RG 2001-05

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Accompanies maps
SI-24E-C2G-01C
SI-24F04-C3G-01C

Brecciated carbonatite dyke.

2002

Québec

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Abstract

The Lac Aigneau area (24E and 24F/04), mapped at a scale of 1:250,000 during the 1998 and 1999 field seasons, was subdivided into two lithodemic complexes and eleven intrusive suites, which were emplaced between *ca.* < 2.80 and > 2.67 Ga. These Archean units may be grouped into two major geological assemblages. They are cut by five families of younger dykes (*ca.* < 2.65 Ga; gabbro, diabase, ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite), and are bounded to the east by the Paleoproterozoic (2.0 to 1.8 Ga) New Québec Orogen.

Volcani-sedimentary units, grouped in the Duvert and Qamaniq complexes, are the oldest rocks inventoried, and are penetratively transposed and affected by two phases of granulite-grade metamorphism. In the west part of the map area, the Duvert Complex is essentially enclaved in tonalites of the Suluppaugalik Suite (2805+9/-4 Ma). These tonalites are invaded by homogeneous intrusions of granodiorite (2725±5 Ma) and tonalite (2710 Ma) of the Rivière aux Feuilles Suite, by heterogeneous migmatitic granodiorites of the Monchy Suite, as well as by diatexites of the Rivière aux Mélèzes Suite (2671 Ma). In the south part of the map area, tonalites of the Suluppaugalik Suite are cut by diorites-tonalites-trondhjemites associated with diorites of the Coursolles Suite (dated at 2718+15/-9 Ma). Locally, within these suites, an early planar fabric (S_2) oriented N-S, is preserved and interpreted as being related to a first phase of deformation (D_2). This fabric is intersected in the south by a second planar fabric (S_3) oriented E-W to ENE-WSW. All of these suites and structures are essentially outlined by regional negative magnetic anomalies, and form the extension of the Goudalie – La Grande Series.

The northeastern half of the map area is underlain by the MacMahon Suite composed of two enderbitic units (dated at 2717±4 Ma and 2704±2 Ma) to which are associated bodies of mafic (orthopyroxene diorite, gabbronorite to anorthositic gabbro) and ultramafic rocks (pyroxenite, peridotite and hornblendite) as well as a synmagmatic metamorphic episode at the granulite facies. Laterally, this suite grades into clinopyroxene tonalites and diorites (Nallualuk Suite; 2698±3 Ma). These pyroxene-bearing suites are intruded by porphyritic monzogranites of the La Chevrotière Suite (*ca.* 2.717 and 2.686 Ga), as well as by late leucogranites of the Morrice (*ca.* 2682±4 Ma) and Dufreboy suites. These granites are the expression of a collisional process that is also responsible for regional metamorphism at the middle to upper amphibolite facies. Gabbro and diorite intrusions (Bacqueville Suite) are locally enclaved in the various granitic rocks. All these suites are bracketed between 2.717 and 2.671 Ga, and define an overall strongly positive magnetic gradient, outlined by a planar fabric oriented NW-SE to WNW-ESE (S_4) and NNW-SSE to N-S (S_5). The northeastern half of the Lac Aigneau area shares numerous similarities, namely gravimetric, magnetic, stratigraphic and tectono-metamorphic features, with units composing the Ashuanipi Subprovince, which suggests these two regions may form a single tectono-stratigraphic assemblage, the Utsalik-Ashuanipi Series.

Mapping in 1998 and 1999 in the Superior Province helped uncover new economically significant mineral occurrences and showings. These occurrences were grouped into five metallogenic settings: iron formations associated with volcani-sedimentary belts (with Cu-Zn-Pb-Co±Ag±Au mineralization), ultramafic and mafic intrusions (with Cu-Ni±Co±Zn mineralization), quartz veins (with Cu mineralization), fault zones (with Cu-Zn-Ag±Au mineralization) associated with ultramafic to mafic lamprophyre dykes, carbonatized lamprophyre and carbonatite dykes, and finally, ultramafic lamprophyre dykes which seem to display some affinity with kimberlites.

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INTRODUCTION

The Lac Aigneau mapping project is part of a vast mapping program undertaken by the Ministère des Ressources naturelles du Québec in Québec's Far North, north of the 55th parallel. In 1997, Géologie Québec launched this program by conducting a lake sediment geochemical survey in partnership with five private companies. The Far North Program, at the time of writing this report, is in its second phase. Its objectives are to build a regional geological framework at a scale of 1:250,000 in order to open this vast (over 350,000 km^2) poorly known territory to mineral exploration. In 1998, four mapping projects were carried out in the northeastern part of the Superior Province (Madore *et al.*, 1999; Gosselin and Simard, 2000; Parent *et al.*, 2000) and in the Rae Province (Verpaelst *et al.*, 2000). In 1999, four new mapping projects were carried out in the northeastern Superior Province. This rate of four mapping projects at the 1:250,000 scale, covering 4 to 7 map sheets per year, should be maintained until 2003.

This report contains the results and interpretations derived from the geological survey carried out in the Lac Aigneau area (NTS 24E and 24F/04). The objectives of the Lac Aigneau project are to increase the level of geological knowledge, define the lithostratigraphic nature of the rocks and identify the metallogenic setting of this part of the Superior Province. It includes the results of mapping conducted by Percival and Card (1994) in the northwestern part of the map area, and by Parent *et al.* (200) in the western part of the Lac Aigneau area (NTS 24E).

Location, Access and Topography

The Lac Aigneau area (NTS 24E) is located in an isolated part of northern Québec, in the heart of Nunavik. It lies in the east-central part of the Ungava Peninsula, between the Rivière aux Feuilles and the Rivière aux Mélèzes (Figure 1). The centre of the area is about 140 km west of the town of Kuujjuaq which is located near the south shore of Ungava Bay. The area is bounded by latitudes 57°00' N and 58°00' N, and longitudes 69°30' W and 72°00' W. Its surface area is about 14,000 km^2, including NTS sheet 24E (Lac Aigneau) and the southwestern part of NTS sheet 24F/04 (Lac Hérodier) (Figure 1). It is accessible by floatplane from Kuujjuaq or from the Lac Pau base located near Réservoir Caniapiscau, about 300 km to the south. Water bodies in the area are free of ice for water landings around mid-June. Several landing strips, suitable for short airlift aircraft (Twin Otter) are found in the area. At the time of field mapping, the Anglefontaine landing strip (70°29.4' W and 57°52.4' N) was completely cleared.

The Lac Aigneau area lies roughly along the boundary between the forested tundra and the arctic tundra. The forest cover is nearly absent, except in the valleys carved by the Rivière aux Mélèzes and the Rivière aux Feuilles. Only the south part of the area is covered by scattered black spruce and tamarack. The topography of the area is weak to moderate, with altitude variations ranging between 120 and 450 metres above sea level. River valleys, with a drop of nearly 300 metres, are the principal topographic elements. Outcrops are numerous and generally extensive. They are lichen-covered and are therefore of a uniform dark colour. The southeastern part of the area is characterized by an important cover of glacial deposits and *felsenmeers* extending over several tens of square kilometres. The area is populated by a wide range of animals including caribou, black bears, wolves, arctic fox, lemmings, hares as well as numerous species of birds, including ptarmigans, ducks and loons. Fish varieties namely include salmon, lake trout and arctic char.

Methodology

Field work in the Lac Aigneau area took place over a period of 11 weeks. Mapping was carried out by seven geologists in the first half of the field season, and by six geologists during the second half. Mapping crews, each composed of one geologist and one assistant, were transported to the field by a Long Ranger 206-L helicopter from the base camp set up near Lac Vanessa (70°47.51' W – 57°44.37' N). Geological surveys were carried out via traverses ranging between 8 and 12 km in length, and spaced by 5 km on average. Certain sectors received more attention given their mineral potential. Isolated helicopter spot checks of nearly 200 sites helped complete the mapping coverage. This methodology allowed us to collect geological data over an area about 120 km long by 90 km wide. The geological interpretation was made using 1:125,000 scale topographic base maps and incorporating aeromagnetic and remote sensing data, subsequently compiled at the 1:250,000 scale. The geological map of the Lac Aigneau area as well as all the field data are contained in the SIGÉOM digital database of the Ministère des Ressources naturelles du Québec.

During the field season, about 1,500 rock samples were collected and systematically sawed. Among the most representative samples, 119 were selected for whole rock analyses, and 166 for the analysis of économic substances. Analytical results are available through the SIGÉOM database. Several hundred samples were used to make thin sections. Five samples were collected to date major geological events, using either the U-Pb or Pb-Pb method. The Far North geochronology program is headed by Jean David at the GÉOTOP laboratory of the *Université du Québec à Montréal*.

Previous Work

The first geological survey of the area consists of a 1:1,000,000 scale reconnaissance survey conducted by Stevenson (1968). This survey is based solely on information collected along predetermined flight lines with

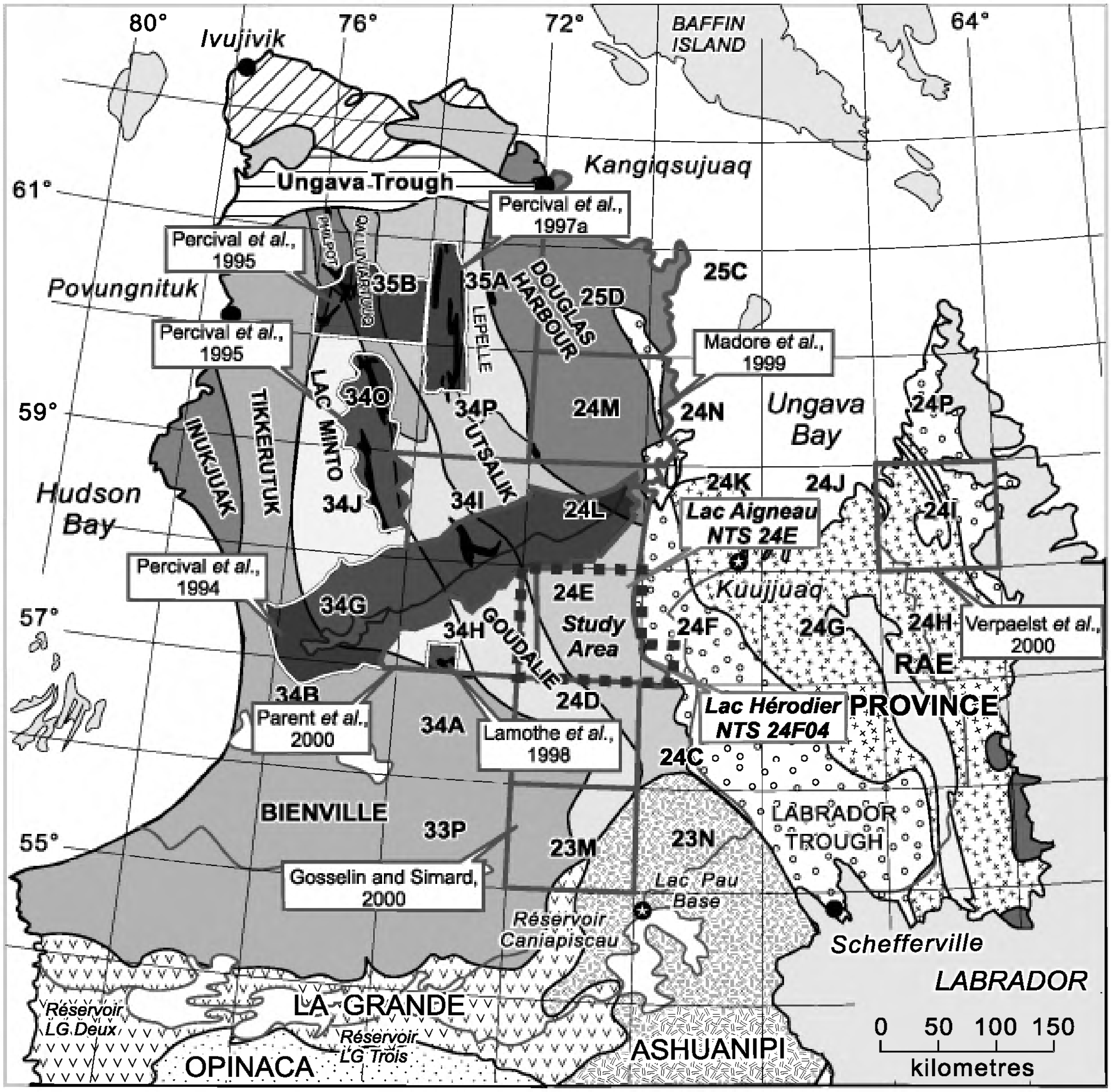

FIGURE 1 – Location map showing the Lac Aigneau (NTS 24E) and Lac Hérodier (NTS 24F/04) areas, recent geological mapping projects in the Far North, and lithostratigraphic subdivisions in the northeastern Superior Province according to Percival *et al.*, 1997b (modified after Leclair, 1998).

observation sites spaced every 10 km or so. The geological map of the Lac Aigneau area (Figure 2) includes the map at the 1:500,000 scale produced by Percival and Card (1994) for the Rivière aux Feuilles transect, and the results of mapping conducted by Parent *et al.* (2000) of *Géologie Québec*, during the summer 1998.

Under the Far North Program, the Lac Aigneau area was covered by a lake sediment geochemical survey (MRN, 1998) performed by SIAL in the summer of 1997. During this geochemical survey funded by the MRN and five partners from industry, samples were collected along a grid with, on average, a 3.5 km spacing. The results highlight several anomalies likely to become exploration targets.

Since 1997, only one exploration licence has been acquired in the Lac Aigneau area, for uranium by SOQUEM in NTS sheet 24E/13. Adjacent areas are the object of exploration work for gold, base metals and uranium by SOQUEM, Cambior, Cominco and Falconbridge.

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REGIONAL GEOLOGY

The Lac Aigneau area lies in the northeastern Superior Province, which was previously defined as the Minto Subprovince (Card and Cieselski, 1986), then as the Minto Block (Percival *et al.*, 1992). This part of the Archean craton of the Superior Province is described as being essentially composed of high-grade (granulitic) granitoid rocks, outlined by a NW-SE trending structural pattern and strongly positive magnetic anomalies (Percival *et al.*, 1992; Card and Poulsen, 1998). This part of the Archean craton is bounded to the east by Paleoproterozoic rocks of the New Québec Orogen (Labrador Trough), to the north and west by Paleoproterozoic rocks of the Trans-Hudson Orogen (Ungava Trough) and to the south, by Archean plutonic rocks of the Bienville Subprovince and granulitic rocks of the Ashuanipi Subprovince.

The northeastern Superior Province was subdivided into various domains based on lithological, structural and aeromagnetic criteria (Percival *et al.*, 1997b; Figure 1). While mapping a transect along the Rivière aux Feuilles, the Tikkerutuk, Lac Minto, Goudalie and Utsalik domains were defined (Percival *et al.*, 1991, 1992). Following more detailed mapping campaigns, the Inukjuak, Philpot, Qalluviartuuq, Lepelle and Douglas Harbour domains were introduced (Percival and Card, 1994; Percival *et al.*, 1995, 1996, 1997a and b). Given their size (several hundred kilometres in length), these domains are comparable to subprovinces defined in the southern Superior Province (Card and Poulsen, 1998). The different domains reportedly contain plutonic assemblages of various ages and compositions, which enclose numerous volcani-sedimentary sequences. Plutonic assemblages are characterized by vast negative and positive aeromagnetic anomalies, and are essentially composed of tonalite, granodiorite, diatexite and granite, with enclaves and intrusions of diorite, gabbro, pyroxenite and peridotite. Volcani-sedimentary sequences are mainly enclosed in tonalites characterized by negative aeromagnetic anomalies. They occur as narrow (10-20 km) bands, and are essentially composed of basalt, greywacke, iron formation, tuff, and minor quantities of rhyolite, sandstone, conglomerate, ultramafic rocks and m-scale horizons of calcitic and dolomitic marble.

Field work carried out over the last few years by Géologie Québec paints a less uniform portrait of the Archean craton in the NE Superior Province. It is now generally perceived as the result of an amalgamation of juxtaposed lithotectonic domains of various origins and ages, in sharp contrast with those forming the southern part of the Superior Province (Percival *et al.*, 1992; Stern *et al.*, 1994; Percival and Skulski, 2000). North of the 55th parallel, a succession of tectonomagmatic events extended over a period of > 3.0 to 2.0 Ga (Machado *et al.*, 1989; Percival *et al.*, 1992; Stern *et al.*, 1994; Buchan *et al.*, 1998; Madore *et al.*, 1999; Gosselin and Simard, 2000; Parent *et al.*, 2000; David, in preparation). This succession of tectonomagmatic events is as follows:

i) First, the formation, between *ca.* 3.1 and 2.9 Ga, of a Mesoarchean tonalitic basement preserved in the form of protocraton remnants and juvenile supracrustal sequences.

ii) Between *ca.* 2.91 and 2.75 Ga, the area underwent three tholeiitic volcanic cycles, to which are associated tonalitic, granodioritic or enderbitic plutonic events, regionally isolated from one another. During this period, a first phase of deformation (D_1) and metamorphism (M_1) is recorded between 2.82 and 2.79 Ga.

iii) Later on, a calc-alkaline volcanic episode associated with a granodioritic magmatic event, both restricted to the Kogaluk and Pelican areas dated between *ca.* 2.77 and 2.74 Ga, appear to extend throughout the region between *ca.* 2.73 and 2.72 Ga.

iv) Between *ca.* 2.71 and 2.69 Ga, the enderbitic event, up until now essentially restricted to the northern part of the area where it formed megacomplexes, also appears to extend throughout the region. This magmatic episode is interpreted as responsible for the onset of granulite-facies metamorphism (M_2) attributed to this period.

v) Between *ca.* 2.69 and 2.66 Ga, the area was subjected to a major collisional event responsible for an important recycling of older lithologies, a metamorphic episode at the upper amphibolite facies (M_3), as well as the emplacement of an important volume of granite, diatexite and pegmatite.

vi) Finally, late alkaline magmatism is recorded in the form of nepheline syenite and carbonatite intrusions (*ca.* 2.66

and 2.64 Ga; Skulski *et al.*, 1997), several networks of diabase and gabbro dykes (*ca.* 2,51 to 2.00 Ga; Buchan *et al.*, 1998), as well as ultramafic to mafic lamprophyre and carbonatite dykes (this report).

STRATIGRAPHY

The Lac Aigneau area is underlain by Archean lithostratigraphic units (Figures 2 and 3) and several Archean and Proterozoic lithodemes (mainly I3A, I3B, etc. dykes). Only the lithostratigraphic units that were the focus of new geological surveys in 1998 and 1999 are described here, namely the complexes, suites and dykes belonging to the Superior Province and located west of the New Québec orogenic front. The stratigraphy, geochronology, structural and tectonic evolution as well as the economic potential of Paleoproterozoic rocks assigned to the New Québec Orogen are described in publications by Remick (1953), Bergeron (1954), Slip (1957), Bérard (1957a and b, 1959a and b, 1965), Ciesielski (1977), Clark (1977, 1979, 1987a, 1987b, 1988), Kish and Tremblay-Clark (1978), Avramtchev *et al.* (1990), Goulet (1986, 1995), and St-Onge *et al.* (2000).

Complexes Enclosed in Granitoids

In the Lac Aigneau area, a variety of remnants of ultramafic (komatiites, picrites), mafic (basalts, amphibolites) to intermediate (andesites) metavolcanic rocks and metasedimentary (paragneisses and iron formations) rocks form enclaves floating in the various granitoid suites. These enclaves are either: *i)* composite and reach several kilometres in size; *ii)* form smaller (> 1 m to < 10 cm) angular to rounded or lens-shaped xenoliths, or *iii)* reduced to schlieren > 1 mm in size.

Although certain remnants of ultramafic, mafic to intermediate metavolcanic rocks, iron formations, paragneisses and ultramafic intrusive rocks are remarkable for their size, reaching up to several kilometres, and although these remnants even form supracrustal belts, the vast majority are discontinuous and of restricted extent. Two major volcani-sedimentary belts present in the area (the Natuak and Kakiattukallat belts) were grouped within the Duvert Complex (*Advt*). Other smaller remains of uncertain origin were grouped in the Qamaniq Complex (*Aqmq*).

Duvert Complex (*Advt*)

The Duvert Complex was defined by Parent *et al.* (2000) to group supracrustal rocks extending over several kilometres, delineated by shear zones and enclosed in late tectonic intrusions. These rocks were divided into four units: basalts (*Advt1*), andesites (*Advt2*), paragneisses and iron formations (*Advt3*), as well as ultramafic rocks (*Advt4*). The Duvert Complex is largely represented in map sheet 34H by the Dupire, Duvert and Morrice belts, and in map sheet 24E, by the Natuak and Kakiattukallak belts (Figure 2).

Basalt (Advt1)

Basalts in the Duvert Complex (*Advt1*) occur in the form of mafic gneisses or amphibolite bands between 10 m and 1 km in size, more or less continuous, which also contain 1 to 10-m thick horizons of intermediate and felsic rocks, paragneisses, iron formations and ultramafic rocks. The basalts are dark green and fine to medium-grained. They are composed of foliated homogeneous amphibolite horizons, locally preserving massive or pillowed flow structures, as well as banded intermediate horizons representing tuffs, with mafic horizons representing lava flows. These horizons are strongly metamorphosed and transposed parallel to the regional foliation.

Homogeneous horizons are mainly composed of variable proportions of olive green to brownish green hornblende, plagioclase and pyroxene (clinopyroxene and orthopyroxene). The groundmass is typically granoblastic and formed of polygonal plagioclase and pyroxene grains, as well as nematoblastic hornblende grains. The groundmass also contains pyroxene poikiloblasts enclosing polygonal plagioclase and pyroxene grains. Magnetite and apatite are present as accessory minerals.

Banded horizons are formed of alternating plagioclase-rich leucocratic to mesocratic layers, and melanocratic layers rich in hornblende±clinopyroxene±orthopyroxene or with plagioclase-clinopyroxene-orthopyroxene. Where the recrystallization rate is lower, pillow chill margins have been preserved. The omnipresence of orthopyroxene neoblasts indicates that metamorphic conditions within the different volcani-sedimentary belts of the Duvert Complex reached the granulite facies. Locally, the basalts may contain up to 20% quartz-feldspar mobilizate with orthopyroxene and clinopyroxene, occurring as aggregates parallel to the regional foliation.

