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GEOLOGY OF THE LAC LA POTHERIE AREA

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GEOLOGY OF THE LAC LA POTHERIE AREA (34I)

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Jean David
Kamal N.M. Sharma
Denis-Jacques Dion

Accompanies map SI-34I-C2G-01C

Scenery near Lac La Potherie.

Québec

2002

Geology of the Lac La Potherie area (NTS 34I)

Alain Leclair
Martin Parent
Jean David
Kamal N.M. Sharma
Denis-Jacques Dion

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(Accompanies map SI-31I-C2G-01C)

Abstract

The Lac La Potherie area (NTS 34I) is located in the centre of the Ungava Peninsula, north of the Rivière aux Feuilles, about 270 km west of Kuujjuaq. The geological survey at a scale of 1:250,000 carried out in this area during the summer of 1999 is part of the Far North Project, whose objectives are to determine the nature, origin, tectonic evolution and mineral potential of the northeastern Superior Province.

Archean rocks in the Lac La Potherie area mainly consist of various plutonic rocks, igneous charnockites and a few remnants of supracrustal rocks. These rocks were subdivided into several lithodemic units in order to establish regional stratigraphic correlations. Supracrustal rocks are essentially concentrated in two lithodemic units: the Vizien Complex and the Faribault-Thury Complex. The Vizien Complex (10 km x 40 km) is subdivided into four informal units: mafic volcanic rocks, felsic and intermediate volcanic rocks, ultramafic rocks and sedimentary rocks, all metamorphosed to the middle amphibolite facies. The Faribault-Thury Complex consists of narrow (<1 km) remnants of volcano-sedimentary rocks disturbed by granodioritic intrusions. These rocks are cut and partially assimilated by charnockitic and granitic intrusions. The metamorphic grade in the complex varies from the upper amphibolite facies to the granulite facies. Elsewhere, the plutonic rocks are subdivided into ten lithodemic units defined on the basis of lithological, geochronological, geophysical and geochemical criteria. Heterogeneous tonalites are assigned to the Suluppaugalik Suite (ca. 2805 Ma), whereas the Rochefort Suite (ca. 2780 Ma) is characterized by homogeneous tonalites. Small bodies (<50 km^2) of gabbro-gabbronorite and diorite-quartz diorite, commonly associated with positive aeromagnetic anomalies, are grouped in the Bacqueville Suite. Granodiorite intrusions, occurring as sheets oriented NW-SE, are assigned to the Rivière-aux-Feuilles Suite (2722 Ma). Granites are assigned to four different lithodemic units: the La Chevrotière Suite (2732 Ma), the La Potherie Batholith (2723 Ma), the Dufreboy Suite and the Morrice Suite (ca. 2700 Ma). The MacMahon Suite (ca. 2700 Ma) is composed of late enderbite and opdalite intrusions. The Minto Suite (ca. 2680 Ma) consists of orthopyroxene diatexites and charnockitic-type rocks.

Rocks in the Lac La Potherie area reflect a complex structural setting, involving a combination of five phases of ductile deformation and folding (D_1-D_5) and one phase of brittle deformation (D_6). The principal foliation (D_2) was affected by tight to isoclinal folds (D_3) and shear zones (D_4). The outcrop pattern was then slightly modified by open folds (D_5) which are only observed locally, and by late brittle faults (D_6). The structural evolution is marked by a high grade regional metamorphism, and a series of pre- to post-tectonic intrusive events that mask contact zones between certain geological assemblages. In the centre of the area, mineral assemblages indicate metamorphic conditions at the lower to middle amphibolite facies, corresponding to weak magnetic signatures. On either side, intense magnetic signatures and granulite-facies conditions are generally associated with charnockitic rocks.

The NE part offers a promising potential for Cu-Au±Ag deposits based on the discovery of a showing and four anomalous zones. Pyrite-pyrrhotite-chalcopyrite mineralization was observed in three different geological settings: 1) silicate-facies iron formations inserted in volcano-sedimentary sequences, 2) gabbro intrusions, and 3) volcanogenic siliceous horizons in a fault zone. The mineralized zone associated with an iron formation that hosts the Bonenfant showing extends for seven kilometres along strike.

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CONTENTS

(continues on the following page)

(Table of Contents continued...)

INTRODUCTION

The northeastern part of the Superior Province undoubtedly represents the largest expanse of Archean rocks in the Canadian Shield where the geology and mineral potential remain poorly known and under-explored. These rocks occupy a vast surface of about 320,000 km^2 north of the 55th parallel, i.e. nearly 1/5 of the total surface area of Québec. Before the 1990s, geological information on this territory was essentially restricted to reconnaissance work dating back to the 1950s and 1960s (Eade, 1966; Stevenson, 1968). In the early 1990s, mapping surveys increased the level of geological data in certain areas (Percival and Card, 1994; Percival *et al.*, 1995a, 1996a, 1997a; Lamothe, 1997). Since 1998, the Archean rocks of the northeastern Superior Province have been the focus of an important project involving systematic mapping in Québec's Far North region undertaken by Géologie Québec (Leclair *et al.*, 1998a). The objectives of this project are to build a geological framework at a scale of 1:250,000 and to uncover geological settings favourable to the discovery of new mineral deposits. Collected geological data will allow to determine the nature, origin and geological evolution of the northeastern Superior Province. During the first two years of the Far North Project, seven new geological surveys, covering twelve NTS sheets at a scale of 1:250,000 were completed in the eastern half of the targeted region (Figure 1). These surveys have led to the discovery of about twenty new well-preserved volcano-sedimentary belts (Leclair *et al.*, 2000) and have made it possible to outline the most interesting sectors in the search for specific potentially ore-bearing environments (Labbé *et al.*, 1998, 1999; Moorhead *et al.*, 2000).

One of the geological surveys carried out under the Far North Project was in the Lac Nedlouc area south of the Rivière aux Feuilles (Figure 1). This work helped establish a stratigraphic reference scheme for supracrustal rocks and intrusive rocks (Parent *et al.*, 2000). It also led to the discovery of several mineral occurrences with precious metal (Au, Ag) and base metal (Cu, Ni, Zn, Co) mineralization (Labbé *et al.*, 1998; Parent *et al.*, 2000). During the 1999 summer season, the geological surveys at a scale of 1:250,000 were completed in the Lac La Potherie and Lac Dufreboy areas (Figure 1), located north of the Lac Nedlouc area. This report contains the results and interpretations derived from work carried out in the Lac La Potherie area. It incorporates mapping carried out by Percival and Card (1991, 1994) in the Rivière aux Feuilles area, which covers the southeastern part of the Lac La Potherie area. Results of complementary work in the adjacent Lac Dufreboy area will be presented separately in another report (in preparation).

The results of a lake sediment geochemical survey (MRN, 1998) revealed several anomalies sufficiently interesting to be considered as exploration targets. Moreover, geological surveys carried out in the Far North since 1990 have revealed the presence of certain geological settings hosting metalliferous showings, several of which are now being explored by mining companies. Submitted assessment work reports mention a promising mineral potential, namely for gold, base metals and uranium in relation to several locations in the Far North (Cattalani and Heidema, 1993; Chapdelaine, 1995, 1996; Francoeur, 1996; Quirion, 1999). In the Lac La Potherie area, the company Noranda inc. acquired an exploration permit on the basis of a lake sediment geochemical anomaly.

Location, Access and Topography

The Lac La Potherie area is located in Nunavik, in Québec's Far North region, in the centre of the Ungava Peninsula (Figure 2). It covers a surface area of about 13,000 km^2 in the sector of the Rivière aux Feuilles, between latitudes 58°00' and 59°00' and longitudes 72°00' and 74°00' (NTS sheet 34I). The centre of the area is located about 270 km west of Kuujjuaq and about 175 km west of Tasiujaq. Several important water bodies allow floatplane access to different parts of the area. Lakes are usually free of ice to allow water landings by mid-June. A landing strip at the eastern end of Lac Payne (Figure 2), suitable for short airlift aircraft (Twin Otter type), also provides access to the area from the north.

The tree line runs across the Lac La Potherie area, which straddles the boundary between the arctic tundra and the forested tundra. Forests composed of fairly scattered black spruce and tamarack are restricted to valley bottoms near the Rivière aux Feuilles. The area is characterized by vast expanses with undulating topography and by an important overburden cover of glacial deposits, marked by numerous *felsenmeers* extending for several tens of square kilometres. Topographic relief is generally very low, except in the southeast part where the Rivière aux Feuilles has carved a deep valley about 220 m deep. The altitude varies between 160 and 320 m above sea level, and reaches 100 m at the bottom of the river valley. Outcrops are generally numerous, large and lichen-covered. They are scattered within vast glacial plains and are less abundant in the northwest third of the area, where topographic variations are minimal.

Methodology

Geological mapping at a scale of 1:250,000 in the Lac La Potherie area was performed in a systematic manner in order to obtain a thorough inventory. Field work, which took place over a period of 10½ weeks, was carried out by six geologists. Mapping crews, each composed of a geologist and an assistant, were mobilized in the field by a Long Ranger 206-L helicopter from the base camp located north of Lac La Chevrotière in the northwesternmost part of the area. Traverses, averaging about a dozen per 1:50,000 scale NTS sheet, varied between 8 to 15 km long and were spaced every 4 to 10 km according to the geological complexity and density of outcrops. The spacing was reduced in areas deemed to be more important, and certain mineralized zones were followed over several kilometres. Isolated spot checks of nearly 180 sites by helicopter helped complete the mapping coverage. A systematic sampling of rock units and mineralized zones was used for geochemical analyses, magnetic susceptibility measurements and thin sections. Seven samples were collected for geochronological analysis. The geological map of the Lac La Potherie area as well as data collected in the field and analytical results are available in the digital database known as SIGÉOM (Québec's geomining information system).

Previous Work

Until the early 1990s, the only geoscience information available on the northeastern Superior Province was derived from 1:1,000,000 scale reconnaissance geological surveys (Eade, 1966; Stevenson, 1968) and regional aeromagnetic

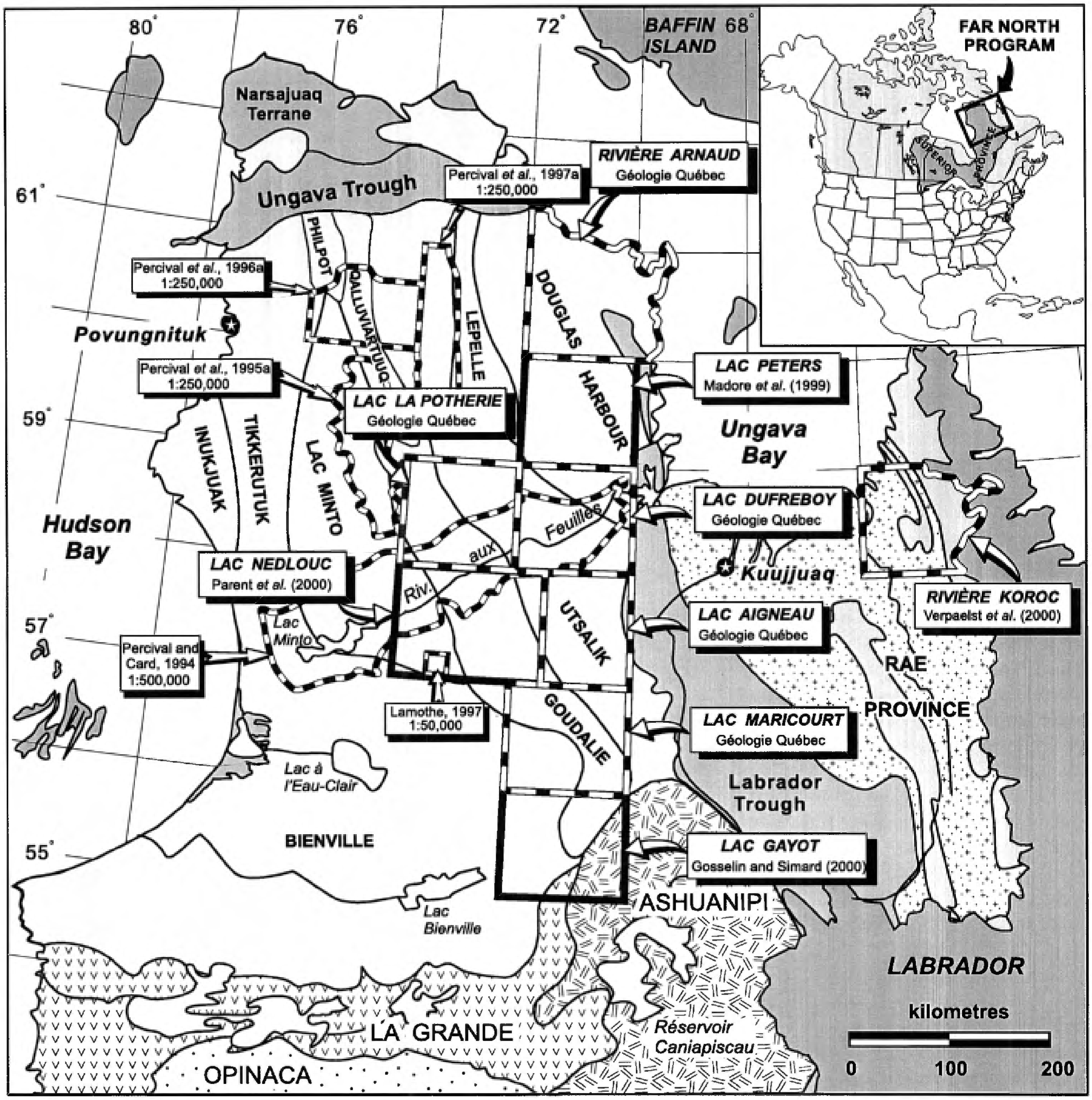

FIGURE 1 - Lithotectonic subdivision of the northeast Superior Province (modified after Percival et al., 1997b), and location of recent geological mapping projects in the Far North.

and gravity surveys. During the 1990s, the Geological Survey of Canada conducted a geological survey at a scale of 1:500,000 in the Rivière aux Feuilles area (Percival and Card, 1994) and three surveys at 1:250,000 in three areas further north (Percival *et al.*, 1995a, 1996a, 1997a) (Figure 1). A map at 1:50,000 scale was also produced for the Vizien greenstone belt (Percival and Card, 1991), located in the central sector of the Rivière aux Feuilles area. The Ministère des Ressources naturelles du Québec then mapped, at 1:50,000 scale, the Lac Dupire area (Lamothe, 1997). Under the Far North Project, Géologie Québec mapped at a scale of 1:250,000, in the summer of 1998, the Lac Peters (Madore *et al.*, 1999), Lac Nedlouc (Parent *et al.*, 2000) and Lac Gayot (Gosselin and Simard, 2000) areas (Figure 1). During the summer of 1999, the Far North team completed four new geological surveys including one in the Lac La Potherie area. The geological map of this region incorporates the 1:50,000 map of the Vizien area published by Percival and Card (1991), and overlaps part of the 1:500,000 scale map of Percival and Card (1994) covering the region along the Rivière aux Feuilles (Figure 1). The rest of the Lac La Potherie area was covered by the reconnaissance survey at 1:1,000,000 by Stevenson (1968). This heliborne survey, carried out in the early 1960s, was based solely on isolated observation sites spaced every 10 km or so.

Acknowledgements

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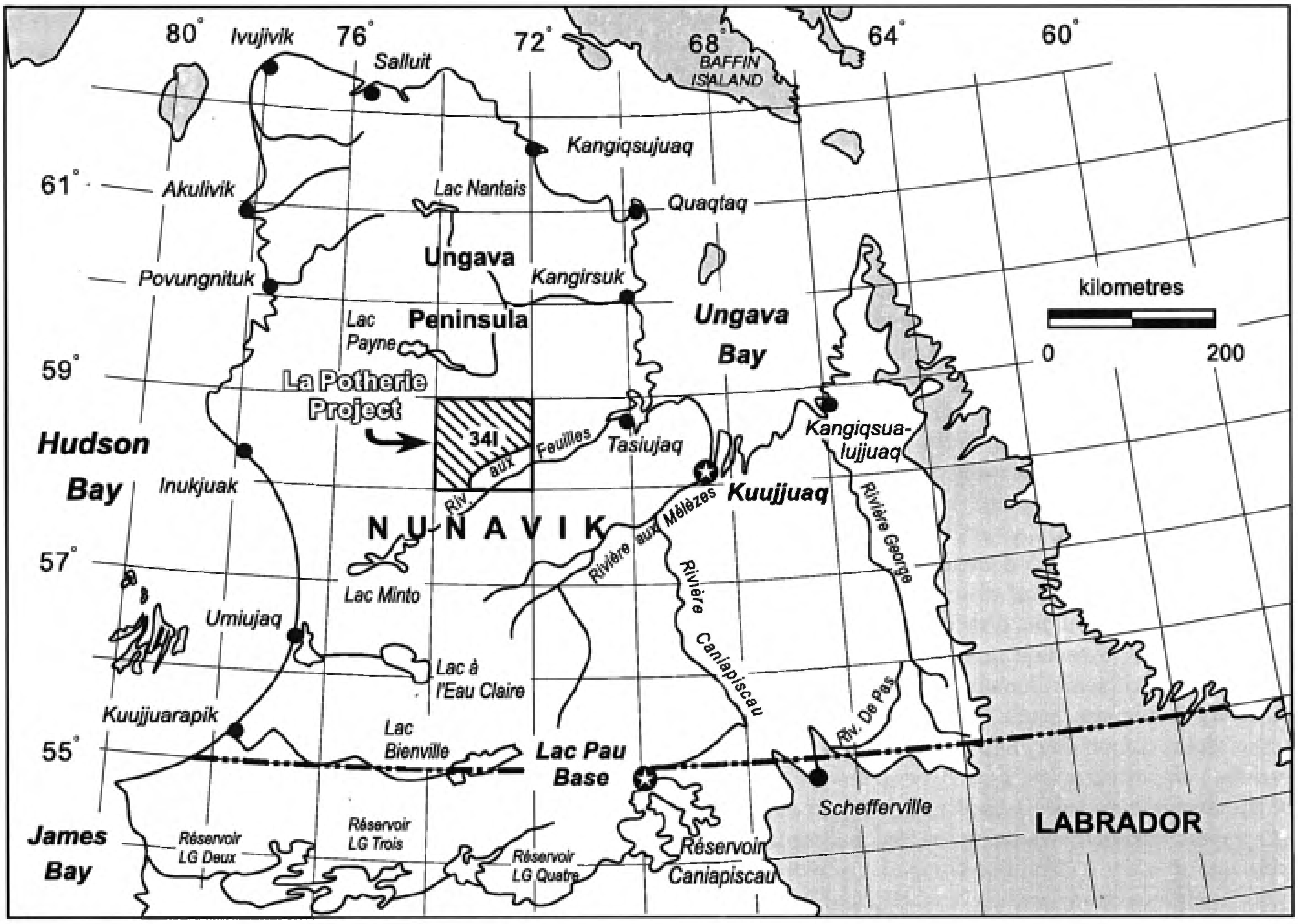

FIGURE 2 - Location of the Lac La Potherie area.

Serge Blouin and Claude Perron. Aviation companies Johnny May's Air Charter Ltd. and Air Inuit Ltd. assured transportation of personnel and supplies. The Service des applications géospatiales produced regional spatiomaps from Landsat images to assist our field work.

REGIONAL GEOLOGY

The northeastern part of the Superior Province occupies over 320,000 km^2 of the Canadian Shield in northernmost Québec. It essentially consists of plutonic Archean rocks which host numerous sequences of fairly well preserved supracrustal rocks. The regional structural trend of major geological assemblages, oriented NNW-SSE, is reflected by high relief aeromagnetic anomalies. The northeastern Superior Province is bounded to the east by Paleoproterozoic rocks of the New Québec Orogen, and to the north and west by rocks equivalent to the Trans-Hudson Orogen. To the south lie volcano-plutonic rocks of the La Grande Subprovince and granulitic rocks of the Ashuanipi Subprovince.

A subdivision of the northeastern Superior Province into different lithotectonic domains was proposed by Percival *et al.* (1992, 1997b). About ten domains, including the "Bienville Domain" (Card and Poulsen, 1998), were identified based on lithological, structural and aeromagnetic criteria (Figure 1). Work by Percival *et al.* (1990, 1991) along the Rivière aux Feuilles led to a preliminary subdivision by which the boundaries of the "Tikkerutuk, Lac Minto, Goudalie and Utsalik domains" were proposed. Studies further north (Percival *et al.*, 1995b, 1996b, 1997b) resulted in the addition of the "Inukjuak, Philpot, Qalluviartuuq, Lepelle and Douglas Harbour domains". Domain boundaries were extrapolated over the entire territory based solely on the extension of their different magnetic signatures. Domains may extend over several hundred kilometres along a dominant northwest direction (Figure 1). However, recent work by the MRN has revealed many problems concerning the boundaries and relationships between certain domains (Madore *et al.*, 1999; Gosselin and Simard, 2000; Parent *et al.*, 2000). Although each domain is characterized by type lithologies, the absence of observable structural boundaries between them and the distribution of certain intrusive suites common to several domains make the nature and contact zones of some domains obscure and arbitrary. In most cases, domains contain several complex geological assemblages comprising plutonic and supracrustal rocks of various compositions and ages. Consequently, the notion of lithotectonic domain is used in this report solely as a geographic reference relative to the regional aeromagnetic map, and in order to facilitate comparisons with previous work. A regional study leading to a better understanding of the principal stratigraphic and structural elements is currently underway in order to build a stratigraphic subdivision of the northeastern Superior and to place constraints on its geotectonic evolution.

