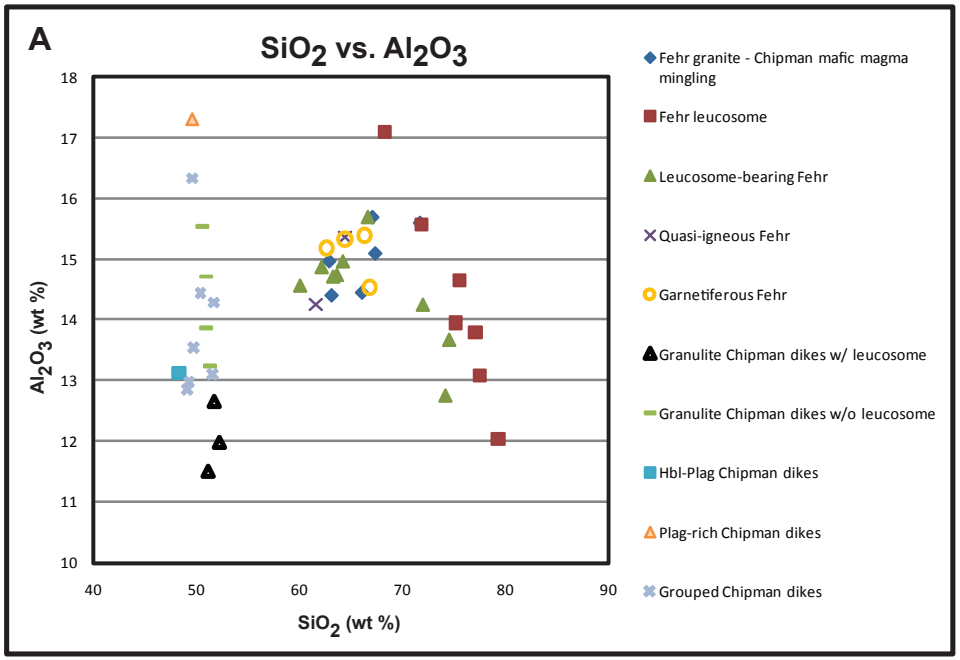
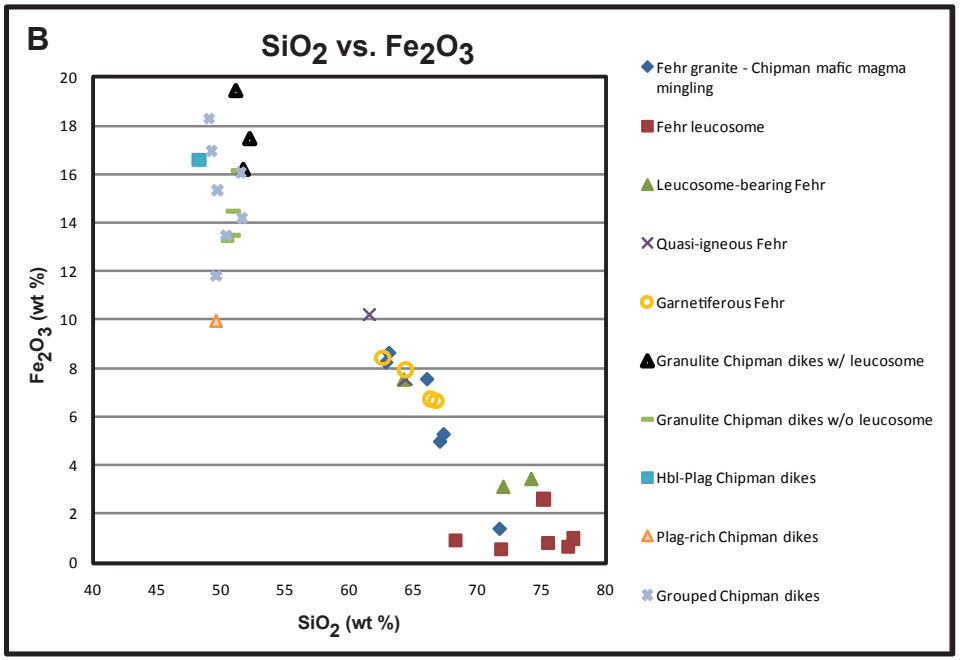
GSA DATA REPOSITORY 2010294

