Geological Survey
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RADIOGENIC AGE AND ISOTOPIC STUDIES: REPORT 13

Current Research
2000-F5

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2000

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Catalogue No. M44-2000/F5E-IN
ISBN 0-660-18231-9

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Late Grenvillian granite plutons in the Central metasedimentary belt, Grenville Province, southeastern Ontario

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Davidson, A. and van Breemen, O., 2000: Late Grenvillian granite plutons in the Central metasedimentary belt, Grenville Province, southeastern Ontario; Geological Survey of Canada, Current Research 2000-F5; Radiogenic Age and Isotopic Studies: Report 13, 9 p. (CD-ROM).

Abstract: Two leucogranite plutons in the Sharbot Lake domain, dated at 1070 and 1066 Ma, are altogether younger than other plutons already dated in the same area; both are coeval with the 1065 Ma Guénette granite in the northern Central metasedimentary belt in Quebec. These two granite plutons, among others, were previously assigned to an alaskitic suite dated 1250–1240 Ma. A review of granite pluton ages in the Central metasedimentary belt shows that lithological similarity alone cannot be used for assigning such rocks to specific age groups. In addition, the two dated plutons are chemically distinct from each other and also from syenitic plutons of the Skootamatta suite (1090–1075 Ma), in the same general region. Geochemically dissimilar plutons thus need not have different ages. However, a consideration of characteristics such as relationship to regional structure allows the prediction that certain other granite plutons may belong to the young age group.

Résumé : Deux plutons leucogranitiques du domaine de Sharbot Lake, datés à 1070 et 1066 Ma, sont plus récents que les autres plutons déjà datés dans la même zone. Ils sont tous les deux contemporains du granite de Guénette de 1065 Ma dans le nord de la ceinture métasédimentaire centrale au Québec. Ces deux plutons granitiques, entre autres, avaient été attribués à une suite alaskitique datée à 1250–1240 Ma. Il ressort d'une analyse des âges des plutons granitiques dans la ceinture métasédimentaire centrale que l'on ne peut pas utiliser que la seule similarité lithologique pour répartir ces roches dans des groupes d'âge spécifiques. De plus, les deux plutons datés se distinguent non seulement l'un de l'autre par leur composition chimique, mais également des plutons syénitiques de la suite de Skootamatta (1090–1075 Ma) qui se rencontre dans la même grande région. Les plutons dont la composition géochimique diffère ne sont pas nécessairement d'âge différent. Cependant, si l'on tient compte de certaines caractéristiques, comme le lien qui existe entre eux et la structure régionale, on peut présumer que certains autres plutons granitiques appartiennent au groupe d'âge jeune.

INTRODUCTION

Plutonic rocks in the Central metasedimentary belt in Ontario fall into three major age groups, 1270–1225 Ma, 1180–1150 Ma, and 1090–1065 Ma, referred to respectively as the 'Elzevir', 'Frontenac', and 'Skootamatta' suites. The Elzevir suite is restricted to the Elzevir terrane (superterrane of Easton, 1992) and overlaps the age span of volcanic rocks in the same region (1290–1250 Ma). It comprises several subsuites, among which are granite plutons referred to by Lumbers et al. (1990) as the alaskite suite, to which a restricted age range of 1250–1240 Ma was assigned. Dated members of this alaskitic subsuite, all in the Elzevir terrane west of the Robertson Lake shear zone, include the following plutons (Fig. 1): Deloro (1241 Ma) and Addington (1245 Ma) (van Breemen and Davidson, 1988), Methuen (1242 Ma) (Heaman et al., 1986), Abinger (1240 Ma) and Norway Lake (1242 Ma) (Corfu and Easton, 1995). Other subsuites include somewhat older calc-alkaline plutons of tonalite and granodiorite (1270–1250 Ma) (*see* Corfu and Easton, 1997; Praamsma et al., 2000), and younger gabbro, diorite, and granodiorite (1242–1224 Ma) (Davis and Bartlett, 1988; Corfu and Easton, 1995; Pehrsson et al., 1996); both of these are also restricted to the Elzevir terrane, but are present on both sides of the Robertson Lake shear zone. The Frontenac suite, ranging from gabbro and anorthosite through diorite, monzonite, syenite, and granite, is restricted to the southeastern part of the Central metasedimentary belt. east of the Robertson Lake shear zone (*see* Davidson and van Breemen, 2000). Some granite plutons of this suite, namely the Rockport-type granite of Wynne-Edwards (1963), dated at 1173 and 1172 Ma (van Breemen and Davidson, 1988; Wasteneys et al., 1996), were assigned by Lumbers et al. (1990) to their alaskite suite, presumably on the basis of lithological similarity. The Skootamatta suite is represented in the Frontenac terrane by the three adjacent Rideau Lakes syenite

