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PRELIMINARY NOTE ON THE LITHOGEOCHEMISTRY AND PETROGENESIS OF INTRUSIVE ROCK SUITES FROM THE MINIPI LAKE REGION (NTS MAP AREA 13C/SOUTH), GRENVILLE PROVINCE, LABRADOR

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ABSTRACT

The Minipi Lake region of southern Labrador straddles the boundary of two major Grenvillian lithotectonic divisions: the Mealy Mountains terrane and the Mecatina terrane. Both are dominated by variably deformed and metamorphosed igneous suites containing local screens of older ortho- and paragneisses.

Four contrasting intrusive rock groups have been distinguished, including: 1) the late Paleoproterozoic Mealy Mountains intrusive suite (MMIS), comprising rock types varying from gabbro to pyroxene monzonite, and occurring in the Mealy Mountains terrane, 2) early Mesoproterozoic units of variably foliated quartz monzonite and K-feldspar porphyritic granite, which underlie much of the Mecatina terrane in the study area, 3) a distinct group of gabbro and gabbronorite, forming small plugs and dykes that punctuate and appear to be restricted to the Mecatina terrane, and 4) plutons of late- to post-Grenvillian granite and K-feldspar porphyritic granite that occur in the Mealy Mountains and Mecatina terranes.

Samples of the MMIS display remarkably similar geochemical signatures. Except for one, all are olivine normative, most are silica-saturated (olivine + hypersthene in the norm) and only a few can be qualified as silica-undersaturated (olivine + nepheline in the norm). As a group, these rocks can be described as transitional to alkaline. Ultramafic and mafic samples are markedly enriched in Al_2O_3 *and deficient in* TiO_2 *compared to basalt and diabase.*

Trace-element patterns in MMIS rocks show a marked enrichment in high-field-strength elements (HFSE) relative to N-MORB, and a relatively flat heavy-REE distribution near, or somewhat below the normalizing values. The most notable features of the patterns are given by the well-defined negative Th, Nb, Zr, Hf, and Ti anomalies, which are coupled with a positive Sr spike. The same trace-element pattern is duplicated in all the analyses, independently of the silica content of the rock, hence providing strong support for a cogenetic origin. Accordingly, the compositional spectrum of the suite can be attributed to variable degrees of fractionation. The patterns also emphasize the importance that fractional crystallization and extraction of cumulates could have played in the petrogenesis of the suite.

The geochemical signature of the Mecatina terrane gabbro and gabbronorite differs significantly from that of the MMIS. Their major-element contents are comparable to those of basalt and diabase, except for a small enrichment in Al_2O_3 *and small depletions in* TiO_2 *and* P_2O_5 *that are consistent with limited plagioclase fractionation. However, incompatible trace-elements Th, Zr, Hf and Y show no evidence of fractionation. These samples plot within the volcanic-arc basalt field in Ti–Zr–Y and Hf–Th–Ta tectonic discrimination diagrams.*

The early Mesoproterozoic quartz monzonite and K-feldspar porphyritic granite samples from the Mecatina terrane plot in the volcanic-arc granite field on Nb–Y and Rb–(Nb+Y) discrimination diagrams. Taken together, the volcanic-arc signatures of Mecatina terrane gabbroic, and spatially associated, granitic rocks provide support for models involving the development of an Andean-type margin in early Mesoproterozoic. In contrast, the within-plate granite signature of the late- to post-Grenvillian granites is consistent with their emplacement in significantly older crust.

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INTRODUCTION AND REGIONAL GEOLOGICAL SETTING

The Minipi Lake region (NTS map area 13C/South) of southern Labrador includes parts of two major Grenvillian lithotectonic divisions, the Mealy Mountains terrane and the Mecatina terrane (Figures 1 and 2). The geology and field relationships of the different plutonic rock suites, which underlie most of the two terranes, have recently been described by James and Nadeau (2000a, b). Preliminary U–Pb geochronological data are reported by James *et al.* (*this volume*). Focus of this complementary note is placed on the whole-rock, major- and trace-element geochemical results obtained from a set of representative rock samples collected during mapping.

The northern two-thirds of the region (Figure 1), part of the Mealy Mountains terrane (Gower and Owen, 1984), is dominated by massive to weakly deformed and recrystallized gabbroic and monzodioritic rocks of the late Paleoproterozoic (Labradorian-age) Mealy Mountains intrusive suite (MMIS) (*see* Emslie, 1976; and Emslie and Hunt, 1990). In contrast, the area south of the Little Mecatina River (Figure 1), provisionally correlated with the northern extension of the Mecatina terrane (Figure 2), is mainly underlain by early Mesoproterozoic (Pinwarian-age), variably foliated and commonly porphyritic, granite and quartz monzonite that are intruded by small plugs and dykes of gabbro and gabbronorite. The Mealy Mountains and Mecatina terranes are intruded by plutons consisting of mostly massive, medium- to coarse-grained granite and K-feldspar porphyritic granite of late- to post-Grenvillian age.

SAMPLING AND ANALYTICAL METHODS

Fifty-six samples, representative of all major rock types, were selected for major- and trace-element analysis on the basis of their mesoscopic textural homogeneity and representativeness of the outcrop area (Figure 2; Tables 1 and 2). None of the samples show field evidence of metamorphic remobilization (e.g., migmatization), fracture related alteration, or weathering. Textures of the rock samples are varied from massive, having complete preservation of igneous texture and mineralogy, to metamorphically recrystallized and foliated. Most gabbroic samples are medium to coarse grained, whereas granitic samples are varied from coarse grained to K-feldspar porphyritic. With a few exceptions, each sample consisted of more than two kilograms of fresh rock.

Major elements, transition metals (Sc, V, Cr, Co, Ni), and Cu, Zn, Sr and Ba were determined by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES). Rare-earth elements (REE), Pb, Y, Hf, Zr, Rb, Ta, and Th were analyzed by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS). Detection limits are given in Tables 1 and 2. Samples were low in volatiles with average (H_2O+CO_2) of 0.76 wt.%, and most totals between 98.7 wt.% and 101.3 wt.%. Norm (CIPW) have been calculated volatile-free to 100% (Table 3). Total iron has been expressed as FeO* using the conversion factor of Irvine and Baragar (1971). Analyses were performed at the geochemistry laboratory of the Québec Geoscience Centre.

MAJOR INTRUSIVE SUITES

MEALY MOUNTAINS INTRUSIVE SUITE

The MMIS consists of an older group of anorthositic, leucogabbroic and leucotroctolitic rocks, and a younger group of pyroxene-bearing monzonitic to granitic rocks. It constitutes one of the most extensive intrusive suites of the Grenville Province in Labrador, underlying most of the region extending from the highlands southeast of Lake Melville, through the Minipi Lake region, over more than 200 km in the southwest direction (*cf.* Emslie, 1976; Gower and van Nostrand, 1996; Nunn and van Nostrand, 1996; Gower, 1999; and James and Lawlor, 1999). In the Minipi Lake region (Figure 1), the MMIS includes two, regionally extensive rock units consisting mainly of gabbro and gabbronorite (Unit P_{MM} gbr), and of pyroxene-bearing monzodiorite to monzonite (Unit P_{MM} mdq).

As described by James and Nadeau (2000a), MMIS gabbro and gabbronorite (Unit P_{MM} gbr, Figure 1), have a wide range in compositions, textures, structures and aeromagnetic signatures, possibly indicating that the unit consists of intrusions of different ages. The unit also contains subordinate amounts of leucogabbro, leucogabbronorite, pyroxenite, diorite and very minor amounts of monzogabbro, monzogabbronorite and amphibolite; anorthosite nor leucotroctolite occur in the study area. Rocks consist of varied amounts of clinopyroxene, orthopyroxene and plagioclase; biotite is a common accessory mineral. The rocks are varied, from massive and unrecrystallized (containing preserved igneous mineral textures) to foliated and pervasively recrystallized. Trace amounts to several percent of pyrite are common.

James and Nadeau (2000a) describe the MMIS pyroxene-bearing monzodiorite and monzonite unit (Unit P_{MM} mdq) as a compositionally and texturally varied unit including monzodiorite, quartz monzodiorite, diorite, granodiorite quartz monzonite and granite. The unit also includes minor amounts of gabbro and gabbronorite that are correlated with Unit P_{MM} gbr. Rocks are texturally varied, even at the outcrop scale, from massive with complete preservation of

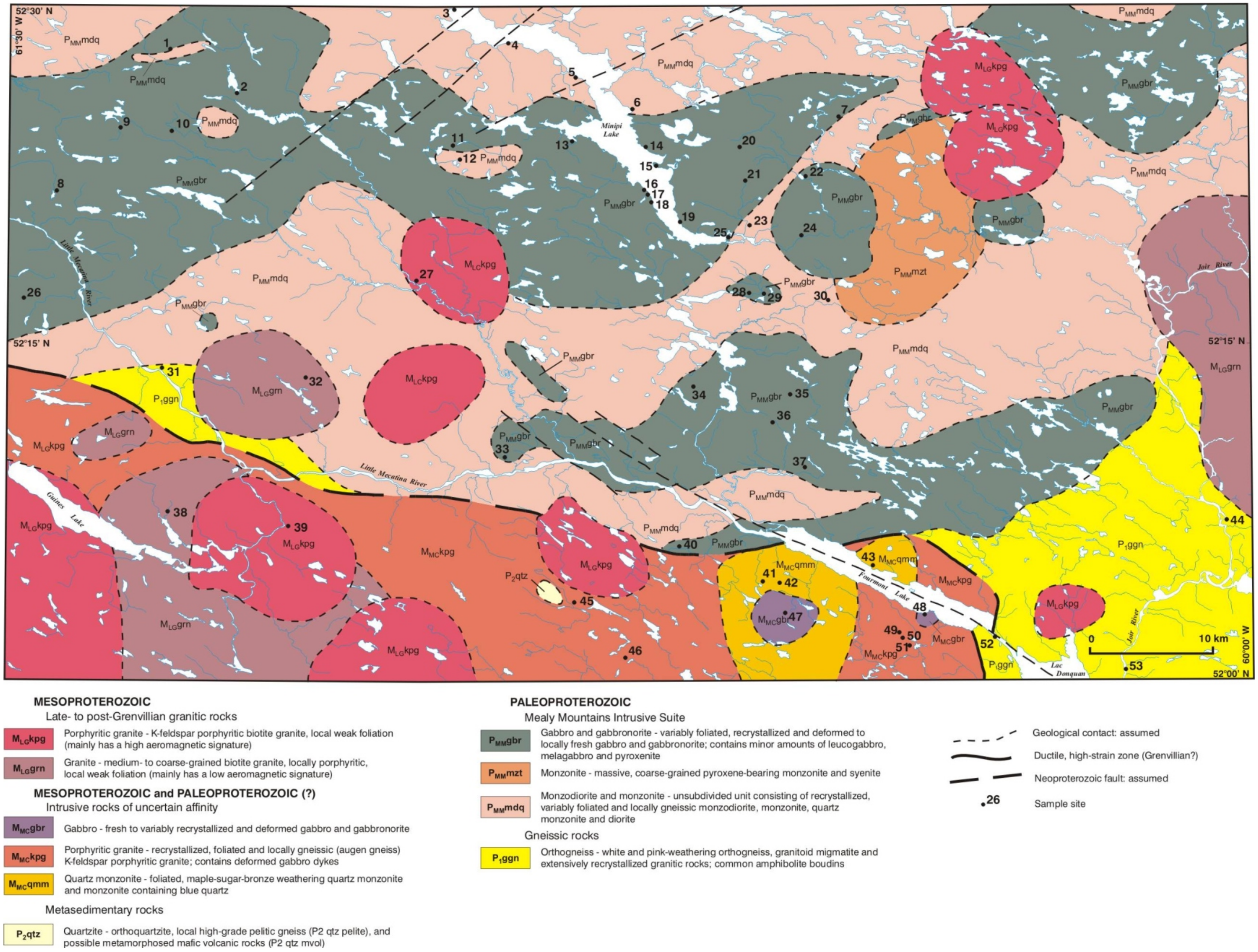


Figure 1. *Geological map of the Minipi Lake region, NTS map area 13C/South (including NTS map areas 13C/1, C/2, C/3, C/6, C/7 and C/8). Simplified from James and Nadeau (2000b).*

