GS-1 ALKALINE INTRUSIONS OF THE CHURCHILL PROVINCE EDEN LAKE (64C/9) AND BREZDEN LAKE (64C/4)

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INTRODUCTION

After the initial study of the Burntwood Lake syenite (McRitchie, 1987), investigations into alkaline intrusions of the Churchill Province were extended this year to encompass all likely felsic intrusions in the Lynn Lake-Leaf Rapids-Kisseynew region.

Previously published reports were used as the principal guide in conducting the initial search. Thin sections, stained slabs and hand specimens were checked to confirm/reject bodies selected from the literature review. In this way, eight intrusions in the Nelson House, Osis Lake region that initially appeared to have alkaline attributes were rejected. Each of the three intrusions investigated to date displays multiphase assemblages recording a complex and extended intrusive history; however, only the earliest phase is conclusively alkaline. Accordingly, the selection process outlined above may inadvertently have excluded some alkaline intrusions if the available hand specimens represented only the younger silica-saturated granitic phases.

Two syenitic bodies were selected for field investigations in 1988 (Fig. GS-1-1), an aegirine-augite bearing monzonite to quartz monzonite on Eden Lake (Cameron, 1988), and a hornblende-alkali feldspar syenite east of Brezden Lake (Lenton, 1981). An occurrence of syenitic rocks recorded by Bateman (1945) south of McVeigh Lake was not field checked this year.