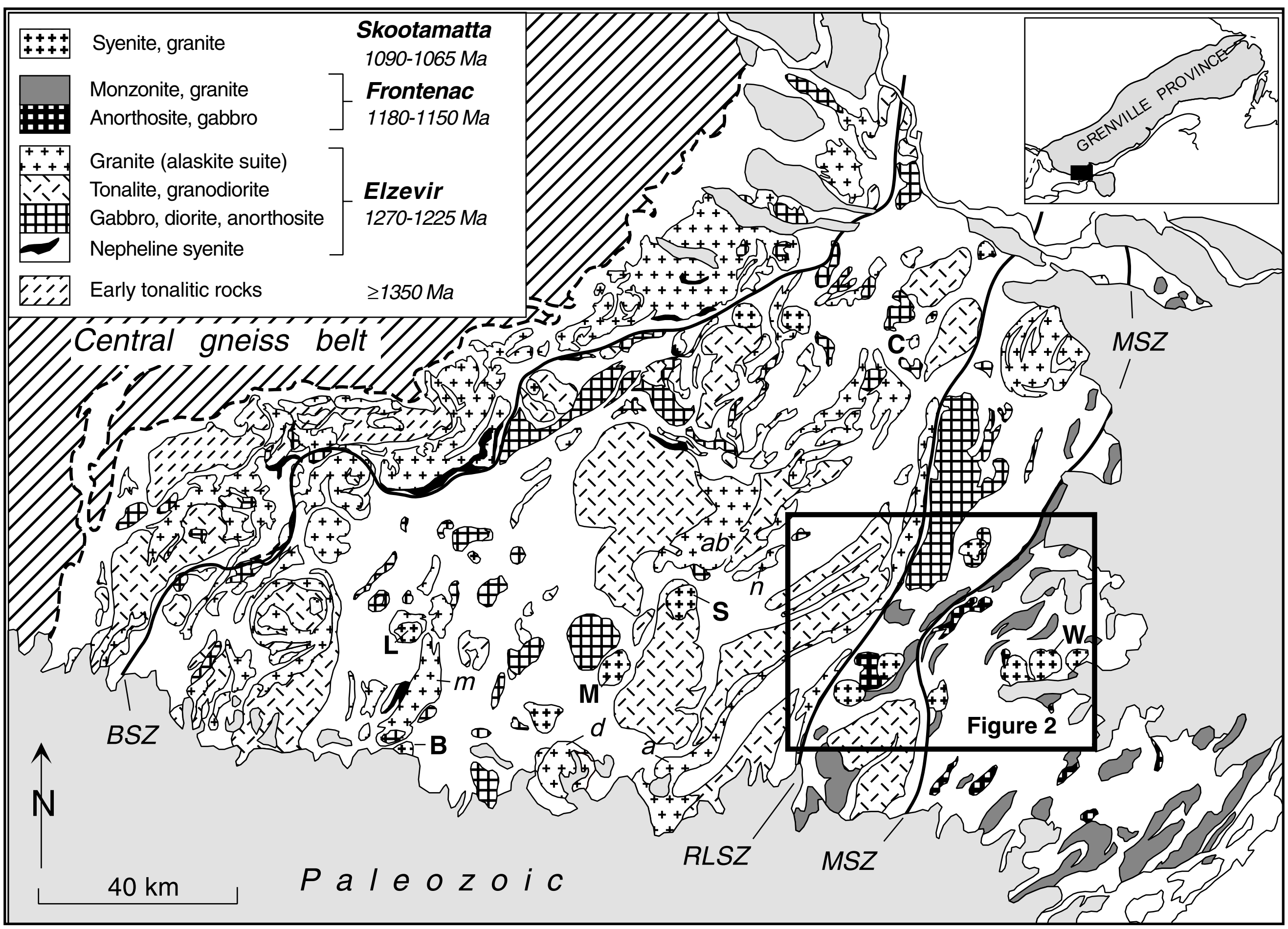

*Figure 1. Distribution of plutonic rocks in the Central metasedimentary belt, Ontario (*modified from *Lumbers et al., 1990). Dated plutons are 1) Elzevir suite granites: a = Addington, ab = Abinger, d = Deloro, m = Methuen, n = Norway Lake; 2) Skootamatta suite: B = Belmont, C = Calabogie, L = Loon Lake, S = Skootamatta, W = Westport. BSZ = Bancroft shear zone; RLSZ = Robertson Lake shear zone; MSZ = Maberly shear zone*

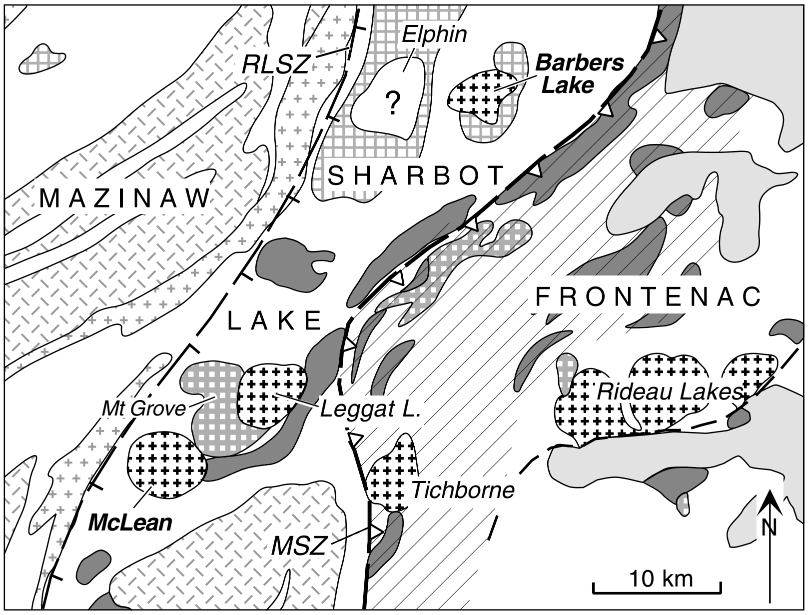

Figure 2.

*Distribution of plutonic rocks in and adjacent to the central Sharbot Lake domain (*see *Figure 1 for legend). The hatched area in the northwest Frontenac terrane is the region affected by mylonitization in shear zones subsidiary to the Maberly shear zone (MSZ).*

Table 1. Uranium-lead analytical data.

