland Tasmania, but unfractionated I-type granodiorites (e.g. Pats River, Wybalenna, Little Chalky Island, Unicorn Point) and unfractionated S-type granites (e.g. Lady Barron, Puncheon Point) are low heat generators.

## Granites of the southeast and central east coast (Figs 1b, 2b, 3b)

A series of diverse granite bodies extends for 150 km southward of Bicheno, roughly parallel to the east coast. Much of the granite is probably offshore, and the land exposures form a narrow coastal strip, mostly lying in National Parks and/or areas of difficult access.

The calculated mean heat generation of the Bicheno Granite, a fractionated S-type, is moderately low ( $\sim 14.3 \times 10^{-10}$  W/kg). Individual analyses, however, show considerable variation, particularly in U content. The average includes two samples from drill holes near Llandaff, petrographically similar to this pluton, which have slightly lower U and heat generation ( $9\text{--}10 \times 10^{-10}$  W/kg). If these are excluded, and only the remaining five samples from outcropping granite considered, the average heat generation is  $15.9 \times 10^{-10}$  W/kg.

In contrast, the major granites of Freycinet Peninsula (including Schouten Island) are felsic, fractionated I-types. Chappell et al. (1991) divided them into the Coles Bay, The Hazards, Freycinet, Hazards and Schouten Island plutons. However, there is no doubt that they are closely related, and it seems possible that they are not separate intrusions, but variably fractionated parts of the same body, connected at depth. All are high in both U and Th. The most strongly fractionated body, The Hazards Granite, has a heat generation (as calculated from five similar analyses) of  $49.9 \times 10^{-10}$  W/kg, the highest in Tasmania. The other three bodies appear to more internally variable, but averages range from  $\sim 27$  to  $38 \times 10^{-10}$  W/kg. A comparable value ( $7.33 \times 10^{-6}$  W/m<sup>3</sup>, equivalent to  $\sim 27.7 \times 10^{-10}$  W/kg) was calculated by Goh (2008) from gamma ray spectrometry of 14 drill core samples of the Coles Bay Granite.

In contrast the Bluestone Bay Granodiorite, which crops out as small disjunct exposures at several places on the peninsula, has much lower K, Th and U contents and heat generation ( $\sim 11.4 \times 10^{-10}$  W/kg), although slightly higher than most other eastern Tasmanian I-type granodiorites.

The Maria Island Granite and the small outcrops to the south at Hippolyte Rocks and Deep Glen Bay are all very similar, moderately fractionated, felsic, probably S-type granites. Possibly they are part of the same pluton, connected at depth. All have low to moderate Th and U contents, and consequently low to moderate heat

generation (range  $13$  to  $14.5 \times 10^{-10}$  W/kg), similar to the Bicheno Granite. Overall, there is a similarity between ICPMS, INAA and XRF-derived data (mostly of different samples). Although samples from North Maria Island are less fractionated (on the basis of lower Rb and higher Sr and Ba contents), this is not expressed in averages of calculated heat generation. The four samples from South Maria Island show a greater range ( $7.8$  to  $21.3 \times 10^{-10}$  W/kg), mainly because of differences in their U content.

The small exposure at Ile des Phoques is of a similar but more strongly peraluminous, fractionated, unequivocally S-type granite. The XRF and ICPMS analyses (of different samples) are similar. Because both Th and U are generally lower, calculated heat generation is lower than that of the granites of Maria Island.

## Heat generation mapping from airborne radiometric data

K, Th and U ground concentrations can, in principle, be calculated from airborne radiometric data, once scale correction factors for the sensor/platform combination used have been determined by calibration flights over a test range. However, these “equivalent” concentrations are invariably less than the absolute concentration of these elements in the source, as soil profile development, vegetation cover and their respective water contents all act to reduce the bedrock signal. Investigating the extent to which this occurs in Tasmanian conditions was a goal of this study.

Nevertheless, relative changes in the ratio of K:Th:U in granite chemistry should, in theory, correlate with relative changes in K:Th:U counts extracted from airborne radiometric data. Therefore, it should also be possible to use the analytical data to make semi-quantitative predictions of ternary radiometric image colour (based on relative ratios of K counts – red, to Th counts – green, to U counts – blue), and vice-versa. Some pre-processing of radiometric grids was required. Previous compilations had clipped data to the coastline, but as this is defined as the high water mark in topographic map series, this had had the effect of excluding valid data. In fact, the data that had been excluded were not merely valid but actually some of the most valuable, in the common case where the

best exposures of a given unit occur on the coast. The Heemskirk Granite is a particularly striking example of this. Inclusion of coastal radiometric responses in the datasets used was ensured by adding a 250 m buffer to the coastline in the geological map layers used. These were then employed in clipping the original radiometric survey grids to granitic units only. 1:25 000 geological layers were used wherever available, otherwise 1:250,000 mapping, via combination into a single “1:25 000/1:250 000 granites” layer.

The resulting clipped radiometric data were used to directly map the notional heat-producing properties of outcropping granitic units (Fig. 5), and in subsequent analysis described below. It presents at a glance a first-order indication of relative heat generation potential and its distribution. Proterozoic, Cambrian and Devonian-Carboniferous granites are all depicted; however note the isochores (showing subsurface distribution as inferred from geophysical modelling) are of low-density Devonian-Carboniferous granites only. Unfortunately there is little or no correlation between density and the concentration of heat-generating elements in granites, so no detailed inference of intra-batholith variations in heat generation can be made from gravity data. It is emphasised that the heat generation values given are semi-quantitative only; bulk properties derived from lithochemical data are invariably higher (see below). The Henbury Granite in northeast Tasmania is prominent as the most heat-producing pluton in the State that has been covered by radiometric data.

### *Point correlation with geochemical data*

Initially, data from the recent (2008) airborne radiometric surveys of northeast Tasmania and the Furneaux islands were compared to the analytical data from the granites. The K, Th and U counts were extracted from points on flight lines as close as possible to sample locations on the ground. Clearly, the signal will be modified by factors such as degree of exposure, weathering, vegetation cover and interference from adjacent units, but it was thought that a broad correlation with granite chemistry should also be apparent.

The results are present in the form of graphs of  $K_2O$ , Th and U content against measured counts ( $K_{rad}$ ,  $Th_{rad}$  and  $U_{rad}$ ) (Fig. 6), for 261 data points. Correlation coefficients ( $r$ ) were also calculated (Table 4, see page 53). Clearly correlation between analytical data and counts is poor for K ( $r = 0.305$ ), and only moderate for U ( $r = 0.563$ ), and slightly better for Th ( $r = 0.686$ ). Possibly the stronger

correlations for U and Th are because they tend to be carried in accessory minerals such as monazite, allanite, xenotime and zircon (e.g. Bea 1996), which are strongly resistant to weathering, whereas K is largely borne by potash feldspar, which is readily altered to micas and ultimately clay minerals.

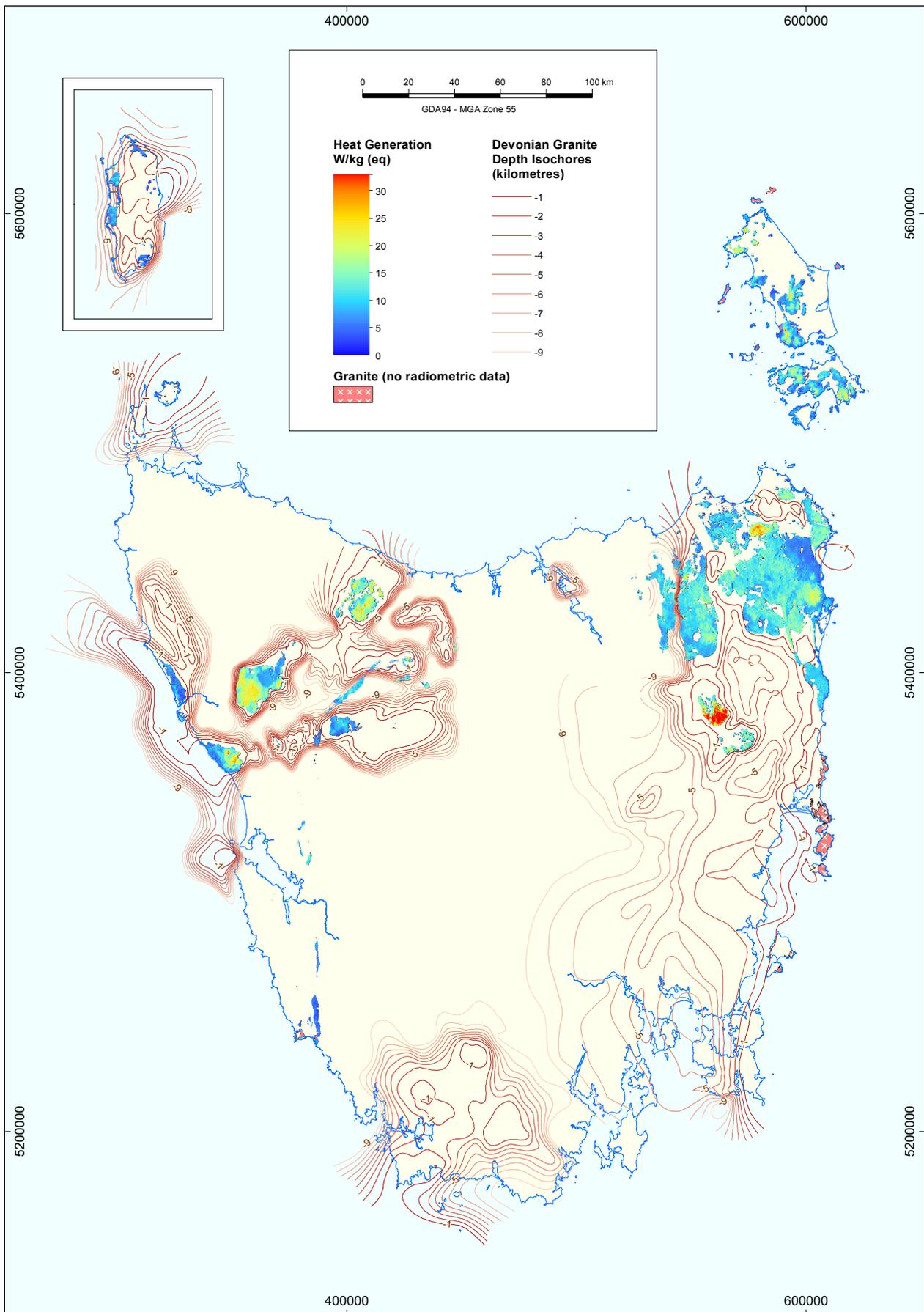
The data were also averaged by pluton and tested for similar correlations (Fig. 7). This significantly increases the correlation for U, but does so only marginally for K and Th (Table 4). It is noteworthy, however, that the Henbury Granite has the highest elemental content and total counts for both Th and U, emphasising its “hot rock” potential. Unfortunately, no airborne radiometric data are available over the granites of Freycinet Peninsula, which on the basis of their chemistry are also prospective.

When averaged data from poorly sampled plutons (with less than three good quality analyses for Th and U) are excluded, the correlation coefficients are not greatly altered (Table 4).

It was thought that ratios of counts ( $U_{rad}/K_{rad}$ ,  $Th_{rad}/K_{rad}$ ,  $U_{rad}/Th_{rad}$ ) might correlate better with the analogous elemental ratios, as this would tend to remove the effects of degree of exposure or attenuation by vegetation. However, the correlations (Figs 8, 9; Table 4) are considerably poorer. A trial of plotting counts against total counts (e.g.  $K_{rad}/total\ counts$ ,  $Th_{rad}/TC$ ,  $U_{rad}/TC$ ) also failed to demonstrate better correlations with the analytical data.

### *Polygon statistical correlation with geochemical data*

An alternative approach to investigation of the relationship between geochemical and corresponding radiometric signatures of granite plutons was undertaken, using statistical analysis of responses observed over substantial areas of outcropping units as a basis for comparison. Characterisation of bulk radiogenic properties of outcropping units from their radiometric signature is confounded by the highly variable nature of the attenuating influences mentioned above (soil development/level of exposure, vegetation density, moisture content, topography), none of which can currently be quantified readily. This means that statistical measures of central tendency such as arithmetic mean calculated across the entire mapped area of a unit may not necessarily give a true characterisation.