Andesite (Advt2)

Intermediate gneisses (*Advt2*, andesite) mainly form km-scale bands, but also occur as thin layers within the basaltic unit. These gneisses are mesocratic, medium greenish grey with a bluish tinge, and fine to medium-grained. Compared to basalts, they are characterized by a larger number of felsic layers, the predominance of clinopyroxene at the expense of orthopyroxene, and the presence of quartz. They are composed on the one hand, of relatively homogeneous horizons with little compositional variation, and on the other hand, of intermediate to felsic tectonic bands which may represent metatuff layers. Intermediate gneisses are composed of plagioclase, hornblende, brown biotite, clinopyroxene, quartz ± orthopyroxene, which form a granoblastic texture. In certain locations, the presence of plagioclase porphyroclasts

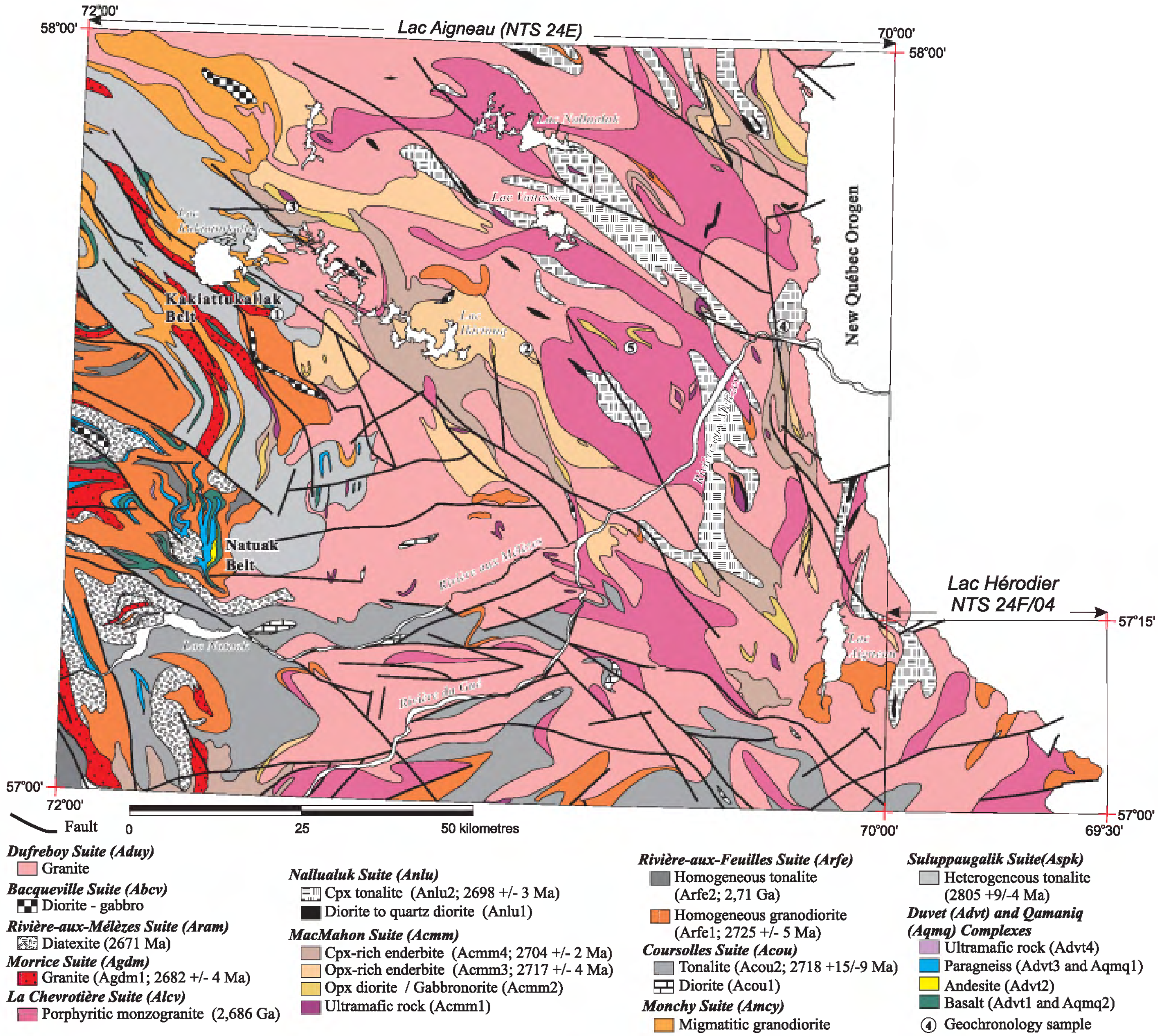

FIGURE 2 – Simplified geology of the Lac Aigneau area (NTS 24 E and 24 F/04).

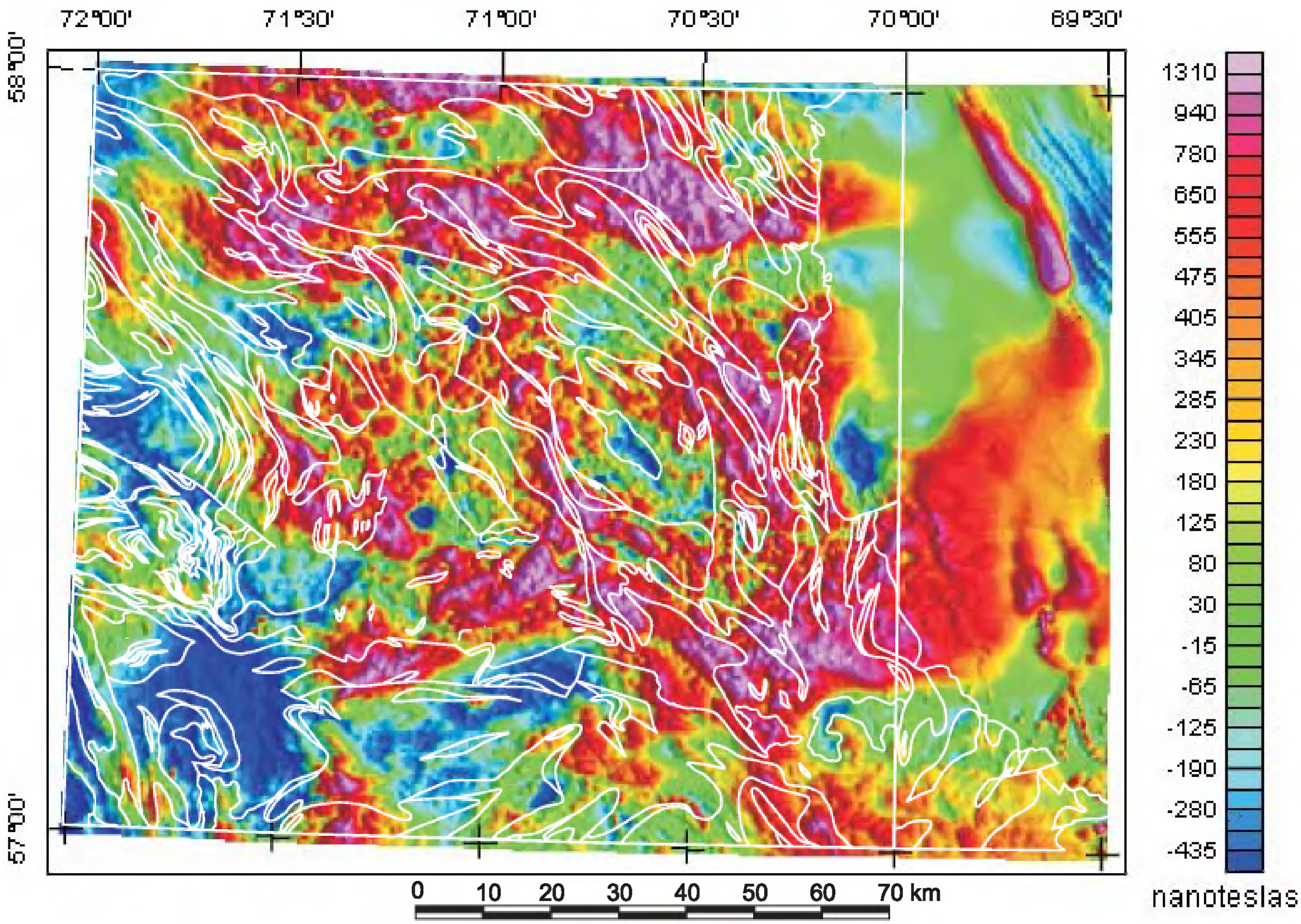

FIGURE 3 – Residual total field magnetic map of the Lac Aigneau area (NTS 24E and the western part of 24F).

suggests that the protolith may have been porphyritic. Homogeneous intermediate horizons (andesitic) are composed of hornblende, clinopyroxene and orthopyroxene, whereas more felsic layers, dacitic to rhyolitic in composition, contain a matrix of quartz and plagioclase with < 10% ferromagnesian minerals. Andesites contain between 5 and 25% migmatitic orthopyroxene mobilizate which forms bands parallel to the foliation.

Paragneiss (Advt3)

The paragneiss unit of the Duvert Complex (*Advt3*) encompasses all metasedimentary rocks containing less than 50% mobilizate. These are divided into two types: quartz-feldspar gneisses and iron formations.

Quartz-feldspar gneisses occur as m-scale to km-scale bands that may reach up to 20 km in length. They generally occur within volcani-sedimentary belts, intimately associated with basalts, andesites and iron formations. These paragneisses also occur as enclaves, between 1 cm and 10 m in size, or remnants, extending for several kilometres, in diatexites, or in the form of metatexites. Contacts between paragneisses and diatexites are generally transitional, suggesting that the diatexites are the result of a more advanced stage of partial melting in the paragneisses (Parent *et al.*, 2000). The paragneisses are grey-brown to rusty brown, and are composed of plagioclase, quartz, biotite, garnet, cordierite and minor quantities of microcline, sillimanite and andalusite. Fresh cordierite shows well-developed wedged twins and yellowish pleochroic halos around zircon grains; however, it is often slightly sericitized to completely pinitized and contains quartz, plagioclase, and biotite inclusions. Garnet is poikiloblastic and contains quartz, plagioclase, biotite, zircon, sillimanite, magnetite and cordierite inclusions. Reddish biotite occurs parallel to the regional foliation. The metamorphic minerals seem to have appeared in the following order: biotite, cordierite-andalusite-sillimanite and garnet. This metamorphism generated a granitic leucosome (5 to 50%) with cordierite, garnet, sillimanite and andalusite, forming mm-scale to cm-scale migmatitic bands. The quartz-microcline (orthoclase)-plagioclase leucosome shows a coarse-grained heterogranular texture. The paleosome on the other hand, is relatively fine-grained. The paragneisses locally form impressive gossans several tens of metres wide. The rusty colour is the result of biotite alteration, and the presence of disseminated pyrite and pyrrhotite. Some of these gossans are intensely deformed and recrystallized, in which case the protolith is difficult to identify. These zones did not yield economic grades. However, the paragneisses also contain iron formation horizons and a few layers of calc-silicate rocks.

These *iron formation* horizons also form gossans, some of which contain anomalous gold concentrations (Parent *et al.*, 2000). Iron formations are generally between 1 and 10 m thick, and contain both silicate and oxide facies. Silicate-facies rocks are dark grey-green in fresh surface and rusty brown in weathered surface. In the Natuak belt, they consist of alternating cm-scale horizons composed of grunerite, garnet-clinopyroxene-orthopyroxene and quartz (metachert), whereas in the Kakiattukallak belt, they are formed of alternating cm-scale horizons composed of hornblende-clinopyroxene-orthopyroxene and quartz. The mineralization is mainly composed of pyrrhotite, pyrite, arsenopyrite and magnetite. It is disseminated or occurs as mm-scale to cm-scale semi-massive horizons. The oxide facies is characterized by alternating mm to cm-scale laminations of bluish grey to black magnetite, and whitish quartz (metachert). The banding in this facies probably reflects the original primary bedding, albeit completely transposed and recrystallized by deformation and metamorphism.

Ultramafic Rocks (Advt4)

Ultramafic volcanic rocks in the Duvert Complex (*Advt4*) are deformed and their contacts with mafic gneisses are parallel to the regional foliation. Ultramafic rocks are dark green to black in fresh surface, but show a typical buff brown weathered surface. They are composed of variable proportions of pyroxenite, peridotite, dunite and hornblendite, which form horizons, lens-shaped bodies and dykes. The pyroxenites are mainly composed of orthopyroxene, clinopyroxene and hornblende, with minor interstitial plagioclase, disseminated sulphides, magnetite and spinel. The igneous origin of certain pyroxene grains is confirmed by the presence of well-developed schiller textures. Deformation is expressed in the pyroxenites by the presence of granoblastic pyroxene and amphibole, and aggregates of talc, carbonate, phlogopite and disseminated iron oxides. The peridotites are composed of variable proportions of olivine, orthopyroxene and clinopyroxene. Pyroxene and olivine occur as phenocrysts; however, olivine grains are fractured and generally serpentinized. Peridotites contain more dark green spinel, sulphides and magnetite than the pyroxenites. The effects of deformation and recrystallization in the peridotites translate into the development of a granoblastic texture, the flattening of olivine crystals, the development of serpentine and trains of magnetite parallel to the regional foliation. Locally, peridotites exhibit fractures filled with carbonates and prehnite, suggesting late low-temperature hydrothermal activity. Dunites are almost exclusively composed of olivine phenocrysts, with abundant dark green spinel and magnetite, as well as a minor quantity of orthopyroxene, clinopyroxene and amphibole. Deformation is characterized by serpentinized zones and trains of magnetite grains.

Qamaniq Complex (*Aqmq*)

Isolated remnants of the Qamaniq Complex (term introduced by Parent *et al.*, 2000) are dominated by paragneisses (*Aqmq1*) and mafic gneisses (*Aqmq2*), distinct from their counterparts in the Duvert Complex due to their much more restricted extent (1 to 2% of the total volume of rock in the map area) as well as their uncertain origin and genetic background. All the lithologies present in the Qamaniq Complex are foliated or gneissic, and generally metamorphosed to the granulite facies or the upper amphibolite facies.

Paragneiss (Aqmq1)

Paragneisses (*Aqmq1*) form enclaves ranging from 100 m to < 1 km in width in the granitoids; they consist of quartz-feldspar augen gneisses with garnet and biotite. These gneisses are composed of a felsic groundmass with plagioclase porphyroclasts (< 1 cm) and porphyroblastic garnet grains (< 5 mm) in a matrix of mosaic-textured quartz and lepidoblastic biotite. Locally, these gneisses alternate with garnetite layers (< 1 m thick). The gneisses are commonly migmatized, and contain between 15 and 30% heterogranular mobilizate occurring as coarse-grained tonalitic veins (<10 cm wide).

Mafic Gneiss (Aqmq2)

The mafic gneisses (*Aqmq2*) are generally dark green to black, and fine to medium-grained. They consist of homogeneous to banded horizons of foliated amphibolite, which contrast with their counterparts in the Duvert Complex due to the absence of volcanic structures and felsic horizons, such that an extrusive or intrusive origin is difficult to ascertain. These amphibolites are essentially composed of olive green to brownish green hornblende, plagioclase, clinopyroxene and orthopyroxene, forming a recrystallized granoblastic and equant matrix.

Intrusive Granitoid Suites

In the Lac Aigneau area (NTS 24E), granitoid assemblages contain very heterogeneous lithologies in terms of their magnetic signature (ranging from negative to strongly positive; Figure 3), lithology (grouped into 11 suites) and structure. This regional heterogeneity is fundamentally different from the description made by Percival *et al.* (1992) based on their survey along the Rivière aux Feuilles, in which the *Utsalik Domain* was originally defined. In order to accommodate this difference, Parent *et al.* (2000) introduced three new very heterogeneous intrusive suites, mainly composed of tonalite (Suluppaugalik Suite, *Aspk*), granodiorite (Monchy Suite, *Amcy*) and diatexite (Rivière aux Mélèzes Suite, *Aram*). These three suites are very different from those comprising more homogeneous lithologies such as the Rivière aux Feuilles Suite (*Arfe*) composed of granodiorite and tonalite, the Bacqueville Suite (*Abcv*) composed of gabbro and diorite, and the Morrice Suite (*Agdm1*) composed of granite. Based on mapping conducted in 1999, new units were defined and grouped into five suites: the Coursolles Suite (*Acou*) composed of tonalite and trondhjemite, associated with diorite or quartz diorite, the MacMahon Suite (*Acmm*) composed of two types of enderbite associated with gabbronorite, orthopyroxene diorite and pyroxenite, the Nallualuk Suite (*Anlu*) composed of clinopyroxene tonalite associated with diorite, the La Chevrotière Suite (*Alcv*) composed of porphyritic monzogranite, and the Dufreboy Suite (*Aduy*) composed of leucogranite.

Suluppaugalik Suite (*Aspk*)

The Suluppaugalik Suite (*Aspk*) was defined by Parent *et al.* (2000) to describe tonalites characterized by a lithological, structural and textural heterogeneity at the scale of the outcrop. The tonalites contain diorite, amphibolite and horblendite occurring as elongate enclaves (< 1 m) or as repetitive layers transposed along the foliation. The tonalites, generally medium grey in fresh surface and grey-white in weathered surface, are composed of equal proportions of idiomorphic plagioclase and quartz, with reddish brown biotite (> 10%), olive green hornblende (< 10%) and epidote. Accessory minerals are microcline, occurring as small interstitial crystals between quartz and plagioclase, apatite, sphene and zircon. Biotite overgrows hornblende crystals, whereas epidote is superimposed upon both biotite and hornblende. Epidote grains are poikilitic, automorphic to xenomorphic and occasionally contain allanite cores.

Monchy Suite (*Amcy*)

The Monchy Suite (*Amcy*; Parent *et al.*, 2000) designates heterogeneous, largely granodioritic plutonic rocks. The dominant feature characterizing this suite is its metatexite to diatexite-type heterogeneity, both on the scale of the outcrop and in hand sample. The presence of tonalitic and granitic material (up to 50% of the volume of the rock) in diffuse contact with the granodiorite is also noted, along with a number of mafic microgranular and foliated enclaves ranging from 1 cm to 10 m in size, with diorite, amphibolite and hornblendite compositions.

The *granodiorites* are medium grey in fresh surface, and display a pinkish white weathering rind. Quartz, plagioclase and microcline (orthoclase) crystals are heterogranular, and vary from medium to coarse-grained. The principal mafic minerals are olive green hornblende, brownish biotite and epidote; clinopyroxene grains are observed in the core of certain hornblende crystals. Other accessory phases are magnetite, sphene, apatite, and zircon. Aligned biotite and hornblende grains commonly form schlieren which, along with diffuse layers of tonalitic material, define an undulating foliation. Deformation also translates into the development of a mortar texture along preferential planes parallel to the foliation.

A metamorphic process of synkinematic (D_2 and/or D_4, see below) migmatitic segregation of the tonalite-diorite assemblage is inferred to be responsible for the formation of granodiorites-amphibolites. The K-feldspar liquid (granodiorite) appears to have formed by transfer, in the tonalites, of potassium contained in the biotites of microgranular dioritic enclaves. Thus, of these diorite enclaves, only an amphibolite restite remains, most commonly in the form of schlieren, according to the incomplete reaction: plagioclase + biotite = K-feldspar + hornblende.

Coursolles Suite (*Acou*)

The Coursolles Suite (*Acou*) is composed of two units: predominantly tonalites and trondhjemites (*Acou2*) that are intimately associated with diorites or quartz diorites (*Acou1*). These units are found in the south part of NTS sheet 24E, and mainly extend southward into NTS sheet 24D, where the lithodeme was originally defined (Gosselin and Simard, 2000) and where an age of 2718+19/-5 Ma was obtained from a tonalite sample (David, in preparation). They typically correspond to a regional low magnetic gradient.

Tonalites (*Acou2*) are generally medium grey, homogeneous, foliated, medium-grained to locally porphyritic, and typically moderately to weakly magnetic. They consist of a deformed mosaic-textured groundmass of plagioclase (30-40%) and quartz (10-20%). Porphyritic tonalites however are composed of ~10% idiomorphic plagioclase grains (> 1 cm) floating in the same type of groundmass. Mafic minerals present in the tonalites essentially consist of nematoblastic hornblende associated or not with lepidoblastic biotite. Accessory minerals are apatite (< 5%), sphene, magnetite and zircon. *Trondhjemites* (*Acou2*) very frequently occur as a medium to coarse-grained leucocratic mobilizate, filling the limbs and noses of microfolds as well as tension gaps. They are composed of equal proportions of quartz and plagioclase, frequently antiperthitic, with interstitial microcline (< 10%) and biotite which contains allanite grains and local poikilitic muscovite, apatite and zircon.

Dark grey *diorites* and local *quartz diorites* (*Acou1*) generally occur as voluminous bodies (> 100 m) interlayered with the tonalites, or as very homogeneous, strongly foliated and generally fine-grained enclaves ranging up to 1 m in size. They are locally reduced to cm-scale schlieren. The diorites contain the same mafic minerals as the tonalites, but in greater proportions, and forming an equigranular granoblastic texture. The tonalites are derived from a synkinematic segregation process involving magmatic differentiation of diorites, of which only biotite and hornblende-rich microgranular enclaves remain. The same ongoing magmatic process is probably also responsible for the segregation of trondhjemitic liquids from the tonalites.

Rivière aux Feuilles Suite (*Arfe*)

The Rivière aux Feuilles Suite (*Arfe*), as defined in publications by the Geological Survey of Canada (Percival *et al.*, 1994; Stern *et al.*, 1994), mainly designates I-type calc-alkaline intrusions comprising pyroxene and hornblende granodiorites, tonalites, granites, diorites, gabbros-pyroxenites and synplutonic mafic dykes. Time constraints established the emplacement of the Rivière aux Feuilles Suite at 2725±5 Ma, based on age dating of granodiorites (Machado *et al.*, 1989; Stern *et al.*, 1994) and at 2710 Ma based on age dating of tonalites (Parent *et al.*, 2000; David, in preparation). Based on work conducted in the Lac Nedlouc area (NTS 34H), Parent *et al.* (2000) restricted the use of the term "Rivière aux Feuilles Suite" to relatively homogeneous intrusive rocks, comprising weakly foliated to strongly deformed hornblende or pyroxene-bearing granodiorites (*Arfe1*) and tonalites (*Arfe2*).

The *granodiorites* (*Arfe1*) of the Rivière aux Feuilles Suite are homogeneous, pale grey to pinkish grey on a fresh surface and white-pink on a weathered surface. They are generally medium-grained. The principal mafic minerals, which account for 5 to 25% of the rock, are either biotite, hornblende and magnetite, or biotite, orthopyroxene, clinopyroxene and magnetite. The alignment of these minerals defines a weakly to strongly developed foliation. In certain cases, the presence of clinopyroxene cores retrograded to hornblende is observed.

The *tonalites* (*Arfe2*) are medium-grey with a mafic mineral content ranging from 10 to 30%. The principal mafic minerals are hornblende, biotite and magnetite. The tonalites are homogeneous, foliated to locally banded where they have undergone a high degree of deformation.

