

GEOLOGICAL SURVEY OF CANADA



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A-TYPE GRANITES: DESCRIPTIVE AND GEOCHEMICAL DATA

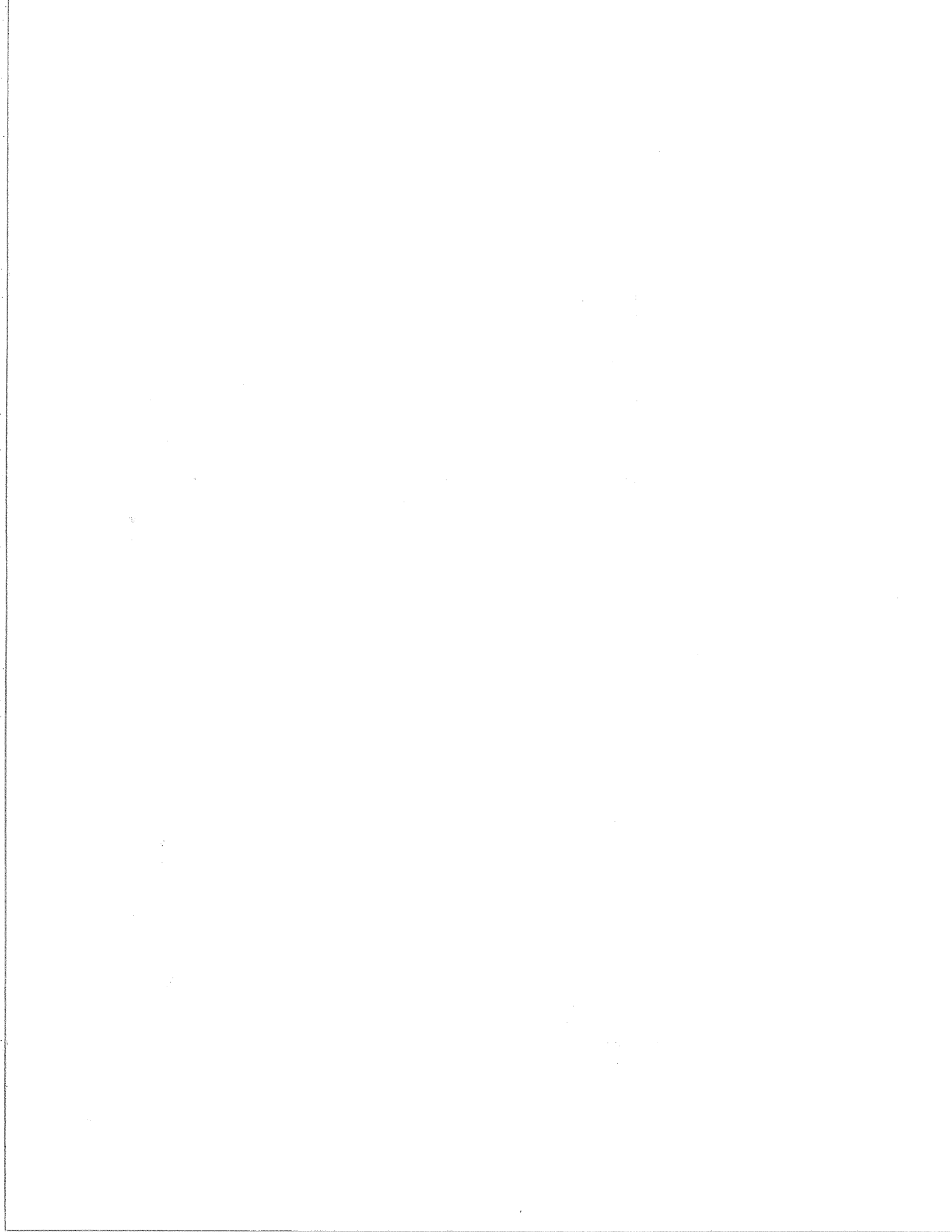
Joseph B. Whalen¹

Kenneth L. Currie¹

Bruce W. Chappell²

¹ Geological Survey of Canada, 601 Booth Street, Ottawa,
Canada K2P 1E7

² Department of Geology, The Australian National University,
G.P.O. Box 4, Canberra, A.C.T. 2600, Australia



This open file report is intended to make available supplementary material to a paper on A-type granites by Whalen et al. (in press). It consists of:

1. Large copies of geochemical discrimination diagrams with captions that are presented in Whalen et al. (in press).
2. Descriptions of the geochemical samples used for the study of A-type granites.
3. A tabulation of all the geochemical analyses obtained for the study of A-type granites.
4. A description of analytical techniques and precision.

The following is a key to symbols and abbreviations used in the report:

SUITES (S)

A-TYPE SUITES:

- | | | |
|--|---|---|
| <ol style="list-style-type: none"> 1. Topsails intrusive suite, Newfoundland 2. Seal Island Bight complex, Newfoundland 3. Saint Lawrence granite, Newfoundland 4. Welsford complex, New Brunswick 5. Shira complex, Nigeria 6. Evisa complex, Corsica 7. Mumbulla suite 8. Gabo suite 9. Monga suite 10. Danswell Creek suite 11. Wangrah suite 12. Yewrangara suite 13. Blackmans Creek suite 14. Spring Road suite 15. Burnt Hill suite 16. Ellery suite 17. Murrungowan suite |] | S.E. Australian
A-type granite
suites |
|--|---|---|

FRACTIONATED SUITES:

18. Ackley granite, Newfoundland - fractionated I-type granite
19. Sandy Cape granite, Tasmania - fractionated S-type granite

INTRUSIVE UNITS (U)

Topsails (suite 1):

1. peralkaline quartz-feldspar porphyry
2. cg. peralkaline amphibole granite
3. fg.-mg. subalkaline to peralkaline marginal phases of unit 2
4. cg. subsolvus bt-amph granite
5. granophyric aplite
6. quartz syenite to granite suite

Ackley (suite 18):

1. cg. K-feldspar megacrystic bt granite
2. mg.-cg. bt alaskite
3. granophyric aplite

ABBREVIATIONS

aeg - aegirine	cpx - clinopyroxene
aenig - aenigmatite	dk - dark
A.I. - agpaitic index	eq - equigranular
amph- amphibole	fg - fine grained
arf - arfvedsonite	mg - medium grained
bt - biotite	NA - not analyzed
cg - coarse grained	

Figure captions

FIGURE 1: $10000 \cdot \text{Ga}/\text{Al}$ versus $(\text{K}_2\text{O} + \text{Na}_2\text{O})$, $(\text{K}_2\text{O} + \text{Na}_2\text{O})/\text{CaO}$, FeO^*/MgO and $\text{K}_2\text{O}/\text{MgO}$ plots of various A-type granites and also, for comparison purposes, the fields of two fractionated felsic granites (dashed outlines) and I-, S- and M-type granites (rectangular boxes) (see averages in Table 1). The coordinates of the latter fields are X= 2.6, Y= A(8.5), B(10), C(16) and D(10).

Symbols used are:

- | | | |
|-----|---|---------------------------|
| (●) | Topsails suite | |
| (★) | Seal Island Bight granite | |
| (★) | St. Lawrence granite | |
| (▽) | Welsford complex | |
| (◇) | Shira complex, Nigeria | |
| (○) | Evisa complex, Corsica | |
| (X) | Ackley granite, fractionated I-type (?) granite | |
| (+) | Sandy Cape granite, fractionated S-type granite | } Lachlan
Fold
Belt |
| (▲) | Mumbulla suite | |
| (■) | Gabo suite | |
| (◆) | Other Lachlan A-type granites | |
| (□) | I-type granite average | |
| (□) | S-type granite average | |
| (○) | felsic I-type granite average | |
| (○) | felsic S-type granite average | |
| (□) | A-type granite average, this study | |
| (□) | M-type granite average from New Britain, P.N.G. | |

FIGURE 2: $10000 \cdot \text{Ga}/\text{Al}$ versus Zr, Nb, Ce, Y, Zn and agpaitic index plots of various A-type granites and also, for comparison purposes, the fields of two fractionated felsic granites (dashed outlines) and I-, S- and M-type granites (rectangular boxes). The coordinates of the latter fields are X= 2.6, Y= A(250), B(20), C(100), D(80), E(100) and F(0.85). Symbols as in Figure 1.

FIGURE 3: $10000 \cdot \text{Ga}/\text{Al}$ versus Zr and agpaitic index plots for various phases of the Topsails suite. Fields and symbols for various granites averages as in Fig.1, other symbols used are:

- | | | |
|-----|--|--|
| (▲) | quartz-K-feldspar porphyry | |
| (△) | coarse-grained amphibole granite | |
| (○) | hypersolvus fg-mg amphibole granite | } marginal phases
of the cg.
amphibole granite |
| (+) | hypersolvus fg-mg amphibole-biotite and
subsolvus biotite+/-amphibole granite | |
| (■) | quartz syenite to granite | |

FIGURE 4: $10000 \cdot \text{Ga}/\text{Al}$ versus Zr and agpaitic index plots comparing A-type granite data of this study with other published data. Fields and symbols for various granite averages as in Fig.1, other symbols used are:

- (●) all A-type granite data of this study except for Nigerian granites
 - (◇) Shira complex, Nigeria of this study
 - (△) subalkaline granites
 - (◆) peralkaline granites
 - (+) subsolvus granites
 - (x) hypersolvus non-alkaline granites
 - (■) peralkaline granites
-] representative Younger Nigerian granites of Imeokparia (1985)
- [anorogenic granites of the Davis Inlet-Flowers Bay area (Collerson 1982)

FIGURE 5: Zr + Nb + Ce + Y versus FeO^*/MgO and $(\text{K}_2\text{O} + \text{Na}_2\text{O})/\text{CaO}$ plots of A-type granites and also fields for fractionated felsic granites (FG) and unfractionated M-, I- and S-type granites (OGT). Coordinates of these fields are X= 350, Y= A(4 and 16) and B(7 and 28). Symbols as in Fig.1.

FIGURE 6: Zr + Ce + Y versus Rb/Ba plot for the Ackley, Sandy Cape and Topsails granite suites. Symbols as in Fig. 1.

FIGURE 7: Distribution of granite data of this paper on the Nb-Y and Rb- (Nb+Y) discrimination diagrams of Pearce et al. (1984). Fields for syn-collision (COLG), volcanic arc (VAG), within plate (WPG) and ocean ridge (ORG) granites are indicated; symbols as in