Koteas et al. Bulk geochemical data for Fehr granite and Chipman mafic dikes

Field evidence supports the interpretation that partial melting of the 2.6 Ga Fehr granite occurred during granulite facies metamorphism at 1.9 Ga, associated with the intrusion of the Chipman mafic dike swarm. During this event, some early-formed Chipman mafic dikes also experienced migmitization, producing local tonalitic leucosomes. Abundant field evidence is preserved that documents the interaction of Chipman mafic dike-related magmas with Fehr granite leucosomes.

Figure DR1: Harker-style bivariant element plots of Fehr granite and related products of migmitization during granulite facies metamorphism. Also included are plots of Fehr granite with petitectic garnet, Fehr granite mechanically mingled with Chipman dike-related mafic magmas, and Chipman dikes having experienced varying degrees of migmitization and peritectic phase-forming reactions. The Fehr granite is the most fertile rock for partial melt generation in the study area. Although some variation exists in the Al content of partial melt-bearing Fehr granite and Fehr leucosome and Chipman dikes (plot A), plots B, C, and D all show a consistent trend of increasing Si and alkali elements (i.e Na) with increasing partial melt concentration and decreasing metals (i.e. Fe) and Zr. This trend is not observed in Chipman dikes, regardless of the degree of partial melting. The lack of overlap in Fehr-related vs. Chipman-related fields suggests that partial melt observed within the Fehr granite was locally generated and was either stored near the site of production or migrated independently of the Chipman mafic dike migmatitie. Data for Chipman dikes and Chipman dike granulites from Williams et al., 1995 and Flowers et al., 2006a (see Table DR1).


A
SiO2 vs. Al2O3
Al2O3 (wt %)
SiO2 (wt %)
Fehr granite - Chipman mafic magma mingling
Fehr leucosome
Leucosome-bearing Fehr
Quasi-igneous Fehr
Garnetiferous Fehr
Granulite Chipman dikes w/ leucosome
Granulite Chipman dikes w/o leucosome
Hbl-Plag Chipman dikes
Plag-rich Chipman dikes
Grouped Chipman dikes


B
SiO2 vs. Fe2O3
Fe2O3 (wt %)
SiO2 (wt %)
Fehr granite - Chipman mafic magma mingling
Fehr leucosome
Leucosome-bearing Fehr
Quasi-igneous Fehr
Garnetiferous Fehr
Granulite Chipman dikes w/ leucosome
Granulite Chipman dikes w/o leucosome
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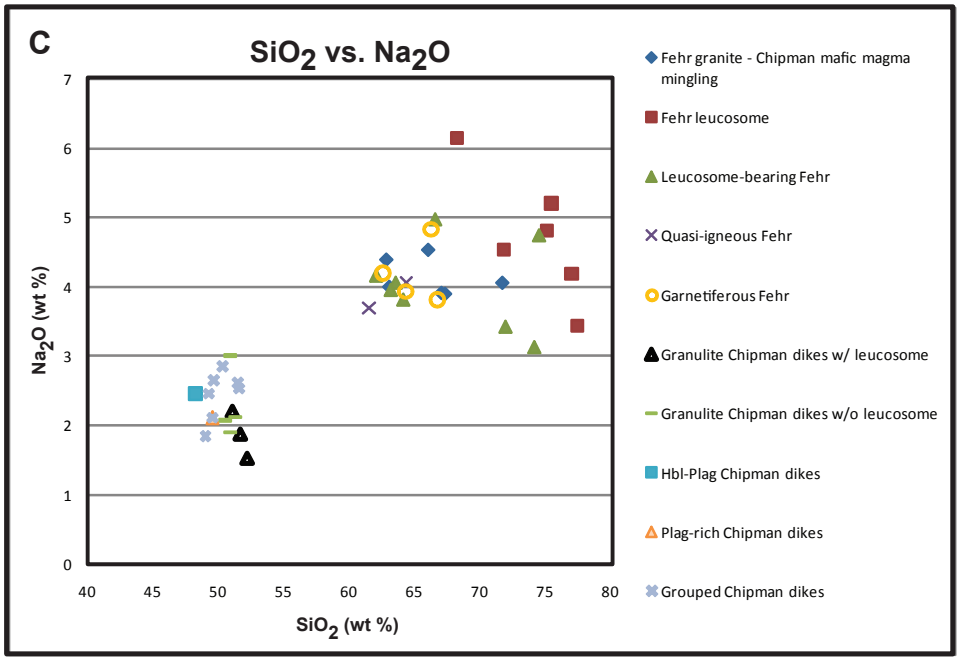
C
SiO2 vs. Na2O
Na2O (wt %)
SiO2 (wt %)
Fehr granite - Chipman mafic magma mingling
Fehr leucosome
Leucosome-bearing Fehr
Quasi-igneous Fehr
Garnetiferous Fehr
Granulite Chipman dikes w/ leucosome
Granulite Chipman dikes w/o leucosome
Hbl-Plag Chipman dikes
Plag-rich Chipman dikes
Grouped Chipman dikes

