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RECONNAISSANCE GEOLOGY OF THE KANAIRIKTOK RIVER HEADWATERS, LABRADOR

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ABSTRACT

Northeast of Michikamau Lake, the eastern Churchill Province includes gneissic and foliated, predominantly plutonic rocks, which underlie a north-northwesterly trending corridor between two anorthositic complexes and their associated granitoid rocks.

The corridor is subdivided into two domains. The southern part of the corridor consists of amphibolite-facies tonalitic to granodioritic orthogneiss containing minor screens of pelitic and metabasic paragneiss. These rocks represent a northward continuation of the Orma Domain lithological association. In the west-centre of the corridor, granulite-facies and transitional amphibolite- to granulite-facies gneisses and foliated plutonic rocks are derived from, or emplaced into, the Orma Domain association. They include pyroxene diorite to enderbitic and opdalite gneiss, clinopyroxene- ± hornblende-bearing monzogranitic gneiss and foliated K-feldspar-megacrystic hornblende pyroxene biotite granite. Farther north, a southeasterly trending line of lenses of layered leucogabbroic rocks defines the northern limit of the Orma Domain. North of the boundary is a granulite-facies gneiss complex, which is composed of interlayered granitoid and metabasic rocks and is assigned to the Mistinibi–Raude Domain. Contrasts across the southeasterly oriented boundary are considerable and suggest a significant crustal boundary. At the northwest end of the boundary, an ovoid pluton of locally foliated, K-feldspar-porphyritic granite spans the boundary and intrudes Orma Domain orthogneiss on its southern margin; it may be a stitching pluton. The northernmost part of the corridor is unexposed.

The anorthositic complexes and their related granitoid rocks are early Middle Proterozoic (Elsonian) anorogenic intrusions. In the southwest, the Michikamau Intrusion consists of leucotroctolite, anorthosite and minor monzogranite. The Harp Lake Complex crops out in the northeast, is comprised mostly of hypersthene anorthosite within the study area and is separated from the gneiss corridor by a wide rim of K-feldspar-megacrystic, predominantly syenitic rocks. Foliations in the Middle Proterozoic plutons are localized and probably mostly emplacement related. To the southeast, the Harp Lake Complex and the syenite are unconformably overlain by terrestrial red beds of the mid-Middle Proterozoic Seal Lake Group.

Border phases of the anorthositic complexes have considerable base-metal and PGE potential.

INTRODUCTION

The aim of the project was to map the corridor between the Michikamau Intrusion and the Harp Lake Complex in map quadrant 13L/NW (NTS map areas 13L/11, 12, 13 and 14). The Michikamau Intrusion (Emslie, 1970) and the Harp Lake Complex (Emslie, 1980) are Middle Proterozoic (Elsonian) anorthositic complexes that have already been mapped in detail (Emslie, *op. cit.*) and were only briefly studied during this program. The quadrant is centred 140 km north by 12° east of Churchill Falls in west-central Labrador (Figure 1) and, in the northwest and west, includes adjacent parts of Quebec.

The provincial boundary is the watershed between the George River basin (Quebec), draining west and then north to Ungava Bay, and the Kanairiktok River basin (Labrador), which drains southeast and then east to the Labrador Sea. The watershed is scarcely even a low ridge in terrain that is underlain by gneissic rocks or that is unexposed; however, in the west, the ridge rises and widens into upland massifs over the Michikamau Intrusion and an ovoid granite pluton (Figure 2). In the east half of the quadrant, a larger upland massif occurs in the area underlain by the Harp Lake Complex and its marginal syenitic rocks. These massifs are the deeply dissected remnants of several former erosion levels between about 550 and 700 m above sea level, and valley-

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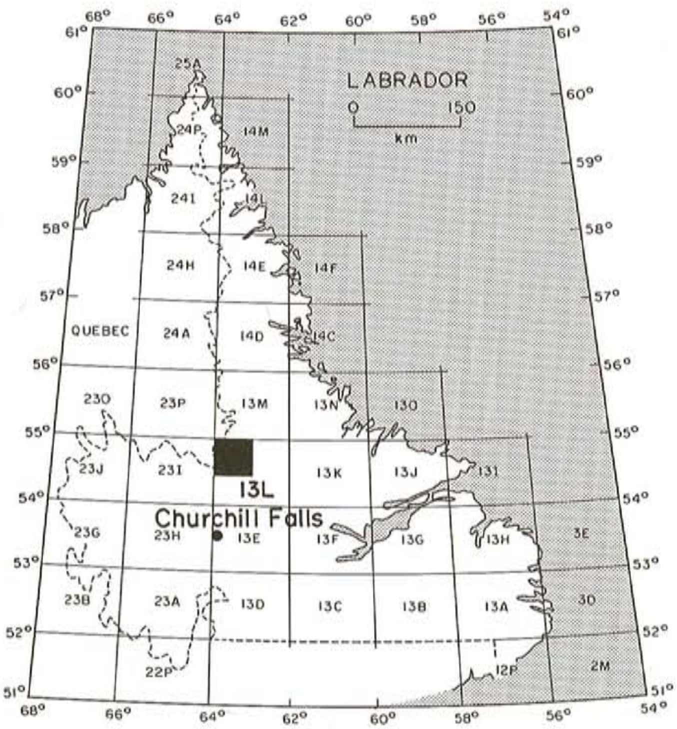

Figure 1. *Location of the Kanairiktok River headwaters map area, NTS map area 13L/NW.*

floor to ridge-top relief commonly reaches 100 m. The area between the upland massifs, on both sides of the border, is, for the most part, a gently undulating plateau level at approximately 500 m that has a relief that seldom exceeds 60 m. In the centre of the map area, the Kanairiktok River begins to cut down into this lower plateau level and at the southeastern corner of the map area is incised into a gorge about 130 m deep.

The upland massifs are well exposed in contrast to the lower plateau level, which is only poorly exposed except in Kenney Lake (Figure 2). In the areas of better exposure, till cover thins to a discontinuous veneer (<1.5 m) except in the more prominent valleys. The lower plateau, however, is mostly blanketed (>1.5 m) by till of unknown thickness.

Kenney, Thompson, Brass and Wilbrow lakes were mapped by boat from a camp on Wilbrow Lake that was positioned by float plane. The area south of Wilbrow Lake was mapped by foot from the same camp. The remainder of the area covered was accessed entirely by helicopter from a base camp at Lobstick Lake over 120 km to the southwest (see James and Mahoney, *this volume*).

Map areas 13L/13 and most of 13L/12E and 13L/14W were completed, excluding parts of Quebec in the northwest of the quadrant and areas covered by Emslie (1970, 1980); map area 13L/11 was not visited. No previous exploration work is known to the author. The quadrant forms the northern half of a 1:250 000-scale map by Emslie (1964).

REGIONAL SETTING

The study area lies within the Central Gneiss Zone (Wardle *et al.*, 1990a) of the Central Division (Wardle *et al.*, *op. cit.*), or Rae Province (Hoffman, 1988, 1989), of the eastern Churchill Province in Quebec and Labrador (Figure 3). The Rae Province forms the hinterland (Hoffman, 1990a; James and Mahoney, *this volume*) to two flanking orogens, in the west the New Quebec Orogen and in the east the Torngat Orogen. These three components form the eastern Churchill Province in this area (Ungava). The hinterland zone is dominated by Hudsonian-reworked Archean gneisses but also contains infolded layers of Lower Proterozoic supracrustal rocks, syn- to late-plutonic, granitoid plutonic rocks, commonly in linear welts, and rare pre-Hudsonian plutonic and volcanic rocks (Figure 4). Tectonic models for the development of the Rae Province in this region have been proposed by Van der Leeden *et al.* (1990) and Hoffman (1990b).

In Ungava, the southern part of the Rae Province has been intruded by Middle Proterozoic (Elsonian) 'anorogenic' plutonic rocks (Emslie, 1978a,b), mainly granitoid and leucotroctolitic rocks, and these and the earlier rocks are unconformably overlain by Middle Proterozoic continental clastic and volcanic rocks (Figure 4).

The entire area lies north of any recognizable Grenvillian deformation.

GENERAL GEOLOGY

The study area consists of a varied collection of gneissic rocks (Units 1 to 4, 7 and 8), foliated plutonic rocks (Units 5, 6 and 9) and Elsonian-related, largely undeformed syenite (Unit 12). The anorthositic rocks (Units 10 and 11) and the Seal Lake Group (Unit 13) make up the remaining map units. The reader is referred to the map (Figure 5) for unit distributions and general dimensions.

Unit Descriptions

Unit 1: Supracrustal Gneisses

Unit 1 consists of garnet–biotite paragneiss (subunit 1a), banded amphibolite and basic gneiss (subunit 1b), one occurrence of carbonate-rich metabasic rock (subunit 1c) and dykes and sheets of granitoid rocks.