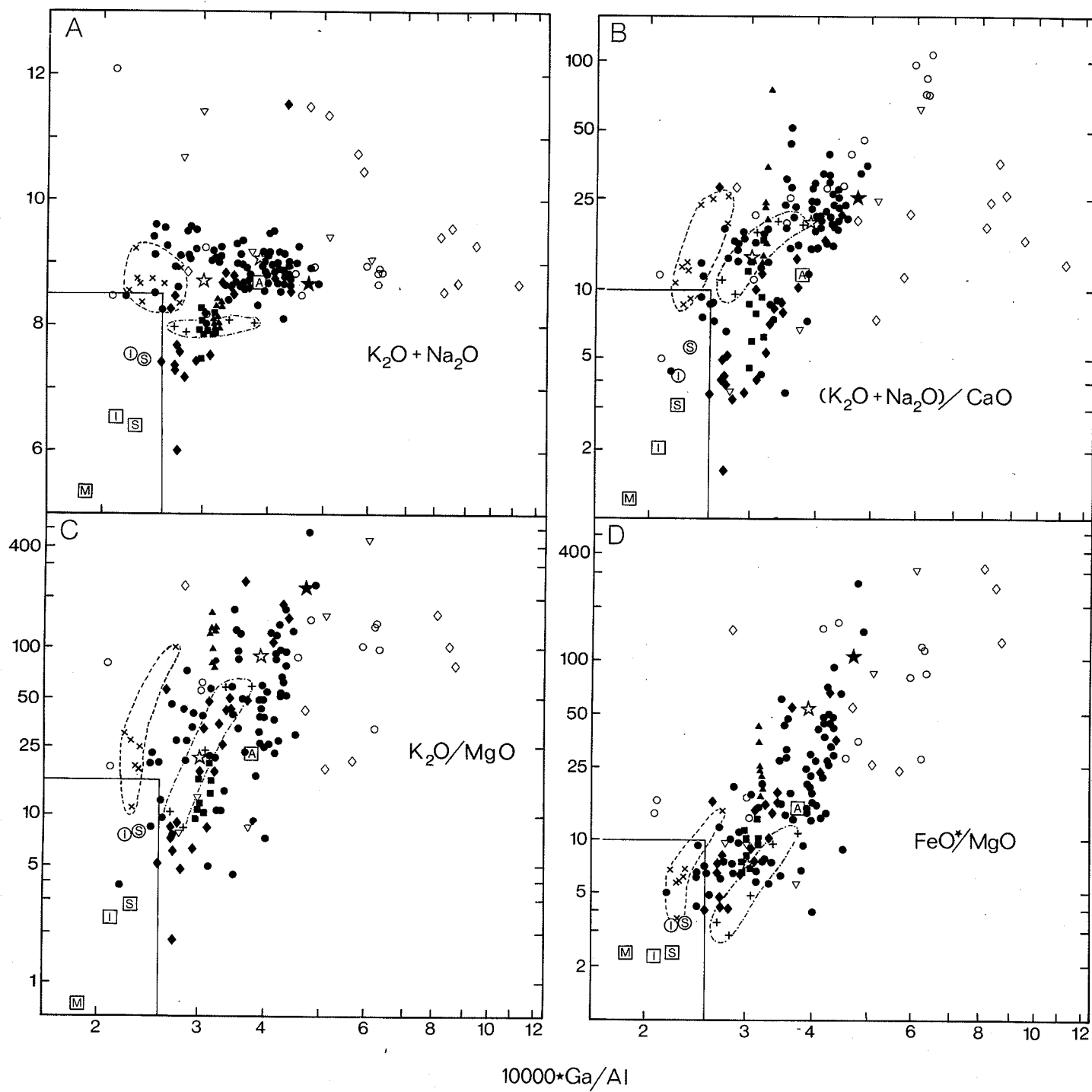


Fig.1

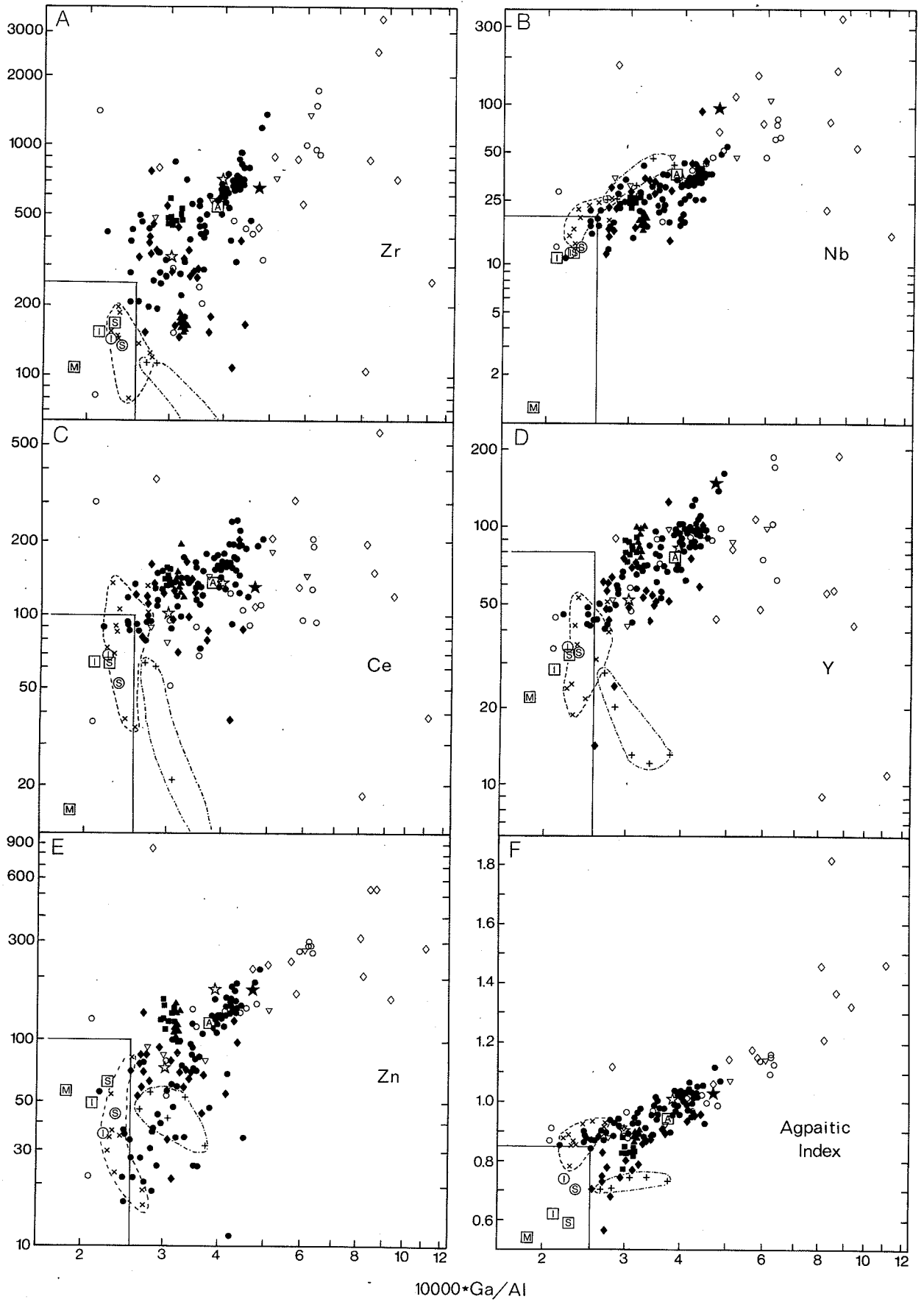


Fig.2

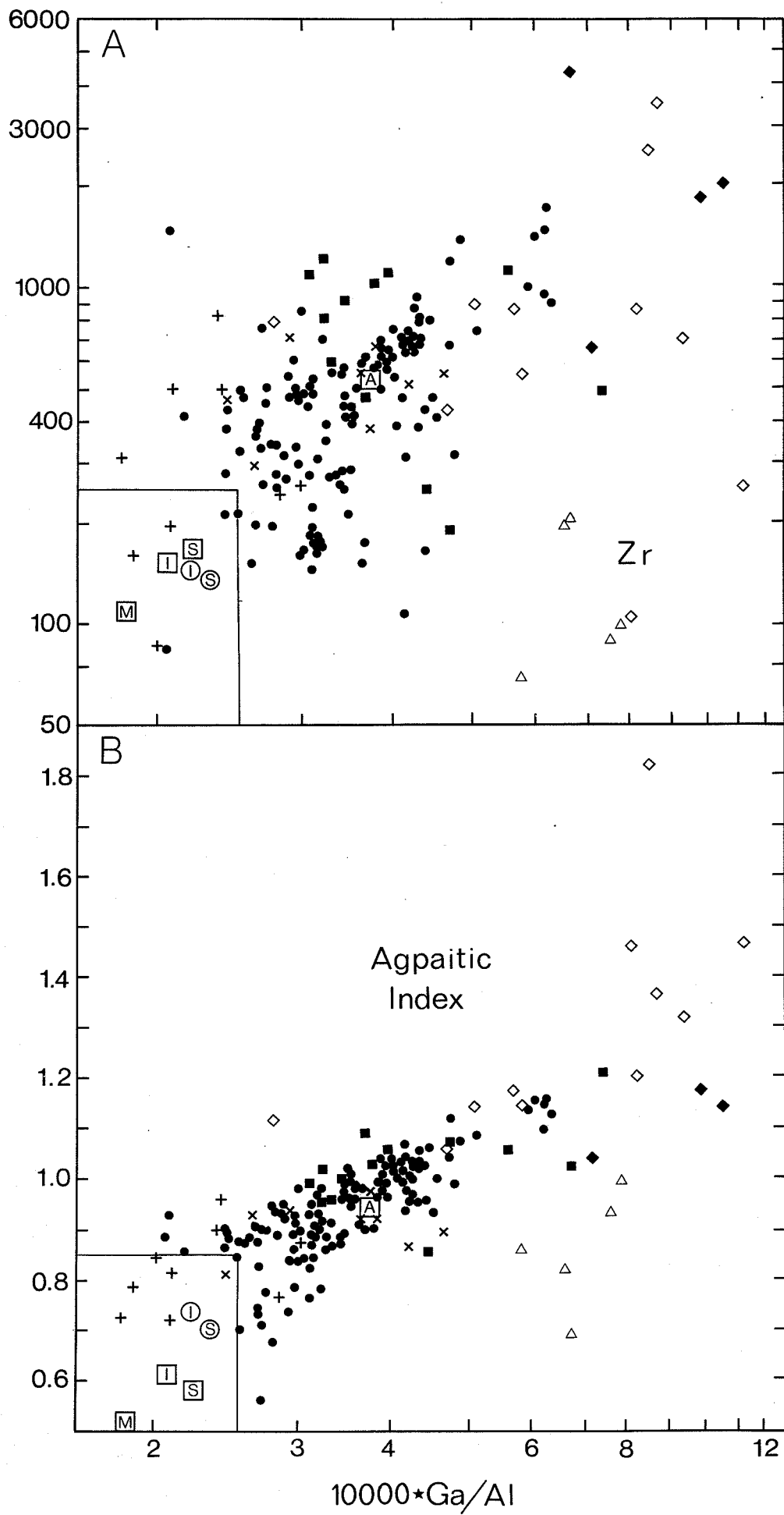


Fig. 3

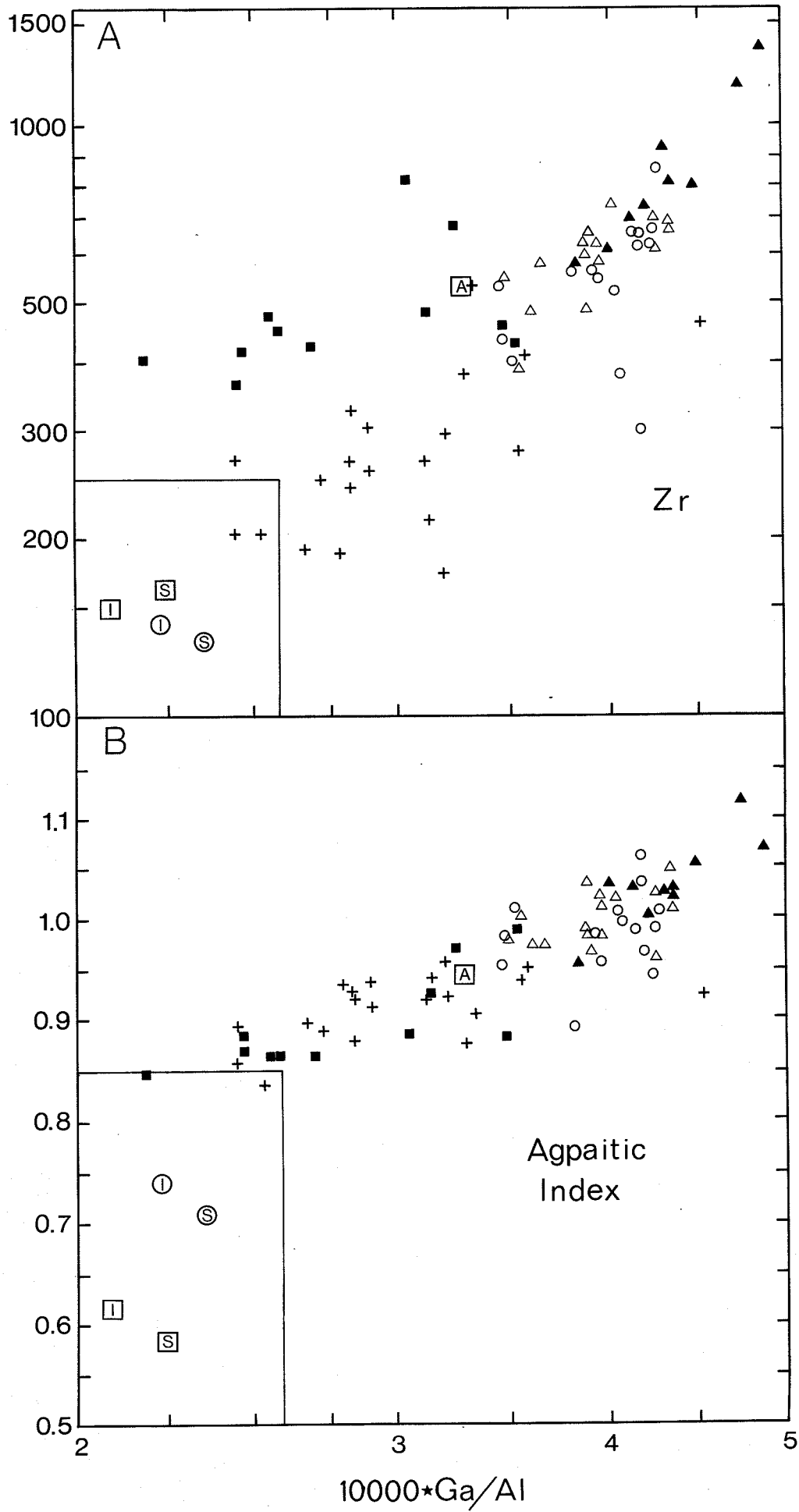


Fig.4

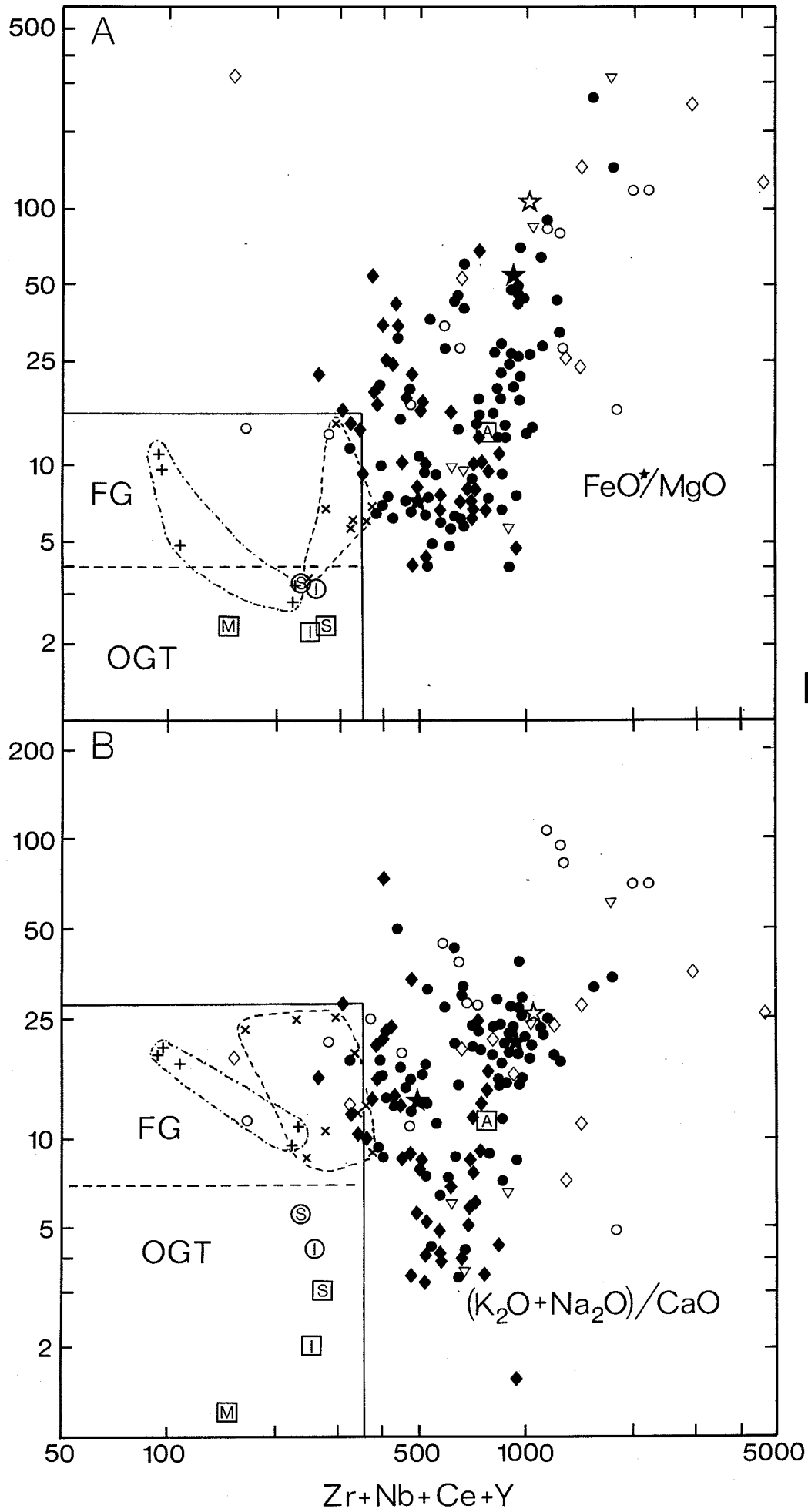


Fig. 5

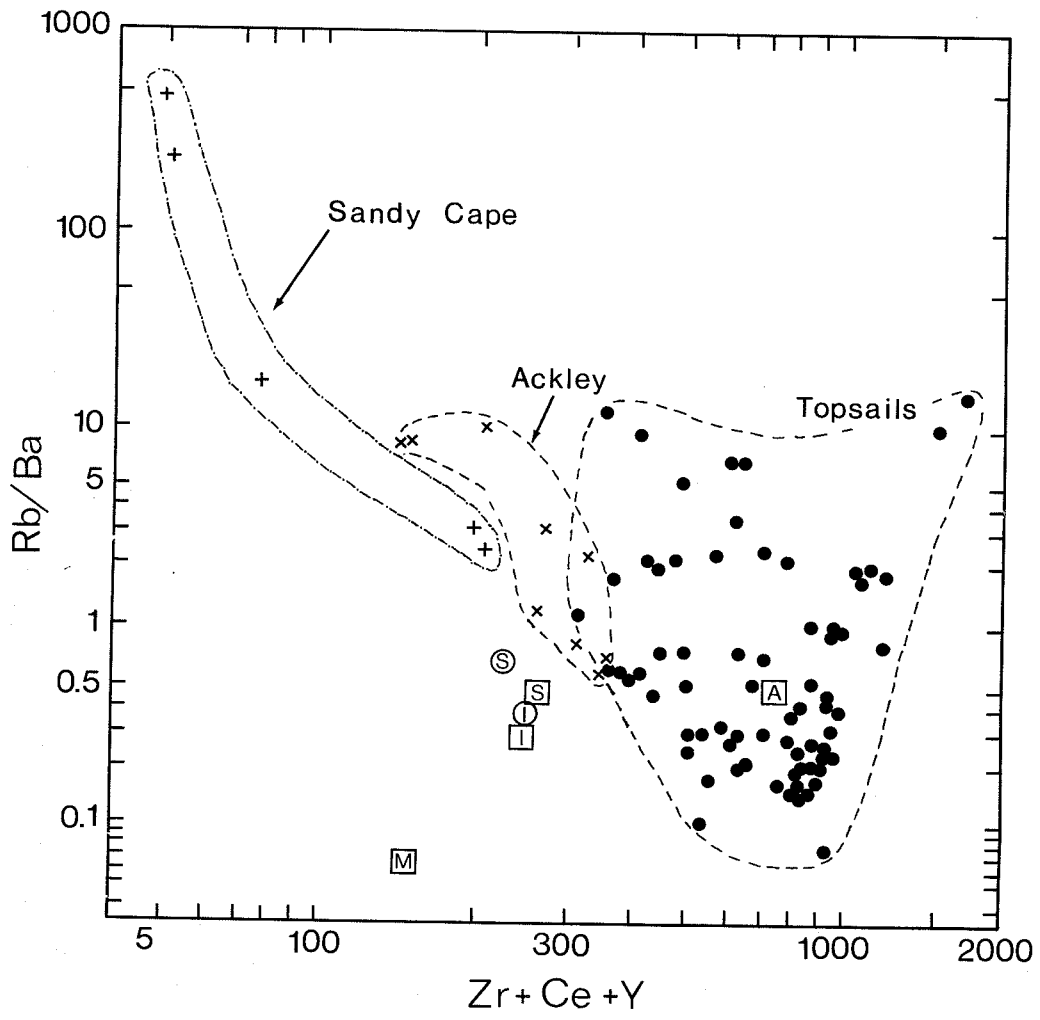


Fig.6

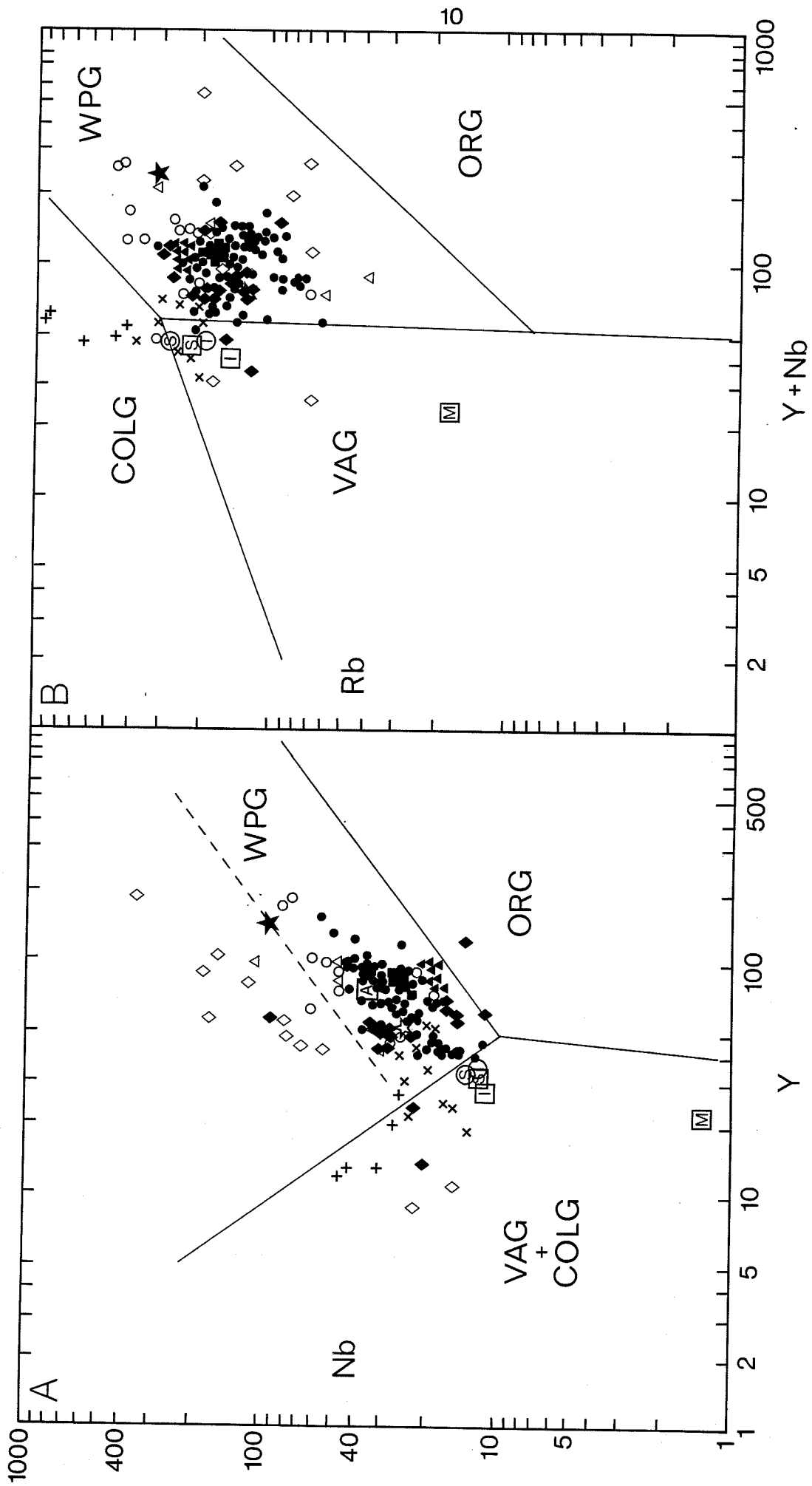


Fig. 7

DESCRIPTIONS OF ANALYZED SAMPLES			
Suite	Sample	Unit	Description
1	1	1	hypersolvus brown quartz-feldspar porphyry
1	5	1	hypersolvus red quartz-feldspar porphyry
1	8	1	hypersolvus red quartz-feldspar porphyry
1	46	1	hypersolvus greenish brown quartz-feldspar porphyry
1	73	1	hypersolvus red brown quartz-feldspar porphyry
1	90	1	hypersolvus dk green quartz-feldspar porphyry
1	92	1	hypersolvus green quartz-feldspar porphyry
1	93	1	hypersolvus green quartz-feldspar porphyry
1	94	1	hypersolvus green quartz-feldspar porphyry
1	118	1	hypersolvus dk red quartz-feldspar porphyry
1	47	2	cg red amph-cpx hypersolvus granite
1	62	2	cg red amph-cpx hypersolvus granite
1	83	2	cg red amph-cpx hypersolvus granite
1	95	2	mg white amph-cpx hypersolvus granite
1	108	2	cg white to pink amph-cpx hypersolvus granite
1	109	2	cg red amph-cpx hypersolvus granite
1	111	2	cg white amph-cpx hypersolvus granite
1	112	2	cg white amph-cpx hypersolvus granite
1	113	2	cg pink amph-cpx hypersolvus granite
1	115	2	cg cream amph-cpx hypersolvus granite
1	116	2	cg red amph-cpx hypersolvus granite
1	123	2	cg red amph hypersolvus granite, pegmatitic patches
1	129	2	cg green amph-cpx hypersolvus granite
1	130	2	cg pale beige amph-cpx hypersolvus granite
1	131	2	cg beige amph-cpx hypersolvus granite
1	137	2	cg white amph hypersolvus granite
1	6	3.1	mg red granophyric amph-cpx hypersolvus granite
1	7	3.1	mg white amph-cpx hypersolvus aplite
1	48	3.1	quartz-feldspar porphyritic amph hypersolvus granite dyke, cuts TB47
1	72	3.1	mg pale red to cream amph-cpx hypersolvus granite dyke
1	89	3.1	mg red amph-cpx hypersolvus granite, grades to porphyritic granite
1	99	3.1	mg medium pink amph-cpx-bt hypersolvus granite
1	101	3.1	mg pink amph-cpx-bt hypersolvus granite
1	103	3.1	cg red amph-cpx hypersolvus granite
1	125	3.1	mg light pink amph-cpx hypersolvus granite, pegmatitic patches
1	126	3.1	cg pink to orange amph hypersolvus granite
1	127	3.1	fg pale pink amph hypersolvus granite, intrudes cg amph granite (TB126)
1	134	3.1	cg red semiporphyritic (feldspar and amph) amph-cpx subsolvus granite
1	136	3.1	cg pale pink to red amph-cpx hypersolvus granite
1	81	3.2	mg pale pink amph-bt hypersolvus granite
1	84	3.2	cg red subporphyritic amph hypersolvus granite, mafic microxenoliths
1	65	3.3	fg plagioclase porphyritic amph-cpx-bt subsolvus granite
1	96	3.3	mg red amph-bt hypersolvus granite
1	97	3.3	cg red amph-bt hypersolvus granite
1	60	3.4	mg red equigranular bt hypersolvus granite
1	36	3.5	Kfeldspar porphyritic bt-amph subsolvus granite
1	37	3.5	fg pink Kfeldspar-quartz porphyritic bt subsolvus aplite, cuts TB38
1	38	3.5	mg pink microlitic bt subsolvus granite
1	39	3.5	cg red bt-amph subsolvus granite
1	57	3.5	mg red bt-amph subsolvus granite
1	69	3.5	mg pink bt-amph subsolvus granite
1	79	3.5	mg pink bt-amph subsolvus granite
1	85	3.5	mg red bt subsolvus granite
1	100	3.5	mg pale pink bt-amph subsolvus granite

