# GS-11 BURNTWOOD LAKE SYENITE

by W.D. McRitchie

## BACKGROUND

In 1972 two samples of aegirine-augite-bearing syenite were collected near the western end of Burntwood Lake (Fig. GS-11-1), during routine 1:50 000 scale mapping of the Kisseynew gneissic terrain (Burntwood Project — Baldwin et al. 1979; McRitchie et al., 1979). Alkaline intrusions are otherwise rare in the region between Flin Flon-Lynn Lake and Thompson (Fig. GS-11-1).

Numerous new applications have recently been discovered for a variety of rare elements, including zirconium, and major new exploration programs have been initiated in Canada, the United States and Greenland.

Accordingly, the current project was undertaken to determine whether any of the alkaline complexes in the Churchill Province of Manitoba are potential sources of zirconium minerals in economic concentrations.

The Burntwood Lake locality was revisited in 1987 and detailed mapping conducted to obtain additional samples for geochemical characterization of the intrusion, as well as further information on field relationships.

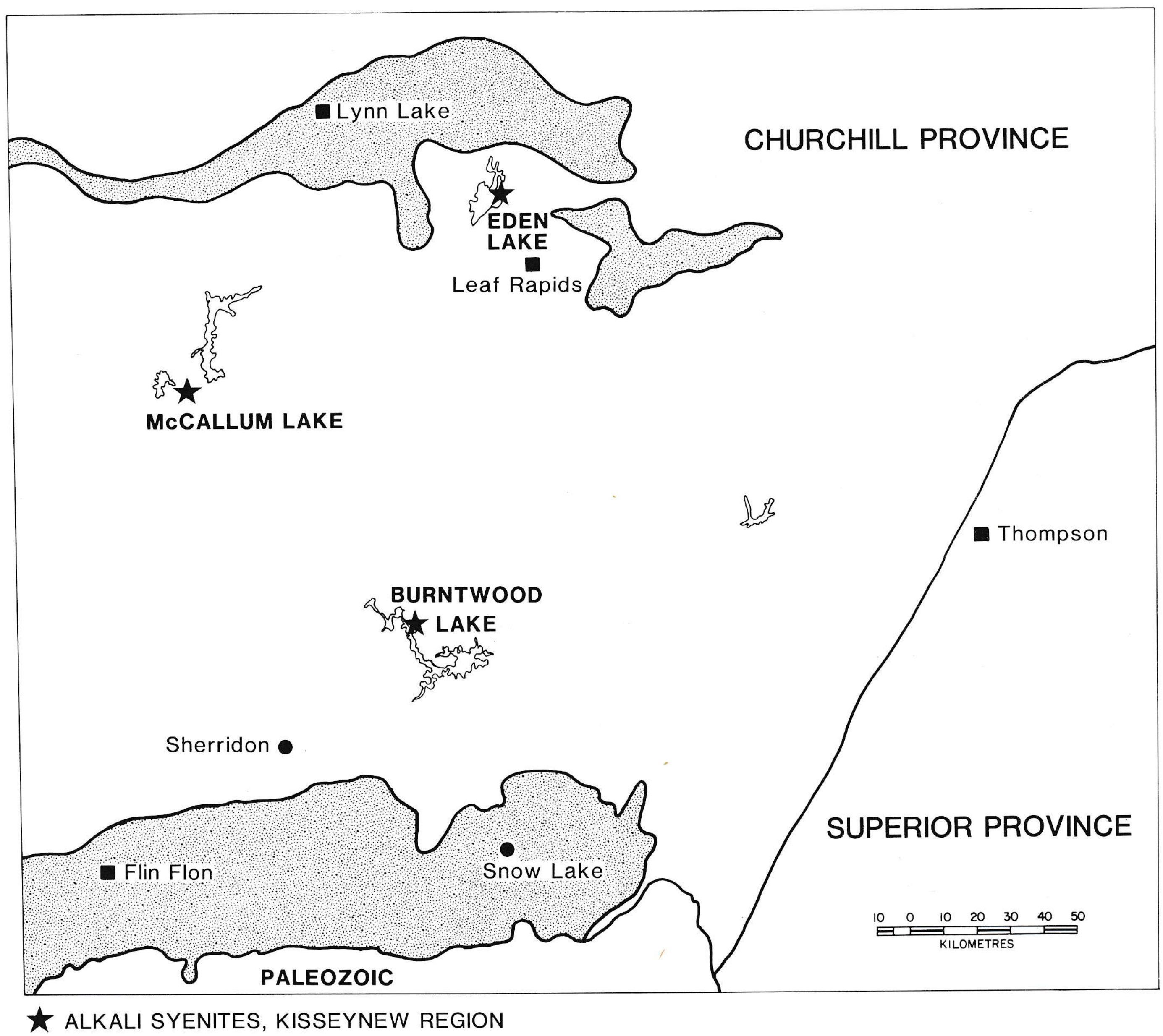



*Figure GS-11-1: Alkali syenites in the Lynn Lake-Kisseynew region, southern Churchill Province.*

