RG 2002-05

GEOLOGY OF THE LAC KLOTZ (35A) AND THE CRATERE DU NOUVEAU-QUEBEC (SOUTHERN HALF OF 35H) AREAS

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Énergie et Ressources naturelles

Québec

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Accompanies maps
SI-35A-C2G-01I
SI-35H-C2G-01I

Aerial view of the Cratère du Nouveau-Québec, Ungava Peninsula.

2002

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ABSTRACT

This new geological survey covers the Lac Klotz area (NTS sheet 35A) and the south half of the Cratère du Nouveau-Québec area (southern half of NTS sheet 35H). The study area is underlain by Archean rocks of the Superior Province assigned to the Douglas Harbour, Lepelle and Utsalik domains. These Archean rocks are intruded by Paleoproterozoic dykes (Payne River dykes and Klotz dykes) and partially overlain by thrust sheets. These thrust sheets, composed of Paleoproterozoic supracrustal sequences, belong to the Ungava Trough.

In the eastern part of the area lies the ***Douglas Harbour Domain***, which consists of the Qimussinguat and Faribault-Thury complexes, two complexes essentially composed of gneissic tonalites. Gneissic tonalites in the ***Qimussinguat Complex*** contain orthopyroxene and clinopyroxene. These tonalites host mafic and metasedimentary enclaves metamorphosed to the granulite facies. In the ***Faribault-Thury Complex***, gneissic tonalites contain hornblende and biotite. They enclose volcano-sedimentary remnants metamorphosed to the amphibolite facies. Rocks of the Qimussinguat and Faribault-Thury complexes are intruded by granodiorites and granites assigned to the ***Leridon Suite***. Two syenite plutons, grouped in the ***Kimber alkaline Suite***, are observed in the rocks of the Qimussinguat Complex.

In the western part of the area, we find the ***Lepelle and Utsalik domains***. Wedged between the two, the ***Pélican-Nantais Complex*** contains lithologies comparable to those observed in the Faribault-Thury Complex. The Pélican-Nantais Complex consists of biotite-hornblende gneissic tonalites enclosing volcano-sedimentary bandsmetamorphosed to the amphibolite facies. However, assemblages typical of the granulite facies are observed locally. The Lepelle and Utsalik domains also contain rafts of gneissic biotite-hornblende tonalite several kilometres in size, assigned to the ***Kapijuq Suite***.

Rocks of the Pélican-Nantais Complex and the Kapijuq Suite are enclosed by large masses of granodiorite and granite. These granodiorites and granites are generally foliated, and typically contain hornblende and clinopyroxene. These composite intrusions form the ***Lepelle and Châtelain suites***. The two suites are separated by an axis occupied by the Pélican-Nantais Complex, and by large ductile deformation zones oriented N-S that transect the entire area. Granodioritic and granitic bodies assigned to the Lepelle and Châtelain suites also contain foliated orthopyroxene-bearing intrusions ranging from tonalitic to granitic and dioritic in composition, grouped in the ***MacMahon Suite***.

Late Archean intrusions, tabular in shape and oriented parallel to the regional N-S fabric are observed in the Lepelle and Utsalik domains. These consist of massive or foliated granitic, monzogranitic and monzonitic rocks that locally display a porphyritic texture. These felsic intrusions belong to the ***La Chevrotière Suite***.

A regional structural study reveals five deformation episodes, along with an anorogenic episode. The first three episodes of deformation (D1, D2 and D3) are ductile and Archean in age. ***Deformation D1*** consists of an early foliation or gneissosity, oriented N-S and steeply dipping. The peak of deformation resulted in the development of isoclinal and intrafolial folds. ***Deformation D2*** corresponds to open folds that generated weak undulations of the regional fabric. This deformation is discrete and weakly developed. ***Deformation D3*** corresponds to ductile shear zones located along major lithotectonic discontinuities. These Archean deformation episodes were followed by a Paleoproterozoic anorogenic event, during which two gabbro dyke swarms were emplaced (***Payne River dykes*** and ***Klotz dykes***). The emplacement of these dykes was followed by another Paleoproterozoic event (D4), which corresponds to the Ungava Orogen. A final episode of late deformation (D5) followed the two Paleoproterozoic events. It consists of rectilinear brittle faults that transect the entire area.

Apart from the sector underlain by rocks of the Ungava Trough, the mineral potential of the study area was very poorly known. During the geological survey carried out in the summer 2000, a few mineral occurrences were identified. These showings are essentially located in the Nantais and Kimber volcano-sedimentary belts. In the ***Nantais belt***, the mineralization consists of Au, Ag, Zn, Pb, Cu. This area shows strong potential for "gold-bearing volcanogenic massive sulphide"-type deposits. In the ***Kimber belt***, high rare earth element concentrations were observed in carbonate rocks. Furthermore, this volcano-sedimentary sequence represents a favourable environment for epithermal or porphyry-type deposits.

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INTRODUCTION

Objectives

This geological survey, carried out during the summer season of 2000, covers the Lac Klotz map sheet (NTS 35A) and the southern half of the Cratère du Nouveau-Québec sheet (NTS 35H). This project is a part of the Far North mapping program undertaken by the Ministère des Ressources naturelles. Its objectives are to produce a geological map at a scale of 1 : 250,000, to establish a comprehensive data base of field data and lithogeochemical analytical data, and to assess the mineral potential of the area by identifying geological settings favourable to the discovery of mineral deposits.

Location and access

The area covered by this survey is located in northern Québec, in the Ungava Peninsula (Figure 1). It is bounded to the north by the Ungava Trough (at an approximate latitude of 61° 25') and to the south by the 60th parallel. It is bounded respectively on the east and the west by longitudes 72° 00' and 74° 00'. The centre of the area is located 230 km east of Puvirnituk. The closest Inuit community is Kangiqsujuaq, located 150 km to the northeast of the centre of the map area. The area is accessible by ski-equipped aircraft, from December to May, and by floatplane during the summer season. The Lepelle, Lestage, Leridon, Vachon and Kimber rivers are the principal waterways that drain the area. The large water bodies are lakes Bécard, Klotz and Nantais. The Cratère du Nouveau-Québec is located in the NW part of the study area. The topographic relief is low, and the land is hilly at best. The average altitude gradually increases from 200 m above sea level in the south to 550 m in the north. The area is located north of the tree line. Rock outcrops are numerous and fairly extensive, but are generally covered with lichen.

Methodology

Fieldwork consisted of geological mapping at 1:250,000 scale, sampling of lithodemic units and mineral occurrences for lithogeochemical analysis, and the collection of six samples for geochronological analysis. Geological crews were transported in the field by helicopter. Traverses, averaging 15 km long, were spaced every 8 km or so. The grid spacing was reduced in more interesting areas, namely in volcano-sedimentary sequences and in alkaline intrusions. Previously acquired geoscience data are integrated to newly collected data. All this information is stored in a spatially referenced information system: SIGÉOM (Québec's geomining information system).

Previous work

In the 1960s, the Geological Survey of Canada (Stevenson, 1968) carried out a 1:1,000,000 scale reconnaissance survey, which covers a major part of the Ungava Peninsula, bounded by longitudes 70°00' and 79°00' and latitudes 56°00' and 61°00'. The Geological Survey of Canada later carried out more detailed studies; first, a reconnaissance geological survey published at a scale of 1:250,000, which includes map sheet 35H (Taylor, 1982), then 1:50,000 scale geological surveys focussed on Paleoproterozoic rock sequences (Scott *et al.*, 1989; St-Onge *et al.*, 1989; St-Onge *et al.*, 1990a to 1990h). The Archean rocks were also mapped at 1:100,000 scale in the Foul Bay, Joy Bay and Pointe Rouge areas (Lucas and St-Onge, 1997; St-Onge and Lucas, 1997a and 1997b). A geological reconnaissance survey at 1:250,000 scale covered the west half of map sheet 35A (Percival *et al.*, 1997a). A lake sediment survey (MRN, 1998), a gravity survey with a 10-km grid spacing (GSC, 1994) and a regional aeromagnetic survey (Dion and Dumont, 1994) complete the geoscience coverage.

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GENERAL GEOLOGY

The NE Superior Province consists of Archean plutonic and gneissic rocks that enclose volcano-sedimentary belts. These Archean rocks are typically metamorphosed to the

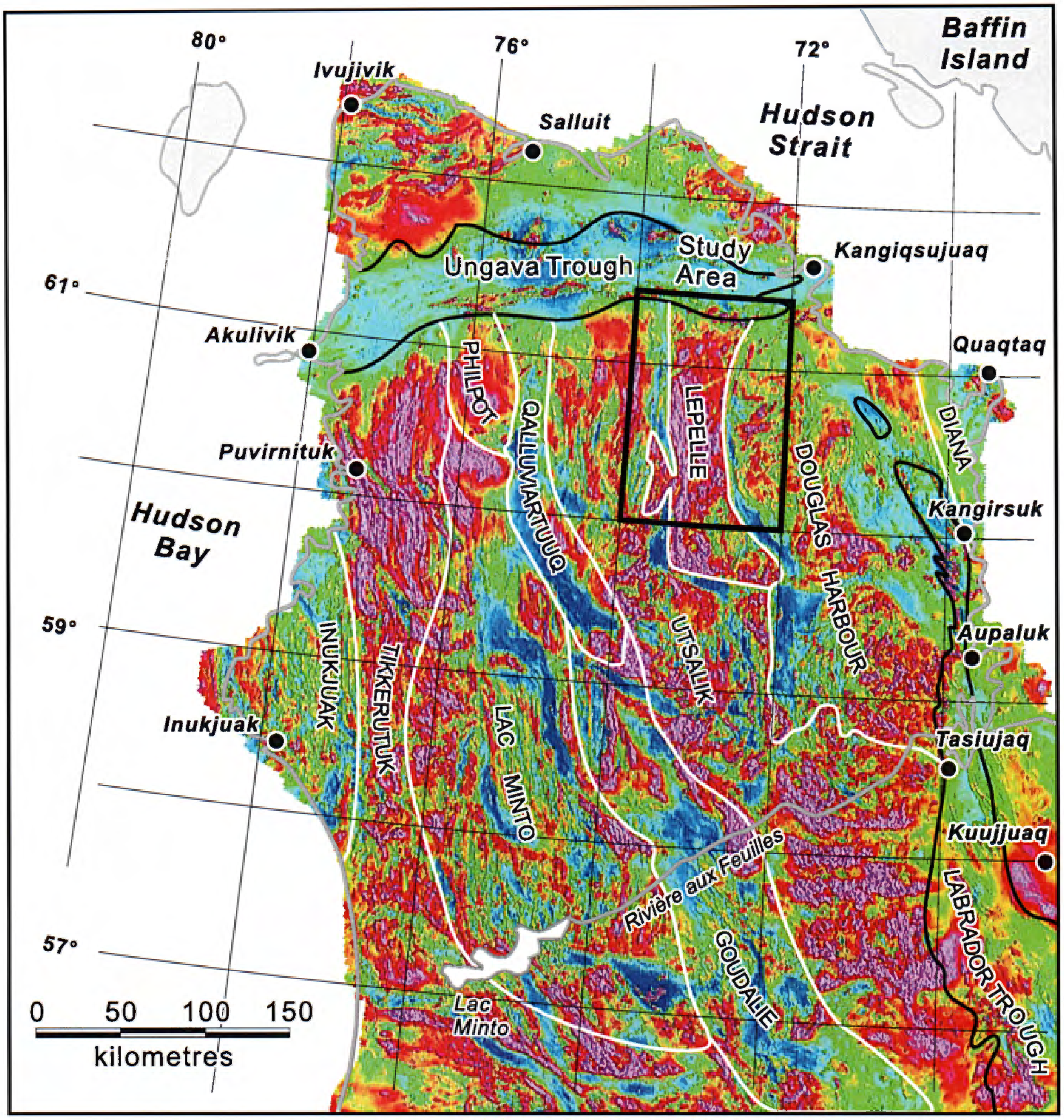


FIGURE 1 - Shaded total magnetic field map showing the location of the study area and the boundaries of lithotectonic domains (modified after Percival *et al.*, 1991, 1992, 1997b).

amphibolite or the granulite facies. This part of the Archean craton has recorded a series of tectono-metamorphic events between 2.8 and 2.6 Ga. The Archean craton is bounded by Paleoproterozoic sequences assigned to the Labrador Trough eastward, and to the Ungava Trough northward. This Paleoproterozoic rock cover is allochthonous, at least along its northern extent, and tectonically overlies the craton (St-Onge *et al.*, 1988; St-Onge and Lucas, 1990; Bouchard *et al.*, 1999). Along the margins of these Paleoproterozoic sequences, the Archean rocks were remobilized during the Proterozoic (New Québec and Ungava orogens; *ca.* 1.8 Ga).

The NE Superior Province was subdivided into nine lithotectonic domains oriented NNW-SSE (Percival *et al.*, 1991, 1992 and 1997b) to which we have added a new domain (Diana Domain; Figure 1) located in the NE part of the Ungava Peninsula. Zones where the magnetic field is high generally coincide with domains composed of granite-granodiorite that commonly contain orthopyroxene, or of granulitic gneiss. Magnetic lows coincide with domains composed of ***tonalite-trondhjemite-granodiorite/granite*** (TTG suite) within which are found volcano-sedimentary belts. The major lithotectonic domains are shown in Figure 1.

The ***Inukjuak Domain***, characterized by a weak magnetic field, is poorly known. According to reconnaissance mapping by Stevenson (1968), it consists of granite (2.69-2.71 Ga) with metasedimentary enclaves. The ***Tikkerutuk Domain*** coincides with an area characterized by a high magnetic field. This zone extends towards the SE into the Bienville Subprovince. The Tikkerutuk Domain is mainly composed of orthopyroxene-bearing tonalitic, granodioritic and granitic intrusive rocks (2.69-2.70 Ga). The ***Lac Minto Domain*** shows a variable magnetic field, and a magnetic trend oriented NW-SE. This domain essentially consists of granodiorites (2.73-2.72 Ga) with supracrustal rock bands dominated by paragneisses and iron formations, including the Kogaluk volcano-sedimentary belt (2.76 Ga). These lithologies are intruded by peraluminous orthopyroxene-biotite-garnet granodiorites (2.69 Ga). The ***Philpot Domain*** coincides with a magnetic high. It is composed of gneisses and intrusive rocks (2.75 Ga). The ***Goudalie Domain*** is confined in a magnetic trough that runs across a major portion of the Ungava Peninsula from the NW to the SE. The Goudalie Domain contains tonalites (2.92-3.01 Ga) and volcano-sedimentary belts including the Vizien belt (2.78-2.71 Ga), interpreted by Skulski and Percival (1996) as an assemblage of oceanic fragments and continental arcs. Along the northward extension of this great magnetic trough, lies the ***Qalluviartuuq Domain***. This domain consists of volcanic (2.84-2.83 Ga) and sedimentary (2.74 Ga) bandsenclosed in granodiorite (2.77 Ga). It namely includes the Payne and Duquet volcano-sedimentary belts. The ***Lepelle and Utsalik domains*** coincide with a large area characterized by a high magnetic field, oriented NW-SE. These two domains are essentially composed of granodiorite (2.75-2.72 Ga). These granodiorites host tonalitic gneisses and orthopyroxene tonalites. They also enclose the Pélican-Nantais volcano-sedimentary belt (2.77-2.74 Ga), which sits at the boundary between the Lepelle and Utsalik domains. The Pélican-Nantais belt coincides with a magnetic trough. The ***Douglas Harbour Domain*** coincides with a zone containing two magnetic domes, characterized by a high and irregular magnetic field and surrounded by magnetic lows. The two magnetic domes correspond to orthopyroxene-bearing gneissic tonalites (2.76-2.73 Ga), which host small bands of supracrustal rocks metamorphosed to the granulite facies. Magnetic lows coincide with volcano-sedimentary belts (2.78 Ga) metamorphosed to the amphibolite facies, and enclosed in gneissic tonalite. In the Douglas Harbour Domain, the oldest gneissic tonalites were dated at 2.87 Ga. A geological survey conducted in the NE Ungava Peninsula (Madore and Larbi, 2000) helped identify a new domain located just east of the Douglas Harbour: the ***Diana Domain***. This domain contains a lithodemic unit known as the Diana structural Complex. It coincides with an area where the magnetic field is variable, with a well-developed magnetic pattern oriented NW-SE. The Diana Domain is essentially formed of Archean (2.77 Ga) gneissic tonalites that were reworked during the Proterozoic (metamorphic age of 1.78 Ga). It is characterized by a well-developed mylonitic foliation that affects both Archean and Paleoproterozoic lithologies.

STRATIGRAPHY

The study area is essentially underlain by rocks of Archean age belonging to the Superior Province. This region is centred on the ***Lepelle Domain***. It also includes part of the ***Utsalik Domain*** to the west, and part of the ***Douglas Harbour Domain*** to the east. These Archean rocks are intruded by Paleoproterozoic dykes (Payne River dykes and Klotz dykes). They are also, in the north part of the area, overlain by Paleoproterozoic supracrustal sequences belonging to the Ungava Trough. The simplified geology of the area is shown in Figure 2. In this report, the description of units deals mainly with Archean rocks, since the rocks of the Ungava Trough have already been mapped at 1:50,000 scale (Scott *et al.*, 1989; St-Onge *et al.*, 1989, 1990a to h).

Douglas Harbour Domain (Archean)

Recent geological mapping (Madore *et al.*, 1999 and 2000) helped subdivide the Douglas Harbour Domain into three major lithodemic units: the Qimussinguat and Faribault-Thury complexes, present in the map area (Figure 2), as well as the Troie Complex, which outcrops to the southeast of the study area. The Troie and Qimussinguat complexes are mainly composed of orthopyroxene-bearing gneissic tonalite. These tonalites contain enclaves and bands of gabbroic, basaltic and sedimentary rocks, metamorphosed to the granulite facies. The bands are rare and generally small. The Faribault-Thury Complex is essentially composed of hornblende-biotite gneissic tonalite. The tonalites of the Faribault-Thury Complex enclose bands of basaltic and sedimentary rocks metamorphosed to the amphibolite facies. The volcano-sedimentary bands range from one to several kilometres in size, and form a string of segments that extend over a distance of more than 100 km. Gneissic tonalites in all three complexes are cross-cut by foliated granodioritic and granitic intrusions. In the map area, these intrusive rocks are assigned to the Leridon Suite. Two small circular nepheline syenite plutons, assigned to the Kimber alkaline Suite, were identified in the area. These intrude gneissic tonalites of the Qimussinguat Complex.