**Figure 5.** Heat generation of outcropping Tasmanian granitoids image, calculated from airborne radiometric data. The extent of subsurface granitoids indicated by isochores is modified from Leaman and Richardson (2003).

Several alternative measures of granite unit heat generation as determined by equivalent element concentrations were calculated via GIS analysis of radiometric responses within granitic units. Two of these were the mean and maximum heat generation observed within the largest mapped polygon. The rationale for these was to minimise edge effects arising from adjacent and cover units, which can dominate in cases where the granite polygon area is small. The other two measures were the mean and maximum of the unit polygon for which the highest mean was observed (which may also have been the largest polygon, but usually was not). This was based on the idea that this would be an area within which the attenuating effects were at their least, so the response would be closest to that of the “true” signal that would be observed if fresh rock were completely exposed. Maxima were considered in addition to means as possible valid indications of bulk unit properties for similar reasons.

A comparison between the four different airborne radiometric characterisations and analytical data for corresponding plutons is given in Figure 10. Each point on this plot represents a particular granite unit, with different colours/symbols representing the different statistical measures (thus each unit is represented four times). Equations for corresponding lines of best fit and correlation coefficients are also depicted. The maximum and mean radiometrically-derived heat generation values based on the largest polygon in each unit are seen to have somewhat better correlation with geochemical data than the measures derived from the maximum-response polygons.

For greater clarity, largest polygon-derived maximum and mean radiometric heat values are plotted separately versus litho-geochemical data for corresponding granites in Figure 11, with some significant plutons labelled.

As was indicated in the heat generation image, the Henbury Granite is again prominent as being by some margin the highest heat-producing granite in the State. It plots substantially above the line of best fit, possibly in part reflecting its location in a relatively arid part of the State and thus less subject to radiation attenuation by vegetation cover and soil moisture. The Strzelecki and Husetop granites also appear more to be more heat-producing than indicated by geochemical data. In the “maxima” measure particularly, these appear genuine outliers; however their mean response is also relatively high, raising the possibility of under-representation by the geochemical data. On the other hand, the Pine Hill

Granite/Renison Complex is poorly represented by the radiometric data, reflecting poor outcrop exposure and heavy vegetation cover.

Notwithstanding only moderate correlations between analytical radioelement concentration and airborne radiometric response, the four radiometric measures of granite pluton heat generating properties are in reasonable agreement with each other. Table 4 (see page 53) shows the top ten heat producers ranked by each metric. Those in green are in the top 10 of all four measures, with those appearing in three out of the four top tens in yellow and those only ranked in the top ten on two measures in pink. Of the four “green” plutons ranked in the top 10 across all radiometric measures, three (Henbury, Dolcoath and Mt Cameron granites) are also in the top 10 heat producers determined geochemically. The fourth, the Gipps Creek pluton, abuts the Henbury Granite, and radiometric images appear to indicate that the mapped extent of the former may incorporate elements of the latter.

Several Furneaux Group plutons (Strzelecki, Killiecrankie, Mt Kerford and Darling Range) are all ranked high heat producers by radiometric measures, not so geochemical (Table 4). This again may be attributable to more arid conditions and sparser vegetation in this region of Tasmania resulting in less radiometric signal attenuation. There is the possibility that geochemical sampling of these units is inadequate, but this seems unlikely (refer Table 1).

Conversely, some plutons ranked as relatively high heat producers on geochemical grounds (Table 4) are not among the highest ranked radiometrically. The Pine Hill Granite is the most pronounced example of this (as mentioned above), with the Constable Creek and Medeas Cove pluton radiometric signals also subdued relative to their analysed heat generating element content. In the latter two cases this is due to extensive masking by transported cover.

### *Implications for ternary radiometric image signature*

The inverse approach to that above is to use K, Th and U whole-rock analyses to calculate the “expected” airborne radiometric signatures of the granites, and to compare them to the signature actually observed. Ternary plots of the relative ratios of decays of K/10, Th and U, which should in principle correlate with ternary radiometric image signature, are presented, in the

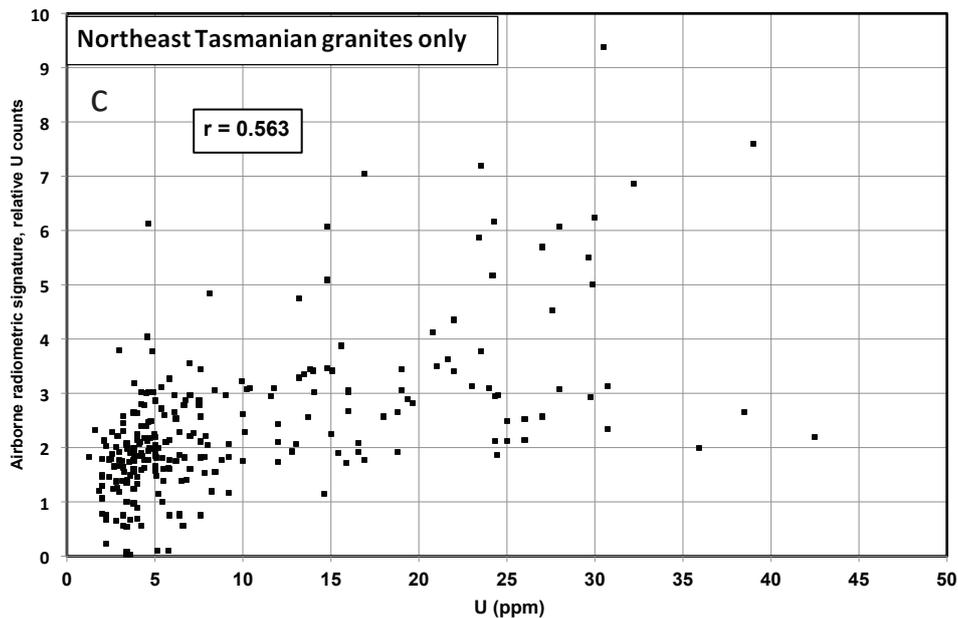
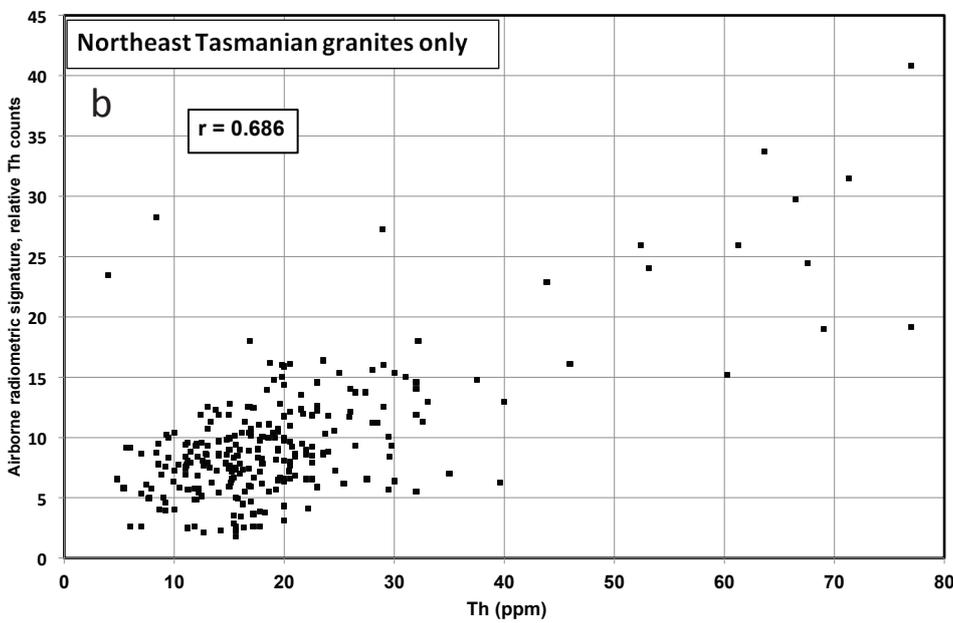
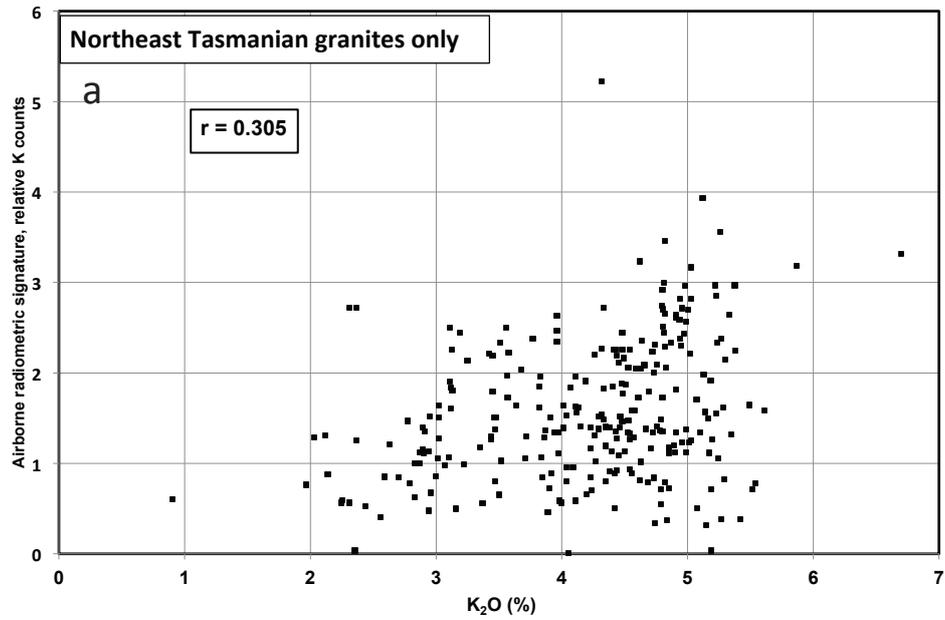


Figure 6. Plots of element concentrations from whole rock analyses (combined ICPMS, INAA and XRF data) versus airborne gamma ray counts over granite, extracted from the northeast Tasmania airborne radiometric survey (2008): (a) potassium (b) thorium (c) uranium.