The paragneiss is characterized by centimetre- to decimetre-scale, stromatic and locally discordant location fabrics and is usually rusty-weathering (Plate 1). The paragneiss is quartzofeldspathic; its melanosome is grey, fine grained and biotite ± garnet bearing and the leucosome is white, medium to coarse grained, commonly discontinuous and garnet ± biotite bearing. Restite seams are biotite rich. Garnet is lilac and, commonly, has subhedral to euhedral form, is 0.3 to 1.5 cm in diameter and forms a heterogeneous spotting that is, in part, layer controlled (Plate 1). The garnet

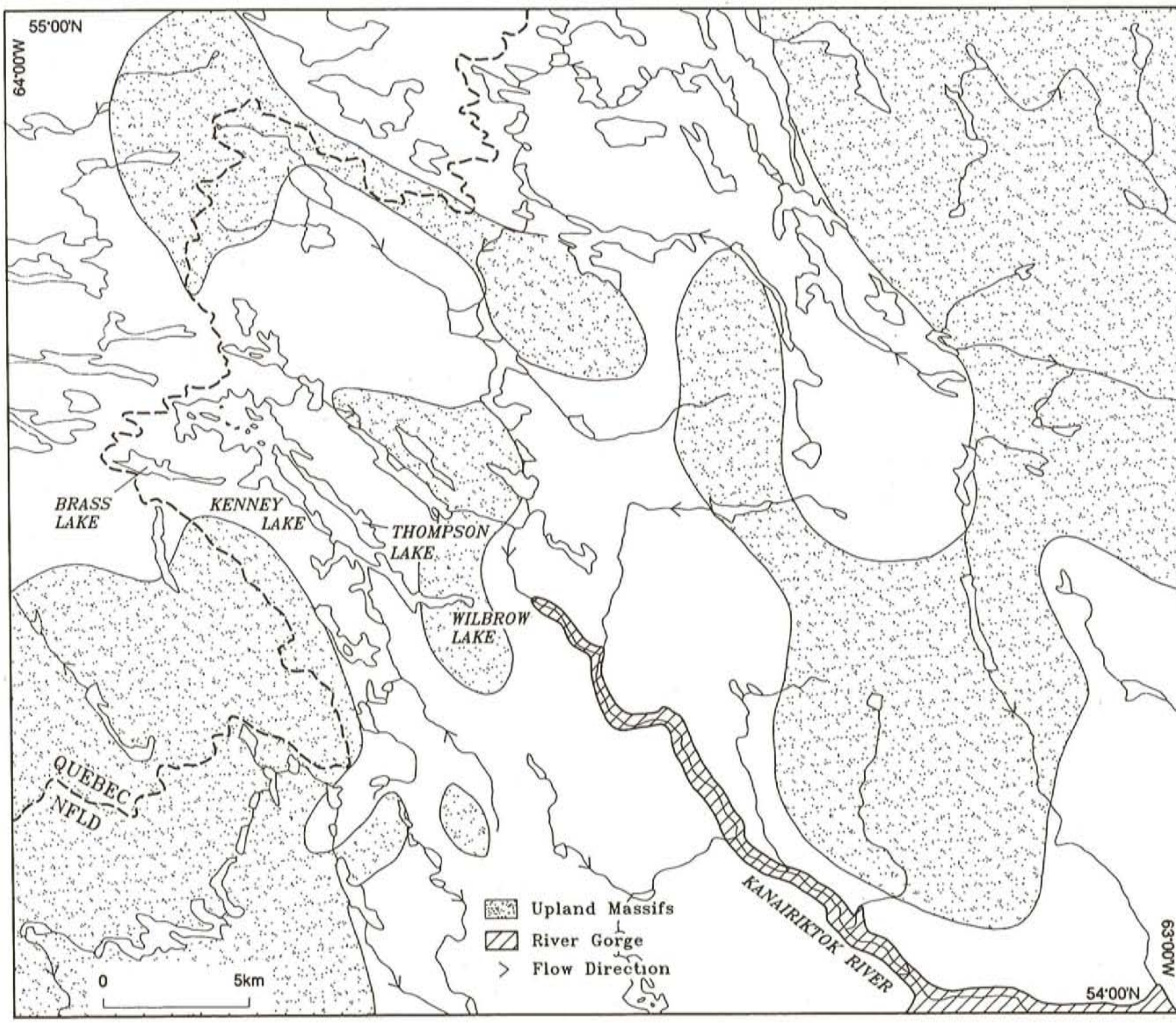

Figure 2. *General physiography of the map area and place names referred to in the text. Upland massifs correlate well with plutonic rock suites (see Figure 5) and, generally, are well exposed. Other areas of good exposure occur in Kenney Lake and along the lower reaches of the Kanairiktok River.*

has grown at the expense of biotite in some melanosomes to produce biotite-depleted felsic haloes; mostly, the garnet and its haloes are posttectonic. The paragneiss contains a weak quartzofeldspathic mineral fabric and moderate to strong location and biotite mineral fabrics. Quartz-rich, strongly rusty-weathering layers and lenses, ± garnet, and cream, biotite-bearing quartzofeldspathic pods form minor constituents of the paragneiss subunit. Close to the Michikamau Intrusion (Unit 10) the paragniess is in pyroxene hornfels facies and its paleosome and restite layers are cordierite rich.

Paragneiss occurs in metre- to decametre-width layers intercalated with sheets of granitic rocks of similar width and is commonly spatially associated with basic gneiss (subunit 1b).

Black-, and rarely greenish- or rusty-weathering, fine-grained, dark-grey plagioclase–hornblende ± garnet ± biotite, or plagioclase–clinopyroxene ± orthopyroxene, layered metabasic rocks comprise subunit 1b. Most rocks are metamorphic-textured, centimetre- to decimetre-scale compositionally layered basic gneisses having a colour index range of from about 15 to 75 (Plate 2). Locally, metabasic rocks are derived from homogeneous medium-grained gabbro and preserve vestiges of relict igneous texture. Both rock types are sporadically, concordantly or discordantly, layered by dioritic to tonalitic neosomes that may be plagioclase, quartz, hornblende or clinopyroxene rich. Commonly, the neosomes are folded, but lack good internal fabrics, and are pyroxene or hornblende porphyroblastic. Concordant layering in the host metabasic rocks is paralleled by moderately developed mineral fabrics. The basic gneisses are associated with the

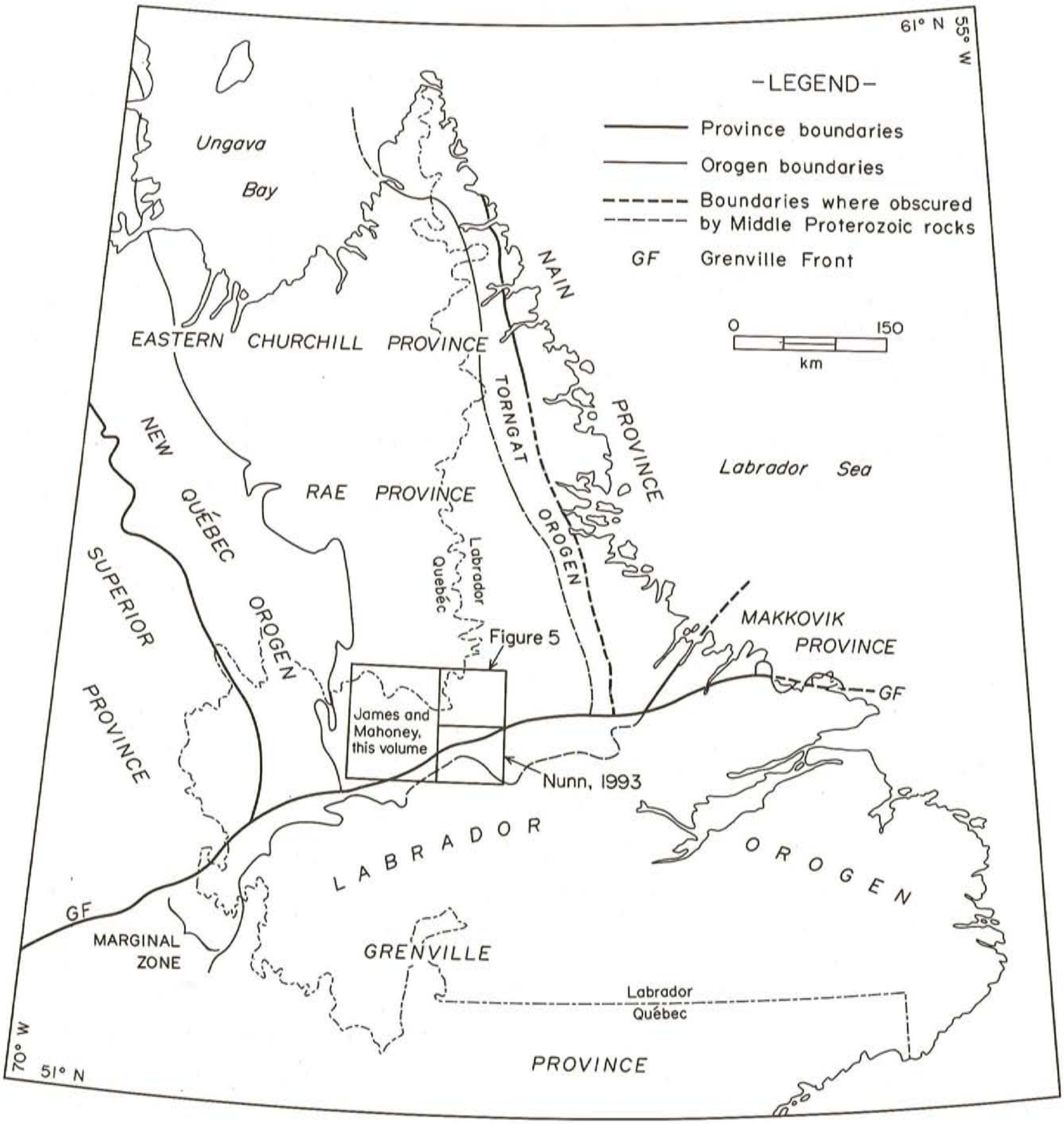

Figure 3. *The map area (Figure 5) in the regional structural context of the eastern Ungava Peninsula (Labrador and New Quebec).*

paragneiss or occur as strips and inclusions in orthogneiss (Unit 2).