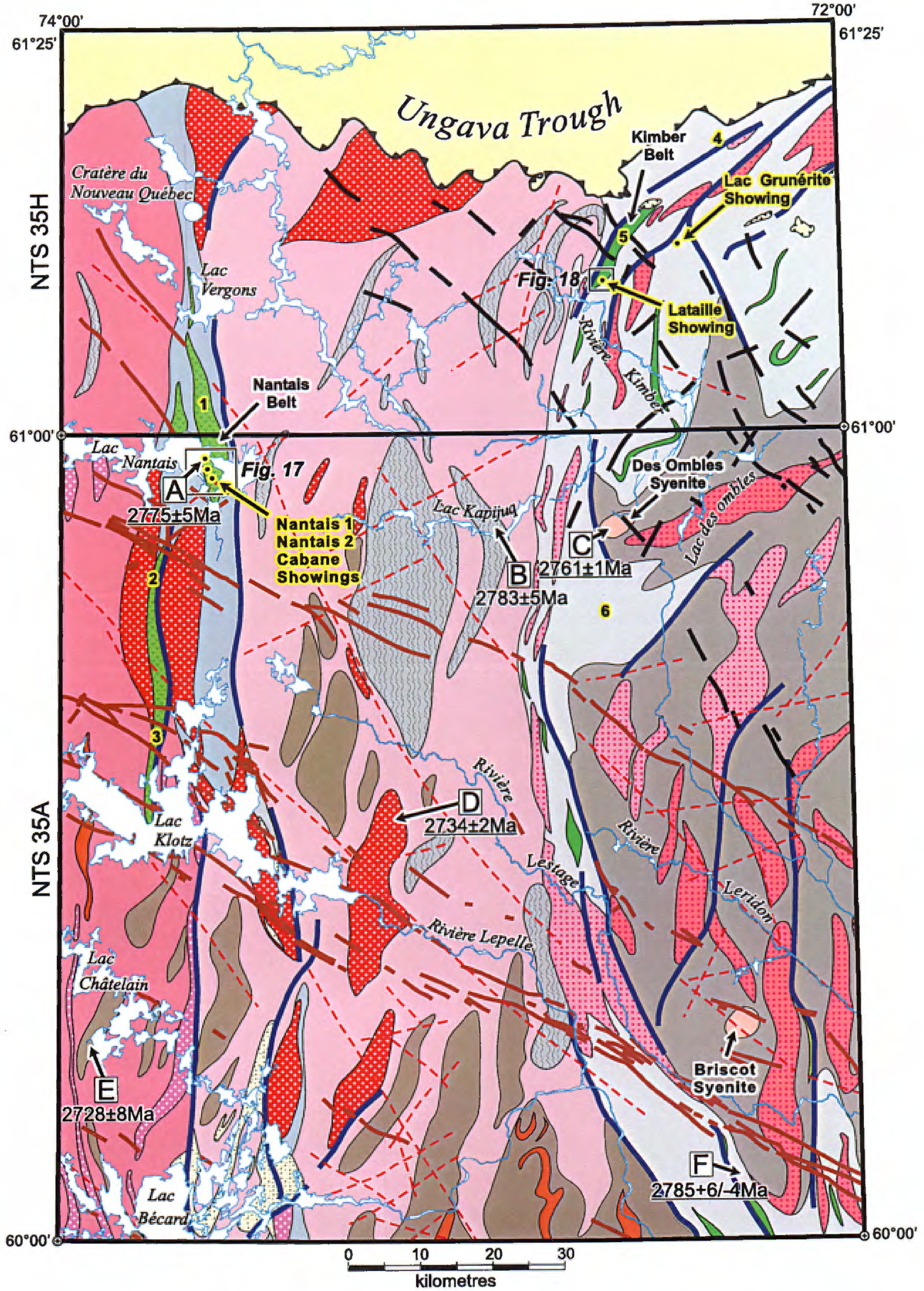


FIGURE 2 - Simplified geology of the Lac Klotz area (NTS 35A) and the south half of the Cratère du Nouveau-Québec area (NTS 35H).

STRATIGRAPHIC LEGEND

UNGAVA TROUGH
PALEOPROTEROZOIC

Undivided: Sedimentary and volcanic rocks, mafic and ultramafic intrusions

DYKE SWARMS
PALEOPROTEROZOIC

Payne River dykes (~2000 Ma)
Ophitic-textured gabbro (pPpay)
Klotz dykes (~2209 Ma)
Ophitic-textured gabbro (pPktz)

SUPERIOR PROVINCE
ARCHEAN

LEPELLE AND UTSALIK DOMAINS

La Chevrotière Suite
Porphyritic monzogranite (Alcv2)
Granite, monzogranite, quartz monzonite (Alcv1)
Lepelle Suite
Clinopyroxene-bearing foliated granodiorite and granite (Alep)
Châtelain Suite
Clinopyroxene-bearing foliated granodiorite and granite (Achl))
MacMahon Suite
Orthopyroxene and clinopyroxene-bearing foliated tonalite and granite (Acmm2)
Orthopyroxene-bearing foliated diorite (Acmm1)
Kapijuq Suite
Gneissic tonalite (Akpj)
Pélican-Nantais Complex
Biotite-hornblende gneissic tonalite (Apna3)
Metabasalt, mafic gneiss (Apna2)
Paragneiss (Apna1)

DOUGLAS HARBOUR DOMAIN

Kimber alkaline Suite
Nepheline syenite (Akmb)
Leridon Suite
Porphyritic granite (Alrd2)
Granodiorite and granite (Alrd1)
Faribault-Thury Complex
Hornblende-biotite gneissic tonalite (Afth4)
Metabasalt, mafic gneiss (Afth3)
Qimussinguat Complex
Orthopyroxene-clinopyroxene gneissic tonalite (Aqim4)
Orthopyroxene-bearing mafic gneiss (Aqim3)

Ductile shear zone

Thrust fault

Late brittle fault

F — Geochronology sample location

2761±1Ma — Age of emplacement obtained by U-Pb/*TIMS* method[1]

2783±5Ma — Age of emplacement obtained by U-Pb/*La-MC-ICP-MS* method[1]

[1] *See Table 1 for details*

• — Mineralized showing[2]

6 — Anomalous occurrence[2]

[2] *See tables 3 and 4 for grades*

FIGURE 2 (continued) - Simplified geological legend.

Qimussinguat Complex (Aqim)

Mafic gneiss (Aqim3)

Mafic gneisses in unit Aqim3 are enclosed in orthopyroxene and clinopyroxene-bearing gneissic tonalite (Aqim4). They form elongate bodies oriented parallel to the regional fabric. These bodies range in thickness from a few metres to a little over one kilometre. They extend for a few kilometres in length, occasionally exceeding 15 km long. These mafic gneisses also form enclaves between 1 and 10 m in size. They are locally associated with small paragneiss or iron formation horizons. In a few rare outcrops, layers of mafic and ultramafic rocks, massive or weakly foliated, are intercalated with the mafic gneisses.

In outcrop, the mafic gneisses display cm-scale compositional banding. They contain between 5 and 15% felsic mobilizate, which occurs as mm-scale to cm-scale discontinuous veins, parallel to the gneissosity. Under the microscope, the mafic gneisses are fine-grained (~ 0.5 to 1 mm) and show a polygonal granoblastic texture. They are mainly composed of plagioclase (5 to 35%), orthopyroxene (10 to 25%), clinopyroxene (10 to 25%) and green hornblende (5 to 30%). These gneisses also contain minor quantities of red biotite and quartz. Magnetite and other opaque minerals (1 to 10%) occur generally as small grains dispersed throughout the rock.

No relic textures or microtextures that may be attributed to volcanism were observed in the mafic gneisses. However, the association of these gneisses with other supracrustal rocks such as paragneisses and iron formations, observed in a few locations, suggests a volcanic protolith for these gneisses. Metamorphic textures and assemblages (orthopyroxene + clinopyroxene + plagioclase ± hornblende) commonly observed in these rocks are typical of the granulite metamorphic facies.

Orthopyroxene-clinopyroxene gneissic tonalite (Aqim4)

Gneissic or foliated tonalites with orthopyroxene and clinopyroxene (Aqim4) constitute the dominant lithology in the Qimussinguat Complex. These tonalites are intercalated with subordinate phases of diorite, trondhjemite, granodiorite and granite. These rocks locally host mafic enclaves composed of metagabbro, amphibolite or mafic gneiss. These enclaves account for less than 10% of the unit, and are generally restricted in size (< 2 m^2).

On outcrop, gneissic tonalites with orthopyroxene and clinopyroxene, as well as their associated phases, are heterogeneous in appearance. The gneissosity is irregular, and is locally disturbed by complex folding. These rocks contain between 10 and 60% felsic mobilizate, which occurs as discontinuous veins ranging from 1 cm to 10 m in thickness. Some veins are parallel to the gneissosity, whereas others are cross-cutting.

In thin section, gneissic or foliated tonalites of unit Aqim4 and their associated phases are fine to medium-grained (0.5 to 2.0 mm), and display a granoblastic texture. Ferromagnesian minerals tend to be concentrated in dioritic bands. These ferromagnesian minerals, commonly occurring as porphyroblasts, include reddish biotite, clinopyroxene, orthopyroxene and green hornblende. Despite the recrystallization, these rocks locally preserve a relic coarsetexture of magmatic origin. Primary (igneous) pyroxene relics are observed as coarse hypidiomorphic grains. Between 1 and 10% opaque minerals, essentially magnetite, are disseminated throughout the rock. The most common accessory minerals are apatite and zircon.

Faribault-Thury Complex (Afth)

Metabasalt and mafic gneiss (Afth3)

Metabasalts and mafic gneisses (Afth3) are the principal lithologies that make up the volcano-sedimentary sequences in the Faribault-Thury Complex. These lithologies are locally intercalated with layers of ultramafic rock, paragneiss, marble or iron formation. In certain locations, small gabbroic intrusions with pyroxenitic phases outcrop in these sequences. The volcano-sedimentary sequences occur as bands ranging from one to several kilometres in size. The thickness of these bands ranges between 0.5 and 5.0 km, but their length does not exceed 20 km. They form a string of segments extending over more than 100 km in length, enclosed in gneissic tonalites of unit Afth4.

In outcrop, a penetrative foliation and a cm-scale compositional banding respectively characterize metabasalts and mafic gneisses. Locally, the metabasalts are only weakly deformed and display volcanic textures and structures such as pillowed flows and flow breccias. The metabasalts and mafic gneisses are injected by veins and patches of granitic and tonalitic material.

In thin section, the metabasalts and mafic gneisses are fine-grained (0.5 to 1.0 mm) with a granoblastic texture. The principal mineral phases are green hornblende (55 to 75%) and plagioclase (20 to 45%). In several cases, hypidiomorphic hornblende porphyroblasts are oriented parallel to the fabric. Biotite is rare (< 5%) and locally chloritized. Quartz (< 5%), epidote (< 1 to 10%), sphene (< 1 to 5%), garnet (< 1 to 3%) and clinopyroxene relics, almost entirely replaced by hornblende, are observed in minor amounts. Between 1 and 5% opaque minerals, essentially magnetite and pyrite, are scattered throughout the rock. Secondary carbonates occur in trace amounts in several locations. Metamorphic assemblages (hornblende + plagioclase ± garnet ± epidote) observed in these rocks are typical of the amphibolite facies.

Hornblende-biotite gneissic tonalite (Afth4)

Gneissic or foliated tonalites with hornblende and biotite (Afth4) are largely predominant in the Faribault-Thury Complex. These tonalites are intercalated with subordinate phases of diorite, trondhjemite, granodiorite, and lesser granite. These rocks locally contain mafic enclaves composed of metagabbro, amphibolite and diorite. They also contain enclaves of supracrustal rocks belonging to unit Afth3, and consists of metabasalt, mafic gneiss, paragneiss, marble and iron formation. These enclaves range from one to ten metres in size, and account for about 15% of the unit.

A sample of foliated hornblende-biotite tonalite assigned to the Faribault-Thury Complex was collected (Figure 2, site F) and analyzed using the U-Pb/TIMS method (isotopic dilution and Thermal Ionization Mass Spectrometry) on zircons. These isotopic analyses yielded an age of emplacement of 2785+6/-4 Ma (Table 1 in appendix).

In outcrop, the hornblende-biotite gneissic tonalites as well as their associated phases have a heterogeneous aspect. The gneissosity is irregular and locally disturbed by complex folding. These rocks contain biotite-rich schlieren, along with 5 to 50% felsic mobilizate, occurring as discontinuous veins between 1 cm and 10 m thick. Some veins are parallel to the gneissosity; others are cross-cutting.

In thin section, the tonalites and associated phases show a granoblastic texture. Microfabrics are affected by a variable degree of deformation. Least deformed rocks locally contain hypidiomorphic plagioclase crystals that are antiperthitic. More deformed rocks show a mylonitic foliation that is partially obliterated by static recrystallization. Quartz generally occurs as polycrystalline ribbons. Plagioclase crystals are sericitized, and contain small grains of epidote, muscovite and secondary calcite. The tonalites, as well as the dioritic, granodioritic and granitic phases, contain between 10 and 40% ferromagnesian minerals, whereas trondhjemitic phases contain less than 10%. Biotite and hornblende are the most common ferromagnesian minerals observed in these rocks. Muscovite is locally present. Accessory minerals include magnetite, pyrite, zircon, sphene (< 8%) associated with biotite, apatite and allanite.

Gneissic tonalite with mafic enclaves (Afth4a)

This facies was originally identified in a geological mapping survey at 1:100,000 scale conducted by the Geological Survey of Canada (St-Onge and Lucas, 1997a and b). From a petrographic standpoint, the tonalite in this unit is comparable to unit Afth4 described above. It is characterized however by the abundance of mafic enclaves it contains.

Lerindon Suite (Alrd)

The Leridon Suite is a new lithodemic unit that we have introduced to designate large intrusive bodies of granodiorite and granite. These intrusions were emplaced in gneissic tonalites of units Afth4 and Aqim4. They are generally elongate, and follow major regional structures.

Granodiorite and granite (Alrd1)

Granodiorites and granites of unit Alrd1 are equivalent to intrusive bodies assigned to units Aqim5a and Afth5a, which were mapped to the east of our study area, in NTS sheets 25D and 25E (Madore and Larbi, 2000). In outcrop, granodiorites and granites of unit Alrd1 display a homogeneous aspect. These intrusive rocks are massive or foliated. The foliation is mostly defined by the alignment of biotite. The granodiorites and granites contain little felsic mobilizate, and generally less than 5% mafic enclaves. In thin section, a coarse igneous texture is observed, partially obliterated by metamorphic recrystallization. The rocks are medium-grained (2 to 4 mm), and contain between 3 and 15% ferromagnesian minerals, essentially biotite and hornblende, although orthopyroxene and clinopyroxene are observed locally. Allanite, apatite and zircon occur in trace amounts.

Porphyritic granite (Alrd2)

In outcrop, the porphyritic granites (Alrd2) appear to be homogeneous. They are massive or foliated and contain very little felsic mobilizate. These rocks locally contain mafic enclaves. In thin section, an igneous porphyritic texture is observed, partially obliterated by recrystallization. This recrystallization produces a mortar texture that develops along the borders of feldspar phenocrysts. Porphyritic granites contain about 10% ferromagnesian minerals, the most common being hornblende and biotite, with local clinopyroxene. Allanite, apatite, zircon and sphene occur in trace amounts.

Kimber alkaline Suite (Akmb)

The Kimber alkaline Suite (Akmb) is a new lithodemic unit that we have introduced to designate small alkaline intrusions. The intrusions identified on the geological map shown in Figure 2 (Des Ombles Syenite and Briscot Syenite) were emplaced within tonalites of the Qimussinguat Complex. They are located near a major lineament oriented NW-SE that separates the Douglas Harbour Domain from the Lepelle Domain. These alkaline intrusions form small rounded plutons (< 30 km^2). They are locally cross-cut by Paleoproterozoic gabbro dykes (Payne River dykes and Klotz dykes).

A sample was collected from the Des Ombles Syenite for age dating analysis (Figure 2, site C). The sample was taken in a late pegmatitic phase occurring as a dyke. A cm-scale zircon phenocryst was extracted from this rock. Several fragments of this zircon were analyzed using the U-Pb/TIMS method (isotopic dilution and thermal ionization mass spectrometry). These isotopic analyses yielded an age of emplacement of 2761±1 Ma (Table 1 in appendix).

Nepheline syenite (Akmb)

Rocks of the Kimber alkaline Suite are homogeneous and essentially composed of nepheline syenite. In outcrop, these rocks display a friable weathered surface produces coarse greyish sand. In certain locations, primary magmatic layering is observed, defined by variations in the proportion of ferromagnesian minerals, and in grain size. Late syenitic phases, either fine-grained or pegmatitic, cross-cut the main body. These late phases form dykes between 10 cm and 1 m thick.

In thin section, the syenites show a coarse magmatic texture. These rocks show no evidence of deformation or metamorphism, and display a trachytoidal texture. They are composed of albite, microcline, and locally, sodalite. The nepheline content ranges from 5 to 60 %. The nepheline is generally poikilitic and contains feldspar inclusions. The feldspars and nepheline are mottled, or surrounded by cancrinite. The syenite contains between 1 and 10% biotite, and locally, small quantities of hornblende and alkaline pyroxene (aegirine). Magnetite and apatite occur in trace amounts.

Lepelle and Utsalik domains (Archean)

The Lepelle and Utsalik domains are, based on the current state of knowledge, similar from a lithological standpoint. They are essentially composed of granodiorite and granite, namely assigned to the Lepelle and Châtelain suites. The Lepelle and Utsalik domains are separated by a N-S axis occupied by the Pélican-Nantais Complex, composed of pelitic and volcano-sedimentary rocks enclosed in gneissic tonalites (Figure 2). The Pélican-Nantais Complex is bounded by major ductile deformation zones oriented N-S that transect the entire study area. Granodiorites and granites assigned to the Lepelle and Châtelain suites contain rafts several kilometres in size, composed of gneissic tonalite inferred to be older and assigned to the Kapijuq Suite. These granodiorites also contain orthopyroxene-bearing tonalites and diorites belonging to the MacMahon Suite. Late granitic intrusions associated with the La Chevrotière Suite intrude granodiorites and tonalites in the Lepelle and Utsalik domains.

Pélican-Nantais Complex (Apna)

Supracrustal rocks, distributed along a N-S axis that runs through Lac Nantais and Lac du Pélican, were discovered during a reconnaissance mapping program (Percival *et al.*, 1997a). The Pélican-Nantais Complex is a new lithodemic unit that we have introduced to designate these supracrustal sequences, along with enclosing gneissic tonalites. In the north part of the complex, in the vicinity of Lac Nantais, these supracrustal rocks mainly consist of mafic volcanic rocks. These volcanic rocks outcrop between Lac Vergons and Lac Klotz, as thin bands a few kilometres wide and reaching up to 40 km long. In the south part of the complex, in the Lac Bécard sector (Lac du Pélican in NTS sheet 34P located just south of our study area), the supracrustal rocks mainly consist of paragneiss. Thin bands of paragneiss are also present in the east part of Lac Klotz.

Paragneiss (Apna1)

In outcrop, the paragneisses display cm-scale compositional banding. They are locally rusty or schistose. The paragneisses are migmatized and contain between 5 and 50% felsic mobilizate, which occurs as cm-scale discontinuous veins, generally parallel to the gneissosity. It locally forms patches that invade the protolith. Bands of whitish mobilizate, a few metres wide, are also observed intercalated with the paragneisses. These mobilizate bands locally contain small paragneiss enclaves.

The mineral composition of paragneisses varies from one location to the next. In thin section, a quartz-feldspar groundmass is observed with a granoblastic texture. Also present are garnet porphyroblasts, biotite, cordierite and sillimanite. Andalusite, staurolite, tourmaline and spinel are locally present. The most commonly observed opaque mineral is magnetite. In certain areas, paragneisses contain the assemblage orthopyroxene + clinopyroxene + plagioclase ± garnet. In these areas, orthopyroxene is also present in the mobilizate. Assemblages such as staurolite + andalusite + sillimanite, and orthopyroxene + clinopyroxene + plagioclase + garnet demonstrate that within the Pélican-Nantais Complex, the metamorphic grade ranges from the middle amphibolite to the granulite facies.

Metabasalt and mafic gneiss (Apna2)

Metabasalts and mafic gneisses (Apna2) are the dominant supracrustal rocks that outcrop in the north part of the Pélican-Nantais Complex (Figure 2). These lithologies are locally intercalated with layers of intermediate to felsic volcanic rocks. Felsic volcanic rocks are moderately deformed and aphanitic. They probably represent fine tuffs. A few horizons of polygenic lapilli and block tuff, or conglomerate, were also observed. A felsic volcanic sample was collected (Figure 2, site A) and analyzed using the U-Pb/TIMS method on zircons. These isotopic analyses yielded an age of emplacement of 2775±5 Ma (Table 1 in appendix).

In outcrop, the metabasalts and mafic gneisses are respectively characterized by a penetrative foliation and cm-scale compositional banding. In certain locations, especially along the margins of the unit, intense deformation is observed. This deformation is shown by the presence of a mylonitic fabric, or of straight gneisses. The metabasalts and mafic gneisses are injected by veins of granitic and tonalitic material.

In thin section, the metabasalts and mafic gneisses are fine-grained (0.2 to 0.5 mm) and display a granoblastic texture. The main mineral constituents are green hornblende (60 to 80%) and plagioclase (10 to 15%). Clinopyroxene and olivine are locally observed. Quartz, epidote and sphene are present in minor quantities. Between 1 and 5% opaque minerals (magnetite or pyrite) are disseminated throughout the rock. Trace chalcopyrite and native copper are also observed in a few rare locations. Secondary carbonates occur in trace amounts in several locations. Metamorphic assemblages (hornblende + garnet + plagioclase ± epidote) commonly observed in these rocks are typical of the amphibolite facies.