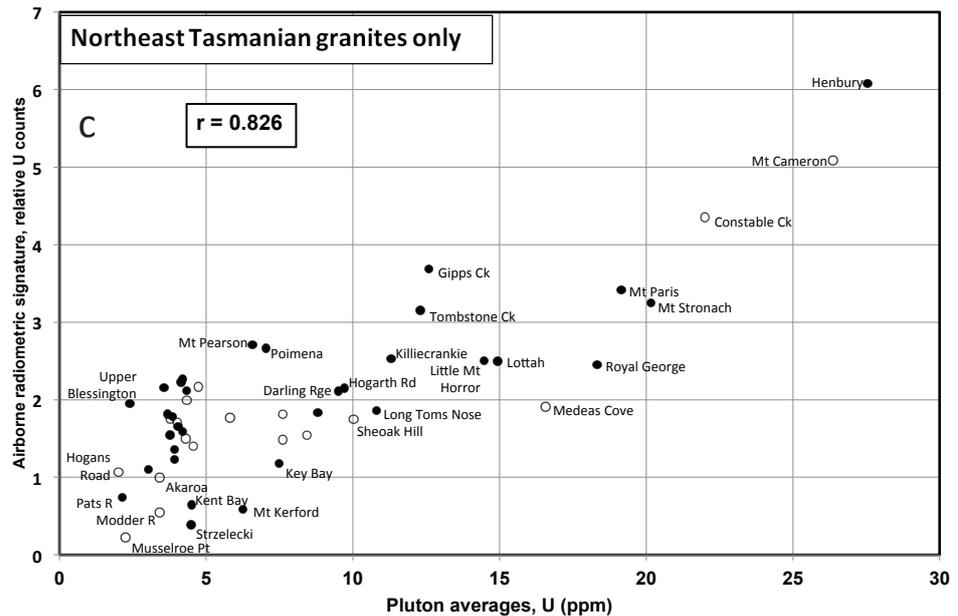
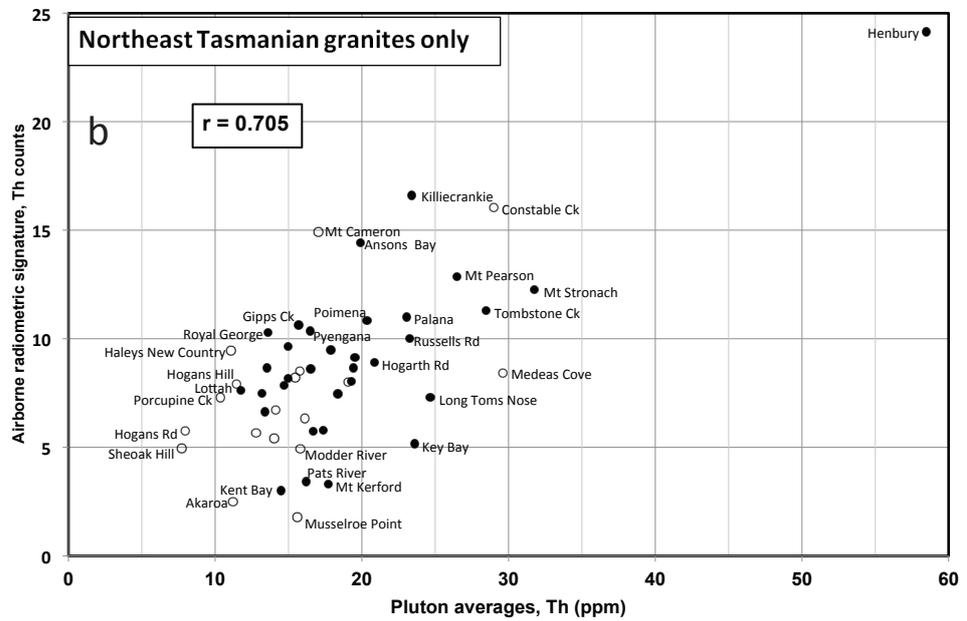
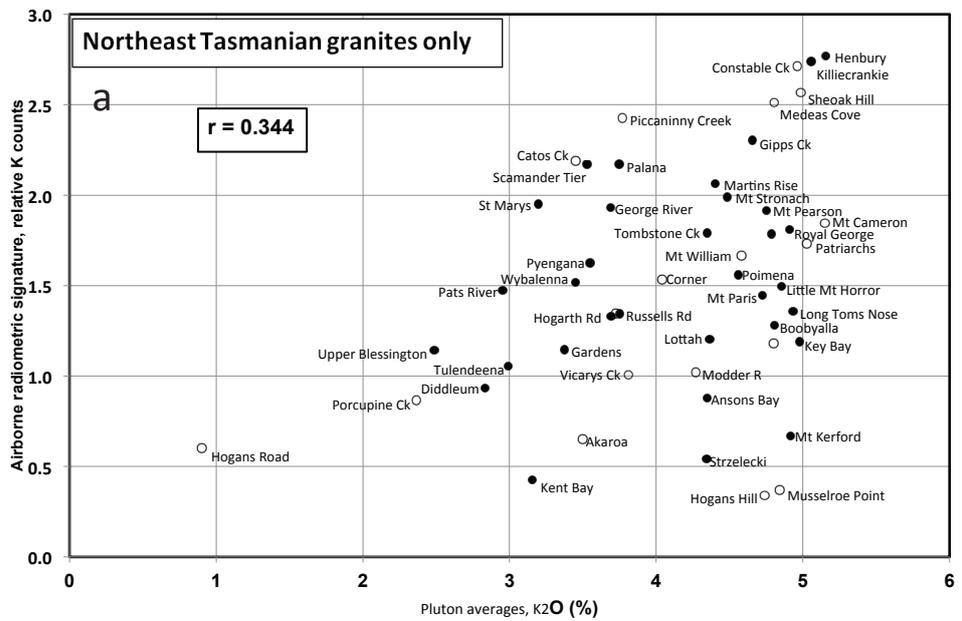


Figure 7. Plots of element concentrations versus airborne gamma ray counts, for northeast Tasmanian granites, averaged by pluton; open symbols indicate plutons with only one or two reliable analyses: (a) potassium (b) thorium (c) uranium.

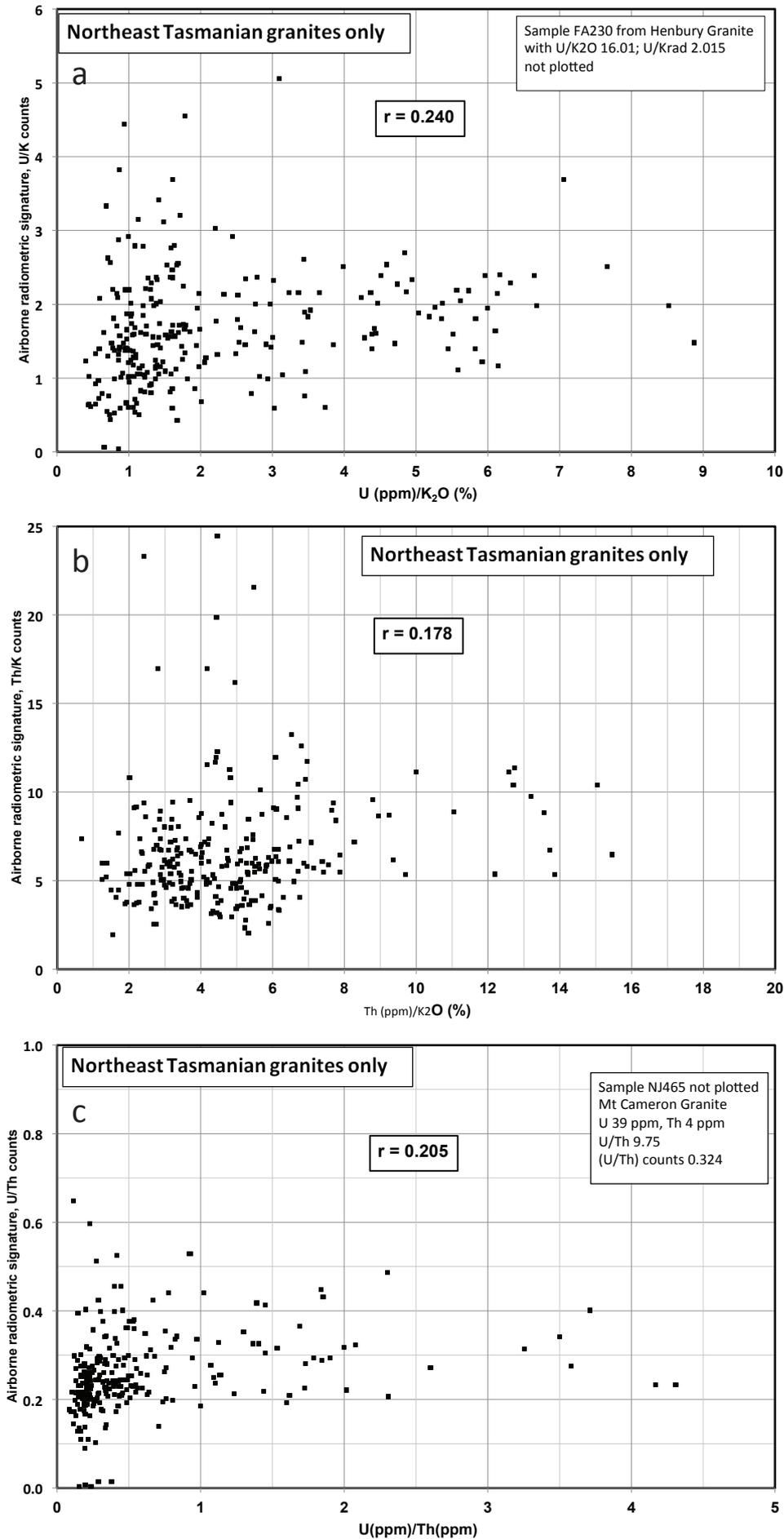


Figure 8. Plots of element ratios from whole rock analyses (combined ICPMS, INAA and XRF data) versus airborne gamma ray count ratios, for northeast Tasmanian granites: (a) U/K (b) Th/K (c) U/Th

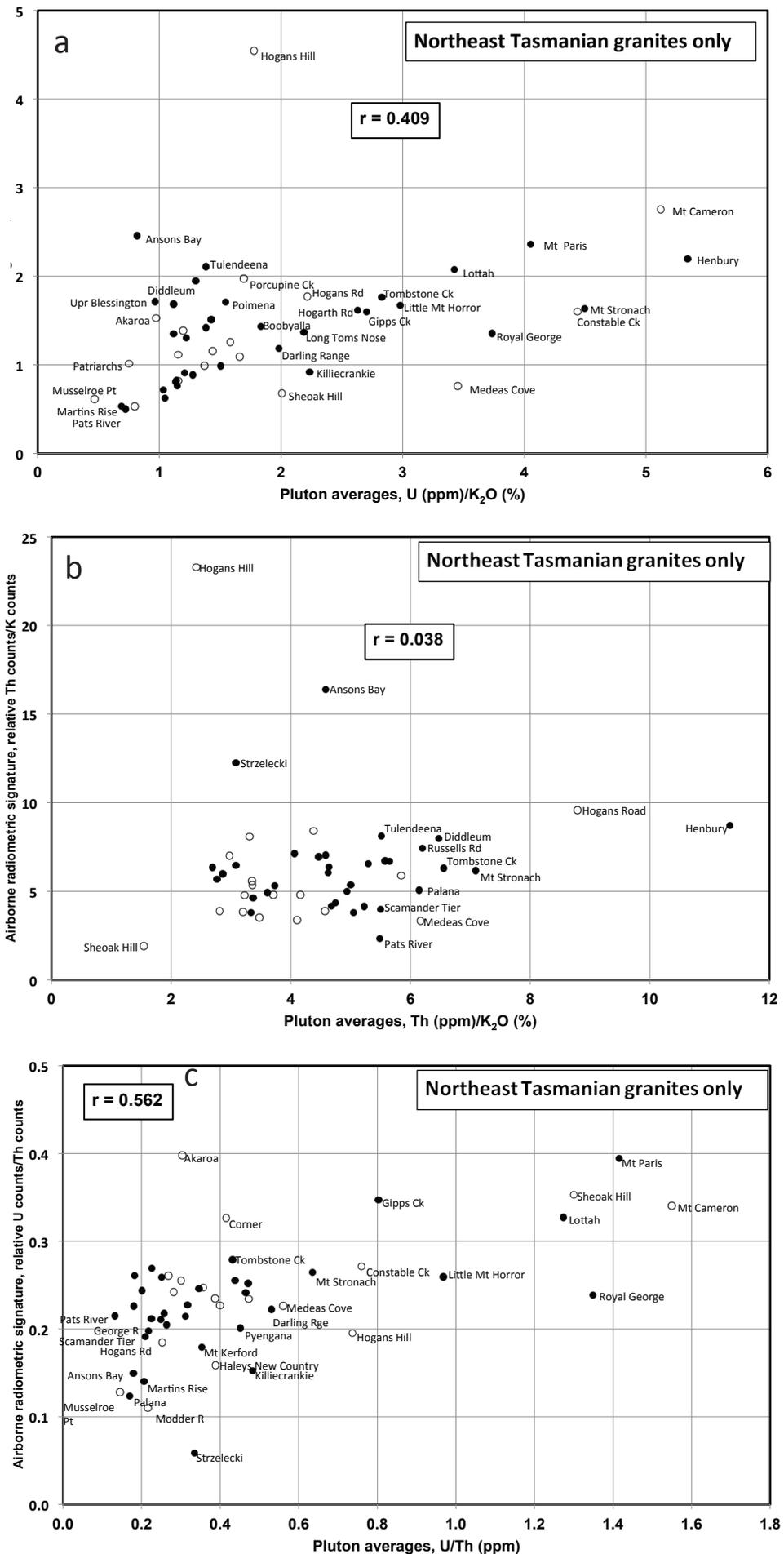


Figure 9. Plots of element ratios versus airborne gamma ray count ratios, for northeast Tasmanian granites, averaged by pluton; open symbols indicate plutons with only one or two reliable analyses: (a) U/K (b) Th/K (c) U/Th.