Centimetre-scale, compositionally layered metabasic rocks consisting of clinopyroxene + hornblende + minor biotite ± plagioclase ± rare garnet ± calcite form a 40-m-thick, black layer (subunit 1c) between paragneiss (subunit 1a) and orthogneiss (subunit 4a) in the southern part of Kenney Lake. Parts of the subunit contain between 10 and 60 percent calcite, which occurs in more massive and recessive-weathering layers than the regular amphibolite. The layers range in composition from amphibolite to ultramafic rock and include green-weathering clinopyroxene segregations. They are folded and have been intruded by concordant sheets of homogeneous leucoamphibolite, up to 1 m thick, and rare felsic veins. The concordant location fabric is prominent whereas mineral fabrics are weakly to moderately developed.

Medium- to coarse-grained sheets of white, grey and pink tonalite to alkali-feldspar granite commonly are interlayered within the other parts of Unit 1. The sheets range in width from decimetres to greater than 10 m and are dominated by K-feldspar-porphyritic granite. In paragneiss, biotite-granite sheets generally contain lilac garnet whereas in metabasic rocks, the sheets mostly consist of hornblende-porphyroblastic or hornblende-porphyroclastic tonalite to granite. Granitoid rocks are homogeneous and contain a weak to moderate porphyritic K-feldspar, quartzofeldspathic and biotite mineral fabric ± posttectonic garnet. Locally, the granitoid sheets form more of the Unit 1 succession than the intercalated layers of other subunits.

Unit 2: Tonalite–Granodiorite Orthogneiss

Unit 2 consists of grey-weathering, tonalitic to granodioritic orthogneiss. The gneiss has a fine- to medium-grained, grey, biotite-bearing melanosome, which is commonly plagioclase porphyroclastic or relict plagioclase porphyritic. The rocks contain subordinate amounts of stromatic and discordant, fine- to coarse-grained, centimetre-scale biotite tonalite to biotite alkali-feldspar granite leucosomes (Plate 3). Locally, the gneiss is more strongly differentiated (Plate 4). Weakly to moderately foliated, medium- to coarse-grained, quartzofeldspathic patches have been recrystallized to fine-grained granoblastic aggregates. A biotite mineral fabric and biotite-rich schlieric streaks mostly parallel the layering. Adjacent to the Michikamau Intrusion (Unit 10) the gneiss is statically recrystallized at pyroxene hornfels grade and contains orthopyroxene. The migmatitic nature of these rocks is much less obvious in the pyroxene hornfels facies areas.

Unit 3: Orthopyroxene-bearing Plutonic Rocks

Subunit 3a is fine- to coarse-grained, grey, commonly brown-weathering, gneissic pyroxene diorite, enderbite, opdalite and minor charnockite. The rocks contain a metamorphic texture, which ranges from isotropic to a moderately developed mineral fabric, and a weak to moderate location fabric of discontinuous, diffuse, generally sparse veins and segregations of medium- to coarse-grained enderbite to alkali-feldspar charnockite, ± quartz-rich varieties of these rocks, which have venitic, anastomosing (Plate 5) or weakly stromatic relationships. The veins and segregations contain clinopyroxene and biotite ± orthopyroxene and garnet, are locally orthopyroxene rich, and, in places, have biotite selvages. The rocks are very heterogeneous in grain size and composition, e.g., medium- to very coarse-grained, diffuse-edged, quartz-rich and charnockite segregations developed in fine- to medium-grained opdalite and charnockite, and also in colour index (3 to 15). In places, they are biotite and pyroxene porphyroblastic or poikiloblastic, or contain porphyritic or porphyroblastic K-feldspar up to 2.5 cm across. Locally, the heterogeneity is enhanced by diffuse-edged, weakly elongate enclaves of two pyroxene diorite or metabasic rock and by xenoliths of compositionally and leucosome-layered migmatitic paragneiss, metabasic rocks and granitoid gneiss.

Pyroxene diorite and enderbite of subunit 3b is fine to medium grained, grey, dark-grey-weathering and metamorphic textured. The subunit is weakly to moderately foliated but is not gneissic. Garnet occurs as very narrow coronas around pyroxene or as sparsely distributed, disseminated granular clusters.

Unit 4: Clinopyroxene-bearing Monzogranite

Unit 4 consists of fine- to coarse-grained, light-grey, white-weathering biotite monzogranite to granodiorite. The rocks are weakly to moderately foliated and mostly homogeneous, although, locally, they are gneissic. They contain pyroxene ± garnet. The leucosomes have a similar monzogranite composition and the melanosomes are relatively biotite rich. In the gneissic part of the subunit, centimetre-scale layers of fine- to medium-grained, grey, biotite-bearing tonalitic to granodioritic paleosome are rare: mostly, the gneiss is completely differentiated into white monzogranite and discontinuous, commonly diffuse, medium-grained, biotite-rich schlieren (Plate 6). Descriptively, this rock is termed a diffusely biotite-banded gneiss. Discordant leucosomes add to the heterogeneity of the migmatite and areas of less stromatic rock occur where layers of leucosome have coalesced. Irregularly shaped, oval or angular, sharply defined to diffusely margined inclusions of dark-coloured metabasic rock and grey to brown stromatic tonalite gneiss are scattered throughout the unit. Outcrop-scale or larger layers and inclusions of paragneiss and metabasic rock are also common.

Biotite is ubiquitous but commonly is subordinate to clinopyroxene. Clinopyroxene is black or greenish, and in places is poikiloblastic. Rarely, orthopyroxene is also present, and black poikiloblastic hornblende occurs with or without cores of greenish clinopyroxene. The colour index is generally 5 to 10 in the monzogranite, 10 to 15 in the paleosome, and ranges up to 100 in the schlieren. Paleosome and restite location fabrics are the most obvious structural feature but are irregular. Biotite forms a good mineral fabric and quartz and feldspar form weak to moderate mineral or shape fabrics. Pyroxene, hornblende and garnet exhibit only weak fabrics and near to the Michikamau Intrusion many rocks are statically recrystallized.

Unit 5: K-feldspar-Megacrystic Granite

Unit 5 is a fine- to medium-grained, grey- to dark-brown-weathering, K-feldspar-megacrystic pyroxene biotite monzogranite that generally contains garnet and hornblende (colour index is between 15 and 20). Minor compositional variants include quartz monzonite, quartz syenite and syenogranite. Dark purplish grey K-feldspar megacrysts, locally having thin albite rims, range from 1 to 5 cm (mostly 1.5–3 cm), are equant to rectangular or oval with aspect ratios of up to 2:1. The megacrysts make up about 30 percent of

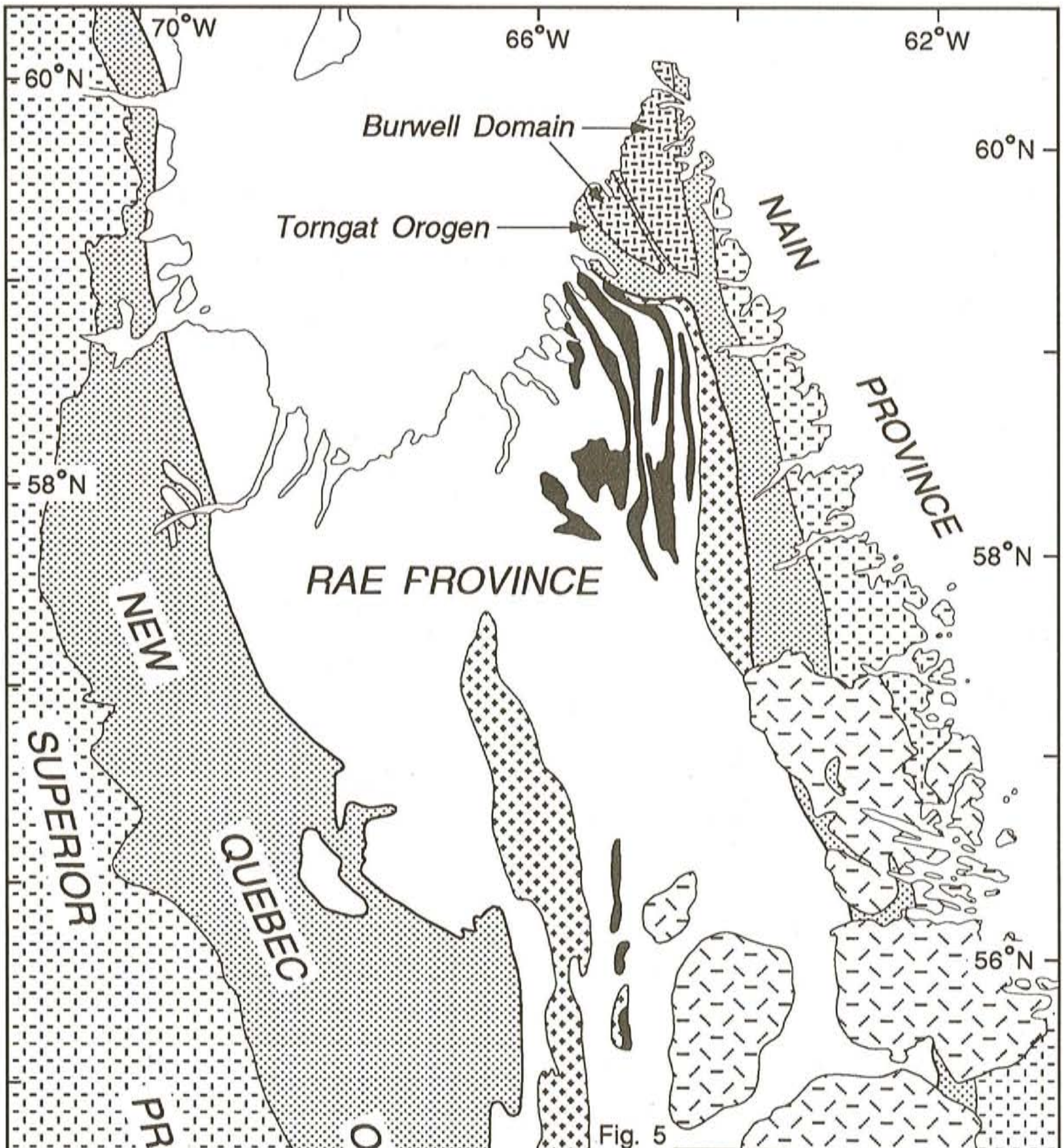

Figure 4. *General geology of the Rae Province and related rocks south of the Grenville Front (after Wardle* et al., *1990b).*