## CURRENT WORK

A five-day mapping program confirmed the existence of a moderately sized (1.4 x 2.4 km) phacolithic syenite intrusion lying within regionally dominant turbidite-derived migmatites and associated S-type peraluminous granites.

## GENERAL SETTING

The syenite occurs on high-relief outcrops and its original form has been substantially modified by post-intrusion deformation. The body exhibits a dentate shape with several south-southeast-trending "roots" (fold keels) the easterly two of which wrap partially around the main north-plunging shallow (25°) synformal fold hinge (Fig. GS-11-2).

A steep northeast- and east-dipping penetrative axial planar gneissic foliation is variably developed, but more pronounced near the east and west flanks, and within the hinge zone of the intrusion.

Contacts with migmatitic country rocks are generally sharp, but at three locations (Stations 6, 12, and 17) large (5-10 m) blocks of the adjacent biotite gneiss have been extensively recrystallized and metasomatized, and included within an hybridized and bleached contact zone of the syenite. Elsewhere an almost ubiquitous 3-5 m wide oxidized zone within the syenite is a persistent feature adjacent to the outer contact.

Pink granitic dykes between 50 cm and 2 m thick are common in the outer contact and hinge zones of the syenite. However, the central more massive phases of the intrusion are rarely cut by younger phases with the exception of sporadic 5-20 cm thick, parallel sided, dykes of white, leucoquartz monzonite (Unit 18 — Burntwood Project Maps 7, 10, and 11).

The thickest and best preserved development of the syenite occurs in the northern sector of the synform; however, the northern contact was not observed during the current mapping program.

The syenite is in contact, on all sides, with Burntwood River Metamorphic Suite diatexitic migmatites derived from greywacke-mudstone precursors. The migmatites comprise well layered, coarse grained, blastic and foliated garnet, biotite, cordierite and sillimanite-bearing gneisses, commonly with predominant white seriate pegmatite/granite leucosomes.

The 315-355° trending foliation is generally parallel to the axial planes of early tight isoclinal folds. Local reactivation of the S-fabrics along hairline foliae has resulted in retrogression of garnet to biotite, straining and granulation of quartzofeldspathic phases and widespread regeneration of biotite. In the southwest corner of the area the diatexitic gneisses are cut by a 40 cm thick $D_3$ cataclastic zone striking 315°/80° which displays typical augen and microgranulation textures.

Although its differentiation layering is repeatedly folded and many of the marginal phases display a pronounced penetrative gneissosity, the syenite still exhibits numerous primary features from which it is inferred that the intrusion had a relatively late stage emplacement (post-$M_2$, pre-$D_3$; Bailes and McRitchie, 1978) compared to other granitoids in the Kisseynew gneissic belt.

## AEGIRINE-AUGITE SYENITE

In its least altered form the syenite is salmon-red, phaneritic, medium-coarse grained, heterogeneous, and weakly to moderately foliated. It universally exhibits textural and compositional layering in units from 2-40 cm thick. The layering is typically undulating and may be substantially segmented and displaced in almost isoclinally folded hinge zones with an axial planar gneissosity.

The composition on any one outcrop may range from almost monomineralic microcline syenite, to syenodiorite with up to 70% concentrations of densely packed equant, equigranular aegirine-augite in 3-20 cm thick mafic layers.

Grain size is highly variable but consistent within individual layers and may range from 1 mm to 3 cm, the coarser phases typically being microcline syenite. Local pegmatite layers up to 20 cm thick contain an equigranular matrix of 3-4 cm microcline crystals.

Crescumulate (comb) layering was noted at four widely spaced localities. Layers range from 3-20 cm thick and contain tabular (2 cm long) aegirine-augite arranged perpendicular to the lower boundary, with an inferred upper zone containing only microcline. In the extreme northeast corner of the map area, a comb-layered phase exhibits white acicular apatite crystals (0.5 x 10 mm) intergrown with slightly longer pyroxene blades. Adjacent cumulate concentrations (30%) of subround aegirine-augite (0.5-1 cm) in a microcline matrix form a 15 cm thick layer flanked on both sides by more feldspathic layers. At Station 41 an 8 cm thick comb-textured layer exhibits tabular pyroxenes growing in opposing directions into an aplitic microcline-dominant central zone.