MacMahon Suite (*Acmm*)

The MacMahon Suite (*Acmm*) was established to describe all orthopyroxene-bearing rocks that form complexes outlined by strongly positive magnetic anomalies. This suite is mainly composed of enderbites, generally homogeneous and foliated, medium to coarse-grained rocks, which may nevertheless contain porphyritic K-feldspar phases. The principal mafic minerals are orthopyroxene, clinopyroxene, magnetite, biotite and green hornblende as an accessory phase. The relative proportions of orthopyroxene vs clinopyroxene and hornblende are used to define an orthopyroxene and biotite-rich unit (*Acmm3*) and an orthopyroxene-poor but clinopyroxene and hornblende-rich unit (*Acmm4*). These two units are associated with an ultramafic rock unit (*Acmm1*; pyroxenite, hornblendite, peridotite, dunite) and a unit composed of gabbronorite to anorthositic gabbro and orthopyroxene diorite (*Acmm2*). Locally, the contact between these different units is marked by massive to banded magnetite horizons, ranging from < 10 cm to > 1 m thick, outcropping discontinuously over several tens of kilometres along strike. This suite is generally in sharp and transposed contact with other granitoid suites. It locally occurs in intrusive contact with tonalites of the Suluppaugalik (*Aspk*) and Coursolles (*Acou2*) suites, but is most often enclosed within the granitic La Chevrotière (*Alcv*), Morrice (*Agdm*) and Dufreboy (*Aduy*) suites.

A certain number of observations clearly support the notion that these orthopyroxene-bearing rocks have a magmatic origin, and are not derived from a regional granulite-grade metamorphic event: *(i)* at the scale of the outcrop, these rocks locally exhibit lobate intrusive contacts, and occasionally isolated mega-enclaves of tonalite-diorite not metamorphosed to the granulite facies; *(ii)* although they can be strongly foliated, these rocks commonly exhibit homogeneous and magmatic textures, where granular pyroxene contains exsolution lamellae and schiller-type textures; and *(iii)* these rocks rarely display the migmatitic layering typically observed in regional granulitic facies. However, these rocks commonly are strongly deformed and recrystallized to the granulite facies phase, as illustrated by the presence of orthopyroxene and clinopyroxene neoblasts around igneous pyroxene porphyroclasts, as well as the preservation of high-temperature brown-red biotite. This deformation is interpreted as synmagmatic (see below).

Ultramafic rock (Acmm1)

The *ultramafic rocks* (*Acmm1*) vary from black to very dark green on both fresh and weathered surfaces. They form homogeneous intrusive bodies generally < 1 km^2, essentially composed of pyroxenite and hornblendite, and more rarely of peridotite and minor dunite.

Pyroxenites display the effects of a wide range of facies, mainly clinopyroxenites to wherlites and, more rarely, websterites or orthopyroxenites and their plagioclase-bearing counterparts. Pyroxenes typically form cm-scale igneous granular crystals or medium to fine-grained neoblasts. It is quite common to observe orthopyroxene inclusions in clinopyroxene, or to observe their replacement by olive green hornblende. Plagioclase varies from granular to microgranular, occurring as aggregates of subgrains or as interstitial neoblasts. Disseminated opaque minerals are dominated by sulphides, with minor oxides. The remaining accessory minerals are orange-coloured lepidoblastic biotite, and apatite. *Hornblendites* are formed of green hornblende poikiloblasts reaching up to several centimetres in size, enclosing the same mineral phases observed in pyroxenites (clinopyroxene, orthopyroxene and plagioclase). *Peridotites* are composed of a coarse to medium-grained groundmass of olivine, orthopyroxene and clinopyroxene with granoblastic microgranular interstitial hornblende and spinel. Disseminated magnetite is abundant; granular to microgranular phlogopite flakes are also common. *Dunites* form medium-grained layers < 10 m thick within the peridotites. All these ultramafic intrusions exhibit some type of alteration at variable intensity: talc-chlorite-carbonate-magnetite alteration for orthopyroxene, actinolite (tremolite)-chlorite alteration for clinopyroxene, serpentine-iddingsite-magnetite for olivine, and sericite-chlorite-epidote alteration for plagioclase.

Gabbronorite to Anorthositic Gabbro and Orthopyroxene Diorite (Acmm2)

Gabbronorites and their anorthositic counterparts form bands < 1 km wide of leuco- to melanocratic rocks that are massive and foliated or locally display granulite-grade metamorphic layering. These rocks are characterized by alternating porphyroclastic and granoblastic polygonal plagioclase-rich horizons, and pyroxene and hornblende-rich horizons. Pyroxenes either occur as granular irregular crystals (> 1 cm), as subgrains in optical continuity to completely recrystallized, or as trains of neoblasts. Orthopyroxene may be altered to chlorite, talc, carbonate and magnetite. Clinopyroxene is rimmed by olive green hornblende, and is often wrapped in brown-red to orange lepidoblastic biotite. Accessory minerals are magnetite, apatite and zircon.

Orthopyroxene diorites are much more massive and more magnetic than gabbronorites. They display a granoblastic, equant, fine-grained texture, where clinopyroxene is often more abundant than orthopyroxene. Brown-red biotite is strongly lepidoblastic, and olive green to brown-green hornblende, although not always present, replaces clinopyroxene and contains vermicular quartz inclusions. Disseminated magnetite is abundant. Sulphides, apatite as well as granular zoned zircon are accessory phases.

Orthopyroxene-Rich Enderbite (Acmm3)

This rock has a honey brown colour, with a slightly pinkish tinge in fresh surface, and a pale grey tinge in weathered surface. These enderbites are strongly magnetic, homogeneous, massive to weakly foliated and medium-grained. They are leucocratic, and contain about 15-20% mafic minerals, among which orthopyroxene dominates over clinopyroxene, red biotite is abundant and hornblende is minor. The state of preservation of minerals is generally exceptional; retrogression phenomena are rare. The foliation is defined by the alignment of granular hypidiomorphic grains or granular recrystallized grains of orthopyroxene (which may be partially rimmed by a clinopyroxene and hornblende corona), clinopyroxene and lepidoblastic biotite. Granular, hypidiomorphic and locally antiperthitic plagioclase, quartz, often occurring as large interstitial grains or as bands, and microcline (5-15%) form a felsic, often mosaic-textured groundmass. Accessory minerals are allanite, as overgrowths on biotite, and zircon.

Clinopyroxene-Rich Enderbite (Acmm4)

Greenish plagioclase and hornblende give these enderbites a greenish brown colour on a fresh surface, and white with brown spots on a weathered surface. These enderbites are strongly foliated, homogeneous, heterogranular, coarse to medium-grained and strongly magnetic. They are generally mesocratic, and contain between 10 and 25% mafic minerals. Among these, the proportion of clinopyroxene is greater than orthopyroxene, red biotite and magnetite are ubiquitous, and green hornblende is frequently observed. The mineral grains have preserved their igneous textures: plagioclase and pyroxene are coarse-grained, pyroxene often occurs in the core of poikiloblastic hornblende grains, lepidoblastic biotite and aligned pyroxene grains define the foliation. In these coarse-grained facies, only orthopyroxene grains were affected by late partial to complete retrogression to talc-carbonate-chlorite-magnetite assemblages. The deformation translates into a mortar or porphyroclastic texture in plagioclase, and the development of subgrains in pyroxene. In mylonitic layers, strings of neoblastic grains are occasionally observed.

Nallualuk Suite (*Anlu*)

The Nallualuk Suite (*Anlu*) is composed of two units: predominantly clinopyroxene tonalites (*Anlu2*), which are intimately associated with diorites (*Anlu1*). This suite forms a series of intrusions concentrated in the eastern part of the map, outlined by positive magnetic anomalies oriented NNW-SSE to N-S.

The dark grey *diorites* (*Anlu1*) generally occur as very homogeneous, strongly foliated, fine to medium-grained enclaves between 10 cm and 1 m in size, as well as cm-scale schlieren. Locally, diorites form larger bodies between 100 m and rarely up to 1 km, as well as dismembered synplutonic dykes. Diorites are rich in biotite, hornblende and clinopyroxene, which, along with plagioclase and quartz, form a recrystallized granoblastic groundmass. Orthopyroxene is locally present; plagioclase and clinopyroxene phenocrysts are rarely preserved.

Clinopyroxene tonalites (*Anlu2*) are generally medium grey, homogeneous, foliated and coarse-grained. They are moderately to strongly magnetic and are characterized by the presence of clinopyroxene, biotite, and occasional hornblende. Accessory minerals are magnetite, apatite, sphene and zircon. Tonalites are frequently deformed: protoclastic to mylonitic facies are commonly observed. Plagioclase forms hypidiomorphic phenocrysts or porphyroclasts with deformed and folded twins bordered by neoblasts. Quartz is interstitial and recrystallized into monocrystalline bands, or as polygonal grains with kink bands. Clinopyroxene forms large primary grains and recrystallized grains stretched along the foliation direction. Biotite is orange-red, lepidoblastic, and occurs as aggregates of variable grain size. Green hornblende forms coronas or poikiloblastic grains around clinopyroxene. Oxides (ilmenite + magnetite) generally account for ~5% of the rock, and are often associated with pyrite. Other accessory minerals include allanite, apatite, sphene and zircon.

La Chevrotière Suite (*Alcv*)

The La Chevrotière Suite (*Alcv*) designates a series of sheets and elongate, lens-shaped plutons > 10 km^2 in size, outlined by positive magnetic anomalies. These plutons cover nearly 30% of the eastern half of the region corresponding to NTS sheet 24E. The rock is grey-pink in fresh surface, and alters to a yellowish pink colour. It is monzogranitic, monzonitic to granodioritic in composition, and is characterized by the presence of microcline and orthoclase megaphenocrysts reaching up to 10 cm long. K-feldspar phenocrysts often contain inclusions of quartz, plagioclase and biotite. The groundmass consists of plagioclase, K-feldspar, quartz, green biotite, olive green hornblende, sphene, magnetite and apatite. Sphene is very abundant and forms coronas around magnetite grains. At the scale of the outcrop, a magmatic foliation defined by a trachytoid arrangement of K-feldspar phenocrysts is commonly observed. These homogeneous facies alternate with more strongly deformed zones, over several kilometres in width. These hornblende-biotite granites are then heterogeneous, leuco- to melanocratic, gneissic, augen-textured, banded and occasionally mylonitic. This heterogeneity is the result of the following sequence of events: *(i)* assimilation and resorption of surrounding country rocks, *(ii)* formation of angular xenoliths derived from the first event and finally, *(iii)* synkinematic (D_4) migmatitic to diatexitic segregation leading to the formation of mafic schlieren with hornblende and biotite, but also with clinopyroxene and orthopyroxene aggregates that are strongly resorbed when the assimilated rocks are ultramafic in composition.

Rivière aux Mélèzes Suite (*Aram*)

The Rivière aux Mélèzes Suite (*Aram*) was defined by Parent *et al.* (2000). It contains diatexites mainly located in the Lac Nedlouc area (NTS 34H) and the southwest quadrant of the Lac Aigneau area (NTS 24E), namely between Lac Duvert and Lac Natuak. *Diatexites* of the Rivière aux Mélèzes Suite (*Aram*) correspond to migmatized rocks in which the proportion of mobilizate derived from partial melting exceeds 50%. This mobilizate is heterogeneous and coarse-grained. Flow structures generally obliterate pre-migmatization textures, preserved only in residual enclaves as bedding or tectonic fabric. These diatexites display the same features as those described in the Ashuanipi Subprovince (Percival *et al.*, 1992; Leclair *et al.*, 1998; Lamothe *et al.*, 1998) and elsewhere in the NE Superior Province (Percival *et al.*, 1991). However, the absence of orthopyroxene, clinopyroxene and hornblende is a distinctive feature of these diatexites compared to those of the Lac Minto Suite defined in the Lac Nedlouc area (Parent *et al.*, 2000).

The rock is yellowish grey or rusty brown where biotite is abundant. The grain size, texture and mineral composition of diatexites are highly variable. The diatexites are composed of a heterogeneous leucosome, most often porphyritic, and a fine-grained mesocratic paleosome. The leucosome ranges from a monzogranitic to granodioritic composition. The neosome contains enclaves (10 cm to 1 m) of paragneiss, and more rarely of mafic to intermediate gneiss, as well as mm-scale schlieren formed of biotite and sillimanite. The schlieren define a more or less developed foliation that wraps around garnet porphyroblasts and feldspar phenocrysts. The general trend of this foliation is conformable with the regional foliation observed in less migmatized rocks; it most likely represents flow structures synchronous with the formation of diatexites. The neosome contains biotite, poikiloblastic garnet (with inclusions of quartz, plagioclase, biotite, cordierite, magnetite and sillimanite), cordierite, andalusite, sillimanite (locally with greenish spinel inclusions), and zircon. In certain locations, plagioclase is sericitized, whereas biotite and garnet are partially retrograded to chlorite. A sample of this diatexite was collected for geochronological purposes, and yielded an age of 2671 Ma (David, in preparation; Parent *et al.*, 2000), which corresponds to the age of regional metamorphic episode M_3.

Parent *et al.* (2000) observed that heterogeneous diatexite bodies show gradual contacts with homogeneous granite and granodiorite bodies. These relations suggest that at least part of these granites and granodiorites are the products of the crystallization of magmas derived from a more advanced phase of intracrustal anatexis than the one responsible for the diatexites.

Bacqueville Suite (*Abcv*)

The Bacqueville Suite (*Abcv*), introduced by Parent *et al.* (2000), is particularly well preserved in the Lac Bacqueville area (NTS 34I). This suite is composed of dismembered dykes or remnants of diorite to quartz diorite and gabbro to gabbronorite, that are homogeneous, medium or coarse-grained, and composed of hornblende-plagioclase-clinopyroxene±orthopyroxene. Percival and Card (1994) noted the rare presence of pyroxenites and lamproites. This suite (*Abcv*) is intrusive into diatexites of the Rivière aux Mélèzes Suite (*Aram*) and granodiorites of the Rivière aux Feuilles Suite (*Arfe1*). The Bacqueville Suite (*Abcv*) is itself injected by granites of the Morrice (*Agdm*) and Dufreboy (*Aduy*) suites.

Morrice Suite (*Agdm*) and Dufreboy Suite (*Aduy*)

The lithodemic suites known as the Morrice (*Agdm*) and Dufreboy (*Aduy*) suites group all granitic intrusions, dykes and pegmatites in the area, with the exception of porphyritic monzogranites of the La Chevrotière Suite (*Alcv*). In the Lac Aigneau area (24E), these granites cut all other previously described suites. They are generally pinkish, medium to coarse-grained and occasionally pegmatitic.

Granites of the Morrice Suite (*Agdm1*), originally defined by Parent *et al.* (2000) in the Lac Nedlouc area (NTS 34H), and found in certain locations in the western part of the Lac Aigneau area (NTS 24E), are well-circumscribed intrusions associated with a low magnetic gradient. The spatial association and the presence of transitional contacts and synchronous ages between these granites (2682±4 Ma; David, in preparation) and diatexites of the Rivière aux Mélèzes Suite (2671 Ma; David, in preparation) suggest a common origin, where the granites are inferred to be derived from a greater degree of melting or to be the product of the crystallization of a more fractionated liquid (Parent *et al.*, 2000).

Granites of the Dufreboy Suite (*Aduy*) occur as bodies several kilometres in size, associated with a regional magnetic gradient that varies from negative to positive. These granites cover at least 50% of the eastern half of NTS sheet 24E. They form bodies or dyke swarms of well-foliated homogeneous rock, generally leucocratic, pale pink to greyish pink in weathered surface and pale pink in fresh surface. Aplitic and pegmatitic facies form numerous apophyses controlled by shear zones, outlining their synkinematic nature. The principal mineral constituents are quartz, microcline and plagioclase. The proportion of mafic minerals generally accounts for less than 15% of the rock, and mainly comprises green biotite, magnetite, and occasional green hornblende. Accessory minerals include muscovite, allanite, apatite, sphene and zircon. Along fault zones, the rock is frequently hematized; this hematization is also accompanied by chlorite and epidote alteration of mafic minerals, as well as sericite alteration of feldspars.

Late Dykes (Archean and/or Proterozoic)

All units in the area are cut by dykes that postdate the regional Archean deformation and metamorphism. These dykes, ranging from < 10 cm to > 100 m in thickness, are divided into five families: diabase, gabbro, ultramafic to mafic lamprophyre, carbonatized ultramafic to mafic lamprophyre, and carbonatite (Table 1 in Appendix).

The five families of dykes are associated with brittle fractures or faults that postdate the Archean deformation and metamorphism. Overall, diabase and gabbro dykes are oriented along three principal directions (Figure 4). The most abundant dykes are oriented NW-SE. A second group is represented by dykes trending WNW-ESE to E-W. The remaining dykes are oriented N-S to NNE-SSW. The age of these three groups of dykes is unknown. However, these three families are respectively parallel to *(i)* Klotz dykes (*ca.* 2209 Ma), *(ii)* Maguire dykes (*ca.* 2230 Ma) and Minto

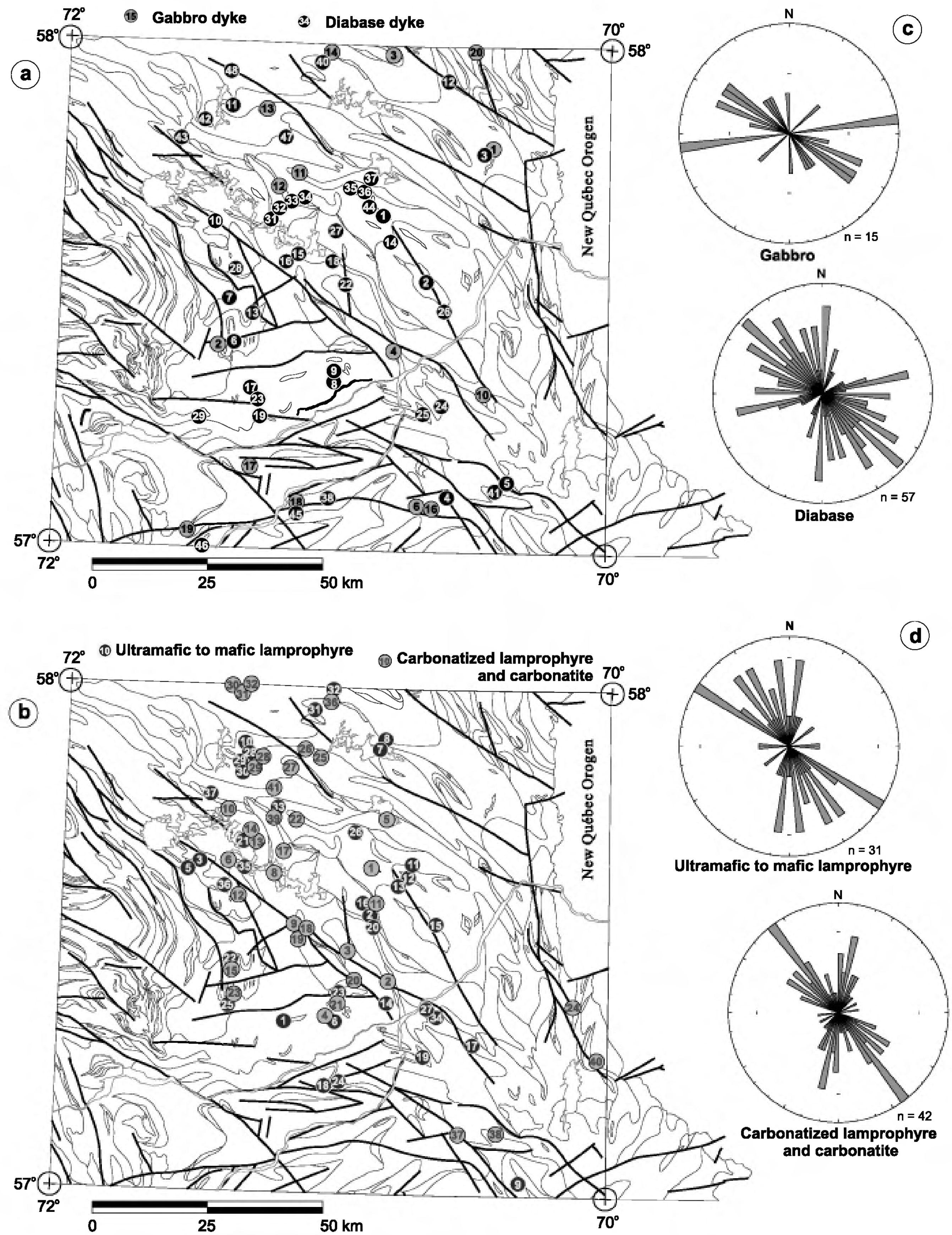

FIGURE 4 – Location maps **(a)** for gabbro and diabase dykes, **(b)** for ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite dykes, and **(c)** and **(d)** stereograms showing their orientation. Lac Aigneau area (NTS 24 E and 24F/04). See table 1 in Appendix.

dykes (*ca.* 1998 Ma), and *(iii)* Ptarmigan dykes (2505±2 Ma), according to a paleomagnetic and geochronological study by Buchan *et al.* (1998) in the NE Superior Province.

Lamprophyre dykes generally follow the same directions as diabase and gabbro dykes (Figure 4b and 4d). These dykes followed deformation zones and fractures that transect the New Québec orogenic front, which suggests they were emplaced after 1.8 Ga. On the other hand, the dykes may have followed Late Archean to Paleoproterozoic deformation zones and fractures which were reactivated after the emplacement of the New Québec Orogen.

Diabase dykes (*I3B*)

Diabase dykes (48 reported occurrences; Figure 4a and Table 1) show an isotropic structure and well-developed chill margins. Most dykes are discontinuous, and are between 10 and 50 cm thick on average. Some may reach up to 1 m in thickness, but rare are those that exceed a width of 5 m. The diabase is strongly magnetic, shows a rusty brown to charcoal brown weathering rind and a blue-grey fresh surface. It is generally fresh, and commonly displays an ophitic to trachytoid texture, with phenocrysts of plagioclase, olivine and clinopyroxene floating in an aphanitic or microlitic groundmass of plagioclase-clinopyroxene±brown hornblende, and rich in disseminated fine-grained magnetite surrounded by brown biotite or leucoxene.

Gabbro dykes (*I3A*)

Gabbro dykes (20 reported occurrences; Figure 4a and Table 1) are associated with fault zones, and are commonly more than 100 m thick. These gabbros are medium to coarse-grained, and display ophitic textures. They are essentially composed of clinopyroxene phenocrysts, idiomorphic tabular plagioclase and occasional poikilitic green hornblende. Accessory minerals are: red-brown biotite, interstitial quartz, Fe-Ti oxides and sphene. Just like the faults that control their location, the gabbro dykes are generally altered to actinolite, chlorite, epidote and sericite.

Ultramafic to mafic lamprophyre dykes (*I4Oa*)

For the first time in the northeastern Superior Province, lamprophyre dykes (37 reported occurrences; Figure 4b and Table 1) were discovered in the Lac Aigneau area (NTS 24E). These dykes are between 10 cm and 5 m thick, with chill margins in sharp contact with the country rock. The dykes are generally fine to very fine-grained to aphanitic. The smallest dykes are invariably aphanitic. They display textures ranging from microporphyritic to porphyritic, amygdaloidal to microbrecciated.