LEGEND (for Figure 4)

MIDDLE PROTEROZOIC

- *Seal Lake Group*
- *Anorthositic, gabbroid and granitoid plutons*

EASTERN CHURCHILL PROVINCE

RAE PROVINCE HINTERLAND

- *Mostly reworked Archean gneisses*
- *Lower Proterozoic metasedimentary rocks*
- *Lower Proterozoic granitoid plutonic rocks*

FLANKING OROGENS

STABLE ARCHEAN CRATONS

——— *Rae Province boundary*

— — — *Grenville Front (approximate)*

the rock; somewhat less in a finer megacryst-size facies. The groundmass was originally medium grained; it now consists of aggregates of fine-grained quartz, plagioclase and clinopyroxene. The pyroxene is rimmed by hornblende or garnet and red garnet also occurs as discrete grains. The monzogranite is moderately foliated although commonly it looks undeformed on subhorizontal surfaces. The foliation is defined by a good ferromagnesian and felsic shape fabric and by a biotite mineral fabric in the groundmass, together with a weak K-feldspar megacryst orientation (Plate 7), and has a moderate to steep linear component. In areas of stronger foliation, the megacrysts have been replaced by flattened aggregates of K-feldspar and the foliation is openly to moderately folded. The monzogranite also contains diffuse streaks of non-megacrystic rock, enclaves of fine-grained, low colour index (<5) felsic rock of unknown parentage, similar enclaves of tonalitic to monzogranitic precursor phases ($\pm$ scattered K-feldspar megacrysts) and xenoliths of garnet paragneiss $\pm$ migmatitic segregations. Many of the inclusions are thermally metamorphosed.

Unit 6: Gabbro and Granite

Single intrusions of foliated gabbroic (subunit 6a) and granitic (subunit 6b) rocks comprise Unit 6. They appear to represent homogeneous plutonic entities, which are elongated parallel to their foliations. Subunit 6a is a medium-grained, dark-grey or greenish-black, weakly to moderately foliated amphibolite derived from medium-grained gabbro. The amphibolite is homogeneous, and has a colour index of about 35, or is weakly layered by indistinct leucogabbroic phases.

Subunit 6b is a medium- to coarse-grained, pink-weathering, K-feldspar-porphyritic biotite syenogranite. The syenogranite is isotropic to moderately foliated (defined by a quartzofeldspathic mineral fabric and biotite seams) and contains posttectonic, locally poikiloblastic, garnet and inclusions of previously foliated leucogabbroic rock.

Unit 7: Leucogabbro

Unit 7 is a layered complex containing a range of compositions from anorthositic to ultramafic. Leucogabbro (gabbroic anorthosite, colour index 10 to 25) dominates. Individual layers are centimetres to several metres thick and consist of centimetre- to decimetre-scale aggregates of equant to strongly flattened plagioclase in a gabbroic to ultramafic groundmass (Plate 8). The aggregates are interpreted to represent deformed and recrystallized cumulus plagioclase. Rare occurrences of dark-grey or black, porphyroclastic plagioclase are presumed to be igneous relicts. Recrystallized plagioclase is light to dark-grey and is white-weathering. Ferromagnesian minerals are mostly black hornblende, biotite and brown or black orthopyroxene. Posttectonic, red garnet is a rare accessory phase. Compositional location and shape fabrics are well developed but mineral fabrics are weak due to the subequant recrystallization habits of most minerals.

Unit 8: Granitic and Metabasic Gneiss

Unit 8 is a bimodal composition gneiss composed of interlayered granitoid and metabasic rocks. The main granitoid phase is of uncertain feldspar proportions (?granodiorite); it is a grey, fine-grained, yellow-brown- or grey-weathering rock of medium- to coarse-grained aggregates of quartz and feldspar, which define a strong subhorizontally lineated shape fabric. It forms decimetre- to decametre-scale layers. The granitoid rocks include subordinate centimetre- to decimetre-scale sheets of grey, lighter weathering granite that has a similar texture. Biotite is the main ferromagnesian species in the granitoid rocks, which have a colour index of <15; garnet and orthopyroxene occur locally.

The metabasic rocks consist of fine-grained, dark-grey, weakly to moderately foliated, black-, dark-grey- or dark-green-weathering amphibolite or plagioclase–pyroxene rock. Garnet is abundant, both as narrow, diffuse coronas on pyroxene and as discrete grains, and minor biotite is usually present. The colour index in metabasic rock ranges from about 25 to 80. Metabasic layers are centimetres to several metres wide and mostly appear homogeneous: internal compositional layering commonly is subtle where present and leucocratic segregations are minor.

The granitoid and metabasic rocks are concordantly interlayered and foliated parallel to the layering (Plate 9). Locally, discordant granitoid dykes, which are otherwise similar to the concordant phases, cut acutely across the layering; in these cases, foliation is usually dyke parallel. Foliation is less strong in the metabasic rocks, probably largely due to mineralogical control and an initially finer grain size than in the granitoid rocks. Some metabasic rocks formerly contained coarse-grained clinopyroxene and are now pyroxene porphyroclastic. Garnet and, locally, hornblende are syn- to posttectonic. The former occurs as, mostly fine-

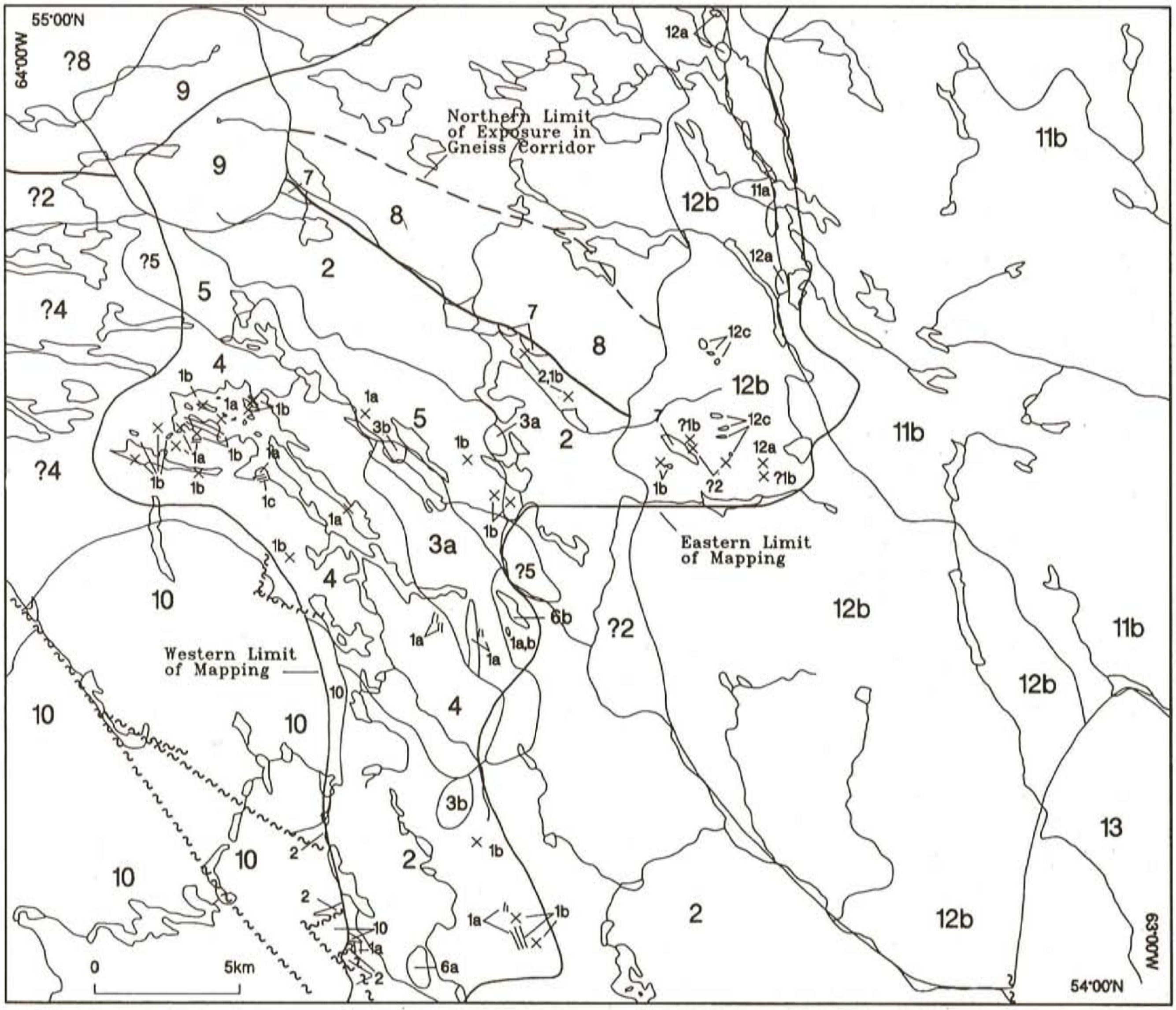

Figure 5. *Geology of the Kanairiktok River headwaters map area, NTS quadrant 13L/NW. Extrapolation to the east and west of the mapped limits to the present study is adapted from Emslie (1970, 1980) and modified from Wilson* et al. *(1990).*

grained, porphyroblasts that range up to 1.5 cm in diameter. The Unit 8 sequence varies from zones hundreds of metres wide that are dominated by granitoid rocks to zones up to 60 m wide that are dominated by metabasic rocks.