With increasing degrees of deformation the grain size becomes progressively finer and the colour changes from red through honey-brown to buff, cream and white. Pyroxenes are retrograded to hornblende and biotite, and the microcline microperthite is unmixed to plagioclase, quartz and microcline.

The southern lobes of the complex are predominantly finer grained and buff.

## PETROGRAPHY

In thin section the syenite displays a relatively simple mineralogy comprising various amounts of aegirine-augite or augite, microcline, microcline microperthite and mesoperthite, apatite and sphene, with trace opaques and zircon, and secondary hornblende, carbonate, scapolite and pale green biotite. Quartz and plagioclase ($An_{8-14}$) are generally absent in fresh syenite but constitute a minor component of the more altered and finer grained gneissic buff syenite. Rare zoned tourmaline is pleochroic from dark to light brown.

Aegirine-augite (X-C = 60°-70°; 2V: 74°-82°) is pleochroic from deep green to olive-green and straw yellow and occurs in 0.3-15 mm crystals that are generally consistently sized within individual layers. Rare layers are characterized by pyroxene clots up to 3 x 7 cm in a syenite matrix. Most aegirine-augite crystals are cumulitic, and either equant or subhedral tabular; however, oikocrysts were identified in some mafic layers and blades up to 3 cm in length occur within some comb-layered phases. Cross-cutting mafic stringers locally define a pre-foliation vein network.

Pale green augite is more common within the southern buff coloured gneissic syenite.

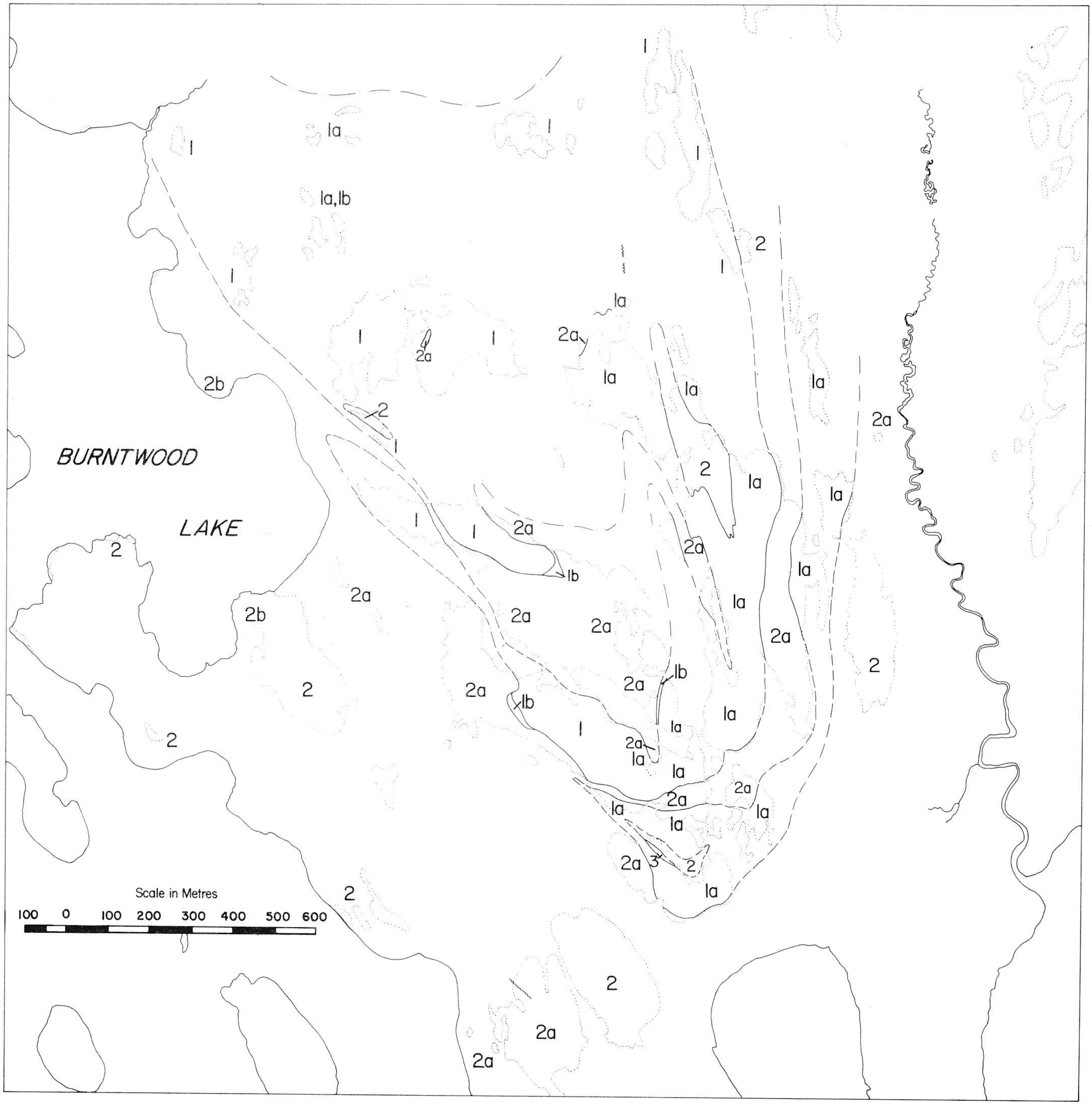
Turbid microcline (up to 3 cm) exhibits a wide range of perthitic intergrowths and intergrowth textures from mesoperthite to microperthite. Grain boundaries are either sutured or recrystallized-granular with preferential exsolution of plagioclase at the grain contacts. A pronounced mortar texture is evident adjacent to the outer contacts of the intrusion, whereas in the less altered red phases microcline perthite occurs as clouded crystals forming a polygonal mosaic with limited grain boundary granulation. Such undeformed contacts locally exhibit delicate suturing or myrmekite development. Most coarse grained crystals are poikilitic with numerous small inclusions of pyroxene and accessory phases.