Biotite-hornblende gneissic tonalite (Apna3)

Gneissic tonalites (Apna3) in the Pélican-Nantais Complex are very similar to those in the Faribault-Thury Complex. They are intercalated with subordinate phases of diorite, trondhjemite, granodiorite and granite. These rocks locally host mafic enclaves between 1 and 10 m in size.

In outcrop, gneissic tonalites of the Pélican-Nantais Complex and their associated phases display a rectilinear gneissosity locally overprinted by a mylonitic fabric. They contain between 5 and 50% felsic mobilizate, which occurs as cm-scale veins, parallel to the gneissosity. In certain locations, these veins, injected *lit-par-lit*, invade the tonalite.

In thin section, the tonalites and their associated phases display a granoblastic texture. The less deformed rocks occasionally contain hypidiomorphic plagioclase crystals with an antiperthitic texture. More deformed rocks show a mylonitic foliation. Plagioclase crystals are sericitized and contain small grains of epidote and secondary calcite. The tonalites as well as the dioritic, granodioritic and granitic phases contain more than 10% ferromagnesian minerals, whereas trondhjemitic phases contain less than 10%. Biotite and hornblende are the most commonly observed ferromagnesian minerals in these rocks. Magnetite, zircon, sphene, apatite and allanite occur in trace amounts.

Kapijuq Suite (Akpj)

The Kapijuq Suite (Akpj) is a new lithodemic unit that we have introduced to designate gneissic tonalites presumably older than the surrounding granodioritic and granitic rocks assigned to the Lepelle and Châtelain suites. Tonalites of the Kapijuq Suite occur as large rafts several kilometres in size. They may represent the tonalitic equivalent of adjacent complexes (Pélican-Nantais or Faribault-Thury).

A sample of gneissic tonalite assigned to the Kapijuq Suite was collected (Figure 2, site B) and analyzed using the U-Pb/LA-MC-ICP-MS method (*in situ* analysis by laser ablation – multicollector inductively coupled plasma mass spectrometry) on zircons. These isotopic analyses yielded an age of emplacement of 2783±5 Ma (Table 1 in appendix). These analyses also yielded a probable metamorphic age of 2755±12 Ma (Table 1 in appendix).

In outcrop, tonalites assigned to the Kapijuq Suite generally display a well-developed gneissosity or foliation. A mylonitic fabric is observed in several locations in these rocks. The tonalites are intercalated with subordinate phases of diorite, trondhjemite, granodiorite and granite. The rocks contain between 5 and 50% felsic mobilizate, occurring as cm-scale veins parallel to the gneissosity. They locally host enclaves of mafic rock and paragneiss, between one and ten metres in size.

In thin section, tonalites of the Kapijuq Suite generally display a granoblastic texture, and, in areas where the degree of deformation is more intense, a mylonitic foliation. Biotite and hornblende are the most commonly observed ferromagnesian minerals in these rocks. Clinopyroxene is also present in several locations. Magnetite, zircon, sphene, apatite and allanite occur in trace amounts.

MacMahon Suite (Acmm)

The MacMahon Suite was introduced by Parent *et al.* (2000) to designate orthopyroxene-bearing felsic intrusive rocks ranging from a granitic to tonalitic composition. In the Lac Klotz area, rocks assigned to the MacMahon Suite mainly consist of orthopyroxene tonalites, associated with orthopyroxene-bearing dioritic phases. These rocks are enclosed in granodiorites and granites of the Châtelain (Achl) and Lepelle (Alep) suites.

Orthopyroxene diorite (Acmm1)

Orthopyroxene diorites (Acmm1) are mafic intrusive rocks associated with the MacMahon Suite. They form small elongate bodies spatially associated with orthopyroxene and clinopyroxene-bearing tonalites and granites (Acmm2). In outcrop, these rocks have a homogeneous aspect. They are generally foliated, gneissic or locally massive. A few rare peridotitic horizons were identified in these rocks. Diorites of the MacMahon Suite contain between 5 and 10% felsic mobilizate, which occurs as cm-scale discontinuous veins, parallel to the structural fabric.

In thin section, orthopyroxene diorites commonly display a granoblastic texture. They are mainly composed of orthopyroxene, clinopyroxene, hornblende and plagioclase. Minor biotite (1 to 25%) is also observed in these rocks. Despite the recrystallization, these rocks locally exhibit a coarse relic texture of magmatic origin. Idiomorphic pyroxene crystals may be observed, along with primary plagioclase. Small quantities of magnetite, quartz, apatite and zircon are present in these rocks.

Orthopyroxene-clinopyroxene tonalite and granite (Acmm2)

Felsic intrusive rocks with orthopyroxene and clinopyroxene assigned to the MacMahon Suite (Acmm2) form bodies several kilometres in size, distributed in the central and western parts of the area. They are abundant in the south, and progressively disappear northward. These rocks are for the most part composed of tonalite, with granodioritic and granitic phases. In outcrop, these rocks have a homogeneous aspect. They are locally massive, with a porphyritic texture. In several locations, they are medium-grained and exhibit a well-developed foliation.

A sample of orthopyroxene-clinopyroxene tonalite assigned to the MacMahon Suite was collected (Figure 2, site E) and analyzed using the U-Pb/LA-MC-ICP-MS method (*in situ* analysis by laser ablation - multicollector inductively coupled plasma mass spectrometry). These isotopic analyses yielded an age of emplacement of 2728±8 Ma (Table 1 in appendix). These analyses also yielded a probable metamorphic age of 2710±11 Ma (Table 1 in appendix).

Tonalites of the MacMahon Suite as well as associated granodioritic and granitic phases contain between 5 and 35% ferromagnesian minerals. These minerals are orthopyroxene, clinopyroxene, biotite and hornblende. Under the microscope, minor apatite, zircon and allanite are also observed. Magnetite is the most common opaque mineral in these rocks. The felsic intrusive rocks of the MacMahon Suite underwent metamorphic recrystallization of variable intensity. The groundmass is generally granoblastic, however, igneous textures are locally preserved. Idiomorphic crystals of antiperthitic plagioclase, microcline, clinopyroxene and orthopyroxenemay be observed.

Châtelain Suite (Achl) and Lepelle suite (Alep)

The Châtelain Suite (Achl) and the Lepelle Suite (Alep) are two new lithodemic units that we have introduced to designate large composite intrusive bodies of regional extent. The lithologies grouped in these two suites are very similar. They mainly consist of granodiorite and granite. The Châtelain Suite, found in the west part of the area, is included in the strongly magnetic, albeit somewhat irregular zone that delineates the Utsalik Domain. The Lepelle Suite, located to the east of the Châtelain Suite, forms a band over 30 km wide along a N-S axis that runs through the centre of the study area. The geographic distribution of rocks of the Lepelle Suite coincides with a very homogeneous magnetic high. This strongly magnetic zone delineates the Lepelle Domain.

In outcrop, granodiorites and granites assigned to the Châtelain and Lepelle suites have a homogeneous aspect. The foliation is generally well developed, and the rocks display in several locations a porphyritic texture defined by feldspar phenocrysts. Rocks in these two units occur, in several locations, in the form of multiple intrusions, injected *lit-par-lit*, which invade the host rock. These intrusive rocks contain tonalitic and mafic enclaves, and very rarely, ultramafic enclaves. Locally, veins and patches of pegmatitic granite cross-cut the granodiorites and granites.

In thin section, a coarse igneous texture is partially obliterated by metamorphic recrystallization. This recrystallization produces a mortar texture that develops along the borders of feldspar phenocrysts. These rocks contain between 2 and 15% ferromagnesian minerals. They commonly contain biotite, clinopyroxene, and minor proportions of orthopyroxene. Magnetite is present in all thin sections. The most common accessory minerals are apatite, sphene, allanite and zircon.

La Chevrotière Suite (Alcv)

The La Chevrotière Suite (Alcv) was introduced by Parent *et al.* (2000) to designate intrusions of alkali feldspar-phyric monzogranite. In the study area, cross-cutting relationships observed in the field suggest that rocks of the La Chevrotière Suite are relatively late. Intrusive rocks assigned to this suite were emplaced in granodiorites of the Châtelain and Lepelle suites. These intrusions are generally elongate and follow major regional structures.

Granite, monzogranite and quartz monzonite (Alcv1)

In outcrop, granitoids assigned to the La Chevrotière Suite (Alcv1) have a homogeneous aspect. These intrusive rocks are locally massive but generally display a foliation. They contain little felsic mobilizate, and less than 5% mafic enclaves. In thin section, a coarse igneous texture is observed, partially obliterated by metamorphic recrystallization. These rocks are medium-grained, with a grain size ranging between 2 and 5 mm. They contain between 1 and 10% ferromagnesian minerals, essentially dominated by biotite and hornblende. Apatite, zircon and magnetite occur in trace amounts.

A sample of granite assigned to the La Chevrotière Suite was collected (Figure 2, site D) and analyzed using the U-Pb/TIMS method (isotopic dilution and thermal ionization mass spectrometry) on a homogeneous population of zircons. These isotopic analyses yielded an age of emplacement of 2734±2 Ma (Table 1 in appendix).

Porphyritic monzogranite (Alcv2)

Monzogranitic intrusions of the La Chevrotière Suite generally form tabular bodies oriented parallel to the regional fabric. These rocks have a homogeneous, massive or foliated aspect. They contain between 10 and 40% idiomorphic K-feldspar phenocrysts ranging between 2 and 5 cm in size. Locally, K-feldspar phenocrysts and ferromagnesian minerals are aligned parallel to the fabric. This fabric is typical of syntectonic intrusions. The monzogranites contain very little felsic mobilizate.

In thin section, monzogranitic rocks are affected by metamorphic recrystallization preferentially along the borders of feldspar phenocrysts. This recrystallization produces a mortar texture that develops along the borders of feldspar phenocrysts. Porphyritic monzogranites contain about 10% ferromagnesian minerals, the most common being biotite and hornblende. Clinopyroxene is present in certain locations, as well as orthopyroxene, in lesser proportions. Apatite, sphene and zircon occur in trace amounts. Magnetite is commonly observed in these rocks, and is locally associated with rutile.

Dyke swarms (Paleoproterozoic)

Payne River Dykes (pPpay) and Klotz Dykes (pPktz)

The Archean rocks in the area are intruded by two Paleoproterozoic dyke swarms: the Payne River dykes, and the Klotz dykes, two lithodemic terms respectively introduced by Fahrig *et al.* (1985) and Buchan *et al.* (1998). Payne River dykes (pPpay) traverse the northeastern part of the area with a dominant 330°N orientation. Klotz dykes (pPktz), for the most part oriented at 310°N, occur mainly in the central part of the area. Isotopic analyses (K-Ar) of two chill margin samples suggest, for the Payne River dykes, an age of emplacement slightly older than 2000 Ma (Fahrig *et al.*, 1985). A sample from a dyke in the Klotz swarm yielded a U-Pb zircon age of 2209±1 Ma (Buchan *et al.*, 1998).

The Paleoproterozoic dykes consist of ophitic-textured gabbro. The grain size of the rock varies from medium to coarse. These rocks are composed of idiomorphic plagioclase crystals surrounded by a clinopyroxene groundmass. Fe-Ti oxides, minor quartz and biotite are also present. Dyke margins are chilled over about ten centimetres. Their mineralogy is characterized by idiomorphic microcrystals of plagioclase and augite, aligned parallel to the dyke contacts. The dykes are generally fresh. Locally, especially in the vicinity of major brittle faults, they are altered and contain chlorite, hematite and epidote veinlets.

METAMORPHISM

The bedrock in the area is dominated by felsic intrusive rocks. The mineralogy observed in these rocks is not always diagnostic to identify the metamorphic grade. Consequently, recrystallization textures must be taken into account in order to assess the effect of deformation and metamorphism on a regional scale. It is also necessary to incorporate observations from mafic enclaves hosted in these intrusive rocks, and to focus on the petrographic study of rocks in volcano-sedimentary sequences. The latter are more likely to contain diagnostic metamorphic assemblages. Furthermore, they are, in most cases, remains of older rocks that had to re-equilibrate under pressure and temperature conditions influenced by magmatism and burial depth.

Rocks in the area show prograde metamorphic assemblages that range from the lower amphibolite facies to the granulite facies. Locally, generally along the margins of late granitic and granodioritic intrusions, retrograde assemblages indicate a shift from the granulite to the amphibolite facies. In other locations, especially near major brittle faults, lower pressure and temperature retrograde assemblages are associated with late hydrothermal fluid circulation. The map in Figure 3 shows the metamorphic grade and the distribution of petrographic textures.

In the eastern part of the area, rocks of the Qimussinguat Complex are typically metamorphosed to the granulite facies. In the gneissic tonalites that dominate this sector, granulitic metamorphism is represented by the assemblage orthopyroxene + clinopyroxene + hornblende + plagioclase + quartz ± biotite. Furthermore, the pyroxenes commonly display a polygonal granoblastic texture, indicating metamorphic recrystallization under high pressure and temperature conditions. In certain locations, primary igneous pyroxene relics are observed, as coarse-grained hypidiomorphic grains. The latter observations indicate that two generations of pyroxene coexist in these tonalites: an igneous and a metamorphic generation. Enclaves and bands of mafic gneiss hosted in tonalites of the Qimussinguat Complex exhibit mineral assemblages and textures typical of the granulite facies. They contain orthopyroxene + clinopyroxene + plagioclase ± hornblende ± biotite. These rocks are fine to medium-grained and show a well-developed granoblastic texture. Locally, along the margins of granitic and granodioritic intrusions assigned to the Leridon Suite, gneissic tonalites of the Qimussinguat Complex display evidence of retrograde metamorphism, characterized by the destabilization of orthopyroxene into hornblende ± quartz.

West of the Qimussinguat Complex (Figure 3), the overall regional metamorphic grade is the middle amphibolite facies. However, certain sectors show evidence of higher-grade metamorphism, to the upper amphibolite facies and the granulite facies. Granulitic areas are typically associated with intrusive orthopyroxene-bearing rocks (MacMahon Suite). The metamorphic grade is essentially determined based on metamorphic assemblages present in mafic enclaves, and remnants of metabasalts and paragneisses. In *mafic enclaves and metabasalts*, typical assemblages for the amphibolite facies contain hornblende + plagioclase ± biotite ± garnet ± epidote. In areas where the metamorphic grade reached the granulite facies, orthopyroxene with a granoblastic texture appears in mafic enclaves. *Paragneisses*,

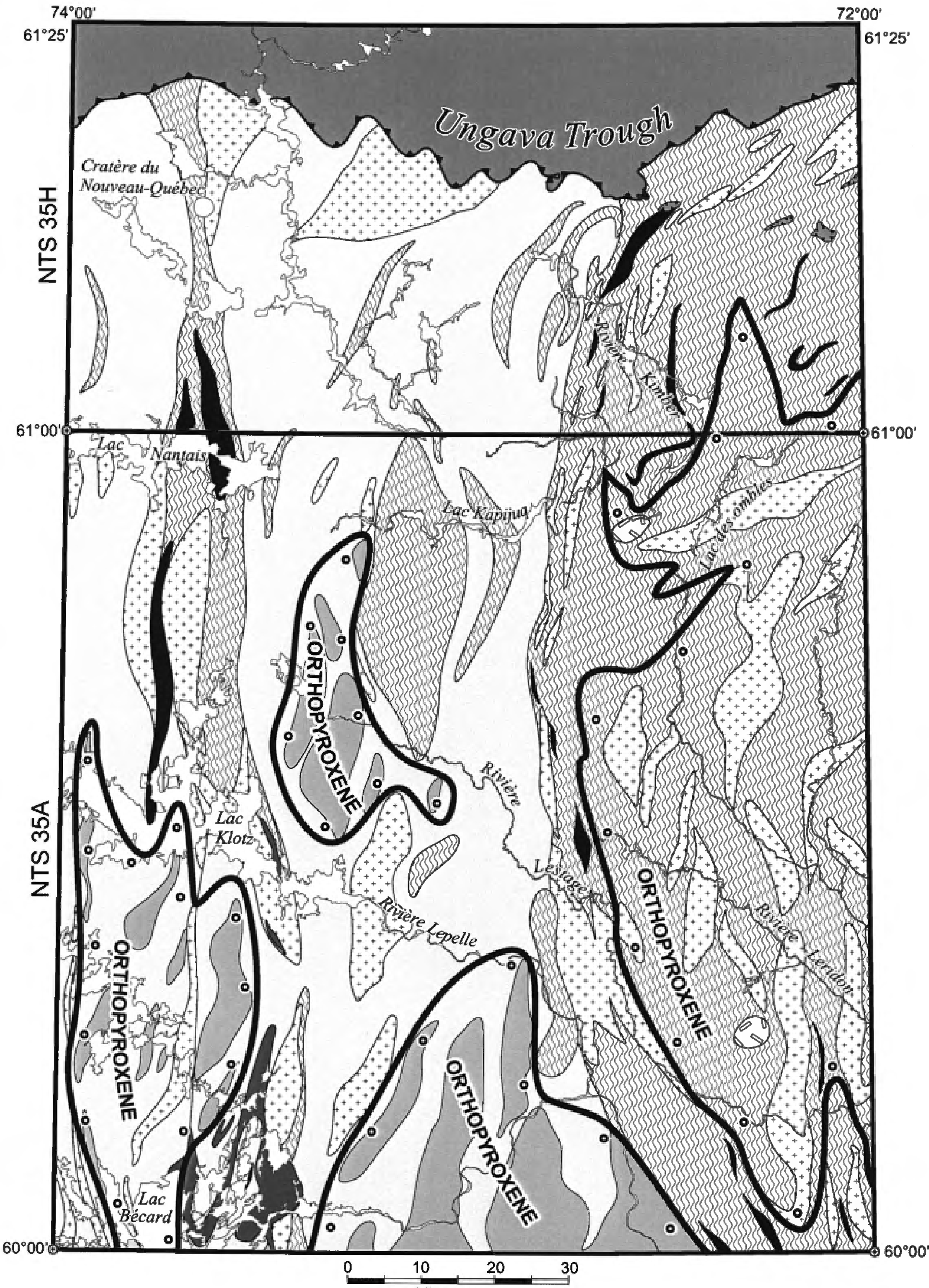


FIGURE 3 - Regional distribution of metamorphism and petrographic textures.