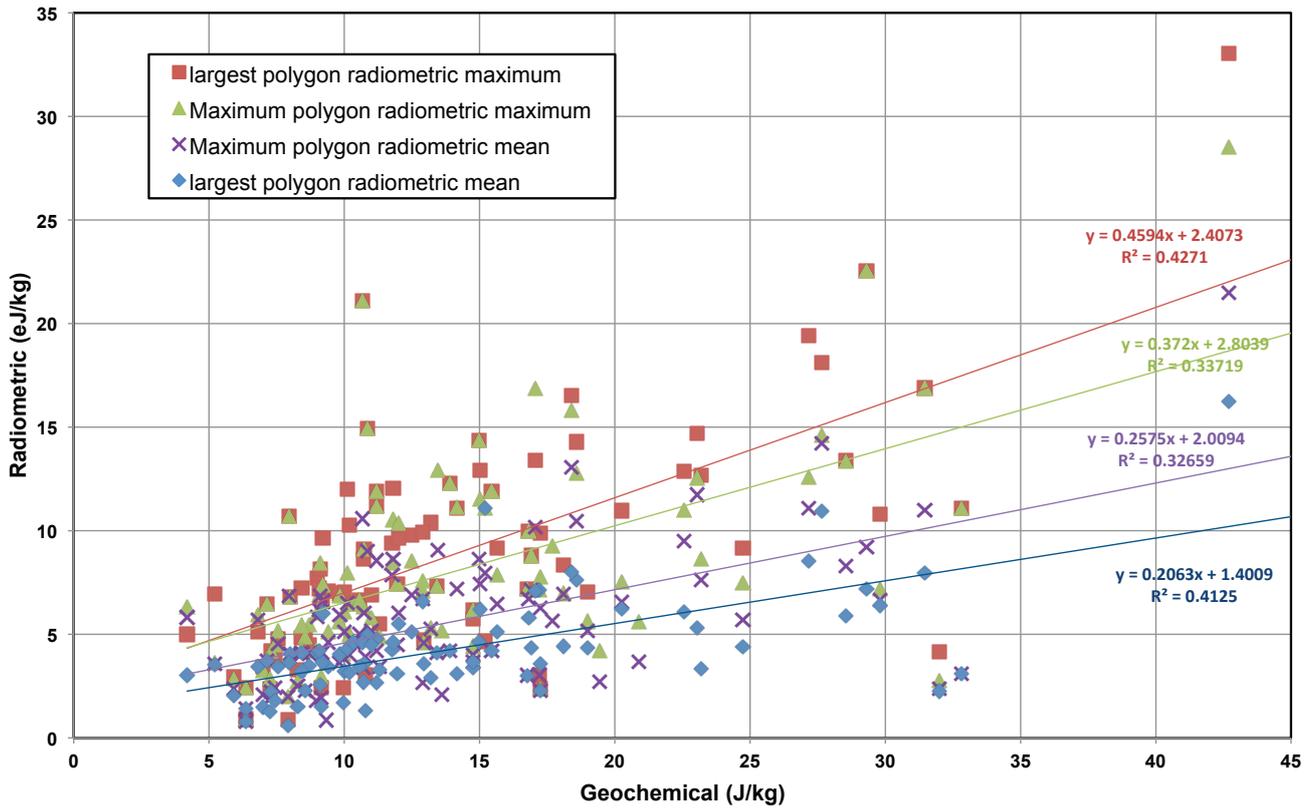


Figure 10. Plot of per-pluton heat production determined from whole rock analyses (horizontal axis) versus that estimated via geospatial radiometric measures (vertical axis), with corresponding lines of best fit and correlation coefficients. All Tasmanian plutons covered by modern radiometric data are represented.

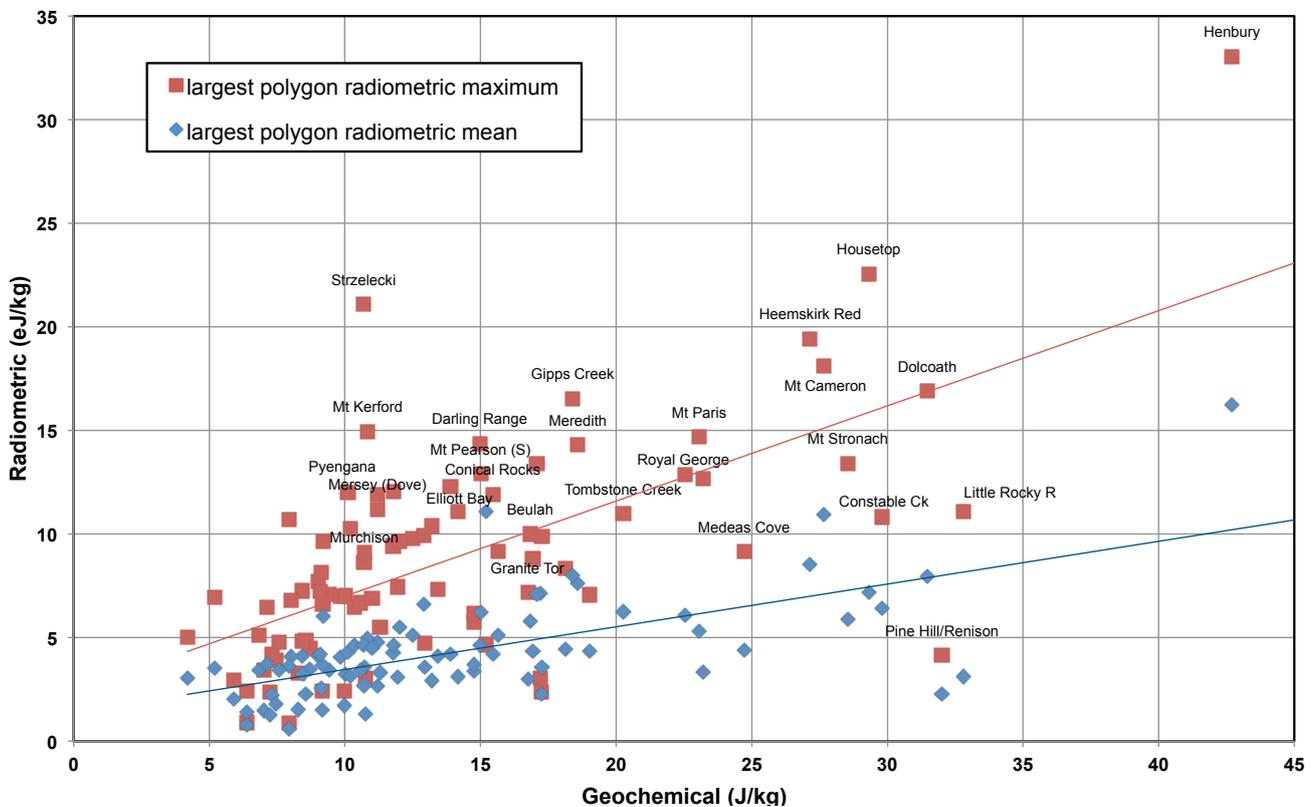


Figure 11. Plot of per-pluton heat production determined from whole rock analyses versus that estimated via the two radiometric measures with highest correlation coefficient (cf. Fig. 10), with significant heat producers labelled.

form of averages by pluton (Fig. 12a-c) and individual analyses (Fig. 13a-n). Granites that plot closer to the K, Th or U apices should, in principle, appear respectively more red, more green, or more blue on standard “RGB” radiometric images. In practise, however, some granite bodies are too poorly exposed (e.g. Hogans Road, Grandfathers, Renison-Pine Hill) to significantly contribute to the airborne radiometric signal. Note also that there are currently no radiometric surveys over the granites of the southeast coast and the far southwest.

Differences in expected radiometric signature of various granite types are most easily seen in the plot of averages by pluton for eastern Tasmania (Fig. 12b), where the granites are most diverse. The unfractionated I-type granites and granodiorites of eastern Tasmania occupy a fairly restricted field in the centre of the diagram, and thus are expected to be fairly neutral in their ternary image colour and, as their total counts are fairly low, not particularly bright. Most unfractionated S-types occupy a similar but slightly wider field, whereas fractionated S-types form an array towards the uranium apex (e.g. Fig. 13b, e) and thus would tend to have a bluish ternary image colour. In contrast, fractionated I-types (e.g. the Henbury Granite, and those of Freycinet Peninsula), are high in both Th and U and thus plot towards the

base of the plot, and therefore would be expected to have a more greenish ternary image signature. In practise, however, all fractionated granites are high in total counts, and in conventional, un-normalised ternary images, their colour tends to be saturated so they appear white.

A plot of individual analyses for the Ben Lomond Granite (Fig. 13b) clearly illustrates contrasting radiometric signatures of fractionated S- and I-types. The need for some modification of mapped contacts between the Henbury and Gipps Creek plutons is indicated by the airborne radiometric data. Subdivision of the Poimena Pluton is also indicated in the vicinity of Mt Cameron. Here, in addition to signal enhancement effects arising from greater topographic relief, the granite is substantially more radiogenic than the main Poimena Pluton mass, the boundary being partially coincident with the Ringarooma River.

However, the green hue of the Ansons Bay Granite on unnormalised ternary radiometric images is not clearly linked to a high Th content in analysed samples (Fig. 13f). This appears to be due to an unusually attenuated K radiometric signal, rather than particularly high Th response.

**Table 4.** Highest heat-producing plutons, ranked by geochemistry and airborne radiometric data

	Geochemistry	largestpolymeans	largestpolymax	maxpolymax	maxpolymeans
1	Henbury	Henbury	Henbury	Henbury	Henbury
2	Little Rocky River	Mt Cameron	Housetop	Housetop	Mt Cameron
3	Pine Hill/Renison	Heemskirk Red	Strzelecki	Strzelecki	Gipps Creek
4	Dolcoath	Gipps Creek	Heemskirk Red	Dolcoath	Mt Paris
5	Constable Creek	Dolcoath	Mt Cameron	Killiecrankie	Heemskirk Red
6	Housetop	Meredith	Dolcoath	Gipps Creek	Dolcoath
7	Mt Stronach	Housetop	Gipps Creek	Mt Kerford	Strzelecki
8	Mt Cameron	Wombat Flat	Mt Kerford	Mt Cameron	Meredith
9	Heemskirk Red	Killiecrankie	Mt Paris	Darling Range	Killiecrankie
10	Medeas Cove	Forth (Dove)	Darling Range	Mt Stronach	Royal George

The Cleveland porphyry (data from a single sample) is not ranked.

The Coles Bay, Hazards, Freycinet and Schouten Island plutons are not covered by radiometric data, but geochemically are comparable to the Henbury Granite.

The Birthday Granite is not covered by radiometric data, but may be geochemically comparable to the Granite Tor Granite.

Plutons in green are in the top 10 of all four measures, with those appearing in three out of the four top tens in yellow and those only ranked in the top ten on two measures in pink.

See text for explanation of radiometric data measures.