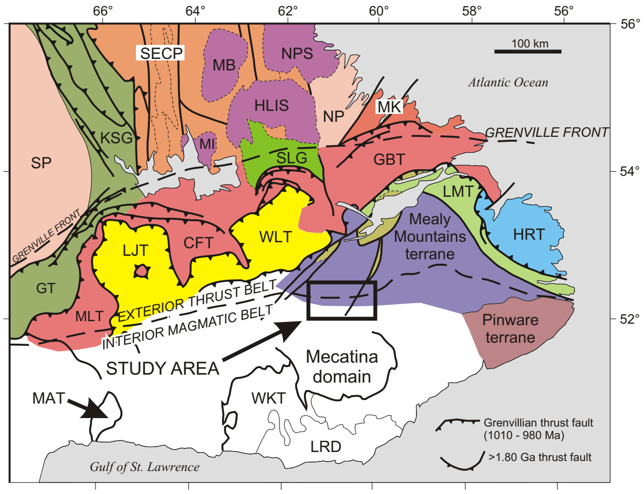


Figure 2. *Location of the Minipi Lake region in relation to the tectonic and major lithotectonic divisions of northeastern Laurentia (modified from Wardle* et al.*, 1997). Grenville Province: HRT - Hawke River terrane, LMT - Lake Melville terrane, GBT - Groswater Bay terrane, WLT - Wilson Lake terrane, CFT - Churchill Falls terrane, LJT - Lac Joseph terrane, MLT - Molson Lake terrane, GT - Gagnon terrane, MAT - Matamec terrane, WKT - Wakeham terrane, LRD - La Romaine terrane. Archean divisions: SP - Superior Province, NP - Nain Province (Hopedale Block). Archean and Paleoproterozoic divisions: MK - Makkovik Province, SECP - Southeastern Churchill Province (Core Zone), KSG - Kaniapiskau Supergroup (2.25-1.86 Ga). Mesoproterozoic units: NPS - Nain Plutonic Suite, HLIS - Harp Lake intrusive suite, MB - Mistastin batholith, MI - Michikamau Intrusion, SLG - Seal Lake Group.*

igneous textures, to recrystallized and foliated; gneissic varieties also occur. The unit probably consists of distinct intrusions of relatively uniform composition, although it is so poorly exposed that it cannot be subdivided at the present scale of mapping. Clinopyroxene, hornblende, biotite and accessory magnetite are common in these rocks. A sample of gneissic P_{MM} mdq monzodiorite, which occurs near Minipi Lake (NTS map area 13C/10), has an igneous emplacement age of 1659 ± 5 Ma based on U–Pb dating of zircon (James *et al.*, 2000).

MECATINA TERRANE QUARTZ MONZONITE AND GRANITE

Quartz monzonite (Unit M_{MC} qmm) and K-feldspar porphyritic granite (Unit M_{MC} kpg) underlie much of Mecatina terrane in the study area. Samples from these units have yielded U–Pb zircon igneous crystallization ages of ca. 1500 ± 4 Ma and 1493 ± 3 Ma, respectively (James *et al.*, *this volume*). (The quartz monzonite sample 43 and porphyritic granite sample 46 (*see* Figure 1) are from the same outcrops that were sampled for the geochronological study.) Unit M_{MC} qmm consists of variably foliated, medium- to coarse-grained, equigranular to K-feldspar porphyritic quartz monzonite and, less commonly, monzonite. Quartz is commonly pale blue. These rocks contain less than 10 percent mafic minerals including clinopyroxene, biotite and accessory magnetite. The K-feldspar porphyritic granite (Unit M_{MC} kpg) is generally well foliated and contains less than 10 percent combined biotite and hornblende.

MECATINA TERRANE GABBRO

Two small bodies and dykes of gabbro (Unit M_{MC} gbr) intrude the quartz monzonite and K-feldspar porphyritic granite units of the Mecatina terrane (Figure 1). The unit mostly consists of fresh gabbro and gabbronorite, although rocks are locally recrystallized and foliated. The rocks are typically medium to coarse grained, ophitic to subophitic. They are mainly homogeneous in composition, although they locally display remarkable igneous layering (James and Nadeau, 2000a). These rocks are interpreted to be part of the regionally extensive Petit Mecatina anorthosite-mangerite-charnockite-granite (AMCG) complex underlying much of the Mecatina terrane south of the study area. Three of the five samples analyzed come from small dykes contained in quartz monzonite and K-feldspar porphyritic granite.

LATE- TO POST-GRENVILLIAN GRANITE

The Mealy Montains and Mecatina terranes are intruded by plutons consisting of medium- to coarse-grained granite (Unit M_{LG} grn) and K-feldspar porphyritic granite (Unit M_{LG} kpg); the two units have similar composition. Rocks are mainly undeformed and massive, and contain less than 10 percent biotite. Similar granite plutons punctuate the Mealy Mountains and the Pinware terranes east of the study area and have emplacement ages between 980 and 950 Ma (*see* Gower, 1996; Gower *et al.*, 1991). A sample of coarse-grained Unit M_{LG} grn granite occurring in the northeastern part of the Minipi Lake region has an emplacement age of 964 ± 3 Ma based on U–Pb dating of zircon (James *et al.*, *this volume*).

RESULTS AND DISCUSSION

It is emphasized that most gabbroic to monzodioritic rocks exhibit medium- and coarse-grained igneous or relict igneous textures, locally with a distinct igneous mineral foliation and, more rarely, compositional layering. Granitic rocks are generally coarse grained, equigranular or K-feldspar porphyritic, and locally retain a subtle prismatic mineral foliation, possibly of igneous origin. These primary igneous textural attributes indicate that some crystal separation and settling occurred during crystallization. Therefore,

Table 1. Major-element and transition metal contents of intrusive rock samples from the Minipi Lake region (For P_{MM}bgr read P_{MM}gbr.)

