GS-40 GRANITE-PEGMATITE INVESTIGATIONS: KNEE LAKE-MAGILL LAKE AREA

by P.G. Lenton

INTRODUCTION

Examination and sampling of pegmatites and granites in the northern Superior Province continued this summer, concentrating in the Knee Lake-Magill Lake area (Fig. GS-40-1) and completing the program in the Cross Lake area (Lenton and Anderson, 1983, Corkery and Lenton, 1984). Field work in the Knee Lake-Magill Lake area involved mapping of a large body of leucocratic and pegmatitic granite at Magill Lake and examination and sampling of pegmatites at the south end of Knee Lake, on Hawkins Lake and at McLaughlin Lake. A nepheline-cancrinite syenite and associated syenite pegmatite at Cinder Lake also was examined and sampled.

MAGILL LAKE GRANITE

The Magill Lake granite is located 7 km south of Knee Lake in the Archean Oxford Lake-Gods Lake greenstone belt. It was previously mapped by Barry (1959) and Gilbert (1985). The granite is a triangular-shaped intrusion approximately 8 km in the north-south direction and 8 km (maximum) in the east-west direction (Fig. GS-40-2). It lies wholly within metasediments of the Oxford Lake Group: metamorphosed greywacke, argillite, conglomerate and iron formation. A second, almost circular granite plug approximately 3 km in diameter, lies to the east of the main body, separated by a 1 km septa of metagreywacke.

Contact relationships with the surrounding Oxford Lake Group rocks indicate a passive dilational intrusion with numerous angular, stoped inclusions near the contact and a complex series of sills and dykes in the country rock. The metagreywacke was foliated and deformed before intrusion of the granite with granite dykes commonly being axial planar; however, since the granite is foliated and dykes are commonly folded and boudinaged, the granite is likely a late-kinematic rather than a post-kinematic intrusion.

The supracrustal rocks in the vicinity of Magill Lake appear to be middle amphibolite grade of low to moderate pressure Abukuma type (andalusite stable). Garnet is ubiquitous and muscovite abundant in aluminous rocks. Mafic assemblages comprise green amphibole, plagioclase, quartz and epidote/calcite.

The dominant lineation in the vicinity of the Magill Lake granite indicates a regional plunge of moderate value (45° to 55°) to the west. The internal structure and zonation of the pluton indicates a similar westerly plunge for the granite body.

The south margin of the Magill granite intruded Oxford Lake Group metasediments with dykes and sills extending into the Hayes River Group metavolcanic rocks farther south. The south margin of this belt of Hayes River Group, 2 km south of the Magill granite, has undergone cataclasis that brought Hayes River Group in tectonic contact with the Bayly Lake complex of cataclastic tonalite, quartz monzonite, and tonalitic mylonite gneiss (see Gilbert, 1985, for details). Dykes show a progressive increase in deformation and foliation towards this cataclastic zone, suggesting extensive movement in this zone after the intrusion of the Magill granite. Although exposure is limited, no pegmatite dykes were observed in the cataclastic zone.

The south central area of the intrusion contains many large stoped blocks of Oxford Lake rocks indicating dilation above the apical portion of the plug.

INTERNAL ZONING OF THE MAGILL GRANITE

Five textural units can be recognized in the Magill granite defining a roughly concentric zonation in the granite (Fig. GS-40-2):

1. fine grained, foliated biotite granite;
2. coarse to very coarse, peraluminous, leucocratic granite with biotite, garnet, tourmaline and sporadic muscovite;
3. pegmatitic leucocratic granite comprising graphic microcline-quartz intergrowth, plagioclase and accessory biotite, garnet, tourmaline and muscovite;
4. fine grained, garnetiferous, sodic aplite with accessory tourmaline;
5. pegmatite consisting of blocky non-graphic microcline and quartz surrounding a quartz core. Common accessories are biotite, muscovite, garnet and tourmaline.

