LEGEND FOR THE GEOLOGICAL MAP OF THE MONT SAINT HILAIRE PLUTON

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CRETACEOUS

MONT SAINT HILAIRE PLUTON (units 3-12)

East Hill Suite (units 9-12)

12 Fine-grained nepheline syenite, porphyry and phonolite with trachytoid felsdpar, nepheline and sodalite phenocrysts and xenocrysts.

----- intrusive contact -----

11 Coarse-grained peralkaline nepheline syenite and pegmatite with feldspar, nepheline and sodalite phenocrysts

----- relations uncertain -----

10 Breccia of well-rounded, locally altered, fragments in comminuted matrix. Fragments mainly of units 2-8, with minor 9, 11 and 12

----- cross-cutting contact -----

9 Igneous breccia with rounded, contorted fragments and xenocrysts of units 3-12 in a trachytoid, opaque-charged matrix

----- cross-cutting contact -----

Pain de Sucre Suite (units 7-8)

8 Medium to coarse-grained nepheline diorite and monzonite, plagioclase rimmed by k-spar, interstitial nepehline, mafic clots containing olivine, titanaugite, kaersutite and biotite

----- gradational contact -----

7 Biotite trachygabbro; plagioclase laths with thin k-spar rims, mafic clots of olivine, titanaugite, kaersutite and biotite

----- intrusive contact -----

Sunrise Suite (units 3-6)

6 Anorthositic gabbro and leucogabbro, commonly foliated and rich in titanaugite and magnetite

----- gradational contact -----

5 Kaersutite gabbro; strongly foliated, coarse-grained rocks with minor titanaugite and biotite

----- gradational contact -----

4 Kaersutite-pyroxene gabbro; moderately to weakly foliated granoblastic rocks with subequal amounts of kaersutite and titanaugite

----- gradational contact -----

3 Melagabbro and jacupirangite: strongly to moderately foliated, medium-grained rocks rich in titanaugite and magnetite

----- intrusive contact -----

2 Hornfels and metasomatised hornfels; fine-grained to aphanitic brown to black, conchoidally fracturing pelites with abundant dyke

ORDOVICIAN

1 RICHMOND GROUP; calcareous siltstone and shale, siltstone, limestone

15 Strike and dip of bedding

80 Strike and dip of joints

45 Strike and dip of igneous lamination or layering

Geological contact, approximate, gradational

Geology by K.C. Rajasekeran 1966; H.M.Aarden 1970; K.L.Currie 1971,1972
Geological compilation and interpretation by K.L. Currie 1982

NOTES TO THE GEOLOGICAL MAP OF THE MONT SAINT HILAIRE PLUTON

Mont Saint Hilaire forms a prominent landmark 30 km east of Montreal, rising as a steep, roughly circular massif about 2 km in diameter which reaches a height of 350 m above the surrounding lowlands. The pluton is readily accessible by highway and local roads in the city of Saint Hilaire. Most of the pluton is owned by McGill University (Gault donation), and the western half is operated as a public park criss-crossed by a network of foot trails. The eastern half forms a biological reserve, but can be examined with permission from the conservators. The present map was compiled from field work at a scale of 1:6000 undertaken in 1971 and 1972, at which time systematic sampling was also completed. Petrological interpretation has been summarised elsewhere (Currie et al. 1985), and the raw analytical data on which this interpretation was based are appended to this report.

General geology

The Mont Saint Hilaire pluton was glaciated during the latest ice advance, producing the characteristic steep north and northwest faces, with a tail of unconsolidated material (now largely covered by orchards) stretching off to the south-southeast. Outcrop is generally good by the standards of the Saint Lawrence lowland, but there is little exposure in the median valley north of Lac Hertel or along the southern edge of the pluton. The pluton intrudes calcareous shale, siltstone and limestone of the Upper Ordovician Lorraine and Richmond Groups (Clark,1955) and a hornfels collar 10 to 150 m wide surrounds the pluton. A pronounced north-south valley divides the pluton into a western mafic portion and an eastern salic portion. The oldest rocks, the Sunrise suite, comprise melanocratic

to ultramafic amphibole-bearing gabbro and melagabbro. The younger Pain de Sucre suite, which locally intrudes the Sunrise suite ranges from biotite trachygabbro to nepheline diorite, and consistently contains olivine, nepheline and potash feldspar. The East Hill suite which intrudes the other two, consists of leucocratic peralkaline rocks ranging from sodalite-nepheline syenite and phonolite through a variety of igneous breccias. All the suites exhibit local well-developed igneous layering. Isotopic data discussed by Currie et al. (1985) suggest emplacement of the Sunrise suite at about 136 Ma (Cretaceous), and emplacement of the Pain de Sucre and East Hill suites at about 122 Ma.

Description of units

Ordovician sedimentary rocks (unit 1) surrounding the pluton can be examined in quarries on the north side of the mountain and rare outcrops elsewhere. More than 150 m from the pluton strata are undisturbed, almost horizontal, fissile, thin to medium-bedded calcareous shale and siltstone.

Hornfels (unit 2) forms a hard, homogeneous grey to brownish-black unit whose contacts with the pluton commonly dip inward at angles from 20 to 70^{0}. The contact is knife sharp on the west side of the pluton, but the igneous rocks rarely display chilling, and may be coarse-grained. The grade of hornfelsing is biotite zone or less, except within 3 m of the contact. On the east side of the intrusion the grade is not higher than albite-chlorite, but arfvedsonite and minute grains of narsarsukite and neptunite are locally present up to 300 m from the contact demonstrating substantial alkali metasomatism. In thin section hornfels specimens consist of fine mosaic quartz, albite, muscovite, biotite, chlorite and calcite. Hornfels

inclusions occur commonly in igneous breccias of the East Hill suite.

The Sunrise suite (units 3-6) outcrops in an elliptical area trending northwest to southeast. With the exception of rare cumulate anorthosite, the colour index of the suite excedes 50 and commonly approaches 80. Most of the rocks are best described as melanocratic gabbro. All of the rocks of the Sunrise suite exhibit trachytoid layering and spectacular cumulate textures. Foliation within the suite defines a saucer-like structure plunging south-east to a steeper pipe-like mass north of Lac Hertel.

The most mafic part of the Sunrise suite (unit 3) comprises pyroxene melagabbro grading to jacupirangite (magnetite-titanaugite pyroxenite) which forms a fringe around the suite, and occurs as large inclusions in the East Hill suite. These relatively fine-grained (<2mm), dark brownish-black rocks exhibit trachytoid texture with distinct foliation. In thin section titanaugite may be cracked or granulated. Kaersutite forms adcumulus overgrowths on titanaugite. Magnetite occurs as large euhedra, locally reaching 25 percent by volume. Bytownite forms clusters of interstital laths. Sphene is present rarely as a secondary alteration of titanaugite. Olivine occurs rarely (2 of 36 specimens), and orthopyroxene was identified in one specimen by electron probe (Table 2), presumably as a result of contamination with host rocks.

Amphibole-pyroxene gabbro (unit 4) forms a belt between the mela-gabbro (to which it grades) and the central amphibole gabbro (unit 5) to which it also grades. The rocks exhibit trachytoid or radiating textures, commonly with euhedra of plagioclase up to 1 cm, and poikilitic clots of amphibole. The rocks contain euhedral phenocrysts of both titanaugite and kaersutite, but pyroxene is always thickly mantled by amphibole, which may form clots

up to several cm across including plagioclase and pyroxene. Plagioclase lathes lie in the labradorite range, and show little zoning. A thin selvedge of biotite is rarely found around amphibole clots. Apatite and magnetite are common accessories.

Amphibole gabbro (unit 5) consists essentially of aligned plagioclase lathes up to 2 cm in length with interstitial poikilitic kaersutite. Minor, thickly rimmed, euhedra of titanaugite may be present, and in thin section cores of euhedral kaersutite can be seen in amphibole clots. The plagioclase is unzoned sodic labradorite. Biotite forms thin fringes on large amphibole clots, and apatite and magnetite occur in accessory amounts. These rocks exhibit a variety of spectacular igneous textures. Similar rocks occur commonly as dykes in the hornfels collar.

Anorthositic gabbro (unit 6) resembles unit 5 and grades to it, but contains 80-85 volume percent of plagioclase. These rocks form two mappable lenticles which appear to represent "top" cumulates.

The Pain de Sucre suite forms a high-standing outer ring around the western part of the pluton. Intrusive relations to the Sunrise suite can be seen on the southern slopes of Sunrise Hill and north of Lac Hertel, and deduced from numerous assimilated blocks within the Pain de Sucre suite. Rocks of the Pain de Sucre suite are generally massive and coarse grained. The Pain de Sucre suite forms a steeply dipping ring-dyke. The portion presently missing from the southeast sector can be reconstructed from inclusions in the East Hill suite.