Fraction[a]	Wt.[b] (mg)	U (ppm)	Pb[c] (ppm)	$^{206}Pb/^{204}Pb$ [d]	Pb[e] (pg)	$^{208}Pb/^{206}Pb$ [f]	$^{207}Pb/^{235}U$ ± 1SE[f]	$^{206}Pb/^{238}U$ ± 1SE[f]	$^{207}Pb/^{206}Pb$ ± 1SE[f]	$^{207}Pb/^{206}Pb$ Age[g] (Ma)	Discord[h] (%)
Barbers Lake pluton				**92DM 92**		**Z3302**	**UTM 379675,4976525 (18)**				
A, 50, N 4	21	112	20	4600	6	0.135	1.785 ± 0.12	0.1734 ± 0.09	0.07469 ± 0.07	1060 ± 3	3.0
B, 70, N 4	44	87	16	2454	18	0.138	1.821 ± 0.16	0.1766 ± 0.14	0.07479 ± 0.09	1063 ± 4	1.5
C, 70, N 4	24	188	34	7458	7	0.120	1.819 ± 0.10	0.1764 ± 0.09	0.07480 ± 0.04	1063 ± 2	1.6
McLean pluton				**92DM 159**		**Z3264**	**UTM 352900,4945675 (18)**				
A, 80	41	319	59	14608	10	0.123	1.853 ± 0.10	0.1791 ± 0.09	0.07500 ± 0.03	1069 ± 4	0.64
B, 150	26	273	51	3757	21	0.144	1.846 ± 0.11	0.1785 ± 0.09	0.07499 ± 0.05	1068 ± 2	0.95
C, 70	32	293	54	2027	53	0.114	1.859 ± 0.12	0.1797 ± 0.09	0.07504 ± 0.06	1070 ± 3	0.43

[a] Approximate average sizes in mm before abrasion; M and N refer to magnetic and nonmagnetic fractions at side slope indicated in degrees. [b] Error on weight = ±1mg. [c] Radiogenic Pb. [d] Measured ratio corrected for spike and Pb fractionation of 0.09 ±0.03%/AM. [e] Total common Pb on analysis corrected for fractionation and spike. [f] Corrected for blank Pb, common Pb, fractionation, and spike. [g] Age error quoted is 2 SE in Ma. [h] Discordance along a discordia to origin.

plutons (Wynne-Edwards, 1967), of which one has been dated at 1076 Ma (Corriveau et al., 1990), and in the Elzevir terrane by the Skootamatta (1083 Ma; S.D. Carr, pers. comm., 1999), Belmont (1088 Ma; Davis and Bartlett, 1988), Loon Lake (1090 Ma) and Calabogie plutons (1088 Ma; Corriveau et al., 1990) (*see* Fig. 1 for localities). This suite has counterparts in adjacent Quebec (Kensington suite), dated at 1083–1076 Ma (Corriveau et al., 1990).

Like the Rockport granite in the Frontenac terrane, several granite plutons in the Sharbot Lake domain were assigned to the alaskite suite by Lumbers et al. (1990, Fig. 1). Two of these plutons of leucogranite (Leggat Lake and Tichborne) were mapped by Wynne-Edwards (1965), but were not specifically assigned to his 'Frontenac-type' suite. The two alaskite suite plutons whose ages are reported here are the Barbers Lake and McLean granites (Fig. 2), mapped by Pauk (1989) and Wolff (1982) respectively; both lie within the Sharbot Lake domain of the greater Elzevir terrane.

GEOLOGY AND GEOCHRONOLOGY

Analytical techniques and interpretation

Analytical techniques are described in Davidson and van Breemen (2000). Isotopic data are presented in Table 1 and displayed in Figure 3. All age uncertainties are given at the 95% confidence level.

Barbers Lake pluton

The Barbers Lake pluton is equant in plan, about 4 km in diameter. It is not well exposed, with most outcrops lying near its margins. These are composed of relatively fine-grained, pink leucogranite, although a grey-white phase is present locally near the outer contact with marble. Small quantities of brown garnet, black tourmaline, purple fluorite, and white mica are present in the granite at several of the outcrops examined. Thin sections show abundant micrographic intergrowth between quartz and K-feldspar, suggestive of crystallization at a high level in the crust. The dated sample, collected from a jointed outcrop knoll at an abandoned farm just west of Barbers Lake, is typical of the prevalent pink leucogranite.

The zircon population is colourless and clear, with no visible cores. Fraction A was composed of prismatic grains with some fractures and minor inclusions. The grains were euhedral, with an elongation ratio of 2:1 or greater and lengths of 70 to 150 µm. In Fraction B, the grains were mostly broken and somewhat rounded, with a length ranging from 100 to 200 µm. Many had internal fractures and fluid inclusions. Fraction C consisted of more elongate, prismatic grains with lengths of 50 to 150 µm. They had sharp terminations and many had minor inclusions.

Three data points range from 1.5 to 3.0% discordant. Regression analysis yields lower and upper intercept ages of 0.22 Ga and 1066 +7/-4 Ma. The upper intercept age is assigned to the time of igneous crystallization.

McLean pluton

The McLean pluton is circular in plan, 8 km in diameter. Wolff's (1982) map does not distinguish this granite from surrounding masses of unspecified granitoid rocks, but it is quite distinct from these on the basis of its aeromagnetic signature and its outcrop pattern on aerial photographs, as confirmed from field relationships during recent detailed mapping (Davidson, 2000). Most of the pluton is composed of massive, medium- to coarse-grained, pink, leucocratic, biotite-bearing quartz syenite to granite. A less common syenitic phase is characterized by scattered, large biotite phenocrysts. A few isolated outcrops within the confines of the pluton are composed of medium-grained, grey hornblende-biotite monzonite, similar in appearance to some phases of the Frontenac suite; related mafic phases or dykes were not observed.