Ultramafic lamprophyres are almost always microporphyritic to porphyritic. Phenocrysts or microphenocrysts of olivine, clinopyroxene, brown hornblende and phlogopite or biotite are supported by a fine-grained to aphanitic groundmass. Olivine phenocrysts are allotriomorphic to idiomorphic, and are generally abundant. They commonly exhibit alteration and replacement phenomena, to carbonate initially, then also to variable proportions of the following minerals: serpentine, iddingsite, chlorite, talc, magnetite. In certain cases, fresh olivine grains or partially altered grains are preserved. Olivine phenocrysts are also present in the chill margins, although their size is generally smaller than in the centre of the dykes. The chill margins are mm-scale but locally up to 10 cm thick, black, aphanitic, and in sharp contact with the country rock. From the chill margin inwards, the grain size increases abruptly. Spectacular magmatic flow textures are represented by variations in the alignment of olivine phenocrysts; or by the alignment of phenocrysts and microphenocrysts of olivine, clinopyroxene, and phlogopite or biotite, with groundmass minerals being deflected around or wrapping around the latter. In several thin sections, lobes of corrosion bordering olivine and clinopyroxene phenocrysts illustrate a partial resorption phenomenon by minerals in the aphanitic groundmass.

Amygdaloidal dykes contain vesicles (< 5 mm diameter) filled with a combination of the following minerals: carbonate, albite, quartz, chlorite and prehnite. These minerals also show radial or fan-shaped growth textures. In certain dykes, vesicles may compose up to 25-30% of the volume of the rock, either isolated or forming coalescent groups.

Microbrecciated dykes are characterized by angular basaltic microxenoliths on the order of 1-2 cm, formed of a homogeneous aphanitic matrix with a purplish blue-grey colour caused by a strong hematite alteration.

Mafic lamprophyres contrast with ultramafic lamprophyres due to the absence of olivine phenocrysts, and the presence of plagioclase occurring as interstitial grains, and locally as microphenocrysts. As in ultramafic lamprophyres, flow textures are common, clinopyroxene and brown hornblende microphenocrysts are often zoned, and small disseminated magnetite grains are abundant. The most commonly observed alteration is the sericitization of plagioclase.

Carbonatized ultramafic to mafic lamprophyre dykes (*I3Oa*)

Another aspect that characterizes lamprophyre dykes in the Lac Aigneau area, particularly the ultramafic variety, is their intense carbonatization. *Carbonatized ultramafic to mafic lamprophyre dykes* (42 reported occurrences; Figure 4b and Table 1) are located within fault zones less than 35 m wide. The carbonatization is more intense along the borders of the dykes than in the cores; it is characterized by a whitish colour in fresh surface, and an orange to rusty brown colour in weathered surface. Numerous lamprophyres exhibit brecciated textures, suggesting a violent activity accompanied the carbonatization phenomenon. The carbonatization initially translates into the replacement of olivine phenocrysts and microphenocrysts by carbonate. At a more advanced stage, carbonates infiltrate the groundmass. At the end of the spectrum, carbonatized ultramafic lamprophyres essentially consist of a fine to coarse-grained groundmass almost entirely composed of carbonate, which contains floating remnants of strongly resorbed olivine pheno- and microphenocrysts. In carbonatized mafic lamprophyre dykes, plagioclase is the first mineral to undergo carbonatization. As in the carbonatized ultramafic lamprophyre dykes, the degree of carbonatization must be fairly high before clinopyroxene, hornblende and mica phenocrysts are replaced by carbonate.

In the granitoids hosting these carbonatized lamprophyre dykes, brittle fractures and cataclastic zones form a system of thin carbonate injections, veins and veinlets. The plagioclase in the country rock is strongly sericitized, and mafic minerals (biotite, hornblende, pyroxene) are gradually transformed into bluish chlorite and blue acicular to fibrous amphibole (riebeckite?) forming radial or fan-shaped textures.

Carbonatite dykes (*I4Qa*)

In addition to the lamprophyre and carbonatized lamprophyre dykes mentioned above, small carbonatite dykes (12 reported occurrences; Figure 4a and Table 1) were also discovered during mapping in the Lac Aigneau area (NTS 24E). *Carbonatite dykes* are essentially composed of carbonate, and are spatially associated with carbonatized lamprophyre dykes. These carbonatites are very homogeneous rocks; only the thickness (< 1 to > 10 m wide) and the grain size (fine to coarse) varies from one dyke to the next. The carbonate groundmass may itself be cross-cut by similar carbonate veins. Chemical analyses of two carbonatite dykes show that their rare earth element content is 10 to 100 times that of chondrites (see chapter entitled "Lithogeochemistry", and Figure 7f).

Carbonatites commonly contain xenoliths of variable sizes, shapes and textures, derived from the enclosing granitoid country rocks. Host rock textures are well preserved; alteration in the xenoliths translates into the sericitization of plagioclase, and the partial replacement of mafic minerals by chlorite and blue amphibole (riebeckite?).

During a mapping program carried out by the Geological Survey of Canada, a carbonatite dyke 2 to 4 m wide by 0.5 km long was recognized in the Lac Couture area (NTS 35B; Percival *et al.*, 1996). This dyke lies along the extension of a deformation zone oriented NNW-SSE, in which the Lac Tasiat nepheline syenite also occurs, 110 km NNW of the Lac Couture carbonatite. The nepheline syenite and the carbonatite yielded respective crystallization ages (Pb/Pb on zircons) of 2643+7/-6 Ma and 2659±1.9 Ma (Skulski *et al.*, 1997).

STRUCTURAL ANALYSIS

The Lac Aigneau area is essentially characterized by a regionally dominant structural trend oriented NW-SE, typical of the entire NE Superior Province. This is reflected in the distribution of the principal intrusive lithologies and their positive aeromagnetic signature. The south and southwest parts of the area are however characterized by a weak aeromagnetic gradient oriented E-W to ENE-SSW. These two patterns are cut in several locations by major E-W and N-S lineaments, interpreted as late ductile-brittle structures.

In the supracrustal rocks of the Lac Aigneau area, volcanic and sedimentary structures and textures (pillow margins, compositional layering with felsic units, and banding in iron formations or paragneisses) most likely reflect the primary stratigraphy. However, they have undergone penetrative deformation and transposition and have been considerably modified by metamorphic recrystallization. It is therefore impossible to conduct a coherent structural analysis of S_0 surfaces and stratigraphic facing directions. Consequently, the structural analysis of the area is essentially based on attitude variations and cross-cutting relationships of ductile and brittle planar structures observed throughout the intrusive lithodemic units. This study has enabled us to subdivide the area into four major structural domains (Figure 5).

The stereogram for *domain I* shows planar structures oriented N-S, concentrated in the southwest and central parts of the map area. An early N-S oriented foliation or gneissosity (called S_2 for regional homogeneity purposes) is preserved within domain I. These structures are accompanied by parallel (N-S) shear zones, which appear to have been followed by late granitic dykes. These structures are interpreted as representing pre-existing structures related to phase of deformation D_2, developed in a penetrative fashion in map areas further north.

This first phase of deformation (D_2) is obliterated by a second phase (D_3). This last deformation is outlined by a foliation, a migmatitic layering and shear zones oriented E-W to ENE-WSW. These structures are concentrated in the south part of the map area, in *domain II*.

Domain III features structures related to D_4, and preferentially oriented NW-SE. This domain covers a major portion of the map area, and represents the principal deformation event responsible for the transposition of planar structures preserved in domains I and II. The dominant regional phase (D_4) is very well defined by a foliation or gneissosity (tectonic layering) responsible for the transposition of tonalites, enderbites and gabbronorites, as well as their respective enclaves. Planar S_4 structures are defined by the preferential orientation of mafic minerals (biotite, hornblende and pyroxene) and are also outlined by a migmatitic layering, shear zones, drag folds and a crenulation

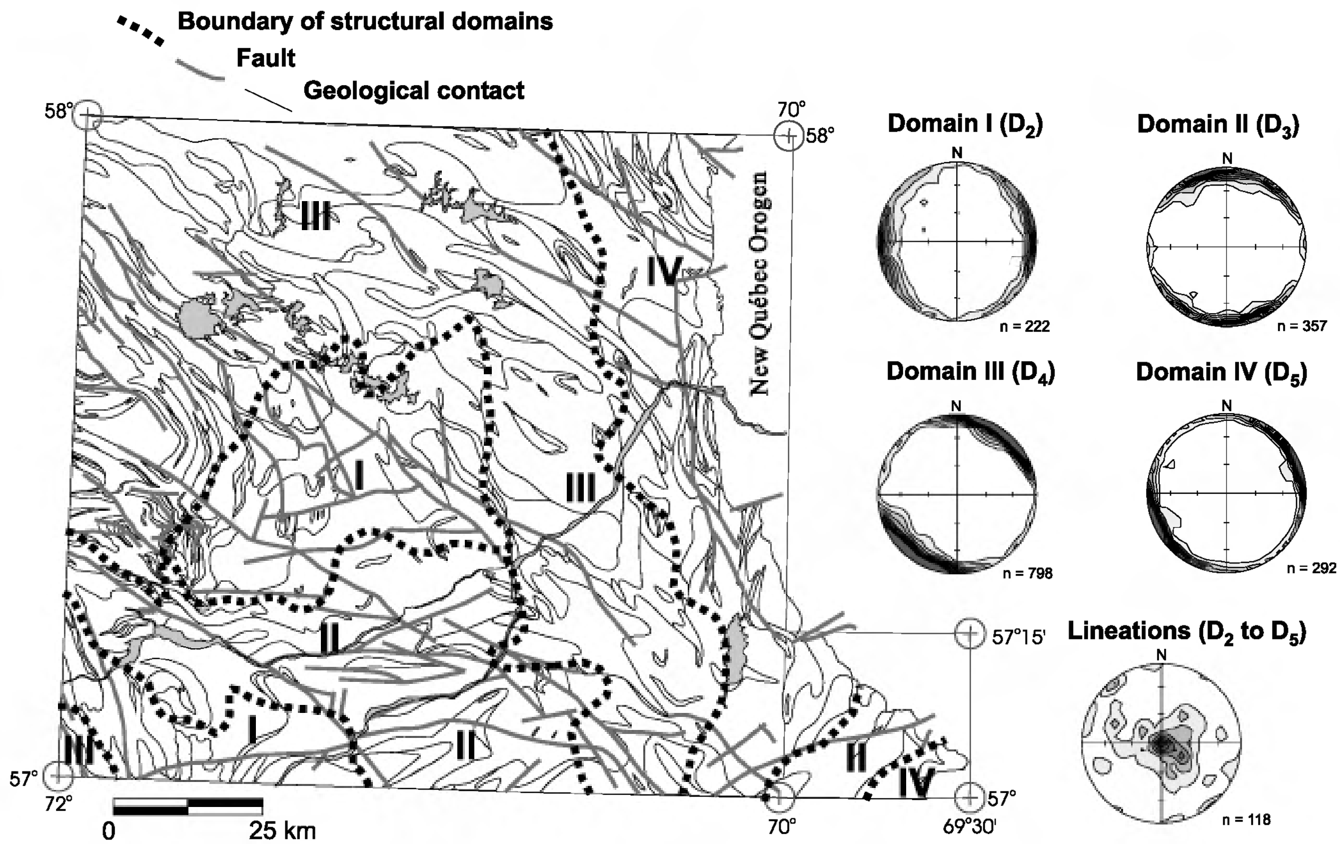

FIGURE 5 – Map showing the structural domains (I to IV) in the Lac Aigneau area (NTS 24E and 24F/04), and stereographic projections of planar structures in each domain and linear structures in the domains (n = number of measurements).

cleavage. The gneissosity appears locally, where the deformation rate is higher. The migmatitic layering appears to be the result of *in situ* partial melting of the rock, and is defined by alternating bands of leucosome and restite in the form of mafic schlieren parallel to the foliation. Phase D_4 also controlled the emplacement of rocks of the enderbitic suite, and of porphyritic granites to monzogranites concentrated in domain III. The oblique angle between shear structures oriented WNW-ESE and magmatic structures oriented NW-SE, seems to indicate a regional dextral shear movement inferred to be syn- to late kinematic relative to D_4.

Planar structures in *domain IV*, located in the east part of the map area, are preferentially oriented NNW-SSE to N-S. They are defined by a foliation, a gneissosity, a migmatitic layering and shear zones that affect S_2 and S_3 structures. These ductile structures are parallel to the New Québec orogenic front, and are interpreted as the expression of an early Trans-Hudsonian deformation on Archean rocks (D_5).

Linear elements are associated with all planar structures generated by ductile deformation events (D_2 to D_5). These linear elements are defined by the elongate habit of minerals along the foliation plane. They display sub-vertical, steep to locally moderate plunges (Figure 5).

These ductile deformation events are superimposed by brittle-ductile, cataclastic to locally protomylonitic fault zones and pseudotachylites, which are metamorphosed to the greenschist facies. These are oriented: *(i)* N-S to NNW-SSE (D_6), i.e. parallel to S_5 structures and the New Québec orogenic front; and *(ii)* roughly E-W to WNW-ESE (D_7), cross-cutting the orogenic front. These D_6 and D_7 deformation zones are represented by faults traced on Figure 5, that cut across all ductile planar structures in domains I to IV (D_2 to D_5). They exert a control on the emplacement of the various families of dykes (diabase, gabbro, lamprophyre, carbonatite) and commonly show evidence of hydrothermal fluid circulation.

METAMORPHISM

Overall, lithological units in the Lac Aigneau area are strongly deformed. The most tectonized zones display metamorphic grades ranging from the granulite facies to the amphibolite and greenschist facies.

Mafic gneisses and iron formations of the Duvert (*Advt*) and Qamaniq (*Aqmq*) complexes commonly contain hornblende-plagioclase-clinopyroxene-orthopyroxene occurring as polygonal granoblasts, as well as the assemblage clinopyroxene-orthopyroxene±hornblende as poikiloblasts surrounding the granoblastic paragenesis. This indicates that, at least locally, these units underwent a polyphase episode of granulitic metamorphism. Paragneisses in the Duvert Complex (*Advt3*) and diatexites in the Rivière aux Mélèzes Suite (*Aram*) contain the assemblage garnet-cordierite-sillimanite-andalusite, indicating low-pressure (< 3.5 kb) metamorphic conditions at the upper amphibolite facies.

Gabbronorites, diorites and enderbites of the MacMahon Suite (*Acmm*) were locally recrystallized to the granulite facies, as illustrated by the assemblage plagioclase-orthopyroxene±clinopyroxene±hornblende. However, these same minerals form igneous assemblages in massive enderbites. Igneous enderbites form massive and foliated cores where a preserved weakly deformed igneous texture dominates over tectonized and mylonitic counterparts. This suggests that enderbitic magmatism and synkinematic granulitic metamorphism are contemporaneous.

These granulitic assemblages strongly contrast with those observed in other granitoid suites. The other suites contain plagioclase-hornblende-biotite±clinopyroxene, indicating metamorphic conditions at the middle to upper amphibolite facies.

Based on the alumina content of hornblende grains, the different intrusive suites indicate crystallization pressures on the order of 3 to 6 kb (Percival *et al.*, 1992; J.H. Bédard, personal communication).

Along major regionally extensive brittle-ductile structures, the mineralogy of the various lithologies underwent a late retrogression phenomenon to the greenschist metamorphic facies. Low-temperature (< 500°C) hydrothermal fluid circulation is interpreted as being responsible for the crystallization of actinolite-chlorite-epidote-sericite-quartz-calcite-hematite assemblages. On either side of these regional structures, evidence of retrogression is minor.

LITHOGEOCHEMISTRY

In order to define the lithogeochemical characteristics of the principal lithological units that were mapped in the Lac Aigneau area, 120 samples, including 76 granitoids and 44 mafic to ultramafic rocks, were analyzed for major and trace elements, as well as rare earth elements (REE). Analyses were performed either at the Consortium de Recherche minérale du Québec (COREM) or at the Québec Geoscience Centre (QGC). At the COREM, major elements and certain trace elements (Nd, Rb, Sr, Y and Zr) were analyzed by X-ray fluorescence; the remaining trace elements and REE were analyzed by neutron activation. At the QGC, major elements and the more conventional trace elements were determined by ICP-AES; the remaining trace elements and REE were analyzed by ICP-MS. The geochemical data related to the samples located in the westernmost part of map area 24E (Lac Natuak sector) were taken from a report by Parent *et al.* (2000).

Volcanic Rocks – Duvert Complex

Samples were collected on outcrops where the volcanic origin could be certified by the presence of pillow basalt relics or by their association with paragneisses, iron formations or pyroclastic rocks. Analytical data from intermediate, mafic and ultramafic samples are plotted in figures 6 and 7.

Volcanic rocks in the Lac Aigneau area show subalkaline compositions covering the spectrum from peridotitic komatiite (PK), to basaltic komatiite (BK), to basalt and andesite (Figure 6a and 6b). On the AFM magmatic discrimination diagram (Figure 6c; Irvine and Baragar, 1971), ultramafic and mafic volcanic rocks plot in the tholeiitic field, whereas intermediate rocks display an alkali enrichment that is closer to the calc-alkaline trend.

Ultramafic volcanic rocks of the Duvert Complex show peridotitic komatiite and basaltic komatiite compositions (Figure 6a and 6b). They display moderate SiO_2 values (45.7-48.7%), and moderate to high Fe_2O_3t (10.0-18.1%), MgO (11.4-29.6%), Cr (420-5100 ppm) and Ni (200-1200 ppm) values. Their REE patterns are flat to slightly enriched in light rare earth elements ($[La/Yb]_{nCH}$ = 1-10) and relatively primitive (1 to 2 times chondrite) (Figure 7a).

Mafic gneisses of the Duvert Complex show compositions ranging from high-Mg basalts to ferrobasalts (Figure 6a and 6b). Magnesian basalts show low TiO_2 (0.46-1.22%) and Fe_2O_3t (9.0-17.6%) contents, and moderate Al_2O_3 (12.9-14.8%), MgO (5.3-8.8%), Cr (28-1500 ppm) and Ni (34-290 ppm) values. The spiderdiagrams (Figure 7b) display negative Th and Nd anomalies, as well as relatively undifferentiated (< 10 times chondrite) and flat to slightly light rare earth depleted ($[La/Tb]_{nCH}$ = 0.6-1.2) REE patterns. Ferrobasalts show low to moderate TiO_2 (0.93-1.03%), MgO (5.6-7.1%), Cr (150-250 ppm) and Ni (63-120 ppm) abundances, but high Al_2O_3 (15.1-15.2%) and Fe_2O_3t (20.2-24.9%) values. The ferrobasalts are characterized by a negative Sr anomaly, and REE patterns very weakly enriched in La and Ce ($[La/Yb]_{nCH}$ = 2 to 20 times chondrite) (Figure 7b). These patterns are parallel to those of ultramafic rocks, which suggests the basalts are derived from the latter through a fractional crystallization process.

Intermediate gneisses of the Duvert Complex have andesitic compositions (Figure 6a and 6b). They have low TiO_2 (0.55-0.90%), Fe_2O_3t (5.6-8.0%) and MgO (2.8-3.3%) contents, but high SiO_2 (55.6-61.9%) and Al_2O_3 (18.1-19.6%) concentrations. The andesites are characterized by REE patterns slightly enriched in light REE ($[La/Yb]_{nCH}$= 7 to 34) at 90-100 times chondrite (Figure 7b).

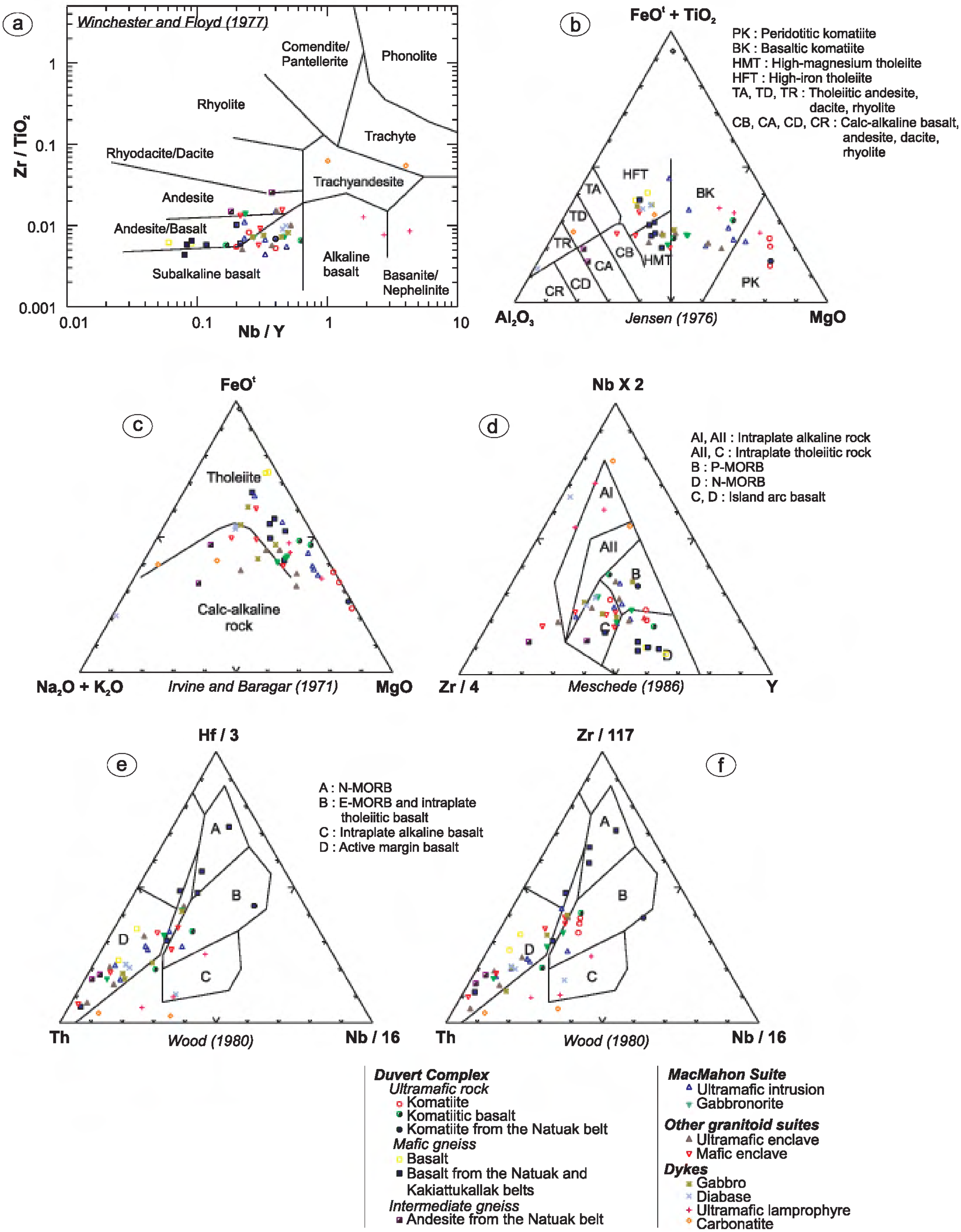

FIGURE 6 – Geochemical diagrams illustrating results of major and trace element analyses obtained from intermediate, mafic and ultramafic volcanic and plutonic rocks of the Lac Aigneau area : **a)** Nb/Y vs Zr/TiO$_2$ classification diagram (Winchester and Floyd, 1977); **b)** AFM diagram (Jensen, 1976); **c)** AFM diagram (Irvine and Baragar, 1971); **d)** Paleotectonic Zr-Nb-Y ternary diagram (Meschede, 1986); **e)** and **f)** Paleotectonic ternary diagrams combining elements Th-Hf-Nb-Zr (Wood, 1980).