The older part of the Pain de Sucre suite consists of biotite trachy-gabbro (unit 7) exposed along the outer edge of the suite. This mesocratic

massive, coarse gabbro consists of plagioclase normally zoned from An_{50-30} with thin rims of alkali feldspar, and about equal amounts of euhedral but associated titanaugite and biotite. Olivine occurs as altered granules, and amphibole locally forms thin selvedges on pyroxene. Magnetite and apatite occur in accessory amounts.

Nepheline diorite and monzonite (unit 8) forms the bulk of the Pain de Sucre suite. These rocks have been called essexite and rouvillite, but a simpler terminology is adequate. In outcrop they form leucocratic, coarse-grained rocks with a distinct blueish cast and visible laths of potash feldspar. Locally textures range from medium-grained to pegmatitic, and a crude, vertical layering may be present. Large feldspar lathes (up to 5 cm long) are zoned from labradoritic cores to about An_{25} and then exhibit an abrupt, but transitional change to thick potash feldspar rims, which may be perthitic. Separate grains of potash feldpar are rare, but the amount of potash feldspar commonly excedes plagioclase. Nepehline occurs as large interstitial grains, commonly partially altered to cancrinite. Mafic minerals occurs as complex polymineralic clots involving olivine, titanaugite, kaersutite and biotite. Titanaugite has been partially replaced by kaersutite, which in turn is rimmed by biotite. Accessory magnetite and apatite also tend to occur in the mafic clots.

The contact between the Sunrise and Pain de Sucre suites and the East Hill suite lies in the median valley running north from Lac Hertel where exposure is poor. The East Hill suite consists of a fragment-charged igneous breccia (unit 9), younger diatreme-like breccias (unit 10) which essentially lack an igneous matrix, sodalite-nepheline syenite and

pegmatite (unit 11), and phonolitic rocks and tinguaites (unit 12). Mutually cross-cutting relations are observed among all these units, so they must be almost contemporaneous. Phonolites exhibit flow-banding suggesting a cone-sheet structure dipping inward at angles of 70-80^0 toward a point north of Lac Hertel. Much of the coarse-grained syenite appears to form large xenoliths, but some is clearly intrusive in the form of dykes or small plugs.

Igneous breccia (unit 9) comprises a fine-grained to aphanitic matrix charged with myriads of inclusions best seen on weathered surface. Inclusions may be stretched or contorted along flow-banding, and many were frozen in the process of disaggregation. Larger inclusions consist of mafic alkaline rocks, and the matrix is charged with cracked and corroded xenocrysts of titanaugite, kaersutite and calcic plagioclase, all in various states of reaction with the matrix. The matrix consists of trachytoid microlites of albite and greenish pyroxene granules in an opaque-charged groundmass. Blocks of mafic alkaline rocks of mappable size occur as enclaves within the breccia. The distinction between mafic rocks disrupted by syenitic net-veining and igneous breccia charged with mafic fragments locally becomes impossible.

Diatreme breccias (unit 10) consist of rounded fragments of rock densely packed together in a comminuted matrix. These breccias appear to occur in irregular or lobate vertical pipes up to 100 m across. The breccia contains not fragments of mafic alkaline rocks up to 50 m across, as well as rare igenous breccia, phonolite and syenite fragments, and also blocks of hornfels and little altered sedimentary rocks. Gold (1963) found that

limestone blocks from the breccia contain fossil assemblages ranging in age from Trentonian (Early Ordovician) to Helderbergian (Devonian), compared to the Late Ordovician age of host rocks at the present level of exposure. Vigourous vertical mixing at low temperatures must have occurred during emplacement of the breccias, suggesting diatreme-like conditions.

Coarse-grained syenitic rocks (unit 11) form a poorly-exposed, discontinuous fringe around the eastern side of Mont Saint Hilaire. This unit occurs as inclusions and xenocrysts in the phonolite of Unit 12, and most of the occurrences may be large inclusions. However well-defined, though irregular and discontinuous, dykes of sodalite syenite cut nepheline diorite in the De Mix quarry, a celebrated mineral-collecting locality, and small plug-like masses of similar rocks appear to cut phonolite northeast of Lac Hertel. The rocks consist of moderately aligned tabular feldspar laths (grid perthite), large greenish nepheline and sodalite euhedra, and fine-grained greenish-brown, interstitial acmitic pyroxene. Small amounts of orange lepidomelane occur in many specimens. Enigmatite, astrophyllite, eudialyte, catapleiite and lavenite form occasional accessories, but rare Na-Zr and Na-Ti silicates tend to be confined to pegmatitic schlieren and patches. All specimens of coarse-grained rocks contain a small amount of interstitial trachytic matrix similar to unit 12, suggesting that coarse-grained phases may be largely cumulates from the phonolitic rocks.

Fine-grained syenite and phonolite (unit 12) form a large mass northeast of Lac Hertel, and occurs ubiquitously in fine-grained green tinguaite dykes. A fine grained trachytoid matrix of feldspar and green pyroxene microlites with minute, equant nepheline, contains large, cracked, granulated and corroded xenocrysts of feldspar, sodalite and nepheline. The

most comon alteration product appears to be natrolite. Minute lepidomelane is locally present, and a variety of Na-bearing minerals have been identified in particular specimens, but they are rare in this unit.

References cited

Clark,T.H. 1955. Saint Jean-Beloeil area; Ministeres des Richesses Naturelles de Quebec. Geological Report 66

Currie,K.L., Eby,G.N. and Gittins,J. 1986. The petrology of the Mont Saint Hilaire complex, southern Quebec: an alkaline gabbro-peralkaline syenite association. Lithos 19, 65-81

Gold,D.P. 1963. The relationships between the limestones and the alkaline igneous rocks of Oka and Saint Hilaire, Quebec. unpublished Ph.D. thesis, McGill University, Montreal

CAPTIONS FOR TABLES

Table 1:
Bulk rock chemical analyses for the Mont Saint Hilaire pluton

Major analyses by GSC Rapid Methods Group, performed in duplicate, mainly by XRF on pressed powders, with separate determinations for FeO, H_2O and CO_2. Trace element analyses by XRF and emission spectroscopy. Trace element analyses on samples marked with an * by instrumental neutron activation analysis, performed by G. Nelson Eby, University of Lowell. Unit numbers refer to the map legend.

Table 2:
Electron microprobe mineral analyses for Mont Saint Hilaire

Analyst, J.Gittins, University of Toronto, using the Cameca instrument at Cambridge University with an accelerating voltage of 20 kv and a specimen current of 5 nA.

Table 1: Bulk rock chemical analyses of the Mont Saint Hilaire pluton

Sample	277	283A	40A	143*	150	188B	205
Location	410/725	450/720	560/560	265/580	260/630	280/585	275/530
Map Unit	2	2	3	3	3	3	3
SiO2	71	67.1	42.35	42.1	37.55	29.7	35.7
TiO2	0.87	0.93	3.29	3.59	6.82	7.9	6.23
Al2O3	11.75	13.1	10.75	11.5	18.65	6.95	14.4
Fe2O3	2.2	1	2.25	5.8	7.3	10.1	6.7
FeO	5	6.3	9.9	8.8	7.05	11.7	7.5
MnO	0.12	0.13	0.25	0.34	0.19	0.45	0.19
MgO	3.45	4.01	11.65	9.36	4.96	10.3	5.8
CaO	2.09	1.51	12.6	14.1	14.46	15.7	17.2
Na2O	1.48	2.03	1.58	2.06	1.49	1.23	1.2
K2O	0.67	1.26	1.03	0.32	0.32	0.31	0.1
H2O	1.65	1.7	2.25	0.6	1.05	0.85	1
CO2	0.45	0.75	1.15	0.3	0.4	0.4	0
P2O5	0.06	0.06	0.63	1.2	0.27	4.16	3.17
S	0.13	0.14	0.31		0.28	0.07	nd
Total	100.92	100.02	99.99	100.07	100.79	99.82	99.19
Trace elements (ppm)							
Nb	14	18	80		26	50	110
Ni	46	60	175		29	0	0
Cr							
Sr	265	135	670		1030	681	1100
V	145	150	315		370	0	nd
Y	23	27	24		15	75	35
Sc				29			
Co	20	23	59	49	36	0	42
Rb	24	79	31		4	8	nd
Cs							
Ba	210	215	405	440	130	0	64
La	nd	nd	nd	42	nd	nd	90
Ce				95			
Nd				40			
Sm				9.1			
Eu				3.7			
Tb				1.32			
Yb				2.3			
Lu				0.36			
Zr	270	280	350	260	145	261	170
Hf				5			
Ta				2			
Th				0.8			