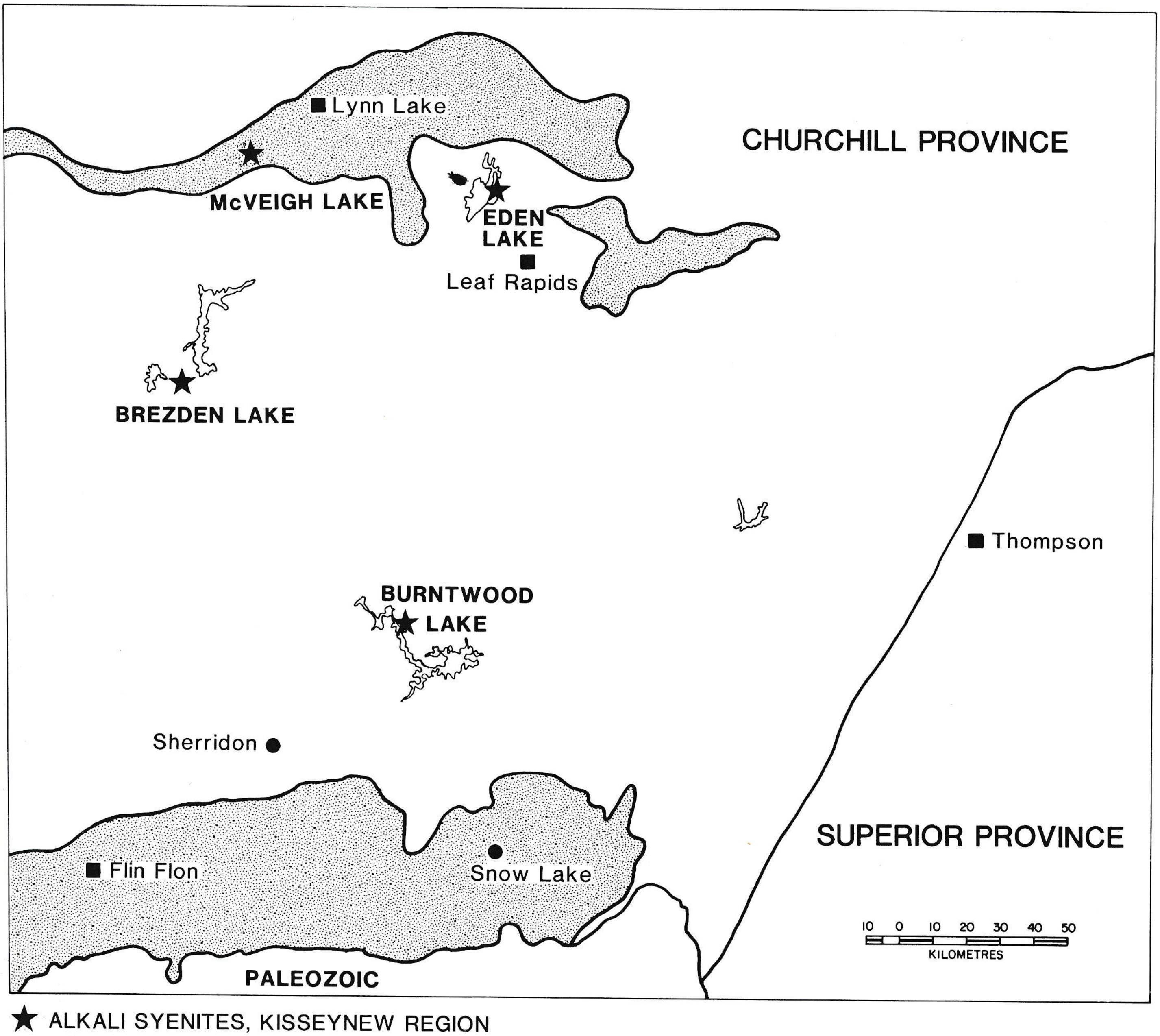

Figure GS-1-1: Alkali syenites of the Kisseynew region.