The dated sample, biotite quartz syenite, was collected from a roadside outcrop 1.2 km southwest of McLean settlement. The zircon crystals in this sample are clear and colourless, with lengths ranging from 100 to 200 µm. Fraction A consisted of equidimensional to prismatic grains with an elongation ratio of less than 2:1. They had few inclusions or

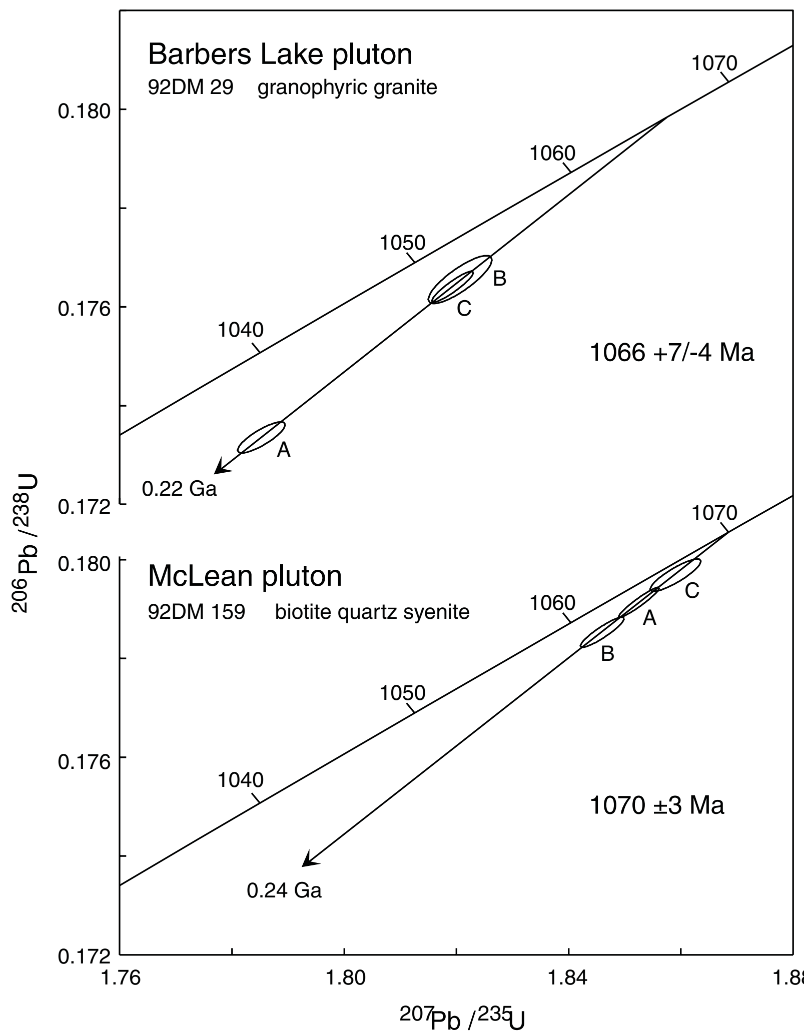

Figure 3.

Uranium-lead concordia diagrams for granites from the Barbers Lake and McLean plutons, Sharbot Lake domain.

fractures and showed no evidence of zoning or cores. Fractions B and C were taken from a population of more elongate grains with length to width ratios of 2:1 to 3:1. The zircons were prismatic and subhedral to euhedral; many had chipped edges. There were no visible cores, but many had minor fluid inclusions.

The three data points range from 0.4 to 0.95% discordant and form a linear array. Regression analysis yields lower and upper intercept ages of 0.24 Ga and 1070 +17/-3 Ma. An age and uncertainty of 1070 ± 3 Ma are assigned to the time of igneous crystallization because fraction C is nearly concordant.

DISCUSSION AND INTERPRETATION

Despite the similarity of their ages (indistinguishable within error limits), the two dated plutons are texturally and mineralogically different; mineralogical differences are reflected in their chemical composition (Table 2). In comparison to the McLean and Leggat Lake granite and quartz syenite, which have very similar trace-element contents, the Barbers Lake granite is relatively impoverished in Ti, P, Ba, Nb, Zr, Y, and heavy rare-earth elements (HREE), and enriched in Be, Rb, Th, and particularly U, suggesting an affinity with granites associated with Be-Li pegmatites and Sn-W mineralization, although neither have been recognized to date. There is, however, considerable similarity in the McLean–Leggat Lake and Barbers Lake granite patterns on chondrite-normalized diagrams (Fig. 4). Both have pronounced negative anomalies for Sr, P, and Ti, and marked negative Eu anomalies.

Rocks of the undated Elphin and Tichborne plutons (Fig. 2) are texturally and mineralogically similar to those of the McLean and Leggat Lake plutons, but not to the Barbers Lake granite; none is deformed. The Elphin pluton intrudes the 1225 Ma Lavant mafic igneous complex near the western edge of the Sharbot Lake domain (Corfu and Easton, 1997). The undeformed Tichborne granite was emplaced astride foliated Frontenac-type plutonic rocks in the Frontenac–Sharbot Lake boundary zone. Of these two, only the Elphin granite has been analyzed; its chondrite-normalized patterns (Fig. 4) are fairly different to those of the McLean and Barbers Lake granites, showing a negative anomaly for Nb and Ta, less depletion in Sr, P and Ti, and a marked impoverishment in HREE. On chemical grounds, therefore, the Elphin pluton cannot be equated with either of the plutons dated at ca. 1070 Ma; it may belong to the ca. 1160 Ma Frontenac suite (*see* Davidson and van Breemen, 2000), but without dating, it can only be stated to be younger than the Lavant complex. The Tichborne granite, however,

Table 2. Whole-rock analyses and norms of granite and quartz syenite, Sharbot Lake domain.