Site	Sample number	Rock unit	Element		SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	Loi	Mg#	Total	Sc	V	Cr	Ni	Co	Cu	Zn	Pb
			Method		ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES				ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-MS
				Limit	0.0100	0.0005	0.015	0.001	0.0005	0.0005	0.0015	0.005	0.010	0.025				1	10	10	37.5	15	15	37.5	0.005
			Coordonates	Unit	%	%	%	%	%	%	%	%	%	%	%		%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Mealy Mountains intrusive suite			UTME	UTMN																					
24	DJ-99-059	P_{MM}bgr	667303	5800528	41.01	4.49	12.93	17.41	0.20	6.15	10.29	2.67	1.02	3.30	1.19	0.41	101.32	25	292	-	-	40	-	130	2.69
25	NK-99-056C	P_{MM}bgr	661239	5800013	41.40	2.36	12.15	19.90	0.35	6.16	9.61	2.61	1.38	2.55	0.75	0.38	99.91	39	320	-	-	56	19	218	5.99
11	DJ-99-187	P_{MM}bgr	638331	5807056	43.11	1.27	19.93	14.66	0.21	6.58	10.32	2.49	1.85	0.55	1.16	0.47	102.70	32	336	14	-	47	155	115	3.29
28	NK-99-040	P_{MM}bgr	663335	5795652	44.62	1.18	15.05	16.75	0.24	7.73	10.53	2.07	0.60	0.62	1.14	0.48	101.03	43	492	41	45	58	305	128	2.81
3	NK-99-068B	P_{MM}bgr	638250	5818300	44.74	1.22	18.66	14.61	0.17	5.63	9.05	3.04	1.25	0.59	1.37	0.43	100.87	23	333	45	-	48	176	110	3.83
22	NK-99-050	P_{MM}bgr	667506	5805214	44.88	3.27	16.31	13.40	0.14	4.57	9.66	3.56	1.12	2.27	0.65	0.40	100.40	17	263	14	-	48	69	116	4.98
13	NK-99-053B	P_{MM}bgr	648368	5807724	45.04	1.08	19.48	13.63	0.21	5.40	8.83	3.57	1.13	0.41	0.77	0.44	100.15	23	229	-	-	39	67	119	2.84
29	NK-99-038	P_{MM}bgr	664495	5795573	45.35	0.54	16.08	8.89	0.17	11.11	10.64	1.83	0.57	0.25	3.01	0.71	98.72	33	163	540	200	52	123	72	2.65
18	DJ-99-176	P_{MM}bgr	654977	5803251	46.12	1.74	16.44	14.39	0.19	7.30	8.69	2.67	0.82	0.25	2.50	0.50	101.33	28	221	68	91	60	84	115	3.95
40	DJ-99-141	P_{MM}bgr	658206	5774516	46.36	2.33	16.74	15.13	0.21	5.38	8.55	3.38	0.70	0.29	0.48	0.41	99.76	30	247	74	51	55	128	131	4.16
20	NK-99-051B	P_{MM}bgr	662214	5807599	46.53	2.45	14.73	16.45	0.22	6.89	7.93	2.69	1.31	0.39	0.73	0.45	100.61	32	292	94	90	65	110	143	4.33
7	DJ-99-191	P_{MM}bgr	670267	5810125	46.56	1.51	16.28	14.09	0.19	8.49	9.81	2.46	0.54	0.17	1.59	0.54	101.87	31	243	98	107	63	85	112	2.60
26	DJ-99-253	P_{MM}bgr	603561	5793435	46.61	0.25	15.70	9.73	0.16	13.87	12.69	1.37	0.14	-	0.30	0.74	101.07	40	97	562	274	71	218	61	1.13
21	NK-99-049	P_{MM}bgr	662775	5804950	47.17	0.46	19.29	7.39	0.14	7.87	13.68	1.72	0.55	0.09	1.67	0.68	100.27	39	148	86	43	36	56	63	3.72
37	DJ-99-154	P_{MM}bgr	668318	5781512	47.64	1.74	16.37	14.07	0.19	8.22	9.03	2.76	0.75	0.28	-0.35	0.54	100.92	28	238	111	125	64	59	119	1.70
16	NK-99-054A	P_{MM}bgr	654615	5803792	48.66	0.41	19.73	7.98	0.13	7.67	11.42	2.26	0.96	0.14	1.36	0.66	101.03	28	128	182	64	39	171	76	4.33
15	NK-99-061B	P_{MM}bgr	655191	5805655	48.91	0.41	24.89	5.06	0.06	2.03	11.29	3.30	1.26	0.59	1.61	0.44	99.86	10	132	136	-	-	200	56	6.59
23	NK-99-045B	P_{MM}mdq	663294	5801336	49.08	1.49	16.65	12.50	0.21	3.80	6.67	4.24	2.25	1.95	0.50	0.38	99.87	12	76	18	-	29	-	154	8.92
12	NK-99-046B	P_{MM}mdq	638934	5805640	49.33	0.86	19.67	10.42	0.17	4.42	7.86	4.37	1.19	0.55	0.81	0.46	100.00	17	187	20	-	31	37	85	4.71
34	NK-99-034B	P_{MM}bgr	659000	5787527	49.49	0.37	20.86	10.00	0.14	4.40	9.44	3.51	0.79	0.15	0.74	0.47	100.33	18	166	40	-	35	105	82	3.15
8	NK-99-118	P_{MM}bgr	606054	5802386	49.54	0.64	19.15	9.59	0.16	5.79	10.53	3.48	0.83	0.62	1.13	0.54	101.84	26	230	109	-	35	147	92	5.74
1	NK-99-135B	P_{MM}bgr	615049	5814314	51.02	0.81	16.30	10.86	0.19	6.46	9.39	3.34	1.30	0.54	0.51	0.54	101.07	34	297	141	100	34	224	118	7.50
2	DJ-99-281B	P_{MM}bgr	620645	5810723	51.67	0.77	18.58	10.02	0.16	4.90	9.61	3.88	1.20	0.62	0.06	0.49	101.86	24	265	107	-	28	139	87	5.38
35	NK-99-033B	P_{MM}bgr	667249	5787316	52.46	0.81	18.95	9.16	0.17	4.22	7.99	4.25	1.21	0.44	0.48	0.48	100.50	23	196	98	-	29	190	107	7.20
30	NK-99-039	P_{MM}mdq	669878	5795287	52.75	0.83	21.64	5.64	0.09	2.26	5.72	4.65	2.94	0.40	1.19	0.44	98.77	12	86	51	-	-	33	83	7.69
36	DJ-99-155	P_{MM}bgr	665806	5785117	53.01	0.54	21.79	6.05	0.09	1.94	7.93	5.04	1.53	0.47	1.07	0.39	99.93	11	99	49	-	15	134	64	7.85
33	DJ-99-151	P_{MM}bgr	643607	5781492	53.07	0.78	18.31	9.39	0.16	3.86	6.07	4.42	2.53	0.52	1.02	0.45	100.49	17	172	20	-	28	108	98	9.65
9	NK-99-133	P_{MM}bgr	611150	5807655	53.55	0.62	20.77	7.36	0.13	3.08	7.93	4.70	1.46	0.65	0.66	0.45	101.30	15	170	28	-	18	226	88	9.42
17	NK-99-055B	P_{MM}bgr	654791	5803467	53.82	0.70	20.41	6.63	0.11	3.12	7.21	4.85	2.28	0.45	0.77	0.48	100.76	14	145	32	-	19	127	78	9.57
19	NK-99-044B	P_{MM}bgr	657376	5801277	54.71	0.71	17.83	7.83	0.18	3.65	6.08	4.31	2.36	0.34	1.22	0.48	99.59	20	160	59	-	24	108	94	11.22
10	DJ-99-279B	P_{MM}bgr	615452	5807619	54.73	0.56	17.49	7.55	0.16	4.90	7.48	4.06	1.98	0.42	0.80	0.56	100.49	23	154	124	-	21	76	88	7.16
4	NK-99-067B	P_{MM}mdq	642939	5815618	54.98	0.72	21.68	5.30	0.08	1.83	5.68	4.83	3.47	0.36	0.59	0.41	100.42	9	72	53	-	-	55	75	11.49
14	NK-99-063B	P_{MM}bgr	654152	5807334	56.04	0.69	18.43	6.99	0.16	2.72	5.42	4.68	3.30	0.38	0.74	0.44	99.97	18	129	92	-	17	56	94	13.85
5	NK-99-066B	P_{MM}mdq	648455	5813139	60.24	0.60	17.48	7.25	0.15	2.37	4.77	4.27	3.29	0.38	0.46	0.39	101.59	11	70	43	-	18	42	75	13.62
Petit Mecatina domain intrusive suite																									
48	DJ-99-098	M_{MC} gbr	678363	5769634	46.49	1.06	16.98	10.55	0.20	8.96	9.80	2.11	1.41	0.09	0.74	0.63	98.49	28	207	292	207	57	-	114	4.26
47	NK-99-020B	M_{MC} gbr	666908	5769332	47.57	2.28	15.81	14.38	0.20	6.37	8.59	2.96	1.15	0.33	0.59	0.47	100.52	31	272	104	114	60	174	139	5.36
41	NK-99-029B	M_{MC} gbr	665242	5771784	48.04	2.52	16.10	14.75	0.20	5.52	8.08	3.07	1.55	0.42	-0.43	0.43	100.08	30	273	95	84	57	106	144	6.07
49	NK-99-009B	M_{MC} gbr	677084	5768152	48.85	1.75	15.33	13.29	0.20	7.19	9.44	2.43	0.81	0.23	0.43	0.52	100.13	37	306	210	95	53	107	108	2.85
50	NK-99-012B	M_{MC} gbr	675928	5768074	50.15	0.94	17.62	9.12	0.14	9.26	11.06	2.49	0.18	0.09	0.78	0.67	101.98	37	218	316	199	50	73	65	1.25
43	DJ-99-084	M_{MC} qmm	674127	5773188	58.78	1.38	15.84	8.59	0.20	2.06	4.39	4.21	2.88	0.52	0.17	0.32	99.41	22	82	76	-	17	22	151	12.90
42	NK-99-021B	M_{MC} qmm	666625	5771900	62.25	0.48	16.64	4.22	0.11	1.54	3.29	4.20	4.35	0.21	0.68	0.42	98.24	9	67	49	-	-	-	73	10.14
51	NK-99-005B	M_{MC} kpg	677415	5767050	69.08	0.72	14.51	4.60	0.13	0.94	2.21	3.95	4.82	0.25	0.19	0.29	101.65	13	22	79	-	-	-	91	21.11
46	DJ-99-110	M_{MC} kpg	654046	5765078	72.94	0.32	12.90	2.40	0.04	0.40	1.06	3.08	6.00	0.06	0.34	0.25	99.73	3	9	158	56	-	-	36	21.21
45	DJ-99-131	M_{MC} kpg	649724	5769762	76.86	0.11	10.72	1.21	0.03	0.07	0.44	3.08	4.70	0.01	0.19	0.11	97.47	2	-	149	-	-	-	31	22.02
Late- to post- Grenvillian granite																									
39	NK-99-078	M_{LG} kpg	625644	5775136	62.67	1.15	15.54	6.39	0.12	1.41	3.02	4.08	5.43	0.58	0.47	0.30	101.32	8	49	122	172	-	17	155	29.35
27	NK-99-037	M_{LG} kpg	635837	5795931	67.68	0.76	13.79	3.97	0.07	0.81	1.87	3.35	5.63	0.32	0.32	0.29	98.87	8	22	122	-	-	18	92	31.28
32	NK-99-072B	M_{LG} gm	626800	5787550	64.55	1.00	14.86	5.59	0.11	1.12	3.27	3.77	4.96	0.76	0.41	0.29	100.91	10	34	77	-	-	20	148	30.01
Plutonic rock of uncertain affinity																									
6	NK-99-064B	P_{MM}mdq (?)	652918	5810578	64.88	0.72	15.83	3.69	0.08	1.12	2.05	4.31	5.08	0.26	0.46	0.38	98.80	8	37	68	-	-	-	62	15.97
38	NK-99-126B	P_{MC}kpg(?)	616152	5776150	66.45	0.18	16.99	1.42	0.03	0.32	1.47	4.88	5.75	0.07	0.33	0.31	98.14	2	-	94	-	-	18	36	43.61
53	DJ-99-091		695263	5765806	74.24	0.26	12.16	2.42	0.04	0.18	0.71	3.42	5.45	0.05	0.19	0.13	99.21	6	-	107	-	-	17	50	26.30
16	NK-99-054F		654615	5803792	57.29	1.27	18.48	7.39	0.06	2.53	5.52	5.40	1.44	0.83	1.37	0.40	101.93	9	110	54	-	19	-	58	10.34
31	DJ-99-241A	P_1ggn	615184	5787716	62.82	0.69	15.51	7.11	0.19	2.59	4.32	4.51	3.09	0.47	0.42	0.42	101.93	18	116	86	-	-	56	103	13.44
44	DJ-99-068A	P_1ggn	702950	5778110	65.29	0.83	14.70	5.46	0.12	1.26	2.13	4.19	3.34	0.31	0.31	0.31	98.14	14	31	102	-	-	-	130	17.00
52	DJ-99-101A	P_1ggn	684486	5767937	68.03	0.31	15.40	3.33	0.12	1.05	2.32	4.17	4.48	0.15	0.35	0.38	99.98	7	34	192	-	-	-	58	18.24
Diabase																									
52	DJ-99-101B		684486	5767937	47.10	2.87	15.46	15.94	0.21	5.38	7.64	3.27	1.91	0.48	0.56	0.40	101.13	28	273	97	67	49	86	140	7.28
16	NK-99-054D		654615	5803792	54.67	0.85	19.33	9.98	0.15	3.12	6.36	4.60	1.78	0.39	1.11	0.38	102.83	13	149	25	-	23	66	79	6.18

Table 2. Trace-element contents of intrusive rock samples from the Minipi Lake region (For P_{MM}bgr read P_{MM}gbr.)

