1 KIMBERLEY PROVINCE SYNTHESIS

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1.1 Executive Summary - Geology

Although the Kimberley Province (including the King Leopold and Halls Creek Orogens) has many geological elements common to other Proterozoic provinces in Australia, it is probably the most poorly endowed with respect to significant economic deposits of Au, base metals, Sn and W. The only world class deposit within the province is the Mesoproterozoic Argyle diamond mine. There are some Ni, Cr and PGE prospects within the layered mafic-ultramafic intrusives (Hoatson 1993a; 1995; Hoatson and Tyler 1993; Trudu and Hoatson 1996) and a suite of alkaline igneous rocks hosts a Nb and rare-earth elements prospect (Chalmers 1990); there are also some VHMS base metal prospects in the Koongie Park area (Rea 1997; Hoatson 1993b). The regional geology of the Kimberley Province has been summarised by Griffin and Grey (1990), Tyler *et al.* (1995) and by Plumb (1990). The region has also been the focus of detailed mapping as part of a revision of the West Kimberleys by GSWA and the East Kimberleys as part of the NGMA program by both AGSO and GSWA.

Like many Palaeoproterozoic provinces, the earliest sediments were deposited between ~1920-1840 Ma and consisted of several packages that include mafic and felsic volcanics, clastic sediments, carbonaceous and calcareous sediments, and some banded iron formations. Some high-level granites were also intruded early into the sequence at ~ 1910 Ma. These rocks were all deformed and metamorphosed, some to granulite facies, before or during the intrusion of most of the granite suites (Tyler *et al.* 1995).

Most granites in the Kimberley Province were intruded from about 1865 Ma to 1818 Ma and there is a gradual shift in the age of the granites during this period from the west-northwest to the east-southeast. At least eight suites occur in the whole Kimberley region; all suites are I-(granodiorite) type, with the exception of the alkaline Butchers Gully Suite. Most granite suites are also interpreted to be predominately restite-rich with the exception of the Koongie Park Suite. Most of the major granite events are coeval with the intrusion of layered mafic-ultramafic complexes (Hoatson 1993a, 1995).

From a metallogenic point of view, there appears to be only minor evidence of fractionation within the major 1865 to 1818 Ma granite suites of the Kimberley Province, unlike the Gawler Craton or the Pine Creek Inlier. Compared with granites from these two areas, those of the Kimberleys are relatively homogeneous over wide areas and there are few major distinctive leucocratic plutons developed. The felsic Whitewater Volcanics are phenocryst-rich (up to 50% crystals (Gellatly *et al.* 1974a)) and are compositionally identical to their comagmatic intrusives (Griffin *et al.* 1993). These factors support the concept that crystallisation of granites of the Kimberley region was largely dominated by restite-separation.

In all other Australian provinces dealt with in this Project, we have not discussed the tectonic setting. Because of the metallogenic implications, the Kimberley Province will be an exception as the regional tectonic setting of this has been contentious for many years, with one interpretation maintaining that the province developed in an intracontinental setting (e.g., Hancock and Rutland 1984), whilst others have drawn analogies to modern continental margins, with the formation of the felsic igneous rocks being directly related to modern-style subduction processes (e.g., Ogasawara 1988; Tyler *et al.* 1995). Although the chemistry of the felsic melts is interpreted by many (e.g., Ogasawara, 1988; Tyler *et al.* 1995; Sheppard *et al.* 1995) to indicate derivation from contemporaneous subduction, there are some arguments inconsistent with this model. The first is that within the comagmatic volcanics in the Kimberley region, andesites, common in regions of subduction-related magmatism, are very rare, and second, the granites are generally more felsic than those found in continental margins. Thirdly, each magmatic event is bimodal and there is a distinct gap in the SiO_2 content between 54 and 58 wt. % within the coeval but not comagmatic compositions. Such a gap, common in extensional regimes, is not usually found in most continental margin regions where instead the suites progress from gabbros through diorite to quartz diorite to tonalite to granodiorite to granite, with rocks of tonalitic to granodioritic compositions being dominant. The presence of coeval, but not comagmatic, layered mafic/ultramafic intrusions is also considered by some to be indicative of extensional conditions (von Gruenewaldt and Harmer 1992).

An alternative interpretation to the contemporaneous subduction model is that mafic to intermediate igneous material was underplated in the lower crust in the late Archaean to earliest Proterozoic (Wyborn *et al.* 1992), and that this material subsequently became the source for the felsic melts emplaced into the Kimberley Province from about 1880 to 1780 Ma. This source was emplaced at around 2.5 to 2.3 Ga based on Nd-Sm data (S.-S. Sun, personal communication, OZCHRON). This underplated source material was of two distinct compositions: the first composition, derived by melting of a plagioclase-stable region, was emplaced into the lower crust in the West Kimberleys and in the western part of the East Kimberleys. In contrast, in the eastern part of the East Kimberleys the material underplated was derived from a garnet-stable source region. It is calculated that this underplated material would be very similar in composition to igneous rocks of modern subduction zones. Both types of underplated material were subsequently remelted during various extensional episodes between 1860 to 1818 Ma to give the two different granite types. Because both are restite-dominated, their chemistry now simply ‘images their source region’ (Chappell 1979), rather than the tectonic setting at the time of emplacement of the granite suites.

The argument for contemporaneous subduction versus extension processes during the emplacement of the granites has little relevance to determining the economic potential of the granite suites. However, it is worth stressing that, based on the compilation of magmas associated with modern porphyry systems in both island arc and continental margins done by this project, there are some significant major element and mineralogical differences between these and the granites of the Kimberley Province and those of modern subduction zones. These differences may explain the apparent absence of major porphyry systems within the Kimberley Province felsic igneous rocks themselves.

A final granite event at around 1800 Ma produced high-SiO_2 granites which are more typical of the Sybella-type. These intrusions appear to be chemically different from granites of similar age in The Granites-Tanami Province, although data are limited.

1.2 Executive Summary - Metallogenic Potential

This compilation has assessed the potential of each granite suite based on the criteria set out in the Project Proposal. Eight suites were recognised and only one, the volumetrically small Koongie Suite, is considered to have major mineral potential (Table 1.1). For the large volume of granite present in the Kimberley Province, no regional or district scale alteration zones have been defined, and aplites and pegmatites are very scarce (Sheppard *et al.*, in prep.). Despite the presence of highly reactive rock types (mafic igneous rocks, carbonates, iron formations, and carbonaceous shales), which in other provinces host significant granite-related mineralisation, no major Au or base metal deposits have been located within the granites, nor in the associated country rock. This study argues that the potential of the granites of the Kimberley Province is limited by the abundance of restite in the granite suites. Some late separation of restite resulted in limited fractionation in the West Kimberleys, particularly in the Lennard 1:250 000 sheet area. There is some evidence that this could have occurred in the East Kimberleys, but more analyses are required of rocks of high-SiO_2 contents (>75 wt%) to confirm this. Volcanics of the Koongie Park Formation were deposited in a subaqueous environment, which may explain their spatial association with small VHMS prospects. Again, there are insufficient analysed samples, particularly at the high-SiO_2 end, to determine if these volcanics are fractionated, although the comagmatic felsic volcanics are predominantly aphyric, indicating that the magma was predominantly liquid. The granites of the youngest suite, the Sans Sou Suite, being a Sybella type, may have some potential for minor Sn and perhaps Mo/W.

1.3 Future work

Because the majority of the granites in the Kimberley Province are interpreted as being restite-rich and unfractionated, they are not considered to have potential for significant mineralisation. However, before completely dismissing their metallogenic potential outright, further sampling of the more fractionated phases identified from the radiometric data is required. Some sampling of the altered phases visible in both the magnetic and radiometric data is also warranted. However, it is to be noted that given the extent of geochemical sampling in this region so far, combined with the lack of significant discoveries, the outlook does not seem to be all that promising.

1.4 Methods

Information Sources: 1:250 000 maps and notes, preliminary 1:100 000 maps and commentaries, published ages, the GSWA whole rock geochemical data, supplemented with data from AGSO OZCHEM data base, AGSO Minloc database, AGSO magnetics and gravity.

Classification of Granites: In this report the granites have been divided into suites essentially as defined by Sheppard *et al*. (1995) with some modifications (Table 1.1). Because of the large aerial extent of the Paperbark Supersuite in the Kimberley region, for the purpose of this project, the Supersuite has been subdivided into the west and east Kimberleys and dealt with in two separate chapters so that readers can more easily relate to the individual granite plutons of the two areas.

Host Rocks: The country rocks which are thought to be intruded by each suite have been summarised, and classified according to mineralogical characteristics thought to be important in determining the metallogenic potential of a granite intrusive event.

Relating Mineralisation: The method used has been to exclude all deposits more than 5 km from a known outcropping granite, then for those remaining, to make an assessment of the likelihood that they may be derived from granite intrusive activity (based on deposit style).

1.5 Acknowledgements

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1.7 Table 1.1

Chpt #	Grouping (Type)	Age (Ma)	Potential					Confid Level	Pluton
			Cu	Au	Pb/Zn	Sn	Mo/W		
5	Sophie Downs (Unclassified)	1910	None	None	None	None	None	221	Sophie Downs Granite
									Esaw Monzogranite
									Junda Microgranite
									Ding Dong Downs Volcanics
2	Paperbark *(West Kimberley)* (Kalkadoon)	1860	Low	Low	None	Low	None	321	Mount Amy Granite
									Barker Monzogranite
									Bickleys Porphyry
									Black Rock Granodiorite
									Cone Hill Granite
									Lerida Granite
									Mount Disaster Porphyry
									Cascade Bay Monzogranite
									Long Hole Granite
									Little Gold River Microgranodiorite
									Louisa Monzogranite
									Kongorow Granite
									King Granodiorite
									Lennard Granite
									Mondooma Granite
									McSherrys Granodiorite
									Nellie Tonalite
									Pillara Monzogranite
									Square Top Microgranite
									Richenda Microgranodiorite
									Scrutons Monzogranite
									Tarraji Microgranite
									Mulkerrins Granite
									Swift Monzogranite
									Dyasons Granite
									Chaneys Granite
									Secure Bay Monzogranite
									Whitewater Volcanics

Chpt #	Grouping (Type)	Age (Ma)	Potential					Confid Level	Pluton
			Cu	Au	Pb/Zn	Sn	Mo/W		
3	Paperbark *(East Kimberley)* (Nicholson)	1855	Low	Low	None	Low	None	321	Neville Granodiorite
									Gnewing Granodiorite
									Mussell Creek Granite
									Sandy Dam Monzogranite
									Togo Monzogranite
									Top Water Tonalite
									Airfield Granodiorite
									Paperbark Granite
									Pandanus Yard Monzogranite
									Tumagee Granite
									Mad Gap Monzogranite
									Castlereagh Hill Porphyry
									Greenvale Porphyry
									Beefwood Yard Granite
									Crooked Creek Granite
									Dinner Creek Tonalite
									Gordons Gorge Granite
									Matchbox Granite
									Mount Nulasy Granite
									Neil Creek Monzogranite
									Whitewater Volcanics
5	Dougalls (Sally Downs)	1850	None	None	None	Low	None	221	Dougalls Tonalite
									Monkey Yard Tonalite
									Corkwood Tonalite
									Dead Finish Tonalite
									Reedy Creek Granodiorite
5	Butchers Gully (Unclassified)	1850	Low	Low	None	None	None	221	Butchers Gully Member
									Maude Headley Member
5	**Koongie Park** (Unclassified)	**1840**	**High**	Low	**High**	Low	Low	221	Koongie Park Formation
									Angelo Microgranite

Chpt #	Grouping (Type)	Age (Ma)	Potential					Confid Level	Pluton
			Cu	Au	Pb/Zn	Sn	Mo/W		
4	Sally Downs (Nicholson)	1825	Low	Low/ Mod	None	Low	None	321	Grimpy Monzogranite
									Loadstone Monzogranite
									Violet Valley Granodiorite
									Dillinger Monzogranite
									Mount Christine Granite
									Mabel Downs Tonalite
									Corrara Granite
									Sally Downs Tonalite
									Mount Fairbairn Granite
									McHale Granodiorite
									Kevins Dam Monzogranite
									Koondooloo Monzogranite
									Magotty Springs Granite
									Granite of Shepherds Bore Plutonic Complex
									Wesley Yard Granite
									Radigans Yard Granodiorite
5	San Sou (Sybella)	1800	None	None	None	Low	Low	221	San Sou Monzogranite
									Eastman Granite

2 PAPERBARK SUPERSUITE (West Kimberley)

2.1 Timing

1860 Ma

2.2 Individual Ages

Primary Ages:

1. McSherrys Granodiorite	1862 ± 4 Ma, SHRIMP
2. Mondooma Granite	1862 ± 4 Ma, SHRIMP
3. Lennard Granite	1862 ± 4 Ma, SHRIMP
4. Lennard Granite	1862 ± 5 Ma, SHRIMP
5. Richenda Granite	1858 ± 5 Ma, SHRIMP
6. Whitewater Volcanics	1854 ± 5 Ma, SHRIMP
7. Kongorow Granite	1852 ± 4 Ma, SHRIMP

Sources: OZCHRON.

2.3 Regional Setting

Because of the extensiveness of the Paperbark Supersuite in the Kimberley region, for the purpose of this project, the Supersuite has been subdivided into the west and east Kimberleys and dealt with in two separate chapters. The Paperbark Supersuite in the west Kimberley incorporates the Hooper Complex (Griffin and Tyler 1992a), and was emplaced at around 1860 Ma. The Paperbark Supersuite covers a large area of at least 5500 km^2 and was intruded over a very short time interval from about 1862-1852 Ma. The suite contains extrusives (Whitewater Volcanics), shallow-level intrusives (including Mondooma Granite, Mount Disaster Porphyry, Bickleys Porphyry and Little Gold River Microgranodiorite) and deeper-level intrusives. The suite is relatively uniform over wide areas and no distinctive leucogranite bodies have been mapped. Many of the plutons are xenolith-rich, whilst the comagmatic volcanics are phenocryst-rich (up to 50% phenocrysts). The Supersuite has been variably deformed and metamorphosed to some degree.

The Paperbark Supersuite appears coeval with the Wombarella Quartz Gabbro. Some members of the suite intrude the metasedimentary rocks of the Marboo Formation, a sequence of variously deformed and metamorphosed mudstone, siltstone, greywacke and quartz wacke with dacitic and rhyolitic tuff in the upper part. This sequence is also intruded by the Ruins Dolerite. The boundary between the pre-1850 Ma rocks of the western Kimberleys and the overlying Kimberley Basin sequence is mostly a low-angle faulted contact (Griffin *et al.* 1993).

2.4 Summary

The suite is classified as I-(granodiorite) type. The dominant rock types present are granodiorite to monzogranite with less important tonalite and syenogranite. The presence of cognate xenoliths (xenoliths from a granite source, rather than host sediments) in some of the more mafic phases, combined with the abundance of phenocrysts in the comagmatic extrusives and high-level porphyries, suggest that for the most part, crystallisation of the Paperbark Supersuite was dominated by restite unmixing, with some late-stage fractionation occurring after restite separation to produce late exponential increases of Rb, U and Rb/Sr ratio at the highest SiO_2 concentrations. Most of these fractionated granites are in the Lennard River 1:250 000 Sheet area where some late fractionation is related to occurrences of Au, Sn and Cu deposits mainly in small quartz-vein deposits, none of which have yet been shown to have any significance. Some of these deposits may be unrelated to the intrusives of the Paperbark Supersuite, and they may in fact be related to younger fluid movement during the pervasive metamorphism and deformation that has affected all members of the Paperbark Supersuite to a greater or lesser extent.

2.5 Potential

The small Au and Cu deposits which occur in the vicinity of plutons of the Paperbark Supersuite are mostly quartz-vein deposits, whilst the tin deposits in the Dyasons Creek area are related to a pegmatite vein; none have yet been shown to have any significance. If these small deposits are definitely related to the granites, then it is probable that their small size is a function of the limited amount of fractionation that has occurred within the Paperbark Supersuite, combined with the absence of more appropriate host rocks such as ironstone and graphitic shale which host the more important granite-related mineral deposits in the Tennant Creek, Pine Creek and Granites-Tanami regions.

Cu:	**low**
Au:	**low**
Pb/Zn:	**none**
Sn:	**low**
Mo/W:	**none**
Confidence Level:	**321**

2.6 Descriptive Data

Location: West Kimberley Province (also known as the King Leopold Inlier). Outcrops on the Yampi, Charnley, Lennard River, Lansdowne, Noonkanbah and Mount Ramsay 1:250 000 Sheet areas.

Dimensions and area: Elongate series of intrusions extending 230 km by 40 km in a west-northwest direction. It has an outcrop area of 5460 km^2.

2.7 Intrusives

Component plutons: Mount Amy Granite, Barker Monzogranite, Bickleys Porphyry, Black Rock Granodiorite, Cascade Bay Monzogranite, Cone Hill Granite, Lerida Granite, Mount Disaster Porphyry, Long Hole Granite, Little Gold River Microgranodiorite, Louisa Monzogranite, Kongorow Granite, King Granodiorite, Lennard Granite, Mondooma Granite, McSherrys Granodiorite, Nellie Tonalite, Pillara Monzogranite, Square Top Microgranite, Richenda Microgranodiorite, Dyasons Granite, Secure Bay Monzogranite, Scrutons Monzogranite, unnamed granite, Tarraji Microgranite, Mulkerrins Granite, Swift Monzogranite, Chaneys Granite.

Form: Elongate linear batholith. Some individual intrusions are elongate parallel to the main axis of granite outcrop, others occur as small stocks. *Specifically:* Lennard Granite - a composite unit which consists of many stocks. Richenda Microgranite - two small stocks; Tarraji Microgranite - circular stock.

Metamorphism and Deformation: Most granites in the Paperbark Supersuite have a moderate to strong foliation defined by aligned phenocrysts, lenticular biotite aggregates and flattened biotite-rich mafic xenoliths. Recrystallisation of quartz and biotite is common, and most plagioclase grains are saussuritised with sericite dominant in the centre of some grains. Decussate biotite aggregates are present and may have formed during greenschist facies metamorphism of primary hornblende crystals. *Specifically:* Lennard Granite - biotite recrystallised to fine-grained mosaics. Scrutons Monzogranite - biotite altered to chlorite.

Dominant intrusive rock types: The dominant rock type is a coarse-grained porphyritic monzogranite with some granite texturally resembling the comagmatic Whitewater Volcanics. Granodiorite is also common, but tonalite and syenogranite are relatively minor. *Specifically*: Kongorow Granite - mainly porphyritic monzogranite and granodiorite, some coarsely banded gneissic granite. Lennard Granite - foliated coarse-grained porphyritic leucocratic biotite monzogranite with minor syenogranite and granodiorite. Mount Amy Granite - fine to coarse-grained leucocratic biotite-muscovite syenogranite, generally even-grained, although locally porphyritic. Mondooma Granite - foliated quartz-phyric biotite micro-monzogranite and a minor even-grained phase, which resembles coarse grained crystal-rich tuff of the Whitewater Volcanics but is distinguished from these because of the micro-granititc groundmass (it is possibly a shallow-level intrusive). Bickleys Porphyry - foliated fine-grained quartz-feldspar porphyry and porphyritic micromonzogranite. Mount Disaster Porphyry - foliated coarsely porphyritic biotite monzogranite. Lerida Granite - foliated porphyritic biotite-hornblende granodiorite and minor tonalite. Barker Monzogranite - weakly foliated fine-grained biotite monzogranite. Richenda Microgranodiorite - foliated medium to fine-gained granodiorite. And minor tonalite and monzogranite. Scrutons Monzogranite - coarse porphyritic biotite monzogranite. Secure Bay Monzogranite - foliated medium to fine-grained generally even-grained biotite monzogranite with minor syenogranite and granodiorite. Nellie Tonalite - foliated medium-grained hornblende-biotite tonalite, diorite and granodiorite. Cone Hill Granite - foliated coarsely porphyritic biotite-muscovite monzogranite. Square Top Microgranite - quartz-phyric microgranite. Mulkerrins Granite - coarse even-grained leucogranite. Long Hole Granite - coarse-grained porphyritic biotite granite. Little Gold River Microgranodiorite - orthopyroxene feldspar porphyry.

Xenoliths: Xenoliths are common in most intrusions, particularly the more mafic granite types. Although some are related to net-veined complexes, many appear to contain minerals that are the same as those in the host granite. *Specifically:* Kongorow Granite - high proportion of biotite-rich mafic xenoliths. Lennard Granite - mafic xenoliths are abundant locally, are biotite-rich or banded amphibolite. Mount Amy Granite - locally contains streaky xenoliths of darker granitoid parallel to the foliation. Lerida Granite - small mafic biotite-rich xenoliths are abundant locally. Barker Monzogranite - small mafic biotite-rich xenoliths. Chaneys Granite - locally contains small mafic biotite-rich xenoliths. McSherrys Granodiorite - small mafic amphibole-rich xenoliths are locally abundant. Cone Hill Granite - small amphibolite xenoliths. Little Gold River Microgranodiorite - abundant angular xenoliths.

Colour: Colour is not all that commonly recorded, although grey does seem to be the dominant colour, with the more mafic rock types being dark grey. Some flesh-coloured feldspars have been noted. *Specifically:* Kongorow Granite - dark grey. Mondooma Granite - grey to grey blue; Bickleys Porphyry - grey. Lennard Granite - grey-white. Long Hole Granite - grey. Little Gold River Microgranodiorite - dark grey.

Veins, Pegmatites, Aplites, Greisens: Unnamed aplite, pegmatite and porphyry dykes 1 to 5 m wide are widespread, particularly in the larger granite bodies. Specifically: Lennard Granite - thin aplite, pegmatite and quartz veins are widespread, but are most abundant close to the granite contact; Richenda Microgranodiorite - the western stock is intruded by narrow (<10 m) almost vertical dykes of aplite, fine-grained porphyry and microgranite; Nellie Tonalite - minor pegmatitic material; Cone Hill Granite - small veins of tourmaline-bearing aplite and pegmatite; Mulkerrins Granite - aplite, pegmatite.

Distinctive mineralogical characteristics: Biotite dominates over hornblende as the main ferromagnesian mineral, and orthopyroxene has been locally observed. Most intrusions record K-feldspar phenocrysts. *Specifically:* Lennard Granite - feldspar phenocrysts (up to 60 mm) dominate, constituting half the rock in some areas. Bickleys Porphyry - quartz phenocrysts are bipyramidal and plagioclase is strongly zoned. Mount Disaster Porphyry - phenocrysts of white or pink K-feldspar, plagioclase and blue-grey quartz. Lerida Granite - pale green plagioclase phenocrysts. Dyasons Granite - small biotite flakes scattered through the rock, some muscovite present. Tarraji Microgranite - K-feldspar, biotite and quartz are present as phenocrysts in a fine-grained groundmass dominated by quartz, K-feldspar and biotite. Little Gold River Microgranodiorite - phenocrysts of orthopyroxene, plagioclase, and magnetite.

Breccias: None recorded.

Alteration in the granite: Where present, appears related to later deformation/metamorphism.

2.8 Extrusives

The Whitewater Volcanics are considered to be comagmatic with granites of the Paperbark Supersuite. They consist of crystal-rich rhyolite, rhyodacite and dacite lava, tuff, agglomerate and minor volcaniclastic sedimentary rocks. Phenocryst abundance is often up to 50% by volume.

2.9 Country Rock

Contact metamorphism: Contacts are mostly with other granite types, although contact metamorphic aureoles have been noted where the granites intrude metasediments. *Specifically:* Kongorow Granite - most contacts are shear zones. Lennard Granite - retrogression of some minerals in the Mount Joseph Migmatite. Tarraji Microgranite - an aureole up to 1 km wide with poikiloblastic andalusite and some cordierite intergrown with biotite, muscovite, and quartz.

Reaction with country rock: None recorded.

Units the granite intrudes: Marboo Formation, Whitewater Volcanics, Ruins Dolerite and Mount Joseph Migmatite.

Dominant rock types: The dominant rock types consist of mudstones and quartz-rich greywacke of the Marboo Formation. One thin carbonaceous unit has been observed in the

Marboo Formation, interlayered with the Ruins Dolerite in the Richenda Anticline (Ian Tyler, *pers. comm.*). Apart from the Ruins Dolerite no iron-rich rocks such as banded iron formations or metasomatic ironstones have been recorded. Specifically: Marboo Formation - turbidites of interbedded mudstone, siltstone and quartz wacke, with dacitic and rhyolitic tuff in the upper part. Thin calcareous layers are present throughout. Whitewater Volcanics - flow banded porphyritic rhyodacite lava and crystal tuff. Ruins Dolerite - layered and amphibolitised mafic sills. Mount Joseph Migmatite - migmatitic pelite and psammopelite.

Potential hosts: Mudstones of the Marboo Formation and amphibolites of the Ruins Dolerite.

2.10 Mineralisation

No significant mineral deposits have been found either within the granite or within the country rock, and not much detail has been published on any of the prospects. Gold has been recorded from quartz reefs in the Marboo Formation and Whitewater Volcanics, and tin has been reported from alluvials in the Dyasons Creek area, all on the LENNARD RIVER 1:250 000 Sheet area. Copper occurrences are in the Marboo Formation on the LENNARD RIVER and YAMPI 1:250 000 Sheet areas, whilst some chalcopyrite has been recorded from the Lennard Granite. A cassiterite and wolfram deposit occurs in the Marboo Formation in the southeast of the CHARNLEY 1:250 000 Sheet area, and alluvial cassiterite has been noted in streams draining areas with thin cassiterite-bearing quartz veins and greisens. Gellatly *et al*. (1974b) reported that some specimens of granite from the CHARNLEY and YAMPI 1:250 000 Sheet areas fluoresce, and contain up to 80 ppm Sn, 20 ppm W and 5 ppm Mo. Some Pb has also been recorded in veins within sheared granite and also in the Marboo Formation. Some of this Pb may be Palaeozoic. Ian Tyler (*pers. comm.*) has noted that the thin carbonaceous unit in the Marboo Formation in the Richenda anticline hosts small Cu, Pb and Zn prospects; it is unknown if these deposits are related to a granitic intrusive.

2.11 Geochemical Data

Data source: GSWA data set, some AGSO analyses. Data are available from the GSWA and the AGSO OZCHEM data base. The samples are plotted in Figures 2.2 to 2.7. As there were so many units, unique symbols were not available for all units and some were grouped together based on field and petrographic descriptions.

Data quality: Good.

Are the data representative? There may not be sufficient samples of the more fractionated varieties.

Are the data adequate? Only if it can be shown that the most felsic samples have been collected.

SiO_2 range (Fig. 2.1): The SiO_2 range is from around 60 wt% to 77 wt% with a peak between 68 and 74 wt.%.

Alteration (Figs. 2.1 & 2.2):

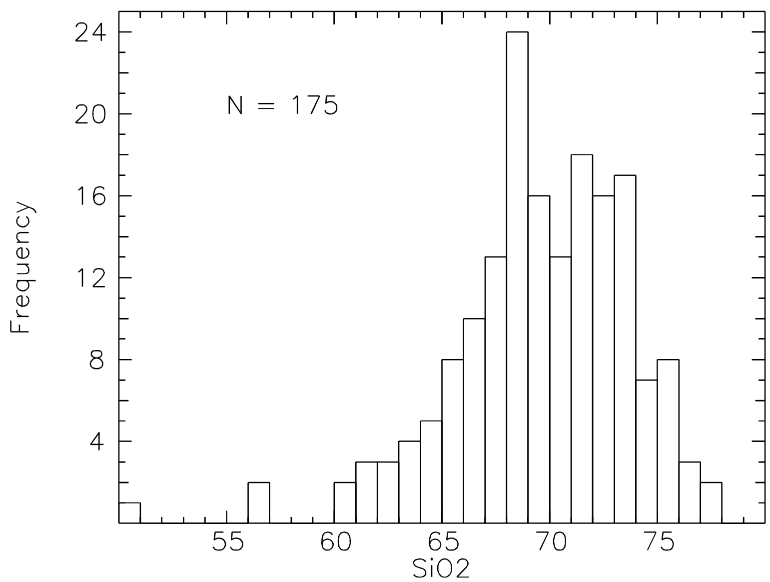

Figure 2.1. Histogram of SiO_2 values for the Paperbark Supersuite

- ***SiO_2:*** Silicification has been noted in the Mulkerrins Granite.
- ***K_2O/Na_2O:*** Some K enrichment evident in a few samples.
- ***Th/U:*** Some samples have lost U, probably during the subsequent deformation.
- ***$Fe_2O_3/(FeO+Fe_2O_3)$:*** Some samples are relatively more oxidised, particularly the volcanics.

Fractionation Plots (Fig. 2.3):

- ***Rb:*** Linear increase with some evidence of a weak exponential trend in the Whitewater Volcanics and some of the intrusives at the highest SiO_2 levels.
- ***U:*** Linear increase with some evidence of a weak exponential trend in some of the intrusives at the highest SiO_2 levels.
- ***Y:*** General weak increase with increasing SiO_2.
- ***P_2O_5:*** Gradual decrease with increasing SiO_2.
- ***Th:*** Weak linear increase with increasing SiO_2.
- ***K/Rb:*** No significant trend.
- ***Rb-Ba-Sr:*** Only a few samples plot in the strongly differentiated field.
- ***Sr:*** Decreases with increasing SiO_2.
- ***Rb/Sr:*** Linear increase with some evidence of a weak exponential trend in the Whitewater Volcanics and some of the intrusives at the highest SiO_2 levels.
- ***Ba:*** Scattered trend, but general overall decrease with increasing SiO_2.
- ***F:*** No data available.

Metals (Fig. 2.4):

- ***Cu:*** Mostly low values, some moderate to high values.
- ***Pb:*** Increases linearly with increasing SiO_2, presumably reflecting the increasing modal abundance of K-feldspar.
- ***Zn:*** Decreases linearly with increasing SiO_2, presumably reflecting decreasing modal abundance of mafic minerals.
- ***Sn:*** Linear increase with some evidence of a weak exponential trend in the Whitewater Volcanics and some of the intrusives at the highest SiO_2 levels.

High field strength elements (Fig. 2.5):

- ***Zr:*** Relatively low levels of abundance.
- ***Nb:*** Relatively low levels of abundance.
- ***Ce:*** Relatively low levels of abundance.

Classification (Fig. 2.6):

- ***The $CaO/Na_2O/K_2O$ plot of White, quoted in Sheraton and Simons (1992):*** Most samples plot in the granodiorite to monzogranite field.
- ***Zr/Y vs Sr/Sr*:*** Nd is not available for the GSWA samples. Those samples that have data plot below the 1.0 line as is typical of Sr-depleted samples.
- ***Spidergram:*** The samples have a typically Sr-depleted, Y-undepleted pattern as is typical of most Proterozoic felsic igneous rocks.
- ***Oxidation plot of Champion and Heinemann (1994):*** Most samples are oxidised, although some plutons (e.g., Chaneys Granite) plot in the reduced field. Some of the reduced samples are close to outcrops of Marboo Formation.
- ***ASI:*** Most samples are metaluminous to weakly peraluminous.
- ***A-type plot of Eby (1990):*** The samples straddle the boundary between A-types and normal granites as defined for Palaeozoic granites.

Granite type (Chappell and White 1974; Chappell and Stephens 1988): I-(granodiorite) type.

Australian Proterozoic granite type: Nicholson type.

2.12 Geophysical Signature

Radiometrics (Fig. 2.7): Most samples plot above the Proterozoic median for K_2O, Th and U. Some of the more mafic groups have distinctly lower Th and U (Richenda Microgranodiorite, Nellie Tonalite, Black Rock Granodiorite) and would appear red in a RGB image, whilst some groups are relatively lower in U and would appear yellow.

Gravity: The elongate outlines of the Paperbark Supersuite generally overlie a gravity low, with the Richenda Anticline overlying a gravity high.

Magnetics: For an I-type granite, the Paperbark Supersuite has an unusually low magnetic response.

2.13 References

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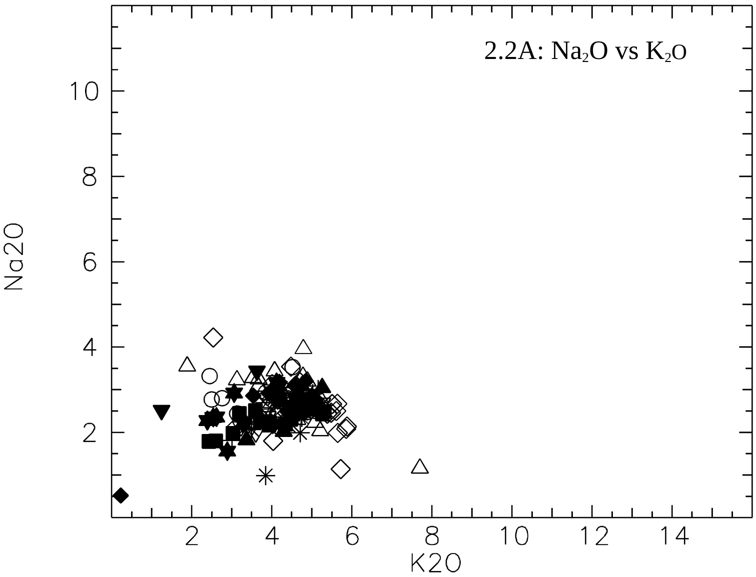
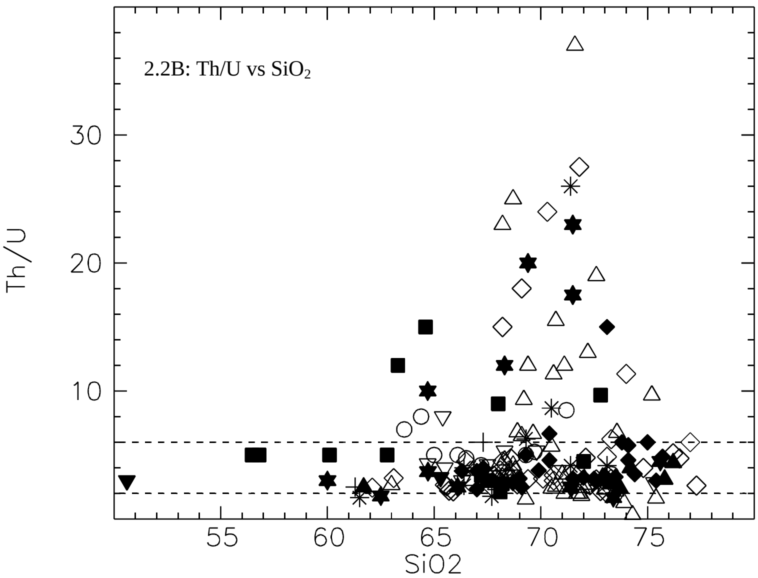
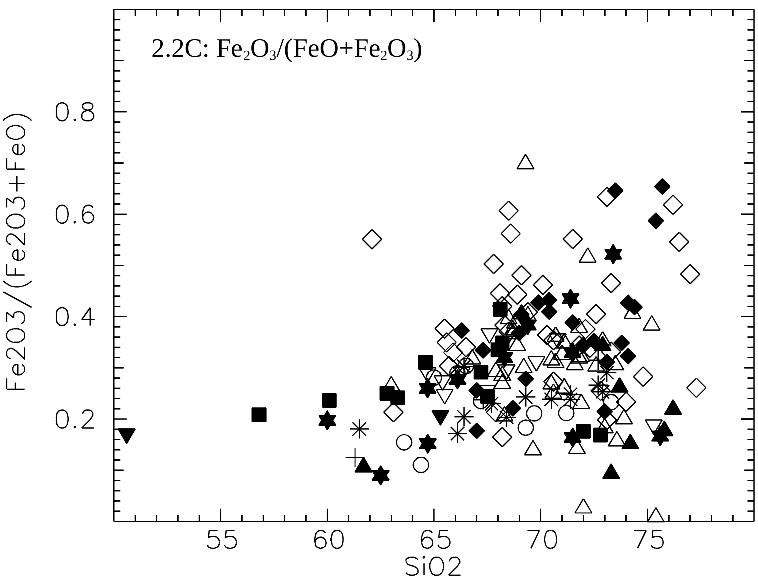
Legend

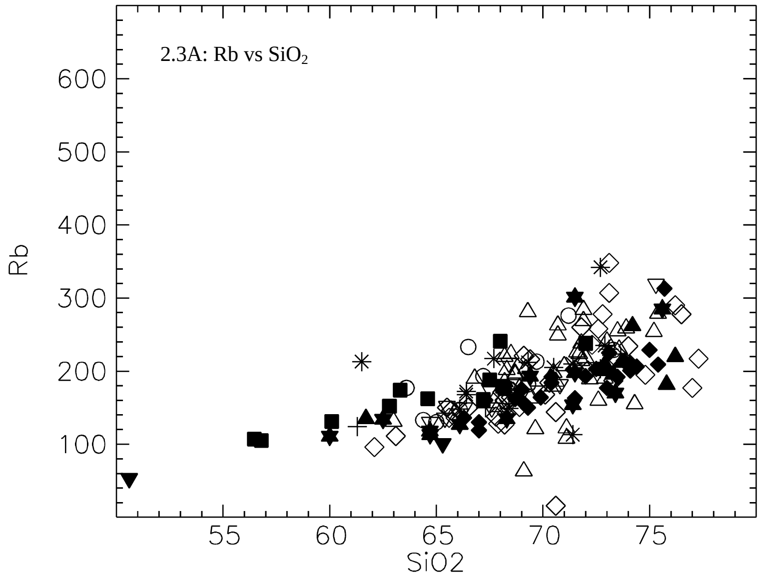

Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
Whitewater Volcanics
Louisa Microgranite
Pillara Monzogranite
Black Rock Granodior
Little Gold River
Square Top Granite
King Granodiorite
Swift Monzogranite


2.2A: Na_2O vs K_2O
Na2O
K2O
2
4
6
8
10
12
14

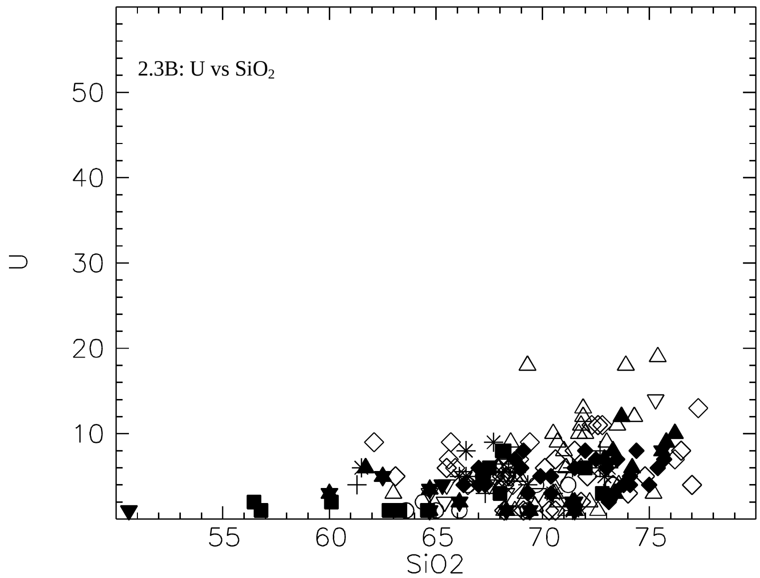

2.2B: Th/U vs SiO_2
Th/U
10
20
30
SiO2
55
60
65
70
75

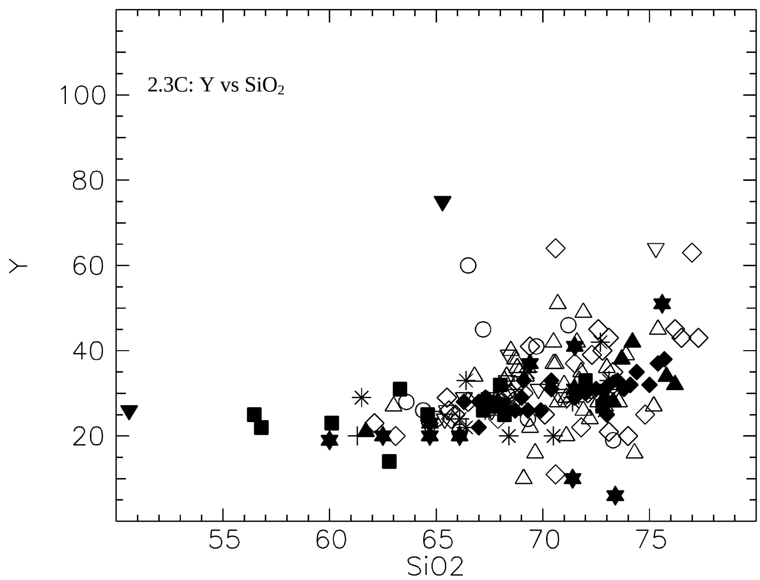

2.2C: $Fe_2O_3/(FeO+Fe_2O_3)$
Fe2O3/(Fe2O3+FeO)
0.2
0.4
0.6
0.8
SiO2
55
60
65
70
75

Legend

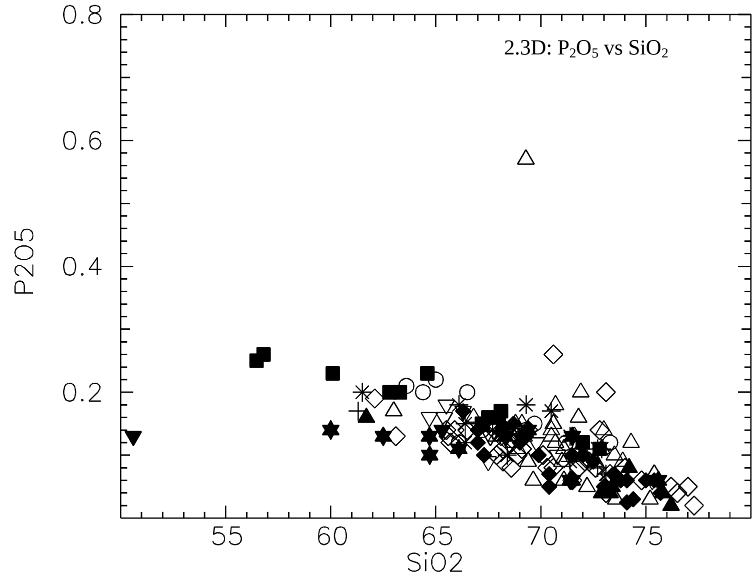

2.3A: Rb vs SiO2
600
500
400
300
200
100
Rb
55
60
65
70
75
SiO2


Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
Whitewater Volcanics
Louisa Microgranite
Pillara Monzogranite
Black Rock Granodior
Little Gold River
Square Top Granite
King Granodiorite
Swift Monzogranite


2.3B: U vs SiO2
50
40
30
20
10
U
55
60
65
70
75
SiO2


2.3C: Y vs SiO2
100
80
60
40
20
Y
55
60
65
70
75
SiO2

Legend


2.3D: P_2O_5 vs SiO_2
0.8
0.6
0.4
0.2
P2O5
55
60
65
70
75
SiO2


Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
Whitewater Volcanics
Louisa Microgranite
Pillara Monzogranite
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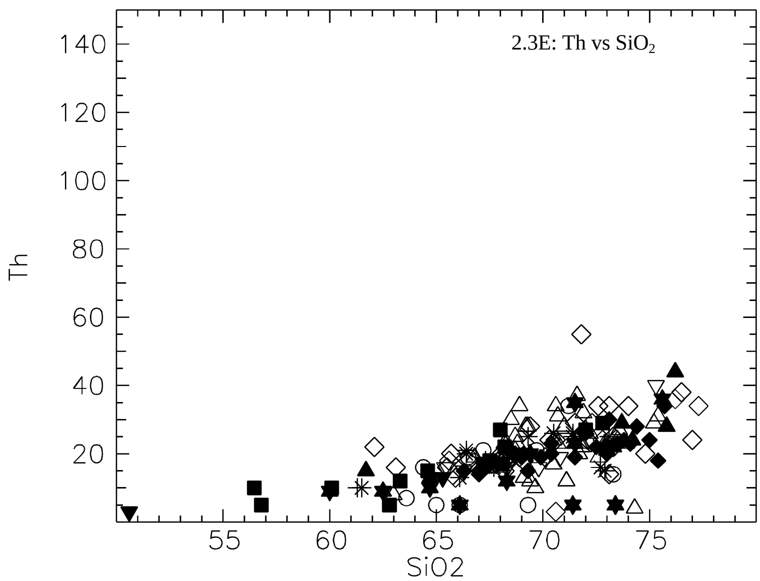
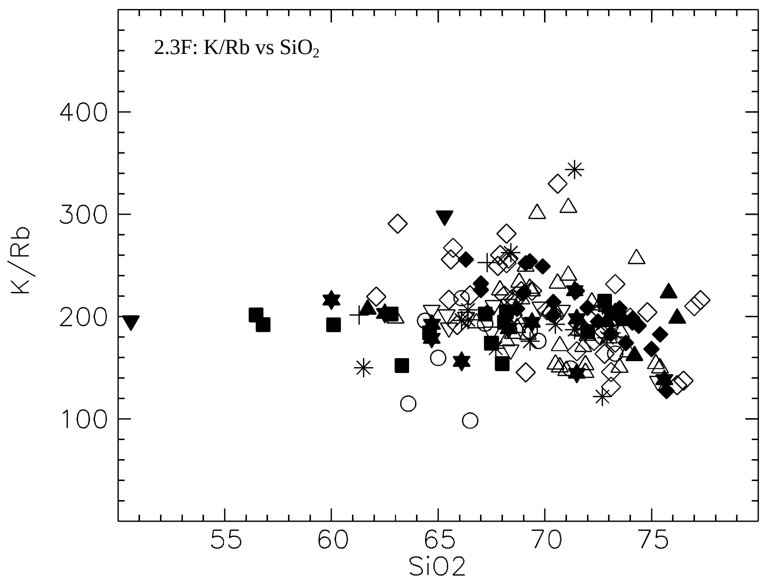
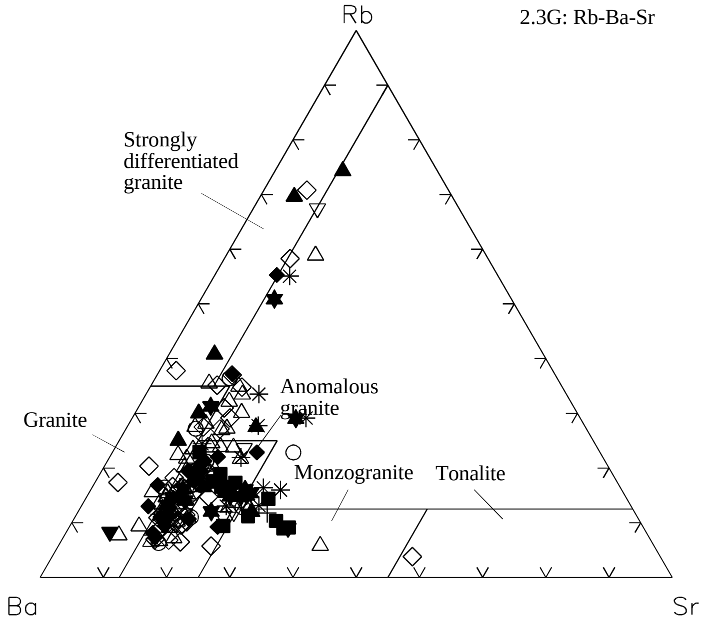
Little Gold River
Square Top Granite
King Granodiorite
Swift Monzogranite


2.3E: Th vs SiO_2
140
120
100
80
60
40
20
Th
55
60
65
70
75
SiO2


2.3F: K/Rb vs SiO_2
400
300
200
100
K/Rb
55
60
65
70
75
SiO2

Legend


2.3G: Rb-Ba-Sr
Rb
Ba
Sr
Strongly differentiated granite
Granite
Anomalous granite
Monzogranite
Tonalite


Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
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McSherrys Granodiori
Mondooma Granite
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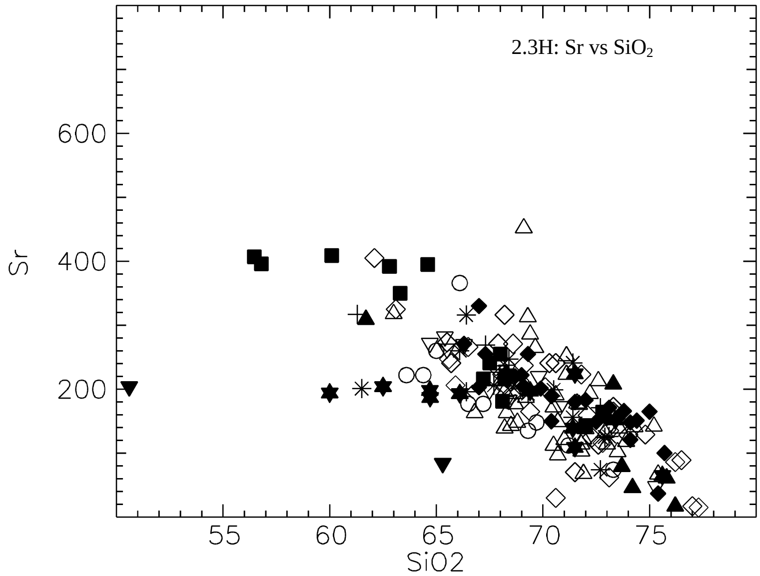
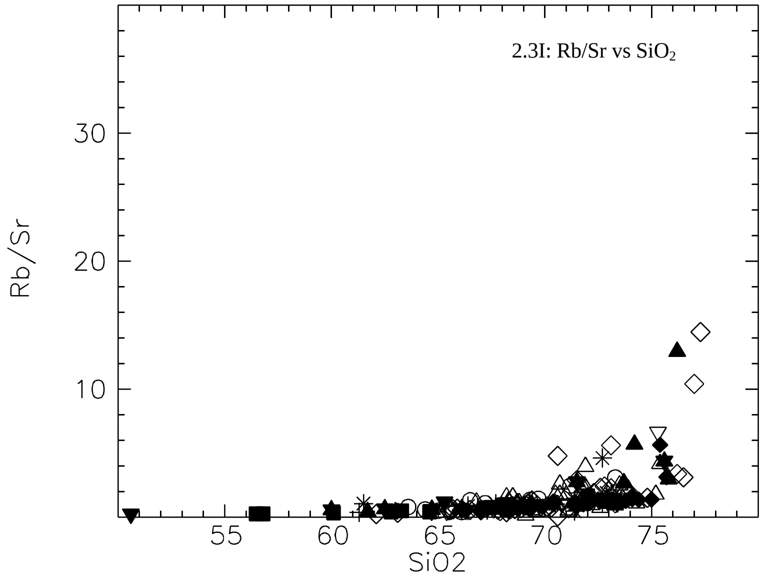
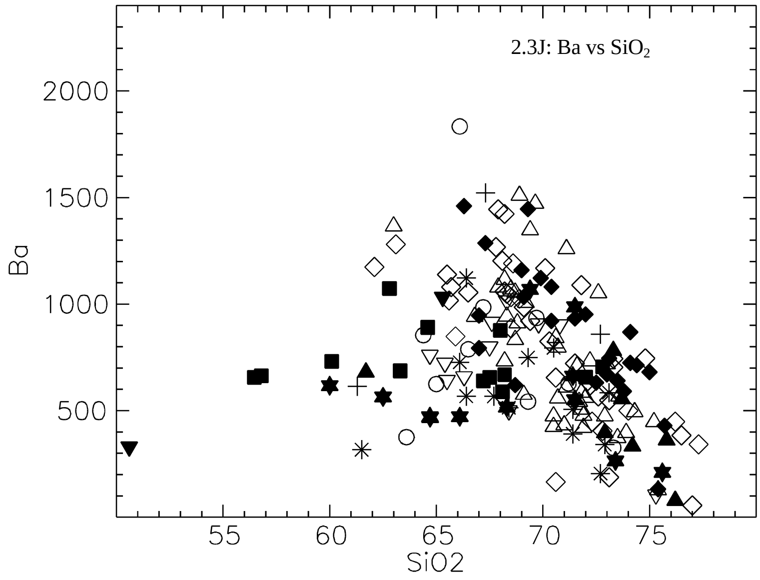
Swift Monzogranite