Field work carried out over the last two years in the Far North has made it possible to identify several regional stratigraphic units and establish the nature and relationships of certain geological assemblages along a N-S axis extending over about 700 km in the eastern part of the territory (Figure 1). These geological assemblages are comparable, in terms of diversity and scale, to those of subprovinces in the southern Superior (Card and Poulsen, 1998). In general, granitic and charnockitic plutonic complexes are associated with vast (40 to 100 km wide) positive aeromagnetic anomalies, whereas supracrustal rock belts, volcanic and sedimentary in origin, are confined to narrow magnetic depressions (10 to 20 km wide), commonly located within suites of tonalitic and granitic rocks. Plutonic rocks essentially consist of tonalite, granodiorite, diatexite and granite, with enclaves and intrusions of diorite, gabbro and pyroxenite-peridotite. These rocks are massive, foliated or gneissic and include hornblende-biotite granitoids and pyroxene granitoids. The configuration of aeromagnetic anomalies is attributed to the distribution of granitic and charnockitic bodies, which were probably emplaced along contemporaneous or pre-existing structures. Volcano-sedimentary belts contain mixed sequences of basalt, greywacke, iron formation, tuff, and minor amounts of rhyolite, sandstone, conglomerate and ultramafic rocks, with rare calc-silicate horizons. The metamorphic grade of supracrustal sequences varies from the upper greenschist facies to the granulite facies. Geological surveys carried out to date have led to the discovery of about thirty volcano-sedimentary belts distributed throughout the mapped territory. These belts extend over a distance of at least 10 km. They are oriented NNW, i.e. parallel to the regional structural trend, and some of them were dismembered by intense deformation zones. Thematic studies on the age, composition and origin of plutonic and supracrustal rocks were undertaken in order to establish the relationship between the different types of plutonic rocks and between the volcano-sedimentary belts. The current model favours an amalgamation of geological assemblages composed of tonalitic and volcano-sedimentary rocks, invaded by voluminous granitoid intrusions of various origins and ages, which have largely obliterated or masked contact zones.

Within a preliminary geological and chronological framework, supracrustal sequences and plutonic suites inventoried to date reflect a complex history of sedimentation, volcanism, plutonism and tectonism within a time frame bracketed between 2.87 Ga and 2.63 Ga. The oldest recognized geological elements consist of remnants of a Mesoarchean protocraton most likely representing an early tonalitic basement with ages on the order of 3.1-2.9 Ga. These early terrains are difficult to identify, and the most common evidence indicating their presence consists of inherited zircons. They appear to have been largely recycled and obliterated by Neoarchean tectono-magmatic processes. Ages obtained in volcanic sequences or tonalitic suites seem to correspond to three major magmatic episodes at ca. 2.86 Ga, ca. 2.78 Ga and ca. 2.72 Ga. The formation of migmatites-diatexites and the emplacement of granitic and charnockitic plutonic suites, which took place between ca. 2.75 Ga and 2.68 Ga, correspond to an important recycling of older lithologies and a regional metamorphic episode at the amphibolite and granulite facies. Younger ages varying between 2.68 Ga and 2.63 Ga indicate an isotopic re-equilibrium, a magmatic disturbance and prolonged metamorphism accompanying an episode of uplift and possibly a widespread hydrothermal activity.

STRATIGRAPHY

According to the lithotectonic subdivision proposed by Percival *et al.* (1992), the Lac La Potherie area is composed of three major lithotectonic domains ("Lac Minto", "Goudalie" and "Utsalik"). These domains cover nearly half of the northeastern Superior Province. However, this subdivision, which is based on extrapolations at a regional scale, does not allow us to establish appropriate correlations between the geological assemblages belonging to the various domains. Furthermore, a stratigraphy based on the notion of lithotectonic domain poses important constraints on attempts to establish a coherent regional stratigraphic framework. Consequently, a lithodemic subdivision based on geological field data is proposed for all the lithological units of the Lac La Potherie area, in order to establish a stratigraphy for supracrustal rocks and intrusive rocks. The lithodemic legend is fundamentally based on the lithological characteristics of each unit, on cross-cutting relationships observed in the field and on radiometric ages. This approach makes it possible to define the geological framework of the area, in addition to forming a reference scheme needed to eventually establish regional stratigraphic correlations. The nomenclature used to describe the different lithologies is based in part on the notions proposed in the North American Stratigraphic Code (MRN, 1986) which may be applied with more or less success to metamorphic rocks. In order to facilitate the description of metavolcanic, metasedimentary and metaplutonic rock units, the prefix "meta" is omitted, considering the fact that all these rocks have undergone amphibolite or granulite facies metamorphism. The Lac La Potherie area comprises two lithological units and twelve lithodemic units, all Archean in age (Figure 3), and three Proterozoic diabase dyke swarms.

Paragneiss *(M4)*

A tectonostratigraphic paragneiss unit, encompassing all the sedimentary rocks of the "Lac Minto Domain", was established by Parent *et al.* (2000). Since this report does not take into account lithotectonic domains, the paragneisses are described as a lithological unit. This unit is used to represent paragneisses of the Lac La Potherie area, with the exception of those included in the Vizien and Faribault-Thury complexes. Within the map area, paragneisses occur as more or less discontinuous km-scale remnants, as well as enclaves between 10 cm to 10 m in size, within diatexites of the Lac Minto Suite (*Amin*). The remnants may be up to 12 km long and over about 2 km wide. Paragneisses in unit *M4*, as opposed to those in the Vizien and Faribault-Thury complexes, were not observed in association with mafic rocks or iron formations which could be linked to volcanic sequences. They are commonly migmatized, and may contain up to about 50% granitic to granodioritic mobilizate. A well-developed gneissosity is observed in these rocks. It is represented by a migmatitic banding and a tectonic banding which define the regional foliation. Paragneisses are characterized by mineral assemblages mainly composed of plagioclase, quartz, biotite and garnet, with local orthopyroxene, cordierite, sillimanite, potassic feldspar and spinel. The rock is fine to medium-grained, and weathered surfaces are grey brown to rusty brown. The paragneisses are actually metatexites which are locally transformed into diatexite where the degree of partial melting increases (> 50% mobilizate).

Amphibolite *(M16)*

A lithological unit (*M16*) is ued to represent undifferentiated amphibolites of uncertain origin in the Lac La Potherie area. These amphibolites contrast with supracrustal rocks of the Vizien Complex given the absence of felsic volcanic rocks, paragneisses and iron formations. In fact, no evidence allowing us to establish a link with a volcanic origin was observed. These amphibolites form several remnants less than two kilometres wide that extend over distances of less than ten kilometres in length. They also occur as 10-cm to 10-m enclaves within tonalites of the Rochefort Suite. The rock is composed of hornblende and plagioclase and displays a well-developed foliation. It is dark green to blackish and is fine to medium-grained.

Vizien Complex *(Aviz)*

A band of volcano-sedimentary rocks surrounded by tonalitic and granitic rocks occurs near the southern margin of the map area. It was named the Vizien greenstone belt by Percival and Card (1992), after the Rivière Vizien. This band, which is 40 km long and thins out towards the northwest from a maximum thickness of 10 km, represents the largest expanse of supracrustal rocks preserved in the Lac La Potherie area. It is composed of a wide variety of volcanic and plutonic rocks that vary from ultramafic to felsic in composition, as well as several units of sedimentary rocks. These rocks are located in the heart of a vast negative aeromagnetic anomaly (Figure 4) and stand out relative to surrounding granitoids due to a weak and narrow crest on the vertical magnetic gradient. Despite the regional

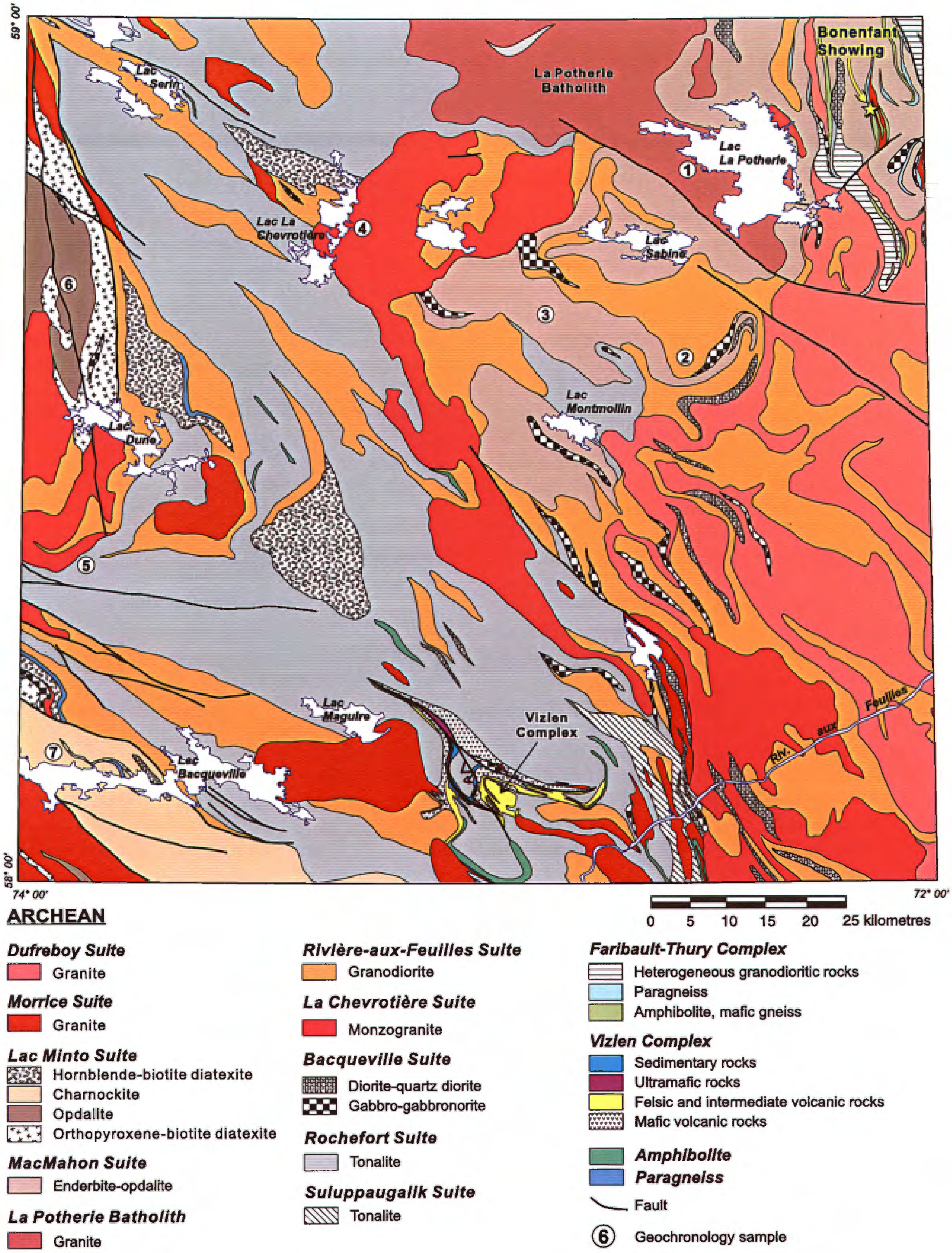

FIGURE 3 - Simplified geological map of the Lac La Potherie area (NTS 34I).

metamorphic grade at the amphibolite facies, exceptionally well preserved primary textures are observed in most rock types in several locations.

Since it was discovered by Percival *et al.* (1991), during reconnaissance work along the Rivière aux Feuilles, the Vizien belt was mapped at a scale of 1:50,000 (Percival and Card, 1991), and was the focus of many thematic studies by the Geological Survey of Canada (Percival and Card, 1992; Percival *et al.*, 1993; Skulski *et al.*, 1994; Lin *et al.*, 1995, 1996; Skulski and Percival, 1996). The latter demonstrated that this belt consists of various lithostratigraphic assemblages separated by faults. These assemblages correspond to distinct tectonic environments that were interpreted based on geochemical, isotopic and geochronological data (Skulski and Percival, 1996). The various tectonic assemblages were juxtaposed through a complex structural evolution involving five phases of ductile deformation as well as brittle faults (Lin *et al.*, 1996). The reader is referred to the publications cited above for more information concerning proposed tectonic evolution models for the Vizien belt. Accordingly, our work during the summer of 1999 on these rocks was restricted to a few isolated field checks. The description of the different units is based on the results of previous work carried out by Percival and Card (1991, 1992). In order to maintain a coherent nomenclature for all volcano-sedimentary belts, the term Vizien Complex is proposed to refer to an association of volcanic, sedimentary and plutonic rocks found in this area. In order to reproduce the dominant lithologies on our map at a scale of 1:250,000, the rocks of the Vizien Complex were grouped into four informal units: 1) mafic volcanic rocks, 2) felsic and intermediate volcanic rocks, 3) ultramafic rocks, and 4) sedimentary rocks. In this report, a brief overview of the principal lithological characteristics of each unit is presented. More detailed lithological and structural descriptions are available in the reports mentioned above.

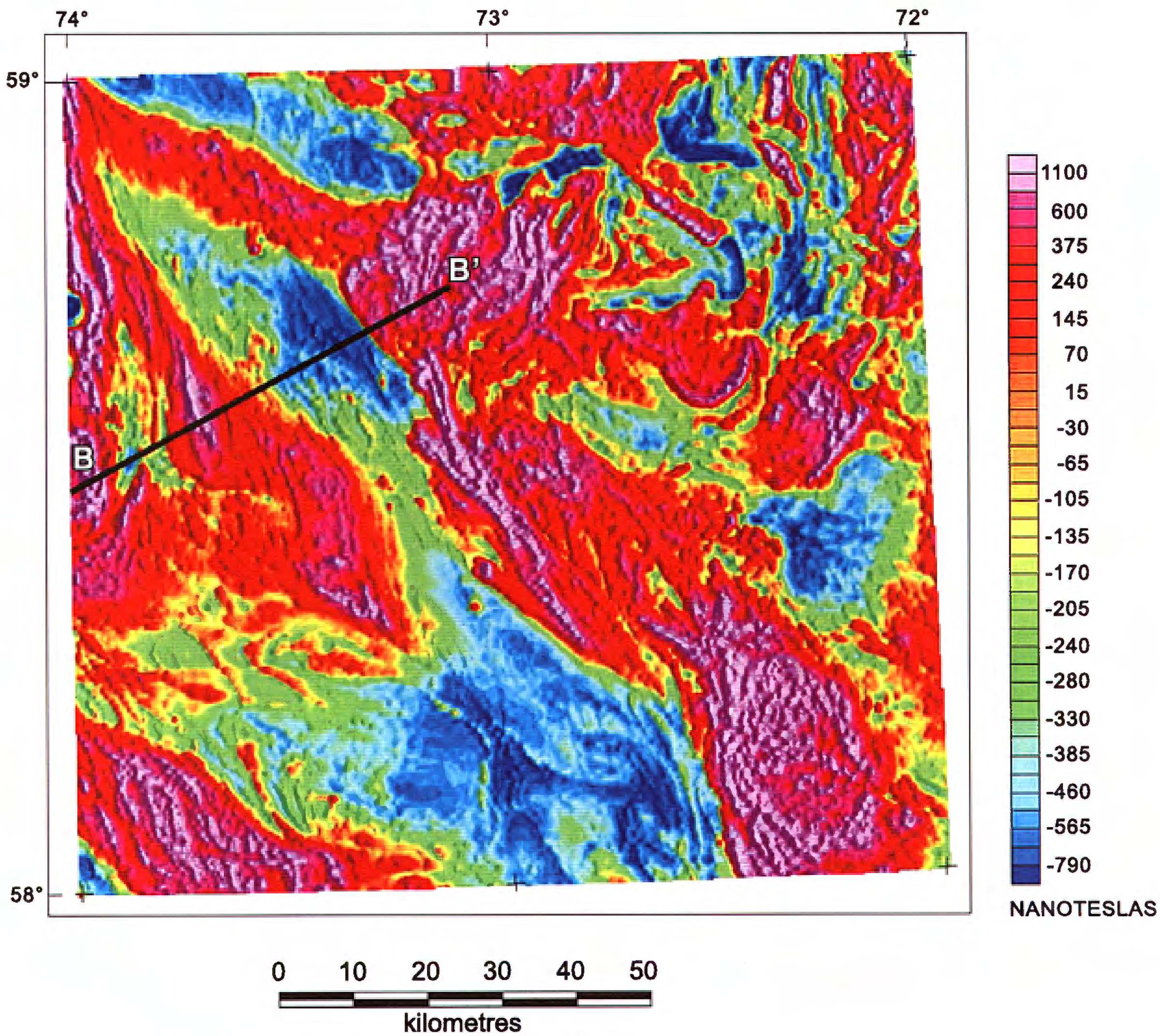

FIGURE 4 - Shaded residual total field magnetic map of the Lac La Potherie area (NTS sheet 34I); location of cross-section BB'; see Figure 12 for the interpretation. The aeromagnetic data was taken from Dion and Lefebvre (2000).

Mafic Volcanic Rocks (Aviz1)

The Vizien Complex is predominantly composed of basaltic lithologies forming thin units (< 3 km wide). The basalts are frequently associated with gabbros and ultramafic rocks. In a few locations, Percival and Card (1991, 1992) observed the presence of flows, pillow lavas, lavas with quartz and carbonate-filled amygdules and rare hyaloclastic breccias within basaltic units. The rock is homogeneous, fine-grained to aphanitic, and dark green. Minor intercalations of felsic volcanic rocks contain the following metamorphic assemblage: garnet-cummingtonite-cordierite-quartz. Iron formations occurring as lenticular bodies and discontinuous bands several metres thick, are locally intercalated with altered mafic volcanic rock units. These iron formations are composed of garnet, grunerite, magnetite, quartz, pyrite and pyrrhotite, and display rusty weathered surfaces. At the western tip of the Vizien Complex, an iron formation associated with mafic rocks contains alterations zones with tourmaline, cummingtonite, and anthophyllite-cordierite. The eastern limb of the complex, largely basaltic in composition, also contains mafic intrusive rocks (gabbro), fine-grained felsic schists interpreted as metavolcanic rocks as well as elongate (<10 m x 50 m) bodies of peridotite and pyroxenite (Percival and Card, 1992). Felsic and mafic rocks are mixed on a scale of 30 cm to 50 m. These rocks are strongly foliated to schistose.

Felsic and Intermediate Volcanic Rocks (Aviz2)

Felsic volcanic rocks are composed of a mixture of dacite and rhyolite with quartz and plagioclase phenocrysts. These rocks structurally overlie an andesitic unit at the western tip of the Vizien Complex, and are intercalated with basalts in the southern part of the complex. A rhyolite sample yielded a U/Pb age of 2724±1 Ma (Percival *et al.*, 1992). Dacite and rhyolite units locally contain minor intercalations of siltstone as well as andesitic bands. According to descriptions by Percival and Card (1991, 1992), dacites contain 5 to 10% plagioclase phenocrysts between 1 to 5 mm long in a fine-grained or aphanitic matrix. In several places, pods up to one centimetre in diameter composed of quartz, plagioclase and biotite are set in a groundmass of similar composition. These pods may represent a primary texture comparable to that observed in a tuff where the fragments were flattened during deformation. Rhyolites are homogeneous and may contain up to 10% quartz and plagioclase phenocrysts. These rocks may be recognized by their aphanitic nature, and by their pink colour on weathered surfaces. A polygenic conglomerate (or a volcanic breccia), composed of clasts up to 30 cm in diameter, forms a small horizon within the rhyolite unit.

Intermediate volcanic rocks sporadically outcrop throughout the Vizien Complex (Percival and Card, 1991). They consist of homogeneous andesites that are typically porphyritic. These rocks occur in association with mafic and felsic volcanic rock units in the southern part of the complex. However, intermediate rocks could not be represented individually on the map at a scale of 1:250,000. The andesite contains 10 to 20% plagioclase phenocrysts, between 5 and 20 mm in diameter, scattered in a fine-grained matrix of quartz and plagioclase. The phenocrysts show a weak preferred orientation parallel to the foliation in the groundmass. The andesites occur in contact with quartz-phyric tonalite, interpreted to be a subvolcanic intrusion (Percival and Card, 1992). Higher in the volcanic sequence, the andesite grades into felsic volcanic rock.

Ultramafic Rocks (Aviz3)

Ultramafic rocks constitute a significant proportion of the Vizien Complex, forming units that reach more than 20 km in length and nearly 1 km in width. These units are mainly composed of peridotite and serpentinite, with lesser amounts of pyroxenite, hornblendite and ultramafic schists (Percival and Card, 1992). These rocks occur as conformable bodies likened to sills, and as masses in mafic units and tonalitic country rocks. Certain ultramafic rock units are interpreted as allochthonous thrust sheets (Skulski and Percival, 1996). Ultramafic schists are composed of talc, chlorite, actinolite and serpentine. They locally contain gabbroic lenses. The presence of hyaloclastic and variolitic textures in some of these schists may indicate an extrusive origin (komatiite), whereas coarse-grained textures probably indicate an intrusive origin. Spinifex textures were not observed. Primary pyroxene-olivine assemblages were preserved in a few places within the peridotite and pyroxenite. The peridotite contains serpentine veins; one of these hosts an occurrence of chrysotile asbestos (Percival and Card, 1991). Ultramafic rock units also contain mafic rocks. One of these units forms a small ridge of serpentinized peridotite that extends for about 10 km. It grades into a heterogeneous sequence consisting of altered mafic and ultramafic rocks interstratified on a scale of 2 to 20 m. This sequence hosts the oldest volcanic rocks identified in the Vizien Complex (2786±1 Ma; Skulski and Percival, 1996). Alteration zones translate into an abundance of anthophyllite, biotite, cordierite, magnesian chlorite and cummingtonite.