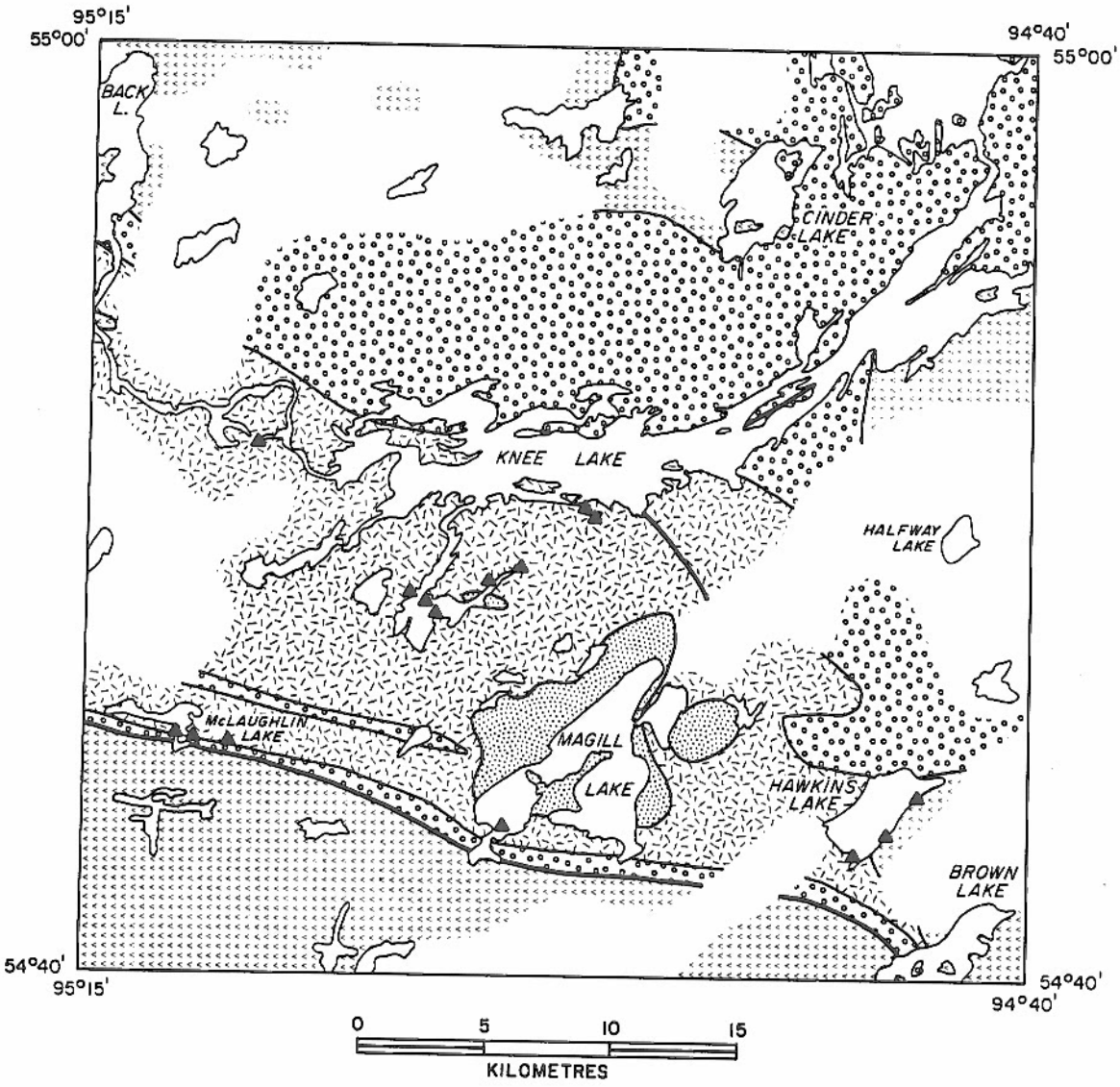
The biotite granite is homogeneous, equigranular (grain size 1 mm) and pinkish grey weathering, and is composed of quartz, microcline, plagioclase and biotite. Mafics never exceed 2 volume per cent. This unit outcrops in one small area on the west shore of Magill Lake. It is extensively intruded by pegmatite dykes and pegmatitic leucocratic granite. Diffuse inclusions of biotite granite occur in the pegmatitic granite. Bleached zones 2 to 5 cm thick occur along the contacts with pegmatite dykes. Garnet is common in the pegmatite and pegmatitic granite but absent in the biotite granite.