Specimens analysed in duplicate by G.S.C. Analytical Chemistry Laborator

Sample	220B*	263	305	310	357*	383*	468
Location	215/485	305/540	290/535	285/610	305/685	380/530	0.632075
Map Unit	3	3	3	3	3	3	3
SiO2	36.7	46.9	39.3	37.5	49.45	40.25	39.9
TiO2	5.55	2.98	5.64	5.63	2.11	5.23	4.1
Al2O3	16.1	16.3	11.2	12.3	20.45	14	20.2
Fe2O3	5.3	4.45	6	5.5	2.35	6.65	4
FeO	9.2	6.7	9.8	10	4.7	6.15	6.5
MnO	0.29	0.34	0.24	0.33	0.22	0.21	0.13
MgO	3.4	3.75	7.7	5.8	2.12	6.57	3.7
CaO	12.1	6.64	14.4	13	7.44	16.7	14.9
Na2O	2.64	5.53	1.9	2.3	5.43	1.54	1.9
K2O	1.3	2.93	0.9	1.2	2.39	0.22	0.4
H2O	0.9	0.8	1.4	0.5	0.65	1.2	1
CO2	0	0.4	0.6	0	0.65	0.1	0
P2O5	3.17	1.62	0.25	2.58	1.16	1.24	1.42
S	nd	0.03	nd	nd	0.05	0.46	nd
Total	96.65	99.37	99.33	96.64	99.17	100.52	98.15
Trace elements (ppm)							
Nb	140	158	110	110	114	43	100
Ni	nd	15	29	0	9	48	0
Cr							
Sr	1900	1160	530	1500	2950	104	1700
V	nd	140	nd	nd	110	440	nd
Y	54	66	36	42	28	24	28
Sc	7.8	5.3			3.7	16.9	
Co	26.1	19.3	36	22	10.8	31	24
Rb	22	73	nd	nd	74	2	nd
Cs	0.31	0.8			0.7		
Ba	490	960	160	290	1150	280	120
La	93	121	170	99	94	40	83
Ce	193	267			193	88	
Nd	103	102			79	43	
Sm	20.7	22			15	8	
Eu	5.45	6.11			5.68	2.82	
Tb	2.1	2.3			1.5	1	
Yb	2.7	3.9			2.4	2.2	
Lu	0.38	0.59			0.33	0.31	
Zr	490	530	90	210	360	250	120
Hf	7.1	11.6			7.1	4	
Ta	5	11.3			8.1	3.5	
Th	3.7	14			11.5	3.9	

ies

2

Sample	161*	190	225B	242	267*	278	344
Location	275/620	280/680	375/645	390/645	380/650	270/590	415/605
Map Unit	4	4	4	4	4	4	4
SiO2	42.3	39.05	41.5	37.3	40	42.6	39.55
TiO2	4.11	4.94	4.88	5.62	4.91	3.52	4.16
Al2O3	18.75	17.35	14.8	16.9	17.85	19.7	18.65
Fe2O3	5.35	4.55	6.3	4.8	5.55	3.5	4.85
FeO	5.8	8.05	8	8.8	6.9	6.1	6.55
MnO	0.19	0.29	0.3	0.22	0.25	0.18	0.27
MgO	3.91	5.24	4.9	4.6	4.69	4	5.49
CaO	12.8	13.1	12.9	15.5	14	11	14.45
Na2O	2.86	3.03	3	1.7	2.62	3.9	2.56
K2O	0.68	0.46	0.6	0.3	0.51	1.1	0.47
H2O	0.85	1.15	0.8	0.7	1	1.1	0.75
CO2	0.35	0.65	0	0	0.45	0	0.25
P2O5	1.29	2.39	2.12	2.05	1.95	1.36	1.79
S	0.06	0.15	nd	nd	0.07	nd	0.12
Total	99.3	100.4	100.1	98.49	100.75	98.06	99.91
Trace elements (ppm)							
Nb	52	48	130	97	57	120	40
Ni	32	25	nd	nd	31	nd	30
Cr							
Sr	1720	2700	2400	2400	1760	2700	3170
V	325	240	nd	nd	255	nd	210
Y	24	37	42	36	32	38	38
Sc	10.3				9.3		
Co	20.9	23	16	22	27.2	18	16
Rb	18.6	4	nd	nd	17	nd	0
Cs	0.37				0.2		
Ba	315	350	260	130	320	360	320
La	41	nd	130	69	63	92	nd
Ce	92.3				144		
Nd	39				71		
Sm	8.6				16.5		
Eu	3.43				4.81		
Tb	1.27				1.7		
Yb	1.7				2.3		
Lu	0.24				0.33		
Zr	229	142	210	170	300	220	85
Hf	4.25				5.6		
Ta	3.45				4.4		
Th	2.25				2.9		

Sample	360	365	463	71068*	103	119	152
Location	380/630	350/585	490/455	380/605	395/620	385/625	0.420634
Map Unit	4	4	4	4	5	5	5
SiO2	46.45	35.5	44.6	46.6	40.8	41.8	41.85
TiO2	3.52	5.63	4.72	3.07	3.81	3.55	3.69
Al2O3	17.2	13.9	15.15	18.25	17.7	18.2	17.3
Fe2O3	6	5.5	5.25	3.35	6.1	3.4	4.7
FeO	6	9.7	7.75	5.8	6.8	7.9	7.85
MnO	0.31	0.32	0.25	0.27	0.23	0.22	0.26
MgO	3.66	7	4.49	3.68	5.5	4.9	5.47
CaO	10.55	14.6	9.82	8.81	10.3	11.3	11.55
Na2O	4.44	2.1	3.93	5.34	3.1	5.7	3.26
K2O	0.63	0.6	2.12	1.87	1.4	1.1	0.96
H2O	0.4	1.1	0.85	1.1	1.5	1.1	1.65
CO2	0.2	0	0.4	0.45	0.1	0.1	0.35
P2O5	1.03	2.57	0.81	1.29	1.58	1.42	1.47
S	0.04	nd	0.11	0.06	nd	nd	0.44
Total	100.43	98.52	100.25	99.94	98.92	100.69	100.8
Trace elements (ppm)							
Nb	48	120	103	127	150	120	60
Ni	27	0	40	9	0	0	23
Cr							
Sr	2025	2200	970	2420	1700	1800	1660
V	255	nd	400	135	nd	nd	265
Y	43	57	37	47	31	43	44
Sc				6.1			
Co	19	32	44	15.5	15	19	12
Rb	0	nd	58	68	nd	nd	9
Cs				0.7			
Ba	820	270	600	940	670	280	350
La	nd	nd	nd	90	100	172	nd
Ce				223			
Nd				95			
Sm				19.7			
Eu				5.87			
Tb				2.2			
Yb				3.2			
Lu				0.42			
Zr	153	240	411	460	220	180	172
Hf				7.9			
Ta				9.8			
Th				7.4			

Sample	162*	260*	350	356*	362	13	106*
Location	365/615	360/620	340/685	325/570	351/460	360/620	335/625
Map Unit	5	5	5	5	5	7	7
SiO2	39.8	42.05	42.9	48	41.95	48.6	48.4
TiO2	4.4	3.79	4.55	2.29	4.18	3	3.01
Al2O3	16.8	17.2	21.3	19.1	15.6	17.6	20.7
Fe2O3	4.3	5.7	4.4	2.6	6.4	3.1	2.5
FeO	8.2	6.95	5.8	5.95	7.26	6.7	6.4
MnO	0.19	0.26	0.22	0.3	0.3	0.29	0.23
MgO	6.5	6	2.25	3.02	5.88	3.4	2.7
CaO	12.7	11.15	10.4	8.39	11.3	7.5	7.3
Na2O	2.9	3.44	3.6	5.37	3.97	5	3.3
K2O	0.9	1.26	0.67	2.13	0.97	2.3	2.1
H2O	1.1	0.95	0.7	0.8	0.85	0.7	0.6
CO2	0.5	0	0	0.45	0.3	0.2	0.1
P2O5	1.61	1.53	2.02	1.41	1.97	1.02	0.96
S	nd	0.07	0.01	0.04	0.14	nd	nd
Total	99.9	100.35	98.82	99.85	101.07	99.41	98.3
Trace elements (ppm)							
Nb	110	69	nd	160	127	170	120
Ni	0	26	0	0	31	0	0
Cr							
Sr	1900	1560	2510	2445	2735	1800	2100
V	nd	265	170	90	200	nd	nd
Y	54	55	0	41	65	51	38
Sc	11.1	4.6		2.2			4.6
Co	21.9	16.7	11	9.7	25	0	14.6
Rb	32	44	0	66	22	nd	27
Cs	0.5	0.5		0.7			0.53
Ba	550	7	484	990	715	680	980
La	55	62	0	89	nd	110	92
Ce	125	144		173			180
Nd	71	78		95			87
Sm	16.1	19.1		13.7			16.3
Eu	5.47	5.7		5.2			4.74
Tb	2.2	1.9		1.3			1.8
Yb	2.9	2.8		2.2			2.6
Lu	0.43	0.47		0.33			0.37
Zr	400	290	137	580	315	520	560
Hf	5.1	5.3		8.1			7.4
Ta	3.7	5.3		9.4			7
Th	1.5	3.5		10.2			7.7