Sedimentary Rocks (Aviz4)

Several sedimentary units which form thin m-scale to km-scale horizons, are locally encountered in the Vizien Complex.These sedimentary rocks are fine-grained and consist of arkose, pelite, siltstone and wacke (Percival and Card, 1992). In the southwest part of the complex, a small unit of muscovite-quartz-garnet pelitic schist grades into a finely-bedded arenaceous siltstone and locally into a conglomerate. In the centre of the complex, a conglomerate unit contains pebbles and blocks of tonalite, gabbro, granite and rare volcanic and ultramafic rocks in a biotite wacke matrix. This conglomerate unconformably overlies a tonalitic basement dated at 2940±5 Ma (Percival *et al.*, 1993). A granite pebble contains zircons dated at 2718±3 Ma (Percival *et al.*, 1993; Skulski *et al.*, 1994), which represents the maximum age for conglomerate deposition. The sedimentary sequence overlying the tonalitic basement notably consists of a basal conglomerate, interstratified with and overlain by biotite wackes, which are in turn overlain by mafic volcanic and intrusive rocks, and then by ultramafic rocks. In certain places, the wacke contains the following metamorphic assemblages: garnet-biotite, staurolite-biotite, and cordierite-anthophyllite-biotite.

Faribault-Thury Complex *(Afth)*

The Faribault-Thury Complex was defined in the Lac Peters area (NTS 24M) by Madore *et al.* (1999) to designate an assemblage composed of large zones of intrusive rocks within which volcano-sedimentary rocks were encountered. This complex contains a large body of tonalite and trondhjemite, along with lesser quantities of granodiorite, diorite and gabbro intrusions from 10 m to 1 km in size. Volcano-sedimentary rocks form numerous units covering small surface areas (<1 km^2) as well as larger belts that reach up to about 5 km wide by over 20 km long. Rock units assigned to the Faribault-Thury Complex are generally all oriented N-S and appear to extend due south, to an area east of Lac La Potherie (NTS sheet 24L).

The few units of mafic rocks and paragneisses that occupy the northeastern part of the Lac La Potherie area are provisionally assigned to the Faribault-Thury Complex (Figure 3). These rocks consist of mixed supracrustal sequences, metamorphosed to the amphibolite and granulite facies. Units containing mafic to felsic volcanic rocks, paragneisses and iron formations form narrow (<1 km) bands within charnockitic intrusions of the MacMahon Suite. These may extend a distance of less than 15 km along the dominant structural trend. Heterogeneous granodioritic units were also recognized. In the Lac La Potherie area, the Faribault-Thury Complex was divided into three informal units: 1) mafic rocks, 2) paragneisses, and 3) mixed granodioritic rocks.

Amphibolite, Mafic Gneiss (Afth1)

The Faribault-Thury Complex contains amphibolites and mafic gneisses which are intimately associated with paragneiss units, iron formations, and intermediate and felsic rocks. This lithological association suggests that these rocks formed in a volcano-sedimentary environment. The amphibolites and mafic gneisses, essentially interpreted as basalts, constitute the dominant lithology of volcanic units.

Mafic volcanic rock units form more or less continuous bands between 10 m and 1 km thick, containing 1 m to 10 cm thick horizons of paragneiss, iron formation, intermediate to felsic rocks and small volumes of ultramafic rocks. On a mesoscopic scale, these rocks exhibit a well-developed penetrative foliation, accentuated by cm-scale banding that defines a gneissosity. They are locally massive, and primary textures have been completely obliterated by intense deformation and strong recrystallization. Mafic volcanic rocks are composed of plagioclase, hornblende, magnetite and clinopyroxene. Some samples also contain biotite and orthopyroxene. The rock is dark green, and fine to medium-grained. Intermediate and felsic rocks exhibit a thin banding and a grey colour; they are relatively rare, locally forming minor intercalations with the mafic volcanic rocks. In certain places, ultramafic rocks essentially composed of medium-grained pyroxenite occur as small lenses or masses within volcanic rock sequences.

In thin section, mafic and intermediate rocks are characterized by a granoblastic texture. Prismatic hornblende grains, as well as rare biotite grains, are aligned parallel to the foliation. Hornblende is olive green to brownish and slightly chloritized. Clinopyroxene occurs as scattered grains partially replaced by hornblende. Orthopyroxene is less abundant than clinopyroxene. In certain samples, plagioclase appears sericitized and saussuritized, and contains small grains of secondary epidote and calcite. Alteration products derived from ferromagnesian minerals include chlorite and epidote.

Paragneiss (Afth2)

Paragneisses of the Faribault-Thury Complex in the Lac La Potherie area represent migmatitic metasedimentary rocks generally intimately associated with volcanic rock units. They may also be associated with thin iron formation horizons between one and ten metres thick, which may be traced over several kilometres along strike. Locally, paragneisses form rusty zones up to 10 m wide. These zones are generally due to alteration of biotite as well as of disseminated pyrite and pyrrhotite which give the rock a rusty colour. Paragneisses and iron formations are migmatized and posess a well-developed foliation or a cm-scale banding that defines a gneissosity. They generally display fairly well developed granoblastic and porphyroblastic textures. The paragneiss consists of a fine-grained matrix of quartz and plagioclase (± potash feldspar) with biotite and garnet (± orthopyroxene) porphyroblasts reaching up to a maximum size of two centimetres. It is grey-brown to rusty brown. Observed iron formations are characterized by regularly alternating cm-scale to mm-scale bands of quartz-magnetite and grunerite-magnetite, and locally quartz-garnet and garnet-magnetite. The rock is dark grey to greyish brown and commonly takes on a rusty colour on weathered surfaces. In certain places, the iron formations display a brecciated texture associated with sulphide mineralization (see section entitled "Economic Geology"). Certain iron formations occur alone, in small bands hosted in the granitoids.

Heterogeneous Granodioritic Rocks (Afth3)

Overall, this unit is characterized by a wide variation in the relative proportions of the lithologies present from outcrop to outcrop. It mainly consists of granodioritic rocks, however an important proportion of tonalitic and granitic mobilizate is also present. Granodiorites in the Faribault-Thury Complex contrast with those of the Rivière-aux-Feuilles Suite given their very heterogeneous nature. The rocks of the Faribault-Thury Complex may generally be described as heterogeneous migmatitic rocks, mainly granodioritic in composition, and containing schlieren rich in ferromagnesian minerals. Certain outcrops exhibit a "diatexite" texture and may contain up to 30% enclaves of paragneiss, iron formation, mafic rocks, diorite and tonalite. The granodiorites are leucocratic and contain the following mafic minerals: biotite, hornblende, clinopyroxene, magnetite and ± orthopyroxene. The rock is medium to coarse-grained, and shows a ubiquitous foliation defined by the alignment of biotite and hornblende. Moreover, the presence of deformed enclaves and schlieren gives the rock a gneissic aspect in several places. A well-developed linear fabric (L-tectonite) is locally observed.

Suluppaugalik Suite *(Aspk)*

The lithodemic unit known as the Suluppaugalik Suite was introduced by Parent *et al.* (2000) to describe heterogeneous tonalitic rocks found in the northeast part of the Lac Nedlouc area ("Utsalik Domain"). This unit extends northward in the Lac La Potherie area, just east of the Vizien Complex (Figure 3) where foliated to gneissic tonalites were reported by Percival *et al.* (1991). Overall, these tonalites are very heterogeneous and show a high degree of lithological and structural complexity at the scale of the outcrop. The unit is composed of gneissic and foliated tonalites, invaded by granodioritic and granitic rocks, which contain enclaves of mafic and ultramafic rocks of uncertain origin. The foliation and gneissosity are well-developed within this unit. The tonalite is medium grey, whereas the granodiorite and granite are pinkish grey. Mafic minerals observed in the tonalites and granodiorites mainly consist of green hornblende, reddish brown biotite, and magnetite. Epidote, allanite and titanite are present in minor quantities in certain samples. Relatively undeformed segregations of tonalitic to granitic mobilizate, as well as late pegmatite and granite injections are also observed. Tonalites of the Suluppaugalik Suite roughly lie along the western margin of a large body of granitoids dominated by granites of the Dufreboy Suite (see description of this suite). The heterogeneous nature of the tonalites and the presence of granodioritic material probably reflect the presence of a migmatization front. A U/Pb zircon analysis carried out on a tonalite sample yielded an age of about 2805 Ma (Berclaz *et al.*, 2001).

Rochefort Suite *(Arot)*

A lithodemic unit known as the Rochefort Suite is proposed to identify tonalitic intrusive rocks that cover nearly 40% of the map area in the Lac La Potherie area (Figure 3). The type locality of this unit is located 17 km west of Lac Maguire, at outcrop AL-99-076 (UTM coordinates, NAD 83: 566,557E, 6,469,529N). Tonalites in this suite are typically associated with northwest-oriented magnetic troughs (Figure 4). They generally exhibit a well-developed foliation or locally a gneissosity with rare biotite-rich schlieren. Two tonalitic phases were observed in certain places, namely a medium-grained leucocratic phase and a coarser-grained more mafic phase. The latter is fairly magnetic, and is commonly observed as enclaves in the leucocratic tonalite. Enclaves of mafic rocks and biotite granite injections parallel to the foliation are also observed. The Rochefort Suite also contains trondhjemite and more rarely granodiorite. The tonalite is locally migmatized, and contains less than 10% granodioritic mobilizate. Despite the homogeneous aspect of tonalite samples, the presence of biotite schlieren, granite injections and mafic enclaves visible at the scale of the outcrop frequently give the rock a heterogeneous aspect. Samples from the Rochefort Suite yielded a radiometric U/Pb age of about 2780 Ma (David, 2001; see section entitled "Geochronology").

The tonalite contains roughly equal proportions of quartz and plagioclase, with less than 10% potash feldspar. The principal minerals characterizing this unit are biotite, epidote and titanite, whereas accessory minerals include allanite, apatite, magnetite and zircon. A few samples also contain muscovite, whereas others contain hornblende. The rock is grey to pale grey and medium-grained to locally coarse-grained. It displays a good foliation defined by biotite and muscovite. In certain areas, the tonalite exhibits a protomylonitic texture. Under the microscope, observed microfabrics reflect a variable intensity of deformation. Less deformed rocks show a preferential orientation of micas that wrap around large plagioclase crystals, along with trains of elongate epidote and titanite grains aligned parallel to the foliation. At the other end of the scale, a mylonitic microfabric is illustrated by the presence of long monocrystalline to polycrystalline quartz ribbons, a fine-grained granoblastic texture, lens-shaped quartz grains aligned parallel to the foliation and the formation of neoblasts along porphyroclastic plagioclase grains, which occasionally display bent and broken twins. The presence of green biotite and epidote implies that the tonalites sustained metamorphic conditions at the amphibolite facies. Epidote occurs as allotriomorphic crystals superimposed upon biotite and hornblende. It may contain inclusions of biotite and quartz. Epidote cores are frequently occupied by zoned allanite. Bluish green to olive green hornblende occurs in variable proportions. Muscovite forms isolated grains, or is associated with biotite and plagioclase. Titanite is hypidiomorphic to xenomorphic and brownish with greyish coronas, suggesting the presence of two generations. The tonalite is generally fresh, and only shows minor alteration of plagioclase (sericitization and saussuritization) and biotite (chloritization).

Bacqueville Suite *(Abcv)*

Mafic rocks of dioritic and gabbroic composition were mapped in numerous places along the Rivière aux Feuilles transect (Percival and Card, 1994), as well as in the Lac Nedlouc area (Parent *et al.*, 2000). These rocks are also present in other sectors of the Lac La Potherie area (Figure 3). They occur in most granitoid units, charnockitic rocks and diatexites, as m-scale to km-scale bodies, sheets and bands. As a general rule, the largest bodies do not exceed 50 km^2 and are frequently associated with elongate positive aeromagnetic anomalies. Sheets, which also resemble trains of dismembered "dykes", reach about three kilometres wide and may extend over tens of kilometres along the dominant structural trend. Remnants observed at the scale of the outcrop appear either as simple isolated enclaves or as trains of rounded and angular fragments, suggesting disturbed "dykes". The various intrusive bodies of diorite and gabbro are variably deformed, segmented and cut by pegmatite injections and late leucogranite dykes.

The Bacqueville Suite was established by Parent *et al.* (2000) to designate all diorites and gabbros, along with a minor amount of pyroxenites. In this report, the suite is subdivided into two informal units: a gabbro-gabbronorite unit and a diorite-quartz diorite unit. These rocks are easily distinguished from felsic plutonic rocks by their relatively high mafic mineral content. They are homogeneous, equigranular and generally appear massive to locally foliated. They are fine to coarse-grained. In several places, an ophitic texture is observed, as well as an igneous texture formed by clinopyroxene and orthopyroxene oikocrysts. Within the map area, the Bacqueville Suite contains more gabbro-gabbronorite than diorite.

Gabbro-Gabbronorite (Abcv1)

The gabbroic rock unit is mainly composed of gabbro and gabbronorite, and locally of ultramafic rocks. Leucogabbro was observed in a few rare locations. The unit also contains magnetite-rich zones (> 70%) which give the rock a dark rusty brown colour on weathered surfaces. Gabbros and gabbronorites generally vary from mesocratic to melanocratic, and contain over 40% biotite, hornblende, clinopyroxene, orthopyroxene and magnetite. Accessory minerals include apatite, titanite, quartz and zircon. The rock has a dark green to greenish brown weathered surface. Biotite is reddish, whereas hornblende is olive green. The latter occurs as separate grains or forms coronas around pyroxenes. Sometimes, orthopyroxene is almost entirely replaced by its alteration products (talc, carbonate, chlorite, iddingsite, magnetite), and plagioclase may be sericitized and saussuritized. Despite its generally massive aspect, the rock was affected by deformation, which becomes obvious in thin section. Primary igneous textures (cumulate and ophitic textures) are either preserved or partially replaced by recrystallization textures (polygonization). The foliation is defined by the alignment of biotite and trains of mafic minerals. Well-developed polygonal granoblastic textures are often observed; these are the result of deformation and an advanced state of recrystallization of primary plagioclase-clinopyroxene-orthopyroxene cumulates.

Gabbros and gabbronorites sporadically grade into ultramafic rocks consisting of pyroxenite and peridotite. The pyroxenite is composed of clinopyroxene, orthopyroxene, hornblende, biotite, magnetite and minor plagioclase. In addition to these minerals, the peridotite contains olivine, spinel and talc. These rocks exhibit well-developed cumulate textures. The effects of deformation are locally shown by a syntectonic recrystallization of certain minerals into small polygonal grains and larger lepidoblastic grains that define the foliation. Rare sulphide-rich zones (pyrite and pyrrhotite), about 10 cm thick, occur in pyroxenites and more mafic gabbroic phases.

Diorite-Quartz Diorite (Abcv2)

Diorites and quartz diorites are generally mesocratic, and contain between 30 and 50% biotite, hornblende, clinopyroxene, magnetite and locally orthopyroxene. Quartz occurs in minor quantities (< 5%) as an interstitial phase. Accessory minerals are apatite and zircon. The rock appears homogeneous and is variably magnetic. It is grey to dark greenish grey in fresh surface and light greenish brown in weathered surface. In the field, the presence of fine-grained leucocratic quartz diorite was reported. The foliation is defined by reddish biotite lepidoblasts and locally by prismatic hornblende grains. In thin section, the presence of a polygonal granoblastic texture indicates syntectonic recrystallization of primary igneous textures. Plagioclase is locally altered to sericite and calcite. The diorite sometimes grades to gabbro and locally to pyroxenite as the mafic mineral content increases.

La Chevrotière Suite *(Alcv)*

The La Chevrotière intrusive Suite was introduced as a lithodemic unit by Parent *et al.* (2000) to describe monzogranitic rocks with alkali feldspar phenocrysts in the Lac Nedlouc area. However, the Lac La Potherie area constitutes the best region to observe these rocks, which are largely concentrated along a NW-SE axis between Lac La Chevrotière and the Rivière aux Feuilles (Figure 3). These rocks are associated with prominent aeromagnetic anomalies (Figure 4) which transect those related to Rochefort Suite tonalites. In certain areas, the monzogranite displays a stretching lineation defined by smoky quartz, as well as a well-developed mylonitic fabric that wraps around potash feldspar augens. In the centre of the map area, a major intrusion of this suite extends for over 70 km along the dominant foliation direction, i.e. NW-SE. Its outcrop pattern suggests a certain structural control for its emplacement. The distribution of some intrusions of the La Chevrotière Suite may be explained by syn- to late tectonic emplacement relative to the development of major ductile deformation zones. Samples from the La Chevrotière Suite yielded a U-Pb radiometric age of about 2732 Ma (David, 2001; see section entitled "Geochronology").

Monzogranites of the La Chevrotière Suite are characterized by the presence of microcline and orthoclase megacrysts reaching up to five centimetres in length. The rock is homogeneous, foliated to locally massive, pinkish red to pinkish white and medium to coarse-grained. It is leucocratic, and contains a total of 10 to 25% biotite, hornblende, titanite and magnetite. Accessory minerals include epidote, allanite, apatite and zircon. Minor amounts of clinopyroxene were also observed in a few thin sections. The reddish brown biotite is superimposed upon green hornblende. Titanite forms small xenomorphic grains, and in certain cases, coronas around magnetite. The core of plagioclase grains is generally sericitized. Mafic minerals typically form aggregates parallel to the foliation. Sometimes, an intergranular deformation results in the formation of neoblasts bordering feldspar grains. Quartz forms large patches, as well as local monocrystalline to polycrystalline ribbons and lens-shaped grains parallel to the foliation. Epidote grains appear as trains along the foliation. The monzogranite locally contains a compositionally similar pegmatitic phase. The latter occurs as late injections which are probably genetically linked to the monzogranite.

Rivière-aux-Feuilles Suite *(Arfe)*

The Rivière-aux-Feuilles Suite, as defined in the work of the Geological Survey of Canada (Percival and Card, 1994; Stern *et al.*, 1994), designated a group of I-type calc-alkaline intrusions including pyroxene and hornblende granodiorites, tonalites, granites, diorites, gabbros-pyroxenites and synplutonic mafic dykes. The emplacement of the Rivière-aux-Feuilles Suite was originally established at ca. 2724 Ma, based on a few age dating analyses on granodiorites (Machado *et al.*, 1989; Stern *et al.*, 1994). However, new geochronological data indicate that this group of plutonic rocks incorporates several intrusive events (David, 2001). Mapping carried out in the summer of 1998 in the Lac Nedlouc area made it possible to subdivide these plutonic rocks into several lithodemic intrusive suites (Parent *et al.*, 2000). These authors restricted the use of the term "Rivière-aux-Feuilles Suite" to identify weakly foliated to strongly deformed granodiorites and tonalites that transcend the boundaries of certain domains. In addition, the results of our work during the summer of 1999 in the Lac La Potherie area, has led to a slight modification in the definition of this suite. It has enabled us to separate tonalites from granodiorites, and to better characterize these two rock types which are not necessarily genetically linked. In this report, the Rivière-aux-Feuilles Suite is thus used exclusively to designate granodioritic intrusive rocks.

Granodiorites of the Rivière-aux-Feuilles Suite form several intrusive bodies, each covering several square kilometres, without a specific magnetic signature (Figures 3 and 4). These intrusions are distributed throughout the map area, and mainly appear as NW-SE oriented sheets. Two phases of granodiorite had originally been observed along the Rivière aux Feuilles, a hornblende granodiorite and a pyroxene granodiorite (Percival and Card, 1994). However, pyroxene granodiorites do not constitute a distinct mappable unit. In the Lac La Potherie area, all units belonging to the Rivière-aux-Feuilles Suite consist of hornblende granodiorite. Mafic minerals, which account for 5 to 25% of the rock, are biotite, hornblende and magnetite, with local epidote, allanite and titanite. The alignment of these minerals defines a weakly to strongly developed foliation. The presence of muscovite and clinopyroxene was reported in a few places. Accessory minerals include apatite and zircon. The rock is pale grey to pinkish grey in fresh surface and alters to a pinkish white to pinkish grey colour. It is generally medium-grained. In several places, the presence of a gneissosity, of mafic rock enclaves and injections of granite and pegmatite give the granodiorite a heterogeneous aspect.

La Potherie Batholith *(Alpo)*

The La Potherie Batholith constitutes a large rounded intrusion covering over 650 km^2, in the northernmost part of the map area (Figure 3). It corresponds to a positive aeromagnetic anomaly (Figure 4) that extends northward into the adjacent map sheet. The anomaly shows a poorly-defined texture that decreases in intensity in the vicinity of Lac La Potherie. The margins of the batholith form hybrid zones with surrounding country rocks which are locally altered and deformed. The outcrop pattern of the batholith suggests it was emplaced late relative to other surrounding felsic plutonic rocks of the Rochefort Suite. The La Potherie Batholith yielded a preliminary radiometric age of 2723±2 Ma (David, 2001; see section entitled "Geochronology").

The La Potherie Batholith is composed of granite characterized by a coarse grain size formed of equidimensional grains. The type locality of this unit is located 2 km west of Lac La Potherie, at outcrop AL-99-159 (UTM coordinates, NAD83; 643,393E, 6,523,553N). The granite takes on a homogeneous foliated aspect, and locally displays a somewhat porphyritic texture. The rock is pinkish grey in fresh surface and has a distinctive pinkish white weathered surface. A protomylonitic microfabric was observed in samples collected near the fault that marks the southern margin of the batholith. The effects of this deformation are shown by a mortar texture, bent plagioclase twins and quartz ribbons. The granite is generally leucocratic, and contains 10 to 20% biotite, hornblende, epidote, titanite, magnetite and allanite. These minerals form aggregates aligned parallel to the foliation. In some cases, clinopyroxene relics are found in the core of certain hornblende grains. High concentrations of magnetite, reaching nearly 5% in certain samples, are responsible for the batholith's distinctive aeromagnetic signature. Olive green hornblende and greenish biotite are ubiquitous. Titanite is very abundant and appears as large (<1 cm) idiomorphic crystals and as coronas around certain magnetite grains. The presence of both dark brown and pale grey titanite grains clearly indicates the presence of two distinct populations. Moreover, hypidiomorphic grains contain small biotite inclusions. Allanite crystals are commonly zoned and occur within epidote grains. Several minerals show evidence of post-metamorphic alteration: hornblende and biotite are partially altered to chlorite, whereas plagioclase is sericitized. Apart from the absence of a megaphyric texture, the La Potherie granite displays certain features similar to those of the La Chevrotière Suite monzogranite.