DESCRIPTIONS OF ANALYZED SAMPLES

Suite	Sample	Unit	Description
1	104	3.5	cg scarlet red bt subsolvus granite
1	105	4	cg white bt-amph subsolvus granite
1	106	4	cg white eq bt-amph subsolvus granite
1	12	5	dk red granophyric chlorite-altered aplite
1	70	5	fg red microlitic aplite, chlorite altered mafics
1	74	5	red granophyric microlitic bt-amph hypersolvus aplite, chlorite-altered
1	138	5	pink to red granophyric bt-amph hypersolvus aplite, chlorite-altered
1	55	6	mg red amph-cpx quartz syenite, abundant mafic inclusions
1	124	6	red subporphyritic amph-cpx-bt quartz syenite, fg mafic inclusions
1	52	6	fg to patchy mg amph-bt subsolvus aplite, inclusion or dyke cutting TB54
1	54	6	mg red amph-bt subsolvus granite, inclusion rich
1	133	6	mg red amph-bt subsolvus granite
1	117	6	red subporphyritic (feldspars) bt-amph subsolvus granite
1	128	6	mg red subporphyritic (feldspar) amph hypersolvus granite
1	68	6	fg red amph-bt subsolvus granite
1	75	6	mg orange red quartz syenite
1	76	6	mg medium pink amph-bt subsolvus granite
1	82	6	mg orange quartz syenite
2	43		fg pale pink granite
2	44		mg white amph hypersolvus granite
3	139		mg feldspar porphyritic arf hypersolvus granite
4	100		fayalite syenite
4	19		fayalite syenite
4	78		arf granite
4	83		porphyritic syenite
4	745		arf granite
5	4		aeg-aenig granite
5	24		arf-bt granite
5	49		blue microgranite
5	59		aeg-arf pitchstone
5	25		arf syenite
5	51		aeg-arf-aeg syenite
5	5		arf-aeg granite
5	71		aeg microgranite
5	30		poikilitic arf-aeg granite
5	90		peralkaline microgranite
5	52		arf granite
6	5		fayalite granite
6	29		bt hypersolvus granite
6	42		barroisite granite
6	49		bt transsolvus granite
6	61		bt subsolvus granite
6	224		monzonite
6	175		arf granite
6	176		arf granite
6	186		arf-aeg albitic granite
6	187		arf-aeg albitic granite
6	4962		riebeckite hypersolvus granite
6	4963		riebeckite hypersolvus granite
6	4965		riebeckite-aeg albitic granite
6	4966		riebeckite-aeg albitic granite
6	4967		riebeckite-aeg albitic granite
7	4473		Mumbulla granite
7	4474		Mumbulla granite

DESCRIPTIONS OF ANALYZED SAMPLES		
Suite	Sample	Description
7	4475	Mumbulla granite
7	4476	Mumbulla granite
7	4477	Mumbulla granite
7	4478	Mumbulla granite
8	4479	Dr George Mountain granite
8	4480	Dr George Mountain granite
8	4464	Watergums granite
8	4465	Watergums granite
8	4466	Watergums granite
8	4467	Naghi granite
8	4468	Naghi granite
8	4469	Naghi granite
8	4470	Howe Range granite
8	4471	Howe Range granite
8	4472	Gabo Island granite
9	41923	Monga granite
9	40349	Monga granite
9	40348	Monga granite
9	40350	Monga granite
9	40347	Monga granite
10	18595	Danswell Creek granite
10	41925	Danswell Creek granite
11	18594	Wangrah granite
11	41926	Wangrah granite
11	18591	Wangrah granite
12	48343	Yewrangara granite
12	48342	Yewrangara granite
12	48323	Yewrangara granite
12	48344	Yewrangara granite
12	48345	Yewrangara granite
12	48325	Yewrangara granite
12	48324	Yewrangara granite
13	33392	Blackmans Creek granite
14	33390	Spring Road granite
15	33394	Burnt Hill granite
16	30243	Ellery granite
16	30245	Ellery granite
16	30244	Ellery granite
17	BG39	Murrungowar granite
17	30250	Murrungowar granite
18	462	1 K-feldspar megacrystic bt granite
18	494	1 K-feldspar megacrystic bt granite
18	495	1 K-feldspar megacrystic bt granite