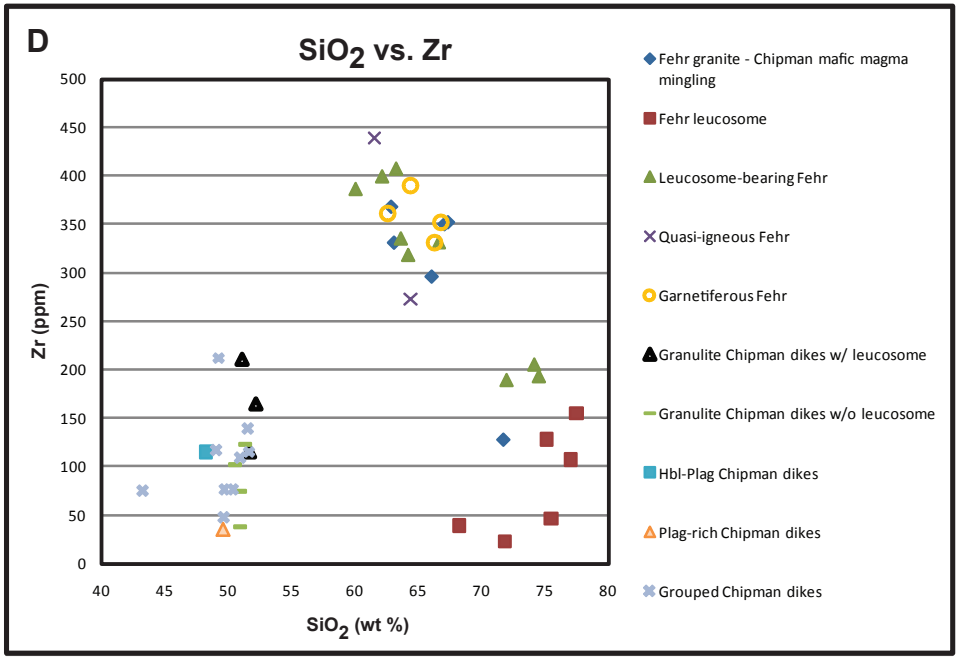
D
SiO2 vs. Zr
Zr (ppm)
SiO2 (wt %)
Fehr granite - Chipman mafic magma mingling
Fehr leucosome
Leucosome-bearing Fehr
Quasi-igneous Fehr
Garnetiferous Fehr
Granulite Chipman dikes w/ leucosome
Granulite Chipman dikes w/o leucosome
Hbl-Plag Chipman dikes
Plag-rich Chipman dikes
Grouped Chipman dikes

Table DR1: Dataset for figure DR1. Bulk geochemical data produced via XRF analysis at the University of Massachusetts, Department of Geosciences.

*Data from Flowers et al., 2006a.
+Data from Williams et al., 1995.