2.3H: Sr vs SiO_2
Sr
SiO2
200
400
600
55
60
65
70
75


2.3I: Rb/Sr vs SiO_2
Rb/Sr
SiO2
10
20
30
55
60
65
70
75

Legend



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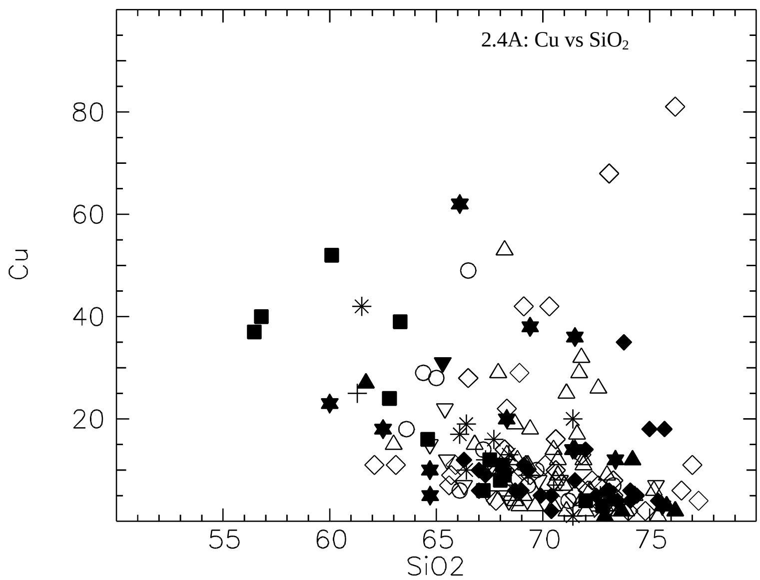

Legend


Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
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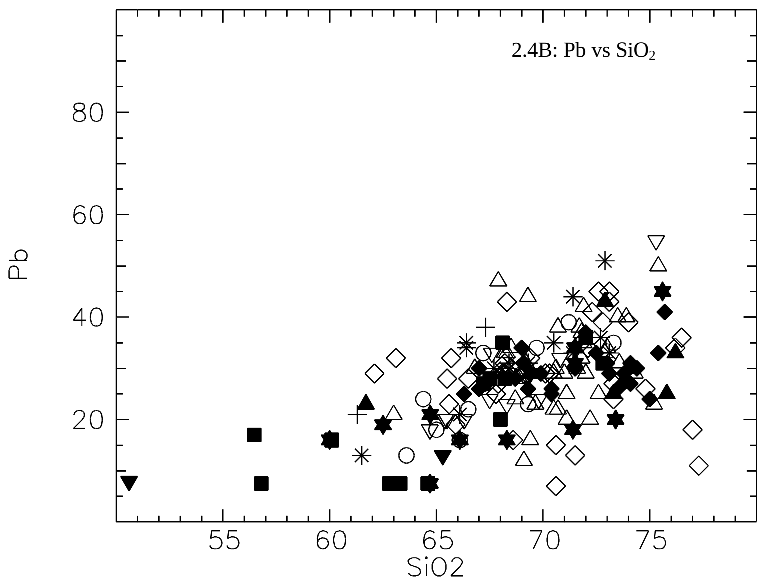
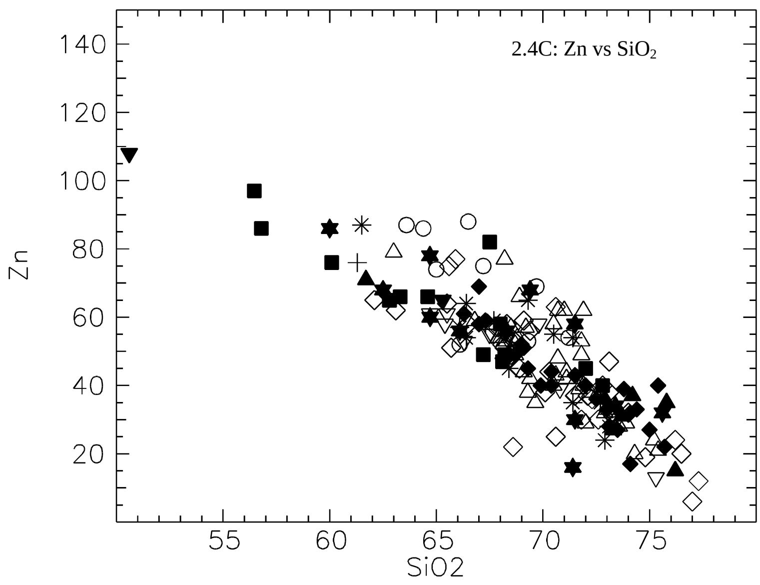
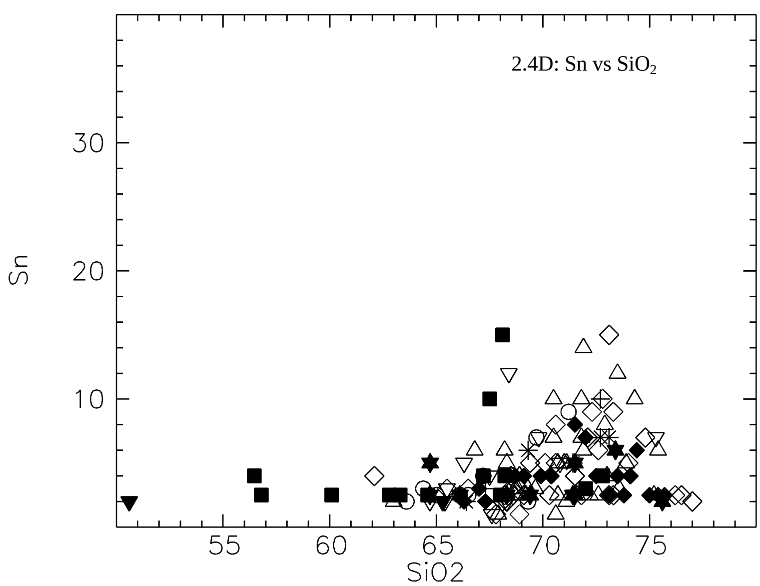
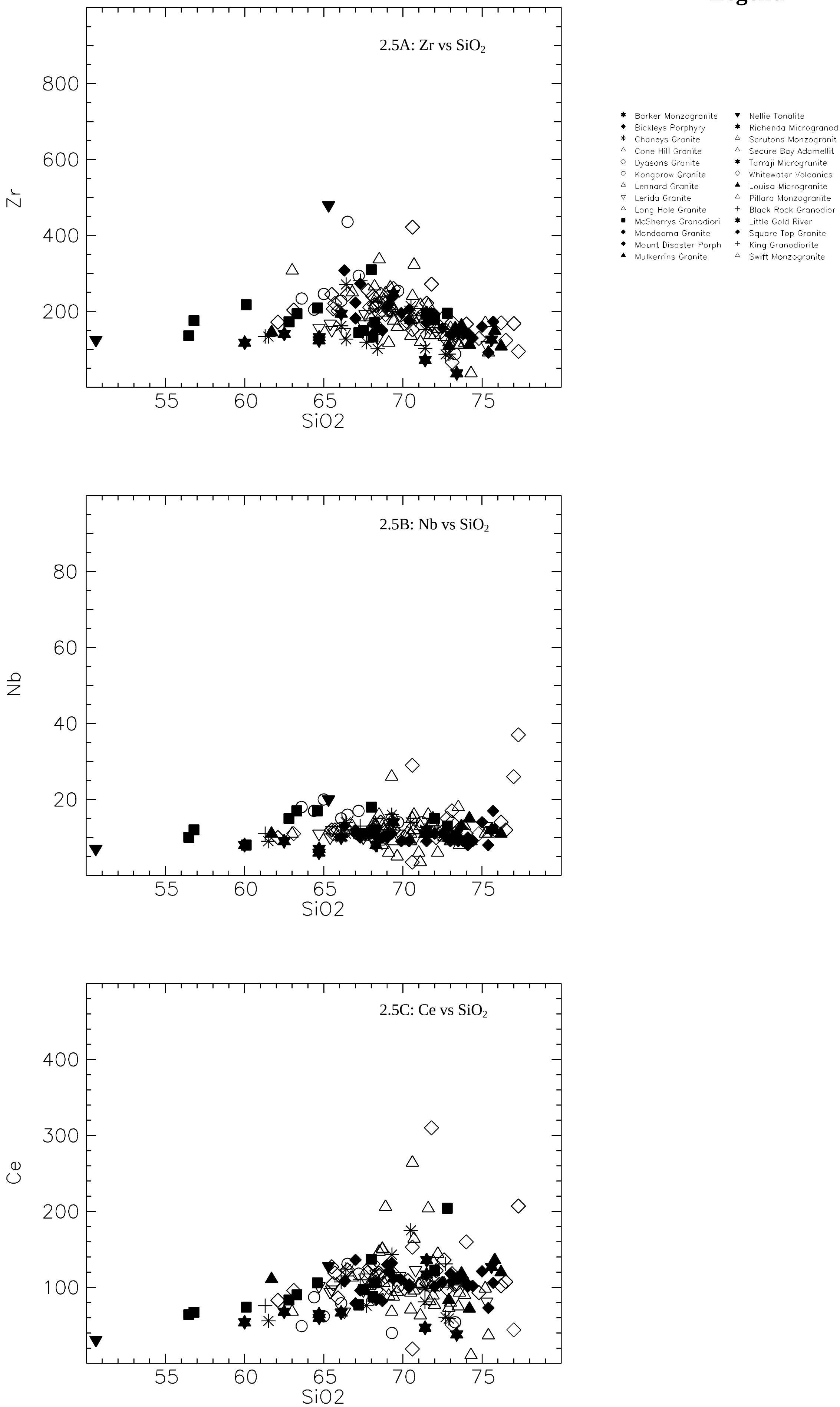
Swift Monzogranite


2.4B: Pb vs SiO_2
Pb
80
60
40
20
55
60
65
70
75
SiO2


2.4C: Zn vs SiO_2
Zn
140
120
100
80
60
40
20
55
60
65
70
75
SiO2


2.4D: Sn vs SiO_2
Sn
30
20
10
55
60
65
70
75
SiO2

Legend


2.5A: Zr vs SiO_2
Zr
SiO2
2.5B: Nb vs SiO_2
Nb
SiO2
2.5C: Ce vs SiO_2
Ce
SiO2
Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
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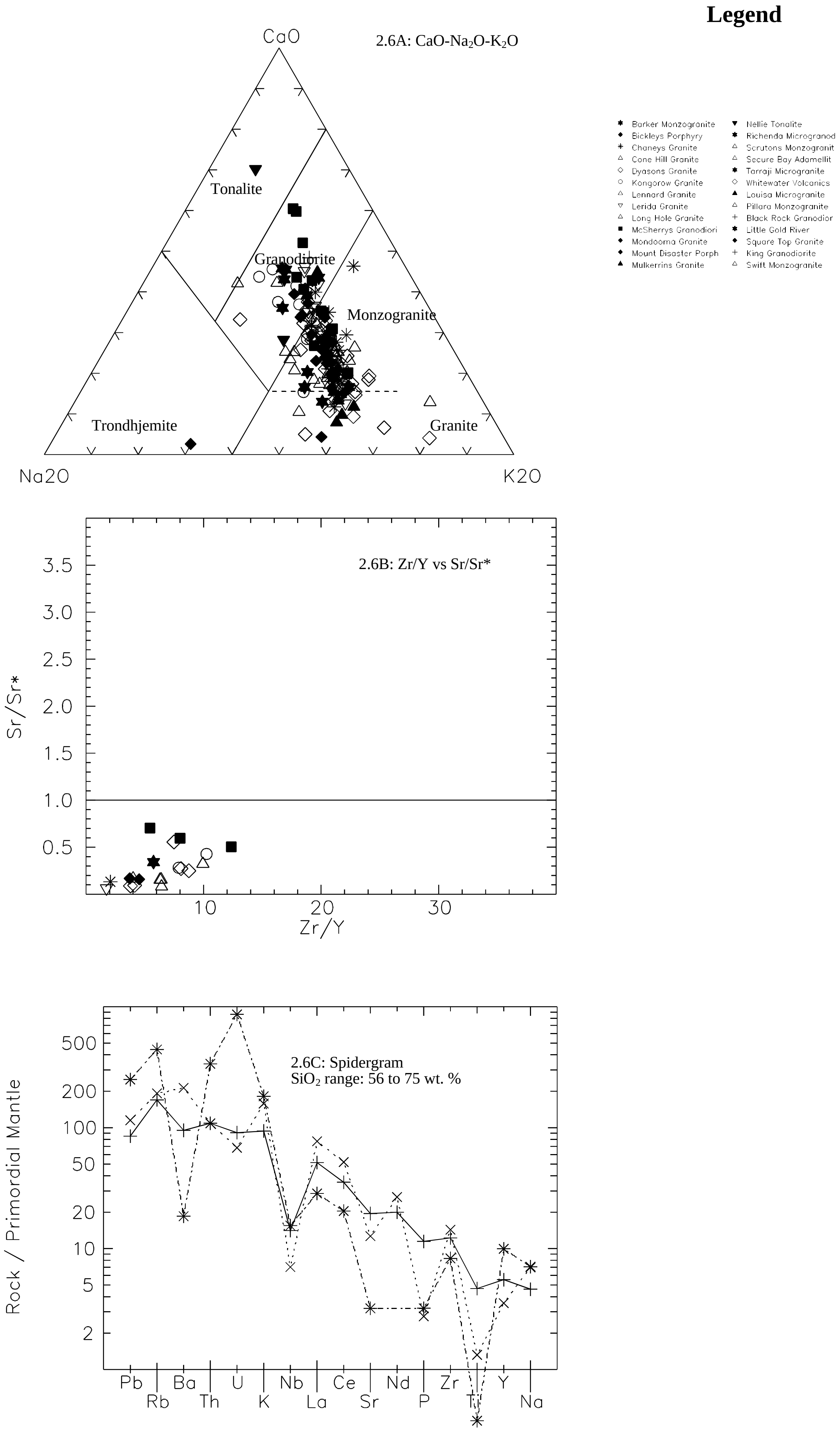
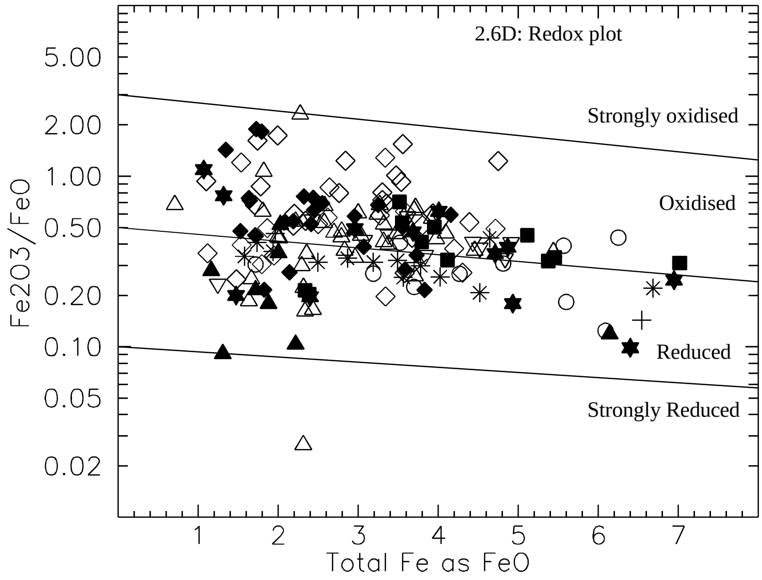
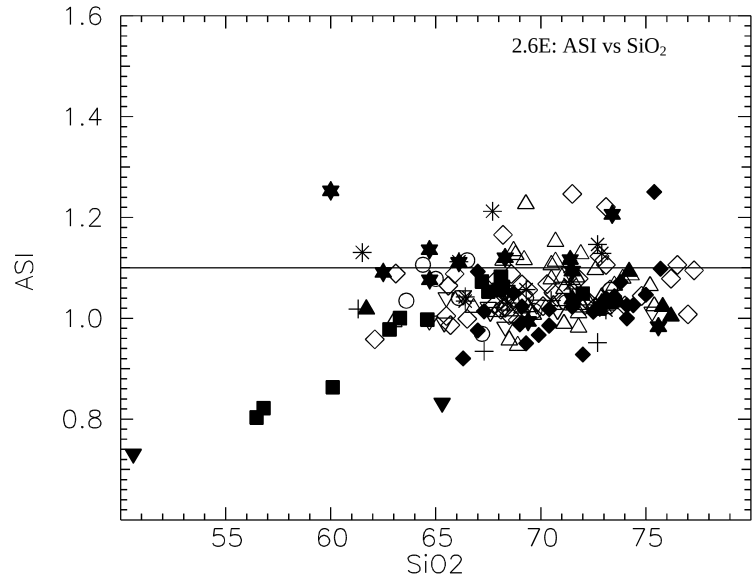
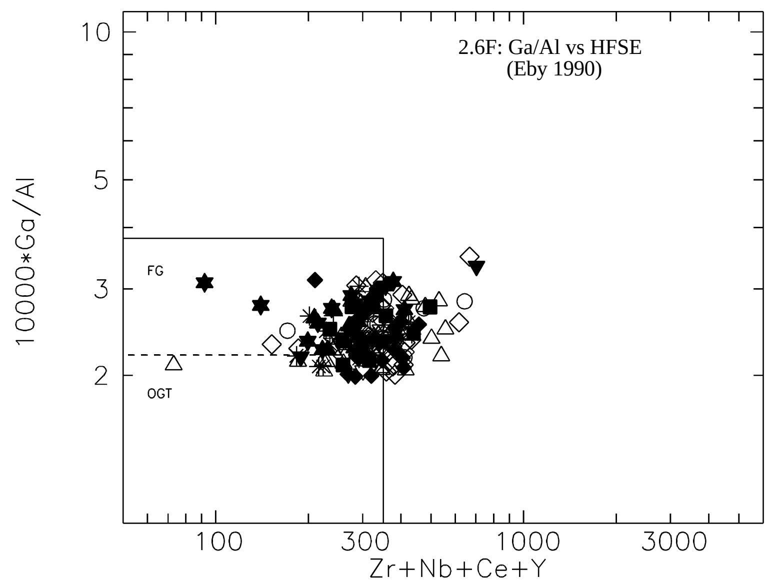

Legend
Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
Whitewater Volcanics
Louisa Microgranite
Pillara Monzogranite
Black Rock Granodior
Little Gold River
Square Top Granite
King Granodiorite
Swift Monzogranite
2.6A: CaO-Na2O-K2O
CaO
Na2O
K2O
Tonalite
Granodiorite
Monzogranite
Trondhjemite
Granite
2.6B: Zr/Y vs Sr/Sr*
Sr/Sr*
Zr/Y
0.5
1.0
1.5
2.0
2.5
3.0
3.5
10
20
30
2.6C: Spidergram
SiO2 range: 56 to 75 wt. %
Rock / Primordial Mantle
2
5
10
20
50
100
200
500
Pb
Rb
Ba
Th
U
K
Nb
La
Ce
Sr
Nd
P
Zr
Ti
Y
Na

Legend

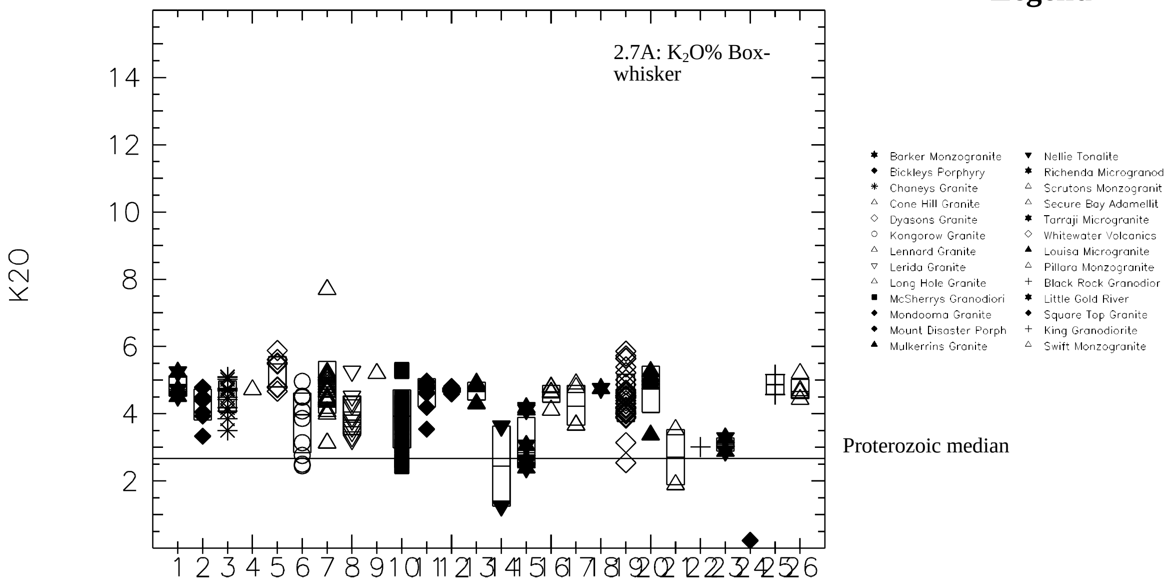

Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
Nellie Tonalite
Richenda Microgranod
Scrutons Monzogranit
Secure Bay Adamellit
Tarraji Microgranite
Whitewater Volcanics
Louisa Microgranite
Pillara Monzogranite
Black Rock Granodior
Little Gold River
Square Top Granite
King Granodiorite
Swift Monzogranite


2.6D: Redox plot
Strongly oxidised
Oxidised
Reduced
Strongly Reduced
Fe2O3/FeO
5.00
2.00
1.00
0.50
0.20
0.10
0.05
0.02
1
2
3
4
5
6
7
Total Fe as FeO


2.6E: ASI vs SiO_2
ASI
1.6
1.4
1.2
1.0
0.8
55
60
65
70
75
SiO2


2.6F: Ga/Al vs HFSE
(Eby 1990)
10000*Ga/Al
10
5
3
2
FG
OGT
100
300
1000
3000
Zr+Nb+Ce+Y

Legend


2.7A: K_2O% Box-whisker
K2O
14
12
10
8
6
4
2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Proterozoic median
Barker Monzogranite
Bickleys Porphyry
Chaneys Granite
Cone Hill Granite
Dyasons Granite
Kongorow Granite
Lennard Granite
Lerida Granite
Long Hole Granite
McSherrys Granodiori
Mondooma Granite
Mount Disaster Porph
Mulkerrins Granite
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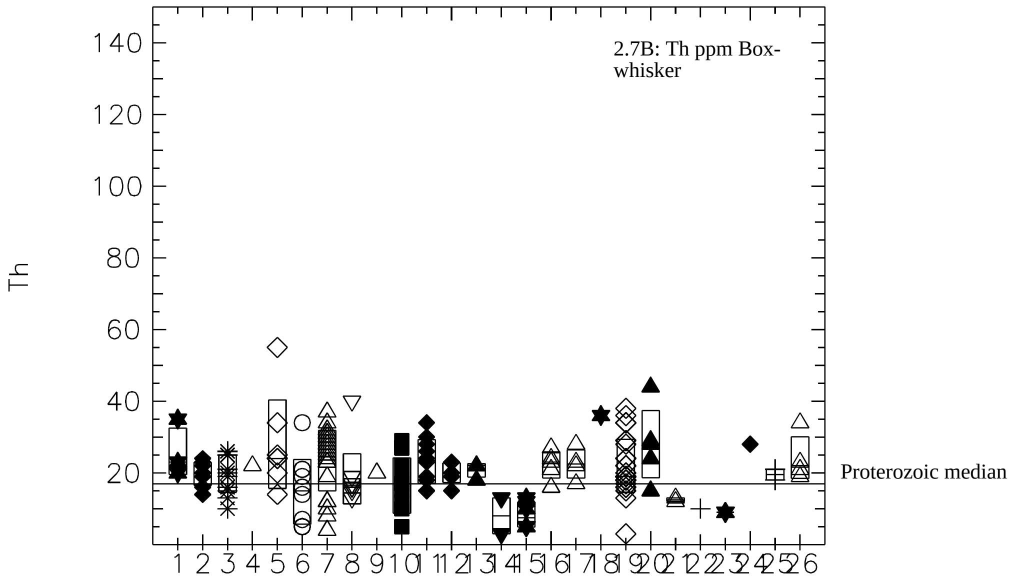
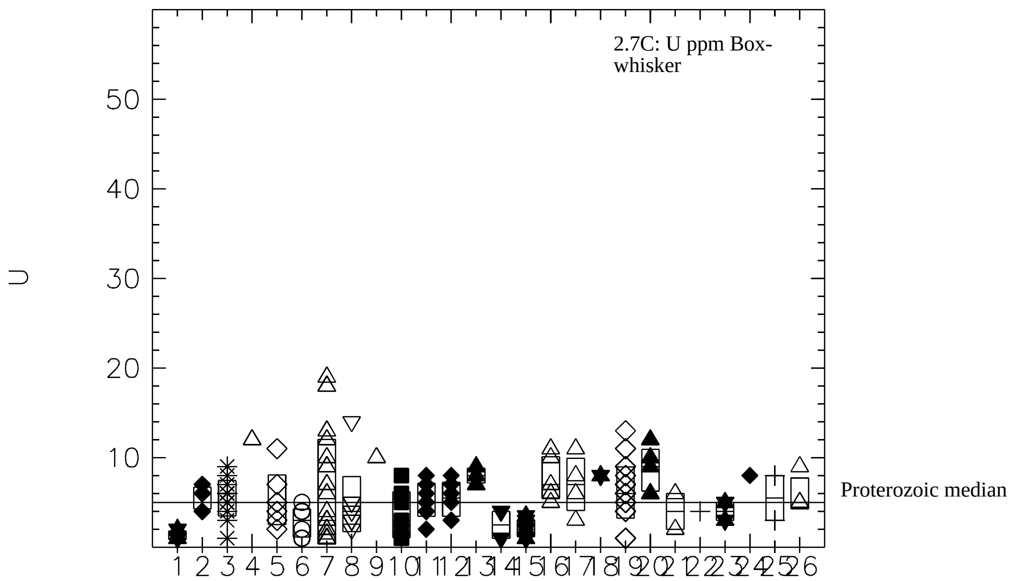
Pillara Monzogranite
Black Rock Granodior
Little Gold River
Square Top Granite
King Granodiorite
Swift Monzogranite


2.7B: Th ppm Box-whisker
Th
140
120
100
80
60
40
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Proterozoic median


2.7C: U ppm Box-whisker
U
50
40
30
20
10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Proterozoic median

Barker Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	No. of Items
SiO2	70.8	71.5	1.21	69.4	71.5	3
TiO2	0.35	0.33	0.13	0.23	0.49	3
Al2O3	13.87	13.9	0.45	13.4	14.3	3
Fe2O3	1	1.01	0.6	0.4	1.6	3
FeO	2.22	2.05	0.3	2.04	2.57	3
MnO	0.05	0.05	0.02	0.04	0.07	3
MgO	0.54	0.5	0.15	0.41	0.71	3
CaO	2.24	2.37	0.64	1.54	2.8	3
Na2O	2.62	2.64	0.13	2.49	2.74	3
K2O	4.83	4.72	0.37	4.52	5.24	3
P2O5	0.11	0.13	0.04	0.06	0.14	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.11	0.13	0.07	0.03	0.16	3
LOI	1.16	1.18	0.06	1.1	1.21	3
Ba	869.33	987	277.86	552	1069	3
Li	27	27	9	18	36	3
Rb	230.67	198	60.96	193	301	3
Sr	176.67	197	60.14	109	224	3
Pb	31.33	31	2.52	29	34	3
Th	26	23	7.94	20	35	3
U	1.33		0.58		2	3
Zr	210.67	196	31.66	189	247	3
Nb	12.33	12	1.53	11	14	3
Y	36.33	37	5.03	31	41	3
La	68.9	66.7	4.43	66	74	3
Ce	121.67	117	12.66	112	136	3
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	7.33	6	2.31	6	10	3
V	19.33	18	6.11	14	26	3
Cr	5		-			3
Mn	-	-	-	-	-	-
Co	-	-	-	-	-	-
Ni	2.33	2	0.58	2	3	3
Cu	29.33	36	13.32	14	38	3
Zn	52	58	19.7	30	68	3
Sn	3.33		1.44		5	3
W	-	-	-	-	-	-
Mo	2.5		-			3
Ga	21.67	22	1.53	20	23	3
As	-	-	-	-	-	-
S	44.17	53	15.3	5	53	3
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Bickleys Porphyry

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	70.99	72	2.9	67	74.1	8
TiO2	0.29	0.25	0.13	0.1	0.46	8
Al2O3	13.77	13.65	0.87	12.6	15.5	8
Fe2O3	0.78	0.77	0.25	0.47	1.23	8
FeO	1.97	1.64	0.77	1.07	3.21	8
MnO	0.05	0.04	0.01	0.02	0.06	8
MgO	0.85	0.51	0.69	0.18	2.21	8
CaO	2.56	2.36	0.72	1.48	3.57	8
Na2O	2.55	2.59	0.24	2.21	2.91	8
K2O	4.27	4.4	0.49	3.33	4.79	8
P2O5	0.09	0.09	0.03	0.05	0.15	8
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.13	0.13	0.08	0.07	0.18	2
LOI	1.07	0.93	0.41	0.63	1.86	8
Ba	799.13	731.5	233.06	591	1286	8
Li	28	25.5	11.4	12	44	8
Rb	174.88	170	30.84	119	214	8
Sr	181.13	173	43.11	121	255	8
Pb	29.38	29.5	2.07	27	33	8
Th	19.75	20	3.41	14	24	8
U	5.5	6	1.31	4	7	8
Zr	168.63	153	44.97	139	273	8
Nb	9.88	10	0.83	9	11	8
Y	28.13	29	3.48	22	32	8
La	52.13	53.5	7.23	37	62.5	8
Ce	101.74	105.5	14.88	79	118	8
Pr	-	-	-	-	-	-
Nd	51.6	51.6	-	51.6	51.6	1
Sc	6.75	5.5	2.6	4	11	8
V	18.75	12	13.35	5	40	8
Cr	15	15	5.66	11	19	2
Mn	-	-	-	-	-	-
Co	6.83	5.5	4.62	2	13	6
Ni	17.75	13	11.85	4	37	8
Cu	9.88	6	10.27	4	35	8
Zn	43.13	41	16.08	17	69	8
Sn	4.08	4	2.11		8	6
W	3.5	3.5	1.52		6	6
Mo	2.64	2	0.94		4	7
Ga	16.88	17	1.73	15	19	8
As	7	9	4.36	2	10	3
S	94.13	100	16.62	53	100	8
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Black Rock Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	61.3	61.3	-	61.3	61.3	1
TiO2	0.68	0.68	-	0.68	0.68	1
Al2O3	14.3	14.3	-	14.3	14.3	1
Fe2O3	0.83	0.83	-	0.83	0.83	1
FeO	5.8	5.8	-	5.8	5.8	1
MnO	0.11	0.11	-	0.11	0.11	1
MgO	5.18	5.18	-	5.18	5.18	1
CaO	4.52	4.52	-	4.52	4.52	1
Na2O	1.81	1.81	-	1.81	1.81	1
K2O	3.01	3.01	-	3.01	3.01	1
P2O5	0.17	0.17	-	0.17	0.17	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	1.4	1.4	-	1.4	1.4	1
Ba	614	614	-	614	614	1
Li	38	38	-	38	38	1
Rb	124	124	-	124	124	1
Sr	317	317	-	317	317	1
Pb	21	21	-	21	21	1
Th	10	10	-	10	10	1
U	4	4	-	4	4	1
Zr	134	134	-	134	134	1
Nb	11	11	-	11	11	1
Y	20	20	-	20	20	1
La	39	39	-	39	39	1
Ce	76	76	-	76	76	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	19	19	-	19	19	1
V	108	108	-	108	108	1
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	26	26	-	26	26	1
Ni	72	72	-	72	72	1
Cu	25	25	-	25	25	1
Zn	76	76	-	76	76	1
Sn	-	-	-	-	-	-
W	2		-			1
Mo	6	6	-	6	6	1
Ga	20	20	-	20	20	1
As	-	-	-	-	-	-
S	300	300	-	300	300	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Chaneys Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	69.06	69.3	3.41	61.5	73.1	13
TiO2	0.38	0.42	0.17	0.14	0.62	13
Al2O3	14.07	14	0.58	13.1	15	13
Fe2O3	0.8	0.78	0.28	0.41	1.45	13
FeO	2.71	2.71	1.19	1.21	5.58	13
MnO	0.06	0.05	0.02	0.03	0.11	13
MgO	1.46	1.07	1.14	0.27	4.06	13
CaO	2.53	2.68	0.93	1.05	4.18	13
Na2O	2.33	2.4	0.5	0.99	2.91	13
K2O	4.51	4.68	0.49	3.5	5.1	13
P2O5	0.13	0.13	0.04	0.07	0.2	13
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.05	0.05	-	0.05	0.05	1
LOI	1.14	1.03	0.33	0.68	1.83	13
Ba	568.23	567	241.72	205	1122	13
Li	47.77	43	14.52	26	73	13
Rb	201.08	210	56.04	113	342	13
Sr	195.38	199	64.35	74	316	13
Pb	32.85	33	9.24	13	51	13
Th	19.77	20	5.43	10	26	13
U	5.46	6	2.07		9	13
Zr	146.62	134	54.26	87	271	13
Nb	11.31	11	2.25	8	16	13
Y	28.46	29	6.32	20	42	13
La	49.95	48	17.51	25	82	13
Ce	98.82	99	34.89	56	175	13
Pr	-	-	-	-	-	-
Nd	26.9	26.9	-	26.9	26.9	1
Sc	10.15	10	5.35	4	23	13
V	35.92	25	31.52	6	123	13
Cr	104.5	104.5	140.71		204	2
Mn	-	-	-	-	-	-
Co	9	9	4.58	3	15	11
Ni	29.08	19	21.75	4	84	13
Cu	12.38	10	11.13	1	42	13
Zn	50.92	54	17.32	24	87	13
Sn	5.4	6	2.07	2	7	5
W	4.18	4	1.25		6	11
Mo	2.19	2	1.41		6	13
Ga	17.69	18	2.06	15	22	13
As	3.6	3	1.82	2	6	5
S	171.08	100	109.37	53	400	12
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Cone Hill Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	71.9	71.9	-	71.9	71.9	1
TiO2	0.34	0.34	-	0.34	0.34	1
Al2O3	13.5	13.5	-	13.5	13.5	1
Fe2O3	0.93	0.93	-	0.93	0.93	1
FeO	1.96	1.96	-	1.96	1.96	1
MnO	0.04	0.04	-	0.04	0.04	1
MgO	0.62	0.62	-	0.62	0.62	1
CaO	1.54	1.54	-	1.54	1.54	1
Na2O	2.77	2.77	-	2.77	2.77	1
K2O	4.71	4.71	-	4.71	4.71	1
P2O5	0.2	0.2	-	0.2	0.2	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	1.15	1.15	-	1.15	1.15	1
Ba	421	421	-	421	421	1
Li	95	95	-	95	95	1
Rb	269	269	-	269	269	1
Sr	68	68	-	68	68	1
Pb	35	35	-	35	35	1
Th	22	22	-	22	22	1
U	12	12	-	12	12	1
Zr	167	167	-	167	167	1
Nb	14	14	-	14	14	1
Y	26	26	-	26	26	1
La	58.4	58.4	-	58.4	58.4	1
Ce	89.4	89.4	-	89.4	89.4	1
Pr	-	-	-	-	-	-
Nd	40.4	40.4	-	40.4	40.4	1
Sc	6	6	-	6	6	1
V	11	11	-	11	11	1
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	6	6	-	6	6	1
Ni	32	32	-	32	32	1
Cu	11	11	-	11	11	1
Zn	62	62	-	62	62	1
Sn	14	14	-	14	14	1
W	6	6	-	6	6	1
Mo	1		-			1
Ga	20	20	-	20	20	1
As	20	20	-	20	20	1
S	200	200	-	200	200	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Dyasons Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	73.13	73.1	1.04	71.8	74.8	7
TiO2	0.19	0.16	0.08	0.12	0.36	7
Al2O3	13.53	13.6	0.45	12.9	14	7
Fe2O3	0.58	0.51	0.22	0.3	0.89	7
FeO	1.38	1.41	0.19	1.14	1.7	7
MnO	0.03	0.03	0.01	0.01	0.04	7
MgO	0.38	0.31	0.16	0.22	0.66	7
CaO	1.61	1.61	0.44	0.84	2.16	7
Na2O	2.54	2.54	0.21	2.14	2.81	7
K2O	5.25	5.48	0.48	4.67	5.88	7
P2O5	0.1	0.08	0.05	0.06	0.2	7
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.1	0.1	0.08	0.05	0.16	2
LOI	0.88	0.83	0.25	0.59	1.32	7
Ba	609.86	639	285.89	187	1089	7
Li	41.29	34	36.51	14	121	7
Rb	248.29	234	53.12	195	348	7
Sr	140.29	129	49.66	62	223	7
Pb	34.29	35	7.02	24	43	7
Th	28	24	13.33	14	55	7
U	5.29	5	2.98	2	11	7
Zr	149.86	138	62.51	66	272	7
Nb	12.14	11	1.86	10	15	7
Y	27.14	25	7.27	20	40	7
La	74.4	60	47.77	27	176	7
Ce	134.11	105	84.18	51	310	7
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	8.43	4	11.73	3	35	7
V	8.57	9	4.93	3	18	7
Cr	15	15	14.14		25	2
Mn	-	-	-	-	-	-
Co	3.2	3	0.84	2	4	5
Ni	13.71	12	10.08	2	31	7
Cu	5.29	3	4.07	2	13	7
Zn	33.86	32	8.78	19	47	7
Sn	7	7	4.43		15	7
W	9	7	7.38	4	22	5
Mo	1.86		0.63		2	7
Ga	17.29	17	2.36	14	21	7
As	3.5	2	3	2	8	4
S	129.43	100	68.75	53	200	7
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

King Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	70	70	3.82	67.3	72.7	2
TiO2	0.33	0.33	0.18	0.2	0.46	2
Al2O3	14.25	14.25	0.92	13.6	14.9	2
Fe2O3	0.77	0.77	0.18	0.64	0.9	2
FeO	2.14	2.14	1.06	1.39	2.89	2
MnO	0.04	0.04	0.02	0.03	0.06	2
MgO	0.54	0.54	0.32	0.32	0.77	2
CaO	2.84	2.84	0.93	2.18	3.49	2
Na2O	3.03	3.03	0.04	3	3.05	2
K2O	4.86	4.86	0.42	4.57	5.16	2
P2O5	0.12	0.12	0.05	0.08	0.15	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.68	0.68	0.11	0.6	0.75	2
Ba	1190.5	1190.5	468.81	859	1522	2
Li	34	34	4.24	31	37	2
Rb	176.5	176.5	37.48	150	203	2
Sr	220	220	69.3	171	269	2
Pb	35.5	35.5	3.54	33	38	2
Th	19.5	19.5	2.12	18	21	2
U	5.5	5.5	3.54	3	8	2
Zr	216.5	216.5	91.22	152	281	2
Nb	11.5	11.5	2.12	10	13	2
Y	28	28	2.83	26	30	2
La	58	58	7.07	53	63	2
Ce	120.5	120.5	14.85	110	131	2
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	6.5	6.5	3.54	4	9	2
V	15.5	15.5	12.02	7	24	2
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	5.5	5.5	3.54	3	8	2
Ni	12	12	1.41	11	13	2
Cu	8.5	8.5	4.95	5	12	2
Zn	46.5	46.5	16.26	35	58	2
Sn	6.5	6.5	4.95	3	10	2
W	6.5	6.5	3.54	4	9	2
Mo	1.5	1.5	0.71		2	2
Ga	18	18	2.83	16	20	2
As	7.5	7.5	4.95	4	11	2
S	150	150	70.71	100	200	2
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Kongorow Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	67.63	66.85	3.15	63.6	73.3	10
TiO2	0.6	0.58	0.24	0.16	0.92	10
Al2O3	14.86	14.6	1.15	13.5	16.6	10
Fe2O3	1	0.9	0.47	0.41	1.96	10
FeO	3.57	3.61	1.23	1.35	5.48	10
MnO	0.07	0.07	0.02	0.04	0.1	10
MgO	1.09	0.85	0.53	0.5	1.94	10
CaO	3.2	3.13	1.01	1.46	4.48	10
Na2O	2.86	2.78	0.34	2.44	3.53	10
K2O	3.73	3.97	0.94	2.45	4.96	10
P2O5	0.16	0.15	0.04	0.12	0.22	10
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.18	0.14	0.09	0.08	0.32	7
LOI	0.84	0.8	0.38	0.07	1.36	10
Ba	789.3	708	428.46	326	1833	10
Li	49.7	41.5	21.77	29	89	10
Rb	191.3	187.5	47.4	130	276	10
Sr	189.3	177	83.39	74	366	10
Pb	25.7	23.5	8.97	13	39	10
Th	14.7	15	9.51		34	10
U	2.7	3	1.64		5	10
Zr	237.6	231	88.23	88	436	10
Nb	15.6	15.5	2.72	10	20	10
Y	33.4	27	13.66	19	60	10
La	45.53	43.5	20.35	19	79.8	10
Ce	82.49	83	30.94	40	131	10
Pr	9	9	-	9	9	1
Nd	34.65	34.65	3.32	32.3	37	2
Sc	11.5	9.5	5.46	4	22	10
V	39.5	30	22.86	10	72	10
Cr	23.88	22.5	16.23		50	8
Mn	-	-	-	-	-	-
Co	6	6	4.24	3	9	2
Ni	12	11	6.57	3	25	10
Cu	17.2	12	14.29	4	49	10
Zn	67.1	71.5	18.45	33	88	10
Sn	3.83		2.49		9	9
W	4	4	1.41	3	5	2
Mo	2.58	2.25	0.74		4	6
Ga	20.1	20.5	2.73	16	24	10
As	3.5	4	2.78	0.5	6	3
S	142.1	100	112.99	d	400	10
F	700	700	-	700	700	1
Cl	305	305	-	305	305	1
Be	3	3	-	3	3	1
Ag	-	-	-	-	-	-
Bi	1	1	-	1	1	1
Hf	3	3	-	3	3	1
Ta	3	3	-	3	3	1
Cs	10	10	-	10	10	1
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Lennard Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	70.72	70.65	2.75	63	75.4	24
TiO2	0.35	0.35	0.17	0.05	0.7	24
Al2O3	14.07	13.85	0.84	12.4	16.6	24
Fe2O3	0.9	0.93	0.47	0.01	1.71	24
FeO	1.96	2.02	0.83	0.44	4.11	24
MnO	0.04	0.04	0.02	05	0.1	24
MgO	0.64	0.56	0.34	0.11	1.62	24
CaO	2.25	2.23	0.8	1.02	4.64	24
Na2O	2.59	2.53	0.52	1.16	3.96	24
K2O	4.78	4.74	0.78	3.13	7.7	24
P2O5	0.13	0.12	0.1	0.03	0.57	24
H2O+	1.01	1.01	-	1.01	1.01	1
H2O-	0.27	0.27	-	0.27	0.27	1
CO2	0.19	0.15	0.16	01	0.67	13
LOI	0.95	0.9	0.34	0.36	1.74	23
Ba	909.96	815.5	571.48	128	3048	24
Li	31.96	33.5	17.22	6	79	24
Rb	204.63	200	51.65	108	284	24
Sr	181.08	174.5	65.49	67	318	24
Pb	29.67	29	8.43	16	50	24
Th	23.42	24.5	8.6	4	37	24
U	6.19	3	5.97		19	24
Zr	196.75	201.5	73.86	37	337	24
Nb	11.81	11.5	4.58		26	24
Y	32.58	32.5	9.57	16	51	24
La	60.27	55.25	26.93	7	140	24
Ce	113.03	105	51.47	11	264	24
Pr	10	10	-	10	10	2
Nd	40.7	40.5	4.5	36	45.8	4
Sc	8.74	8	4.94	4	23	23
V	26.44	21.5	31.78		162	24
Cr	15.4	9	13.86		50	15
Mn	-	-	-	-	-	-
Co	7	7.5	2.67	2	11	10
Ni	11.58	10	9.55	2	43	24
Cu	11.08	8.5	10.98		53	24
Zn	44.13	42	15.4	20	79	24
Sn	3.77	2	2.35		10	24
W	5.44	5	1.94	4	10	9
Mo	2.28		0.79		4	20
Ga	18.29	18	2.39	14	22	24
As	6	2.5	6.79	0.5	20	10
S	92.54	53	66.69	d	300	23
F	800	800	424.26	500	1100	2
Cl	138.5	138.5	17.68	126	151	2
Be	3	3	-	3	3	1
Ag	-	-	-	-	-	-
Bi	0.5		-			2
Hf	3	3	-	3	3	2
Ta	2	2	1.41		3	2
Cs	8	8	1.41	7	9	2
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Lerida Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	68.15	67.6	3.03	64.7	75.3	11
TiO2	0.39	0.43	0.13	0.09	0.53	11
Al2O3	14.21	14.5	0.84	12.2	15	11
Fe2O3	1.12	1.23	0.36	0.24	1.48	11
FeO	2.66	2.72	0.84	1.03	3.73	11
MnO	0.06	0.07	0.02	0.03	0.08	11
MgO	1.6	1.3	0.93	0.21	2.92	11
CaO	3.37	3.54	1.03	1.14	4.6	11
Na2O	2.35	2.37	0.23	1.99	2.69	11
K2O	3.96	3.81	0.6	3.23	5.26	11
P2O5	0.13	0.13	0.04	0.06	0.18	11
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.16	0.16	-	0.16	0.16	1
LOI	1.34	1.32	0.3	0.73	1.8	11
Ba	721.73	762	252.65	106	1017	11
Li	30.09	28	10.57	17	51	11
Rb	175.18	152	53	130	319	11
Sr	214.45	220	66.53	48	282	11
Pb	27.09	24	10.54	18	55	11
Th	18.36	16	7.32	13	40	11
U	4.82	4	3.22	2	14	11
Zr	164.27	166	29.87	111	215	11
Nb	11.09	11	0.94	10	13	11
Y	32	29	11.57	22	64	11
La	53.2	52.8	7.28	42	63	11
Ce	99.48	97	16.86	68.2	123	11
Pr	-	-	-	-	-	-
Nd	38.5	38.5	-	38.5	38.5	1
Sc	10.36	10	3.26	4	14	11
V	35.91	29	21.57	4	64	11
Cr	94	94	-	94	94	1
Mn	-	-	-	-	-	-
Co	10.5	9	5.32	3	18	10
Ni	23.18	21	9.93	8	42	11
Cu	9.45	8	5.32	4	22	11
Zn	50.55	55	13.9	13	61	11
Sn	4.55	4	3.21	1	12	11
W	4.89	5	1.45	2	7	9
Mo	1.9	1.5	1.2		4	10
Ga	17.18	17	1.78	13	19	11
As	4.22	4	2.77	1	11	9
S	122.73	100	51.79	d	200	11
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Little Gold River Microgranodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	61.25	61.25	1.77	60	62.5	2
TiO2	0.69	0.69	0.06	0.64	0.73	2
Al2O3	14.5	14.5	-	14.5	14.5	2
Fe2O3	0.99	0.99	0.58	0.58	1.4	2
FeO	5.78	5.78	0.13	5.69	5.88	2
MnO	0.15	0.15	0.04	0.12	0.18	2
MgO	4.74	4.74	0.76	4.21	5.28	2
CaO	3.47	3.47	0.08	3.42	3.53	2
Na2O	1.88	1.88	0.46	1.56	2.21	2
K2O	3.09	3.09	0.28	2.89	3.28	2
P2O5	0.13	0.13	0.01	0.13	0.14	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	2.37	2.37	1.36	1.41	3.33	2
Ba	590.5	590.5	37.48	564	617	2
Li	43	43	21.21	28	58	2
Rb	122.5	122.5	16.26	111	134	2
Sr	199	199	7.07	194	204	2
Pb	17.5	17.5	2.12	16	19	2
Th	9	9	-	9	9	2
U	4	4	1.41	3	5	2
Zr	129.5	129.5	16.26	118	141	2
Nb	8.5	8.5	0.71	8	9	2
Y	19.5	19.5	0.71	19	20	2
La	27.5	27.5	6.36	23	32	2
Ce	61	61	9.9	54	68	2
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	18	18	1.41	17	19	2
V	74	74	5.66	70	78	2
Cr	333	333	-	333	333	1
Mn	-	-	-	-	-	-
Co	24	24	-	24	24	1
Ni	41.5	41.5	2.12	40	43	2
Cu	20.5	20.5	3.54	18	23	2
Zn	77	77	12.73	68	86	2
Sn	-	-	-	-	-	-
W	4	4	-	4	4	1
Mo	1		-			2
Ga	19.5	19.5	2.12	18	21	2
As	-	-	-	-	-	-
S	200	200	141.42	100	300	2
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Long Hole Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	71.7	71.7	-	71.7	71.7	1
TiO2	0.25	0.25	-	0.25	0.25	1
Al2O3	13.8	13.8	-	13.8	13.8	1
Fe2O3	0.35	0.35	-	0.35	0.35	1
FeO	2.12	2.12	-	2.12	2.12	1
MnO	0.05	0.05	-	0.05	0.05	1
MgO	0.49	0.49	-	0.49	0.49	1
CaO	1.72	1.72	-	1.72	1.72	1
Na2O	2.58	2.58	-	2.58	2.58	1
K2O	5.2	5.2	-	5.2	5.2	1
P2O5	0.1	0.1	-	0.1	0.1	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.74	0.74	-	0.74	0.74	1
Ba	542	542	-	542	542	1
Li	38	38	-	38	38	1
Rb	224	224	-	224	224	1
Sr	176	176	-	176	176	1
Pb	38	38	-	38	38	1
Th	20	20	-	20	20	1
U	10	10	-	10	10	1
Zr	138	138	-	138	138	1
Nb	11	11	-	11	11	1
Y	33	33	-	33	33	1
La	45	45	-	45	45	1
Ce	82	82	-	82	82	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	5	5	-	5	5	1
V	12	12	-	12	12	1
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	7	7	-	7	7	1
Ni	11	11	-	11	11	1
Cu	29	29	-	29	29	1
Zn	39	39	-	39	39	1
Sn	-	-	-	-	-	-
W	2		-			1
Mo	2	2	-	2	2	1
Ga	17	17	-	17	17	1
As	-	-	-	-	-	-
S	100	100	-	100	100	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Louisa Microgranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	72.32	74.2	6.03	61.7	76.2	5
TiO2	0.26	0.17	0.23	0.08	0.66	5
Al2O3	12.72	12.5	0.91	12	14.2	5
Fe2O3	0.41	0.31	0.18	0.26	0.66	5
FeO	2.21	1.52	1.88	0.93	5.55	5
MnO	0.05	0.04	0.03	0.03	0.1	5
MgO	1.14	0.28	2	0.13	4.71	5
CaO	1.67	1.16	1.45	0.71	4.22	5
Na2O	2.63	2.77	0.47	1.83	3.05	5
K2O	4.73	5	0.77	3.37	5.26	5
P2O5	0.07	0.06	0.05	0.02	0.16	5
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.9	0.8	0.32	0.61	1.43	5
Ba	402.6	363	230.23	79	681	5
Li	28.4	31	12.6	9	41	5
Rb	202.2	212	47.2	135	262	5
Sr	102.4	61	117.71	17	309	5
Pb	27.6	27	3.97	23	33	5
Th	28	28	10.51	15	44	5
U	8.6	9	2.61	6	12	5
Zr	135.6	145	23.93	108	163	5
Nb	12.4	12	1.67	11	15	5
Y	33.4	34	7.92	21	42	5
La	56.2	58	16.24	32	77	5
Ce	111.4	118	23.85	72	136	5
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	7	5	6.2	3	18	5
V	29.5	8	45.05	5	97	4
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	7.7	4	10.28		26	5
Ni	20	7	24.57	6	63	5
Cu	9.2	3	10.8	2	27	5
Zn	37.8	35	20.47	15	71	5
Sn	-	-	-	-	-	-
W	3.4	4	1.34		5	5
Mo	2.4	2	0.89	2	4	5
Ga	16.6	16	1.34	15	18	5
As	-	-	-	-	-	-
S	200	100	173.21	100	400	3
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