The coarse leucocratic granite is equigranular to seriate and white weathering with less than one volume per cent of mafics (Fig. GS-40-3). Grain size varies from 4 to 8 mm with scattered microcline megacrysts up to 5 cm long. It normally contains biotite and muscovite, but varieties with only muscovite or biotite also occur. Garnet always occurs in small amounts and tourmaline is a common accessory. Pegmatites occur as both dykes and isolated pods. Pegmatitic leucocratic granite is commonly intimately associated with the coarse granite with gradational contacts. Aplite is rare in the coarse granite. Although extensive in occurrence, the coarse granite is restricted to the central region of the intrusion around the biotite granite.

Pegmatitic leucocratic granite is very coarse to pegmatitic, comprising quartz, microcline, biotite and plagioclase with accessory garnet, tourmaline and muscovite. It contains large megacrysts of graphic microcline-quartz intergrowth. Locally it comprises 30 to 50 cm subhedral graphic microcline (with biotite inclusions) in a quartz-biotite matrix (Fig. GS-40-4). This is the most extensive unit of the intrusion, extending from the coarse granite core to the margins in association with garnetiferous aplite and pegmatite.

The garnetiferous sodic aplite, Figure GS-40-5, is fine grained (less than 1 mm) comprising quartz, plagioclase, microcline and muscovite. It always contains red garnets, commonly segregated into layers up to 2 mm thick that are continuous for more than a metre. Layering can also be defined by coarser (2 to 3 mm) muscovite crystals or by tourmaline. Aplite units occur throughout the pegmatitic granite as layers up to 1 m thick, but are rarely continuous for more than 5 m. Aplite increases in abundance toward the margin of the intrusion, especially toward the south and west where locally it is the dominant textural phase. Aplite layers commonly contain pods of pegmatite in the core regions. Aplites in the pegmatitic granite commonly have graphic microcline-quartz crystals up to 1.5 m long which are rooted in the aplite layer and have grown into the pegmatitic granite.

Pegmatites comprise massive quartz cores surrounded by subhedral, non-graphic microcline crystals. Garnet, tourmaline, biotite and muscovite are common along the margins of the quartz core. One pegmatite contains several grains of arsenopyrite. Microcline is mottled with common pink, white and blue-grey varieties. Pegmatites occur throughout the intrusion and in the country rock. Within the intrusion