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Sample	127	246	447*	25*	33*	58	130*
Location	365/615	490/650	495/660	240/625	245/560	380/465	385/510
Map Unit	7	7	7	8	8	8	8
SiO2	44.5	47.3	51.9	51.45	50.1	50	52.8
TiO2	3.46	3.3	2.45	2.57	2.44	2.75	2.67
Al2O3	17.2	18.2	17.5	18.75	19.8	18.2	17.7
Fe2O3	3.9	1.6	2.7	2.4	2.8	3.3	2.3
FeO	7.1	6.7	5.9	5.95	5.7	5.7	6
MnO	0.23	0.2	0.29	0.3	0.27	0.3	0.25
MgO	4.7	3.5	3.19	2.66	2.5	3	1.8
CaO	9.8	9.1	6.43	7.3	6.6	6.2	4.3
Na2O	3.9	4.4	5.45	5.58	5.6	5.5	5.9
K2O	1.6	1.6	2.38	2.55	2.7	2.4	4.2
H2O	0.8	0.7	0.65	0.45	0.8	1	0.5
CO2	0.4	0	0.55	0.35	0.1	0.1	0
P2O5	1.31	1.31	1.04	0.98	0.99	1.01	0.55
S	nd	nd	0.04	0.04	ND	nd	nd
Total	98.9	97.91	100.47	101.33	100.4	99.46	98.97
Trace elements (ppm)							
Nb	210	120	112	130	190	170	120
Ni	0	nd	16	8	24	0	0
Cr							
Sr	1700	2100	1715	1830	1800	1800	1100
V	nd	nd	115	135	nd	nd	nd
Y	55	36	46	49	46	47	38
Sc			6.6	2.5	2.3		2.1
Co	0	nd	7	6.6	6.1	0	6
Rb	nd	nd	86	70	67	nd	69
Cs			1.3	1.1	1		0.8
Ba	460	460	1020	950	1050	900	1330
La	170	70	108	97	103	120	115
Ce			229	196	213		243
Nd			119	105	90		102
Sm			18.6	16	17.5		20.9
Eu			5.4	5.1	5.17		5.4
Tb			1.9	1.7	1.9		2.3
Yb			3.1	3.1	3.3		3.8
Lu			0.52	0.45	0.5		0.6
Zr	220	300	600	610	580	510	800
Hf			8.5	9.5	10.9		12.7
Ta			8.8	8.7	9.9		12.9
Th			10.6	10.8	8.3		6.9

Sample	372	244*	452	480	57	407	437B
Location	390/490	485/650	490/695	555/655	520/555	410/565	560/605
Map Unit	8	8	8	8	9	9	9
SiO2	51.4	52.5	50.6	50.6	59.9	41.35	51.1
TiO2	1.17	2.78	2.5	2.34	0.12	2.74	2.52
Al2O3	24.2	17.6	18.2	20.5	19.4	8.9	16
Fe2O3	1.2	2.8	2.4	2.7	1.1	5.8	3.15
FeO	2.2	6.3	6.1	4.9	3.4	7.6	5.95
MnO	0.11	0.28	0.25	0.26	0.75	0.2	0.21
MgO	1	3.2	3	2	0.03	12.55	4.56
CaO	6.7	6.7	6.5	6	0.27	13.1	8.73
Na2O	6.3	5.1	5.2	5.5	4.9	1.03	4.69
K2O	2	0.4	2.5	2.6	6.4	0.81	2.1
H2O	3	0.8	0.7	0.7	0.9	3	0.8
CO2	0.1	0	0	0	0.9	4.35	0.5
P2O5	0.47	1.08	1.14	0.75	0.45	0.21	0.45
S	nd	nd	nd	nd	0.8	0.05	0.38
Total	99.85	99.54	99.09	98.85	99.32	101.69	101.14
Trace elements (ppm)							
Nb	130	160	150	150	nd	27	105
Ni	0	nd	0	0	0	220	45
Cr							
Sr	3500	1900	1700	1800	75	305	870
V	nd	nd	nd	nd	24	305	195
Y	31	42	42	37	0	18	42
Sc		6.3					
Co	0	6.8	0	0	0	73	25
Rb	nd	59	nd	nd	36	27	65
Cs		1.2					
Ba	960	990	720	990	42	195	670
La	110	98	130	120	0	nd	nd
Ce		205					
Nd		75					
Sm		17.3					
Eu		4.92					
Tb		1.8					
Yb		2.7					
Lu		0.39					
Zr	290	440	430	440	346	152	456
Hf		7.4					
Ta		8.2					
Th		5.6					

Sample	399	403	396*	427*	433	71069*	ES1
Location	480/680	392/510	480/680	475/440	565/660	380/460	370/440
Map Unit	10	10	11	11	11	11	11
SiO2	53.8	58.5	48.65	58.7	57.55	55.8	51.3
TiO2	1.11	0.21	0.05	0.3	1.09	0.11	0.18
Al2O3	19.05	17.8	24.6	20.8	19.25	19	15
Fe2O3	1.25	4.6	3.9	2.75	2.85	5.8	1.9
FeO	3.9	0.7	0.3	1	1.75	1	2.3
MnO	0.35	0.47	0.23	0.3	0.32	0.41	1.46
MgO	1.12	0.16	0.05	0.06	0.65	0.09	2.8
CaO	2.74	0.57	0.24	0.24	3.05	0.62	4.4
Na2O	8.87	9.6	18.6	7.08	9.41	11.2	11.8
K2O	3.64	3.42	1.77	5.24	3.35	3.94	2.3
H2O	1.35	1.1	1.05	2.65	0.75	0.5	1.3
CO2	3.35	1.3	0.8	0.45	0.55	0	0.4
P2O5	0.33	0.2	0.01	0.02	0.21	0	0.01
S	0.18	0.1	0.06	0.03	0.09	0	nd
Total	101.04	98.73	100.31	99.62	100.87	98.47	95.15
Trace elements (ppm)							
Nb	445	nd	270	725	268	nd	9200
Ni	5	0	0	0	0	0	nd
Cr							
Sr	720	105	29	162	1145	136	150
V	80	0	35	44	62	0	nd
Y	85	0	25	80	74	10	nd
Sc			0.1	0.1		0.2	
Co	0	0	0.1	0.6	0	0.5	nd
Rb	200	32	84	228	62	224	nd
Cs			2.4	2.6		1.1	
Ba	595	42	130	200	1450	170	nd
La	nd	0	70	194	nd	271	5100
Ce			120	337		432	
Nd			49	89		144	
Sm			5.2	13.9		22.2	
Eu			0.37	1.41		1.69	
Tb			0.8	2.1		4.2	
Yb			2.8	7.7		14.8	
Lu			0.41	1.25		2.31	
Zr	2160	5400	1430	2090	430	4030	21000
Hf			38	44		78	
Ta			17	46		72	
Th			33	54		31	

Sample	167A*	394*	419*	424	451B	454*	457B*
Location	345/600	380/530	445/630	450/532	330/440	455/615	425/445
Map Unit	12	12	12	12	12	12	12
SiO2	53.9	53.8	57.1	65.2	56.9	54.7	57.4
TiO2	0.89	0.12	0.08	0.25	0.43	0.28	0.35
Al2O3	20.4	19	19.6	18.3	20.2	21.2	22.6
Fe2O3	2.9	5.9	2.9	3	2.3	2.2	1.7
FeO	1.1	0.1	0.3	0.1	1.25	0.5	0.9
MnO	0.28	0.12	0.26	0.1	0.33	0.29	0.24
MgO	0.75	0.2	0.2	0.04	0.4	0.21	0.34
CaO	1.47	0.6	0.37	0.2	0.97	0.63	0.6
Na2O	8.9	9.46	8.5	9.1	9.92	11.3	10.3
K2O	4.88	4.4	4.35	2.53	6.23	5.22	5.32
H2O	2.8	2.5	7.1	0.2	0.9	0.8	0.6
CO2	0	0.6	0	0	1	0.7	0
P2O5	0.22	0.09	0.02	0	0.05	0.03	0.04
S	0	nd	0	0	0.02	0	0
Total	98.49	96.89	100.78	99.02	100.9	98.06	100.39
Trace elements (ppm)							
Nb	nd	530	nd	nd	240	nd	nd
Ni	nd	87	0	0	0	0	0
Cr							
Sr	nd	48	80	700	92	40	75
V	nd	nd	23	nd	59	0	24
Y	nd	81	0	0	17	0	0
Sc	0.9	0.1	5.2			0.3	0.4
Co	2.4	0.6	0.7	0	0	1	1.3
Rb	188	271	157	210	255	2.3	176
Cs	2.5	190	1.8			2.3	0.8
Ba	510	5.1	220	54	70	140	140
La	136	194	195	nd	nd	335	74
Ce	225	348	343			488	138
Nd	82	108	113			93	32
Sm	9.4	17.8	15			10.4	4.1
Eu	2.18	1.42	1.29			1.83	0.68
Tb	1.1	2.4	2.1			1.6	0.4
Yb	4.6	9.8	7.6			9.6	1.9
Lu	0.74	1.51	1.26			1.59	0.35
Zr	1330	2220	3300	5800	1000	1390	530
Hf	23	49	75			24	9.6
Ta	15.1	45	49			9.8	9.5
Th	42	21	47			40	10.2