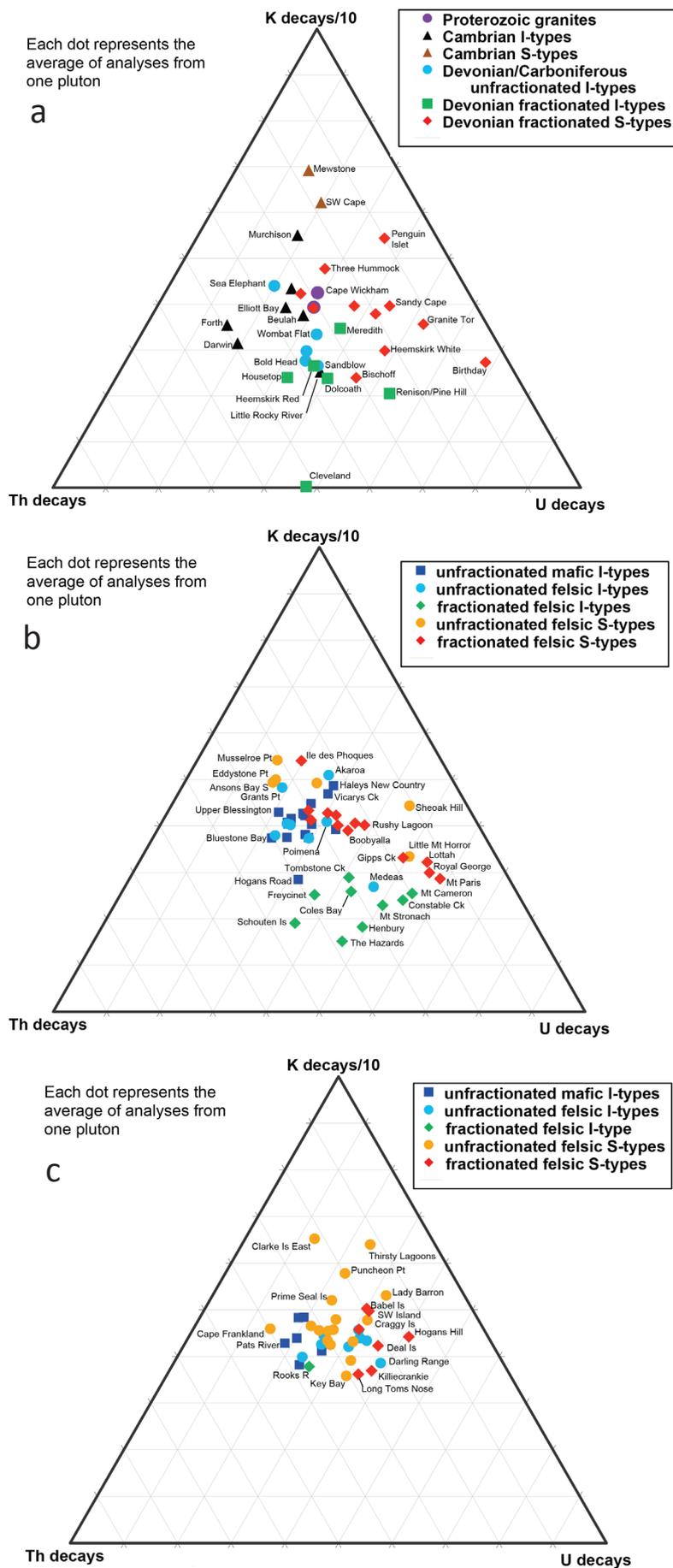
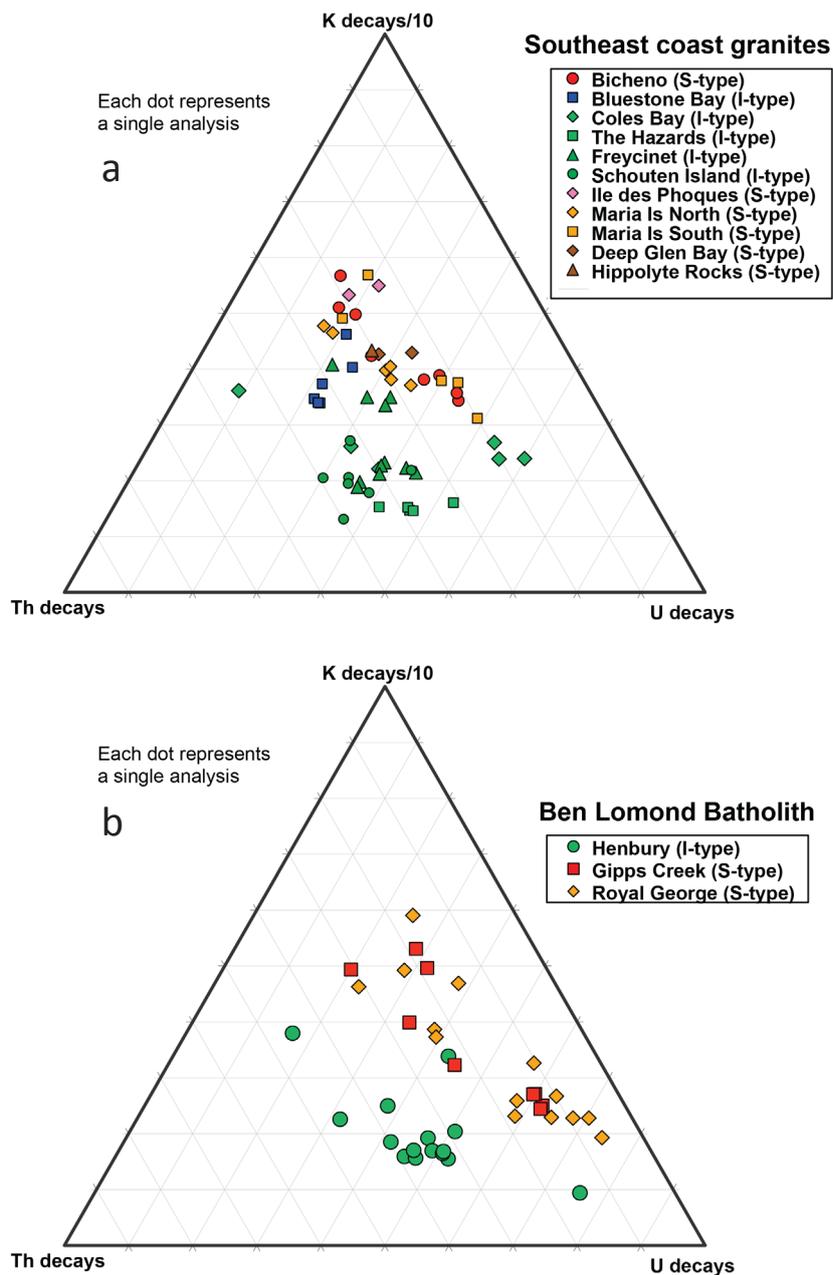
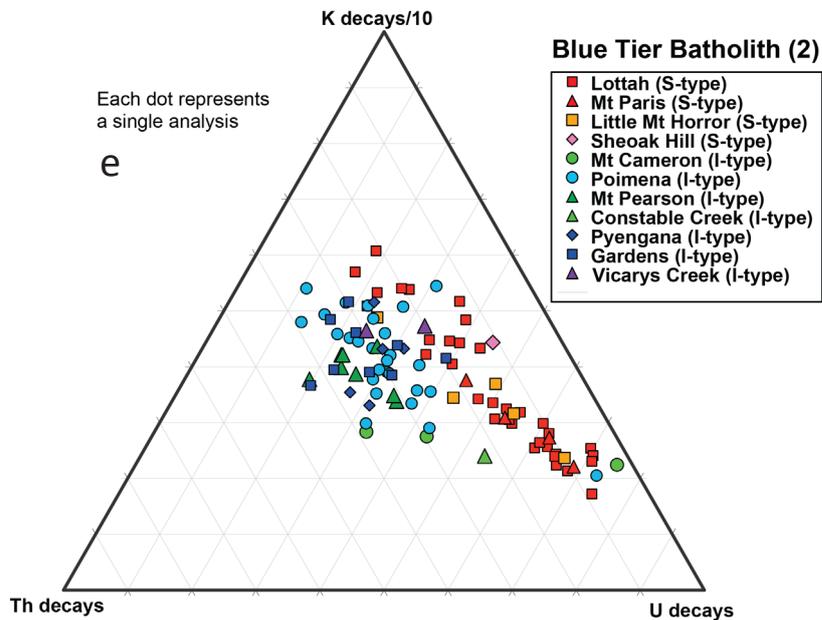
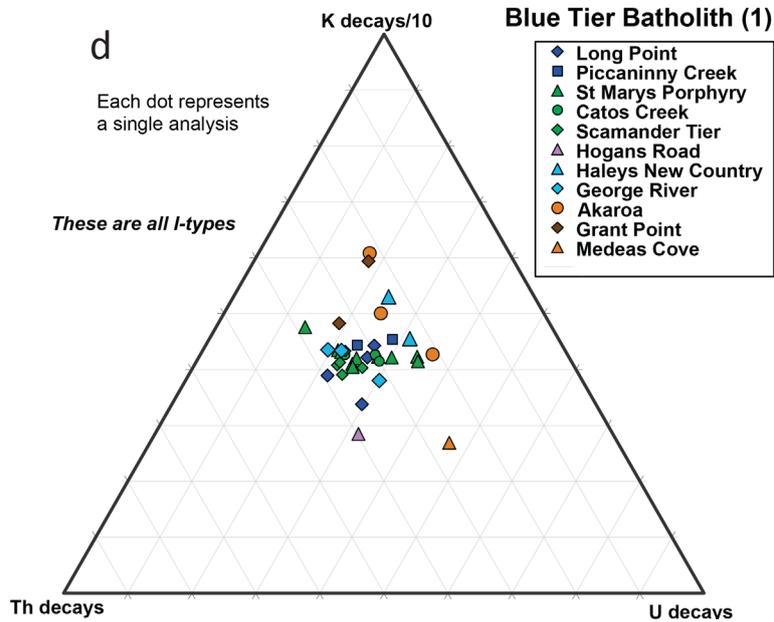
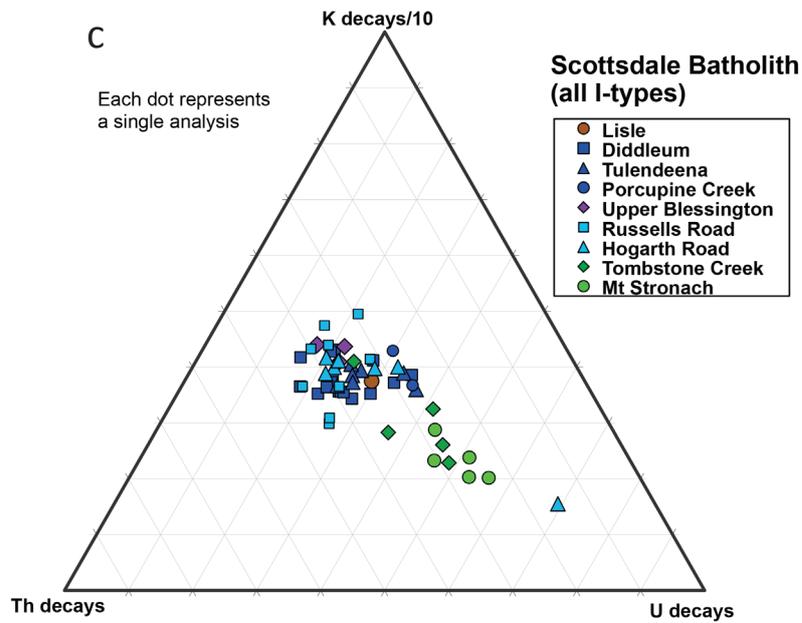
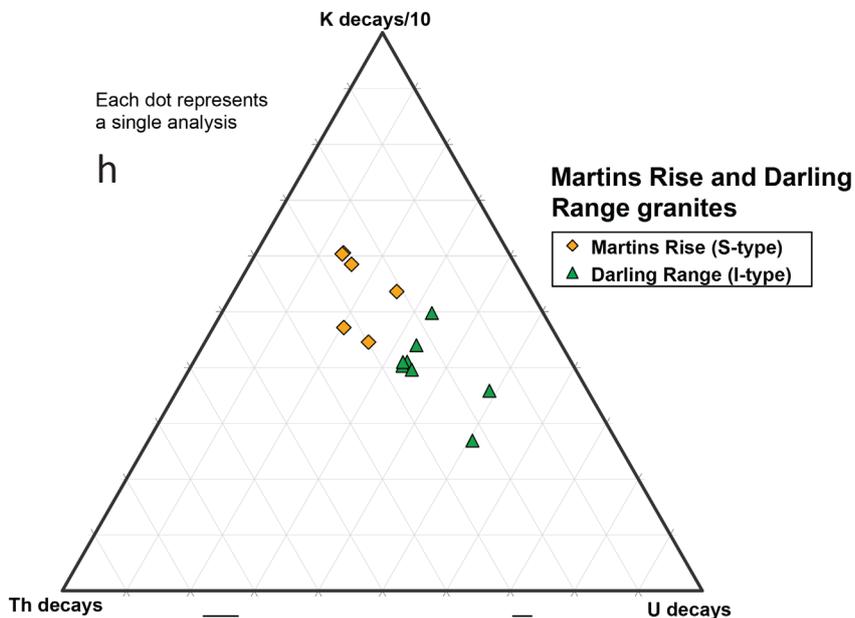
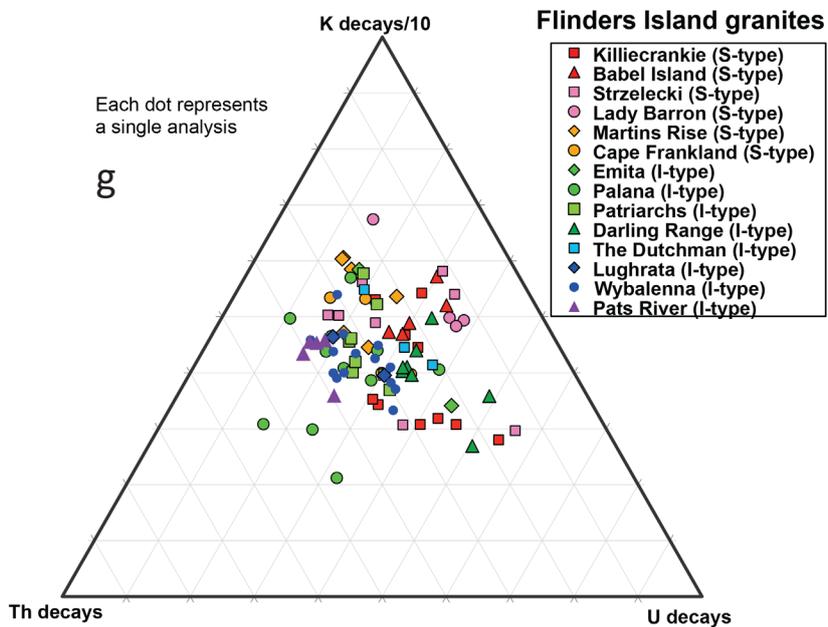
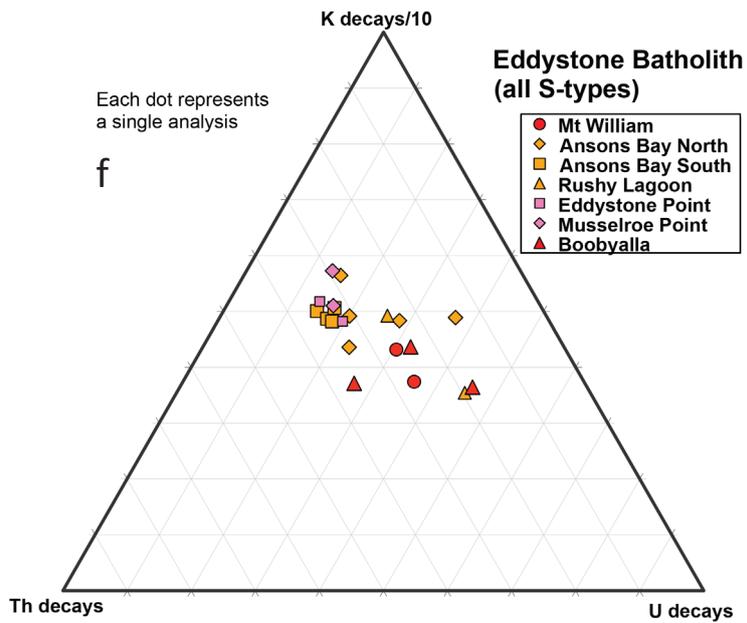