Site	Sample number	Rock unit	Element	Rb	Sr	Ba	Nb	Zr	Y	Th	La	Ce	Hf	Nd	Sm	Eu	Tb	Yb	Gd	Dy	Ho	Er	Tm	Ta	Pr	Lu
			Method	ICP-MS	ICP-AES	ICP-AES	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
			Limit	0.003	0.5	1	0.020	0.010	0.020	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.005	0.002	0.0001	0.002	0.0005	0.0005	0.0005	0.0005
			Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Mealy Mountains intrusive suite																										
24	DJ-99-059	P_{MM}bgr		27	1256	1999	9	90	29	0.55	43.26	105.44	2.09	73.59	14.76	4.54	1.34	1.58	12.36	6.71	1.10	2.61	0.30	0.54	15.24	0.24
25	NK-99-056C	P_{MM}bgr		25	739	1365	3	84	57	0.38	51.88	121.66	1.99	81.31	17.17	4.62	1.89	3.96	15.35	10.81	2.03	5.47	0.70	0.15	17.31	0.59
11	DJ-99-187	P_{MM}bgr		29	1385	1210	3	30	24	0.09	13.27	36.85	1.08	28.15	6.47	2.10	0.78	2.14	5.94	4.67	0.91	2.55	0.36	0.09	5.80	0.33
28	NK-99-040	P_{MM}bgr		11	1174	352	1	22	21	0.29	10.83	28.02	0.69	21.90	5.28	1.43	0.63	1.66	4.87	3.76	0.72	1.98	0.27	0.04	4.39	0.25
3	NK-99-068B	P_{MM}bgr		19	1499	792	2	32	15	0.27	16.75	38.40	0.89	23.73	4.88	1.61	0.53	1.25	4.31	3.05	0.58	1.62	0.21	0.09	5.26	0.19
22	NK-99-050	P_{MM}bgr		8	1394	1156	9	109	22	0.32	45.25	102.12	2.30	59.76	10.94	3.36	0.94	1.23	8.71	4.69	0.79	1.92	0.23	0.46	13.61	0.18
13	NK-99-053B	P_{MM}bgr		12	1815	1214	4	40	24	0.12	19.13	48.53	1.15	33.09	7.03	2.15	0.75	1.77	5.92	4.28	0.81	2.21	0.31	0.11	7.19	0.28
29	NK-99-038	P_{MM}bgr		10	506	252	1	10	9	0.10	3.24	7.28	0.31	5.47	1.46	0.76	0.23	0.67	1.66	1.50	0.31	0.83	0.11	0.03	1.07	0.10
18	DJ-99-176	P_{MM}bgr		15	393	324	8	124	29	0.93	11.85	28.27	3.05	18.72	4.84	1.71	0.81	2.66	5.29	5.22	1.05	3.06	0.44	0.55	3.99	0.40
40	DJ-99-141	P_{MM}bgr		17	320	244	12	173	39	1.26	12.50	31.78	4.04	21.79	6.07	2.07	1.08	3.56	6.96	7.00	1.42	4.13	0.59	0.80	4.59	0.56
20	NK-99-051B	P_{MM}bgr		25	358	606	10	191	39	1.62	19.92	46.91	4.58	29.31	7.21	2.22	1.14	3.43	7.58	7.08	1.43	4.06	0.57	0.62	6.47	0.53
7	DJ-99-191	P_{MM}bgr		8	292	232	6	89	23	0.57	7.96	19.47	2.21	13.23	3.63	1.35	0.65	2.16	4.13	4.24	0.85	2.44	0.35	0.42	2.80	0.33
26	DJ-99-253	P_{MM}bgr		1	552	197	0	7	7	0.05	1.80	4.51	0.24	3.89	1.14	0.60	0.20	0.59	1.30	1.32	0.26	0.74	0.10	0.01	0.74	0.09
21	NK-99-049	P_{MM}bgr		5	1304	417	2	27	13	0.12	7.43	18.07	0.79	13.08	3.26	0.97	0.39	1.09	2.85	2.40	0.46	1.33	0.19	0.06	2.70	0.17
37	DJ-99-154	P_{MM}bgr		11	421	456	7	125	26	0.85	13.38	31.22	2.95	19.99	4.96	1.73	0.76	2.29	5.26	4.81	0.95	2.71	0.39	0.41	4.34	0.35
16	NK-99-054A	P_{MM}bgr		21	1311	648	1	25	9	0.53	8.65	17.48	0.61	9.93	2.16	0.93	0.27	0.73	2.02	1.59	0.30	0.90	0.12	0.05	2.29	0.12
15	NK-99-061B	P_{MM}bgr		27	2781	799	4	30	11	1.23	21.36	45.47	0.68	22.56	3.97	1.30	0.36	0.86	3.00	2.00	0.37	1.03	0.14	0.15	5.70	0.14
23	NK-99-045B	P_{MM}mdq		27	1584	2624	4	43	46	0.64	48.81	108.06	1.06	62.78	12.05	3.69	1.33	3.40	10.58	7.84	1.55	4.35	0.58	0.18	14.43	0.52
12	NK-99-046B	P_{MM}mdq		22	1688	1263	2	14	17	0.35	24.09	50.86	0.36	27.40	5.16	1.78	0.53	1.25	4.31	2.93	0.56	1.54	0.21	0.08	6.52	0.20
34	NK-99-034B	P_{MM}bgr		7	2146	545	1	17	8	0.24	8.04	16.69	0.40	10.05	2.19	0.95	0.25	0.66	1.89	1.44	0.28	0.78	0.11	0.04	2.23	0.10
8	NK-99-118	P_{MM}bgr		10	2000	883	1	22	14	0.62	19.19	42.93	0.63	25.56	5.15	1.66	0.51	1.12	4.21	2.84	0.53	1.47	0.19	0.06	5.77	0.18
1	NK-99-135B	P_{MM}bgr		18	1330	1126	2	32	20	0.80	26.42	58.01	0.91	32.63	6.56	1.81	0.66	1.77	5.49	3.82	0.74	2.08	0.29	0.11	7.51	0.28
2	DJ-99-281B	P_{MM}bgr		10	1704	1162	2	23	16	0.65	24.54	53.17	0.65	29.40	5.61	1.88	0.56	1.33	4.67	3.16	0.59	1.64	0.23	0.09	6.90	0.21
35	NK-99-033B	P_{MM}bgr		15	1340	1008	3	26	24	0.37	31.02	65.02	0.65	34.26	6.59	1.91	0.69	1.92	5.54	4.00	0.79	2.21	0.31	0.11	8.28	0.29
30	NK-99-039	P_{MM}mdq		56	1374	4899	3	17	14	0.53	27.70	54.18	0.40	27.46	5.00	2.62	0.49	0.95	4.11	2.65	0.51	1.35	0.18	0.13	6.66	0.15
36	DJ-99-155	P_{MM}bgr		13	1585	1534	1	11	13	0.41	27.42	52.79	0.29	26.37	4.73	2.29	0.46	0.98	3.88	2.52	0.47	1.29	0.17	0.06	6.37	0.15
33	DJ-99-151	P_{MM}bgr		45	1115	1531	5	223	17	1.49	26.59	56.62	4.54	29.84	5.57	1.69	0.55	1.60	4.58	3.06	0.60	1.75	0.26	0.21	7.13	0.27
9	NK-99-133	P_{MM}bgr		19	1976	1252	2	25	17	1.00	29.43	62.21	0.69	31.80	5.80	2.02	0.56	1.40	4.71	3.17	0.61	1.73	0.23	0.10	7.76	0.21
17	NK-99-055B	P_{MM}bgr		52	1859	1767	6	68	17	1.14	34.57	70.33	1.48	34.96	6.22	2.13	0.58	1.37	4.83	3.14	0.59	1.66	0.23	0.23	8.68	0.22
19	NK-99-044B	P_{MM}bgr		34	891	1561	6	139	28	0.42	31.58	65.91	2.66	34.02	6.74	1.75	0.76	2.41	5.72	4.51	0.91	2.64	0.39	0.20	8.28	0.38
10	DJ-99-279B	P_{MM}bgr		17	1377	1778	2	23	17	0.71	25.33	53.17	0.70	28.38	5.61	1.83	0.56	1.53	4.53	3.22	0.62	1.73	0.25	0.10	6.75	0.25
4	NK-99-067B	P_{MM}mdq		52	1481	6895	4	109	14	0.43	30.77	60.85	2.20	29.45	5.12	2.59	0.49	1.16	4.08	2.76	0.52	1.49	0.20	0.15	7.31	0.18
14	NK-99-063B	P_{MM}bgr		53	821	1938	9	70	24	1.76	32.34	65.35	1.74	33.98	6.60	2.11	0.71	2.18	5.49	4.18	0.83	2.46	0.35	0.35	8.28	0.35
5	NK-99-066B	P_{MM}mdq		68	990	1716	6	115	22	4.46	37.44	77.00	3.21	37.60	7.02	1.71	0.70	2.24	5.49	4.24	0.82	2.42	0.35	0.39	9.55	0.36
Petit Mecatina domain intrusive suite																										
48	DJ-99-098	M_{MC} gbr		152	229	152	4	57	18	1.16	5.69	15.11	1.42	9.50	2.58	1.08	0.48	1.63	3.05	3.12	0.65	1.86	0.27	0.21	2.03	0.26
47	NK-99-020B	M_{MC} gbr		32	314	443	11	203	39	2.06	21.97	49.85	4.63	29.71	7.12	2.04	1.09	3.42	7.36	6.94	1.39	3.98	0.56	0.66	6.78	0.52
41	NK-99-029B	M_{MC} gbr		42	337	533	14	252	45	2.73	28.01	63.06	5.59	36.27	8.43	2.34	1.26	3.85	8.65	7.85	1.58	4.48	0.64	0.82	8.37	0.59
49	NK-99-009B	M_{MC} gbr		20	292	341	9	153	34	1.60	16.40	37.01	3.80	23.00	5.81	1.84	0.94	3.11	6.34	6.21	1.24	3.63	0.51	0.51	5.10	0.48
50	NK-99-012B	M_{MC} gbr		2	330	41	3	54	16	0.43	4.07	9.54	1.40	6.76	2.02	0.74	0.40	1.49	2.58	2.74	0.57	1.71	0.24	0.17	1.39	0.23
43	DJ-99-084	M_{MC} qmm		51	521	2545	16	458	55	1.96	47.94	103.42	9.12	57.34	11.96	3.38	1.57	4.76	11.28	9.62	1.94	5.57	0.78	0.73	13.43	0.75
42	NK-99-021B	M_{MC} qmm		100	641	1855	7	202	20	1.73	37.27	72.79	4.38	33.81	6.20	1.74	0.61	1.84	4.84	3.59	0.70	2.02	0.30	0.29	8.67	0.30
51	NK-99-005B	M_{MC} kpg		151	272	1773	14	412	52	5.43	34.19	77.77	9.52	43.21	9.38	2.30	1.32	5.43	8.90	8.85	1.80	5.69	0.86	0.95	10.36	0.86
46	DJ-99-110	M_{MC} kpg		208	144	1016	12	178	19	37.19	47.58	101.48	4.69	31.27	4.55	0.81	0.51	2.21	3.76	3.32	0.68	2.12	0.33	0.88	9.71	0.36
45	DJ-99-131	M_{MC} kpg		217	26	124	13	102	34	18.22	32.60	72.66	3.79	27.75	5.41	0.22	0.76	3.67	4.86	5.13	1.11	3.59	0.57	1.11	7.84	0.58
Late- to post- Grenvillian granite																										
39	NK-99-078	M_{LG} kpg		143	579	2081	49	907	50	12.27	120.64	363.28	20.32	121.94	20.77	3.82	1.94	4.47	15.28	10.90	1.97	5.42	0.76	3.02	31.88	0.68
27	NK-99-037	M_{LG} kpg		170	425	1891	27	598	55	18.49	144.93	406.66	12.70	121.78	19.91	3.46	1.80	4.45	14.30	10.14	1.89	5.17	0.74	1.61	34.04	0.68
32	NK-99-072B	M_{LG} gm		145	764	2609	33	685	44	12.06	115.16	342.35	15.77	116.31	19.77	4.33	1.76	3.97	14.39	9.69	1.76	4.73	0.66	1.93	29.78	0.61
Plutonic rock of uncertain affinity																										
6	NK-99-064B	P_{MM}mdq (?)		62	556	1591	33	519	35	6.54	84.18	272.16	11.59	82.15	12.93	2.24	1.14	3.13	9.05	6.57	1.26	3.66	0.52	1.26	23.36	0.47
38	NK-99-126B	P_{MC}kpg(?)		246	425	1886	15	191	20	22.53	90.67	156.32	4.53	50.06	7.26	1.15	0.66	1.68	5.24	3.77	0.71	2.01	0.29	1.19	15.72	0.25
53	DJ-99-091			171	76	452	13	287	49	16.25	64.84	132.77	7.47	57.82	10.54	0.62	1.30	4.97	9.12	8.14	1.68	5.16	0.79	0.58	15.67	0.80
16	NK-99-054F			43	1336	835	38	696	23	13.21	148.08	409.53	14.24	120.66	16.86	3.12	1.05	1.50	10.06	4.94	0.82	2.11	0.27	1.73	34.06	0.23
31	DJ-99-241A	P_1ggn		125	536	978	11	136	27	6.15	30.38	66.72	3.50	32.44	6.23	1.64	0.76	2.83	5.53	4.64	0.94	2.87	0.43	0.54	8.17	0.47
44	DJ-99-068A	P_1ggn		168	276	1161	11	344	36	10.73	49.56	103.98	7.46	47.45	9.02	1.87	1.11	3.39	8.09	6.75	1.34	3.86	0.56	0.54	12.26	0.54
52	DJ-99-101A	P_1ggn		122	522	1607	9	177	18	7.81	34.62	66.26	4.21	26.29	4.39	1.08	0.47	2.10	3.51	2.83	0.59	1.85	0.31	0.76	7.37	0.35
Diabase																										
52	DJ-99-101B			84	348	694	19	281	49	2.23	30.30	70.36	6.38	43.03	10.15	3.00	1.47	4.45	10.14	9.27	1.83	5.27	0.75	1.18	9.57	0.71
16	NK-99-054D			24	1548	1423	2	57	17	0.74	19.98	43.60	1.50	25.93	5.27	1.67	0.55	1.43	4.49	3.13	0.60	1.68	0.23	0.10	7.92	0.23