Table 2: Electron microprobe data for the Mont Saint Hilaire pluton

Sample	305						
Mineral	plag	plag	ilm	ilm	mgt	amph	cpx
SiO2	53.10	53.31	1.17	2.24	1.33	40.45	50.58
TiO2			47.27	47.05	0.34	5.45	1.24
Al2O3	29.03	29.07	0.42	0.24	0.75	12.17	3.59
FeO*	0.39	0.48	47.44	45.93	89.08	12.01	7.63
MnO			1.12	1.76		0.22	0.21
MgO			1.05	0.81	0.42	11.56	13.45
CaO	10.89	11.10	0.18	1.02	0.28	11.71	22.58
Na2O	4.52	5.05				2.29	0.63
K2O	0.13						
V2O5			0.32	0.23	0.50	0.13	
Cr2O3					0.84		0.14
CoO			0.29	0.30	0.15		

Sample	305	71220b					
Mineral	cpx	plag	neph	albite	plag	biotite	amph
SiO2	50.14	51.98	45.43	68.10	53.49	36.34	40.64
TiO2	1.40	0.18		0.14	0.12	9.95	6.49
Al2O3	3.56	30.16	34.53	20.02	29.46	13.63	11.45
FeO*	8.17			0.26	0.23	15.51	12.77
MnO	0.27					0.18	0.25
MgO	13.20					11.53	11.05
CaO	22.39	12.14	2.38	0.15	11.09	0.30	11.45
Na2O	0.75	4.33	12.62	9.37	4.72		2.28
K2O		0.23	4.08	0.12	0.37	9.26	1.54
V2O5							
Cr2O3							
							0.18

Sample	71220b						
Mineral	cpx	rim cpx	cpx	ilm	mgt	ilm.2	mgt.2
SiO2	48.43	47.68	48.07	1.22	1.25	1.19	1.10
TiO2	2.71	2.72	2.85	51.51	9.63	52.03	9.58
Al2O3	5.36	5.23	5.49	0.56	5.06	0.51	4.03
FeO*	8.11	8.12	8.33	43.23	76.92	43.06	78.52
MnO	0.29	0.19	0.25	2.09	0.41	2.08	0.39
MgO	12.25	12.34	12.23	0.59	0.65	0.75	0.71
CaO	21.61	21.64	21.44	0.12	0.23	0.25	0.15
Na2O	0.96	0.68	0.65				
K2O							
V2O5				0.31		0.14	0.18
Cr2O3			0.14				
CoO				0.25	0.50		

Sample	71468						
Mineral	plag	plag	plag	amph	biotite	cpx	cpx
SiO2	49.21	49.44	51.55	41.13	37.22	50.36	51.10
TiO2	0.17			4.68	6.08	1.57	1.34
Al2O3	31.78	31.87	30.78	12.70	15.13	3.98	3.64
FeO*	0.43	0.55	0.36	12.27	12.57	7.67	7.84
MnO	0.00					0.21	0.21
MgO	0.00			11.98	15.41	13.08	13.61
CaO	14.43	14.72	13.34	11.84	0.35	22.31	22.61
Na2O	3.00	2.43	3.66	2.28	0.67		0.46
K2O	0.11	0.07	0.09	1.31	8.94		
V2O5							
Cr2O3							

Sample	71468			71103			
Mineral	rim cpx	ilm	mgt	plag	plag	plag	plag
SiO2	50.50	1.22	1.33	54.88	56.49	57.71	55.52
TiO2	1.20	45.06	0.39			0.13	0.12
Al2O3	3.44	0.65	4.59	27.13	27.73	26.78	27.57
FeO*	7.98	4.37	87.21	0.32	0.33	0.38	0.40
MnO	0.27	6.03					
MgO	12.97	0.62	0.57				
CaO	22.38	0.31	0.23	9.84	10.14	8.66	10.04
Na2O				5.59	5.38	6.28	5.66
K2O				0.39	0.36	0.45	0.22
V2O5		0.31	0.53				
Cr2O3	0.14						
CoO		0.17	0.63				
ZnO		0.25					

Sample	71103						
Mineral	cpx	cpx	cpx	biotite	amph	amph	mgt
SiO2	54.68	51.87	52.02	36.79	42.04	41.17	1.38
TiO2	0.27	0.78	0.51	7.20	4.47	5.23	0.43
Al2O3	1.32	2.22	1.92	14.17	11.47	12.39	1.50
FeO*	8.50	8.93	9.06	13.01	12.85	12.15	89.77
MnO	0.54	0.44	0.59	0.19	0.33	0.39	
MgO	14.95	14.07	14.49	15.30	12.62	12.71	0.44
CaO	21.33	20.63	20.45	0.11	11.34	11.55	0.11
Na2O			0.62	0.42	2.30	2.54	
K2O				9.06	1.22	0.91	
V2O5							0.28
Cr2O3	0.15	0.16	0.15				
CoO							0.54

Sample	71103		71454				
Mineral	mgt	ilm	elpidite	gittinsit	cpx	cpx	cpx
SiO2	2.56	1.02	28.27	12.97	52.97	52.79	53.50
TiO2	3.30	50.16	2.76	0.88	0.62	0.39	1.21
Al2O3	3.69	0.40		0.18	1.53	1.56	2.19
FeO*	84.48	45.50		0.43	27.38	27.23	26.12
MnO	0.19	1.73	1.32	2.59	0.30	0.42	0.46
MgO	1.17	2.10	5.75				
CaO	0.20	0.11		45.78	0.99	1.66	0.43
Na2O			7.93	5.38	14.24	14.00	14.65
K2O			14.25		0.09	0.11	
V2O5	0.37	0.26	0.10				
Cr2O3							
ZrO2	0.27	ZrO2	33.96	15.75	0.22	0.57	0.25
CoO	0.80						

Sample	71454						
Mineral	biotite	kspar	biotite	biotite	neph	sodalite	cpx
SiO2	36.97	65.54	36.90	36.51	43.56	36.63	51.50
TiO2	2.74		2.62	2.91			0.86
Al2O3	10.03	18.23	10.27	10.11	31.89	30.54	1.40
FeO*	22.34	0.34	20.59	22.23	0.81	0.32	26.33
MnO	6.01		5.27	5.99			0.38
MgO	6.70		7.51	6.67			
CaO							1.77
Na2O		1.10	0.43	0.44	16.57	25.35	13.47
K2O		15.04	9.52	9.29	5.62	0.12	
V2O5	9.29						
Cr2O3							
					Cl	6.57	
						ZrO2	0.24

Sample	71454			71069			
Mineral	cpx	kspar	kspar	neph	unk	unk	unk
SiO2	52.06	62.92	64.30	43.88	49.28	43.65	21.93
TiO2	0.83	0.39			0.23		
Al2O3	1.43	17.52	17.98	33.74	21.88	24.35	13.40
FeO*	26.49	0.53	0.15	0.43	12.36	0.11	0.27
MnO	0.54	0.39			0.14		
MgO							
CaO	2.00				0.27	11.73	44.75
Na2O	13.44	1.40	1.39	16.56	14.88		0.39
K2O		14.27	14.86	6.88	3.32	2.01	1.04
V2O5							
Cr2O3							
ZrO2	0.48						

Sample	71069						
Mineral	neph	kspar	albite	cpx	elpidite	catapleii	cpx
SiO2	45.00	66.10	70.20	54.23	53.51	48.46	52.57
TiO2				0.46	0.19	0.48	0.26
Al2O3	33.14	18.26	19.55	1.93	1.15	0.20	1.70
FeO*	0.30	0.26	0.26	26.50	10.37	1.39	23.39
MnO				0.55	0.22	0.12	0.22
MgO							
CaO				1.65	1.16	3.70	0.43
Na2O	16.30	1.02	10.15	13.19	8.60	5.04	13.58
K2O	6.06	15.61	0.17	0.27	0.47	0.15	
V2O5							
Cr2O3							
ZrO2					20.67	28.28	5.19

Sample	71069					71167	
Mineral	elpidite	cpx	rim cpx	core cpx	rim cpx	kspar	sodalite
SiO2	48.80	53.97	53.45	53.45	53.88	60.95	38.91
TiO2		0.23	0.35	0.38	0.62		
Al2O3	0.26	1.74	1.42	1.36	1.58	21.22	31.97
FeO*	1.04	28.47	26.99	27.37	27.39		0.18
MnO	3.43	0.15	1.09	0.89	0.61		
MgO			0.33	0.27	0.30		
CaO	4.66	0.31	2.94	2.24	1.82		0.08
Na2O	7.66	14.58	12.86	13.19	13.56	4.59	21.40
K2O	0.25	0.09				9.32	0.32
V2O5							
Cr2O3							
ZrO2	21.67					Cl	6.47
Cl	0.14						