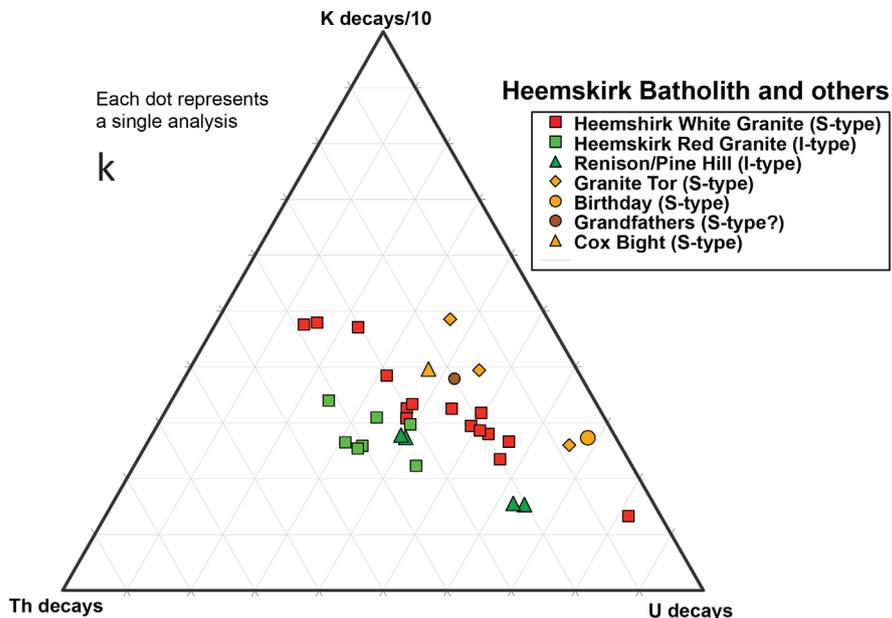
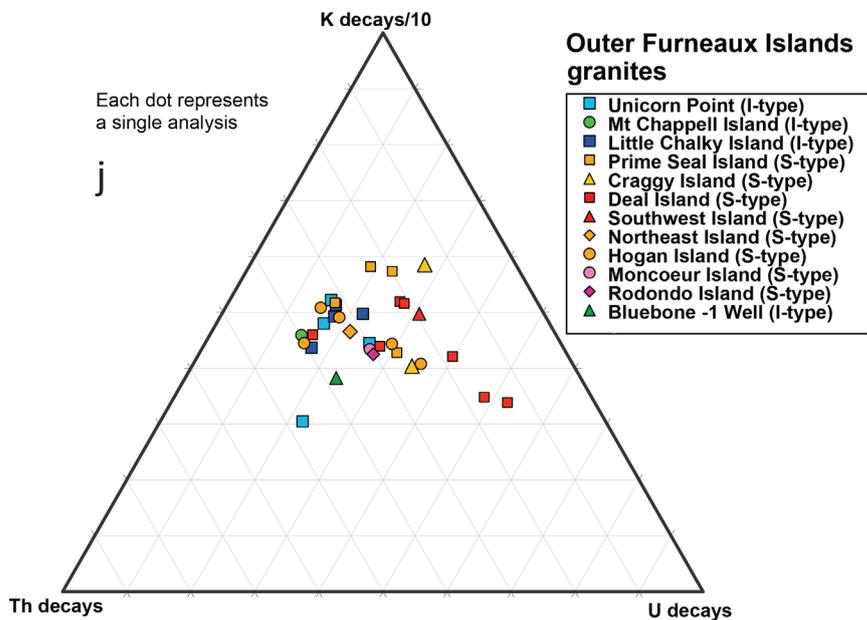
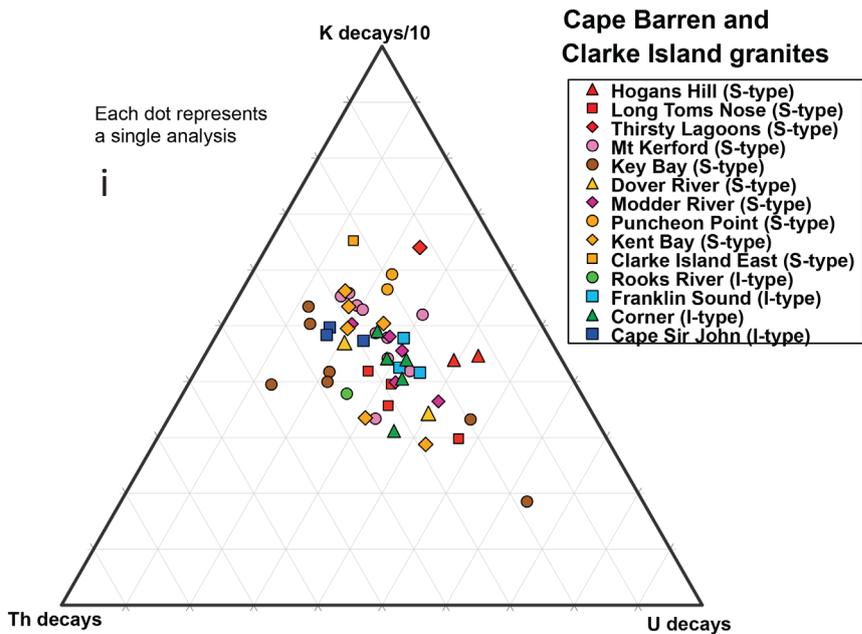
Figure 12. Ternary plots of relative K/10:Th:U decays, calculated from combined ICPMS, INAA and XRF data and averaged by pluton (a) western Tasmania (b) eastern Tasmania (c) granites of the Furneaux islands.

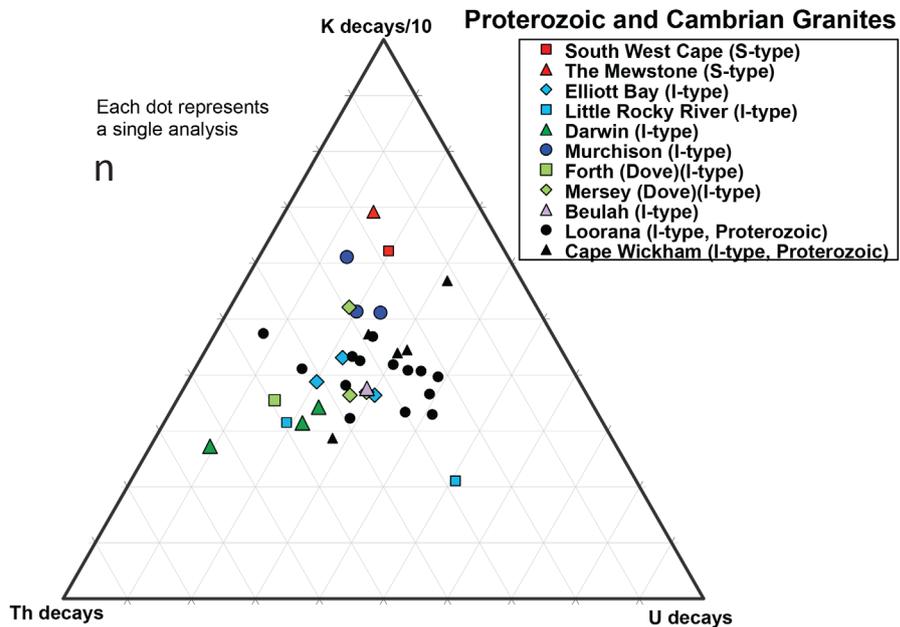
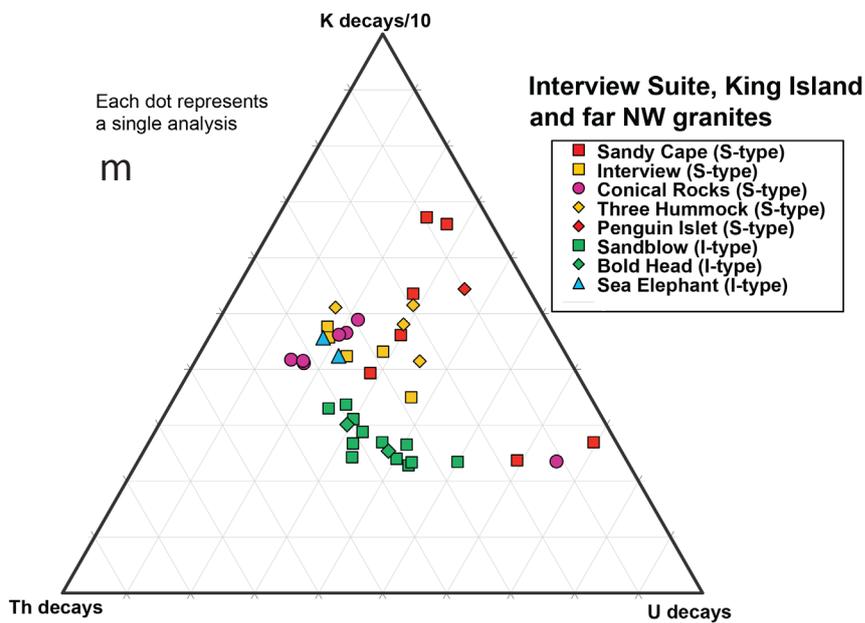
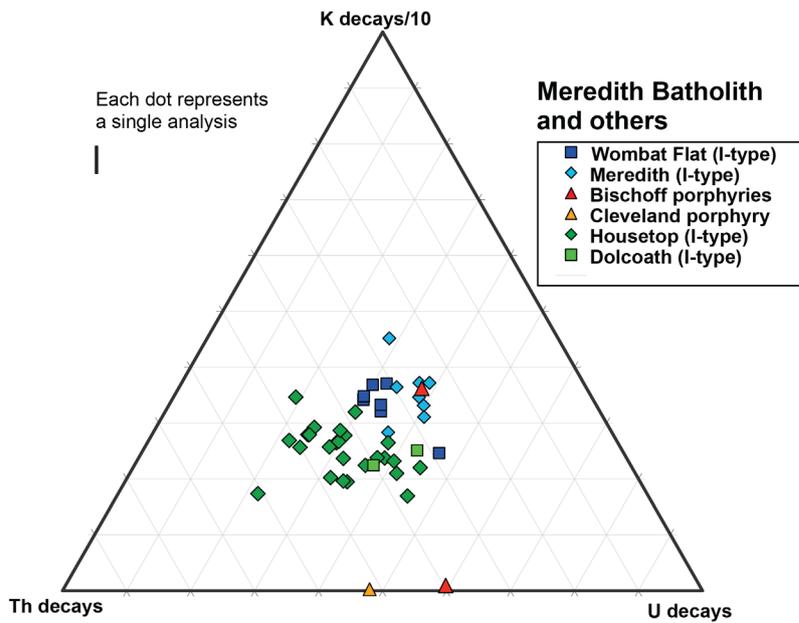