LEGEND

GRANITE, PEGMATITIC GRANITE, PEGMATITE

OXFORD LAKE GROUP - METAMORPHOSED VOLCANIC AND SEDIMENTARY ROCKS

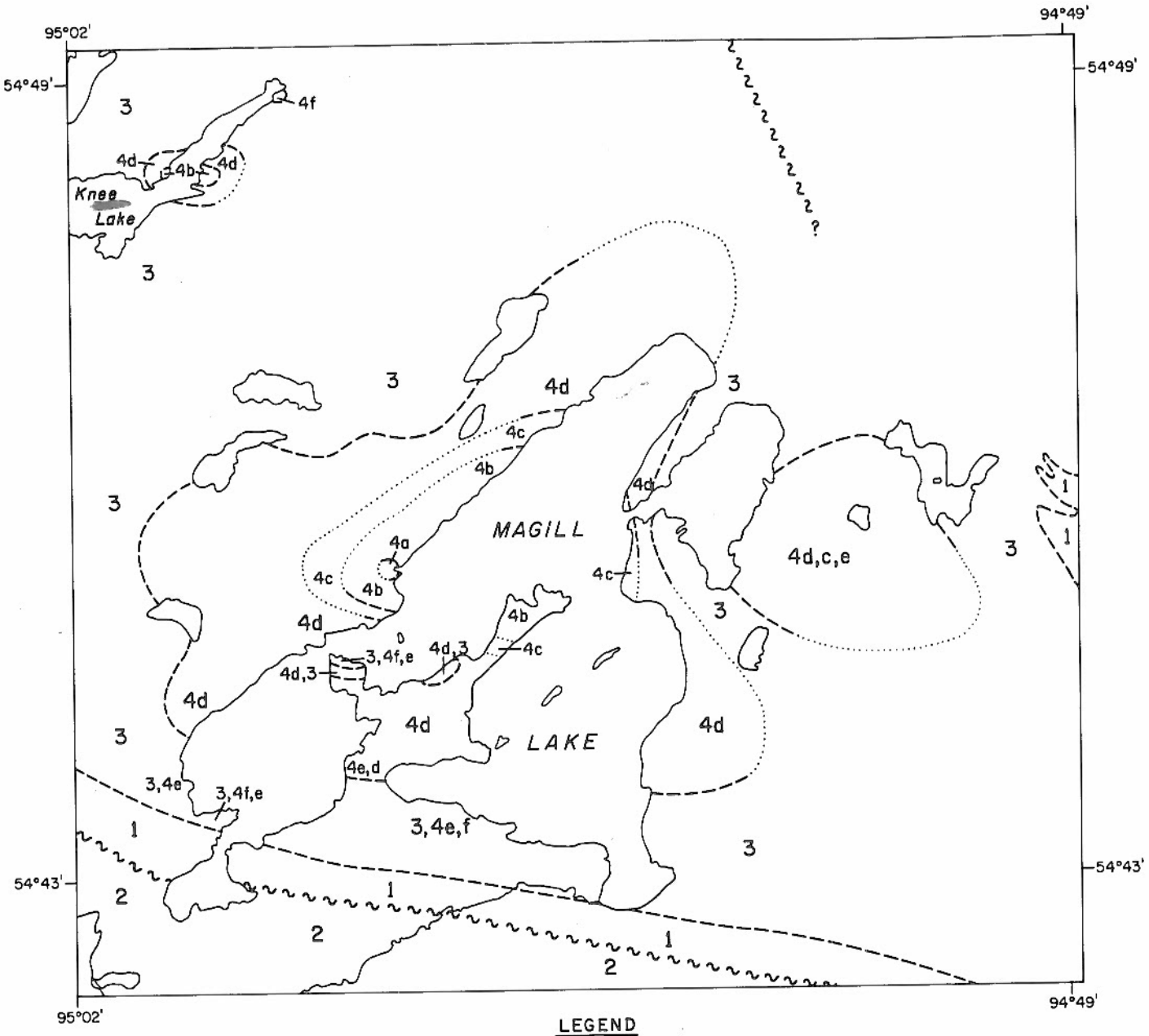
BAYLY LAKE COMPLEX - METAMORPHOSED INTRUSIVE ROCKS OF TONALITE TO SYENITE COMPOSITION

HAYES RIVER GROUP - METAMORPHOSED VOLCANIC AND VOLCANOGENIC SEDIMENTARY ROCKS

▲ PEGMATITE LOCATION

FAULT

Figure GS-40-1: General geology of the Magill Lake-Knee Lake area modified from Gilbert (1985).



LEGEND

MAGILL LAKE GRANITE

4 a Biotite granite
b Leucocratic granite
c Coarse leucocratic granite
d Pegmatitic leucocratic granite
e Garnetiferous sodic aplite
f Pegmatite

OXFORD LAKE GROUP

3 Metamorphosed sedimentary and volcanic rocks

BAYLY LAKE COMPLEX

2 Orthogneisses and paragneisses

HAYES RIVER GROUP

1 Metavolcanic rocks

KM 1 0 1 2 KM

Figure GS-40-2: Geological sketch map of the Magill Lake granite modified after Gilbert (1985).