Pluton sample no.	Barbers L.			McLean			Leggat L.		Elphin
	92DM 30a	92DM 30b	*89RME-0063	92DM 158	92DM 159	92DM 160	92DM 42.1	92DM 69a	91DM-2
SiO_2	73.5	74.3	74.6	73.5	63.6	70.6	62.2	63.5	68.5
TiO_2	0.09	0.08	0.03	0.27	0.89	0.48	0.90	0.69	0.34
Al_2O_3	13.7	13.6	14.0	13.3	15.1	14.5	16.1	16.9	15.3
Fe_2O_3	0.5	0.6	0.57	1.1	3.1	1.4	2.3	2.3	1.2
FeO	0.6	0.4	0.47	0.9	2.3	1.0	2.1	1.6	0.8
MnO	0.01	<.01	0.01	0.02	0.06	0.04	0.07	0.07	0.01
MgO	0.21	0.16	0.06	0.34	0.91	0.55	0.96	0.73	0.78
CaO	0.71	0.85	0.54	0.64	2.34	0.99	2.15	1.40	1.31
Na_2O	3.6	3.8	3.83	3.9	4.3	4.2	5.2	5.4	5.0
K_2O	4.93	5.22	4.49	4.92	5.28	5.49	5.90	6.10	4.20
P_2O_5	0.02	0.02	0.01	0.04	0.24	0.10	0.34	0.14	0.10
S	<0.02	0.29	0.01	0.05	0.05	0.02	0.05	0.09	0.02
CO_2	0.3	0.4	0.17	0.2	0.9	0.1	0.7	0.3	0.8
H_2O	0.3	0.2	0.6	0.2	0.4	0.2	0.2	0.1	0.8
Total	98.61	100.06	99.39	99.38	99.28	99.67	99.17	99.32	99.29
Ba	130	110	70	200	865	560	1200	740	1800
Be	5.5	5.2			2.8	3.7	2.0	2.9	2.8
Co	<5	<5	<5	<5	12	7	11	10	5
Cr	<10		<10		<10	<10	<10	<10	<10
Cu	<10	12	<5	21	<10	<10	<10	<10	<10
Hf						18			
Nb	28	29	15	66	62	26	45	57	3.2
Ni	<10	<10	<5	<10	<10	<10	<10	<10	<10
Rb	290	280	223	170	130	96	110	100	57
Sc	1.6	1.3	<2	1.8	4.1	3.0	3.1	3.6	5.0
Sr	48	44	44	58	370	170	710	220	580
Ta	2.4	1.5			3.3	3.9	1.5	0.79	1
Th	54	60	72	27	10	4.6	16	11	4.6
U	23	36			4.4	5.0	1.5	4.6	4.5
V	<5	<5	<5	<5	31	8	27	7	22
Y	32	36	30	86	100	76	49	80	5.8
Zn	10	11			16	51	33	65	51
Zr	130	100	117	400	715	390	570	960	130

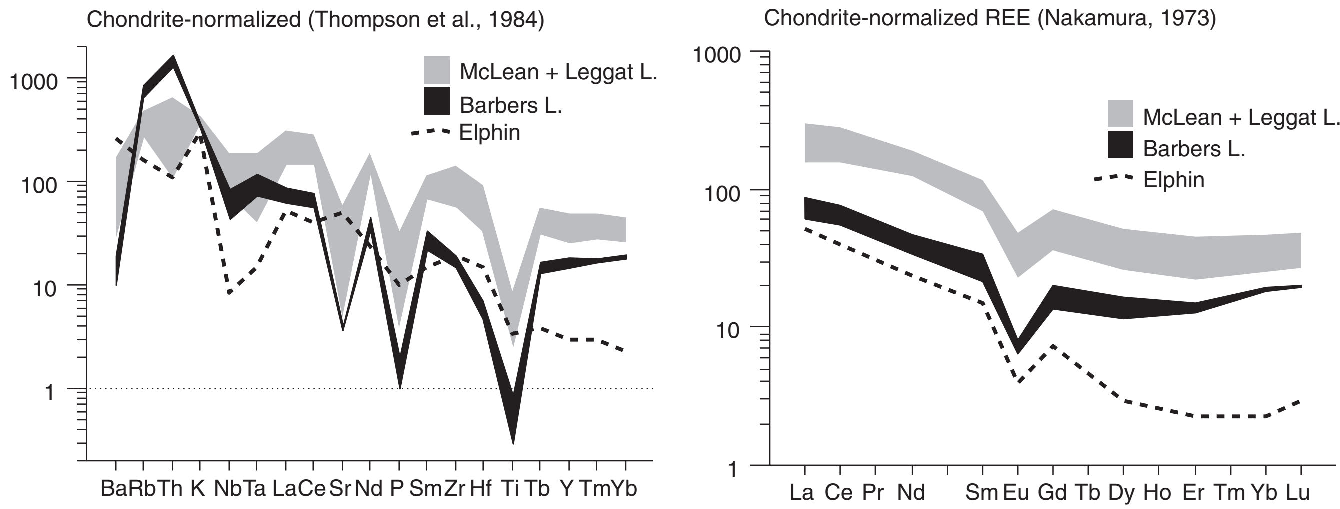

Figure 4. *Chondrite-normalized rare-earth-element and trace-element plots for the McLean and Leggat Lake granite and quartz syenite (total range of three and two analyses respectively), Barbers Lake granophyric granite (range of three analyses), and Elphin granite (one analysis).*

Table 2. (cont.)