18	499	1 K-feldspar megacrystic bt granite
18	468	2 cg eq bt alaskite
18	469	2 cg eq bt alaskite
18	154	2 cg eq bt alaskite
18	156	2 cg eq bt alaskite
18	AC6A	3 bt aplite
18	AC98	3 bt aplite
19	1753	Sandy Cape granite
19	1754	Sandy Cape granite
19	1755	Sandy Cape granite
19	1756	Sandy Cape granite

ANALYTICAL TECHNIQUES

Major element analyses were determined in the labs of the Geological Survey of Canada, Ottawa by X-ray fluorescence on duplicate glass buttons, except for duplicate analyses for Na_2O (atomic absorption spectrometry), FeO (titration against $\text{K}_2\text{Cr}_2\text{O}_7$), and volatiles (infra-red). F and Cl were determined in duplicate by fusion with lithium tetraborate followed by selective ion electrode analyses and colorimetric (thiocyanate) analysis, respectively. Trace elements were determined in duplicate in the Department of Geology, The Australian National University by B.W. Chappell by the X-ray fluorescence methods of Norrish and Chappell (1977). Relative percent standard deviation ($\text{SD} \times 100 / \text{Mean}$) on BCR-1 was 5 to 10 percent for Th, U and Ni; 1 to 5 percent for Pb, Sc, Nb, Ce and Cu; less than 1 percent for the other trace elements.

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1977: X-ray fluorescence spectrometry. in: Zussman J. (ed)
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- Whalen J.B., Currie, K.L. and Chappell B.W.
in press: A-type granites: geochemical characteristics,
discrimination and petrogenesis. Contributions to
Mineralogy and Petrology, accepted Jan 12, 1987

	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1
Sample	TB1	TB5	TB8	TB46	TB73	TB90	TB92	TB93	TB94
SiO2	75.00	74.65	75.65	74.00	75.10	76.20	76.75	75.70	76.25
TiO2	0.25	0.26	0.21	0.27	0.22	0.18	0.18	0.21	0.22
Al2O3	11.60	11.60	11.20	12.25	11.30	10.75	10.75	11.25	11.45
Fe2O3	1.66	1.14	1.09	0.90	1.03	1.72	1.29	1.41	1.29
FeO	1.10	1.70	1.60	2.00	1.65	1.30	1.50	1.40	1.40
MnO	0.07	0.08	0.07	0.10	0.07	0.07	0.06	0.07	0.07
MgO	0.19	0.21	0.09	0.18	0.08	0.02	0.01	0.03	0.04
CaO	0.43	0.41	0.38	0.46	0.48	0.25	0.28	0.35	0.39
Na2O	3.73	4.13	4.01	4.36	3.87	3.96	4.21	3.76	4.14
K2O	5.03	4.73	4.51	5.03	4.80	4.58	4.65	4.88	4.83
P2O5	0.01	0.03	0.01	0.02	0.03	<0.01	0.01	0.01	0.02
S	0.02	0.01	0.02	0.05	0.01	0.02	0.02	0.02	0.02
Cl	0.03	0.03	0.02	0.04	0.04	0.01	0.02	0.02	0.01
F	0.04	0.06	0.05	0.06	0.06	0.07	0.06	0.04	0.04
H2O	0.60	0.50	0.45	0.50	0.45	0.30	0.40	0.35	0.35
CO2	0.30	0.15	0.25	0.05	0.25	0.05	0.05	0.15	0.10
Total	100.06	99.69	99.61	100.27	99.44	99.48	100.24	99.65	100.62

Traces

Ba	135	120	74	115	82	14	18	70	72
Rb	122	112	120	108	138	193	170	133	130
Sr	21.5	17.5	11.0	15.5	18.5	3.0	5.0	8.0	8.0
Pb	22	18	19	20	25	37	31	23	24
Th	18.0	18.0	20.0	13.0	22.0	31.0	28.5	20.0	20.0
U	4.0	4.5	5.5	3.5	5.5	8.0	8.5	5.0	5.0
Zr	720	690	790	610	905	1340	1160	795	780
Nb	33	32	36	31	39	54	48	35	36
Y	86	82	92	79	105	159	135	108	96
Ce	191	191	190	176	189	200	189	217	184
Sc	<1	<1	<1	<1	<1	<1	<1	<1	<1
V	2	3	2	2	2	<1	<1	<1	1
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	2	2	1	3	3	2	2	2	2
Zn	143	130	138	129	170	215	186	135	144
Ga	26.0	25.5	26.0	26.0	26.0	28.0	27.0	26.0	27.0
Ga/Al	4.20	4.11	4.33	3.99	4.29	4.87	4.73	4.33	4.46
A.I.	1.00	1.03	1.02	1.03	1.02	1.07	1.11	1.02	1.05