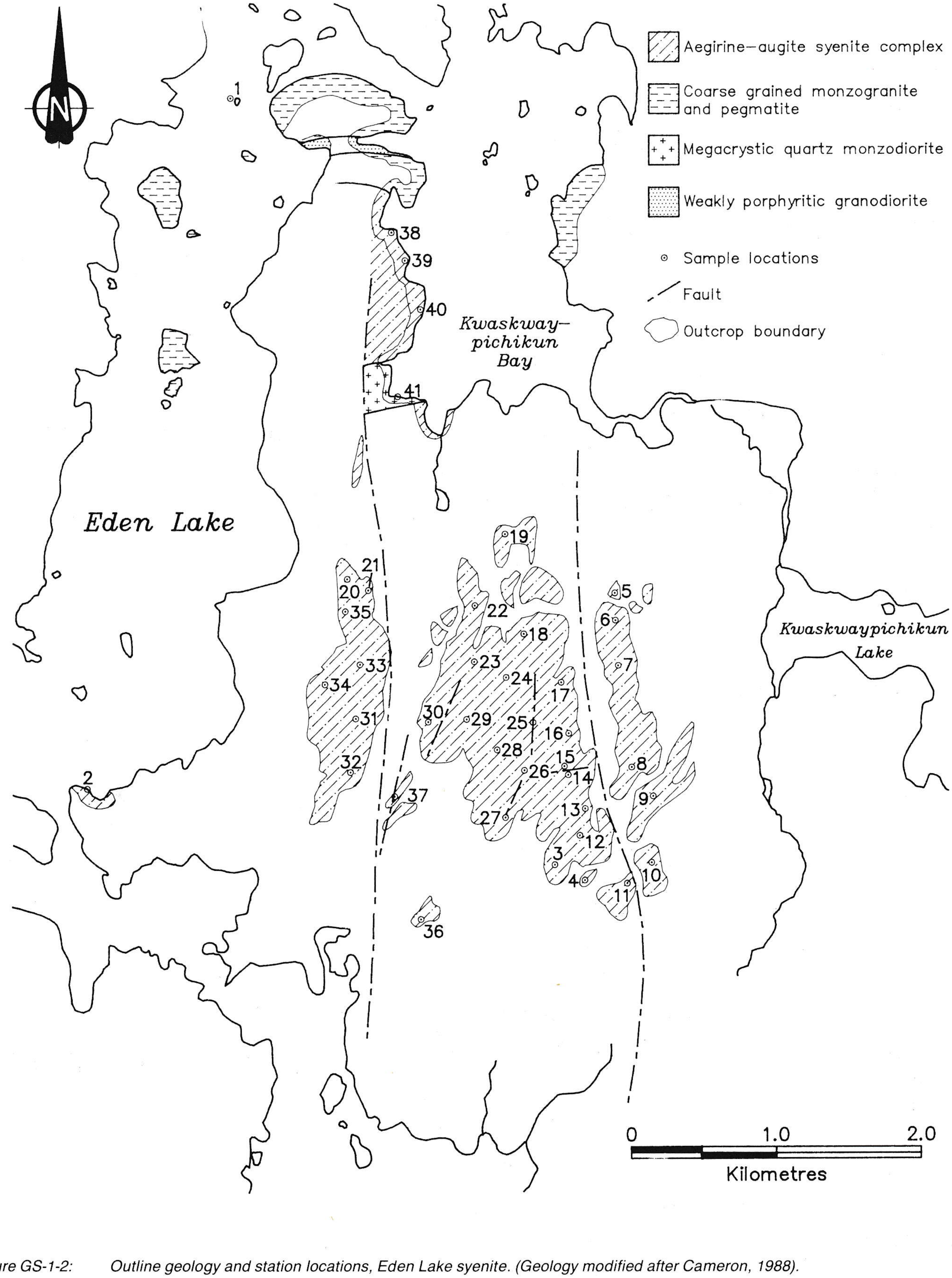

Figure GS-1-2: Outline geology and station locations, Eden Lake syenite. (Geology modified after Cameron, 1988).

EDEN LAKE AEGIRINE-AUGITE SYENITE

This 15 km^2 intrusion occurs on the east shore of Eden Lake, 60 km east-southeast of Lynn Lake (Fig. GS-1-2). Syenitic and associated granitic rocks form three high north-trending ridges (rising over 90 m above lake level) dissected by steep sided gullies that are probably fault controlled. Contacts with country rocks were not observed.

The body has a low to moderate aeromagnetic response (2600-2700 gammas) extending to 2980 gammas over the southeast corner, which is also the site of a URP uranium anomaly.

Forty-one stations were spaced evenly over the available exposures and more than 120 specimens of the various phases taken for follow-up analysis and study.

Most outcrops display several granitoid phases. An older, pink to pale cream, more monzosyenitic phase contains 15-30% ferromagnesian minerals. It is typically intruded by fine grained, pink aplitic leucosyenite, which in turn is cut by younger pink and white granite and pegmatitic granite dykes and stockworks. These are intruded by parallel sided pink pegmatites (002° and 280° azimuth) with purple interstitial fluorite, graphically intergrown quartz and potassium feldspar, plagioclase, and local, centrally concentrated, pods and lenses of white bull quartz.

Several narrow (1 mm-20 cm) vertical, north-trending cataclastic zones were observed containing finely ground quartz and cryptocrystalline crushed granite. One near-vertical 020° trending fault zone manifested as a curvilinear 20-40 cm wide recessively weathered trench, contains clotted ferromagnesian minerals in a carbonate matrix with smeared purple fluorite segregations in a finely ground granitic host.

An extensive, subhorizontal, 20 cm thick recessively weathered fault zone containing intensely microbrecciated granite, (exposed for 50 m in a 15 m vertical face) suggests that the intrusion may in large part be structurally bounded, and allochthonous.

The older syenite and monzosyenite is typically medium grained, homogeneous, weakly to non-foliated and equigranular with pink to pale orange potassium feldspar, deep green-olive brown pleochroic and locally twinned aegirine/augite, blue-green hornblende, abundant sphene, minor apatite and trace zircon. Centimetre layering is rare; however, layered segregations of clotted ferromagnesian minerals are fairly common as are rectilinear networks of centimetre and millimetre thick pyroxene-rich veinlets with feldspar/apatite-rich cores enclosed by pyroxene envelopes with "ingrowing" subhedral tabular crystals. More massive phases contain 0.3-0.8 cm poikilitic feldspars containing seed-like inclusions of 1.3 mm ferromagnesian minerals. In some coarser grained leucogranitic syenitic phases pyroxene megacrysts can are 2-3 cm long. Fine grained, dioritic or amphibolitic rafts and schlieren are uncommon but locally occur in abundance, forming hybridized contamination zones (southern end of western ridge).

The "older" coarser phases, are cut by extensive dykes and stockworks of more leucocratic, equigranular, homogeneous and unfoliated, pink to pale purple, fine grained aegirine-augite syenite with a sugary texture and average grain size less than 1 mm. At most locations quartz content is less than 4%.

Both syenitic phases are cut by locally dominant, pink, quartz-rich dykes and stockworks of aplite and granite, the latter commonly ranging in grain size from medium to very coarse grained or pegmatitic.

The youngest intrusive unit comprises pegmatite dykes ranging in thickness from 2 cm to 2 m. Most strike 280° or 0-20° and dip 40° to vertical. Quartz-rich cores occur in the larger bodies. Typically the dykes contain abundant pink or orange potassium feldspar with graphic intergrowths of quartz, almost ubiquitous interstitial purple fluorite (up to 1.5 cm), and less common andradite.