DRtable1	Fehr granite - Chipman mafic magma mingling						Fehr leucosome		
sample	09K-013a	09K-013c	09K-020b	09K-036b	09K-072b	08K-004	09K-017	09K-065a	09K-072d
lake	No-Name	No-Name	No-Name	No-Name	Fehr	Steinhauer	No-Name	Cross	Fehr
SiO2	71.70	67.08	63.12	67.35	62.89	66.07	71.83	75.16	68.26
Al2O3	15.59	15.68	14.40	15.09	14.96	14.45	15.57	13.94	17.10
Fe2O3	1.37	4.97	8.63	5.27	8.24	7.55	0.43	0.52	2.60
MnO	0.02	0.05	0.11	0.07	0.11	0.13	0.01	0.02	0.03
MgO	0.60	1.10	1.77	1.05	1.57	1.59	0.09	0.34	0.64
CaO	2.07	3.49	4.14	3.25	4.46	2.84	0.48	1.78	2.06
Na2O	4.05	3.90	3.99	3.89	4.38	4.52	2.92	4.54	4.81
K2O	4.54	2.99	2.37	3.38	2.85	2.01	9.03	3.82	4.38
TiO2	0.19	0.74	1.30	0.76	1.22	1.09	0.06	0.07	0.30
P2O5	0.08	0.21	0.41	0.23	0.38	0.36	0.02	0.12	0.09
Total	100.21	100.21	100.24	100.34	101.07	100.61	100.44	100.30	100.26
V	20.00	68.00	94.00	63.00	87.00	85.00	5.00	6.00	32.00
Cr	18.00	35.00	32.00	28.00	31.00	33.00	4.00	3.00	14.00
Ni	9.00	12.00	15.00	10.00	14.00	16.00	1.00	1.00	7.00
Zn	22.00	75.00	93.00	82.00	110.00	69.00	6.00	14.00	43.00
Ga	15.00	20.00	21.00	19.00	21.00	18.00	12.00	12.00	17.00
Rb	69.80	60.80	52.80	67.30	53.60	50.60	76.70	40.70	43.20
Sr	523.00	321.00	290.00	320.00	312.00	299.00	226.00	313.00	328.00
Y	1.60	15.70	32.70	18.60	30.00	25.00	0.40	4.30	6.80
Zr	128.00	350.00	331.00	352.00	368.00	296.00	13.00	23.00	128.00
Nb	1.70	12.50	18.60	15.20	18.00	13.90	1.00	1.20	4.40
Ba	1287.00	1488.00	910.00	1644.00	1201.00	681.00	2346.00	2170.00	2808.00
La	43.00	111.00	52.00	38.00	56.00	57.00	3.00	29.00	87.00
Ce	82.00	227.00	117.00	73.00	123.00	125.00	3.00	55.00	147.00
Pb	19.00	17.00	10.00	12.00	16.00	6.00	32.00	12.00	26.00
Th	14.00	19.00	5.00	2.00	5.00	14.00	0.00	13.00	18.00
U	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00