McSherrys Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	65.22	67.2	5.17	56.47	72.8	13
TiO2	0.6	0.61	0.24	0.28	0.99	13
Al2O3	14.2	14.4	0.57	13.2	15	13
Fe2O3	1.86	1.37	2.25	0.41	9.23	13
FeO	3.45	2.98	1.46	1.96	6.63	12
MnO	0.08	0.07	0.03	0.03	0.13	13
MgO	2.77	2.11	1.96	0.35	6.6	13
CaO	3.87	3.37	1.54	1.93	6.54	13
Na2O	2.26	2.25	0.28	1.79	2.77	13
K2O	3.85	3.93	0.9	2.43	5.31	13
P2O5	0.18	0.17	0.05	0.11	0.26	13
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.19	0.19	0.11	0.04	0.35	6
LOI	1.43	1.43	0.46	0.58	2.29	13
Ba	730.54	669	135.34	589	1073	13
Li	34.69	31	14.26	18	70	13
Rb	170.54	174	42.22	105	241	13
Sr	289.62	255	103.3	143	409	13
Pb	20.62	20	10.89		36	13
Th	16.46	17	8.07		29	13
U	3.62	3	2.66		8	13
Zr	183.69	176	46.46	133	310	13
Nb	13.08	12	3.07	8	18	13
Y	25.92	26	4.87	14	33	13
La	54.95	50	17.31	36	99	13
Ce	101.22	90.2	37.44	64	204	13
Pr	9	9	-	9	9	1
Nd	33.73	35.9	5.95	27	38.3	3
Sc	13.23	11	6.35	6	29	13
V	74.46	50	53.71	9	178	13
Cr	230.14	168	143.18	66	453	7
Mn	1058	1058	-	1058	1058	1
Co	9.5	10.5	3.73	5	14	6
Ni	36.08	28	21.16	12	84	13
Cu	20.08	12	16.47	3	52	13
Zn	63.54	65	17.7	40	97	13
Sn	4.54	3	3.74		15	13
W	5.21	5	4.1		14	7
Mo	2.42		1.08		5	13
Ga	18.92	18	2.36	16	23	13
As	4.71	5	2.98	1	9	7
S	113.77	100	77.23	53	300	13
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	2	2	-	2	2	1
Ag	3	3	-	3	3	1
Bi	1		-			1
Hf	4	4	-	4	4	1
Ta	1		-			1
Cs	8	8	-	8	8	1
Ge	3	3	-	3	3	1
Se	1	1	-	1	1	1

Mondooma Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	72.29	73.6	3.44	66.3	75.7	10
TiO2	0.25	0.19	0.15	0.05	0.54	10
Al2O3	13.65	13.45	0.87	12.6	15.4	10
Fe2O3	1.07	0.92	0.47	0.55	2.12	10
FeO	1.45	1.22	0.83	0.59	2.85	9
MnO	0.03	0.03	0.01	05	0.06	10
MgO	0.47	0.31	0.33	0.18	1.18	10
CaO	2.2	1.9	1.12	0.35	4.17	10
Na2O	2.83	2.76	0.26	2.45	3.2	10
K2O	4.62	4.77	0.44	3.54	4.97	10
P2O5	0.08	0.06	0.05	05	0.17	10
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.13	0.11	0.04	0.1	0.2	5
LOI	0.94	0.87	0.21	0.73	1.38	10
Ba	790.7	735	364.64	132	1460	10
Li	24.2	27	10.86	8	38	10
Rb	201.6	207.5	52.48	130	313	10
Sr	175.7	168	81.69	37	330	10
Pb	30.5	29.5	5.34	24	41	10
Th	23.2	23.5	6.44	15	34	10
U	5.3	5	1.95	2	8	10
Zr	175.7	166.5	59.83	92	308	10
Nb	11.1	10.5	2.92	8	17	10
Y	31.8	32	3.97	26	38	10
La	59.31	63.5	16	21	81.3	10
Ce	106.6	107	15.99	73	136	10
Pr	11	11	-	11	11	1
Nd	40	40	-	40	40	1
Sc	11.2	6	12.18	2	41	10
V	12.6	10.5	8.81	2	29	10
Cr	5.17		0.41		6	6
Mn	-	-	-	-	-	-
Co	7	7.5	2.45	4	9	4
Ni	8.8	4.5	8.94		26	10
Cu	9.8	8	5.43	4	18	10
Zn	38.1	36.5	12.82	22	61	10
Sn	3.6	2.5	1.68		7	10
W	4.75	4.5	0.96	4	6	4
Mo	2.56		0.95		4	9
Ga	18.8	20	2.44	14	22	10
As	6.8	6	1.3	6	9	5
S	98.9	53	72	d	200	10
F	1300	1300	-	1300	1300	1
Cl	57	57	-	57	57	1
Be	3	3	-	3	3	1
Ag	-	-	-	-	-	-
Bi	1	1	-	1	1	1
Hf	3	3	-	3	3	1
Ta	2	2	-	2	2	1
Cs	10	10	-	10	10	1
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Mount Disaster Porphyry

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	70.28	69.85	1.7	69	73.5	6
TiO2	0.31	0.33	0.08	0.17	0.37	6
Al2O3	14.13	14.2	0.56	13.1	14.8	6
Fe2O3	1.13	1.11	0.17	0.88	1.37	6
FeO	1.64	1.76	0.57	0.68	2.28	6
MnO	0.05	0.05	0.01	0.03	0.05	6
MgO	0.53	0.55	0.15	0.28	0.71	6
CaO	2.61	2.68	0.53	1.71	3.22	6
Na2O	2.76	2.74	0.21	2.48	3.08	6
K2O	4.71	4.72	0.08	4.59	4.81	6
P2O5	0.09	0.09	0.04	0.05	0.13	6
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.44	0.44	0.43	0.14	0.75	2
LOI	1.3	1.25	0.48	0.63	2.08	6
Ba	1047	1057.5	266	641	1446	6
Li	22	23	12.46	6	38	6
Rb	174.83	179.5	18.14	150	192	6
Sr	195.83	196.5	40.17	150	255	6
Pb	28	26	3.63	25	34	6
Th	20	20	2.97	15	23	6
U	5.33	5.5	2.07	3	8	6
Zr	198.5	208.5	33.58	143	236	6
Nb	9.83	9.5	0.98	9	11	6
Y	30.83	32	2.86	26	33	6
La	59	59	6.57	52	69	6
Ce	116.83	117.5	13.24	100	132	6
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	6.67	7	1.51	4	8	6
V	15.67	17.5	4.97	6	19	6
Cr	9	9	2.83	7	11	2
Mn	-	-	-	-	-	-
Co	5.25	6	2.22	2	7	4
Ni	15.33	13	10.76	6	36	6
Cu	6.33	5.5	3.5		11	6
Zn	43.17	44.5	9.11	27	52	6
Sn	4	4	-	4	4	4
W	4.5	4	1.91	3	7	4
Mo	2.25	2	1.26		4	4
Ga	16.83	16.5	1.47	15	19	6
As	5.33	4	3.21	3	9	3
S	100	100	61.24	d	200	5
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Mulkerrins Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	75.67	73.3	4.45	72.9	80.8	3
TiO2	0.14	0.18	0.08	0.05	0.18	3
Al2O3	12.06	13.4	2.32	9.38	13.4	3
Fe2O3	0.35	0.21	0.33	0.11	0.72	3
FeO	1.54	1.38	0.43	1.21	2.03	3
MnO	0.04	0.04	0.01	0.03	0.04	3
MgO	0.22	0.27	0.13	0.07	0.31	3
CaO	1.58	1.92	0.64	0.84	1.99	3
Na2O	2.42	2.54	0.35	2.02	2.69	3
K2O	4.67	4.81	0.33	4.3	4.91	3
P2O5	0.03	0.04	0.01	0.02	0.04	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.67	0.63	0.08	0.61	0.76	3
Ba	409	396	366.67	49	782	3
Li	27	20	23.3	8	53	3
Rb	216	209	24.27	196	243	3
Sr	132.67	155	88.64	35	208	3
Pb	33.33	32	9.07	25	43	3
Th	20.67	22	2.31	18	22	3
U	8	8	1	7	9	3
Zr	116.33	109	36.56	84	156	3
Nb	11.33	10	2.31	10	14	3
Y	39.33	29	18.77	28	61	3
La	41.33	43	11.59	29	52	3
Ce	80.67	83	29.57	50	109	3
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	6	6	1	5	7	3
V	16	16	11.31	8	24	2
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	4.67	3	2.89	3	8	3
Ni	9.33	8	4.16	6	14	3
Cu	5	4	4.58	1	10	3
Zn	24	27	13.75	9	36	3
Sn	-	-	-	-	-	-
W	3		1.73		5	3
Mo	2	2	-	2	2	3
Ga	15	16	1.73	13	16	3
As	-	-	-	-	-	-
S	100	100	-	100	100	2
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Nellie Tonalite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	57.95	57.95	10.39	50.6	65.3	2
TiO2	0.97	0.97	0.18	0.84	1.1	2
Al2O3	13.75	13.75	2.62	11.9	15.6	2
Fe2O3	1.86	1.86	0.2	1.72	2	2
FeO	8.14	8.14	2.17	6.6	9.67	2
MnO	0.18	0.18	0.04	0.15	0.2	2
MgO	3.19	3.19	4.1	0.29	6.09	2
CaO	5.84	5.84	4.32	2.78	8.89	2
Na2O	2.98	2.98	0.65	2.52	3.44	2
K2O	2.44	2.44	1.68	1.25	3.63	2
P2O5	0.13	0.13	0.01	0.13	0.14	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.97	0.97	1.17	0.15	1.8	2
LOI	1.79	1.79	0.76	1.26	2.33	2
Ba	682	682	496.39	331	1033	2
Li	20.5	20.5	3.54	18	23	2
Rb	77	77	33.94	53	101	2
Sr	144	144	84.85	84	204	2
Pb	10.5	10.5	3.54	8	13	2
Th	8	8	7.07	3	13	2
U	2.5	2.5	2.12		4	2
Zr	302.5	302.5	251.02	125	480	2
Nb	13.5	13.5	9.19	7	20	2
Y	50.5	50.5	34.65	26	75	2
La	36	36	31.11	14	58	2
Ce	79.5	79.5	68.59	31	128	2
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	16.5	16.5	9.19	10	23	2
V	123.5	123.5	164.76	7	240	2
Cr	25.5	25.5	33.23		49	2
Mn	-	-	-	-	-	-
Co	-	-	-	-	-	-
Ni	62.5	62.5	75.66	9	116	2
Cu	69	69	53.74	31	107	2
Zn	86.5	86.5	30.41	65	108	2
Sn	2		-			2
W	-	-	-	-	-	-
Mo	-	-	-	-	-	-
Ga	19.5	19.5	2.12	18	21	2
As	-	-	-	-	-	-
S	50	d	-	d	d	2
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Pillara Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	70.1	70.1	1.41	69.1	71.1	2
TiO2	0.37	0.37	0.15	0.26	0.47	2
Al2O3	14.45	14.45	0.78	13.9	15	2
Fe2O3	1.15	1.15	0.32	0.93	1.38	2
FeO	1.88	1.88	0.21	1.74	2.03	2
MnO	0.05	0.05	0.01	0.05	0.06	2
MgO	1	1	0.25	0.82	1.18	2
CaO	3.13	3.13	1.17	2.3	3.95	2
Na2O	3.41	3.41	0.19	3.28	3.55	2
K2O	2.71	2.71	1.16	1.89	3.53	2
P2O5	0.13	0.13	0.03	0.11	0.15	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	1.01	1.01	0.08	0.96	1.07	2
Ba	593	593	24.04	576	610	2
Li	26.5	26.5	2.12	25	28	2
Rb	92.5	92.5	41.72	63	122	2
Sr	337.5	337.5	161.93	223	452	2
Pb	18.5	18.5	9.19	12	25	2
Th	12.5	12.5	0.71	12	13	2
U	4	4	2.83	2	6	2
Zr	119	119	1.41	118	120	2
Nb	9.5	9.5	4.95	6	13	2
Y	19.5	19.5	13.44	10	29	2
La	39	39	5.66	35	43	2
Ce	76	76	18.38	63	89	2
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	4.5	4.5	0.71	4	5	2
V	33.5	33.5	10.61	26	41	2
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	9.5	9.5	2.12	8	11	2
Ni	15	15	-	15	15	2
Cu	15	15	14.14	5	25	2
Zn	44	44	-	44	44	2
Sn	5	5	-	5	5	1
W	2	2	1.41	1	3	2
Mo	1.5	1.5	0.71		2	2
Ga	16	16	1.41	15	17	2
As	2.5	2.5	2.12	1	4	2
S	150	150	70.71	100	200	2
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Richenda Microgranodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	68.1	67.2	3.64	64.7	73.4	6
TiO2	0.29	0.37	0.21	01	0.49	6
Al2O3	14.87	14.75	0.44	14.3	15.6	6
Fe2O3	0.97	0.99	0.36	0.59	1.39	6
FeO	2.56	3.09	1.57	0.54	4.25	6
MnO	0.06	0.07	0.03	0.02	0.08	6
MgO	2.05	2.26	1.72	0.09	3.8	6
CaO	3.08	3.53	1.14	1.45	4.15	6
Na2O	2.69	2.64	0.41	2.28	3.17	6
K2O	3.15	2.84	0.81	2.39	4.18	6
P2O5	0.1	0.11	0.03	0.05	0.13	6
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.54	0.41	0.4	0.21	1.24	5
LOI	1.41	1.51	0.37	0.94	1.77	6
Ba	475.33	471	127.78	264	663	6
Li	29.67	33	10.07	15	41	6
Rb	136.17	131	21.98	113	170	6
Sr	182.17	190	31.35	139	224	6
Pb	16.42	17	4.82		21	6
Th	8.33	7.5	3.78		13	6
U	2.08	2	1.02		3.5	6
Zr	119.17	128	56.78	37	194	6
Nb	8.83	9	2.14	6	11	6
Y	17.5	20	7.79	6	26	6
La	31.07	32.75	12.51	12	47.3	6
Ce	60.35	62.35	16.54	38	85.4	6
Pr	6	6	-	6	6	1
Nd	26	26	-	26	26	1
Sc	10.83	12	6.27	3	18	6
V	32.17	32	26.95	2	65	6
Cr	130	122	128.82		266	6
Mn	-	-	-	-	-	-
Co	-	-	-	-	-	-
Ni	21.83	23	19.24	2	40	6
Cu	20.5	13	20.92	5	62	6
Zn	50	56	21.76	16	78	6
Sn	3.5		1.58		6	6
W	-	-	-	-	-	-
Mo	2.25		0.61			6
Ga	21.17	20.5	2.4	18	24	6
As	2.5	2.5	-	2.5	2.5	1
S	46.83	53	15.11	16	53	6
F	500	500	-	500	500	1
Cl	171	171	-	171	171	1
Be	3	3	-	3	3	1
Ag	-	-	-	-	-	-
Bi	1	1	-	1	1	1
Hf	3	3	-	3	3	1
Ta	4	4	-	4	4	1
Cs	12	12	-	12	12	1
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Scrutons Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	71	72	2.54	67.9	73.5	5
TiO2	0.28	0.24	0.1	0.18	0.39	5
Al2O3	13.72	13.4	0.61	13.2	14.6	5
Fe2O3	0.75	0.81	0.45	0.06	1.26	5
FeO	1.94	2.11	0.45	1.43	2.42	5
MnO	0.05	0.05	0.01	0.04	0.05	5
MgO	0.65	0.53	0.21	0.44	0.91	5
CaO	2.41	2.08	0.7	1.71	3.42	5
Na2O	2.57	2.53	0.14	2.44	2.75	5
K2O	4.59	4.65	0.28	4.11	4.8	5
P2O5	0.11	0.11	0.01	0.1	0.13	5
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.96	0.99	0.15	0.74	1.16	5
Ba	708.4	561	334.16	373	1079	5
Li	27.2	26	16.16	8	52	5
Rb	201.8	195	38.27	151	255	5
Sr	161.8	138	56.48	102	244	5
Pb	35.4	33	8.02	28	47	5
Th	22.2	23	4.09	16	27	5
U	7.8	7	2.59	5	11	5
Zr	151.4	138	39.6	113	197	5
Nb	12.6	11	3.21	10	18	5
Y	30.6	30	4.77	26	38	5
La	51.44	48.1	14.75	37	71	5
Ce	95.56	76.8	33.16	73	151	5
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	6.4	5	1.95	5	9	5
V	16.4	13	5.59	12	23	5
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	8.4	7	3.65	5	14	5
Ni	17.6	17	1.82	16	20	5
Cu	8.2	3	11.65	2	29	5
Zn	39	32	11.6	29	54	5
Sn	6	5.5	4.97	1	12	4
W	3.6	4	1.82	1	6	5
Mo	2.6	2	1.34		4	5
Ga	16.8	17	1.1	15	18	5
As	2.6	2	1.34	1	4	5
S	150	100	100	100	300	4
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Secure Bay Adamellite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	71.28	71.4	0.64	70.5	71.8	4
TiO2	0.32	0.32	0.03	0.28	0.34	4
Al2O3	13.73	13.7	0.44	13.3	14.2	4
Fe2O3	1.05	1.07	0.13	0.89	1.18	4
FeO	2.09	2.01	0.26	1.9	2.46	4
MnO	0.05	0.05	0.01	0.04	0.06	4
MgO	0.52	0.51	0.09	0.44	0.63	4
CaO	1.98	1.97	0.26	1.7	2.27	4
Na2O	3.21	3.22	0.1	3.08	3.31	4
K2O	4.25	4.23	0.68	3.66	4.89	4
P2O5	0.13	0.14	0.03	0.09	0.16	4
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.08	0.08	0.08	0.02	0.14	2
LOI	0.99	1.03	0.12	0.81	1.07	4
Ba	487.25	469	75.35	425	586	4
Li	45	46.5	21.92	21	66	4
Rb	214.25	210.5	17.13	198	238	4
Sr	112.5	113	7.42	103	121	4
Pb	30	30.5	6.27	22	37	4
Th	22.5	22.5	4.51	17	28	4
U	7	7	3.37	3	11	4
Zr	180.75	178.5	7.8	174	192	4
Nb	10.75	11.5	3.95	6	14	4
Y	33.75	33.5	2.75	31	37	4
La	43.5	45	10.25	30	54	4
Ce	94.5	101.5	15.76	71	104	4
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	7.25	7.5	0.96	6	8	4
V	12.75	12	5.19	8	19	4
Cr	5		-			2
Mn	-	-	-	-	-	-
Co	5	5	1.41	4	6	2
Ni	8.5	8.5	6.45	2	15	4
Cu	14.25	10.5	12.55	4	32	4
Zn	55.5	55.5	5.69	49	62	4
Sn	7.25	7	2.06	5	10	4
W	7.5	7.5	3.54	5	10	2
Mo	2.25	2.25	0.29		2	4
Ga	19	19	2.31	17	21	4
As	2	2	-	2	2	2
S	101.5	76.5	69.3	53	200	4
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Square Top Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	80.2	80.2	-	80.2	80.2	1
TiO2	0.29	0.29	-	0.29	0.29	1
Al2O3	15.9	15.9	-	15.9	15.9	1
Fe2O3	0.33	0.33	-	0.33	0.33	1
FeO	1.53	1.53	-	1.53	1.53	1
MnO	0.01	0.01	-	0.01	0.01	1
MgO	0.07	0.07	-	0.07	0.07	1
CaO	0.02	0.02	-	0.02	0.02	1
Na2O	0.52	0.52	-	0.52	0.52	1
K2O	0.23	0.23	-	0.23	0.23	1
P2O5	0.08	0.08	-	0.08	0.08	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.78	0.78	-	0.78	0.78	1
Ba	19	19	-	19	19	1
Li	1		-			1
Rb	8	8	-	8	8	1
Sr	8	8	-	8	8	1
Pb	5	5	-	5	5	1
Th	28	28	-	28	28	1
U	8	8	-	8	8	1
Zr	196	196	-	196	196	1
Nb	11	11	-	11	11	1
Y	34	34	-	34	34	1
La	74	74	-	74	74	1
Ce	140	140	-	140	140	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	6	6	-	6	6	1
V	4	4	-	4	4	1
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	4	4	-	4	4	1
Ni	9	9	-	9	9	1
Cu	13	13	-	13	13	1
Zn	13	13	-	13	13	1
Sn	5	5	-	5	5	1
W	6	6	-	6	6	1
Mo	1		-			1
Ga	19	19	-	19	19	1
As	2	2	-	2	2	1
S	100	100	-	100	100	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

wift Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	69.25	68.6	2.65	66.8	73	4
TiO2	0.44	0.47	0.12	0.27	0.54	4
Al2O3	13.95	14.1	0.45	13.3	14.3	4
Fe2O3	0.93	0.98	0.41	0.43	1.34	4
FeO	2.52	2.58	0.51	1.93	3.01	4
MnO	0.04	0.05	0.01	0.03	0.05	4
MgO	0.79	0.82	0.21	0.51	1.01	4
CaO	2.5	2.63	0.54	1.73	3.01	4
Na2O	2.8	2.78	0.14	2.63	2.98	4
K2O	4.74	4.66	0.33	4.43	5.2	4
P2O5	0.14	0.14	0.02	0.11	0.16	4
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	1.11	1.12	0.24	0.89	1.33	4
Ba	1028.5	942	337.63	720	1510	4
Li	35	34.5	13.74	20	51	4
Rb	202.5	196	27.62	177	241	4
Sr	162	163	38.39	114	208	4
Pb	31.25	31.5	2.75	28	34	4
Th	24.25	22	6.7	19	34	4
U	6	5	2	5	9	4
Zr	222.5	241.5	44.17	157	250	4
Nb	12	13	2	9	13	4
Y	34.75	34.5	0.96	34	36	4
La	64.5	54.5	29.69	41	108	4
Ce	126.5	110	54.91	80	206	4
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	8	9	2.71	4	10	4
V	24.75	26.5	8.46	14	32	4
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	8	8	2.58	5	11	4
Ni	16.25	16	3.69	12	21	4
Cu	10	11	5.29	3	15	4
Zn	52.75	56	14.2	33	66	4
Sn	4.75	4.5	0.96	4	6	4
W	6	5.5	2.16	4	9	4
Mo	3.5	4	1	2	4	4
Ga	17.75	18	1.26	16	19	4
As	5.75	5	4.65	1	12	4
S	275	250	95.74	200	400	4
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Tarraji Microgranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	75.6	75.6	-	75.6	75.6	1
TiO2	0.11	0.11	-	0.11	0.11	1
Al2O3	12	12	-	12	12	1
Fe2O3	0.25	0.25	-	0.25	0.25	1
FeO	1.25	1.25	-	1.25	1.25	1
MnO	0.02	0.02	-	0.02	0.02	1
MgO	0.12	0.12	-	0.12	0.12	1
CaO	1.17	1.17	-	1.17	1.17	1
Na2O	3.09	3.09	-	3.09	3.09	1
K2O	4.75	4.75	-	4.75	4.75	1
P2O5	0.06	0.06	-	0.06	0.06	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.7	0.7	-	0.7	0.7	1
Ba	210	210	-	210	210	1
Li	50	50	-	50	50	1
Rb	285	285	-	285	285	1
Sr	65	65	-	65	65	1
Pb	45	45	-	45	45	1
Th	36	36	-	36	36	1
U	8	8	-	8	8	1
Zr	126	126	-	126	126	1
Nb	12	12	-	12	12	1
Y	51	51	-	51	51	1
La	65	65	-	65	65	1
Ce	127	127	-	127	127	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	3	3	-	3	3	1
V	-	-	-	-	-	-
Cr	-	-	-	-	-	-
Mn	-	-	-	-	-	-
Co	3	3	-	3	3	1
Ni	12	12	-	12	12	1
Cu	3	3	-	3	3	1
Zn	32	32	-	32	32	1
Sn	2	2	-	2	2	1
W	4	4	-	4	4	1
Mo	4	4	-	4	4	1
Ga	18	18	-	18	18	1
As	4	4	-	4	4	1
S	100	100	-	100	100	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

Whitewater Volcanics

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	69.6	68.75	3.78	62.1	77.3	32
TiO2	0.34	0.37	0.14	0.05	0.57	32
Al2O3	14.1	14.4	1.14	11.3	15.7	32
Fe2O3	1.29	1.28	0.52	0.3	2.77	32
FeO	1.9	1.87	0.81	0.6	3.46	32
MnO	0.05	0.05	0.03	05	0.16	32
MgO	0.93	0.87	0.62	0.12	2.53	32
CaO	2.42	2.84	1	0.29	3.92	32
Na2O	2.62	2.61	0.52	1.14	4.22	32
K2O	4.47	4.43	0.72	2.54	5.86	32
P2O5	0.11	0.11	0.05	0.02	0.26	32
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.32	0.17	0.39	0.13	1.36	9
LOI	1.5	1.38	0.72	0.82	4.14	32
Ba	879.91	1001	357.97	56	1445	32
Li	17.78	18	9.52	5	38	32
Rb	173.5	166	59.02	16	307	32
Sr	195.59	212.5	91.53	15	405	32
Pb	27.88	29	9.21	7	45	32
Th	21.97	19	7.52	3	38	32
U	6.09	6	2.9		13	32
Zr	202.38	203	55.73	95	422	32
Nb	13.11	11	6.25		37	32
Y	32.75	29.5	11.28	11	64	32
La	58.79	57.95	16.78	10	116	32
Ce	109.19	108.15	30.54	19	207	32
Pr	-	-	-	-	-	-
Nd	44.04	49.9	10.32	32.4	53	5
Sc	9.88	8	8.46	3	45	32
V	21.58	22	14.33	3	61	31
Cr	19.44	13	24.2		79	9
Mn	-	-	-	-	-	-
Co	8.11	9	4.33		17	23
Ni	16.22	14	11.4	2	50	32
Cu	20.41	11	25.91	4	123	32
Zn	45.75	50	17.71	6	77	32
Sn	3.74	3	2.24		9	25
W	4.17	4	1.83		8	23
Mo	2.82	2	1.49		8	30
Ga	18.41	18	2.7	12	24	32
As	3.38	2.5	2.96	1	11	16
S	105.05	100	57.02	d	300	30
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Be	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Cs	-	-	-	-	-	-
Ge	-	-	-	-	-	-
Se	-	-	-	-	-	-

3 PAPERBARK SUPERSUITE (E. Kimberley)

3.1 Timing

1855 Ma

3.2 Individual Ages

Primary Ages:

1. Neville Granodiorite	(1860 ± 3 Ma, SHRIMP)
2. Mount Nulasy Granite	(1856 ± 10 Ma, SHRIMP)
3. Castlereagh Hill Porphyry	(1855 ± 2 Ma, SHRIMP)
3. Whitewater Volcanics	(1855 ± 5 Ma, SHRIMP)
4. Paperbark Granite	(1854 ± 3 Ma, SHRIMP)
5. Whitewater Volcanics	(1850 ± 3 Ma, U-Pb Conventional)

Other ages of coeval events in the East Kimberley Region:

1. Rose Bore Granite	(1863 ± 3 Ma, SHRIMP)
2. Metamorphism of Marboo Fm.	(1861 ± 5 Ma, SHRIMP)
3. Butchers Gully Member	(1857 ± 5 Ma, SHRIMP)
4. Butchers Gully Member	(1857 ± 2 Ma, SHRIMP)
5. Alice Downs Ultrabasics	(1856 ± 2 Ma, SHRIMP)
6. McIntosh Gabbro	(1855 ± 2 Ma, SHRIMP)
7. Tickalara Metamorphics	(1852 ± 2 Ma, SHRIMP)
8. Tickalara Metamorphics	(1850 ± 2 Ma, SHRIMP)
9. Dougalls Tonalite	(1849 ± 3 Ma, SHRIMP)
10. Butchers Gully Member	(1848 ± 3 Ma, SHRIMP)

Sources: All ages are from OZCHRON.

3.3 Regional Setting

Because of the large aerial extent of the Paperbark Supersuite in the Kimberley region, for the purpose of this project, the Supersuite has been subdivided into the west and east Kimberleys and dealt with in two separate chapters. In the east Kimberleys, the Paperbark Supersuite is part of the Bow River Batholith (Sheppard *et al.* 1997) which intrudes the western and central zones of the Halls Creek Orogen (Tyler *et al.* 1995). The Supersuite is unconformably overlain by sediments of the Kimberley Basin sequence. The Paperbark Supersuite was intruded simultaneously with gabbro (Page *et al.* 1995) as is shown by the development of numerous net-veined complexes and magma mingling (Blake and Hoatson 1993; Sheppard 1996). The granites are not derived by fractionation from the gabbros, and a distinct gap between ~53 to 63 wt.% SiO_2 is observed between the two different petrological groups (Sheppard 1996). The granites of the Paperbark Supersuite are coeval with sediments and alkaline volcanics of the lower part of the Olympio Formation of the eastern zone of the Halls Creek Orogen.

3.4 Summary

The Paperbark Supersuite has all the hallmarks of a major restite suite with some evidence of late fractionation after restite separation at high SiO_2 values. Individual granite intrusions are relatively homogenous over wide areas and xenoliths are common, particularly in the more mafic end members. The presence of cored plagioclase feldspars and inclusions within biotite are further evidence of a restite origin for this Supersuite (White and Chappell 1977; Chappell *et al.* 1987). The comagmatic Whitewater Volcanics are phenocryst-rich (up to 50%) and compositionally identical to the intrusives, whilst flow banded rhyolites are rare; these characteristics also support a restite origin (Wyborn and Chappell 1986).

3.5 Potential

The classification of the Paperbark Supersuite as a restite suite considerably downgrades its potential. This is supported by the observation that there is no known significant mineralisation in the vicinity of the Supersuite. The Supersuite has been classified as a Nicholson-type, indicating that some minor fractionation has occurred at the high SiO_2 end-members, presumably after complete restite separation. The three members of the Paperbark Supersuite that show minor fractionation are the Paperbark Granite, Tumagee Granite and the Whitewater Volcanics; there are no known major prospects in the vicinity of these units. It is to be emphasised that some areas of highest radiometric response do not appear to have been sampled, and it is suggested that these be more closely examined before downgrading the Supersuite. At best, it is likely that this Supersuite will produce only small Sn, Au and Cu vein deposits. In the country rock the most significant host rocks that are described are the Fe-rich gabbros that are coeval with the granites.

Cu:	**low**
Au:	**low**
Pb/Zn:	**none**
Sn:	**low**
Mo/W:	**none**
Confidence Level:	**321**

3.6 Descriptive Data

Location: The Paperbark Supersuite is the most westerly granite suite in the East Kimberley Region. It crops out over the Mount Ramsay, Dixon Range, Lissadell, and Cambridge Gulf 1:250 000 Sheet areas.

Dimensions and area: The intrusives form an elongate belt over 300 km long and up to 40 km wide in a NNE direction, and have an outcrop area of 3220 km^2.

3.7 Intrusives

Component plutons: Airfield Granodiorite, Gnewing Granodiorite, Mad Gap Monzogranite, Mussell Creek Granite, Neville Granodiorite, Paperbark Granite, Sandy Dam Monzogranite, Togo Monzogranite, Top Water Tonalite, Tumagee Granite, Castlereagh Hill Porphyry, Greenvale Porphyry, Beefwood Yard Granite, Crooked Creek Granite, Dinner Creek Tonalite, Gordons Gorge Granite, Matchbox Granite, Mount Nulasy Granite, Neil Creek Monzogranite, Pandanus Yard Monzogranite.

Form: Elongate bodies some of which intrude cogenetic volcanics.

Metamorphism and Deformation: Samples of the Sandy Dam Monzogranite, Togo Monzogranite, Mussell Creek Granite, Paperbark Granite and the eastern part of the Tumagee Granite are foliated. Some prehnite recorded in the Neville Granodiorite and the Tumagee Granite. Most samples, whether deformed or not, have been weakly metamorphosed (Sheppard *et al.* 1995).

Dominant intrusive rock types: The granite types are homogeneous over wide areas (Dow and Gemuts 1969). No major leucogranite bodies or zoned plutons have been mapped, although minor potassic leucogranites have been noted (Dow and Gemuts 1967). Sheppard (1996) notes that the intrusions are homogenous and that there are few indicators of compositional zoning. He also noted that within individual intrusions the variation in SiO_2 content is ≤ 6-8 wt.%. Sheppard *et al.* (1995) note that medium to coarse-grained porphyritic biotite-bearing monzogranite, granodiorite and tonalite are the dominant rock-types and that the Sandy Dam Monzogranite, Togo Monzogranite, Mussell Creek Granite, Paperbark Granite, and Tumagee Granite are fine-grained. *Specifically:* <u>Neville Granodiorite</u> - medium-grained and medium to fine-grained even-grained or weakly porphyritic tonalite and granodiorite. <u>Gnewing Granodiorite</u> - coarse-grained strongly porphyritic biotite-hornblende granodiorite and tonalite. <u>Airfield Granodiorite</u> - medium to coarse-grained, variably porphyritic biotite granodiorite and monzogranite with minor tonalite. <u>Mussell Creek Granite</u> - fine to medium-grained even-grained to weakly porphyritic biotite monzogranite. <u>Pandanus Yard Monzogranite</u> - variably foliated medium-grained weakly porphyritic to even-grained biotite monzogranite. <u>Paperbark Granite</u> - coarse-grained rapakivi-like granite and porphyritic biotite monzogranite. <u>Sandy Dam Monzogranite</u> - medium- to coarse-grained, variably porphyritic tonalite, mottled biotite tonalite and hornblende-biotite granodiorite. <u>Togo Monzogranite</u> - moderately to strongly foliated medium to coarse-grained porphyritic biotite (-hornblende) monzogranite and minor granodiorite. Top Water Tonalite - porphyritic, medium-grained biotite-hornblende(-orthopyroxene) tonalite and granodiorite. Tumagee Granite - medium-grained, even-grained to weakly porphyritic biotite granodiorite. Castlereagh Porphyry - fine-grained weakly porphyritic microgranite with phenocrysts of plagioclase. Greenvale Porphyry - medium to coarse-grained massive quartz-feldspar porphyry. Beefwood Yard Granite - medium and coarse-grained porphyritic biotite monzogranite. Crooked Creek Granite - medium-grained biotite granodiorite. Dinner Creek Tonalite - fine to medium-grained weakly porphyritic or even-grained biotite-amphibole(-hypersthene) tonalite. Gordons Gorge Granite - massive, coarse-grained porphyritic biotite(-hornblende) monzogranite and syenogranite. Matchbox Granite - massive medium to coarse-grained porphyritic biotite monzogranite and syenogranite. Mount Nulasy Granite - massive coarse-grained porphyritic biotite monzogranite and syenogranite. Neil Creek Monzogranite - fine to medium-grained weakly porphyritic monzogranite.

Colour: Very rarely described, but appears to be dominantly dark grey to grey with pink K-feldspar phenocrysts.

Veins, Pegmatites, Aplites, Greisens: No greisens noted in the literature. Pegmatite and aplite have been noted, but are not abundant. Quartz veins occur in most of the plutons, although these may not be related to magmatic processes.

Distinctive mineralogical characteristics: K-feldspar phenocrysts are ubiquitous, and many are ovoid. Rapakivi textures have been recorded in some intrusions. Some plagioclase crystals have mottled cores and complexly zoned rims. Plagioclase phenocrysts in tonalite and granodiorite have euhedral inclusions of biotite and opaques (Sheppard *et al.* 1995); these characteristics suggest a restite origin (White and Chappell 1977). Biotite is the dominant ferromagnesian mineral, is reddish brown and hosts most of the inclusions. Amphibole is a minor but widespread component and may be of metamorphic origin. Dow and Gemuts (1969) noted that hornblende appears more common near gabbro bodies. Accessories include opaques, apatite, zircon, monazite and rare allanite with almandine garnet present in some of the leucocratic phases.

Xenoliths: Within the Paperbark Supersuite, and in particular the mafic varieties, widespread mafic inclusions with an igneous texture are common. Fine-grained inclusions are more numerous near the margins, particularly near the net-veined complexes, and some of these are probably derived from the coeval mafic intrusions. There are also fine to medium-grained porphyritic inclusions that are identical in mineralogy to the host granite, but are more mafic.

Breccias: None noted.

Alteration in the granite: There is no clear evidence of magmatic-related alteration. Most alteration observed could be attributed to subsequent deformation or metamorphism. Many descriptions note plagioclase altered to sericite and epidote, and hornblende pseudomorphed by biotite or by chlorite and epidote. Alteration of biotite to chlorite+quartz has been recorded. Fluorite has been noted as an alteration product of plagioclase (Sheppard *et al.,* in prep).

3.8 Extrusives

The Whitewater Volcanics are predominantly dacitic to rhyodacitic ignimbrites, but include some lavas. The textures are predominantly porphyritic with phenocrysts of quartz and feldspar which can constitute up to 30 to 50 % by volume (Sheppard *et al.,* in prep., Tyler *et al.,* in prep b). Some of the lavas are strongly flow banded (Dow and Gemuts 1967). Sediments are a minor component. The volcanics have been interpreted as subaerial (Sheppard *et al.,* in prep).

3.9 Country Rock

Contact metamorphism: No significant contact effects noted in the literature. Dinner Creek Tonalite and Mount Nulasy Granite intrude hornfelsed Marboo Formation (Thorne *et al.*, in prep). Sheppard (written communication 1997) notes that there is contact metamorphism of Marboo Formation throughout the western zone.

Reaction with country rock: Magma mingling is commonly noted where the granites are adjacent to gabbroic rocks. This is presumably because the two intrusive types are coeval, rather than the granitic intrusives reacting with older, already crystallised gabbroic rocks.

Units the granite intrudes: Marboo Formation. To some extent it could be argued that mafic intrusions such as the Toby Gabbro, Springvale Intrusion and unnamed gabbros also host the granite. However, these are probably coeval with the granite.

Dominant rock types: Greywacke, siltstone, carbonaceous shale, arkose, schist, migmatite, amphibolite. If it is argued that the mafic intrusions definitely predate the granitic intrusives then these, consisting of olivine gabbro, gabbronorite, troctolite and anorthosite, would also be good hosts.

Potential hosts: Carbonaceous shale, carbonates, (?) mafic igneous rocks.

3.10 Mineralisation

Mineralisation within the vicinity of the Paperbark Supersuite includes the very small Mount Amherst Ag-Pb deposit approximately 70 km west of Halls Creek (Jones 1938) which occurs within the Neville Granodiorite. Pirajno *et al.* (1994) also record several hydrothermal vein and Au—base-metal deposits near the Gnewing Granodiorite. Several minor Cu occurrences have been recorded in the Whitewater Volcanics; most are related to quartz veins (Marston 1979; Dow and Gemuts 1969). Small Cu occurrences such as these are widespread throughout the Kimberleys and are unlikely to be related to the Paperbark Supersuite.

3.11 Geochemical Data

Data source: Most of the data used are from GSWA; some samples are in OZCHEM.

Data quality: Very good, although most of the GSWA analyses do not have Nd.

Are the data representative? There are very few samples with > 75 wt.% SiO_2. This is surprising in view of the high total count signatures visible in the regional airborne radiometric data. However, if the petrology is correct and it is a genuine restite suite, then samples with > 75 wt.% SiO_2 will be rare, as rocks made up predominantly of the minimum melt component with ~ 77 wt.% SiO_2 will not be common. Sheppard (*written communication,* 1997) suggests that large areas with > 75 wt.% SiO_2 are not present.

Are the data adequate? Provided the most felsic samples have been collected then the data are

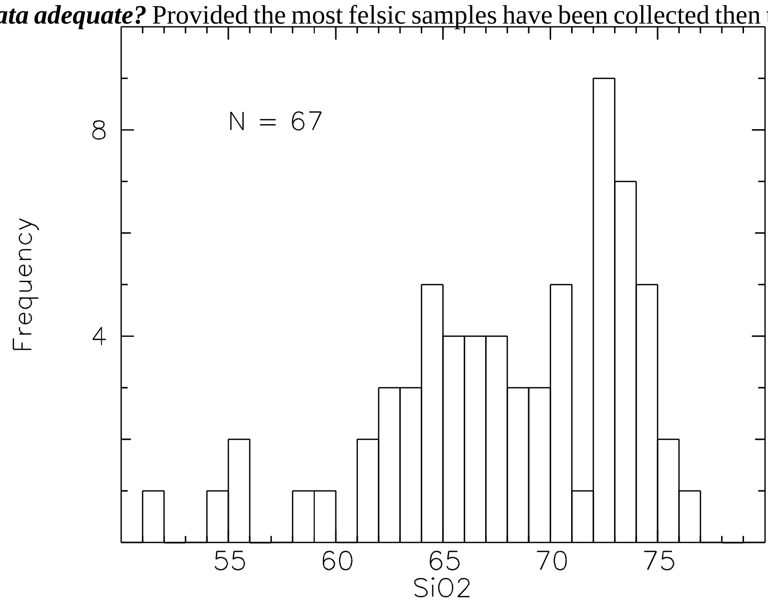


Figure 3.1. Histogram of SiO_2 values for the Paperbark Supersuite in the east Kimberley Region.

more than adequate.

SiO_2 range (Fig. 3.1): Most samples are between 65 and 75 wt.% SiO_2, with a peak at 72 wt.%.

Alteration (Fig. 3.2):

- ***SiO_2:*** No strong evidence of silicification, although quartz veins are locally common.
- ***K_2O/Na_2O:*** Some samples have evidence of sodic alteration in the Neville Granodiorite and the Paperbark Granite.
- ***Th/U:*** Some samples have elevated Th/U values: this may be an effect of later deformation and metamorphism.
- ***$Fe_2O_3/(FeO+Fe_2O_3)$:*** A few samples have anomalously high ratios: this may be an effect of weathering. In general however, the values are very low and the lowest for the whole of the Kimberley Region.

Fractionation Plots (Fig. 3.3):

- ***Rb:*** Very late exponential increase with increasing SiO_2.
- ***U:*** Very weak, very late exponential increase with increasing SiO_2.
- ***Y:*** Very weak, very late exponential increase with increasing SiO_2.
- ***P_2O_5:*** General linear decrease with increasing SiO_2.
- ***Th:*** Very weak, very late increase with increasing SiO_2.
- ***K/Rb:*** Very weak, very late decrease with increasing SiO_2.
- ***Rb-Ba-Sr:*** Some samples of the Paperbark Granite and the Tumagee Granite plot in the strongly differentiated field.
- ***Sr:*** General linear decrease with increasing SiO_2.
- ***Rb/Sr:*** Very weak, very late exponential increase with increasing SiO_2.
- ***Ba:*** Scattered trend, but general weak decrease with increasing SiO_2.
- ***F:*** No data.

Metals (Fig. 3.4):

- ***Cu:*** Decreases with increasing SiO_2.
- ***Pb:*** Weak increase with increasing SiO_2; presumably reflects increasing K-feldspar content.
- ***Zn:*** Decreases with increasing SiO_2.
- ***Sn:*** Scattered but within the samples that plot in the strongly differentiated field on the Rb-Sr-Ba plot there is a weak increase with increasing SiO_2 in SiO_2 values >72 wt.%.

High field strength elements (Fig. 3.5):

- ***Zr:*** No trend and values are relatively low.
- ***Nb:*** No trend and values are relatively low.
- ***Ce:*** No trend and values are relatively low.

Classification (Fig. 3.6):

- ***The $CaO/Na_2O/K_2O$ plot of White, quoted in Sheraton and Simons (1992):*** Most samples plot in the tonalite, granodiorite, and monzogranite to granite field.
- ***Zr/Y vs Sr/Sr*:*** Most samples do not have Nd values which are essential for this plot. Most of those samples that have Nd plot below 1, which indicates that they are Sr-depleted as is typical of most Australian Proterozoic granites.
- ***Spidergram:*** The pattern is typical of Sr-depleted, Y-undepleted granites, which is typical of most Australian Proterozoic granites.
- ***Oxidation plot of Champion and Heinemann (1994):*** Most samples plot in the reduced field, and become oxidised with increasing SiO_2 content.
- ***ASI:*** Most samples are metaluminous to weakly peraluminous.
- ***A-type plot of Eby (1990):*** The samples straddle the boundary between normal granite and A-type granite as defined for Palaeozoic granites.

Granite type (Chappell and White 1974; Chappell and Stephens 1988): I-(granodiorite) type.

Australian Proterozoic granite type: Nicholson-type.

3.12 Geophysical Signature

Radiometrics (Fig. 3.7): All samples plot well above the median value for K_2O for Australian Proterozoic crust, and many plot above for Th and U; these would appear white in a RGB image. Assuming that the samples are representative, some groups plot below for U only (Airfield Granodiorite, Togo Monzogranite, Whitewater Volcanics) and would appear yellowish to pink in a RGB image, whilst other groups are lower in both Th and U and would appear red (Neville Granodiorite, Gnewing Granodiorite, Top Water Tonalite).

Gravity: The granite outcrops of the Paperbark Supersuite are generally coincident with gravity highs. This could be a function of the coeval gabbros; however, similar resitite-rich granite suites in the Mount Isa Inlier (Kalkadoon Supersuite) and the Tennant Creek Inlier (Tennant Creek Supersuite) are also coincident with gravity highs.

Magnetics: The Paperbark Supersuite has a very low magnetic response. This is somewhat predictable from Figure 3.6D as many of the samples fit below the magnetite/ilmenite line which divides oxidised from reduced granites (Champion and Heinemann 1994).