BREZDEN LAKE HORNBLENDE-ALKALI FELDSPAR SYENITE

This 3 km^2 intrusion has no aeromagnetic expression and occupies high ground east and southeast of Brezden Lake, a narrow north-trending topographic feature 5 km east of McCallum Lake (NTS 64C/4). Lenton (1981) describes the body as an indistinct area in a magnetite-bearing syenogranite (unit 14) with hornblende pseudomorphous after clinopyroxene, and with clinopyroxene remnants in crystal cores.

Country rocks comprise migmatitic metagreywacke-derived paragneiss metatexite and diatexite with locally dominant white granitic/pegmatitic mobilizate.

During the current investigation particular attention was given to mapping and tracing the contacts of the body (Fig. GS-1-3), to define the range and distribution of compositional variations. Forty-one stations and over 100 samples were collected from the northern two-thirds of the intrusion.

The body is banana-shaped, 4 km long in its northern dimension and with an average width of 0.8 km. Typically, it has eastward-dipping (30-50°) foliation, with oxidized and heterogeneous multiphase contact zones up to 40 m wide, and slightly less foliated, more massive syenitic core. All outcrops contain numerous crosscutting granitoid rocks, the older phases being syenitic, the younger, quartz-bearing and granitic or pegmatitic.

Fresh, less metamorphosed phases contain equant to stubby tabular pale green augite, with local twinning, as discrete and aggregated crystals in a hypidiomorphic-granular matrix of plagioclase (An_{18-25}), locally perthitic to mesoperthitic twinned microcline (up to 0.8 cm) and sporadic minor quartz. Accessory apatite is clouded with minute inclusions. Sphene is euhedral and fairly common as an accessory mineral, as is metamict allanite. Secondary minerals include blue-green hornblende as overgrowths on the augite, biotite and scattered carbonate.

CONCLUSION

The principal features of the three alkaline intrusions investigated thus far are compared in Table GS-1-1, and modal and chemical analyses for the Eden and Brezden bodies in Tables GS-1-2 and GS-1-3, respectively. Mineralogically the three intrusions are very similar, differing only in the degree of metamorphic overprint. The Burntwood intrusion is chemically the most undersaturated of this otherwise miaskitic and possibly comagmatic suite. Although no economic concentrations have yet been identified, one sample from Eden Lake was recorded to contain 14% allanite; the sample will be analyzed for rare earth element content.

REFERENCES

Cameron, H.D.M.
1988: Geology of the Eden Lake area; Manitoba Energy and Mines, Geological Report GR84-2.

Lenton, P.G.
1981: Geology of the McKnight-McCallum lakes area, Manitoba; Mineral Resources Division, Geological Report GR79-1.

McRitchie, W.D.
1987: Burntwood Lake syenite; **in** Manitoba Energy and Mines, Report of Field Activities 1987, p. 65-69.