Unit 9: Porphyritic Granite

Medium- to very coarse-grained, red-, orange- or pink-weathering (commonly with a deep, red-stained rind), K-feldspar- ± plagioclase-porphyritic biotite syenogranite forms the bulk of Unit 9. The granite is generally pinkish grey on fresh surfaces but on smooth, washed surfaces it is pink (K-feldspar), white (Na-feldspar) and grey (quartz) spotted. Biotite is the only ferromagnesiam species and defines a colour index range of 3 to 8. Porphyritic K-feldspar is usually 1 to 2 cm across, but may reach 4 cm, and is euhedral to subhedral and of equant to rectangular shape with aspect ratios of up to 3:1. Commonly, these grains are zoned and contain tiny quartz and Na-feldspar inclusions. Monzogranite occurs in patches containing greater concentrations of porphyritic plagioclase. Porphyritic plagioclase is up to 1.5 cm long, of similar form and shape to K-feldspar and has aspect ratios of up to 4:1. The groundmass is anhedral or, locally, sugary (in finer grained alkali-feldspar granite patches) and, commonly, is seriate.

The syenogranite contains pinkish-grey patches of non-porphyritic material and abundant dykes, veins and patches of granitic rocks. The most common dykes are coarse- to very coarse-grained and locally pegmatitic, white, low colour index (< 5), rectiplanar, wavy or very irregular (possibly folded) syenogranite and alkali-feldspar granite. The dykes are up to several metres thick and form up to 50 percent of the rock. Commonly, the coarser dykes are graphic textured. Less

LEGEND (for Figure 5)

MIDDLE PROTEROZOIC

13 *Seal Lake Group*

12 *K-feldspar-megacrystic syenitic rocks*
- *c granite*
- *b syenite and quartz syenite*
- *a felsic and metabasic rocks*

11 *Harp Lake Complex*
- *b anorthosite*
- *a troctolite*

10 *Michikamau Intrusion*

MIDDLE PROTEROZOIC OR OLDER

9 *Porphyritic granite*

EARLY PROTEROZOIC OR OLDER

8 *Granitic and metabasic gneiss*

7 *Leucogabbro*

6 *Plutonic rocks*
- *b granite*
- *a metagabbro*

5 *K-feldspar-megacrystic granite*

4 *Clinopyroxene-bearing monzogranite*

3 *Orthopyroxene-bearing plutonic rocks*
- *b pyroxene diorite and enderbite*
- *a gneissic opdalite, enderbite and charnockite*

ARCHEAN

2 *Tonalite - granodiorite orthogneiss*

1 *Supracrustal gneisses*
- *c carbonate-bearing metabasic rocks*
- *b basic gneiss*
- *a pelitic paragneiss*