Apatite and local euhedral sphene are ubiquitous and fairly abundant accessory phases. Apatite contents up to 30% are not uncommon in more mafic layers, approximately 10 cm thick, in which the yellow to reddish-brown apatite prisms may reach 3 cm in length. Some contain numerous fine needle-like inclusions oriented parallel to the c-axis.

Zircon is restricted to selected phases but where present occurs in well zoned crystals up to 0.6 mm.

Magnetite is present in some layers, and in the most northeasterly ridges was recorded in 20 cm clots and segregations parallel to the igneous layering.

Green or variably blue-green amphibole patchily replaces pyroxene in some contact zones; associated carbonate occurs as skeletal aggregates or lattice-works either disseminated throughout the matrix or filling cracks in feldspar. Carbonate and scapolite-bearing bleached phases were recorded in plagioclase-rich zones near the northern contact of the syenite.




**BURNTWOOD LAKE SYENITE**

| | |
|---|---|
| I | Pink aegirine–augite syenite |
| Ia | Buff gneissic augite syenite |
| Ib | Hybridized contact zone |
| 2 | Migmatite–greywacke-derived diatexite |
| 2a | White pegmatite/granite mobilizate dominant |
| 2b | Paragneiss dominant (garnet, biotite, cordierite & sillimanite-bearing) |
| 3 | Amphibolite |