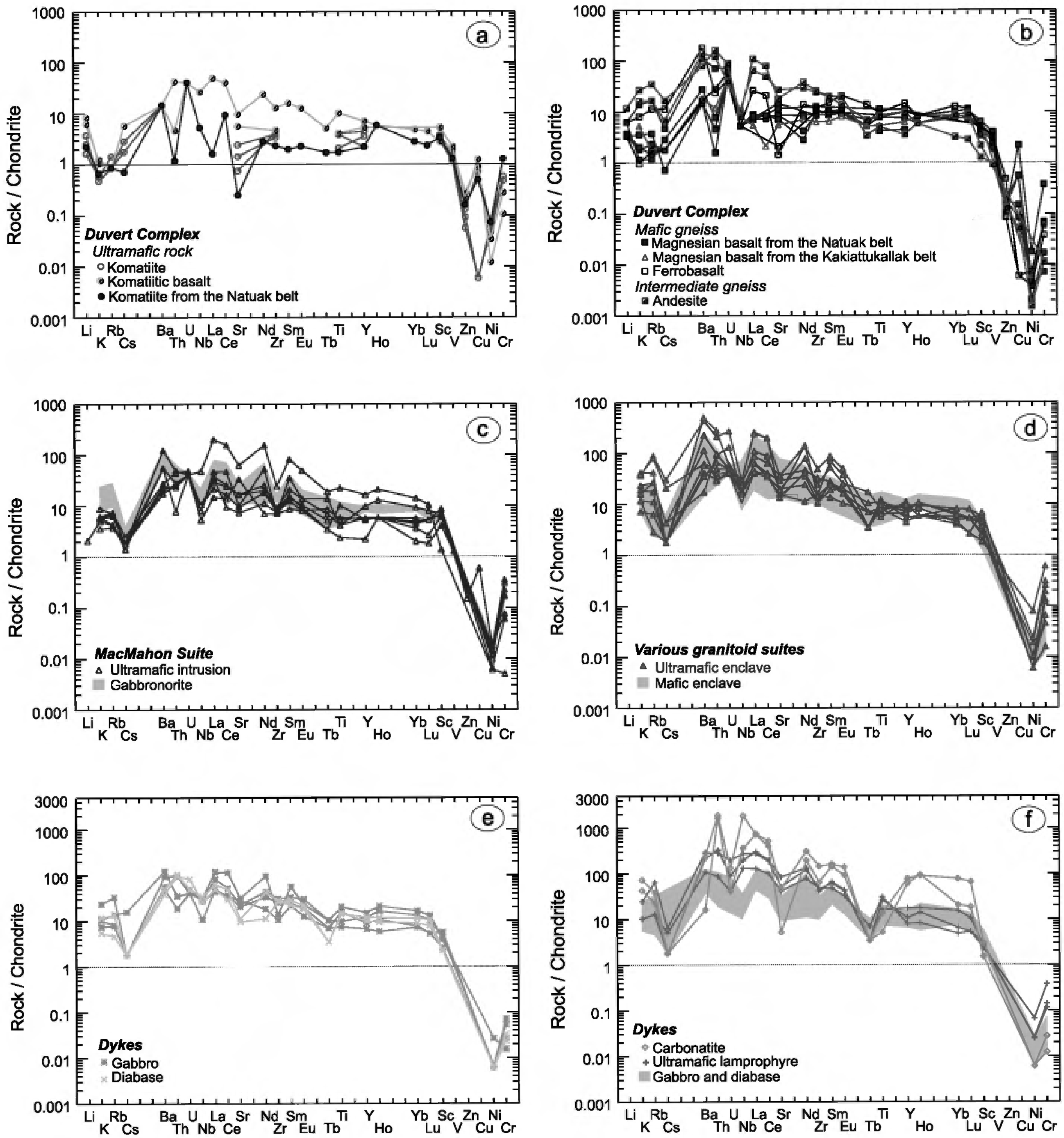

FIGURE 7 – Chondrite-normalized multi-element geochemical diagrams illustrating the results of trace and rare earth element analyses obtained from intermediate, mafic and ultramafic volcanic and plutonic rocks of the Lac Aigneau area: **a)** and **b)** Duvert Complex, including the Natuak and Kakkiatukallak belts; **c)** Ultramafic and gabbronoritic intrusions of the MacMahon Suite; **d)** Ultramafic and mafic enclaves in various granitoid suites; **e)** gabbro and diabase dykes; **f)** Ultramafic lamprophyre and carbonatite dykes.

Granitoid Suites

Analytical results from the various granitoid suites are plotted on diagrams shown in figures 8 and 9.

Diorites, tonalites and granodiorites

All the diorites (from the Suluppaugalik, Coursolles and Nallualuk suites) show homogeneous, metaluminous compositions (Figures 8d and 9a), whereas associated tonalites and granodiorites display a compositional spectrum ranging from metaluminous and enriched in heavy REE, to weakly peraluminous and depleted in heavy REE (Figures 8d, 9b, 9c, 9d and 9e).

Diorites and tonalites enriched in heavy REE have comparable Al_2O_3 (13.0-18.7%), MgO (1.3-10.7%), and P_2O_5 (0.11-1.20%) concentrations, and Na_2O/K_2O ratios (1.39-5.71). The diorites have lower SiO_2 (44.1-53.8%), but are enriched in TiO_2 (0.84-2.19%), CaO (6.4-10.2%), MnO (0.12-0.21%) and P_2O_5 (0.27-0.91%) relative to heavy REE-enriched tonalites and granodiorites (SiO_2 = 54.9-68.9%; Zr/Y = 13.6-22.3; TiO_2 = 0.35-2.39%; CaO = 3.7-9.6%; MnO = 0.02-0.14%). In addition to the heavy REE enrichment (Y = 12-43 ppm; Yb = 1.4-3.9 ppm; Zr/Y = 5-12), spiderdiagrams show negative Nb, Hf and Ti anomalies, positive Sm anomalies, and light REE enriched patterns ($[La/Yb]_{nCH}$ = 6-30) (Figure 9b, 9c, 9d and 9e).

Although diorites of the Suluppaugalik Suite show major element compositions similar to diorites of the Coursolles and Nallualuk suites, they have lower light REE, Sr and Nd contents, and show REE patterns parallel to MORBs ($[La/Yb]_{nCH}$=1-3) at 0.5-0.8 times MORB (Figure 9a).

Heavy REE-depleted tonalites and granodiorites show roughly comparable Al_2O_3 (14.2-20.3%), MnO (< 0.18%) abundances and Na_2O/K_2O ratios (0.73-6.64) relative to their enriched counterparts. However, they show higher SiO_2 (60.3-73.6%) and lower TiO_2 (0.23-0.77%), CaO (2.5-5.5%), MgO (<2.8%) and P_2O_5 (< 0.32%) values. Spiderdiagrams for these heavy REE-depleted tonalites and granodiorites (Y = 12-43 ppm; Yb = 1.4-3.9 ppm; Zr/Y = 4-77) show stronger negative Nb anomalies, and steeper REE patterns ($[La/Yb]_{nCH}$=17-68) (Figure 9b, 9c, 9d, 9e).

The *compositional continuum*, which ranges from metaluminous diorites, through heavy REE-enriched tonalites-granodiorites to weakly peraluminous and heavy REE-depleted tonalites-trondhjemites-granodiorites, may be explained by the progressive fractionation of hornblende, magnetite and apatite to biotite, sphene and zircon.

Enderbites, orthopyroxene diorites, gabbronorites and ultramafic intrusions

Ultramafic plutonic rocks of the MacMahon Suite show subalkaline compositions plotting in the basaltic komatiite (BK) and high-magnesium tholeiite (HMT) fields (Figure 6a and 6b). These rocks contain low to moderate SiO_2 (38.6-50.4%), moderate to high Fe_2O_3t (9.9-23.0%) and MgO (7.4-16.5%), and low Cr (< 1400 ppm) and Ni (< 300 ppm). The ultramafic plutonic rocks display weakly to moderately light REE-enriched ($[La/Yb]_{nCH}$ = 5-14), and moderately evolved patterns (10-100 times chondrite; Figure 7c). They display negative Cs, Th, Nb and Zr anomalies; the most primitive magmas also show weakly negative Ti and Y anomalies, typical of island arc tholeiitic magmas (Figure 6c, 6d, 6e and 6f).

Ultramafic and mafic rocks occurring as m-scale *enclaves* in the various granitoid suites (Figure 7d) contrast with their km-scale counterparts of the MacMahon Suite (Figure 7c) due to a global enrichment in lithophile elements (K to Ba) and high ionic potential incompatible elements (Th to Eu), which suggests a strong contamination from surrounding intrusive felsic magmas.

Gabbronorites of the MacMahon Suite have subalkaline basaltic komatiite to high-magnesium tholeiite compositions (Figure 6a and 6b). They display SiO_2 contents between 48.5 and 50.5%, Fe_2O_3t between 10.6 and 11.7%, and MgO between 10.1 and 11.5%. Spiderdiagrams (Figures 7c and 9f) show negative Cs, Nb, Hf, Zr and Tb+Ti anomalies, as well as low Cr (560-740 ppm) and Ni (8-47 ppm) values. The gabbronorites show Ba peaks, as well as positive La+Ce and Nd anomalies. Their REE patterns are slightly enriched in light REE ($[La/Yb]_{nCH}$ = 3-9) and moderately to strongly evolved (10-100 times chondrite). The trace element and REE contents of gabbronorites are similar to those observed in ultramafic intrusions of the MacMahon Suite and ultramafic and mafic enclaves enclosed in the various granitoid suites. They are characterized however by an enrichment in K, Rb, Cs, weaker negative anomalies in Hf, Zr, Ti and Ni, and a Zr/Y ratio of 3.0 to 5.5 (Figure 7c). Paleotectonic discrimination diagrams are ambiguous, as the data straddles the modern intraplate basalt field and the island arc field.

The trace element and REE composition of *orthopyroxene diorites of the MacMahon Suite* almost entirely covers the gabbronorite compositional range (Figure 9f). Compared to gabbronorites, orthopyroxene diorites tend to show lower MgO (2.7-7.6%), but higher SiO_2 (< 54.4%) and Fe_2O_3t (< 17.6%) and Zr/Y ratios (2.9-7.9). Spiderdiagrams show stronger negative Nb, Hf and Zr anomalies and positive Sr and Ti anomalies. REE patterns tend to be more strongly depleted in heavy REE ($[La/Yb]_{nCH}$ = 6-12).

A similar, but sharper trend of enrichment and depletion of heavy REE, major and trace elements is observed for orthopyroxene-rich enderbites (Zr/Y = 10-15; $[La/Yb]_{nCH}$ = 14-17) and for clinopyroxene-rich enderbites (Zr/Y = 12-28; $[La/Yb]_{nCH}$ = 21-52) (Figure 9g).

Granites

Porphyritic monzogranites of the La Chevrotière Suite and *late leucogranites* of the Dufreboy Suite have very similar and very homogeneous geochemical compositions.

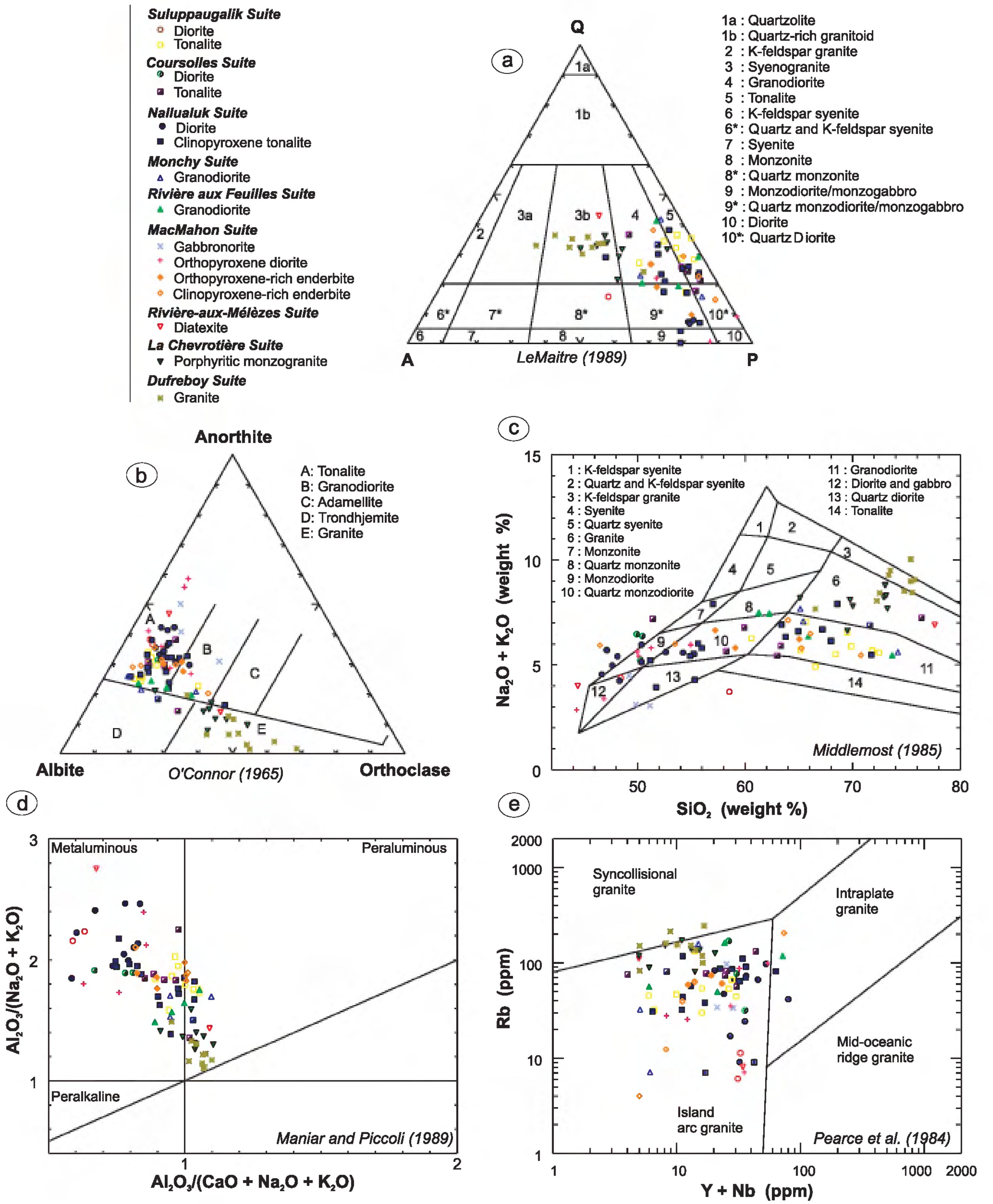

FIGURE 8 – Geochemical diagrams illustrating the results of major and trace element analyses obtained from granitoids in the Lac Aigneau area : **a)** Normative quartz-anorthite-plagioclase classification diagram (Le Maître, 1989); **b)** Normative albite-anorthite-orthoclase diagram (O'Connor, 1965); **c)** Na_2O+K_2O vs SiO_2 binary classification diagram (Middlemost, 1985); **d)** A/NK versus A/CNK discrimination diagram (Maniar and Piccoli, 1989); **e)** Rb versus Y+Nb binary paleotectonic diagram (Pearce *et al.,* 1984).

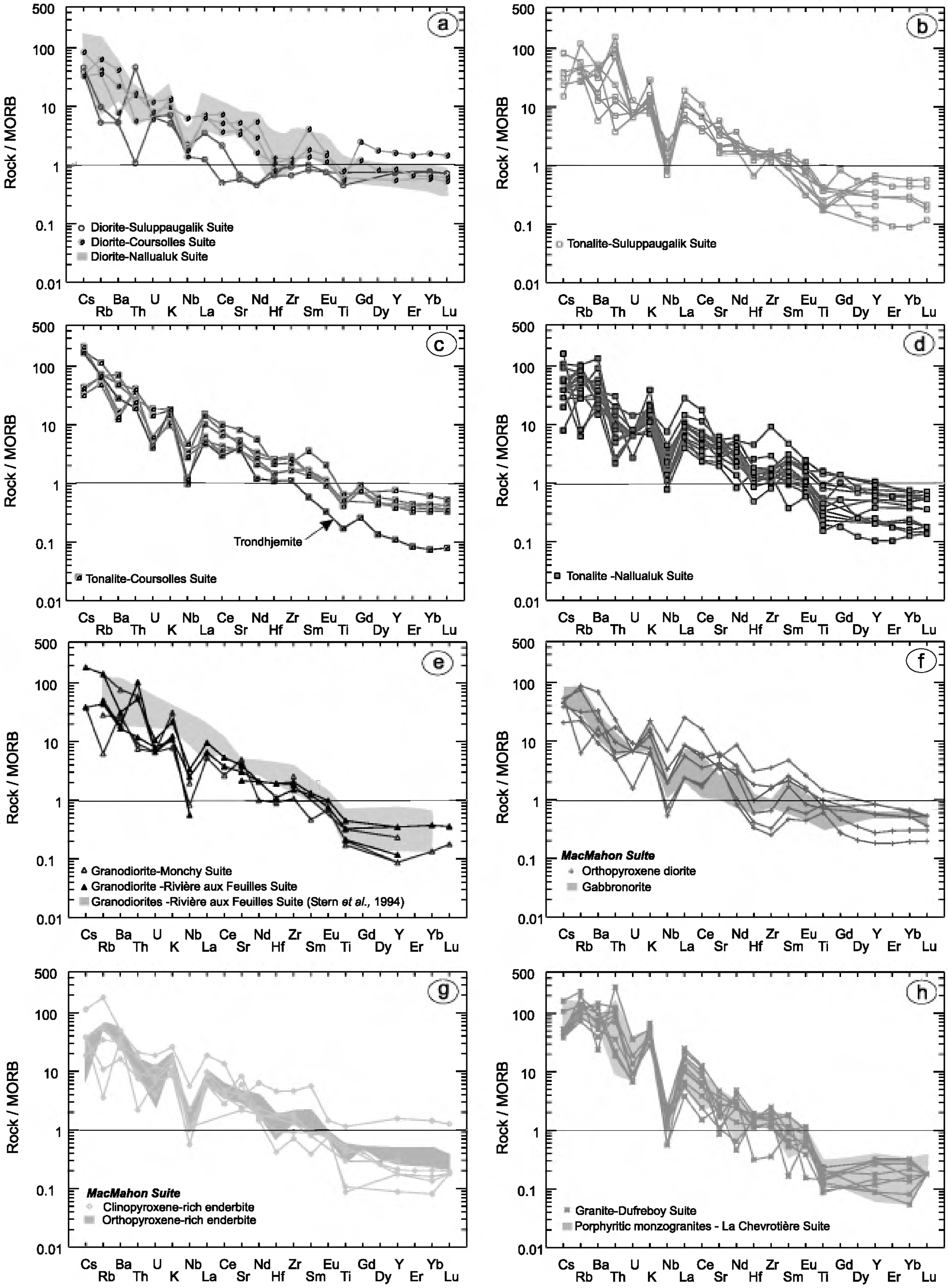

FIGURE 9 – MORB-normalized multi-element diagrams, illustrating the results of trace and rare element analyses obtained from granitoids in the Lac Aigneau area : **a)** Diorites; **b), c)** and **d)** Tonalites; **e)** Granodiorites; **f)** Orthopyroxene diorites and gabbronorites; **g)** Enderbites; **h)** Granites.

These rocks are weakly peraluminous (A/CNK = 0.9-1.1; Figure 8d). They also show the highest SiO_2 (63.6-81.0%) and K_2O (3.3-7.8%) contents, and the lowest TiO_2 (< 0.47%), CaO (< 3.3%), MgO (< 1.9%) and P_2O_5 (< 0.24%) abundances. Spiderdiagrams (Figure 9h) show patterns with extremely high Rb, Ba and Th values, as well as prominent negative Nb anomalies. REE patterns strongly enriched in light REE ($[La/Yb]_{nCH}$= 20-113) and depleted in heavy REE (Y< 13 ppm; Yb < 1.2 ppm), combined with Zr/Y ratios = 12-66, suggest that the genesis of these granites was strongly influenced by partial melting processes. Furthermore, while the composition of diorites, tonalites and granodiorites plot in the island arc field, the granites appear to be more closely related to the field of syncollisional granites (Figure 8e).

Late Dykes

Gabbro and diabase dykes

Already sharing similar orientations and hydrothermal alteration, gabbro and diabase dykes have very similar geochemical signatures. Gabbro and diabase dykes show subalkaline tholeiitic high-magnesium basalt and ferrobasalt compositions (Figure 6a and 6b) formed in an intraplate environment (Figure 6d, 6e and 6f). The gabbros are markedly enriched in magnesium (MgO = 5.7-10.1%) and less siliceous (SiO_2 = 46.8-49.6%) compared to the diabases (MgO = 5.4-5.8%; SiO_2= 50.1-51.1%). The two types of dykes are rich in Fe_2O_3t (11.2-16.6%), and poor in Cr (61-280 ppm) and Ni (8-69 ppm). Spiderdiagrams (Figure 7e) show weakly negative Nb anomalies, slightly enriched light REE patterns ($[La/Yb]_{nCH}$= 3-9) and moderately evolved compositions (10 to 100 times chondrite).

Ultramafic lamprophyre and carbonatite dykes

Ultramafic lamprophyre and carbonatite dykes have alkaline (Figure 6a) intraplate-type (Figure 6d to 6f) compositions. Ultramafic lamprophyre dykes are enriched in MgO (12.8-23.8%) and Fe_2O_3t (13.9-16.7%) and depleted in SiO_2 (26.7-36.3%). K_2O contents ranges from 1.1 to 2.5%, and TiO_2 compositions between 1.8 and 3.3%. Cr (460-1500 ppm) and Ni (56-95 ppm) are relatively low. Spiderdiagrams (Figure 7f) show strongly negative anomalies in Cs, U and Tb, and weaker anomalies in Sr and Zr, as well as REE patterns that vary from very steep ($[La/Yb]_{nCH}$= 20-42) to < 20 times chondrite.

Carbonatites are not as rich in MgO (0.9-5.0%), Fe_2O_3t (7.82-9.92%), TiO_2 (0.6-1.47%), Cr (49-110 ppm) and Ni (100 ppm), but show higher SiO_2 (31.0-56.6%) and K_2O (4.4-7.5%) contents compared to ultramafic lamprophyre dykes. Spiderdiagrams (Figure 7f) also show that the carbonatites are fairly enriched in Nd (140-120 ppm), to strongly enriched in Th (69-80 ppm), Nb (136-690 ppm), La+Ce and Y+heavy REE (up to 100 times chondrite), and they have lower $[La/Yb]_{nCH}$ ratios (10-34).