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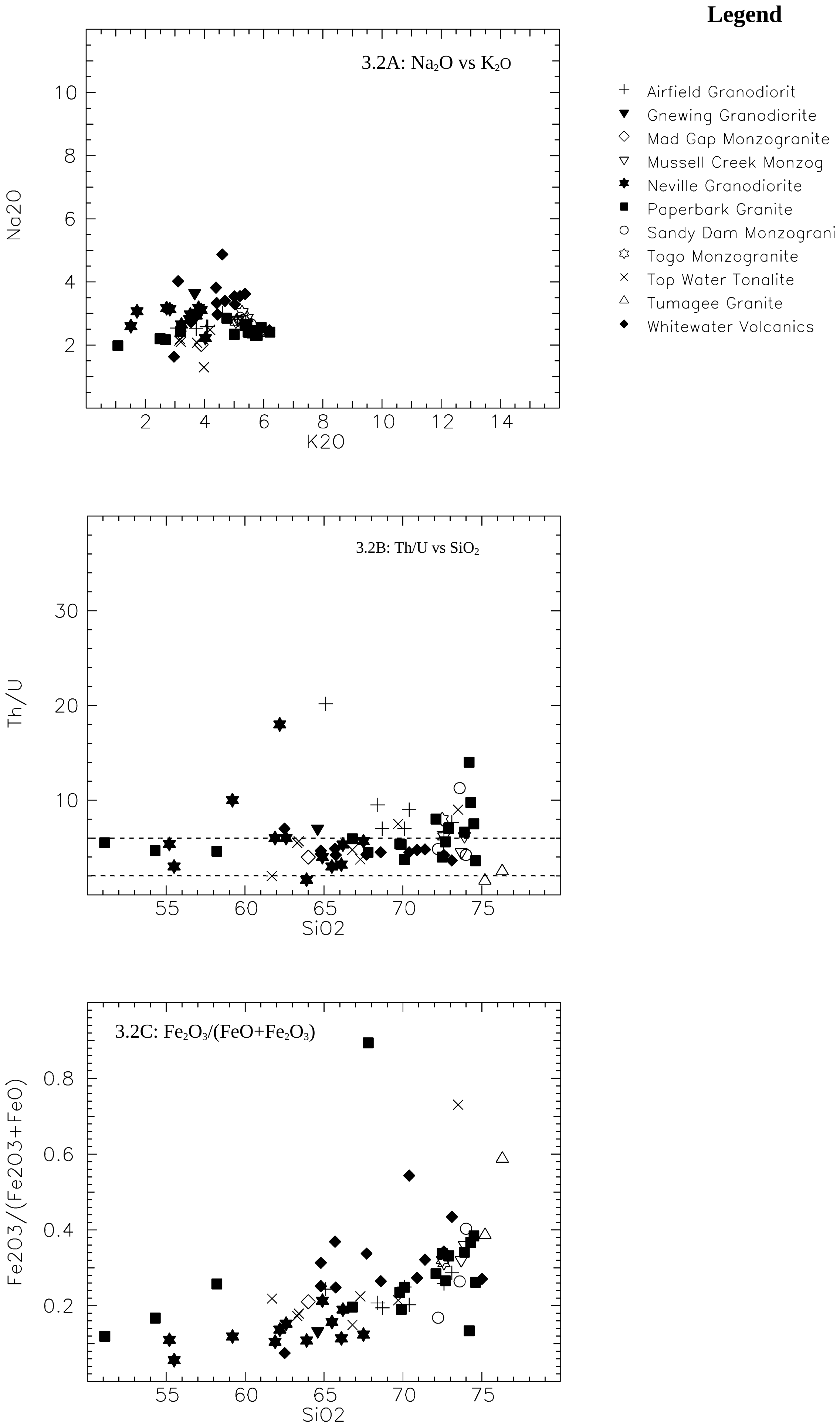
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Mussell Creek Monzog
Neville Granodiorite
Paperbark Granite
Sandy Dam Monzograni
Togo Monzogranite
Top Water Tonalite
Tumagee Granite
Whitewater Volcanics
3.2A: Na2O vs K2O
Na2O
K2O
3.2B: Th/U vs SiO2
Th/U
SiO2
3.2C: Fe2O3/(FeO+Fe2O3)
Fe2O3/(Fe2O3+FeO)
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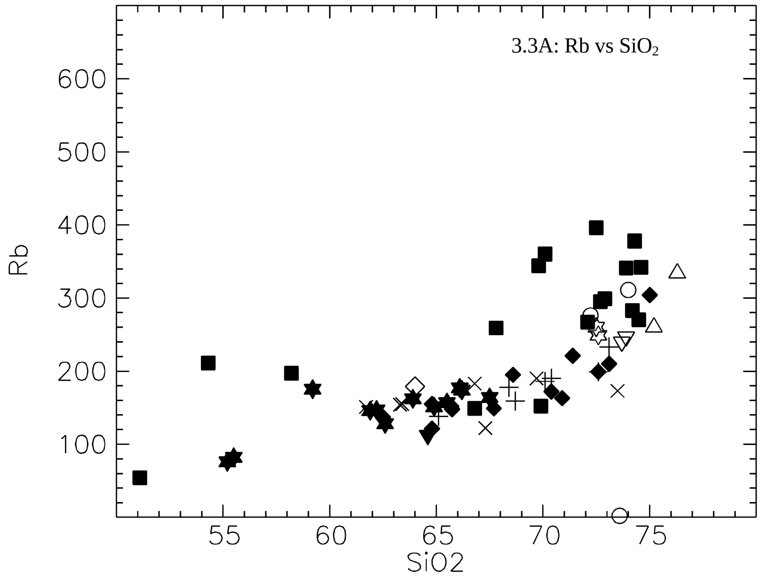

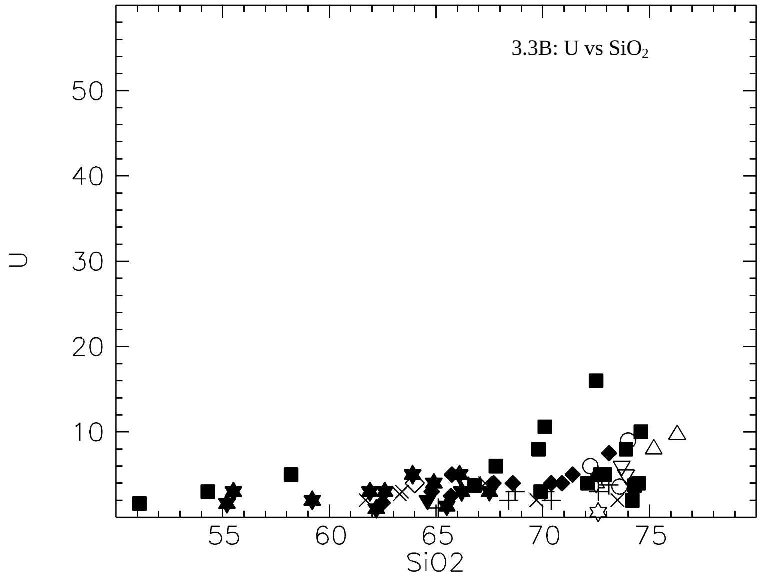

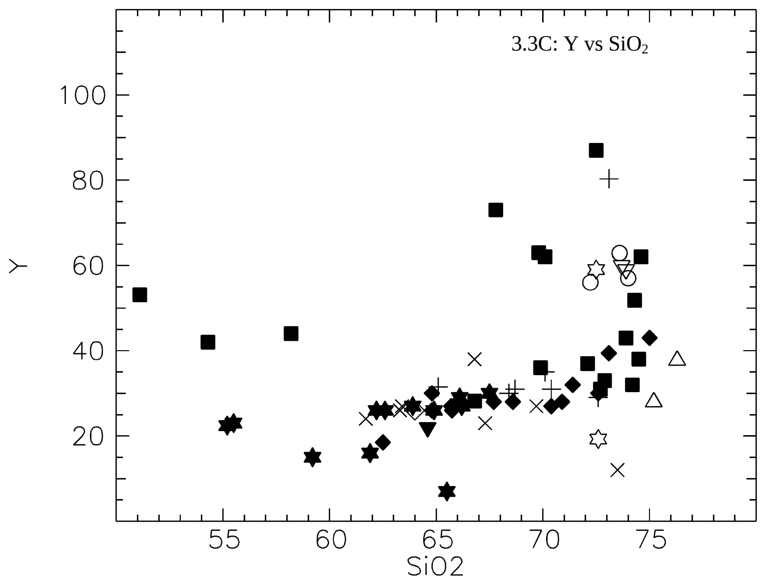

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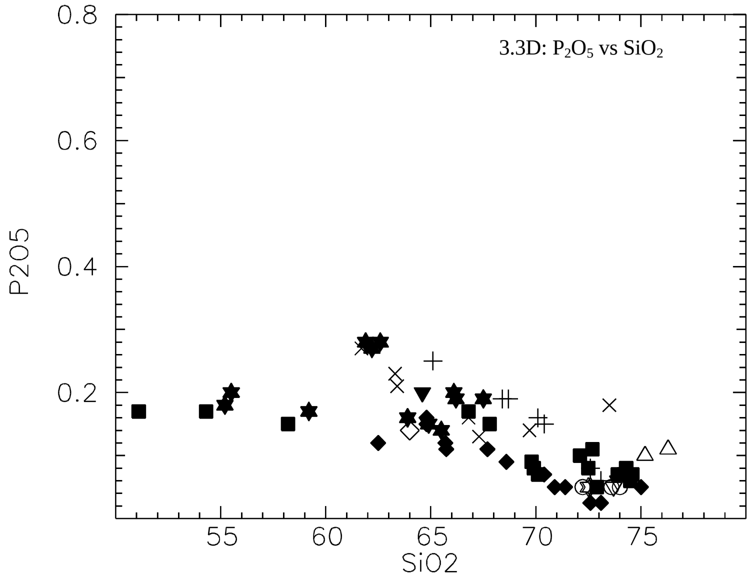

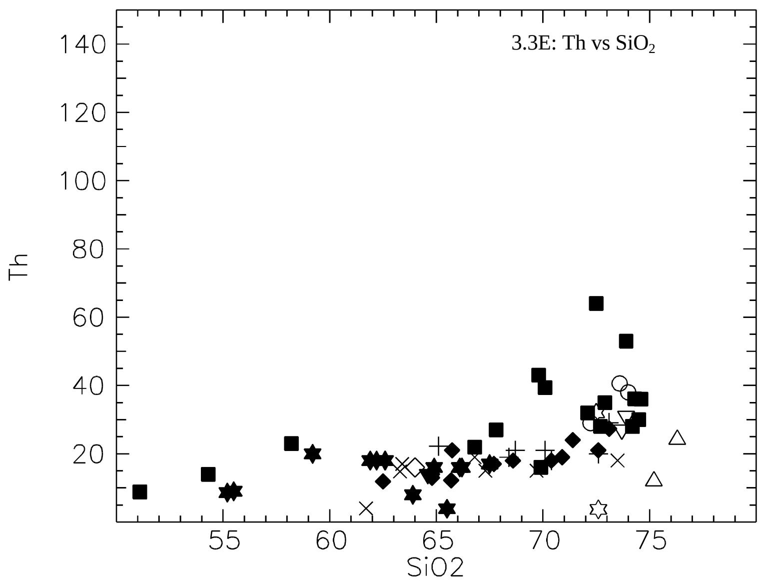

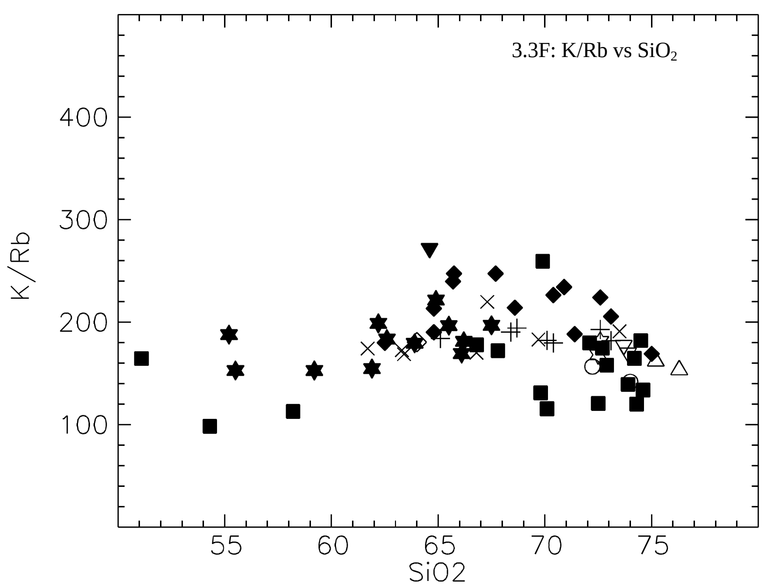

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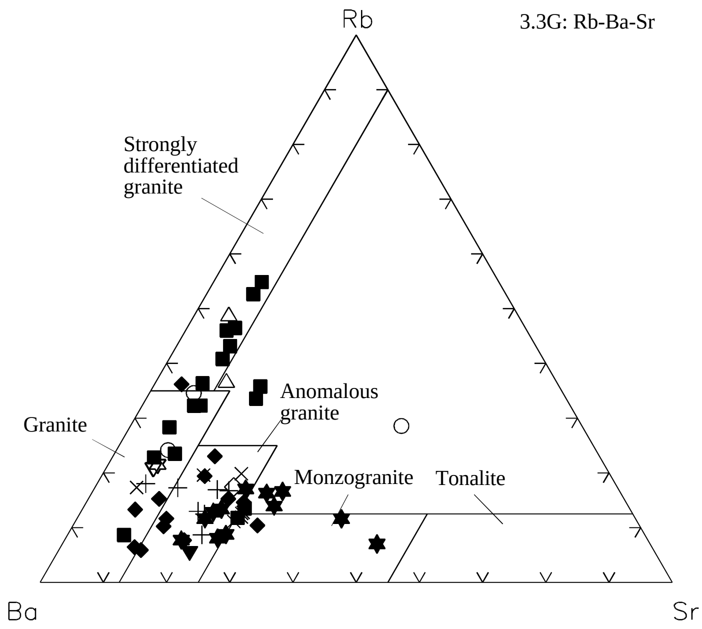
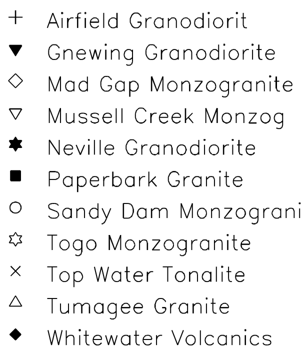

Rb
3.3G: Rb-Ba-Sr
Strongly differentiated granite
Granite
Anomalous granite
Monzogranite
Tonalite
Ba
Sr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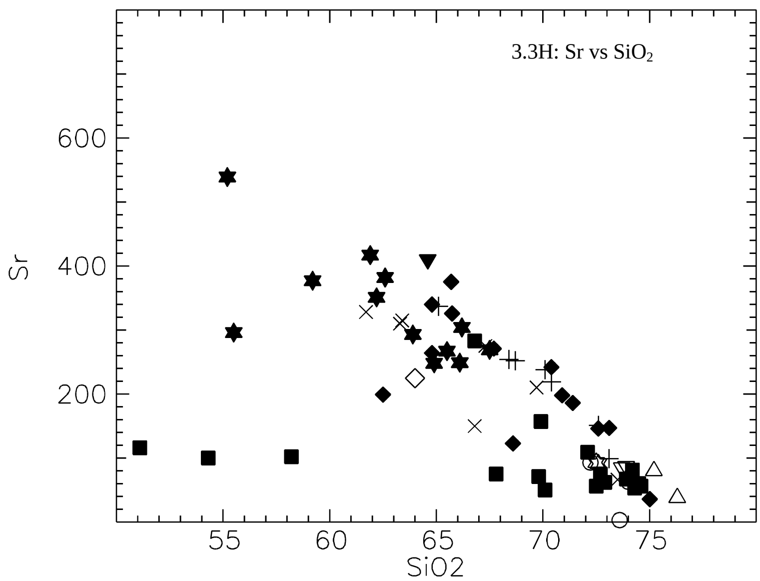
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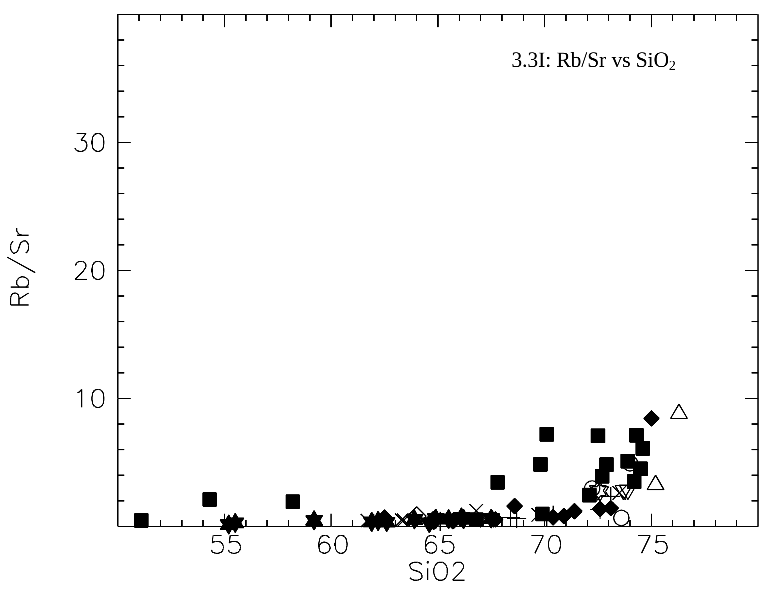
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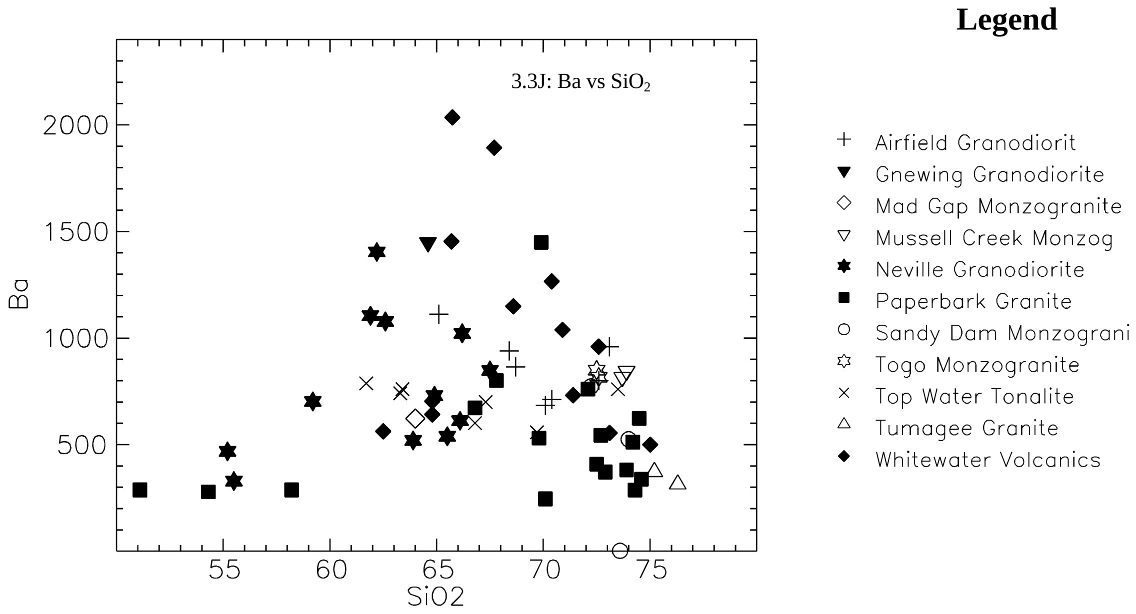

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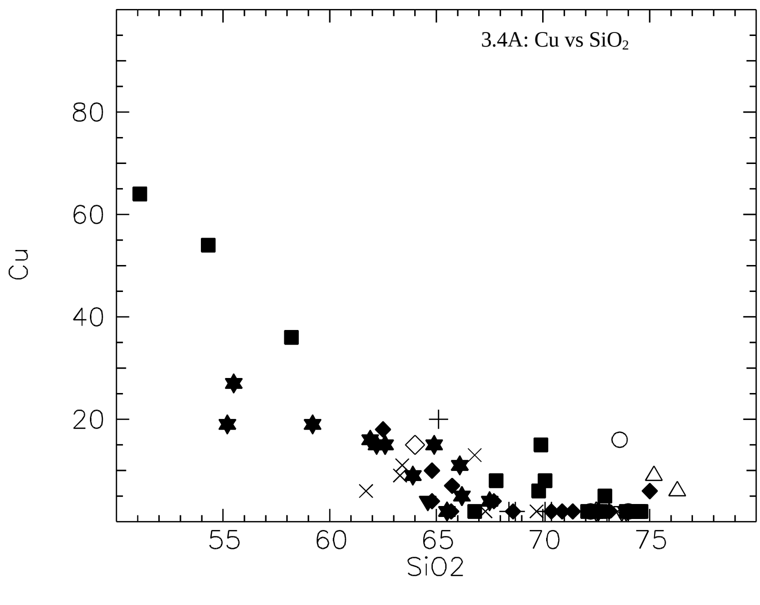

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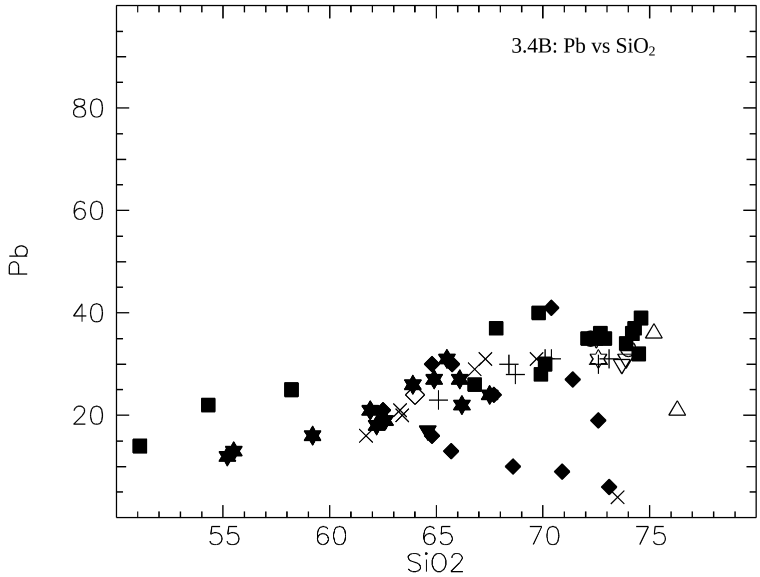

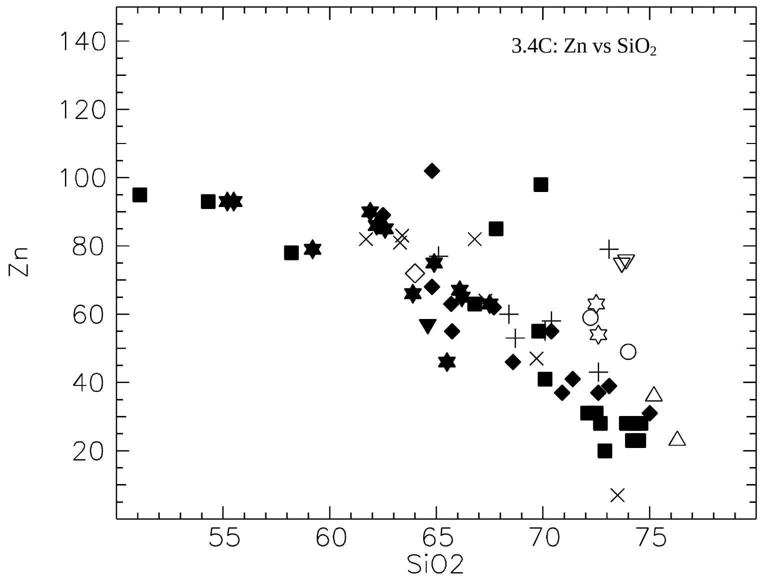

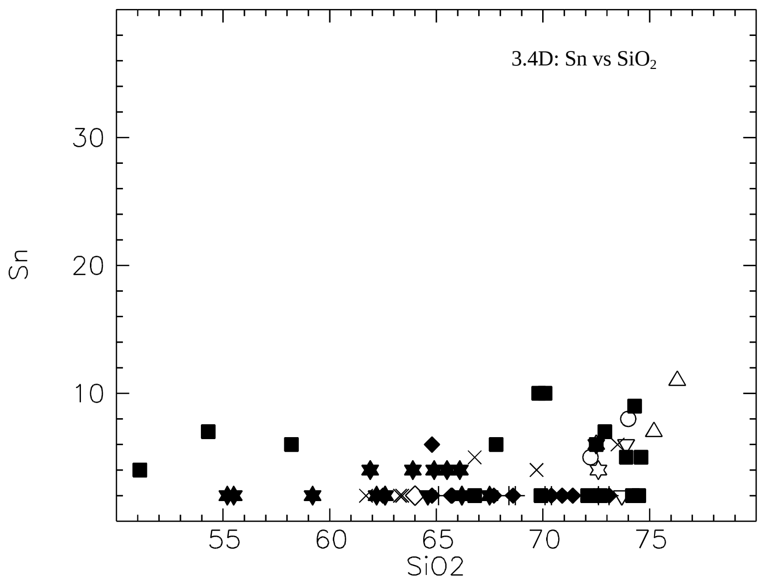

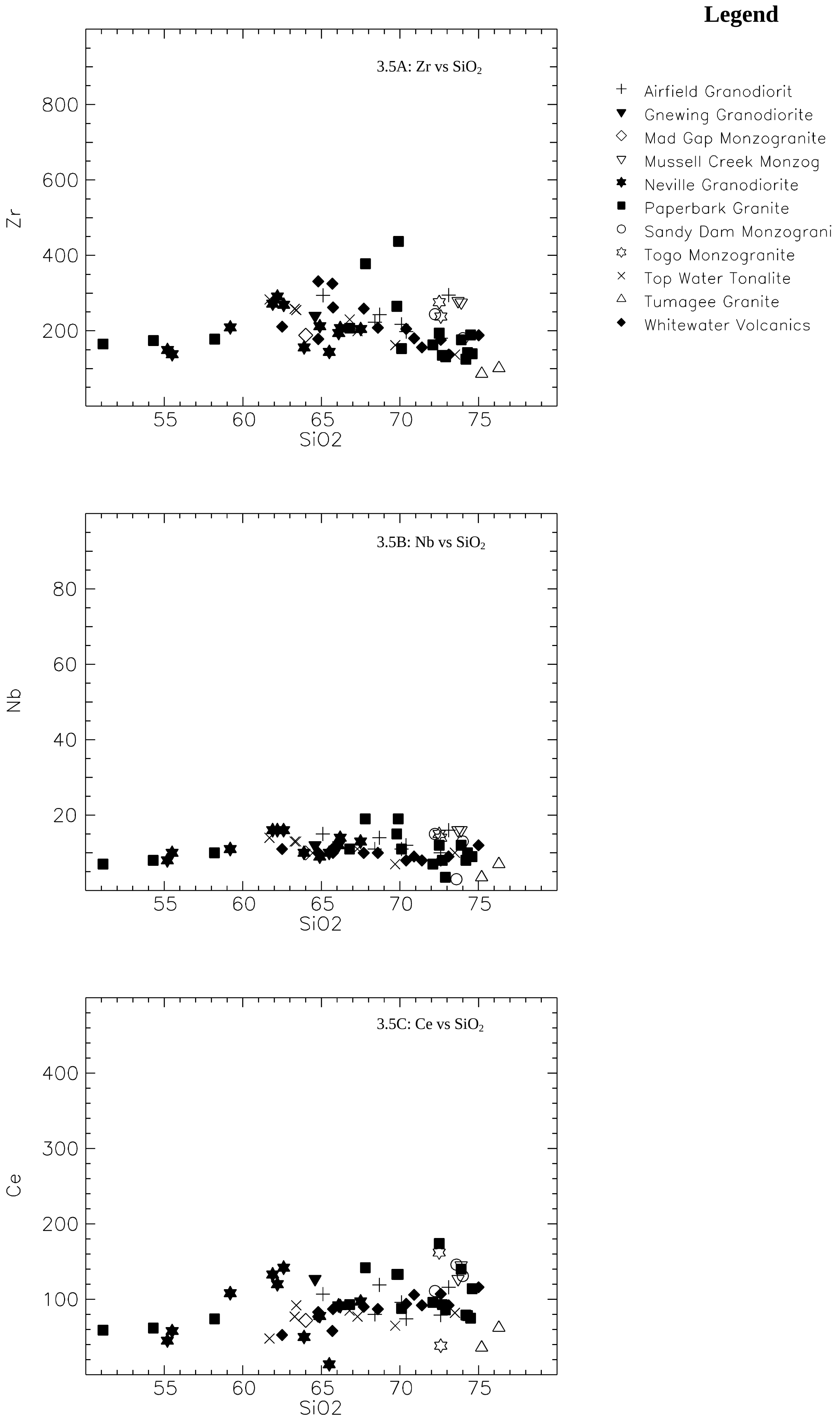
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3.5A: Zr vs SiO_2
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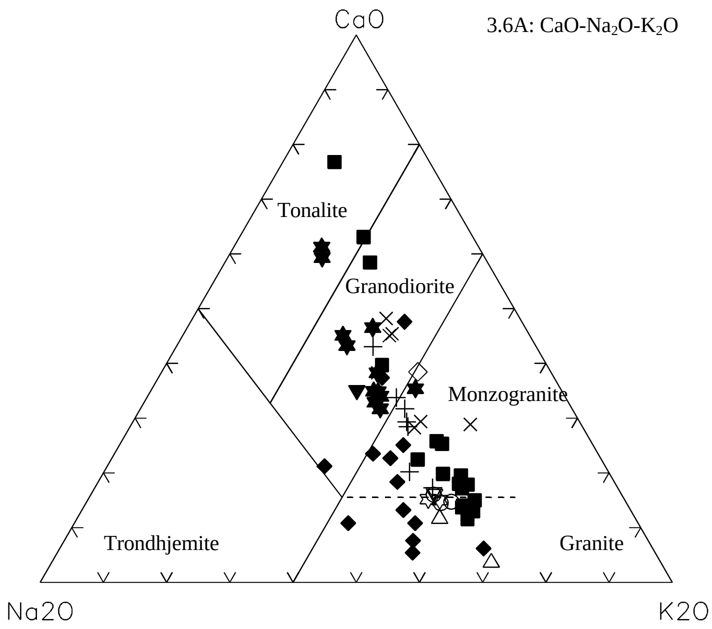

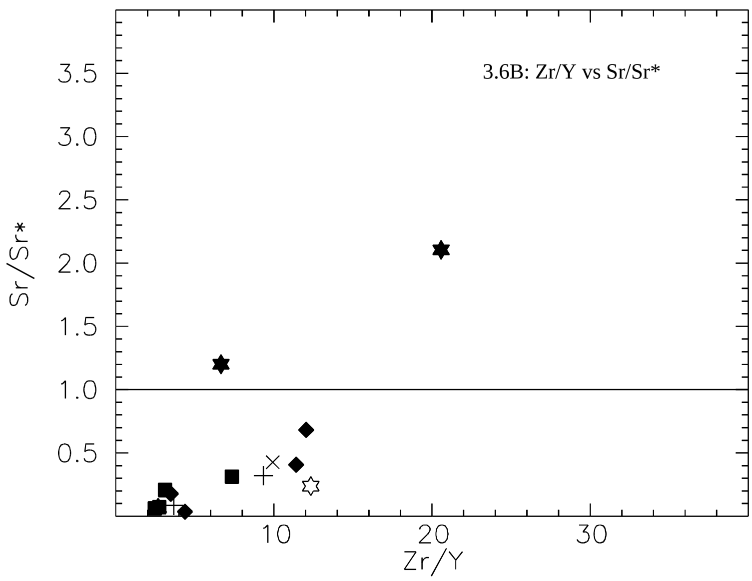

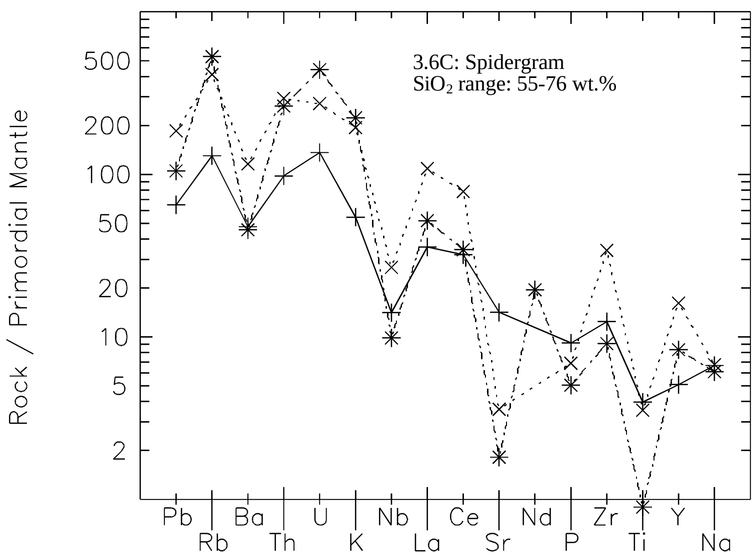

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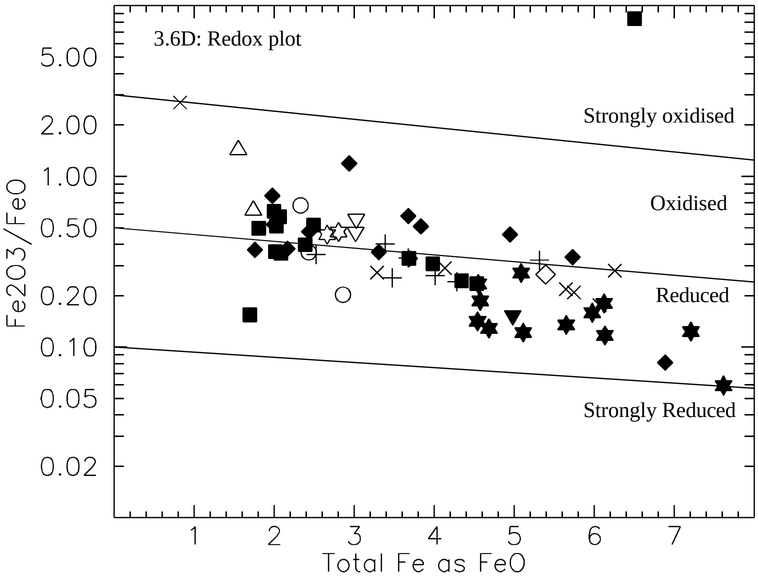

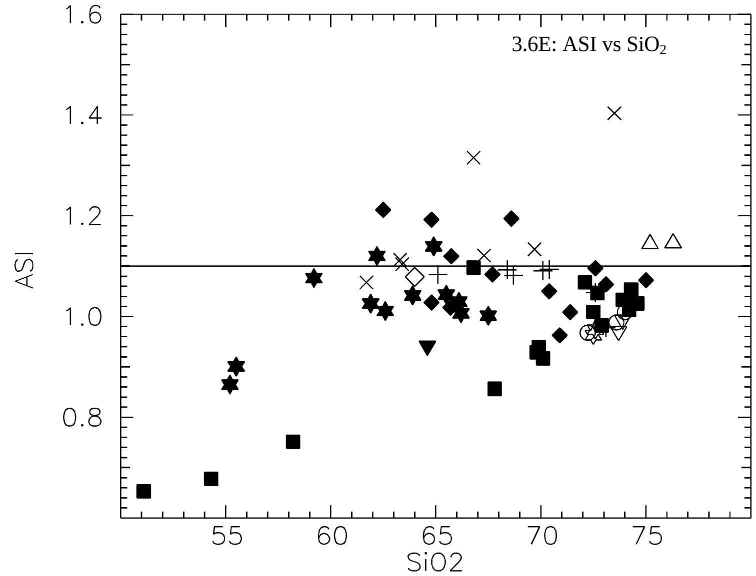

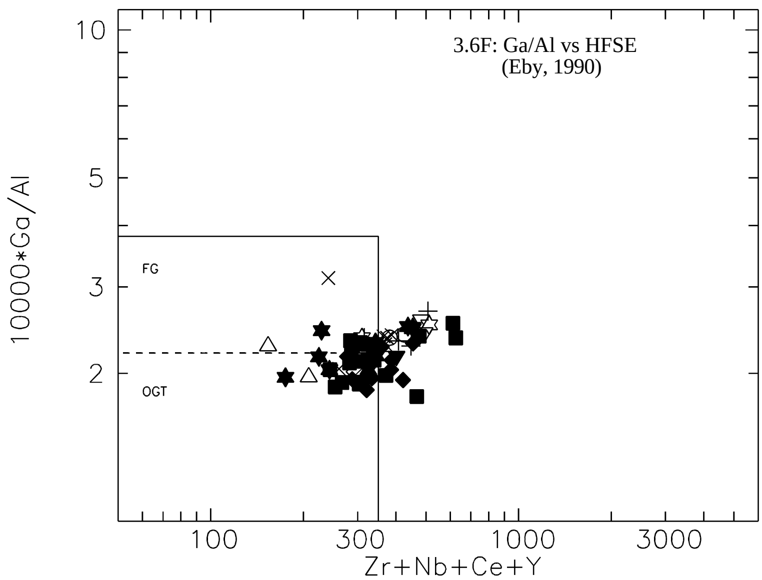

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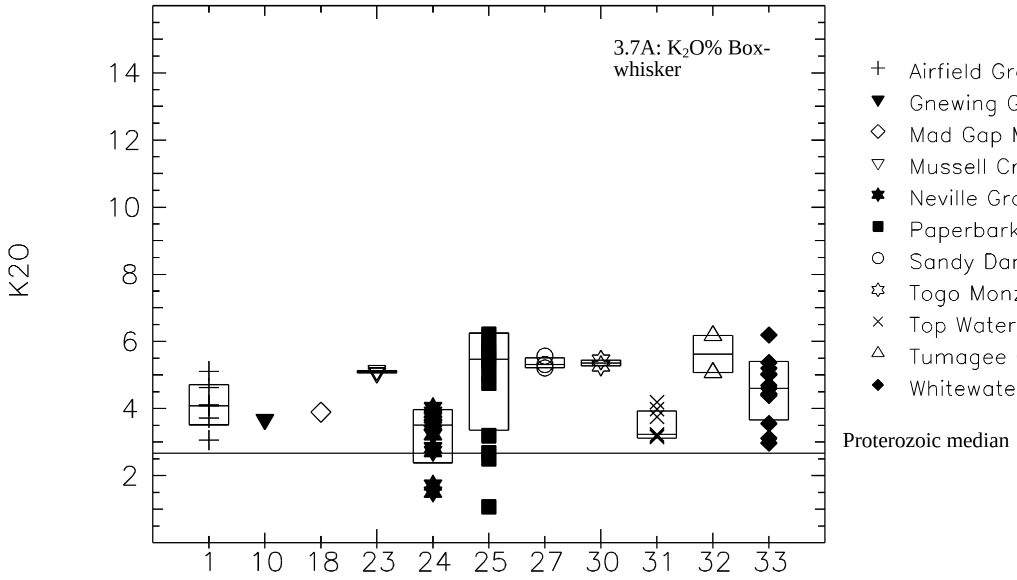
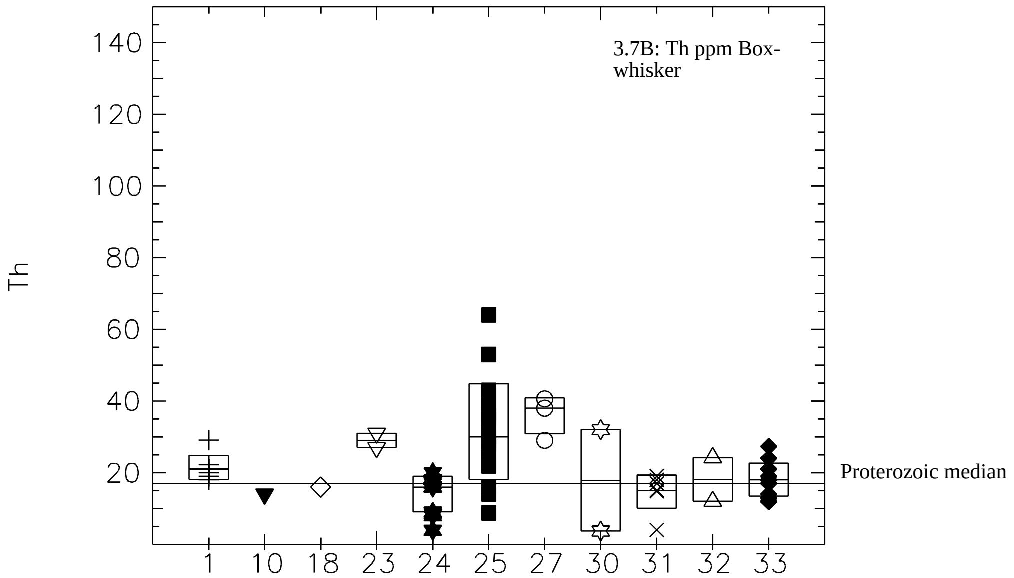
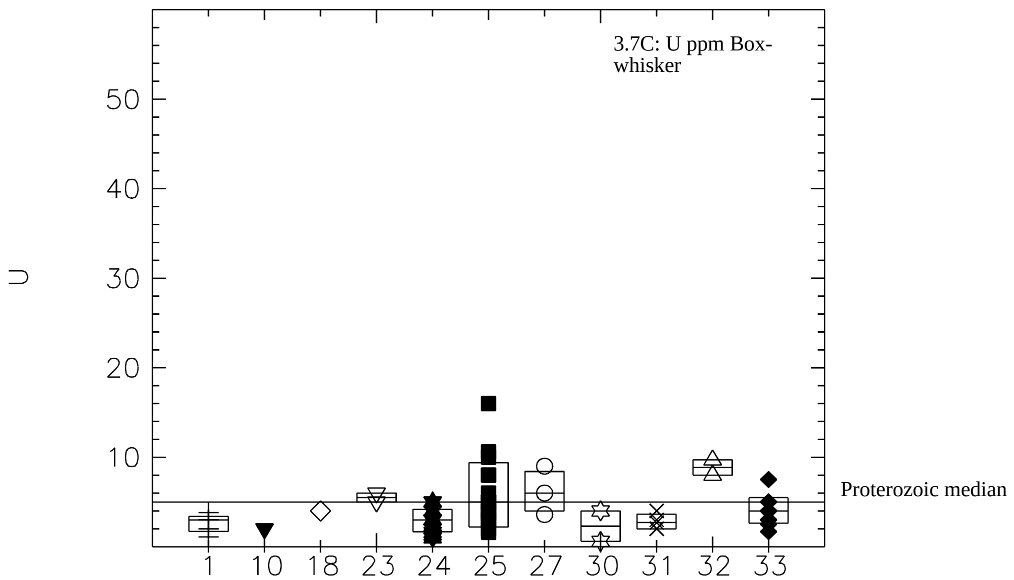
- ◆ Whitewater Volcanics







Airfield Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	69.77	70.1	2.72	65.1	73.1	7
TiO2	0.5	0.48	0.17	0.28	0.8	7
Al2O3	14.43	14.5	0.97	12.7	15.8	7
Fe2O3	0.91	0.85	0.22	0.67	1.33	7
FeO	2.99	2.83	0.72	1.92	4.12	7
MnO	0.03	05	0.01	05	0.05	7
MgO	0.79	0.79	0.37	0.22	1.37	7
CaO	2.79	2.76	0.85	1.65	4.23	7
Na2O	2.66	2.58	0.18	2.52	3.01	7
K2O	4.11	4.08	0.65	3.06	5.11	7
P2O5	0.15	0.16	0.07	0.06	0.25	7
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.93	0.89	0.21	0.71	1.29	7
Ba	867.57	864	150.18	685	1112	7
Li	44.29	42	11.61	29	65	7
Rb	183.29	186	30.11	138	233	7
Sr	221.43	238	77.01	99	337	7
Pb	29.14	30	2.91	23	31	7
Th	21.47	21	3.64	18	29.1	7
U	2.56	3	0.9	1.1	3.8	7
Zr	235.71	223	44.73	180	295	7
Nb	12.71	12	2.29	10	16	7
Y	38.26	31	18.63	29	80.3	7
La	55.84	51	18.85	38	85.7	7
Ce	95.84	96	18.61	74	119	7
Pr	14.8	14.8	1.41	13.8	15.8	2
Nd	59.8	59.8	5.23	56.1	63.5	2
Sc	8.29	10	3.32	3.4	12	7
V	33.14	33	17.01	10	64	7
Cr	17.86	18	7.34	8	29	7
Ni	9.86	10	2.73	6	14	7
Cu	4.57		6.8		20	7
Zn	60.71	58	13	43	79	7
Sn	2		-			7
Mo	3		-			7
Ga	17.71	18	0.95	16	19	7
As	2		-			7
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	2.3	2.3	1.56	1.2	3.4	2
Ta	1	1	-	1	1	7
Ge	1.5		-			7

Gnewing Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	64.6	64.6	-	64.6	64.6	1
TiO2	0.8	0.8	-	0.8	0.8	1
Al2O3	15.7	15.7	-	15.7	15.7	1
Fe2O3	0.67	0.67	-	0.67	0.67	1
FeO	4.38	4.38	-	4.38	4.38	1
MnO	0.07	0.07	-	0.07	0.07	1
MgO	1.51	1.51	-	1.51	1.51	1
CaO	3.95	3.95	-	3.95	3.95	1
Na2O	3.65	3.65	-	3.65	3.65	1
K2O	3.67	3.67	-	3.67	3.67	1
P2O5	0.2	0.2	-	0.2	0.2	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.6	0.6	-	0.6	0.6	1
Ba	1449	1449	-	1449	1449	1
Li	26	26	-	26	26	1
Rb	112	112	-	112	112	1
Sr	410	410	-	410	410	1
Pb	17	17	-	17	17	1
Th	14	14	-	14	14	1
U	2	2	-	2	2	1
Zr	240	240	-	240	240	1
Nb	12	12	-	12	12	1
Y	22	22	-	22	22	1
La	68	68	-	68	68	1
Ce	127	127	-	127	127	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	12	12	-	12	12	1
V	63	63	-	63	63	1
Cr	32	32	-	32	32	1
Ni	8	8	-	8	8	1
Cu	4	4	-	4	4	1
Zn	57	57	-	57	57	1
Sn	2		-			1
Mo	-	-	-	-	-	-
Ga	18	18	-	18	18	1
As	-	-	-	-	-	-
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Mad Gap Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	64	64	-	64	64	1
TiO2	0.67	0.67	-	0.67	0.67	1
Al2O3	15	15	-	15	15	1
Fe2O3	1.16	1.16	-	1.16	1.16	1
FeO	4.35	4.35	-	4.35	4.35	1
MnO	0.08	0.08	-	0.08	0.08	1
MgO	3.04	3.04	-	3.04	3.04	1
CaO	3.69	3.69	-	3.69	3.69	1
Na2O	2.02	2.02	-	2.02	2.02	1
K2O	3.89	3.89	-	3.89	3.89	1
P2O5	0.14	0.14	-	0.14	0.14	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	1.82	1.82	-	1.82	1.82	1
LOI	0.91	0.91	-	0.91	0.91	1
Ba	623	623	-	623	623	1
Li	46	46	-	46	46	1
Rb	179	179	-	179	179	1
Sr	225	225	-	225	225	1
Pb	24	24	-	24	24	1
Th	16	16	-	16	16	1
U	4	4	-	4	4	1
Zr	188	188	-	188	188	1
Nb	10	10	-	10	10	1
Y	26	26	-	26	26	1
La	37	37	-	37	37	1
Ce	72	72	-	72	72	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	15	15	-	15	15	1
V	87	87	-	87	87	1
Cr	154	154	-	154	154	1
Ni	24	24	-	24	24	1
Cu	15	15	-	15	15	1
Zn	72	72	-	72	72	1
Sn	2		-			1
Mo	3		-			1
Ga	16	16	-	16	16	1
As	2		-			1
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	2.5		-			1
Ge	1.5		-			1

Mussell Creek Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	73.8	73.8	0.14	73.7	73.9	2
TiO2	0.31	0.31	0.01	0.31	0.32	2
Al2O3	12.5	12.5	-	12.5	12.5	2
Fe2O3	1.07	1.07	0.09	1	1.13	2
FeO	2.07	2.07	0.08	2.01	2.12	2
MnO	0.03	05	-	05	05	2
MgO	0.17	0.17	0.02	0.16	0.19	2
CaO	1.53	1.53	0.04	1.5	1.56	2
Na2O	2.78	2.78	0.04	2.75	2.8	2
K2O	5.1	5.1	0.05	5.06	5.13	2
P2O5	0.05	0.05	0.01	0.05	0.06	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.87	0.87	0.06	0.83	0.91	2
Ba	831	831	21.21	816	846	2
Li	33.5	33.5	9.19	27	40	2
Rb	243.5	243.5	4.95	240	247	2
Sr	86	86	1.41	85	87	2
Pb	30.5	30.5	0.71	30	31	2
Th	29	29	2.83	27	31	2
U	5.5	5.5	0.71	5	6	2
Zr	277	277	2.83	275	279	2
Nb	16	16	-	16	16	2
Y	59.5	59.5	0.71	59	60	2
La	74	74	8.49	68	80	2
Ce	136	136	12.73	127	145	2
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	9	9	-	9	9	2
V	12	12	-	12	12	2
Cr	3	3	1.41		4	2
Ni	6.5	6.5	0.71	6	7	2
Cu	2		-			2
Zn	75.5	75.5	0.71	75	76	2
Sn	4	4	2.83		6	2
Mo	3		-			2
Ga	16.5	16.5	0.71	16	17	2
As	2		-			2
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	1	1	-	1	1	2
Ge	1.5		-			2

Neville Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	62.56	63.25	4.07	55.2	67.5	12
TiO2	0.81	0.78	0.16	0.59	1.04	12
Al2O3	15.92	15.8	1.04	14.7	18	12
Fe2O3	0.73	0.71	0.2	0.43	1.11	12
FeO	4.95	4.82	1.08	3.76	7.23	12
MnO	0.08	0.07	0.03	0.06	0.14	12
MgO	2.68	2.21	1.81	1.14	7.85	12
CaO	4.37	3.7	1.33	3.25	7.57	12
Na2O	2.9	2.95	0.29	2.22	3.18	12
K2O	3.17	3.51	0.83	1.51	4.03	12
P2O5	0.2	0.19	0.05	0.14	0.28	12
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.28	0.28	-	0.28	0.28	1
LOI	1.68	1.61	0.54	0.82	2.65	12
Ba	779.83	716	317.62	329	1404	12
Li	42.42	40.5	11.38	26	68	12
Rb	144.92	154	33.87	76	177	12
Sr	332.67	300	85.65	248	539	12
Pb	21.33	21.5	5.94	12	31	12
Th	14.04	16	5.2	3.9	20	12
U	2.91	3	1.31		5	12
Zr	203.83	206	52.14	138	291	12
Nb	12.08	11.5	2.87	8	16	12
Y	22.87	26	6.83	7	30	12
La	43.37	45.5	18.17	9.3	69	12
Ce	85.67	91.5	38.36	13.8	142	12
Pr	3.9	3.9	3.25	1.6	6.2	2
Nd	15.2	15.2	12.87	6.1	24.3	2
Sc	12.43	13	5.07	1.1	20	12
V	78	71.5	29.25	47	158	12
Cr	112.67	50.5	177.14	32	668	12
Ni	25.25	17	32.48	8	127	12
Cu	13.08	15	7.23		27	12
Zn	75.67	77	14.57	46	93	12
Sn	2.83		1.03		4	12
Mo	3		-			1
Ga	19	18.5	2.13	16	22	12
As	13	13	-	13	13	1
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	0.73	0.73	0.67	50	1.2	2
Ta	2.5		-			1
Ge	1.5		-			1