Sample	71167						
Mineral	albite	perthite	sphene	amph	cor amph	rim amph	cpx
SiO2	53.73	66.95	30.42	41.90	40.08	41.03	49.40
TiO2			35.87	4.30	5.54	4.13	5.01
Al2O3	24.69	19.29	1.44	10.57	12.71	10.82	0.99
FeO*		0.13	1.47	15.75	13.74	16.78	24.13
MnO				0.93	0.57	1.12	2.62
MgO				9.90	10.72	9.09	0.23
CaO		0.27	27.06	10.62	11.05	10.82	1.10
Na2O	12.00	6.61		3.52	3.74	3.35	13.48
K2O	0.54	7.25		1.45	0.93	1.49	0.08
V2O5							
Cr2O3							
Cl						0.06	
ZrO2							1.00

Sample	71167						
Mineral	cpx	cpx	cpx	cpx	cpx pcr	rim cpx	core cpx
SiO2	49.74	52.33	50.46	50.15	48.95	49.84	51.05
TiO2	2.77	2.08	2.68	1.32	1.04	0.91	0.74
Al2O3	2.28	8.80	2.27	3.21	2.96	2.94	2.31
FeO*	23.21	16.26	22.05	10.49	14.36	11.65	9.83
MnO	2.19	1.14	1.61	1.07	1.13	1.06	1.04
MgO	0.92	0.24	0.24	9.95	7.08	9.16	11.09
CaO	10.94	2.60	4.10	20.58	17.97	20.33	20.96
Na2O	7.97	13.00	11.13	2.08	3.50	2.19	1.72
K2O	0.09	0.12	0.24		0.22		
V2O5							
Cr2O3							0.16
ZrO2	0.44	1.78	2.49		0.53		

Sample	71167				71451		
Mineral	amph	perthite	perthite	neph	neph	neph	cpx
SiO2	40.60	67.62	65.74	45.75	45.56	44.87	53.93
TiO2	3.69	0.15	0.15				0.24
Al2O3	11.03	19.66	19.21	32.38	33.25	33.03	1.52
FeO*	17.04	0.24	0.24	0.68	0.41	0.36	26.38
MnO	1.07						1.01
MgO	8.92						
CaO	10.33	0.35	0.34	0.58			4.37
Na2O	3.47	6.47	6.35	17.18	15.39	16.89	12.10
K2O	1.51	7.41	7.19	5.32	5.77	5.85	
V2O5							
Cr2O3							

Sample	71451						
Mineral	cpx	cpx	cpx	cpx	sodalite	ilm	ilm
SiO2	52.61	53.88	52.17	51.80	37.68	0.69	0.89
TiO2	0.53	0.55	0.99	0.64		51.65	51.21
Al2O3	1.38	1.34	1.32	1.32	31.08		0.25
FeO*	27.17	25.27	25.17	25.26	0.31	29.84	30.78
MnO	1.12	1.55	1.49	1.50		18.54	16.79
MgO							
CaO	3.30	2.93	3.93	4.95			
Na2O	12.35	13.52	12.34	11.55	25.03		
K2O							
V2O5							
Cr2O3							
				Cl	6.30		

Sample	71451						
Mineral	ilm	mgt	mgt	ilm	cpx	inc bio	cpx
SiO2	0.88	1.16	1.05	0.99	53.16	37.12	51.30
TiO2	51.89	10.02	12.36	50.61	0.59	2.46	0.45
Al2O3		0.21	0.25	0.22	1.02	10.34	1.57
FeO*	29.15	78.99	76.02	31.69	25.98	25.75	18.47
MnO	19.24	4.11	5.37	16.53	0.87	3.61	2.18
MgO					1.22	6.85	5.06
CaO					3.44		16.46
Na2O					12.77		3.86
K2O						9.35	
V2O5							
Cr2O3							
CoO							0.13

Sample	71451			25			
Mineral	cpx	cpx	kspar	mgt	mgt	ilm	mgt
SiO2	53.27	51.15	63.90	0.97	1.09	1.18	1.31
TiO2	0.22	0.51		25.26	25.01	52.45	22.54
Al2O3	1.55	1.49	17.86	2.18	2.12	0.28	2.53
FeO*	28.98	18.07	0.15	66.28	66.90	44.26	69.57
MnO	0.13	2.20		2.14	2.16	2.35	1.82
MgO		5.30			0.40	0.66	0.28
CaO	0.20	16.87				0.19	0.24
Na2O	14.45	3.76	0.64				
K2O			15.60				
V2O5				0.16	0.18		0.17
Cr2O3					0.62		
			CoO	0.81		0.49	0.69
				ZnO	0.25		

Sample	25						
Mineral	core cpx	rim cpx	cpx	biotite	biotite	biotite	olivine
SiO2	50.31	50.46	50.85	37.23	37.24	35.95	33.45
TiO2	1.84	1.40	1.28	8.47	8.01	6.87	
Al2O3	2.66	3.06	2.50	13.68	13.62	13.58	0.22
FeO*	8.86	10.21	9.43	18.38	17.90	19.70	51.35
MnO	0.29	0.44	0.41	0.31	0.32	0.23	3.42
MgO	13.50	10.87	11.77	10.05	10.49	9.92	12.44
CaO	21.28	21.81	21.76	0.09	0.09		
Na2O	0.49	0.59	0.48	0.48	0.48		
K2O				9.00	9.41	9.22	
V2O5							
Cr2O3	0.17	0.13	0.17				

Sample	25						
Mineral	olivine	amph	amph	plag	plag	kspar	neph
SiO2	33.48	39.66	40.75	59.91	60.64	64.21	46.24
TiO2		4.04	3.87				0.12
Al2O3	0.30	11.43	11.58	25.11	24.45	19.37	32.97
FeO*	50.39	16.14	16.90	0.12	0.16	0.14	0.29
MnO	3.21	0.47	0.37				
MgO	12.89	8.96	8.28				
CaO		10.67	11.32	6.67	5.88	0.73	1.34
Na2O		2.21	2.31	6.95	6.54	2.47	15.09
K2O		1.70	1.65	0.75	0.85	11.91	3.65
V2O5							
Cr2O3							

Sample	25	71127					
Mineral	kspar	cor plag	rim plag	plag	biotite	biotite	cpx
SiO2	64.36	52.52	57.70	58.83	37.47	36.88	53.42
TiO2	0.12	0.11	0.13		5.44	5.60	0.52
Al2O3	19.60	29.37	26.04	25.46	13.38	13.55	1.72
FeO*	0.12	0.37	0.40	0.36	13.34	13.95	9.37
MnO						0.12	0.51
MgO				0.22	15.55	15.18	14.29
CaO	0.72	12.14	8.24	7.35		0.11	21.25
Na2O	3.35	4.14	6.50	6.90			
K2O	10.91	0.15	0.19	0.34	9.22	9.30	
V2O5							
Cr2O3							
Cl					0.11	0.08	
CoO							0.14

Sample	71127						
Mineral	amph	amph	cpx	opx	opx	cpx	cpx
SiO2	39.03	41.81	52.07	54.47	54.48	52.87	51.76
TiO2	5.47	3.77	0.15	0.32	0.24	0.63	0.21
Al2O3	9.83	10.47	0.73	0.85	0.55	1.97	0.78
FeO*	14.54	13.31	9.07	19.29	21.14	9.12	9.11
MnO	0.30	0.34	0.53	1.24	1.41	0.49	0.56
MgO	11.65	12.51	14.00	24.27	22.74	14.76	13.73
CaO	10.06	11.35	20.67	1.37	1.52	20.76	20.60
Na2O	1.60	1.81	0.44				
K2O	1.03	1.10					
V2O5							
Cr2O3			0.13				
Cl	0.08						
CoO				0.14		0.14	

Sample	--- 71127 ---		---------- 365 ----------				
Mineral	cpx	cpx	cpx	plag	cpx	plag	plag
SiO2	51.98	53.53	46.97	49.64	47.69	49.64	49.64
TiO2	0.39	0.51	2.98		2.66		0.12
Al2O3	1.38	1.31	6.30	31.95	5.93	31.42	31.51
FeO*	9.09	9.79	8.17	0.55	8.04	0.33	0.35
MnO	0.50	0.57	0.27		0.26		
MgO	13.91	14.65	12.18		11.94		
CaO	20.73	20.34	22.38	14.94	22.75	14.58	14.41
Na2O			0.65	2.42	0.60	2.68	2.71
K2O				0.11		0.10	0.15
V2O5							
Cr2O3					0.11		
CoO		0.16					

Sample	---------- 365 ----------						
Mineral	plag	plag	amph	amph	amph	amph2	hematite
SiO2	54.74	53.92	37.55	39.40	39.79	45.73	3.15
TiO2	0.18	0.19	6.20	6.30	6.54	1.49	0.77
Al2O3	28.75	29.59	12.28	12.82	13.04	11.12	1.33
FeO*	1.00	0.38	11.43	11.19	11.78	10.45	82.27
MnO			0.28	0.22	0.13	0.14	
MgO			10.97	11.92	11.80	14.82	0.65
CaO	11.00	11.93	11.75	12.33	12.02	12.17	0.32
Na2O	4.96	4.71	2.34	2.51	2.16	2.74	
K2O	0.22	0.16	1.12	0.90	0.96		0.09
V2O5							
Cr2O3							