DRtable1 cont.	Fehr Leucosome				Leucosome-bearing Fehr granite				
sample	09K-074	09K-079	09K-081	08K-015C	09K-050a	09K-063	09K-065b	09K-065d	09K-073
lake	Fehr	Fehr	Fehr	Steinhauer	Cross	Cross	Cross	Cross	Fehr
SiO2	75.50	77.05	77.49	79.25	74.16	71.97	64.20	63.62	63.25
Al2O3	14.65	13.79	13.08	12.03	12.74	14.24	14.95	14.73	14.70
Fe2O3	0.91	0.80	0.62	0.97	3.44	3.12	7.51	8.22	8.94
MnO	0.02	0.02	0.02	0.04	0.04	0.04	0.10	0.11	0.11
MgO	0.16	0.18	0.14	0.22	0.87	0.82	1.38	1.54	1.71
CaO	2.32	2.96	1.23	0.90	1.71	1.64	4.11	4.16	4.53
Na2O	6.15	5.20	4.19	3.44	3.12	3.42	3.81	4.06	3.95
K2O	0.75	0.41	3.53	4.10	3.84	4.90	2.90	2.51	1.55
TiO2	0.10	0.10	0.06	0.07	0.56	0.45	1.11	1.21	1.35
P2O5	0.04	0.01	0.01	0.01	0.15	0.13	0.34	0.36	0.41
Total	100.59	100.52	100.39	101.03	100.62	100.71	100.43	100.52	100.51
V	8.00	8.00	5.00	11.00	44.00	36.00	83.00	89.00	97.00
Cr	4.00	4.00	3.00	7.00	25.00	20.00	25.00	29.00	36.00
Ni	1.00	1.00	1.00	2.00	8.00	7.00	12.00	13.00	16.00
Zn	12.00	12.00	33.00	13.00	54.00	46.00	108.00	108.00	116.00
Ga	13.00	13.00	19.00	11.00	16.00	17.00	21.00	21.00	21.00
Rb	11.70	6.30	28.40	47.90	87.00	100.50	47.60	38.90	35.00
Sr	362.00	421.00	211.00	161.00	240.00	257.00	324.00	340.00	330.00
Y	1.20	0.20	31.10	3.20	9.70	8.80	23.70	27.50	33.10
Zr	39.00	46.00	107.00	155.00	205.00	189.00	318.00	335.00	407.00
Nb	1.00	1.60	22.30	0.90	8.90	7.80	15.00	16.50	19.60
Ba	378.00	216.00	1000.00	986.00	1235.00	1372.00	1551.00	1325.00	766.00
La	5.00	2.00	6.00	54.00	58.00	76.00	41.00	54.00	50.00
Ce	16.00	7.00	16.00	106.00	113.00	149.00	88.00	111.00	120.00
Pb	17.00	19.00	35.00	20.00	18.00	21.00	13.00	13.00	17.00
Th	0.00	1.00	15.00	16.00	8.00	15.00	1.00	2.00	7.00
U	0.00	0.00	14.00	0.00	0.00	2.00	0.00	0.00	0.00

DRtable1 cont.	Leucosome-bearing Fehr granite				Non-migmatized Fehr granite		Garnetifeous Fehr granite		
sample	09K-091d	08K-009A	08K-009C	08K-012B	09K-072a	08K-011B	08K-012	08K-015A	08K-016
lake	Fehr	Steinhauer	Steinhauer	Steinhauer	Fehr	Steinhauer	Steinhauer	Steinhauer	Steinhauer
SiO2	62.14	74.52	66.62	60.05	61.54	64.39	62.59	64.38	66.77
Al2O3	14.86	13.66	15.69	14.55	14.25	15.36	15.18	15.32	14.53
Fe2O3	9.61	3.18	6.55	10.73	10.20	7.54	8.43	7.92	6.65
MnO	0.12	0.08	0.10	0.16	0.12	0.12	0.15	0.12	0.11
MgO	1.93	0.43	1.13	2.23	1.92	1.20	1.56	1.46	1.08
CaO	5.13	2.71	2.64	4.39	4.50	4.12	3.87	4.17	3.40
Na2O	4.16	4.74	4.98	4.18	3.70	4.06	4.20	3.93	3.81
K2O	0.97	0.84	2.04	2.04	2.47	2.68	2.09	1.93	3.33
TiO2	1.48	0.39	0.87	1.52	1.48	1.07	1.18	1.17	0.96
P2O5	0.48	0.12	0.25	0.47	0.46	0.33	0.38	0.33	0.29
Total	100.88	100.67	100.87	100.34	100.63	100.87	99.65	100.73	100.92
V	104.00	38.00	70.00	114.00	104.00	77.00	93.00	86.00	66.00
Cr	39.00	16.00	26.00	51.00	38.00	26.00	37.00	36.00	29.00
Ni	17.00	5.00	12.00	22.00	17.00	11.00	15.00	13.00	11.00
Zn	119.00	46.00	120.00	118.00	132.00	105.00	100.00	96.00	97.00
Ga	21.00	15.00	20.00	22.00	22.00	20.00	21.00	20.00	19.00
Rb	24.60	21.30	60.80	43.70	52.70	45.30	49.80	43.40	43.30
Sr	324.00	290.00	275.00	305.00	299.00	319.00	345.00	343.00	321.00
Y	36.00	11.90	14.50	35.30	33.80	23.70	27.40	20.20	20.70
Zr	399.00	193.00	331.00	386.00	439.00	273.00	361.00	390.00	352.00
Nb	19.60	8.50	14.80	18.80	20.70	15.40	16.40	17.90	16.20
Ba	421.00	711.00	1676.00	696.00	907.00	1354.00	1060.00	1198.00	2040.00
La	53.00	25.00	22.00	61.00	71.00	35.00	52.00	44.00	59.00
Ce	131.00	54.00	47.00	137.00	156.00	74.00	112.00	89.00	110.00
Pb	14.00	12.00	14.00	10.00	14.00	12.00	10.00	7.00	18.00
Th	6.00	6.00	1.00	2.00	6.00	1.00	2.00	1.00	5.00
U	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00