——— *Domain boundary*

~~~~~ *Faults*

common dyke phases include seriate and pegmatitic, graphic alkali-feldspar granite, quartz-rich granitoid rocks, rare granite-aplite composite veins and milky quartz. Most of these form sharp- to diffuse-edged patches or rectiplanar veins, are fine grained to pegmatitic, and contain up to 5 percent of biotite.

Unit 9 is isotropic to weakly foliated. The foliation is defined by biotite streaks and schlieren (rare) and a biotite mineral fabric, by elongate feldspar phenocrysts and by a quartz aggregate shape fabric. Locally, the fabric has a steep linear component. Dykes of all phases of Unit 9 intrude the country rocks for several kilometres from the main body on its southern margin. The dykes are buckled but contain only a rarely developed axial-planar fracture fabric.

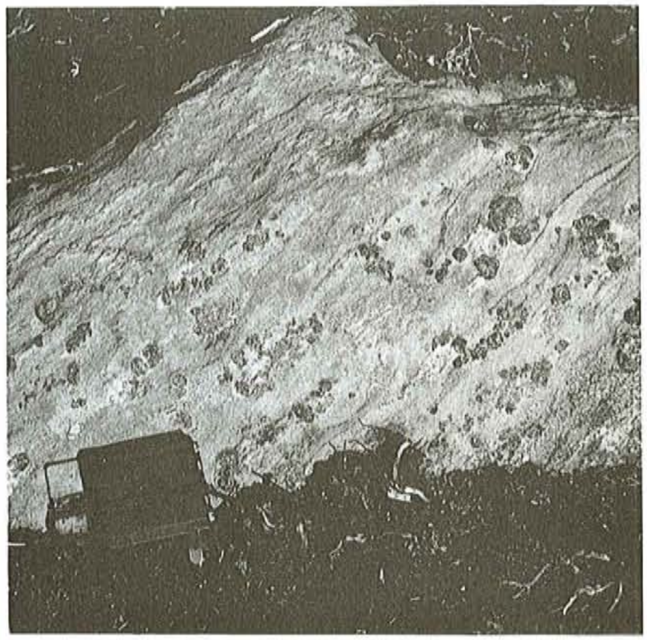

Plate 1. *Layered quartzofeldspathic paragneiss (subunit la) overprinted by, partly layer-controlled, posttectonic garnet, which is associated with migmatitic and/or depletion-halo-generated leucocratic segregations. The clinometer is 10 cm long.*

Plate 2. *Layered metabasic supracrustal rocks (subunit lb) containing a strong, gently plunging lineation (mullions) parallel to the hammer handle. The hammer is 34 cm long.*
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Plate 3. *Weakly layered tonalite gneiss (Unit 2) containing plagioclase aggregates, a porphyroclastic plagioclase relict (centre) and stromatic leucosomes of tonalite (centre) and granite (top). The clinometer is 6.5 cm wide.*

Plate 4. *Strongly layered tonalitic gneiss (Unit 2). Melanosome-rich layers between the more prominent leucosome-dominated ribs contain porphyroclastic textures. The clinometer is 10 cm long.*

Plate 5. *Enderbite containing anastomosing enderbite to opdalite leucocratic segregations (subunit 3a). The hammer is 34 cm long.*

Plate 6. *Diffusely biotite-banded granitoid orthogneiss (Unit 4) dominated by white monzogranite leucosome. In the upper right, largely lichen covered, is a part of a thin metabasic strip. The clinometer is 10 cm long.*

Unit 10: The Michikamau Intrusion

The Michikamau Intrusion (Emslie, 1970) was visited in only a few places near its eastern contact. At these localities it consists of either leuconorite and olivine leuconorite, or of leucotroctolite and anorthosite. The leuconorite and olivine leuconorite are medium- to coarse-grained, dark-grey, isotropic rocks containing random plagioclase laths (up to 2.5 cm long and with aspect ratios of 2 to 3:1) and a colour index of between 10 and 15 defined by intergranular orthopyroxene ± olivine. The leucotroctolite is medium- to

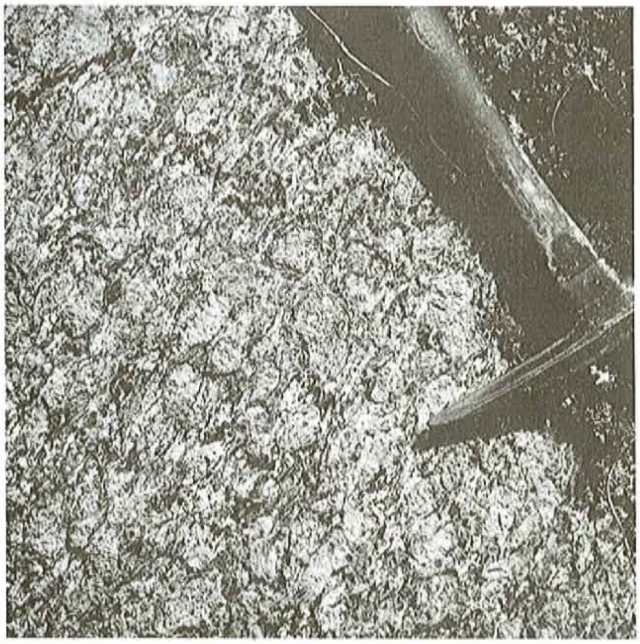

Plate 7. *Foliated, K-feldspar-megacrystic granite (Unit 5). The hammer spike is 10 cm long.*

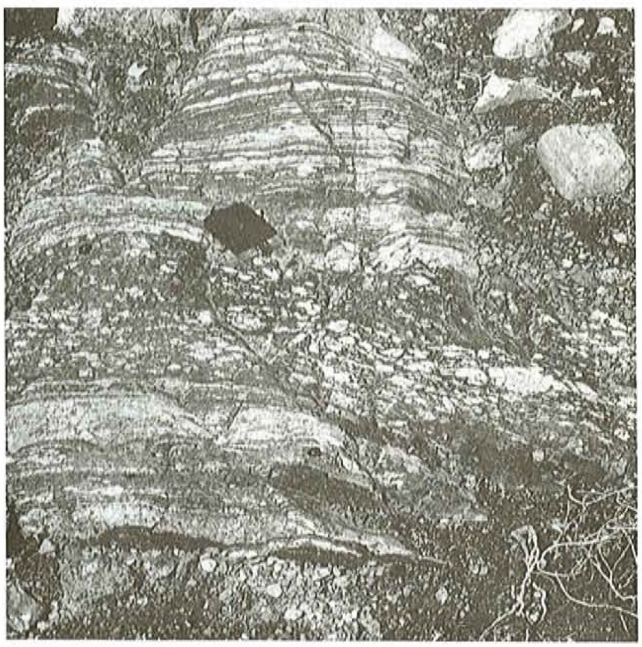

Plate 8. *Layered gabbro–leucogabbro (Unit 7) showing plagioclase aggregates, which are regarded as metamorphosed primary cumulus grains in varying states of strain. Clinometer is 10 cm long.*

coarse-grained, brown- and dark-grey-weathering, laminated and occurs in 4- to 100-cm-thick layers. Intercalated with the leucotroctolite are up to 20 percent, coarse-grained, dark-grey, weakly laminated, 4- to 30-cm-thick anorthosite layers. In the leucotroctolite, olivine is fine grained (in which case both olivine and plagioclase components define the lamination) or forms large intergranular plates enclosing

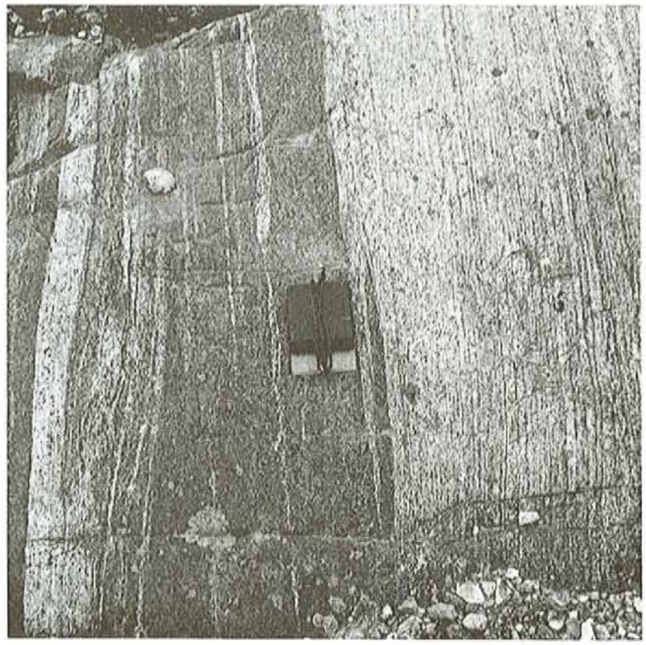

Plate 9. *Interlayered basic gneiss and granitoid gneiss (Unit 8). The basic rock is weakly leucosome layered; the granitoid gneiss is strongly differentiated. The contacts between the two are isoclinally infolded and a strong lineation is oriented subparallel to the outcrop surface. The clinometer is 10 cm long.*

laminated plagioclase. Plagioclase also forms scattered, coarse- to very coarse-grained megacrysts that are generally aligned subparallel to the lamination. Leucotroctolite layers commonly consist of brown-weathering, troctolite patches and elongate lenses in dark-grey anorthosite, or vice versa, which give a bulk leucotroctolite compositon. Locally, the Michikamau Intrusion contains thin rims of white, recrystallized feldspar at plagioclase grain boundaries and centimetre-scale, rectiplanar granite veins.

Unit 11: The Harp Lake Complex

The Harp Lake Complex (Emslie, 1980) consists of troctolite (subunit 11a) and anorthosite (subunit 11b). Layered, fine- to medium-grained, dark rusty-brown-weathering, dark-grey, commonly laminated troctolite, leucotroctolite and pyroxene troctolite form subunit 11a (Plate 10). Most rocks contain magnetite, locally exceeding 10 percent, and some leucotroctolite contains large (2 to 3 cm across), bronze, poikilitic plates of dark mica. The subunit is intruded by rare, centimetre-width biotite granite veins.

Subunit 11b consists of coarse-grained, dark-grey magnetite hypersthene anorthosite (colour index ranges between 5 and 10) at the few localities visited near the western margin of the complex. Hypersthene and magnetite are medium grained and intergranular to plagioclase. Plagioclase is coarse to very coarse grained, the latter commonly occurring as tabular megacrysts up to 8 cm long, which define a lamination. These megacrysts show as large, dark-grey

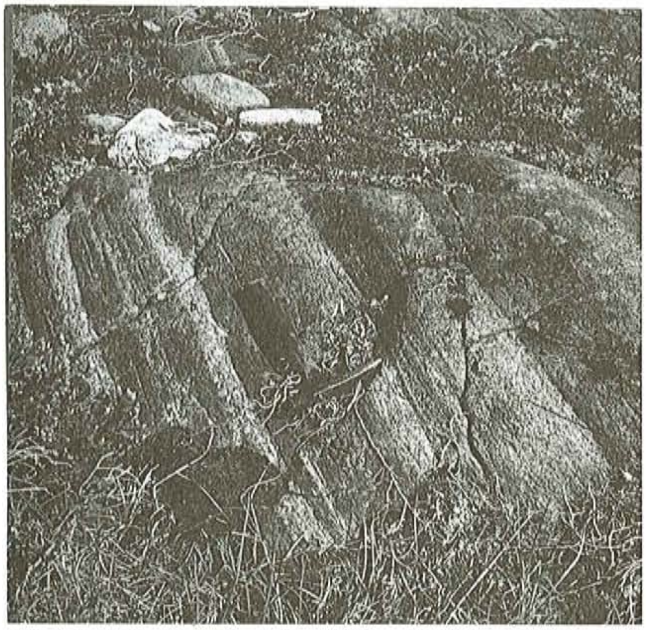

Plate 10. *Mineral-graded troctolite and leucotroctolite layers (subunit 11a); tops are to the right. The hammer is 34 cm long.*

relicts; the coarse-grained anorthosite groundmass consists of smaller, dark-grey relicts in an abundant network of white to light-grey plagioclase defining grain boundary recrystallization (Plate 11). Iridescent plagioclase is very rare in the outcrops visited. Locally, the anorthosite is layered and laminated; the layering is defined by the absence of larger

Plate 11. *Harp Lake Complex magnetite hypersthene anorthosite (subunit 11b) showing darker grey relict plagioclase defining the igneous lamination in a lighter grey recrystallized plagioclase matrix. The clinometer is 10 cm long.*

lenticular patches containing intergranular orthopyroxene. The patches have a colour index that ranges up to 30. Rarely, they include irregularly shaped patches of solid orthopyroxene up to 12 cm across.

Unit 12: K-feldspar-megacrystic Syenitic Rocks

Unit 12 occurs around the western margin of the Harp Lake Complex. In map area 13L/14, Unit 12 mostly consists of medium- to coarse-grained, dark- to rusty brown-, orange- or buff-weathering, greasy grey-green, K-feldspar-megacrystic syenite and quartz syenite (subunit 12b). Fine-grained, equigranular, yellow-brown-weathering felsic rocks and dark-brown-weathering pyroxene-bearing dioritic or metabasic rock form subunit 12a and subunit 12c consists of coarse-grained, pink, K-feldspar-porphyritic alkali-feldspar granite and syenogranite.