S	1	1	1	1	1	1	1	1	1
U	1	2	2	2	2	2	2	2	2
Sample	TB118	TB47	TB62	TB83	TB95	TB108	TB109	TB111	TB112
SiO2	73.90	74.95	75.90	75.00	75.05	74.50	75.55	75.25	75.20
TiO2	0.23	0.22	0.16	0.20	0.20	0.21	0.16	0.19	0.23
Al2O3	12.15	12.15	12.25	11.95	11.90	12.65	12.45	11.90	11.65
Fe2O3	0.96	0.82	0.57	1.02	0.72	0.40	0.53	0.52	0.69
FeO	1.55	1.65	1.25	1.45	1.80	1.65	1.20	1.75	1.80
MnO	0.07	0.06	0.06	0.07	0.08	0.07	0.05	0.05	0.06
MgO	0.27	0.19	0.10	0.09	0.05	0.13	0.06	0.10	0.09
CaO	0.74	0.44	0.39	0.39	0.45	0.49	0.34	0.38	0.48
Na2O	4.15	4.42	4.16	4.42	3.91	4.32	4.35	4.30	4.14
K2O	4.38	4.65	4.69	4.61	4.62	4.89	4.92	4.70	4.69
P2O5	0.02	0.01	<0.01	0.02	0.02	0.03	0.01	0.03	0.01
S	0.01	0.01	0.01	0.01	0.02	0.01	0.01	<0.01	0.01
Cl	0.04	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02
F	0.09	0.07	0.10	0.08	0.09	0.08	0.09	0.09	0.10
H2O	0.60	0.35	0.30	0.45	0.40	0.35	0.30	0.40	0.35
CO2	0.15	0.05	0.05	0.20	0.05	0.15	0.05	0.10	0.20
Total	99.31	100.06	100.02	99.98	99.38	99.94	100.09	99.78	99.72

Traces

Ba	530	660	62	595	540	72	64	300	315
Rb	120	119	142	112	124	145	140	113	111
Sr	29.0	25.0	13.0	18.0	15.0	11.0	11.5	14.5	16.5
Pb	24	21	19	14	13	16	18	21	28
Th	21.0	17.5	21.5	17.5	19.5	15.5	12.5	15.0	20.5
U	4.0	4.0	5.5	4.0	5.5	4.5	3.0	4.0	5.0
Zr	575	590	484	625	695	555	387	580	735
Nb	34	31	36	32	36	30	23	25	32
Y	96	84	69	83	94	68	55	89	97
Ce	151	163	148	167	131	154	128	153	155
Sc	2	1	2	<1	<1	3	2	<1	1
V	8	4	<1	1	<1	1	1	4	3
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	2	1	<1	<1	<1	<1	<1	2	<1
Zn	127	117	81	149	177	83	80	124	124
Ga	25.0	25.5	23.5	27.0	27.0	23.5	23.5	25.0	25.0
Ga/Al	3.83	3.95	3.61	4.24	4.24	3.49	3.55	3.94	4.02
A.I.	0.95	1.01	0.97	1.03	0.96	0.98	1.00	1.02	1.02

S	1	1	1	1	1	1	1	1	1
U	2	2	2	2	2	2	2	2	3.1
Sample	TB113	TB115	TB116	TB123	TB129	TB130	TB131	TB137	TB6
SiO2	75.20	74.95	75.55	75.85	75.45	74.15	74.65	74.45	76.00
TiO2	0.22	0.28	0.19	0.20	0.23	0.25	0.22	0.19	0.13
Al2O3	11.90	12.10	11.50	11.80	11.95	12.05	12.00	11.80	11.95
Fe2O3	0.88	0.72	1.33	1.02	0.59	0.79	0.76	0.67	0.54
FeO	1.65	2.00	1.30	1.45	1.80	1.80	1.60	1.75	1.20
MnO	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.07	0.03
MgO	0.10	0.21	0.06	0.12	0.08	0.18	0.16	0.05	0.04
CaO	0.41	0.57	0.33	0.31	0.49	0.59	0.37	0.45	0.21
Na2O	4.38	4.06	4.36	4.02	4.11	4.25	4.08	4.24	4.14
K2O	4.71	4.70	4.51	4.43	4.61	4.53	4.74	4.55	4.86
P2O5	0.02	0.04	0.01	0.03	0.02	0.03	0.02	0.01	<0.01
S	0.01	0.01	0.01	0.01	<0.01	0.01	<0.01	0.02	0.02
Cl	0.02	0.01	0.06	0.04	0.02	0.02	0.03	0.02	0.02
F	0.09	0.06	0.14	0.04	0.06	0.06	0.08	0.11	0.07
H2O	0.40	0.45	0.45	0.45	0.40	0.40	0.50	0.30	0.40
CO2	0.15	0.05	0.05	0.25	0.20	0.30	0.20	0.25	0.35
Total	100.20	100.28	99.91	100.08	100.07	99.47	99.47	98.93	99.96

Traces

Ba	240	490	305	625	575	560	350	585	30
Rb	117	74	123	97	75	76	95	142	193
Sr	12.0	20.0	9.5	15.5	13.5	16.5	12.0	16.0	7.0
Pb	66	11	41	19	13	11	7	26	36
Th	14.0	9.5	15.0	17.0	9.5	9.0	12.0	19.5	27.5
U	2.5	2.0	3.5	5.0	2.5	2.5	2.5	5.0	7.0
Zr	610	585	690	660	630	630	487	665	399
Nb	24	18	25	30	18	17	19	36	25
Y	93	66	94	100	67	68	69	83	76
Ce	172	174	142	128	139	153	152	121	129
Sc	1	2	1	1	<1	2	<1	<1	<1
V	3	6	<1	2	1	3	3	<1	<1
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	<1	2	4	4	1	2	2	2	1
Zn	112	105	183	155	107	118	112	150	70
Ga	24.5	23.5	26.5	24.5	25.0	25.0	25.0	27.5	22.5
Ga/Al	3.87	3.66	4.32	3.90	3.93	3.87	3.88	4.33	3.53
A.I.	1.03	0.97	1.05	0.97	0.98	0.99	0.99	1.01	1.01

	1	1	1	1	1	1	1	1	1
S	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
U	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Sample	TB7	TB48	TB72	TB89	TB99	TB101	TB103	TB125	TB126
SiO2	76.30	76.95	76.85	74.50	73.50	75.25	75.50	75.35	74.75
TiO2	0.14	0.13	0.15	0.26	0.29	0.19	0.21	0.18	0.19
Al2O3	12.20	11.85	11.55	11.65	12.65	12.10	12.10	12.15	11.85
Fe2O3	0.91	0.40	1.41	1.03	1.07	0.80	0.88	0.77	0.82
FeO	0.95	1.25	0.80	1.70	2.10	1.40	1.60	1.45	1.40
MnO	0.04	0.04	0.02	0.07	0.10	0.06	0.07	0.04	0.04
MgO	0.03	0.04	0.03	0.06	0.20	0.12	0.11	0.08	0.11
CaO	0.30	0.28	0.31	0.31	0.48	0.57	0.55	0.37	0.30
Na2O	4.09	4.07	4.00	4.12	4.43	4.11	4.69	4.13	4.08
K2O	4.85	4.72	3.99	4.89	5.02	4.44	3.91	4.43	4.56
P2O5	0.01	0.02	<0.01	0.03	0.03	0.01	<0.01	0.01	0.01
S	0.01	0.01	<0.01	0.02	0.01	0.03	0.01	0.01	0.01
Cl	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.01
F	0.08	0.09	0.04	0.04	0.06	0.12	0.08	0.10	0.06
H2O	0.30	0.30	0.35	0.80	0.50	0.35	0.40	0.40	0.45
CO2	0.10	0.15	0.20	0.25	0.05	0.10	0.10	0.10	0.35
Total	100.32	100.32	99.73	99.75	100.51	99.67	100.23	99.59	98.99

Traces

Ba	32	215	455	135	135	470	385	520	625
Rb	209	148	103	118	88	160	85	131	88
Sr	3.0	8.0	20.0	8.0	18.5	26.5	29.5	10.0	10.0
Pb	38	21	4	20	16	22	21	19	13
Th	31.5	22.0	20.5	17.5	11.0	24.5	17.5	18.0	12.5
U	8.0	6.0	5.5	3.0	3.0	5.5	4.5	5.0	4.0
Zr	435	378	630	625	525	550	660	535	570
Nb	29	34	39	32	26	42	34	23	20
Y	77	94	125	86	61	101	98	94	86
Ce	127	160	169	236	125	154	161	160	156
Sc	<1	<1	<1	<1	1	1	1	2	1
V	<1	<1	<1	3	2	4	2	<1	2
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	2	2	<1	2	3	2	1	1	2
Zn	90	113	11	132	125	129	157	92	117
Ga	22.5	25.5	26.0	26.0	27.0	25.5	26.5	22.5	25.0
Ga/Al	3.48	4.06	4.22	4.16	4.03	3.94	4.12	3.46	3.91
A. I.	0.98	1.00	0.94	1.04	1.01	0.96	0.99	0.95	0.98

	1	1	1	1	1	1	1	1	1
S									
U	3.1	3.1	3.1	3.2	3.2	3.3	3.3	3.3	3.4
Sample	TB127	TB134	TB136	TB81	TB84	TB65	TB96	TB97	TB60
SiO2	77.00	75.30	75.40	76.85	72.90	72.95	74.10	74.45	74.90
TiO2	0.18	0.27	0.21	0.09	0.45	0.42	0.20	0.24	0.28
Al2O3	11.40	11.75	12.00	11.65	12.55	13.05	13.50	13.10	13.20
Fe2O3	1.64	1.27	0.78	0.72	1.82	0.96	0.70	0.56	0.39
FeO	0.85	1.90	1.65	0.80	1.45	1.65	0.85	1.20	1.20
MnO	0.04	0.10	0.09	0.03	0.05	0.05	0.03	0.05	0.03
MgO	0.05	0.07	0.09	0.04	0.47	0.46	0.16	0.23	0.18
CaO	0.23	0.47	0.57	0.27	1.15	1.18	0.54	0.70	0.46
Na2O	4.42	4.26	4.31	3.86	4.10	3.89	4.35	4.20	4.00
K2O	4.46	4.46	4.43	4.54	4.12	4.66	5.09	4.80	5.20
P2O5	0.01	0.02	<0.01	<0.01	0.09	0.06	0.02	0.03	0.02
S	0.01	0.03	0.04	<0.01	0.01	0.01	0.02	0.01	0.01
Cl	0.01	0.02	0.02	0.06	0.03	0.03	0.03	<0.01	0.02
F	0.06	0.08	0.10	0.11	0.06	0.07	0.08	0.06	0.06
H2O	0.30	0.40	0.40	0.30	0.55	0.40	0.45	0.40	0.50
CO2	0.15	0.15	0.25	0.05	0.10	0.05	0.25	0.05	0.10
Total	100.81	100.55	100.34	99.37	99.90	99.89	100.37	100.08	100.55

Traces

Ba	295	140	610	34	600	455	230	530	405
Rb	122	104	122	172	104	136	163	117	199
Sr	4.0	10.5	22.0	4.0	79	63	29.0	43.0	62
Pb	20	13	31	13	10	18	16	17	19
Th	17.5	22.0	19.0	23.5	21.0	21.5	34.0	21.0	39.5
U	5.0	5.0	5.0	7.5	5.0	5.5	7.5	4.0	7.5
Zr	655	845	665	304	565	380	308	301	462
Nb	25	40	34	42	33	26	24	24	36
Y	119	96	102	96	91	70	63	67	89
Ce	154	240	150	90	168	138	125	139	117
Sc	<1	1	<1	<1	4	4	2	2	2
V	<1	2	2	<1	18	24	3	7	7
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	<1	4	1	<1	9	5	<1	<1	3
Zn	143	138	152	67	46	73	24	58	33
Ga	25.0	26.5	27.0	26.0	25.5	23.0	21.0	22.5	31.5
Ga/Al	4.16	4.26	4.23	4.17	3.81	3.31	2.93	3.23	4.50
A.I.	1.06	1.01	0.99	0.97	0.89	0.88	0.94	0.92	0.92

	1	1	1	1	1	1	1	1	1
S									
U	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Sample	TB36	TB37	TB38	TB39	TB57	TB69	TB79	TB85	TB100
SiO2	76.10	76.15	74.15	74.70	73.45	74.25	75.35	73.65	74.45
TiO2	0.14	0.09	0.18	0.15	0.30	0.24	0.18	0.30	0.28
Al2O3	12.85	12.55	13.50	13.35	13.80	13.30	12.90	13.40	12.80
Fe2O3	0.47	0.16	0.27	0.36	0.61	0.57	0.40	0.71	0.61
FeO	0.90	1.05	1.30	0.95	1.15	0.95	1.00	1.00	1.00
MnO	0.04	0.02	0.03	0.03	0.03	0.02	0.03	0.02	0.03
MgO	0.09	0.06	0.08	0.13	0.28	0.20	0.12	0.26	0.24
CaO	0.53	0.50	0.61	0.59	0.73	0.67	0.49	0.69	0.73
Na2O	4.11	4.17	3.91	4.07	3.95	3.72	3.61	3.72	3.80
K2O	4.94	4.77	5.60	5.35	5.40	5.28	5.22	5.23	5.11
P2O5	0.02	<0.01	0.02	0.03	0.04	0.02	0.01	0.03	0.04
S	0.01	0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	0.02
Cl	0.03	0.02	0.02	0.02	0.02	0.06	0.08	0.02	0.02
F	0.10	0.19	0.15	0.10	0.08	0.09	0.06	0.08	0.08
H2O	0.45	0.40	0.45	0.60	0.50	0.45	0.45	0.55	0.45
CO2	0.15	0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.05
Total	100.93	100.24	100.37	100.54	100.46	99.93	99.96	99.71	99.71