Figure GS-40-3: Coarse leucocratic granite from the centre of the Magill Lake granite.

Figure GS-40-4: Biotite-rich graphic granite in the pegmatitic leucocratic granite at Magill Lake.

they occur as dykes or, more commonly, as discontinuous pods and lenses that rarely exceed 1.5 m in thickness. Aplite is a common marginal phase of pegmatites within the country rock. In general, pegmatites are most abundant in the pegmatitic granite zone.

There is a marked asymmetry to the zoning of the intrusion with the thickest section of pegmatitic granite-aplite-pegmatite occurring in the west and south. This is accompanied by a zonation of peraluminous minerals with an east to west sequence of: biotite; biotite plus muscovite; biotite, muscovite plus garnet; muscovite, biotite, garnet plus tourmaline and muscovite, garnet, tourmaline. This zonation, combined with structural evidence and the presence of a region of large stoped blocks in the southwest suggests a plunging attitude in a westerly direction. If a rare-element-enriched pegmatite halo exists about the Magill granite, the region to the west of Magill Lake would be the most probable area for such a body. Unfortunately, this area is swampy with little bedrock exposure.

MCLAUGHLIN LAKE

McLaughlin Lake lies near the south margin of the supracrustal belt. Barry (1959 and 1962), Gilbert (1985) and Bannatyne (1985) reported pegmatites within Oxford Lake Group metagreywacke-metasiltstone along the south shore of the lake.

The largest dyke has a lenticular shape with a maximum thickness of 2.5 m and an exposed strike length of 11 m. The dyke comprises quartz, cleavelandite, grey microcline, muscovite, spodumene, garnet and tourmaline. Traces of triphyllite-lithiophilite [$Li(Fe,Mn)PO_4$] and jarosite [$KFe_3(SO_4)_2(OH)_6$] were identified in the central portion of the dyke. Spodumene averages 3 to 4 volume per cent. The dyke exhibits very little zonal structure. The contact has a 1 cm border zone of medium grained grey plagioclase, quartz and tourmaline. There is a general inward increase in grain size with the largest blocky microclines and spodumenes near the centre of the dyke. Oval pods up to 20 cm long of fine grained lath albite, pale orange-pink garnet, muscovite and tourmaline occur in the central region and along the dyke margins. These are late sodic replacement units. Microcline crystals show extensive corrosion along the contacts with replacement units. Spodumene shows very little replacement during the albitization event other than a surface coating of green, secondary muscovite. Spodumene forms pale green,

subhedral to euhedral crystals up to 15 cm long. It shows an alignment parallel to the dyke margins.

Other dykes examined on McLaughlin Lake and to the east of the lake have a simple quartz, albite, microcline, muscovite, garnet and tourmaline mineralogy with no zonal development other than rare segregations of quartz into pods 15 to 25 cm long which are randomly distributed in the dyke. Secondary muscovite (probably shear induced) is common. All dykes examined show slight tourmalinization of the metagreywacke at the contact, but rarely more than 2 mm thick.

All dykes examined were constrained to the regional foliation plane and showed an internal penetrative foliation that locally developed into zones of moderate shearing. This shear fabric is parallel to the faulted contact of the Bayly Lake complex to the south.

KNEE LAKE

Gilbert (1985) mapped several small pegmatite dykes and one body 1.5 by 0.6 km of pegmatite along the southern shore of Knee Lake. These bodies were examined and sampled to determine if they represent a pegmatite differentiate of the Magill Lake granite.

The largest body, located in a narrow bay south of Knee Lake (Fig GS-40-2) is a small plug of leucocratic granite, pegmatitic leucogranite, garnetiferous aplite and pegmatite. The textural diversity and mineralogy of this body is the same as the Magill granite suggesting that it likely represents a small offshoot of that granite. The pegmatites in the vicinity are probably derived from this plug rather than the main intrusion. The pegmatites are generally less deformed than around the Magill body and rarely show evidence of shearing. The dykes are commonly anastomosing, controlled by dilational fractures rather than constrained to the regional foliation.