In the syenitic rocks, the main rock type is a coarse megacryst facies consisting of 40 to 75 percent of 2- to 3.5-cm (range, 1.0-4.5 cm), equant to stumpy (aspect ratios up to 2:1), euhedral to rounded cornered megacrysts that are densely packed or framework supported in a groundmass of quartz, ferromagnesian minerals, and Na-feldspar ± K-feldspar (Plate 12). Locally, thin Na-feldspar rims surround the megacrysts. Ferromagnesian species commonly are black, ± brown-weathering or green cores, or green, ± brownish cores, and include clinopyroxene (black or green), hornblende (black), minor biotite, and rare garnet and magnetite, and are very rarely concentrated in dark, non-magnetic schlieren. The colour index ranges from 5 to 15, quartz up to 15 percent (normally about 5 percent), and Na-feldspar up to 15 percent. Very rarely, variations in quartz content define 5- to 10-cm-scale layers and patches (e.g., 20 to 25 percent quartz in quartz syenite or 10 to 20 percent quartz in rock with about 5 percent quartz) that have diffuse, rapidly gradational margins (Plate 13). More commonly, variation occurs in the size of the megacrysts to form medium-sized (1-2.5 cm) and fine (0.5-1.5 cm) megacryst facies.

Subunit 12b contains a wide variety of inclusions, divided, for descriptive purposes, into two groups. The first group is the most common, and consists of felsic enclaves including possible cognate rocks, leucodioritic rocks, leucogabbronoritic and gabbronoritic metabasic rocks and lesser numbers of leucogabbroic, anorthositic and aplitic xenoliths. These enclaves are characterized by generally low colour indices. The possibly cognate inclusion types commonly contain randomly oriented and scattered, corroded, K-feldspar of 0.5 to 3 cm diameter, which are invariably smaller and less abundant than those in the surrounding syenitic rocks. Anorthosite xenoliths locally contain porphyroclastic plagioclase. Leucogabbro enclaves are homogeneous, streaky or layered.

The second group consists of gneissic enclaves. Mostly they are granitoid-layered metabasic or enderbitic rock. The leucosomes consist of pyroxene-bearing tonalite to granite and are commonly clinopyroxene porphyroblastic. Granitoid orthogneiss inclusions are very rare.

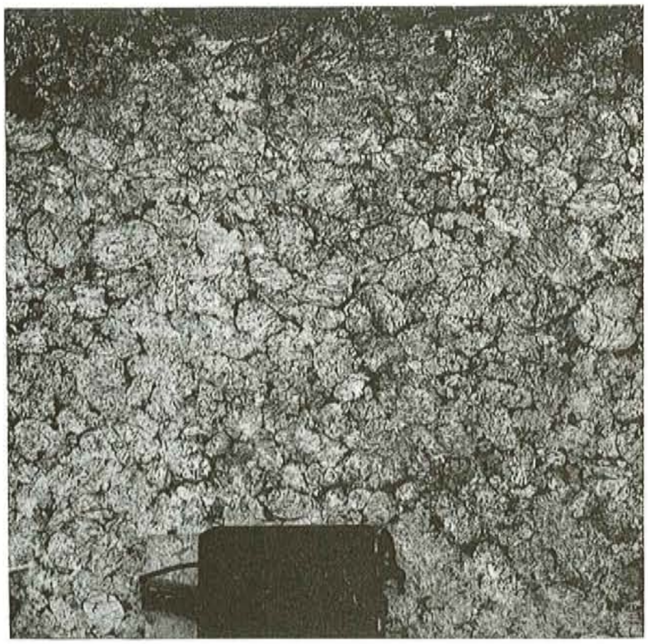

Plate 12. *Syenite (subunit 12b) exhibiting a packite of rounded cornered, euhedral to subhedral K-feldspar megacrysts in a clinopyroxene- and plagioclase-dominated groundmass. The clinometer is 10 cm long.*

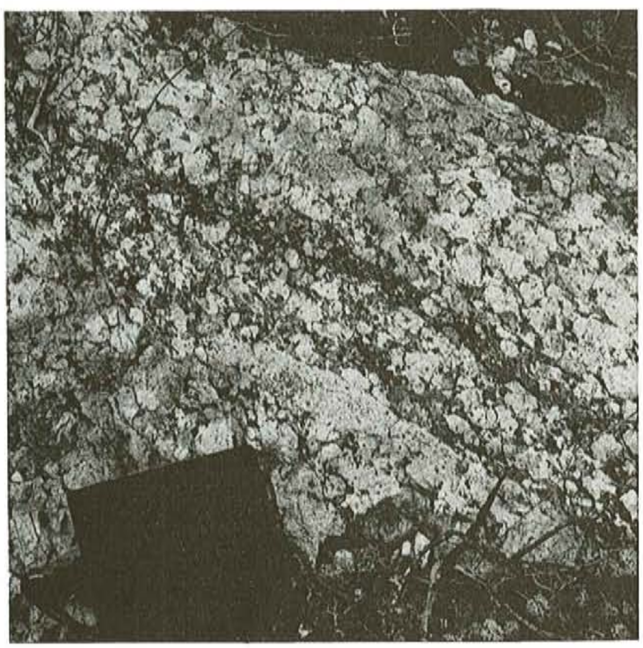

Plate 13. *Quartz content variations in syenitic rocks (subunit 12b). Quartz syenite (upper right) is separated from syenite (lower left) by a layer of alkali-feldspar granite and a lens of aplite. The granite layer is probably lenticular on a larger scale. The clinometer is 10 cm long.*

The enclaves are fine to, rarely, medium grained, medium to greasy dark-grey, grey, brown or buff-weathering, angular to rounded, mostly elongated and locally tabular, random or aligned, and 2 cm to >6.5 m in length. They contain polygonal to anhedral granoblastic textures. Overall, inclusions are sparse but scattered throughout the unit. Locally, however, enclaves are common and at one locality form a syenite-infiltrated packite (Plate 14). The packite consists of ovoid, homogeneous and gneissic, decimetre-scale enclaves of leucodiorite or metabasic rocks, commonly containing bleached reaction rims up to 1.5 cm wide, which are surrounded by medium megacryst facies syenite that commonly has a 1- to 2-mm-wide concentration of ferromagnesian minerals adjacent to the xenoliths. In places, enclaves are feldspar porphyritic or porphyroclastic, or ferromagnesian porphyroblastic. Where present, foliation in the enclaves is stronger than that in the host syenite. Commonly, both internal and external foliation and the xenolith elongation are all parallel. Most enclaves have an annealed texture and, locally, they include stromatic segregations.

Plate 14. *Packite of irregular lenticular xenoliths of leucodiorite or metabasic rocks infiltrated by K-feldspar-megacrystic syenite (subunit 12b). Both the xenoliths and the syenite are rimmed (see text). The clinometer is 10 cm long.*

Locally, the felsic rocks of subunit 12a contain scattered K-feldspar megacrysts and possibly are a source of the cognate-looking felsic inclusions in subunit 12b. Subunit 12c is K-feldspar-porphyritic to megacrystic (K-feldspar up to 3 cm in diameter). The K-feldspar is pink and blends into a groundmass of the same colour.

Unit 12 is undeformed to locally weakly, and rarely moderately, foliated. The foliation is defined by a quartz aggregate shape fabric, an anastomosing ferromagnesian aggregate fabric, K-feldspar lath orientations (these are oval in zones of moderate foliation), and xenolith alignment. In any one place, some of these features may still exhibit an isotropic distribution. Locally, a pervasive fracture cleavage is present.

Unit 13: The Seal Lake Group

The Seal Lake Group occurs in the southeast corner of NTS area 13L/11. It was not a focus of this study, but it has been mapped in areas to the east by Roscoe and Emslie (1973) and to the south by Nunn (1993). In areas that are adjacent to the study area, the Seal Lake Group consists of a red-bed sequence of conglomerate, arenite and minor shale interlayered with mafic fragmental tuffaceous rocks.

Mafic Dykes

Two occurrences of diabase were found in the study area but are not shown on the map. They are fine grained, dark-grey and undeformed. One is rectiplanar, 1.5 cm thick and subhorizontal. The other has one poorly exposed contact, is a minimum of 1 m thick, steeply oriented, contains xenoliths of gneiss and looks recrystallized on fresh surfaces: it has probably been metamorphosed in the aureole of the Michikamau Intrusion.

Structural, Metamorhpic and Chronological History

Orma Domain

Subunits 1a, 1b and 1c are associated and, in part, interlayered, indicating that they comprise a supracrustal succession. They may have been deformed prior to emplacement of the tonalite and granodiorite protoliths of Unit 2, in which they now occur as layers and lenses, but direct evidence of this was not observed.

Deformation of Units 1 and 2, including gneiss formation, foliation development and folding, occurred at upper amphibolite to granulite grade. During this orogeny granitoid sheets were intercalated with the rest of Unit 1. Following gneiss formation, by an unknown amount of time but possibly coeval with the main foliation development in Units 1 and 2, the gneisses were affected by a number of intrusive events. Subunit 3a pyroxene-bearing granitoid rocks were emplaced, migmatized and foliated under granulite-facies conditions and subunit 3b is a similar, but non-gneissic, rock. Unit 4 has characteristics that suggest it is derived from Unit 2, perhaps by anatexis. Unit 4 and most of Unit 5 exhibit a transition from granulite to upper amphibolite facies (pyroxene + hornblende and a locally greasy cast) whereas Unit 6 and parts of Unit 5 were foliated in the amphibolite facies.

Structural trends in the Orma Domain (Units 1 to 7) are steep and describe an arc subparallel to the margin of the Michikamau Intrusion (fortuitous). The foliation surfaces contain variably pitching lineations.

Mistinibi–Raude Domain