DRtable1 cont.	Garnetifeous Fehr granite	Granulite Chipman dikes with leucosome*			Granulite Chipman dikes with no leucosome*				
sample	08K-017	O2-125	O2-58	99B-15	O2-112	SZ00-182A	SZ00-182B	SZ00-201A	SZ00-186A
lake	Steinhauer	Steinhauer	Chipman	Steinhauer	Steinhauer	Chipman	Chipman	Chipman	Chipman
SiO2	66.31	52.21	51.13	51.71	50.96	51.31	50.52	50.93	49.90
Al2O3	15.39	11.97	11.49	12.65	13.86	13.23	15.54	14.71	13.32
Fe2O3	6.71	17.46	19.46	16.18	13.48	16.15	13.27	14.48	16.86
MnO	0.08	0.21	0.26	0.27	0.22	0.23	0.19	0.20	0.25
MgO	1.16	4.36	3.26	4.89	7.10	5.34	6.04	5.59	5.72
CaO	2.93	9.04	7.77	8.92	11.45	9.57	10.46	9.31	9.90
Na2O	4.83	1.53	2.21	1.88	1.90	2.12	2.07	3.00	2.34
K2O	2.16	1.12	1.13	1.02	0.09	0.73	0.70	0.64	0.24
TiO2	0.98	1.92	2.50	1.78	0.72	1.53	1.22	1.17	1.40
P2O5	0.27	0.18	0.30	0.17	0.05	0.20	0.15	0.11	0.11
Total	100.82	100.23	99.73	100.06	99.47	100.24	100.03	99.99	99.71
V	82.00	397.89	278.39	321.52	269.74	344.15	278.84	250.83	314.15
Cr	42.00	23.58	-20.00	46.28	119.29	90.02	157.72	26.23	24.08
Ni	5.00	45.56	29.35	50.14	78.64	55.91	88.05	63.60	46.45
Zn	85.00	136.96	150.42	107.44	85.63	78.71	95.70	67.01	96.17
Ga	21.00	20.66	19.96	18.28	15.32	16.53	16.47	20.23	17.13
Rb	50.80	14.60	31.46	15.91	3.02	16.42	19.53	18.00	2.78
Sr	276.00	89.34	135.57	202.62	70.45	150.35	169.51	262.03	84.54
Y	11.00	34.79	44.91	24.56	19.19	30.29	24.32	21.70	31.34
Zr	331.00	164.88	210.95	115.33	37.83	123.22	101.96	74.04	84.03
Nb	19.50	11.11	13.04	13.77	4.89	6.86	5.98	3.82	5.71
Ba	1314.00	142.44	286.71	168.70	24.64	231.19	224.81	219.16	27.10
La	14.00	15.94	27.00	17.77	2.20	17.38	13.25	10.08	6.49
Ce	22.00	37.46	59.35	37.10	5.02	36.68	27.81	20.77	15.32
Pb	14.00	0.00	8.22	0.00	0.00	0.00	0.00	0.00	0.00
Th	9.00	4.57	5.27	2.31	0.28	1.64	1.37	1.21	0.70
U	2.00	1.85	2.68	0.55	0.12	0.38	1.40	7.12	0.17