MacMahon Suite *(Acmm)*

The MacMahon Suite, as defined by geological mapping in the Lac Nedlouc area (Parent *et al.*, 2000), designates charnockitic-type rocks, with the exception of those located in the southwest corner of that map area (NTS sheet 34H). It consists of orthopyroxene-bearing intrusive rocks that vary from tonalitic to granitic in composition. The results of geological surveys carried out last summer suggest that the rocks of this suite extend into the Lac La Potherie area. These rocks are found in the northeastern sector of the map area. They are composed of enderbite and opdalite, which are generally associated with a magnetic depression, showing a weak internal texture curved towards the east (Figure 4).

The enderbite and opdalite of the MacMahon Suite form a large irregular body occupying a surface area of at least 1,000 km^2 on either side of Lac La Potherie (Figure 3). In the field, these two lithologies are difficult to distinguish from one another based on the relative proportions of feldspars. They appear as homogeneous and equigranular, foliated to locally massive rocks. These rocks are variably magnetic and intensely altered near margins of the La Potherie Batholith. They are generally leucocratic, and contain between 5 and 35% biotite, hornblende, orthopyroxene, clinopyroxene and magnetite. The proportion of these minerals varies considerably on a mesoscopic scale. Accessory minerals are allanite, apatite and zircon. The rock is medium-grained. The greenish colour of plagioclase gives the rock a brown-green to light grey-brown colour in fresh surface, typical of rocks of charnockitic suites. Locally, charnockite and injections of orthopyroxene-free granitic and granodioritic material are also observed.

In thin section, biotite is typically reddish brown whereas hornblende is olive green to brownish green. Primary igneous textures and deformation-recrystallization textures are observed in the different samples of enderbite and opdalite. Preserved igneous textures are represented by large irregular grains of primary feldspar and pyroxene. Primary plagioclase grains are often antiperthitic. These minerals also occur as smaller polygonized grains. In fact, most of the rocks in this suite exhibit a certain degree of deformation and recrystallization. These two phenomena are mainly shown by the development of a granoblastic texture and the alignment of mineral aggregates parallel to the regional foliation. In several samples, the formation of neoblasts is observed near the margins of feldspar and pyroxene grains. These minerals also form porphyroclastic and granoblastic textures. Quartz locally occurs as lenses and polycrystalline ribbons parallel to the foliation. A reduction in grain size and a granoblastic texture develops near the La Potherie Batholith. Locally, orthopyroxene shows evidence of becoming unstable and is consequently replaced by its alteration products, namely talc, carbonate, chlorite, iddingsite and magnetite. In some cases, plagioclase is partially sericitized and biotite is somewhat chloritized. Secondary epidote was observed in certain altered rocks.

Lac Minto Suite *(Amin)*

The presence of important diatexite masses in the Rivière aux Feuilles area was recognized by Percival *et al.* (1990, 1991) as one of the principal characteristics of the "Lac Minto Domain". Later on, a lithodemic unit known as the Lac Minto Suite was introduced by Parent *et al.* (2000) to designate diatexites belonging to this "domain" in the northwest part of the Lac Nedlouc area. Geological surveys carried out in the summer of 1999 indicate that diatexites similar to those described in the Lac Nedlouc area are also present in the western part of the Lac La Potherie area (Figure 3). Since field evidence suggests a genetic link between diatexites and charnockitic rocks, the latter will be included in the same suite. Consequently, the Lac Minto Suite in this area is composed of four major units: 1) orthopyroxene-biotite diatexite, 2) opdalite, 3) charnockite, and 4) hornblende-biotite diatexite. In most cases, these units are associated with positive aeromagnetic anomalies oriented north-northwest (Figure 4). They occur as masses and sheets injected in granodiorites of the Rivière-aux-Feuilles Suite and in tonalites of the Rochefort Suite. The presence of orthopyroxene in rocks of units 1, 2 and 3 suggests that these rocks formed under conditions corresponding to the granulite facies, whereas diatexites of unit 4 correspond to the amphibolite facies. A U/Pb zircon analysis performed on a diatexite sample yielded an age of 2713±2 Ma (Percival and Card, 1994).

The term diatexite designates migmatized rocks in which the proportion of material derived from partial melting exceeds 50% of the volume of the rock (Brown, 1973).

Diatexites are therefore migmatites where a high degree of partial melting has generated important volumes of magma. However, diatexites cannot be defined solely on the proportion of material generated through anatexis. Sawyer (1996) proposed a more restricted definition of diatexites based on certain observations concerning textures and structures characterizing this lithology. He noted an increase in grain size, a heterogeneity at a macroscopic scale and the development of flow structures that obliterate premigmatization structures (banding or tectonic fabrics). These structures are preserved only in residual enclaves (Sawyer and Barnes, 1988). Thus, the term diatexite was applied in the Lac La Potherie area to rocks that correspond exactly to this definition.

Orthopyroxene-Biotite Diatexite (Amin1)

Overall, orthopyroxene-biotite diatexites in the Lac La Potherie area possess the same features as diatexites described in the Lac Minto and Rivière aux Feuilles areas (Percival *et al.*, 1990, 1991) and in the Ashuanipi Subprovince (Percival *et al.*, 1992; Leclair *et al.*, 1998b; Lamothe *et al.*, 1998; Gosselin and Simard, 2000). They mainly occur north of Lac Dune, in the western part of the map area. Orthopyroxene-biotite diatexites are separated from hornblende-biotite diatexites to the east by a ductile structure. A feature shared by both types of diatexite is the variability, on a mesoscopic scale, in mineral composition, grain size and texture. In addition to orthopyroxene and biotite which are ubiquitous, diatexites of the Lac Minto Suite may also contain variable proportions of clinopyroxene, hornblende and magnetite, as well as accessory minerals such as apatite and zircon. The relative proportions of plagioclase, potash feldspar and quartz are also variable, yielding a granodioritic or monzogranitic composition. The grain size varies from coarse to medium-grained over a distance of a few centimetres, producing the heterogranular texture typical of diatexites. This texture, combined with the presence of mm-scale biotite schlieren, commonly gives the rock a heterogeneous, disorganized and badly crystallized aspect. The diatexite, normally fairly magnetic, varies from leucocratic to mesocratic and from foliated to locally massive. It is brownish grey to greenish grey in fresh surface, with a greenish brown to yellowish grey weathered surface. The diatexite may contain 5 to 40% enclaves between 10 cm and 1 m, mainly of dioritic composition. Paragneiss and mafic rock enclaves are also present in minor proportions. The enclaves are generally fine to medium-grained.

The diatexite unit contains pegmatitic veins, as well as coarse-grained granitic phases. The latter locally possess a porphyritic texture and have gradual contacts with heterogeneous-type diatexites. Furthermore, field observations suggest that the boundaries between certain granite and diatexite intrusions are commonly represented by transitional contact zones. It is possible that certain granites may represent more evolved magmas that were derived from the same processes that generated the diatexites.

Opdalite (Amin2)

The Lac Minto Suite opdalite forms a single unit located near the western margin of the map area, where an intense aeromagnetic anomaly oriented N-S is present. It is in gradational contact with orthopyroxene-biotite diatexites to the east. In the field, the gradual transition from diatexite to opdalite suggests that a genetic link exists between the two lithologies. Overall, the opdalite possesses certain characteristics, including its composition, similar to those of diatexites. Nevertheless, it may be distinguished from diatexite by its greater homogeneity and by the scarcity of biotite schlieren. Opdalite outcrops are free of enclaves, with the exception of a few located near diatexite bodies, where up to 25% dioritic enclaves and local paragneiss enclaves were observed. The weathered surface of the rock is light grey-brown, whereas its fresh surface is grey-brown with a common greenish tinge due to the plagioclase. Mafic minerals, which account for 10 to 40% of the rock, include biotite, orthopyroxene, clinopyroxene, magnetite and rare hornblende. The foliation, generally fairly well developed, is defined by the alignment of biotite and orthopyroxene. The biotite is reddish brown and the hornblende is green, which is typical of charnockitic rocks. Along major deformation zones, orthopyroxene grain margins are replaced by talc, carbonate, iddingsite and chlorite. In certain cases, orthopyroxene is completely replaced by its alteration products. The rock varies from medium to coarse-grained. The texture is generally granular, but locally heterogranular. The opdalite locally grades to an enderbite or a charnockite, which is marked by the presence of potash feldspar phenocrysts reaching up to about 1.5 cm long. In places, medium-grained granitic phases occur as injections or in gradational contact with the opdalite.

Charnockite (Amin3)

The charnockite unit, located in the southwest corner of the map area, forms a band about 12 km wide oriented NW-SE. It is associated with a strong positive aeromagnetic anomaly, with a weak NW-oriented linear internal texture. This unit also contains local enderbite, opdalite and granite. The Lac Minto Suite charnockite is separated from granitoid units to the northeast and to the southwest by ductile deformation zones. On outcrop, the charnockite is foliated and typically displays a coarse igneous texture. It is very magnetic and generally leucocratic, containing from 10 to 20% orthopyroxene, clinopyroxene, hornblende, biotite and magnetite. The greenish brown colour in fresh surface, due to the colour of plagioclase grains, is characteristic of charnockitic rocks. Overall, the charnockite is quite variable in terms of texture and in the proportion of enclaves. It may contain up to about 20% enclaves of biotite±garnet± orthopyroxene paragneiss and biotite-garnet-sillimanite±spinel paragneiss, and more rarely dioritic enclaves. The grain size may vary from coarse to medium-grained over a few centimetres, giving the rock a heterogranular texture. The presence of potash feldspar phenocrysts from 1 to 3 cm long, and of a few orthopyroxene grains up to 1 cm long create a porphyritic aspect in several places. The alignment of biotite defines a foliation which is locally accentuated by the presence of biotite schlieren. The preferential orientation of phenocrysts parallel to the foliation plane may suggest a syn- to late tectonic emplacement relative to the principal deformation. In several places, a granitic phase with potash feldspar phenocrysts, with or without orthopyroxene, is present as in situ mobilizate and as injections in the charnockite. It is possible that this may indicate a local transformation of charnockite into granite.

Hornblende-Biotite Diatexite (Amin4)

Hornblende-biotite diatexites of the Lac Minto Suite form plutons of less than 150 km^2, associated with positive aeromagnetic anomalies, and also occur as sheets in a few places. They contrast with other diatexites in this suite, namely due to the absence of orthopyroxene. The rock is greenish grey in fresh surface, and takes on a greyish tinge in weathered surface. It is essentially granodioritic in composition and normally contains between 10 to 20% mafic minerals, dominated by biotite, hornblende and magnetite. The heterogeneous nature of these diatexites is caused by textural and structural variations and by the presence of a variable proportion of enclaves. The diatexites are foliated to locally gneissic and may contain up to 40% enclaves of mafic rocks, diorite and paragneiss, which are commonly elongated parallel to the foliation plane. This foliation is accentuated by mm-scale biotite schlieren and cm-scale restites. Diatexites generally display a heterogranular texture due to the grain size of quartz, potash feldspar and plagioclase grains which varies from coarse to medium-grained. In certain places, the presence of potash feldspar phenocrysts between 1 and 2 cm long gives the rock a porphyritic aspect. The unit locally contains granitic pegmatite injections. Numerous zones of epidotization, chloritization and hematitization are observed in areas where brittle deformation is more widespread.

Morrice Suite *(Agdm)*

The Morrice Suite, as originally defined by Parent *et al.* (2000), grouped all granite intrusions in the Lac Nedlouc area, with the exception of porphyritic monzogranites (La Chevrotière Suite), granites of the La Potherie Batholith and charnockitic rocks (MacMahon Suite) (Parent *et al.*, 2000). In this report, granitic rocks are subdivided into two intrusive suites: the Morrice Suite and the Dufreboy Suite. Granitic rocks cut across most units present in the Lac La Potherie area. Although granites assigned to these two suites display several similarities on a mesoscopic scale, their spatial distribution and mode of occurrence are different. Granites of the Dufreboy Suite are located in the eastern part of the area (Figure 3), where they form vast intrusions several kilometres in size, associated with a distinct regional magnetic high (Figure 4). As opposed to the latter, granites of the Morrice Suite are located in the western part of the map, and mainly form well-circumscribed plutons, generally associated with negative anomalies, as well as multiple injections between one to ten metres. Furthermore, granites of the Morrice Suite appear to be genetically linked to diatexites of the Lac Minto Suite in the western part of the map. It is possible that these granites may be derived from the crystallization of a liquid that fractionated from the diatexites (see description of the Lac Minto Suite). A preliminary age of about 2700 Ma was obtained for the emplacement of Morrice Suite granites (Parent *et al.*, 2000).

Granites of the Morrice Suite were emplaced in granodiorites of the Rivière-aux-Feuilles Suite and in tonalites of the Rochefort Suite. In the southwest corner of the map, the granite occurs in tectonic contact with charnockites of the Minto Suite. The granites are commonly associated with a pegmatitic phase of the same composition, occurring as masses or dykes. They are leucocratic to locally hololeucocratic, and contain between 5 to 15% biotite, hornblende and magnetite. Locally, the presence of clinopyroxene, muscovite, epidote, titanite and allanite is reported. With the exception of biotite, these minerals are not always present in each sample. Accessory minerals observed in certain samples are apatite and zircon. Alteration products include sericite, chlorite, calcite and secondary epidote. The rock is foliated to rarely massive, medium-grained to locally coarse-grained, and typically appears homogeneous. It varies from a pinkish white to a light red colour. The effect of deformation is shown by the alignment of biotite, the preferential orientation of quartz lenses and by a mortar texture. Potash feldspar phenocrysts are locally perthitic to microperthitic. A rounded granite pluton, covering a surface area of about 180 km^2 just west of the Vizien Complex, locally contains potash feldspar and plagioclase phenocrysts reaching up to 5 cm long.

Dufreboy Suite *(Aduy)*

The Dufreboy Suite lithodemic unit was established to designate homogeneous granites that extend eastward from Lac Montmollin (Figure 3). These granites belong to an extensive mass of granitoids associated with major magnetic high that covers most of the Lac Dufreboy area. This area (NTS sheet 24L) constitutes the best place to observe these rocks. The granitoid mass , which roughly corresponds to the "Utsalik Domain" (Percival *et al.*, 1992), is characterized by NW-SE oriented sheets of granite, granodiorite, porphyritic monzogranite and locally tonalite, diorite and gabbro. Work by the MRN has made it possible to subdivide this series of granitoids into several intrusive suites (Parent *et al.*, 2000; Berclaz *et al.*, 2001). In the Lac La Potherie area, granites of the Dufreboy Suite are, exceptionally, mainly associated with a magnetic low located in the eastern part of the map, where they form a large body several kilometres in size that also contains granodiorite. Granitic outcrops are generally homogeneous, and show very little lithological or structural complexity. Some outcrops contain minor injections of pegmatite and hololeucocratic aplite. The rock is foliated to rarely massive, leucocratic to locally hololeucocratic, and light greyish pink in fresh surface with a light pink colour in weathered surface. The grain size is generally fine to medium-grained, but becomes coarse in rare places where the granite shows a porphyritic texture. Mafic minerals, which account for less than 15% of the rock, consist of brown biotite, green hornblende and magnetite. They form trains parallel to the foliation. A few samples also contain clinopyroxene and orthopyroxene relics, whereas others are devoid of hornblende. Accessory minerals are titanite, apatite, allanite and zircon. Plagioclase and potash feldspar display porphyroclastic and fine-grained granoblastic textures. Potash feldspar phenocrysts are locally perthitic to microperthitic. The rock is hematitized in several places near fracture zones. In thin sections, chloritization of biotite and sericitization of plagioclases in observed.

Diabase Dykes

Diabase dykes complete the series of intrusive rocks in the Lac La Potherie area. These dykes are post-orogenic relative to the Archean deformation and regional metamorphism. They cut across most Archean units in the area and are affected by late fractures. A few dykes, reaching up to 60 m in thickness, form ridges that extend over several tens of kilometres. Because of their size, these dykes could not be represented on our geological map at a scale of 1:250,000. The dykes have chilled margins, and medium to coarse-grained centres. The diabase, with an ophitic to subophitic texture, is generally fresh and has a typically greenish brown weathered surfaces.

Recent paleomagnetic studies in the Rivière aux Feuilles area (Buchan *et al.*, 1998) reveal paleomagnetic directions associated with the Ptarmigan (2505±2 Ma), Maguire (ca. 2230 Ma) and Minto (1998±2 Ma) dyke swarms. Dykes in the Lac La Potherie area may be subdivided into three distinct groups based on their orientation. Most reported dykes occur in the northeast and south parts of the map area. The most abundant are oriented NNE-SSW to NE-SW, i.e. between 10 and 75°. These dykes most likely belong to the Ptarmigan swarm. The second most common group contains dykes oriented WNW-ESE to WSW-ENE, i.e. between 75 and 120°. These dykes are concentrated in the northeastern part of the map area. The orientation of this group is analogous to that of the Maguire dykes. Dykes of the third group are oriented NW-SE, between 305 and 340°, and could belong to the Minto swarm.

STRUCTURE

The regional structural trend in the northeastern Superior Province, as illustrated on aeromagnetic maps, is oriented NNW-SSE. In the western part, the magnetic pattern displays regional sigmoidal structures several kilometres in size. In addition, aeromagnetic and gravity anomalies are truncated in several areas by major lineaments oriented E-W. Some of these lineaments were interpreted as ductile-brittle structures (Parent *et al.*, 2000). In the Lac La Potherie area, the configuration of aeromagnetic anomalies (Figure 4) combined with mapping results (Figure 3) indicate a structural trend that varies from a NW-SE to N-S orientation.

The outcrop distribution pattern of units in the Lac La Potherie area reflects a complex structural setting that includes ductile deformation upon which a brittle deformation event, indicated by an important network of lineaments, is superimposed. The structural evolution is punctuated by pre- to post-tectonic intrusive events that significantly modify or mask the general structural portrait. Furthermore, the absence of stratigraphic marker horizons, the high metamorphic grade, as well as the lack of primary structures place important constraints on the feasibility of a detailed structural analysis. Nevertheless, observed mesoscopic and km-scale structures, responsible for the outcrop pattern, make it possible to propose a structural interpretation suitable for a regional mapping program at a scale of 1:250,000.

In general, the structural record is generally much more complete in supracrustal rock sequences than in associated intrusive rocks. The relationship between different generations of structures, as well as the structural evolution, were documented for several volcano-sedimentary belts including the Vizien belt. A detailed structural analysis of the Vizien Complex indicates a complex structural evolution involving five phases of ductile deformation as well as brittle faults (Lin *et al.*, 1996). The first phase of deformation, D_1, is revealed by the presence of a pre-D_2 foliation. Phase D_2 is associated with the principal penetrative foliation, along with tight to isoclinal folds. Phases D_3 and D_4 are represented by open to tight folds at a mappable scale, with axial surfaces respectively oriented NNW-SSE and E-W. Phase D_5 is associated with dextral strike-slip movement along a NNW-trending shear zone. The Kogaluc volcano-sedimentary belt, located just west of the map area, displays similar structural characteristics and a structural history comparable to that of the Vizien Complex (Lin *et al.*, 1995).

The structural framework of the Lac La Potherie area may be correlated in a general fashion with that already proposed for the Lac Nedlouc area (Parent *et al.*, 2000). In the Lac Nedlouc area, complex polyphase deformation resulted in the dismemberment of supracrustal rock sequences. The outcrop distribution pattern of units reveals the presence of five phases of ductile deformation and folding (D_1-D_5) and one phase of brittle deformation (D_6). Phase of deformation

D_2 is manifested by the principal penetrative foliation oriented parallel to lithological contacts (NNW-SSE), as well as by isoclinal folds. This foliation is affected by tight to isoclinal m-scale to km-scale F_3 folds oriented WNW-ESE to NNE-SSW. Phase of deformation D_4 is associated with shear zones oriented NW-SE. It is probably equivalent to same-direction shearing observed in the Vizien belt (Lin *et al.*, 1996). Structures associated with phase D_5 were only observed locally in volcano-sedimentary sequences. They correspond to open folds oriented E-W. Phase D_6 is responsible for a network of late brittle faults that form important cataclasite and pseudotachylite zones with associated hematitization and epidotization.

The principal foliation in the Lac La Potherie area is generally fairly well developed in all map units, with the exception of diabase dykes. It is defined by the preferential orientation of biotite, hornblende and pyroxene crystals. It is also represented in a few places by a gneissosity, and locally by migmatitic banding. This foliation is identified as an S_2 fabric, in accordance with the structural framework already proposed for the Vizien and Kogaluc areas (Lin *et al.*, 1995), and adapted for the Lac Nedlouc area (Parent *et al.*, 2000). In the Vizien area, the principal foliation is preceded by an S_1 fabric, locally preserved in conglomeratic blocks, and deformed by F_2 folds. The S_1 fabric is associated with an early phase of deformation D_1 marking an early thrusting episode (Percival *et al.*, 1995b; Lin *et al.*, 1996). In the Lac Nedlouc area, a fabric is locally preserved in supracrustal rock enclaves. This fabric also exists in enclaves in the Lac La Potherie area, and may be related to a pre-D_2 deformation. The orientation of the principal foliation (S_2) in the map area varies from WNW-ESE to N-S with an overall steep dip. Variations in the attitude of this foliation were used to subdivide the area into six structural domains (Figure 5). Stereograms for structural domains 1 and 6 outline an orientation varying from N-S to NNW-SSE for foliation S_2, whereas the stereogram for domain 3 indicates a NW-SE orientation for the same foliation. Stereograms for domains 2 and 4 show a WNW-ESE orientation of the foliation in the southwest part of the map (Figure 5). However, the stereogram for domain 5 shows a wider variation in the orientation of planar structures in the north-central part of the map area. A stereogram of mineral and stretching lineations also shows a certain amount of scatter. Overall, lineations plunge steeply to the NW.