Unit 8 consists of metabasic rocks that were intruded by granitoid sheets either before or during granulite-facies metamorphism. This metamorphism, together with amphibolite-facies retrogression, was synchronous with intense deformation, which produced a very strong, penetrative, west-northwest-trending, subvertical foliation containing a strong horizontal lineation.

Orma Domain–Mistinibi–Raude Domain Boundary

The boundary between the Orma Domain and the Mistinibi–Raude Domain parallels the structure in Unit 8 and is marked on its southern side by a discontinuous outcropping of Unit 7 leucogabbroic rocks. Unit 7 may be tectonically repeated and the boundary may be imbricated.

Unit 9 geographically spans the boundary between the two domains although intrusive relationships were seen on only the southern side of the boundary where dykes of granite crosscut country rock that, locally, is intensely sheared, porphyroclastic and contains a subvertical lineation. In places, the granite dykes are buckled ($\pm$ a steep, axial-planar fracture cleavage that parallels the porphyroclastic foliation in the host rocks) and along its southern margin the granite body itself may also be mylonitic. The Mistinibi–Raude Domain may have been juxtaposed against the Orma Domain along a structure relating to this set of shear zones, rather than to the deformation that resulted in the horizontal lineation in Unit 8, and Unit 9 may be related, causally and in approximate timing (as well as spatially), to the juxtaposition.

Ubiquitous Presence of Garnet

Garnet is present in varying amounts in almost all units or subunits over much of the map area, and is generally related to syntectonic or posttectonic amphibolite-facies, commonly retrogresssive, metamorphism. The garnet probably, however, represents several episodes of growth.

Middle Proterozoic and Later Events

Units 10, 11 and 12 are Elsonian intrusions. The Elsonian is a reportedly anorogenic magmatic event occurring about 1450 $\pm$ 50 Ma ago. Subunit 12a relationships and felsic rock compositions are uncertain (except that it is intruded by subunit 12b); it may be early, fine-grained parts of the syenite suite, be related to fine-grained marginal phases of the Harp Lake Complex, or be older country rock. Foliations in these units are either primary or are thought to relate to immediately post-consolidation tectonic adjustments (approximately synplutonic), rather than to any subsequent orogenic event; they developed in the same facies as adjacent areas of igneous crystallization. The fracture cleavage locally present in Unit 12 may be lineament-related and younger altogether.

Diabase dykes are of unknown, but posttectonic timing. The Seal Lake Group (Unit 13) is a fluviatile, continental cover sequence unconformably overlying Unit 11 east of the map area (Emslie, 1980); it was not visited.

Surficial deposits, mostly till, blanket most of the lower lying areas and occur as a discontinuous veneer over higher ground.

REGIONAL AND TECTONIC RELATIONSHIPS

Units 1 and 2 comprise a north and northwestward extension of the Orma Domain (Figure 6; Wardle *et al.*, 1990a; Nunn, 1993). Unit 8 and the unexposed area to its north comprise the southern subdomain of the Mistinibi–Raude Domain (Figure 6; Figure 3 of Van der Leeden *et al.*, 1990). The rocks and the age of the main thermotectonic event in the Orma Domain are probably Late Archean based on U–Pb geochronological data (Nunn *et al.*, 1990). Units 3, 4 and 5 form an arcuate plutonic welt that also represents a metamorphic culmination. Unit 4 correlates descriptively with the easternmost part of Unit 3 of James and Mahoney (*this volume*). Emplacement and deformation of Units 3 through 5 may have occurred during the same orogeny as that in Units 1 and 2 or at a later date, and deformation in the Mistinibi–Raude Domain may also relate to either possibility: all are granulite- to upper amphibolite-facies events that were followed, locally, by amphibolite-facies retrogression. However, the deformation in the Mistinibi–Raude Domain is thought to be a separate event, at least spatially, and the boundary between the two domains, marked by the lenses of leucogabbro (Unit 7), is regarded as a significant structure that separates two crustal blocks (northeast and southwest). Unit 7 has many characteristics of a Fiskenaesset-type layered anorthositic complex: it may relate to underplating during extension or rifting of Archean crust. Unit 9 could be a stitching pluton relating to juxtaposition of the two crustal blocks, or be younger.

Bimodal (anorthositic and granitoid) magmatism of Elsonian age (Units 10-12) is a regional characteristic of central Labrador north of the Grenville Front. The unconformable relationship of the Seal Lake Group (Unit 13), and probably equivalent rocks, is of regional extent and has been preserved in all directions (except northwestward) from the map area. The Seal Lake Group was probably deposited across most of the map area in the Middle Proterozoic and has since been eroded away. Preservation of the Seal Lake Group in the southeast of the map area is partly due to protection in post-Grenvillian half graben (Nunn, 1993).

ECONOMIC GEOLOGY

There is little evidence of economic mineralization in the study area, although there is potential for Unit 7 to contain PGE or Fiskenaesset-type Cr deposits, and for marginal phases of the Michikamau Intrusion and the Harp Lake Complex to contain pyrrhotite–chalcopyrite (Ni-Co potential) or PGE mineralization. The pyrrhotite–chalcopyrite association is known from the margin of the Michikamau Intrusion south of the present study area (Nunn, 1993; Kennecott Inc., unpublished data). Rare gossanous layers occur in the granitoid rocks of Unit 8.

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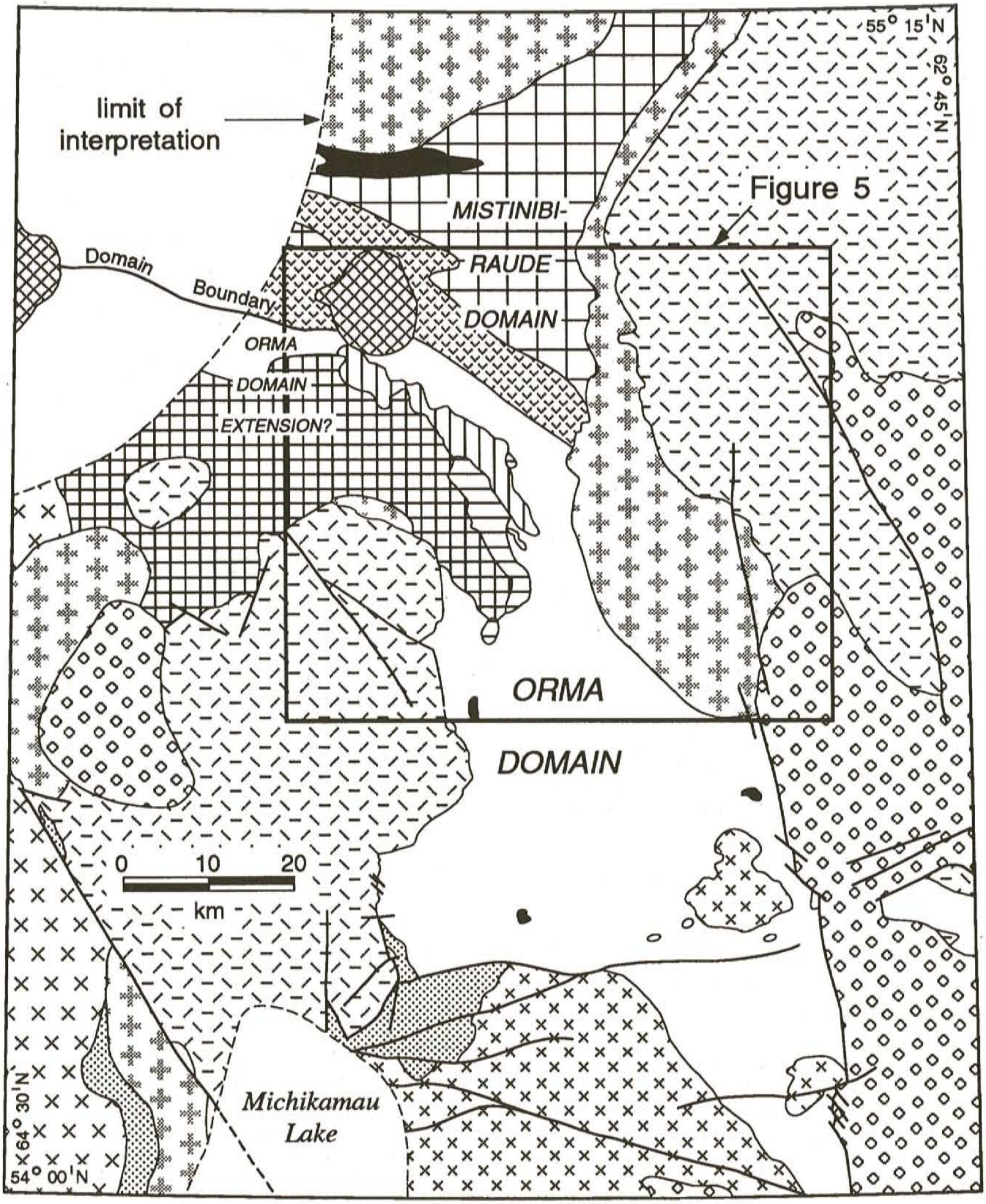

Figure 6. *Tentative regional correlations with rocks of the Kanairiktok River headwaters; based on the author's interpretation of work by Emslie (1970, 1980), Roscoe and Emslie (1973), Taner (1987), Wilson* et al. *(1990), Wilson and Bélanger (1990), Nunn (1993), Wardle (1993), James and Mahoney* (this volume) *and aeromagnetic data.*

LEGEND (for Figure 6)

MIDDLE PROTEROZOIC

Seal Lake Group (Unit 13) and equivalent rocks: continental red beds and mafic rocks

Granitoid plutonic rocks (e.g., Unit 12)

Basic plutonic rocks (Units 10 and 11)

MIDDLE PROTEROZOIC OR OLDER

Porphyritic granite (Unit 9)

EARLY PROTEROZOIC

Post-Hudsonian granitoid batholith and cover rocks (Labrador Orogen)

Pre-Hudsonian granitoid plutonic rocks

Petscapiskau Group: volcanosedimentary sequence

EARLY PROTEROZOIC AND/OR ARCHEAN

Mistinibi-Raude Domain

Metagabbro

Intercalated granitoid and metabasic rocks (Unit 8)

Migmatitic granitoid and sedimentary gneiss, and dioritic rocks

Possible Orma Domain extension

Metagabbro and granite (Unit 6)

Megacrystic granite (Unit 5)

Monzogranite and orthogneiss (Unit 4)

Orthopyroxene-bearing plutonic rocks (Unit 3)

ARCHEAN

Orma Domain

Paragneiss (Unit 1), orthogneiss (Unit 2) and leucogabbro (Unit 7)

Faults (many not shown)

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