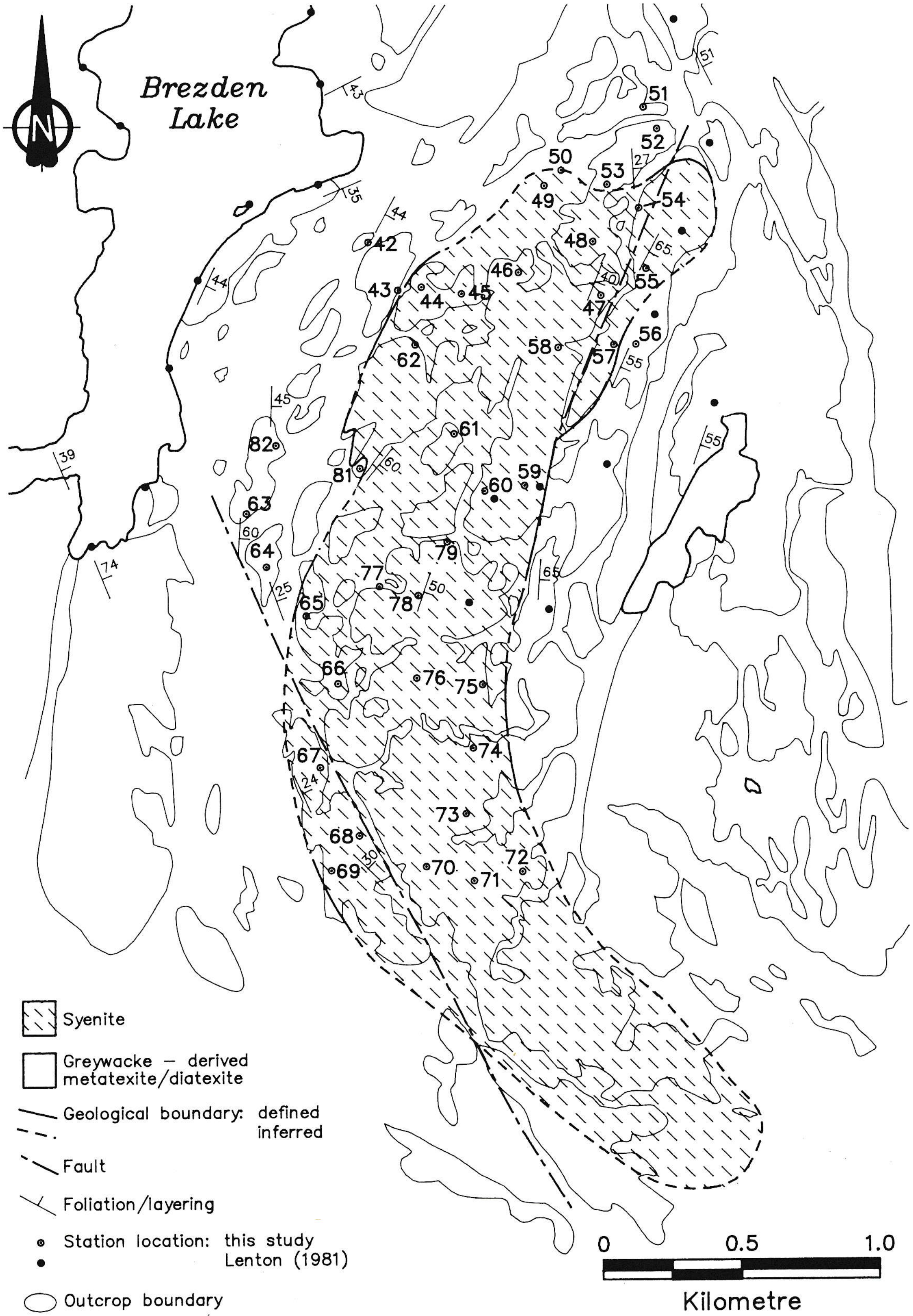

Figure GS-1-3: Outline geology and sample locations, Brezden Lake syenite.

TABLE GS-1-1
TYPICAL FEATURES OF ALKALI SYENITES IN THE CHURCHILL PROVINCE, MANITOBA

Features	LOCATION BURNTWOOD LAKE (63N/8, 9, 10)	 EDEN LAKE (64C/9)	 BREZDEN LAKE (64C/4)
Size of Intrusion	3 km^2	15 km^2	3 km^2
Shape of Intrusion	Folded sheets, phacolithic	Irregular elliptical outline; no contact observed	Folded sheet
Country rocks: a) Type b) Metamorphic Grade	 Greywacke-derived migmatite Uppermost amphibolite	 Granite/greenstone Lower/middle amphibolite	 Greywacke-derived migmatite Uppermost amphibolite
Relationship to Country Rocks	Structurally conformable; local contact metasomatism - peripheral oxidized zone (3.5 m)	Unknown	Structurally conformable; local contact metasomatism - Peripheral oxidized zone (20-40 m)
Associated Phases	Granite, aplite, pegmatite (mafic rafts and schlieren)	Microsyenite, granite, aplite, fluorite-bearing pegmatite (mafic rafts and schlieren)	Granite, aplite (mafic rafts and schlieren)
Homogeneity	Heterogeneous	Heterogeneous	Heterogeneous
Range of Compositions	Syenite to syenodiorite	Syenite; separate syenodiorite?	Syenite to monzogranite
Colour	Salmon pink to cream	Salmon pink to cream	Pale orange or pink
Igneous Features a) Structures b) Textures	 Modal, textural, grain size and inclusion layering: vein networks of ferromagnesian minerals Cumulitic pyroxene; oikocrystic microcline	 Local textural, minor modal, and inclusion layering: vein networks of ferromagnesian minerals: oikocrystic microcline	 Minor modal and contamination layering
Grain Size	Coarse to medium	Medium to fine	Medium
Metamorphic/Tectonic Overprint	Strong marginal foliation; weak to moderate internal foliation and folding of igneous layering. Fresh textures and mineralogy near core. Local scapolite-rich phases.	Strong marginal foliation; weak internal foliation in older phases. Local scapolite-rich phases ± carbonate	Rare phaneritic phases. Moderate foliation present throughout. Minor blue-green hornblende, biotite and secondary carbonate.
Chemistry a) Silica Content b) K + Na : Al c) K + Na : 1/6 Si d) Na : K e) Trace elements	 49.5 - 69.5% K+Na < Al K+Na > 1/6Si Na << K Ba up to 5600 ppm Sr up to 2574 ppm	 56.5 - 72.1 K+Na < Al K+Na ≈ 1/6 Si Na ≥ K Ba 1300-3310 ppm Sr 1400-2200 ppm Local high REE, Y, etc.	 61.0 - 71.5 K+Na < Al K+Na ≈6 Si Na < K Ba 1100-3500 ppm Sr 600-2400 ppm
Mineralogy a) Felsic Minerals b) Ferromagnesian Minerals c) Accessory Minerals	 Microcline meso- and micro-perthite; plag. An_{8-14}; minor quartz Aeg./augite, augite, hornblende Sphene, apatite, (clouded) magnetite, zircon. Common myrmekite and albitization	 Microcline mesoperthite and plagioclase An_{7-13}; minor quartz Aeg/augite, minor augite Sphene, sparse apatite, allanite and zircon	 Microcline locally mesoperthitic plagioclase An_{18-25}; minor quartz Augite or hornblende Sphene, apatite (clouded), trace allanite Rare myrmekite and albitization