*Figure GS-11-2:* *Burntwood Lake aegirine-augite syenite.*

## TABLE GS-11-1
## BURNTWOOD LAKE SYENITE: CHEMICAL ANALYSES

| SAMPLE NO. | 04-87-1A-1 | 04-87-1B | 04-87-1-D | 04-87-03(B) | 04-87-5(1)A | 04-87-5(1)B | 04-87-12(1) | 04-87-16(2) | 04-87-16(3) | 04-87-20(3)-2 | 04-87-21 | 04-87-21(C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 62.0 | 61.6 | 59.8 | 63.7 | 62.4 | 62.7 | 62.7 | 68.3 | 59.0 | 64.4 | 60.7 | 60.2 |
| Al2O3 | 15.1 | 14.0 | 15.7 | 14.6 | 14.9 | 15.1 | 14.7 | 14.8 | 11.5 | 16.2 | 14.3 | 12.8 |
| FeO | 1.96 | 2.70 | 3.41 | 1.23 | 2.69 | 2.47 | 2.59 | 0.71 | 3.47 | 0.92 | 2.82 | 3.90 |
| Fe2O3 | 0.88 | 0.86 | 1.01 | 1.41 | 0.49 | 0.78 | 0.60 | 0.48 | 0.67 | 0.63 | 0.99 | 1.31 |
| CaO | 4.50 | 5.76 | 4.89 | 3.56 | 4.62 | 4.43 | 4.30 | 1.44 | 7.97 | 2.43 | 5.29 | 5.87 |
| MgO | 1.33 | 1.59 | 1.96 | 1.29 | 1.70 | 1.67 | 1.44 | 0.39 | 2.87 | 0.75 | 1.35 | 1.58 |
| Na2O | 4.50 | 4.35 | 5.44 | 4.87 | 4.03 | 4.09 | 3.92 | 3.89 | 2.96 | 5.17 | 3.58 | 3.80 |
| K2O | 6.61 | 5.89 | 4.50 | 7.14 | 7.02 | 7.08 | 6.88 | 8.09 | 6.89 | 7.09 | 7.41 | 6.54 |
| TiO2 | 0.78 | 1.04 | 1.21 | 0.47 | 0.11 | 0.04 | 0.63 | 0.10 | 0.16 | 0.36 | 0.53 | 0.47 |
| P2O5 | 0.49 | 0.61 | 0.88 | 0.55 | 0.70 | 0.74 | 0.59 | 0.96 | 1.63 | 0.38 | 0.95 | 0.77 |
| MnO | 0.07 | 0.09 | 0.07 | 0.06 | 0.11 | 0.10 | 0.07 | 0.01 | 0.10 | 0.05 | 0.07 | 0.11 |
| H2O | 0.47 | 0.58 | 0.47 | 0.34 | 0.50 | 0.50 | 0.55 | 0.34 | 0.45 | 0.42 | 0.46 | 0.63 |
| S | 0.01 | 0.01 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 |
| CO2 | 0.25 | 0.11 | 0.07 | 0.25 | 0.32 | 0.26 | 0.41 | 0.17 | 0.23 | 0.23 | 0.21 | 0.21 |
| F | 0.10 | 0.12 | 0.38 | 0.09 | 0.07 | 0.08 | 0.09 | 0.15 | 0.15 | 0.06 | 0.12 | 0.10 |
| Other | 0.59 | 0.57 | 0.52 | 0.39 | 0.45 | 0.45 | 0.47 | 0.11 | 0.55 | 0.40 | 0.92 | 0.67 |
| Total | 99.60 | 99.83 | 100.17 | 99.93 | 100.09 | 100.46 | 99.91 | 99.88 | 98.55 | 99.47 | 99.66 | 98.93 |
| FeO(T) | 2.75 | 3.47 | 4.32 | 2.50 | 3.13 | 3.17 | 3.13 | 1.14 | 4.07 | 1.49 | 3.71 | 5.08 |
| O=S | 0.00 | 0.00 | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| O=F | -0.04 | -0.05 | -0.16 | -0.04 | -0.03 | -0.03 | -0.04 | -0.06 | -0.06 | -0.02 | -0.05 | -0.04 |
| * Y | 28 | 40 | 34 | 16 | 18 | 17 | 23 | 43 | 23 | 14 | 26 | 29 |
| * Zr | 180 | 217 | 557 | 167 | 256 | 242 | 186 | 27 | 195 | 117 | 391 | 659 |
| * Nb | 25 | 41 | 29 | 18 | 0 | 6 | 23 | 0 | 8 | 11 | 27 | 33 |
| * Rb | 126 | 115 | 77 | 192 | 161 | 159 | 175 | 220 | 218 | 146 | 200 | 199 |
| * Sr | 1909 | 1929 | 1889 | 933 | 1412 | 1397 | 1567 | 256 | 1391 | 1545 | 2386 | 1567 |
| Ba | 2820 | 2590 | 1830 | 2030 | 2022 | 2060 | 2140 | 380 | 2930 | 1660 | 4980 | 3280 |