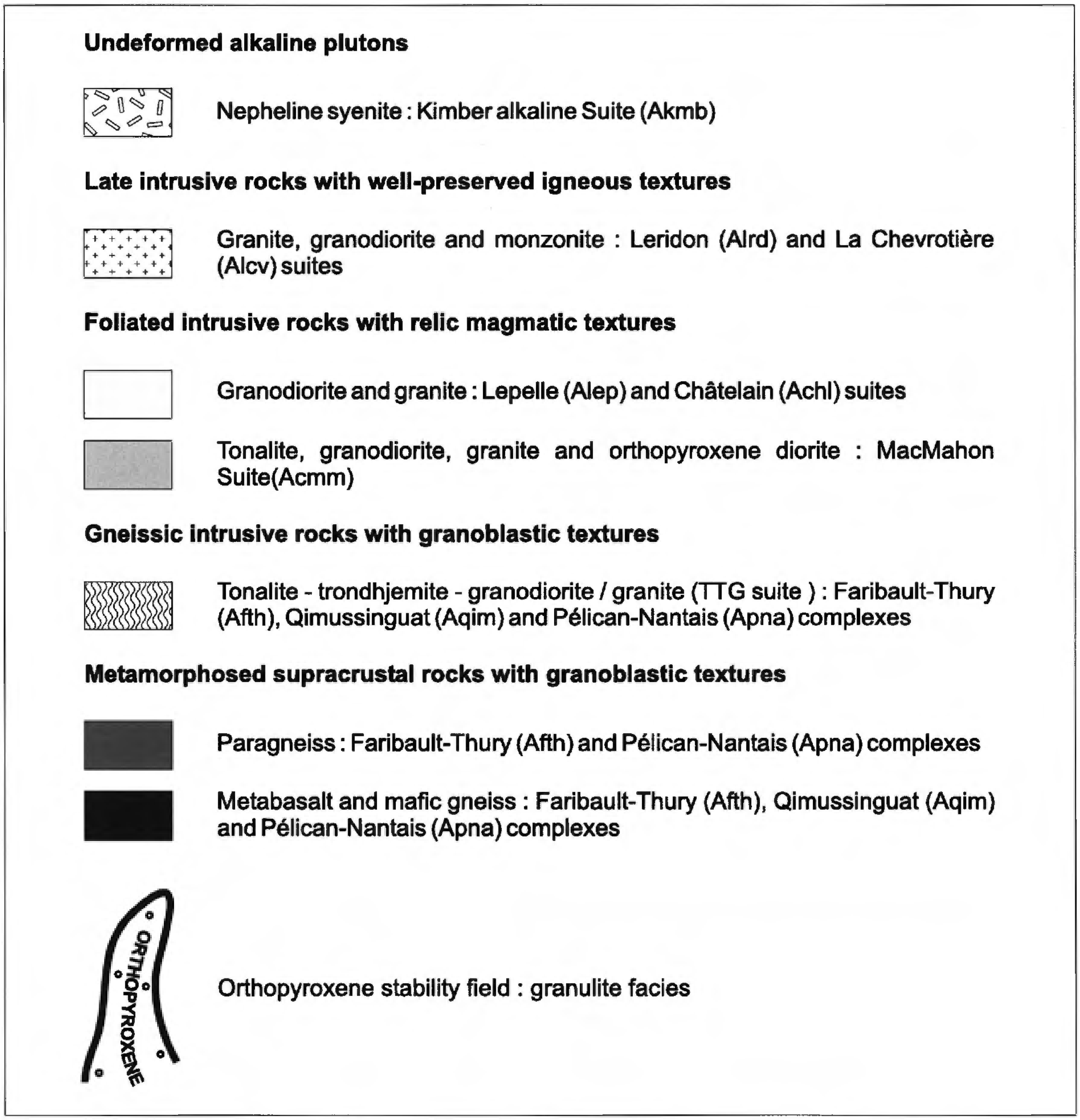


FIGURE 3 (continued) - Legend of metamorphism and petrographic textures.

mostly observed in the south part of the area, contain diverse metamorphic assemblages, such as cordierite + garnet + biotite + sillimanite, which are minerals typical of the upper amphibolite facies. Locally, the coexistence of metamorphic minerals such as staurolite + andalusite + sillimanite + cordierite indicates that the temperature reached about 550°C, and that the pressure did not exceed 3 kb (Figure 4). The presence of orthopyroxene in a few paragneiss samples indicates that the latter recorded, at least locally, granulite-facies metamorphic conditions. The mobilizate in these granulitized paragneisses also contains orthopyroxene.

STRUCTURAL GEOLOGY

A regional structural study, based on cross-cutting relationships, reveals the existence of five deformation episodes, along with an anorogenic episode. The first three episodes of deformation (D1, D2 and D3) are ductile and probably all Archean in age. These Archean deformation episodes were followed by a Paleoproterozoic anorogenic event during which two gabbro dyke swarms (Payne River

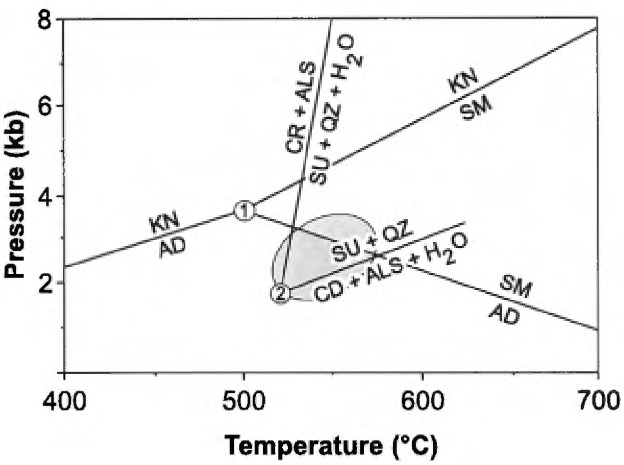


FIGURE 4 - Petrogenetic grid: 1) stability fields of Al_2SiO_5 polymorphs (Holdaway, 1971), 2) stability field of staurolite (Richardson, 1968). KN = kyanite, AD = andalusite, SM = sillimanite, CR = chloritoid, ALS = aluminosilicate, CD = cordierite, SU = staurolite, QZ = quartz. The shaded area corresponds to the stability field of the assemblage staurolite + andalusite + sillimanite + cordierite locally observed in paragneisses.

dykes and Klotz dykes) were emplaced. The emplacement of these dykes was followed by another Paleoproterozoic event (D4) that corresponds to the Ungava Orogen. Structures associated with this event are observed in the north part of the area (NTS sheet 35H). They are represented by major thrust faults shallowly dipping to the north, associated with the tectonic transport towards the SE of Paleoproterozoic sequences of the Ungava Trough over the Archean basement. A final episode of late deformation (D5) occurred subsequently to the Paleoproterozoic deformation events. It consists of rectilinear brittle faults that transect the entire area. The regional structural pattern that resulted from these deformation episodes is shown in Figure 5.

The Archean regional fabric consists of an early foliation or gneissosity (Figure 5; S1) generally striking N-S and steeply dipping (Figure 6a). This planar fabric is accompanied by isoclinal intrafolial F1 folds (figures 5 and 7). These structures characterize the first phase of ductile deformation D1. Locally, especially in the eastern part of the area underlain by gneissic tonalites of the Faribault-Thury and Qimussinguat complexes, the structural pattern associated with deformation D1 is affected by open F2 folds (figures 5 and 7). These F2 folds illustrate a phase of ductile deformation D2 that is visible in outcrop, but discrete and weakly developed on a regional scale.

Ductile shear zones of regional extent are superposed upon structures related to deformation episodes D1 and D2. These shear zones correspond to a D3 episode of ductile deformation, believed to be Archean in age. These structures generally occur along major lithotectonic discontinuities, namely on either side of the Pélican-Nantais Complex as well as along the boundary between gneissic tonalites assigned to the Douglas Harbour Domain and foliated granodiorites of the Lepelle Domain (Figure 5). The vast majority of mineral and stretching lineations measured in the field come from ductile shear zones associated with deformation D3. These lineations show generally steep plunges (Figure 6b). Tectono-metamorphic in origin, they are defined by the preferential orientation of ferromagnesian minerals, essentially biotite and hornblende, and locally, by the development of ribbon quartz. Deformation D3, characterized by the development of steeply plunging lineations in ductile shear zones, suggests a tectonic event involving important vertical movements. These vertical movements, particularly well developed at the contact of major lithological assemblages, probably control the metamorphic contrasts observed in the field.

In the northernmost part of the study area, another type of deformation is observed. It consists of Paleoproterozoic ductile structures (D4) related to the Ungava Orogen (*ca.* 1.8 Ga). During this orogenic event, Paleoproterozoic sequences belonging to the Ungava Trough were thrust over the Archean rocks of the Superior Province. Structures associated with this thrusting event are characterized by shear zones shallowly dipping to the north, ranging from 5 to 10 m thick . They affect both Paleoproterozoic rocks and the Archean basement. Numerous kinematic indicators, as well as stretching lineations shallowly plunging to the NW are observed in these detachment zones. These latter structural observations helped us determine that the sequences of the Ungava Trough were subjected to tectonic transport from the NW towards the SE. Certain authors, namely Lucas (1989) and St-Onge and Lucas (1990), have already documented in greater detail this tectonic transport.

The rocks in the area are transected by major rectilinear lineaments, several of which exceed 50 km in length. These lineaments coincide with a late brittle deformation (D5) that overprints Archean (D1, D2, D3) and Paleoproterozoic (D4) fabrics. Epidotization, sericitization and hematitization as well as quartz veining are observed in the vicinity of these major brittle faults. Despite the magnitude of these structures, apparent movements observed along these normal faults are generally not significant.

LITHOGEOCHEMISTRY

About one hundred rock samples were collected and analyzed for major and trace elements. This sampling is representative of the principal lithologies in the study area. Samples of felsic intrusive rocks consist of granite, granodiorite, monzonite and tonalite. Samples of mafic intrusive rocks consist of gabbro, diabase, diorite and amphibolite, whereas samples of ultramafic intrusive rocks consist of pyroxenite. Mafic and felsic volcanic rocks were sampled. A few samples of nepheline syenite were also collected and analyzed. Analyses were performed at the Consortium de

Recherche minérale (COREM). Major elements as well as trace elements (Nb, Rb, Sr, Zr, Cs, Th and Y) were analyzed by X-ray fluorescence (XRF). Typical analytical results are shown in Table 2 (in appendix). All analytical results are available in the SIGÉOM database.

Felsic rocks

The results of lithogeochemical analyses performed on felsic plutonic rock samples were plotted on various classification diagrams. On the classification diagram proposed by O'Connor (1965), felsic plutonic rock compositions cover a range between the granite field and the tonalite field (Figure 8a). Most of the samples plot in the granodiorite field. For the same samples, the classification diagram by De La Roche *et al.* (1980) shows compositions ranging from the granodiorite field to the tonalite field (Figure 8b). A few samples also fall in the monzonite field. On this diagram, we can also see that only pyroxene-bearing gneissic tonalites assigned to the Qimussinguat Complex (Aqim4) have a tonalitic cationic composition (Figure 8b). Pyroxene tonalites assigned to the MacMahon Suite (Acmm2) have more dioritic and gabbroic compositions. The nepheline syenites, originally identified by modal point counting, also show compositions that fall in the field of nepheline syenites in the cationic classification diagram (Figure 8b).

All the felsic plutonic rock samples in the area show a calc-alkaline affinity (Figure 8c). They are peraluminous to metaluminous ($Al_2O_3 > CaO + Na_2O + K_2O$), I-type (Figure 8d) and alumina-saturated ($0.95 < Al_2O_3/CaO + Na_2O + K_2O < 1.14$; Zen, 1988). The parent magmas were probably derived from the anatexis of crustal rocks with peraluminous and metaluminous compositions (White and Chappell, 1977). These felsic plutonic rocks are rich in Al_2O_3 (12 to 23%) and SiO_2 (60 to 78%), but poor in MgO (0.10 to 3.66%). Their Na_2O/K_2O ratios are high (up to 12.9) for tonalites, but low (between 0.6 and 2.1) for granodiorites, granites and monzonites. Binary diagrams showing major elements Al_2O_3, CaO, FeOt, MgO and TiO_2 versus SiO_2 show negatively sloped correlations (Figure 9a, b, c, d, e). The high SiO_2 content (60 to 70%) as well as the negative correlation observed between variations in SiO_2 relative to other major elements suggest that the felsic intrusive rocks in the study area constitute highly differentiated phases. Overall, these felsic intrusive rocks are even more differentiated than those located to the east, in the Rivière Arnaud area (Madore and Larbi, 2000).

The diagram K_2O versus SiO_2 (Rickwood, 1989) shows compositional fields for the low-K tholeiitic series, low-K calc-alkaline series, high-K calc-alkaline series and shoshonitic series (Figure 9f). Granodiorite and granite samples from the study area containing up to 70% SiO_2 are enriched in potassium. However, tonalite samples with the same SiO_2 content are depleted in potassium. Various magmatic processes may be envisaged to explain these differences in K_2O content. On one hand, fractional crystallization from a common source could have generated the large composite intrusive bodies assigned to the Lepelle and Châtelain suites. It would also have generated late intrusions of the Leridon and La Chevrotière suites. On the other hand, the differentiation of tonalites to more evolved phases would produce the tonalite-granodiorite-granite assemblagesobserved in gneisses of the Faribault-Thury, Qimussinguat and Pélican-Nantais complexes. This phenomenon likely prevailed in the Kapijuq Suite as well.

The trace element geochemical signature varies from one intrusive family to the next. Trace element analyses of granodioritic, granitic and monzonitic samples (Figure 10a) show Nb and Th concentrations typical of the upper continental crust (Weaver and Tarney, 1984), whereas gneissic tonalites (Figure 10b) show Nb and Th concentrations typical of lower continental crust. However, the trace element geochemistry is, for a given lithology, identical from one lithodemic unit to the next. Consequently, units cannot be distinguished solely on the basis of their trace element geochemistry.

Trace element patterns shown in diagrams in Figure 10 outline fractionated rocks enriched in Rb and Ba. Ti depletion, supported by a slight positive Sr anomaly, suggests that magmatic differentiation of felsic plutonic rocks took place during their emplacement. The diagram Rb versus Y+Nb (Pearce *et al.*, 1984) shows that felsic plutonic rocks in the area formed in a volcanic arc setting (Figure 11). Low Ti and Nb values are probably related to the fractionation of minerals such as sphene, rutile or ilmenite. Elevated Zr and Th values suggest that the parent magma of felsic plutonic rocks assimilated felsic crustal material containing Zr-rich minerals such as zircon or monazite.

The tonalites are the only felsic rocks which, given their trace element patterns, show a similarity with lower continental crust (Figure 10b). This suggests that the source of tonalites in the Faribault-Thury and Qimussinguat complexes is likely derived from this deep portion of the earth's crust.

In the area, felsic volcanic rocks are scarce, and represent only a very small volume of rock. Only one sample of felsite was analyzed. It probably represents an aphanitic tuff, found in the Nantais belt. This felsite has a rhyolitic to dacitic composition characterized by an SiO_2 content of about 70%.

Mafic rocks

Volcano-sedimentary sequences are essentially found in the Faribault-Thury and Pélican-Nantais complexes. Analyzed samples of mafic and ultramafic rocks were mostly derived from these sequences. A few mafic and ultramafic samples were also collected in other units, from small-scale isolated geological bodies that could not be represented on the map at 1:250,000 scale. These geological bodies probably once belonged to now-dismembered volcano-sedimentary sequences.

Major element analyses indicate that mafic rock samples plot in the tholeiitic field (Figure 8c), with MgO contents

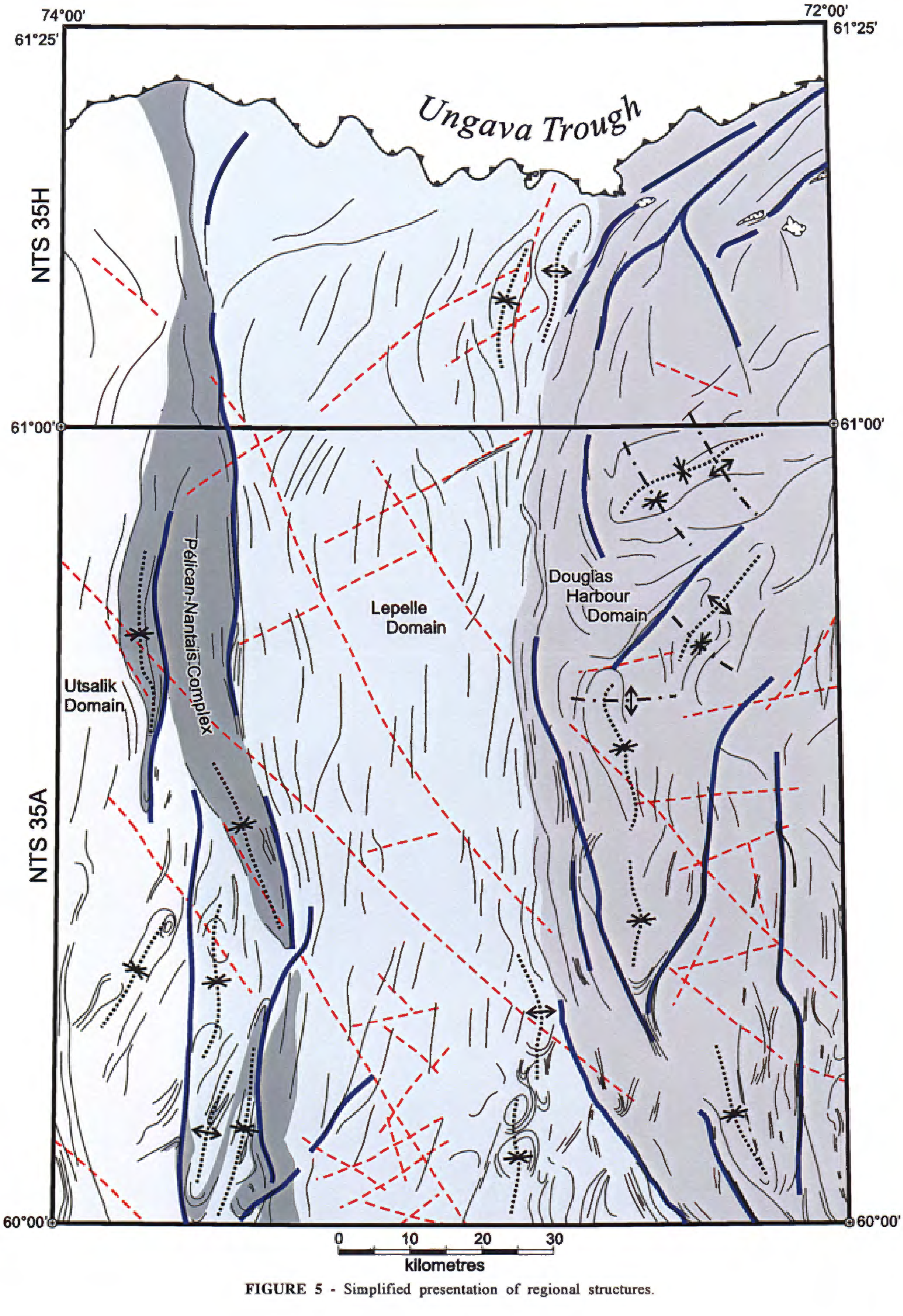


FIGURE 5 - Simplified presentation of regional structures.

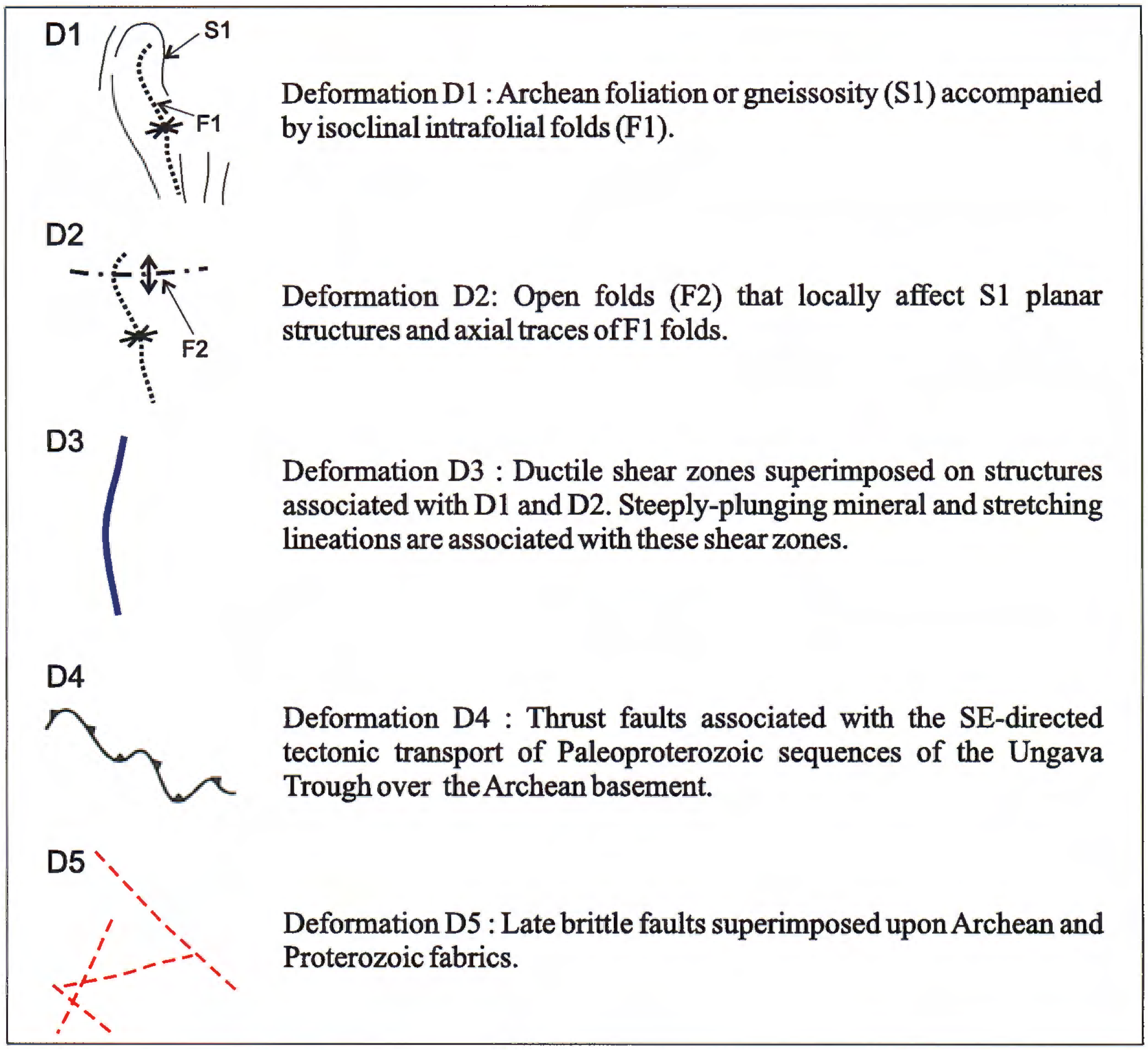


FIGURE 5 (continued) - Legend of regional structures.