TABLE GS-1-2
EDEN AND BREZDEN LAKES: MINERALOGICAL SUMMARY

Mineral	EDEN LAKE 04-88-03-1	04-88-6-5	04-88-33-4	04-88-33-2	04-88-35-2	BREZDEN LAKE 04-88-50-1	04-88-65-1	04-88-70-3
Clinopyroxene	15 (aegirine-augite)	20 (aegirine-augite)	30 (aegirine-augite)	40 (aegirine-augite)	10 (aegirine-augite)	46 (augite)	40 (augite)	35 (augite)
Plagioclase	35 (An_8)	25 (An_6)	20 (An_5)	25 (An_9)	10 (An_{12})	10 (An_{37})	24 (An_{29})	20 (An_{27})
K-feldspar	20	30	15	20	60	21	20	25
Clinoamphibole	-	-	-	-	-	3	10	-
Quartz	22	5	< 1	-	< 1	5	< 1	5
Apatite	2	3	13	5	-	7	3	10
Sphene (Titanite)	1	2	2	10	5	2	3	3
Allanite	1	14	< 1	-	< 1	3	-	-
Oxides	< 1	-	-	-	< 1	-	< 1	-
Carbonates	3	-	20	< 1	10	3	-	2
Zircon	1	-	-	-	-	< 1	-	-
Fluorite	-	1	pr.	-	-	-	-	-
Chlorite	-	-	-	-	< 1	-	< 1	< 1
Garnet	-	-	-	-	5	-	-	-