On a mesoscopic scale, the foliation is affected by tight folds oriented NW-SE, without axial fabric. These folds are correlated with the D_3 phase of deformation as documented in the Lac Nedlouc area (Parent *et al.*, 2000). Several km-scale folds belonging to phase D_3 were mapped in the volcano-sedimentary sequences of the Lac Nedlouc area. These were also observed in the Vizien Complex (Lin *et al.*, 1996). In the northeast corner of the Lac La Potherie area, volcano-sedimentary units are deformed by km-scale folds which may belong to phase D_3. No km-scale folds were however identified in the granitoids in the area.

Phase of deformation D_4 was associated with important shear zones in the Lac Nedlouc area (Parent *et al.*, 2000). These shear zones, oriented NW-SE, extend into the Lac La Potherie area. They are manifested in the field by the presence of a mylonitic fabric along which the principal foliation and lithological contacts are transposed. Similar structures were also documented in the Vizien Complex (phase D_5 of Lin *et al.*, 1996). The development of the Dune and Bacqueville structures may be related to phase D_4. The dismemberment of certain volcano-sedimentary units was attributed to structures associated with D_4 (Parent *et al.*, 2000). This deformation is probably, at least in part, responsible for the change in orientation of the principal foliation between the different structural domains.

Open folds oriented E-W were attributed to phase of deformation D_5 (Parent *et al.*, 2000). In the study area, these folds were observed only locally in the volcano-sedimentary sequences of the Vizien Complex (F_4 folds of Lin *et al.*, 1996). However, they are most likely responsible for undulations observed in geological contacts.

A major network of physiographic lineaments associated with late brittle faults transects all units in the area. These faults appear as 10-m wide cataclastic zones. The most prominent faults are oriented E-W, and they develop conjugate fractures oriented NW-SE and NE-SW. All these brittle structures are responsible for the development of cataclasites and locally pseudotachylites, and are commonly associated with alteration zones rich in hematite, chlorite and epidote. They correspond to phase of deformation D_6 as defined by Parent *et al.* (2000).

METAMORPHISM

Rocks in the Lac La Potherie area contain prograde metamorphic assemblages that vary from the lower amphibolite facies to the granulite facies. In certain areas, lower temperature retrograde assemblages are related to late hydrothermal fluid circulation. Figure 6 illustrates the distribution of various minerals which can provide information on prevailing metamorphic conditions. This figure presents the results of a petrographic study combined with field observations. It shows the distribution of the following minerals: red biotite, green biotite, orthopyroxene, clinopyroxene, hornblende, titanite, epidote, muscovite, spinel, cordierite and sillimanite. The distribution of these minerals is used to subdivide the area into six distinct metamorphic domains (Figure 6).

Domains 1 and 2, located in the west and southwest portions of the map area, are associated with high magnetic signatures (Figure 4). These domains are characterized by the presence of red biotite and orthopyroxene, typical of the granulite facies. The study of thin sections from different lithologies present in domains 1 and 2 shows that most orthopyroxene grains have an igneous origin. However, the blastesis, the development of a granoblastic texture of pyroxene and plagioclase crystals, as well as the stability of orthopyroxene suggest that the rocks in these domains underwent deformation under granulite-facies conditions. Orthopyroxene is generally stable with the exception of a few cases where it is affected by late fluid circulation in the vicinity of brittle deformation zones. In these cases, orthopyroxene may be variably replaced by alteration products such as talc, carbonate, magnetite, chlorite and biotite. In a few places, paragneiss remnants contain the following assemblages: biotite-quartz-plagioclase-garnet-cordierite, biotite-quartz-plagioclase-garnet-sillimanite and biotite-quartz-plagioclase-garnet-spinel.

The disappearance of orthopyroxene east of domain 1 corresponds to the Dune ductile structure (Figure 6). This structure marks the appearance, in domain 3, of hornblende-biotite diatexites (*Amin4*) of the Lac Minto Suite. This domain also coincides with a reduction in the intensity of the total magnetic field (Figure 4). The presence of red biotite combined with the disappearance of orthopyroxene suggests metamorphic conditions at the middle to upper amphibolite facies. The Dune structure may juxtapose different crustal levels, and consequently, explain the presence

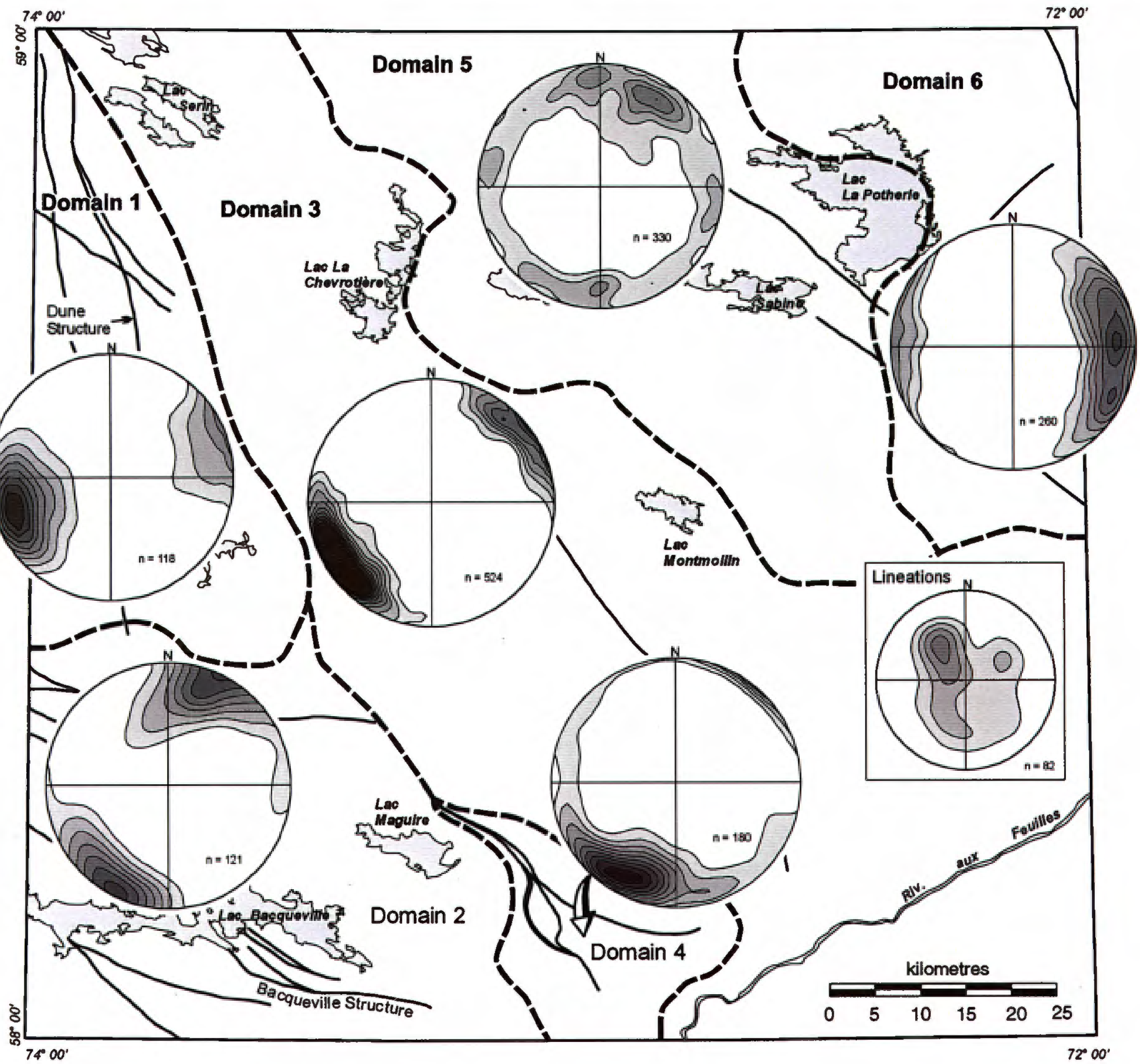

FIGURE 5 - Stereographic projections of the principal foliation and tectonometamorphic lineations in the Lac La Potherie area (n = number of measurements).

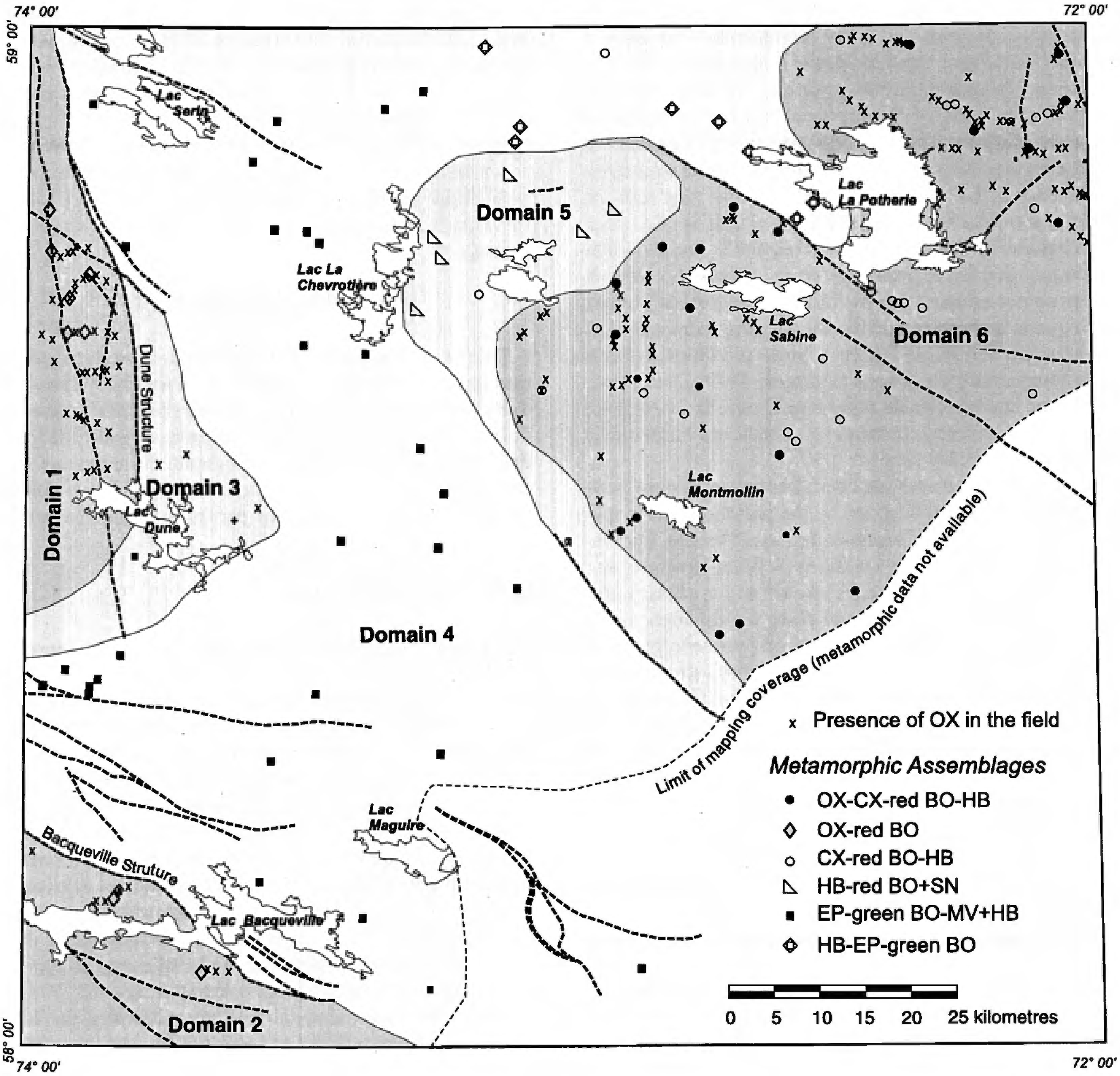

FIGURE 6 - Simplified metamorphic map of the Lac La Potherie area showing the distribution of metamorphic domains and assemblages. BO = biotite, CX = clinopyroxene, EP = epidote, HB = hornblende, MV = muscovite, OX = orthopyroxene, SN = sphene-titanite.

of granulite-facies diatexites to the west and amphibolite-facies rocks to the east.

Domain 4 is characterized by a weak magnetic signature and by the appearance of the assemblage green biotite + epidote + muscovite. This assemblage is typical of metamorphic conditions at the lower to middle amphibolite facies (Turner, 1981). Domain 4 is bounded to the southwest by the Bacqueville ductile-brittle structure. Further north, the boundary between domains 3 and 4 does not appear to be structural, but is marked by a change in the colour of biotite (green) and by the appearance of epidote and muscovite. Green biotite occurs as lepidoblastic crystals containing vermicular quartz. Muscovite, often associated with biotite, displays similar textures. The regional foliation is defined by the mafic minerals (biotite, muscovite and titanite) wrapping around quartz and plagioclase grain boundaries. Locally, a more intense deformation is manifested by the presence of quartz ribbons and porphyroclastic and granoblastic textures. Epidote forms idiomorphic to hypidiomorphic grains, and contains inclusions of biotite, apatite and quartz. It overprints the foliation, quartz ribbons and recrystallization textures. Locally, epidote occurs parallel to the foliation.

In the north-central part of the area, within domain 4, an assemblage of green biotite + hornblende + epidote + brownish titanite + greyish titanite + allanite + chlorite is reported. Petrographic observations suggest that the second generation of titanite (greyish) is superimposed upon the chloritized biotite. The growth of this generation of titanite is probably associated with late brittle structures.

Domain 5, located in the centre of the map area, is characterized by the appearance of red biotite coexisting with titanite. Rocks in this domain frequently display mortar textures (reduction in grain size), quartz ribbons, hornblende grains reoriented parallel to the foliation, poikiloblastic biotite with quartz inclusions, and titanite forming trains of grains oriented parallel to the foliation. Since red biotite reflects high temperature conditions (Hayama, 1959; Deer *et al.*, 1963) and titanite is stable at the amphibolite facies, domain 5 most likely represents metamorphic conditions at the middle to upper amphibolite facies.

Domain 6 constitutes the central and northeastern parts of the map. It is characterized by the presence of orthopyroxene, clinopyroxene, hornblende and red biotite. Pyroxenes display igneous crystal textures (Schiller structure) and are generally stable. Pyroxenes also show granoblastic textures; some grains are realigned along the foliation, while others form aggregates of polygonized pyroxene grains in optical continuity, which resemble poikiloblastic textures. The foliation is generally defined by the alignment of pyroxenes, hornblende and magnetite. Locally, hornblende coronas were noted around clinopyroxene. The stability of orthopyroxene as well as the degree of deformation and recrystallization indicate that rocks in domain 6 underwent granulite-facies metamorphism.

GEOCHRONOLOGY

A geochronological study encompassing all projects under the Far North Program was undertaken by the MRN at GÉOTOP laboratories of the Université du Québec à Montréal. Results of U-Pb isotopic analyses (isotopic dilution and thermal ionization mass spectrometry – *TIMS*) and $^{207}Pb/^{206}Pb$ isotopic analyses (in situ analysis by laser ablation and inductively coupled plasma mass spectrometry – *LA-ICP-MS*) helped establish emplacement and metamorphic ages as well as inherited ages for the principal units mapped. Results of U-Pb analyses in this report are given in million years (Ma) with a confidence interval of 2 standard deviations whereas results of $^{207}Pb/^{206}Pb$ analyses are reported in billion years (Ga) with an interval of 1 standard deviation. In the latter case, uncertainties not mentioned in the text are estimated at about ±1%. U-Pb analyses were specifically performed to define ages of emplacement for lithologies, and the obtained results are generally preferred to results of $^{207}Pb/^{206}Pb$ analyses. All these results will also be the object of a more detailed report dealing exclusively with the geochronological study (David, 2001). This report will also discuss analytical methods and their respective precision, statistical processing methods used and results obtained for all samples collected under the Far North Program during the 1999 field season. A part of this study deals with seven samples (1 to 7, Figure 3) from the Lac La Potherie area. These samples were selected in order to better define the principal lithodemic suites, and to decipher their relative timing.

Samples – Eastern Half

Four samples were collected in the east-central part of the map area, i.e. near Lac La Potherie and Lac Sabine (sites 1 to 4; Figure 3). Samples of the La Potherie Batholith, a granodiorite from the Rivière-aux-Feuilles Suite, an enderbite from the MacMahon Suite and a monzogranite from the La Chevrotière Suite were selected to establish the relative timing of these units, which could be part of the same magmatic suite.

La Potherie Batholith (Alpo)

A sample of biotite-hornblende granite (site 1, Figure 3) (CHV0159, UTM coordinates – NAD 83: 643,393E, 6,523,553N) was collected where the lithology appears to be very homogeneous. This granite displays a discrete but ubiquitous structural fabric. At the sample location, 10-cm wide NE-trending mylonite zones were observed. Zircons recovered from this sample form two populations. The first population is composed of small stubby prismatic crystals. These crystals are idiomorphic, uncoloured to dark brown with simple terminations. The second population of zircons consists of dark brown, ovoid xenomorphic crystals. Results of $^{207}Pb/^{206}Pb$ analyses yielded two statistically distinct modes, namely a principal mode reflecting an age of 2.705 Ga and a second mode representing an age of 2.795 Ga. It is possible to correlate, almost systematically, the first zircon population with the age of 2.705 Ga, and the second population with the age of 2.795 Ga. U-Pb analyses from three crystals of the first population yielded concordant results which were used to calculate an age, the age of crystallization of the granite, of 2723±2 Ma. The age difference between the two methods will be discussed in the detailed geochronology report.

Granodiorite – Rivière-aux-Feuilles Suite (Arfe)

A granodiorite sample was collected (CHV5001, UTM coordinates – NAD 83: 641,056E, 6,498,491N) (site 2, Figure 3) in the Lac Sabine area, south of the La Potherie Batholith. The sample location is situated near the contact with enderbites of the MacMahon Suite. The granodiorite is homogeneous and characterized by the presence of two distinct foliations. Two types of zircons were identified in this sample:

a first population of small dark brown stubby prisms with simple crystal shapes, and a second population of brownish elongate xenomorphic crystals. $^{207}Pb/^{206}Pb$ analyses yielded ages distributed almost continuously between 2.675 Ga and 2.750 Ga. U-Pb analyses of prismatic crystals of the first population yielded ages between 2712 Ma and 2720 Ma. These results are distributed along a regression line whose upper intercept, at 2722±4 Ma, is interpreted as the age of crystallization. This age is identical to that of the La Potherie Batholith (2723±2 Ma), suggesting the two lithologies may be related to the same magmatic event.

Enderbite – MacMahon Suite (Acmm)

A sample of foliated enderbite (CHV5196, UTM coordinates – NAD 83: 624,583E, 6,503,871N) was collected at site 3 located southwest of Lac Sabine (Figure 3). The sampled enderbite is adjacent to the Rivière-aux-Feuilles Suite granodiorite from which sample CHV5001 was described in the previous paragraph. These two lithologies display several similar features suggesting that they may be genetically related. Zircons in this sample are difficult to characterize, as they seem to consist of a single category of crystals that vary progressively from idiomorphic to xenomorphic. Idiomorphic crystals are represented by brownish stubby prisms with a rectangular section, which display simple and asymmetrical pyramid-shaped terminations. Another class of zircons, morphologically similar to the prisms, is rather subhedral. This gives a xenomorphic aspect to certain crystals. Finally, some of these crystals are mixed, and are characterized by the presence of cores with diffuse boundaries. $^{207}Pb/^{206}Pb$ analyses on 24 grains yielded ages varying between 2.660 Ga and 2.765 Ga. Statistical processing outlines two modes of distribution. The first mode represents an age of 2.697 Ga, which is not exclusively linked with idiomorphic prismatic crystals. The second mode, not as clearly established, corresponds to an age of 2.748 Ga which may be correlated with xenomorphic crystals. These results are respectively interpreted as the age of emplacement of the enderbite, and the age of zircon cores inherited from an earlier lithology and probably the host of the enderbitic magma.

Monzogranite – La Chevrotière Suite (Alcv)

A megaphyric hornblende-biotite monzogranite was sampled east of Lac La Chevrotière (CHV5219, UTM coordinates – NAD 83: 602,701E, 6,516,404N) (site 4, Figure 3). The coarse-grained monzogranite is very homogeneous and displays a weak foliation defined by the alignment of mafic minerals and potash feldspar phenocrysts. Structural features as well as field relations lead us to interpret this lithology as late relative to other intermediate to felsic units. Zircons recovered from this sample form a relatively homogeneous population of uncoloured elongate prisms with a rectangular section, and relatively sharp edges. They systematically contain inclusions, although it is not possible to clearly identify actual cores of older zircons. Despite the fact that grains were specifically selected to test for the possible presence of older cores, statistical processing of $^{207}Pb/^{206}Pb$ analyses outlined a single mode corresponding to an age of 2.735 Ga. U-Pb analyses on idiomorphic crystals yielded ages between 2724 Ma and 2733 Ma, distributed along a single regression line to produce an age of 2732+4/-2 Ma, interpreted as the age of emplacement of the monzogranite. This age indicates, as opposed to field observations, that the monzogranite is one of the oldest lithologies in the area.