Traces

Ba	100	26	120	125	385	340	190	360	270
Rb	204	301	219	205	210	174	204	171	187
Sr	21.5	4.5	18.5	21.5	45.0	38.0	23.0	48.0	34.0
Pb	23	32	26	25	17	14	23	11	27
Th	22.5	32.0	21.5	23.5	39.5	31.5	43.0	31.0	32.0
U	4.5	10.0	4.5	4.5	7.0	6.0	9.0	7.0	5.5
Zr	215	175	244	189	272	251	192	330	270
Nb	28	41	30	27	17	18	12	22	27
Y	68	77	55	49	45	47	40	57	64
Ce	136	96	145	126	91	91	76	112	117
Sc	2	1	3	2	3	3	2	3	2
V	2	<1	2	3	11	6	5	7	9
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	<1	<1	<1	2	2	<1	3	2	5
Zn	46	33	36	29	21	20	26	18	59
Ga	21.5	21.5	20.5	20.0	18.0	19.5	18.5	20.5	21.5
Ga/Al	3.17	3.22	2.86	2.82	2.46	2.75	2.69	2.86	3.14
A.I.	0.94	0.96	0.93	0.94	0.89	0.89	0.90	0.88	0.92

	1	1	1	1	1	1	1	1	1
	3.5	4	4	5	5	5	5	6	6
Sample	TB104	TB105	TB106	TB12	TB70	TB74	TB138	TB55	TB124
SiO2	74.80	75.30	74.60	77.10	75.05	74.15	76.50	67.70	67.15
TiO2	0.17	0.24	0.23	0.08	0.25	0.27	0.12	0.89	0.98
Al2O3	13.15	12.95	12.95	12.20	13.20	12.55	12.10	13.80	13.55
Fe2O3	0.48	0.23	0.37	0.94	0.64	1.26	1.09	1.20	1.77
FeO	1.05	1.45	1.25	0.70	0.70	1.05	0.85	3.80	4.05
MnO	0.03	0.05	0.05	0.02	0.02	0.04	0.01	0.12	0.14
MgO	0.14	0.24	0.25	0.05	0.18	0.30	0.04	0.86	0.92
CaO	0.56	0.96	0.92	0.17	0.62	0.94	0.42	2.20	2.49
Na2O	3.78	3.48	3.60	3.99	4.35	4.30	3.92	5.08	4.74
K2O	5.35	4.71	4.79	4.52	4.70	3.97	4.69	4.07	3.88
P2O5	0.02	0.05	0.04	<0.01	0.02	0.03	<0.01	0.25	0.26
S	0.02	0.02	0.01	0.01	0.01	<0.01	0.01	0.04	0.03
Cl	0.02	0.01	0.02	0.02	0.02	0.02	0.04	0.03	0.04
F	0.16	0.09	0.08	0.03	0.08	0.06	0.10	0.08	0.06
H2O	0.50	0.35	0.50	0.30	0.60	0.45	0.30	0.65	0.60
CO2	0.15	0.20	0.20	0.10	0.25	0.45	0.20	0.10	0.10
Total	100.38	100.33	99.86	100.23	100.69	99.84	100.39	100.87	100.76

Traces

Ba	115	325	305	18	320	605	56	460	410
Rb	238	176	171	156	135	92	182	87	74
Sr	15.0	62	61	13.0	75	39.0	19.0	152	150
Pb	27	20	20	9	13	6	15	15	14
Th	28.5	27.5	25.0	22.0	33.5	20.5	33.5	11.5	9.5
U	6.5	4.0	4.5	4.5	6.0	4.5	8.0	4.5	3.0
Zr	262	205	204	281	270	540	409	488	462
Nb	33	19	21	36	23	30	30	21	21
Y	66	43	41	52	58	83	89	57	60
Ce	148	130	115	71	107	132	118	106	112
Sc	3	4	3	<1	2	3	<1	9	9
V	1	7	7	1	6	13	<1	39	43
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	1	<1	1	2	1	2	1	5	5
Zn	42	32	34	24	36	33	24	98	116
Ga	20.5	17.5	17.0	23.0	20.0	22.5	23.0	23.0	25.0
Ga/Al	2.93	2.54	2.46	3.55	2.86	3.35	3.58	3.15	3.48
A. I.	0.91	0.84	0.86	0.94	0.93	0.91	0.95	0.92	0.89

	1	1	1	1	1	1	1	1	1
	6	6	6	6	6	6	6	6	6
Sample	TB52	TB54	TB133	TB117	TB128	TB68	TB75	TB76	TB82
SiO2	70.10	71.90	71.00	75.90	75.35	71.90	70.25	71.10	71.20
TiO2	0.58	0.41	0.62	0.30	0.19	0.46	0.46	0.49	0.29
Al2O3	14.70	12.95	13.45	11.55	12.20	13.75	14.60	14.15	14.30
Fe2O3	0.70	1.46	1.22	1.22	0.71	1.54	1.52	1.51	1.13
FeO	2.50	1.90	2.25	1.15	1.25	1.00	1.30	1.30	1.15
MnO	0.06	0.08	0.09	0.04	0.04	0.05	0.04	0.03	0.03
MgO	0.65	0.43	0.57	0.13	0.14	0.58	0.43	0.56	0.24
CaO	1.95	1.09	1.32	0.50	0.59	1.22	1.10	1.29	0.85
Na2O	6.04	4.79	4.37	3.08	4.45	4.32	4.37	4.09	4.05
K2O	2.35	4.36	4.13	4.80	4.41	4.73	5.05	5.11	5.38
P2O5	0.11	0.04	0.11	0.03	0.01	0.09	0.07	0.08	0.02
S	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.01
Cl	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.04	0.04
F	0.09	0.05	0.06	0.03	0.11	0.06	0.07	0.09	0.10
H2O	0.60	0.50	0.60	0.35	0.35	0.60	0.60	0.45	0.60
CO2	0.05	0.05	0.15	0.05	0.10	0.05	0.05	0.05	0.05
Total	100.51	100.07	99.98	99.16	99.93	100.38	99.95	100.35	99.44

Traces

Ba	620	985	640	475	495	550	530	500	500
Rb	59	70	101	135	130	150	130	147	136
Sr	132	62	135	63	30.5	87	91	89	70
Pb	15	12	15	17	17	19	7	8	8
Th	17.5	12.0	13.5	17.0	16.0	26.5	28.5	25.0	30.0
U	3.0	2.5	3.0	4.0	5.5	5.5	7.0	5.5	7.0
Zr	404	685	425	820	432	369	482	454	418
Nb	11	17	17	14	22	18	17	21	15
Y	45	69	41	42	82	48	43	50	41
Ce	87	168	91	86	109	89	89	84	84
Sc	8	4	8	2	2	5	5	6	3
V	40	16	15	7	5	23	18	23	4
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	4	4	3	1	<1	3	1	2	2
Zn	54	96	76	54	69	35	26	21	16
Ga	17.0	22.5	19.5	19.0	23.0	18.0	20.0	19.5	19.0
Ga/Al	2.18	3.26	2.72	3.07	3.54	2.46	2.57	2.60	2.48
A. I.	0.85	0.97	0.87	0.89	0.99	0.89	0.87	0.87	0.87

S	2	2	3	4	4	4	4	4	5
U									
Sample	TB43	TB44	TB139	100	19	78	83	745	4
SiO ₂	74.95	73.75	76.35	63.40	60.75	74.77	70.77	74.16	69.10
TiO ₂	0.24	0.22	0.13	0.69	0.87	0.16	0.38	0.20	0.46
Al ₂ O ₃	12.70	12.20	11.10	16.90	16.50	10.55	13.33	11.67	12.80
Fe ₂ O ₃	0.52	0.92	0.98	1.49	1.66	1.33	0.88	0.64	2.30
FeO	1.15	1.90	1.30	3.20	4.60	2.15	2.25	2.05	3.50
MnO	0.04	0.09	0.06	0.14	0.24	0.06	0.06	0.05	0.14
MgO	0.22	0.05	0.02	0.45	0.62	0.01	0.52	0.03	0.23
CaO	0.64	0.44	0.33	1.82	2.87	0.14	1.32	0.37	0.95
Na ₂ O	3.81	4.52	3.94	5.65	5.74	4.37	4.60	4.49	6.00
K ₂ O	4.81	4.42	4.64	5.74	4.84	4.53	4.46	4.80	4.78
P ₂ O ₅	0.03	0.01	<0.01	0.13	0.21	<0.01	0.06	<0.01	0.07
S	<0.01	0.06	0.02	<0.01	0.03	<0.01	<0.01	<0.01	0.01
Cl	<0.01	0.03	0.04	0.01	0.02	0.04	0.04	0.03	0.01
F	0.02	0.08	0.22	0.03	0.03	0.18	0.11	0.12	0.05
H ₂ O	0.50	0.40	0.40	0.60	0.60	0.50	0.50	0.50	0.40
CO ₂	0.45	0.15	0.20	0.20	0.15	0.20	0.05	0.35	<0.01
Total	100.08	99.24	99.73	100.45	99.73	98.99	99.33	99.46	100.80

Traces

Ba	270	615	34	400	555	14	230	28	375
Rb	135	118	311	60	40	319	188	180	145
Sr	47.5	11.5	7.0	67	96	2.0	62	4.5	43.5
Pb	20	17	29	7	5	32	18	17	36
Th	19.0	13.0	37.0	3.5	2.0	40.0	31.5	19.0	25.0
U	3.5	3.5	11.0	1.5	0.5	10.5	5.0	3.5	3.5
Zr	322	675	655	465	490	1370	600	725	865
Nb	24	33	97	32	36	109	48	48	154
Y	52	83	149	42	52	100	99	88	107
Ce	99	135	131	78	90	147	146	183	297
Sc	2	1	<1	8	10	<1	4	<1	3
V	7	<1	<1	4	10	<1	19	<1	3
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	2	<1	3	6	12	2	6	4	2
Zn	74	173	181	86	94	281	81	142	240
Ga	20.5	25.5	28.0	27.0	24.5	34.5	26.5	32.0	38.5
Ga/Al	3.02	3.89	4.71	3.01	2.77	6.06	3.70	5.10	5.70
A.I.	0.90	1.00	1.04	0.92	0.89	1.15	0.93	1.08	1.18

	S	S	S	S	S	S	S	S	S
U									
Sample	24	49	59	25	51	5	71	30	90
SiO2	71.50	72.60	73.10	64.00	63.90	75.00	70.50	75.60	70.40
TiO2	0.31	0.17	0.16	0.68	0.58	0.16	0.30	0.08	0.38
Al2O3	12.50	8.30	8.60	13.70	14.80	9.30	8.80	9.60	7.30
Fe2O3	3.40	3.90	5.10	3.20	3.80	2.40	4.50	2.60	8.70
FeO	0.60	4.70	1.80	4.50	3.60	3.60	5.90	1.60	2.50
MnO	0.09	0.16	0.14	0.23	0.19	0.10	0.17	0.06	0.21
MgO	<0.01	<0.01	0.05	0.28	0.13	<0.01	0.03	<0.01	0.04
CaO	0.48	0.66	0.32	1.52	0.56	0.35	0.50	0.56	0.26
Na2O	5.50	5.10	4.60	6.10	6.00	3.60	4.70	4.80	5.40
K2O	4.88	3.49	3.87	5.18	5.40	4.89	4.72	4.42	4.07
P2O5	0.03	0.04	0.03	0.14	0.32	0.02	0.01	0.04	0.01
S	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Cl	0.05	0.02	0.01	0.02	0.02	0.10	0.02	<0.01	0.01
F	0.10	0.25	0.19	0.08	0.05	0.18	0.31	0.06	0.09
H2O	0.40	0.30	0.50	0.50	0.80	0.40	0.60	0.40	0.50
CO2	<0.01	<0.01	0.30	0.10	<0.01	<0.01	<0.01	0.10	<0.01
Total	99.85	99.70	98.79	100.25	100.17	100.12	101.08	99.94	99.89
Traces									
Ba	68	28	38	610	195	20	24	38	42
Rb	126	67	203	82	68	179	176	155	199
Sr	6.5	17.0	22.0	41.0	13.0	2.0	5.0	4.0	8.0
Pb	20	2	55	17	11	16	5	12	5
Th	12.0	0.5	43.0	14.0	6.5	11.5	<0.5	8.0	5.5
U	2.5	1.0	12.0	3.5	1.5	3.0	<0.5	1.5	6.0
Zr	555	258	3530	890	437	865	104	710	2560
Nb	77	15	348	114	68	79	22	54	165
Y	48	11	190	82	44	56	9	42	57
Ce	131	38	560	206	108	196	18	121	150
Sc	<1	<1	<1	5	4	<1	<1	<1	<1
V	<1	<1	<1	7	<1	<1	<1	<1	1
Ni	<1	3	<1	2	<1	<1	<1	<1	<1
Cu	3	<1	<1	5	4	2	2	3	3
Zn	168	277	540	231	220	205	312	158	540
Ga	39.0	49.5	40.5	37.0	37.0	40.5	37.5	48.0	33.0
Ga/Al	5.85	11.17	8.70	5.08	4.69	8.18	8.06	9.39	8.48
A.I.	1.15	1.47	1.37	1.14	1.06	1.21	1.46	1.32	1.82