TABLE GS-1-3
EDEN AND BREZDEN LAKES SYENITES: CHEMICAL ANALYSES

EDEN LAKE

Sample #	04-88-03-1	04-88-03-4	04-88-05-1	04-88-06-5	04-88-15-2	04-88-19-1	04-88-20-3	04-88-33-2	04-88-34-2	04-88-36-1	04-88-36-2	04-88-40-2
SiO_2%	67.2	63.8	60.9	59.1	61.9	62.4	62.8	60.6	72.1	60.0	56.5	70.2
Al_2O_3	15.74	17.10	13.43	12.20	14.45	15.31	16.80	14.39	14.49	13.52	10.96	15.08
FeO	0.72	1.06	3.16	2.16	2.46	2.12	1.54	2.24	0.56	2.60	3.62	0.91
Fe_2O_3	1.27	1.24	2.49	2.64	2.03	2.03	1.86	2.20	0.41	2.66	3.75	0.87
CaO	1.78	2.51	6.28	6.69	5.56	3.90	3.12	5.47	1.21	6.59	9.58	1.82
MgO	0.52	0.61	2.21	1.26	1.75	1.15	0.75	1.42	0.34	1.85	2.33	0.56
Na_2O	5.71	6.11	5.23	4.18	6.39	5.05	6.51	5.76	6.70	5.65	4.96	5.44
K_2O	6.04	6.50	4.81	3.91	3.67	6.67	4.53	4.72	3.09	4.55	4.02	3.88
TiO_2	0.24	0.30	0.38	0.38	0.39	0.38	0.51	0.57	0.17	0.36	0.24	0.31
P_2O_5	0.10	0.21	0.15	1.56	0.17	0.26	0.25	0.54	0.05	0.59	1.16	0.10
MnO	0.06	0.07	0.20	0.26	0.17	0.16	0.12	0.14	0.02	0.19	0.28	0.05
H_2O	0.37	0.33	0.35	0.95	0.42	0.32	0.42	0.27	0.20	0.21	0.29	0.23
S	0.01	0.00	0.00	0.02	0.00	0.01	0.01	0.02	0.00	0.01	0.02	0.01
CO_2	0.35	0.42	0.14	0.28	0.61	0.12	0.3	0.42	0.12	0.64	1.14	0.12
Other	0.20	0.46	0.47	0.40	0.35	0.45	0.59	0.62	0.16	0.39	0.35	0.23
LOI												
O=S,F	-0.02	-0.02	-0.02	-0.12	-0.02	-0.02	-0.03	-0.04	-0.07	-0.04	-0.08	-0.05
TOTAL	100.33	100.75	100.02	96.16	100.35	100.36	100.14	99.42	99.72	99.87	99.29	99.87
FeO(T)	1.86	2.18	5.40	4.54	4.29	3.95	3.21	4.22	0.93	4.99	6.99	1.69
*Rb ppm	125	113	108	87	65	174	115	82	101	79	60	131
Sr	334	1430	1520	1470	1390	1130	1750	2270	464	1580	1430	638
Ba	1290	2458	2482	1951	1611	2688	3310	3052	867	1762	1558	1300
F	390	455	408	2910	479	504	564	774	1665	1010	1680	1100
Y	13	13	18	1152	30	18	27	44	3	36	62	4
Zr	398	319	200	162	388	313	771	286	121	263	230	153
Nb	11	15	17	43	26	28	44	21	5	17	10	4

TABLE GS-1-3 (CONT'D.)

Sample #	04-88-62-2	BREZDEN LAKE 04-88-69-1	04-88-73	04-88-75-1	04-88-77-2	04-88-78-1
SiO_2%	62.2	63.0	61.0	65.3	71.5	61.8
Al_2O_3	15.13	15.33	16.89	14.89	14.96	15.36
FeO	2.72	1.86	1.72	2.40	1.06	2.52
Fe_2O_3	0.90	1.02	1.88	0.99	0.47	0.98
CaO	4.57	4.45	3.43	3.70	1.85	5.02
MgO	1.49	1.77	1.38	1.32	0.53	1.88
Na_2O	3.38	4.49	4.61	3.77	5.33	4.15
K_2O	8.03	6.17	6.66	5.80	3.34	6.67
TiO_2	0.39	0.43	0.53	0.35	0.19	0.44
P_2O_5	0.38	0.39	0.33	0.39	0.06	0.43
MnO	0.11	0.08	0.08	0.08	0.02	0.12
H_2O	0.42	0.45	0.47	0.46	0.42	0.43
S	0.00	0.04	0.05	0.01	0.01	0.00
CO_2	0.09	0.25	0.12	0.12	0.1	0.19
Other	0.65	0.68	0.52	0.53	0.21	0.61
LOI						
O=S,F	-0.02	-0.04	-0.05	-0.04	-0.02	-0.02
TOTAL	100.49	100.42	99.69	100.16	100.07	100.64
FeO(T)	3.53	2.78	3.41	3.29	1.48	3.40
*Rb ppm	133	134	131	102	52	112
Sr	2100	2370	1830	1720	628	2190
Ba	3490	3460	2585	2790	1127	3032
F	461	532	743	895	411	584
Y	24	22	38	24	4	24
Zr	224	290	485	206	99	106
Nb	19	15	29	14	<2	14

*Rare element analyses by N. Halden, Department of Geological Sciences, University of Manitoba

ACKNOWLEDGEMENTS:

1) Table GS-1-2: Mineral identifications by C. McGregor.
2) Table GS-1-3: Major element analyses by Geological Services Analytical Laboratory.