Table 3. Table of the CIPW norm of intrusive rock samples from the Minipi Lake region

Site	Sample number	Lithology / *Normative mineral*	*Q*	*or*	*ab*	*an*	*PLAG*	*n*	*Di wo*	*Di en*	*Di fs*	*CPX*	*Hy en*	*Hy fs*	*OPX*	*Ol fo*	*Ol fa*	*OL*	*mt*	*il*	*ap*
Mealy Mountains intrusive suite																					
24	DJ-99-059	monzogabbronorite	-	6.15	23.01	20.65	***43.66***	-	4.87	2.52	2.22	***9.61***	2.97	2.62	***5.59***	7.13	6.94	***14.07***	4.86	8.70	7.35
25	NK-99-056C	gabbro	-	8.43	20.59	17.90	***38.49***	*1.19*	6.64	2.79	3.87	***13.30***	-	-	-	9.18	14.03	***23.21***	5.00	4.63	5.75
11	DJ-99-187	gabbro	-	10.97	6.35	37.78	***44.13***	*8.00*	4.32	2.11	2.13	***8.56***	-	-	-	10.07	11.19	***21.26***	3.47	2.42	1.20
28	NK-99-040	gabbro	-	3.62	17.86	30.58	***48.44***	-	7.95	3.89	3.92	***15.76***	2.12	2.14	***4.26***	9.60	10.68	***20.28***	3.98	2.29	1.38
3	NK-99-068B	dioritic gneiss	-	7.57	20.21	34.31	***54.52***	*3.29*	3.39	1.54	1.81	***6.74***	-	-	-	9.00	11.67	***20.67***	3.52	2.37	1.32
22	NK-99-050	gabbro	-	6.75	30.67	25.67	***56.34***	-	4.02	2.02	1.91	***7.95***	0.23	0.22	***0.45***	6.58	6.85	***13.43***	3.70	6.33	5.05
13	NK-99-053B	monzodioritic/dioritic gneiss	-	6.85	20.45	34.56	***55.01***	*5.66*	3.28	1.51	1.75	***6.54***	-	-	-	8.62	11.02	***19.64***	3.28	2.10	0.92
29	NK-99-038	gabbro	-	3.56	16.34	35.84	***52.18***	-	7.68	5.13	1.96	***14.77***	4.14	1.58	***5.72***	14.04	5.91	***19.95***	2.17	1.08	0.58
18	DJ-99-176	gabbro	-	4.98	23.17	31.22	***54.39***	-	4.82	2.55	2.13	***9.50***	3.70	3.09	***6.79***	8.74	8.05	***16.79***	3.60	3.39	0.56
40	DJ-99-141	gabbro	-	4.23	29.20	29.03	***58.23***	-	5.27	2.46	2.75	***10.48***	0.65	0.72	***1.37***	7.45	9.19	***16.64***	3.88	4.53	0.65
20	NK-99-051B	gabbro/clinopyroxenite	-	7.89	23.15	24.65	***47.80***	-	5.47	2.73	2.61	***10.81***	4.65	4.45	***9.10***	7.11	7.51	***14.62***	4.19	4.74	0.87
7	DJ-99-191	pyroxenite	-	3.23	21.02	32.09	***53.11***	-	6.73	3.75	2.71	***13.19***	3.25	2.34	***5.59***	10.12	8.06	***18.18***	3.43	2.90	0.38
26	DJ-99-253	gabbro	-	0.83	11.61	36.34	***47.95***	-	11.20	7.62	2.69	***21.51***	1.67	0.59	***2.26***	17.85	6.95	***24.80***	2.18	0.48	-
21	NK-99-049	gabbro	-	3.33	14.87	44.24	***59.11***	-	10.31	6.64	2.96	***19.91***	1.78	0.79	***2.57***	8.20	4.04	***12.24***	1.75	0.89	0.20
37	DJ-99-154	gabbro	-	4.44	23.35	30.06	***53.41***	-	5.50	3.06	2.21	***10.77***	4.29	3.09	***7.38***	9.25	7.37	***16.62***	3.44	3.31	0.61
16	NK-99-054A	gabbro	-	5.75	19.35	41.34	***60.69***	-	6.37	3.98	2.00	***12.35***	3.51	1.76	***5.27***	8.36	4.63	***12.99***	1.85	0.79	0.31
15	NK-99-061B	dioritic gneiss	-	7.65	28.08	50.64	***78.72***	*0.31*	1.40	0.65	0.74	***2.79***	-	-	-	3.19	4.00	***7.19***	1.22	0.80	1.32
23	NK-99-045B	monzonite	-	13.61	36.64	20.16	***56.80***	-	0.83	0.35	0.49	***1.67***	1.35	1.90	***3.25***	5.61	8.71	***14.32***	3.11	2.89	4.35
12	NK-99-046B	monzonite	-	7.18	34.36	31.13	***65.49***	*1.81*	2.25	1.07	1.15	***4.47***	-	-	-	7.15	8.50	***15.65***	2.50	1.67	1.23
34	NK-99-034B	monzogabbro/monzodiorite	-	4.75	30.18	39.45	***69.63***	-	3.06	1.43	1.60	***6.09***	1.69	1.88	***3.57***	5.65	6.98	***12.63***	2.29	0.72	0.33
8	NK-99-118	diorite/gabbro	-	4.93	29.17	34.30	***63.47***	*0.21*	6.08	3.30	2.57	***11.95***	-	-	-	7.87	6.76	***14.63***	2.24	1.22	1.36
1	NK-99-135B	gabbro	-	7.74	28.43	25.79	***54.22***	-	7.50	4.06	3.17	***14.73***	4.46	3.48	***7.94***	5.42	4.67	***10.09***	2.56	1.55	1.19
2	DJ-99-281B	biotite gabbro	-	7.06	32.61	29.53	***62.14***	-	5.96	3.00	2.83	***11.79***	1.50	1.41	***2.91***	5.38	5.60	***10.98***	2.33	1.45	1.35
35	NK-99-033B	gabbro	-	7.24	36.32	29.34	***65.66***	-	3.40	1.68	1.66	***6.74***	4.80	4.73	***9.53***	2.93	3.19	***6.12***	2.19	1.56	0.97
30	NK-99-039	monzogabbro/monzodiorite	-	18.03	40.75	27.00	***67.75***	-	-	-	-	-	0.50	0.51	***1.01***	3.75	4.17	***7.92***	1.46	1.64	0.91
36	DJ-99-155	leucogabbronorite	-	9.25	42.51	32.96	***75.47***	*0.54*	1.85	0.77	1.09	***3.71***	-	-	-	2.93	4.54	***7.47***	1.46	1.05	1.05
33	DJ-99-151	gabbronorite	-	15.22	37.99	22.99	***60.98***	-	1.90	0.89	0.99	***3.78***	2.17	2.41	***4.58***	4.73	5.80	***10.53***	2.25	1.51	1.15
9	NK-99-133	meta-gabbro	-	8.67	39.87	31.33	***71.20***	-	1.81	0.86	0.93	***3.60***	2.88	3.14	***6.02***	2.79	3.36	***6.15***	1.74	1.18	1.42
17	NK-99-055B	méta-gabbro	-	13.62	39.80	27.40	***67.20***	*0.87*	2.53	1.28	1.19	***5.00***	-	-	-	4.62	4.75	***9.37***	1.61	1.34	0.99
19	NK-99-044B	monzogabbro/monzodiorite	0.23	14.34	37.42	22.90	***60.32***	-	2.53	1.25	1.22	***5.00***	8.12	7.93	***16.05***	-	-	-	1.91	1.39	0.76
10	DJ-99-279B	biotite gabbro	-	11.87	34.77	23.92	***58.69***	-	4.67	2.61	1.88	***9.16***	9.01	6.49	***15.50***	0.55	0.44	***0.99***	1.79	1.08	0.93
4	NK-99-067B	qtz-monzonitic gneiss	-	20.84	40.94	26.48	***67.42***	*0.27*	-	-	-	-	-	-	-	3.25	4.29	***7.54***	1.33	1.39	0.80
14	NK-99-063B	monzogabbro/monzodiorite	-	19.87	40.27	19.84	***60.11***	-	2.20	1.01	1.17	***4.38***	4.19	4.83	***9.02***	1.20	1.53	***2.73***	1.70	1.33	0.84
5	NK-99-066B	monzodioritic/dioritic gneiss	6.81	19.42	36.02	18.73	***54.75***	-	1.12	0.47	0.66	***2.25***	5.45	7.66	***13.11***	-	-	-	1.70	1.14	0.83
Petit Mecatina domain intrusive suite																					
48	DJ-99-098	gabbro	-	8.62	18.43	33.74	***52.17***	-	6.67	4.12	2.15	***12.94***	0.87	0.46	***1.33***	12.71	7.34	***20.05***	2.61	2.08	0.20
47	NK-99-020B	gabbro	-	6.91	25.41	26.83	***52.24***	-	6.06	3.12	2.77	***11.95***	3.96	3.52	***7.48***	6.37	6.24	***12.61***	3.68	4.40	0.73
41	NK-99-029B	gabbro	-	9.26	26.20	25.78	***51.98***	-	5.10	2.48	2.54	***10.12***	3.76	3.85	***7.61***	5.39	6.09	***11.48***	3.79	4.83	0.93
49	NK-99-009B	gabbro	-	4.87	20.87	28.95	***49.82***	-	7.22	3.93	3.02	***14.17***	11.33	8.72	***20.05***	2.10	1.78	***3.88***	3.32	3.38	0.51
50	NK-99-012B	gabbro	-	1.06	20.98	36.22	***57.20***	-	7.51	4.88	2.11	***14.50***	10.65	4.61	***15.26***	5.29	2.53	***7.82***	2.18	1.78	0.20
43	DJ-99-084	qtz-monzonite	9.04	17.36	36.26	16.08	***52.34***	-	1.26	0.48	0.80	***2.54***	4.77	7.93	***12.70***	-	-	-	2.21	2.67	1.16
42	NK-99-021B	qtz-monzonite gneiss	10.92	26.54	36.62	14.09	***50.71***	-	0.62	0.28	0.34	***1.24***	3.69	4.44	***8.13***	-	-	-	1.05	0.94	0.47
51	NK-99-005B	granitic gneiss	20.30	28.28	33.11	7.52	***40.63***	-	0.80	0.27	0.54	***1.61***	2.06	4.09	***6.15***	-	-	-	1.15	1.36	0.54
46	DJ-99-110	kspar-phy. Granite	28.79	35.85	26.29	3.64	***29.93***	-	0.55	0.16	0.41	***1.12***	0.85	2.11	***2.96***	-	-	-	0.60	0.61	0.13
45	DJ-99-131	granite	40.63	28.62	26.80	1.55	***28.35***	-	0.27	0.03	0.26	***0.56***	0.15	1.16	***1.31***	-	-	-	0.30	0.22	0.02
Late- to post- Grenvillian granite																					
39	NK-99-078	porphyritic granite	9.10	32.16	34.53	8.01	***42.54***	-	1.50	0.56	0.96	***3.02***	2.97	5.11	***8.08***	-	-	-	1.64	2.19	1.27
27	NK-99-037	biotite augen granite	21.35	34.01	28.91	6.04	***34.95***	-	0.64	0.23	0.42	***1.29***	1.84	3.33	***5.17***	-	-	-	1.05	1.47	0.71
32	NK-99-072B	biotite granite	15.17	29.48	32.01	8.97	***40.98***	-	1.19	0.42	0.80	***2.41***	2.39	4.55	***6.94***	-	-	-	1.44	1.91	1.67
Plutonic rock of uncertain affinity																					
6	NK-99-064B	biotite augen granite	13.75	30.75	37.28	8.85	***46.13***	-	-	-	-	-	2.87	3.49	***6.36***	-	-	-	0.98	1.40	0.58
38	NK-99-126B	biotite granite	12.27	34.90	42.33	7.07	***49.40***	-	-	-	-	-	0.82	1.55	***2.37***	-	-	-	0.36	0.35	0.16
53	DJ-99-091	foliated granite	31.38	32.65	29.28	1.71	***30.99***	-	0.65	0.10	0.61	***1.36***	0.35	2.07	***2.42***	-	-	-	0.59	0.50	0.11
16	NK-99-054F	felsic dyke	3.87	8.55	45.82	21.98	***67.80***	-	0.27	0.12	0.14	***0.53***	6.23	6.88	***13.11***	-	-	-	1.89	2.24	1.82
31	DJ-99-241A	intermediate gneiss	10.36	18.15	37.85	12.82	***50.67***	-	2.39	1.06	1.32	***4.77***	5.37	6.67	***12.04***	-	-	-	1.68	1.30	1.02
44	DJ-99-068A	granitic orthogneiss	20.57	20.33	36.44	9.01	***45.45***	-	-	-	-	-	3.24	5.69	***8.93***	-	-	-	1.41	1.62	0.70
52	DJ-99-101A	tonalitic gneiss	19.05	26.74	35.57	10.12	***45.69***	-	0.26	0.10	0.15	***0.51***	2.54	3.74	***6.28***	-	-	-	0.80	0.59	0.33
Diabase																					
52	DJ-99-101B	metagabbro dyke	-	11.42	27.14	22.06	***49.20***	*0.43*	5.60	2.62	2.92	***11.14***	-	-	-	7.68	9.44	***17.12***	4.13	5.51	1.06
16	NK-99-054D	diabase	-	10.49	38.73	26.69	***65.42***	-	1.03	0.42	0.62	***2.07***	6.10	8.86	***14.96***	0.87	1.39	***2.26***	2.35	1.61	0.85