S	5	6	6	6	6	6	6	6	6
U									
Sample	52	5	29	42	49	61	224	175	176
SiO2	75.40	77.60	74.50	78.80	76.30	76.90	60.40	75.81	76.18
TiO2	0.19	0.10	0.16	0.08	0.10	0.06	0.55	0.11	0.04
Al2O3	10.50	12.00	12.60	12.20	12.10	12.80	17.50	11.75	12.02
Fe2O3	2.40	0.70	0.60	0.40	0.50	0.40	1.30	1.73	1.20
FeO	0.80	0.90	1.10	0.80	0.50	0.50	4.40	NA	NA
MnO	0.06	0.04	0.04	0.03	0.02	0.06	0.20	0.02	0.02
MgO	0.02	<0.01	0.09	<0.01	0.07	0.06	0.33	<0.01	0.03
CaO	0.31	0.44	0.81	0.34	0.37	0.72	2.34	0.31	0.19
Na2O	4.10	3.90	4.10	3.90	3.60	3.60	5.50	4.21	4.30
K2O	4.61	4.81	5.09	4.86	4.44	4.89	6.49	4.69	4.52
P2O5	0.03	0.02	0.03	<0.01	0.02	0.03	0.12	<0.01	<0.01
S	0.02	0.02	0.01	0.02	0.02	0.02	0.03	<0.02	<0.02
Cl	0.03	0.09	0.01	0.01	0.01	0.02	0.01	NA	NA
F	0.15	0.10	0.14	0.06	0.03	0.04	0.01	NA	NA
H2O	0.50	0.60	0.60	0.60	1.00	0.60	0.70	NA	NA
CO2	0.10	0.30	0.10	<0.01	0.70	0.10	0.10	NA	NA
Total	99.22	101.62	99.98	102.10	99.78	100.80	99.98	98.63	98.50

Traces

Ba	48	2	125	4	82	44	1530	16	10
Rb	70	159	211	162	246	317	71	215	269
Sr	7.5	1.5	24.5	0.5	18.0	15.0	83.0	3.0	4.0
Pb	29	13	24	13	26	30	15	141	48
Th	18.0	21.5	23.5	17.0	48.0	35.0	9.5	25.0	31.5
U	4.5	5.0	6.5	4.5	9.5	10.5	2.0	8.0	11.0
Zr	795	245	293	207	154	82	1420	476	322
Nb	180	23	23	19	26	13	29	40	54
Y	90	91	59	73	48	34	45	92	100
Ce	361	90	96	69	52	37	295	124	111
Sc	<1	<1	2	<1	<1	2	16	<1	0
V	<1	<1	4	<1	3	<1	2	<1	0
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	<1	<1	<1	<1	19	<1	2	<1	1
Zn	840	143	80	117	55	22	127	139	152
Ga	16.0	22.0	20.5	22.5	20.0	14.0	19.5	26.0	31.0
Ga/Al	2.83	3.48	3.05	3.53	3.06	2.07	2.09	4.12	4.80
A.I.	1.12	0.97	0.97	0.96	0.89	0.88	0.92	1.02	1.00

	6	6	6	6	6	6	6	7	7
S									
U									
Sample	186	187	4962	4963	4965	4966	4967	4473	4474
SiO2	74.88	74.98	77.05	76.36	75.23	75.23	75.35	77.00	76.84
TiO2	0.10	0.10	0.09	0.11	0.12	0.11	0.11	0.15	0.14
Al2O3	10.68	10.66	11.27	11.50	10.69	10.40	10.47	11.83	11.76
Fe2O3	3.89	3.66	1.31	1.47	3.37	2.99	3.01	0.40	0.38
FeO	NA	NA	0.29	0.36	0.80	0.95	0.95	1.05	0.95
MnO	0.04	0.04	0.02	0.03	0.05	0.04	0.04	0.04	0.03
MgO	0.04	0.04	0.05	<0.01	0.13	0.03	0.03	0.04	0.03
CaO	0.08	0.09	0.21	0.30	0.10	0.12	0.12	0.61	0.56
Na2O	4.72	4.67	3.94	4.22	4.30	4.52	4.67	3.06	3.06
K2O	4.01	4.17	4.46	4.51	4.32	4.29	4.10	4.98	4.86
P2O5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02
S	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	NA	NA	NA	NA	NA	NA	NA	NA	NA
H2O	NA	NA	0.18	0.14	0.18	0.01	0.00	0.65	0.76
CO2	NA	NA	NA	NA	NA	NA	NA	0.07	0.20
Total	98.44	98.41	98.87	99.00	99.29	98.69	98.85	99.90	99.59

Traces

Ba	10	4	10	12	6	6	10	655	645
Rb	362	429	232	257	423	475	444	230	229
Sr	3.0	5.5	3.0	2.5	4.0	10.0	10.5	50	53
Pb	13	50	48	32	72	55	54	33	36
Th	51.0	33.5	28.0	27.0	35.0	73.0	87.0	21.8	25.9
U	23.0	11.0	9.0	9.4	12.6	15.6	15.2	5.1	5.5
Zr	920	1020	417	441	976	1751	1514	187	176
Nb	64	48	48	44	63	84	77	18	19
Y	63	76	91	94	104	174	190	100	87
Ce	95	96	92	106	129	194	208	132	150
Sc	<1	<1	<1	<1	<1	<1	<1	12	13
V	<1	<1	<1	<1	<1	<1	<1	2	3
Ni	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cu	1	<1	3	3	<1	<1	2	8	9
Zn	269	272	145	138	296	291	300	106	112
Ga	36.5	34.0	27.5	27.0	35.5	35.0	35.0	20.0	20.0
Ga/Al	6.36	5.93	4.55	4.39	6.22	6.28	6.25	3.19	3.21
A. I.	1.13	1.14	1.00	1.03	1.10	1.16	1.16	0.88	0.88

S	7	7	7	7	7	7	8	8	8
U									
Sample	4475	4476	4477	4478	4479	4480	4464	4465	4466
SiO2	77.51	77.77	77.14	77.12	77.00	77.33	72.06	73.34	73.60
TiO2	0.14	0.12	0.13	0.12	0.12	0.12	0.38	0.36	0.34
Al2O3	11.76	11.49	11.91	11.79	11.78	11.99	12.43	12.58	12.44
Fe2O3	0.27	0.34	0.32	0.40	0.14	0.65	1.61	1.38	1.42
FeO	1.04	0.89	0.77	0.64	1.14	0.34	1.55	1.66	1.49
MnO	0.03	0.03	0.03	0.02	0.05	0.02	0.08	0.10	0.08
MgO	0.05	0.06	0.06	0.04	<0.01	0.04	0.40	0.42	0.27
CaO	0.34	0.38	0.50	0.34	0.11	0.24	0.93	0.99	1.24
Na2O	3.04	3.01	3.14	3.07	3.10	3.15	3.94	3.58	3.53
K2O	4.94	4.87	4.91	5.12	5.16	5.19	4.13	4.21	4.23
P2O5	0.02	0.02	0.01	0.02	0.01	0.02	0.09	0.09	0.07
S	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	NA	NA	NA	NA	NA	NA	NA	NA	NA
H2O	0.76	0.60	0.91	1.11	0.51	0.70	1.22	1.28	0.90
CO2	0.18	0.12	0.12	0.14	0.69	0.10	0.83	0.11	0.14
Total	100.08	99.70	99.95	99.93	99.81	99.89	99.65	100.10	99.75
Traces									
Ba	640	555	575	520	510	500	725	875	710
Rb	232	242	255	248	240	261	159	168	201
Sr	43.5	43.0	45.0	37.5	31.0	37.5	95	187	142
Pb	37	35	36	48	32	38	22	29	31
Th	26.8	24.0	25.2	25.7	25.1	26.9	19.7	19.8	22.3
U	5.6	5.4	5.8	5.6	4.7	5.3	5.0	5.2	6.0
Zr	173	159	169	171	165	163	460	465	472
Nb	20	17	19	19	19	21	25	25	28
Y	84	79	77	94	100	99	79	84	83
Ce	134	124	120	130	119	196	132	136	136
Sc	13	14	12	13	13	13	15	15	15
V	2	2	2	2	2	2	8	6	5
Ni	<1	1	<1	1	1	1	1	<1	2
Cu	5	9	12	17	7	8	4	4	5
Zn	116	135	101	151	138	118	125	123	121
Ga	20.0	19.8	20.4	20.2	20.6	20.6	20.2	20.8	21.2
Ga/Al	3.21	3.26	3.24	3.24	3.30	3.25	3.07	3.12	3.22
A.I.	0.88	0.89	0.88	0.90	0.91	0.90	0.88	0.83	0.83

S	8	8	8	8	8	8	9	9	9
U									
Sample	4467	4468	4469	4470	4471	4472	41923	40349	40348
SiO2	73.62	73.13	73.71	71.46	73.34	73.06	62.09	71.30	70.95
TiO2	0.38	0.39	0.35	0.42	0.37	0.37	1.25	0.50	0.50
Al2O3	12.72	12.66	12.59	12.87	12.77	12.54	14.74	13.20	13.17
Fe2O3	1.99	1.96	1.67	1.40	1.74	1.47	1.80	1.27	1.61
FeO	0.82	1.33	1.20	2.67	1.26	1.60	6.10	2.63	2.28
MnO	0.04	0.07	0.08	0.14	0.07	0.08	0.12	0.06	0.05
MgO	0.20	0.32	0.26	0.35	0.43	0.36	1.60	0.49	0.46
CaO	0.83	0.47	0.59	1.61	0.65	1.29	3.73	1.77	1.46
Na2O	3.62	3.87	3.78	3.60	3.77	3.59	3.17	3.17	3.48
K2O	4.11	4.21	4.16	3.73	4.04	4.15	2.85	4.21	4.16
P2O5	0.08	0.08	0.07	0.10	0.08	0.08	0.46	0.12	0.11
S	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	NA	NA	NA	NA	NA	NA	NA	NA	NA
H2O	1.02	1.09	1.25	1.13	0.90	0.93	1.68	1.00	1.32
CO2	0.29	0.17	0.16	0.28	0.56	0.15	0.07	0.08	0.18
Total	99.79	99.75	99.87	99.76	99.98	99.67	99.69	99.80	99.73

Traces

Ba	745	740	735	920	720	730	570	605	725
Rb	166	165	172	136	165	169	127	187	181
Sr	161	123	127	205	146	150	177	112	110
Pb	30	27	30	27	29	31	22	21	19
Th	20.1	20.1	19.8	19.6	20.2	20.0	15.2	27.0	28.0
U	5.6	5.5	5.3	4.7	5.3	5.3	3.0	5.0	4.8
Zr	496	520	484	589	457	464	765	386	453
Nb	27	27	25	24	25	25	17	15	17
Y	81	91	87	73	89	78	60	56	63
Ce	135	141	154	156	140	137	103	120	162
Sc	15	16	15	17	15	15	22	11	11
V	7	7	6	6	7	6	79	16	15
Ni	<1	<1	1	2	2	<1	11	5	3
Cu	5	5	4	4	4	4	18	8	7
Zn	139	142	149	157	125	112	136	79	85
Ga	21.6	21.6	20.4	20.8	20.4	20.4	21.2	18.8	19.2
Ga/Al	3.21	3.22	3.06	3.05	3.02	3.07	2.72	2.69	2.75
A. I.	0.82	0.86	0.85	0.77	0.83	0.83	0.56	0.74	0.78