GEOCHRONOLOGY

A geochronology study encompassing all the projects in the Far North Program was undertaken by the MRN at the GÉOTOP laboratories of the Université du Québec à Montréal. Results of U-Pb isotopic analyses (isotopic dilution and thermal ionization mass spectrometry – TIMS) and $^{207}Pb/^{206}Pb$ isotopic analyses (*in situ* analysis by laser ablation and inductively coupled plasma mass spectrometry – LA-ICP-MS) are presented in order to establish emplacement ages, metamorphic ages and inherited ages. *In this report, results of U-Pb analyses are given in millions of years (**Ma**) with a confidence interval of 2 sigmas, whereas $^{207}Pb/^{206}Pb$ analytical results are given in billions of years (**Ga**) with an interval of 1 standard deviation.* In the latter case, uncertainties not mentioned in the text are estimated at *ca.* ±1%. U-Pb analyses are specifically performed to define emplacement ages of lithologies, and the results obtained are generally preferred to $^{207}Pb/^{206}Pb$ analytical results. These results will also be integrated in a more detailed report (David, in preparation) discussing the geochronology, analytical methods and their respective precision, statistical processing techniques as well as the results obtained for all samples collected under the Far North Program during the 1999 field season.

A component of this study is based on five samples (#1 to #5; Figure 2) selected in the Lac Aigneau area (NTS 24E) in order to better characterize lithodemic units and define their relative timing. These five samples are distributed along an east-west transect, and represent: *i)* a biotite tonalite from the Suluppaugalik Suite (sample #1: *Aspk*), *ii)* two types of enderbite from the MacMahon Suite (samples #2 and #3: *Acmm*), *iii)* a clinopyroxene-hornblende-biotite tonalite from the Nallualuk Suite (sample #4: *Anlu*), and *iv)* a porphyritic monzogranite from the La Chevrotière Suite (sample #5: *Alcv*).

Tonalite – Suluppaugalik Suite

The Suluppaugalik tonalite (*Aspk*) systematically hosts 10-cm-scale dioritic enclaves, and is injected within highly dismembered supracrustal sequences. The biotite tonalite sample (99-AB-1150; UTM coordinates, NAD 83: 350212E and 6391667N) was collected along the margins of the Kakiattukallak belt (sample #1; Figure 2), which is composed of transposed mafic gneiss and iron formation. Two morphological crystal types are recognized among the zircons recovered in this sample. The first and most important population consists of dark brown prisms with traces of diffuse magmatic zoning. They have variable length-to-width ratios, but the same type of simple terminations and moderately dulled faces. Certain crystals contain brownish cores, difficult to observe. The second population is formed of uncoloured equidimensional zircons, either hypidiomorphic or xenomorphic. Statistical processing of $^{207}Pb/^{206}Pb$ analytical results from 24 crystals derived from both populations outlined four statistical modes. A principal mode associated with the brownish prisms corresponds to an age of 2.790 Ga, *i.e.* the age of emplacement of the tonalite. Two other modes are indistinctly associated with the uncoloured zircons, and yield inherited ages of 2.898 and 3.064 Ga. Finally, the fourth mode outlines a relatively young and poorly precise age of 2.709 Ga. U-Pb analyses conducted on the terminations of crystals of the first population yielded ages between 2790 and 2802 Ma, with an upper intercept on the Concordia line at 2805+9/-4 Ma, which represents the age of emplacement of the tonalite.

Enderbites – MacMahon Suite

Two enderbites of the MacMahon Suite (*Acmm*) representing the orthopyroxene-rich unit (*Acmm3*) and the clinopyroxene-rich unit (*Acmm4*) were sampled in order to confirm/infirm the synchronous timing of their emplacement and the possibility that the two may represent metamorphic equivalents of the tonalite.

The enderbite of unit *Acmm3* (sample #2; Figure 2) was sampled in the central part of NTS sheet 24E, east of Lac Ikirtuuq (99-FM-4052; UTM coordinates, NAD 83: 387800E and 6382400N), along the border of a late granitic pluton. At this location, the enderbite is massive and homogeneous, but contains dioritic enclaves. The zircons recovered from this sample are difficult to characterize, as they consist of strongly fractured crystals almost systematically composed of cores and an important envelope. At best, 1-2% small uncoloured stubby crystals are recognized, with dulled edges and rarely homogeneous. The vast majority of zircons appear to be hypidiomorphic mixed prisms, in which two generations are distinguished in equal proportions. Indistinctly, these zircon generations are clear and uncoloured or brownish. Results of $^{207}Pb/^{206}Pb$ analyses derived from the ablation of different crystal parts, yielded ages ranging from 2.665 to 2.755 Ga. However, statistical processing of these results yielded a single mode representing an age of 2.712 Ga. U-Pb analyses were conducted on uncoloured terminations, and yielded ages between 2674 and 2677 Ma; a single analysis was performed on an uncoloured stubby prism; it yielded an age of 2717±4 Ma. The results obtained from terminations fall along a line whose upper intercept with the Concordia line represents an age of 2679±3 Ma. New analyses currently underway should be able to duplicate the results obtained on the prism. As for the previous sample, the results are not easy to interpret. The hypothesis we are considering is that the U-Pb age of 2717±4 Ma is equivalent to the $^{207}Pb/^{206}Pb$ age of 2.712 Ga, and represents the age of crystallization, whereas the age of 2679±3 Ma corresponds to the age of the regional metamorphic episode, which may be confirmed at a later date with titanite analyses.

Another massive to weakly foliated enderbite (sample #3; Figure 2) (99-JD-7150; UTM coordinates, NAD 83: 350050E and 6404900N) was sampled a few kilometres to the northeast of the Suluppaugalik tonalite sample (99-AB-1150). This sample represents the clinopyroxene-rich *Acmm4* unit. At the sample locality, the enderbite hosts leucogranite veins with diffuse contacts; it contains pyroxenite enclaves and massive magnetite-rich horizons about 10 cm thick. It is not easy to classify the zircons recovered from the enderbite; they mainly consist of uncoloured zircon xenocrysts, among which a low percentage of grains show random crystal faces, or rarely, are derived from equidimensional crystals with traces of symmetry. Results of $^{207}Pb/^{206}Pb$ analyses, given the important error margins, allow us to interpret that the vast majority of grains are mixed, and composed of zircons derived from several generations of crystallization. Statistical processing outlines three modes. A principal mode corresponds to an age of 2.683 Ga and may be linked to zircons with crystalline faces. Two other modes correspond to ages of 2.756 Ga and 2.620 Ga, interpreted as respectively representing cores and overgrowths. One possibility is that the overgrowths may be associated with the granitization phase. U-Pb analyses performed on several crystals characterized by symmetrically organized crystal faces yielded ages between 2652 and 2704 Ma. These analyses fall along a single line, whose upper intercept with the Concordia line corresponds to an age of 2704±2 Ma, the age of crystallization of the enderbite, and considered here as equivalent to the $^{207}Pb/^{206}Pb$ age of 2.683 Ga.

Tonalite – Nallualuk Suite

A clinopyroxene tonalite (*Anlu2*; sample #4, Figure 2), sampled in the easternmost part of the map area, near the New Québec Orogen (99-AB-1103; UTM coordinates, NAD 83: 427085E and 6390416N), displays lithological features similar to those of enderbites: it is granular, porphyroclastic and contains diorite enclaves, very rare remnants of massive to banded magnetitite, and ubiquitous, albeit not abundant, injections of late granitic material. The zircons in this sample are grouped into one population of stubby rectangular prisms with simple asymmetrical terminations. The crystals are brown to uncoloured, and traces of magmatic zoning are visible. A second type of zircon, completely clear and uncoloured, occurs as overgrowths on the ends of certain prisms. Ablation processing did not allow us to analyze the latter type of zircon correctly, and so the statistical processing of $^{207}Pb/^{206}Pb$ analytical results is essentially focussed on the stubby prismatic crystals. Three modes were outlined by the statistical processing. A first mode representing an age of 2.706 Ga is interpreted as the age of emplacement; a second mode with an age of 2.864 Ga represents older cores contained in the prisms; finally, a third mode yielded an age of 2.648 Ga. U-Pb analyses carried out on individual prismatic crystals yielded ages between

2698 and 2699 Ma. These two ages are practically concordant, and the weighed average produces an age of 2698±3 Ma. This age is preferentially considered equivalent to the principal mode obtained from $^{207}Pb/^{206}Pb$ analyses (2.706 Ga), and corresponds to the age of emplacement of the tonalite. U-Pb analyses currently underway may help us understand the significance of the younger $^{207}Pb/^{206}Pb$ age of 2.648 Ga. It may be related to a late granitization event, or correspond to a hydrothermal episode.

Porphyritic Monzogranite – La Chevrotière Suite

A *porphyritic monzogranite* pluton of the La Chevrotière Suite (*Alcv*), transected by an important mylonitic zone, was sampled (sample #5, Figure 2) about ten kilometres east of the orthopyroxene-rich enderbite sample (*Acmm3*). The mylonitic fabric in this sample (99-AB-1053; UTM coordinates, NAD 83: 398200E and 6386100N) is particularly well-developed, and is outlined by the alignment of K-feldspar porphyroclastic phenocrysts. As in most lithologies, the presence of intermediate enclaves is noted. All of the recovered zircons form a population of heterogeneous crystals. Elongate or stubby prisms, with or without cores, were selected for LA-ICP-MS analyses for a preliminary reconnaissance study. Statistical processing of the results outlined a principal mode representing an age of 2.717 Ga and a secondary mode at 2.686 Ga. The latter are respectively comparable to the ages of emplacement and of regional metamorphic event M_3 obtained from the orthopyroxene-rich enderbite sample (*Acmm3*; #99-FM-4052). However, two other less abundant modes are outlined, representing ages of 2.629 Ga and 2.573 Ga. More detailed work is warranted in order to understand the significance of these ages, and determine if one of these could be related to the development of the mylonitic fabric.

ECONOMIC GEOLOGY

Other than the lake sediment anomalies, work performed in the Lac Aigneau area prior to the 1998 and 1999 mapping campaigns had not identified mineral occurrences or showings of economic importance in the Archean bedrock. But work carried out since that time has outlined a five-fold economic potential for base and precious metals: *i)* iron formations associated with volcani-sedimentary belts, with Cu-Zn-Pb-Co±Ag±Au mineralization, *ii)* ultramafic intrusions with Cu-Ni±Co±Zn mineralization, as well as lithogeochemically anomalous deformation zones, to which are associated: *iii)* quartz veins with Cu mineralization, *iv)* REE-enriched carbonatized lamprophyre dykes and carbonatite dykes, associated with faults containing Cu-Zn-Ag±Au mineralization, and finally *v)* ultramafic lamprophyre dykes which may offer diamond potential. Assay results obtained from numerous sampling locations have helped identify several mineral occurrences and showings in an environment dominated by granitoid intrusions. The only detailed study performed on the various showings and occurrences that yielded anomalous assay results (Table 2 in Appendix, and Figure 10) is a petrographic analysis of each mineralization.

The mineral occurrences and showings represent the strongest anomalous response relative to the regional background. However, the showings mentioned here are in no way comparable to major showings discovered elsewhere in the Far North region (Labbé *et al.*, 1998, 1999, 2000). On the other hand, they reflect fairly accurately the distribution of belt remnants and fault zones in an environment dominated by granitoids. On Figure 10, lake sediment anomalies identified in the survey carried out in 1997 for the entire Far North Project by the MRN (1998) are shown in the background. Multi-element Cr, Ba and Ce anomalies, which possibly indicate remobilization of kimberlitic till as suggested by Moorhead *et al.* (2000), are also shown on Figure 10 for reference. Most geochemical anomalies detected in lake sediments were not reproduced by the lithogeochemistry of surface rocks. However, a few lithogeochemical anomalies correspond fairy well to lake sediment anomalies. Copper is the element showing the best correlation. For example, sites 27, 29, 31, 45 and 48 (blue) contain up to 0.32% Cu, whereas site 13 (black) contains up to 470 ppm Cu; all these occurrences are located over lake sediment anomalies of more than 49 ppm Cu. Lead also shows a good correlation for certain occurrences. Showings 2, 3, 5 and 6 (red) in the Natuak belt, containing up to 0.2% Pb, are located over a lake sediment anomaly with > 11 ppm Pb. A sample containing 186 ppm Ni (site 45 in blue) is also associated with a lake sediment anomaly of > 59 ppm Ni.

Iron Formations and Volcani-Sedimentary Rocks with Cu-Zn-Pb-Co±Ag±Au Mineralization

The Natuak and Kakiattukallak volcani-sedimentary belts, one to several kilometres in size, host important mineral occurrences and showings. *i) Iron formations* occur as dismembered horizons between 1 and 10 m thick, transposed in the mafic gneisses (metabasalts). The iron formations are generally banded; they vary from the silicate to the oxide facies, and often show a hybrid facies. Paragneisses hosting disseminated sulphides (pyrite, pyrrhotite and chalcopyrite) occur in association with these iron formations. *ii)* Metre-scale oxidized and sulphide-rich (pyrite-pyrrhotite-chalcopyrite) *silicified horizons* are also found in the mafic gneisses. *iii)* Several mineralized zones occur *within the mafic gneisses* (metabasalts), as well as at the *interface between mafic gneisses and ultramafic rocks*.

Mapping conducted by Parent *et al.* (2000) in 1998 in the Natuak belt revealed several mineralized *iron formation*

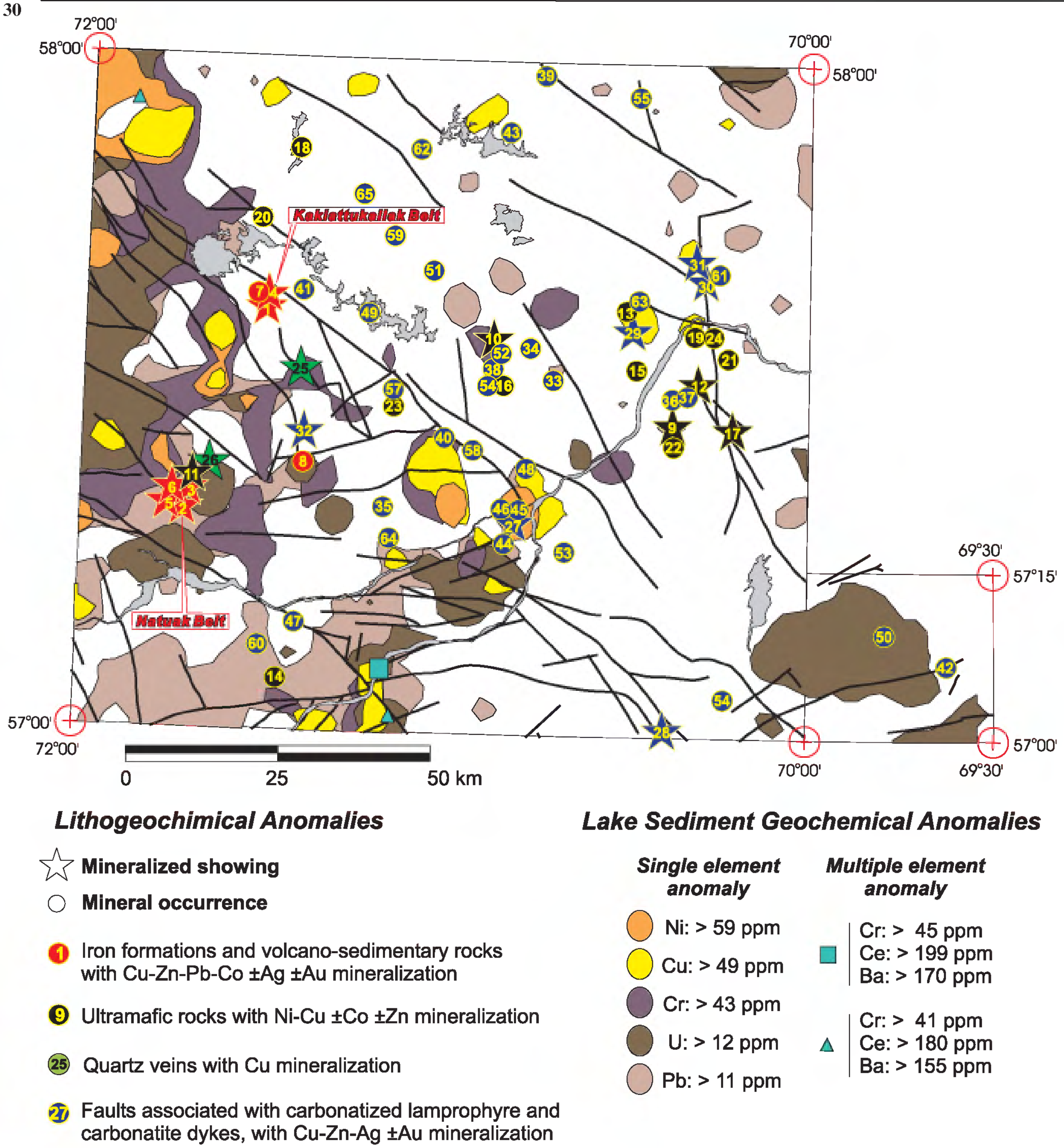

FIGURE 10 – Map showing the location of mineral occurrences and showings in the Lac Aigneau area. The background map shows lake sediment anomalies, major faults and principal lakes in the area. See Table 2 in Appendix.

horizons (showings 2, 3, and 6 in red; Figure 10, Table 2). In this belt, silicate iron formations, composed of banded grunerite-clinopyroxene-garnet-quartz-magnetite, generally possess a better gold potential than oxide-facies iron formations. Pyrite-pyrrhotite-arsenopyrite mineralization occurs as disseminations or in mm-scale bands parallel to the foliation. The most recent campaign in 1999 uncovered the presence of similar iron formation horizons in the Kakiattukallak belt. The best grades obtained from all sampled iron formations in the Lac Aigneau area are: 0.12% Cr and 990 ppm Ni (showing 2 in red; Table 2, Figure 10). Opaque mineral assemblages, for all iron formations in the map area, are dominated by oxides, which form mm-scale banded aggregates alternating with silicate beds composed of hornblende-clinopyroxene±orthopyroxene±quartz. In silicate bands, disseminated oxides are an accessory phase; magnetite *sensu stricto* and titaniferous magnetite represent the most abundant oxides, and are associated with ilmenite and occasionally hematite. Pyrite, chalcopyrite and pyrrhotite grains are also disseminated throughout the oxides. Pyrite is coarse-grained and hypidiomorphic, chalcopyrite is very fine-grained and often occurs as inclusions in pyrite or pyrrhotite, whereas pyrrhotite is fine-grained, allotriomorphic and locally occurs as inclusions in pyrite.

Siliceous horizons, mapped in the Natuak belt by Parent *et al.* (2000), are 1 to 10 m thick, and are commonly associated with metabasalts and ultramafic rocks. The best results obtained in these horizons are: 0.31% Zn, 0.14% Pb, 710 ppm Cu and 4 g/t Ag (showing 5 in red; Table 2; Figure 10). Quartz is characterized by well-developed mylonitic, granoblastic or cataclastic textures, indicating that these horizons have undergone intense deformation. The mineralization observed in these horizons is generally composed of pyrite-arsenopyrite-pyrrhotite±chalcopyrite; tourmaline and tremolite are locally associated with the mineralization.

Mineral occurrences hosted *within the mafic gneisses* (metabasalts) form small veinlets of pyrite-pyrrhotite±chalcopyrite, that are either 1 to 10 cm thick, disseminated and parallel to the regional foliation, or cm-scale, semi-massive and cross-cutting the foliation. Pyrrhotite-pyrite±chalcopyrite mineralization located at the *interface between metabasalts and ultramafic rocks* is disseminated along m-scale horizons. The best grades obtained in these zones is 0.10% Cu (site 4 in red; Table 2, Figure 10).

Ultramafic and Mafic Rocks with Ni-Cu±Co±Zn Mineralization

Horizons between 10 m and 1 km thick, and m-scale enclaves of ultramafic (pyroxenite, hornblende pyroxenite and pyroxene hornblendite) and mafic rocks (gabbro, diorite and their orthopyroxene-bearing counterparts) enclosed in granitoids, locally host copper and nickel mineralization. These mineral occurrences are represented by disseminated and cm-scale to m-scale pods of sulphides, and oxides. Sulphide and oxide phases generally occur along the borders of mafic silicate grains (pyroxene, hornblende and biotite) or, more rarely, infilling microfractures and fractures. Opaque minerals are the same in both cases, which suggests a remobilization of intergranular sulphides in late fractures. The best grades obtained in these settings are: 0.25% Ni and 0.39% Cu (showing 11, in black; Figure 10; Table 2).

Sulphide phases, assembled into mm-scale aggregates, are listed here in order of abundance: pyrite, chalcopyrite, pyrrhotite and pentlandite. Coarse-grained and allotriomorphic pyrite contains inclusions of all other sulphide phases. Chalcopyrite is fine-grained, and occurs as inclusions in pyrite and pyrrhotite, or infilling microfractures in pyrite (remobilized or second generation). Pyrrhotite is coarse-grained, disseminated or forms aggregates with chalcopyrite (most often) and/or with pyrite. Pentlandite is fine-grained, and mostly occurs as exsolutions in pyrrhotite. It also forms exsolution blebs in chalcopyrite, or occurs as grains welded to pyrite or replaced by pyrite.

In these ultramafic rocks, magnetite is ubiquitous. It is generally fine-grained, allotriomorphic, disseminated or forms reaction rims around sulphides. Ilmenite exsolution lamellae are locally present in magnetite grains. Ilmenite is sometimes the dominant oxide (sample 6096-B, site 14 in black; Figure 10, Table 2), occurring in rounded forms or as idiomorphic tabular grains containing hematite exsolutions. Ilmenite also forms replacement rims around pyrite.

Quartz Veins with Cu Mineralization

Mineralized quartz veins cut across granitoids and volcanisedimentary rocks. They most often occur in cataclasites, and are accompanied by epidote and hematite alteration, and sulphides (pyrite and chalcopyrite). These cataclasites are cut by diabase and gabbro dykes, and represent a favourable location for the remobilization of precious metals, base metals and uranium. The best grades obtained from such veins are 0.16% Cu in two samples (sites 25 and 26, in green; Figure 10; Table 2).

Faults with Cu-Zn-Ag±Au Mineralization, Associated with Carbonatized Lamprophyre and Carbonatite Dykes

Deformations zones and faults locally cut by lamprophyre dykes are often formed of fault breccia characterized by ductile-brittle deformation, and generally accompanied by orange-red alteration rich in carbonates (calcite and dolomite), hematite, various disseminated sulphides, and iron oxides and hydroxides. The best assay obtained in one of these environments is 0.32% Cu (site 31 in blue; Figure 10; Table 2).