**Figure 13.** Ternary plots of relative K/10:Th:U decays, calculated from combined ICPMS, INAA and XRF data, for Tasmanian granites. Each point represents a single analysis (a) granites of the southeast coast (b) Ben Lomond Batholith (c) Scottsdale Batholith (d) and (e) Blue Tier Batholith (f) Eddystone Batholith (g) granites of Flinders Island (h) comparison of Martins Rise and Darling Range Granites, Flinders Island (i) granites of Cape Barren Island and Clarke Island (j) granites of the outer Furneaux islands (k) western Tasmania: Heemskirk Batholith and other granites (l) western Tasmania: Meredith Batholith and other granites (m) granites of far northwestern Tasmania and King Island (n) western Tasmanian Cambrian and Proterozoic granites.









In western Tasmania, where fractionated granites predominate, the data are more scattered, but fractionated I- and S-types also tend to occupy different fields in a plot of K/10:Th:U decay rates (Fig. 12b), although the S-types show more intra-pluton variation (Fig. 13k, m). The Heemskirk White and Heemskirk Red granites occupy adjacent, elongate fields (Fig. 13k) and might be best distinguished by extracting and imaging the K/Th ratio from airborne data. There are also distinct differences between some I-types. For instance, the unfractionated Wombat Flat Granite has similar K:Th:U ratios to the adjacent fractionated Meredith Granite (Fig. 13l), but these elements have lower absolute values, and the Wombat Flat Granite is clearly distinguished on radiometric images by lower total counts. The Housatop Granite also occupies a different field to the Meredith Granite, with relatively higher Th (Fig. 13l), although both are considered fractionated I-types; this should be reflected on normalised ternary images. On King Island, the poorly exposed Sea Elephant Granite has, on the basis of two analysis), markedly lower Th and U than the apparently similar Bold Head and Sandblow Granites (Fig. 13m).

Most Cambrian granites (apart from the Little Rocky River Granite) tend to be relatively low in U, and the S-type South West Cape Granite (and small Mewstone Granite) are also low in Th and thus plots closer to the K apex than other granites (Fig. 13n).

In the Furneaux islands, there are relatively few strongly fractionated granites (Figs 12c, 13g, i, j), but again the unfractionated I-types (e.g. of the Wybalenna Suite) occupy a tight central field, whereas the S-types are more dispersed and tend to be relatively higher in U and/or lower in Th.

Airborne radiometrics could potentially identify the unmapped contact between the Darling Range Granite and Martins Rise Granite, in rugged country in central Flinders Island. These bodies, although both quite felsic, have a distinct chemistry, and their mutual boundary on the existing 1:250 000 map is simply drawn around a handful of analysed sample locations. The granites are also expected to have a different radiometric signature as the Martins Rise Granite is relatively poorer in uranium (Fig. 13g, h). However, no such distinction is apparent, even in ratio images (e.g. U/Th).

## Conclusion

The highest calculated heat generation is generally from fractionated I-type granites, because of their high thorium and uranium content. Some fractionated S-types have moderately high values, principally due to high uranium.

Thus in eastern Tasmania, the “hottest” plutons are the Henbury Granite (mean  $\sim 42 \times 10^{-10}$  W/kg) from the Ben Lomond Batholith, the granites of Freycinet Peninsula, particularly the most strongly fractionated samples from The Hazards ( $\sim 48 \times 10^{-10}$  W/kg) and Schouten Island ( $\sim 41 \times 10^{-10}$  W/kg), and to a lesser degree, the Mt Stronach Granite ( $\sim 27 \times 10^{-10}$  W/kg) from the Scottsdale Batholith. In the Blue Tier Batholith, the Mt Cameron Granite ( $\sim 22 \times 10^{-10}$  W/kg) near Gladstone, and the Medeas Cove Granite ( $\sim 25 \times 10^{-10}$  W/kg) near St Helens, have moderately high values, but more data are needed from these bodies. Some samples of fractionated S-types, notably from the Royal George Granite, the Gipps Creek Granite (both also from the Ben Lomond Batholith) and the Mt Paris Granite have moderately high heat generation due to their high but erratic uranium content. On the other hand, the relatively mafic I-type granodiorites of eastern Tasmania have uniformly low heat generation (generally  $< 10 \times 10^{-10}$  W/kg). All the granites of the Eddystone Batholith and Furneaux Islands have relatively low heat generation, perhaps the least so being the fractionated S-type Killiecrankie Granite ( $\sim 17 \times 10^{-10}$  W/kg).

In western Tasmania, the highest mean heat generation is also from fractionated I-types, notably the Housatop Granite ( $29 \times 10^{-10}$  W/kg) and the small, similar Dolcoath Granite ( $\sim 32 \times 10^{-10}$  W/kg, but more data are needed). Other moderately “hot” plutons ( $20\text{--}30 \times 10^{-10}$  W/kg) are the I-type Heemskirk Red Granite, the Renison/Pine Hill Granite (more data are needed) and the unfractionated Sandblow Granite on King Island. Two western Tasmanian fractionated S-type granites, the Heemskirk White Granite ( $28 \times 10^{-10}$  W/kg) and the small Birthday Granite ( $\sim 25 \times 10^{-10}$  W/kg), have moderately high mean values due to their high uranium content. Total count or ternary images of airborne radiometric data can distinguish different plutons. Fractionated granites will appear brighter than unfractionated granites on total count images. Fractionated S-types will be relatively high in U, and fractionated I-types may be high in both Th and U. However, quantitative correlations between

the airborne radiometric signal and actual analyses of fresh granite samples are relatively poor.

## Acknowledgements

The authors particularly thank Dr David Champion and staff at Geoscience Australia for providing the new ICPMS analyses, at no cost to MRT. This valuable dataset also includes rare earth and other trace elements and will be utilised in further reports on the geochemistry of Tasmanian granites. The University of Tasmania supplied some powders and hand specimens of granites from remote areas, mainly the Furneaux Group islands. Dr Geoff Green and Dr Andrew McNeill made constructive comments on earlier versions of the manuscript.

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## Appendix 1: Physical background

The decay of the radioactive elements potassium, thorium and uranium are important sources of internal heat in the modern Earth. An algorithm for calculating the heat generated by a given volume of rock, as a function of the concentration of these elements, is given by Birch (1954), and was refined by Rybach (1976). Only a brief explanation is given here.

In general, the energy released, in unit time, by the decay of a radioactive isotope of a particular element in a unit mass of rock in unit time is given by:

$$(\text{concentration of element}) \times (\text{relative abundance of isotope}) \times (\text{decay rate}) \times (\text{decay energy})$$

The decay energy is expressed as kinetic energy of the emitted  $\alpha$  or  $\beta$  particles, recoil of the nucleus, and the energy of neutrinos and gamma rays. The neutrinos are extremely weakly interacting and lost to space, whereas in the Earth the other particles eventually collide with or are absorbed by atoms, and their energy is dissipated as heat.

### Potassium

Although potassium is by far the most abundant of these elements, the radioactive isotope  $^{40}\text{K}$  accounts for only 0.01167% of natural potassium. It decays with a half life of 1.25 Ga ( $\lambda = 5.543 \times 10^{-10} \text{ yr}^{-1}$ ). From these parameters, it can be calculated that in 1 kg of rock containing 1%  $\text{K}_2\text{O}$ , 256.4 atoms of  $^{40}\text{K}$  will, on the average, decay each second.

Most (89.52 %) of the atoms undergo  $\beta$  decay to  $^{40}\text{Ca}$ :



Whereas 10.48% undergo electron capture:



Thus the mean decay energy is 1.331 MeV, but part of this energy is lost to the neutrinos ( $\nu$ ) in the first reaction, and the emitted  $\beta$  particles exhibit a range of energies (1.311 MeV being the maximum possible). Overall, only about 0.70 MeV per decay is dissipated as heat.

Thus 1 kg of rock containing 1%  $\text{K}_2\text{O}$  will generate, in unit time:

$$256.4 \times 0.70 \text{ MeV/s} = 179.5 \text{ MeV/s} = 0.288 \times 10^{-10} \text{ W}$$

### Rubidium

Another naturally occurring radio-isotope is  $^{87}\text{Rb}$ , which accounts for 27.85% of naturally rubidium and decays with a half life of 48.8 Ga ( $\lambda = 1.42 \times 10^{-11} \text{ yr}^{-1}$ ).



Likewise, it can be calculated that in 1 kg of rock containing 1 ppm Rb, 0.883 atoms of  $^{87}\text{Rb}$  will, on the average, decay each second. Because some decay energy is lost to neutrinos, the emitted  $\beta$  particles will exhibit a range of energies, their mean being about two-thirds of their maximum (0.2825 MeV); i.e. about 0.19 MeV. Thus the rate that energy is dissipated as heat is

$$0.883 \times 0.19 \text{ MeV/s} = 0.168 \text{ MeV/s} = 2.69 \times 10^{-14} \text{ W.}$$

Since Tasmanian granites typically contain 200–500 ppm Rb, their radiogenic heat generation from Rb is typically 0.054 to  $0.1356 \times 10^{-10} \text{ W}$ . These values are an order of magnitude less than the (relatively small) contribution from K, and insignificant relative to the contribution from Th and U. Therefore rubidium is not considered in the remainder of the discussion.

### Thorium

The longest lived isotope of thorium,  $^{232}\text{Th}$ , which accounts for essentially all natural Th, undergoes  $\alpha$  decay to  $^{208}\text{Pb}$  with a half life of 14.0 Ga ( $\lambda = 0.49475 \times 10^{-10} \text{ yr}^{-1}$ ). Thus in 1 kg of rock containing 1 ppm Th, 4.07 atoms of  $^{232}\text{Th}$  will, on the average, decay each second.