Sample	-------- 365 --------			---------- 242 ----------			
Mineral	ilm	mgt	ilm	cpx	cpx	amph1	amph2
SiO2	1.30	1.50	1.07	47.86	47.81	39.13	49.12
TiO2	32.38	0.55	50.74	2.58	2.89	5.01	0.48
Al2O3	3.01	0.86	0.37	6.28	6.57	13.04	5.81
FeO*	58.65	89.73	44.61	7.74	7.98	13.51	13.35
MnO	2.02		2.44	0.26	0.19	0.24	0.28
MgO	1.96		2.25	12.61	12.14	10.66	14.47
CaO	0.16	0.18	0.23	22.33	22.96	12.03	11.61
Na2O	0.51			0.46	0.41	2.22	0.54
K2O						1.82	
V2O5							
Cr2O3					0.12		

Sample	242						
Mineral	amph	amph	core ol	rim ol	olivine	cor plag	rim plag
SiO2	40.21	39.81	39.39	39.43	39.07	49.94	50.81
TiO2	5.82	5.63				0.25	0.28
Al2O3	12.71	13.33				30.71	30.84
FeO*	11.92	11.99	21.95	21.96	22.46	0.34	0.40
MnO	0.24	0.25	0.65	0.79	0.59		
MgO	11.68	10.94	39.02	39.27	39.52		
CaO	12.25	12.05	0.32	0.38	0.40	13.90	13.71
Na2O	2.48	2.29				3.27	3.76
K2O	1.02	1.18				0.13	0.10
V2O5							
Cr2O3							

Sample	242					71278	
Mineral	plag	cor plag	rim plag	biotite	ilm	biotite	biotite
SiO2	49.92	53.65	51.90	35.82	0.96	36.51	36.70
TiO2				5.44	49.18	6.42	5.71
Al2O3	31.02	28.94	29.71	16.75	0.83	15.04	15.43
FeO*	0.30		0.29	9.67	45.77	16.49	16.89
MnO					1.37	0.20	0.13
MgO				16.98	2.01	12.44	12.38
CaO	13.87	11.17	12.63	0.33	0.16	0.15	0.22
Na2O	2.68	4.92	4.06			0.42	0.50
K2O	0.10	0.32	0.18	9.18		9.34	9.50
V2O5							
Cr2O3							

Sample	71278						
Mineral	ilm	mgt	cor amph	rim amph	rim amph	cor plag	rim plag
SiO2	0.91	3.09	39.83	39.90	40.12	53.48	54.23
TiO2	50.32	7.80	5.96	4.64	5.62	0.15	0.21
Al2O3	0.45	3.82	12.13	12.15	12.27	29.55	29.02
FeO*	44.93	78.11	11.47	13.10	12.00	0.35	0.34
MnO	2.95	0.58	0.21	0.30	0.25		
MgO	0.44	1.76	12.28	11.11	11.12		
CaO	0.16	0.20	11.96	11.52	11.62	12.24	11.17
Na2O			3.29	2.47	2.48	4.34	4.93
K2O			0.79	1.56	1.43	0.17	0.11
V2O5							
Cr2O3				0.14			

Sample	71278			162			
Mineral	plag	plag	plag	plag cor	plag rim	plag	plag1
SiO2	53.86	54.54	54.18	51.96	54.57	51.08	52.93
TiO2		0.17	0.15	0.22	0.20	0.14	0.13
Al2O3	30.33	29.63	28.23	29.66	27.56	30.23	30.18
FeO*	0.17	0.25	0.26	0.46	0.38	0.46	0.35
MnO							
MgO							
CaO	12.54	11.52	10.41	12.14	10.22	13.12	12.41
Na2O	4.40	4.80	5.22	4.37	5.36	3.57	4.21
K2O	0.16	0.15	0.15	0.17	0.26	0.13	0.15
V2O5							
Cr2O3						0.14	

Sample	162						
Mineral	plag2	plag3	plag4	cpx	cpx	cpx	cpx
SiO2	50.64	52.07	50.71	51.58	49.68	51.41	51.80
TiO2	0.14	0.14	0.14	0.85	1.76	1.00	0.87
Al2O3	29.50	30.01	30.64	2.49	4.34	3.04	2.56
FeO*	0.42	0.39	0.29	7.94	7.73	8.31	7.84
MnO				0.30	0.28	0.24	0.35
MgO				13.20	13.23	13.91	13.30
CaO	12.56	12.76	14.03	22.02	21.52	22.12	21.98
Na2O	3.83	4.13	3.60	0.52	0.52	0.59	0.46
K2O	0.13	0.11	0.10				
V2O5							
Cr2O3							

Sample	162				71106		
Mineral	amph	amph	biotite	mgt	plag	plag	dk br bio
SiO2	40.44	39.45	37.40	1.09	58.89	58.03	37.27
TiO2	6.95	6.33	6.37	5.30	0.25	0.25	5.94
Al2O3	12.75	12.78	14.37	1.84	25.63	26.26	14.21
FeO*	10.05	11.81	12.86	85.69	0.23	0.39	15.09
MnO	0.18	0.13	0.13	0.18			0.20
MgO	12.56	12.53	15.82	0.53			13.47
CaO	12.06	11.94	0.20	0.10	6.93	7.82	0.14
Na2O	2.16	2.42			6.24	6.71	0.48
K2O	1.16	1.21	9.39		0.53	0.44	9.55
V2O5				0.31			
Cr2O3							
			CoO	0.63			

Sample	71106						396
Mineral	lt br biocore amph		rim amph	olivine	rim ol	magnetite	neph
SiO2	37.94	41.43	41.15	36.28	35.15	1.52	45.40
TiO2	5.19	5.76	5.65			22.39	
Al2O3	13.86	11.17	11.57	0.68	0.60		32.26
FeO*	11.61	12.13	12.95	40.91	41.98	67.84	0.49
MnO		0.22	0.28	1.74	1.82	1.12	
MgO	16.85	11.08	10.37	22.07	20.14	0.87	
CaO	0.23	11.22	11.09	0.28	0.26	0.10	
Na2O		2.41	2.62				16.14
K2O	9.53	1.57	1.69				5.17
V2O5						0.34	
Cr2O3							
					CoO	0.76	
					Zn	0.28	

Sample	396						
Mineral	albite	sodalite	cpx	cpx	cpx	cpx	cpx
SiO2	69.41	38.94	53.76	53.29	53.24	52.47	54.60
TiO2			0.17	0.21	0.64		6.16
Al2O3	19.07	33.58	1.35	1.08	1.16	0.78	1.36
FeO*	0.45	0.21	28.66	28.58	27.18	29.65	29.36
MnO			0.21	0.22	1.41	0.64	0.17
MgO							
CaO		0.16	0.42	0.71	1.22	2.74	0.66
Na2O	11.36	19.50	14.59	14.17	14.03	13.00	14.87
K2O	0.14						
V2O5							
Cr2O3		0.13					
Cl		6.28					

Sample	407						
Mineral	cpx	amph	mgt ox	matrix	matrix	mgt	?matrix
SiO2	46.52	59.72	1.51	41.59	49.92	1.80	53.94
TiO2	2.32		14.97	3.58	0.77	9.34	0.22
Al2O3	7.38	0.75	0.67	12.13	8.65	0.59	4.40
FeO*	7.60	7.68	75.35	12.14	8.28	79.90	7.87
MnO			0.52	0.12	0.13	0.27	
MgO	13.04	25.37	0.53	15.72	16.84	0.60	20.11
CaO	21.60		0.13	5.58	9.79	0.26	9.52
Na2O	0.46				0.51		0.69
K2O				5.55	0.78	0.15	0.83
V2O5							
Cr2O3	0.17		1.94			2.40	
CoO							

Sample	407						
Mineral	matrix	matrix	mgt	mgt	mgt	mgt	cpx
SiO2	54.65	28.93	0.70	0.60	0.57	1.35	47.11
TiO2			3.44	16.18	17.09	15.71	2.32
Al2O3	5.18	15.46	0.24		0.21	0.32	7.36
FeO*	8.01	12.30	86.02	74.08	73.47	76.00	7.52
MnO					0.17		
MgO	19.65	19.21				0.32	12.70
CaO	0.40	5.93	0.24	0.34	0.25	0.66	22.26
Na2O	1.40	0.59					0.44
K2O							
V2O5							
Cr2O3			2.89	2.44	2.62	1.22	0.19
CoO							

Sample	407						
Mineral	alter/amp	alter.	alter.	core cpx	core cpx	rim cpx	rim cpx
SiO2	47.13	39.83	49.91	46.08	46.22	46.63	47.43
TiO2	0.72	0.64	0.52	2.05	2.36	2.29	2.26
Al2O3	7.95	7.10	7.22	6.93	7.26	7.30	7.26
FeO*	9.39	7.58	9.69	7.25	7.53	7.60	7.79
MnO	0.18	0.14	0.19				
MgO	15.68	13.90	16.92	12.73	12.79	12.66	13.25
CaO	14.20	19.56	12.89	21.64	21.83	21.85	21.77
Na2O	1.39	1.23	1.41		0.52		0.44
K2O	0.16		6.07				
V2O5							
Cr2O3				0.18	0.14	0.18	0.22
CoO							