| SAMPLE NO. | 04-87-22(B) | 04-87-22(C) | 04-87-24(1) | 04-87-25(1) | 04-87-28(B) | 04-87-32(A) | 04-87-40-1 | 04-87-40-2 | 04-87-43 | 04-87-75(1) | 04-87-76(B) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 69.5 | 63.3 | 49.5 | 61.4 | 64.7 | 65.6 | 63.9 | 62.4 | 61.8 | 57.7 | 58.7 |
| Al2O3 | 15.4 | 15.1 | 3.2 | 14.2 | 16.8 | 16.7 | 17.1 | 15.8 | 15.0 | 12.5 | 11.1 |
| FeO | 0.43 | 1.37 | 9.31 | 3.00 | 1.00 | 0.69 | 0.57 | 1.29 | 2.16 | 3.84 | 2.35 |
| Fe2O3 | 0.50 | 0.52 | 1.67 | 0.51 | 0.57 | 0.52 | 0.58 | 0.97 | 0.67 | 0.71 | 1.47 |
| CaO | 0.72 | 3.43 | 20.8 | 5.15 | 2.06 | 1.49 | 1.74 | 3.48 | 4.69 | 9.06 | 8.86 |
| MgO | 0.42 | 1.10 | 6.80 | 1.89 | 0.69 | 0.60 | 0.65 | 1.38 | 1.25 | 2.62 | 3.70 |
| Na2O | 4.35 | 5.05 | 0.93 | 3.56 | 5.27 | 5.14 | 3.99 | 3.86 | 4.51 | 2.06 | 2.26 |
| K2O | 7.47 | 6.50 | 1.53 | 7.03 | 7.37 | 8.03 | 9.55 | 8.46 | 6.45 | 7.71 | 7.85 |
| TiO2 | 0.06 | 0.71 | 0.24 | 0.36 | 0.01 | 0.13 | 0.02 | 0.04 | 0.75 | 0.14 | 0.17 |
| P2O5 | 0.20 | 0.42 | 3.74 | 0.73 | 0.22 | 0.20 | 0.35 | 0.59 | 0.53 | 1.36 | 1.46 |
| MnO | 0.01 | 0.06 | 0.23 | 0.09 | 0.04 | 0.03 | 0.02 | 0.05 | 0.07 | 0.09 | 0.08 |
| H2O | 0.41 | 0.42 | 0.78 | 0.52 | 0.39 | 0.41 | 0.38 | 0.50 | 0.46 | 0.36 | 0.28 |
| S | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 | 0.00 | 0.01 |
| CO2 | 0.10 | 0.35 | 0.35 | 0.28 | 0.28 | 0.19 | 0.30 | 0.30 | 0.38 | 0.77 | 0.15 |
| F | 0.05 | 0.07 | 0.29 | 0.07 | 0.03 | 0.02 | 0.03 | 0.05 | 0.10 | 0.12 | 0.11 |
| Other | 0.12 | 0.42 | 0.08 | 0.45 | 0.28 | 0.44 | 0.45 | 0.46 | 0.52 | 1.00 | 0.69 |
| Total | 99.72 | 98.53 | 99.33 | 98.96 | 99.69 | 100.19 | 99.63 | 99.62 | 99.31 | 99.99 | 99.19 |
| FeO(T) | 0.88 | 1.84 | 10.81 | 3.46 | 1.51 | 1.16 | 1.09 | 2.16 | 2.76 | 4.48 | 3.67 |
| O=S | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 |
| O=F | -0.02 | -0.29 | -0.12 | -0.29 | -0.01 | -0.01 | -0.01 | -0.02 | -0.04 | -0.05 | -0.05 |
| * Y | 0 | 22 | na | 22 | 7 | 9 | 8 | 12 | 27 | 30 | 24 |
| * Zr | 17 | 124 | na | 195 | 81 | 235 | 102 | 91 | 216 | 359 | 221 |
| * Nb | 0 | 25 | na | 18 | 0 | 10 | 0 | 0 | 29 | 0 | 0 |
| * Rb | 121 | 151 | na | 121 | 123 | 198 | 202 | 187 | 167 | 148 | 181 |
| * Sr | 408 | 1511 | na | 1580 | 1196 | 1418 | 1434 | 1199 | 2014 | 2574 | 1518 |
| Ba | 510 | 1850 | 720 | 1950 | 980 | 1980 | 2170 | 2500 | 2000 | 5600 | 4100 |

* Elements analyzed by Dept. of Geological Sciences,U.of M. Values have been rounded.

## CHEMISTRY

Twenty-two samples were submitted for major and trace element analyses (Table GS-11-1) including yttrium, niobium and zirconium. Initial results indicate elevated levels of strontium in some zones (2600 ppm) near the northern end of the complex. The unique composition, and highly heterogeneous and well fractionated nature of the intrusion, may indicate a good potential for the development of near-monomineralic phases during the magmatic or late magmatic evolution of the syenite.

Significant concentrations of zirconium were not encountered during initial geochemical screening. However, elevated levels of zircon minerals were detected in some layers, and further indications may become apparent once the results of the chemical analyses are received.

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