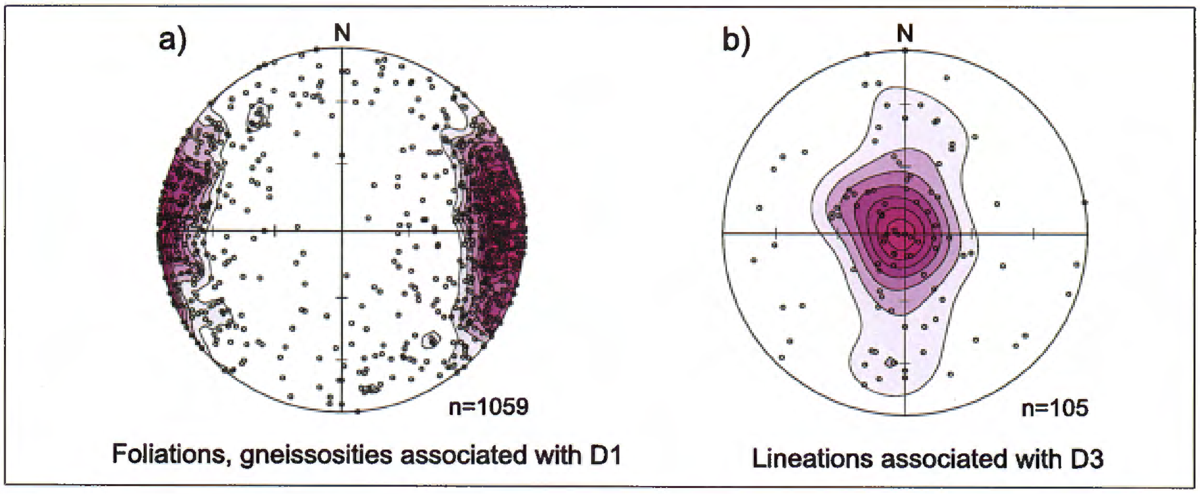


FIGURE 6 - Equal area stereographic projections. Contours were drawn according to the method of Robin and Jowett (1986). n = number of measurements. Stereogram (a) shows projections of poles of measured planes. Stereogram (b) shows projections of measured lineations.

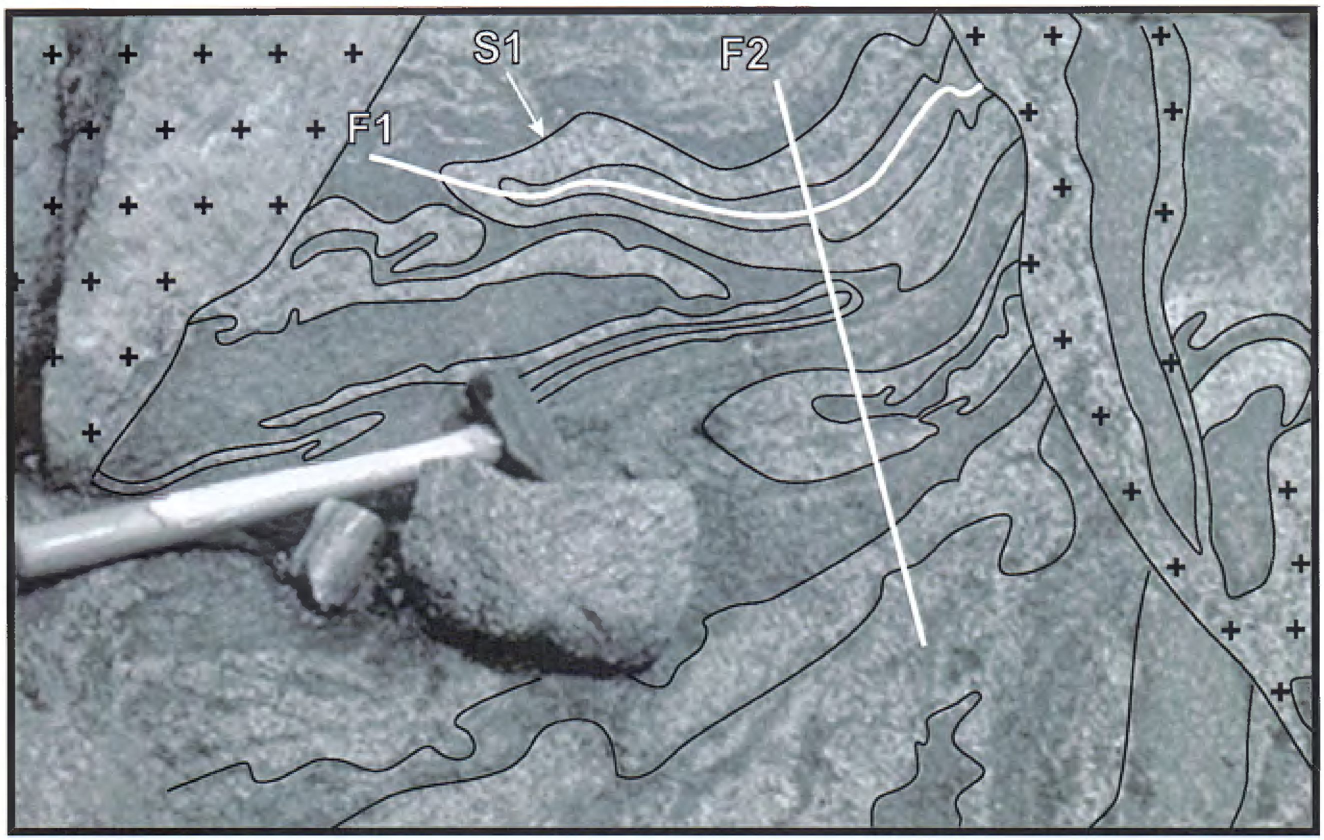


FIGURE 7 - Outcrop of gneissic tonalite (Faribault-Thury Complex) where gneissosity S1 is affected by isoclinal intrafolial F1 folds. F1 and S1 structures are affected by an undulation attributed to open F2 folds. On the photograph, grey areas correspond to the tonalite and pale bands, to felsic mobilizate occurring as veins parallel to the gneissosity. Pale areas with (+) signs correspond to veins of felsic mobilizate that cross-cut the gneissosity.

ranging from 3.3% (gabbros and mafic lavas) to 31.8% (ultramafic rocks and amphibolites) (Table 2 in appendix). According to Figure 12a, mafic rocks are largely subalkaline, and a small number of samples are scattered in the alkali basalt and the andesite fields. On the Jensen (1976) diagram, mafic rocks show high-Fe tholeiite compositions (Figure 12b). The Ti-Zr-Sr paleotectonic diagram by Pearce and Cann (1973) shows that most mafic rocks in the area exhibit features similar to mid-oceanic ridge basalts (MORB, Figure 13). On the same diagram, a few samples plot in the island arc tholeiite field, or in the calc-alkaline basalt field. This compositional range is probably due to magma contamination during ascent and emplacement of mafic intrusive rocks.

Analytical results for mafic lavas in the area show moderate trace element concentrations similar to MORBs (Figure 14a). However, Sr, K, Rb and Ba (LILE, large ion lithophile elements, the most mobile elements) are strongly enriched relative to MORBs. This is probably the result of LILE remobilization, or of magma assimilation of minerals such as plagioclase and K-feldspar. Analytical results from diorite, gabbro and diabase (Klotz dykes) samples also show trace element patterns similar to those of MORBs contaminated by continental crust (high Ba, Rb and K contents, Figure 14a). As with mafic lavas, these intrusive rocks are enriched in LILE and slightly depleted in HFSE (high field strength elements). This is probably caused by magmatic differentiation, or in the case of diabase dykes, by crustal contamination during emplacement in an older crust.

Ultramafic rocks

According to the Jensen (1976) diagram, the composition of ultramafic rocks ranges from the basaltic komatiite field to the peridotitic komatiite field (Figure 12b). As opposed to mafic rocks, which are very rich in iron, the ultramafic rocks are very rich in magnesium (figures 8c and 12b) and generally poor in K_2O (Table 2 in appendix). These features are typical of ultramafic rocks derived from a passive margin environment in an oceanic crust setting.

The trace element patterns of volcanic and plutonic ultramafic rocks (Figure 14b) are enriched in mobile elements (LILE) and depleted in immobile elements (HFSE) relative to MORBs. These trends are similar to those of the continental crust. These variations suggest that the ultramafic rocks were contaminated by continental crust during magma ascent from a mantle source depleted in LILE (Pearce, 1983).

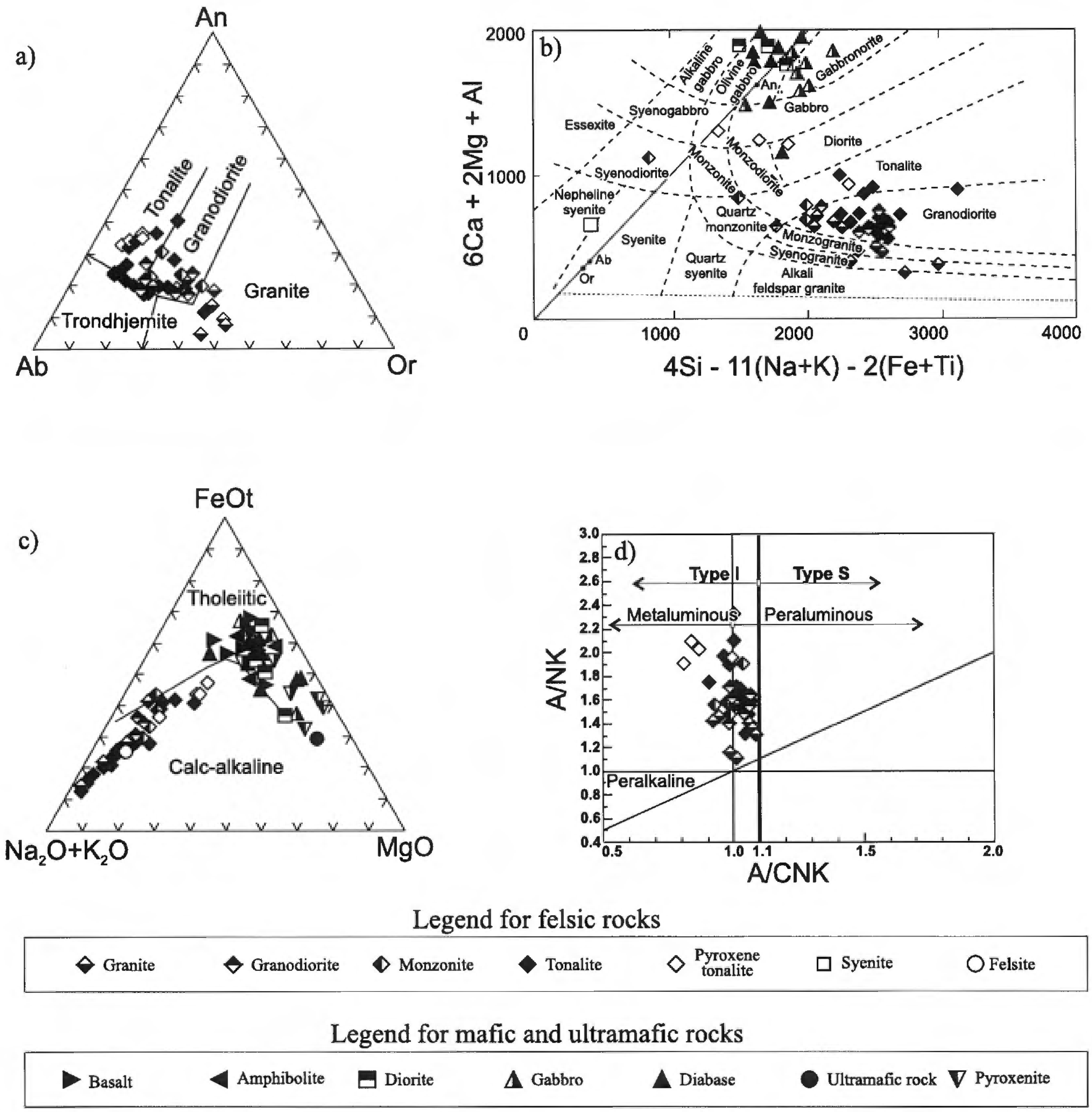


FIGURE 8 - **a)** Normative anorthite-albite-orthoclase diagram by O'Connor (1965) for felsic plutonic rocks. **b)** Cationic classification diagram for plutonic rocks by De La Roche *et al.* (1980). **c)** AFM ternary diagram by Irvine and Baragar (1971) for felsic, mafic and ultramafic rocks. **d)** A/NK versus A/CNK discrimination diagram for felsic plutonic rocks. Metaluminous, peraluminous and peralkaline field boundaries are by Maniar and Piccoli (1989) and boundaries of I-type and S-type fields, by White and Chappell (1977).

Geochemical characteristics of lithodemic units

Douglas Harbour Domain

Qimussinguat Complex

Felsic intrusive rocks of the Qimussinguat Complex essentially consist of gneissic tonalites (Aqim4) intruded by granodioritic and granitic bodies assigned to the Leridon Suite (Alrd). In gneissic tonalites of the Qimussinguat Complex (Aqim4), the trace element patterns show characteristics typical of lower continental crust, with similar Nb and Th concentrations (Figure 10b). This suggests that these gneissic tonalites represent a deep level of exhumed early basement. The mafic rocks (Aqim3) of the Qimussinguat Complex have a geochemical signature similar to all other mafic rocks in the study area.

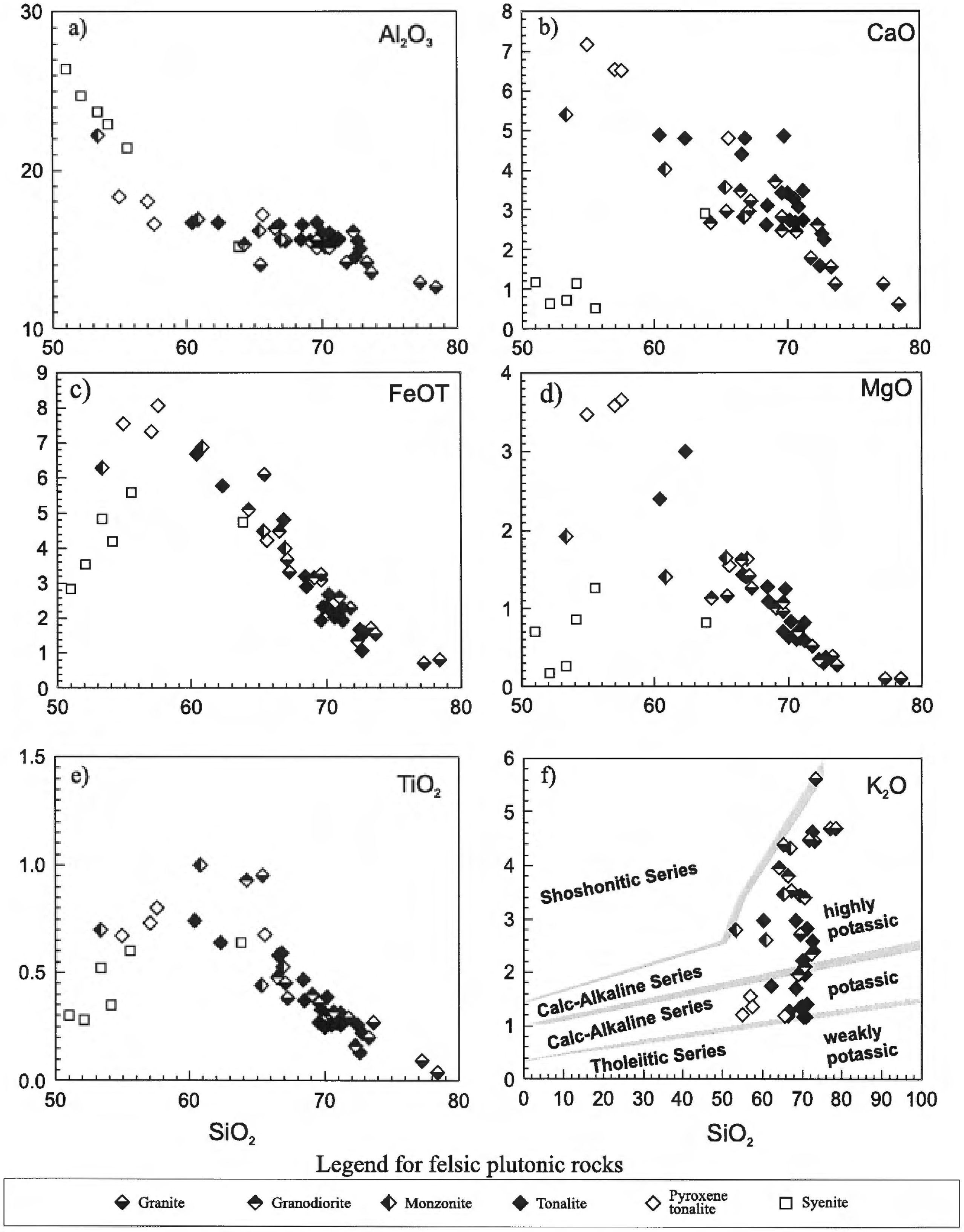


FIGURE 9 - a), b), c), d) and e) Binary diagrams Al_2O_3, CaO, FeOt, MgO and TiO_2 versus SiO_2, showing the magmatic evolution of felsic plutonic rocks. f) K_2O versus SiO_2 binary diagram by Rickwood (1989).

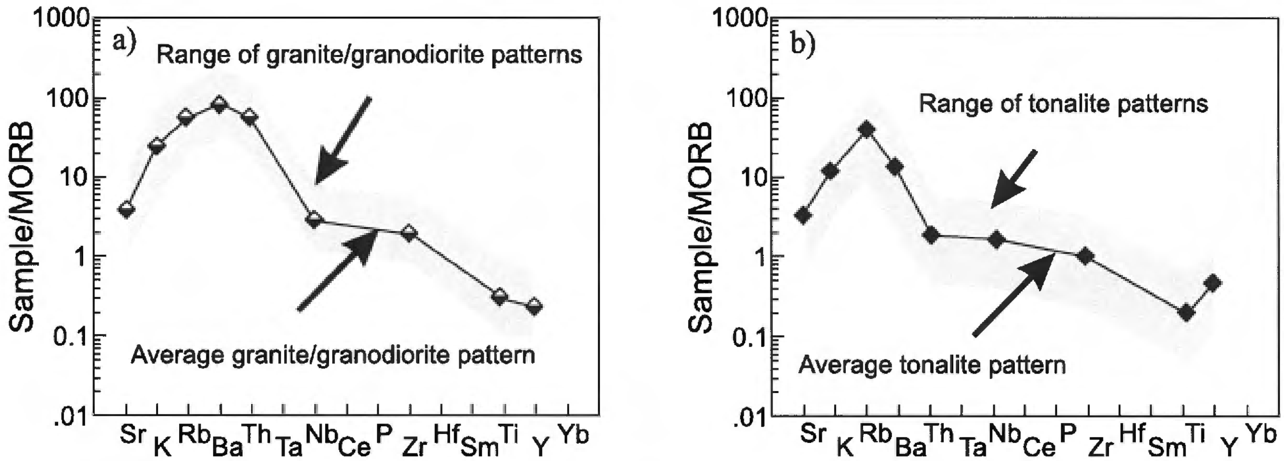


FIGURE 10 - a) MORB-normalized spiderdiagram (Sun and McDonough, 1989) to characterize granites/granodiorites in the area. **b)** MORB-normalized spiderdiagram (Sun and McDonough, 1989) to characterize tonalites in the area.