$^{228}\text{Ra}$  is itself radioactive, and leads into a decay chain ultimately leading to stable  $^{208}\text{Pb}$ . As  $^{228}\text{Ra}$  and the other intermediate members of the decay series have much shorter half-lives,  $^{232}\text{Th}$  can be considered to decay to  $^{208}\text{Pb}$ , six  $\alpha$  particles (4He nuclei), four  $\beta$  particles (electrons) and four neutrinos, with a effective half-life of 14.0 Ga:



Of this, 3.9 MeV (which is about 2/3 of the sum of the maximum energies of the four  $\beta$  particles, 5.71 MeV) is accounted for by the neutrinos, whereas 39.0 MeV is dissipated as heat. If radioactive equilibrium is maintained (i.e.  $^{228}\text{Ra}$  and other intermediate members of the decay chain remain in situ and have not been separated from Th by geological processes), 1 kg of rock containing 1 ppm Th will generate, in unit time:

$$4.069 \times 38.99 \text{ MeV/s} = 158.7 \text{ MeV/s} = 0.254 \times 10^6 \text{ W}$$

### Uranium

The most abundant isotope  $^{238}\text{U}$ , which accounts for 99.276% of natural uranium, decays with a half life of 4.47 Ga ( $\lambda = 1.55125 \times 10^{-10} \text{ yr}^{-1}$ ). Thus in 1 kg of rock containing 1 ppm U, 12.35 atoms of  $^{238}\text{U}$  will decay, on the average, each second. This process is the first link in a decay chain, comprising eight  $\alpha$  decays and four  $\beta$  decays, ultimately leading to stable  $^{206}\text{Pb}$ :



Again, because of the energy lost to the neutrinos, only 46.3 MeV of this is eventually expressed as heat.

Likewise,  $^{235}\text{U}$ , which accounts for 0.718% of natural uranium, decays with a half life of 703.8 Ma ( $\lambda = 9.8485 \times 10^{-10} \text{ yr}^{-1}$ ). Thus in 1 kg of rock containing 1 ppm U, an average of 0.57 atoms of  $^{235}\text{U}$  will decay each second, leading to the decay chain summarised as:



Again, a small fraction of this ( $\sim 2 \text{ MeV}$ ) is lost to the neutrinos.

Thus, assuming radioactive equilibrium, 1 kg of rock containing 1 ppm U will generate, in unit time:

$$(12.35 \times 46.3) + (0.57 \times 44.4) = 597.1 \text{ MeV/s} = 0.956 \times 10^{-10} \text{ W}$$

Thus the specific heat generation for a rock unit of particular composition is given by:

$$\text{HGU} (\times 10^{-10} \text{ W/kg}) = 0.2884 * \text{K}_2\text{O} (\text{wt}\%) + 0.256 * \text{Th} (\text{ppm}) + 0.9523 * \text{U} (\text{ppm})$$

(Slight differences in coefficients to those calculated above are probably attributable to uncertainties in decay constants and energy losses to neutrinos.)

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## Appendix 2: Comparison of ICPMS and XRF data

Although ICPMS analysis can produce precise results at low concentrations, the method requires total dissolution of the sample. In granites, thorium and uranium (together with the rare earth elements and Y) are commonly present in accessory minerals such as monazite, xenotime and zircon (e.g, Sawka and Chappell 1986; Bea 1996) which may be difficult to digest. Incomplete dissolution of the sample could thus result in spuriously low values for these elements. It is therefore prudent to compare, for each sample, the ICPMS results with those obtained by the XRF method, which are obtained on dry pressed pellets, and does not require sample dissolution.

Uranium values obtained by ICPMS agree well with those obtained by XRF (Fig. A1a). Most data points plot close to the diagonal line of agreement, whereas if there were non-dissolution of uranium-bearing accessory minerals, those samples would plot below the line. A small number of samples, however, plot appreciably *above* the line.

A similar plot of ICPMS and XRF thorium values (Fig. A1b) also shows reasonable agreement, but there are more samples appreciably displaced from the line of agreement, both above and below it. These samples with poor agreement are mostly from a group of nine samples from western Tasmania (401383–401412) which were among those collected during helicopter-supported gravity data acquisition in the 1980s.

As a further check, zirconium and cerium contents obtained by XRF at both Geoscience Australia and Mineral Resources Tasmania (Fig. A1c, d), were plotted against the ICPMS results. These elements will be largely borne by the resistant accessory minerals zircon and monazite, which are also major bearers of U and Th respectively. Again, there is good agreement between methods, except for Zr in the same group of samples. As they were analysed at the same laboratory and the same time as the other samples, it seems likely that there is a serious problem with the preparation of these powders, possibly small sample size, inadequate grinding or incomplete mixing, resulting in powder inhomogeneity.

With this reservation, however, the ICPMS results for Th and U appear to be both accurate and precise, and sample non-dissolution has not been a problem.

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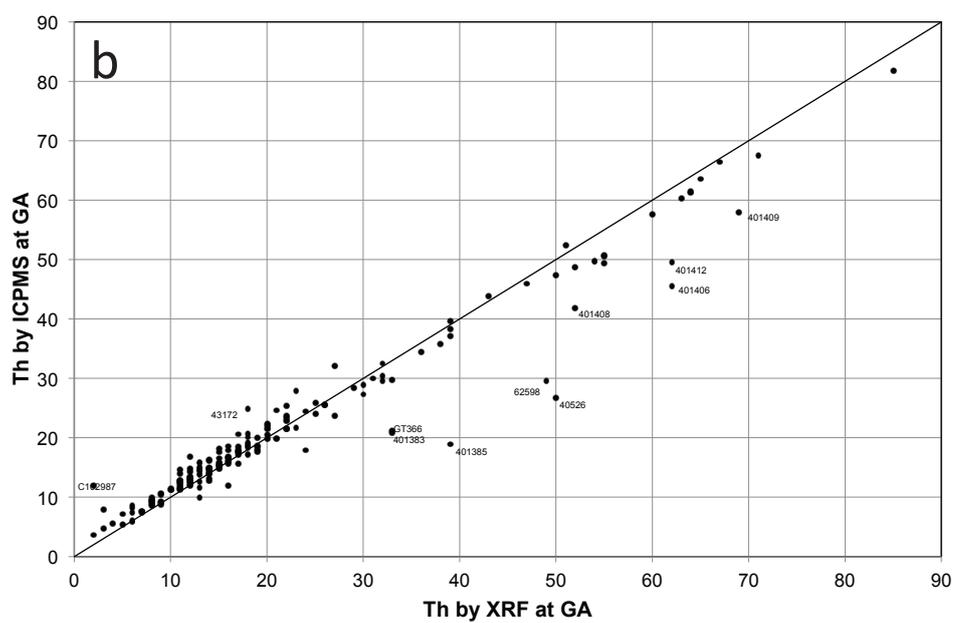
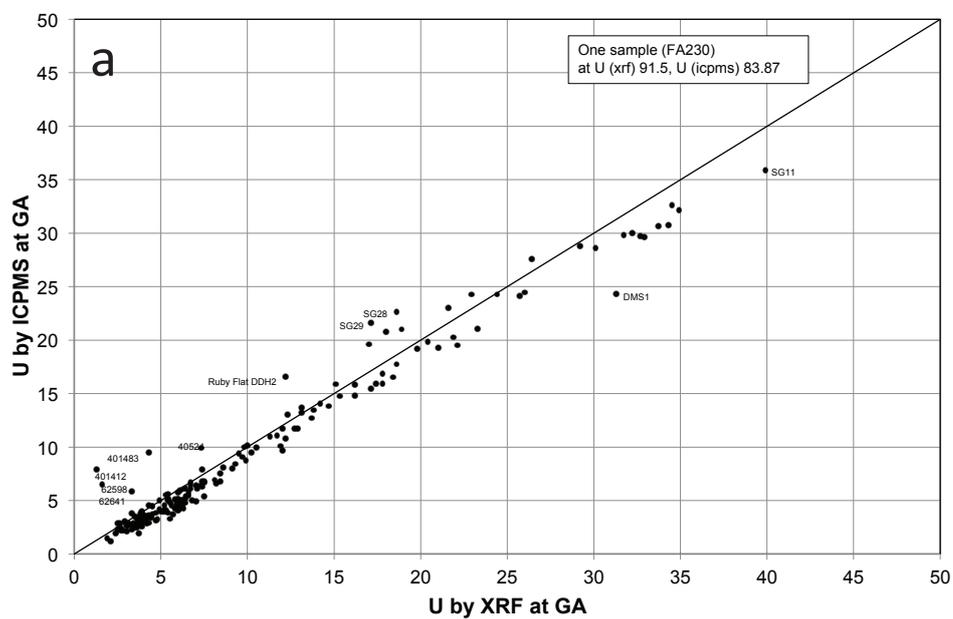
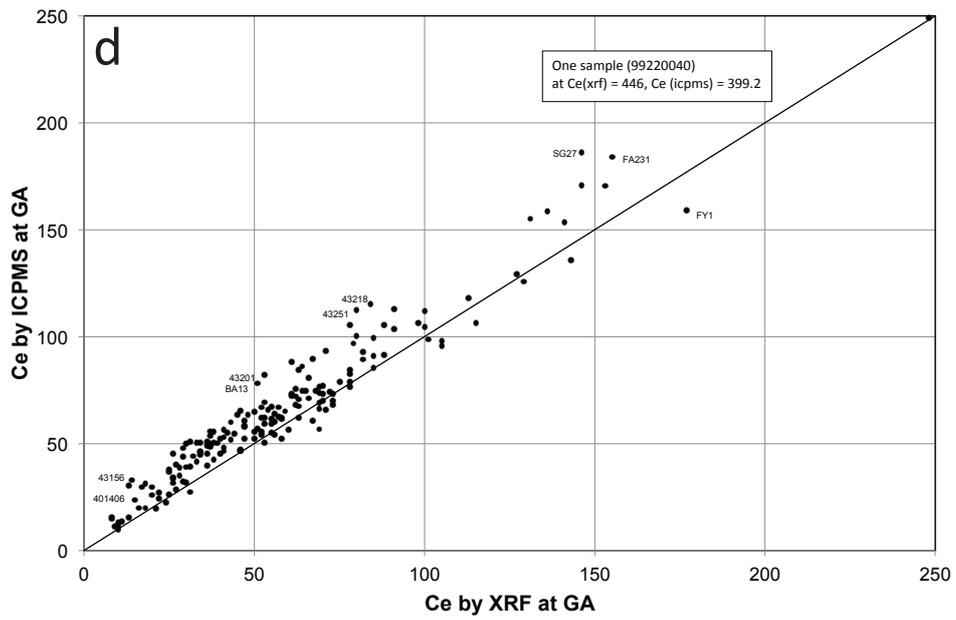
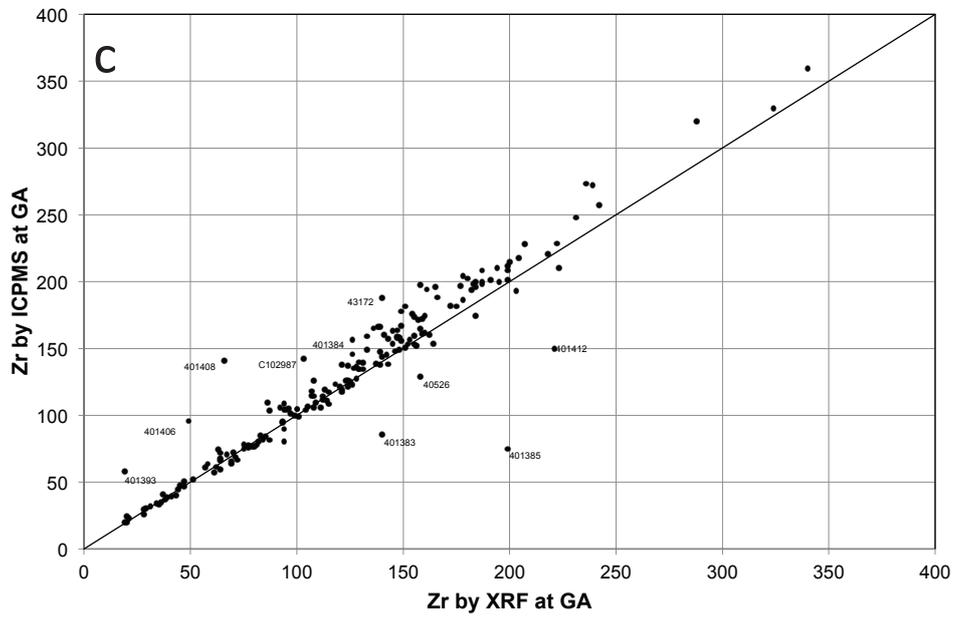


Figure A1. Comparison of ICPMS and XRF results at Geoscience Australia for each sample: (a) U (b) Th. Significant discrepancies are annotated with sample number.







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