Paperbark Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	68.81	72.1	7.3	51.1	74.6	17
TiO2	0.52	0.35	0.31	0.26	1.22	17
Al2O3	13.29	13	0.81	12.4	15.1	17
Fe2O3	1.24	0.87	1.4	0.23	6.39	17
FeO	3.04	1.7	2.65	0.76	9.98	17
MnO	0.06	05	0.05	05	0.17	17
MgO	1.53	0.73	1.81	0.29	6.73	17
CaO	3.04	1.98	2.66	1.11	10.1	17
Na2O	2.41	2.4	0.2	1.98	2.85	17
K2O	4.8	5.47	1.49	1.07	6.21	17
P2O5	0.1	0.08	0.04	0.05	0.17	17
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.28	0.27	0.21	10	0.73	15
LOI	0.66	0.67	0.33	0.14	1.4	17
Ba	516.65	409	297.51	246	1449	17
Li	31	31	2.83	29	33	2
Rb	270.41	283	92.58	54	396	17
Sr	92.53	75	56.62	50	283	17
Pb	31.82	35	6.87	14	40	17
Th	31.48	30	13.78	8.8	64	17
U	5.8	5	3.7	1.6	16	17
Zr	197.12	174	86.74	125	437	17
Nb	10.5	10	4.09		19	17
Y	48.01	43	16.6	28.2	87	17
La	59.44	54.4	26.23	32	143	17
Ce	101.14	93	32.57	59.1	174	17
Pr	9.6	9.9	2.15	6.7	11.9	4
Nd	37.67	37.55	8.01	28	47.6	4
Sc	5.77	5	3.67	1.6	13.9	8
V	51.47	22	67.68	7	222	17
Cr	51.94	12	79.95		261	17
Mn	-	-	-	-	-	-
Co	-	-	-	-	-	-
Ni	20.88	9	27.31	3	92	17
Cu	12.59		19.47		64	17
Zn	49.88	31	29.02	20	98	17
Sn	5.12	5	2.87		10	17
W	-	-	-	-	-	-
Mo	1.94		1		3	16
Ga	14.88	14	1.69	13	18	17
As	2.65		1.62		8	17
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	1.45	1	1.96		7	10
Bi	2		-			11
Sb	2		-			10
Hf	3.68	3.75	0.67	2.8	4.4	4
Ta	1	1	-	1	1	6
Ge	1.5		-			16

Sandy Dam Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	73.28	73.6	0.93	72.23	74	3
TiO2	0.28	0.28	0.02	0.27	0.3	3
Al2O3	12.7	12.7	0.1	12.6	12.8	3
Fe2O3	0.71	0.66	0.25	0.49	0.98	3
FeO	1.9	1.84	0.49	1.45	2.42	3
MnO	0.03	05	-	05	05	3
MgO	0.58	0.72	0.25	0.3	0.73	3
CaO	1.44	1.42	0.09	1.37	1.54	3
Na2O	2.77	2.78	0.1	2.66	2.86	3
K2O	5.36	5.31	0.18	5.21	5.56	3
P2O5	0.05	0.05	-	0.05	0.05	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.25	0.11	0.27	0.07	0.56	3
LOI	0.44	0.62	0.38	01	0.69	3
Ba	433.33	525	393.59		773	3
Li	-	-	-	-	-	-
Rb	196.33	276	169.21		311	3
Sr	53	63	45.83		93	3
Pb	102	35	117.78	33	238	3
Th	35.87	38	6.09	29	40.6	3
U	6.2	6	2.71	3.6	9	3
Zr	212	212	45.25	180	244	2
Nb	10.33	13	6.43	3	15	3
Y	58.63	57	3.73	56	62.9	3
La	78.17	74	20.57	60	100.5	3
Ce	129.33	131	17.56	111	146	3
Pr	19	19	-	19	19	1
Nd	72.5	72.5	-	72.5	72.5	1
Sc	5	5	2.83	3	7	2
V	24	13	19.92	12	47	3
Cr	7	7	5		12	3
Ni	15.67	7	15.89	6	34	3
Cu	6.67		8.08		16	3
Zn	114.33	59	104.62	49	235	3
Sn	34	8	47.66	5	89	3
Mo	5		5.29		11	3
Ga	11.17	16	8.37		16	3
As	239		410.5		713	3
S	-	01	-	01	01	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	1.25	.50	1.06			2
Bi	2.25	.50	0.35			2
Sb	4	4	-	4	4	1
Hf	3.8	3.8	-	3.8	3.8	1
Ta	2	2	-	2	2	1
Ge	1.5		-			2

Togo Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	72.55	72.55	0.06	72.5	72.6	2
TiO2	0.31	0.31	0.01	0.3	0.31	2
Al2O3	12.8	12.8	-	12.8	12.8	2
Fe2O3	0.89	0.89	0.05	0.86	0.93	2
FeO	1.93	1.93	0.06	1.89	1.97	2
MnO	0.03	05	-	05	05	2
MgO	0.68	0.68	0.01	0.67	0.69	2
CaO	1.48	1.48	0.01	1.47	1.49	2
Na2O	2.95	2.95	0.13	2.86	3.04	2
K2O	5.36	5.36	0.12	5.27	5.44	2
P2O5	0.05	0.05	-	0.05	0.05	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.22	0.22	0.14	0.12	0.32	2
LOI	0.5	0.5	0.23	0.34	0.66	2
Ba	833.5	833.5	23.33	817	850	2
Li	-	-	-	-	-	-
Rb	254.5	254.5	7.78	249	260	2
Sr	92	92	1.41	91	93	2
Pb	33	33	2.83	31	35	2
Th	17.85	17.85	20.01	3.7	32	2
U	2.3	2.3	2.4	0.6	4	2
Zr	257	257	26.87	238	276	2
Nb	14.5	14.5	0.71	14	15	2
Y	39.15	39.15	28.07	19.3	59	2
La	52.95	52.95	43.91	21.9	84	2
Ce	100.25	100.25	87.33	38.5	162	2
Pr	4.6	4.6	-	4.6	4.6	1
Nd	20.7	20.7	-	20.7	20.7	1
Sc	4.1	4.1	-	4.1	4.1	1
V	11.5	11.5	0.71	11	12	2
Cr	9.5	9.5	0.71	9	10	2
Ni	5	5	-	5	5	2
Cu	2		-			2
Zn	58.5	58.5	6.36	54	63	2
Sn	5	5	1.41	4	6	2
Mo	1		-			2
Ga	16.5	16.5	0.71	16	17	2
As	2		-			2
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	0.5		-			2
Bi	2		-			2
Sb	2		-			2
Hf	0.5	0.5	-	0.5	0.5	1
Ta	-	-	-	-	-	-
Ge	1.5		-			2

Top Water Tonalite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	66.53	66.8	4.14	61.7	73.5	7
TiO2	0.64	0.78	0.26	0.21	0.95	7
Al2O3	15.4	15.7	0.87	13.9	16.5	7
Fe2O3	0.95	0.95	0.24	0.65	1.4	7
FeO	3.71	4.72	1.81	0.24	5.24	7
MnO	0.05	0.06	0.02	05	0.07	7
MgO	1.75	1.76	0.81	0.41	2.67	7
CaO	3.51	3.61	1.12	2.14	4.99	7
Na2O	2.12	2.14	0.41	1.3	2.59	7
K2O	3.52	3.23	0.44	3.15	4.19	7
P2O5	0.19	0.18	0.05	0.13	0.27	7
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.04	02	0.06	02	0.14	4
LOI	1.44	1.36	0.47	1.02	2.35	7
Ba	701.29	741	88.22	558	788	7
Li	42	47	20.95	19	60	3
Rb	161.14	155	23	122	190	7
Sr	236.29	275	98.89	66	328	7
Pb	21.71	21	9.79	4	31	7
Th	14.69	15	4.99	4	19	7
U	2.81	2.7	0.9	2	4	7
Zr	217.71	230	53.84	137	283	7
Nb	11.29	11	2.36	7	14	7
Y	25.29	26	7.65	12	38	7
La	40.29	43	10.8	20	52	7
Ce	75.16	77.1	14.58	48	92	7
Pr	9	9	-	9	9	1
Nd	36.4	36.4	-	36.4	36.4	1
Sc	10.56	12	4.84	4	16	7
V	55.14	69	26.6	11	84	7
Cr	58.57	66	29.06	6	89	7
Ni	20	21	7.48	6	28	7
Cu	6.43	6	4.65		13	7
Zn	63.71	81	28.39	7	83	7
Sn	3.29		1.7		6	7
Mo	3		-			7
Ga	19.29	20	2.29	16	23	7
As	2		-			7
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	3	3	-	3	3	1
Ta	1	1	-	1	1	7
Ge	1.5		-			7

Tumagee Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	75.75	75.75	0.78	75.2	76.3	2
TiO2	0.15	0.15	0.06	0.11	0.19	2
Al2O3	12.9	12.9	0.57	12.5	13.3	2
Fe2O3	0.84	0.84	0.19	0.7	0.97	2
FeO	0.89	0.89	0.3	0.68	1.11	2
MnO	0.03	05	-	05	05	2
MgO	0.22	0.22	0.13	0.12	0.31	2
CaO	0.67	0.67	0.5	0.32	1.03	2
Na2O	2.56	2.56	0.25	2.38	2.74	2
K2O	5.62	5.62	0.78	5.07	6.17	2
P2O5	0.11	0.11	0.01	0.1	0.11	2
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.14	0.14	0.16	0.03	0.25	2
LOI	0.78	0.78	0.06	0.74	0.83	2
Ba	344	344	41.01	315	373	2
Li	-	-	-	-	-	-
Rb	297	297	52.33	260	334	2
Sr	59	59	29.7	38	80	2
Pb	28.5	28.5	10.61	21	36	2
Th	18.1	18.1	8.63	12	24.2	2
U	8.85	8.85	1.2	8	9.7	2
Zr	93.5	93.5	10.61	86	101	2
Nb	5.25	5.25	2.47		7	2
Y	32.85	32.85	6.86	28	37.7	2
La	27.65	27.65	12.23	19	36.3	2
Ce	49.15	49.15	18.6	36	62.3	2
Pr	6.9	6.9	-	6.9	6.9	1
Nd	26.3	26.3	-	26.3	26.3	1
Sc	2.65	2.65	1.91	1.3	4	2
V	5.5	5.5	0.71	5	6	2
Cr	4	4	-	4	4	2
Ni	7	7	2.83	5	9	2
Cu	7.5	7.5	2.12	6	9	2
Zn	29.5	29.5	9.19	23	36	2
Sn	9	9	2.83	7	11	2
Mo	2.5	2.5	0.71		2	2
Ga	14.5	14.5	2.12	13	16	2
As	12	12	14.14		22	2
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	1	1	-	1	1	1
Bi	2		-			1
Sb	2		-			1
Hf	3.3	3.3	-	3.3	3.3	1
Ta	1	1	-	1	1	1
Ge	1.5		-			2

Whitewater Volcanics

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	68.71	68.6	3.84	62.5	75.01	13
TiO2	0.43	0.44	0.2	0.2	0.85	13
Al2O3	14.66	14.9	1.07	12.52	16	13
Fe2O3	1.03	0.9	0.42	0.49	1.69	13
FeO	2.56	2.41	1.5	1.17	6.42	13
MnO	0.05	0.05	0.03	05	0.11	13
MgO	1.26	1.06	0.74	0.23	2.94	13
CaO	1.86	1.82	1.16	0.5	4.18	13
Na2O	3.33	3.4	0.78	1.63	4.87	13
K2O	4.54	4.6	0.91	2.97	6.19	13
P2O5	0.09	0.09	0.05	05	0.16	13
H2O+	0.67	0.67	-	0.67	0.67	1
H2O-	0.05	10	-	10	10	1
CO2	0.45	0.28	0.31	0.1	0.91	11
LOI	1.55	1.58	0.56	0.64	2.49	12
Ba	1037.77	960	506.46	500	2035	13
Li	22.33	23	10.32	10	40	9
Rb	178.92	163	47.96	121	304	13
Sr	219.46	199	96.1	36	375	13
Pb	20.5	20	10.39	6	41	12
Th	18.03	18	4.81	11.9	27.3	12
U	4.06	4	1.5	1.7	7.5	12
Zr	216.62	205	60.72	137	331	13
Nb	9.69	10	1.25	8	12	13
Y	29.45	28	6.14	18.5	43	13
La	48.25	46	7.64	36.8	61	13
Ce	87.82	90	17.88	52.6	116	13
Pr	7.83	7	2.17	6.2	10.3	3
Nd	33.63	33	9.45	24	44.5	4
Sc	6.47	6	3.82	1.5	16	11
V	36.15	34	28.06	8	111	13
Cr	27.77	17	27.85	4	86	13
Ni	6.77	3	8.5		26	13
Cu	4.85		4.69		18	13
Zn	55.77	55	21.21	31	102	13
Sn	2.33		1.15		6	12
Mo	2.4		0.97			10
Ga	16.31	16	1.7	14	19	13
As	4.82	5	2.23		10	11
S	-	01	-	01	01	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	0.83	1	0.29		1	3
Bi	2		-			3
Sb	5	5	3		8	3
Hf	3.23	3.8	1.25	1.8	4.1	3
Ta	2.5		-			7
Ge	1.5		-			10

4 SALLY DOWNS SUPERSUITE

4.1 Timing

1825 Ma

4.2 Individual Ages

Primary Ages:

1. Mabel Downs Granodiorite	(1832 ± 3 Ma, SHRIMP)
2. Loadstone Monzogranite	(1827 ± 2 Ma, SHRIMP)
3. McHale Granodiorite	(1827 ± 3 Ma, SHRIMP)
4. Mabel Downs Tonalite	(1821 ± 4 Ma, SHRIMP)
5. Sally Downs Tonalite	(1821 ± 4 Ma, SHRIMP)
6. Mount Christine Granite	(1819 ± 4 Ma, SHRIMP)
7. Unfoliated Mount Christine Granite	(1808 ± 3 Ma, SHRIMP)

Other ages of coeval events in the Kimberley Region:

1. Valentine Siltstone	(1834 ± 3 Ma, SHRIMP)
2. McIntosh Intrusion	(1830 ± 3 Ma, SHRIMP)
3. Plagioclase-rich dyke	(1829 ± 4 Ma, SHRIMP)
4. Pegmatite cutting Panton Intrusion	(1825 ± 6 Ma, SHRIMP)
5. Copperhead 'carbonatite'	(1821 ± 4 Ma, SHRIMP)

Source: All ages are from OZCHRON.

4.3 Regional Setting

The period 1830 to 1810 Ma was a time of significant igneous activity in the East Kimberley Region, with major gabbroic bodies and layered mafic/ultramafic intrusions being emplaced contemporaneously with the felsic members of the Sally Downs Supersuite. During this time interval the Copperhead 'carbonatite' was also emplaced, and the Speewah Group, the lowermost unit of the nearby Kimberley Basin sequence, was deposited. The amount of igneous activity suggests that there was a significant heat pulse into the upper mantle and lower crust at this time. The Sally Downs Supersuite, which intrudes all three zones of the Halls Creek Orogen (Tyler *et al.* 1995), contains three suites: the Mabel Downs Suite, the Kevins Dam Suite and the Syenite Camp Suite (Sheppard, *pers. comm.* 1997). Many plutons show extensive interaction with coeval gabbroic intrusions at their margins (Blake and Hoatson 1993; Sheppard 1996). The Mabel Downs and Syenite Camp Suites may not be consanguineous, as some members (in particular, the as yet undated Mount Fairbairn Granite) of the latter suite show close affinities with the Paperbark Supersuite.

4.4 Summary

The plutons of the Sally Downs Supersuite were intruded into a wide variety of rock types, many of which would be potential host rocks for hydrothermal mineralisation. The lack of significant mineralisation associated with the Sally Downs Supersuite may be attributed to the near absence of strong fractionation within the granite system. The relatively more mafic Mabel Downs Suite shows strong evidence of restite, particularly in the most mafic end-members. Overall, members of the Sally Downs Supersuite show only weak evidence for fractionation at the high-SiO_2 end members. Only one area of significant leucogranite has been identified and that is within the Shepperds Bore Plutonic Complex; there are no strongly zoned plutons. This suggests that crystallisation was dominated by restite-unmixing in the initial phases, with the minor fractionation occurring later in the residual fluid after total separation of the restite.

4.5 Potential

If the identification of the more mafic end members of this suite as being restite-controlled is correct, then the potential of this suite is limited, even though there are many adequate potential host rocks surrounding the granites.

Cu:	**Low**
Au:	**Low to Moderate**
Pb/Zn:	**None**
Sn:	**Low**
Mo/W:	**None**
Confidence Level:	**321**

4.6 Descriptive Data

Location: The Sally Downs Supersuite is an elongate group of northwest-trending plutons extending in a linear belt through the Mount Ramsay, Gordon Downs, Dixon Range and Lissadell 1:250 000 Sheet areas.

Dimensions and area: 380 km by 30 km.

4.7 Intrusives

Component plutons: Sheppard *et al.* (in press) have divided the Sally Downs Supersuite into three suites. These are: the *Mabel Downs Suite* which consists primarily of granodiorite/tonalite and comprises the Mabel Downs Tonalite, Sally Downs Tonalite and McHale Granodiorite; the *Syenite Camp Suite* which consists mainly of monzogranites and syenogranites and contains the Corrara Granite, Grimpy Monzogranite, Mount Fairbairn Granite, and felsic granites of the Shepherds Bore Plutonic Complex; and the ‘in between’ *Kevins Dam Suite* comprising the Violet Valley Granodiorite, Radigans Yard Granodiorite, Mount Christine Granite, Loadstone Monzogranite, Koondooloo Monzogranite, Maggoty Springs Granite, Kevins Dam Monzogranite, Dillinger Monzogranite and Wesley Yard Granite. For this project, in contrast to the subdivision of Sheppard *et al.* (1995), we have put the Eastman Granite in the San Sou Suite.

Form: Individual intrusions are mostly elongate to oblong in shape, although some circular stocks and plugs occur.

Metamorphism and Deformation: Most intrusions show some signs of deformation which is pervasive in some intrusions and very localised in others. Many samples appear to have a weak low-grade metamorphic overprint. *Specifically: Mabel Downs Suite:* Mabel Downs Tonalite - most samples have a well spaced foliation; Sally Downs Tonalite - does not contain an S_3 foliation. *Syenite Camp Suite:* Grimpy Monzogranite - mainly massive but some strongly foliated rocks occur, altered and fresh biotite grains contain lamellae of prehnite; Shepherds Bore Plutonic Complex - generally appears to be undeformed. *Kevins Dam Suite* : Kevins Dam Monzogranite - deformation and foliation is accompanied by trace amounts of fluorite and tourmaline; Koondooloo Monzogranite - moderate to strong foliation along the southeast margin; Loadstone Monzogranite **-** most of the intrusion is undeformed, but shear zones within the granite are recrystallised to finely cataclastic rocks; Mount Christine Granite - most samples are deformed and recrystallised.

Dominant intrusive rock types: The bulk of the Sally Downs Supersuite is composed of medium to coarse-grained variably porphyritic biotite tonalite, granodiorite and monzogranite. *Specifically: Mabel Downs Suite:* Mabel Downs Tonalite - fine to medium-grained foliated biotite-quartz diorite and tonalite and minor biotite granite; Sally Downs Tonalite - medium-grained even-grained biotite-hornblende tonalite with minor biotite-bearing quartz diorite and biotite leucogranite. *Syenite Camp Suite:* Grimpy Monzogranite - medium to fine-grained, even-grained or weakly porphyritic biotite granodiorite and tonalite with lesser biotite monzogranite; Shepherds Bore Plutonic Complex - porphyritic even-grained tonalite to leucogranite (gabbroic rocks are also associated with this suite). *Kevins Dam Suite* : Violet Valley Granodiorite - massive to weakly foliated medium-grained biotite granodiorite and minor tonalite; Radigans Yard Granodiorite - foliated medium-grained weakly porphyritic biotite granodiorite and biotite-hornblende tonalite; Kevins Dam Monzogranite - medium- to coarse-grained, variably porphyritic biotite monzogranite; Koondooloo Monzogranite - foliated to massive weakly porphyritic, coarse-grained biotite monzogranite; Loadstone Monzogranite - homogeneous, consists of medium to coarse-grained, weakly porphyritic biotite monzogranite and syenogranite; Dillinger Monzogranite - a homogenous intrusion consisting of medium-grained even-grained or weakly porphyritic leucocratic biotite monzogranite; Mount Christine Granite - composed of a wide variety of rock types, but medium to coarse-grained biotite monzogranite and medium-grained hornblende-biotite monzogranite and granodiorite are predominant; other rock types include quartz monzodiorite, quartz diorite, leucocratic biotite monzogranite and syenogranite and two-mica monzogranite; Wesley Yard Monzogranite - medium to coarse-grained variably porphyritic biotite monzogranite and minor granodiorite.

Colour: No descriptions available with the exception of the Kevins Dam Monzogranite, which is described as pale grey or pinkish grey.

Veins, Pegmatites, Aplites, Greisens: None noted in the literature.

Xenoliths: Xenoliths appear more prominent in the more mafic end members, and in particular in the Mabel Downs Suite. Some are described as having identical mineralogical composition as their host granite, which is supportive of a restite origin for the Mabel Downs Suite. Some of the xenoliths are also derived from the coeval gabbros and mafic intrusives. *Specifically: Mabel Downs Suite:* Mabel Downs Tonalite - abundant angular inclusions of fine-grained mafic rocks which are of two types: fine-grained even-grained biotite-rich inclusions and fine to medium-grained weakly porphyritic quartz diorite and tonalite inclusions which have a similar texture and identical mineral assemblage to the host tonalite. *Kevins Dam Suite*: Radigans Yard Granodiorite - contains fewer xenoliths than the Mabel Downs Tonalite; Kevins Dam Monzogranite - mafic inclusions are rare and mainly consist of fine-grained, biotite-rich inclusions up to 3 cm in diameter; Koondooloo Monzogranite - inclusions of mafic and xenocrystic hybrid rocks are widespread and locally abundant; some inclusions have rounded microcline xenocrysts similar in size to phenocrysts within the host granite; Dillinger Monzogranite **-** fine-grained mafic inclusions are abundant near gabbros. Mount Christine Granite - contains a variety of pelitic and mafic inclusions; Grimpy Monzogranite - around the southeast margin mafic inclusions are abundant; Wesley Yard Monzogranite - widespread mafic inclusions.

Distinctive mineralogical characteristics: A significant difference between the Mabel Downs and Syenite Camp Suites is that the Mabel Downs Suite appears to have more modal hornblende than the Syenite Camp Suite which is dominated by biotite. This petrological observation is supported to some extent by the whole-rock geochemistry (see Figure 4.8), where the Mabel Downs Suite has lower K_2O and higher Na_2O and CaO contents than members of the Syenite Camp Suite; K_2O is higher in biotite, whilst Na_2O and CaO are higher in hornblende. *Specifically: Mabel Downs Suite:* Mabel Downs Tonalite - contains plagioclase, quartz, up to 12 % biotite and up to 15 % hornblende; Sally Downs Tonalite - plagioclase and quartz with interstitial biotite and hornblende. *Syenite Camp Suite:* Grimpy Monzogranite - quartz, plagioclase, microperthite, biotite and rare hornblende. *Kevins Dam Suite*: Dillinger Monzogranite **-** microperthite, quartz, plagioclase and minor biotite; granophyric textures are widespread; Mount Christine Granite - quartz, microcline, plagioclase, biotite and hornblende in some phases; Loadstone Monzogranite - quartz, plagioclase, microcline, biotite, and rare hornblende (some with cores of orthopyroxene); Wesley Yard Monzogranite - microperthite, plagioclase, quartz, biotite, magnetite and ilmenite. The biotite is dark brown and contains numerous inclusions; Kevins Dam Monzogranite - contains tabular K-feldspar phenocrysts up to 1 cm long; Koondooloo Monzogranite - contains 10-25 % microcline phenocrysts up to 1.5 cm long, plagioclase, quartz and biotite; Violet Valley Granodiorite - hornblende is restricted to samples which have not been recrystallised; Radigans Yard Granodiorite - tonalite contains plagioclase, quartz, biotite, hornblende and epidote, whilst the granodiorite contains only traces of hornblende.

Breccias: The only occurrence of breccias recorded in the literature is in the McHale Granodiorite (Witt and Saunders 1996).

Alteration in the granite: Many of the documented alteration features could be attributed to later low-grade metamorphic/deformation events. However, Witt and Saunders (1996) describe magmatic-hydrothermal breccia dykes and hydrothermal alteration in the McHale Granodiorite approximately 10 km southeast of Turkey Creek. They suggest that the dykes and styles of alteration are similar to those that are found typically in mineralised porphyry-copper and epithermal environments. *Mabel Downs Suite:* Mabel Downs Tonalite - igneous hornblende is replaced by pseudomorphs of hastingsitic (?) amphibole; magnetite and ilmenite are pseudomorphed by epidote and sphene. *Syenite Camp Suite:* Grimpy Monzogranite **-** most samples show sericite and clinozoisite alteration of plagioclase cores, and epidote and sphene rimming magnetite and ilmenite respectively. *Kevins Dam Suite*: Loadstone Monzogranite, Mount Christine Granite - alteration of plagioclase to clinozoisite and sericite, magnetite to epidote and biotite to chlorite.

4.8 Extrusives

No co-magmatic felsic volcanics have been identified. It is worth noting that a felsic volcanic within the Valentine Siltstone of the Speewah Group of the adjacent Kimberley Basin Sequence has an age of 1834 ± 3 Ma, which is within error of the age of the Mabel Downs Tonalite.

4.9 Country Rock

Contact metamorphism: Apart from the ‘magma mingling’ effects noted around the mafic intrusions, significant contact effects have been described around the Kevins Dam Monzogranite. Its contact with migmatites of the Tickalara Metamorphics is marked by retrogression of garnet to cordierite and by the appearance of S-type melt veins cutting the foliation in the granite. Adjacent to the Castlereagh Hill Porphyry the Kevins Dam Monzogranite is chilled. On the Halls Creek 1:100 000 Sheet area, high-grade contact aureoles are developed in the Koongie Park Formation adjacent to the Sally Downs Supersuite. Spotted hornfelses cordierite and andalusite porphyroblasts up to 1 cm in diameter, and in some areas anatexis has taken place.

Reaction with country rock: Co-mingling is commonly recorded where members of all three suites are closely associated with coeval mafic igneous rocks.

Units the granite intrudes: Tickalara Metamorphics, Amhurst Metamorphics, Halls Creek Group (Olympio Formation and Biscay Formation), Marboo Formation, Koongie Park Formation, Lamboo Ultramafics, Emull Gabbro, undivided gabbro and tonalite, other granites.

Dominant rock types: Migmatite, mafic granulite, gabbro, calc-silicate rocks, carbonate rocks, metasediments (greywacke, mudstone, sandstone), mafic volcanics, minor felsic volcanics. No major ironstone bodies or significant areas of graphitic shale have been documented.

Potential hosts: Carbonate, gabbro and reduced metasedimentary rocks.

4.10 Mineralisation

Several small Cu and Au shows (including the Nicholson Gold mine) and prospects occur in and near members of the Sally Downs Supersuite. Their relationship to any of the granites is not clear, even for those that are hosted by granite. They may be related to later deformation processes. The Mount Amherst gold deposits are quartz-vein deposits located within the Grimpy Monzogranite some 70 km south-southeast of Halls Creek (Jones 1938). Other Au deposits that are in the vicinity of the Supersuite may not necessarily be related to magmatic processes (e.g., Warren 1994a, b; Pirajno 1996). Witt and Saunders (1996) made an analogy between breccia dykes and hydrothermal alteration described in the McHale Granodiorite, approximately 10 km southeast of Turkey Creek, and mineralised porphyry-copper and epithermal environments. However, these authors also noted that many of the small Cu deposits are associated with hematite, epidote and carbonate alteration and appear to be spatially related to the Halls Creek Fault, and suggested that they may be related to movements on this fault system.

4.11 Geochemical Data

Data source: Most of the data used come from the GSWA. Some analyses are in the AGSO OZCHEM data base. In the Figures, the Mabel Downs Suite has been shown with line symbols, the Kevins Dam Suite with open symbols, and the Syenite Camp Suite with solid symbols.

Data quality: Good, although most of the GSWA samples do not have Nd.

Are the data representative? Probably.

Are the data adequate? Probably.

SiO_2 range (Fig. 4.1): Wide: from about 55 to 77 wt % SiO_2, with a peak at 70 wt. % SiO_2.

Alteration (Fig. 4.2):

- ***SiO_2:*** No evidence of silicification in the available geochemical data.
- ***K_2O/Na_2O:*** As noted by Sheppard *et al.* (1995), one characteristic of the Sally Downs Supersuite is the high Na_2O content. Relative to other members of the suite, at least half of the Mount Fairbairn Granite samples have low Na_2O contents that are more compatible with values of the Paperbark Supersuite (see Figure 4.8 A-C).
- ***Th/U:*** Some samples of the Mabel Downs suite have disturbed Th/U ratios. This may reflect alteration.

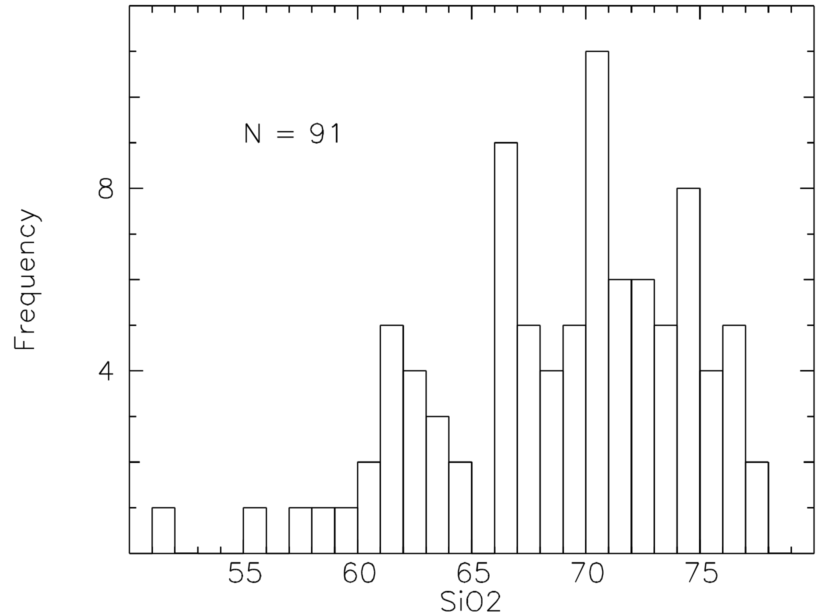


Figure 4.1: Histogram of SiO_2 values.

- ***$Fe_2O_3/(FeO+Fe_2O_3)$*:** Values are generally moderate; again, most of the samples of the Mount Fairbairn Granite have very low $Fe_2O_3/(FeO+Fe_2O_3)$ ratios that are more compatible with values of samples from the Paperbark Supersuite.

Fractionation Plots (Fig. 4.3):

- ***Rb:*** The members of the Mabel Downs Suite show a late exponential increase in Rb at highest SiO_2 contents; members of the Kevins Dam and Syenite Camp Suite show only a linear increase.
- ***U:*** No increase with increasing SiO_2 content.
- ***Y:*** Mabel Downs and Kevins Dam suites show a late exponential increase in Y at highest SiO_2 contents.
- ***P_2O_5*:** Linear decrease with increasing SiO_2 content.
- ***Th:*** Weak increase with increasing SiO_2 content.
- ***K/Rb:*** No significant trends.
- ***Rb-Ba-Sr:*** One sample of the Grimpy Monzogranite and two samples of the Shepherds Bore Plutonic Complex plot in the strongly differentiated field.
- ***Sr:*** Linear decrease with increasing SiO_2 content. For Proterozoic granites, some samples have very high values.
- ***Rb/Sr:*** Both suites show a late exponential increase in Rb/Sr at highest SiO_2 contents: two samples of the Shepherds Bore Plutonic Complex have quite high values.
- ***Ba:*** No trend.
- ***F:*** No data.

Metals (Fig. 4.4):

- ***Cu:*** Highest values are in the more mafic end members suggesting that Cu has been sequestered by some of the ferromagnesian minerals.
- ***Pb:*** Weak increase with increasing SiO_2 content, presumably reflecting increasing modal abundance of K-feldspar.
- ***Zn:*** Decreases with increasing SiO_2 content, possibly reflecting decreasing ferromagnesian minerals.
- ***Sn:*** Some members of the Syenite Camp Suite have high values at high SiO_2 contents.

High field strength elements (Fig. 4.5):

- ***Zr:*** No trend, values are moderate to low for Australian Proterozoic granites.
- ***Nb:*** No trend, values are moderate to low for Australian Proterozoic granites.
- ***Ce:*** No trend, values are moderate to low for Australian Proterozoic granites.

Classification (Fig. 4.6):

- ***The $CaO/Na_2O/K_2O$ plot of White, quoted in Sheraton and Simons (1992):*** All samples range from tonalite, through granodiorite and monzogranite to granite.
- ***Zr/Y vs Sr/Sr*:*** Nd is not available for most samples. For the data that are available, many samples of the Mabel Downs Suite are Sr-undepleted, whilst the Syenite Camp Suite is Sr-depleted.
- ***Spidergram:*** The Mabel Downs Suite has a Sr-undepleted, Y-depleted pattern at low SiO_2 values and a Sr-depleted, Y-undepleted pattern at high SiO_2 contents. This could suggest Y-depleted pattern is inherited from the source region and is reflected in those samples that are restite-dominated and that the Sr-depleted, Y-undepleted pattern comes from the melt component. The Syenite Camp Suite is Sr-depleted, Y-undepleted, not unlike the Paperbark Supersuite.
- ***Oxidation plot of Champion and Heinemann (1994):*** Most samples plot in the oxidised field with the exception of the samples of the Mount Fairbairn Granite which plot in the reduced field which is where most of the samples of the Paperbark Supersuite plot.
- ***ASI:*** Most samples are metaluminous to weakly peraluminous.
- ***A-type plot of Eby (1990):*** The samples straddle the boundary for normal and A-type granites as defined by Eby for Palaeozoic granites.

Granite type (Chappell and White 1974; Chappell and Stephens 1988): I-(granodiorite) type.

Australian Proterozoic granite type: Sally Downs type - the type example.

4.12 Geophysical Signature

Radiometrics (Fig. 4.7): Relative to the Australian Proterozoic crustal average, most samples plot above the average values for K2O, but near average or slightly below for Th and well below for U. Most members of this suite would therefore appear pink to yellow in a RGB image. Parts of the Shepherds Bore Plutonic Complex, the Dillinger Monzogranite and the Loadstone Monzogranite would appear white to pink as they plot above average for all three elements, in particular K_2O. On radiometric data, parts of the Shepherds Bore Plutonic Complex represent significant radiometric highs.

Gravity: The suite generally coincides with gravity lows.

Magnetics: The suite has a variable magnetic response and the more northerly plutons have the highest magnetisation. This is predictable, as the more northerly plutons are those of the more mafic Mabel Downs Suite, which has a higher modal magnetite abundance.

4.13 References

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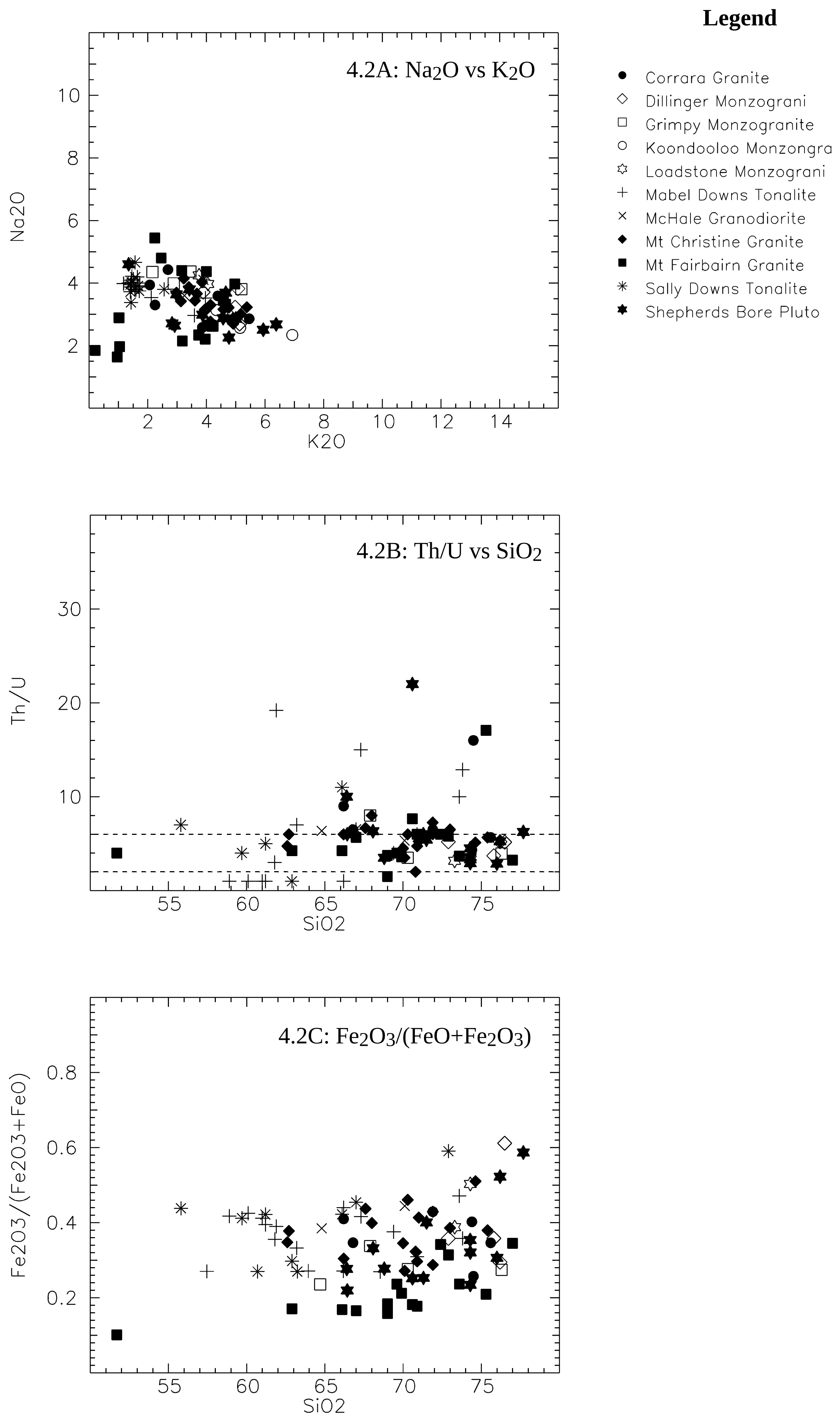
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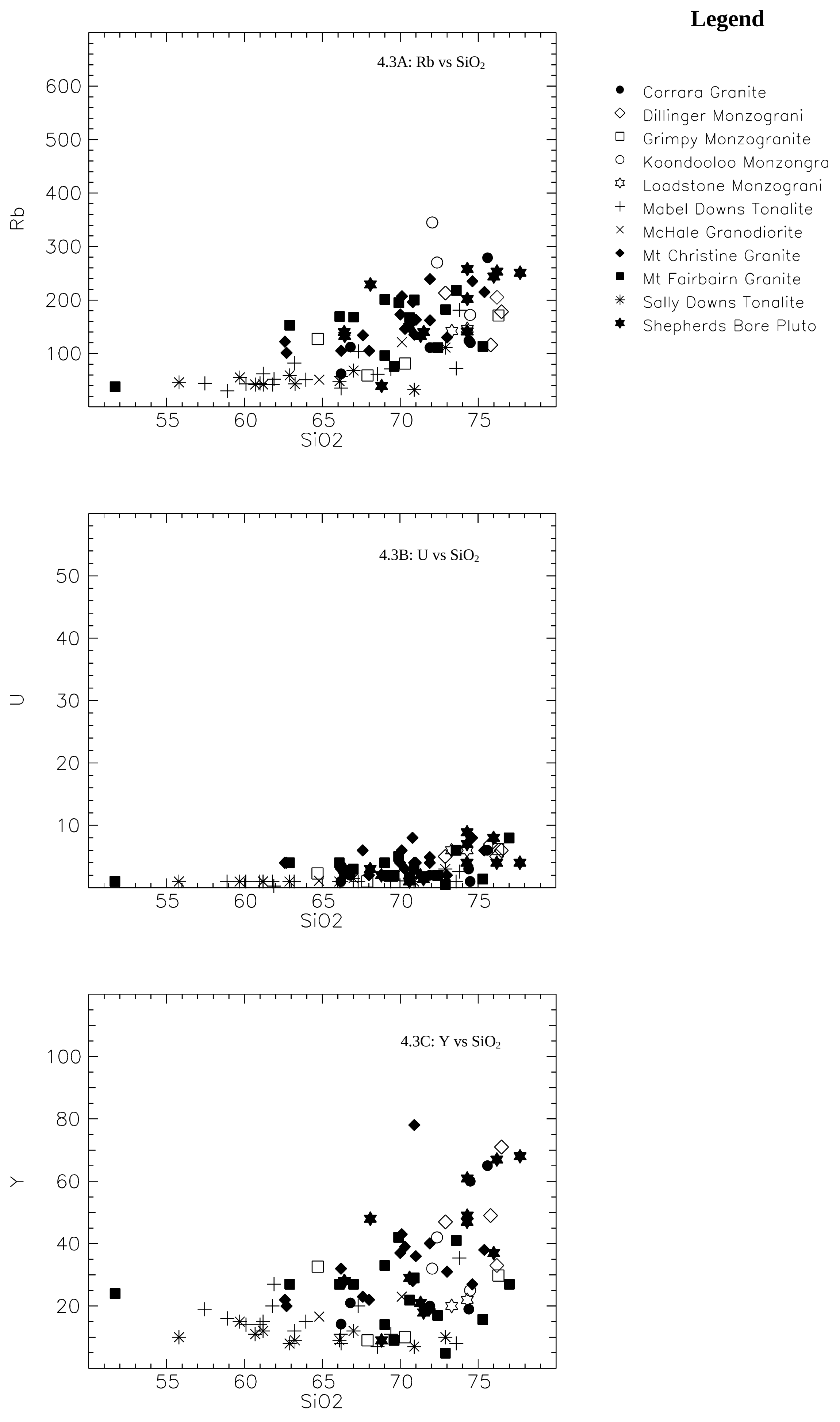
Grimpy Monzogranite
Koondooloo Monzongra
Loadstone Monzograni
Mabel Downs Tonalite
McHale Granodiorite
Mt Christine Granite
Mt Fairbairn Granite
Sally Downs Tonalite
Shepherds Bore Pluto
4.2A: Na2O vs K2O
Na2O
K2O
4.2B: Th/U vs SiO2
Th/U
SiO2
4.2C: Fe2O3/(FeO+Fe2O3)
Fe2O3/(Fe2O3+FeO)
SiO2



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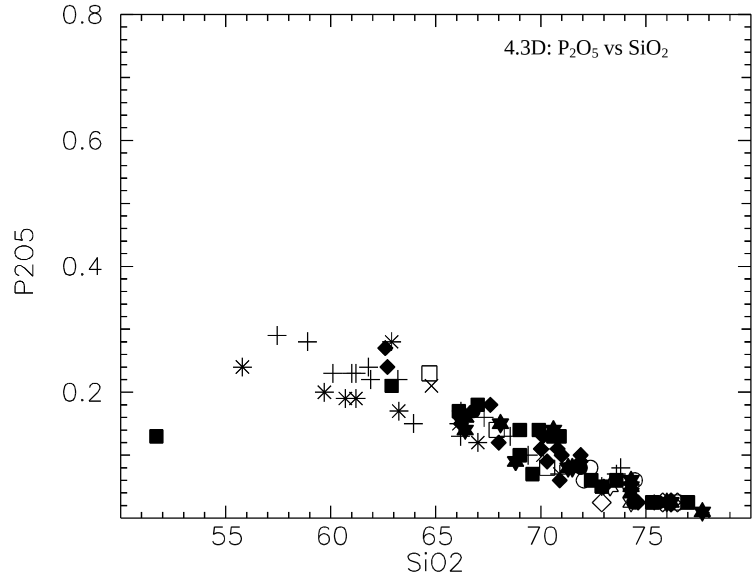
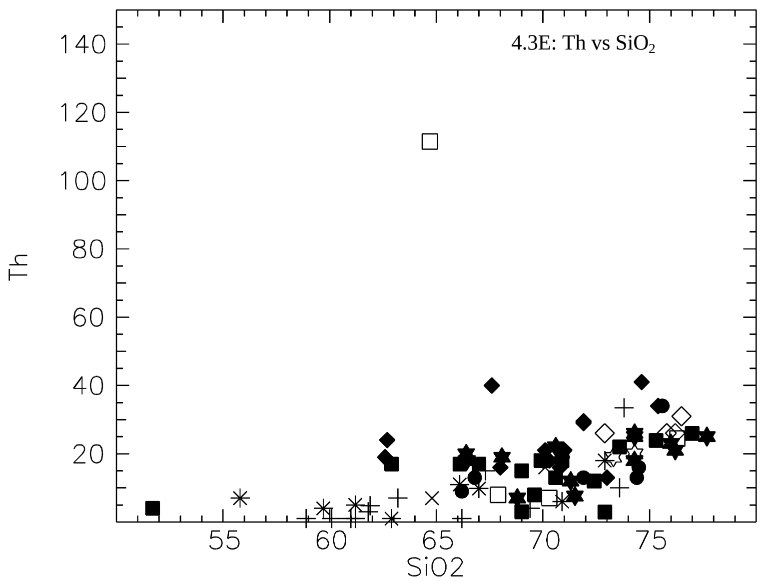
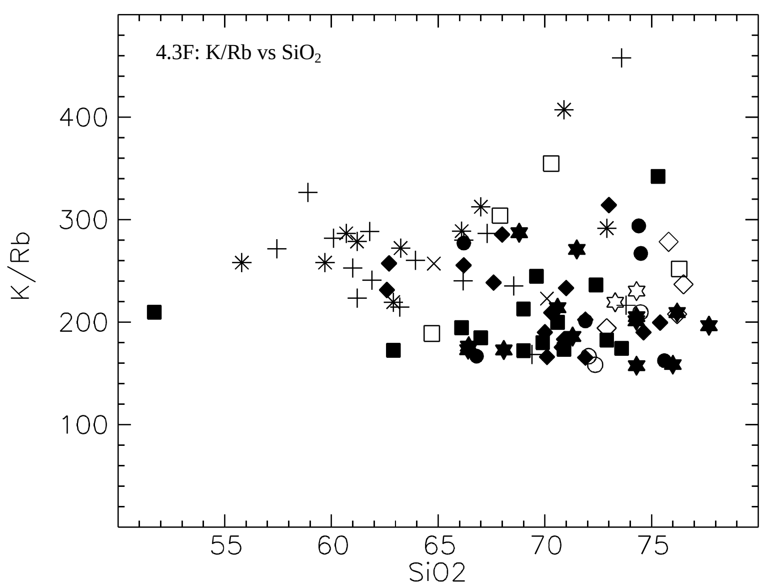
Dillinger Monzograni
Grimpy Monzogranite
Koondooloo Monzongra
Loadstone Monzograni
Mabel Downs Tonalite
McHale Granodiorite
Mt Christine Granite
Mt Fairbairn Granite
Sally Downs Tonalite
Shepherds Bore Pluto
4.3A: Rb vs SiO2
Rb
SiO2
4.3B: U vs SiO2
U
SiO2
4.3C: Y vs SiO2
Y
SiO2

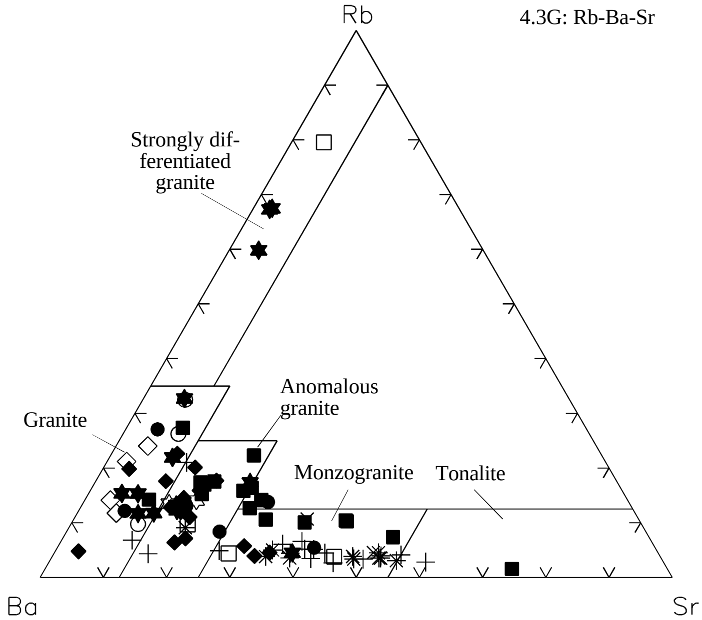
Legend

- ● Corrara Granite
- ◇ Dillinger Monzograni
- □ Grimpy Monzogranite
- ○ Koondooloo Monzongra
- ✡ Loadstone Monzograni
- + Mabel Downs Tonalite
- × McHale Granodiorite
- ◆ Mt Christine Granite
- ■ Mt Fairbairn Granite
- ✳ Sally Downs Tonalite
- ✶ Shepherds Bore Pluto