Although very few pegmatites are exposed, some increase in differention is indicated along a northeast trend. Internal zoning becomes better developed and accessory minerals such as garnet, apatite and molybdenite become more abundant. The dyke farthest east appears to represent the highest level of differentiation. It is a 1 m thick, steeply dipping dyke parallel to the west-trending foliation. The dyke is symmetrically zoned with garnetiferous sodic aplite on both margins. Intermediate zones are coarse microcline-albite-quartz-garnet-tourmaline pegmatite surrounding a core of euhedral, blocky, pink and grey mottled microcline crystals in a quartz matrix. The intermediate zone and sodic aplite contain abundant subhedral, up to 5 mm wide, pale green beryl. This is the only beryl occurrence discovered in the Knee Lake-Magill Lake area. Pegmatites do not occur farther to the northeast. Chemical analyses of mineral samples collected from the pegmatites may verify this differentiation trend.

HAWKINS LAKE

Pegmatite dykes within the Bayly Lake gneiss complex east of Magill Lake were sampled to determine if differentiated pegmatites derived from Magill Lake granite extend eastwards along the east-trending shear at Magill and McLaughlin Lakes.

All dykes examined on Hawkins Lake are simple unzoned pegmatites comprising coarse graphic intergrowth of microcline and quartz with minor plagioclase and accessory biotite and garnet. They are weakly foliated planar dykes that follow a westerly trend cutting the cataclastic fabric of the gneiss complex.

CROSS LAKE

Sampling of granites and pegmatites, started on Cross Lake in 1983, was completed this summer. Sampling of granites was extended to the west and south of the areas previously mapped (see Corkery and Lenton, 1984) to the immediate vicinity of Jenpeg.

A small body of rubidium-enriched, differentiated granite (Whiskey Jack granite of Anderson, 1984) was extended along strike to the east and west to a total strike length of 5 km. Both extremities terminate at faults. The body forms a thick sill (up to 1 km) within the supracrustal

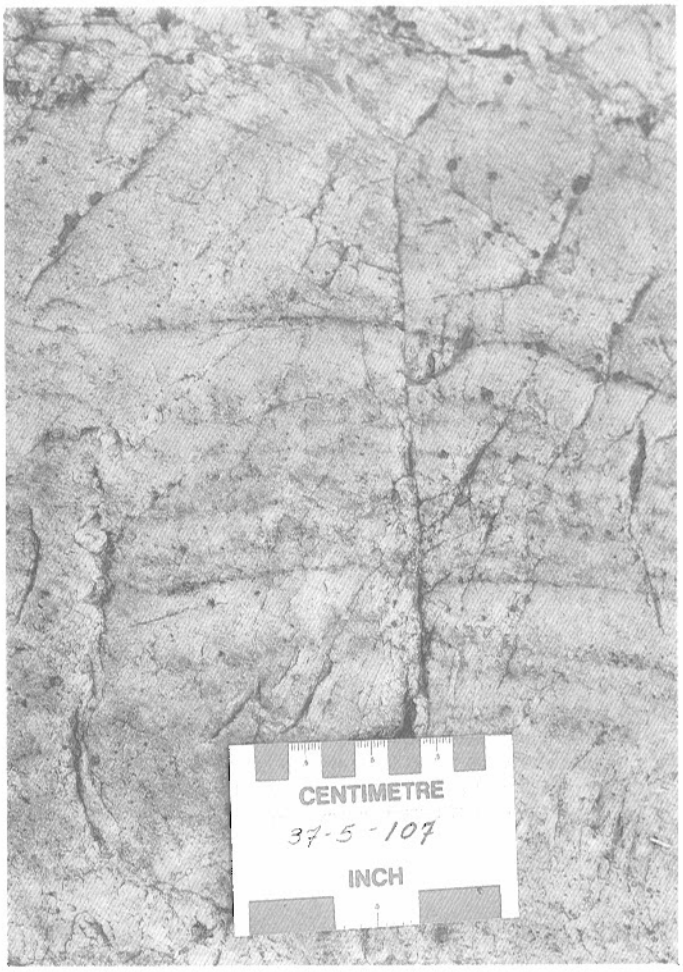


Figure GS-40-5: Layered garnetiferous sodic aplite of the Magill granite.