Sample	407		71244				
Mineral	cpx	cpx	mgt	ilmenite	cpx	core cpx	rim cpx
SiO2	46.68	47.80	3.18	2.84	51.78	51.46	53.11
TiO2	2.20	2.25	4.81	48.71	0.76	1.07	0.77
Al2O3	7.26	7.13	1.10	0.30	1.72	2.24	1.59
FeO*	7.53	7.56	83.25	43.29	10.23	9.69	10.21
MnO	0.14	0.17	0.75	3.10	0.56	0.37	0.63
MgO	12.83	13.27	0.78	1.03	12.81	14.23	13.27
CaO	21.65	22.14	0.17	0.23	20.42	20.54	20.70
Na2O	0.40				0.48	0.54	0.93
K2O							
V2O5			0.30				
Cr2O3					0.18		0.15
CoO							

Sample	71244						
Mineral	cpx	bio	bio	amph	plag	plag	plag
SiO2	51.61	37.05	37.00	46.06	66.05	55.89	65.36
TiO2	0.92	5.82	5.56	0.81		0.23	
Al2O3	2.12	12.39	12.78	6.32	21.67	27.39	20.24
FeO*	9.49	22.50	23.34	19.80	0.35	0.25	0.42
MnO	0.51	0.19	0.29	0.61			
MgO	13.45	9.68	9.36	9.77			
CaO	20.25		0.11	10.90	2.21	9.37	1.38
Na2O	0.55			1.46	8.16	6.04	9.71
K2O		9.13	9.29	0.75	0.65	0.27	0.31
V2O5							
Cr2O3							
CoO							

Sample	71244						
Mineral	plag	plag	amph	opx	opx	plag	plag
SiO2	62.91	55.92	53.61	52.07	51.46	62.88	59.57
TiO2	0.15	0.31	0.19				0.15
Al2O3	22.65	24.68	0.83	0.57	0.41	22.03	23.97
FeO*	0.16	2.97	17.42	30.03	30.92	0.11	0.16
MnO			1.33	2.16	2.74		
MgO			17.43	15.03	13.51		
CaO	3.69	6.88	5.87	1.06	2.02	3.37	5.45
Na2O	8.44	6.86				8.26	8.05
K2O	0.61	0.62	0.08		0.10	0.91	0.40
V2O5							
Cr2O3							
CoO							

Sample	71244	314					
Mineral	plag	kspar	kspar	kspar	alkspr	alkspr	alkspr
SiO2	60.69	65.03	59.81	52.86	66.21	63.83	53.72
TiO2			0.20	0.34		0.12	0.22
Al2O3	23.36	19.73	24.14	30.06	20.35	22.14	27.11
FeO*		0.23	1.19	2.26	0.37	1.14	1.86
MnO							
MgO				0.25			
CaO	4.63	0.19	0.09	0.20	0.40	0.26	0.15
Na2O	8.40	3.32	1.91	1.83	6.52	4.40	1.10
K2O	0.39	11.38	11.83	9.29	6.17	7.21	10.57
V2O5							
Cr2O3							
CoO							

Sample	314						
Mineral	matrix	matrix	matrix	alt leuc	alt leuc	matrix	matrix
SiO2	63.22	61.84	72.47	47.98	46.67	63.17	48.51
TiO2		0.12	0.19	0.27	0.28		0.36
Al2O3	24.13	24.40	18.58	32.23	33.17	26.01	28.73
FeO*	0.81	1.10	0.65	2.94	3.24	1.31	2.42
MnO			0.11				
MgO				0.38	0.52		
CaO	0.84	0.81	0.77			0.25	0.13
Na2O	7.55	6.45	5.69	0.46		4.45	1.31
K2O	4.27	4.56	3.36	10.41	10.65	8.28	8.88
V2O5							
Cr2O3							
CoO							
						ZrO2	0.18

Sample	314			33			
Mineral	matrix	matrix	pcrystfsp	plag	plag	cpx	neph
SiO2	67.07	60.72	66.76	62.53	62.59	52.34	45.63
TiO2		0.16	0.13	0.31	0.18	0.27	
Al2O3	20.98	23.70	20.24	24.08	23.54	0.57	34.06
FeO*	0.37	1.16	0.17	0.29		12.10	0.25
MnO						0.63	
MgO						10.63	
CaO	0.44	0.23	0.92	4.96	4.77	23.38	1.60
Na2O	8.20	2.37	7.91	6.78	6.64	0.42	14.41
K2O	1.90	10.76	4.59	0.99	0.96		4.88
V2O5							
Cr2O3							
CoO							

Sample	33						
Mineral	cpx	cpx	cpx	cpx	cpx	bio	bio
SiO2	50.44	51.52	51.40	51.11	51.92	36.76	36.38
TiO2	1.56	1.59	1.47	1.80	1.58	6.42	6.07
Al2O3	2.96	3.02	2.82	3.18	3.16	13.57	13.64
FeO*	8.77	8.95	9.40	8.80	8.85	23.67	25.44
MnO	0.44	0.45	0.43	0.40	0.39	0.45	0.55
MgO	12.23	12.46	12.22	13.29	13.49	7.95	6.32
CaO	21.09	21.54	21.33	21.36	21.09	0.12	
Na2O	0.87	0.89	0.96	0.62	0.65	0.46	
K2O						9.52	9.25
V2O5							
Cr2O3			0.12		0.12		
CoO							
						Cl	0.09

Sample	33						
Mineral	amph	amph	amph	amph	amph	neph	neph
SiO2	39.30	39.60	39.57	39.16	38.93	45.94	47.79
TiO2	3.55	3.01	2.98	3.04	3.07		
Al2O3	12.30	12.25	12.30	12.07	12.44	34.17	32.46
FeO*	23.95	23.04	24.31	24.67	24.53	0.19	0.86
MnO	1.02	1.04	0.96	0.97	0.95		
MgO	4.25	4.49	3.76	3.86	3.67		
CaO	10.90	10.87	10.76	10.74	10.75	1.46	1.19
Na2O	2.49	2.39	2.14	2.70	2.12	15.47	14.05
K2O	1.83	1.90	1.85	1.89	1.85	5.13	4.16
V2O5							
Cr2O3							
CoO							
Cl	0.08	0.08	0.13	0.10	0.12		

Sample	33			452			
Mineral	bio	mgt	ilmenite	amph	olivine	olivine	ilmenite
SiO2	32.28	1.52	1.43	41.64	34.93	35.38	0.61
TiO2	0.12	9.90	51.92	4.35			52.29
Al2O3	22.88	3.22	0.41	10.51			0.18
FeO*	30.53	79.78	43.58	13.07	43.59	41.42	44.83
MnO	0.54	1.18	4.08	0.28	2.02	1.67	2.23
MgO	1.89			11.33	20.32	22.21	0.87
CaO		0.12		11.11		0.10	
Na2O				3.01			
K2O	9.31			1.57			
V2O5		0.34	0.34				
Cr2O3							
CoO							
Cl				0.09			

Sample	452						
Mineral	ilmenite	ilmenite	plag	olivine	olivine	plag	plag
SiO2	0.59	0.64	62.39	35.93	36.63	64.22	59.45
TiO2	52.07	51.89	Ba 0.14			0.20	0.17
Al2O3		0.29	22.75		0.78	22.48	26.03
FeO*	44.52	44.78	0.73	38.67	42.96	0.45	0.23
MnO	1.84	2.27		1.54	2.00		
MgO	1.05	0.81		24.96	15.61		
CaO			4.03	0.23	1.89	3.71	7.43
Na2O			8.49		0.50	8.16	6.97
K2O			0.75			0.86	0.35
V2O5							
Cr2O3							
CoO							
Cl							

Sample	452						
Mineral	plag	neph	alksp	alksp	bio	bio	cpx
SiO2	65.01	45.76	68.46	68.04	39.06	37.57	51.28
TiO2	0.28				6.00	8.11	0.93
Al2O3	23.00	32.40	19.64	19.28	12.76	12.24	1.91
FeO*	0.15	0.84	0.25	0.21	16.27	15.45	10.23
MnO					0.17		0.36
MgO					14.13	13.19	12.32
CaO	3.88					0.17	20.48
Na2O	8.54	14.06	10.42	10.34		0.85	0.43
K2O	1.02	5.06	0.13	0.10	9.83	8.96	
V2O5							
Cr2O3							0.13
CoO							
Cl						0.06	

Sample	452		
Mineral	cpx	olivine	olivine
SiO2	51.06	34.71	34.94
TiO2	1.19		
Al2O3	1.95		
FeO*	10.49	42.89	42.87
MnO	0.41	1.79	1.76
MgO	12.46	20.68	20.57
CaO	20.46	0.19	0.23
Na2O	0.41		
K2O			
V2O5			
Cr2O3			
CoO			
Cl			