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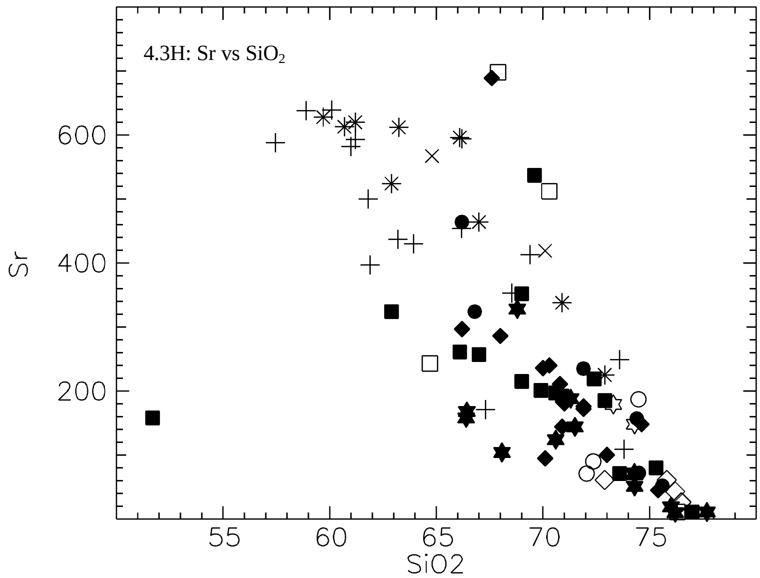
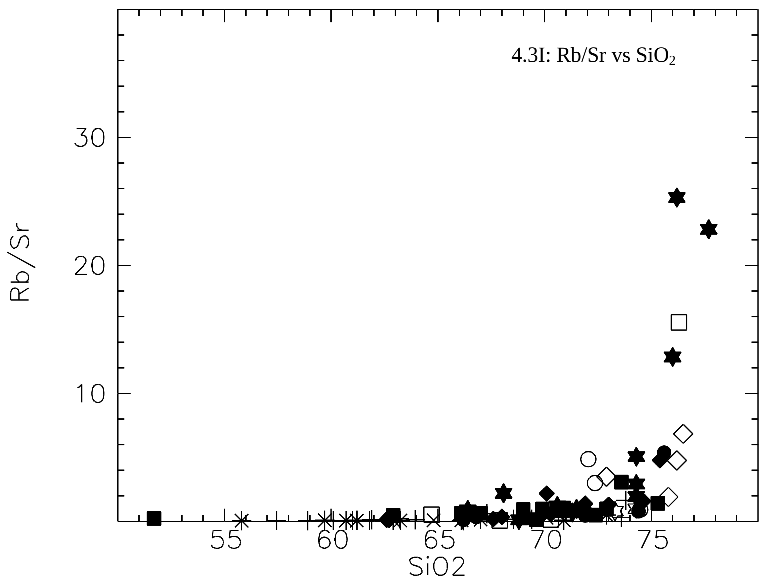
- ◇ Dillinger Monzograni
- □ Grimpy Monzogranite
- ○ Koondooloo Monzongra
- ✡ Loadstone Monzograni
- + Mabel Downs Tonalite
- × McHale Granodiorite
- ◆ Mt Christine Granite
- ■ Mt Fairbairn Granite
- ✳ Sally Downs Tonalite
- ✶ Shepherds Bore Pluto





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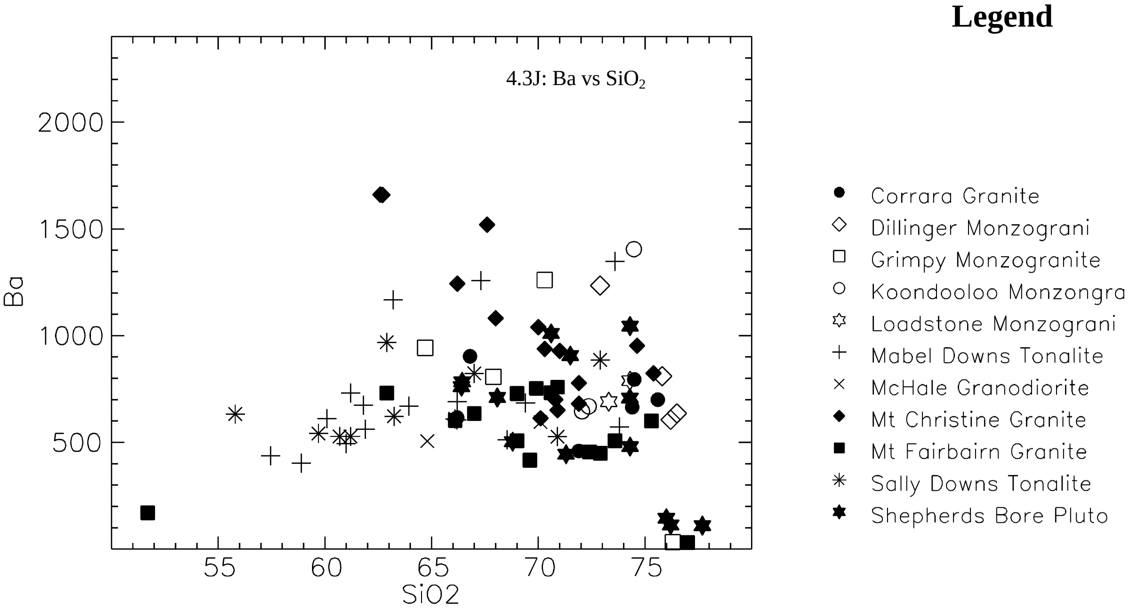

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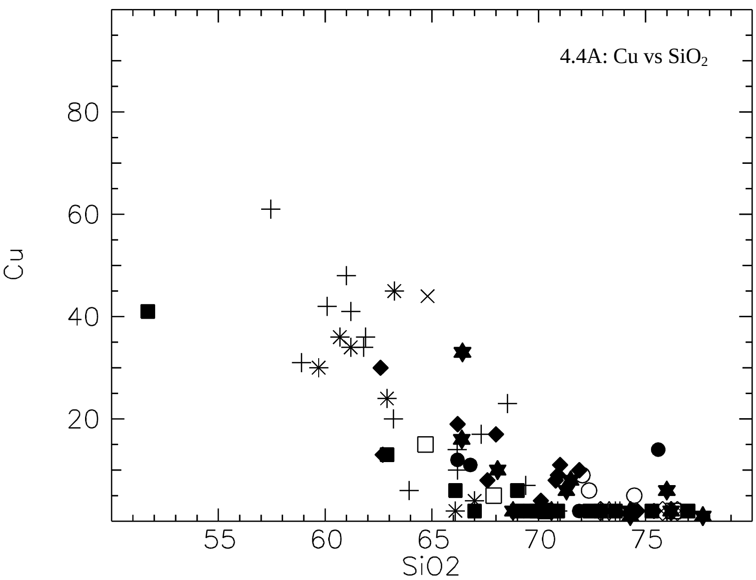

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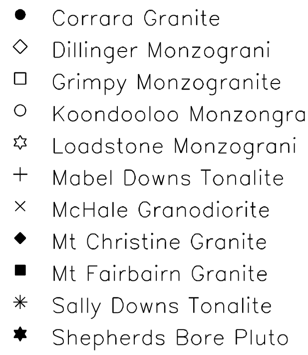
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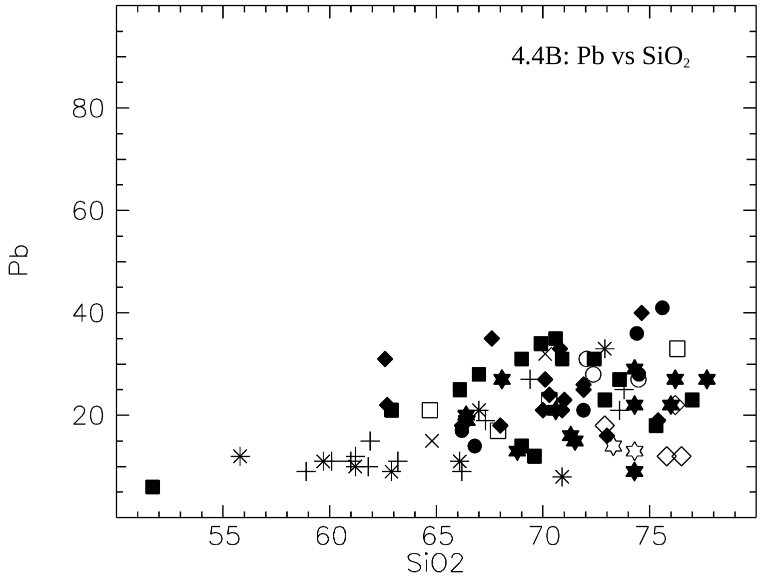
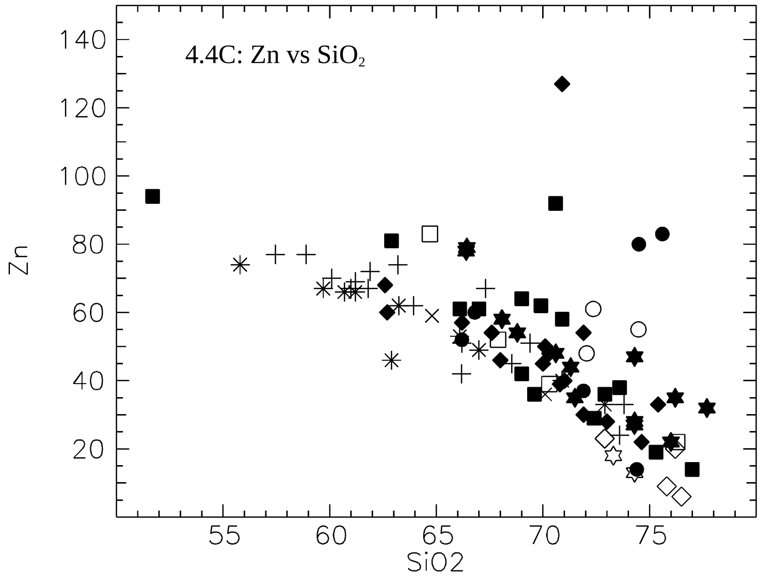
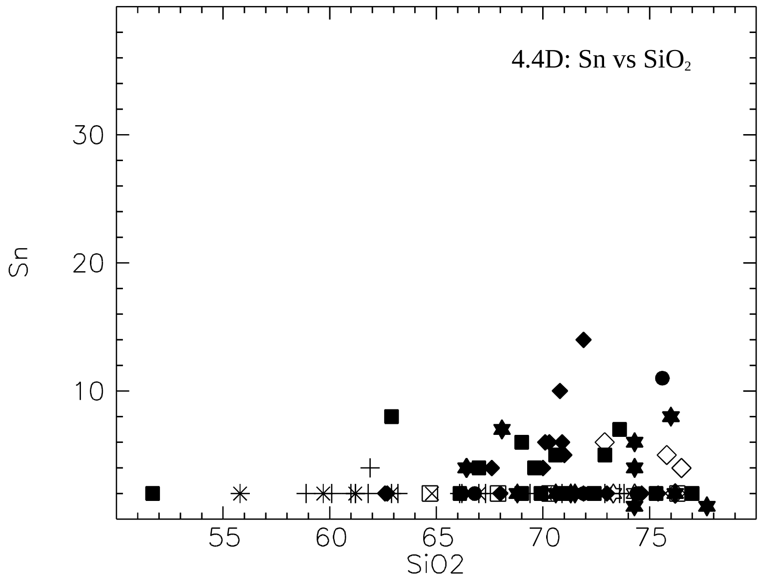
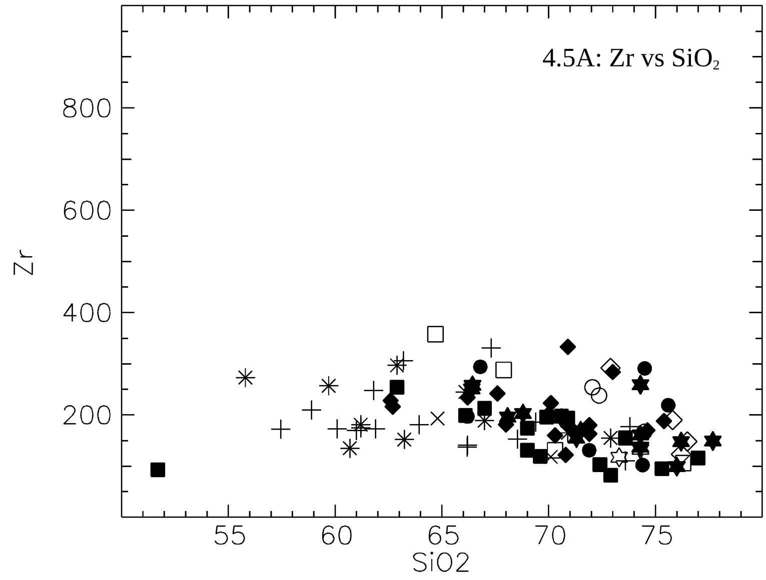

4.4B: Pb vs SiO2
Pb
SiO2

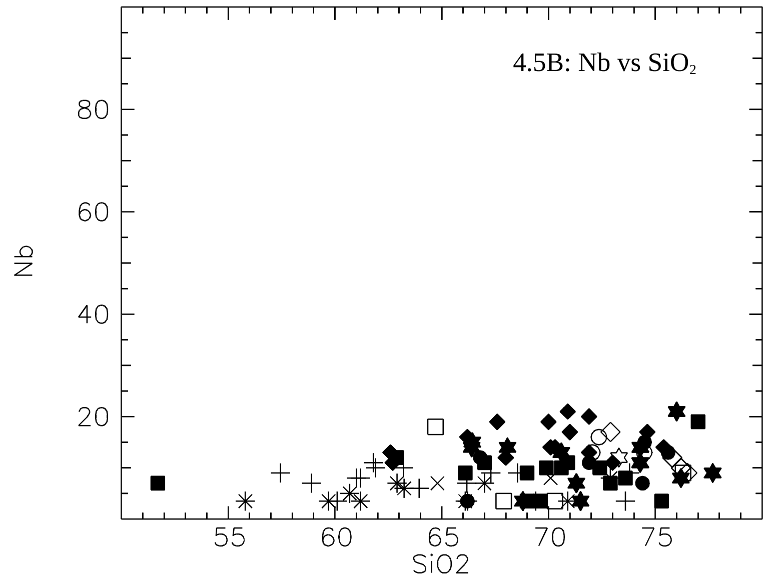

4.4C: Zn vs SiO2
Zn
SiO2

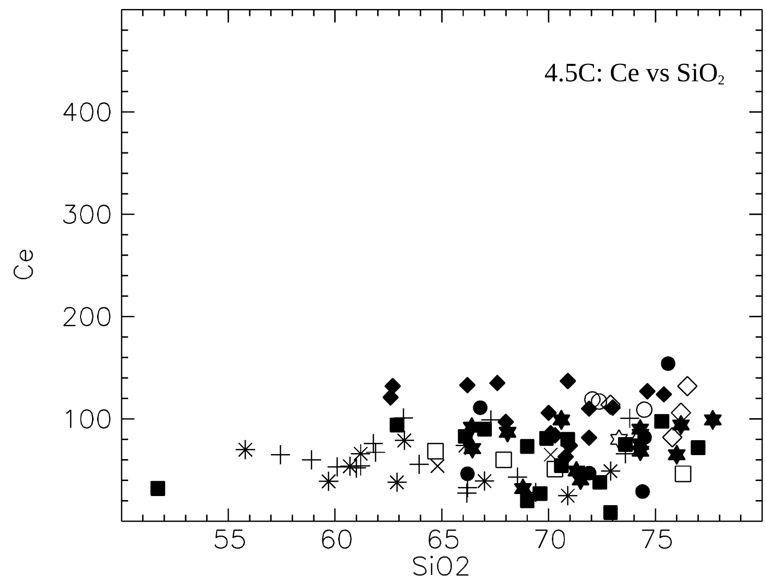

4.4D: Sn vs SiO2
Sn
SiO2

Legend

- ● Corrara Granite
- ◇ Dillinger Monzograni
- □ Grimpy Monzogranite
- ○ Koondooloo Monzongra
- ✡ Loadstone Monzograni
- + Mabel Downs Tonalite
- × McHale Granodiorite
- ◆ Mt Christine Granite
- ■ Mt Fairbairn Granite
- ✳ Sally Downs Tonalite
- ✶ Shepherds Bore Pluto







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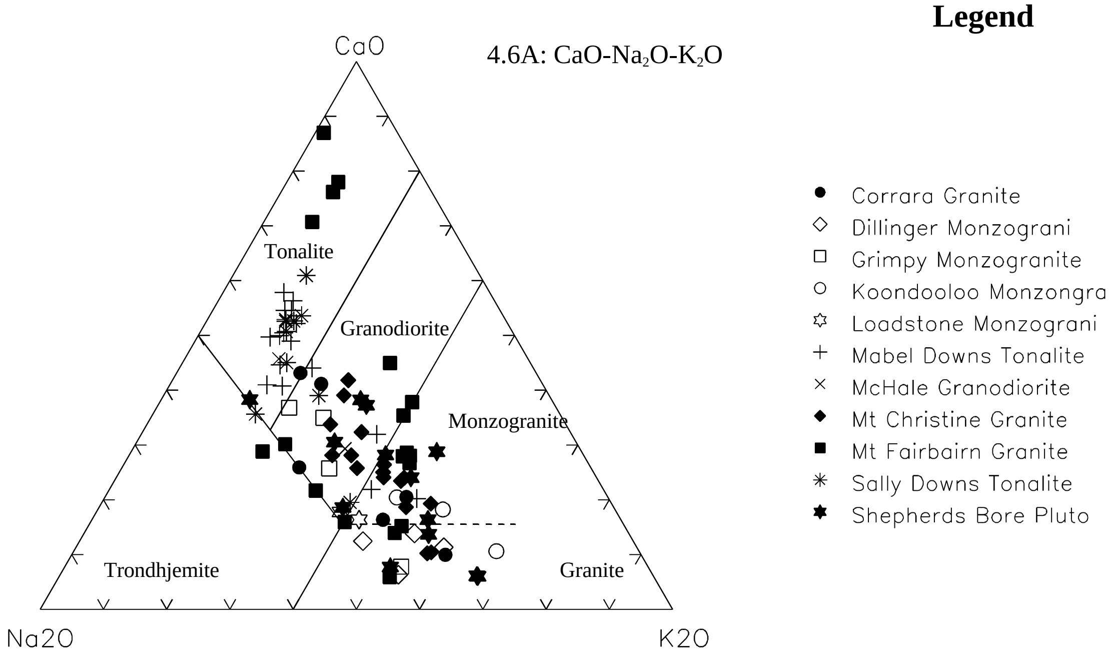
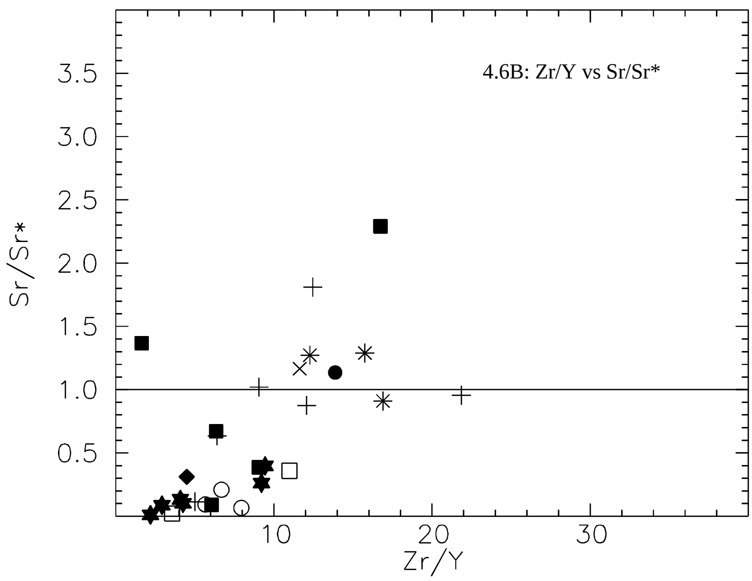
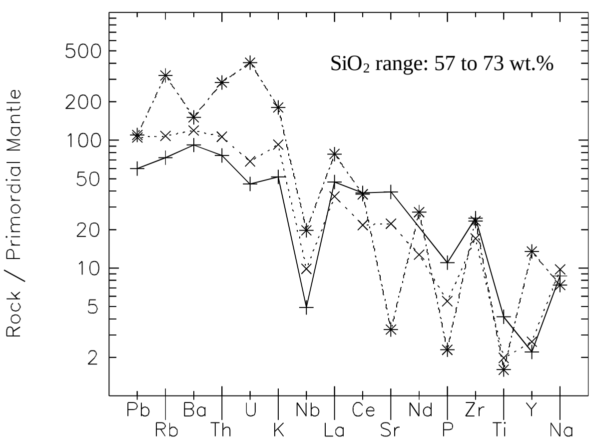
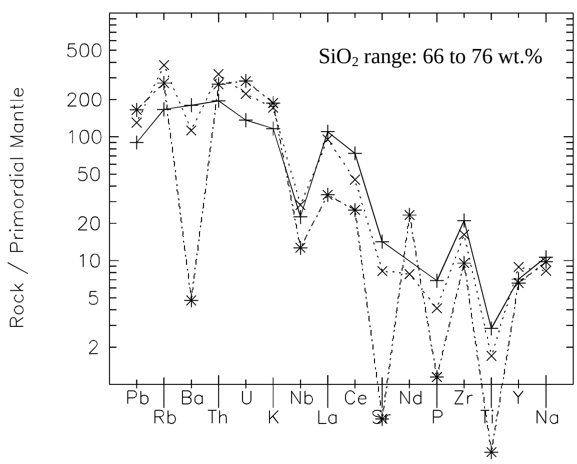


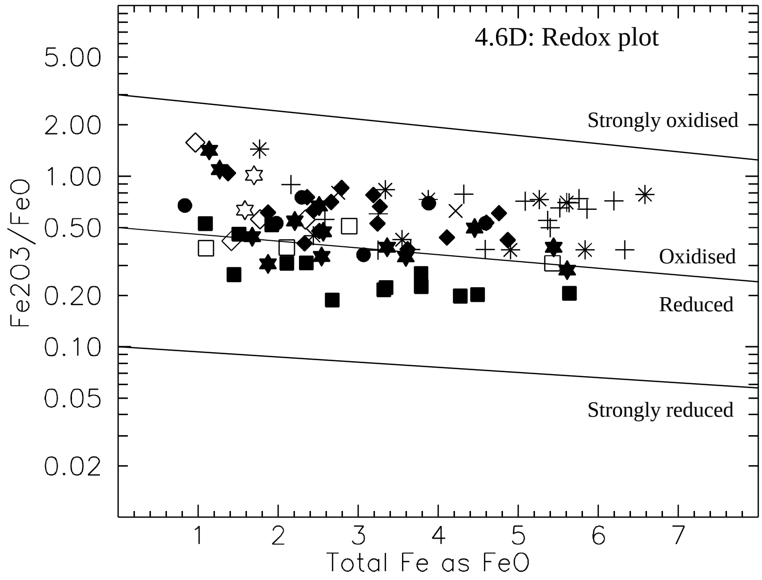


4.6Ca: Mabel Downs Suite Spidergram



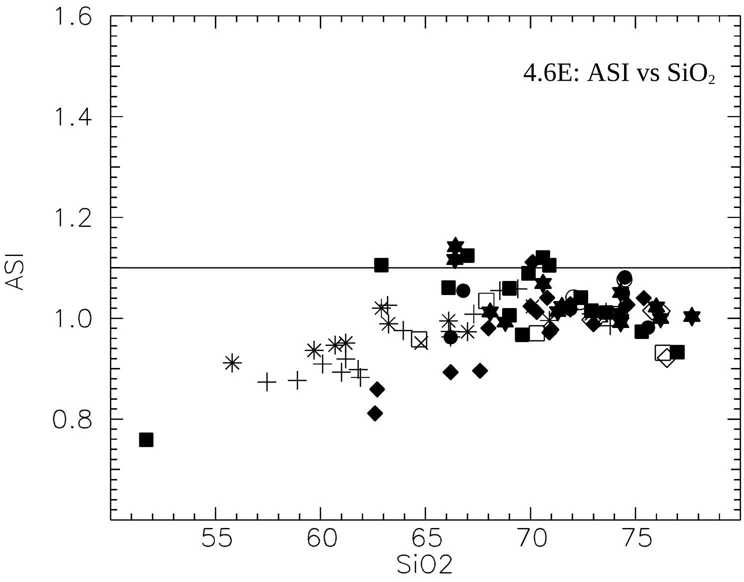
4.6Cb: Syenite Camp Suite Spidergram

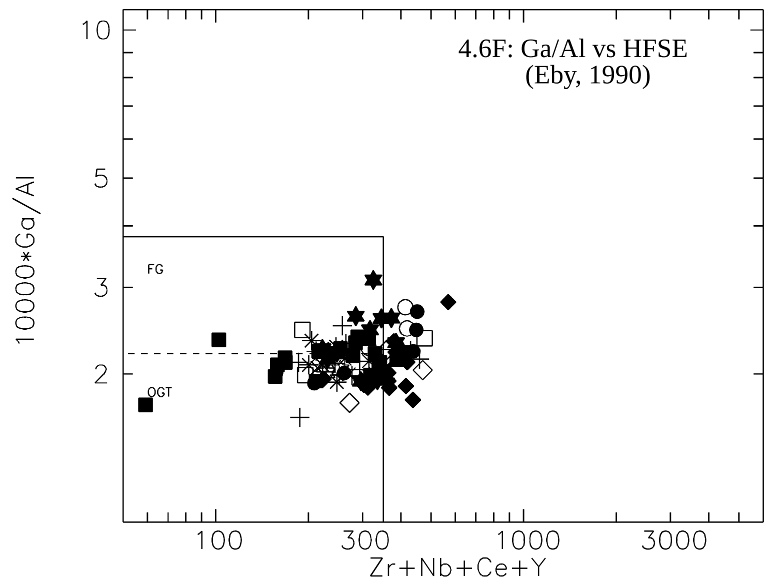


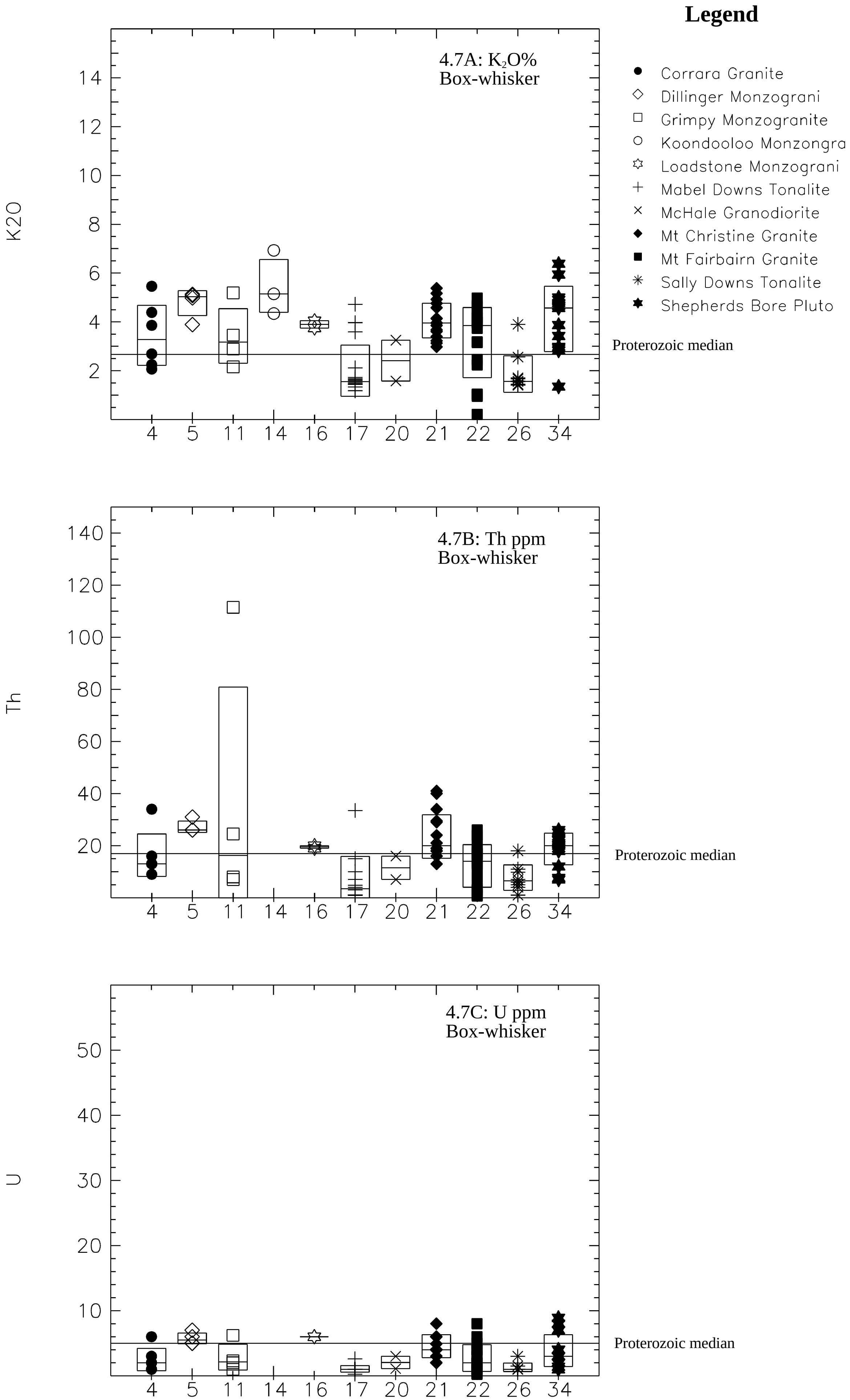


Legend

- ● Corrara Granite
- ◇ Dillinger Monzograni
- □ Grimpy Monzogranite
- ○ Koondooloo Monzongra
- ✡ Loadstone Monzograni
- + Mabel Downs Tonalite
- × McHale Granodiorite
- ◆ Mt Christine Granite
- ■ Mt Fairbairn Granite
- ✳ Sally Downs Tonalite
- ✶ Shepherds Bore Pluto



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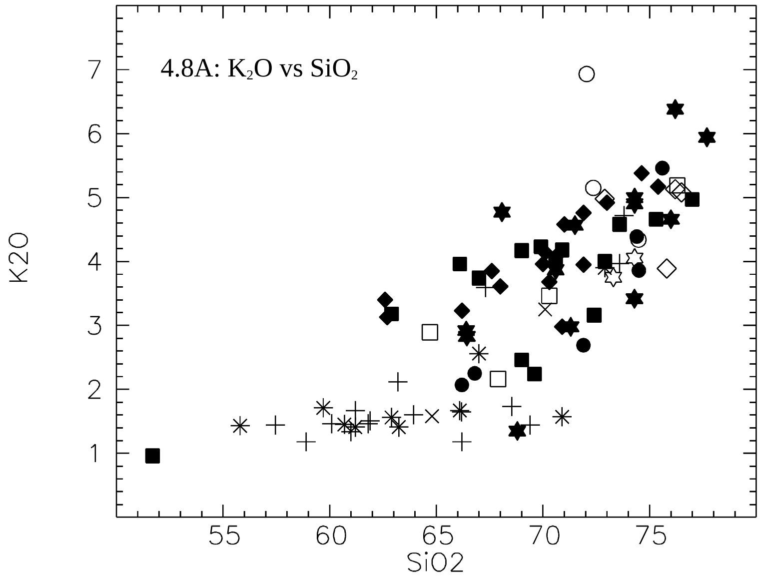
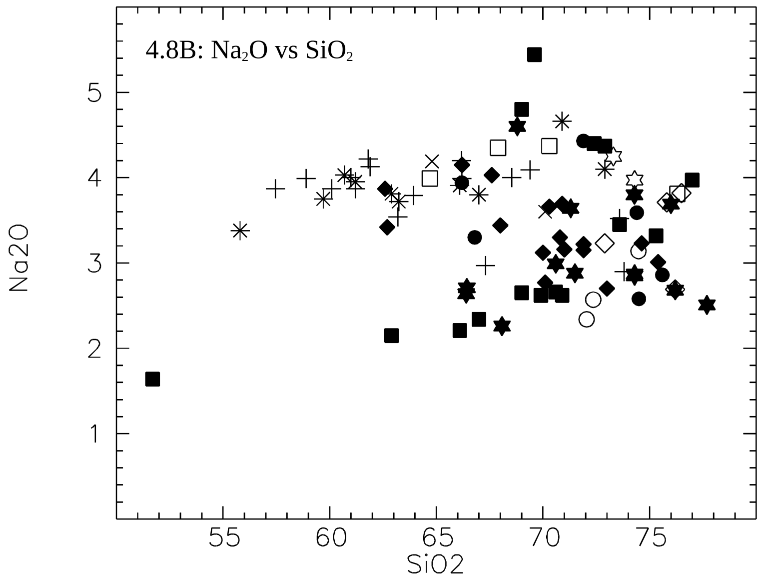
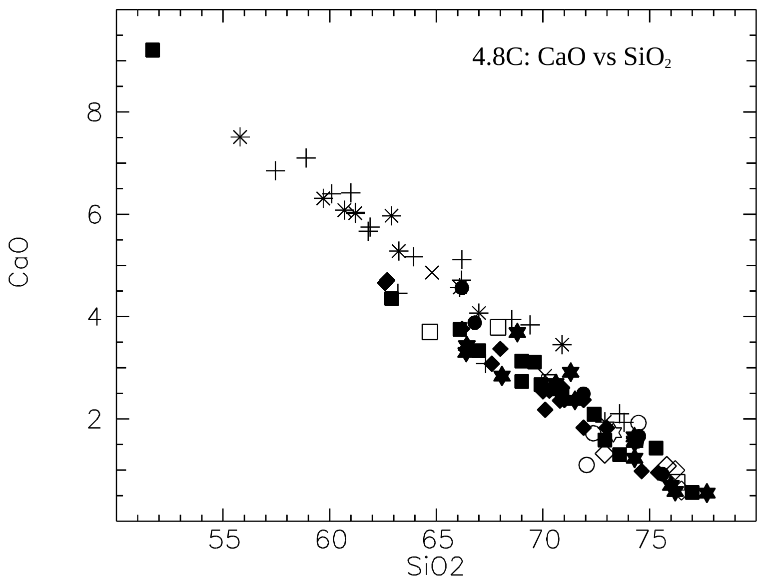
Dillinger Monzogrunderi
Grimpy Monzogranite
Koondooloo Monzongra
Loadstone Monzograni
Mabel Downs Tonalite
McHale Granodiorite
Mt Christine Granite
Mt Fairbairn Granite
Sally Downs Tonalite
Shepherds Bore Pluto
4.7A: K_2O%
Box-whisker
K2O
Proterozoic median
4.7B: Th ppm
Box-whisker
Th
Proterozoic median
4.7C: U ppm
Box-whisker
U
Proterozoic median
4 5 11 14 16 17 20 21 22 26 34

Legend

- ● Corrara Granite
- ◇ Dillinger Monzograni
- □ Grimpy Monzogranite
- ○ Koondooloo Monzongra
- ✡ Loadstone Monzograni
- + Mabel Downs Tonalite
- × McHale Granodiorite
- ◆ Mt Christine Granite
- ■ Mt Fairbairn Granite
- ✳ Sally Downs Tonalite
- ✶ Shepherds Bore Pluto







Corrara Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	71.57	73.15	4.11	66.2	75.6	6
TiO2	0.34	0.29	0.22	0.09	0.68	6
Al2O3	14.08	14.45	1.62	12	16	6
Fe2O3	1.03	0.92	0.53	0.35	1.66	6
FeO	1.84	1.86	0.94	0.52	3.11	6
MnO	0.05	0.04	0.03	05	0.11	6
MgO	0.81	0.64	0.74	05	1.88	6
CaO	2.51	2.08	1.43	0.92	4.56	6
Na2O	3.45	3.44	0.69	2.58	4.43	6
K2O	3.45	3.28	1.34	2.07	5.46	6
P2O5	0.08	0.05	0.07	05	0.17	6
H2O+	0.57	0.57	-	0.57	0.57	1
H2O-	0.12	0.12	-	0.12	0.12	1
CO2	0.11	0.1	0.05	0.07	0.17	3
LOI	0.82	0.85	0.23	0.58	1.14	5
Ba	689.83	682.5	151.98	460	903	6
Li	20	24.5	11.63		28	4
Rb	134.67	116	74.18	62	279	6
Sr	217.33	196	157.88	52	464	6
Pb	26.17	24.5	10.76	14	41	6
Th	16.33	13	8.94	9	34	6
U	2.5	2	1.87		6	6
Zr	205.67	208	79.57	102	294	6
Nb	10.25	11.5	4.24		15	6
Y	33.2	20.5	22.87	14.2	65	6
La	41.87	34.6	25.32	15	83	6
Ce	78.23	64.5	47.42	29	154	6
Pr	4.8	4.8	-	4.8	4.8	1
Nd	18.2	18.2	-	18.2	18.2	1
Sc	5.82	5.5	3.33	2	11	6
V	29.5	19.5	26.12	7	63	6
Cr	11.5	6.5	11.54		27	6
Mn	-	-	-	-	-	-
Co	-	-	-	-	-	-
Ni	9.92	7.5	7.67		22	6
Cu	7.17	6.5	5.74		14	6
Zn	54.33	56	26.25	14	83	6
Sn	3.5		3.67		11	6
W	-	-	-	-	-	-
Mo	3		-			6
Ga	16.33	16.5	1.21	15	18	6
As	2.83		1.33		5	6
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	1	1	-	1	1	1
Ta	1.3	1	0.67		1	5
Ge	1.5		-			5

Dillinger Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	75.35	76	1.66	72.9	76.5	4
TiO2	0.2	0.21	0.07	0.12	0.28	4
Al2O3	12.27	12.15	0.55	11.8	13	4
Fe2O3	0.65	0.64	0.18	0.43	0.87	4
FeO	1.04	1.11	0.48	0.4	1.56	4
MnO	0.03	05	-	05	05	4
MgO	0.22	0.24	0.14	05	0.36	4
CaO	1	1.04	0.3	0.6	1.32	4
Na2O	3.36	3.47	0.52	2.69	3.82	4
K2O	4.77	5.03	0.59	3.89	5.13	4
P2O5	0.03	05	-	05	05	4
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.1	0.11	0.03	0.06	0.12	4
LOI	0.78	0.79	0.1	0.68	0.88	4
Ba	821.5	723	289.33	606	1234	4
Li	10.25	9	7.5		20	4
Rb	178	191.5	43.96	116	213	4
Sr	47.75	52	16.8	26	61	4
Pb	16	15	4.9	12	22	4
Th	27.25	26	2.5	26	31	4
U	5.75	5.5	0.96	5	7	4
Zr	188.25	169	74.49	123	292	4
Nb	12	11	3.56	9	17	4
Y	50	48	15.71	33	71	4
La	60.5	65.5	11.03	44	67	4
Ce	108.5	110	20.74	82	132	4
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	4.5	4.5	1.29	3	6	4
V	5.88	6.5	3.17		9	4
Cr	2		-			4
Ni	5.88	6.5	3.17		9	4
Cu	2		-			4
Zn	14.5	14.5	8.27	6	23	4
Sn	4.25	4.5	1.71		6	4
Mo	3		-			1
Ga	13	13.5	1.41	11	14	4
As	-	-	-	-	-	-
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Grimpy Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	69.8	69.1	4.9	64.7	76.3	4
TiO2	0.4	0.34	0.34	0.06	0.87	4
Al2O3	14.83	15.2	1.81	12.3	16.6	4
Fe2O3	0.81	0.81	0.44	0.31	1.31	4
FeO	2.16	1.78	1.48	0.82	4.25	4
MnO	0.04	05	0.03	05	0.09	4
MgO	0.86	0.96	0.63	05	1.52	4
CaO	2.74	3.2	1.41	0.76	3.79	4
Na2O	4.13	4.17	0.28	3.81	4.37	4
K2O	3.43	3.18	1.29	2.16	5.19	4
P2O5	0.12	0.11	0.09	05	0.23	4
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.12	0.12	-	0.12	0.12	1
LOI	1.01	1.02	0.27	0.68	1.33	4
Ba	760.75	875	520.97	33	1260	4
Li	21.25	22.5	3.59	16	24	4
Rb	109.5	104	49.84	59	171	4
Sr	366	377.5	301.49	11	698	4
Pb	23.5	22	6.81	17	33	4
Th	37.75	16.25	49.82	7	111.5	4
U	2.88	2.15	2.29		6.2	4
Zr	220.75	209.5	121.91	106	358	4
Nb	8.5	6.25	6.84		18	4
Y	20.35	19.9	12.59	9	32.6	4
La	32.25	29.5	9.89	23.8	46.2	4
Ce	56.45	55.5	9.77	46.4	68.4	4
Pr	8.3	8.3	1.41	7.3	9.3	2
Nd	34.05	34.05	3.61	31.5	36.6	2
Sc	2.65	2.7	1.17	1.2	4	4
V	30.88	31.5	24.27		59	4
Cr	7	5.5	5.72		15	4
Ni	3.88	3	2.84		8	4
Cu	6	3.5	6.16		15	4
Zn	49	45.5	25.78	22	83	4
Sn	2		-			4
Mo	3		-			1
Ga	17.5	17.5	1.73	16	19	4
As	2		-			1
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	3.25	3.25	1.06	2.5	4	2
Ta	2.5		-			1
Ge	1.5		-			1

Koondooloo Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	72.96	72.36	1.32	72.05	74.48	3
TiO2	0.31	0.33	0.09	0.21	0.38	3
Al2O3	13.7	13.75	0.54	13.14	14.22	3
Fe2O3	2.72	2.68	0.5	2.25	3.24	3
FeO	-	-	-	-	-	-
MnO	0.03	0.03	0.01	0.03	0.04	3
MgO	0.42	0.39	0.07	0.38	0.5	3
CaO	1.58	1.72	0.43	1.1	1.92	3
Na2O	2.68	2.57	0.41	2.34	3.14	3
K2O	5.47	5.15	1.32	4.34	6.93	3
P2O5	0.07	0.06	0.01	0.06	0.08	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.2	0.23	0.09	0.09	0.27	3
Ba	906.67	669	431.72	646	1405	3
Li	-	-	-	-	-	-
Rb	262.33	270	86.75	172	345	3
Sr	116	90	62.22	71	187	3
Pb	28.67	28	2.08	27	31	3
Th	-	-	-	-	-	-
U	-	-	-	-	-	-
Zr	219.67	238	46.31	167	254	3
Nb	14	13	1.73	13	16	3
Y	33	32	8.54	25	42	3
La	-	-	-	-	-	-
Ce	115	117	5.29	109	119	3
Pr	-	-	-	-	-	-
Nd	41	38	8.89	34	51	3
Sc	9.67	8	4.73	6	15	3
V	15.33	16	7.02	8	22	3
Cr	8.67	9	3.51	5	12	3
Ni	3.67	4	1.53		5	3
Cu	6.67	6	2.08	5	9	3
Zn	54.67	55	6.51	48	61	3
Sn	-	-	-	-	-	-
Mo	-	-	-	-	-	-
Ga	18	18	1	17	19	3
As	7	7	5.66	3	11	2
S	0.01	0.01	-	0.01	0.01	3
F	-	-	-	-	-	-
Cl	147	135	72.75	81	225	3
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Loadstone Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	73.8	73.8	0.71	73.3	74.3	2
TiO2	0.19	0.19	-	0.19	0.19	2
Al2O3	14	14	0.14	13.9	14.1	2
Fe2O3	0.77	0.77	0.18	0.64	0.9	2
FeO	0.95	0.95	0.08	0.89	1.01	2
MnO	0.03	05	-	05	05	2
MgO	0.41	0.41	0.04	0.38	0.43	2
CaO	1.65	1.65	0.11	1.57	1.73	2
Na2O	4.11	4.11	0.2	3.97	4.25	2
K2O	3.9	3.9	0.21	3.75	4.05	2
P2O5	0.04	0.04	0.02	05	0.05	2
H2O+	0.31	0.31	-	0.31	0.31	1
H2O-	0.14	0.14	-	0.14	0.14	1
CO2	0.14	0.14	0.01	0.13	0.15	2
LOI	0.8	0.8	-	0.8	0.8	1
Ba	739.5	739.5	70	690	789	2
Li	38	38	21.21	23	53	2
Rb	144	144	2.83	142	146	2
Sr	163.5	163.5	21.92	148	179	2
Pb	13.5	13.5	0.71	13	14	2
Th	19.5	19.5	0.71	19	20	2
U	6	6	-	6	6	2
Zr	125	125	11.31	117	133	2
Nb	13	13	1.41	12	14	2
Y	21	21	1.41	20	22	2
La	43.5	43.5	2.12	42	45	2
Ce	82.5	82.5	3.54	80	85	2
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	6.5	6.5	3.54	4	9	2
V	16.5	16.5	2.12	15	18	2
Cr	8	8	2.83	6	10	2
Mn	-	-	-	-	-	-
Co	-	-	-	-	-	-
Ni	2.25	2.25	1.06		3	2
Cu	2		-			2
Zn	15.5	15.5	3.54	13	18	2
Sn	2		-			2
W	-	-	-	-	-	-
Mo	3		-			2
Ga	15	15	-	15	15	2
As	2		-			1
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	2.5		-			1
Ge	-	-	-	-	-	-

Mabel Downs Tonalite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	64.66	63.57	4.92	57.45	73.8	16
TiO2	0.63	0.7	0.2	0.28	0.91	16
Al2O3	16.08	16.3	1.31	13	17.6	16
Fe2O3	1.79	1.92	0.62	0.9	2.7	16
FeO	3.08	3.45	0.9	1.2	4.75	16
MnO	0.06	0.06	0.03	05	0.11	16
MgO	1.81	2.01	0.81	0.46	3.47	16
CaO	4.91	5.14	1.6	1.93	7.1	16
Na2O	3.81	3.93	0.39	2.9	4.22	16
K2O	2	1.56	1.08	1.18	4.72	16
P2O5	0.18	0.19	0.07	0.07	0.29	16
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.17	0.16	0.06	0.1	0.31	12
LOI	0.88	0.94	0.23	0.59	1.21	16
Ba	713.75	640.5	286.96	403	1347	16
Li	-	-	-	-	-	-
Rb	64.44	54.5	36.35	30	181	16
Sr	446.69	445.5	163.25	109	639	16
Pb	15	11.5	6.4	9	27	12
Th	6.86	3.5	9.46		33.5	12
U	1.07		0.53		2.6	12
Zr	190.19	174	58.81	110	331	16
Nb	7.31	8	2.59		11	16
Y	15.77	14.5	7.41	7	35.4	16
La	33.85	28	17.37	14	78.5	15
Ce	61.32	57.75	23.76	27.5	101	16
Pr	10.2	10.2	3.68	7.6	12.8	2
Nd	25.63	24.05	12.72	11.9	47.6	6
Sc	10.25	8.55	6.26	2.4	21	6
V	76.19	82	35.56	19	129	16
Cr	29.81	30	17.31		55	16
Ni	26.06	22.5	14.46	10	52	16
Cu	24.63	21.5	17.87		61	16
Zn	59.25	67	16.28	24	77	16
Sn	2.17		0.58		4	12
Mo	1.33		0.78		3	12
Ga	17.87	18	2.56	12	22	15
As	2		-			12
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	2.17	2.5	1.01		3	12
Bi	2		-			12
Sb	2.17		0.58		4	12
Hf	2.05	2.05	2.19	0.5	3.6	2
Ta	-	-	-	-	-	-
Ge	1.5		-			12

McHale Granodiorite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO_2	67.45	67.45	3.75	64.8	70.1	2
TiO_2	0.46	0.46	0.17	0.34	0.58	2
Al_2O_3	15.4	15.4	0.99	14.7	16.1	2
Fe_2O_3	1.49	1.49	0.29	1.28	1.69	2
FeO	2.15	2.15	0.78	1.6	2.7	2
MnO	0.05	0.05	0.01	0.05	0.06	2
MgO	1.24	1.24	0.55	0.85	1.63	2
CaO	3.85	3.85	1.43	2.84	4.86	2
Na_2O	3.89	3.89	0.42	3.6	4.19	2
K_2O	2.41	2.41	1.18	1.58	3.25	2
P_2O_5	0.16	0.16	0.08	0.1	0.21	2
H_2O+	-	-	-	-	-	-
H_2O-	-	-	-	-	-	-
CO_2	0.15	0.15	0.07	0.1	0.2	2
LOI	1.65	1.65	0.29	1.45	1.86	2
Ba	550.5	550.5	62.93	506	595	2
Li	-	-	-	-	-	-
Rb	86	86	49.5	51	121	2
Sr	493	493	104.65	419	567	2
Pb	23.5	23.5	12.02	15	32	2
Th	11.5	11.5	6.36	7	16	2
U	2.05	2.05	1.34	1.1	3	2
Zr	155.5	155.5	53.03	118	193	2
Nb	7.5	7.5	0.71	7	8	2
Y	19.8	19.8	4.53	16.6	23	2
La	33.85	33.85	0.21	33.7	34	2
Ce	59.45	59.45	7.85	53.9	65	2
Pr	5.9	5.9	-	5.9	5.9	1
Nd	22.7	22.7	-	22.7	22.7	1
Sc	2.8	2.8	-	2.8	2.8	1
V	60.5	60.5	28.99	40	81	2
Cr	26.5	26.5	9.19	20	33	2
Ni	25.5	25.5	4.95	22	29	2
Cu	23	23	29.7		44	2
Zn	47.5	47.5	16.26	36	59	2
Sn	2		-			2
Mo	1		-			2
Ga	16.5	16.5	0.71	16	17	2
As	2		-			2
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	3	3	-	3	3	2
Bi	2		-			2
Sb	2		-			2
Hf	1	1	-	1	1	1
Ta	-	-	-	-	-	-
Ge	1.5		-			2