rocks conformable to the margin of the major batholith to the south. It comprises three different units, an early grey feldspar porphyry intruded by a pink biotite granite and a quartz-rich muscovite-biotite-garnet granite. All three units exhibit enrichment in Rb, Nb, F and Ga and depletion of Sr, Mg and Ba with the garnetiferous phase showing the highest level of differentiation.

One additional pegmatite not examined by Anderson (1984) was sampled. It is a 2 m thick, subhorizontal, poorly zoned dyke belonging to the northern group of beryl-bearing pegmatites. It lies 1.5 km northeast of the main group of beryl-bearing pegmatites within a layer of metamorphosed pelitic-matrix conglomerate. It comprises microcline, albite, muscovite, quartz, garnet and tourmaline. Beryl is absent, being replaced by small anhedral masses of chrysoberyl ($BeAl_2O_4$). It also contains traces of a greenish-black phosphate mineral tentatively identfied as graftonite [$(Fe,Mn,Ca)_3(PO_4)_2$].

CINDER LAKE

A body of syenite previously mapped by Elbers (in Gilbert, 1985) was examined and sampled. It is a grey weathering fine grained nepheline syenite comprised of microcline, albite, nepheline, cancrinite, blue-green amphibole, clinopyroxene, biotite, calcite, fluorite, andradite, sphene, apatite, magnetite, pyrite and zircon. A large body of syenite pegmatite on the east shore of Cinder Lake comprises 1 to 5 cm crystals of microcline and plagioclase in a fine grained matrix of calcite and

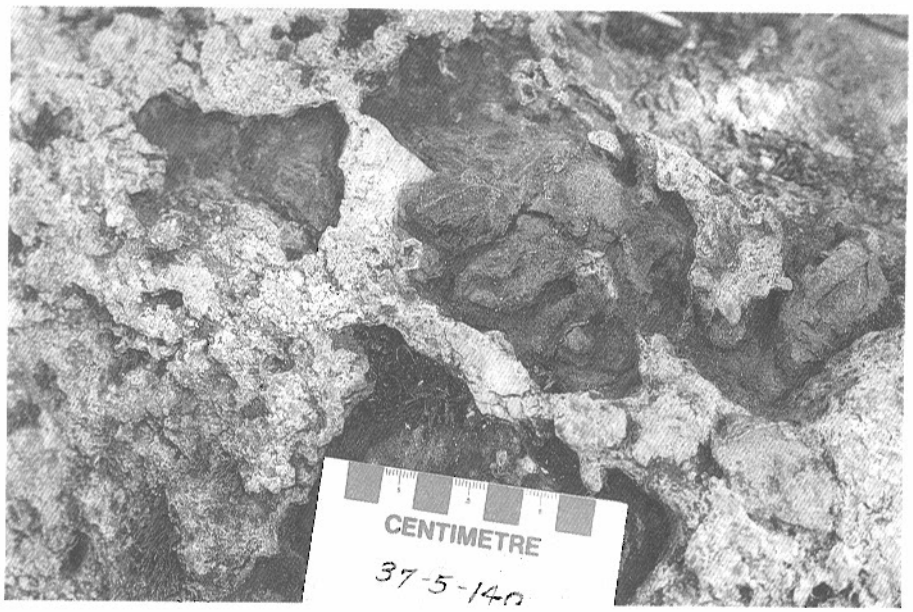


Figure GS-40-6: Partially altered melanite (andradite) crystals in a syenite pegmatite on Cinder Lake.

muscovite with subordinate fluorite. This body is weakly layered with local development of layers containing concentrations of partially altered black melanite crystals up to 5 cm wide (Fig. GS-40-6).

Samples of the syenite are to be analyzed to determine the REE, niobium, titanium and phosphorus content.

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