S	9	9	10	10	11	11	11	12	12
U									
Sample	40350	40347	18595	41925	18594	41926	18591	48343	48342
SiO ₂	71.02	76.38	70.16	70.97	76.17	75.33	76.70	72.06	73.29
TiO ₂	0.50	0.18	0.55	0.49	0.13	0.15	0.08	0.25	0.20
Al ₂ O ₃	13.04	12.14	13.58	13.16	12.58	12.61	12.47	13.21	13.03
Fe ₂ O ₃	1.51	0.81	0.98	0.86	0.30	0.34	0.64	0.56	0.43
FeO	2.36	0.78	3.40	2.90	1.21	1.10	0.53	1.92	1.69
MnO	0.06	0.02	0.11	0.08	0.04	0.03	0.03	0.05	0.06
MgO	0.55	0.09	0.63	0.50	0.10	0.15	0.02	0.15	0.12
CaO	1.82	0.29	2.09	1.82	0.66	0.80	0.63	1.20	1.02
Na ₂ O	3.15	3.16	3.55	3.40	3.31	3.22	3.61	3.50	3.53
K ₂ O	4.19	5.13	3.91	4.16	4.83	4.98	5.07	5.22	5.14
P ₂ O ₅	0.11	0.05	0.18	0.16	0.05	0.05	0.01	0.04	0.03
S	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	NA	NA	NA	NA	NA	NA	NA	NA	NA
H ₂ O	1.22	0.87	0.75	0.67	0.43	0.55	0.13	0.72	0.62
CO ₂	0.08	0.02	0.05	0.11	0.28	0.17	0.07	0.01	0.16
Total	99.61	99.92	99.94	99.28	100.09	99.48	99.99	98.89	99.32

Traces

Ba	640	650	500	520	135	195	46	685	545
Rb	183	230	149	158	302	269	202	136	147
Sr	110	34.5	135	122	36.0	49.0	13.0	112	88
Pb	21	30	22	21	30	30	28	20	20
Th	24.0	22.0	16.0	21.0	24.5	24.0	33.0	25.0	29.5
U	5.0	4.2	4.0	3.8	11.2	5.6	4.8	2.4	4.8
Zr	379	152	545	445	146	163	152	350	281
Nb	15	12	25	23	21	17	14	36	34
Y	60	61	75	72	88	70	125	56	54
Ce	119	82	127	125	70	98	79	171	141
Sc	11	5	17	13	6	6	4	NA	NA
V	17	2	20	17	3	4	0	5	3
Ni	4	<1	4	2	2	<1	<1	1	1
Cu	7	9	9	1	5	<1	<1	<1	<1
Zn	85	53	92	80	21	33	44	72	73
Ga	18.6	17.0	21.2	21.8	21.0	20.6	24.2	23.0	23.4
Ga/Al	2.70	2.65	2.95	3.13	3.15	3.09	3.67	3.29	3.39
A.I.	0.75	0.89	0.74	0.77	0.85	0.85	0.92	0.86	0.87

	S	12	12	12	12	12	13	14	15	15
U										
Sample	48323	48344	48345	48325	48324	33392	33390	33394	30243	
SiO2	73.46	72.33	74.09	74.73	76.69	76.83	70.01	67.63	70.80	
TiO2	0.20	0.18	0.17	0.12	0.06	0.08	0.49	0.13	0.39	
Al2O3	13.12	13.70	12.76	12.69	12.60	11.98	14.01	16.63	14.15	
Fe2O3	0.54	0.52	0.63	0.34	0.34	0.84	1.00	1.51	0.90	
FeO	1.54	1.41	1.30	1.09	0.62	0.33	2.38	0.72	2.57	
MnO	0.05	0.06	0.05	0.03	0.03	0.03	0.07	0.09	0.06	
MgO	0.12	0.18	0.10	0.10	0.04	0.03	0.52	0.03	0.77	
CaO	1.09	1.02	0.95	0.82	0.54	0.39	1.69	0.46	1.85	
Na2O	3.72	4.06	3.43	3.73	4.16	3.87	4.24	6.04	3.03	
K2O	5.13	4.83	5.13	4.94	4.60	4.74	4.27	5.50	4.70	
P2O5	0.03	0.04	0.03	0.02	<0.01	<0.01	0.12	<0.01	0.15	
S	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA	
F	NA	NA	NA	NA	NA	NA	NA	NA	NA	
H2O	0.45	0.86	0.85	0.57	0.61	0.43	0.64	0.44	0.66	
CO2	0.03	0.01	0.16	0.01	0.02	0.22	0.22	0.36	0.01	
Total	99.48	99.20	99.65	99.19	100.31	99.77	99.66	99.54	100.04	
Traces										
Ba	515	360	490	280	58	45	430	35	600	
Rb	152	137	144	181	284	176	134	97	194	
Sr	86	78	82	50	13.5	9.0	109	11.5	161	
Pb	21	22	21	22	32	23	16	10	26	
Th	27.5	24.0	25.5	30.0	38.5	23.5	17.8	17.2	19.4	
U	1.8	5.4	4.2	3.2	6.6	3.4	3.0	3.4	3.4	
Zr	287	275	263	176	107	165	390	382	336	
Nb	33	32	31	29	43	44	23	93	31	
Y	51	43	50	51	75	100	48	58	43	
Ce	136	98	126	86	37	88	114	202	116	
Sc	5	NA	NA	2	1	<1	7	2	10	
V	3	3	3	2	<1	<1	24	<1	19	
Ni	<1	<1	<1	<1	<1	<1	2	<1	4	
Cu	1	<1	<1	4	<1	3	3	3	3	
Zn	70	59	65	68	55	97	60	125	70	
Ga	24.0	24.2	23.2	24.8	27.5	27.8	20.0	37.8	20.4	
Ga/Al	3.46	3.34	3.44	3.69	4.12	4.38	2.70	4.29	2.72	
A.I.	0.89	0.87	0.88	0.90	0.94	0.96	0.83	0.96	0.71	

S	16	16	17	17	18	18	18	18	18
U					1	1	1	1	2
Sample	30245	30244	BG39	30250	462	494	495	499	488
SiO2	71.92	73.01	69.67	69.85	73.89	74.01	75.35	71.78	76.12
TiO2	0.24	0.20	0.59	0.52	0.26	0.25	0.24	0.32	0.12
Al2O3	13.54	13.45	13.83	13.77	12.98	13.37	12.48	14.50	12.50
Fe2O3	0.64	0.74	0.56	0.72	0.89	0.74	0.66	0.96	0.34
FeO	2.17	1.65	3.44	3.14	0.67	0.52	0.59	0.79	0.59
MnO	0.06	0.05	0.05	0.05	0.03	0.04	0.05	0.05	0.03
MgO	0.27	0.28	0.93	0.91	0.21	0.20	0.17	0.45	<0.01
CaO	1.52	1.44	2.10	2.09	0.92	0.71	0.78	0.98	0.45
Na2O	3.25	3.22	2.82	2.83	3.34	3.63	3.32	3.68	3.46
K2O	4.90	5.07	4.36	4.65	5.26	5.55	5.17	4.98	5.41
P2O5	0.08	0.06	0.19	0.19	0.06	0.05	0.04	0.10	0.02
S	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	NA	NA	NA	NA	NA	NA	NA	NA	NA
H2O	0.82	0.73	0.87	0.90	1.68	0.58	0.81	1.04	0.58
CO2	0.39	0.01	0.20	0.15	<0.01	0.11	<0.01	<0.01	0.21
Total	99.80	99.91	99.61	99.77	100.19	99.76	99.66	99.63	99.83

Traces

Ba	530	490	725	1065	305	195	175	515	130
Rb	209	202	161	125	222	250	225	206	303
Sr	133	122	192	250	80	87	78	342	38.0
Pb	30	29	28	29	20	29	31	36	25
Th	23.0	24.0	28.0	19.6	26.8	36.8	34.8	22.0	39.6
U	3.8	4.8	1.8	2.0	2.6	4.2	4.0	1.6	4.8
Zr	314	282	345	325	191	145	160	142	125
Nb	36	30	23	21	20	17	16	14	19
Y	53	49	24	14	54	25	24	19	52
Ce	123	134	134	121	107	137	74	70	133
Sc	10	10	9	9	4	6	5	5	2
V	5	5	38	31	7	10	10	25	2
Ni	3	2	6	7	<1	2	2	3	<1
Cu	2	2	1	2	3	3	3	7	2
Zn	87	70	64	70	23	29	36	34	19
Ga	23.2	21.6	20.6	18.6	16.4	16.2	14.8	17.8	18.2
Ga/Al	3.24	3.03	2.81	2.55	2.35	2.27	2.21	2.29	2.72
A.I.	0.79	0.80	0.68	0.70	0.86	0.90	0.89	0.79	0.92

	18	18	18	18	18	19	19	19	19
U	2	2	2	3	3				
Sample	469	154	156	AC6A	AC98	1753	1754	1755	1756
SiO2	78.06	75.46	73.58	76.39	77.65	72.17	72.73	74.47	73.94
TiO2	0.12	0.27	0.30	0.09	0.05	0.31	0.29	0.12	0.05
Al2O3	11.50	12.71	12.98	11.85	12.14	14.57	14.68	14.66	14.84
Fe2O3	0.52	0.72	0.84	0.42	0.23	0.31	0.22	0.20	0.17
FeO	0.27	0.85	0.79	0.36	0.20	1.43	1.41	0.70	0.62
MnO	0.01	0.05	0.07	0.02	0.02	0.04	0.04	0.04	0.05
MgO	0.05	0.24	0.25	<0.01	<0.01	0.58	0.47	0.18	0.07
CaO	0.32	0.67	0.64	0.36	0.34	0.82	0.72	0.45	0.41
Na2O	3.16	3.70	3.64	3.08	3.70	3.17	3.14	3.86	3.87
K2O	5.14	4.64	4.88	5.52	4.93	4.74	4.85	4.24	4.18
P2O5	0.01	0.06	0.07	<0.01	0.01	0.27	0.25	0.29	0.39
S	<0.02	0.03	0.02	0.06	0.05	<0.02	<0.02	<0.02	<0.02
Cl	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	NA	NA	NA	NA	NA	NA	NA	NA	NA
H2O	0.11	0.54	1.52	0.97	0.57	1.16	1.25	1.04	1.01
CO2	0.12	<0.01	<0.01	0.57	0.18	0.13	0.18	0.03	0.05
Total	99.39	99.94	99.58	99.69	100.07	99.70	100.23	100.28	99.65

Traces

Ba	80	240	365	45	30	150	170	38	4
Rb	255	203	215	393	312	478	424	655	950
Sr	24.5	78	78	20.0	11.5	57	49.5	21.5	20.0
Pb	23	20	20	45	41	28	33	19	12
Th	41.8	23.4	27.2	38.2	66.0	24.5	22.0	9.2	2.8
U	4.8	3.2	5.0	21.0	18.4	6.8	24.0	4.4	3.4
Zr	123	187	200	79	138	112	113	42	29
Nb	27	20	23	24	25	28	26	32	43
Y	40	35	42	22	31	20	27	13	13
Ce	104	86	91	38	35	62	64	21	9
Sc	2	4	4	3	2	NA	NA	NA	NA
V	1	10	11	3	<1	14	11	4	<1
Ni	<1	1	1	<1	<1	<1	2	<1	1
Cu	3	1	2	25	9	<1	<1	<1	<1
Zn	16	37	55	35	83	56	46	42	31
Ga	16.8	15.8	16.2	15.6	16.6	21.8	20.8	24.0	29.4
Ga/Al	2.74	2.33	2.31	2.44	2.56	2.83	2.68	3.09	3.74
A. I.	0.94	0.87	0.87	0.93	0.94	0.71	0.71	0.75	0.73

S	19
U	
Sample	1757
SiO ₂	73.72
TiO ₂	0.05
Al ₂ O ₃	14.79
Fe ₂ O ₃	0.17
FeO	0.52
MnO	0.05
MgO	0.07
CaO	0.40
Na ₂ O	4.00
K ₂ O	4.11
P ₂ O ₅	0.42
S	<0.02
Cl	NA
F	NA
H ₂ O	0.93
CO ₂	0.41
Total	99.64

Traces

Ba	2
Rb	945
Sr	14.5
Pb	18
Th	3.4
U	21.0
Zr	27
Nb	47
Y	12
Ce	10
Sc	NA
V	<1
Ni	2
Cu	<1
Zn	53
Ga	26.4
Ga/Al	3.37
A.I.	0.75