Mount Christine Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	69.81	70.55	3.66	62.6	75.4	16
TiO2	0.42	0.44	0.11	0.19	0.6	16
Al2O3	14.04	14.1	0.71	12.7	15.1	16
Fe2O3	1.18	1.15	0.34	0.69	1.87	16
FeO	2.07	1.82	0.79	0.71	3.53	16
MnO	0.06	0.06	0.03	05	0.11	16
MgO	1.22	0.88	1.07	0.26	3.73	16
CaO	2.63	2.45	1.09	0.95	4.71	16
Na2O	3.37	3.26	0.42	2.7	4.15	16
K2O	4.06	3.95	0.73	2.98	5.38	16
P2O5	0.12	0.11	0.07	05	0.27	16
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.13	0.1	0.08	0.04	0.35	15
LOI	1.08	1.08	0.21	0.81	1.53	16
Ba	1110.38	945.5	503.45	613	2495	16
Li	25.5	21	18.01		70	16
Rb	160.5	154	46.15	101	239	16
Sr	297.88	196	266.9	45	920	16
Pb	24.94	23.5	6.79	16	40	16
Th	23.53	20	8.65	13	41	16
U	4.56	4	1.82	2	8	16
Zr	206.31	195	51.69	122	333	16
Nb	15.13	14	3.36	11	21	16
Y	33.44	31.5	14.22	19	78	16
La	61.11	64	13.03	37	80	16
Ce	107.6	110.5	23.99	63	137	16
Pr	10.5	10.5	-	10.5	10.5	1
Nd	10.5	10.5	-	10.5	10.5	1
Sc	7.18	7	4.52		20	16
V	41.19	37	27.65	6	99	16
Cr	30.88	9	49.05	4	156	16
Ni	14.19	5.5	20.41		67	16
Cu	16.06	8.5	28.26		118	16
Zn	50.06	47	24.02	22	127	16
Sn	4.44	3	3.44		14	16
Mo	3		-			13
Ga	15.06	15	1.95	12	20	16
As	2		-			3
S	-	01	-	01	01	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	3.2	3.2	-	3.2	3.2	1
Ta	2.5		-			2
Ge	1.5		-			3

Mount Fairbairn Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	65.84	69.3	9.46	48.7	77	18
TiO2	0.53	0.39	0.42	0.08	1.65	18
Al2O3	14.74	14.8	1.26	12	17	18
Fe2O3	0.73	0.65	0.4	0.31	2.16	18
FeO	3.93	2.92	3.1	0.74	10.4	18
MnO	0.07	0.04	0.07	05	0.21	18
MgO	2.44	0.89	3.04	0.11	9.47	18
CaO	4.29	2.92	3.66	0.56	13.8	18
Na2O	3.07	2.66	1.1	1.64	5.44	18
K2O	3.15	3.85	1.48	0.21	4.97	18
P2O5	0.11	0.13	0.07	05	0.26	18
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.21	0.22	0.11	0.05	0.37	8
LOI	1.27	0.92	0.62	0.57	2.45	18
Ba	484	508	239.38	31	759	18
Li	32.25	32	22.19		64	16
Rb	129.76	153	65.84	2	218	17
Sr	209.06	199	118.41	11	537	18
Pb	20.94	23	10.39		35	18
Th	12.21	14	8.4		26	18
U	2.73	2	2.12		8	18
Zr	148.5	144	57.14	31	254	18
Nb	8.61	9	3.83		19	18
Y	24.44	27	9.95	4.9	42	18
La	29.83	33.5	18.21	2.7	73	18
Ce	55.65	63.2	30.67	5.6	97.7	18
Pr	4.78	3.4	4.68	0.9	12.1	5
Nd	18.34	15.5	15.77	4.1	41.9	5
Sc	9.59	7.7	8.86	50	32	17
V	69.81	27	83.17		252	18
Cr	86.83	14	139.41		530	18
Ni	26.92	8	43.84		154	18
Cu	18.33		36.66		150	18
Zn	59.67	61	29.72	14	117	18
Sn	3.39		2		8	18
Mo	3.44		1.74		8	9
Ga	16.78	17.5	1.93	13	20	18
As	3.5		3.51		12	8
S	0.05	0.05	0.07	01	0.1	2
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	0.5		-			1
Bi	2		-			1
Sb	2		-			1
Hf	1.44	1.9	1.13	50	2.7	5
Ta	1.75	1.75	0.82		1	6
Ge	1.5		-			8

Sally Downs Tonalite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	64.04	63.07	5.23	55.8	72.9	10
TiO2	0.56	0.63	0.22	0.21	0.88	10
Al2O3	16.84	17.13	1.38	14.5	18.5	10
Fe2O3	1.7	1.61	0.69	0.78	3.02	10
FeO	2.79	2.88	1.12	0.77	4.38	10
MnO	0.05	0.05	0.02	05	0.08	10
MgO	2	1.95	1.04	0.43	3.95	10
CaO	5.12	5.63	1.63	1.94	7.51	10
Na2O	3.91	3.86	0.33	3.38	4.66	10
K2O	1.87	1.57	0.79	1.41	3.9	10
P2O5	0.17	0.18	0.07	0.05	0.28	10
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.18	0.21	0.12	10	0.29	3
LOI	1	0.96	0.32	0.58	1.61	10
Ba	666.8	616	164.59	527	969	10
Li	16.4	17	8.65		27	5
Rb	54.6	47	22.26	32	111	10
Sr	544.4	604	168.1	225	824	10
Pb	14.38	11	8.52	8	33	8
Th	7.72	6.5	5.22		18	8
U	1.31		0.7		3	8
Zr	204.9	185	57.77	135	297	10
Nb	5.05	4.25	1.8		8	10
Y	10.3	10	2.31	7	15	10
La	27.16	26	7.95	16	36	9
Ce	53.3	51.35	18.21	25	79	10
Pr	4.4	4.4	-	4.4	4.4	1
Nd	22.47	22.2	5.4	17.2	28	3
Sc	8.16	7	5.44	2.1	15	7
V	76.1	78	37.66	18	147	10
Cr	26	27.5	15.24	5	57	10
Ni	21.3	19	9.33	9	42	10
Cu	29.8	27	35.37		119	10
Zn	55.6	57.5	13.43	33	74	10
Sn	2		-			8
Mo	2.25		1.04			8
Ga	18.7	19.5	2.06	16	22	10
As	2		-			8
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	2.33	3	1.15	1	3	3
Bi	2		-			3
Sb	2		-			3
Hf	1.3	1.3	-	1.3	1.3	1
Ta	2	1	1.73	1	4	3
Ge	1.5		-			8

Shepherds Bore Plutonic Complex

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	71.99	71.5	3.79	66.4	77.69	13
TiO2	0.36	0.34	0.23	05	0.74	13
Al2O3	13.64	13.85	1.23	11.57	15.4	13
Fe2O3	0.92	0.85	0.35	0.45	1.55	13
FeO	2.11	1.8	1.21	0.5	4.48	13
MnO	0.04	0.03	0.02	05	0.07	13
MgO	0.67	0.67	0.54	05	1.5	13
CaO	2.11	2.36	1.13	0.55	3.69	13
Na2O	3.09	2.87	0.65	2.26	4.6	13
K2O	4.12	4.57	1.39	1.35	6.38	13
P2O5	0.08	0.08	0.05	05	0.16	13
H2O+	0.62	0.62	0.21	0.41	0.83	3
H2O-	0.09	0.1	0.03	10	0.11	3
CO2	0.17	0.12	0.16	0.07	0.57	8
LOI	0.77	0.77	0.19	0.49	1.08	9
Ba	593.85	708	325.8	110	1044	13
Li	23.67	21.5	12.49	7	40	12
Rb	177.92	150	66.65	39	258	13
Sr	111.23	104	89.13	10	328	13
Pb	20.54	21	6.09	9	29	13
Th	18.74	20	6.29	7	26	13
U	3.87	3	2.56		8.9	13
Zr	183	169	49.78	99	259	13
Nb	11.08	11	4.9		21	13
Y	39.22	37	19.07	9	68	13
La	39.92	43	11.17	18	54.5	13
Ce	73.97	75	22.45	32	99	13
Pr	6.65	6.65	3.46	4.2	9.1	2
Nd	35.93	36.45	12.85	16.7	56	6
Sc	7.47	5.5	4.8	2.1	18	12
V	26.92	27	22.93		63	13
Cr	14	8	13.55		42	13
Mn	346.75	379.5	169.5	133	495	4
Co	10.33	8	5.86	6	17	3
Ni	7.96	7	5.55		20	13
Cu	7	1	8.97		33	13
Zn	45.15	44	18.3	22	79	13
Sn	3.46		2.3		8	13
W	3.5	3	2.29		6	3
Mo	2.1		0.99		2	10
Ga	16.92	17	2.18	13	21	13
As	2.1		0.74		4	10
S	63.75	70	43.47		110	4
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	1.8	2	0.84	1	3	5
Bi	1.2		0.45			5
Sb	2		-			1
Hf	3.6	3.6	-	3.6	3.6	2
Ta	2.5		-			4
Ge	1.64	1	0.38		2	7

5 OTHERS

5.1 Introduction

This section contains brief descriptions of granites/granite suites not included in the preceding chapters. These units either have few geochemical analyses or else do not fit into any of the suites described in the preceding chapters.

5.2 Sophie Downs Suite

Location: The Sophie Downs Suite occurs in the eastern zone of the Halls Creek Orogen (Tyler *et al.*, 1995). The Suite includes the Sophie Downs Granite, the Esaw Monzogranite, the Junda Microgranite and the felsic volcanics of the Ding Dong Downs Volcanics. The Sophie Downs Granite has been recently redefined to include only the granite in the core of the Sophie Downs Dome (Blake *et al.*, in prep). The Esaw Monzogranite consists of several small outcrops in the Taylor Lookout Inlier, whilst the Sophie Downs Granite is exposed in the cores of a series of structural domes in the southern part of the Dockerell 1:1000 000 sheet area.

Timing and Relationships: The Sophie Downs Suite is the oldest igneous suite in the Kimberley Region. The Sophie Downs Granite itself is unconformably overlain by the Saunders Creek Formation, the oldest unit in the Halls Creek Group (Griffin and Tyler, 1992; Tyler *et al.*, 1995). Three members of this suite have been dated using SHRIMP: the Junda Microgranite (1913 ± 5 Ma), the Sophie Downs Granite (1912 ± 5 Ma), and the Ding Dong Downs Volcanics (1912 ± 3) (OZCHRON, unpublished data).

Description: The Sophie Downs Granite consists of partly recrystallised, fine-grained two-mica granite with a granophyric texture. For a felsic granite, the Sophie Downs Granite has high measured magnetic susceptibilities. The Esaw Monzogranite is composed of moderately to strongly recrystallised, leucocratic biotite-muscovite monzogranite and garnet-muscovite monzogranite. The Junda Microgranite is composed of foliated and partly recrystallised fine-grained leucogranite. All three intrusions consist predominantly of quartz, plagioclase, and microcline, with minor biotite, muscovite, and magnetite. The felsic volcanics of the Ding Dong Downs Volcanics have been described as brecciated in places (Dow and Gemuts, 1969).

Analysed samples have a high and restricted SiO_2 range (Figure 5.2.1). The samples show rapidly increasing exponential values for Rb, Y, and Rb/Sr (Figures 5.3A, C, and I). The Esaw Monzogranite shows decreasing K/Rb with increasing SiO_2 content (Figure 5.3F) and some samples plot in the strongly differentiated field (Figure 5.3G). The Spidergram pattern for the suite is typically a Sr-depleted, Y-undepleted pattern (Figure 5.2.2).

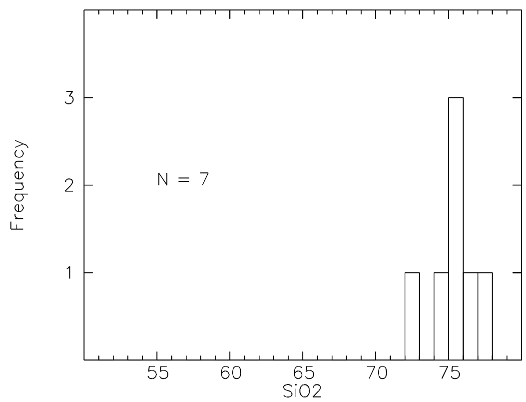


Figure 5.2.1 Histogram of SiO_2 values for the Sophie Downs Suite.

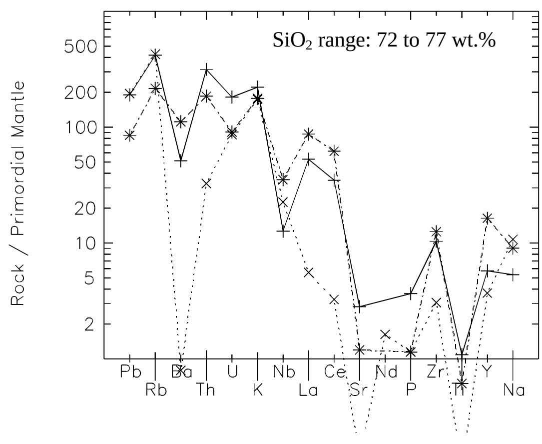


Figure 5.2.2 Spidergram for selected samples from the Sophie Downs Suite.

Country Rocks: Most observed contacts are either sheared or extensively veined by quartz. The members of this suite are inferred to intrude the Ding Dong Downs Volcanics, which consist of felsic and mafic volcanics with minor sediments. The mafic volcanics, which in places are full of carbonate-filled vesicles, would make an appropriate host.

Potential: From the data available, the Sophie Downs Suite is regarded as an I-(granodiorite) type, and a Sybella type. It is not regarded as having any potential because of the very high and limited SiO_2 range and also its very limited outcrop extent.

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Blake, D.H., Tyler, I.M., Griffin, T.J., Sheppard, S., Thorne, A.M. and Warren, R.G., *in prep.* Halls Creek, Western Australia, 1:100 000 Geological Series. *Australian Geological Survey Organisation, Explanatory Notes.*

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Tyler, I.M., Griffin, T.J. and Sheppard, S., *in prep.* Dockrell, Western Australia, 1:100 000 Geological Series. *Geological Survey of Western Australia, Explanatory Notes.*

5.3 Dougalls Suite

Location: The Dougalls Suite outcrops mainly on the east part of the Dixon Range 1:250 000 Sheet area. The suite was emplaced along the eastern margin of the Central Zone (Griffin and Tyler, 1992) and includes the Dougalls Tonalite, Corkwood Tonalite, Dead Finish Tonalite, Monkey Yard Tonalite, and the Reedy Creek Granodiorite.

Timing and Relationships: The suite was emplaced as a series of sheets into the Tickalara Metamorphics. The age obtained by SHRIMP on the Dougalls Tonalite is 1849 ± 3 Ma. Some members of this suite were affected by D_1, D_2, and also a high grade metamorphic event M_2 which produced extensive migmatisation of the country rocks and the granites. Migmatites within the Tickalara Metamorphics have been dated at 1854 ± 6 Ma by conventional zircon techniques (Page and Hancock, 1988). Some granites were emplaced during and after M_2.

Description: The suite consists predominantly of tonalite, trondhjemite, and leucogranite. Most samples are strongly recrystallised and contain mainly plagioclase, quartz, and subordinate mafic minerals. Biotite is the dominant ferromagnesian mineral, with edenitic amphibole and minor clinopyroxene.

Geochemistry was available for 11 samples and the silica range was from 52 to 77 wt.% SiO_2, with the dominant range being from 66 to 77 wt.%. SiO_2 (Fig. 5.3.1). Chemically the suite has very little evidence of fractionation, resembles a tonalite rather than a trondhjemite and is mostly metaluminous and oxidised. Like the Sally Downs Supersuite which was emplaced into

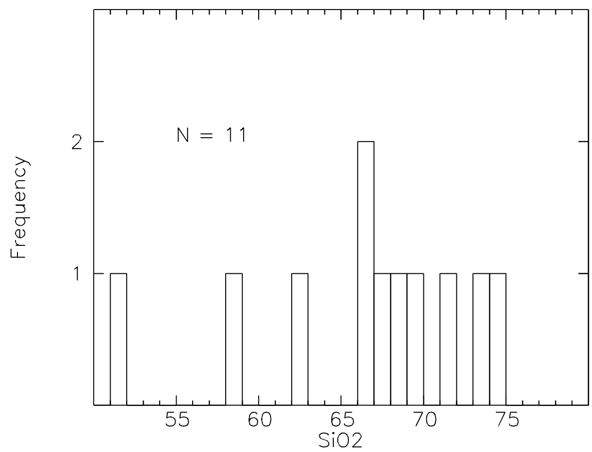

Figure 5.3.1 Histogram of SiO_2 values for the Dougalls Suite.

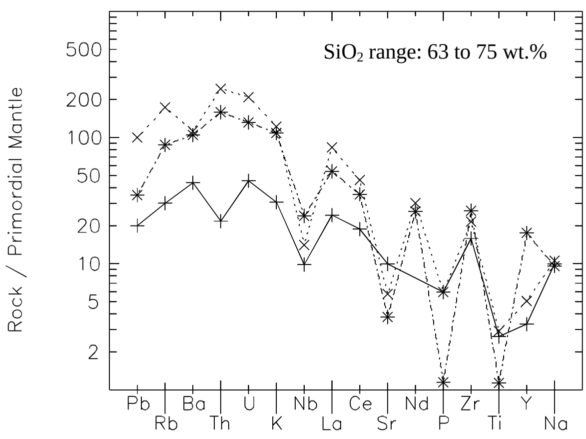

Figure 5.3.2 Spidergram for selected samples from the Dougalls Suite.

the same geographical area some 20-30 Ma later, the more mafic end members of the Dougalls Suite have a Sr-undepleted, Y-depleted pattern which is unusual for Proterozoic granites of Australia. The Dougalls Suite would be classed as an I-(granodiorite) type and a Sally Downs type.

Country Rocks: The suite mostly intrudes the Tickalara Metamorphics, which contain interlayered mafic volcanic rocks and siliciclastic and calcareous metasedimentary rocks metamorphosed to upper amphibolite to granulite facies.

Potential: In view of the limited fractionation shown in the plots and the sheeted nature of these granites, the metallogenic potential is likely to be low.

References:

Dow, D.B. and Gemuts, I., 1969. Geology of the Kimberley Region, Western Australia: The East Kimberley. *Bureau of Mineral Resources, Geology and Geophysics, Australia, Bulletin,* 106, 135 pp.

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Ogasawara, M., 1988. Geochemistry of Early Proterozoic Granitoids in the Halls Creek orogenic subprovince, Northern Australia. *Precambrian Research,* 40/41, 469-486.

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Sheppard, S., Griffin, T.J. and Tyler, I.M., 1995. Geochemistry of the felsic igneous rocks of the southern Halls Creek Orogen. *Geological Survey of Western Australia, Record,* 1995/4, 81 pp.

Tyler, I.M., Griffin, T.J., Page, R.W. and Shaw, R.D., 1995. Are there terranes within the Lamboo Complex of the Halls Creek Orogen? *Geological Survey of Western Australia, Annual Review,* 1993-1994, 37-46.

5.4 Butchers Gully Suite

Location: The Butchers Gully Suite is a sequence of subaerial to submarine alkaline volcanic and volcaniclastic rocks which occurs in the lower part of the Olympio Formation (Griffin and Tyler, 1992). It crops out as two northeast-trending belts up to 25 km long and 4 km wide to the south and southeast of Halls Creek township. A thin unit of carbonate-altered volcanics occurs to the west of the Ruby Queen mine on the Halls Creek 1:100 000 Sheet area.

Timing and Relationships: Three SHRIMP ages are available for the Butchers Gully Member: 1857 ± 5 Ma, 1857 ± 2 Ma, and 1848 ± 3 Ma.

Description: The unit consists mainly of trachyandesite, leucocratic trachyte, quartz trachyte, and rhyolite. The main minerals present are albite with subordinate K-feldspar. Clinopyroxene phenocrysts up to 1.5 cm long are be preserved in places. The mineralised 'Niobium Tuff' crops out along the western side of the Butchers Gully Suite. It consists of a tuffaceous fragmental volcaniclastic sandstone with quartz-fluorite-sericite segregations (Taylor *et al.,* 1995a, 1995b).

Fifteen samples were analysed, and the SiO_2 range is from 58 to 68 wt.% SiO_2, with a peak at 60 wt % (Fig. 5.4.1). These volcanics are clearly alkaline in character. The samples are high in total alkalis, Na_2O in particular (Fig. 5.2A). Some samples have a moderately high Th/U ratio (Fig. 5.2B), presumably reflecting late alteration. The samples show steeply increasing values for Rb, U, Th, and Rb/Sr (Figs. 5.3A, B, E, I) and a decreasing K/Rb ratio and Ba content with increasing SiO_2 (Figs. 5.3F, J). On the Rb-Ba-Sr plot, several samples plot in the strongly differentiated field (Fig. 5.3G). Cu, Pb and Zn values are moderately high (Figs. 5.4A, B, C) whilst the values for high field strength elements such as Y, Zr, and Nb are moderately high (Figs. 5.2C, 5A, 5B).The samples are nearly all oxidised (Fig. 5.6D) and metaluminous (Fig. 5.6E). The samples clearly plot in the A-type field as defined for Palaeozoic granites (Fig. 5.6F). The spidergram plot is clearly Sr-depleted, Y-undepleted (Fig. 5.4.2) and indicates crustal melting and an intraplate setting (Taylor *et al.,* 1995b). The volcanic unit is classified as alkaline and as such does not fit into the Australian Proterozoic Granites classification used in this project.

Country Rocks: The Butchers Gully Suite is interbedded with turbiditic sediments of the Olympio Formation.

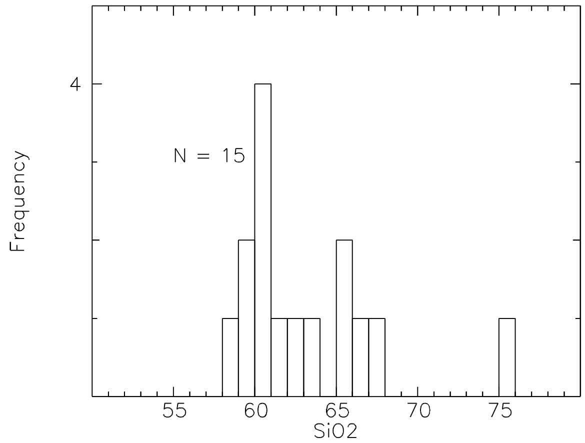

Figure 5.4.1 Histogram of SiO_2 values for the Butchers Gully Suite.

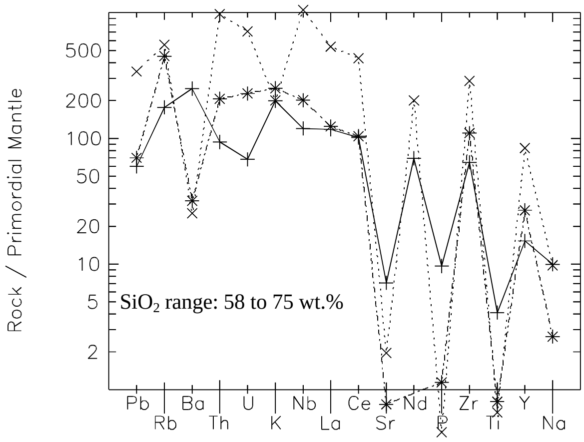

Figure 5.4.2. Spidergram of the Butchers Gully Suite.

Potential: There are two possible associations of mineralisation with the Butchers Gully Suite: (1) Nb, Ta, Y, Zr, Hf, Ga, Ta, Be, and rare earths; and (2) Au.

The Brockman deposit is a multimetal deposit which contains Nb, Ta, Y, Zr, Hf, Ga and rare earths. The mineralisation is fine-grained and is the result of alteration and remobilisation by F-rich deuteric solutions of an alkaline magmatic precursor which contained columbite and zircon.

Warren (1994a, b) noted that there was a close spatial association between the alkaline volcanics of the Butchers Gully Suite and Au deposits/prospects such as Dry Creek, Grants Patch, and Maude Headley. She suggested that the Butchers Gully Suite may have been the source of the Au which was subsequently remobilised during late faulting associated with D_3/D_4. Warren (1994a, b) also noted that if the volcanics were absent or had been removed by D_1, then there were no Au deposits in this area.

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Taylor, W.R., Esslemont, G. and Sun, S.-S., 1995b. Geology of the volcanic-hosted rare-metal deposit, Halls Creek Mobile Zone, northwest Australia. I. Geochemistry and petrogenesis of the Brockman Volcanics. *Contributions to Mineralogy and Petrology*, 52, 231-255.

Warren, R.G., 1994a. Gold mineralisation in the northern East Kimberley Gold District, Western Australia. *The Australasian Institute of Mining and Metallurgy, Publication Series,* 5/94, 117-121.

Warren, R.G., 1994b. Role of early extensional faults in the Grants Patch District, East Kimberley, Western Australia. *Geological Society of Australia, Abstracts,* 37, 453.

5.5 Koongie Park Suite

Location: The Koongie Park Suite lies within the central part of the Halls Creek Orogen (Tyler *et al.,* 1995) and comprises the volcanics of the Koongie Park Formation and the Angelo Microgranite. Both outcrop on the Mount Ramsay and Gordon Downs 1:250 000 Sheet areas, mainly on the Angelo 1:100 000 Sheet area. The suite is believed to be associated with VHMS mineralisation at Koongie Park, including the Sandiego and Onedin Prospects (Orth, 1993; Rea, 1997).

Timing and Relationships: Three SHRIMP ages have been obtained on the Koongie Park Formation: 1845 ± 3 Ma; 1843 ± 5 Ma; and 1840 ± 4 Ma.

Description: The Angelo Microgranite is an elongate intrusion 5 km long by 1 km wide. It is an altered medium to fine-grained strongly recrystallised leucocratic monzogranite with a granophyric texture. The intrusion is altered adjacent to the Angelo Fault and contains disseminated malachite along joint surfaces and foliation planes. The Koongie Park Formation consists of metamorphosed mafic volcanic, felsic volcanic, and volcaniclastic rocks, turbiditic sandstone, laminated siltstone, carbonate, mudstone and iron-formation. On the Angelo 1:100 000 Sheet area, the felsic lavas are aphyric to quartz-phyric with minor quartz feldspar-phyric rhyolite to rhyodacite. Some of the aphyric bodies are up to 500 m long and 100 m wide and Orth (1993) noted that phenocrysts are rare within the volcanics. Orth (1993) also noted that patches of silica increase near mineralisation and more talc and chlorite are also present. Chlorite, actinolite and talc alteration is common around the Sandiego Zn-Cu prospect. On the Halls Creek 1:100 000 Sheet area the volcanics are crystal-rich massive welded pyroclastic rocks and flow-banded lava flows.

Geochemical data are available for eight samples of the Koongie Park Suite. As noted by Sheppard *et al.* (1995) the available analyses are all >69 wt.% SiO_2 (Fig. 5.5.1). Chemical alteration is prominent in four of the eight samples analysed, with two being depleted in K_2O and two in Na_2O (Fig. 5.2A). Although the data are limited, Rb, Y, and Rb/Sr show increases with increasing SiO_2 (Figs. 5.3A, 3C, 3I) and the K/Rb ratio decreases with increasing SiO_2 (Fig. 5.3F). Some Cu, Pb and Zn values are high (Figs. 5.4A, 4B, 4C). High Field Strength Element concentrations are generally low to moderate, although the two samples that are strongly depleted in K_2O have anomalously high Zr concentrations (Figs. 5.5A, 5B, 5C). The samples are mostly oxidised and metaluminous to peraluminous. Unaltered samples plot in the field of normal Palaeozoic granites, and are distinctly different from the samples of the alkaline Butchers Gully Suite. The spidergram (Fig. 5.5.2) is the classic Sr-depleted, Y-undepleted pattern which is so typical of the Proterozoic of Australia. The Koongie Park Suite is classified as I-(granodiorite) type and Cullen-type.

Country Rocks: The country rocks are reactive and contain carbonate and iron-formation. The hosts for the primary mineralisation at the Sandiego Zn-Cu deposit are chert and carbonate.

Potential: The data are limited, but the Koongie Park Suite is possibly one of the more prospective of the whole Kimberley region. The assertion by Orth (1993) that the volcanics are mostly aphyric (*c.f.* the phenocryst rich nature of the Whitewater Volcanics) suggests that this suite is not dominated by restite (Wyborn and Chappell, 1986). Alteration has been described in the volcanics. Griffin *et al.,* (in prep) have described the mineralisation at Mount Angelo South

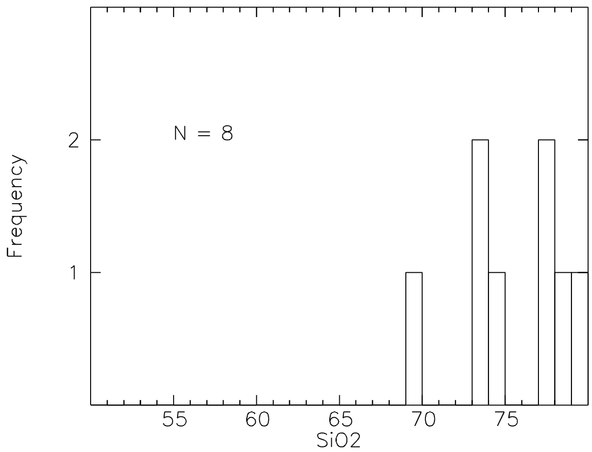

Figure 5.5.1 Histogram of SiO_2 values for the Koongie Park Suite.

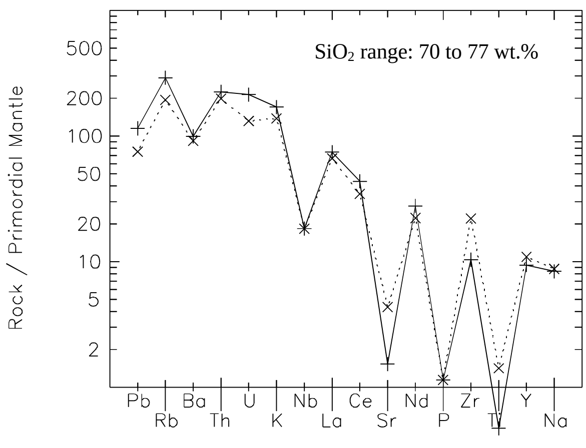

Figure 5.5.2 Spidergram for the Koongie Park Suite.

prospect which is within the Angelo Microgranite, as being a possible porphyry copper deposit. Several polymetallic volcanogenic base metal sulphide prospects occur within the Koongie Park Formation including the Mount Angelo North (Cu), Sandiego (Zn-Cu), Onedin (Cu-Pb-Zn) and Gosford (Cu-Pb-Zn) prospects. Other prospects in this area are listed in Hoatson (1993).

References:

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5.6 San Sou Suite

Location: The San Sou Suite comprises the San Sou Monzogranite and the Eastman Granite. Both occur in the southern most part of the Halls Creek Inlier.

Timing and Relationships: Two SHRIMP ages have been obtained: San Sou Monzogranite at 1788 ± 6 Ma and the Eastman Granite at 1805 ± 5 Ma. These ages are comparable with the age of the Hart Dolerite at 1790 ± 4 Ma, a major intrusive dolerite event throughout the Kimberley Basin. The Hart Dolerite has associated granophyre on the Lissadell 1:250 000 Sheet area (Plumb, 1968) and on the Lansdowne 1:250 000 Sheet area (Gellatly *et al.,* 1975). The Wotjulum Porphyry on the Yampi 1:250 000 Sheet area (Sofoulis *et al.*, 1971; Tyler and Griffin, 1992, 1993) is also of a similar age. Unfortunately no chemical data are available on any of these units for comparison with the San Sou Suite.

Description: The San Sou Monzoranite is poorly exposed, and the dominant rock type is variably recrystallised, medium to fine-grained leucocratic biotite monzogranite.

As there are only five analyses are available for this suite, very little can be said about the geochemistry. The five samples have a high and very narrow SiO_2 range from 72 to 77 wt. % (Fig. 5.6.1) . There is little evidence of fractionation within these samples and they have low values of incompatible elements. The spidergram (Fig. 5.6.2) is a Sr-depleted, Y-undepleted pattern. The San Sou Suite would be classed as I-(granodiorite) type and a Sybella type.

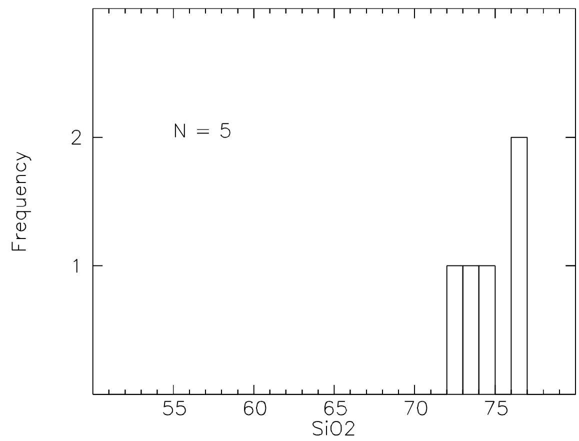

Figure 5.6.1 Histogram of SiO_2 values for the San Sou Suite.

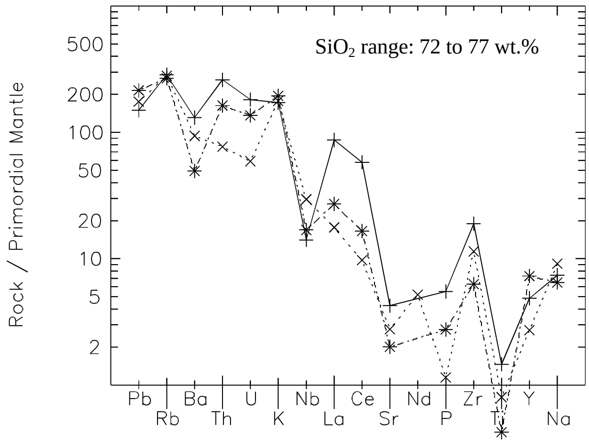

Figure 5.6.2 Spidergram of the San Sou Suite.

Country Rocks: Intrudes the Ding Dong Downs Volcanics, Esaw Monzogranite, and the Saunders Creek Formation, Biscay Formation and Olympio Formation of the Halls Creek Group. The Biscay Formation and Ding Dong Downs Volcanics have the best host rocks in the form of carbonates and mafic volcanics.

Potential: The San Sou Monzogranite is spatially associated with the tin-columbite deposits of the Mount Dockrell area (Finucane, 1938). Tyler (*pers. comm.*) has argued that all the Sn mineralisation on Dockrell is located in the dome structures produced by fold interference between 1200 to ?300 Ma. The available granite geochemical data are insufficient to argue for a link between the San Sou Suite and this Sn-Nb mineralisation.

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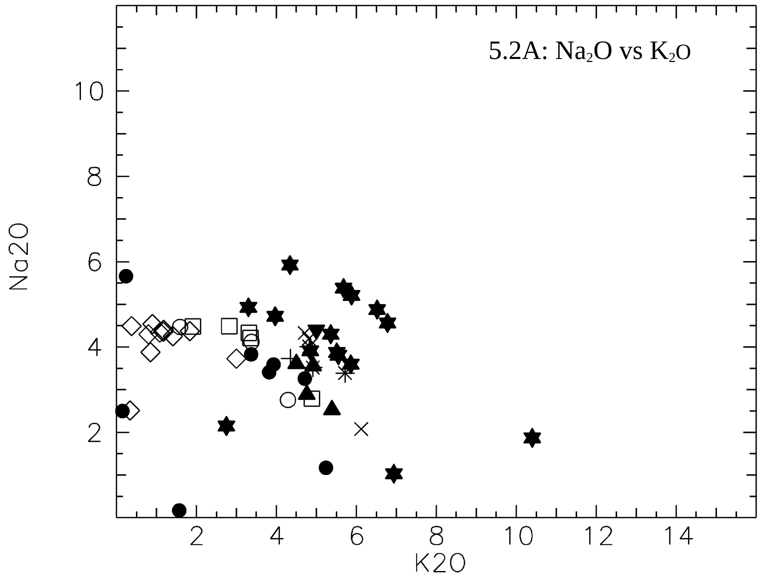
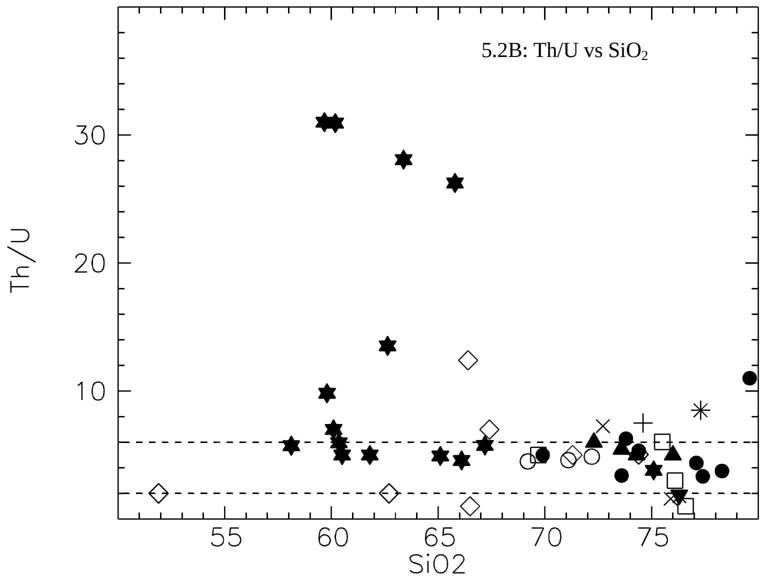
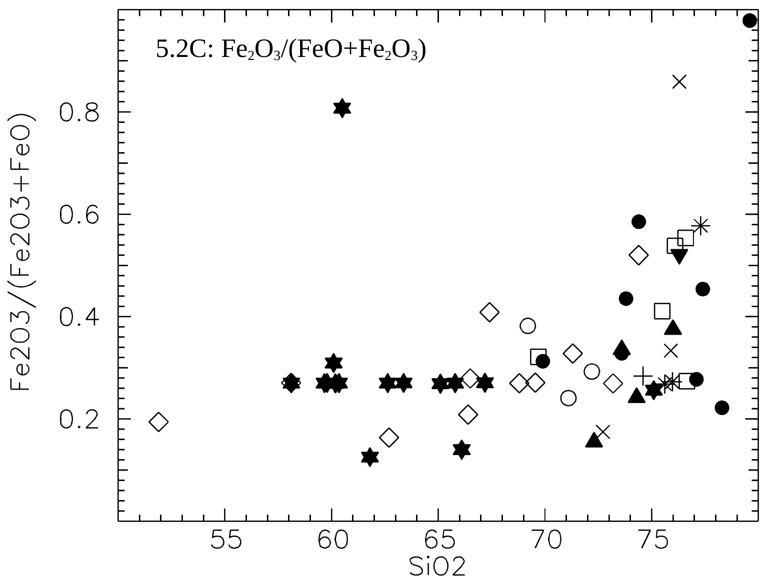
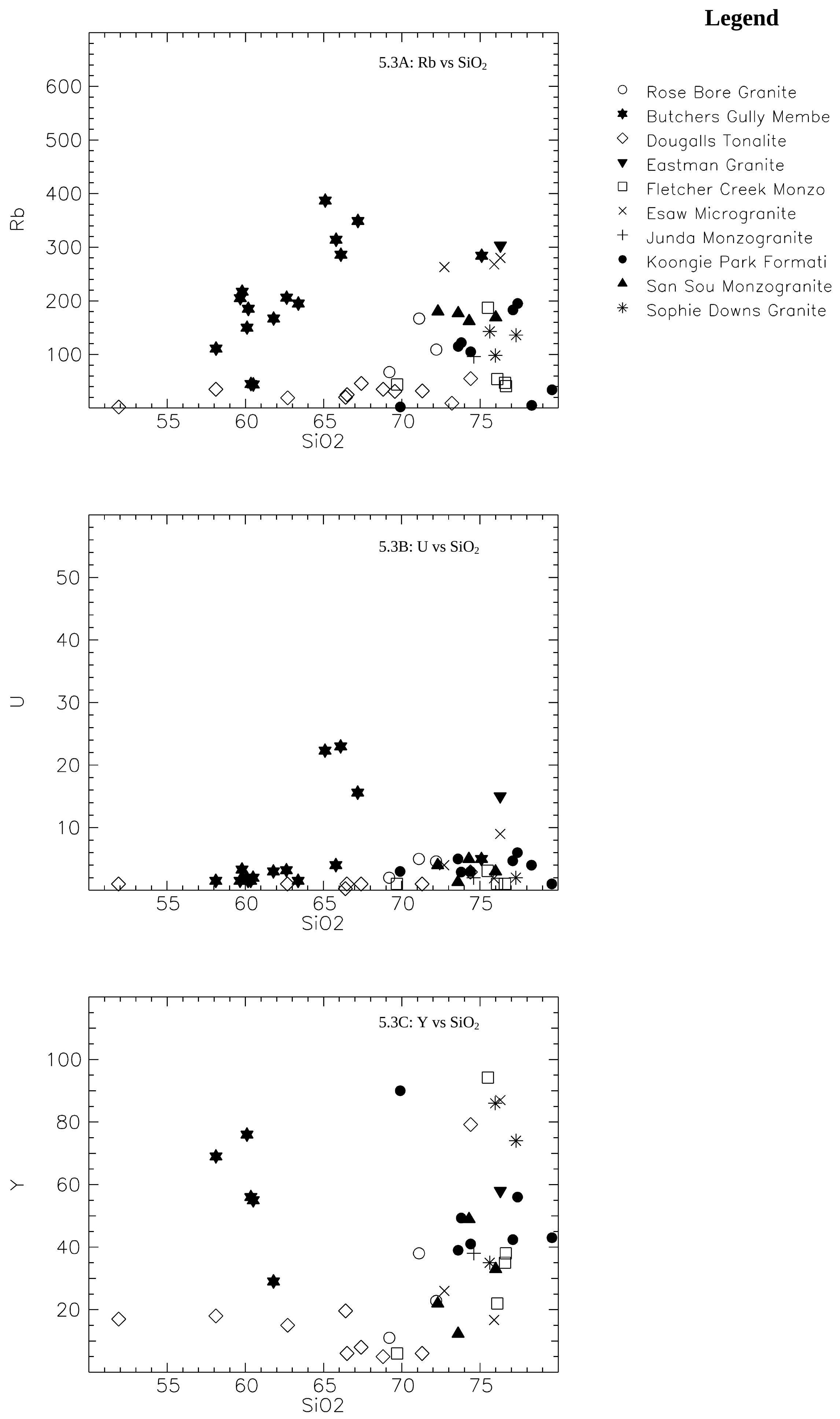
Legend

- Rose Bore Granite
- Butchers Gully Membe
- Dougalls Tonalite
- Eastman Granite
- Fletcher Creek Monzo
- Esaw Microgranite
- Junda Monzogranite
- Koongie Park Formati
- San Sou Monzogranite
- Sophie Downs Granite

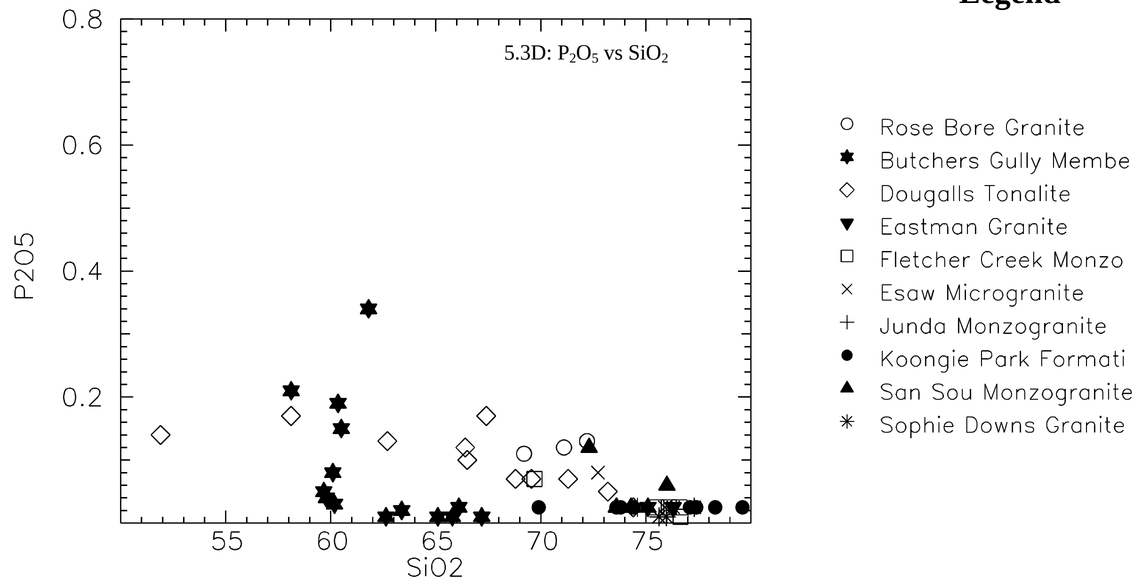




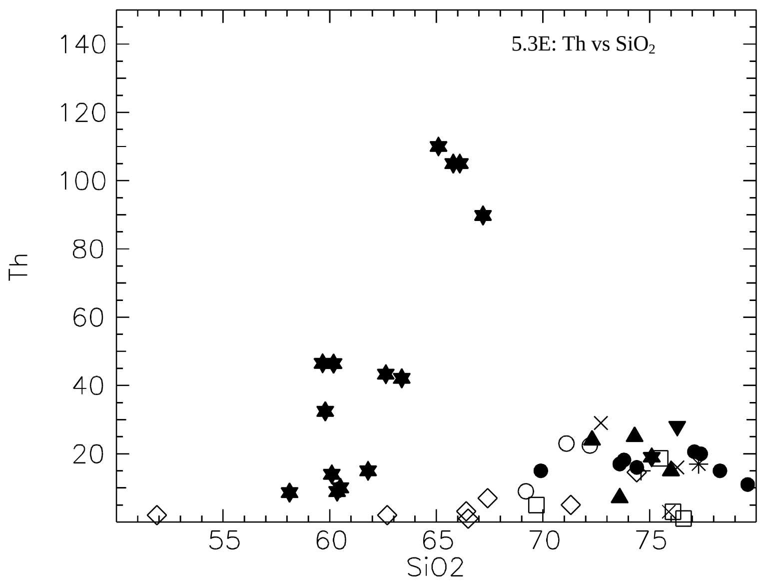



Legend
Rose Bore Granite
Butchers Gully Membe
Dougalls Tonalite
Eastman Granite
Fletcher Creek Monzo
Esaw Microgranite
Junda Monzogranite
Koongie Park Formati
San Sou Monzogranite
Sophie Downs Granite
5.3A: Rb vs SiO_2
Rb
SiO2
5.3B: U vs SiO_2
U
SiO2
5.3C: Y vs SiO_2
Y
SiO2

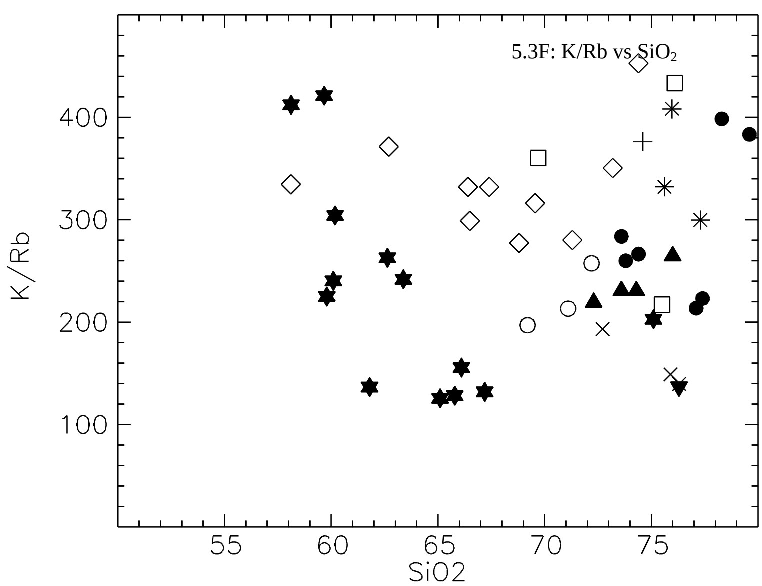
Legend



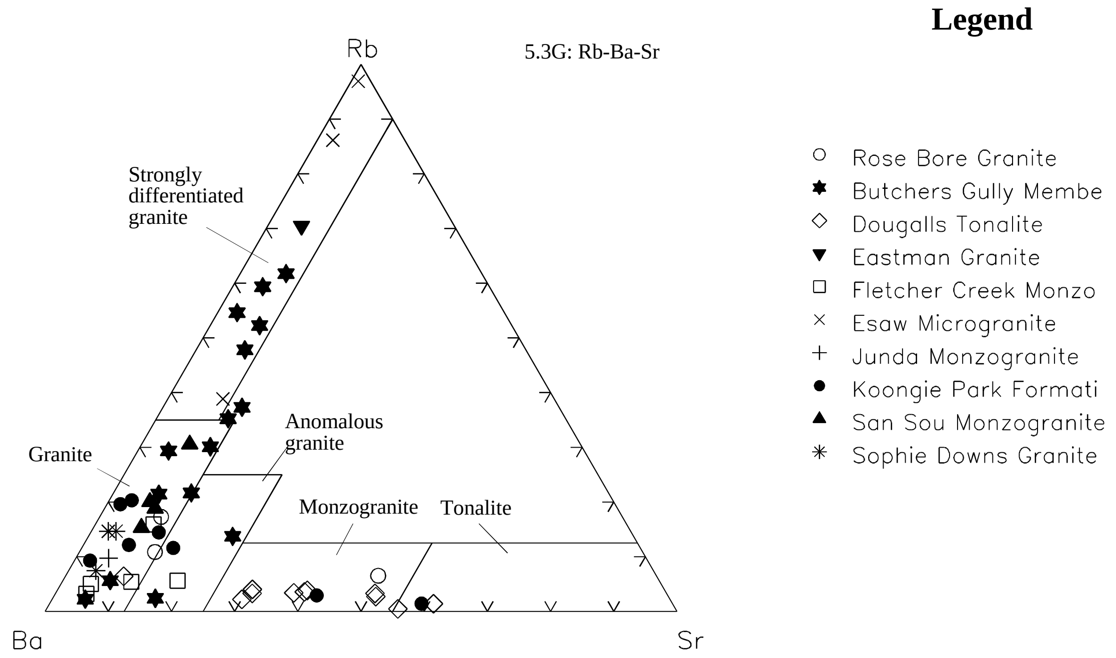
5.3D: P2O5 vs SiO2
P2O5
SiO2
Rose Bore Granite
Butchers Gully Membe
Dougalls Tonalite
Eastman Granite
Fletcher Creek Monzo
Esaw Microgranite
Junda Monzogranite
Koongie Park Formati
San Sou Monzogranite
Sophie Downs Granite