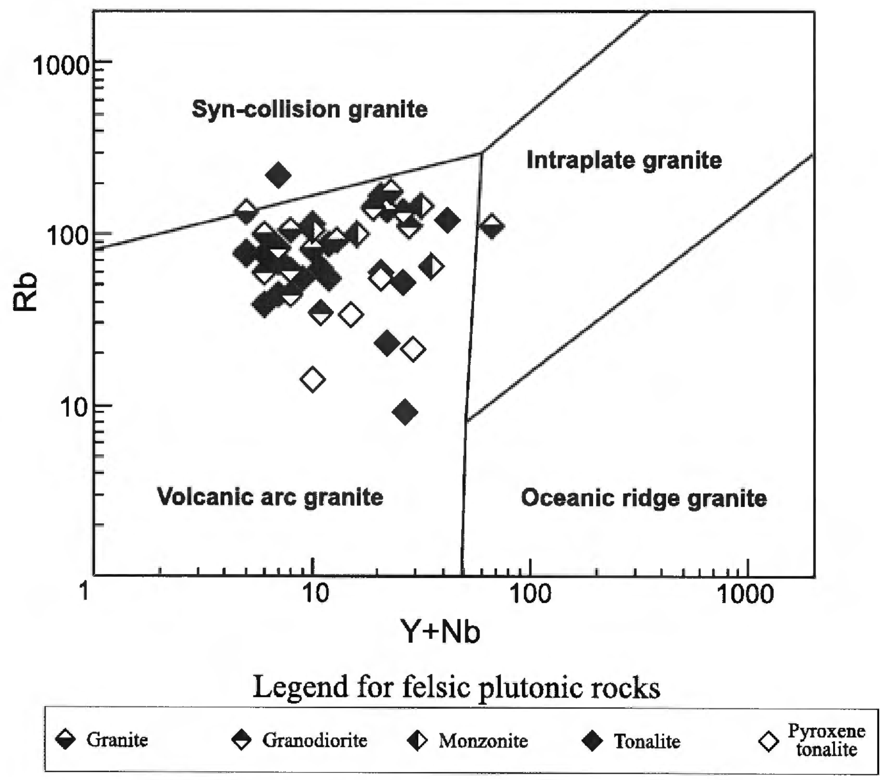


FIGURE 11 - Rb versus Y+Nb paleotectonic diagram (Pearce *et al.*, 1984) for felsic plutonic rocks in the area.

Faribault-Thury Complex

Felsic rocks in the Faribault-Thury Complex are largely composed of hornblende-biotite gneissic tonalites (Afth4) intruded by granodioritic and granitic bodies assigned to the Leridon Suite (Alrd). The trace element geochemistry (Figure 10b) reveals, similar to the Qimussinguat Complex, that gneissic tonalites in the Faribault-Thury Complex (Afth4) have a signature akin to that of lower crust, and also correspond to a fairly deep level of exhumed early basement.

Overall, mafic and ultramafic rocks in the Faribault-Thury Complex (Afth3) are Mg-rich (up to 33% MgO, Table 2 in appendix), but depleted in Ti (< 1.1% TiO_2) and Zr (< 60 ppm). The presence of Mg-rich lavas, the lack of intermediate to felsic volcanic rocks and the low Ti contents characterize the volcanic rocks of the Faribault-Thury Complex. These observations suggest that these rocks represent the base of a large volcanic edifice whose upper part was presumably eroded.

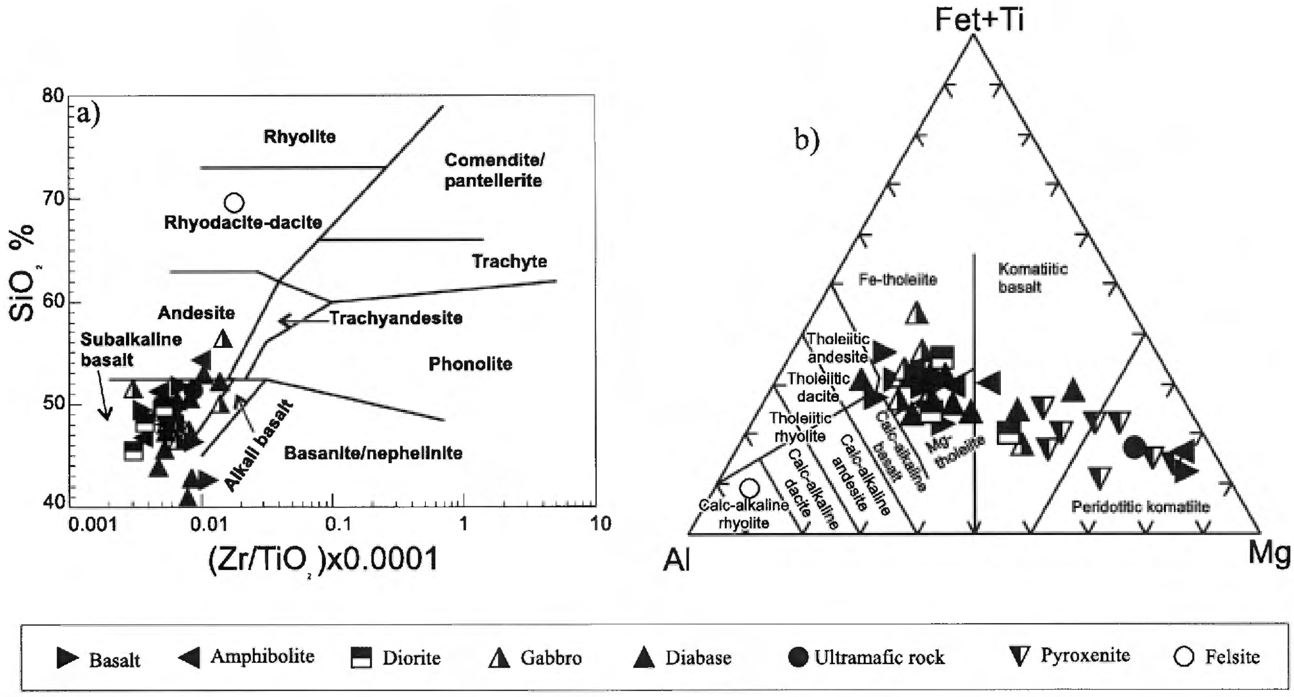


FIGURE 12 - a) SiO_2 versus Zr/TiO_2 classification diagram (Winchester and Floyd, 1977). b) Jensen cation plot (1976).

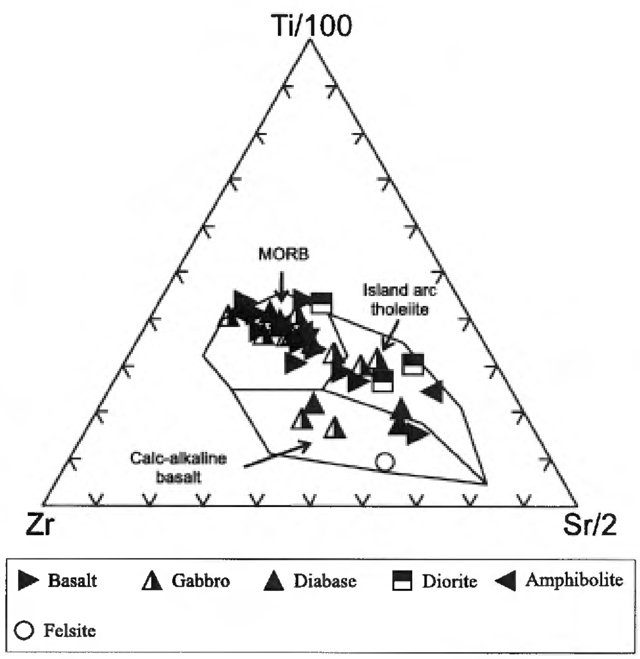


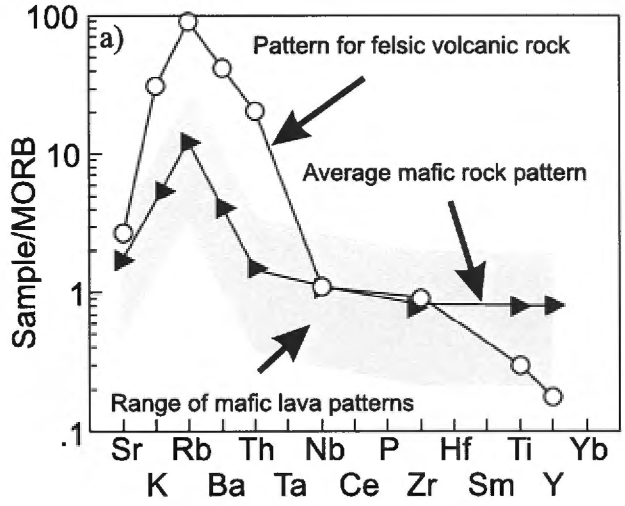
FIGURE 13 - Ti-Zr-Sr paleotectonic diagram (Pearce and Cann, 1973).

Leridon Suite (Alrd)

The felsic plutonic rocks of the Leridon Suite are composed of metaluminous granodiorite (Alrd1) and granite (Alrd2) characterized by high K_2O contents (Table 2 in appendix). Major element, and certain trace element analyses of granodiorites and granites assigned to the Leridon Suite show no significant differences with granodiorites and granites assigned to other suites in the area (Lepelle, Châtelain and La Chevrotière suites). As is the case for all felsic plutonic rocks in the area, the trace element patterns are similar to those of upper continental crust (Figure 10a).

Kimber Alkaline Suite (Akmb)

The Kimber alkaline Suite (Akmb) is mainly formed of nepheline syenite. The major element lithogeochemistry of these rocks confirms their alkaline nature (Figure 15a). Samples collected in the different syenitic phases (granular syenite from the main intrusive bodies, late fine-grained or pegmatitic syenite dykes) show (Na_2O+K_2O) values ranging from 11.5 to 16%, and SiO_2 contents between 50 and 56% (Table 2 in appendix). These major element analyses show that the ratio of alkalis to SiO_2 is inversely proportional; that the dykes are abnormally SiO_2-rich, and that certain phases are strongly depleted in (Na_2O+K_2O) (Table 2 in appendix). These observations suggest that these plutonic bodies underwent substantial differentiation. The classification proposed by De La Roche *et al.* (1980) defines these rocks



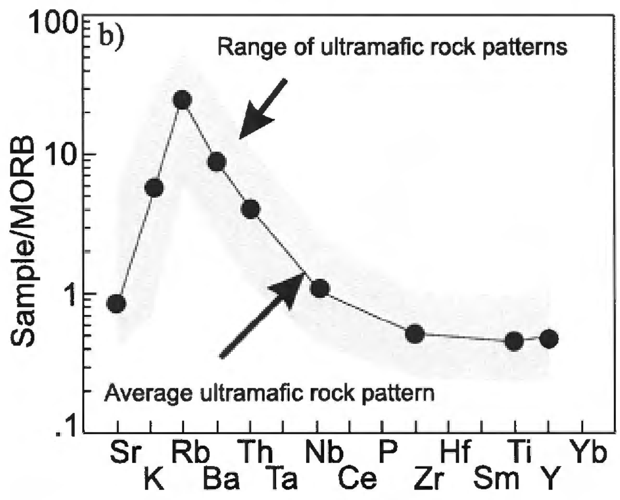


FIGURE 14 - **a)** MORB-normalized spiderdiagram (Sun and McDonough, 1989) to characterize mafic rocks. **b)** MORB-normalized spiderdiagram (Sun and McDonough, 1989) to characterize ultramafic rocks.

as nepheline syenites. They are enriched in LILE and slightly depleted in HFSE relative to MORBs (Figure 15b). The depletion in HFSE, and especially in Ti versus Y is a mantle characteristic.

Lepelle and Utsalik domains

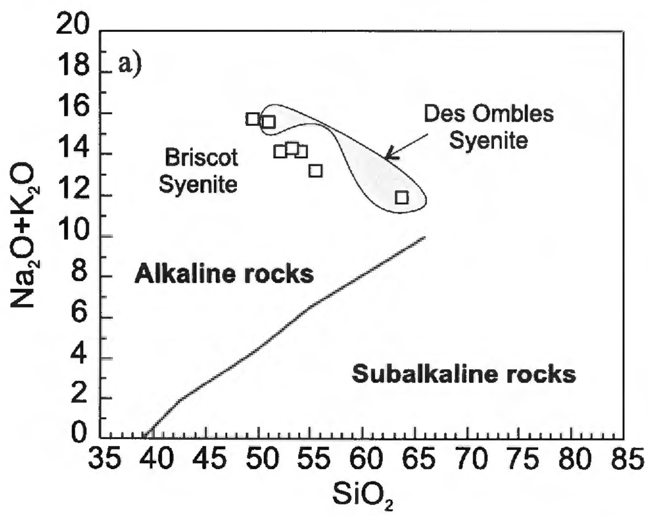
Pélican-Nantais Complex (Apna)

This complex is geochemically comparable to the Faribault-Thury Complex. The Pélican-Nantais Complex, however, is characterized by the abundance of paragneisses (Apna1) in the south part of the complex, and the presence of felsic lavas. Major and trace element analytical results of gneissic tonalites and mafic rocks in the Pélican-Nantais Complex are comparable to analytical results obtained for tonalites and mafic rocks in the Faribault-Thury Complex. The two complexes are therefore geochemically similar.

In the north part of the Pélican-Nantais Complex, a felsite sample, probably an aphanitic tuff, was analyzed for major and trace elements. On the Jensen (1976) diagram, this sample plots in the calc-alkaline rhyolite field, with 15% Al_2O_3 (Figure 12b). The diagram by Pearce and Cann (1973) indicates that the emplacement setting of this felsite corresponds to that of calc-alkaline basalts (Figure 13).

Châtelain (Achl), Lepelle (Alep) and La Chevrotière (Alcv) suites

The Châtelain, Lepelle and La Chevrotière suites are essentially composed of granodiorite and granite. These rocks are highly differentiated. Trace element patterns show



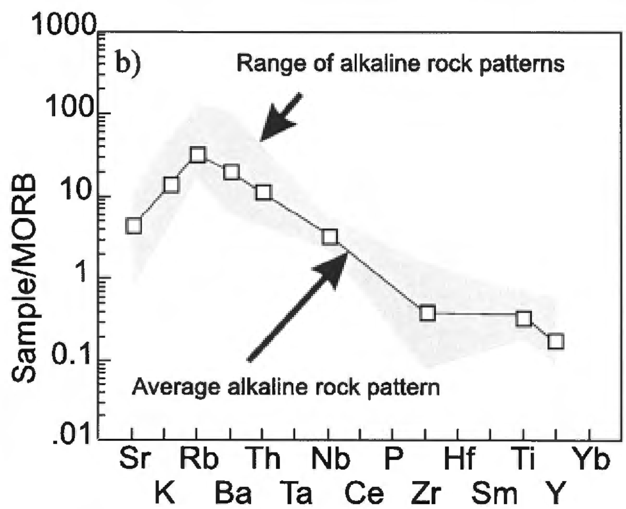


FIGURE 15 - **a)** Diagram by Irvine and Baragar (1971) to characterize alkaline rocks. **b)** MORB-normalized spiderdiagram (Sun and McDonough, 1989) to characterize alkaline rocks.

high concentrations in incompatible elements (Rb, Sr, K and Ba) and low concentrations in moderately incompatible to compatible elements (Ti, Y, Zr, Nb and Th) (Figure 10a). These rocks are probably derived from differentiation of a primitive source at the base of the crust, or from the melting of rocks in the upper continental crust.

Summary

In the study area, the geochemical composition of felsic intrusive rocks appears to be homogeneous, and shows only subtle differences from one unit to the next. These felsic intrusive rocks occur as gneisses (Qimussinguat, Faribault-Thury, Pélican-Nantais complexes, Kapijuq Suite), foliated intrusive rocks (MacMahon, Lepelle and Châtelain suites), and more massive late intrusive rocks (Leridon and La Chevrotière suites). Gneissic rocks, essentially composed of tonalite, appear to be the result of melting in the lower continental crust, whereas massive or foliated intrusive rocks, mainly composed of granodiorite and granite, appear to be derived from melting in the upper continental crust.

All these felsic intrusive rocks probably formed in an active tectonic setting, either along an active margin, or during a collision of island arcs or microcontinents. The diagram by Batchelor and Bowden (1985, Figure 16) suggests that the felsic plutonic rocks evolved in a pre-collisional to syn-collisional tectonic setting.

Mafic and ultramafic rocks, largely observed in volcano-sedimentary sequences in the Faribault-Thury and Pélican-Nantais complexes, share similar geochemical features with MORBs. As previously suggested by the lithogeochemistry of mafic and ultramafic rocks in the Rivière Arnaud area (Madore and Larbi, 2000), the lithogeochemistry of mafic and ultramafic rocks in the Lac Klotz area indicates that Archean MORBs were much richer in Fe and more depleted in trace elements (Zr, Y) than modern MORBs (Table 2 in appendix). These observations suggest that the Archean upper mantle was more Fe-rich and compositionally closer to chondrites than the modern mantle.

ECONOMIC GEOLOGY

Other than exploration work carried out in the Paleoproterozoic supracrustal sequences of the Ungava Trough, and a quick reconnaissance of Archean rocks effected by a limited number of exploration companies, the mineral potential of the area covered by this survey remains poorly known. In 1997, the Ministère des Ressources naturelles conducted, in cooperation with Cambior, Falconbridge, Noranda, SOQUEM and Virginia Gold Mines, a lake sediment geochemistry survey that covers a major portion of the Ungava Peninsula, including the south part of the study area (NTS 35A). The results of this geochemistry survey are now available to the public (MRN, 1998). The digital data is available through SIGÉOM. The geological survey covering the Lac Klotz area (NTS 35A) and the south half of the Cratère du Nouveau-Québec area (NTS 35H) is but another component of the MRN's program to outline the mineral potential of northern Québec.

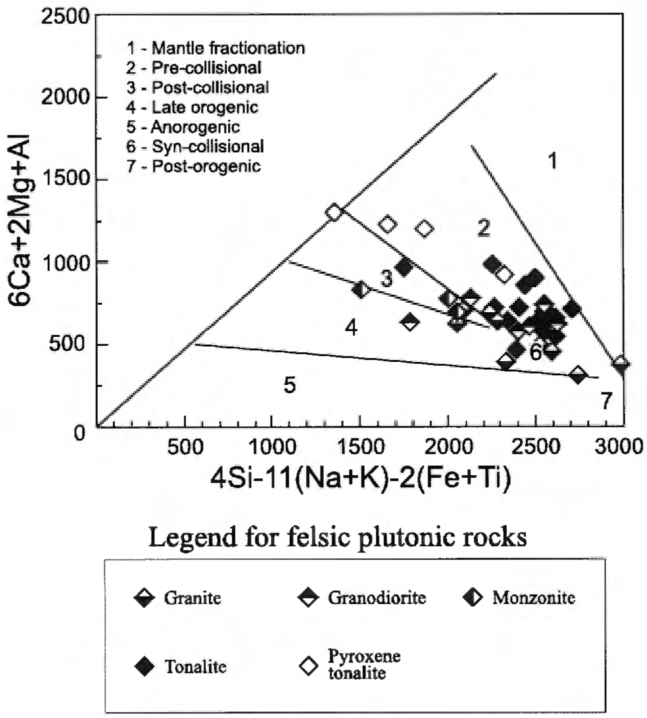


FIGURE 16 - Petrogenetic and paleotectonic diagram (Batchelor and Bowden, 1985) for felsic plutonic rocks in the area.

Economic potential of Archean rocks

During the geological survey carried out in the summer 2000, our mapping efforts were mainly focussed on Archean lithologies that remained poorly known. A few new supracrustal belts were identified, and known belts were reviewed in greater detail. These belts offer an interesting potential for metalliferous deposits, especially the Nantais and Kimber belts (Figure 2), the most important in the area.