Samples – Western Half

Three samples were collected in the western part of the map area (sites 5 to 7, Figure 3) in order to establish stratigraphic correlations with surrounding rocks, and to define the chronological sequence more accurately. The three samples were respectively taken from a tonalite of the Rochefort Suite, an opdalite and a charnockite of the Minto Suite.

Tonalite – Rochefort Suite (Arot)

The western part of the map area is underlain by a vast expanse of tonalite corresponding to a weak aeromagnetic signature (Figures 3 and 4). A sample of biotite tonalite (CHV0076, UTM coordinates – NAD 83: 566,557E, 6,469,529N) (site 5, Figure 3) was collected to determine its affinity with tonalites adjacent to the Vizien Complex. The sampled tonalite is homogeneous and shows a penetrative foliation. Zircons recovered from this sample are very distinctive and constitute a homogeneous population of uncoloured crystals with a hexagonal section. These crystals are characterized by a marked zonation, and older cores are frequently observed. Statistical processing of $^{207}Pb/^{206}Pb$ analytical results outlined two modes of distribution. The principal mode corresponds to an age of 2.779 Ga, whereas the second mode represents an age of 2.824 Ga. U-Pb analyses performed on crystal tips yielded discordant results with minimum ages varying between 2763 and 2776 Ma. Additional U-Pb results should help confirm the age of crystallization of the tonalite at ca. 2780 Ma.

Opdalite – Lac Minto Suite (Amin2)

A sample of opdalite (CHV5175, UTM coordinates – NAD 83: 564,247E, 6,507,491N) (site 6, Figure 3) was collected where the lithology appears heterogeneous and is characterized by a high percentage of stretched diorite enclaves outlining a foliation that is locally isoclinally folded. These features may suggest a transition between opdalites and diatexites of the Minto Suite. This sample contains two distinct zircon populations. The most abundant population corresponds to brownish elongate prisms with a hexagonal section. These prisms are mixed and consist of a central core surrounded by several generations of zoned zircon. The second population is represented by uncoloured xenomorphic crystals with barely recognizable crystal faces. It was not possible to obtain $^{207}Pb/^{206}Pb$ analytical results from this population due to their low lead content. $^{207}Pb/^{206}Pb$ analyses from 24 prisms yielded results which helped outline four statistically distinct modes corresponding to ages of 2.682 Ga, 2.742 Ga, 2.782 Ga and 2.840 Ga. The youngest age is interpreted as the age of emplacement of the opdalite. It is similar to ages already obtained for the same lithology in the Nedlouc (Parent *et al.*, 2000) and Maricourt (David, 2001) areas. The age of 2.742 Ga reflects a late felsic magmatic event (leucotonalite or trondhjemite) that affected older tonalites in the "Goudalie Domain". Finally, the last two ages are typical of those found in older tonalites which are associated with volcanic belts, such as the Rochefort tonalite.

Charnockite – Lac Minto Suite (Amin3)

A charnockite (CHV1158, UTM coordinates – NAD 83: 566,512E, 6,444,296N) (site 7, Figure 3) was sampled from a very homogeneous outcrop located in the southwest part of the map area near Lac Bacqueville. Recovered zircons form a single morphological population composed of uncoloured elongate prisms whose cores display magmatic zoning. The prismatic section is characterized by truncated edges whereas the terminations are complex. Furthermore, large fragments of uncoloured clear xenomorphic crystals were also identified. $^{207}Pb/^{206}Pb$ analyses were performed in order to distinguish the prismatic part from the terminal part of the crystals, and a few xenocrysts were also analyzed. The results obtained are homogeneous, and statistical processing has outlined only one mode representing an age of 2.730 Ga. This age is interpreted as the age of emplacement of the charnockite, and it indicates that this lithology was not derived from the same event as the one represented by the Lac Minto Suite opdalite (CHV5175); it rather indicates that it could be a granulitic equivalent of the La Chevrotière monzogranite, dated at 2732+4/-2 Ma.

LITHOGEOCHEMISTRY

The main purpose of the lithogeochemical study presented in this section is to characterize the principal lithodemic suites mapped in the Lac La Potherie area. To do so, 86 samples of these various lithologies were selected and analyzed. All samples were analyzed for major elements, trace elements and rare earth elements (REE). Analyses were performed at the Centre de Recherche minérale du Québec (COREM) using the various analytical methods described hereafter. Major elements and certain trace elements (Ga, Nd, Rb, Sr, Y and Zr) were analyzed by X-ray fluorescence (packages A01 and A04), whereas the other trace elements and REE were analyzed by neutron activation (package A19). The results presented in this report are restricted to those obtained for the Rochefort, Rivière-aux-Feuilles, La Chevrotière and Morrice suites and the La Potherie Batholith. The different suites were established based on field observations, megascopic features, feldspar staining, petrographic descriptions and magnetic characteristics. Geochemistry represents an important tool to verify field observations, to allow for a better global understanding and to establish genetic links between the suites. Results obtained for charnockitic and gabbroic rocks are not discussed in this report, but will be the focus of a subsequent study. Given the low proportion of volcanic rocks in the map area, with the exception of the Vizien Complex (studied by Skulski and Percival, 1996), it is impossible to draw any conclusions on these types of lithologies for NTS sheet 34I.

Results

The normative classification diagram by O'Connor (1965) (Figure 7a) indicates that samples of the Rochefort Suite have tonalitic and trondhjemitic compositions, whereas those of the La Chevrotière and Morrice suites and the La Potherie Batholith fall in the field of granites. Analytical results of granodiorite samples from the Rivière-aux-Feuilles Suite show considerable scatter, falling in the fields of trondhjemite-granodiorite and in the granite field.

Figure 8 illustrates a series of Harker diagrams, showing the variation of the principal major elements as a function of silica contents. These diagrams are used to characterize, subdivide and better define the geochemical behaviour of certain suites listed above. Minimum, maximum and average compositions for these suites are also listed in Table 1.

Rochefort Suite (Arot)

Analyses of Rochefort Suite tonalites contain between 61.5 and 72.0% SiO_2, with an average of 68.0%. When considering major elements, tonalites contrast with other suites due to their higher Al_2O_3 (16.1%), Na_2O (4.97%) and CaO (3.2%) contents, as well as their lower K_2O (1.8%), TiO_2 (0.38%) and P_2O_5 (0.13%) concentrations (Figure 8; Table 1). As is the case for other suites, tonalites show decreasing MgO, Fe_2O_3tot and TiO_2 concentrations as the silica content increases (Figure 8). However, tonalites do not show any variation in the K_2O content relative to SiO_2 increases. The Mg# differentiation index (see definition in Table 1) for this suite varies between 0.33 and 0.47 (average 0.40). As for trace elements, the tonalites contrast with other suites due to their low Ba (499 ppm) and Rb (54 ppm) contents and their high Sr values (538 ppm) (Table 1).

Figures 7e and 7f illustrate the average trace element and REE concentrations for the different suites. The multielement diagram normalized relative to chondrites shows generally similar patterns for all suites, i.e. fractionated patterns with

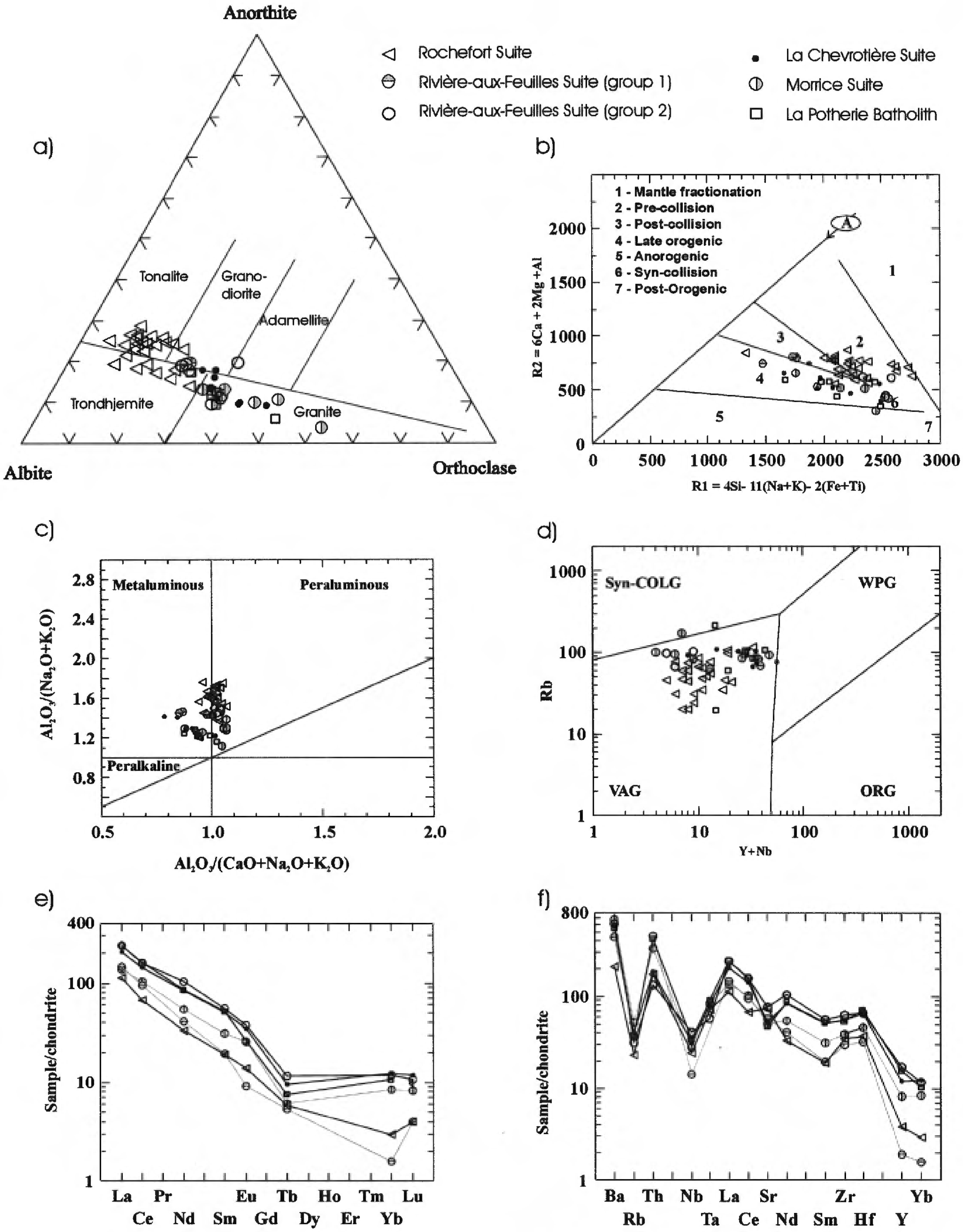

FIGURE 7 - Classification of principal intrusive suites in the Lac La Potherie area: **a)** Normative anorthite-albite-orthoclase diagram by O'Connor (1965); **b)** Discrimination diagram by Bachelor and Bowden (1985); **c)** Alumina saturation index by Maniar and Piccoli (1989); **d)** Paleotectonic diagram by Pearce et al. (1984). Syn-COLG = syn-collisional granitoids; WPG = within-plate granitoids; VAG = volcanic arc granitoids; ORG = oceanic ridge granitoids; **e)** Chondrite-normalized multielement diagram; **f)** Chondrite-normalized rare earth element diagram.

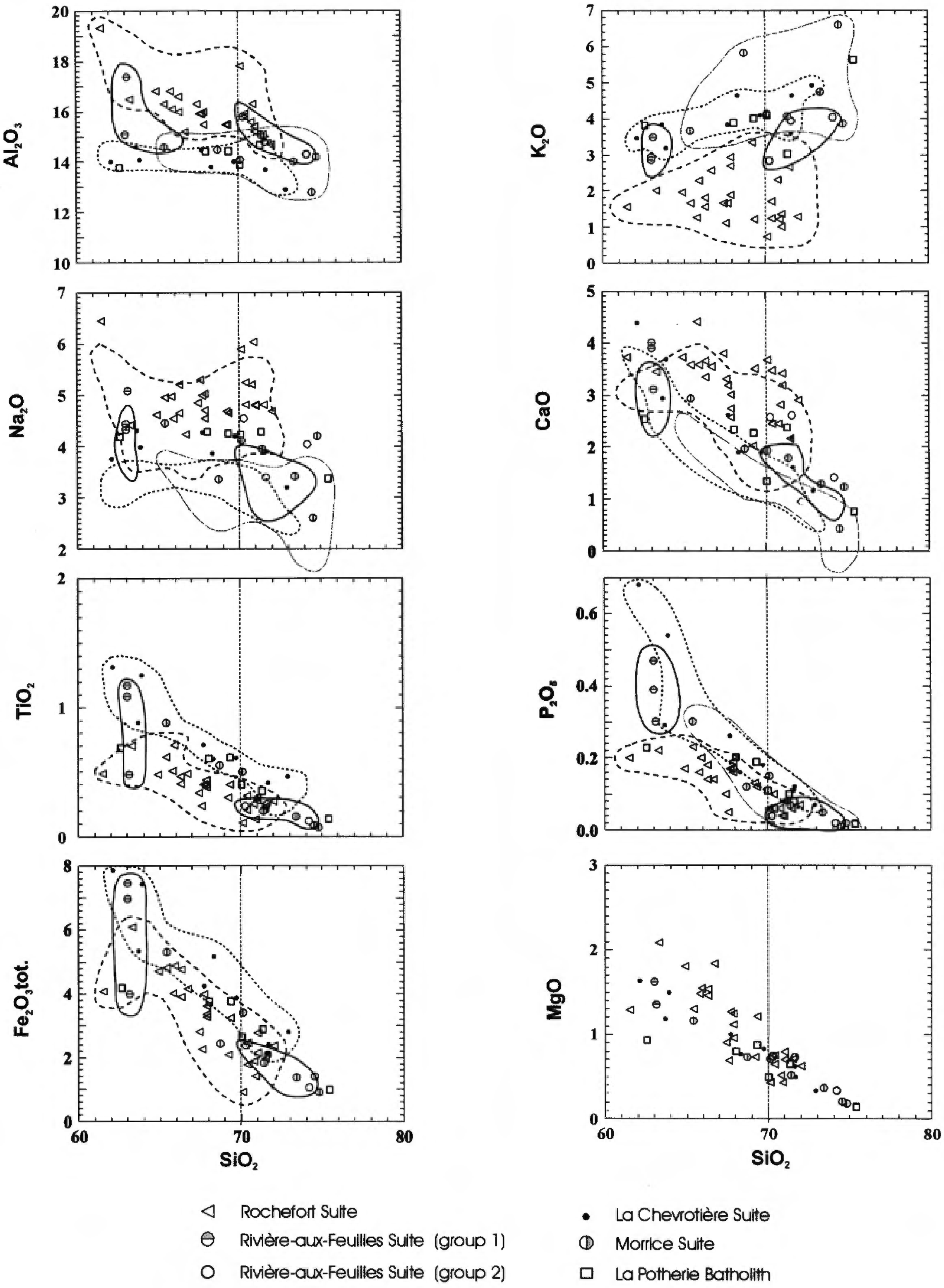

FIGURE 8 - Harker diagrams showing major element variations as a function of silica content.

TABLE 1 - Minimum, maximum and average compositions of the Rochefort, Rivière-aux-Feuilles (groups 1 and 2), and La Chevrotière suites, and undivided granites of the Morrice Suite and La Potherie Batholith.

	Rochefort		Rivière-aux-Feuilles (group 1)		Rivière-aux-Feuilles (group 2)		La Chevrotière		Morrice		La Potherie	
N	26		3		3		9		7		6	
	min-max	ave.	min-max	ave.	min-max	ave.	min-max	ave.	min-max	ave.	min-max	ave.
SiO_2	61.5-72.0	68.04	63.0-63.1	63.03	70.3-74.2	72	62.1-72.9	67.96	65.4-74.8	71.19	62.7-75.5	69.53
TiO_2	0.11-0.71	0.38	0.48-1.17	0.91	0.12-0.25	0.2	0.22-1.31	0.72	0.07-0.88	0.35	0.13-0.69	0.46
Al_2O_3	14.7-19.3	16.08	15.1-17-4	15.87	14.3-15.80	14.9	12.9-14.9	14.06	12.8-15.1	14.19	13.4-14.7	14.1
Fe_2O_3tot.	0.93-6.08	3.23	3.99-7.44	6.14	1.06-2.38	1.85	2.13-7.86	4.58	0.93-5.31	2.39	0.98-4.17	3.04
MnO	0.01-0.10	0.04	0.05-0.14	0.11	0.02-0.03	0.02	0.02-0.13	0.07	0.01-0.10	0.04	0.03-0.08	0.05
MgO	0.43-2.09	1.08	1.36-1.62	1.53	0.34-0.74	0.6	0.34-1.63	0.93	0.19-1.16	0.56	0.14-0.94	0.66
CaO	2.02-4.40	3.22	3.12-4.01	3.68	1.42-2.62	2.21	1.17-4.39	2.49	0.44-2.94	1.66	0.75-2.56	1.95
Na_2O	4.24-6.45	4.97	4.33-5.08	4.62	3.40-4.55	4	3.20-4.31	3.94	2.62-4.46	3.73	3.38-4.30	4.11
K_2O	0.73-3.35	1.8	2.87-3.48	3.09	2.83-4.03	3.6	3.18-4.91	4.02	3.67-6.60	4.7	3.05-5.61	4.11
P_2O_5	0.04-0.23	0.13	0.30-0.47	0.39	0.02-0.08	0.05	0.07-0.68	0.27	0.01-0.30	0.1	0.02-0.23	0.14
Ba	120-970	522	1300-1600	1433	1000-1200	1100	1100-2100	1567	510-5200	1921	460-1600	1226
Rb	20-116	56	63-82	71	66-104	89	67-109	91	83-170	103	59-212	108
Sr	309-825	534	479-796	600	395-538	453	184-503	369	193-758	432	103-396	304
Zr	49-249	135	233-246	240	78-128	106	158-280	227	54-287	148	107-249	202
Th	0.4-21.0	5.14	1.90-7.40	4.17	12.0-15.0	13	0.8-13	5.26	0.5-26	6.64	4.0-30.0	14.3
La	7-71	26.5	43-75	57	20-42	34.3	11-100	48.9	3-56	29.57	41-86	57
Ce	10-120	41.46	85-120	97	32-79	58.3	19-170	87.3	6-130	59.14	89-130	98.7
Nd	5-48	15.5	45-52	48.3	18-22	19.3	5-76	39.2	5-52	23.29	20-61	39.8
Sm	0.8-5.40	2.9	7.0-9.4	8.53	2.0-4.5	2.97	1.6-13.0	7.8	0.5-11.0	4.53	4.4-11.0	8
Eu	0.2-1.5	0.8	1.4-2.8	2.2	0.3-0.9	0.53	1.0-2.7	2	0.6-3.6	1.49	0.7-2.4	1.52
Tb	0.2-0.5	0.22	0.2-0.8	0.43	0.2-0.2	0.2	0.2-1.1	0.36	0.2-0.5	0.24	0.2-0.5	0.28
Yb	0.2-1.4	0.5	0.9-2.8	2.03	0.2-0.3	0.27	0.3-4.0	2.1	0.2-4.1	1.26	0.2-3.0	1.8
Lu	0.1-0.2	0.1	0.1-0.4	0.27	0.1-0.1	0.1	0.1-0.6	0.3	0.1-0.4	0.19	0.1-0.4	0.25
Mg#	0.33-0.47	0.4	0.30-0.40	0.34	0.38-0.41	0.39	0.19-0.36	0.28	0.23-0.37	0.31	0.22-0.32	0.29

Mg# = 100[MgO/(MgO+FeO)]

negative Rb, Nb and Ta anomalies, and slightly positive Hf and Zr anomalies. Tonalites stand out due to a weakly positive Sr anomaly, as opposed to other suites where Sr shows negative anomalies. REE patterns indicate that Rivière-aux-Feuilles granodiorites (group 2) and Rochefort tonalites (see also Mg# differentiation index) are the least evolved suites. Furthermore, the two suites display markedly depleted heavy rare earth contents.

Rivière-aux-Feuilles Suite (Arfe)

From a geochemical standpoint, granodiorites of the Rivière-aux-Feuilles Suite form two distinct groups (trondhjemites-granodiorites and granites) which may belong to two separately evolving suites. In order to better understand variations within the Rivière-aux-Feuilles Suite, the granodiorites were separated into two groups based solely on geochemical criteria (group 1 and group 2), although this distinction was not observed in the field, probably due to the scale of mapping. Group 1 is characterized by silica concentrations around 63%, high Fe_2O_3tot (6.14%), TiO_2 (0.91%), P_2O_5 (0.39%) and Ba (1433 ppm) contents, and by important variations in Al_2O_3, P_2O_5 and Na_2O for a constant silica content (Figure 8; Table 1). The Mg# differentiation index for this group varies between 0.3 and 0.4 with an average of 0.34. Group 2 is characterized by silica concentrations between 70.3 and 74.2%, low Fe_2O_3tot (1.85%), TiO_2 (0.2%) and P_2O_5 (0.05%) values, moderate Ba concentrations (1100 ppm) and a high Th (13 ppm) content. The differentiation index for group 2 granodiorites (0.39) is comparable to that of Rochefort Suite tonalites.

Trace elements and REE confirm the presence of two groups of granodiorites (Figures 7e and 7f). Group 1 shows a REE pattern comparable to that of tonalites. Figure 7e also illustrates that tonalites and group 1 granodiorites are more depleted in heavy rare earth elements. The similar geochemistry indicated by comparable patterns and abundances suggests that group 1 granodiorites may be derived from the same magma as the tonalites. As for group 2, it shows patterns comparable to the granitic suites (La Chevrotière, Morrice suites and La Potherie Batholith), suggesting a genetic link between group 2 granodiorites and the various granitic suites.