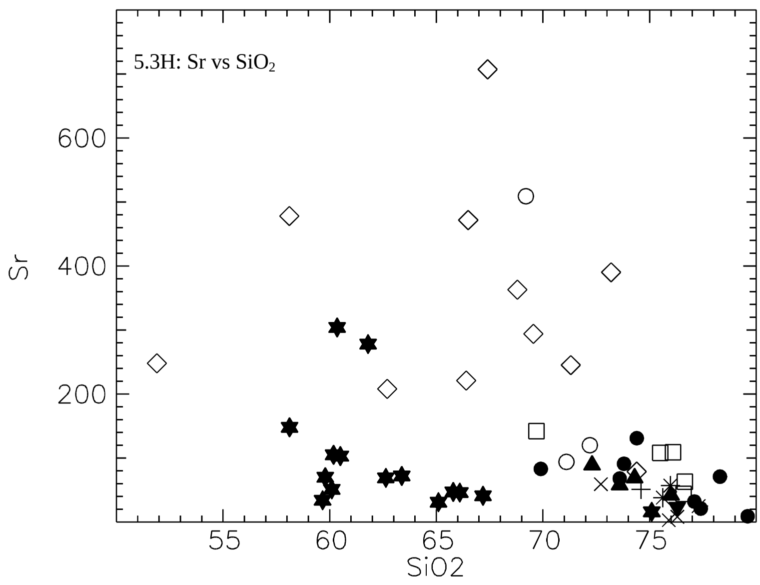


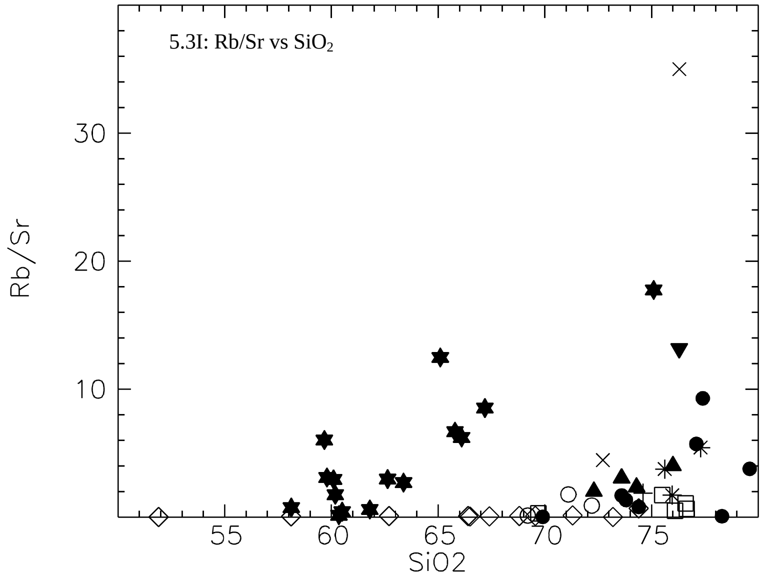
5.3E: Th vs SiO2
Th
SiO2

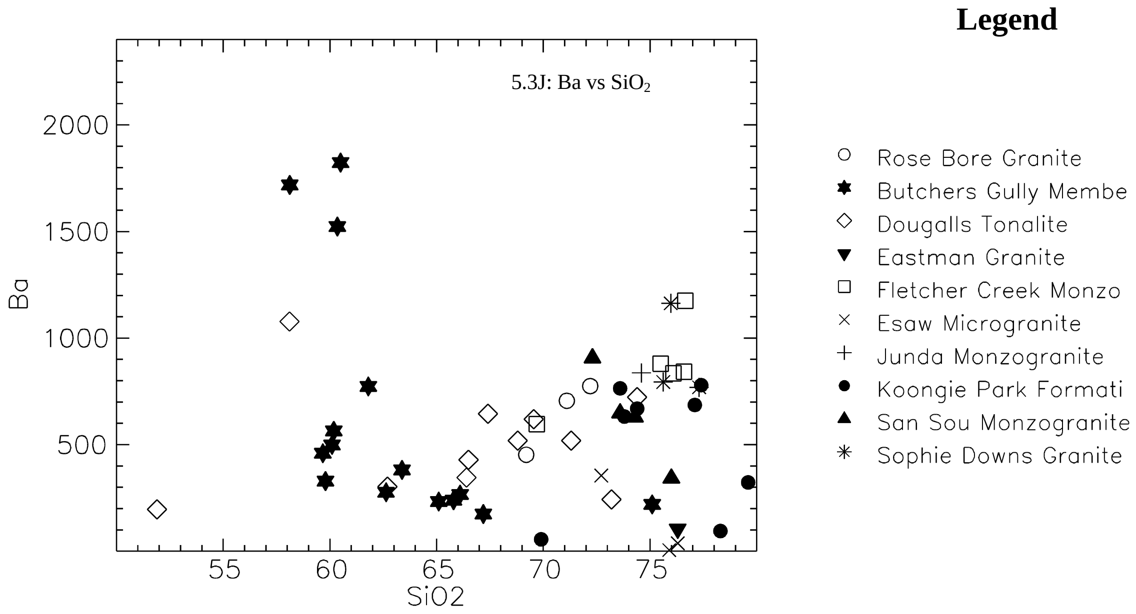


5.3F: K/Rb vs SiO2
K/Rb
SiO2


Legend
5.3G: Rb-Ba-Sr
Rb
Ba
Sr
Strongly differentiated granite
Anomalous granite
Granite
Monzogranite
Tonalite
Rose Bore Granite
Butchers Gully Membe
Dougalls Tonalite
Eastman Granite
Fletcher Creek Monzo
Esaw Microgranite
Junda Monzogranite
Koongie Park Formati
San Sou Monzogranite
Sophie Downs Granite


5.3H: Sr vs SiO2
Sr
SiO2


5.3I: Rb/Sr vs SiO2
Rb/Sr
SiO2



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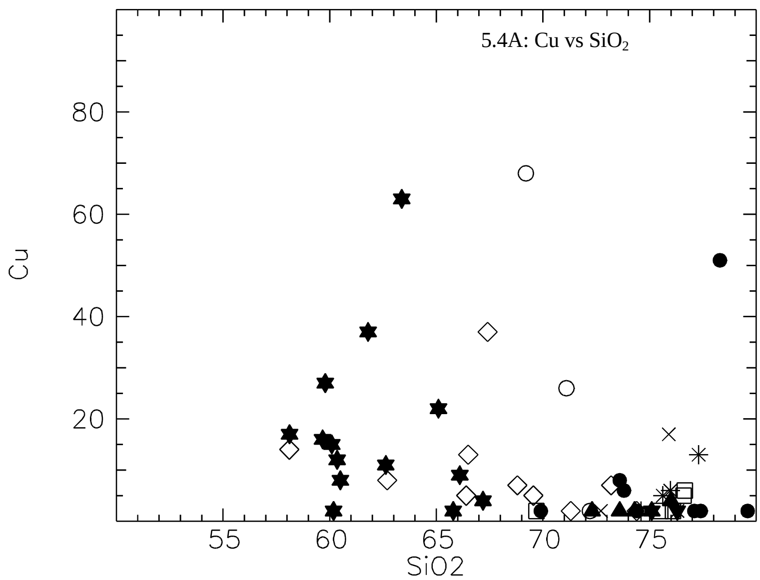
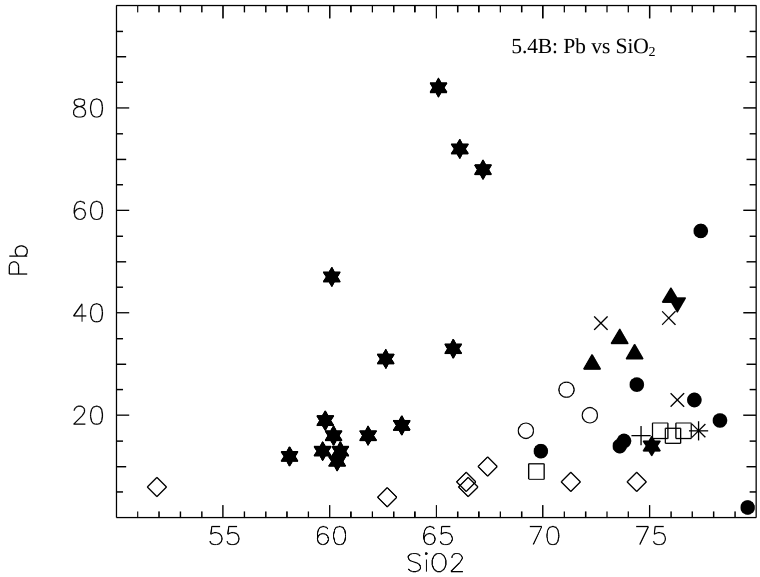
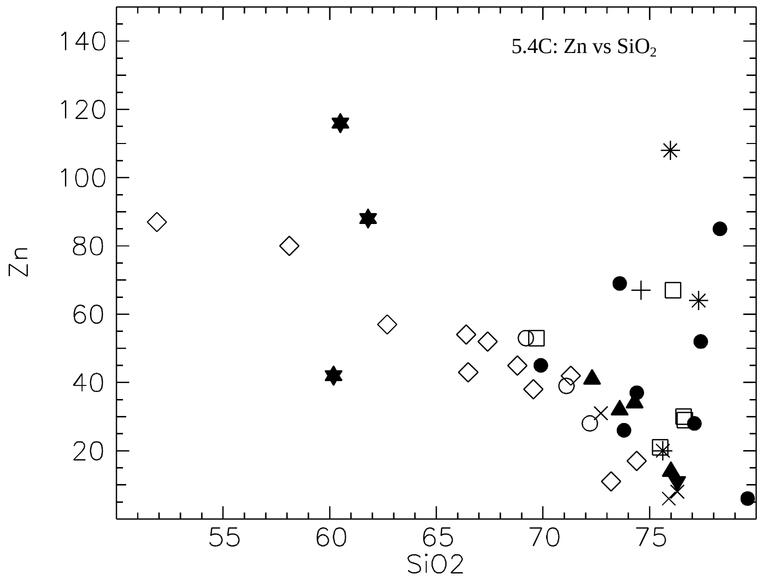
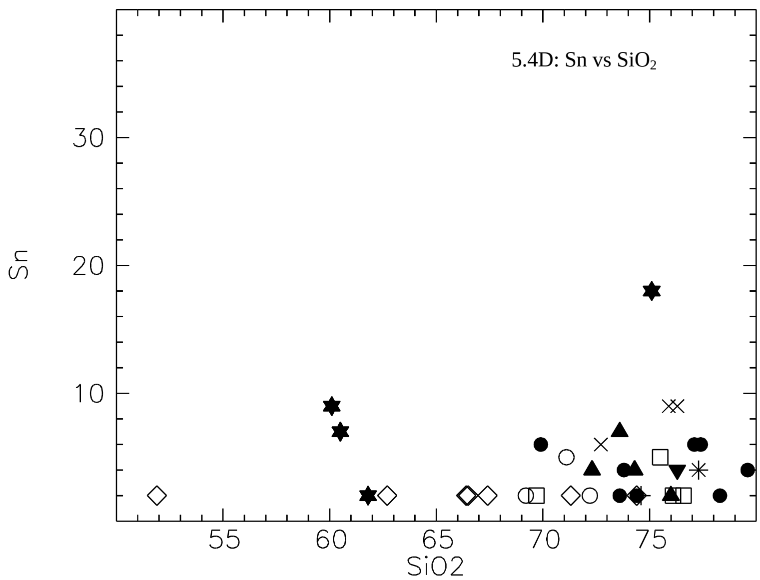


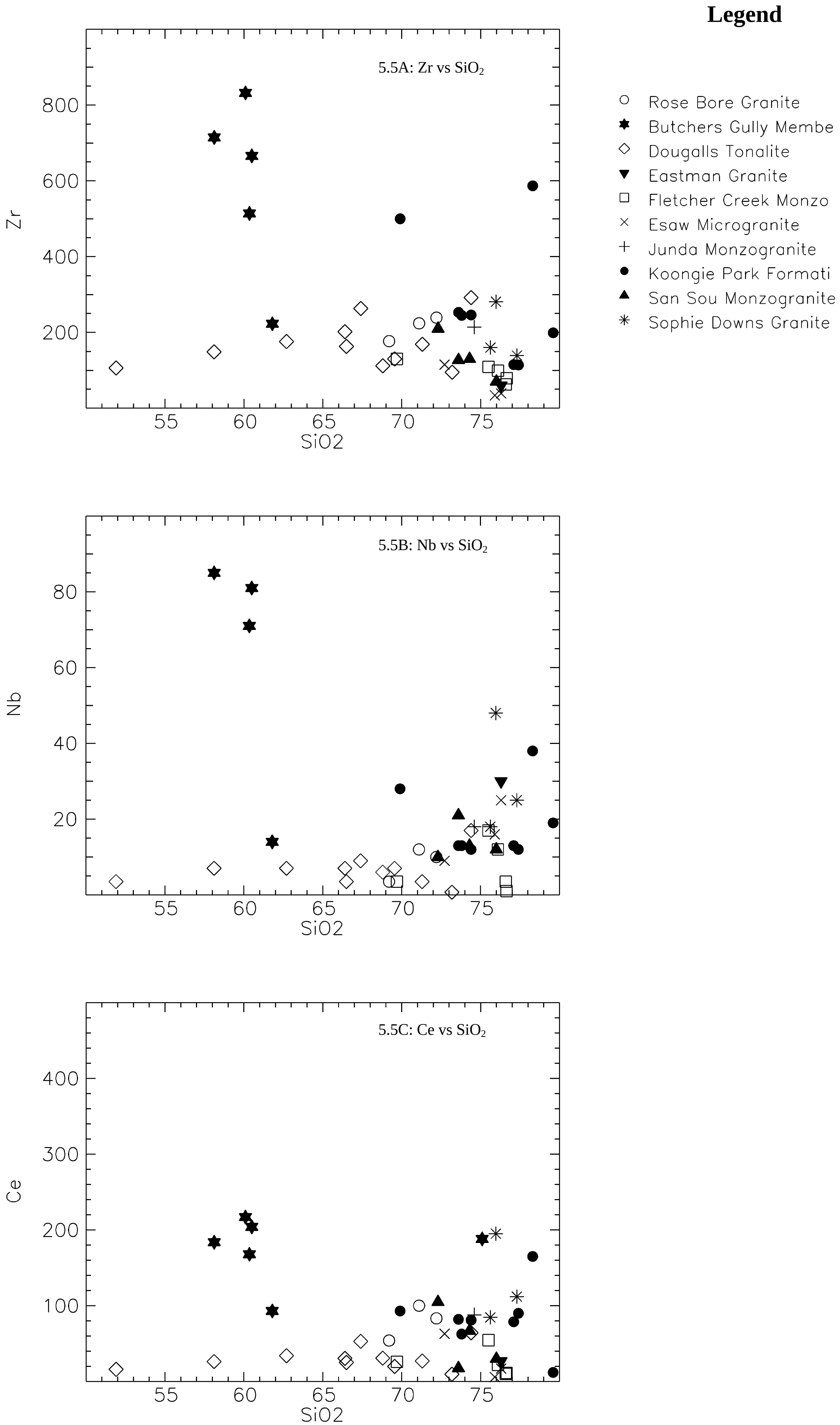
Legend

- Rose Bore Granite
- Butchers Gully Membe
- Dougalls Tonalite
- Eastman Granite
- Fletcher Creek Monzo
- Esaw Microgranite
- Junda Monzogranite
- Koongie Park Formati
- San Sou Monzogranite
- Sophie Downs Granite

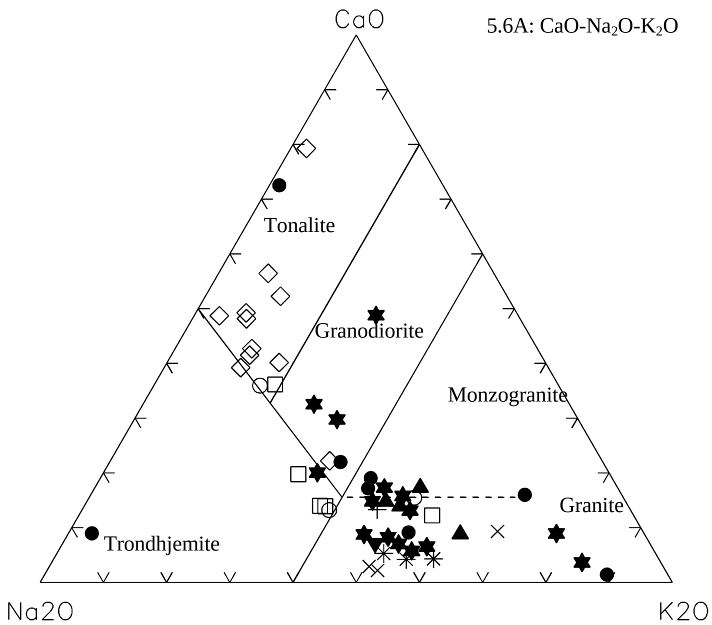


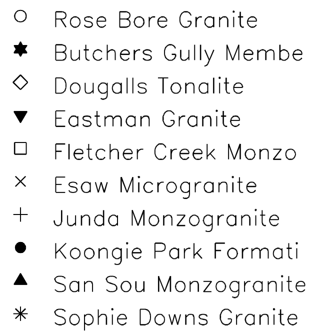


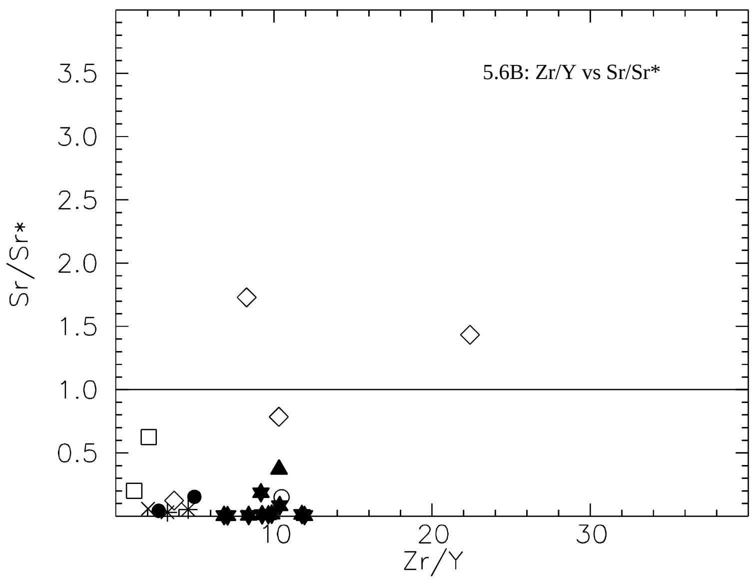



Legend
Rose Bore Granite
Butchers Gully Membe
Dougalls Tonalite
Eastman Granite
Fletcher Creek Monzo
Esaw Microgranite
Junda Monzogranite
Koongie Park Formati
San Sou Monzogranite
Sophie Downs Granite
5.5A: Zr vs SiO2
Zr
800
600
400
200
5.5B: Nb vs SiO2
Nb
80
60
40
20
5.5C: Ce vs SiO2
Ce
400
300
200
100
55
60
65
70
75
SiO2

Legend



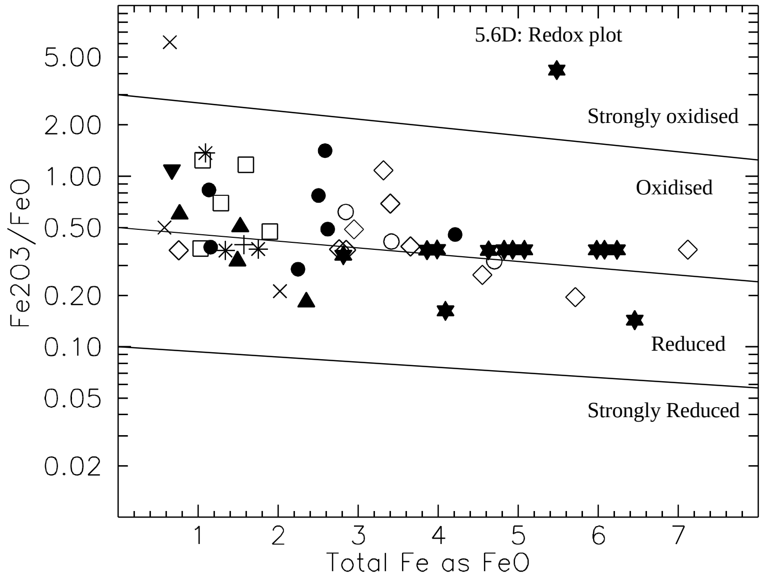




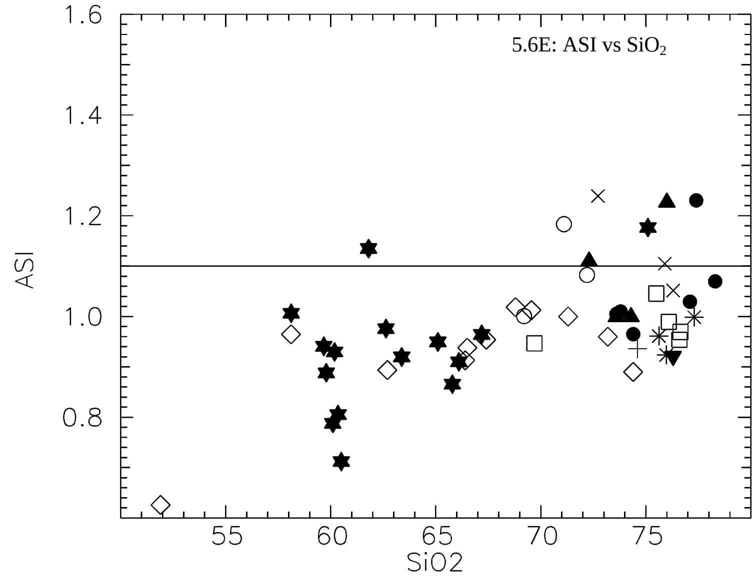
5.6C: Spidergram
SiO_2 range:

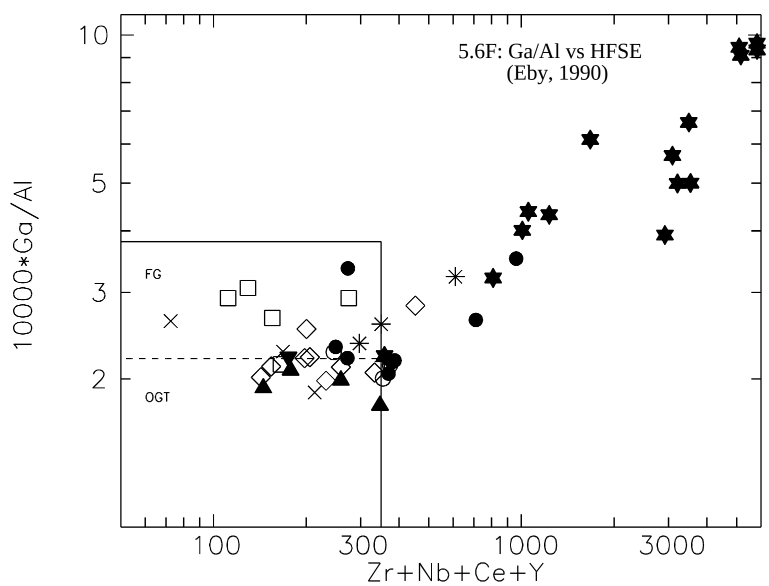
See Figure in each section

Legend



- ○ Rose Bore Granite
- ✶ Butchers Gully Membe
- ◇ Dougalls Tonalite
- ▼ Eastman Granite
- □ Fletcher Creek Monzo
- × Esaw Microgranite
- + Junda Monzogranite
- ● Koongie Park Formati
- ▲ San Sou Monzogranite
- ✳ Sophie Downs Granite





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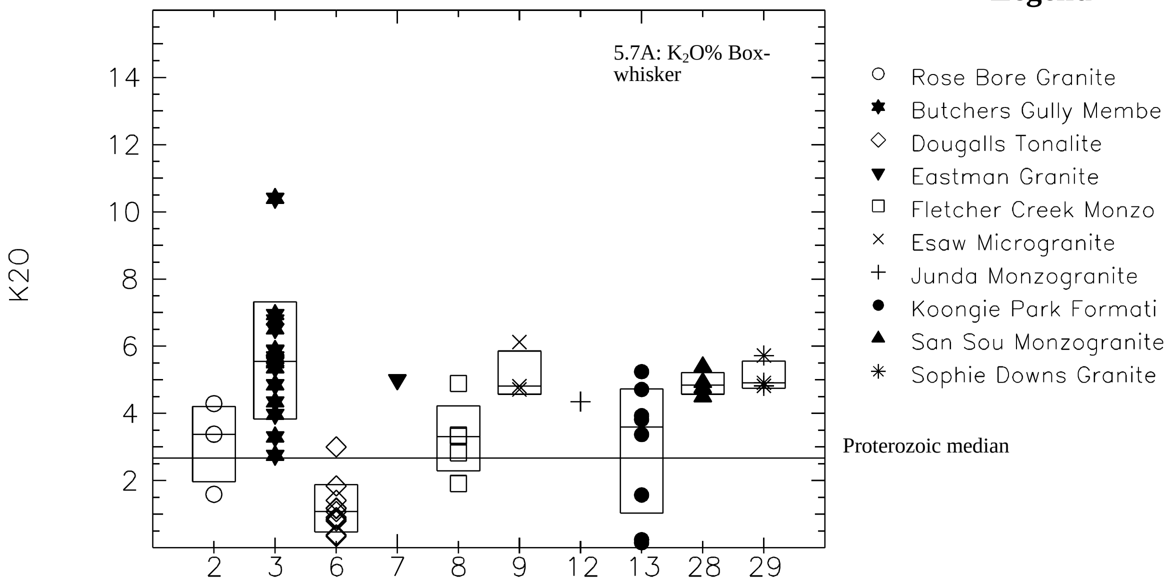
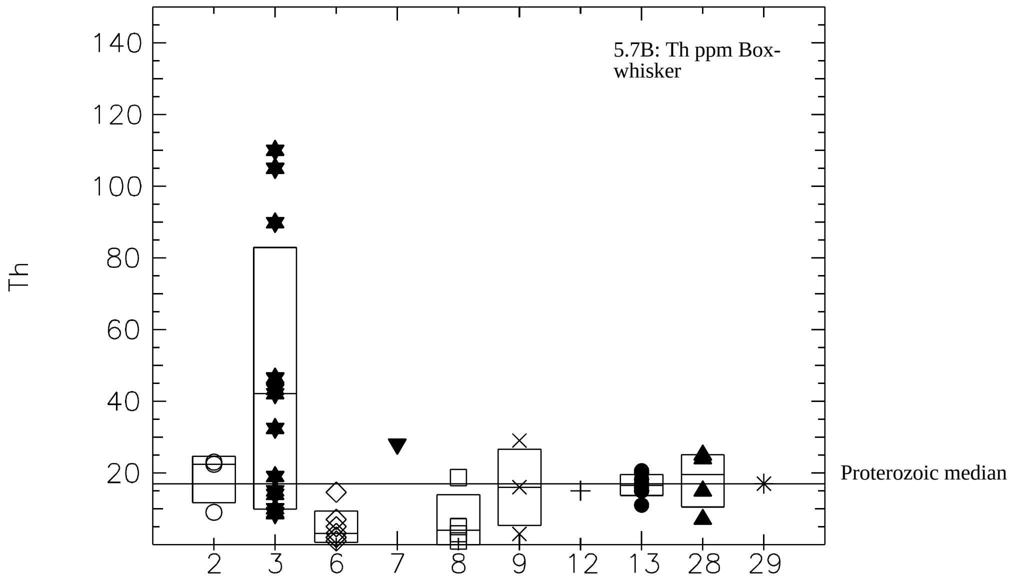
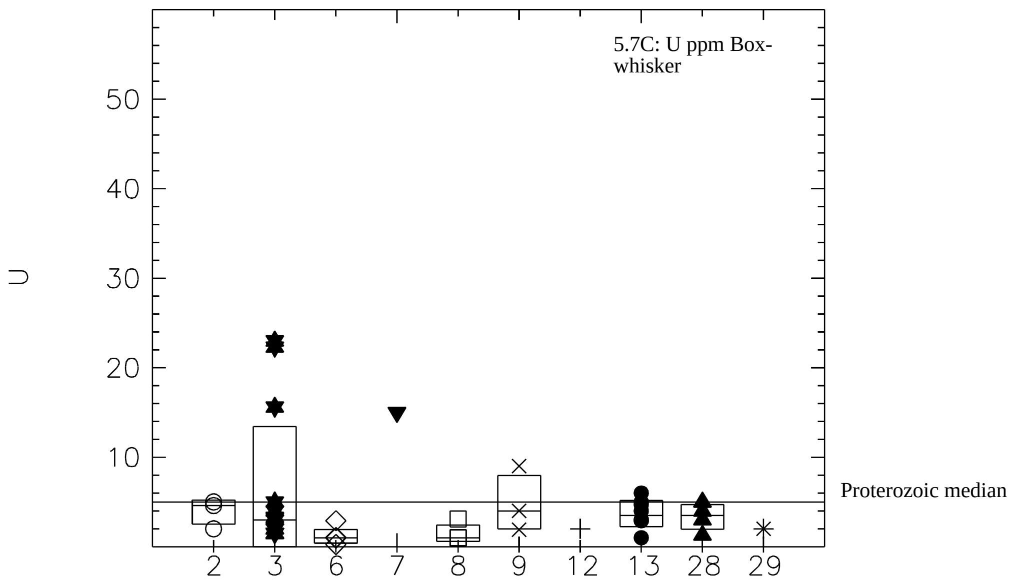

5.7A: K_2O% Box-whisker
K2O
Proterozoic median
Rose Bore Granite
Butchers Gully Membe
Dougalls Tonalite
Eastman Granite
Fletcher Creek Monzo
Esaw Microgranite
Junda Monzogranite
Koongie Park Formati
San Sou Monzogranite
Sophie Downs Granite


5.7B: Th ppm Box-whisker
Th
Proterozoic median


5.7C: U ppm Box-whisker
U
Proterozoic median

Rose Bore Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	70.83	71.1	1.52	69.2	72.2	3
TiO2	0.53	0.62	0.17	0.34	0.64	3
Al2O3	13.83	13.3	1.01	13.2	15	3
Fe2O3	1.11	1.13	0.07	1.03	1.16	3
FeO	2.66	2.49	0.93	1.83	3.66	3
MnO	0.03	05	0.01	05	0.05	3
MgO	1.16	1.25	0.16	0.98	1.25	3
CaO	1.94	1.29	1.26	1.14	3.4	3
Na2O	3.78	4.12	0.9	2.76	4.47	3
K2O	3.09	3.38	1.37	1.59	4.29	3
P2O5	0.12	0.12	0.01	0.11	0.13	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.22	0.11	0.24	10	0.49	3
LOI	0.82	0.82	0.19	0.63	1.01	3
Ba	644.67	706	169.54	453	775	3
Li	-	-	-	-	-	-
Rb	114.33	109	50.21	67	167	3
Sr	241	120	232.46	94	509	3
Pb	20.67	20	4.04	17	25	3
Th	18.13	22.4	7.92	9	23	3
U	3.87	4.6	1.63	2	5	3
Zr	213.33	224	32.35	177	239	3
Nb	8.5	10	4.44		12	3
Y	23.93	22.8	13.54	11	38	3
La	47.1	52	14.29	31	58.3	3
Ce	79.1	83.3	23.29	54	100	3
Pr	10.2	10.2	-	10.2	10.2	1
Nd	40.8	40.8	-	40.8	40.8	1
Sc	10.5	10.5	7.78	5	16	2
V	34	31	7	29	42	3
Cr	14	14	1	13	15	3
Ni	7.67	8	2.52	5	10	3
Cu	32	26	33.41		68	3
Zn	40	39	12.53	28	53	3
Sn	3		1.73		5	3
Mo	1.67		1.15			3
Ga	15.67	15	2.08	14	18	3
As	2		-			3
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	0.5		-			2
Bi	2		-			2
Sb	3	3	1.41		4	2
Hf	5.4	5.4	-	5.4	5.4	1
Ta	1	1	-	1	1	1
Ge	1.5		-			3

Butchers Gully Member

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	63.05	61.8	4.33	58.12	75.1	15
TiO2	0.41	0.23	0.34	0.14	1.22	15
Al2O3	14.48	14.9	1.63	11.4	16.62	15
Fe2O3	1.67	1.37	1.07	0.58	4.82	15
FeO	4.02	3.7	1.56	1.15	7.32	15
MnO	0.14	0.13	0.04	0.06	0.24	15
MgO	0.9	0.89	0.72	0.03	2.64	15
CaO	1.84	1.71	1.33	0.3	4.67	15
Na2O	4.01	4.3	1.38	1.03	5.92	15
K2O	5.58	5.55	1.8	2.75	10.4	15
P2O5	0.08	0.03	0.1	05	0.34	15
H2O+	0.46	0.46	0.35	0.21	0.71	2
H2O-	0.05	10	-	10	10	2
CO2	1.56	1.43	1.19	0.25	4.43	15
LOI	2.63	2.29	0.8	1.36	3.94	13
Ba	632.2	381	571.41	175	1823	15
Li	24	18.5	18.02	9	50	4
Rb	209.67	205	101.31	44	387	15
Sr	94.33	69	86.84	16	304	15
Pb	31.13	18	24.76	11	84	15
Th	46.4	42.1	37.76	8.6	110	15
U	6.06	3	7.6	1.5	23	15
Zr	1875.6	1999	1155.24	223	3644	15
Nb	351.2	240	314.55	14	929	15
Y	212.07	181	163.05	29	532	15
La	254.56	309	167.59	47	637	15
Ce	513.32	675	299	93	964	15
Pr	-	-	-	-	-	-
Nd	257.47	274	106	86	455	10
Sc	3.36		5.24		20	14
V	12.73		38.86		153	15
Cr	3.73		5.93		25	15
Ni	8.8	7	6.94	4	21	5
Cu	16.47	12	16.24		63	15
Zn	285.67	260	170.6	42	642	15
Sn	20.8	9	27.01		68	5
Mo	4		3.46		9	4
Ga	43.8	41	15.63	19	65	15
As	2		-			4
S	0.01	0.01	0.01	01	0.05	10
F	0.21	0.06	0.37	0.02	1.19	10
Cl	-	-	-	-	-	-
Ag	1	1	-	1	1	1
Bi	2		-			1
Sb	2		-			1
Hf	60.56	52.5	35.49	11.9	110	10
Ta	28.43	22.4	23.64		65.5	13
Ge	1.5		-			2

Dougalls Tonalite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	66.39	67.4	6.66	51.9	74.4	11
TiO2	0.45	0.39	0.27	0.09	0.97	11
Al2O3	15.46	15.6	1.73	11.4	18.69	11
Fe2O3	1.16	1	0.54	0.21	1.98	11
FeO	3.15	2.14	2.01	0.57	7.48	11
MnO	0.06	0.04	0.04	05	0.14	10
MgO	1.91	1.66	1.78	0.25	6.87	11
CaO	5.05	4.62	2.28	1.92	10.9	11
Na2O	4.11	4.34	0.58	2.51	4.54	11
K2O	1.18	1.08	0.74	0.34	3	11
P2O5	0.1	0.1	0.05	05	0.17	11
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.25	0.11	0.39	10	1.05	6
LOI	0.55	0.51	0.34	0.09	1.15	11
Ba	510.91	519	253.86	196	1078	11
Li	14	14	-	14	14	1
Rb	28.09	31	15.38	2	55	11
Sr	336.82	294	171.29	79	707	11
Pb	6.71	7	1.8	4	10	7
Th	4.96	3.1	4.72		14.6	7
U	1.16		0.81		2.9	7
Zr	168.82	163	63.05	95	292	11
Nb	6.47	7	4.22		17	11
Y	19.31	15	23.18	5	79.2	9
La	17.17	17	9.52		37.7	11
Ce	30.55	27	15.71	9.6	64.1	11
Pr	5.65	5.65	3.32	3.3	8	2
Nd	14.01	11.69	11.33	4	35.1	6
Sc	8.2	5	7.26	2.3	20	7
V	60	50	58.26	6	216	11
Cr	45.73	25	84.73	3	298	11
Ni	21.5	13	27.79		100	11
Cu	18.45	7	29.69		103	11
Zn	47.82	45	22.75	11	87	11
Sn	2		-			7
Mo	1.57		0.98		3	7
Ga	17.91	17	2.63	15	25	11
As	2		-			7
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	0.5		-			6
Bi	2		-			6
Sb	2.33		0.82		4	6
Hf	2.4	2.4	2.26	0.8	4	2
Ta	1	1	-	1	1	1
Ge	1.5		-			7

Eastman Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	76.3	76.3	-	76.3	76.3	1
TiO2	0.07	0.07	-	0.07	0.07	1
Al2O3	12.8	12.8	-	12.8	12.8	1
Fe2O3	0.37	0.37	-	0.37	0.37	1
FeO	0.34	0.34	-	0.34	0.34	1
MnO	0.03	05	-	05	05	1
MgO	0.07	0.07	-	0.07	0.07	1
CaO	0.72	0.72	-	0.72	0.72	1
Na2O	4.4	4.4	-	4.4	4.4	1
K2O	5	5	-	5	5	1
P2O5	0.03	05	-	05	05	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	-	-	-	-	-	-
LOI	0.59	0.59	-	0.59	0.59	1
Ba	104	104	-	104	104	1
Li	8	8	-	8	8	1
Rb	303	303	-	303	303	1
Sr	23	23	-	23	23	1
Pb	42	42	-	42	42	1
Th	28	28	-	28	28	1
U	15	15	-	15	15	1
Zr	60	60	-	60	60	1
Nb	30	30	-	30	30	1
Y	58	58	-	58	58	1
La	14	14	-	14	14	1
Ce	27	27	-	27	27	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	1		-			1
V	3	3	-	3	3	1
Cr	2		-			1
Ni	1.5		-			1
Cu	2		-			1
Zn	11	11	-	11	11	1
Sn	4	4	-	4	4	1
Mo	-	-	-	-	-	-
Ga	15	15	-	15	15	1
As	-	-	-	-	-	-
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Fletcher Creek Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	74.91	76.1	2.95	69.7	76.65	5
TiO2	0.11	0.07	0.09	0.04	0.26	5
Al2O3	13.09	12.35	1.18	12.3	15	5
Fe2O3	0.6	0.62	0.22	0.29	0.91	5
FeO	0.83	0.78	0.3	0.5	1.33	5
MnO	0.05	0.05	0.02	05	0.08	5
MgO	0.5	0.5	0.44	06	1.21	5
CaO	1.79	1.24	1.06	1.07	3.62	5
Na2O	4.06	4.33	0.72	2.79	4.49	5
K2O	3.26	3.31	1.08	1.91	4.89	5
P2O5	0.03	05	0.02	05	0.07	5
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.37	0.34	0.31	10	0.76	4
LOI	0.33	0.21	0.23	0.17	0.72	5
Ba	865.6	842	206.22	596	1175	5
Li	-	-	-	-	-	-
Rb	74.6	47	63.02	41	187	5
Sr	93.2	108	39.32	44	142	5
Pb	14.75	16.5	3.86	9	17	4
Th	6.93	4	8.02		18.7	4
U	1.52		1.05		3.1	4
Zr	96	99	26.04	63	130	5
Nb	7.4	1	6.8		17	5
Y	39.04	35	33.32	6	94.2	5
La	14.04	13	9.7	6	30.2	5
Ce	24.76	22	17.98	10	54.5	5
Pr	6.5	6.5	-	6.5	6.5	1
Nd	16.8	16.8	17.26	4.59	29	2
Sc	1.4	1.4	-	1.4	1.4	2
V	7.1	5	8.49		22	5
Cr	6	5	4.8		11	5
Ni	3.7		3.01		7	5
Cu	3.4		1.95		6	5
Zn	40	30	19.24	21	67	5
Sn	2.75		1.5		5	4
Mo	1.25		0.5		2	4
Ga	18.8	19	1.1	17	20	5
As	2		-			4
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	1.13		1.25		3	4
Bi	2		-			4
Sb	2		-			4
Hf	4.3	4.3	-	4.3	4.3	1
Ta	-	-	-	-	-	-
Ge	1.5		-			4

Esaw Microgranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	74.97	75.9	1.96	72.72	76.3	3
TiO2	0.09	05	0.12	05	0.23	3
Al2O3	13.7	13.7	0.4	13.3	14.1	3
Fe2O3	0.39	0.36	0.21	0.2	0.61	3
FeO	0.73	0.4	0.85	0.1	1.7	3
MnO	0.06	05	0.06	05	0.13	3
MgO	0.21	05	0.31	05	0.57	3
CaO	0.44	0.27	0.35	0.2	0.84	3
Na2O	3.53	4.19	1.26	2.08	4.33	3
K2O	5.21	4.81	0.79	4.71	6.12	3
P2O5	0.04	05	0.03	05	0.08	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.06	0.06	-	0.06	0.06	2
LOI	0.75	0.7	0.19	0.59	0.96	3
Ba	132.5	37	193.33		355	3
Li	16	15	10.54	6	27	3
Rb	270.33	268	8.74	263	280	3
Sr	23.33	8	30.99	3	59	3
Pb	33.33	38	8.96	23	39	3
Th	16	16	13	3	29	3
U	4.97	4	3.65	1.9	9	3
Zr	62.67	39	45.39	34	115	3
Nb	16.67	16	8.02	9	25	3
Y	43.23	26	38.19	16.7	87	3
La	16.3	8	18.04	3.9	37	3
Ce	28.63	17	30.28	5.9	63	3
Pr	0.6	0.6	-	0.6	0.6	1
Nd	2.2	2.2	-	2.2	2.2	1
Sc	2.42	3	1.94	50	4	3
V	6.33		8.37		16	3
Cr	3		1.73		5	3
Ni	3.33		3.18		7	3
Cu	7		8.66		17	3
Zn	15	8	13.89	6	31	3
Sn	8	9	1.73	6	9	3
Mo	3		-			2
Ga	16.33	16	2.52	14	19	3
As	-	-	-	-	-	-
S	-	01	-	01	01	1
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	0.6	0.6	-	0.6	0.6	1
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Junda Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	74.6	74.6	-	74.6	74.6	1
TiO2	0.18	0.18	-	0.18	0.18	1
Al2O3	12.2	12.2	-	12.2	12.2	1
Fe2O3	0.46	0.46	-	0.46	0.46	1
FeO	1.16	1.16	-	1.16	1.16	1
MnO	0.05	0.05	-	0.05	0.05	1
MgO	0.17	0.17	-	0.17	0.17	1
CaO	1.24	1.24	-	1.24	1.24	1
Na2O	3.73	3.73	-	3.73	3.73	1
K2O	4.35	4.35	-	4.35	4.35	1
P2O5	0.03	05	-	05	05	1
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.63	0.63	-	0.63	0.63	1
LOI	1.24	1.24	-	1.24	1.24	1
Ba	837	837	-	837	837	1
Li	21	21	-	21	21	1
Rb	96	96	-	96	96	1
Sr	51	51	-	51	51	1
Pb	16	16	-	16	16	1
Th	15	15	-	15	15	1
U	2	2	-	2	2	1
Zr	214	214	-	214	214	1
Nb	18	18	-	18	18	1
Y	38	38	-	38	38	1
La	47	47	-	47	47	1
Ce	88	88	-	88	88	1
Pr	-	-	-	-	-	-
Nd	-	-	-	-	-	-
Sc	2	2	-	2	2	1
V	5	5	-	5	5	1
Cr	2		-			1
Ni	7	7	-	7	7	1
Cu	2		-			1
Zn	67	67	-	67	67	1
Sn	2		-			1
Mo	-	-	-	-	-	-
Ga	14	14	-	14	14	1
As	-	-	-	-	-	-
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Koongie Park Formation

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	75.51	75.75	3.16	69.9	79.6	8
TiO2	0.25	0.25	0.12	0.1	0.48	8
Al2O3	11.6	12.1	1.62	9.01	13.1	8
Fe2O3	1.59	1.01	1.98	0.33	6.38	8
FeO	1.36	1.31	0.87	0.14	2.99	8
MnO	0.04	05	0.03	05	0.11	8
MgO	0.97	0.4	1.71	0.05	5.17	8
CaO	1.86	1.39	2.17	05	7	8
Na2O	2.95	3.34	1.69	0.17	5.66	8
K2O	2.88	3.59	1.97	0.15	5.24	8
P2O5	0.03	05	-	05	05	8
H2O+	0.65	0.68	0.06	0.58	0.69	3
H2O-	0.07	10	0.03	10	0.1	3
CO2	0.23	0.23	0.12	0.1	0.48	8
LOI	1.29	0.96	0.8	0.65	2.64	5
Ba	500.5	650.5	297.75	56	779	8
Li	8.25	7	5.56		16	4
Rb	95.13	110	75.06	2	195	8
Sr	63.25	69.5	40.6	9	131	8
Pb	21	17	15.89		56	8
Th	16.6	16.5	3.1	11	20.6	8
U	3.7	3.5	1.56		6	8
Zr	282.38	245.5	171.99	114	587	8
Nb	18.5	13	9.61	12	38	8
Y	66.46	46.15	45.38	39	171	8
La	44.25	46.2	21.27		80	8
Ce	83.05	81.5	42.01	12	165	8
Pr	8.55	8.55	1.2	7.7	9.4	2
Nd	33.75	33.75	5.3	30	37.5	2
Sc	5.02	5.5	2.67	1.8	9	6
V	7.75	7	6.06		15	8
Cr	4.63	5	2.45		8	8
Ni	6.31	6	4.99		14	8
Cu	9.38		16.98		51	8
Zn	43.5	41	25.19	6	85	8
Sn	4	4	1.85		6	8
Mo	3		2		7	7
Ga	15.38	15	2.45	13	21	8
As	2.57		0.98		4	7
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	1	1	-	1	1	2
Bi	2		-			2
Sb	2		-			2
Hf	3.85	3.85	0.49	3.5	4.2	2
Ta	1.9		0.82		1	5
Ge	1.5		-			4

San Sou Monzogranite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	74.05	73.95	1.54	72.3	76	4
TiO2	0.18	0.16	0.09	0.09	0.31	4
Al2O3	13.65	13.7	0.26	13.3	13.9	4
Fe2O3	0.39	0.37	0.1	0.3	0.53	4
FeO	1.18	1.11	0.63	0.5	2.02	4
MnO	0.04	0.04	0.01	05	0.05	4
MgO	0.25	0.24	0.12	0.13	0.41	4
CaO	1.29	1.39	0.36	0.77	1.6	4
Na2O	3.15	3.22	0.53	2.53	3.61	4
K2O	4.89	4.84	0.37	4.5	5.39	4
P2O5	0.06	0.04	0.04	05	0.12	4
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.18	0.13	0.12	0.1	0.36	4
LOI	0.85	0.84	0.08	0.79	0.96	4
Ba	631.5	639	230.53	342	906	4
Li	30.5	34.5	14.8	11	42	4
Rb	172	173	8.12	162	180	4
Sr	64.5	63.5	19.74	42	89	4
Pb	35	33.5	5.72	30	43	4
Th	17.77	19.5	8.42	7.1	25	4
U	3.33	3.5	1.58	1.3	5	4
Zr	134.25	128.5	57.55	70	210	4
Nb	14	12.5	4.83	10	21	4
Y	29.08	27.5	15.75	12.3	49	4
La	32.6	28.5	21.82	12.4	61	4
Ce	54.9	48.5	39.44	17.6	105	4
Pr	1.8	1.8	-	1.8	1.8	1
Nd	7	7	-	7	7	1
Sc	2.81	3	1.95	50	5	4
V	11	11	5.72	4	18	4
Cr	4.25	4	2.06		7	4
Ni	1.5		-			4
Cu	2.5		1		4	4
Zn	30.25	33	11.5	14	41	4
Sn	4.25	4	2.06		7	4
Mo	3		-			4
Ga	14	14	0.82	13	15	4
As	-	-	-	-	-	-
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	0.6	0.6	-	0.6	0.6	1
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

Sophie Downs Granite

MEANS AND STANDARD DEVIATIONS

Element	Mean	Median	Standard Deviation	Minimum	Maximum	Number of Items
SiO2	76.3	75.97	0.89	75.62	77.3	3
TiO2	0.15	0.13	0.03	0.13	0.18	3
Al2O3	11.8	11.71	0.17	11.7	12	3
Fe2O3	0.51	0.49	0.15	0.37	0.67	3
FeO	0.94	1.01	0.41	0.49	1.31	3
MnO	0.02	02	0.01	05	0.02	3
MgO	0.13	0.17	0.09	05	0.18	3
CaO	0.42	0.41	0.06	0.37	0.49	3
Na2O	3.64	3.52	0.33	3.39	4.01	3
K2O	5.15	4.91	0.5	4.82	5.72	3
P2O5	0.02	0.01	0.01	05	0.01	3
H2O+	-	-	-	-	-	-
H2O-	-	-	-	-	-	-
CO2	0.14	0.14	-	0.14	0.14	1
LOI	0.53	0.55	0.07	0.45	0.58	3
Ba	908.67	794	220.61	769	1163	3
Li	9	9	-	9	9	1
Rb	125.67	136	24.21	98	143	3
Sr	40	38	16.09	25	57	3
Pb	17	17	-	17	17	1
Th	17	17	-	17	17	1
U	2	2	-	2	2	1
Zr	193.33	160	76.64	139	281	3
Nb	30.33	25	15.7	18	48	3
Y	65	74	26.66	35	86	3
La	51.75	51.75	13.08	42.5	61	2
Ce	130.53	112	57.49	84.6	195	3
Pr	-	-	-	-	-	-
Nd	59.2	59.2	43.56	28.4	90	2
Sc	2	2	1		3	3
V	3.17		2.47		6	3
Cr	2		-			3
Ni	2.67	2	1.15	2	4	3
Cu	8	6	4.36	5	13	3
Zn	64	64	44	20	108	3
Sn	4	4	-	4	4	1
Mo	-	-	-	-	-	-
Ga	17	16	2.65	15	20	3
As	-	-	-	-	-	-
S	-	-	-	-	-	-
F	-	-	-	-	-	-
Cl	-	-	-	-	-	-
Ag	-	-	-	-	-	-
Bi	-	-	-	-	-	-
Sb	-	-	-	-	-	-
Hf	-	-	-	-	-	-
Ta	-	-	-	-	-	-
Ge	-	-	-	-	-	-