Pluton sample no.	Barbers L.			McLean			Leggat L.		Elphin
	92DM 30a	92DM 30b	*89RME-0063	92DM 158	92DM 159	92DM 160	92DM 42.1	92DM 69a	91DM-2
La	21	20	29	95	81	49	81	100	17
Ce	48	49	66	200	210	130	190	240	34
Pr	5.6	5.8	7.8	24	31	19	22	32	4.1
Nd	21	22	29	87	115	75	82	120	15
Sm	4.4	5.0	6.9	17	23	15	14	22	2.5
Eu	0.49	0.49	0.61	1.7	3.3	2.0	2.5	3.7	0.34
Gd	3.7	4.3	5.5	14	19	13	9.9	16	1.7
Tb	0.66	0.77	0.89	2.3	3.0	2.1	1.6	2.6	0.22
Dy	4.0	4.6	5.6	13	17	12	8.9	14	1.0
Ho	0.90	1.0	1.1	2.8	3.6	2.6	1.8	3.0	0.21
Er	2.9	3.1	3.4	8.0	9.8	7.8	5.0	8.1	0.50
Tm	0.57	0.60	0.59	1.4	1.7	1.4	0.91	1.4	0.08
Yb	4.1	4.0	4.3	9.1	10	8.3	5.6	9.1	0.48
Lu	0.69	0.68	0.65	1.3	1.6	1.2	0.9	1.4	0.08
Wt norm									
q	31.67	30.22	33.77	30.12	13.65	22.51	5.21	5.52	19.66
co	1.20	0.20	1.88		0.49		0.09		
or	29.13	30.85	26.53	29.07	31.20	32.45	34.86	36.06	24.82
ab	30.46	32.15	32.41	33.00	35.96	35.55	44.00	45.71	42.31
an	3.39	4.09	2.61	2.91	6.39	4.26	3.16	3.86	5.85
ne									
cp						2.86		4.19	1.67
op	1.06	0.40	0.49	1.08	1.08	1.35	0.90	1.01	1.94
ol									
py	0.02	0.61	0.02	0.11	0.11	0.04	0.11	0.19	0.04
il	0.17	0.15	0.06	0.51	1.69	0.91	1.71	1.31	0.65
mt	0.72	0.04	0.83	1.59	4.42	1.89	3.33	3.06	1.56
hm			0.57				0.10		0.19
ap	0.05	0.05	0.02	0.09	0.54	0.23	0.79	0.32	0.23
An%	9.5	10.7	7.06	7.7	14.36	10.1	6.3	7.37	11.5
Mg/(Mg+Fe)	0.26	0.23	0.10	0.24	0.24	0.30	0.29	0.26	0.42
Agpaicity	0.82	0.88	0.80	0.88	0.84	0.89	0.93	0.92	0.83

*Analysis courtesy R.M. Easton, Geological Survey of Ontario. All other analyses done at the Geological Survey of Canada.

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cuts Frontenac suite plutonic rocks deformed in the Maberly Shear Zone, and on structural grounds it is therefore predicted to belong to the same age group as the McLean and Barbers Lake granites.

The question arises whether or not the McLean and Barbers Lake plutons (and by inference the undated Leggat Lake, Elphin, and Tichborne plutons) belong to the Skootamatta suite in Ontario and to the equivalent Kensington suite in neighbouring Quebec, for which ages so far determined are somewhat older, ranging from 1090 to 1076 Ma. The Kensington suite plutons are composed largely of silica-undersaturated and relatively potassic rocks (Corriveau, 1989, 1990), and unpublished whole-rock chemical compositions for some members of the Skootamatta suite indicates a similar nature. On the whole, chondrite- normalized trace-element and rare-earth-element patterns for these rocks are different from those shown in Figure 4, being characterized by strong depletion in Nb and Ta, marked enrichment in Ba, and no marked depletion in Sr, P, and Ti. Only silica-saturated rocks (Corriveau, 1989, Fig. 3-7) have patterns similar to those of the two Ontario granite plutons. For present purposes, therefore, only analyses of silica-saturated rocks of the Kensington suite (syenite and quartz syenite from the Baskatong, Kensington, and Loranger intrusions; Corriveau, 1989) were used to derive the range of trace-element contents for comparison with quartz syenite and granite from the McLean and Leggat Lake plutons. As illustrated in Figure 5, trace-element and rare-earth-element patterns are strikingly similar, the exceptions being that the Kensington saturated rocks have more pronounced negative Nb and Ta anomalies and light rare-earth-element enrichment.