La Chevrotière Suite (Alcv)

Monzogranites of the La Chevrotière Suite contain between 62.1 and 72.9% SiO_2, with an average content of 67.7%. They contrast with other suites due to their high Fe_2O_3tot (4.58%), TiO_2 (0.72%) and P_2O_5 (0.27%) content. Elevated iron, titanium and phosphorus concentrations reflect the abundance of magnetite, titanite and apatite. Monzogranites are characterized by high K_2O (4.02%) concentrations that increase along with silica. On multielement and rare earth diagrams, the La Chevrotière Suite displays slightly more evolved patterns relative to Rochefort Suite tonalites and Rivière-aux-Feuilles Suite granodiorites (group 1). The monzogranites also stand out as the suite showing the highest heavy rare earth concentrations.

Morrice Suite (Agdm)

Given the insufficient number of samples from the Dufreboy Suite in map sheet 34I, only samples from the Morrice Suite were considered for the geochemical interpretation of granites in the Lac La Potherie area. These consist of small isolated intrusions and late dykes. These granites contain between 64.4 and 74.8% SiO_2, with an average of 71.2%. They are characterized by high K_2O (4.70%) and Ba (1921 ppm) concentrations. TiO_2 (0.35%), Fe_2O_3tot (2.39%), MgO (0.56%) and Na_2O (3.73%) concentrations in granites of the Morrice Suite are all lower than those measured in other granitic intrusions (La Chevrotière Suite and La Potherie Batholith). REE patterns for Morrice Suite granites are similar to those for the La Chevrotière and Rivière-aux-Feuilles (group 2) suites and the La Potherie Batholith. However, REE abundances are generally lower in the Morrice Suite. Trace elements and REE suggest that granites from this suite are the result of a mixture between, on the one hand, tonalites of the Rochefort Suite and granodiorites of the Rivière-aux-Feuilles Suite (group 1) and on the other hand, granodiorites of the Rivière-aux-Feuilles Suite (group 2) and granites of the La Chevrotière Suite and the La Potherie Batholith.

La Potherie Batholith (Alpo)

Analyzed samples from the La Potherie Batholith have silica contents varying between 62.7 and 75.5%, with an average concentration of 69.5%. This batholith shows high TiO_2 (0.46%) concentrations, and moderate Fe_2O_3tot (3.04%). Titanium concentrations may be explained by the presence of titanite, whereas iron concentrations reflect the presence of hornblende and epidote. However, batholith samples are characterized by low Na_2O, Ba and Rb contents. Important variations in Na_2O, K_2O and CaO are probably due to the effect of late alterations. These alterations had a direct impact on mobile elements such as sodium, potassium and calcium. Looking at trace elements and rare earth elements, the La Potherie Batholith shows patterns comparable to those of the La Chevrotière Suite, albeit slightly more enriched in light rare earths.

Tectonic Environment

The alumina saturation diagram (Maniar and Piccoli, 1989) indicates that the Rochefort, Rivière-aux-Feuilles (group 2) and Morrice suites are peraluminous, whereas the La

Chevrotière Suite, La Potherie Batholith and group 1 from the Rivière-aux-Feuilles Suite straddle the metaluminous and peraluminous fields (Figure 7c).

Several diagrams are used in the literature to discriminate geological environments. Bachelor and Bowden (1985) established a link between the major element composition of granites and their tectonic environment. They believed that primitive basaltic magmas evolve along a silica saturation line and according to a potassium and sodium enrichment trend resulting from the crystallization of feldspars (line A, Figure 7b). Subsequently, these magmas differentiate as a function of increasing silica, and depending on the tectonic environment in which they are emplaced. The tectonic environment discrimination diagram proposed by Bachelor and Bowden (1985) illustrates that tonalites of the Rochefort Suite represent a "pre-collisional" environment, whereas the emplacement of the other suites took place in a syn- to late orogenic setting (Figure 7b). The diagram by Pearce *et al.* (1984) indicates that all analyses fall in the island arc granitoid field, or in the syn-collisional granitoid field (Figure 7d). Based on the diagram by Bachelor and Bowden (1985) as well as on obtained ages (see section entitled "Geochronology"), the tonalites may reflect a pre-collisional island arc setting, whereas the other suites appear to be associated with an orogenic period (pre- to late tectonic).

GEOPHYSICS

The magnetic data used during our field work, and during the interpretation presented in this section are derived from a survey carried out in 1973 for both the federal Department of Natural Resources and the Ministère des Ressources naturelles du Québec. Flight lines were oriented east-west and spaced every 800 m. During the aeromagnetic survey, the magnetometer was maintained at 300 m above ground (Dion and Lefebvre, 2000). The total magnetic field was interpolated to produce a regular grid with a cell size of 200 m. This grid and various derivative products (ex: the vertical magnetic gradient) were used during the mapping survey as well as in the interpretation of the magnetic cross-section illustrated in Figure 4.

The Bouguer anomaly map (Figure 9) was produced by gridding gravity data published by the Geological Survey of Canada (GSC, 1994). Field measurements were sometimes spaced more than 15 km apart. The data were gridded to an interval of 2000 m. From this grid, a cross-section was prepared and will be discussed below.

Physical Properties of Units

Following the geological mapping carried out in the Lac La Potherie area, a total of 908 magnetic susceptibility readings were taken on as many samples. Furthermore, density measurements were made on 15 of these samples. An EDA susceptibilitymeter (model K2) was used to determine magnetic susceptibilities. Measurements were taken on sawed surfaces for each sample. Intervals of measured values for the principal lithologies are listed in Table 2.

The histograms in Figure 10 show the distribution of magnetic susceptibility values as a function of the number of measurements for all samples taken in the area, as well as for each of the following lithologies: granodiorites, tonalites, granites, hypersthene tonalites and diatexites.

The geographical distribution of magnetic susceptibility measurements makes is possible to interpolate to a 2 km grid cell size (Figure 11). Overall, it is possible to establish a good correlation between magnetic susceptibility readings and metamorphic domains (see section entitled "Metamorphism"). In general, higher values correspond to granulite-facies or upper amphibolite-facies domains.

The database containing magnetic susceptibility values measured from samples may be compared with the calculated apparent magnetic susceptibility. Using residual total field magnetic profiles, it is possible to calculate (by filtering) the value of the apparent magnetic susceptibility. This

TABLE 2 - Magnetic susceptibility of principal lithologies in the Lac La Potherie area.

Lithology	Number of measurements	Range ($\times 10^{-3}$ SI)	Average ($\times 10^{-3}$ SI)
Granodiorites	211	0.02 - 153	19
Tonalites	174	0.01 - 156	15
Granites	151	0.02 - 106	15.7
Hypersthene tonalites	70	2 - 117	28.9
Diatexites	60	0.02 - 66.4	9
Monzogranites	56	0.7 - 68	25
Intermediate intrusive rocks	35	2.4 - 180	47
Massive intrusive rocks	36	0.4 - 86	22
Gneiss	23	0.14 - 66	15
Tectonites	26	0.01 - 72	12.5

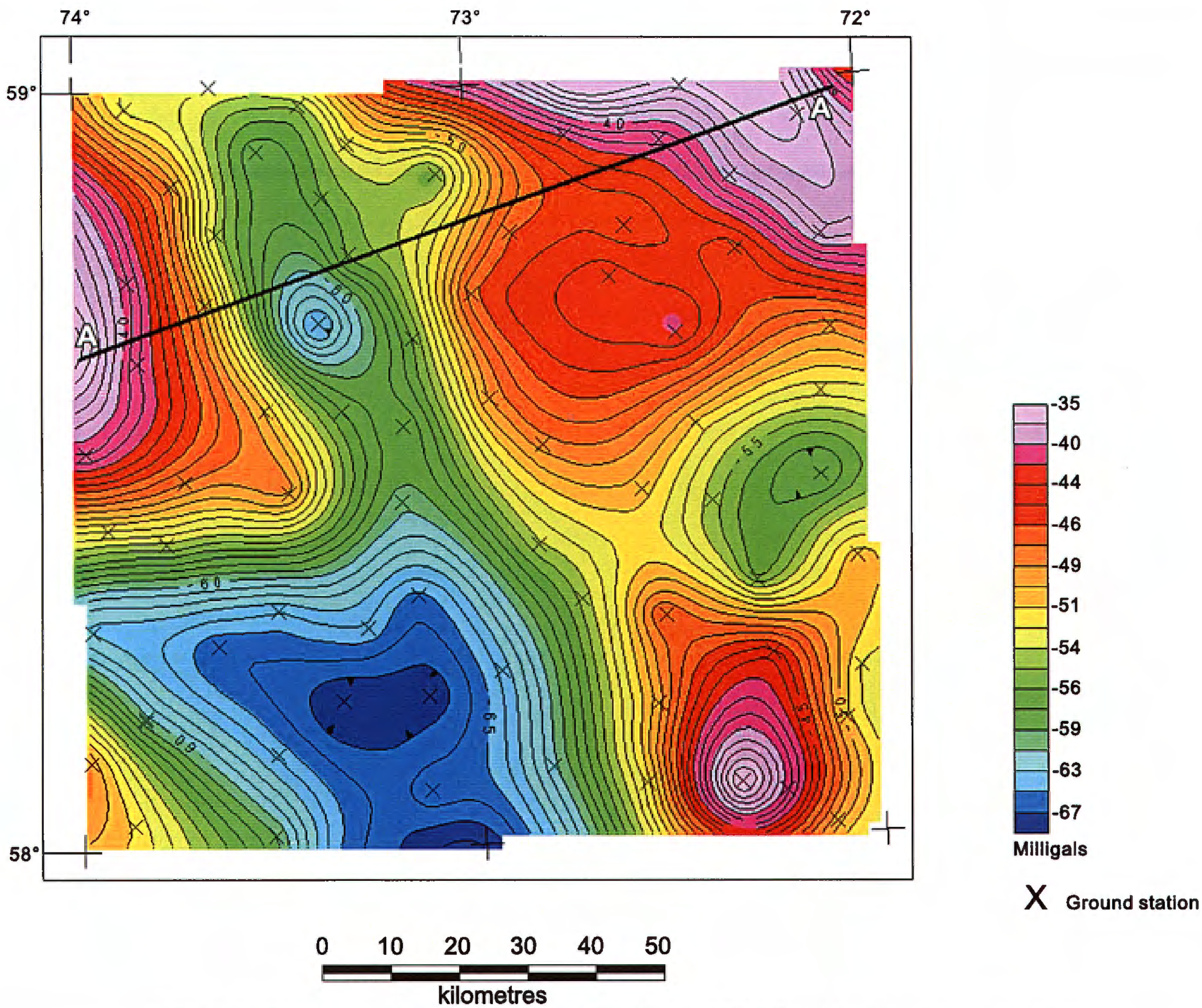

FIGURE 9 - Bouguer anomaly map of the Lac La Potherie area (NTS 34I) and location of cross-section AA'.

calculation is valid if the two following conditions are met: if the magnetic field has been adequately defined and if structures are nearly vertical. This calculation was done, and the results were compared with data from Table 2 and Figure 11.

This analysis brings out a difference between the two types of data. The average for the entire NTS 34I (Lac La Potherie) map sheet equals 0.065 SI (varies from 0 to 0.265 SI), whereas the average for all measured samples equals 0.021 SI (varies from 0 to 0.180 SI). It is generally recognized that magnetic susceptibility can vary within a single lithology, especially if this lithology shows compositional variations. The averages are different, but the range of values is nearly identical. This calculation was performed on the entire database (217,000 magnetic measurements), whereas we have only 908 sample measurements. Given the scale factor however, these measurements are adequate to characterize the lithologies encountered during our field program.

The 15 measurements of specific gravity are not sufficient to outline global trends. However, values are grouped into two families; one includes 10 measurements with an average value of 2.665 g/cc, and the other with 5 measurements has an average value of 2.75 g/cc.

Interpretation of Cross-Sections

The GM SYS software developed by the firm Northwest Geophysical Associates Inc. was used to model magnetic and gravity profiles. This software works in 2½ and 2¾ dimensions as one can modify the Y axis of the model. The method used to calculate the response of the magnetic model is based on the method proposed by Talwani and Heirtzler (1964), and uses algorithms described by Won and Bevis (1987). Calculations for 2½ and 2¾ dimension modelling use the theory of Rasmussen and Pedersen (1979).

The first model refers to a cross-section (AA') from the gravity anomaly map (Figure 9) and shows an anomaly with an apmplitude of 25 mgals (Figure 12). The purpose of this cross-section is to better define the contacts of the Rochefort Suite tonalite, which is associated with the low gravity data(see correlation with the geological map, Figure 3, and Figure 9). From a geological standpoint, the western end of this section is characterized by granulitic rocks, and the eastern end, by the presence of more than 20% mafic and ultramafic rocks. A density of 2.80 g/cc was attributed to both entities. The tonalite in this model displays a nearly vertical eastern contact whereas the western contact is shallowly dipping (Figure 12).

A density of 2.75 g/cc was attributed to the host rocks, which is concordant with the second set of observations. This interpretation is based on an understanding of the Bouguer anomaly and the general density of rocks.

The second model was built from cross-section BB' which is shown on the total magnetic field map (Figure 4). Locally, this profile shows anomalies exceeding 1,500 nanoteslas (Figure 13). Geological contacts and magnetic susceptibility measurements served as a basis for this model. From west to east, three distinct metamorphic facies are observed: the granulite facies, the upper amphibolite facies and the lower amphibolite facies.

When building a magnetic model, the contribution of near surface rocks dominates the magnetic response. This is why the maximum depth of structures is indicative at best, the latter could be deeper or shallower, if variations in the magnetic susceptibility were observed with depth. On Figure 13, lithologies in the western half show nearly vertical contacts, whereas the Rochefort Suite tonalite also shows a subvertical eastern contact but a shallower western dip.

ECONOMIC GEOLOGY

Previous work (Cattalani and Heidema, 1993; Chapdelaine, 1995 and 1996; Cuerrier, 1997 and 1998; Francoeur, 1996; Labbé *et al.*, 1998; Labbé *et al.*, 1999; Lamothe, 1997) has demonstrated the metalliferous potential of Québec's Far North region, especially in the Kogaluc, Qalluviartuuq, Dupire and Duquet volcano-sedimentary belts. These belts contain numerous gold-bearing iron formations as well as

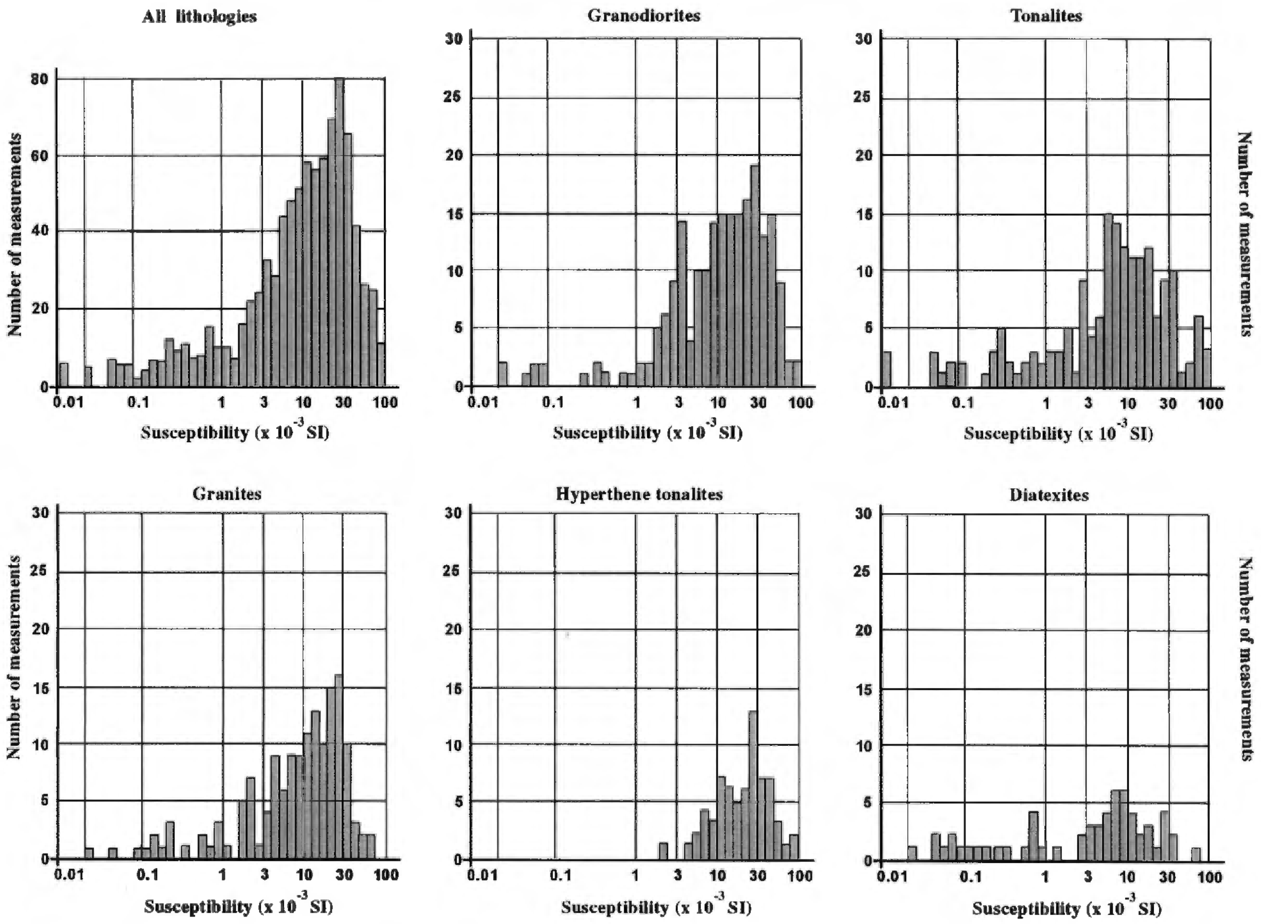

FIGURE 10 - Histograms of magnetic susceptibility (x 10^{-3} SI) for the different lithologies of the Lac La Potherie area.

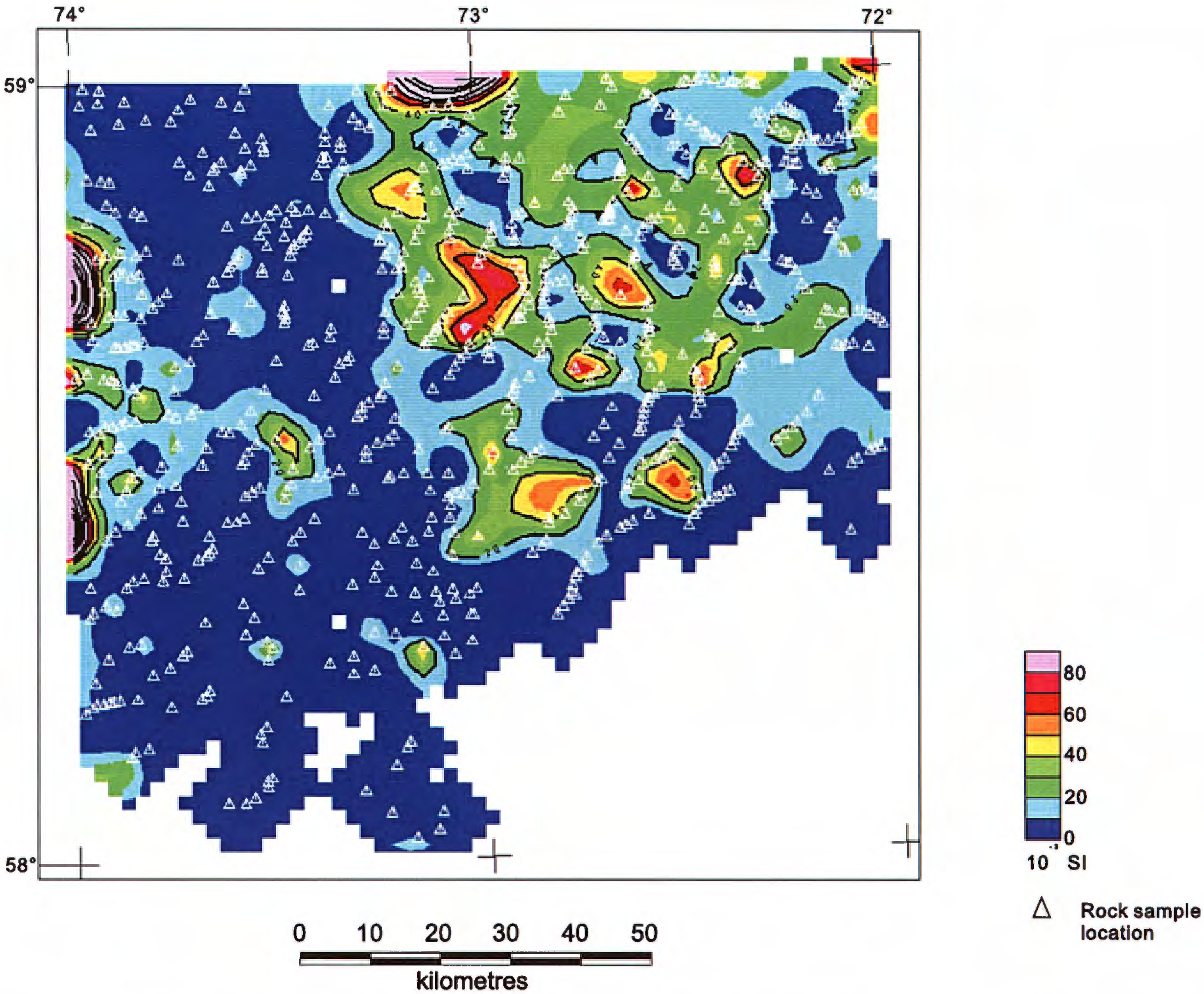

FIGURE 11 - Map showing magnetic susceptibility measurements in the Lac La Potherie area (NTS 34I).

several polymetallic showings. Until 1998, most discoveries were made within three lithotectonic domains (see section entitled "Regional Geology") recognized for their volcano-sedimentary character, namely the "Goudalie, Lac Minto and Qalluviartuuq domains".