DRtable1 cont.	Hb-Pl dikes*	Pl-rich dikes*	Undifferentiated migmatitic Chipman dikes*						
sample	O2-123B	SZ00-200A	W2-41	M112-D	W2-36A	W2-26	M2479B	M112-2	M2432B
lake	Steinhauer	Chipman	Woolheather	Woolheather	Woolheather	Woolheather	Woolheather	Woolheather	Woolheather
SiO2	48.27	49.60	49.26	49.69	49.06	51.52	49.61	51.63	43.23
Al2O3	13.12	17.30	12.97	13.54	12.85	13.10	16.33	14.28	16.91
Fe2O3	16.58	9.95	16.95	15.34	18.28	16.05	11.80	14.17	16.86
MnO	0.23	0.16	0.22	0.21	0.29	0.22	0.19	0.22	0.25
MgO	5.38	7.10	5.13	6.20	5.57	4.72	8.48	5.65	9.32
CaO	9.61	11.76	9.16	9.90	10.09	8.88	10.87	9.52	11.43
Na2O	2.46	2.11	2.46	2.65	1.85	2.61	2.11	2.53	1.02
K2O	1.31	0.57	0.49	0.75	0.31	0.90	0.38	0.62	0.18
TiO2	1.82	0.58	3.09	1.31	1.83	1.78	0.60	1.46	1.19
P2O5	0.17	0.04	0.34	0.11	0.16	0.18	0.05	0.14	0.13
Total	99.76	100.35	100.07	99.70	100.29	99.96	100.42	100.22	100.52
V	346.60	186.94	437.34	332.79	401.76	335.11	182.45	312.14	231.56
Cr	107.04	213.77	67.74	134.48	111.04	24.91	132.18	110.93	129.32
Ni	72.04	89.39	66.17	115.90	66.66	52.15	165.37	72.58	103.96
Zn	111.76	63.35	135.94	96.94	141.13	135.48	86.04	126.70	132.25
Ga	18.40	13.98	23.52	17.07	20.26	19.09	15.26	20.69	15.94
Rb	29.77	15.87	6.68	8.19	6.36	19.91	6.87	20.81	1.99
Sr	114.72	181.63	135.85	139.91	117.77	225.93	160.31	171.54	266.69
Y	33.40	11.29	52.47	27.68	32.96	24.52	12.56	24.58	32.39
Zr	114.98	34.99	211.94	76.47	116.91	139.22	47.39	115.14	75.36
Nb	7.54	3.19	12.58	3.84	6.99	11.94	2.09	7.55	8.81
Ba	159.59	86.52	55.89	68.18	60.39	230.29	71.75	184.21	14.90
La	12.59	3.14	12.70	5.07	3.95	19.69	8.92	12.41	4.95
Ce	23.38	6.80	37.24	12.62	21.05	45.89	9.77	30.14	9.99
Pb	5.28	0.00	3.27	1.74	2.39	6.94	3.21	4.50	3.17
Th	0.98	0.40	1.36	0.24	0.35	2.03	0.36	2.29	0.06
U	0.32	1.13	1.25	1.10	0.83	0.90	0.32	0.71	0.51

DRtable1 cont.	Undifferentiated migmatitic Chipman dikes*	
sample	M2432C	08K-015B
lake	Woolheather	Steinhauer
SiO2	50.97	50.38
Al2O3	13.22	14.43
Fe2O3	17.52	13.48
MnO	0.34	0.24
MgO	5.12	5.94
CaO	9.34	10.83
Na2O	1.27	2.85
K2O	0.22	1.08
TiO2	1.68	1.18
P2O5	0.16	0.10
Total	99.84	100.52
V	374.89	283.00
Cr	108.61	102.00
Ni	63.98	61.00
Zn	133.54	114.00
Ga	17.37	17.00
Rb	2.17	8.30
Sr	111.56	184.00
Y	31.11	17.00
Zr	108.89	76.00
Nb	9.12	7.20
Ba	26.90	117.00
La	6.34	6.00
Ce	18.02	23.00
Pb	3.47	8.00
Th	0.76	2.00
U	0.00	0.00