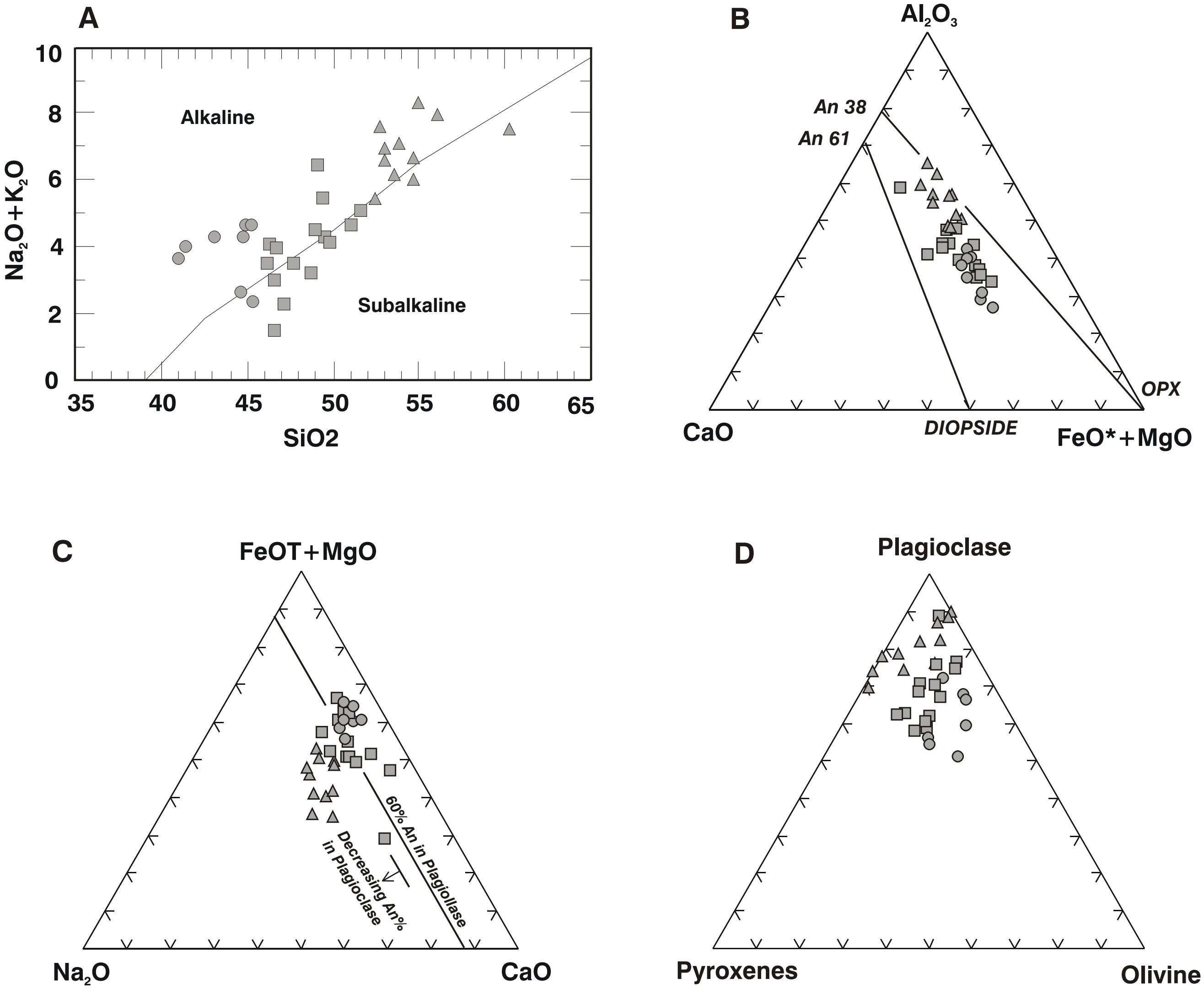


Figure 3. *Major-element and normative composition diagrams of the MMIS samples. Legend: circle - ultramafic rock (SiO_2<46 wt.%); square - mafic rock (46-52 wt.% SiO_2); triangle - intermediate rock (SiO_2>52 wt.%). (A) Plot of total alkali* vs *silica showing the alkaline–subalkaline boundary of Irvine and Baragar (1971). (B) ACF diagram. (C) FNC diagram. (D) Ternary plot of normative plagioclase, pyroxenes (diopside + hypersthene), and olivine.*

the geochemistry of the rocks cannot be directly discussed in terms of models applied to lava, considerably limiting the petrogenetic interpretation. Normative mineral mode (CIPW norm, Table 3) and composition diagrams are used to characterize the rocks and to show their similarities and differences.

MEALY MOUNTAINS INTRUSIVE SUITE

Mesoscopic examination of the MMIS gabbro and diorite samples indicates they are essentially composed of plagioclase, clinopyroxene, orthopyroxene, accessory hornblende and biotite, and up to a few percent sulphides and Fe–Ti oxides; olivine occurs only rarely. Dioritic and monzodioritic samples are distinguished by ubiquitous K-feldspar and by greater abundances of biotite and hornblende at the expense of pyroxenes.