Following the lake sediment survey carried out over the entire territory of the Far North Project (MRN, 1998), SOQUEM began investigations in the Lac Nedlouc area (NTS sheet 34H) for its uraniferous potential related to late granites and pegmatites (Quirion, 1999). In 1998, mapping by Madore *et al.* (1999) demonstrated that the Troie and Faribault-Thury complexes ("Douglas Harbour Domain"), located in the eastern part of the Ungava Peninsula, also hosted supracrustal rock remnants, numerous showings, anomalous zones and several interesting geological settings for Au, Ag and base metal ore deposits. And finally, the diamond potential was highlighted over the past year through the work of Moorhead *et al.* (2000) and Berclaz *et al.* (2001). These authors studied possible relations between the distribution of kimberlite fields located throughout Québec and the presence of post-Archean lamprophyre dykes in NTS sheet 24E. Furthermore, the processing of lake sediment geochemistry results reveals several multi-element anomalies in Cr, Ba and Ce (Moorhead *et al.*, 2000). One of these anomalies is located in the northwest part of the Lac La Potherie area (NTS sheet 34I). This type of multi-element anomaly is comparable to one recognized in the vicinity of the Lac De Gras kimberlites in the Northwest Territories (Kjarsgaard *et al.*, 1992).

Investigations performed in recent years have identified a wide diversity of mineralization as well as the potential to discover important showings outside of domains already recognized as being "fertile".

Mapping conducted in NTS sheets 34I and 24L during the 1999 summer season have outlined the mineral potential of the Lac Faribault and Lac Tasiataq areas, located along

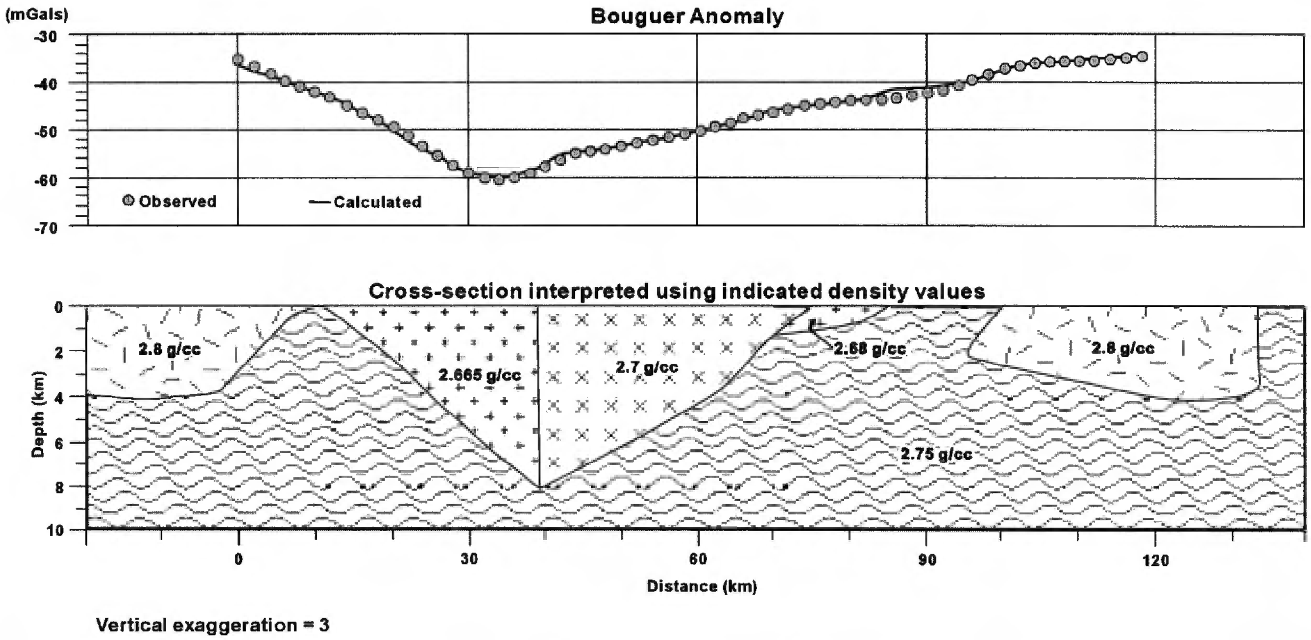

FIGURE 12 - Gravity modelling along section AA'; see Figure 9 for cross-section location.

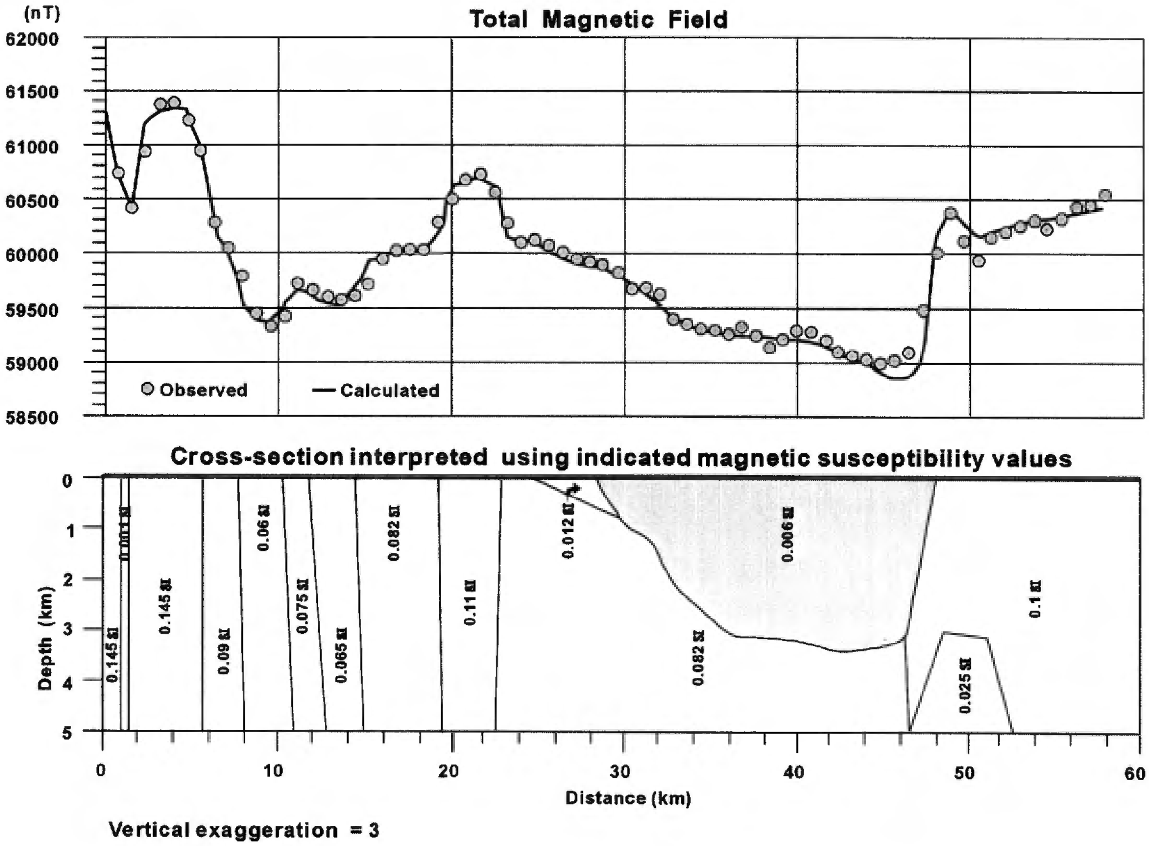

FIGURE 13 - Magnetic modelling along section BB'; see Figure 4 for cross-section location.

the southern extension of the Faribault-Thury Complex (Madore *et al.*, 1999). Four new showings, as well as about ten anomalous zones and interesting geological settings for Au, Ag and base metal ore deposits were discovered in that region. This report will discuss newly discovered showings and anomalous zones exclusively found within NTS sheet 34I. Showings located in map sheet 24L will be described in the report on the Lac Dufreboy area (in preparation). No detailed metallogenic study was conducted on these mineralized zones. However, the principal sites of economic interest located in the Lac La Potherie area (sites 1 to 5), which yielded anomalous Au, Ag and base metal values, are briefly described in Table 3. Site locations are shown on GC-type geological maps (mineral deposit maps) in the SIGÉOM system. Sites of economic interest identified in the area occur in two distinct geological settings, i.e. either in association with supracrustal rocks (site 1 – Bonenfant showing, and anomalous sites 2 to 4), or in association with gabbronorite intrusions (site 5). Supracrustal rock remnants hosting sites of economic interest extend over several kilometres along strike, and vary from a few tens of metres to a few hundred metres in width.

Bonenfant Showing

The Bonenfant showing is located about 15 km east of the northern tip of Lac La Potherie (Figure 3). It is essentially composed of silicate-facies iron formation and siliceous horizons. These lithologies occur in association with garnet paragneisses to the north and mafic rocks to the south. The mafic rocks are interpreted to be of volcanic origin. They consist of alternating layers of intermediate to mafic, and locally felsic rocks. This alternance probably reflects primary bedding (layering) albeit more accentuated by deformation and metamorphism. The Bonenfant showing and the surrounding supracrustal rocks are hosted in enderbites of the MacMahon Suite.

The mineralized horizon, which varies from 15 to 20 m in width, may be traced over nearly 7 km along a N20°W orientation. However, sulphide-rich sections are concentrated over a width of 4 to 5 m. These horizons generally consist of fragmental rocks derived from dismembered outcrops. The mineralization, composed of pyrite-pyrrhotite-chalcopyrite, is either disseminated or occurs as mm-scale veinlets and trains wrapping around fragments. In certain places , siliceous nodules are observed in a matrix of idiomorphic to hypidiomorphic pyrite-pyrrhotite. The matrix may form over 40% of the rock. These siliceous nodules either represent an exhalative facies, or dismembered quartzites that were mechanically rounded by deformation. However, the high degree of recrystallization makes it very difficult to identify the protolith. Within the nodules, small stringers of pyrite-pyrrhotite are observed. This suggests early phase mineralization (syngenetic ?) emplaced prior to the deformation of siliceous horizons. A second phase of mineralization presumably involved the remobilization of metals from the first phase, and the emplacement of idiomorphic to hypidiomorphic sulphides. This second phase was presumably generated in synchronous fashion relative to late deformation. The best results for this showing, 0.54% Cu and 17 ppb Au, were obtained from a sample of iron formation containing chalcopyrite veinlets.

DISCUSSION AND CONCLUSION

The geology of the Lac La Potherie area discussed here is based on the results and interpretations derived from a

TABLE 3 - Characteristics of principal sites where anomalous Au, Ag and base metal values were found.

site	SIGÉOM NUMBER	LOCATION: UTM Nad 83	SETTING	GRADES
			Bonenfant Showing	
1	9064	666,084E 6,531,858N	Silicate-facies iron formation and fragmental siliceous horizons (brecciated aspect), with disseminated PY-PO-CP mineralization, also as veinlets and trains wrapping around fragments.	17 ppb Au, 0.54 % Cu
			Anomalous Sites	
2	38	665,676E 6,532,866N	Silicate-facies iron formation and fragmental siliceous horizons (brecciated aspect) located along the extension of the Bonenfant showing. Rusty zone about 25 metres wide with PY-PO-CP mineralization.	23 ppb Au, 0.11 % Cu
3	5065	669,429E 6,541,342N	Ten-metre enclave of iron formation and paragneiss in diatexites.	0.14 % Cu, 26 ppb Au
4	5092	666,130E 6,520,550N	Thinly laminated siliceous felsic horizons, probably volcanogenic, affected by a fault zone.	87 ppb Au, 1.4 ppm Ag,
5	1256	666,125E 6,529,624N	Gabbronorite with CP-PO mineralization concentrated in the more mafic phases of the gabbronorite. The latter cross-cuts granodiorites of the Rivière-aux-Feuilles Suite.	0.24% Cu, 0.24% Ni, 31 ppb Au, 2 ppm Ag

CP = chalcopyrite; PO = pyrrhotite; PY = pyrite geological survey carried out at a scale of 1:250,000 during the 1999 summer season. The Archean rocks underlying the area belong to the northeastern Superior Province. Based on the tectonic subdivision proposed by Percival *et al.* (1992, 1997b), these rocks form a part of the "Lac Minto, Goudalie and Utsalik domains". As opposed to the notion of lithotectonic domain, the stratigraphic reference scheme proposed in this report helps define the geological framework of the area more accurately, while serving as a basis for regional stratigraphic correlations. As a first step, the stratigraphy established for the study area provides a link with the geology of adjacent regions to the south (Lac Nedlouc; Parent *et al.*, 2000), to the southeast (Lac Aigneau; Berclaz *et al.*, 2000) and to the east (Lac Dufreboy; in preparation). A regional study to obtain a better understanding of the principal stratigraphic and structural elements is currently underway, in order to review the lithotectonic subdivision of the northeastern Superior.

The Lac La Potherie area mainly consists of felsic plutonic rocks, as well as diatexites, igneous charnockites, small gabbro-diorite intrusions, and a few remnants of supracrustal rocks. The geological survey in this area helped define two supracrustal rock complexes, ten suites of intrusive rocks and two lithological units. These Archean units are transected by post-orogenic diabase dykes which may belong to the Ptarmigan, Maguire and Minto dyke swarms.

The supracrustal rocks in the area are essentially concentrated in two important complexes: the Vizien Complex located in the south and the Faribault-Thury Complex which occurs in the northeastern part of the area. The Vizien Complex, which represents the most extensive concentration (10 x 40 km) of supracrustal rocks in the area, contains felsic to ultramafic volcanic and plutonic rocks, as well as several types of sedimentary rocks. The oldest volcanic rocks (ca. 2786 Ma) in this complex occur within a mafic-ultramafic sequence that rests in tectonic contact on a tonalitic basement (ca. 2940 Ma). The presence of similar tonalitic rocks, with a Mesoarchean age (3.1-2.9 Ga), was not observed elsewhere in the area. On the other hand, the vestiges of an early Mesoarchean protocraton are locally indicated by the presence of inherited zircons in younger rocks (David, 2001). Sedimentary rocks in the Vizien Complex consist of wackes and conglomerates (<2718 Ma). The Faribault-Thury Complex, however, is composed of narrow (<1 km) bands of volcano-sedimentary rocks hosted in charnockitic and granitic intrusions. This complex extends northward in the Lac Peters area (Madore *et al.*, 1999) where it contains several fairly well preserved volcano-sedimentary belts within tonalite intrusions. To the south, the Faribault-Thury Complex is invaded by a huge body of granite associated with a major magnetic high covering the southeast part of the map area, as well as a large portion of the Lac Dufreboy area to the east.

The Lac La Potherie area is, above all, characterized by an imposing series of ten intrusive suites which were emplaced between 2.81 and 2.68 Ga. The oldest intrusive rocks in the area are the tonalites of the Suluppaugalik Suite (ca. 2.805 Ga) and the Rochefort Suite (ca. 2.780 Ga). These rocks are typically associated with magnetic lows related to volcano-sedimentary sequences. They possibly represent early tonalite-trondhjemite-granodiorite (TTG) suites that developed in a "pre-collisional" island arc environment. The other suites of younger intrusive rocks represent widespread calc-alkaline magmatic activity which is presumably "syn-collisional" (ca. <2.76 to 2.68 Ga) relative to the orogenic event. This magmatism, among others, is marked by the syn- to late tectonic (between about 2.74 and 2.70 Ga) emplacement of important volumes of granodiorite and granite belonging to the La Potherie Batholith and to the La Chevrotière, Rivière-aux-Feuilles, Dufreboy and Morrice suites. Moreover, the major collision is characterized by the emplacement of charnockitic intrusions (MacMahon Suite, ca. 2.70 Ga) and diatexites (Minto Suite, ca. 2.68 Ga), which accompany a regional metamorphic event varying from the amphibolite facies to the granulite facies, as well as an important recycling of lithologies.

The structural evolution of rocks in the Lac La Potherie area is expressed by complex folding deformation events and regional shearing. The principal foliation is affected by at least two phases of folding and one phase of major shearing. In certain places, metamorphic rocks at the amphibolite facies are juxtaposed against granulite-facies rocks, generally along more intense ductile deformation zones. Several shear zones were presumably largely obliterated by syn- to late tectonic intrusions relative to their development. This hypothesis is based on the distribution of certain intrusions, which appear as sheets oriented parallel to the structural trend. For example, granites of the La Chevrotière Suite are massive to foliated, and locally display a mylonitic fabric. These granites roughly coincide with a metamorphic transition, and were probably emplaced along active deformation zones.

Mapping in the Lac La Potherie area has led to the discovery of several mineral occurrences containing pyrite-pyrrhotite-chalcopyrite mineralization, which yielded significant Cu-Au-Ag values (Table 3). These mineralisations, concentrated in the NE part of the area, outline the mineral potential of volcano-sedimentary rocks belonging to the Faribault-Thury Complex. The Bonenfant showing, associated with an iron formation inserted within a volcano-sedimentary sequence, occurs in a mineralized zone that measures 15 to 20 m wide by 7 km long. Other volcano-sedimentary rocks in the Faribault-Thury Complex also revealed an interesting mineral potential (Madore *et al.*, 1999). Moreover, anomalous values obtained from mineral occurrences hosted in gabbro intrusions indicate a promising mineral potential in the area for magmatic Ni-Cu deposits associated with mafic to ultramafic intrusions. As illustrated by the recent discovery of an important Ni-Cu-Co showing in the Lac Qullinaaraaluk area (Labbé *et al.*, 2000), gabbro-pyroxenite intrusions represent a new exploration target that is bound to generate an increased economic interest for the Archean rocks of the Far North.

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Abstract

The Lac La Potherie area (NTS 34I) is located in the centre of the Ungava Peninsula, north of the Rivière aux Feuilles, about 270 km west of Kuujjuaq. The geological survey at a scale of 1:250,000 carried out in this area during the summer of 1999 is part of the Far North Project, whose objectives are to determine the nature, origin, tectonic evolution and mineral potential of the northeastern Superior Province.

Archean rocks in the Lac La Potherie area mainly consist of various plutonic rocks, igneous charnockites and a few remnants of supracrustal rocks. These rocks were subdivided into several lithodemic units in order to establish regional stratigraphic correlations. Supracrustal rocks are essentially concentrated in two lithodemic units: the Vizien Complex and the Faribault-Thury Complex. The Vizien Complex (10 km x 40 km) is subdivided into four informal units: mafic volcanic rocks, felsic and intermediate volcanic rocks, ultramafic rocks and sedimentary rocks, all metamorphosed to the middle amphibolite facies. The Faribault-Thury Complex consists of narrow (<1 km) remnants of volcano-sedimentary rocks disturbed by granodioritic intrusions. These rocks are cut and partially assimilated by charnockitic and granitic intrusions. The metamorphic grade in the complex varies from the upper amphibolite facies to the granulite facies. Elsewhere, the plutonic rocks are subdivided into ten lithodemic units defined on the basis of lithological, geochronological, geophysical and geochemical criteria. Heterogeneous tonalites are assigned to the Suluppaugalik Suite (ca. 2805 Ma), whereas the Rochefort Suite (ca. 2780 Ma) is characterized by homogeneous tonalites. Small bodies (<50 km) of gabbro-gabbronorite and diorite-quartz diorite, commonly associated with positive aeromagnetic anomalies, are grouped in the Bacqueville Suite. Granodiorite intrusions, occurring as sheets oriented NW-SE, are assigned to the Rivière-aux-Feuilles Suite (2722 Ma). Granites are assigned to four different lithodemic units: the La Chevrotière Suite (2732 Ma), the La Potherie Batholith (2723 Ma), the Dufreboy Suite and the Morrice Suite (ca. 2700 Ma). The MacMahon Suite (ca. 2700 Ma) is composed of late enderbite and opdalite intrusions. The Minto Suite (ca. 2680 Ma) consists of orthopyroxene diatexites and charnockitic-type rocks.

Rocks in the Lac La Potherie area reflect a complex structural setting, involving a combination of five phases of ductile deformation and folding (D-D) and one phase of brittle deformation (D). The principal foliation (D) was affected by tight to isoclinal folds (D) and shear zones (D). The outcrop pattern was then slightly modified by open folds (D) which are only observed locally, and by late brittle faults (D). The structural evolution is marked by a high grade regional metamorphism, and a series of pre- to post-tectonic intrusive events that mask contact zones between certain geological assemblages. In the centre of the area, mineral assemblages indicate metamorphic conditions at the lower to middle amphibolite facies, corresponding to weak magnetic signatures. On either side, intense magnetic signatures and granulite-facies conditions are generally associated with charnockitic rocks.

The NE part offers a promising potential for Cu-Au±Ag deposits based on the discovery of a showing and four anomalous zones. Pyrite-pyrrhotite-chalcopyrite mineralization was observed in three different geological settings: 1) silicate-facies iron formations inserted in volcano-sedimentary sequences, 2) gabbro intrusions, and 3) volcanogenic siliceous horizons in a fault zone. The mineralized zone associated with an iron formation that hosts the Bonenfant showing extends for seven kilometres along strike.

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