Fifty samples collected from rusty horizons and sulphide-rich zones were analyzed for their base and precious metal content. A few showings (tables 3 and 5 in appendix) and six anomalous occurrences distributed in three sectors (tables 4 and 5 in appendix) were identified from these assay results. The mineral occurrences contain Cu, Au, Ag, Zn or Pb. Figure 2 shows the location of showings and anomalous occurrences, generally found within volcano-sedimentary belts. Mafic and ultramafic intrusive rocks were also identified. Despite their high magnesium content (up to 30%

MgO), these rocks contain very few anomalous metal grades (Ni, Cu).

Nantais Belt

The Nantais belt consists of three bands of volcanic rock remnants, dominantly mafic in composition, generally trending N-S. On the south shore of Lac Nantais, the supracrustal rocks form a peninsula with particularly interesting mineral potential (figures 2 and 17). An anomaly delineated by the vast lake sediment geochemistry survey prompted joint venture partners SOQUEM, Virginia Gold Mines and Cambior to explore in this area. A brief reconnaissance led to the discovery of the *Nantais 1 showing* (Figure 17), a shear zone hosted in mafic volcanic rocks. This showing contains pyrite, pyrrhotite, arsenopyrite and native copper, and yielded a grade of 4.7 g/t Au (Francoeur and Chapdelaine, 1999).

More detailed work helped us identify two new showings in this sector, in addition to outlining a sequence of felsic volcanic rocks likely to host volcanogenic mineralization. The *Nantais 2 showing* (Figure 17) is located about 600 m NW of the Nantais 1 showing. The mineralization consists of a poorly outcropping rusty horizons about 2-3 m wide by 10-20 m long. The sulphides are finely disseminated, except for a thin (10-15 cm) semi-massive band composed mainly of pyrrhotite, with trace chalcopyrite and sphalerite. A sample from this semi-massive sulphide zone yielded grades of 7.9 g/t Au and 7.2 g/t Ag.

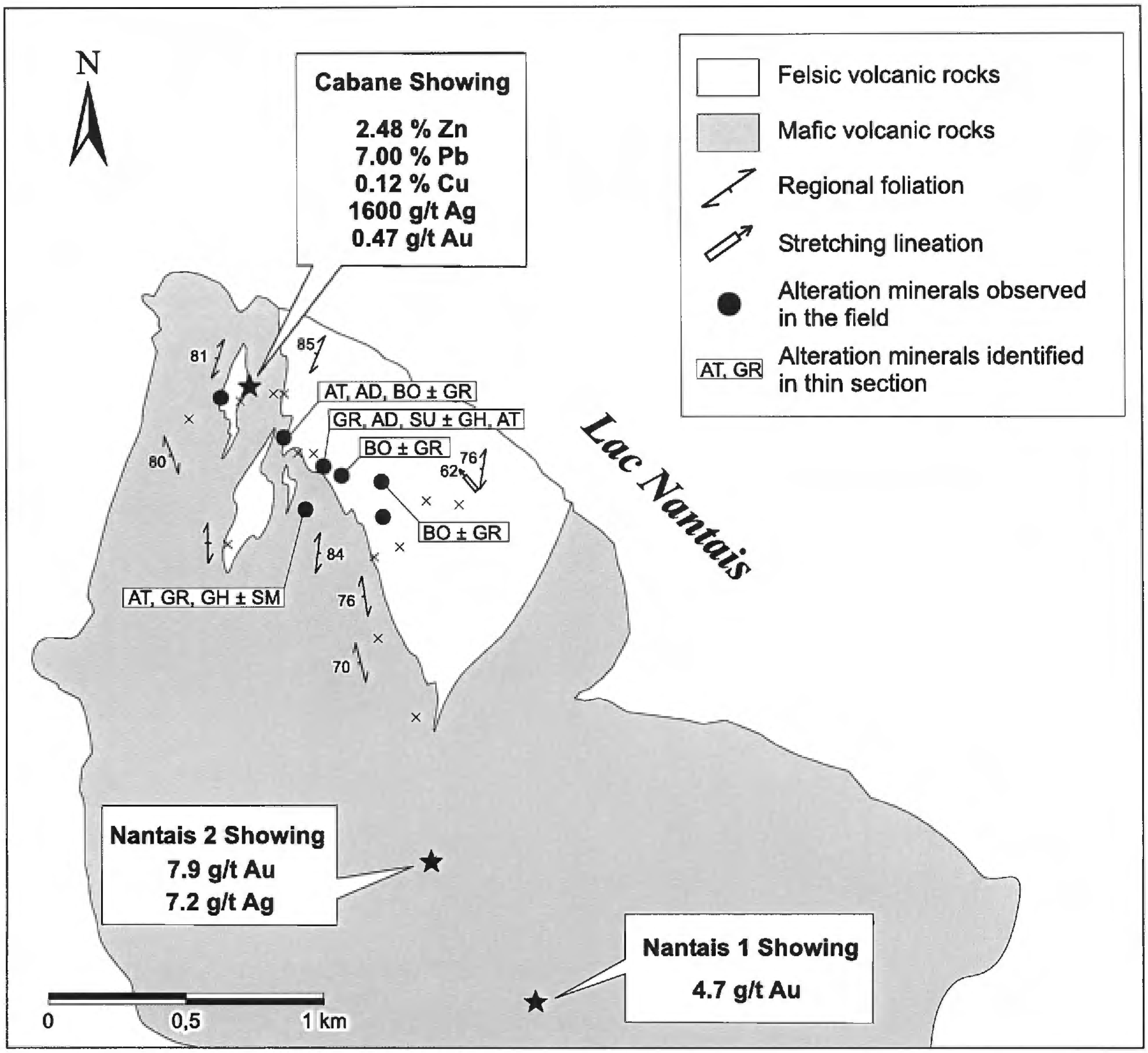


FIGURE 17 - Simplified geology of the Nantais belt on the south shore of Lac Nantais, and location of main mineral occurrences. Alteration minerals: AD-andalusite, AT-anthophyllite, BO-biotite, GH-gahnite, GR-garnet, SM-sillimanite and SU-staurolite.

The *Cabane showing* (Figure 17) is located less than two kilometres NW of the Nantais 2 showing, near the northern tip of the peninsula. This showing occurs near the contact between a mafic volcanic unit and a band of felsic rock. It consists of a vein of massive to semi-massive sphalerite and galena, about 15 cm wide. A sample from this vein yielded grades of 2.48% Zn, 7.00% Pb, 0.12% Cu, 1600 g/t Ag and 0.47 g/t Au. Other than sphalerite and galena, a polished thin section revealed the presence of pyrrhotite, argentite and tetrahedrite.

East of the Cabane showing, a felsic volcanic sequence nearly one kilometre wide was delineated, in contact with basaltic rocks. The felsic volcanic rocks, like the basalts, exhibit a strong tectonic foliation. They are mainly composed of fine dacitic tuffs or aphanitic flows with a few horizons of lapilli and block tuff, polygenic conglomerate and magnetite iron formation. The contact between the felsic sequence and the mafic volcanic rocks is deformed by folds with axial planes parallel to the regional foliation. This contact does not appear to be faulted or transposed. The same situation prevails for three other smaller-scale felsic volcanic units, located further west (Figure 17). It is difficult to determine if these lens-shaped felsic units were emplaced in the mafic sequence, or if they were separated by the folding event. The presence of minerals such as anthophyllite, garnet, biotite, andalusite, staurolite and gahnite suggests synvolcanic hydrothermal alteration affected both felsic and mafic rocks. A more detailed study of this alteration is provided in Labbé and Lacoste (in preparation). This part of the Nantais belt offers strong potential for "gold-bearing volcanogenic massive sulphide"-type deposits.

Kimber Belt

The Kimber belt, located in the NE part of the study area (Figure 2), extends over more than ten kilometres long, and locally reaches up to four kilometres in width. The south part of the belt, mapped in greater detail (Figure 18), shows interesting features. In this sector, the Kimber belt is approximately two kilometres wide. It is enclosed in dominantly

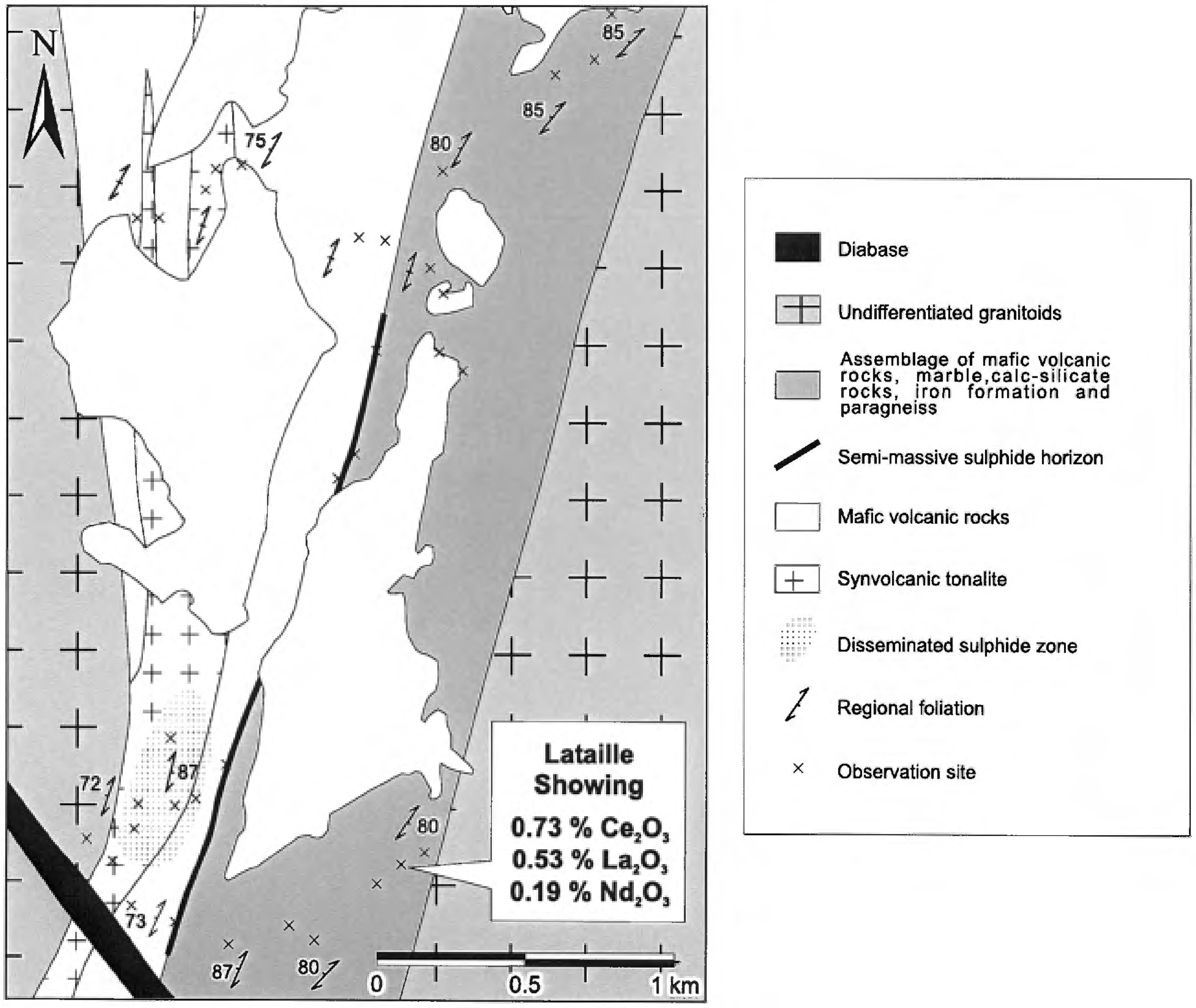


FIGURE 18 - Simplified geology of the south part of the Kimber belt.

tonalitic country rocks. In the west part of the area, the supracrustal rocks consist of a strongly deformed mafic volcanic sequence in which a tonalite, just as deformed and most likely synvolcanic, was introduced. East of these metabasalts, a predominantly mafic volcano-sedimentary sequence was observed, represented by locally carbonatized metabasalts. These metabasalts are accompanied by numerous horizons of carbonate and calc-silicate rocks, magnetite iron formations and paragneiss. The two mafic sequences are separated by a subvertical horizon of massive to semi-massive sulphides reaching up to two metres thick. The sulphide layer extends over about two kilometres along strike. Disseminated sulphides are also present in the volcano-sedimentary rocks, mainly in the western mafic sequence and in the synvolcanic tonalite.

One of the most striking features of the Kimber belt is the presence of carbonate layers in the eastern mafic sequence. These rocks were described as marbles during the field campaign. They form locally discontinuous horizons ranging from 10 cm to more than 10 m thick. The rock mainly consists of calcite, with hornblende, biotite, quartz, plagioclase and monazite. It is strongly deformed, similar to adjacent lithologies. These carbonate rocks host the ***Lataille showing***, where a sample yielded 0.73% Ce_2O_3, 0.53% La_2O_3 and 0.19% Nd_2O_3. The geometry and volume of this anomalous occurrence of rare earth elements is not known. Additional work is needed to define the mineralized zone and to determine the exact nature of these carbonate rocks. Originally mapped as marbles of sedimentary origin, these rocks have rare earth element contents that appear more closely related to carbonatites. At this stage, since these rocks occur in a volcano-sedimentary sequence, that they are deformed and metamorphosed, we will consider them as sedimentary in origin. In this case, the rare earth mineralization may be due to a metasomatic episode related to the emplacement of rocks of the Kimber alkaline Suite.

The massive to semi-massive sulphide horizon separating the two mafic sequences (Figure 18) is also an important feature of the Kimber belt. This horizon consists of mm-scale to cm-scale quartz and granitoid fragments, in a matrix of pyrite and pyrrhotite. It consists of a conglomerate with a sulphide matrix. The sulphide content ranges from 50% to nearly 90% in certain locations. No anomalous base or precious metal assays were obtained from samples of this unit. The nature of this sulphide horizon remains problematic. It does however appear to mark the boundary between two distinct supracrustal sequences. It may represent a reworked exhalative horizon, or perhaps a paleoregolith.

Despite their important disseminated sulphide content, the synvolcanic tonalite and the western mafic sequence yielded fairly disappointing assay results. The Kimber belt nevertheless offers an interesting volcanic setting from a metallogenic standpoint. The presence of synvolcanic tonalite, of carbonate horizons which may represent a shallow marine, even subaerial, environment, as well as the abundance of sulphides indicative of substantial hydrothermal activity, suggest the presence of a setting favourable for epithermal or porphyry-type deposits.

Lac Grunerite showing

The ***Lac Grunérite showing*** is located in the north part of the Faribault-Thury Complex, about twenty kilometres south of the Ungava Trough (Figure 2, and Table 3 in appendix). The host rock consists of foliated granodiorite and gneissic tonalite. These felsic plutonic rocks are in contact with volcanic rock remnants about 10 m in size. The granodiorites and tonalites are cross-cut by a multitude of m-scale quartz veins. These veins locally contain up to 5% sulphides (pyrite, pyrrhotite, chalcopyrite) and minor malachite. The enclosing wall rock contains chalcopyrite mineralization. Assays of surface samples reached up to 0.56% Cu.

Anomalous occurrences

Six anomalous occurrences were identified in the study area (Figure 2, and Table 4 in appendix). Assays of rock samples collected at these occurrences show anomalous base and precious metal grades that are significant for mineral exploration. Most of these anomalous occurrences (sites 1 to 5) are found in supracrustal rocks (volcanic rocks). Site 6 is found in late granodioritic rocks in the Faribault-Thury Complex.

Anomalous occurrences 1, 2 and 3 are found in the north part of the Pélican-Nantais Complex, in the Nantais belt (Figure 2, and Table 4 in appendix). Assay results from basalt samples (Apna2) show grades on the order of 0.17% Cu (site 3), 4 g/t Ag (site 2) and 0.15 g/t Au (site 1). In all three cases, the mineralization consists of disseminated sulphides (~2% pyrite, ~5% pyrrhotite and 1% chalcopyrite).

Anomalous occurrences 4 and 5 are located in the Kimber belt, in the north part of the Faribault-Thury Complex (Figure 2, and Table 4 in appendix). Cu (0.22%), Ag (4.5 g/t), Zn (0.13%) and Pb (0.13%) mineralization is hosted in mafic metavolcanic rocks (Afth3). The mineralization consists of disseminated sulphides (2% pyrite, 1% chalcopyrite and 2% pyrrhotite).

Occurrence no.6 (Figure 2, and Table 4 in appendix) is located in the central part of the Faribault-Thury Complex. A diorite enclaved in a tonalite contains some disseminated pyrite, and yielded an anomalous silver assay on the order of 3 g/t.

Economic potential of Paleoproterozoic sequences

During the geological survey carried out in the summer 2000, no work was performed in Paleoproterozoic units of the Ungava Trough located in the north part of NTS sheet 35H. This area has however been the focus of mapping (Taylor, 1982) and prospecting work in the past. The rocks of the Ungava Trough contain vast basaltic and komatiitic assemblages as well as mafic and ultramafic intrusions. These rocks offer great potential for nickel and copper mineralization. They namely host the Raglan mine, operated by Falconbridge Limited since 1998. This mine produces annually 21,000 tonnes of nickel, 5,000 tonnes of copper, 200 tonnes of cobalt as well as platinum group metals. Current reserves are estimated at 19M tonnes of ore at an average grade of 2.82% Ni and 0.77% Cu (source: www.falconbridge.com). For an overview of the ore deposit settings of Proterozoic mafic and ultramafic rocks in this sector, the reader is referred to the work of Picard *et al.* (1994).

CONCLUSION

The study area is dominated by rocks belonging to the Archean craton. These Archean rocks are intruded by Paleoproterozoic dykes (Payne River dykes and Klotz dykes) and are partially overlain by thrust sheets formed of Paleoproterozoic sequences of the Ungava Trough. The Archean rocks are divided into three major lithotectonic domains. These broad subdivisions are, from east to west: the Douglas Harbour Domain, the Lepelle Domain and the Utsalik Domain.

The *Douglas Harbour Domain* is mainly composed of hornblende-biotite gneissic tonalite (Faribault-Thury Complex) and two-pyroxene gneissic tonalite (Qimussinguat Complex). Overall, these tonalites are relatively old, with ages ranging between 2.74 and 2.87 Ga. A lithogeochemistry study indicates that gneissic tonalites sampled in the Douglas Harbour Domain display features typical of lower continental crust. This suggests that the gneissic tonalites represent the deep portion of an exhumed early basement. The gneissic tonalites of the Faribault-Thury Complex contain dislocated volcano-sedimentary sequences aligned as a string of bands. Supracrustal rocks in the Faribault-Thury Complex recorded metamorphic conditions at the middle to upper amphibolite facies. Small bands of metavolcanic and metasedimentary rocks, as well as enclaves of mafic intrusive rocks observed in the two-pyroxene tonalites of the Qimussinguat Complex are metamorphosed to the granulite facies. Ages obtained for volcano-sedimentary sequences in the Douglas Harbour Domain are bracketed between 2.78 and 2.82 Ga. Rocks of the Qimussinguat and Faribault-Thury complexes are intruded by granodiorites and granites that display compositional features typical of upper continental crust. These late intrusions belong to the Leridon Suite. Two syenite plutons, assigned to the Kimber alkaline Suite, are also observed in the west part of the Qimussinguat Complex.

Further west, in the *Lepelle and Utsalik domains*, the bedrock is mainly composed of granodiorites and granites with hornblende, biotite and clinopyroxene (*ca.* 2.71 Ga). These form foliated composite intrusions belonging to the Lepelle and Châtelain suites. The chemical composition of these granodiorites and granites is typical of upper continental crust. These intrusions host small enclaves as well as rafts several kilometres in size, of older tonalitic gneisses of the Kapijuq Suite (*ca.* 2.76 Ga). These intrusions also enclose gneissic tonalites and volcano-sedimentary sequences assigned to the Pélican-Nantais Complex (*ca.* 2.77 Ga). Foliated orthopyroxene and clinopyroxene-bearing intrusions ranging from tonalitic to granitic and dioritic compositions are also present in the Lepelle and Utsalik domains. These form the MacMahon Suite (*ca.* 2.72 Ga).

Late Archean intrusions, tabular in shape and oriented parallel to the regional N-S fabric, are observed in the Lepelle and Utsalik domains. They are composed of massive or foliated rocks with a granitic, monzogranitic or monzonitic composition, and locally display a porphyroid texture. These rocks typically contain hornblende and biotite. Clinopyroxene is also observed in certain locations. These felsic intrusions belong to the La Chevrotière Suite.