Pyrite is the dominant sulphide in these deformed environments. It forms coarse to medium hypidiomorphic grains, disseminated or in mm-scale aggregates. Pyrite is most often surrounded by an oxidation rim composed of magnetite and/or hematite and/or goethite. Chalcopyrite is frequently observed; it generally occurs as small blebby inclusions in pyrite, and more rarely, in pyrrhotite. Pyrrhotite is much less common; it may occur as aggregates with pyrite, or as inclusions in pyrite, or disseminated, or show evidence of replacement by pyrite.

Magnetite is the dominant oxide. Two types of magnetite are present: magnetite *sensu stricto* and titaniferous magnetite. It is generally granular and coarse-grained, allotriomorphic, disseminated or forming cm-scale (or less) aggregates that often show intergrowth textures with coarse allotriomorphic ilmenite. Magnetite occasionally contains hematite and/or ilmenite exsolution lamellae. These oxides also form alteration rims around sulphides (pyrite, chalcopyrite and pyrrhotite) and fill late microfractures.

Ultramafic Lamprophyre Dykes

Field relationships, combined with the petrographic nature and the geochemical composition of ultramafic lamprophyre and carbonatite dykes appear to indicate that these may be derived from the same alkaline magmatism, the origin of which could be related to the emplacement of a kimberlite that evolved into a carbonatite. A more exhaustive and detailed study of the nature of minerals composing these dykes is underway, in order to better define the petrogenetic relationship between these different types of dykes, and to determine their diamond potential.

DISCUSSION AND CONCLUSIONS

Mapping in the Lac Aigneau area in the 1998 and 1999 field seasons led to the definition of two lithodemic complexes and eleven intrusive suites of Archean age, which were emplaced between > 2.810 and < 2.670 Ga. These Archean units are cut by five families of younger dykes (*ca.* < 2.510 Ga), and are bounded to the east by the Paleoproterozoic New Québec Orogen (1.998-1.800 Ga).

The Duvert Complex encompasses all volcani-sedimentary units, and namely the Natuak and Kakiattukallak belts. These units are composed of mafic to intermediate gneisses, ultramafic rocks, paragneisses and iron formations. These units are the oldest rocks mapped in the study area (> 2.810 Ga). They are penetratively transposed and affected by two phases of granulite-grade metamorphism. In the west part of the map area, the Duvert Complex is essentially enclaved in the Suluppaugalik Suite (2805+9/-4 Ma) composed of strongly heterogeneous biotite-hornblende tonalite, with enclaves of diorite, amphibolite and hornblendite. This suite is invaded by the Rivière aux Feuilles Suite, composed of homogeneous intrusions of granodiorite (2725±5 Ma) and tonalite (2710 Ma), by the Monchy Suite (unknown age) composed of heterogeneous migmatitic granodiorite, and by the Rivière aux Mélèzes Suite (2671 Ma; Parent *et al.*, 2000) composed of diatexites. In the south part of the map area, the Suluppaugalik Suite is cut by the Coursolles Suite (2718+19/-5 Ma) composed of diorite and horblende-biotite-epidote tonalite-trondhjemite. Locally, within these suites, an early planar fabric (S_2), oriented N-S, is preserved and interpreted as being related to phase of deformation D_2, developed in a penetrative fashion further north (Madore *et al.*, 1999). This fabric is cross-cut by a second planar fabric (S_3) oriented E-W to ENE-WSW, which appears to be contemporaneous with the emplacement of the Coursolles Suite. All these suites and structures are essentially outlined by regional negative magnetic anomalies. It is on this basis that the Goudalie Domain was defined by Percival *et al.* (1992), following the limits of this weak aeromagnetic gradient. These suites and structures appear to form the extension of the Goudalie – La Grande Series, which was defined further south, in the Lac Gayot (NTS 23M; Gosselin and Simard, 2000) and Lac Maricourt (NTS 24D; Gosselin *et al.*, 2001) areas.

All these suites, and the S_2 and S_3 fabrics, are obliterated by numerous intrusions covering the northeastern half of the map area. These intrusions are dominated: *(i)* by the MacMahon Suite composed of bodies of ultramafic rock (pyroxenites, peridotites and hornblendites), orthopyroxene diorite and gabbronorite to anorthositic gabbro, enclosed in two enderbitic units (dated at 2717±4 Ma and 2704±2 Ma); *(ii)* by the Nallualuk Suite (dated at 2698±3 Ma) composed of diorite and clinopyroxene tonalite; *(iii)* by the La Chevrotière Suite (*ca.* 2.686 Ga) formed of porphyritic monzogranite, as well as *(iv)* by the Morrice (*ca.* 2682±4 Ma) and Dufreboy suites, both composed of late leucogranite. In lesser proportions, the following units occur as enclaves: gabbro and diorite intrusions (Bacqueville Suite), paragneisses and mafic rocks (Qamaniq Complex). All these suites have ages between 2.717 and 2.671 Ga, and define an overall strongly positive magnetic gradient outlined by a planar fabric oriented NW-SE to WNW-ESE (S_4) and NNW-SSE to N-S (S_5).

At the scale of the NE Superior Province, the NE half of the Lac Aigneau area, affected in a penetrative fashion by fabrics S_4 and S_5, shows numerous stratigraphic and tectonometamorphic similarities with the Ashuanipi Subprovince (or Complex), which strongly suggests that these two regions could form, in the same way as the Goudalie – La Grande Series (Gosselin and Simard, 2000), a single stratigraphic assemblage, *i.e.* the Utsalik – Ashuanipi Series. Supporting arguments are as follows:

(1) The boundary between the NE Superior Province and the Ashuanipi Complex is defined by a negative aeromagnetic lineament oriented NE-SW that corresponds to the post-Archean Saindon-Cambrien structural zone. If we disregard this zone, the Archean rocks of these two regions are aligned in a continuous fashion along a strongly positive magnetic gradient, and a structural trend that varies from NW-SE to N-S.

(2) The Lac Aigneau area and the Ashuanipi Complex have undergone important intraplate or island arc magmatism, partially characterized by pyroxene-bearing (enderbitic) magmatic rocks. These enderbitic rocks cut: in the NE Superior Province, the margin of a basement largely composed of tonalite-trondhjemite-granodiorite (3.100 to 2.718 Ga; Percival and Card, 1994; David, in preparation), and in the Ashuanipi Complex, supracrustal assemblages mainly composed of paragneisses (3.010 to 2.700 Ga; Percival *et al.*, 1992). In the Lac Aigneau area (NTS 24E), the MacMahon Suite, whose enderbitic units (2.717 and 2.704 Ga) also outcrop further north in the Lac Dufreboy area (NTS 24L) and further west in the Lac Nedlouc area (NTS 34H; Parent *et al.*, 2000), as well as the Nallualuk Suite (2.698 Ga) may form a single magmatic evolution series, and have as lateral equivalents to the south and southeast, the

Beausac Suite and the Desliens Suite. The Beausac Suite (2.700 Ga; David, in preparation) is intrusive in the Lac Gayot area (NTS 23M; Gosselin and Simard, 2000) and in the Lac Hureault area (NTS 23L; Thériault and Chevé, 2000) where it was subdivided into a unit composed of mafic to ultramafic intrusions (gabbro, gabbronorite, pyroxenite) and units composed of tonalite, granodiorite and quartz monzodiorite (Thériault and Chevé, 2000). The Desliens Suite (2.690 Ga; Mortensen and Percival, 1987) is intrusive in an area west of Schefferville, where it essentially consists of porphyritic orthopyroxene tonalite and lesser proportions of gabbro, diorite, leucotonalite and pyroxenite (Percival, 1991). It is also intrusive in the Lac Bermen area (NTS 23F; Leclair *et al.*, 1998) where it is formed of metagabbro and metatonalite.

(3) The Lac Aigneau area and the Ashuanipi Complex were both affected by a syncollisional peraluminous granitic episode. In the Lac Aigneau area, this magmatism produced: *(i)* syntectonic porphyritic granite intrusions of the La Chevrotière Suite (2.717 Ga and 2.686 Ga), *(ii)* leucogranites of the Morrice Suite (2.682 Ga) and *(iii)* of the Dufreboy Suite. These different granites appear to have lateral equivalents to the south and southeast: *(iv)* porphyritic granites of the Maurel Suite (*ca.* 2.68 Ga; David, in preparation) recognized in the Lac Maricourt (NTS 24D; Gosselin *et al.*, 2001) and Lac Gayot (NTS 23M; Gosselin and Simard, 2000) areas; *(v)* porphyritic granites of the Druillon and Gamart suites (2.647 Ga, Parent, 1998) recognized in the Lac Hureault (NTS 23L; Thériault and Chevé, 2000), Lac Bermen (NTS 23F; Leclair *et al.*, 1998) and Lac Viar (NTS 23C; Lamothe *et al.*, 1998) areas; *(vi)* granites of the Tramont Suite recognized in the Lac Gayot (NTS 23M; Gosselin and Simard, 2000), Lac Hureault (NTS 23L; Thériault and Chevé, 2000), and Lac Bermen (NTS 23F; Leclair *et al.*, 1998) areas; and *(vii)* late granites, leucogranites and pegmatites found to the west of Schefferville and which yielded monazite ages of 2.65 Ga (Mortensen and Percival, 1987).

(4) The two regions were subjected to a metamorphic episode at the upper amphibolite facies (and locally granulitic) between 2.69 and 2.67 Ga, *i.e.* immediately following the enderbitic magmatic episode. This metamorphic episode is synchronous with the syncollisional peraluminous granites. It is represented in the Lac Aigneau area by the emplacement of diatexites of the Rivière aux Mélèzes Suite (2.671 Ga; Parent *et al.*, 2000), which appear to have lateral equivalents to the south and southeast: *(viii)* diatexites of the Opiscotéo Suite (2.675 Ga; Parent, 1998) recognized in the Lac Gayot (NTS 23M; Gosselin and Simard, 2000), Lac Hureault (NTS 23L; Thériault and Chevé, 2000), and Lac Bermen (NTS 23F; Leclair *et al.*, 1998) areas. In the Ashuanipi Complex west of Schefferville, the Desliens Suite is injected by coarse-grained and massive to weakly foliated granodioritic diatexites dated at 2.680 and 2.670 Ga, *i.e.* the same age (2.670 Ga; Mortensen and Percival, 1987) as the granulitic metamorphism of enderbites in the Desliens Suite; the entire sequence is cut by small bodies of tonalite, diorite, monzonite, granite and syenite (Percival and Girard, 1988; Chevé and Brouillette, 1995).

In the Lac Aigneau area, most lithologies contain zircons that also yielded a series of secondary ages ranging from 2.648 to 2.573 Ga. Studies on monazite and titanite crystals are underway to determine the origin of these secondary ages. For reference, diatexites of the Opiscotéo Suite in the Ashuanipi Complex also yielded metamorphic ages ranging up to 2.633 Ga (Parent, 1998). The secondary and poorly precise age of *ca.* 2.709 Ga obtained on zircons of the Suluppaugalik tonalite appears much older than the secondary ages obtained from enderbites and granites, but could nevertheless be contemporaneous with the enderbitic-type magmatic episode.

This suggests that a direct link exists between, on the one hand, an ultramafic magmatic episode (probably mantle-derived) and an enderbitic episode (attributed to the fractionation of an H_2O-deficient magma; Percival *et al.*, 1992; Stern *et al.*, 1994) and on the other hand, an M_2 metamorphic episode at the granulite facies phase, between 2.710 and 2.698 Ga. There is also a second direct link between, on the one hand, an episode of orogenic collision (responsible for the anatectic melting of the middle crust to produce the different granites), and on the other hand, an M_3 metamorphic episode at the upper amphibolite facies, roughly between 2.688 and 2.671 Ga. The M_2 metamorphic episode is interpreted as a syntectonic (D_2) thermal episode synmagmatic with the MacMahon Suite, probably largely responsible for: *i)* polyphase granulitic metamorphism observed in rocks of the Kakiattukallak belt, and *ii)* migmatization of tonalites of the Suluppaugalik Suite, which led to the formation of granodiorites of the Monchy Suite. The M_3 episode, on the other hand, is interpreted as a syn to post-collisional episode (D_4) responsible for the migmatization of paragneisses, which led to the formation of diatexites of the Rivière aux Mélèzes Suite. Units of the Monchy and Rivière aux Mélèzes suites form a migmatitic front more than 50 km wide, that borders the eastern margin of the Goudalie – La Grande Series. This metamorphic front presumably represents the tectonic and thermal expression that resulted from, first, the emplacement of the ultramafic to enderbitic MacMahon Suite, and then, from the orogenic collision between the Utsalik – Ashuanipi Series and the Goudalie – La Grande Series.

In the Lac Aigneau area, five families of dykes (gabbro, diabase, ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite) cut all Archean stratigraphic units. The gabbro dykes are commonly associated with deuteric hydrothermal alteration, and are parallel to the diabase dykes. Their orientation is similar to dykes of regional extent recognized in the NE Superior Province, with ages ranging from 2.505 to 1.998 Ga (Buchan *et al.*, 1998) straddling the extension period of the New Québec Orogen. The lamprophyre and carbonatite dykes were channelled along structures that cut across the New Québec orogenic front. The age of emplacement of these dykes may therefore be younger than *ca.* 1.8 Ga.

Mapping conducted in 1998 and 1999 led to the discovery of new economic mineral occurrences and showings. These showings and occurrences were grouped into five metallogenic settings: iron formations associated with volcani-sedimentary belts (Cu-Zn-Pb-Co±Ag±Au mineralization), ultramafic and mafic intrusions (Cu-Ni±Co±Zn mineralization), quartz veins (Cu mineralization), fault zones (Cu-Zn-Ag±Au mineralization) associated with carbonatized ultramafic to mafic lamprophyre and carbonatite dykes, and finally, ultramafic lamprophyre dykes which may possibly be related to type-1 kimberlites. Mineralogy studies are underway to determine the potential for platinum group minerals of ultramafic and mafic intrusions of the MacMahon Suite, and the diamond potential of lamprophyre dykes.

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TABLE 1 - Characteristics of the different families of dykes (gabbro, diabase, lamprophyre) in the Lac Aigneau area (24E). Sites are located on Figure 4.

Gabbro dykes

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sample	1067-D	1140-A	3019-B	3093-A	3187-A	3219-A	4005-B+D	4006-C+D3	4007-C	4055-A	6069-B	6074-D	6176-E	6215-D	6226-B	6235-B	7098-B+C
NTS	24E16	24E06	24E15	24E07	24L08	24E02	24L08	24L08	24L08	24E07	24E11	24E11	24E14	24E14	24L09	24E02	24E03
Easting	414218	354836	393277	393211	421629	398207	421547	420398	419847	411943	372535	368254	365705	379340	436394	401493	361806
Northing	6406999	6364725	6428483	6363071	6472707	6328985	6477438	6476704	6475939	6352831	6402590	6399611	6416820	6428483	6493255	6328335	6337914
Thickness	100 m	>30 m	30 cm	>50 m	-	-	>50 m	-	-	-	5 cm	1 to 2 m	5 to 10 cm	2 to 3 m	60 to 80 cm	20 to 30 m	>100 m
Orientation	290/ -	300/ -	125/90	356/ -	-	-	260/82	-	-	150/85	120/75	110/90	280/ -	-	140/ -	045/75	305/ -

Gabbro dykes (continued)

Site	18	19	20
Sample	7151-B	7164-A	7179-A
NTS	24E03	24E04	24E16
Easting	371951	347997	411415
Northing	6329331	6324027	6429217
Thickness	>100 m	-	-
Orientation	080/90	-	145/90

Diabase dykes

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sample	1018-F	1035-C	1067-C	1123-C	1134-C	1143-D	2045-C	2105-D	2106-B	2125-B	3029-D	3038-B	3046-D	3052-B	3060-C	3062-B	3075-D
NTS	24E10	24E10	24E16	24E02	24E01	24E06	24E06	24E07	24E07	24E11	24E14	24E15	24E06	24E10	24E11	24E11	24E06
Easting	390977	400346	414218	404865	417753	358234	357272	380194	380201	354484	358103	405428	362336	392699	371511	369783	361939
Northing	6392758	6378153	6406999	6330681	6333770	6365190	6374976	6357105	6357511	6392190	6417346	6422428	6371590	6387242	6383991	6383041	6355299
Thickness	50 cm	50 cm	70 cm	1 cm	1 to 2 m	50 cm	1 to 2 m	-	10 to 20 cm	-	10 to 20 cm	10 cm	-	-	10 cm	-	-
Orientation	270/88	130/60	200/ -	180/90	280/88	260/85	120/75	140/ -	140/ -	090/90	355/90	110/90	181/88	145/90	079/90	306/70	-
								170/ -	150/ -								

Diabase dykes (continued)

Site	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Sample	3124-C+E	3157-B	4009-B	4016-C+E	4037-B	4064-D	4074-D	4076-D	4079-C	4118-B	4123-B	4150-B	6022-D	6025-B	6027-B	6032-C	6034-B
NTS	24E11	24E06	24L01	24L01	24E10	24E06	24E07	24E07	24E07	24E11	24E11	24E03	24L02	24E11	24E11	24E11	24E11
Easting	379856	363896	413544	412837	382763	363896	403579	399623	378968	380527	358730	350293	383180	367239	367816	370981	372514
Northing	6382833	6348810	6455175	6450090	6377717	6348810	6350879	6349224	6345913	6389490	6381357	6347969	6454413	6393003	6393850	6395958	6396464
Thickness	5 to 20 cm		-	1 to 7 m	10 to 20 cm	50 cm	2 à 3 m	-	20 to 40 cm	1 to 20 cm	20 cm	5 m	20 to 50 cm	2 to 30 cm	50 to 60 cm	0.1 to 1 m	1 to 30 cm
Orientation	240/90	110/75	-	270/90	310/90	027/90	350/ -	-	160/ -	180/ -	145/80	120/ -	250/57	320/ -	326/90	325/ -	130/ -
	345/90								180/ -								

Diabase dykes (continued)

Site	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Sample	6090-B/E	6092-B	6093-C	6167-F	6200-B	6212-B	6244-D	6262-C	6268-F	7092-B	7152-C/D	7157-B	7166-B	7211-B
NTS	24E10	24E10	24E10	24E03	24L08	24E14	24E01	24E14	24E13	24E10	24E03	24E03	24E14	24E14
Easting	384885	386478	387375	378968	419682	377689	415506	352109	346826	387884	371922	351303	369722	357787
Northing	6398799	6399381	6400313	6345913	6457798	6426765	6332206	6414191	6410270	6394755	6328531	6320483	6410303	6424876
Thickness	1 to 5 cm	10 to 40 cm	20 cm	50 cm	10 cm	60 to 80 cm	20 to 40 cm	10 to 20 cm	40 cm	10 to 20 cm	50 cm	>30 m	60 cm	20 to 50 cm
Orientation	125/90	070/90	135/90	068/90	258/90	170/90	300/90	160/ -	280/90	290/ -	075/90	015/64	150/90	130/90

TABLE 1 (continued)

Ultramafic to mafic lamprophyre dykes

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	13	13	14	15
Sample	1073-D	1105-D	1150-K2	2002-E	2013-B	2105-D	2178-C	2181-F	2217-B	3026-B	3047-C	3048-C/D	3050-C/D/E	3050-D	3050-E	3091-D	3114-C
NTS	24E06	24E10	24E12	24L08	24E12	24E07	24E15	24E15	24E01	24E14	24E10	24E10	24E10	24E10	24E10	24E07	24E10
Easting	369334	387993	350212	424400	349154	380194	390214	391096	420336	360864	397297	396331	394783	394783	394783	391668	402409
Northing	6356976	6379986	6391667	6479900	6391806	6357105	6416962	6418672	6321196	6418789	6389420	6388573	6387678	6387678	6387678	6361119	6378745
Thickness	2.5 m	9 m	1 - 2 m	60 cm	1 m	10 - 20 cm	10 - 20 cm	0.5 - 1 m	20 - 30 cm	50 - 60 cm	10 - 40 cm	1 - 2 m	3 - 10 cm	7 -10 cm	30 cm	-	-
Orientation	335/75	325/ -	-	-	-	140 to 150/-	200/75	005/ -	350/90	135/90	105/ -	120/ -	120/90	105/90	130/90	120/70	266/90

Ultramafic to mafic lamprophyre dykes (continued)

Site	16	17	18	19	20	21	22	23	24	25		26	27	28		29	
Sample	4052-D	4056-B	4071-C	4076-D	4109-C	4141-C	5025-C	6057-E	6067-E	6083-D	6083-G	6090-E	6112-B1+B2	6181-B	6182-E	6182-F	6182-G
NTS	24E10	24E08	24E03	24E07	24E10	24E11	24E06	24E07	24E02	24E06	24E06	24E10	24E07	24E14	24E14	24E14	24E14
Easting	388021	411193	378294	399623	388480	361743	357629	381008	381240	357167	357167	384885	400790	361712	361445	361445	361445
Northing	6382598	6352255	6342975	6349224	6377438	6397336	6369859	6361956	6343805	6361397	6361397	6398799	6359145	6414562	6414090	6414090	6414090
Thickness	35 cm	0.8 - 1 m	10 - 30 cm	2 m-3 m	1D-2D	50 - 60 cm	50 cm	-	0.5 - 1 m	10 - 20 cm	-	10 - 30 cm	60 - 80 cm	50 cm	50 cm	50 - 60 cm	2 m
Orientation	140/80	340/90	-	350/ -	150/ -	135/70	300/ -	015/58	-	330/90	355/ -	125/90	170/90	230/90	122/60	305/75	270/ -

Ultramafic to mafic lamprophyre dykes (continued)

Site	30	31	32	33	34	35	36	37
Sample	6183-B	6210-D	6216-B	7027-C	7067-C	7073-B1 à B3	7079-B	7147-B
NTS	24E14	24E14	24E14	24E14	24E07	24E11	24E11	24E14
Easting	360854	376130	380113	367433	402501	360627	356196	353295
Northing	6413660	6425850	6429329	6403227	6357783	6391241	6387403	6407484
Thickness	30 cm	5 -40 cm	10 cm	-	-	-	1 - 10 cm	-
Orientation	185/65	185/90	360/90	-	-	140/90	010/ -	162/ -

Ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite dykes

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sample	1003-D	1104-B	1106-B	1108-A	1211-B	2121-B/C	2157-G	3132-C	3227-A	3237-D	4052-E	4133-C	4141-D	4143-C	5025-D	6017-B	6029-A
NTS	24E10	24E07	24E07	24E06	24E10	24E11	24L01	24E11	24E11	24E11	24E10	24E11	24E11	24E11	24E06	24L02	24E11
Easting	388483	392361	383170	378559	391674	356734	420711	367403	371191	356972	388021	359115	361744	362395	357629	385715	369061
Northing	6390867	6365634	6372336	6357898	6401604	6392791	6438038	6388896	6378684	6403574	6382598	6384543	6397336	6397725	6369859	6456819	6394764
Thickness	-	15 m	1 m	>35 m	-	-	30-40 cm	-	-	-	35 cm	7 - 8 cm	10 cm	3 - 5 cm	1 m	4 -5 m	0.3 - 9 m
Orientation	165/75	300/ -	360/90	320/ -	130/74	030 to 040/ -	185/90	340/90	-	300/ -	140/80	140/90	135/70	340/ -	060/90	-	010/90

Ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite dykes (continued)

Site	18	19	20	20	21	22	23	24	25	26	27	28	29	30	30	31	32
Sample	6045-C2	6046-C	6054-B	6054-C/E	6057-G/H	6070-B	6082-B	6132-E	6158-B	6160-D	6163-E	6179-B	6182-B	6185-B/C	6185-D	6186-B	6187-C
NTS	24E11	24E11	24E07	24E07	24E07	24E11	24E06	24E08	24E14	24E14	24E14	24E14	24E14	24L03	24L03	24L03	24L03
Easting	372970	372568	384524	384524	381008	371817	358084	432371	376144	374756	370454	363941	361445	359342	359342	360294	361316
Northing	6376851	6376058	6366131	6366131	6361956	6401631	6362616	6360011	6415996	6416377	6412966	6415955	6414090	6432452	6432452	6433021	6433719
Thickness	50 cm	1 m	10 - 50 cm	20 -50 cm	50 cm	50 cm	40 cm	10 cm	1 m	10 - 20 cm	-	10 - 20 cm	30 cm	50 cm	3 m	50 - 80 cm	-
Orientation		316/ -	208/90	323/90	149/37	-	360/90	-	325/90	010/90	170/90	110/90	310/75	290/90	020/55	190/90	-
					325/55		347/90		010/71					260/ -			

Ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite dykes (continued)

Site	33	34	35	36	37	38	39	40	41	42
Sample	6193-D	6196-B	6202-B	6215-B	6237-B	6244-C	7027-B	7118-D	7169-B	7190-D
NTS	24L01	24L01	24L08	24E14	24E02	24E01	24E14	24E08	24E14	24L08
Easting	419733	417133	420994	379340	407138	415506	367433	437736	366861	417833
Northing	6444874	6442320	6458318	6428483	6331204	6332206	6403227	6347903	6408588	6465254
Thickness	0.5 - 1 m	-	60 cm	10 cm	50 cm	20 - 40 cm	-	-	20 cm	-
Orientation	150/ -	187/90	205/90	360/67	310/ -	300/90	-	300/90	140/90	295/42
						022/90				

TABLE 2 - Chararacteristics of the principal mineral occurrences and showings in the Lac Aigneau area (24E and 24F/04). Occurrence and showing locations are shown in Figure 10.