Analyzed MMIS samples (Tables 1 and 2) have SiO_2 contents ranging from 41.01 to 60.24 wt.% (average = 49.29 wt.%; Table 1). Three subgroups are distinguished in Figures 3 and 4; ultramafic (SiO_2 <46 wt.%), mafic (SiO_2 46 to 52 wt.%), and intermediate (SiO_2 >52 wt.%). The mafic and ultramafic subgroups have average CaO of 9.80 wt.% (6.67 to 13.68 wt.%), Na_2O of 2.92 wt.% (1.37 to 4.37 wt.%), K_2O of 1.02 wt.% (0.14 to 2.25 wt.%), MgO of 6.56 wt.% (2.03 to 13.87 wt.%), and total iron expressed as Fe_2O_3 of 12.47 wt.% (5.06-19.90 wt.%). The intermediate subgroup, which

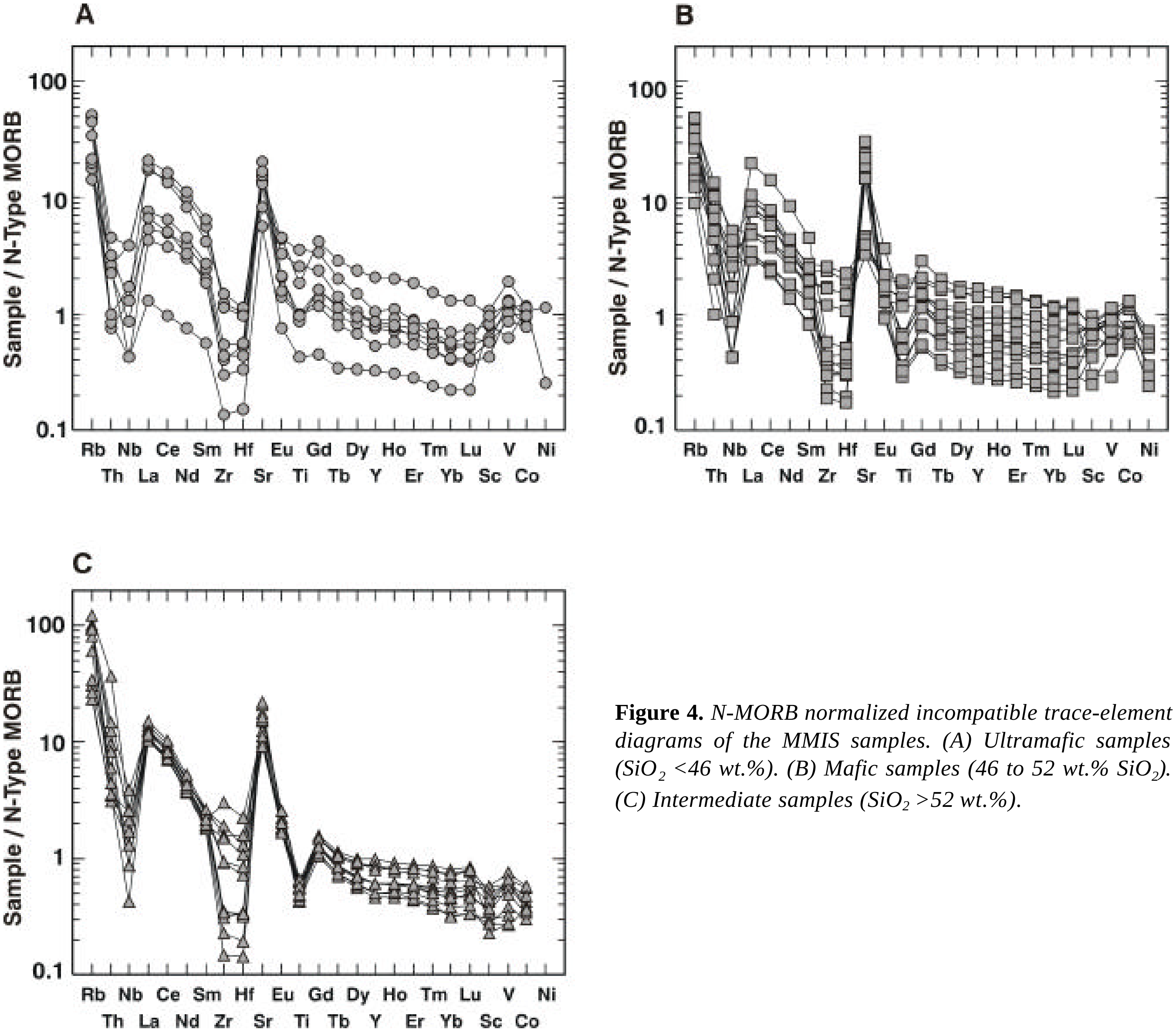


Figure 4. *N-MORB normalized incompatible trace-element diagrams of the MMIS samples. (A) Ultramafic samples (SiO_2 <46 wt.%). (B) Mafic samples (46 to 52 wt.% SiO_2). (C) Intermediate samples (SiO_2 >52 wt.%).*

has an average K_2O of 2.39 wt% (1.21 to 3.47 wt.%), includes the monzodioritic samples. The latter are further distinguished by their higher average Na_2O of 4.55 wt.% (4.06 to 5.04 wt.%), and lower average CaO of 6.57 wt.% (4.77 to 7.99 wt.), MgO of 3.09 wt.% (1.83 to 4.90 wt.%), and total iron as Fe_2O_3 of 7.19 wt.% (5.30 to 9.39 wt.%).

The mafic and ultramafic samples are also markedly enriched in Al_2O_3 (18.09 wt.%) and deficient in TiO_2 (1.08 wt.%) compared to the Mackenzie dyke swarm (Al_2O_3 =13.86 wt.%; TiO_2= 2.47 wt.%), to the Columbia River basalts (Al_2O_3=14.34 wt.%; TiO_2= 2.33 wt.%), and to ocean-island basalts (Al_2O_3=12.80 wt.%; TiO_2=2.57 wt.%). This is consistent with crystal fractionation and accumulation.

All the analyzed MMIS samples are silica-saturated (olivine + hypersthene in the norm) or silica-undersaturated (olivine and nepheline in the norm), except Sample 5 containing over 60 wt.% SiO_2 (Table 3). They can be described as transitional to alkaline because they tend to plot near or slightly above the alkaline–subalkaline dividing line on an $Na_2O + K_2O$ *vs* SiO_2 diagram (Figure 3a). The abundance of normative olivine contrasts with it scarcity in the field; this results essentially from the anhydrous nature of the norm. The abundance of primary hornblende and biotite, which are common accessory minerals in these rocks, was likely controlled by the availability of deuteric water during crystallization.

That the MMIS samples are essentially mixtures of plagioclase, pyroxenes and olivine is well illustrated in the ACF and normative Plagioclase–Pyroxenes–Olivine diagrams (Figures 3a and d). Normative plagioclase content of the ultramafic, mafic and intermediate subgroups average 49 wt.%, 59 wt.%, and 64 wt.% respectively. Orthose content of intermediate samples average 14 wt.%, in contrast with the 6 wt.% averages of the more mafic subgroups. Mean anorthite content in plagioclase decreases from approximately An60 in ultramafic samples, to approximately An56 and An40 in mafic and intermediate samples, respectively. Except for Sample 23, rocks of the mafic and ultramafic subgroups can be described either as olivine–gabbronorite or olivine–diorite (normative plagioclase < An50). Given their high normative orthose and K_2O content, intermediate samples are best described as olivine-monzodiorite. The trend of decreasing normative anorthite in plagioclase is reflected in the ACF and Na_2O–CaO–FeOT* +MgO diagrams (Figure 3b, and c), which also illustrate the limited compositional variability and the continuous nature of the suite.

The principal features of the trace-element patterns for the three subgroups are shown in N-MORB normalized extended elemental plots (Figure 4). The elemental abundances and distribution patterns of the three subgroups are remarkably similar, essentially overlapping each other. The pattern shows a marked enrichment in high-field strength elements (HFSE) relative to N-MORB, and a relatively flat heavy-REE distribution near or somewhat below the normalizing values. As expected, the samples of the intermediate subgroup are depleted in transition metals relative to the more mafic rocks. The close similarities observed in the trace-element pattern provide strong support to the hypothesis that these rocks are all genetically related.

The most notable features of the patterns are given by the well-defined negative Th, Nb, Zr, and Hf anomalies, which are coupled with a positive Sr spike. Titanium also defines a small negative anomaly, relative to Eu and Gd, that is more pronounced in the intermediate samples. The absence of an Eu anomaly, relative to Sm and Gd, is also notable. Such patterns indicate that fractional crystallization could have been an important process in the petrogenesis of the suite. The compatibility of Sr in plagioclase, which cotectically crystallized with olivine and/or pyroxenes, results in a nearly constant Sr in magma as elements highly incompatible in plagioclase, olivine, and pyroxenes gradually increase concentration in residual melt.

MECATINA TERRANE GABBRO (Unit M_{MC} gbr)

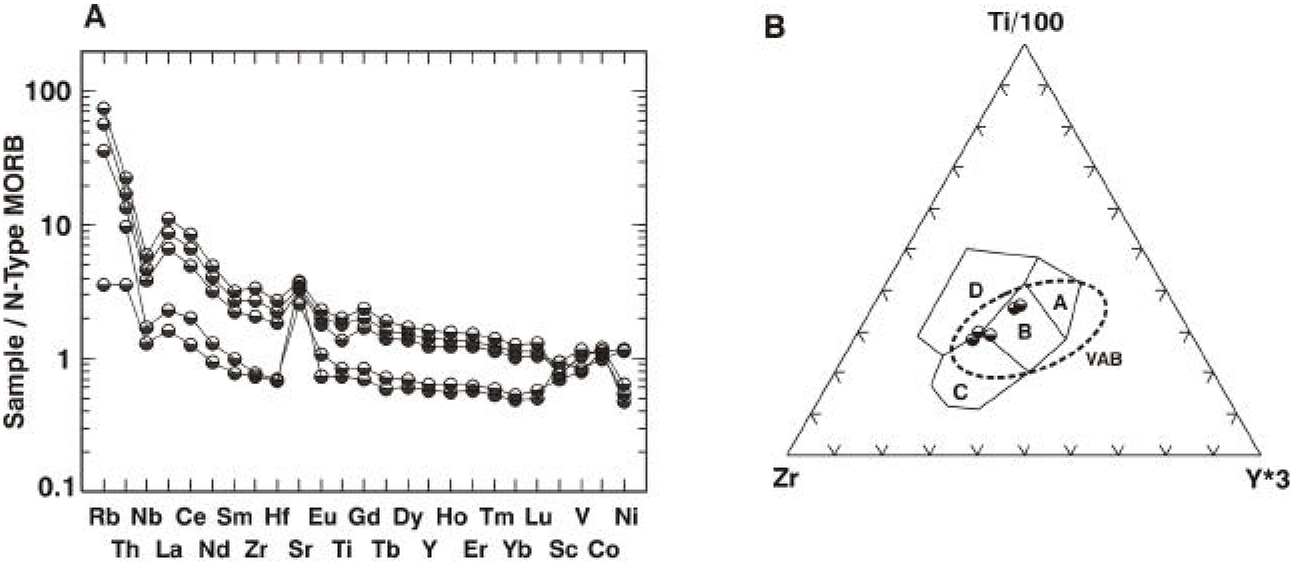
The geochemistry of gabbro bodies and dykes in the Mecatina terrane differs considerably from the geochemistry of MMIS gabbro and gabbronorite. Samples of Mecatina terrane gabbro have a major-element composition that closely resembles the typical gabbro and basalt of Le Maitre (1976). The presence of plagioclase cumulate in the rock is suggested by the small enrichment in Al_2O_3 (16.37 wt.%) and depletions in TiO_2 (1.71 wt.%) and P_2O_5 (0.23 wt.%) compared to the Mackenzie dyke swarm (Al_2O_3 =13.86 wt.%; TiO_2= 2.47 wt.%; P_2O_5=0.97 wt.%), and to the Columbia River basalts (Al_2O_3 =14.34 wt.%; TiO_2= 2.33 wt.%; P_2O_5=0.45 wt.%).