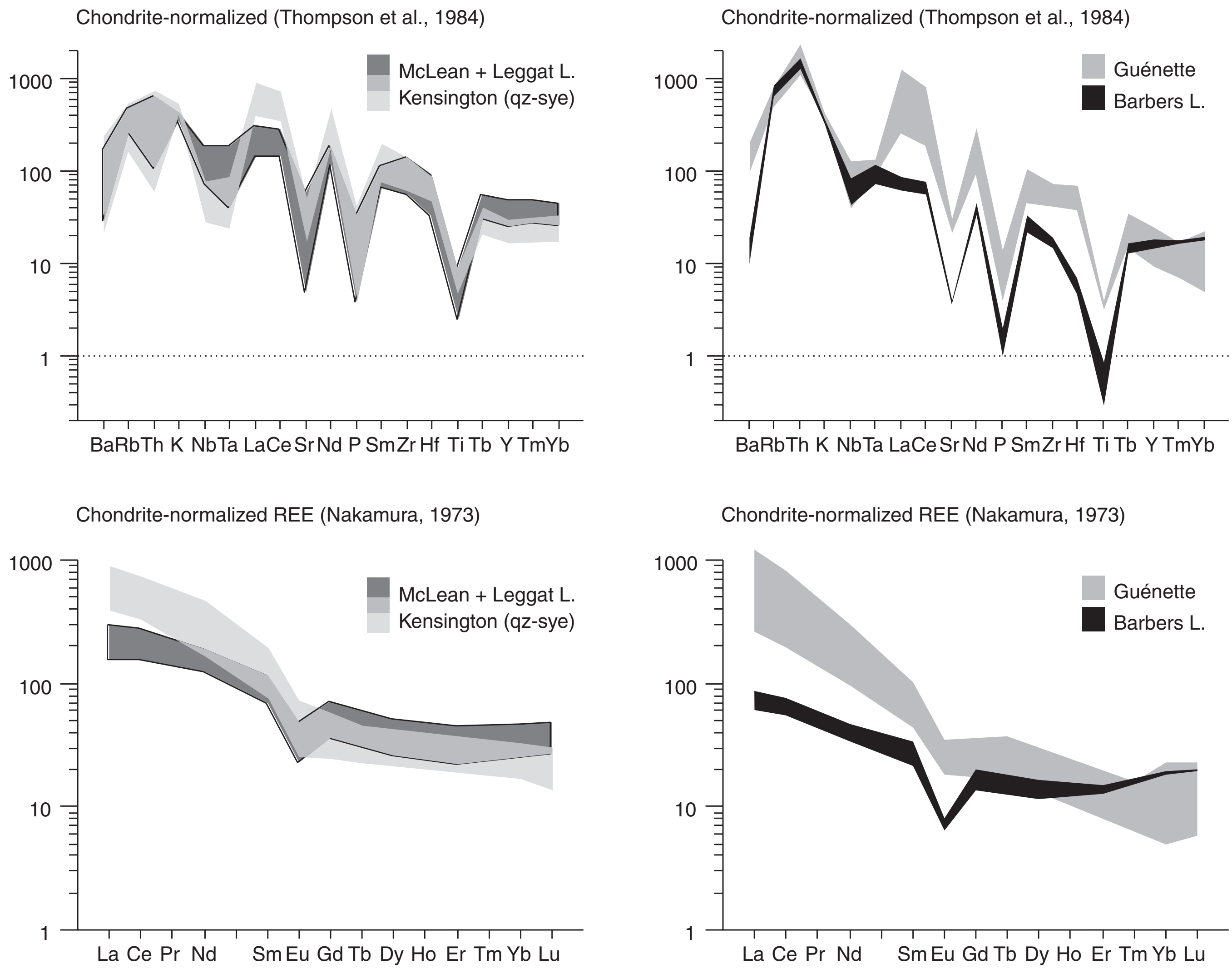

Figure 5. *Chondrite-normalized trace-element and rare-earth-element plots comparing the Barbers Lake granite with the Guénette granite, and the McLean–Leggat Lake quartz syenite and granite with similar rocks of the Kensington suite (range of six analyses) in the Central metasedimentary belt of Quebec (data* from *Corriveau, 1989).*

Because their ages are identical and younger than those of the other dated plutons of Kensington and Skootamatta suites, and both are leucogranite rather than syenite and monzonite, the Barbers Lake granite is compared in Figure 5 with the Guénette granite, located in the northern part of the Central metasedimentary belt in Quebec and dated at 1065 Ma (Corriveau and van Breemen, 1994). Both show the same enrichment in Rb and Th, no appreciable Nb or Ta anomaly, and identical depletions in Sr, P, and Ti, such as are shown by all the analyzed rocks reported here. It would appear, therefore, that the McLean, Leggat Lake, Barbers Lake, and Guénette granites are indeed chemically related, but that silica-saturated members of this suite developed late in the intrusive history of this magma series.

As a whole, the Skootamatta–Kensington suite is alkaline (A-type), and was emplaced as small stocks throughout most of the Central metasedimentary belt long after the collision that terminated the Elzevirian orogeny (ca 1.2 Ga) and the post-collisional plutonism (1180–1155 Ma Frontenac suite) that followed it. The Skootamatta–Kensington suite has hallmarks, other than its chemical composition, of being an 'anorogenic' suite. Its plutons were emplaced in regions that had already cooled from peak metamorphism (e.g. Cosca et al., 1992; Friedman and Martignole, 1995). They intrude rocks of widely different metamorphic grade, and are themselves neither deformed nor metamorphosed; some, like the Barbers Lake granophyric granite, appear to have been emplaced at high crustal level. Nevertheless, the timing of their emplacement in this part of the Grenville Province closely predates and is in part coeval with intense compressive tectonism in the Central metasedimentary belt boundary thrust zone (McEachern and van Breemen, 1993), ductile deformation and high-grade metamorphism in the Central Gneiss Belt (e.g. Bussy et al., 1995), and folding and metamorphism that affected the Flinton Group (<1150 Ma) in the Mazinaw domain (Corfu and Easton, 1995). The suite is apparently not represented in these regions, but it is coeval with much more widespread granite magmatism in the Adirondack region of New York to the southeast (Chiarenzelli and McLelland, 1991), and farther east in central Quebec (Higgins and van Breemen, 1996; Hébert et al., 1998); in these regions, the granites are syntectonic with respect to late Grenvillian deformation and high-grade metamorphism.

REFERENCES

Bussy, F., Krogh, T.E., Klemens, W.P., and Schwerdtner, W.M.
1995: Tectonic and metamorphic events in the westernmost Grenville Province, central Ontario: new results from high-precision U-Pb zircon geochronology; Canadian Journal of Earth Sciences, v. 32, p. 660–671.

Chiarenzelli, J.R. and McLelland, J.M.
1991: Age and regional relationships of granitoid rocks in the Adirondack Highlands; Journal of Geology, v. 99, p. 571–590.

Corfu, F. and Easton, R.M.
1995: U-Pb geochronology of the Mazinaw Terrane, an imbricate segment of the Central Metasedimentary Belt, Grenville Province, Ontario; Canadian Journal of Earth Sciences, v. 32, p. 959–967.
1997: Sharbot Lake terrane and its relationships to Frontenac terrane, Central Metasedimentary Belt, Grenville Province: new insights from U-Pb geochronology; Canadian Journal of Earth Sciences, v. 34, p. 1239–1257.

Corriveau, L.
1989: Potassic alkaline plutonism in the southwestern Grenville Province; Ph.D. thesis, McGill University, Montreal, Quebec, 263 p.
1990: Proterozoic subduction and terrane amalgamation in the SW Grenville Province: evidence from ultrapotassic to shoshonitic plutonism; Geology, v. 18, p. 614–617.

Corriveau, L. and van Breemen, O.
1994: The Central Metasedimentary Belt in Québec: are terrane boundaries largely cryptic?; Geological Association of Canada, Program with Abstracts, v. 19, p. A23.

Corriveau, L., Heaman, L.M., Marcantonio, F., and van Breemen, O.
1990: 1.1 Ga K-rich alkaline plutonism in the SW Grenville Province; U-Pb constraints for the timing of subduction-related magmatism; Contributions to Mineralogy and Petrology, v. 105, p. 473–485.