Iron formations and volcano-sedimentary rocks with Cu-Zn-Pb-Co ±Ag ±Au mineralization

OCCURRENCE OR SHOWING	LOCATION (UTM Nad 83)	HOST ROCK	METAL GRADES	SAMPLE	OPAQUE MINERALS
1	350212E 6391667N	**Kakiattukallak belt** - Mafic gneiss with sulphide veinlets	520 ppm Cu; 140 ppm Co	1150-KAK-01-A	PY-CP
		Rusty paragneiss with traces of sulphides	140 ppm Cu; 110 ppm Zn	1150-KAK-01-B1	MG-PO-CP
		Iron formation with 5-10% sulphides	510 ppm Cu; 140 ppm Zn	1150-KAK-01-B2	PO-PY-CP
		Silicate-facies iron formation with 1 to 20% disseminated sulphides or veinlets	350 ppm Cu; 240 ppm Zn	1150-KAK-02-A1	PO-PY-MG-CP
			740 ppm Cu; 490 ppm Zn; 120 ppm Ni	1150-KAK-02-A2	
			680 ppm Cu	1150-KAK-02-A10	
		Altered and banded ultramafic rock resembling an iron formation	600 ppm Cu	1150-KAK-02-A3	MG-PO-PY-CP
		Silicate-facies iron formation with 1 to 20% disseminated sulphides or veinlets	550 ppm Cu; 140 ppm Zn	1150-KAK-02-A4	
			770 ppm Cu; 170 ppm Ni	1150-KAK-02-A5	
			490 ppm Cu; 310 ppm Zn	1150-KAK-02-A6	
			900 ppm Cu; 300 ppm Zn	1150-KAK-02-A7	
			0.10% Zn; 780 ppm Cu; 200 ppm Ni	1150-KAK-02-A8	
		Chert and oxide-facies iron formation associated with volcanic rocks	600 ppm Zn; 580 ppm Cu; 220 ppm Ni	1150-KAK-02-A9	MG-PO-PY-CP
		Silicate-facies iron formation associated with volcanic rocks	430 ppm Cu; 250 ppm Ni; 170 ppm Zn	1150-KAK-03-1	
		Paragneiss	719 ppm Cu; 285 ppm Ni; 289 ppm Zn; 1 g/t Ag	1150-KAK-03-2	
2	336830E 6361259N	**Natuak belt** - Silicate-facies iron formation associated with andesites	0.2% Cr; 990 ppm Ni; 180 ppm Cu	98-1196-B1	
			370 ppm Cr; 110 ppb Au; 150 ppm Ni; 150 ppm Cu	98-1196-A3	
3	337113E 6360202N	**Natuak belt -** Silicate-facies iron formation with PY-PO-AS mineralization, associated with basalts	530 ppm Zn; 170 ppm Cu; 2 g/t Ag	98-4539-D	
			520 ppm Zn; 1 g/t Ag	98-4539-F	
			960 ppm Zn; 170 ppm Cu; 1 g/t Ag	98-4539-G2	
			6 g/t Ag; 140 ppm Cu	98-4539-K2	
			540 ppm Cu; 240 ppm Zn; 190 ppm Pb; 2 g/t Ag	98-4539-P2	
			830 ppm Zn; 170 ppm Pb; 140 ppm Cu; 1 g/t Ag	98-4539-FD	
			350 ppm Zn; 110 ppm Pb; 1 g/t Ag	98-4539-F1	
			2 g/t Ag	98-4539-F2	
			0.78% Zn; 0.20% Pb; 170 ppm Cu; 1 g/t Ag	98-4539-L1	
			4 g/t Ag; 170 ppm Zn	98-4539-L2	
4	349728E 6392307N	**Kakiattukallak belt** - Semi-massive sulphide (PY+CP) veinlets +/- parallel to the foliation, in an amphibolite	0.10% Cu; 260 ppm Ni; 0.02% Co	1016-A	
		Banded (mm-scale) silicate and magnetite iron formation	290 ppm Cu	1016-B2	PY-CP-PO-MG
5	333510E 6357749N	**Natuak belt** - Six metre wide siliceous horizons (QZ-PY) associated with basalts	0.16% Zn; 8 g/t Ag; 950 ppm Pb; 400 ppm Cu	98-090-C2	
			0.31% Zn; 0.14% Pb; 710 ppm Cu; 4 g/t Ag; 220 ppb Au	98-090-D	
6	334784E 6360186N	**Natuak belt** - Two to three metre thick oxide-facies iron formation with PY-PO mineralization, associated with migmatized paragneisses	556 ppb Au	98-1156-B1	
7	349294E 6392124N	**Kakiattukallak belt** - Iron formation with small pods of disseminated magnetite and pyrite, enclosed in metabasalts (mafic gneisses)	400 ppm Cu; 110 ppm Zn	2012-D	MG
8	356308E 6364317N	Silicited PY-rich gossan (20 x 30 m), controlled by a deformation zone in amphibolites	102 ppm Cu	1141-A2	CP-PO-PY

Ultramafic and mafic rocks with Ni-Cu ±Co ±Zn mineralization

OCCURRENCE OR SHOWING	LOCATION (UTM Nad 83)	HOST ROCK	METAL GRADES	SAMPLE	OPAQUE MINERALS
9	417563E 6369782N	Angular to subrounded pyroxenite enclaves with disseminated pyrite (enclosed in granite)	0.13% Cu; 190 ppb Au; 110 ppm Zn	3099-B	PY-CP-PD-MG
10	388646E 6383225N	35 x 15 m pod rich in disseminated sulphides +/- garnet, enclosed in a homogeneous ultramafic body (pyroxenite to hornblendite) over 750 m wide	0.11% Cu; 200 ppm Ni; 150 ppm Co; 105 ppm Zn	4051-A4	
			900 ppm Cu; 270 ppm Ni; 110 ppm Co	4051-A6	PY-CP-PD-MG-PO
11	336829E 6361259N	Felsic horizon with PO-PY mineralization and fuchsite, associated with basalt, andesites, ultramafic rocks, paragneisses and thin carbonate horizons	0.25 % Ni; 0,39% Cr; 290 ppm Zn; 140 ppm Co; 67 ppb Au	98-1210-A4	
			0.27% Cr; 730 ppm Ni	98-1210-A7	
12	421955E 6376821N	Ultramafic enclaves strongly enriched in biotite. At the contact, the granite is strongly altered and contains disseminated sulphides	320 ppm Cu; 140 ppm Ni	5002-B	
		Enclaves of ultramafic rock with OX and micas (BO and MU)	0.10% Ni; 110 ppm Zn	5002-F	
13	411138E 6389875N	Massive PX hornblendite, locally rusty and containing cm-scale pods of chalcopyrite and disseminated pyrite	470 ppm Cu; 420 ppm Ni	7057-B1	HM-PY-CP-MG-PO
			180 ppm Cu; 170 ppm Ni	7057-B2	
14	351678E 6328695N	Enclaves of moderately magnetic ultramafic rock in tonalite	170 ppm Cu; 160 ppm Ni; 100 ppm Zn	6096-B	IM-CP-HM-PY-PD
15	411349E 6379271N	Dense pod of rusty felsic material in ultramafic rock	100 ppm Cu; 100 ppm Ni	7051-E	
16	387500E 6377009N	Pyroxenite with disseminated PY	350 ppm Cu; 20 ppb Au; 95 ppm Ni	4111-C	PY-CP-PO-HM
17	427623E 6368872N	M-scale massive magnetite layers enclosed in gabbro	3 g/t Ag; 260 ppm Zn; 110 ppm Ni	6220-C	MG-IM
18	356965E 6416567N	Amphibolitic zone with disseminated sulphides in pyroxenite	180 ppm Cu; 130 ppm Ni	3032-B	
19	422415E 6384755N	Magnetite-ilmenite iron formation associated with diorite	180 ppm Zn	6117-C	MG-IM-HM
20	350004E 6405067N	Massive layer formed of sulphide-rich magnetite laminations (< 5mm thick) and silicate laminations (1-2 cm thick) at the contact between enderbite and pyroxenite	100 ppm Cu	7150-D	
21	426909E 6381011N	Diorite enclaves with disseminated microcrystalline pyrite, parallel to the foliation and associated with chlorite veinlets (<1 mm)	330 ppm Ni; 230 ppm Cu	1084-C	PY-PO-CP-IM-PD
		Deformed gossan in a diorite	300 ppm Ni; 110 ppm Cu	1084-D	
22	417813E 6366963N	Very rusty pods of pyrite and chalcopyrite associated with diorite	270 ppm Cu; 170 ppm Zn	4086-B2	
23	371443E 6374826N	Diorite dyke with disseminated sulphides	900 ppm Cu; 130 ppm Zn; 130 ppm Pb; 100 ppm Co; 1,5 g/t Ag	6050-C	
24	424287E 6384669N	Sulphide-rich zone in tonalite (about 4 m wide by 40 m long)	1 g/t Ag	6120-A	PY-PO-CP-HM
		Monzonite with disseminated sulphides injected in amphibolites and ultramafic rocks	270 ppm Cu; 170 ppm Ni; 130 ppm Zn	6120-C	PY-PO-CP-PD-HM

Quartz veins with Cu mineralization

OCCURRENCE OR SHOWING	LOCATION (UTM Nad 83)	HOST ROCK	METAL GRADES	SAMPLE	OPAQUE MINERALS
25	356065E 6379776N	Cm-scale quartz-epidote-hematite vein with sulphides (CP-PY), cutting a tonalite	0.16% Cu	4126-C	
26	340941E 6364355N	Quartz veins with PY mineralization, cutting a sequence of pillowed basalts	0.16% Cu	98-178-D	

Faults with Cu-Zn-Ag ±Au mineralization, associated with carbonatized lamprophyre and carbonatite dykes

OCCURRENCE OR SHOWING	LOCATION (UTM Nad 83)	HOST ROCK	METAL GRADES	SAMPLE	OPAQUE MINERALS
27	391252E 6353727N	Sheared rusty layers with PY-MG-HM-BO, enclosed in tonalite-enderbite	370 ppb Au; 200 ppm Cu	2189-G	
28	415915E 6319839N	Quartz-rich felsic dykes in deformed tonalite	160 ppb Au; 600 ppm Cu	2215-B1	
		Sulphide-rich (CP, PY) rusty layers (0,1 to 1 m) in strongly deformed tonalite	0.20% Cu; 240 ppb Au	2215-D3	
29	410962E 6385601N	Deformed zone; alternating felsic and biotite-rich layers. Pyrite and malachite associated with ribbon quartz	0.11% Cu; 2.2 g/t Ag; 170 ppm Zn	3223-B2	
30	422682E 6394115N	Sulphide-rich shear zone about 10 m wide, in epidotized diorite	130 ppm Cu	6122-D1	PY-HM-IM-RU-MG
			6.7 g/t Ag; 190 ppm Cu	6122-D2	PY
31	421785E 6396595N	Hematized deformed granite. Presence of sulphide pods accompanied by rusty alteration Size: 30 cm x 10 cm up to 1 m x 1 m	0.32% Cu; 1 g/t Ag	6153-A	
32	356698E 6369292N	Deformed and rusty diorite (gneissic aspect)	0.27% Cu; 360 ppm Ni; 325 ppm Zn; 200 ppm Co; 1,1 g/t Ag; 10 ppb Au	5026-B	
33	397797E 6377533N	Altered granodiorite with disseminated pyrite	190 ppm Cu; 47 ppb Au	1037-B	
		Disseminated sulphides and gossan alteration, parallel to the foliation in granodiorite	100 ppm Cu; 74 ppb Au	1037-C	
34	394186E 6382986N	Dense network of epidote+chlorite+sericite, more or less parallel to the foliation in a diorite injected with porphyritic granite	170 ppm Zn	1056-B	
35	369334E 6356976N	4 to 5 m wide zone parallel to the foliation with 15-20% disseminated pyrite, in a gneissic granite	140 ppm Cu; 1.2 g/t Ag	1073-I	PY-CP
36	418427E 6374511N	Dedormed rusty zones in granodiorite	190 ppm Cu	1088-D	
37	419858E 6374742N	Gossan in granodiorite	120 ppm Zn	1090-B	
38	387993E 6379986N	Brittle fault with disseminated pyrite (locally up to 2%) in enderbite with opdalite enclaves and granite injections	150 ppm Cu	1105-C2	
39	396812E 6428076N	Sulphide-rich (up to 7% pyrite with a trace of arsenopyrite) mylonitic deformation zone in granite	110 ppm Cu	2040-A	
40	379794E 6368238N	Late sulphide-rich (malachite, chacopyrite and pyrite) rusty layer in charnockite	860 ppm Cu	2050-B	PY-CP-MG-HM
41	356734E 6392791N	Carbonatized mafic lamprophyre dyke, 1 to 10 cm thick	110 ppm Cu	2121-B	
42	462759E 6329956N	Sheared and altered (oxidized, silicified and carbonatized) shale with pyrite nodules and veinlets	120 ppm Cu; 100 ppm Ni	2130-A4	PY-CP
43	391096E 6418672N	Mafic lamprophyre dyke with disseminated sulphides and calcite, 0.1 to 1 m thick	110 ppm Zn	2181-F	
44	391081E 6352558N	Sheared and rusty (disseminated PY-MG) layers in tonalite-enderbite	38 ppb Au; 99 ppm Cu	2188-C	
45	390883E 6355553N	Altered tonalite with disseminated PY	210 ppm Cu; 186 ppm Ni; 129 ppm Zn; 80 ppb Au	2194-B	
46	390503E 6355608N	Felsic gossans with disseminated pyrite and magnetite cutting hornblendite	330 ppm Cu	2195-C2	
47	355424E 6338342N	Chloritized granite with hematite-chlorite-malachite association	100 ppm Zn	3083-B	HM
48	393212E 6363071N	Granite injection in pyroxenites. Chlorite and epidote alteration with abundant hornblende. Pyrite associated with chlorite. Low-temperature deformation along chloritized slip planes.	120 ppm Cu	3093-B	MG-PY-CP
49	367403E 6388896N	Tonalite injected with chloritized granite containing disseminated sulphides (pyrite)	530 ppm Cu	3132-B1	
50	452522E 6335178N	Two metre thick brittle fault, strongly chloritized and hematized, schistose with disseminated sulphides (pyrite, chalcopyrite). A few quartz veins and calcite veinlets along the deformation zone	190 ppm Ni	3142-B1	
51	378390E 6395761N	Fractures injected with epidote and chlorite in granodiorite	100 ppm Cu	4033-A2	
52	389081E 6382679N	10-cm sulphide-rich pods (chalcopyrite and pyrite) in tonalite	420 ppm Cu; 12 ppb Au	4050-A3	

Faults with Cu-Zn-Ag ±Au mineralization associated with carbonatized lamprophyre and carbonatite dykes (continued)

OCCURRENCE OR SHOWING	LOCATION (UTM Nad 83)	HOST ROCK	METAL GRADES	SAMPLE	OPAQUE MINERALS
53	399623E 6349224N	Ultramafic lamprophyre dyke with PY and CP	580 ppm Ni; 190 ppm Cu; 140 ppm Zn	4076-D	
54	387500E 6377009N	Very rusty pyrite-chalcopyrite pod in siliceous host rock (quartz-rich granitoid)	130 ppm Cu	4111-A3	
			110 ppm Cu	4111-A5	
55	412447E 6424388N	Greenish cataclastic granite with hematite-rich mafic bands and hematite and chlorite-rich felsic bands	180 ppm Cu; 100 ppm Zn	4194-A2	
56	425668E 6324654N	Strongly hematized granitic migmatite with pyrite and gossan	133 ppm Cu	4232-A3	
57	371143E 6375110N	Weakly magnetic rusty tonalitic blocks with sulphides (PY)	280 ppm Cu;140 ppm Ni; 38 ppm W	6049-B	PY-HM-CP-GO-PO
58	384524E 6366131N	Greenish mafic lamprophyre dyke	160 ppm Ni	6054-C	
59	371817E 6401631N	Mafic lamprophyre dyke with disseminated sulphides	170 ppm Ni; 140 ppm Cu	6070-B	
60	348826E 6334187N	Amphibolite enclaves in cataclastic deformation zone	200 ppm Ni; 130 ppm Zn	6094-E	
61	424957E 6394541N	Hematized and chloritized protomylonitic tonalite	130 ppm Zn	6125-B	MG-PY-IM-CP
62	376144E 6415996N	Calc-silicate fault breccia cutting a strongly altered granite	20 ppm W	6158-B	
63	411543E 6390243N	Mica-rich rusty pods (10 cm) in granite	330 ppm Zn	7056-D	
64	370587E 6351581N	Hornblendite cut by fault with disseminated pyrite and small pyrite pods	270 ppm Ni; 190 ppm Cu	7083-A1	MG-PY-CP-HM-IM
65	366861E 6408588N	Calc-silicate mafic lamprophyre dyke	160 ppm Zn; 31 ppm U	7169-B	

Abstract

The Lac Aigneau area (24E and 24F/04), mapped at a scale of 1:250,000 during the 1998 and 1999 field seasons, was subdivided into two lithodemic complexes and eleven intrusive suites, which were emplaced between ca. <2.80 and > 2.67 Ga. These Archean units may be grouped into two major geological assemblages. They are cut by five families of younger dykes (ca. < 2.65 Ga; gabbro, diabase, ultramafic to mafic lamprophyre, carbonatized lamprophyre and carbonatite), and are bounded to the east by the Paleoproterozoic (2.0 to 1.8 Ga) New Québec Orogen.

Volcani-sedimentary units, grouped in the Duvert and Qamaniq complexes, are the oldest rocks inventoried, and are penetratively transposed and affected by two phases of granulite-grade metamorphism. In the west part of the map area, the Duvert Complex is essentially enclaved in tonalites of the Suluppaugalik Suite (2805+9/-4 Ma). These tonalites are invaded by homogeneous intrusions of granodiorite (2725±5 Ma) and tonalite (2710 Ma) of the Rivière aux Feuilles Suite, by heterogeneous migmatitic granodiorites of the Monchy Suite, as well as by diatexites of the Rivière aux Mélèzes Suite (2671 Ma). In the south part of the map area, tonalites of the Suluppaugalik Suite are cut by diorites-tonalites-trondhjemites associated with diorites of the Coursolles Suite (dated at 2718+15/-9 Ma). Locally, within these suites, an early planar fabric (S$_2$) oriented N-S, is preserved and interpreted as being related to a first phase of deformation (D$_2$). This fabric is intersected in the south by a second planar fabric (S$_3$) oriented E-W to ENE-WSW. All of these suites and structures are essentially outlined by regional negative magnetic anomalies, and form the extension of the Goudalie – La Grande Series.

The northeastern half of the map area is underlain by the MacMahon Suite composed of two enderbitic units (dated at 2717±4 Ma and 2704±2 Ma) to which are associated bodies of mafic (orthopyroxene diorite, gabbronorite to anorthositic gabbro) and ultramafic rocks (pyroxenite, peridotite and hornblendite) as well as a synmagmatic metamorphic episode at the granulite facies. Laterally, this suite grades into clinopyroxene tonalites and diorites (Nallualuk Suite; 2698±3 Ma). These pyroxene-bearing suites are intruded by porphyritic monzogranites of the La Chevrotière Suite (ca. 2.717 and 2.686 Ga), as well as by late leucogranites of the Morrice (ca. 2682±4 Ma) and Dufreboy suites. These granites are the expression of a collisional process that is also responsible for regional metamorphism at the middle to upper amphibolite facies. Gabbro and diorite intrusions (Bacqueville Suite) are locally enclaved in the various granitic rocks. All these suites are bracketed between 2.717 and 2.671 Ga, and define an overall strongly positive magnetic gradient, outlined by a planar fabric oriented NW-SE to WNW-ESE (S$_4$) and NNW-SSE to N-S (S$_5$). The northeastern half of the Lac Aigneau area shares numerous similarities, namely gravimetric, magnetic, stratigraphic and tectono-metamorphic features, with units composing the Ashuanipi Subprovince, which suggests these two regions may form a single tectono-stratigraphic assemblage, the Utsalik-Ashuanipi Series.

Mapping in 1998 and 1999 in the Superior Province helped uncover new economically significant mineral occurrences and showings. These occurrences were grouped into five metallogenic settings: iron formations associated with volcani-sedimentary belts (with Cu-Zn-Pb-Co±Ag±Au mineralization), ultramafic and mafic intrusions (with Cu-Ni±Co±Zn mineralization), quartz veins (with Cu mineralization), fault zones (with Cu-Zn-Ag±Au mineralization) associated with ultramafic to mafic lamprophyre dykes, carbonatized lamprophyre and carbonatite dykes, and finally, ultramafic lamprophyre dykes which seem to display some affinity with kimberlites.