The N-MORB normalized extended elemental plots also show a marked enrichment in high-field strength elements (HFSE), and very gently dipping heavy-REE (Figure 5a). In contrast to MMIS rocks, there is no depletion in Th, Zr, and Hf, and the amplitudes of the Nb, Sr, and Ti anomalies are much smaller. While the least fractionated samples exhibit prominent positive Sr spikes, and small positive Eu anomalies, the most fractionated rocks show much smaller positive Sr anomalies, and weak negative Eu and Ti anomalies. These signatures suggest that the samples with the strongest positive Eu anomalies and the lowest concentrations of incompatible elements are likely to represent plagioclase cumulate and, conversely, that those with higher concentrations of incompatible elements are most likely to approach residual liquid composition. Accordingly, the compositional range of samples having higher concentrations of incompatible elements is likely to reflect the composition of the parent magma.

It is emphasized that the patterns suggest limited Ti fractionation, and show no evidence for Th, Zr, Hf and Y fractionation, hence providing justification for the use of incompatible trace-element tectonic discrimination diagrams. The Mecatina terrane gabbro samples plot within the 10 percent probability ellipse for volcanic-arc basalts of Pearce (1996) in both the Ti–Zr–Y (Pearce and Cann, 1973) and Th–Ta–Hf (Wood *et al.*, 1979) discrimination diagrams (Figure 5b, and c). This is consistent with emplacement in an Andean-type arc setting.

QUARTZ MONZONITE (Unit M_{MC} qmm), PORPHYRITIC GRANITE (Unit M_{MC} kpg), and GRANITE (Unit M_{LG} kpg-grn)

Given the small number of analyses, interpretation of the geochemical data from the early Mesoproterozoic (Pinwarian) Mecatina terrane quartz monzonite (Unit M_{MC} qmm) and K-feldspar porphyritic granite (Unit M_{MC} kpg), and of the late- to post-Grenvillian granite (M_{LG} kpg-grn) samples is provisional. Significant differences in trace-element compositions are nonetheless recognizable (Figure 6a). Continental crust normalized REE patterns of the Mecatina terrane quartz monzonite and K-feldspar por-



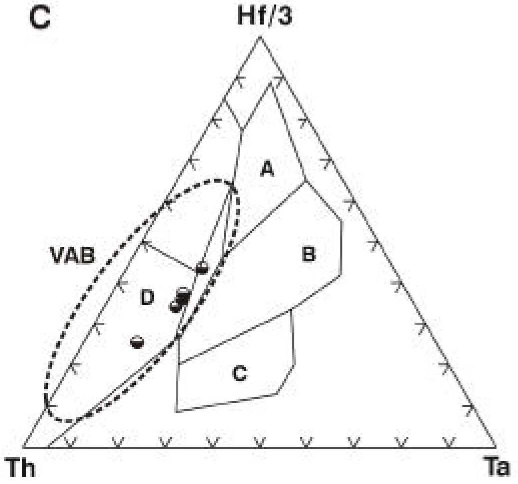


Figure 5. *Trace-element composition diagrams of early Mesoproterozoic gabbro from the Mecatina terrane. (A) N-MORB normalized incompatible trace-element diagram. (B) Ti–Y–Zr tectonic discrimination diagram of Pearce and Cann (1973). The diagram shows the 10 percent probability ellipse for volcanic-arc basalt (VAB) of Pearce (1996) and emphasizes the absence of data points in the within-plate basalt (WPB) field. Note: 1) on the Ti–Zr–Y diagram, MORB plot in field B, calc-alkaline VAB plot in fields B and C, tholeiitic VAB plot in field A and C, and WPB plot on field D; 2) on the Th–Ta–Hf diagram, tholeiitic MORB plot in field A, E-MORB and tholeiitic WPB plot in field B, alkalic WPB plot in field C, and VAB in field D.*

phyritic granite show subtle enrichments in relative light- to heavy-REE, with negative Eu anomalies varying in amplitude. The width of the trace-element spectrum reflects compositional variability of these units. In contrast, late- to post-Grenvillian granite samples are singled out by their generally higher abundances in trace elements, a small positive Ce anomaly, and an overall greater enrichment in relative light- to heavy-REE. It may be worth noting that granite samples from sites 38 and 53 share the geochemical signature of the early Mesoproterozoic granitic rocks, although initially assigned to other units from field observations (Figure 6a).

Analyses from the early Mesoproterozoic units plot within or close to the boundary of volcanic-arc granite fields on both Nb–Y and Rb–Y+Nb tectonic discrimination diagrams (Figure 6b and c). This is consistent with models involving the development of an early Mesoproterozoic Andean-type margin along the southeastern margin of Laurentia. In contrast, the late- to post-Grenvillian granites form a tight cluster in the within-plate-granite field, consistent with their emplacement in significantly older crust.

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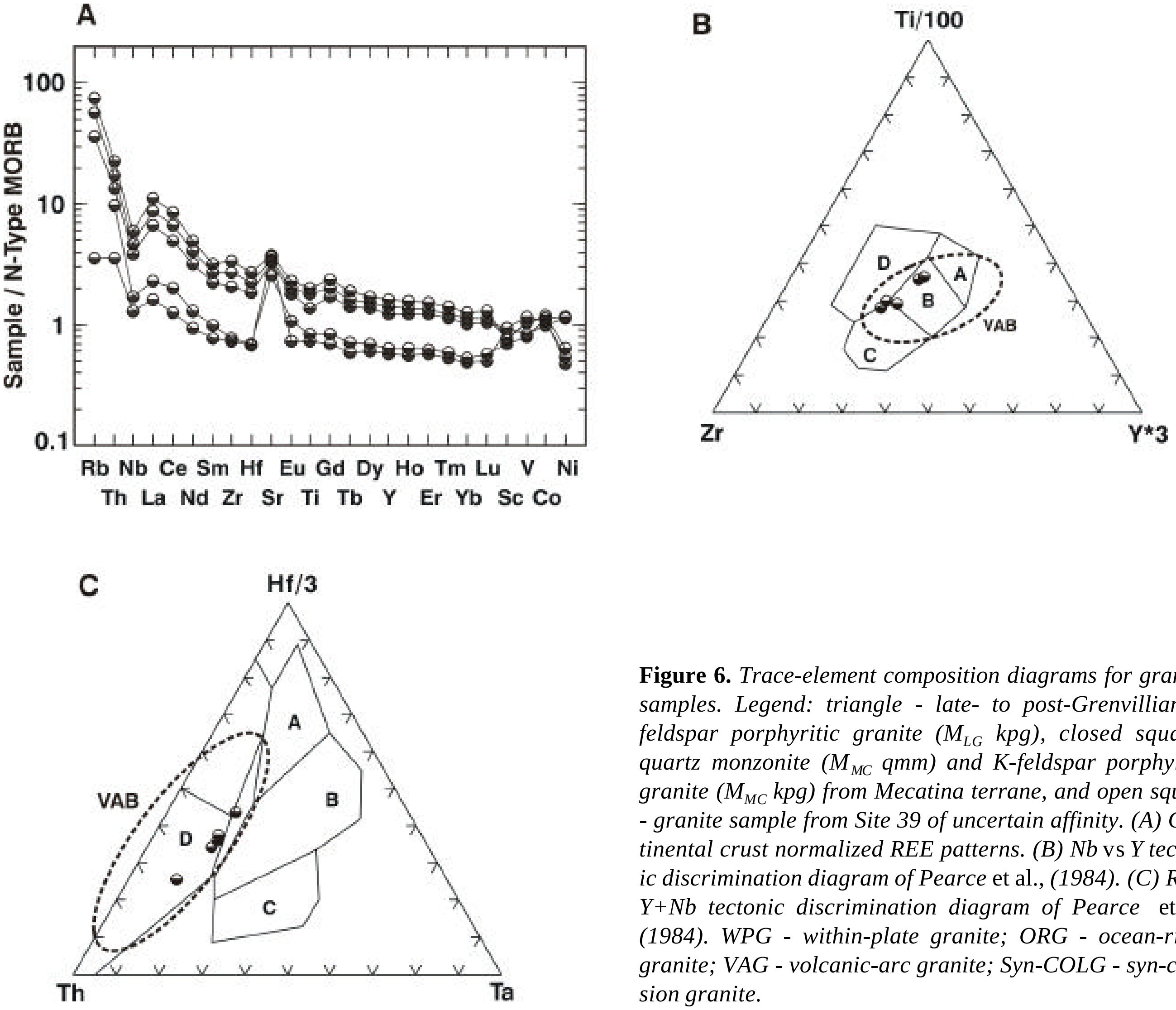

Figure 6. *Trace-element composition diagrams for granitic samples. Legend: triangle - late- to post-Grenvillian K-feldspar porphyritic granite (M_{LG} kpg), closed square - quartz monzonite (M_{MC} qmm) and K-feldspar porphyritic granite (M_{MC} kpg) from Mecatina terrane, and open square - granite sample from Site 39 of uncertain affinity. (A) Continental crust normalized REE patterns. (B) Nb* vs *Y tectonic discrimination diagram of Pearce* et al., *(1984). (C) Rb* vs *Y+Nb tectonic discrimination diagram of Pearce* et al., *(1984). WPG - within-plate granite; ORG - ocean-ridge granite; VAG - volcanic-arc granite; Syn-COLG - syn-collision granite.*

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