Apart from the sector underlain by rocks of the Ungava Trough, the mineral potential of the study area was very poorly known. During the geological survey carried out in the summer 2000, a few showings and six anomalous occurrences were identified. Most of these mineralized showings and anomalous occurrences are found in the Nantais and Kimber volcano-sedimentary belts.

In the Nantais belt, a showing grading 4.7 g/t Au (Francoeur and Chapdelaine, 1999) was discovered by partners SOQUEM, Virginia Gold Mines and Cambior. During this survey, a showing grading 7.9 g/t Au and 7.2 g/t Ag, and another showing containing 2.48% Zn, 7.00% Pb, 0.12% Cu, 1600 g/t Ag and 0.47 g/t Au were discovered in the Nantais belt. The presence of minerals such as anthophyllite, garnet, biotite, andalusite, staurolite and gahnite suggests synvolcanic hydrothermal alteration. This part of the Nantais belt offers strong potential for "gold-bearing volcanogenic massive sulphide"-type deposits.

In the Kimber belt, a massive to semi-massive sulphide horizon was identified. This horizon reaches up to two metres in thickness, and extends over about two kilometres along strike. Despite the extent of the sulphide zone, no anomalous base or precious metal grades were obtained. Carbonate rocks, inserted with the volcanic rocks in the Kimber belt, locally host elevated rare earth element concentrations (0.73% Ce_2O_3, 0.53% La_2O_3 and 0.19% Nd_2O_3). The nature of this anomaly remains unknown. Overall, the Kimber belt represents an interesting volcanic setting from a metallogenic standpoint. The presence of synvolcanic tonalite, of carbonate horizons which may represent a shallow marine setting, even subaerial, as well as the abundance of sulphides reflecting substantial hydrothermal activity, support the hypothesis of an environment potentially hosting epithermal or porphyry-type deposits.

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APPENDIX : TABLES

Table 1 - Geochronology data for the study area.

Site (Figure 2)	Lithology	Location UTM NAD83 Zone 18	Analytical tecnique (U-Pb in zircon)	Age (Ma)	Type of age	Comments
A	Felsic volcanic rock	574111mE 6760263mN	*TIMS*	2775 ±5	crystallization	3 concordant analyses
B	Gneissic tonalite	612711mE 6751462mN	*La-MC-ICP-MS*	2783 ±5	crystallization	8 analyses of mineral cores
				2755 ±12	secondary	6 analyses of cores and exteriors
C	Syenite dyke	632984mE 6752751mN	*TIMS*	2761 ±1	crystallization	10 analyses <1% discordant
			La-MC-ICP-MS	2764 ±2	crystallization	150 analyses
D	Granite	602013mE 6708778mN	*TIMS*	2734 ±2	crystallization	1 concordant analysis and 2 slightly discordant analyses
				2754 ±3	inherited	1 concordant mineral core analysis
E	Two-pyroxene tonalite	559223mE 6681077mN	*La-MC-ICP-MS*	2728 ±8	crystallization	9 analyses of mineral cores
				2710 ±11	secondaire	5 analyses of zoned exteriors
F	Foliated tonalite	654641mE 6658285mN	*TIMS*	2785 +6/-4	crystallization	2 concordant analyses and 1 slightly discordant analysis

TIMS : Analysis by isotopic dilution and thermal ionization mass spectrometry.

La-Mc-ICP-MS : In situ analysis by laser ablation and multicollector inductively coupled plasma mass spectrometry.

The accuracy (±) represents a confidence interval of 2 standard deviations (95%).

Results are derived from linear regression calculations based on Davis (1982) for *TIMS* analyses, and on Ludwig (1999) for *La-MC-ICP-MS* analyses.

The geochronology study was undertaken by Jean David (Ministère des Ressources naturelles). Isotopic analyses were conducted in the GÉOTOP laboratories of the Université du Québec à Montréal.

Table 2 – Results of chemical analyses of typical rock samples in the study area.

	Qimussinguat Complex		Faribault-Thury Complex			Leridon Suite	Kimder Suite	Pélican-Nantais Complex	
Lithology	I1T	M1[MX]	I1D	V3	I4B	I1C	I2D	I1D	V3
SiO_2 (%)	68.40	48.30	66.80	46.30	40.90	67.30	54.10	69.60	48.70
TiO_2 (%)	0.47	0.96	0.59	1.60	0.22	0.38	0.35	0.27	1.10
Al_2O_3 (%)	15.60	14.80	16.50	18.20	4.20	15.50	22.90	16.70	15.40
Fe_2O_3t (%)	3.20	12.90	4.80	13.10	10.90	3.32	4.18	1.92	14.10
MnO (%)	0.03	0.20	0.06	0.18	0.15	0.06	0.06	0.03	0.22
MgO (%)	1.28	7.80	1.41	5.19	31.80	1.26	0.86	0.70	6.73
CaO (%)	2.62	11.10	4.79	9.42	3.15	3.21	1.14	3.40	10.20
Na_2O (%)	4.01	2.80	4.23	3.55	0.32	4.14	10.90	5.22	2.83
K_2O (%)	2.96	0.39	1.28	1.23	0.09	3.52	3.20	1.34	0.48
P_2O_5 (%)	0.09	0.03	0.11	0.46	0.01	0.11	0.43	0.05	0.04
Cr_2O_3 (%)	0.01	0.05	0.01	0.01	0.36	0.01	0.01	0.01	0.04
LOI (%)	1.13	0.37	0.32	1.38	6.47	0.42	0.70	0.47	0.88
Total (%)	99.80	99.70	100.90	100.62	98.57	99.23	98.83	99.71	100.72
As (ppm)	0.50	0.50	0.50	0.60	2.10	0.50	0.50	0.50	0.50
Co (ppm)	8.00	50.00	11.00	38.00	100.00	8.00	9.00	5.00	52.00
Cr (ppm)	26.00	300.00	20.00	20.00	2400.00	20.00	20.00	20.00	250.00
Ni (ppm)	100.00	109.00	100.00	100.00	1700.00	100.00	100.00	115.00	105.00
Ba (ppm)	950.00	50.00	340.00	330.00	50.00	900.00	740.00	200.00	88.00
Br (ppm)	2.20	0.50	1.20	0.90	8.60	1.70	0.90	0.60	1.20
Cs (ppm)	3.50	0.50	1.20	0.50	0.60	0.50	0.50	0.50	0.50
Ga (ppm)	22.00	16.00	21.00	25.00	4.00	19.00	18.00	22.00	20.00
Ir (ppm)	60.00	50.00	50.00	55.00	50.00	50.00	75.00	50.00	53.00
Mo (ppm)	2.00	2.00	1.00	1.00	3.00	6.00	2.00	1.00	2.00
Nb (ppm)	5.00	3.00	6.00	5.00	2.00	4.00	13.00	4.00	4.00
Rb (ppm)	113.00	7.00	52.00	22.00	4.00	92.00	59.00	44.00	21.00
Sc (ppm)	3.50	42.00	10.00	25.00	17.00	7.00	0.50	0.70	38.00
Se (ppm)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Sr (ppm)	271.00	103.00	279.00	777.00	2.00	631.00	767.00	660.00	135.00
Ta (ppm)	5.00	5.00	22.00	11.00	5.00	41.00	5.00	5.00	17.00
Th (ppm)	18.00	0.40	2.80	0.50	0.30	11.00	0.30	1.50	0.20
U (ppm)	2.00	0.50	0.60	0.50	0.50	0.50	0.50	0.60	0.60
W (ppm)	1.00	1.00	1.00	1.00	5.00	1.40	1.00	1.00	8.00
Y (ppm)	5.00	23.00	20.00	24.00	6.00	9.00	7.00	3.00	24.00
Zr (ppm)	215.00	52.00	172.00	137.00	17.00	87.00	40.00	112.00	63.00

Lithology codes :

I1B = granite, I1C = granodiorite, I1D = tonalite, I1T = orthopyroxene tonalite
I2F = monzonite, I2D = syenite, I2J = diorite
I3B = diabase, M1[MX] = mafic gneiss, V3 = mafic volcanic rock, I4B = pyroxenite

Table 2 (continued) – Results of chemical analyses of typical rock samples in the study area.

	Kapijuq Suite	Macmahon Suite		Châtelain Suite	Lepelle Suite	La Chevrotière Suite		Klotz Dyke	Payne Dyke
Lithology	I1D	I1D	I2J	I1C	I1C	I1C	I1B[PO]	I3B	I3B
SiO_2 (%)	60.40	57.50	48.00	72.30	70.70	70.70	73.30	49.70	49.10
TiO_2 (%)	0.74	0.80	0.71	0.16	0.32	0.30	0.20	1.25	2.35
Al_2O_3 (%)	16.70	16.60	15.00	16.10	15.30	15.30	14.20	15.00	15.13
Fe_2O_3t (%)	6.66	8.06	12.70	1.35	2.27	2.48	1.70	14.80	17.00
MnO (%)	0.10	0.14	0.20	0.02	0.03	0.03	0.01	0.22	0.23
MgO (%)	2.39	3.66	8.21	0.35	0.71	0.70	0.39	5.47	4.55
CaO (%)	4.88	6.52	10.50	2.62	2.43	2.78	1.54	10.60	8.80
Na_2O (%)	3.86	3.93	2.84	4.95	4.02	4.26	3.42	2.48	2.64
K_2O (%)	2.96	1.35	0.83	2.35	3.40	2.11	4.45	0.16	0.31
P_2O_5 (%)	0.22	0.19	0.02	0.01	0.08	0.04	0.01	0.06	0.21
Cr_2O_3 (%)	0.01	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01
LOI (%)	0.84	0.21	0.42	0.27	0.94	0.59	0.44	0.15	0.45
Total (%)	99.76	98.97	99.48	100.49	100.21	99.30	99.67	99.90	100.78
As (ppm)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.00
Co (ppm)	16.00	25.00	52.00	5.00	5.00	6.00	5.00	49.00	39.00
Cr (ppm)	20.00	27.00	300.00	20.00	20.00	20.00	20.00	74.00	42.00
Ni (ppm)	100.00	110.00	160.00	123.00	100.00	145.00	100.00	115.00	1.00
Ba (ppm)	720.00	410.00	110.00	700.00	1400.00	810.00	2600.00	50.00	68.00
Br (ppm)	0.80	0.70	0.50	0.50	0.80	0.70	2.40	3.70	n.a
Cs (ppm)	0.90	0.50	0.60	0.70	0.50	0.50	0.50	0.50	119.00
Ga (ppm)	20.00	21.00	16.00	18.00	18.00	20.00	16.00	20.00	23.00
Ir (ppm)	63.00	50.00	57.00	50.00	50.00	50.00	50.00	59.00	n.a
Mo (ppm)	5.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	n.a
Nb (ppm)	10.00	6.00	2.00	3.00	3.00	3.00	2.00	6.00	9.00
Rb (ppm)	120.00	55.00	9.00	60.00	83.00	61.00	79.00	5.00	11.00
Sc (ppm)	13.00	19.00	42.00	0.50	0.90	2.50	1.10	40.00	40.00
Se (ppm)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	n.a
Sr (ppm)	567.00	573.00	134.00	497.00	644.00	534.00	592.00	115.00	121.00
Ta (ppm)	12.00	5.00	10.00	5.00	5.00	5.00	5.00	5.00	32.00
Th (ppm)	17.00	0.40	0.30	1.10	5.90	4.10	4.40	0.50	0.80
U (ppm)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.00
W (ppm)	1.00	1.00	7.00	1.00	1.00	1.00	1.00	10.00	91.00
Y (ppm)	32.00	15.00	16.00	3.00	4.00	5.00	3.00	26.00	42.00
Zr (ppm)	216.00	94.00	38.00	67.00	120.00	117.00	106.00	71.00	137.00

Fe_2O_3t = Total iron oxides expressed as Fe_2O_3.

n. a. = not analysed

Lithology codes :

I1B = granite, I1C = granodiorite, I1D = tonalite, I1T = orthopyroxene tonalite

I2F = monzonite, I2D = syenite, I2J = diorite

I3B = diabase, M1[MX] = mafic gneiss, V3 = mafic volcanic rock, I4B = pyroxenite

Table 3 – Characteristics of mineral occurrences. Showing locations are shown in Figure 2.

Showing	Location UTM NAD83 Zone 18	Commodity and grade	Description
Nantais 1	*NTS 35A* 574,982 mE 6,758,261 mN	Au = 4.7 g/t	Mineralized shear zone cross-cutting a metabasalt.
Nantais 2	*NTS 35A* 574,553 mE 6,758,802 mN	Au = 7.9 g/t Ag = 7.2 g/t	Thin (10-15 cm) semi-massive sulphide horizon (PO +/- CP, SP) in sheared metabasalt.
Cabane	*NTS 35A* 573,915 mE 6,760,460 mN	Zn = 2.48 % Pb = 7.00 % Cu = 0.12 % Ag =1600 g/t Au = 0.47 g/t	Vein about 15 cm thick, composed of sphalerite, galena, pyrrhotite, argentite and tetrahedrite, hosted in a metabasalt near a contact with felsic volcanic rocks.
Lataille	*NTS 35H* 629,648 mE 6,786,855 mN	Ce_2O_3 = 0.73 % La_2O_3 = 0.53 % Nd_2O_3 = 0.19 %	Sheared marble or carbonatite horizon containing up to 3% of fairly coarse monazite (1-2 mm).
Lac Grunérite	*NTS 35H* 639,499 mE 6,792,819 mN	Cu = 0.56 %	Cm-scale quartz veins with PY (5%), PO (2%), CP (<1%) and malachite. These veins, hosted in foliated granodiorite, cross-cut the foliation.

CP = chalcopyrite, PO = pyrrhotite, PY = pyrite, SP = sphalerite

Table 4 – Characteristics of anomalous occurrences. Site locations are shown in Figure 2.

Anomalous occurrence	Location UTM NAD83 zone 18	Commodity and grade	Description
1	*NTS 35H* 572,776 mE 6,768,612 mN	Au = 0.15 g/t	Metabasalt in the Nantais belt, hosting several sulphide zones (trace PY, CP and PO)
2	*NTS 35A* 567,485 mE 6,744,863 mN	Ag = 4 g/t	Folded and sheared mafic volcanic rocks. Trace PY mineralization is disseminated throughout the rock.
3	*NTS 35A* 568,642 mE 6,722,070 mN	Cu = 0.17 %	Foliated metabasalt cross-cut by quartz-epidote veinlets. The PY (1%) mineralization is disseminated in the dominant lithology.
4	*NTS 35H* 645,102 mE 6,804,532 mN	Cu = 0.22 %	Deformed mafic volcanic rock located along the northern extension of the Kimper belt. The mineralization consists of disseminated PY (2%), CP (1%) and PO (2%) in rusty layers.
5	*NTS 35H* 633,016 mE 6,794,112 mN	Ag = 4.5 g/t Zn = 0.13 % Pb = 0.13 %	Mafic volcanic rock in the Kimber belt. PY and PO mineralization is concentrated in the extremities of m-scale quartz veins and along the foliation.
6	*NTS 35A* 630,697 m.E 6,741,841 m.N	Ag = 3 g/t	Diorite enclave in tonalite. The diorite is only slightly rusty. The mineralization is hardly visible, and consists of disseminated PY.

CP = chalcopyrite, PO = pyrrhotite, PY = pyrite

TABLE 5 – Threshold values used to discriminate mineralized showings and significant lithogeochemical anomalies.

Mineral commodity	Threshold grades used by Descarreaux (1973) to discriminate anomalies in the Abitibi mining camp	Threshold grades used to discriminate showings in this project	Threshold grades used to discriminate important anomalies in this project
Au	0.5 g/t	1 g/t	0.5 g/t
Ag	2 g/t	5 g/t	3 g/t
Cu	0.3 %	0.50%	0.1 %
Ni	0.2 %	0.25%	0.2 %
Zn	0.03 %	0.75%	0.05 %
Pb	0.02 %	0.50%	0.05 %
Cr	0.2 %	1%	0.2 %
As	0.005 %	----	0.015 %
W	0.1 %	----	0.1 %

Abstract

This new geological survey covers the Lac Klotz area (NTS sheet 35A) and the south half of the Cratère du Nouveau-Québec area (southern half of NTS sheet 35H). The study area is underlain by Archean rocks of the Superior Province assigned to the Douglas Harbour, Lepelle and Utsalik domains. These Archean rocks are intruded by Paleoproterozoic dykes (Payne River dykes and Klotz dykes) and partially overlain by thrust sheets. These thrust sheets, composed of Paleoproterozoic supracrustal sequences, belong to the Ungava Trough.

In the eastern part of the area lies the Douglas Harbour Domain, which consists of the Qimussinguat and Faribault-Thury complexes, two complexes essentially composed of gneissic tonalites. Gneissic tonalites in the Qimussinguat Complex contain orthopyroxene and clinopyroxene. These tonalites host mafic and metasedimentary enclaves metamorphosed to the granulite facies. In the Faribault-Thury Complex, gneissic tonalites contain hornblende and biotite. They enclose volcano-sedimentary remnants metamorphosed to the amphibolite facies. Rocks of the Qimussinguat and Faribault-Thury complexes are intruded by granodiorites and granites assigned to the Leridon Suite. Two syenite plutons, grouped in the Kimber alkaline Suite, are observed in the rocks of the Qimussinguat Complex.

In the western part of the area, we find the Lepelle and Utsalik domains. Wedged between the two, the Pélican-Nantais Complex contains lithologies comparable to those observed in the Faribault-Thury Complex. The Pélican-Nantais Complex consists of biotite-hornblende gneissic tonalites enclosing volcano-sedimentary bandsmetamorphosed to the amphibolite facies. However, assemblages typical of the granulite facies are observed locally. The Lepelle and Utsalik domains also contain rafts of gneissic biotite-hornblende tonalite several kilometres in size, assigned to the Kapijuq Suite.

Rocks of the Pélican-Nantais Complex and the Kapijuq Suite are enclosed by large masses of granodiorite and granite. These granodiorites and granites are generally foliated, and typically contain hornblende and clinopyroxene. These composite intrusions form the Lepelle and Châtelain suites. The two suites are separated by an axis occupied by the Pélican-Nantais Complex, and by large ductile deformation zones oriented N-S that transect the entire area. Granodioritic and granitic bodies assigned to the Lepelle and Châtelain suites also contain foliated orthopyroxene-bearing intrusions ranging from tonalitic to granitic and dioritic in composition, grouped in the MacMahon Suite.

Late Archean intrusions, tabular in shape and oriented parallel to the regional N-S fabric are observed in the Lepelle and Utsalik domains. These consist of massive or foliated granitic, monzogranitic and monzonitic rocks that locally display a porphyritic texture. These felsic intrusions belong to the La Chevrotière Suite.

A regional structural study reveals five deformation episodes, along with an anorogenic episode. The first three episodes of deformation (D1, D2 and D3) are ductile and Archean in age. Deformation D1 consists of an early foliation or gneissosity, oriented N-S and steeply dipping. The peak of deformation resulted in the development of isoclinal and intrafolial folds. Deformation D2 corresponds to open folds that generated weak undulations of the regional fabric. This deformation is discrete and weakly developed. Deformation D3 corresponds to ductile shear zones located along major lithotectonic discontinuities. These Archean deformation episodes were followed by a Paleoproterozoic anorogenic event, during which two gabbro dyke swarms were emplaced (Payne River dykes and Klotz dykes). The emplacement of these dykes was followed by another Paleoproterozoic event (D4), which corresponds to the Ungava Orogen. A final episode of late deformation (D5) followed the two Paleoproterozoic events. It consists of rectilinear brittle faults that transect the entire area.

Apart from the sector underlain by rocks of the Ungava Trough, the mineral potential of the study area was very poorly known. During the geological survey carried out in the summer 2000, a few mineral occurrences were identified. These showings are essentially located in the Nantais and Kimber volcano-sedimentary belts. In the Nantais belt, the mineralization consists of Au, Ag, Zn, Pb, Cu. This area shows strong potential for "gold-bearing volcanogenic massive sulphide"-type deposits. In the Kimber belt, high rare earth element concentrations were observed in carbonate rocks. Furthermore, this volcano-sedimentary sequence represents a favourable environment for epithermal or porphyry-type deposits.

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