Cosca, M.A., Essene, E.J., Kunk, M.J., and Sutter, J.F.
1992: Differential unroofing within the Central Metasedimentary Belt of the Grenville Orogen: constraints from $^{40}Ar/^{39}Ar$ thermochronology; Contributions to Mineralogy and Petrology, v. 110, p. 211–225.

Davidson, A.
2000: Geology of the Mountain Grove pluton, Central Metasedimentary Belt, Grenville Province, Ontario; *in* Geological Survey of Canada, Current Research 2000-C23, 7 p. (online: http://www.nrcan.gc.ca/gsc/bookstore)

Davidson, A. and van Breemen, O.
2000: Age and extent of the Frontenac plutonic suite in the Central metasedimentary belt, Grenville Province, southeastern Ontario; *in* Geological Survey of Canada, Current Research 2000-F4; Radiogenic Age and Isotopic Studies: Report 13 (CD-ROM)

Davis, D.W. and Bartlett, J.R.
1988: Geochronology of the Belmont Lake metavolcanic complex and implications for crustal development in the Central Metasedimentary Belt, Grenville Province, Ontario; Canadian Journal of Earth Sciences, v. 25, p. 1751–1759.

Easton, R.M.
1992: The Grenville Province and the Proterozoic history of central and southern Ontario; *in* Geology of Ontario, (ed.) P.C. Thurston, H.R. Williams, R.H. Sutcliffe, and G.M. Stott; Ontario Geological Survey, Special Volume 4, pt. 2, p. 714–904.

Friedman, R.M. and Martignole, J.
1995: Mesoproterozoic sedimentation, magmatism, and metamorphism in the southern part of the Grenville Province (western Quebec): U-Pb geochronological constraints; Canadian Journal of Earth Sciences, v. 32, p. 2103–2114.

Heaman, L.M., McNutt, R.H., and Krogh, T.E.
1986: Geological significance of U-Pb and Rb-Sr ages for two pre-tectonic granites from the Central Metasedimentary Belt, Ontario; *in* The Grenville Province, (ed.) J.M. Moore, A. Davidson, and A.J. Baer; Geological Association of Canada, Special Paper 31, p. 209–221.

Hébert, C., van Breemen, O., and Lacoste, P.
1998: Tectonic setting and U-Pb zircon age of the Poulin-de-Courval mangerite, Saguenay–Lac Saint-Jean area, Grenville Province, Quebec; *in* Radiogenic Age and Isotopic Studies: Report 11; Geological Survey of Canada, Current Research 1998-F, p. 69–76.

Higgins, M.D. and van Breemen, O.
1996: Three generations of anorthosite-mangerite-charnockite-granite (AMCG) magmatism, contact metamorphism and tectonism in the Saguenay–Lac-Saint-Jean region of the Grenville Province, Canada; Precambrian Research, v. 79, p. 327–346.

Lumbers, S.B., Heaman, L.M., Vertolli, V.M., and Wu, T.-W.
1990: Nature and timing of Middle Proterozoic magmatism in the Central Metasedimentary Belt, Ontario; *in* Mid-Proterozoic Laurentia–Baltica, (ed.) C.F. Gower, T. Rivers, and A.B. Ryan; Geological Association of Canada, Special Paper 38, p. 243–276.

McEachern, S.J. and van Breemen, O.
1993: Age of deformation within the Central Metasedimentary Belt boundary thrust zone, southwest Grenville Orogen: constraints on the collision of the Mid-Proterozoic Elzevir terrane; Canadian Journal of Earth Sciences, v. 30, p. 1155–1165.

Nakamura, N.
1973: Determination of REE, Ba, Fe, Mg, Na and K in carbonaceous and ordinary chondrites; Geochimica et Cosmochimica Acta, v. 38, p. 757–775.

Pauk, L.
1989: Geology of the Dalhousie Lake area; Ontario Geological Survey, Report 245, 57 p.

Pehrsson, S.J., Hanmer, S., and van Breemen, O.
1996: U-Pb geochronology of the Raglan gabbro belt, Central Metasedimentary Belt, Ontario: implications for an ensialic marginal basin in the Grenville orogen; Canadian Journal of Earth Sciences, v. 33, p. 691–702.

Praamsma, T., Wodicka, N., and Easton, R.M.
2000: Evidence for magmatism of Elzevirian age in the Sharbot Lake domain, Central metasedimentary belt, Grenville Province of Ontario; *in* Geological Survey of Canada; Current Research 2000-F6; Radiogenic Age and Isotopic Studies: Report 13 (CD-ROM).

Thompson, R.N., Morrison, M.A., Hendry, G.L., and Parry, S.J.
1984: An assessment of the relative roles of crust and mantle in magma genesis: an elemental approach; Philosophical Transactions of the Royal Society of London, series A, v. 310, p. 549–590.

van Breemen, O. and Davidson, A.
1988: U-Pb zircon ages of granites and syenites in the Central Metasedimentary Belt, Grenville Province, Ontario; *in* Radiogenic Age and Isotopic Studies: Report 2; Geological Survey of Canada, Paper 88-2, p. 45–50.

Wasteneys, H.A., Lumbers, S.B., McLelland, J., and Daly, J.S.
1996: Wellesley Island leucogranite dated at 1172 ± 5 Ma by single zircon U-Pb method and implications for the geologic history of the Adirondack Lowlands; Geological Society of America, Northeastern Section, 31st Annual Meeting, Abstracts with Programs, p. 108–109.

Wolff, J.M.
1982: Geology of the Long Lake area; Ontario Geological Survey, Report 216, 76 p.

Wynne-Edwards, H.R.
1963: Geology, Brockville–Mallorytown area, Ontario; Geological Survey of Canada, Map 7-1963, scale 1:63 360.
1965: Geology of Tichborne (east half) map-area, Ontario; Geological Survey of Canada, Paper 64-56, 5 p.
1967: Westport map-area, with special emphasis on the Precambrian rocks; Geological Survey of Canada, Memoir 346, 142 p.

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